Technical Memorandum

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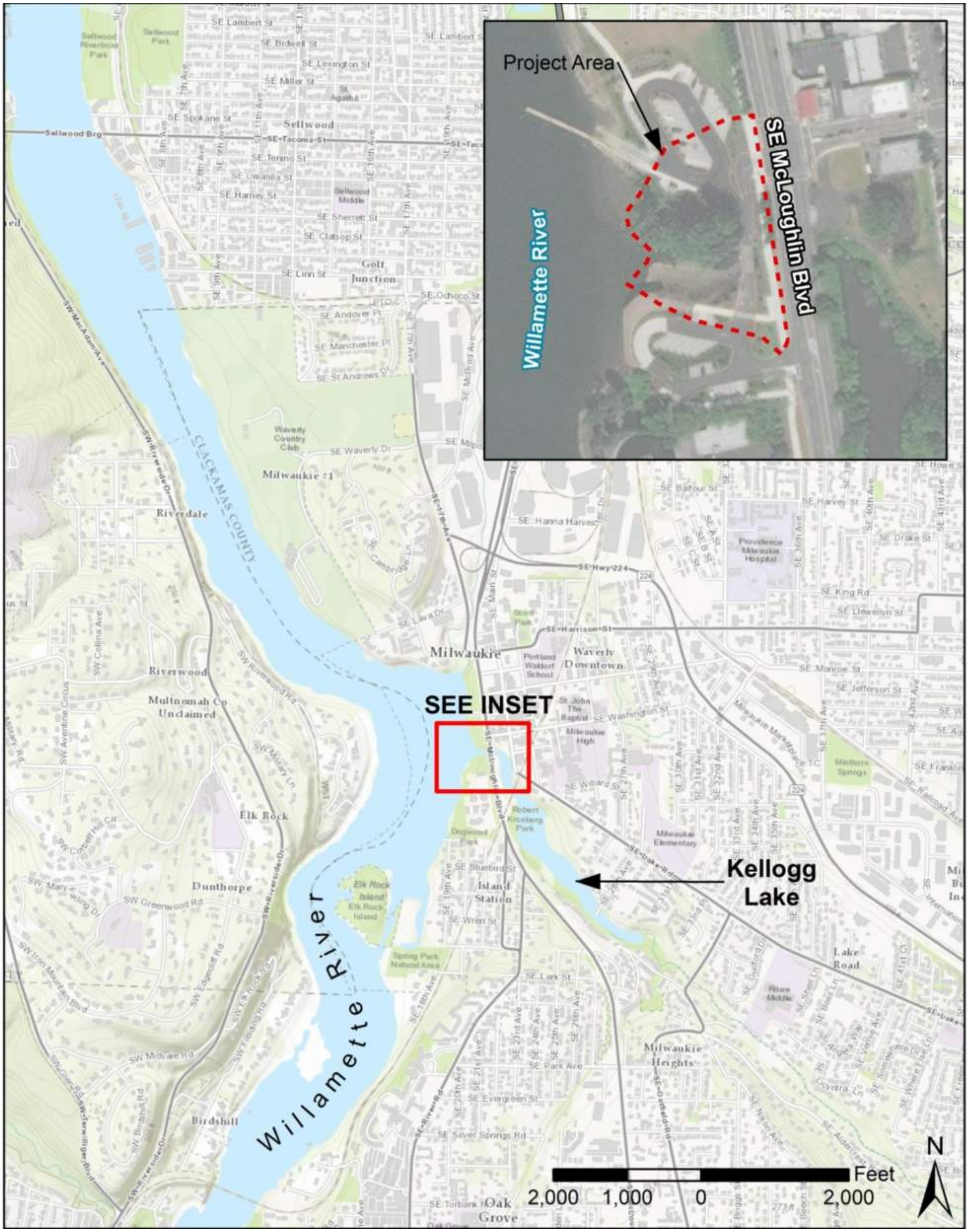
Date:	August 17, 2017
Subject:	Kellogg Creek Bridge Replacement Stormwater Design Memo (DRAFT)
Project No.:	18328

Section 1—Overview

Project Description and Introduction

The Kellogg Creek Bridge Replacement Project will include the complete removal of an existing bridge (No. 22142) spanning Kellogg Creek, approximately 150-ft upstream of the confluence of the Willamette River and Kellogg Creek, located in the City of Milwaukie, Oregon (see Vicinity Map). The existing bridge connects the parking areas for the Milwaukie Riverfront Park on either side of the creek for a day-use area and boat ramp and is adjacent (west) of the highway OR-99E crossing of Kellogg Creek. A bridge replacement has been recommended due to undermining of the concrete pedestals supporting the bridge and the velocities through the channel eroding the south bank. The new bridge will be wider (32-ft wide) than the existing 20-ft wide bridge and will be located immediately west of the existing bridge. The parking lot approaches on either side will be regraded to match the proposed bridge. A fish ladder exists underneath the existing bridge which will be left in place and will not be impacted as part of this project.



Vicinity Map

Purpose of the Study

The purpose of this technical memo is to document the background and design of the stormwater management for the project. The memo includes the following sections: Overview, Background, Design, Maintenance, and Conclusion. The purpose of this study is to develop a stormwater management plan to treat stormwater before discharging to the confluence of Kellogg Creek and the Willamette River. The existing impervious areas within the park are currently being treated by vegetated facilities except for the bridge, which is not treated. Project activities that have the potential to affect ESA-listed species include an increase in contributing impervious area (CIA) that drains to Kellogg Creek. Design objectives for the mitigation of the increased impervious area include water quality treatment per the programmatic biological opinion Standard Local Operating Procedures for Endangered Species (SLOPES) V design standards (NMFS, 2014). SLOPES V does not require quantity mitigation because the project discharges to the Willamette River downstream of Eugene, however, the City of Milwaukie Public Works Standards require flow control. Conveyance design objectives include inlet capacity, pipe capacity including freeboard, and energy dissipation at the new storm outfall to prevent erosion of the receiving soil per the ODOT Hydraulics Manual (ODOT, 2014).

Key Issues

The key design issues affecting the stormwater design include:

- minimizing the footprint of the proposed water quality facility to avoid impacting existing park infrastructure and adjacent steep slopes
- minimizing impacts below ordinary high water (OHW)
- verifying the capacity of the existing stormwater facilities to accommodate changes in the contributing impervious area

Summary of Results

The proposed stormwater system meets all applicable design standards except for the minimum velocity in the pipes routed to the stormwater basin and the peak discharge for storm events below the 25-year recurrence interval. These design exceptions are discussed in further detail in Section 3. The increase in contributing impervious area has been mitigated by providing water quality treatment through a bioretention basin. Runoff will infiltrate through an 18" water quality mix layer and a 12" drain rock layer before being collected by a 4" perforated pipe. During high flow events, water will overtop a beehive grate outlet structure. In all design storms water will be collected and piped to a flow control structure with a single 1" orifice and an emergency overflow weir. Runoff from the flow-control structure will outfall onto the riprap scour protection for the bridge abutment, above the ordinary high water elevation (21.8ft) of the confluence of Kellogg Creek and the Willamette River. This project impacts several existing stormwater facilities due to the reconfiguration of existing parking lots and driveways to meet the new bridge alignment and the wider bridge footprint. The existing stormwater facilities were modeled using the Presumptive Approach Calculator (PAC) tool. Under the proposed conditions all stormwater facilities will meet water quality standards, based on an analysis using the PAC tool.

A system of grate inlets, manholes, and pipes will convey runoff to the water quality basin. Note that runoff from a section of the existing bridge (see Figure 1) is not currently treated, but discharges directly from the bridge to Kellogg Creek through scuppers on the bridge. The improvements of this project will treat all contributing impervious areas including all runoff from the proposed bridge and sidewalk.

Table 1: Impervious Surface Areas and Stormwater Treatment BMP by Drainage Basin

Basin	Pre-Project On-Site Impervious Area (SF)	Proposed On-Site Impervious Area (SF)	New On-Site Impervious Area (SF)	BMP
C2	16,320*	16,320	0	Existing Planter #3
C3	10,212*	10,212	0	Existing Large Pond
C4	3,328*	1,286	-2,042	Existing Planter #4
N1	11,375*	12,209	834	Existing Planter #5
N2	6,372*	661	-5,711	Existing Planter #6
N3	3,429*	4,298	869	Existing Planter #7
N4	0	4,815	4,815	Bioretention Basin
N5	0	2,808	2,808	
Total	**51,036**	**52,609**	**1,573**	

*From David Evans & Associates Stormwater Report (see Appendix A)

Table 2: BMP Specifications*

Basin	BMP Type	Bottom Length (ft)	Bottom Width (ft)	Depth (ft)	Side Slopes (ft/ft)
C4 (Proposed)	Planter #4 (Modified)	23	15 (average)	1	Vertical
N4/N5	Bioretention Basin	32.5	8	1.2	3:1

*For existing facility information, see DEA report in Appendix A

Section 2 – Background

Watershed Characteristics

The site is located within the City of Milwaukie, OR. At the downtown Portland, OR weather station (within 10 miles of the project site) the average annual rainfall is 42.85 inches (NOAA, 2015). Soils at the site are classified as Urban Soils, with no associated Hydrologic Soil Group. Nearby soils are classed mostly Woodburn silt loam, Hydrologic Soil Group C. Group C soils are soils that have a slow infiltration rate when thoroughly wet. A past geotechnical investigation in the area revealed stiff brown silt fill in the first ten feet below the surface (See Appendix B for the soil survey and geotechnical report). Land use adjacent to the site consists of a wastewater treatment facility to the south, a day use area to the north, the Willamette River to the west, and highway OR-99E to the east.

The project will discharge into Kellogg Creek approximately at its confluence with the Willamette River. This section of Kellogg Creek is listed on the 303(d) list of the EPA's Clean Water Act (ODEQ, 2012). There are no TMDLs in effect, but the following parameters are recommended:

- <u>Dissolved Oxygen (January 1 – May 15):</u> spawning period – dissolved oxygen not less than 11.0 mg/L or 95% of saturation.
- <u>Dissolved Oxygen (Year-Round):</u> Non-spawning period – cool water, dissolved oxygen not less than 6.5 mg/L.

Project Area Characteristics

Pre-Construction Characteristics

The existing conditions at the site of the Kellogg Creek Bridge Replacement project contain a 20 ft wide bridge with concrete pedestals exposed, and an over steepened south bank. A fish ladder exists underneath the existing bridge– this fish ladder will not be affected by the bridge replacement. The bridge is surrounded by parking lots and existing stormwater facilities constructed during the Milwaukie Riverfront Park development to treat the stormwater generated by the parking lots. The existing bridge currently discharges directly to Kellogg Creek through scuppers.

Post-Construction Characteristics

The parking lots and driveway immediately adjacent to the new bridge will be regraded and realigned to match the new bridge. Previously paved areas not needed for the new bridge will be de-paved and planted. One of the existing stormwater planters on the south side of Kellogg Creek (Existing Planter #4) will be modified such that some of its area will be paved to match the alignment of the new bridge; however, the contributing impervious area draining to the modified planter will also be reduced (see Table 1). The new bridge drains mostly to the north. Three grate inlets (ODOT Type G-2) will be installed on the north side of Kellogg Creek to capture runoff from the north driveway, the new bridge deck, and the new sidewalk. Conveyance pipes will carry water from these inlets to a new bioretention basin (constructed as part of this project), which will provide water quality treatment and peak flow mitigation.

The Outfall

Stormwater from the planter will leave via a perforated underdrain at the bottom of the planter or via a beehive grate overflow, and will enter a flow control manhole, before ultimately outfalling onto the bridge scour protection riprap, which will also function as riprap outfall protection (see Figure 3). The stormwater will flow into Kellogg Creek at its confluence with the Willamette River.

Utilities

There is an existing overhead power line along highway OR-99E. Existing sanitary sewer lines are present on both sides of the bridge (see Figure 1). Five existing planters and one existing large pond are located on the site; one of the planters (Existing Planter #4) will be modified. During removal of the existing bridge span, caution will be taken to protect the existing utilities and highway OR-99E.

Investigations

Otak conducted a detailed topographic survey of the site in 2017. GeoDesign conducted a geotechnical engineering evaluation of the site soils in 2000 (see Appendix B).

Section 3 – Design

Design Criteria

The City of Milwaukie Public Works Standards (last revised February 4, 2015) was the primary design document for stormwater management. However, the City of Milwaukie defers to the City of Portland Stormwater Management Manual for water quality treatment. Aside from water quality treatment, where the City of Milwaukie did not have design standards the Oregon Department of Transportation (ODOT) Hydraulics Manual was used (ODOT, 2014).

Inlet Capacity

Inlet capacity was assessed for the new grate inlets used to capture runoff from Basin N4 and Basin N5 (see Figure 2). The City of Milwaukie Standard Detail #600 – G-2 Catchbasin was used as the design inlet. The inlet capacity calculations were performed according the ODOT Hydraulics Manual Chapter 13 Appendices C and D (see Appendix D). No sag inlets were present as part of the proposed construction. The design rainfall event was the 25-year recurrence interval, 5-minute duration event, with a rainfall intensity of 2.1 in/hr. This rainfall intensity was obtained from ODOT's Rainfall Intensity – Duration – Recurrence Interval Curves in Appendix A, Figure for Zone 7 (ODOT, 2014).

Pipe Conveyance Network

In order to convey stormwater from the grate inlets to the water quality basin, a pipe conveyance network was designed according to the City of Milwaukie Publics Works Standards Sections 2.012 and 2.013.C (City of Milwaukie, 2015):

- Conveyance network sized to safely pass the 100-year recurrence interval, 24-hour duration storm event
- Minimum pipe diameter = 10-inches
- Manning pipe friction equation used to calculate minimum slopes/velocities
- Pipe roughness coefficient not less than 0.013
- Pipes graded to produce minimum velocity when flowing full = 2 feet per second
- Minimum pipe slope = 0.0055 ft/ft
- Minimum pipe cover within roadway = 36 inches
- Minimum pipe cover outside roadway = 30 inches
- Preferred pipe material for pipes < 24-inch diameter = Ribbed PVC
- If unable to achieve minimum pipe cover, use concrete or ductile iron pipe

Water Quality Treatment

The City of Portland Stormwater Management Manual requires that the Presumptive Approach (Section 2.2.2, City of Portland, 2016) be used for projects on public property and not requiring an advanced design.

The Presumptive Approach Calculator (PAC) Tool was used to assess the new basin, the modified planter (C4), and each of the planters which will not be modified but whose contributing impervious area will be modified due to regrading. The City of Portland lined basin detail (City of Portland, 2016) was used to design the new bioretention basin. The proposed bioretention basin is lined due to geotechnical concerns regarding infiltration near the top of a steep slope.

Flow Control

The City of Milwaukie requires that the flow control be designed using the following parameters:

- The 2-, 5-, 10-, 25-, and 100-year events are required to be detained to the pre-developed site conditions using the Santa Barbara Unit Hydrograph (SBUH) Method. Proposed conditions peak flows will be matched to pre-developed conditions peak flows.
- A flow control structure is required. The minimum flow control orifice diameter = 1 inch.

Riprap Outfall Protection

The City of Milwaukie does not have specific design requirements for riprap outfall projection, beyond what is shown on City of Milwaukie Detail #625 – Riprap (City of Milwaukie, 2015). Due to the proximity of the bridge scour protection riprap, the decision was made to outfall onto the scour protection riprap to provide outfall energy dissipation (see Figure 3).

Analysis Methods

Hydrology

The contributing basins were initially taken from a David Evans & Associates, Inc. (DEA) report for the Milwaukie Riverfront Park improvements (see Appendix A). The survey conducted for this project did not extend past the proposed construction limits and did not fully capture the contributing impervious area for each existing drainage basin. To estimate the contributing impervious area in each existing drainage basin, the net change to the contributing impervious area of each of the basins provided in the DEA report was used for design (see Table 1). Existing basin N2 is an exception to this: under proposed conditions the contributing impervious area for basin N2 is located entirely within the project limits and the new drainage basin was delineated using AutoCAD. Likewise, the two proposed basins, N4 and N5, were delineated using AutoCAD.

Water quality flow rates were calculated using the City of Portland Presumptive Approach Calculator (PAC) tool. The design infiltration rate for the growing media was 2.0 in/hr. An output report of the PAC tool is included in Appendix E.

