PCHB NO. 01-133

PORT OF SEATTLE'S
MEMO OPPOSING
ACC'S MOTION FOR STAY

Declaration of Paul S. Fendt

Volume 1 of 3

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AIRPORT COMMUNITIES COALITION, Appellant, v. DEPARTMENT OF ECOLOGY and THE PORT OF SEATTLE, Respondents.	No. PCHB 01-133 DECLARATION OF PAUL S. FENDT

Paul S. Fendt declares as follows:

1. I am over the age of eighteen, have personal knowledge of the facts stated in this declaration and would be competent to testify to them if necessary.

2. I have more than 18 years of stormwater engineering and planning experience, encompassing a broad range of stormwater and surface water projects. I have significant experience working with hydrologic and hydraulic modeling (HEC-1, WaterWorks, HEC-2, HEC-RAS), NPDES stormwater permits, erosion control on creeks and lake shores, comprehensive storm and surface water plans, preparation of drainage ordinances and environmental impact statements. I have worked extensively with the Department of Ecology's Stormwater Manuals and with King County's Surface Water Design Manual.

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3. I have been the project manager for stormwater management and low flow mitigation for the Port of Seattle's Master Plan Update (MPU) projects for the past four years. I was the principal author of the Port of Seattle's Comprehensive Stormwater Management Plan and a principal author of the Low Flow Analysis - Flow Impact Offset Facility Proposal ("Low Flow Analysis"). I graduated from the University of North Dakota with a degree in Geological Engineering in 1981. I was licensed as a Professional Engineer (Civil) by the State of Washington in January 1991 and the State of Florida in February 1990. I have been employed by Parametrix, Inc. for the past 11years. A copy of my current curriculum vitae is attached to this declaration as Exhibit A.

4. Sea-Tac International Airport (STIA) lies along the drainage divide between the Miller Creek and Des Moines Creek watersheds (See Figure 6.1-1 in the Port's Natural Resources Mitigation Plan). The Miller Creek watershed covers approximately 8.1 square miles of predominantly urban area lying mostly within the cities of Burien and SeaTac, plus a small portion of Normandy Park and King County. Currently, about 23 percent of the total surface area in the Miller Creek watershed is impervious. Miller Creek drains a relatively small portion of STIA, including the north end of the runways and the air cargo areas north of the terminal. The STIA stormwater drainage system will cover about 9 percent of the Miller Creek watershed (including newly acquired property for the MPU). Walker Creek is a tributary to Miller Creek.

5. The Des Moines Creek watershed covers 5.9 square miles of predominantly urban area lying mostly within the cities of SeaTac and Des Moines, plus a small area of unincorporated King County. This creek drains most of STIA, the City of SeaTac commercial area along International Boulevard (Highway 99), and residential areas in the remainder of the basin. Currently, about 32 percent of the total surface area in the Des Moines Creek watershed is impervious. The STIA stormwater drainage system will cover about 23 percent of the Des Moines Creek watershed.

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6. New impervious surface construction for MPU projects will change the hydrology and stormwater runoff patterns of land draining from STIA. During rain storms, increased volumes of stormwater will drain to Miller, Walker and Des Moines Creeks that, if unmitigated, will cause peak flows in the stream to increase. Higher peak flows are a problem because they can damage the stream channel, cause significant erosion and damage aquatic habitat. Stream flows in the summertime during periods of low rainfall will also be impacted. In the predeveloped condition, precipitation that falls on pervious areas infiltrates into the soil. Some of this infiltrated precipitation seeps slowly downward and laterally through the soil, eventually reemerging as seepage from slopes or in streams. This gradual seepage water is a source of summer low flow water in the area streams. Thus, adding impervious surfaces may not only increase high flows, but it may also reduce low summer flows.

7. A total of approximately 106, 6, and 128 acres of new impervious area are proposed to drain to Miller, Walker, and Des Moines Creek respectively. In addition, 67 acres of new impervious surface will be constructed at STIA that would drain to the Industrial Wastewater System (IWS) and discharge directly (after treatment) to Puget Sound. Peak flow impacts will be mitigated by capturing all stormwater runoff and detaining it in 344.1 acre-feet of new stormwater detention storage. Low flow impacts will be mitigated by retaining a small portion of the detained stormwater and releasing it to area streams during low flow periods. The Port will detain excess stormwater runoff from new impervious areas in underground vaults and release the detained water continuously into the affected streams during the normal low stream flow period for each of the streams. The amount of low flow releases will be determined based on site specific hydrologic modeling, which predicts the impact on area streams from the construction of the MPU improvements. Low flow impacts will also be mitigated for by seepage from the new embankment, which will partially offset low flow impacts from new impervious surfaces.

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8. **HSPF Modeling Used To Model Existing and Future Hydrologic Conditions.** The Hydrologic Simulation Program – Fortran ("HSPF") model was one of the most important tools used to determine existing and future hydrologic conditions at STIA. It was also critical to identifying how those conditions will change as result of the construction of the Port's MPU projects. The HSPF model allows continuous simulation of stormwater runoff at STIA, both as currently configured and as it will be configured when the MPU projects are complete. The model is appropriate for western Washington, where stream flow is dominated by runoff from sequential storms rather than single, large storms. This modeling method is recommended by local agencies for modeling large drainage areas and evaluating runoff impacts on stream systems.

9. A description of how the HSPF model was used to evaluate stormwater runoff from the Port's planned MPU projects and to evaluate how these projects would affect stream flow in Miller, Walker, and Des Moines Creeks is included in the Comprehensive Stormwater Management Plan ("SMP") at Section 3.3, pp. 3-7a to 3-8; Sec. 6.2, pp. 6-3-6-11; and Vol. 2, Appendix A. A copy of the SMP is attached to this declaration as Exhibit B.

10. King County's Stormwater Management Department was hired by Ecology to act as one of its experts on the hydrologic modeling, and on the adequacy of the Low Flow Analysis and the SMP. A copy of the Low Flow Analysis is attached to this declaration as Exhibit C. The approach described in the Low Flow Analysis was discussed with both the Department of Ecology and King County and was accepted as an appropriate approach to evaluating, quantifying, and mitigating impacts. Contrary to the assertion of Dr. Willing and Mr. Rozeboom in their declarations (Willing ¶¶ 8-9; Rozeboom, ¶ 6), the Port had been focused on the plan of detaining and releasing stormwater as a means of mitigating low flows since December 2000 as reported in the Low Stream Flow Analysis (Earth Tech, Inc., 2000). Mr. Kelly Whiting, who worked on this project for King County, has reviewed and approved the SMP, which includes the HSPF modeling. A copy of King County's letter approving the SMP is attached to this declaration as Exhibit D.

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11. The primary purpose of the SMP was to quantify peak flow impacts. The primary purpose of the Low Flow Analysis was to quantify low flow impacts. Together, the SMP and Low Flow Analysis ensure that streamflow impacts are understood and mitigated for.

12. **Calculation of Summer Low Flow Impacts.** Summer low flow impacts in Miller, Des Moines and Walker Creeks were calculated using methods described in the Low Flow Analysis. Following is a short description of the approach used to quantify predicted reductions in low summer flows:

13. The first step in the process was identifying current stream flow levels, focusing on low flow periods of the year. The HSPF model of current conditions (pre-MPU project development) provides daily average flows in each of the streams for 47 years of precipitation record (1949-1995). The daily average flow was grouped and averaged in seven-day increments. The lowest seven-day flow in each year of the record (a total of 47 values) was selected and ranked in order of smallest to largest seven-day low flow. The 24th value in the ranking statistically has a 50 percent chance of being equaled or exceeded in any year (also referred to as the 2-year, 7-day low flow). Attached to this declaration as Exhibit E are the figures used to document the selection of appropriate stream flows.

14. The 2-year, 7-day low flow was selected as the flow value for impact and mitigation evaluation. The 2-year flow is protective, since the magnitude (flow rate) of more extreme low flows is lower than the 2-year flow, so the subsequent impact would be a lower flow rate. Therefore, impacts from more extreme droughts would be mitigated with this standard. As is explained more fully in the Declaration of Donald Weitkamp, more frequent low flows (i.e. those occurring more frequently, on average, than every other year) are not limiting factors in stream production.

15. The time of year that low flows typically occur and the amount of low stream flow impact were determined in order to quantify the amount of stormwater to be reserved for release during the low flow period. The 47 years of record for each stream were plotted to determine when

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seven day low flows have historically occurred. In Miller Creek, 44 of the 47 seven-day annual low flows occurred between August 7 and November 1. In Walker Creek, 44 of the 47 low flows occurred between August 7 and November 9. The three remaining low flows in each stream occurred in November and December during the typical rainy season. In Des Moines Creek, low flows in all 47 years of record occurred between August 3 and October 24.

16. One of the primary concerns arising from changes in flow is that these changes could adversely impact the biological quality of affected streams. A discussion of potential impacts to aquatic organisms in the streams is included in the Weitkamp Declaration, describing the time of year that low stream flow mitigation is needed to avoid impacts. Contrary to the claims of Dr. Strand (Strand, ¶ 32), the proposed mitigation facilities are appropriately sized and will mitigate the change in water depth during the critical summer low flow.

17. Impacts from new impervious surfaces that were determined in the Low Stream Flow report are offset by three methods: (1) slow release of reserved stormwater during the summer low flow season (Des Moines and Walker Creeks); (2) retirement of existing water uses (Miller Creek); and (3) seepage water from the new third runway embankment (Miller and Walker Creeks). The Low Stream Flow report describes how the low flow mitigation was quantified and how it will be implemented. One component, groundwater seepage from the new embankment, required that additional modeling be completed.

18. The HSPF modeling for low stream flows was supplemented by a groundwater study conducted by Pacific Groundwater Group and referred to as the Embankment Fill Modeling (Pacific Groundwater Group 2000) ("PGG Study"). This study evaluated the stormwater that infiltrates into the embankment and flows to groundwater into the embankment for the new third runway. A copy of the PGG Study is attached to this declaration as Exhibit F.

19. The hydrogeologic modeling conducted by PGG for the PGG Study is the same model and approach used in the Ecology-sponsored Sea-Tac Runway Fill Hydrologic Studies (PGG

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2000) and additionally refined as requested by Ecology. The Low Flow Analysis, the SMP, the HSPF modeling and the groundwater modeling conducted by PGG were reviewed and approved by Ecology.

20. The hydrogeologic modeling was used to determine how groundwater that enters the embankment would travel through embankment soils and eventually emerge as seeps at the base of the embankment. These seeps from the embankment will flow into area wetlands and streams. The embankment is very large, and large volumes of stormwater will infiltrate into it. This infiltrated stormwater will remain within the embankment for many weeks or months, depending on the thickness and width of the fill (which varies depending on the amount of fill needed to raise the ground to the level of the existing airfield). This infiltrated stormwater will travel from the point of infiltration to the base of the embankment where it will emerge as seeps. This travel time means that rain that falls on the surface during the winter and spring rains will emerge as seeps later in the year during the summer low flow period, as modeled by PGG.

21. The Port's SMP has been accepted by the Washington State Department of Ecology as constituting all known and available reasonable methods of treatment. All major inputs to waters of the State are accounted for in the SMP. As is outlined in more detail below, although the scope of the MPU projects is large, the SMP is based on the construction and implementation of typical technologies for stormwater management.

22. **Calibration of the HSPF Model.** Hydrologic and hydraulic models are often calibrated before using them for design or analysis. Calibration involves simulating a recorded storm event to compare the model output hydrograph with the actual measured flow. If the model results match measured flow, the model is well calibrated. If it does not, the model input parameters are adjusted to achieve a high degree of correlation between model results and measured stream flow. Calibration of models is performed to improve the accuracy of simulations of synthetic design storms or historical precipitation records for which there are no measured flow or stage data.

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23. Dr. Willing has asserted that there were calibration errors in the HSPF model. *See* Willing Dec., ¶ 19. Contrary to Dr. Willing's testimony, however, the HSPF model was calibrated to existing gages in the three streams, as described in Volume 3, Appendix B of the SMP. *See* Exhibit B. Additional calibration for lows flows was completed as described in the low flow report and as explained in detail in the Declaration of Joe Brascher. A high degree of model calibration was achieved, and the model output provides a level of accuracy and reliability more than adequate to formulate protective mitigation requirements.

24. The calibration approved by King County in the SMP is also applicable to the Low Flow Analysis. The HSPF model provides a reliable and accurate measure of the likely low flow impacts arising from the construction of the MPU projects. Contrary to the approach suggested by Mr. Rozeboom in his declaration (Rozeboom, ¶ 10), using the gage data from a single year would overestimate stream flow and, therefore, underestimate project impacts. In my opinion, the calibration is appropriate for evaluating low flow and peak flow analyses, such as those undertaken in the SMP and the Low Flow Analysis.

25. **Review of Low Flow Analysis and Revised Analysis Requested by Ecology.** The Low Flow Analysis is the basis of conditions in the water quality certification requiring mitigation for anticipated reductions in stream flow in Des Moines, Miller and Walker Creeks.

26. Ecology has requested additional information prior to final design of the low flow facilities that will be provided in the form of an updated Low Flow Analysis. The updated Low Flow Analysis will contain the following:

- Additional detail on design elements of the reserve vaults;
- Additional model calibration;
- Modified approach to collecting reserve stormwater for the Walker Creek vault;
- Additional monitoring requirements, including infiltration testing and biological monitoring;
- Revised drawings showing the modified storage vaults;

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- Additional detail as required in the §401 Certification.

27. These additional details and requested revisions are in response to a review of the Low Flow Analysis study by King County. Dr. Willing criticized the Low Flow Analysis in his declaration and referred to a number of comments made by King County's reviewers to support his criticisms. *See* Willing Declaration, ¶ 17. Dr. Willing is apparently unaware that a new version of the Low Flow Analysis is required by Ecology as a condition of its §401 Certification, and that the new version, which will be submitted to Ecology by November 5, 2001, will address and respond to each and every condition provided by Ecology, which incorporate and address all of the King County review comments.

28. **All of the Final Design Issues Noted By Willing and Rozeboom Have Been Identified and Addressed in the §401 Certification and the Revised Low Flow Analysis.** Dr. Willing and Mr. Rozeboom have both listed alleged deficiencies in the low flow mitigation plan. *See* Willing Dec., ¶17; Rozeboom Dec., ¶20. In each instance, the potential deficiencies were previously noted by Ecology and will be addressed in the updated low flow report For reference, the proposed methods used to address potential deficiencies are listed here:

- A floating orifice outlet will be used to maintain constant head, draw water from strata below the surface yet above the bottom sediment, and allow for larger orifice openings that are dependent on floating orifice dimensions, not water depth in the vault.
- Mechanical aeration, if needed, is routinely applied in similar conditions.
- If monitoring shows that additional flow mitigation is needed to offset low flow for longer periods, sites for additional storage vaults and impervious area to fill them are available.
- Ecology has included a condition to preclude impervious areas to increase available impervious area for vault filling.

29. Mr. Rozeboom has asserted that the Port's low flow mitigation plan is inconsistent with the SMP. (Rozeboom, ¶17). This is incorrect. Mr. Rozeboom's confusion may arise from the fact that the SMP is not intended to show precise size of low flow mitigation vaults – only their probable locations in relationship to the proposed stormwater detention vaults. In fact, the SMP references the Low Flow Mitigation Plan as the place to find details for those systems. SMP Sec.

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6.2.1, pp. 6-3 to 6-5. The SMP does, in fact, show all the reserve storage facilities. Details of the precise sizing of those facilities are in the Low Stream Flow Report

30. **The Impact of Improvements to the IWS.** Both Dr. Willing and Mr. Rozeboom have asserted in their declarations that improvements to the IWS lagoons will reduce area stream flows, and that these impacts have not been adequately modeled and are not addressed in the SMP. *See* Willing Declaration, ¶18; Rozeboom Declaration, ¶¶5, 8 and 11. Contrary to the contention of Mr. Rozeboom (Rozeboon ¶11), the IWS Lagoon 3 is not in the Walker Creek groundwater contribution area, but rather in the Des Moines Creek groundwater contribution area (See Figure B1-3 or B2-2, not B2-23 as indicated by Mr. Rozeboom).

31. The IWS lagoons are man-made facilities for collecting stormwater runoff from industrial areas at Sea-Tac Airport, such as aircraft movement areas and surrounding the terminals and gates. The IWS lagoons collect and hold stormwater runoff to be treated in the Industrial Wastewater Treatment Plant. Stormwater is held in the lagoons only until it can be treated; desired operation maintains the greatest volume of available storage to prevent overflows, which means the lowest amount of water storage. Water was not routinely stored in the lagoons for infiltration (which is now prevented by lining).

32. The three lagoons at STIA are lined or scheduled to be lined, as required by Section S4 of the STIA NPDES permit (the IWS Engineering Report AKART analysis). The purpose of the liner is to prevent any seepage. Lagoon 1 was lined in 1997, followed by lagoon 2 in 1998. Lagoon 3 is now under construction for expansion and lining. The expansion and lining of IWS Lagoon 3 is not an MPU project, although additional capacity in the lagoon will serve MPU projects.

33. The HSPF model models the IWS lagoons as "water". Water in the model is treated as an area that does not infiltrate or contribute runoff. The existing lagoons therefore do not contribute infiltration to the modeled system in the predeveloped or built condition. Lining IWS

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Lagoon 3 will reduce infiltration in the model from the lagoon expansion area, approximately 8 acres. This expanded area was not included in the SMP, as lagoon expansion is not an MPU project.

34. **The Expansion of IWS Lagoon 3 Will Have Not Have a Significant Impact On the Flow in Des Moines Creek.** The expansion of IWS Lagoon 3, which is located in the IWS drainage basin, will increase new impervious area in the basin by only approximately 8 acres, compared to approximately 314 acres of existing IWS impervious area (less than 3 percent). This will have a negligible effect on groundwater recharge. The background and significance of this action is addressed in the Weitkamp Declaration. Moreover, IWS Lagoon 3 was designed with a drainage and pump system beneath the liner to reduce upward groundwater discharge pressure, which suggests that this area is actually a groundwater discharge area and an insignificant groundwater recharge area. This provides another basis for the conclusion that no significant impact will result from the expansion of IWS Lagoon 3.

35. In addition, Mr. Rozeboom asserts that reserve storage water for Walker Creek requires installation of an impervious liner on 6 acres of drainage swale. (Rozeboom, ¶ 18). While an impervious liner was included in the low stream flow report, Mr. Rozeboom did not correctly interpret its purpose. In fact, mitigation from embankment seepage was not included in Walker Creek, contrary to what was stated by Mr. Rozeboom. Ecology has directed the Port to develop an alternate plan to fill the Walker Creek low flow reserve vault, and to reintroduce Walker Creek embankment seepage. The impervious liner is not part of the Port's current proposal.

36. **Des Moines Creek Technology Center Is No Longer a Proposed Project.** Contrary to Mr. Rozeboom's assertion (Rozeboom Dec., ¶ 5), the Des Moines Creek Technology Center is no longer a proposed Port project. Because this project is currently not under consideration by the Port, the SMP and Low Flow Analysis do not take that project into account, nor is there any need to mitigate for potential impacts from projects that are not included in the JARPA or covered by Ecology's §401 Certification.

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37. **Impacts from Borrow Areas.** Mr. Rozeboom asserts that the low flow impacts from removal of soil at the Borrow areas has not been considered. *See* Rozeboom Declaration, ¶ 15. In fact, it is erroneous to state that hydrogeologic conditions at the borrow areas are comparable to the proposed Third Runway embankment, when considering the depth of material, location, material composition (grain size distribution), position relative to the respective streams, and variable stream hydrology.

38. In fact, the Sea-Tac Runway Fill Hydrologic Studies Reports (PGG 2000), prepared by PGG for the Department of Ecology, indicated that recharge to the shallow regional aquifer would be expected to increase because of excavation in the borrow area. Des Moines Creek receives substantial base flow from this aquifer.

39. **Monitoring and Adaptive Management.** The modeling and analysis in the Low Flow Analysis are a detailed and exhaustive study of hydrologic conditions in the three watersheds of STIA. I believe that we have a thorough understanding of conditions at the site, and how the MPU improvements will affect area stream flows. However, it is possible that required stream flow monitoring may identify the need to provide additional water for release during the summer dry season. Ecology's §401 Certification requires compliance with the Low Flow Analysis, which in turn requires substantial monitoring of area streams to determine whether low flow impacts have, in fact, been accurately predicted. In the event that the analysis is inaccurate, the Low Flow Analysis requires that stormwater releases be revised to provide full mitigation for low flow impacts.

40. Low flow impacts are a result of new impervious surface constructed for MPU projects. If stream flow monitoring identifies additional low flow impacts from the project, additional stormwater can be collected to provide low flow mitigation. This stormwater would be available for storage, since there is a direct connection between additional runoff from new impervious surfaces and water lost to the groundwater. In other words, precipitation that does not infiltrate to groundwater and is, therefore, unavailable to recharge area streams during low flow

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periods is available for collection and delayed release to area streams to avoid adverse low flow impacts.

41. **All Stormwater Used for Low Flow Mitigation Is Treated to Remove Sediment and Particulates.** In the NDPES permit for the facility, Ecology has previously required that the Port capture, detain, treat and release stormwater at the site to ensure that the stormwater does not contain unacceptable levels of pollutants, and to avoid harm to area streams potentially caused by increases in high stream flows caused by project improvements. See, NPDES Permit No.WA-002465-1 (copy attached as Exhibit G). Stormwater from the airport runways is treated using BMPs, as described in the SMP (primarily using filter strips). This includes stormwater runoff that flows to the reserved stormwater vaults used for low flow mitigation. In addition, the reserve vaults themselves act as a BMP that allows for additional settling and removal of particulates.

42. Scientific studies have demonstrated that biofiltration swales and filter strips are BMPs that effectively remove other pollutants besides sediment. These BMPs are included in BMP menus in the King County Surface Water Design Manual (1998) and the Revised Stormwater Management Ecology Manual (Ecology 2001) as treatment for stormwater. Such BMPs take advantage of the binding capacity of soil particles and the organic and inorganic ligands in soils to render the chemicals inert. These bound chemicals will either not be able to enter the stormwater system, or if they do, they will be unavailable to exert harmful consequences.

43. There is nothing about the stormwater discharged by STIA that would indicate that the BMPs prescribed by the King County Basic Water Quality menu are inappropriate, and this fact was confirmed by the preliminary WER analysis undertaken by the Port.

44. Dr. Willing incorrectly states the water temperature standards (Willing, ¶11). For class AA waters, the standard is not to raise the temperature of the receiving waters over 16 degrees, or not to raise the temperature of the receiving waters by more than 0.3 degrees C if they are already over 16 degrees. Therefore, the allowable temperature of discharged water depends on the

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temperature of the receiving waters and the volume of both the flow in the stream and the reserved discharge. Existing data in the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997) (REF) shows that in-stream water temperatures regularly exceeds 19 degrees in summer and early fall.

45. **Water Quality Will Be Maintained in the Water Used for Low Flow Mitigation.** Waters released from the reserved storage vaults will not be anoxic, and aeration measures proposed are not sporadic. In fact, the Port is committing to features that will result in favorable dissolved oxygen concentrations of reserved stormwater releases. Aeration is a commonly used technology in water treatment; there is little concern regarding engineering feasibility. The Port's proposal includes features that will add/maintain dissolved oxygen (DO) at several points throughout the cycle of collection/storage/release of the reserved stormwater. The redundancies will ensure that DO concentrations are adequate so as not to cause in-stream water quality violations. These include:

- Runoff is naturally aerated due to its contact with the atmosphere, both as precipitation and surface runoff. Therefore, water entering the vaults will have high DO concentrations.
- Runoff from the airfield has lower biological oxygen demand (BOD) than typical urban stormwater due to controlled access, vegetation management practices, and source control BMPs, so little, if any, DO will be consumed during storage (Runoff generated during deicing events is an exception, but such events are infrequent, generally occur during winter months when BOD is low, and is associated with high flow, and, in any event, flushes through system in a matter of hours).
- The reserved storage vaults will have ventilation features, allowing contact with the atmosphere to maintain DO concentrations.
- Reserved stormwater discharges will be passively aerated by splashing at discharge points or through energy dissipaters.
- DO concentrations will be monitored, and if DO concentrations are not favorable, mechanical aeration will be added. Weekly monitoring is proposed as a starting point; if DO fluctuations are noted, monitoring schedules will be adjusted.
- The discharge rates are small enough that complete aeration is easily attainable.

46. Dr. Willing assumes that the Port is using typical stormwater vaults for the reserved stormwater program, and merely using the dead storage areas to hold the reserved water (Willing,

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¶14). This is incorrect. The vaults are being designed to employ additional features to enhance their water quality treatment abilities, and to provide the reserved stormwater function, in addition to all the typical BMPs already employed. Additional features include:

- Increased baffling to enhance sediment trapping capabilities
- More intense inspection/maintenance to ensure proper function
- Special placement of inlets and outlets to minimize resuspension of sediments
- Floating discharge structures to minimize discharge of floatables/settled solids
- Ventilation features
- Provision for reserved storage above dead storage areas
- Provision for contingencies if pilot program/monitoring show that they are needed (filtration/mechanical aeration)

Also, stormwater monitoring data (annual reports) show that airfield runoff is cleaner than typical urban stormwater due to restricted access and source control. These features will continue to be employed in addition to the special features noted above. All this gives assurance that violations of water quality standards will not occur in area streams or in other receiving waters. Finally, the adaptive management system proposed (similar to NPDES approach of implementing BMPs, monitoring their effectiveness and if necessary, making changes to enhance performance) provides assurance that unanticipated concerns can be detected and corrected, both during the pilot program (prior to operation) and during operation of the facility.

47. In addition to BMPs outlined above and those conditions required by Ecology in the §401 Certification, stormwater used for mitigation will be detained for a period of time that will allow for settling and management of particulates, as well as monitoring and management for dissolved oxygen. Contrary to Dr. Strand's contention (Strand, ¶ 34), weekly monitoring for dissolved oxygen is sufficient. While DO can increase rapidly from new stormwater input, a decrease in DO occurs gradually. If necessary, reaeration can be accomplished for the small flow

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from the facilities using passive aeration systems such as drip towers or cascades over roughened surfaces.

48. Dr. Willing's observations that STIA lies in a "semi-arid" climate (Willing, ¶ 34) calls into question his conclusions with respect to the viability of filter strips and bioswales as BMPs.

49. Dr. Willing cites a 1992 Metro study that observed negative removal efficiency for fecal coliform in bioswales or open grassed channels, and then suggests that bioswales can behave as a source of bacteria. I have reviewed the Biofiltration Swale Performance, Recommendations and Design Considerations Report (Seattle Metro 1992) cited by Dr. Willing (Willing, ¶35). The report concludes that the swale which had negative removal efficiency was located next to a major arterial and near a city park and goes on to note that, "It was often observed that people walked their dogs in and around the swale." The report concluded that it was "highly likely" that the unexpected increase in coliform bacteria was due to animal feces and bacteria multiplication within the swale. It is inappropriate to compare the STIA filter strips with the bioswale cited in the study, especially given the fact that that animals will not be able to access the bioswales employed by the Port.

50. **Mitigation Losses from Evapotranspiration and Infiltration Can Be Easily Addressed.** Stormwater from the vaults will be discharged via the same pathways as the detention facilities. In the event that low flow discharge is lost via infiltration or evapotranspiration, water can be piped directly to the streams, or the drainage channels can be lined to reduce losses. Complete preliminary drawings will be provided in the updated low stream flow report.

51. **Compliance With Water Quality Standards.** Both Dr. Willing and Mr. Rozeboom express concern throughout their declarations that the MPU projects and airport operations in general may cause violations of water quality standards. Both ignore, however, the fact that, in addition to the §401 Certification, Ecology has also issued a stringent National Pollution Discharge Elimination System (NPDES) permit for STIA. The NPDES permit was issued to the Port by Ecology under §402

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of the Clean Water Act. The NPDES permit contains the requirements that mandate compliance with the Clean Water Act's standards, as well as protecting the receiving waters to which the Port is discharging. The NPDES permit states "Compliance with this permit is deemed compliance with the Federal Water Pollution Control Act, also known as the Clean Water Act (33 USC §1251, et seq.), and the Water Pollution Control Act (RCW 90.48)." (NPDES Permit No. WA0002465-1, p. 8). *See* Exhibit G.

52. The Port's NPDES permit was conditioned to comply with water quality standards. Any future NPDES permits must likewise be conditioned to comply with water quality standards and the anti-degradation requirements of the Clean Water Act. (WAC 173-201A-060, 173-201A-070, Fact Sheet to NPDES Permit No. WA-002465-1, pp. 22-23). The Fact Sheet that accompanies the Port's existing NPDES Permit states as follows:

> In order to protect existing water quality and preserve the designated beneficial uses of Washington's surface waters, WAC 173-201A-060 states that waste discharge permits shall be conditioned such that the discharge will meet established Surface Water Quality Standards... The Department has reviewed the ambient water quality monitoring results gathered by the Port... and [t]he discharges authorized by this permit should not cause further degradation which would interfere with or become injurious to existing beneficial uses. (Fact Sheet, pp. 22-23).

53. In my opinion, and consistent with this language, in instances where an applicant has an existing NPDES permit, compliance with the permit will provide reasonable assurance that the discharges covered by the permit will comply with applicable state water quality standards.

54. The Port's NPDES permit imposes an ongoing process under which (1) best management practices (BMPs) are identified in the *Stormwater Pollution Prevention Plan*, (2) BMPs are implemented, (3) BMPs are inspected and monitored to demonstrate BMP effectiveness, (4) BMP improvements are made when necessary, and (5) follow-up sampling is used to demonstrate that the improvements are effective. The Port submits an Annual Stormwater Monitoring Report to Ecology. Ecology reviews this report to ensure that the Port's discharges are in compliance with the Clean Water Act, and that discharge conditions actually protect receiving waters. See also *Comprehensive*

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Stormwater Management Plan (December 2000), Sec. 2.2 "Water Quality Management Standards" (p. 2-5 – 2.6).

55. **Glycols Will Not Impact the Quality of Water.** The Federal Aviation Administration (FAA) authorizes only ethylene and propylene glycol for aircraft deicing and anti-icing. Port tenants apply all glycol at STIA. Prior to 1997, some isolated areas where glycol was applied did drain to storm drains. However, as of 1997, all ramp areas where aircraft are routinely deiced drain to the IWS.

56. The Port continues to sample for glycols in stormwater and develop BMPs to address findings. For example, glycol found in SDS1 appeared to come from runoff of glycol from aircraft sprayed in the IWS area under an overhang at the South Satellite. When this problem was identified, drains in this area were connected to the IWS.

57. Additional BMPs are continually evaluated to limit deicing activities to areas that drain to the IWS. Other source controls are not possible, based on the public safety policy that gives aircraft pilots the final say on glycol application. Overspray, tracking, and other possible sources are continually reviewed to determine if additional areas should be diverted to the IWS.

58. The Declaration of Linda Logan contains an extended discussion of the appropriate standard for determining the toxicity of glycols. See Logan Dec., pp. 16-26.

59. **Retrofitting Undertaken In Conjunction with the Construction of MPU Improvements Will Allow for Complete Peak Flow Control and Water Quality BMPs.** Contrary to the assertion of Dr. Strand (Strand, ¶25), the Port will retrofit the entire STIA facility for peak flow control, including portions of the facility that are not modified for MPU projects. The SMP (§§ 2.1.2; 2.1.3; and 6.2.2) describes the standards for retrofitting the airport to meet peak flow reduction objectives. The King County review letter indicates that the peak flow control "will serve to reduce existing rates of erosion." Mr. Rozeboom states in his declaration that the SMP "...should provide sufficient capacity to mitigate for quantitative airport impacts to peak flows...". Since the

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peak flow controls in the SMP includes retrofitting, there is consensus (including consensus from the ACC's experts) that there is 100 percent retrofitting for peak flow controls.

60. In addition to retrofit for peak flow control, the Port will retrofit the airport for water quality BMPs to the extent practicable. All of the new MPU improvements will have water quality BMPs.

61. Section 7.1.4. of the SMP details the proposed retrofitting of areas not included in the MPU improvements that will be retrofit. Section 7.1.5 describes approximately 80 acres (of 570 acres in the STIA industrial stormwater drainage area, or 14 percent) of existing STIA area that will not be retrofit. This area is not proposed for any modifications by the MPU, and construction costs and service disruption make retrofitting impracticable at this time.

62. Moreover, Section 7.1.5 requires the Port to retrofit this area in the event that future redevelopment takes place on those 80 acres or emerging technology in stormwater treatment makes retrofitting these areas practicable.

63. Irrespective of whether this area is ultimately retrofit or not, source control BMPs are applied to those 80 acres, as described in Table 7-10 of the SMP and the STIA Stormwater Pollution Prevention Plan.

64. Dr. Strand is incorrect when he asserts in his declaration that there has been no final decision on retrofitting. *See* Strand Declaration, ¶6. Table 7-8 of the SMP describes the proposed water quality BMPs for STIA that are practicable for implementation. The schedule for implementation is described in Section 7.1 of the SMP. This schedule is required under Condition J.1.c of Ecology's §401 Certification.

65. **Construction of the MPU Improvements Will Result in Increased Water Quality.** The MPU projects will be constructed on existing STIA areas or, in the case of the third runway, on recently acquired residential land. Many existing land uses and potential water quality impact sources will be retired as a result of the MPU projects. For example, over 400 houses and

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businesses will be removed, each of which contributes stormwater pollutants such as sediment, metals, pesticides, herbicides, fertilizers, and animal waste. In addition, farms in the Port's acquisition area will be removed, reducing pollutants commonly associated with farms, such as sediments, animal waste (fecal coliforms), and agrichemicals. Animal waste is by far the primary contributor to fecal coliform in area creeks. Removing uses such as houses, septic systems, golf course (favored goose habitat), and farm should have a positive impact on fecal coliform. The new uses (ruways, taxiways, infields, and rooftops) are insignificant contributors of fecal coliform into the environment.

66. Finally, stormwater runoff from runways compares favorably with runoff from residential areas. This fact is elaborated more fully in the Declaration of James C. Kelley. Contrary to the assertion made by Tom Luster (Luster, ¶ 26), it is unclear what is unique about existing conditions near the site. From the perspective of stormwater management, this is an urban/suburban setting very similar to hundreds of other such sites located throughout the Puget Sound region, with small salmonid-bearing streams heavily impacted by development and few BMPs for stormwater quality management in place.

67. Contrary to Mr. Luster's assertions, what may be unique about the stormwater from STIA is that runways and aircraft movement areas typically have lower concentrations of stormwater pollutants, especially when compared with other land uses in the vicinity of STIA and in the affected watersheds. *See* SMP, p. 4-17.

68. While the MPU projects are significant in their scale, the size and extent of stormwater management facilities that will be constructed to mitigate potential stormwater impacts are likewise significant in their scale.

69. Several factors must be considered in a assessing whether the Port's proposed MPU improvements will have an impact in the overall water quality of the watersheds of Miller, Des Moines and Walker Creeks.

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70. First, the extent of the Port's impacts to the watershed is limited to property that is actually in the Port's control. In the Miller Creek watershed (which includes Walker Creek), even with the acquisition of west side properties, the Port's holdings will increase from approximately 3% of the total Miller Creek watershed to approximately 9% of the watershed.

71. A majority of this acquisition will be permanently set aside for wetland mitigation or stormwater management. The SMP and natural resource mitigation plans describe how the Port is mitigating potential watershed impacts and providing additional mitigation to retrofit existing impacts. The Port's mitigation plans are consistent with overall watershed-wide objectives.

72. In the Des Moines Creek watershed, the Port controls approximately 23 percent in airport area. Several acres in the Port's control are included in noise abatement and runway protection zones that are undeveloped. The Des Moines Creek Basin Plan identifies existing problems in the heavily impacted watershed. Each of the Port's actions addresses a component of the Des Moines Creek problems including:

- Peak flow impacts, which the Port will mitigate and improve with peak flow retrofitting described in the SMP
- Water quality impacts that will be reduced by retrofitting water quality BMPs and on-going monitoring under the §401 Certification and NPDES permit
- Wetland enhancement and riparian area restoration on the Tyee Valley Golf Course
- Continued participation in the Des Moines Creek Basin Plan
- Low flow water to mitigate low stream flow impacts

The Port's mitigation plans are consistent with overall watershed-wide objectives.

73. Copper, lead and zinc are common pollutants from roadways. Given the amount of the three watersheds that the Port actually controls, there is a strong probability that these pollutants are also contributed from sources other than the Port's operations.

74. **The Port's MPU Project Has Changed and Many New Reports and Analyses Have Been Submitted to Ecology Since October 2000.** Since the withdrawal and reapplication of

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the MPU's Joint Aquatic Resource Permit Application (JARPA) in October of 2000, several additional analyses and reports have been completed. The SMP was resubmitted in December 2000 for King County review. The updated report included a revision to the retrofitting standard on the west side acquisition area, in addition to addressing review comments to the August draft SMP. Multiple iterations of revised reports and review are typical, especially for large, complex projects such as this and the "new ground" of continually changing stormwater standards. The December report was then updated through a facilitated review and page replacement process. Therefore, there have been at least two significant updates to the last stormwater documents "reviewed" by Mr. Luster, prior to his reassignment within the Department of Ecology.

75. The Low Flow Analysis was a part of the August 2000 SMP. The Port elected to remove an updated low flow analysis from the SMP and convert it to a stand alone document that was released in December 2000. An updated low flow study was submitted to Ecology in July, 2001 to address review comments by Ecology. Here again, there have been two updates to review documents since the last review by Mr. Luster when working at the Department of Ecology.

76. **The Northwest Ponds Do Not Exceed Water Quality Standards.** The Dissolved Oxygen Deicing Study (Cosmopolitan Engineering Group 1999) shows that, contrary to Mr. Luster's assertion in ¶29 of his declaration, copper, lead, and zinc levels in the Northwest Ponds do not exceed water quality criteria in the Northwest Ponds (see Table 16, instream metals results).

77. The Northwest Ponds are man-made ponds that were excavated for peat in the 1950s and farmed prior to mining. The surrounding wetland complex has been highly altered by clearing and golf course operations. The Port discharges stormwater into the Northwest ponds from the SDS3 and SDS2 outfalls. The discharge point for SDS 3 is approximately 1,500 feet from the Northwest ponds; SDS2 is approximately 980 feet upstream of the ponds.

78. In response to the assertion that there may be impacts to Northwest Ponds, the Port undertook a study of dissolved oxygen (DO) in the Northwest Ponds subsequent to the Mr. Luster's

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departure from the Department of Ecology. Because multiple factors influence the levels of dissolved oxygen in Northwest Ponds and Lake Reba (e.g., rainfall, wind, temperature, length of dry period, natural organic carbon in runoff and pond sediments), the Cosmopolitan (1999) study was unable to show any relationship between the application of de-icers and levels of dissolved oxygen in the ponds. The Port undertook a second study the following winter that reached similar conclusions. *See* Examining the Effects of Runway Deicing On Dissolved Oxygen in Receiving Waters: Results of the 1999-2000 Winter Season (Seattle-Tacoma International Airport, Janaury 2001). Given the infrequent and minimal use of ground de-icers at Sea-Tac Airport, further studies are not likely to change the findings reported thus far.

79. **Mr. Luster Has Misconstrued the Booth and Horner Study.** Research conducted by Horner and Booth on Puget Sound Lowland streams is extensive and has looked at several biological and physical parameters of stream integrity (Horner et al 1996). A copy of the Horner and Booth study is attached as Exhibit H. Parameters measured include Benthic Index of Biological Integrity, ratio of coho salmon/cutthroat trout, zinc concentrations, ratio of 2-yr peak to winter base flow, LWD, ratio of water column dissolved oxygen (DO) to intragravel DO. Zinc concentrations are regulated by the Washington State Department of Ecology under WAC 173-201A. The others are indices of quality, but are not regulated parameters. Mr. Luster has cited the Horner and Booth research in his declaration in support of his claim that watersheds that have more than 20% impervious surface will show a decline in water quality. *See* Luster Declaration, ¶29.

80. A key finding of Horner & Booth study was that there is little association between water and sediment quality and relatively low and moderate levels of urbanization, and that "increasing hydrologic fluctuation seems to be an early harbinger of rising impervious surface cover". In general, according to Horner & Booth's research, the condition of urban streams, such as Miller and Des Moines creeks, are more related to changes in watershed hydrology than an increase in chemical pollutants. The data that supports this conclusion is summarized below:

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- "the concentration [of zinc] was well below both criteria under all conditions until TIA [total impervious area] rose above 40 percent." (Horner et al 1996).

- all zinc concentrations were "below the 'lowest effects threshold' of the Washington State Department of Ecology (1991) freshwater sediment criteria and far below the 'severe effects threshold.' The low measured concentrations relative to advisory or regulation criteria were found with other metals as well. As with water quality, it appears that sediment quality does not change appreciably until urbanization reaches the vicinity of 50 percent impervious." (Horner et al 1996).

- Concentrations of metals in sediments "did not change much over the urbanization gradient until imperviousness approached 50 percent ... and sediment concentrations remained far below freshwater sediment criteria." (Horner et al 1996).

81. Horner et al 1996 concluded that "There was direct evidence in both stream and wetland cases that altered watershed hydrology was at the source of the overall changes observed." Based on this statement, the SMP proposes significant measures to enhance beneficial uses of the streams.

82. The Port is proposing to retrofit an area of 2.7 square miles in the three watersheds located at both the existing airport and in new airport area and provide Level II detention for all new impervious surfaces. The HSPF models developed for the SMP demonstrate that these BMPs will restore the hydrologic regime, peak flows and flow durations of these airport basins to a pre-developed condition. The Low Flow Analysis demonstrates that the proposed Master Plan Improvements will not significantly impact summer base flows.

83. It is also important to note that the studies referred to in Horner et al 1996 were performed on watersheds where development was constructed prior to 1990 and which therefore had little or no stormwater detention and treatment. In addition to the proposed stormwater improvements, the Port is also proposing to restore 1.4 miles of stream buffer in Miller Creek, which Horner et al 1996 also state may "help ameliorate the effects of more distant urbanization."

84. **The Mitigation Plans Submitted to Ecology Contained Appropriate Levels of Detail to Allow for Review.** Monitoring plans for construction are typically submitted and reviewed prior to construction. The mitigation plans submitted by the Port to Ecology contain a sufficient level of detail to allow for review by the Department and there is reasonable assurance that

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those plans can be developed and implemented. A project cannot start if a plan has not been submitted and reviewed.

85. Contrary to the assertion of Mr. Rozeboom (Rozeboom, ¶ 7), the mere fact that there is not a technical manual for the low flow proposal does not mean it is not feasible or based on sound engineering. The low flow mitigation approach is fully described and the analysis supporting the mitigation approach is fully explained. The details of final vault construction are not fully drawn, but these are not feasibility concerns. The vaults and other systems used in the Low Flow Analysis utilize standard engineering that is common in stormwater management. The scale of the proposal is significantly larger than most projects, but the constructibility and engineering issues are far from unique and do not raise feasibility concerns.

86. Similarly, Mr. Luster's contention (Luster, ¶35) that final drawings are required for reasonable assurance is not well taken. Reasonable assurance does not require that the project be put to final design and built to determine if the proposed mitigation and other plans will work. Also, as Mr. Luster notes, this was the last in a long series of applications and submittals and Ecology's review of the current Port plans did not start over with the submittal of the Port's final application. The Ecology team had been reviewing the project for years (including a year when Mr. Luster wasn't involved in the review).

87. In fact, the detail of Ecology's review is demonstrated by the specification of the revisions and updates required in the §401 Certification. This level of analysis demonstrates a detailed evaluation by Ecology and the fact that the Port's plans were well understood by Ecology.

88. **Dr. Willing Overstates the Impact of "First Flush."** Dr. Willing asserts that BMPs for stormwater will be ineffective based on the existing low stream flows that provide little dilution of contaminants and that the first flush of accumulated pollutants in stormwater runoff will have severe impacts on streams. *See* Willing Declaration, ¶ 37. In fact, when the "first flush" of pollutants are flowing to streams, those streams are rising in response to the same storm. In addition,

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as was noted above, runways and taxiways have reduced concentration of stormwater pollutants. Based on the increased dilution from the "first flush" storm and the reduced concentration of stormwater pollutants from runways and taxiways, the severe water quality impacts asserted by Dr. Willing will not arise.

89. **The Port's Proposed Plans Provide Reasonable Assurance that Water Quality Standards Will Be Met.** The Port has approached stormwater management at STIA with BMPs that have been studied, applied, updated, and monitored for decades. Potential stormwater and water resource impacts from the MPU project have been thoroughly assessed. Peak flow impacts due to new impervious surfaces and embankment construction are mitigated with 344.1 acre-feet of stormwater detention. Existing airfield facilities will be retrofit to mitigate existing peak flow impacts as well. The MPU projects are redevelopment of land that caused water quality impacts without mitigation, such as residential areas, streets, businesses and farms. Water quality impacts have been addressed using BMPs to reduce pollutants in stormwater runoff for new MPU projects as well as existing Port facilities. These BMPs are continually reviewed and tested, and emerging technology to address complex or unique stormwater runoff is being applied at STIA. The Port's NPDES permit provides the opportunity to continually monitor stormwater and update BMPs as problem areas are found. Finally, the Port's low stream flow mitigation plan has been developed using innovative applications of state of the art modeling approaches to determine impacts and simple, straightforward BMPs to offset impacts.

90. The Port will operate STIA for many years to come. There is continual oversight of the Port's operations and permits. The NPDES permit provides a mechanism to implement updated stormwater control BMPs. The Port has sufficient resources to perform ongoing monitoring, apply new technology BMPs when needed, and implement contingencies. There is reasonable assurance that water quality impacts have been fully mitigated for MPU projects.

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I declare under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Executed at Kirkland, Washington this 28th day of September, 2001.

Paul S. Fendt

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Paul S. Fendt, P.E.

Bachelor of Science, Geological Engineering
Registered Professional Engineer in Washington and Florida

Paul Fendt has over 16 years of stormwater engineering and planning experience. His project experience includes a broad range of stormwater and surface water projects, including hydrologic and hydraulic modeling (HEC-1, WaterWorks, HEC-2, SEDIMOT II), NPDES stormwater permits erosion control on creeks and lake shores, comprehensive storm and surface water plans, and preparation of drainage ordinances and environmental impact statements.

Stormwater Management/Surface Water Hydrology/Flood Control

Valley Creek Estuary Restoration – Port of Port Angeles, WA
Project Hydrologist for design and permitting of a new, man-made 4-acre marine estuary in downtown Port Angeles. The new estuary and associated park is a centerpiece for the downtown Port Angeles re-development program. The project consists of converting an existing log-sort yard and tight-lined 84-inch diameter culvert into a combination of a park, marsh, beach, and mud-flat estuary.

Stormwater Pollution Prevention Plan – Potlatch Corporation, Lewiston, ID
Parametrix was retained to update the Stormwater Pollution Prevention Plan (SWPPP) for Potlatch Corporation's Lewiston, Idaho facility.

Design and Operation of Stormwater Treatment System – Port of Seattle, WA
Parametrix staff designed two movable stormwater treatment systems to treat up to 500 gpm stormwater per unit from a 40-acre parking lot construction site. The systems were designed to reduce turbidity and were operational within two weeks. Alum was used as the coagulant. Additionally, our staff also managed the procurement and assembly of rental equipment and were responsible for the operation and staffing of the units, which are operated two shifts a day, 7 days a week, when required by weather conditions.

Butter Creek Engineering Analysis – Lewis County, WA
Parametrix will provide an engineering analysis of revetment repair and actions taken in response to flooding along lower Butter Creek. Responsibilities will include document review, scheduling interviews, and site visits.

Park Hill Stormwater – Langley Associates, Bellevue, WA
Parametrix provided a stormwater analysis and developed recommendations for stormwater handling.

Sammamish River Habitat Improvements – City of Redmond, WA
Parametrix was selected by the City of Redmond to design habitat enhancements for the Sammamish River through downtown Redmond. The river was channelized for flood control with little consideration of habitat and aesthetics. Mr. Fendt is the Project Manager and Fluvial Geomorphologist for the habitat enhancement planning and design effort. Habitat enhancements include modifying the channel geometry with benches and meanders, adding emergent wetland habitat, enhancing channel substrate, removing exotic vegetation, and replanting the riparian corridor with native plants to improve wildlife habitat. Project planning has included public workshops and meetings with affected agencies, including the Army Corps of Engineers, Washington Department of Ecology, Washington Department of Fish and Wildlife, the Muckleshoot Tribe, and King County. Construction was completed in the summer of 1997.

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On-Call Small Stormwater Projects Program – City of Redmond, WA
Provides on-call services for the City's Stormwater Management Division. Projects include small project designs to solve neighborhood flooding problems, drainage studies to identify alternatives for solving flooding problems, surveying easements for stormwater facility maintenance, basin planning assistance, and spill response. The key to the success of the project has been our rapid turnaround preparing work authorizations.

On-Call Stormwater Management Planning – Port of Seattle, SeaTac, WA
Project Manager for on-call stormwater management planning at SeaTac International Airport. Provided support on many projects, including the SeaTac Master Plan Project stormwater master plan. Other projects include NPDES permit support; sediment and erosion control review and design; hydrologic and hydraulic modeling (HSPF and WaterWorks); stormwater management facility planning and design; and a report regarding stormwater on Miller and Des Moines Creeks.

Dredge Island Stormwater Sampling Program – Lavaca Bay Superfund Site, Point Comfort, TX
Mr. Fendt designed and implemented a stormwater runoff collection program on a contaminated dredge spoil island in Lavaca Bay on the South Texas coast. Automated stormwater samplers were installed to collect water and sediment associated with stormwater runoff. Using the results of the six-month program, sediment and contaminant loading will be calculated. The collection system includes lined collection channels and pre-fabricated channels and flumes and collect runoff, transport sediment, and measure flows. The samplers have been programmed to trigger a sampling program when a pre-determined flow rate is measured. Grain size distribution of the sampled storm sediments will be determined to correlate storm intensity and sediment yield.

Stormwater Pollution Prevention Plan (SWPPP) – Port of Vancouver, WA
Project Manager for the completion of an SWPPP for the Port's facilities on the Columbia River. The plan includes a number of Best Management Practices (BMPs) and identifies potential stormwater treatment alternatives.

Master Plan Update: Natural Resource Mitigation – Port of Seattle, WA
The Port of Seattle asked Parametrix to prepare a natural resource mitigation plan for a master plan update NEPA/SEPA final EIS. This work included relocating a portion of Miller Creek and tributaries in addition to the stream relocation design. The proposed wetland mitigation site located adjacent to the Green River near Auburn, Washington. Parametrix is developing a bank protection plan to mitigate bank erosion, which is threatening the mitigation site.

Strandley Environmental Services – Seattle City Light, Purdy, WA
Project engineer for a multidisciplined Superfund site cleanup. A PCB contaminated stream flowing through the project site required assessment and design of a new cleanup project. The project includes removing PCB contaminated soils from the creek while minimizing site disturbance. Stream habitat was restored using log weirs, deflector logs, and large woody debris from the adjacent remediation areas. Provided direct field oversight and field placement of new stream habitat features during construction.

South Prairie Creek Flood Study – Pierce County, WA
The Pierce County Public Works Department is proposing to improve South Prairie Road, with safety improvements that include widening the road and straightening several curves. To improve drainage and public safety in an emergency, the road, which is partially constructed in the South Prairie Creek floodplain, will be raised above the existing 100-year flood elevation of South Prairie Creek. Concerns

about potential floodplain impacts from the proposed road improvements prompted the preparation of a new flood study for the potentially affected portion of South Prairie Creek.

A computer simulation of the floodplain was prepared, using the hydraulic backwater model HEC-2. Two HEC-2 models of South Prairie Creek were prepared: the first was created using the input parameters from the original Federal Emergency Management Agency (FEMA) floodplain study; the second model was prepared by supplementing the original study with new channel cross sections. The new model with added cross sections was then checked and used as the basis for comparing impacts from the proposed road improvements. The proposed road improvements were added to the new study and compared to determine flood elevations and impacts from the new road.

Clover Island Redevelopment Stormwater Management Plan – Port of Kennewick, WA
The Port of Kennewick, Washington, is proposing redevelopment of Clover Island as part of its future expansion plans. The plans include redevelopment of existing developed areas, expansion of water-dependent businesses, and expansion of the island with new development. A Conceptual Stormwater Management Plan (SWMP) for Clover Island Redevelopment, was prepared. The plan included measures for reducing existing stormwater runoff impacts from existing Port facilities. Alternatives for controlling runoff from newly developed areas included biofiltration swales and constructed wetlands.

87th Street Extension Burnt Bridge Creek Flood Study – City of Vancouver, WA
The proposed 87th Street extension contemplated by the City of Vancouver requires a new Burnt Bridge Crossing. To ensure that the crossing will cause no floodplain impacts, Parametrix prepared a flood study of the creek using HEC-2. There was limited existing data available for completing the study, and the existing FEMA study was flawed. Working with the County and City, Parametrix prepared a hydraulic model that determined flood elevations and allowed for bridge design that mitigated potential impacts.

Kalauao Stream Flood Study – Department of the Navy, Oahu, HI
Sediment and debris collecting at the mouth of Kalauao Stream raised concerns about potential house flooding and property damage near the mouth of the stream. Parametrix prepared a study to: (1) determine the current extent of the 100-year floodplain; (2) determine the probable causes of flooding and factors that have changed flood patterns since development along the lower stream banks; (3) develop and compare alternatives for controlling flooding and limiting flood damage; and (4) make recommendations for action (or no action) to limited flood damage. Several flood control alternatives were considered, and action recommendations were made, including reconstruction of the gas and sewer lines crossing the stream and causing floodplain impacts.

Woodland Creek – Pierce County, WA
Prepared a conceptual regional stormwater reduction plan to reduce potential peak flows. The project included hydraulic modeling (compared HEC-1 against WaterWorks modeling program) and predesign of regional stormwater management ponds to reduce peak flows generated from increased development of the watershed.

Canyon Creek – Pierce County, WA
Prepared a conceptual regional stormwater reduction plan to reduce potential peak flows. Similar in scope to the Woodland Creek project with its own specific design criteria.

Southwest Harbor Project – Port of Seattle, WA
Prepared a site stormwater management assessment and mitigation plan for the proposed expansion of container facilities and site remediation for existing tenants. The project included recommended Best Management Practices (BMPs) for source reduction as well as alternatives for stormwater treatment, such as wet ponds and biofiltration swales.

Storm and Surface Water Master Planning Study – City of Camas, WA
Prepared a storm and surface water management plan for a new industrial area. The project includes hydrologic modeling and pre-design of regional stormwater management ponds to mitigate potential impacts from development of the industrial area. Stormwater management planning will be concurrent with wetlands management planning to develop an integrated approach to water resource planning.

Stormwater Improvements – U.S. Navy SUBASE Bangor, Kitsap County, WA
Concept study and design of stormwater improvements for the industrial and vehicle maintenance area at the Bangor base. A stormwater pollution prevention plan (SWPPP) includes a number of source control options for reducing stormwater runoff contact with pollutants. Because of the extensive vehicle maintenance activity at the site, oil/water separators have been included as a stormwater treatment option. The project included modeling the existing storm sewer system, investigating sources of oily discharges, and preparing drawings of the existing storm sewer system.

East Texas Hydrologic Study – Confidential Client
Conducting a hydrologic analysis and model of an interconnected lake system in eastern Texas. The project includes the interpretation of rainfall data, development of a continuous hydrologic model for the water shed, stream gaging, automated sampling, and the use of GIS for determining hydrologic parameters for the model. The results will be used to determine annual pollutant loading in the system.

Waiawa Stream Sediment Removal and Wetland Enhancement – U.S. Navy, Oahu, HI
Prepared a hydrologic study and conceptual engineering design of a wetland enhancement and sediment removal facility to reduce sediment load to Pearl Harbor. The project includes a detailed study of rainfall and stream flow conditions, sediment loads, and wetland hydrology. The conceptual design of the proposed wetland includes removal of suspended sediments in constructed wetlands and enhancement of existing wetland habitat and function.

South Aviation Support Area (SASA) Stormwater Management Alternatives Feasibility Study – Port of Seattle, WA
Prepared an assessment of nine alternatives for regional stormwater management on Des Moines Creek located near Sea-Tac International Airport. The purpose of the report was to determine the best alternative for replacing an existing stormwater facility which will be removed as the result of construction of the SASA site. The preferred alternative combined peak flow reduction for improved fish habitat, regional water quality enhancement, spill control, and wetlands protection with cost effective design and efficient use of land.

Lake Park Condominiums Drainage Plan Review – City of Kirkland, WA
Reviewed the drainage plans for a condominium development proposed in Kirkland. The review included potential hydrologic impacts to wetlands, flooding impacts, and flood stages on Lake Kirkland (Forbes Lake). Stormwater mitigation measures were proposed for basin build-out on Lake Kirkland. The Forbes Lake drainage basin was also modeled for existing and basin build-out to determine 100-year flood stages on Forbes Lake.

AR 010199

Aberdeen Sawmill Stormwater Plan – Weyerhaeuser, Aberdeen, WA
Prepared a hydrologic analysis of a sawmill site which included analyzing rainfall records determining return frequencies for different storm durations; estimating runoff volumes and contaminant concentrations; and evaluating stormwater control and treatment alternatives.

Kitsap County Stormwater Management Ordinance – Kitsap County, WA
Prepared a stormwater management ordinance for the County. The Ordinance has heavy emphasis on inspection, maintenance, and enforcement of stormwater systems and construction. The ordinance approval process included a multidisciplinary technical advisory committee review. The ordinance was written to comply with the Stormwater Management Manual for the Puget Sound Basin.

Utilities Comprehensive Plan – Grays Harbor County, WA
Managed storm and surface water portion of the County utilities comprehensive plan. The plan includes water resource protection, facilities improvements, and basin planning concepts. The project has an emphasis in public participation and economic development.

Fitzgerald Road Culvert Replacement – Polk County, FL
Prepared the design and specifications for replacement of culverts in a high, unstable road fill. Existing culverts had been blocked and failed due to bank slumping, causing a back-up that threatened the road and a downstream mobile home park. The design required the use of level pool routing models, riser sizing with trash skimmers, and tightline culverts down the backslope. The project was constructed, and the structure has experienced a significant storm event (between a 10- and 25-year storm) with no further problems.

Lyon Creek 100-year Flood Study – Canaan Apartment, Lake Forest Park, WA
Managed determination of the 100-year flood plain of Lyon Creek for an apartment complex in Lake Forest Park (North Seattle area). Mitigation for proposed flood plain encroachments were included in the final project report.

Derby Ditch – Lake Jessie, Polk County, FL
Developed the conceptual design for a stormwater detention facility in a 400-acre urbanized drainage basin to provide water quality enhancement of runoff to a recreational lake chain. The system will provide treatment of approximately 1/3 of the contributory drainage basin to the lake.

Amendment to Polk County Flood Protection and Surface Water Management Ordinance – Polk County, FL
Prepared for adoption of a major revision and subsequent amendment to the Polk County, Florida, Flood Protection and Surface Water Management Ordinance. The ordinance also provided for the protection of wetlands and water resources. Responsibilities as program manager included preparation of map amendments and revisions, interpretation of Flood Insurance Rate Maps, and county compliance with the National Flood Insurance program.

Comprehensive Growth Management Plan – Polk County, FL
Prepared and presented the drainage sub-element of the infrastructure element of the County's Comprehensive Growth Management Plan. Provided technical assistance in the preparation of the Conservation (surface water, wetlands, floodplains, groundwater sub-elements), infrastructure (potable water, aquifer recharge), and land use (wetland, floodplain overlays) elements.

Mill Creek Erosion Control – City of Kent, WA
Comprehensive study and preliminary design to reduce erosion in an unstable urban canyon damaged by high flows. Project elements included the following: inventory and prioritization of erosion problems; surveying; hydrologic and hydraulic modeling; and bioengineering and engineering designs for stabilization of streambanks and slopes.

Luther Burbank Park Erosion Control Project – King County Parks Department, WA
King County's Luther Burbank Park on Lake Washington was experiencing accelerated shoreline erosion. Mr. Fendt led Parametrix's investigation of the historical rates of erosion and determined probable causes of the shoreline erosion problems. An innovative combination of engineering design alternatives and recommended operation and use modifications were developed to control the erosion rate while also maintaining the natural, recreational, and aesthetic values of the park.

Madsen Creek Interceptor Environmental Analysis – Metro, Renton, WA
Conducted reconnaissance of streambank and side slope erosion sites in an unstable canyon subjected to increased peak stormflows from urbanization. Evaluated alternatives to reconstruct the sewer interceptor pipe in Madsen Creek Canyon. Identified bioengineering and engineering alternatives for stabilization and erosion control including riprap, gabions, live cribwalls, live staking, and branch packing.

Inspection and Maintenance Manuals for Tyee Pond and Miller Creek Regional Detention Facilities – Port of Seattle, WA
Paul managed the development of inspection and maintenance manuals for two stormwater detention facilities (Tyee Pond and Miller Creek Regional Detention Facility) located on Port of Seattle property to help facilitate the transfer of responsibilities for the facilities from King County to the Port of Seattle. The inspection and maintenance manuals are intended to be working documents that could be used by the field crew responsible for inspecting and maintaining the facilities. In addition, the manuals will serve as documentation of facility maintenance in compliance with State and Local stormwater regulations. Manual development included researching standard inspection and maintenance procedures used by King County and others; conducting interviews with County employees familiar with the operation and maintenance of the facilities; gathering information relevant to the proper functioning of the facilities, such as as-built diagrams and specific equipment operation manuals; evaluation of current facility conditions and operation; development of an inspection and maintenance schedule; and development of inspection and maintenance checklists to be used in the field.

Water Quality

Derby Ditch – Lake Jessie, Polk County, FL
Developed the conceptual design for a stormwater detention facility in a 400-acre urbanized drainage basin to provide water quality enhancement of runoff to a recreational lake chain. The system will provide treatment of approximately one-third of the contributory drainage basin to the lake.

Environmental Impact Statements and Assessments

SEPA Assistance – Port of Seattle, WA
Parametrix is providing miscellaneous on-call SEPA assistance to the Port of Seattle.

AR 010201

King County Regional Justice Center EIS – King County, WA
Analyzed stormwater quality and quantity discharge on four alternative sites for both pre- and post-development conditions. Developed recommendations for stormwater management facilities to comply with King County Surface Water Design Manual.

Black River Transfer Facility EIS Stormwater Management – City of Renton, Tukwila, WA
Prepared the conceptual design of a stormwater management system for a regional waste transfer site, and included the preparation of an EIS document for impacts to water. The project required analysis of stormwater quantity and quality discharges, wetlands, and floodplains. The proposed stormwater management facilities were designed for compliance with the King County Surface Water Design Manual.

South Aviation Support Area (SASA) EIS Stormwater Study – Port of Seattle, WA
Directed the review of stormwater impacts for a proposed 100-acre airport maintenance facility. Analysis included impacts and mitigation for removal of a regional detention facility, relocation of Des Moines Creek, and preliminary design of a new regional stormwater management facility. The proposed facility included a regional water quality pond. A basin model was developed to assess several stormwater pond design alternatives. Peak flow rates in Des Moines Creek will be reduced to improve fish habitat.

Indian Summer EIS – Private Developer, Olympia, WA
Reviewed stormwater impacts for a new residential subdivision. The review included an analysis of proposed stormwater management techniques, including filtration facilities. BMPs for erosion control and stormwater discharging to significant wetland resources were also reviewed, and additional mitigation measures were proposed.

Specialized Environmental Investigations (Land Preservation)

Lake Marion Creek – Polk County, FL
Prepared a land acquisition proposal submitted to Florida Water Management Districts under the Save Our Rivers (SOR) acquisition program. The proposal recommends the purchase of an 18,000-acre watershed, nearly one-half of which contains a variety of wetland types. The remainder is relict sand dunes, noted for their high aquifer recharge potential. The watershed is a major tributary to the Kissimmee River, which is the upper watershed of the Florida Everglades. The project was "A" listed, and negotiations are presently underway for purchase of several tracts.

Geographic Information Systems

East Texas Hydrologic Analysis – Confidential Client
Managed hydrologic analysis and modeling of an interconnected lake system in eastern Texas. The project includes the interpretation of rainfall data, development of a continuous hydrologic model for the watershed, and the use of GIS for determining hydrologic parameters for the model. The results will be used to determine annual pollutant loading in the system.

AR 010202

Transportation

Hillsboro Light Rail Extension – Metro, Portland, OR
Mr. Fendt was the task manager for hydraulic and hydrologic analysis of eight proposed light-rail stream crossings. The proposed alignment was on an existing rail line. Each crossing was assessed for potential floodplain impacts and new crossings were designed to mitigate potential impacts.

Stream Habitat Enhancement

Bear Creek Habitat Assistance – City of Redmond, WA
Parametrix has been retained by the City of Redmond to assist with review of the proposed lower Bear Creek Habitat Restoration Plan. The Army Corps of Engineers is preparing the project plans, with participation by the City. Responsibilities include assisting the City with defining project goals, providing technical review and analysis, and participating in team meetings. Technical elements include engineering, floodplain analysis, fish passage and use, and habitat planting review.

Expert Testimony

Legal Response Assistance – Port of Seattle, WA
Parametrix provided professional services for the SeaTac International Airport Master Plan Update EIS to respond to comments received. Parametrix will provide legal response as needed, meet with Port of Seattle attorneys, and prepare files for disclosure request.

State vs. Spath – Olympia, WA
Parametrix will provide expert testimony in support of WSDOT litigation.

Added Projects that Need to be Moved to a Specific Category

Strandley Environmental Services – Seattle City Light, Purdy, WA
Project Engineer for a multidisciplined Superfund site cleanup. A PCB contaminated stream flowing through the project site required assessment and design of a new cleanup project. The project includes removing PCB contaminated soils from the creek while minimizing site disturbance. Stream habitat will be restored using log weirs, deflector logs, and large woody debris from the adjacent remediation areas. Will direct field oversight and field placement of new stream habitat features during construction.

AR 010203

Cosmopolitan Engineering Group. 1999. Dissolved Oxygen Deicing Study

Des Moines Creek Basin Committee. 1997. Des Moines Creek Basin Plan

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Horner, R.R., D.B. Booth, A. Azous, and C.W. May. 1996. Watershed determinants of ecosystem functioning. Proceedings of an Engineering Foundation Conference. American Society of Civil Engineers, Snowbird, Utah.

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Seattle Metro. 1992. Biofiltration Swale Performance, Recommendations, and Design Considerations.

B

Comprehensive Stormwater Management Plan

Master Plan Update Improvements Seattle-Tacoma International Airport

Port of Seattle

December 2000

Volume 1

Parametrix, Inc.

AR 010206

PREFACE

Comprehensive Stormwater Management Plan
Seattle-Tacoma International Airport
Master Plan Update Improvements

July 2001

This document contains replacement pages developed in response to comments received from the Washington State Department of Ecology (Ecology) on Volumes 1 through 4 of the December 2000 Comprehensive Stormwater Management Plan (SMP) for the Seattle-Tacoma International Airport Master Plan Update Improvements. A facilitated process was used to document specific revisions required by Ecology to the December 2000 SMP. Each SMP volume contains an itemized list of replacement pages, and the replacement pages are identified by a July 2001 footer.

AR 010207

SMP VOLUME 1
JULY 2001 REPLACEMENT PAGES

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Table 4-3 (pg. 4-9)
Table 4-5 (pg. 4-11)
Table 4-6 (pg. 4-14)
Figure 4-4 (pg. 4-16)
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Section 5.1 (pg. 5-1)
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Section 6.2.2 (pg. 6-11)
Section 6.4.4 (pg. 6-12)
Figure 7-1 (pg. 7-2)
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Section 7.1.4.1 (pg. 7-9)
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Table 7-8 (pg. 7-13)
Section 7.8 (pg. 7-23)
Section 8 (pgs. 8-3 and 8-4)

COMPREHENSIVE STORMWATER MANAGEMENT PLAN

FOR AGENCY REVIEW

SEATTLE-TACOMA INTERNATIONAL AIRPORT
MASTER PLAN UPDATE IMPROVEMENTS

Prepared for

PORT OF SEATTLE
Seattle-Tacoma International Airport
P.O. Box 69727
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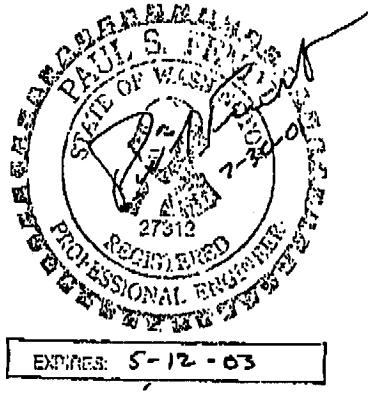
December 2000
556-2912-001 (28)

AR 010209

CERTIFICATE OF ENGINEER

The technical material and data contained in this document were prepared under the supervision and direction of the undersigned, whose seal, as a professional engineer licensed to practice as such, is affixed below.



Paul S. Fendt, P.E.

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B HSPF MODEL CALIBRATION REPORT

VOLUME 4

C EXISTING DETENTION FACILITY DATA
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E BMP SIZING ESTIMATIONS PER UNIT PGIS AREA
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G WATER RIGHTS ON MILLER CREEK
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I LANDSCAPE MANAGEMENT PLAN
J MILLER CREEK FLOODPLAIN ANALYSIS SUMMARY
K EMBANKMENT AQUIFER CONSTRUCTION MEMO
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M WATER QUALITY BMP COST ESTIMATES FOR AREAS DETERMINED TO BE NON-PRACTICABLE FOR RETROFITTING
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O IWS OUTFALL HYDRAULIC CAPACITY MODELING RESULTS
P DES MOINES CREEK AND MILLER CREEK DOWNSTREAM ANALYSES
Q PROPOSED STORMWATER CONVEYANCE FIGURES
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ACRONYMS

AKART	All known available and reasonable treatment
AMA	Aircraft Movement Area
AOA	Aircraft Operations Area
ARFF	Airport Rescue and Firefighting
ATCT	Air Traffic Control Tower
ASDE	Airport Surface Detection Equipment
ASR	Airport Surveillance Radar
BCT	Best Conventional Control Technology
BMPs	Best Management Practices
BOD	Biochemical Oxygen Demand
BPJ	Best Professional Judgement
cf	Cubic feet
cfs	Cubic feet per second
CIP	Capital Improvement Project
CMA	Calcium Magnesium Acetate
CMP	Corrugated metal pipe
CN	Curve number
CWA	Clean Water Act
DAF	Dissolved Air Flotation
DO	Dissolved Oxygen
DMRs	Discharge Monitoring Reports
DNR	Department of Natural Resources
Ecology	Washington State Department of Ecology
EDRPR	East Division Reclamation Plant at Renton
EIA	Effective impervious area
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ET	Evapotranspiration
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FSEIS	Final Supplemental Environmental Impact Statement
ft	Feet
GIS	Geographic Information System
HELP	Hydrologic Evaluation of Landfill Performance
HFAM	Hydrocomp Forecast and Analysis Model
hr	Hour
HSPF	Hydrologic Simulation Program – FORTRAN
IDF	Inflow design flow
in	Inches

AR 010216

ACRONYMS (Continued)

IWS	Industrial Wastewater System
IWTP	Industrial Wastewater Treatment Plant
KCRTS	King County Runoff Time Series
L	Liter
MCDF	Miller Creek Detention Facility
mg	Milligrams
mgd	Million gallons per day
mi	Miles
MPU	Master Plan Update
NAVAIDS	Navigational aids
NEAT	North End Air Terminal
NEPL	North Employees Parking Lot
NPDES	National Pollutant Discharge Elimination System
NWRC	U.S. Department of Agriculture National Wildlife Research Center
NWS	National Weather Service
PGIS	Pollution-generating impervious surfaces
PGPS	Pollution-generating pervious surfaces
Port	Port of Seattle
RDF	Regional Detention Facility
ROFA	Runway Object Free Area
RPE	Relative percent error
RPZ	Runway Protection Zone
RSA	Runway Safety Area
SASA	South Aviation Support Area
SBUH	Santa Barbara Urban Hydrograph
SCS	Soil Conservation Service
SDS	Storm Drain System
SMP	Preliminary Comprehensive Stormwater Management Plan
SPU	Seattle Public Utilities
STEP	South Terminal Expansion Project
STIA	Seattle-Tacoma International Airport
SWMD	Solid Waste Management Division
SWPPP	Stormwater Pollution Prevention Plan
TESC	Temporary Erosion and Sedimentation Control
TSS	Total suspended solids
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WDM	Watershed data management
WET	Whole Effluent Toxicity
WSDOT	Washington State Department of Transportation

AR 010217

EXECUTIVE SUMMARY

The purpose of the Comprehensive Stormwater Management Plan (SMP) is to provide for the management of stormwater quantity and quality required as mitigation for the Master Plan Update (MPU) improvements for the Seattle-Tacoma International Airport (STIA). The plan identifies stormwater management standards that are administered through the Clean Water Act, Section 401 Water Quality Certification, and Section 402 National Pollutant Discharge Elimination System (NPDES) Permit.

In the interest of stormwater quantity management, the SMP includes recommendations that:

1. Identify new and existing stormwater detention facilities that will provide stormwater detention for proposed MPU projects and, in some cases, retrofit the airport to developed conditions existing prior to airport construction;
2. Identify locations for detention facilities that avoid aircraft movement areas;
3. Propose design guidelines that minimize waterfowl attraction to detention facilities; and
4. Propose a schedule for implementation of new stormwater facilities that is synchronized with projects contained in the MPU.

In addition to the new facilities that are proposed for stormwater management, policies are proposed in this plan that:

1. Provide stormwater detention facilities to retrofit existing drainage systems;
2. Improve flow regimes in the receiving waters, namely Miller and Des Moines Creeks;
3. Provide supplemental flow to the creeks during low stream flow;
4. Provide opportunities, where appropriate, to incorporate infiltration into detention project design; and
5. Provide administrative support to King County and local jurisdictions engaged in the basin planning process.

Stormwater quality recommendations in this plan include:

1. Using appropriate best management practices (BMPs) to meet or exceed stormwater quality treatment standards;
2. Retrofitting existing portions of the stormwater drainage system with BMPs;
3. Removing existing sources of stormwater pollutants from drainage areas where BMPs are not proposed; and
4. Implementing projects that enhance water quality such as wetland restoration, stream restoration, and enhancement of riparian buffer zones within the Miller and Des Moines Creek basins.

Ongoing compliance of the stormwater management system with state water quality standards is administered through the NPDES Permit and demonstrated by monitoring performed as part of the NPDES Permit.

The SMP was prepared by following a logical planning process that included:

1. Establishing the stormwater management goals, design standards, and design guidelines and constraints to guide stormwater planning activities;
2. Analyzing the existing hydrologic conditions, facilities, and stormwater quantity and quality conditions;
3. Reviewing the proposed STIA MPU improvements, particularly to identify their potential impacts upon stormwater management systems;
4. Evaluating future conditions in terms of flood flow and water quality impacts; and
5. Identifying new detention facility construction, BMPs, and stormwater quality treatment options, and evaluating the proposed stormwater management plan elements in terms of achieving standards and complying with regulations.

AR 010219

1. INTRODUCTION

1.1 PURPOSE

The Comprehensive Stormwater Management Plan (SMP) was prepared for the Port of Seattle (Port) to guide the development of stormwater facilities for projects associated with the Seattle-Tacoma International Airport (STIA) Master Plan Update (MPU). Technical analyses for this plan evaluated the feasibility of various stormwater management options, identified the potential issues associated with stormwater detention at the airport (such as waterfowl attraction), and recommended a comprehensive plan for managing stormwater for STIA as a whole, after integration of the MPU improvements.

The plan addresses construction for full build-out of the MPU program over the period from 1998 to around 2006 (and possibly later). These projects encompass several major revisions to the airport, including:

- New third runway and parallel taxiway;
- Expansion of the parking garage;
- New remote parking lots;
- New north terminal;
- Reconstruction of Concourse A (south terminal expansion project, or STEP);
- Development of the South Aviation Support Area (SASA);
- New air cargo facilities;
- New air traffic control tower; and
- Other minor projects.

Initial stormwater management planning for the MPU improvements was performed during the Final Supplemental Environmental Impact Statement (FSEIS) (Port of Seattle 1997). The FSEIS described the proposed MPU improvements and their potential impacts on streamflows in Miller[1] and Des Moines Creeks—the receiving waters for airport stormwater drainage—and the measures proposed to mitigate the impacts. This plan updates and refines those analyses by incorporating revised stormwater management standards for water quantity and quality into the mitigation analysis. A review draft of this plan was initially issued in June 1998. It was updated in November 1999 and August 2000 with additional analyses of revised flow control standards, water quality treatment, and updated MPU preliminary designs and schedules.[2] This current draft responds to written and oral review comments received from King County and other reviewers from November 1999 through November 2000.

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[1] Walker Creek is a tributary to Miller Creek. General discussions of Miller Creek include Walker Creek.

[2] Note: This Comprehensive Stormwater Management Plan contains the results of current hydrologic and hydraulic analyses of stormwater facilities for Master Plan Update improvements. Further refinement of this plan will occur as the Master Plan Update schedule is updated and final designs of MPU improvements and stormwater facilities are prepared.

1.2 GOALS AND OBJECTIVES

The overall goal of the SMP is to provide a design basis for all MPU improvements to meet or exceed applicable local and state stormwater regulatory requirements for stormwater management. The King County Surface Water Design Manual (the King County Manual; King County Department of Natural Resources 1998) and the Washington Department of Ecology's (Ecology) Stormwater Management Manual for the Puget Sound Basin (the Ecology Manual; Ecology 1992) provide the foundation for these requirements. Additional stormwater management activities were identified to protect Miller and Des Moines Creeks from increased stormwater runoff. To achieve these goals, the following specific objectives have been identified:

- Design the MPU improvements in accordance with applicable stormwater regulations and the conditions of approval for the MPU FSEIS (Port of Seattle 1997), and the Governor's Certification of Compliance with Applicable Air and Water Quality Standards (the Governor's Certification; Locke 1997);
- Meet Level 2 stormwater discharge criteria (as described in the King County Manual) for all airport runoff, as measured downstream of proposed or existing detention facilities, to mitigate impacts of stormwater discharge;
- Enhance stream low flows by ceasing the exercise of existing surface water rights (obtained by the Port through property acquisitions) on Miller Creek, supporting and participating in the Des Moines Creek Basin Committee's flow augmentation project on Des Moines Creek, incorporating infiltration into stormwater detention facilities where feasible, and if necessary, supplementing low flow with stored stormwater;
- Mitigate the potential impacts of stormwater discharge on water quality in Miller and Des Moines Creeks, thereby maintaining or improving the beneficial uses of the surface waters in the Miller Creek and Des Moines Creek drainage basins; and
- Reduce potential waterfowl attraction to stormwater facilities through appropriate design.

In addition to providing stormwater management for all new MPU improvements, the Port is actively working with King County and local jurisdictions to implement the recommendations of the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997), and is supporting a similar planning process for the Miller Creek basin. The Port is committed to supporting the recommendations of these studies to (1) improve the management of stormwater runoff in Miller and Des Moines Creeks, (2) help implement those recommendations that are found to be feasible, and (3) explore opportunities to increase the performance of existing facilities, if the proposed enhancement does not create a safety hazard to air traffic.

1.3 DOCUMENT ORGANIZATION

The SMP is organized into eight sections. Section 2 describes the stormwater management standards for water quantity and quality. Airport-specific stormwater design guidelines and hydrologic analysis methodology are discussed in Section 3. Section 4 provides information on the existing conditions at STIA, including drainage basins, conveyance systems, stormwater detention facilities, water quality, best management practices (BMPs), and hydrologic modeling of the

existing conditions. Proposed MPU improvements are summarized in Section 5, which also includes information on 1994 and future (2006) land use. Section 6 describes hydrologic modeling of future conditions, and the associated stormwater quantity management options. Future stormwater quality is discussed in Section 7, which provides information on measures to mitigate potential water quality impacts associated with the proposed MPU improvements, including source control and treatment BMPs and receiving stream enhancement projects. References are listed in Section 8.

Twenty-six appendices containing technical support data are included with this document under separate cover (Volumes 2 through 4). Appendix A (Volume 2) contains data on hydrologic modeling for individual MPU improvements. Calibration of the hydrologic model is summarized in Appendix B (Volume 3). Appendices C through Z are contained in Volume 4. Existing detention facility data and proposed detention facility drawings are provided in Appendices C and D. BMP sizing estimations per unit area and water quality treatment BMP sizing calculations are included in Appendices E and H. Appendix F discusses the feasibility of stormwater infiltration and Appendix G discusses the benefits of acquiring water rights on Miller Creek. Appendices I through Z include the Landscape Management Plan, flooding analysis, water quality BMP cost estimates, industrial wastewater system monthly discharge monitoring reports, downstream analyses for Miller , Walker, and Des Moines Creeks, proposed stormwater conveyance drawings and information, construction erosion control information, Spill Prevention Plan, energy dissipation design, NEPL soil information, stormwater analysis of the ASR Site, and IWS lagoon storage capacity modeling results.

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2. STORMWATER MANAGEMENT STANDARDS

The Port has established stormwater management procedures for MPU improvements to ensure that regulatory requirements for stormwater control and treatment are met, and that potential downstream impacts from the improvements are mitigated in accordance with the approved FSEIS for the MPU (Port of Seattle 1997), the Governor's Certification (Locke 1997), and the Clean Water Act.

2.1 WATER QUANTITY MANAGEMENT STANDARDS

The flow control standards adopted by the Port are in the King County and Ecology Manuals, which do not have identical requirements. The Port's objective is to integrate these requirements to reduce the impacts from peak stormwater runoff on Miller and Des Moines Creeks. First, however, the base year and the target watershed flow regimes needed to be determined since they define the pre-developed conditions and establish the goal for the flow control standards. Subsequently, the flow control standards were evaluated to achieve the goal.

2.1.1 Definition of Level 1 and Level 2 Flow Control Standards

Stormwater standards for the City of SeaTac and other local jurisdictions are based on the King County Manual. Level 1 and Level 2 flow control standards defined in the King County Manual are provided below:

- The **Level 1** flow control standard calls for detaining the post-developed 2- and 10-year peak flow rates to existing conditions.
- The **Level 2** flow control standard requires the flow duration of post-developed runoff to match the pre-developed flow duration for all flow magnitudes between 50 percent of the 2-year flow event and the 50-year flow event.

The flow control standard defined in the Ecology Manual is provided below.

- The Ecology standards call for detaining the 10- and 100-year post-developed peak flows and the 2-year post development peak flow to 50 percent of its existing rates.[3]

The King County Manual's basic requirement for stormwater detention is the Level 1 standard, which is intended to achieve the basic goals for stormwater management in urban areas. However, the Level 1 standard may not prevent increased streambed and bank erosion or increased flooding.

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[3] The intent of the 50 percent flow reduction is to account for the inadequacy of hydrologic modeling using event models, and failure to account for peak flow duration. The Level 2 standard is generally more restrictive than the Ecology standard. In fact, Ecology proposes adopting the Level 2 standard to replace the existing standard (Ecology 2000b).

In response to these differences, the Port has combined the standards of the two manuals to create an "Enhanced Level 1:"[4] flow control standard:

- Enhanced Level 1 standard requires detaining the 2-, 10-, and 100-year post-developed peak flows to their pre-developed magnitudes.

Proposed regional detention facilities would provide the storage needed to control streamflows to meet the Level 2 flow control goal, as discussed below.

2.1.2 Base Year

A common element of the different flow control standards is the need to define the existing (pre-developed) conditions. The selection of a base year defines the degree of basin development (i.e., impervious area and land cover) against which future development conditions will be compared. As described below, current regulations specify different base year conditions. However, STIA implementation of this SMP will involve retrofitting all of the STIA basins to pre-developed conditions (as described in Section 2.1.3), which is more restrictive (less developed) than the proposed base years. Therefore, the base year comparison is used only to determine the degree of development that existed prior to application of the retrofitting standard.

Several base year alternatives were considered for defining the existing condition for the MPU:

- 1974 was used as the base year for the *1997 Seattle-Tacoma International Airport Storm Drainage System Comprehensive Plan* (HDR 1997). This base year was required by Ecology in the August 1995 amendment to the Port's National Pollutant Discharge Elimination System (NPDES) permit since 1974 was the first full year in which flow controls were in effect in compliance with the Kludt (1972) stipulated agreement.

- The King County Manual requires the base year to be either (1) the year since 1979 in which a project was permitted and constructed in compliance with the Manual, or (2) the year 1979, when King County first required flow controls (King County 1998). With the exception of NEPL (see below), no significant drainage plans were implemented by the Port between 1979 and the present; therefore, 1979 is generally the base year required by the King County Manual.

- 1994 was used as the base year for the MPU EIS, with the assumption that all changes made to airport land use since 1994 were the result of MPU activities or NPDES requirements.

1994 conditions were used to define existing conditions for purposes of retrofitting the airport, with the exception of NEPL.[5]

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[4] "Enhanced" refers to the addition of the 100-year peak for MPU improvements.

[5] NEPL was permitted in 1997 and constructed in 1997-1998, in compliance with the 1992 King County Manual. Therefore, NEPL's existing site conditions are those created by the site improvements and drainage facilities constructed per the approved permits and engineering plans. If applicable, the retrofitting standard applied to NEPL assumes that the existing constructed parking lot will be retrofitted.

2.1.3 Target Watershed Flow Regime

To reduce stormwater peak flows and flow volume impacts from existing airport areas, the Port has committed to adopting a flow control goal for streamflows in Miller, Walker, and Des Moines Creeks that will protect the creeks from frequent, high velocity flows. The flow control goal, or target flow regime, was determined based on flow duration analyses.[6] Development of the target flow regime is described below.

Streamflow is expressed as a flow duration curve, which is calculated from a continuous streamflow time series (or hydrograph). The flow duration curve shows the amount of time that streamflow is exceeded at different flow magnitudes. Greater imperviousness in a watershed typically increases the duration and magnitude of high flows in a stream if these impacts have not been mitigated through detention.

The Miller and Des Moines Creek watersheds have been altered by human activities such as farming and logging for more than 100 years (Des Moines Creek Basin Committee 1997). Urbanization over the last 50 years (since the airport has been in existence) has resulted in total impervious surface area within the watersheds of about 24 percent in Miller Creek and 30 percent in Des Moines Creek.

While it was recognized that the level of imperviousness in Miller and Des Moines Creek watersheds has resulted in considerable degradation of the natural stream ecosystem, to a certain degree the stream morphology has stabilized and adapted to the more recent flow regimes. By re-introducing streams to pre-developed (i.e., forested) flow regimes that existed prior to development, unstable channel conditions may again result, and the stream could require years to adapt to this change. For example, a large reduction in peak flow magnitudes and sediment transport capability could cause increased sedimentation in a channel.

In watersheds experiencing low levels of urban development, it has been shown that streams can handle a certain amount of urbanization before signs of stream degradation are observed. The relationship between watershed imperviousness and resulting stream channel changes has been discussed in several comprehensive reviews (e.g., Scheuler 1994; Booth and Jackson 1997). Research models and data developed in the Pacific Northwest suggest that a threshold for urban stream stability exists at about 10 percent imperviousness (expressed as effective impervious area). Impervious area above this level results in unstable and eroding stream channels. Booth and Jackson (1997) measured habitat quality variables such as pool and riffle sequence, overhead cover, and wetted perimeter. They found decreases in these indices at 10 to 15 percent imperviousness. Therefore, 10 percent imperviousness was identified as a threshold for degraded channel conditions.

There is currently no policy by local jurisdictions to retrofit the Miller and Des Moines Creek watersheds through the site development permitting process. During the Des Moines Creek watershed basin planning process, the Des Moines Creek Basin Committee chose to rely on regional detention facilities to mitigate existing impacts for development constructed prior to adoption of stormwater detention standards (first enacted by King County in 1979 and then upgraded in 1990

[6] A flow duration analysis depicts the percent of time that a range of flows are exceeded over the hydrologic period of record.

and 1998). In the Miller Creek basin, the MCDF was constructed in 1992 by King County to reduce downstream flooding and reduce the impacts of future development.

Therefore, for the purposes of establishing a target flow regime, a uniform watershed[7] land cover of 10 percent impervious was assumed, with 15 percent pervious grass and 75 percent pervious forest.[8,9] Basing target flows on theoretical basin development of 10 percent is expected to reduce existing peak flows and durations and be beneficial in maintaining stable stream channels (Ecology 2000a).

The above assumptions and goals are compatible with the goals of the Des Moines Creek Basin Committee for stabilizing the Des Moines Creek channel. The Draft Preliminary Design Report for the Des Moines Creek Regional Detention Facility (RDF) notes that the critical erosive flow rate under current conditions is higher than would exist under forested conditions (King County CIP Design Team 1999). With the proposed reduction in assumed impervious area, the resulting assumed pre-development flow duration curve will be lower than the actual existing conditions flow duration curve.

2.1.4 Updated Detention Requirements

During Section 401 Water Quality Certification discussions with Ecology in 1998, additional mitigation to reduce stormwater discharge rates was identified. To provide additional protection to Miller, Walker, and Des Moines Creeks, the following standards were added to the mitigation requirements for MPU improvements:

- In the Miller and Walker Creek basins (draining airport areas), the stormwater detention facilities will be designed to Level 2 (using a theoretical basin development of 10 percent impervious area as described above). For sub-watersheds draining to the Miller Creek Detention Facility (MCDF), additional future analysis by the Port or the Miller Creek Basin Committee may show that the target flow and Level 2 standards can be met at the outlet of the MCDF (with or without expansion or modification of the facility). Stormwater detention facilities shown by the Port may be modified, with approval by Ecology, to reflect using available detention in the MCDF and a new point of compliance. In either case, the objective to meet the target flow using the Level 2 standard in Miller Creek will be met.
- The Level 2 detention storage will be provided in on-site stormwater detention vaults in the Des Moines Creek basin (using a theoretical basin development of 10 percent impervious area). However, if the proposed Des Moines Creek RDF is constructed, the detention standard will be Enhanced Level 1, and 1994 land cover will be used.

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[7] For application of this standard a "watershed" means the area that drains to a detention pond and/or has a unique point of compliance.

[8] This target flow regime of 10 percent impervious area, 15 percent grass, and 75 percent forest is more restrictive than the flow regime used in the November 1999 SMP. The previous retrofitting target flow also assumed 10 percent impervious area, but existing impervious was converted to grass, and the remaining pervious area was unchanged.

[9] In watersheds when existing imperious area is less than 10 percent, the impervious area is not changed and the difference between actual percent impervious and 10 percent is assumed to be grass.

- 100-year peak flows will be matched to address potential downstream flooding.

The point of compliance for Level 2 analysis is the downstream future subbasin outlet (see Appendix A – Figure A-7 for node locations).[10]

2.2 WATER QUALITY MANAGEMENT STANDARDS

This section describes the regulatory and treatment standards required to retrofit existing developed areas and to provide water quality BMP guidance for MPU projects.

2.2.1 Regulatory Requirements

Water quality is regulated by the Federal Water Pollution Control Act (33 USC § 1251, et seq.), also known as the Clean Water Act, and the Washington Water Pollution Control Act (RCW 90.48).

The Clean Water Act was designed to protect the "chemical, physical, and biological integrity of the Nation's waters (U.S. Environmental Protection Agency [EPA] 1993)."

The portions of the Clean Water Act relevant to this project are implemented through Section 401 (water quality certification), Section 402 (NPDES) and Section 404 (addressing fill in waters of the United States). Issuance of a 401 Certification for the MPU improvement considers standards that are required at one point in time, whereas the NPDES Permit under Section 402 considers compliance with standards over time.

The Port's ongoing compliance with the Clean Water Act and, in turn, protection of STIA's receiving waters, are demonstrated through compliance with its Section 402 (NPDES) Permit, administered in Washington by Ecology (Ecology 1998). As stated in the associated Fact Sheet for the Permit, "compliance with the effluent limitations and other conditions in this permit constitutes compliance with the Federal Water Pollution Control Act... and the Washington Water Pollution Control Act (RCW 90.48)."

NPDES Permit Compliance is continually executed via an adaptive management process by which (1) BMPs are implemented, (2) monitoring and inspections demonstrate BMP effectiveness, (3) BMP improvements are made when necessary, and (4) follow-up sampling demonstrates that the improvements are effective. Ecology reviews and approves this process annually to ensure that the Port's discharges are in compliance with the Clean Water Act, and that the discharge conditions are protective of the receiving waters. Numerous BMP improvements have been implemented through this process and follow-up monitoring has confirmed their efficacy.

Specifically, the NPDES Permit requires the following measures for stormwater:

- A stormwater pollution prevention plan (SWPPP) that identifies and implements source control and treatment BMPs;

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[10] The downstream future subbasin outlet for the relocated 154th Street is the MCDF.

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- Routine water quality and toxicity monitoring for STIA stormwater outfalls and IWS discharge, and reporting of these results to Ecology; and
- Evaluation of pollution sources and BMP effectiveness via self-inspection and monitoring results, to identify when and where additional BMPs are necessary to accomplish the SWPPP objectives.

Water quality BMP retrofitting would be performed over a number of years as needed. Where possible, retrofitting would be coordinated and scheduled to occur in conjunction with redevelopment actions in specific parts of STIA. As an ongoing action, an overall water quality BMP retrofitting implementation schedule would be most appropriately addressed by the Port's Section 402 Permit.

2.2.2 Water Quality Treatment Requirements for New, Redeveloped, and Retrofitted Surfaces

The Ecology Manual requires that water quality BMPs, to the maximum extent practicable, be implemented for the entire site (i.e., new and redeveloped surfaces, water quality treatment, and retrofitting for existing surfaces not otherwise to be redeveloped). The King County Manual requires that water quality treatment facilities be provided for all runoff from new and redeveloped or retrofitted Pollution-Generating Impervious Surface (PGIS) and Pollution-Generating Pervious Surface (PGPS); the King County Manual does not require water quality treatment for existing surfaces not to be redeveloped.

The standards for water quality treatment are described in the King County Manual (King County Department of Natural Resources [DNR] 1998) and the Ecology Manual (Ecology 1992). If these basins were in unincorporated King County, the King County Manual would require the Basic Water Quality Menu for all new development in the Miller and Walker Creek basins and redevelopment areas in the Miller and Des Moines Creek basins.

On-going water quality monitoring may indicate the need for future additional water quality BMPs. Technology in the field is continually improving the effectiveness and application of new water treatment systems. While the airport has unique operation requirements (i.e., wildlife control), the proposed drainage design would allow the application of future stormwater treatment technology to the proposed drainage system.

Water quality treatment BMPs are briefly described below.

2.2.2.1 Pollution-Generating Surfaces

The King County Manual requires stormwater treatment BMPs for land areas classified as PGIS and PGPS.

The King County Manual defines PGIS as follows:

> *Pollution-Generating Impervious Surface (PGIS): Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to vehicular use or storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the*

run-on or blow-in of rainfall. Metal roofs are also considered to be PGIS unless they are treated to prevent leaching.

The King County Manual defines PGPS as follows:

Any non-impervious surface with vegetative ground cover subject to use of pesticides and fertilizers. Such surfaces include, but are not limited to, the lawn and landscaped areas of residential or commercial sites, golf courses, parks and sports fields.

Infrequently used maintenance roads (such as those in the runway infields), sidewalks, non-metallic and coated metallic roof tops are not considered PGIS. Water quality treatment BMPs are not required and would not necessarily be provided for these impervious areas. However, per the King County Manual, where non-PGIS and PGPS runoff cannot be separated, BMPs will be sized for the total flow.

2.2.2.2 Best Management Practices

Water quality for the MPU improvements will be managed through use of treatment BMPs. The King County and the Ecology Manuals provide standards for application of BMPs to different land areas and their design. BMPs are briefly described below.

New development and redevelopment projects will use any one of the following BMPs from the Basic Water Quality Menu in the King County Manual:

- Filter strip;
- Bioswale;
- Wetpond;
- Wetvault;
- Stormwater wetland;
- Combined detention and wetpool facility; or
- Sand filter.

Stormwater wetlands and wetpool facility BMPs are not further evaluated below because they are inconsistent with the STIA waterfowl attraction guidelines. Additional BMPs, such as oil control, are used for high use areas (e.g., entry drives).

As described in Section 4.5.1, many of the facilities at STIA have BMPs in place that meet the required standards. For new development and redevelopment, BMPs will be added and/or retrofitted as described in Section 7.1 to ensure compliance with all applicable standards.

Filter Strips

The primary water quality BMP for impervious surfaces such as runways and taxiways would be filter strips. Runoff from these surfaces sheet flows over broad, shallow-sloped grassy areas. Flow

velocity is slowed by grass, thereby enhancing the settling of particulates. Vegetation also mechanically traps particles. Some water infiltrates into the ground as it flows over the vegetated area, further filtering out particles. Removal of metals and organic compounds is also significant, as these pollutants typically bind to trapped particles and/or the organic material in the soil and vegetation.

Bioswales

Bioswales are grassy, flat-bottomed swales that receive runoff after it is collected and concentrated (in most cases, runoff passes through a detention facility before entering a bioswale). Although flow depth and flow path length are typically greater than for filter strips, the pollutant-removal mechanisms are the same. Where space permits, bioswales are generally the preferred treatment BMP for runoff that has already been concentrated in a collection system.

Wetvaults

Wetvaults provide a permanent pool (dead storage) to settle particulates. Metals and organic compounds that sorb to particulates are removed to some extent as well. Wetvaults are designed to enhance settling by using "plug flow," whereby inflowing stormwater displaces the treated water already in the vault as a unit. Vaults would be used in place of wetponds because the creation of additional open water within 10,000 ft of an active runway must be designed to minimize wildlife attraction (Federal Aviation Administration [FAA] 1997). Wetvaults are generally used to treat stormwater when space limitations do not allow for bioswales.

Oil Control

Per the King County Manual, sites with potential petroleum sources, such as high-vehicle-use sites or storage/transfer areas, must provide oil control in addition to other water quality BMPs. The upper and lower Terminal Drives have been identified as high vehicle use sites. In addition, the ramp areas near the terminals are aircraft fueling areas. Oil controls will be installed for the drives by retrofitting with appropriate treatment BMPs or diversion to the IWS. The ramp area drains to the IWS, which is a petroleum spill control BMP. The Port has a spill control plan for SDS areas, which is included in Appendix V. Additional spill control measures are included in the STIA SWPPP. The Port will continue to evaluate its spill control plan per its NPDES permit.

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3. DESIGN CONSIDERATIONS AND HYDROLOGIC ANALYSIS METHODOLOGY

3.1 AIRPORT-SPECIFIC DESIGN GUIDELINES

Due to the unique nature of airport activities, stormwater facilities must be designed to be compatible with aircraft operations and not pose an unacceptable risk to air traffic safety. The facilities must also be designed to accommodate the hydrologic divide between two watersheds, which must be preserved (Locke 1997).

3.1.1 Overall Guidelines

The following summarizes the overall design guidelines and constraints that guide the development of stormwater facilities at STIA:

- The Port's stormwater management standards, described in Sections 2.1 and 2.2, shall be used in the design of all new stormwater facilities;
- The hydrologic divide separating Miller, Walker, and Des Moines Creeks shall maintain the same basin areas;
- Open stormwater detention ponds shall be designed to minimize the attractants of wildlife that pose a hazard to aircraft;
- Locations of potential stormwater management facilities shall avoid areas slated for MPU development or other future commercial development;
- Site geotechnical conditions must be favorable; and
- Consideration should be given to minimize potential impacts and permitting issues associated with stormwater facility construction within sensitive areas (e.g., wetlands).

3.1.2 Wildlife Proximity to Open Detention Ponds

The Port and FAA are very concerned about attracting wildlife at stormwater detention facilities. As is the case in most large airports, STIA contains large open tracts of unimproved land that are required for safety and noise mitigation. These areas, and in particular areas of open water and wetlands, can present potential hazards to air traffic because water bodies often attract wildlife. During the past century, wildlife-aircraft strikes have resulted in the loss of hundreds of lives worldwide and caused billions of dollars worth of aircraft damage (FAA 1997).

Although this issue at stormwater management facilities can be effectively avoided by constructing underground stormwater vaults, constructing facilities underground results in higher cost for stormwater detention. Other factors that weigh into whether open ponds or underground facilities are selected include land availability to site the facility, proximity of that land to flight lines, competing uses for the land, long-term maintenance, and confined space entry requirements.

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3.1.2.1 FAA Guidance

FAA Advisory Circular 150/5200-33 (FAA 1997) describes FAA policy regarding wildlife attraction near airports. The circular states that any activity or land use on or near an airport that threatens aircraft safety by attracting or sustaining hazardous wildlife is an incompatible land use. Examples of wildlife species that pose a threat to aircraft safety include waterfowl, flocking birds (starlings, blackbirds, and pigeons), raptors (owls and hawks), and other common passerine birds (sparrows).

Land uses identified by FAA as being incompatible with safe airport operations include wastewater treatment facilities, wetlands, and landfills containing organic wastes. The advisory circular (FAA 1997) states that when siting land uses such as wetland mitigation projects, these projects can be no closer than 10,000 ft from turbine aircraft movement areas and 5 miles from approach or departure airspace if the wildlife attraction may cause hazardous wildlife movement into or across these zones.

FAA identifies stormwater detention and retention ponds as compatible land uses at or near an airport. FAA recognizes that stormwater runoff is a normal function at most airports and runoff control is necessary for safe aircraft operation. Detention and retention ponds provide benefits of controlling runoff and protecting water quality, but they can attract hazardous wildlife. The FAA and the Port are mandated to adhere to established guidelines that prevent creation of hazardous wildlife attractants on or near STIA.

3.1.2.2 Research into Wildlife Attraction to Stormwater Ponds

Several U.S. and Canadian agencies involved in wildlife management at airports were contacted to determine how the FAA policy is interpreted, whether more specific standards for wildlife control at stormwater ponds have been developed, and if research has been conducted that supports these policies. Current practices at STIA were also reviewed. Agencies and personnel contacted include:

- U.S. Department of Agriculture (USDA) Wildlife Services, Olympia (Mike Linnel);
- USDA National Wildlife Research Center (NWRC), Landusky, Ohio (Richard Doldeer);
- FAA Office of Airport Safety and Standards (Ed Cleary, Wildlife Specialist);
- Transport Canada Wildlife Control Manual (Transport Canada 1994); and
- STIA Wildlife Manager (Dennis Bulman).

These individuals and agencies recognized the risk due to attracting wildlife at open stormwater detention ponds, and agreed that measures should be implemented to minimize the occurrence of waterfowl at these locations. However, since conditions vary widely throughout the country (i.e., geographic, climate, wildlife of concern, etc.), no agency has proposed a universal quantitative standard that identifies how much open water is acceptable in terms of duration and frequency of occurrence. A literature search could not locate any research on attractants of wildlife to detention ponds, and persons contacted could not identify any. The STIA Wildlife Hazard Management Plan (Port of Seattle 2000a) and subsequent updates are expected to provide further guidance.

3.1.2.3 Maximum Duration of Open Water at Detention Ponds

Wildlife managers agree that stormwater management practices are necessary and mandated at airports, and identify permanent open water as the primary concern. Retention ponds having permanent water are considered to have moderate to high hazard to aircraft operations and are universally regarded as unacceptable. Temporary open-water surfaces are not as large an issue as permanent ponds, except under continuous runoff events that create extended periods of open water. The following comments were offered by the persons contacted:

- USDA Wildlife Services: The primary concern is with continuous storm events producing extended duration of water surface (a maximum acceptable duration was not specified);
- NWRC: Temporary open-water surfaces of 1 week or less should not be a problem;
- FAA: As a general guidance, the pond should be dry after 24 to 48 hours after end of storm event, but this can be enhanced for local conditions and concerns;
- Transport Canada: No suggestions on detention ponds (other than habitat modification) were offered except that under extreme problem areas (gulls and waterfowl causing major problems), physical barriers should be in place; and
- STIA: A maximum continuous open-water surface of 24 to 48 hours was considered acceptable.

These statements suggest that stormwater detention ponds that occasionally hold water for periods of up to several days may not present a wildlife attractant hazard. Also, many recognize that natural flooding of nearby streams, open ditches, and other areas would occur during storm events. Under such conditions, open water would be widespread throughout the region, making it difficult to justify a requirement for covering open detention ponds for extreme rainfall conditions.

Based on the information summarized above, it was concluded that the duration of open water in stormwater detention ponds should be minimized in all runoff events up to and including the 2-year design storm. The 2-year storm event is typically identified as the flooding event when significant overbank flooding starts to occur; therefore, control of open water in stormwater facilities should not be required during events exceeding the 2-year storm. Following FAA guidance, a conservative standard for the maximum duration of open water during the 2-year event is 24 hours. This duration is measured starting at the end of the precipitation event.[11] For the purposes of this analysis, the duration of open water is calculated as the time it takes for the pond to drain, starting at the maximum storage of the 2-year design storm event.

[11] It is assumed that, during a design storm event, there would be numerous and widespread open water attractants until the precipitation event ends.

3.1.2.4 Detention Pond Design Requirements

Based on the above review, the following are design guidelines and considerations for new stormwater management facilities sited at or near STIA (within 10,000 ft of active runways), recommended by FAA Advisory Circular 150/5200-33 (FAA 1997). These measures are intended to minimize hazards associated with wildlife attractants to stormwater detention ponds.

- Cover or net all permanent open-water surfaces;
- To minimize the frequency and duration of open water to acceptable levels, water that is detained by the 2-year design storm should completely drain (or fall to a level that is covered by a net or solid cover) within 24 hours after the end of the storm event. That is, the pond should drain from the 2-year design storm depth to the bottom or covered depth in 24 hours or less;
- Use steep side slopes and deep pond depths to minimize shallow water areas and minimize the total water surface area;
- Slope the pond bottom to allow quick drainage and reduce the potential for standing water;
- Eliminate the potential for wetland vegetation growth on the pond bottom and side slopes by lining the pond with riprap or quarry spalls. Alternatively, use vegetation that provides no food or habitat for wildlife. For example, closely mowed grass, which is preferred by waterfowl, should be avoided;
- Break up possible avian flight lines by planting trees, setting up poles and/or fences which do not allow most waterfowl clear landing or takeoff room on the pond surface; and
- Designs of open stormwater facilities should be reviewed and approved by USDA Wildlife Services and the STIA Wildlife Manager to ensure that these objectives are met.

3.1.2.5 Maintenance

The maintenance and performance of the as-built pond should be closely monitored after construction. The maintenance program should control growth of unwanted vegetation. The performance of the facility, in terms of the type and frequency of occurrence of wildlife at the facility, should also be monitored. If performance does not meet expectations, it may be necessary to retrofit the facility with nets, wire grids, or similar deterrents. These activities should be integrated into an active airport bird avoidance program.

3.1.3 Proximity to Aircraft Movement Areas

FAA (1989) Advisory Circular 150/5300-13, *Airport Design*, identifies three zones that impact the siting of detention facilities:

- Runway Safety Area (RSA)–A defined surface surrounding the runway prepared or suitable for reducing the risk to airplane passengers if a plane leaves the runway;

- Runway Object Free Area (ROFA)–An area on the ground, centered on the runway, taxiway, or taxi lane centerline, that is provided to enhance the safety of aircraft operation by remaining free of objects, except for objects that need to be located in the ROFA for air navigation or aircraft ground maneuvering purposes; and
- Runway Protection Zone (RPZ)–A safeguarded area off the runway end created to enhance the protection of people and property on the ground.

The delineation of these zones under the future condition with the third runway is illustrated in Figure 3-1.

Stormwater detention facilities must be located outside runway and taxiway safety areas. The RSA extends a minimum of 250 ft from runway centerlines and 1,000 ft beyond the end of the runway. A similar zone for taxiways extends 117 ft from taxiway centerlines.

While the restrictions for the ROFA refer to aboveground objects, it is recommended that stormwater detention facilities not be located in this zone unless no other location is hydraulically feasible. The ROFA extends a minimum of 400 ft from runway centerlines and 1,000 ft beyond the end of the runway.

Objects may be located within the RPZ if they do not attract wildlife and are outside the ROFA. If detention facilities must be located in the RPZ due to hydraulic limitations, they should either be constructed underground or incorporate special design features to prevent the attraction of wildlife.

3.1.4 Feasibility of Creating Artificial Aquifer Storage in New Embankments

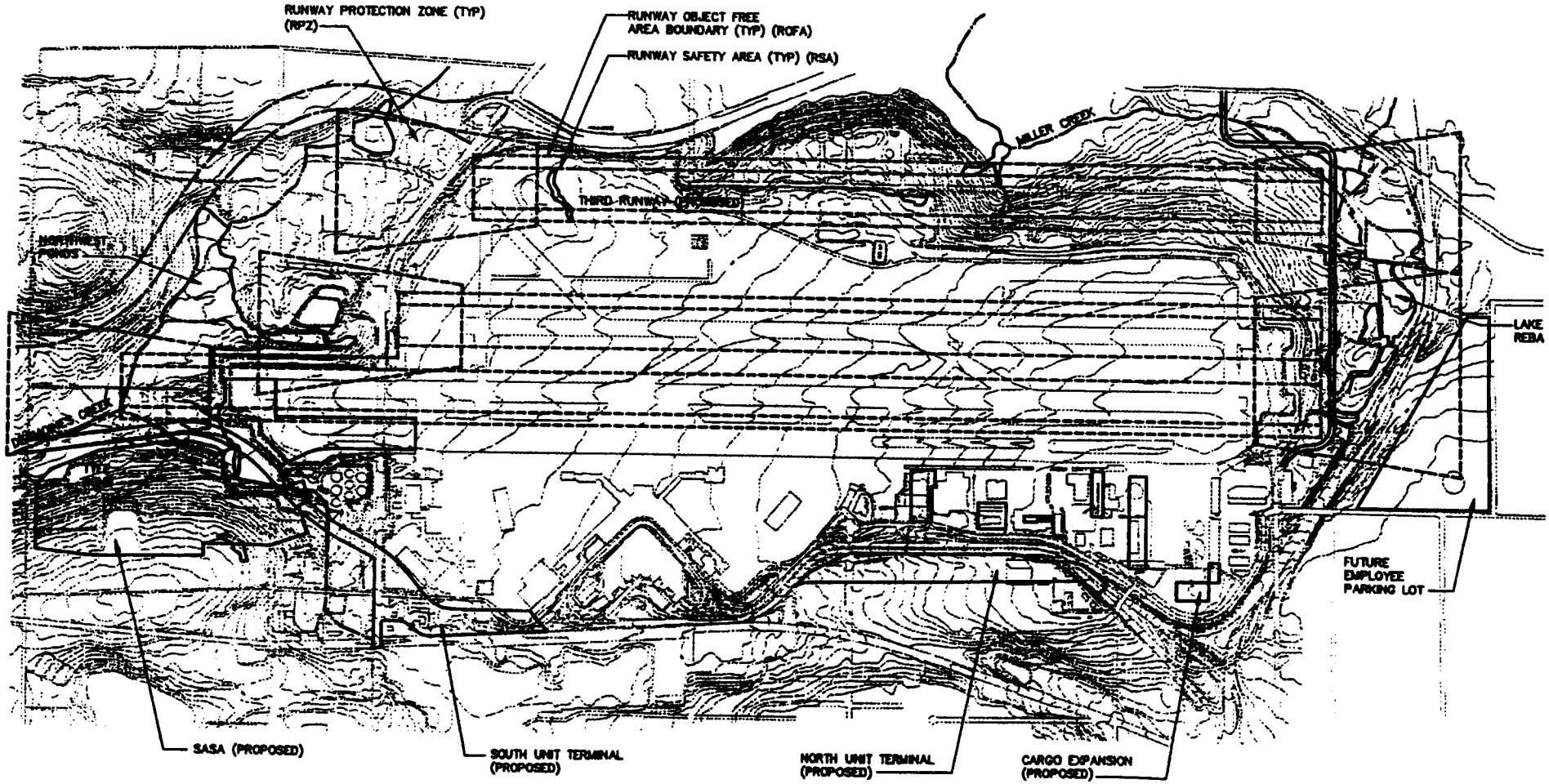
One of the conditions identified in the Governor's Certificate that provided state approval to the EIS is the possible use of a man-made aquifer within the new third runway embankment to detain runoff and enhance groundwater recharge (Locke 1997). In response, an engineering review was conducted to evaluate the potential of constructing such an aquifer (HNTB 1998) (Appendix K).

HNTB's review identified the following key issues regarding a constructed aquifer in the embankment:

- Overall embankment stability and long-term settlement parameters for the runway shall be primary factors for analysis and design;
- Long-term maintenance and reliability of the drainage system are critical to ensure viability of both the runway embankment and the constructed aquifer system; and
- Constructability, increased long-term performance risks, and project cost must also be evaluated.

While the concept of creating an aquifer within the embankment may be within the realm of theoretical feasibility, the specific application to a runway embankment introduces potential significant risks to the project. The primary risks identified by HNTB include:

- An aquifer located within an embankment would introduce water into potential failure planes within the embankment, reducing the factor of safety for the embankment;
- The added weight of a fully charged aquifer would substantially impact the seismic stability of the embankment, requiring additional buttress features or slope stabilization;



Source: HDR (1997)

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Figure 3-1
Aircraft Movement Area Restrictions on Detention Pond Siting

AR 010236

- Water introduced into the aquifer and subsequently released for discharge may affect the fines content of the engineered fill material, potentially causing clogging of the aquifer system, transport of fines to surface discharge points, piping within the fill, and long-term settlement;
- The ability to maintain the embankment aquifer would be very limited because it is located deep within the embankment fill; and
- Constructing an aquifer would require extensive processing of aggregate materials to obtain the necessary performance characteristics to process and discharge water.

Several examples of water-induced slope failures have occurred recently, including one airport embankment project in Telluride, Colorado that resulted in airport closure for one year. The slope failure was primarily attributed to stormwater build-up within the embankment. HNTB has discussed the aquifer concept with FAA and several geotechnical engineers to determine whether any man-made aquifer embankments are in existence at major airports. No such projects have been identified.

After considering the issues, risks, and lack of practical application data, it was concluded by the Port that enhanced infiltration into the runway embankment is not a viable option for this project.

Conventional embankment design and construction techniques will, however, provide benefits to stormwater management without a constructed aquifer. These benefits include rainfall infiltration through the soil to the groundwater, which would reduce peak runoff discharge, promote groundwater recharge, and enhance baseflows in Miller Creek (Appendix L). Additional detailed analysis of the hydrology and hydrogeology of the embankment are included in the report *Low Streamflow Analyses for the Seattle-Tacoma International Airport Master Plan Update* (Earth Tech 2000).

3.2 DAM SAFETY

Washington Administrative Code (WAC) from *Washington State Department of Ecology, Water Resources Program, Dam Safety Section* (DSS) manual Part II, Chapter 173-175, "Dam Safety Regulations," was reviewed for the applicability of dam safety regulations. Two threshold criteria are defined in this manual:

> "The Dam Safety Regulations (Chapter 173-175 WAC) are applicable to dams which can impound a volume of 10 acre-ft or more of water above natural ground as measured at the dam crest elevation."
>
> "For a dam whose height is 6 feet or less and which meets the above conditions [and is not judged to pose a risk to life, and minimal property damage], the Dam Safety Section (DSS) may elect to exempt the dam from regulations."

The proposed detention pond facilities were reviewed and SDW1B "Pond D," SDW1A "Pond G," and the SASA pond were identified as ponds that qualify for the dam permit (Table 3-1).

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Table 3-1. Summary of water impoundment behind earthen dams.

Pond	Bottom Elevation (ft)	Natural Ground Elevation (ft)	Crest Elevation (ft)	Impounded Volume to Crest Elevation	Volume Impounded above Natural Ground	Criteria	
						Vol. >10 AF	Height ≥6 ft
C	272.0	275.0	278.7	15.9 AF	9.3 AF	No	No
D	340.0	343.0	350.0	67.8 AF	41.5 AF	Yes	Yes
F	342.0	348.0	351.6	15.7 AF	5.7 AF	No	No
G	246.0	246.0	258.1	28.7 AF	28.7 AF	Yes	Yes
SASA	300.0	310.0	325.0	92.0 AF	66.0 AF	Yes	Yes

Source: HNTB Corporation, February 2001.

The Port has retained a geotechnical consultant to address the geotechnical or hydrogeological analyses required for the design of these facilities.

Both ponds D and G will exist by the end of the year 2001, but the designs impound less than the threshold volume of 10 acre-ft in their initial development.

The Port understands that the dam safety permit must be in place prior to excavating to impound a volume of 10 acre-ft or more of water above natural ground as measured at the dam crest elevation behind new or existing earthen dams.

3.3 HYDROLOGIC ANALYSIS METHODOLOGY

Two hydrologic model computer programs were used to simulate continuous watershed hydrology and design stormwater detention facilities for the MPU projects: Hydrologic Simulation Program-FORTRAN (HSPF; EPA 1997) and King County Runoff Times Series (KCRTS; King County Department of Natural Resources 1995)

HSPF allows continuous simulation (as opposed to an event-based model) of complex drainage networks. The model is especially appropriate for Western Washington, where hydrology is dominated by runoff from sequential storms, rather than single storm events. This model is recommended by local agencies for large modeling areas and is considered an appropriate method for evaluating effects of stormwater runoff on receiving streams. The model calculates stormwater runoff from the airport drainage basins to compare the effects of airport runoff downstream of the proposed MPU projects.

The HSPF model is currently supported and maintained by the EPA's Environmental Research Laboratory. Because the airport encompasses three watersheds, separate HSPF models for Miller, Walker, and Des Moines Creeks were developed. For each watershed, an existing condition model and a proposed condition model were developed. The difference between these two modeling scenarios quantifies the impact that MPU development has on subbasin runoff. The development

and application of these models are further described in Sections 4.4 and 6.1 and Appendices A and B.

The HSPF model was used to:

- Develop runoff parameters for model input by calibrating the model to project watersheds (see Appendix B).
- Model the existing (pre-developed/target flow standards) and future (post-developed/2006) hydrologic conditions in the watersheds.
- Model low stream flow conditions in the watersheds.
- Verify the results and performance of the KCRTS stormwater detention designs.
- Model stream flow conditions at points downstream of STIA to demonstrate that there are no adverse stream impacts.

King County Department of Natural Resources (KCDNR) developed KCRTS software to estimate flows and design detention facilities using runoff file data. Runoff files are a database of 50 years of continuous flows for typical King County land cover and soil types. KCDNR provided basin-specific runoff files corresponding to the HSPF calibration for the three affected watersheds (see Appendix B).

KCRTS is most appropriate for modeling discrete drainage areas, rather than complex drainage areas or watersheds. KCRTS was used to:

- Provide initial estimates of pre-developed and develop flow rates from individual subbasins.
- Perform preliminary detention facility designs to meet Level 2 flow controls.
- Generate stage-storage-discharge tables for input into the HSPF model.

Model Calibration

Hydrological modeling using HSPF requires the calibration of many parameters that describe different hydrologic processes. These processes include:

- Rainfall runoff from pervious and impervious surfaces;
- Infiltration of rainfall to soils;
- Soil moisture accounting;
- Flow of groundwater from soils to streams; and
- Loss of groundwater to deep aquifers.

Each of these physical processes is controlled by several parameters. The calibration process adjusts model parameters to achieve a close match between recorded streamflows and simulated streamflows for a period when streamflow data are available. Calibration of the HSPF model is discussed in detail in Appendix B.

4. EXISTING CONDITIONS

This section describes the existing conditions for the drainage basins, conveyance systems, and detention of stormwater at STIA. Included is a long-term hydrologic simulation of current conditions for Miller, Walker, and Des Moines Creeks using the HSPF model as well as a summary of model calibration for each watershed and airport runoff. In addition, this section provides a summary of existing water quality BMPs at STIA and current water quality conditions based on several years of monitoring data.

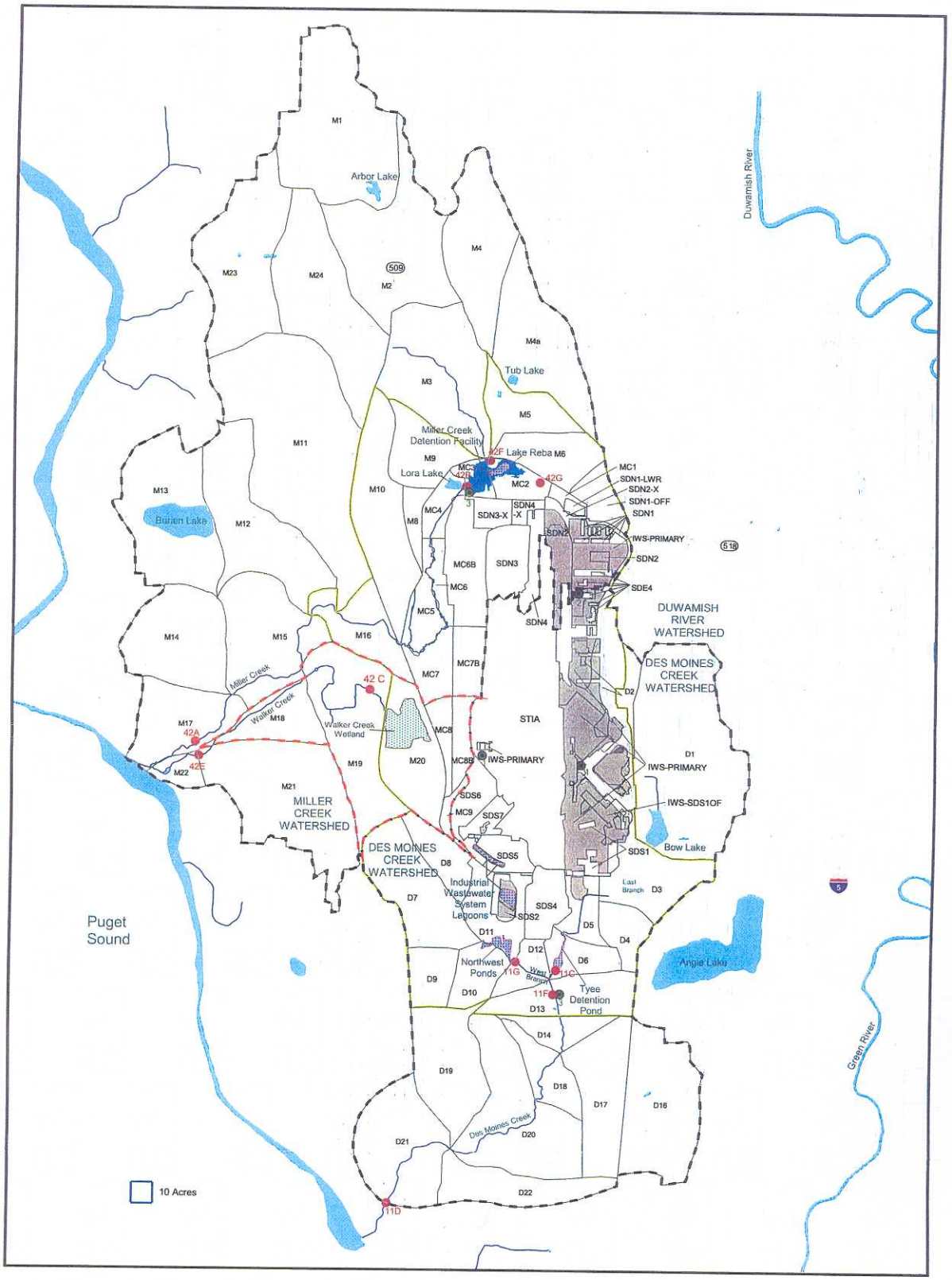
4.1 DRAINAGE BASINS

Sea-Tac International Airport lies along the drainage divide between the Miller Creek and Des Moines Creek watersheds (Figure 4-1). Figure 4-2 illustrates the 1994 land use condition and future drainage subbasin boundaries. 1994 represents existing land use condition for purposes of retrofitting the airport, with the exception of NEPL (see Section 2.1.2).

The Miller Creek watershed covers approximately 8.1 mi^2 of predominantly urban area lying mostly within the cities of Burien and SeaTac, plus a small portion of Normandy Park and King County. Miller Creek drains a relatively small portion of STIA, including the north end of the runways and the air cargo areas north of the terminal. The upper reaches of Miller Creek, north of Highway 518, drain a gently rolling plateau between the Duwamish/Green River Valley and Puget Sound. In the lower reaches, the creek flows through a well-incised ravine cut through glacial material, and enters Puget Sound at the City of Normandy Park. Walker Creek is a tributary to Miller Creek.

The Des Moines Creek watershed covers 5.9 mi^2 of predominantly urban area lying mostly within the cities of SeaTac and Des Moines, plus a small area of King County. This creek drains most of STIA, the City of SeaTac commercial area along International Boulevard (Highway 99), and residential areas in the remainder of the basin. Des Moines Creek is approximately 3.5 miles long; it flows from an elevation of about 350 ft and drains into Puget Sound. Additional information on the Des Moines Creek watershed can be found in the 1997 Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997).

Table 4-1 summarizes the Miller Creek and Des Moines Creek STIA drainage areas and percent impervious surface areas under existing and future conditions. The STIA stormwater drainage system will cover about 9 percent of the Miller Creek watershed and 23 percent of the Des Moines Creek watershed (including newly acquired property for the MPU). Currently, about 23 percent of the total surface area in the Miller Creek watershed and 32 percent in the Des Moines Creek watershed are impervious.



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Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries are approximate.
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.
STIA subbasins assume existing (1994) conditions.

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Roads

Existing (1994) Drainage Subbasins

STIA Area (see note)

Constructed Water Features

IWS Drainage Area

Subwatershed Boundary

Watershed Boundary

Rivers

Water Bodies

Detention Facilities (existing)

Precipitation Gaging Stations:
Type 1 - National Weather Service (Gage relocated 1996)
Type 2 - POS Rainfall Monitoring
Type 3 - King County Rainfall Monitoring

Streamflow
King County Gaging Stations:
42A - Miller Ck @ SW 175th Pl & 12th Ave SW
42B - Miller Ck @ Lake Reba/RDF Outlet
42C - Walker Ck @ 171st Pl
42E - Walker Ck @ 12th Ave SW
42F - Miller Ck @ SR518
42G - Miller Ck @ East Branch
11D - Des Moines Ck near mouth
11F - Des Moines Ck @ Golf Course
11C - Des Moines Ck @ Tyee Pond
11G - Des Moines Ck @ NW Ponds

Figure 4-1
Miller/Walker Creek and Des Moines Creek Watersheds (Existing Conditions)

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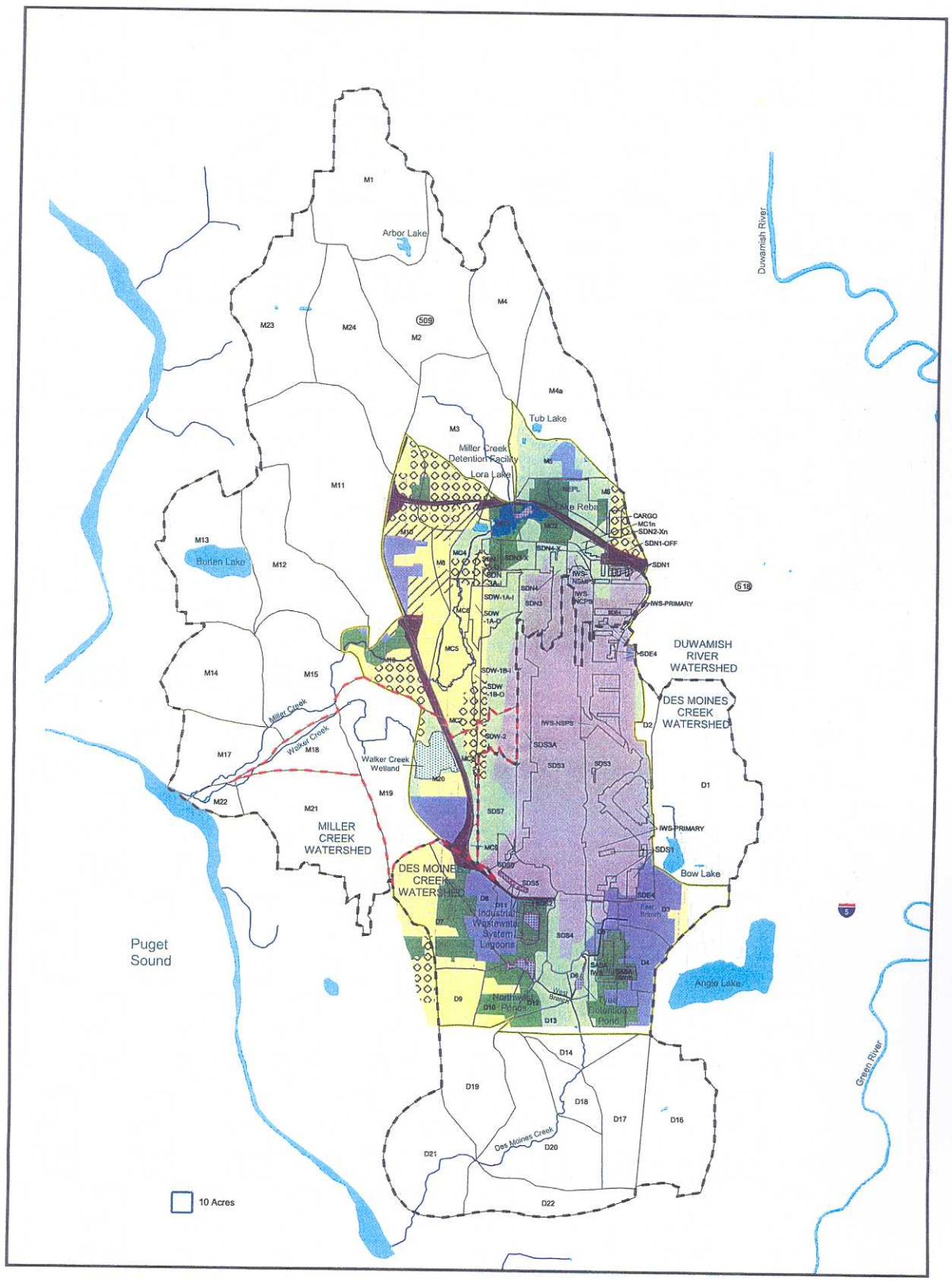

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Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Estimated wetland boundaries are based on field reconnaissance by Parametrix, Inc.
Land use data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note Subbasin boundaries shown outside of STIA area are for illustration and reference only.

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Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary

Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing)

Sea-Tac Airport
Commercial
Open/Grass
Transportation

Low Density Residential
High Density Residential
Multi-Family Residential
Forest

Figure 4-2 Future STIA Drainage Subbasins and 1994 Land Use

AR 010242

Table 4-1. Summary of Miller, Walker, and Des Moines Creek drainage areas at STIA and change in impervious area between 1994 baseline and 2006 future conditions (acres).[a]

	1994 Baseline			2006 Future Condition			Increase in Impervious Area
	Pervious	Impervious[b]	Total	Pervious	Impervious[b]	Total	
Miller Creek							
SDN1	6.2	9.9	16.1	3.5	12.7	16.1	2.8
SDN1LWR	5.0	0.4	5.4	4.9	0.6	5.4	0.2
SDN1OFF	25.8	10.5	36.3	28.3	8.0	36.3	-2.5
SDN2Xn	4.3	0.0	4.3	3.9	0.3	4.3	0.3
SDN3	33.4	14.5	47.9	23.6	24.3	47.9	9.8
SDN3A	28.6	1.9	30.5	22.2	8.2	30.5	6.3
SDN3X	25.4	0.0	25.4	25.4	0.0	25.4	0.0
SDN4	27.7	2.6	30.3	18.1	12.3	30.3	9.7
SDN4X	14.1	1.1	15.2	11.0	4.2	15.2	3.1
SDW1A	52.0	0.9	52.8	37.4	15.4	52.8	14.5
SDW1B	92.5	4.3	96.9	69.9	27.0	96.9	22.7
NEPL	41.4	0.9	42.3	10.0	32.3	42.3	31.4
CARGO	7.0	1.1	8.1	0.0	8.1	8.1	7.0
Other STIA[c]	246.5	15.1	261.8	247.8	13.8	261.8	-1.3
Total							**103.7**
Walker Creek							
SDW2	41.3	3.3	44.6	35.1	9.5	44.6	6.2
M8	22.2	6.6	28.8	22.2	6.6	28.8	0.0
M9	76.1	22.5	98.6	76.1	22.5	98.6	0.0
Total							**6.2**
Des Moines Creek							
SDE4	50.7	115.5	166.2	40.1	126.1	166.2	10.6
SDS1	0.9	16.8	17.7	1.4	16.3	17.7	-0.5
SDS2	7.7	1.5	9.2	8.1	1.0	9.2	-0.5
SDS3	165.5	178.0	343.5	144.3	199.2	343.5	21.2
SDS3A	62.7	7.1	69.8	34.6	35.1	69.8	28.0
SDS4	45.4	19.2	64.6	32.1	32.5	64.6	13.3
SDS5	32.1	0.4	32.5	28.3	4.2	32.5	3.8
SDS6	12.5	4.3	16.7	13.5	3.2	16.7	-1.1
SDS7	83.2	8.0	91.3	55.1	36.2	91.3	28.2
SASA	25.3	8.9	34.3	0.0	34.3	34.3	25.4
Other STIA[d]	136.1	57.7	194.4	136.0	57.5	193.5	-0.2
Total							**128.2**
IWS							
NCPS	6.9	28.8	35.7	4.8	30.9	35.7	2.1
NSMPS	6.6	0.0	6.6	4.7	2.0	6.6	2.0
NSPS	0.3	13.5	13.8	0.3	13.4	13.8	-0.1
Primary	24.9	277.6	302.6	13.5	289.1	302.6	11.5
SASA	51.8	6.5	58.3	0.1	58.3	58.4	51.8
Total							**67.3**
TOTAL	**1462.1**	**839.4**	**2302.6**	**1156.3**	**1145.1**	**2301.7**	**305.7**

Note: Rows may not total exactly as shown due to rounding. Source: GIS coverage.

[a] The purpose of this table is to provide supporting data for comparing pervious areas; this data was not used for modeling purposes.

[b] Impervious area includes impervious area, lakes, and detention ponds.

[c] Includes subbasins M6, MC1, MC2, MC3, MC4, MC5, MC6, MC7.

[d] Includes subbasins D5, D6, D11, D13.

4.2 CONVEYANCE SYSTEMS

Stormwater runoff from the airport discharges to Miller Creek and the west and east branches of Des Moines Creek through a system of piped conveyances and outfalls referred to as the storm drain system (SDS). Stormwater runoff from areas around the airport terminal and apron areas is captured by the industrial wastewater system (IWS), which is a separate collection and treatment system. After treatment at the Industrial Wastewater Treatment Plant (IWTP) the IWS directly discharges to Puget Sound. Both of these conveyance systems are described below. The subbasin designations and drainage areas of the SDS and IWS under existing (1994) conditions are shown in Figure 4-1; impervious areas are depicted in Figure 4-3.

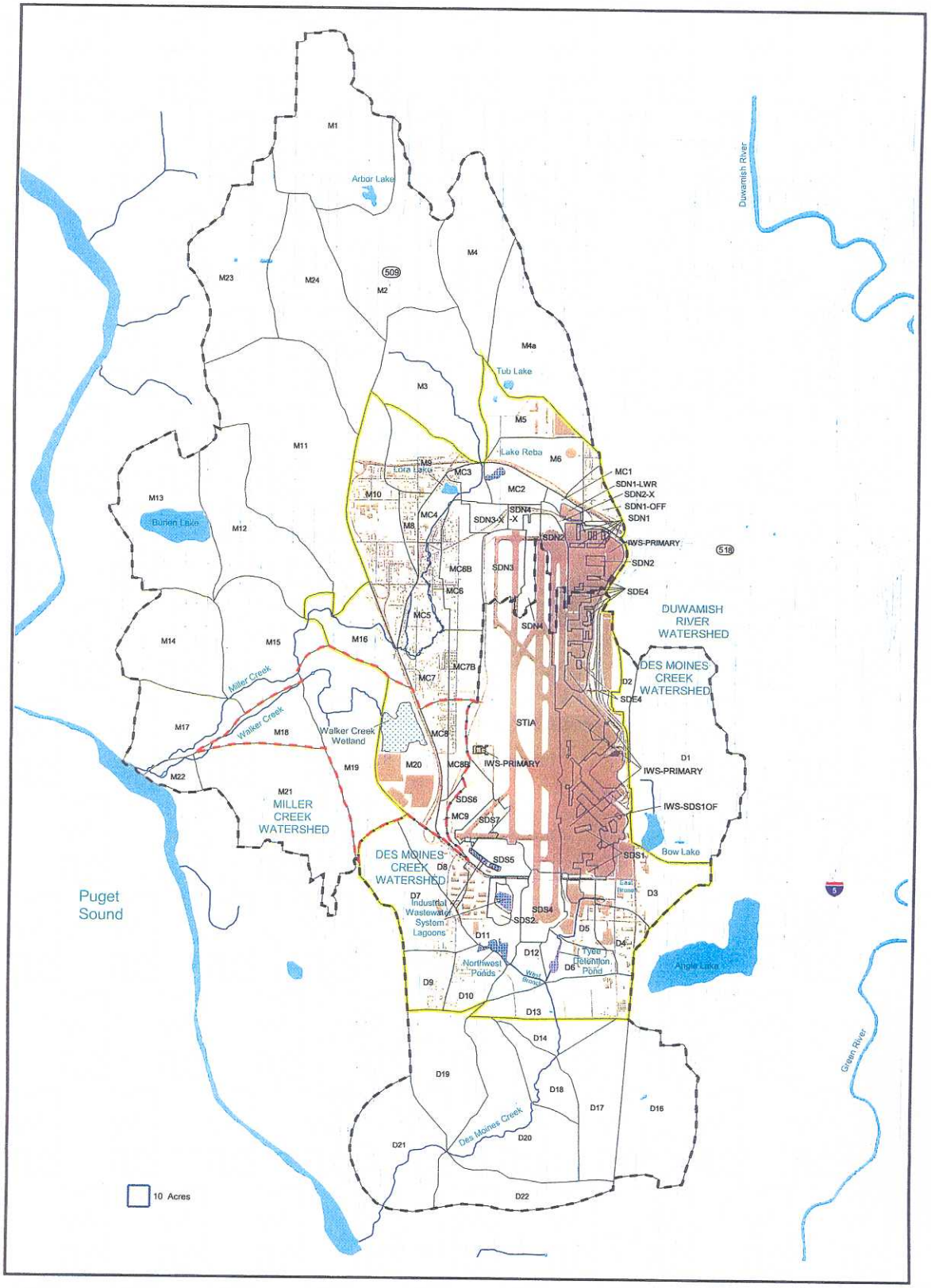
Some areas of the airport drain to the IWS via diversion and pump facilities. The diversion and pump facilities are discussed in Section 4.2.3. In the event of a large storm, excess runoff may be diverted back to the SDS. These diversions and overflows are accounted for in the HSPF model, as described in Section 4.2.3.

4.2.1 Storm Drainage System

The SDS has operated since the airport was commissioned in the 1940s. This stormwater system consists of pipes, manholes, catch basins, and pumping facilities that collect surface water runoff from pervious and impervious surfaces, including runways, taxiways, runway fields, most roof tops, and roadways.

The stormwater system discharges directly and indirectly (via City of SeaTac storm drains or constructed drainage ditches and stormwater facilities) to Miller and Des Moines Creeks at 12 outfalls that are authorized by the NPDES Permit issued by Ecology (Ecology 1998). In addition, portions of Port property drain from 2 permitted outfalls via City of SeaTac storm drains to Gilliam Creek. No new impervious areas or MPU projects are proposed in the area draining to Gilliam Creek. Therefore, stormwater management is not evaluated in this basin. Combined, the Port's SDS is comprised of more than 33 miles of pipeline covering over 800 acres.

The Port recently completed a Comprehensive Drainage Plan that evaluated the hydraulic capacity of the SDS (HDR 1997; the conveyance evaluation chapter of that plan is provided in Appendix S). The study concluded that the SDS is sized to convey the 10-year design storm event (the King County design standard for existing conveyance systems), and up to 98 percent of the system can convey the 25-year storm event. New conveyance will be designed to the 25-year capacity and will include spill containment (the King County standard for new conveyance systems).



Parametrix, Inc. Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rrseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Impervious surface data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

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Roads
Watershed Boundary
Subwatershed Boundary
Rivers
STIA Area (see note)
Existing (1994) Drainage Subbasins
Impervious Areas
Constructed Water Features
Water Bodies

Figure 4-3
STIA and Surrounding Development 1994

AR 010245

4.2.2 Industrial Wastewater System

The IWS collects and treats industrial wastewater;[12] the IWS serves as a spill-control BMP. The IWS was initially constructed in 1963 to collect runoff from terminal aprons, taxiways, hangars, portions of the terminal roof top,[13] the parking garage, the toll plaza, aircraft and vehicle maintenance areas, and some parking lots in the air cargo area. Runoff from these areas may be contaminated by accidental fuel spills, de-icing chemicals, and washwater from cleaning of aircraft and ground support vehicles. A comprehensive engineering evaluation of the IWS system was conducted in 1995 (Kennedy/Jenks 1995) and a program for upgrading the system is ongoing. The original IWS system has been gradually expanded over the years to include larger areas of terminal apron plus newly developed areas subject to industrial activities. Many parts of the current IWS system originally belonged to the SDS, but were later connected to the IWS.

Runoff from the IWS catchment areas is collected by the IWS conveyance system. The IWS is divided into two primary drainage areas: the air cargo/runway system and the terminal system. Runoff from these areas is conveyed to the IWTP via separate pipeline routes. With upcoming planned improvements, the IWS conveyance system will be sized to handle approximately the 25-year design storm. Because the IWS does not discharge to the streams, it is not included in the hydrologic modeling analysis for the SMP. However, five pump stations, which normally drain to the IWS, overflow to the SDS under high flow conditions (see Section 4.2.3 below). These overflows are included in the hydrologic model of the SDS and receiving streams.

Three lagoons (Lagoons 1, 2, and 3) in the southwest corner of STIA provide storage for the industrial wastewater prior to treatment in the IWTP. Treated discharge flows to an outfall pipeline that joins the Midway Wastewater Treatment Plant effluent pipe for discharge into Puget Sound via a marine outfall. The discharge is authorized by the Port's NPDES Permit. IWS treatment performance and the Port's determination of all known available and reasonable treatment (AKART) for the IWS are discussed in Sections 4.5.3 and 7.5, respectively.

4.2.2.1 IWS Storage Capacity

The 2006 configuration of the IWS (land use, lagoon storage capacity, treatment rate, and outfall discharge capacity) is summarized in Table 4-2. A continuous simulation of the IWS was performed using KCRTS (King County Regional Time Series) to demonstrate that overflows will

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[12] As defined in STIA's NPDES Permit WA-002465-1, "Industrial wastewater is water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater, non-contact cooling water, or stormwater associated with industrial activity. Industrial wastewater may result from any process or activity of industry, manufacturer, trade, or business, and includes, but is not limited to: water used for industrial processes such as pipe integrity pressure testing and vehicle and aircraft wash water; stormwater contaminated with fuel, oil, fire foam, cleaning agents, and aircraft deicing/anti-icing agents; contaminated construction dewatering waters; excess water from groundwater well construction and monitoring; and leachate from solid waste facilities. Industrial wastewater does not include stormwater runoff that contains deicing/anti-icing agents that shear or drip from aircraft in the stormwater system."

[13] Although the intent of the IWS is to treat areas subject to industrial pollution, most of the IWS was constructed by diverting existing drainage areas. In some areas that were diverted to the IWS, it was generally not practicable to separate non-industrial drainage areas from industrial drainage areas. The Port undertakes an ongoing effort to remove non-industrial drainage areas from the IWS, where such diversions become practicable.

not occur under proposed IWS conditions (see Appendix Z). This analysis confirmed that zero overflows occur when the 50-year KCRTS period of record is simulated for the conditions described in Table 4-2. If any future additional diversion to the IWS is proposed, then the performance of the IWS system will be evaluated prior to the diversion to verify that SMP performance standards are met.

Table 4-2. IWS configuration (land use, storage, treatment rate, discharge rate, number of overflows)

Parameter	Value
Land Use	
Till Grass	16.53 acres
Outwash Grass	8.16 acres
Airport Fill	0.01 acres
Wetland	0.01 acres
Impervious Area	410.00 acres
TOTAL	**434.71 acres**[a]
Storage Volume	
Lagoon 1	1.6 mg
Lagoon 2	3.3 mg
Lagoon 3	72.0 mg
TOTAL	**76.9 mg**
Outfall Discharge Capacity	**7.1 mgd**
Treatment Rate	**4.0 mgd**
Number of Overflows in 50-year Simulation	**0**
Treatment Rate at Which One Overflow Occurs	**3.1 mgd**
Treatment Rate at Which Two Overflows Occur	**2.4 mgd**

[a] Although all major planned additions to the IWS are included, this area conservatively includes approximately 16 acres of impervious area to account for future unplanned additions to the IWS.

To demonstrate IWS performance at reduced treatment rates, an analysis was also performed to determine the treatment rates at which one and two overflows would occur over the 50-year KCRTS period of record, with all other future conditions (Table 4-2) held constant (see Appendix Z). This analysis determined that one overflow would occur at a treatment rate of approximately 3.1 mgd, and two overflows would occur at a treatment rate of approximately 2.4 mgd.

If the safe storage capacity of IWS storage is exceeded during extreme precipitation events untreated water would have to be released to Des Moines Creek. This has occurred only once under

the current configuration of the IWS, during an extreme rain-on-snow event in December 1996-January 1997. The release lasted only a few hours. No petroleum hydrocarbons were detected downstream of the release. As stated above, increased storage capacity and treatment rate will prevent overflows.

If a release becomes necessary, operational procedures will minimize the impact on Des Moines Creek. Initial runoff from each storm (which flushes most of the pollutant load from the ground surfaces) flows to Lagoons 1 and 2. Any release of untreated water would occur from Lagoon 3, in which pollutants would be more dilute, especially under the extreme events in which overflow would occur. Although an overflow spillway is provided to meet dam safety requirements, overflows from Lagoon 3 would be released from a bypass pipe at mid-depth to avoid discharge from the lagoon surface (preventing release of floating petroleum product) or from the lagoon bottom (preventing entrainment and discharge of accumulated sediment).

4.2.2.2 IWS Discharge Line Capacity

The hydraulic capacity of the existing 18-inch outfall has been evaluated and determined to be at least 6.3 MGD (Appendix O, Case 1). This is in excess of the current and proposed future maximum treatment rate of 4 MGD. Additionally, approximately 75 ft of the effluent line upstream of the effluent manhole was replaced in 1996 (Kennedy/Jenks 1998) and a portion of the 18-inch effluent line under Lagoon 3 is scheduled to be replaced in 2001. These improvements will increase the capacity of the outfall to 7.1 MGD (Appendix O, Case 2).

4.2.3 Pump Facilities

Five pump stations divert runoff from the SDS to the IWS. Table 4-3 summarizes the location, drainage area (1998), and capacity of these facilities.

Table 4-3. IWS pump stations.

Name	Location	Drainage Area (acres)	Pump Capacity (gpm)
North Snowmelt Pump Station (SDS to IWS)	SDN2	6.63	750
Central Snowmelt Pump Station (SDS to IWS)[1]	SDE4	0.75	750
South Snowmelt/Olympic Tank Farm Pump Station (SDS to IWS)[1]	Olympic Tank Farm	0.01	750
North Cargo Pump Station (SDS to IWS)	SDN2	35.60	2750
North Satellite Pump Station (SDS to IWS)	SDE4	13.75	2150

[1] No excess runoff is discharged to streams under the 100-year storm event (or smaller storm events).

The pump stations divert runoff up to at least the 6-month/24-hour event from these areas. Under high-flow conditions, excess runoff discharges to the SDS system. Detailed information on the above pump facilities is provided in Appendix C. The hydrologic models described in Section 3.2 incorporate the drainage areas and pump capacities shown in the Table 4-3 facilities.

Pump facilities are also located in the parking garage area to pump runoff to the IWS, along the utility tunnel under the arrival/departure drives and ramps to pump roadway drainage to SDE4, and at other miscellaneous sites where gravity drainage is not feasible. These small pump stations are not included in the hydrologic model because of their small size, or because they affect only the IWS, which was not analyzed in detail in the HSPF models.

4.2.4 Recent SDS to IWS Reroutes

Many projects have been constructed at the airport in recent years to reroute potentially polluted storm drainage from the terminal area to the IWS. The SDS Comprehensive Drainage Plan (HDR 1997) incorporated improvements that were recommended by the STIA SWPPP (Port of Seattle 1998a) to reduce the potential for anti- and de-icing chemicals to reach the SDS. Other projects were also identified and constructed. Table 4-4 summarizes airport projects that were constructed during the period 1994-1998 to reroute critical storm drainage areas to the IWS.

Table 4-4. SDS to IWS reroute projects implemented during 1994-1998.

		Change in Drainage Area		
SWPPP Project	Year	From[a]	To	Acres
North Cargo Area pump station	1997	SDN2	IWS	39.79
Cargo Area 4	1996	SDE4	IWS	4.40
North Satellite pump station	1995	SDE4	IWS	6.63
Gate C-8	1995	SDS3	IWS	0.27
South Satellite apron	1997	SDS1	IWS	1.75
Gate B5	1995	SDS1	IWS	0.25
Concourse A-D apron	1996	SDS1	IWS	16.82
D-gate flush gutter reroute	1994	SDE4	IWS	5.26
North snowmelt pump station	1998	SDN2	IWS	6.63
Central snowmelt pump station	1998	SDE4	IWS	0.75
South snowmelt pump station	1998	SDS4	IWS	0.34
South Satellite	2000	SDS1	IWS	1.91
TOTAL				**84.8**

[a] These drainage basins refer to basins defined in the STIA comprehensive storm drainage system plan technical information notebook (Symonds 1996).

As a result of these improvements, approximately 85 acres of impervious area have been transferred from the SDS to the IWS. These transfers included direct pipe reconnections from the SDS to the IWS, and for areas that could not be gravity-drained, pump stations sized for either the 6-month/24-hour storm or the 2-year/24-hour storm to divert flow from the SDS to the IWS. All projects recommended in the 1997 SWPPP have been completed.

4.3 STORMWATER DETENTION

Stormwater runoff at STIA is currently detained by approximately 351.1 acre-ft of detention storage (Table 4-5). This includes facilities that were built prior to 1994 and new facilities built at the airport for MPU improvements currently under development. Available facility descriptions, physical data, and operational data for the stormwater facilities are provided in Appendix C. Two existing regional facilities serve the airport and surrounding communities: Tyee Pond and the Miller Creek Detention Facility (see Figure 4-1). King County is currently designing a third facility, the Des Moines Creek RDF, which will be implemented as part of the Des Moines Creek Basin Plan (Des Moines Creek Basin Committee 1997). This facility is to be located at the head of the west branch of Des Moines Creek at the Northwest Ponds, and is anticipated to provide a total of

Table 4-5. Existing stormwater detention facilities.

Name	Location	Year Built	Drainage Areas Served[e]	Active Storage Capacity (acre-ft)
IWS Lagoons[a]	Southwest corner of airport	1960s-1980's	Airport IWS system (discharges directly to Puget Sound)	236.0[f]
Lake Reba	Miller Creek tributary	1973	SDN1, SDN1-OFF, SDN1-LWR, SDN2X, SDN3, SDN3X, SDN4, SDN4X, NEPL, CARGO, MC1, MC2, MC6, NCPS[c], NSMPS[c]	15.8 (at overflow crest)
Miller Creek Detention Facility	Miller Creek	1992	SDN1, SDN1-OFF, SDN1-LWR, SDN2X, SDN3, SDN3X, SDN4, SDN4X, NEPL, CARGO, MC1, MC2, M6, M1, M2, M3, M4, M5, MC3, NCPS[c], NSMPS[c]	68.0[d] (at emergency spillway)
Northwest Ponds	West Branch Des Moines Creek	Pre-1970	DM10, DM11, DM9, DM7, DM8, SDS2, SDS5, SDS6, SDS3A, SDS3, SDS7, IWS[c]	16.9 (at road crest)
Tyee Regional Detention Pond	East Branch Des Moines Creek	1988	DM6, SDS1, DM5, DM4, SASA, SDE4, DM2, DM1, DM3, IWS-Primary[c], NSPC[c]	18.5 (at overflow structure)
NEPL Vault[b]	Tributary to Miller Creek via Lake Reba	1997	NEPL	4.0 (at 100-year design level)
1998 Taxiway Vault[b]	SDS-3	1998	Airport (SDS-3, new taxiway for third runway)	5.5 (at 100-year design level)
South remote parking lot and expansion[g]	East Branch Des Moines Creek	1985-86	Parking lots	0.7 total
Doug Fox infiltration facility[g]	SDE-4	1989	Parking lot and flight kitchen	0.06 (plus 300' x 30' infiltration trench)
S. 160th St. Remote Parking Lot[h]	City of SeaTac storm system	1990	Parking lot	1.3
Starling Road detention pond[g]	West Branch Des Moines Creek	1993	Road	Not available
Flying Food detention vault[g]	Miller Creek tributary	1987	Roof and parking lot	0.05
Lufthansa detention pond[g]	Miller Creek tributary	1989	Roof and parking lot	0.06
TOTAL				**351.1 acre-ft**

[a] The IWS discharges to Puget Sound and does not impact Des Moines or Miller Creeks.
[b] These facilities were built as part of MPU improvements.
[c] Only during overflow conditions.
[d] The Miller Creek Detention Facility active storage capacity includes Lake Reba's active storage of 15.8 acre-ft; Lake Reba's storage was only counted once in the overall total.
[e] Refer to Figure 4-1.
[f] 236.0 acre-ft is the total storage capacity after expansion of Lagoon 3, currently under way. The existing storage is 90.5 acre-ft.
[g] These projects will be removed due to MPU projects.
[h] S. 160th Remote Parking Lot is in the Gilliam Creek basin and will not be changed.

NEPL = North Employee Parking Lot.

Table 4-6. BMP inventory for existing STIA subbasins as they will be configured for Master Plan Update buildout, prior to additional treatment.

Subbasin	Approx. Future PGIS[a] (ac)	Existing WQ Treatment[b]					Existing Source Control BMPs[c]
		Existing Treatment BMPs	Filter Strip (sf)	Bio-swale (sf)	Fully Treated PGIS[e] (ac)	PGIS Not Fully Treated (ac)	
SDN1	7.5	Bioswale	0	3,500	0.7	6.8	SPC, SWP, CBC, LND, SWE
SDN2	2.1	Diverted to IWS	0	0	2.1	0.0	SPC, SWP, CBC, SWE
SDN3	24.7	Filter Strips	782,000	0	24.7	0.0	SPC, SWP, CBC, SWE
SDN4	9.0	Filter Strips	96,000	0	9.0	0.0	SPC, SWP, CBC, SWE
SDN6 cargo area north of SR518	4.1	none	0	0	0.0	4.1	(none – no exist. PGIS)
MC1-MC3 S. 154th	3.9	none	0	0	0.0	3.9	SWE[d]
MC4-MC8 New west side buffer area subbasins	7.3	none	0	0	0.0	7.3	(not currently part of STIA)
NEPL	29.0	Bioswale	0	4,400	29.0	0.0	SPC, SWP, CBC, LND, SWE
SDW1, SDW2 new 3RW	55.1	none	0	0	0.0	55.1	(none – no exist. PGIS)
SDE4-South south of 170th	32.0	none	0	0	0.0	32.0	SPC, SWP, CBC, LND, SWE
SDE4-Taxiways taxiway area	18.8	Filter Strips	50,000	0	4.6	14.2	SPC, SWP, CBC, SWE
SDE4-NEAT NEAT area, north of 170th	35.0	Bioswale	0	2,160	2.9	32.1	SPC, SWP, CBC, SWE, LND
Delta Parking Lot	3.2	none	0	0	0.0	3.2	SPC, SWP, CBC, SWE
SDS1	11.7	none	0	0	0.0	11.7	SPC, SWP, CBC, SWE
SDS2	0.0	none (no PGIS)	0	0	0.0	0.0	none
SDS3	234.6	Filter Strips	1,680,000	0	190.0	44.6	SPC, SWP, CBC, SWE
SDS4	32.3	Filter Strips	360,000	0	32.3	0.0	SPC, SWP, CBC, SWE
SDS5 formerly subbasin D	0.0	none (no PGIS)	0	0	0.0	0.0	SPC, SWP, CBC
SDS6 formerly subbasin B	1.5	none	0	0	0.0	1.5	SPC, SWP, CBC
SDS7 (new 3RW, includes former SDW-3)	40.2	none	0	0	0.0	40.2	SPC, SWP, CBC
SASA	27.4	Bioswale	0	13,000	17.6	9.8	SPC, SWP, CBC, LND, SWE
TOTAL SDS DRAINAGE AREA (acres)	579.4						

[a] PGIS = Pollution Generating Impervious Surface, the amount of area requiring water quality treatment BMPs. Includes existing and new surfaces.

[b] Basins SDN1, SDN2, SDN3, SDN4, NEPL, SDN6 flow to Lake Reba, which has a permanent pool volume that provides additional wetpool treatment not included in these calculations.

[c] SOURCE CONTROLS
SPC = Spill Control and Countermeasures Planning
SWP = Stormwater Pollution Prevention Planning (POS and Tenants)
SWE = Sweeping
CBC = Regular Catchbasin Cleanout
LND = Landscape Maintenance BMPs, including Integrated Pest Management

[d] These subbasins will be under the jurisdiction of the City of SeaTac. Source control operations would be performed by the City.

[e] BMP — Approx. Required Treatment/Acre

BMP	Approx. Required Treatment/Acre
Bioswale	960 sf
Filter Strips	5,000 sf
Wetvaults	4,610 cf

180 acre-ft of storage. The Port is actively working with the County and Basin Committee to implement the project as a plan participant. This facility would mitigate impacts of stormwater runoff from all past and future (beyond Level 1 of King County standards) development in the Des Moines Creek watershed.

Detention storage provided by the smaller facilities (those with less than 1 acre-ft of storage) is not currently considered in the hydrologic modeling of the SDS and IWS systems described in this report. Future model updates may include these facilities when design data are obtained and models are refined.

4.4 HYDROLOGIC MODELING/WATER QUANTITY

As described in Section 3.2, the HSPF model was used to evaluate the stormwater impacts, including flood frequency, flow duration, and baseflow maintenance under existing conditions. These analyses, when compared with those for proposed conditions, quantify the storage requirements for the proposed stormwater detention facilities.

This section describes the use of HSPF to model current hydrologic conditions at the airport. Details are presented in Appendices A and B and Section 6.1.

4.4.1 Model Development

The HSPF models of Miller Creek and Des Moines Creek have previously been prepared by several investigators (NHC 1990, Montgomery Water Group 1995, Des Moines Creek Basin Plan Committee 1997, and Parametrix 1999a). Each investigation contributed to the understanding of the hydrologic processes that quantify the amount of streamflow in each watershed.

The Miller Creek HSPF model developed for the FEIS (FAA 1996) was adapted from a previous version developed for the Miller Creek Regional Stormwater Facilities Design Hydrologic Modeling (NHC 1990). The NHC model was modified using updated watershed characteristics (land use and drainage area). Corrections to the stream network, and additional streamflow monitoring data for calibration, were included in the FEIS version of the model.

The HSPF models in the 1999 draft SMP (Parametrix 1999a) updated the FEIS versions (for Miller and Des Moines Creeks). The revisions consisted of updated watershed characteristics and SDS network information, additional information describing existing stormwater detention facilities, and MPU project effects (for future condition simulation). Additional streamflow monitoring data were obtained for SDS and Miller Creek flow and used for calibration of the model.

The HSPF models in this SMP were further updated with new land use and soils data from King County and further calibration of model input (see Appendix B). In addition, Walker Creek was separated from Miller Creek and calibrated independently.

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4.4.1.1 Land Use Characterization

Characterization of land use is prerequisite to calibrating the HSPF models because land use data influence parameters that describe hydrologic processes. Data used to develop the previous FEIS and 1999 SMP Miller and Des Moines basin models were checked against available information.

Land use data for areas draining to the detention facilities were compiled using ArcView 3.2 Geographic Information Systems (GIS) coverage of airport land use, based on 1993 aerial photography (Walker and Associates 1993). Data included drainage basin boundaries, soil, vegetation, and impervious surfaces. Appendix B provides further detail of land use characterization.

4.4.1.2 Model Calibration

Appendix B presents the results of the calibration effort for modeling the Miller, Walker, and Des Moines Creek basins.

4.4.2 Long-term Simulation

Following calibration of the HSPF models, long-term hydrologic simulations of current conditions for Miller and Des Moines Creeks were performed. These simulations were run for the 1948-1996 (49-year) period using hourly STIA precipitation and daily Puyallup evaporation data as input.

The results of the simulations were summarized using flood frequency estimates and flow durations at selected locations shown on Figure A-7, Appendix A.

4.4.3 Flow Duration Analysis of Target Watershed Flow Regime

Section 2.1.3 describes how the target watershed flow regimes for Miller and Des Moines Creeks were derived and established. To derive the target watershed flow regime for the pre-developed condition, the HSPF models (incorporating 2006 basin boundaries) were modified by changing basin land cover to 10 percent impervious, 15 percent grass, and 75 percent forest. The physical characteristics of the stream reaches were unchanged.

4.5 EXISTING BMPs AND WATER QUALITY

An analysis of existing BMPs and a summary of NPDES monitoring water quality data are provided below.

4.5.1 Best Management Practices

Most of STIA's existing SDS and the current off-site areas to be incorporated into the SDS were developed before current water quality treatment BMP requirements were established. Therefore, these areas are not completely served by water quality BMPs. Nevertheless, approximately 68 percent of existing STIA SDS pollution-generating impervious surfaces are treated with water quality BMPs that meet current design standards.

Existing water quality BMPs were analyzed to help determine the treatment BMPs that would be required for future development and redevelopment. A subbasin-by-subbasin inventory was prepared for (1) PGIS, and (2) existing treatment BMPs. This analysis is described below, and summarized in Table 4-6. The analysis of existing BMP conditions was performed for subbasins as they are anticipated to be configured upon completion of the Master Plan Update. These are pre-design estimates, and may change as project design proceeds.

Table 4-6. BMP inventory for existing STIA subbasins as they will be configured for Master Plan Update buildout, prior to additional treatment.

Subbasin	Approx. Future PGIS[a] (ac)	Existing WQ Treatment[b]					Existing Source Control BMPs[c]
		Existing Treatment BMPs	Filter Strip (sf)	Bio-swale (sf)	Fully Treated PGIS[a] (ac)	PGIS Not Fully Treated (ac)	
SDN1	7.5	Bioswale	0	3,500	0.7	6.8	SPC, SWP, CBC, LND, SWE
SDN2	2.1	Diverted to IWS	0	0	2.1	0.0	SPC, SWP, CBC, SWE
SDN3	24.7	Filter Strips	782,000	0	24.7	0.0	SPC, SWP, CBC, SWE
SDN4	9.0	Filter Strips	96,000	0	9.0	0.0	SPC, SWP, CBC, SWE
SDN6 cargo area north of SR518	4.1	none	0	0	0.0	4.1	(none -- no exist. PGIS)
MC1-MC3 S. 154th	3.9	none	0	0	0.0	3.9	SWE[d]
MC4-MC8 New west side buffer area subbasins	7.3	none	0	0	0.0	7.3	(not currently part of STIA)
NEPL	29.0	Bioswale	0	4,400	29.0	0.0	SPC, SWP, CBC, LND, SWE
SDW1, SDW2 new SRW	55.1	none	0	0	0.0	55.1	(none -- no exist. PGIS)
SDE4-South south of 170th	32.0	none	0	0	0.0	32.0	SPC, SWP, CBC, LND, SWE
SDE4-Taxiways taxiway area	18.8	Filter Strips	50,000	0	4.6	14.2	SPC, SWP, CBC, SWE
SDE4-NEAT NEAT area, north of 170th	35.0	Bioswale	0	2,160	2.9	32.1	SPC, SWP, CBC, SWE, LND
Delta Parking Lot	3.2	none	0	0	0.0	3.2	SPC, SWP, CBC, SWE
SDS1	2.6	none	0	0	0.0	2.6	SPC, SWP, CBC, SWE
SDS2	0.0	none (no PGIS)	0	0	0.0	0.0	none
SDS3	234.6	Filter Strips	1,680,000	0	190.0	44.6	SPC, SWP, CBC, SWE
SDS4	32.3	Filter Strips	360,000	0	32.3	0.0	SPC, SWP, CBC, SWE
SDS5 formerly subbasin D	0.0	none (no PGIS)	0	0	0.0	0.0	SPC, SWP, CBC
SDS6 formerly subbasin B	1.5	none	0	0	0.0	1.5	SPC, SWP, CBC
SDS7 (new SRW, includes former SDW-3)	40.2	none	0	0	0.0	40.2	SPC, SWP, CBC
SASA	27.4	Bioswale	0	13,000	17.6	9.8	SPC, SWP, CBC, LND, SWE
TOTAL SDS DRAINAGE AREA (acres)	570.3						

[a] PGIS = Pollution Generating Impervious Surface, the amount of area requiring water quality treatment BMPs. Includes existing and new surfaces.

[b] Basins SDN1, SDN2, SDN3, SDN4, NEPL, SDN6 flow to Lake Reba, which has a permanent pool volume that provides additional wetpool treatment not included in these calculations.

[c] SOURCE CONTROLS
SPC = Spill Control and Countermeasures Planning
SWP = Stormwater Pollution Prevention Planning (POS and Tenants)
SWE = Sweeping
CBC = Regular Catchbasin Cleanout
LND = Landscape Maintenance BMPs, including Integrated Pest Management

[d] These subbasins will be under the jurisdiction of the City of SeaTac. Source control operations would be performed by the City.

[e] BMP — Approx. Required Treatment/Acre
Bioswale — 960 sf
Filter Strips — 5,000 sf
Wetvaults — 4,610 cf

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4.5.1.1 Estimation of BMP Size Requirements Per Unit PGIS Area

For each type of BMP, size requirements were estimated for 1 acre of PGIS (Table 4-7) per the Basic Menu in the King County Manual. Runoff calculations and BMP sizing calculations for these estimates are described in Appendix E. Per the King County Manual, filter strips and bioswales were sized based on peak flows. For this analysis, they were sized for undetained runoff. When these BMPs follow a detention facility, their required size may be substantially smaller.

Table 4-7. Estimated BMP size per acre of PGIS.

BMP	Approximate Required Size Per Acre of PGIS
Filter Strip	5,000 ft^{2} [a,b]
Bioswale	960 ft^{2} [a,c]
Wetvault	4,610 ft^{3}

[a] For undetained runoff.
[b] Minimum filter strip length = 34.5 ft for 300-ft flow path; filter strip length and area changes with contributing flow path length.
[c] Area given is for bottom of bioswale. Including side slopes, bioswale area at 1.0 ft depth would be 1915 ft^{2}. However, where the unit size (960 ft^{2}) was used to evaluate existing bioswales, the bottom width of the existing bioswales was used, consistent with the area calculation used to estimate 960 ft^{2}. Where this area figure is used to estimate future bioswale area, planners should be aware that an additional 6 ft of width is necessary (assuming Z = 3, 3 ft needed on each side of bottom).

4.5.1.2 Subbasin PGIS Areas

Subbasin PGIS areas listed in Table 4-6 represent PGIS areas for subbasins as they will be configured upon completion of the Master Plan Update. PGIS areas were estimated for each subbasin by using a combination of GIS analysis and manual map and aerial photograph measurements to determine the amount of non-roof impervious area. For the purposes of this initial assessment, roof tops were assumed to be non-PGIS. However, as discussed in Section 7.4, roof tops will be inventoried and tested to determine their status as PGIS or non-PGIS.

4.5.1.3 BMP Inventory

The inventory of existing BMPs (Table 4-6) was developed using a combination of existing engineering plans, aerial photos, historical information, and direct observation and measurement. For example, for existing runway and taxiway drainage, cross-sections on original plans showed flowpaths passing over grassy strips before discharging to catchbasins in the grass infields. Although these original cross-sections were not available for all runways and taxiways, Port engineering staff (Rothnie 1999 personal communication) confirmed that all existing runways and taxiways are similarly configured.

Bioswales were conservatively assumed to be trapezoidal, 6-ft-wide at the base, 2-inch-deep flow (regularly mowed), with 3:1 side slopes. Upon completion of the inventory, consistency of BMP coverage with Ecology Manual requirements was assessed for each subbasin (Table 4-6 and Figure 4-4). In Table 4-6, if the "PGIS Treated" equals "PGIS" for a subbasin, that subbasin is compliant. If not compliant, the number of acres of PGIS requiring treatment is listed.

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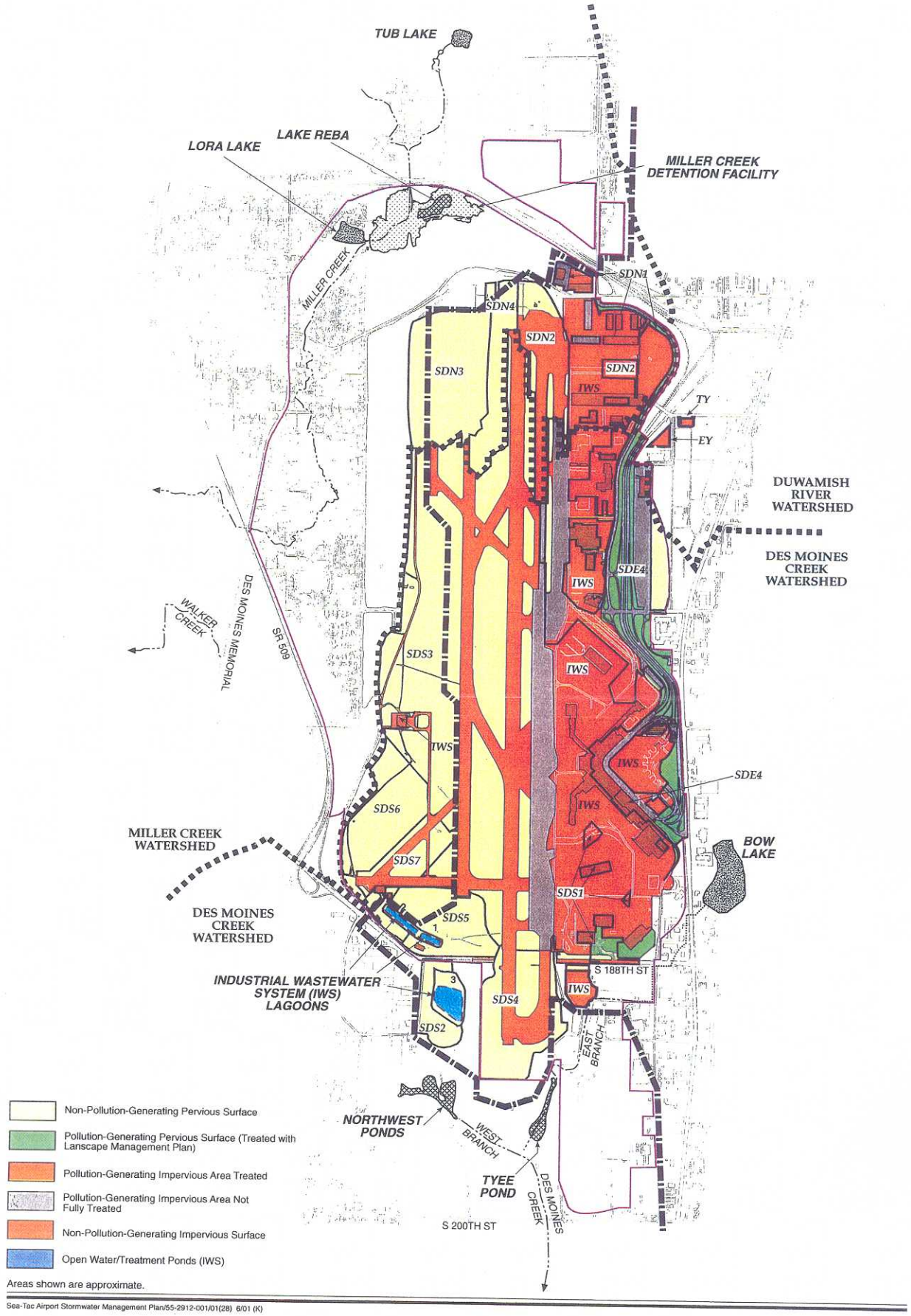

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Figure 4-4
Water Quality Treatment for Existing Surfaces

4.5.2 SDS Water Quality

As required by its current NPDES Permit, the Port has monitored the stormwater quality from its SDS outfalls since 1995. Overall, the data show that the concentrations of various constituents in STIA stormwater are generally less than those in runoff from other residential, urban, and industrial areas in the region (Table 4-8). For example, the median concentrations for STIA constituents (column 3) are lower than those in urban stormwater (columns 5 and 6), with the exception of total recoverable copper. These data provide evidence for the efficacy of BMPs that have been implemented by the Port over a number of years. The following sections provide a brief description for each constituent category.