Runoff rates into the conveyance system were computed using XP-SWMM 2014 software (version 15.0) with the following assumptions:

- Santa Barbara Urban Hydrograph (SBUH) methodology was used to perform hydrologic calculations in accordance with the ODOT Hydraulics Manual, Chapter 7.
- Type 1A 24-hour rainfall distribution was used with precipitation depths of 2.29, 2.75, 3.08, 3.59, and 4.38 inches for the 2-year, 5-year, 10-year, 25-year, and 100-year storm events respectively.
- Soils within the project limits are categorized by the National Resource Conservation Service (NRCS) soil survey as Urban Soils. This does not indicate a soil type, so the soil types of the surrounding area were considered. The nearest areas to the project site are surveyed as Hydrologic Soil Group C; based on this the soils of this project site were assumed to be Hydrologic Soil Group C. See Appendix B for the complete soil report.
- A concentration time of 5 minutes was assumed for all impervious surfaces (proposed conditions). Time of concentration was only calculated for the pre-development conditions of the new proposed driveway drainage basin, N5. Time of concentration calculations are included in Appendix C.
- Contributing impervious area computations are based on two methods, as follows:
    - The impervious area of existing basins was taken from the DEA report, and changes to the impervious area were then measured using AutoCAD. The net change was applied to achieve a new basin area. This method was used because survey beyond the extents of the project site was not conducted as part of this project, requiring an assumption of offsite contributing impervious area.
    - The proposed basin boundaries were measured from the proposed site layout (see Figure 2). This method was used when the basin boundary was within the survey

limits and a complete basin could be delineated. This includes basins N2, N4, and N5.

- For all impervious surfaces, a curve number (CN) of 98 was used. A CN of 70 (Woods, Good Condition, HSG C) was used for pre-developed pervious areas. Proposed pervious areas are not directly connected to a storm line, and so were not modeled.

An output report of the hydrologic characteristics from the XP-SWMM model can be seen in Appendix F.

Hydraulics

Inlet capacity calculations were computed using the rational method to obtain design flow rates for the 25-year, 5-minute duration event. These flow rates were input to the Hydraflow Express AutoCAD extension (version 10.5) along with physical characteristics of the inlets and the site and applying a 30% clogging factor, per ODOT Chapter 13 Appendix D (ODOT, 2014).

The bioretention basin was modeled using the node storage component of the Hydraulics mode in XP-SWMM 2014, with the following basin design parameters:

- The "VS" configuration parameter was used – this changes the stage-incremental area (as acres) to stage-cumulative volume (as cubic feet).
- The cumulative volume was calculated from the bottom of the pond using 30% voids in the 12" deep rock layer, 4% voids in the 18" deep water quality mix layer, and 100% voids in the 12" deep surface storage layer (above soil surface and below the beehive grate). Vertical walls were assumed for the storage despite the sloped basin walls – this is a conservative estimate, meant to offset lost storage volume due to riprap outfall protection in the basin, the physical space of the plants, etc. The area of the beehive grate (10 sf) was removed from the footprint of the treatment area.

Table 3: Stage-Volume Storage in Bioretention Basin		
Elevation from bottom (feet)	Porosity	Cumulative storage (cubic feet)
0	0.3	0.00
0.25	0.3	18.75
0.5	0.3	37.50
0.75	0.3	56.25
1	0.3	75.00
1.25	0.04	77.50
1.5	0.04	80.00
1.75	0.04	82.50
2	0.04	85.00
2.25	0.04	87.50
2.5	0.04	90.00
2.75	1	152.50
3	1	215.00
3.25	1	277.50
3.5	1	340.00
3.75	1	402.50
4	1	465.00
4.1	1	490.00

Conveyance calculations required an infiltration flow rate through the water quality media of the basin. An infiltration rate of 0.012 cubic feet per second was calculated by taking the area of the bioretention basin (260 square-feet) and subtracting the area of the beehive grate outlet structure (10 square-feet), then multiplying that value (250 square-feet) by the infiltration rate through the growing media (2 in/hr). Hydraulic head due to water storage on top of the growing media was not factored in; a constant infiltration flow rate of 0.012 cubic feet per second was used for the conveyance analysis.

The water quality basin discharges to two links (see Appendix F for XP-SWMM layout):

- An "Infilt" link representing the infiltration rate through the water quality media (as cubic feet per second), described above. This leads to a link representing the perforated pipe running through the bottom of the planter.
- A "Beehive" link representing the beehive grate and functioning as overflow drain for the facility.

Both links connect to the flow control manhole, which contains a single 1” orifice (the minimum allowable diameter) and an overflow weir. The weir is set at a sufficient elevation that it is not activated by the 100-year runoff event, but is present as an emergency overflow device. Flow control is provided entirely by the 1” orifice.

Stormwater Narrative and Calculations

Treatment of stormwater from the proposed contributing impervious areas will be accomplished using a new bioretention basin for the new bridge and realigned north driveway. This was selected from the City of Portland’s Stormwater Management Manual (City of Portland, 2016). The other impervious surfaces within the project area discharge to the existing stormwater facilities installed during the Milwaukie Riverfront Park development.

Inlet Capacity

Three G-2 inlets will be installed on grade as shown in Figure 2. One inlet located at the gore point of the north driveway will function to capture the runoff of Basin N5, and bypass flows will contribute to the flow of Basin N4. During the 25-year, 5-minute storm (design storm) this inlet has the following characteristics:

- 92% efficiency
- 2.76 ft of spread (within the gutter)
- 0.21 ft of depth at the inlet
- 0.01 cfs of bypass flow

Two inlets located along the new sidewalk adjacent to the water quality basin will be installed to capture the runoff from Basin N4 and any bypass from the inlet at the driveway gore point (see Figure 2). The second inlet for Basin N4 was added to capture bypass from the first, and to ensure that bypass from the first will be captured and routed to the water quality basin to meet the flow control targets during the 25-year design storm. The two inlets will be connected via a 10-inch pipe and discharge to the water quality basin. During the design storm, the first of the flanking inlets has the following characteristics:

- 84% efficiency
- 3.18 ft of spread (within the gutter)
- 0.22 ft of depth at the inlet
- 0.04 cfs of bypass flow

During the design storm, the second of the flanking inlets has the following:

- 100% efficiency (all flow captured)
- 1.65 ft of spread (within the gutter)
- 0.20 ft of depth at the inlet
- No bypass flow

Pipe Conveyance Network

In order to convey stormwater to and from the bioretention basin, a new pipe network will be constructed underneath the north parking lot and the adjacent vegetated space. Runoff will be captured using three G-2 inlets (see above), and will be conveyed using 10" diameter pipes. Stormwater will outfall into the bioretention basin. See Table 4 for a summary of pipes.

Table 4: Pipe Summary Table

Pipe ID	Upstream Structure	Downstream Structure	Length (ft)	Diameter (inches)	Slope (ft/ft)	Minimum Cover (ft)	Pipe Material
Pipe CB1 CB2	CB1	CB2	29.5	10	0.0288	2.6	Ductile Iron
Pipe CB3 CB2	CB3	CB2	6.9	10	0.0390	1.8	Ductile Iron
Pipe CB2 OUT	CB2	Outfall to water quality basin	22.3	10	0.0055	2.8, under sidewalk	Ductile Iron
BEEHIVE TO MH	BEEHIVE	FCMH	22.7	10	0.0057	2.5	Ribbed PVC
MH TO PLANTER OUTFALL	FCMH	Outfall to scour protection riprap	28.6	10	0.0063	0, outfall	Ribbed PVC

Water Quality Treatment

The bioretention basin will have a bottom area of 260 square feet, arranged as an 8 foot by 32.5 foot rectangle, with 3H:1V side slopes up to the existing ground. The basin will be lined with an impermeable liner, preventing infiltration into the surrounding soil, which could destabilize the adjacent steep slope. For storm events less than or equal to the 2-year, 24-hour storm event, runoff will infiltrate through 18" of water quality mix and into a 12" layer of drainage rock, inside of which is a 4" perforated PVC pipe which will collect treated runoff and convey it to the flow control structure. For storm events larger than the 2-year, 24-hour event, water unable to infiltrate through the water quality mix will overflow into the beehive grate located 12" above the soil surface which is routed to the flow control manhole.

Flow Control

Flows from the perforated pipe and the beehive grate will be combined and conveyed a short distance to a manhole with the following flow control structure:

- A single 1" diameter orifice (invert elevation 21.7') – this is the minimum size allowable. Section 2.0013.A of the City of Milwaukie Public Works Standards states that if a single 1" orifice is unable to detain water to the maximum release rate (the matching storm event under pre-developed conditions in this case) then the 1" orifice will be deemed acceptable, per approval by the City Engineer (Chuck Eaton).

- An overflow weir, located at elevation 26.7'. This weir is designed for emergency overflow in case the 1" orifice becomes clogged. Under design conditions it is not used to convey any flow.

See Table 5 for pre-developed and proposed peak runoff rates. Using the 1" orifice, pre-developed flow rates cannot be met for the 2-year, 5-year, 10-year, and 25-year events. However, the differences in flow rate are one hundredth or several thousandths of a cubic foot per second, suggesting that no appreciable difference in flow will occur. The stormwater system discharges to the confluence of Kellogg Creek and the Willamette River which is generally considered a waterbody exempt from flow control although the Milwaukie Public Works Standards has no such exception.

Table 5: Peak Flow Matching Results

Condition	Design Storm Recurrence Interval				
	2-yr	5-yr	10-yr	25-yr	100-yr
Pre-Developed (cfs)	0.004	0.007	0.011	0.021	0.038
Post Construction (cfs)	0.012	0.019	0.022	0.028	0.035

Riprap Outfall Protection

The proposed riprap scour protection for the new bridge abutments will double as outfall protection for the conveyance system (see Figure 3). An outfall splash pad was added inside of the water quality basin to protect the basin from scour around the inlet pipe which discharges partway up the side slope of the basin. During high flow events the basin will quickly fill and the pipe will become backwatered, minimizing erosion in the basin. For this reason, a smaller design than is provided by City of Milwaukie detail #625 is proposed, using modified ODOT sizing to form a splash pad with the following dimensions:

- Length = 40" (4 X outfall pipe diameter, 10")
- Width = 30" (3 X outfall pipe diameter, 10")
- The splash pad will be shaped along the basin slope and along the toe of slope, to protect against potential splashing at the toe of slope.

Water Quality

Regrading and paving caused changes in the contributing impervious areas of several existing treatment facilities (see Figures 1 & 2). Notably, Existing Planter #4 was shrunk from 435 sf to 260 sf as part of the new bridge approach (south of Kellogg Creek). Additionally, basins N1 and N3 will receive additional runoff due to regrading of the parking lot north of Kellogg Creek. All modified treatment facilities were modeled using the PAC tool to ensure that they would still meet water quality treatment standards as designed based on the DEA Stormwater Report provided by the City. The new water quality basin was also modeled (as a planter, to ensure a conservative estimate).

Modeling the facility as a planter assumes straight walls without any additional surface for infiltration. The bioretention basin will be graded with 3H:1V sloped sides which increases the area of infiltration through the water quality media. All facilities pass water quality treatment standards using the PAC tool for the proposed conditions (see Appendix E).

Section 4 – Maintenance

Responsible Party

After construction, City of Milwaukie maintenance staff will review the facilities at intervals sufficient to ensure that facilities continue functioning as designed.

Routine Maintenance Actions

After the facilities have been constructed, a comprehensive Operations & Maintenance Manual will be prepared for each facility using standards described in the ODOT Hydraulics Manual (ODOT, 2014). At a minimum, the actions in Table 2: Maintenance of Stormwater Ponds apply (see Appendix G).

Maintenance Activity Schedule

The water quality basin should be inspected prior to fall rains. Also, if applicable, the facilities should be inspected after the first significant rain event following a dry spell.

Contingency and Repair Plan

In the event of hazardous materials spills, crashes, or uprooted or fallen trees, inspect the water quality basin for contamination or damage. Repair or reconstruct the facility to conform to original design specifications as required. Handle and dispose of contaminated materials using only approved methods, equipment, and sites.

Section 5 – Conclusion

Stormwater treatment of this project will achieve complete pollutant removal by treating runoff from the contributing impervious areas with existing planters or the new water quality basin.

Changes to the contributing impervious areas of the existing stormwater facilities as part of this project will not cause any of the facilities to become unable to adequately treat stormwater. The new water quality basin will provide water quality treatment to the north driveway and the new bridge. Three G-2 catch basins will be installed to capture all runoff from the north driveway and the new bridge without bypassing water to the existing stormwater facilities.

The water quality basin has been sized to treat the water quality flow and the beehive grate has been installed to ensure that higher flow rates can be safely passed without overflowing the facility. The basin was designed to have 2" of freeboard while passing runoff from the 100-year storm event.

The new water quality basin will outfall onto the scour protection riprap that will be installed around the bridge abutments.

Section 6 – References

Oregon Department of Environmental Quality (DEQ), 2012. Oregon's Integrated Report. Accessed August 7, 2017: http://www.deq.state.or.us/wq/assessment/rpt2012/results.asp

National Marine Fisheries Service, March 2014. United States Department of Commerce, National Oceanic and Atmospheric Administration, Reinitiation of the Endangered Species Act Section 7 Programmatic Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for revision to Standard Local Operating Procedures for endangered Species to Administer Maintenance or Improvement of Stormwater, Transportation or Utility Actions Authorized or Carried Out by the U.S. Army Corps of Engineering in Oregon (SLOPES for Stormwater, Transportation or Utilities), NMFS No.: 2013/10411, Action Agency: National Marine Fisheries Service, March 2014.

National Weather Service Forecast Office (NOAA), 2015. Local Climate Data from Portland Downtown. Accessed August 7, 2017. http://www.wrh.noaa.gov/pqr/pdxclimate/pg75.pdf

Oregon Department of Transportation (ODOT), 2014. Hydraulics Design Manual, Engineering and Asset Management Unit, Geo-Environmental Section, Salem, Oregon.

City of Milwaukie, 2015. Public Works Standards.

City of Portland, 2016. Stormwater Management Manual.

Oregon Department of Environmental Quality (ODEQ), 2012. Water Quality Assessment – Oregon's 2012 Integrated Report Assessment Database and 303(d) List. Accessed August 10, 2017. http://www.deq.state.or.us/wq/assessment/rpt2012/search.asp

Attachments

Figures

- Figure 1 - Existing Drainage Plan
- Figure 2 - Proposed Drainage Plan
- Figure 3 – Facilities Plan

Appendices

- DEA Report and Basin Areas
- Hydrologic Soil Group and Geotechnical Report
- Curve Number and Time of Concentration
- Inlet Capacity Calculations
- PAC Report
- XP-SWMM Output
- Maintenance of Stormwater Ponds (To be included in final stormwater memo)

Figures

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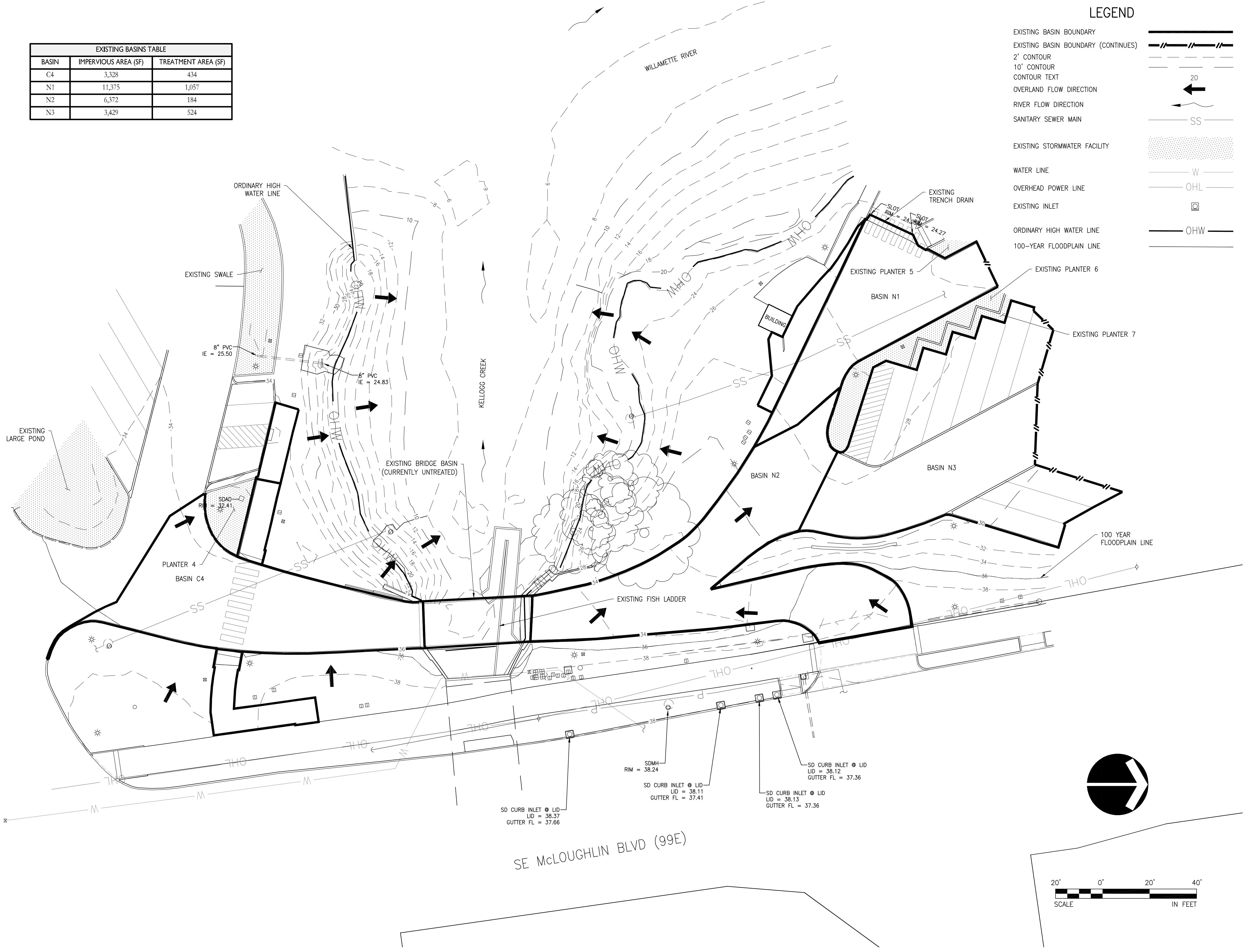
EXISTING BASINS TABLE		
BASIN	IMPERVIOUS AREA (SF)	TREATMENT AREA (SF)
C4	3,328	434
N1	11,375	1,057
N2	6,372	184
N3	3,429	524

LEGEND

EXISTING BASIN BOUNDARY	━━━
EXISTING BASIN BOUNDARY (CONTINUES)	━//━//━
2' CONTOUR	— — —
10' CONTOUR	— — —
CONTOUR TEXT	20
OVERLAND FLOW DIRECTION	←
RIVER FLOW DIRECTION	←
SANITARY SEWER MAIN	— SS —
EXISTING STORMWATER FACILITY	▨
WATER LINE	— W —
OVERHEAD POWER LINE	— OHL —
EXISTING INLET	▣
ORDINARY HIGH WATER LINE	— OHW —
100-YEAR FLOODPLAIN LINE	———



20' 0' 20' 40'

SCALE IN FEET

NO.	DATE	BY	REVISION COMMENTS

Design	Drawn	Checked	Date	Initial Issue Date:
				August 16, 2017

PRELIMINARY

KELLOGG CREEK EMERGENCY BRIDGE REPLACEMENT

CITY OF MILWAUKIE, OR

EXISTING DRAINAGE PLAN

otak

808 SW 3rd Ave., Ste. 300
Portland, OR 97204
Phone: (503) 287-6825
FAX: (503) 415-2304
www.otak.com

Datum: NAVD 88

18328

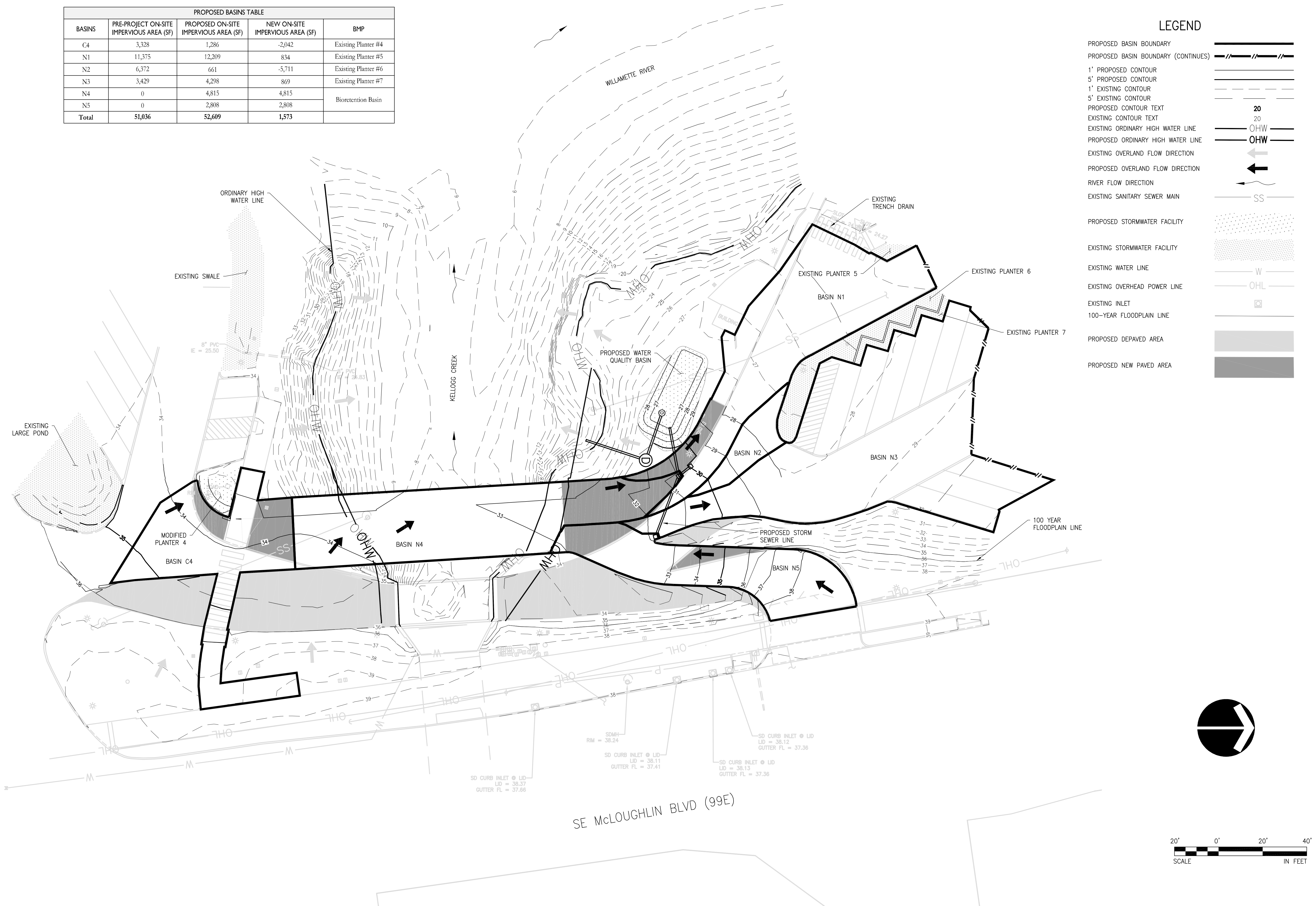
Project No. Drawing Name

Sheet No.

Figure 1

Plotted: Aug 16, 2017 – 12:29pm philipk L:\Project\18300\18328\CADD\ACAD\Dwg\Exhibits\WNR\Existing Conditions.dwg Layout Name: Existing Drainage Plan

PROPOSED BASINS TABLE				
BASINS	PRE-PROJECT ON-SITE IMPERVIOUS AREA (SF)	PROPOSED ON-SITE IMPERVIOUS AREA (SF)	NEW ON-SITE IMPERVIOUS AREA (SF)	BMP
C4	3,328	1,286	-2,042	Existing Planter #4
N1	11,375	12,209	834	Existing Planter #5
N2	6,372	661	-5,711	Existing Planter #6
N3	3,429	4,298	869	Existing Planter #7
N4	0	4,815	4,815	Bioretention Basin
N5	0	2,808	2,808	
Total	**51,036**	**52,609**	**1,573**	



NO.	DATE	BY	REVISION COMMENTS

Design	Drawn	Checked	Date	Initial Issue Date: August 16, 2017

PRELIMINARY

KELLOGG CREEK EMERGENCY BRIDGE REPLACEMENT
CITY OF MILWAUKIE, OR
PROPOSED DRAINAGE PLAN

otak
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Datum: NAVD 88

18328
Project No. Drawing Name

Sheet No.
Figure 2

Plotted: Aug 16, 2017 – 2:20pm philipk L:\Project\18300\18328\CADD\ACAD\Dwg\Exhibits\WNR\Proposed Conditions.dwg Layout Name: Proposed Drainage Plan

XREF LIST
Ltscale: 10

Resolved
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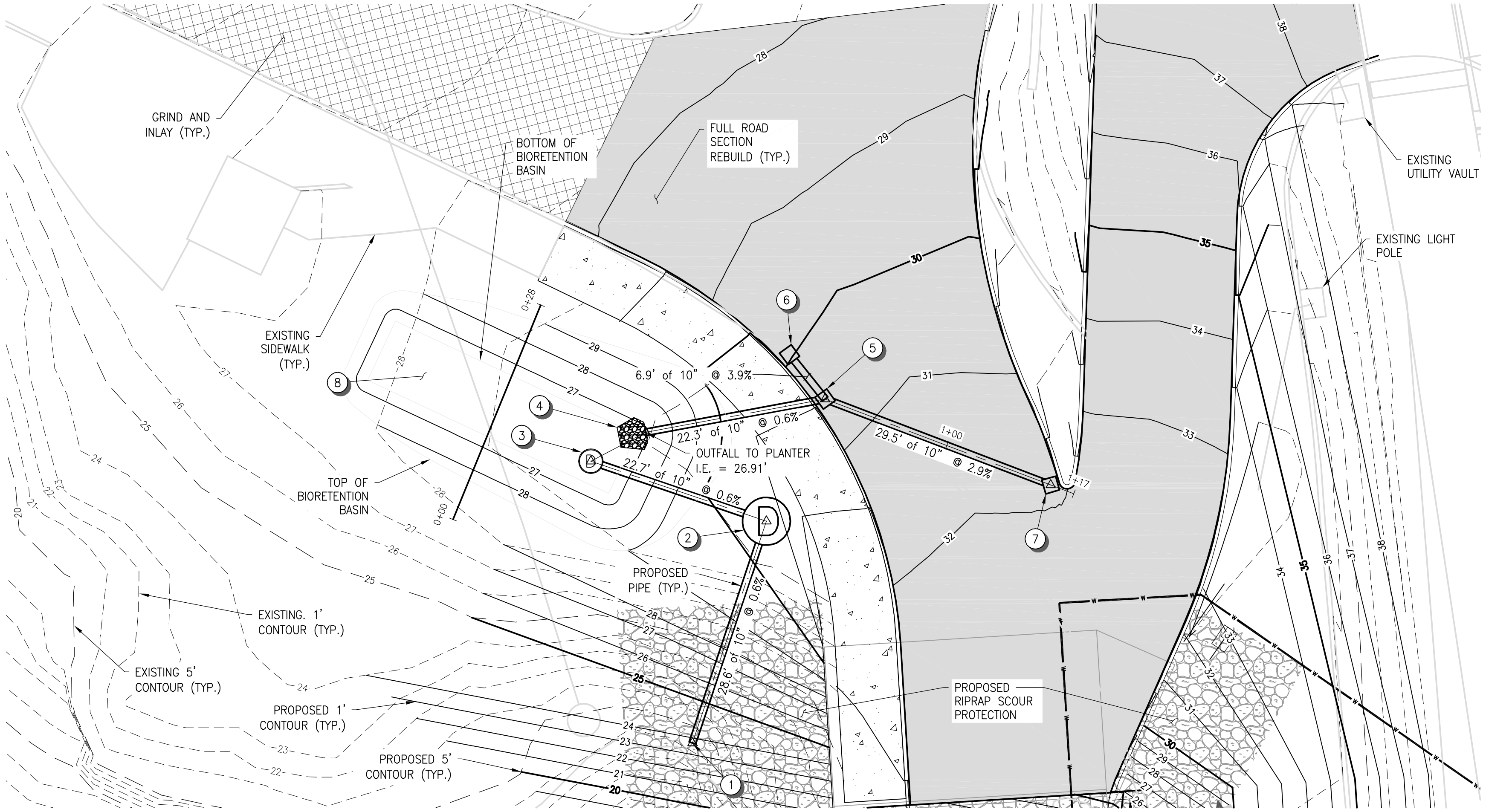
S18328x190
C18328X002
C18328X630
C18328X691

Unresolved
C18328x001



STORM PLAN

10' 0' 10' 20'
SCALE IN FEET

① "STORM" STA. 0+00
INSTALL 10" RIBBED PVC PIPE – 29'
OUTFALL TO RIPRAP SCOUR PROTECTION (SEE DETAIL XXX, SHEET XXX)

② "STORM" STA. 0+29
INSTALL 60" PRECAST MANHOLE WITH FLOW CONTROL STRUCTURE
(SEE DETAIL XXX, SHEET XXX)
INSTALL 10" DUCTILE IRON PIPE – 23'

③ "STORM" STA. 0+51
INSTALL BEEHIVE GRATE INLET (SEE DETAIL XXX, SHEET XXX)

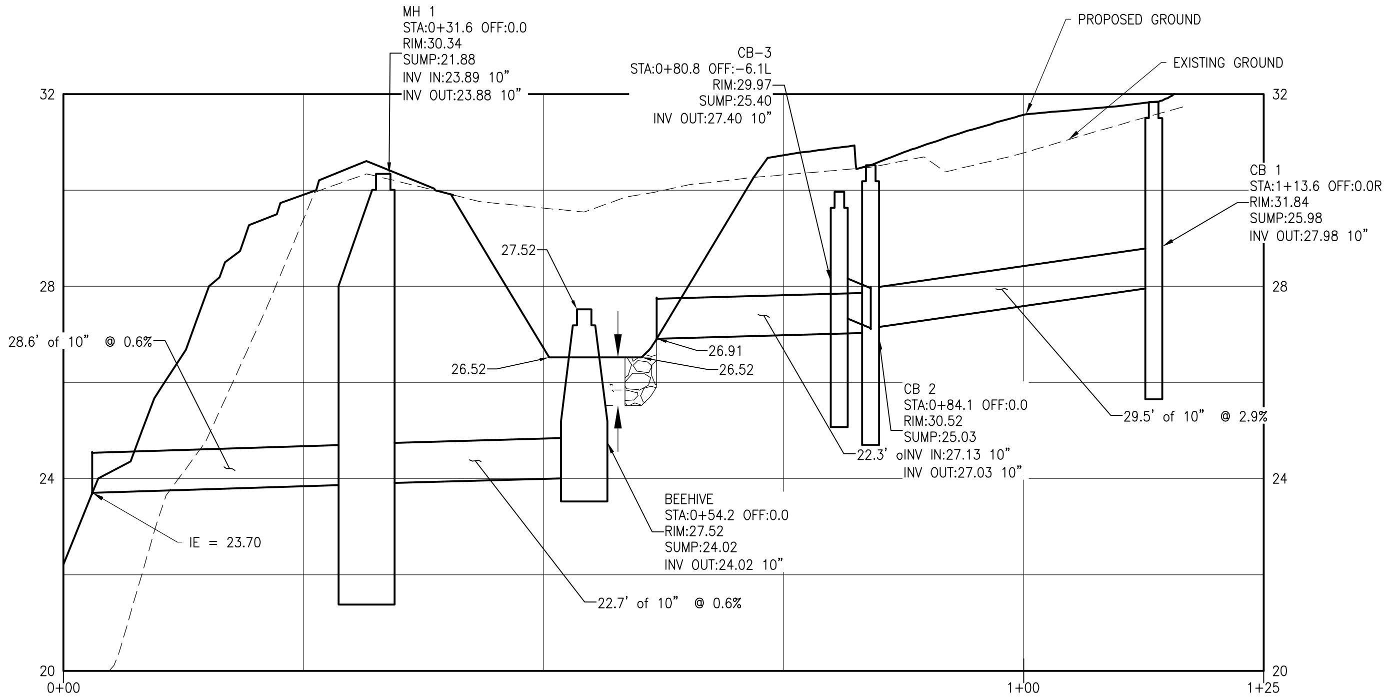
④ "STORM" STA. 0+59
CONSTRUCT SPLASH PAD (SEE DETAIL XXX, SHEET XXX)
INSTALL 10" RIBBED PVC PIPE – 23'

⑤ "STORM" STA. 0+81
INSTALL INLET, TYPE G-2 (SEE STANDARD DRAWING 600)
INSTALL 10" DUCTILE IRON PIPE – 37'

⑥ "STORM" STA. 0+78, OFFSET -5.2'
INSTALL INLET, TYPE G-2 (SEE STANDARD DRAWING 600)

⑦ "STORM" STA. 1+11
INSTALL INLET, TYPE G-2 (SEE STANDARD DRAWING 600)

⑧ CONSTRUCT WATER QUALITY BASIN
(FOR DETAILS, SEE SHEET XXX)



STORM PROFILE: 0+00–1+25

Horiz. Sc 1"=10')'
Vert. Sc 1"=2'

NOT FOR CONSTRUCTION

NO.	DATE	BY	REVISION COMMENTS

Design	Drawn	Checked	Date	Initial Issue Date:
PTK	PTK	MCK		AUGUST 23, 2017

PRELIMINARY

KELLOGG CREEK EMERGENCY BRIDGE REPLACEMENT

MILWAUKIE, OR
KELLOGG CREEK EMERGENCY BRIDGE REPLACEMENT
STREET AND STORM DRAIN PLAN & PROFILE

otak
808 SW 3rd Ave., Ste. 300
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Phone: (503) 287-6825
FAX: (503) 415-2304
www.otak.com

Datum: NAVD 88

C18328-UTIL – SD PLAN
Project No. Drawing Name

Sheet No.
Figure 3

Appendices

Appendix A
DEA Report and Basin Areas

HanmiGlobal Partner

Stormwater Report

Milwaukie Riverfront Park

City of Milwaukie

Prepared For:
City of Milwaukie

Prepared By:
David Evans and Associates, Inc.