Table 4-8. Seattle-Tacoma International Airport runoff quality (1994-2000) compared to regional and national urban stormwater quality studies[a] (from Port of Seattle 2000b).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constituent	Units	STIA: RW/TW[b] (median)	STIA: All Data (median)	Bellevue: Sturtevant Creek[c] (log-normal median)	Bellevue: BURP[e] (mean, median)	King County: (Metro 1982) (mean)	NURP[h]: (EPA 1983) (median)	Portland NPDES[i] (median)	Freeway Runoff (mean)
FOG	mg/L	0.5	1.0	3.7	2.5	7.8	–	–	30[f]
TPH	mg/L	0.08	0.3[j]	3.7	–	–	–	6.5	–
Fecal coliforms	mpn/ 100 ml	14	42	201	980	–	1000 to 21000	–	–
BOD	mg/L	5.0	6.0	–	6.6	–	9	20	–
TSS	mg/L	9	17	82.3	50	–	100	119	106[g]
Turbidity	mg/L	7	13	29.4	19	–	–	–	–
NH3[d]	mg/L	0.03	0.1	0.58	0.17	–	–	–	–
Cu (TR)	µg/L	26	25	10.4		20	34	40	43[g]
Pb (TR)	µg/L	1	4	26.3	170	210	144	25	466[g]
Zn (TR)	µg/L	34	69	161.4	120	110	160	376	638[g]

[a] "–" indicates no data available, reported, or applicable.
[b] RW/TW = runways/taxiways, represented by SDS3, SDS4, SDN3, and SDN4 subbasin data.
[c] From Bellevue (1996), Sturtevant Creek, downstream site.
[d] Ammonia values are expressed as total ammonia, not as ammonia-nitrogen. Data from 1998 Annual Report (Port of Seattle 1998b), the last year in which NH3 was reported.
[e] Bellevue Urban Runoff Program. From Pitt and Bissonnette (1984). For turbidity, Cu, Pb, and Zn, data reported as mean of grab samples; therefore, Bellevue (1996) data are better comparators because they represent median.
[f] Highway runoff in England (Booth and Horner 1995).
[g] Highway runoff from Interstate 5 freeway in Seattle with 57,000 automobiles per day, 43 to 54 storm samples in 1980-81 (Chui, et al. 1982).
[h] National Urban Runoff Program.
[i] City of Portland (1993).
[j] Results from NWTPH-Dx analyses since March 1998. NWTPH-Dx method replaced TPH (IR).

FOG = Fats, oil, grease
TPH = Total petroleum hydrocarbons
BOD = Biochemical oxygen demand
TSS = Total suspended solids

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4.5.2.1 Metals and Hydrocarbons

Both Miller and Des Moines Creeks are affected by stormwater from the surrounding urban areas, including local streets and State Routes (SR) 518 and 509. Streets and highways are a source of heavy metals, such as lead and zinc, as well as hydrocarbons, such as gasoline and oil (EPA 1983). Metals sources also include tire wear, brake linings, exhaust fumes, and exterior metal products. Since there are few or no BMPs in place in the surrounding urban area to control runoff from these sources, SR 518, SR 509, and SR 99, and other roads and streets are expected to contribute significantly to the pollutant load of Miller and Des Moines Creeks.

Stormwater from STIA is also a potential contributor of hydrocarbons, oils and grease, and metals to both creeks. However, as Table 4-8 shows, concentrations of these pollutants in STIA's runoff are typically lower than those found in urban and highway runoff in Puget Sound. For example, the Port's 2000 Annual Stormwater Monitoring Report (Port of Seattle 2000b) indicated that more than 95 percent of the airport's petroleum-type pollutants in stormwater runoff were below levels found in urban runoff from other sources in the region. According to the report, 36 percent of samples collected since March 1998 have had TPH concentrations less than the detectable limit (Port of Seattle 2000b). Similarly, over 75 percent of the lead, copper, and zinc concentrations in airport runoff were below the median from the comparable regional data. In particular, it should be noted that copper and zinc concentrations have dropped significantly at outfall SDS1 since the rerouting of runoff from aircraft service areas from the SDS to the IWS in June 1997 (Port of Seattle 1999a).

4.5.2.2 Fecal Coliforms

Stormwater runoff from SDS subbasins typically contains fewer fecal coliforms than other urban stormwater. However, instream data collected by the City of Des Moines shows locally elevated levels of fecal coliforms under both storm and baseflow conditions. Although fecal coliforms are not a perfect indicator of contamination, they generally indicate the presence and magnitude of human and animal wastes. Microbial source tracing (MST; a genetic "fingerprint"-matching method) by King County found that bacteria from human sources dominated the identifiable strains of coliforms in the stream, especially downstream of residential areas serviced by septic systems (Des Moines Creek Basin Plan Committee 1997). However, source-tracing studies, including MST, performed by the Port since 1998 do not indicate sanitary sewage as a source of fecal contamination in storm or base flows (Port of Seattle 2000b).

4.5.2.3 Suspended Solids and Turbidity

During storm flow, turbidity and suspended solids in both creeks can increase as a result of runoff from surrounding urban areas and STIA, as well as from instream bank erosion and streambed scour. Median values of total suspended solids (TSS) and turbidity in STIA stormwater were less than values observed in comparable regional data in more than 80 percent of samples.

4.5.2.4 Nutrients

Data collected by the City of Des Moines indicate that septic systems are also a probable source of elevated nitrogen levels observed in Des Moines Creek after storm events (Des Moines Creek Basin

Plan Committee 1997). Other sources of elevated nutrients in the watersheds include fertilizers used on lawns, parks, and golf courses. Urea, a source of ammonia, was formerly used as a runway de-icer. The Port discontinued the use of urea by the end of 1996. Current data show that ammonia concentrations in STIA stormwater have decreased to background levels (Port of Seattle 1998b).

4.5.2.5 Temperature

During the summer months, water temperatures in Des Moines Creek can exceed the optimal upper temperature of 14°C for salmonid species and the water quality standard of 16°C (Des Moines Creek Basin Plan Committee 1997). The Des Moines Creek study also reported that water temperatures in Bow Lake and the Northwest Ponds exceeded the lethal limit for salmonids of 22°C, although these extreme temperatures were not observed farther downstream. More favorable downstream temperatures result from shading by riparian bank vegetation, inputs of cooler groundwater, and evaporative cooling. High temperatures have not been identified as a primary concern for Miller Creek (Parametrix 1996).

4.5.2.6 Dissolved Oxygen and Biochemical Oxygen Demand

In late summer, dissolved oxygen (DO) concentrations in the Northwest Ponds are periodically below the water quality standard of 9.5 mg/L for Class AA waters. These low DO levels are probably associated with a biochemical oxygen demand (BOD) caused by organic sediments and algae blooms combined with minimal wind and hydraulic mixing. Warm water temperatures and reduced baseflows during the summer months also contribute to low DO. However, DO does not appear to be a problem farther downstream because of re-aeration through weirs and riffled stream-bed areas (Des Moines Creek Basin Plan Committee 1997). During winter months, de-icing chemicals applied to runways and taxiways are a potential source of BOD and declines in DO to Lake Reba, Miller Creek, the Northwest Ponds, and Des Moines Creek. The Port has completed a study of the effects of runway de-icing on instream DO (Port of Seattle 2000c). The study documented fluctuating DO, with decreases in DO most directly related to the occurrence of dry periods. Changes in DO patterns attributable to de-icing chemicals were not distinguishable.

4.5.3 IWS Treatment Performance

As described in Section 4.2.2, the IWS collects, stores, treats, and discharges industrial wastewater. The IWTP is not a stormwater treatment facility. Treatment and discharge of industrial wastewater is permitted and regulated by the Port's NPDES Permit WA-002465-1 (Ecology 1998). The interim technology-based effluent limitations were set by Ecology using best professional judgement (BPJ), based on best conventional control technology (BCT) for stormwater runoff treatment in the Petroleum Refining Point Source category (40 CFR Part 419; the Port's treatment technology is the same as was used to develop the BCT limits for runoff treatment in this category).

The IWTP treats collected water by flash-mixing aluminum chloride into the influent water to flocculate particulates and oils, dissolved air flotation (DAF) to carry the floc to the surface, and a skimmer to remove the floated contaminants. IWTP effluent is monitored continuously for flow rate; weekly for pH, total suspended solids, and oil/grease; and monthly for BOD, glycols, and total petroleum hydrocarbons.

Since 1997, several improvements to the IWTP treatment process have been made, including (1) two new DAF units, (2) cleaning and lining Lagoons 1 and 2, (3) new DAF flow controls, (4) new aluminum chloride feed pumps, (5) a new effluent sampling system to allow "live" sampling, and (6) new pH monitoring and control equipment (Kennedy/Jenks 1998).

As demonstrated in the monthly Discharge Monitoring Reports (DMRs) submitted to Ecology, with the exception of one TSS excursion in summer 2000,[14] effluent water quality limitations have been met since November 1996 (for recent data, see Appendix N).

4.5.3.1 Oil and Grease Removal

King County's performance goal for treatment of runoff from high-use sites is 10 mg/L TPH (King County 1998). The Port of Seattle NPDES permit limitations for oil and grease are 8 mg/L (average monthly) and 15 mg/L (daily maximum). Based on NPDES monitoring data from April 1995 through January 1999 (reported in monthly discharge monitoring reports to Ecology), the average oil and grease concentration in IWTP effluent is 4.80 mg/L (less than the typical detection limit of 5.00 mg/L). Therefore, the IWTP exceeds the performance goal for treatment of runoff from high-use areas, and is compliant with NPDES permit limitations.

4.5.3.2 TSS Removal

The interim effluent limitations for TSS in IWS discharge are 21 mg/L (monthly average) and 33 mg/L (daily maximum). As with oil and grease, the IWTP was designed to remove TSS to meet these numerical criteria, as opposed to a criterion based on percent removal. As demonstrated in the monthly DMRs submitted to Ecology, these effluent water quality limits have been met since November 1996, with the exception of a TSS excursion due to atypical pumping and treatment necessary for Lagoon 3 construction activities (for recent data, see Appendix N). Current effluent data (January 1999-October 2000, representative of current treatment conditions after the above-described improvements were made) demonstrate an average IWTP effluent TSS concentration of approximately 12.7 mg/L.

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[14] A single TSS excursion occurred in Summer 2000, during an atypical event. Under current conditions, pumping Lagoon 3 completely empty would disturb sediment on the bottom of the Lagoon. Therefore, a small amount of water normally is allowed to remain in the bottom of the Lagoon. To allow for Lagoon 3 expansion construction, it was necessary to pump and treat this water. Algae concentrated in this small amount of water was sufficient to cause a TSS excursion. This excursion is a result of one-time operational conditions. Furthermore, cleaning and lining of the Lagoon will occur in 2001, inhibiting future algae growth.

5. PROPOSED MPU IMPROVEMENTS

5.1 SUMMARY OF PROPOSED IMPROVEMENTS

MPU improvements that would likely require stormwater management are summarized in Table A-3 (Appendix A). Also included in Table A-3 are the names of potential stormwater detention facilities that could serve the new MPU improvements. These facilities are described in more detail in Section 6.1.3.

The primary MPU improvements are shown in Figure 5-1. This figure shows the general extent of the major projects and proposed new impervious surfaces. Minor MPU improvements are not shown on this figure; these are primarily located in the terminal and air cargo redevelopment areas and generally do not create new impervious surface area draining to the SDS. Also, the SMP addresses only permanent projects.[15] These and other projects that may be developed to support needed infrastructure improvements will be evaluated for stormwater impacts based on criteria established herein to ensure that cumulative impacts are addressed. Updated information on all MPU improvements would be periodically incorporated into the SMP as necessary.

The Airport Surveillance Radar (ASR), which is being relocated as a result of other MPU improvements, was not evaluated with other MPU projects. It is located outside of the active STIA footprint on the west side acquisition area. Although total impervious area on the site will decrease from 1994 to 2006, effective impervious area (EIA) will increase. Level 2 flow controls will be provided to meet the target flow regime discussed in Section 2.1.3 (the predeveloped condition is adjusted to assume 75 percent forest; the 3 percent EIA is less than 10 percent and is unadjusted; the remainder is grass). The site will be accessed only for infrequent maintenance and repair (no more than four times per week), thus will not have PGIS. See Appendix Y for discussion of hydrologic analysis and flow controls and Section 7.1.2.5 for discussion of water quality.

MPU improvements in Table A-3 (Appendix A) are based on project scheduling developed in late 1998, and will likely change as project priorities change and schedules are further refined. In general, projects not assigned a construction start and end date have not been scheduled, other than being assigned to one of the four MPU phases (i.e., Phase I, II, III, and IV).

5.2 LAND USE CHANGES

To determine the future land use characteristics of the airport property, available data on current MPU improvements were compiled into a GIS database to allow the calculation of pervious and impervious areas. The GIS database was also used to calculate changes in soil types and vegetation cover. These data were then incorporated into the HSPF modeling analysis, as discussed in Section 4.4.1. Figure 4-2 illustrates the 1994 land use condition and Figure 4-3 depicts drainage subbasin boundaries prior to 1994.

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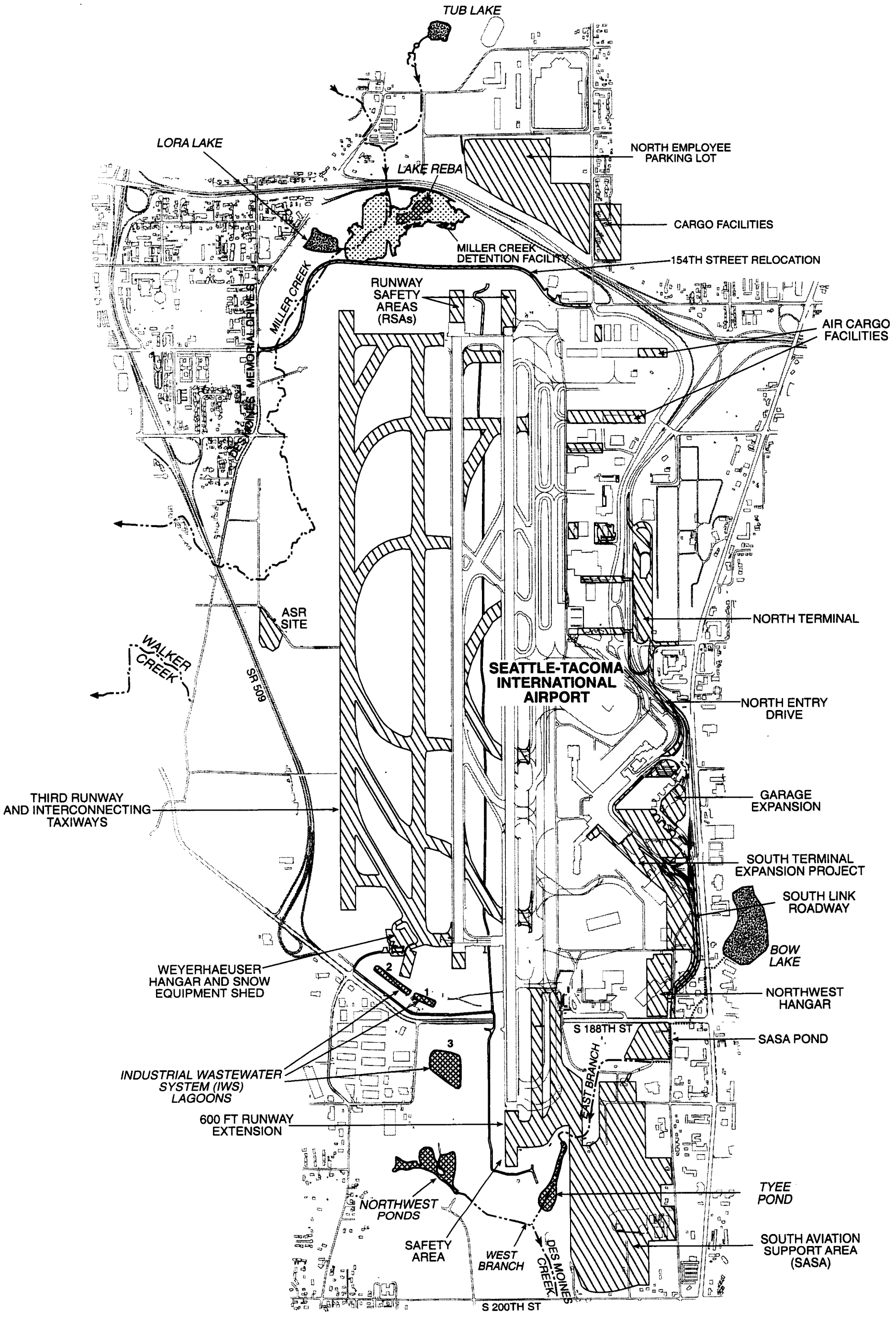
[15] The SMP addresses permanent projects. The SR 509 temporary interchange project was not evaluated as an MPU project in the SMP. However, temporary stormwater impacts from the SR 509 interchange are being evaluated by King County under separate cover (HNTB 2000).



AR 010263

Sea-Tac Airport/Stormwater Management Plan/556-2912-001(28) 6/01 (K)

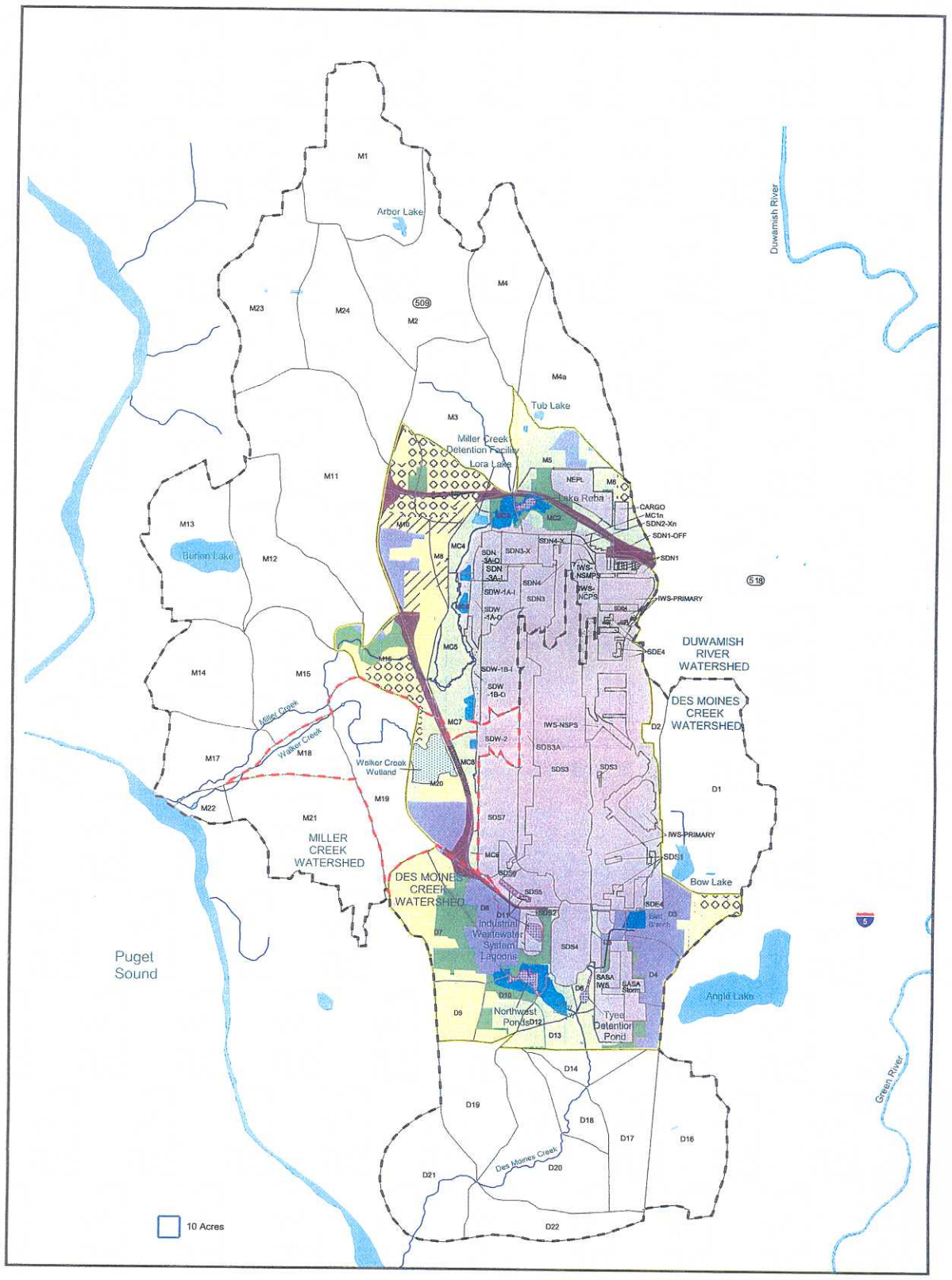
July 2001
556-2912-001 (28)

SCALE IN FEET
0 750 1,500

N

Water Bodies
Master Plan Projects (Impervious Surface Area)
Detention Facility (Existing)
Creek
Piped Creek
Constructed Water Feature

Figure 5-1
Master Plan Projects



AR 010264

Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rrseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Estimated wetland boundaries are based on field reconnaissance by Parametrix, Inc.
Land use data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note Subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

N
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Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary

Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)

Sea-Tac Airport
Commercial
Open/Grass
Transportation

Low Density Residential
High Density Residential
Multi-Family Residential
Forest

Figure 5-2
STIA Drainage Subbasins and 2006 Land Use

5.2.1 Future Land Use

Figure 5-2 illustrates the land use condition and drainage subbasin boundaries after MPU improvement build-out, estimated at this time to occur in about 2006. Changes in land use are based on the available design layouts of those projects currently under design or construction (e.g., the Third Runway, associated taxiway, and the garage expansion). The layout for the remaining MPU improvements is based on preliminary design data and the Airport Layout Plan. This includes the SASA in the southeast corner of the airport, the north and south terminal expansions, new cargo facilities in the air cargo area and north of SR-518, the relocated Northwest Hangar, the South LINK roadway, and other miscellaneous projects.

The drainage basin boundaries under the build-out condition (Figure 5-2) will be similar to the baseline (1994) drainage boundaries (Figure 4-2). However, minor changes to the boundary resulting from newly constructed drainage systems for the Third Runway and parallel taxiway, and improvements to the existing system in the vicinity of redevelopment projects will occur. However, future development will not change the total amount of airport area draining to Miller, Walker, and Des Moines Creeks (i.e., the hydrologic divide will remain balanced and no net change to each watershed area will occur).

For the Third Runway acquisition area, located west of 12th Avenue South, it was assumed that houses would be removed and only the primary streets would remain (streets would be used only for emergency and maintenance access). With the exception of the ASR site, potential future commercial development of that area is not part of the MPU and therefore was not evaluated.

Under the future condition model, only the airport land use changes; the remainder of the watershed remains identical to the 1994 base year. (A review of the areas upstream shows little available land for development not controlled by the Port. In addition, existing stormwater management standards and proposed RDF should be adequate to address impacts.)

5.2.2 Changes in Impervious Area

Future impervious area is depicted in Figure 5-3 and enumerated in Table 4-1. Approximately 106 acres (net) of new impervious surface area will be created in the Miller Creek watershed, approximately 6 acres will be added in the Walker Creek watershed, and approximately 128 acres will be created in the Des Moines Creek watershed. In the Miller Creek watershed, most new impervious surface area will be from the Third Runway, associated taxiways, and the NEPL. In the Walker Creek watershed, new impervious area will be attributable to the Third Runway and associated taxiways. In the Des Moines Creek watershed, most new impervious surface area to Des Moines Creek will be from the Third Runway, associated taxiways, and the SASA parking and roof drainage.

An additional 111 acres of impervious area will be added to the IWS, either by rerouting existing impervious areas currently in the SDS (e.g., terminal areas) or by constructing new impervious areas (e.g., SASA).

AR 010265

5.2.1 Future Land Use

Figure 5-2 illustrates the land use condition and drainage subbasin boundaries after MPU improvement build-out, estimated at this time to occur in about 2006. Changes in land use are based on the available design layouts of those projects currently under design or construction (e.g., the Third Runway, associated taxiway, and the garage expansion). The layout for the remaining MPU improvements is based on preliminary design data and the Airport Layout Plan. This includes the SASA in the southeast corner of the airport, the north and south terminal expansions, new cargo facilities in the air cargo area and north of SR-518, the relocated Northwest Hangar, the South LINK roadway, and other miscellaneous projects.

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For the Third Runway acquisition area, located west of 12th Avenue South, it was assumed that houses would be removed and only the primary streets would remain (streets would be used only for emergency and maintenance access). With the exception of the ASR site, potential future commercial development of that area is not part of the MPU and therefore was not evaluated.

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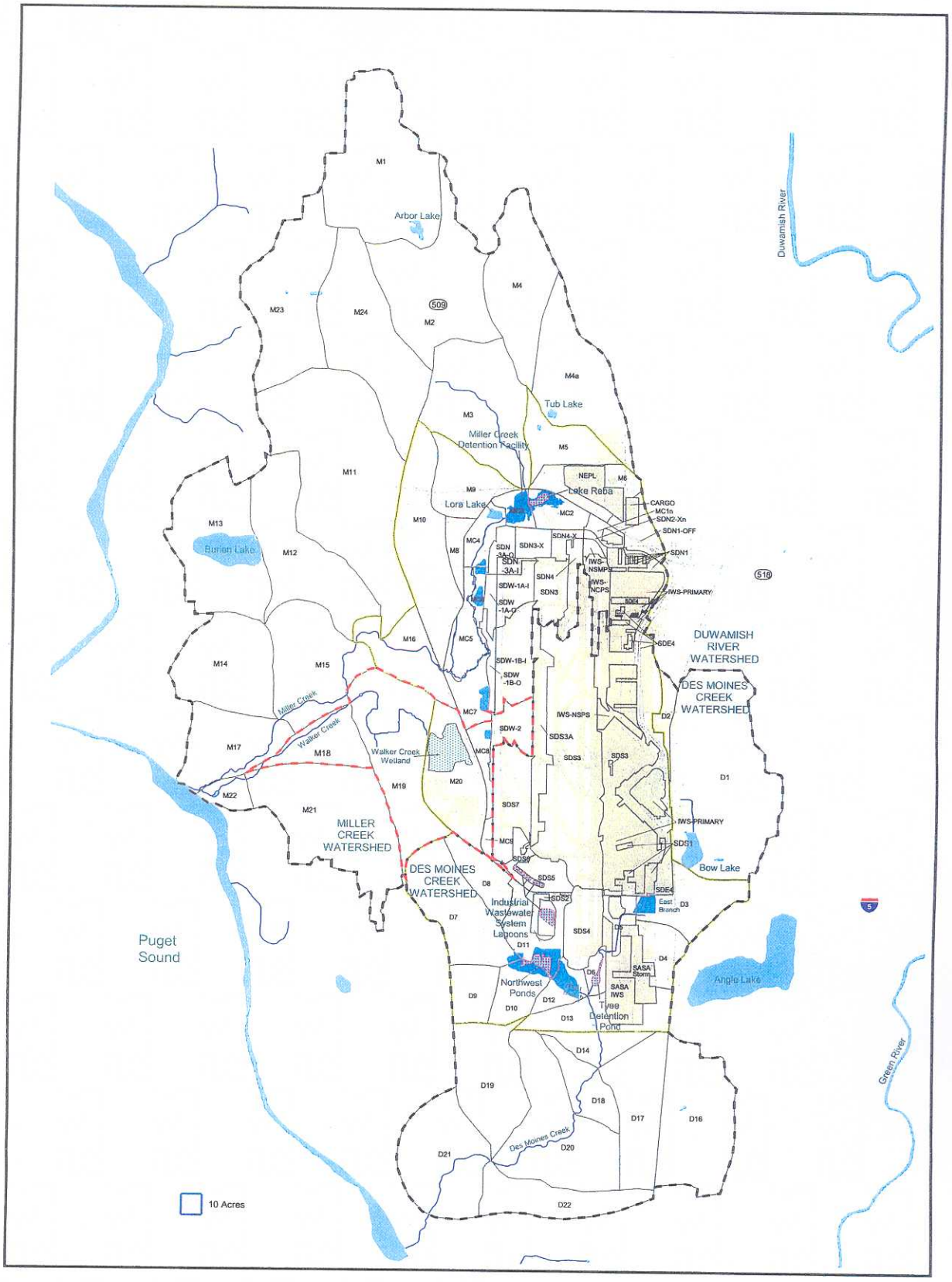
An additional 111 acres of impervious area will be added to the IWS, either by rerouting existing impervious areas currently in the SDS (e.g., terminal areas) or by constructing new impervious areas (e.g., SASA).



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File:K:\GIS\2912\Arcview\rrseatac_apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Impervious surface data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: STIA Subbasin GIS coverage obtained where conditions may change between 2006 base conditions and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only.

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N

1000 0 1000 2000 Feet

1:36,000

Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)
Impervious Areas

Figure 5-3
STIA Subbasins Future Impervious Areas

AR 010267

6. HYDROLOGIC MODELING OF FUTURE CONDITIONS AND STORMWATER QUANTITY MANAGEMENT

6.1 HYDROLOGIC MODELING

6.1.1 Model Development

For the hydrologic analysis of future conditions after completion of the MPU improvements, the Miller, Walker, and Des Moines Creek HSPF models were enhanced to reflect changes in impervious areas and drainage basin boundaries in the STIA subbasins. Existing and future impervious areas associated with the proposed MPU improvements are shown on Figure 5-3, and the revised drainage basin boundaries are shown in Figure 5-2.

6.1.2 Detention Options

The stormwater detention options for STIA MPU improvements are:

- New stormwater detention vaults;
- New stormwater detention ponds; and
- Expanded existing detention ponds.

6.1.2.1 New Stormwater Detention Vaults

A stormwater detention vault is a large, reinforced concrete containment structure. Normally, vaults are constructed underground. Vaults have advantages in that they can be constructed with only minimal conflicts with existing land uses; they do not create a wildlife attractant hazard; and they can be built concurrently with construction of the MPU improvement they intend to serve. The Port recently constructed a 4.0 acre-ft vault at the NEPL and a 5.9 acre-ft vault to serve the 1998-99 taxiway project.

The disadvantages of underground vaults are that they are expensive; they provide little economy of size when structures exceed a few acre-ft in volume; and maintenance is more difficult within the confined space of the vault.

6.1.2.2 New Stormwater Detention Ponds

A stormwater detention pond is created by excavating a depression or creating a berm (or a combination thereof). The pond outflow is controlled by an outlet structure with a series of vertically-arranged orifices.

Ponds have advantages in that they are relatively inexpensive to construct, with construction mostly consisting of earthwork and an outlet structure. With regard to construction, they are particularly economical for large-scale applications. Ponds are open, allowing for easy maintenance. The disadvantages of detention ponds is that they generally preclude other use of the land that they occupy. Also, near STIA they create a wildlife attractant, which must be controlled with netting and other deterrents.

6.1.2.3 Expanded Existing Detention Facilities

Several options exist for expanding the existing detention ponds serving STIA - the Miller Creek Detention Facility and Northwest Ponds. Table 6-1 summarizes the potential for expanding these facilities.

Table 6-1. Existing detention ponds serving Seattle-Tacoma International Airport with potential for expansion.

Facility	Current Active Storage Volume (acre-ft)	Maximum Expanded Storage (acre-ft)
Miller Creek Detention Facility		
Existing	68.0	68.0
Site 1	--	24.0
Site 2	--	16.4
TOTAL	**68.0**	**108.4**
Northwest Ponds		
Existing	16.9	--
Proposed RDF	--	180
TOTAL	**16.9**	**180**

6.1.2.4 Expanded Miller Creek Detention Facility

The expansion of the Miller Creek Detention Facility would require enlarging the existing live storage volume, and the existing gate opening area may need to be adjusted to gain the full detention benefits from the new storage. No expansion for MPU projects is proposed; future expansion alternatives may be evaluated that reduce the sizes of detention facilities proposed in the SMP.

Figure D-3 (Appendix D) illustrates where excavation would occur. Wetlands in the area would be avoided. To avoid increasing wildlife attraction to the area, the area of pond expansion would be designed as a free-draining (no standing water) facility.

6.1.2.5 Expanded Northwest Ponds

The Port is currently working with King County to design and construct a regional detention pond at the Northwest Ponds, located at the head of the west branch of Des Moines Creek (Des Moines Creek RDF). The Des Moines Creek Basin Plan determined that up to 180 acre-ft of detention storage can be developed at that site. The basin plan includes diverting water from the detention pond to an abandoned sewerline for direct discharge to Puget Sound. The Port is actively working with the County as a plan participant to implement that project (the Port has been responsible for funding 40 percent of the plan). The facility would reduce existing peak flood impacts in the Des Moines Creek basin.

Flooding in the Tyee golf course would be substantially reduced by the proposed regional pond because the West Branch of Des Moines Creek would be rebuilt to improve flow and reduce over-bank flooding. Areas of expanded detention storage within the facility would be planted with shrub-scrub vegetation intended to deter use by waterfowl.

6.1.3 Estimated Detention Storage

Proposed stormwater detention facilities for the MPU were designed based on the drainage area served by each facility, the detention standard, the detention storage volume required to meet the flow control standards, and potential for waterfowl attraction. As shown in the following sections, proposed storage volumes were designed to prevent increases in flood frequency and flow duration.

Approximately 344 acre-ft of new stormwater detention storage (see Table 6-2) will be needed to mitigate the impacts of increased stormwater runoff associated with MPU projects. The locations of new facilities are shown in Figure 6-1.

Further refinement of stormwater detention storage volumes will occur during the final design of the Stormwater Management Improvements for each MPU project. During this process the hydraulic design of the facilities will be reevaluated and detention volumes adjusted as appropriate to ensure that the Port's stormwater management standards are met as described in Section 2.1.4 (pg. 2-4) and Section 2.2.2 (pg. 2-6) of this document. Hydraulic design reports for each proposed facility will document these detailed modeling and design analyses.

6.1.4 Water Quality of Stormwater Stored in Vaults

Stormwater may be stored in vaults for periods of weeks or months (this may apply to water detained for long periods due to low target release rates or to water retained during the winter for low stream flow support during the dry season). Storage for long periods may result in low dissolved oxygen (DO) concentrations. However, dissolved oxygen is not expected to be reduced to anoxic levels, because (1) median BOD in runway/taxiway runoff is only 5 mg/L (see Section 4.5.2), (2) vault storage would preclude the growth of algae, which would consume dissolved oxygen (however, microbial activity could consume oxygen), and (3) water stored in vaults will remain cool, allowing a higher saturation level and slowing microbial activity. Furthermore, stormwater will be released via small orifices, and in most cases, must flow in channels or pipes for a considerable distance before reaching the receiving water; these conditions which will induce turbulence and reaeration before water reaches the receiving waters. No additional design features are expected to be necessary to treat water stored or released from vaults.

6.2 STORMWATER QUANTITY MANAGEMENT

6.2.1 Low Stream Flow Impacts and Mitigation

6.2.1.1 Predicted Low Stream Flow Impacts

The hydrologic analysis of potential impacts of the STIA MPU improvements on Miller and Des Moines Creeks was originally presented in the MPU EIS. That EIS analysis was based on studies conducted in 1995.

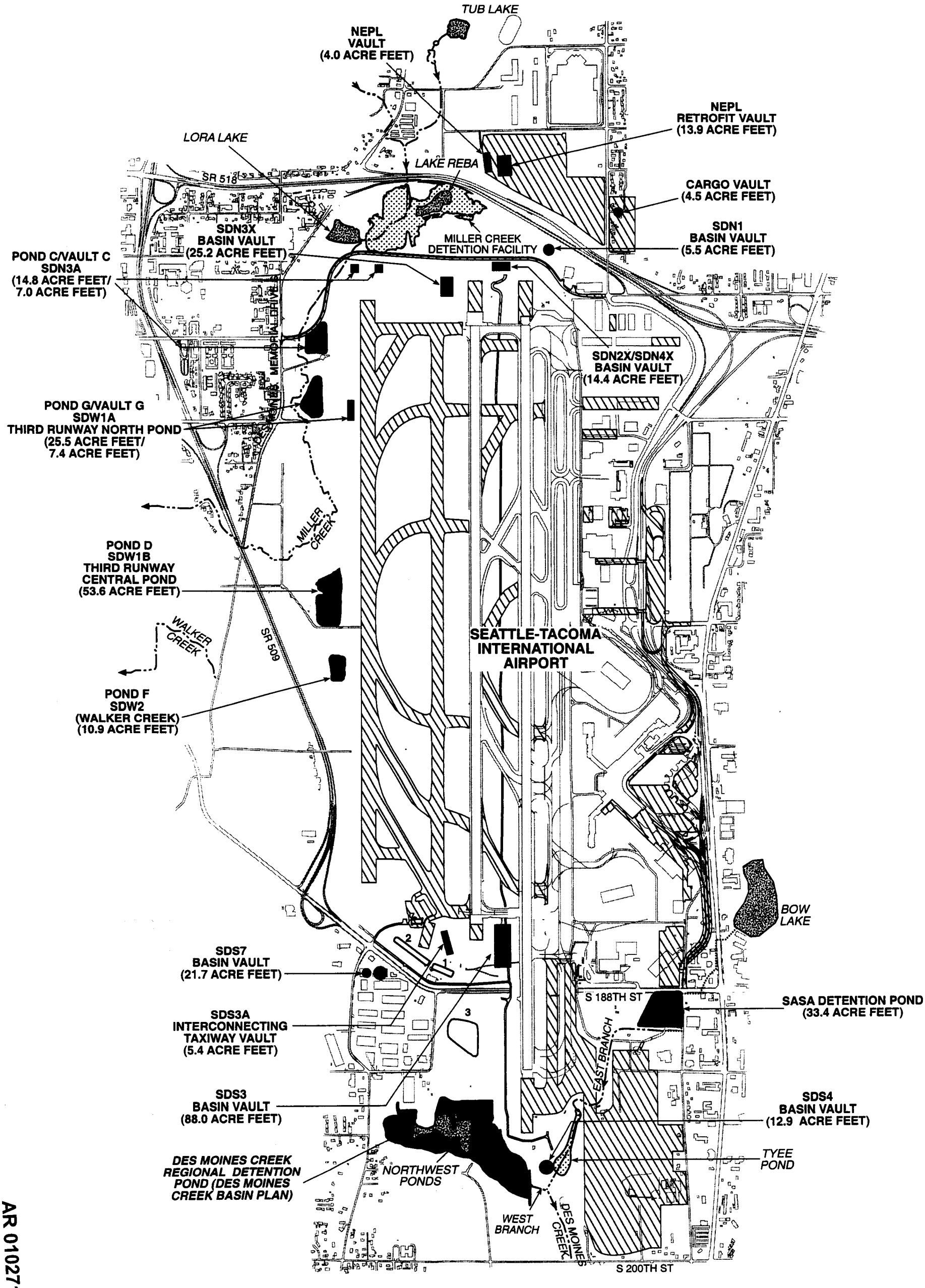

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Figure 6-1
Proposed Detention Facilities for Master Plan Projects

Table 6-2. Summary of required detention facility volumes.

Watershed	Hydrologic Evaluation Point	Volume Required (acre-ft)	Type of Facility[a]	Comments
Miller Creek	NEPL	13.9[b]	Vault	In addition to existing 4 acre-ft
	CARGO	4.5	Vault	
	SDN2x + SDN4x	14.4	Vault	
	SDN3/3x	25.2	Vault	
	SDN1	5.5	Vault	
	SDN3A	Pond: 14.8 / Vault: 7.0	Pond/Vault	
	SDW1A	Pond: 25.5 / Vault: 7.4	Pond/Vault	Infiltration used
	SDW1B	53.6	Pond	Infiltration used
Total Miller Creek		**171.8**		
Walker Creek	**SDW2**	**10.9**	**Pond**	
Des Moines Creek	SASA Detention Facility	33.4[c]	Pond	
	Interconnecting taxiway (SDS3A)	5.4	Vault	
	Third Runway South (SDS7 and 6)	21.7	Vault	
	SDS3	88.0	Vault	
	SDS4	12.9	Vault	
Total Des Moines Creek		**161.4**		

[a] Types of facilities: Vault – enclosure with multiple orifice outlets on vertical riser with overflow spillway; Pond – open earth construction with netting or other means to provide wildlife deterrent.

[b] Volume needed to retrofit existing facility.

[c] Retrofit STIA area only.

Modeling conducted in 2000 presented a more comprehensive evaluation of the potential low stream flow impacts in Miller, Des Moines, and Walker Creeks from the planned STIA improvements. The *Low Streamflow Analysis for Seattle-Tacoma Master Plan Update* (Earth Tech 2000) contains detailed information and references for this work. This analysis was revised in 2001; results of the update are provided in the revised *Low Streamflow Analysis* report and therefore are not included in the SMP.

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6.2.1.2 Infiltration Facilities

Ecology has indicated that infiltration is the highest priority for stormwater control, provided that proper soil conditions exist and groundwater quality is protected. The Port has reviewed the feasibility of providing infiltration facilities for stormwater management to determine opportunities to minimize the potential effect of new impervious surfaces on low stream flows in Miller, Walker, and Des Moines Creeks.

The locations of stormwater management facilities discussed in the previous sections were selected based on hydrologic and hydraulic conditions (i.e., the sites are downstream of development to mitigate peak flows prior to discharge to surface water). These sites were further analyzed for their feasibility as infiltration sites (see Appendix F).

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The Ecology and King County Manuals provide design guidance for stormwater infiltration facilities. The Port's policy on wildlife attractant hazards at open-water facilities imposes additional constraints on the design and location of infiltration facilities. In general, the following conditions must exist for infiltration to be further considered:

- Site soils must have natural infiltration rates that meet the minimum requirements specified in the King County Surface Water Design Manual;
- No potential can exist for impacts caused by infiltrated stormwater, such as increased water to landslide areas or fill slopes, increased water effects in nearby closed depressions, and higher groundwater levels that may cause flooding;
- The water table must be sufficiently below the bottom of the infiltration facility (minimum 3 ft, verified by wet season monitoring) to provide adequate infiltration rates during prolonged storms; and
- Long periods of open standing water must not exceed the Port's policy on preventing wildlife attraction (see Section 3.1.2).

Site Investigations

Based on the location of detention ponds C, D, and G, three immediately adjacent sites (defined as Infiltration Areas 1, 2, and 3; see Appendix F) were identified as potential sites for infiltration of water discharged from the detention ponds and/or vaults on the airfield. The footprints of detention ponds C, D, and G were also considered for potential infiltration capacity (see Figure 6-1). In addition, infiltration testing was conducted at and adjacent to the site of Pond F (Walker Creek watershed). Infiltration testing was conducted along with collection of soils and groundwater data to establish the feasibility of infiltration in these areas. Again, infiltration facility requirements were established based on those contained in the King County Surface Water Design Manual.

Infiltration Areas 1 and 3 were found to be suitable for stormwater infiltration. Infiltration Area 2 and Pond G were deemed unacceptable due to low permeability soils and/or high groundwater levels. Ponds C and D were also deemed unacceptable based on the presence of groundwater seepage. The Pond F site and adjacent area north of Pond F was deemed unacceptable for stormwater infiltration due to saturated till conditions. Additional information on the site investigations is provided in Appendix F.

Infiltration Rates

The soils in both Infiltration Areas 1 and 3 were characterized as silty fine to medium sands. The locations tested exhibited moderate to high infiltration capacities. Specifically, Area 1 capacities ranged from 4.6 to 20.4 in/hr; Area 3 capacities ranged from 0.94 to 7.5 in/hr. Assuming a nominal 400 lineal ft of an 8-ft wide infiltration trench for both areas, and design infiltration rates of 4.2 in/hr and 2.7 in/hr respectively, Area 1 can be expected to infiltrate 0.30 cfs of stormwater, and Area 3 can be expected to infiltrate 0.20 cfs of stormwater. Additional information on site tests can be found in Appendix F.

Wildlife Attraction

As previously stated, the Port has established a policy restricting the duration of open water at stormwater detention facilities to 24 hours following a 2-year runoff event. Because infiltration facilities must retain water within the facility to allow water to infiltrate into the ground, the duration of water storage in an infiltration facility could be much greater than that in a detention pond. Therefore, infiltration facilities present a greater design challenge. To create an infiltration facility that meets the Port's policy on wildlife attractants, infiltration ponds would need to be covered with a permanent net or structural cover, or constructed in vaults or trenches.

6.2.1.3 Acquisition of Water Rights on Miller Creek

As a mitigation measure to offset potential baseflow impacts, the Port will cease the exercise of existing water rights along Miller Creek, thereby eliminating these withdrawals and improving baseflows. These surface water rights will be acquired during private property acquisition along Miller Creek for the Third Runway project. These surface water rights were originally issued to allow property owners to divert flow from Miller Creek for domestic use, lawn and yard watering, and irrigation. The detailed analysis of the benefits of ceasing withdrawals from the creek is provided in Appendix G.

Based on water rights records obtained from Ecology, at least 17 residential properties, and one farm property with recorded surface water right certificates or claims exist along Miller Creek. Properties with water right permits or certificates can legally divert water from Miller Creek. Five additional farm properties below Lake Reba were also identified that could potentially divert water from Miller Creek but for which a registered water right or claim could not be found. Nevertheless, it was initially assumed that all of these properties could actively divert surface water from Miller Creek, thereby creating an impact to baseflows. However, in an attempt to verify this assumption, individual property owners were contacted to ascertain their actual water withdrawal practices from Miller Creek. Nineteen of the 23 property owners responded. The majority of these did not withdraw any water from the creek, regardless of their right to do so. For the four non-respondents, water withdrawal rates were estimated based on property size and potential water use.

Using this information and the stated assumptions, the estimated total quantity of water withdrawn by the identified water rights holders and other users was estimated to be 0.042 cfs.

6.2.1.4 Baseflow Augmentation in Des Moines Creek

The 1997 Des Moines Creek Basin Plan recommended that a well and pump system be constructed near South 200th Street to mitigate existing low baseflow impacts in Des Moines Creek (Des Moines Creek Basin Committee 1997). The flow augmentation to the stream would help the existing poor water quality conditions in the stream during the late summer, when low flow rates contribute to elevated temperatures and lowered dissolved oxygen levels.

The water for this project will come from an existing Port-owned well located within the Tyee Valley Golf Course. Cool, high quality water from a deep aquifer will be drawn from the well and aerated by discharging it onto a rock pile before it enters the stream. This water should improve the

current water quality conditions in the stream and may also improve downstream fish habitat conditions. The basin plan recommended that the augmentation system supply up to 400 gpm (about 0.8 cfs) of water from the well to the stream for several weeks during the normal summer low-flow period.

Streamflow data recorded in 1996 and 1997 (King County 1997) indicate that late summer flow rates in the stream below the confluence of the east and west branches drop to about 0.3 to 0.5 cfs. Based on a potential well supply of 0.8 cfs, flow augmentation should prevent streamflow levels from dropping below 1.0 cfs.

The baseflow augmentation system would probably be operated by an automated stream gage on Des Moines Creek at the location where King County currently operates a gage. The County gage is located at a concrete weir a short distance north of South 200th Street. Permanent instrumentation would be installed at that site to operate the flow augmentation system. The pump system would be turned on when the streamflow drops below 1.0 cfs. The system could also be set to pump cool groundwater to the stream when temperatures exceed a critical level. Initially, the critical water temperature would be set at 19°C, which was about the maximum water temperature in lower Des Moines Creek in 1996 (upper Des Moines Creek reached 20.5°C). The pumping rate would have different levels so that flow augmentation could be ramped up as the streamflow drops or as the temperature increases. Additional streamflow measurements should be conducted to confirm the late summer flow rates, and tests should be conducted after the facility is installed to evaluate the benefits of different pumping rates on instream temperature and dissolved oxygen levels.

The Des Moines Creek Basin Committee will be responsible for implementing the plan, as provided in the Des Moines Creek Basin Plan. However, the Port will work with the Des Moines Creek Basin Committee to ensure that the flow augmentation project is implemented once the Section 401 Water Quality Certification for the Third Runway is issued. Ecology has indicated its support of this project.

6.2.2 Retrofit of Stormwater Detention for Existing Airport Areas

As previously discussed, stormwater impacts from existing airport areas will be mitigated by proposed detention ponds and vaults. In addition, the entire airport will be retrofit to the theoretical basin development condition with the proposed detention facilities. However, the Port will continue participation in constructing regional stormwater detention facilities. Miller Creek Detention Facility expansion and the proposed Des Moines RDF would reduce peak flows and durations, and achieve stable and non-degrading flow regimes in Miller and Des Moines Creeks. If the facilities are expanded (MCDF) or constructed (RDF), the Port would reduce detention volumes to meet the Enhanced Level 1 or other applicable standard. Regional detention facilities provide stormwater detention storage needed to retrofit the airport to pre-developed conditions (as defined in Section 2.1).

6.3 CONSTRUCTION SCHEDULE

The MPU improvements would be constructed over a period of approximately 10 years. The goal of the scheduling analysis is to verify that stormwater detention requirements for the MPU

improvements are met during the period of MPU development. Prior to build-out, some MPU improvement projects may be built before certain stormwater detention facilities are in place. Thus, MPU improvement project implementation must be tracked on a yearly basis to verify that individual projects do not cause peak flows to increase at the stormwater outfalls, and to approximately schedule the construction of stormwater detention as needed.

Table A-3 in Appendix A shows the schedule of required start and completion dates of the principal MPU improvements that will require stormwater detention, the stormwater detention facilities that will serve those projects, and estimated dates when detention facilities would be required to be on-line. This schedule identifies when the stormwater detention facilities should be constructed so that MPU improvements have the detention available at the appropriate time. Construction of these facilities must be phased such that they are on-line before construction commences on the new impervious areas they would serve. Since multiple MPU improvements could be served by a single detention facility, certain detention facilities may need to be constructed several years before construction begins on the principal MPU improvement slated to use that facility.

6.4 OTHER KING COUNTY MANUAL REQUIREMENTS

6.4.1 Flood Analysis

The MPU improvements encroach into the 100-year floodplain in two locations on Miller Creek: the Vacca Farm restoration site and the MSE Wall location. At the Vacca Farm, Miller Creek will be relocated and 8,455 cubic yards of floodplain storage will be displaced with fill for the relocated 154th Street. This lost storage will be mitigated by excavating 9,589 cubic yards of new floodplain. The effects on 100-year flood elevations are discussed in detail in Appendix J. No floodplain impacts have been identified at Vacca Farm or at the proposed MSE wall site (Appendix J).

6.4.2 Downstream Analysis Impacts

Evaluation of downstream analysis impacts for Miller, Walker, and Des Moines Creeks are discussed in Appendix P.

6.4.3 Conveyance System

Proposed stormwater conveyance figures are included in Appendix Q. These design drawings are subject to revision as the SMP if further refined and designs of MPU improvements and stormwater facilities are finalized. Energy dissipation design criteria and parameters are included in Appendix W.

6.4.4 Restricting Public Access to Ponds with Steep Slopes

The airport's perimeter security fence will restrict public access to stormwater ponds. Ponds not included in the airport's security area will have slopes less than 3:1 or will be fenced.

7. FUTURE STORMWATER QUALITY

This section discusses structural and nonstructural treatment BMPs for pollution-generating surfaces as they will be configured under future conditions. For purposes of this discussion, the areas and BMPs are organized as follows:

- Structural BMPs for SDS pollution-generating impervious surfaces: Section 7.1;
  - New development impervious surfaces: Section 7.1.1
  - Redeveloped surfaces: Section 7.1.2
  - Existing areas in compliance: Section 7.1.3
  - Retrofitted surfaces: Section 7.1.4
  - Existing surfaces not practicable for retrofitting: Section 7.1.5
- Non-pollution-generating impervious surfaces: Section 7.3;
- Roof Tops: Section 7.4;
- Industrial Wastewater System: Section 7.5; and
- Pervious Surfaces: Section 7.6.

7.1 STORMWATER DRAINAGE SYSTEM WATER QUALITY TREATMENT BMPS

This section describes water quality treatment BMP implementation for new development, redevelopment, and retrofitted areas in the SDS. In keeping with the standards described in Section 2.2, the Port plans to implement BMPs according to the following schedule (see Figure 7-1 for BMP implementation):

1. In all new SDS subbasins (SDW1A, SDW1B, SDW2, and SDN3A) and existing subbasins that will be 100 percent redeveloped (e.g., SDS6 and SDS7) for MPU improvements, implement treatment BMPs in accordance with the King County Manual.
2. For all portions of existing SDS subbasins that will be partially redeveloped as part of MPU improvements, implement BMPs in those areas. BMPs shall comply with the King County Manual.
3. For portions of existing subbasins that are anticipated to be redeveloped as part of non-MPU improvements within the next 20 years (e.g., the North Air Terminal), implement BMPs during those redevelopment actions.
4. For portions of existing subbasins that are not anticipated to be redeveloped:
   a.) if already in compliance, nothing is proposed; or
   b.) if not in compliance and retrofitting is practicable, install BMPs; or
   c.) if not in compliance and retrofitting is not practicable and water quality monitoring has indicated actions may be needed, evaluate the application of new or experimental BMPs (see Section 7.1.5).
5. For non-Port PGIS draining to Port outfalls, nothing is proposed by the Port.

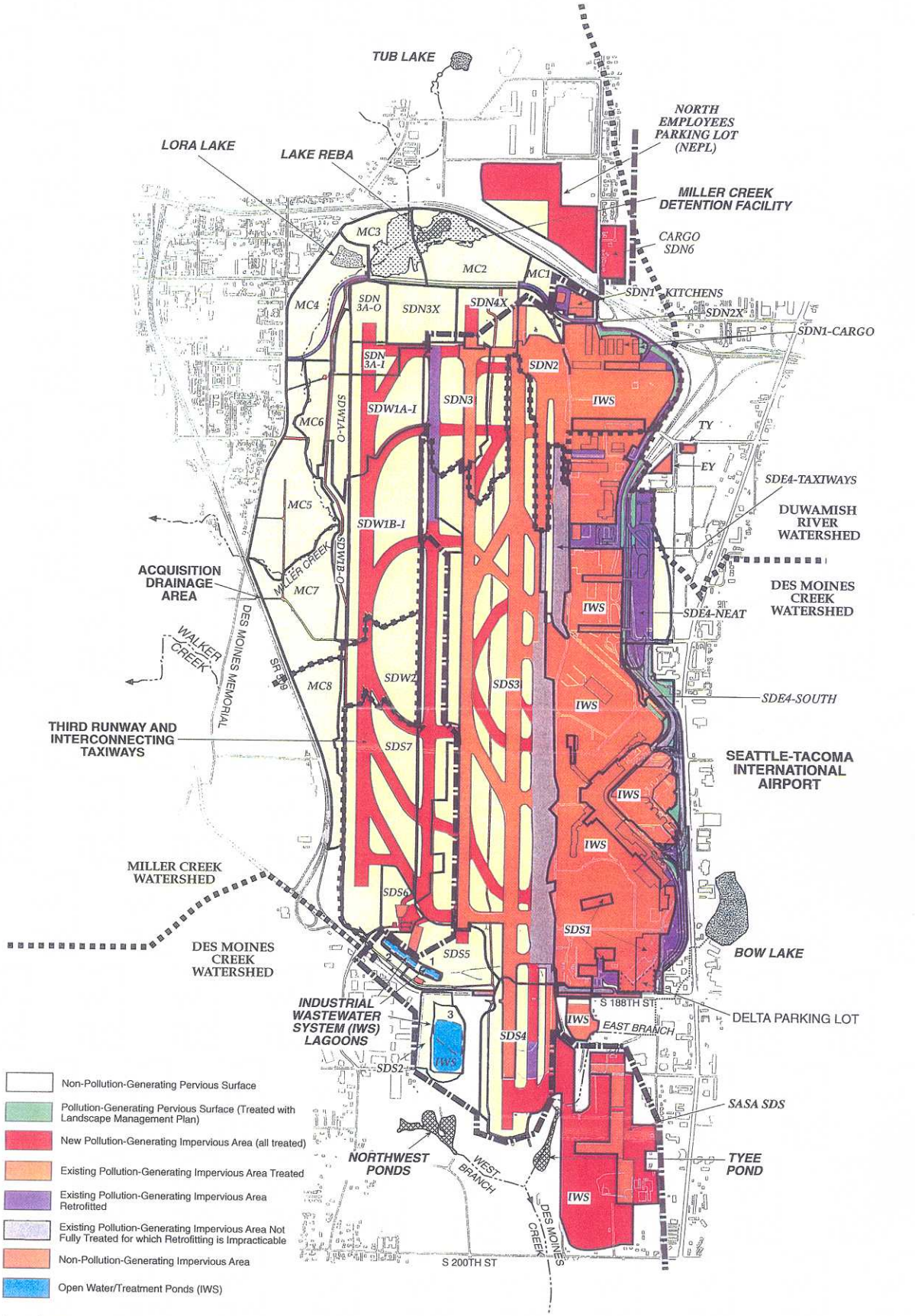

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Figure 7-1
Water Quality Treatment for New and Retrofitted Surfaces

Treatment BMPs for new development and redevelopment areas will be applied in accordance with the King County Basic Water Quality Menu.

Water quality treatment facility designs described in the following sections are conceptual, and are based on preliminary project information. They are intended to demonstrate the Port's capability to provide treatment BMPs for these areas. Other treatment options may be used at the Port's discretion. Final design will comply with the King County and Ecology Manuals.

7.1.1 Treatment BMPs for New Development

7.1.1.1 Third Runway and Connecting Taxiways

Construction of the new Third Runway and connecting taxiways (Figure 5-1) will add approximately 50 acres of pervious (grass infield) surface and 156 acres of impervious surface area to the STIA SDS. As shown in Figure 5-2, these areas will drain to Miller Creek via two new SDS outfalls (SDW1A and SDW1B), Walker Creek via a new outfall (SDW2), and to Des Moines Creek via an existing outfall (SDS7).

Water quality for the Third Runway drainage is expected to be similar to that measured in subbasin SDS3 in recent years. Subbasin SDS3 consists almost exclusively of runways, taxiways, and grass infields. As discussed in Section 4.5.2, stormwater from this subbasin is generally less polluted than regional and national urban stormwater.

Filter strips will treat stormwater runoff as it drains directly from new impervious areas of the runway and taxiways. After draining through filter strips, runway and taxiway drainage will be conveyed via pipes to the detention vaults or ponds prior to discharge to Miller or Des Moines Creeks.

Required filter strip length was conservatively calculated for the greatest width of pavement measured from the crown, which occurs at runway-taxiway intersections. At these locations, flow travels from the shoulder-pavement crown, diagonally across the runway, and partially along the taxiway before sloping off to the filter strips. The total flow path distance is approximately 300 ft (Appendix H). Relevant area and flow parameters for a 1-acre section of Taxiway are given in Table 7-1. Filter strip size calculations are provided in Appendix H.

Table 7-1. Water Quality BMP design parameters, Third Runway and connecting taxiways.

Parameter	Value
IWS Area (acres)	0
SDS PGIS (acres)	156
SDS Non-PGIS (acres)	0
PGIS Treatment BMPs	Filter strips
Water Quality Design Storm Flow	0.31 cfs per acre
BMP Size	Required filter strip length is 34 ft. Actual filter strip length is at least 75 ft on straightaways and 34 ft on connecting taxiway sections.

For the widest sections of taxiways, the minimum required filter strip length will be 34 ft (for filter strips, as with bioswales, *length* is the dimension parallel to the flow path). This size will provide the 9-minute hydraulic residence time required by the King County Manual. For other taxiway and runway sections, the flow path will be smaller, and therefore the minimum strip length will be less than 34 ft. As previously noted, the actual filter strip widths in most locations will be substantially greater than the minimum required width; average filter strip width for straight sections of the Third Runway and taxiways will typically be at least 75 ft on straightaways and 34 ft on connecting taxiway sections.

7.1.1.2 The South Aviation Support Area

The proposed SASA will be constructed in areas occupied by portions of the Tyee Valley Golf Course and the South Employee Parking Lot (see Figure 5-1). The SASA will create a total of approximately 93 acres of new impervious surface, including roof tops, apron, taxiways from runway 34R, and vehicle parking.

All apron areas at SASA (approximately 58 acres) will drain to the IWS. The hangar roof tops in the SASA (15 acres) will drain to Des Moines Creek via the new SASA detention pond;[16] as non-PGIS, the roof tops are not anticipated to have an adverse effect on stormwater quality (see Section 7.4). Parking areas would comprise the only PGIS draining to the SDS, and would be treated by bioswales before discharging to the new detention pond.

The SASA PGIS area was divided into subareas A through D (Appendix H). Relevant area and flow parameters for SASA are given in Table 7-2. Bioswale size calculations are provided in Appendix H.

Table 7-2. Water quality BMP design parameters, SASA.

Parameter	Value
IWS Area (acres)	58.4
SDS PGIS (acres)	17.8
SDS Non-PGIS (acres)	16.7
PGIS Treatment BMPs	Bioswales
Water Quality Design Storm Flow	5.03 cfs
BMP Size	Eight bioswales each approximately 255 ft long, width 7.0 ft to 8.4 ft

Each subarea would drain to a bioswale approximately 255 ft long (Appendix H). Bioswale widths would vary from 7.0 to 8.4 ft, depending on each subarea's drainage area. These swales would provide at least the 9-minute hydraulic residence time, per the King County Manual.

[16] Stormwater runoff from SASA may be discharged directly to Des Moines Creek after water quality treatment. The SASA pond will then be designed to over detain stormwater upstream of the SASA discharge points, thereby mitigating flow impacts from SASA.

7.1.1.3 North Employee Parking Lot

The NEPL, completed in 1998, added 29 acres of new impervious surface to a previously undeveloped area north of SR 518. The NEPL drains to an 18-ft-wide (20-ft bottom width minus 2-ft earthen divider) by 200-ft-long bioswale, installed downstream of the NEPL detention vault (Appendix H). Sizing calculations for the bioswale are provided in Appendix H and summarized in Table 7-3. All PGIS will be treated per the requirements of the King County Manual.

Table 7-3. Water quality BMP design parameters, NEPL.

Parameter	Value
IWS Area (acres)	0
New SDS PGIS (acres)	29.0
SDS Non-PGIS (acres)	0
PGIS Treatment BMPs	Bioswale
Water Quality Design Storm Flow	2.96 cfs
BMP Size	Bioswale 200 ft long, width 18 ft

7.1.1.4 North Safety Zone

The north safety zone consists of an unpaved apron at the north end of the Third Runway. The embankment for the safety zone will be constructed on areas currently occupied by South 154th Street and open STIA property. This project area will have no new impervious surfaces (and no pollution-generating pervious surfaces); thus, water quality treatment is not necessary.

7.1.1.5 South 154th Street

South 154th Street will be relocated approximately 500 ft north to allow construction of the Third Runway and the safety areas for runways 16R and 16L. The existing road area will increase only slightly, from 5.8 acres to approximately 5.9 acres of impervious surface (the total impervious area draining to the new water quality facilities will be approximately 6.2 acres). The existing road surface is untreated.

The South 154th Street relocation will be constructed by the Port, and will be owned and maintained by the City of SeaTac. Preliminary designs call for drainage to four bioswales located along the new roadway (Appendix H). Preliminary BMP design for the project is presented in Appendix H and summarized in Table 7-4. All PGIS will be treated per the requirements of the King County Manual.

Table 7-4. Water quality BMP design parameters, South 154th Street.

Parameter	Value
IWS Area (acres)	0
SDS PGIS (acres)	6.2
SDS Non-PGIS (acres)	0
PGIS Treatment BMPs	Bioswales
Water Quality Design Storm Flow	0.11 cfs, 1.0 cfs, 1.40 cfs, 0.16 cfs
BMP Size	2 x 135 ft, 9 x 180 ft, 8 x 300 ft, 3 x 200 ft

7.1.1.6 North Cargo Area

Cargo handling facilities (freight terminal buildings, warehouses, and parking lots) will be constructed north of SR 518 and east of 24th Avenue South. The project will create approximately 8.1 acres of new impervious surface, approximately 4.3 acres of which will be PGIS. The area is currently undeveloped.

Although the footprint for the North Cargo Area is defined (Figures 5-1 and 6-1), no plans exist for the area layout. BMP design for the area is conceptual.

The North Cargo Area will drain to a detention vault that will serve both PGIS and non-PGIS. A bioswale was conservatively sized for pre-detained flows from PGIS areas only (pre-detained flow rates from PGIS areas will exceed combined detained flow rates).

Sizing calculations for the bioswale are provided in Appendix H and summarized in Table 7-5. All PGIS will be treated per the requirements of the King County Manual.

Table 7-5. Water quality BMP design parameters, North Cargo Area.

Parameter	Value
IWS Area (acres)	0
New SDS PGIS (acres)	4.3
SDS Non-PGIS (acres)	3.8
PGIS Treatment BMPs	Bioswale
Water Quality Design Storm Flow	1.29 cfs
BMP Size	2 bioswales 254 ft long, width 7.7 ft

7.1.2 Treatment BMPs for Redevelopment Projects

7.1.2.1 South Terminal Expansion Project

The South Terminal Expansion Project will consist of hangar relocation, pavement replacement, construction of temporary baggage handling facilities, expansion of Terminal A, and reconfiguration of service areas, parking lots, and the south end of Air Cargo Road (Figure 5-1).

The ramp area improvements will continue to drain to the IWS, which provides water quality controls for high use areas. New roof surfaces, constructed with non-leaching surfaces, will drain to the SDS, which will discharge to the east branch of Des Moines Creek.

The STEP PGIS runoff could be treated by a wetvault. Relevant area and flow parameters for STEP are summarized in Table 7-6. Wetvault size calculations are provided in Appendix H.

Table 7-6. Water quality BMP design parameters, STEP.

Parameter	Value
IWS Area (acres)	1.6
New SDS PGIS (acres)	9.1
SDS Non-PGIS (acres)	5.1
PGIS Treatment BMPs	Wetvault
Mean Annual Storm Runoff Volume	13,900 cf
BMP Size	41,700 cf

Based on the preliminary STEP layout, the wetvault volume will be 41,700 cf. The wetvault location and details are provided in Appendix H. The wetvault will be placed at the south end of the Air Cargo Road realignment. The wetvault will be located on the west side of the new roadway to avoid interference with the proposed South Access Freeway lanes. The proposed vault will be relatively long and narrow to allow placement parallel to the roadway and Aircraft Operating Area fence line. Use of a wetvault is conceptual. Other BMPs, such as bioswales, may be used instead of wetvaults in accordance with the King County and Ecology Manuals.

7.1.2.2 North End Air Terminal

The area north of South 170th Street (including the Doug Fox parking lot, north entry and exit freeways, and air cargo areas) is planned to undergo substantial redevelopment as part of the North End Air Terminal (NEAT) project. The NEAT will add new passenger terminal and ground transportation facilities. Although no schedule has been set for NEAT development, it is anticipated to commence near the completion of the Master Plan Update.

The NEAT project is not an MPU project. The project design and drainage network layout have not progressed to a stage where BMPs could be sized for specific areas. However, the projected footprint of the area (SDE4 north of South 170th Street, excluding SDE4 Taxiways) can be used to estimate the total size of BMPs needed to serve the area. For a conservative estimate, BMP size was estimated for the area without detention.

Based on the unit BMP size estimate (discussed in Section 4.5.1), the NEAT's 35 acres of PGIS will require approximately 14,400 square ft of bioswales (new and existing) and 92,200 cf of wetvault (new).

Most pervious surfaces within the NEAT area would likely be classified as PGPS. Treatment for these areas would be provided via a landscape management plan (Section 7.6 and Appendix I).

7.1.2.3 South Link Freeway

The South Link connector will be the northerly freeway section of the South Access Road constructed between the south end of the passenger terminal and South 188th Street. It will be built approximately along the existing alignment of Air Cargo Road south of the terminal.

Similar to NEAT, design for the South Link Freeway between South 188th Street and the south end of the terminal has not progressed to a stage where BMPs could be designed for specific areas of the project. BMP size was estimated for the project based on the unit BMP size estimate described in Section 4.5.1.

The South Link Freeway's 8.8 acres of PGIS could be treated by approximately 40,600 cf of wetvaults. Most pervious surfaces within the South Link Freeway area would likely be classified as PGPS. Treatment for these areas would be provided via a landscape management plan (see Section 7.6 and Appendix I).

7.1.2.4 Delta Parking Lot

The Delta Parking Lot currently discharges to undesignated storm drains. The parking lot is not currently served by treatment BMPs. All PGIS in this subbasin is anticipated to be diverted to the IWS as part of the South Terminal Expansion Project. If any PGIS remains in the subbasin, it will be treated by BMPs in compliance with King County and Ecology Manual requirements.

7.1.2.5 ASR Site

The ASR site will redevelop former residential property to construct a radar tower and control building. The rooftop will be constructed with non-pollution-generating materials (no bare metal). Equipment and vehicle access on both the gravel and paved surfaces will be only for infrequent maintenance and repair (no more than four times per week). Thus the surfaces are not PGIS, and no water quality treatment is required.

A 1000-gallon fuel tank will be installed on the ASR site for emergency power generation. Because the tank is double-walled, the Ecology Manual does not require separate containment. As required by the Ecology Manual, the tank's fill connection is fitted with overfill/spill control features (see detail drawings in Appendix Y). Leak detection features are also included. Less than 1000 gallons of fuel would be transferred within any year, therefore the site does not meet the King County Manual "high-use" threshold requiring oil controls.

7.1.3 Existing Areas in Compliance with Treatment Requirements

Several subbasins and portions of subbasins have BMPs in compliance with the King County Manual. The analysis of these areas, discussed in detail in Section 4.5.1, is summarized in Table 7-7.

Portions of these fully treated existing areas will be redeveloped. Any redevelopment of the above areas will be designed and constructed to result in full treatment of PGIS to the maximum extent practicable.

Additionally, the NEPL, a Master Plan project completed in 1998, has full treatment of all PGIS, as described in Section 7.1.1.3.

Table 7-7. Summary of existing areas in compliance with water quality treatment BMP requirements.

Area	Existing Treated Land Use	PGIS Treated	BMPs
SDN1-Kitchens[a]	Parking lot	0.7	Treatment wetland, bioswale
SDN3	Runway and taxiways	24.7	Filter strips
SDN4	Runway and taxiways	9.0	Filter strips
SDE4-Taxiways[a]	Taxiways	4.6	Filter strips
SDE4-NEAT[a]	Parking lot	2.9	Bioswale
SDS3[a]	Runway and taxiways	190.0	Filter strips
SDS4	Runway and taxiways	32.3	Filter strips
SASA area[a]	Construction staging area	17.6	Bioswale

[a] The areas reflected in this table represent the treated portion of the PGIS in these areas. Some existing PGIS in these areas is untreated. Treatment of untreated portions of these areas is discussed in Sections 7.1.1, 7.1.2, 7.1.4, and 7.1.5.

7.1.4 Treatment BMP Retrofitting

Additional BMPs were identified to provide runoff treatment to the maximum extent practicable for subbasins where existing BMP coverage is not consistent with the Ecology Manual (Table 7-8). The proposed additional BMPs were selected and sized based on best available information. These BMPs were identified to demonstrate the Port's ability and intent to provide treatment BMPs per the implementation plan described at the beginning of Section 7.1.

7.1.4.1 Subbasin SDN1

An existing bioswale provides full treatment for approximately 0.7 acre of the flight kitchen parking lots north of South 154th Street. Approximately 6.8 acres of PGIS in subbasin SDN1 are currently partially treated or untreated.

As shown in Appendix D, a detention vault will be constructed to detain runoff from subbasin SDN1, with a volume of approximately 5.6 acre-ft and a footprint of approximately 22,000 square ft. Subbasin SDN1 will be retrofitted for water quality treatment by constructing a wetvault combined with the detention vault. The approximate wetvault volume required to treat this area would be calculated as follows (formula given for land use types found in subbasin SDN1; note that 0.27 acre of airport fill was included in the till grass area):

$$\text{Volume} = 3^* [(0.9 * A_{impervious}) + (0.25 * A_{till\ grass}) + (0.01 * A_{outwash})] * (R/12)$$

Where:

R = rainfall from mean annual storm (inches)
All areas in square ft

$$\text{Volume} = 3^* [(0.9 * 576{,}700) + (0.25 * 97{,}600) + (0.01 * 267{,}500)] * (0.47/12)$$

Volume = 64,200 cubic ft

Four ft of dead storage plus 1 ft of sediment storage within the footprint of the detention vault would provide more than this volume and would meet minimum and maximum wetvault depth requirements (with baffle and other design requirements also included).

The Port will implement the above alternative, or another alternative that will provide treatment for all PGIS in subbasin (SDN1).

7.1.4.2 Terminal Drives

Based on the volume of vehicle traffic and the traffic use pattern (idling, stop-and-go traffic) on the Upper and Lower Terminal Drives (approximately 2.0 acres), the area meets the intent of the King County Manual definition of a high-use site. Therefore, oil control BMPs in compliance with the King County Manual will be applied to drainage from the Terminal Drives. The Terminal Drives will be diverted to the IWS. As discussed in Section 4.5.3, the IWS meets the oil-control treatment requirement for high-use sites. However, should diversion to the IWS be unfeasible, oil control facilities will be installed per the King County Manual (coalescing plate oil-water separator or equivalent).

7.1.4.3 South Satellite Canopy

Stormwater monitoring in subbasin SDS1 indicated that approximately 0.6 acre of area under the building overhang at the South Satellite Terminal may have been contributing types and quantities of pollutants more appropriate for drainage to the IWS. Therefore, the entire south Satellite SDS area was diverted to the IWS in 2000. The 0.6-acre SDS area under the overhang could not be effectively separated from the roof drainage; thus, the entire South Satellite SDS was diverted.

7.1.4.4 Alaska Airlines Parking

The Alaska Airlines Parking Lot (approximately 2.0 acres) is currently untreated. The area, which is part of subbasin SDS1, drains to South 188th Street. A bioswale (approximately 1,500 square ft) would be installed along the vegetated strip of South 188th Street.

7.1.5 Areas Not Practicable for Retrofitting

The Ecology Manual states that the minimum stormwater requirements (including water quality treatment) shall be implemented to the maximum extent practicable for the entire site.

As described in Sections 7.1.1 through 7.1.4 above, water quality treatment will be implemented for the majority of the SDS, via treatment BMPs installed concurrently with new development or redevelopment, or installed solely as a retrofit. However, as described below, retrofitting of approximately 35.4 acres of subbasin SDE4 and 44.6 acres of subbasin SDS3 with conventional treatment BMPs would be impracticable, requiring extensive disturbance of complex drainage areas not scheduled for redevelopment (Figure 7-1). Retrofitting these fully developed existing areas would require the use of wetvaults. The total cost to retrofit these areas would be approximately $15 million (Appendix M). The Port will continue to evaluate the need for and use of innovative

treatment BMPs to treat portions of SDS3 and SDE4 taxiways. These BMPs would be used where practicable and cost-effective.

If future redevelopment in SDE4 or SDS3 takes place, BMPs will be installed for the redeveloped areas as required by the Ecology and King County Manuals. Source control BMPs will continue to be used for all subbasins, as described in Table 7-10 and the STIA SWPPP (Port of Seattle 1998a).

As described in Section 6.2, peak flow retrofitting will be implemented for 100 percent of STIA's stormwater drainage system.

7.1.5.1 SDE4-South

This area is a part of subbasin SDE4 containing portions of the airport entry and exit freeways and ramps, and a portion of Air Cargo Road. Within this basin, treatment for 8.8 acres of PGIS will be installed with the redevelopment of the South Access Freeway. The Upper and Lower Terminal Drives (approximately 2 acres), which lie within SDE4, are determined to be a high-use area, and will be diverted to the IWS (see Table 4.1 for IWS capacity). Approximately 21.2 acres are non-practicable for water quality treatment retrofitting, located between the north end of the South Access Freeway and South 170th Street.

The non-practicable treatment area within SDE4-South drains directly to the storm sewer trunk line that conveys runoff from approximately 123 acres of subbasin SDE4 upstream of this area. It would be difficult to isolate SDE4-South drainage from the runoff conveyed within the trunk line. Furthermore, most of the upstream area is in need of treatment through redevelopment (e.g., SDE4-NEAT) or retrofitting (e.g., SDE4-Taxiways). Therefore, for purposes of a planning-level cost estimate, if treatment were to be provided for this area, it was assumed that the treatment would also include capacity for the upstream areas.

Because the area is fully developed (exit freeway and parking lot), costs were estimated for an underground wetvault. As demonstrated in Appendix M, an approximately 550,000-cf vault would be required, at a cost of $7.2 million. Although this would defray costs of installing treatment for the upstream areas, the unit cost of treatment would be much higher to include this area. In particular, construction of the vault would be difficult due to the depth of the existing drainage pipes (approximately 16 to 18 ft below the surface) and the location of the trunk line under the exit freeway. The exit freeway would need to remain open, which would add substantial logistical constraints to construction, and a large premium on construction costs (included in "contingency" - Appendix M). Even if construction were conducted to allow the freeway to remain open, the impacts on local traffic would be severe.

7.1.5.2 Portion of SDE4-Taxiways

This is the area of subbasin SDE4 containing a portion of Taxiway A (Figure 7-1). Of this area, 4.6 acres drain to grassy filter strips adjacent to the taxiway, which provide adequate treatment. However, 14.2 acres of the taxiway in this area do not drain to grassy filter strips with sufficient width, or do not drain to grassy filter strips at all.

This area and the area downstream of its collected drainage are fully developed. To treat this area, a wetvault would be necessary. Because this area drains through SDE4-South described above, treatment costs would be included in the costs for that area. However if the SDE4-South wetvault were not constructed, and a wetvault was constructed for this area alone, the unit costs would be similar. This is because the wetvault would be installed in a cargo-handling area subject to high aircraft and ground vehicle use.

Although retrofitting with conventional BMPs is not practicable, new or alternative BMPs would be evaluated for this area as pavement panel replacement or other maintenance takes place. These BMPs could include catch basin filter inserts or similar devices that could be installed in targeted locations in the drainage system.

7.1.5.3 Portion of SDS3 Taxiways

Most of subbasin SDS3 receives adequate treatment with grassy filter strips adjacent to the runways and taxiways. However, no grassy infields exist for the SDS3 ramp and taxiways contiguous with the IWS ramp area surrounding the terminals. Approximately 44.6 acres are not practicable for treatment (see Figure 7-1).

Because the area drains to different branches of the subbasin SDS3 drainage system, treatment of this area would require four separate wetvaults (Appendix M). The estimated total cost of constructing these vaults would be $7.7 million.

Each of these vaults would be built nearly adjacent to Runway 16L/34R (the longest runway). Any work within 250 ft of a runway requires total closure of the runway during work. Due to operational requirements, this would place constraints on the hours when construction could occur. Construction of the vaults would require demolition and replacement of approximately 101,000 square ft of taxiway pavement. The above factors would add premiums to construction costs (included in "contingency" - Appendix M). Furthermore, construction would be occurring in the highest-traffic area within the entire airport, and would result in substantial impacts and delays to aircraft.

As indicated above for SDE4 taxiways, alternative BMPs will be evaluated for this area as pavement panel replacement or other maintenance takes place.

7.2 SUMMARY OF BMP COVERAGE

Upon completion of the MPU and other anticipated projects (e.g., north terminal expansion), an estimated 499.4 acres (86 percent) of the STIA SDS will have water quality treatment BMPs, out of a total SDS PGIS area of 579.4 acres (Table 7-8 and Figure 7-1). All areas except portions of subbasins SDE4 and SDS3 will be fully served by water quality treatment BMPs. Source control BMPs will be implemented for all PGIS, and regularly reviewed for additional or improved methods.

Table 7-8. Summary of proposed water quality treatment BMP coverage for STIA SDS subbasins.

Subbasin	Retrofit Category	Existing Treatment[b] (see Table 4-6)		Land Use and Activities	New or Additional Source Controls[c]	Proposed Additional Treatment					Fully Treated PGIS (ac)	PGIS Not Fully Treated (ac)
		Fully Treated PGIS[a] (ac)	PGIS Not Fully Treated (ac)			Additional Treatment BMPs[e] or Conditions	Wetvault (cf)	Bio-swale (sf)	Filter Strip (sf)	Re-route to IWS (ac)		
SDN1	4B	0.7	6.8	Air Cargo Road, cargo building rooftops, flight kitchen rooftops and parking lots. Some metal rooftops are uncoated.	Roof coating.	Approx.64,200 cf wetvault. Apply coating or install membrane on rooftops.	64,200	0	0	0	7.5	0.0
SDN2	4A	2.1	3.0	Taxiways and aircraft operating area. All PGIS in this subbasin is diverted to the IWS (up to the water quality design storm).		No additional BMPs needed.	0	0	0	0	2.1	0.0
SDN3	4A	24.7	0.0	Taxiways and runways.		Existing filter strips exceed treatment BMP requirements. No additional BMPs needed.	0	0	0	0	24.7	0.0
SDN4	4A	9.0	0.0	Taxiways.		Existing filter strips exceed treatment BMP requirements. No additional BMPs needed.	0	0	0	0	9.0	0.0
SDN6 cargo area north of SR518	3	0.0	4.1	New cargo facility. PGIS would be parking lots and loading areas.	SPC, SWP, LND, CBC, SWE	Approx. 3,910 sf bioswale.	0	3,910	0	0	4.1	0.0
MC1-MC3 S. 154th	2	0.0	3.9	Relocated S. 154th Street, constructed by the Port. After construction, will be under the jurisdiction of the City of SeaTac.	[d]	Approx. 4,890 sf bioswale for new S. 154th Street Alignment.	0	4,890	0	0	3.9	0.0
MC4-MC8 New west side buffer area subbasins	2	0.0	7.3	West side residential area to become part of STIA. Most of the area would be demolished and undeveloped. Some new commercial development.	SPC, SWP, LND, SWE	As part of future commercial development: Approx. 7,000 sf bioswale.	0	7,000	0	0	7.3	0.0
NEPL	4A	29.0	0.0	North Employees' Parking Lot, completed in 1998.		Fully treated by bioswale constructed with NEPL. No additional BMPs needed.	0	0	0	0	29.0	0.0
SDW1, SDW2 new 3RW	1	0.0	55.1	New Third Runway and taxiways.	SPC, SWP, CBC, SWE	386,000 sf filter strips for runway and taxiway areas.	0	0	385,700	0	55.1	0.0
SDE4-South south of 170th	3, 4C	0.0	32.0	Area south of S. 170th Street, including entry/exit freeway, service roads, terminal drives, parking, New South Access Freeway and Light Rail Link will be constructed.		Route Terminal drives (2 ac) to IWS. Install BMPs (likely ~40,600 cf wetvaults) for S. Access Fwy (8.8 ac) when constructed. 21.2 ac of Exit Fwy are impracticable for treatment.	40,600	0	0	2	10.8	21.2
SDE4-Taxiways taxiway area	4C	4.6	14.2	Taxiways.		Existing filter strips exceed treatment BMP requirements for 4.6 acres. Investigate use of alternative BMPs for 14.2 acres of taxiway impracticable for conventional treatment.	0	0	0	0	4.6	14.2
SDE4-NEAT NEAT area, north of 170th	3	2.9	32.1	North End Air Terminal development north of S. 170th Street. New passenger terminal and ground transportation facilities.		BMPs will be incorporated into NEAT development (likely 92,200 cf wetvaults and 14,400 sf bioswales).	92,200	14,400	0	0	35.0	0.0
Delta Parking Lot	2	0.0	3.2	Area to be redeveloped as part of STEP.		All PGIS in this basin will be diverted to IWS as part of Master Plan ramp and hangar expansion.	0	0	0	3.2	3.2	0.0
SDS1	4B	0.0	11.7	Alaska Airlines parking lot, a portion of aircraft movement area, and area under South Satellite building overhang. STEP parking.		Aircraft movement area and area under S. Satellite canopy has been routed to IWS (0.6 ac). 1,920 sf bioswale for Alaska parking lot. 41,700 cf wetvault for STEP parking.	41,700	1,920	0	0.6	11.7	0.0
SDS2	4A	0.0	0.0	Use of existing gravel parking area will be discontinued, leaving no PGIS.		No STIA PGIS will remain in this basin.	0	0	0	0	0.0	0.0
SDS3	4C	190.0	44.6	Runways and taxiways.		Existing filter strips exceed treatment BMP requirements for 190 acres. Investigate use of alternative BMPs for 44.6 acres of taxiway impracticable for conventional treatment.	0	0	0	0	190.0	44.6
SDS4	4A	32.3	0.0	Runways and taxiways.		Existing filter strips exceed treatment BMP requirements. No additional BMPs needed.	0	0	0	0	32.3	0.0
SDS5 formerly subbasin D	4A	0.0	0.0	Perimeter Road (infrequently used).		No PGIS.	0	0	0	0	0.0	0.0
SDS6 formerly subbasin B	1	0.0	1.5	New Weyerhaeuser Hangar driveway and parking lot. Perimeter Road (infrequently-used).		Convert Perimeter Road ditches to 1,440 sf bioswale or create new bioswale for roads.	0	1,440	0	0	1.5	0.0
SDS7 (new 3RW, includes former SDW-3)	1	0.0	40.2	Redeveloped area to become Third Runway and taxiways.	SPC, SWP, CBC, SWE	Construct at least 201,000 sf filter strips for runway and taxiway areas.	0	0	201,000	0	40.2	0.0
SASA	1	17.6	9.8	South Aviation Support Area. PGIS would be aircraft operation and service area and parking lots.		Aircraft operation and service area to drain to IWS. Approx. 15,300 sf bioswales to serve parking lots.	0	15,300	0	0	27.4	0.0
TOTAL SDS DRAINAGE AREA (acres)											499.4	80.0

[a] PGIS = Pollution Generating Impervious Surface, the amount of area requiring water quality treatment BMPs.

[b] Basins SDN1, SDN2, SDN3, SDN4, NEPL, and SDN6 flow to Lake Reba, which has a permanent pool volume that provides additional wetpool treatment not included in these calculations.

[c] SOURCE CONTROLS
SPC = Spill Control and Countermeasures Planning
SWP = Stormwater Pollution Prevention Planning (POS and Tenants)
SWE = Sweeping
CBC = Regular Catchbasin Cleanout
LND = Landscape Maintenance BMPs, including Integrated Pest Management

[d] These subbasins will be under the jurisdiction of the City of SeaTac. Source control operations would be performed by the City.

[e] BMP — Approx. Required Treatment/Acre
Bioswale — 960 sf
Filter Strips — 5,000 sf
Wetvaults — 4,610 cf

Ref: SWMP Dec. 2000

AR 010293

7.3 NON-POLLUTION-GENERATING IMPERVIOUS SURFACES

As described in the King County Manual, water quality treatment is not required for non-pollution-generating impervious surfaces, including, but not limited to: road shoulders used primarily for emergency parking, paved bicycle pathways, fenced firelanes, or infrequently used maintenance access roads. Most roof tops are also considered non-PGIS, as discussed in Section 7.4 below.

7.4 ROOF TOPS

The King County Manual states that metal roofs are considered pollution-generating unless they are treated to prevent leaching. Most existing roof tops at STIA are constructed of non-metallic materials. Therefore, these roof tops are considered non-PGIS, and will not require treatment. However, a limited number of existing roof tops have metal surfaces that drain to the SDS (see Figures T-1a through T-1c, Appendix T).

To be considered non-PGIS, at least one of the following practices will be implemented for each new roof top at STIA: (1) the roof top surface will be constructed with a non-metal or factory-coated metal surface to prevent leaching, or (2) runoff from the roof top will receive treatment as PGIS, with a BMP from the Basic Water Quality Menu.

The retrofitting of existing roof tops will be assessed and managed under the Port's SWPPP. This process will include the following steps:

1. Sampling and testing of stormwater will be performed at accessible locations in the SDS downstream of metal roof tops.[17] These monitoring locations will be selected to minimize runoff from other sources. At least two flow-weighted composite stormwater samples from representative storms will be analyzed for appropriate constituents and acute whole effluent toxicity (WET). Sampling and analysis will be consistent with the NPDES Permit and the *Procedure Manual for Stormwater Monitoring at Sea-Tac International Airport* (Port of Seattle, 1999c). Roof top assessments will begin prior to renewal of the Port's NPDES Permit in 2001.
2. Roof tops whose runoff does not meet Ecology's acute WET performance standards[18] will be considered PGIS. The Port will submit to Ecology a schedule for retrofitting the roof tops to eliminate or reduce the source. The Port will develop a retrofit schedule and submit it to Ecology for concurrence by the end of the next NPDES Permit cycle.[19]
3. Retrofitting will include at least one of the following:
    - Coatings or membranes: Use of a thermoplastic polyolefin or polyethylene heat-weldable membrane with characteristics similar to those described in Appendix T (data

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[17] Exempt from this sampling and testing would be any roof tops constructed with a material or finish that has been designated by King County DNR or Ecology as non-PGIS.

[18] According to WAC 173-205, for acute WET tests, the average survival in 100% effluent shall be at least 80 percent, and no single sample shall have less than 65 percent survival.

[19] Based on a four-and-one-half-year permit cycle, the next cycle would be 2002-2007.

provided for a currently-available product). However, if other coating or paint methods are demonstrated to produce runoff meeting the WET performance standard, the Port may implement these methods, with appropriate monitoring to demonstrate effectiveness.

- Treatment BMPs: Routing of roof top runoff through a Basic Water Quality Menu treatment BMP.
- Roof replacement: Replacement of roof top with a non-metal or factory-coated surface to prevent leaching (e.g., non-PGIS roof top).

The above process identified two roof tops in subbasin SDN1 that act as PGIS (Port of Seattle 2000b). The Port is implementing the process described above to control pollutants generated by these roof tops. When corrective actions are implemented, the Port will perform follow-up monitoring to verify effective pollutant control.

As discussed in Section 2.1, stormwater detention will be provided for all new and existing impervious surfaces as part of the MPU SMP, regardless of status as PGIS or non-PGIS.

7.5 IWS AKART DETERMINATION

As required by its NPDES Permit, the Port has performed an analysis and determination of all known available and reasonable methods of treatment (AKART) for handling of IWS flows (Kennedy/Jenks 1998). The Port has determined that the recommended AKART alternative is to discharge treated effluent from the IWTP to the King County DNR East Division Reclamation Plant at Renton (EDRPR). This alternative will eliminate or reduce IWS discharge to Puget Sound. IWS flows will continue to be treated by the IWTP to remove oil and grease as well as TSS before flowing to the EDRPR. The Port is negotiating with DNR to determine pretreatment standards, flow limits and timing, conveyance from the IWTP to the EDRPR, permitting, monitoring, and fees (Feldman 1999). The Port's NPDES Permit requires that the AKART recommendation must be fully implemented by June 2004. It has been submitted to Ecology for concurrence.

7.6 PERVIOUS SURFACES

STIA has both *managed* and *unmanaged* landscapes (Figure 7-1). Unmanaged landscapes are those in which there is no physical (e.g., mowing) or chemical (e.g., fertilizers, herbicides, pesticides) management. All unmanaged landscapes are considered non-pollution-generating pervious surfaces (non-PGPS). Managed landscapes require a landscape management plan or water quality treatment.

7.6.1 Managed Areas

7.6.1.1 Runway/Taxiway Infields

The runway/taxiway infield consists of a uniform grass/legume/cover crop mixture. For safe operation of the Aircraft Operation Area (AOA), landscape management is limited to mowing. Typically, no fertilizers, pesticides, or herbicides are applied to the infields nor is application anticipated or planned. A landscape management plan for the infields is provided in Appendix U.

7.6.1.2 Landscaped Areas

The Port's SWPPP for Airport Operations (Port of Seattle 1998a) and Interim Landscape Design Standards (Port of Seattle 1999b) apply to management of the following areas:

- Landscaped areas along the east side of the AOA;
- AOA fence;
- Airport drives and Air Cargo Road;
- Areas around Port/tenant facilities on the airport perimeter; and
- Emergency and fire access roads.

The Interim Landscape Design Standards and applicable sections of the SWPPP are included in Appendix I.

The SWPPP for Airport Operations is required by Special Condition S 12 B of the Port's NPDES permit. Section 3.8 of the SWPPP covers landscape activities, including chemical use, container disposal, integrated pest management, fertilizer application, weeding, pruning, and a prohibition of herbicide application near water courses. The SWPPP for Airport Operations has been reviewed and approved by Ecology. The SWPPP has been incorporated into the Port's Interim Landscape Design Standards.

The Port's Interim Landscape Design Standards (Appendix I) are part of the Regulations for Airport Construction and are used to direct landscape development by the Port and its tenants. The goals of the plan include: "promote the retention and conservation of existing natural vegetation, and reduce the impacts of development on storm drainage systems and natural habitats." These goals are accomplished by "providing increased areas of permeable surfaces which allow infiltration of storm water, reduction in the quantity of stormwater discharge, improvement in the quality of stormwater discharge, and creating more sustainable landscapes through the use of 'water wise' irrigation techniques, drought-tolerant or native plants and other water management strategies."

7.6.2 Unmanaged Areas

Areas such as the west side of the airport and the areas surrounding Lake Reba and the Northwest Ponds are unmanaged PGPS[20] – little or no mowing or landscape maintenance occurs, and no fertilizers or pesticides are applied.

7.7 OTHER ACTIONS BENEFITING WATER QUALITY

This section describes Port actions being taken to mitigate potential impacts to water quality in Miller and Des Moines Creeks that result from implementation of the MPU improvements. Proposed actions to mitigate water quality impacts include treatment and source control BMPs,

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[20] Emergency and fire access roads and corridors in these areas (mostly consisting of abandoned residential streets) are managed as described in the Port's SWPPP and landscape design standards.

receiving stream enhancement projects, and elimination of impacts via removal of some existing watershed activities.

Several existing and proposed facilities, changes in land use, and BMPs will mitigate the potential impacts of stormwater discharge from MPU improvement projects. These activities will either maintain or improve upon the beneficial uses in the Miller Creek and Des Moines Creek drainage basins. Potential beneficial uses include water supply; stock watering; fish and shellfish migration, rearing, spawning, and harvesting; wildlife habitat; and recreation. All but stock watering are known to be current or recent uses.

Mitigation activities currently in place or planned for existing and new SDS subbasins, the IWS, and the receiving watersheds are summarized in Table 7-9.

Table 7-9. Summary of Master Plan Update improvements related to water quality mitigation activities and benefits.

Action	Water Quality Benefits
Elimination of existing pollutant sources in areas to be redeveloped	Remove pollution-generating activities and land uses generally not served by BMPs, and replace with activities served by BMPs
Source controls	Presented in Table 7-10
Existing and proposed conventional water quality treatment BMPs (bioswales, filter strips, wetvaults)	Remove particulates, metals, and other constituents that bind to particulates
Pollutant removal in Lake Reba	Remove particulates and metals that bind to particulates
Flow augmentation	Increase summer low flows, with the goal of reducing stream temperatures and increasing dissolved oxygen in Des Moines Creek
Construction erosion control	Reduce sediment load to receiving waters
Snowmelt facilities	Reduce BOD (in snowmelt runoff with de-icing chemicals) that reaches receiving waters
Enhancement of wetland water quality functions (Miller Creek and Tyee Valley Golf Course wetland restoration)	Convert farmland and golf course to vegetated wetlands, removing sources of pollutants; restored wetlands will remove and uptake particulates, nutrients, metals, and other toxics from stormwater
Miller Creek buffer enhancement	Increase biofiltration of runoff flowing into the creek from riparian areas, reduce erosion and sediment supply, shade the creek to reduce stream temperatures and increase DO carrying capacity
Miller Creek stream channel restoration and enhancement	Reduce scour, erosion, and sediment supply
Level 2 hydrologic controls	Reduce scour, erosion, and sediment supply

Overall, the quality of stormwater in the watersheds is expected to either stay the same or improve because:

- The areas to be developed for the Third Runway and taxiways, which will be constructed with water quality BMPs as described in Section 7.1.1, consist largely of medium-density residential neighborhoods, farms, roads, and a golf course. Impacts associated with these existing land uses will be removed and replaced with MPU improvements, the largest portion of which will be runways and taxiways. STIA's runways and taxiways produce runoff quality with characteristics similar to, or better than, residential runoff in the Seattle metropolitan area (Section 4.5.2) and the land use change should benefit water quality.
- Existing land uses in the acquisition area generally do not have BMPs that comply with the King County and Ecology Manuals, whereas the MPU improvements replacing these areas will be served by BMPs that do comply and should thus generate runoff with pollutant loading below existing levels.
- Existing SDS subbasins will be retrofitted with water quality BMPs to the maximum extent practicable, increasing the extent of treated drainage area.

Furthermore, stream channels, buffers, and riparian wetlands in both watersheds will be enhanced and restored, which will provide additional water quality benefits. Information on each specific mitigation action and water quality benefit is provided below. A complete discussion of mitigation goals and proposals is contained in the *Natural Resources Mitigation Plan* (Parametrix 2000).

7.7.1 Removal of PGIS from Subbasins

For certain limited areas (e.g., the Upper and Lower Terminal Drives), the most appropriate BMP for runoff treatment is diversion to the IWS. SDS diversions to the IWS would be included in the implementation plans.

Roof top coatings can also convert PGIS to non-PGIS, and are included as a potential BMP (see Appendix T).

7.7.2 Elimination of Existing Pollutant Sources in Areas to be Redeveloped

The MPU improvements will redevelop existing medium-density residential neighborhoods, golf course, arterial roads, cultivated farms, and some undeveloped properties. Most of these areas had been developed before water quality treatment BMPs were required. Redevelopment of these areas will remove past cumulative impacts that are untreated by BMPs and that currently degrade water quality in Miller and Des Moines Creeks, including:

- 380 septic tanks (removing sources of fecal coliforms and excess nutrients);
- 183 underground fuel storage tanks (eliminating potential sources of petroleum pollutants);
- 29.8 acres of streets and driveways, (reducing sources of particulates, oils and greases, and heavy metals);

- 13.6 acres of cultivated farmland to be restored to floodplain and vegetated buffer (eliminating sediment and other water quality impacts normally associated with farming);
- Lawns on over 400 residential properties (eliminating potential sources of fertilizers, herbicides, and pesticides);
- 80 acres of golf course (eliminating potential sources of fertilizers, herbicides, and pesticides); and
- Approximately 17 domestic and 6 commercial agricultural water withdrawals (Appendix G).

7.7.3 Source Controls

Source controls are used throughout STIA (Table 7-10). Source controls are nonstructural measures that are intended to prevent stormwater contact with pollutants. Source identification is also an important part of source control; if elevated pollution levels or aquatic toxicity are noted, the Port undertakes an effort to trace and eliminate the source.

7.7.4 Pollutant Removal in Lake Reba

Lake Reba, a Port constructed stormwater facility, has a permanent pool that functions as a wetpond. Wetponds are water quality treatment BMPs that settle particulates out of the water column. Pollutants such as heavy metals and nutrients that sorb to particulates are also removed. Although Lake Reba does not fully meet existing wetpond design standards, it provides water quality benefits to the downstream systems.

Table 7-10. Seattle-Tacoma International Airport source control BMPs.

Activity	BMPs
Aircraft servicing	Restrict to IWS areas or block drains
	Store glycol in IWS areas
	Confine parking of lavatory waste trucks to IWS
	Identify and connect problem SDS areas to IWS
	Restrictions for fueling on taxiway Alpha
	Monitor SDS outfalls during de-icing
Aircraft Movement Area (AMA) anti-icing/de-icing	Minimize de-icing chemical use
	Use calcium magnesium acetate (CMA)/sand mixture for roadways
Snow storage	Operate pump stations to divert snowmelt to IWS
Spill control	Implement spill plan
Vehicle washing and maintenance	Prohibit vehicle washing in SDS areas
	Place signs in key locations
	Clean sumps in Taxi Yard annually
	Sweep Taxi Yard and control litter
	Maintain catch basin inserts

Table 7-10. Seattle-Tacoma International Airport source control BMPs (continued).

Activity	BMPs
AMA maintenance	Sweep pavement frequently
	Inspect catch basin sumps annually and clean as needed
	Store and dispose of sediments properly
	Construct secondary containment for used engine fluids
Inappropriate connections and discharges	Inspect outfalls for evidence of illicit connections
Temporary storage of surplus and used materials	Store liquids in approved secondary containment or IWS areas only
	Control entry of surplus materials
Landscape management (see Section 7.6)	Strive to use environmentally benign chemicals
	If landscape chemicals are used:
	Follow proper cleaning/disposal procedures
	Apply during dry periods
	Restrict use near waterways
	Incorporate BMPs into contractor specifications
	Apply herbicides/pesticides according to instructions
	Avoid catch basin grates when applying fertilizer or pesticides
	Implement Integrated Pest Management Plan
	Give priority to biological methods of pest management
	Conduct regular weeding and pruning
	Follow Ecology guidelines for herbicide application
	Trim ivy-covered areas by hand
	Fertilize shrubs and trees by hand
	Do not use beauty bark in drainage ditches
Tenant activities in SDS areas	Monitor and educate tenants on source and spill control
	De-ice aircraft according to established procedures
	Encourage drip pans beneath fueling trucks if leakage is observed
	Sweep around dumpsters
	Store liquids in secondary containment
	Do not store used fluids or hazardous waste in SDS areas
	Do not maintain vehicles or equipment in SDS areas
	Inspect catch basin grates
	Require tenant water pollution control plans
	Ensure tenant compliance with Port SWPPP
	Require tenant spill control plans

Table 7-10. Seattle-Tacoma International Airport source control BMPs (continued).

Activity	BMPs
Other operational BMPs	Evaluate operations to determine potential pollution and revise SOPs to minimize pollution
	Designate an SWPPP implementation monitor
	Conduct regular inspections
	Assemble pollution prevention team
	Conduct SDS outfall monitoring
	Sign catch basins ("dump no waste – drains to salmon stream")
	Establish packing material source control

7.7.5 Low Streamflow Augmentation in Des Moines Creek

As discussed in Section 6.2.1, the Port will work with the Des Moines Creek Basin Committee to ensure that the flow augmentation project is implemented as soon as possible. Flow augmentation would aim to reduce temperatures and increase dissolved oxygen potential during the late summer low flows.

7.7.6 Construction Erosion Control

The Port applies construction temporary erosion and sedimentation control (TESC) measures in excess of Ecology Manual minimum requirements, by:

- Planning and implementing construction SWPPPs and monitoring plans[21] for every individual MPU improvement activity (Appendix R, Attachments 2 and 3);
- Applying and monitoring conventional TESC BMPs;
- Providing advanced stormwater treatment where necessary and appropriate;
- Supervising contractor erosion control compliance with an erosion control and stormwater specialist; and
- Funding independent third-party oversight of construction erosion control and stormwater management and compliance.[22]

Potential construction impacts and corresponding mitigation activities that will reduce or eliminate the potential impacts are summarized in Appendix R. This appendix contains design drawings subject to revision as the SMP is further refined and designs of MPU improvements and stormwater facilities are finalized.

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[21] The Port's NPDES Permit requires an Ecology-approved stormwater monitoring plan for each construction project to be performed by the Port.

[22] As required by the Governor's Certificate for this project, the Port is required to hire a third party to ensure that all TESC plans are properly implemented.

7.7.7 Snowmelt Facilities

The Port recently constructed three snowmelt facilities to store melting snow from runways and taxiways that may contain de-icing chemicals. These facilities include:

- North snowmelt pump station, located just south of South 154th Street (former SDN2 drainage basin which is now diverted to IWS);
- Central snowmelt pump station, located just south of the fire station at the edge of the aircraft apron, east of the North Satellite; and
- South snowmelt pump station, located immediately west of the Olympic Tank Farm, at the edge of the Runway 34R hardstand and taxiway.

A fourth snow storage area lies within the IWS area near the Delta hangar. Melt water from these facilities drains to the IWS. This BMP is designed to reduce a potential source of BOD in SDS runoff that reaches Miller and Des Moines Creeks.

7.7.8 Enhancement of Wetland Water Quality Functions

Existing degraded wetlands in the Miller Creek and Des Moines Creek basins will be enhanced to improve water quality functions. Restored wetlands will benefit water quality by:

- Eliminating existing agricultural pollution sources;
- Increasing settling and mechanical trapping of particulates;
- Removing dissolved metals and other toxics that bind to particulates;
- Reducing and binding metals in humic material; and
- Biologically removing and uptaking nutrients.

7.7.9 Miller Creek Buffer Enhancement

The riparian buffers along approximately 6,500 linear ft of Miller Creek will be enhanced (Parametrix 1999b). Native trees, understory plants, and ground cover will replace lawns, agricultural areas, and other areas to restore buffer quality and continuity. Enhanced buffers should:

- Increase biofiltration of runoff flowing into the creek from riparian areas;
- Reduce bank erosion, and thus sediment supply, from areas directly adjacent to the creek;
- Remove potential pollutant runoff from lawns; and
- Shade the creek, which will reduce stream temperatures and increase the DO saturation concentration, which potentially increases ambient DO concentrations.

7.7.10 Miller Creek Stream Channel Restoration and Enhancement

Approximately 1,500 ft of the Miller Creek channel south of the Vacca Farm site will be restored and enhanced by repairing and re-vegetating eroding and hardened streambanks and by installing

large woody debris in the channel. These restoration activities are intended to provide water quality benefits to Miller Creek by reducing erosion and sediment supply.

7.7.11 Level 2 Hydrologic Controls

As discussed in Section 2.1, all STIA impervious surfaces draining to Miller and Des Moines creeks will have Level 2 hydrologic controls. Level 2 hydrologic controls will limit the duration of erosive flows, in turn benefiting water quality by reducing suspended solids, turbidity, and sedimentation.

7.8 STORMWATER FACILITY MAINTENANCE

Maintenance of existing stormwater facilities is covered by the *STIA Stormwater Pollution Prevention Plan* (SWPPP; Port of Seattle 1999d). Additionally, inspection and maintenance manuals exist for larger, complex facilities such as Tyee Pond and the Miller Creek Detention Facility (Parametrix 1999c). The SWPPP will be updated to provide for inspection and maintenance of new ponds and vaults, including the following procedures:

- Inspect facilities annually—check orifices, hardware, vegetation (if applicable), and sedimentation; if conditions warrant, inspect more frequently.
- Check facility outlets for signs of erosion.
- Maintain inspection records for at least 5 years.
- Remove accumulated sediment in excess of 6 inches.
- Maintain vegetation.
- Maintain facility hardware.

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COMPREHENSIVE STORMWATER MANAGEMENT PLAN

VOLUME 2—APPENDIX A

HYDROLOGIC EVALUATION OF STORMWATER DRAINAGE BASIN CHANGES AND DETENTION POND PERFORMANCE BETWEEN 1994 AND MASTER PLAN COMPLETION

SEATTLE-TACOMA INTERNATIONAL AIRPORT MASTER PLAN UPDATE IMPROVEMENTS

FOR AGENCY REVIEW

Prepared for

PORT OF SEATTLE
Seattle-Tacoma International Airport
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December 2000
556-2912-001 (28)

AR 010308

PREFACE

Comprehensive Stormwater Management Plan
Seattle-Tacoma International Airport
Master Plan Update Improvements

July 2001

This document contains replacement pages developed in response to comments received from the Washington State Department of Ecology (Ecology) on Volumes 1 through 4 of the December 2000 Comprehensive Stormwater Management Plan (SMP) for the Seattle-Tacoma International Airport Master Plan Update Improvements. A facilitated process was used to document specific revisions required by Ecology to the December 2000 SMP. Each SMP volume contains an itemized list of replacement pages, and the replacement pages are identified by a July 2001 footer.

SMP VOLUME 2

JULY 2001 REPLACEMENT PAGES

Preface (before pg. *i*)
List of Volume 2 Replacement Pages
Table of Contents (pg. A-*iii*)
Section 2.1 (pgs. A-2 and A-2a)
Figure A-1a (pg. A-2b)
Figure A-1b (pg. A-2c)
Figure A-1c (pg. A-3)
Table A-3 (pgs. A-4 through A-9a)
Figure A-2 (pg. A-10)
Figure A-3 (pg. A-12)
Figure A-4 (pg. A-13)
Figure A-5 (pg. A-14)
Figure A-7 (pg. A-21)
Table A-7 (pg. A-24)
Table A-8 (pg. A-25)
Table A-9 (pg. A-26)
Figure A-8 (pg. A-27)
Figure A-9 (pg. A-28)
Figure A-10 (pg. A-29)
Figure A-11 (pg. A-30)
ATTACHMENT A:
- Tables A-1a and A-1b (*STIA basins only*) (24 pgs.)

ATTACHMENT C:
- Cover page
- Miller Creek Watershed Detention Pond Performance Data:
  - Computation of Basic Statistics (2 pgs.)
  - SDN3A (11 pgs.)
  - SDN3/3X (12 pgs.)
  - SDN4X/2X (16 pgs.)
  - SDW1B (11 pgs.)
  - SDN1 (14 pgs.)
  - SDW1A (13 pgs.)
  - *Note: SDN6 and NEPL not included since not revised*
- Miller Creek Watershed Additional Points of Compliance Performance Data:
  - Cover page
  - SR509 (9 pgs.)
  - MCDF (10 pgs.)
  - Lake Reba (9 pgs.)
- Walker Creek Watershed Detention Pond Performance Data:
  - SDW2 (South 12th Street) (18 pgs.)
- Des Moines Creek Watershed Detention Pond Performance Data:
  - SDS7 (7 pgs.)

SMP VOLUME 2

JULY 2001 REPLACEMENT PAGES (CONTINUED)

ATTACHMENT C (CONTINUED):

Des Moines Creek Watershed Additional Points of Compliance Performance Data:

Cover Page
SDS POC-1 (8 pgs.)
SDS POC-2 (8 pgs.)
South 200th Street (7 pgs.)
Note: SASA Inline Facility Analysis not included since not revised

ATTACHMENT D:

Miller Creek Watershed HSPF Input Files:

Predevelopment Conditions (21 pgs.)
2006 Conditions (56 pgs.)

Walker Creek Watershed HSPF Input Files:

Predevelopment Conditions (9 pgs.)
2006 Conditions (10 pgs.)

Des Moines Watershed HSPF Input Files:

Predevelopment Conditions (19 pgs.)
2006 Conditions (21 pgs.)

Note: Listed page totals do not include "guidance" pages (the guidance pages do not need to be inserted as replacement pages).

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B 1998 EMBANKMENT FILL CALIBRATION DATA

C HSPF AND KCRTS SUBBASIN DETENTION POND PERFORMANCE DATA AND ADDITIONAL POINTS OF COMPLIANCE PERFORMANCE DATA

D HSPF INPUT FILES FOR MILLER, WALKER, AND DES MOINES CREEKS

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AR 010313

1. INTRODUCTION

This appendix summarizes changes made to the Hydrologic Simulation Program – FORTRAN (HSPF) hydrologic data used to model the hydrology of Miller, Walker, and Des Moines Creek watersheds with completion of Master Plan Update (MPU) improvement projects. The future project condition (2006) considered changes to the subbasin boundaries assumed in the model (but not the watershed boundaries), the effect of new embankment fill, additional impervious area, and enlarged or new detention facilities.

Section 2 discusses hydrologic data changes. The changes included subbasin boundaries, land use, impervious area, soils and wetlands, period of hydrologic record, and calibration of airport fill parameters.

Section 3 explains how detention facility design standards were determined, the assumptions made for detention planning purposes, and the basis for target flow determination to achieve preliminary design criteria. This section also compares hydrologic conditions prior to and with the proposed project.

Section 4 compares the flood frequency and flow duration at several evaluation locations within each watershed. These hydrologic analyses show the changes between the pre- and post-project conditions. The amount of detention volume required to achieve the stormwater design criteria was also determined.

Conclusions are presented in Section 5 and references are provided in Section 6.

Attachment A contains the subbasin characteristics information for Miller, Walker, and Des Moines Creek watersheds. Attachment B contains 1998 embankment fill calibration data. Attachment C contains HSPF and KCRTS subbasin detention pond performance data and additional points of compliance performance data for Miller, Walker, and Des Moines Creeks. Attachment D contains the HSPF input files for Miller, Walker, and Des Moines Creek watersheds.

AR 010314

2. HYDROLOGIC DATA

Hydrologic conditions that are expected to change between the base year (1994) HSPF model calibration period and future (2006) Master Plan Update completion period are described in this section. These changes include land use, impervious cover, soils, and wetlands. In addition, this section describes the hydrologic data used to determine target flows for the points of compliance for stormwater quantity management.

A series of figures are presented showing the future conditions in the subsequent subsections. GIS data were used to create tables that calculated the pervious and impervious land segments input data for the HSPF model. Tables A-1a and A1b (Attachment A) summarize the results and show the model land segments input data used to simulate predevelopment and future conditions for Miller and Walker Creeks. Both predevelopment and future conditions are based on the future subbasin boundaries.[1] The analysis of the land area conditions is discussed in the subsequent sections. Tables A-2a and A-2b (Attachment A) provide similar information for Des Moines Creek.

2.1 SUBBASIN DRAINAGE BOUNDARIES

Construction of the Third Runway project and diversion of stormwater to the Industrial Wastewater System (IWS) drainage network (Subbasin 2) are expected to alter the location of several subbasin boundaries (compared to their position in 1994). Figures A-1a and A-1b show the future (2006) and existing (1994) watershed boundaries and the future and existing subbasin boundaries. These figures depict the approximate location of the subbasin boundaries within the area where hydrologic conditions may change between 1994 and 2006. No major hydrologic changes are anticipated to the subbasin boundaries outside of this area. These boundaries were assumed identical to the 1994 condition used to calibrate the HSPF models. Figure A-1c shows the future watershed and subbasin boundaries for Miller, Walker, and Des Moines Creek watersheds that were used for the predevelopment and future conditions modeling described in this document.

2.2 LAND USE CHANGES

Table A-3 contains a list of the principal Master Plan Update improvement projects that will require stormwater detention, the stormwater detention facilities that will serve these projects, and estimated dates of construction.

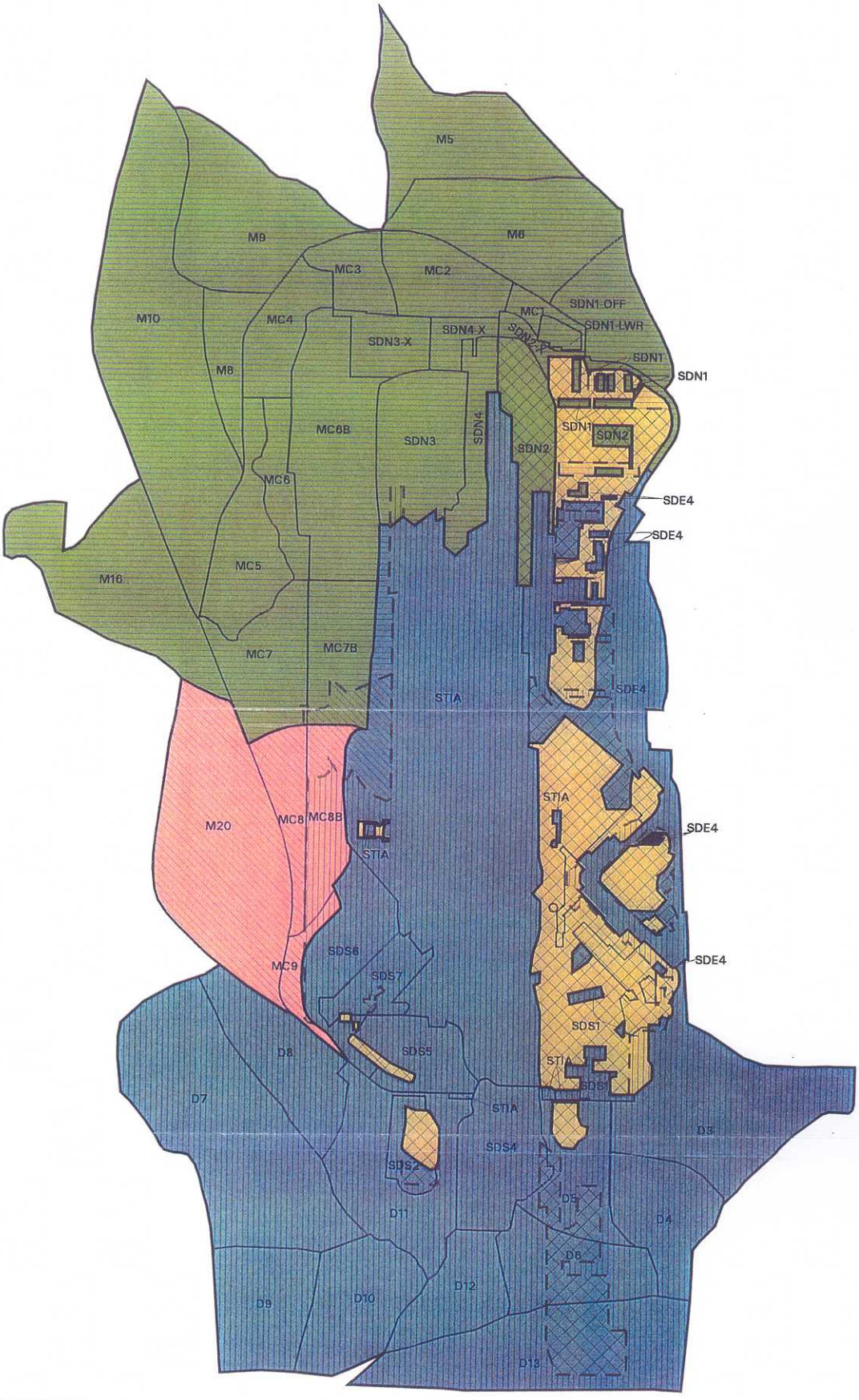
The proposed Seattle-Tacoma International Airport (STIA) drainage subbasin boundaries and future land uses that are projected based on the Master Plan Update improvement projects and preliminary drainage improvements design are shown in Figure A-2. A comparison between

---

[1] The Walker Creek predevelopment condition is referred to as MC-8B special, which is a combination of the calibrated MC-8B plus a portion of calibrated MC-7, MC-8, and MC-9. The predevelopment MC-8B special condition is compared to the SDW2 future condition.

Figures A-2 and B1-4 (contained in Appendix B) shows that the storm drain system (SDS) subbasins encompass additional areas that were not included in the 1994 drainage pattern.

AR 010316



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July 2001
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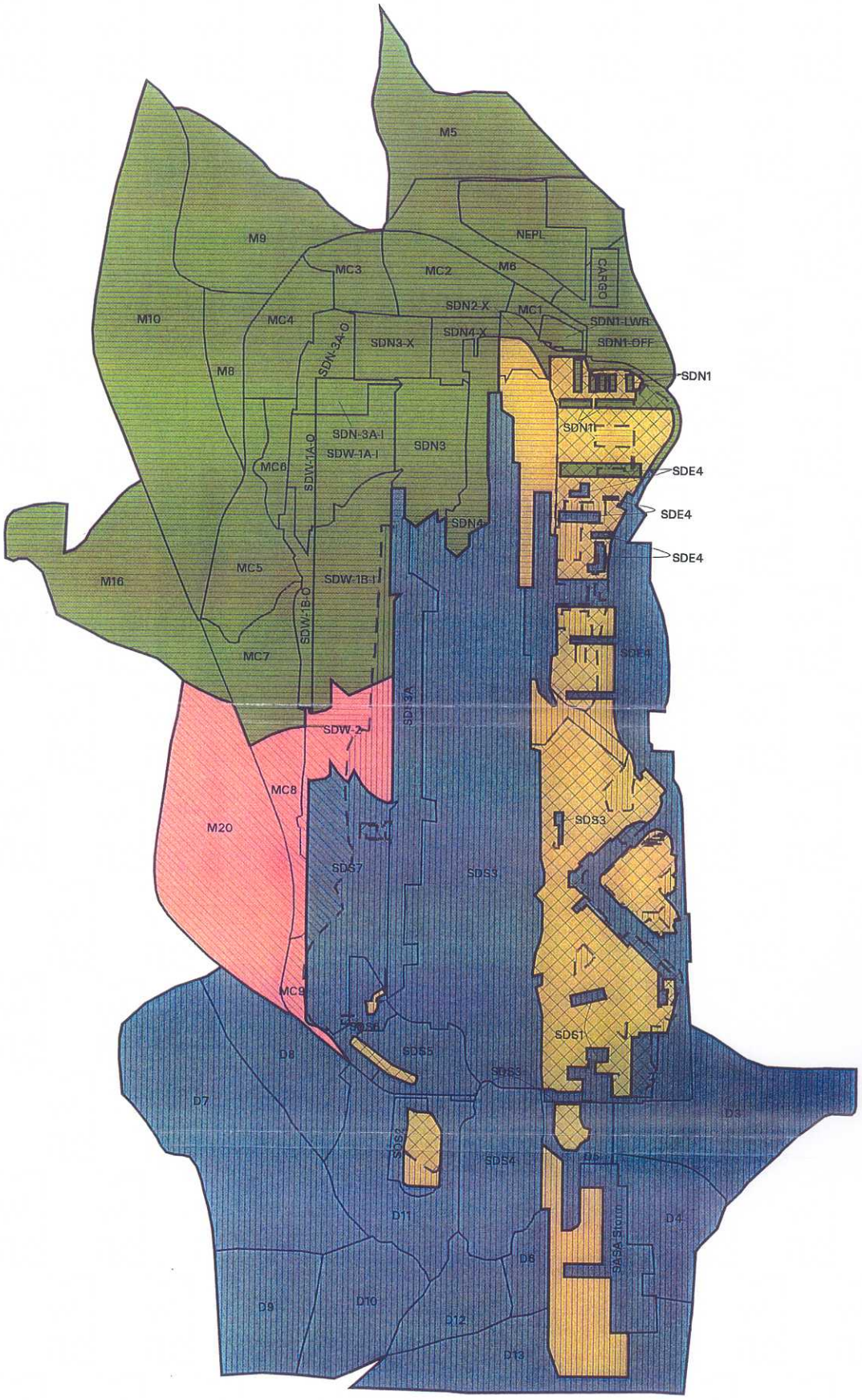
N

0 500 1000 1500

Scale in Feet

- Existing Miller Creek Watershed
- Existing Walker Creek Watershed
- Existing DesMoines Creek Watershed
- Existing IWS
- Future Miller Creek Watershed
- Future Walker Creek Watershed
- Future DesMoines Creek Watershed
- Future IWS
- Existing Watershed Boundary
- Future Watershed Boundary
- Existing (1994) Subbasin Boundary

Figure A-1a
Existing and Future Watersheds with Existing (1994) Subbasins



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N

0 500 1000 1500

Scale in Feet

- Existing Miller Creek Watershed
- Existing Walker Creek Watershed
- Existing DesMoines Creek Watershed
- Existing IWS
- Future Miller Creek Watershed
- Future Walker Creek Watershed
- Future DesMoines Creek Watershed
- Future IWS
- Existing Watershed Boundary
- Future Watershed Boundary
- Future (2006) Subbasin Boundary

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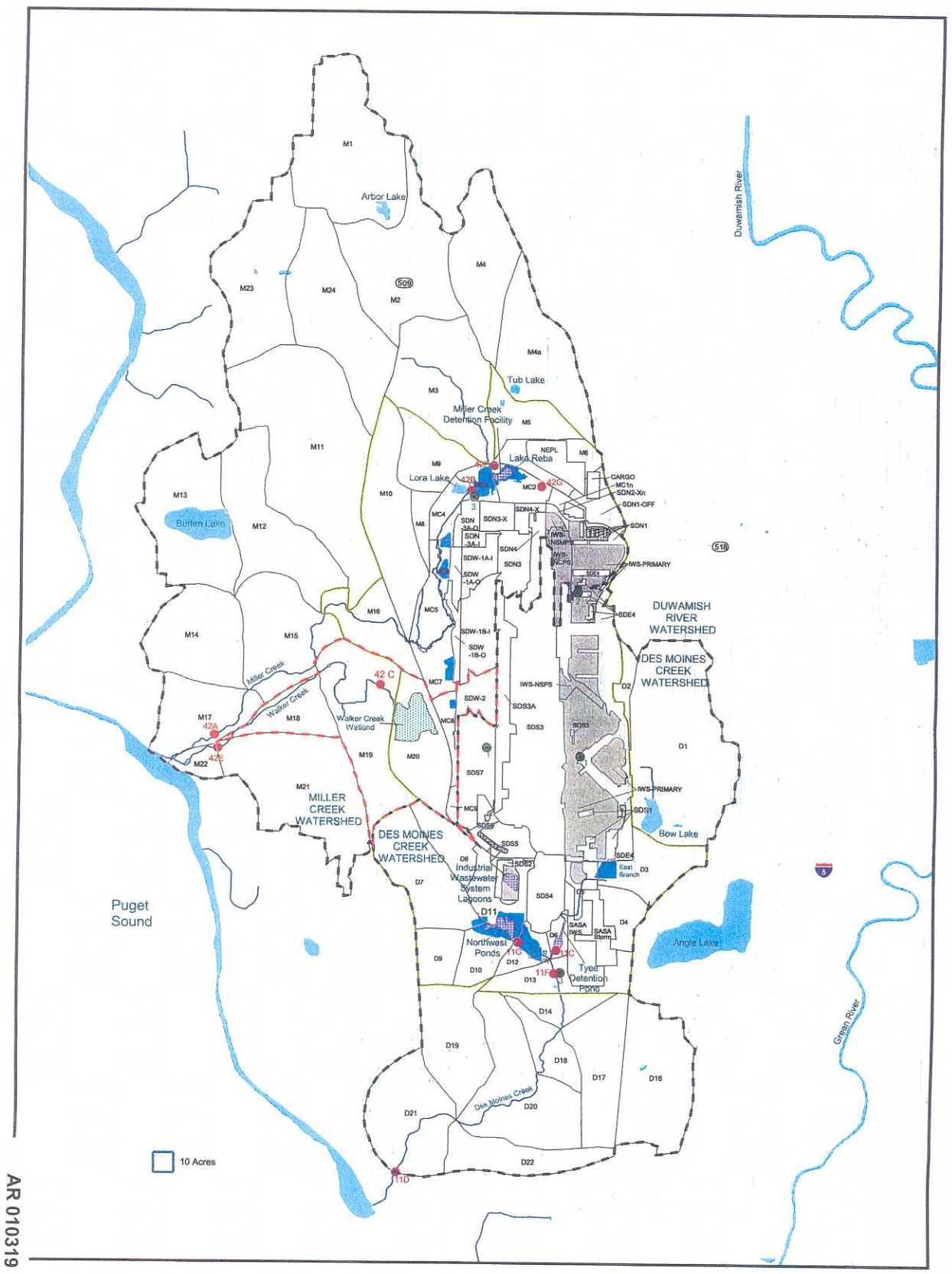
Figure A-1b
Future and Existing Watersheds with Future (2006) Subbasins



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Parametrix, Inc. Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File:K:\GIS\12912\Arcview\rrseatac_apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Note: STIA Subbasin GIS coverage obtained where conditions may change between 1994 base conditions and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only. The subbasin boundary between M18 and M15/M17 was revised from the previous model as shown, and the basin areas were revised. Modeling input parameters for areas outside of the STIA area are provided by other studies.

July 2001
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N

1000 0 1000 2000 Feet

1:36,000

- Roads
- Future (2006) Drainage Subbasins
- STIA Area (see note)
- Constructed Water Features
- Watershed Boundary
- Subwatershed Boundary
- Rivers
- Water Bodies
- Detention Facilities (existing and proposed)
- IWS Drainage Area

- Precipitation Gauging Stations:
  - Type 1 - National Weather Service (Gauge relocated 1996)
  - Type 2 - POS Rainfall Monitoring
  - Type 3 - King County Rainfall Monitoring
- Stream Flow
  - King County Gauging Stations:
  - 42A - Miller Ck @ SW 175th Pl & 12th Ave SW
  - 42B - Miller Ck @ Lake Reba/RDF Outlet
  - 42C - Walker Ck @ 171st Pl
  - 42E - Walker Ck @ 12th Ave SW
  - 42F - Miller Ck @ SR518
  - 42G - Miller Ck @ East Branch
  - 11D - Des Moines Ck near mouth
  - 11F - Des Moines Ck @ Golf Course
  - 11C - Des Moines Ck @ Tyee Pond
  - 11G - Des Moines Ck @ NW Ponds

Figure A-1c
Miller Creek and Des Moines Creek Watersheds 2006

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management.[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
A. RUNWAY AND TAXIWAYS							
Runway Safety Area							
Runway 34R Safety Fill	1/96	12/96	Yes	T	SDS(5)	Retrofit	No new impervious; detention was not required when the facility was built
Auburn Wetlands Mitigation	8/01	6/04	No	—	N/A	—	No new impervious
Miller Creek Relocation	4/02	12/02	No	—	N/A	—	No new impervious
Vacca Farm Floodplain Restoration	3/02	12/02	No	—	N/A	—	No new impervious
154th / 156th Street Relocation	4/02	10/03	Yes[c]	3	MCDF (T)	Retrofit	No new net impervious; detention provided in regional facility
Safety Areas 16R/16L	5/04	10/05	Yes	5	SDN2x/4x (4)	New	New fill and impervious
Miller Creek Sewer Relocation	3/02	12/02	No	—	N/A	—	No new impervious
Embankment							
Property Acquisition, Street and Utility Vacation	1/98	12/04	No	—	N/A	—	Impervious area removed
Borrow sites 1, 3A, and 4	6/02	6/06	No[g]	—	Temporary detention	—	Cleared and graded areas will drain to temporary TESC ponds
Phase 1 1997 Embankment Stockpile	6/97	11/97	No[d]	—	Temporary detention	—	Cleared and graded areas will drain to temporary TESC ponds
Phase 2 1998 Embankment Fill	3/98	10/98	No[e]	6	Temporary detention	New	Cleared and graded areas will drain to temporary TESC ponds
Phase 3 1999 Embankment Fill	3/99	3/01	No[e]	6	Temporary detention	New	Cleared and graded areas will drain to temporary TESC ponds
Phase 4 2000-2001 Embankment Fill	5/01	1/02	No[e]	6	Temporary detention	New	Cleared and graded areas will drain to temporary TESC ponds

AR 010320

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
Temporary SR-518 Interchange	5/02	10/02	No[d,g]	—	Temporary detention	—	New temporary impervious
Temporary SR-509 Interchange	6/01	10/01	No[d,g]	—	Temporary detention	—	New temporary impervious
FAA & NAVAIDS							
Relocation of Airborne Cargo	10/99	8/00	Yes	T	SASA (4)	Retrofit	Retrofit existing conditions, no net new impervious
New ATCT	3/00	9/02	Yes	4	SASA (4)	Retrofit	Retrofit existing conditions, no net new impervious
Relocate ASR	6/01	8/04	Yes	4	On-site detention ponds	New	New impervious
ASDE, NAVAIDS	6/01	8/04	No[g,f]	4	—	New or retrofit	New impervious or retrofit existing conditions
Airfield							
Interconnecting Taxiways 16R-34L	4/94	12/95	Yes	T	1) SDN3x (4)[i] 2) SDN2x/4x (4)[i] 3) SDS3 (6)	Retrofit	Retrofit existing conditions
Phase 1 1998 Taxiway Construction	4/98	6/98	Yes	T	SDS3A (T) 1) SDN3x (4)[i] 2) SDN2x/4x (4)[i] 3) SDS3 (6)	New	Retrofit existing conditions, new impervious in SDS3
Phase 2 1999 Taxiway Construction	3/99	12/99	Yes	T	SDS3A (T) 1) SDN3x (4)[i] 2) SDN2x/4x (4)[i] 3) SDS3 (6)	New	Retrofit existing conditions, new impervious in SDS3

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Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
Phase 3 2002-2004 Runway 16X/34X	3/05	12/06	Yes	6	1) SDS7 (5) 2) SDW1A (6) 3) SDW1B (6) 4) SDW2 (6) 5) SDN3A (5)	New	New impervious
Other							
New Snow Equipment Storage	11/96	9/97	Yes	T	SDS3 (6)	New	New impervious areas are included in runway/taxiway drainage
B. TERMINAL AND LANDSIDE IMPROVEMENTS – 1996-2000 (PHASE I)							
Terminal/Roadways							
Central Terminal Expansion	3/02	11/04	Yes	4	SASA (4)	Retrofit	Retrofit existing conditions
Expansion of Concourse A (South Terminal)	12/99	12/03	Yes	3	SASA (4)	Retrofit	Retrofit existing conditions
Improvements to Main Terminal Roads (Ground access and seismic improvements, widen lower terminal drive, widen north entry drive)	3/97	9/99	Yes	T	SASA (4)	Retrofit	Retrofit existing conditions
Satellite Transit Shuttle System Rehab	2/00	12/01	No	—	N/A	—	Drains to IWS
Westin Hotel			Yes	—	SASA (4)	Retrofit	Project cancelled but included in SMP, no net new impervious, will be retrofitted by SASA facility

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Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
Air Cargo							
Redevelopment of North Air Cargo (ground support equipment relocation)	2001	2006	Yes	6	SDN1 (6)	Retrofit, New	Retrofit existing conditions. Increase in SDN1 is offset by previous SDN1 and SDN2 reroutes to IWS.
Runway/Apron							
Removal of displaced threshold on Runway 16L	2000	2000	Yes	—	SDN2x/4x	Retrofit	No net new impervious
Parking							
Main Garage Expansion to South, North, East	2/98	5/00	No	T	N/A	—	Drains to IWS
NEPL, Phase 1	7/97	7/98	Yes	T	NEPL retrofit vault (4)	Retrofit	Retrofit existing NEPL
C. TERMINAL AND LANDSIDE IMPROVEMENTS – 2000-2005 (PHASE II)							
SASA							
SASA Site preparation	2004	2006	No[d]	—	N/A	—	Cleared and graded areas will drain to TESC ponds
SASA and Access Taxiways	2004	2007	Yes	7	SASA (4)	New	Retrofit existing conditions, new impervious (SDS and IWS)
Ground Support Equipment Location	2004	2006	Yes	6	SASA (4)	New	Retrofit existing conditions, new impervious
Ground/Corporate Aviation Facilities (SASA)	2004	2006	Yes	6	SASA (4)	New	Retrofit existing conditions, new impervious
Relocation of United Maintenance Complex to SASA	2004	2006	Yes	6	SASA (4)	New	Retrofit existing conditions, new impervious at SASA

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Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued). [a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
Terminal/Roadways							
Improved Access and Circulation Roadway Improvements	2001	2005	Yes	5	SASA (4)	Retrofit	Retrofit existing conditions, no new net impervious
First Phase of North Unit Terminal (South Pier)	2006	2008	Yes[h]	8	SASA (4)	Retrofit	Retrofit existing conditions, no new net impervious
Ramps off SR-518, S. 160th Improvements			No[g]	—	N/A	—	Project cancelled
North Unit Terminal Roadways	2006	2008	Yes[h]	8	SASA (4)	Retrofit	Retrofit existing conditions, no new net impervious
New ARFF (fire station)	2006	2007	Yes[h]	7	SASA (4)	Retrofit	Retrofit existing conditions
Improvements to South Access Connector Roadway	2006	2008	Yes	8	SASA (4)	Retrofit, New	Retrofit existing conditions and new impervious
Air Cargo							
Continued Expansion of North Cargo Facilities	2001	2005	Yes	5	Cargo vault (4)	Retrofit	Retrofit existing conditions
Runway/Apron							
Dual Taxiway 34R	2010	2015	Yes	15	SDS4 (5)	Retrofit	Retrofit existing conditions
Parking							
Expansion of NEPL to 6000 stalls	2002	2004	No[g]	4		New	New impervious, project not included in SMP
First Phase of North Unit Terminal Parking Structure	2006	2009	Yes	9	SASA(4)	Retrofit	Retrofit existing conditions

AR 010324

Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Activity	Construction Start	Construction End	Permanent Stormwater Detention Provided?	Year MPU in Service[b]	Facility (Year in Service)	New or Retrofit	Comment
D. TERMINAL AND LANDSIDE IMPROVEMENTS – 2006-2010 (PHASE III)							
Terminal/Roadways							
Expansion of North Unit Terminal (North Pier)	2006	2010	Yes[h]	10	SASA (4)	Retrofit	Retrofit existing conditions
Complete Connectors to South Access Roadway	2006	2010	Yes	10	SASA (4)	Retrofit	Retrofit existing conditions
Air Cargo							
Cargo Warehouse at 24th Avenue South	2006	2010	Yes	10	Cargo vault (4)	New	Retrofit existing conditions, new impervious
Runway/Apron							
Extension of Runway 34R by 600 feet	2006	2010	Yes	10	SDS4 (5)	New, Retrofit	Retrofit existing conditions
Additional Taxiway Exits on 16L/34R	2006	2010	—[g]	—	N/A	—	Future project not included in SMP
Parking							
Additional Expansion of Main Parking Garage	2006	2010	No[g]	—	N/A	—	Future project not included in SMP
Additional Expansion of North Employee Parking Lot	2006	2010	—[g]	—	N/A	—	Future project not included in SMP
Expand North Unit Parking Structure	2010	2013	—[g]	—	N/A	—	Future project not included in SMP
E. TERMINAL AND LANDSIDE IMPROVEMENTS – 2010-2020 (PHASE IV)							
SR-509 Extension/South Access							
SR-509 Extension/South Access	2005	2010	—	—	N/A	—	WSDOT project/ New impervious

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Table A-3. Sea-Tac Airport Master Plan Update projects requiring stormwater management (continued).[a]

Note: T = End of 2000.

[a] Projects with new impervious surface, changed land cover, or change from IWS to SDS. Based on information presented in Master Plan Update FEIS and subsequent schedules. Schedule of Phase II-IV projects is approximate, and schedule and data on all projects are subject to change. Schedule assumes Section 404 permit granted in Summer 2001.

[b] End of first calendar year following approval of permit. For example, if permit is issued in 2001, year 1 is the end of 2001.

[c] Construction of 154th below the MCDF will be offset by removal of existing houses in the MC4, MC5, and MC6 basins. 154th upstream of the MCDF will be controlled by the MCDF outlet.

[d] Temporary construction facility. Temporary detention provided. No permanent detention required.

[e] Detention included in TESC facilities. At final buildout, detention is included in Airfield phase 3.

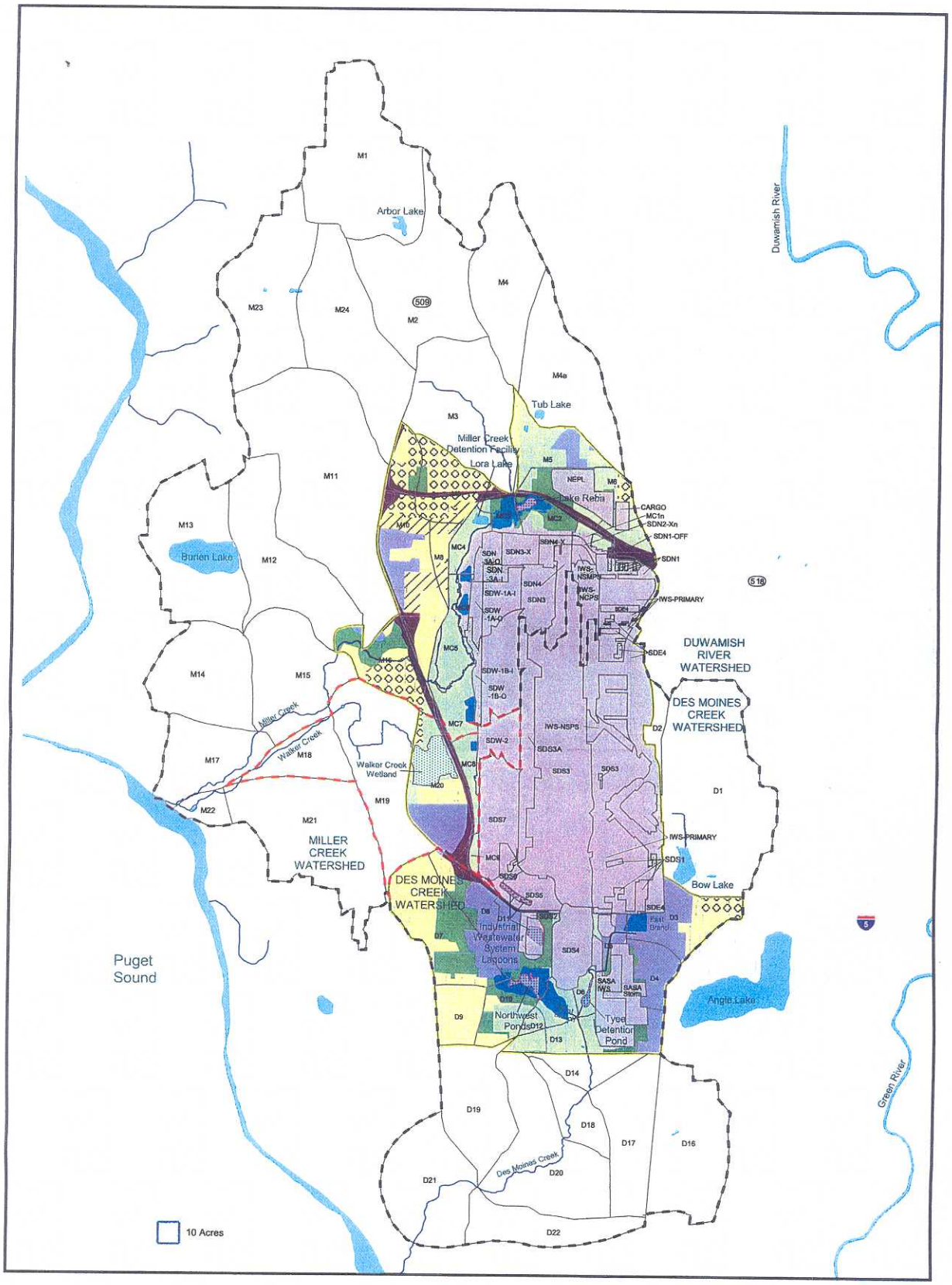
[f] New navigation facilities will require revisions to SMP if there is new impervious area required.

[g] Not included in MPU SMP.

[h] Project was included in SMP but is under evaluation for modification. The SMP considers original project proposal. Increases in net impervious area will require revisions to the SMP.

[i] New impervious areas in Miller Creek basin are temporarily offset by IWS diversions.

AR 010326



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rrseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Estimated wetland boundaries are based on field reconnaissance by Parametrix, Inc.
Land use data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note Subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

N
1000 0 1000 2000 Feet
1:36,000

Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)
Sea-Tac Airport
Commercial
Open/Grass
Transportation
Low Density Residential
High Density Residential
Multi-Family Residential
Forest

Figure A-2
STIA Drainage Subbasins and 2006 Land Use

AR 010327

The procedure used for sizing detention facilities required comparison of the hydrologic regime between two land use conditions—project and pre-project. Assumptions were used to estimate the land area under a pre-project condition since this is different from the present (and 1994 base) condition. The assumptions for Miller and Des Moines Creek models are shown on Tables A-5 and A-6.

2.3 IMPERVIOUS AREA

The STIA subbasin impervious surface areas for the future condition are shown in Figure A-3. The additional impervious areas include the Third Runway and taxiway areas, cargo handling areas, and employee parking areas.

In acquisition areas, the amount of impervious area will be reduced due to the demolition of residential and other building structures. These impervious surfaces were deleted from the GIS impervious cover layer, leaving only roads as the principal impervious surface in those acquisition subbasins.

The EIA fractions developed during model calibration (Appendix B) were adopted for other subbasins for future condition hydrologic modeling. Effective impervious area was assumed to be 100 percent of the total impervious area for the airport land use category. In addition, the EIA was assumed to be 100 percent of impervious area for the transportation land use category.

2.4 SOILS AND WETLANDS

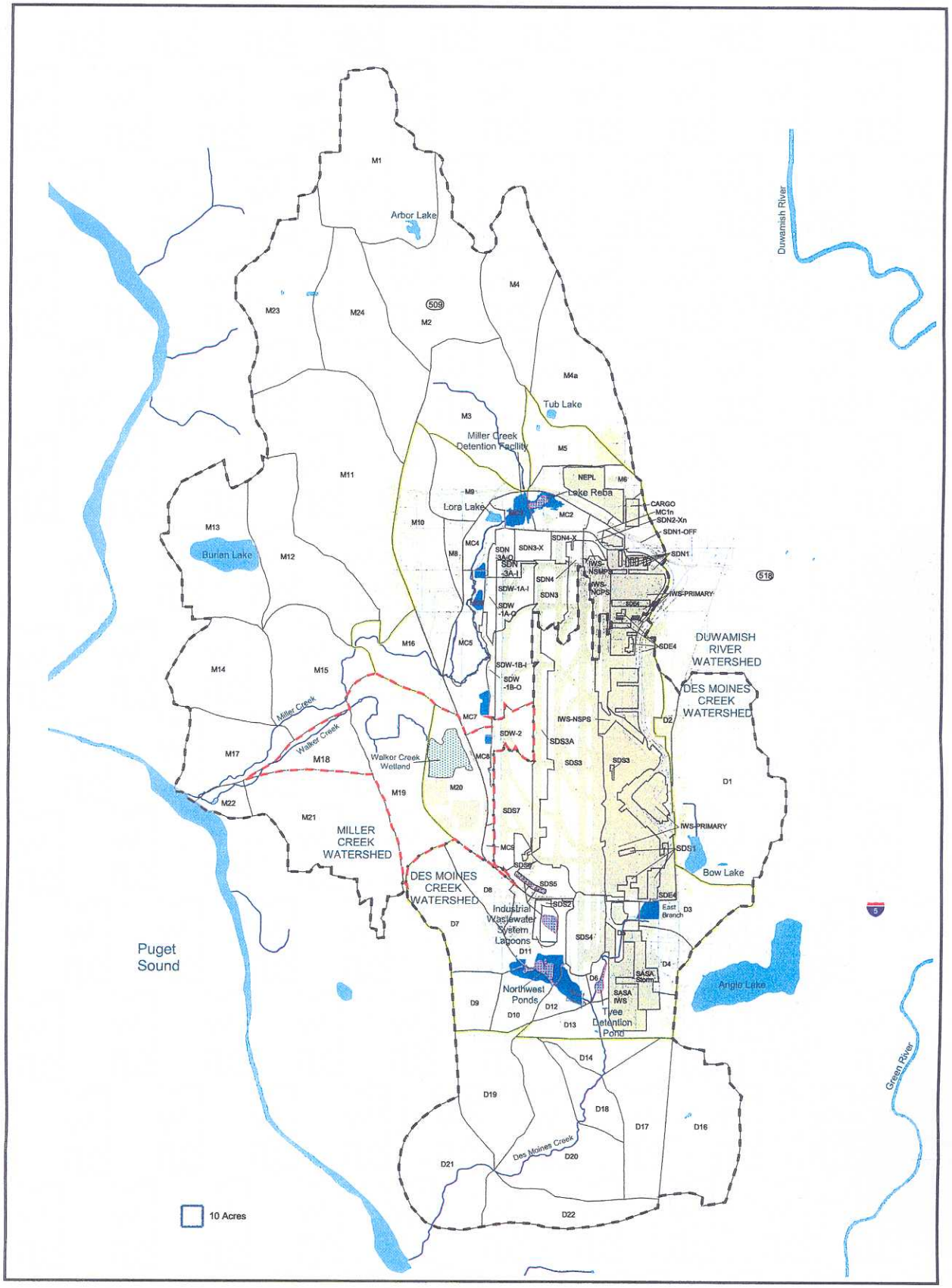
The subbasin boundaries and soils and wetland coverage for future conditions are shown in Figure B1-5. Wetland delineation was based on the sources shown in the figure. The sources are similar to the sources used for the 1994 soil and wetland coverage (Figure B1-5 in Appendix B). However, where embankment or other construction would result in the loss of wetland areas, the wetland areas were removed (Figure A-4). Wetland mitigation and compensation is proposed at a site outside of the Miller/Walker and Des Moines watersheds; therefore, the effect of wetland loss was included in the HSPF model.

A special embankment fill category was added to the soil's GIS layer for 2006 conditions. Preliminary (30 percent) design drawings were used to delineate the areal extent of the fill for the Third Runway project. The coverage was included in the GIS analysis of soil type in each STIA subbasin.

The 1994 slope map was reanalyzed to consider new embankment fills. The future condition slope analysis is shown in Figure A-5.

2.5 HYDROLOGIC ROUTING

The HSPF model routes subbasin flows (surface, interflow, and groundwater) to the outlet of each subbasin unless otherwise specified by the user. The changes to groundwater routings developed for subbasins upstream of the MCDF, and groundwater input from non-contiguous



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File:K:\GIS\2912\Arcview\rrseatac_apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Impervious surface data interpreted from 1993 STIA aerial photograph (Walker and Assoc. 1993).
Note: STIA Subbasin GIS coverage obtained where conditions may change between 2006 base conditions and other conditions; subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

AR 010329

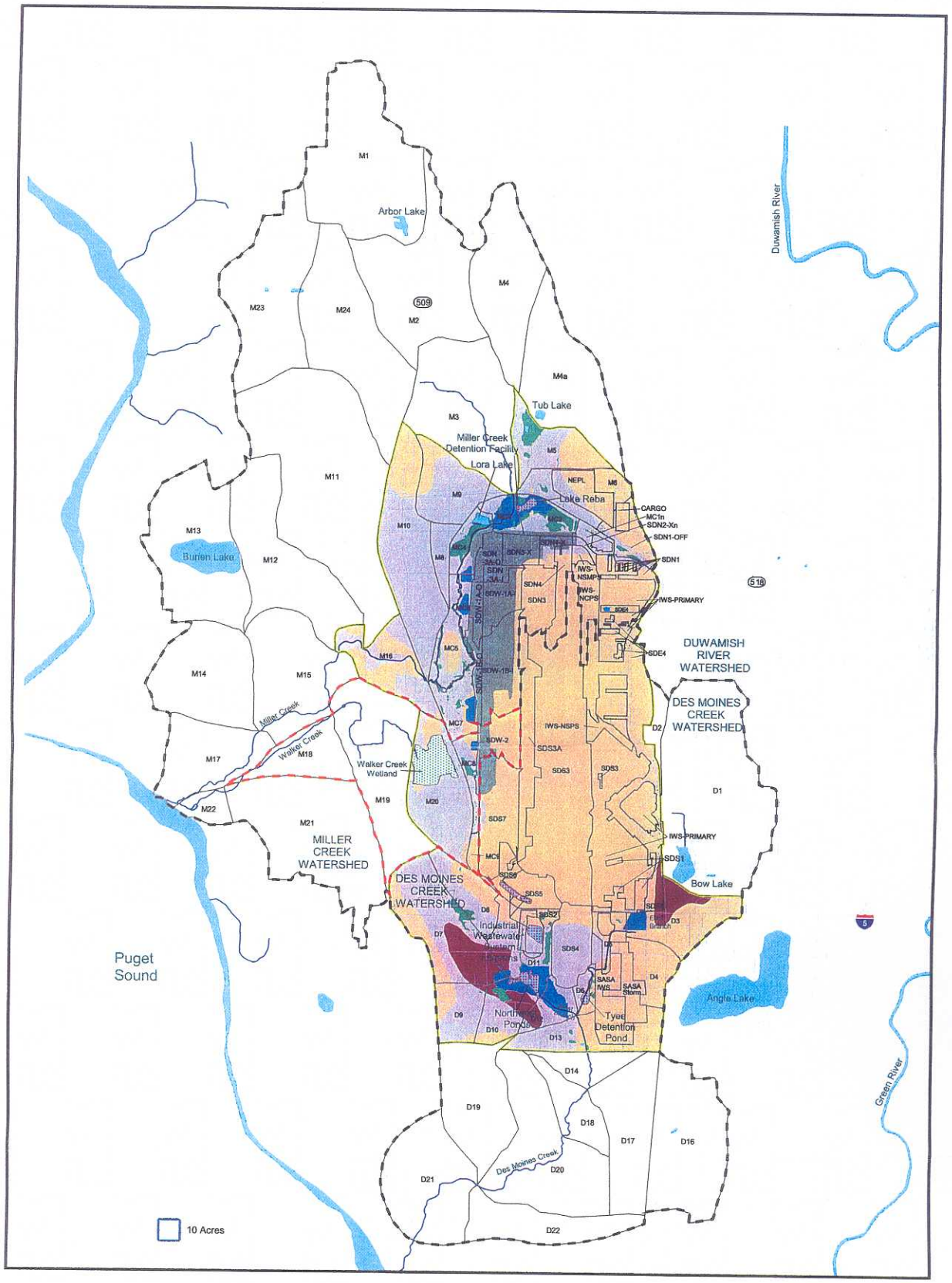
N

1000 0 1000 2000 Feet

1:36,000

Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Constructed Water Features
Detention Facilities (existing and proposed)
Impervious Areas

Figure A-3
STIA Subbasins Future Impervious Areas



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rrseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. Detention boundaries estimated by Parametrix, Inc.
Estimated wetland boundaries are based on field reconaissance by Parametrix, Inc.
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

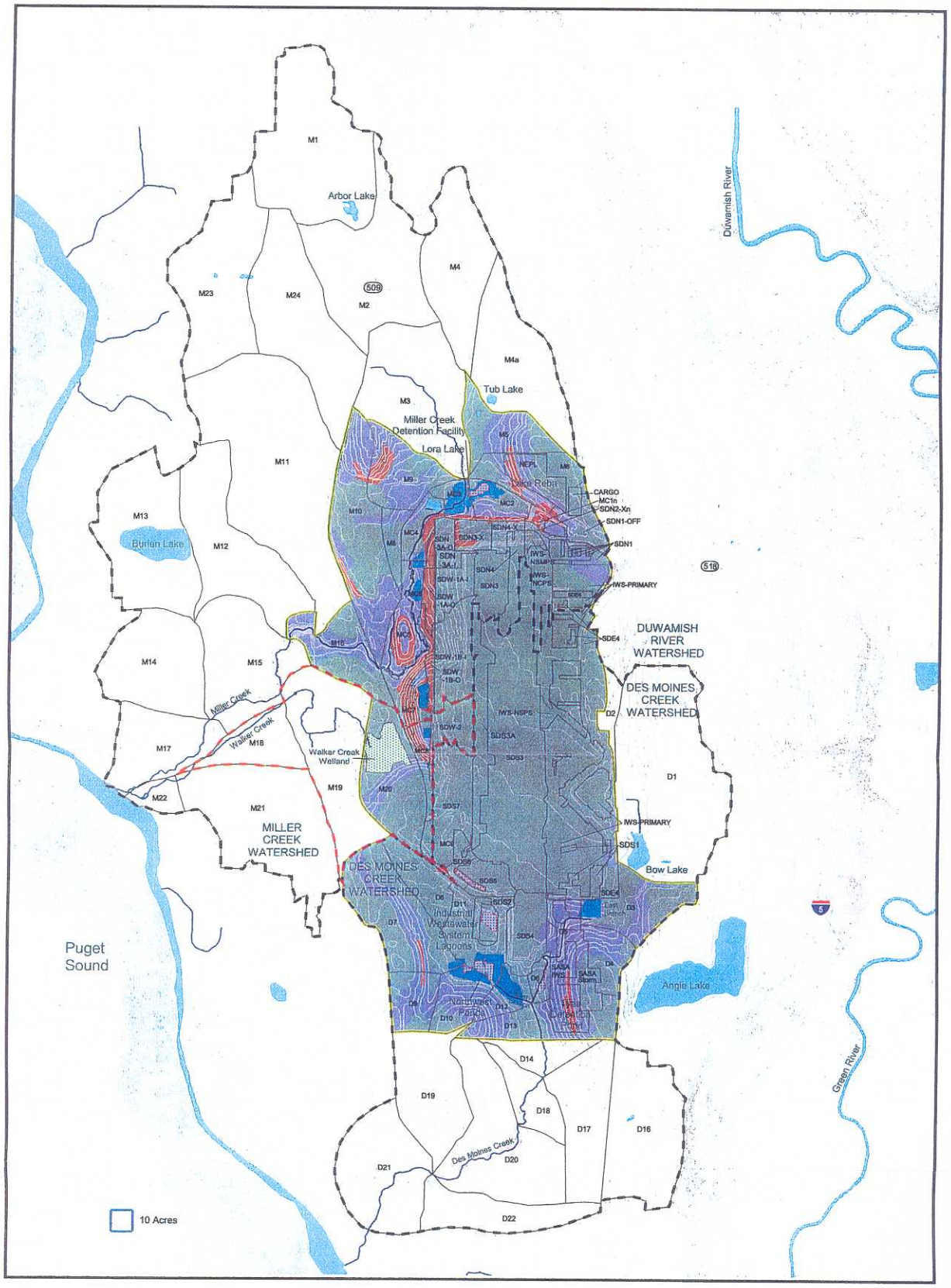
July 2001
556-2912-001 (28)

N
1000 0 1000 2000 Feet
1:36,000

Roads
Future (2006) Drainage Subbasins
STIA Area (see note)
Watershed Boundary
Subwatershed Boundary
Rivers
Water Bodies
Detention Facilities (existing and proposed)
Constructed Water Features
Outwash
Till
Fill
Wetland
Lacustrine

Figure A-4
STIA Drainage Subbasins and 2006 Soils/ Wetland Areas

AR 010330



Parametrix, Inc./Sea-Tac Airport Stormwater Management Plan/556-2912-001(28) 6/00 File: K:\Gis\2912\Arcview\rrseatac-apdxa_may2001.apr
Source: Roads based on King County data. Water bodies derived from USGS hypsography data. USGS Des Moines Quadrangle Map Revised 1973 (U.S. Army Corps of Engineers).
Note: Subbasin boundaries shown outside of STIA area are for illustration and reference only.

July 2001
556-2912-001 (28)

N
1000 0 1000 2000 Feet
1:36,000

- Future (2006) Drainage Subbasins
- STIA Area (see note)
- Watershed Boundary
- Bathymetry
- USGS Hypsography
- Subwatershed Boundary
- Rivers
- Water Bodies
- Detention Facilities (existing and proposed)
- Constructed Water Features
- Slope Less than 6%
- Slope 6 to 15%
- Slope Greater than 15%

Figure A-5
STIA Subbasins and Future Slope Map

AR 010331

aquifer areas in the Des Moines Creek subbasins (determined during HSPF model calibration), were included in the future condition model for Des Moines Creek.

Other changes for future conditions made in the hydrologic routing scheme included the following:

1. SDW subbasin changes proposed in the west draining portion of the Third Runway project;
2. Additional flows from the North Employee Parking Lot (NEPL) and Cargo subbasins;
3. Overflows from the North Cargo and North Snow Melt Pump Stations; and
4. Elimination of SDN2, which drains to the IWS system.

2.6 PERIOD OF HYDROLOGIC RECORD

The analysis of future hydrologic conditions (and comparison to pre-development conditions) was conducted using an extended hydrologic record relative to the period used for the HSPF model calibration. The Miller Creek and Walker Creek model was calibrated using a hydrologic record from October 1992 through August 1996 for reasons described in Appendix B. The Des Moines Creek model was calibrated using a hydrologic record from January 1994 through September 1996, as described in Appendix B.

Long-term records are recommended for flood frequency and flow duration analyses, typically a minimum of 10 years (U.S. Department of Interior 1982). The period used for evaluation of detention facility requirements described in this appendix was based on the rainfall and evaporation data from October 1948 though September 1996 (a 49-year record).

Long-term precipitation and evaporation records were used as follows:

- Hourly precipitation records for STIA (NOAA Weather Service station) from October 1948 through September 1996; and
- Daily pan evaporation data (based on the Puyallup Experiment Station) from October 1948 through September 1996 obtained from King County DNR.

2.7 CALIBRATION OF AIRPORT FILL PARAMETERS

A preliminary analysis was made of the stormwater runoff during a 1-month period (late January through late February 1999) at the 1998 embankment fill site to calibrate HSPF PWATER parameter values. The Hydrocomp Forecast and Analysis Model (HFAM) computer program was used for this analysis. This program incorporates the same numerical algorithms for hydrologic processes as HSPF, but has additional features that facilitate the study of surface runoff, interflow, and base flow components.

The 1998 embankment fill site was approximately 19.4 acres in size. It was constructed over an area formerly sloping toward Miller Creek in the north end of the new runway fill (Figure A-4). The fill overlies an area mapped as till soil. The original site was cleared and grubbed prior to placement of a gravel underdrain layer beneath the fill. The fill was a combination of materials (called for in the specifications) that had similar gradations. Groups 1A, 2, and 3 fill materials were placed. Group 2 material (Port of Seattle 1998) has the following specifications:

Sieve Size	Percent Passing
6-inch	100
3-inch	70 – 700
¾-inch	50 – 85
US No. 4 (0.18-inch)	30 – 65
US No. 40 (0.02-inch)	5 – 30
US No. 200 (0.003-inch)	0 – 12

Surface runoff was collected and piped to a sedimentation pond at the base of the fill. In addition, the pond collected interflow and base flow since its elevation was well below the base of the fill. During monitoring, numerous seeps were observed that fed into the sedimentation pond.

The volume of water collected in the pond was recorded. Precipitation and evaporation data were obtained from the National Weather Service rainfall gage at STIA and the Puyallup Experimental Station (Figure A-1). When sufficient rainfall resulted in water treatment operations, water level records were kept. These data were used to estimate the mean daily flow from the site. The flow estimate was the sum of direct surface and interflow runoff plus base flow (shallow groundwater).

HFAM was used to simulate a 52-month period of streamflow. For comparison purposes, a conceptual model of the entire Miller/Walker Creek watershed during the same period was also constructed. The conceptual model included only till, outwash, and impervious land segments representing the total acreage in each soil/cover category based on the drainage area at King County Streamflow Gage 42A (near the mouth of Miller Creek). The purpose of the conceptual Miller/Walker Creek model was to compare the proportion of surface runoff, interflow, and base flow between the other pervious/impervious land segments and airport embankment fill. The conceptual model did not include detention facility or channel routing characteristics.

The conceptual pervious areas were assigned the PWATER parameters determined during the model calibration process. The initial values used for airport fill were those determined for till soil. An interactive process was used to adjust the PWATER parameters. The first parameters to be adjusted included those that significantly affected the amount of outflow from the fill site. The water balance was determined to be suitable when the total outflow volume from the site was within 10 percent of that observed during January and February 1999.

Other PWATER parameters were adjusted to calibrate the hydrograph recession, baseflow recession rates, and peak flow rates.

The results of the calibration are summarized in Table A-4 and detailed in Attachment B.

Table A-4. Summary of embankment fill parameter calibration.

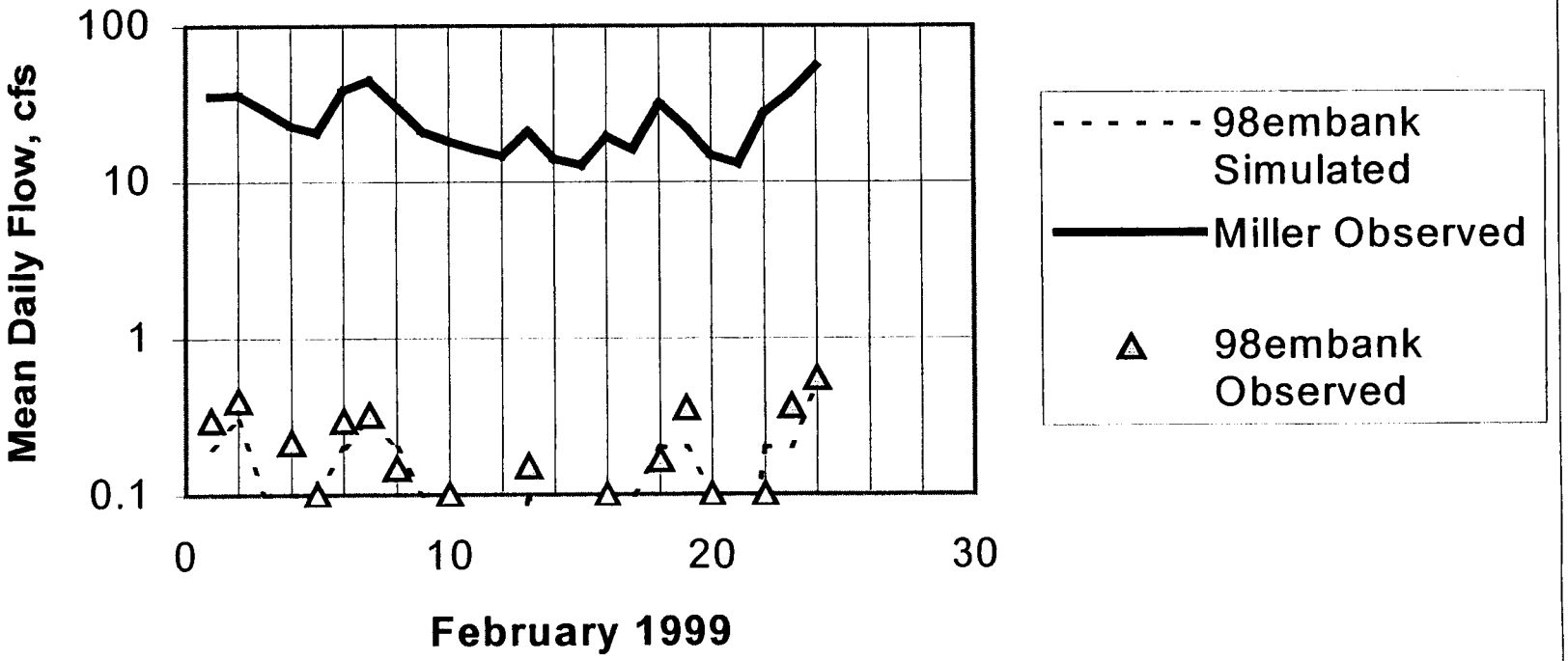
PWATER Parameter	Fill Material Value
LZSN	7.5
INFILT	0.02
INFEXP	2.0
DEEPFR	0.10
BASETP	0.0
UZSN	0.28
AGWRC	0.90
INTFW	6.0
LZETP	0.6
IRC	0.15
AGWETP	0.0
CEPSC	0.10
NSUR	0.25
LSUR	300
SLSUR	0.07

Compared to till, the fill has the following characteristics:

1. The fill is deeper and has a greater lower zone storage (LZSN);
2. The fill has up to 12 percent fines (silt and clay) and lower infiltration at the compacted surface; therefore, it has a lower INFILT value;
3. The fill overlies the till layer so it has about the same order of deep percolation loss as the till (i.e., DEEPFR is about the same);
4. The fill has no losses from base flow or groundwater to ET pathways; therefore, BASETP and AGWETP are zero;
5. The fill has a fast groundwater recession rate, resulting in a similar AGWRC to till;
6. The fill has a faster interflow recession rate and therefore a lower IRC;
7. The fill has a much greater proportion of water moving as interflow and therefore a higher INTFW; and
8. The fill has about the same upper zone storage (UZSN) as till.

The simulated versus observed mean daily flow is compared in Figure A-6. The observed flow at the Miller Creek gage near the mouth is included for reference. Most mean daily flow fluctuation at the 1998 embankment corresponds to fluctuation near the mouth. There are exceptions, such as on February 2 and 4. The accuracy of the estimated embankment flow was limited by the frequency at which pond levels were recorded, which limited close correlation between simulated and observed daily flow. Nonetheless, the total observed runoff volume for February 1999 was approximately 6.83 acre-feet in comparison to the simulated runoff volume of 6.87 acre-feet—a difference of about 0.5 percent.

Figure A-6. Comparison of Simulated 1998 Embankment Flow to Observed Embankment and Miller Creek Flow During Calibration



AR 010335

3. HYDROLOGIC SIMULATION

3.1 DETENTION FACILITY PLANNING

To perform the detention facility analysis, the future STIA subbasins were combined with hydrologic data for three base conditions (Tables A-5 and A-6). Factors applying to the Miller and Walker Creek watershed and the Des Moines Creek watershed are discussed in the following sections.

Future land use, subbasin, and existing/proposed detention facilities within the STIA subbasin study area are shown in Figure A-7. The figure defines the detention facility design standards for stormwater volume management and identifies the applicable standard for each detention facility. Figure A-7 also shows the location of the hydrologic evaluation point for each facility.

Each existing/proposed detention facility was considered a hydrologic evaluation point. In addition, there were mainstem creek evaluation points for Miller, Walker, and Des Moines Creeks at the downstream boundaries of the STIA analysis area. These locations are closest to the Master Plan Update improvement projects (relative to the main creeks) and are more sensitive to hydrologic effects than locations farther downstream.

3.1.1 Miller and Walker Creek Factors

The evaluation of detention facility requirements involves comparing pre- and post-project hydrologic regimes. Project conditions have also been termed future or 2006 conditions; the terms are synonymous in this appendix. Similarly, pre-project conditions are referred to as pre-development conditions. The hydrologic statistics compared between these two regimes were the flood peak flow return period and the flow duration frequency for the long-term simulation period.

The pre- and project conditions were evaluated by processing the land use coverage, subbasin boundary, and hydrologic routing data together in a series of HSPF simulations for the period of record. A post-processor program (SWSTAT) was used to prepare the output statistical analysis. The subbasins and land use coverage development are summarized in Tables A-5 and A-6. The HSPF input files for Miller and Walker Creeks are provided in Attachment D.

Table A-5. Hydrologic conditions – Miller and Walker Creek watershed land use coverage, subbasins, and HSPF output used for detention facility analysis.

Factors	Pre-development			Base (1994)	Future (2006)		
	STIA Impact Subbasins	North of 144th/142nd St. (u/s MCDF)[a]	South and West of SR 509		STIA Impact Subbasins	North of 144th/142nd St. (u/s MCDF)[a]	South and West of SR 509
HSPF Input	1994 Soils	1994 Soils	1994 Soils	1994 Soils	1994 Soils	1994 Soils	1994 Soils
Land Use Coverage	10% Impervious 75% Forest 15% Grass	1994 Land Use and Impervious Areas	1994 Land Use and Impervious Areas	1994 Land Use and Impervious Areas	2006 Land Use and Impervious Areas	1994 Land Use and Impervious Areas	1994 Land Use and Impervious Areas
Hydrologic Routing	Groundwater routing based on model calibration scheme	Groundwater routing based on model calibration scheme	Groundwater routing based on model calibration scheme	Groundwater routing based on model calibration scheme	Groundwater routing based on model calibration scheme	Groundwater routing based on model calibration scheme	Groundwater routing based on model calibration scheme
Subbasin Boundaries	2006 w/ POS Property Acquisitions	1994 Drainage	1994 Drainage	1994 Drainage	2006 w/ POS Property Acquisitions	1994 Drainage	1994 Drainage

[a] u/s MCDF = Upstream of Miller Creek Detention Facility.

Table A-6. Hydrologic conditions – Des Moines Creek watershed land use coverage, subbasins, and HSPF output used for detention facility analysis.

Factors	Pre-development		Base (1994)	Future (2006)	
	STIA Impact Subbasins	Non-STIA Subbasins		STIA Impact Subbasins	Non-STIA Subbasins
HSPF Input	1994 Soils	1994 Soils	1994 Soils	1994 Soils	1994 Soils
Land use Coverage	10% Impervious 75% Forest 25% Grass	1994 Land Use and Impervious Areas	1994 Land Use and Impervious Areas	2006 Land Use and Impervious Areas	1994 Land Use and Impervious Areas
Hydrologic Routing	Interflow routed to subbasin outlet	Groundwater routing based on model calibration scheme	STIA Interflow routed downstream for calibration only	Proposed Detention Facilities	Groundwater routing based on model calibration scheme
Subbasin Boundaries	2006 w/ POS Property Acquisitions	1994 Drainage	1994 Drainage	2006 w/ POS Property Acquisitions	1994 Drainage

[a] u/s MCDF = Upstream of Miller Creek Detention Facility.

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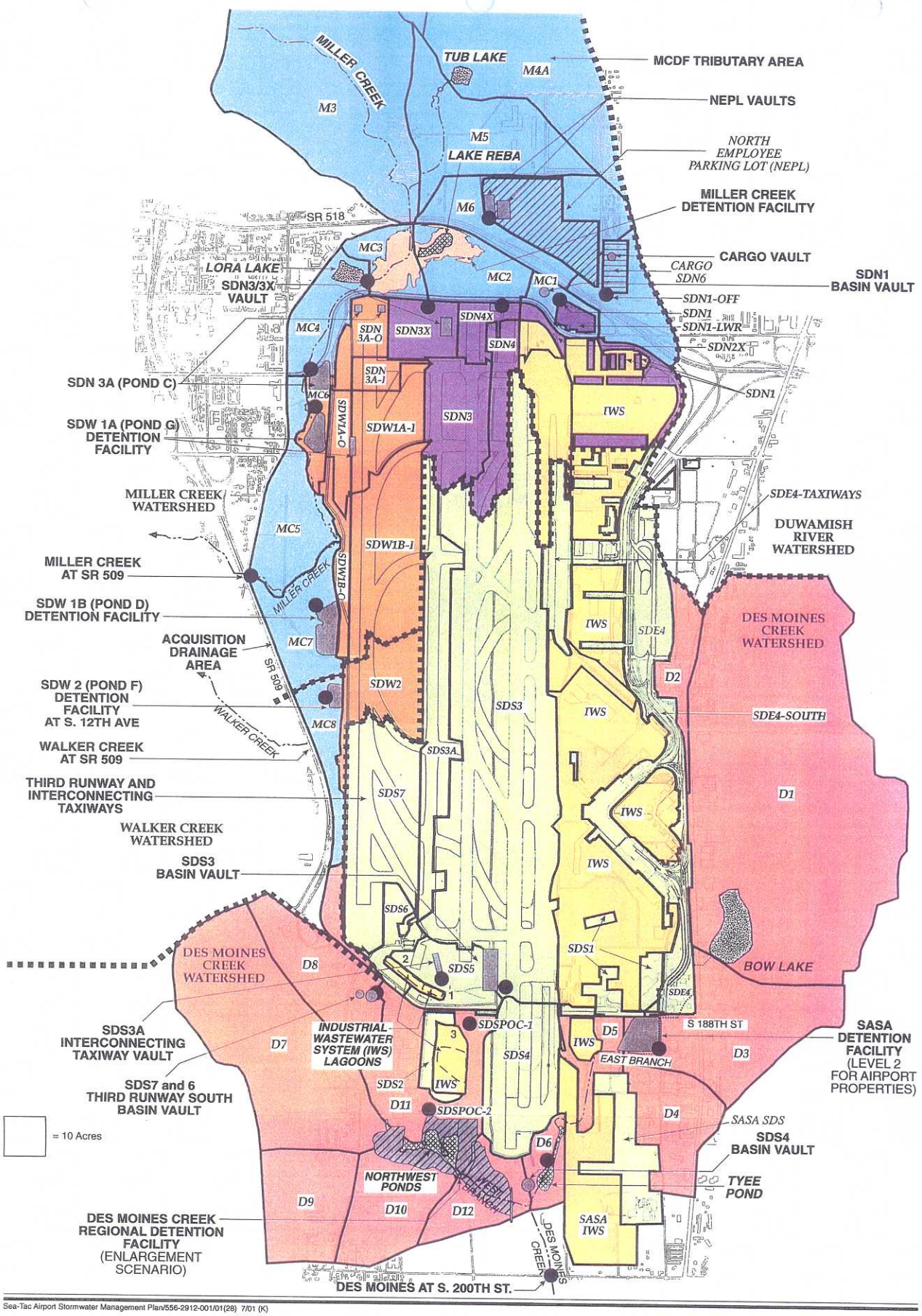

Sea-Tac Airport Stormwater Management Plan/556-2912-001/01(28) 7/01 (K)

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Figure A-7
Future Land Use and Existing/Proposed Detention Facility Locations

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The pre-project condition data combined land use and subbasin boundary coverages (Table A-5). This coverage was distributed uniformly across existing soil type (e.g., till or outwash soil has 10 percent impervious area covering the pervious land segment). The impervious area was assumed to be 100 percent effective in terms of surface runoff. The 2006 subbasin boundaries for areas within STIA that would be impacted were used to determine the pervious and impervious land segment inputs for the HSPF model. The subbasin boundaries needed to be consistent between pre- and post-project conditions to evaluate detention size requirements resulting from changed land use conditions.

3.1.2 Des Moines Creek Factors

Evaluation of detention facility requirements within the Des Moines Creek drainage basin followed the same process as for Miller and Walker Creeks. The same statistical analyses were performed to verify detention facility compliance. All detention facilities within the Des Moines Creek basin were sized to the previously discussed pre-project conditions.

3.2 DETENTION FACILITY SIZING

Each onsite (STIA) detention facility was sized using a two-step process. In the first step, the King County Runoff Time Series (KCRTS) program was used to create an initial set of stage-volume-discharge relationships. KCRTS was then used to generate a preliminary estimate of orifice size and detention volume required to achieve the design standard. Soil and impervious cover information from Tables A-1(a and b) and A-2 (a and b)(Attachment A) was used to develop the facility size. An airport fill category was created with the assistance of King County DNR. The PWATER parameters described in Section 2.7 were used to develop a special runoff file. The runoff file was used with other soil runoff files to estimate streamflow at each detention site.

In the second step, the stage-volume-discharge relationships obtained from the KCRTS analysis were used as input into the HSPF model. Pre-project and post-project simulations were performed and the statistical output was compared to determine whether the design standard was achieved. If the project condition flow exceeded the pre-project condition flow for the evaluation point, the facility design was reanalyzed using KCRTS and the process was repeated until satisfactory design configurations were obtained. Final outlet configuration data are provided in Attachment C.

4. COMPARISON OF PRE-PROJECT AND PROJECT CONDITIONS

The detention facility volumes required to achieve design standards are summarized in Table A-7. The table indicates the maximum storage that occurs during the future project condition simulation when discharge is controlled such that the project flow range (½ Q_2 to Q_{50}) is less than the pre-project flow range over the same time duration.

4.1 ANNUAL FLOOD FREQUENCY ANALYSIS

The pre-project and project (2006) peak flood flows for 2-, 10-, 25-, 50-, and 100-year return periods are summarized in Tables A-8 and A-9 and the corresponding back-up output data are contained in Attachment C (printout and graphs provide detailed information from the SWSTAT program). Peak project flows are less than to pre-project flows except at the NEPL facility. This facility was constructed based on the Enhanced Level 1 design standard. To achieve Level 2 design, a new detention facility operating in parallel with the existing one is proposed.

4.2 FLOW FREQUENCY ANALYSIS

The flow frequency results from the SWSTAT program are contained in Attachment C. The curves show the project flow regime compared to the pre-project flow regime. The project flows are less for flows between one-half of the 2-year peak flow to the 50-year peak flow. The results for downstream points of evaluation are shown in Figures A-8 through A-11. The flow frequency comparison at SASA shown in Attachment C shows the pre- and project conditions for STIA property retrofit.

The flow frequency curves (Figure A-11) for Des Moines Creek at South 200 Street show the pre-project target flow regime will be achieved by the project on-site detention facilities if it becomes necessary to retrofit SASA for all contributing area upstream. Figure A-11 assumes that the Des Moines Creek Regional Detention Facility is not constructed.

Table A-7. Summary of required detention facility volumes.

Watershed	Hydrologic Evaluation Point	Volume Required (acre-ft)	Type of Facility[a]	Comments
Miller Creek	NEPL	13.9[b]	Vault	In addition to existing 4 ac-ft
	CARGO	4.5	Vault	
	SDN2x + SDN4x	14.4	Vault	
	SDN3/3x	25.2	Vault	
	SDN1	5.5	Vault	
	SDN3A	Pond: 14.8 / Vault: 7.0	Pond/Vault	
	SDW1A	Pond: 25.5 / Vault: 7.4	Pond/Vault	Infiltration used
	SDW1B	53.6	Pond	Infiltration used
Total Miller Creek		**171.8**		
Walker Creek	**SDW2**	**10.9**	**Pond**	
Des Moines Creek	SASA Detention Facility	33.4[c]	Pond	
	Interconnecting taxiway (SDS3A)	5.4	Vault	
	Third Runway South (SDS7 and 6)	21.7	Vault	
	SDS3	88.0	Vault	
	SDS4	12.9	Vault	
Total Des Moines Creek		**161.4**		

[a] Types of facilities: Vault – enclosure with multiple orifice outlets on vertical riser with overflow spillway; Pond – open earth construction with netting or other means to provide wildlife deterrent.

[b] Volume needed to retrofit existing facility.

[c] Retrofit STIA area only.

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Table A-8. Summary of flood peak flow frequency results for Miller and Walker Creek subbasins (all values are cubic feet per second).

Return Period Peak	NEPL		CARGO		SDW2		SDW1B		SDN3A (Vacca)	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	0.61	0.22	0.12	0.05	1.04	0.31	0.66	0.22	0.26	0.09
Q_2	1.22	0.44	0.24	0.09	2.07	0.62	1.31	0.45	0.52	0.18
Q_{10}	1.70	0.73	0.33	0.14	3.83	1.80	2.04	0.56	0.72	0.32
Q_{25}	1.96	0.96	0.38	0.18	4.78	3.11	2.52	0.59	0.83	0.44
Q_{50}	2.16	1.18	0.42	0.21	5.51	4.66	2.92	0.62	0.92	0.56
Q_{100}	2.37	1.46	0.46	0.25	6.26	6.91	3.37	0.64	1.01	0.70

Return Period Peak	SDW1A		SDN3, SDN3X		Combined SDN2X/SDN4/SDN4X		Miller Creek at RDF		
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project	Pre-Project	1994[a]	Project
1/2 Q_2	0.15	0.006	0.69	0.27	0.52	0.19	19.33	21.55	19.55
Q_2	0.30	0.01	1.38	0.53	1.04	0.38	38.65	43.10	39.11
Q_{10}	0.56	0.05	1.93	0.81	1.45	0.56	55.17	58.44	55.61
Q_{25}	0.78	0.12	2.25	0.99	1.67	0.67	63.17	65.75	63.59
Q_{50}	0.98	0.25	2.49	1.14	1.85	0.77	69.05	71.10	69.45
Q_{100}	1.24	0.52	2.74	1.31	2.03	0.87	74.87	76.37	75.25

Return Period Peak	Miller Creek at Lake Reba			Miller Creek at SR509			Walker Creek at South 12th Street		SDN1	
	Pre-Project	1994[a]	Project	Pre-Project	1994[a]	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	2.41	5.95	2.50	20.96	24.98	22.30	1.04	0.31	0.28	0.12
Q_2	4.82	11.90	5.00	41.90	49.96	44.60	2.07	0.62	0.55	0.24
Q_{10}	7.29	16.55	7.41	62.97	69.99	64.41	3.83	1.80	0.76	0.40
Q_{25}	8.75	18.93	8.79	73.07	79.34	73.57	4.78	3.11	0.87	0.53
Q_{50}	9.93	20.73	9.91	80.43	86.08	80.14	5.51	4.66	0.96	0.66
Q_{100}	11.20	22.56	11.10	87.68	92.67	86.53	6.26	6.91	1.05	0.83

[a] 1994 conditions from calibration modeling.

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Table A-9. Summary of flood peak flow frequency results for Des Moines Creek subbasins (all values are cubic feet per second).

Return Period Peak	SASA[a]		SDS3		SDS3A	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	31.95	13.57	6.03	2.40	1.23	1.52
Q_2	63.90	27.13	12.06	4.79	2.45	3.05
Q_{10}	97.35	44.54	21.07	10.85	4.28	7.80
Q_{25}	116.65	56.20	26.92	16.51	5.47	12.09
Q_{50}	132.17	66.34	31.92	22.46	6.49	16.50
Q_{100}	148.69	77.82	37.52	30.39	7.62	22.26

Return Period Peak	SDS4		SDS - Point of Compliance #1		SDS - Point of Compliance #2	
	Pre-Project	Project	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	0.86	0.35	7.16	4.22	9.97	8.75
Q_2	1.72	0.69	14.32	8.44	19.94	17.51
Q_{10}	2.65	1.29	24.92	17.82	31.50	26.81
Q_{25}	3.21	1.80	31.91	25.67	38.68	32.46
Q_{50}	3.67	2.29	37.94	33.41	44.68	37.12
Q_{100}	4.17	2.92	44.73	43.17	51.27	42.19

Return Period Peak	SDS7		Des Moines Creek @ S. 200 St.	
	Pre-Project	Project	Pre-Project	Project
1/2 Q_2	1.44	0.64	45.88	35.51
Q_2	2.88	1.28	91.75	71.03
Q_{10}	5.13	2.77	155.01	113.48
Q_{25}	6.64	4.27	197.03	140.54
Q_{50}	7.95	5.91	233.38	163.42
Q_{100}	9.45	8.16	274.46	188.79

[a] STIA basins plus non-STIA basins D1 and D2 routed to pond. Retrofitting applied only to STIA drainage areas.

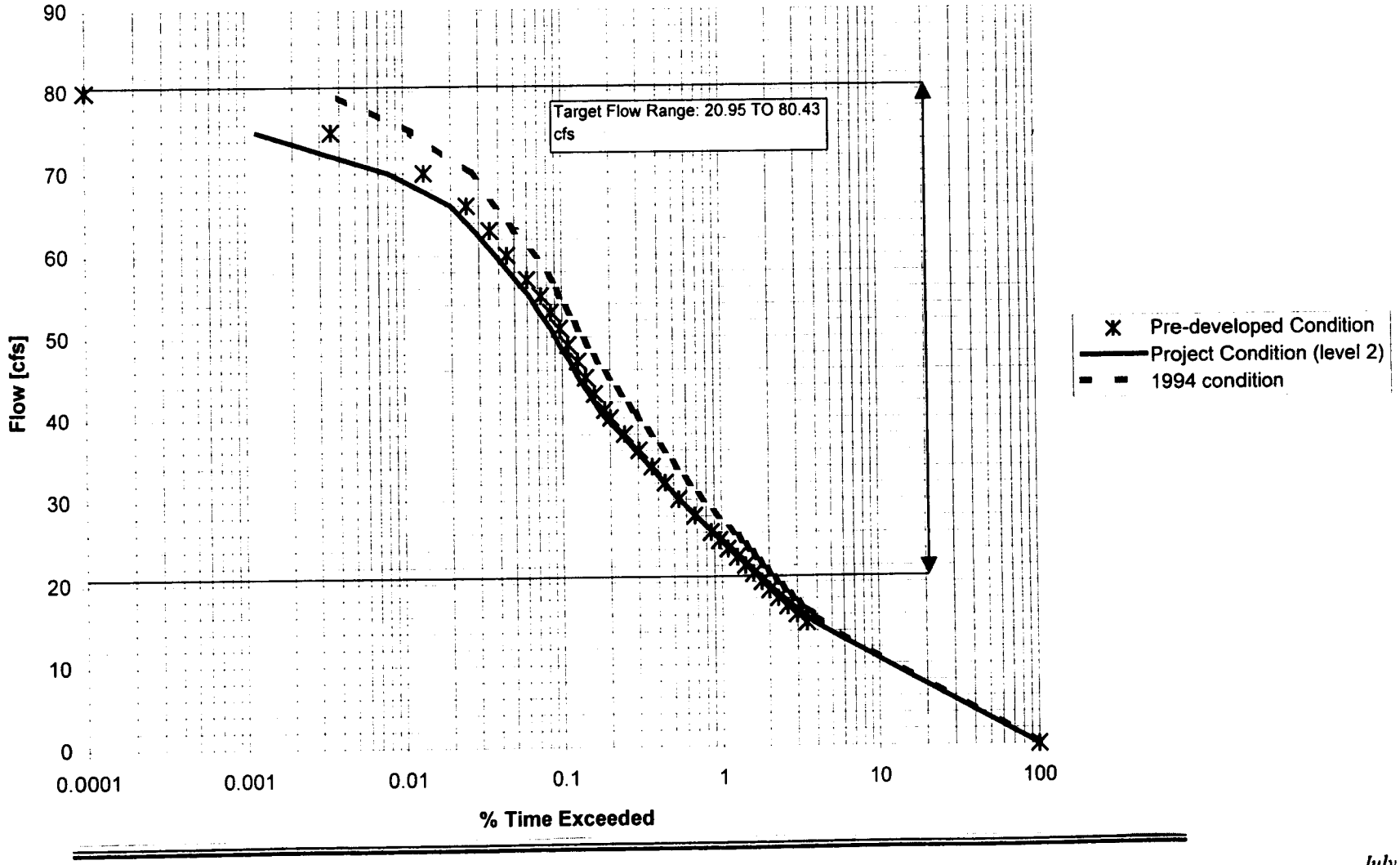

Figure A-8
Flow Duration Curve for
Miller Creek at SR509

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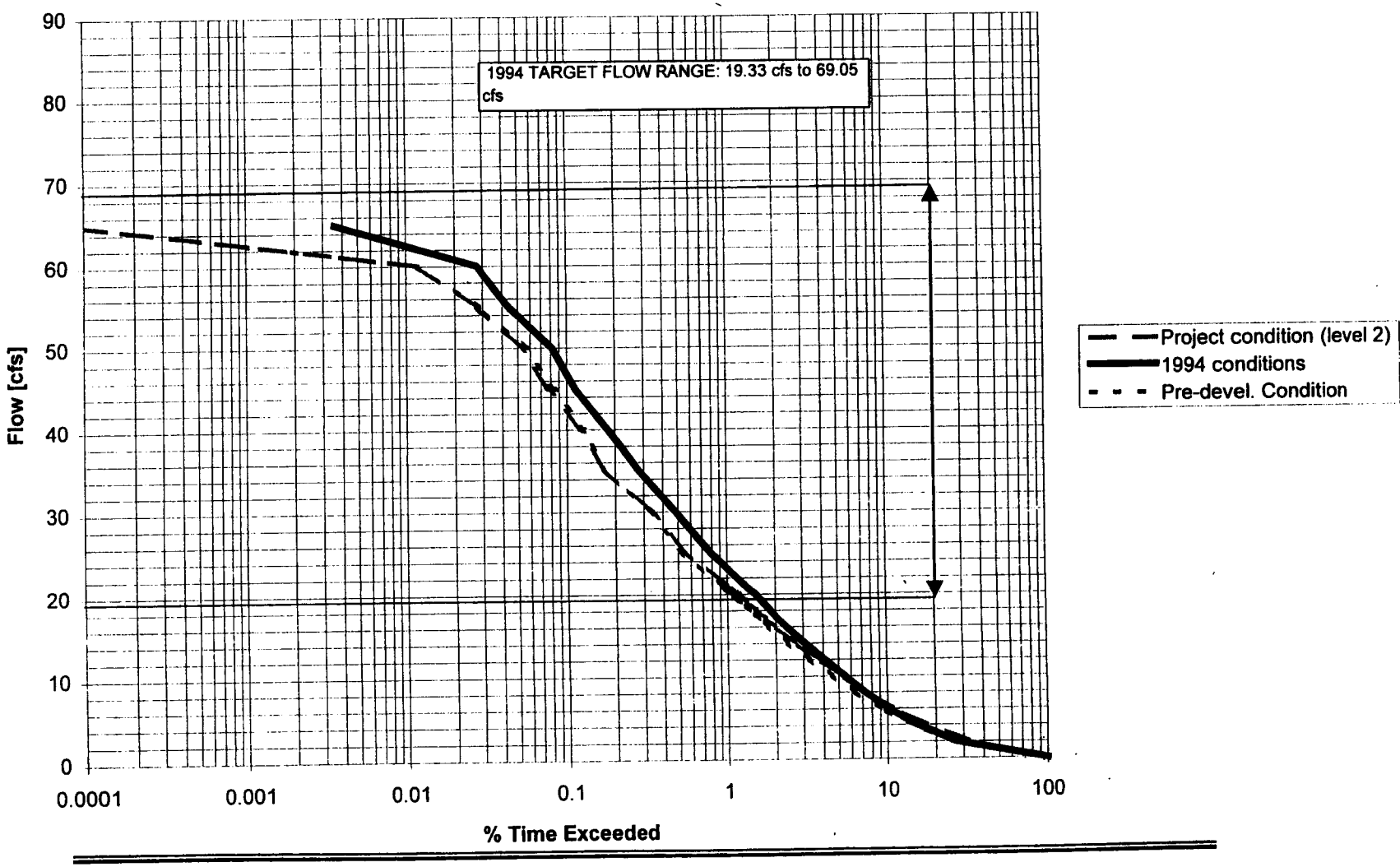

Figure A-9
Flow Duration Curve for Miller Creek at MCDF

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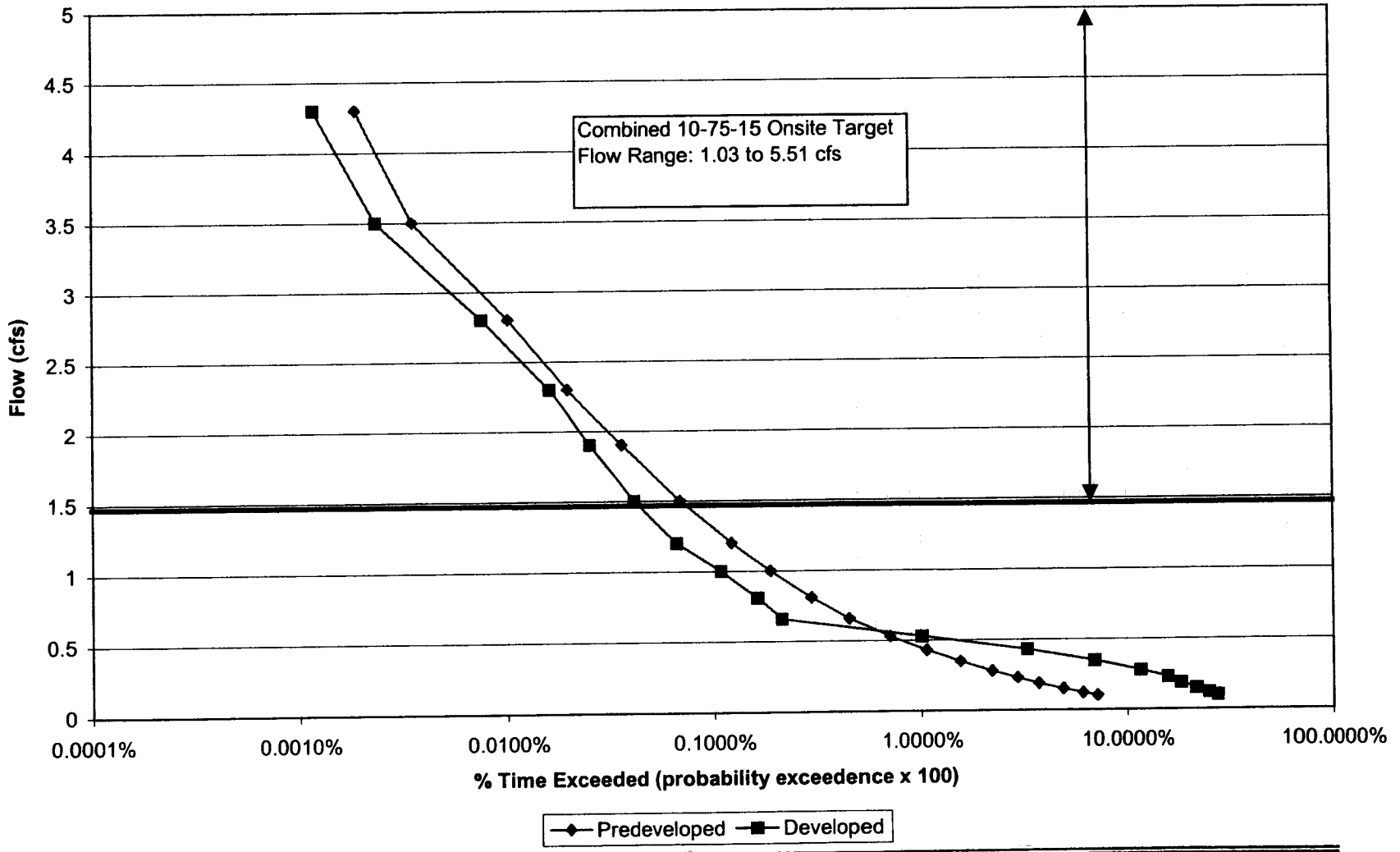

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Figure A-10
Flow Duration Curve for
Walker Creek at South 12th Street

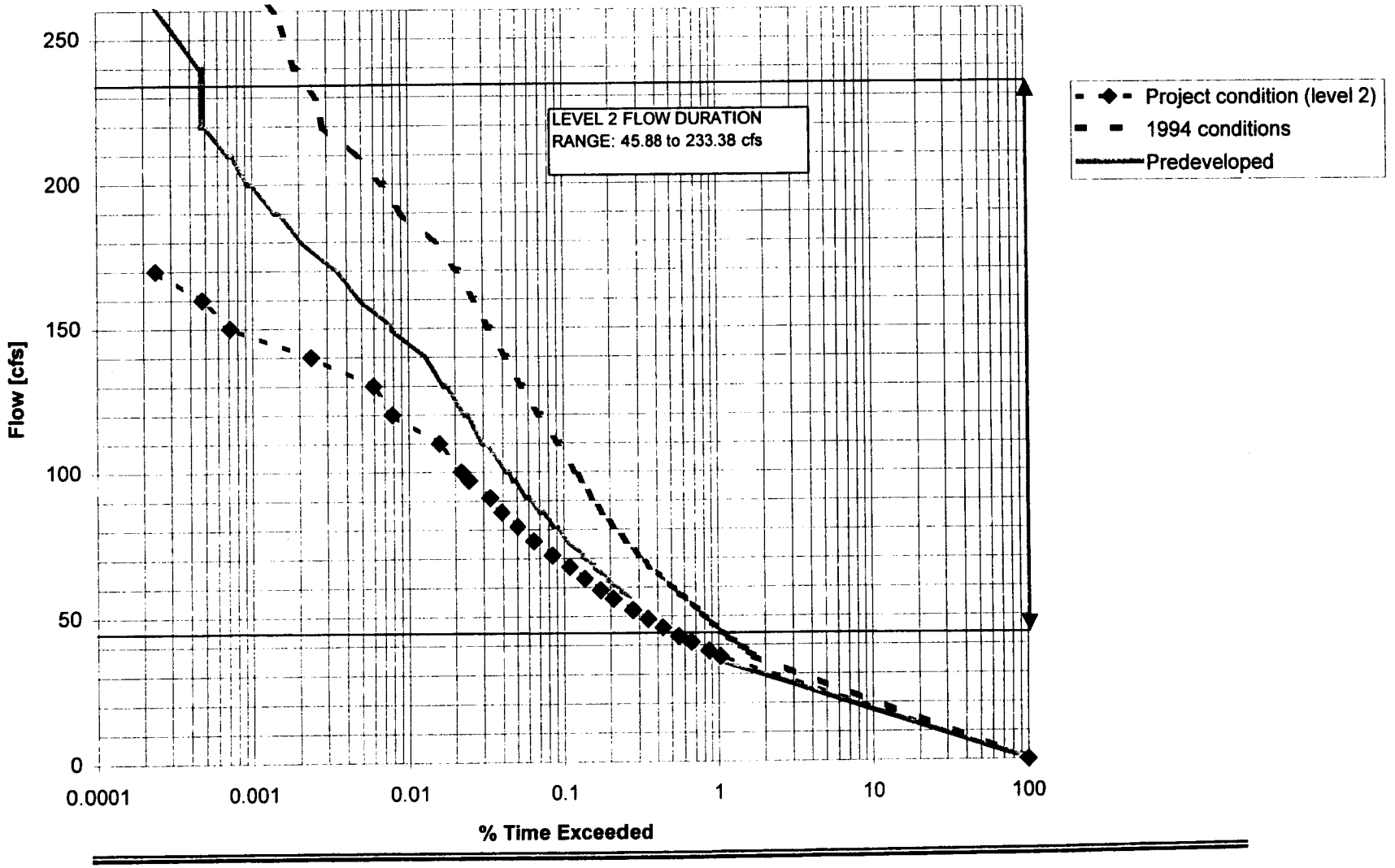

Figure A-11
Flow Duration Curves for Des Moines Creek at South 200th Street

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5. CONCLUSIONS

5.1 MILLER/WALKER CREEK

Detention facilities have been sized for subbasins draining to Miller and Walker Creeks that will meet Level 2 design standards. The maximum storage volumes that are detained during the HSPF simulation of project conditions are shown in Table A-7. Each facility controls runoff rates to less than pre-project conditions for the Level 2 flow duration analysis. The HSPF input files and outlet configurations derived from KCRTS used to develop the facility sizes are provided in Attachments C and D.

The analysis of detention for the North Employees Parking Lot (NEPL) assumed that 6 acres of impervious area would drain to the existing vault, and the remaining area (10 acres till grass and 36.3 acres impervious) would drain to a new vault. The existing vault outlet works will need to be reconfigured. Output from the KCRTS program is provided in Attachment C.

5.2 DES MOINES CREEK

Detention facilities have been sized for subbasins draining to Des Moines Creek that will meet Level 2 design standards. The maximum storage volumes detained during the HSPF simulation are shown in Table A-7. Each facility controls runoff rates to less than the pre-project (target) flow rates. The HSPF input files and outlet configurations derived from KCRTS used to develop the facility sizes are provided in Attachments C and D.

An analysis has been provided that shows the volume required for meeting Level 2 design criteria for the SASA detention facility in the event this detention facility is proposed to retrofit the non-STIA tributary area to predevelopment conditions. If the SASA detention facility were only required to provide stormwater management benefits for the STIA portion of the watershed, the size would be significantly less, as shown on Table A-7.

6. REFERENCES

HNTB. 2000. Personal communication with Alan Black, July 2000.

Port of Seattle. 1998. Third Runway embankment construction division 2, sitework specification.

U.S. Department of Interior Geological Survey. 1982. Guidelines for determining flood flow frequency for flood frequency analysis, Bulletin #17B.

ATTACHMENT A

Tables A-1a, A-1b, A-2a, and A-2b

Tables

A-1a Miller and Walker Creeks subbasin characteristics - pre-development

A-1b Miller and Walker Creeks subbasin characteristics - 2006

A-2a Des Moines Creek subbasin characteristics - pre-development

A-2b Des Moines Creek subbasin characteristics - 2006

Legend for Tables A-1a and A-1b

Soil Types:

M	Modified land (Holocene)
Qb	Beach deposits (Holocene)
Qpf	Sedimentary deposits of pre-Fraser glaciation age (Pleistocene)
Qu	Surficial deposits, undivided (Holocene and Pleistocene)
Qvi	Ice-contact deposits
Qvr	Recessional outwash deposits
Qvrl	Silt-dominated lowland lacustrine deposits
Qvt	Till
Qvu	Vashon drift, undivided
Qw	Wetland deposits (Holocene)
Qyal	Younger alluvium (Holocene)
SA	Wetland
TIA	Total impervious area
EIA	Effective impervious area

Land Use Types:

AP	Commercial airport and measured EIA
C	Commercial
TR	Transport
MF	Multi-family
HD	High density residential
LD	Low density residential
G	Grass or open
F	Forest

Bare ground asphalt
Bare rock concrete
Develop high intensity
Develop medium intensity
Develop low intensity

PERLND number refers to the unique soil pervious land segment in HSPF.
IMPLND refers to the impervious land segment.

shaded subbasins included in the STIA subbasin characteristics evaluation area.

Explanation of Calculation of Effective Impervious Area for Tables A-1a and A-1b

Unshaded Basins:

Table	Basins
A-1a	M1, M2, M3, M4, M4A, M11, M12, M13, M14, M15, M17, M18, M19, M21, M22, M23, M24
A-1b	M1, M2, M3, M4, M4A, M11, M12, M13, M14, M15, M17, M18, M19, M21, M22, M23, M24

Effective Impervious Area

Total acreage within the basin for a given land use and soil type * EIA percentage

Pervious Area

Total acreage within the basin for a given land use and soil type * (1 - EIA percentage)

STIA (shaded) Basins:

Table	Basins
A-1a	M8, M9, M10, M16, M20, MC4, MC5, MC6, MC7, MC8, MC9, SDN1-OFF, SDN3A, SDW1A, SDW1B, SDW2
A-1b	M5, M6, M8, M9, M10, M16, M20, MC1, MC2, MC3, MC4, MC5, MC6, MC7, MC8, MC9, CARGO, NEPL, SDN1, SDN1-LWR, SDN1-OFF, SDN2X, SDN3, SDN3A, SDN3X, SDN4, SDN4X, NCPS, NSMPS, IWS-Miller, SDW1A, SDW1B, SDW2

Effective Impervious Area

land use AP and TR: impervious acreage from GIS analyses
all other land use categories: total acreage within the basin for a given land use and soil type * EIA percentage

Pervious Area

land use AP and TR: pervious acreage within the basin for a given land use and soil type
all other land use categories: total acreage within the basin for a given land use and soil type * (1 - EIA percentage)

Remaining Pre-Development Condition Basins (Table A-1a):

Basins
M1, M2, M3, M4, M4A, M5, M6, MC1, MC2, MC3, NEPL, CARGO, SDN1, SDN1-LWR, SDN2X, SDN3, SDN3X, SDN4, SDN4X, NCPS, NSMPS, IWS-Miller These basins drain to the MCDF under pre-development conditions.

Effective Impervious Area

Total impervious area is 10 percent of the total basin acreage not including wetland area.

Pervious Area

75 percent of the total basin acreage not including wetland area is distributed as forest. 15 percent of the total basin acreage not including wetland area is distributed as grass. Forest and grass areas distributed proportionately to till and outwash according to the till and outwash total acreage proportions.

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			M-1 to M-22												MC-1 to MC-9	
		% of total basin	M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMM	Qvr	85%	0.53	3.01	-	-	-	-	5.35	30.34	0.02	0.12	7.04	39.91	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	0.46	2.60	-	-	-	-
	Qvt	85%	2.18	12.34	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	1.74	-	0.10	-
	Qvr	0%	-	-	-	-	3.83	-	11.34	-	7.22	-	10.76	-	3.82	-
	Qvrl	0%	-	-	-	-	-	-	-	-	3.48	-	0.95	-	-	-
	Qvt	0%	-	-	-	-	0.36	-	4.32	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	7.21	-	16.75	-	5.40	-	11.38	-	0.37
MF	Qvr	47%	0.62	0.55	6.68	5.92	5.13	4.55	19.97	17.71	1.19	1.06	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	0.20	0.17	-	-	-	-
HD	Qvr	15%	-	-	0.48	0.08	46.39	8.19	6.98	1.23	15.22	2.69	3.66	0.65	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	16.63	2.94	0.16	0.03	-	-
	Qvt	15%	-	-	-	-	14.03	2.48	19.60	3.46	-	-	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	0.16	0.01	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	0.01	0.00	-	-	-	-
	Qvr	4%	9.67	0.40	14.21	0.59	1.26	0.05	51.59	2.15	5.78	0.24	20.81	0.87	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	9.38	0.39	0.00	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	8.02	0.33	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.07	-
	Qvr	0%	39.23	-	0.84	-	0.10	-	-	-	1.98	-	11.16	-	7.33	-
	Qvrl	0%	-	-	-	-	-	-	-	-	0.00	-	9.37	-	-	-
	Qvt	0%	8.11	-	-	-	-	-	-	-	-	-	0.31	-	-	-
	Qw	0%	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			M-1 to M-22												MC-1 to MC-9	
		% of total basin	M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	1.17	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	0.77	-	-	-	-	-
	Qvr	0%	-	-	-	-	0.05	-	-	-	19.26	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	9.76	-	-	-	-	-
	Qvt	0%	-	-	-	-	4.98	-	4.15	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.27	-	-	-	-	-	-	-	-	-	33.43	-	0.27	-
	Lake		0.44		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		0.00		-		-		-	
Basin total:			71.08	16.31	22.21	6.60	76.14	22.47	131.32	71.98	92.70	15.62	99.40	52.83	11.60	0.37
PERLND areas:																
(16)	Till-Forest		-		-		4.98		4.15		10.93		-		-	
(26)	Till-Grass		10.29		-		14.38		31.94		30.30		12.53		0.17	
(34)	Outwash-Forest		-		-		0.05		-		20.03		-		-	
(44)	Outwash-Grass		50.05		22.21		56.71		95.23		31.43		53.43		11.15	
(54)	Wetland		10.74		-		0.01		-		-		33.43		0.27	
	subtotal:		71.08		22.21		76.14		131.32		92.70		99.40		11.60	
IMPLND areas:																
	EIA			16.31		6.60		22.47		71.98		15.62		52.83		0.37
Basin total:			87.39		28.80		98.61		203.30		108.32		152.23		11.97	
Percent Impervious				18.7%		22.9%		22.8%		35.4%		14.4%		34.7%		3.1%

AR 010354

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)											
			MC-1 to MC-9											
		% of total basin	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	2.55	-	1.32	-	-	-	-	-	-	-	0.02	-	1.19	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	0.22	-	0.43	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.27	-	0.01	-	-	-	-	-	-	-	-	-	0.01
MF	Qvr	47%	-	-	-	-	0.07	0.06	0.71	0.63	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	9.41	1.66	0.30	0.05	1.74	0.31	2.77	0.49	3.70	0.65
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	9.06	1.60	3.97	0.70
	Qw	15%	-	-	-	-	0.92	0.16	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	2.55	0.11	3.43	0.14	30.11	1.25	11.82	0.49	23.01	0.96	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.08	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	13.49	0.56	-	-	0.05	0.00	-	-
	Qw	4%	-	-	-	-	0.33	0.01	-	-	-	-	-	-	-	-
OG	M	0%	0.62	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	7.86	-	1.16	-	6.56	-	-	-	-	-	4.74	-	13.83	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.04	-	0.11	-
	Qw	0%	0.55	-	0.05	-	7.51	-	-	-	-	-	-	-	-	-

AR 010355

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-9													
		% of total basin	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	6.66	-	5.53	-	0.05	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	4.17	-	1.28	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.30	-	0.52	-	5.95	-	7.60	-	0.99	-	3.47	-	2.56	-
	Lake		2.98		-		3.33		0.76		0.29		0.24		-	
	Mcrk-df		7.00		13.17		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			33.04	0.27	12.83	0.11	34.24	2.04	52.21	2.50	14.55	0.80	43.24	3.05	25.36	1.36
PERLND areas:																
(16)	Till-Forest		0.08		-		-		-		-		-		-	
(26)	Till-Grass		0.64		-		-		13.49		-		9.23		4.08	
(34)	Outwash-Forest		6.66		5.53		0.05		-		-		-		-	
(44)	Outwash-Grass		10.41		5.03		19.47		31.13		13.56		30.54		18.72	
(54)	Wetland		15.25		2.27		14.72		7.60		0.99		3.47		2.56	
	subtotal:		33.04		12.83		34.24		52.21		14.55		43.24		25.36	
IMPLND areas:																
	EIA			0.27		0.11		2.04		2.50		0.80		3.05		1.36
Basin total:			33.31		12.94		36.28		54.71		15.35		46.29		26.73	
Percent Impervious				0.8%		0.9%		5.6%		4.6%		5.2%		6.6%		5.1%

AR 010356

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-9										SDS Basins			
		% of total basin	MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	1.31	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	0.47	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	1.93	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-
	TIA	100%	-	0.23	-	-	-	-	-	-	-	-	-	8.69	-	-
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	0.15	0.87	0.08	0.44	0.23	1.31	-	-	-	-
TRANS	M	0%	1.76	-	-	-	-	-	0.03	-	0.03	-	-	-	-	-
	Qvr	0%	0.33	-	-	-	-	-	3.44	-	3.44	-	0.78	-	0.10	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	0.01	-	0.01	-	0.03	-	-	-
	TIA	100%	-	0.01	-	-	-	-	-	4.79	-	4.79	-	1.22	-	0.38
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	6.09	1.07	-	-	5.70	1.01	5.70	1.01	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	6.37	-	-	-	-	-	0.21	-	0.21	-	-	-	-	-
	Qvr	0%	0.41	-	-	-	2.40	-	8.35	-	10.74	-	1.05	-	4.87	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	0.96	-	21.32	-	14.35	-	35.66	-	1.82	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 010357

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-9										SDS Basins			
		% of total basin	MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	0.07	-	0.07	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	8.78	-	13.43	-	22.21	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	8.77	-	1.37	-	10.14	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	0.80	-	0.80	-	-	-	0.07	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		0.07		-		-		-	
	Other		-		-		-		0.01		0.01		-		-	
Basin total:			10.19	0.24	7.04	1.07	41.42	0.87	47.84	6.23	89.26	7.11	6.24	9.90	5.04	0.38
PERLND areas:																
(16)	Till-Forest		-		6.09		23.15		1.43		24.58		7.27		-	
(26)	Till-Grass		9.44		1.22		4.63		20.37		25.00		1.45		-	
(34)	Outwash-Forest		-		-		8.57		13.43		22.00		4.69		4.01	
(44)	Outwash-Grass		0.74		-		1.71		11.79		13.50		0.94		0.96	
(54)	Wetland		-		-		-		0.82		0.82		0.20		0.07	
	subtotal:		10.19		7.31		38.06		47.84		85.90		14.55		5.04	
IMPLND areas:																
	EIA			0.24		0.81		4.23		6.23		10.46		1.59		0.38
Basin total:			10.43		8.12		42.29		54.07		96.36		16.14		5.42	
Percent Impervious				2.3%		10.0%		10.0%		11.5%		10.9%		9.9%		7.0%

AR 010358

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
		% of total basin	SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	6.62	-	-	-	-	-	-	-	19.72	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-
	Qvt	0%	-	-	-	-	18.87	-	-	-	-	-	-	-	0.06	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	14.50	-	-	-	-	-	-	-	2.63
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.28	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	1.76	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	1.63	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	7.88	-	-	-	-	-	-	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	2.12	0.37	8.28	1.46	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	14.65	2.58	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	0.62	0.03	0.16	0.01	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.00	-	1.14	-	0.02	-	-	-	-	-	-	-	4.70	-
	Qvr	0%	0.37	-	3.12	-	-	-	1.09	-	1.74	-	5.01	-	3.18	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	3.40	-	-	-	7.85	-	5.27	-	-	-	6.94	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 010359

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)											
			SDS Basins											
		% of total basin	SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	1.03	-	8.09	-	12.20	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	0.65	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	0.04	-	-	-	-	-	-	-	0.19	-	0.57	-	-	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		0.04		-		-		-		-		-		-	
Basin total:			25.81	10.46	4.26	-	33.36	14.50	10.13	0.40	18.45	1.47	25.38	-	27.69	2.63
PERLND areas:																
(16)	Till-Forest		21.99		0.85		35.89		4.18		-		4.71		20.23	
(26)	Till-Grass		4.40		0.28		7.18		1.18		-		1.57		4.41	
(34)	Outwash-Forest		3.96		2.34		-		3.72		14.80		13.89		2.50	
(44)	Outwash-Grass		0.79		0.78		-		1.05		3.47		4.63		0.55	
(54)	Wetland		1.67		-		-		-		0.19		0.57		-	
	subtotal:		32.81		4.26		43.07		10.13		18.45		25.38		27.69	
IMPLND areas:																
	EIA			3.46		-		4.79		0.40		1.47		-		2.63
Basin total:			36.27		4.26		47.86		10.52		19.92		25.38		30.32	
Percent Impervious				9.5%		0.0%		10.0%		3.8%		7.4%		0.0%		8.7%

AR 010360

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)													
			SDS Basins		IWS Basins						SDS Basins					
		% of total basin	SDN-4X		IWS-NCPS		IWS-NSMPS		IWS-Miller		SDW-1A-I		SDW-1A-O		SDW-1B-I	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	1.83	-	6.52	-	1.97	-	0.06	-	-	-	-	-	14.15	-
	Qvr	0%	0.66	-	-	-	1.02	-	0.08	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	0.33	-	-	-	-	-	0.47	-
	Qw	0%	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
	TIA	100%	-	1.05	-	28.79	-	0.04	-	30.41	-	-	-	-	-	2.02
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	0.50	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	0.06	0.01	0.75	0.13
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	-	-	4.63	0.82
	Qw	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	8.50	0.35	12.14	0.51	4.95	0.21
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.22	-	0.41	-	1.73	-	-	-	-	-	-	-	2.49	-
	Qvr	0%	9.51	-	-	-	1.86	-	8.55	-	4.18	-	-	-	14.61	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	0.71	-	-	-	-	-	3.83	-	24.10	-	-	-	31.33	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 010361

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)											
			SDS Basins		IWS Basins						SDS Basins			
			SDN-4X		IWS-NCPS		IWS-NSMPS		IWS-Miller		SDW-1A-I		SDW-1A-O		SDW-1B-I	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	1.22	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	-	-	0.33	-	2.63	-	3.31	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			14.14	1.05	6.93	28.79	6.58	0.04	12.86	30.92	37.11	0.35	14.84	0.52	76.68	3.18
PERLND areas:																
(16)	Till-Forest		2.43		26.79		2.80		26.61		19.00		-		41.99	
(26)	Till-Grass		0.59		5.36		0.91		5.32		6.09		-		11.67	
(34)	Outwash-Forest		8.96		-		2.17		6.22		8.86		9.54		15.42	
(44)	Outwash-Grass		2.16		-		0.70		1.24		2.84		2.66		4.29	
(54)	Wetland		-		-		-		0.00		0.33		2.63		3.31	
	subtotal:		14.14		32.14		6.58		39.40		37.11		14.84		76.68	
IMPLND areas:																
	EIA			1.05		3.57		0.04		4.38		0.35		0.52		3.18
Basin total:			15.18		35.71		6.63		43.78		37.47		15.36		79.86	
Percent Impervious				6.9%		10.0%		0.7%		10.0%		0.9%		3.4%		4.0%

AR 010362

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)								Sub-basin Area (ac)	
			SDS Basins								SDS Basin	
		% of total basin	SDW-1B-O		SDW-2		Total		Percent of Total		Special MC-8b	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	19.07	-	71.25	-	4.85%	0.00%	0.69	-
	Qvr	0%	-	-	-	-	2.25	-	0.15%	0.00%	-	-
	Qvt	0%	-	-	0.54	-	22.20	-	1.51%	0.00%	0.63	-
	Qw	0%	-	-	-	-	0.18	-	0.01%	0.00%	-	-
	TIA	100%	-	-	-	1.94	-	90.30	0.00%	6.14%	-	0.28
COMM	Qvr	85%	-	-	-	-	12.95	73.39	0.88%	4.99%	-	-
	Qvrl	85%	-	-	-	-	0.46	2.60	0.03%	0.18%	-	-
	Qvt	85%	-	-	-	-	2.41	13.66	0.16%	0.93%	-	-
TRANS	M	0%	-	-	-	-	4.33	-	0.29%	0.00%	-	-
	Qvr	0%	-	-	-	-	49.99	-	3.40%	0.00%	-	-
	Qvrl	0%	-	-	-	-	4.44	-	0.30%	0.00%	-	-
	Qvt	0%	-	-	-	-	6.43	-	0.44%	0.00%	-	-
	Qw	0%	-	-	-	-	2.33	-	0.16%	0.00%	-	-
	TIA	100%	-	-	-	-	-	56.16	0.00%	3.82%	-	-
MF	Qvr	47%	-	-	-	-	34.37	30.48	2.34%	2.07%	-	-
	Qvrl	47%	-	-	-	-	0.20	0.17	0.01%	0.01%	-	-
HD	Qvr	15%	0.89	0.16	1.54	0.27	95.06	16.78	6.46%	1.14%	4.28	0.76
	Qvrl	15%	-	-	-	-	16.79	2.96	1.14%	0.20%	-	-
	Qvt	15%	4.21	0.74	6.26	1.11	83.98	14.82	5.71%	1.01%	6.59	1.16
	Qw	15%	-	-	-	-	0.92	0.16	0.06%	0.01%	-	-
LD	M	4%	-	-	-	-	0.16	0.01	0.01%	0.00%	-	-
	Qu	4%	-	-	-	-	0.01	0.00	0.00%	0.00%	-	-
	Qvr	4%	6.30	0.26	-	-	188.30	7.85	12.80%	0.53%	-	-
	Qvrl	4%	-	-	-	-	9.46	0.39	0.64%	0.03%	-	-
	Qvt	4%	-	-	-	-	21.56	0.90	1.47%	0.06%	-	-
	Qw	4%	-	-	-	-	0.33	0.01	0.02%	0.00%	-	-
OG	M	0%	-	-	0.41	-	18.40	-	1.25%	0.00%	1.85	-
	Qvr	0%	-	-	0.78	-	164.14	-	11.16%	0.00%	16.42	-
	Qvrl	0%	-	-	-	-	9.37	-	0.64%	0.00%	-	-
	Qvt	0%	-	-	11.55	-	142.00	-	9.66%	0.00%	11.15	-
	Qw	0%	-	-	-	-	8.59	-	0.58%	0.00%	-	-

AR 010363

Table A-1a. Miller and Walker Creeks Subasin Characteristics - Predevelopment (STIA basins)

Land Use			Sub-basin Areas (acres)								Sub-basin Area (ac)	
			SDS Basins								SDS Basin	
		% of total basin	SDW-1B-O		SDW-2		Total		Percent of Total		Special MC-8b	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Effective Pervious	Effective Impervious
F	M	0%	-	-	-	-	1.32	-	0.09%	0.00%	-	-
	Qu	0%	-	-	-	-	0.77	-	0.05%	0.00%	-	-
	Qvr	0%	-	-	-	-	68.20	-	4.64%	0.00%	-	-
	Qvrl	0%	-	-	-	-	9.76	-	0.66%	0.00%	-	-
	Qvt	0%	-	-	-	-	19.92	-	1.35%	0.00%	-	-
	Qw	0%	-	-	-	-	5.44	-	0.37%	0.00%	-	-
	Wetland	0%	4.43	-	1.13	-	81.62	-	5.55%	0.00%	1.05	-
	Lake		-		-		8.04		0.55%	0.00%	-	
	Mcrk-df		-		-		20.24		1.38%	0.00%	-	
	Other		-		-		0.04		0.00%	0.00%	-	
Basin total:			15.84	1.16	41.29	3.31	1159.88	310.64	78.88%	21.12%	42.66	2.20
PERLND areas:												
(16)	Till-Forest		3.26		30.91		299.72		19.68%		16.38	
(26)	Till-Grass		0.68		8.68		222.50		14.61%		4.37	
(34)	Outwash-Forest		6.17		1.69		163.27		10.72%		16.47	
(44)	Outwash-Grass		1.30		0.48		492.15		32.32%		4.39	
(54)	Wetland		4.43		1.13		106.66		7.00%		1.05	
	subtotal:		15.84		42.89		1284.31		84.34%		42.66	
IMPLND areas:												
	EIA			1.16		1.71		238.51		15.66%		2.20
Basin total:			17.00		44.60		1522.81		100.00%		44.86	
Percent Impervious				6.8%		3.8%						4.9%

AR 010364

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
	Soil	equal to		Effective		Effective		Effective		Effective		Effective		Effective		Effective
Land Use	Type	EIA	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious	Pervious	Impervious
Bare	M	85%	-	-	0.49	2.77	-	-	0.00	0.01	0.37	2.11	0.24	1.33	-	-
Ground	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.76	4.31	0.85	4.82	1.58	8.96	0.56	3.18	0.99	5.61	11.64	65.96	1.21	6.86
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.67	3.77	1.21	6.88
	Qvt	85%	3.62	20.53	1.99	11.26	0.10	0.56	0.12	0.71	0.54	3.03	9.34	52.91	5.32	30.15
	Qw	85%	-	-	-	-	-	-	-	-	0.07	0.37	-	-	0.25	1.42
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.01	0.04	-	-
Rock	Qvr	85%	0.05	0.26	-	-	0.02	0.13	-	-	-	-	0.59	3.36	0.11	0.62
Concrete	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	0.07	0.39	-	-	-	-	-	-	0.05	0.26	0.26	1.48	0.14	0.80
Develop	M	85%	-	-	0.22	1.27	-	-	-	-	0.08	0.47	0.11	0.61	-	-
High	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.43	2.46	0.06	0.34	0.59	3.33	0.23	1.31	0.10	0.57	7.59	42.99	0.50	2.81
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.12	0.70	0.18	1.03
	Qvt	85%	0.87	4.95	0.47	2.68	0.24	1.38	0.08	0.45	1.70	9.64	5.96	33.78	2.64	14.97
	Qw	85%	0.00	0.02	-	-	-	-	-	-	0.00	0.02	-	-	0.27	1.52
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	0.43	0.05	-	-	0.87	0.10	1.89	0.21	0.67	0.07	-	-
Medium	Qb	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	10%	25.02	2.78	23.96	2.66	30.84	3.43	43.41	4.82	11.93	1.33	34.17	3.80	29.76	3.31
	Qvrl	10%	-	-	-	-	-	-	-	-	-	-	1.07	0.12	4.03	0.45
	Qvt	10%	153.51	17.06	113.34	12.59	51.26	5.70	37.01	4.11	19.59	2.18	161.00	17.89	65.20	7.24
	Qvu	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	10%	0.42	0.05	-	-	0.04	0.00	-	-	0.35	0.04	-	-	0.05	0.01
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop.	M	4%	-	-	-	-	-	-	1.01	0.04	1.81	0.08	0.45	0.02	-	-
Low	Qb	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	10.82	0.45	13.18	0.55	42.19	1.76	44.72	1.86	49.05	2.04	10.49	0.44	21.25	0.89
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.15	0.01	3.02	0.13
	Qvt	4%	66.93	2.79	77.05	3.21	49.44	2.06	43.74	1.82	27.82	1.16	36.85	1.54	18.11	0.75
	Qvu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	1.98	0.08	-	-	-	-	-	-	0.82	0.03	-	-	0.07	0.00
	Qyal	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 010365

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	0.62	-	-	-	0.01	-	2.76	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.95	-	0.65	-	27.67	-	3.14	-	16.01	-	1.17	-	2.16	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-
	Qvt	0%	7.36	-	5.44	-	7.34	-	3.11	-	5.04	-	1.04	-	0.71	-
	Qw	0%	0.39	-	-	-	-	-	-	-	1.28	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.07	-	0.46	-	16.02	-	3.75	-	22.06	-	1.32	-	5.64	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-
	Qvt	0%	3.41	-	5.56	-	8.26	-	2.95	-	8.66	-	0.89	-	0.31	-
	Qw	0%	1.08	-	-	-	-	-	-	-	0.66	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland		-		-		-		-		9.32		-		-	
	Lake		4.59		-		-		-		2.13		-		0.65	
	Other		-		-		-		-		-		-		-	
Basin total:			280.75	56.14	244.78	42.22	235.59	27.30	184.72	18.43	173.62	29.14	285.78	230.80	162.84	79.83
PERLND areas:																
perlnd 16	Till-forest		3.41		5.56		8.26		2.95		8.66		0.89		0.39	
perlnd 26	Till-grass		232.36		200.05		108.38		85.95		61.64		217.92		101.18	
perlnd 34	Outwash-forest		3.07		0.46		16.02		3.75		22.06		1.32		5.64	
perlnd 44	Outwash-grass		38.03		38.71		102.89		92.06		78.09		65.65		54.98	
perlnd 54	Wetland		3.87		-		0.04		-		12.50		-		0.64	
	subtotal:		280.75		244.78		235.59		184.72		182.95		285.78		162.84	
IMPLND areas:																
	EIA			56.14		42.22		27.30		18.43		29.14		230.80		79.83
Basin total:			336.89		286.99		262.89		203.14		212.09		516.59		242.67	
Percent Impervious				16.7%		14.7%		10.4%		9.1%		13.7%		44.7%		32.9%

AR 010366

Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare Ground Asphalt	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qb	85%	-	-	-	-	-	-	0.06	0.31	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.99	5.61	0.24	1.39	-	-	2.12	12.02	2.55	14.45
	Qvrl	85%	-	-	-	-	0.42	2.38	-	-	-	-	0.03	0.14	-	-
	Qvt	85%	1.09	6.20	0.81	4.60	0.03	0.19	-	-	-	-	0.08	0.46	0.66	3.76
	Qw	85%	-	-	-	-	-	-	0.01	0.04	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare Rock Concrete	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	-	-	-	-	0.19	1.05	-	-	0.02	0.10	0.09	0.52
	Qvrl	85%	-	-	-	-	0.05	0.26	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	0.12	0.66	-	-	-	-	-	-	-	-	0.03	0.15
Develop High Intensity	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qb	85%	-	-	-	-	-	-	0.03	0.16	-	-	-	-	-	-
	Qpf	85%	-	-	-	-	0.03	0.15	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.14	0.77	0.56	3.15	0.01	0.05	0.41	2.31	0.92	5.20
	Qvrl	85%	-	-	-	-	0.12	0.66	-	-	-	-	0.11	0.60	-	-
	Qvt	85%	0.87	4.95	0.35	1.97	0.07	0.39	-	-	-	-	0.27	1.52	1.15	6.51
	Qw	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop Medium Intensity	M	10%	-	-	-	-	-	-	-	-	-	-	0.71	0.08	-	-
	Qb	10%	-	-	-	-	-	-	0.17	0.02	-	-	-	-	-	-
	Qpf	10%	-	-	0.16	0.02	1.37	0.15	2.75	0.31	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	1.47	0.16
	Qvr	10%	-	-	13.61	1.51	20.11	2.23	5.84	0.65	6.70	0.74	45.89	5.10	52.06	5.78
	Qvrl	10%	-	-	-	-	3.38	0.38	-	-	-	-	21.79	2.42	-	-
	Qvt	10%	122.70	13.63	82.83	9.20	27.53	3.06	1.20	0.13	2.21	0.25	16.06	1.78	75.17	8.35
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	-	-	-	-	-	-
	Qw	10%	-	-	-	-	-	-	0.38	0.04	-	-	-	-	-	-
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.00
Develop. Low Intensity	M	4%	-	-	-	-	-	-	-	-	-	-	1.23	0.05	-	-
	Qb	4%	-	-	-	-	-	-	0.05	0.00	-	-	-	-	-	-
	Qpf	4%	-	-	2.21	0.09	3.36	0.14	8.61	0.36	-	-	-	-	-	-
	Qu	4%	-	-	-	-	1.42	0.06	-	-	-	-	0.10	0.00	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	2.87	0.12
	Qvr	4%	-	-	23.03	0.96	55.70	2.32	51.91	2.16	41.48	1.73	44.89	1.87	57.86	2.41
	Qvrl	4%	-	-	-	-	7.20	0.30	-	-	-	-	37.05	1.54	-	-
	Qvt	4%	69.05	2.88	33.29	1.39	9.84	0.41	14.64	0.61	12.79	0.53	12.72	0.53	52.24	2.18
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	0.98	0.04	-	-	-	-	-	-
	Qyal	4%	-	-	-	-	-	-	0.82	0.03	-	-	-	-	0.36	0.02

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Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	0.20	-	0.45	-	0.99	-	-	-	-	-	-	-
	Qvr	0%	-	-	2.66	-	2.97	-	9.39	-	1.03	-	2.13	-	5.18	-
	Qvrl	0%	-	-	-	-	0.23	-	-	-	-	-	1.70	-	-	-
	Qvt	0%	3.96	-	1.28	-	0.70	-	0.47	-	1.08	-	0.34	-	3.66	-
	Qw	0%	-	-	-	-	-	-	0.55	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	0.32	-	-	-
	Qpf	0%	-	-	2.48	-	-	-	1.83	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	3.20	-	-	-	-	-	0.24	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	10.98	-	46.89	-	29.25	-	20.95	-	8.15	-	5.96	-
	Qvrl	0%	-	-	-	-	0.41	-	-	-	-	-	12.09	-	-	-
	Qvt	0%	0.79	-	0.24	-	6.18	-	0.90	-	0.76	-	0.30	-	7.61	-
	Qw	0%	-	-	-	-	-	-	0.27	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	3.73	-	-	-	-	-	0.13	-
	Wetland		-		-		-		-		-		-		-	
	Lake		41.70		-		-		0.24		-		0.25		-	
	Other		-		-		-		-		-		-		-	
Basin total:			198.47	27.66	174.29	20.66	192.75	19.47	136.33	10.49	87.00	3.30	208.72	30.53	269.99	49.63
PERLND areas:																
perlnd 16	Till-forest		0.79		0.24		6.59		0.90		0.76		12.72		7.61	
perlnd 26	Till-grass		197.68		118.67		49.55		16.31		16.08		92.07		132.91	
perlnd 34	Outwash-forest		-		13.46		50.09		34.82		20.95		8.39		6.09	
perlnd 44	Outwash-grass		-		41.91		86.52		82.11		49.22		95.55		123.39	
perlnd 54	Wetland		-		-		-		2.19		-		-		-	
	subtotal:		198.47		174.29		192.75		136.33		87.00		208.72		269.99	
IMPLND areas:																
	EIA			27.66		20.66		19.47		10.49		3.30		30.53		49.63
Basin total:			226.12		194.94		212.22		146.82		90.30		239.25		319.62	
Percent Impervious				12.2%		10.6%		9.2%		7.1%		3.7%		12.8%		15.5%

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Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
			Non-STIA Basins of M-1 to M-24									
		% of total basin	M-22		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	1.19	6.75	2.29	12.98	0.06%	0.32%
Ground	Qb	85%	0.20	1.11	-	-	-	-	0.25	1.43	0.01%	0.04%
Asphalt	Qvi	85%	0.00	0.01	-	-	-	-	0.00	0.01	0.00%	0.00%
	Qvr	85%	-	-	1.12	6.34	2.54	14.41	27.19	154.06	0.67%	3.78%
	Qvrl	85%	-	-	0.17	0.96	-	-	2.49	14.14	0.06%	0.35%
	Qvt	85%	-	-	3.61	20.44	3.69	20.88	31.00	175.66	0.76%	4.31%
	Qw	85%	0.06	0.32	-	-	-	-	0.38	2.15	0.01%	0.05%
	Qyal	85%	0.02	0.13	-	-	-	-	0.02	0.13	0.00%	0.00%
Bare	M	85%	-	-	-	-	-	-	0.01	0.04	0.00%	0.00%
Rock	Qvr	85%	-	-	0.16	0.93	0.53	3.02	1.76	10.00	0.04%	0.25%
Concrete	Qvrl	85%	-	-	-	-	-	-	0.05	0.26	0.00%	0.01%
	Qvt	85%	-	-	0.16	0.91	0.07	0.39	0.89	5.05	0.02%	0.12%
Develop	M	85%	-	-	-	-	0.17	0.97	0.59	3.32	0.01%	0.08%
High	Qb	85%	0.04	0.25	-	-	-	-	0.07	0.41	0.00%	0.01%
Intensity	Qpf	85%	-	-	-	-	-	-	0.03	0.15	0.00%	0.00%
	Qvi	85%	0.02	0.11	-	-	-	-	0.02	0.11	0.00%	0.00%
	Qvr	85%	-	-	0.33	1.88	1.45	8.20	13.33	75.53	0.33%	1.85%
	Qvrl	85%	-	-	0.22	1.27	-	-	0.75	4.25	0.02%	0.10%
	Qvt	85%	-	-	1.38	7.83	1.33	7.54	17.39	98.56	0.43%	2.42%
	Qw	85%	0.02	0.13	-	-	-	-	0.30	1.69	0.01%	0.04%
	Qyal	85%	0.12	0.66	-	-	-	-	0.12	0.66	0.00%	0.02%
Develop	M	10%	-	-	-	-	2.47	0.27	7.04	0.78	0.17%	0.02%
Medium	Qb	10%	0.14	0.02	-	-	-	-	0.31	0.03	0.01%	0.00%
Intensity	Qpf	10%	-	-	-	-	-	-	4.28	0.48	0.11%	0.01%
	Qvi	10%	4.17	0.46	-	-	-	-	5.65	0.63	0.14%	0.02%
	Qvr	10%	0.07	0.01	28.90	3.21	40.50	4.50	412.77	45.86	10.13%	1.13%
	Qvrl	10%	-	-	2.78	0.31	-	-	33.04	3.67	0.81%	0.09%
	Qvt	10%	-	-	111.89	12.43	103.71	11.52	1144.19	127.13	28.09%	3.12%
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	0.00%	0.00%
	Qw	10%	0.81	0.09	-	-	-	-	2.05	0.23	0.05%	0.01%
	Qyal	10%	1.31	0.15	-	-	-	-	1.33	0.15	0.03%	0.00%
Develop.	M	4%	-	-	-	-	0.19	0.01	4.68	0.20	0.11%	0.00%
Low	Qb	4%	-	-	-	-	-	-	0.05	0.00	0.00%	0.00%
Intensity	Qpf	4%	-	-	-	-	-	-	14.18	0.59	0.35%	0.01%
	Qu	4%	-	-	-	-	-	-	1.51	0.06	0.04%	0.00%
	Qvi	4%	6.50	0.27	-	-	-	-	9.37	0.39	0.23%	0.01%
	Qvr	4%	0.71	0.03	14.46	0.60	17.88	0.74	499.61	20.82	12.26%	0.51%
	Qvrl	4%	-	-	2.73	0.11	-	-	50.15	2.09	1.23%	0.05%
	Qvt	4%	-	-	29.04	1.21	18.29	0.76	571.83	23.83	14.04%	0.58%
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	0.01%	0.00%
	Qw	4%	0.42	0.02	-	-	-	-	4.26	0.18	0.10%	0.00%
	Qyal	4%	4.61	0.19	-	-	-	-	5.80	0.24	0.14%	0.01%

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Table A-1a. Miller and Walker Creeks Subbasin Characteristics - Predevelopment (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
			Non-STIA Basins of M-1 to M-24									
		% of total basin	M-22		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	-	-	0.89	-	4.29	-	0.11%	0.00%
	Qb	0%	0.01	-	-	-	-	-	0.01	-	0.00%	0.00%
	Qpf	0%	-	-	-	-	-	-	1.63	-	0.04%	0.00%
	Qvr	0%	0.08	-	0.87	-	6.39	-	82.44	-	2.02%	0.00%
	Qvrl	0%	-	-	0.79	-	-	-	3.34	-	0.08%	0.00%
	Qvt	0%	-	-	3.37	-	3.43	-	48.31	-	1.19%	0.00%
	Qw	0%	1.83	-	-	-	-	-	4.05	-	0.10%	0.00%
	Qyal	0%	1.49	-	-	-	-	-	1.53	-	0.04%	0.00%
Forest	M	0%	-	-	-	-	-	-	0.32	-	0.01%	0.00%
	Qpf	0%	-	-	-	-	-	-	4.31	-	0.11%	0.00%
	Qu	0%	-	-	-	-	-	-	3.44	-	0.08%	0.00%
	Qvi	0%	0.64	-	-	-	-	-	0.64	-	0.02%	0.00%
	Qvr	0%	1.32	-	2.25	-	2.02	-	180.10	-	4.42%	0.00%
	Qvrl	0%	-	-	1.03	-	-	-	13.61	-	0.33%	0.00%
	Qvt	0%	-	-	2.06	-	-	-	48.88	-	1.20%	0.00%
	Qw	0%	0.07	-	-	-	-	-	2.08	-	0.05%	0.00%
	Qyal	0%	2.35	-	-	-	-	-	6.21	-	0.15%	0.00%
	Wetland		-		-		-		9.32		0.23%	
	Lake		0.47		0.94		0.33		51.30		1.26%	
	Other		-		-		-		-		0.00%	
Basin total:			27.01	3.95	207.33	58.44	206.74	79.98	3286.03	787.96	80.66%	19.34%
PERLND areas:												
perlnd 16	Till-forest		-		3.09		-		62.82		1.54%	
perlnd 26	Till-grass		-		156.15		135.43		1922.33		47.19%	
perlnd 34	Outwash-forest		4.30		2.25		2.02		194.70		4.78%	
perlnd 44	Outwash-grass		19.49		45.84		69.29		1083.74		26.60%	
perlnd 54	Wetland		3.21		-		-		22.44		0.55%	
	subtotal:		27.01		207.33		206.74		3286.03		80.66%	
IMPLND areas:												
	EIA			3.95		58.44		79.98		787.96		19.34%
Basin total:			30.96		265.77		286.72		4073.98		100.00%	
Percent Impervious				12.8%		22.0%		27.9%				

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
			M-1 to M-22												MC-1 to MC-9	
		% of total basin	M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	3.19	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.14	-
	TIA	100%	-	-	-	0.00	-	-	-	-	-	-	-	-	-	1.63
COMM	Qvr	85%	0.53	3.01	-	-	-	-	5.35	30.34	0.02	0.12	7.04	39.91	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	0.46	2.60	-	-	-	-
	Qvt	85%	2.18	12.34	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	1.74	-	0.10	-
	Qvr	0%	-	-	-	-	3.83	-	11.33	-	7.22	-	10.76	-	3.84	-
	Qvrl	0%	-	-	-	-	-	-	-	-	3.48	-	0.95	-	-	-
	Qvt	0%	-	-	-	-	0.36	-	4.32	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	7.21	-	16.76	-	5.40	-	11.38	-	0.35
MF	Qvr	47%	0.62	0.55	6.68	5.92	5.13	4.55	19.97	17.71	1.19	1.06	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	0.20	0.17	-	-	-	-
HD	Qvr	15%	-	-	0.48	0.08	46.39	8.19	6.98	1.23	15.22	2.69	3.66	0.65	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	16.63	2.94	0.16	0.03	-	-
	Qvt	15%	-	-	-	-	14.03	2.48	19.60	3.46	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	0.15	0.01	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	0.01	0.00	-	-	-	-
	Qvr	4%	9.67	0.40	14.21	0.59	1.26	0.05	51.59	2.15	5.35	0.22	20.81	0.87	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	8.95	0.37	0.00	0.00	-	-
	Qvt	4%	-	-	-	-	-	-	8.02	0.33	-	-	-	-	-	-
OG	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.04	-
	Qvr	0%	39.23	-	0.84	-	0.10	-	-	-	2.82	-	11.16	-	2.41	-
	Qvrl	0%	-	-	-	-	-	-	-	-	0.06	-	9.37	-	-	-
	Qvt	0%	8.12	-	-	-	-	-	-	-	-	-	0.31	-	-	-
	Qw	0%	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
			M-1 to M-22												MC-1 to MC-9	
		% of total basin	M-5		M-8		M-9		M-10		M-16		M-20		MC-1n	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	1.17	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	0.77	-	-	-	-	-
	Qvr	0%	-	-	-	-	0.05	-	-	-	19.26	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	9.76	-	-	-	-	-
	Qvt	0%	-	-	-	-	4.98	-	4.15	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.27	-	-	-	-	-	-	-	-	-	33.43	-	0.27	-
	Lake		0.44		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		0.00		-		-		-	
Basin total:			71.08	16.31	22.21	6.60	76.14	22.47	131.32	71.98	92.73	15.58	99.40	52.83	9.99	1.98
PERLND areas:																
(16)	Till-Forest		-		-		4.98		4.15		10.93		-		-	
(26)	Till-Grass		10.29		-		14.38		31.94		29.93		12.53		0.14	
(34)	Outwash-Forest		-		-		0.05		-		20.03		-		-	
(44)	Outwash-Grass		50.05		22.21		56.71		95.22		31.83		53.43		9.44	
(45)	Fill		-		-		-		-		-		-		0.14	
(54)	Wetland		10.74		-		0.01		-		-		33.43		0.27	
	subtotal:		71.08		22.21		76.14		131.32		92.73		99.40		9.99	
IMPLND areas:																
	EIA			16.31		6.60		22.47		71.98		15.58		52.83		1.98
Basin total:			87.39		28.80		98.61		203.30		108.32		152.23		11.97	
Percent Impervious				18.7%		22.9%		22.8%		35.4%		14.4%		34.7%		16.5%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-9													
			MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.08	-	0.59	-	3.16	-	0.42	-	11.72	-	0.02	-	1.14	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	3.17	-	2.27	-
	Qw	0%	0.03	-	0.18	-	0.26	-	-	-	-	-	-	-	-	-
	Fill	0%	2.22	-	1.07	-	4.23	-	-	-	0.09	-	-	-	-	-
	TIA	100%	-	2.27	-	1.41	-	3.31	-	0.02	-	0.26	-	0.03	-	-
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	2.55	-	1.32	-	-	-	-	-	-	-	0.02	-	1.19	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	0.22	-	0.43	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.27	-	0.01	-	-	-	-	-	-	-	-	-	0.01
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.46	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.57	-	2.99	-	13.36	-	33.42	-	2.37	-	31.75	-	16.60	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	0.07	-	-	-
	Qvt	0%	-	-	-	-	-	-	13.43	-	-	-	8.03	-	2.97	-
	Qw	0%	0.49	-	-	-	6.36	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
			MC-1 to MC-9													
		% of total basin	MC-2		MC-3		MC-4		MC-5		MC-6		MC-7		MC-8	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.60	-	3.70	-	0.27	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	4.23	-	1.20	-	0.35	-	-	-	-	-	-	-	-	-
	Fill	0%	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	10.16	-	0.04	-	5.02	-	7.44	-	0.90	-	3.20	-	2.54	-
	Lake		2.98		-		3.30		0.73		0.29		0.24		-	
	Mcrk-df		7.00		13.17		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			30.77	2.54	11.52	1.42	33.00	3.31	54.71	0.02	15.09	0.26	46.26	0.03	26.72	0.01
PERLND areas:																
(16)	Till-Forest		0.08		-		-		-		-		-		-	
(26)	Till-Grass		0.53		-		-		13.43		-		11.26		5.25	
(34)	Outwash-Forest		3.60		3.70		0.27		-		-		-		-	
(44)	Outwash-Grass		9.20		4.91		16.51		33.84		14.10		31.80		18.93	
(45)	Fill		2.22		1.07		4.23		-		0.09		-		-	
(54)	Wetland		15.14		1.84		11.98		7.44		0.90		3.20		2.54	
	subtotal:		30.77		11.52		33.00		54.71		15.09		46.26		26.72	
IMPLND areas:																
	EIA			2.54		1.42		3.31		0.02		0.26		0.03		0.01
Basin total:			33.31		12.94		36.31		54.74		15.35		46.29		26.73	
Percent Impervious				7.6%		11.0%		9.1%		0.0%		1.7%		0.1%		0.0%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)											
			MC-1 to MC-9								SDS Basins			
		% of total basin	MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	2.42	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.12	-	-	-	10.00	-	-	-	10.00	-	0.51	-	0.03	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	1.97	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	0.39	-	8.12	-	32.29	-	-	-	32.29	-	11.46	-	0.19
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	0.08	0.44	0.08	0.44	-	-	-	-
TRANS	M	0%	1.76	-	-	-	-	-	0.03	-	0.03	-	-	-	-	-
	Qvr	0%	0.33	-	-	-	-	-	3.45	-	3.45	-	0.78	-	0.10	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	0.01	-	0.01	-	0.03	-	-	-
	TIA	100%	-	0.01	-	-	-	-	-	4.78	-	4.78	-	1.22	-	0.38
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	5.70	1.01	5.70	1.01	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	5.10	-	-	-	-	-	0.21	-	0.21	-	-	-	-	-
	Qvr	0%	0.30	-	-	-	-	-	8.34	-	8.34	-	-	-	4.66	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	14.36	-	14.36	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)											
			MC-1 to MC-9								SDS Basins			
		% of total basin	MC-9		CARGO		NEPL		M-6		M-6X**		SDN-1		SDN1-LWR	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	0.07	-	0.07	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	13.44	-	13.44	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	1.35	-	1.35	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	0.80	-	0.80	-	-	-	0.07	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		0.07		0.07		-		-	
	Other		-		-		-		0.01		0.01		-		-	
Basin total:			10.03	0.40	-	8.12	10.00	32.29	47.84	6.23	57.84	38.52	3.46	12.68	4.86	0.56
PERLND areas:																
(16)	Till-Forest		-		-		-		1.42		1.42		-		-	
(26)	Till-Grass		9.28		-		-		20.38		20.38		1.97		-	
(34)	Outwash-Forest		-		-		-		13.44		13.44		-		-	
(44)	Outwash-Grass		0.76		-		10.00		11.79		21.79		1.29		4.79	
(45)	Fill		-		-		-		-		-		-		-	
(54)	Wetland		-		-		-		0.82		0.82		0.20		0.07	
	subtotal:		10.03		-		10.00		47.84		57.84		3.46		4.86	
IMPLND areas:																
	EIA			0.40		8.12		32.29		6.23		38.52		12.68		0.56
Basin total:			10.43		8.12		42.29		54.07		96.36		16.14		5.42	
Percent Impervious				3.8%		100.0%		76.4%		11.5%		40.0%		78.6%		10.4%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
		% of total basin	SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	-	-	0.63	-	4.73	-	-	-	-	-	-	-	15.69	-
	Qvr	0%	-	-	2.40	-	-	-	-	-	0.03	-	-	-	1.31	-
	Qvt	0%	-	-	-	-	18.83	-	0.08	-	-	-	1.61	-	0.06	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	0.86	-	-	-	4.58	-	17.54	-	23.77	-	0.99	-
	TIA	100%	-	-	-	0.36	-	24.30	-	5.87	-	2.35	-	0.00	-	12.26
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	0.68	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.28	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	1.76	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	1.63	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	7.88	-	-	-	-	-	-	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	0.70	0.12	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.30	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	19.87	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)											
			SDS Basins											
		% of total basin	SDN1-OFF		SDN-2Xn		SDN-3		SDN-3A-I		SDN-3A-O		SDN-3X		SDN-4	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		0.04		-		-		-		-		-		-	
Basin total:			28.27	8.00	3.90	0.36	23.56	24.30	4.66	5.87	17.57	2.35	25.38	0.00	18.06	12.26
PERLND areas:																
(16)	Till-Forest		-		-		-		-		-		-		-	
(26)	Till-Grass		23.01		0.63		23.56		0.08		-		1.61		15.75	
(34)	Outwash-Forest		-		-		-		-		-		-		-	
(44)	Outwash-Grass		3.58		2.40		-		-		0.03		-		1.31	
(45)	Fill		-		0.86		-		4.58		17.54		23.77		0.99	
(54)	Wetland		1.67		-		-		-		-		-		-	
	subtotal:		28.27		3.90		23.56		4.66		17.57		25.38		18.06	
IMPLND areas:																
	EIA			8.00		0.36		24.30		5.87		2.35		0.00		12.26
Basin total:			36.27		4.26		47.86		10.52		19.92		25.38		30.32	
Percent Impervious				22.1%		8.5%		50.8%		55.7%		11.8%		0.0%		40.4%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)													
			SDS Basins		IWS Basins				SDS Basins							
			SDN-4X		IWS-NCPS		IWS-NSMPS		SDW-1A-I		SDW-1A-O		SDW-1B-I		SDW-1B-O	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	1.35	-	4.78	-	2.69	-	-	-	-	-	11.17	-	-	-
	Qvr	0%	0.75	-	-	-	1.97	-	-	-	0.69	-	-	-	2.39	-
	Qvt	0%	0.57	-	-	-	-	-	4.28	-	-	-	9.20	-	0.89	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	8.31	-	-	-	0.01	-	19.41	-	13.03	-	35.97	-	10.30	-
	TIA	100%	-	4.21	-	30.93	-	1.95	-	13.78	-	1.64	-	23.52	-	3.42
COMM	Qvr	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA	100%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MF	Qvr	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	Qvr	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	15%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	M	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)											
			SDS Basins		IWS Basins				SDS Basins					
		% of total basin	SDN-4X		IWS-NCPS		IWS-NSMPS		SDW-1A-I		SDW-1A-O		SDW-1B-I		SDW-1B-O	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Fill	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.00	-
	Lake		-		-		-		-		-		-		-	
	Mcrk-df		-		-		-		-		-		-		-	
	Other		-		-		-		-		-		-		-	
Basin total:			10.97	4.21	4.78	30.93	4.67	1.95	23.69	13.78	13.72	1.64	56.33	23.52	13.58	3.42
PERLND areas:																
(16)	Till-Forest		-		-		-		-		-		-		-	
(26)	Till-Grass		1.92		4.78		2.69		4.28		-		20.37		0.89	
(34)	Outwash-Forest		-		-		-		-		-		-		-	
(44)	Outwash-Grass		0.75		-		1.97		-		0.69		-		2.39	
(45)	Fill		8.31		-		0.01		19.41		13.03		35.97		10.30	
(54)	Wetland		-		-		-		-		-		-		0.00	
	subtotal:		10.97		4.78		4.67		23.69		13.72		56.33		13.58	
IMPLND areas:																
	EIA			4.21		30.93		1.95		13.78		1.64		23.52		3.42
Basin total:			15.18		35.71		6.63		37.47		15.36		79.86		17.00	
Percent Impervious				27.7%		86.6%		29.5%		36.8%		10.7%		29.5%		20.1%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)					
			SDS Basins					
			SDW-2		Total		Percent of Total	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	M	0%	20.39	-	63.91	-	4.48%	0.00%
	Qvr	0%	1.51	-	41.93	-	2.94%	0.00%
	Qvt	0%	6.49	-	48.52	-	3.40%	0.00%
	Qw	0%	-	-	0.64	-	0.04%	0.00%
	Fill	0%	6.70	-	108.34	-	7.59%	0.00%
	TIA	100%	-	9.51	-	188.10	0.00%	13.18%
COMM	Qvr	85%	-	-	12.95	73.39	0.91%	5.14%
	Qvrl	85%	-	-	0.46	2.60	0.03%	0.18%
	Qvt	85%	-	-	2.26	12.78	0.16%	0.90%
TRANS	M	0%	-	-	4.33	-	0.30%	0.00%
	Qvr	0%	-	-	50.01	-	3.50%	0.00%
	Qvrl	0%	-	-	4.44	-	0.31%	0.00%
	Qvt	0%	-	-	6.43	-	0.45%	0.00%
	Qw	0%	-	-	2.33	-	0.16%	0.00%
	TIA	100%	-	-	-	55.64	0.00%	3.90%
MF	Qvr	47%	-	-	33.59	29.78	2.35%	2.09%
	Qvrl	47%	-	-	0.20	0.17	0.01%	0.01%
HD	Qvr	15%	-	-	72.73	12.84	5.10%	0.90%
	Qvrl	15%	-	-	16.79	2.96	1.18%	0.21%
	Qvt	15%	-	-	40.03	7.06	2.81%	0.50%
LD	M	4%	-	-	0.15	0.01	0.01%	0.00%
	Qu	4%	-	-	0.01	0.00	0.00%	0.00%
	Qvr	4%	-	-	102.88	4.29	7.21%	0.30%
	Qvrl	4%	-	-	8.95	0.37	0.63%	0.03%
	Qvt	4%	-	-	8.02	0.33	0.56%	0.02%
OG	M	0%	-	-	5.80	-	0.41%	0.00%
	Qvr	0%	-	-	174.23	-	12.21%	0.00%
	Qvrl	0%	-	-	9.50	-	0.67%	0.00%
	Qvt	0%	-	-	67.09	-	4.70%	0.00%
	Qw	0%	-	-	7.32	-	0.51%	0.00%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (STIA basins)

Land Use			Sub-basin Areas (acres)					
			SDS Basins					
		% of total basin	SDW-2		Total		Percent of Total	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	M	0%	-	-	1.32	-	0.09%	0.00%
	Qu	0%	-	-	0.77	-	0.05%	0.00%
	Qvr	0%	-	-	40.33	-	2.83%	0.00%
	Qvrl	0%	-	-	9.76	-	0.68%	0.00%
	Qvt	0%	-	-	10.49	-	0.73%	0.00%
	Qw	0%	-	-	5.78	-	0.40%	0.00%
	Fill	0%	-	-	0.00	-	0.00%	0.00%
	Wetland	0%	-	-	74.19	-	5.20%	0.00%
	Lake		-		7.98		0.56%	
	Mcrk-df		-		20.24		1.42%	
	Other		-		0.04		0.00%	
Basin total:			35.09	9.51	1036.47	390.34	72.64%	27.36%
PERLND areas:								
(16)	Till-Forest		-		21.56		1.46%	
(26)	Till-Grass		26.88		287.76		19.45%	
(34)	Outwash-Forest		-		41.10		2.78%	
(44)	Outwash-Grass		1.51		491.45		33.23%	
(45)	Fill		6.70		149.21		10.09%	
(54)	Wetland		-		90.26		6.10%	
	subtotal:		35.09		1081.34		73.11%	
IMPLND areas:								
	EIA			9.51		397.75		26.89%
Basin total:			44.60		1479.09		100.00%	
Percent Impervious				21.3%				

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	0.49	2.77	-	-	0.00	0.01	0.37	2.11	0.24	1.33	-	-
Ground	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.76	4.31	0.85	4.82	1.58	8.96	0.56	3.18	0.99	5.61	11.64	65.96	1.21	6.86
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.67	3.77	1.21	6.88
	Qvt	85%	3.62	20.53	1.99	11.26	0.10	0.56	0.12	0.71	0.54	3.03	9.34	52.91	5.32	30.15
	Qw	85%	-	-	-	-	-	-	-	-	0.07	0.37	-	-	0.25	1.42
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	0.01	0.04	-	-
Rock	Qvr	85%	0.05	0.26	-	-	0.02	0.13	-	-	-	-	0.59	3.36	0.11	0.62
Concrete	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvt	85%	0.07	0.39	-	-	-	-	-	-	0.05	0.26	0.26	1.48	0.14	0.80
Develop	M	85%	-	-	0.22	1.27	-	-	-	-	0.08	0.47	0.11	0.61	-	-
High	Qb	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	0.43	2.46	0.06	0.34	0.59	3.33	0.23	1.31	0.10	0.57	7.59	42.99	0.50	2.81
	Qvrl	85%	-	-	-	-	-	-	-	-	-	-	0.12	0.70	0.18	1.03
	Qvt	85%	0.87	4.95	0.47	2.68	0.24	1.38	0.08	0.45	1.70	9.64	5.96	33.78	2.64	14.97
	Qw	85%	0.00	0.02	-	-	-	-	-	-	0.00	0.02	-	-	0.27	1.52
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	0.43	0.05	-	-	0.87	0.10	1.89	0.21	0.67	0.07	-	-
Medium	Qb	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	10%	25.02	2.78	23.96	2.66	30.84	3.43	43.41	4.82	11.93	1.33	34.17	3.80	29.76	3.31
	Qvrl	10%	-	-	-	-	-	-	-	-	-	-	1.07	0.12	4.03	0.45
	Qvt	10%	153.51	17.06	113.34	12.59	51.26	5.70	37.01	4.11	19.59	2.18	161.00	17.89	65.20	7.24
	Qvu	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	10%	0.42	0.05	-	-	0.04	0.00	-	-	0.35	0.04	-	-	0.05	0.01
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop.	M	4%	-	-	-	-	-	-	1.01	0.04	1.81	0.08	0.45	0.02	-	-
Low	Qb	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	4%	10.82	0.45	13.18	0.55	42.19	1.76	44.72	1.86	49.05	2.04	10.49	0.44	21.25	0.89
	Qvrl	4%	-	-	-	-	-	-	-	-	-	-	0.15	0.01	3.02	0.13
	Qvt	4%	66.93	2.79	77.05	3.21	49.44	2.06	43.74	1.82	27.82	1.16	36.85	1.54	18.11	0.75
	Qvu	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qw	4%	1.98	0.08	-	-	-	-	-	-	0.82	0.03	-	-	0.07	0.00
	Qyal	4%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-1		M-2		M-3		M-4		M-4A		M-11		M-12	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	0.62	-	-	-	0.01	-	2.76	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	0.95	-	0.65	-	27.67	-	3.14	-	16.01	-	1.17	-	2.16	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.62	-
	Qvt	0%	7.36	-	5.44	-	7.34	-	3.11	-	5.04	-	1.04	-	0.71	-
	Qw	0%	0.39	-	-	-	-	-	-	-	1.28	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	3.07	-	0.46	-	16.02	-	3.75	-	22.06	-	1.32	-	5.64	-
	Qvrl	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.08	-
	Qvt	0%	3.41	-	5.56	-	8.26	-	2.95	-	8.66	-	0.89	-	0.31	-
	Qw	0%	1.08	-	-	-	-	-	-	-	0.66	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland		-		-		-		-		9.32		-		-	
	Lake		4.59		-		-		-		2.13		-		0.65	
	Other		-		-		-		-		-		-		-	
Basin total:			280.75	56.14	244.78	42.22	235.59	27.30	184.72	18.43	173.62	29.14	285.78	230.80	162.84	79.83
PERLND areas:																
perlnd 16	Till-forest		3.41		5.56		8.26		2.95		8.66		0.89		0.39	
perlnd 26	Till-grass		232.36		200.05		108.38		85.95		61.64		217.92		101.18	
perlnd 34	Outwash-forest		3.07		0.46		16.02		3.75		22.06		1.32		5.64	
perlnd 44	Outwash-grass		38.03		38.71		102.89		92.06		78.09		65.65		54.98	
perlnd 54	Wetland		3.87		-		0.04		-		12.50		-		0.64	
	subtotal:		280.75		244.78		235.59		184.72		182.95		285.78		162.84	
IMPLND areas:																
	EIA			56.14		42.22		27.30		18.43		29.14		230.80		79.83
Basin total:			336.89		286.99		262.89		203.14		212.09		516.59		242.67	
Percent Impervious				16.7%		14.7%		10.4%		9.1%		13.7%		44.7%		32.9%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground	Qb	85%	-	-	-	-	-	-	0.06	0.31	-	-	-	-	-	-
Asphalt	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.99	5.61	0.24	1.39	-	-	2.12	12.02	2.55	14.45
	Qvrl	85%	-	-	-	-	0.42	2.38	-	-	-	-	0.03	0.14	-	-
	Qvt	85%	1.09	6.20	0.81	4.60	0.03	0.19	-	-	-	-	0.08	0.46	0.66	3.76
	Qw	85%	-	-	-	-	-	-	0.01	0.04	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bare	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rock	Qvr	85%	-	-	-	-	-	-	0.19	1.05	-	-	0.02	0.10	0.09	0.52
Concrete	Qvrl	85%	-	-	-	-	0.05	0.26	-	-	-	-	-	-	-	-
	Qvt	85%	-	-	0.12	0.66	-	-	-	-	-	-	-	-	0.03	0.15
Develop	M	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
High	Qb	85%	-	-	-	-	-	-	0.03	0.16	-	-	-	-	-	-
Intensity	Qpf	85%	-	-	-	-	0.03	0.15	-	-	-	-	-	-	-	-
	Qvi	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	85%	-	-	0.02	0.13	0.14	0.77	0.56	3.15	0.01	0.05	0.41	2.31	0.92	5.20
	Qvrl	85%	-	-	-	-	0.12	0.66	-	-	-	-	0.11	0.60	-	-
	Qvt	85%	0.87	4.95	0.35	1.97	0.07	0.39	-	-	-	-	0.27	1.52	1.15	6.51
	Qw	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qyal	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Develop	M	10%	-	-	-	-	-	-	-	-	-	-	0.71	0.08	-	-
Medium	Qb	10%	-	-	-	-	-	-	0.17	0.02	-	-	-	-	-	-
Intensity	Qpf	10%	-	-	0.16	0.02	1.37	0.15	2.75	0.31	-	-	-	-	-	-
	Qvi	10%	-	-	-	-	-	-	-	-	-	-	-	-	1.47	0.16
	Qvr	10%	-	-	13.61	4.51	20.11	2.23	5.84	0.65	6.70	0.74	45.89	5.10	52.06	5.78
	Qvrl	10%	-	-	-	-	3.38	0.38	-	-	-	-	21.79	2.42	-	-
	Qvt	10%	122.70	13.63	82.83	9.20	27.53	3.06	1.20	0.13	2.21	0.25	16.06	1.78	75.17	8.35
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	-	-	-	-	-	-
	Qw	10%	-	-	-	-	-	-	0.38	0.04	-	-	-	-	-	-
	Qyal	10%	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.00
Develop.	M	4%	-	-	-	-	-	-	-	-	-	-	1.23	0.05	-	-
Low	Qb	4%	-	-	-	-	-	-	0.05	0.00	-	-	-	-	-	-
Intensity	Qpf	4%	-	-	2.21	0.09	3.36	0.14	8.61	0.36	-	-	-	-	-	-
	Qu	4%	-	-	-	-	1.42	0.06	-	-	-	-	0.10	0.00	-	-
	Qvi	4%	-	-	-	-	-	-	-	-	-	-	-	-	2.87	0.12
	Qvr	4%	-	-	23.03	0.96	55.70	2.32	51.91	2.16	41.48	1.73	44.89	1.87	57.86	2.41
	Qvrl	4%	-	-	-	-	7.20	0.30	-	-	-	-	37.05	1.54	-	-
	Qvt	4%	69.05	2.88	33.29	1.39	9.84	0.41	14.64	0.61	12.79	0.53	12.72	0.53	52.24	2.18
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	-	-	-	-	-	-
	Qw	4%	-	-	-	-	-	-	0.98	0.04	-	-	-	-	-	-
	Qyal	4%	-	-	-	-	-	-	0.82	0.03	-	-	-	-	0.36	0.02

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)													
			Non-STIA Basins of M-1 to M-24													
		% of total basin	M-13		M-14		M-15		M-17		M-18		M-19		M-21	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Grass	M	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qb	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qpf	0%	-	-	0.20	-	0.45	-	0.99	-	-	-	-	-	-	-
	Qvr	0%	-	-	2.66	-	2.97	-	9.39	-	1.03	-	2.13	-	5.18	-
	Qvrl	0%	-	-	-	-	0.23	-	-	-	-	-	1.70	-	-	-
	Qvt	0%	3.96	-	1.28	-	0.70	-	0.47	-	1.08	-	0.34	-	3.66	-
	Qw	0%	-	-	-	-	-	-	0.55	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-
Forest	M	0%	-	-	-	-	-	-	-	-	-	-	0.32	-	-	-
	Qpf	0%	-	-	2.48	-	-	-	1.83	-	-	-	-	-	-	-
	Qu	0%	-	-	-	-	3.20	-	-	-	-	-	0.24	-	-	-
	Qvi	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Qvr	0%	-	-	10.98	-	46.89	-	29.25	-	20.95	-	8.15	-	5.96	-
	Qvrl	0%	-	-	-	-	0.41	-	-	-	-	-	12.09	-	-	-
	Qvt	0%	0.79	-	0.24	-	6.18	-	0.90	-	0.76	-	0.30	-	7.61	-
	Qw	0%	-	-	-	-	-	-	0.27	-	-	-	-	-	-	-
	Qyal	0%	-	-	-	-	-	-	3.73	-	-	-	-	-	0.13	-
	Wetland		-		-		-		-		-		-		-	
	Lake		41.70		-		-		0.24		-		0.25		-	
	Other		-		-		-		-		-		-		-	
Basin total:			198.47	27.66	174.29	20.66	192.75	19.47	136.33	10.49	87.00	3.30	208.72	30.53	269.99	49.63
PERLND areas:																
perlnd 16	Till-forest		0.79		0.24		6.59		0.90		0.76		12.72		7.61	
perlnd 26	Till-grass		197.68		118.67		49.55		16.31		16.08		92.07		132.91	
perlnd 34	Outwash-forest		-		13.46		50.09		34.82		20.95		8.39		6.09	
perlnd 44	Outwash-grass		-		41.91		86.52		82.11		49.22		95.55		123.39	
perlnd 54	Wetland		-		-		-		2.19		-		-		-	
	subtotal:		198.47		174.29		192.75		136.33		87.00		208.72		269.99	
IMPLND areas:																
	EIA			27.66		20.66		19.47		10.49		3.30		30.53		49.63
Basin total:			226.12		194.94		212.22		146.82		90.30		239.25		319.62	
Percent Impervious				12.2%		10.6%		9.2%		7.1%		3.7%		12.8%		15.5%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
			Non-STIA Basins of M-1 to M-24									
		% of total basin	M-22		M-23		M-24		Total		Percent of Total	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Bare Ground Asphalt	M	85%	-	-	-	-	1.19	6.75	2.29	12.98	0.06%	0.32%
	Qb	85%	0.20	1.11	-	-	-	-	0.25	1.43	0.01%	0.04%
	Qvi	85%	0.00	0.01	-	-	-	-	0.00	0.01	0.00%	0.00%
	Qvr	85%	-	-	1.12	6.34	2.54	14.41	27.19	154.06	0.67%	3.78%
	Qvrl	85%	-	-	0.17	0.96	-	-	2.49	14.14	0.06%	0.35%
	Qvt	85%	-	-	3.61	20.44	3.69	20.88	31.00	175.66	0.76%	4.31%
	Qw	85%	0.06	0.32	-	-	-	-	0.38	2.15	0.01%	0.05%
	Qyal	85%	0.02	0.13	-	-	-	-	0.02	0.13	0.00%	0.00%
Bare Rock Concrete	M	85%	-	-	-	-	-	-	0.01	0.04	0.00%	0.00%
	Qvr	85%	-	-	0.16	0.93	0.53	3.02	1.76	10.00	0.04%	0.25%
	Qvrl	85%	-	-	-	-	-	-	0.05	0.26	0.00%	0.01%
	Qvt	85%	-	-	0.16	0.91	0.07	0.39	0.89	5.05	0.02%	0.12%
Develop High Intensity	M	85%	-	-	-	-	0.17	0.97	0.59	3.32	0.01%	0.08%
	Qb	85%	0.04	0.25	-	-	-	-	0.07	0.41	0.00%	0.01%
	Qpf	85%	-	-	-	-	-	-	0.03	0.15	0.00%	0.00%
	Qvi	85%	0.02	0.11	-	-	-	-	0.02	0.11	0.00%	0.00%
	Qvr	85%	-	-	0.33	1.88	1.45	8.20	13.33	75.53	0.33%	1.85%
	Qvrl	85%	-	-	0.22	1.27	-	-	0.75	4.25	0.02%	0.10%
	Qvt	85%	-	-	1.38	7.83	1.33	7.54	17.39	98.56	0.43%	2.42%
	Qw	85%	0.02	0.13	-	-	-	-	0.30	1.69	0.01%	0.04%
	Qyal	85%	0.12	0.66	-	-	-	-	0.12	0.66	0.00%	0.02%
Develop Medium Intensity	M	10%	-	-	-	-	2.47	0.27	7.04	0.78	0.17%	0.02%
	Qb	10%	0.14	0.02	-	-	-	-	0.31	0.03	0.01%	0.00%
	Qpf	10%	-	-	-	-	-	-	4.28	0.48	0.11%	0.01%
	Qvi	10%	4.17	0.46	-	-	-	-	5.65	0.63	0.14%	0.02%
	Qvr	10%	0.07	0.01	28.90	3.21	40.50	4.50	412.77	45.86	10.13%	1.13%
	Qvrl	10%	-	-	2.78	0.31	-	-	33.04	3.67	0.81%	0.09%
	Qvt	10%	-	-	111.89	12.43	103.71	11.52	1144.19	127.13	28.09%	3.12%
	Qvu	10%	-	-	-	-	-	-	0.07	0.01	0.00%	0.00%
	Qw	10%	0.81	0.09	-	-	-	-	2.05	0.23	0.05%	0.01%
	Qyal	10%	1.31	0.15	-	-	-	-	1.33	0.15	0.03%	0.00%
Develop. Low Intensity	M	4%	-	-	-	-	0.19	0.01	4.68	0.20	0.11%	0.00%
	Qb	4%	-	-	-	-	-	-	0.05	0.00	0.00%	0.00%
	Qpf	4%	-	-	-	-	-	-	14.18	0.59	0.35%	0.01%
	Qu	4%	-	-	-	-	-	-	1.51	0.06	0.04%	0.00%
	Qvi	4%	6.50	0.27	-	-	-	-	9.37	0.39	0.23%	0.01%
	Qvr	4%	0.71	0.03	14.46	0.60	17.88	0.74	499.61	20.82	12.26%	0.51%
	Qvrl	4%	-	-	2.73	0.11	-	-	50.15	2.09	1.23%	0.05%
	Qvt	4%	-	-	29.04	1.21	18.29	0.76	571.83	23.83	14.04%	0.58%
	Qvu	4%	-	-	-	-	-	-	0.40	0.02	0.01%	0.00%
	Qw	4%	0.42	0.02	-	-	-	-	4.26	0.18	0.10%	0.00%
	Qyal	4%	4.61	0.19	-	-	-	-	5.80	0.24	0.14%	0.01%

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Table A-1b. Miller and Walker Creeks Subbasin Characteristics - 2006 (Non-STIA basins)

Land Use			Sub-basin Areas (acres)									
			Non-STIA Basins of M-1 to M-24									
		% of total basin	M-22		M-23		M-24		Total		Percent of Total	
	Soil	equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
Land Use	Type	EIA										
Grass	M	0%	-	-	-	-	0.89	-	4.29	-	0.11%	0.00%
	Qb	0%	0.01	-	-	-	-	-	0.01	-	0.00%	0.00%
	Qpf	0%	-	-	-	-	-	-	1.63	-	0.04%	0.00%
	Qvr	0%	0.08	-	0.87	-	6.39	-	82.44	-	2.02%	0.00%
	Qvrl	0%	-	-	0.79	-	-	-	3.34	-	0.08%	0.00%
	Qvt	0%	-	-	3.37	-	3.43	-	48.31	-	1.19%	0.00%
	Qw	0%	1.83	-	-	-	-	-	4.05	-	0.10%	0.00%
	Qyal	0%	1.49	-	-	-	-	-	1.53	-	0.04%	0.00%
Forest	M	0%	-	-	-	-	-	-	0.32	-	0.01%	0.00%
	Qpf	0%	-	-	-	-	-	-	4.31	-	0.11%	0.00%
	Qu	0%	-	-	-	-	-	-	3.44	-	0.08%	0.00%
	Qvi	0%	0.64	-	-	-	-	-	0.64	-	0.02%	0.00%
	Qvr	0%	1.32	-	2.25	-	2.02	-	180.10	-	4.42%	0.00%
	Qvrl	0%	-	-	1.03	-	-	-	13.61	-	0.33%	0.00%
	Qvt	0%	-	-	2.06	-	-	-	48.88	-	1.20%	0.00%
	Qw	0%	0.07	-	-	-	-	-	2.08	-	0.05%	0.00%
	Qyal	0%	2.35	-	-	-	-	-	6.21	-	0.15%	0.00%
	Wetland		-		-		-		9.32		0.23%	
	Lake		0.47		0.94		0.33		51.30		1.26%	
	Other		-		-		-		-		0.00%	
Basin total:			27.01	3.95	207.33	58.44	206.74	79.98	3286.03	787.96	80.66%	19.34%
PERLND areas:												
perlnd 16	Till-forest		-		3.09		-		62.82		1.54%	
perlnd 26	Till-grass		-		156.15		135.43		1922.33		47.19%	
perlnd 34	Outwash-forest		4.30		2.25		2.02		194.70		4.78%	
perlnd 44	Outwash-grass		19.49		45.84		69.29		1083.74		26.60%	
perlnd 54	Wetland		3.21		-		-		22.44		0.55%	
	subtotal:		27.01		207.33		206.74		3286.03		80.66%	
IMPLND areas:												
	EIA			3.95		58.44		79.98		787.96		19.34%
Basin total:			30.96		265.77		286.72		4073.98		100.00%	
Percent Impervious				12.8%		22.0%		27.9%				

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Legend for Tables A-2a and A-2b

Soil Types:

TFF	Till, forest, flat
TFM	Till, forest, moderate
TFS	Till, forest, steep
TGF	Till, grass, flat
TGM	Till, grass, moderate
TGS	Till, grass, steep
FLF	Fill, flat
FLM	Fill, moderate
FLS	Fill, steep
FL	Fill (all slopes)
LAC	Lacustrine
OFF	Outwash forest, flat
OFM	Outwash forest, moderate
OFS	Outwash forest, steep
OF	Outwash forest (all slopes)
OGF	Outwash grass, flat
OGM	Outwash grass, moderate
OGS	Outwash grass, steep
OG	Outwash grass (all slopes)
SA	Wetland
EIA	Effective impervious area

Land Use Types:

AP	Commercial airport and measured EIA
C	Commercial
TR	Transport
MF	Multi-family
HD	High density residential
LD	Low density residential
G	Grass or open
F	Forest

PERLND number refers to the unique soil and slope pervious land segment in HSPF.
IMPLND refers to the impervious land segment.
Network factors are the area for each PERLND or IMPLND divided by 12.

shaded subbasins included in the STIA subbasin characteristics evaluation area.

[a] - Land use is extrapolated.

[b] - Areas prorated to new subbasin total areas from previous version of model.

Explanation of Calculations of Effective Impervious Area for Tables A-2a and A-2b

Unshaded Basins:

Table	Basins
A-2a	DM14, DM18
A-2b	DM1, DM2, DM14, DM16, DM17, DM18, DM19, DM20, DM21, DM22

Acreage by soil type is extrapolated.

Unshaded Basins:

Table	Basins
A-2a	DM6, DM10
A-2b	DM3, DM4, DM5, DM6, DM7, DM8, DM9, DM10, DM11, DM12, DM13

Effective Impervious Area

Total area within the basin for a given land use, soil type, and slope * EIA percentage

Pervious Area

Total area within the basin for a given land use, soil type, and slope * (1 - EIA percentage)

STIA (shaded) Basins:

Table	Basins
A-2a	SDS2, SDS5, SDS6, SSMPS, IWS-West, IWS-SASA
A-2b	SDE4, SDS1, SDS2, SDS3, SDS3A, SDS4, SDS5, SDS6, SDS7, SASA, NSPS, Primary, SSMPS, IWS-SASA

Effective Impervious Area

Total impervious area within the basin for a given land use (from GIS analysis) * fraction contribution for specific soil type and slope . Impervious area distributed among present soil types and slopes according to fraction contribution to basin area.

Pervious Area

Total pervious area within the basin for a given land use, soil type, and slope.

Remaining Pre-Development Condition Basins (Table A-2a):

Table	Basins
A-2a:	DM1, DM2, DM16, DM17, DM19, DM20, DM21, DM22, SDE4, SDS1, SDS3, SDS3A, SDS4, SDS7, SASA, NSPS, Primary, SSMPS, IWS-SASA

Effective Impervious Area

Total impervious area is 10 percent of the total basin acreage not including wetland area. Impervious area distributed proportionately to the grass and forest pervious areas.

Pervious Area

75 percent of the total basin acreage not including wetland area is distributed as forest. 15 percent of the total basin acreage not including wetland area is distributed as grass. Forest and grass areas distributed proportionately to till and outwash according to the till and outwash total acreage proportions.

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			Bow Lake		East Branch										West Branch (NW Ponds)	
		% of total	DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type	basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%					-	-	-	-	0.16	-	-	-	-	-
	TGM	0%					-	-	-	-	1.57	-	-	-	-	-
	TGS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	-	-	-	-	-	-
	OGM	0%					-	-	-	-	-	-	-	-	-	-
	TIA						-	-		-		0.08		-		-
COMM	TGF	85%					2.79	15.81	3.71	21.05	0.00	0.00	-	-	-	-
	TGM	85%					3.29	18.63	3.38	19.17	1.44	8.15	-	-	-	-
	TGS	85%					-	-	-	-	-	-	-	-	-	-
	LAC	85%					3.09	17.52	-	-	-	-	-	-	2.15	12.17
	OGF	85%					-	-	-	-	-	-	0.01	0.06	0.65	3.70
	OGM	85%					-	-	-	-	0.28	1.56	0.00	0.02	0.07	0.39
TRANS	TGF	30%					-	-	-	-	-	-	-	-	-	-
	OGF	30%					-	-	-	-	-	-	-	-	-	-
	OGM	30%					-	-	-	-	-	-	-	-	-	-
	TIA						-	-		-		-		-		-
MF	TGF	47%					-	-	-	-	-	-	-	-	-	-
	TGM	47%					-	-	-	-	-	-	-	-	-	-
	OGF	47%					-	-	-	-	-	-	-	-	-	-
	OGM	47%					-	-	-	-	-	-	-	-	-	-
	OGS	47%					-	-	-	-	-	-	-	-	-	-
HD	TGF	30%					9.67	4.14	-	-	-	-	-	-	0.96	0.41
	TGM	30%					0.43	0.19	-	-	-	-	-	-	-	-
	TGS	30%					-	-	-	-	-	-	-	-	-	-
	LAC	30%					1.39	0.59	-	-	-	-	-	-	-	-
LD	TGF	13%					14.66	2.19	-	-	-	-	-	-	26.29	3.93
	TGM	13%					7.21	1.08	-	-	-	-	-	-	-	-
	TGS	13%					-	-	-	-	-	-	-	-	-	-
	LAC	13%					1.21	0.18	-	-	-	-	-	-	5.93	0.89
	OGF	13%					-	-	-	-	-	-	-	-	37.35	5.58
	OGM	13%					-	-	-	-	-	-	-	-	11.55	1.73
	OGS	13%					-	-	-	-	-	-	-	-	0.09	0.01
OG	TGF	0%					-	-	-	-	1.96	-	4.83	-	-	-
	TGM	0%					-	-	-	-	0.80	-	1.57	-	-	-
	TGS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	0.18	-	8.49	-	-	-
	OGM	0%					-	-	-	-	0.51	-	-	-	-	-

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			Bow Lake	East Branch											West Branch (NW Ponds)	
		% of total basin	DM-1	DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%					-	-	1.59	-	-	-	-	-	4.21	-
	TFM	0%					-	-	1.91	-	2.08	-	-	-	-	-
	TFS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	22.07	-
	OFF	0%					-	-	-	-	-	-	0.02	-	15.40	-
	OFM	0%					-	-	-	-	0.88	-	-	-	8.23	-
	Wetland	0%					0.16		0.06		1.36		3.74		6.62	
	Lake		12.19		-		-		-		-		0.03		-	
	Other						0.02		0.06		-		-		0.01	
Basin total:			-		-		43.90	60.33	10.65	40.21	11.21	9.80	18.67	0.08	141.59	28.81
PERLND areas:																
(16)	TF		10.32		-		-		38.11		12.18		4.81		26.28	
(26)	TG		132.94		14.78		43.74		7.62		2.44		1.57		35.33	
(34)	OF		7.19		-		-		-		2.56		6.45		23.63	
(44)	OG		92.36		-		-		-		0.51		2.10		49.72	
(54)	Wetland		14.11		-		0.16		0.06		1.36		3.74		6.62	
	subtotal:		256.92		14.78		43.90		45.79		19.05		18.67		141.59	
IMPLND areas:																
	EIA			171.29		9.85		60.33		5.08		1.97		0.08		28.81
Basin total:			428.21		24.64		104.22		50.87		21.01		18.75		170.40	
Percent Impervious				40.0%		40.0%		57.9%		10.0%		9.4%		0.4%		16.9%
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
NETWORK FACTORS																
PERLND 16	(TF)		0.860		-		-		3.175		1.015		0.400		2.190	
PERLND 26	(TG)		11.078		1.232		3.645		0.635		0.203		0.131		2.944	
PERLND 34	(OF)		0.599		-		-		-		0.213		0.538		1.970	
PERLND 44	(OG)		7.697		-		-		-		0.043		0.175		4.143	
PERLND 54	(SA)		1.176		-		0.013		0.005		0.113		0.312		0.552	
IMPLND 14	(EIA)		14.274		0.821		5.027		0.423		0.164		0.007		2.401	
SUM			35.684		2.053		8.685		4.239		1.751		1.563		14.200	

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			West Branch (NW Ponds)								Upper Main					
		% of total basin	DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			-		-		-		-		-		-		
COMM	TGF	85%	1.86	10.54	-	-	-	-	1.36	7.72	-	-	2.59	14.66		
	TGM	85%	-	-	-	-	-	-	-	-	-	-	0.04	0.20		
	TGS	85%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	85%	-	-	-	-	-	-	1.12	6.35	-	-	-	-		
	OGF	85%	2.28	12.89	-	-	-	-	2.89	16.37	-	-	-	-		
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-		
TRANS	TGF	30%	4.81	-	-	-	-	-	0.99	-	-	-	-	-		
	OGF	30%	0.95	-	-	-	-	-	-	-	-	-	-	-		
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			3.98		-		-		2.27		-		-		
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGM	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGF	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGM	47%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGS	47%	-	-	-	-	-	-	-	-	-	-	-	-		
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	0.06	0.02		
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGS	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-		
LD	TGF	13%	0.64	0.10	10.27	1.53	6.33	0.95	-	-	-	-	-	-		
	TGM	13%	-	-	2.89	0.43	-	-	-	-	-	-	-	-		
	TGS	13%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	13%	-	-	1.25	0.19	2.50	0.37	-	-	-	-	-	-		
	OGF	13%	10.37	1.55	8.69	1.30	0.67	0.10	-	-	-	-	1.47	0.22		
	OGM	13%	-	-	26.75	4.00	5.39	0.81	-	-	-	-	0.04	0.01		
	OGS	13%	-	-	1.04	0.16	-	-	-	-	-	-	-	-		
OG	TGF	0%	-	-	-	-	-	-	1.42	-	-	-	9.55	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	6.52	-		
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	0%	-	-	-	-	0.02	-	-	-	0.01	-	-	-		
	OGF	0%	-	-	-	-	0.06	-	2.72	-	18.81	-	15.48	-		
	OGM	0%	-	-	-	-	0.00	-	-	-	1.93	-	4.35	-		

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			West Branch (NW Ponds)								Upper Main					
		% of total basin	DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	2.43	-	-	-	0.18	-	3.12	-	-	-	4.95	-		
	TFM	0%	-	-	-	-	-	-	-	-	-	-	6.34	-		
	TFS	0%	-	-	-	-	-	-	-	-	-	-	0.24	-		
	LAC	0%	-	-	0.02	-	11.16	-	0.73	-	6.13	-	0.00	-		
	OFF	0%	8.58	-	-	-	8.80	-	12.28	-	0.02	-	0.02	-		
	OFM	0%	-	-	0.20	-	14.42	-	-	-	4.48	-	14.42	-		
	Wetland	0%	1.93		0.12		8.55		12.43		6.65		1.08			
	Lake		-		-		0.97		5.33		0.63		0.85		-	
	Other		0.01		-		0.00		-		0.00		0.07			
Basin total:			33.84	29.06	51.23	7.60	58.08	2.22	39.06	32.71	38.02	-	67.13	15.11	-	
PERLND areas:																
(16)	TF		2.43		0.02		11.34		3.85		6.13		33.87		5.78	
(26)	TG		7.31		14.41		8.85		4.89		0.01		6.77		3.54	
(34)	OF		8.58		0.20		23.22		12.28		4.50		27.00		23.28	
(44)	OG		13.59		36.48		6.12		5.61		20.73		5.40		14.34	
(54)	Wetland		1.93		0.12		8.55		12.43		6.65		1.08		-	
	subtotal:		33.84		51.23		58.08		39.06		38.02		74.12		46.94	
IMPLND areas:																
	EIA			29.06		7.60		2.22		32.71		-		8.12		4.08
Basin total:			62.90		58.83		60.30		71.77		38.02		82.24		51.02	
Percent Impervious				46.2%		12.9%		3.7%		45.6%		0.0%		9.9%		8.0%
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
NETWORK FACTORS																
PERLND 16	(TF)		0.203		0.002		0.945		0.321		0.510		2.823		0.481	
PERLND 26	(TG)		0.609		1.201		0.738		0.408		0.001		0.565		0.295	
PERLND 34	(OF)		0.715		0.017		1.935		1.024		0.375		2.250		1.940	
PERLND 44	(OG)		1.133		3.040		0.510		0.467		1.728		0.450		1.195	
PERLND 54	(SA)		0.161		0.010		0.712		1.036		0.554		0.090		-	
IMPLND 14	(EIA)		2.422		0.634		0.185		2.726		-		0.676		0.340	
SUM			5.242		4.903		5.025		5.981		3.168		6.853		4.252	

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			Lower Main Stem													
		% of total basin	DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%														
	TGM	0%														
	TGS	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														
	TIA															
COMM	TGF	85%														
	TGM	85%														
	TGS	85%														
	LAC	85%														
	OGF	85%														
	OGM	85%														
TRANS	TGF	30%														
	OGF	30%														
	OGM	30%														
	TIA															
MF	TGF	47%														
	TGM	47%														
	OGF	47%														
	OGM	47%														
	OGS	47%														
HD	TGF	30%														
	TGM	30%														
	TGS	30%														
	LAC	30%														
LD	TGF	13%														
	TGM	13%														
	TGS	13%														
	LAC	13%														
	OGF	13%														
	OGM	13%														
	OGS	13%														
OG	TGF	0%														
	TGM	0%														
	TGS	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)											
			Lower Main Stem											
		% of total basin	DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%														
	TFM	0%														
	TFS	0%														
	LAC	0%														
	OFF	0%														
	OFM	0%														
	Wetland	0%														
	Lake		0.44		-		-		-		-		-		-	
	Other															
Basin total:			-		-		-		-		-		-		-	
PERLND areas:																
(16)	TF		7.76		24.93		9.47		2.19		48.08		25.72		4.58	
(26)	TG		66.87		27.13		3.32		72.22		79.49		75.68		55.85	
(34)	OF		7.67		36.04		37.81		2.00		33.40		17.14		2.62	
(44)	OG		96.28		39.36		13.27		66.63		55.22		50.46		31.44	
(54)	Wetland		2.19		-		3.60		-		1.39		-		0.19	
	subtotal:		180.77		127.45		67.48		143.04		217.58		168.99		94.67	
IMPLND areas:																
	EIA			50.99		31.86		3.55		31.40		44.56		37.10		23.67
Basin total:			231.75		159.31		71.03		174.44		262.14		206.09		118.34	
Percent Impervious				22.0%		20.0%		5.0%		18.0%		17.0%		18.0%		20.0%
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
NETWORK FACTORS																
PERLND 16	(TF)		0.647		2.078		0.789		0.182		4.007		2.143		0.381	
PERLND 26	(TG)		5.573		2.261		0.277		6.019		6.624		6.306		4.654	
PERLND 34	(OF)		0.639		3.003		3.151		0.167		2.784		1.429		0.218	
PERLND 44	(OG)		8.023		3.280		1.106		5.552		4.602		4.205		2.620	
PERLND 54	(SA)		0.183		-		0.300		-		0.116		-		0.016	
IMPLND 14	(EIA)		4.249		2.655		0.296		2.617		3.714		3.091		1.972	
SUM			19.313		13.276		5.919		14.537		21.845		17.174		9.862	

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Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	34.49	-	-	-	160.47	-	50.52	-	6.17	-	-	-	31.99	-
	TGM	0%	1.77	-	-	-	5.07	-	10.06	-	-	-	-	-	-	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	0.78	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	9.96	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.45	-	-	-	-	-
	TIA			97.69		11.54		177.95		7.05		19.09		-		0.39
COMM	TGF	85%	1.69	9.58	0.81	4.61	-	-	-	-	-	-	0.05	0.30	-	-
	TGM	85%	0.16	0.92	0.12	0.66	0.00	0.00	-	-	-	-	-	-	-	-
	TGS	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	85%	1.28	7.25	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	0.15	0.83	-	-
	OGM	85%	-	-	-	-	-	-	-	-	0.01	0.08	-	-	-	-
TRANS	TGF	30%	-	-	-	-	-	-	-	-	0.01	-	0.12	-	0.08	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA			-		-		-		-		-		0.36		-
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGS	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	10.57	-	-	-	-	-	-	-	2.96	-	-	-	-	-
	TGM	0%	-	-	-	-	-	-	2.14	-	-	-	-	-	-	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	25.08	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.60	-	-	-	-	-

AR 010397

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)											
			SDS Basins											
		% of total basin	SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type	equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	-	-	-	-	-	-	-	-	-	-	2.76	-	-	-
	TFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TFS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	0.14	-	4.06	-	-	-
	OFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Wetland	0%	-		-		-		-		-		0.52		-	
	Lake		-		-		-		-		-		-		-	
	Other		0.13		-		-		-		-		-		-	
Basin total:			50.74	115.45	0.93	16.81	165.53	177.95	62.72	7.05	45.39	19.17	7.66	1.49	32.07	0.39
PERLND areas:																
(16)	TF		124.64		13.31		257.61		52.33		11.29		2.70		24.34	
(26)	TG		24.93		2.66		51.52		10.47		2.26		0.54		4.87	
(34)	OF		-		-		-		-		37.13		3.78		-	
(44)	OG		-		-		-		-		7.43		0.76		-	
(54)	Wetland		-		-		-		-		-		0.52		-	
	subtotal:		149.56		15.97		309.14		62.80		58.11		8.29		29.21	
IMPLND areas:																
	EIA			16.62		1.77		34.35		6.98		6.46		0.86		3.25
Basin total:			166.18		17.74		343.49		69.78		64.56		9.15		32.46	
Percent Impervious				10.0%		10.0%		10.0%		10.0%		10.0%		9.4%		10.0%
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
NETWORK FACTORS																
PERLND 16	(TF)		10.386		1.109		21.468		4.361		0.941		0.225		2.029	
PERLND 26	(TG)		2.077		0.222		4.294		0.872		0.188		0.045		0.406	
PERLND 34	(OF)		-		-		-		-		3.094		0.315		-	
PERLND 44	(OG)		-		-		-		-		0.619		0.063		-	
PERLND 54	(SA)		-		-		-		-		-		0.043		-	
IMPLND 14	(EIA)		1.385		0.148		2.862		0.581		0.538		0.072		0.270	
SUM			13.849		1.478		28.624		5.815		5.380		0.762		2.705	

AR 010398

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)													
			SDS Basins						IWS Basins							
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		WEST		SASA	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	11.12	-	20.55	-	-	-	0.32	-	11.95	-	2.72	-	-	-
	TGM	0%	-	-	0.23	-	-	-	-	-	0.96	-	-	-	-	-
	TGS	0%	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	0.37	-
	TIA			4.27		6.56		-		13.48		231.69		0.44		-
COMM	TGF	85%	-	-	-	-	1.37	7.76	-	-	0.23	1.30	-	-	0.02	0.13
	TGM	85%	-	-	-	-	0.19	1.10	-	-	0.08	0.48	-	-	0.48	2.71
	TGS	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.20	1.15
	LAC	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	-	-	0.01	0.04
	OGM	85%	-	-	-	-	0.01	0.08	-	-	-	-	-	-	0.44	2.51
TRANS	TGF	30%	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA			0.00		-		-		-		-		-		-
MF	TGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	47%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HD	TGF	30%	-	-	0.95	0.41	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	1.15	0.49	-	-	-	-	-	-	-	-	-	-
	TGS	30%	-	-	1.29	0.55	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	1.31	-	49.88	-	-	-	-	-	0.05	-	-	-	0.32	-
	TGM	0%	-	-	2.01	-	0.19	-	-	-	0.12	-	-	-	9.00	-
	TGS	0%	-	-	1.91	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	4.59	-	-	-	-	-	-	-	-	-	0.09	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	2.71	-

AR 010399

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use			Sub-basin Areas (acres)											
			SDS Basins						IWS Basins					
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		WEST		SASA	
Land Use	Soil Type	% of total basin equal to EIA	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
F	TFF	0%	-	-	-	-	12.32	-	-	-	-	-	2.67	-	1.08	-
	TFM	0%	-	-	-	-	9.89	-	-	-	-	-	-	-	28.69	-
	TFS	0%	-	-	-	-	0.58	-	-	-	-	-	-	-	6.80	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	-	-	6.14	-	0.04	-
	OFM	0%	-	-	-	-	0.23	-	-	-	-	-	-	-	0.20	-
	Wetland	0%	-		0.39		0.54		-		-		0.00		1.34	
	Lake		-		-		-		-		-		6.65		-	
	Other		-		-		-		-		-		-		-	
Basin total:			12.46	4.27	83.24	8.01	25.33	8.94	0.32	13.48	13.40	233.48	11.53	0.44	51.79	6.53
PERLND areas:																
(16)	TF		12.54		64.70		25.05		10.35		185.16		4.37		37.93	
(26)	TG		2.51		13.96		5.01		2.07		37.03		1.24		7.59	
(34)	OF		-		3.44		0.24		-		-		4.60		4.80	
(44)	OG		-		0.74		0.05		-		-		1.31		0.96	
(54)	Wetland		-		0.39		0.54		-		-		0.00		1.34	
	subtotal:		15.05		83.24		30.90		12.42		222.19		11.53		52.63	
IMPLND areas:																
	EIA			1.67		8.01		3.37		1.38		24.69		0.44		5.70
Basin total:			16.72		91.25		34.27		13.80		246.87		11.97		58.32	
Percent Impervious				10.0%		8.8%		9.8%		10.0%		10.0%		3.7%		9.8%
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		WEST		SASA	
NETWORK FACTORS																
PERLND 16	(TF)		1.045		5.392		2.088		0.863		15.430		0.364		3.161	
PERLND 26	(TG)		0.209		1.164		0.418		0.173		3.086		0.104		0.632	
PERLND 34	(OF)		-		0.287		0.020		-		-		0.384		0.400	
PERLND 44	(OG)		-		0.062		0.004		-		-		0.109		0.080	
PERLND 54	(SA)		-		0.033		0.045		-		-		0.000		0.112	
IMPLND 14	(EIA)		0.139		0.668		0.281		0.115		2.057		0.037		0.475	
SUM			1.394		7.605		2.856		1.150		20.573		0.997		4.860	

AR 010400

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use		
Land Use	Soil Type	% of total basin equal to EIA
STIA	TGF	0%
	TGM	0%
	TGS	0%
	LAC	0%
	OGF	0%
	OGM	0%
	TIA	
COMM	TGF	85%
	TGM	85%
	TGS	85%
	LAC	85%
	OGF	85%
	OGM	85%
TRANS	TGF	30%
	OGF	30%
	OGM	30%
	TIA	
MF	TGF	47%
	TGM	47%
	OGF	47%
	OGM	47%
	OGS	47%
HD	TGF	30%
	TGM	30%
	TGS	30%
	LAC	30%
LD	TGF	13%
	TGM	13%
	TGS	13%
	LAC	13%
	OGF	13%
	OGM	13%
	OGS	13%
OG	TGF	0%
	TGM	0%
	TGS	0%
	LAC	0%
	OGF	0%
	OGM	0%

AR 010401

Table A-2a. DesMoines Creek subbasin characteristics - pre-development

Land Use		
Land Use	Soil Type	% of total basin equal to EIA
F	TFF	0%
	TFM	0%
	TFS	0%
	LAC	0%
	OFF	0%
	OFM	0%
	Wetland	0%
	Lake	
	Other	

Basin total:		Total	Percent
PERLND areas:			
(16)	TF	1104.15	30.31%
(26)	TG	831.41	22.82%
(34)	OF	329.58	9.05%
(44)	OG	610.85	16.77%
(54)	Wetland	66.99	1.84%
	subtotal:	2942.99	80.79%
IMPLND areas:			
	EIA	699.88	19.21%
Basin total:		3642.86	100.00%
Percent Impervious			
		Total	Percent
NETWORK FACTORS			
PERLND 16	(TF)	92.01	30.31%
PERLND 26	(TG)	69.28	22.82%
PERLND 34	(OF)	27.46	9.05%
PERLND 44	(OG)	50.90	16.77%
PERLND 54	(SA)	5.58	1.84%
IMPLND 14	(EIA)	58.32	19.21%
SUM		303.57	100.00%

AR 010402

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			Bow Lake		East Branch										West Branch (NW Ponds)	
		% of total	DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type	basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%					-	-	-	-	0.16	-	-	-	-	-
	TGM	0%					-	-	-	-	1.53	-	-	-	-	-
	TGS	0%					-	-	-	-	-	-	-	-	-	-
	FLF	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	-	-	-	-	-	-
	OGM	0%					-	-	-	-	0.00	-	-	-	-	-
	TIA							-		0.08		0.27		-		-
COMM	TGF	85%					2.54	14.37	3.71	21.04	0.00	0.00	-	-	-	-
	TGM	85%					2.44	13.83	3.38	19.17	1.37	7.79	-	-	-	-
	LAC	85%					3.09	17.52	-	-	-	-	-	-	2.15	12.17
	OGF	85%					-	-	-	-	-	-	0.01	0.06	0.65	3.70
	OGM	85%					-	-	-	-	0.27	1.53	0.00	0.02	0.07	0.39
TRANS	TGF	30%					-	-	-	-	-	-	-	-	-	-
	OGF	30%					-	-	-	-	-	-	-	-	-	-
	OGM	30%					-	-	-	-	-	-	-	-	-	-
	TIA							-		-		-		-		-
HD	TGF	30%					9.67	4.14	-	-	-	-	-	-	0.96	0.41
	TGM	30%					0.43	0.19	-	-	-	-	-	-	-	-
	LAC	30%					1.39	0.59	-	-	-	-	-	-	-	-
LD	TGF	13%					14.66	2.19	-	-	-	-	-	-	26.29	3.93
	TGM	13%					7.21	1.08	-	-	-	-	-	-	-	-
	LAC	13%					1.21	0.18	-	-	-	-	-	-	5.93	0.89
	OGF	13%					-	-	-	-	-	-	-	-	37.35	5.58
	OGM	13%					-	-	-	-	-	-	-	-	11.55	1.73
	OGS	13%					-	-	-	-	-	-	-	-	0.09	0.01
OG	TGF	0%					-	-	-	-	1.97	-	4.83	-	-	-
	TGM	0%					-	-	-	-	0.78	-	1.57	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	-	-
	OGF	0%					-	-	-	-	0.15	-	8.49	-	-	-
	OGM	0%					-	-	-	-	0.51	-	-	-	-	-
F	TFF	0%					-	-	1.52	-	-	-	-	-	4.21	-
	TFM	0%					-	-	1.91	-	2.07	-	-	-	-	-
	TFS	0%					-	-	-	-	-	-	-	-	-	-
	LAC	0%					-	-	-	-	-	-	-	-	22.07	-
	OFF	0%					-	-	-	-	-	-	0.02	-	15.40	-
	OFM	0%					-	-	-	-	0.88	-	-	-	8.23	-

AR 010403

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			Bow Lake		East Branch										West Branch (NW Ponds)	
		% of total	DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
Land Use	Soil Type	basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%					0.07		0.06		1.35		3.74		6.62	
	Lake		12.19		-		-		-		-		0.03		-	
	sasa-dp						7.42		-		0.28		-		-	
	Other						0.02		0.06		-		-		0.01	
Basin total:			-		-		42.71	54.10	10.58	40.28	11.05	9.59	18.67	0.08	141.59	28.81
PERLND areas:																
(16)	TF		10.32		-		-		3.43		2.07		-		26.28	
(26)	TG		132.94		14.78		42.64		7.10		5.82		6.41		35.33	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		7.19		-		-		-		0.88		0.02		23.63	
(44)	OG		92.36		-		-		-		0.93		8.50		49.72	
(54)	SA		14.11		-		0.07		0.06		1.35		3.74		6.62	
	subtotal:		256.92		14.78		42.71		10.58		11.05		18.67		141.59	
IMPLND areas:																
	EIA			171.29		9.85		54.10		40.28		9.59		0.08		28.81
Basin total:			428.21		24.64		96.81		50.87		20.64		18.75		170.40	
Percent Impervious				40.0%		40.0%		55.9%		79.2%		46.5%		0.4%		16.9%
			DM-1		DM-2		DM-3		DM-4		DM-5		DM-6		DM-7	
NETWORK FACTORS																
PERLND 16	(TF)		0.860		-		-		0.286		0.173		-		2.190	
PERLND 26	(TG)		11.078		1.232		3.553		0.591		0.485		0.534		2.944	
PERLND 45	(FL)		-		-		-		-		-		-		-	
PERLND 34	(OF)		0.599		-		-		-		0.074		0.002		1.970	
PERLND 44	(OG)		7.697		-		-		-		0.077		0.709		4.143	
PERLND 54	(SA)		1.176		-		0.006		0.005		0.112		0.312		0.552	
IMPLND 14	(EIA)		14.274		0.821		4.508		3.357		0.799		0.007		2.401	
SUM			35.684		2.053		8.067		4.239		1.720		1.563		14.200	

AR 010404

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			West Branch (NW Ponds)								Upper Main				Lower Main Stem	
		% of total	DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land Use	Soil Type	basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	-	-	-	-	-	-	-	-	-	-	0.00	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	FLF	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	OGF	0%	-	-	-	-	-	-	0.00	-	-	-	-	-		
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			-		-		-		-		-		0.00		
COMM	TGF	85%	1.86	10.54	-	-	-	-	1.36	7.72	-	-	2.59	14.66		
	TGM	85%	-	-	-	-	-	-	-	-	-	-	0.04	0.20		
	LAC	85%	-	-	-	-	-	-	1.12	6.35	-	-	-	-		
	OGF	85%	2.28	12.89	-	-	-	-	2.89	16.37	-	-	-	-		
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-		
TRANS	TGF	30%	4.81	-	-	-	-	-	0.99	-	-	-	-	-		
	OGF	30%	0.95	-	-	-	-	-	-	-	-	-	-	-		
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	TIA			3.98		-		-		2.27		-		-		
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	0.06	0.02		
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-		
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-		
LD	TGF	13%	0.64	0.10	10.27	1.53	6.33	0.95	-	-	-	-	-	-		
	TGM	13%	-	-	2.89	0.43	-	-	-	-	-	-	-	-		
	LAC	13%	-	-	1.25	0.19	2.50	0.37	-	-	-	-	-	-		
	OGF	13%	10.37	1.55	8.69	1.30	0.67	0.10	-	-	-	-	1.47	0.22		
	OGM	13%	-	-	26.75	4.00	5.39	0.81	-	-	-	-	0.04	0.01		
	OGS	13%	-	-	1.04	0.16	-	-	-	-	-	-	-	-		
OG	TGF	0%	-	-	-	-	-	-	1.42	-	-	-	9.55	-		
	TGM	0%	-	-	-	-	-	-	-	-	-	-	6.52	-		
	LAC	0%	-	-	-	-	0.02	-	-	-	0.01	-	-	-		
	OGF	0%	-	-	-	-	0.06	-	2.72	-	18.81	-	15.48	-		
	OGM	0%	-	-	-	-	0.00	-	-	-	1.93	-	4.35	-		
F	TFF	0%	2.43	-	-	-	0.18	-	3.12	-	-	-	4.94	-		
	TFM	0%	-	-	-	-	-	-	-	-	-	-	6.35	-		
	TFS	0%	-	-	-	-	-	-	-	-	-	-	0.24	-		
	LAC	0%	-	-	0.02	-	11.16	-	0.73	-	6.13	-	0.00	-		
	OFF	0%	8.58	-	-	-	8.80	-	12.28	-	0.02	-	0.02	-		
	OFM	0%	-	-	0.20	-	14.42	-	-	-	4.48	-	14.42	-		

AR 010405

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)											
			West Branch (NW Ponds)								Upper Main			Lower Main Stem
		% of total	DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
Land Use	Soil Type	basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%	1.93		0.12		8.55		12.43		6.65		1.07			
	Lake		-		-		0.97		5.33		0.63		0.85		-	
	sasa-dp		-		-		-		-		-		-			
	Other		0.01		-		0.00		-		0.00		0.07			
Basin total:			33.84	29.06	51.23	7.60	58.08	2.22	39.06	32.71	38.02	-	67.13	15.11	-	
PERLND areas:																
(16)	TF		2.43		0.02		11.34		3.85		6.13		11.53		5.78	
(26)	TG		7.31		14.41		8.85		4.89		0.01		18.75		3.54	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		8.58		0.20		23.22		12.28		4.50		14.44		23.28	
(44)	OG		13.59		36.48		6.12		5.61		20.73		21.33		14.34	
(54)	SA		1.93		0.12		8.55		12.43		6.65		1.07		-	
	subtotal:		33.84		51.23		58.08		39.06		38.02		67.13		46.94	
IMPLND areas:																
	EIA			29.06		7.60		2.22		32.71		-		15.11		4.08
Basin total:			62.90		58.83		60.30		71.77		38.02		82.24		51.02	
Percent Impervious				46.2%		12.9%		3.7%		45.6%		0.0%		18.4%		8.0%
			DM-8		DM-9		DM-10		DM-11		DM-12		DM-13		DM-14	
NETWORK FACTORS																
PERLND 16	(TF)		0.203		0.002		0.945		0.321		0.510		0.961		0.481	
PERLND 26	(TG)		0.609		1.201		0.738		0.408		0.001		1.562		0.295	
PERLND 45	(FL)		-		-		-		-		-		-			
PERLND 34	(OF)		0.715		0.017		1.935		1.024		0.375		1.203		1.940	
PERLND 44	(OG)		1.133		3.040		0.510		0.467		1.728		1.778		1.195	
PERLND 54	(SA)		0.161		0.010		0.712		1.036		0.554		0.089		-	
IMPLND 14	(EIA)		2.422		0.634		0.185		2.726		-		1.259		0.340	
SUM			5.242		4.903		5.025		5.981		3.168		6.853		4.252	

AR 010406

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			Lower Main Stem													
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type	% of total basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%														
	TGM	0%														
	TGS	0%														
	FLF	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														
	TIA															
COMM	TGF	85%														
	TGM	85%														
	LAC	85%														
	OGF	85%														
	OGM	85%														
TRANS	TGF	30%														
	OGF	30%														
	OGM	30%														
	TIA															
HD	TGF	30%														
	TGM	30%														
	LAC	30%														
LD	TGF	13%														
	TGM	13%														
	LAC	13%														
	OGF	13%														
	OGM	13%														
	OGS	13%														
OG	TGF	0%														
	TGM	0%														
	LAC	0%														
	OGF	0%														
	OGM	0%														
F	TFF	0%														
	TFM	0%														
	TFS	0%														
	LAC	0%														
	OFF	0%														
	OFM	0%														

AR 010407

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)											
			Lower Main Stem											
		% of total	DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
Land Use	Soil Type	basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%	0.44		-		-		-		-		-		-	
	Lake															
	sasa-dp															
	Other															
Basin total:			-		-		-		-		-		-		-	
PERLND areas:																
(16)	TF		7.76		24.93		9.47		2.19		48.08		25.72		4.58	
(26)	TG		66.87		27.13		3.32		72.22		79.49		75.68		55.85	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		7.67		36.04		37.81		2.00		33.40		17.14		2.62	
(44)	OG		96.28		39.36		13.27		66.63		55.22		50.46		31.44	
(54)	SA		2.19		-		3.60		-		1.39		-		0.19	
	subtotal:		180.77		127.45		67.48		143.04		217.58		168.99		94.67	
IMPLND areas:																
	EIA			50.99		31.86		3.55		31.40		44.56		37.10		23.67
Basin total:			231.75		159.31		71.03		174.44		262.14		206.09		118.34	
Percent Impervious				22.0%		20.0%		5.0%		18.0%		17.0%		18.0%		20.0%
			DM-16		DM-17		DM-18		DM-19		DM-20		DM-21		DM-22	
NETWORK FACTORS																
PERLND 16	(TF)		0.647		2.078		0.789		0.182		4.007		2.143		0.381	
PERLND 26	(TG)		5.573		2.261		0.277		6.019		6.624		6.306		4.654	
PERLND 45	(FL)		-		-		-		-		-		-		-	
PERLND 34	(OF)		0.639		3.003		3.151		0.167		2.784		1.429		0.218	
PERLND 44	(OG)		8.023		3.280		1.106		5.552		4.602		4.205		2.620	
PERLND 54	(SA)		0.183		-		0.300		-		0.116		-		0.016	
IMPLND 14	(EIA)		4.249		2.655		0.296		2.617		3.714		3.091		1.972	
SUM			19.313		13.276		5.919		14.537		21.845		17.174		9.862	

AR 010408

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type	% of total basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	37.54	-	1.09	-	144.03	-	34.64	-	6.76	-	2.87	-	28.20	-
	TGM	0%	0.98	-	0.30	-	0.28	-	-	-	-	-	-	-	-	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	FLF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	1.60	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	24.91	-	4.61	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.40	-	-	-	-	-
	TIA			126.09		16.32		199.17		35.14		32.48		0.67		4.18
COMM	TGF	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	TGF	30%	-	-	-	-	-	-	-	-	0.01	-	0.12	-	0.08	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TIA			-		-		-		-		0.00		0.36		-
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	TFF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	TFS	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	OFM	0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AR 010409

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)													
			SDS Basins													
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
Land Use	Soil Type	% of total basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%	-		-		-		-		-		0.52		-	
	Lake		-		-		-		-		-		-		-	
	sasa-dp		0.03		0.04		-		-		-		-		-	
	Other		0.13		-		-		-		-		-		-	
Basin total:			40.12	126.09	1.39	16.32	144.31	199.17	34.64	35.14	32.08	32.48	8.12	1.03	28.28	4.18
PERLND areas:																
(16)	TF		-		-		-		-		-		-		-	
(26)	TG		40.12		1.39		144.31		34.64		6.77		2.99		28.28	
(45)	FL		-		-		-		-		-		-		-	
(34)	OF		-		-		-		-		-		-		-	
(44)	OG		-		-		-		-		25.31		4.61		-	
(54)	SA		-		-		-		-		-		0.52		-	
	subtotal:		40.12		1.39		144.31		34.64		32.08		8.12		28.28	
IMPLND areas:																
	EIA			126.09		16.32		199.17		35.14		32.48		1.03		4.18
Basin total:			166.21		17.71		343.49		69.78		64.56		9.15		32.46	
Percent Impervious				75.9%		92.2%		58.0%		50.4%		50.3%		11.3%		12.9%
			SDE-4		SDS-1		SDS-3		SDS-3A		SDS-4		SDS-2		SDS-5	
NETWORK FACTORS																
PERLND 16	(TF)		-		-		-		-		-		-		-	
PERLND 26	(TG)		3.344		0.115		12.026		2.886		0.564		0.249		2.356	
PERLND 45	(FL)		-		-		-		-		-		-		-	
PERLND 34	(OF)		-		-		-		-		-		-		-	
PERLND 44	(OG)		-		-		-		-		2.109		0.384		-	
PERLND 54	(SA)		-		-		-		-		-		0.043		-	
IMPLND 14	(EIA)		10.507		1.360		16.598		2.928		2.707		0.086		0.348	
SUM			13.851		1.476		28.624		5.815		5.380		0.762		2.705	

AR 010410

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)											
			SDS Basins						IWS Basins					
			SDS-6		SDS-7		SASA		NSPS		PRIMARY		SASA	
Land Use	Soil Type	% of total basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
STIA	TGF	0%	13.51	-	45.69	-	0.01	-	0.31	-	6.52	-	-	-
	TGM	0%	-	-	-	-	0.00	-	-	-	0.86	-	0.05	-
	TGS	0%	-	-	-	-	-	-	-	-	-	-	-	-
	FLF	0%	-	-	5.48	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	3.93	-	-	-	-	-	6.15	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	0.00	-	0.04	-
	TIA			3.18		36.15		34.26		13.44		288.58		58.32
COMM	TGF	85%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	85%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	85%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	85%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	85%	-	-	-	-	-	-	-	-	-	-	-	-
TRANS	TGF	30%	0.03	-	-	-	-	-	-	-	0.00	-	-	-
	OGF	30%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	30%	-	-	-	-	-	-	-	-	0.00	-	-	-
	TIA			0.00		-		-		-		0.50		-
HD	TGF	30%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	30%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	30%	-	-	-	-	-	-	-	-	-	-	-	-
LD	TGF	13%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	13%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	13%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	13%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	13%	-	-	-	-	-	-	-	-	-	-	-	-
	OGS	13%	-	-	-	-	-	-	-	-	-	-	-	-
OG	TGF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	TGM	0%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OGF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OGM	0%	-	-	-	-	-	-	-	-	-	-	-	-
F	TFF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	TFM	0%	-	-	-	-	-	-	-	-	-	-	-	-
	TFS	0%	-	-	-	-	-	-	-	-	-	-	-	-
	LAC	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OFF	0%	-	-	-	-	-	-	-	-	-	-	-	-
	OFM	0%	-	-	-	-	-	-	-	-	-	-	-	-

AR 010411

Table A-2b. DesMoines Creek subbasin characteristics - 2006

Land Use			Sub-basin Areas (acres)											
			SDS Basins						IWS Basins					
		% of total	SDS-6		SDS-7		SASA		NSPS		PRIMARY		SASA	
Land Use	Soil Type	basin equal to	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious	Pervious	Effective Impervious
	Wetland	0%	-		-		-		-		0.00		0.01	
	Lake		-		-		-		-		6.65		-	
	sasa-dp		-		-		-		-		-		-	
	Other		-		-		-		-		-		-	
Basin total:			13.54	3.18	55.10	36.15	0.01	34.26	0.31	13.44	13.53	289.08	0.11	58.32
PERLND areas:														
(16)	TF		-		-		-		-		-		-	
(26)	TG		13.54		45.69		0.01		0.31		7.38		0.05	
(45)	FL		-		5.48		-		-		-		-	
(34)	OF		-		-		-		-		-		-	
(44)	OG		-		3.93		-		-		6.15		0.04	
(54)	SA		-		-		-		-		0.00		0.01	
	subtotal:		13.54		55.10		0.01		0.31		13.53		0.11	
IMPLND areas:														
	EIA			3.18		36.15		34.26		13.44		289.08		58.32
Basin total:			16.72		91.25		34.27		13.75		302.62		58.42	
Percent Impervious				19.0%		39.6%		100.0%		97.8%		95.5%		99.8%

		SDS-6	SDS-7	SASA	NSPS	PRIMARY	SASA	Total	Percent
NETWORK FACTORS									
PERLND 16	(TF)	-	-	-	-	-	-	17.16	5.60%
PERLND 26	(TG)	1.128	3.808	0.001	0.026	0.615	0.004	84.07	27.42%
PERLND 45	(FL)	-	0.457	-	-	-	-	0.46	0.15%
PERLND 34	(OF)	-	-	-	-	-	-	21.24	6.93%
PERLND 44	(OG)	-	0.327	-	-	0.512	0.004	55.20	18.01%
PERLND 54	(SA)	-	-	-	-	0.000	0.001	5.39	1.76%
IMPLND 14	(EIA)	0.265	3.013	2.855	1.120	24.090	4.860	123.06	40.14%
SUM		1.394	7.605	2.856	1.146	25.218	4.869	306.57	100.00%

AR 010412

ATTACHMENT B

1998 Embankment Fill Calibration Data

HFAM INPUT DATA FILE

```
Index Number:       1001
Name:             Till at Seatac
melev      :      400.0
eldif      :        0.0
Lat. (deg min):     0  0

Linkages with Meteorologic Stations: Station - Mult. Factor

 PR:       101   1.000
 T :         0   0.000
 ET:       105   0.750
 W :         0   0.000
 SR:         0   0.000

PWATER PARAMETERS:

 cepsc  :   0.100     uzsn   :   0.800     lzsn   :   5.000
 infexp :   2.000     infilt :   0.250     intfw  :   2.500
 agwrc  :  0.9000     irc    :  0.5000     deepfr :  0.0700
 nsur   :  0.3500     lsur   : 300.000     slsur  :  0.1000
 basetp :  0.0000     lzetp  :  0.7000     agwetp :  0.0000
 petmax :   40.00     petmin :   35.00

No snow simulation
```

```
Index Number:       1002
Name:             Outwash at Seatac
melev      :      400.0
eldif      :        0.0
Lat. (deg min):     0  0

Linkages with Meteorologic Stations: Station - Mult. Factor

 PR:       101   1.000
 T :         0   0.000
 ET:       105   0.750
 W :         0   0.000
 SR:         0   0.000

PWATER PARAMETERS:

 cepsc  :   0.250     uzsn   :   0.900     lzsn   :   5.500
 infexp :   2.000     infilt :   0.330     intfw  :   4.500
 agwrc  :  0.9960     irc    :  0.6600     deepfr :  0.0600
 nsur   :  0.3500     lsur   : 300.000     slsur  :  0.1000
 basetp :  0.0000     lzetp  :  0.9000     agwetp :  0.0000
 petmax :   40.00     petmin :   35.00

No snow simulation
```

```
Index Number:       1003
Name:             Impevious at Seatac
melev      :      400.0
eldif      :        0.0
Lat. (deg min):     0  0

Linkages with Meteorologic Stations: Station - Mult. Factor

 PR:       101   1.000
 T :         0   0.000
 ET:       105   0.750
 W :         0   0.000
 SR:         0   0.000
```

PWATER PARAMETERS:

cepsc :	0.100	uzsn :	0.050	lzsn :	0.040
infexp :	2.000	infilt :	0.005	intfw :	1.000
agwrc :	0.7000	irc :	0.5000	deepfr :	0.0000
nsur :	0.3000	lsur :	300.000	slsur :	0.0200
basetp :	0.0000	lzetp :	0.7000	agwetp :	0.0000
petmax :	40.00	petmin :	35.00		

No snow simulation

Index Number: 1004
Name: New Airport Fill-Sea
melev : 400.0
eldif : 0.0
Lat. (deg min): 0 0

Linkages with Meteorologic Stations: Station - Mult. Factor

PR:	101	1.000
T :	0	0.000
ET:	105	0.750
W :	0	0.000
SR:	0	0.000

PWATER PARAMETERS:

cepsc :	0.150	uzsn :	0.280	lzsn :	7.500
infexp :	2.000	infilt :	0.020	intfw :	6.000
agwrc :	0.9000	irc :	0.1500	deepfr :	0.1000
nsur :	0.2500	lsur :	300.000	slsur :	0.1500
basetp :	0.0000	lzetp :	0.7000	agwetp :	0.0000
petmax :	40.00	petmin :	35.00		

No snow simulation

```
**** REACH:*******
  Index Number:     500
  Name:                    Millerreach
   Precip. station      Mult. Factor
             101                1.00
   Evap. station        Mult. Factor
             105                1.00
   3     No. of land segm contributing
      Segment      Area [acres]
      1001          1601.0
      1002          1480.0
      1003          1035.0
   0     No. of aquifer elements contributing
   1     No. of flow elements contributing
    Flow Element     Mult. Factor
             400             1.0
  Flags: (on=1,off=0)
      Historic Flow /  Real T. Flow /  External T.S.
                1                0                0
    STCOR[ft]  SURFAREA[ac] SEEPFACTR[1/hr]  KS[-]
       0.00          0.20          0.00        0.300
    BWIDTH[ft]    TWIDTH[ft]    HEIGHT[ft]    LENGTH[mi]
      15.00          30.00          5.00          5.000
     NCH [-]       NFP [-]      SO  [-]     SFP  [-]
     0.0800        0.1000       0.0500        0.1000
        0.10   {Initial flow [ cfs]}
**** REACH:*******
  Index Number:     400
  Name:             98embankment Pond
   Precip. station      Mult. Factor
             101                1.00
   Evap. station        Mult. Factor
             105                0.75
   1     No. of land segm contributing
      Segment      Area [acres]
      1004            19.4
   0     No. of aquifer elements contributing
   0     No. of flow elements contributing
  Flags: (on=1,off=0)
      Historic Flow /  Real T. Flow /  External T.S.
                1                0                0
    STCOR[ft]  SURFAREA[ac] SEEPFACTR[1/hr]  KS[-]
       0.00          0.58          0.00        0.500
    BWIDTH[ft]    TWIDTH[ft]    HEIGHT[ft]    LENGTH[mi]
      20.00          35.00          3.00          0.140
     NCH [-]       NFP [-]      SO  [-]     SFP  [-]
     0.0350        0.0500       0.0050        0.2000
        0.00   {Initial flow [ cfs]}
```

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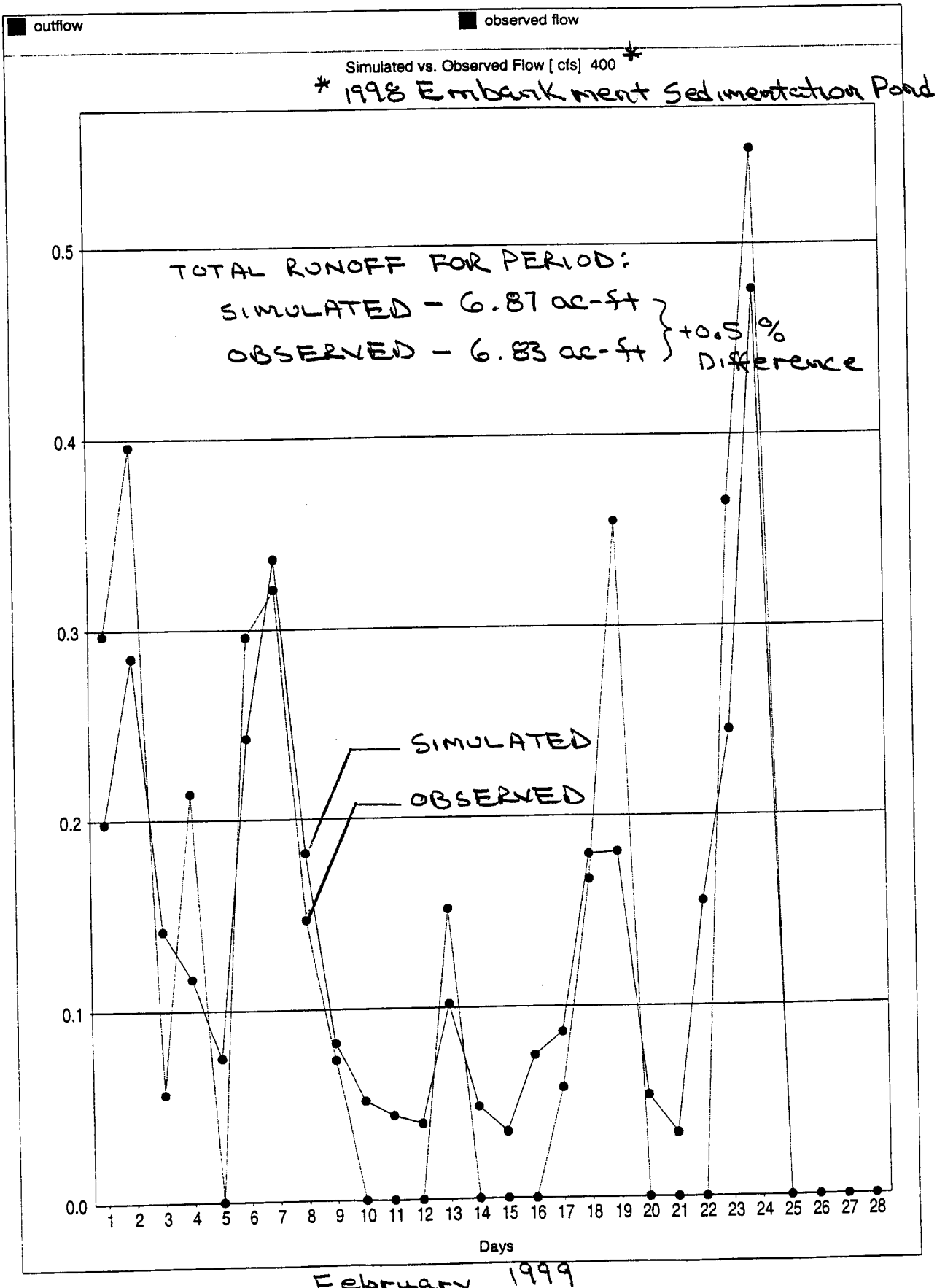
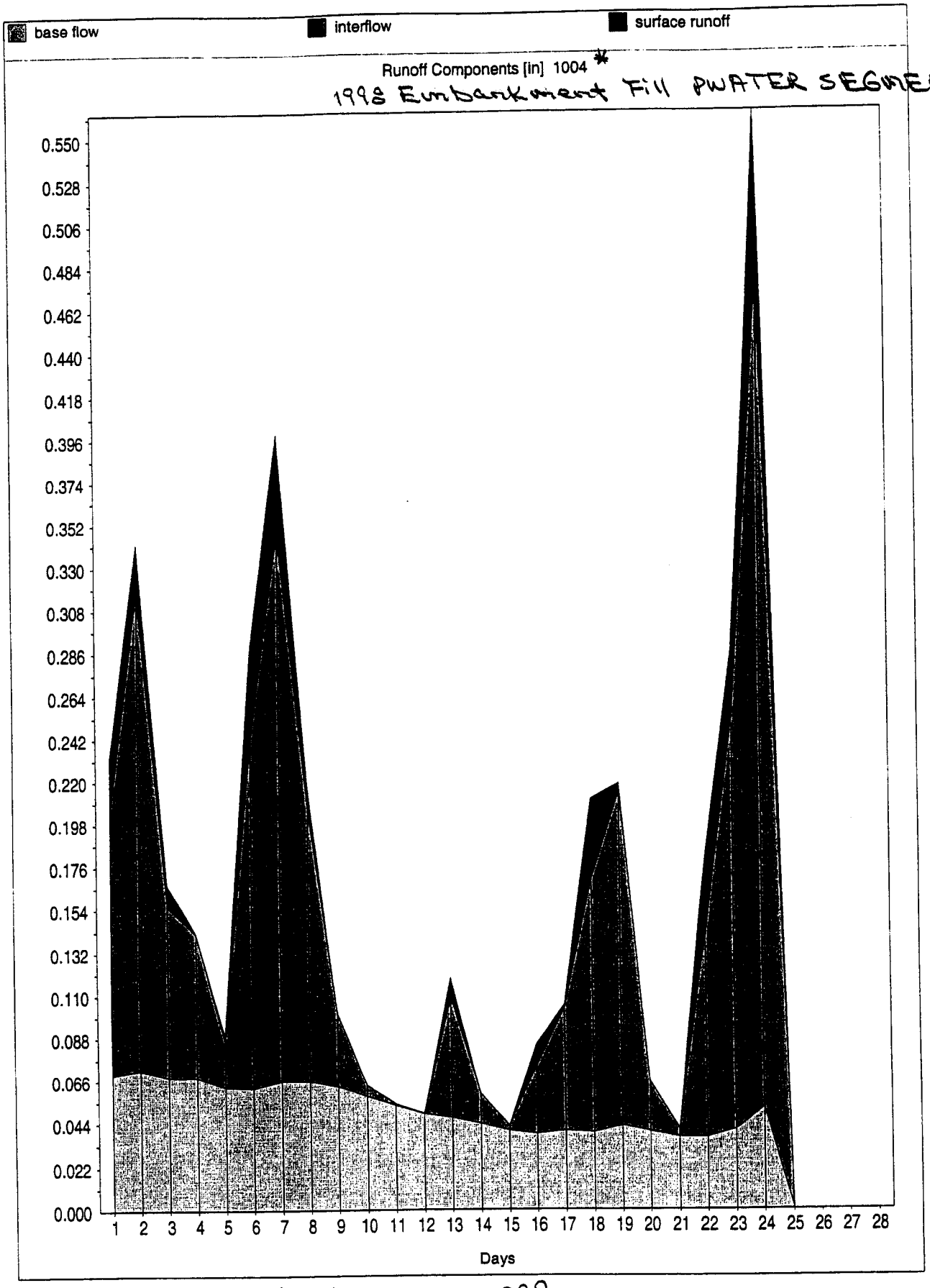
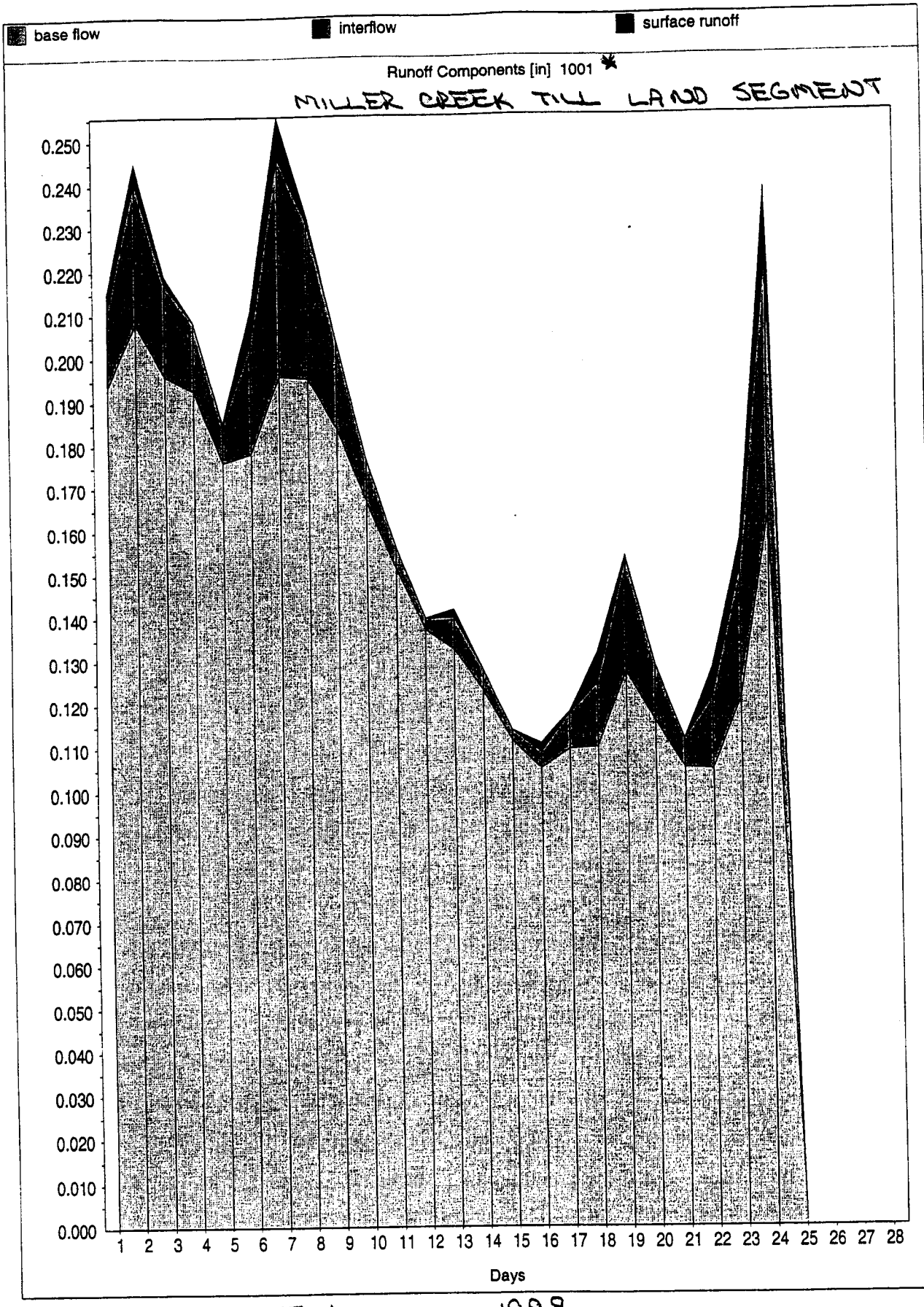


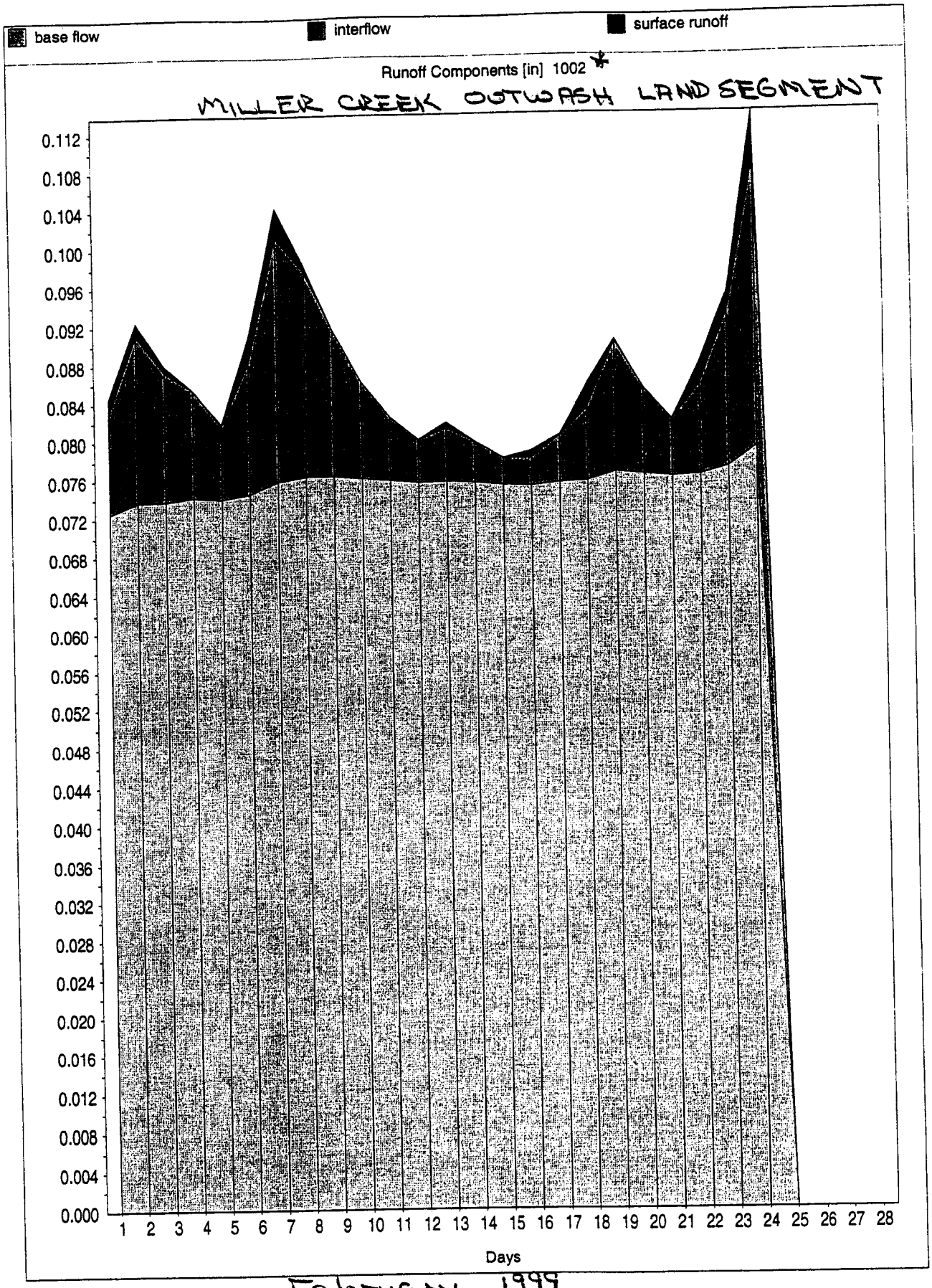
February 1999



February 1999



February 1999



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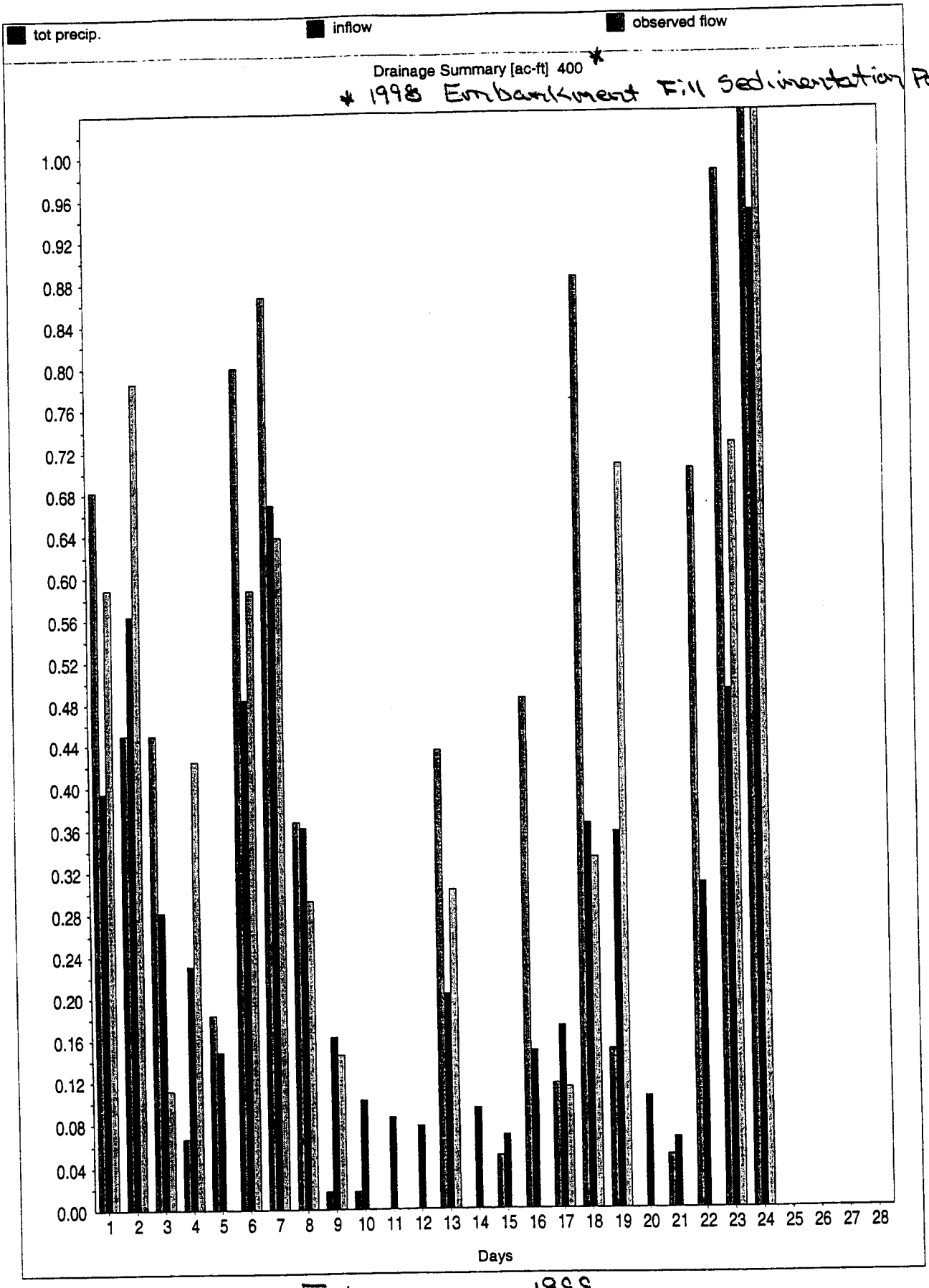

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ATTACHMENT C

HSPF and KCRTS Subbasin Detention Pond Performance Data and Additional Points of Compliance Performance Data

Miller Creek Watershed

Subbasin Detention Pond Performance Data:

- Cargo (SDN6)
- SDN3A
- SDS3/3X
- SDN4X/2X
- SDW1B
- SDN1
- SDW1A
- NEPL

Additional Points of Compliance Performance Data:

- SR509
- MCDF
- Lake Reba

Walker Creek Watershed

Subbasin Detention Pond Performance Data:

- SDW2 (South 12th Street)

Des Moines Creek Watershed

Subbasin Detention Pond Performance Data

- SDS3
- SDS3A
- SDS4
- SDS7
- SASA

Additional Points of Compliance Performance Data:

- SDS POC-1
- SDS POC-2
- SASA Inline Facility Analysis
- South 200th Street

MILLER CREEK WATERSHED
DETENTION POND PERFORMANCE DATA
(HSPF AND KCRTS BACKUP)

- CARGO (SDN6)
- SDN3A
- SDN3/3X
- SDN4X/2X
- SDW1B
- SDN1
- SDW1A
- NEPL

Computation of Basic statistics.

DATA-SET NUMBER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER OF DATA USED	VALUES UNUSED	
106	0.000	0.238	0.029	0.027	423142	578	CARGO - Flow
663	0.000	12.852	1.401	1.896	423311	409	- Stage
763	0.000	4.543	0.495	0.670	423691	29	- Volume
122	0.000	0.814	0.059	0.050	313685	110035	SDN3A pond - Flow
656	0.000	9.615	1.216	1.550	327579	96141	- Stage
756	0.000	14.771	1.727	2.224	318771	104949	- Volume
125	0.000	0.892	0.064	0.062	423720	0	SDN3A Flow at POC
111	0.000	0.080	0.021	0.013	423720	0	SD3A vault - Flow
650	0.000	10.873	2.349	2.102	423720	0	- Stage
750	0.000	6.990	1.510	1.351	423720	0	- Volume
103	0.000	1.572	0.138	0.157	413313	10407	SDN3/3X - Flow
664	0.000	19.581	1.355	2.285	405405	18315	- Stage
764	0.000	25.218	1.708	2.922	414066	9654	- Volume
139	0.000	1.259	0.088	0.106	411497	12223	SDN4X/2X - Flow
666	0.000	18.203	1.072	1.904	399238	24482	- Stage
766	0.000	14.365	0.820	1.486	412123	11597	- Volume
121	0.000	0.000	0.000	0.000	0	423720	SDW1B inf. tank - Storm flow
120	0.000	0.185	0.047	0.058	319351	104369	- Infiltrat.
655	0.000	2.607	0.635	0.821	335867	87853	- Stage
755	0.000	0.037	0.008	0.011	378385	45335	- Volume
211	0.000	0.627	0.187	0.153	333715	90005	SDW1B pond - Flow
651	0.000	11.708	1.819	2.137	333714	90006	- Stage
751	0.000	53.625	5.362	7.632	333714	90006	- Volume
7001	0.000	0.627	0.187	0.153	333715	90005	SDW1B Flow at POC
102	0.000	0.857	0.049	0.060	422660	1060	SDN1 - Flow
601	0.000	10.983	0.723	1.134	422786	934	- Stage
602	0.000	5.547	0.365	0.572	423691	29	- Volume
107	0.000	0.000	0.000	0.000	0	423720	SDW1A inf. tank - Storm flow
108	0.000	0.297	0.141	0.124	313896	109824	- Infiltrat.
652	0.000	2.739	1.247	1.140	328783	94937	- Stage
752	0.000	0.038	0.015	0.016	375222	48498	- Volume
1090	0.000	0.000	0.000	0.000	0	423720	SDW1A vault - Emergency flow
109	0.000	0.147	0.113	0.054	185231	238489	- Infiltrat.
657	0.000	10.737	1.171	1.639	190073	233647	- Stage
757	0.000	7.394	0.478	0.955	320320	103400	- Volume
112	0.000	0.601	0.006	0.010	263051	160669	SDW1A pond - Storm flow
1120	0.000	0.150	0.088	0.071	263048	160672	- Pumping to infilt.
654	0.000	11.088	1.499	2.280	275272	148448	- Stage
754	0.000	25.504	2.416	4.204	275338	148382	- Volume
7000	0.000	0.601	0.006	0.010	263051	160669	SDW1A Flow at POC
105	0.000	0.289	0.021	0.019	423720	0	NEPL exist. vault - Flow
662	0.000	16.188	2.094	2.481	423720	0	- Stage
762	0.000	3.628	0.469	0.556	423720	0	- Volume
119	0.000	1.709	0.100	0.108	423691	29	NEPL new vault - Flow
667	0.000	18.648	1.507	2.270	423405	315	- Stage

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DATA-SET NUMBER	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	NUMBER OF DATA VALUES USED	UNUSED	
767	0.000	13.871	1.120	1.688	423720	0	- Volume
210	0.000	32.717	0.211	0.708	349087	74633	SDW1B Flow splitter - Total inflow
110	0.001	23.019	0.787	1.178	74381	349339	- Outflow to Pond D
115	0.000	0.189	0.049	0.061	302483	121237	- Outflow to Infiltr.
399	0.000	10.112	0.501	0.575	423719	1	Lake Reba Flow at POC
114	0.044	64.300	2.503	4.335	423719	1	MCRDF Flow at POC
118	0.376	76.927	4.048	5.146	423720	0	SR-509 Flow at POC

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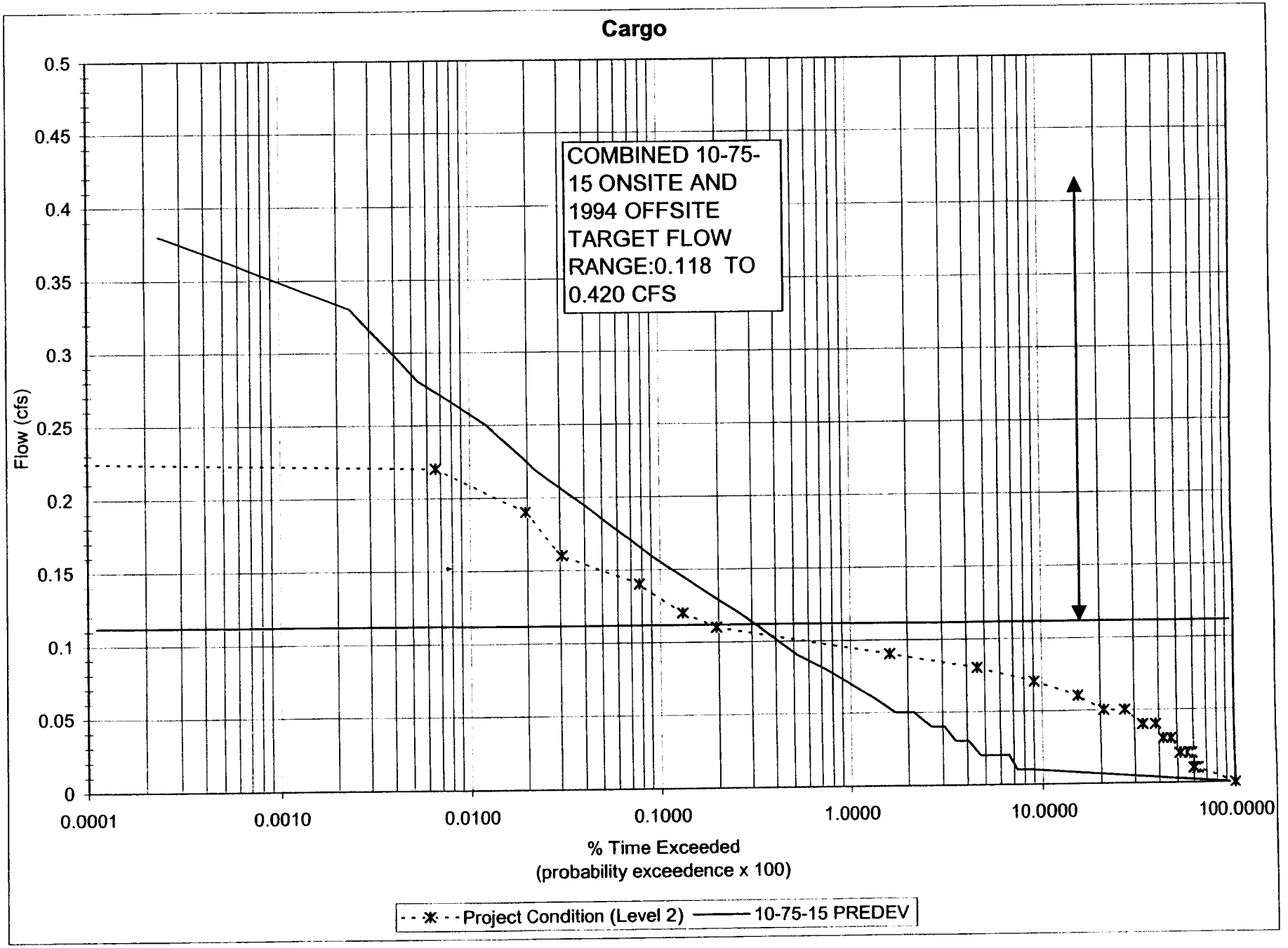
CARGO (SDN6)


Cargo
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE:0.118 TO 0.420 CFS
Flow (cfs)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

AR 010427

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW CARGO (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.235	0.402	0.264	0.189	0.192
0.221	0.216	0.228	0.254	0.233
0.193	0.211	0.213	0.212	0.218
0.219	0.205	0.201	0.306	0.356
0.182	0.205	0.199	0.314	0.172
0.252	0.279	0.174	0.220	0.343
0.354	0.269	0.267	0.360	0.272
0.231	0.186	0.248	0.360	0.186
0.259	0.375	0.346	0.215	0.172
0.175	0.212	0.306		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.618
Variance (logs)	0.011
Standard Deviation (logs)	0.103
Skewness (logs)	0.562
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.200
Coefficient of Variation (logs)	-0.167

1

HOURLY FLOW CARGO (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.153
0.9500	1.05	0.170
0.9000	1.11	0.181
0.8000	1.25	0.196
0.5000	2.00	0.236
0.2000	5.00	0.292
0.1000	10.00	0.330
0.0400	25.00	0.381
0.0200	50.00	0.420
0.0100	100.00	0.461
0.0050	200.00	0.503

$Y_2 Q_2 = 0.118$
$Q_{50} = 0.420$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW CARGO (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.084	0.105	0.238	0.075	0.111
0.092	0.081	0.185	0.091	0.093
0.092	0.104	0.102	0.075	0.098
0.107	0.105	0.094	0.102	0.089
0.090	0.098	0.092	0.177	0.105
0.098	0.088	0.088	0.071	0.094
0.069	0.160	0.088	0.106	0.093
0.078	0.076	0.093	0.104	0.084
0.080	0.106	0.124	0.093	0.071
0.071	0.102	0.221		

The following 7 statistics are based on non-zero values.