December 2009

Stormwater Report

Milwaukie Riverfront Park

City of Milwaukie

Prepared for:

City of Milwaukie
JoAnn Herrigel, Community Services Director
10722 SE Main Street
Milwaukie, OR 97222

Prepared by:

David Evans and Associates, Inc.
2100 SW River Parkway
Portland, Oregon 97201

DEA Project Number: MAEX0000-0019

December 2009

Table of Contents

Appendices:

1 INTRODUCTION

The City of Milwaukie Riverfront Park Project is located between Mcloughlin Blvd. and the Willamette River at the Kellogg Creek inflow. The City has long desired to improve pedestrian access to Riverfront recreational facilities and to reconnect the downtown business and retail areas to Riverfront. Improvements to the park include an amphitheater, restrooms, plaza, boat parking, car parking, pedestrian suspension bridge, boat ramp and dock, floating dock, pavilion with overlook, and multi-use paths.

The project is located in the City of Milwaukie and falls under the administration of the City of Milwaukie (COM) Public Works Design Standards for stormwater design. This report addresses the stormwater design of the park improvements in relation to COM stormwater regulations.

2 EXISTING SITE

The existing park has two parking areas and a boat ramp. The majority of the existing impervious areas will be removed for the new layout of parking and sidewalks. The vehicular bridge crossing Kellogg Creek and connecting the north and south parking areas will remain and will be incorporated into the site improvements. The total pre-development site impervious area is approximately 103,960 square-feet (2.4 acres). An impervious area of 95,756 square-feet (2.2 acres) will be removed. An impervious area of 8,204 square-feet (0.2 acres) of sidewalk will remain. For the most part there is not an existing storm system. Stormwater from the impervious surfaces flows down the river bank to the Willamette River. However, there are two existing catch basins that collect part of the driveway stormwater runoff. These catch basins will be removed during construction since the driveway will be relocated.

3 PROPOSED IMPROVEMENTS

The Riverfront Park project has multiple uses including large grassy areas, picnic facilities, plaza with restrooms, amphitheater, benches for viewing the river, natural vegetative areas with trails, a boat ramp and parking, and transient boat dock. The site has 20 long parking spaces for vehicles with trailers and 16 standard size parking spaces. The site improvements will add 122,821 square-feet (2.8 acres) of impervious area to the existing 8,204 square-feet (0.2 acres) that will remain. The total impervious area for the site post-development will be 131,025 square-feet (3.0 acres). The project will create a net increase of 27,065 square-feet (0.6 acres) of impervious area. For discussion of stormwater the site has been divided into three key areas. These areas are the north and south parking (intersected by Kellogg creek connected by an existing vehicle bridge and the proposed pedestrian bridge) and the north pedestrian plaza. All storm water from vehicular impervious surfaces on the site will be collected and all storm water up to the 10-year event will be treated and infiltrated on the site. Overflow from larger storms, and runoff from some non-vehicular surfaces will be discharged at six pipe outfalls into the Willamette River.

Appendix A shows the existing site plan and the proposed site layout and storm design.

4 HYDROLOGIC PARAMETERS

Table 4.1 details the 24-hour rainfall amounts for the City of Milwaukie taken from Oregon's isopluvial maps published by NOAA.

Table 4.1: 24-Hour Rainfall Amounts for the City of Milwaukie

Recurrence Interval (years)	Total Rainfall (inches)
2	2.7
5	3.1
10	3.4
25	3.9
100	4.6
WQ	0.83

The existing soil in the project area is Urban Land (Hydrologic Soil Group D). The pervious area curve number (CN) used is 84 (fair condition open space) and the impervious area CN used is 98. An estimated time of concentration of 15.0 minutes was used for existing conditions analysis. The post construction time of concentration was calculated as a 5 minute travel time to water quality and detention facilities plus the travel time through the water quality and detention facilities.

5 PROPOSED WATER QUALITY

COM stormwater regulations state that water quality facilities are required to meet the design standards of the current City of Portland, Stormwater Management Manuel (SWMM). SWMM specifies that pollution reduction is required for all impervious areas created by development projects with the exception of roof areas. SWMM regulations require water quality facilities to treat stormwater runoff generated by 0.83 inches of rainfall over a 24-hour period when using the SBUH hydrograph-based analysis method.

5.1 SOUTH PARKING

Stormwater runoff in the south parking area (Basins C1, C2, C3 and C4) is treated and detained in four (4) separate facilities; one (1) vegetated swale/planter and three (3) infiltration planters. All facilities are designed to meet the water quality treatment requirements specified by the SWMM. The City of Portland, Bureau of Environmental Services (BES), Presumptive Approach Calculator was used to model water quality storm event capacity of all water quality facilities. For Basin Map see Appendix B.

The south parking area includes a plaza overlooking the Willamette River. This overlook is Basin C1 (3,796 square feet impervious). The storm water runoff from Basin C1 is collected by sheet flow into two (2) infiltration planters, Planter #1 and Planter #2. The two planters combine to provide 477 cubic feet (cf) of storage volume (344 cf above grade, and 103 cf in the voids of drain rock below grade). An area drain overflow will be placed 12-inches above the bottom of the planter. The 12 inches of dead storage provides water quality treatment and allows time for the storm water to infiltrate. The planters treat the water quality storm event flow of 0.016 cubic feet per second (cfs) and also fully infiltrate the 10-year storm water runoff of 0.077 cfs. The soils for the project site are classified as Urban Soils by the USDA Soil Conservation Service. Urban Soils are not provided with typical infiltration rates. Soils adjacent to our site that are classified have reported infiltration rates between 0.6 – 2.0 inches per hour. We have assumed an infiltration rate of 2.0 inches per hour.

Runoff from Basin C2 (16,320 square-feet impervious and 3,465 square feet pervious) is conveyed to a vegetated swale, “South Swale,” through concrete curb cuts. The swale is located along vehicle turn-around next to the river overlook. The swale is 188 feet long. It has a 0.5-foot bottom width and 3L:1V side slopes. Initially the swale is 1.5 feet deep, but increases to a depth of 3 feet at the outlet point. The South Swale coveys the storm water to Planter #3.

Planter #3 is along the same alignment as South Swale. The remainder of the C2 Basin surface area that does not discharge storm water to the swale is collected into Planter #3 through concrete curb cuts Basin C2 generates a water quality runoff flow rate of 0.067 cfs. Planter #3 has 1,814 cf of storage volume (1,395 cf above grade, and 418 cf below grade). An area drain overflow is placed at an elevation of 12-inches above the bottom of the pond. The 12-inches of dead storage provide water quality and infiltration. The swale and Planter #3 combine to treat a water quality runoff flow rate of 0.067 cfs and also fully infiltrate the runoff from a 10-year event of 0.208 cfs.

Runoff from Basin C3 is conveyed to “Large Pond”. The pond is located at the center island between trailer parking and standard parking. Runoff from Basin C3 (10,212 square feet impervious and 3,222 square-feet pervious) is conveyed to Large Pond through concrete curb cuts. The water quality storm event for Basin C3 generates a runoff of 0.042 cfs. Large Pond has a storage volume of 1,032 cf. The proposed outlet is a ditch inlet with inlet elevation 18 inches above the bottom of the pond. The 18-inch difference creates a dead storage for water quality and infiltration (2.0 inches per hour infiltration was used for modeling). The Large Pond also infiltrates the entire storm water runoff from a 10-year storm event, 0.208 cfs

Basin C4 includes the roadway area south of the bridge crossing Kellogg Creek. Runoff from Basin C4 (3,328 sf impervious) is conveyed to Planter #4. Similar to the other planters, there is an area drain placed 12 inches above the bottom of the planter to maximize treatment and infiltration. Planter #4 provides 553 cf of storage volume (425 cf above grade, and 128 cf below grade). The planter provides treatment for the water quality flow of 0.014 cfs and fully infiltrates the runoff from the 10-year event, 0.068 cfs.

For water quality and detention calculations see Appendix C.

5.2 NORTH PARKING

Stormwater runoff in the north parking area (Basins N1, N2, and N3) is treated and detained in three (3) separate facilities; one (1) flat planter and two (2) sloped planters. All three planters are designed to SWMM’s water quality requirements.

Basin N1 includes the lower level parking drive aisle and sidewalks. Storm water is conveyed into Planter #5 via trench drain located at the top of the boat ramp and by curb cuts along the drive aisle. Storm water runoff from Basins N1 (11,375 square-feet impervious) generates a water quality runoff flow of 0.047 cfs. Planter #5 is 7 feet wide by 151 feet long and is sloped at 1.5% to match the slope of the adjacent drive aisle. The planter has six (6) check dams spaced equally along the bottom of the planter to maximize the infiltration area. With 12-inches of dead storage and 12-inches of drain rock media below grade, there is approximately 1,205 cf of storage volume (907 cf above grade, and 298 cf below grade). The planter provides treatment for the water quality storm event (0.047 cfs) and fully infiltrates the 10-year storm event runoff (0.232 cfs) with no overflow. An overflow catch basin is providing 12 inches above the bottom of the planter for larger storm events.

Basin N2 (6,372 sf impervious) includes the paved drive aisle directly north of the Kellogg Creek Bridge. Storm water is conveyed to Planter #6 via trench drain. Planter #6 is on the opposite side of the lower drive aisle from Planter #5. And, it is just west of Planter #7. The planter is shaped like a sawtooth and is sloped, similar to Planter #5, at a 1.5-percent grade. Planter #6 also includes check dams to maximize infiltration. The planter has an average bottom width of 7 feet. The planter has a vertical retaining wall on the east side and has 3L:1V side slopes on the west side. Planter #6 provides treatment for the water quality storm event (0.026 cfs) and fully infiltrates the 10-year storm event runoff (0.130 cfs) with no overflow. An overflow catch basin is provided 12 inches from the bottom of the planter to manage larger storm events.

Basin N3 (3,429 sf impervious, and 6,487 pervious) includes the upper level parking and drive aisle. The parking stall pavement surface is a pervious pavement material to allow for immediate surface infiltration. Storm water runoff from Basin N3 sheet flows across the parking stalls and through curb cuts to Planter #7. The planter zigzags along the front of the parking stall and is 3 feet wide. Planter #7 has 3 inches of dead storage and 12 inches of drain rock media below grade, providing 288 cf of storage volume (131 cf above grade, and 157 cf below grade). Planter #7 provides treatment for the water quality storm event (0.014 cfs) and fully infiltrates the 10-year storm event runoff (0.070 cfs) with no overflow. Overflow notches in the planter wall located 3 inches above the bottom of the planter allow for sufficient overflow for the larger storm events.

For water quality and detention calculations see Appendix C.

5.3 PEDESTRIAN PLAZA

The Pedestrian Plaza area includes the restrooms, water features, planters, and amphitheater these areas have two (2) water quality features for stormwater treatment. A swale is proposed on the south side of the plaza and a filter strip is proposed on the far north side of the plaza. All the facilities meet SWMM’s requirements for water quality. A large percentage of the plaza is graded to sheet flow stormwater runoff run into adjacent planters or grassy areas. These areas were not modeled for water quality purposes.

On the south side of the plaza there is a 100-foot long water quality swale with 12-inch high check dams located every 25 feet to allow for higher infiltration. The swale is sloped at approximately 4 percent and the bottom width is 9 feet. The side slopes are 2L:1V. The swale treats a water quality runoff event of 0.044 cfs from Basin P1 (10,660 square-feet of impervious). Basin P1 storm water is collected in area drains and is conveyed to the swale using a 12-inch pipe. The swale also infiltrates 99 percent of the 10-year storm event with a runoff flow rate of 0.07 cfs.

On the south side of the plaza there is an 80-foot long water quality swale with 12-inch high check dams located every 20 feet to allow for higher infiltration. The swale is sloped at approximately 3.4 percent and the bottom width is 4 feet. The side slopes are 2L:1V. The swale treats a water quality runoff event of 0.009 cfs from Basin P2

(2,145 square-feet of impervious). Basin P2 storm water is collected by area drains and is conveyed to the swale using a 12-inch pipe. The swale also infiltrates 100 percent of the 10-year storm event with a runoff flow rate of 0.044cfs.

Both swales treating storm water from the plaza areas eventually discharge to the Willamette River.

For water quality and detention calculations see Appendix C.

6 PROPOSED DETENTION

Since infiltration rates in this area are not high enough to infiltrate the 2-, 5-, 10-, and 25-year storm event, it is necessary to provide a detention system in order to meet the COM flow attenuation requirements: post-development flow for 2-, 5-, 10-, and 25-year storm events shall be detained to the pre-development discharge rate. The detention facilities for the project have been designed to meet the COM requirements.

Table 6.0 is a summary of the pre and post development runoff flow-rates for the 2-, 5-, 10-, and 25-year storm events.

Table 6.0: Pre- and Post-Development Flow and Detention Requirements

Recurrence Interval (years)	Pre-Development Flow (cfs)	Post-Development Flow (cfs)	Flow Reduction (cfs)
2	1.31	0.96	0.35
5	1.52	1.17	0.35
10	1.67	1.38	0.29
25	1.93	1.59	0.34

6.1 SOUTH PARKING

Table 6.1.1 is a summary of the proposed South Parking area water quality and detention facilities. Inflow is the sum of flow from all basins (Basins C1, C2, C3 and C4). Modeled outflow is the post-development flow released from the four (4) separate facilities; one (1) vegetated swale/planter and three (3) infiltration planters.

Table 6.1.1: South Parking Detention Summary

Recurrence Interval (years)	Inflow (cfs)	Modeled Outflow (cfs)	Flow Reduction (cfs)
2	0.52	0.48	0.02
5	0.61	0.58	0.03
10	0.68	0.68	0.00
25	0.79	0.79	0.00

The total storm water detention storage volume for the South Parking treatment facilities is approximately 3,846 cubic feet.

For water quality and detention calculations see Appendix C.

6.2 NORTH PARKING

Table 6.2.1 is a summary of the proposed North Parking area water quality and detention facilities. Inflow is the sum of flow from all the basins (Basin N1, N2, and N3). Modeled outflow summation of the flow that is released from the three (3) facilities; one (1) flat planter and two (2) sloped planters.

Table 6.2.1: North Parking Detention Summary

Recurrence Interval (years)	Inflow (cfs)	Modeled Outflow (cfs)	Flow Reduction (cfs)
2	0.42	0.30	0.12
5	0.49	0.37	0.12
10	0.55	0.43	0.12
25	0.62	0.50	0.12

The total storm water detention storage volume for the North Parking treatment facilities is approximately 1,822 cubic feet.

For water quality and detention calculations see Appendix C.