Mean (logs)	-1.006
Variance (logs)	0.014
Standard Deviation (logs)	0.118
Skewness (logs)	1.689
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.099
Coefficient of Variation (logs)	-0.117

1

HOURLY FLOW CARGO (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.072
0.9500	1.05	0.074
0.9000	1.11	0.076
0.8000	1.25	0.079
0.5000	2.00	0.092
0.2000	5.00	0.118
0.1000	10.00	0.141
0.0400	25.00	0.178
0.0200	50.00	0.212
0.0100	100.00	0.251
0.0050	200.00	0.297

$\frac{1}{2}Q_2 = 0.046$
$Q_{50} = 0.212$

1

Simulated - HOURLY FLOW CARGO (PREDEV)
Observed - HOURLY FLOW CARGO (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	156588	0.002	*	0.004	*	-0.002	*
0.01	4405	0.010	100.0	0.011	104.7	-0.010	-91.2
0.01	7907	0.012	99.1	0.012	102.6	-0.011	-91.0
0.01	6794	0.014	99.0	0.014	102.6	-0.013	-91.3
0.02	6063	0.016	98.8	0.016	102.6	-0.014	-90.0
0.02	7826	0.018	98.1	0.019	100.6	-0.017	-90.9
0.02	15235	0.021	97.6	0.022	101.2	-0.019	-89.2
0.02	21873	0.024	96.6	0.025	100.1	-0.022	-88.8
0.03	18154	0.028	95.3	0.028	97.6	-0.026	-89.3
0.03	15553	0.031	94.6	0.032	97.2	-0.029	-88.8
0.04	23140	0.035	93.5	0.036	95.9	-0.033	-88.4
0.04	26061	0.040	92.6	0.041	94.9	-0.038	-88.0
0.05	25962	0.045	91.5	0.046	93.6	-0.043	-87.9
0.05	23067	0.051	90.4	0.053	92.6	-0.049	-87.0
0.06	26449	0.059	89.1	0.060	91.3	-0.057	-86.1
0.07	19335	0.066	87.3	0.068	89.5	-0.064	-84.7
0.08	12506	0.073	85.3	0.075	87.6	-0.071	-82.6
0.09	5975	0.081	81.3	0.084	84.1	-0.078	-78.0
0.11	276	0.083	73.9	0.086	76.4	-0.077	-68.6
0.12	222	0.090	69.2	0.093	71.9	-0.086	-66.7
0.14	199	0.105	70.5	0.109	73.0	-0.099	-66.2
0.16	47	0.100	58.5	0.103	60.7	-0.089	-52.1
0.19	55	0.110	53.8	0.118	57.3	-0.106	-52.0
0.22	28	0.119	52.2	0.127	55.8	-0.118	-51.9
0.25	0	0.000	0.0	0.000	0.0	0.000	0.0
0.28	0	0.000	0.0	0.000	0.0	0.000	0.0
0.33	0	0.000	0.0	0.000	0.0	0.000	0.0
0.38	0	0.000	0.0	0.000	0.0	0.000	0.0
0.43	0	0.000	0.0	0.000	0.0	0.000	0.0
0.50	0	0.000	0.0	0.000	0.0	0.000	0.0
0.57	0	0.000	0.0	0.000	0.0	0.000	0.0
0.66	0	0.000	0.0	0.000	0.0	0.000	0.0
0.76	0	0.000	0.0	0.000	0.0	0.000	0.0
0.87	0	0.000	0.0	0.000	0.0	0.000	0.0
1.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.026	*	0.036	*	-0.025	*

Standard error of estimate = 0.03
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW CARGO (PREDEV)
Observed - HOURLY FLOW CARGO (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		91.35	36.96	100.00	100.00	0.00	0.00
0.01	2160	4405	0.51	1.04	8.65	63.04	0.01	0.01
0.01	3661	7907	0.86	1.87	8.14	62.00	0.01	0.01
0.01	2876	6794	0.68	1.60	7.28	60.14	0.01	0.01
0.02	2456	6063	0.58	1.43	6.60	58.54	0.02	0.02
0.02	3045	7826	0.72	1.85	6.02	57.10	0.02	0.02
0.02	250015235		0.59	3.60	5.30	55.26	0.02	0.02
0.02	278521873		0.66	5.16	4.71	51.66	0.02	0.02
0.03	230918154		0.54	4.28	4.05	46.50	0.03	0.03
0.03	185715553		0.44	3.67	3.51	42.22	0.03	0.03
0.04	198323140		0.47	5.46	3.07	38.54	0.04	0.04
0.04	196126061		0.46	6.15	2.60	33.08	0.04	0.04
0.05	183425962		0.43	6.13	2.14	26.93	0.05	0.05
0.05	160223067		0.38	5.44	1.70	20.81	0.06	0.06
0.06	142926449		0.34	6.24	1.33	15.36	0.07	0.07
0.07	105119335		0.25	4.56	0.99	9.12	0.08	0.08
0.08	93812506		0.22	2.95	0.74	4.56	0.09	0.09
0.09	813	5975	0.19	1.41	0.52	1.61	0.10	0.10
0.11	311	276	0.07	0.07	0.33	0.20	0.11	0.11
0.12	453	222	0.11	0.05	0.25	0.13	0.13	0.13
0.14	249	199	0.06	0.05	0.15	0.08	0.15	0.15
0.16	188	47	0.04	0.01	0.09	0.03	0.17	0.17
0.19	97	55	0.02	0.01	0.04	0.02	0.20	0.20
0.22	40	28	0.01	0.01	0.02	0.01	0.23	0.23
0.25	29	0	0.01	0.00	0.01	0.00	0.27	0.00
0.28	13	0	0.00	0.00	0.01	0.00	0.31	0.00
0.33	9	0	0.00	0.00	0.00	0.00	0.35	0.00
0.38	1	0	0.00	0.00	0.00	0.00	0.40	0.00
0.43	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.50	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.57	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.66	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.76	0	0	0.00	0.00	0.00	0.00	0.00	0.00
0.87	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.00	0.03

578 Observed values are zero
73111 Simulated values are zero
578 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
72533 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW CARGO (PREDEV)
Observed - HOURLY FLOW CARGO (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	154615	340	156	73	67	105	1232	0
0.01	4231	46	20	3	4	15	86	0
0.01	7552	96	42	15	11	22	169	0
0.01	6501	80	24	15	15	22	137	0
0.02	5750	99	29	16	7	23	139	0
0.02	7447	92	49	15	15	30	178	0
0.02	14324	260	87	45	46	74	399	0
0.02	20472	406	175	57	80	129	554	0
0.03	16929	394	176	64	59	105	427	0

0.03	14470	368	158	66	60	87	344	0
0.04	21401	654	252	105	99	160	469	0
0.04	23970	815	315	131	116	186	528	0
0.05	23782	920	386	152	104	159	459	0
0.05	21052	893	337	126	120	156	383	0
0.06	24022	1137	387	154	134	203	412	0
0.07	17375	993	323	107	103	157	277	0
0.08	11119	725	242	79	63	93	185	0
0.09	5094	492	150	56	27	48	108	0
0.11	229	21	6	1	3	7	9	0
0.12	149	58	4	3	0	4	4	0
0.14	139	46	3	2	0	4	5	0
0.16	21	20	3	0	0	0	3	0
0.19	22	25	3	3	0	2	0	0
0.22	9	15	2	1	1	0	0	0
0.25	0	0	0	0	0	0	0	0
0.28	0	0	0	0	0	0	0	0
0.33	0	0	0	0	0	0	0	0
0.38	0	0	0	0	0	0	0	0
0.43	0	0	0	0	0	0	0	0
0.50	0	0	0	0	0	0	0	0
0.57	0	0	0	0	0	0	0	0
0.66	0	0	0	0	0	0	0	0
0.76	0	0	0	0	0	0	0	0
0.87	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0
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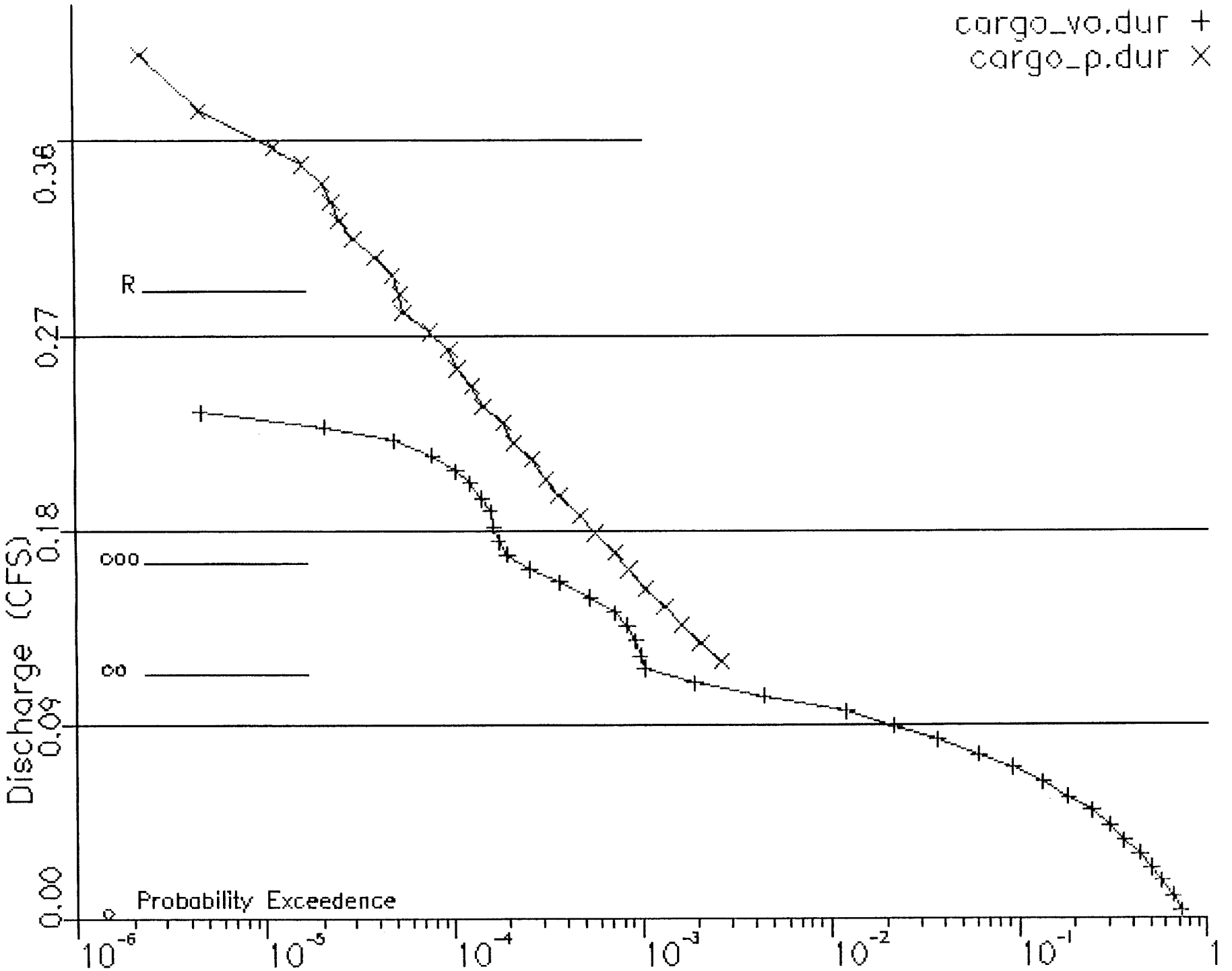
	400675	8995	3329	1289	1134	1791	6507	0


cargo_vo.dur +
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AR 010433

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	140.00	ft
Facility Width:	110.00	ft
Facility Area:	15400.	sq. ft
Effective Storage Depth:	14.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	215600.	cu. ft
Riser Head:	14.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.13	0.128	
2	10.80	1.25	0.076	4.0
3	12.00	1.50	0.086	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	154.	0.004	0.004	0.00
0.02	0.02	308.	0.007	0.005	0.00
0.04	0.04	616.	0.014	0.006	0.00
0.05	0.05	770.	0.018	0.007	0.00
0.06	0.06	924.	0.021	0.008	0.00
0.07	0.07	1078.	0.025	0.009	0.00
0.08	0.08	1232.	0.028	0.010	0.00
0.09	0.09	1386.	0.032	0.011	0.00
0.37	0.37	5698.	0.131	0.021	0.00
0.64	0.64	9856.	0.226	0.028	0.00
0.92	0.92	14168.	0.325	0.033	0.00
1.19	1.19	18326.	0.421	0.037	0.00
1.47	1.47	22638.	0.520	0.042	0.00
1.74	1.74	26796.	0.615	0.045	0.00
2.02	2.02	31108.	0.714	0.049	0.00
2.29	2.29	35266.	0.810	0.052	0.00
2.56	2.56	39424.	0.905	0.055	0.00
2.84	2.84	43736.	1.004	0.058	0.00
3.11	3.11	47894.	1.099	0.061	0.00
3.39	3.39	52206.	1.198	0.063	0.00
3.66	3.66	56364.	1.294	0.066	0.00
3.94	3.94	60676.	1.393	0.068	0.00
4.21	4.21	64834.	1.488	0.070	0.00
4.49	4.49	69146.	1.587	0.073	0.00
4.76	4.76	73304.	1.683	0.075	0.00
5.03	5.03	77462.	1.778	0.077	0.00
5.31	5.31	81774.	1.877	0.079	0.00
5.58	5.58	85932.	1.973	0.081	0.00
5.86	5.86	90244.	2.072	0.083	0.00
6.13	6.13	94402.	2.167	0.085	0.00
6.41	6.41	98714.	2.266	0.087	0.00

6.68	6.68	102872.	2.362	0.089	0.00
6.96	6.96	107184.	2.461	0.091	0.00
7.23	7.23	111342.	2.556	0.092	0.00
7.51	7.51	115654.	2.655	0.094	0.00
7.78	7.78	119812.	2.751	0.096	0.00
8.05	8.05	123970.	2.846	0.097	0.00
8.33	8.33	128282.	2.945	0.099	0.00
8.60	8.60	132440.	3.040	0.101	0.00
8.88	8.88	136752.	3.139	0.102	0.00
9.15	9.15	140910.	3.235	0.104	0.00
9.43	9.43	145222.	3.334	0.105	0.00
9.70	9.70	149380.	3.429	0.107	0.00
9.98	9.98	153692.	3.528	0.108	0.00
10.25	10.25	157850.	3.624	0.110	0.00
10.53	10.53	162162.	3.723	0.111	0.00
10.80	10.80	166320.	3.818	0.113	0.00
10.81	10.81	166474.	3.822	0.113	0.00
10.83	10.83	166782.	3.829	0.114	0.00
10.84	10.84	166936.	3.832	0.116	0.00
10.85	10.85	167090.	3.836	0.118	0.00
10.87	10.87	167398.	3.843	0.121	0.00
10.88	10.88	167552.	3.846	0.125	0.00
10.89	10.89	167706.	3.850	0.126	0.00
10.90	10.90	167860.	3.854	0.127	0.00
10.92	10.92	168168.	3.861	0.128	0.00
11.19	11.19	172326.	3.956	0.141	0.00
11.47	11.47	176638.	4.055	0.151	0.00
11.74	11.74	180796.	4.151	0.159	0.00
12.00	12.00	184800.	4.242	0.165	0.00
12.02	12.02	185108.	4.249	0.166	0.00
12.03	12.03	185262.	4.253	0.168	0.00
12.05	12.05	185570.	4.260	0.171	0.00
12.06	12.06	185724.	4.264	0.174	0.00
12.08	12.08	186032.	4.271	0.179	0.00
12.09	12.09	186186.	4.274	0.184	0.00
12.11	12.11	186494.	4.281	0.188	0.00
12.13	12.13	186802.	4.288	0.190	0.00
12.40	12.40	190960.	4.384	0.213	0.00
12.67	12.67	195118.	4.479	0.230	0.00
12.95	12.95	199430.	4.578	0.245	0.00
13.22	13.22	203588.	4.674	0.258	0.00
13.50	13.50	207900.	4.773	0.270	0.00
13.77	13.77	212058.	4.868	0.282	0.00
14.00	14.00	215600.	4.949	0.291	0.00
14.10	14.10	217140.	4.985	0.910	0.00
14.20	14.20	218680.	5.020	2.040	0.00
14.30	14.30	220220.	5.056	3.500	0.00
14.40	14.40	221760.	5.091	5.230	0.00
14.50	14.50	223300.	5.126	7.200	0.00
14.60	14.60	224840.	5.162	9.360	0.00
14.70	14.70	226380.	5.197	11.720	0.00
14.80	14.80	227920.	5.232	13.850	0.00
14.90	14.90	229460.	5.268	14.670	0.00
15.00	15.00	231000.	5.303	15.450	0.00
15.10	15.10	232540.	5.338	16.200	0.00
15.20	15.20	234080.	5.374	16.900	0.00
15.30	15.30	235620.	5.409	17.580	0.00

15.40	15.40	237160.	5.444	18.240	0.00
15.50	15.50	238700.	5.480	18.870	0.00
15.60	15.60	240240.	5.515	19.480	0.00
15.70	15.70	241780.	5.551	20.070	0.00
15.80	15.80	243320.	5.586	20.650	0.00

Route Time Series through Facility
Inflow Time Series File:cargo_d.tsf
Outflow Time Series File:cargo_vo

Inflow/Outflow Analysis

Peak Inflow Discharge:	3.60	CFS	at	0:00	on	Oct 26	in 1986
Peak Outflow Discharge:	0.236	CFS	at	12:00	on	Jan 2	in 1997
Peak Reservoir Stage:	12.78	Ft					
Peak Reservoir Elev:	12.78	Ft					
Peak Reservoir Storage:	196834.	Cu-Ft					
:	4.519	Ac-Ft					

Flow Frequency Analysis
Time Series File:cargo_p.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.615 StdDev= 0.103
Skew= 0.476

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			0.455		100.00	0.990
Computed Peaks			0.417		50.00	0.980
Computed Peaks			0.380		25.00	0.960
Computed Peaks			0.331		10.00	0.900
Computed Peaks			0.321		8.00	0.875
Computed Peaks			0.294		5.00	0.800
Computed Peaks			0.238		2.00	0.500
Computed Peaks			0.202		1.30	0.231

Flow Frequency Analysis
Time Series File:cargo_vo.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -1.114 StdDev= 0.105
Skew= 1.159

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.264	13.35		100.00	0.990
Computed Peaks			0.220	12.52		50.00	0.980
Computed Peaks			0.184	12.09		25.00	0.960
Computed Peaks			0.144	11.28		10.00	0.900
Computed Peaks			0.137	11.12		8.00	0.875
Computed Peaks			0.119	10.86		5.00	0.800
Computed Peaks			0.092	7.10		2.00	0.500
Computed Peaks			0.080	5.41		1.30	0.231

Duration Comparison Anaylsis
Base File: cargo_p.tsf
New File: cargo_vo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.120	0.25E-02	0.99E-03	-61.0	0.25E-02	0.120	0.107	-10.5
0.129	0.20E-02	0.92E-03	-53.2	0.20E-02	0.129	0.109	-15.6
0.138	0.15E-02	0.79E-03	-48.4	0.15E-02	0.138	0.111	-19.9
0.147	0.12E-02	0.59E-03	-52.6	0.12E-02	0.147	0.112	-23.9
0.156	0.95E-03	0.35E-03	-63.1	0.95E-03	0.156	0.127	-18.8
0.165	0.79E-03	0.21E-03	-74.1	0.79E-03	0.165	0.138	-16.8
0.175	0.63E-03	0.17E-03	-72.3	0.63E-03	0.175	0.146	-16.3
0.184	0.51E-03	0.16E-03	-68.2	0.51E-03	0.184	0.149	-18.7
0.193	0.40E-03	0.15E-03	-63.1	0.40E-03	0.193	0.153	-20.5
0.202	0.32E-03	0.12E-03	-61.2	0.32E-03	0.202	0.158	-21.6
0.211	0.26E-03	0.96E-04	-63.8	0.26E-03	0.211	0.161	-23.6
0.220	0.21E-03	0.55E-04	-74.2	0.21E-03	0.220	0.164	-25.3
0.229	0.18E-03	0.21E-04	-88.9	0.18E-03	0.229	0.172	-25.1
0.238	0.14E-03	0.00E+00	-100.0	0.14E-03	0.238	0.194	-18.5
0.248	0.13E-03	0.00E+00	-100.0	0.13E-03	0.248	0.201	-18.7
0.257	0.11E-03	0.00E+00	-100.0	0.11E-03	0.257	0.208	-19.1
0.266	0.89E-04	0.00E+00	-100.0	0.89E-04	0.266	0.213	-19.7
0.275	0.71E-04	0.00E+00	-100.0	0.71E-04	0.275	0.216	-21.5
0.284	0.53E-04	0.00E+00	-100.0	0.53E-04	0.284	0.220	-22.4
0.293	0.50E-04	0.00E+00	-100.0	0.50E-04	0.293	0.221	-24.8
0.302	0.46E-04	0.00E+00	-100.0	0.46E-04	0.302	0.222	-26.6
0.311	0.37E-04	0.00E+00	-100.0	0.37E-04	0.311	0.224	-28.2
0.321	0.27E-04	0.00E+00	-100.0	0.27E-04	0.321	0.226	-29.4
0.330	0.23E-04	0.00E+00	-100.0	0.23E-04	0.330	0.228	-31.0
0.339	0.21E-04	0.00E+00	-100.0	0.21E-04	0.339	0.229	-32.3
0.348	0.16E-04	0.00E+00	-100.0	0.16E-04	0.348	0.231	-33.6
0.357	0.11E-04	0.00E+00	-100.0	0.11E-04	0.357	0.232	-35.0
0.366	0.46E-05	0.00E+00	-100.0	0.46E-05	0.366	0.234	-36.0
0.375	0.23E-05	0.00E+00	-100.0	0.23E-05	0.375	0.236	-37.2
0.384	0.23E-05	0.00E+00	-100.0	0.23E-05	0.384	0.236	-38.7
0.394	0.23E-05	0.00E+00	-100.0	0.23E-05	0.394	0.236	-40.1

There is no positive excursion

Maximum negative excursion = 0.165 cfs (-41.3%)
occuring at 0.401 cfs on the Base Data:cargo_p.tsf
and at 0.236 cfs on the New Data:cargo_vo.tsf

Land Use Summary	
Till Forest	6.09 acres
Till Pasture	0.00 acres
Till Grass	1.22 acres
Airport Fill	0.00 acres
Outwash Forest	0.00 acres
Outwash Pasture	0.00 acres
Outwash Grass	0.00 acres
Wetland	0.00 acres
Impervious	0.81 acres
Total Area :	8.12 acres
Scale Factor :	1.00 Hourly Historic

Time Series: cargo_p

Compute Time Series
Modify User Input

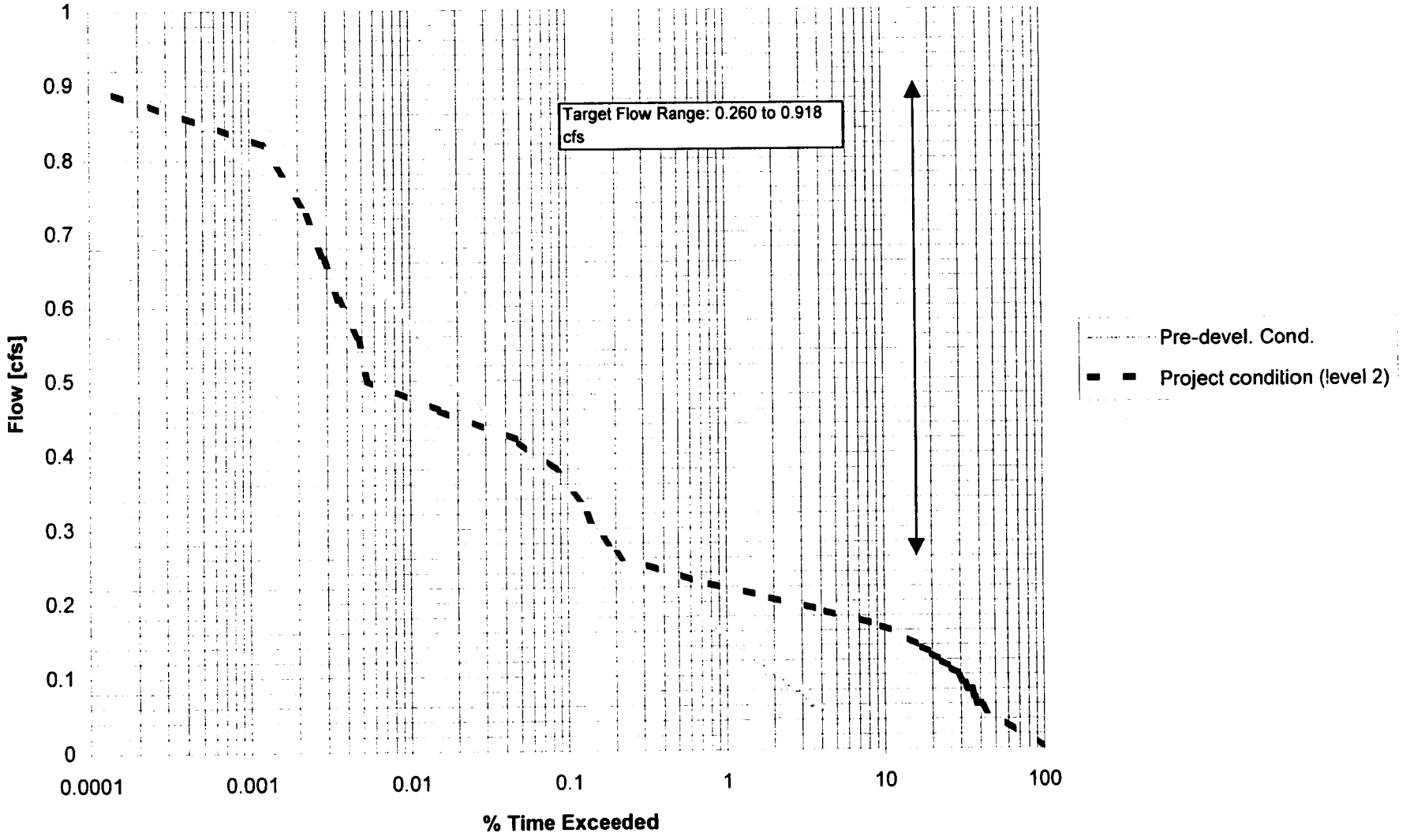
Land Use Summary	
Till Forest	0.00 acres
Till Pasture	0.00 acres
Till Grass	0.00 acres
Airport Fill	0.00 acres
Outwash Forest	0.00 acres
Outwash Pasture	0.00 acres
Outwash Grass	0.00 acres
Wetland	0.00 acres
Impervious	8.12 acres
Total Area :	8.12 acres
Scale Factor :	1.00 Hourly Historic

Time Series: cargo_d

Compute Time Series
Modify User Input

SDN3A

MILLER at SDN3A



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1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3A (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.536	0.916	0.576	0.384	0.435
0.499	0.490	0.519	0.569	0.531
0.430	0.468	0.474	0.489	0.491
0.496	0.466	0.451	0.698	0.814
0.403	0.461	0.457	0.731	0.393
0.573	0.619	0.402	0.507	0.791
0.818	0.606	0.602	0.458	0.611
0.522	0.429	0.537	0.529	0.431
0.597	0.826	0.767	0.487	0.400
0.403	0.487	0.696		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.273
Variance (logs)	0.010
Standard Deviation (logs)	0.098
Skewness (logs)	0.717
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.203
Coefficient of Variation (logs)	-0.358

1

HOURLY FLOW SDN3A (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.356
0.9500	1.05	0.388
0.9000	1.11	0.409
0.8000	1.25	0.440
0.5000	2.00	0.519
0.2000	5.00	0.637
0.1000	10.00	0.720
0.0400	25.00	0.831
0.0200	50.00	0.918
0.0100	100.00	1.009
0.0050	200.00	1.105

$1/2Q_2 = 0.260$ cfs
$Q_{50} = 0.918$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3A poc (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.166	0.275	0.892	0.154	0.218
0.204	0.167	0.395	0.191	0.187
0.198	0.198	0.228	0.140	0.188
0.220	0.191	0.191	0.229	0.190
0.194	0.198	0.184	0.435	0.193
0.210	0.182	0.181	0.080	0.168
0.125	0.224	0.170	0.207	0.194
0.147	0.117	0.184	0.187	0.133
0.155	0.206	0.218	0.177	0.135
0.129	0.195	0.465		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.710
Variance (logs)	0.026
Standard Deviation (logs)	0.163
Skewness (logs)	1.634
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.078
Coefficient of Variation (logs)	-0.229

1

HOURLY FLOW SDN3A poc (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.126
0.9500	1.05	0.130
0.9000	1.11	0.135
0.8000	1.25	0.144
0.5000	2.00	0.177
0.2000	5.00	0.251
0.1000	10.00	0.321
0.0400	25.00	0.439
0.0200	50.00	0.555
0.0100	100.00	0.699
0.0050	200.00	0.878

$1/2 Q_2 = 0.089$ cfs
$Q_{50} = 0.555$ cfs

1

Simulated - HOURLY FLOW SDN3A (PREDEV)
Observed - HOURLY FLOW SDN3A poc (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	235575	0.018	103.7	0.028	125.1	-0.014	-86.7
0.05	18130	0.054	97.8	0.057	103.8	-0.046	-83.9
0.06	7669	0.060	96.3	0.063	100.9	-0.053	-85.1
0.06	7039	0.065	95.9	0.067	99.3	-0.059	-87.2
0.07	6312	0.070	96.0	0.073	100.2	-0.063	-87.2
0.08	6396	0.073	94.8	0.076	97.8	-0.068	-88.2
0.08	10803	0.080	94.7	0.083	97.4	-0.075	-88.6
0.09	10744	0.089	93.7	0.092	96.2	-0.085	-88.8
0.10	15488	0.098	93.7	0.101	95.7	-0.094	-89.5
0.11	14411	0.107	93.3	0.110	95.3	-0.103	-89.8
0.12	11985	0.116	92.9	0.118	94.7	-0.112	-90.0
0.13	12700	0.125	92.6	0.128	94.4	-0.122	-90.0
0.14	21448	0.138	92.5	0.141	94.3	-0.135	-90.0
0.16	11436	0.152	92.0	0.155	93.8	-0.149	-90.3
0.17	18587	0.165	92.0	0.168	93.5	-0.162	-90.5
0.19	8806	0.181	91.3	0.184	92.8	-0.180	-90.5
0.21	3695	0.199	91.2	0.203	92.8	-0.196	-89.5
0.23	1555	0.216	90.2	0.220	91.7	-0.212	-88.5
0.26	175	0.242	89.6	0.247	91.1	-0.239	-88.3
0.28	173	0.268	91.4	0.271	92.4	-0.260	-88.7
0.31	81	0.280	85.7	0.286	87.6	-0.273	-83.6
0.34	166	0.312	87.5	0.317	88.9	-0.307	-86.3
0.38	151	0.352	88.4	0.357	89.6	-0.351	-88.1
0.42	131	0.388	88.9	0.389	89.1	-0.388	-88.9
0.46	41	0.406	86.9	0.407	87.0	-0.406	-86.9
0.50	3	0.397	74.1	0.411	76.9	-0.397	-74.1
0.56	5	0.478	82.5	0.479	82.6	-0.478	-82.5
0.61	3	0.579	90.6	0.579	90.6	-0.579	-90.6
0.67	3	0.553	78.7	0.568	80.7	-0.553	-78.7
0.74	4	0.665	85.5	0.669	86.2	-0.665	-85.5
0.82	5	0.778	89.8	0.779	89.8	-0.778	-89.8
0.90	0	0.000	0.0	0.000	0.0	0.000	0.0
0.99	0	0.000	0.0	0.000	0.0	0.000	0.0
1.10	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.061	99.2	0.085	113.2	-0.057	-87.6

Standard error of estimate = 0.06
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN3A (PREDEV)
Observed - HOURLY FLOW SDN3A poc (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit: Simulated	Observed	Average of cases within class limits: Simulated	Observed
0.00	**********		95.56	55.60	100.00	100.00	0.00	0.02
0.05	273	118130	0.64	4.28	4.44	44.40	0.05	0.05
0.06	1193	7669	0.28	1.81	3.79	40.12	0.06	0.06
0.06	1110	7039	0.26	1.66	3.51	38.31	0.07	0.07
0.07	957	6312	0.23	1.49	3.25	36.65	0.07	0.07
0.08	932	6396	0.22	1.51	3.02	35.16	0.08	0.08

0.08	155410803	0.37	2.55	2.80	33.65	0.08	0.08
0.09	142110744	0.34	2.54	2.44	31.10	0.09	0.10
0.10	118815488	0.28	3.66	2.10	28.57	0.11	0.11
0.11	101614411	0.24	3.40	1.82	24.91	0.11	0.11
0.12	81111985	0.19	2.83	1.58	21.51	0.12	0.12
0.13	73712700	0.17	3.00	1.39	18.68	0.13	0.14
0.14	120221448	0.28	5.06	1.22	15.69	0.15	0.15
0.16	45711436	0.11	2.70	0.93	10.62	0.16	0.16
0.17	79518587	0.19	4.39	0.83	7.93	0.18	0.18
0.19	578 8806	0.14	2.08	0.64	3.54	0.20	0.20
0.21	465 3695	0.11	0.87	0.50	1.46	0.22	0.22
0.23	501 1555	0.12	0.37	0.39	0.59	0.24	0.24
0.26	250 175	0.06	0.04	0.27	0.22	0.27	0.27
0.28	276 173	0.07	0.04	0.21	0.18	0.29	0.29
0.31	193 81	0.05	0.02	0.15	0.14	0.32	0.33
0.34	159 166	0.04	0.04	0.10	0.12	0.36	0.36
0.38	97 151	0.02	0.04	0.07	0.08	0.40	0.40
0.42	63 131	0.01	0.03	0.04	0.05	0.44	0.44
0.46	45 41	0.01	0.01	0.03	0.02	0.48	0.47
0.50	28 3	0.01	0.00	0.02	0.01	0.52	0.54
0.56	17 5	0.00	0.00	0.01	0.00	0.59	0.58
0.61	12 3	0.00	0.00	0.01	0.00	0.63	0.64
0.67	10 3	0.00	0.00	0.00	0.00	0.70	0.70
0.74	7 4	0.00	0.00	0.00	0.00	0.79	0.78
0.82	2 5	0.00	0.00	0.00	0.00	0.83	0.87
0.90	1 0	0.00	0.00	0.00	0.00	0.92	0.00
0.99	0 0	0.00	0.00	0.00	0.00	0.00	0.00
1.10	0 0	0.00	0.00	0.00	0.00	0.00	0.00
1.20	0 0	0.00	0.00	0.00	0.00	0.00	0.00
	423720423720	100.00	100.00			0.01	0.06

0 Observed values are zero
68593 Simulated values are zero
0 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
68593 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN3A (PREDEV)
Observed - HOURLY FLOW SDN3A poc (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	224778	2078	998	389	366	667	6299	0
0.05	16578	354	193	79	73	115	738	0
0.06	7007	168	80	34	37	56	287	0
0.06	6501	158	77	30	21	45	207	0
0.07	5809	154	77	22	30	41	179	0
0.08	5906	161	78	35	28	27	161	0
0.08	9973	280	124	54	48	70	254	0
0.09	9904	307	132	52	45	70	234	0
0.10	14367	437	180	77	57	73	297	0
0.11	13349	475	175	60	60	70	222	0
0.12	11132	375	152	52	49	68	157	0
0.13	11786	431	162	48	49	72	152	0
0.14	19847	738	266	106	83	128	280	0
0.16	10597	420	142	49	48	71	109	0
0.17	17405	618	219	67	42	84	152	0
0.19	8209	370	111	27	23	30	36	0
0.21	3454	128	36	13	13	17	34	0
0.23	1440	74	11	5	4	3	18	0
0.26	166	2	1	1	1	3	1	0
0.28	164	3	2	0	0	1	3	0
0.31	74	4	0	1	0	0	2	0
0.34	154	7	2	0	1	0	2	0
0.38	142	6	1	0	1	1	0	0
0.42	131	0	0	0	0	0	0	0
0.46	41	0	0	0	0	0	0	0
0.50	2	1	0	0	0	0	0	0
0.56	5	0	0	0	0	0	0	0

0.61	3	0	0	0	0	0	0	0
0.67	2	1	0	0	0	0	0	0
0.74	4	0	0	0	0	0	0	0
0.82	5	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0
0.99	0	0	0	0	0	0	0	0
1.10	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
	398935	7750	3219	1201	1079	1712	9824	0

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Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	2.00	H:1V
Pond Bottom Length:	300.00	ft
Pond Bottom Width:	190.00	ft
Pond Bottom Area:	57000.	sq. ft
Top Area at 1 ft. FB:	79344.	sq. ft
	1.821	acres
Effective Storage Depth:	9.50	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	634518.	cu. ft
	14.567	ac-ft
Riser Head:	9.50	ft
Riser Diameter:	12.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.60	0.208	
2	7.75	1.60	0.078	4.0
3	8.25	1.75	0.072	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	0.00	0.	0.000	0.000	0.00	57000.
0.02	0.02	1140.	0.026	0.009	0.00	57039.
0.03	0.03	1711.	0.039	0.013	0.00	57059.
0.05	0.05	2853.	0.065	0.016	0.00	57098.
0.07	0.07	3995.	0.092	0.018	0.00	57137.
0.08	0.08	4566.	0.105	0.020	0.00	57157.
0.10	0.10	5710.	0.131	0.022	0.00	57196.
0.12	0.12	6854.	0.157	0.024	0.00	57235.
0.13	0.13	7427.	0.170	0.025	0.00	57255.
0.32	0.32	18341.	0.421	0.039	0.00	57629.
0.51	0.51	29326.	0.673	0.049	0.00	58004.
0.69	0.69	39798.	0.914	0.058	0.00	58360.
0.88	0.88	50923.	1.169	0.065	0.00	58737.
1.06	1.06	61527.	1.412	0.072	0.00	59096.
1.25	1.25	72792.	1.671	0.078	0.00	59475.
1.44	1.44	84128.	1.931	0.083	0.00	59856.
1.62	1.62	94935.	2.179	0.088	0.00	60217.
1.81	1.81	106412.	2.443	0.093	0.00	60600.
2.00	2.00	117963.	2.708	0.098	0.00	60984.
2.18	2.18	128973.	2.961	0.103	0.00	61349.
2.37	2.37	140666.	3.229	0.107	0.00	61735.
2.55	2.55	151811.	3.485	0.111	0.00	62102.
2.74	2.74	163647.	3.757	0.115	0.00	62491.
2.93	2.93	175557.	4.030	0.119	0.00	62880.
3.11	3.11	186909.	4.291	0.123	0.00	63250.
3.30	3.30	198964.	4.568	0.126	0.00	63642.
3.49	3.49	211093.	4.846	0.130	0.00	64035.
3.67	3.67	222653.	5.111	0.133	0.00	64409.

3.86	3.86	234928.	5.393	0.136	0.00	64804.
4.05	4.05	247279.	5.677	0.140	0.00	65200.
4.23	4.23	259049.	5.947	0.143	0.00	65577.
4.42	4.42	271546.	6.234	0.146	0.00	65976.
4.60	4.60	283456.	6.507	0.149	0.00	66355.
4.79	4.79	296101.	6.798	0.152	0.00	66756.
4.98	4.98	308823.	7.090	0.155	0.00	67158.
5.16	5.16	320946.	7.368	0.158	0.00	67540.
5.35	5.35	333817.	7.663	0.161	0.00	67944.
5.54	5.54	346765.	7.961	0.163	0.00	68349.
5.72	5.72	359102.	8.244	0.166	0.00	68735.
5.91	5.91	372200.	8.545	0.169	0.00	69142.
6.09	6.09	384681.	8.831	0.171	0.00	69530.
6.28	6.28	397931.	9.135	0.174	0.00	69940.
6.47	6.47	411258.	9.441	0.177	0.00	70351.
6.65	6.65	423956.	9.733	0.179	0.00	70742.
6.84	6.84	437437.	10.042	0.182	0.00	71155.
7.03	7.03	450995.	10.353	0.184	0.00	71570.
7.21	7.21	463913.	10.650	0.186	0.00	71963.
7.40	7.40	477626.	10.965	0.189	0.00	72380.
7.58	7.58	490690.	11.265	0.191	0.00	72776.
7.75	7.75	503094.	11.549	0.193	0.00	73151.
7.77	7.77	504557.	11.583	0.194	0.00	73195.
7.78	7.78	505289.	11.600	0.196	0.00	73217.
7.80	7.80	506754.	11.633	0.199	0.00	73261.
7.82	7.82	508220.	11.667	0.203	0.00	73306.
7.83	7.83	508953.	11.684	0.207	0.00	73328.
7.85	7.85	510420.	11.718	0.213	0.00	73372.
7.87	7.87	511888.	11.751	0.218	0.00	73416.
7.88	7.88	512622.	11.768	0.220	0.00	73438.
8.07	8.07	526615.	12.089	0.237	0.00	73859.
8.25	8.25	539946.	12.395	0.249	0.00	74259.
8.27	8.27	541432.	12.430	0.250	0.00	74303.
8.29	8.29	542918.	12.464	0.253	0.00	74348.
8.30	8.30	543662.	12.481	0.257	0.00	74370.
8.32	8.32	545150.	12.515	0.263	0.00	74415.
8.34	8.34	546638.	12.549	0.270	0.00	74459.
8.36	8.36	548128.	12.583	0.277	0.00	74504.
8.38	8.38	549619.	12.618	0.286	0.00	74548.
8.40	8.40	551110.	12.652	0.289	0.00	74593.
8.58	8.58	564573.	12.961	0.315	0.00	74995.
8.77	8.77	578862.	13.289	0.335	0.00	75420.
8.95	8.95	592474.	13.601	0.354	0.00	75824.
9.14	9.14	606921.	13.933	0.370	0.00	76251.
9.33	9.33	621449.	14.267	0.385	0.00	76680.
9.50	9.50	634518.	14.567	0.399	0.00	77064.
9.60	9.60	642235.	14.744	0.714	0.00	77291.
9.70	9.70	649976.	14.921	1.280	0.00	77517.
9.80	9.80	657739.	15.100	2.020	0.00	77745.
9.90	9.90	665525.	15.278	2.820	0.00	77972.
10.00	10.00	673333.	15.458	3.110	0.00	78200.
10.10	10.10	681165.	15.637	3.370	0.00	78428.
10.20	10.20	689019.	15.818	3.610	0.00	78657.
10.30	10.30	696896.	15.999	3.840	0.00	78885.
10.40	10.40	704796.	16.180	4.050	0.00	79115.
10.50	10.50	712719.	16.362	4.250	0.00	79344.
10.60	10.60	720665.	16.544	4.440	0.00	79574.

10.70	10.70	728634.	16.727	4.620	0.00	79804.
10.80	10.80	736626.	16.911	4.790	0.00	80034.
10.90	10.90	744641.	17.095	4.960	0.00	80265.
11.00	11.00	752679.	17.279	5.130	0.00	80496.
11.10	11.10	760740.	17.464	5.280	0.00	80727.
11.20	11.20	768824.	17.650	5.440	0.00	80959.
11.30	11.30	776932.	17.836	5.580	0.00	81191.
11.40	11.40	785062.	18.023	5.730	0.00	81423.

Route Time Series through Facility
Inflow Time Series File:sdn3aod2.tsf
Outflow Time Series File:sdn3ao_o.tsf

Inflow/Outflow Analysis
Peak Inflow Discharge: 6.30 CFS at 16:00 on Mar 3 in 1950
Peak Outflow Discharge: 0.346 CFS at 11:00 on Feb 11 in 1951
Peak Reservoir Stage: 8.88 Ft
Peak Reservoir Elev: 8.88 Ft
Peak Reservoir Storage: 587002. Cu-Ft
: 13.476 Ac-Ft

Flow Frequency Analysis
Time Series File:sdn3aop2.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.366 StdDev= 0.101
Skew= 0.544

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			0.811		100.00	0.990
Computed Peaks			0.741		50.00	0.980
Computed Peaks			0.674		25.00	0.960
Computed Peaks			0.586		10.00	0.900
Computed Peaks			0.569		8.00	0.875
Computed Peaks			0.520		5.00	0.800
Computed Peaks			0.422		2.00	0.500
Computed Peaks			0.360		1.30	0.231

Flow Frequency Analysis
Time Series File:sdn3ao_o.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.845 StdDev= 0.125
Skew= 0.909

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.336	8.78		100.00	0.990
Computed Peaks			0.294	8.44		50.00	0.980
Computed Peaks			0.256	8.30		25.00	0.960
Computed Peaks			0.210	7.84		10.00	0.900
Computed Peaks			0.202	7.81		8.00	0.875
Computed Peaks			0.178	6.59		5.00	0.800
Computed Peaks			0.137	3.90		2.00	0.500
Computed Peaks			0.114	2.69		1.30	0.231

Duration Comparison Anaylsis
Base File: sdn3aop2.tsf
New File: sdn3ao_o.tsf
Cutoff Units: Discharge in CFS

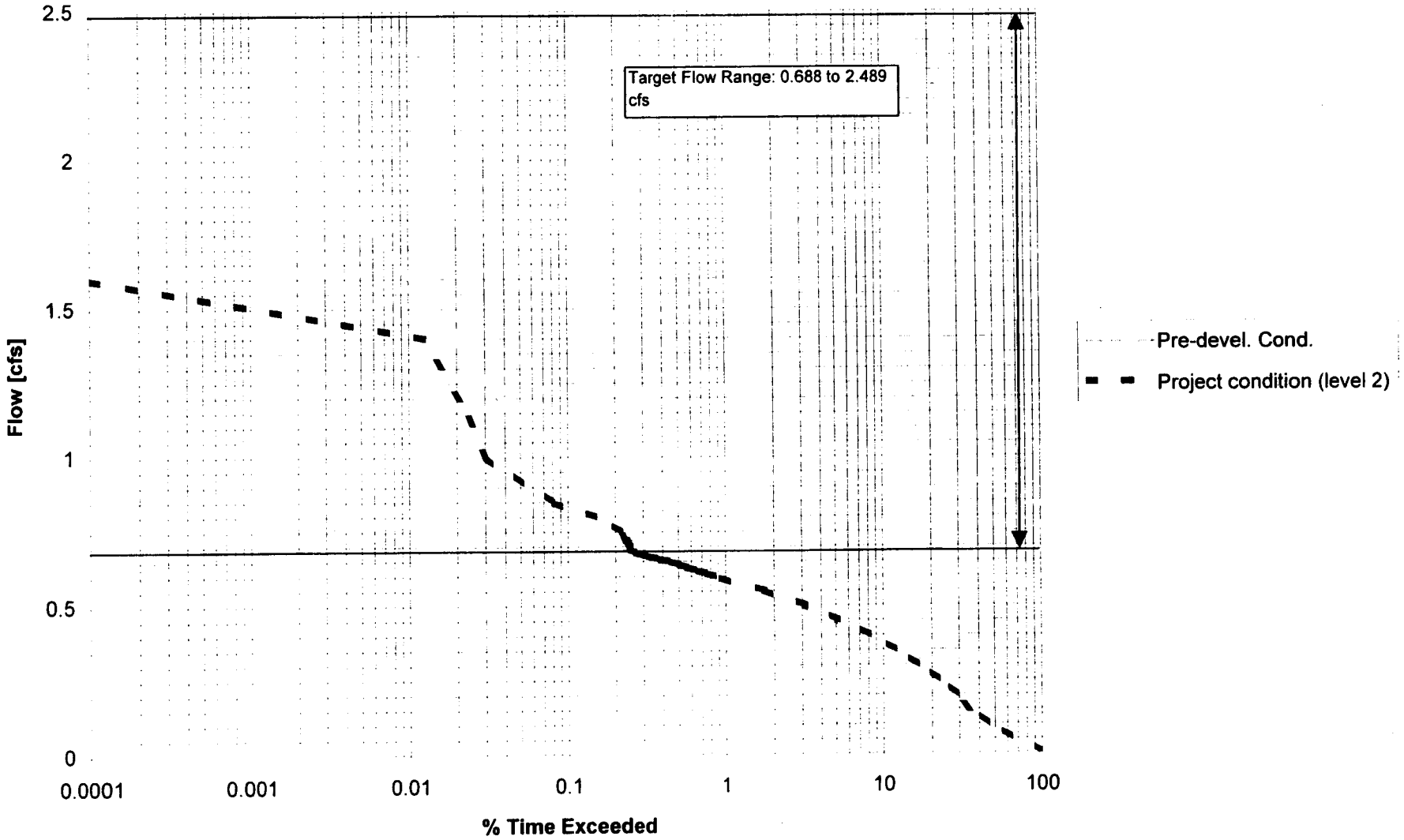
	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.212	0.24E-02	0.11E-02	-55.7	0.24E-02	0.212	0.186	-12.1
0.228	0.18E-02	0.87E-03	-52.7	0.18E-02	0.228	0.189	-16.9
0.244	0.14E-02	0.61E-03	-57.5	0.14E-02	0.244	0.192	-21.4
0.260	0.11E-02	0.46E-03	-58.2	0.11E-02	0.260	0.206	-21.0
0.276	0.85E-03	0.40E-03	-53.1	0.85E-03	0.276	0.229	-17.1
0.293	0.68E-03	0.32E-03	-53.7	0.68E-03	0.293	0.240	-18.1
0.309	0.56E-03	0.13E-03	-76.6	0.56E-03	0.309	0.247	-19.9
0.325	0.44E-03	0.96E-04	-78.4	0.44E-03	0.325	0.264	-18.7
0.341	0.37E-03	0.48E-04	-87.0	0.37E-03	0.341	0.287	-15.9
0.357	0.29E-03	0.00E+00	-100.0	0.29E-03	0.357	0.295	-17.5
0.374	0.23E-03	0.00E+00	-100.0	0.23E-03	0.374	0.299	-20.0
0.390	0.18E-03	0.00E+00	-100.0	0.18E-03	0.390	0.302	-22.6
0.406	0.15E-03	0.00E+00	-100.0	0.15E-03	0.406	0.306	-24.7
0.422	0.12E-03	0.00E+00	-100.0	0.12E-03	0.422	0.313	-25.9
0.438	0.11E-03	0.00E+00	-100.0	0.11E-03	0.438	0.317	-27.7
0.455	0.96E-04	0.00E+00	-100.0	0.96E-04	0.455	0.325	-28.5
0.471	0.80E-04	0.00E+00	-100.0	0.80E-04	0.471	0.332	-29.5
0.487	0.66E-04	0.00E+00	-100.0	0.66E-04	0.487	0.336	-31.0
0.503	0.48E-04	0.00E+00	-100.0	0.48E-04	0.503	0.341	-32.2
0.519	0.48E-04	0.00E+00	-100.0	0.48E-04	0.519	0.341	-34.3
0.536	0.39E-04	0.00E+00	-100.0	0.39E-04	0.536	0.343	-35.9
0.552	0.30E-04	0.00E+00	-100.0	0.30E-04	0.552	0.344	-37.6
0.568	0.25E-04	0.00E+00	-100.0	0.25E-04	0.568	0.345	-39.3
0.584	0.23E-04	0.00E+00	-100.0	0.23E-04	0.584	0.345	-41.0
0.601	0.21E-04	0.00E+00	-100.0	0.21E-04	0.601	0.345	-42.5
0.617	0.16E-04	0.00E+00	-100.0	0.16E-04	0.617	0.345	-44.0
0.633	0.11E-04	0.00E+00	-100.0	0.11E-04	0.633	0.346	-45.4
0.649	0.46E-05	0.00E+00	-100.0	0.46E-05	0.649	0.346	-46.7
0.665	0.23E-05	0.00E+00	-100.0	0.23E-05	0.665	0.346	-47.9
0.682	0.23E-05	0.00E+00	-100.0	0.23E-05	0.682	0.346	-49.2
0.698	0.23E-05	0.00E+00	-100.0	0.23E-05	0.698	0.346	-50.4

There is no positive excursion

Maximum negative excursion = 0.367 cfs (-51.4%)
occuring at 0.713 cfs on the Base Data:sdn3aop2.tsf
and at 0.346 cfs on the New Data:sdn3ao_o.tsf

SDN3/3X

MILLER at SDN3/3X



AR 010454

July 2001
556-2912-001 (28)

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3/3X (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.397	2.509	1.718	1.025	1.141
1.317	1.287	1.375	1.515	1.385
1.150	1.282	1.289	1.260	1.300
1.306	1.231	1.202	1.821	2.114
1.095	1.222	1.182	2.075	1.037
1.496	1.668	1.031	1.302	2.030
2.096	1.607	1.588	1.196	1.569
1.389	1.103	1.497	1.410	1.101
1.530	2.255	2.076	1.279	1.021
1.033	1.257	2.031		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.150
Variance (logs)	0.010
Standard Deviation (logs)	0.102
Skewness (logs)	0.691
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.174
Coefficient of Variation (logs)	0.681

1

HOURLY FLOW SDN3/3X (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.922
0.9500	1.05	1.010
0.9000	1.11	1.069
0.8000	1.25	1.155
0.5000	2.00	1.376
0.2000	5.00	1.703
0.1000	10.00	1.934
0.0400	25.00	2.245
0.0200	50.00	2.489
0.0100	100.00	2.744
0.0050	200.00	3.013

$1/2Q_2 = 0.688$ cfs

$Q_{50} = 2.489$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN3/3X (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.497	0.644	1.458	0.446	0.601
0.543	0.502	0.806	0.550	0.538
0.521	0.615	0.620	0.395	0.565
0.584	0.623	0.545	0.617	0.516
0.554	0.593	0.507	1.223	0.617
0.558	0.504	0.487	0.327	0.528
0.380	0.798	0.511	0.599	0.546
0.416	0.349	0.581	0.616	0.406
0.383	0.663	0.675	0.561	0.416
0.357	0.585	0.878		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.256
Variance (logs)	0.015
Standard Deviation (logs)	0.122
Skewness (logs)	1.046
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.022
Coefficient of Variation (logs)	-0.477

1

HOURLY FLOW SDN3/3X (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.359
0.9500	1.05	0.385
0.9000	1.11	0.405
0.8000	1.25	0.437
0.5000	2.00	0.529
0.2000	5.00	0.685
0.1000	10.00	0.809
0.0400	25.00	0.988
0.0200	50.00	1.139
0.0100	100.00	1.307
0.0050	200.00	1.494

$1/2\ Q_2 = 0.265$ cfs

$Q_{50} = 1.139$ cfs

1

Simulated - HOURLY FLOW SDN3/3X (PREDEV)
Observed - HOURLY FLOW SDN3/3X (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	234244	0.022	*	0.043	*	-0.018	*
0.10	41218	0.119	96.6	0.129	104.8	-0.099	-80.7
0.15	27589	0.161	93.1	0.170	98.1	-0.142	-81.6
0.20	28952	0.205	90.6	0.214	94.1	-0.187	-82.4
0.25	23802	0.243	89.1	0.252	92.1	-0.226	-82.8
0.30	18211	0.287	88.2	0.296	90.8	-0.270	-82.9
0.35	15903	0.324	86.8	0.333	89.3	-0.309	-82.8
0.40	12102	0.365	85.9	0.375	88.2	-0.351	-82.6
0.45	8445	0.404	85.3	0.415	87.7	-0.388	-82.0
0.50	5937	0.438	83.9	0.451	86.3	-0.425	-81.2
0.55	3784	0.478	83.6	0.491	85.7	-0.464	-81.1
0.60	436	0.497	82.2	0.512	84.7	-0.473	-78.1
0.61	458	0.492	80.0	0.507	82.5	-0.476	-77.4
0.62	274	0.496	79.5	0.511	81.8	-0.487	-78.0
0.63	255	0.505	79.6	0.526	82.8	-0.475	-74.8
0.64	300	0.510	79.1	0.524	81.2	-0.487	-75.6
0.65	298	0.484	73.9	0.507	77.4	-0.470	-71.6
0.66	261	0.438	66.0	0.465	70.0	-0.432	-65.1
0.67	145	0.487	72.2	0.517	76.6	-0.463	-68.6
0.68	53	0.578	84.6	0.592	86.6	-0.526	-77.0
0.69	11	0.575	82.7	0.593	85.3	-0.515	-74.2
0.70	19	0.576	81.6	0.599	84.8	-0.484	-68.5
0.71	29	0.602	84.2	0.613	85.7	-0.563	-78.8
0.72	90	0.613	83.3	0.631	85.7	-0.555	-75.4
0.75	278	0.627	80.9	0.642	82.8	-0.589	-76.0
0.80	291	0.597	72.4	0.610	74.1	-0.564	-68.4
0.85	205	0.531	60.9	0.560	64.2	-0.502	-57.5
1.00	41	0.656	58.5	0.674	60.1	-0.656	-58.5
1.20	37	0.793	61.7	0.840	65.1	-0.793	-61.7
1.40	52	0.999	67.4	1.018	68.5	-0.999	-67.4
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.80	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.20	0	0.000	0.0	0.000	0.0	0.000	0.0
2.70	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.120	*	0.185	*	-0.110	*

Standard error of estimate = 0.15
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN3/3X (PREDEV)
Observed - HOURLY FLOW SDN3/3X (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		93.69	55.28	100.00	100.00	0.01	0.02
0.10	775541218		1.83	9.73	6.31	44.72	0.12	0.12
0.15	499027589		1.18	6.51	4.48	34.99	0.17	0.17
0.20	343328952		0.81	6.83	3.30	28.48	0.22	0.23
0.25	250923802		0.59	5.62	2.49	21.65	0.27	0.27
0.30	183118211		0.43	4.30	1.90	16.03	0.32	0.33
0.35	141315903		0.33	3.75	1.47	11.73	0.37	0.37
0.40	101112102		0.24	2.86	1.13	7.98	0.42	0.43
0.45	822	8445	0.19	1.99	0.89	5.12	0.47	0.47
0.50	631	5937	0.15	1.40	0.70	3.13	0.52	0.52
0.55	488	3784	0.12	0.89	0.55	1.73	0.57	0.57
0.60	78	436	0.02	0.10	0.44	0.83	0.60	0.60
0.61	79	458	0.02	0.11	0.42	0.73	0.61	0.61
0.62	70	274	0.02	0.06	0.40	0.62	0.62	0.62
0.63	72	255	0.02	0.06	0.38	0.56	0.64	0.64
0.64	75	300	0.02	0.07	0.37	0.50	0.64	0.64
0.65	53	298	0.01	0.07	0.35	0.43	0.66	0.66
0.66	71	261	0.02	0.06	0.34	0.36	0.66	0.66
0.67	71	145	0.02	0.03	0.32	0.30	0.68	0.67
0.68	42	53	0.01	0.01	0.30	0.26	0.68	0.68
0.69	54	11	0.01	0.00	0.29	0.25	0.70	0.69
0.70	41	19	0.01	0.00	0.28	0.25	0.70	0.71
0.71	51	29	0.01	0.01	0.27	0.24	0.71	0.72
0.72	144	90	0.03	0.02	0.26	0.23	0.73	0.74
0.75	182	278	0.04	0.07	0.22	0.21	0.77	0.78
0.80	155	291	0.04	0.07	0.18	0.15	0.82	0.82
0.85	279	205	0.07	0.05	0.14	0.08	0.92	0.87
1.00	177	41	0.04	0.01	0.08	0.03	1.09	1.12
1.20	79	37	0.02	0.01	0.04	0.02	1.29	1.29
1.40	35	52	0.01	0.01	0.02	0.01	1.50	1.48
1.60	21	0	0.00	0.00	0.01	0.00	1.67	0.00
1.80	9	0	0.00	0.00	0.01	0.00	1.90	0.00
2.00	11	0	0.00	0.00	0.00	0.00	2.08	0.00
2.20	2	0	0.00	0.00	0.00	0.00	2.38	0.00
2.70	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.02	0.13

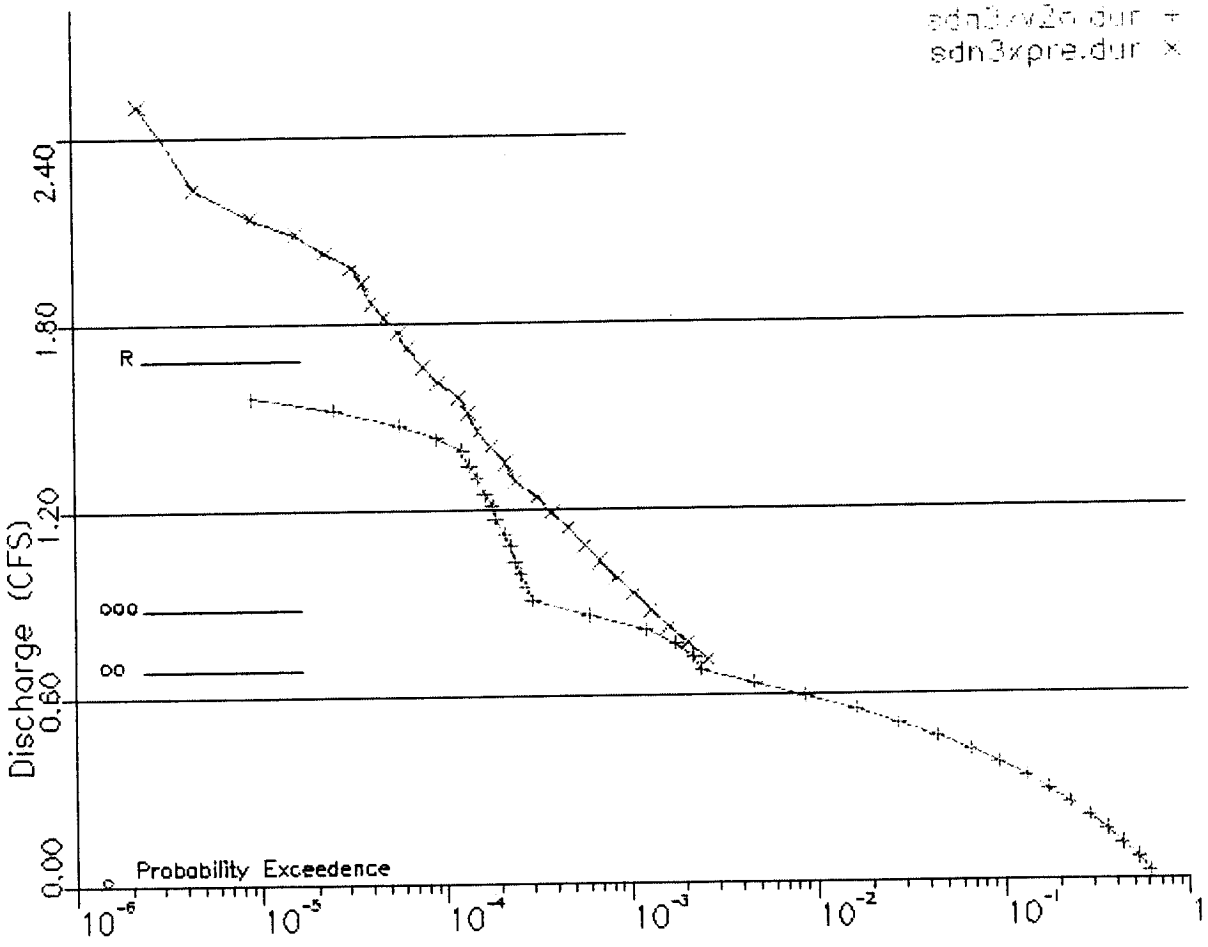
10049 Observed values are zero
68593 Simulated values are zero
10049 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
58544 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN3/3X (PREDEV)
Observed - HOURLY FLOW SDN3/3X (2006)

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	219357	1453	652	8226	240	445	3871	0
0.10	37154	1042	492	203	185	302	1840	0
0.15	24635	904	410	175	135	254	1076	0
0.20	25759	1085	481	167	149	310	1001	0
0.25	21181	1002	438	170	133	202	676	0
0.30	16279	837	301	99	102	159	434	0
0.35	14219	771	308	96	89	108	312	0
0.40	10805	632	209	55	69	114	218	0

0.45	7537	432	173	53	41	65	144	0
0.50	5261	384	126	30	24	30	82	0
0.55	3380	247	54	18	18	19	48	0
0.60	375	33	14	2	1	2	9	0
0.61	404	28	8	8	3	3	4	0
0.62	240	18	10	2	0	1	3	0
0.63	216	18	9	4	0	2	6	0
0.64	259	24	3	1	3	3	7	0
0.65	249	21	10	7	4	2	5	0
0.66	162	73	18	4	1	1	2	0
0.67	97	29	12	1	2	0	4	0
0.68	47	0	2	0	0	1	3	0
0.69	9	1	0	0	0	0	1	0
0.70	16	0	0	0	1	0	2	0
0.71	25	3	0	0	0	0	1	0
0.72	80	2	1	0	1	2	4	0
0.75	244	15	5	1	1	5	7	0
0.80	241	35	5	2	0	1	7	0
0.85	131	47	16	4	1	1	5	0
1.00	25	15	1	0	0	0	0	0
1.20	26	7	2	2	0	0	0	0
1.40	39	12	1	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.80	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.20	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	0
	388452	9170	3761	9330	1203	2032	9772	0


sdn3xpre.dur
2.40
1.80
1.20
0.60
0.00
Discharge (CFS)
R
ooo
oo
Probability Exceedence
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
1

SDN3X
(SDN3 + SDN3X)

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	300.00	ft
Facility Width:	187.00	ft
Facility Area:	56100.	sq. ft
Effective Storage Depth:	20.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	1122000.	cu. ft
Riser Head:	20.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.60	0.820	
2	14.00	1.38	0.126	4.0
3	18.00	4.38	0.736	8.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.03	0.03	1683.	0.039	0.030	0.00
0.05	0.05	2805.	0.064	0.043	0.00
0.08	0.08	4488.	0.103	0.052	0.00
0.11	0.11	6171.	0.142	0.060	0.00
0.14	0.14	7854.	0.180	0.067	0.00
0.16	0.16	8976.	0.206	0.074	0.00
0.19	0.19	10659.	0.245	0.080	0.00
0.22	0.22	12342.	0.283	0.085	0.00
0.61	0.61	34221.	0.786	0.143	0.00
1.00	1.00	56100.	1.288	0.183	0.00
1.39	1.39	77979.	1.790	0.216	0.00
1.79	1.79	100419.	2.305	0.245	0.00
2.18	2.18	122298.	2.808	0.271	0.00
2.57	2.57	144177.	3.310	0.294	0.00
2.96	2.96	166056.	3.812	0.316	0.00
3.35	3.35	187935.	4.314	0.336	0.00
3.75	3.75	210375.	4.830	0.355	0.00
4.14	4.14	232254.	5.332	0.373	0.00
4.53	4.53	254133.	5.834	0.390	0.00
4.92	4.92	276012.	6.336	0.407	0.00
5.31	5.31	297891.	6.839	0.423	0.00
5.71	5.71	320331.	7.354	0.438	0.00
6.10	6.10	342210.	7.856	0.453	0.00
6.49	6.49	364089.	8.358	0.467	0.00
6.88	6.88	385968.	8.861	0.481	0.00
7.28	7.28	408408.	9.376	0.495	0.00
7.67	7.67	430287.	9.878	0.508	0.00
8.06	8.06	452166.	10.380	0.521	0.00
8.45	8.45	474045.	10.883	0.533	0.00
8.84	8.84	495924.	11.385	0.545	0.00
9.24	9.24	518364.	11.900	0.557	0.00

SDN3X
(SDN3 + SDN3X)

9.63	9.63	540243.	12.402	0.569	0.00
10.02	10.02	562122.	12.905	0.580	0.00
10.41	10.41	584001.	13.407	0.592	0.00
10.80	10.80	605880.	13.909	0.603	0.00
11.20	11.20	628320.	14.424	0.614	0.00
11.59	11.59	650199.	14.927	0.624	0.00
11.98	11.98	672078.	15.429	0.635	0.00
12.37	12.37	693957.	15.931	0.645	0.00
12.77	12.77	716397.	16.446	0.655	0.00
13.16	13.16	738276.	16.948	0.665	0.00
13.55	13.55	760155.	17.451	0.675	0.00
13.94	13.94	782034.	17.953	0.685	0.00
14.00	14.00	785400.	18.030	0.686	0.00
14.01	14.01	785961.	18.043	0.687	0.00
14.03	14.03	787083.	18.069	0.688	0.00
14.04	14.04	787644.	18.082	0.691	0.00
14.06	14.06	788766.	18.108	0.694	0.00
14.07	14.07	789327.	18.120	0.698	0.00
14.09	14.09	790449.	18.146	0.702	0.00
14.10	14.10	791010.	18.159	0.705	0.00
14.11	14.11	791571.	18.172	0.706	0.00
14.13	14.13	792693.	18.198	0.708	0.00
14.52	14.52	814572.	18.700	0.736	0.00
14.91	14.91	836451.	19.202	0.757	0.00
15.31	15.31	858891.	19.717	0.776	0.00
15.70	15.70	880770.	20.220	0.794	0.00
16.09	16.09	902649.	20.722	0.810	0.00
16.48	16.48	924528.	21.224	0.826	0.00
16.87	16.87	946407.	21.727	0.841	0.00
17.27	17.27	968847.	22.242	0.855	0.00
17.66	17.66	990726.	22.744	0.869	0.00
18.00	18.00	1009800.	23.182	0.881	0.00
18.05	18.05	1012605.	23.246	0.888	0.00
18.09	18.09	1014849.	23.298	0.907	0.00
18.14	18.14	1017654.	23.362	0.937	0.00
18.18	18.18	1019898.	23.414	0.975	0.00
18.23	18.23	1022703.	23.478	1.020	0.00
18.27	18.27	1024947.	23.530	1.080	0.00
18.32	18.32	1027752.	23.594	1.150	0.00
18.37	18.37	1030557.	23.658	1.210	0.00
18.76	18.76	1052436.	24.161	1.360	0.00
19.15	19.15	1074315.	24.663	1.480	0.00
19.54	19.54	1096194.	25.165	1.580	0.00
19.93	19.93	1118073.	25.667	1.670	0.00
20.00	20.00	1122000.	25.758	1.680	0.00
20.10	20.10	1127610.	25.886	2.320	0.00
20.20	20.20	1133220.	26.015	3.470	0.00
20.30	20.30	1138830.	26.144	4.950	0.00
20.40	20.40	1144440.	26.273	6.690	0.00
20.50	20.50	1150050.	26.402	8.670	0.00
20.60	20.60	1155660.	26.530	10.860	0.00
20.70	20.70	1161270.	26.659	13.230	0.00
20.80	20.80	1166880.	26.788	15.370	0.00
20.90	20.90	1172490.	26.917	16.210	0.00
21.00	21.00	1178100.	27.045	17.010	0.00
21.10	21.10	1183710.	27.174	17.760	0.00
21.20	21.20	1189320.	27.303	18.490	0.00

21.30	21.30	1194930.	27.432	19.180	0.00
21.40	21.40	1200540.	27.561	19.850	0.00
21.50	21.50	1206150.	27.689	20.490	0.00
21.60	21.60	1211760.	27.818	21.120	0.00
21.70	21.70	1217370.	27.947	21.720	0.00
21.80	21.80	1222980.	28.076	22.310	0.00

Reservoir Routing [R/D Facility]
Years Complete: 50

Inflow/Outflow Analysis

Peak Inflow Discharge:	16.75 CFS at 16:00 on Mar 3 in 1950	
Peak Outflow Discharge:	1.57 CFS at 2:00 on Jan 3 in 1997	
Peak Reservoir Stage:	19.51	Ft
Peak Reservoir Elev:	19.51	Ft
Peak Reservoir Storage:	1094347.	Cu-Ft
:	25.123	Ac-Ft

Storing Time Series File:sdn3xv2o.tsf 50

Facility Routing Complete

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdn3xpre.tsf Mean= 0.163 StdDev= 0.106
Project Location:Sea-Tac Miller Skew= 0.470

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			2.80		100.00	0.990
Computed Peaks			2.56		50.00	0.980
Computed Peaks			2.32		25.00	0.960
Computed Peaks			2.01		10.00	0.900
Computed Peaks			1.95		8.00	0.875
Computed Peaks			1.78		5.00	0.800
Computed Peaks			1.43		2.00	0.500
Computed Peaks			1.20		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdn3xv2o.tsf Mean= -0.250 StdDev= 0.135
Project Location:Sea-Tac Miller Skew= 1.310

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			1.53	19.33		100.00	0.990
Computed Peaks			1.29	18.57		50.00	0.980
Computed Peaks			1.08	18.27		25.00	0.960
Computed Peaks			0.852	17.19		10.00	0.900
Computed Peaks			0.812	16.14		8.00	0.875
Computed Peaks			0.703	14.09		5.00	0.800
Computed Peaks			0.527	8.24		2.00	0.500
Computed Peaks			0.442	5.82		1.30	0.231

SDN3X
(SDN3 + SDN3X)

Duration Comparison Anaylsis
Base File: sdn3xpre.tsf
New File: sdn3xv2o.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.712	0.26E-02	0.23E-02	-13.3	0.26E-02	0.712	0.673	-5.5
0.770	0.20E-02	0.18E-02	-12.8	0.20E-02	0.770	0.749	-2.8
0.828	0.16E-02	0.99E-03	-36.9	0.16E-02	0.828	0.785	-5.2
0.886	0.12E-02	0.31E-03	-74.7	0.12E-02	0.886	0.811	-8.5
0.944	0.97E-03	0.28E-03	-71.7	0.97E-03	0.944	0.829	-12.2
1.00	0.78E-03	0.25E-03	-67.6	0.78E-03	1.00	0.844	-15.7
1.06	0.63E-03	0.23E-03	-63.3	0.63E-03	1.06	0.858	-19.1
1.12	0.50E-03	0.21E-03	-57.7	0.50E-03	1.12	0.865	-22.6
1.18	0.40E-03	0.19E-03	-53.1	0.40E-03	1.18	0.871	-25.9
1.23	0.33E-03	0.17E-03	-47.6	0.33E-03	1.23	0.879	-28.8
1.29	0.25E-03	0.16E-03	-37.0	0.25E-03	1.29	1.01	-21.6
1.35	0.21E-03	0.14E-03	-36.2	0.21E-03	1.35	1.11	-17.4
1.41	0.17E-03	0.11E-03	-36.8	0.17E-03	1.41	1.24	-11.8
1.46	0.15E-03	0.66E-04	-56.7	0.15E-03	1.46	1.30	-11.4
1.52	0.13E-03	0.25E-04	-80.0	0.13E-03	1.52	1.39	-9.0
1.58	0.11E-03	0.00E+00	-100.0	0.11E-03	1.58	1.41	-11.1
1.64	0.84E-04	0.00E+00	-100.0	0.84E-04	1.64	1.44	-12.1
1.70	0.66E-04	0.00E+00	-100.0	0.66E-04	1.70	1.46	-13.6
1.75	0.57E-04	0.00E+00	-100.0	0.57E-04	1.75	1.48	-15.9
1.81	0.50E-04	0.00E+00	-100.0	0.50E-04	1.81	1.50	-17.4
1.87	0.41E-04	0.00E+00	-100.0	0.41E-04	1.87	1.51	-19.3
1.93	0.37E-04	0.00E+00	-100.0	0.37E-04	1.93	1.51	-21.6
1.99	0.32E-04	0.00E+00	-100.0	0.32E-04	1.99	1.51	-23.8
2.04	0.21E-04	0.00E+00	-100.0	0.21E-04	2.04	1.53	-25.1
2.10	0.14E-04	0.00E+00	-100.0	0.14E-04	2.10	1.56	-26.0
2.16	0.68E-05	0.00E+00	-100.0	0.68E-05	2.16	1.57	-27.3
2.22	0.46E-05	0.00E+00	-100.0	0.46E-05	2.22	1.57	-29.1
2.27	0.23E-05	0.00E+00	-100.0	0.23E-05	2.27	1.57	-30.9
2.33	0.23E-05	0.00E+00	-100.0	0.23E-05	2.33	1.57	-32.6
2.39	0.23E-05	0.00E+00	-100.0	0.23E-05	2.39	1.57	-34.2
2.45	0.23E-05	0.00E+00	-100.0	0.23E-05	2.45	1.57	-35.8
2.51	0.23E-05	0.00E+00	-100.0	0.23E-05	2.51	1.57	-37.3

There is no positive excursion

Maximum negative excursion = 0.934 cfs (-37.3%)
occuring at 2.51 cfs on the Base Data:sdn3xpre.tsf
and at 1.57 cfs on the New Data:sdn3xv2o.tsf

KCRTS: SEATAC MILLER

```
+-Land Use Summary-------------------------------------------+
|Till Forest              40.60 acres                        |
|Till Pasture              0.00 acres                        |
|Till Grass                8.75 acres                        |
|Airport Fill              0.00 acres                        |
|Outwash Forest           13.89 acres                        |
|Outwash Pasture           0.00 acres                        |
|Outwash Grass             4.63 acres                        |
|Wetland                   0.57 acres                        |
|Impervious                4.79 acres                        |
|------------------------------------------------------------|
|         Total Area :    73.23 acres                        |
|       Scale Factor :     1.00      Hourly      Historic    |
|------------------------------------------------------------|
|                                                            |
|   Time Series: sdn3xpre                                    |
|------------------------------------------------------------|
|                     Compute Time Series                    |
|                      Modify User Input                     |
+------------------------------------------------------------+
```

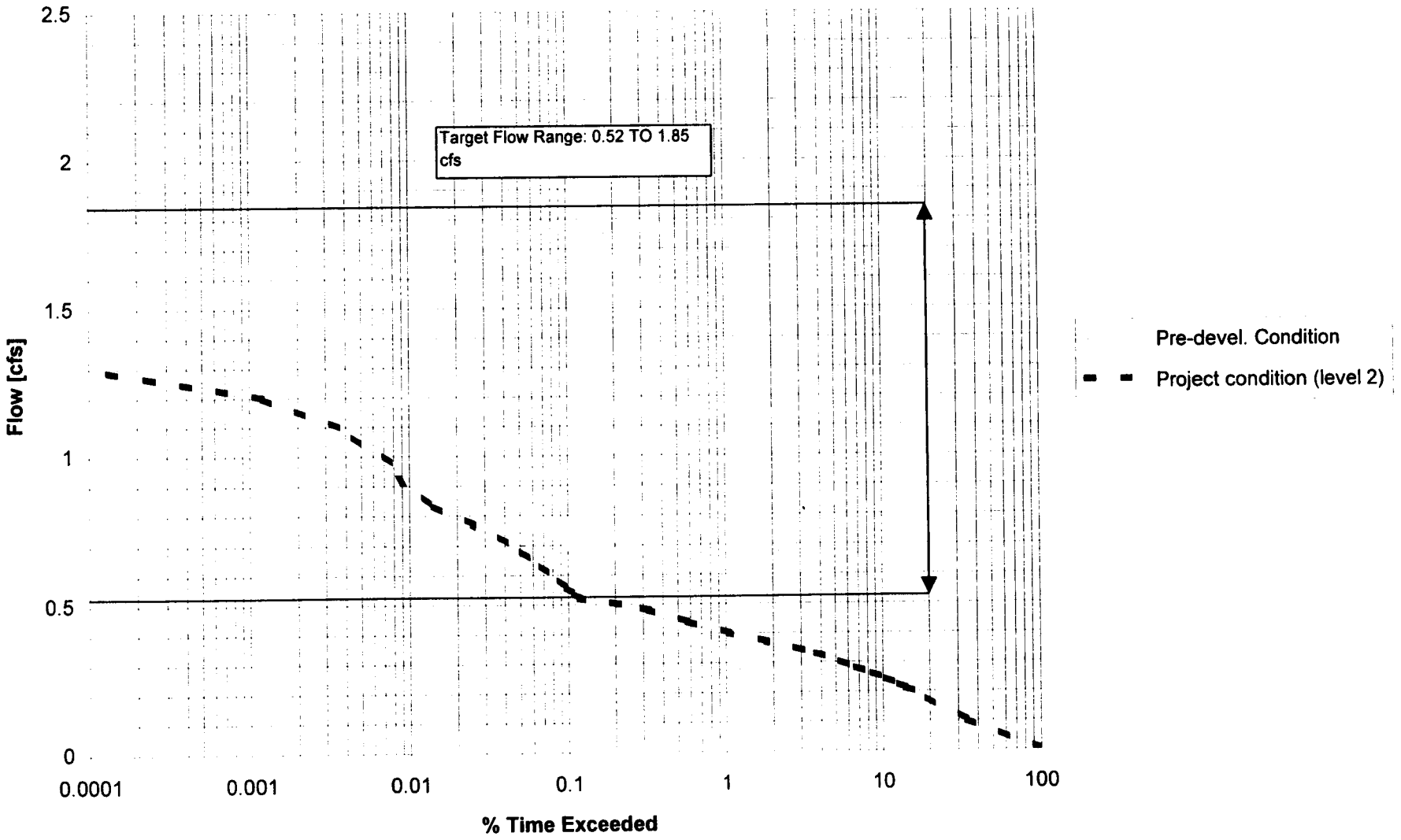
Retrieve runoff files and compute Time Series

KCRTS: SEATAC MILLER

```
+-Land Use Summary-------------------------------------------+
|Till Forest               0.00 acres                        |
|Till Pasture              0.00 acres                        |
|Till Grass               25.16 acres                        |
|Airport Fill             23.77 acres                        |
|Outwash Forest            0.00 acres                        |
|Outwash Pasture           0.00 acres                        |
|Outwash Grass             0.00 acres                        |
|Wetland                   0.00 acres                        |
|Impervious               24.30 acres                        |
|------------------------------------------------------------|
|         Total Area :    73.23 acres                        |
|       Scale Factor :     1.00      Hourly      Historic    |
|------------------------------------------------------------|
|                                                            |
|   Time Series: sdn3xdev                                    |
|------------------------------------------------------------|
|                     Compute Time Series                    |
|                      Modify User Input                     |
+------------------------------------------------------------+
```

SDN4X/2X

MILLER at SDN4X/2X



AR 010467

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN4X/2X (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.067	1.850	1.196	0.777	0.870
1.002	0.981	1.034	1.150	1.058
0.872	0.952	0.965	0.965	0.988
0.992	0.929	0.911	1.391	1.617
0.823	0.929	0.905	1.460	0.779
1.142	1.262	0.791	0.999	1.559
1.610	1.221	1.209	0.913	1.204
1.047	0.846	1.121	1.056	0.846
1.175	1.698	1.568	0.975	0.785
0.794	0.963	1.418		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.029
Variance (logs)	0.010
Standard Deviation (logs)	0.099
Skewness (logs)	0.692
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.198
Coefficient of Variation (logs)	3.441

1

HOURLY FLOW SDN4X/2X (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.707
0.9500	1.05	0.772
0.9000	1.11	0.816
0.8000	1.25	0.879
0.5000	2.00	1.041
0.2000	5.00	1.279
0.1000	10.00	1.447
0.0400	25.00	1.671
0.0200	50.00	1.846
0.0100	100.00	2.030
0.0050	200.00	2.222

$1/2\,Q_2 = 0.521$ cfs

$Q_{50} = 1.846$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN4X/2X (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.353	0.463	0.870	0.312	0.395
0.368	0.361	0.494	0.374	0.387
0.353	0.454	0.413	0.278	0.390
0.403	0.444	0.377	0.414	0.361
0.379	0.410	0.371	0.814	0.436
0.390	0.348	0.351	0.263	0.380
0.271	0.581	0.364	0.415	0.382
0.289	0.269	0.419	0.453	0.294
0.261	0.519	0.508	0.402	0.296
0.256	0.408	0.732		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.407
Variance (logs)	0.013
Standard Deviation (logs)	0.115
Skewness (logs)	0.981
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.027
Coefficient of Variation (logs)	-0.284

1

HOURLY FLOW SDN4X/2X (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.256
0.9500	1.05	0.276
0.9000	1.11	0.290
0.8000	1.25	0.312
0.5000	2.00	0.375
0.2000	5.00	0.479
0.1000	10.00	0.559
0.0400	25.00	0.673
0.0200	50.00	0.768
0.0100	100.00	0.872
0.0050	200.00	0.986

$1/2 Q_2 = 0.188$ cfs
$Q_{50} = 0.768$ cfs

Miler Creek at SDN4X/2X

Percent cases equal or exceeding limit

Pre-devel. Condition	Project condition (level 2)	Flow [cfs]
100	100	0
4.82653639	33.4806	0.1
2.24818276	15.28132	0.2
2.0912395	13.81738	0.21
1.8075616	11.42453	0.23
1.57273671	9.377419	0.25
1.37803266	7.307184	0.27
1.20315303	5.835929	0.29
0.99098461	4.076985	0.32
0.86944208	3.029359	0.34
0.71934296	1.813226	0.37
0.58623619	1.051166	0.4
0.4566695	0.567828	0.44
0.36793165	0.325451	0.48
0.32497876	0.210044	0.5
0.28887001	0.11871	0.52
0.25936939	0.105494	0.54
0.22467667	0.094638	0.56
0.16968753	0.07269	0.61
0.12791466	0.055225	0.66
0.09534598	0.040357	0.71
0.07103748	0.025253	0.77
0.04861701	0.013216	0.84
0.03327669	0.009204	0.91
0.0238365	0.007552	0.98
0.01368828	0.00354	1.1
0.0094402	0.00118	1.2
0.00519211	0.0001	1.3
0.00401208	0	1.4
0.00236005	0	1.5
0.00165203	0	1.6
0.000236	0	1.7
0.0001	0	1.9
0	0	2
0	0	2.4

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	281856	0.023	*	0.042	*	-0.019	*
0.10	77114	0.134	91.3	0.143	96.2	-0.117	-79.6
0.20	6203	0.180	87.9	0.187	91.2	-0.164	-80.1
0.21	10139	0.193	87.8	0.200	91.2	-0.176	-80.2
0.23	8674	0.209	87.2	0.217	90.4	-0.192	-80.2
0.25	8772	0.224	86.3	0.232	89.3	-0.208	-80.3
0.27	6234	0.239	85.7	0.247	88.5	-0.225	-80.5
0.29	7453	0.259	85.3	0.268	88.1	-0.244	-80.2
0.32	4439	0.277	84.1	0.286	86.8	-0.264	-80.1
0.34	5153	0.294	83.1	0.304	85.8	-0.281	-79.6
0.37	3229	0.319	83.1	0.328	85.7	-0.305	-79.5
0.40	2048	0.347	83.0	0.359	85.8	-0.328	-78.6
0.44	1027	0.370	81.0	0.382	83.7	-0.342	-75.0
0.48	489	0.370	75.6	0.384	78.5	-0.351	-71.7
0.50	387	0.378	73.8	0.390	76.3	-0.361	-70.6
0.52	56	0.397	75.1	0.412	77.9	-0.392	-74.1
0.54	46	0.423	76.9	0.435	79.0	-0.379	-68.9
0.56	93	0.434	74.3	0.443	75.8	-0.403	-69.2
0.61	74	0.425	67.3	0.439	69.6	-0.405	-64.1
0.66	63	0.435	64.0	0.447	65.7	-0.420	-61.7
0.71	64	0.434	59.2	0.450	61.2	-0.426	-58.0
0.77	51	0.510	63.4	0.526	65.4	-0.509	-63.2
0.84	17	0.542	62.7	0.564	65.1	-0.542	-62.7
0.91	7	0.671	71.0	0.698	73.8	-0.571	-60.0
0.98	17	0.778	74.6	0.810	77.6	-0.778	-74.6
1.10	10	0.859	74.4	0.867	75.0	-0.859	-74.4
1.20	5	0.899	72.5	0.905	73.1	-0.899	-72.5
1.30	0	0.000	0.0	0.000	0.0	0.000	0.0
1.40	0	0.000	0.0	0.000	0.0	0.000	0.0
1.50	0	0.000	0.0	0.000	0.0	0.000	0.0
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.70	0	0.000	0.0	0.000	0.0	0.000	0.0
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.40	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.077	*	0.122	*	-0.068	*

Standard error of estimate = 0.10
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		95.17	66.52	100.00	100.00	0.01	0.02
0.10	1092	577114	2.58	18.20	4.83	33.48	0.14	0.15
0.20	665	6203	0.16	1.46	2.25	15.28	0.20	0.20
0.21	1202	10139	0.28	2.39	2.09	13.82	0.22	0.22
0.23	995	8674	0.23	2.05	1.81	11.42	0.24	0.24
0.25	825	8772	0.19	2.07	1.57	9.38	0.26	0.26
0.27	741	6234	0.17	1.47	1.38	7.31	0.28	0.28
0.29	899	7453	0.21	1.76	1.20	5.84	0.30	0.30
0.32	515	4439	0.12	1.05	0.99	4.08	0.33	0.33
0.34	636	5153	0.15	1.22	0.87	3.03	0.35	0.35
0.37	564	3229	0.13	0.76	0.72	1.81	0.38	0.38
0.40	549	2048	0.13	0.48	0.59	1.05	0.42	0.42
0.44	376	1027	0.09	0.24	0.46	0.57	0.46	0.46
0.48	182	489	0.04	0.12	0.37	0.33	0.49	0.49
0.50	153	387	0.04	0.09	0.32	0.21	0.51	0.51
0.52	125	56	0.03	0.01	0.29	0.12	0.53	0.53
0.54	147	46	0.03	0.01	0.26	0.11	0.55	0.55
0.56	233	93	0.05	0.02	0.22	0.09	0.58	0.58
0.61	177	74	0.04	0.02	0.17	0.07	0.63	0.63
0.66	138	63	0.03	0.01	0.13	0.06	0.68	0.68
0.71	103	64	0.02	0.02	0.10	0.04	0.74	0.73
0.77	95	51	0.02	0.01	0.07	0.03	0.80	0.80
0.84	65	17	0.02	0.00	0.05	0.01	0.87	0.86
0.91	40	7	0.01	0.00	0.03	0.01	0.95	0.94
0.98	43	17	0.01	0.00	0.02	0.01	1.03	1.04
1.10	18	10	0.00	0.00	0.01	0.00	1.15	1.15
1.20	18	5	0.00	0.00	0.01	0.00	1.24	1.24
1.30	5	0	0.00	0.00	0.01	0.00	1.36	0.00
1.40	7	0	0.00	0.00	0.00	0.00	1.45	0.00
1.50	3	0	0.00	0.00	0.00	0.00	1.55	0.00
1.60	6	0	0.00	0.00	0.00	0.00	1.64	0.00
1.70	1	0	0.00	0.00	0.00	0.00	1.85	0.00
1.90	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	42372	042372	100.00	100.00			0.02	0.09

12223 Observed values are zero
73109 Simulated values are zero
12223 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
60886 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	260028	2722	1090	11097	405	712	5802	0
0.10	67700	2967	1300	559	470	780	3338	0
0.20	5422	285	123	45	41	65	222	0
0.21	8863	514	199	84	49	102	328	0
0.23	7597	438	173	65	50	82	269	0
0.25	7676	450	200	55	51	88	252	0
0.27	5450	365	117	48	45	54	155	0
0.29	6524	404	156	54	38	85	192	0

0.32	3870	254	104	37	37	45	92	0
0.34	4489	346	111	40	30	39	98	0
0.37	2818	215	58	31	12	23	72	0
0.40	1777	165	42	11	7	12	34	0
0.44	885	58	28	4	6	7	39	0
0.48	405	42	18	5	4	5	10	0
0.50	299	68	8	1	0	5	6	0
0.52	48	5	0	1	0	2	0	0
0.54	38	5	1	0	0	0	2	0
0.56	83	4	1	1	1	0	3	0
0.61	62	5	2	2	0	1	2	0
0.66	45	14	3	0	0	0	1	0
0.71	29	32	1	0	1	0	1	0
0.77	40	8	1	0	2	0	0	0
0.84	11	5	1	0	0	0	0	0
0.91	5	1	0	0	0	0	1	0
0.98	15	0	1	1	0	0	0	0
1.10	8	2	0	0	0	0	0	0
1.20	4	1	0	0	0	0	0	0
1.30	0	0	0	0	0	0	0	0
1.40	0	0	0	0	0	0	0	0
1.50	0	0	0	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.70	0	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.40	0	0	0	0	0	0	0	0
	384191	9375	3738	12141	1249	2107	10919	0

COMPARISON ANALYSIS
(EXCLUDED DATA OCT 96–JAN 97)

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	281005	0.023	*	0.042	*	-0.019	*
0.10	76207	0.134	91.2	0.143	96.1	-0.117	-79.7
0.20	6158	0.180	87.9	0.187	91.1	-0.164	-80.1
0.21	10067	0.193	87.7	0.200	91.2	-0.176	-80.2
0.23	8506	0.209	87.1	0.217	90.4	-0.192	-80.3
0.25	8600	0.224	86.3	0.232	89.4	-0.208	-80.4
0.27	6141	0.239	85.7	0.247	88.5	-0.225	-80.5
0.29	7378	0.259	85.2	0.268	88.0	-0.244	-80.2
0.32	4387	0.277	84.0	0.286	86.8	-0.264	-80.1
0.34	5022	0.294	83.1	0.303	85.8	-0.281	-79.5
0.37	3148	0.318	83.0	0.328	85.6	-0.305	-79.5
0.40	2001	0.346	82.7	0.357	85.5	-0.328	-78.6
0.44	966	0.369	80.9	0.382	83.6	-0.341	-74.7
0.48	451	0.369	75.5	0.383	78.4	-0.349	-71.4
0.50	357	0.376	73.4	0.388	75.7	-0.359	-70.1
0.52	51	0.398	75.2	0.411	77.9	-0.396	-74.8
0.54	42	0.418	75.9	0.431	78.2	-0.370	-67.1
0.56	77	0.428	73.4	0.437	75.0	-0.403	-69.2
0.61	56	0.415	65.7	0.430	68.2	-0.388	-61.4
0.66	39	0.404	59.0	0.415	60.6	-0.380	-55.4
0.71	54	0.416	56.8	0.425	57.9	-0.407	-55.6
0.77	43	0.480	59.6	0.494	61.3	-0.479	-59.4
0.84	12	0.463	53.9	0.476	55.5	-0.463	-53.9
0.91	0	0.000	0.0	0.000	0.0	0.000	0.0
0.98	0	0.000	0.0	0.000	0.0	0.000	0.0
1.10	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
1.30	0	0.000	0.0	0.000	0.0	0.000	0.0
1.40	0	0.000	0.0	0.000	0.0	0.000	0.0
1.50	0	0.000	0.0	0.000	0.0	0.000	0.0
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.70	0	0.000	0.0	0.000	0.0	0.000	0.0
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.40	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.076	*	0.121	*	-0.068	*

Standard error of estimate = 0.10
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		95.23	66.78	100.00	100.00	0.01	0.02
0.10	1077976207		2.56	18.11	4.77	33.22	0.14	0.15
0.20	645	6158	0.15	1.46	2.21	15.10	0.20	0.20
0.21	117510067		0.28	2.39	2.06	13.64	0.22	0.22
0.23	967	8506	0.23	2.02	1.78	11.25	0.24	0.24
0.25	807	8600	0.19	2.04	1.55	9.23	0.26	0.26
0.27	734	6141	0.17	1.46	1.36	7.18	0.28	0.28
0.29	887	7378	0.21	1.75	1.18	5.72	0.30	0.30
0.32	509	4387	0.12	1.04	0.97	3.97	0.33	0.33
0.34	623	5022	0.15	1.19	0.85	2.93	0.35	0.35
0.37	552	3148	0.13	0.75	0.70	1.73	0.38	0.38
0.40	541	2001	0.13	0.48	0.57	0.99	0.42	0.42
0.44	373	966	0.09	0.23	0.44	0.51	0.46	0.46
0.48	179	451	0.04	0.11	0.36	0.28	0.49	0.49
0.50	151	357	0.04	0.08	0.31	0.17	0.51	0.51
0.52	122	51	0.03	0.01	0.28	0.09	0.53	0.53
0.54	141	42	0.03	0.01	0.25	0.08	0.55	0.55
0.56	224	77	0.05	0.02	0.22	0.07	0.58	0.58
0.61	167	56	0.04	0.01	0.16	0.05	0.63	0.63
0.66	131	39	0.03	0.01	0.12	0.04	0.68	0.69
0.71	100	54	0.02	0.01	0.09	0.03	0.74	0.73
0.77	89	43	0.02	0.01	0.07	0.01	0.80	0.81
0.84	59	12	0.01	0.00	0.05	0.00	0.87	0.86
0.91	38	0	0.01	0.00	0.03	0.00	0.95	0.00
0.98	40	0	0.01	0.00	0.02	0.00	1.04	0.00
1.10	18	0	0.00	0.00	0.01	0.00	1.15	0.00
1.20	17	0	0.00	0.00	0.01	0.00	1.24	0.00
1.30	5	0	0.00	0.00	0.01	0.00	1.36	0.00
1.40	7	0	0.00	0.00	0.00	0.00	1.45	0.00
1.50	3	0	0.00	0.00	0.00	0.00	1.55	0.00
1.60	6	0	0.00	0.00	0.00	0.00	1.64	0.00
1.70	1	0	0.00	0.00	0.00	0.00	1.85	0.00
1.90	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.02	0.09

12223 Observed values are zero
73027 Simulated values are zero
12223 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
60804 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDN4X/2X (PREDEV)
Observed - HOURLY FLOW SDN4X/2X (2006)

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	259230	2711	1080	11093	405	708	5778	0
0.10	66883	2953	1290	555	468	772	3286	0
0.20	5384	282	122	45	40	65	220	0
0.21	8797	513	198	84	49	102	324	0
0.23	7449	429	171	63	49	82	263	0
0.25	7527	446	195	51	49	88	244	0
0.27	5369	362	115	47	44	53	151	0
0.29	6459	401	153	53	38	84	190	0

0.32	3827	252	100	36	37	45	90	0
0.34	4377	335	105	40	30	39	96	0
0.37	2747	210	57	30	12	23	69	0
0.40	1735	165	41	11	7	12	30	0
0.44	836	51	27	4	5	5	38	0
0.48	374	39	16	5	3	4	10	0
0.50	274	66	8	0	0	3	6	0
0.52	44	5	0	1	0	1	0	0
0.54	34	5	1	0	0	0	2	0
0.56	70	2	1	1	1	0	2	0
0.61	47	2	2	2	0	1	2	0
0.66	23	13	2	0	0	0	1	0
0.71	21	31	1	0	0	0	1	0
0.77	32	8	1	0	2	0	0	0
0.84	6	5	1	0	0	0	0	0
0.91	0	0	0	0	0	0	0	0
0.98	0	0	0	0	0	0	0	0
1.10	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
1.30	0	0	0	0	0	0	0	0
1.40	0	0	0	0	0	0	0	0
1.50	0	0	0	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.70	0	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.40	0	0	0	0	0	0	0	0
	381545	9286	3687	12121	1239	2087	10803	0

July 2001
556-2912-001 (28)

AR 010477

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	275.00	ft
Facility Width:	125.00	ft
Facility Area:	34375.	sq. ft
Effective Storage Depth:	19.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	653125.	cu. ft
Riser Head:	19.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.25	0.598	
2	14.50	2.00	0.230	4.0
3	16.50	3.00	0.386	6.0

Top Notch Weir:	Rectangular	
Length:	4.50	in
Weir Height:	18.00	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.02	0.02	688.	0.016	0.021	0.00
0.05	0.05	1719.	0.039	0.030	0.00
0.07	0.07	2406.	0.055	0.036	0.00
0.09	0.09	3094.	0.071	0.042	0.00
0.12	0.12	4125.	0.095	0.047	0.00
0.14	0.14	4813.	0.110	0.051	0.00
0.16	0.16	5500.	0.126	0.056	0.00
0.19	0.19	6531.	0.150	0.059	0.00
0.63	0.63	21656.	0.497	0.109	0.00
1.07	1.07	36781.	0.844	0.142	0.00
1.51	1.51	51906.	1.192	0.169	0.00
1.95	1.95	67031.	1.539	0.192	0.00
2.40	2.40	82500.	1.894	0.213	0.00
2.84	2.84	97625.	2.241	0.231	0.00
3.28	3.28	112750.	2.588	0.249	0.00
3.72	3.72	127875.	2.936	0.265	0.00
4.16	4.16	143000.	3.283	0.280	0.00
4.61	4.61	158469.	3.638	0.295	0.00
5.05	5.05	173594.	3.985	0.309	0.00
5.49	5.49	188719.	4.332	0.322	0.00
5.93	5.93	203844.	4.680	0.334	0.00
6.37	6.37	218969.	5.027	0.347	0.00
6.82	6.82	234438.	5.382	0.358	0.00
7.26	7.26	249563.	5.729	0.370	0.00
7.70	7.70	264688.	6.076	0.381	0.00
8.14	8.14	279813.	6.424	0.392	0.00
8.58	8.58	294938.	6.771	0.402	0.00
9.02	9.02	310063.	7.118	0.413	0.00
9.47	9.47	325531.	7.473	0.422	0.00

SDN4X2X
(SDN2X + SDN4 + SDN4X)

9.91	9.91	340656.	7.820	0.432	0.00
10.35	10.35	355781.	8.168	0.442	0.00
10.79	10.79	370906.	8.515	0.451	0.00
11.23	11.23	386031.	8.862	0.460	0.00
11.68	11.68	401500.	9.217	0.469	0.00
12.12	12.12	416625.	9.564	0.478	0.00
12.56	12.56	431750.	9.912	0.487	0.00
13.00	13.00	446875.	10.259	0.495	0.00
13.44	13.44	462000.	10.606	0.503	0.00
13.89	13.89	477469.	10.961	0.512	0.00
14.33	14.33	492594.	11.308	0.520	0.00
14.50	14.50	498438.	11.443	0.523	0.00
14.52	14.52	499125.	11.458	0.524	0.00
14.54	14.54	499813.	11.474	0.527	0.00
14.56	14.56	500500.	11.490	0.531	0.00
14.58	14.58	501188.	11.506	0.538	0.00
14.60	14.60	501875.	11.521	0.545	0.00
14.62	14.62	502563.	11.537	0.554	0.00
14.65	14.65	503594.	11.561	0.563	0.00
14.67	14.67	504281.	11.577	0.570	0.00
14.69	14.69	504969.	11.592	0.573	0.00
15.13	15.13	520094.	11.940	0.620	0.00
15.57	15.57	535219.	12.287	0.654	0.00
16.01	16.01	550344.	12.634	0.683	0.00
16.45	16.45	565469.	12.981	0.709	0.00
16.50	16.50	567188.	13.021	0.711	0.00
16.53	16.53	568219.	13.045	0.715	0.00
16.56	16.56	569250.	13.068	0.724	0.00
16.59	16.59	570281.	13.092	0.737	0.00
16.63	16.63	571656.	13.123	0.754	0.00
16.66	16.66	572688.	13.147	0.775	0.00
16.69	16.69	573719.	13.171	0.800	0.00
16.72	16.72	574750.	13.194	0.828	0.00
16.75	16.75	575781.	13.218	0.847	0.00
17.19	17.19	590906.	13.565	0.950	0.00
17.63	17.63	606031.	13.913	1.030	0.00
18.00	18.00	618750.	14.205	1.080	0.00
18.13	18.13	623219.	14.307	1.150	0.00
18.25	18.25	627344.	14.402	1.250	0.00
18.38	18.38	631813.	14.504	1.360	0.00
18.50	18.50	635938.	14.599	1.470	0.00
18.63	18.63	640406.	14.702	1.570	0.00
18.75	18.75	644531.	14.796	1.660	0.00
18.88	18.88	649000.	14.899	1.810	0.00
19.00	19.00	653125.	14.994	1.960	0.00
19.10	19.10	656563.	15.073	2.580	0.00
19.20	19.20	660000.	15.152	3.720	0.00
19.30	19.30	663438.	15.230	5.190	0.00
19.40	19.40	666875.	15.309	6.930	0.00
19.50	19.50	670313.	15.388	8.900	0.00
19.60	19.60	673750.	15.467	11.080	0.00
19.70	19.70	677188.	15.546	13.440	0.00
19.80	19.80	680625.	15.625	15.580	0.00
19.90	19.90	684063.	15.704	16.410	0.00
20.00	20.00	687500.	15.783	17.190	0.00
20.10	20.10	690938.	15.862	17.940	0.00
20.20	20.20	694375.	15.941	18.660	0.00

20.30	20.30	697813.	16.020	19.350	0.00
20.40	20.40	701250.	16.098	20.010	0.00
20.50	20.50	704688.	16.177	20.640	0.00
20.60	20.60	708125.	16.256	21.260	0.00
20.70	20.70	711563.	16.335	21.860	0.00
20.80	20.80	715000.	16.414	22.440	0.00
20.90	20.90	718438.	16.493	23.010	0.00

Route Time Series through Facility
Inflow Time Series File:sdn4xxdv.tsf
Outflow Time Series File:sdn4xxvo

Inflow/Outflow Analysis
Peak Inflow Discharge: 11.01 CFS at 16:00 on Mar 3 in 1950
Peak Outflow Discharge: 1.59 CFS at 12:00 on Jan 2 in 1997
Peak Reservoir Stage: 18.66 Ft
Peak Reservoir Elev: 18.66 Ft
Peak Reservoir Storage: 641421. Cu-Ft
: 14.725 Ac-Ft

Flow Frequency Analysis
Time Series File:sdn4xxpr.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= 0.071 StdDev= 0.103
Skew= 0.496

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- Peaks (CFS)	Rank	Return Period	Prob
Computed Peaks			2.22		100.00	0.990
Computed Peaks			2.03		50.00	0.980
Computed Peaks			1.85		25.00	0.960
Computed Peaks			1.61		10.00	0.900
Computed Peaks			1.56		8.00	0.875
Computed Peaks			1.42		5.00	0.800
Computed Peaks			1.15		2.00	0.500
Computed Peaks			0.979		1.30	0.231

Flow Frequency Analysis
Time Series File:sdn4xxvo.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.378 StdDev= 0.144
Skew= 1.926

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- Peaks (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			1.37	18.39		100.00	0.990
Computed Peaks			1.09	18.02		50.00	0.980
Computed Peaks			0.872	16.86		25.00	0.960
Computed Peaks			0.646	15.47		10.00	0.900
Computed Peaks			0.610	15.04		8.00	0.875
Computed Peaks			0.515	14.03		5.00	0.800
Computed Peaks			0.379	7.63		2.00	0.500
Computed Peaks			0.328	5.71		1.30	0.231

SDN4X2X
(SDN2X + SDN4 + SDN4X)

Duration Comparison Anaylsis
Base File: sdn4xxpr.tsf
New File: sdn4xxvo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.573	0.26E-02	0.12E-02	-55.0	0.26E-02	0.573	0.486	-15.2
0.618	0.20E-02	0.90E-03	-54.9	0.20E-02	0.618	0.502	-18.8
0.663	0.15E-02	0.64E-03	-58.4	0.15E-02	0.663	0.517	-22.1
0.708	0.12E-02	0.35E-03	-71.3	0.12E-02	0.708	0.539	-23.9
0.753	0.95E-03	0.29E-03	-69.8	0.95E-03	0.753	0.608	-19.2
0.798	0.77E-03	0.27E-03	-64.4	0.77E-03	0.798	0.639	-19.9
0.843	0.61E-03	0.26E-03	-57.2	0.61E-03	0.843	0.667	-20.9
0.888	0.48E-03	0.20E-03	-58.6	0.48E-03	0.888	0.693	-21.9
0.933	0.39E-03	0.15E-03	-62.6	0.39E-03	0.933	0.703	-24.6
0.978	0.31E-03	0.11E-03	-64.2	0.31E-03	0.978	0.713	-27.1
1.02	0.26E-03	0.84E-04	-67.8	0.26E-03	1.02	0.843	-17.6
1.07	0.21E-03	0.55E-04	-74.2	0.21E-03	1.07	0.884	-17.2
1.11	0.18E-03	0.50E-04	-71.4	0.18E-03	1.11	0.910	-18.2
1.16	0.14E-03	0.46E-04	-66.7	0.14E-03	1.16	0.954	-17.6
1.20	0.12E-03	0.43E-04	-64.2	0.12E-03	1.20	0.971	-19.3
1.25	0.10E-03	0.39E-04	-62.2	0.10E-03	1.25	0.995	-20.3
1.29	0.84E-04	0.32E-04	-62.2	0.84E-04	1.29	1.02	-20.9
1.34	0.64E-04	0.25E-04	-60.7	0.64E-04	1.34	1.05	-21.6
1.38	0.53E-04	0.18E-04	-65.2	0.53E-04	1.38	1.09	-20.9
1.43	0.48E-04	0.16E-04	-66.7	0.48E-04	1.43	1.14	-20.5
1.47	0.41E-04	0.11E-04	-72.2	0.41E-04	1.47	1.24	-15.8
1.52	0.37E-04	0.68E-05	-81.3	0.37E-04	1.52	1.25	-17.3
1.56	0.23E-04	0.46E-05	-80.0	0.23E-04	1.56	1.35	-13.3
1.61	0.23E-04	0.00E+00	-100.0	0.23E-04	1.61	1.35	-15.7
1.65	0.21E-04	0.00E+00	-100.0	0.21E-04	1.65	1.37	-17.3
1.70	0.16E-04	0.00E+00	-100.0	0.16E-04	1.70	1.43	-15.6
1.74	0.68E-05	0.00E+00	-100.0	0.68E-05	1.74	1.54	-11.8
1.79	0.46E-05	0.00E+00	-100.0	0.46E-05	1.79	1.57	-11.9
1.83	0.23E-05	0.00E+00	-100.0	0.23E-05	1.83	1.59	-13.2
1.88	0.23E-05	0.00E+00	-100.0	0.23E-05	1.88	1.59	-15.3
1.92	0.23E-05	0.00E+00	-100.0	0.23E-05	1.92	1.59	-17.3
1.97	0.23E-05	0.00E+00	-100.0	0.23E-05	1.97	1.59	-19.1

There is no positive excursion

Maximum negative excursion = 0.267 cfs (-27.3%)
occuring at 0.981 cfs on the Base Data:sdn4xxpr.tsf
and at 0.713 cfs on the New Data:sdn4xxvo.tsf

SDN4X2X
(SDN2X + SDN4 + SDN4X)

KCRTS: SEATAC-MILLER

Land Use Summary	
Till Forest	23.66 acres
Till Pasture	0.00 acres
Till Grass	5.29 acres
Airport Fill	0.00 acres
Outwash Forest	16.00 acres
Outwash Pasture	0.00 acres
Outwash Grass	3.99 acres
Wetland	0.00 acres
Impervious	3.94 acres
Total Area :	52.88 acres
Scale Factor :	1.00 Hourly Historic

Time Series: sdn4xxpr

Compute Time Series
Modify User Input

KCRTS: SEATAC-MILLER

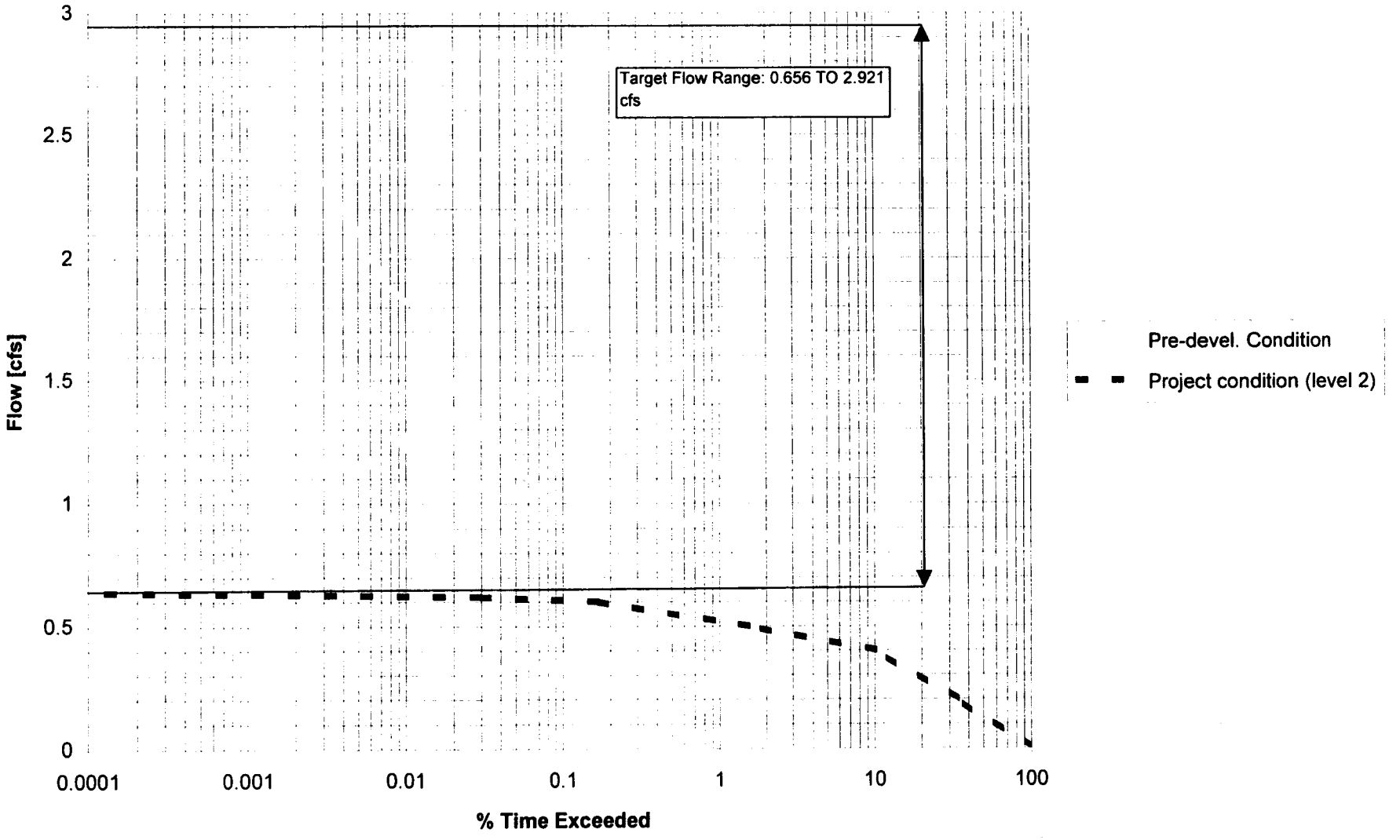
Land Use Summary	
Till Forest	0.00 acres
Till Pasture	0.00 acres
Till Grass	18.26 acres
Airport Fill	10.28 acres
Outwash Forest	0.00 acres
Outwash Pasture	0.00 acres
Outwash Grass	5.71 acres
Wetland	0.00 acres
Impervious	18.66 acres
Total Area :	52.91 acres
Scale Factor :	1.00 Hourly Historic

Time Series: sdn4xxdv

Compute Time Series
Modify User Input

SDW1B

MILLER at SDW1B



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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1B (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.281	2.662	2.365	0.958	1.052
1.219	1.391	1.459	1.412	1.271
1.075	1.338	1.317	1.152	1.209
1.258	1.276	1.129	1.672	1.934
1.095	1.137	1.107	2.728	1.071
1.377	1.568	0.969	1.182	1.842
1.904	1.492	1.470	1.100	1.425
1.415	1.002	1.440	1.356	1.001
1.387	2.144	2.645	1.179	0.928
0.938	1.149	2.792		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.139
Variance (logs)	0.016
Standard Deviation (logs)	0.128
Skewness (logs)	1.039
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.117
Coefficient of Variation (logs)	0.916

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HOURLY FLOW SDW1B (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.871
0.9500	1.05	0.940
0.9000	1.11	0.992
0.8000	1.25	1.073
0.5000	2.00	1.311
0.2000	5.00	1.719
0.1000	10.00	2.043
0.0400	25.00	2.517
0.0200	50.00	2.921
0.0100	100.00	3.372
0.0050	200.00	3.877

$1/2 Q_2 = 0.656$ cfs

$Q_{50} = 2.921$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1B combined POC (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.412	0.571	0.625	0.383	0.512
0.464	0.407	0.601	0.455	0.447
0.450	0.480	0.517	0.361	0.455
0.499	0.469	0.454	0.532	0.444
0.452	0.467	0.416	0.627	0.468
0.486	0.427	0.414	0.260	0.423
0.333	0.541	0.418	0.473	0.455
0.374	0.298	0.450	0.463	0.353
0.357	0.483	0.502	0.439	0.367
0.323	0.461	0.619		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.352
Variance (logs)	0.006
Standard Deviation (logs)	0.080
Skewness (logs)	-0.508
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.084
Coefficient of Variation (logs)	-0.226

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HOURLY FLOW SDW1B combined POC (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.272
0.9500	1.05	0.321
0.9000	1.11	0.349
0.8000	1.25	0.384
0.5000	2.00	0.452
0.2000	5.00	0.520
0.1000	10.00	0.556
0.0400	25.00	0.592
0.0200	50.00	0.615
0.0100	100.00	0.635
0.0050	200.00	0.653

$1/2\,Q_2 = 0.226$ cfs

$Q_{50} = 0.615$ cfs

1

Simulated - HOURLY FLOW SDW1B (PREDEV)
Observed - HOURLY FLOW SDW1B combined POC (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	282679	0.048	*	0.079	*	-0.040	*
0.20	99080	0.262	88.7	0.274	91.4	-0.248	-83.9
0.40	35531	0.368	84.3	0.380	86.9	-0.356	-81.5
0.50	5738	0.447	82.6	0.469	86.6	-0.411	-76.0
0.60	570	0.368	60.5	0.405	66.7	-0.305	-50.2
0.62	122	0.269	43.1	0.306	49.1	-0.230	-36.9
0.64	0	0.000	0.0	0.000	0.0	0.000	0.0
0.66	0	0.000	0.0	0.000	0.0	0.000	0.0
0.68	0	0.000	0.0	0.000	0.0	0.000	0.0
0.70	0	0.000	0.0	0.000	0.0	0.000	0.0
0.72	0	0.000	0.0	0.000	0.0	0.000	0.0
0.75	0	0.000	0.0	0.000	0.0	0.000	0.0
0.80	0	0.000	0.0	0.000	0.0	0.000	0.0
0.90	0	0.000	0.0	0.000	0.0	0.000	0.0
1.00	0	0.000	0.0	0.000	0.0	0.000	0.0
1.10	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
1.30	0	0.000	0.0	0.000	0.0	0.000	0.0
1.40	0	0.000	0.0	0.000	0.0	0.000	0.0
1.60	0	0.000	0.0	0.000	0.0	0.000	0.0
1.70	0	0.000	0.0	0.000	0.0	0.000	0.0
1.80	0	0.000	0.0	0.000	0.0	0.000	0.0
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.00	0	0.000	0.0	0.000	0.0	0.000	0.0
2.10	0	0.000	0.0	0.000	0.0	0.000	0.0
2.20	0	0.000	0.0	0.000	0.0	0.000	0.0
2.30	0	0.000	0.0	0.000	0.0	0.000	0.0
2.40	0	0.000	0.0	0.000	0.0	0.000	0.0
2.50	0	0.000	0.0	0.000	0.0	0.000	0.0
2.60	0	0.000	0.0	0.000	0.0	0.000	0.0
2.70	0	0.000	0.0	0.000	0.0	0.000	0.0
2.80	0	0.000	0.0	0.000	0.0	0.000	0.0
2.90	0	0.000	0.0	0.000	0.0	0.000	0.0
3.00	0	0.000	0.0	0.000	0.0	0.000	0.0
3.10	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.131	*	0.192	*	-0.121	*

Standard error of estimate = 0.15
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDW1B (PREDEV)
Observed - HOURLY FLOW SDW1B combined POC (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		96.65	66.71	100.00	100.00	0.01	0.05
0.20	957999080		2.26	23.38	3.35	33.29	0.28	0.30
0.40	185835531		0.44	8.39	1.09	9.90	0.45	0.44
0.50	1002	5738	0.24	1.35	0.65	1.52	0.55	0.54
0.60	151	570	0.04	0.13	0.41	0.16	0.61	0.61
0.62	138	122	0.03	0.03	0.38	0.03	0.63	0.62
0.64	128	0	0.03	0.00	0.35	0.00	0.65	0.00
0.66	106	0	0.03	0.00	0.31	0.00	0.67	0.00
0.68	110	0	0.03	0.00	0.29	0.00	0.69	0.00
0.70	92	0	0.02	0.00	0.26	0.00	0.71	0.00
0.72	122	0	0.03	0.00	0.24	0.00	0.73	0.00
0.75	157	0	0.04	0.00	0.21	0.00	0.77	0.00
0.80	260	0	0.06	0.00	0.18	0.00	0.84	0.00
0.90	144	0	0.03	0.00	0.11	0.00	0.95	0.00
1.00	96	0	0.02	0.00	0.08	0.00	1.04	0.00
1.10	64	0	0.02	0.00	0.06	0.00	1.15	0.00
1.20	47	0	0.01	0.00	0.04	0.00	1.25	0.00
1.30	35	0	0.01	0.00	0.03	0.00	1.35	0.00
1.40	34	0	0.01	0.00	0.02	0.00	1.49	0.00
1.60	12	0	0.00	0.00	0.02	0.00	1.64	0.00
1.70	9	0	0.00	0.00	0.01	0.00	1.74	0.00
1.80	14	0	0.00	0.00	0.01	0.00	1.86	0.00
1.90	7	0	0.00	0.00	0.01	0.00	1.95	0.00
2.00	3	0	0.00	0.00	0.01	0.00	2.06	0.00
2.10	5	0	0.00	0.00	0.01	0.00	2.16	0.00
2.20	4	0	0.00	0.00	0.00	0.00	2.26	0.00
2.30	6	0	0.00	0.00	0.00	0.00	2.36	0.00
2.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.50	1	0	0.00	0.00	0.00	0.00	2.52	0.00
2.60	3	0	0.00	0.00	0.00	0.00	2.65	0.00
2.70	3	0	0.00	0.00	0.00	0.00	2.75	0.00
2.80	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.90	0	0	0.00	0.00	0.00	0.00	0.00	0.00
3.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
3.10	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.03	0.15

90005 Observed values are zero
68593 Simulated values are zero
65756 Observed values are zero when simulated are zero
24249 Observed values are zero when simulated are not
2837 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDW1B (PREDEV)
Observed - HOURLY FLOW SDW1B combined POC (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	178756	3130	1444	90555	502	920	7372	0
0.20	89487	4197	1550	562	463	730	2091	0
0.40	31495	2300	645	215	155	233	488	0
0.50	4782	524	149	53	36	46	148	0
0.60	310	131	41	17	13	18	40	0
0.62	40	36	18	8	4	13	3	0
0.64	0	0	0	0	0	0	0	0
0.66	0	0	0	0	0	0	0	0

0.68	0	0	0	0	0	0	0	0
0.70	0	0	0	0	0	0	0	0
0.72	0	0	0	0	0	0	0	0
0.75	0	0	0	0	0	0	0	0
0.80	0	0	0	0	0	0	0	0
0.90	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0
1.10	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
1.30	0	0	0	0	0	0	0	0
1.40	0	0	0	0	0	0	0	0
1.60	0	0	0	0	0	0	0	0
1.70	0	0	0	0	0	0	0	0
1.80	0	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.00	0	0	0	0	0	0	0	0
2.10	0	0	0	0	0	0	0	0
2.20	0	0	0	0	0	0	0	0
2.30	0	0	0	0	0	0	0	0
2.40	0	0	0	0	0	0	0	0
2.50	0	0	0	0	0	0	0	0
2.60	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	0
2.80	0	0	0	0	0	0	0	0
2.90	0	0	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0
3.10	0	0	0	0	0	0	0	0
	304870	10318	3847	91410	1173	1960	10142	0

July 2001
556-2912-001 (28)

AR 010490

SDW1B

ROUTE FLOW THROUGH **FLOW SPLITTER** PRIOR TO POND
DISCHARGE A GOES TO INFILTRATION, DISCHARGE B GOES TO POND

FLOW SPLITTER IS A **100 S.F. BOX** WITH **ORIFICE** (DISCHARGE A) CONTROLLING FLOW TO INFILTRATION BASIN AND **WEIR** (DISCHARGE B) CONTROLLING FLOW TO POND D

AFTER ROUTING THROUGH FLOW SPLITTER, ROUTE DISCHARGE B TIME SERIES (SDW1BSPO) THROUGH POND D

FLOW SPLITTER RESERVOIR FILE

Stage (Ft)	Discharge (CFS)		Storage (Cu-Ft)	Perm-Area (Sq-Ft)
	A	B		
0.00	0.000	0.000	0.	0.
0.10	0.050	0.000	10.	0.
0.40	0.110	0.000	40.	0.
0.60	0.130	0.000	60.	0.
0.75	0.150	0.000	75.	0.
0.80	0.150	0.720	80.	0.
1.00	0.170	8.050	100.	0.
1.10	0.180	13.330	110.	0.
1.20	0.190	19.440	120.	0.
1.30	0.190	26.270	130	0.
1.40	0.200	33.750	140.	0.
1.46	0.200	38.530	146.	0.

```
Reservoir Routing [Double Outlet]
 Computing Series:sdw1bini.tsf
      and Series:sdw1bspo.tsf
   Years Complete: 50
                          Inflow/Outflow Analysis
                          -----------------------
   Peak Inflow Discharge:      23.20 CFS at 16:00 on Mar  3 in 1950
Peak A-Outflow Discharge:      0.190 CFS at 16:00 on Mar  3 in 1950
Peak B-Outflow Discharge:      22.75 CFS at 16:00 on Mar  3 in 1950
    Peak Reservoir Stage:       1.25  Ft
     Peak Reservoir Elev:       1.25  Ft
  Peak Reservoir Storage:     125.    Cu-Ft
                        :       0.003 Ac-Ft
                                Storing Time Series File:sdw1bini.tsf  50
                                Storing Time Series File:sdw1bspo.tsf  50
```

POND D:

Effective Storage Depth:	14.00	ft
Stage 0 Elevation:	0.00	ft
Riser Head:	14.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.60	0.686	
2	12.80	3.50	0.364	6.0

Top Notch Weir:	Rectangular	
Length:	2.50	in
Weir Height:	13.25	ft

Stage (Ft)	Discharge (CFS) A	Discharge (CFS) B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
1.00	0.000	0.183	105032.	0.
2.00	0.000	0.257	211715.	0.
3.00	0.000	0.319	321103.	0.
4.00	0.000	0.366	433230.	0.
5.00	0.000	0.411	667352.	0.
6.00	0.000	0.450	903530.	0.
7.00	0.000	0.481	1144090.	0.
8.00	0.000	0.518	1389054.	0.
9.00	0.000	0.550	1638448.	0.
10.00	0.000	0.583	1892299.	0.
11.00	0.000	0.609	2150631.	0.
12.00	0.000	0.634	2413468.	0.
13.00	0.000	0.764	2680839.	0.
14.00	0.000	1.320	2952767.	0.
15.00	0.000	16.600	3049200.	0.

Inflow/Outflow Analysis

Peak Inflow Discharge:	22.75	CFS	at 16:00	on Mar	3	in 1950
Peak B-Outflow Discharge:	0.599	CFS	at 11:00	on Mar	14	in 1972
Peak Reservoir Stage:	10.63	Ft				
Peak Reservoir Elev:	10.63	Ft				
Peak Reservoir Storage:	2054369.	Cu-Ft				
:	47.162	Ac-Ft				

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw1bpre.tsf Mean= 0.152 StdDev= 0.129
Project Location:Sea-Tac Miller Skew= 0.772

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			3.34		100.00	0.990
Computed Peaks			2.93		50.00	0.980
Computed Peaks			2.56		25.00	0.960
Computed Peaks			2.11		10.00	0.900
Computed Peaks			2.03		8.00	0.875
Computed Peaks			1.79		5.00	0.800
Computed Peaks			1.37		2.00	0.500
Computed Peaks			1.13		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw1br20.tsf Mean= -0.360 StdDev= 0.070
Project Location:Sea-Tac Miller Skew= -0.240

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.617	11.33		100.00	0.990
Computed Peaks			0.595	10.47		50.00	0.980
Computed Peaks			0.571	9.63		25.00	0.960
Computed Peaks			0.534	8.50		10.00	0.900
Computed Peaks			0.525	8.23		8.00	0.875
Computed Peaks			0.500	7.53		5.00	0.800
Computed Peaks			0.439	5.72		2.00	0.500
Computed Peaks			0.387	4.47		1.30	0.231

Duration Comparison Anaylsis
Base File: sdw1bpre.tsf
New File: sdw1br20.tsf
Cutoff Units: Discharge in CFS

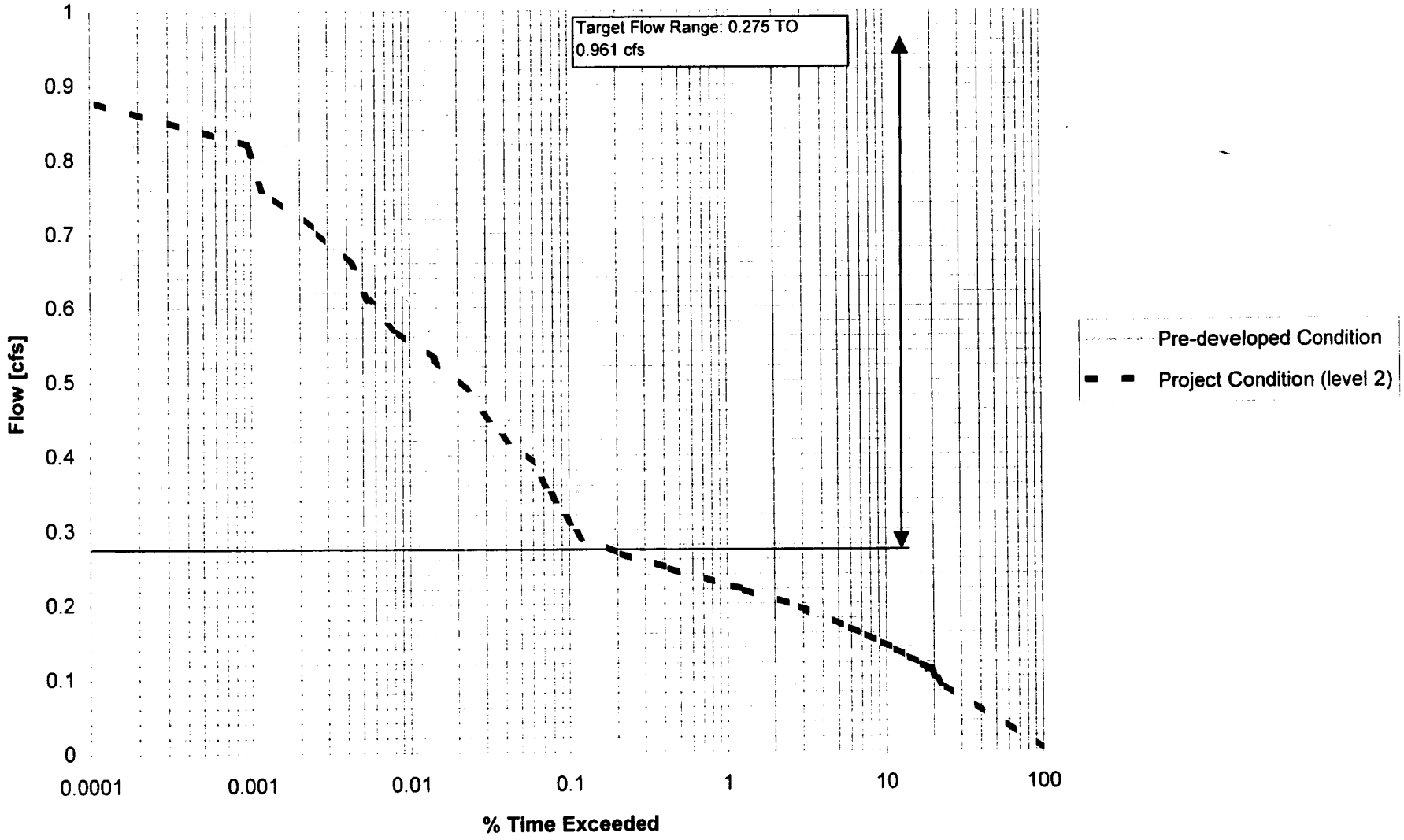
	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.683	0.29E-02	0.00E+00	-100.0	0.29E-02	0.683	0.554	-19.0
0.751	0.21E-02	0.00E+00	-100.0	0.21E-02	0.751	0.562	-25.2
0.819	0.16E-02	0.00E+00	-100.0	0.16E-02	0.819	0.567	-30.8
0.887	0.12E-02	0.00E+00	-100.0	0.12E-02	0.887	0.573	-35.4
0.955	0.95E-03	0.00E+00	-100.0	0.95E-03	0.955	0.578	-39.5
1.02	0.74E-03	0.00E+00	-100.0	0.74E-03	1.02	0.581	-43.2
1.09	0.60E-03	0.00E+00	-100.0	0.60E-03	1.09	0.584	-46.5
1.16	0.49E-03	0.00E+00	-100.0	0.49E-03	1.16	0.586	-49.4
1.23	0.39E-03	0.00E+00	-100.0	0.39E-03	1.23	0.588	-52.1
1.29	0.32E-03	0.00E+00	-100.0	0.32E-03	1.29	0.589	-54.5
1.36	0.27E-03	0.00E+00	-100.0	0.27E-03	1.36	0.590	-56.7
1.43	0.22E-03	0.00E+00	-100.0	0.22E-03	1.43	0.592	-58.6
1.50	0.19E-03	0.00E+00	-100.0	0.19E-03	1.50	0.592	-60.5
1.57	0.17E-03	0.00E+00	-100.0	0.17E-03	1.57	0.593	-62.2
1.63	0.14E-03	0.00E+00	-100.0	0.14E-03	1.63	0.593	-63.7
1.70	0.13E-03	0.00E+00	-100.0	0.13E-03	1.70	0.594	-65.1
1.77	0.11E-03	0.00E+00	-100.0	0.11E-03	1.77	0.595	-66.4
1.84	0.98E-04	0.00E+00	-100.0	0.98E-04	1.84	0.595	-67.6
1.91	0.71E-04	0.00E+00	-100.0	0.71E-04	1.91	0.597	-68.7
1.97	0.62E-04	0.00E+00	-100.0	0.62E-04	1.97	0.597	-69.7
2.04	0.55E-04	0.00E+00	-100.0	0.55E-04	2.04	0.598	-70.7
2.11	0.50E-04	0.00E+00	-100.0	0.50E-04	2.11	0.598	-71.7
2.18	0.43E-04	0.00E+00	-100.0	0.43E-04	2.18	0.598	-72.5
2.25	0.37E-04	0.00E+00	-100.0	0.37E-04	2.25	0.599	-73.3
2.31	0.30E-04	0.00E+00	-100.0	0.30E-04	2.31	0.600	-74.1
2.38	0.18E-04	0.00E+00	-100.0	0.18E-04	2.38	0.601	-74.8
2.45	0.16E-04	0.00E+00	-100.0	0.16E-04	2.45	0.601	-75.5
2.52	0.16E-04	0.00E+00	-100.0	0.16E-04	2.52	0.601	-76.1
2.59	0.14E-04	0.00E+00	-100.0	0.14E-04	2.59	0.601	-76.7
2.65	0.91E-05	0.00E+00	-100.0	0.91E-05	2.65	0.602	-77.3
2.72	0.46E-05	0.00E+00	-100.0	0.46E-05	2.72	0.602	-77.9
2.79	0.23E-05	0.00E+00	-100.0	0.23E-05	2.79	0.603	-78.4

There is no positive excursion

Maximum negative excursion = 2.19 cfs (-78.4%)
occuring at 2.79 cfs on the Base Data:sdw1bpre.tsf
and at 0.603 cfs on the New Data:sdw1br20.tsf

SDN1

MILLER at SDN1



AR 010496

July 2001
556-2912-001 (28)

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN1 PREDEV

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.566	0.948	0.614	0.407	0.460
0.528	0.518	0.548	0.603	0.561
0.456	0.494	0.504	0.514	0.519
0.525	0.495	0.478	0.737	0.859
0.429	0.488	0.481	0.757	0.412
0.605	0.657	0.422	0.534	0.834
0.861	0.642	0.637	0.484	0.644
0.554	0.452	0.573	0.558	0.453
0.629	0.877	0.814	0.515	0.420
0.424	0.513	0.712		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.250
Variance (logs)	0.009
Standard Deviation (logs)	0.097
Skewness (logs)	0.690
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.209
Coefficient of Variation (logs)	-0.388

1

HOURLY FLOW SDN1 PREDEV

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.376
0.9500	1.05	0.409
0.9000	1.11	0.432
0.8000	1.25	0.465
0.5000	2.00	0.549
0.2000	5.00	0.671
0.1000	10.00	0.757
0.0400	25.00	0.872
0.0200	50.00	0.961
0.0100	100.00	1.054
0.0050	200.00	1.152

$1/2 Q_2 = 0.295$ cfs
$Q_{50} = 0.961$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDN1 2006

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.212	0.253	0.731	0.188	0.230
0.228	0.233	0.272	0.229	0.243
0.213	0.422	0.249	0.184	0.237
0.251	0.275	0.222	0.244	0.226
0.214	0.236	0.241	0.501	0.266
0.238	0.224	0.232	0.201	0.243
0.183	0.536	0.222	0.245	0.234
0.194	0.209	0.267	0.353	0.209
0.202	0.436	0.432	0.246	0.198
0.179	0.255	0.712		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.587
Variance (logs)	0.021
Standard Deviation (logs)	0.143
Skewness (logs)	1.824
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.061
Coefficient of Variation (logs)	-0.244

1

HOURLY FLOW SDN1 2006

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.181
0.9500	1.05	0.185
0.9000	1.11	0.190
0.8000	1.25	0.199
0.5000	2.00	0.236
0.2000	5.00	0.320
0.1000	10.00	0.399
0.0400	25.00	0.534
0.0200	50.00	0.664
0.0100	100.00	0.825
0.0050	200.00	1.023

$1/2Q_2 = 0.118$ cfs
$Q_{50} = 0.664$ cfs

1

Simulated - HOURLY FLOW SDN1 PREDEV
Observed - HOURLY FLOW SDN1 2006

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	329033	0.020	*	0.032	*	-0.018	*
0.09	8879	0.086	90.2	0.089	93.9	-0.079	-83.1
0.10	4017	0.092	89.4	0.095	92.5	-0.086	-84.2
0.11	3696	0.096	89.3	0.100	92.6	-0.089	-82.9
0.11	13281	0.103	89.3	0.106	92.5	-0.096	-83.4
0.12	11523	0.111	88.6	0.114	91.5	-0.103	-82.9
0.13	9382	0.118	87.7	0.122	90.8	-0.111	-82.6
0.14	8931	0.127	87.4	0.131	90.4	-0.119	-82.4
0.15	7276	0.135	87.3	0.140	90.2	-0.127	-82.3
0.16	5911	0.142	86.3	0.147	89.4	-0.135	-81.8
0.17	8415	0.155	86.2	0.160	89.0	-0.146	-81.5
0.19	3414	0.165	85.0	0.171	88.1	-0.157	-80.7
0.20	4903	0.176	83.9	0.182	87.0	-0.168	-80.2
0.22	1684	0.185	82.4	0.192	85.4	-0.177	-78.6
0.23	1713	0.197	82.4	0.203	85.1	-0.186	-78.1
0.25	850	0.210	81.0	0.217	83.8	-0.195	-75.1
0.27	303	0.217	78.7	0.226	81.9	-0.199	-72.3
0.29	72	0.232	77.4	0.240	80.0	-0.204	-68.0
0.31	85	0.247	76.2	0.259	79.8	-0.232	-71.6
0.34	44	0.252	72.1	0.264	75.3	-0.243	-69.5
0.36	55	0.281	74.9	0.294	78.3	-0.264	-70.5
0.39	76	0.299	73.8	0.308	76.2	-0.294	-72.6
0.42	43	0.319	73.6	0.326	75.3	-0.304	-70.1
0.45	40	0.334	71.0	0.352	74.8	-0.330	-70.2
0.49	34	0.373	73.1	0.386	75.6	-0.373	-73.1
0.53	26	0.408	74.7	0.421	77.1	-0.407	-74.5
0.57	11	0.371	62.9	0.406	68.9	-0.363	-61.5
0.61	5	0.488	76.7	0.492	77.4	-0.488	-76.7
0.66	8	0.457	66.5	0.486	70.7	-0.457	-66.5
0.71	5	0.465	64.1	0.481	65.9	-0.465	-64.1
0.76	1	0.706	89.7	0.706	89.7	-0.706	-89.7
0.82	4	0.582	69.5	0.597	71.3	-0.582	-69.5
0.88	0	0.000	0.0	0.000	0.0	0.000	0.0
0.95	0	0.000	0.0	0.000	0.0	0.000	0.0
1.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.044	*	0.070	*	-0.040	*

Standard error of estimate = 0.06
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDN1 PREDEV
Observed - HOURLY FLOW SDN1 2006

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		97.35	77.65	100.00	100.00	0.00	0.02
0.09	1431	8879	0.34	2.10	2.65	22.35	0.09	0.09
0.10	655	4017	0.15	0.95	2.31	20.25	0.10	0.10
0.11	617	3696	0.15	0.87	2.16	19.30	0.11	0.11
0.11	106613281		0.25	3.13	2.01	18.43	0.11	0.12
0.12	94511523		0.22	2.72	1.76	15.30	0.12	0.12
0.13	781	9382	0.18	2.21	1.54	12.58	0.13	0.13
0.14	672	8931	0.16	2.11	1.35	10.36	0.15	0.15
0.15	573	7276	0.14	1.72	1.19	8.25	0.15	0.15
0.16	546	5911	0.13	1.40	1.06	6.54	0.16	0.16
0.17	832	8415	0.20	1.99	0.93	5.14	0.18	0.18
0.19	366	3414	0.09	0.81	0.73	3.16	0.20	0.19
0.20	550	4903	0.13	1.16	0.65	2.35	0.21	0.21
0.22	247	1684	0.06	0.40	0.52	1.19	0.22	0.22
0.23	387	1713	0.09	0.40	0.46	0.80	0.24	0.24
0.25	314	850	0.07	0.20	0.37	0.39	0.26	0.26
0.27	247	303	0.06	0.07	0.29	0.19	0.28	0.28
0.29	206	72	0.05	0.02	0.23	0.12	0.30	0.30
0.31	222	85	0.05	0.02	0.19	0.10	0.32	0.32
0.34	117	44	0.03	0.01	0.13	0.08	0.35	0.35
0.36	120	55	0.03	0.01	0.11	0.07	0.37	0.38
0.39	87	76	0.02	0.02	0.08	0.06	0.40	0.41
0.42	55	43	0.01	0.01	0.06	0.04	0.43	0.43
0.45	62	40	0.01	0.01	0.04	0.03	0.47	0.47
0.49	44	34	0.01	0.01	0.03	0.02	0.51	0.51
0.53	20	26	0.00	0.01	0.02	0.01	0.55	0.55
0.57	14	11	0.00	0.00	0.01	0.01	0.58	0.59
0.61	17	5	0.00	0.00	0.01	0.01	0.64	0.64
0.66	6	8	0.00	0.00	0.01	0.00	0.67	0.69
0.71	9	5	0.00	0.00	0.00	0.00	0.73	0.72
0.76	3	1	0.00	0.00	0.00	0.00	0.80	0.79
0.82	7	4	0.00	0.00	0.00	0.00	0.85	0.84
0.88	1	0	0.00	0.00	0.00	0.00	0.95	0.00
0.95	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.01	0.05

336 Observed values are zero
68593 Simulated values are zero
336 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
68257 Observed values are not zero when simulated are

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Simulated - HOURLY FLOW SDN1 PREDEV
Observed - HOURLY FLOW SDN1 2006

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	315353	3356	1529	829	563	918	6485	0
0.09	7842	404	144	67	63	89	270	0
0.10	3555	172	98	34	24	44	90	0
0.11	3236	191	59	34	21	52	103	0
0.11	11681	605	297	99	92	145	362	0
0.12	10099	592	220	87	76	131	318	0
0.13	8174	478	218	78	74	115	245	0
0.14	7792	492	180	71	70	86	240	0

0.15	6343	394	157	57	56	76	193	0
0.16	5104	353	159	46	39	67	143	0
0.17	7337	470	182	60	63	85	218	0
0.19	2925	236	101	26	20	26	80	0
0.20	4208	320	124	55	35	59	102	0
0.22	1421	129	52	16	14	13	39	0
0.23	1462	133	34	8	13	16	47	0
0.25	720	63	16	5	14	3	29	0
0.27	251	24	8	2	5	3	10	0
0.29	58	7	1	0	0	2	4	0
0.31	73	4	2	2	0	3	1	0
0.34	35	4	2	1	0	1	1	0
0.36	45	4	2	1	1	0	2	0
0.39	65	7	3	0	0	0	1	0
0.42	35	6	0	0	0	0	2	0
0.45	31	4	3	1	0	1	0	0
0.49	27	5	1	1	0	0	0	0
0.53	23	2	0	0	1	0	0	0
0.57	8	1	1	0	1	0	0	0
0.61	4	1	0	0	0	0	0	0
0.66	6	1	1	0	0	0	0	0
0.71	2	3	0	0	0	0	0	0
0.76	1	0	0	0	0	0	0	0
0.82	3	1	0	0	0	0	0	0
0.88	0	0	0	0	0	0	0	0
0.95	0	0	0	0	0	0	0	0
1.00	0	0	0	0	0	0	0	0
	397919	8462	3594	1580	1245	1935	8985	0

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Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	200.00	ft
Facility Width:	110.00	ft
Facility Area:	22000.	sq. ft
Effective Storage Depth:	12.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	264000.	cu. ft
Riser Head:	12.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.90	0.339	
2	8.20	2.00	0.211	4.0
3	9.70	2.30	0.218	6.0

Top Notch Weir:	Rectangular	
Length:	2.40	in
Weir Height:	10.50	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.02	0.02	440.	0.010	0.014	0.00
0.04	0.04	880.	0.020	0.019	0.00
0.06	0.06	1320.	0.030	0.024	0.00
0.08	0.08	1760.	0.040	0.028	0.00
0.10	0.10	2200.	0.051	0.031	0.00
0.12	0.12	2640.	0.061	0.034	0.00
0.14	0.14	3080.	0.071	0.036	0.00
0.16	0.16	3520.	0.081	0.039	0.00
0.18	0.18	3960.	0.091	0.041	0.00
0.46	0.46	10120.	0.232	0.066	0.00
0.74	0.74	16280.	0.374	0.084	0.00
1.02	1.02	22440.	0.515	0.099	0.00
1.29	1.29	28380.	0.652	0.111	0.00
1.57	1.57	34540.	0.793	0.123	0.00
1.85	1.85	40700.	0.934	0.133	0.00
2.13	2.13	46860.	1.076	0.143	0.00
2.41	2.41	53020.	1.217	0.152	0.00
2.69	2.69	59180.	1.359	0.161	0.00
2.97	2.97	65340.	1.500	0.169	0.00
3.25	3.25	71500.	1.641	0.176	0.00
3.53	3.53	77660.	1.783	0.184	0.00
3.81	3.81	83820.	1.924	0.191	0.00
4.09	4.09	89980.	2.066	0.198	0.00
4.36	4.36	95920.	2.202	0.205	0.00
4.64	4.64	102080.	2.343	0.211	0.00
4.92	4.92	108240.	2.485	0.217	0.00
5.20	5.20	114400.	2.626	0.223	0.00
5.48	5.48	120560.	2.768	0.229	0.00

5.76	5.76	126720.	2.909	0.235	0.00
6.04	6.04	132880.	3.051	0.241	0.00
6.32	6.32	139040.	3.192	0.246	0.00
6.60	6.60	145200.	3.333	0.251	0.00
6.88	6.88	151360.	3.475	0.257	0.00
7.15	7.15	157300.	3.611	0.262	0.00
7.43	7.43	163460.	3.753	0.267	0.00
7.71	7.71	169620.	3.894	0.272	0.00
7.99	7.99	175780.	4.035	0.277	0.00
8.20	8.20	180400.	4.141	0.280	0.00
8.22	8.22	180840.	4.152	0.282	0.00
8.24	8.24	181280.	4.162	0.284	0.00
8.26	8.26	181720.	4.172	0.289	0.00
8.28	8.28	182160.	4.182	0.295	0.00
8.30	8.30	182600.	4.192	0.302	0.00
8.32	8.32	183040.	4.202	0.312	0.00
8.35	8.35	183700.	4.217	0.321	0.00
8.37	8.37	184140.	4.227	0.328	0.00
8.39	8.39	184580.	4.237	0.331	0.00
8.67	8.67	190740.	4.379	0.362	0.00
8.95	8.95	196900.	4.520	0.387	0.00
9.22	9.22	202840.	4.657	0.407	0.00
9.50	9.50	209000.	4.798	0.426	0.00
9.70	9.70	213400.	4.899	0.438	0.00
9.72	9.72	213840.	4.909	0.441	0.00
9.75	9.75	214500.	4.924	0.446	0.00
9.77	9.77	214940.	4.934	0.454	0.00
9.80	9.80	215600.	4.949	0.465	0.00
9.82	9.82	216040.	4.960	0.478	0.00
9.84	9.84	216480.	4.970	0.493	0.00
9.87	9.87	217140.	4.985	0.506	0.00
9.89	9.89	217580.	4.995	0.512	0.00
9.92	9.92	218240.	5.010	0.517	0.00
10.19	10.19	224180.	5.146	0.567	0.00
10.47	10.47	230340.	5.288	0.607	0.00
10.50	10.50	231000.	5.303	0.610	0.00
10.69	10.69	235180.	5.399	0.677	0.00
10.88	10.88	239360.	5.495	0.750	0.00
11.06	11.06	243320.	5.586	0.843	0.00
11.25	11.25	247500.	5.682	0.954	0.00
11.44	11.44	251680.	5.778	1.080	0.00
11.63	11.63	255860.	5.874	1.210	0.00
11.81	11.81	259820.	5.965	1.350	0.00
12.00	12.00	264000.	6.061	1.500	0.00
12.10	12.10	266200.	6.111	2.130	0.00
12.20	12.20	268400.	6.162	3.260	0.00
12.30	12.30	270600.	6.212	4.730	0.00
12.40	12.40	272800.	6.263	6.460	0.00
12.50	12.50	275000.	6.313	8.430	0.00
12.60	12.60	277200.	6.364	10.610	0.00
12.70	12.70	279400.	6.414	12.970	0.00
12.80	12.80	281600.	6.465	15.100	0.00
12.90	12.90	283800.	6.515	15.930	0.00
13.00	13.00	286000.	6.566	16.710	0.00
13.10	13.10	288200.	6.616	17.460	0.00
13.20	13.20	290400.	6.667	18.170	0.00
13.30	13.30	292600.	6.717	18.860	0.00

13.40	13.40	294800.	6.768	19.520	0.00
13.50	13.50	297000.	6.818	20.150	0.00
13.60	13.60	299200.	6.869	20.770	0.00
13.70	13.70	301400.	6.919	21.360	0.00
13.80	13.80	303600.	6.970	21.940	0.00
13.90	13.90	305800.	7.020	22.500	0.00

Route Time Series through Facility
Inflow Time Series File:sdn1x_d.tsf
Outflow Time Series File:sdn1_vo

Inflow/Outflow Analysis

Peak Inflow Discharge:	5.87	CFS at 0:00 on Oct 26 in 1986	
Peak Outflow Discharge:	0.820	CFS at 12:00 on Jan 2 in 1997	
Peak Reservoir Stage:	11.02	Ft	
Peak Reservoir Elev:	11.02	Ft	
Peak Reservoir Storage:	242353.	Cu-Ft	
:	5.564	Ac-Ft	

Flow Frequency Analysis
Time Series File:sdn1x_p.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.236 StdDev= 0.101
Skew= 0.515

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			1.08		100.00	0.990
Computed Peaks			0.993		50.00	0.980
Computed Peaks			0.904		25.00	0.960
Computed Peaks			0.789		10.00	0.900
Computed Peaks			0.765		8.00	0.875
Computed Peaks			0.700		5.00	0.800
Computed Peaks			0.569		2.00	0.500
Computed Peaks			0.485		1.30	0.231

Flow Frequency Analysis
Time Series File:sdn1_vo.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.585 StdDev= 0.150
Skew= 1.684

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.849	11.07		100.00	0.990
Computed Peaks			0.684	10.71		50.00	0.980
Computed Peaks			0.550	10.10		25.00	0.960
Computed Peaks			0.410	9.27		10.00	0.900
Computed Peaks			0.387	8.96		8.00	0.875
Computed Peaks			0.326	8.37		5.00	0.800
Computed Peaks			0.237	5.86		2.00	0.500
Computed Peaks			0.200	4.18		1.30	0.231

Duration Comparison Anaylsis
Base File: sdn1x_p.tsf
New File: sdn1_vo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.285	0.24E-02	0.11E-02	-54.9	0.24E-02	0.285	0.261	-8.4
0.307	0.19E-02	0.10E-02	-47.8	0.19E-02	0.307	0.267	-12.8
0.328	0.15E-02	0.95E-03	-36.0	0.15E-02	0.328	0.273	-16.6
0.349	0.12E-02	0.83E-03	-29.2	0.12E-02	0.349	0.279	-20.0
0.371	0.89E-03	0.70E-03	-21.5	0.89E-03	0.371	0.339	-8.5
0.392	0.73E-03	0.57E-03	-21.1	0.73E-03	0.392	0.365	-7.0
0.413	0.60E-03	0.37E-03	-38.8	0.60E-03	0.413	0.388	-6.2
0.435	0.47E-03	0.23E-03	-51.7	0.47E-03	0.435	0.404	-7.0
0.456	0.39E-03	0.18E-03	-54.1	0.39E-03	0.456	0.409	-10.3
0.477	0.32E-03	0.17E-03	-47.9	0.32E-03	0.477	0.421	-11.7
0.498	0.26E-03	0.16E-03	-40.9	0.26E-03	0.498	0.430	-13.8
0.520	0.20E-03	0.12E-03	-38.6	0.20E-03	0.520	0.438	-15.7
0.541	0.17E-03	0.96E-04	-43.2	0.17E-03	0.541	0.472	-12.8
0.562	0.13E-03	0.82E-04	-39.0	0.13E-03	0.562	0.509	-9.6
0.584	0.11E-03	0.57E-04	-50.0	0.11E-03	0.584	0.529	-9.4
0.605	0.10E-03	0.34E-04	-65.9	0.10E-03	0.605	0.540	-10.8
0.626	0.89E-04	0.21E-04	-76.9	0.89E-04	0.626	0.550	-12.2
0.648	0.71E-04	0.18E-04	-74.2	0.71E-04	0.648	0.575	-11.2
0.669	0.53E-04	0.14E-04	-73.9	0.53E-04	0.669	0.588	-12.1
0.690	0.50E-04	0.14E-04	-72.7	0.50E-04	0.690	0.589	-14.7
0.712	0.46E-04	0.11E-04	-75.0	0.46E-04	0.712	0.590	-17.0
0.733	0.34E-04	0.91E-05	-73.3	0.34E-04	0.733	0.606	-17.3
0.754	0.25E-04	0.91E-05	-63.6	0.25E-04	0.754	0.622	-17.5
0.776	0.23E-04	0.91E-05	-60.0	0.23E-04	0.776	0.625	-19.4
0.797	0.23E-04	0.46E-05	-80.0	0.23E-04	0.797	0.625	-21.6
0.818	0.21E-04	0.23E-05	-88.9	0.21E-04	0.818	0.637	-22.1
0.840	0.14E-04	0.00E+00	-100.0	0.14E-04	0.840	0.693	-17.5
0.861	0.68E-05	0.00E+00	-100.0	0.68E-05	0.861	0.781	-9.3
0.882	0.23E-05	0.00E+00	-100.0	0.23E-05	0.882	0.820	-7.1
0.904	0.23E-05	0.00E+00	-100.0	0.23E-05	0.904	0.820	-9.3
0.925	0.23E-05	0.00E+00	-100.0	0.23E-05	0.925	0.820	-11.4

There is no positive excursion

Maximum negative excursion = 0.188 cfs (-23.1%)
occuring at 0.813 cfs on the Base Data:sdn1x_p.tsf
and at 0.625 cfs on the New Data:sdn1_vo.tsf

Land Use Summary	
Till Forest	7.27 acres
Till Pasture	0.00 acres
Till Grass	1.45 acres
Airport Fill	0.00 acres
Outwash Forest	8.74 acres
Outwash Pasture	0.00 acres
Outwash Grass	1.92 acres
Wetland	0.21 acres
Impervious	1.97 acres

Total Area : 21.56 acres
Scale Factor : 1.00 Hourly Historic

Time Series: sdn1x_p

Compute Time Series
Modify User Input

Land Use Summary	
Till Forest	0.00 acres
Till Pasture	0.00 acres
Till Grass	1.97 acres
Airport Fill	0.00 acres
Outwash Forest	0.00 acres
Outwash Pasture	0.00 acres
Outwash Grass	6.14 acres
Wetland	0.21 acres
Impervious	13.24 acres

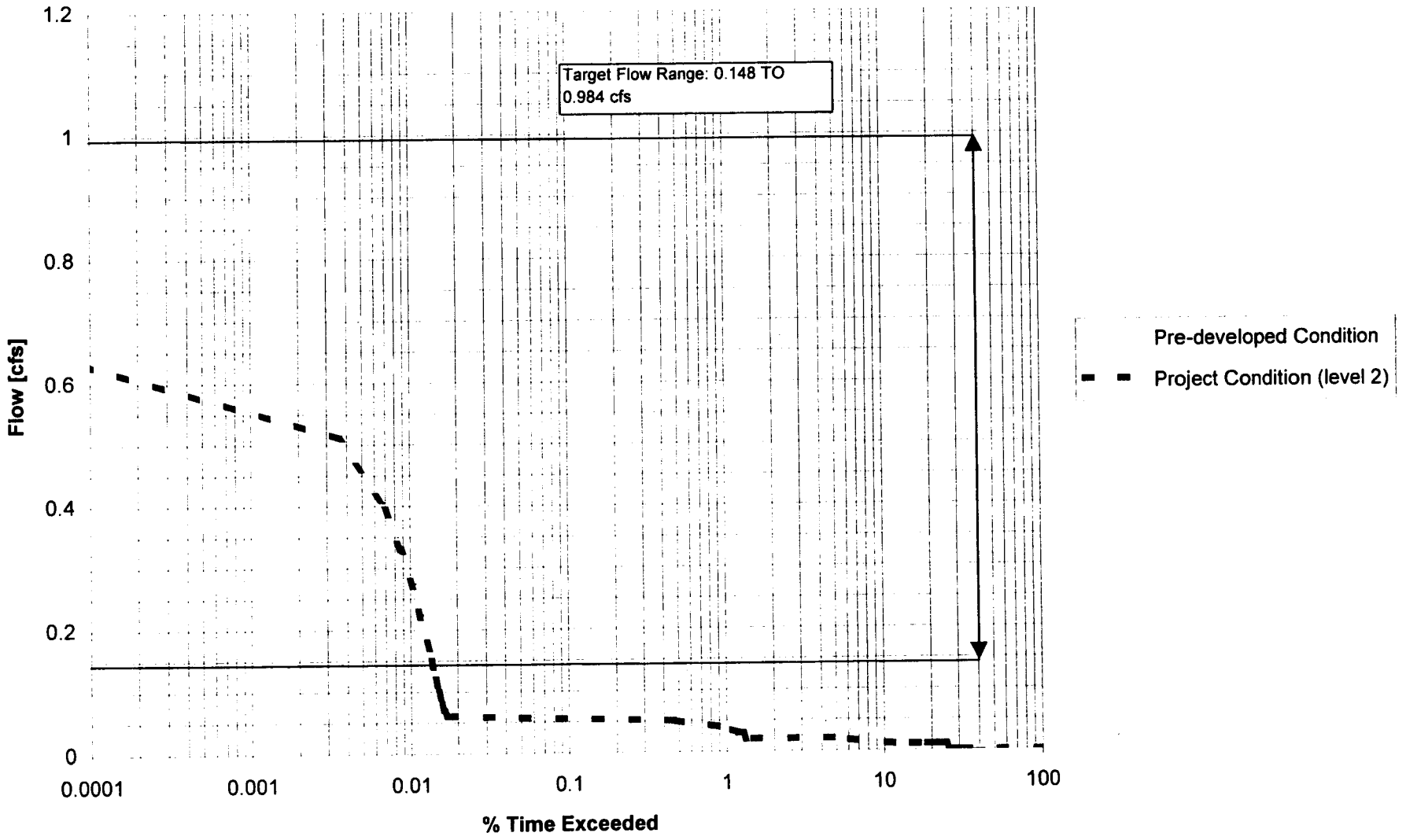
Total Area : 21.56 acres
Scale Factor : 1.00 Hourly Historic

Time Series: sdn1x_d

Compute Time Series
Modify User Input

SDW1A

MILLER at SDW1A



AR 010511

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1A (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.270	0.756	0.849	0.216	0.226
0.265	0.404	0.429	0.316	0.269
0.243	0.346	0.325	0.241	0.268
0.299	0.302	0.255	0.457	0.404
0.266	0.251	0.268	0.923	0.261
0.294	0.361	0.223	0.239	0.372
0.387	0.330	0.321	0.266	0.288
0.335	0.204	0.358	0.336	0.204
0.279	0.513	0.922	0.254	0.189
0.189	0.239	0.959		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.489
Variance (logs)	0.032
Standard Deviation (logs)	0.178
Skewness (logs)	1.397
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.104
Coefficient of Variation (logs)	-0.365

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HOURLY FLOW SDW1A (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.188
0.9500	1.05	0.200
0.9000	1.11	0.211
0.8000	1.25	0.230
0.5000	2.00	0.296
0.2000	5.00	0.433
0.1000	10.00	0.561
0.0400	25.00	0.777
0.0200	50.00	0.984
0.0100	100.00	1.242
0.0050	200.00	1.560

$1/2Q_2 = 0.148$ cfs

$Q_{50} = 0.984$ cfs

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW SDW1A combined POC flow (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.013	0.051	0.601	0.012	0.018
0.015	0.013	0.050	0.016	0.016
0.014	0.016	0.019	0.009	0.015
0.018	0.016	0.015	0.019	0.015
0.017	0.016	0.013	0.484	0.016
0.018	0.014	0.013	0.004	0.013
0.009	0.018	0.013	0.016	0.014
0.011	0.008	0.015	0.015	0.010
0.009	0.017	0.017	0.014	0.011
0.007	0.015	0.058		

The following 7 statistics are based on non-zero values.

Mean (logs)	-1.765
Variance (logs)	0.136
Standard Deviation (logs)	0.369
Skewness (logs)	2.904
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.099
Coefficient of Variation (logs)	-0.209

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HOURLY FLOW SDW1A combined POC flow (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.010
0.9500	1.05	0.010
0.9000	1.11	0.010
0.8000	1.25	0.010
0.5000	2.00	0.012
0.2000	5.00	0.025
0.1000	10.00	0.047
0.0400	25.00	0.119
0.0200	50.00	0.247
0.0100	100.00	0.522
0.0050	200.00	1.119

$1/2Q_2 = 0.006$ cfs

$Q_{50} = 0.247$ cfs

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Simulated - HOURLY FLOW SDW1A (PREDEV)
Observed - HOURLY FLOW SDW1A combined POC flow (2006)

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	278388	0.001	*	0.006	*	0.001	*
0.00	6342	0.026	2431.1	0.042	3839.0	0.026	2427.7
0.00	5011	0.022	1631.4	0.042	3208.5	0.021	1623.3
0.00	4522	0.015	873.4	0.032	1950.3	0.014	860.1
0.00	4616	0.013	602.1	0.030	1438.7	0.012	584.1
0.00	4122	0.012	445.2	0.028	1075.6	0.011	424.0
0.00	4644	0.011	345.7	0.026	788.7	0.010	316.5
0.00	5050	0.011	281.9	0.027	664.5	0.010	244.9
0.00	6192	0.011	222.9	0.026	512.7	0.009	183.3
0.01	6118	0.012	192.9	0.028	453.7	0.009	146.8
0.01	11650	0.013	165.5	0.028	358.0	0.008	103.3
0.01	17425	0.015	151.2	0.029	294.1	0.008	85.1
0.01	21477	0.016	135.6	0.031	260.1	0.007	59.2
0.01	28409	0.018	129.3	0.036	248.5	0.009	63.4
0.02	14100	0.026	146.9	0.051	290.5	0.013	74.5
0.02	285	0.034	152.3	0.080	358.8	0.011	48.6
0.03	362	0.039	138.5	0.079	278.2	0.007	22.8
0.03	1307	0.040	114.3	0.079	230.0	0.001	4.3
0.04	1758	0.042	96.6	0.078	177.9	-0.008	-17.7
0.05	1869	0.051	95.4	0.088	164.6	0.012	20.5
0.06	4	0.132	202.0	0.188	287.5	0.132	202.0
0.07	3	0.085	102.5	0.104	126.0	0.085	102.5
0.09	3	0.055	53.2	0.069	66.2	0.046	44.2
0.11	4	0.066	51.7	0.072	56.9	0.028	22.6
0.14	3	0.066	41.5	0.066	41.9	0.023	14.4
0.17	7	0.089	46.7	0.103	54.4	-0.014	-6.0
0.22	5	0.090	36.1	0.113	44.8	-0.086	-34.2
0.27	7	0.109	36.3	0.131	43.7	-0.096	-32.1
0.33	9	0.206	56.4	0.218	59.5	-0.206	-56.4
0.41	13	0.261	56.7	0.279	60.4	-0.261	-56.7
0.51	15	0.248	43.7	0.249	43.8	-0.248	-43.7
0.63	0	0.000	0.0	0.000	0.0	0.000	0.0
0.78	0	0.000	0.0	0.000	0.0	0.000	0.0
0.97	0	0.000	0.0	0.000	0.0	0.000	0.0
1.20	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.007	*	0.023	*	0.004	*

Standard error of estimate = 0.02
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW SDW1A (PREDEV)
Observed - HOURLY FLOW SDW1A combined POC flow (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		58.36	65.70	100.00	100.00	0.00	0.00
0.00	7354	6342	1.74	1.50	41.64	34.30	0.00	0.00
0.00	9161	5011	2.16	1.18	39.91	32.80	0.00	0.00
0.00	9784	4522	2.31	1.07	37.74	31.62	0.00	0.00
0.00	9997	4616	2.36	1.09	35.43	30.55	0.00	0.00
0.00	8294	4122	1.96	0.97	33.08	29.46	0.00	0.00
0.00	9920	4644	2.34	1.10	31.12	28.49	0.00	0.00
0.00	10120	5050	2.39	1.19	28.78	27.39	0.00	0.00
0.00	9745	6192	2.30	1.46	26.39	26.20	0.01	0.01
0.01	9385	6118	2.21	1.44	24.09	24.74	0.01	0.01
0.01	9724	11650	2.29	2.75	21.87	23.30	0.01	0.01
0.01	10669	17425	2.52	4.11	19.58	20.55	0.01	0.01
0.01	7221	21477	1.70	5.07	17.06	16.44	0.01	0.01
0.01	8646	28409	2.04	6.70	15.36	11.37	0.01	0.01
0.02	9092	14100	2.15	3.33	13.32	4.66	0.02	0.02
0.02	8742	285	2.06	0.07	11.17	1.33	0.02	0.02
0.03	7805	362	1.84	0.09	9.11	1.27	0.03	0.03
0.03	7254	1307	1.71	0.31	7.26	1.18	0.03	0.03
0.04	5727	1758	1.35	0.41	5.55	0.87	0.04	0.04
0.05	4662	1869	1.10	0.44	4.20	0.46	0.05	0.05
0.06	3881	4	0.92	0.00	3.10	0.02	0.07	0.07
0.07	3208	3	0.76	0.00	2.19	0.02	0.08	0.08
0.09	2094	3	0.49	0.00	1.43	0.02	0.10	0.10
0.11	1733	4	0.41	0.00	0.93	0.01	0.12	0.13
0.14	828	3	0.20	0.00	0.52	0.01	0.15	0.16
0.17	647	7	0.15	0.00	0.33	0.01	0.19	0.19
0.22	324	5	0.08	0.00	0.18	0.01	0.24	0.25
0.27	174	7	0.04	0.00	0.10	0.01	0.30	0.30
0.33	134	9	0.03	0.00	0.06	0.01	0.36	0.37
0.41	62	13	0.01	0.00	0.03	0.01	0.45	0.46
0.51	22	15	0.01	0.00	0.01	0.00	0.56	0.57
0.63	20	0	0.00	0.00	0.01	0.00	0.70	0.00
0.78	13	0	0.00	0.00	0.00	0.00	0.86	0.00
0.97	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1.20	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.01	0.00

160669 Observed values are zero
68595 Simulated values are zero
68119 Observed values are zero when simulated are zero
92550 Observed values are zero when simulated are not
476 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW SDW1A (PREDEV)
Observed - HOURLY FLOW SDW1A combined POC flow (2006)

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	1282	440	229	160780	101	219	115337	0
0.00	90	52	46	41	40	61	6012	0
0.00	170	97	77	23	35	123	4486	0
0.00	253	156	72	39	61	156	3785	0
0.00	371	197	93	104	113	150	3588	0
0.00	390	180	132	162	65	176	3017	0
0.00	587	278	264	165	130	225	2995	0
0.00	840	356	340	192	162	295	2865	0

0.00	1129	459	379	281	201	395	3348	0
0.01	1262	560	367	307	249	413	2960	0
0.01	3188	1578	745	328	321	618	4872	0
0.01	5500	1879	1083	514	484	808	7157	0
0.01	7951	2420	1304	592	515	965	7730	0
0.01	8565	3766	2013	831	758	1358	11118	0
0.02	4942	1478	916	425	362	650	5327	0
0.02	159	27	0	0	0	12	87	0
0.03	216	51	5	2	1	0	87	0
0.03	734	154	77	28	18	47	249	0
0.04	985	259	129	49	41	41	254	0
0.05	595	396	177	62	47	80	512	0
0.06	0	0	0	0	0	1	3	0
0.07	0	0	0	0	1	0	2	0
0.09	0	0	1	0	0	0	2	0
0.11	0	1	1	0	0	0	2	0
0.14	0	1	0	0	0	0	2	0
0.17	0	4	0	0	0	2	1	0
0.22	1	2	0	1	1	0	0	0
0.27	3	0	2	1	0	1	0	0
0.33	6	2	1	0	0	0	0	0
0.41	7	4	2	0	0	0	0	0
0.51	0	15	0	0	0	0	0	0
0.63	0	0	0	0	0	0	0	0
0.78	0	0	0	0	0	0	0	0
0.97	0	0	0	0	0	0	0	0
1.20	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---
	39226	14812	8455	164927	3706	6796	185798	0

July 2001
556-2912-001 (28)

AR 010517

PREDEVELOPED CONDITIONS SUM THESE 2 TIME SERIES:

Land Use Summary	
Till Forest	19.00 acres
Till Pasture	0.00 acres
Till Grass	6.09 acres
Airport Fill	0.00 acres
Outwash Forest	8.86 acres
Outwash Pasture	0.00 acres
Outwash Grass	2.84 acres
Wetland	0.33 acres
Impervious	0.35 acres
Total Area :	37.47 acres
Scale Factor :	1.00 Hourly Historic

Time Series: SWD1AIPR

Compute Time Series
Modify User Input

Land Use Summary	
Till Forest	0.00 acres
Till Pasture	0.00 acres
Till Grass	0.00 acres
Airport Fill	0.00 acres
Outwash Forest	9.54 acres
Outwash Pasture	0.00 acres
Outwash Grass	2.66 acres
Wetland	2.63 acres
Impervious	0.52 acres
Total Area :	15.35 acres
Scale Factor :	1.00 Hourly Historic

Time Series: SDW1AOPR

Compute Time Series
Modify User Input

DEVELOPED AREA DRAINING TO POND = ALL AREA EXCEPT AIRFIELD IMPERVIOUS

```
+-Land Use Summary-------------------------------------------+
|Till Forest              0.00 acres                         |
|Till Pasture             0.00 acres                         |
|Till Grass               4.28 acres                         |
|Airport Fill            32.44 acres                         |
|Outwash Forest           0.00 acres                         |
|Outwash Pasture          0.00 acres                         |
|Outwash Grass            0.69 acres                         |
|Wetland                  0.00 acres                         |
|Impervious               1.64 acres                         |
|-----------------------------------------------------------|
|         Total Area :   39.05 acres                        |
|       Scale Factor :    1.00      Hourly      Historic    |
|-----------------------------------------------------------|
|                                                           |
|   Time Series: sdw1apdv                                   |
|-----------------------------------------------------------|
|                     Compute Time Series                   |
|                      Modify User Input                    |
+-----------------------------------------------------------+
```

DEVELOPED AREA DRAINING TO VAULT = AIRFIELD IMPERVIOUS

```
+-Land Use Summary-------------------------------------------+
|Till Forest              0.00 acres                         |
|Till Pasture             0.00 acres                         |
|Till Grass               0.00 acres                         |
|Airport Fill             0.00 acres                         |
|Outwash Forest           0.00 acres                         |
|Outwash Pasture          0.00 acres                         |
|Outwash Grass            0.00 acres                         |
|Wetland                  0.00 acres                         |
|Impervious              13.78 acres                         |
|-----------------------------------------------------------|
|         Total Area :   13.78 acres                        |
|       Scale Factor :    1.00      Hourly      Historic    |
|-----------------------------------------------------------|
|                                                           |
|   Time Series: sdw1avdv                                   |
|-----------------------------------------------------------|
|                     Compute Time Series                   |
|                      Modify User Input                    |
+-----------------------------------------------------------+
```

SDW1A VAULT

Two Outlet Reservoir Routing File

Stage (Ft)	Discharge (CFS) A	Discharge (CFS) B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
0.01	0.140	0.000	300.	0.
1.00	0.141	0.000	30000.	0.
2.00	0.142	0.000	60000.	0.
4.00	0.143	0.000	120000.	0.
6.00	0.145	0.000	180000.	0.
8.00	0.146	0.000	240000.	0.
10.00	0.148	0.000	300000.	0.
12.00	0.149	0.000	360000.	0.
14.00	0.150	0.000	420000.	0.
16.00	0.152	0.000	480000.	0.
16.75	0.152	10.760	502500.	0.
16.90	0.152	13.960	507000.	0.
17.00	0.152	16.100	510000.	0.
17.10	0.152	18.570	513000.	0.
17.30	0.152	23.860	519000.	0.
18.00	0.152	45.540	540000.	0.

0.00 Ft : Base Reservoir Elevation
0.0 Minutes/Inch: Average Perm-Rate

Inflow/Outflow Analysis

Peak Inflow Discharge:	6.10	CFS at	0:00	on Oct	26	in 1986
Peak A-Outflow Discharge:	0.148	CFS at	2:00	on Jan	3	in 1997
Peak B-Outflow Discharge:	0.000	CFS at	2:00	on Jan	3	in 1997
Peak Reservoir Stage:	10.71	Ft				
Peak Reservoir Elev:	10.71	Ft				
Peak Reservoir Storage:	321220.	Cu-Ft				
:	7.374	Ac-Ft				

SDW1A POND

Two Outlet Reservoir Routing File

Stage (Ft)	Discharge (CFS) A	Discharge (CFS) B	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.000	0.	0.
0.01	0.150	0.001	600.	0.
1.00	0.150	0.007	57500.	0.
2.00	0.150	0.010	115400.	0.
3.00	0.150	0.012	174200.	0.
4.00	0.150	0.013	233900.	0.
5.00	0.150	0.015	348400.	0.
6.00	0.150	0.017	466000.	0.
7.00	0.150	0.018	586600.	0.
8.00	0.150	0.019	710100.	0.
8.30	0.150	0.031	748100.	0.
9.00	0.150	0.041	836700.	0.
10.00	0.150	0.051	966200.	0.
11.00	0.150	0.058	1098800.	0.
11.10	0.150	0.675	1112350.	0.
11.30	0.150	3.260	1139450.	0.
12.00	0.150	15.190	1234300.	0.

0.00 Ft : Base Reservoir Elevation
0.0 Minutes/Inch: Average Perm-Rate

Inflow/Outflow Analysis

Peak Inflow Discharge:	8.56	CFS	at	16:00	on	Mar 3	in 1950
Peak A-Outflow Discharge:	0.150	CFS	at	22:00	on	Mar 14	in 1972
Peak B-Outflow Discharge:	0.052	CFS	at	17:00	on	Mar 14	in 1972
Peak Reservoir Stage:	10.09	Ft					
Peak Reservoir Elev:	10.09	Ft					
Peak Reservoir Storage:	977508.	Cu-Ft					
:	22.441	Ac-Ft					

INFILTRATION VAULT DOES NOT OVERFLOW FOR MODELED PERIOD OF RECORD. COMPARE POND OUTFLOW TO OVERALL SDW1A PREDEVELOPED TIME SERIES.

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw1acpr.tsf Mean= -0.475 StdDev= 0.179
Project Location:Sea-Tac Miller Skew= 1.165

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			1.22		100.00	0.990
Computed Peaks			0.985		50.00	0.980
Computed Peaks			0.791		25.00	0.960
Computed Peaks			0.583		10.00	0.900
Computed Peaks			0.548		8.00	0.875
Computed Peaks			0.454		5.00	0.800
Computed Peaks			0.310		2.00	0.500
Computed Peaks			0.243		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw1apo.tsf Mean= -1.821 StdDev= 0.190
Project Location:Sea-Tac Miller Skew= 1.274

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			0.061	11.00		100.00	0.990
Computed Peaks			0.048	9.72		50.00	0.980
Computed Peaks			0.038	8.78		25.00	0.960
Computed Peaks			0.027	8.20		10.00	0.900
Computed Peaks			0.025	8.16		8.00	0.875
Computed Peaks			0.021	8.04		5.00	0.800
Computed Peaks			0.014	4.40		2.00	0.500
Computed Peaks			0.011	2.38		1.30	0.231

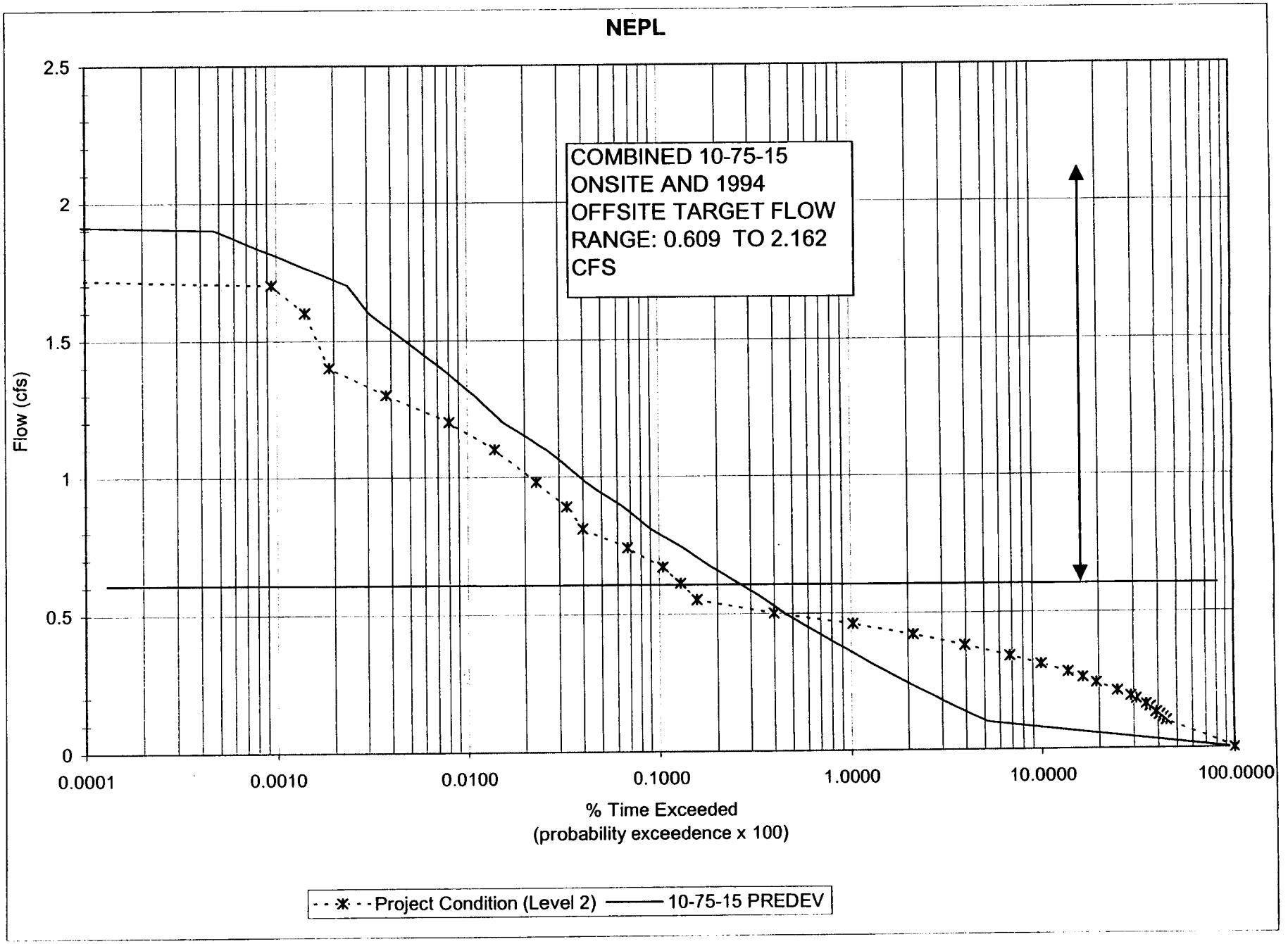
Duration Comparison Analysis
Base File: sdw1acpr.tsf
New File: sdw1apo.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.156	0.41E-02	0.00E+00	-100.0	0.41E-02	0.156	0.035	-77.5
0.182	0.29E-02	0.00E+00	-100.0	0.29E-02	0.182	0.039	-78.6
0.208	0.21E-02	0.00E+00	-100.0	0.21E-02	0.208	0.042	-79.7
0.234	0.15E-02	0.00E+00	-100.0	0.15E-02	0.234	0.043	-81.4
0.260	0.12E-02	0.00E+00	-100.0	0.12E-02	0.260	0.045	-82.9
0.286	0.90E-03	0.00E+00	-100.0	0.90E-03	0.286	0.045	-84.1
0.312	0.74E-03	0.00E+00	-100.0	0.74E-03	0.312	0.046	-85.2
0.338	0.55E-03	0.00E+00	-100.0	0.55E-03	0.338	0.047	-86.0
0.364	0.43E-03	0.00E+00	-100.0	0.43E-03	0.364	0.048	-86.8
0.390	0.33E-03	0.00E+00	-100.0	0.33E-03	0.390	0.049	-87.4
0.415	0.26E-03	0.00E+00	-100.0	0.26E-03	0.415	0.049	-88.1
0.441	0.22E-03	0.00E+00	-100.0	0.22E-03	0.441	0.050	-88.7
0.467	0.18E-03	0.00E+00	-100.0	0.18E-03	0.467	0.050	-89.3
0.493	0.15E-03	0.00E+00	-100.0	0.15E-03	0.493	0.050	-89.8
0.519	0.12E-03	0.00E+00	-100.0	0.12E-03	0.519	0.051	-90.3
0.545	0.11E-03	0.00E+00	-100.0	0.11E-03	0.545	0.051	-90.7
0.571	0.96E-04	0.00E+00	-100.0	0.96E-04	0.571	0.051	-91.1
0.597	0.94E-04	0.00E+00	-100.0	0.94E-04	0.597	0.051	-91.5
0.623	0.82E-04	0.00E+00	-100.0	0.82E-04	0.623	0.051	-91.8
0.649	0.66E-04	0.00E+00	-100.0	0.66E-04	0.649	0.051	-92.1
0.675	0.57E-04	0.00E+00	-100.0	0.57E-04	0.675	0.051	-92.4
0.701	0.50E-04	0.00E+00	-100.0	0.50E-04	0.701	0.051	-92.7
0.727	0.46E-04	0.00E+00	-100.0	0.46E-04	0.727	0.051	-92.9
0.753	0.41E-04	0.00E+00	-100.0	0.41E-04	0.753	0.051	-93.2
0.779	0.30E-04	0.00E+00	-100.0	0.30E-04	0.779	0.052	-93.4
0.805	0.27E-04	0.00E+00	-100.0	0.27E-04	0.805	0.052	-93.6
0.831	0.21E-04	0.00E+00	-100.0	0.21E-04	0.831	0.052	-93.8
0.857	0.11E-04	0.00E+00	-100.0	0.11E-04	0.857	0.052	-94.0
0.883	0.68E-05	0.00E+00	-100.0	0.68E-05	0.883	0.052	-94.1
0.909	0.68E-05	0.00E+00	-100.0	0.68E-05	0.909	0.052	-94.3
0.935	0.23E-05	0.00E+00	-100.0	0.23E-05	0.935	0.052	-94.4

There is no positive excursion

Maximum negative excursion = 0.907 cfs (-94.6%)
occurring at 0.959 cfs on the Base Data:sdw1acpr.tsf
and at 0.052 cfs on the New Data:sdw1apo.tsf

NEPL


NEPL
COMBINED 10-75-15
ONSITE AND 1994
OFFSITE TARGET FLOW
RANGE: 0.609 TO 2.162
CFS
Flow (cfs)
2.5
2
1.5
1
0.5
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

AR 010525

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW NEPL (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.221	2.049	1.314	0.985	0.994
1.144	1.120	1.183	1.309	1.211
0.991	1.103	1.092	1.105	1.125
1.133	1.060	1.037	1.591	1.852
0.931	1.058	1.035	1.589	0.884
1.306	1.431	0.907	1.148	1.791
1.848	1.391	1.379	1.851	1.418
1.193	0.972	1.260	1.880	0.971
1.350	1.918	1.775	1.114	0.900
0.912	1.103	1.518		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.095
Variance (logs)	0.010
Standard Deviation (logs)	0.102
Skewness (logs)	0.580
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.203
Coefficient of Variation (logs)	1.073

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HOURLY FLOW NEPL (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.798
0.9500	1.05	0.883
0.9000	1.11	0.938
0.8000	1.25	1.018
0.5000	2.00	1.217
0.2000	5.00	1.503
0.1000	10.00	1.700
0.0400	25.00	1.960
0.0200	50.00	2.162
0.0100	100.00	2.370
0.0050	200.00	2.587

$\frac{1}{2}Q_2 = 0.609$
$Q_{50} = 2.162$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW NEPL POC

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.408	0.496	1.354	0.364	0.520
0.430	0.403	0.775	0.437	0.449
0.421	0.525	0.477	0.355	0.468
0.511	0.516	0.447	0.476	0.430
0.434	0.475	0.442	1.119	0.513
0.453	0.415	0.416	0.350	0.453
0.335	0.924	0.428	0.520	0.440
0.357	0.364	0.462	0.513	0.398
0.359	0.566	0.639	0.462	0.347
0.322	0.486	1.215		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.318
Variance (logs)	0.019
Standard Deviation (logs)	0.136
Skewness (logs)	1.869
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.075
Coefficient of Variation (logs)	-0.428

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HOURLY FLOW NEPL POC

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.346
0.9500	1.05	0.352
0.9000	1.11	0.360
0.8000	1.25	0.375
0.5000	2.00	0.439
0.2000	5.00	0.586
0.1000	10.00	0.726
0.0400	25.00	0.959
0.0200	50.00	1.182
0.0100	100.00	1.456
0.0050	200.00	1.793

$Y_2Q_2 = 0.220$
$Q_{50} = 1.182$

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Simulated - HOURLY FLOW NEPL (PREDEV)
Observed - HOURLY FLOW NEPL POC

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	237042	0.027	102.7	0.042	139.5	-0.023	-91.3
0.10	7339	0.102	97.0	0.107	102.2	-0.091	-86.3
0.11	6707	0.111	96.2	0.115	100.4	-0.100	-86.7
0.12	6231	0.120	95.8	0.124	99.3	-0.108	-86.2
0.13	11418	0.133	94.9	0.139	99.5	-0.119	-84.7
0.15	7134	0.144	93.1	0.150	97.0	-0.132	-85.3
0.16	16649	0.159	93.2	0.165	96.8	-0.146	-85.6
0.18	8367	0.171	92.5	0.177	95.4	-0.158	-85.5
0.19	17914	0.184	91.9	0.189	94.7	-0.171	-85.7
0.21	22807	0.204	90.8	0.210	93.7	-0.191	-85.1
0.24	12437	0.225	90.0	0.231	92.6	-0.212	-84.9
0.26	11561	0.242	89.7	0.250	92.5	-0.227	-84.2
0.28	15924	0.262	88.8	0.269	91.4	-0.248	-84.2
0.31	13283	0.285	88.0	0.294	90.6	-0.271	-83.5
0.34	12160	0.311	86.9	0.320	89.4	-0.297	-82.9
0.38	7721	0.340	85.3	0.351	87.9	-0.325	-81.4
0.42	4685	0.369	84.3	0.381	87.0	-0.354	-80.8
0.46	2651	0.394	82.7	0.406	85.3	-0.375	-78.8
0.50	1026	0.401	77.5	0.417	80.6	-0.377	-72.8
0.55	121	0.425	73.6	0.443	76.7	-0.397	-68.8
0.61	100	0.493	76.8	0.506	78.8	-0.471	-73.3
0.67	156	0.520	73.9	0.539	76.6	-0.503	-71.5
0.74	118	0.549	71.6	0.565	73.6	-0.527	-68.7
0.81	30	0.629	73.9	0.647	76.1	-0.629	-73.9
0.89	41	0.648	69.8	0.666	71.9	-0.602	-64.8
0.98	39	0.658	63.7	0.689	66.6	-0.653	-63.2
1.10	25	0.712	62.2	0.749	65.3	-0.690	-60.2
1.20	18	0.840	67.2	0.870	69.5	-0.840	-67.2
1.30	8	0.851	64.0	0.878	66.1	-0.851	-64.0
1.40	2	1.247	85.8	1.247	85.8	-1.247	-85.8
1.60	2	0.974	60.5	1.056	65.8	-0.974	-60.5
1.70	4	1.399	77.7	1.404	78.1	-1.399	-77.7
1.90	0	0.000	0.0	0.000	0.0	0.000	0.0
2.10	0	0.000	0.0	0.000	0.0	0.000	0.0
2.30	0	0.000	0.0	0.000	0.0	0.000	0.0
	423720	0.110	97.4	0.160	121.6	-0.102	-88.3

Standard error of estimate = 0.12
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW NEPL (PREDEV)
Observed - HOURLY FLOW NEPL POC

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		94.81	55.94	100.00	100.00	0.01	0.03
0.10	1537	7339	0.36	1.73	5.19	44.06	0.10	0.10
0.11	1454	6707	0.34	1.58	4.83	42.32	0.11	0.11
0.12	1328	6231	0.31	1.47	4.48	40.74	0.12	0.12
0.13	226111418		0.53	2.69	4.17	39.27	0.14	0.14
0.15	1003	7134	0.24	1.68	3.64	36.58	0.15	0.16
0.16	173916649		0.41	3.93	3.40	34.89	0.17	0.17
0.18	793	8367	0.19	1.97	2.99	30.96	0.19	0.19
0.19	143317914		0.34	4.23	2.80	28.99	0.20	0.20
0.21	182022807		0.43	5.38	2.47	24.76	0.22	0.22
0.24	99912437		0.24	2.94	2.04	19.38	0.25	0.25
0.26	89611561		0.21	2.73	1.80	16.44	0.27	0.27
0.28	109315924		0.26	3.76	1.59	13.72	0.29	0.29
0.31	90413283		0.21	3.13	1.33	9.96	0.32	0.32
0.34	99312160		0.23	2.87	1.12	6.82	0.36	0.36
0.38	737	7721	0.17	1.82	0.88	3.95	0.40	0.40
0.42	619	4685	0.15	1.11	0.71	2.13	0.44	0.44
0.46	460	2651	0.11	0.63	0.56	1.02	0.48	0.48
0.50	415	1026	0.10	0.24	0.45	0.40	0.52	0.52
0.55	405	121	0.10	0.03	0.36	0.16	0.58	0.58
0.61	316	100	0.07	0.02	0.26	0.13	0.64	0.64
0.67	229	156	0.05	0.04	0.19	0.10	0.70	0.70
0.74	178	118	0.04	0.03	0.13	0.07	0.77	0.77
0.81	110	30	0.03	0.01	0.09	0.04	0.85	0.85
0.89	97	41	0.02	0.01	0.06	0.03	0.93	0.93
0.98	65	39	0.02	0.01	0.04	0.02	1.03	1.03
1.10	45	25	0.01	0.01	0.03	0.01	1.14	1.14
1.20	19	18	0.00	0.00	0.02	0.01	1.24	1.25
1.30	15	8	0.00	0.00	0.01	0.00	1.35	1.33
1.40	18	2	0.00	0.00	0.01	0.00	1.49	1.45
1.60	3	2	0.00	0.00	0.00	0.00	1.65	1.62
1.70	8	4	0.00	0.00	0.00	0.00	1.82	1.80
1.90	2	0	0.00	0.00	0.00	0.00	1.98	0.00
2.10	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2.30	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	423720	423720	100.00	100.00			0.02	0.12

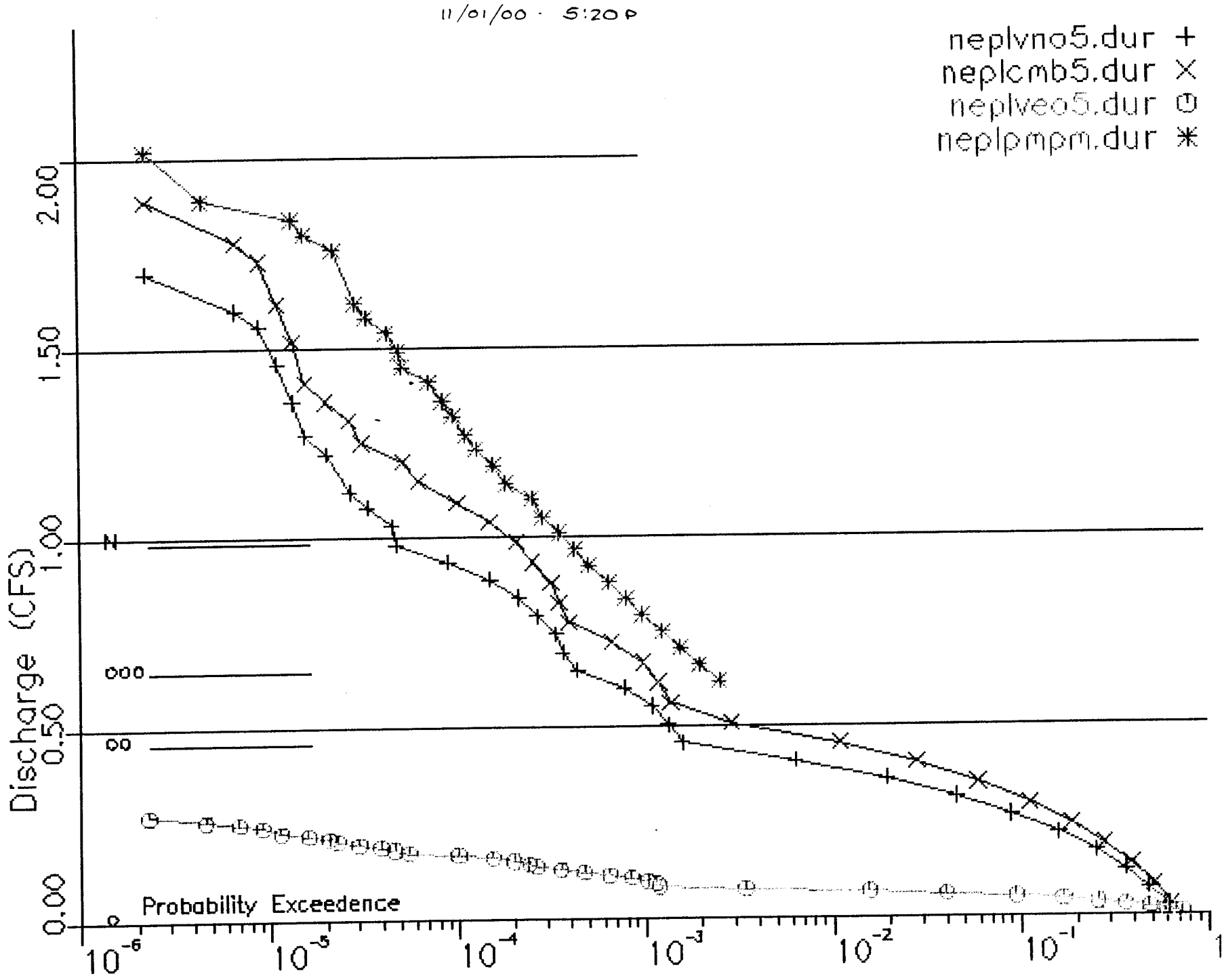
0 Observed values are zero
73109 Simulated values are zero
0 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
73109 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW NEPL (PREDEV)
Observed - HOURLY FLOW NEPL POC

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	230743	1253	562	258	215	373	3638	0
0.10	6810	138	71	29	16	43	232	0
0.11	6200	145	72	23	21	36	210	0
0.12	5733	150	62	23	18	50	195	0
0.13	10387	307	130	57	51	84	402	0
0.15	6452	231	104	42	47	52	206	0
0.16	15117	504	228	98	73	138	491	0
0.18	7558	296	114	41	40	71	247	0
0.19	16216	603	253	113	93	166	470	0

0.21	20489	892	389	143	116	189	589	0
0.24	11122	519	212	92	75	108	309	0
0.26	10325	509	200	60	57	115	295	0
0.28	14206	725	298	91	95	142	367	0
0.31	11783	649	269	87	70	126	299	0
0.34	10767	629	251	78	68	113	254	0
0.38	6774	453	155	68	42	73	156	0
0.42	4095	301	97	38	27	35	92	0
0.46	2287	207	57	13	16	17	54	0
0.50	830	119	30	6	6	14	21	0
0.55	102	5	2	1	2	3	6	0
0.61	87	7	1	1	1	0	3	0
0.67	132	12	6	1	2	0	3	0
0.74	102	8	3	0	1	1	3	0
0.81	25	4	1	0	0	0	0	0
0.89	36	1	0	1	0	1	2	0
0.98	31	4	2	1	0	1	0	0
1.10	19	2	3	0	0	1	0	0
1.20	12	5	1	0	0	0	0	0
1.30	6	2	0	0	0	0	0	0
1.40	2	0	0	0	0	0	0	0
1.60	1	1	0	0	0	0	0	0
1.70	4	0	0	0	0	0	0	0
1.90	0	0	0	0	0	0	0	0
2.10	0	0	0	0	0	0	0	0
2.30	0	0	0	0	0	0	0	0
	398453	8681	3573	1365	1152	1952	8544	0


11/01/00 · 5:20 P
neplvno5.dur +
neplcmb5.dur ×
neplveo5.dur ⊙
neplpmpm.dur ✳
Discharge (CFS)
2.00
1.50
1.00
0.50
0.00
Probability Exceedence
10-6
10-5
10-4
10-3
10-2
10-1
1

AR 010531

NEPL NEW VAULT

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	180.00	ft
Facility Width:	180.00	ft
Facility Area:	32400.	sq. ft
Effective Storage Depth:	20.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	648000.	cu. ft
Riser Head:	20.00	ft
Riser Diameter:	24.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	2.13	0.548	
2	14.00	2.00	0.266	4.0
3	16.00	2.75	0.410	6.0

Top Notch Weir:	Rectangular	
Length:	3.50	in
Weir Height:	17.63	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.02	0.02	648.	0.015	0.018	0.00
0.04	0.04	1296.	0.030	0.026	0.00
0.07	0.07	2268.	0.052	0.032	0.00
0.09	0.09	2916.	0.067	0.036	0.00
0.11	0.11	3564.	0.082	0.041	0.00
0.13	0.13	4212.	0.097	0.045	0.00
0.15	0.15	4860.	0.112	0.048	0.00
0.18	0.18	5832.	0.134	0.052	0.00
0.64	0.64	20736.	0.476	0.098	0.00
1.11	1.11	35964.	0.826	0.129	0.00
1.57	1.57	50868.	1.168	0.154	0.00
2.04	2.04	66096.	1.517	0.175	0.00
2.50	2.50	81000.	1.860	0.194	0.00
2.97	2.97	96228.	2.209	0.211	0.00
3.43	3.43	111132.	2.551	0.227	0.00
3.90	3.90	126360.	2.901	0.242	0.00
4.36	4.36	141264.	3.243	0.256	0.00
4.83	4.83	156492.	3.593	0.269	0.00
5.29	5.29	171396.	3.935	0.282	0.00
5.76	5.76	186624.	4.284	0.294	0.00
6.22	6.22	201528.	4.626	0.306	0.00
6.69	6.69	216756.	4.976	0.317	0.00
7.15	7.15	231660.	5.318	0.328	0.00
7.62	7.62	246888.	5.668	0.338	0.00
8.08	8.08	261792.	6.010	0.348	0.00
8.55	8.55	277020.	6.360	0.358	0.00
9.01	9.01	291924.	6.702	0.368	0.00
9.48	9.48	307152.	7.051	0.377	0.00
9.94	9.94	322056.	7.393	0.386	0.00

10.41	10.41	337284.	7.743	0.395	0.00
10.87	10.87	352188.	8.085	0.404	0.00
11.34	11.34	367416.	8.435	0.412	0.00
11.80	11.80	382320.	8.777	0.421	0.00
12.27	12.27	397548.	9.126	0.429	0.00
12.74	12.74	412776.	9.476	0.437	0.00
13.20	13.20	427680.	9.818	0.445	0.00
13.67	13.67	442908.	10.168	0.453	0.00
14.00	14.00	453600.	10.413	0.458	0.00
14.02	14.02	454248.	10.428	0.459	0.00
14.04	14.04	454896.	10.443	0.462	0.00
14.06	14.06	455544.	10.458	0.467	0.00
14.08	14.08	456192.	10.473	0.473	0.00
14.10	14.10	456840.	10.488	0.480	0.00
14.12	14.12	457488.	10.502	0.489	0.00
14.15	14.15	458460.	10.525	0.499	0.00
14.17	14.17	459108.	10.540	0.505	0.00
14.19	14.19	459756.	10.555	0.508	0.00
14.65	14.65	474660.	10.897	0.557	0.00
15.12	15.12	489888.	11.246	0.591	0.00
15.58	15.58	504792.	11.588	0.620	0.00
16.00	16.00	518400.	11.901	0.643	0.00
16.03	16.03	519372.	11.923	0.647	0.00
16.06	16.06	520344.	11.945	0.654	0.00
16.09	16.09	521316.	11.968	0.665	0.00
16.11	16.11	521964.	11.983	0.680	0.00
16.14	16.14	522936.	12.005	0.698	0.00
16.17	16.17	523908.	12.027	0.719	0.00
16.20	16.20	524880.	12.050	0.744	0.00
16.23	16.23	525852.	12.072	0.754	0.00
16.69	16.69	540756.	12.414	0.849	0.00
17.16	17.16	555984.	12.764	0.921	0.00
17.62	17.62	570888.	13.106	0.982	0.00
17.63	17.63	571212.	13.113	0.982	0.00
17.92	17.92	580608.	13.329	1.140	0.00
18.22	18.22	590328.	13.552	1.310	0.00
18.52	18.52	600048.	13.775	1.570	0.00
18.81	18.81	609444.	13.991	1.860	0.00
19.11	19.11	619164.	14.214	2.190	0.00
19.41	19.41	628884.	14.437	2.550	0.00
19.70	19.70	638280.	14.653	2.940	0.00
20.00	20.00	648000.	14.876	3.350	0.00
20.10	20.10	651240.	14.950	3.980	0.00
20.20	20.20	654480.	15.025	5.110	0.00
20.30	20.30	657720.	15.099	6.580	0.00
20.40	20.40	660960.	15.174	8.310	0.00
20.50	20.50	664200.	15.248	10.280	0.00
20.60	20.60	667440.	15.322	12.460	0.00
20.70	20.70	670680.	15.397	14.820	0.00
20.80	20.80	673920.	15.471	16.950	0.00
20.90	20.90	677160.	15.545	17.780	0.00
21.00	21.00	680400.	15.620	18.560	0.00
21.10	21.10	683640.	15.694	19.310	0.00
21.20	21.20	686880.	15.769	20.020	0.00
21.30	21.30	690120.	15.843	20.710	0.00
21.40	21.40	693360.	15.917	21.370	0.00
21.50	21.50	696600.	15.992	22.000	0.00

21.60	21.60	699840.	16.066 22.620	0.00
21.70	21.70	703080.	16.140 23.210	0.00
21.80	21.80	706320.	16.215 23.790	0.00
21.90	21.90	709560.	16.289 24.360	0.00

```
Route Time Series through Facility
  Inflow Time Series File:nepl_dnm.tsf
 Outflow Time Series File:neplvno5
     POC Time Series File:neplcmb5

Inflow/Outflow Analysis
   Peak Inflow Discharge:       11.65 CFS at  0:00 on Oct 26 in 1986
  Peak Outflow Discharge:        1.71 CFS at 12:00 on Jan  2 in 1997
    Peak Reservoir Stage:       18.66  Ft
     Peak Reservoir Elev:       18.66  Ft
  Peak Reservoir Storage:  604564.     Cu-Ft
                         :       13.879 Ac-Ft
Add Time Series:neplveo5.tsf
   Peak Summed Discharge:        1.90 CFS at 12:00 on Jan  2 in 1997
Point of Compliance File:neplcmb5.tsf
```

Flow Frequency Analysis
Time Series File:neplpmpm.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= 0.098 StdDev= 0.101
Skew= 0.504

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
2.34		100.00	0.990
2.15		50.00	0.980
1.95		25.00	0.960
1.70		10.00	0.900
1.65		8.00	0.875
1.51		5.00	0.800
1.23		2.00	0.500
1.05		1.30	0.231

Flow Frequency Analysis
Time Series File:neplvno5.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.381 StdDev= 0.151
Skew= 2.216

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
1.51	18.45		100.00	0.990
1.17	17.97		50.00	0.980
0.906	17.06		25.00	0.960
0.649	16.04		10.00	0.900
0.610	15.43		8.00	0.875
0.507	14.18		5.00	0.800
0.371	9.15		2.00	0.500
0.325	7.04		1.30	0.231

Flow Frequency Analysis
Time Series File:neplcmb5.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.313 StdDev= 0.153
Skew= 2.129

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
1.77		100.00	0.990
1.38		50.00	0.980
1.07		25.00	0.960
0.766		10.00	0.900
0.720		8.00	0.875
0.598		5.00	0.800
0.434		2.00	0.500
0.377		1.30	0.231

NEPL NEW VAULT

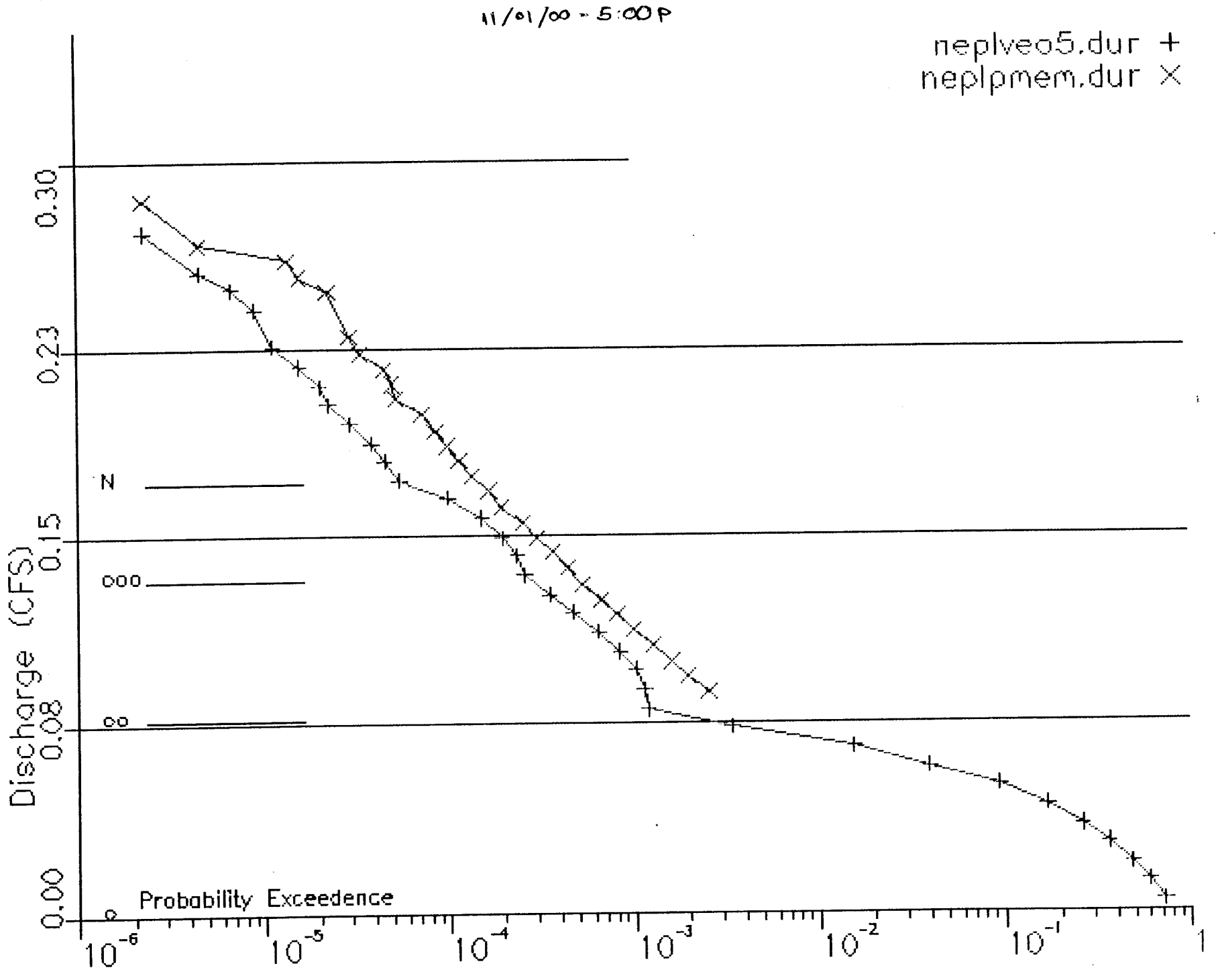
Duration Comparison Anaylsis
Base File: neplpmpm.tsf
New File: neplcmb5.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.615	0.25E-02	0.12E-02	-52.5	0.25E-02	0.615	0.513	-16.7
0.662	0.19E-02	0.10E-02	-48.0	0.19E-02	0.662	0.523	-21.0
0.708	0.15E-02	0.77E-03	-49.6	0.15E-02	0.708	0.531	-24.9
0.754	0.12E-02	0.47E-03	-61.4	0.12E-02	0.754	0.608	-19.4
0.800	0.94E-03	0.37E-03	-61.0	0.94E-03	0.800	0.676	-15.6
0.847	0.76E-03	0.34E-03	-54.5	0.76E-03	0.847	0.710	-16.2
0.893	0.62E-03	0.30E-03	-51.5	0.62E-03	0.893	0.727	-18.5
0.939	0.47E-03	0.26E-03	-46.2	0.47E-03	0.939	0.753	-19.8
0.985	0.39E-03	0.21E-03	-46.8	0.39E-03	0.985	0.777	-21.1
1.03	0.33E-03	0.16E-03	-52.4	0.33E-03	1.03	0.871	-15.5
1.08	0.27E-03	0.11E-03	-58.0	0.27E-03	1.08	0.912	-15.4
1.12	0.21E-03	0.78E-04	-63.4	0.21E-03	1.12	0.982	-12.6
1.17	0.18E-03	0.57E-04	-67.9	0.18E-03	1.17	1.01	-13.5
1.22	0.14E-03	0.43E-04	-69.4	0.14E-03	1.22	1.05	-13.8
1.26	0.12E-03	0.32E-04	-73.1	0.12E-03	1.26	1.07	-14.9
1.31	0.10E-03	0.27E-04	-73.3	0.10E-03	1.31	1.09	-16.6
1.35	0.87E-04	0.21E-04	-76.3	0.87E-04	1.35	1.11	-17.9
1.40	0.73E-04	0.18E-04	-75.0	0.73E-04	1.40	1.13	-19.2
1.45	0.53E-04	0.16E-04	-69.6	0.53E-04	1.45	1.20	-17.0
1.49	0.50E-04	0.14E-04	-72.7	0.50E-04	1.49	1.20	-19.3
1.54	0.43E-04	0.14E-04	-68.4	0.43E-04	1.54	1.22	-20.6
1.59	0.34E-04	0.11E-04	-66.7	0.34E-04	1.59	1.25	-21.1
1.63	0.30E-04	0.11E-04	-61.5	0.30E-04	1.63	1.28	-21.4
1.68	0.23E-04	0.91E-05	-60.0	0.23E-04	1.68	1.33	-20.8
1.72	0.23E-04	0.91E-05	-60.0	0.23E-04	1.72	1.33	-22.9
1.77	0.21E-04	0.68E-05	-66.7	0.21E-04	1.77	1.39	-21.4
1.82	0.16E-04	0.46E-05	-71.4	0.16E-04	1.82	1.46	-19.6
1.86	0.68E-05	0.23E-05	-66.7	0.68E-05	1.86	1.79	-3.7
1.91	0.46E-05	0.00E+00	-100.0	0.46E-05	1.91	1.82	-4.8
1.96	0.23E-05	0.00E+00	-100.0	0.23E-05	1.96	1.90	-3.0
2.00	0.23E-05	0.00E+00	-100.0	0.23E-05	2.00	1.90	-5.2

There is no positive excursion

Maximum negative excursion = 0.182 cfs (-25.4%)
occuring at 0.716 cfs on the Base Data:neplpmpm.tsf
and at 0.534 cfs on the New Data:neplcmb5.tsf

AR 010537


11/01/00 - 5:00P
neplveo5.dur +
neplpmem.dur ×
0.30
0.23
0.15
0.08
0.00
N
000
00
Discharge (CFS)
Probability Exceedence
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
1

AR 010538

NEPL EXISTING VAULT

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	380.00	ft
Facility Width:	25.69	ft
Facility Area:	9762.	sq. ft
Effective Storage Depth:	18.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	175720.	cu. ft
Riser Head:	18.00	ft
Riser Diameter:	21.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.88	0.088	
2	13.50	1.25	0.090	4.0
3	15.00	1.13	0.059	4.0

Top Notch Weir:	Rectangular	
Length:	1.38	in
Weir Height:	15.63	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.01	0.01	98.	0.002	0.002	0.00
0.02	0.02	195.	0.004	0.003	0.00
0.03	0.03	293.	0.007	0.003	0.00
0.04	0.04	391.	0.009	0.004	0.00
0.05	0.05	488.	0.011	0.005	0.00
0.06	0.06	586.	0.013	0.005	0.00
0.07	0.07	683.	0.016	0.006	0.00
0.49	0.49	4784.	0.110	0.015	0.00
0.91	0.91	8884.	0.204	0.020	0.00
1.33	1.33	12984.	0.298	0.024	0.00
1.75	1.75	17084.	0.392	0.027	0.00
2.17	2.17	21184.	0.486	0.031	0.00
2.58	2.58	25186.	0.578	0.033	0.00
3.00	3.00	29287.	0.672	0.036	0.00
3.42	3.42	33387.	0.766	0.038	0.00
3.84	3.84	37487.	0.861	0.041	0.00
4.26	4.26	41587.	0.955	0.043	0.00
4.68	4.68	45687.	1.049	0.045	0.00
5.10	5.10	49787.	1.143	0.047	0.00
5.51	5.51	53790.	1.235	0.049	0.00
5.93	5.93	57890.	1.329	0.051	0.00
6.35	6.35	61990.	1.423	0.052	0.00
6.77	6.77	66090.	1.517	0.054	0.00
7.19	7.19	70190.	1.611	0.056	0.00
7.61	7.61	74290.	1.705	0.057	0.00
8.03	8.03	78390.	1.800	0.059	0.00
8.45	8.45	82491.	1.894	0.060	0.00
8.86	8.86	86493.	1.986	0.062	0.00
9.28	9.28	90593.	2.080	0.063	0.00

NEPL EXISTING VAULT

9.70	9.70	94693.	2.174	0.065	0.00
10.12	10.12	98793.	2.268	0.066	0.00
10.54	10.54	102894.	2.362	0.067	0.00
10.96	10.96	106994.	2.456	0.069	0.00
11.38	11.38	111094.	2.550	0.070	0.00
11.79	11.79	115096.	2.642	0.071	0.00
12.21	12.21	119196.	2.736	0.073	0.00
12.63	12.63	123297.	2.831	0.074	0.00
13.05	13.05	127397.	2.925	0.075	0.00
13.47	13.47	131497.	3.019	0.076	0.00
13.50	13.50	131790.	3.025	0.076	0.00
13.51	13.51	131887.	3.028	0.077	0.00
13.53	13.53	132083.	3.032	0.078	0.00
13.54	13.54	132180.	3.034	0.079	0.00
13.55	13.55	132278.	3.037	0.082	0.00
13.57	13.57	132473.	3.041	0.085	0.00
13.58	13.58	132571.	3.043	0.088	0.00
13.59	13.59	132668.	3.046	0.089	0.00
13.60	13.60	132766.	3.048	0.090	0.00
13.62	13.62	132961.	3.052	0.091	0.00
14.04	14.04	137061.	3.146	0.109	0.00
14.45	14.45	141064.	3.238	0.120	0.00
14.87	14.87	145164.	3.333	0.130	0.00
15.00	15.00	146433.	3.362	0.132	0.00
15.01	15.01	146531.	3.364	0.133	0.00
15.02	15.02	146628.	3.366	0.134	0.00
15.04	15.04	146823.	3.371	0.135	0.00
15.05	15.05	146921.	3.373	0.137	0.00
15.06	15.06	147019.	3.375	0.140	0.00
15.07	15.07	147116.	3.377	0.143	0.00
15.08	15.08	147214.	3.380	0.144	0.00
15.09	15.09	147312.	3.382	0.145	0.00
15.51	15.51	151412.	3.476	0.166	0.00
15.63	15.63	152583.	3.503	0.171	0.00
15.92	15.92	155414.	3.568	0.218	0.00
16.22	16.22	158343.	3.635	0.295	0.00
16.52	16.52	161272.	3.702	0.391	0.00
16.81	16.81	164103.	3.767	0.502	0.00
17.11	17.11	167031.	3.835	0.628	0.00
17.41	17.41	169960.	3.902	0.766	0.00
17.70	17.70	172791.	3.967	0.915	0.00
18.00	18.00	175720.	4.034	1.080	0.00
18.10	18.10	176696.	4.056	1.620	0.00
18.20	18.20	177672.	4.079	2.600	0.00
18.30	18.30	178648.	4.101	3.880	0.00
18.40	18.40	179624.	4.124	5.400	0.00
18.50	18.50	180601.	4.146	7.110	0.00
18.60	18.60	181577.	4.168	9.010	0.00
18.70	18.70	182553.	4.191	10.780	0.00
18.80	18.80	183529.	4.213	11.450	0.00
18.90	18.90	184506.	4.236	12.080	0.00
19.00	19.00	185482.	4.258	12.680	0.00
19.10	19.10	186458.	4.280	13.250	0.00
19.20	19.20	187434.	4.303	13.790	0.00
19.30	19.30	188410.	4.325	14.310	0.00
19.40	19.40	189387.	4.348	14.810	0.00
19.50	19.50	190363.	4.370	15.290	0.00

19.60	19.60	191339.	4.393	15.760	0.00
19.70	19.70	192315.	4.415	16.210	0.00
19.80	19.80	193292.	4.437	16.650	0.00
19.90	19.90	194268.	4.460	17.080	0.00

Route Time Series through Facility
Inflow Time Series File:nepl_dem.tsf
Outflow Time Series File:neplveo5

Inflow/Outflow Analysis

Peak Inflow Discharge:	2.66	CFS	at	0:00	on Oct 26	in	1986
Peak Outflow Discharge:	0.273	CFS	at	20:00	on Feb 9	in	1951
Peak Reservoir Stage:	16.13	Ft					
Peak Reservoir Elev:	16.13	Ft					
Peak Reservoir Storage:	157493.	Cu-Ft					
:	3.616	Ac-Ft					

NEPL EXISTING VAULT

Flow Frequency Analysis
Time Series File:neplpmem.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -0.750 StdDev= 0.101
Skew= 0.503

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
0.332		100.00	0.990
0.304		50.00	0.980
0.277		25.00	0.960
0.242		10.00	0.900
0.235		8.00	0.875
0.214		5.00	0.800
0.174		2.00	0.500
0.148		1.30	0.231

Flow Frequency Analysis
Time Series File:neplveo5.tsf
Project Location:Sea-Tac Miller

LogPearson III Coefficients
Mean= -1.154 StdDev= 0.169
Skew= 2.114

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.291	16.20		100.00	0.990
0.220	15.93		50.00	0.980
0.167	15.53		25.00	0.960
0.116	14.30		10.00	0.900
0.108	14.02		8.00	0.875
0.088	13.58		5.00	0.800
0.062	8.86		2.00	0.500
0.053	6.59		1.30	0.231

Duration Comparison Anaylsis
Base File: neplpmem.tsf
New File: neplveo5.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.088	0.24E-02	0.11E-02	-53.2	0.24E-02	0.088	0.074	-15.5
0.094	0.19E-02	0.10E-02	-45.7	0.19E-02	0.094	0.075	-20.1
0.100	0.16E-02	0.92E-03	-41.0	0.16E-02	0.100	0.076	-24.3
0.106	0.13E-02	0.77E-03	-39.1	0.13E-02	0.106	0.076	-28.1
0.112	0.99E-03	0.62E-03	-37.6	0.99E-03	0.112	0.097	-13.5
0.118	0.81E-03	0.48E-03	-40.7	0.81E-03	0.118	0.105	-11.3
0.124	0.66E-03	0.39E-03	-41.2	0.66E-03	0.124	0.110	-11.0
0.130	0.54E-03	0.30E-03	-43.9	0.54E-03	0.130	0.115	-11.4
0.136	0.45E-03	0.25E-03	-45.2	0.45E-03	0.136	0.120	-12.0
0.142	0.38E-03	0.24E-03	-37.3	0.38E-03	0.142	0.125	-12.2
0.148	0.31E-03	0.21E-03	-32.8	0.31E-03	0.148	0.129	-12.7
0.154	0.27E-03	0.17E-03	-35.9	0.27E-03	0.154	0.132	-14.4
0.160	0.21E-03	0.13E-03	-37.6	0.21E-03	0.160	0.147	-7.7
0.166	0.18E-03	0.87E-04	-51.3	0.18E-03	0.166	0.152	-8.4
0.172	0.14E-03	0.57E-04	-60.3	0.14E-03	0.172	0.159	-7.6
0.178	0.12E-03	0.53E-04	-57.4	0.12E-03	0.178	0.161	-9.7
0.184	0.11E-03	0.43E-04	-60.4	0.11E-03	0.184	0.163	-11.3
0.190	0.94E-04	0.37E-04	-61.0	0.94E-04	0.190	0.166	-12.8
0.196	0.82E-04	0.30E-04	-63.9	0.82E-04	0.196	0.166	-15.2
0.202	0.64E-04	0.23E-04	-64.3	0.64E-04	0.202	0.170	-15.6
0.208	0.50E-04	0.21E-04	-59.1	0.50E-04	0.208	0.179	-14.0
0.214	0.50E-04	0.18E-04	-63.6	0.50E-04	0.214	0.179	-16.4
0.220	0.43E-04	0.16E-04	-63.2	0.43E-04	0.220	0.185	-15.7
0.226	0.30E-04	0.11E-04	-61.5	0.30E-04	0.226	0.197	-12.8
0.232	0.30E-04	0.91E-05	-69.2	0.30E-04	0.232	0.197	-15.0
0.238	0.23E-04	0.91E-05	-60.0	0.23E-04	0.238	0.204	-14.2
0.244	0.23E-04	0.91E-05	-60.0	0.23E-04	0.244	0.204	-16.3
0.250	0.21E-04	0.68E-05	-66.7	0.21E-04	0.250	0.213	-14.7
0.256	0.16E-04	0.46E-05	-71.4	0.16E-04	0.256	0.220	-13.9
0.262	0.14E-04	0.46E-05	-66.7	0.14E-04	0.262	0.223	-14.9
0.268	0.46E-05	0.23E-05	-50.0	0.46E-05	0.268	0.262	-2.2

There is no positive excursion

Maximum negative excursion = 0.030 cfs (-28.2%)
occuring at 0.106 cfs on the Base Data:neplpmem.tsf
and at 0.076 cfs on the New Data:neplveo5.tsf

MILLER CREEK WATERSHED
ADDITIONAL POINTS OF COMPLIANCE PERFORMANCE DATA

- SR509
- MCDF
- LAKE REBA

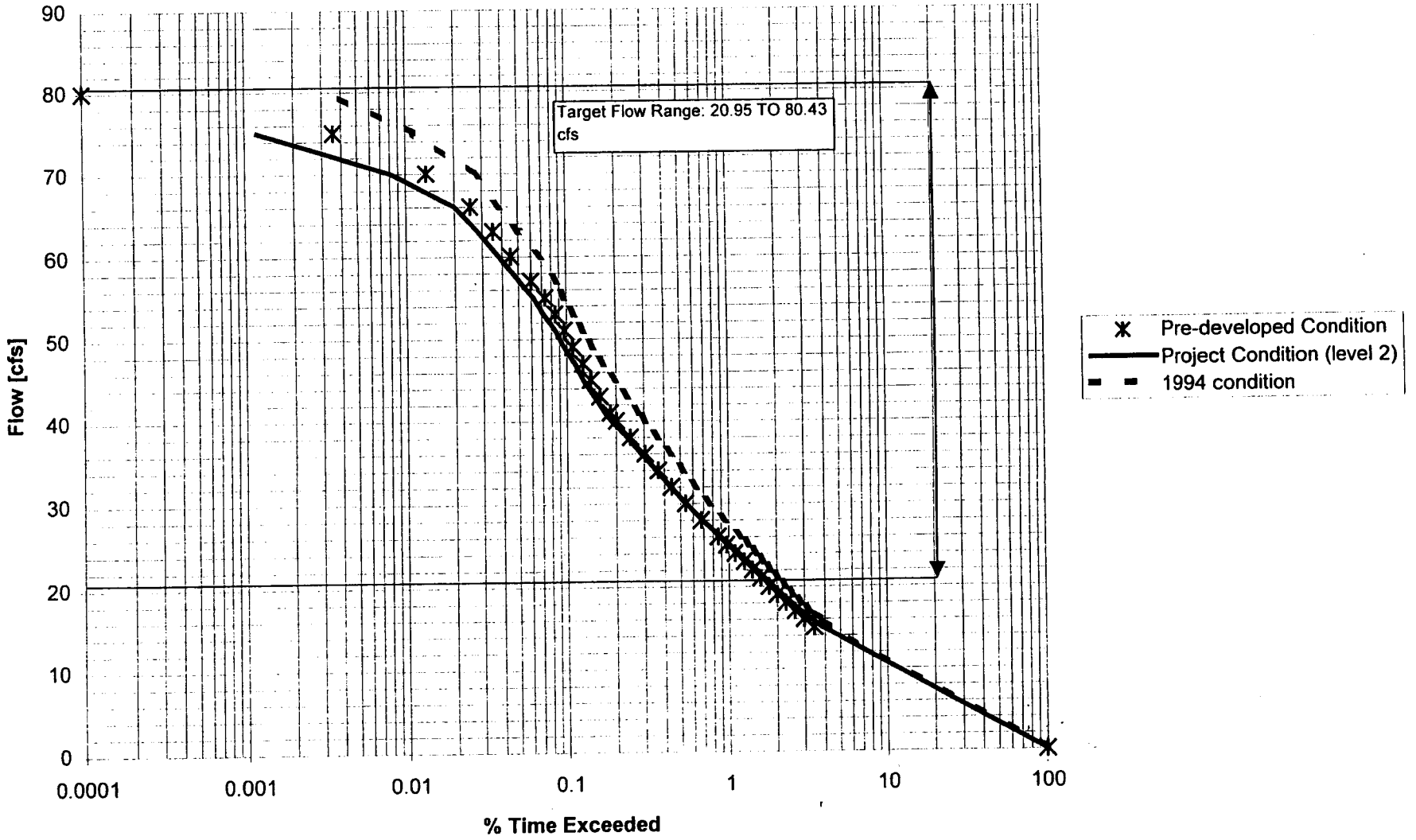
July 2001
556-2912-001 (28)

SR509

July 2001
556-2912-001 (28)

AR 010546

POC at SR-509


Target Flow Range: 20.95 TO 80.43 cfs
Flow [cfs]
90
80
70
60
50
40
30
20
10
0
0.0001
0.001
0.01
0.1
1
10
100
% Time Exceeded
Pre-developed Condition
Project Condition (level 2)
1994 condition

POC at SR-509

Percent cases equal or exceeding limit

Pre-developed Condition	1994 condition	Project Condition (level 2)	Flow [cfs]
100	100	100	0
3.4423676	4.242852789	3.839542502	15
2.9885302	3.735500829	3.30576348	16
2.6154064	3.296002133	2.857931928	17
2.2866516	2.912690703	2.482001029	18
2.0121779	2.592232825	2.167971354	19
1.7936373	2.315105803	1.906319639	20
1.5894931	2.078928823	1.688236863	21
1.4122534	1.863703026	1.496819229	22
1.2527141	1.68633221	1.32206731	23
1.0962428	1.521103556	1.1601718	24
0.9723402	1.363255433	1.01446584	25
0.8602379	1.221120698	0.887568329	26
0.6778061	0.971134983	0.686865512	28
0.5385632	0.781145839	0.54068339	30
0.4420372	0.640201512	0.435689389	32
0.3676956	0.532112451	0.357836695	34
0.3053904	0.447831552	0.28998343	36
0.2473331	0.371169267	0.235700817	38
0.2015482	0.309268042	0.187132164	40
0.1847918	0.283793307	0.170704531	41
0.1590673	0.24046245	0.147372531	43
0.1399509	0.201893225	0.125707102	45
0.1253186	0.169276041	0.112374531	47
0.1092703	0.145467878	0.09618498	49
0.096762	0.127135592	0.084757062	51
0.0847258	0.112612613	0.07142449	53
0.0733975	0.097137306	0.061901225	55
0.0599452	0.087852123	0.050711388	57
0.0448409	0.070234082	0.038093061	60
0.0351647	0.050711388	0.028093633	63
0.0252525	0.039045388	0.019998857	66
0.0134523	0.026665143	0.008094776	70
0.0035401	0.011189837	0.001190408	75
0.0001	0.003333143	0.0001	80
	0.0001		---------

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT 509 (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

44.180	52.125	77.608	33.913	29.400
37.485	62.203	47.176	49.760	47.574
36.058	56.421	40.753	28.514	36.591
36.706	41.207	34.471	57.129	38.162
45.789	38.067	35.458	67.999	39.773
32.529	54.180	37.452	22.686	42.049
30.898	52.741	37.336	34.680	41.163
37.740	34.472	65.153	63.178	33.179
21.815	74.051	71.853	38.392	36.374
18.933	42.387	74.740		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.622
Variance (logs)	0.019
Standard Deviation (logs)	0.138
Skewness (logs)	-0.009
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.020
Coefficient of Variation (logs)	0.085

1

HOURLY FLOW MILLER AT 509 (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	19.926
0.9500	1.05	24.786
0.9000	1.11	27.840
0.8000	1.25	32.040
0.5000	2.00	41.901
0.2000	5.00	54.763
0.1000	10.00	62.971
0.0400	25.00	73.071
0.0200	50.00	80.433
0.0100	100.00	87.681
0.0050	200.00	94.879

$1/2 Q_2 = 20.95$ cfs

$Q_{50} = 80.43$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT 509 (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

46.916	54.440	76.927	36.618	32.676
39.714	62.522	49.682	52.169	49.926
38.946	59.358	43.790	31.224	38.864
38.882	44.278	37.539	58.927	41.153
48.102	40.378	38.613	68.835	42.900
35.629	56.644	39.841	25.613	44.880
33.757	55.913	40.158	36.831	44.821
39.772	36.824	67.618	65.003	35.901
24.710	73.303	72.233	41.770	38.547
21.565	46.386	74.884		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.649
Variance (logs)	0.016
Standard Deviation (logs)	0.126
Skewness (logs)	-0.037
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.024
Coefficient of Variation (logs)	0.076

1

HOURLY FLOW MILLER AT 509 (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	22.555
0.9500	1.05	27.598
0.9000	1.11	30.711
0.8000	1.25	34.932
0.5000	2.00	44.604
0.2000	5.00	56.812
0.1000	10.00	64.406
0.0400	25.00	73.570
0.0200	50.00	80.140
0.0100	100.00	86.526
0.0050	200.00	92.794

$1/2 Q_2 = 22.30$ cfs
$Q_{50} = 80.14$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT 509 (1994)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1995

Parameter is 1-day high value.

0 zero values in data

47 non-zero values in data

54.801	61.494	85.364	42.164	37.257
45.247	69.435	55.141	57.970	55.634
44.126	67.187	49.205	35.891	44.388
44.856	49.632	43.099	64.138	47.258
53.309	47.286	43.833	77.739	49.213
40.321	61.955	45.982	30.197	50.514
38.934	61.540	46.690	43.377	49.922
46.717	43.710	73.393	71.172	40.966
28.296	81.207	81.065	48.075	44.592
28.161	50.554			

The following 7 statistics are based on non-zero values.

Mean (logs)	1.700
Variance (logs)	0.013
Standard Deviation (logs)	0.113
Skewness (logs)	0.053
Standard Error of Skewness (logs)	0.347
Serial Correlation Coefficient (logs)	0.030
Coefficient of Variation (logs)	0.066

1

HOURLY FLOW MILLER AT 509 (1994)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	27.614
0.9500	1.05	32.768
0.9000	1.11	35.928
0.8000	1.25	40.199
0.5000	2.00	49.957
0.2000	5.00	62.288
0.1000	10.00	69.993
0.0400	25.00	79.342
0.0200	50.00	86.083
0.0100	100.00	92.669
0.0050	200.00	99.168

$1/2 Q_2 = 24.98$ cfs

$Q_{50} = 86.08$ cfs

1

Simulated - HOURLY FLOW MILLER AT 509 (1994)
Observed - HOURLY FLOW MILLER AT 509 (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	403897	0.462	15.5	0.696	21.8	-0.201	-0.5
15.00	2242	1.234	8.0	1.733	11.2	0.798	5.1
16.00	1881	1.267	7.7	1.819	11.0	0.898	5.4
17.00	1579	1.428	8.2	1.971	11.3	1.166	6.7
18.00	1319	1.556	8.4	2.155	11.6	1.336	7.2
19.00	1099	1.680	8.6	2.255	11.6	1.525	7.8
20.00	916	1.766	8.6	2.340	11.4	1.641	8.0
21.00	804	1.956	9.1	2.530	11.8	1.860	8.7
22.00	734	2.147	9.5	2.684	11.9	2.076	9.2
23.00	680	2.334	9.9	2.796	11.9	2.285	9.7
24.00	612	2.428	9.9	2.977	12.2	2.393	9.8
25.00	533	2.561	10.1	3.064	12.0	2.527	9.9
26.00	843	2.820	10.5	3.319	12.3	2.800	10.4
28.00	614	3.326	11.5	3.779	13.0	3.315	11.4
30.00	441	3.765	12.2	4.114	13.3	3.759	12.1
32.00	327	4.161	12.6	4.487	13.6	4.153	12.6
34.00	285	4.473	12.8	4.796	13.7	4.466	12.8
36.00	228	4.848	13.1	5.106	13.8	4.846	13.1
38.00	204	5.127	13.2	5.397	13.8	5.125	13.2
40.00	69	5.834	14.4	6.030	14.9	5.826	14.4
41.00	98	5.802	13.8	6.020	14.3	5.798	13.8
43.00	91	5.748	13.1	6.011	13.7	5.748	13.1
45.00	56	5.739	12.5	5.965	13.0	5.739	12.5
47.00	68	6.029	12.6	6.199	12.9	6.029	12.6
49.00	48	6.326	12.6	6.531	13.0	6.326	12.6
51.00	56	6.628	12.8	6.708	12.9	6.628	12.8
53.00	40	6.551	12.1	6.676	12.4	6.551	12.1
55.00	47	6.128	11.0	6.251	11.2	6.128	11.0
57.00	53	5.986	10.3	6.076	10.4	5.986	10.3
60.00	42	6.542	10.7	6.708	11.0	6.542	10.7
63.00	34	6.213	9.6	6.367	9.8	6.213	9.6
66.00	50	6.131	9.0	6.325	9.3	6.131	9.0
70.00	29	6.718	9.3	6.870	9.5	6.718	9.3
75.00	5	7.858	10.3	7.869	10.3	7.858	10.3
80.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420024	0.531	15.3	0.899	21.5	-0.114	-0.1

Standard error of estimate = 0.89
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW MILLER AT 509 (1994)
Observed - HOURLY FLOW MILLER AT 509 (2006)

AR 010552

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit: Simulated	Observed	Average of cases within class limits: Simulated	Observed
0.00**********	95.76	96.16	100.00	100.00	3.01	3.27		

15.00	2131	2242	0.51	0.53	4.24	3.84	15.49	15.49
16.00	1846	1881	0.44	0.45	3.74	3.31	16.48	16.49
17.00	1610	1579	0.38	0.38	3.30	2.86	17.50	17.48
18.00	1346	1319	0.32	0.31	2.91	2.48	18.50	18.50
19.00	1164	1099	0.28	0.26	2.59	2.17	19.51	19.48
20.00	992	916	0.24	0.22	2.32	1.91	20.49	20.49
21.00	904	804	0.22	0.19	2.08	1.69	21.48	21.47
22.00	745	734	0.18	0.17	1.86	1.50	22.48	22.49
23.00	694	680	0.17	0.16	1.69	1.32	23.49	23.51
24.00	663	612	0.16	0.15	1.52	1.16	24.52	24.48
25.00	597	533	0.14	0.13	1.36	1.01	25.49	25.48
26.00	1050	843	0.25	0.20	1.22	0.89	26.94	26.96
28.00	798	614	0.19	0.15	0.97	0.69	28.94	28.94
30.00	592	441	0.14	0.10	0.78	0.54	30.95	30.96
32.00	454	327	0.11	0.08	0.64	0.44	32.97	32.99
34.00	354	285	0.08	0.07	0.53	0.36	34.93	34.99
36.00	322	228	0.08	0.05	0.45	0.29	36.96	36.97
38.00	260	204	0.06	0.05	0.37	0.24	38.95	38.96
40.00	107	69	0.03	0.02	0.31	0.19	40.51	40.49
41.00	182	98	0.04	0.02	0.28	0.17	41.97	41.99
43.00	162	91	0.04	0.02	0.24	0.15	43.89	43.99
45.00	137	56	0.03	0.01	0.20	0.13	45.96	46.05
47.00	100	68	0.02	0.02	0.17	0.11	47.92	47.94
49.00	77	48	0.02	0.01	0.15	0.10	49.87	50.04
51.00	61	56	0.01	0.01	0.13	0.08	52.02	51.94
53.00	65	40	0.02	0.01	0.11	0.07	54.00	54.02
55.00	39	47	0.01	0.01	0.10	0.06	56.06	55.97
57.00	74	53	0.02	0.01	0.09	0.05	58.54	58.16
60.00	82	42	0.02	0.01	0.07	0.04	61.45	61.36
63.00	49	34	0.01	0.01	0.05	0.03	64.23	64.67
66.00	52	50	0.01	0.01	0.04	0.02	67.92	67.86
70.00	65	29	0.02	0.01	0.03	0.01	72.40	72.07
75.00	33	5	0.01	0.00	0.01	0.00	77.11	76.41
80.00	14	0	0.00	0.00	0.00	0.00	82.60	0.00
	420024	420024	100.00	100.00			3.91	4.02

1

Simulated - HOURLY FLOW MILLER AT 509 (1994)
Observed - HOURLY FLOW MILLER AT 509 (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	2	11041	135049	69525	59577	118455	10248	0
15.00	0	0	8	849	768	563	54	0
16.00	0	0	1	678	705	459	38	0
17.00	0	0	0	433	650	465	31	0
18.00	0	0	0	337	537	421	24	0
19.00	0	0	0	206	492	381	20	0
20.00	0	0	0	143	434	330	9	0
21.00	0	0	0	96	384	309	15	0
22.00	0	0	0	67	355	301	11	0
23.00	0	0	0	47	314	316	3	0
24.00	0	0	0	34	319	250	9	0
25.00	0	0	0	21	269	239	4	0
26.00	0	0	0	26	407	405	5	0
28.00	0	0	0	13	273	323	5	0
30.00	0	0	0	7	159	274	1	0
32.00	0	0	0	6	93	228	0	0
34.00	0	0	0	3	83	198	1	0
36.00	0	0	0	1	45	182	0	0
38.00	0	0	0	1	38	165	0	0
40.00	0	0	0	1	5	63	0	0
41.00	0	0	0	1	10	87	0	0
43.00	0	0	0	0	17	74	0	0
45.00	0	0	0	0	17	39	0	0
47.00	0	0	0	0	9	59	0	0
49.00	0	0	0	0	5	43	0	0

51.00	0	0	0	0	5	51	0	0
53.00	0	0	0	0	9	31	0	0
55.00	0	0	0	0	18	29	0	0
57.00	0	0	0	0	25	28	0	0
60.00	0	0	0	0	17	25	0	0
63.00	0	0	0	0	21	13	0	0
66.00	0	0	0	0	34	16	0	0
70.00	0	0	0	0	20	9	0	0
75.00	0	0	0	0	3	2	0	0
80.00	0	0	0	0	0	0	0	0
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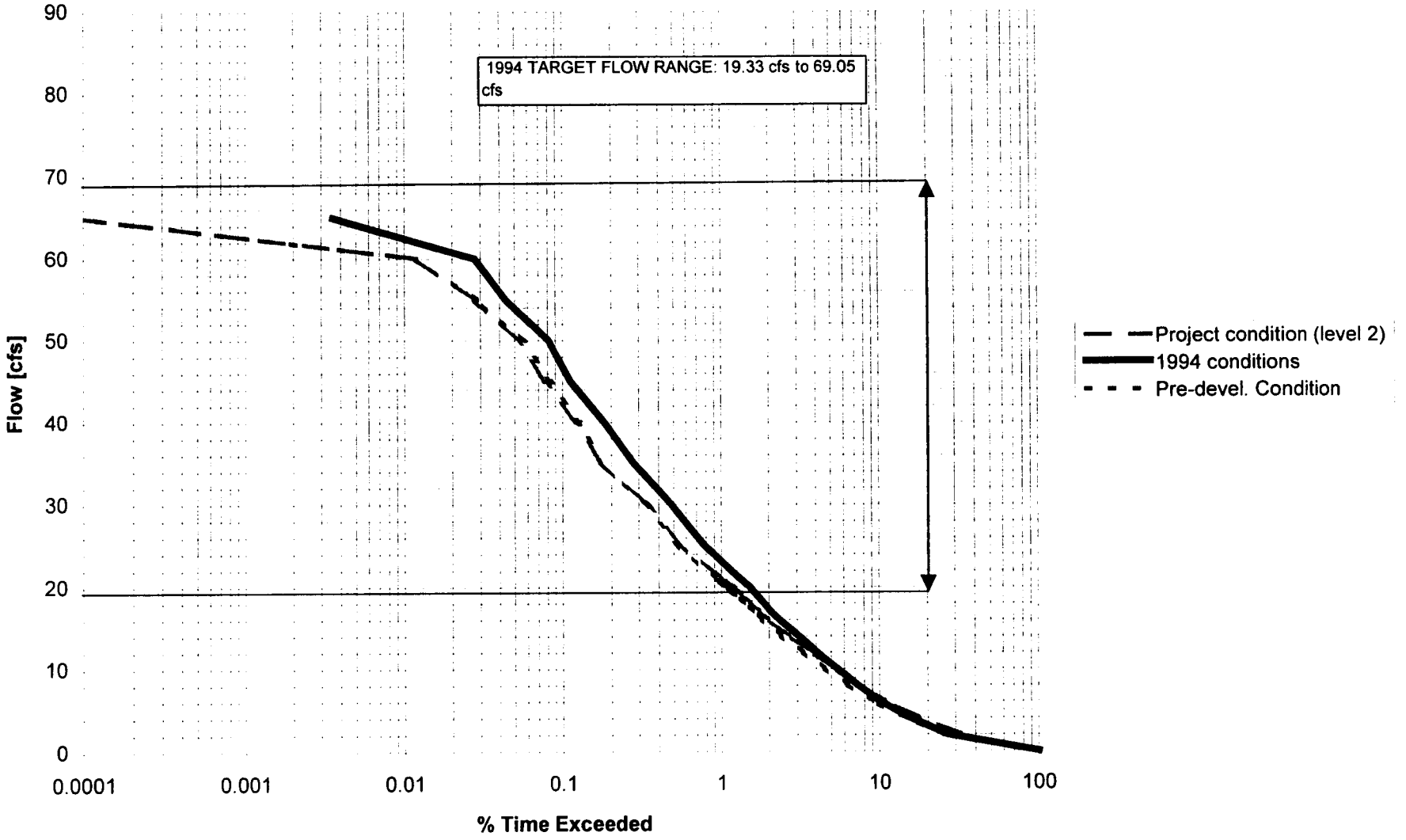
	2	11041	135058	72495	66117	124833	10478	0

MCDF

July 2001
556-2912-001 (28)

AR 010555

MILLER at RDF



AR 010556

July 2001
556-2912-001 (28)

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT RDF (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

43.116	46.711	63.732	32.046	28.874
32.819	54.419	43.174	47.522	43.266
32.574	51.316	35.365	26.806	33.069
32.820	37.983	31.966	51.384	35.331
42.247	35.981	33.393	55.995	36.756
30.604	50.650	34.627	24.925	40.871
29.994	48.681	37.224	31.841	39.505
34.350	33.662	58.946	57.141	31.290
23.326	63.281	61.402	37.970	33.235
21.460	40.271	61.260		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.590
Variance (logs)	0.014
Standard Deviation (logs)	0.117
Skewness (logs)	0.136
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.027
Coefficient of Variation (logs)	0.074

1

HOURLY FLOW MILLER AT RDF (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	21.324
0.9500	1.05	25.214
0.9000	1.11	27.632
0.8000	1.25	30.938
0.5000	2.00	38.655
0.2000	5.00	48.717
0.1000	10.00	55.173
0.0400	25.00	63.172
0.0200	50.00	69.048
0.0100	100.00	74.873
0.0050	200.00	80.701

$1/2Q_2 = 19.33$ cfs

$Q_{50} = 69.05$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT RDF (1994)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1995

Parameter is 1-day high value.

0 zero values in data

47 non-zero values in data

49.757	51.247	67.842	37.069	33.772
37.766	59.155	47.407	51.650	48.393
37.469	56.961	40.060	30.907	38.065
37.992	42.525	37.008	54.778	40.604
46.746	40.925	38.311	60.489	41.572
35.238	54.302	40.110	29.628	45.454
34.342	53.010	41.905	37.003	43.391
39.916	40.159	62.443	61.229	36.029
27.581	66.576	64.769	42.330	38.533
28.238	44.172			

The following 7 statistics are based on non-zero values.

Mean (logs)	1.638
Variance (logs)	0.010
Standard Deviation (logs)	0.099
Skewness (logs)	0.205
Standard Error of Skewness (logs)	0.347
Serial Correlation Coefficient (logs)	0.026
Coefficient of Variation (logs)	0.060

1

HOURLY FLOW MILLER AT RDF (1994)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	26.468
0.9500	1.05	30.276
0.9000	1.11	32.617
0.8000	1.25	35.790
0.5000	2.00	43.102
0.2000	5.00	52.484
0.1000	10.00	58.435
0.0400	25.00	65.753
0.0200	50.00	71.096
0.0100	100.00	76.369
0.0050	200.00	81.626

$1/2Q_2 = 21.55$ cfs

$Q_{50} = 71.10$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW MILLER AT RDF (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

43.301	46.788	64.300	32.369	28.979
33.494	54.636	43.635	47.694	43.849
33.375	51.992	36.322	27.375	33.944
33.095	38.706	32.682	51.524	35.935
42.511	36.336	34.248	56.856	37.251
31.153	50.838	35.073	25.391	40.843
30.117	49.339	37.264	32.189	40.030
34.573	33.610	59.659	57.817	31.672
23.985	63.558	61.798	38.328	33.833
21.644	40.865	61.698		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.595
Variance (logs)	0.013
Standard Deviation (logs)	0.116
Skewness (logs)	0.139
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.028
Coefficient of Variation (logs)	0.073

1

HOURLY FLOW MILLER AT RDF (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	21.729
0.9500	1.05	25.638
0.9000	1.11	28.065
0.8000	1.25	31.380
0.5000	2.00	39.109
0.2000	5.00	49.168
0.1000	10.00	55.613
0.0400	25.00	63.592
0.0200	50.00	69.448
0.0100	100.00	75.251
0.0050	200.00	81.053

$Q_2 = 19.55$ cfs

$Q_{50} = 69.45$ cfs

Miller Creek at RDF (New POC)

Percent cases equal or exceeding limit

Pre-devel. Condition	Project condition (level 2)	1994 conditions	Flow [cfs]
100	100	100	0
25.42363	32.42267	26.38992	2
14.13292	17.51519	15.32222	4
8.92901	10.80034	10.04657	6
6.297555	7.264585	7.216969	8
4.544747	5.21375	5.431594	10
3.262768	3.721454	4.061197	12
2.393326	2.674847	3.076253	14
1.800953	1.983934	2.340104	16
1.569905	1.727996	2.064644	17
1.379449	1.522056	1.85418	18
1.216841	1.347066	1.666571	19
1.184509	1.316115	1.635859	19.2
1.156424	1.281593	1.599194	19.4
1.134004	1.250405	1.569434	19.6
1.108987	1.218264	1.537769	19.8
1.083499	1.189694	1.510152	20
1.043614	1.145411	1.471344	20.2
1.006561	1.101128	1.428014	20.4
0.973284	1.066606	1.388254	20.6
0.912867	0.998276	1.315639	21
0.534315	0.564492	0.786146	25
0.325451	0.337124	0.480687	30
0.17488	0.173323	0.278794	35
0.128387	0.122136	0.180942	40
0.083546	0.077138	0.112375	45
0.056405	0.052378	0.081186	50
0.028557	0.027379	0.043569	55
0.0118	0.011904	0.027617	60
0.0001	0.0001	0.003571	65
0	0	0.0001	70
0	0	0	75
0	0	0	80
0	0	0	85
0	0	0	90

1

Simulated - HOURLY FLOW MILLER AT RDF (1994)
Observed - HOURLY FLOW MILLER AT RDF (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	283841	0.156	*	0.270	*	-0.126	*
2.00	62615	0.697	25.0	0.777	27.8	-0.576	-20.9
4.00	28204	0.796	16.5	0.943	19.5	-0.494	-10.4
6.00	14851	0.840	12.3	1.073	15.7	-0.276	-4.1
8.00	8614	0.870	9.8	1.177	13.2	0.054	0.5
10.00	6268	0.963	8.8	1.333	12.2	0.389	3.5
12.00	4396	1.125	8.7	1.564	12.1	0.714	5.5
14.00	2902	1.336	9.0	1.828	12.3	1.020	6.8
16.00	1075	1.572	9.5	2.080	12.6	1.327	8.0
17.00	865	1.653	9.5	2.078	11.9	1.451	8.3
18.00	735	1.822	9.9	2.163	11.7	1.666	9.0
19.00	130	1.922	10.1	2.257	11.8	1.789	9.4
19.20	145	1.865	9.7	2.201	11.4	1.695	8.8
19.40	131	1.798	9.2	2.199	11.3	1.591	8.2
19.60	135	1.838	9.3	2.213	11.2	1.729	8.8
19.80	120	1.838	9.2	2.135	10.7	1.614	8.1
20.00	186	1.928	9.6	2.267	11.3	1.832	9.1
20.20	186	1.962	9.7	2.352	11.6	1.884	9.3
20.40	145	2.081	10.2	2.516	12.3	1.984	9.7
20.60	287	2.085	10.0	2.518	12.1	1.998	9.6
21.00	1822	2.407	10.6	2.947	12.9	2.337	10.3
25.00	955	3.195	11.8	3.473	12.9	3.150	11.7
30.00	688	3.970	12.3	4.275	13.2	3.942	12.2
35.00	215	4.346	11.8	4.482	12.2	4.333	11.7
40.00	189	4.561	10.8	4.738	11.1	4.561	10.8
45.00	104	4.543	9.6	4.622	9.8	4.543	9.6
50.00	105	4.115	7.9	4.223	8.1	4.115	7.9
55.00	65	3.759	6.6	3.831	6.7	3.759	6.6
60.00	50	2.951	4.8	2.971	4.8	2.951	4.8
65.00	0	0.000	0.0	0.000	0.0	0.000	0.0
70.00	0	0.000	0.0	0.000	0.0	0.000	0.0
75.00	0	0.000	0.0	0.000	0.0	0.000	0.0
80.00	0	0.000	0.0	0.000	0.0	0.000	0.0
85.00	0	0.000	0.0	0.000	0.0	0.000	0.0
90.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420024	0.394	*	0.720	*	-0.146	*

Standard error of estimate = 0.71
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW MILLER AT RDF (1994)
Observed - HOURLY FLOW MILLER AT RDF (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit: Simulated	Observed	Average of cases within class limits: Simulated	Observed
0.00**********	73.61	67.58	100.00	100.00	0.59	0.63		

2.004648762615	11.07	14.91	26.39	32.42	2.85	2.85
4.002215928204	5.28	6.71	15.32	17.52	4.91	4.90
6.001188514851	2.83	3.54	10.05	10.80	6.91	6.89
8.00 7499 8614	1.79	2.05	7.22	7.26	8.94	8.93
10.00 5756 6268	1.37	1.49	5.43	5.21	10.95	10.93
12.00 4137 4396	0.98	1.05	4.06	3.72	12.95	12.93
14.00 3092 2902	0.74	0.69	3.08	2.67	14.95	14.94
16.00 1157 1075	0.28	0.26	2.34	1.98	16.48	16.48
17.00 884 865	0.21	0.21	2.06	1.73	17.48	17.48
18.00 788 735	0.19	0.17	1.85	1.52	18.49	18.47
19.00 129 130	0.03	0.03	1.67	1.35	19.10	19.10
19.20 154 145	0.04	0.03	1.64	1.32	19.30	19.30
19.40 125 131	0.03	0.03	1.60	1.28	19.50	19.50
19.60 133 135	0.03	0.03	1.57	1.25	19.69	19.70
19.80 116 120	0.03	0.03	1.54	1.22	19.91	19.90
20.00 163 186	0.04	0.04	1.51	1.19	20.10	20.09
20.20 182 186	0.04	0.04	1.47	1.15	20.30	20.30
20.40 167 145	0.04	0.03	1.43	1.10	20.50	20.50
20.60 305 287	0.07	0.07	1.39	1.07	20.80	20.79
21.00 2224 1822	0.53	0.43	1.32	1.00	22.74	22.73
25.00 1283 955	0.31	0.23	0.79	0.56	27.16	27.06
30.00 848 688	0.20	0.16	0.48	0.34	32.08	32.10
35.00 411 215	0.10	0.05	0.28	0.17	37.18	37.13
40.00 288 189	0.07	0.04	0.18	0.12	41.82	42.27
45.00 131 104	0.03	0.02	0.11	0.08	47.29	47.42
50.00 158 105	0.04	0.02	0.08	0.05	52.31	52.07
55.00 67 65	0.02	0.02	0.04	0.03	57.26	57.57
60.00 101 50	0.02	0.01	0.03	0.01	62.17	61.61
65.00 15 0	0.00	0.00	0.00	0.00	66.51	0.00
70.00 0 0	0.00	0.00	0.00	0.00	0.00	0.00
75.00 0 0	0.00	0.00	0.00	0.00	0.00	0.00
80.00 0 0	0.00	0.00	0.00	0.00	0.00	0.00
85.00 0 0	0.00	0.00	0.00	0.00	0.00	0.00
90.00 0 0	0.00	0.00	0.00	0.00	0.00	0.00
420024420024	100.00	100.00			2.33	2.48

1 Observed values are zero
1 Simulated values are zero
1 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
0 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW MILLER AT RDF (1994)
Observed - HOURLY FLOW MILLER AT RDF (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	16	62867	75981	44578	49599	43107	7693	0
2.00	2	18749	33648	4682	2157	1905	1472	0
4.00	0	782	17578	4868	2317	1776	883	0
6.00	0	0	6477	4304	2091	1413	566	0
8.00	0	0	1546	3601	1821	1346	300	0
10.00	0	0	265	2685	1829	1279	210	0
12.00	0	0	38	1607	1457	1161	133	0
14.00	0	0	6	945	979	889	83	0
16.00	0	0	1	276	370	405	23	0
17.00	0	0	0	178	331	348	8	0
18.00	0	0	1	109	270	350	5	0
19.00	0	0	0	19	46	65	0	0
19.20	0	0	1	20	58	64	2	0
19.40	0	0	0	27	48	54	2	0
19.60	0	0	1	13	61	59	1	0
19.80	0	0	0	21	49	50	0	0
20.00	0	0	0	21	72	93	0	0

20.20	0	0	0	18	82	85	1	0
20.40	0	0	0	16	59	70	0	0
20.60	0	0	0	31	116	140	0	0
21.00	0	0	0	142	794	876	10	0
25.00	0	0	0	28	314	613	0	0
30.00	0	0	0	12	206	469	1	0
35.00	0	0	0	2	59	154	0	0
40.00	0	0	0	0	79	110	0	0
45.00	0	0	0	0	60	44	0	0
50.00	0	0	0	0	88	17	0	0
55.00	0	0	0	0	64	1	0	0
60.00	0	0	0	0	50	0	0	0
65.00	0	0	0	0	0	0	0	0
70.00	0	0	0	0	0	0	0	0
75.00	0	0	0	0	0	0	0	0
80.00	0	0	0	0	0	0	0	0
85.00	0	0	0	0	0	0	0	0
90.00	0	0	0	0	0	0	0	0
	18	82398	135543	68203	65526	56943	11393	0

154th STREET RELOCATION INFORMATION

Table 1. Miller Creek effective impervious area (EIA) below the MCDF.

Basin	Basin Area (acres)	Pre-development EIA (acres)[a] With 154th	Pre-development EIA (acres)[a] Without 154th	Post-development EIA (acres)	Difference (acres)	Total Impervious Area (acres)
MC4	36.31	2.04	2.04	3.31	1.27	4.89
MC5	54.74	2.50	2.50	0.02	-2.48	8.20
MC6	15.35	0.80	0.80	0.26	-0.54	2.6[b]
MC7	46.29	3.05	3.05	0.03	-3.02	7.8[b]
Subtotal		8.39		3.62	-4.77	
SDN3A0	10.52	1.47	1.47	2.35	0.88	
SDN3A1	19.92	0.40	0.40	5.87	5.47	
SDW1A0	15.36	0.52	0.52	1.64	1.12	

[a] EIA was determined based on applying an effective impervious fraction to each designated land use cover.

[b] Prorated impervious area; actual for MC6 and MC7 (1994) are 4.4 and 9.2 acres, respectively.

Table 2. Miller Creek effective impervious area (EIA) above the MCDF.

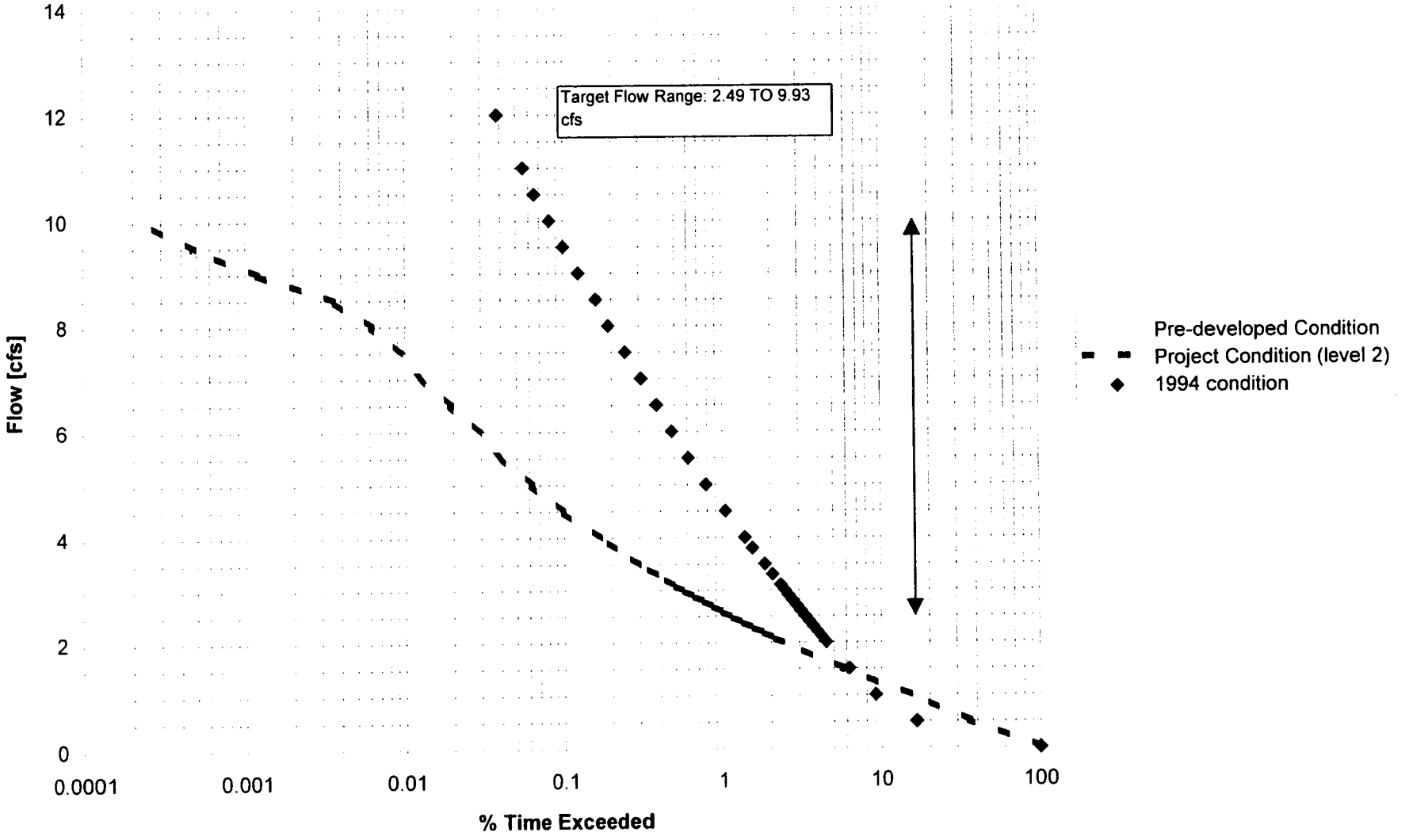
Basin	Basin Area (acres)	Pre-development EIA (acres)[a] With 154th	Pre-development EIA (acres)[a] Without 154th	Post-development EIA (acres)	Difference (acres)
SDN1-lwr	5.42	0.38	0.38	0.56	0.18
SDN2Xn	4.26	0	0	0	0
SDN3X	25.38	0	0	0	0
SDN4	30.32	2.63	2.63	12.26	9.63
SDN4X	15.18	1.05	1.05	4.21	3.16
MC1n	11.97	0.11	0.11	2.34	2.23
MC2	33.31	0.27	0.27	2.54	2.27
MC3	12.94	0.11	0.11	1.42	1.31
Subtotal					5.81

[a] EIA was determined based on applying an effective impervious fraction to each designated land use cover.

LAKE REBA

July 2001
556-2912-001 (28)

AR 010565



AR 010566

July 2001
556-2912-001 (28)

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW Lake Reba Flow (Predev)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

5.844	7.060	8.621	4.007	4.013
4.579	6.443	5.481	6.086	4.522
4.125	5.719	4.324	3.619	3.725
4.840	4.410	4.148	6.448	5.125
4.951	4.752	4.337	8.948	4.389
3.996	5.708	4.128	3.584	5.854
3.802	5.526	5.210	4.627	4.325
3.872	4.840	6.579	6.463	3.739
3.222	9.859	8.730	5.116	3.186
3.276	4.291	9.202		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.698
Variance (logs)	0.015
Standard Deviation (logs)	0.124
Skewness (logs)	0.725
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.132
Coefficient of Variation (logs)	0.177

1

HOURLY FLOW Lake Reba Flow (Predev)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	2.995
0.9500	1.05	3.331
0.9000	1.11	3.563
0.8000	1.25	3.905
0.5000	2.00	4.818
0.2000	5.00	6.240
0.1000	10.00	7.291
0.0400	25.00	8.749
0.0200	50.00	9.932
0.0100	100.00	11.202
0.0050	200.00	12.571

$Q_2 = 2.41$ cfs

$Q_{50} = 9.93$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW Lake REba Flow (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

5.913	7.046	8.705	4.233	3.928
4.739	6.580	6.172	6.112	5.004
4.316	5.764	4.883	3.625	4.277
4.766	5.079	4.587	6.621	4.898
5.202	4.843	4.361	8.699	4.737
4.352	5.903	4.441	3.817	5.543
3.701	5.801	5.154	4.527	4.404
3.912	4.684	6.845	6.966	3.834
3.483	10.112	8.677	5.186	3.628
3.272	4.786	9.152		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.713
Variance (logs)	0.014
Standard Deviation (logs)	0.118
Skewness (logs)	0.701
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.150
Coefficient of Variation (logs)	0.165

1

HOURLY FLOW Lake REba Flow (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	3.162
0.9500	1.05	3.508
0.9000	1.11	3.743
0.8000	1.25	4.090
0.5000	2.00	5.000
0.2000	5.00	6.392
0.1000	10.00	7.405
0.0400	25.00	8.794
0.0200	50.00	9.908
0.0100	100.00	11.095
0.0050	200.00	12.363

$Q_2 = 2.50$ cfs

$Q_{50} = 9.91$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

HOURLY FLOW Lake Reba Flow (1994)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1995

Parameter is 1-day high value.

0 zero values in data

47 non-zero values in data

14.678	16.281	17.079	9.580	10.131
11.285	14.654	12.905	14.769	11.003
10.462	14.187	10.873	8.945	9.376
12.357	10.254	10.854	15.255	14.010
11.728	11.929	10.599	18.265	10.883
9.619	14.343	10.323	10.055	15.459
10.473	13.376	13.805	11.996	10.913
9.758	11.852	16.450	15.819	9.199
8.044	22.012	19.601	12.568	7.905
8.082	10.544			

The following 7 statistics are based on non-zero values.

Mean (logs)	1.082
Variance (logs)	0.011
Standard Deviation (logs)	0.104
Skewness (logs)	0.397
Standard Error of Skewness (logs)	0.347
Serial Correlation Coefficient (logs)	0.172
Coefficient of Variation (logs)	0.096

1

HOURLY FLOW Lake Reba Flow (1994)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	7.440
0.9500	1.05	8.398
0.9000	1.11	9.006
0.8000	1.25	9.853
0.5000	2.00	11.896
0.2000	5.00	14.687
0.1000	10.00	16.550
0.0400	25.00	18.931
0.0200	50.00	20.732
0.0100	100.00	22.558
0.0050	200.00	24.425

$Q_2 = 5.948$ cfs

$Q_{50} = 20.73$ cfs

POC at Lake Reba

Percent cases equal or exceeding limit

Pre-developed Condition	1994 condition	Project Condition (level 2)	Flow [cfs]
100	100	100	0
10.39011611	16.4831057	35.764147	0.5
4.19569527	9.16519056	14.934623	1
2.026810158	6.22750129	5.6908653	1.5
1.025441329	4.47022075	2.3317715	2
0.895638629	4.19761728	1.9925052	2.1
0.779996224	3.93691789	1.7220445	2.2
0.691730388	3.6995505	1.472773	2.3
0.614792788	3.48027732	1.2651658	2.4
0.551307467	3.28028875	1.0916043	2.5
0.489710186	3.08172866	0.9535169	2.6
0.43944114	2.90531017	0.8325715	2.7
0.393420183	2.74198617	0.7247205	2.8
0.350703295	2.58889968	0.627107	2.9
0.315066553	2.45033617	0.5447308	3
0.284385915	2.30796335	0.4752109	3.1
0.228216747	2.05083519	0.3721216	3.3
0.18219579	1.83632364	0.2926023	3.5
0.136410837	1.53967392	0.2061787	3.8
0.113754366	1.37777841	0.1659429	4
0.07646559	1.04470221	0.0980896	4.5
0.0528651	0.78590747	0.0619012	5
0.035164731	0.60806049	0.0411881	5.5
0.022892476	0.47640135	0.029046	6
0.016284339	0.3823591	0.0192846	6.5
0.011092231	0.30902996	0.0130945	7
0.007788162	0.24593833	0.0092852	7.5
0.004484093	0.19094147	0.0061901	8
0.002360049	0.15951469	0.0035712	8.5
0.001180025	0.12451669	0.0011904	9
0.00047201	0.09999429	0.0004762	9.5
0.0001	0.08142392	0.0002381	10
0	0.06523437	0.0001	10.5
0	0.05547302	0	11
0	0.03833114	0	12

1

Simulated - HOURLY FLOW Lake Reba Flow (1994)
Observed - HOURLY FLOW Lake REba Flow (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	269806	0.085	*	0.135	*	-0.067	*
0.50	87489	0.440	61.4	0.478	65.7	-0.346	-49.0
1.00	38826	0.623	51.7	0.714	58.8	-0.283	-24.4
1.50	14109	0.816	47.9	1.027	59.7	0.217	11.8
2.00	1425	1.109	54.1	1.416	69.1	0.840	41.0
2.10	1136	1.154	53.7	1.453	67.7	0.899	41.8
2.20	1047	1.329	59.1	1.642	72.9	1.152	51.2
2.30	872	1.380	58.8	1.702	72.5	1.221	52.0
2.40	729	1.514	61.8	1.840	75.0	1.399	57.1
2.50	580	1.699	66.7	1.996	78.3	1.596	62.6
2.60	508	1.871	70.7	2.203	83.2	1.763	66.6
2.70	453	2.004	72.9	2.338	85.0	1.901	69.1
2.80	410	2.120	74.4	2.403	84.3	2.024	71.0
2.90	346	2.364	80.2	2.652	90.0	2.278	77.2
3.00	292	2.454	80.4	2.767	90.7	2.369	77.6
3.10	433	2.755	86.3	3.085	96.5	2.677	83.8
3.30	334	3.054	89.9	3.357	98.8	2.977	87.7
3.50	363	3.436	94.4	3.742	102.8	3.372	92.7
3.80	169	3.722	95.6	4.016	103.1	3.640	93.5
4.00	285	4.076	96.0	4.442	104.4	3.946	92.9
4.50	152	4.778	100.9	5.159	108.8	4.678	98.8
5.00	87	5.299	101.2	5.718	109.1	5.253	100.3
5.50	51	6.278	109.3	6.717	117.0	6.278	109.3
6.00	41	6.138	98.4	6.639	106.6	6.138	98.4
6.50	26	6.587	97.4	6.913	102.4	6.587	97.4
7.00	16	7.079	98.3	7.376	102.6	7.079	98.3
7.50	13	7.262	93.6	7.688	98.9	7.262	93.6
8.00	11	7.220	87.2	7.476	90.5	7.220	87.2
8.50	10	8.218	94.8	8.525	98.2	8.218	94.8
9.00	3	9.737	106.1	9.812	106.8	9.737	106.1
9.50	1	11.663	117.9	11.663	117.9	11.663	117.9
10.00	1	11.900	117.7	11.900	117.7	11.900	117.7
10.50	0	0.000	0.0	0.000	0.0	0.000	0.0
11.00	0	0.000	0.0	0.000	0.0	0.000	0.0
12.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420024	0.278	*	0.544	*	-0.091	*

Standard error of estimate = 0.54
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - HOURLY FLOW Lake Reba Flow (1994)
Observed - HOURLY FLOW Lake REba Flow (2006)

Lower class limit	Cases equal or exceeding lower limit & less then upper limit: Cases Sim	Cases Obs	Percent Simulated	Percent Observed	Percent cases equal or exceeding limit: Simulated	Observed	Average of cases within class limits: Simulated	Observed
0.00**********			83.52	64.24	100.00	100.00	0.14	0.18

0.503073787489	7.32	20.83	16.48	35.76	0.70	0.72
1.001233938826	2.94	9.24	9.17	14.93	1.22	1.21
1.50 738114109	1.76	3.36	6.23	5.69	1.73	1.70
2.00 1145 1425	0.27	0.34	4.47	2.33	2.05	2.05
2.10 1095 1136	0.26	0.27	4.20	1.99	2.15	2.15
2.20 997 1047	0.24	0.25	3.94	1.72	2.25	2.25
2.30 921 872	0.22	0.21	3.70	1.47	2.35	2.35
2.40 840 729	0.20	0.17	3.48	1.27	2.45	2.45
2.50 834 580	0.20	0.14	3.28	1.09	2.55	2.55
2.60 741 508	0.18	0.12	3.08	0.95	2.65	2.65
2.70 686 453	0.16	0.11	2.91	0.83	2.75	2.75
2.80 643 410	0.15	0.10	2.74	0.72	2.85	2.85
2.90 582 346	0.14	0.08	2.59	0.63	2.95	2.95
3.00 598 292	0.14	0.07	2.45	0.54	3.05	3.05
3.10 1080 433	0.26	0.10	2.31	0.48	3.20	3.19
3.30 901 334	0.21	0.08	2.05	0.37	3.40	3.40
3.50 1246 363	0.30	0.09	1.84	0.29	3.65	3.64
3.80 680 169	0.16	0.04	1.54	0.21	3.90	3.89
4.00 1399 285	0.33	0.07	1.38	0.17	4.24	4.25
4.50 1087 152	0.26	0.04	1.04	0.10	4.74	4.73
5.00 747 87	0.18	0.02	0.79	0.06	5.24	5.23
5.50 553 51	0.13	0.01	0.61	0.04	5.74	5.75
6.00 395 41	0.09	0.01	0.48	0.03	6.23	6.25
6.50 308 26	0.07	0.01	0.38	0.02	6.73	6.78
7.00 265 16	0.06	0.00	0.31	0.01	7.23	7.22
7.50 231 13	0.05	0.00	0.25	0.01	7.73	7.74
8.00 132 11	0.03	0.00	0.19	0.01	8.22	8.30
8.50 147 10	0.03	0.00	0.16	0.00	8.73	8.65
9.00 103 3	0.02	0.00	0.12	0.00	9.26	9.16
9.50 78 1	0.02	0.00	0.10	0.00	9.72	9.89
10.00 68 1	0.02	0.00	0.08	0.00	10.23	10.11
10.50 41 0	0.01	0.00	0.07	0.00	10.74	0.00
11.00 72 0	0.02	0.00	0.06	0.00	11.55	0.00
12.00 161 0	0.04	0.00	0.04	0.00	14.36	0.00
420024420024	100.00	100.00			0.41	0.50

1 Observed values are zero
0 Simulated values are zero
0 Observed values are zero when simulated are zero
1 Observed values are zero when simulated are not
0 Observed values are not zero when simulated are

1

Simulated - HOURLY FLOW Lake Reba Flow (1994)
Observed - HOURLY FLOW Lake REba Flow (2006)

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	47638	66088	38783	20926	23207	37581	35583	0
0.50	47926	24943	3887	1502	1214	2097	5920	0
1.00	10120	14857	3365	1324	1172	2032	5956	0
1.50	423	4125	1905	736	680	1367	4873	0
2.00	1	131	168	107	77	177	764	0
2.10	0	83	143	58	78	143	631	0
2.20	0	52	107	49	66	111	662	0
2.30	0	39	77	34	45	126	551	0
2.40	0	25	38	38	26	95	507	0
2.50	0	14	21	32	17	57	439	0
2.60	0	13	18	22	17	47	391	0
2.70	0	5	25	8	12	35	368	0
2.80	0	6	19	3	14	17	351	0
2.90	0	3	18	3	6	20	296	0
3.00	0	1	16	2	4	24	245	0
3.10	0	0	25	5	13	13	377	0
3.30	0	0	19	3	3	11	298	0

3.50	0	0	17	2	4	10	330	0
3.80	0	0	10	0	1	8	150	0
4.00	0	0	26	5	1	3	250	0
4.50	0	0	11	2	1	0	138	0
5.00	0	0	1	6	1	1	78	0
5.50	0	0	0	0	3	1	47	0
6.00	0	0	0	0	1	2	38	0
6.50	0	0	0	0	0	2	24	0
7.00	0	0	0	0	0	0	16	0
7.50	0	0	0	0	0	0	13	0
8.00	0	0	0	0	0	0	11	0
8.50	0	0	0	0	0	0	10	0
9.00	0	0	0	0	0	0	3	0
9.50	0	0	0	0	0	0	1	0
10.00	0	0	0	0	0	0	1	0
10.50	0	0	0	0	0	0	0	0
11.00	0	0	0	0	0	0	0	0
12.00	0	0	0	0	0	0	0	0
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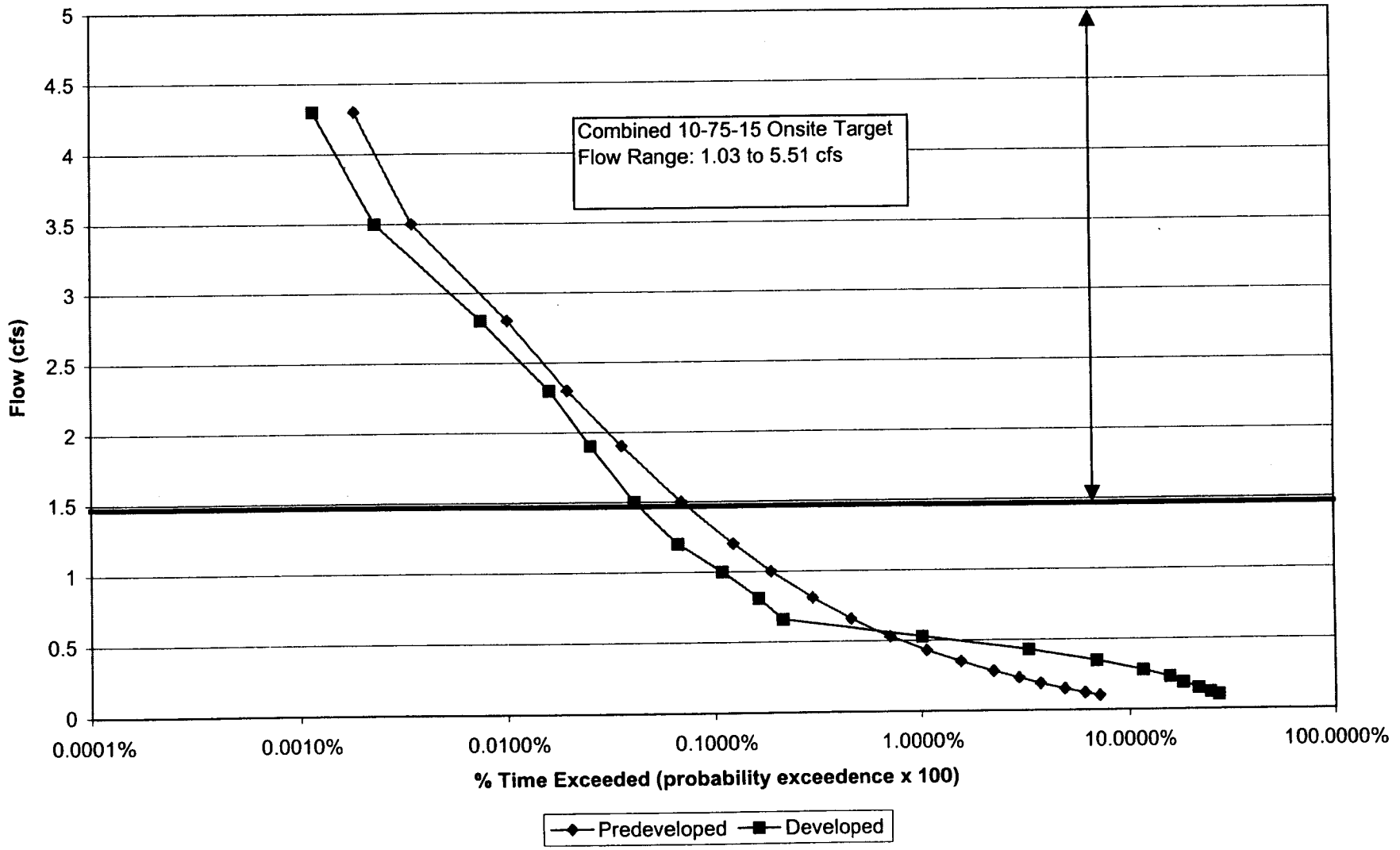
	106108	110385	48699	24867	26663	43980	59322	0

WALKER CREEK WATERSHED
DETENTION POND PERFORMANCE DATA
FOR SDW2 (SOUTH 12TH STREET)
(HSPF AND KCRTS BACKUP)

SDW2



AR 010575

Computation of Basic Statistics. WALKER CREEK DETENTION FACILITIES

SDW-2 Data Set Number	MINIMUM	MAXIMUM	MEAN	STANDARD DEVIATION	Number Of data Values Used	Unused	
109	0.00	4.918	0.088	0.143	420024	0.00	flow
649	0.00	8.586	0.482	0.943	420024	0.00	stage
749	0.00	10.860	0.536	1.085	420024	0.00	volume

Flood Frequency For SDW-2

Pre and Post developed

Return Period

Walker Creek at South 12th Street

Return Period Peak	Pre-Project (cfs)	Project (cfs)
1/2 Q2	1.036	0.3105
Q2	2.072	0.621
Q10	3.827	1.801
Q25	4.778	3.114
Q50	5.512	4.657
Q100	6.264	6.914

Flow(cfs)	Predeveloped	Developed
0.1	7.1349%	27.3060%
0.12	6.0708%	24.7106%
0.15	4.8778%	21.5641%
0.19	3.7210%	18.2207%
0.23	2.9240%	15.7153%
0.28	2.2084%	11.5860%
0.35	1.5441%	6.9259%
0.43	1.0625%	3.2756%
0.53	0.7062%	1.0086%
0.66	0.4518%	0.2125%
0.81	0.2958%	0.1622%
1	0.1868%	0.1085%
1.2	0.1227%	0.0667%
1.5	0.0693%	0.0411%
1.9	0.0359%	0.0253%
2.3	0.0196%	0.0161%
2.8	0.0102%	0.0076%
3.5	0.0035%	0.0024%
4.3	0.0019%	0.0012%

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

0 RCHRES FLOWP.D64 SIMULATED YEARLY PEAKS

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

2.676	5.918	3.397	1.719	1.673
2.005	2.803	2.678	2.227	1.727
1.545	2.497	2.057	1.026	1.945
2.301	1.760	2.002	3.365	1.850
1.987	2.020	1.688	4.390	1.725
2.065	3.017	1.724	0.951	1.470
1.394	2.440	1.708	3.743	1.787
2.174	1.076	3.386	2.728	1.166
0.786	5.677	4.827	1.847	1.292
0.571	1.899	4.405		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.315
Variance (logs)	0.044
Standard Deviation (logs)	0.210
Skewness (logs)	-0.038
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.125
Coefficient of Variation (logs)	0.665

1

0 RCHRES FLOWP.D64 SIMULATED YEARLY PEAKS

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.663
0.9500	1.05	0.929
0.9000	1.11	1.111
0.8000	1.25	1.377

0.5000	2.00	2.072
0.2000	5.00	3.103
0.1000	10.00	3.827
0.0400	25.00	4.778
0.0200	50.00	5.512
0.0100	100.00	6.264
0.0050	200.00	7.040

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

0 RCHRES FLOWPOST.D64 SIMULATED YEARLY PEAKS

Analysis for -- 12 month period
starting October 1
ending September 30
1950-1997

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.495	0.954	4.918	0.433	0.504
0.554	0.586	1.087	0.554	0.583
0.511	1.795	0.558	0.385	0.562
0.554	0.935	0.516	0.574	0.527
0.508	0.554	0.565	2.707	0.745
0.582	0.546	0.556	0.314	0.555
0.403	2.023	0.514	1.403	0.575
0.444	0.405	1.197	1.481	0.464
0.380	2.888	3.001	0.578	0.482
0.378	0.665	4.653		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.137
Variance (logs)	0.086
Standard Deviation (logs)	0.294
Skewness (logs)	1.485
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.020
Coefficient of Variation (logs)	-2.150

1

0 RCHRES FLOWPOST.D64 SIMULATED YEARLY PEAKS

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.310
0.9500	1.05	0.338
0.9000	1.11	0.366
0.8000	1.25	0.417

0.5000	2.00	0.621
0.2000	5.00	1.167
0.1000	10.00	1.801
0.0400	25.00	3.114
0.0200	50.00	4.657
0.0100	100.00	6.914
0.0050	200.00	10.211

1

Flow Comparison: Predeveloped vs. Developed SDW2

MEASURED = Observed - HOURLY F SIMULATED = Simulated- HOURLY FL

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	329596	0.040	*	0.089	*	0.040	*
0.01	4797	0.173	1583.2	0.215	1969.4	0.173	1581.4
0.01	5923	0.177	1321.0	0.219	1636.2	0.176	1317.7
0.01	6311	0.182	1080.3	0.224	1329.7	0.182	1077.2
0.02	5263	0.183	877.4	0.226	1083.0	0.182	873.4
0.02	5515	0.189	745.2	0.231	911.8	0.188	740.4
0.03	6393	0.188	600.5	0.230	737.9	0.186	594.9
0.04	5846	0.190	490.8	0.233	602.7	0.187	484.1
0.04	5980	0.185	388.0	0.228	479.2	0.181	379.0
0.05	6014	0.184	312.0	0.228	386.6	0.178	300.8
0.07	5644	0.182	249.7	0.226	310.0	0.173	237.3
0.08	5515	0.177	197.3	0.220	246.3	0.164	182.5
0.10	4501	0.170	156.1	0.214	196.0	0.151	138.1
0.12	5046	0.166	124.6	0.209	156.9	0.140	105.0
0.15	4893	0.160	95.4	0.205	122.6	0.124	73.9
0.19	3371	0.148	71.1	0.192	92.8	0.098	47.1
0.23	3027	0.136	54.1	0.187	74.3	0.070	27.8
0.28	2810	0.126	40.7	0.185	59.3	0.032	10.4
0.35	2037	0.132	34.0	0.190	49.3	-0.023	-5.6
0.43	1507	0.169	35.5	0.248	52.2	-0.073	-15.2
0.53	1076	0.249	42.1	0.325	54.8	-0.153	-26.0
0.66	660	0.367	50.3	0.425	58.2	-0.256	-35.1
0.81	461	0.525	58.6	0.574	64.0	-0.368	-41.0
1.00	271	0.693	63.3	0.733	66.8	-0.525	-47.9
1.20	226	0.890	66.9	0.932	69.8	-0.668	-50.3
1.50	141	1.144	68.4	1.197	71.4	-0.939	-55.6
1.90	69	1.457	70.7	1.535	74.3	-1.120	-54.4
2.30	40	1.715	68.2	1.810	71.8	-1.493	-59.2
2.80	28	2.090	67.7	2.259	72.9	-1.819	-58.4
3.50	7	3.076	80.3	3.090	80.6	-3.076	-80.3
4.30	6	3.381	70.5	3.477	72.5	-3.381	-70.5
5.30	2	5.250	90.5	5.254	90.5	-5.250	-90.5
6.60	0	0.000	0.0	0.000	0.0	0.000	0.0
8.10	0	0.000	0.0	0.000	0.0	0.000	0.0
10.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	422976	0.072	*	0.142	*	0.061	*

STANDARD ERROR OF ESTIMATE = 0.12801
= (n/n-1)*square root((tot.col.5)**2 - (tot.col.7)**2)

(1) AVERAGE = sum (|S-M|/n)
PERCENT = 100.0 * (sum(|S-M|/M))/n for all M > 0.0

(2) AVERAGE = square root(sum((S-M)**2)/n)
PERCENT = 100.0 * square root(sum(((S-M)/M)**2)/n) for all M > 0

(3) AVERAGE = sum (S-M)/n
PERCENT = 100.0 * (sum ((S-M)/M)/n) for all M > 0.0

S = Simulated value
M = Measured value
sum = Summation
n = Number of pairs of values
| | = Absolute value

note: Percents for the first class interval and the total should not be used if there are measured events that are zero.

1

Flow Comparison: Predeveloped vs. Developed SDW2

MEASURED = Observed - HOURLY F SIMULATED = Simulated- HOURLY FL

Lower class limit	Cases equal or exceeding lower limit & less than upper limit: Cases Meas	Cases Sim	Percent Measured	Percent Simulated	Percent cases equal or exceeding limit: Measured	Simulated	Average of cases within class limits: Measured	Simulated
0.00	**********		77.92	43.72	100.00	100.00	0.00	0.00
0.01	4797	6898	1.13	1.63	22.08	56.28	0.01	0.01
0.01	5923	9390	1.40	2.22	20.94	54.65	0.01	0.01
0.01	631111041		1.49	2.61	19.54	52.43	0.02	0.02
0.02	5263	9392	1.24	2.22	18.05	49.82	0.02	0.02
0.02	551510081		1.30	2.38	16.81	47.60	0.03	0.03
0.03	639312297		1.51	2.91	15.50	45.21	0.03	0.03
0.04	584611820		1.38	2.79	13.99	42.31	0.04	0.04
0.04	598012377		1.41	2.93	12.61	39.51	0.05	0.05
0.05	601413487		1.42	3.19	11.19	36.58	0.06	0.06
0.07	564412682		1.33	3.00	9.77	33.40	0.07	0.07
0.08	551513078		1.30	3.09	8.44	30.40	0.09	0.09
0.10	450110978		1.06	2.60	7.13	27.31	0.11	0.11
0.12	504613309		1.19	3.15	6.07	24.71	0.13	0.13
0.15	489314142		1.16	3.34	4.88	21.56	0.17	0.17
0.19	337110597		0.80	2.51	3.72	18.22	0.21	0.21
0.23	302717466		0.72	4.13	2.92	15.72	0.25	0.26
0.28	281019711		0.66	4.66	2.21	11.59	0.31	0.31
0.35	203715440		0.48	3.65	1.54	6.93	0.39	0.38
0.43	1507	9589	0.36	2.27	1.06	3.28	0.48	0.47
0.53	1076	3367	0.25	0.80	0.71	1.01	0.59	0.56
0.66	660	213	0.16	0.05	0.45	0.21	0.73	0.73
0.81	461	227	0.11	0.05	0.30	0.16	0.89	0.90
1.00	271	177	0.06	0.04	0.19	0.11	1.09	1.10
1.20	226	108	0.05	0.03	0.12	0.07	1.33	1.36
1.50	141	67	0.03	0.02	0.07	0.04	1.67	1.70
1.90	69	39	0.02	0.01	0.04	0.03	2.06	2.08
2.30	40	36	0.01	0.01	0.02	0.02	2.52	2.57
2.80	28	22	0.01	0.01	0.01	0.01	3.09	2.98
3.50	7	5	0.00	0.00	0.00	0.00	3.84	4.00
4.30	6	5	0.00	0.00	0.00	0.00	4.80	4.63
5.30	2	0	0.00	0.00	0.00	0.00	5.80	0.00
6.60	0	0	0.00	0.00	0.00	0.00	0.00	0.00
8.10	0	0	0.00	0.00	0.00	0.00	0.00	0.00
10.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00

422976422976 100.00 100.00 0.03 0.09

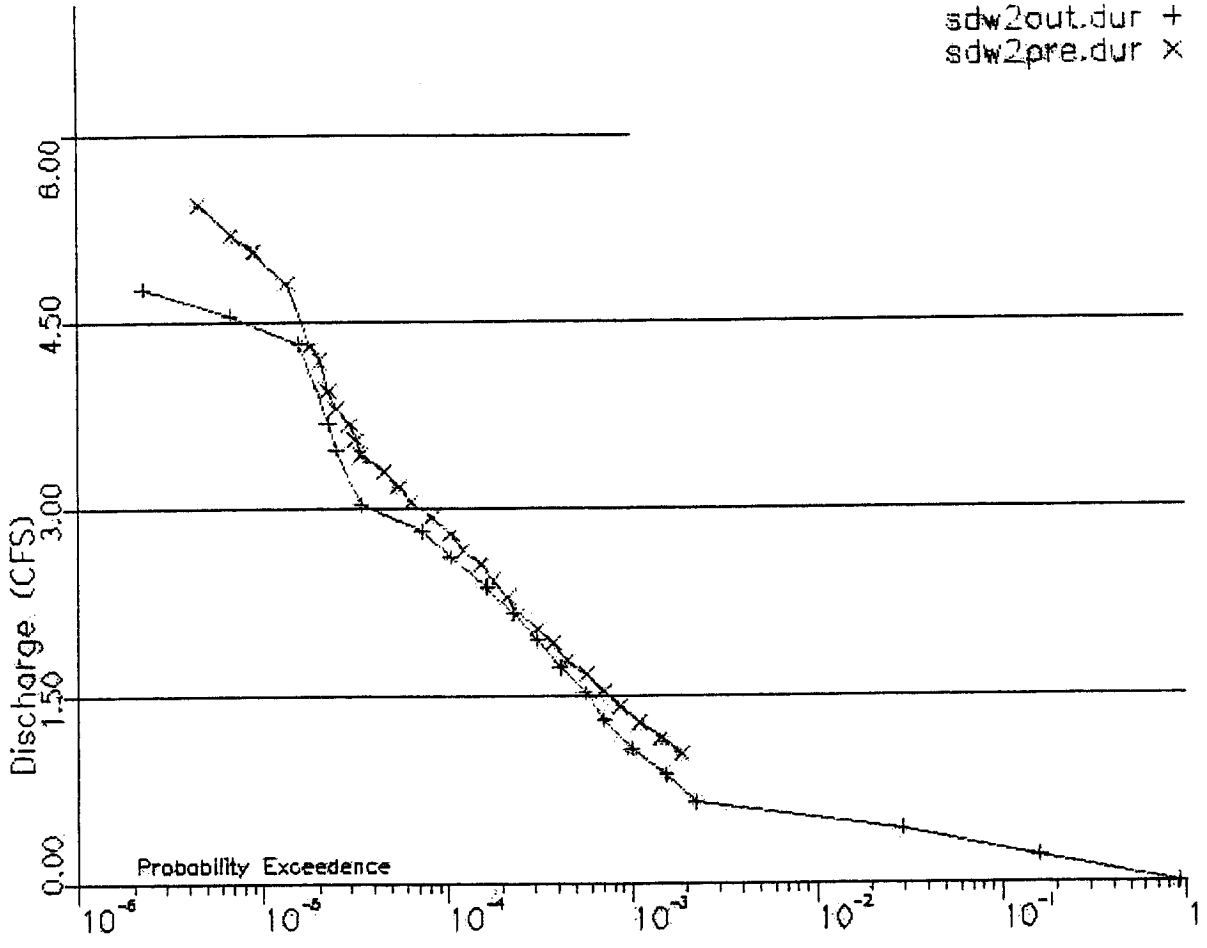
92917 Measured events are zero
***** Simulated events are zero
76691 Measured events are zero when simulated events are zero
16226 Measured events are zero when simulated events are not zero
49589 Measured events are not zero when simulated events are zero

zero is defined as less than 0.01

1

Flow Comparison: Predeveloped vs. Developed SDW2

Lower class limit	Number of deviations between indicated percentages							
	-60	-30	-10	0	10	30	60	
0.00	126694	187	125	62	58	131	202339	0
0.01	37	19	24	7	8	32	4670	0
0.01	87	47	35	22	20	38	5674	0
0.01	82	66	36	20	36	46	6025	0
0.02	86	64	46	28	33	55	4951	0
0.02	102	97	64	22	25	69	5136	0
0.03	135	113	85	47	40	108	5865	0
0.04	154	129	94	53	55	106	5255	0
0.04	226	147	117	69	71	145	5205	0
0.05	266	226	132	96	71	157	5066	0
0.07	259	261	170	95	79	183	4597	0
0.08	289	315	201	101	97	207	4305	0
0.10	301	294	191	100	97	190	3328	0
0.12	357	384	223	115	115	247	3605	0
0.15	381	398	267	158	135	280	3274	0
0.19	285	314	203	130	108	357	1974	0
0.23	287	293	225	155	249	447	1371	0
0.28	248	332	427	258	241	458	846	0
0.35	209	352	453	205	185	323	310	0
0.43	161	436	369	157	142	156	86	0
0.53	118	503	290	68	31	9	57	0
0.66	127	367	114	3	3	7	39	0
0.81	156	254	7	1	1	6	36	0
1.00	142	99	3	1	2	4	20	0
1.20	154	44	1	3	2	4	18	0
1.50	115	5	4	1	2	4	10	0
1.90	54	2	1	0	2	2	8	0
2.30	28	6	2	1	1	0	2	0
2.80	21	0	2	1	1	0	3	0
3.50	7	0	0	0	0	0	0	0
4.30	5	1	0	0	0	0	0	0
5.30	2	0	0	0	0	0	0	0
6.60	0	0	0	0	0	0	0	0
8.10	0	0	0	0	0	0	0	0
10.00	0	0	0	0	0	0	0	0
	131575	5755	3911	1979	1910	3771	274075	0


sdw2out.dur +
sdw2pre.dur ×
Discharge (CFS)
6.00
4.50
3.00
1.50
0.00
Probability Exceedence
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1
1

One Outlet Reservoir Routing File

Stage (Ft)	Discharge (CFS)	Storage (Cu-Ft)	Perm-Area (Sq-Ft)
0.00	0.000	0.	0.
1.00	0.250	47146.	0.
2.00	0.350	96254.	0.
3.00	0.420	147358.	0.
4.00	0.490	200497.	0.
5.00	0.550	255812.	0.
6.00	0.600	313352.	0.
7.00	1.200	373070.	0.
8.00	2.690	434996.	0.
8.30	3.090	455400.	0.
9.00	7.570	499162.	0.
10.00	16.880	565746.	0.

0.00 Ft : Base Reservoir Elevation
0.0 Minutes/Inch: Average Perm-Rate

```
Reservoir Routing [Single Outlet]
Computing Series:sdw2out.tsf
  Years Complete: 50
                          Inflow/Outflow Analysis
                          -----------------------
  Peak Inflow Discharge:      16.14 CFS at  6:00 on Jan  9 in 1990
 Peak Outflow Discharge:       4.96 CFS at 19:00 on Feb  9 in 1951
   Peak Reservoir Stage:       8.59  Ft
    Peak Reservoir Elev:       8.59  Ft
 Peak Reservoir Storage:  473712.    Cu-Ft
                        :     10.875 Ac-Ft
```

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw2pre.tsf Mean= 0.315 StdDev= 0.207
Project Location:Sea-Tac Walker Skew= -0.043

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			6.18		100.00	0.990
Computed Peaks			5.45		50.00	0.980
Computed Peaks			4.73		25.00	0.960
Computed Peaks			3.80		10.00	0.900
Computed Peaks			3.61		8.00	0.875
Computed Peaks			3.09		5.00	0.800
Computed Peaks			2.07		2.00	0.500
Computed Peaks			1.44		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sdw2out.tsf Mean= -0.127 StdDev= 0.309
Project Location:Sea-Tac Walker Skew= 1.375

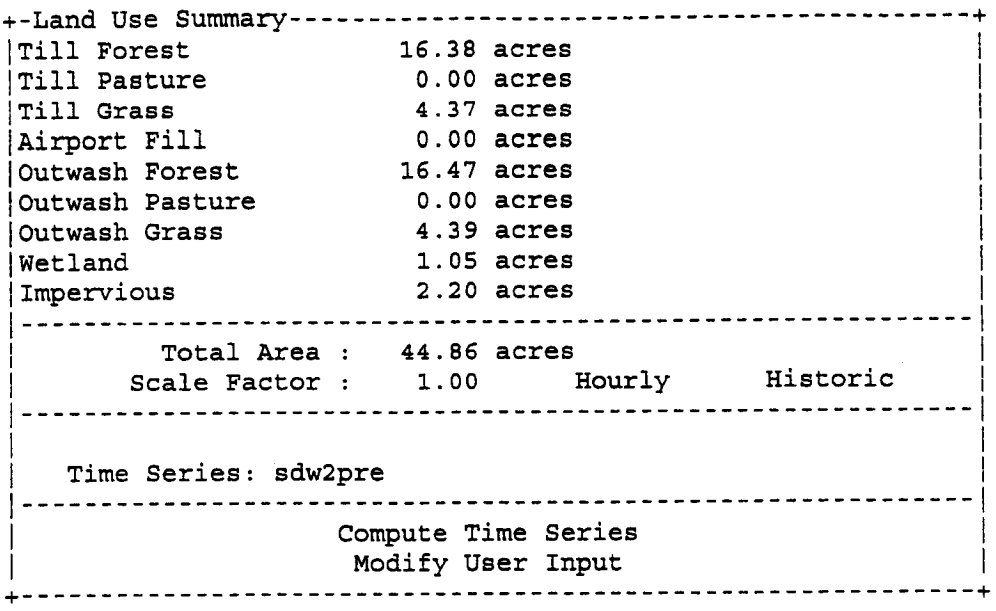
---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			7.58	9.00		100.00	0.990
Computed Peaks			5.09	8.61		50.00	0.980
Computed Peaks			3.38	8.35		25.00	0.960
Computed Peaks			1.93	7.49		10.00	0.900
Computed Peaks			1.73	7.36		8.00	0.875
Computed Peaks			1.24	7.02		5.00	0.800
Computed Peaks			0.638	6.06		2.00	0.500
Computed Peaks			0.431	3.16		1.30	0.231

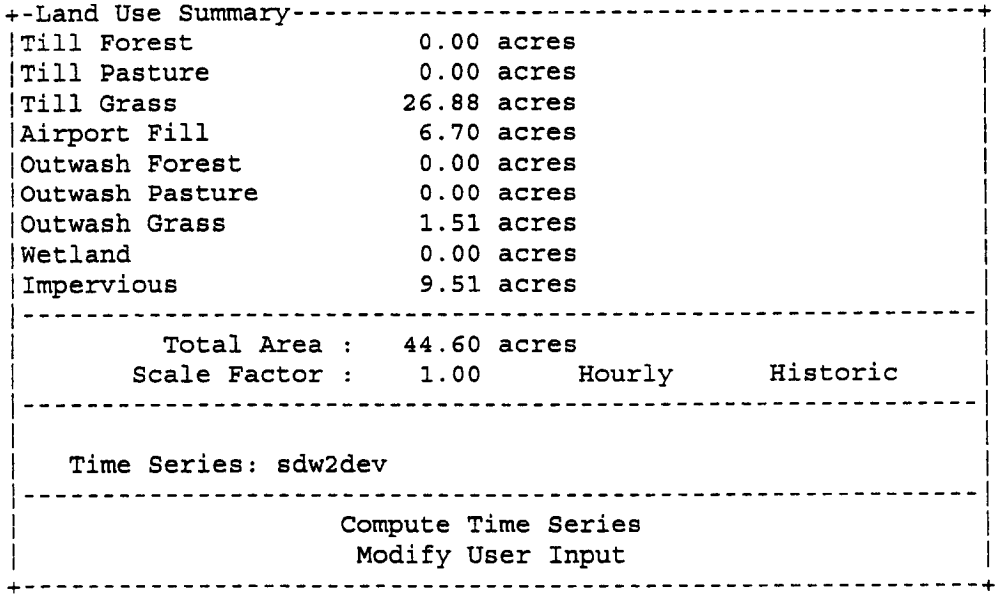
Duration Comparison Anaylsis
Base File: sdw2pre.tsf
New File: sdw2out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
1.03	0.19E-02	0.11E-02	-41.6	0.19E-02	1.03	0.759	-26.6
1.19	0.13E-02	0.79E-03	-40.7	0.13E-02	1.19	0.938	-21.2
1.35	0.96E-03	0.67E-03	-30.2	0.96E-03	1.35	1.10	-18.1
1.51	0.74E-03	0.56E-03	-23.9	0.74E-03	1.51	1.26	-16.2
1.66	0.57E-03	0.45E-03	-19.8	0.57E-03	1.66	1.50	-9.9
1.82	0.43E-03	0.36E-03	-16.5	0.43E-03	1.82	1.70	-6.7
1.98	0.34E-03	0.29E-03	-15.3	0.34E-03	1.98	1.87	-5.5
2.14	0.26E-03	0.24E-03	-9.6	0.26E-03	2.14	2.07	-3.2
2.29	0.21E-03	0.18E-03	-12.9	0.21E-03	2.29	2.19	-4.4
2.45	0.17E-03	0.14E-03	-20.0	0.17E-03	2.45	2.33	-4.8
2.61	0.13E-03	0.11E-03	-22.0	0.13E-03	2.61	2.46	-5.7
2.77	0.11E-03	0.80E-04	-25.5	0.11E-03	2.77	2.59	-6.4
2.92	0.82E-04	0.57E-04	-30.6	0.82E-04	2.92	2.74	-6.2
3.08	0.64E-04	0.27E-04	-57.1	0.64E-04	3.08	2.87	-6.7
3.24	0.53E-04	0.25E-04	-52.2	0.53E-04	3.24	2.95	-8.8
3.40	0.39E-04	0.25E-04	-35.3	0.39E-04	3.40	3.02	-11.0
3.55	0.34E-04	0.23E-04	-33.3	0.34E-04	3.55	3.03	-14.7
3.71	0.30E-04	0.21E-04	-30.8	0.30E-04	3.71	3.07	-17.2
3.87	0.25E-04	0.16E-04	-36.4	0.25E-04	3.87	3.47	-10.2
4.02	0.23E-04	0.16E-04	-30.0	0.23E-04	4.02	3.68	-8.6
4.18	0.21E-04	0.16E-04	-22.2	0.21E-04	4.18	3.77	-9.9
4.34	0.18E-04	0.16E-04	-12.5	0.18E-04	4.34	3.82	-12.0
4.50	0.14E-04	0.68E-05	-50.0	0.14E-04	4.50	4.47	-0.7
4.65	0.14E-04	0.46E-05	-66.7	0.14E-04	4.65	4.47	-4.0
4.81	0.14E-04	0.23E-05	-83.3	0.14E-04	4.81	4.47	-7.2
4.97	0.91E-05	0.00E+00	-100.0	0.91E-05	4.97	4.48	-9.8
5.13	0.68E-05	0.00E+00	-100.0	0.68E-05	5.13	4.61	-10.2
5.28	0.46E-05	0.00E+00	-100.0	0.46E-05	5.28	4.69	-11.2
5.44	0.46E-05	0.00E+00	-100.0	0.46E-05	5.44	4.69	-13.7
5.60	0.46E-05	0.00E+00	-100.0	0.46E-05	5.60	4.69	-16.2
5.76	0.23E-05	0.00E+00	-100.0	0.23E-05	5.76	4.96	-13.8
5.91	0.23E-05	0.00E+00	-100.0	0.23E-05	5.91	4.96	-16.1

Maximum positive excursion = 0.059 cfs (1.3%)
occuring at 4.39 cfs on the Base Data:sdw2pre.tsf
and at 4.45 cfs on the New Data:sdw2out.tsf

Maximum negative excursion = 0.275 cfs (-26.6%)
occuring at 1.03 cfs on the Base Data:sdw2pre.tsf
and at 0.759 cfs on the New Data:sdw2out.tsf


Land Use Summary
Till Forest 16.38 acres
Till Pasture 0.00 acres
Till Grass 4.37 acres
Airport Fill 0.00 acres
Outwash Forest 16.47 acres
Outwash Pasture 0.00 acres
Outwash Grass 4.39 acres
Wetland 1.05 acres
Impervious 2.20 acres
Total Area : 44.86 acres
Scale Factor : 1.00 Hourly Historic
Time Series: sdw2pre
Compute Time Series
Modify User Input


Land Use Summary
Till Forest 0.00 acres
Till Pasture 0.00 acres
Till Grass 26.88 acres
Airport Fill 6.70 acres
Outwash Forest 0.00 acres
Outwash Pasture 0.00 acres
Outwash Grass 1.51 acres
Wetland 0.00 acres
Impervious 9.51 acres
Total Area : 44.60 acres
Scale Factor : 1.00 Hourly Historic
Time Series: sdw2dev
Compute Time Series
Modify User Input

SDW2 Test Facility
USED ONLY TO STAGE-DISCHARGE CURVE FOR SDW2 KCRTS RESERVOIR FILE

Retention/Detention Facility

Type of Facility:	Detention Vault	
Effective Storage Depth:	9.00	ft
Stage 0 Elevation:	0.00	ft
Riser Head:	9.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	3.00	0.732	
2	6.00	4.50	0.951	8.0
3	7.50	8.00	2.126	10.0

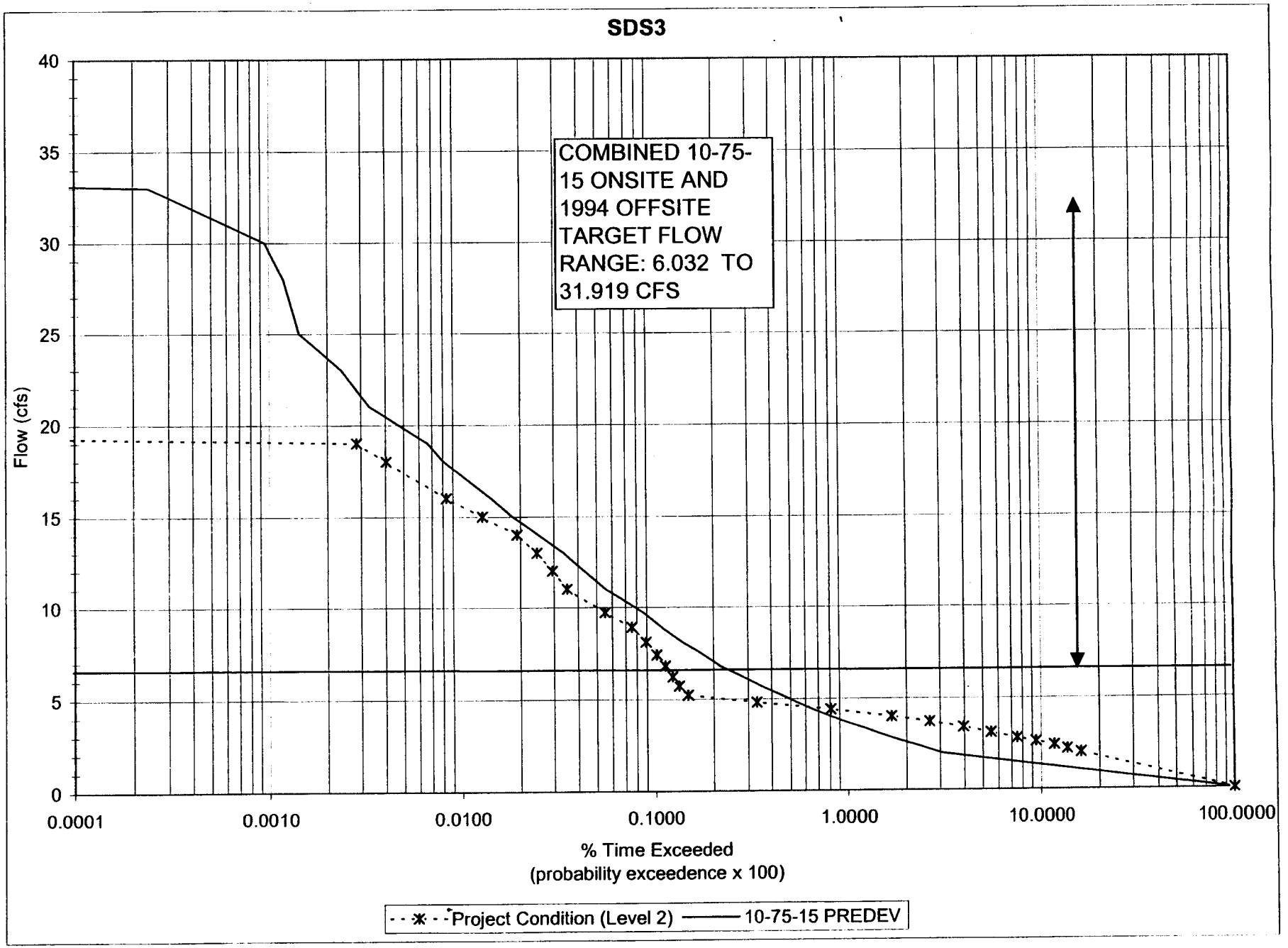
Top Notch Weir:	Rectangular	
Length:	25.00	in
Weir Height:	8.30	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
1.09	1.09	10900.	0.250	0.255	0.00
1.92	1.92	19200.	0.441	0.339	0.00
2.97	2.97	29700.	0.682	0.421	0.00
4.02	4.02	40200.	0.923	0.489	0.00
5.06	5.06	50600.	1.162	0.549	0.00
7.00	7.00	70000.	1.607	1.200	0.00
8.00	8.00	80000.	1.837	2.690	0.00
8.30	8.30	83000.	1.905	3.090	0.00
9.00	9.00	90000.	2.066	7.570	0.00
10.00	10.00	100000.	2.296	16.880	0.00

DES MOINES CREEK WATERSHED
DETENTION POND PERFORMANCE DATA
(HSPF AND KCRTS BACKUP)

- SDS3
- SDS3A
- SDS4
- SDS7
- SASA

SDS3


SDS3
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 6.032 TO 31.919 CFS
Flow (cfs)
40
35
30
25
20
15
10
5
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

AR 010595

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS-3

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

14.877	33.894	20.581	9.940	10.291
11.832	15.450	15.394	12.113	10.138
9.805	13.530	12.210	8.180	11.892
14.027	10.327	11.590	18.894	14.332
11.037	11.395	9.947	23.885	10.869
10.614	14.043	9.004	8.795	12.445
10.821	12.499	12.433	20.154	10.782
12.751	8.054	19.839	13.994	6.527
7.207	32.347	26.257	10.733	7.471
6.181	11.363	24.992		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.101
Variance (logs)	0.028
Standard Deviation (logs)	0.167
Skewness (logs)	0.721
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.171
Coefficient of Variation (logs)	0.151

1

PREDEV SDS-3

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	6.354
0.9500	1.05	7.336
0.9000	1.11	8.032
0.8000	1.25	9.091
0.5000	2.00	12.064
0.2000	5.00	17.087
0.1000	10.00	21.067
0.0400	25.00	26.916
0.0200	50.00	31.919
0.0100	100.00	37.521
0.0050	200.00	43.811

$Y_2 Q_2 = 6.032$

$Q_{50} = 31.919$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SDS-3

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

4.037	5.012	20.577	3.556	4.277
4.296	4.376	8.393	4.330	4.620
3.952	11.922	4.636	3.308	4.512
4.659	7.448	4.210	4.570	4.240
4.126	4.517	4.503	16.830	5.059
4.598	4.117	4.310	3.458	4.566
3.336	15.376	4.222	9.726	4.525
3.541	3.653	5.041	9.935	3.651
3.490	15.208	15.459	4.741	3.707
3.219	4.783	20.018		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.734
Variance (logs)	0.051
Standard Deviation (logs)	0.226
Skewness (logs)	1.470
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.062
Coefficient of Variation (logs)	0.308

1

2006 SDS-3

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	2.792
0.9500	1.05	2.991
0.9000	1.11	3.179
0.8000	1.25	3.524
0.5000	2.00	4.794
0.2000	5.00	7.781
0.1000	10.00	10.853
0.0400	25.00	16.509
0.0200	50.00	22.460
0.0100	100.00	30.385
0.0050	200.00	40.931

$\frac{1}{2}Q_2 = 2.397$

$Q_{50} = 22.460$

1

Simulated - PREDEV SDS-3
Observed - 2006 SDS-3

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	352393	0.389	*	0.670	*	-0.350	*
2.00	10731	1.680	80.1	1.775	84.6	-1.530	-73.0
2.20	8567	1.814	79.0	1.914	83.3	-1.658	-72.2
2.40	9445	1.946	77.9	2.057	82.3	-1.773	-71.0
2.60	8006	2.041	75.7	2.179	80.8	-1.837	-68.1
2.80	8435	2.215	75.4	2.367	80.5	-1.983	-67.5
3.10	6525	2.409	74.2	2.583	79.5	-2.144	-66.1
3.40	5592	2.544	71.8	2.769	78.1	-2.223	-62.7
3.70	4027	2.676	69.5	2.921	75.8	-2.292	-59.5
4.00	3644	2.814	67.3	3.079	73.7	-2.339	-56.1
4.40	1995	2.883	63.1	3.245	70.9	-2.343	-51.3
4.80	788	2.876	58.3	3.443	69.8	-1.948	-39.6
5.20	61	2.573	47.3	2.868	52.7	-2.109	-38.5
5.70	42	3.101	52.3	3.441	57.9	-2.349	-39.7
6.20	44	3.202	49.3	3.433	52.8	-2.988	-46.1
6.80	47	4.169	58.5	4.949	69.0	-2.242	-31.5
7.40	50	3.864	50.6	4.242	55.8	-3.073	-40.2
8.10	58	4.040	47.1	4.545	53.1	-2.954	-34.6
8.90	86	4.421	47.5	5.240	56.2	-3.146	-33.9
9.70	84	4.583	45.1	5.014	49.3	-3.792	-37.2
11.00	24	5.725	49.5	6.177	53.4	-4.467	-38.6
12.00	21	5.112	40.9	6.012	47.8	-2.997	-24.1
13.00	22	5.447	40.2	5.934	43.7	-4.485	-33.1
14.00	27	5.195	35.7	5.865	40.3	-3.809	-26.2
15.00	19	4.404	28.8	5.204	34.0	-4.325	-28.3
16.00	18	4.782	28.2	5.131	30.2	-3.602	-21.3
18.00	5	5.626	30.2	6.082	32.7	-5.626	-30.2
19.00	12	4.334	21.9	4.901	24.8	-4.099	-20.6
21.00	0	0.000	0.0	0.000	0.0	0.000	0.0
23.00	0	0.000	0.0	0.000	0.0	0.000	0.0
25.00	0	0.000	0.0	0.000	0.0	0.000	0.0
28.00	0	0.000	0.0	0.000	0.0	0.000	0.0
30.00	0	0.000	0.0	0.000	0.0	0.000	0.0
33.00	0	0.000	0.0	0.000	0.0	0.000	0.0
36.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.678	*	1.142	*	-0.605	*

Standard error of estimate = 0.97
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS-3
Observed - 2006 SDS-3

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		96.94	83.75	100.00	100.00	0.14	0.45
2.00	178	110731	0.42	2.55	3.06	16.25	2.10	2.10
2.20	1472	8567	0.35	2.04	2.64	13.70	2.30	2.30
2.40	1288	9445	0.31	2.24	2.29	11.66	2.50	2.50
2.60	1107	8006	0.26	1.90	1.98	9.42	2.70	2.70
2.80	1239	8435	0.29	2.00	1.72	7.52	2.95	2.94
3.10	1010	6525	0.24	1.55	1.42	5.51	3.25	3.25
3.40	848	5592	0.20	1.33	1.18	3.96	3.54	3.55
3.70	701	4027	0.17	0.96	0.98	2.63	3.84	3.85
4.00	672	3644	0.16	0.87	0.82	1.67	4.19	4.18
4.40	499	1995	0.12	0.47	0.66	0.81	4.58	4.57
4.80	396	788	0.09	0.19	0.54	0.33	4.99	4.94
5.20	394	61	0.09	0.01	0.44	0.15	5.44	5.45
5.70	296	42	0.07	0.01	0.35	0.13	5.95	5.93
6.20	264	44	0.06	0.01	0.28	0.12	6.49	6.50
6.80	169	47	0.04	0.01	0.22	0.11	7.09	7.11
7.40	165	50	0.04	0.01	0.18	0.10	7.74	7.66
8.10	128	58	0.03	0.01	0.14	0.09	8.49	8.58
8.90	87	86	0.02	0.02	0.11	0.08	9.28	9.30
9.70	131	84	0.03	0.02	0.09	0.06	10.33	10.19
11.00	53	24	0.01	0.01	0.06	0.04	11.47	11.55
12.00	39	21	0.01	0.00	0.04	0.03	12.46	12.46
13.00	37	22	0.01	0.01	0.03	0.02	13.45	13.50
14.00	28	27	0.01	0.01	0.02	0.02	14.51	14.52
15.00	17	19	0.00	0.00	0.02	0.01	15.46	15.32
16.00	26	18	0.01	0.00	0.01	0.01	16.84	16.92
18.00	6	5	0.00	0.00	0.01	0.00	18.59	18.59
19.00	14	12	0.00	0.00	0.01	0.00	19.94	19.83
21.00	4	0	0.00	0.00	0.00	0.00	22.38	0.00
23.00	4	0	0.00	0.00	0.00	0.00	24.12	0.00
25.00	1	0	0.00	0.00	0.00	0.00	26.26	0.00
28.00	1	0	0.00	0.00	0.00	0.00	29.51	0.00
30.00	3	0	0.00	0.00	0.00	0.00	30.97	0.00
33.00	1	0	0.00	0.00	0.00	0.00	33.89	0.00
36.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.25	0.86

11795 Observed values are zero
118000 Simulated values are zero
11795 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
106205 Observed values are not zero when simulated are

1

Simulated - PREDEV SDS-3
Observed - 2006 SDS-3

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	322350	7690	2872	9939	953	1512	7077	0
2.00	8645	1062	301	129	92	137	365	0
2.20	6816	859	285	100	89	135	283	0
2.40	7474	1008	331	111	74	128	319	0
2.60	6037	1018	350	114	85	116	286	0
2.80	6306	1144	348	119	76	128	314	0
3.10	4809	891	316	84	68	106	251	0
3.40	3913	921	265	81	82	108	222	0
3.70	2673	643	272	96	63	87	193	0

4.00	2306	675	251	85	53	70	204	0
4.40	1176	455	126	49	37	46	106	0
4.80	282	335	73	13	12	19	54	0
5.20	23	16	14	3	0	1	4	0
5.70	15	19	5	0	0	0	3	0
6.20	16	19	7	0	0	1	1	0
6.80	17	16	8	1	0	0	5	0
7.40	18	17	10	1	0	1	3	0
8.10	17	19	17	0	0	0	5	0
8.90	28	29	13	5	2	3	6	0
9.70	23	40	9	2	1	5	4	0
11.00	9	10	2	0	0	1	2	0
12.00	2	12	4	0	0	2	1	0
13.00	4	12	4	0	0	1	1	0
14.00	5	10	5	2	0	3	2	0
15.00	1	8	7	2	1	0	0	0
16.00	0	10	4	0	1	3	0	0
18.00	0	4	0	1	0	0	0	0
19.00	0	5	4	2	1	0	0	0
21.00	0	0	0	0	0	0	0	0
23.00	0	0	0	0	0	0	0	0
25.00	0	0	0	0	0	0	0	0
28.00	0	0	0	0	0	0	0	0
30.00	0	0	0	0	0	0	0	0
33.00	0	0	0	0	0	0	0	0
36.00	0	0	0	0	0	0	0	0
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	372965	16947	5903	10939	1690	2613	9711	0

4.00	2306	675	251	85	53	70	204	0
4.40	1176	455	126	49	37	46	106	0
4.80	282	335	73	13	12	19	54	0
5.20	23	16	14	3	0	1	4	0
5.70	15	19	5	0	0	0	3	0
6.20	16	19	7	0	0	1	1	0
6.80	17	16	8	1	0	0	5	0
7.40	18	17	10	1	0	1	3	0
8.10	17	19	17	0	0	0	5	0
8.90	28	29	13	5	2	3	6	0
9.70	23	40	9	2	1	5	4	0
11.00	9	10	2	0	0	1	2	0
12.00	2	12	4	0	0	2	1	0
13.00	4	12	4	0	0	1	1	0
14.00	5	10	5	2	0	3	2	0
15.00	1	8	7	2	1	0	0	0
16.00	0	10	4	0	1	3	0	0
18.00	0	4	0	1	0	0	0	0
19.00	0	5	4	2	1	0	0	0
21.00	0	0	0	0	0	0	0	0
23.00	0	0	0	0	0	0	0	0
25.00	0	0	0	0	0	0	0	0
28.00	0	0	0	0	0	0	0	0
30.00	0	0	0	0	0	0	0	0
33.00	0	0	0	0	0	0	0	0
36.00	0	0	0	0	0	0	0	0
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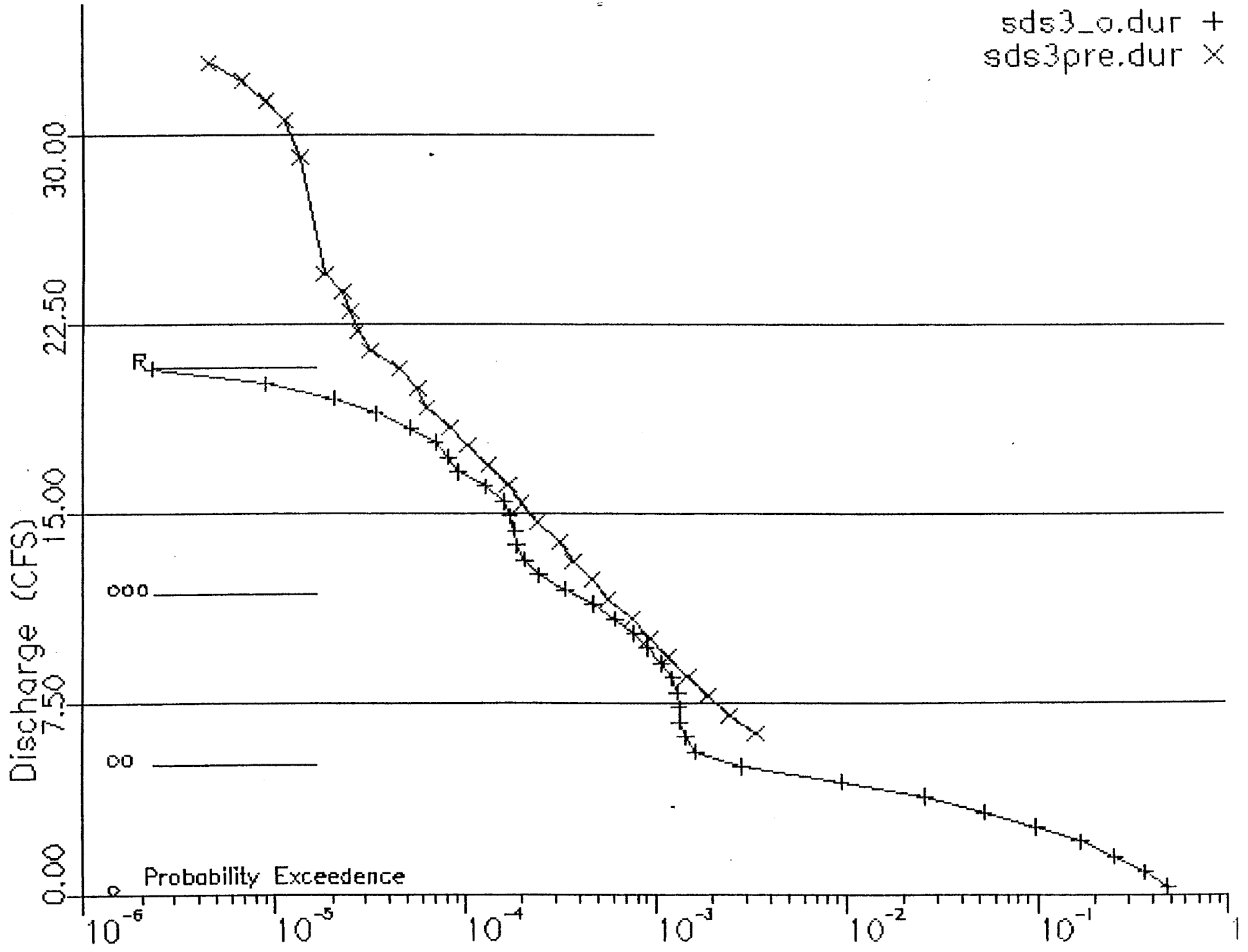
	372965	16947	5903	10939	1690	2613	9711	0


sds3_o.dur +
sds3pre.dur X
30.00
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Discharge (CFS)
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10^{-3}
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AR 010602

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	700.00	ft
Facility Width:	275.00	ft
Facility Area:	192500.	sq. ft
Effective Storage Depth:	20.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	3850000.	cu. ft
Riser Head:	20.00	ft
Riser Diameter:	36.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	7.00	5.942	
2	14.50	11.50	8.411	15.0
3	17.50	12.25	6.434	15.0

Top Notch Weir: None

Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.07	0.07	13475.	0.309	0.359	0.00
0.15	0.15	28875.	0.663	0.508	0.00
0.22	0.22	42350.	0.972	0.622	0.00
0.29	0.29	55825.	1.282	0.718	0.00
0.36	0.36	69300.	1.591	0.803	0.00
0.44	0.44	84700.	1.944	0.879	0.00
0.51	0.51	98175.	2.254	0.950	0.00
0.58	0.58	111650.	2.563	1.020	0.00
0.98	0.98	188650.	4.331	1.310	0.00
1.37	1.37	263725.	6.054	1.550	0.00
1.76	1.76	338800.	7.778	1.760	0.00
2.15	2.15	413875.	9.501	1.950	0.00
2.54	2.54	488950.	11.225	2.120	0.00
2.94	2.94	565950.	12.992	2.280	0.00
3.33	3.33	641025.	14.716	2.420	0.00
3.72	3.72	716100.	16.439	2.560	0.00
4.11	4.11	791175.	18.163	2.700	0.00
4.50	4.50	866250.	19.886	2.820	0.00
4.90	4.90	943250.	21.654	2.940	0.00
5.29	5.29	1018325.	23.378	3.060	0.00
5.68	5.68	1093400.	25.101	3.170	0.00
6.07	6.07	1168475.	26.824	3.280	0.00
6.47	6.47	1245475.	28.592	3.380	0.00
6.86	6.86	1320550.	30.316	3.480	0.00
7.25	7.25	1395625.	32.039	3.580	0.00
7.64	7.64	1470700.	33.763	3.670	0.00
8.03	8.03	1545775.	35.486	3.770	0.00
8.43	8.43	1622775.	37.254	3.860	0.00
8.82	8.82	1697850.	38.977	3.950	0.00
9.21	9.21	1772925.	40.701	4.030	0.00
9.60	9.60	1848000.	42.424	4.120	0.00
10.00	10.00	1925000.	44.192	4.200	0.00
10.39	10.39	2000075.	45.915	4.280	0.00

10.78	10.78	2075150.	47.639	4.360	0.00
11.17	11.17	2150225.	49.362	4.440	0.00
11.56	11.56	2225300.	51.086	4.520	0.00
11.96	11.96	2302300.	52.854	4.600	0.00
12.35	12.35	2377375.	54.577	4.670	0.00
12.74	12.74	2452450.	56.301	4.740	0.00
13.13	13.13	2527525.	58.024	4.820	0.00
13.52	13.52	2602600.	59.747	4.890	0.00
13.92	13.92	2679600.	61.515	4.960	0.00
14.31	14.31	2754675.	63.239	5.030	0.00
14.50	14.50	2791250.	64.078	5.060	0.00
14.62	14.62	2814350.	64.609	5.140	0.00
14.74	14.74	2837450.	65.139	5.320	0.00
14.86	14.86	2860550.	65.669	5.590	0.00
14.98	14.98	2883650.	66.199	5.960	0.00
15.10	15.10	2906750.	66.730	6.400	0.00
15.22	15.22	2929850.	67.260	8.230	0.00
15.34	15.34	2952950.	67.790	8.490	0.00
15.46	15.46	2976050.	68.321	8.740	0.00
15.85	15.85	3051125.	70.044	9.460	0.00
16.24	16.24	3126200.	71.768	10.090	0.00
16.63	16.63	3201275.	73.491	10.660	0.00
17.03	17.03	3278275.	75.259	11.190	0.00
17.42	17.42	3353350.	76.982	11.680	0.00
17.50	17.50	3368750.	77.336	11.770	0.00
17.63	17.63	3393775.	77.910	11.990	0.00
17.76	17.76	3418800.	78.485	12.320	0.00
17.88	17.88	3441900.	79.015	12.750	0.00
18.01	18.01	3466925.	79.590	13.280	0.00
18.14	18.14	3491950.	80.164	15.750	0.00
18.27	18.27	3516975.	80.739	16.200	0.00
18.39	18.39	3540075.	81.269	16.630	0.00
18.52	18.52	3565100.	81.843	17.030	0.00
18.65	18.65	3590125.	82.418	17.410	0.00
19.04	19.04	3665200.	84.141	18.500	0.00
19.43	19.43	3740275.	85.865	19.480	0.00
19.82	19.82	3815350.	87.588	20.400	0.00
20.00	20.00	3850000.	88.384	20.790	0.00
20.10	20.10	3869250.	88.826	21.930	0.00
20.20	20.20	3888500.	89.268	23.840	0.00
20.30	20.30	3907750.	89.710	26.240	0.00
20.40	20.40	3927000.	90.152	29.040	0.00
20.50	20.50	3946250.	90.593	32.180	0.00
20.60	20.60	3965500.	91.035	35.640	0.00
20.70	20.70	3984750.	91.477	39.370	0.00
20.80	20.80	4004000.	91.919	43.370	0.00
20.90	20.90	4023250.	92.361	47.600	0.00
21.00	21.00	4042500.	92.803	52.070	0.00
21.10	21.10	4061750.	93.245	56.750	0.00
21.20	21.20	4081000.	93.687	60.520	0.00
21.30	21.30	4100250.	94.129	62.230	0.00
21.40	21.40	4119500.	94.571	63.880	0.00
21.50	21.50	4138750.	95.013	65.480	0.00
21.60	21.60	4158000.	95.455	67.030	0.00
21.70	21.70	4177250.	95.896	68.540	0.00
21.80	21.80	4196500.	96.338	70.000	0.00
21.90	21.90	4215750.	96.780	71.430	0.00

Route Time Series through Facility
Inflow Time Series File:sds3dev.tsf
Outflow Time Series File:sds3_o

Inflow/Outflow Analysis

Peak Inflow Discharge:	102.89	CFS	at	6:00	on Jan	9	in 1990
Peak Outflow Discharge:	20.76	CFS	at	20:00	on Feb	9	in 1951
Peak Reservoir Stage:	19.99	Ft					
Peak Reservoir Elev:	19.99	Ft					
Peak Reservoir Storage:	3847379.	Cu-Ft					
:	88.324	Ac-Ft					

Flow Frequency Analysis
Time Series File:sds3pre.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 1.122 StdDev= 0.169
Skew= 0.577

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
38.49		100.00	0.990
33.05		50.00	0.980
28.12		25.00	0.960
22.21		10.00	0.900
21.10		8.00	0.875
18.11		5.00	0.800
12.77		2.00	0.500
9.78		1.30	0.231

Flow Frequency Analysis
Time Series File:sds3_o.tsf
Project Location:Sea-Tac DMoines

LogPearson III Coefficients
Mean= 0.754 StdDev= 0.238
Skew= 1.313

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		
Computed Peaks		

-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
33.22	20.53		100.00	0.990
24.61	20.23		50.00	0.980
18.09	18.89		25.00	0.960
11.84	17.54		10.00	0.900
10.87	16.79		8.00	0.875
8.42	15.31		5.00	0.800
5.06	14.48		2.00	0.500
3.72	7.82		1.30	0.231

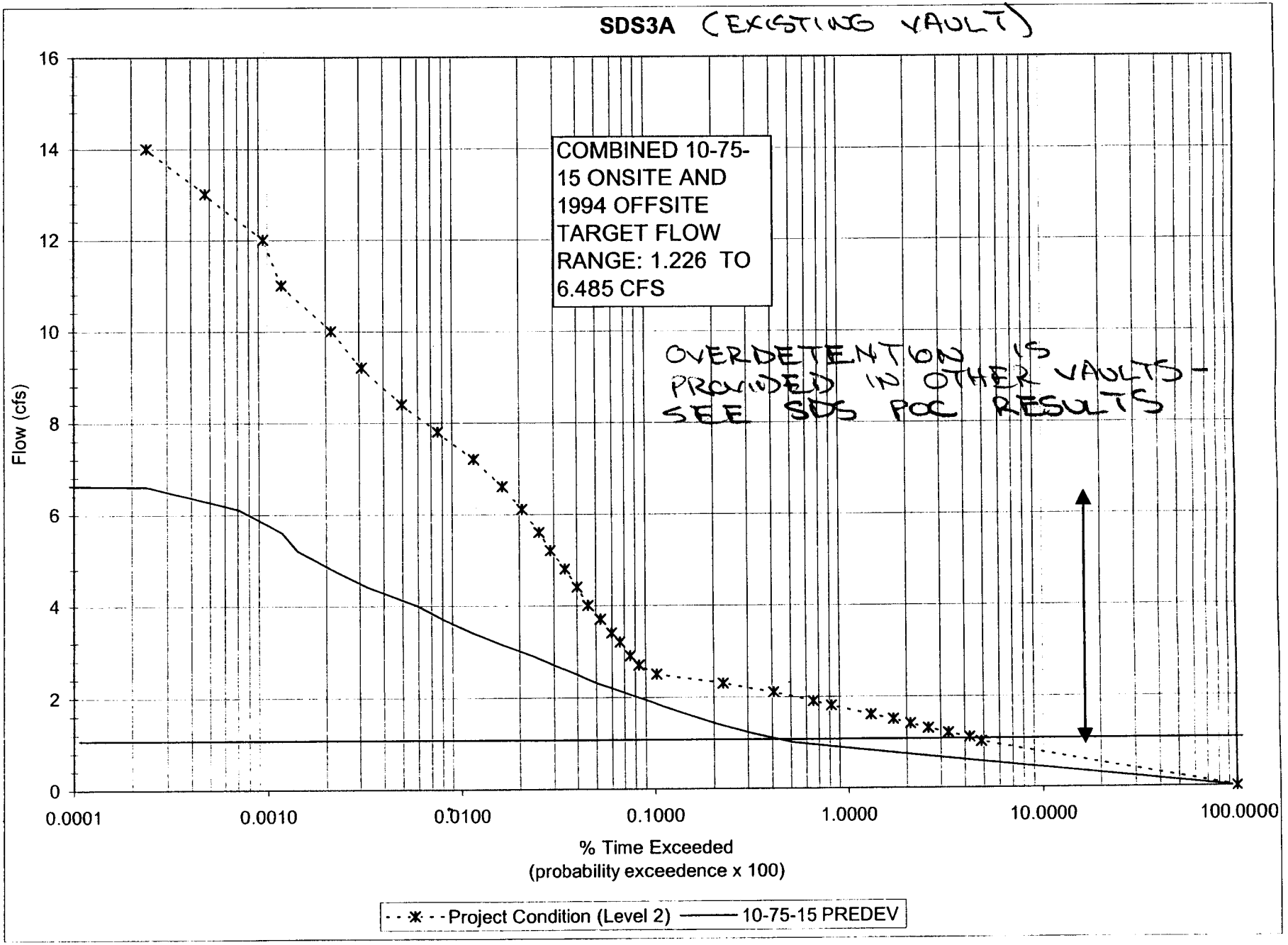
Duration Comparison Anaylsis
Base File: sds3pre.tsf
New File: sds3_o.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
2.52	0.23E-01	0.11E+00	379.1	0.23E-01	2.52	3.88	54.1
3.55	0.12E-01	0.36E-01	196.1	0.12E-01	3.55	4.27	20.3
4.58	0.69E-02	0.67E-02	-2.5	0.69E-02	4.58	4.56	-0.4
5.61	0.43E-02	0.16E-02	-62.9	0.43E-02	5.61	4.78	-14.8
6.65	0.28E-02	0.14E-02	-52.2	0.28E-02	6.65	4.96	-25.4
7.68	0.20E-02	0.13E-02	-33.3	0.20E-02	7.68	5.14	-33.1
8.71	0.14E-02	0.12E-02	-17.1	0.14E-02	8.71	6.27	-28.0
9.74	0.10E-02	0.88E-03	-14.0	0.10E-02	9.74	9.25	-5.0
10.77	0.76E-03	0.62E-03	-18.6	0.76E-03	10.77	10.30	-4.4
11.81	0.53E-03	0.37E-03	-31.3	0.53E-03	11.81	11.17	-5.4
12.84	0.40E-03	0.23E-03	-44.1	0.40E-03	12.84	11.65	-9.3
13.87	0.31E-03	0.19E-03	-39.0	0.31E-03	13.87	12.13	-12.6
14.90	0.24E-03	0.17E-03	-26.9	0.24E-03	14.90	12.67	-15.0
15.94	0.17E-03	0.14E-03	-19.7	0.17E-03	15.94	15.16	-4.9
16.97	0.13E-03	0.87E-04	-32.1	0.13E-03	16.97	16.10	-5.1
18.00	0.91E-04	0.64E-04	-30.0	0.91E-04	18.00	16.71	-7.2
19.03	0.71E-04	0.34E-04	-51.6	0.71E-04	19.03	17.81	-6.4
20.06	0.55E-04	0.91E-05	-83.3	0.55E-04	20.06	18.35	-8.5
21.10	0.37E-04	0.00E+00	-100.0	0.37E-04	21.10	18.90	-10.4
22.13	0.32E-04	0.00E+00	-100.0	0.32E-04	22.13	19.06	-13.8
23.16	0.25E-04	0.00E+00	-100.0	0.25E-04	23.16	19.35	-16.4
24.19	0.18E-04	0.00E+00	-100.0	0.18E-04	24.19	19.68	-18.7
25.23	0.14E-04	0.00E+00	-100.0	0.14E-04	25.23	19.90	-21.1
26.26	0.14E-04	0.00E+00	-100.0	0.14E-04	26.26	19.90	-24.2
27.29	0.14E-04	0.00E+00	-100.0	0.14E-04	27.29	19.90	-27.1
28.32	0.14E-04	0.00E+00	-100.0	0.14E-04	28.32	19.90	-29.7
29.35	0.11E-04	0.00E+00	-100.0	0.11E-04	29.35	19.94	-32.1
30.39	0.11E-04	0.00E+00	-100.0	0.11E-04	30.39	19.94	-34.4
31.42	0.91E-05	0.00E+00	-100.0	0.91E-05	31.42	20.32	-35.3
32.45	0.46E-05	0.00E+00	-100.0	0.46E-05	32.45	20.58	-36.6
33.48	0.46E-05	0.00E+00	-100.0	0.46E-05	33.48	20.58	-38.5
34.52	0.23E-05	0.00E+00	-100.0	0.23E-05	34.52	20.71	-40.0