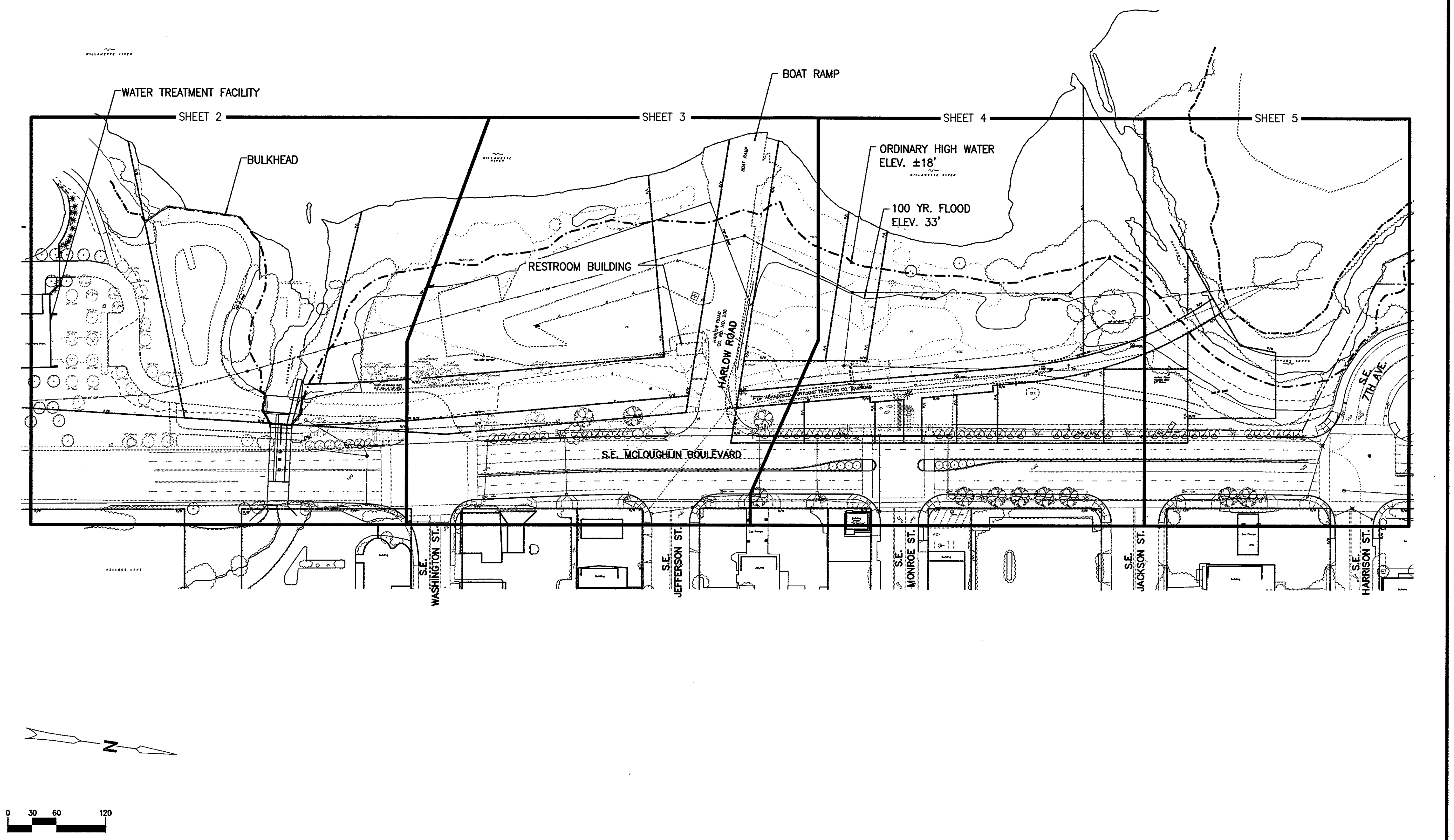
6.3 PEDESTRIAN PLAZA

The proposed Pedestrian Plaza area water quality swales provide treatment and some detention value; however, we did not include detention in our analysis. The detention value is in the form of check dams spaced 20 to 25 feet apart. The total storm water detention storage volume for the Pedestrian Plaza treatment facilities is approximately 814 cubic feet.

For water quality and detention calculations see Appendix C.

Appendix A

Existing Site Plan and Proposed Site Plan



2100 SW River Parkway
Portland OR 97201
Phone: 503.223.6663
Fax: 503.223.2701

CITY OF MILWAUKIE

DEPARTMENT	SIGNATURE	APPROVAL DATE
CITY LANDSCAPE ARCHITECT		
COMMUNITY DEVELOPMENT		
PUBLIC WORKS		

PROJECT
MILWAUKIE RIVERFRONT PARK
PARK IMPROVEMENT PROJECT
S.E. HARRISON STREET - KELLOGG CREEK

SHEET TITLE
EXISTING SITE CONDITIONS

NO.	DATE	REVISION	BY

SCALE:	1" = 60'
DATE:	01-05-2009
DRN.	BAR
CK.	RGWI

1

JOB NO. MAEX00000018

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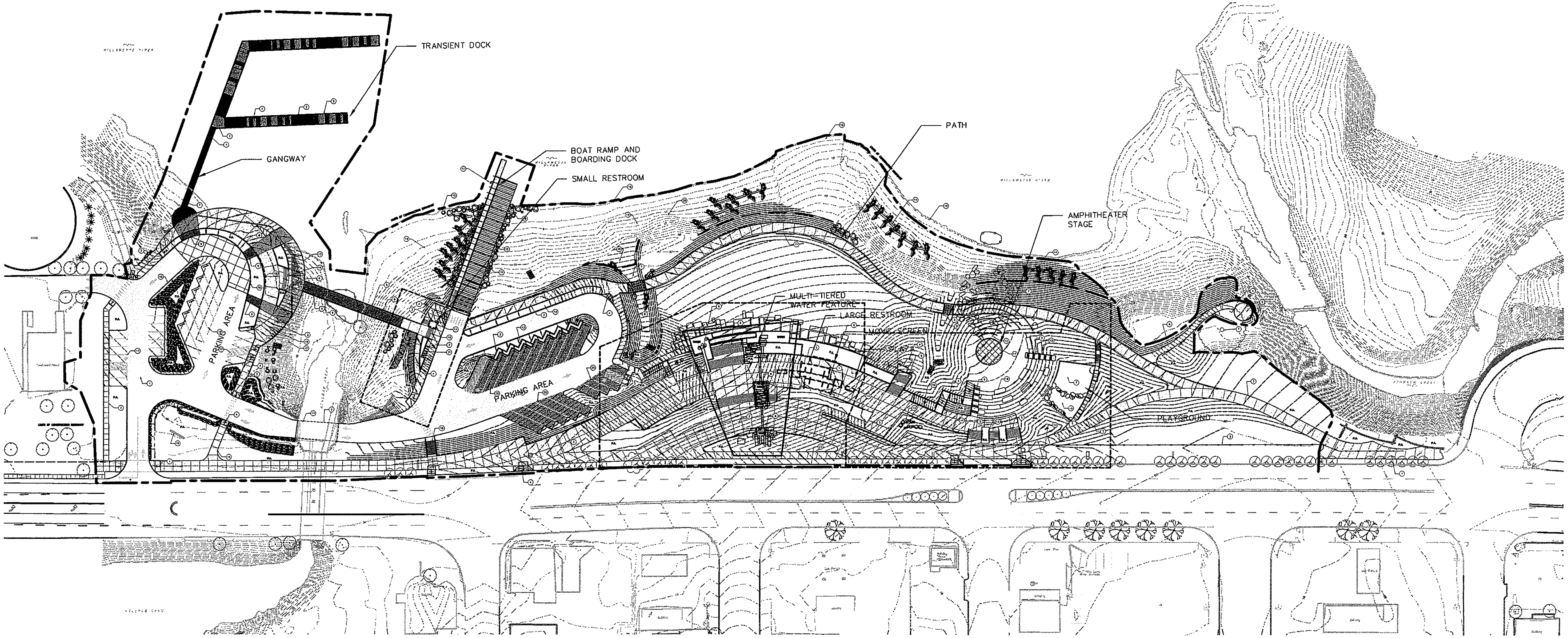

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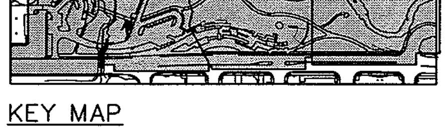

KEY MAP
NOT TO SCALE

DAVID EVANS AND ASSOCIATES
LANDSCAPE ARCHITECTURE · ENGINEERING · PLANNING · ARCHITECTURE · SURVEY

2100 SW River Parkway
Portland OR 97201
Phone: 503.223.6663
Fax: 503.223.2701

CITY OF MILWAUKIE

DEPARTMENT	SIGNATURE	APPROVAL DATE
CITY LANDSCAPE ARCHITECT		
COMMUNITY DEVELOPMENT		
PUBLIC WORKS		

PROJECT

MILWAUKIE RIVERFRONT PARK
PARK IMPROVEMENT PROJECT
S.E. HARRISON STREET - KELLOGG CREEK

SHEET TITLE

LANDSCAPE SITE PLAN
SHEET 0

NO.	DATE	REVISION	BY

PRELIMINARY:
NOT FOR CONSTRUCTION

SCALE: AS SHOWN
DATE: 12-01-08
DRN. BAR
CK. RGWI

L200

JOB NO. MAEX00000018

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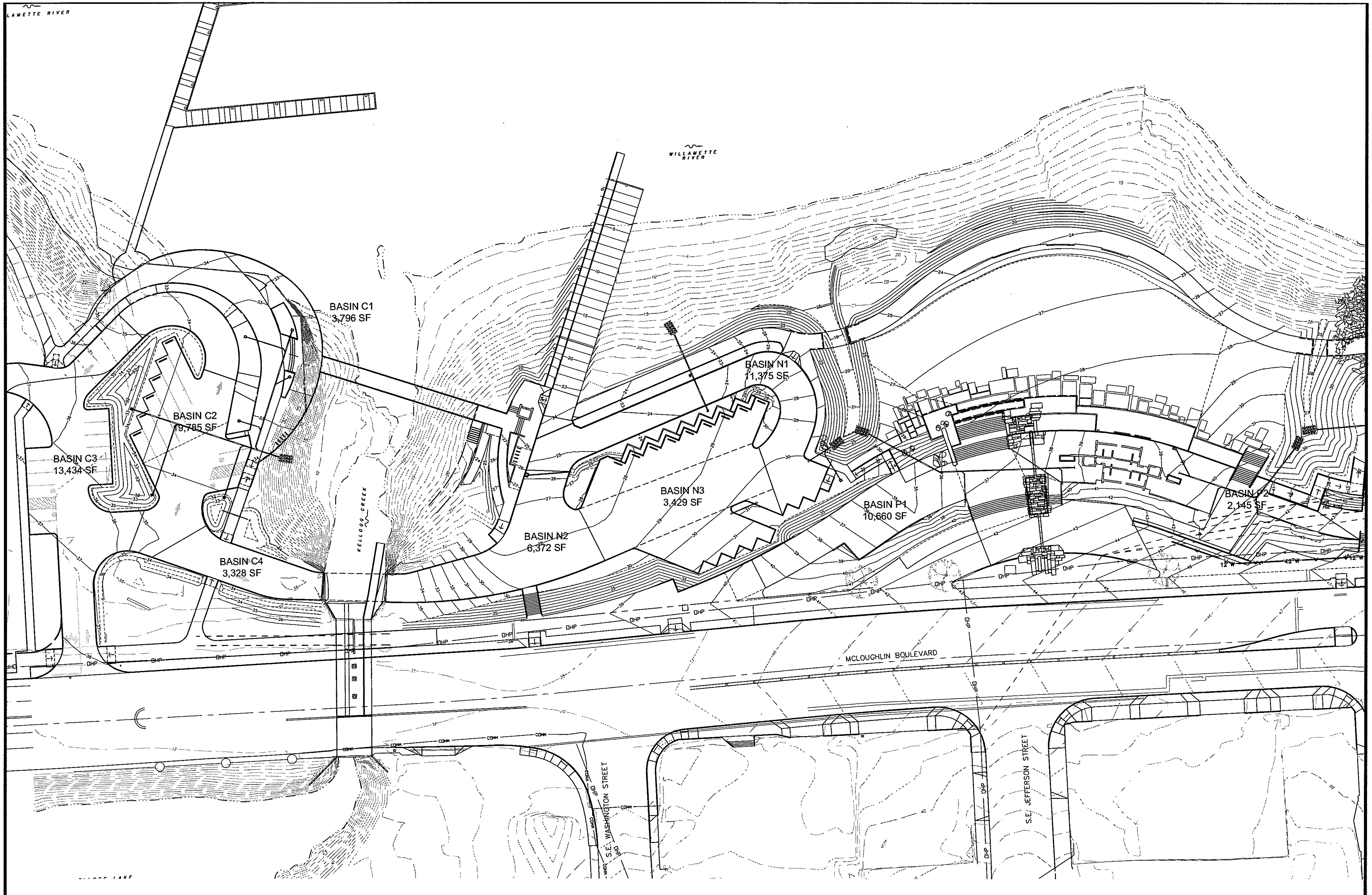
Appendix B

Basin Map



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Fax: 503.223.2701

CITY OF MILWAUKIE

DEPARTMENT	SIGNATURE	APPROVAL DATE
CITY LANDSCAPE ARCHITECT		
COMMUNITY DEVELOPMENT		
PUBLIC WORKS		

PROJECT
MILWAUKIE RIVERFRONT PARK
PARK IMPROVEMENT PROJECT
S.E. HARRISON STREET - KELLOGG CREEK

SHEET TITLE
APPENDIX-B
BASIN MAP

NO.	DATE	REVISION	BY

SCALE: NTS
DATE:
DRN. KRN
CK.

B
JOB ND. MAEX00000018

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Appendix C

Water Quality and Detention Analysis

Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: C1
Date: 03/15/09
Permit Number:
Run Time: 5/13/2009 10:56:06 AM

Project Name: Milwaukie Park - Overlook Catch
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	C1	
	Catchment Area	
Impervious Area	3,796	SF
Impervious Area	0.09	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

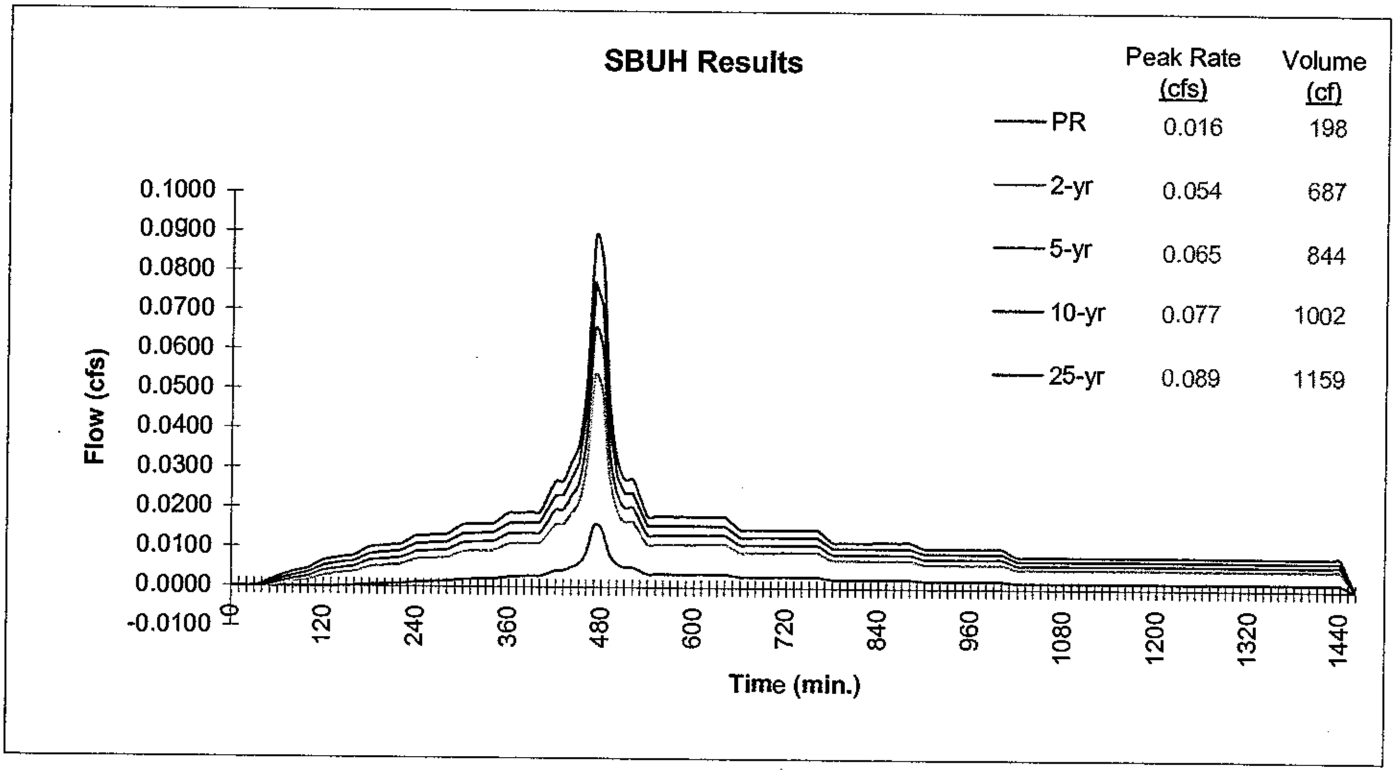
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.016	198
2-yr	0.054	687
5-yr	0.065	844
10-yr	0.077	1002
25-yr	0.089	1159