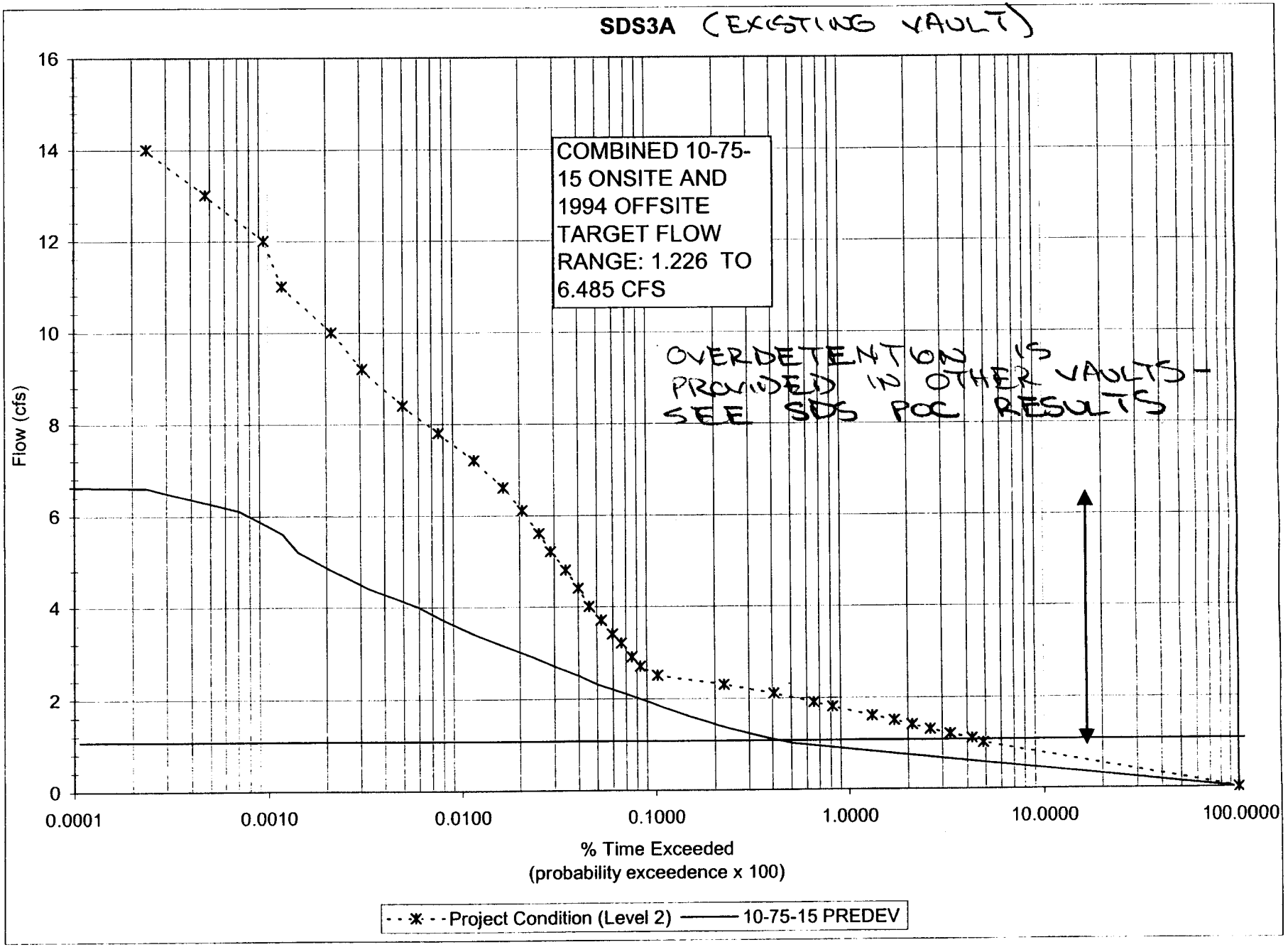
Maximum positive excursion = 1.36 cfs (54.1%)
occuring at 2.52 cfs on the Base Data:sds3pre.tsf
and at 3.88 cfs on the New Data:sds3_o.tsf

Maximum negative excursion = 13.87 cfs (-40.3%)
occuring at 34.45 cfs on the Base Data:sds3pre.tsf
and at 20.58 cfs on the New Data:sds3_o.tsf

SDS3A



Sim = Pre obs = 2006



Sim = Pre obs = 2006

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SIMULATED FLOW @ SDS-3A

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

3.022	6.887	4.182	2.019	2.091
2.404	3.139	3.127	2.460	2.059
1.992	2.749	2.481	1.661	2.416
2.850	2.098	2.354	3.839	2.911
2.242	2.315	2.021	4.853	2.208
2.156	2.853	1.829	1.786	2.527
2.198	2.539	2.525	4.094	2.190
2.590	1.636	4.031	2.843	1.326
1.464	6.572	5.334	2.180	1.518
1.255	2.309	5.078		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.409
Variance (logs)	0.028
Standard Deviation (logs)	0.167
Skewness (logs)	0.721
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.171
Coefficient of Variation (logs)	0.407

1

PREDEV SIMULATED FLOW @ SDS-3A

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.290
0.9500	1.05	1.490
0.9000	1.11	1.631
0.8000	1.25	1.846
0.5000	2.00	2.451
0.2000	5.00	3.471
0.1000	10.00	4.280
0.0400	25.00	5.469
0.0200	50.00	6.485
0.0100	100.00	7.624
0.0050	200.00	8.902

$\frac{1}{2}Q_2 = 1.226$

$Q_{50} = 6.485$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SIMULATED FLOW @ SDS-3A

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

2.456	3.973	8.106	2.096	2.128
2.285	6.881	3.291	3.472	2.505
2.228	7.456	2.408	1.897	2.444
2.366	3.253	2.022	6.232	2.198
2.450	2.315	2.499	7.851	2.201
2.161	6.195	2.308	1.880	2.376
1.928	5.400	2.172	12.521	3.855
2.139	2.400	9.105	9.744	2.155
1.637	14.657	12.111	2.207	2.332
1.581	3.887	10.415		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.528
Variance (logs)	0.074
Standard Deviation (logs)	0.272
Skewness (logs)	0.992
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.008
Coefficient of Variation (logs)	0.515

1

2006 SIMULATED FLOW @ SDS-3A

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.244
0.9500	1.05	1.477
0.9000	1.11	1.664
0.8000	1.25	1.979
0.5000	2.00	3.046
0.2000	5.00	5.419
0.1000	10.00	7.797
0.0400	25.00	12.085
0.0200	50.00	16.499
0.0100	100.00	22.261
0.0050	200.00	29.765

$\frac{1}{2}Q_2 = 1.523$
$Q_{50} = 16.499$

1

Simulated - PREDEV SIMULATED FLOW @ SDS-3A
Observed - 2006 SIMULATED FLOW @ SDS-3A

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	400309	0.066	*	0.155	*	-0.065	*
1.00	2600	0.754	71.5	0.781	74.0	-0.751	-71.2
1.10	4035	0.808	70.5	0.839	73.1	-0.803	-70.0
1.20	2897	0.874	70.0	0.908	72.7	-0.868	-69.6
1.30	2100	0.924	68.6	0.964	71.5	-0.916	-68.0
1.40	1653	0.992	68.5	1.034	71.4	-0.986	-68.1
1.50	1654	1.047	67.6	1.090	70.4	-1.035	-66.8
1.60	2074	1.122	66.4	1.169	69.2	-1.108	-65.6
1.80	696	1.208	65.3	1.260	68.1	-1.192	-64.4
1.90	1032	1.252	62.8	1.319	66.2	-1.228	-61.6
2.10	775	1.318	60.2	1.398	63.8	-1.277	-58.3
2.30	513	1.268	53.0	1.374	57.4	-1.235	-51.6
2.50	79	1.208	47.7	1.343	53.0	-1.190	-47.0
2.70	34	1.369	48.9	1.470	52.5	-1.354	-48.4
2.90	38	1.431	47.2	1.592	52.5	-1.397	-46.1
3.20	27	1.710	51.7	1.811	54.7	-1.710	-51.7
3.40	31	1.799	51.1	1.862	52.8	-1.769	-50.2
3.70	29	2.022	53.1	2.129	55.9	-2.022	-53.1
4.00	23	2.192	51.8	2.279	53.8	-2.192	-51.8
4.40	24	2.626	56.8	2.719	58.7	-2.458	-53.1
4.80	24	2.837	56.8	2.967	59.3	-2.837	-56.8
5.20	15	3.308	62.1	3.367	63.3	-3.308	-62.1
5.60	19	3.307	57.1	3.363	58.1	-3.307	-57.1
6.10	18	3.615	57.2	3.733	59.1	-3.615	-57.2
6.60	20	4.067	59.1	4.165	60.6	-4.067	-59.1
7.20	17	4.252	56.7	4.323	57.6	-4.252	-56.7
7.80	11	4.941	61.2	5.021	62.3	-4.941	-61.2
8.40	8	5.124	58.4	5.199	59.4	-5.124	-58.4
9.20	4	6.979	73.5	6.994	73.7	-6.979	-73.5
10.00	4	5.698	54.1	5.788	54.9	-5.698	-54.1
11.00	1	7.272	61.4	7.272	61.4	-7.272	-61.4
12.00	2	8.216	66.7	8.219	66.7	-8.216	-66.7
13.00	1	7.609	55.1	7.609	55.1	-7.609	-55.1
14.00	1	8.661	59.1	8.661	59.1	-8.661	-59.1
15.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.111	*	0.284	*	-0.109	*

Standard error of estimate = 0.26
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SIMULATED FLOW @ SDS-3A
Observed - 2006 SIMULATED FLOW @ SDS-3A

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		99.49	95.14	100.00	100.00	0.04	0.09
1.00	436	2600	0.10	0.62	0.51	4.86	1.05	1.05
1.10	345	4035	0.08	0.96	0.40	4.24	1.15	1.15
1.20	265	2897	0.06	0.69	0.32	3.29	1.25	1.25
1.30	195	2100	0.05	0.50	0.26	2.60	1.35	1.35
1.40	138	1653	0.03	0.39	0.21	2.10	1.45	1.45
1.50	119	1654	0.03	0.39	0.18	1.70	1.55	1.55
1.60	174	2074	0.04	0.49	0.15	1.31	1.69	1.69
1.80	57	696	0.01	0.17	0.11	0.82	1.84	1.85
1.90	106	1032	0.03	0.25	0.10	0.65	2.00	1.99
2.10	81	775	0.02	0.18	0.07	0.41	2.19	2.19
2.30	46	513	0.01	0.12	0.05	0.22	2.39	2.40
2.50	42	79	0.01	0.02	0.04	0.10	2.60	2.53
2.70	28	34	0.01	0.01	0.03	0.08	2.80	2.80
2.90	35	38	0.01	0.01	0.02	0.08	3.03	3.03
3.20	15	27	0.00	0.01	0.02	0.07	3.29	3.30
3.40	15	31	0.00	0.01	0.01	0.06	3.50	3.52
3.70	9	29	0.00	0.01	0.01	0.05	3.82	3.81
4.00	11	23	0.00	0.01	0.01	0.05	4.09	4.22
4.40	5	24	0.00	0.01	0.00	0.04	4.57	4.62
4.80	3	24	0.00	0.01	0.00	0.03	4.97	4.99
5.20	1	15	0.00	0.00	0.00	0.03	5.33	5.33
5.60	2	19	0.00	0.00	0.00	0.03	6.05	5.79
6.10	2	18	0.00	0.00	0.00	0.02	6.39	6.32
6.60	1	20	0.00	0.00	0.00	0.02	6.89	6.88
7.20	0	17	0.00	0.00	0.00	0.01	0.00	7.50
7.80	0	11	0.00	0.00	0.00	0.01	0.00	8.08
8.40	0	8	0.00	0.00	0.00	0.00	0.00	8.80
9.20	0	4	0.00	0.00	0.00	0.00	0.00	9.50
10.00	0	4	0.00	0.00	0.00	0.00	0.00	10.51
11.00	0	1	0.00	0.00	0.00	0.00	0.00	11.85
12.00	0	2	0.00	0.00	0.00	0.00	0.00	12.32
13.00	0	1	0.00	0.00	0.00	0.00	0.00	13.82
14.00	0	1	0.00	0.00	0.00	0.00	0.00	14.66
15.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.05	0.16

38133 Observed values are zero
118000 Simulated values are zero
38133 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
79867 Observed values are not zero when simulated are

1

Simulated - PREDEV SIMULATED FLOW @ SDS-3A
Observed - 2006 SIMULATED FLOW @ SDS-3A

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	276644	63094	15854	37973	1791	1890	3063	0
1.00	2025	463	80	17	5	5	5	0
1.10	3082	742	138	30	17	17	9	0
1.20	2197	550	92	21	19	13	5	0
1.30	1549	425	76	16	12	14	8	0
1.40	1219	326	79	8	10	9	2	0
1.50	1162	403	57	8	8	10	6	0
1.60	1455	483	78	17	17	17	7	0
1.80	465	183	31	5	1	7	4	0

1.90	621	328	50	4	11	10	8	0
2.10	424	270	47	11	10	4	9	0
2.30	208	215	61	8	11	8	2	0
2.50	29	29	17	3	0	1	0	0
2.70	13	15	5	0	1	0	0	0
2.90	14	14	7	0	2	1	0	0
3.20	9	14	4	0	0	0	0	0
3.40	8	21	1	0	0	1	0	0
3.70	9	17	3	0	0	0	0	0
4.00	5	17	1	0	0	0	0	0
4.40	8	15	0	0	0	0	1	0
4.80	11	12	1	0	0	0	0	0
5.20	7	8	0	0	0	0	0	0
5.60	6	13	0	0	0	0	0	0
6.10	8	9	1	0	0	0	0	0
6.60	8	12	0	0	0	0	0	0
7.20	7	10	0	0	0	0	0	0
7.80	5	6	0	0	0	0	0	0
8.40	4	4	0	0	0	0	0	0
9.20	4	0	0	0	0	0	0	0
10.00	1	3	0	0	0	0	0	0
11.00	1	0	0	0	0	0	0	0
12.00	2	0	0	0	0	0	0	0
13.00	0	1	0	0	0	0	0	0
14.00	0	1	0	0	0	0	0	0
15.00	0	0	0	0	0	0	0	0
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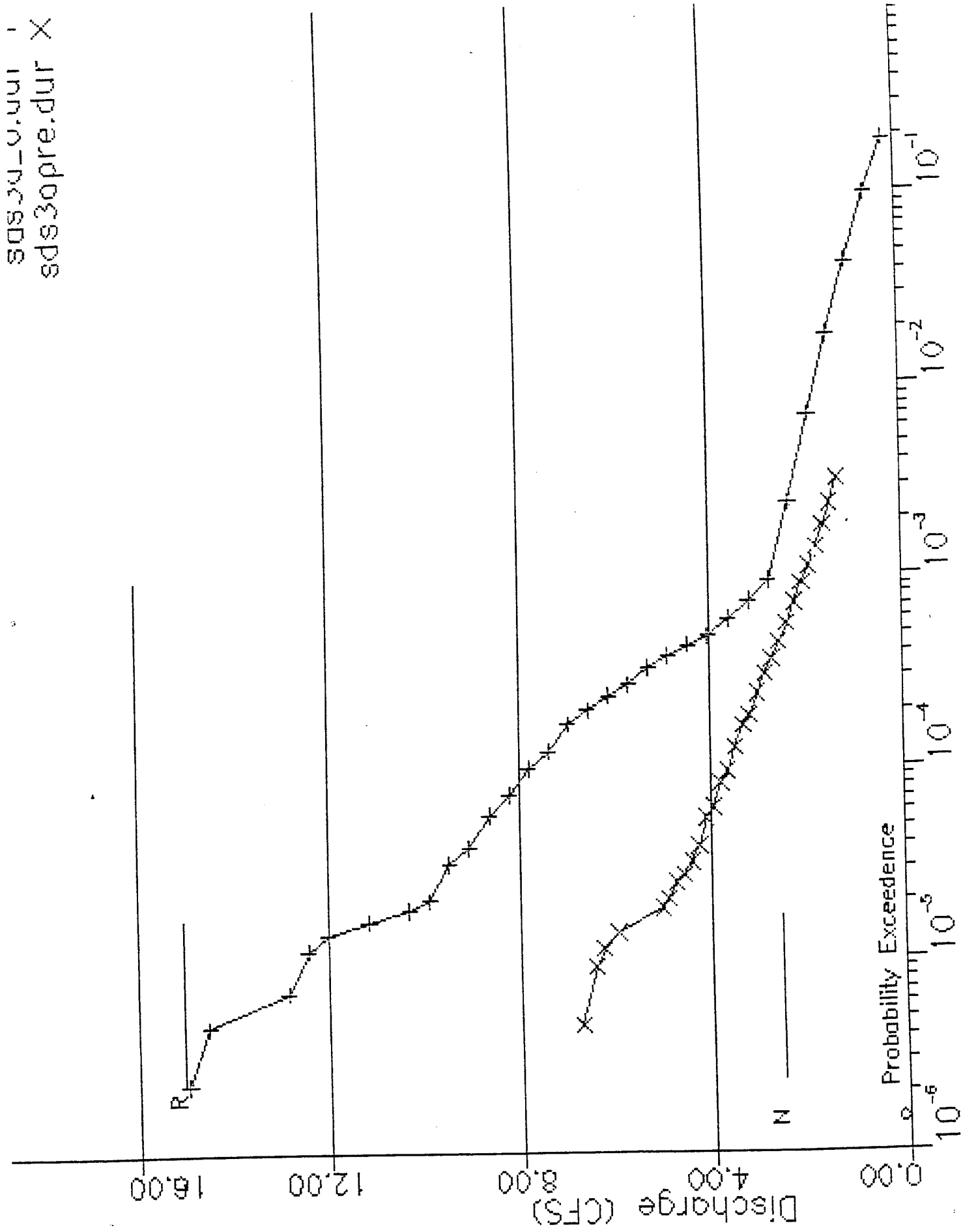
	291210	67703	16683	38121	1915	2007	3129	0


sds3opre.dur
Discharge (CFS)
0.00
4.00
8.00
12.00
16.00
Probability Exceedence
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
R
N

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	375.00	ft
Facility Width:	80.00	ft
Facility Area:	30000.	sq. ft
Effective Storage Depth:	7.94	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	238200.	cu. ft
Riser Head:	7.94	ft
Riser Diameter:	36.00	inches
Number of orifices:	1	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	6.25	2.985	

Top Notch Weir:	Rectangular	
Length:	18.00	in
Weir Height:	5.70	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.07	0.07	2100.	0.048	0.270	0.00
0.13	0.13	3900.	0.090	0.382	0.00
0.20	0.20	6000.	0.138	0.468	0.00
0.26	0.26	7800.	0.179	0.541	0.00
0.33	0.33	9900.	0.227	0.605	0.00
0.39	0.39	11700.	0.269	0.662	0.00
0.46	0.46	13800.	0.317	0.715	0.00
0.52	0.52	15600.	0.358	0.765	0.00
0.66	0.66	19800.	0.455	0.858	0.00
0.79	0.79	23700.	0.544	0.942	0.00
0.92	0.92	27600.	0.634	1.020	0.00
1.06	1.06	31800.	0.730	1.090	0.00
1.19	1.19	35700.	0.820	1.160	0.00
1.33	1.33	39900.	0.916	1.220	0.00
1.46	1.46	43800.	1.006	1.280	0.00
1.60	1.60	48000.	1.102	1.340	0.00
1.73	1.73	51900.	1.191	1.390	0.00
1.87	1.87	56100.	1.288	1.450	0.00
2.00	2.00	60000.	1.377	1.500	0.00
2.14	2.14	64200.	1.474	1.550	0.00
2.27	2.27	68100.	1.563	1.600	0.00
2.40	2.40	72000.	1.653	1.640	0.00
2.54	2.54	76200.	1.749	1.690	0.00
2.67	2.67	80100.	1.839	1.730	0.00
2.81	2.81	84300.	1.935	1.780	0.00
2.94	2.94	88200.	2.025	1.820	0.00
3.08	3.08	92400.	2.121	1.860	0.00
3.21	3.21	96300.	2.211	1.900	0.00
3.35	3.35	100500.	2.307	1.940	0.00
3.48	3.48	104400.	2.397	1.980	0.00

3.62	3.62	108600.	2.493	2.010	0.00
3.75	3.75	112500.	2.583	2.050	0.00
3.89	3.89	116700.	2.679	2.090	0.00
4.02	4.02	120600.	2.769	2.120	0.00
4.15	4.15	124500.	2.858	2.160	0.00
4.29	4.29	128700.	2.955	2.190	0.00
4.42	4.42	132600.	3.044	2.230	0.00
4.56	4.56	136800.	3.140	2.260	0.00
4.69	4.69	140700.	3.230	2.300	0.00
4.83	4.83	144900.	3.326	2.330	0.00
4.96	4.96	148800.	3.416	2.360	0.00
5.10	5.10	153000.	3.512	2.390	0.00
5.23	5.23	156900.	3.602	2.420	0.00
5.37	5.37	161100.	3.698	2.450	0.00
5.50	5.50	165000.	3.788	2.480	0.00
5.63	5.63	168900.	3.877	2.520	0.00
5.70	5.70	171000.	3.926	2.530	0.00
5.83	5.83	174900.	4.015	2.800	0.00
5.97	5.97	179100.	4.112	3.250	0.00
6.10	6.10	183000.	4.201	3.820	0.00
6.24	6.24	187200.	4.298	4.470	0.00
6.37	6.37	191100.	4.387	5.170	0.00
6.51	6.51	195300.	4.483	5.930	0.00
6.64	6.64	199200.	4.573	6.730	0.00
6.78	6.78	203400.	4.669	7.560	0.00
6.91	6.91	207300.	4.759	8.410	0.00
7.05	7.05	211500.	4.855	9.280	0.00
7.18	7.18	215400.	4.945	10.160	0.00
7.31	7.31	219300.	5.034	11.040	0.00
7.45	7.45	223500.	5.131	11.920	0.00
7.58	7.58	227400.	5.220	12.800	0.00
7.72	7.72	231600.	5.317	13.670	0.00
7.85	7.85	235500.	5.406	14.530	0.00
7.94	7.94	238200.	5.468	15.070	0.00
8.04	8.04	241200.	5.537	16.020	0.00
8.14	8.14	244200.	5.606	17.720	0.00
8.24	8.24	247200.	5.675	19.930	0.00
8.34	8.34	250200.	5.744	22.540	0.00
8.44	8.44	253200.	5.813	25.500	0.00
8.54	8.54	256200.	5.882	28.760	0.00
8.64	8.64	259200.	5.950	32.310	0.00
8.74	8.74	262200.	6.019	36.130	0.00
8.84	8.84	265200.	6.088	40.180	0.00
8.94	8.94	268200.	6.157	44.470	0.00
9.04	9.04	271200.	6.226	48.980	0.00
9.14	9.14	274200.	6.295	52.580	0.00
9.24	9.24	277200.	6.364	54.120	0.00
9.34	9.34	280200.	6.433	55.600	0.00
9.44	9.44	283200.	6.501	57.030	0.00
9.54	9.54	286200.	6.570	58.410	0.00
9.64	9.64	289200.	6.639	59.760	0.00
9.74	9.74	292200.	6.708	61.060	0.00
9.84	9.84	295200.	6.777	62.330	0.00

Route Time Series through Facility
Inflow Time Series File:sds3adev.tsf
Outflow Time Series File:sds3a_o

Inflow/Outflow Analysis

Peak Inflow Discharge:	19.60	CFS	at	6:00	on Jan 9	in 1990
Peak Outflow Discharge:	14.99	CFS	at	9:00	on Jan 9	in 1990
Peak Reservoir Stage:	7.93	Ft				
Peak Reservoir Elev:	7.93	Ft				
Peak Reservoir Storage:	237794.	Cu-Ft				
:	5.459	Ac-Ft				

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sds3apre.tsf Mean= 0.430 StdDev= 0.169
Project Location:Sea-Tac DMoines Skew= 0.578

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			7.82		100.00	0.990
Computed Peaks			6.72		50.00	0.980
Computed Peaks			5.71		25.00	0.960
Computed Peaks			4.51		10.00	0.900
Computed Peaks			4.29		8.00	0.875
Computed Peaks			3.68		5.00	0.800
Computed Peaks			2.59		2.00	0.500
Computed Peaks			1.99		1.30	0.231

Flow Frequency Analysis LogPearson III Coefficients
Time Series File:sds3a_o.tsf Mean= 0.540 StdDev= 0.278
Project Location:Sea-Tac DMoines Skew= 0.928

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			23.27	8.36		100.00	0.990
Computed Peaks			17.28	8.11		50.00	0.980
Computed Peaks			12.67	7.56		25.00	0.960
Computed Peaks			8.17	6.87		10.00	0.900
Computed Peaks			7.45	6.76		8.00	0.875
Computed Peaks			5.66	6.46		5.00	0.800
Computed Peaks			3.15	5.94		2.00	0.500
Computed Peaks			2.10	3.95		1.30	0.231

Duration Comparison Anaylsis

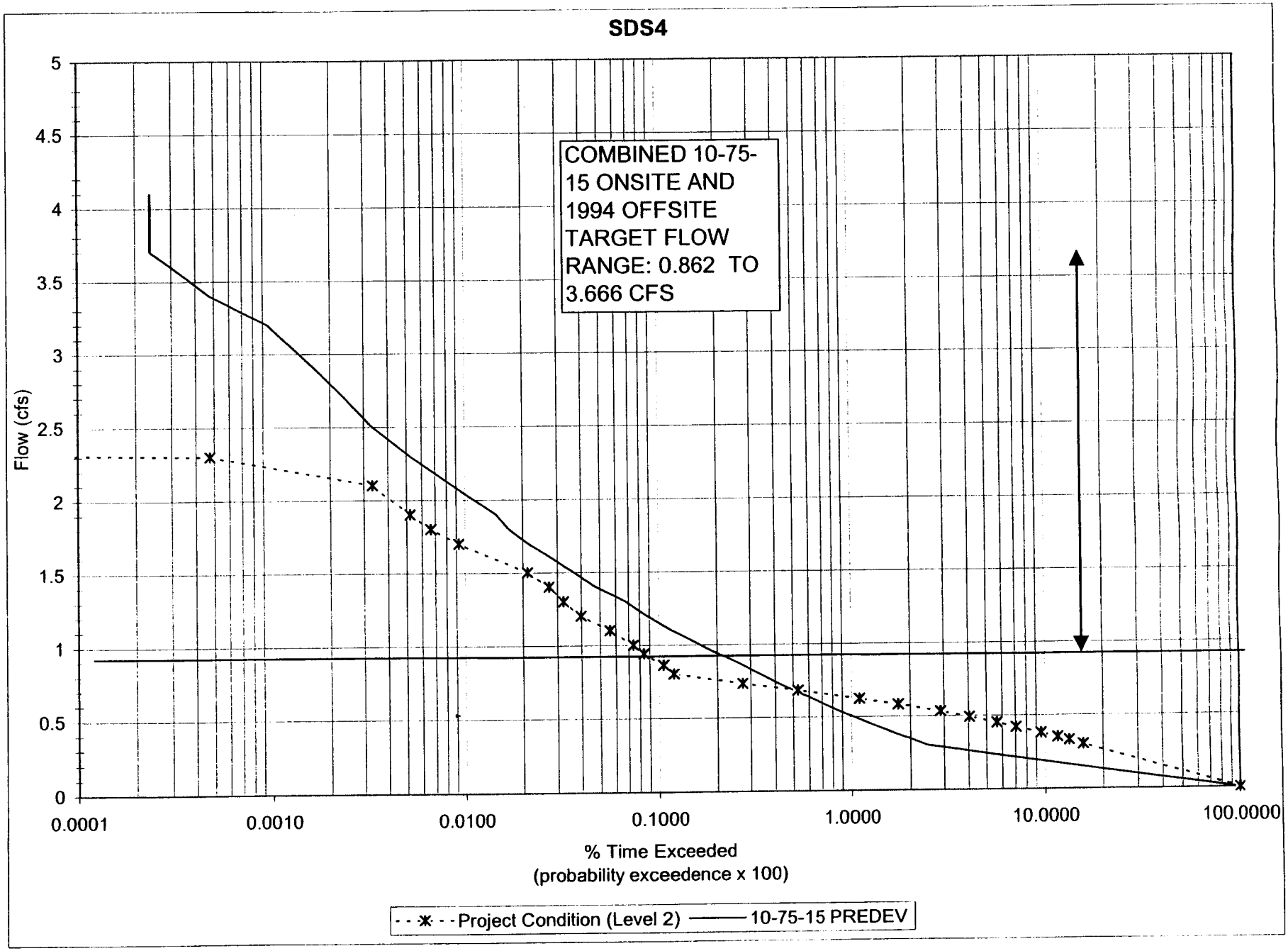
Base File: sds3apre.tsf
New File: sds3a_o.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			--------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
4.23	0.46E-04	0.46E-03	910.0	0.46E-04	4.23	8.92	110.9
4.41	0.32E-04	0.43E-03	1250.0	0.32E-04	4.41	9.56	116.8
4.60	0.25E-04	0.41E-03	1518.2	0.25E-04	4.60	9.86	114.6
4.78	0.23E-04	0.39E-03	1600.0	0.23E-04	4.78	9.89	106.8
4.97	0.18E-04	0.37E-03	1950.0	0.18E-04	4.97	10.49	111.2
5.15	0.14E-04	0.34E-03	2416.7	0.14E-04	5.15	12.38	140.4
5.34	0.14E-04	0.32E-03	2233.3	0.14E-04	5.34	12.38	132.0
5.52	0.14E-04	0.29E-03	2000.0	0.14E-04	5.52	12.38	124.3
5.71	0.14E-04	0.27E-03	1850.0	0.14E-04	5.71	12.38	117.0
5.89	0.14E-04	0.25E-03	1750.0	0.14E-04	5.89	12.38	110.2
6.08	0.11E-04	0.24E-03	2000.0	0.11E-04	6.08	12.52	106.1
6.26	0.11E-04	0.22E-03	1860.0	0.11E-04	6.26	12.52	100.0
6.45	0.91E-05	0.21E-03	2150.0	0.91E-05	6.45	12.82	98.9
6.63	0.46E-05	0.20E-03	4200.0	0.46E-05	6.63	14.62	120.6
6.82	0.46E-05	0.18E-03	3900.0	0.46E-05	6.82	14.62	114.6
7.00	0.46E-05	0.17E-03	3600.0	0.46E-05	7.00	14.62	108.9
1.27	0.34E-02	0.28E-01	733.1	0.34E-02	1.27	2.21	73.7
1.46	0.23E-02	0.19E-01	713.5	0.23E-02	1.46	2.33	59.8
1.64	0.17E-02	0.12E-01	620.8	0.17E-02	1.64	2.42	47.3
1.83	0.13E-02	0.82E-02	526.6	0.13E-02	1.83	2.49	36.3
2.01	0.98E-03	0.53E-02	441.9	0.98E-03	2.01	2.68	33.4
2.19	0.76E-03	0.35E-02	356.0	0.76E-03	2.19	3.11	41.5
2.38	0.55E-03	0.20E-02	256.2	0.55E-03	2.38	3.74	57.3
2.56	0.43E-03	0.10E-02	143.6	0.43E-03	2.56	4.44	73.0
2.75	0.34E-03	0.94E-03	175.8	0.34E-03	2.75	5.20	89.1
2.93	0.25E-03	0.83E-03	231.8	0.25E-03	2.93	5.90	101.2
3.12	0.20E-03	0.75E-03	272.7	0.20E-03	3.12	6.54	109.6
3.30	0.17E-03	0.68E-03	306.8	0.17E-03	3.30	7.01	112.1
3.49	0.12E-03	0.61E-03	398.1	0.12E-03	3.49	7.55	116.6
3.67	0.91E-04	0.57E-03	522.5	0.91E-04	3.67	7.90	115.1
3.86	0.73E-04	0.51E-03	603.1	0.73E-04	3.86	8.22	113.2
4.04	0.59E-04	0.47E-03	700.0	0.59E-04	4.04	8.55	111.4

Maximum positive excursion = 7.25 cfs (141.4%)
occuring at 5.13 cfs on the Base Data:sds3apre.tsf
and at 12.38 cfs on the New Data:sds3a_o.tsf

Maximum negative excursion = -0.593 cfs (30.2%)
occuring at 1.96 cfs on the Base Data:sds3apre.tsf
and at 2.56 cfs on the New Data:sds3a_o.tsf

SDS4


SDS4
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 0.862 TO 3.666 CFS
Flow (cfs)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

AR 010623

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS-4

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.914	4.165	2.362	1.405	1.452
1.658	1.833	1.802	1.880	1.646
1.300	1.787	1.677	1.401	1.530
1.857	1.523	1.565	2.222	2.401
1.453	1.549	1.374	2.965	1.460
1.482	1.999	1.355	1.597	2.096
1.981	1.822	2.001	2.814	1.941
1.661	1.416	2.163	2.363	1.144
1.354	3.463	3.031	1.545	1.020
1.161	1.504	2.787		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.253
Variance (logs)	0.016
Standard Deviation (logs)	0.127
Skewness (logs)	0.792
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.183
Coefficient of Variation (logs)	0.503

1

PREDEV SDS-4

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.076
0.9500	1.05	1.191
0.9000	1.11	1.272
0.8000	1.25	1.393
0.5000	2.00	1.723
0.2000	5.00	2.249
0.1000	10.00	2.647
0.0400	25.00	3.206
0.0200	50.00	3.666
0.0100	100.00	4.165
0.0050	200.00	4.710

$\frac{1}{2}Q_2 = 0.862$
$Q_{50} = 3.666$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SDS-4

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

0.591	0.747	2.297	0.519	0.632
0.663	0.682	0.770	0.663	0.700
0.600	1.436	0.705	0.498	0.679
0.695	0.781	0.623	0.699	0.640
0.591	0.651	0.695	1.632	0.746
0.695	0.650	0.669	0.571	0.691
0.515	1.695	0.621	1.112	0.686
0.551	0.595	0.784	1.157	0.570
0.568	1.560	1.798	0.706	0.574
0.505	0.720	2.312		

The following 7 statistics are based on non-zero values.

Mean (logs)	-0.117
Variance (logs)	0.029
Standard Deviation (logs)	0.172
Skewness (logs)	1.612
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	-0.044
Coefficient of Variation (logs)	-1.468

1

2006 SDS-4

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.478
0.9500	1.05	0.497
0.9000	1.11	0.517
0.8000	1.25	0.554
0.5000	2.00	0.691
0.2000	5.00	0.997
0.1000	10.00	1.291
0.0400	25.00	1.797
0.0200	50.00	2.294
0.0100	100.00	2.921
0.0050	200.00	3.709

$\frac{1}{2}Q_2 = 0.346$

$Q_{50} = 2.294$

1

Simulated - PREDEV SDS-4
Observed - 2006 SDS-4

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	354193	0.058	*	0.102	*	-0.051	*
0.30	10259	0.270	85.6	0.282	89.4	-0.243	-76.9
0.33	7420	0.286	84.3	0.300	88.3	-0.260	-76.5
0.35	8716	0.309	84.6	0.323	88.6	-0.279	-76.5
0.38	10379	0.333	83.2	0.349	87.2	-0.303	-75.7
0.42	5985	0.360	82.8	0.377	86.7	-0.328	-75.5
0.45	6760	0.386	82.2	0.406	86.4	-0.350	-74.5
0.49	4908	0.416	81.8	0.435	85.5	-0.380	-74.7
0.53	4800	0.444	80.0	0.469	84.6	-0.404	-72.9
0.58	2721	0.472	78.8	0.497	83.0	-0.431	-72.0
0.62	2401	0.503	77.6	0.528	81.4	-0.457	-70.5
0.68	1079	0.531	75.8	0.557	79.5	-0.480	-68.5
0.73	648	0.592	78.1	0.634	83.7	-0.492	-64.9
0.80	54	0.635	76.4	0.656	78.9	-0.563	-68.0
0.86	91	0.641	71.1	0.663	73.4	-0.584	-64.8
0.94	42	0.766	78.8	0.861	88.7	-0.440	-45.3
1.00	76	0.730	69.4	0.768	73.0	-0.696	-66.2
1.10	68	0.748	65.5	0.792	69.4	-0.717	-62.8
1.20	32	0.859	68.9	0.921	73.8	-0.728	-58.6
1.30	22	0.900	66.5	0.951	70.2	-0.798	-58.9
1.40	25	0.916	63.5	0.972	67.4	-0.911	-63.2
1.50	50	0.991	62.0	1.032	64.5	-0.925	-58.0
1.70	11	0.997	56.8	1.053	60.0	-0.997	-56.8
1.80	6	0.978	52.8	1.096	59.0	-0.969	-52.3
1.90	8	1.204	60.0	1.311	65.4	-1.204	-60.0
2.10	12	1.231	55.6	1.315	59.4	-1.231	-55.6
2.30	2	1.116	48.3	1.135	49.2	-1.116	-48.3
2.50	0	0.000	0.0	0.000	0.0	0.000	0.0
2.70	0	0.000	0.0	0.000	0.0	0.000	0.0
2.90	0	0.000	0.0	0.000	0.0	0.000	0.0
3.20	0	0.000	0.0	0.000	0.0	0.000	0.0
3.40	0	0.000	0.0	0.000	0.0	0.000	0.0
3.70	0	0.000	0.0	0.000	0.0	0.000	0.0
4.10	0	0.000	0.0	0.000	0.0	0.000	0.0
4.40	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.105	*	0.180	*	-0.094	*

Standard error of estimate = 0.15
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS-4
Observed - 2006 SDS-4

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		97.53	84.18	100.00	100.00	0.02	0.06
0.30	135910259		0.32	2.44	2.47	15.82	0.31	0.32
0.33	779	7420	0.19	1.76	2.15	13.38	0.34	0.34
0.35	1057	8716	0.25	2.07	1.96	11.62	0.36	0.36
0.38	112710379		0.27	2.47	1.71	9.55	0.40	0.40
0.42	805	5985	0.19	1.42	1.44	7.08	0.43	0.43
0.45	814	6760	0.19	1.61	1.25	5.66	0.47	0.47
0.49	678	4908	0.16	1.17	1.06	4.05	0.51	0.51
0.53	680	4800	0.16	1.14	0.90	2.89	0.55	0.55
0.58	437	2721	0.10	0.65	0.74	1.75	0.60	0.60
0.62	528	2401	0.13	0.57	0.63	1.10	0.65	0.65
0.68	379	1079	0.09	0.26	0.51	0.53	0.70	0.70
0.73	358	648	0.09	0.15	0.42	0.27	0.76	0.76
0.80	253	54	0.06	0.01	0.33	0.12	0.83	0.83
0.86	296	91	0.07	0.02	0.27	0.11	0.90	0.90
0.94	155	42	0.04	0.01	0.20	0.08	0.97	0.97
1.00	202	76	0.05	0.02	0.16	0.07	1.05	1.05
1.10	118	68	0.03	0.02	0.12	0.06	1.14	1.14
1.20	83	32	0.02	0.01	0.09	0.04	1.25	1.24
1.30	85	22	0.02	0.01	0.07	0.03	1.35	1.36
1.40	45	25	0.01	0.01	0.05	0.03	1.44	1.44
1.50	64	50	0.02	0.01	0.04	0.02	1.60	1.60
1.70	19	11	0.00	0.00	0.02	0.01	1.76	1.76
1.80	10	6	0.00	0.00	0.02	0.01	1.84	1.86
1.90	25	8	0.01	0.00	0.01	0.01	1.99	2.01
2.10	14	12	0.00	0.00	0.01	0.00	2.19	2.22
2.30	8	2	0.00	0.00	0.01	0.00	2.37	2.31
2.50	4	0	0.00	0.00	0.00	0.00	2.62	0.00
2.70	3	0	0.00	0.00	0.00	0.00	2.80	0.00
2.90	3	0	0.00	0.00	0.00	0.00	3.02	0.00
3.20	2	0	0.00	0.00	0.00	0.00	3.22	0.00
3.40	1	0	0.00	0.00	0.00	0.00	3.46	0.00
3.70	0	0	0.00	0.00	0.00	0.00	0.00	0.00
4.10	1	0	0.00	0.00	0.00	0.00	4.17	0.00
4.40	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.03	0.12

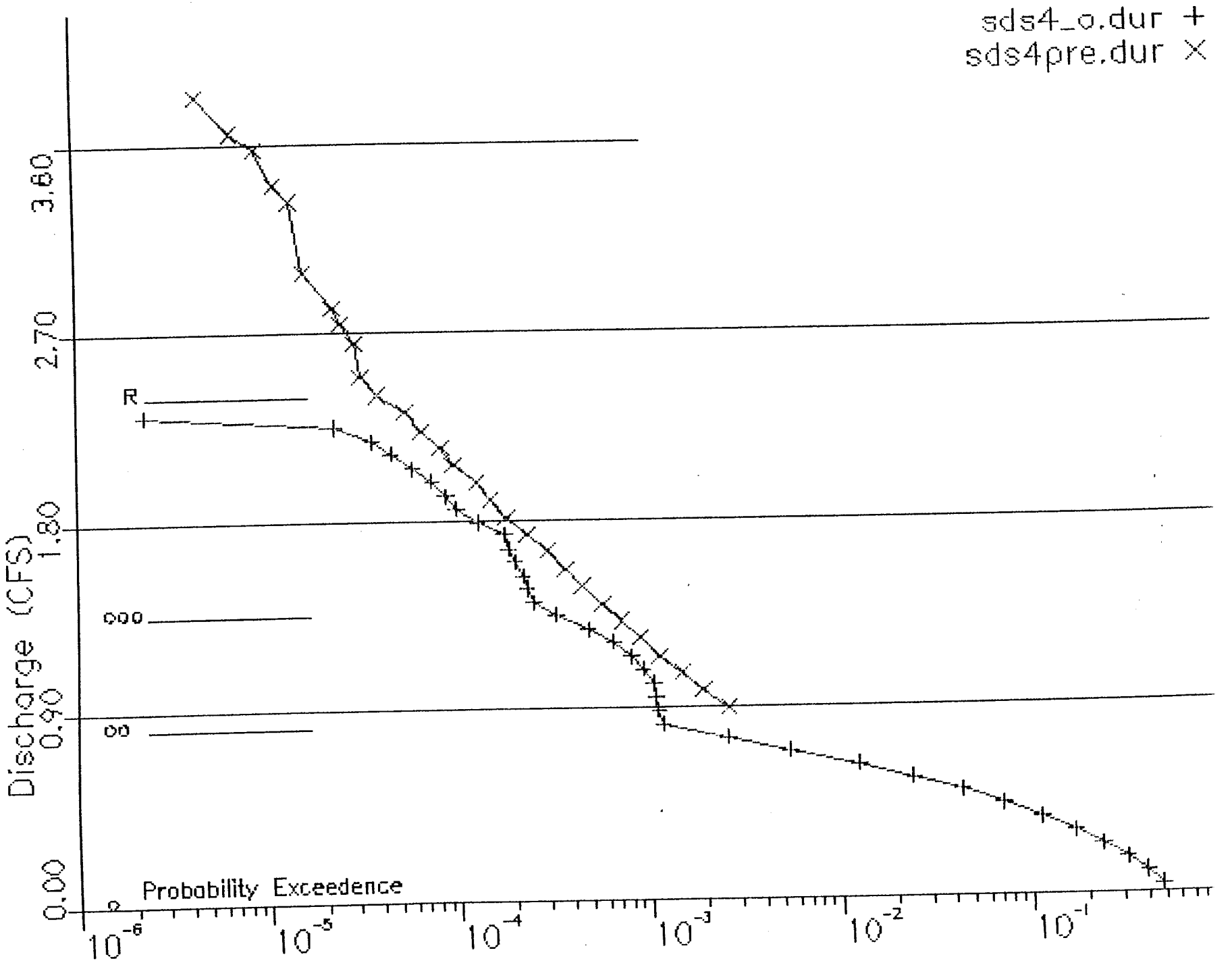
13083 Observed values are zero
118000 Simulated values are zero
13083 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
104917 Observed values are not zero when simulated are

1

Simulated - PREDEV SDS-4
Observed - 2006 SDS-4

Lower class limit	Number of occurrences between indicated deviations							
		-60%	-30%	-10%	0%	10%	30%	60%
0.00	325068	6279	2541	9848	931	1529	7997	0
0.30	8614	634	265	84	98	149	415	0
0.33	6185	529	189	69	70	103	275	0
0.35	7306	543	228	78	87	126	348	0
0.38	8622	760	304	100	77	141	375	0
0.42	4958	443	154	73	56	82	219	0
0.45	5553	521	206	74	58	98	250	0
0.49	4036	389	167	46	38	56	176	0
0.53	3879	426	153	58	52	78	154	0

0.58	2182	240	91	40	26	50	92	0
0.62	1888	263	82	26	20	30	92	0
0.68	831	137	35	7	9	17	43	0
0.73	522	54	20	7	7	9	29	0
0.80	46	3	1	1	0	1	2	0
0.86	68	15	1	1	1	2	3	0
0.94	31	3	0	1	2	0	5	0
1.00	59	8	3	2	0	3	1	0
1.10	52	8	1	3	1	2	1	0
1.20	25	2	1	1	1	1	1	0
1.30	17	1	1	1	0	1	1	0
1.40	19	4	0	1	1	0	0	0
1.50	33	12	1	0	0	2	2	0
1.70	6	3	2	0	0	0	0	0
1.80	3	2	0	0	1	0	0	0
1.90	6	1	0	1	0	0	0	0
2.10	8	2	2	0	0	0	0	0
2.30	0	2	0	0	0	0	0	0
2.50	0	0	0	0	0	0	0	0
2.70	0	0	0	0	0	0	0	0
2.90	0	0	0	0	0	0	0	0
3.20	0	0	0	0	0	0	0	0
3.40	0	0	0	0	0	0	0	0
3.70	0	0	0	0	0	0	0	0
4.10	0	0	0	0	0	0	0	0
4.40	0	0	0	0	0	0	0	0
	380017	11284	4448	10522	1536	2480	10481	0


sds4_o.dur +
sds4pre.dur ×
3.60
2.70
1.80
0.90
0.00
Discharge (CFS)
R
ooo
oo
Probability Exceedence
10^-6
10^-5
10^-4
10^-3
10^-2
10^-1

AR 010629

Retention/Detention Facility

Type of Facility:	Detention Vault	
Facility Length:	195.00	ft
Facility Width:	195.00	ft
Facility Area:	38025.	sq. ft
Effective Storage Depth:	15.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	570375.	cu. ft
Riser Head:	15.00	ft
Riser Diameter:	10.00	inches
Number of orifices:	3	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	3.00	0.945	
2	11.00	3.50	0.664	6.0
3	13.00	4.50	0.777	8.0

Top Notch Weir: None

Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)
0.00	0.00	0.	0.000	0.000	0.00
0.03	0.03	1141.	0.026	0.043	0.00
0.06	0.06	2282.	0.052	0.061	0.00
0.09	0.09	3422.	0.079	0.075	0.00
0.13	0.13	4943.	0.113	0.086	0.00
0.16	0.16	6084.	0.140	0.096	0.00
0.19	0.19	7225.	0.166	0.106	0.00
0.22	0.22	8366.	0.192	0.114	0.00
0.25	0.25	9506.	0.218	0.122	0.00
0.54	0.54	20534.	0.471	0.180	0.00
0.84	0.84	31941.	0.733	0.224	0.00
1.13	1.13	42968.	0.986	0.260	0.00
1.43	1.43	54376.	1.248	0.292	0.00
1.72	1.72	65403.	1.501	0.320	0.00
2.01	2.01	76430.	1.755	0.347	0.00
2.31	2.31	87838.	2.016	0.371	0.00
2.60	2.60	98865.	2.270	0.394	0.00
2.90	2.90	110273.	2.532	0.416	0.00
3.19	3.19	121300.	2.785	0.436	0.00
3.49	3.49	132707.	3.047	0.456	0.00
3.78	3.78	143735.	3.300	0.475	0.00
4.07	4.07	154762.	3.553	0.493	0.00
4.37	4.37	166169.	3.815	0.510	0.00
4.66	4.66	177197.	4.068	0.527	0.00
4.96	4.96	188604.	4.330	0.543	0.00
5.25	5.25	199631.	4.583	0.559	0.00
5.54	5.54	210659.	4.836	0.575	0.00
5.84	5.84	222066.	5.098	0.590	0.00
6.13	6.13	233093.	5.351	0.605	0.00
6.43	6.43	244501.	5.613	0.619	0.00
6.72	6.72	255528.	5.866	0.633	0.00
7.01	7.01	266555.	6.119	0.647	0.00

7.31	7.31	277963.	6.381	0.660	0.00
7.60	7.60	288990.	6.634	0.673	0.00
7.90	7.90	300398.	6.896	0.686	0.00
8.19	8.19	311425.	7.149	0.699	0.00
8.49	8.49	322832.	7.411	0.711	0.00
8.78	8.78	333860.	7.664	0.723	0.00
9.07	9.07	344887.	7.918	0.735	0.00
9.37	9.37	356294.	8.179	0.747	0.00
9.66	9.66	367322.	8.433	0.759	0.00
9.96	9.96	378729.	8.694	0.770	0.00
10.25	10.25	389756.	8.948	0.782	0.00
10.54	10.54	400784.	9.201	0.793	0.00
10.84	10.84	412191.	9.463	0.804	0.00
11.00	11.00	418275.	9.602	0.810	0.00
11.04	11.04	419796.	9.637	0.814	0.00
11.07	11.07	420937.	9.663	0.825	0.00
11.11	11.11	422458.	9.698	0.842	0.00
11.15	11.15	423979.	9.733	0.863	0.00
11.18	11.18	425120.	9.759	0.891	0.00
11.22	11.22	426641.	9.794	0.922	0.00
11.26	11.26	428162.	9.829	0.987	0.00
11.29	11.29	429302.	9.855	1.000	0.00
11.33	11.33	430823.	9.890	1.010	0.00
11.62	11.62	441851.	10.143	1.090	0.00
11.92	11.92	453258.	10.405	1.160	0.00
12.21	12.21	464285.	10.659	1.220	0.00
12.50	12.50	475313.	10.912	1.270	0.00
12.80	12.80	486720.	11.174	1.320	0.00
13.00	13.00	494325.	11.348	1.350	0.00
13.05	13.05	496226.	11.392	1.360	0.00
13.09	13.09	497747.	11.427	1.390	0.00
13.14	13.14	499649.	11.470	1.420	0.00
13.19	13.19	501550.	11.514	1.470	0.00
13.23	13.23	503071.	11.549	1.530	0.00
13.28	13.28	504972.	11.593	1.590	0.00
13.33	13.33	506873.	11.636	1.670	0.00
13.38	13.38	508775.	11.680	1.740	0.00
13.67	13.67	519802.	11.933	1.890	0.00
13.96	13.96	530829.	12.186	2.020	0.00
14.26	14.26	542237.	12.448	2.140	0.00
14.55	14.55	553264.	12.701	2.240	0.00
14.85	14.85	564671.	12.963	2.340	0.00
15.00	15.00	570375.	13.094	2.390	0.00
15.10	15.10	574178.	13.181	2.670	0.00
15.20	15.20	577980.	13.269	3.170	0.00
15.30	15.30	581783.	13.356	3.810	0.00
15.40	15.40	585585.	13.443	4.170	0.00
15.50	15.50	589388.	13.530	4.390	0.00
15.60	15.60	593190.	13.618	4.600	0.00
15.70	15.70	596993.	13.705	4.790	0.00
15.80	15.80	600795.	13.792	4.970	0.00
15.90	15.90	604598.	13.880	5.140	0.00
16.00	16.00	608400.	13.967	5.300	0.00
16.10	16.10	612203.	14.054	5.450	0.00
16.20	16.20	616005.	14.142	5.600	0.00
16.30	16.30	619808.	14.229	5.740	0.00
16.40	16.40	623610.	14.316	5.880	0.00

16.50	16.50	627413.	14.403	6.020	0.00
16.60	16.60	631215.	14.491	6.150	0.00
16.70	16.70	635018.	14.578	6.270	0.00
16.80	16.80	638820.	14.665	6.400	0.00
16.90	16.90	642623.	14.753	6.520	0.00

Route Time Series through Facility
Inflow Time Series File:sds4dev.tsf
Outflow Time Series File:sds4_o

Inflow/Outflow Analysis

Peak Inflow Discharge:	15.82	CFS	at	16:00	on Mar	3	in 1950
Peak Outflow Discharge:	2.32	CFS	at	20:00	on Feb	9	in 1951
Peak Reservoir Stage:	14.80	Ft					
Peak Reservoir Elev:	14.80	Ft					
Peak Reservoir Storage:	562952.	Cu-Ft					
:	12.924	Ac-Ft					

Flow Frequency Analysis — LogPearson III Coefficients
Time Series File:sds4pre.tsf — Mean= 0.266 StdDev= 0.129
Project Location:Sea-Tac DMoines — Skew= 0.787

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	Rank	Return Period	Prob
Computed Peaks			4.36		100.00	0.990
Computed Peaks			3.83		50.00	0.980
Computed Peaks			3.34		25.00	0.960
Computed Peaks			2.75		10.00	0.900
Computed Peaks			2.64		8.00	0.875
Computed Peaks			2.33		5.00	0.800
Computed Peaks			1.78		2.00	0.500
Computed Peaks			1.46		1.30	0.231

Flow Frequency Analysis — LogPearson III Coefficients
Time Series File:sds4_o.tsf — Mean= -0.105 StdDev= 0.180
Project Location:Sea-Tac DMoines — Skew= 1.552

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
Computed Peaks			3.15	15.20		100.00	0.990
Computed Peaks			2.46	15.03		50.00	0.980
Computed Peaks			1.92	13.73		25.00	0.960
Computed Peaks			1.36	13.05		10.00	0.900
Computed Peaks			1.27	12.52		8.00	0.875
Computed Peaks			1.04	11.44		5.00	0.800
Computed Peaks			0.709	8.45		2.00	0.500
Computed Peaks			0.573	5.51		1.30	0.231

Duration Comparison Anaylsis
Base File: sds4pre.tsf
New File: sds4_o.tsf
Cutoff Units: Discharge in CFS

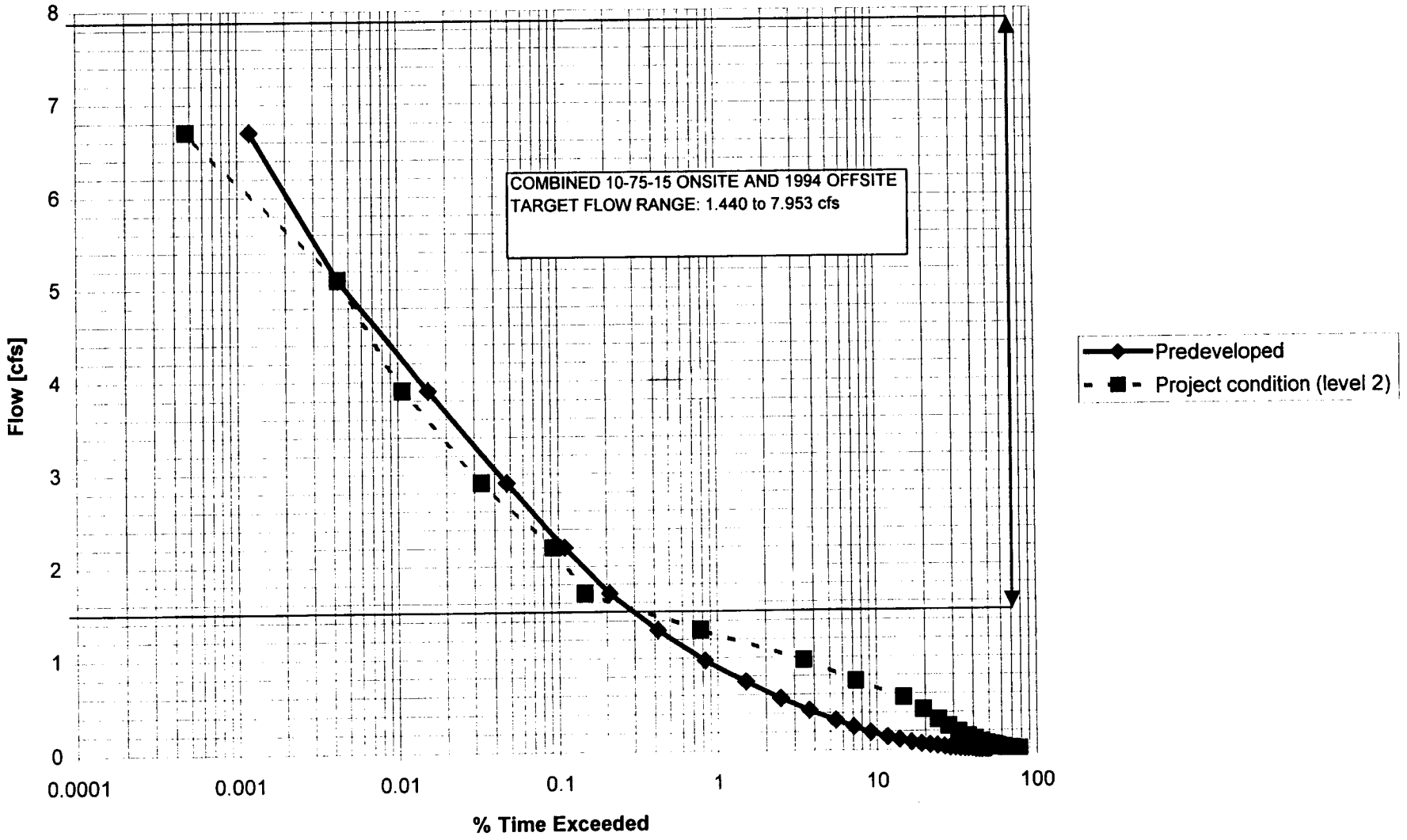
	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.890	0.26E-02	0.11E-02	-57.5	0.26E-02	0.890	0.750	-15.7
1.00	0.18E-02	0.11E-02	-41.6	0.18E-02	1.00	0.779	-22.1
1.11	0.13E-02	0.86E-03	-32.1	0.13E-02	1.11	0.805	-27.5
1.22	0.92E-03	0.61E-03	-33.8	0.92E-03	1.22	1.08	-11.3
1.33	0.69E-03	0.34E-03	-50.2	0.69E-03	1.33	1.19	-10.5
1.44	0.50E-03	0.24E-03	-52.9	0.50E-03	1.44	1.26	-12.6
1.55	0.37E-03	0.21E-03	-42.7	0.37E-03	1.55	1.32	-14.9
1.66	0.29E-03	0.19E-03	-34.4	0.29E-03	1.66	1.35	-18.5
1.77	0.21E-03	0.15E-03	-29.3	0.21E-03	1.77	1.57	-11.5
1.88	0.15E-03	0.94E-04	-38.8	0.15E-03	1.88	1.77	-6.2
1.99	0.12E-03	0.73E-04	-40.7	0.12E-03	1.99	1.81	-9.2
2.10	0.96E-04	0.48E-04	-50.0	0.96E-04	2.10	1.88	-10.8
2.21	0.73E-04	0.30E-04	-59.4	0.73E-04	2.21	2.01	-9.3
2.32	0.55E-04	0.00E+00	-100.0	0.55E-04	2.32	2.08	-10.7
2.43	0.39E-04	0.00E+00	-100.0	0.39E-04	2.43	2.17	-10.8
2.55	0.30E-04	0.00E+00	-100.0	0.30E-04	2.55	2.22	-12.7
2.66	0.30E-04	0.00E+00	-100.0	0.30E-04	2.66	2.22	-16.4
2.77	0.23E-04	0.00E+00	-100.0	0.23E-04	2.77	2.25	-18.7
2.88	0.16E-04	0.00E+00	-100.0	0.16E-04	2.88	2.27	-21.1
2.99	0.16E-04	0.00E+00	-100.0	0.16E-04	2.99	2.27	-24.0
3.10	0.14E-04	0.00E+00	-100.0	0.14E-04	3.10	2.27	-26.6
3.21	0.14E-04	0.00E+00	-100.0	0.14E-04	3.21	2.27	-29.1
3.32	0.14E-04	0.00E+00	-100.0	0.14E-04	3.32	2.27	-31.5
3.43	0.91E-05	0.00E+00	-100.0	0.91E-05	3.43	2.28	-33.5
3.54	0.91E-05	0.00E+00	-100.0	0.91E-05	3.54	2.28	-35.6
3.65	0.91E-05	0.00E+00	-100.0	0.91E-05	3.65	2.28	-37.5
3.76	0.46E-05	0.00E+00	-100.0	0.46E-05	3.76	2.30	-38.7
3.87	0.46E-05	0.00E+00	-100.0	0.46E-05	3.87	2.30	-40.5
3.98	0.23E-05	0.00E+00	-100.0	0.23E-05	3.98	2.32	-41.8
4.09	0.23E-05	0.00E+00	-100.0	0.23E-05	4.09	2.32	-43.3
4.20	0.23E-05	0.00E+00	-100.0	0.23E-05	4.20	2.32	-44.8
4.31	0.23E-05	0.00E+00	-100.0	0.23E-05	4.31	2.32	-46.2

There is no positive excursion

Maximum negative excursion = 1.99 cfs (-46.2%)
occuring at 4.31 cfs on the Base Data:sds4pre.tsf
and at 2.32 cfs on the New Data:sds4_o.tsf

SDS7

SDS7



AR 010637

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SIMULATED FLOW @ SDS-7

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

3.633	8.587	5.187	2.416	2.500
2.872	3.801	3.803	2.931	2.450
2.399	3.336	3.001	1.946	2.915
3.424	2.498	2.820	4.711	3.424
2.690	2.771	2.432	6.006	2.643
2.588	3.427	2.178	2.068	2.971
2.542	3.042	2.991	2.562	2.611
3.129	1.906	4.905	3.430	1.577
1.683	8.035	6.483	2.619	1.828
1.444	2.791	6.299		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.482
Variance (logs)	0.029
Standard Deviation (logs)	0.170
Skewness (logs)	0.803
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.187
Coefficient of Variation (logs)	0.354

1

PREDEV SIMULATED FLOW @ SDS-7

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	1.538
0.9500	1.05	1.760
0.9000	1.11	1.920
0.8000	1.25	2.168
0.5000	2.00	2.880
0.2000	5.00	4.121
0.1000	10.00	5.128
0.0400	25.00	6.638
0.0200	50.00	7.953
0.0100	100.00	9.447
0.0050	200.00	11.150

$1/2\,Q_2 = 1.440$

$Q_{50} = 7.953$

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SIMULATED FLOW @ SDS-7

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

1.156	1.540	6.504	1.023	1.159
1.272	1.352	1.543	1.275	1.358
1.160	2.359	1.295	0.865	1.319
1.280	1.503	1.184	1.340	1.207
1.176	1.261	1.328	3.671	1.438
1.381	1.233	1.275	0.856	1.310
0.900	3.503	1.197	1.378	1.350
1.017	0.962	1.709	2.119	1.076
0.886	3.264	4.067	1.379	1.103
0.854	1.424	7.379		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.167
Variance (logs)	0.044
Standard Deviation (logs)	0.210
Skewness (logs)	1.877
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.001
Coefficient of Variation (logs)	1.261

1

2006 SIMULATED FLOW @ SDS-7

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	0.883
0.9500	1.05	0.908
0.9000	1.11	0.938
0.8000	1.25	1.001
0.5000	2.00	1.275
0.2000	5.00	1.993
0.1000	10.00	2.773
0.0400	25.00	4.271
0.0200	50.00	5.908
0.0100	100.00	8.162
0.0050	200.00	11.266

SDS7 - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	Flow [cfs]
100	100	0
50.6272	78.1148	0
48.9241	77.0508	0
47.0704	75.8691	0
45.0196	74.4241	0
43.1896	73.079	0
41.1956	71.5085	0
39.3359	69.9564	0.01
37.2659	68.1551	0.01
35.2852	66.3247	0.01
33.0617	64.1855	0.01
30.7542	61.9108	0.02
28.4805	59.6215	0.02
26.3231	57.3207	0.03
23.7528	54.4041	).04
21.36	51.5106	0.05
18.8524	48.3136	0.06
16.2983	44.7681	0.08
13.6724	40.7481	0.11
11.5817	37.2148	0.14
9.12807	32.4533	0.19
7.06993	28.0903	0.25
5.41177	24.1946	0.32
3.72533	19.5143	0.43
2.47595	14.69	0.56
1.49108	7.37247	0.74
0.83062	3.46224	0.97
0.41923	0.77905	1.3
0.2089	0.14569	1.7
0.10861	0.09269	2.2
0.04753	0.03327	2.9
0.01545	0.01069	3.9
0.00428	0.00428	5.1
0.00119	0.00048	6.7
0	0	8.8

1

Simulated - PREDEV SIMULATED FLOW @ SDS-7
Observed - 2006 SIMULATED FLOW @ SDS-7

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	92086	0.000	*	0.000	*	0.000	*
0.00	4477	0.001	100.5	0.001	104.4	-0.001	-96.7
0.00	4972	0.002	102.4	0.002	111.3	-0.001	-93.4
0.00	6080	0.002	102.2	0.002	111.2	-0.002	-93.2
0.00	5660	0.003	102.4	0.003	112.1	-0.002	-92.6
0.00	6608	0.004	102.0	0.004	110.8	-0.003	-92.3
0.00	6531	0.005	101.7	0.005	110.5	-0.004	-91.9
0.01	7579	0.006	102.7	0.007	114.2	-0.005	-89.5
0.01	7702	0.008	103.0	0.009	115.9	-0.007	-88.2
0.01	9001	0.011	102.8	0.012	116.4	-0.009	-87.4
0.01	9571	0.014	102.6	0.016	115.4	-0.012	-87.3
0.02	9633	0.019	103.2	0.022	116.6	-0.016	-84.8
0.02	9681	0.024	101.9	0.027	114.6	-0.020	-84.9
0.03	12272	0.032	100.8	0.035	112.7	-0.026	-83.6
0.04	12175	0.041	100.3	0.046	111.4	-0.034	-82.4
0.05	13452	0.054	99.5	0.060	110.1	-0.044	-81.4
0.06	14918	0.069	96.6	0.076	105.5	-0.058	-80.5
0.08	16915	0.091	95.4	0.099	103.5	-0.076	-79.7
0.11	14867	0.117	94.1	0.127	101.8	-0.097	-77.9
0.14	20035	0.148	90.5	0.159	96.6	-0.126	-77.1
0.19	18358	0.191	87.6	0.202	92.7	-0.167	-76.3
0.25	16392	0.241	84.9	0.253	88.9	-0.214	-75.3
0.32	19693	0.304	81.8	0.319	85.6	-0.277	-74.6
0.43	20299	0.401	79.7	0.421	83.4	-0.371	-73.6
0.56	30790	0.493	77.2	0.521	81.4	-0.455	-71.3
0.74	16453	0.619	74.0	0.660	78.6	-0.562	-67.2
0.97	11290	0.775	69.8	0.834	74.9	-0.696	-62.8
1.30	2665	0.898	63.8	0.993	70.4	-0.751	-53.6
1.70	223	1.169	58.9	1.275	63.9	-0.956	-48.4
2.20	250	1.299	53.3	1.379	56.7	-1.060	-43.6
2.90	95	1.298	39.3	1.411	42.8	-1.096	-33.0
3.90	27	1.361	31.7	1.464	33.8	-1.280	-29.7
5.10	16	2.067	35.6	2.203	37.9	-2.067	-35.6
6.70	2	3.041	42.6	3.041	42.7	-3.041	-42.6
8.80	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.163	*	0.291	*	-0.146	*

Standard error of estimate = 0.25
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SIMULATED FLOW @ SDS-7
Observed - 2006 SIMULATED FLOW @ SDS-7

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	92086	49.37	21.89	100.00	100.00	0.00	0.00
0.00	7166	4477	1.70	1.06	50.63	78.11	0.00	0.00
0.00	7800	4972	1.85	1.18	48.92	77.05	0.00	0.00
0.00	8629	6080	2.05	1.44	47.07	75.87	0.00	0.00
0.00	7700	5660	1.83	1.35	45.02	74.42	0.00	0.00
0.00	8390	6608	1.99	1.57	43.19	73.08	0.00	0.00
0.00	7825	6531	1.86	1.55	41.20	71.51	0.00	0.00
0.01	8710	7579	2.07	1.80	39.34	69.96	0.01	0.01
0.01	8334	7702	1.98	1.83	37.27	68.16	0.01	0.01
0.01	9356	9001	2.22	2.14	35.29	66.32	0.01	0.01
0.01	9709	9571	2.31	2.27	33.06	64.19	0.01	0.01
0.02	9567	9633	2.27	2.29	30.75	61.91	0.02	0.02
0.02	9078	9681	2.16	2.30	28.48	59.62	0.02	0.02
0.03	1081	512272	2.57	2.92	26.32	57.32	0.03	0.03
0.04	1006	812175	2.39	2.89	23.75	54.40	0.04	0.04
0.05	1055	113452	2.51	3.20	21.36	51.51	0.05	0.05
0.06	1074	714918	2.55	3.55	18.85	48.31	0.07	0.07
0.08	1104	916915	2.63	4.02	16.30	44.77	0.10	0.10
0.11	879	714867	2.09	3.53	13.67	40.75	0.12	0.12
0.14	1032	420035	2.45	4.76	11.58	37.21	0.16	0.16
0.19	866	018358	2.06	4.36	9.13	32.45	0.22	0.22
0.25	697	716392	1.66	3.90	7.07	28.09	0.28	0.28
0.32	709	619693	1.69	4.68	5.41	24.19	0.37	0.37
0.43	525	720299	1.25	4.82	3.73	19.51	0.49	0.50
0.56	414	430790	0.98	7.32	2.48	14.69	0.64	0.64
0.74	277	916453	0.66	3.91	1.49	7.37	0.84	0.84
0.97	173	111290	0.41	2.68	0.83	3.46	1.11	1.11
1.30	885	2665	0.21	0.63	0.42	0.78	1.47	1.41
1.70	422	223	0.10	0.05	0.21	0.15	1.91	1.98
2.20	257	250	0.06	0.06	0.11	0.09	2.50	2.45
2.90	135	95	0.03	0.02	0.05	0.03	3.31	3.32
3.90	47	27	0.01	0.01	0.02	0.01	4.38	4.27
5.10	13	16	0.00	0.00	0.00	0.00	5.69	5.81
6.70	5	2	0.00	0.00	0.00	0.00	7.80	7.14
8.80	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.06	0.21

6831 Observed values are zero
96528 Simulated values are zero
6831 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
89697 Observed values are not zero when simulated are

1

Simulated - PREDEV SIMULATED FLOW @ SDS-7
Observed - 2006 SIMULATED FLOW @ SDS-7

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	87662	12	7	4260	3	5	137	0
0.00	4434	9	2	1	1	4	26	0
0.00	4891	9	5	7	2	7	51	0
0.00	5973	20	14	5	2	3	63	0
0.00	5552	32	7	0	3	1	65	0
0.00	6464	39	10	2	3	6	84	0
0.00	6399	21	8	7	3	7	86	0
0.01	7374	27	17	5	7	13	136	0

0.01	7477	33	16	5	8	11	152	0
0.01	8700	56	26	10	7	15	187	0
0.01	9249	61	25	11	13	9	203	0
0.02	9227	73	35	12	7	21	258	0
0.02	9240	98	43	13	10	17	260	0
0.03	11587	158	61	21	18	57	370	0
0.04	11430	157	76	29	18	49	416	0
0.05	12546	199	88	38	39	52	490	0
0.06	13675	350	125	63	54	93	558	0
0.08	15418	407	171	70	58	124	667	0
0.11	13380	421	162	73	79	93	659	0
0.14	17667	785	321	105	111	177	869	0
0.19	15972	880	325	134	110	175	762	0
0.25	14014	884	366	127	143	173	685	0
0.32	16550	1436	487	189	148	235	648	0
0.43	16511	1906	618	212	162	263	627	0
0.56	24416	3308	1076	345	302	427	916	0
0.74	12312	2352	661	197	161	234	536	0
0.97	7847	1920	625	196	116	198	388	0
1.30	1587	657	160	58	37	46	120	0
1.70	126	56	17	3	1	8	12	0
2.20	69	143	11	3	3	4	17	0
2.90	14	58	12	2	4	1	4	0
3.90	0	15	9	2	0	1	0	0
5.10	0	12	3	1	0	0	0	0
6.70	0	2	0	0	0	0	0	0
8.80	0	0	0	0	0	0	0	0
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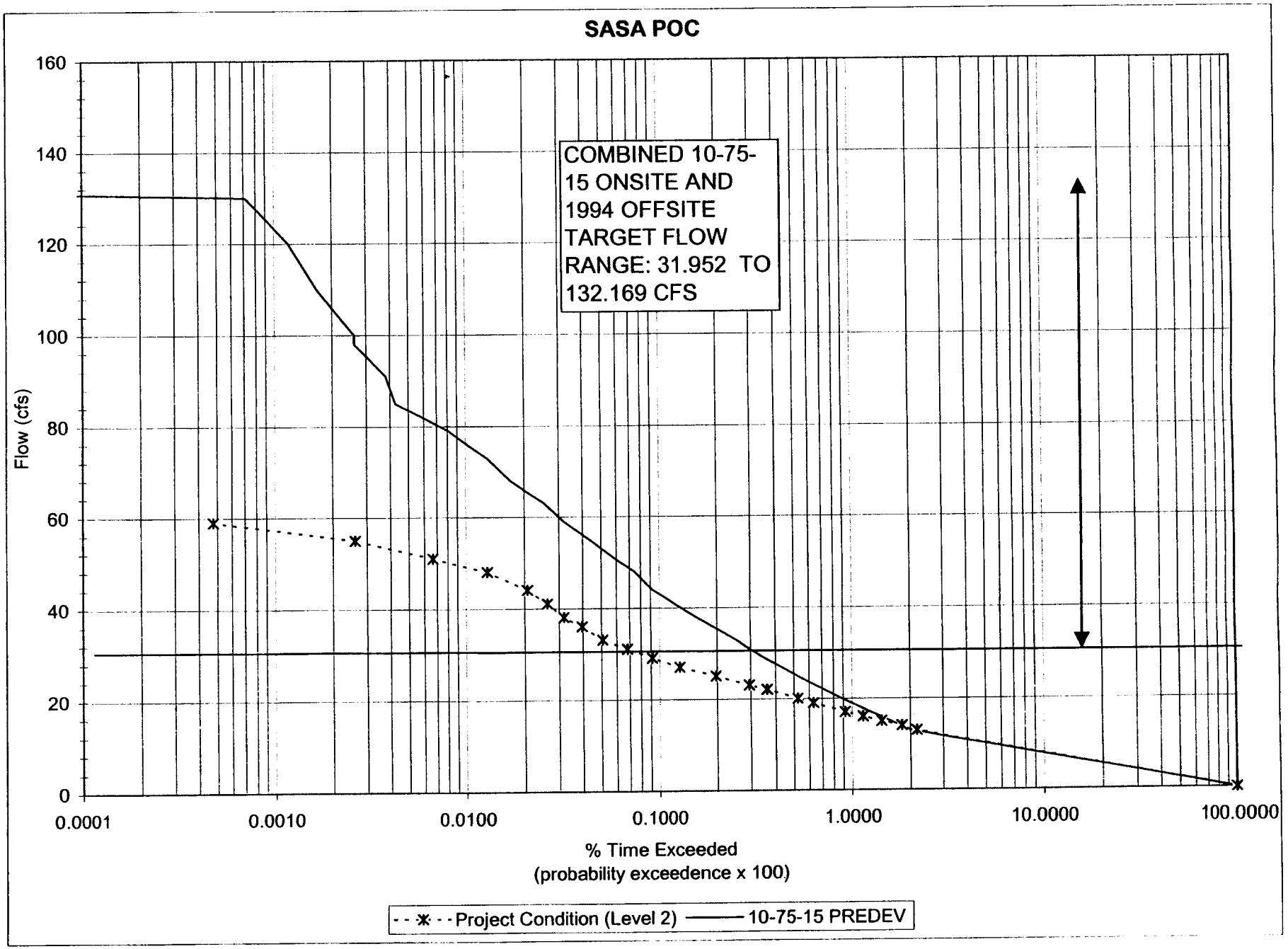
	377763	16596	5589	6206	1633	2529	10452	0

SASA


SASA POC
COMBINED 10-75-15 ONSITE AND 1994 OFFSITE TARGET FLOW RANGE: 31.952 TO 132.169 CFS
Flow (cfs)
160
140
120
100
80
60
40
20
0
0.0001
0.0010
0.0100
0.1000
1.0000
10.0000
100.0000
% Time Exceeded
(probability exceedence x 100)
Project Condition (Level 2)
10-75-15 PREDEV

AR 010645

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

STIA FLOW PREDEV SD34 SDS1 SASA

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

73.632	135.722	84.919	51.285	53.338
62.586	71.288	67.897	70.916	61.171
47.655	64.416	59.859	50.581	56.395
70.826	56.892	59.352	83.054	84.648
55.287	60.174	52.688	101.459	55.615
55.186	75.445	52.450	56.742	76.187
64.717	72.045	74.751	110.667	67.736
60.880	51.160	83.737	79.136	40.694
44.999	136.619	119.201	59.882	36.964
40.195	55.036	100.612		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.819
Variance (logs)	0.016
Standard Deviation (logs)	0.128
Skewness (logs)	0.624
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.210
Coefficient of Variation (logs)	0.070

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STIA FLOW PREDEV SD34 SDS1 SASA

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	38.122
0.9500	1.05	43.038
0.9000	1.11	46.360
0.8000	1.25	51.214
0.5000	2.00	63.904
0.2000	5.00	83.254
0.1000	10.00	97.345
0.0400	25.00	116.654
0.0200	50.00	132.169
0.0100	100.00	148.687
0.0050	200.00	166.367

$\frac{1}{2}Q_2 = 31.952$

$Q_{50} = 132.169$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

27.039	29.179	59.112	21.741	23.364
23.110	36.235	27.551	29.154	27.556
25.123	47.716	26.062	18.846	25.436
23.531	27.889	21.173	31.730	23.799
26.255	24.636	25.661	38.612	24.308
21.864	32.190	24.410	20.050	25.865
20.499	37.410	23.981	54.795	28.337
22.778	26.038	49.952	50.531	22.894
18.201	59.943	56.266	24.205	24.265
17.888	27.699	53.919		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.457
Variance (logs)	0.020
Standard Deviation (logs)	0.143
Skewness (logs)	1.026
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.012
Coefficient of Variation (logs)	0.098

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STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	17.112
0.9500	1.05	18.656
0.9000	1.11	19.826
0.8000	1.25	21.677
0.5000	2.00	27.129
0.2000	5.00	36.734
0.1000	10.00	44.536
0.0400	25.00	56.203
0.0200	50.00	66.335
0.0100	100.00	77.821
0.0050	200.00	90.876

$\frac{1}{2}Q_2 = 13.565$
$Q_{50} = 66.335$

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Simulated - STIA FLOW PREDEV SD34 SDS1 SASA
Observed - STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Lower class limit	Number of cases	Mean absolute error(1) Average	Mean absolute error(1) Percent	Root mean square error(2) Average	Root mean square error(2) Percent	Bias(3) Average	Bias(3) Percent
0.00	411654	0.715	1375.6	1.671	2943.0	-0.335	1318.2
13.00	1457	6.547	48.2	8.081	59.5	-0.886	-6.5
14.00	1669	7.503	51.8	9.430	65.1	-0.889	-6.1
15.00	1185	8.172	52.8	10.128	65.4	-0.678	-4.3
16.00	916	8.789	53.3	11.156	67.7	-0.331	-2.0
17.00	1227	9.342	52.0	11.661	64.9	-0.958	-5.3
19.00	451	10.948	56.2	13.697	70.3	-1.190	-6.1
20.00	680	11.012	52.6	13.780	65.8	-1.981	-9.4
22.00	287	12.095	53.8	14.798	65.8	-1.928	-8.5
23.00	413	12.614	52.7	16.280	68.0	-1.692	-7.1
25.00	287	13.240	51.1	16.843	65.0	-2.168	-8.4
27.00	156	13.696	49.2	17.147	61.6	-0.667	-2.3
29.00	99	15.105	50.7	20.798	69.9	-0.370	-1.2
31.00	73	15.687	49.2	20.546	64.2	-0.417	-1.2
33.00	47	17.097	49.8	20.117	58.7	-3.787	-10.9
36.00	33	18.018	48.9	25.069	68.1	0.368	1.0
38.00	24	18.379	46.6	22.382	56.6	-5.943	-15.3
41.00	23	17.633	41.7	21.667	51.6	-4.900	-11.5
44.00	33	22.229	48.1	27.363	59.1	-0.508	-1.4
48.00	26	12.108	24.4	14.423	29.1	-3.763	-7.6
51.00	17	17.828	33.6	21.259	40.0	-0.704	-1.5
55.00	9	16.703	29.8	24.643	43.8	4.808	8.5
59.00	2	6.419	10.8	6.859	11.6	6.419	10.8
63.00	0	0.000	0.0	0.000	0.0	0.000	0.0
68.00	0	0.000	0.0	0.000	0.0	0.000	0.0
73.00	0	0.000	0.0	0.000	0.0	0.000	0.0
79.00	0	0.000	0.0	0.000	0.0	0.000	0.0
85.00	0	0.000	0.0	0.000	0.0	0.000	0.0
91.00	0	0.000	0.0	0.000	0.0	0.000	0.0
98.00	0	0.000	0.0	0.000	0.0	0.000	0.0
100.00	0	0.000	0.0	0.000	0.0	0.000	0.0
110.00	0	0.000	0.0	0.000	0.0	0.000	0.0
120.00	0	0.000	0.0	0.000	0.0	0.000	0.0
130.00	0	0.000	0.0	0.000	0.0	0.000	0.0
140.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.901	1346.9	2.432	2911.0	-0.350	1289.5

Standard error of estimate = 2.41
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

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Simulated - STIA FLOW PREDEV SD34 SDS1 SASA
Observed - STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

AR 010648

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		97.97	97.83	100.00	100.00	0.78	1.20
13.00	1020	1457	0.24	0.35	2.03	2.17	13.48	13.57
14.00	870	1669	0.21	0.40	1.78	1.82	14.50	14.47
15.00	737	1185	0.18	0.28	1.58	1.42	15.48	15.49
16.00	688	916	0.16	0.22	1.40	1.14	16.47	16.49
17.00	1050	1227	0.25	0.29	1.24	0.92	17.91	17.95
19.00	451	451	0.11	0.11	0.99	0.63	19.49	19.48
20.00	723	680	0.17	0.16	0.88	0.52	20.94	20.91
22.00	299	287	0.07	0.07	0.71	0.36	22.47	22.51
23.00	522	413	0.12	0.10	0.64	0.30	23.92	23.94
25.00	389	287	0.09	0.07	0.52	0.20	25.92	25.94
27.00	315	156	0.07	0.04	0.42	0.13	27.98	27.81
29.00	231	99	0.05	0.02	0.35	0.09	30.03	29.83
31.00	188	73	0.04	0.02	0.29	0.07	32.03	31.90
33.00	259	47	0.06	0.01	0.25	0.05	34.39	34.32
36.00	133	33	0.03	0.01	0.19	0.04	36.94	36.86
38.00	152	24	0.04	0.01	0.16	0.03	39.43	39.29
41.00	117	23	0.03	0.01	0.12	0.03	42.39	42.33
44.00	74	33	0.02	0.01	0.09	0.02	45.84	46.33
48.00	66	26	0.02	0.01	0.07	0.01	49.46	49.40
51.00	62	17	0.01	0.00	0.06	0.01	52.53	53.24
55.00	50	9	0.01	0.00	0.04	0.00	56.74	56.21
59.00	28	2	0.01	0.00	0.03	0.00	60.82	59.53
63.00	35	0	0.01	0.00	0.03	0.00	65.36	0.00
68.00	17	0	0.00	0.00	0.02	0.00	70.74	0.00
73.00	20	0	0.00	0.00	0.01	0.00	76.32	0.00
79.00	16	0	0.00	0.00	0.01	0.00	81.55	0.00
85.00	2	0	0.00	0.00	0.00	0.00	88.22	0.00
91.00	5	0	0.00	0.00	0.00	0.00	94.00	0.00
98.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
100.00	4	0	0.00	0.00	0.00	0.00	103.54	0.00
110.00	2	0	0.00	0.00	0.00	0.00	114.93	0.00
120.00	2	0	0.00	0.00	0.00	0.00	123.83	0.00
130.00	3	0	0.00	0.00	0.00	0.00	134.47	0.00
140.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420	768	420	768	100.00	100.00	1.22	1.57

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Simulated - STIA FLOW PREDEV SD34 SDS1 SASA
Observed - STIA FLOW SDE4/SDS1/SASA INTO E.BRANCH

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	94991	83137	31739	13618	12647	18079	157443	0
13.00	245	386	175	81	76	146	348	0
14.00	308	462	170	99	93	127	410	0
15.00	209	338	135	65	64	72	302	0
16.00	155	259	105	43	40	69	245	0
17.00	226	339	139	71	54	97	301	0
19.00	93	131	54	17	16	34	106	0
20.00	130	219	61	36	27	58	149	0
22.00	50	102	32	8	13	13	69	0
23.00	64	146	45	25	12	29	92	0
25.00	37	116	31	12	9	16	66	0
27.00	19	52	20	8	4	17	36	0
29.00	14	31	13	5	3	10	23	0
31.00	7	29	7	4	1	8	17	0
33.00	8	21	1	2	3	1	11	0
36.00	4	9	6	2	3	1	8	0
38.00	2	13	1	3	0	1	4	0

41.00	4	7	2	0	3	4	3	0
44.00	2	13	4	2	0	5	7	0
48.00	1	7	4	2	5	5	2	0
51.00	0	5	4	1	2	1	4	0
55.00	0	1	2	1	2	1	2	0
59.00	0	0	0	0	1	1	0	0
63.00	0	0	0	0	0	0	0	0
68.00	0	0	0	0	0	0	0	0
73.00	0	0	0	0	0	0	0	0
79.00	0	0	0	0	0	0	0	0
85.00	0	0	0	0	0	0	0	0
91.00	0	0	0	0	0	0	0	0
98.00	0	0	0	0	0	0	0	0
100.00	0	0	0	0	0	0	0	0
110.00	0	0	0	0	0	0	0	0
120.00	0	0	0	0	0	0	0	0
130.00	0	0	0	0	0	0	0	0
140.00	0	0	0	0	0	0	0	0
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	96569	85823	32750	14105	13078	18795	159648	0

Retention/Detention Facility SASA

KCRTS DATA USED IN HSPF MODEL FOR SASA RETROFIT INCLUDING INLINE TRIBUTARY AREA

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	484.77	ft
Pond Bottom Width:	242.38	ft
Pond Bottom Area:	117500.	sq. ft
Top Area at 1 ft. FB:	191044.	sq. ft
	4.386	acres
Effective Storage Depth:	14.00	ft
Stage 0 Elevation:	0.00	ft
Storage Volume:	2105493.	cu. ft
	48.335	ac-ft
Riser Head:	14.00	ft
Riser Diameter:	48.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	21.00	44.746	
2	6.50	12.00	10.694	15.0

Top Notch Weir:	Rectangular	
Length:	36.00	in
Weir Height:	9.00	ft
Outflow Rating Curve:	None	

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	0.00	0.	0.000	0.000	0.00	117500.
0.22	0.22	25956.	0.596	5.590	0.00	118462.
0.44	0.44	52123.	1.197	7.910	0.00	119427.
0.66	0.66	78504.	1.802	9.690	0.00	120395.
0.88	0.88	105097.	2.413	11.190	0.00	121367.
1.09	1.09	130682.	3.000	12.510	0.00	122298.
1.31	1.31	157696.	3.620	13.700	0.00	123277.
1.53	1.53	184925.	4.245	14.800	0.00	124260.
1.75	1.75	212370.	4.875	15.820	0.00	125245.
2.02	2.02	246350.	5.655	17.020	0.00	126460.
2.30	2.30	281936.	6.472	18.140	0.00	127725.
2.57	2.57	316587.	7.268	19.190	0.00	128950.
2.85	2.85	352872.	8.101	20.190	0.00	130227.
3.12	3.12	388200.	8.912	21.140	0.00	131463.
3.40	3.40	425189.	9.761	22.050	0.00	132750.
3.67	3.67	461200.	10.588	22.920	0.00	133997.
3.95	3.95	498901.	11.453	23.760	0.00	135295.
4.22	4.22	535600.	12.296	24.570	0.00	136553.
4.50	4.50	574018.	13.178	25.360	0.00	137862.
4.77	4.77	611412.	14.036	26.120	0.00	139130.
5.04	5.04	649149.	14.902	26.870	0.00	140404.
5.32	5.32	688647.	15.809	27.590	0.00	141730.
5.59	5.59	727088.	16.692	28.290	0.00	143014.
5.87	5.87	767318.	17.615	28.980	0.00	144351.
6.14	6.14	806468.	18.514	29.650	0.00	145645.
6.42	6.42	847437.	19.454	30.300	0.00	146994.

6.50	6.50	859212.	19.725	30.500	0.00	147380.
6.63	6.63	878412.	20.166	30.850	0.00	148009.
6.75	6.75	896208.	20.574	31.310	0.00	148590.
6.88	6.88	915566.	21.018	31.870	0.00	149221.
7.00	7.00	933507.	21.430	32.530	0.00	149804.
7.13	7.13	953023.	21.878	33.260	0.00	150438.
7.25	7.25	971111.	22.294	35.590	0.00	151023.
7.38	7.38	990785.	22.745	36.140	0.00	151659.
7.50	7.50	1009019.	23.164	36.660	0.00	152247.
7.77	7.77	1050305.	24.112	37.760	0.00	153573.
8.05	8.05	1093499.	25.103	38.800	0.00	154954.
8.32	8.32	1135517.	26.068	39.790	0.00	156291.
8.60	8.60	1179473.	27.077	40.730	0.00	157684.
8.87	8.87	1222230.	28.059	41.650	0.00	159031.
9.00	9.00	1242946.	28.534	42.060	0.00	159682.
9.27	9.27	1286243.	29.528	44.320	0.00	161038.
9.55	9.55	1331531.	30.568	47.660	0.00	162449.
9.82	9.82	1375577.	31.579	51.620	0.00	163815.
10.10	10.10	1421644.	32.636	56.040	0.00	165238.
10.37	10.37	1466444.	33.665	60.810	0.00	166615.
10.65	10.65	1513297.	34.741	65.860	0.00	168048.
10.92	10.92	1558857.	35.786	71.120	0.00	169436.
11.20	11.20	1606501.	36.880	76.550	0.00	170880.
11.47	11.47	1652827.	37.944	82.110	0.00	172279.
11.75	11.75	1701269.	39.056	87.750	0.00	173734.
12.02	12.02	1748368.	40.137	93.450	0.00	175144.
12.29	12.29	1795847.	41.227	99.160	0.00	176558.
12.57	12.57	1845489.	42.367	104.870	0.00	178030.
12.84	12.84	1893750.	43.475	110.550	0.00	179455.
13.12	13.12	1944204.	44.633	116.170	0.00	180938.
13.39	13.39	1993252.	45.759	121.700	0.00	182374.
13.67	13.67	2044525.	46.936	127.130	0.00	183868.
13.94	13.94	2094365.	48.080	132.430	0.00	185315.
14.00	14.00	2105493.	48.335	133.540	0.00	185637.
14.10	14.10	2124084.	48.762	135.000	0.00	186174.
14.20	14.20	2142728.	49.190	137.490	0.00	186712.
14.30	14.30	2161427.	49.620	140.630	0.00	187251.
14.40	14.40	2180178.	50.050	144.310	0.00	187791.
14.50	14.50	2198985.	50.482	148.460	0.00	188331.
14.60	14.60	2217845.	50.915	153.020	0.00	188872.
14.70	14.70	2236759.	51.349	157.950	0.00	189414.
14.80	14.80	2255728.	51.784	163.230	0.00	189957.
14.90	14.90	2274750.	52.221	168.840	0.00	190500.
15.00	15.00	2293828.	52.659	174.760	0.00	191044.
15.10	15.10	2312959.	53.098	180.970	0.00	191588.
15.20	15.20	2332145.	53.539	187.450	0.00	192134.
15.30	15.30	2351386.	53.980	194.210	0.00	192680.
15.40	15.40	2370681.	54.423	201.210	0.00	193227.
15.50	15.50	2390031.	54.868	208.470	0.00	193774.
15.60	15.60	2409436.	55.313	213.660	0.00	194322.
15.70	15.70	2428896.	55.760	216.230	0.00	194871.
15.80	15.80	2448410.	56.208	218.730	0.00	195421.
15.90	15.90	2467980.	56.657	221.170	0.00	195971.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	184.48	*******	128.47	13.74	13.74	2057151.	47.226

DES MOINES CREEK WATERSHED
ADDITIONAL POINTS OF COMPLIANCE PERFORMANCE DATA

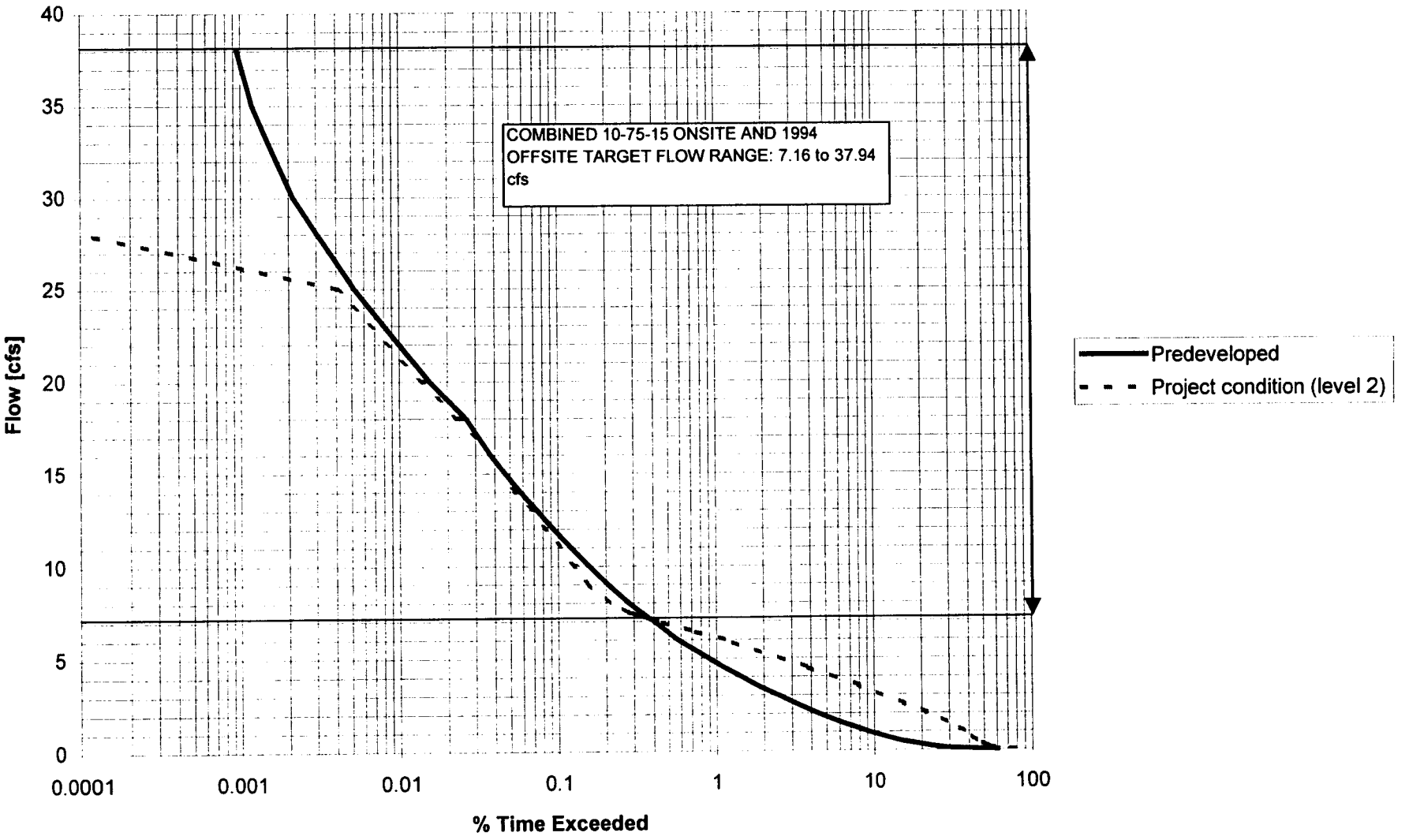
- SDS POC-1
- SDS POC-2
- SASA INLINE FACILITY ANALYSIS
- SOUTH 200TH STREET

July 2001
556-2912-001 (28)

SDS POC-1

July 2001
556-2912-001 (28)

SDS POC-1



AR 010655

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS POC-1 (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

18.765	37.704	26.767	12.075	12.852
13.810	19.464	18.045	14.404	12.938
10.946	16.067	14.014	9.464	13.085
17.860	12.157	13.746	23.709	15.884
13.804	14.807	12.211	27.283	13.772
12.237	15.963	11.295	10.664	15.058
11.511	16.125	14.966	13.554	13.079
13.979	10.336	24.189	18.052	8.459
8.069	39.666	31.663	13.153	9.467
7.434	14.051	30.988		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.177
Variance (logs)	0.027
Standard Deviation (logs)	0.164
Skewness (logs)	0.790
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.195
Coefficient of Variation (logs)	0.139

1

PREDEV SDS POC (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	7.795
0.9500	1.05	8.890
0.9000	1.11	9.677
0.8000	1.25	10.885
0.5000	2.00	14.320
0.2000	5.00	20.205
0.1000	10.00	24.920
0.0400	25.00	31.910
0.0200	50.00	37.936
0.0100	100.00	44.728
0.0050	200.00	52.403

$1/2\,Q_2 = 7.16$

$Q_{50} = 37.94$

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SDS POC-1 (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

7.883	11.281	29.424	6.231	6.954
7.382	12.771	11.446	8.160	8.063
6.996	17.973	7.857	5.417	7.747
7.335	10.338	7.149	11.515	7.153
7.287	7.022	8.025	24.787	7.947
7.432	11.081	7.296	5.669	7.224
5.470	19.700	7.058	7.148	9.127
6.048	6.676	15.298	19.045	6.512
5.616	29.632	23.650	7.164	6.744
5.053	9.574	29.178		

The following 7 statistics are based on non-zero values.

Mean (logs)	0.968
Variance (logs)	0.044
Standard Deviation (logs)	0.211
Skewness (logs)	1.221
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.020
Coefficient of Variation (logs)	0.218

1

2006 SDS POC (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	4.631
0.9500	1.05	5.103
0.9000	1.11	5.499
0.8000	1.25	6.176
0.5000	2.00	8.444
0.2000	5.00	13.251
0.1000	10.00	17.822
0.0400	25.00	25.672
0.0200	50.00	33.413
0.0100	100.00	43.168
0.0050	200.00	55.458

POC - 1 - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	Flow [cfs]
100	100	0
60.33	77.7497	0.01
29.1046	56.9832	0.1
23.0621	51.9032	0.2
14.8462	44.0518	0.5
9.10407	37.0149	1
6.16563	28.6944	1.5
4.40718	21.4166	2
3.24882	15.5863	2.5
1.84306	7.90792	3.5
1.11487	3.69586	4.5
0.57348	1.10964	6
0.48103	0.68327	6.5
0.39951	0.42137	7
0.38667	0.38644	7.1
0.37099	0.35554	7.2
0.35697	0.32464	7.3
0.3458	0.29779	7.4
0.33177	0.27379	7.5
0.27901	0.21033	8
0.20558	0.15686	9
0.15591	0.12786	10
0.09364	0.08508	12
0.05775	0.05442	14
0.03755	0.03874	16
0.02614	0.02305	18
0.01545	0.01402	20
0.00523	0.00404	25
0.00214	0.00001	30
0.00119	0	35
0.00095	0	38
0	0	40
0	0	42
0	0	45
0	0	48

1

Simulated - PREDEV SDS POC-1 (PREDEV)
Observed - 2006 SDS POC-1 (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	93622	0.000	*	0.000	*	0.000	*
0.00	87379	0.026	96.6	0.038	97.5	-0.025	-93.1
0.10	21375	0.139	95.4	0.144	97.1	-0.128	-88.2
0.20	33036	0.309	93.4	0.325	95.4	-0.283	-85.8
0.50	29609	0.661	90.5	0.691	92.7	-0.611	-83.5
1.00	35010	1.106	89.3	1.133	91.0	-1.065	-86.0
1.50	30623	1.489	85.2	1.534	87.5	-1.431	-81.8
2.00	24532	1.796	80.5	1.861	83.2	-1.727	-77.4
2.50	32308	2.235	75.9	2.341	79.2	-2.141	-72.7
3.50	17723	2.694	68.4	2.857	72.5	-2.536	-64.5
4.50	10882	2.984	58.6	3.228	63.4	-2.675	-52.6
6.00	1794	3.026	48.6	3.371	54.2	-2.504	-40.2
6.50	1102	2.953	43.9	3.389	50.4	-2.080	-31.0
7.00	147	2.747	39.0	3.240	46.0	-1.429	-20.3
7.10	130	3.251	45.5	3.760	52.6	-1.570	-22.0
7.20	130	3.177	43.8	3.640	50.2	-1.653	-22.8
7.30	113	2.704	36.8	3.263	44.4	-1.163	-15.9
7.40	101	2.830	38.0	3.557	47.8	-1.352	-18.2
7.50	267	2.873	37.2	3.678	47.6	-0.807	-10.5
8.00	225	3.317	39.3	4.124	48.7	0.046	0.4
9.00	122	4.933	51.9	5.661	59.6	-1.020	-10.4
10.00	180	5.068	46.0	5.910	53.6	-2.889	-26.1
12.00	129	5.960	46.3	6.839	52.8	-4.493	-35.0
14.00	66	5.929	39.7	6.924	46.3	-2.108	-14.1
16.00	66	6.428	37.8	7.576	44.4	-4.327	-25.5
18.00	38	6.657	35.2	7.575	40.1	-4.490	-23.9
20.00	42	5.566	25.0	6.263	28.0	-3.990	-18.1
25.00	17	5.843	21.2	6.457	23.6	-4.802	-17.7
30.00	0	0.000	0.0	0.000	0.0	0.000	0.0
35.00	0	0.000	0.0	0.000	0.0	0.000	0.0
38.00	0	0.000	0.0	0.000	0.0	0.000	0.0
40.00	0	0.000	0.0	0.000	0.0	0.000	0.0
42.00	0	0.000	0.0	0.000	0.0	0.000	0.0
45.00	0	0.000	0.0	0.000	0.0	0.000	0.0
48.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.788	*	1.318	*	-0.734	*

Standard error of estimate = 1.09
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS POC-1 (PREDEV)
Observed - 2006 SDS POC-1(2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	*****	93622	39.67	22.25	100.00	100.00	0.00	0.00
0.00	*****	87379	31.22	20.77	60.33	77.75	0.02	0.03
0.102542521375			6.04	5.08	29.10	56.98	0.14	0.15
0.203457033036			8.22	7.85	23.06	51.90	0.33	0.33
0.502416129609			5.74	7.04	14.85	44.05	0.71	0.73
1.001236435010			2.94	8.32	9.10	37.01	1.23	1.24
1.50	739930623		1.76	7.28	6.17	28.69	1.73	1.75
2.00	487424532		1.16	5.83	4.41	21.42	2.24	2.24
2.50	591532308		1.41	7.68	3.25	15.59	2.94	2.96
3.50	306417723		0.73	4.21	1.84	7.91	3.95	3.94
4.50	227810882		0.54	2.59	1.11	3.70	5.14	5.12
6.00	389	1794	0.09	0.43	0.57	1.11	6.25	6.23
6.50	343	1102	0.08	0.26	0.48	0.68	6.74	6.73
7.00	54	147	0.01	0.03	0.40	0.42	7.04	7.05
7.10	66	130	0.02	0.03	0.39	0.39	7.16	7.15
7.20	59	130	0.01	0.03	0.37	0.36	7.25	7.25
7.30	47	113	0.01	0.03	0.36	0.32	7.34	7.35
7.40	59	101	0.01	0.02	0.35	0.30	7.45	7.45
7.50	222	267	0.05	0.06	0.33	0.27	7.74	7.73
8.00	309	225	0.07	0.05	0.28	0.21	8.47	8.42
9.00	209	122	0.05	0.03	0.21	0.16	9.49	9.48
10.00	262	180	0.06	0.04	0.16	0.13	10.88	11.03
12.00	151	129	0.04	0.03	0.09	0.09	13.01	12.87
14.00	85	66	0.02	0.02	0.06	0.05	14.84	14.93
16.00	48	66	0.01	0.02	0.04	0.04	16.83	17.00
18.00	45	38	0.01	0.01	0.03	0.02	18.92	18.88
20.00	43	42	0.01	0.01	0.02	0.01	22.38	22.37
25.00	13	17	0.00	0.00	0.01	0.00	26.61	27.69
30.00	4	0	0.00	0.00	0.00	0.00	30.89	0.00
35.00	1	0	0.00	0.00	0.00	0.00	37.70	0.00
38.00	4	0	0.00	0.00	0.00	0.00	39.26	0.00
40.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
42.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
45.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
48.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			0.33	1.06

10350 Observed values are zero
117496 Simulated values are zero
10350 Observed values are zero when simulated are zero
0 Observed values are zero when simulated are not
107146 Observed values are not zero when simulated are

1

Simulated - PREDEV SDS POC-1 (PREDEV)
Observed - 2006 SDS POC-1 (2006)

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	84895	1	0	8712	0	0	14	0
0.00	85869	343	131	45	46	65	880	0
0.10	20469	200	83	35	40	61	487	0
0.20	30979	566	228	86	81	166	930	0
0.50	26922	916	395	147	111	214	904	0
1.00	32422	1131	400	148	121	194	594	0
1.50	27406	1545	512	202	170	269	519	0
2.00	20924	1985	585	199	158	245	436	0

2.50	25808	3734	1070	369	297	414	616	0
3.50	12262	3362	862	274	225	311	427	0
4.50	5667	3214	842	253	214	283	409	0
6.00	529	780	229	59	49	63	85	0
6.50	259	414	203	47	35	55	89	0
7.00	25	42	34	7	9	14	16	0
7.10	26	52	14	5	8	9	16	0
7.20	22	51	21	6	5	7	18	0
7.30	9	39	24	10	10	7	14	0
7.40	13	33	17	13	6	8	11	0
7.50	28	83	46	28	17	26	39	0
8.00	29	45	26	15	16	38	56	0
9.00	36	27	6	3	3	13	34	0
10.00	42	76	22	6	2	11	21	0
12.00	40	50	21	2	3	4	9	0
14.00	10	20	11	5	2	6	12	0
16.00	12	28	8	3	5	6	4	0
18.00	6	15	8	1	2	3	3	0
20.00	0	18	12	5	3	3	1	0
25.00	0	4	9	3	0	1	0	0
30.00	0	0	0	0	0	0	0	0
35.00	0	0	0	0	0	0	0	0
38.00	0	0	0	0	0	0	0	0
40.00	0	0	0	0	0	0	0	0
42.00	0	0	0	0	0	0	0	0
45.00	0	0	0	0	0	0	0	0
48.00	0	0	0	0	0	0	0	0
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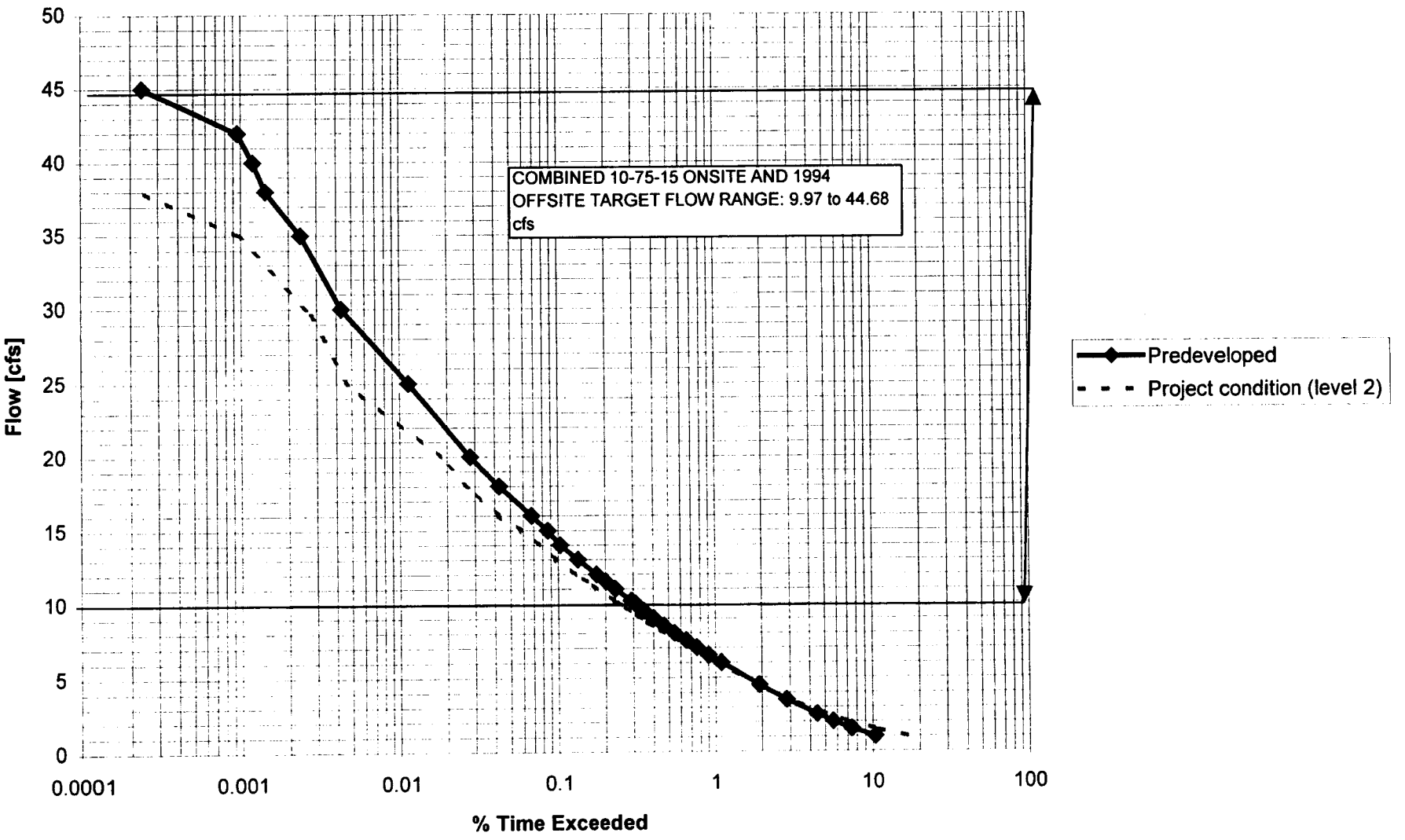
	374709	18774	5819	10688	1638	2496	6644	0

SDS POC-2

July 2001
556-2912-001 (28)

SDS POC-2



AR 010663

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SDS POC-2 (PREDEV)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

24.049	48.542	29.929	16.294	16.958
19.267	23.386	21.733	23.022	18.742
15.503	21.425	19.066	15.268	16.913
23.240	17.724	18.709	28.794	26.430
17.863	19.786	16.469	36.154	18.208
17.077	24.088	16.893	17.572	24.797
19.014	23.237	24.069	19.785	17.797
18.448	16.775	27.247	23.533	13.448
12.987	44.210	38.579	19.670	12.090
12.334	17.134	36.423		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.318
Variance (logs)	0.018
Standard Deviation (logs)	0.135
Skewness (logs)	0.823
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.189
Coefficient of Variation (logs)	0.102

1

PREDEV SDS POC (PREDEV)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	12.209
0.9500	1.05	13.550
0.9000	1.11	14.502
0.8000	1.25	15.946
0.5000	2.00	19.939
0.2000	5.00	26.473
0.1000	10.00	31.496
0.0400	25.00	38.683
0.0200	50.00	44.682
0.0100	100.00	51.269
0.0050	200.00	58.529

$1/2Q_2 = 9.97$ cfs
$Q_{50} = 44.68$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SDS POC-2 (2006)

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

20.712	40.089	25.637	14.241	14.772
16.589	19.950	18.714	20.594	16.625
14.183	18.691	16.490	13.594	14.318
19.868	15.411	16.329	24.495	23.088
15.611	17.396	15.095	30.348	15.914
14.875	21.186	15.286	15.924	22.047
16.345	20.985	21.383	17.546	15.604
15.423	15.324	22.773	21.068	12.187
12.134	36.318	32.252	17.643	11.005
11.153	15.293	30.832		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.260
Variance (logs)	0.016
Standard Deviation (logs)	0.126
Skewness (logs)	0.817
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.198
Coefficient of Variation (logs)	0.100

1

2006 SDS POC (2006)

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	11.060
0.9500	1.05	12.198
0.9000	1.11	13.000
0.8000	1.25	14.208
0.5000	2.00	17.508
0.2000	5.00	22.806
0.1000	10.00	26.812
0.0400	25.00	32.464
0.0200	50.00	37.124
0.0100	100.00	42.189
0.0050	200.00	47.716

POC - 2 - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	Flow [cfs]
100	100	0
10.3813	16.5466	1
7.42832	10.1895	1.5
5.63446	6.91474	2
4.43023	5.04387	2.5
2.85098	2.9893	3.5
1.91911	1.89178	4.5
1.08658	0.9977	6
0.90525	0.81779	6.5
0.76146	0.67163	7
0.65	0.55993	7.5
0.54638	0.46296	8
0.46653	0.38596	8.5
0.40212	0.33177	9
0.34912	0.28377	9.5
0.31514	0.25121	9.9
0.30872	0.2417	10
0.29256	0.22768	10.2
0.23219	0.17468	11
0.20201	0.15068	11.5
0.17468	0.12691	12
0.13261	0.09649	13
0.10291	0.07581	14
0.08603	0.05846	15
0.06773	0.0423	16
0.04254	0.02733	18
0.02804	0.01806	20
0.01141	0.00475	25
0.00428	0.00261	30
0.00238	0.00095	35
0.00143	0.00024	38
0.00119	0.00024	40
0.00095	0	42
0.00024	0	45
0.00024	0	48

1

Simulated - PREDEV SDS POC-2 (PREDEV)
Observed - 2006 SDS POC-2 (2006)

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	351145	0.098	26.8	0.181	37.0	-0.096	-24.6
1.00	26749	0.512	42.4	0.572	47.3	-0.502	-41.6
1.50	13779	0.520	30.4	0.613	36.1	-0.497	-29.1
2.00	7872	0.443	20.0	0.543	24.7	-0.397	-17.9
2.50	8645	0.329	11.4	0.420	14.7	-0.231	-8.1
3.50	4618	0.287	7.3	0.398	10.1	-0.077	-2.0
4.50	3762	0.313	6.1	0.412	8.0	0.089	1.6
6.00	757	0.382	6.1	0.465	7.4	0.250	4.0
6.50	615	0.418	6.2	0.503	7.5	0.304	4.5
7.00	470	0.499	6.9	0.581	8.0	0.398	5.5
7.50	408	0.584	7.5	0.677	8.7	0.481	6.2
8.00	324	0.614	7.4	0.706	8.6	0.500	6.1
8.50	228	0.734	8.4	0.810	9.3	0.651	7.5
9.00	202	0.799	8.6	0.873	9.4	0.736	8.0
9.50	137	0.828	8.5	0.896	9.2	0.759	7.8
9.90	40	0.950	9.5	1.017	10.2	0.875	8.8
10.00	59	0.994	9.9	1.052	10.4	0.938	9.3
10.20	223	1.021	9.6	1.093	10.3	0.963	9.1
11.00	101	1.109	9.9	1.182	10.5	1.013	9.0
11.50	100	1.188	10.1	1.259	10.7	1.152	9.8
12.00	128	1.283	10.3	1.371	11.0	1.158	9.3
13.00	87	1.513	11.2	1.584	11.7	1.461	10.8
14.00	73	1.805	12.5	1.874	13.0	1.737	12.0
15.00	68	1.884	12.2	1.983	12.8	1.809	11.7
16.00	63	2.175	12.9	2.244	13.4	2.094	12.5
18.00	39	2.579	13.6	2.690	14.2	2.579	13.6
20.00	56	3.050	13.8	3.176	14.3	2.933	13.2
25.00	9	4.147	15.1	4.433	16.2	4.129	15.1
30.00	7	5.347	17.0	5.409	17.1	5.347	17.0
35.00	3	7.316	20.3	7.328	20.3	7.316	20.3
38.00	0	0.000	0.0	0.000	0.0	0.000	0.0
40.00	1	8.453	21.1	8.453	21.1	8.453	21.1
42.00	0	0.000	0.0	0.000	0.0	0.000	0.0
45.00	0	0.000	0.0	0.000	0.0	0.000	0.0
48.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	0.160	26.8	0.290	36.7	-0.133	-24.6

Standard error of estimate = 0.26
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SDS POC-2(PREDEV)
Observed - 2006 SDS POC-2 (2006)

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		89.62	83.45	100.00	100.00	0.16	0.22
1.00	1242526749		2.95	6.36	10.38	16.55	1.22	1.22
1.50	754813779		1.79	3.27	7.43	10.19	1.73	1.72
2.00	5067	7872	1.20	1.87	5.63	6.91	2.24	2.23
2.50	6645	8645	1.58	2.05	4.43	5.04	2.96	2.94
3.50	3921	4618	0.93	1.10	2.85	2.99	3.96	3.96
4.50	3503	3762	0.83	0.89	1.92	1.89	5.17	5.17
6.00	763	757	0.18	0.18	1.09	1.00	6.24	6.23
6.50	605	615	0.14	0.15	0.91	0.82	6.75	6.74
7.00	469	470	0.11	0.11	0.76	0.67	7.25	7.24
7.50	436	408	0.10	0.10	0.65	0.56	7.74	7.73
8.00	336	324	0.08	0.08	0.55	0.46	8.26	8.24
8.50	271	228	0.06	0.05	0.47	0.39	8.73	8.74
9.00	223	202	0.05	0.05	0.40	0.33	9.25	9.25
9.50	143	137	0.03	0.03	0.35	0.28	9.70	9.70
9.90	27	40	0.01	0.01	0.32	0.25	9.95	9.95
10.00	68	59	0.02	0.01	0.31	0.24	10.10	10.09
10.20	254	223	0.06	0.05	0.29	0.23	10.59	10.58
11.00	127	101	0.03	0.02	0.23	0.17	11.26	11.22
11.50	115	100	0.03	0.02	0.20	0.15	11.74	11.73
12.00	177	128	0.04	0.03	0.17	0.13	12.53	12.45
13.00	125	87	0.03	0.02	0.13	0.10	13.49	13.51
14.00	71	73	0.02	0.02	0.10	0.08	14.50	14.43
15.00	77	68	0.02	0.02	0.09	0.06	15.48	15.45
16.00	106	63	0.03	0.01	0.07	0.04	17.02	16.81
18.00	61	39	0.01	0.01	0.04	0.03	18.92	18.98
20.00	70	56	0.02	0.01	0.03	0.02	22.29	22.14
25.00	30	9	0.01	0.00	0.01	0.00	26.83	27.29
30.00	8	7	0.00	0.00	0.00	0.00	32.58	31.44
35.00	4	3	0.00	0.00	0.00	0.00	35.87	36.12
38.00	1	0	0.00	0.00	0.00	0.00	38.58	0.00
40.00	1	1	0.00	0.00	0.00	0.00	40.88	40.09
42.00	3	0	0.00	0.00	0.00	0.00	43.43	0.00
45.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
48.00	1	0	0.00	0.00	0.00	0.00	48.54	0.00
	420768	420768	100.00	100.00			0.47	0.60

1

Simulated - PREDEV SDS POC (PREDEV)
Observed - 2006 SDS POC (2006)

Lower class limit	Number of occurrences between indicated deviations							
	-60%	-30%	-10%	0%	10%	30%	60%	
0.00	51970	89887	54773	41080	112396	1039	0	0
1.00	6008	13231	4610	1424	1055	421	0	0
1.50	1205	5230	4593	1430	955	366	0	0
2.00	33	1922	3273	1420	944	280	0	0
2.50	0	470	2955	2927	1803	490	0	0
3.50	0	88	677	1762	1707	384	0	0
4.50	0	27	234	1053	2041	407	0	0
6.00	0	0	23	141	489	104	0	0
6.50	0	1	14	97	426	77	0	0
7.00	0	0	14	45	331	80	0	0
7.50	0	0	10	32	283	83	0	0
8.00	0	0	8	18	234	64	0	0
8.50	0	0	5	5	150	68	0	0
9.00	0	0	3	5	123	71	0	0
9.50	0	0	2	4	91	40	0	0
9.90	0	0	1	0	24	15	0	0

10.00	0	0	1	0	30	28	0	0
10.20	0	0	3	2	123	95	0	0
11.00	0	0	2	2	53	44	0	0
11.50	0	0	1	3	40	56	0	0
12.00	0	0	2	6	54	66	0	0
13.00	0	0	1	1	30	55	0	0
14.00	0	0	1	0	22	50	0	0
15.00	0	0	1	2	14	51	0	0
16.00	0	0	1	0	12	50	0	0
18.00	0	0	0	0	8	31	0	0
20.00	0	0	0	3	5	48	0	0
25.00	0	0	0	1	0	8	0	0
30.00	0	0	0	0	0	7	0	0
35.00	0	0	0	0	0	3	0	0
38.00	0	0	0	0	0	0	0	0
40.00	0	0	0	0	0	1	0	0
42.00	0	0	0	0	0	0	0	0
45.00	0	0	0	0	0	0	0	0
48.00	0	0	0	0	0	0	0	0
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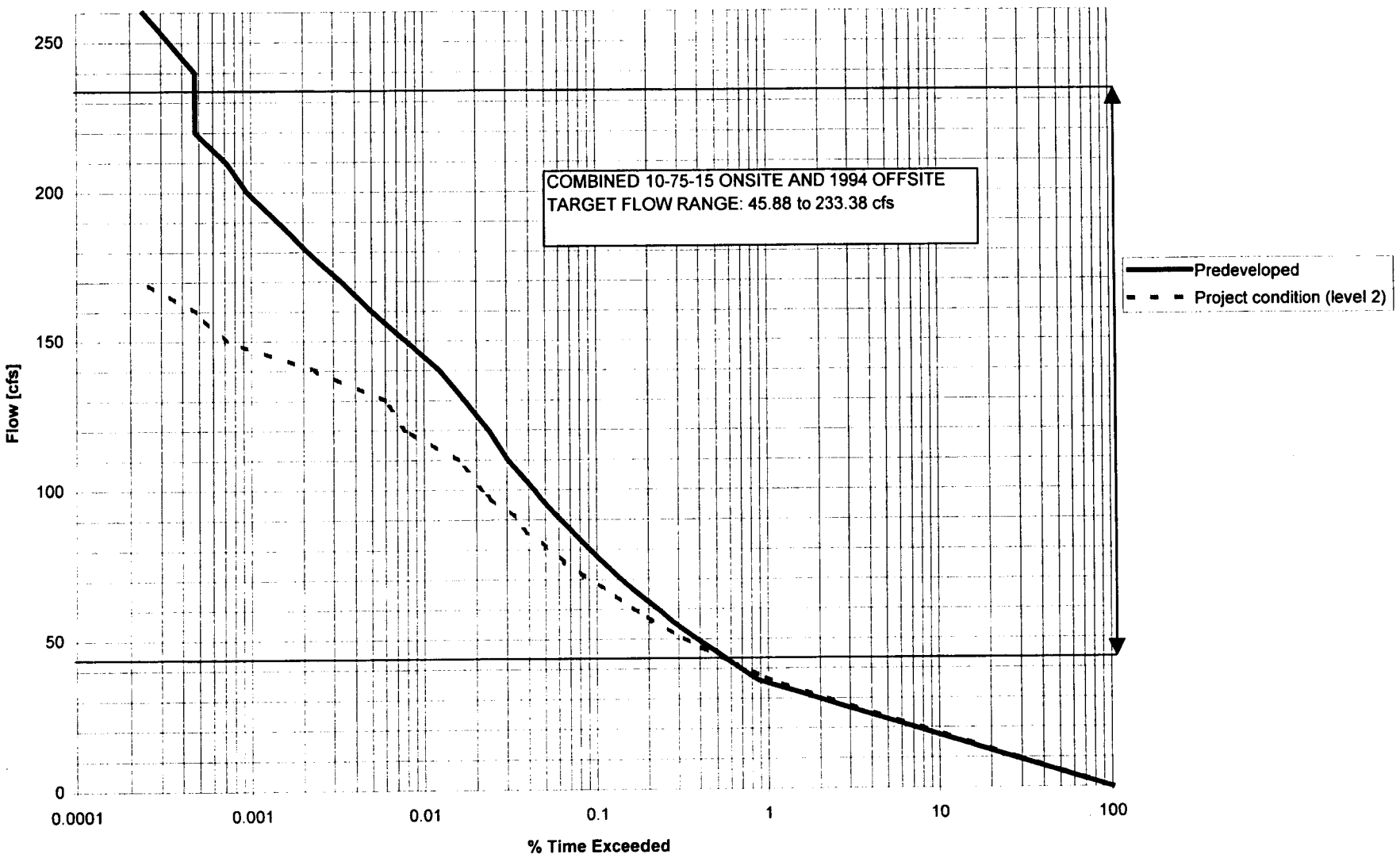
	59216	110856	71208	51463	123443	4582	0	0

SOUTH 200TH STREET

Des Moines Creek at South 200th Street



AR 010671

July 2001
556-2912-001 (28)

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Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

PREDEV SIM SOUTH 200TH STREET

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

122.981	166.733	167.003	79.350	70.532
86.954	138.000	103.731	114.550	89.858
76.011	106.940	79.298	60.528	75.784
90.482	77.645	81.295	151.266	91.617
96.550	90.882	77.699	178.019	85.062
77.479	110.259	82.537	70.834	94.611
66.897	109.739	91.995	81.573	84.913
70.945	69.289	159.147	141.139	69.556
63.317	262.423	199.243	96.596	69.986
51.129	91.202	189.139		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.985
Variance (logs)	0.023
Standard Deviation (logs)	0.153
Skewness (logs)	0.904
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.189
Coefficient of Variation (logs)	0.077

1

PREDEV SIM SOUTH 200TH STREET

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	53.911
0.9500	1.05	60.044
0.9000	1.11	64.549
0.8000	1.25	71.553
0.5000	2.00	91.754
0.2000	5.00	126.778
0.1000	10.00	155.009
0.0400	25.00	197.025
0.0200	50.00	233.378
0.0100	100.00	274.464
0.0050	200.00	321.030

$1.2Q_2 = 45.88$ cfs

$Q_{50} = 233.38$ cfs

1

Log-Pearson Type III Statistics (formerly USGS Program A193, Jan. 1986)
Note -- Use of Log-Pearson Type III or Pearson-Type III distributions are for preliminary computations. User is responsible for assessment and interpretation.

2006 SIM SOUTH 200TH STREET

Analysis for -- 12 month period
starting October 1
ending September 30
1949-1996

Parameter is 1-day high value.

0 zero values in data

48 non-zero values in data

81.855	99.826	145.239	59.304	57.039
61.320	92.578	80.005	85.909	72.696
62.534	102.963	64.817	50.957	64.552
58.732	67.396	64.213	95.642	67.725
72.218	68.963	69.340	118.691	65.077
59.914	87.423	66.786	56.232	71.542
52.043	83.429	72.338	57.980	72.099
53.602	57.276	111.874	122.616	59.511
49.143	174.423	142.678	70.465	59.845
40.351	72.530	141.935		

The following 7 statistics are based on non-zero values.

Mean (logs)	1.872
Variance (logs)	0.019
Standard Deviation (logs)	0.137
Skewness (logs)	0.892
Standard Error of Skewness (logs)	0.343
Serial Correlation Coefficient (logs)	0.131
Coefficient of Variation (logs)	0.073

1

2006 SIM SOUTH 200TH STREET

Exceedence Probability	Recurrence Interval	Parameter Value
0.9900	1.01	43.986
0.9500	1.05	48.504
0.9000	1.11	51.780
0.8000	1.25	56.816
0.5000	2.00	71.025
0.2000	5.00	94.842
0.1000	10.00	113.483
0.0400	25.00	140.538
0.0200	50.00	163.415
0.0100	100.00	188.792
0.0050	200.00	217.039

South 200th Street - Percent cases equal or exceeding limit

Predeveloped	Project condition (level 2)	1994 conditions	Flow [cfs]
100	100	100	0
0.88006	1.0305	1.6645753	36
0.77382	0.85819	1.491083	38
0.64763	0.65689	1.2617404	41
0.57514	0.55232	1.1300764	43
0.48625	0.43421	0.9663282	46
0.40426	0.34271	0.8265838	49
0.34294	0.2745	0.7184482	52
0.27283	0.20867	0.6012815	56
0.23647	0.17278	0.5204768	59
0.19441	0.13713	0.4330177	63
0.1609	0.10932	0.3576793	67
0.1338	0.08413	0.3061069	71
0.1079	0.06441	0.2552475	76
0.08793	0.05038	0.2131816	81
0.07225	0.03921	0.1801468	86
0.05918	0.03303	0.1549547	91
0.04729	0.02448	0.13309	97
0.04302	0.02186	0.1207316	100
0.03042	0.01569	0.0929253	110
0.02353	0.00784	0.0703476	120
0.01711	0.00594	0.0541866	130
0.01236	0.00238	0.0423036	140
0.00784	0.00071	0.0327972	150
0.00499	0.00048	0.026618	160
0.00333	0.00024	0.0209141	170
0.00214	0	0.0142596	180
0.00143	0	0.0090311	190
0.00095	0	0.0068922	200
0.00071	0	0.0045156	210
0.00048	0	0.0028519	220
0.00048	0	0.0026143	230
0.00048	0	0.0019013	240
0.00024	0	0.001426	260
0	0	0.000713	280

1

Simulated - PREDEV SIM SOUTH 200TH STREET
Observed - 2006 SIM SOUTH 200TH STREET

Lower class limit	Number of cases	Mean absolute error(1)		Root mean square error(2)		Bias(3)	
		Average	Percent	Average	Percent	Average	Percent
0.00	416432	1.586	32.0	2.893	38.3	-1.329	-18.3
36.00	725	8.856	24.0	10.562	28.6	-4.646	-12.6
38.00	847	9.009	22.9	10.857	27.6	-3.374	-8.6
41.00	440	9.741	23.2	11.664	27.8	-3.712	-8.8
43.00	497	10.229	23.0	12.006	27.0	-2.651	-6.0
46.00	385	9.954	21.0	11.830	25.0	-1.506	-3.2
49.00	287	10.533	20.9	12.631	25.1	-0.343	-0.7
52.00	277	11.215	20.8	13.357	24.7	0.632	1.1
56.00	151	11.317	19.7	13.505	23.5	2.767	4.8
59.00	150	13.994	23.0	16.323	26.8	4.421	7.3
63.00	117	14.581	22.5	16.860	26.0	4.762	7.3
67.00	106	17.504	25.4	19.476	28.2	8.190	11.9
71.00	83	19.016	25.9	21.707	29.5	8.498	11.5
76.00	59	21.603	27.6	25.121	32.2	10.824	13.9
81.00	47	23.422	28.0	25.970	31.1	7.195	8.6
86.00	26	25.124	28.4	29.665	33.5	6.504	7.3
91.00	36	30.038	32.1	34.827	37.2	11.557	12.4
97.00	11	25.964	26.2	31.790	32.0	10.173	10.2
100.00	26	21.538	20.6	28.080	26.7	7.970	7.5
110.00	33	24.174	21.1	30.184	26.4	19.297	16.9
120.00	8	17.423	14.0	21.154	16.8	17.423	14.0
130.00	15	26.677	19.9	33.035	24.7	23.659	17.6
140.00	7	24.159	17.0	36.677	25.7	22.913	16.1
150.00	1	49.347	31.1	49.347	31.1	49.347	31.1
160.00	1	94.361	57.9	94.361	57.9	94.361	57.9
170.00	1	88.000	50.5	88.000	50.5	88.000	50.5
180.00	0	0.000	0.0	0.000	0.0	0.000	0.0
190.00	0	0.000	0.0	0.000	0.0	0.000	0.0
200.00	0	0.000	0.0	0.000	0.0	0.000	0.0
210.00	0	0.000	0.0	0.000	0.0	0.000	0.0
220.00	0	0.000	0.0	0.000	0.0	0.000	0.0
230.00	0	0.000	0.0	0.000	0.0	0.000	0.0
240.00	0	0.000	0.0	0.000	0.0	0.000	0.0
260.00	0	0.000	0.0	0.000	0.0	0.000	0.0
280.00	0	0.000	0.0	0.000	0.0	0.000	0.0
	420768	1.686	31.9	3.224	38.2	-1.323	-18.1

Standard error of estimate = 2.94
= square root((n/n-1)*((tot.col.5)**2-(tot.col.7)**2))

(1) Average = sum(|S-O|/n)
Percent = 100 * (sum(|S-O|/O))/n for all O > 0
(2) Average = square root(sum((S-O)**2)/n)
Percent = 100 * square root(sum(((S-O)/O)**2)/n) for all O > 0
(3) Average = sum (S-O)/n
Percent = 100 * sum (((S-O)/O)/n) for all O > 0

1

Simulated - PREDEV SIM SOUTH 200TH STREET
Observed - 2006 SIM SOUTH 200TH STREET

Lower class	Cases equal or exceeding lower limit & less then upper limit: Cases	Cases equal or exceeding lower limit & less then upper limit: Percent	Percent cases equal or exceeding limit	Average of cases within class limits

limit	Sim	Obs	Simulated	Observed	Simulated	Observed	Simulated	Observed
0.00	**********		99.12	98.97	100.00	100.00	2.65	3.97
36.00	447	725	0.11	0.17	0.88	1.03	36.93	36.95
38.00	531	847	0.13	0.20	0.77	0.86	39.42	39.42
41.00	305	440	0.07	0.10	0.65	0.66	41.98	41.96
43.00	374	497	0.09	0.12	0.58	0.55	44.46	44.39
46.00	345	385	0.08	0.09	0.49	0.43	47.46	47.43
49.00	258	287	0.06	0.07	0.40	0.34	50.42	50.44
52.00	295	277	0.07	0.07	0.34	0.27	53.89	53.96
56.00	153	151	0.04	0.04	0.27	0.21	57.48	57.40
59.00	177	150	0.04	0.04	0.24	0.17	60.95	60.73
63.00	141	117	0.03	0.03	0.19	0.14	64.85	64.76
67.00	114	106	0.03	0.03	0.16	0.11	69.00	68.80
71.00	109	83	0.03	0.02	0.13	0.08	73.41	73.31
76.00	84	59	0.02	0.01	0.11	0.06	78.42	78.29
81.00	66	47	0.02	0.01	0.09	0.05	83.56	83.59
86.00	55	26	0.01	0.01	0.07	0.04	88.30	88.23
91.00	50	36	0.01	0.01	0.06	0.03	94.05	93.58
97.00	18	11	0.00	0.00	0.05	0.02	98.64	98.85
100.00	53	26	0.01	0.01	0.04	0.02	104.44	103.90
110.00	29	33	0.01	0.01	0.03	0.02	114.61	114.66
120.00	27	8	0.01	0.00	0.02	0.01	124.31	124.34
130.00	20	15	0.00	0.00	0.02	0.01	135.30	134.24
140.00	19	7	0.00	0.00	0.01	0.00	143.87	142.52
150.00	12	1	0.00	0.00	0.01	0.00	155.23	158.79
160.00	7	1	0.00	0.00	0.00	0.00	164.43	163.11
170.00	5	1	0.00	0.00	0.00	0.00	176.49	174.42
180.00	3	0	0.00	0.00	0.00	0.00	187.47	0.00
190.00	2	0	0.00	0.00	0.00	0.00	199.15	0.00
200.00	1	0	0.00	0.00	0.00	0.00	208.13	0.00
210.00	1	0	0.00	0.00	0.00	0.00	218.80	0.00
220.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
230.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
240.00	1	0	0.00	0.00	0.00	0.00	257.47	0.00
260.00	1	0	0.00	0.00	0.00	0.00	262.42	0.00
280.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00
	420768	420768	100.00	100.00			3.11	4.43

1

Simulated - PREDEV SIM SOUTH 200TH STREET
Observed - 2006 SIM SOUTH 200TH STREET

Lower class limit	Number of occurrences between indicated deviations						
	-60%	-30%	-10%	0%	10%	30%	60%
0.00	49156	121110	73931	39285	38926	55566	38458	0
36.00	20	162	221	104	67	108	43	0
38.00	16	170	223	98	98	184	58	0
41.00	7	90	123	45	57	87	31	0
43.00	6	92	130	52	51	125	41	0
46.00	4	52	103	42	46	107	31	0
49.00	4	36	63	33	31	101	19	0
52.00	5	26	64	30	29	95	28	0
56.00	1	10	30	18	19	55	18	0
59.00	2	13	25	9	18	55	28	0
63.00	1	11	15	9	15	45	21	0
67.00	1	8	14	2	10	43	28	0
71.00	0	6	13	8	4	29	23	0
76.00	0	6	6	2	8	18	19	0
81.00	0	4	14	2	1	11	15	0
86.00	0	4	4	3	2	6	7	0

91.00	0	5	6	3	3	5	14	0
97.00	0	0	4	0	2	2	3	0
100.00	0	0	9	1	5	7	4	0
110.00	0	0	3	4	6	11	9	0
120.00	0	0	0	0	2	5	1	0
130.00	0	0	1	1	4	4	5	0
140.00	0	0	0	1	3	1	2	0
150.00	0	0	0	0	0	0	1	0
160.00	0	0	0	0	0	0	1	0
170.00	0	0	0	0	0	0	1	0
180.00	0	0	0	0	0	0	0	0
190.00	0	0	0	0	0	0	0	0
200.00	0	0	0	0	0	0	0	0
210.00	0	0	0	0	0	0	0	0
220.00	0	0	0	0	0	0	0	0
230.00	0	0	0	0	0	0	0	0
240.00	0	0	0	0	0	0	0	0
260.00	0	0	0	0	0	0	0	0
280.00	0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---	---
	49223	121805	75002	39752	39407	56670	38909	0

ATTACHMENT D

HSPF Input Files for Miller, Walker, and Des Moines Creeks

Miller Creek Watershed

- Predevelopment Conditions
- 2006 Conditions

Walker Creek Watershed

- Predevelopment Conditions
- 2006 Conditions

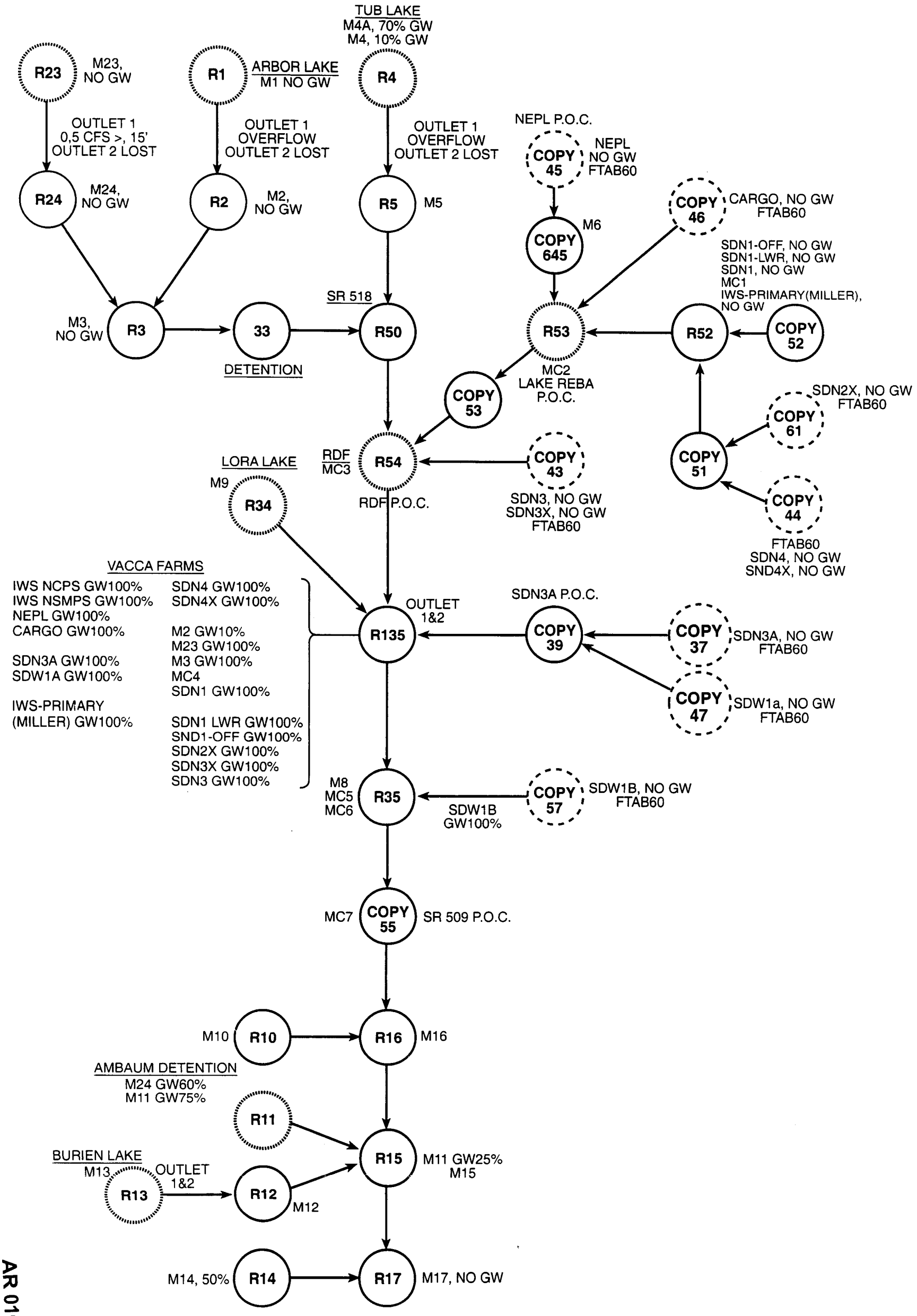
Des Moines Creek Watershed

- Predevelopment Conditions
- 2006 Conditions

MILLER CREEK WATERSHED
HSPF INPUT FILES

- PREDEVELOPMENT CONDITIONS
- 2006 CONDITIONS

PREDEVELOPMENT CONDITIONS



AR 010681

Notes: GW routed to reach unless otherwise noted.
Reaches have one outlet unless otherwise noted.
Reach table # is the same as reach # unless otherwise noted.

Precipitation and Evaporation

Future Pond/ Vault Site

M5 ← Tributary Subbasin ID
R5 ← Routing Reach Number

COPY 52 — Summation of Upstream Flow

Miller Creek Predevelopment HSPF Model Routing Schematic

```
RUN
GLOBAL
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***  FILE: MCPRED10.INP - predevelopment condition
  ***
  ***  BASED ON MILL64.INP FILE
  ***  - UPDATED LAND USE, revised MC-1 and SDN-2X land uses (FK, June 2001)
  MILLER CREEK BASIN HSPF MODEL
  START       1948 10  1  0  0  END    1997  1 31 24  0
  RUN INTERP OUTPUT LEVEL     6
  RESUME     0 RUN      1
END GLOBAL

FILES
<type>  <fun>***<------------fname---------------------------------------------->
MESSU       24   MILL.MES
WDM         25   MCPOND22.WDM
            61   PER.L61
            62   RCH.L62
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      54
      IMPLND      14
      RCHRES       1
      RCHRES      23
      RCHRES      24
      RCHRES       2
      RCHRES       3
      RCHRES      33
      RCHRES       4
      RCHRES       5
      RCHRES      50
 *** OUTPUT AT NODES 242, 240, 61, 43, 44, 45 & 46 FOR DETENTION PONDS:
 *** NOte: 240 and 242 removed from analysis
 ***   COPY      242
 ***   COPY      240
       COPY       61
       COPY       43
       COPY       44
       COPY       51
       COPY       45
       COPY      645
       COPY       46
       COPY       52
       RCHRES     52
       RCHRES     53
       COPY       53
       RCHRES     54
 *** OUTPUT AT NODES 37 & 47 FOR DETENTION PONDS:
       COPY       37
       COPY       47
       COPY       39
       RCHRES     34
       RCHRES    135
 *** OUTPUT AT NODE 57 FOR DETENTION PONDS:
       COPY       57
       RCHRES     35
 *** OUTPUT AT NODE 55 FOR SR509 COMPARISON
       COPY       55
       RCHRES     10
       RCHRES     16
```

```
      RCHRES      11
      RCHRES      13
      RCHRES      12
      RCHRES      15
      RCHRES      14
      RCHRES      17
    END INGRP
END OPN SEQUENCE                                                    ***

PERLND
  GEN-INFO
    <PLS >      Name           NBLKS   Unit-systems   Printer      ***
    # -  #                       User  t-series Engl Metr          ***
                                       in  out                    ***
   16       TFM- TILL FOR MOD      1    1    1    1   61    0
   26       TGM- TILL GR MOD       1    1    1    1   61    0
   34       OF - OUTWASH FOR       1    1    1    1   61    0
   44       OG - OUTWASH GR        1    1    1    1   61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN PREDEV
   45       AIRPORT FILL           1    1    1    1   61    0
   54       SA - WETLANDS          1    1    1    1   61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC      ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ********************* Print-flags ************************* PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ********
   14  200    0    0    0    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > ***************** Flags ********************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                  ***
   14  200    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST       LZSN     INFILT       LSUR      SLSUR      KVARY      AGWRC
   16                     9.0000     0.3200     400.00     0.1000     0.5000     0.9960
   26                     9.0000     0.1200     400.00     0.1000     0.5000     0.9960
   34                    10.0000     2.0000     400.00     0.0500     0.3000     0.9960
   44                    10.0000     0.8000     400.00     0.0500     0.3000     0.9960
   54                     8.0000     2.0000     100.00     0.0010     0.5000     0.9960
  END PWAT-PARM2
  PWAT-PARM3
    <PLS >***
    # -  #*** PETMAX     PETMIN     INFEXP     INFILD     DEEPFR     BASETP     AGWETP
   16                               2.0000     2.0000       0.33       0.00        0.0
   26                               2.0000     2.0000       0.33         0.        0.
   34                               2.0000     2.0000       0.33       0.00        0.0
   44                               2.0000     2.0000       0.33         0.        0.
   54                               10.000     2.0000       0.33         0.        0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                          ***
    # -  #      CEPSC      UZSN       NSUR      INTFW       IRC     LZETP***
   16          0.2000     0.7500     0.3500     9.000     0.7000     0.7000
   26          0.1000     0.3750     0.2500     9.000     0.7000     0.2500
   34          0.2000     0.7500     0.3500     0.000     0.7000     0.7000
   44          0.1000     0.7500     0.2500     0.000     0.7000     0.2500
   54          0.1000     2.2500     0.5000     1.000     0.7000     0.8000
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***    CEPS       SURS        UZS        IFWS        LZS        AGWS       GWVS
```

```
  16          0.078        0.    0.2500      0.10     2.000     2.000     0.000
  26          0.051        0.    0.2500      0.10     2.000     2.000     0.000
  34          0.078        0.    0.2500      0.10     2.000     2.000     0.000
  44          0.051        0.    0.2500      0.10     2.000     2.000     0.000
  54          0.051        0.    0.2500      0.10     2.000     2.000     0.000
  END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO                                                                  ***
    <ILS >      Name             Unit-systems   Printer                     ***
    # -  #                      User  t-series Engl Metr                    ***
                                     in  out
   14      IMPERVIOUS              1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************ Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   14         0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14         0    0    0    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1                                                                ***
    <ILS >           Flags            ***                                   ***
    # -  # CSNO RTOP  VRS  VNN RTLI   ***
   14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                                ***
    <ILS >                                                                  ***
    # -  #      LSUR     SLSUR      NSUR      RETSC
   14         100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
  IWAT-PARM3                                                                ***
    <ILS >                                                                  ***
    # -  #    PETMAX    PETMIN
   14
  END IWAT-PARM3
  IWAT-STATE1                                                               ***
    <ILS >  IWATER state variables                                          ***
    # -  #      RETS      SURS
   14      1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                                  ***

EXT SOURCES                                                                 ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes.     ***

<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC     ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM   1002 PREC     ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM      1 EVAP     ENGLZERO  0.8           PERLND  14  18 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           PERLND  24  28 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           PERLND  34  54 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           PERLND  64     EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC     ENGLZERO                RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES   1     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES   4     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES   4     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  11     EXTNL  PREC
```

```
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  11     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  13     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  13     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  23     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  23     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  34     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  34     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  53     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  53     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  54     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  54     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
***
*** NOTE: MFACTOR 12.1 CONVERTS ACRE-FEET OF RUNOFF TO AVERAGE CFS PER HOUR.
***
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***PREDEVELOPMENT CONDITION FLOWS
*** 54=MCDF      47=SDW1A       43=SDN3X
*** 17=MOUTH     49=SDW2        44=SDN4X
*** 61=SDN2X     57=SDW1B       39=MILLER POC FOR SDN3A/SDW1A
*** 45=NEPL      55=SR509       645=NEPL+M6 (M6X)
*** 46=CARGO     37=SDN3A
*** 53=LAKE REBA
***
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 55=SR509)
RCHRES  17 HYDR   RO     1 1                WDM     93 FLOW     ENGL      REPL
COPY    55 OUTPUT MEAN   1 1 12.1          WDM     98 FLOW     ENGL      REPL
RCHRES  54 HYDR   RO     1 1                WDM     94 FLOW     ENGL      REPL
*** DETENTION POND POC LOCATIONS
COPY    61 OUTPUT MEAN   1 1 12.1          WDM     81 FLOW     ENGL      REPL
COPY    52 OUTPUT MEAN   1 1 12.1          WDM     82 FLOW     ENGL      REPL
COPY    45 OUTPUT MEAN   1 1 12.1          WDM     85 FLOW     ENGL      REPL
COPY    46 OUTPUT MEAN   1 1 12.1          WDM     86 FLOW     ENGL      REPL
COPY    47 OUTPUT MEAN   1 1 12.1          WDM     87 FLOW     ENGL      REPL
COPY    57 OUTPUT MEAN   1 1 12.1          WDM     90 FLOW     ENGL      REPL
COPY    37 OUTPUT MEAN   1 1 12.1          WDM     91 FLOW     ENGL      REPL
COPY    43 OUTPUT MEAN   1 1 12.1          WDM     83 FLOW     ENGL      REPL
COPY    44 OUTPUT MEAN   1 1 12.1          WDM     84 FLOW     ENGL      REPL
COPY    51 OUTPUT MEAN   1 1 12.1          WDM     39 FLOW     ENGL      REPL
*** OTHER POC LOCATIONS
***COPY   645 OUTPUT MEAN   1 1 12.1   ***       WDM     99 FLOW     ENGL
REPL
COPY    39 OUTPUT MEAN   1 1 12.1          WDM     95 FLOW     ENGL      REPL
COPY    53 OUTPUT MEAN   1 1 12.1          WDM    499 FLOW     ENGL      REPL
END EXT TARGETS                                                          ***

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK    ***
<Name>   #                  <-factor->     <Name>   #   Tbl#    ***
  *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                      3.41       RCHRES   1      6
PERLND  26                    232.36       RCHRES   1      6
PERLND  34                      3.07       RCHRES   1      6
PERLND  44                     38.03       RCHRES   1      6
PERLND  54                      3.87       RCHRES   1      6
IMPLND  14                     56.14       RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                      5.56       RCHRES   2      6
PERLND  26                    200.05       RCHRES   2      6
PERLND  34                      0.46       RCHRES   2      6
PERLND  44                     38.71       RCHRES   2      6
PERLND  16                      0.56       RCHRES 135      7
PERLND  26                     20.01       RCHRES 135      7
PERLND  34                      0.05       RCHRES 135      7
```

```
PERLND  44                          3.87     RCHRES 135       7
IMPLND  14                         42.22     RCHRES   2       2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                          3.09     RCHRES  23       6
PERLND  26                        156.15     RCHRES  23       6
PERLND  34                          2.25     RCHRES  23       6
PERLND  44                         45.84     RCHRES  23       6
PERLND  16                          0.46     RCHRES 135       7
PERLND  26                         23.42     RCHRES 135       7
PERLND  34                          0.34     RCHRES 135       7
PERLND  44                          6.88     RCHRES 135       7
IMPLND  14                         58.44     RCHRES  23       2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  16                          ****     RCHRES  24       6
PERLND  26                        135.43     RCHRES  24       6
PERLND  34                          2.02     RCHRES  24       6
PERLND  44                         69.29     RCHRES  24       6
PERLND  16                          ****     RCHRES  11       7
PERLND  26                         81.26     RCHRES  11       7
PERLND  34                          1.21     RCHRES  11       7
PERLND  44                         41.57     RCHRES  11       7
IMPLND  14                         79.98     RCHRES  24       2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                          8.26     RCHRES   3       6
PERLND  26                        108.38     RCHRES   3       6
PERLND  34                         16.02     RCHRES   3       6
PERLND  44                        102.89     RCHRES   3       6
PERLND  54                          0.04     RCHRES   3       6
PERLND  16                          8.26     RCHRES 135       7
PERLND  26                        108.38     RCHRES 135       7
PERLND  34                         16.02     RCHRES 135       7
PERLND  44                        102.89     RCHRES 135       7
PERLND  54                          0.04     RCHRES 135       7
IMPLND  14                         27.30     RCHRES   3       2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                          2.95     RCHRES   4       6
PERLND  26                         85.95     RCHRES   4       6
PERLND  34                          3.75     RCHRES   4       6
PERLND  44                         92.06     RCHRES   4       6
PERLND  16                          0.30     RCHRES   4       7
PERLND  26                          8.60     RCHRES   4       7
PERLND  34                          0.38     RCHRES   4       7
PERLND  44                          9.21     RCHRES   4       7
IMPLND  14                         18.43     RCHRES   4       2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                          8.66     RCHRES   4       6
PERLND  26                         61.64     RCHRES   4       6
PERLND  34                         22.06     RCHRES   4       6
PERLND  44                         78.09     RCHRES   4       6
PERLND  54                         12.50     RCHRES   4       6
PERLND  16                          6.06     RCHRES   4       7
PERLND  26                         43.15     RCHRES   4       7
PERLND  34                         15.44     RCHRES   4       7
PERLND  44                         54.66     RCHRES   4       7
PERLND  54                          8.75     RCHRES   4       7
IMPLND  14                         29.14     RCHRES   4       2
  *** SUB-CATCHMENT 5
PERLND  26                         10.29     RCHRES   5       1
PERLND  44                         50.05     RCHRES   5       1
PERLND  54                         10.74     RCHRES   5       1
IMPLND  14                         16.31     RCHRES   5       2
  *** SUB-CATCHMENT 6
PERLND  16                          1.43     COPY   645      21
PERLND  26                         20.37     COPY   645      21
PERLND  34                         13.43     COPY   645      21
PERLND  44                         11.79     COPY   645      21
PERLND  54                          0.82     COPY   645      21
```

IMPLND	14	6.23	COPY	645	22
*** SUB-CATCHMENT 8					
PERLND	44	22.21	RCHRES	35	1
IMPLND	14	6.60	RCHRES	35	2
*** SUB-CATCHMENT 9					
PERLND	16	4.98	RCHRES	34	1
PERLND	26	14.38	RCHRES	34	1
PERLND	34	0.05	RCHRES	34	1
PERLND	44	56.71	RCHRES	34	1
PERLND	54	0.01	RCHRES	34	1
IMPLND	14	22.47	RCHRES	34	2
*** SUB-CATCHMENT 10					
PERLND	16	4.15	RCHRES	10	1
PERLND	26	31.94	RCHRES	10	1
PERLND	44	95.23	RCHRES	10	1
IMPLND	14	71.98	RCHRES	10	2
*** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15					
PERLND	16	0.89	RCHRES	11	6
PERLND	26	217.92	RCHRES	11	6
PERLND	34	1.32	RCHRES	11	6
PERLND	44	65.65	RCHRES	11	6
PERLND	16	0.67	RCHRES	11	7
PERLND	26	163.44	RCHRES	11	7
PERLND	34	0.99	RCHRES	11	7
PERLND	44	49.24	RCHRES	11	7
PERLND	16	0.22	RCHRES	15	7
PERLND	26	54.48	RCHRES	15	7
PERLND	34	0.33	RCHRES	15	7
PERLND	44	16.41	RCHRES	15	7
IMPLND	14	230.80	RCHRES	11	2
*** SUB-CATCHMENT 12					
PERLND	16	0.39	RCHRES	12	1
PERLND	26	101.18	RCHRES	12	1
PERLND	34	5.64	RCHRES	12	1
PERLND	44	54.98	RCHRES	12	1
PERLND	54	0.64	RCHRES	12	1
IMPLND	14	79.83	RCHRES	12	2
*** SUB-CATCHMENT 13					
PERLND	16	0.79	RCHRES	13	1
PERLND	26	197.68	RCHRES	13	1
IMPLND	14	27.66	RCHRES	13	2
*** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND					
PERLND	16	0.24	RCHRES	14	6
PERLND	26	118.67	RCHRES	14	6
PERLND	34	13.46	RCHRES	14	6
PERLND	44	41.91	RCHRES	14	6
PERLND	16	0.12	RCHRES	14	7
PERLND	26	59.34	RCHRES	14	7
PERLND	34	6.73	RCHRES	14	7
PERLND	44	20.96	RCHRES	14	7
IMPLND	14	20.66	RCHRES	14	2
*** SUB-CATCHMENT 15					
PERLND	16	6.59	RCHRES	15	1
PERLND	26	49.55	RCHRES	15	1
PERLND	34	50.09	RCHRES	15	1
PERLND	44	86.52	RCHRES	15	1
IMPLND	14	19.47	RCHRES	15	2
*** SUB-CATCHMENT 16					
PERLND	16	10.93	RCHRES	16	1
PERLND	26	30.30	RCHRES	16	1
PERLND	34	20.03	RCHRES	16	1
PERLND	44	31.43	RCHRES	16	1
IMPLND	14	15.62	RCHRES	16	2
*** SUB-CATCHMENT 17 AGWO GOES TO SOUND					
PERLND	16	0.90	RCHRES	17	6
PERLND	26	16.31	RCHRES	17	6
PERLND	34	34.82	RCHRES	17	6

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PERLND  44                          82.11     RCHRES  17       6
PERLND  54                           2.19     RCHRES  17       6
IMPLND  14                          10.49     RCHRES  17       2
  *** SUB-CATCHMENT MC-1 (revised by FK, 06/04/01)
PERLND  26                           0.17     RCHRES  52       1
PERLND  44                          11.15     RCHRES  52       1
PERLND  54                           0.27     RCHRES  52       1
IMPLND  14                           0.37     RCHRES  52       2
  *** SUB-CATCHMENT MC-2
PERLND  16                           0.08     RCHRES  53       1
PERLND  26                           0.64     RCHRES  53       1
PERLND  34                           6.66     RCHRES  53       1
PERLND  44                          10.41     RCHRES  53       1
PERLND  54                          15.25     RCHRES  53       1
IMPLND  14                           0.27     RCHRES  53       2
  *** SUB-CATCHMENT MC-3
PERLND  34                           5.53     RCHRES  54       1
PERLND  44                           5.03     RCHRES  54       1
PERLND  54                           2.27     RCHRES  54       1
IMPLND  14                           0.11     RCHRES  54       2
  *** SUB-CATCHMENT MC-4
PERLND  34                           0.05     RCHRES 135       1
PERLND  44                          19.47     RCHRES 135       1
PERLND  54                          14.72     RCHRES 135       1
IMPLND  14                           2.04     RCHRES 135       2
  *** SUB-CATCHMENT MC-5
PERLND  26                          13.49     RCHRES  35       1
PERLND  44                          31.13     RCHRES  35       1
PERLND  54                           7.60     RCHRES  35       1
IMPLND  14                           2.50     RCHRES  35       2
  *** SUB-CATCHMENT MC-6
PERLND  44                          13.56     RCHRES  35       1
PERLND  54                           0.99     RCHRES  35       1
IMPLND  14                           0.80     RCHRES  35       2
  *** SUB-CATCHMENT MC-7
PERLND  26                           9.23     COPY    55      21
PERLND  44                          30.54     COPY    55      21
PERLND  54                           3.47     COPY    55      21
IMPLND  14                           3.05     COPY    55      22

*** NOTE: SDN AGWO TO VACA FARMS (135), no AGWO to ponds

  *** SUB-CATCHMENT SDN-1
PERLND  16                           7.27     COPY    52      26
PERLND  26                           1.45     COPY    52      26
PERLND  34                           4.69     COPY    52      26
PERLND  44                           0.94     COPY    52      26
PERLND  54                           0.20     COPY    52      26
PERLND  16                           7.27     RCHRES 135       7
PERLND  26                           1.45     RCHRES 135       7
PERLND  34                           4.69     RCHRES 135       7
PERLND  44                           0.94     RCHRES 135       7
PERLND  54                           0.20     RCHRES 135       7
IMPLND  14                           1.59     COPY    52      22

  *** SUB-CATCHMENT SDN-1-LWR
PERLND  34                           4.01     COPY    52      26
PERLND  44                           0.96     COPY    52      26
PERLND  54                           0.07     COPY    52      26
PERLND  34                           4.01     RCHRES 135       7
PERLND  44                           0.96     RCHRES 135       7
PERLND  54                           0.07     RCHRES 135       7
IMPLND  14                           0.38     COPY    52      22

  *** SUB-CATCHMENT SDN-1-OFF
PERLND  16                          21.99     RCHRES  52       6
PERLND  26                           4.40     RCHRES  52       6
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PERLND  34                          3.96     RCHRES  52      6
PERLND  44                          0.79     RCHRES  52      6
PERLND  54                          1.67     RCHRES  52      6
PERLND  16                         21.99     RCHRES 135      7
PERLND  26                          4.40     RCHRES 135      7
PERLND  34                          3.96     RCHRES 135      7
PERLND  44                          0.79     RCHRES 135      7
PERLND  54                          1.67     RCHRES 135      7
IMPLND  14                          3.46     RCHRES  52      2

  *** SUB-CATCHMENT SDN-2X (TO POND)(revised by FK 06/02/01)
PERLND  16                          0.85     COPY    61     26
PERLND  26                          0.28     COPY    61     26
PERLND  34                          2.34     COPY    61     26
PERLND  44                          0.78     COPY    61     26
PERLND  16                          0.85     RCHRES 135      7
PERLND  26                          0.28     RCHRES 135      7
PERLND  34                          2.34     RCHRES 135      7
PERLND  44                          0.78     RCHRES 135      7
IMPLND  14                          ****     COPY    61     22

  *** SUB-CATCHMENT SDN-3 (TO POND)
PERLND  16                         35.89     COPY    43     26
PERLND  26                          7.18     COPY    43     26
PERLND  16                         35.89     RCHRES 135      7
PERLND  26                          7.18     RCHRES 135      7
IMPLND  14                          4.79     COPY    43     22

  *** SUB-CATCHMENT SDN-3X (TO POND)
PERLND  16                          4.71     COPY    43     26
PERLND  26                          1.57     COPY    43     26
PERLND  34                         13.89     COPY    43     26
PERLND  44                          4.63     COPY    43     26
PERLND  54                          0.57     COPY    43     26
PERLND  16                          4.71     RCHRES 135      7
PERLND  26                          1.57     RCHRES 135      7
PERLND  34                         13.89     RCHRES 135      7
PERLND  44                          4.63     RCHRES 135      7
PERLND  54                          0.57     RCHRES 135      7

  *** SUB-CATCHMENT SDN-4 (TO POND)
PERLND  16                         20.23     COPY    44     26
PERLND  26                          4.41     COPY    44     26
PERLND  34                          2.50     COPY    44     26
PERLND  44                          0.55     COPY    44     26
PERLND  16                         20.23     RCHRES 135      7
PERLND  26                          4.41     RCHRES 135      7
PERLND  34                          2.50     RCHRES 135      7
PERLND  44                          0.55     RCHRES 135      7
IMPLND  14                          2.63     COPY    44     22

  *** SUB-CATCHMENT SDN-4X (TO POND)
PERLND  16                          2.43     COPY    44     26
PERLND  26                          0.59     COPY    44     26
PERLND  34                          8.96     COPY    44     26
PERLND  44                          2.16     COPY    44     26
PERLND  16                          2.43     RCHRES 135      7
PERLND  26                          0.59     RCHRES 135      7
PERLND  34                          8.96     RCHRES 135      7
PERLND  44                          2.16     RCHRES 135      7
IMPLND  14                          1.05     COPY    44     22

*** EXTRA POND TRIBUTARY FLOWS:

  *** SUB-CATCHMENT IWS-NCPS (TO POND)
PERLND  16                         26.79     COPY   242     26
PERLND  26                          5.36     COPY   242     26
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PERLND	16	26.79	RCHRES	135	7
PERLND	26	5.36	RCHRES	135	7
IMPLND	14	3.57	COPY	242	22

*** SUB-CATCHMENT IWS-NSMPS (TO POND)

PERLND	16	2.80	COPY	240	26
PERLND	26	0.91	COPY	240	26
PERLND	34	2.17	COPY	240	26
PERLND	44	0.70	COPY	240	26
PERLND	16	2.80	RCHRES	135	7
PERLND	26	0.91	RCHRES	135	7
PERLND	34	2.17	RCHRES	135	7
PERLND	44	0.70	RCHRES	135	7
IMPLND	14	0.04	COPY	240	22

*** SUB-CATCHMENT NEPL (TO POND)

PERLND	16	23.15	COPY	45	26
PERLND	26	4.63	COPY	45	26
PERLND	34	8.57	COPY	45	26
PERLND	44	1.71	COPY	45	26
PERLND	16	23.15	RCHRES	135	7
PERLND	26	4.63	RCHRES	135	7
PERLND	34	8.57	RCHRES	135	7
PERLND	44	1.71	RCHRES	135	7
IMPLND	14	4.23	COPY	45	22

*** SUB-CATCHMENT CARGO (TO POND)

PERLND	16	6.09	COPY	46	26
PERLND	26	1.22	COPY	46	26
PERLND	16	6.09	RCHRES	135	7
PERLND	26	1.22	RCHRES	135	7
IMPLND	14	0.81	COPY	46	22

*** SUB-CATCHMENT SDN3A (TO POND)

PERLND	16	4.26	COPY	37	26
PERLND	26	1.07	COPY	37	26
PERLND	34	18.43	COPY	37	26
PERLND	44	4.63	COPY	37	26
PERLND	54	0.19	COPY	37	26
PERLND	16	4.26	RCHRES	135	7
PERLND	26	1.07	RCHRES	135	7
PERLND	34	18.43	RCHRES	135	7
PERLND	44	4.63	RCHRES	135	7
PERLND	54	0.19	RCHRES	135	7
IMPLND	14	1.87	COPY	37	22

*** SUB-CATCHMENT SDW1A (TO POND)

PERLND	16	19.29	COPY	47	26
PERLND	26	5.98	COPY	47	26
PERLND	34	18.40	COPY	47	26
PERLND	44	5.50	COPY	47	26
PERLND	54	2.96	COPY	47	26
PERLND	16	19.29	RCHRES	135	7
PERLND	26	5.98	RCHRES	135	7
PERLND	34	18.40	RCHRES	135	7
PERLND	44	5.50	RCHRES	135	7
PERLND	54	2.96	RCHRES	135	7
IMPLND	14	0.87	COPY	47	22

*** SUB-CATCHMENT SDW1B (TO POND)

PERLND	16	45.57	COPY	57	26
PERLND	26	12.23	COPY	57	26
PERLND	34	21.27	COPY	57	26
PERLND	44	5.71	COPY	57	26
PERLND	54	7.74	COPY	57	26
PERLND	16	45.57	RCHRES	135	7
PERLND	26	12.23	RCHRES	135	7

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PERLND  34                      21.27     RCHRES 135      7
PERLND  44                       5.71     RCHRES 135      7
PERLND  54                       7.74     RCHRES 135      7
IMPLND  14                       4.34     COPY    57     22

  *** ADD SUB-CATCHMENT IWS-PRIMARY TO PREDEVELOPEMENT ONLY
PERLND  16                      26.61     RCHRES  52      6
PERLND  26                       5.32     RCHRES  52      6
PERLND  34                       6.22     RCHRES  52      6
PERLND  44                       1.24     RCHRES  52      6
PERLND  16                      26.61     RCHRES 135      7
PERLND  26                       5.32     RCHRES 135      7
PERLND  34                       6.22     RCHRES 135      7
PERLND  44                       1.24     RCHRES 135      7
IMPLND  14                       4.38     RCHRES  52      2

***ROUTING FOR MILLER CREEK
*** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                                RCHRES   2      4
RCHRES  23                                RCHRES  24      4
RCHRES  24                                RCHRES   3      3
RCHRES   2                                RCHRES   3      3
RCHRES   3                                RCHRES  33      3
RCHRES  33                                RCHRES  50      3
RCHRES   4                                RCHRES   5      4
RCHRES   5                                RCHRES  50      3
*** PONDS TO 52, 53 & 54
COPY   242                                COPY   240     10
COPY   240                                COPY    61     10
COPY    61                                COPY    51     10
COPY    43                                RCHRES  54     12
COPY    44                                COPY    51     10
COPY    51                                RCHRES  52     12
COPY    52                                RCHRES  52     12
COPY    45                                COPY   645     10
COPY   645                                RCHRES  53     12
COPY    46                                RCHRES  53     12
*** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54 (Revised by FK)
RCHRES  52                                RCHRES  53      3
RCHRES  53                                COPY    53     11
COPY    53                                RCHRES  54     12
RCHRES  50                                RCHRES  54      3
*** RDF 54 TO 35
RCHRES  54                                RCHRES 135      3
*** PONDS TO 34
COPY    37                                COPY    39     10
COPY    47                                COPY    39     10
COPY    39                                RCHRES 135     12
RCHRES  34                                RCHRES 135      4
RCHRES  34                                RCHRES 135      5
RCHRES 135                                RCHRES  35      3
RCHRES  10                                RCHRES  16      3
*** PONDS TO 35
COPY    57                                RCHRES  35     12
RCHRES  35                                COPY    55     11
COPY    55                                RCHRES  16     12
RCHRES  11                                RCHRES  15      3
RCHRES  13                                RCHRES  12      4
RCHRES  13                                RCHRES  12      5
RCHRES  12                                RCHRES  15      3
RCHRES  16                                RCHRES  15      3
RCHRES  14                                RCHRES  17      3
RCHRES  15                                RCHRES  17      3
END SCHEMATIC

NETWORK
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>         <-MEMBER->
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<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
END NETWORK                                                                 ***

RCHRES
  GEN-INFO
    RCHRES        Name          Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG              ***
                                          in  out                               ***
    1     Arbor Lake  M 1          2    1    1    1   62    0    0
    2     Arbor Ck -03710 M 2      1    1    1    1   62    0    0
    3     Arbor Ck   M 3           1    1    1    1   62    0    0
    4     Tub Lake   M 4           2    1    1    1   62    0    0
    5     Miller Ck SR518 M5       1    1    1    1   62    0    0
   10     Trib (0371G)   M 10      1    1    1    1   62    0    0
   11     M11 Ambaum Detention     1    1    1    1   62    0    0
   12     Trib(0354)  M 12         1    1    1    1   62    0    0
   13     Burien Lake M 13         2    1    1    1   62    0    0
   14     Trib (0353) M 14         1    1    1    1   62    0    0
   15     M/S U/S OF 17            1    1    1    1   62    0    0
   16     U/S OF 15 M/S            1    1    1    1   62    0    0
   17     GAGE                     1    1    1    1   62    0    0
   23     BASIN M23                2    1    1    1   62    0    0
   24     BASIN M24                1    1    1    1   62    0    0
   33     detention m3             1    1    1    1   62    0    0
   34     LORA LAKE                2    1    1    1   62    0    0
   35     D/S OF VACA FARM         1    1    1    1   62    0    0
***37     sdn3a pond               1    1    1    1   62    0    0
   38     MC basins                1    1    1    1   62    0    0
***39     sdn3a/sdw1a              1    1    1    1   62    0    0
***43     sdn3 pond                1    1    1    1   62    0    0
***44     sdn4 pond                1    1    1    1   62    0    0
***45     nepl pond                1    1    1    1   62    0    0
***46     cargo pond               1    1    1    1   62    0    0
***47     sdw1a pond               1    1    1    1   62    0    0
   50     sr 518                   1    1    1    1   62    0    0
***51     sdn4x/2x basins          1    1    1    1   62    0    0
   52     U/S OF LAKE REBA         1    1    1    1   62    0    0
   53     Reba outflow             1    1    1    1   62    0    0
   54     Miller RDF outflow       1    1    1    1   62    0    0
***55     MC7                      1    1    1    1   62    0    0
***57     sdw1b pond               1    1    1    1   62    0    0
***61     sdn2x pond               1    1    1    1   62    0    0
  135     VACA FARMS               1    1    1    1   62    0    0
***240     iws-nsmps pond           1    1    1    1   62    0    0
***242     iws-nsmps                1    1    1    1   62    0    0
***645     nepl poc                 1    1    1    1   62    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                 ***
    1  200    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1  200    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
```

```
  3          0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  4          0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
  5    12    0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 13          0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 14    22    0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 23          0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 24    33    0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 34          0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 35   200    0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2                                                                    ***
  RCHRES                                                                      ***
  # -  #     FTABNO       LEN      DELTH      STCOR        KS       DB50       ***
<------><--------><--------><--------><--------><--------><-------->          ***
  1              1   0.010                                0.3
  2              2   0.776                                0.3
  3              3   0.980                                0.3
  4              4   0.010                                0.3
  5              5   0.380                                0.3
 10             10   0.380                                0.3
 11             11   0.010                                0.3
 12             12   1.000                                0.3
 13             13   0.015                                0.3
 14             14   0.450                                0.3
 15             15   0.735                                0.3
 16             16   0.587                                0.3
 17             17   0.379                                0.3
 23             23   0.379                300.0           0.3
 24             24   0.379                                0.3
 33             33   0.200                                0.3
 34             34   0.852                                0.3
 35             35   0.663                                0.3
 38             38   0.010                                0.3
 50             50   0.010                                0.3
 52             52   0.010                                0.3
 53             53   0.010                                0.3
 54             54   0.010                                0.3
135            135   0.350                                0.3
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                            ***
  # -  # ***   VOL      Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft      for each possible exit        for each possible exit
<------><-------->      <---><---><---><---><---> *** <---><---><---><---><--->
  1      2.0              4.0  5.0
  2      0.0              4.0
  3      0.0              4.0
  4      2.0              4.0  5.0
  5      0.0              4.0
 10      0.0              4.0
 11      0.0              4.0
 12      0.0              4.0
 13      10.0             4.0  5.0
 14      0.0              4.0
 15      0.0              4.0
 16      0.0              4.0
 17      0.0              4.0
 23      6.0              4.0  5.0
 24      0.0              4.0
 33      0.0              4.0
 34      9.0              4.0  5.0
 35      0.1              4.0
 38      0.1              4.0
 50      0.0              4.0
 52      0.0              4.0
```

```
  53      0.1                4.0
  54      2.25               4.0
 135      0.00               4.0
  END HYDR-INIT
END RCHRES

FTABLES
***UPPER BASIN
***============

  FTABLE      1
 ROWS COLS ***
   11    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
      0.00       3.00      0.00       0.00     0.00
      2.50       3.00      7.50       0.00     0.11
      3.00       3.00      9.00       1.80     0.11
      3.50       3.30     10.58       5.00     0.11
      4.00       3.60     12.30      10.90     0.11
      4.50       3.90     14.18      17.50     0.11
      5.00       4.10     16.18      26.20     0.11
      5.50       4.30     18.28      32.50     0.11
      6.00       4.50     20.48      35.90     0.11
      7.00       5.00     25.23      38.10     0.11
      8.00       5.50     30.48      46.40     0.11
  END FTABLE  1

  FTABLE      2
 ROWS COLS ***
    9    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000      0.00
     0.100     0.2571     0.0129      0.16
     0.500     0.3873     0.1417      6.53
     1.000     0.5501     0.3761     25.95
     1.500     0.7128     0.6918     59.86
     2.000     0.8756     1.0889    110.67
     3.000     1.2011     2.1273    272.24
     3.500     1.3639     2.7685    387.38
     4.000     1.5266     3.4912    528.19
  END FTABLE  2

  FTABLE      3
 ROWS COLS ***
   12    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000      0.00
     0.100     0.9669     0.0483      0.13
     0.500     1.0637     0.4545      4.92
     1.000     1.1846     1.0165     17.12
     1.500     1.3055     1.6390     34.92
     2.000     1.4264     2.3220     57.95
     2.500     1.5473     3.0654     86.14
     3.000     1.6682     3.8693    119.53
     3.500     1.7891     4.7336    158.24
     4.000     1.9100     5.6584    202.41
     4.500     2.0294     6.6310    251.52
     5.000     2.1488     7.6624    306.28
  END FTABLE  3

  FTABLE      4
 ROWS COLS ***
    7    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
      0.00      3.00      0.00       0.00      0.00
      2.50      4.50      9.38       0.00      0.11
      3.00      6.00     12.00       6.00      0.11
```

```
     4.00     10.00     20.00      13.00      0.11
     5.00     15.00     32.50      20.00      0.11
     6.00     20.00     50.00      26.00      0.11
     7.00     25.00     72.50     168.00      0.11
 END FTABLE  4

 FTABLE       5
ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1010     0.0051       0.03
    0.500     0.1754     0.0603       1.46
    1.000     0.2684     0.1713       6.16
    1.500     0.3614     0.3288      14.89
    2.000     0.4544     0.5327      28.48
    2.500     0.5474     0.7832      47.70
    3.000     0.6404     1.0801      73.29
    3.500     0.7334     1.4236     105.94
    4.000     0.8264     1.8136     146.33
 END FTABLE  5

 FTABLE      10
ROWS COLS ***
   9    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1010     0.0051       0.06
    0.500     0.1660     0.0585       2.27
    1.000     0.2472     0.1618       9.32
    1.500     0.3285     0.3057      22.08
    2.000     0.4097     0.4902      41.66
    2.500     0.4909     0.7154      69.09
    3.000     0.5722     0.9811     105.37
    4.000     0.6887     1.6116     209.70
 END FTABLE 10

 POST AMBAUM DETENTION ***
 FTABLE      11
ROWS COLS ***
  11    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    1.000     0.1000     0.2300       3.90
    2.000     0.2000     0.6000       6.30
    3.000     0.3000     0.9700       8.10
    4.000     0.4000     1.3400      11.10
    5.000     0.5000     1.8200      16.00
    6.000     0.6000     2.2700      19.10
    7.000     0.7000     2.8300      21.60
    8.000     0.8000     3.3700      30.80
    9.000     0.9000     4.0000      38.10
   10.000     1.0000     4.6500      74.10
   10.500     1.1000     5.2000     133.00
   11.000     1.1500     5.3000     500.00
 END FTABLE 11

 FTABLE      12
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.6327     0.0316       0.15
    0.500     0.7960     0.3174       5.87
    1.000     1.0002     0.7664      21.53
    1.500     1.2043     1.3176      46.43
    2.000     1.4085     1.9708      81.20
```

```
    3.000     1.8168     3.5834     183.79
    4.000     2.2251     5.6044     336.22
    5.000     2.6335     8.0337     545.30
    6.000     3.0418    10.8713     817.51
 END FTABLE 12

 FTABLE      13
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
    0.000     40.000     0.0000       0.00     0.00
    1.000     41.400     40.000       0.00     0.11
    1.500     42.000     60.000      10.00     0.11
    2.000     42.700     80.000      16.00     0.11
    2.500     43.300     100.00      20.00     0.11
    3.000     44.000     120.00      28.00     0.11
    5.000     45.000     210.00      45.00     0.11
 END FTABLE 13

 FTABLE      14
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3361     0.0168       0.24
    0.500     0.3809     0.1602       9.04
    1.000     0.4370     0.3647      31.61
    1.500     0.4930     0.5972      65.00
    2.000     0.5491     0.8577     108.85
    2.500     0.6051     1.1462     163.33
    3.000     0.6612     1.4628     228.78
 END FTABLE 14

 FTABLE      15
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      91.00
     2.00       1.10       1.60     268.00
     3.00       1.20       2.75     493.00
 END FTABLE 15

 FTABLE      16
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      74.00
     2.00       1.10       1.60     219.00
     3.00       1.20       2.75     403.00
 END FTABLE 16

 FTABLE      17
ROWS COLS ***
   5    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      59.00
     2.00       1.10       1.60     173.00
     3.00       1.20       2.75     318.00
     4.00       1.30       4.00     484.00
 END FTABLE 17

 FTABLE      23
ROWS COLS ***  HERMES
   9    5
```

```
   DEPTH      AREA     VOLUME    OUTFLOW OUTFLOW  ***
    0.00      0.00       0.00       0.00    0.00          0.00
    5.00      0.50       1.91       0.00    0.00        305.00
   11.00      0.79       5.79       0.00    0.00        311.00
   15.00      1.13       9.64       0.50    0.01        315.00
   19.00      1.72      15.34       0.50    0.05        319.00
   29.00      2.86      38.25       0.50    0.10        329.00
   39.00      4.40      74.55       0.50    0.20        339.00
   50.00      6.22     132.98       0.50    0.30        350.00
   60.00     10.00    1212.98       0.50    0.40        360.00
 END FTABLE 23

 FTABLE     24
ROWS COLS ***
   9    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
    0.000    0.0000    0.0000       0.00
    0.100    0.2571    0.0129       0.16
    0.500    0.3873    0.1417       6.53
    1.000    0.5501    0.3761      25.95
    1.500    0.7128    0.6918      59.86
    2.000    0.8756    1.0889     110.67
    3.000    1.2011    2.1273     272.24
    3.500    1.3639    2.7685     387.38
    4.000    1.5266    3.4912     528.19
 END FTABLE 24

 FTABLE     33
ROWS COLS ***
  11    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
     0.00      1.00       0.00       0.00
     0.50      1.20       0.55       2.00
     1.00      1.40       1.20       6.00
     1.50      1.60       1.95       9.00
     2.00      1.80       2.80      13.00
     2.50      2.00       3.75      16.50
     3.00      2.20       4.80      20.00
     3.50      2.40       5.95      23.00
     4.00      2.60       7.20      26.00
     5.00      2.80       9.90     104.00
     6.00      3.00      12.80     246.00
 END FTABLE 33

 FTABLE     34
ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
   6    5
    DEPTH      AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00      3.00       0.00       0.00    0.00
     3.00      3.05       9.08       0.00    0.11
     4.00      3.10      12.15       0.00    0.11
     5.00      3.15      15.28       0.00    0.11
     6.00      3.20      18.45       72.0    0.11
     7.00      3.25      21.68      225.0    0.11
 END FTABLE 34

 FTABLE     35
ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
   5    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
     0.00      0.10       0.00       0.00
     1.00      1.10       0.60      38.00
     2.00      1.20       1.75     108.00
     3.00      1.30       3.00     194.00
     4.00      1.40       4.35     290.00
 END FTABLE 35
```

```
 FTABLE      38
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    1.000     0.4000     0.4000       2.00
    1.500     0.5000     1.0000       4.00
    2.000     0.9000     1.3000      11.00
    2.500     1.3000     1.6000      15.00
    3.000     1.6000     2.0000      18.00
    3.500     1.9000     2.5000      20.80
 END FTABLE 38

 FTABLE      45
ROWS COLS ***
NORTH EMPLOYEE PARKING LOT VAULT (AS-BUILT)*** not used in predev run
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.2200     0.0000       0.00
    2.000     0.2200     0.4500       1.20
    4.000     0.2200     0.9000       1.70
    6.000     0.2200     1.3400       2.10
    8.000     0.2200     1.7900       2.40
   10.000     0.2200     2.2400       2.70
   12.240     0.2200     2.7400       3.00
   14.000     0.2200     3.1400       6.90
   15.440     0.2200     3.4600       8.30
   16.000     0.2200     3.5800      10.30
   18.000     0.2200     4.0300      13.60
   20.000     0.2200     4.4800      30.79
 END FTABLE 45

 FTABLE      50
ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       1.00       0.00       0.00
     0.50       1.10       0.53       5.00
     1.00       1.20       1.10      15.00
     1.50       1.30       1.73      25.00
     2.00       1.40       2.40      35.00
     2.50       1.50       3.13      52.00
     3.00       1.60       3.90      70.00
     3.50       1.70       4.73      87.00
     4.00       1.80       5.60     105.00
     6.00       1.90       9.30     165.00
 END FTABLE 50

 FTABLE      52
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3680     0.0184       0.25
    0.500     0.3717     0.1664       9.39
    1.000     0.3763     0.3534      31.06
    2.000     0.3819     0.7325      94.37
    3.000     0.3874     1.1171     174.33
 END FTABLE 52

 FTABLE      53                                  ***
OLD LAKE REBA                                   ***
MAX DEPTH = 4.9 FEET                            ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH          ***
 ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
```

```
   0.000     2.4000     0.0000       0.00
   1.000     2.5800     2.5000      18.00
   2.000     2.9400     5.3000      26.00
   3.000     3.4100     8.4000      31.00
   4.000     3.8800    12.100       36.00
   4.900     4.3000    15.800       40.00
   6.000     4.3000    15.810      500.00
 END FTABLE 53

 FTABLE     54
EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
GATE SETTING: 2.0 FEET***
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000       0.00       0.00       0.00
    1.300       0.01       0.01      10.00
    2.000       0.01       0.02      20.00
    2.900       0.70       0.40      30.00
    4.000       1.50       1.50      40.00
    5.400       3.50       4.90      50.00
    7.000       8.60      13.30      60.00
    8.800      15.60      34.80      70.00
   10.000      19.90      57.30      76.00
   10.500      21.50      68.00      92.00
   11.000      23.10      78.80     179.00
   11.500      24.70      88.60     303.00
 END FTABLE 54

 FTABLE     69
PRE-MILLER CREEK DETENTION FACILITY***
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1860     0.0093       0.12
    0.500     0.2552     0.0975       4.84
    1.000     0.3417     0.2467      18.49
    1.500     0.4282     0.4392      41.30
    2.000     0.5148     0.6750      74.40
    2.500     0.6013     0.9540     119.01
    3.000     0.6878     1.2763     176.30
    3.500     0.7744     1.6418     247.41
    4.000     0.8609     2.0506     333.43
    4.500     0.9470     2.4992     434.59
    5.000     1.0331     2.9905     552.33
 END FTABLE 69

 PRE AMBAUM DETENTION ***
 FTABLE    111
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0000     0.0000       0.00
    0.500     0.2160     0.0750       5.30
    1.000     0.2730     0.1990      21.10
    1.500     0.2890     0.3410      43.90
    2.000     0.2900     0.4830      68.80
    2.500     0.2910     0.6070      89.10
    3.000     0.2950     0.6820      90.00
    3.500     0.3000     2.1000     100.00
    4.000     0.3050     2.5000     105.00
    4.500     0.3100     3.0000     110.00
    5.000     0.3200     3.5000     120.00
    5.500     0.3300     4.0000     130.00
 END FTABLE111
```

```
  FTABLE    135
 ROWS COLS *** VACA FARM
    6    4
     DEPTH       AREA     VOLUME    OUTFLOW  ***
      0.00       0.10       0.00       0.00
      1.00       0.10       0.10       4.00
      2.00       0.11       0.21       8.00
      2.50       1.00       0.48      13.00
      3.50       6.50       4.23      86.00
      4.50      13.00      13.98     235.00
  END FTABLE135
END FTABLES

MASS-LINK
***
*** NOTE: MFACTOR 0.083 CONVERTS ACRE-INCHES TO ACRE-FT (1/12)
***
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        1
PERLND     PWATER PERO       0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND     IWATER SURO       0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES     ROFLOW                          RCHRES         INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND     PWATER SURO       0.0833333     RCHRES         INFLOW IVOL
PERLND     PWATER IFWO       0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND     PWATER AGWO       0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK       10
COPY       OUTPUT MEAN                     COPY           INPUT  MEAN
  END MASS-LINK   10

  MASS-LINK       11
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   11

  MASS-LINK       12
COPY       OUTPUT MEAN                     RCHRES         INFLOW IVOL
  END MASS-LINK   12

  MASS-LINK       21
PERLND     PWATER PERO       0.0833333     COPY           INPUT  MEAN
  END MASS-LINK   21

  MASS-LINK       22
IMPLND     IWATER SURO       0.0833333     COPY           INPUT  MEAN
  END MASS-LINK   22
```

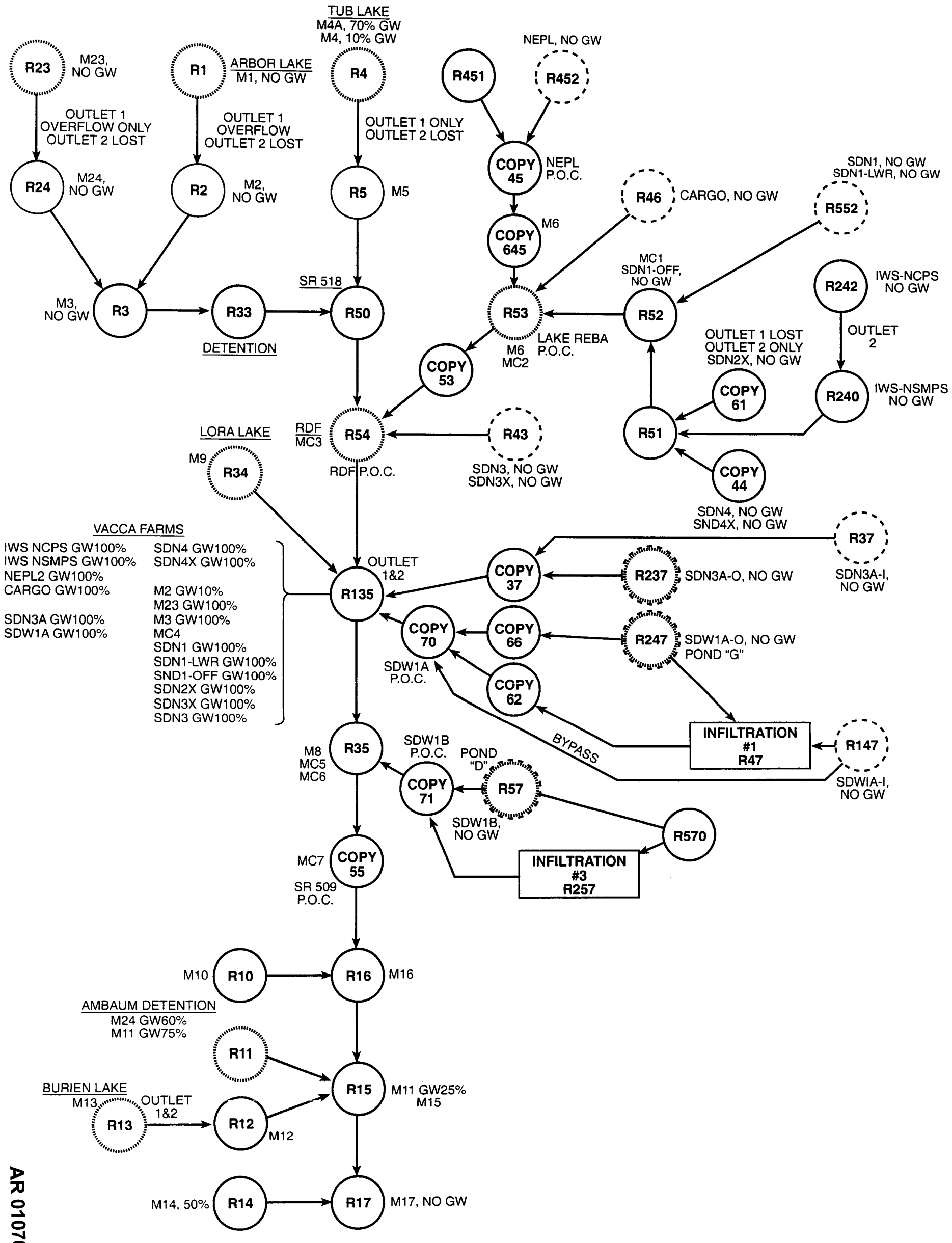
```
  MASS-LINK        26
PERLND     PWATER SURO       0.0833333     COPY          INPUT  MEAN
PERLND     PWATER IFWO       0.0833333     COPY          INPUT  MEAN
  END MASS-LINK    26

  MASS-LINK        27
PERLND     PWATER AGWO       0.0833333     COPY          INPUT  MEAN
  END MASS-LINK    27
END MASS-LINK

COPY
  TIMESERIES                                                      ***
  Copy-opn                                                        ***
    # -   #  NPT  NMN
   37    61          1
  240   242          1
  645   645          1
  END TIMESERIES
END COPY

END RUN
```

2006 CONDITIONS



AR 010703

Notes: GW routed to reach unless otherwise noted.
Reaches have one outlet unless otherwise noted.
Reach table # is the same as reach # unless otherwise noted.

GW Ground Water Routing

Precipitation and Evaporation

Future Pond/ Vault Site

M5 ← Tributary Subbasin ID
R5 ← Routing Reach Number

COPY 52 — Summation of Upstream Flow

Miller Creek Project Condition HSPF Model Routing Schematic

```
RUN
GLOBAL
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***  FILE: MC23inif.INP - 2006 future condition
  ***
  ***  BASED ON MILL64.INP FILE FROM AQUA TERRA
  ***  MC22WDM:
  ***  ADDED PERLND 47,57,
  ***  ADDED GROUND WATER INFILTRATION TO WDM FOR USE WITH MCAGWO.INP
  ***  FK revised SDW1A and SDW1B with flow splitters, storages at SDN3/3X, SDN2X/4X;
  ***  FK revised MC-1 and SDN-2X land uses, added POC at Lake Reba, removed run-of-river
tables
  ***  FK added POC downstream of facilities SDW1A and SDW1B
  MILLER CREEK BASIN HSPF MODEL
***  START       1994  1  1  0  0  END    1996  8 30 24  0
  START       1948 10  1  0  0  END    1997  1 31 24  0
  RUN INTERP OUTPUT LEVEL    6
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname---------------------------------------------->
MESSU      24   MILL.MES
WDM        25   MCPOND23.WDM
           61   PER.L61
           62   RCH.L62
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      47 ***
      PERLND      54
      PERLND      57 ***
      IMPLND      14
      RCHRES       1
      RCHRES      23
      RCHRES      24
      RCHRES       2
      RCHRES       3
      RCHRES      33
      RCHRES       4
      RCHRES       5
      RCHRES      50
      RCHRES     242
      RCHRES     240
      COPY        61
      COPY        44
      RCHRES      51
      RCHRES      43
      RCHRES     451
      RCHRES     452
      COPY        45
      COPY       645
      RCHRES      46
      RCHRES     552
      RCHRES      52
      RCHRES      53
      COPY        53
      RCHRES      54
      RCHRES      37
      RCHRES     237
      COPY        37
      RCHRES     147
      RCHRES     247
      COPY        66
      COPY        69
```

```
    RCHRES      47
    COPY        62
    COPY        63
    COPY        67
    COPY        68
***  --> output SDW1A infiltration discharge to WDM dataset 5 in in/ac <--
    COPY        47
    COPY        70
    RCHRES      34
    RCHRES     135
    RCHRES     570
    RCHRES      57
    RCHRES     257
    COPY        64
    COPY        65
    COPY       357
***  --> output SDW1B infiltration discharge to WDM dataset 6 in in/ac <--
    COPY        56
    COPY        57
    COPY        71
    RCHRES      35
    COPY        55
    RCHRES      10
    RCHRES      16
    RCHRES      11
    RCHRES      13
    RCHRES      12
    RCHRES      15
    RCHRES      14
    RCHRES      17
  END INGRP
END OPN SEQUENCE                                                        ***

PERLND
  GEN-INFO
    <PLS >      Name           NBLKS   Unit-systems   Printer          ***
    # -  #                       User  t-series Engl Metr               ***
                                       in  out                         ***
   16       TFM- TILL FOR MOD      1    1    1    1   61    0
   26       TGM- TILL GR MOD       1    1    1    1   61    0
   34       OF - OUTWASH FOR       1    1    1    1   61    0
   44       OG - OUTWASH GR        1    1    1    1   61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
   45       AIRPORT FILL           1    1    1    1   61    0
   47       OG - INFILTRATION 1    1    1    1    1   61    0
   54       SA - WETLANDS          1    1    1    1   61    0
   57       OG - INFILTRATION 3    1    1    1    1   61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC      ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ********************* Print-flags ************************ PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > ***************** Flags ********************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                   ***
   14  200    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST       LZSN     INFILT       LSUR      SLSUR      KVARY      AGWRC
   16                    9.0000     0.3200     400.00     0.1000     0.5000     0.9960
   26                    9.0000     0.1200     400.00     0.1000     0.5000     0.9960
   34                   10.0000     2.0000     400.00     0.0500     0.3000     0.9960
   44                   10.0000     0.8000     400.00     0.0500     0.3000     0.9960
   45                    7.5000     0.0200     300.00     0.0700     0.0000     0.9960
```

```
 47                  10.0000    0.8000    400.00    0.0500    0.3000    0.9960
 54                   8.0000    2.0000    100.00    0.0010    0.5000    0.9960
 57                  10.0000    0.8000    400.00    0.0500    0.3000    0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 16                             2.0000    2.0000      0.33      0.00       0.0
 26                             2.0000    2.0000      0.33        0.       0.
 34                             2.0000    2.0000      0.33      0.00       0.0
 44                             2.0000    2.0000      0.33        0.       0.
 47                             2.0000    2.0000      0.33        0.       0.
 45                             2.0000    2.0000      0.33        0.       0.
 54                             10.000    2.0000      0.33        0.       0.7
 57                             2.0000    2.0000      0.33        0.       0.
END PWAT-PARM3
PWAT-PARM4
                                                                    ***
  <PLS >
  # -  #      CEPSC      UZSN      NSUR      INTFW       IRC    LZETP***
 16          0.2000    0.7500    0.3500     9.000    0.7000    0.7000
 26          0.1000    0.3750    0.2500     9.000    0.7000    0.2500
 34          0.2000    0.7500    0.3500     0.000    0.7000    0.7000
 44          0.1000    0.7500    0.2500     0.000    0.7000    0.2500
 47          0.1000    0.7500    0.2500     0.000    0.7000    0.2500
 45          0.1000    0.2800    0.2500     6.000    0.1500    0.6000
 54          0.1000    2.2500    0.5000     1.000    0.7000    0.8000
 57          0.1000    0.7500    0.2500     0.000    0.7000    0.2500

END PWAT-PARM4
PWAT-STATE1
  <PLS >  PWATER state variables***
  # -  #***    CEPS      SURS       UZS       IFWS       LZS       AGWS       GWVS
 16          0.078        0.    0.2500       0.10     2.000     2.000      0.000
 26          0.051        0.    0.2500       0.10     2.000     2.000      0.000
 34          0.078        0.    0.2500       0.10     2.000     2.000      0.000
 44          0.051        0.    0.2500       0.10     2.000     2.000      0.000
 47          0.051        0.    0.2500       0.10     2.000     2.000      0.000
 45          0.051        0.    0.2500       0.10     2.000     2.000      0.000
 54          0.051        0.    0.2500       0.10     2.000     2.000      0.000
 57          0.051        0.    0.2500       0.10     2.000     2.000      0.000
END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >      Name             Unit-systems   Printer                    ***
    # -  #                      User  t-series Engl Metr                   ***
                                      in  out                              ***
   14      IMPERVIOUS              1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   14         0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14         0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <ILS >           Flags            ***                                  ***
    # -  # CSNO RTOP  VRS  VNN RTLI   ***                                  ***
   14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2
    <ILS >                                                                 ***
    # -  #      LSUR      SLSUR      NSUR      RETSC                       ***
   14         100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
  IWAT-PARM3
```

```
    <ILS >                                                              ***
    # -  #    PETMAX    PETMIN                                          ***
   14
  END IWAT-PARM3
  IWAT-STATE1
    <ILS >  IWATER state variables                                      ***
    # -  #      RETS      SURS                                          ***
   14      1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                              ***

EXT SOURCES                                                             ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes and ponds
*** FOLLOWING RCHRES ARE PONDS: 57, 247, 237
                                                                        ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC     ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM   1002 PREC     ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM      1 EVAP     ENGLZERO  0.8           PERLND  14 200 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC     ENGLZERO                RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES   1     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES   4     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES   4     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  11     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  11     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  13     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  13     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  23     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  23     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  34     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  34     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  53     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  53     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  54     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  54     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES 237     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES 237     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES 247     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES 247     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  57     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  57     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***PROJECT CONDITION FLOWS
*** RCHRES=LOCATION:
*** 54=MCDF      47=SDW1A INFILTRATION TANK      43=SDN3X     247=SDW1A POND G
*** 17=MOUTH     49=SDW2        44=SDN4X         52=SDN1      451= EXISTING NEPL
*** 61=SDN2X     57=SDW1B       51=SDN2X+SDN4X   53=Lake Reba 452=NEW NEPL
*** 45=NEPL POC  55=SR509       39=SDN3A/SDW1A POC
*** 46=CARGO     37=SDN3AI VAULT 237=SDN3AO POND
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 55=SR509)
RCHRES  17 HYDR   RO     1 1                WDM    113 FLOW     ENGL      REPL
COPY    55 OUTPUT MEAN   1 1 12.1           WDM    118 FLOW     ENGL      REPL
RCHRES  54 HYDR   RO     1 1                WDM    114 FLOW     ENGL      REPL
*** DETENTION POND FLOWS
COPY    61 OUTPUT MEAN   1 1 12.1           WDM    101 FLOW     ENGL      REPL
RCHRES 552 HYDR   RO     1 1                WDM    102 FLOW     ENGL      REPL
RCHRES 451 HYDR   RO     1 1                WDM    105 FLOW     ENGL      REPL
RCHRES 452 HYDR   RO     1 1                WDM    119 FLOW     ENGL      REPL
RCHRES  46 HYDR   RO     1 1                WDM    106 FLOW     ENGL      REPL
*** write SDW1A Inf.Tank # 1 outlets to WDM 107 and 108 like so:
COPY    62 OUTPUT MEAN   1 1 12.1           WDM    107 FLOW     ENGL      REPL
COPY    63 OUTPUT MEAN   1 1 12.1           WDM    108 FLOW     ENGL      REPL
```

```
*** write SDW1A det. pond G outlets to WDM files:
COPY    66 OUTPUT MEAN   1 1 12.1          WDM    112 FLOW     ENGL      REPL
COPY    69 OUTPUT MEAN   1 1 12.1          WDM   1120 FLOW     ENGL      REPL
*** write SDW1A det. vault G1 to WDM files:
COPY    67 OUTPUT MEAN   1 1 12.1          WDM    109 FLOW     ENGL      REPL
COPY    68 OUTPUT MEAN   1 1 12.1          WDM   1090 FLOW     ENGL      REPL
*** write flow splitter outlets to WDM files:
RCHRES 570 HYDR   RO     1 1               WDM    210 FLOW     ENGL      REPL
COPY    64 OUTPUT MEAN   1 1 12.1          WDM    110 FLOW     ENGL      REPL
COPY    65 OUTPUT MEAN   1 1 12.1          WDM    115 FLOW     ENGL      REPL
*** write SDW1B inf. tank outlets to WDM files:
COPY    56 OUTPUT MEAN   1 1 12.1          WDM    121 FLOW     ENGL      REPL
COPY    57 OUTPUT MEAN   1 1 12.1          WDM    120 FLOW     ENGL      REPL
*** write SDW1B pond D outlet to WDM file:
COPY   357 OUTPUT MEAN   1 1 12.1          WDM    211 FLOW     ENGL      REPL
*** write SDN3A vaults to WDM files:
RCHRES  37 HYDR   RO     1 1               WDM    111 FLOW     ENGL      REPL
RCHRES 237 HYDR   RO     1 1               WDM    122 FLOW     ENGL      REPL
*** write SDN3/3X, SDN4/4X, and SDN4X/2X vaults to WDM files:
RCHRES  43 HYDR   RO     1 1               WDM    103 FLOW     ENGL      REPL
COPY    44 OUTPUT MEAN   1 1 12.1          WDM    104 FLOW     ENGL      REPL
RCHRES  51 HYDR   RO     1 1               WDM    139 FLOW     ENGL      REPL
*** DETENTION STAGES
RCHRES  47 HYDR   STAGE                    WDM    652 STAG     ENGL      REPL
RCHRES 147 HYDR   STAGE                    WDM    657 STAG     ENGL      REPL
RCHRES 247 HYDR   STAGE                    WDM    654 STAG     ENGL      REPL
RCHRES 552 HYDR   STAGE                    WDM    601 STAG     ENGL      REPL
RCHRES  57 HYDR   STAGE                    WDM    651 STAG     ENGL      REPL
RCHRES 257 HYDR   STAGE                    WDM    655 STAG     ENGL      REPL
RCHRES 237 HYDR   STAGE                    WDM    656 STAG     ENGL      REPL
RCHRES  37 HYDR   STAGE                    WDM    650 STAG     ENGL      REPL
RCHRES  54 HYDR   STAGE                    WDM     61 STAG     ENGL      REPL
RCHRES 451 HYDR   STAGE                    WDM    662 STAG     ENGL      REPL
RCHRES 452 HYDR   STAGE                    WDM    667 STAG     ENGL      REPL
RCHRES  46 HYDR   STAGE                    WDM    663 STAG     ENGL      REPL
RCHRES  43 HYDR   STAGE                    WDM    664 STAG     ENGL      REPL
***RCHRES  44 HYDR   STAGE                    WDM    665 STAG     ENGL      REPL
RCHRES  51 HYDR   STAGE                    WDM    666 STAG     ENGL      REPL
*** DETENTION VOLUMES
RCHRES  47 HYDR   VOL                      WDM    752 VOL      ENGL      REPL
RCHRES 147 HYDR   VOL                      WDM    757 VOL      ENGL      REPL
RCHRES 247 HYDR   VOL                      WDM    754 VOL      ENGL      REPL
RCHRES 552 HYDR   VOL                      WDM    602 VOL      ENGL      REPL
RCHRES  57 HYDR   VOL                      WDM    751 VOL      ENGL      REPL
RCHRES 257 HYDR   VOL                      WDM    755 VOL      ENGL      REPL
RCHRES 237 HYDR   VOL                      WDM    756 VOL      ENGL      REPL
RCHRES  37 HYDR   VOL                      WDM    750 VOL      ENGL      REPL
RCHRES  54 HYDR   VOL                      WDM     62 VOL      ENGL      REPL
RCHRES 451 HYDR   VOL                      WDM    762 VOL      ENGL      REPL
RCHRES 452 HYDR   VOL                      WDM    767 VOL      ENGL      REPL
RCHRES  46 HYDR   VOL                      WDM    763 VOL      ENGL      REPL
RCHRES  43 HYDR   VOL                      WDM    764 VOL      ENGL      REPL
***RCHRES  44 HYDR   VOL                      WDM    765 VOL      ENGL      REPL
RCHRES  51 HYDR   VOL                      WDM    766 VOL      ENGL      REPL
*** POINT OF COMPLIANCE (POC) FLOWS
COPY    37 OUTPUT MEAN   1 1 12.1          WDM    125 FLOW     ENGL      REPL
COPY    45 OUTPUT MEAN   1 1 12.1          WDM    199 FLOW     ENGL      REPL
COPY    53 OUTPUT MEAN   1 1 12.1          WDM    399 FLOW     ENGL      REPL
COPY    70 OUTPUT MEAN   1 1 12.1          WDM   7000 FLOW     ENGL      REPL
COPY    71 OUTPUT MEAN   1 1 12.1          WDM   7001 FLOW     ENGL      REPL
***INFILTRATION FLOW
  ***  --> output SDW1A infiltration discharge to WDM dataset 5 <--
  ***  --> convert acft to in/ac, assuming reinfiltrate to 2 ac <--
COPY    47 OUTPUT MEAN   1 1  6            WDM      5 FLOW     ENGL      REPL
  ***  --> output SDW1B infiltration discharge to WDM dataset 6 <--
  ***  --> convert acft to in/ac, assuming reinfiltrate to 2 ac <--
COPY    57 OUTPUT MEAN   1 1  6            WDM      6 FLOW     ENGL      REPL
END EXT TARGETS

SCHEMATIC
<-Source->                 <--Area-->     <-Target->   MBLK    ***
```

```
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
  *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                      3.41      RCHRES   1      6
PERLND  26                    232.36      RCHRES   1      6
PERLND  34                      3.07      RCHRES   1      6
PERLND  44                     38.03      RCHRES   1      6
PERLND  54                      3.87      RCHRES   1      6
IMPLND  14                     56.14      RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                      5.56      RCHRES   2      6
PERLND  26                    200.05      RCHRES   2      6
PERLND  34                      0.46      RCHRES   2      6
PERLND  44                     38.71      RCHRES   2      6
PERLND  16                      0.56      RCHRES 135      7
PERLND  26                     20.00      RCHRES 135      7
PERLND  34                      0.05      RCHRES 135      7
PERLND  44                      3.87      RCHRES 135      7
IMPLND  14                     42.22      RCHRES   2      2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                      3.09      RCHRES  23      6
PERLND  26                    156.15      RCHRES  23      6
PERLND  34                      2.25      RCHRES  23      6
PERLND  44                     45.84      RCHRES  23      6
PERLND  16                      0.46      RCHRES 135      7
PERLND  26                     23.42      RCHRES 135      7
PERLND  34                      0.34      RCHRES 135      7
PERLND  44                      6.88      RCHRES 135      7
IMPLND  14                     58.44      RCHRES  23      2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  26                    135.43      RCHRES  24      6
PERLND  34                      2.02      RCHRES  24      6
PERLND  44                     69.29      RCHRES  24      6
PERLND  26                     81.26      RCHRES  11      7
PERLND  34                      1.21      RCHRES  11      7
PERLND  44                     41.57      RCHRES  11      7
IMPLND  14                     79.98      RCHRES  24      2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                      8.26      RCHRES   3      6
PERLND  26                    108.38      RCHRES   3      6
PERLND  34                     16.02      RCHRES   3      6
PERLND  44                    102.89      RCHRES   3      6
PERLND  54                      0.04      RCHRES   3      6
PERLND  16                      8.26      RCHRES 135      7
PERLND  26                    108.38      RCHRES 135      7
PERLND  34                     16.02      RCHRES 135      7
PERLND  44                    102.89      RCHRES 135      7
PERLND  54                      0.04      RCHRES 135      7
IMPLND  14                     27.30      RCHRES   3      2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                      2.95      RCHRES   4      6
PERLND  26                     85.95      RCHRES   4      6
PERLND  34                      3.75      RCHRES   4      6
PERLND  44                     92.06      RCHRES   4      6
PERLND  16                      0.30      RCHRES   4      7
PERLND  26                      8.59      RCHRES   4      7
PERLND  34                      0.38      RCHRES   4      7
PERLND  44                      9.21      RCHRES   4      7
IMPLND  14                     18.43      RCHRES   4      2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                      8.66      RCHRES   4      6
PERLND  26                     61.64      RCHRES   4      6
PERLND  34                     22.06      RCHRES   4      6
PERLND  44                     78.09      RCHRES   4      6
PERLND  54                     12.50      RCHRES   4      6
PERLND  16                      6.06      RCHRES   4      7
PERLND  26                     43.15      RCHRES   4      7
PERLND  34                     15.44      RCHRES   4      7
PERLND  44                     54.66      RCHRES   4      7
PERLND  54                      8.75      RCHRES   4      7
IMPLND  14                     29.14      RCHRES   4      2
  *** SUB-CATCHMENT 5
```

```
PERLND  26                      10.29     RCHRES   5      1
PERLND  44                      50.05     RCHRES   5      1
PERLND  54                      10.74     RCHRES   5      1
IMPLND  14                      16.31     RCHRES   5      2
  *** SUB-CATCHMENT 6
PERLND  16                       1.42     COPY   645     26
PERLND  26                      20.38     COPY   645     26
PERLND  34                      13.44     COPY   645     26
PERLND  44                      11.79     COPY   645     26
PERLND  54                       0.82     COPY   645     26
PERLND  16                       1.42     RCHRES  53      7
PERLND  26                      20.38     RCHRES  53      7
PERLND  34                      13.44     RCHRES  53      7
PERLND  44                      11.79     RCHRES  53      7
PERLND  54                       0.82     RCHRES  53      7
IMPLND  14                       6.23     COPY   645     22
  *** SUB-CATCHMENT 8
PERLND  44                      22.21     RCHRES  35      1
IMPLND  14                       6.60     RCHRES  35      2
  *** SUB-CATCHMENT 9
PERLND  16                       4.98     RCHRES  34      1
PERLND  26                      14.38     RCHRES  34      1
PERLND  34                       0.05     RCHRES  34      1
PERLND  44                      56.71     RCHRES  34      1
PERLND  54                       0.01     RCHRES  34      1
IMPLND  14                      22.47     RCHRES  34      2
  *** SUB-CATCHMENT 10
PERLND  16                       4.15     RCHRES  10      1
PERLND  26                      31.94     RCHRES  10      1
PERLND  44                      95.22     RCHRES  10      1
IMPLND  14                      71.98     RCHRES  10      2
  *** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15
PERLND  16                       0.89     RCHRES  11      6
PERLND  26                     217.92     RCHRES  11      6
PERLND  34                       1.32     RCHRES  11      6
PERLND  44                      65.65     RCHRES  11      6
PERLND  16                       0.67     RCHRES  11      7
PERLND  26                     163.44     RCHRES  11      7
PERLND  34                       0.99     RCHRES  11      7
PERLND  44                      49.24     RCHRES  11      7
PERLND  16                       0.22     RCHRES  15      7
PERLND  26                      54.48     RCHRES  15      7
PERLND  34                       0.33     RCHRES  15      7
PERLND  44                      16.41     RCHRES  15      7
IMPLND  14                     230.80     RCHRES  11      2
  *** SUB-CATCHMENT 12
PERLND  16                       0.39     RCHRES  12      1
PERLND  26                     101.18     RCHRES  12      1
PERLND  34                       5.64     RCHRES  12      1
PERLND  44                      54.98     RCHRES  12      1
PERLND  54                       0.64     RCHRES  12      1
IMPLND  14                      79.83     RCHRES  12      2
  *** SUB-CATCHMENT 13
PERLND  16                       0.79     RCHRES  13      1
PERLND  26                     197.68     RCHRES  13      1
IMPLND  14                      27.66     RCHRES  13      2
  *** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND
PERLND  16                       0.24     RCHRES  14      6
PERLND  26                     118.67     RCHRES  14      6
PERLND  34                      13.46     RCHRES  14      6
PERLND  44                      41.91     RCHRES  14      6
PERLND  16                       0.12     RCHRES  14      7
PERLND  26                      59.34     RCHRES  14      7
PERLND  34                       6.73     RCHRES  14      7
PERLND  44                      20.95     RCHRES  14      7
IMPLND  14                      20.66     RCHRES  14      2
  *** SUB-CATCHMENT 15
PERLND  16                       6.59     RCHRES  15      1
PERLND  26                      49.55     RCHRES  15      1
PERLND  34                      50.09     RCHRES  15      1
PERLND  44                      86.52     RCHRES  15      1
```

IMPLND	14	19.47	RCHRES	15	2
*** SUB-CATCHMENT 16					
PERLND	16	10.93	RCHRES	16	1
PERLND	26	29.93	RCHRES	16	1
PERLND	34	20.03	RCHRES	16	1
PERLND	44	31.83	RCHRES	16	1
IMPLND	14	15.58	RCHRES	16	2
*** SUB-CATCHMENT 17 AGWO GOES TO SOUND					
PERLND	16	0.90	RCHRES	17	6
PERLND	26	16.31	RCHRES	17	6
PERLND	34	34.82	RCHRES	17	6
PERLND	44	82.11	RCHRES	17	6
PERLND	54	2.19	RCHRES	17	6
IMPLND	14	10.49	RCHRES	17	2
*** SUB-CATCHMENT MC-1					
PERLND	26	0.14	RCHRES	52	1
PERLND	44	9.44	RCHRES	52	1
PERLND	45	0.14	RCHRES	52	1
PERLND	54	0.27	RCHRES	52	1
IMPLND	14	1.98	RCHRES	52	2
*** SUB-CATCHMENT MC-2					
PERLND	16	0.08	RCHRES	53	1
PERLND	26	0.53	RCHRES	53	1
PERLND	34	3.60	RCHRES	53	1
PERLND	44	9.20	RCHRES	53	1
PERLND	45	2.22	RCHRES	53	1
PERLND	54	15.14	RCHRES	53	1
IMPLND	14	2.54	RCHRES	53	2
*** SUB-CATCHMENT MC-3					
PERLND	34	3.70	RCHRES	54	1
PERLND	44	4.91	RCHRES	54	1
PERLND	45	1.07	RCHRES	54	1
PERLND	54	1.84	RCHRES	54	1
IMPLND	14	1.42	RCHRES	54	2
*** SUB-CATCHMENT MC-4					
PERLND	34	0.27	RCHRES	135	1
PERLND	44	16.51	RCHRES	135	1
PERLND	45	4.23	RCHRES	135	1
PERLND	54	11.98	RCHRES	135	1
IMPLND	14	3.31	RCHRES	135	2
*** SUB-CATCHMENT MC-5					
PERLND	26	13.43	RCHRES	35	1
PERLND	44	33.84	RCHRES	35	1
PERLND	54	7.44	RCHRES	35	1
IMPLND	14	0.02	RCHRES	35	2
*** SUB-CATCHMENT MC-6					
PERLND	44	14.10	RCHRES	35	1
PERLND	45	0.09	RCHRES	35	1
PERLND	54	0.90	RCHRES	35	1
IMPLND	14	0.26	RCHRES	35	2
*** SUB-CATCHMENT MC-7					
PERLND	26	11.26	COPY	55	21
PERLND	44	31.80	COPY	55	21
PERLND	54	3.20	COPY	55	21
IMPLND	14	0.03	COPY	55	22

***note: SDN AGWO TO VACCA FARMS (135)NOT TO PONDS

*** SUB-CATCHMENT SDN-1					
PERLND	26	1.97	RCHRES	552	6
PERLND	44	1.29	RCHRES	552	6
PERLND	54	0.20	RCHRES	552	6
PERLND	26	1.97	RCHRES	135	7
PERLND	44	1.29	RCHRES	135	7
PERLND	54	0.20	RCHRES	135	7
IMPLND	14	12.68	RCHRES	552	2
*** SUB-CATCHMENT SDN-1-LWR					
PERLND	44	4.79	RCHRES	552	6
PERLND	54	0.07	RCHRES	552	6
PERLND	44	4.79	RCHRES	135	7

PERLND	54	0.07	RCHRES	135	7
IMPLND	14	0.56	RCHRES	552	2

*** SUB-CATCHMENT SDN-1-OFF

PERLND	26	23.01	RCHRES	52	6
PERLND	44	3.58	RCHRES	52	6
PERLND	54	1.67	RCHRES	52	6
PERLND	26	23.01	RCHRES	135	7
PERLND	44	3.58	RCHRES	135	7
PERLND	54	1.67	RCHRES	135	7
IMPLND	14	8.00	RCHRES	52	2

*** SUB-CATCHMENT SDN-2X (TO POND)

PERLND	26	0.63	COPY	61	26
PERLND	44	2.40	COPY	61	26
PERLND	45	0.86	COPY	61	26
PERLND	26	0.63	RCHRES	135	7
PERLND	44	2.40	RCHRES	135	7
PERLND	45	0.86	RCHRES	135	7
IMPLND	14	0.36	COPY	61	22

*** SUB-CATCHMENT SDN-3 (TO POND)

PERLND	26	23.56	RCHRES	43	6
PERLND	26	23.56	RCHRES	135	7
IMPLND	14	24.30	RCHRES	43	2

*** SUB-CATCHMENT SDN-3X (TO POND)

PERLND	26	1.61	RCHRES	43	6
PERLND	45	23.77	RCHRES	43	6
PERLND	26	1.61	RCHRES	135	7
PERLND	45	23.77	RCHRES	135	7

*** SUB-CATCHMENT SDN-4 (TO POND)

PERLND	26	15.75	COPY	44	26
PERLND	44	1.31	COPY	44	26
PERLND	45	0.99	COPY	44	26
PERLND	26	15.75	RCHRES	135	7
PERLND	44	1.31	RCHRES	135	7
PERLND	45	0.99	RCHRES	135	7
IMPLND	14	12.26	COPY	44	22

*** SUB-CATCHMENT SDN-4X (TO POND)

PERLND	26	1.92	COPY	44	26
PERLND	44	0.75	COPY	44	26
PERLND	45	8.31	COPY	44	26
PERLND	26	1.92	RCHRES	135	7
PERLND	44	0.75	RCHRES	135	7
PERLND	45	8.31	RCHRES	135	7
IMPLND	14	4.21	COPY	44	22

*** SUB-CATCHMENT IWS-NCPS (TO POND)

PERLND	26	4.78	RCHRES	242	6
PERLND	26	4.78	RCHRES	135	7
IMPLND	14	30.93	RCHRES	242	2

*** SUB-CATCHMENT IWS-NSMPS (TO POND)

PERLND	26	2.69	RCHRES	240	6
PERLND	44	1.97	RCHRES	240	6
PERLND	45	0.01	RCHRES	240	6
PERLND	26	2.69	RCHRES	135	7
PERLND	44	1.97	RCHRES	135	7
PERLND	45	0.01	RCHRES	135	7
IMPLND	14	1.95	RCHRES	240	2

*** SUB-CATCHMENT NEPL (TO POND)

PERLND	26	10.00	RCHRES	452	6
PERLND	26	10.00	RCHRES	135	7
IMPLND	14	6.00	RCHRES	451	2
IMPLND	14	26.29	RCHRES	452	2

*** SUB-CATCHMENT CARGO (TO POND)

```
IMPLND  14                          8.12     RCHRES  46      2

  *** SUB-CATCHMENT SDN3AI (TO VAULT)
IMPLND  14                          5.87     RCHRES  37      2

  *** SUB-CATCHMENT SDN3AO (TO POND)
PERLND  26                          0.08     RCHRES 237      6
PERLND  44                          0.03     RCHRES 237      6
PERLND  45                         22.12     RCHRES 237      6
PERLND  26                          0.08     RCHRES 135      7
PERLND  44                          0.03     RCHRES 135      7
PERLND  45                         22.12     RCHRES 135      7
IMPLND  14                          2.35     RCHRES 237      2

  *** SUB-CATCHMENT SDW1O (TO POND)
PERLND  26                          4.28     RCHRES 247      6
PERLND  44                          0.69     RCHRES 247      6
PERLND  45                         32.44     RCHRES 247      6
PERLND  26                          4.28     RCHRES 135      7
PERLND  44                          0.69     RCHRES 135      7
PERLND  45                         32.44     RCHRES 135      7
IMPLND  14                          1.64     RCHRES 247      2

  *** SUB-CATCHMENT SDN1AI (TO VAULT)
IMPLND  14                         13.78     RCHRES 147      2

  *** SUB-CATCHMENT SDW1B (TO POND)
  *** AGWO TO 35, AS 57 IS D/S OF VACCA FARMS (135)
PERLND  26                         21.25     RCHRES 570      6
PERLND  44                          2.39     RCHRES 570      6
PERLND  45                         46.26     RCHRES 570      6
PERLND  26                         21.25     RCHRES  35      7
PERLND  44                          2.39     RCHRES  35      7
PERLND  45                         46.26     RCHRES  35      7
IMPLND  14                         26.95     RCHRES 570      2

  *** ADD SUB-CATCHMENT IWS-PRIMARY TO PREDEVELOPEMENT ONLY

***ROUTING FOR MILLER CREEK
 *** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                          RCHRES   2      4
RCHRES  23                          RCHRES  24      4
RCHRES  24                          RCHRES   3      3
RCHRES   2                          RCHRES   3      3
RCHRES   3                          RCHRES  33      3
RCHRES  33                          RCHRES  50      3
RCHRES   4                          RCHRES   5      4
RCHRES   5                          RCHRES  50      3
 *** PONDS TO 52, 53 & 54
RCHRES 242                          RCHRES 240      5
 *** OVERFLOW ONLY TO 61
RCHRES 240                          RCHRES  51      5
COPY    61                          RCHRES  51     12
COPY    44                          RCHRES  51     12
RCHRES  51                          RCHRES  52      3
RCHRES  43                          RCHRES  54      3
 *** 2 NEPL VAULTS* (FK-Changed to eliminate run-of-river tables)
RCHRES 451                          COPY    45     11
RCHRES 452                          COPY    45     11
COPY    45                          COPY   645     10
COPY   645                          RCHRES  53     12
RCHRES  46                          RCHRES  53      3
 *** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54 (FK-changed to insert new POC at Lake
Reba)
RCHRES 552                          RCHRES  52      3
RCHRES  52                          RCHRES  53      3
RCHRES  53                          COPY    53     11
COPY    53                          RCHRES  54     12
RCHRES  50                          RCHRES  54      3
 *** RDF 54 TO 35
RCHRES  54                          RCHRES 135      3
```

```
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
 *** PONDS TO 34
RCHRES  37                                 COPY    37     11
RCHRES 237                                 COPY    37     11
COPY    37                                 RCHRES 135     12
 *** SDW1A flow to bypass added (FK, June 2001)
SDW1AI VAULT FLOW TO INFILTRATION 1                                ***
RCHRES 147                                 RCHRES  47      4
SDW1AI VAULT FLOW TO BYPASS                                        ***
RCHRES 147                                 COPY    70     15
STORMWATER Q 1ST EXIT AT POND G (Bypass)                           ***
RCHRES 247                                 COPY    70     14
RCHRES 247                                 COPY    66     14
2ND EXIT TO INFILTRATION TANK-MILLER CREEK                         ***
RCHRES 247                                 RCHRES  47      5
RCHRES 247                                 COPY    69     15
STORMWATER Q 1ST EXIT TO BYPASS                                    ***
RCHRES  47                                 COPY    70     14
2ND EXIT TO SOIL AND MILLER CREEK                                  ***
RCHRES  47                                 COPY    70     15
COPY BLOCK FOR OUTPUT PURPOSES                                     ***
RCHRES  47                                 COPY    62     14
RCHRES  47                                 COPY    63     15
RCHRES 147                                 COPY    67     14
RCHRES 147                                 COPY    68     15
  ***  --> output SDW1A infiltration discharge to WDM dataset 5 <--
RCHRES  47                                 COPY    47     15
COPY    70                                 RCHRES 135     12
RCHRES  34                                 RCHRES 135      4
RCHRES  34                                 RCHRES 135      5
RCHRES 135                                 RCHRES  35      3
RCHRES  10                                 RCHRES  16      3
 *** PONDS TO 35
 *** Configuration changed to flow splitter to Pond D and Infiltration Basin 3 (FK, June
2001)
STORM Q - 1ST EXIT OF FLOW SPLITTER TO POND D                      ***
RCHRES 570                                 RCHRES  57      4
INFILTRATION Q - 2ND EXIT OF FLOW SPLITTER TO SOIL                 ***
RCHRES 570                                 RCHRES 257      5
STORM Q EXIT OF POND D TO MILLER CREEK                        ***
RCHRES  57                                 COPY    71     11
COPY BLOCK FOR OUTPUT PURPOSES                                     ***
RCHRES  57                                 COPY   357     11
RCHRES 570                                 COPY    64     14
RCHRES 570                                 COPY    65     15
  ***  --> output SDW1B infiltration discharge to WDM dataset 6 <--
RCHRES 257                                 COPY    56     14
RCHRES 257                                 COPY    57     15
RCHRES 257                                 COPY    71     14
RCHRES 257                                 COPY    71     15
COPY    71                                 RCHRES  35     12
RCHRES  35                                 COPY    55     11
COPY    55                                 RCHRES  16     12
RCHRES  11                                 RCHRES  15      3
RCHRES  13                                 RCHRES  12      4
RCHRES  13                                 RCHRES  12      5
RCHRES  12                                 RCHRES  15      3
RCHRES  16                                 RCHRES  15      3
RCHRES  14                                 RCHRES  17      3
RCHRES  15                                 RCHRES  17      3
END SCHEMATIC

NETWORK
***        <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
END NETWORK
                                                                          ***
RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                ***
```

```
  # -  #<------------------><---> User T-series  Engl Metr LKFG                ***
                                        in  out                                 ***
   1     Arbor Lake  M 1          2    1    1    1   62    0    0
   2     Arbor Ck -03710 M 2      1    1    1    1   62    0    0
   3     Arbor Ck   M 3           1    1    1    1   62    0    0
   4     Tub Lake   M 4           2    1    1    1   62    0    0
   5     Miller Ck SR518 M5       1    1    1    1   62    0    0
  10     Trib (0371G)   M 10      1    1    1    1   62    0    0
  11     M11 Ambaum Detention     1    1    1    1   62    0    0
  12     Trib(0354)  M 12         1    1    1    1   62    0    0
  13     Burien Lake M 13         2    1    1    1   62    0    0
  14     Trib (0353) M 14         1    1    1    1   62    0    0
  15     M/S U/S OF 17            1    1    1    1   62    0    0
  16     U/S OF 15 M/S            1    1    1    1   62    0    0
  17     GAGE                     1    1    1    1   62    0    0
  23     BASIN M23                2    1    1    1   62    0    0
  24     BASIN M24                1    1    1    1   62    0    0
  33     detention m3             1    1    1    1   62    0    0
  34     LORA LAKE                2    1    1    1   62    0    0
  35     D/S OF VACA FARM         1    1    1    1   62    0    0
  37     sdn3ai vault             1    1    1    1   62    0    0
  38     MC basins                1    1    1    1   62    0    0
***   39     SDN3A/SDW1A POC          1    1    1    1   62    0    0
  43     sdn3 pond                1    1    1    1   62    0    0
***   44     sdn4 pond                1    1    1    1   62    0    0
***   45     nepl poc                 1    1    1    1   62    0    0
  46     cargo pond               1    1    1    1   62    0    0
  47     sdw1a infiltration       2    1    1    1   62    0    0
  50     sr 518                   1    1    1    1   62    0    0
  51     SDN2X+SDN4X              1    1    1    1   62    0    0
  52     U/S OF LAKE REBA         1    1    1    1   62    0    0
  53     Reba outflow             1    1    1    1   62    0    0
  54     Miller RDF outflow       1    1    1    1   62    0    0
  57     sdw1b pond               1    1    1    1   62    0    0
 135     VACA FARMS               1    1    1    1   62    0    0
 147     sdw1a vault              2    1    1    1   62    0    0
 237     sdn3ao-pond c            1    1    1    1   62    0    0
 240     iws-ncps                 2    1    1    1   62    0    0
 242     iws-nsmps                2    1    1    1   62    0    0
 247     sdw1a pond g             2    1    1    1   62    0    0
 257     sdw1b infiltration       2    1    1    1   62    0    0
 451     nepl VAULT               1    1    1    1   62    0    0
 452     nepl VAULT               1    1    1    1   62    0    0
 552     SDN1 POC                 1    1    1    1   62    0    0
 570     SDW1B flow splitter      2    1    1    1   62    0    0
***  645     nepl POC                 1    1    1    1   62    0    0
 END GEN-INFO

 ACTIVITY
   RCHRES *************** Active Sections *****************
   # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                    ***
   1  999    1    0    0    0    0    0    0    0    0    0
 END ACTIVITY

 PRINT-INFO
   RCHRES *************** Printout Flags ****************** PIVL  PYR
   # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
   1  999    5    0    0    0    0    0    0    0    0    0    1    9
 END PRINT-INFO

 HYDR-PARM1
   RCHRES  Flags for each HYDR Section                                         ***
   # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
           FG FG FG FG  possible  exit  *** possible  exit      possible  exit
            *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
   1        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
   2        0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
   3        0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
   4        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
   5   12   0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  13        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
```

```
 14   22   0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 23        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 24   33   0  0  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 34        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 35   46   0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 47        0  1  0  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 50   54   0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 57        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
100  135   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
147        0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
237        0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
240  300   0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
301  552   0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
570        0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2
  RCHRES                                                                  ***
  # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
<------><--------><--------><--------><--------><--------><-------->       ***
  1             1   0.010                              0.3
  2             2   0.776                              0.3
  3             3   0.980                              0.3
  4             4   0.010                              0.3
  5             5   0.380                              0.3
 10            10   0.380                              0.3
 11            11   0.010                              0.3
 12            12   1.000                              0.3
 13            13   0.015                              0.3
 14            14   0.450                              0.3
 15            15   0.735                              0.3
 16            16   0.587                              0.3
 17            17   0.379                              0.3
 23            23   0.379                  0.0         0.3
 24            24   0.379                              0.3
 33            33   0.200                              0.3
 34            34   0.852                              0.3
 35            35   0.663                              0.3
 37            37   0.010                  0.0         0.3
 38            38   0.010                              0.3
 43            43   0.010                              0.3
 46            46   0.010                              0.3
 47            47   0.010                  0.0         0.3
 50            50   0.010                              0.3
 51            51   0.010                              0.3
 52            52   0.010                              0.3
 53            53   0.010                              0.3
 54            54   0.010                  0.0         0.3
 57            57   0.010                  0.0         0.3
135           135   0.350                              0.3
147           147   0.010                  0.0         0.3
237           237   0.010                  0.0         0.3
240           240   0.010                              0.3
242           242   0.010                              0.3
247           247   0.010                  0.0         0.3
257           257   0.010                  0.0         0.3
451           451   0.010                  0.0         0.3
452           452   0.010                  0.0         0.3
552           552   0.010                  0.0         0.3
570           570   0.010                  0.0         0.3
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                        ***
  # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  1     2.0              4.0  5.0
  2     0.0              4.0
  3     0.0              4.0
  4     2.0              4.0  5.0
```

```
  5      0.0              4.0
 10      0.0              4.0
 11      0.0              4.0
 12      0.0              4.0
 13      10.0             4.0   5.0
 14      0.0              4.0
 15      0.0              4.0
 16      0.0              4.0
 17      0.0              4.0
 23      6.0              4.0   5.0
 24      0.0              4.0
 33      0.0              4.0
 34      9.0              4.0   5.0
 35      0.1              4.0
 37      0.0              4.0
 38      0.1              4.0
 43      0.0              4.0
 46      0.0              4.0
 47      0.0              4.0   5.0
 50      0.0              4.0
 51      0.0              4.0
 52      0.0              4.0
 53      0.1              4.0
 54      2.25             4.0
 57      0.0              4.0
237      0.00             4.0
147      1.00             4.0   5.0
135      0.00             4.0
240      0.0              4.0   5.0
242      0.0              4.0   5.0
247      0.0              4.0   5.0
257      0.0              4.0   5.0
451      0.0              4.0
452      0.0              4.0
552      0.0              4.0
570      0.0              4.0   5.0
  END HYDR-INIT
END RCHRES


FTABLES
***UPPER BASIN
***===========

  FTABLE      1
           *** REVISED 8/16/00 ADDED 2ND OUTFLOW
 ROWS COLS ***
   11    5
     DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00        3.00      0.00       0.00    0.00
     2.50        3.00      7.50       0.00    0.11
     3.00        3.00      9.00       1.80    0.11
     3.50        3.30     10.58       5.00    0.11
     4.00        3.60     12.30      10.90    0.11
     4.50        3.90     14.18      17.50    0.11
     5.00        4.10     16.18      26.20    0.11
     5.50        4.30     18.28      32.50    0.11
     6.00        4.50     20.48      35.90    0.11
     7.00        5.00     25.23      38.10    0.11
     8.00        5.50     30.48      46.40    0.11
  END FTABLE  1

  FTABLE      2
 ROWS COLS ***
    9    4
     DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.000     0.0000     0.0000       0.00
     0.100     0.2571     0.0129       0.16
     0.500     0.3873     0.1417       6.53
     1.000     0.5501     0.3761      25.95
     1.500     0.7128     0.6918      59.86
```

```
    2.000     0.8756     1.0889     110.67
    3.000     1.2011     2.1273     272.24
    3.500     1.3639     2.7685     387.38
    4.000     1.5266     3.4912     528.19
 END FTABLE  2

 FTABLE      3
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.9669     0.0483       0.13
    0.500     1.0637     0.4545       4.92
    1.000     1.1846     1.0165      17.12
    1.500     1.3055     1.6390      34.92
    2.000     1.4264     2.3220      57.95
    2.500     1.5473     3.0654      86.14
    3.000     1.6682     3.8693     119.53
    3.500     1.7891     4.7336     158.24
    4.000     1.9100     5.6584     202.41
    4.500     2.0294     6.6310     251.52
    5.000     2.1488     7.6624     306.28
 END FTABLE  3

 FTABLE      4
         *** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00     3.00      0.00       0.00       0.00
     2.50     4.50      9.38       0.00       0.11
     3.00     6.00     12.00       6.00       0.11
     4.00    10.00     20.00      13.00       0.11
     5.00    15.00     32.50      20.00       0.11
     6.00    20.00     50.00      26.00       0.11
     7.00    25.00     72.50     168.00       0.11
 END FTABLE  4

 FTABLE      5
ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1010     0.0051       0.03
    0.500     0.1754     0.0603       1.46
    1.000     0.2684     0.1713       6.16
    1.500     0.3614     0.3288      14.89
    2.000     0.4544     0.5327      28.48
    2.500     0.5474     0.7832      47.70
    3.000     0.6404     1.0801      73.29
    3.500     0.7334     1.4236     105.94
    4.000     0.8264     1.8136     146.33
 END FTABLE  5

 FTABLE     10
ROWS COLS ***
   9    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1010     0.0051       0.06
    0.500     0.1660     0.0585       2.27
    1.000     0.2472     0.1618       9.32
    1.500     0.3285     0.3057      22.08
    2.000     0.4097     0.4902      41.66
    2.500     0.4909     0.7154      69.09
    3.000     0.5722     0.9811     105.37
    4.000     0.6887     1.6116     209.70
 END FTABLE 10

 POST AMBAUM DETENTION ***
 FTABLE     11
```

```
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    1.000     0.1000     0.2300       3.90
    2.000     0.2000     0.6000       6.30
    3.000     0.3000     0.9700       8.10
    4.000     0.4000     1.3400      11.10
    5.000     0.5000     1.8200      16.00
    6.000     0.6000     2.2700      19.10
    7.000     0.7000     2.8300      21.60
    8.000     0.8000     3.3700      30.80
    9.000     0.9000     4.0000      38.10
   10.000     1.0000     4.6500      74.10
   10.500     1.1000     5.2000     133.00
   11.000     1.1500     6.0000     500.00
   11.500     1.3000     11.000    1300.00
 END FTABLE 11

 FTABLE     12
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.6327     0.0316       0.15
    0.500     0.7960     0.3174       5.87
    1.000     1.0002     0.7664      21.53
    1.500     1.2043     1.3176      46.43
    2.000     1.4085     1.9708      81.20
    3.000     1.8168     3.5834     183.79
    4.000     2.2251     5.6044     336.22
    5.000     2.6335     8.0337     545.30
    6.000     3.0418    10.8713     817.51
 END FTABLE 12

 FTABLE     13
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
    0.000     40.000     0.0000       0.00     0.00
    1.000     41.400     40.000       0.00     0.11
    1.500     42.000     60.000      10.00     0.11
    2.000     42.700     80.000      16.00     0.11
    2.500     43.300     100.00      20.00     0.11
    3.000     44.000     120.00      28.00     0.11
    5.000     45.000     210.00      45.00     0.11
 END FTABLE 13

 FTABLE     14
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3361     0.0168       0.24
    0.500     0.3809     0.1602       9.04
    1.000     0.4370     0.3647      31.61
    1.500     0.4930     0.5972      65.00
    2.000     0.5491     0.8577     108.85
    2.500     0.6051     1.1462     163.33
    3.000     0.6612     1.4628     228.78
 END FTABLE 14

 FTABLE     15
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      91.00
     2.00       1.10       1.60     268.00
     3.00       1.20       2.75     493.00
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 END FTABLE 15

 FTABLE      16
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      74.00
     2.00       1.10       1.60     219.00
     3.00       1.20       2.75     403.00
 END FTABLE 16

 FTABLE      17
ROWS COLS ***
   5    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       0.10       0.00       0.00
     1.00       1.00       0.55      59.00
     2.00       1.10       1.60     173.00
     3.00       1.20       2.75     318.00
     4.00       1.30       4.00     484.00
 END FTABLE 17

 FTABLE      23
ROWS COLS ***  HERMES
   9    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW  ***
     0.00       0.00       0.00       0.00    0.00         0.00
     5.00       0.50       1.91       0.00    0.00       305.00
    11.00       0.79       5.79       0.00    0.00       311.00
    15.00       1.13       9.64       0.50    0.01       315.00
    19.00       1.72      15.34       0.50    0.05       319.00
    29.00       2.86      38.25       0.50    0.10       329.00
    39.00       4.40      74.55       0.50    0.20       339.00
    50.00       6.22     132.98       0.50    0.30       350.00
    60.00      10.00    1212.98       0.50    0.40       360.00
 END FTABLE 23

 FTABLE      24
ROWS COLS ***
   9    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.2571     0.0129       0.16
    0.500     0.3873     0.1417       6.53
    1.000     0.5501     0.3761      25.95
    1.500     0.7128     0.6918      59.86
    2.000     0.8756     1.0889     110.67
    3.000     1.2011     2.1273     272.24
    3.500     1.3639     2.7685     387.38
    4.000     1.5266     3.4912     528.19
 END FTABLE 24

 FTABLE      33
ROWS COLS ***
  11    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       1.00       0.00       0.00
     0.50       1.20       0.55       2.00
     1.00       1.40       1.20       6.00
     1.50       1.60       1.95       9.00
     2.00       1.80       2.80      13.00
     2.50       2.00       3.75      16.50
     3.00       2.20       4.80      20.00
     3.50       2.40       5.95      23.00
     4.00       2.60       7.20      26.00
     5.00       2.80       9.90     104.00
     6.00       3.00      12.80     246.00
 END FTABLE 33

 FTABLE      34
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ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
   6    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
     0.00       3.00       0.00       0.00     0.00
     3.00       3.05       9.08       0.00     0.11
     4.00       3.10      12.15       0.00     0.11
     5.00       3.15      15.28       0.00     0.11
     6.00       3.20      18.45       72.0     0.11
     7.00       3.25      21.68      225.0     0.11
 END FTABLE 34

 FTABLE     35
ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
   5    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.00       0.10       0.00       0.00
     1.00       1.10       0.60      38.00
     2.00       1.20       1.75     108.00
     3.00       1.30       3.00     194.00
     4.00       1.40       4.35     290.00
 END FTABLE 35


 FTABLE     38
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0000     0.0000       0.00
    1.000     0.4000     0.4000       2.00
    1.500     0.5000     1.0000       4.00
    2.000     0.9000     1.3000      11.00
    2.500     1.3000     1.6000      15.00
    3.000     1.6000     2.0000      18.00
    3.500     1.9000     2.5000      20.80
 END FTABLE 38

 FTABLE     45
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0010     0.0000       0.00
    0.000     0.0100     0.0100      10.00
    0.100     0.1000     0.1000     100.00
    1.000     1.0000     1.0000    1000.00
   10.000    10.0000    10.0000   10000.00
 END FTABLE 45

 FTABLE    645
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0010     0.0000       0.00
    0.000     0.0100     0.0100      10.00
    0.100     0.1000     0.1000     100.00
    1.000     1.0000     1.0000    1000.00
   10.000    10.0000    10.0000   10000.00
 END FTABLE645

 FTABLE     50
ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
     0.00       1.00       0.00       0.00
     0.50       1.10       0.53       5.00
     1.00       1.20       1.10      15.00
     1.50       1.30       1.73      25.00
     2.00       1.40       2.40      35.00
     2.50       1.50       3.13      52.00
     3.00       1.60       3.90      70.00
     3.50       1.70       4.73      87.00
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     4.00      1.80       5.60     105.00
     6.00      1.90       9.30     165.00
 END FTABLE 50

 FTABLE      52
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3680     0.0184       0.25
    0.500     0.3717     0.1664       9.39
    1.000     0.3763     0.3534      31.06
    2.000     0.3819     0.7325      94.37
    3.000     0.3874     1.1171     174.33
 END FTABLE 52

 FTABLE     552
ROWS COLS ***  SDN1 VAULT EFFECTIVE DEPTH=12 FT  RISER=24 INCHES
  15    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.4308     0.0000       0.00
    1.290     0.4308     0.6520      0.111
    2.130     0.4308     1.0760      0.143
    3.530     0.4308     1.7830      0.184
    4.640     0.4308     2.3430      0.211
    5.200     0.4308     2.6260      0.223
    6.320     0.4308     3.1920      0.246
    7.430     0.4308     3.7530      0.267
    8.200     0.4308     4.1410      0.280
    9.220     0.4308     4.6570      0.407
   10.190     0.4308     5.1460      0.567
   11.250     0.4308     5.6820      0.954
   12.100     0.4308     6.1110      2.130
   12.300     0.4308     6.2120      4.730
   13.700     0.4308     6.9190     21.360
 END FTABLE552

 FTABLE      53
OLD LAKE REBA                                  ***
MAX DEPTH = 4.9 FEET                           ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH         ***
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     2.4000     0.0000       0.00
    1.000     2.5800     2.5000      18.00
    2.000     2.9400     5.3000      26.00
    3.000     3.4100     8.4000      31.00
    4.000     3.8800    12.100       36.00
    4.900     4.3000    15.800       40.00
    6.000     4.3000    15.810      500.00
 END FTABLE 53

 FTABLE      54
EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
GATE SETTING: 2.0 FEET***  BASED ON CALIBRATION FILE
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000       0.00       0.00       0.00
    1.300       0.01       0.01      10.00
    2.000       0.01       0.02      20.00
    2.900       0.70       0.40      30.00
    4.000       1.50       1.50      40.00
    5.400       3.50       4.90      50.00
    7.000       8.60      13.30      60.00
    8.800      15.60      34.80      70.00
   10.000      19.90      57.30      76.00
   10.500      21.50      68.00      92.00
   11.000      23.10      78.80     179.00
   11.500      24.70      88.60     303.00
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 END FTABLE 54

 FTABLE    104
MILLER CREEK DETENTION FACILITY*** WITH ADD'L AREA 1+AREA 2 55.5 ACFT @ 10FT
GATE SETTING: 2.0 FEET*** EXISTING OUTLET NO LOW FLOW CONTROL
ROWS COLS ***
  17    4
    DEPTH      AREA     VOLUME   OUTFLOW  ***
    0.000    0.0000     0.0000      0.00
    0.500    0.0100     0.0100      2.50
    1.500    0.0300     0.2800     14.29
    2.500    1.1100     1.3900     24.88
    3.500    2.6100     4.0000     34.51
    4.500    4.6100     9.1400     43.20
    5.500    7.1200     19.600     50.98
    6.000    8.3600     21.180     54.53
    6.500    11.870     30.060     57.87
    7.000    15.370     38.930     61.00
    7.500    18.870     47.800     63.91
    8.000    21.860     59.160     66.62
    8.500    24.850     70.510     69.12
    9.000    27.340     84.160     71.42
    9.500    29.820     97.820     73.53
   10.000    32.050     112.83     75.44
   10.500    34.275     127.84     90.74
   11.500    38.220     161.54    320.00
 END FTABLE104

 FTABLE     69
PRE-MILLER CREEK DETENTION FACILITY***
ROWS COLS ***
  12    4
    DEPTH      AREA     VOLUME   OUTFLOW  ***
    0.000    0.0000     0.0000      0.00
    0.100    0.1860     0.0093      0.12
    0.500    0.2552     0.0975      4.84
    1.000    0.3417     0.2467     18.49
    1.500    0.4282     0.4392     41.30
    2.000    0.5148     0.6750     74.40
    2.500    0.6013     0.9540    119.01
    3.000    0.6878     1.2763    176.30
    3.500    0.7744     1.6418    247.41
    4.000    0.8609     2.0506    333.43
    4.500    0.9470     2.4992    434.59
    5.000    1.0331     2.9905    552.33
 END FTABLE 69

*** PROJECT CONDITION PONDS/VAULTS
 FTABLE    452
ROWS COLS ***
*** NEW NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
*** PARALLEL VAULT BASED ON KCRTS EFFECTIVE DEPTH=20 FT
  20    4
    DEPTH      AREA     VOLUME   OUTFLOW ***
     0.00     3.214      0.000     0.000
     1.11     3.214      0.826     0.129
     1.57     3.214      1.168     0.154
     3.43     3.214      2.551     0.227
     4.83     3.214      3.593     0.269
     8.08     3.214      6.010     0.348
    10.41     3.214      7.743     0.395
    12.74     3.214      9.476     0.437
    14.00     3.214     10.413     0.458
    14.65     3.214     10.897     0.557
    16.09     3.214     11.968     0.665
    16.23     3.214     12.072     0.754
    17.92     3.214     13.329     1.140
    18.22     3.214     13.552     1.310
    18.81     3.214     13.991     1.860
    19.11     3.214     14.214     2.190
    20.00     3.214     14.876     3.350
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   20.20      3.214     15.025      5.110
   20.70     32.14      15.397     14.820
   21.00     32.14      15.620     18.560
 END FTABLE452

 FTABLE    451
ROWS COLS ***
*** NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
*** EXISTING VAULT W/MODIFIED OUTLET   EFFECTIVE DEPTH= 18.0 FT
  14    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
    0.000    0.2240     0.0000      0.00
    2.170    0.2240     0.4860     0.031
    4.260    0.2240     0.9550     0.043
    5.930    0.2240     1.3290     0.051
    8.030    0.2240     1.8000     0.059
   10.120    0.2240     2.2680     0.066
   12.210    0.2240     2.7360     0.073
   14.040    0.2240     3.1460     0.109
   15.510    0.2240     3.4760     0.166
   16.220    0.2240     3.6350     0.295
   18.000    0.2240     4.0340     1.080
   18.400    0.2240     4.1240     5.400
   19.000    0.2240     4.2580    12.680
   19.900    0.2240     4.4600    17.080
 END FTABLE451


 FTABLE     46
ROWS COLS ***
SDN-6: 24TH STREET CARGO VAULT ***  EFFECTIVE DEPTH=14 FT RISER DIA=12 IN
  20    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
     0.00      0.35      0.000      0.000
     0.37      0.35      0.131      0.021
     1.19      0.35      0.421      0.037
     3.39      0.35      1.198      0.063
     5.03      0.35      1.778      0.077
     7.23      0.35      2.556      0.092
     9.15      0.35      3.235      0.104
    10.25      0.35      3.624      0.110
    10.53      0.35      3.723      0.111
    10.92      0.35      3.861      0.128
    12.00      0.35      4.242      0.165
    12.13      0.35      4.288      0.190
    12.95      0.35      4.578      0.245
    13.77      0.35      4.868      0.282
    14.00      0.35      4.949      0.291
    14.10      0.35      4.985      0.910
    14.20      0.35      5.020      2.040
    14.30      0.35      5.056      3.500
    14.50      0.35      5.126      7.200
    14.70      0.35      5.197     11.720
 END FTABLE 46


*** SDW-1A: 3RD RUNWAY POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE     47
  *** PROJECT  SDW1A   EFFECTIVE DIAMETER=3.0 FT
 ROWS COLS ***         INFILTRATION TANK TO OBTAIN 0.3 CFS
   14    5
    DEPTH      AREA     VOLUME     STORMQ  INFILTRQ ***
    0.000     0.000     0.000      0.000     0.000
    0.250     0.002     0.002      0.000     0.027
    0.500     0.004     0.004      0.000     0.054
    1.000     0.012     0.012      0.000     0.109
    1.500     0.020     0.020      0.000     0.164
    2.000     0.029     0.029      0.000     0.218
    2.500     0.036     0.036      0.000     0.272
    3.000     0.041    0.0406      0.000     0.327
    3.100     0.041    0.0419      0.596     0.338
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     3.200      0.041    0.0420      1.685     0.349
     3.300      0.041    0.0421      3.096     0.360
     3.400      0.041    0.0422      4.766     0.371
     3.500      0.041    0.0423      6.661     0.382
     3.750      0.041    0.0424     12.237     0.409
  END FTABLE 47

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE    147
  *** PROJECT  SDW1A   EFFECTIVE DEPTH=14.0 FT RISER DIA 24 INCHES
 ROWS COLS ***         VAULT BASED ON INFILTRATION=0.15CFS
   17    5
     DEPTH       AREA     VOLUME    INFILTRQ   BYPASS Q***
     0.000      0.689     0.000      0.0000     0.0000
     0.010      0.689     0.007      0.1400     0.0000
     1.000      0.689     0.689      0.1408     0.0000
     2.000      0.689     1.377      0.1417     0.0000
     4.000      0.689     2.755      0.1432     0.0000
     6.000      0.689     4.132      0.1446     0.0000
     8.000      0.689     5.510      0.1461     0.0000
    10.000      0.689     6.887      0.1475     0.0000
    12.000      0.689     8.264      0.1489     0.0000
    14.000      0.689     9.642      0.1503     0.0000
    16.000      0.689    11.019      0.1517     0.0000
    16.750      0.689    11.536      0.1517    10.7600
    16.900      0.689    11.639      0.1517    13.9600
    17.000      0.689    11.708      0.1517    16.1000
    17.100      0.689    11.777      0.1517    18.5700
    17.300      0.689    11.915      0.1517    23.8600
    18.000      0.689    12.397      0.1517    45.5400
  END FTABLE147

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE    247
  *** PROJECT  SDW1A   EFFECTIVE DEPTH=12.0 FT RISER DIA 12 INCHES
 ROWS COLS ***         POND BASED ON INFILTRATION=0.15CFS
   17    5
     DEPTH       AREA     VOLUME      STORMQ    INFILTRQ ***
     0.000      1.300     0.000        0.00      0.00
     0.010      1.310     0.010       0.001      0.15
     1.000      1.320     1.320       0.007      0.15
     2.000      1.342     2.650       0.010      0.15
     3.000      1.363     4.000       0.012      0.15
     4.000      1.385     5.370       0.013      0.15
     5.000      2.672     8.000       0.015      0.15
     6.000      2.739    10.700       0.017      0.15
     7.000      2.807    13.470       0.018      0.15
     8.000      2.876    16.300       0.019      0.15
     8.300      2.896    17.176       0.031      0.15
     9.000      2.945    19.210       0.041      0.15
    10.000      3.014    22.180       0.051      0.15
    11.000      3.084    25.228       0.058      0.15
    11.100      3.092    25.540       0.675      0.15
    11.300      3.106    26.162       3.260      0.15
    12.000      3.155    28.340      15.190      0.15
  END FTABLE247

*** SDN3A: 3RD RUNWAY VAULT TO MILLER CREEK (LEVEL 2): ***
  FTABLE     37
  *** PROJECT C SDN3A    EFFECTIVE DEPTH=11.0FT RISER DIA=24 INCHES
 ROWS COLS ***           VAULT BASED ON IMPERVIOUS TOP SURO
   14    4
     DEPTH       AREA    VOLUME    OUTFLOW    ***
     0.000     0.644     0.000     0.000
     0.010     0.644     0.006     0.001
     1.000     0.644     0.643     0.016
     3.980     0.644     2.558     0.033
     6.030     0.644     3.876     0.041
     9.010     0.644     5.792     0.050
     10.00     0.644     6.428     0.052
     10.46     0.644     6.724     0.072
```

```
    11.00     0.644       7.071     0.082
    11.10     0.644       7.135     0.699
    11.20     0.644       7.199     1.830
    11.30     0.644       7.264     3.290
    11.40     0.644       7.328     5.020
    11.60     0.644       7.456     9.140
  END FTABLE 37

*** SDN3A: 3RD RUNWAY POND C TO MILLER CREEK (LEVEL 2): ***
  FTABLE    237
  *** PROJECT C SDN3A     EFFECTIVE DEPTH= 9.0FT RISER DIA=24 INCHES
 ROWS COLS ***            POND BASED ON INTERFLOW AND PERVIOUS TOP SURO
   19    4
     DEPTH       AREA     VOLUME    OUTFLOW    ***
     0.000     1.3090      0.000      0.00
     0.020     1.3120      0.026     0.009
     1.020     1.3550      1.358     0.070
     2.070     1.4030      2.806     0.100
     3.130     1.4530      4.320     0.123
     4.020     1.4980      5.632     0.139
     5.070     1.5460      7.229     0.156
     7.750     1.6720     11.549     0.193
     7.800     1.6800     11.633     0.199
     7.850     1.6840     11.718     0.213
     8.250     1.7050     12.395     0.249
     8.340     1.7090     12.549     0.270
     8.570     1.7210     12.944     0.313
     8.950     1.7410     13.601     0.354
     9.500     1.7690     14.567     0.399
     9.600     1.7740     14.744     0.714
     9.800     1.7850     15.100     2.020
    10.300     1.8110     15.999     3.840
    10.900     1.8430     17.095     4.960
  END FTABLE237

*** SDN-3X: 3RD RUNWAY NORTH VAULT (LEVEL 2): ***
  FTABLE     43
 ROWS COLS ***        EFFECTIVE DEPTH=20 FT RISER DIA=24 INCHES
   21    4
     DEPTH       AREA     VOLUME     FLOW                                  ***
      (FT)    (ACRES) (ACRE-FT)    (FT3/S)                                ***
      0.00     1.288       0.00       0.00
      0.14     1.288      0.180      0.067
      1.39     1.288      1.790      0.216
      3.35     1.288      4.314      0.336
      5.31     1.288      6.839      0.423
      8.06     1.288     10.380      0.521
      8.84     1.288     11.385      0.545
     10.02     1.288     12.905      0.580
     11.98     1.288     15.429      0.635
     12.37     1.288     15.931      0.645
     14.00     1.288     18.030      0.686
     14.10     1.288     18.159      0.705
     14.91     1.288     19.202      0.757
     16.09     1.288     20.722      0.810
     18.00     1.288     23.182      0.881
     18.32     1.288     23.594      1.150
     18.76     1.288     24.161      1.360
     20.00     1.288     25.758      1.680
     20.10     1.288     25.886      2.320
     20.50     1.288     26.402      8.620
     20.80     1.288     26.788     15.370
  END FTABLE 43

  *** SDN-4X/2X: 3RD RUNWAY NORTH VAULT      (COMBINED FACILITY)
   FTABLE     51
  ROWS COLS ***        EFFECTIVE DEPTH=19FT RISER DIA=24 INCHES
    20    4
     DEPTH       AREA     VOLUME     OUTFLOW                               ***
      (FT)    (ACRES) (ACRE-FT)    (FT3/S)                                ***
      0.00     0.789      0.000      0.000
```

```
      0.16      0.789      0.126      0.056
      1.51      0.789      1.192      0.169
      3.28      0.789      2.588      0.249
      5.49      0.789      4.332      0.322
      7.26      0.789      5.729      0.370
     10.35      0.789      8.168      0.442
     12.12      0.789      9.564      0.478
     13.44      0.789     10.606      0.503
     14.33      0.789     11.308      0.520
     15.57      0.789     12.287      0.654
     16.72      0.789     13.194      0.828
     17.19      0.789     13.565      0.950
     17.63      0.789     13.913      1.030
     18.00      0.789     14.205      1.080
     19.00      0.789     14.994      1.960
     19.10      0.789     15.073      2.580
     19.40      0.789     15.309      6.930
     19.60      0.789     15.467     11.080
     20.00      0.789     15.783     17.190
  END FTABLE 51

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
  FTABLE     57
 ROWS COLS ***      EFFECTIVE DEPTH = 14.0 FT
   17    4
     DEPTH       AREA     VOLUME     STORMQ     ***
      (FT)    (ACRES)  (ACRE-FT)    (FT3/S)     ***
      0.00      2.430      0.000      0.000
      0.01      2.430      0.041      0.010
      1.00      2.680      2.411      0.183
      2.00      2.760      4.860      0.257
      3.00      2.818      7.370      0.319
      4.00      3.079      9.945      0.366
      5.00      5.832     15.320      0.411
      6.00      5.927     20.742      0.450
      7.00      6.022     26.264      0.481
      8.00      6.118     31.888      0.518
      9.00      6.210     37.613      0.550
     10.00      6.311     43.441      0.583
     11.00      6.408     49.372      0.609
     12.00      6.607     55.406      0.634
     13.00      6.405     61.543      0.764
     14.00      6.504     67.786      1.320
     15.00      7.000     70.000     16.600
  END FTABLE 57

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
  FTABLE    257
   *** PROJECT  SDW1B   EFFECTIVE DIAMETER=3.0 FT
 ROWS COLS ***          INFILTRATION TANK TO OBTAIN 0.2 CFS
   15    5
     DEPTH       AREA     VOLUME      STORMQ  INFILTRQ ***
     0.000      0.001      0.000       0.000     0.000
     0.010      0.001      0.001       0.000     0.002
     0.250      0.002      0.002       0.000     0.017
     0.500      0.004      0.004       0.000     0.035
     1.000      0.012      0.012       0.000     0.071
     1.500      0.020      0.020       0.000     0.106
     2.000      0.029      0.029       0.000     0.142
     2.500      0.036      0.036       0.000     0.178
     3.000      0.041     0.0406       0.000     0.213
     3.100      0.041     0.0420       0.596     0.220
     3.200      0.041     0.0421       1.685     0.227
     3.300      0.041     0.0422       3.096     0.233
     3.400      0.041     0.0423       4.766     0.241
     3.500      0.041     0.0424       6.661     0.248
     3.750      0.041     0.0425      12.237     0.266
  END FTABLE257

  FTABLE    570
  *** PROJECT  SDW1B   FLOW SPLITTER (to 257 and 57)
```

```
ROWS COLS ***
  15    5
    DEPTH       AREA     VOLUME      STORMQ   INFILTRQ ***
    0.000       0.00      0.000       0.000      0.000
    0.100       0.01     0.0002       0.000      0.050
    0.400       0.01     0.0009       0.000      0.110
    0.600       0.01     0.0014       0.000      0.130
    0.750       0.01     0.0017       0.000      0.150
    0.800       0.01     0.0018       0.720      0.150
    1.000       0.01     0.0023       8.050      0.170
    1.100       0.01     0.0025      13.330      0.180
    1.200       0.01     0.0027      19.440      0.190
    1.300       0.01     0.0030      26.270      0.190
    1.400       0.01     0.0032      33.750      0.200
    1.420       0.01     0.0033      35.320      0.200
    1.440       0.01     0.0033      36.910      0.200
    1.450       0.01     0.0034      37.920      0.200
    1.460       0.01     0.0035      38.530      0.200
 END FTABLE570

 FTABLE     61
ROWS COLS ***
*** SDN-2X: DETAIN OVERFLOW FROM NCPS AND NSMPS-
   17    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.5740     0.0000      0.00
    1.200     0.5740     0.7710      0.151
    2.220     0.5740     1.4270      0.205
    3.240     0.5740     2.0830      0.247
    3.650     0.5740     2.3460      0.262
    4.260     0.5740     2.7380      0.283
    4.660     0.5740     2.9950      0.296
    5.680     0.5740     3.6510      0.327
    6.640     0.5740     4.2680      0.517
    7.650     0.5740     4.9170      0.644
    8.670     0.5740     5.9710      0.739
    9.810     0.5740     6.3570      0.836
   10.700     0.5740     6.8780      0.894
   12.000     0.5740     7.7130      0.978
   12.100     0.5740     7.7780      1.600
   12.300     0.5740     7.9060      4.200
   12.800     0.5740     8.2280     14.560
 END FTABLE 61

 PRE AMBAUM DETENTION ***
 FTABLE    111
ROWS COLS ***
  15    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000      0.00
    0.500     0.2160     0.0750      5.30
    1.000     0.2730     0.1990     21.10
    1.500     0.2890     0.3410     43.90
    2.000     0.2900     0.4830     68.80
    2.500     0.2910     0.6070     89.10
    3.000     0.2950     0.6820     90.00
    3.500     0.3000     2.1000    100.00
    4.000     0.3050     2.5000    105.00
    4.500     0.3100     3.0000    110.00
    5.000     0.3200     3.5000    120.00
    5.500     0.3300     4.0000    130.00
    6.000     0.3800     5.0530    166.48
    6.500     0.3980     5.9430    225.31
    7.000     0.4150     6.9040    320.10
 END FTABLE111

 FTABLE    135
ROWS COLS *** VACA FARM
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       0.10       0.00       0.00
```

```
      1.00      0.10      0.10      4.00
      2.00      0.11      0.21      8.00
      2.50      1.00      0.48     13.00
      3.50      6.50      4.23     86.00
      4.50     13.00     13.98    235.00
  END FTABLE135

  FTABLE    240
*** NORTH SNOWMELT PUMP STATION (SDN-2) (INSTALLED IN LATE 1997/1998)
                                                                        ***
 ROWS COLS                                                              ***
   14    5                                                              ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                  ***
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
       0.0      0.002      0.00       0.00       0.00
      1.00      0.002    0.0023       0.00       0.00
      2.00      0.002    0.0046       1.67       0.00
      3.00      0.002    0.0069       1.67       0.00
      4.00      0.002    0.0092       1.67       0.00
      5.00      0.002    0.0115       1.67       0.00
      5.25      0.002    0.0121       1.67       1.53
      5.50      0.002    0.0126       1.67       6.06
      5.75      0.002    0.0132       1.67      12.65
      6.00      0.002    0.0138       1.67      19.83
      6.25      0.002    0.0144       1.67      25.66
      6.50      0.002    0.0149       1.67      25.70
      6.75      0.002    0.0155       1.67      26.70
      7.00      0.002    0.0161       1.67      50.00
  END FTABLE240

  FTABLE    242
*** NORTH CARGO PUMP STATION (SDN-2) (INSTALLED IN OCTOBER 1997)
                                                                        ***
 ROWS COLS                                                              ***
   14    5                                                              ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                  ***
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
       0.0      0.002      0.00       0.00       0.00
      1.00      0.002    0.0023       0.00       0.00
      2.00      0.002    0.0046       6.13       0.00
      3.00      0.002    0.0069       6.13       0.00
      4.00      0.002    0.0092       6.13       0.00
      5.00      0.002    0.0115       6.13       0.00
      5.25      0.002    0.0121       6.13       0.28
      5.50      0.002    0.0126       6.13       1.16
      5.75      0.002    0.0132       6.13       2.53
      6.00      0.002    0.0138       6.13       4.23
      6.25      0.002    0.0144       6.13       6.05
      6.50      0.002    0.0149       6.13       7.72
      6.75      0.002    0.0155       6.13       8.50
      7.00      0.002    0.0161       6.13       20.0
  END FTABLE242

END FTABLES

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>        <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                 <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)             ***
PERLND     PWATER PERO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    1

  MASS-LINK        2
IMPLND     IWATER SURO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES     ROFLOW                          RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES     OFLOW  OVOL   1                 RCHRES          INFLOW IVOL
```

```
  END MASS-LINK    4

  MASS-LINK        5
RCHRES     OFLOW  OVOL   2                RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND     PWATER SURO       0.0833333   RCHRES          INFLOW IVOL
PERLND     PWATER IFWO       0.0833333   RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND     PWATER AGWO       0.0833333   RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        10
COPY       OUTPUT MEAN                    COPY            INPUT  MEAN
  END MASS-LINK   10

  MASS-LINK        11
RCHRES     ROFLOW                         COPY            INPUT  MEAN
  END MASS-LINK   11

  MASS-LINK        12
COPY       OUTPUT MEAN                    RCHRES          INFLOW IVOL
  END MASS-LINK   12

  MASS-LINK        14
RCHRES     OFLOW  OVOL   1                COPY            INPUT  MEAN
  END MASS-LINK   14

  MASS-LINK        15
RCHRES     OFLOW  OVOL   2                COPY            INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK        21
PERLND     PWATER PERO       0.0833333   COPY            INPUT  MEAN
  END MASS-LINK   21

  MASS-LINK        22
IMPLND     IWATER SURO       0.0833333   COPY            INPUT  MEAN
  END MASS-LINK   22

  MASS-LINK        26
PERLND     PWATER SURO       0.0833333   COPY            INPUT  MEAN
PERLND     PWATER IFWO       0.0833333   COPY            INPUT  MEAN
  END MASS-LINK   26

  MASS-LINK        27
PERLND     PWATER AGWO       0.0833333   COPY            INPUT  MEAN
  END MASS-LINK   27

END MASS-LINK

COPY
  TIMESERIES                                                      ***
  Copy-opn                                                        ***
    # -  #  NPT  NMN
   37   71    1
  240  242    1
  357  357    1
  645  645    1
  END TIMESERIES
END COPY

END RUN
```

```
RUN
GLOBAL
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF MILLER CREEK
  ***  FILE: MC23AGIF.INP - 2006 future condition
  ***  Second run to apply re-infiltration
  ***  BASED ON MILL64.INP FILE FROM AQUA TERRA
  ***  MC22WDM:
  ***  ADDED PERLND 47,57,
  ***  ADDED GROUND WATER INFILTRATION TO WDM FOR USE WITH MCAGWO.INP
  ***  FK revised SDW1A and SDW1B with flow splitters, storages at SDN3/3X, SDN2X/4X;
  ***  FK revised MC-1 and SDN-2X land uses, added POC at Lake Reba, removed run-of-
river tables
  MILLER CREEK BASIN HSPF MODEL
***  START       1994  1  1  0  0  END    1996  8 30 24  0
  START       1948 10  1  0  0  END    1997  1 31 24  0
  RUN INTERP OUTPUT LEVEL    6
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname---------------------------------------------->
MESSU      24   MILL.MES
WDM        25   MCPOND23.WDM
           61   PER.L61
           62   RCH.L62
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      45
  *** special PERLND for infiltration SDW1A
      PERLND      47
      PERLND      54
  *** special PERLND for infiltration SDW1B
      PERLND      57
      IMPLND      14
      RCHRES       1
      RCHRES      23
      RCHRES      24
      RCHRES       2
      RCHRES       3
      RCHRES      33
      RCHRES       4
      RCHRES       5
      RCHRES      50
      RCHRES     242
      RCHRES     240
      COPY        61
      COPY        44
      RCHRES      51
      RCHRES      43
      RCHRES     451
      RCHRES     452
      COPY        45
      COPY       645
      RCHRES      46
      RCHRES     552
      RCHRES      52
      RCHRES      53
      COPY        53
      RCHRES      54
      RCHRES      37
      RCHRES     237
      COPY        37
      RCHRES     147
      RCHRES     247
      COPY        66
```

```
      COPY        69
      RCHRES      47
      COPY        62
      COPY        63
      COPY        67
      COPY        68
  *** output special PERLND outflow to check
      COPY        47
      COPY        70
      RCHRES      34
      RCHRES     135
      RCHRES     570
      RCHRES      57
      RCHRES     257
      COPY        64
      COPY        65
      COPY       357
      COPY        56
  *** output special PERLND outflow to check
      COPY        57
      COPY        71
      RCHRES      35
      COPY        55
      RCHRES      10
      RCHRES      16
      RCHRES      11
      RCHRES      13
      RCHRES      12
      RCHRES      15
      RCHRES      14
      RCHRES      17
    END INGRP
END OPN SEQUENCE                                                        ***

PERLND
  GEN-INFO                                                              ***
    <PLS >      Name           NBLKS   Unit-systems   Printer           ***
    # -  #                       User  t-series Engl Metr               ***
                                       in  out                          ***
   16       TFM- TILL FOR MOD      1     1    1    1   61    0
   26       TGM- TILL GR MOD       1     1    1    1   61    0
   34       OF - OUTWASH FOR       1     1    1    1   61    0
   44       OG - OUTWASH GR        1     1    1    1   61    0
 ***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
   45       AIRPORT FILL           1     1    1    1   61    0
   47       OG - INFILTRATION 1    1     1    1    1   61    0
   54       SA - WETLANDS          1     1    1    1   61    0
   57       OG - INFILTRATION 3    1     1    1    1   61    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************ Active Sections ******************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC      ***
   14  200    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ********************* Print-flags ************************ PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > ***************** Flags ********************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                   ***
   14  200    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1
  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST       LZSN     INFILT       LSUR      SLSUR      KVARY      AGWRC
   16                    9.0000     0.3200     400.00     0.1000     0.5000     0.9960
   26                    9.0000     0.1200     400.00     0.1000     0.5000     0.9960
   34                   10.0000     2.0000     400.00     0.0500     0.3000     0.9960
   44                   10.0000     0.8000     400.00     0.0500     0.3000     0.9960
```

```
 45                    7.5000    0.0200    300.00    0.0700    0.0000    0.9960
 47                   10.0000    0.8000    400.00    0.0500    0.3000    0.9960
 54                    8.0000    2.0000    100.00    0.0010    0.5000    0.9960
 57                   10.0000    0.8000    400.00    0.0500    0.3000    0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 16                              2.0000    2.0000      0.33      0.00       0.0
 26                              2.0000    2.0000      0.33        0.       0.
 34                              2.0000    2.0000      0.33      0.00       0.0
 44                              2.0000    2.0000      0.33        0.       0.
 47                              2.0000    2.0000      0.33        0.       0.
 45                              2.0000    2.0000      0.33        0.       0.
 54                              10.000    2.0000      0.33        0.       0.7
 57                              2.0000    2.0000      0.33        0.       0.
END PWAT-PARM3
PWAT-PARM4
  <PLS >                                                              ***
  # -  #      CEPSC      UZSN      NSUR      INTFW       IRC     LZETP***
 16          0.2000    0.7500    0.3500      9.000    0.7000     0.7000
 26          0.1000    0.3750    0.2500      9.000    0.7000     0.2500
 34          0.2000    0.7500    0.3500      0.000    0.7000     0.7000
 44          0.1000    0.7500    0.2500      0.000    0.7000     0.2500
 47          0.1000    0.7500    0.2500      0.000    0.7000     0.2500
 45          0.1000    0.2800    0.2500      6.000    0.1500     0.6000
 54          0.1000    2.2500    0.5000      1.000    0.7000     0.8000
 57          0.1000    0.7500    0.2500      0.000    0.7000     0.2500

END PWAT-PARM4
PWAT-STATE1
  <PLS >  PWATER state variables***
  # -  #***    CEPS      SURS       UZS       IFWS       LZS      AGWS      GWVS
 16          0.078        0.    0.2500       0.10     2.000     2.000     0.000
 26          0.051        0.    0.2500       0.10     2.000     2.000     0.000
 34          0.078        0.    0.2500       0.10     2.000     2.000     0.000
 44          0.051        0.    0.2500       0.10     2.000     2.000     0.000
 47          0.051        0.    0.2500       0.10     2.000     2.000     0.000
 45          0.051        0.    0.2500       0.10     2.000     2.000     0.000
 54          0.051        0.    0.2500       0.10     2.000     2.000     0.000
 57          0.051        0.    0.2500       0.10     2.000     2.000     0.000
END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >      Name             Unit-systems   Printer                    ***
    # -  #                     User  t-series Engl Metr                    ***
                                     in  out                               ***
   14      IMPERVIOUS              1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   14         0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14         0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <ILS >           Flags            ***                                 ***
    # -  # CSNO RTOP  VRS  VNN RTLI   ***                                 ***
   14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                              ***
    <ILS >                                                                ***
    # -  #      LSUR      SLSUR      NSUR      RETSC
   14         100.00     0.0100     0.1000     0.1000
  END IWAT-PARM2
```

```
  IWAT-PARM3
    <ILS >                                                              ***
    # -  #     PETMAX     PETMIN                                        ***
   14
  END IWAT-PARM3
  IWAT-STATE1
    <ILS >  IWATER state variables                                      ***
    # -  #       RETS       SURS                                       ***
   14       1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                              ***

EXT SOURCES                                                            ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes and ponds
*** FOLLOWING RCHRES ARE PONDS: 57, 247, 237                           ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC     ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM   1002 PREC     ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM      1 EVAP     ENGLZERO  0.8           PERLND  14 200 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
  ***  --> lateral inflow from reinfiltration chamber for SDW1A
WDM      5 FLOW     ENGLZERO  1.0           PERLND  47     EXTNL  AGWLI
  ***  --> lateral inflow from reinfiltration chamber for SDW1B
WDM      6 FLOW     ENGLZERO  1.0           PERLND  57     EXTNL  AGWLI
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC     ENGLZERO                RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES   1     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES   4     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES   4     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  11     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  11     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  13     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  13     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  23     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  23     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  34     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  34     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  53     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  53     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  54     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  54     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES 237     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES 237     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES 247     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES 247     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  57     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  57     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***PROJECT CONDITION FLOWS
*** RCHRES=LOCATION:
*** 54=MCDF       47=SDW1A INFILTRATION TANK      43=SDN3X     247=SDW1A POND G
*** 17=MOUTH      49=SDW2         44=SDN4X        52=SDN1      451= EXISTING NEPL
*** 61=SDN2X      57=SDW1B        51=SDN2X+SDN4X  53=Lake Reba 452=NEW NEPL
*** 45=NEPL POC   55=SR509        39=SDN3A/SDW1A POC
*** 46=CARGO      37=SDN3AI VAULT 237=SDN3AO POND
*** GAUGE POINTS (17=MOUTH, 54=MILLER RDF, 55=SR509)
RCHRES  17 HYDR   RO     1 1              WDM    113 FLOW     ENGL      REPL
COPY    55 OUTPUT MEAN   1 1 12.1         WDM    118 FLOW     ENGL      REPL
RCHRES  54 HYDR   RO     1 1              WDM    114 FLOW     ENGL      REPL
*** DETENTION POND FLOWS
COPY    61 OUTPUT MEAN   1 1 12.1         WDM    101 FLOW     ENGL      REPL
RCHRES 552 HYDR   RO     1 1              WDM    102 FLOW     ENGL      REPL
RCHRES 451 HYDR   RO     1 1              WDM    105 FLOW     ENGL      REPL
```

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RCHRES 452 HYDR   RO     1 1              WDM    119 FLOW     ENGL      REPL
RCHRES  46 HYDR   RO     1 1              WDM    106 FLOW     ENGL      REPL
*** write RCHRES 47 (Inf. Area # 1)outlet 1 and 2 to WDM 107 and 108 like so:
COPY    62 OUTPUT MEAN   1 1 12.1         WDM    107 FLOW     ENGL      REPL
COPY    63 OUTPUT MEAN   1 1 12.1         WDM    108 FLOW     ENGL      REPL
COPY    66 OUTPUT MEAN   1 1 12.1         WDM    112 FLOW     ENGL      REPL
COPY    69 OUTPUT MEAN   1 1 12.1         WDM   1120 FLOW     ENGL      REPL
*** write SDW1a vault flows to WDM:
COPY    67 OUTPUT MEAN   1 1 12.1         WDM    109 FLOW     ENGL      REPL
COPY    68 OUTPUT MEAN   1 1 12.1         WDM   1090 FLOW     ENGL      REPL
*** write RCHRES 570 outlet 1 and 2 to WDM 110 and 115 like so:
RCHRES 570 HYDR   RO     1 1              WDM    210 FLOW     ENGL      REPL
COPY    64 OUTPUT MEAN   1 1 12.1         WDM    110 FLOW     ENGL      REPL
COPY    65 OUTPUT MEAN   1 1 12.1         WDM    115 FLOW     ENGL      REPL
COPY   357 OUTPUT MEAN   1 1 12.1         WDM    211 FLOW     ENGL      REPL
COPY    56 OUTPUT MEAN   1 1 12.1         WDM    121 FLOW     ENGL      REPL
*** write RCHRES 37 vault to WDM 111
RCHRES  37 HYDR   RO     1 1              WDM    111 FLOW     ENGL      REPL
RCHRES 237 HYDR   RO     1 1              WDM    122 FLOW     ENGL      REPL
RCHRES  43 HYDR   RO     1 1              WDM    103 FLOW     ENGL      REPL
COPY    44 OUTPUT MEAN   1 1 12.1         WDM    104 FLOW     ENGL      REPL
RCHRES  51 HYDR   RO     1 1              WDM    139 FLOW     ENGL      REPL
*** DETENTION STAGES
RCHRES  47 HYDR   STAGE                   WDM    652 STAG     ENGL      REPL
RCHRES 147 HYDR   STAGE                   WDM    657 STAG     ENGL      REPL
RCHRES 247 HYDR   STAGE                   WDM    654 STAG     ENGL      REPL
RCHRES 552 HYDR   STAGE                   WDM    601 STAG     ENGL      REPL
RCHRES  57 HYDR   STAGE                   WDM    651 STAG     ENGL      REPL
RCHRES 257 HYDR   STAGE                   WDM    655 STAG     ENGL      REPL
RCHRES 237 HYDR   STAGE                   WDM    656 STAG     ENGL      REPL
RCHRES  37 HYDR   STAGE                   WDM    650 STAG     ENGL      REPL
RCHRES  54 HYDR   STAGE                   WDM     61 STAG     ENGL      REPL
RCHRES 451 HYDR   STAGE                   WDM    662 STAG     ENGL      REPL
RCHRES 452 HYDR   STAGE                   WDM    667 STAG     ENGL      REPL
RCHRES  46 HYDR   STAGE                   WDM    663 STAG     ENGL      REPL
RCHRES  43 HYDR   STAGE                   WDM    664 STAG     ENGL      REPL
***RCHRES  44 HYDR   STAGE                   WDM    665 STAG     ENGL      REPL
RCHRES  51 HYDR   STAGE                   WDM    666 STAG     ENGL      REPL
*** DETENTION VOLUMES
RCHRES  47 HYDR   VOL                     WDM    752 VOL      ENGL      REPL
RCHRES 147 HYDR   VOL                     WDM    757 VOL      ENGL      REPL
RCHRES 247 HYDR   VOL                     WDM    754 VOL      ENGL      REPL
RCHRES 552 HYDR   VOL                     WDM    602 VOL      ENGL      REPL
RCHRES  57 HYDR   VOL                     WDM    751 VOL      ENGL      REPL
RCHRES 257 HYDR   VOL                     WDM    755 VOL      ENGL      REPL
RCHRES 237 HYDR   VOL                     WDM    756 VOL      ENGL      REPL
RCHRES  37 HYDR   VOL                     WDM    750 VOL      ENGL      REPL
RCHRES  54 HYDR   VOL                     WDM     62 VOL      ENGL      REPL
RCHRES 451 HYDR   VOL                     WDM    762 VOL      ENGL      REPL
RCHRES 452 HYDR   VOL                     WDM    767 VOL      ENGL      REPL
RCHRES  46 HYDR   VOL                     WDM    763 VOL      ENGL      REPL
RCHRES  43 HYDR   VOL                     WDM    764 VOL      ENGL      REPL
***RCHRES  44 HYDR   VOL                     WDM    765 VOL      ENGL      REPL
RCHRES  51 HYDR   VOL                     WDM    766 VOL      ENGL      REPL
*** POINT OF COMPLIANCE (POC) FLOWS
COPY    37 OUTPUT MEAN   1 1 12.1         WDM    125 FLOW     ENGL      REPL
COPY    45 OUTPUT MEAN   1 1 12.1         WDM    199 FLOW     ENGL      REPL
COPY    53 OUTPUT MEAN   1 1 12.1         WDM    399 FLOW     ENGL      REPL
COPY    70 OUTPUT MEAN   1 1 12.1         WDM   7000 FLOW     ENGL      REPL
COPY    71 OUTPUT MEAN   1 1 12.1         WDM   7001 FLOW     ENGL      REPL
*** SPECIAL PERLND REINFILTRATION RESULTS
  ***  --> output special PERLND parameters to check operations:
  ***  --> PERLND 47 active ground water storage depth (in)
PERLND  47 PWATER AGWS                    WDM    471 AGWS     ENGL      REPL
  ***  --> PERLND 47 active ground water outflow (acft/2ac -> in/acre)
COPY    47 OUTPUT MEAN   1 1 12           WDM    472 FLOW     ENGL      REPL
  ***  --> PERLND 57 active ground water storage depth (in)
PERLND  57 PWATER AGWS                    WDM    571 AGWS     ENGL      REPL
  ***  --> PERLND 57 active ground water outflow (acft/2ac -> in/acre)
COPY    57 OUTPUT MEAN   1 1 12           WDM    572 FLOW     ENGL      REPL
```

```
END EXT TARGETS

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
  *** SUB-CATCHMENT 1 all agwo goes to sound
PERLND  16                      3.41     RCHRES   1      6
PERLND  26                    232.36     RCHRES   1      6
PERLND  34                      3.07     RCHRES   1      6
PERLND  44                     38.03     RCHRES   1      6
PERLND  54                      3.87     RCHRES   1      6
IMPLND  14                     56.14     RCHRES   1      2
 *** SUB-CATCHMENT 2 10% of area GW goes to vaca 90% goes to sound
PERLND  16                      5.56     RCHRES   2      6
PERLND  26                    200.05     RCHRES   2      6
PERLND  34                      0.46     RCHRES   2      6
PERLND  44                     38.71     RCHRES   2      6
PERLND  16                      0.56     RCHRES 135      7
PERLND  26                     20.00     RCHRES 135      7
PERLND  34                      0.05     RCHRES 135      7
PERLND  44                      3.87     RCHRES 135      7
IMPLND  14                     42.22     RCHRES   2      2
 *** SUB-CATCHMENT 23 New subbasin 15 % OF GW GOES TO VACCA 85% TO SOUND
PERLND  16                      3.09     RCHRES  23      6
PERLND  26                    156.15     RCHRES  23      6
PERLND  34                      2.25     RCHRES  23      6
PERLND  44                     45.84     RCHRES  23      6
PERLND  16                      0.46     RCHRES 135      7
PERLND  26                     23.42     RCHRES 135      7
PERLND  34                      0.34     RCHRES 135      7
PERLND  44                      6.88     RCHRES 135      7
IMPLND  14                     58.44     RCHRES  23      2
 *** SUB-CATCHMENT 24 New subbasin 60 % OF GW GOES TO 11 40% TO SOUND
PERLND  26                    135.43     RCHRES  24      6
PERLND  34                      2.02     RCHRES  24      6
PERLND  44                     69.29     RCHRES  24      6
PERLND  26                     81.26     RCHRES  11      7
PERLND  34                      1.21     RCHRES  11      7
PERLND  44                     41.57     RCHRES  11      7
IMPLND  14                     79.98     RCHRES  24      2
  *** SUB-CATCHMENT 3 agwo goes to vaca(135)
PERLND  16                      8.26     RCHRES   3      6
PERLND  26                    108.38     RCHRES   3      6
PERLND  34                     16.02     RCHRES   3      6
PERLND  44                    102.89     RCHRES   3      6
PERLND  54                      0.04     RCHRES   3      6
PERLND  16                      8.26     RCHRES 135      7
PERLND  26                    108.38     RCHRES 135      7
PERLND  34                     16.02     RCHRES 135      7
PERLND  44                    102.89     RCHRES 135      7
PERLND  54                      0.04     RCHRES 135      7
IMPLND  14                     27.30     RCHRES   3      2
  *** SUB-CATCHMENT 4 10% of agwo goes to rchres 90% goes to sound
PERLND  16                      2.95     RCHRES   4      6
PERLND  26                     85.95     RCHRES   4      6
PERLND  34                      3.75     RCHRES   4      6
PERLND  44                     92.06     RCHRES   4      6
PERLND  16                      0.30     RCHRES   4      7
PERLND  26                      8.59     RCHRES   4      7
PERLND  34                      0.38     RCHRES   4      7
PERLND  44                      9.21     RCHRES   4      7
IMPLND  14                     18.43     RCHRES   4      2
  *** SUB-CATCHMENT 4a 70% of agwo goes to rchres 30% goes to sound
PERLND  16                      8.66     RCHRES   4      6
PERLND  26                     61.64     RCHRES   4      6
PERLND  34                     22.06     RCHRES   4      6
PERLND  44                     78.09     RCHRES   4      6
PERLND  54                     12.50     RCHRES   4      6
PERLND  16                      6.06     RCHRES   4      7
PERLND  26                     43.15     RCHRES   4      7
PERLND  34                     15.44     RCHRES   4      7
```

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PERLND  44                          54.66     RCHRES   4       7
PERLND  54                           8.75     RCHRES   4       7
IMPLND  14                          29.14     RCHRES   4       2
  *** SUB-CATCHMENT 5
PERLND  26                          10.29     RCHRES   5       1
PERLND  44                          50.05     RCHRES   5       1
PERLND  54                          10.74     RCHRES   5       1
IMPLND  14                          16.31     RCHRES   5       2
  *** SUB-CATCHMENT 6
PERLND  16                           1.42     COPY   645      26
PERLND  26                          20.38     COPY   645      26
PERLND  34                          13.44     COPY   645      26
PERLND  44                          11.79     COPY   645      26
PERLND  54                           0.82     COPY   645      26
PERLND  16                           1.42     RCHRES  53       7
PERLND  26                          20.38     RCHRES  53       7
PERLND  34                          13.44     RCHRES  53       7
PERLND  44                          11.79     RCHRES  53       7
PERLND  54                           0.82     RCHRES  53       7
IMPLND  14                           6.23     COPY   645      22
  *** SUB-CATCHMENT 8
PERLND  44                          22.21     RCHRES  35       1
IMPLND  14                           6.60     RCHRES  35       2
  *** SUB-CATCHMENT 9
PERLND  16                           4.98     RCHRES  34       1
PERLND  26                          14.38     RCHRES  34       1
PERLND  34                           0.05     RCHRES  34       1
PERLND  44                          56.71     RCHRES  34       1
PERLND  54                           0.01     RCHRES  34       1
IMPLND  14                          22.47     RCHRES  34       2
  *** SUB-CATCHMENT 10
PERLND  16                           4.15     RCHRES  10       1
PERLND  26                          31.94     RCHRES  10       1
PERLND  44                          95.22     RCHRES  10       1
IMPLND  14                          71.98     RCHRES  10       2
  *** SUB-CATCHMENT 11 25% OF AGWO GOES TO 15
PERLND  16                           0.89     RCHRES  11       6
PERLND  26                         217.92     RCHRES  11       6
PERLND  34                           1.32     RCHRES  11       6
PERLND  44                          65.65     RCHRES  11       6
PERLND  16                           0.67     RCHRES  11       7
PERLND  26                         163.44     RCHRES  11       7
PERLND  34                           0.99     RCHRES  11       7
PERLND  44                          49.24     RCHRES  11       7
PERLND  16                           0.22     RCHRES  15       7
PERLND  26                          54.48     RCHRES  15       7
PERLND  34                           0.33     RCHRES  15       7
PERLND  44                          16.41     RCHRES  15       7
IMPLND  14                         230.80     RCHRES  11       2
  *** SUB-CATCHMENT 12
PERLND  16                           0.39     RCHRES  12       1
PERLND  26                         101.18     RCHRES  12       1
PERLND  34                           5.64     RCHRES  12       1
PERLND  44                          54.98     RCHRES  12       1
PERLND  54                           0.64     RCHRES  12       1
IMPLND  14                          79.83     RCHRES  12       2
  *** SUB-CATCHMENT 13
PERLND  16                           0.79     RCHRES  13       1
PERLND  26                         197.68     RCHRES  13       1
IMPLND  14                          27.66     RCHRES  13       2
  *** SUB-CATCHMENT 14 50% OF AGWO GOES TO SOUND
PERLND  16                           0.24     RCHRES  14       6
PERLND  26                         118.67     RCHRES  14       6
PERLND  34                          13.46     RCHRES  14       6
PERLND  44                          41.91     RCHRES  14       6
PERLND  16                           0.12     RCHRES  14       7
PERLND  26                          59.34     RCHRES  14       7
PERLND  34                           6.73     RCHRES  14       7
PERLND  44                          20.95     RCHRES  14       7
IMPLND  14                          20.66     RCHRES  14       2
  *** SUB-CATCHMENT 15
```

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PERLND  16                          6.59     RCHRES  15      1
PERLND  26                         49.55     RCHRES  15      1
PERLND  34                         50.09     RCHRES  15      1
PERLND  44                         86.52     RCHRES  15      1
IMPLND  14                         19.47     RCHRES  15      2
  *** SUB-CATCHMENT 16
PERLND  16                         10.93     RCHRES  16      1
PERLND  26                         29.93     RCHRES  16      1
PERLND  34                         20.03     RCHRES  16      1
PERLND  44                         31.83     RCHRES  16      1
IMPLND  14                         15.58     RCHRES  16      2
  *** SUB-CATCHMENT 17 AGWO GOES TO SOUND
PERLND  16                          0.90     RCHRES  17      6
PERLND  26                         16.31     RCHRES  17      6
PERLND  34                         34.82     RCHRES  17      6
PERLND  44                         82.11     RCHRES  17      6
PERLND  54                          2.19     RCHRES  17      6
IMPLND  14                         10.49     RCHRES  17      2
  *** SUB-CATCHMENT MC-1
PERLND  26                          0.14     RCHRES  52      1
PERLND  44                          9.44     RCHRES  52      1
PERLND  45                          0.14     RCHRES  52      1
PERLND  54                          0.27     RCHRES  52      1
IMPLND  14                          1.98     RCHRES  52      2
  *** SUB-CATCHMENT MC-2
PERLND  16                          0.08     RCHRES  53      1
PERLND  26                          0.53     RCHRES  53      1
PERLND  34                          3.60     RCHRES  53      1
PERLND  44                          9.20     RCHRES  53      1
PERLND  45                          2.22     RCHRES  53      1
PERLND  54                         15.14     RCHRES  53      1
IMPLND  14                          2.54     RCHRES  53      2
  *** SUB-CATCHMENT MC-3
PERLND  34                          3.70     RCHRES  54      1
PERLND  44                          4.91     RCHRES  54      1
PERLND  45                          1.07     RCHRES  54      1
PERLND  54                          1.84     RCHRES  54      1
IMPLND  14                          1.42     RCHRES  54      2
  *** SUB-CATCHMENT MC-4
PERLND  34                          0.27     RCHRES 135      1
PERLND  44                         16.51     RCHRES 135      1
PERLND  45                          4.23     RCHRES 135      1
PERLND  54                         11.98     RCHRES 135      1
IMPLND  14                          3.31     RCHRES 135      2
  *** SUB-CATCHMENT MC-5
PERLND  26                         13.43     RCHRES  35      1
PERLND  44                         33.84     RCHRES  35      1
PERLND  54                          7.44     RCHRES  35      1
IMPLND  14                          0.02     RCHRES  35      2
  *** SUB-CATCHMENT MC-6
  ***  --> reduce by 2 acres to make special PERLND 47 for SDW1A
***PERLND  44                        14.10     RCHRES  35      1
PERLND  44                         12.10     RCHRES  35      1
PERLND  45                          0.09     RCHRES  35      1
PERLND  54                          0.90     RCHRES  35      1
IMPLND  14                          0.26     RCHRES  35      2
  ***  --> add 2 acres from special PERLND 47 for SDW1A
PERLND  47                          2.00     RCHRES  35      1
  ***  --> output outflow from special PERLND 47 (acft/ac)
PERLND  47                          1.00     COPY    47     21

  *** SUB-CATCHMENT MC-7
  ***  --> reduce by 2 acres to make special PERLND 57 for SDW1B
PERLND  26                         11.26     COPY    55     21
  ***  --> reduce by 2 acres to make special PERLND 57 for SDW1B
***PERLND  44                        31.80     COPY    55     21
  ***  --> add 2 acres from special PERLND 57 for SDW1B
PERLND  57                          2.00     COPY    55     21
  ***  --> output outflow from special PERLND 57 (acft/ac)
PERLND  57                          1.00     COPY    57     21
PERLND  44                         29.80     COPY    55     21
```

```
PERLND  54                      3.20     COPY     55      21
IMPLND  14                      0.03     COPY     55      22

***note: SDN AGWO TO VACCA FARMS (135)NOT TO PONDS

  *** SUB-CATCHMENT SDN-1
PERLND  26                      1.97     RCHRES 552       6
PERLND  44                      1.29     RCHRES 552       6
PERLND  54                      0.20     RCHRES 552       6
PERLND  26                      1.97     RCHRES 135       7
PERLND  44                      1.29     RCHRES 135       7
PERLND  54                      0.20     RCHRES 135       7
IMPLND  14                     12.68     RCHRES 552       2

  *** SUB-CATCHMENT SDN-1-LWR
PERLND  44                      4.79     RCHRES 552       6
PERLND  54                      0.07     RCHRES 552       6
PERLND  44                      4.79     RCHRES 135       7
PERLND  54                      0.07     RCHRES 135       7
IMPLND  14                      0.56     RCHRES 552       2

  *** SUB-CATCHMENT SDN-1-OFF
PERLND  26                     23.01     RCHRES  52       6
PERLND  44                      3.58     RCHRES  52       6
PERLND  54                      1.67     RCHRES  52       6
PERLND  26                     23.01     RCHRES 135       7
PERLND  44                      3.58     RCHRES 135       7
PERLND  54                      1.67     RCHRES 135       7
IMPLND  14                      8.00     RCHRES  52       2

  *** SUB-CATCHMENT SDN-2X (TO POND)
PERLND  26                      0.63     COPY     61      26
PERLND  44                      2.40     COPY     61      26
PERLND  45                      0.86     COPY     61      26
PERLND  26                      0.63     RCHRES 135       7
PERLND  44                      2.40     RCHRES 135       7
PERLND  45                      0.86     RCHRES 135       7
IMPLND  14                      0.36     COPY     61      22

  *** SUB-CATCHMENT SDN-3 (TO POND)
PERLND  26                     23.56     RCHRES  43       6
PERLND  26                     23.56     RCHRES 135       7
IMPLND  14                     24.30     RCHRES  43       2

  *** SUB-CATCHMENT SDN-3X (TO POND)
PERLND  26                      1.61     RCHRES  43       6
PERLND  45                     23.77     RCHRES  43       6
PERLND  26                      1.61     RCHRES 135       7
PERLND  45                     23.77     RCHRES 135       7

  *** SUB-CATCHMENT SDN-4 (TO POND)
PERLND  26                     15.75     COPY     44      26
PERLND  44                      1.31     COPY     44      26
PERLND  45                      0.99     COPY     44      26
PERLND  26                     15.75     RCHRES 135       7
PERLND  44                      1.31     RCHRES 135       7
PERLND  45                      0.99     RCHRES 135       7
IMPLND  14                     12.26     COPY     44      22

  *** SUB-CATCHMENT SDN-4X (TO POND)
PERLND  26                      1.92     COPY     44      26
PERLND  44                      0.75     COPY     44      26
PERLND  45                      8.31     COPY     44      26
PERLND  26                      1.92     RCHRES 135       7
PERLND  44                      0.75     RCHRES 135       7
PERLND  45                      8.31     RCHRES 135       7
IMPLND  14                      4.21     COPY     44      22

  *** SUB-CATCHMENT IWS-NCPS (TO POND)
PERLND  26                      4.78     RCHRES 242       6
PERLND  26                      4.78     RCHRES 135       7
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IMPLND  14                          30.93     RCHRES 242       2

  *** SUB-CATCHMENT IWS-NSMPS (TO POND)
PERLND  26                           2.69     RCHRES 240       6
PERLND  44                           1.97     RCHRES 240       6
PERLND  45                           0.01     RCHRES 240       6
PERLND  26                           2.69     RCHRES 135       7
PERLND  44                           1.97     RCHRES 135       7
PERLND  45                           0.01     RCHRES 135       7
IMPLND  14                           1.95     RCHRES 240       2

  *** SUB-CATCHMENT NEPL (TO POND)
PERLND  26                          10.00     RCHRES 452       6
PERLND  26                          10.00     RCHRES 135       7
IMPLND  14                           6.00     RCHRES 451       2
IMPLND  14                          26.29     RCHRES 452       2

  *** SUB-CATCHMENT CARGO (TO POND)
IMPLND  14                           8.12     RCHRES  46       2

  *** SUB-CATCHMENT SDN3AI (TO VAULT)
IMPLND  14                           5.87     RCHRES  37       2

  *** SUB-CATCHMENT SDN3AO (TO POND)
PERLND  26                           0.08     RCHRES 237       6
PERLND  44                           0.03     RCHRES 237       6
PERLND  45                          22.12     RCHRES 237       6
PERLND  26                           0.08     RCHRES 135       7
PERLND  44                           0.03     RCHRES 135       7
PERLND  45                          22.12     RCHRES 135       7
IMPLND  14                           2.35     RCHRES 237       2

  *** SUB-CATCHMENT SDW1O (TO POND)
PERLND  26                           4.28     RCHRES 247       6
PERLND  44                           0.69     RCHRES 247       6
PERLND  45                          32.44     RCHRES 247       6
PERLND  26                           4.28     RCHRES 135       7
PERLND  44                           0.69     RCHRES 135       7
PERLND  45                          32.44     RCHRES 135       7
IMPLND  14                           1.64     RCHRES 247       2

  *** SUB-CATCHMENT SDN1AI (TO VAULT)
IMPLND  14                          13.78     RCHRES 147       2

  *** SUB-CATCHMENT SDW1B (TO POND)
  *** AGWO TO 35, AS 57 IS D/S OF VACCA FARMS (135)
PERLND  26                          21.25     RCHRES 570       6
PERLND  44                           2.39     RCHRES 570       6
PERLND  45                          46.26     RCHRES 570       6
PERLND  26                          21.25     RCHRES  35       7
PERLND  44                           2.39     RCHRES  35       7
PERLND  45                          46.26     RCHRES  35       7
IMPLND  14                          26.95     RCHRES 570       2

  *** ADD SUB-CATCHMENT IWS-PRIMARY TO PREDEVELOPEMENT ONLY

***ROUTING FOR MILLER CREEK
 *** M1 TO M2 TO M3 TO STORAGE 50.  M4 TO M5 TO STORAGE 50
RCHRES   1                          RCHRES   2       4
RCHRES  23                          RCHRES  24       4
RCHRES  24                          RCHRES   3       3
RCHRES   2                          RCHRES   3       3
RCHRES   3                          RCHRES  33       3
RCHRES  33                          RCHRES  50       3
RCHRES   4                          RCHRES   5       4
RCHRES   5                          RCHRES  50       3
 *** PONDS TO 52, 53 & 54
RCHRES 242                          RCHRES 240       5
 *** OVERFLOW ONLY TO 61
RCHRES 240                          RCHRES  51       5
COPY    61                          RCHRES  51      12
```

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COPY    44                                  RCHRES  51      12
RCHRES  51                                  RCHRES  52       3
RCHRES  43                                  RCHRES  54       3
 *** 2 NEPL VAULTS* (FK-Changed to eliminate run-of-river tables)
RCHRES 451                                  COPY    45      11
RCHRES 452                                  COPY    45      11
COPY    45                                  COPY   645      10
COPY   645                                  RCHRES  53      12
RCHRES  46                                  RCHRES  53       3
 *** NEW STREAM REACH 52 TO LAKE REBA 53 TO RDF 54 (FK-changed to insert new POC at
Lake Reba)
RCHRES 552                                  RCHRES  52       3
RCHRES  52                                  RCHRES  53       3
RCHRES  53                                  COPY    53      11
COPY    53                                  RCHRES  54      12
RCHRES  50                                  RCHRES  54       3
 *** RDF 54 TO 35
RCHRES  54                                  RCHRES 135       3
<-Source->                  <--Area-->      <-Target->   MBLK    ***
<Name>   #                  <-factor->      <Name>   #   Tbl#    ***
 *** PONDS TO 34
RCHRES  37                                  COPY    37      11
RCHRES 237                                  COPY    37      11
COPY    37                                  RCHRES 135      12
 *** SDW1A flow to bypass added (FK, June 2001)
SDW1AI VAULT FLOW TO INFILTRATION 1                                 ***
RCHRES 147                                  RCHRES  47       4
SDW1AI VAULT FLOW TO BYPASS                                         ***
RCHRES 147                                  COPY    70      15
STORMWATER Q 1ST EXIT AT POND G (Bypass)                            ***
RCHRES 247                                  COPY    70      14
RCHRES 247                                  COPY    66      14
RCHRES 247                                  COPY    69      15
2ND EXIT TO INFILTRATION TANK-MILLER CREEK                          ***
RCHRES 247                                  RCHRES  47       5
STORMWATER Q 1ST EXIT TO BYPASS                                     ***
RCHRES  47                                  COPY    70      14
*** 2ND EXIT TO SOIL AND MILLER CREEK (2nd exit intr. as AGWLI)***
*** RCHRES  47                                  COPY    70      15
COPY BLOCK FOR OUTPUT PURPOSES                                      ***
RCHRES  47                                  COPY    62      14
RCHRES  47                                  COPY    63      15
RCHRES 147                                  COPY    67      14
RCHRES 147                                  COPY    68      15
COPY    70                                  RCHRES 135      12
RCHRES  34                                  RCHRES 135       4
RCHRES  34                                  RCHRES 135       5
RCHRES 135                                  RCHRES  35       3
RCHRES  10                                  RCHRES  16       3
 *** PONDS TO 35
 *** Configuration changed to flow splitter to Pond D and Infiltration Basin 3 (FK,
June 2001)
STORM Q - 1ST EXIT OF FLOW SPLITTER TO POND D                           ***
RCHRES 570                                  RCHRES  57       4
***INFILTRATION Q - 2ND EXIT OF FLOW SPLITTER TO SOIL                   ***
RCHRES 570                                  RCHRES 257       5
STORM Q EXIT OF POND D TO MILLER CREEK                                  ***
RCHRES  57                                  COPY    71      11
COPY BLOCK FOR OUTPUT PURPOSES                                      ***
RCHRES 570                                  COPY    64      14
RCHRES 570                                  COPY    65      15
RCHRES  57                                  COPY   357      11
RCHRES 257                                  COPY    56      14
RCHRES 257                                  COPY    71      14
*** RCHRES 257                                  COPY    71      15
COPY    71                                  RCHRES  35      12
RCHRES  35                                  COPY    55      11
COPY    55                                  RCHRES  16      12
RCHRES  11                                  RCHRES  15       3
RCHRES  13                                  RCHRES  12       4
RCHRES  13                                  RCHRES  12       5
```

```
RCHRES  12                                  RCHRES  15      3
RCHRES  16                                  RCHRES  15      3
RCHRES  14                                  RCHRES  17      3
RCHRES  15                                  RCHRES  17      3
END SCHEMATIC

NETWORK
***        <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
END NETWORK                                                                 ***

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                             ***
    1     Arbor Lake  M 1         2    1    1    1   62    0    0
    2     Arbor Ck -03710 M 2     1    1    1    1   62    0    0
    3     Arbor Ck   M 3          1    1    1    1   62    0    0
    4     Tub Lake   M 4          2    1    1    1   62    0    0
    5     Miller Ck SR518 M5      1    1    1    1   62    0    0
   10     Trib (0371G)   M 10     1    1    1    1   62    0    0
   11     M11 Ambaum Detention    1    1    1    1   62    0    0
   12     Trib(0354)  M 12        1    1    1    1   62    0    0
   13     Burien Lake M 13        2    1    1    1   62    0    0
   14     Trib (0353) M 14        1    1    1    1   62    0    0
   15     M/S U/S OF 17           1    1    1    1   62    0    0
   16     U/S OF 15 M/S           1    1    1    1   62    0    0
   17     GAGE                    1    1    1    1   62    0    0
   23     BASIN M23               2    1    1    1   62    0    0
   24     BASIN M24               1    1    1    1   62    0    0
   33     detention m3            1    1    1    1   62    0    0
   34     LORA LAKE               2    1    1    1   62    0    0
   35     D/S OF VACA FARM        1    1    1    1   62    0    0
   37     sdn3ai vault            1    1    1    1   62    0    0
   38     MC basins               1    1    1    1   62    0    0
***   39     SDN3A/SDW1A POC         1    1    1    1   62    0    0
   43     sdn3 pond               1    1    1    1   62    0    0
***   44     sdn4 pond               1    1    1    1   62    0    0
***   45     nepl poc                1    1    1    1   62    0    0
   46     cargo pond              1    1    1    1   62    0    0
   47     sdw1a infiltration      2    1    1    1   62    0    0
   50     sr 518                  1    1    1    1   62    0    0
   51     SDN2X+SDN4X             1    1    1    1   62    0    0
   52     U/S OF LAKE REBA        1    1    1    1   62    0    0
   53     Reba outflow            1    1    1    1   62    0    0
   54     Miller RDF outflow      1    1    1    1   62    0    0
   57     sdw1b pond              1    1    1    1   62    0    0
  135     VACA FARMS              1    1    1    1   62    0    0
  147     sdw1a vault             2    1    1    1   62    0    0
  237     sdn3ao-pond c           1    1    1    1   62    0    0
  240     iws-ncps                2    1    1    1   62    0    0
  242     iws-nsmps               2    1    1    1   62    0    0
  247     sdw1a pond g            2    1    1    1   62    0    0
  257     sdw1b infiltration      2    1    1    1   62    0    0
  451     nepl VAULT              1    1    1    1   62    0    0
  452     nepl VAULT              1    1    1    1   62    0    0
  552     SDN1 POC                1    1    1    1   62    0    0
  570     SDW1B flow splitter     2    1    1    1   62    0    0
***  645     nepl POC                1    1    1    1   62    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                 ***
    1  999    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
```

```
  1  999    5    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO

HYDR-PARM1
  RCHRES  Flags for each HYDR Section                                                    ***
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each      FUNCT  for each
          FG FG FG FG  possible  exit  *** possible  exit       possible  exit
           *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
  1        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
  2        0  0  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  3        0  0  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
  4        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
  5   12   0  0  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 13        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 14   22   0  0  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 23        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 24   33   0  0  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 34        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 35   46   0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
 47        0  1  0  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
 48  146   0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
147        0  1  1  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
148  239   0  1  1  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
240  257   0  1  1  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
258  552   0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
553  570   0  1  1  0    4  5  0  0  0       0  0  0  0  0        2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2
  RCHRES                                                                                 ***
  # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50                     ***
<------><--------><--------><--------><--------><--------><-------->                     ***
  1             1   0.010                              0.3
  2             2   0.776                              0.3
  3             3   0.980                              0.3
  4             4   0.010                              0.3
  5             5   0.380                              0.3
 10            10   0.380                              0.3
 11            11   0.010                              0.3
 12            12   1.000                              0.3
 13            13   0.015                              0.3
 14            14   0.450                              0.3
 15            15   0.735                              0.3
 16            16   0.587                              0.3
 17            17   0.379                              0.3
 23            23   0.379                  0.0         0.3
 24            24   0.379                              0.3
 33            33   0.200                              0.3
 34            34   0.852                              0.3
 35            35   0.663                              0.3
 37            37   0.010                  0.0         0.3
 38            38   0.010                              0.3
 43            43   0.010                              0.3
 46            46   0.010                              0.3
 47            47   0.010                  0.0         0.3
 50            50   0.010                              0.3
 51            51   0.010                              0.3
 52            52   0.010                              0.3
 53            53   0.010                              0.3
 54            54   0.010                  0.0         0.3
 57            57   0.010                  0.0         0.3
135           135   0.350                              0.3
147           147   0.010                              0.3
237           237   0.010                  0.0         0.3
240           240   0.010                              0.3
242           242   0.010                              0.3
247           247   0.010                  0.0         0.3
257           257   0.010                  0.0         0.3
451           451   0.010                  0.0         0.3
452           452   0.010                  0.0         0.3
552           552   0.010                  0.0         0.3
```

```
570             570   0.010                  0.0         0.3
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                          ***
  # -  # ***   VOL      Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft      for each possible exit        for each possible exit
<------><--------->     <---><---><---><---><---> *** <---><---><---><---><--->
  1      2.0               4.0  5.0
  2      0.0               4.0
  3      0.0               4.0
  4      2.0               4.0  5.0
  5      0.0               4.0
 10      0.0               4.0
 11      0.0               4.0
 12      0.0               4.0
 13      10.0              4.0  5.0
 14      0.0               4.0
 15      0.0               4.0
 16      0.0               4.0
 17      0.0               4.0
 23      6.0               4.0  5.0
 24      0.0               4.0
 33      0.0               4.0
 34      9.0               4.0  5.0
 35      0.1               4.0
 37      0.0               4.0
 38      0.1               4.0
 43      0.0               4.0
 46      0.0               4.0
 47      0.0               4.0  5.0
 50      0.0               4.0
 51      0.0               4.0
 52      0.0               4.0
 53      0.1               4.0
 54      2.25              4.0
 57      0.0               4.0
237      0.00              4.0
147      0.00              4.0  5.0
135      0.00              4.0
240      0.0               4.0  5.0
242      0.0               4.0  5.0
247      0.0               4.0  5.0
257      0.0               4.0  5.0
451      0.0               4.0
452      0.0               4.0
552      0.0               4.0
570      0.0               4.0  5.0
  END HYDR-INIT
END RCHRES

FTABLES
***UPPER BASIN
***===========

  FTABLE      1
           *** REVISED 8/16/00 ADDED 2ND OUTFLOW
 ROWS COLS ***
   11    5
     DEPTH      AREA     VOLUME    OUTFLOW OUTFLOW2***
      0.00      3.00      0.00       0.00    0.00
      2.50      3.00      7.50       0.00    0.11
      3.00      3.00      9.00       1.80    0.11
      3.50      3.30     10.58       5.00    0.11
      4.00      3.60     12.30      10.90    0.11
      4.50      3.90     14.18      17.50    0.11
      5.00      4.10     16.18      26.20    0.11
      5.50      4.30     18.28      32.50    0.11
      6.00      4.50     20.48      35.90    0.11
      7.00      5.00     25.23      38.10    0.11
      8.00      5.50     30.48      46.40    0.11
```

END FTABLE 1

FTABLE 2
ROWS COLS ***
9 4

DEPTH	AREA	VOLUME	OUTFLOW	***
0.000	0.0000	0.0000	0.00	
0.100	0.2571	0.0129	0.16	
0.500	0.3873	0.1417	6.53	
1.000	0.5501	0.3761	25.95	
1.500	0.7128	0.6918	59.86	
2.000	0.8756	1.0889	110.67	
3.000	1.2011	2.1273	272.24	
3.500	1.3639	2.7685	387.38	
4.000	1.5266	3.4912	528.19	

END FTABLE 2

FTABLE 3
ROWS COLS ***
12 4

DEPTH	AREA	VOLUME	OUTFLOW	***
0.000	0.0000	0.0000	0.00	
0.100	0.9669	0.0483	0.13	
0.500	1.0637	0.4545	4.92	
1.000	1.1846	1.0165	17.12	
1.500	1.3055	1.6390	34.92	
2.000	1.4264	2.3220	57.95	
2.500	1.5473	3.0654	86.14	
3.000	1.6682	3.8693	119.53	
3.500	1.7891	4.7336	158.24	
4.000	1.9100	5.6584	202.41	
4.500	2.0294	6.6310	251.52	
5.000	2.1488	7.6624	306.28	

END FTABLE 3

FTABLE 4
*** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
7 5

DEPTH	AREA	VOLUME	OUTFLOW	OUTFLOW2***
0.00	3.00	0.00	0.00	0.00
2.50	4.50	9.38	0.00	0.11
3.00	6.00	12.00	6.00	0.11
4.00	10.00	20.00	13.00	0.11
5.00	15.00	32.50	20.00	0.11
6.00	20.00	50.00	26.00	0.11
7.00	25.00	72.50	168.00	0.11

END FTABLE 4

FTABLE 5
ROWS COLS ***
10 4

DEPTH	AREA	VOLUME	OUTFLOW	***
0.000	0.0000	0.0000	0.00	
0.100	0.1010	0.0051	0.03	
0.500	0.1754	0.0603	1.46	
1.000	0.2684	0.1713	6.16	
1.500	0.3614	0.3288	14.89	
2.000	0.4544	0.5327	28.48	
2.500	0.5474	0.7832	47.70	
3.000	0.6404	1.0801	73.29	
3.500	0.7334	1.4236	105.94	
4.000	0.8264	1.8136	146.33	

END FTABLE 5

FTABLE 10
ROWS COLS ***
9 4

DEPTH	AREA	VOLUME	OUTFLOW	***
0.000	0.0000	0.0000	0.00	
0.100	0.1010	0.0051	0.06	

```
    0.500     0.1660     0.0585      2.27
    1.000     0.2472     0.1618      9.32
    1.500     0.3285     0.3057     22.08
    2.000     0.4097     0.4902     41.66
    2.500     0.4909     0.7154     69.09
    3.000     0.5722     0.9811    105.37
    4.000     0.6887     1.6116    209.70
 END FTABLE 10

 POST AMBAUM DETENTION ***
 FTABLE     11
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    1.000     0.1000     0.2300       3.90
    2.000     0.2000     0.6000       6.30
    3.000     0.3000     0.9700       8.10
    4.000     0.4000     1.3400      11.10
    5.000     0.5000     1.8200      16.00
    6.000     0.6000     2.2700      19.10
    7.000     0.7000     2.8300      21.60
    8.000     0.8000     3.3700      30.80
    9.000     0.9000     4.0000      38.10
   10.000     1.0000     4.6500      74.10
   10.500     1.1000     5.2000     133.00
   11.000     1.1500     6.0000     500.00
   11.500     1.3000     11.000    1300.00
 END FTABLE 11

 FTABLE     12
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.6327     0.0316       0.15
    0.500     0.7960     0.3174       5.87
    1.000     1.0002     0.7664      21.53
    1.500     1.2043     1.3176      46.43
    2.000     1.4085     1.9708      81.20
    3.000     1.8168     3.5834     183.79
    4.000     2.2251     5.6044     336.22
    5.000     2.6335     8.0337     545.30
    6.000     3.0418    10.8713     817.51
 END FTABLE 12

 FTABLE     13
         *** REVISED 8/16/00 ADDED 2ND OUTFLOW
ROWS COLS ***
   7    5
    DEPTH       AREA     VOLUME    OUTFLOW OUTFLOW2***
    0.000     40.000     0.0000       0.00     0.00
    1.000     41.400     40.000       0.00     0.11
    1.500     42.000     60.000      10.00     0.11
    2.000     42.700     80.000      16.00     0.11
    2.500     43.300     100.00      20.00     0.11
    3.000     44.000     120.00      28.00     0.11
    5.000     45.000     210.00      45.00     0.11
 END FTABLE 13

 FTABLE     14
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3361     0.0168       0.24
    0.500     0.3809     0.1602       9.04
    1.000     0.4370     0.3647      31.61
    1.500     0.4930     0.5972      65.00
    2.000     0.5491     0.8577     108.85
    2.500     0.6051     1.1462     163.33
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   3.000    0.6612    1.4628    228.78
 END FTABLE 14

 FTABLE     15
ROWS COLS ***
   4    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
     0.00      0.10      0.00      0.00
     1.00      1.00      0.55     91.00
     2.00      1.10      1.60    268.00
     3.00      1.20      2.75    493.00
 END FTABLE 15

 FTABLE     16
ROWS COLS ***
   4    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
     0.00      0.10      0.00      0.00
     1.00      1.00      0.55     74.00
     2.00      1.10      1.60    219.00
     3.00      1.20      2.75    403.00
 END FTABLE 16

 FTABLE     17
ROWS COLS ***
   5    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
     0.00      0.10      0.00      0.00
     1.00      1.00      0.55     59.00
     2.00      1.10      1.60    173.00
     3.00      1.20      2.75    318.00
     4.00      1.30      4.00    484.00
 END FTABLE 17

 FTABLE     23
ROWS COLS ***  HERMES
   9    5
    DEPTH      AREA    VOLUME   OUTFLOW OUTFLOW  ***
     0.00      0.00      0.00      0.00    0.00        0.00
     5.00      0.50      1.91      0.00    0.00      305.00
    11.00      0.79      5.79      0.00    0.00      311.00
    15.00      1.13      9.64      0.50    0.01      315.00
    19.00      1.72     15.34      0.50    0.05      319.00
    29.00      2.86     38.25      0.50    0.10      329.00
    39.00      4.40     74.55      0.50    0.20      339.00
    50.00      6.22    132.98      0.50    0.30      350.00
    60.00     10.00   1212.98      0.50    0.40      360.00
 END FTABLE 23

 FTABLE     24
ROWS COLS ***
   9    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
    0.000    0.0000    0.0000      0.00
    0.100    0.2571    0.0129      0.16
    0.500    0.3873    0.1417      6.53
    1.000    0.5501    0.3761     25.95
    1.500    0.7128    0.6918     59.86
    2.000    0.8756    1.0889    110.67
    3.000    1.2011    2.1273    272.24
    3.500    1.3639    2.7685    387.38
    4.000    1.5266    3.4912    528.19
 END FTABLE 24

 FTABLE     33
ROWS COLS ***
  11    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
     0.00      1.00      0.00      0.00
     0.50      1.20      0.55      2.00
     1.00      1.40      1.20      6.00
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     1.50      1.60      1.95      9.00
     2.00      1.80      2.80     13.00
     2.50      2.00      3.75     16.50
     3.00      2.20      4.80     20.00
     3.50      2.40      5.95     23.00
     4.00      2.60      7.20     26.00
     5.00      2.80      9.90    104.00
     6.00      3.00     12.80    246.00
 END FTABLE 33

 FTABLE      34
ROWS COLS *** REVISED 11/19/97 BASED ON HEC-RAS MODEL
          *** REVISED 8/16/00 ADDED 2ND OUTFLOW
   6    5
    DEPTH       AREA     VOLUME   OUTFLOW OUTFLOW2***
     0.00       3.00      0.00      0.00    0.00
     3.00       3.05      9.08      0.00    0.11
     4.00       3.10     12.15      0.00    0.11
     5.00       3.15     15.28      0.00    0.11
     6.00       3.20     18.45      72.0    0.11
     7.00       3.25     21.68     225.0    0.11
 END FTABLE 34

 FTABLE      35
ROWS COLS *** REVISED 11/19/97 BASED ON HECRAS MODEL
   5    4
    DEPTH       AREA     VOLUME   OUTFLOW  ***
     0.00      0.10      0.00      0.00
     1.00      1.10      0.60     38.00
     2.00      1.20      1.75    108.00
     3.00      1.30      3.00    194.00
     4.00      1.40      4.35    290.00
 END FTABLE 35


 FTABLE      38
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME   OUTFLOW  ***
    0.000     0.0000    0.0000      0.00
    1.000     0.4000    0.4000      2.00
    1.500     0.5000    1.0000      4.00
    2.000     0.9000    1.3000     11.00
    2.500     1.3000    1.6000     15.00
    3.000     1.6000    2.0000     18.00
    3.500     1.9000    2.5000     20.80
 END FTABLE 38

 FTABLE      45
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME   OUTFLOW  ***
    0.000     0.0010    0.0000      0.00
    0.000     0.0100    0.0100     10.00
    0.100     0.1000    0.1000    100.00
    1.000     1.0000    1.0000   1000.00
   10.000    10.0000   10.0000  10000.00
 END FTABLE 45

 FTABLE     645
ROWS COLS ***
   4    4
    DEPTH       AREA     VOLUME   OUTFLOW  ***
    0.000     0.0010    0.0000      0.00
    0.000     0.0100    0.0100     10.00
    0.100     0.1000    0.1000    100.00
    1.000     1.0000    1.0000   1000.00
   10.000    10.0000   10.0000  10000.00
 END FTABLE645

 FTABLE      50
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ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       1.00       0.00       0.00
     0.50       1.10       0.53       5.00
     1.00       1.20       1.10      15.00
     1.50       1.30       1.73      25.00
     2.00       1.40       2.40      35.00
     2.50       1.50       3.13      52.00
     3.00       1.60       3.90      70.00
     3.50       1.70       4.73      87.00
     4.00       1.80       5.60     105.00
     6.00       1.90       9.30     165.00
 END FTABLE 50

 FTABLE     52
ROWS COLS ***
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3680     0.0184       0.25
    0.500     0.3717     0.1664       9.39
    1.000     0.3763     0.3534      31.06
    2.000     0.3819     0.7325      94.37
    3.000     0.3874     1.1171     174.33
 END FTABLE 52

 FTABLE    552
ROWS COLS ***  SDN1 VAULT EFFECTIVE DEPTH=12 FT  RISER=24 INCHES
  15    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.4308     0.0000       0.00
    1.290     0.4308     0.6520      0.111
    2.130     0.4308     1.0760      0.143
    3.530     0.4308     1.7830      0.184
    4.640     0.4308     2.3430      0.211
    5.200     0.4308     2.6260      0.223
    6.320     0.4308     3.1920      0.246
    7.430     0.4308     3.7530      0.267
    8.200     0.4308     4.1410      0.280
    9.220     0.4308     4.6570      0.407
   10.190     0.4308     5.1460      0.567
   11.250     0.4308     5.6820      0.954
   12.100     0.4308     6.1110      2.130
   12.300     0.4308     6.2120      4.730
   13.700     0.4308     6.9190     21.360
 END FTABLE552

 FTABLE     53
OLD LAKE REBA                                  ***
MAX DEPTH = 4.9 FEET                           ***
30" CMP, 40 CFS DISCHARGE AT MAX DEPTH         ***
ROWS COLS ***
   7    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     2.4000     0.0000       0.00
    1.000     2.5800     2.5000      18.00
    2.000     2.9400     5.3000      26.00
    3.000     3.4100     8.4000      31.00
    4.000     3.8800     12.100      36.00
    4.900     4.3000     15.800      40.00
    6.000     4.3000     15.810     500.00
 END FTABLE 53

 FTABLE     54
EXISTING MILLER CREEK DETENTION FACILITY*** REVISED STORAGE/Q DATA
GATE SETTING: 2.0 FEET***  BASED ON CALIBRATION FILE
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000       0.00       0.00       0.00
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    1.300       0.01       0.01      10.00
    2.000       0.01       0.02      20.00
    2.900       0.70       0.40      30.00
    4.000       1.50       1.50      40.00
    5.400       3.50       4.90      50.00
    7.000       8.60      13.30      60.00
    8.800      15.60      34.80      70.00
   10.000      19.90      57.30      76.00
   10.500      21.50      68.00      92.00
   11.000      23.10      78.80     179.00
   11.500      24.70      88.60     303.00
 END FTABLE 54

 FTABLE    104
MILLER CREEK DETENTION FACILITY*** WITH ADD'L AREA 1+AREA 2 55.5 ACFT @ 10FT
GATE SETTING: 2.0 FEET*** EXISTING OUTLET NO LOW FLOW CONTROL
ROWS COLS ***
  17    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.500     0.0100     0.0100       2.50
    1.500     0.0300     0.2800      14.29
    2.500     1.1100     1.3900      24.88
    3.500     2.6100     4.0000      34.51
    4.500     4.6100     9.1400      43.20
    5.500     7.1200     19.600      50.98
    6.000     8.3600     21.180      54.53
    6.500     11.870     30.060      57.87
    7.000     15.370     38.930      61.00
    7.500     18.870     47.800      63.91
    8.000     21.860     59.160      66.62
    8.500     24.850     70.510      69.12
    9.000     27.340     84.160      71.42
    9.500     29.820     97.820      73.53
   10.000     32.050     112.83      75.44
   10.500     34.275     127.84      90.74
   11.500     38.220     161.54     320.00
 END FTABLE104

 FTABLE     69
PRE-MILLER CREEK DETENTION FACILITY***
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
    0.000     0.0000     0.0000       0.00
    0.100     0.1860     0.0093       0.12
    0.500     0.2552     0.0975       4.84
    1.000     0.3417     0.2467      18.49
    1.500     0.4282     0.4392      41.30
    2.000     0.5148     0.6750      74.40
    2.500     0.6013     0.9540     119.01
    3.000     0.6878     1.2763     176.30
    3.500     0.7744     1.6418     247.41
    4.000     0.8609     2.0506     333.43
    4.500     0.9470     2.4992     434.59
    5.000     1.0331     2.9905     552.33
 END FTABLE 69

*** PROJECT CONDITION PONDS/VAULTS
 FTABLE    452
ROWS COLS ***
*** NEW NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
*** PARALLEL VAULT BASED ON KCRTS EFFECTIVE DEPTH=20 FT
  20    4
    DEPTH       AREA     VOLUME    OUTFLOW ***
    0.00       3.214      0.000      0.000
    1.11       3.214      0.826      0.129
    1.57       3.214      1.168      0.154
    3.43       3.214      2.551      0.227
    4.83       3.214      3.593      0.269
    8.08       3.214      6.010      0.348
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   10.41      3.214     7.743     0.395
   12.74      3.214     9.476     0.437
   14.00      3.214    10.413     0.458
   14.65      3.214    10.897     0.557
   16.09      3.214    11.968     0.665
   16.23      3.214    12.072     0.754
   17.92      3.214    13.329     1.140
   18.22      3.214    13.552     1.310
   18.81      3.214    13.991     1.860
   19.11      3.214    14.214     2.190
   20.00      3.214    14.876     3.350
   20.20      3.214    15.025     5.110
   20.70      32.14    15.397    14.820
   21.00      32.14    15.620    18.560
 END FTABLE452

 FTABLE    451
ROWS COLS ***
*** NORTH EMPLOYEE PARKING LOT VAULT (NEPL)
*** EXISTING VAULT W/MODIFIED OUTLET   EFFECTIVE DEPTH= 18.0 FT
  14    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
    0.000    0.2240     0.0000      0.00
    2.170    0.2240     0.4860     0.031
    4.260    0.2240     0.9550     0.043
    5.930    0.2240     1.3290     0.051
    8.030    0.2240     1.8000     0.059
   10.120    0.2240     2.2680     0.066
   12.210    0.2240     2.7360     0.073
   14.040    0.2240     3.1460     0.109
   15.510    0.2240     3.4760     0.166
   16.220    0.2240     3.6350     0.295
   18.000    0.2240     4.0340     1.080
   18.400    0.2240     4.1240     5.400
   19.000    0.2240     4.2580    12.680
   19.900    0.2240     4.4600    17.080
 END FTABLE451


 FTABLE     46
ROWS COLS ***
SDN-6: 24TH STREET CARGO VAULT ***  EFFECTIVE DEPTH=14 FT RISER DIA=12 IN
  20    4
    DEPTH      AREA     VOLUME    OUTFLOW  ***
     0.00      0.35      0.000      0.000
     0.37      0.35      0.131      0.021
     1.19      0.35      0.421      0.037
     3.39      0.35      1.198      0.063
     5.03      0.35      1.778      0.077
     7.23      0.35      2.556      0.092
     9.15      0.35      3.235      0.104
    10.25      0.35      3.624      0.110
    10.53      0.35      3.723      0.111
    10.92      0.35      3.861      0.128
    12.00      0.35      4.242      0.165
    12.13      0.35      4.288      0.190
    12.95      0.35      4.578      0.245
    13.77      0.35      4.868      0.282
    14.00      0.35      4.949      0.291
    14.10      0.35      4.985      0.910
    14.20      0.35      5.020      2.040
    14.30      0.35      5.056      3.500
    14.50      0.35      5.126      7.200
    14.70      0.35      5.197     11.720
 END FTABLE 46


*** SDW-1A: 3RD RUNWAY POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE     47
  *** PROJECT  SDW1A    EFFECTIVE DIAMETER=3.0 FT
 ROWS COLS ***          INFILTRATION TANK TO OBTAIN 0.3 CFS
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  14    5
    DEPTH      AREA      VOLUME      STORMQ   INFILTRQ ***
    0.000     0.000      0.000       0.000     0.000
    0.250     0.002      0.002       0.000     0.027
    0.500     0.004      0.004       0.000     0.054
    1.000     0.012      0.012       0.000     0.109
    1.500     0.020      0.020       0.000     0.164
    2.000     0.029      0.029       0.000     0.218
    2.500     0.036      0.036       0.000     0.272
    3.000     0.041     0.0406       0.000     0.327
    3.100     0.041     0.0419       0.596     0.338
    3.200     0.041     0.0420       1.685     0.349
    3.300     0.041     0.0421       3.096     0.360
    3.400     0.041     0.0422       4.766     0.371
    3.500     0.041     0.0423       6.661     0.382
    3.750     0.041     0.0424      12.237     0.409
 END FTABLE 47

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE    147
  *** PROJECT  SDW1A   EFFECTIVE DEPTH=14.0 FT RISER DIA 24 INCHES
 ROWS COLS ***         VAULT BASED ON INFILTRATION=0.15CFS
   17    5
    DEPTH      AREA      VOLUME    INFILTRQ   BYPASS Q***
    0.000     0.689      0.000      0.0000     0.0000
    0.010     0.689      0.007      0.1400     0.0000
    1.000     0.689      0.689      0.1408     0.0000
    2.000     0.689      1.377      0.1417     0.0000
    4.000     0.689      2.755      0.1432     0.0000
    6.000     0.689      4.132      0.1446     0.0000
    8.000     0.689      5.510      0.1461     0.0000
   10.000     0.689      6.887      0.1475     0.0000
   12.000     0.689      8.264      0.1489     0.0000
   14.000     0.689      9.642      0.1503     0.0000
   16.000     0.689     11.019      0.1517     0.0000
   16.750     0.689     11.536      0.1517    10.7600
   16.900     0.689     11.639      0.1517    13.9600
   17.000     0.689     11.708      0.1517    16.1000
   17.100     0.689     11.777      0.1517    18.5700
   17.300     0.689     11.915      0.1517    23.8600
   18.000     0.689     12.397      0.1517    45.5400
  END FTABLE147

*** SDW-1A: 3RD RUNWAY NORTH POND G TO MILLER CREEK (LEVEL 2): ***
  FTABLE    247
  *** PROJECT  SDW1A   EFFECTIVE DEPTH=12.0 FT RISER DIA 12 INCHES
 ROWS COLS ***         POND BASED ON INFILTRATION=0.15CFS
   17    5
    DEPTH      AREA      VOLUME      STORMQ   INFILTRQ ***
    0.000     1.300      0.000        0.00      0.00
    0.010     1.310      0.010       0.001      0.15
    1.000     1.320      1.320       0.007      0.15
    2.000     1.342      2.650       0.010      0.15
    3.000     1.363      4.000       0.012      0.15
    4.000     1.385      5.370       0.013      0.15
    5.000     2.672      8.000       0.015      0.15
    6.000     2.739     10.700       0.017      0.15
    7.000     2.807     13.470       0.018      0.15
    8.000     2.876     16.300       0.019      0.15
    8.300     2.896     17.176       0.031      0.15
    9.000     2.945     19.210       0.041      0.15
   10.000     3.014     22.180       0.051      0.15
   11.000     3.084     25.228       0.058      0.15
   11.100     3.092     25.540       0.675      0.15
   11.300     3.106     26.162       3.260      0.15
   12.000     3.155     28.340      15.190      0.15
  END FTABLE247

*** SDN3A: 3RD RUNWAY VAULT TO MILLER CREEK (LEVEL 2): ***
  FTABLE     37
  *** PROJECT C SDN3A    EFFECTIVE DEPTH=11.0FT RISER DIA=24 INCHES
```

```
ROWS COLS ***            VAULT BASED ON IMPERVIOUS TOP SURO
  14    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000      0.644      0.000     0.000
    0.010      0.644      0.006     0.001
    1.000      0.644      0.643     0.016
    3.980      0.644      2.558     0.033
    6.030      0.644      3.876     0.041
    9.010      0.644      5.792     0.050
    10.00      0.644      6.428     0.052
    10.46      0.644      6.724     0.072
    11.00      0.644      7.071     0.082
    11.10      0.644      7.135     0.699
    11.20      0.644      7.199     1.830
    11.30      0.644      7.264     3.290
    11.40      0.644      7.328     5.020
    11.60      0.644      7.456     9.140
 END FTABLE 37

*** SDN3A: 3RD RUNWAY POND C TO MILLER CREEK (LEVEL 2): ***
  FTABLE    237
  *** PROJECT C SDN3A     EFFECTIVE DEPTH= 9.0FT RISER DIA=24 INCHES
 ROWS COLS ***            POND BASED ON INTERFLOW AND. PERVIOUS TOP SURO
  19    4
    DEPTH       AREA     VOLUME    OUTFLOW    ***
    0.000     1.3090      0.000       0.00
    0.020     1.3120      0.026      0.009
    1.020     1.3550      1.358      0.070
    2.070     1.4030      2.806      0.100
    3.130     1.4530      4.320      0.123
    4.020     1.4980      5.632      0.139
    5.070     1.5460      7.229      0.156
    7.750     1.6720     11.549      0.193
    7.800     1.6800     11.633      0.199
    7.850     1.6840     11.718      0.213
    8.250     1.7050     12.395      0.249
    8.340     1.7090     12.549      0.270
    8.570     1.7210     12.944      0.313
    8.950     1.7410     13.601      0.354
    9.500     1.7690     14.567      0.399
    9.600     1.7740     14.744      0.714
    9.800     1.7850     15.100      2.020
   10.300     1.8110     15.999      3.840
   10.900     1.8430     17.095      4.960
 END FTABLE237

*** SDN-3X: 3RD RUNWAY NORTH VAULT (LEVEL 2): ***
  FTABLE     43
 ROWS COLS ***        EFFECTIVE DEPTH=20 FT RISER DIA=24 INCHES
  21    4
    DEPTH       AREA     VOLUME     FLOW                                    ***
     (FT)    (ACRES)  (ACRE-FT)   (FT3/S)                                   ***
     0.00      1.288       0.00      0.00
     0.14      1.288      0.180     0.067
     1.39      1.288      1.790     0.216
     3.35      1.288      4.314     0.336
     5.31      1.288      6.839     0.423
     8.06      1.288     10.380     0.521
     8.84      1.288     11.385     0.545
    10.02      1.288     12.905     0.580
    11.98      1.288     15.429     0.635
    12.37      1.288     15.931     0.645
    14.00      1.288     18.030     0.686
    14.10      1.288     18.159     0.705
    14.91      1.288     19.202     0.757
    16.09      1.288     20.722     0.810
    18.00      1.288     23.182     0.881
    18.32      1.288     23.594     1.150
    18.76      1.288     24.161     1.360
    20.00      1.288     25.758     1.680
    20.10      1.288     25.886     2.320
```

```
    20.50     1.288    26.402     8.620
    20.80     1.288    26.788    15.370
 END FTABLE 43

*** SDN-4X/2X: 3RD RUNWAY NORTH VAULT      (COMBINED FACILITY)
 FTABLE     51
ROWS COLS ***       EFFECTIVE DEPTH=19FT RISER DIA=24 INCHES
  20    4
    DEPTH      AREA    VOLUME    OUTFLOW                                  ***
     (FT)   (ACRES) (ACRE-FT)   (FT3/S)                                  ***
     0.00     0.789     0.000     0.000
     0.16     0.789     0.126     0.056
     1.51     0.789     1.192     0.169
     3.28     0.789     2.588     0.249
     5.49     0.789     4.332     0.322
     7.26     0.789     5.729     0.370
    10.35     0.789     8.168     0.442
    12.12     0.789     9.564     0.478
    13.44     0.789    10.606     0.503
    14.33     0.789    11.308     0.520
    15.57     0.789    12.287     0.654
    16.72     0.789    13.194     0.828
    17.19     0.789    13.565     0.950
    17.63     0.789    13.913     1.030
    18.00     0.789    14.205     1.080
    19.00     0.789    14.994     1.960
    19.10     0.789    15.073     2.580
    19.40     0.789    15.309     6.930
    19.60     0.789    15.467    11.080
    20.00     0.789    15.783    17.190
 END FTABLE 51

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
 FTABLE     57
ROWS COLS ***     EFFECTIVE DEPTH = 14.0 FT
  17    4
    DEPTH      AREA    VOLUME    STORMQ    ***
     (FT)   (ACRES) (ACRE-FT)   (FT3/S)    ***
     0.00     2.430     0.000     0.000
     0.01     2.430     0.041     0.010
     1.00     2.680     2.411     0.183
     2.00     2.760     4.860     0.257
     3.00     2.818     7.370     0.319
     4.00     3.079     9.945     0.366
     5.00     5.832    15.320     0.411
     6.00     5.927    20.742     0.450
     7.00     6.022    26.264     0.481
     8.00     6.118    31.888     0.518
     9.00     6.210    37.613     0.550
    10.00     6.311    43.441     0.583
    11.00     6.408    49.372     0.609
    12.00     6.607    55.406     0.634
    13.00     6.405    61.543     0.764
    14.00     6.504    67.786     1.320
    15.00     7.000    70.000    16.600
 END FTABLE 57

*** SDW-1B:3RD RUNWAY CENTRAL SOUTH POND D TO MILLER CREEK (LEVEL 2): ***
 FTABLE    257
 *** PROJECT  SDW1B   EFFECTIVE DIAMETER=3.0 FT
ROWS COLS ***         INFILTRATION TANK TO OBTAIN 0.2 CFS
  15    5
    DEPTH      AREA    VOLUME     STORMQ  INFILTRQ ***
    0.000     0.001     0.000     0.000     0.000
    0.010     0.001     0.001     0.000     0.002
    0.250     0.002     0.002     0.000     0.017
    0.500     0.004     0.004     0.000     0.035
    1.000     0.012     0.012     0.000     0.071
    1.500     0.020     0.020     0.000     0.106
    2.000     0.029     0.029     0.000     0.142
    2.500     0.036     0.036     0.000     0.178
```

```
    3.000     0.041   0.0406      0.000    0.213
    3.100     0.041   0.0420      0.596    0.220
    3.200     0.041   0.0421      1.685    0.227
    3.300     0.041   0.0422      3.096    0.233
    3.400     0.041   0.0423      4.766    0.241
    3.500     0.041   0.0424      6.661    0.248
    3.750     0.041   0.0425     12.237    0.266
 END FTABLE257

 FTABLE    570
 *** PROJECT  SDW1B   FLOW SPLITTER (to 257 and 57)
ROWS COLS ***
  15    5
    DEPTH      AREA    VOLUME     STORMQ  INFILTRQ ***
    0.000     0.00    0.000      0.000    0.000
    0.100     0.01    0.0002     0.000    0.050
    0.400     0.01    0.0009     0.000    0.110
    0.600     0.01    0.0014     0.000    0.130
    0.750     0.01    0.0017     0.000    0.150
    0.800     0.01    0.0018     0.720    0.150
    1.000     0.01    0.0023     8.050    0.170
    1.100     0.01    0.0025    13.330    0.180
    1.200     0.01    0.0027    19.440    0.190
    1.300     0.01    0.0030    26.270    0.190
    1.400     0.01    0.0032    33.750    0.200
    1.420     0.01    0.0033    35.320    0.200
    1.440     0.01    0.0033    36.910    0.200
    1.450     0.01    0.0034    37.920    0.200
    1.460     0.01    0.0035    38.530    0.200
 END FTABLE570

 FTABLE     61
ROWS COLS ***
*** SDN-2X: DETAIN OVERFLOW FROM NCPS AND NSMPS-
   17    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
    0.000    0.5740    0.0000      0.00
    1.200    0.5740    0.7710     0.151
    2.220    0.5740    1.4270     0.205
    3.240    0.5740    2.0830     0.247
    3.650    0.5740    2.3460     0.262
    4.260    0.5740    2.7380     0.283
    4.660    0.5740    2.9950     0.296
    5.680    0.5740    3.6510     0.327
    6.640    0.5740    4.2680     0.517
    7.650    0.5740    4.9170     0.644
    8.670    0.5740    5.9710     0.739
    9.810    0.5740    6.3570     0.836
   10.700    0.5740    6.8780     0.894
   12.000    0.5740    7.7130     0.978
   12.100    0.5740    7.7780     1.600
   12.300    0.5740    7.9060     4.200
   12.800    0.5740    8.2280    14.560
 END FTABLE 61

 PRE AMBAUM DETENTION ***
 FTABLE    111
ROWS COLS ***
  15    4
    DEPTH      AREA    VOLUME   OUTFLOW  ***
    0.000    0.0000    0.0000      0.00
    0.500    0.2160    0.0750      5.30
    1.000    0.2730    0.1990     21.10
    1.500    0.2890    0.3410     43.90
    2.000    0.2900    0.4830     68.80
    2.500    0.2910    0.6070     89.10
    3.000    0.2950    0.6820     90.00
    3.500    0.3000    2.1000    100.00
    4.000    0.3050    2.5000    105.00
    4.500    0.3100    3.0000    110.00
    5.000    0.3200    3.5000    120.00
```

```
    5.500     0.3300     4.0000     130.00
    6.000     0.3800     5.0530     166.48
    6.500     0.3980     5.9430     225.31
    7.000     0.4150     6.9040     320.10
 END FTABLE111

 FTABLE    135
ROWS COLS *** VACA FARM
   6    4
    DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.00       0.10       0.00       0.00
     1.00       0.10       0.10       4.00
     2.00       0.11       0.21       8.00
     2.50       1.00       0.48      13.00
     3.50       6.50       4.23      86.00
     4.50      13.00      13.98     235.00
 END FTABLE135

 FTABLE    240
*** NORTH SNOWMELT PUMP STATION (SDN-2) (INSTALLED IN LATE 1997/1998)
                                                                      ***
 ROWS COLS                                                            ***
   14    5                                                            ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                ***
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
       0.0      0.002       0.00       0.00       0.00
      1.00      0.002     0.0023       0.00       0.00
      2.00      0.002     0.0046       1.67       0.00
      3.00      0.002     0.0069       1.67       0.00
      4.00      0.002     0.0092       1.67       0.00
      5.00      0.002     0.0115       1.67       0.00
      5.25      0.002     0.0121       1.67       1.53
      5.50      0.002     0.0126       1.67       6.06
      5.75      0.002     0.0132       1.67      12.65
      6.00      0.002     0.0138       1.67      19.83
      6.25      0.002     0.0144       1.67      25.66
      6.50      0.002     0.0149       1.67      25.70
      6.75      0.002     0.0155       1.67      26.70
      7.00      0.002     0.0161       1.67      50.00
 END FTABLE240

 FTABLE    242
*** NORTH CARGO PUMP STATION (SDN-2) (INSTALLED IN OCTOBER 1997)
                                                                      ***
 ROWS COLS                                                            ***
   14    5                                                            ***
     DEPTH       AREA     VOLUME      (IWS)      (SDS)                ***
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)
       0.0      0.002       0.00       0.00       0.00
      1.00      0.002     0.0023       0.00       0.00
      2.00      0.002     0.0046       6.13       0.00
      3.00      0.002     0.0069       6.13       0.00
      4.00      0.002     0.0092       6.13       0.00
      5.00      0.002     0.0115       6.13       0.00
      5.25      0.002     0.0121       6.13       0.28
      5.50      0.002     0.0126       6.13       1.16
      5.75      0.002     0.0132       6.13       2.53
      6.00      0.002     0.0138       6.13       4.23
      6.25      0.002     0.0144       6.13       6.05
      6.50      0.002     0.0149       6.13       7.72
      6.75      0.002     0.0155       6.13       8.50
      7.00      0.002     0.0161       6.13       20.0
 END FTABLE242

END FTABLES

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        1
  conversion from acre-inches to acre-ft (1/12)            ***
PERLND     PWATER PERO       0.0833333     RCHRES         INFLOW IVOL
  END MASS-LINK    1
```

```
  MASS-LINK        2
IMPLND     IWATER SURO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
RCHRES     ROFLOW                          RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES     OFLOW  OVOL   1                 RCHRES          INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES     OFLOW  OVOL   2                 RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND     PWATER SURO       0.0833333     RCHRES          INFLOW IVOL
PERLND     PWATER IFWO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND     PWATER AGWO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        10
COPY       OUTPUT MEAN                     COPY            INPUT  MEAN
  END MASS-LINK    10

  MASS-LINK        11
RCHRES     ROFLOW                          COPY            INPUT  MEAN
  END MASS-LINK    11

  MASS-LINK        12
COPY       OUTPUT MEAN                     RCHRES          INFLOW IVOL
  END MASS-LINK    12

  MASS-LINK        14
RCHRES     OFLOW  OVOL   1                 COPY            INPUT  MEAN
  END MASS-LINK    14

  MASS-LINK        15
RCHRES     OFLOW  OVOL   2                 COPY            INPUT  MEAN
  END MASS-LINK    15

  MASS-LINK        21
PERLND     PWATER PERO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK    21

  MASS-LINK        22
IMPLND     IWATER SURO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK    22

  MASS-LINK        26
PERLND     PWATER SURO       0.0833333     COPY            INPUT  MEAN
PERLND     PWATER IFWO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK    26

  MASS-LINK        27
PERLND     PWATER AGWO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK    27

END MASS-LINK

COPY
  TIMESERIES
  Copy-opn
    # -  #  NPT  NMN
   37   71    1
  240  242    1
```

```
  357  357          1
  645  645          1
  END TIMESERIES
END COPY

END RUN
```

WALKER CREEK WATERSHED
HSPF INPUT FILES

- PREDEVELOPMENT CONDITIONS
- 2006 CONDITIONS

PREDEVELOPMENT CONDITIONS

```
RUN
GLOBAL
  ***  COPY COMMAND ADDED
  ***  FILE: WCPRED04.inp REVISED OCTOBER 2000
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF WALKER CREEK
  WALKER CREEK BASIN HSPF MODEL
  START       1948 10  1  0  0  END    1996  8 30 24  0
  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname---------------------------------------------->
MESSU       24   D:\PARA\SEATAC\MILLER\WALKERf\WALKER.MES
WDM         25   D:\PARA\SEATAC\MILLER\WALKERf\WCPOND03.WDM
            61   D:\PARA\SEATAC\MILLER\WALKERf\wPER.L61
            62   D:\PARA\SEATAC\MILLER\WALKERf\wRCH.L62
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      14
      PERLND      16
      PERLND      18
      PERLND      24
      PERLND      26
      PERLND      28
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      54
      PERLND      64
      PERLND      65
      IMPLND      14
      COPY         2
      COPY         1
      COPY         3
      RCHRES      20
      RCHRES      19
      RCHRES      18
    END INGRP
END OPN SEQUENCE
                                                                        ***
COPY
  TIMESERIES                                                            ***
  Copy-opn                                                              ***
    # -  #  NPT  NMN
    1    5         1
  END TIMESERIES
END COPY