Printed: 5/13/2009 10:56 AM

Presumptive Approach Calculator ver. 1.1

Catchment ID: C1

Run Time: 5/13/2009 10:56:06 AM

Project Name: Milwaukie Park - Overlook Catch **Catchment ID:** C1 **Date:** 3/15/2009

Instructions:

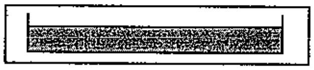
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identity facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

Goal Summary:

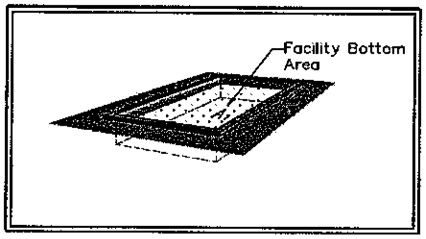
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

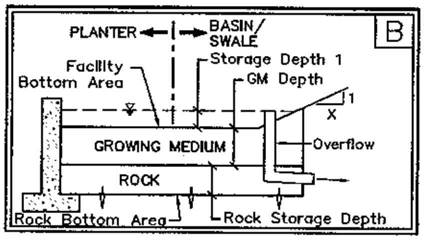
Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square

Facility Configuration: B





Calculation Guide
Max. Rock Stor. Bottom Area 344 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area = 344 sf
Bottom Width = 18.0 ft
Facility Side Slope = 0 to 1
Storage Depth 1 = 12 in
Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 344 cf
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.016 cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area = 344 sf
Rock Storage Depth = 12 in
Rock Void Ratio = 0.3

Rock Storage Capacity = 103 cf
Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.008 cfs

RESULTS

		Overflow Volume			
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used	Run PAC
			9%	Rock Cap. Used	
10-yr	PASS	0 CF	81%	Surf. Cap. Used	
			100%	Rock Cap. Used	

FACILITY FACTS

Total Facility Area Including Freeboard = 344 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.091

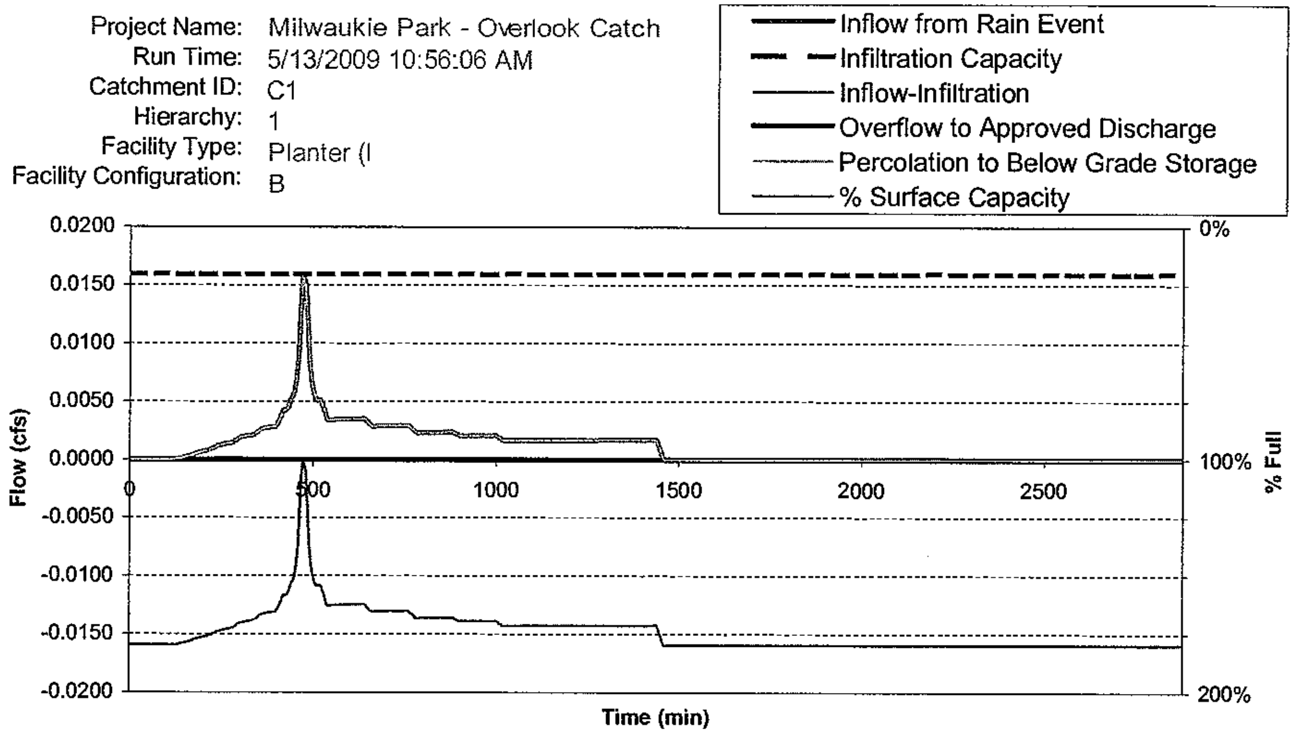
Printed: 5/13/2009 10:57 AM

BES - Presumptive Approach Calculator - Ver 1.1

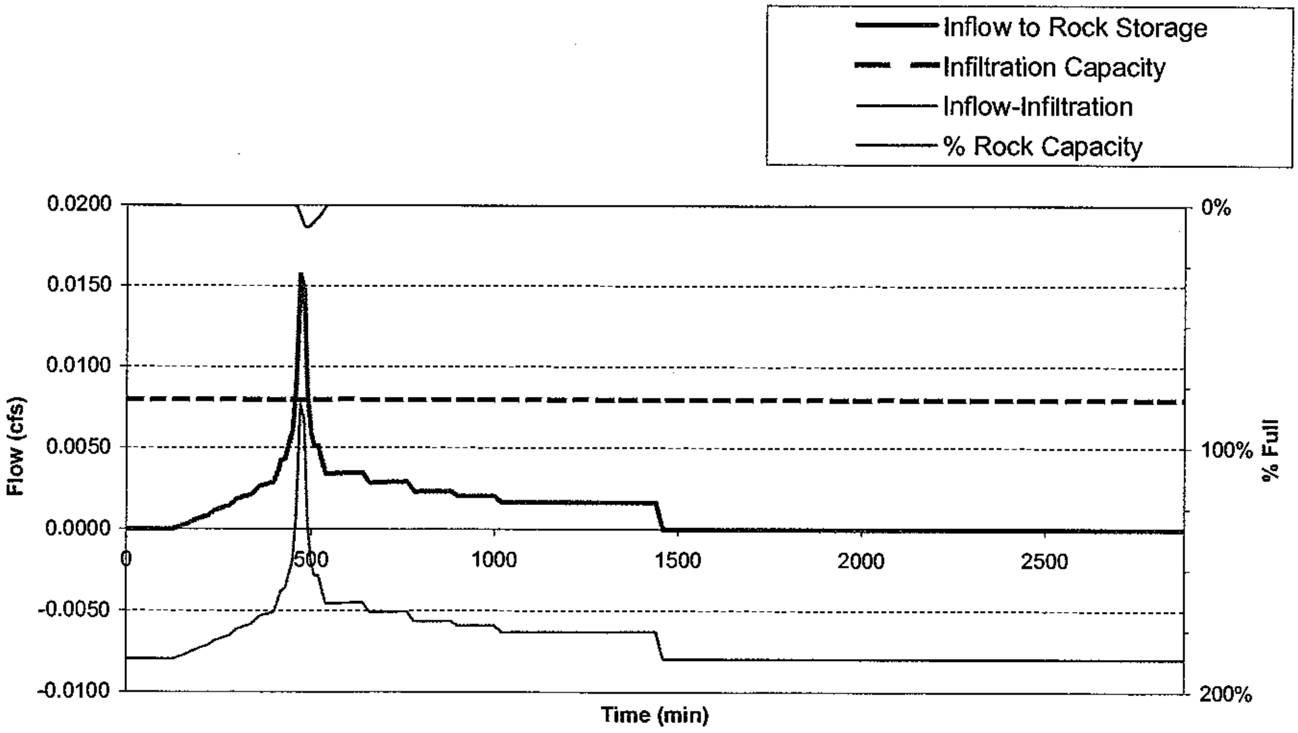
PR Con-A&B

Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - Overlook Catch
Run Time: 5/13/2009 10:56:06 AM
Catchment ID: C1
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B



Pollution Reduction Event
Below Grade Modeling

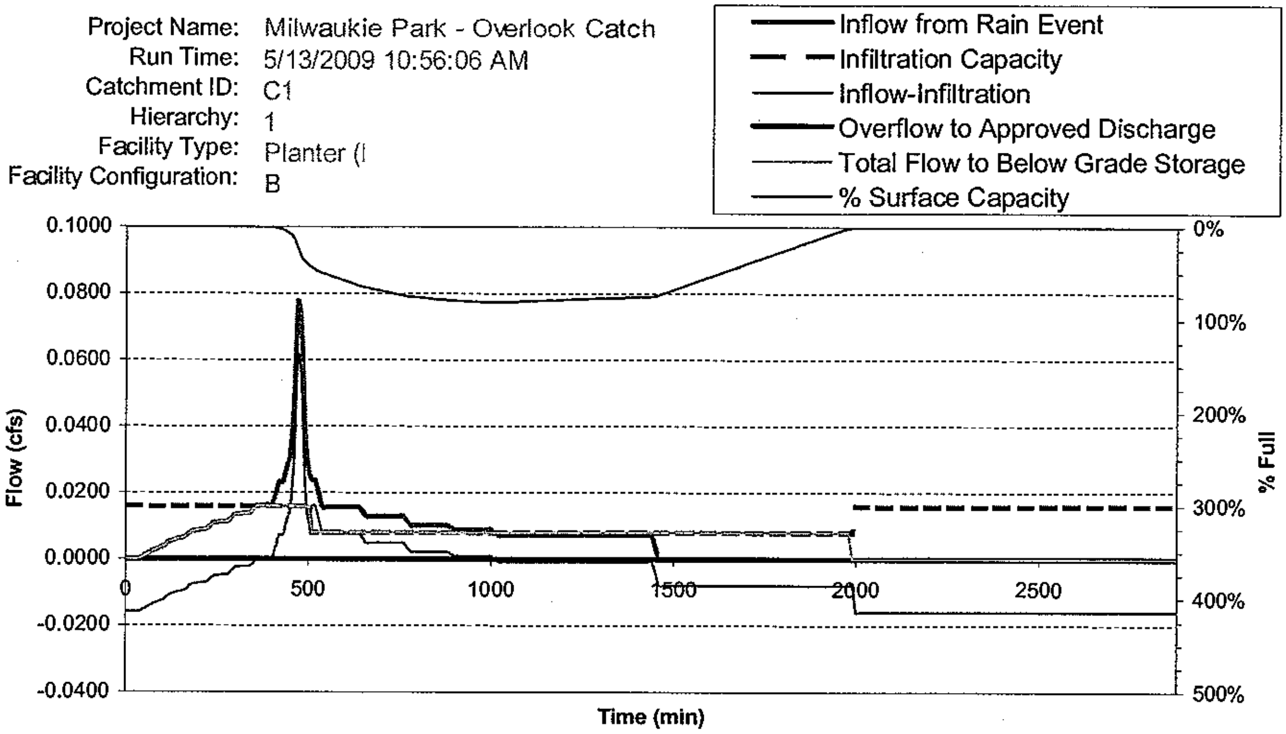


Printed: 5/13/2009 10:57 AM

BES - Presumptive Approach Calculator - Ver 1.1

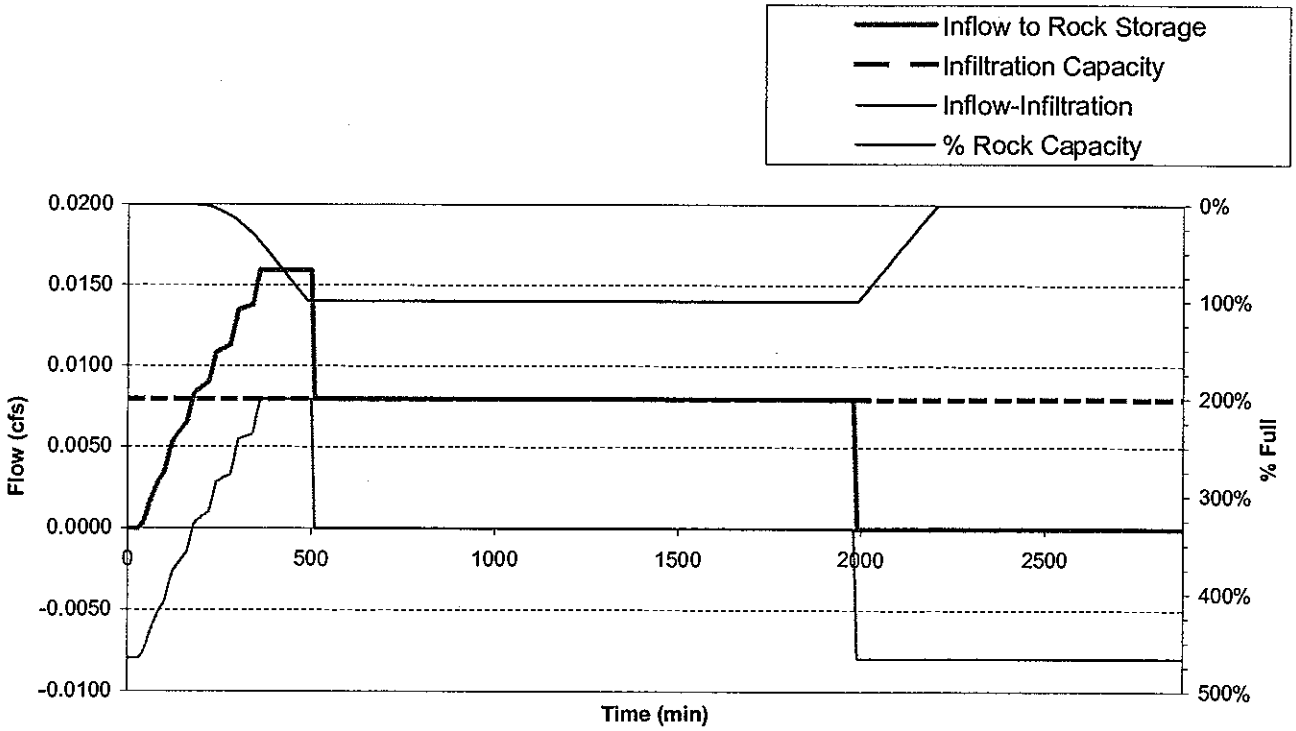
10-yr Con-A&B

10-yr Event
Surface Facility Modeling



Project Name: Milwaukie Park - Overlook Catch
Run Time: 5/13/2009 10:56:06 AM
Catchment ID: C1
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B

10-yr Event
Below Grade Modeling



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Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: C2

Project Name: Milwaukie Park - So. Parking1 Catch

Date: 03/15/09

Project Address: -
Milwaukie, OR

Permit Number:

Run Time: 5/13/2009 11:09:52 AM

Designer: SDH

Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	C2	
	Catchment Area	
Impervious Area	16,320	SF
Impervious Area	0.37	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

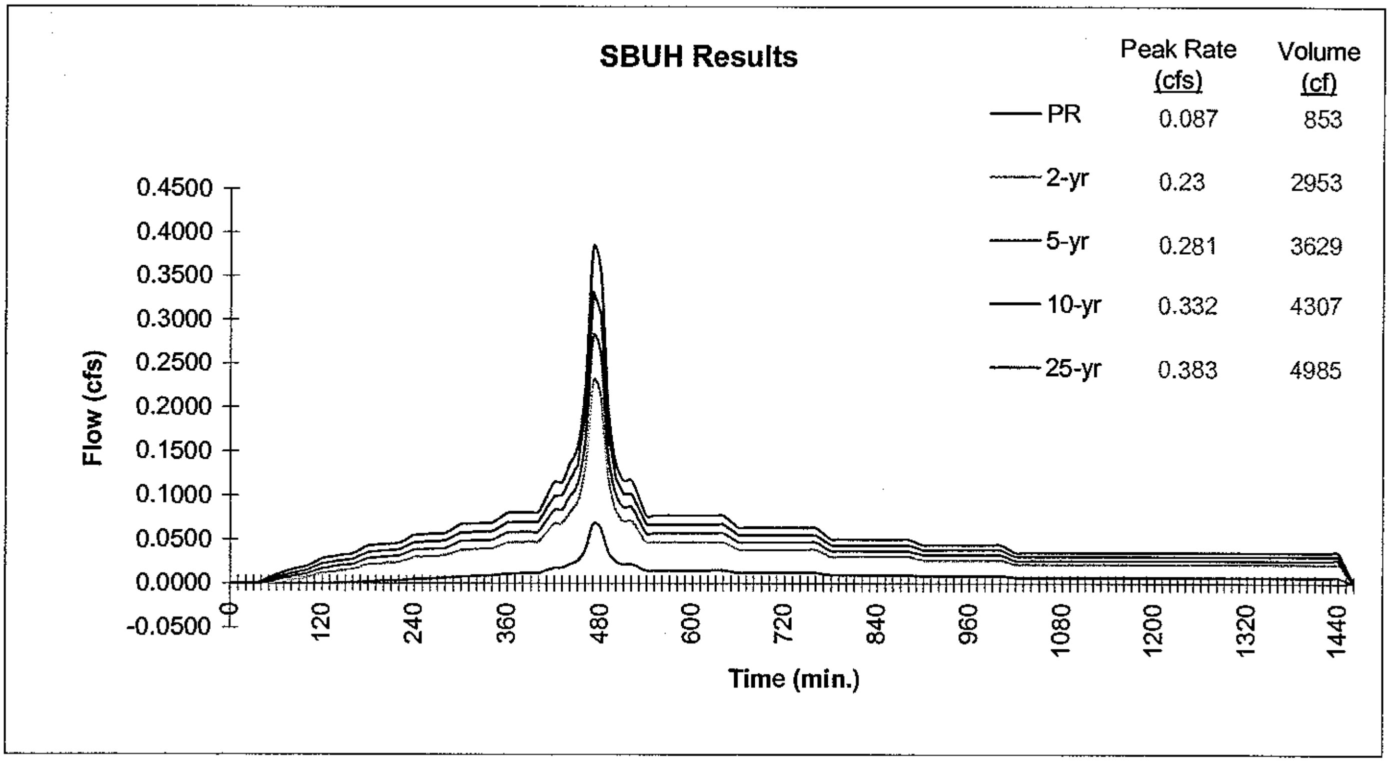
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.087	853
2-yr	0.23	2953
5-yr	0.281	3629
10-yr	0.332	4307
25-yr	0.383	4985

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Presumptive Approach Calculator ver. 1.1

Catchment ID: C2

Run Time: 5/13/2009 11:09:52 AM

Project Name: Milwaukie Park - So. Parking1 Catch **Catchment ID:** C2 **Date:** 3/15/2009

Instructions:
1. Identity which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

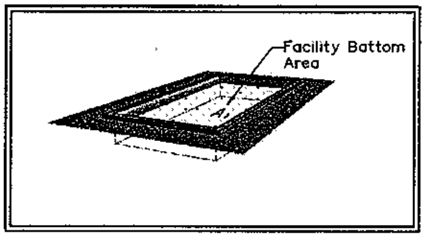
Catchment facility will meet Hierarchy Category: 1

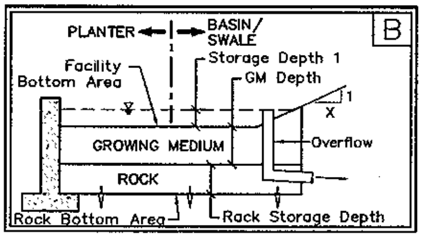
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Planter (Flat)

Facility Shape: Rectangle/Square **Facility Configuration:** B





Calculation Guide
Max. Rock Stor. Bottom Area
1,395 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area = 1,395 sf
Bottom Width = 15.0 ft
Facility Side Slope = 0 to 1
Storage Depth 1 = 12 in
Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 1,395 cf
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.065 cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area = 1,395 sf
Rock Storage Depth = 12 in
Rock Void Ratio = 0.3

Rock Storage Capacity = 419 cf
Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.032 cfs

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used
			11%	Rock Cap. Used
10-yr	PASS	0 CF	94%	Surf. Cap. Used
			100%	Rock Cap. Used

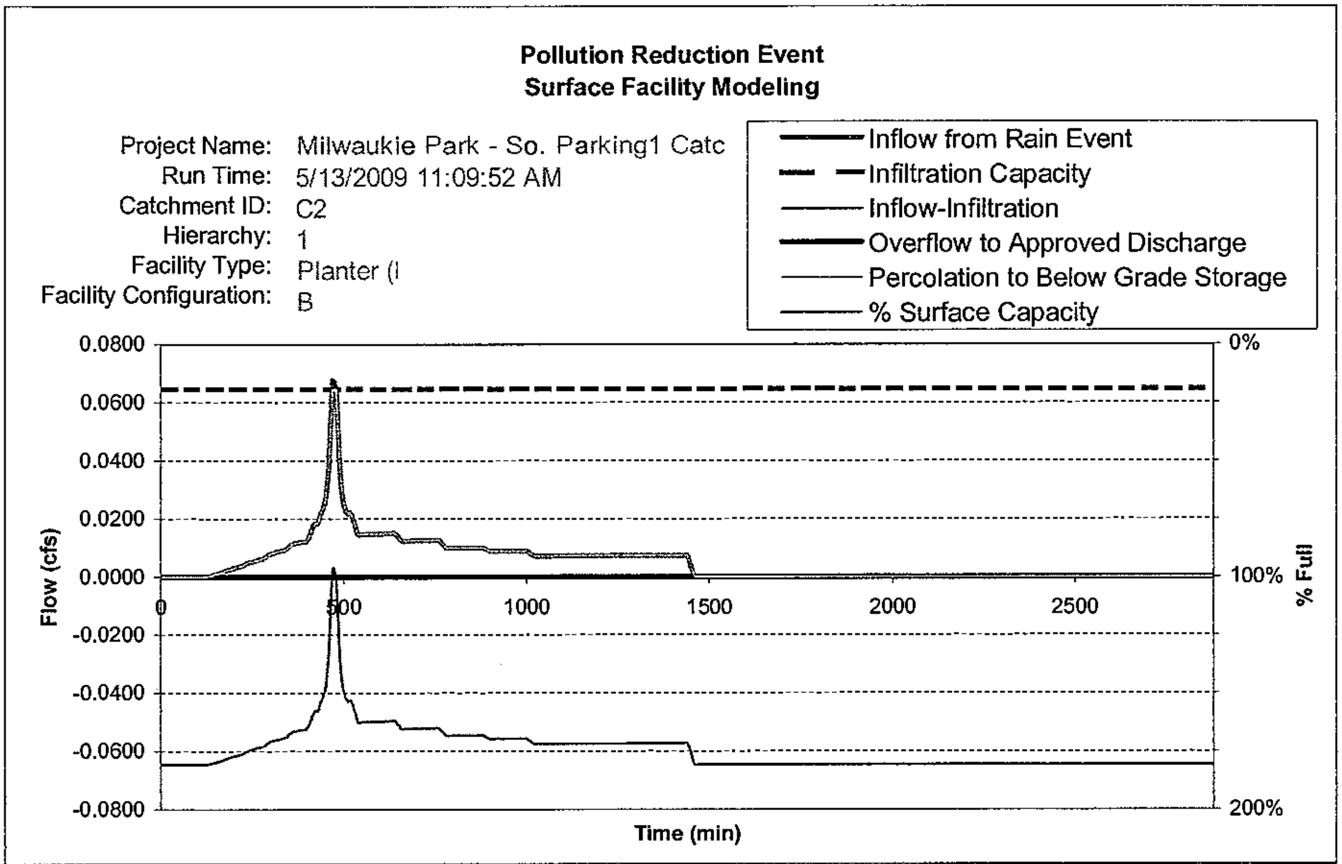
Run PAC

FACILITY FACTS

Total Facility Area Including Freeboard = 1,395 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.085

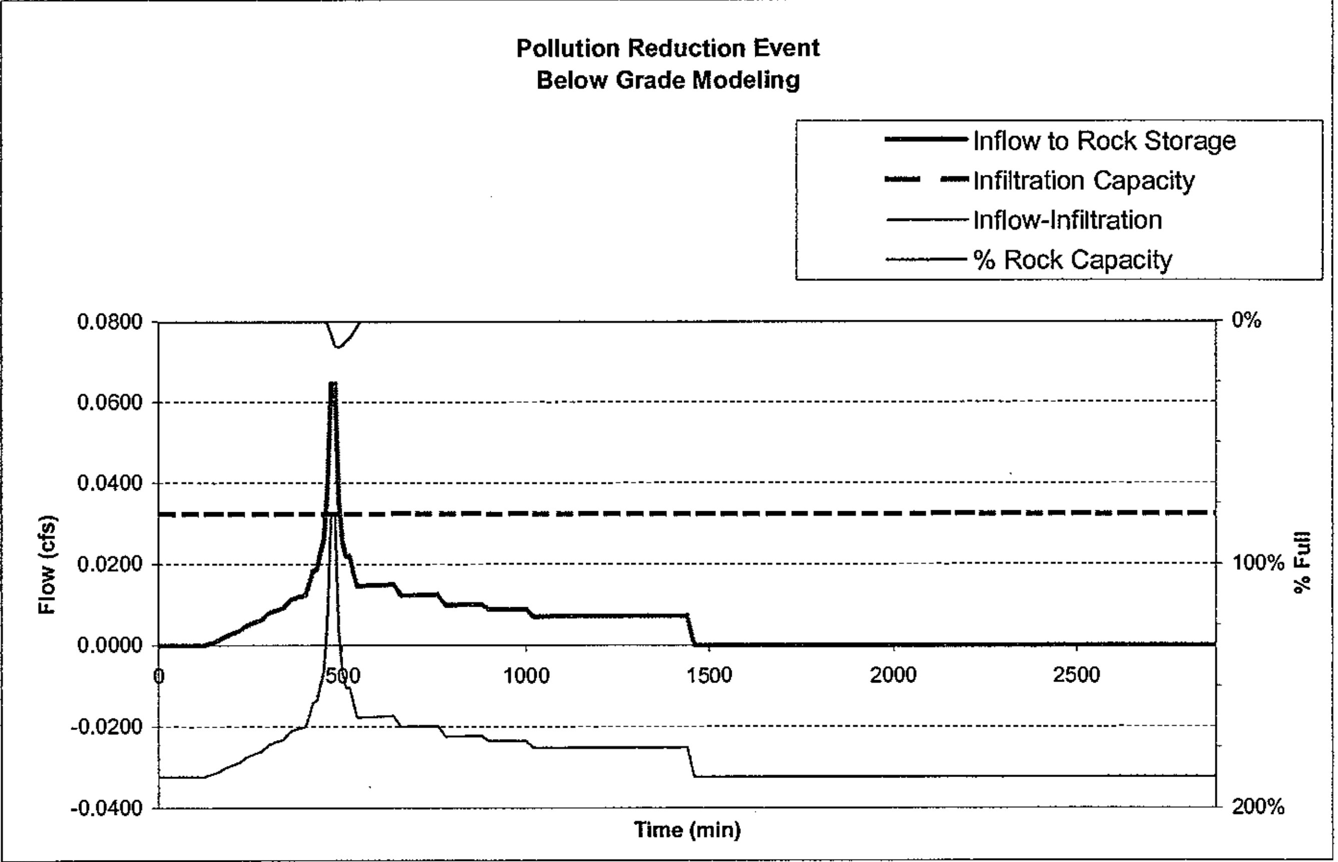
BES - Presumptive Approach Calculator - Ver 1.1

PR Con-A&B



Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - So. Parking1 Catc
Run Time: 5/13/2009 11:09:52 AM
Catchment ID: C2
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B



Pollution Reduction Event
Below Grade Modeling

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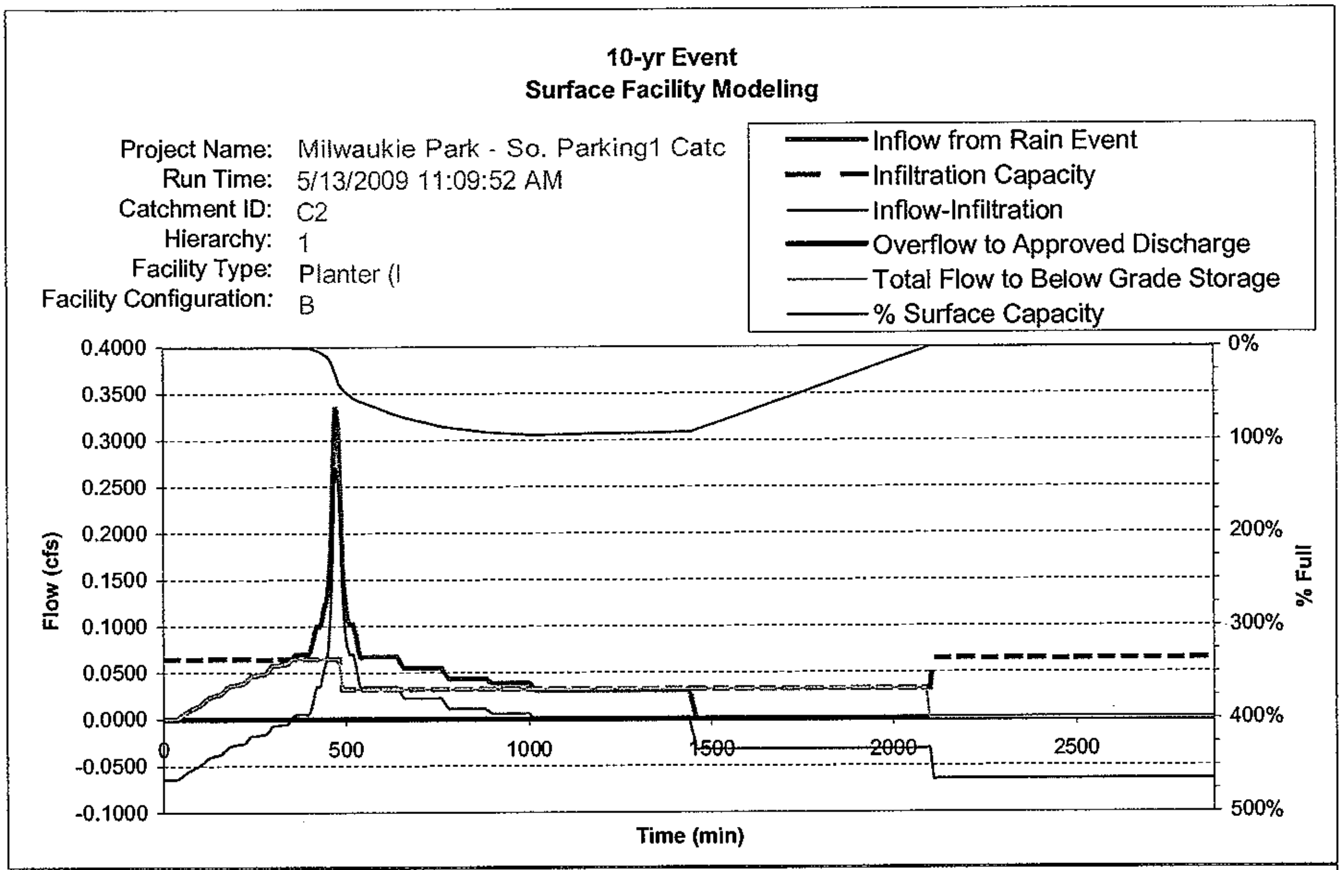
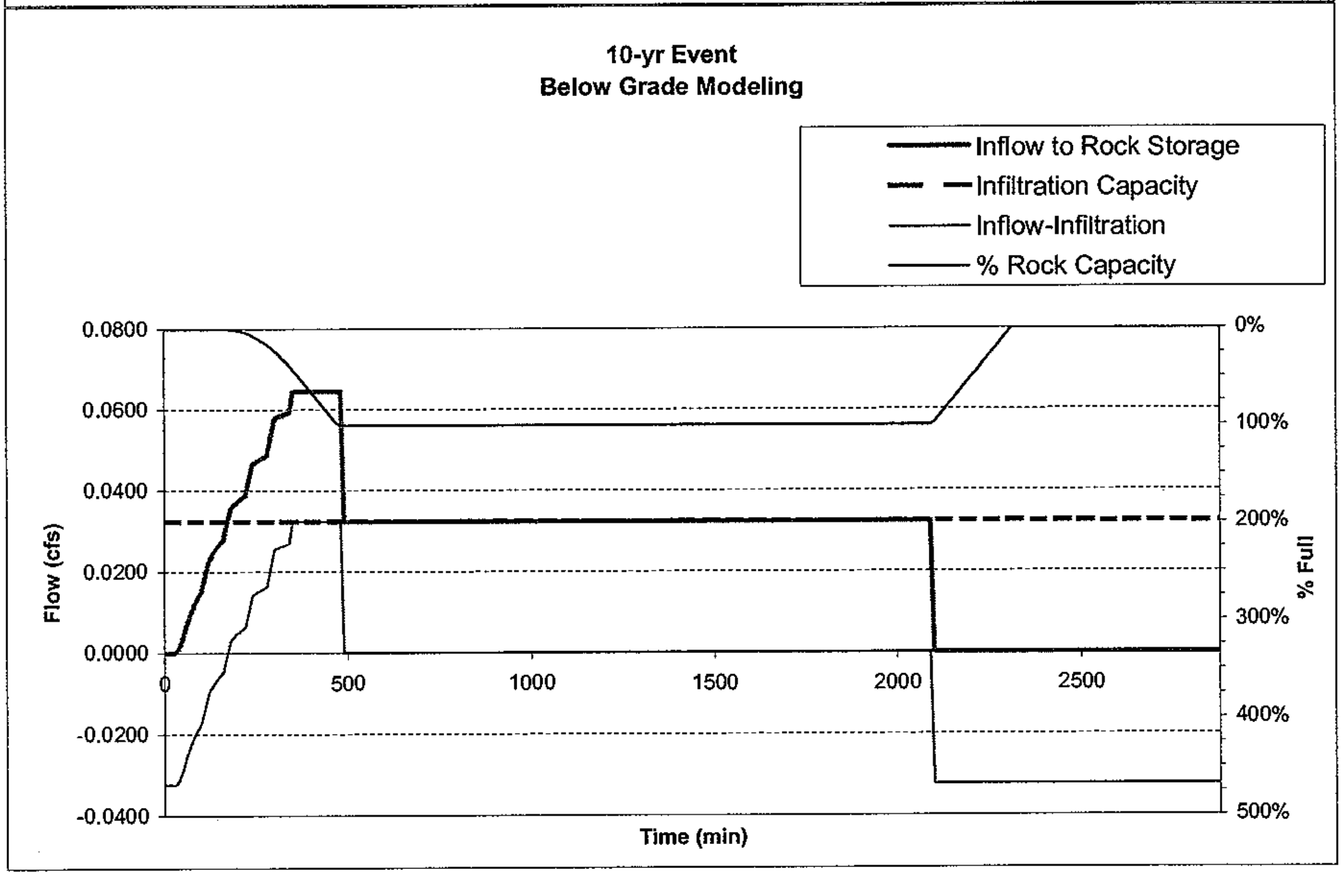
BES - Presumptive Approach Calculator - Ver 1.1