PERLND
  GEN-INFO
    <PLS >      Name          NBLKS   Unit-systems   Printer            ***
    # -  #                          User  t-series Engl Metr            ***
                                        in  out                         ***
   14       TFF- TILL FOR FLT      1    1    1    1   61    0
```

```
  16       TFM- TILL FOR MOD       1    1    1    1   61    0
  18       TFS- TILL FOR STP       1    1    1    1   61    0
  24       TGF- TILL GR FLT        1    1    1    1   61    0
  26       TGM- TILL GR MOD        1    1    1    1   61    0
  28       TGS- TILL GR STP        1    1    1    1   61    0
  34       OF - OUTWASH FOR        1    1    1    1   61    0
  44       OG - OUTWASH GR         1    1    1    1   61    0
***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
  45       AIRPORT FILL            1    1    1    1   61    0
  54       SA - WETLANDS           1    1    1    1   61    0
  64       TGM DES MOINES          1    1    1    1   61    0
  65       OG  DES MOINES          1    1    1    1   61    0
END GEN-INFO
ACTIVITY
  <PLS > ************ Active Sections ******************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC       ***
 14  200    0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY
PRINT-INFO
  <PLS > ********************* Print-flags ************************* PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ********
 14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
PWAT-PARM1
  <PLS > ***************** Flags ********************
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                    ***
 14         0    0    0    0    0    0    0    0    0
 16         0    0    0    0    0    0    0    0    0
 18         0    0    0    0    0    0    0    0    0
 24         0    0    0    0    0    0    0    0    0
 26         0    0    0    0    0    0    0    0    0
 28         0    0    0    0    0    0    0    0    0
 34         0    0    0    0    0    0    0    0    0
 44         0    0    0    0    0    0    0    0    0
 45         0    0    0    0    0    0    0    0    0
 54         0    0    0    0    0    0    0    0    0
 64         0    0    0    0    0    0    0    0    0
END PWAT-PARM1
PWAT-PARM2
  <PLS > ***
  # -  # ***FOREST      LZSN     INFILT      LSUR      SLSUR      KVARY      AGWRC
 14                   4.5000     0.0800    400.00     0.0500     0.5000     0.9960
 16                   4.5000     0.0800    400.00     0.1000     0.5000     0.9960
 18                   4.5000     0.0800    200.00     0.2000     0.5000     0.9960
 24                   4.5000     0.0300    400.00     0.0500     0.5000     0.9960
 26                   4.5000     0.0300    400.00     0.1000     0.5000     0.9960
 28                   4.5000     0.0300    200.00     0.2000     0.5000     0.9960
 34                   5.0000     2.0000    400.00     0.0500     0.3000     0.9960
 44                   5.0000     0.8000    400.00     0.0500     0.3000     0.9960
 45                   7.5000     0.0200    300.00     0.0700     0.0000     0.9960
 54                   4.0000     2.0000    100.00     0.0010     0.5000     0.9960
 64                   4.5000     0.1200    400.00     0.1000     0.5000     0.9990
 65                   5.0000     0.8000    400.00     0.0500     0.5000     0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
```

```
  14                                  2.0000    2.0000      0.00      0.00       0.0
  16                                  2.0000    2.0000      0.00      0.00       0.0
  18                                  2.0000    2.0000      0.00      0.00       0.0
  24                                  2.0000    2.0000      0.00      0.00        0.
  26                                  2.0000    2.0000      0.00        0.        0.
  28                                  2.0000    2.0000      0.00        0.        0.
  34                                  2.0000    2.0000      0.00      0.00       0.0
  44                                  2.0000    2.0000      0.00        0.        0.
  45                                  2.0000    2.0000      0.00        0.        0.
  54                                  10.000    2.0000      0.00        0.       0.7
  64                                  2.0000    2.0000      0.00        0.       0.0
 END PWAT-PARM3
 PWAT-PARM4
   <PLS >                                                                  ***
   # -  #      CEPSC      UZSN       NSUR      INTFW       IRC     LZETP***
  14          0.2000    1.0000     0.3500      2.000    0.1500    0.7000
  16          0.2000    0.5000     0.3500      2.000    0.1500    0.7000
  18          0.2000    0.3000     0.3500      2.000    0.1500    0.7000
  24          0.1000    0.5000     0.2500      2.000    0.1500    0.2500
  26          0.1000    0.2500     0.2500      2.000    0.1500    0.2500
  28          0.1000    0.1500     0.2500      2.000    0.1500    0.2500
  34          0.2000    0.5000     0.3500      0.000    0.5000    0.7000
  44          0.1000    0.5000     0.2500      0.000    0.5000    0.2500
  45          0.1000    0.2800     0.2500      6.000    0.1500    0.6000
  54          0.1000    3.0000     0.5000      1.000    0.7000    0.8000
  64          0.1000    0.2500     0.2500      3.000    0.5000    0.2500
  65          0.1000    0.5000     0.2500      0.000    0.5000    0.2500
 END PWAT-PARM4
 PWAT-STATE1
   <PLS >  PWATER state variables***
   # -  #***   CEPS       SURS        UZS       IFWS        LZS       AGWS       GWVS
  14          0.078         0.     0.2500       0.10      2.500       2.00      0.000
  16          0.078         0.     0.2500       0.10      2.500       2.00      0.000
  18          0.078         0.     0.2500       0.10      2.500       2.00      0.000
  24          0.051         0.     0.2500       0.10      2.500       2.00      0.000
  26          0.051         0.     0.2500       0.10      2.500       2.00      0.000
  28          0.051         0.     0.2500       0.10      2.500       2.00      0.000
  34          0.078         0.     0.2500       0.10      0.000       2.00      0.000
  44          0.051         0.     0.2500       0.10      0.000       2.00      0.000
  45          0.051         0.     0.2500       0.10      0.000       2.00      0.000
  54          0.051         0.     0.2500       0.10      2.000       2.00      0.000
  64          0.051         0.     0.2500       0.10      2.000      20.00      0.000
  65          0.051         0.     0.2500       0.10      0.000      20.00      0.000
 END PWAT-STATE1
END PERLND
IMPLND
 GEN-INFO
   <ILS >      Name              Unit-systems   Printer                          ***
   # -  #                      User  t-series Engl Metr                          ***
                                      in  out                                    ***
  14      IMPERVIOUS              1    1    1   60    0
 END GEN-INFO
 ACTIVITY
   <ILS > ************* Active Sections ****
   # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
  14         0    0    1    0    0    0
 END ACTIVITY
```

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14         0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <ILS >           Flags            ***                                  ***
    # -  # CSNO RTOP  VRS  VNN RTLI   ***                                  ***
   14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                               ***
    <ILS >                                                                 ***
    # -  #      LSUR     SLSUR      NSUR     RETSC
   14         100.00    0.0100    0.1000    0.1000
  END IWAT-PARM2
  IWAT-PARM3                                                               ***
    <ILS >                                                                 ***
    # -  #    PETMAX    PETMIN
   14
  END IWAT-PARM3
  IWAT-STATE1                                                              ***
    <ILS >  IWATER state variables                                         ***
    # -  #      RETS      SURS                                            ***
   14      1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                                 ***

EXT SOURCES                                                                ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes.   ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC     ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM   1002 PREC     ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM      1 EVAP     ENGLZERO  0.8           PERLND  14  65 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC     ENGLZERO                RCHRES  20     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8         RCHRES  20     EXTNL  POTEV

END EXT SOURCES                                                            ***

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
***WALKER NR MTH
RCHRES  18 HYDR   RO                       WDM     96 FLOW     ENGL      REPL
*** MISC (20=WALKER WETLAND, 55=SR509, 56=1ST AVE)
RCHRES  20 HYDR   RO     ***               WDM     97 FLOW     ENGL      REPL
COPY     2 OUTPUT MEAN   1 1     12.1      WDM     89 FLOW     ENGL      REPL
END EXT TARGETS                                                                ***

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
```

```
***WALKER CREEK
  *** SUB-CATCHMENT  MC 8
PERLND  26                          4.10      COPY      1       8
PERLND  44                         18.57      COPY      1       8
PERLND  54                          2.72      COPY      1       8
IMPLND  14                          1.34      COPY      1       9
***  *** SUB-CATCHMENT  SDW2  10-75-15 PREDEVELOPMENT W/1994 IMP
***PERLND  16                         30.91      COPY      2      10
***PERLND  26                          7.16      COPY      2      10
***PERLND  34                          1.69      COPY      2      10
***PERLND  44                          0.39      COPY      2      10
***PERLND  54                          1.13      COPY      2      10
***PERLND  16                         30.91      COPY      1      11
***PERLND  26                          7.16      COPY      1      11
***PERLND  34                          1.69      COPY      1      11
***PERLND  44                          0.39      COPY      1      11
***PERLND  54                          1.13      COPY      1      11
***IMPLND  14                          3.31      COPY      2       9
  *** SUB-CATCHMENT  SDW2  10-75-15 PREDEVELOPMENT W/1994 IMP
PERLND  16                         16.38      COPY      2      10
PERLND  26                          4.37      COPY      2      10
PERLND  34                         16.47      COPY      2      10
PERLND  44                          4.39      COPY      2      10
PERLND  54                          1.05      COPY      2      10
PERLND  16                         16.38      COPY      1      11
PERLND  26                          4.37      COPY      1      11
PERLND  34                         16.47      COPY      1      11
PERLND  44                          4.39      COPY      1      11
PERLND  54                          1.05      COPY      1      11
IMPLND  14                          2.20      COPY      2       9
  *** SUB-CATCHMENT  MC 9
PERLND  26                          9.44      COPY      1       8
PERLND  44                          0.74      COPY      1       8
PERLND  54            ***           0.00      COPY      1       8
IMPLND  14                          0.24      COPY      1       9
  *** SUB-CATCHMENT 18
PERLND  16                          0.76      RCHRES   18       1
PERLND  26                         16.08      RCHRES   18       1
PERLND  34                         20.95      RCHRES   18       1
PERLND  44                         49.22      RCHRES   18       1
IMPLND  14                          3.30      RCHRES   18       2
  *** SUB-CATCHMENT 19
PERLND  16                         12.72      RCHRES   19       1
PERLND  26                         92.07      RCHRES   19       1
PERLND  34                          8.39      RCHRES   19       1
PERLND  44                         95.55      RCHRES   19       1
IMPLND  14                         30.53      RCHRES   19       2
  *** SUB-CATCHMENT 20
PERLND  26                         12.53      RCHRES   20       1
PERLND  44                         53.43      RCHRES   20       1
PERLND  54                         33.43      RCHRES   20       1
IMPLND  14                         52.83      RCHRES   20       2
*** DOWN STREAM OF WALKER CREEK GAGE
  *** SUB-CATCHMENT 21 33% OF GW GOES TO GAGE REST GOES TO SOUND
PERLND  16                          2.54      RCHRES   18       7
PERLND  26                         44.30      RCHRES   18       7
```

```
PERLND  34                          2.03      RCHRES  18       7
PERLND  44                         41.13      RCHRES  18       7
PERLND  16                          2.54      RCHRES  21       6
PERLND  26                         44.30      RCHRES  21       6
PERLND  34                          2.03      RCHRES  21       6
PERLND  44                         41.13      RCHRES  21       6
PERLND  16                          5.07      RCHRES  21       1
PERLND  26                         88.61      RCHRES  21       1
PERLND  34                          4.06      RCHRES  21       1
PERLND  44                         82.26      RCHRES  21       1
IMPLND  14                         33.09      RCHRES  21       2
IMPLND  14                         16.54      RCHRES  21       2
  *** SUB-CATCHMENT 22
PERLND  34                          4.30      RCHRES  22       1
PERLND  44                         19.49      RCHRES  22       1
PERLND  54                          3.21      RCHRES  22       1
IMPLND  14                          3.95      RCHRES  22       2

***GROUNDWATER FROM OUTSIDE OF WALKER CREEK

PERLND  64                        630.00      RCHRES  20       7
PERLND  65                 ***    130.00      RCHRES  20       7

***STREAM ROUTING
COPY     2                                   COPY     3      14
COPY     1                                   COPY     3      14
COPY     3                                   RCHRES  20      13
RCHRES  20                                   RCHRES  19       3
RCHRES  19                                   RCHRES  18       3

END SCHEMATIC


NETWORK                                                                  ***
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>         <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #    # <-GRP> <NAME> # # ***
                                                                         ***
END NETWORK                                                              ***

RCHRES
  GEN-INFO                                                               ***
    RCHRES        Name         Nexits   Unit Systems   Printer          ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG       ***
                                          in  out                        ***
   18      Trib (0371A) M 18       1    1    1    1   62    0    0
   19      Trib (0371A) M 19       1    1    1    1   62    0    0
   20      Trib   M 20             1    1    1    1   62    0    1
   21      Trib (0371H) M 21       1    1    1    1   62    0    0
   22      Trib (0371A) M 22       1    1    1    1   62    0    0

  END GEN-INFO
  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG              ***
    1   63    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1   63    5    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                    ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1   99   0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1
  HYDR-PARM2
    RCHRES                                                                 ***
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50      ***
  <------><--------><--------><--------><--------><--------><-------->      ***
   18             18   0.800                              0.3
   19             19   0.568                              0.3
   20             20   0.379                              0.3
   21             21   0.450                              0.3
   22             22   0.300                              0.3
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                       ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
           *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
   18     0.1              4.0
   19     0.1              4.0
   20     10.0             4.0
   21     0.1              4.0
   22     0.1              4.0
  END HYDR-INIT
END RCHRES

FTABLES

  FTABLE     18
 ROWS COLS ***
    3    4
     DEPTH      AREA    VOLUME   OUTFLOW  ***
      0.00      1.30      0.00      0.00
      1.00      1.30      1.30    166.00
      2.00      1.40      2.65    490.00
  END FTABLE 18

  FTABLE     19
 ROWS COLS ***
    3    4
     DEPTH      AREA    VOLUME   OUTFLOW  ***
      0.00      1.10      0.00      0.00
      1.00      1.10      1.10     65.00
      2.00      1.20      2.25    223.00
  END FTABLE 19

  FTABLE     20
*** WALKER CREEK WETLAND
```

```
 ROWS COLS ***
   10    4
     DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW ***
      0.00       0.00       0.00       0.00
      1.00       2.50       1.25       7.04
      2.00       5.00       5.00      17.84
      3.00      12.00      13.50      32.17
      4.00      19.00      29.00      45.13
      5.00      22.00      49.50      54.95
      6.00      23.00      72.00      61.62
      6.10      23.00      74.30      62.15
      7.00      23.50      95.25      67.00
      7.24      24.10     101.10     100.00
  END FTABLE 20

  FTABLE     21
 ROWS COLS ***
    8    4
     DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.000     0.0000     0.0000       0.00
     0.100     0.2259     0.0113       0.11
     0.500     0.2707     0.1106       4.27
     1.000     0.3268     0.2600      15.13
     1.500     0.3828     0.4374      31.67
     2.000     0.4389     0.6428      54.02
     2.500     0.4949     0.8763      82.52
     3.000     0.5510     1.1377     117.55
  END FTABLE 21

  FTABLE     22
 ROWS COLS ***
    9    4
     DEPTH       AREA     VOLUME    OUTFLOW  ***
     0.000     0.0000     0.0000       0.00
     0.100     0.3680     0.0184       0.25
     0.500     0.3717     0.1664       9.39
     1.000     0.3763     0.3534      31.06
     2.000     0.3819     0.7325      94.37
     3.000     0.3874     1.1171     174.33
     4.000     0.3930     1.5073     265.38
     5.000     0.3985     1.9030     364.68
     6.000     0.4040     2.3043     470.60
  END FTABLE 22
END FTABLES
MASS-LINK
<Volume>    <-Grp> <-Member-><--Mult-->     <Target>        <-Grp> <-Member->***
<Name>             <Name> # #<-factor->     <Name>                 <Name> # #***
  MASS-LINK         1
  conversion from acre-inches to acre-ft (1/12)            ***
PERLND     PWATER PERO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK     1

  MASS-LINK         2
IMPLND     IWATER SURO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK     2

  MASS-LINK         3
```

```
RCHRES     ROFLOW                              RCHRES          INFLOW
  END MASS-LINK    3

  MASS-LINK        4
RCHRES     OFLOW  OVOL   1                    RCHRES          INFLOW IVOL
  END MASS-LINK    4

  MASS-LINK        5
RCHRES     OFLOW  OVOL   2                    RCHRES          INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
PERLND     PWATER SURO          0.0833333    RCHRES          INFLOW IVOL
PERLND     PWATER IFWO          0.0833333    RCHRES          INFLOW IVOL
  END MASS-LINK    6

  MASS-LINK        7
PERLND     PWATER AGWO          0.0833333    RCHRES          INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
PERLND     PWATER PERO          0.0833333    COPY            INPUT  MEAN
  END MASS-LINK    8

  MASS-LINK        9
IMPLND     IWATER SURO          0.0833333    COPY            INPUT  MEAN
  END MASS-LINK    9

  MASS-LINK       10
PERLND     PWATER SURO          0.0833333    COPY            INPUT  MEAN
PERLND     PWATER IFWO          0.0833333    COPY            INPUT  MEAN
  END MASS-LINK   10

  MASS-LINK       11
PERLND     PWATER AGWO          0.0833333    COPY            INPUT  MEAN
  END MASS-LINK   11

  MASS-LINK       12
PERLND     PWATER AGWO          0.0833333    COPY            INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
COPY       OUTPUT MEAN                       RCHRES          INFLOW IVOL
  END MASS-LINK   13

  MASS-LINK       14
COPY       OUTPUT MEAN                       COPY            INPUT  MEAN
  END MASS-LINK   14

END MASS-LINK
END RUN
```

2006 CONDITIONS

```
RUN
GLOBAL
  ***  FILE: WCPOND05.inp REVISED April 2001. ATC
  ***  SEATAC AIRPORT HSPF BASIN MODEL OF WALKER CREEK
  ***  2006 FUTURE PROJECT CONDITION SIZING BASED
  ***  CHANGED PREC DSN 2 TO NEW PREC DSN 1002
  WALKER CREEK BASIN HSPF MODEL
  START       1948 10  1  0  0  END    1996  8 30 24  0

  RUN INTERP OUTPUT LEVEL    3
  RESUME     0 RUN     1
END GLOBAL

FILES
<type>  <fun>***<------------fname---------------------------------------------->
MESSU       24   D:\PARA\SEATAC\MILLER\WALKERf\WALKER.MES
WDM         25   D:\PARA\SEATAC\MILLER\WALKERf\WCPOND03.WDM
            61   D:\PARA\SEATAC\MILLER\WALKERf\wPER.L61
            62   D:\PARA\SEATAC\MILLER\WALKERf\wRCH.L62
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      14
      PERLND      16
      PERLND      18
      PERLND      24
      PERLND      26
      PERLND      28
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      54
      PERLND      64
      PERLND      65
      IMPLND      14
      RCHRES      49
      RCHRES      20
      RCHRES      19
      RCHRES      18
    END INGRP
END OPN SEQUENCE
                                                                      ***
COPY
  TIMESERIES                                                          ***
  Copy-opn                                                            ***
    # -  #  NPT  NMN
    1    5         1
  END TIMESERIES
END COPY

PERLND
  GEN-INFO
    <PLS >      Name           NBLKS   Unit-systems   Printer        ***
    # -  #                          User  t-series Engl Metr         ***
                                         in  out                    ***
   14       TFF- TILL FOR FLT      1    1    1    1   61    0
```

```
 16       TFM- TILL FOR MOD       1    1    1    1   61    0
 18       TFS- TILL FOR STP       1    1    1    1   61    0
 24       TGF- TILL GR FLT        1    1    1    1   61    0
 26       TGM- TILL GR MOD        1    1    1    1   61    0
 28       TGS- TILL GR STP        1    1    1    1   61    0
 34       OF - OUTWASH FOR        1    1    1    1   61    0
 44       OG - OUTWASH GR         1    1    1    1   61    0
***PERLND FOR NEW AIRPORT FILL; NONE IN CALIBRATION
 45       AIRPORT FILL            1    1    1    1   61    0
 54       SA - WETLANDS           1    1    1    1   61    0
 64       TGM DES MOINES          1    1    1    1   61    0
 65       OG  DES MOINES          1    1    1    1   61    0
END GEN-INFO
ACTIVITY
  <PLS > ************ Active Sections ******************************
  # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC        ***
 14  200    0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY
PRINT-INFO
  <PLS > ********************* Print-flags ************************* PIVL  PYR
  # -   # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ********
 14  200    0    0    5    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
PWAT-PARM1
  <PLS > ***************** Flags ********************
  # -   # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                      ***
 14         0    0    0    0    0    0    0    0    0
 16         0    0    0    0    0    0    0    0    0
 18         0    0    0    0    0    0    0    0    0
 24         0    0    0    0    0    0    0    0    0
 26         0    0    0    0    0    0    0    0    0
 28         0    0    0    0    0    0    0    0    0
 34         0    0    0    0    0    0    0    0    0
 44         0    0    0    0    0    0    0    0    0
 45         0    0    0    0    0    0    0    0    0
 54         0    0    0    0    0    0    0    0    0
 64         0    0    0    0    0    0    0    0    0
END PWAT-PARM1
PWAT-PARM2
  <PLS > ***
  # -   # ***FOREST      LZSN     INFILT      LSUR      SLSUR      KVARY      AGWRC
 14                    4.5000     0.0800    400.00     0.0500     0.5000     0.9960
 16                    4.5000     0.0800    400.00     0.1000     0.5000     0.9960
 18                    4.5000     0.0800    200.00     0.2000     0.5000     0.9960
 24                    4.5000     0.0300    400.00     0.0500     0.5000     0.9960
 26                    4.5000     0.0300    400.00     0.1000     0.5000     0.9960
 28                    4.5000     0.0300    200.00     0.2000     0.5000     0.9960
 34                    5.0000     2.0000    400.00     0.0500     0.3000     0.9960
 44                    5.0000     0.8000    400.00     0.0500     0.3000     0.9960
 45                    7.5000     0.0200    300.00     0.0700     0.0000     0.9960
 54                    4.0000     2.0000    100.00     0.0010     0.5000     0.9960
 64                    4.5000     0.1200    400.00     0.1000     0.5000     0.9990
 65                    5.0000     0.8000    400.00     0.0500     0.5000     0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -   #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
```

```
  14                                  2.0000    2.0000      0.00      0.00       0.0
  16                                  2.0000    2.0000      0.00      0.00       0.0
  18                                  2.0000    2.0000      0.00      0.00       0.0
  24                                  2.0000    2.0000      0.00      0.00        0.
  26                                  2.0000    2.0000      0.00        0.        0.
  28                                  2.0000    2.0000      0.00        0.        0.
  34                                  2.0000    2.0000      0.00      0.00       0.0
  44                                  2.0000    2.0000      0.00        0.        0.
  45                                  2.0000    2.0000      0.00        0.        0.
  54                                  10.000    2.0000      0.00        0.       0.7
  64                                  2.0000    2.0000      0.00        0.       0.0
 END PWAT-PARM3
 PWAT-PARM4
   <PLS >                                                                  ***
   # -  #      CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
  14          0.2000    1.0000    0.3500     2.000    0.1500    0.7000
  16          0.2000    0.5000    0.3500     2.000    0.1500    0.7000
  18          0.2000    0.3000    0.3500     2.000    0.1500    0.7000
  24          0.1000    0.5000    0.2500     2.000    0.1500    0.2500
  26          0.1000    0.2500    0.2500     2.000    0.1500    0.2500
  28          0.1000    0.1500    0.2500     2.000    0.1500    0.2500
  34          0.2000    0.5000    0.3500     0.000    0.5000    0.7000
  44          0.1000    0.5000    0.2500     0.000    0.5000    0.2500
  45          0.1000    0.2800    0.2500     6.000    0.1500    0.6000
  54          0.1000    3.0000    0.5000     1.000    0.7000    0.8000
  64          0.1000    0.2500    0.2500     3.000    0.5000    0.2500
  65          0.1000    0.5000    0.2500     0.000    0.5000    0.2500
 END PWAT-PARM4
 PWAT-STATE1
   <PLS >  PWATER state variables***
   # -  #***    CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
  14           0.078        0.    0.2500      0.10     2.500      2.00     0.000
  16           0.078        0.    0.2500      0.10     2.500      2.00     0.000
  18           0.078        0.    0.2500      0.10     2.500      2.00     0.000
  24           0.051        0.    0.2500      0.10     2.500      2.00     0.000
  26           0.051        0.    0.2500      0.10     2.500      2.00     0.000
  28           0.051        0.    0.2500      0.10     2.500      2.00     0.000
  34           0.078        0.    0.2500      0.10     0.000      2.00     0.000
  44           0.051        0.    0.2500      0.10     0.000      2.00     0.000
  45           0.051        0.    0.2500      0.10     0.000      2.00     0.000
  54           0.051        0.    0.2500      0.10     2.000      2.00     0.000
  64           0.051        0.    0.2500      0.10     2.000     20.00     0.000
  65           0.051        0.    0.2500      0.10     0.000     20.00     0.000
 END PWAT-STATE1
END PERLND
IMPLND
 GEN-INFO
   <ILS >       Name              Unit-systems   Printer                      ***
   # -  #                       User  t-series Engl Metr                      ***
                                       in  out                                ***
  14       IMPERVIOUS              1    1    1   60    0
 END GEN-INFO
 ACTIVITY
   <ILS > ************* Active Sections ****
   # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
  14          0    0    1    0    0    0
 END ACTIVITY
```

```
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   14         0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <ILS >           Flags            ***                                  ***
    # -  # CSNO RTOP  VRS  VNN RTLI   ***                                  ***
   14         0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2
    <ILS >                                                                 ***
    # -  #      LSUR      SLSUR      NSUR      RETSC                       ***
   14        100.00     0.0100     0.1000     0.1000
  END IWAT-PARM2
  IWAT-PARM3
    <ILS >                                                                 ***
    # -  #    PETMAX    PETMIN                                            ***
   14
  END IWAT-PARM3
  IWAT-STATE1
    <ILS >  IWATER state variables                                         ***
    # -  #      RETS      SURS                                            ***
   14      1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND                                                                 ***

EXT SOURCES                                                                ***

*** NOTE: The only RCHRES that precip and PET are applied to are lakes.
                                                                           ***
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
*** PRECIP/EVAP TO PERVIOUS/IMPERV SURFACES
WDM   1002 PREC     ENGLZERO  1.00          PERLND  14 200 EXTNL  PREC
WDM   1002 PREC     ENGLZERO  1.00          IMPLND  14     EXTNL  PREC
WDM      1 EVAP     ENGLZERO  0.8           PERLND  14  65 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO  0.8           IMPLND  14     EXTNL  PETINP
*** PRECIP/EVAP TO LAKES
WDM   1002 PREC     ENGLZERO                RCHRES  20     EXTNL  PREC
WDM      1 EVAP     ENGLZERO     0.8        RCHRES  20     EXTNL  POTEV
WDM   1002 PREC     ENGLZERO                RCHRES  49     EXTNL  PREC
WDM      1 EVAP     ENGLZERO     0.8        RCHRES  49     EXTNL  POTEV

END EXT SOURCES                                                            ***

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES  18 HYDR   RO                       WDM    116 FLOW     ENGL       REPL
 ***PROJECT CONDITION FLOWS
RCHRES  49 HYDR   RO     1 1               WDM    109 FLOW     ENGL       REPL
*** DETENTION STAGES
RCHRES  49 HYDR   STAGE                    WDM    649 STAG     ENGL       REPL
*** DETENTION VOLUME
RCHRES  49 HYDR   VOL                      WDM    749 VOL      ENGL       REPL
*** 39=SR509     37=SDW2
```

```
END EXT TARGETS                                                          ***

SCHEMATIC
<-Source->                    <--Area-->     <-Target->   MBLK    ***
<Name>   #                    <-factor->     <Name>   #   Tbl#    ***

***WALKER CREEK
*** SUB-CATCHMENT  MC 8
PERLND  26                      3.93     RCHRES  20       1
PERLND  44                     18.73     RCHRES  20       1
PERLND  54                      2.70     RCHRES  20       1
IMPLND  14                      0.01     RCHRES  20       2
***  *** SUB-CATCHMENT  SDW-2
***PERLND  26                    26.82     RCHRES  49       6
***PERLND  44                     1.42     RCHRES  49       6
***PERLND  45                     6.70     RCHRES  49       6
***PERLND  26                    26.82     RCHRES  20       7
***PERLND  44                     1.42     RCHRES  20       7
***PERLND  45                     6.70     RCHRES  20       7
***IMPLND  14                     9.51     RCHRES  49       2
***REPLACE SUBCATCHMENT SDW-2    WITH NEW SDW-2 SUBBASIN
***SUBBASIN SDW-2 ROUTING AS OF 4/19/01
PERLND  26                     26.88     RCHRES  49       6
PERLND  44                      1.51     RCHRES  49       6
PERLND  45                     6.700     RCHRES  49       6
PERLND  26                     26.88     RCHRES  20       7
PERLND  44                      1.51     RCHRES  20       7
PERLND  45                     6.700     RCHRES  20       7
IMPLND  14                      9.51     RCHRES  49       2
*** SUB-CATCHMENT  MC 9
PERLND  26                      9.28     RCHRES  20       1
PERLND  44                      0.76     RCHRES  20       1
IMPLND  14                      0.40     RCHRES  20       2
  *** SUB-CATCHMENT 18
PERLND  16                      0.76     RCHRES  18       1
PERLND  26                     16.08     RCHRES  18       1
PERLND  34                     20.95     RCHRES  18       1
PERLND  44                     49.22     RCHRES  18       1
IMPLND  14                      3.30     RCHRES  18       2
  *** SUB-CATCHMENT 19
PERLND  16                     12.72     RCHRES  19       1
PERLND  26                     92.07     RCHRES  19       1
PERLND  34                      8.39     RCHRES  19       1
PERLND  44                     95.55     RCHRES  19       1
IMPLND  14                     30.53     RCHRES  19       2
  *** SUB-CATCHMENT 20
PERLND  26                     12.54     RCHRES  20       1
PERLND  44                     53.42     RCHRES  20       1
PERLND  54                     33.43     RCHRES  20       1
IMPLND  14                     52.83     RCHRES  20       2
*** DOWN STREAM OF WALKER CREEK GAGE
  *** SUB-CATCHMENT 21 33% OF GW GOES TO GAGE REST GOES TO SOUND
PERLND  16                      2.54     RCHRES  18       7
PERLND  26                     44.30     RCHRES  18       7
PERLND  34                      2.03     RCHRES  18       7
PERLND  44                     41.13     RCHRES  18       7
PERLND  16                      2.54     RCHRES  21       6
```

```
PERLND  26                          44.30      RCHRES  21       6
PERLND  34                           2.03      RCHRES  21       6
PERLND  44                          41.13      RCHRES  21       6
IMPLND  14                          16.54      RCHRES  21       2
PERLND  16                           5.07      RCHRES  21       1
PERLND  26                          88.61      RCHRES  21       1
PERLND  34                           4.06      RCHRES  21       1
PERLND  44                          82.26      RCHRES  21       1
IMPLND  14                          33.09      RCHRES  21       2
  *** SUB-CATCHMENT 22
PERLND  34                           4.30      RCHRES  22       1
PERLND  44                          19.49      RCHRES  22       1
PERLND  54                           3.21      RCHRES  22       1
IMPLND  14                           3.95      RCHRES  22       2

***GROUNDWATER FROM OUTSIDE OF WALKER CREEK

PERLND  64                         630.00      RCHRES  20       7
PERLND  65                  ***    130.00      RCHRES  20       7


***STREAM ROUTING
RCHRES  49                                     RCHRES  20       3
RCHRES  20                                     RCHRES  19       3
RCHRES  19                                     RCHRES  18       3

END SCHEMATIC


NETWORK                                                                  ***
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>         <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #    # <-GRP> <NAME> # # ***
                                                                         ***
END NETWORK                                                              ***

RCHRES
  GEN-INFO
    RCHRES       Name         Nexits   Unit Systems   Printer             ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG        ***
                                        in  out                          ***
   18      Trib (0371A) M 18       1    1    1    1   62     0     0
   19      Trib (0371A) M 19       1    1    1    1   62     0     0
   20      Trib   M 20             1    1    1    1   62     0     1
   21      Trib (0371H) M 21       1    1    1    1   62     0     0
   22      Trib (0371A) M 22       1    1    1    1   62     0     0
   39      SR509                   1    1    1    1   62     0     0
   49      SDW2 POND               1    1    1    1   62     0     0

  END GEN-INFO
  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG              ***
    1   63    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
```

```
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
  1   63    5    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
HYDR-PARM1
  RCHRES  Flags for each HYDR Section                                    ***
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
         FG FG FG FG  possible  exit  *** possible  exit      possible  exit
          *  *  *  *    *  *  *  *  *      *  *  *  *  *         ***
  1   99   0  1  0  0    4  0  0  0  0       0  0  0  0  0        2  2  2  2  2
END HYDR-PARM1
HYDR-PARM2
  RCHRES                                                                 ***
  # -  #    FTABNO       LEN      DELTH     STCOR        KS       DB50     ***
<------><--------><--------><--------><--------><--------><--------->     ***
 18             18    0.800                              0.3
 19             19    0.568                              0.3
 20             20    0.379                              0.3
 21             21    0.450                              0.3
 22             22    0.300                              0.3
 49             49    0.010                    0.0       0.3

END HYDR-PARM2
HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                       ***
  # -  # ***   VOL     Initial value of COLIND     Initial value of OUTDGT
        *** ac-ft     for each possible exit      for each possible exit
<------><--------->    <---><---><---><---><---> *** <---><---><---><---><--->
 18      0.1             4.0
 19      0.1             4.0
 20      10.0            4.0
 21      0.1             4.0
 22      0.1             4.0
 49      0.0             4.0

  END HYDR-INIT
END RCHRES

FTABLES

  FTABLE     18
 ROWS COLS ***
    3    4
     DEPTH      AREA     VOLUME    OUTFLOW  ***
      0.00      1.30       0.00       0.00
      1.00      1.30       1.30     166.00
      2.00      1.40       2.65     490.00
 END FTABLE 18

  FTABLE     19
 ROWS COLS ***
    3    4
     DEPTH      AREA     VOLUME    OUTFLOW  ***
      0.00      1.10       0.00       0.00
      1.00      1.10       1.10      65.00
      2.00      1.20       2.25     223.00
 END FTABLE 19
```

```
 FTABLE      49
 *** PROJECT POND F SDW2
ROWS COLS ***
  12    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.8880     0.0000    0.00
    1.000     0.9270     1.0823    0.25
    2.000     0.9690     2.2096    0.35
    3.000     1.0450     3.3828    0.42
    4.000     1.0450     4.6027    0.49
    5.000     1.0860     5.8726    0.55
    6.000     1.1260     7.1935    0.60
    7.000     1.1670     8.5645    1.20
    8.000     1.2130     9.9861    2.69
    8.300     1.2560     10.454    3.09
    9.000     1.2560     11.459    7.57
   10.000     1.3000     12.987    16.88
 END FTABLE 49

 FTABLE      20
*** WALKER CREEK WETLAND
 ROWS COLS ***
  10    4
    DEPTH       AREA     VOLUME    OUTFLOW   OUTFLOW ***
     0.00       0.00       0.00       0.00
     1.00       2.50       1.25       7.04
     2.00       5.00       5.00      17.84
     3.00      12.00      13.50      32.17
     4.00      19.00      29.00      45.13
     5.00      22.00      49.50      54.95
     6.00      23.00      72.00      61.62
     6.10      23.00      74.30      62.15
     7.00      23.50      95.25      67.00
     7.24      24.10     101.10     100.00
 END FTABLE 20

 FTABLE      21
 ROWS COLS ***
    8    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0000     0.0000       0.00
    0.100     0.2259     0.0113       0.11
    0.500     0.2707     0.1106       4.27
    1.000     0.3268     0.2600      15.13
    1.500     0.3828     0.4374      31.67
    2.000     0.4389     0.6428      54.02
    2.500     0.4949     0.8763      82.52
    3.000     0.5510     1.1377     117.55
 END FTABLE 21

 FTABLE      22
 ROWS COLS ***
    9    4
    DEPTH       AREA     VOLUME    OUTFLOW   ***
    0.000     0.0000     0.0000       0.00
    0.100     0.3680     0.0184       0.25
    0.500     0.3717     0.1664       9.39
```


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```
     1.000     0.3763     0.3534      31.06
     2.000     0.3819     0.7325      94.37
     3.000     0.3874     1.1171     174.33
     4.000     0.3930     1.5073     265.38
     5.000     0.3985     1.9030     364.68
     6.000     0.4040     2.3043     470.60
  END FTABLE 22
END FTABLES
MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>        <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                 <Name> # #***
  MASS-LINK         1
  conversion from acre-inches to acre-ft (1/12)            ***
PERLND     PWATER PERO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK     1

  MASS-LINK         2
IMPLND     IWATER SURO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK     2

  MASS-LINK         3
RCHRES     ROFLOW                          RCHRES          INFLOW
  END MASS-LINK     3

  MASS-LINK         4
RCHRES     OFLOW  OVOL   1                 RCHRES          INFLOW IVOL
  END MASS-LINK     4

  MASS-LINK         5
RCHRES     OFLOW  OVOL   2                 RCHRES          INFLOW IVOL
  END MASS-LINK     5

  MASS-LINK         6
PERLND     PWATER SURO       0.0833333     RCHRES          INFLOW IVOL
PERLND     PWATER IFWO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK     6

  MASS-LINK         7
PERLND     PWATER AGWO       0.0833333     RCHRES          INFLOW IVOL
  END MASS-LINK     7

  MASS-LINK         8
PERLND     PWATER PERO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK     8
  MASS-LINK        12
PERLND     PWATER AGWO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK    12

  MASS-LINK         9
IMPLND     IWATER SURO       0.0833333     COPY            INPUT  MEAN
  END MASS-LINK     9

  MASS-LINK        10
COPY       OUTPUT MEAN                     RCHRES          INFLOW IVOL
  END MASS-LINK    10

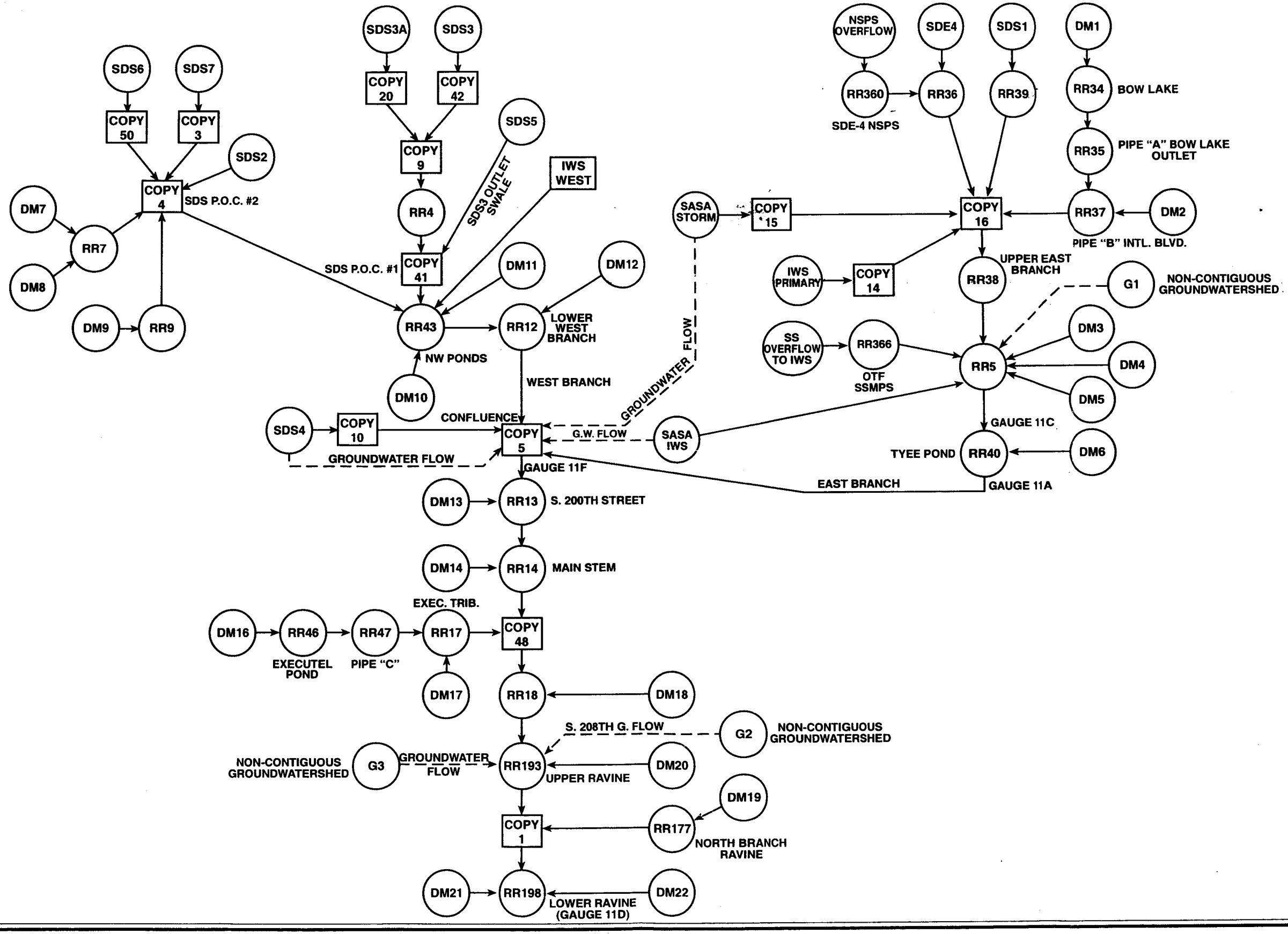
END MASS-LINK
```

```
END RUN
```

DES MOINES CREEK WATERSHED
HSPF INPUT FILES

- PREDEVELOPMENT CONDITIONS
- 2006 CONDITIONS

PREDEVELOPMENT CONDITIONS



July 2001
556-2912-001 (28)

Parametrix, Inc. Port of Seattle/HSPF Model/556-2912-001/01(028) 12/00 (K)

DM# = Des Moines Creek Subbasin Number
SDS# = Storm Drainage South Number
SDE# = Storm Drainage East Number
R# = Routing Reach Number (Channel or Storage Pond)

Stormwater
IWS
Groundwater

DM1 / RR12 —Subbasin ID / —Routing Reach Number

COPY 8 Summation of upstream flow

Figure 1
Des Moines Creek
HSPF Model Schematic
Predevelopment Conditions

AR 010783

```
RUN
GLOBAL
  ***  FILE: DMPRER5M.INP (MODIFY DMPRE.INP)
  ***  Revised March 2001 to reflect King County changes (FK, 03/22/2001)
  ***  HSPF MODEL OF DES MOINES CREEK
  ***  UPDATE MODEL TO CREATE DOWNSTREAM EVALUATION POINT FOR SDS TO WEST BRANCH
  ***  FUTURE CONDITIONS = DM06R.INP
  ***  PREDEVELOPED CONDITION (SDS2,5,6 removed; SDS2, SDS5, SDS6 watersheds added)
  ***  10-75-15 LAND USE (<10% 94 IMPERV -->GRASS) ON STIA PROJECT AREA
  ***  1994 COVER CONDITIONS ON NON PROJECT AREAS
  ***  ELIMINATE IWS SYSTEM COMPONENTS NOT ROUTED TO SDS
  DES MOINES CREEK BASIN HSPF MODEL
  START       1948/10/01 00:00  END    1996/09/30 24:00
  START       1992/01/01 00:00  END    1996/09/30 24:00***
  RUN INTERP OUTPUT LEVEL    0
  RESUME     0 RUN     1
END GLOBAL

FILES
MESSU      24   DMPRE.MES
WDM        25   DM.WDM
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      54
      IMPLND      14
      RCHRES     360
      RCHRES      36
      RCHRES      39
      COPY        20
      COPY        42
      COPY         9
      RCHRES       4
      COPY        41
      COPY        10
      RCHRES     366
      COPY        50
      COPY         3
      RCHRES       7
      RCHRES       9
      COPY         4
      RCHRES      43
      COPY        15
      RCHRES      34
      RCHRES      35
      RCHRES      37
      COPY        14
      COPY        16
      RCHRES      38
      RCHRES       5
      RCHRES      40
      RCHRES      12
      COPY         5
      RCHRES      13
      RCHRES      14
      RCHRES     177
      RCHRES      46
      RCHRES      47
      RCHRES      17
      COPY        48
      RCHRES      18
      RCHRES     193
      COPY         1
      RCHRES     198
    END INGRP
END OPN SEQUENCE

PERLND
  GEN-INFO
    <PLS >      Name          NBLKS   Unit-systems   Printer              ***
    # -  #                           User  t-series Engl Metr              ***
```

```
                                                in  out                                  ***
 16      TFM- TILL FOR MOD       1    1    1    1   60    0
 26      TGM- TILL GR MOD        1    1    1    1   60    0
 34      OF - OUTWASH FOR        1    1    1    1   60    0
 44      OG - OUTWASH GR         1    1    1    1   60    0
 54      SA - WETLANDS           1    1    1    1   60    0
END GEN-INFO
ACTIVITY
  <PLS > ************* Active Sections *****************************
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC        ***
 14   54    0    0    1    0    0    0    0    0    0    0    0    0
END ACTIVITY
PRINT-INFO
  <PLS > ********************* Print-flags ************************* PIVL  PYR
  # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
 14   54    0    0    6    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
PWAT-PARM1
  <PLS > ***************** Flags ********************
  # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                        ***
 14   54    0    0    0    0    0    0    0    0    0
END PWAT-PARM1

PWAT-PARM2
  <PLS > ***
  # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
 16                   4.5000    0.2000    200.00    0.1000    0.5000    0.9960
 26                   4.5000    0.0750    400.00    0.1000    0.5000    0.9960
 34                   5.0000    2.0000    200.00    0.0500    0.3000    0.9960
 44                   5.0000    0.8000    200.00    0.0500    0.3000    0.9960
 54                   4.0000    2.0000    200.00    0.0010    0.5000    0.9960
END PWAT-PARM2
PWAT-PARM3
  <PLS >***
  # -  #*** PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
 16                             2.0000    2.0000      0.55      0.00       0.0
 26                             2.0000    2.0000      0.55      0.00       0.0
 34                             2.0000    2.0000      0.55      0.00       0.0
 44                             2.0000    2.0000      0.55      0.00       0.0
 54                             10.000    2.0000      0.55      0.00       0.7
END PWAT-PARM3
PWAT-PARM4
  <PLS >                                                                  ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
 16         0.2000    0.5000    0.3500     3.000    0.5000    0.7000
 26         0.1000    0.2500    0.2500     3.000    0.5000    0.2500
 34         0.2000    0.5000    0.3500     0.000    0.7000    0.7000
 44         0.1000    0.5000    0.2500     0.000    0.7000    0.2500
 54         0.2000    3.0000    0.5000     1.000    0.7000    0.8000
END PWAT-PARM4

PWAT-STATE1
  <PLS >  PWATER state variables***
  # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
 16          0.078        0.    0.0010        0.     0.075     0.267     0.026
 26          0.051        0.    0.0350        0.     1.928     0.680     0.049
 34          0.078        0.    0.0010        0.     0.090     0.676     0.038
 44          0.051        0.    0.0040        0.     1.127     0.614     0.152
 54          0.051        0.    0.3330        0.     0.622     0.000     0.000
END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >      Name              Unit-systems   Printer                        ***
    # -  #                      User  t-series Engl Metr                        ***
                                       in  out                                  ***
  13  140 IMPERVIOUS              1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <ILS > ************* Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
  13  140    0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
```

```
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   13  140    0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1
    <ILS >            Flags            ***                                    ***
    # -  # CSNO RTOP  VRS  VNN RTLI    ***                                    ***
   13  140    0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2
    <ILS >                                                                    ***
    # -  #      LSUR     SLSUR      NSUR     RETSC ***
   14          500.0    0.0100    0.1000    0.100
  140         100.00    0.0500    0.1000    0.0500
  END IWAT-PARM2
  IWAT-PARM3
    <ILS >                                                                    ***
    # -  #    PETMAX    PETMIN                                                ***
   13  140
  END IWAT-PARM3
  IWAT-STATE1
    <ILS >  IWATER state variables                                            ***
    # -  #      RETS      SURS                                                ***
   13  140 1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND

RCHRES
  GEN-INFO
    RCHRES       Name         Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG             ***
                                          in  out                             ***
    4     SDS-3 Outlet Swale      1    1    1    1    0    0    0
    5     E.Branch above TyeeP    1    1    1    1    0    0    0
    7     DM7 & DM8 Conveyance    1    1    1    1    0    0    0
    9     DM9 Conveyance          1    1    1    1    0    0    0
   12     Lower W. Branch         1    1    1    1    0    0    0
   13     Confl. to 200th St.     1    1    1    1    0    0    0
   14     200th to Exec. Trib.    1    1    1    1    0    0    0
   17     Executel Tributary      1    1    1    1    0    0    0
   18     Exec.Confl. to 208th    1    1    1    1    0    0    0
   34     Bow Lake                1    1    1    1    0    0    1
   35     Pipe A Bow LK Outlet    1    1    1    1    0    0    0
   36     SDE-4 Combined Disch    1    1    1    1    0    0    0
   37     Pipe B 60" Intl Blvd    1    1    1    1    0    0    0
   38     Upper E. Branch         1    1    1    1    0    0    0
   39     SDS-1 Storm Only        1    1    1    1    0    0    0
   40     Tyee Pond Reach         1    1    1    1    0    0    0
   43     Northwest Ponds Rch     1    1    1    1    0    0    1
   46     Executel Pond Reach     1    1    1    1    0    0    0
   47     Pipe C Exec.Pond Dis    1    1    1    1    0    0    0
  177     North Branch Ravine     1    1    1    1    0    0    0
  193     Upper Ravine            1    1    1    1    0    0    0
  198     Lower Ravine            1    1    1    1    0    0    0
  360     SDE-4 NSPS              1    1    1    1    0    0    0
  366     OTF   SSMPS             1    1    1    1    0    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG                  ***
    1  366    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    RCHRES *************** Printout Flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
    1  366    6    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                       ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    4   17   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
   18   34   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
   35   42   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
   43        0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
```

```
  46  198   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 360  366   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 END HYDR-PARM1

 HYDR-PARM2
***Modified by FK to include 40 and 46 in the model
   RCHRES                                                                  ***
   # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
 <------><--------><--------><--------><--------><--------><-------->       ***
   4              4   0.530                             0.3
   5              5   0.380                             0.3
   7              7   0.341                             0.3
   9              9   0.189                             0.3
  12             12   0.273                             0.3
  13             13   0.218                             0.3
  14             14   0.218                             0.3
  17             17   0.246                             0.3
  18             18   0.303                             0.3
  34             34   0.208                             0.3
  35             35   0.123                             0.3
  36              1   0.100                             0.3
  37             37   0.381                             0.3
  38             38   0.142                             0.3
  39              1   0.100                             0.3
  40             40   0.189                             0.3
  43             43   0.189                             0.3
  46             46   0.047                             0.3
  47             47   0.417                             0.3
 177            177   0.407                             0.3
 193            193   0.795                             0.3
 198            198   0.631                             0.3
 360              1   0.100                             0.3
 366              1   0.100                             0.3
 END HYDR-PARM2

 HYDR-INIT
   RCHRES  Initial conditions for each HYDR section                         ***
   # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit        for each possible exit
 <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
   3     0.1              4.0
   4     0.1              4.0
   5     0.1              4.0
   7     0.1              4.0
   9     0.1              4.0
  12     0.1              4.0
  13     0.1              4.0
  14     0.1              4.0
  17     0.1              4.0
  18     0.1              4.0
  34     35.              4.0
  35     0.0              4.0
  36     0.0              4.0
  37     0.0              4.0
  38     0.0              4.0
  39     0.0              4.0
  40     0.0              4.0
  43     0.1              4.0  5.0
  46     0.0              4.0
  47     0.0              4.0
 177     0.0              4.0
 193     0.0              4.0
 198     0.0              4.0
 360     0.0              4.0
 366     0.0              4.0
 END HYDR-INIT
END RCHRES

FTABLES

  FTABLE      1
 ROWS COLS ***
    8    4
     DEPTH      AREA    VOLUME     DISCH  OUTFLOW2 ***
      (FT)   (ACRES)   (AC-FT)     (CFS)     (CFS) ***
      0.00     0.000     0.000       0.0
```

```
      0.50      0.016      0.006          1
      1.00      0.016      0.011          4
      1.50      0.024      0.025         12
      2.00      0.032      0.045         30
      2.50      0.040      0.070         50
      3.00      0.048      0.101         80
      5.00      0.064      0.225        250
  END FTABLE  1

  FTABLE      4
*** SDS-3 OUTLET SWALE
 ROWS COLS ***
    7    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
       (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)                ***
      .000       .000        0.0       0.0
      .500       .198        0.1       9.0
     1.000       .236        0.5      30.9
     2.000       .306        1.0     115.8
     3.000       .376        1.5     265.5
     4.000       .446        5.0     491.8
     5.000       .517       20.0     806.3
  END FTABLE  4

  FTABLE      5
*** EAST BRANCH ABOVE TYEE POND
 ROWS COLS ***
   13    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
       (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)                ***
      .000       .000        .000      .000
      .550       .290        .100     4.900
     1.100       .543        .200    20.800
     1.650       .609        .300    46.500
     2.200       .671        .400    80.000
     2.750       .732       0.500   118.700
     3.300       .778       0.600   159.500
     3.850       .819       0.700   198.400
     4.400       .849       0.801   231.900
     4.950       .866       1.000   252.900
     5.500       .865       1.200   253.000
     8.200       .973       1.500   400.000
    10.200      1.043       2.000   520.000
  END FTABLE  5

  FTABLE      7
*** DM7 & DM8 CONVEYANCE
 ROWS COLS ***
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
       (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)                ***
      .000       .000        .000      .000
      .500       .360        .120     6.200
     1.000       .416        .276    20.800
     2.000       .520        .694    75.400
     3.000       .626       1.252   168.700
     4.000       .732       1.950   306.900
     5.000       .836       2.790   496.100
     6.000       .942       3.768   742.300
  END FTABLE  7

  FTABLE      9
*** DM9 CONVEYANCE
 ROWS COLS ***
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
       (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)                ***
      .000        .00         0.0        .0
      .500        .20         0.7       9.7
     1.000        .23         3.1      32.6
     2.000        .29        14.9       118
     3.000        .35        38.4       265
     4.000        .41          77       482
     5.000        .47         135       778
     6.000        .52         214      1165
  END FTABLE  9
```

```
  FTABLE     12
*** LOWER WEST BRANCH
*** REVISED BASED ON HEC-RAS MODEL
 ROWS COLS ***
   13    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)      (CFS)
      .000       .000     0.000       .000
      .500       .291     0.030      0.150
     1.000       .346     0.260      6.600
     2.000       .450     0.430     14.100
     3.000       .554     0.650     25.000
     4.000       .656     1.180     50.000
     5.000       .753     2.170     75.000
     6.000       .796     3.820    100.000
     7.000       .837     8.820    150.000
     8.000       .837    16.200    200.000
     9.000       .837    27.920    250.000
    10.000       .837    33.530    350.000
    11.000       .837    35.380    450.000
  END FTABLE 12

  FTABLE     13
*** CONFLUENCE TO 200TH STREET
 ROWS COLS ***
    9    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)      (CFS)
      .000       .000      .000       .000
      .500       .153      .051      4.300
     1.000       .272      .132     14.400
     2.000       .317      .312     50.400
     3.000       .360      .544    109.600
     4.000       .404      .826    195.000
     5.000       .450     1.163    309.500
     6.000       .497     1.548    456.300
     7.000       .542     1.984    638.000
  END FTABLE 13

  FTABLE     14
*** 200TH STREET TO EXECUTEL TRIBUTARY
*** REACH 190 FROM TR-20/KING COUNTY BASIN PLAN MODEL:
 ROWS COLS ***
    5    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)      (CFS)
     0.000      0.000     0.000      0.000
     0.900      0.70      0.4000     30.00
     1.800      0.80      1.1000    115.60
     2.700      1.10      2.1000    269.80
     4.200      1.30      4.3000    707.10
  END FTABLE 14

  FTABLE     17
*** EXECUTEL TRIBUTARY
 ROWS COLS ***
   10    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)      (CFS)
      .000       .000      .000       .000
      .300       .169      .034      2.900
      .600       .192      .076      9.800
      .900       .215      .128     20.400
     1.200       .238      .189     35.100
     1.500       .259      .258     54.100
     1.800       .282      .336     77.700
     2.100       .303      .423    106.200
     3.100       .376      .779    245.000
     3.600       .412      .988    335.000
  END FTABLE 17

  FTABLE     18
*** CONFLUENCE WITH EXECUTEL TRIBUTARY TO 208TH STREET
*** REPRESENTS GW LOSS IN WETLAND BELOW 200TH
 ROWS COLS ***
```

```
   14    5
***  DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)     (CFS)
       .000      .000      .000     .000      0.00
       .500      .572      .191    7.300      0.00
      1.000      .799      .438   10.000      0.00
      2.000      .968     1.001   20.700      0.00
      3.000     1.155     1.727  100.000      0.00
      4.000     1.317     2.542  262.700      0.00
      5.000     1.478     3.475  400.300      0.00
      6.000     1.643     4.545  570.200      0.00
      7.000     1.791     5.688  774.400      0.00
      8.000     1.932     6.822 1015.100      0.00
      9.000     1.945     7.025 1294.500      0.00
     10.000     1.958     7.244 1614.500      0.00
     11.000     1.970     7.481 1977.000      0.00
     12.000     1.983     7.734 2384.700      0.00
  END FTABLE 18

  FTABLE     34
*** BOW LAKE
*** BASED ON ENTRANCE CONTROL FOR 36 INCH OUTLET PIPE
 ROWS COLS ***
    8    5
***  DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)     (CFS)
      0.000    14.000     0.000     0.000      0.00
      1.000    14.000    14.000     7.000      0.00
      1.500    14.000    21.000    13.000      0.00
      2.000    14.000    28.000    17.000      0.00
      3.000    14.000    42.000    35.000      0.00
      4.000    14.000    56.000    49.000      0.00
      5.000    14.000    70.000    60.000      0.00
      6.000    14.000    84.000    70.000      0.00
  END FTABLE 34

  FTABLE     35
*** 36" BOW LAKE DISCHARGE PIPELINE (A)
 ROWS COLS ***
   13    4
***  DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)     (CFS)
       .000      .000      .000     .000
       .300      .020     .0006    1.000
       .600      .026     .0026    4.200
       .900      .032     .0068    9.400
      1.200      .034     .0134   16.200
      1.500      .037     .0226   24.000
      1.800      .039     .0346   32.300
      2.100      .040     .0492   40.100
      2.400      .040     .0667   46.900
      2.700      .039     .0857   51.200
      3.000      .037     .1000   55.300
*** SURCHARGING-
      3.300      .038     .2500   60.300
      4.000      .038     .4000   80.000
  END FTABLE 35

  FTABLE     37
*** 60" INTERNATIONAL BLVD PIPELINE (B)
 ROWS COLS ***
   13    4
***  DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES)  (ACRE-FT)    (CFS)     (CFS)
       .000      .000      .000     .000
       .450      .134      .045    4.800
       .900      .190      .100   20.300
      1.350      .225      .150   45.400
      1.800      .249      .200   78.000
      2.250      .266      .250  115.900
      2.700      .271      .300  155.800
      3.150      .264      .350  193.800
      3.600      .251      .400  226.500
      4.050      .238      .450  247.000
      4.500      .234      .500  247.100
      6.500      .185      .600  340.000
```

```
    8.500      .166      .700   415.000
  END FTABLE 37

  FTABLE     38
*** UPPER EAST BRANCH
 ROWS COLS ***
    9    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                    ***
       (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
       .000      .000      .000      .000
       .500      .176      .100     9.200
      1.000      .194     0.150    30.400
      2.000      .232     0.200   105.800
      3.000      .271     0.250   228.900
      4.000      .310     0.350   405.800
      5.000      .349     0.450   642.700
      6.000      .387     0.600   945.700
      7.000      .426     0.800  1320.700
  END FTABLE 38

  FTABLE     40
*** TYEE POND
*** BASED ON TYEE POND AS-BUILTS AND AUTOMATED GATE OPERATION MANUAL
*** K RITLAND 2/4/98
*** Inserted by FK to reflect KC comments (03/22/2001)
 ROWS COLS ***
   20    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                    ***
       (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
       0.00      0.00      0.00      0.00
       0.90      0.01      0.01     10.00
       1.65      0.02      0.02     20.00
       3.11      0.07      0.07     30.00
       4.56      0.22      0.29     40.00
       6.02      0.63      0.89     50.00
       7.48      0.88      2.02     60.00
       8.62      1.06      3.18     70.00
       9.79      1.18      4.29     80.00
      10.88      1.34      5.83     90.00
      11.99      1.48      7.20    100.00
      13.12      1.69      9.17    110.00
      15.13      2.04     12.90    120.00
      16.10      2.20     14.92    124.10
      16.30      2.24     15.40    129.65
      16.57      2.28     15.88    150.36
      16.64      2.32     16.36    155.00
      16.80      2.36     16.84    208.74
      17.03      2.40     17.32    293.59
      17.26      2.43     17.79    428.11
  END FTABLE 40

  FTABLE     43
*** NORTHWEST PONDS
*** BASED ON KING COUNTY BASIN PLANNING MODEL
 ROWS COLS ***
   17    5
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                    ***
       (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
      0.000    12.000     0.000     0.000      0.00
      0.100    12.000    18.800     0.000      0.00
      1.000    12.000    24.000     0.200      0.00
      2.000    12.000    30.000     0.500      0.00
      3.000    12.000    37.000     1.000      0.00
      3.500    13.000    41.000     5.000      0.00
      4.000    13.000    45.700    15.000      0.00
      4.500    13.000    51.000    35.000      0.00
      5.000    14.000    56.500   150.000      0.00
      5.500    14.000    62.800   200.000      0.00
      6.000    14.000    69.000   300.000      0.00
      6.500    14.000    83.500   350.000      0.00
      7.000    15.000    99.900   400.000      0.00
      8.000    17.000    119.00   500.000      0.00
      9.000    20.000    141.50   550.000      0.00
     10.000    23.000    180.00   600.000      0.00
     11.000    27.000    200.00   650.000      0.00
  END FTABLE 43
```

```
  FTABLE     46
*** EXECUTEL POND
***Inserted by FK to reflect KC comments (03/22/2001)
 ROWS COLS ***
   20    4
***   DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)   (ACRES)  (ACRE-FT)     (CFS)     (CFS)
       .000      .000       .000      .000
      1.000      .080       .080    24.420
      2.000      .230       .310    34.540
      3.000      .393       .703    42.300
      3.500      .494       .950    45.690
      4.000      .508      1.204    48.850
      4.500      .532      1.470    51.810
      5.000      .540      1.740    54.610
      5.500      .540      2.010    57.280
      6.000      .580      2.300    59.820
      6.500      .600      2.600    62.270
      7.000      .600      2.900    64.620
      7.500      .600      3.200    66.900
      8.000      .620      3.510    69.100
      8.500      .640      3.830    71.200
      9.000      .740      4.200    82.220
     10.000      .650      4.850   119.830
     11.000      .720      5.570   169.000
     12.000      .750      6.320   250.900
     13.000     1.000      7.320   500.900
  END FTABLE 46

  FTABLE     47
*** EXECUTEL POND DISCHARGE PIPELINE (C)
 ROWS COLS ***
   11    4
***   DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)   (ACRES)  (ACRE-FT)     (CFS)     (CFS)
       .000      .000       .000      .000
       .350      .069       .020     4.600
       .700      .096       .056    19.200
      1.050      .112       .099    42.800
      1.400      .124       .150    73.400
      1.750      .125       .203   109.000
      2.100      .121       .240   146.600
      2.450      .110       .264   182.400
      2.800      .096       .284   213.200
      3.150      .090       .290   232.400
      3.500      .088       .293   232.600
  END FTABLE 47

  FTABLE    177
*** NORTH BRANCH RAVINE
 ROWS COLS ***
   14    4
***   DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)   (ACRES)  (ACRE-FT)     (CFS)     (CFS)
       .000      .000       .000        .0
       .500      .572       .191       7.3
      1.000      .799       .438      23.2
      2.000      .968      1.001      75.7
      3.000     1.155      1.727     155.1
      4.000     1.317      2.542     262.7
      5.000     1.478      3.475     400.3
      6.000     1.643      4.545     570.2
      7.000     1.791      5.688     774.4
      8.000     1.932      6.822    1015.1
      9.000     1.945      7.025    1294.5
     10.000     1.958      7.244    1614.5
     11.000     1.970      7.481    1977.0
     12.000     1.983      7.734    2384.7
  END FTABLE177

  FTABLE    193
*** UPPER RAVINE
 ROWS COLS ***
   14    4
***   DEPTH      AREA     VOLUME    OUTFLOW  OUTFLOW2
```

```
      (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)                    ***
      0.00       0.00       0.00       0.0
      0.35       0.72       0.75       7.8
      0.70       0.72       1.51      23.5
      1.05       0.72       2.28      44.3
      1.40       0.72       3.03      68.2
      1.75       0.72       3.81      95.8
      2.10       0.72       4.56     125.2
      2.45       0.75       5.36     169.0
      2.80       0.89       6.30     171.5
      3.15       1.00       7.35     247.6
      3.50       1.08       8.49     332.7
      3.85       1.21       9.75     396.5
      4.20       1.32      11.13     521.2
      4.55       1.41      12.60     655.5
  END FTABLE193

  FTABLE    198
 ROWS COLS ***
*** LOWER RAVINE
*** ROUGH ESTIMATE BASED ON FIELD VISIT OF 12/20/95
*** FLOW WAS 6 TO 7 CFS WITH DEPTH OF 8"
*** NEAR OUTLET.
*** DRIVE WHICH REPRESENTS A RESTRICTION ACCORDING TO OBSERVATION
    8    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                        ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)      (CFS)                    ***
      0.00       0.00       0.00       0.0
      1.00       0.50       0.80      10.0
      2.00       0.55       1.30      25.0
      3.00       0.60       1.80      50.0
      5.00       0.70       2.50     100.0
*** SUBMERGENCE OF CULVERT
     10.00       2.50      12.00     245.0
*** OVERBANK STORAGE
*** FLOWS BASED ON 243', .03 D-W FACTOR, PLUS LOSS OF 1. VELOCITY HEAD
     15.00      10.00      40.00     325.0
     20.00      11.00      90.00     390.0
  END FTABLE198

END FTABLES

COPY
  TIMESERIES                                                              ***
  Copy-opn                                                                ***
    # -  #  NPT  NMN
    1   59         1
  END TIMESERIES
END COPY

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #    #        <Name> # #  ***
WDM      2 PREC     ENGLZERO               PERLND  14   54 EXTNL   PREC
WDM      2 PREC     ENGLZERO               IMPLND  14      EXTNL   PREC
WDM      2 PREC     ENGLZERO               RCHRES  34      EXTNL   PREC
WDM      2 PREC     ENGLZERO               RCHRES  40      EXTNL   PREC
WDM      2 PREC     ENGLZERO               RCHRES  43      EXTNL   PREC
WDM      1 EVAP     ENGLZERO     0.8       PERLND  14  440 EXTNL   PETINP
WDM      1 EVAP     ENGLZERO     0.8       IMPLND  14  140 EXTNL   PETINP
WDM      1 EVAP     ENGLZERO     0.8       RCHRES  34      EXTNL   POTEV
WDM      1 EVAP     ENGLZERO     0.8       RCHRES  43      EXTNL   POTEV
WDM      1 EVAP     ENGLZERO     0.8       RCHRES  40      EXTNL   POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*******************************************************************************
*** SDS
*******************************************************************************
*** SDE-4 (TOTAL)
RCHRES  36 HYDR   RO                       WDM    121 FLOW     ENGL       REPL
*******************************************************************************
*** SDS-1 (TOTAL)
RCHRES  39 HYDR   RO                       WDM    122 FLOW     ENGL       REPL
```

```
********************************************************************************
*** SDS-3
COPY    42 OUTPUT MEAN   1    12.1         WDM    157 FLOW     ENGL      REPL
********************************************************************************
*** SDS-4
COPY    10 OUTPUT MEAN   1    12.1         WDM    158 FLOW     ENGL      REPL
********************************************************************************
*** SDS-3A TAXIWAY VAULT
COPY    20 OUTPUT MEAN   1    12.1         WDM    124 FLOW     ENGL      REPL
********************************************************************************
*** SDS-7 3RD RUNWAY VAULT
COPY     3 OUTPUT MEAN   1    12.1         WDM    126 FLOW     ENGL      REPL
********************************************************************************

*** WEST BRANCH
********************************************************************************
*** NORTHWEST PONDS REACH
RCHRES  43 HYDR   RO                      WDM    131 FLOW     ENGL      REPL
********************************************************************************
*** LOWER WEST BRANCH
RCHRES  12 HYDR   RO                      WDM    135 FLOW     ENGL      REPL
********************************************************************************
*** EVALUATION POINT FOR SDS DISCHARGE TO WEST BRANCH - POC-1
COPY    41 OUTPUT MEAN   1    12.1         WDM    160 FLOW     ENGL      REPL
********************************************************************************
*** EVALUATION POINT FOR SDS DISCHARGE TO WEST BRANCH - POC-2
COPY     4 OUTPUT MEAN   1    12.1         WDM    161 FLOW     ENGL      REPL
********************************************************************************

*** EAST BRANCH
********************************************************************************
*** BOW LAKE OUTFLOW
RCHRES  35 HYDR   RO                      WDM    136 FLOW     ENGL      REPL
RCHRES  37 HYDR   RO                      WDM     47 FLOW     ENGL      REPL
*** SASA POC
COPY    16 OUTPUT MEAN   1    12.1         WDM    438 FLOW     ENGL      REPL

********************************************************************************
*** EXISTING UPPER EAST BRANCH (FUTURE SASA DETENTION SITE)
RCHRES  38 HYDR   RO                      WDM    137 FLOW     ENGL      REPL
********************************************************************************
*** TYEE INFLOW (GAUGE 11C)
RCHRES   5 HYDR   RO                      WDM    138 FLOW     ENGL      REPL
********************************************************************************

*** MAIN STEM
********************************************************************************
*** BELOW CONFLUENCE AT TYEE GOLF COURSE WEIR (GAUGE 11F)
COPY     5 OUTPUT MEAN   1    12.1         WDM    140 FLOW     ENGL      REPL
********************************************************************************
*** BELOW CONFLUENCE AT SOUTH 200TH STREET
RCHRES  13 HYDR   RO                      WDM    141 FLOW     ENGL      REPL
********************************************************************************
*** LOWER DES MOINES CREEK NEAR MOUTH (GAUGE 11D)
RCHRES 198 HYDR   RO                      WDM    142 FLOW     ENGL      REPL
********************************************************************************

END EXT TARGETS
                                                                            ***

NETWORK
***         <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>         <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
********************************************************************************
*** AIRPORT SUBBASINS
********************************************************************************
*** (DM23) SDE-4
PERLND  16 PWATER SURO          10.389      RCHRES  36     EXTNL  IVOL
PERLND  16 PWATER IFWO          10.389      RCHRES  36     EXTNL  IVOL
PERLND  26 PWATER SURO           2.078      RCHRES  36     EXTNL  IVOL
PERLND  26 PWATER IFWO           2.078      RCHRES  36     EXTNL  IVOL
IMPLND  14 IWATER SURO           1.385      RCHRES  36     EXTNL  IVOL
********************************************************************************
*** (DM24) SDS-1
PERLND  16 PWATER SURO           1.109      RCHRES  39     EXTNL  IVOL
PERLND  16 PWATER IFWO           1.109      RCHRES  39     EXTNL  IVOL
PERLND  26 PWATER SURO           0.222      RCHRES  39     EXTNL  IVOL
```

```
PERLND  26 PWATER IFWO          0.222       RCHRES  39      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.148       RCHRES  39      EXTNL  IVOL
********************************************************************************
*** (DM25) SDS-3A
PERLND  16 PWATER SURO          4.361       COPY    20      INPUT  MEAN   1
PERLND  16 PWATER IFWO          4.361       COPY    20      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.872       COPY    20      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.872       COPY    20      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.581       COPY    20      INPUT  MEAN   1
********************************************************************************
*** (DM25) SDS-7
PERLND  16 PWATER SURO          5.392       COPY     3      INPUT  MEAN   1
PERLND  16 PWATER IFWO          5.392       COPY     3      INPUT  MEAN   1
PERLND  26 PWATER SURO          1.164       COPY     3      INPUT  MEAN   1
PERLND  26 PWATER IFWO          1.164       COPY     3      INPUT  MEAN   1
PERLND  34 PWATER SURO          0.287       COPY     3      INPUT  MEAN   1
PERLND  34 PWATER IFWO          0.287       COPY     3      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.062       COPY     3      INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.062       COPY     3      INPUT  MEAN   1
PERLND  54 PWATER SURO          0.033       COPY     3      INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.033       COPY     3      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.668       COPY     3      INPUT  MEAN   1
********************************************************************************
*** (DM25) SDS-3
PERLND  16 PWATER SURO         21.455       COPY    42      INPUT  MEAN   1
PERLND  16 PWATER IFWO         21.455       COPY    42      INPUT  MEAN   1
PERLND  26 PWATER SURO          4.291       COPY    42      INPUT  MEAN   1
PERLND  26 PWATER IFWO          4.291       COPY    42      INPUT  MEAN   1
IMPLND  14 IWATER SURO          2.861       COPY    42      INPUT  MEAN   1
********************************************************************************
*** (New watershed SDS-6)
PERLND  16 PWATER SURO          1.045       COPY    50      INPUT  MEAN   1
PERLND  16 PWATER IFWO          1.045       COPY    50      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.209       COPY    50      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.209       COPY    50      INPUT  MEAN   1
PERLND  34 PWATER SURO          *****       COPY    50      INPUT  MEAN   1
PERLND  34 PWATER IFWO          *****       COPY    50      INPUT  MEAN   1
PERLND  44 PWATER SURO          *****       COPY    50      INPUT  MEAN   1
PERLND  44 PWATER IFWO          *****       COPY    50      INPUT  MEAN   1
PERLND  54 PWATER SURO          *****       COPY    50      INPUT  MEAN   1
PERLND  54 PWATER IFWO          *****       COPY    50      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.139       COPY    50      INPUT  MEAN   1
********************************************************************************
*** (New watershed SDS-5)
PERLND  16 PWATER SURO          2.029       COPY    41      INPUT  MEAN   1
PERLND  16 PWATER IFWO          2.029       COPY    41      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.406       COPY    41      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.406       COPY    41      INPUT  MEAN   1
PERLND  34 PWATER SURO          *****       COPY    41      INPUT  MEAN   1
PERLND  34 PWATER IFWO          *****       COPY    41      INPUT  MEAN   1
PERLND  44 PWATER SURO          *****       COPY    41      INPUT  MEAN   1
PERLND  44 PWATER IFWO          *****       COPY    41      INPUT  MEAN   1
PERLND  54 PWATER SURO          *****       COPY    41      INPUT  MEAN   1
PERLND  54 PWATER IFWO          *****       COPY    41      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.270       COPY    41      INPUT  MEAN   1
********************************************************************************
*** (New watershed SDS-2)
PERLND  16 PWATER SURO          0.225       COPY     4      INPUT  MEAN   1
PERLND  16 PWATER IFWO          0.225       COPY     4      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.045       COPY     4      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.045       COPY     4      INPUT  MEAN   1
PERLND  34 PWATER SURO          0.315       COPY     4      INPUT  MEAN   1
PERLND  34 PWATER IFWO          0.315       COPY     4      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.063       COPY     4      INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.063       COPY     4      INPUT  MEAN   1
PERLND  54 PWATER SURO          0.043       COPY     4      INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.043       COPY     4      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.072       COPY     4      INPUT  MEAN   1
********************************************************************************

*** (DM27) SDS-4
PERLND  16 PWATER SURO          0.940       COPY    10      INPUT  MEAN   1
PERLND  16 PWATER IFWO          0.940       COPY    10      INPUT  MEAN   1
PERLND  16 PWATER AGWO          0.940       COPY     5      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.188       COPY    10      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.188       COPY    10      INPUT  MEAN   1
```

```
PERLND  26 PWATER AGWO          0.188      COPY     5      INPUT  MEAN   1
PERLND  34 PWATER SURO          3.095      COPY    10      INPUT  MEAN   1
PERLND  34 PWATER IFWO          3.095      COPY    10      INPUT  MEAN   1
PERLND  34 PWATER AGWO          3.095      COPY     5      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.619      COPY    10      INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.619      COPY    10      INPUT  MEAN   1
PERLND  44 PWATER AGWO          0.619      COPY     5      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.538      COPY    10      INPUT  MEAN   1
*****************************************************************************
*** SASA STORM
PERLND  16 PWATER SURO          2.088      COPY    15      INPUT  MEAN   1
PERLND  16 PWATER IFWO          2.088      COPY    15      INPUT  MEAN   1
PERLND  16 PWATER AGWO          2.088      COPY     5      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.418      COPY    15      INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.418      COPY    15      INPUT  MEAN   1
PERLND  26 PWATER AGWO          0.418      COPY     5      INPUT  MEAN   1
PERLND  34 PWATER SURO          0.020      COPY    15      INPUT  MEAN   1
PERLND  34 PWATER IFWO          0.020      COPY    15      INPUT  MEAN   1
PERLND  34 PWATER AGWO          0.020      COPY     5      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.004      COPY    15      INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.004      COPY    15      INPUT  MEAN   1
PERLND  44 PWATER AGWO          0.004      COPY     5      INPUT  MEAN   1
PERLND  54 PWATER SURO          0.045      COPY    15      INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.045      COPY    15      INPUT  MEAN   1
PERLND  54 PWATER AGWO          0.045      COPY     5      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.281      COPY    15      INPUT  MEAN   1
*****************************************************************************

*** IWS SYSTEM PRIMARY SYSTEM AND PUMP STATIONS
*****************************************************************************
*** I-3: NORTH SATELLITE PUMP STATION (NSPS) TO IWS
*** OVERFLOW TO SDE-4
*** INSTALLED IN 1995
PERLND  16 PWATER SURO          0.859      RCHRES 360      EXTNL  IVOL
PERLND  16 PWATER IFWO          0.859      RCHRES 360      EXTNL  IVOL
PERLND  26 PWATER SURO          0.172      RCHRES 360      EXTNL  IVOL
PERLND  26 PWATER IFWO          0.172      RCHRES 360      EXTNL  IVOL
IMPLND  14 IWATER SURO          0.115      RCHRES 360      EXTNL  IVOL
*****************************************************************************
*****************************************************************************
*** I-5: SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION TO IWS
*** OVERFLOW TO DES MOINES EAST BRANCH
*** INSTALLED IN LATE 1997/1998
IMPLND  14 IWATER SURO          0.001      RCHRES 366      EXTNL  IVOL
*****************************************************************************
*****************************************************************************
*** I-7: IWS - PRIMARY
***
PERLND  16 PWATER SURO         15.430      COPY    14      INPUT  MEAN   1
PERLND  16 PWATER IFWO         15.430      COPY    14      INPUT  MEAN   1
PERLND  26 PWATER SURO          3.086      COPY    14      INPUT  MEAN   1
PERLND  26 PWATER IFWO          3.086      COPY    14      INPUT  MEAN   1
IMPLND  14 IWATER SURO          2.057      COPY    14      INPUT  MEAN   1
*****************************************************************************
*** SASA IWS
PERLND  16 PWATER SURO          3.163      RCHRES   5      EXTNL  IVOL
PERLND  16 PWATER IFWO          3.163      RCHRES   5      EXTNL  IVOL
PERLND  16 PWATER AGWO          3.163      COPY     5      INPUT  MEAN   1
PERLND  26 PWATER SURO          0.633      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER IFWO          0.633      RCHRES   5      EXTNL  IVOL
PERLND  26 PWATER AGWO          0.633      COPY     5      INPUT  MEAN   1
PERLND  34 PWATER SURO          0.402      RCHRES   5      EXTNL  IVOL
PERLND  34 PWATER IFWO          0.402      RCHRES   5      EXTNL  IVOL
PERLND  34 PWATER AGWO          0.402      COPY     5      INPUT  MEAN   1
PERLND  44 PWATER SURO          0.080      RCHRES   5      EXTNL  IVOL
PERLND  44 PWATER IFWO          0.080      RCHRES   5      EXTNL  IVOL
PERLND  44 PWATER AGWO          0.080      COPY     5      INPUT  MEAN   1
PERLND  54 PWATER SURO          0.113      RCHRES   5      EXTNL  IVOL
PERLND  54 PWATER IFWO          0.113      RCHRES   5      EXTNL  IVOL
PERLND  54 PWATER AGWO          0.113      COPY     5      INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.475      RCHRES   5      EXTNL  IVOL
*****************************************************************************
*** IWS WEST
PERLND  16 PWATER SURO          0.364      RCHRES  43      EXTNL  IVOL
PERLND  16 PWATER IFWO          0.364      RCHRES  43      EXTNL  IVOL
PERLND  26 PWATER SURO          0.104      RCHRES  43      EXTNL  IVOL
```

```
PERLND  26 PWATER IFWO          0.104      RCHRES  43     EXTNL  IVOL
PERLND  34 PWATER SURO          0.384      RCHRES  43     EXTNL  IVOL
PERLND  34 PWATER IFWO          0.384      RCHRES  43     EXTNL  IVOL
PERLND  44 PWATER SURO          0.109      RCHRES  43     EXTNL  IVOL
PERLND  44 PWATER IFWO          0.109      RCHRES  43     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.037      RCHRES  43     EXTNL  IVOL
********************************************************************************

*** EAST BRANCH OF CREEK
********************************************************************************
*** DM1
PERLND  16 PWATER SURO          0.860      RCHRES  34     EXTNL  IVOL
PERLND  16 PWATER IFWO          0.860      RCHRES  34     EXTNL  IVOL
PERLND  16 PWATER AGWO          0.241      RCHRES  34     EXTNL  IVOL
PERLND  26 PWATER SURO         11.078      RCHRES  34     EXTNL  IVOL
PERLND  26 PWATER IFWO         11.078      RCHRES  34     EXTNL  IVOL
PERLND  26 PWATER AGWO          3.101      RCHRES  34     EXTNL  IVOL
PERLND  34 PWATER SURO          0.599      RCHRES  34     EXTNL  IVOL
PERLND  34 PWATER IFWO          0.599      RCHRES  34     EXTNL  IVOL
PERLND  34 PWATER AGWO          0.168      RCHRES  34     EXTNL  IVOL
PERLND  44 PWATER SURO          7.697      RCHRES  34     EXTNL  IVOL
PERLND  44 PWATER IFWO          7.697      RCHRES  34     EXTNL  IVOL
PERLND  44 PWATER AGWO          2.155      RCHRES  34     EXTNL  IVOL
PERLND  54 PWATER SURO          1.176      RCHRES  34     EXTNL  IVOL
PERLND  54 PWATER IFWO          1.176      RCHRES  34     EXTNL  IVOL
PERLND  54 PWATER AGWO          0.329      RCHRES  34     EXTNL  IVOL
IMPLND  14 IWATER SURO         14.274      RCHRES  34     EXTNL  IVOL
********************************************************************************
*** DM2
PERLND  16 PWATER SURO          *****      RCHRES  37     EXTNL  IVOL
PERLND  16 PWATER IFWO          *****      RCHRES  37     EXTNL  IVOL
PERLND  26 PWATER SURO          1.232      RCHRES  37     EXTNL  IVOL
PERLND  26 PWATER IFWO          1.232      RCHRES  37     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.821      RCHRES  37     EXTNL  IVOL
********************************************************************************
*** DM3
PERLND  16 PWATER PERO          3.645      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER PERO          *****      RCHRES   5     EXTNL  IVOL
PERLND  54 PWATER PERO          0.013      RCHRES   5     EXTNL  IVOL
IMPLND  14 IWATER SURO          5.030      RCHRES   5     EXTNL  IVOL
********************************************************************************
*** DM4
PERLND  16 PWATER PERO          3.165      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER PERO          0.633      RCHRES   5     EXTNL  IVOL
PERLND  54 PWATER PERO          0.005      RCHRES   5     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.422      RCHRES   5     EXTNL  IVOL
********************************************************************************
*** DM5
PERLND  16 PWATER PERO          1.013      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER PERO          0.203      RCHRES   5     EXTNL  IVOL
PERLND  34 PWATER PERO          0.210      RCHRES   5     EXTNL  IVOL
PERLND  44 PWATER PERO          0.042      RCHRES   5     EXTNL  IVOL
PERLND  54 PWATER PERO          0.112      RCHRES   5     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.163      RCHRES   5     EXTNL  IVOL
********************************************************************************
*** DM6
PERLND  16 PWATER PERO          0.401      RCHRES  40     EXTNL  IVOL
PERLND  26 PWATER PERO          0.131      RCHRES  40     EXTNL  IVOL
PERLND  34 PWATER PERO          0.538      RCHRES  40     EXTNL  IVOL
PERLND  44 PWATER PERO          0.175      RCHRES  40     EXTNL  IVOL
PERLND  54 PWATER PERO          0.312      RCHRES  40     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.008      RCHRES  40     EXTNL  IVOL
********************************************************************************

*** WEST BRANCH OF CREEK
********************************************************************************
*** DM7
PERLND  16 PWATER SURO          2.190      RCHRES   7     EXTNL  IVOL
PERLND  16 PWATER IFWO          2.190      RCHRES   7     EXTNL  IVOL
PERLND  16 PWATER AGWO          0.788      RCHRES   7     EXTNL  IVOL
PERLND  26 PWATER SURO          2.944      RCHRES   7     EXTNL  IVOL
PERLND  26 PWATER IFWO          2.944      RCHRES   7     EXTNL  IVOL
PERLND  26 PWATER AGWO          1.060      RCHRES   7     EXTNL  IVOL
PERLND  34 PWATER SURO          1.969      RCHRES   7     EXTNL  IVOL
PERLND  34 PWATER IFWO          1.969      RCHRES   7     EXTNL  IVOL
PERLND  34 PWATER AGWO          0.709      RCHRES   7     EXTNL  IVOL
```

```
PERLND   44 PWATER SURO          4.142      RCHRES    7     EXTNL  IVOL
PERLND   44 PWATER IFWO          4.142      RCHRES    7     EXTNL  IVOL
PERLND   44 PWATER AGWO          1.491      RCHRES    7     EXTNL  IVOL
PERLND   54 PWATER SURO          0.551      RCHRES    7     EXTNL  IVOL
PERLND   54 PWATER IFWO          0.551      RCHRES    7     EXTNL  IVOL
PERLND   54 PWATER AGWO          0.198      RCHRES    7     EXTNL  IVOL
IMPLND   14 IWATER SURO          2.399      RCHRES    7     EXTNL  IVOL
*******************************************************************************
*** DM8
PERLND   16 PWATER SURO          0.203      RCHRES    7     EXTNL  IVOL
PERLND   16 PWATER IFWO          0.203      RCHRES    7     EXTNL  IVOL
PERLND   16 PWATER AGWO          0.077      RCHRES    7     EXTNL  IVOL
PERLND   26 PWATER SURO          0.609      RCHRES    7     EXTNL  IVOL
PERLND   26 PWATER IFWO          0.609      RCHRES    7     EXTNL  IVOL
PERLND   26 PWATER AGWO          0.231      RCHRES    7     EXTNL  IVOL
PERLND   34 PWATER SURO          0.715      RCHRES    7     EXTNL  IVOL
PERLND   34 PWATER IFWO          0.715      RCHRES    7     EXTNL  IVOL
PERLND   34 PWATER AGWO          0.272      RCHRES    7     EXTNL  IVOL
PERLND   44 PWATER SURO          1.132      RCHRES    7     EXTNL  IVOL
PERLND   44 PWATER IFWO          1.132      RCHRES    7     EXTNL  IVOL
PERLND   44 PWATER AGWO          0.430      RCHRES    7     EXTNL  IVOL
PERLND   54 PWATER SURO          0.161      RCHRES    7     EXTNL  IVOL
PERLND   54 PWATER IFWO          0.161      RCHRES    7     EXTNL  IVOL
PERLND   54 PWATER AGWO          0.061      RCHRES    7     EXTNL  IVOL
IMPLND   14 IWATER SURO          2.420      RCHRES    7     EXTNL  IVOL
*******************************************************************************
*** DM9
PERLND   16 PWATER SURO          0.002      RCHRES    9     EXTNL  IVOL
PERLND   16 PWATER IFWO          0.002      RCHRES    9     EXTNL  IVOL
PERLND   16 PWATER AGWO          0.001      RCHRES    9     EXTNL  IVOL
PERLND   26 PWATER SURO          1.200      RCHRES    9     EXTNL  IVOL
PERLND   26 PWATER IFWO          1.200      RCHRES    9     EXTNL  IVOL
PERLND   26 PWATER AGWO          0.600      RCHRES    9     EXTNL  IVOL
PERLND   34 PWATER SURO          0.016      RCHRES    9     EXTNL  IVOL
PERLND   34 PWATER IFWO          0.016      RCHRES    9     EXTNL  IVOL
PERLND   34 PWATER AGWO          0.008      RCHRES    9     EXTNL  IVOL
PERLND   44 PWATER SURO          3.040      RCHRES    9     EXTNL  IVOL
PERLND   44 PWATER IFWO          3.040      RCHRES    9     EXTNL  IVOL
PERLND   44 PWATER AGWO          1.520      RCHRES    9     EXTNL  IVOL
PERLND   54 PWATER SURO          0.010      RCHRES    9     EXTNL  IVOL
PERLND   54 PWATER IFWO          0.010      RCHRES    9     EXTNL  IVOL
PERLND   54 PWATER AGWO          0.005      RCHRES    9     EXTNL  IVOL
IMPLND   14 IWATER SURO          0.634      RCHRES    9     EXTNL  IVOL
*******************************************************************************
*** DM10
PERLND   16 PWATER PERO          0.944      RCHRES   43     EXTNL  IVOL
PERLND   26 PWATER PERO          0.738      RCHRES   43     EXTNL  IVOL
PERLND   34 PWATER PERO          1.935      RCHRES   43     EXTNL  IVOL
PERLND   44 PWATER PERO          0.510      RCHRES   43     EXTNL  IVOL
PERLND   54 PWATER PERO          0.712      RCHRES   43     EXTNL  IVOL
IMPLND   14 IWATER SURO          0.185      RCHRES   43     EXTNL  IVOL
*******************************************************************************
*** DM11
PERLND   16 PWATER PERO          0.321      RCHRES   43     EXTNL  IVOL
PERLND   26 PWATER PERO          0.408      RCHRES   43     EXTNL  IVOL
PERLND   34 PWATER PERO          1.024      RCHRES   43     EXTNL  IVOL
PERLND   44 PWATER PERO          0.467      RCHRES   43     EXTNL  IVOL
PERLND   54 PWATER PERO          1.036      RCHRES   43     EXTNL  IVOL
IMPLND   14 IWATER SURO          2.726      RCHRES   43     EXTNL  IVOL
*******************************************************************************
*** DM12
PERLND   16 PWATER PERO          0.510      RCHRES   12     EXTNL  IVOL
PERLND   26 PWATER PERO          0.001      RCHRES   12     EXTNL  IVOL
PERLND   34 PWATER PERO          0.375      RCHRES   12     EXTNL  IVOL
PERLND   44 PWATER PERO          1.740      RCHRES   12     EXTNL  IVOL
PERLND   54 PWATER PERO          0.543      RCHRES   12     EXTNL  IVOL
*******************************************************************************
*** DM13
PERLND   16 PWATER PERO          2.822      RCHRES   13     EXTNL  IVOL
PERLND   26 PWATER PERO          0.564      RCHRES   13     EXTNL  IVOL
PERLND   34 PWATER PERO          2.298      RCHRES   13     EXTNL  IVOL
PERLND   44 PWATER PERO          0.460      RCHRES   13     EXTNL  IVOL
PERLND   54 PWATER PERO          0.025      RCHRES   13     EXTNL  IVOL
IMPLND   14 IWATER SURO          0.683      RCHRES   13     EXTNL  IVOL
*******************************************************************************
```

```
*** LOWER BASIN
********************************************************************************
*** DM14
PERLND  16 PWATER PERO          0.481      RCHRES  14     EXTNL  IVOL
PERLND  26 PWATER PERO          0.291      RCHRES  14     EXTNL  IVOL
PERLND  34 PWATER PERO          1.940      RCHRES  14     EXTNL  IVOL
PERLND  44 PWATER PERO          1.195      RCHRES  14     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.340      RCHRES  14     EXTNL  IVOL
********************************************************************************

*** EXECUTEL TRIBUTARY
********************************************************************************
*** DM16 INFLOW TO EXECUTEL POND REACH
PERLND  16 PWATER SURO          0.647      RCHRES  46     EXTNL  IVOL
PERLND  16 PWATER IFWO          0.647      RCHRES  46     EXTNL  IVOL
PERLND  16 PWATER AGWO          0.446      RCHRES  46     EXTNL  IVOL
PERLND  26 PWATER SURO          5.573      RCHRES  46     EXTNL  IVOL
PERLND  26 PWATER IFWO          5.573      RCHRES  46     EXTNL  IVOL
PERLND  26 PWATER AGWO          3.846      RCHRES  46     EXTNL  IVOL
PERLND  34 PWATER SURO          0.639      RCHRES  46     EXTNL  IVOL
PERLND  34 PWATER IFWO          0.639      RCHRES  46     EXTNL  IVOL
PERLND  34 PWATER AGWO          0.441      RCHRES  46     EXTNL  IVOL
PERLND  44 PWATER SURO          8.023      RCHRES  46     EXTNL  IVOL
PERLND  44 PWATER IFWO          8.023      RCHRES  46     EXTNL  IVOL
PERLND  44 PWATER AGWO          5.536      RCHRES  46     EXTNL  IVOL
PERLND  54 PWATER SURO          0.183      RCHRES  46     EXTNL  IVOL
PERLND  54 PWATER IFWO          0.183      RCHRES  46     EXTNL  IVOL
PERLND  54 PWATER AGWO          0.126      RCHRES  46     EXTNL  IVOL
IMPLND  14 IWATER SURO          4.249      RCHRES  46     EXTNL  IVOL
********************************************************************************
*** DM17
PERLND  16 PWATER PERO          2.078      RCHRES  17     EXTNL  IVOL
PERLND  26 PWATER PERO          2.261      RCHRES  17     EXTNL  IVOL
PERLND  34 PWATER PERO          3.003      RCHRES  17     EXTNL  IVOL
PERLND  44 PWATER PERO          3.280      RCHRES  17     EXTNL  IVOL
IMPLND  14 IWATER SURO          2.655      RCHRES  17     EXTNL  IVOL
********************************************************************************

*** MAINSTEM RAVINE
********************************************************************************
*** DM18
PERLND  16 PWATER PERO          0.789      RCHRES  18     EXTNL  IVOL
PERLND  26 PWATER PERO          0.277      RCHRES  18     EXTNL  IVOL
PERLND  34 PWATER PERO          3.151      RCHRES  18     EXTNL  IVOL
PERLND  44 PWATER PERO          1.106      RCHRES  18     EXTNL  IVOL
PERLND  54 PWATER PERO          0.300      RCHRES  18     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.296      RCHRES  18     EXTNL  IVOL
********************************************************************************

*** NORTH BRANCH RAVINE
********************************************************************************
*** DM19
PERLND  16 PWATER PERO          0.182      RCHRES 177     EXTNL  IVOL
PERLND  26 PWATER PERO          6.019      RCHRES 177     EXTNL  IVOL
PERLND  34 PWATER PERO          0.167      RCHRES 177     EXTNL  IVOL
PERLND  44 PWATER PERO          5.552      RCHRES 177     EXTNL  IVOL
IMPLND  14 IWATER SURO          2.617      RCHRES 177     EXTNL  IVOL
********************************************************************************
*** DM20
PERLND  16 PWATER PERO          4.007      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER PERO          6.624      RCHRES 193     EXTNL  IVOL
PERLND  34 PWATER PERO          2.784      RCHRES 193     EXTNL  IVOL
PERLND  44 PWATER PERO          4.602      RCHRES 193     EXTNL  IVOL
PERLND  54 PWATER PERO          0.116      RCHRES 193     EXTNL  IVOL
IMPLND  14 IWATER SURO          3.714      RCHRES 193     EXTNL  IVOL
********************************************************************************

*** LOWER MAINSTEM
********************************************************************************
*** DM21
PERLND  16 PWATER PERO          2.143      RCHRES 198     EXTNL  IVOL
PERLND  26 PWATER PERO          6.306      RCHRES 198     EXTNL  IVOL
PERLND  34 PWATER PERO          1.429      RCHRES 198     EXTNL  IVOL
PERLND  44 PWATER PERO          4.205      RCHRES 198     EXTNL  IVOL
IMPLND  14 IWATER SURO          3.091      RCHRES 198     EXTNL  IVOL
********************************************************************************
```

```
*** DM22
PERLND  16 PWATER PERO          0.391      RCHRES 198     EXTNL  IVOL
PERLND  26 PWATER PERO          4.654      RCHRES 198     EXTNL  IVOL
PERLND  34 PWATER PERO          0.218      RCHRES 198     EXTNL  IVOL
PERLND  44 PWATER PERO          2.620      RCHRES 198     EXTNL  IVOL
PERLND  54 PWATER PERO          0.016      RCHRES 198     EXTNL  IVOL
IMPLND  14 IWATER SURO          1.972      RCHRES 198     EXTNL  IVOL
********************************************************************************

*** NONCONTIGUOUS GROUNDWATER BASINS
********************************************************************************
*** G1
PERLND  16 PWATER AGWO          2.833      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER AGWO          9.917      RCHRES   5     EXTNL  IVOL
********************************************************************************
*** G2
PERLND  16 PWATER AGWO          0.417      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER AGWO          1.333      RCHRES 193     EXTNL  IVOL
********************************************************************************
*** G3
PERLND  16 PWATER AGWO          5.083      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER AGWO         17.667      RCHRES 193     EXTNL  IVOL
PERLND  34 PWATER AGWO          1.167      RCHRES 193     EXTNL  IVOL
PERLND  44 PWATER AGWO          4.250      RCHRES 193     EXTNL  IVOL
********************************************************************************
********************************************************************************

*** CHANNEL NETWORK LINKAGES ***
********************************************************************************

*** DISCHARGE FROM IWS SUBBASINS
********************************************************************************
RCHRES 360 HYDR   ROVOL  1                 RCHRES  36     EXTNL  IVOL
RCHRES 366 HYDR   ROVOL  1                 RCHRES   5     EXTNL  IVOL
********************************************************************************

*** EAST BRANCH OF CREEK
********************************************************************************
RCHRES  34 HYDR   OVOL   1                 RCHRES  35     EXTNL  IVOL
RCHRES  35 HYDR   ROVOL  1                 RCHRES  37     EXTNL  IVOL
RCHRES  36 HYDR   ROVOL  1                 COPY    16     INPUT  MEAN   1
COPY    14 OUTPUT MEAN   1                 COPY    16     INPUT  MEAN   1
COPY    15 OUTPUT MEAN   1                 COPY    16     INPUT  MEAN   1
RCHRES  39 HYDR   ROVOL  1                 COPY    16     INPUT  MEAN   1
RCHRES  37 HYDR   ROVOL  1                 COPY    16     INPUT  MEAN   1
COPY    16 OUTPUT MEAN   1                 RCHRES  38     EXTNL  IVOL
RCHRES  38 HYDR   ROVOL  1                 RCHRES   5     EXTNL  IVOL
RCHRES   5 HYDR   ROVOL  1                 RCHRES  40     EXTNL  IVOL
RCHRES  40 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
********************************************************************************


*** WEST BRANCH OF CREEK
********************************************************************************
COPY    20 OUTPUT MEAN   1                 COPY     9     INPUT  MEAN   1
COPY    42 OUTPUT MEAN   1                 COPY     9     INPUT  MEAN   1
COPY     9 OUTPUT MEAN   1                 RCHRES   4     EXTNL  IVOL
RCHRES   4 HYDR   ROVOL  1                 COPY    41     INPUT  MEAN   1
COPY    50 OUTPUT MEAN   1                 COPY     4     INPUT  MEAN   1
COPY     3 OUTPUT MEAN   1                 COPY     4     INPUT  MEAN   1
RCHRES   7 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
RCHRES   9 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
COPY     4 OUTPUT MEAN   1                 RCHRES  43     EXTNL  IVOL
COPY    41 OUTPUT MEAN   1                 RCHRES  43     EXTNL  IVOL
RCHRES  43 HYDR   ROVOL  1                 RCHRES  12     EXTNL  IVOL
COPY    10 OUTPUT MEAN   1                 COPY     5     INPUT  MEAN   1
RCHRES  12 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
********************************************************************************

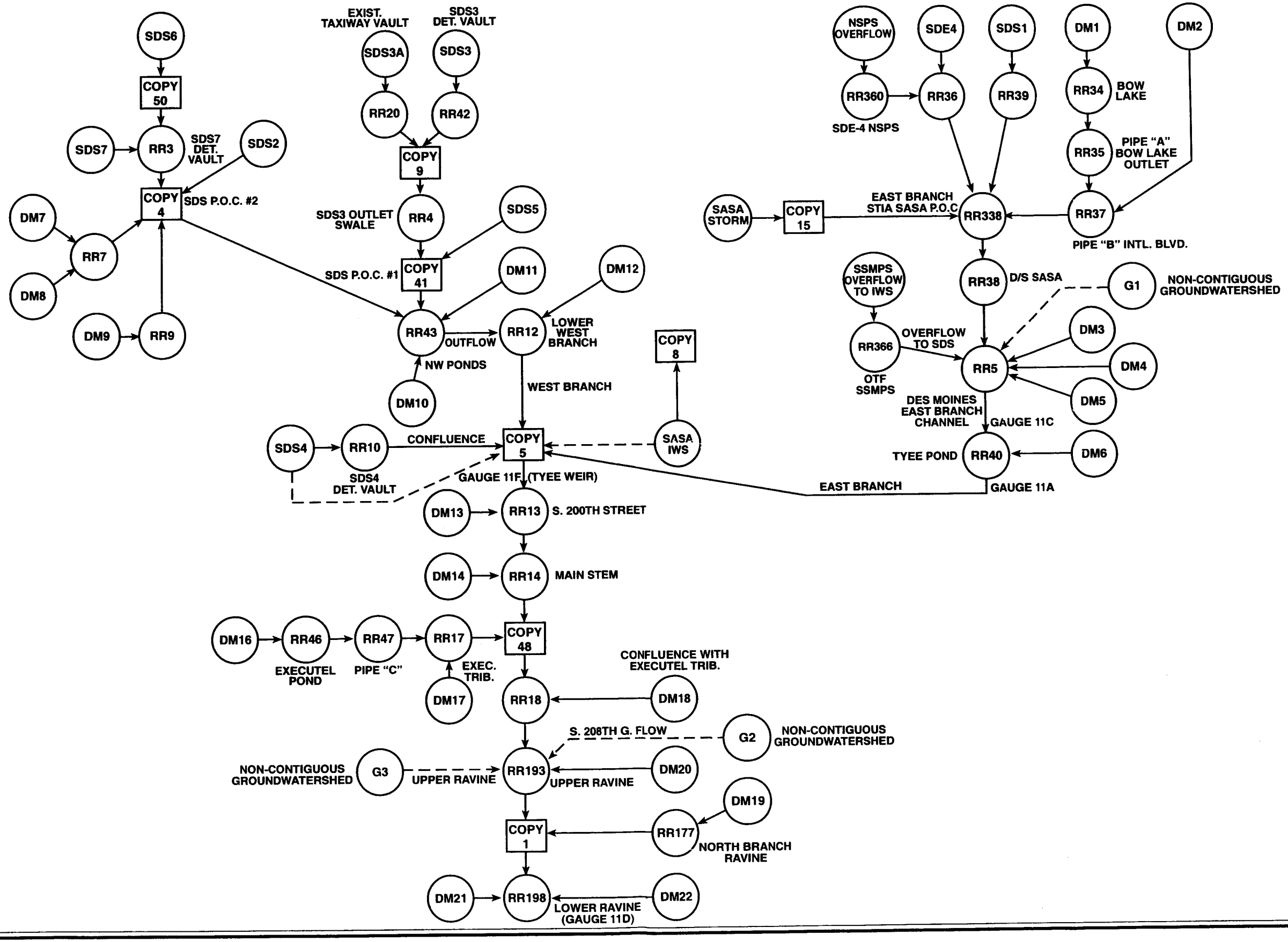
*** MAINSTEM BELOW CONFLUENCE OF E. AND W. BRANCH
********************************************************************************
*** MAINSTEM ABOVE EXECUTEL TRIBUTARY
COPY     5 OUTPUT MEAN   1                 RCHRES  13     EXTNL  IVOL
RCHRES  13 HYDR   ROVOL  1                 RCHRES  14     EXTNL  IVOL
RCHRES  14 HYDR   ROVOL  1                 COPY    48     INPUT  MEAN   1
********************************************************************************
```

```
*** EXECUTEL TRIBUTARY
RCHRES  46 HYDR   ROVOL  1                RCHRES  47     EXTNL  IVOL
RCHRES  47 HYDR   ROVOL  1                RCHRES  17     EXTNL  IVOL
RCHRES  17 HYDR   ROVOL  1                COPY    48     INPUT  MEAN   1
*****************************************************************************
*** MAINSTEM FROM HEAD OF RAVINE TO NORTH BRANCH CONFLUENCE
COPY    48 OUTPUT MEAN   1                RCHRES  18     EXTNL  IVOL
RCHRES  18 HYDR   ROVOL  1                RCHRES 193     EXTNL  IVOL
RCHRES 193 HYDR   ROVOL  1                COPY     1     INPUT  MEAN   1
*****************************************************************************
*** NORTH BRANCH RAVINE TO MAINSTEM
RCHRES 177 HYDR   ROVOL  1                COPY     1     INPUT  MEAN   1
*****************************************************************************
*** MAINSTEM FROM NORTH BRANCH CONFLUENCE TO PARK BELOW MVD CULVERT
COPY     1 OUTPUT MEAN   1                RCHRES 198     EXTNL  IVOL
*****************************************************************************

END NETWORK

END RUN
```

2006 CONDITIONS



July 2001
556-2912-001 (28)

Parametrix, Inc. Port of Seattle/HSPF Model/556-2912-001/01(028) 12/00 (K)

DM# = Des Moines Creek Subbasin Number

Stormwater

IWS

Groundwater

SDS# = Storm Drainage South Number

SDE# = Storm Drainage East Number

R# = Routing Reach Number (Channel or Storage Pond)

DM1 / RR12 —Subbasin ID / —Routing Reach Number

COPY 8 Summation of upstream flow

Figure 2
Des Moines Creek
HSPF Model Schematic
2006 Conditions

AR 010803

```
RUN
GLOBAL
  ***  FILE: DM06R6M.INP (MODIFY DM06.INP)
  ***  HSPF MODEL OF DES MOINES CREEK
  ***  2006 CONDITIONS (SDS2,5,6 removed: SDS6,SDS7,SDS2 drain west..
  ***  Modified to include King County comments, April 2001
  ***  SDS5 drains with SDS3A and SDS3 east)
  ***  WITH NORTHWEST PONDS RDF (1994 NW PONDS CONFIGURATION)
  ***  TYEE POND NOT REMOVED
  ***  LEVEL 2 DETENTION FOR STIA
  ***  SASA RETROFIT FOR STIA & NONSTIA UPSTREAM WATERSHED
  ***  EXISTING SDS3A VAULT FTAB (JD)
  ***  ELIMINATE IWS SYSTEM COMPONENTS NOT ROUTED TO SDS
  ***  REVISIONS TO SUBBASIN 2,5,6 ROUTING
  DES MOINES CREEK BASIN HSPF MODEL
  START       1948/10/01 00:00  END    1996/09/30 24:00
  START       1992/01/01 00:00  END    1996/09/30 24:00***
  RUN INTERP OUTPUT LEVEL    0
  RESUME     0 RUN     1
END GLOBAL

FILES
MESSU      24   DM06.MES
WDM        25   DM.WDM
END FILES

OPN SEQUENCE
    INGRP               INDELT 01:00
      PERLND      16
      PERLND      26
      PERLND      34
      PERLND      44
      PERLND      45
      PERLND      54
      IMPLND      14
      RCHRES     360
      RCHRES      36
      RCHRES      39
      RCHRES      20
      RCHRES      42
      COPY         9
      RCHRES       4
      COPY        41
      RCHRES      10
      RCHRES     366
      COPY         8
      COPY        50
      RCHRES       3
      RCHRES       7
      RCHRES       9
      COPY         4
      RCHRES      43
      COPY        15
      RCHRES      34
      RCHRES      35
      RCHRES      37
      RCHRES     338
      RCHRES      38
      RCHRES       5
      RCHRES      40
      RCHRES      12
      COPY         5
      RCHRES      13
      RCHRES      14
      RCHRES     177
      RCHRES      46
      RCHRES      47
      RCHRES      17
      COPY        48
      RCHRES      18
      RCHRES     193
      COPY         1
      RCHRES     198
    END INGRP
END OPN SEQUENCE
```

```
PERLND
  GEN-INFO
    <PLS >       Name           NBLKS   Unit-systems   Printer                  ***
    # -  #                             User  t-series Engl Metr                  ***
                                             in  out                            ***
   16       TFM- TILL FOR MOD       1    1    1    1   60    0
   26       TGM- TILL GR MOD        1    1    1    1   60    0
   34       OF - OUTWASH FOR        1    1    1    1   60    0
   44       OG - OUTWASH GR         1    1    1    1   60    0
   45       AF - AIRPORT FILL       1    1    1    1   60    0
   54       SA - WETLANDS           1    1    1    1   60    0
  END GEN-INFO
  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC        ***
   14   54    0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
    <PLS > ********************* Print-flags ************************* PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC *********
   14   54    0    0    6    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO
  PWAT-PARM1
    <PLS > ***************** Flags ********************
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE                        ***
   14   54    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS > ***
    # -  # ***FOREST       LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16                    4.5000    0.2000    200.00    0.1000    0.5000    0.9960
   26                    4.5000    0.0750    400.00    0.1000    0.5000    0.9960
   34                    5.0000    2.0000    200.00    0.0500    0.3000    0.9960
   44                    5.0000    0.8000    200.00    0.0500    0.3000    0.9960
   45                    7.5000    0.0200    300.00    0.0700    0.0000    0.9960
   54                    4.0000    2.0000    200.00    0.0010    0.5000    0.9960
  END PWAT-PARM2
  PWAT-PARM3
    <PLS >***
    # -  #*** PETMAX     PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16                              2.0000    2.0000      0.55      0.00       0.0
   26                              2.0000    2.0000      0.55      0.00       0.0
   34                              2.0000    2.0000      0.55      0.00       0.0
   44                              2.0000    2.0000      0.55      0.00       0.0
   45                              2.0000    2.0000      0.55      0.00       0.0
   54                              10.000    2.0000      0.55      0.00       0.7
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >                                                                ***
    # -  #      CEPSC      UZSN      NSUR     INTFW       IRC     LZETP***
   16          0.2000    0.5000    0.3500     3.000    0.5000    0.7000
   26          0.1000    0.2500    0.2500     3.000    0.5000    0.2500
   34          0.2000    0.5000    0.3500     0.000    0.7000    0.7000
   44          0.1000    0.5000    0.2500     0.000    0.7000    0.2500
   45          0.1000    0.2800    0.2500     6.000    0.1500    0.6000
   54          0.2000    3.0000    0.5000     1.000    0.7000    0.8000
  END PWAT-PARM4
  PWAT-STATE1
    <PLS >  PWATER state variables***
    # -  #***   CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16          0.078        0.    0.0010        0.     0.075     0.267     0.026
   26          0.051        0.    0.0350        0.     1.928     0.680     0.049
   34          0.078        0.    0.0010        0.     0.090     0.676     0.038
   44          0.051        0.    0.0040        0.     1.127     0.614     0.152
   45          0.051        0.    0.0200        0.     1.528     0.647     0.101
   54          0.051        0.    0.3330        0.     0.622     0.000     0.000
  END PWAT-STATE1
END PERLND

IMPLND
  GEN-INFO
    <ILS >       Name             Unit-systems   Printer                      ***
    # -  #                      User  t-series Engl Metr                      ***
                                        in  out                               ***
   13  140 IMPERVIOUS              1    1    1   60    0
```

```
  END GEN-INFO
  ACTIVITY
    <ILS > ************ Active Sections ****
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL  ***
   13  140    0    0    1    0    0    0
  END ACTIVITY
  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL *********
   13  140    0    0    6    0    0    0    1    9
  END PRINT-INFO
  IWAT-PARM1                                                          ***
    <ILS >           Flags            ***                             ***
    # -  # CSNO RTOP  VRS  VNN RTLI   ***
   13  140    0    0    0    0    0
  END IWAT-PARM1
  IWAT-PARM2                                                          ***
    <ILS >
    # -  #      LSUR     SLSUR      NSUR     RETSC ***
   14          500.0    0.0100    0.1000    0.100
  140         100.00    0.0500    0.1000    0.0500
  END IWAT-PARM2
  IWAT-PARM3                                                          ***
    <ILS >                                                            ***
    # -  #    PETMAX    PETMIN
   13  140
  END IWAT-PARM3
  IWAT-STATE1                                                         ***
    <ILS >  IWATER state variables                                    ***
    # -  #       RETS      SURS
   13  140 1.0000E-3 1.0000E-3
  END IWAT-STATE1
END IMPLND

RCHRES
  GEN-INFO                                                            ***
    RCHRES       Name        Nexits   Unit Systems   Printer          ***
    # -  #<-----------------><---> User T-series  Engl Metr LKFG      ***
                                        in  out                       ***
     3     SDS-7 Det. Vault       1    1    1    1    0    0    0
     4     SDS-3 Outlet Swale     1    1    1    1    0    0    0
     5     E.Branch above TyeeP   1    1    1    1    0    0    0
     7     DM7 & DM8 Conveyance   1    1    1    1    0    0    0
     9     DM9 Conveyance         1    1    1    1    0    0    0
    10     SDS-4 Det. Vault       1    1    1    1    0    0    0
    12     Lower W. Branch        1    1    1    1    0    0    0
    13     Confl. to 200th St.    1    1    1    1    0    0    0
    14     200th to Exec. Trib.   1    1    1    1    0    0    0
    17     Executel Tributary     1    1    1    1    0    0    0
    18     Exec.Confl. to 208th   2    1    1    1    0    0    0
    20     SDS-3A Det. Vault      1    1    1    1    0    0    0
    34     Bow Lake               2    1    1    1    0    0    1
    35     Pipe A Bow LK Outlet   1    1    1    1    0    0    0
    36     SDE-4 Combined Disch   1    1    1    1    0    0    0
    37     Pipe B 60" Intl Blvd   1    1    1    1    0    0    0
    38     D/S SASA               1    1    1    1    0    0    0
    39     SDS-1 Storm Only       1    1    1    1    0    0    0
    40     Tyee Pond              1    1    1    1    0    0    0
    42     SDS-3 Det. Vault       1    1    1    1    0    0    0
    43     NW Ponds               2    1    1    1    0    0    1
    46     Executel Pond          1    1    1    1    0    0    0
    47     Pipe C Exec.Pond Dis   1    1    1    1    0    0    0
   177     North Branch Ravine    1    1    1    1    0    0    0
   193     Upper Ravine           1    1    1    1    0    0    0
   198     Lower Ravine           1    1    1    1    0    0    0
   338     E.BR. STIA SASA POC    1    1    1    1    0    0    0
   360     SDE-4 NSPS             2    1    1    1    0    0    0
   366     OTF   SSMPS            2    1    1    1    0    0    0
  END GEN-INFO

  ACTIVITY
    RCHRES *************** Active Sections *****************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG          ***
    1  366    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
  PRINT-INFO
```

```
  RCHRES *************** Printout Flags ****************** PIVL  PYR
  # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB *********
  1  366    6    0    0    0    0    0    0    0    0    0    1    9
END PRINT-INFO
HYDR-PARM1
  RCHRES  Flags for each HYDR Section                                    ***
  # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
          FG FG FG FG  possible  exit  *** possible  exit      possible  exit
           *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
  3   17   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 18        0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 20        0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 34        0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 35   40   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 42        0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
 43        0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
 46  338   0  1  1  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
360  366   0  1  1  0    4  5  0  0  0       0  0  0  0  0       2  2  2  2  2
END HYDR-PARM1

HYDR-PARM2
  RCHRES                                                                 ***
  # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50      ***
<------><--------><--------><--------><--------><--------><-------->     ***
  3             3   0.071                             0.3
  4             4   0.530                             0.3
  5             5   0.380                             0.3
  7             7   0.341                             0.3
  9             9   0.189                             0.3
 10            10   0.071                             0.3
 12            12   0.273                             0.3
 13            13   0.218                             0.3
 14            14   0.218                             0.3
 17            17   0.246                             0.3
 18            18   0.303                             0.3
 20            20   0.071                             0.3
 34            34   0.208                             0.3
 35            35   0.123                             0.3
 36            36   0.100                             0.3
 37            37   0.381                             0.3
 38            38   0.142                             0.3
 39            39   0.100                             0.3
 40            40   0.189                             0.3
 42            42   0.071                             0.3
 43            43   0.189                             0.3
 46            46   0.047                             0.3
 47            47   0.417                             0.3
177           177   0.407                             0.3
193           193   0.795                             0.3
198           198   0.631                             0.3
338           338   0.010                             0.3
360           360   0.010                             0.0
366           366   0.010                             0.0
END HYDR-PARM2

HYDR-INIT
  RCHRES  Initial conditions for each HYDR section                       ***
  # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
<------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  3     0.1              4.0
  4     0.1              4.0
  5     0.1              4.0
  7     0.1              4.0
  9     0.1              4.0
 10     0.1              4.0
 12     0.1              4.0
 13     0.1              4.0
 14     0.1              4.0
 17     0.1              4.0
 18     0.1              4.0  5.0
 20     0.1              4.0
 34     35.              4.0  5.0
 35     0.0              4.0
 36     0.0              4.0
 37     0.0              4.0
```

```
   38      0.0              4.0
   39      0.0              4.0
   40      0.0              4.0
   42      0.1              4.0
   43      0.7              4.0   5.0
   46      0.0              4.0
   47      0.0              4.0
  177      0.0              4.0
  193      0.0              4.0
  198      0.0              4.0
  338      0.0              4.0
  360      0.0              4.0   5.0
  366      0.0              4.0   5.0
  END HYDR-INIT
END RCHRES

FTABLES
  FTABLE      3

*** SDS-7 DETENTION VAULT   20 FT DEPTH 36-in riser diam.+3 orifices
***SDS-7 DEt. VAULT accepts runoff from SDS-6 and SDS-7
 ROWS COLS ***
   23    4
     DEPTH      AREA    VOLUME   OUTFLOW                                  ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)                                 ***
      0.00     1.079      0.00      0.00
      1.72     1.079      1.86      0.53
      7.30     1.079      7.87      1.10
     14.28     1.079     15.40      1.54
     14.50     1.079     15.64      1.55
     14.59     1.079     15.74      1.58
     15.34     1.079     16.55      2.10
     17.20     1.079     18.55      2.59
     17.50     1.079     18.88      2.66
     17.55     1.079     18.93      2.67
     17.69     1.079     19.08      2.79
     17.83     1.079     19.23      2.99
     18.25     1.079     19.69      3.28
     18.69     1.079     20.16      3.94
     19.13     1.079     20.64      4.73
     19.56     1.079     21.10      5.53
     20.00     1.079     21.57      6.61
     20.10     1.079     21.68      7.57
     20.20     1.079     21.79      9.29
     20.30     1.079     21.90     11.51
     21.00     1.079     22.65     36.14
     21.30     1.079     22.98     45.82
     21.90     1.079     23.62     54.10
  END FTABLE  3


  FTABLE      4
*** SDS-3 OUTLET SWALE
 ROWS COLS ***
    7    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                         ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)                        ***
      .000      .000       0.0       0.0
      .500      .198       0.1       9.0
     1.000      .236       0.5      30.9
     2.000      .306       1.0     115.8
     3.000      .376       1.5     265.5
     4.000      .446       5.0     491.8
     5.000      .517      20.0     806.3
  END FTABLE  4

  FTABLE      5
*** EAST BRANCH ABOVE TYEE POND
 ROWS COLS ***
   13    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                         ***
      (FT)    (ACRES) (ACRE-FT)     (CFS)     (CFS)                        ***
     0.000      .000      .000      .000
     0.550      .290      .100     4.900
     1.100      .543      .200    20.800
     1.650      .609      .300    46.500
```

```
    2.200       .671       .400    80.000
    2.750       .732      0.500   118.700
    3.300       .778      0.600   159.500
    3.850       .819      0.700   198.400
    4.400       .849      0.801   231.900
    4.950       .866      1.000   252.900
    5.500       .865      1.200   253.000
    8.200       .973      1.500   400.000
   10.200     1.043       2.000   520.000
  END FTABLE  5

  FTABLE      7
*** DM7 & DM8 CONVEYANCE
 ROWS COLS ***
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES) (ACRE-FT)      (CFS)     (CFS)
      .000       .000       .000       .000
      .500       .360       .120      6.200
     1.000       .416       .276     20.800
     2.000       .520       .694     75.400
     3.000       .626      1.252    168.700
     4.000       .732      1.950    306.900
     5.000       .836      2.790    496.100
     6.000       .942      3.768    742.300
  END FTABLE  7

  FTABLE      9
*** DM9 CONVEYANCE
 ROWS COLS ***
    8    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES) (ACRE-FT)      (CFS)     (CFS)
      .000        .00        0.0         .0
      .500        .20        0.7        9.7
     1.000        .23        3.1       32.6
     2.000        .29       14.9        118
     3.000        .35       38.4        265
     4.000        .41         77        482
     5.000        .47        135        778
     6.000        .52        214       1165
  END FTABLE  9

  FTABLE     10
*** SDS-4 DETENTION VAULT  15 FT DEPTH 10-IN RISER DIA
 ROWS COLS ***
   18    4
     DEPTH       AREA     VOLUME    OUTFLOW  ***
      0.00       0.87       0.00       0.00
      0.54       0.87      0.471      0.180
      1.72       0.87      1.501      0.320
      2.60       0.87      2.270      0.394
      3.49       0.87      3.047      0.456
      5.25       0.87      4.583      0.559
      7.60       0.87      6.634      0.673
      8.19       0.87      7.149      0.699
      8.78       0.87      7.664      0.723
      9.37       0.87      8.179      0.747
      9.96       0.87      8.694      0.770
     10.54       0.87      9.201      0.793
     12.21       0.87     10.659      1.220
     14.55       0.87     12.701      2.240
     15.00       0.87     13.094      2.390
     15.10       0.87     13.181      2.670
     15.50       0.87     13.530      4.390
     16.80       0.80     14.665      6.400
  END FTABLE 10

  FTABLE     12
*** LOWER WEST BRANCH
*** REVISED BASED ON HEC-RAS MODEL
 ROWS COLS ***
   13    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES) (ACRE-FT)      (CFS)     (CFS)
      .000       .000      0.000       .000
```

.500	.291	0.030	0.150
1.000	.346	0.260	6.600
2.000	.450	0.430	14.100
3.000	.554	0.650	25.000
4.000	.656	1.180	50.000
5.000	.753	2.170	75.000
6.000	.796	3.820	100.000
7.000	.837	8.820	150.000
8.000	.837	16.200	200.000
9.000	.837	27.920	250.000
10.000	.837	33.530	350.000
11.000	.837	35.380	450.000

END FTABLE 12

FTABLE 13
*** CONFLUENCE TO 200TH STREET
ROWS COLS ***
9 4

*** DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	OUTFLOW (CFS)	OUTFLOW2 (CFS)	***
.000	.000	.000	.000		
.500	.153	.051	4.300		
1.000	.272	.132	14.400		
2.000	.317	.312	50.400		
3.000	.360	.544	109.600		
4.000	.404	.826	195.000		
5.000	.450	1.163	309.500		
6.000	.497	1.548	456.300		
7.000	.542	1.984	638.000		

END FTABLE 13

FTABLE 14
*** 200TH STREET TO EXECUTEL TRIBUTARY
*** REACH 190 FROM TR-20/KING COUNTY BASIN PLAN MODEL:
ROWS COLS ***
5 4

*** DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	OUTFLOW (CFS)	OUTFLOW2 (CFS)	***
0.000	0.000	0.000	0.000		
0.900	0.70	0.4000	30.00		
1.800	0.80	1.1000	115.60		
2.700	1.10	2.1000	269.80		
4.200	1.30	4.3000	707.10		

END FTABLE 14

FTABLE 17
*** EXECUTEL TRIBUTARY
ROWS COLS ***
10 4

*** DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	OUTFLOW (CFS)	OUTFLOW2 (CFS)	***
.000	.000	.000	.000		
.300	.169	.034	2.900		
.600	.192	.076	9.800		
.900	.215	.128	20.400		
1.200	.238	.189	35.100		
1.500	.259	.258	54.100		
1.800	.282	.336	77.700		
2.100	.303	.423	106.200		
3.100	.376	.779	245.000		
3.600	.412	.988	335.000		

END FTABLE 17

FTABLE 18
*** CONFLUENCE WITH EXECUTEL TRIBUTARY TO 208TH STREET
*** REPRESENTS GW LOSS IN WETLAND BELOW 200TH
ROWS COLS ***
14 5

*** DEPTH (FT)	AREA (ACRES)	VOLUME (ACRE-FT)	OUTFLOW (CFS)	OUTFLOW2 (CFS)	***
.000	.000	.000	.000	0.00	
.500	.572	.191	7.300	0.00	
1.000	.799	.438	10.000	0.00	
2.000	.968	1.001	20.700	0.00	
3.000	1.155	1.727	100.000	0.00	
4.000	1.317	2.542	262.700	0.00	

```
    5.000      1.478      3.475    400.300       0.00
    6.000      1.643      4.545    570.200       0.00
    7.000      1.791      5.688    774.400       0.00
    8.000      1.932      6.822   1015.100       0.00
    9.000      1.945      7.025   1294.500       0.00
   10.000      1.958      7.244   1614.500       0.00
   11.000      1.970      7.481   1977.000       0.00
   12.000      1.983      7.734   2384.700       0.00
 END FTABLE 18

 FTABLE     20
*** SDS-3A EXISTING TAXIWAY DETENTION VAULT  EFFECTIVE DEPTH=7.94 FT 36-IN RISER
 ROWS COLS ***
   14    4
     DEPTH       AREA     VOLUME    OUTFLOW                                  ***
      (FT)    (ACRES)  (ACRE-FT)      (CFS)                                  ***
      0.00       0.69       0.00       0.00
      1.06       0.69       0.73       1.09
      2.00       0.69       1.38       1.50
      3.08       0.69       2.12       1.86
      4.00       0.69       2.77       2.12
      5.10       0.69       3.51       2.39
      5.70       0.69       3.93       2.53
      6.24       0.69       4.30       4.47
      7.05       0.69       4.86       9.28
      7.58       0.69       5.22      12.80
      7.94       0.69       5.47      15.07
      8.54       0.69       5.88      28.76
      9.04       0.69       6.23      48.98
      9.54       0.69       6.57      58.41
 END FTABLE 20

 FTABLE     34
*** BOW LAKE
*** BASED ON ENTRANCE CONTROL FOR 36 INCH OUTLET PIPE
 ROWS COLS ***
    8    5
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)                       ***
     0.000     14.000      0.000      0.000      0.00
     1.000     14.000     14.000      7.000      0.00
     1.500     14.000     21.000     13.000      0.00
     2.000     14.000     28.000     17.000      0.00
     3.000     14.000     42.000     35.000      0.00
     4.000     14.000     56.000     49.000      0.00
     5.000     14.000     70.000     60.000      0.00
     6.000     14.000     84.000     70.000      0.00
 END FTABLE 34

 FTABLE     35
*** 36" BOW LAKE DISCHARGE PIPELINE (A)
 ROWS COLS ***
   13    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                        ***
       (FT)    (ACRES)  (ACRE-FT)      (CFS)     (CFS)                       ***
       .000       .000       .000       .000
       .300       .020      .0006      1.000
       .600       .026      .0026      4.200
       .900       .032      .0068      9.400
      1.200       .034      .0134     16.200
      1.500       .037      .0226     24.000
      1.800       .039      .0346     32.300
      2.100       .040      .0492     40.100
      2.400       .040      .0667     46.900
      2.700       .039      .0857     51.200
      3.000       .037      .1000     55.300
*** SURCHARGING-
      3.300       .038      .2500     60.300
      4.000       .038      .4000     80.000
 END FTABLE 35

 FTABLE     36
*** SDE-4 COMBINED DISCHARGE
 ROWS COLS ***
   11    4
***   DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2
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```
      (FT)    (ACRES)  (ACRE-FT)      (CFS)      (CFS)                    ***
      .000       .000       .000       .000
      .400       .343      0.090      2.200
      .800       .442      0.150      9.500
     1.200       .523      0.200     21.100
     1.600       .577      0.250     36.300
     2.000       .618      0.300     54.000
     2.400       .646      0.350     72.500
     2.800       .659      0.400     90.200
     3.200       .662      0.450    105.500
     3.600       .649      0.550    115.000
     4.000       .618      0.650    115.100
  END FTABLE 36

  FTABLE     37
*** 60" INTERNATIONAL BLVD PIPELINE (B)
 ROWS COLS ***
   13    4
***   DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2
      (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)                    ***
      .000       .000       .000       .000
      .450       .134       .045      4.800
      .900       .190       .100     20.300
     1.350       .225       .150     45.400
     1.800       .249       .200     78.000
     2.250       .266       .250    115.900
     2.700       .271       .300    155.800
     3.150       .264       .350    193.800
     3.600       .251       .400    226.500
     4.050       .238       .450    247.000
     4.500       .234       .500    247.100
     6.500       .185       .600    340.000
     8.500       .166       .700    415.000
  END FTABLE 37

  FTABLE    238
  *** STIA FLOW COMBINED (NOT USED)
 ROWS COLS ***
    5    4
     DEPTH      AREA    VOLUME   OUTFLOW  ***
     0.000    0.0010    0.0000      0.00
     0.000    0.0100    0.0100     10.00
     0.100    0.1000    0.1000    100.00
     1.000    1.0000    1.0000   1000.00
    10.000   10.0000   10.0000  10000.00
  END FTABLE238

  FTABLE    338
*** SASA DETENTION FACILITY RETROFIT SIZE ***
 ROWS COLS ***                          EFFECTIVE DEPTH=14 FT
   14    4
     DEPTH      AREA    VOLUME     DISCH           ***
      (FT)    (ACRES)   (AC-FT)     (CFS)          ***
      0.00      0.000     0.00       0.00
      1.31      2.802    3.620      13.70
      2.30      2.881    6.472      18.14
      3.40      2.983    9.761      22.05
      4.22      3.043   12.296      24.57
      5.32      3.151   15.809      27.59
      6.14      3.233   18.514      29.65
      7.13      3.326   21.878      33.26
      8.05      3.426   25.103      38.80
     10.10      3.608   32.636      56.04
     11.20      3.699   36.880      76.55
     12.29      4.053   41.227      99.16
     13.12      4.154   44.633     116.70
     14.40      4.311   50.050     144.31
  END FTABLE338

  FTABLE     39
*** SDS-1 DISCHARGE
 ROWS COLS ***
   11    4
***   DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2
      (FT)    (ACRES)  (ACRE-FT)     (CFS)     (CFS)                    ***
      .000       .000       .000       .000
```

```
      .250      .020      .030     2.200
      .500      .027      .035     9.400
      .750      .031      .042    21.000
     1.000      .035      .049    36.000
     1.250      .039     0.056    53.600
     1.500      .039     0.064    72.000
     1.750      .041     0.074    89.500
     2.000      .041     0.084   104.700
     2.250      .041     0.094   114.200
     2.500      .038     0.100   114.300
  END FTABLE 39

  FTABLE     40
*** TYEE POND
*** BASED ON TYEE POND AS-BUILTS AND AUTOMATED GATE OPERATION MANUAL
*** K RITLAND 2/4/98
 ROWS COLS ***
   20    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                          ***
       (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
      0.00      0.00      0.00      0.00
      0.90      0.01      0.01     10.00
      1.65      0.02      0.02     20.00
      3.11      0.07      0.07     30.00
      4.56      0.22      0.29     40.00
      6.02      0.63      0.89     50.00
      7.48      0.88      2.02     60.00
      8.62      1.06      3.18     70.00
      9.79      1.18      4.29     80.00
     10.88      1.34      5.83     90.00
     11.99      1.48      7.20    100.00
     13.12      1.69      9.17    110.00
     15.13      2.04     12.90    120.00
     16.10      2.20     14.92    124.10
     16.30      2.24     15.40    129.65
     16.57      2.28     15.88    150.36
     16.64      2.32     16.36    155.00
     16.80      2.36     16.84    208.74
     17.03      2.40     17.32    293.59
     17.26      2.43     17.79    428.11
  END FTABLE 40

  FTABLE     42
*** SDS-3 DETENTION VAULT EFFECTIVE DEPTH = 20.0 FT
 ROWS COLS ***
   17    4
     DEPTH      AREA    VOLUME   OUTFLOW           ***
      (FT)   (ACRES) (ACRE-FT)     (CFS)           ***
      0.00      4.19       .00      0.00
      0.51      4.19      2.254     0.95
      1.37      4.19      6.054     1.55
      3.33      4.19     14.716     2.42
      6.07      4.19     26.824     3.28
      8.43      4.19     37.254     3.86
     10.00      4.19     44.192     4.20
     12.74      4.19     56.301     4.74
     14.50      4.19     64.078     5.06
     15.46      4.19     68.321     8.74
     16.63      4.19     73.491    10.66
     18.39      4.19     81.269    16.63
     20.00      4.19     88.384    20.79
     20.20      4.19     89.268    23.84
     20.70      4.19     91.477    39.37
     21.00      4.19     92.803    52.07
     21.90      4.19     96.780    71.43
  END FTABLE 42

  FTABLE     43
*** NORTHWEST PONDS
*** BASED ON KING COUNTY BASIN PLANNING MODEL
 ROWS COLS ***
   17    5
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2                          ***
       (FT)   (ACRES) (ACRE-FT)     (CFS)     (CFS)
     0.000    12.000     0.000     0.000      0.00
     0.100    12.000    18.800     0.000      0.00
```

```
     1.000    12.000    24.000     0.200      0.00
     2.000    12.000    30.000     0.500      0.00
     3.000    12.000    37.000     1.000      0.00
     3.500    13.000    41.000     5.000      0.00
     4.000    13.000    45.700    15.000      0.00
     4.500    13.000    51.000    35.000      0.00
     5.000    14.000    56.500   150.000      0.00
     5.500    14.000    62.800   200.000      0.00
     6.000    14.000    69.000   300.000      0.00
     6.500    14.000    83.500   350.000      0.00
     7.000    15.000    99.900   400.000      0.00
     8.000    17.000    119.00   500.000      0.00
     9.000    20.000    141.50   550.000      0.00
    10.000    23.000    180.00   600.000      0.00
    11.000    27.000    200.00   650.000      0.00
  END FTABLE 43

  FTABLE     46
*** EXECUTEL POND
 ROWS COLS ***
   20    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES) (ACRE-FT)      (CFS)     (CFS)                    ***
       .000       .000       .000       .000
     1.000       .080       .080     24.420
     2.000       .230       .310     34.540
     3.000       .393       .703     42.300
     3.500       .494       .950     45.690
     4.000       .508      1.204     48.850
     4.500       .532      1.470     51.810
     5.000       .540      1.740     54.610
     5.500       .540      2.010     57.280
     6.000       .580      2.300     59.820
     6.500       .600      2.600     62.270
     7.000       .600      2.900     64.620
     7.500       .600      3.200     66.900
     8.000       .620      3.510     69.100
     8.500       .640      3.830     71.200
     9.000       .740      4.200     82.220
    10.000       .650      4.850    119.830
    11.000       .720      5.570    169.000
    12.000       .750      6.320    250.900
    13.000      1.000      7.320    500.900
  END FTABLE 46

  FTABLE     47
*** EXECUTEL POND DISCHARGE PIPELINE (C)
 ROWS COLS ***
   11    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES) (ACRE-FT)      (CFS)     (CFS)                    ***
       .000       .000       .000       .000
       .350       .069       .020      4.600
       .700       .096       .056     19.200
     1.050       .112       .099     42.800
     1.400       .124       .150     73.400
     1.750       .125       .203    109.000
     2.100       .121       .240    146.600
     2.450       .110       .264    182.400
     2.800       .096       .284    213.200
     3.150       .090       .290    232.400
     3.500       .088       .293    232.600
  END FTABLE 47

  FTABLE    177
*** NORTH BRANCH RAVINE
 ROWS COLS ***
   14    4
***  DEPTH       AREA     VOLUME    OUTFLOW  OUTFLOW2                    ***
       (FT)    (ACRES) (ACRE-FT)      (CFS)     (CFS)                    ***
       .000       .000       .000         .0
       .500       .572       .191        7.3
     1.000       .799       .438       23.2
     2.000       .968      1.001       75.7
     3.000      1.155      1.727      155.1
     4.000      1.317      2.542      262.7
```

```
     5.000     1.478     3.475     400.3
     6.000     1.643     4.545     570.2
     7.000     1.791     5.688     774.4
     8.000     1.932     6.822    1015.1
     9.000     1.945     7.025    1294.5
    10.000     1.958     7.244    1614.5
    11.000     1.970     7.481    1977.0
    12.000     1.983     7.734    2384.7
  END FTABLE177

  FTABLE    193
*** UPPER RAVINE
 ROWS COLS ***
   14    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2
       (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)                    ***
      0.00      0.00      0.00      0.0
      0.35      0.72      0.75      7.8
      0.70      0.72      1.51     23.5
      1.05      0.72      2.28     44.3
      1.40      0.72      3.03     68.2
      1.75      0.72      3.81     95.8
      2.10      0.72      4.56    125.2
      2.45      0.75      5.36    169.0
      2.80      0.89      6.30    171.5
      3.15      1.00      7.35    247.6
      3.50      1.08      8.49    332.7
      3.85      1.21      9.75    396.5
      4.20      1.32     11.13    521.2
      4.55      1.41     12.60    655.5
  END FTABLE193

  FTABLE    198
 ROWS COLS ***
*** LOWER RAVINE
*** ROUGH ESTIMATE BASED ON FIELD VISIT OF 12/20/95
*** FLOW WAS 6 TO 7 CFS WITH DEPTH OF 8"
*** NEAR OUTLET.
*** DRIVE WHICH REPRESENTS A RESTRICTION ACCORDING TO OBSERVATION
    8    4
***  DEPTH      AREA    VOLUME   OUTFLOW  OUTFLOW2
       (FT)   (ACRES) (ACRE-FT)    (CFS)     (CFS)                    ***
      0.00      0.00      0.00      0.0
      1.00      0.50      0.80     10.0
      2.00      0.55      1.30     25.0
      3.00      0.60      1.80     50.0
      5.00      0.70      2.50    100.0
*** SUBMERGENCE OF CULVERT
     10.00      2.50     12.00    245.0
*** OVERBANK STORAGE
*** FLOWS BASED ON 243', .03 D-W FACTOR, PLUS LOSS OF 1. VELOCITY HEAD
     15.00     10.00     40.00    325.0
     20.00     11.00     90.00    390.0
  END FTABLE198

  FTABLE     38
*** UPPER EAST BRANCH
 ROWS COLS ***
    9    4
***  DEPTH      AREA    VOLUME   OUTFLOW
       (FT)   (ACRES) (ACRE-FT)    (CFS)      ***
       .000      .000      .000      .000
       .500      .176      .100     9.200
     1.000      .194     0.150    30.400
     2.000      .232     0.200   105.800
     3.000      .271     0.250   228.900
     4.000      .310     0.350   405.800
     5.000      .349     0.450   642.700
     6.000      .387     0.600   945.700
     7.000      .426     0.800  1320.700
  END FTABLE 38

  FTABLE    360
*** NORTH SATELLITE PUMP STATION (SDE-4) (INSTALLED IN 1995)
 ROWS COLS                                                          ***
    5    5
```

```
    DEPTH      AREA     VOLUME      (IWS)      (SDS)                    ***
     (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)                    ***
       .0       1.0        .00       0.00       0.00
     1.00       1.0        .01       4.79       0.00
     2.00       1.0        .02       4.79       0.00
     3.00       1.0        .03       4.79      25.00
     4.00       1.0        .04       4.79      50.00
  END FTABLE360



  FTABLE    366
*** SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION (INSTALLED IN LATE 1997/1998)
 ROWS COLS                                                              ***
    5    5
    DEPTH      AREA     VOLUME      (IWS)      (SDS)                    ***
     (FT)    (ACRES) (ACRE-FT)      (CFS)      (CFS)                    ***
       .0       1.00       .00       0.00       0.00
     1.00       1.00       .01       1.67       0.00
     2.00       1.00       .02       1.67       0.00
     3.00       1.00       .03       1.67      25.00
     4.00       1.00       .04       1.67      50.00
  END FTABLE366


END FTABLES

COPY
  TIMESERIES
  Copy-opn                                                              ***
    # -  #  NPT  NMN                                                    ***
    1   54         1
  END TIMESERIES
END COPY

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGLZERO               PERLND  14  54 EXTNL  PREC
WDM      2 PREC     ENGLZERO               IMPLND  14     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  34     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  40     EXTNL  PREC
WDM      2 PREC     ENGLZERO               RCHRES  43     EXTNL  PREC
WDM      1 EVAP     ENGLZERO    0.8        PERLND  14 440 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO    0.8        IMPLND  14 140 EXTNL  PETINP
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  34     EXTNL  POTEV
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  43     EXTNL  POTEV
WDM      1 EVAP     ENGLZERO    0.8        RCHRES  40     EXTNL  POTEV
END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
*******************************************************************************
*** SDS
*******************************************************************************
*** SDE-4 (TOTAL)
RCHRES  36 HYDR   RO                       WDM    221 FLOW     ENGL       REPL
*******************************************************************************
*** SDS-1 (TOTAL)
RCHRES  39 HYDR   RO                       WDM    222 FLOW     ENGL       REPL
*******************************************************************************
*** SDS-3
RCHRES  42 HYDR   RO                       WDM    257 FLOW     ENGL       REPL
RCHRES  42 HYDR   STAGE                    WDM    757 STAG     ENGL       REPL
RCHRES  42 HYDR   VOL                      WDM    857 VOL      ENGL       REPL

*******************************************************************************
*** SDS-4
RCHRES  10 HYDR   RO                       WDM    258 FLOW     ENGL       REPL
RCHRES  10 HYDR   STAGE                    WDM    758 STAG     ENGL       REPL
RCHRES  10 HYDR   VOL                      WDM    858 VOL      ENGL       REPL

*******************************************************************************
*** SDS-3A TAXIWAY VAULT
RCHRES  20 HYDR   RO                       WDM    224 FLOW     ENGL       REPL
```

```
RCHRES  20 HYDR   STAGE                    WDM    724 STAG     ENGL      REPL
RCHRES  20 HYDR   VOL                      WDM    824 VOL      ENGL      REPL

*****************************************************************************
*** SDS-7 3RD RUNWAY VAULT
RCHRES   3 HYDR   RO                       WDM    226 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE                    WDM    726 STAG     ENGL      REPL
RCHRES   3 HYDR   VOL                      WDM    826 VOL      ENGL      REPL

*****************************************************************************
*** SASA DETENTION FACILITY
RCHRES 338 HYDR   RO                       WDM    338 FLOW     ENGL      REPL
RCHRES 338 HYDR   STAGE                    WDM    745 STAG     ENGL      REPL
RCHRES 338 HYDR   VOL                      WDM    845 VOL      ENGL      REPL

*****************************************************************************
*** EVALUATION POINT 1 FOR SDS DISCHARGE TO WEST BRANCH
COPY    41 OUTPUT MEAN   1    12.1         WDM    260 FLOW     ENGL      REPL
*****************************************************************************
*** EVALUATION POINT 2 FOR SDS DISCHARGE TO WEST BRANCH
COPY    4  OUTPUT MEAN   1    12.1         WDM    261 FLOW     ENGL      REPL

*** WEST BRANCH
*****************************************************************************
*** NORTHWEST PONDS
RCHRES  43 HYDR   RO                       WDM    231 FLOW     ENGL      REPL
*****************************************************************************
*** LOWER WEST BRANCH
RCHRES  12 HYDR   RO                       WDM    235 FLOW     ENGL      REPL
*****************************************************************************

*** EAST BRANCH
*****************************************************************************
*** BOW LAKE OUTFLOW
RCHRES  35 HYDR   RO                       WDM    236 FLOW     ENGL      REPL
RCHRES  37 HYDR   RO                       WDM     37 FLOW     ENGL      REPL
*** D/S SASA
RCHRES  38 HYDR   RO                       WDM    245 FLOW     ENGL      REPL

*****************************************************************************
*** TYEE INFLOW (GAUGE 11C)
RCHRES   5 HYDR   RO                       WDM    238 FLOW     ENGL      REPL
*****************************************************************************
*** TYEE OUTFLOW
RCHRES  40 HYDR   RO                       WDM    239 FLOW     ENGL      REPL
*****************************************************************************

*** MAIN STEM
*****************************************************************************
*** BELOW CONFLUENCE AT TYEE GOLF COURSE WEIR (GAUGE 11F)
COPY     5 OUTPUT MEAN   1    12.1         WDM    240 FLOW     ENGL      REPL
*****************************************************************************
*** BELOW CONFLUENCE AT SOUTH 200TH STREET
RCHRES  13 HYDR   RO                       WDM    241 FLOW     ENGL      REPL
*****************************************************************************
*** LOWER DES MOINES CREEK NEAR MOUTH (GAUGE 11D)
RCHRES 198 HYDR   RO                       WDM    242 FLOW     ENGL      REPL
*****************************************************************************

END EXT TARGETS
                                                                          ***
NETWORK
***        <MEMBER> SSYSSGAP<--MULT-->TRAN <-TARGET VOLS>        <-MEMBER->
<NAME>   # <NAME>   TEM STRG<-FACTOR->STRG <NAME>   #   # <-GRP> <NAME> # # ***
*****************************************************************************
*** AIRPORT SUBBASINS
*****************************************************************************
*** (DM23) SDE-4
PERLND  26 PWATER SURO          3.344      RCHRES  36     EXTNL  IVOL
PERLND  26 PWATER IFWO          3.344      RCHRES  36     EXTNL  IVOL
IMPLND  14 IWATER SURO         10.507      RCHRES  36     EXTNL  IVOL
*****************************************************************************
*** (DM24) SDS-1
PERLND  26 PWATER SURO          0.115      RCHRES  39     EXTNL  IVOL
PERLND  26 PWATER IFWO          0.115      RCHRES  39     EXTNL  IVOL
IMPLND  14 IWATER SURO          1.360      RCHRES  39     EXTNL  IVOL
```

```
**********************************************************************************
*** (DM25) SDS-3A  TAXIWAY VAULT
PERLND  26 PWATER SURO          2.886      RCHRES  20     EXTNL  IVOL
PERLND  26 PWATER IFWO          2.886      RCHRES  20     EXTNL  IVOL
IMPLND  14 IWATER SURO          2.928      RCHRES  20     EXTNL  IVOL
**********************************************************************************
*** (DM25) SDS-7   3RD RUNWAY VAULT
PERLND  26 PWATER SURO          3.808      RCHRES   3     EXTNL  IVOL
PERLND  26 PWATER IFWO          3.808      RCHRES   3     EXTNL  IVOL
PERLND  44 PWATER SURO          0.327      RCHRES   3     EXTNL  IVOL
PERLND  44 PWATER IFWO          0.327      RCHRES   3     EXTNL  IVOL
PERLND  45 PWATER SURO          0.457      RCHRES   3     EXTNL  IVOL
PERLND  45 PWATER IFWO          0.457      RCHRES   3     EXTNL  IVOL
IMPLND  14 IWATER SURO          3.013      RCHRES   3     EXTNL  IVOL
**********************************************************************************
*** (DM25) SDS-3
PERLND  26 PWATER SURO         12.026      RCHRES  42     EXTNL  IVOL
PERLND  26 PWATER IFWO         12.026      RCHRES  42     EXTNL  IVOL
IMPLND  14 IWATER SURO         16.599      RCHRES  42     EXTNL  IVOL
**********************************************************************************
****SDS-6*NEW WATERSHED
PERLND  26 PWATER SURO          1.128      COPY    50     INPUT  MEAN   1
PERLND  26 PWATER IFWO          1.128      COPY    50     INPUT  MEAN   1
PERLND  44 PWATER SURO          *****      COPY    50     INPUT  MEAN   1
PERLND  44 PWATER IFWO          *****      COPY    50     INPUT  MEAN   1
PERLND  54 PWATER SURO          *****      COPY    50     INPUT  MEAN   1
PERLND  54 PWATER IFWO          *****      COPY    50     INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.265      COPY    50     INPUT  MEAN   1
**********************************************************************************
****SDS-5*NEW WATERSHED
PERLND  26 PWATER SURO          2.356      COPY    41     INPUT  MEAN   1
PERLND  26 PWATER IFWO          2.356      COPY    41     INPUT  MEAN   1
PERLND  44 PWATER SURO          *****      COPY    41     INPUT  MEAN   1
PERLND  44 PWATER IFWO          *****      COPY    41     INPUT  MEAN   1
PERLND  54 PWATER SURO          *****      COPY    41     INPUT  MEAN   1
PERLND  54 PWATER IFWO          *****      COPY    41     INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.348      COPY    41     INPUT  MEAN   1
**********************************************************************************
****SDS-2*NEW WATERSHED
PERLND  26 PWATER SURO          0.249      COPY     4     INPUT  MEAN   1
PERLND  26 PWATER IFWO          0.249      COPY     4     INPUT  MEAN   1
PERLND  44 PWATER SURO          0.384      COPY     4     INPUT  MEAN   1
PERLND  44 PWATER IFWO          0.384      COPY     4     INPUT  MEAN   1
PERLND  54 PWATER SURO          0.043      COPY     4     INPUT  MEAN   1
PERLND  54 PWATER IFWO          0.043      COPY     4     INPUT  MEAN   1
IMPLND  14 IWATER SURO          0.086      COPY     4     INPUT  MEAN   1
**********************************************************************************

*** (DM27) SDS-4
PERLND  26 PWATER SURO          0.564      RCHRES  10     EXTNL  IVOL
PERLND  26 PWATER IFWO          0.564      RCHRES  10     EXTNL  IVOL
PERLND  26 PWATER AGWO          0.564      COPY     5     INPUT  MEAN   1
PERLND  44 PWATER SURO          2.109      RCHRES  10     EXTNL  IVOL
PERLND  44 PWATER IFWO          2.109      RCHRES  10     EXTNL  IVOL
PERLND  44 PWATER AGWO          2.109      COPY     5     INPUT  MEAN   1
IMPLND  14 IWATER SURO          2.707      RCHRES  10     EXTNL  IVOL
**********************************************************************************
*** SASA STORM
IMPLND  14 IWATER SURO          2.855      COPY    15     INPUT  MEAN   1
**********************************************************************************

*** IWS SYSTEM PUMP STATION OVERFLOWS
**********************************************************************************
**********************************************************************************
*** I-3: NORTH SATELLITE PUMP STATION (NSPS) TO IWS
*** OVERFLOW TO SDE-4
*** INSTALLED IN 1995
PERLND  26 PWATER SURO          0.026      RCHRES 360     EXTNL  IVOL
PERLND  26 PWATER IFWO          0.026      RCHRES 360     EXTNL  IVOL
IMPLND  14 IWATER SURO          1.120      RCHRES 360     EXTNL  IVOL
**********************************************************************************
**********************************************************************************
*** I-5: SOUTH SNOWMELT (OLYMPIC TANK FARM) PUMP STATION (SSMPS) TO IWS
*** OVERFLOW TO DES MOINES EAST BRANCH
*** INSTALLED IN LATE 1997/1998
IMPLND  14 IWATER SURO          0.001      RCHRES 366     EXTNL  IVOL
```

```
**************************************************************************************
*** SASA IWS
PERLND   26 PWATER SURO          0.004      COPY      8      INPUT   MEAN    1
PERLND   26 PWATER IFWO          0.004      COPY      8      INPUT   MEAN    1
PERLND   26 PWATER AGWO          0.004      COPY      5      INPUT   MEAN    1
PERLND   44 PWATER SURO          0.004      COPY      8      INPUT   MEAN    1
PERLND   44 PWATER IFWO          0.004      COPY      8      INPUT   MEAN    1
PERLND   44 PWATER AGWO          0.004      COPY      5      INPUT   MEAN    1
PERLND   54 PWATER SURO          0.001      COPY      8      INPUT   MEAN    1
PERLND   54 PWATER IFWO          0.001      COPY      8      INPUT   MEAN    1
PERLND   54 PWATER AGWO          0.001      COPY      5      INPUT   MEAN    1
IMPLND   14 IWATER SURO          4.860      COPY      8      INPUT   MEAN    1
**************************************************************************************

*** EAST BRANCH OF CREEK
**************************************************************************************
*** DM1
PERLND   16 PWATER SURO          0.860      RCHRES   34      EXTNL   IVOL
PERLND   16 PWATER IFWO          0.860      RCHRES   34      EXTNL   IVOL
PERLND   16 PWATER AGWO          0.241      RCHRES   34      EXTNL   IVOL
PERLND   26 PWATER SURO         11.078      RCHRES   34      EXTNL   IVOL
PERLND   26 PWATER IFWO         11.078      RCHRES   34      EXTNL   IVOL
PERLND   26 PWATER AGWO          3.102      RCHRES   34      EXTNL   IVOL
PERLND   34 PWATER SURO          0.599      RCHRES   34      EXTNL   IVOL
PERLND   34 PWATER IFWO          0.599      RCHRES   34      EXTNL   IVOL
PERLND   34 PWATER AGWO          0.168      RCHRES   34      EXTNL   IVOL
PERLND   44 PWATER SURO          7.697      RCHRES   34      EXTNL   IVOL
PERLND   44 PWATER IFWO          7.697      RCHRES   34      EXTNL   IVOL
PERLND   44 PWATER AGWO          2.155      RCHRES   34      EXTNL   IVOL
PERLND   54 PWATER SURO          1.176      RCHRES   34      EXTNL   IVOL
PERLND   54 PWATER IFWO          1.176      RCHRES   34      EXTNL   IVOL
PERLND   54 PWATER AGWO          0.329      RCHRES   34      EXTNL   IVOL
IMPLND   14 IWATER SURO         14.274      RCHRES   34      EXTNL   IVOL
**************************************************************************************
*** DM2
PERLND   26 PWATER SURO          1.232      RCHRES   37      EXTNL   IVOL
PERLND   26 PWATER IFWO          1.232      RCHRES   37      EXTNL   IVOL
IMPLND   14 IWATER SURO          0.821      RCHRES   37      EXTNL   IVOL
**************************************************************************************
*** DM3
PERLND   26 PWATER PERO          3.553      RCHRES    5      EXTNL   IVOL
PERLND   54 PWATER PERO          0.006      RCHRES    5      EXTNL   IVOL
IMPLND   14 IWATER SURO          4.508      RCHRES    5      EXTNL   IVOL
**************************************************************************************
*** DM4
PERLND   16 PWATER PERO          0.286      RCHRES    5      EXTNL   IVOL
PERLND   26 PWATER PERO          0.591      RCHRES    5      EXTNL   IVOL
PERLND   54 PWATER PERO          0.005      RCHRES    5      EXTNL   IVOL
IMPLND   14 IWATER SURO          3.357      RCHRES    5      EXTNL   IVOL
**************************************************************************************
*** DM5
PERLND   16 PWATER PERO          0.173      RCHRES    5      EXTNL   IVOL
PERLND   26 PWATER PERO          0.485      RCHRES    5      EXTNL   IVOL
PERLND   34 PWATER PERO          0.074      RCHRES    5      EXTNL   IVOL
PERLND   44 PWATER PERO          0.077      RCHRES    5      EXTNL   IVOL
PERLND   54 PWATER PERO          0.112      RCHRES    5      EXTNL   IVOL
IMPLND   14 IWATER SURO          0.799      RCHRES    5      EXTNL   IVOL
**************************************************************************************
*** DM6
PERLND   16 PWATER PERO          *****      RCHRES   40      EXTNL   IVOL
PERLND   26 PWATER PERO          0.534      RCHRES   40      EXTNL   IVOL
PERLND   34 PWATER PERO          0.002      RCHRES   40      EXTNL   IVOL
PERLND   44 PWATER PERO          0.709      RCHRES   40      EXTNL   IVOL
PERLND   54 PWATER PERO          0.312      RCHRES   40      EXTNL   IVOL
IMPLND   14 IWATER SURO          0.007      RCHRES   40      EXTNL   IVOL
**************************************************************************************

*** WEST BRANCH OF CREEK
**************************************************************************************
*** DM7
PERLND   16 PWATER SURO          2.190      RCHRES    7      EXTNL   IVOL
PERLND   16 PWATER IFWO          2.190      RCHRES    7      EXTNL   IVOL
PERLND   16 PWATER AGWO          0.788      RCHRES    7      EXTNL   IVOL
PERLND   26 PWATER SURO          2.944      RCHRES    7      EXTNL   IVOL
PERLND   26 PWATER IFWO          2.944      RCHRES    7      EXTNL   IVOL
PERLND   26 PWATER AGWO          1.060      RCHRES    7      EXTNL   IVOL
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PERLND   34 PWATER SURO          1.970      RCHRES   7     EXTNL  IVOL
PERLND   34 PWATER IFWO          1.970      RCHRES   7     EXTNL  IVOL
PERLND   34 PWATER AGWO          0.709      RCHRES   7     EXTNL  IVOL
PERLND   44 PWATER SURO          4.143      RCHRES   7     EXTNL  IVOL
PERLND   44 PWATER IFWO          4.143      RCHRES   7     EXTNL  IVOL
PERLND   44 PWATER AGWO          1.492      RCHRES   7     EXTNL  IVOL
PERLND   54 PWATER SURO          0.552      RCHRES   7     EXTNL  IVOL
PERLND   54 PWATER IFWO          0.552      RCHRES   7     EXTNL  IVOL
PERLND   54 PWATER AGWO          0.199      RCHRES   7     EXTNL  IVOL
IMPLND   14 IWATER SURO          2.401      RCHRES   7     EXTNL  IVOL
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*** DM8
PERLND   16 PWATER SURO          0.203      RCHRES   7     EXTNL  IVOL
PERLND   16 PWATER IFWO          0.203      RCHRES   7     EXTNL  IVOL
PERLND   16 PWATER AGWO          0.077      RCHRES   7     EXTNL  IVOL
PERLND   26 PWATER SURO          0.609      RCHRES   7     EXTNL  IVOL
PERLND   26 PWATER IFWO          0.609      RCHRES   7     EXTNL  IVOL
PERLND   26 PWATER AGWO          0.231      RCHRES   7     EXTNL  IVOL
PERLND   34 PWATER SURO          0.715      RCHRES   7     EXTNL  IVOL
PERLND   34 PWATER IFWO          0.715      RCHRES   7     EXTNL  IVOL
PERLND   34 PWATER AGWO          0.272      RCHRES   7     EXTNL  IVOL
PERLND   44 PWATER SURO          1.133      RCHRES   7     EXTNL  IVOL
PERLND   44 PWATER IFWO          1.133      RCHRES   7     EXTNL  IVOL
PERLND   44 PWATER AGWO          0.431      RCHRES   7     EXTNL  IVOL
PERLND   54 PWATER SURO          0.161      RCHRES   7     EXTNL  IVOL
PERLND   54 PWATER IFWO          0.161      RCHRES   7     EXTNL  IVOL
PERLND   54 PWATER AGWO          0.061      RCHRES   7     EXTNL  IVOL
IMPLND   14 IWATER SURO          2.422      RCHRES   7     EXTNL  IVOL
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*** DM9
PERLND   16 PWATER SURO          0.002      RCHRES   9     EXTNL  IVOL
PERLND   16 PWATER IFWO          0.002      RCHRES   9     EXTNL  IVOL
PERLND   16 PWATER AGWO          0.001      RCHRES   9     EXTNL  IVOL
PERLND   26 PWATER SURO          1.201      RCHRES   9     EXTNL  IVOL
PERLND   26 PWATER IFWO          1.201      RCHRES   9     EXTNL  IVOL
PERLND   26 PWATER AGWO          0.528      RCHRES   9     EXTNL  IVOL
PERLND   34 PWATER SURO          0.017      RCHRES   9     EXTNL  IVOL
PERLND   34 PWATER IFWO          0.017      RCHRES   9     EXTNL  IVOL
PERLND   34 PWATER AGWO          0.007      RCHRES   9     EXTNL  IVOL
PERLND   44 PWATER SURO          3.040      RCHRES   9     EXTNL  IVOL
PERLND   44 PWATER IFWO          3.040      RCHRES   9     EXTNL  IVOL
PERLND   44 PWATER AGWO          1.338      RCHRES   9     EXTNL  IVOL
PERLND   54 PWATER SURO          0.010      RCHRES   9     EXTNL  IVOL
PERLND   54 PWATER IFWO          0.010      RCHRES   9     EXTNL  IVOL
PERLND   54 PWATER AGWO          0.005      RCHRES   9     EXTNL  IVOL
IMPLND   14 IWATER SURO          0.634      RCHRES   9     EXTNL  IVOL
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*** DM10
PERLND   16 PWATER PERO          0.945      RCHRES  43     EXTNL  IVOL
PERLND   26 PWATER PERO          0.738      RCHRES  43     EXTNL  IVOL
PERLND   34 PWATER PERO          1.935      RCHRES  43     EXTNL  IVOL
PERLND   44 PWATER PERO          0.510      RCHRES  43     EXTNL  IVOL
PERLND   54 PWATER PERO          0.712      RCHRES  43     EXTNL  IVOL
IMPLND   14 IWATER SURO          0.185      RCHRES  43     EXTNL  IVOL
*******************************************************************************
*** DM11
PERLND   16 PWATER PERO          0.321      RCHRES  43     EXTNL  IVOL
PERLND   26 PWATER PERO          0.408      RCHRES  43     EXTNL  IVOL
PERLND   34 PWATER PERO          1.024      RCHRES  43     EXTNL  IVOL
PERLND   44 PWATER PERO          0.467      RCHRES  43     EXTNL  IVOL
PERLND   54 PWATER PERO          1.036      RCHRES  43     EXTNL  IVOL
IMPLND   14 IWATER SURO          2.726      RCHRES  43     EXTNL  IVOL
*******************************************************************************
*** DM12
PERLND   16 PWATER PERO          0.510      RCHRES  12     EXTNL  IVOL
PERLND   26 PWATER PERO          0.001      RCHRES  12     EXTNL  IVOL
PERLND   34 PWATER PERO          0.375      RCHRES  12     EXTNL  IVOL
PERLND   44 PWATER PERO          1.728      RCHRES  12     EXTNL  IVOL
PERLND   54 PWATER PERO          0.554      RCHRES  12     EXTNL  IVOL
*******************************************************************************
*** DM13
PERLND   16 PWATER PERO          0.961      RCHRES  13     EXTNL  IVOL
PERLND   26 PWATER PERO          1.562      RCHRES  13     EXTNL  IVOL
PERLND   34 PWATER PERO          1.203      RCHRES  13     EXTNL  IVOL
PERLND   44 PWATER PERO          1.778      RCHRES  13     EXTNL  IVOL
PERLND   54 PWATER PERO          0.089      RCHRES  13     EXTNL  IVOL
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IMPLND  14 IWATER SURO          1.259      RCHRES  13     EXTNL  IVOL
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*** LOWER BASIN
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*** DM14
PERLND  16 PWATER PERO          0.481      RCHRES  14     EXTNL  IVOL
PERLND  26 PWATER PERO          0.295      RCHRES  14     EXTNL  IVOL
PERLND  34 PWATER PERO          1.940      RCHRES  14     EXTNL  IVOL
PERLND  44 PWATER PERO          1.195      RCHRES  14     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.340      RCHRES  14     EXTNL  IVOL
********************************************************************************

*** EXECUTEL TRIBUTARY
********************************************************************************
*** DM16 INFLOW TO EXECUTEL POND
PERLND  16 PWATER SURO          0.647      RCHRES  46     EXTNL  IVOL
PERLND  16 PWATER IFWO          0.647      RCHRES  46     EXTNL  IVOL
PERLND  16 PWATER AGWO          0.446      RCHRES  46     EXTNL  IVOL
PERLND  26 PWATER SURO          5.573      RCHRES  46     EXTNL  IVOL
PERLND  26 PWATER IFWO          5.573      RCHRES  46     EXTNL  IVOL
PERLND  26 PWATER AGWO          3.845      RCHRES  46     EXTNL  IVOL
PERLND  34 PWATER SURO          0.639      RCHRES  46     EXTNL  IVOL
PERLND  34 PWATER IFWO          0.639      RCHRES  46     EXTNL  IVOL
PERLND  34 PWATER AGWO          0.441      RCHRES  46     EXTNL  IVOL
PERLND  44 PWATER SURO          8.023      RCHRES  46     EXTNL  IVOL
PERLND  44 PWATER IFWO          8.023      RCHRES  46     EXTNL  IVOL
PERLND  44 PWATER AGWO          5.536      RCHRES  46     EXTNL  IVOL
PERLND  54 PWATER SURO          0.183      RCHRES  46     EXTNL  IVOL
PERLND  54 PWATER IFWO          0.183      RCHRES  46     EXTNL  IVOL
PERLND  54 PWATER AGWO          0.126      RCHRES  46     EXTNL  IVOL
IMPLND  14 IWATER SURO          4.249      RCHRES  46     EXTNL  IVOL
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*** DM17
PERLND  16 PWATER PERO          2.078      RCHRES  17     EXTNL  IVOL
PERLND  26 PWATER PERO          2.261      RCHRES  17     EXTNL  IVOL
PERLND  34 PWATER PERO          3.003      RCHRES  17     EXTNL  IVOL
PERLND  44 PWATER PERO          3.280      RCHRES  17     EXTNL  IVOL
IMPLND  14 IWATER SURO          2.655      RCHRES  17     EXTNL  IVOL
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*** MAINSTEM RAVINE
********************************************************************************
*** DM18
PERLND  16 PWATER PERO          0.789      RCHRES  18     EXTNL  IVOL
PERLND  26 PWATER PERO          0.277      RCHRES  18     EXTNL  IVOL
PERLND  34 PWATER PERO          3.151      RCHRES  18     EXTNL  IVOL
PERLND  44 PWATER PERO          1.106      RCHRES  18     EXTNL  IVOL
PERLND  54 PWATER PERO          0.300      RCHRES  18     EXTNL  IVOL
IMPLND  14 IWATER SURO          0.296      RCHRES  18     EXTNL  IVOL
********************************************************************************

*** NORTH BRANCH RAVINE
********************************************************************************
*** DM19
PERLND  16 PWATER PERO          0.182      RCHRES 177     EXTNL  IVOL
PERLND  26 PWATER PERO          6.019      RCHRES 177     EXTNL  IVOL
PERLND  34 PWATER PERO          0.167      RCHRES 177     EXTNL  IVOL
PERLND  44 PWATER PERO          5.552      RCHRES 177     EXTNL  IVOL
IMPLND  14 IWATER SURO          2.617      RCHRES 177     EXTNL  IVOL
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*** DM20
PERLND  16 PWATER PERO          4.007      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER PERO          6.624      RCHRES 193     EXTNL  IVOL
PERLND  34 PWATER PERO          2.784      RCHRES 193     EXTNL  IVOL
PERLND  44 PWATER PERO          4.602      RCHRES 193     EXTNL  IVOL
PERLND  54 PWATER PERO          0.116      RCHRES 193     EXTNL  IVOL
IMPLND  14 IWATER SURO          3.714      RCHRES 193     EXTNL  IVOL
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*** LOWER MAINSTEM
********************************************************************************
*** DM21
PERLND  16 PWATER PERO          2.143      RCHRES 198     EXTNL  IVOL
PERLND  26 PWATER PERO          6.306      RCHRES 198     EXTNL  IVOL
PERLND  34 PWATER PERO          1.429      RCHRES 198     EXTNL  IVOL
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PERLND  44 PWATER PERO          4.205      RCHRES 198     EXTNL  IVOL
IMPLND  14 IWATER SURO          3.091      RCHRES 198     EXTNL  IVOL
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*** DM22
PERLND  16 PWATER PERO          0.381      RCHRES 198     EXTNL  IVOL
PERLND  26 PWATER PERO          4.654      RCHRES 198     EXTNL  IVOL
PERLND  34 PWATER PERO          0.218      RCHRES 198     EXTNL  IVOL
PERLND  44 PWATER PERO          2.620      RCHRES 198     EXTNL  IVOL
PERLND  54 PWATER PERO          0.016      RCHRES 198     EXTNL  IVOL
IMPLND  14 IWATER SURO          1.972      RCHRES 198     EXTNL  IVOL
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*** NONCONTIGUOUS GROUNDWATER BASINS
*******************************************************************************
*** G1
PERLND  16 PWATER AGWO          2.833      RCHRES   5     EXTNL  IVOL
PERLND  26 PWATER AGWO          9.917      RCHRES   5     EXTNL  IVOL
*******************************************************************************
*** G2
PERLND  16 PWATER AGWO          0.417      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER AGWO          1.333      RCHRES 193     EXTNL  IVOL
*******************************************************************************
*** G3
PERLND  16 PWATER AGWO          5.083      RCHRES 193     EXTNL  IVOL
PERLND  26 PWATER AGWO         17.667      RCHRES 193     EXTNL  IVOL
PERLND  34 PWATER AGWO          1.167      RCHRES 193     EXTNL  IVOL
PERLND  44 PWATER AGWO          4.250      RCHRES 193     EXTNL  IVOL
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*** CHANNEL NETWORK LINKAGES ***
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*** PUMP STATION OVERFLOW TO SDS
*******************************************************************************
RCHRES 360 HYDR   OVOL   2                 RCHRES  36     EXTNL  IVOL
RCHRES 366 HYDR   OVOL   2                 RCHRES   5     EXTNL  IVOL
*******************************************************************************

*** EAST BRANCH OF CREEK
*******************************************************************************
RCHRES  34 HYDR   OVOL   1                 RCHRES  35     EXTNL  IVOL
RCHRES  35 HYDR   ROVOL  1                 RCHRES  37     EXTNL  IVOL
RCHRES  36 HYDR   ROVOL  1                 RCHRES 338     EXTNL  IVOL
COPY    15 OUTPUT MEAN   1                 RCHRES 338     EXTNL  IVOL
RCHRES  39 HYDR   ROVOL  1                 RCHRES 338     EXTNL  IVOL
RCHRES  37 HYDR   ROVOL  1                 RCHRES 338     EXTNL  IVOL
RCHRES 338 HYDR   ROVOL  1                 RCHRES  38     EXTNL  IVOL
RCHRES  38 HYDR   ROVOL  1                 RCHRES   5     EXTNL  IVOL
RCHRES   5 HYDR   ROVOL  1                 RCHRES  40     EXTNL  IVOL
RCHRES  40 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
*******************************************************************************


*** WEST BRANCH OF CREEK
*******************************************************************************
RCHRES  20 HYDR   ROVOL  1                 COPY     9     INPUT  MEAN   1
RCHRES  42 HYDR   ROVOL  1                 COPY     9     INPUT  MEAN   1
COPY     9 OUTPUT MEAN   1                 RCHRES   4     EXTNL  IVOL
RCHRES   4 HYDR   ROVOL  1                 COPY    41     INPUT  MEAN   1
COPY    50 OUTPUT MEAN   1                 RCHRES   3     EXTNL  IVOL
RCHRES   3 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
RCHRES   7 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
RCHRES   9 HYDR   ROVOL  1                 COPY     4     INPUT  MEAN   1
COPY    41 OUTPUT MEAN   1                 RCHRES  43     EXTNL  IVOL
COPY     4 OUTPUT MEAN   1                 RCHRES  43     EXTNL  IVOL
RCHRES  43 HYDR   OVOL   1                 RCHRES  12     EXTNL  IVOL
RCHRES  10 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
RCHRES  12 HYDR   ROVOL  1                 COPY     5     INPUT  MEAN   1
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*** MAINSTEM BELOW CONFLUENCE OF E. AND W. BRANCH
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*** MAINSTEM ABOVE EXECUTEL TRIBUTARY
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COPY     5 OUTPUT MEAN   1                  RCHRES  13     EXTNL  IVOL
RCHRES  13 HYDR   ROVOL  1                  RCHRES  14     EXTNL  IVOL
RCHRES  14 HYDR   ROVOL  1                  COPY    48     INPUT  MEAN   1
**************************************************************************************
*** EXECUTEL TRIBUTARY
RCHRES  46 HYDR   ROVOL  1                  RCHRES  47     EXTNL  IVOL
RCHRES  47 HYDR   ROVOL  1                  RCHRES  17     EXTNL  IVOL
RCHRES  17 HYDR   ROVOL  1                  COPY    48     INPUT  MEAN   1
**************************************************************************************
*** MAINSTEM FROM HEAD OF RAVINE TO NORTH BRANCH CONFLUENCE
COPY    48 OUTPUT MEAN   1                  RCHRES  18     EXTNL  IVOL
RCHRES  18 HYDR   OVOL   1                  RCHRES 193     EXTNL  IVOL
RCHRES 193 HYDR   ROVOL  1                  COPY     1     INPUT  MEAN   1
**************************************************************************************
*** NORTH BRANCH RAVINE TO MAINSTEM
RCHRES 177 HYDR   ROVOL  1                  COPY     1     INPUT  MEAN   1
**************************************************************************************
*** MAINSTEM FROM NORTH BRANCH CONFLUENCE TO PARK BELOW MVD CULVERT
COPY     1 OUTPUT MEAN   1                  RCHRES 198     EXTNL  IVOL
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END NETWORK

END RUN
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