10-yr Con-A&B



10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - So. Parking1 Catc
Run Time: 5/13/2009 11:09:52 AM
Catchment ID: C2
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B



10-yr Event
Below Grade Modeling

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Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: C3

Project Name: Milwaukie Park - No. Parking2 Catch
Date: 03/15/09
Project Address:
Permit Number: -
Milwaukie, OR
Run Time: 5/13/2009 12:54:02 PM
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	C3	
	Catchment Area	
Impervious Area	10,212	SF
Impervious Area	0.23	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

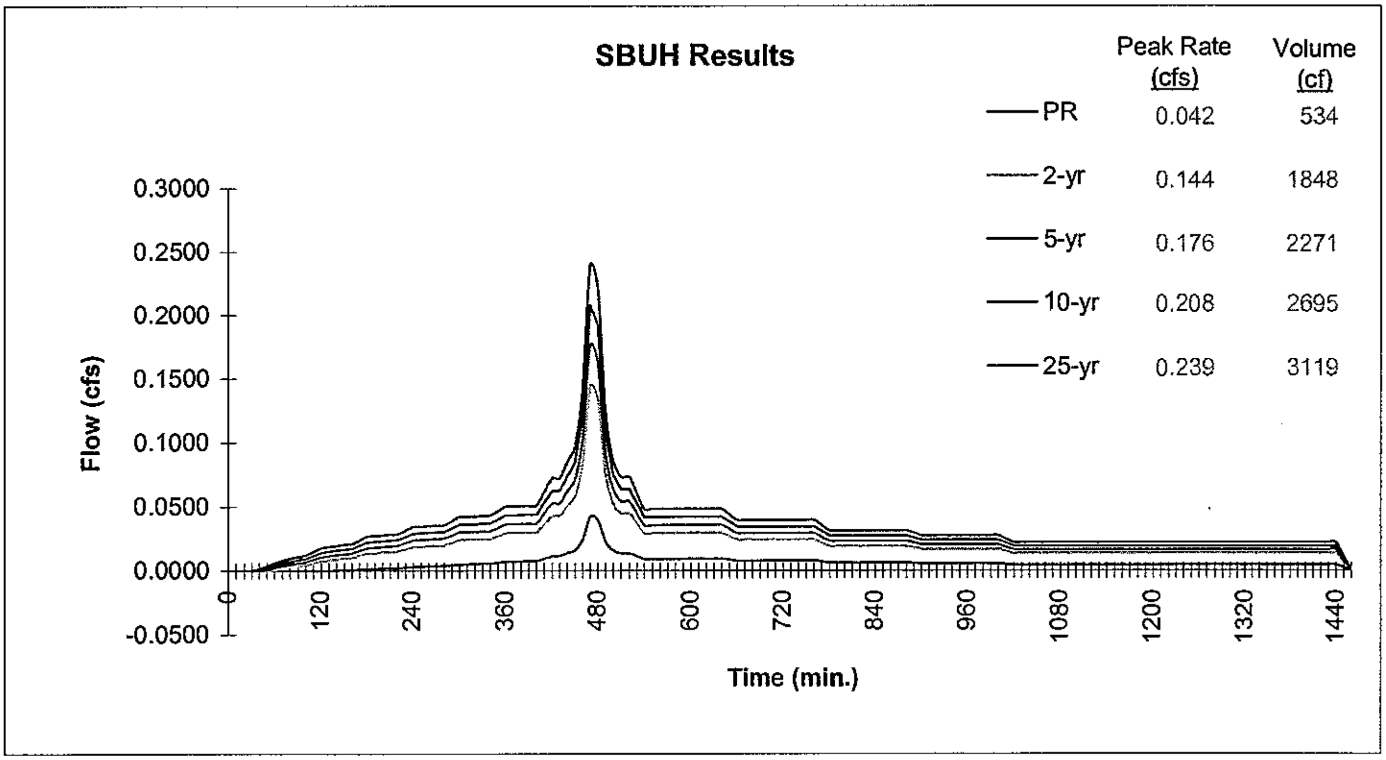
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.042	534
2-yr	0.144	1848
5-yr	0.176	2271
10-yr	0.208	2695
25-yr	0.239	3119

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Presumptive Approach Calculator ver. 1.1

Catchment ID: C3

Run Time: 5/13/2009 12:54:02 PM

Project Name: Milwaukie Park - No. Parking2 Catch **Catchment ID:** C3 **Date:** 3/15/2009

Instructions:
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

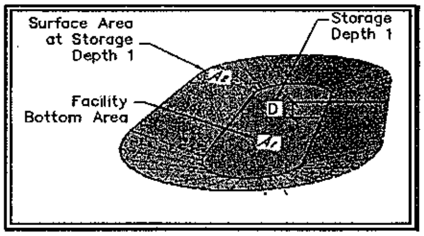
Goal Summary:

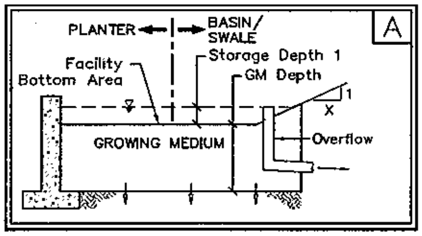
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Basin

Facility Shape: User Defined

Facility Configuration: A





Calculation Guide
Max. Rock Stor. Bottom Area
1,245 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area = 131 sf
Surf. Area at Storage Depth 1 = 1245.0 sf

Storage Depth 1 = 18 in
Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 1,032 cf
Infiltration Area at 75% Depth1 = 966 SF
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.045 cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area = 966 sf
Rock Storage Depth = 0 in

Rock Storage Capacity = 0 cf

Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.022 cfs

Native Infiltration Rate Used in P

RESULTS		Overflow Volume		
Pollution Reduction	PASS	0 CF	2%	Surf. Cap. Used
10-yr	PASS	0 CF	95%	Surf. Cap. Used

Run PAC

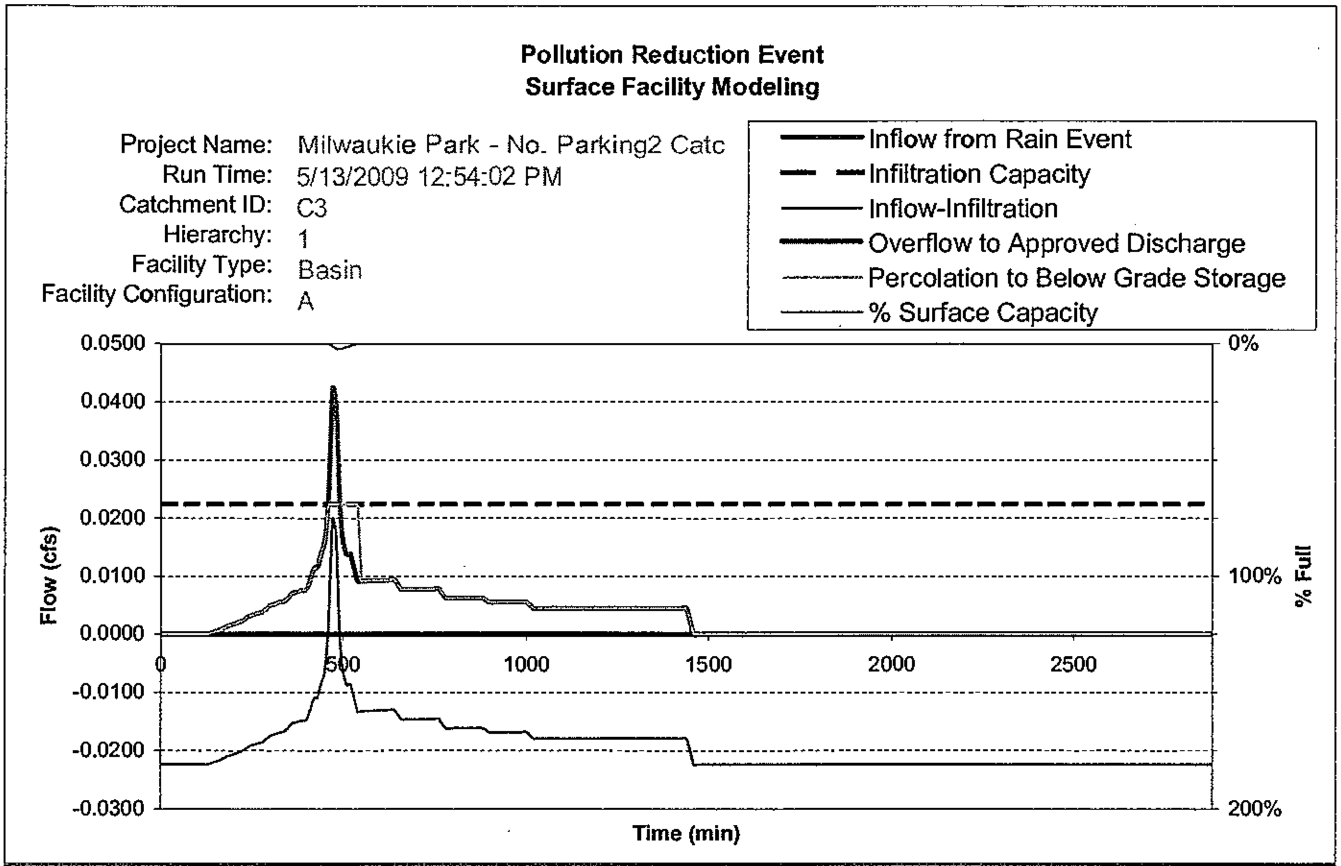
FACILITY FACTS

Total Facility Area Including Freeboard = 1,245 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.122

Current data has been exported:

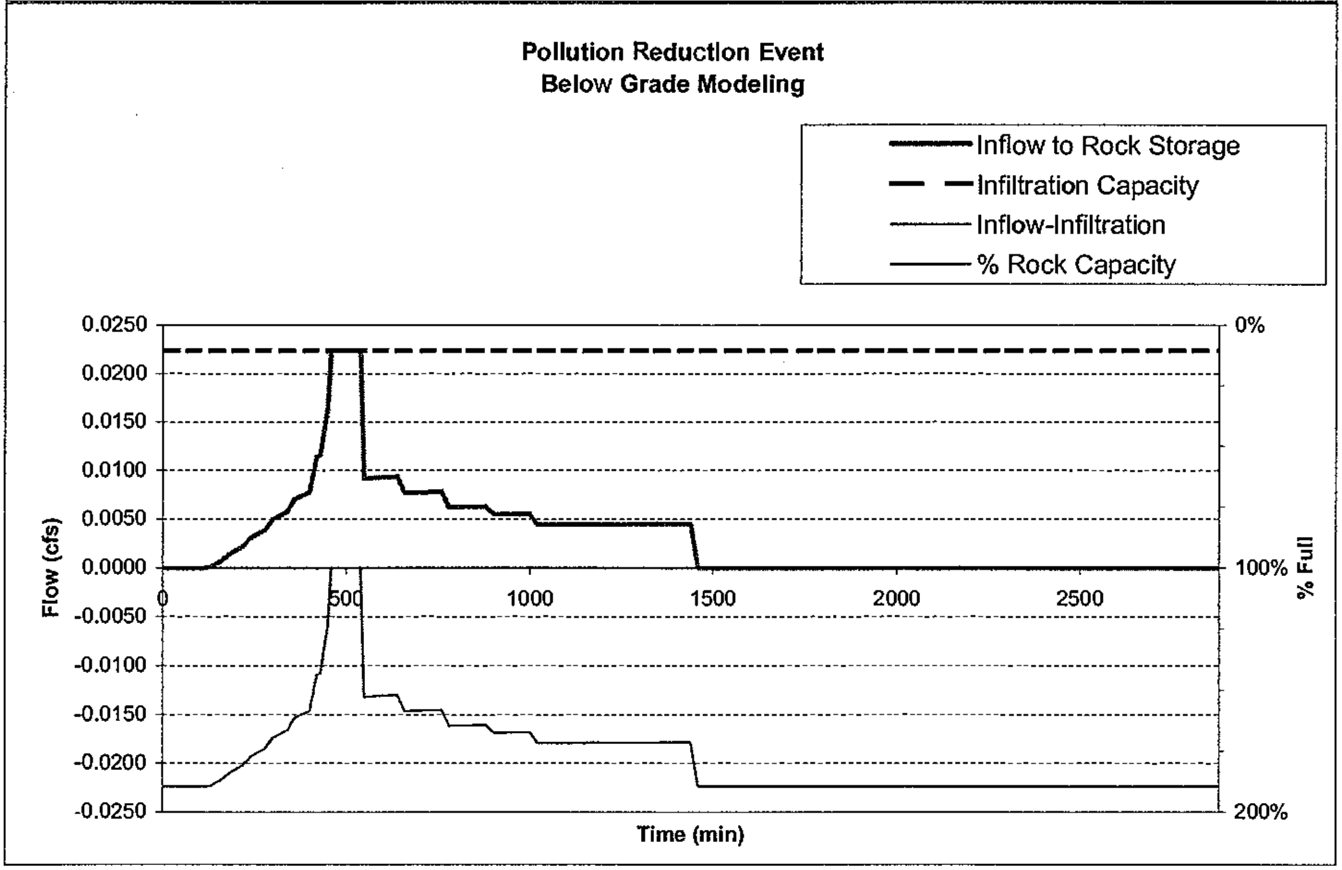
No_Parking22_Export.xls 5/13/2009 12:55:36 PM

BES - Presumptive Approach Calculator - Ver 1.1



Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - No. Parking2 Catc
Run Time: 5/13/2009 12:54:02 PM
Catchment ID: C3
Hierarchy: 1
Facility Type: Basin
Facility Configuration: A



Pollution Reduction Event
Below Grade Modeling

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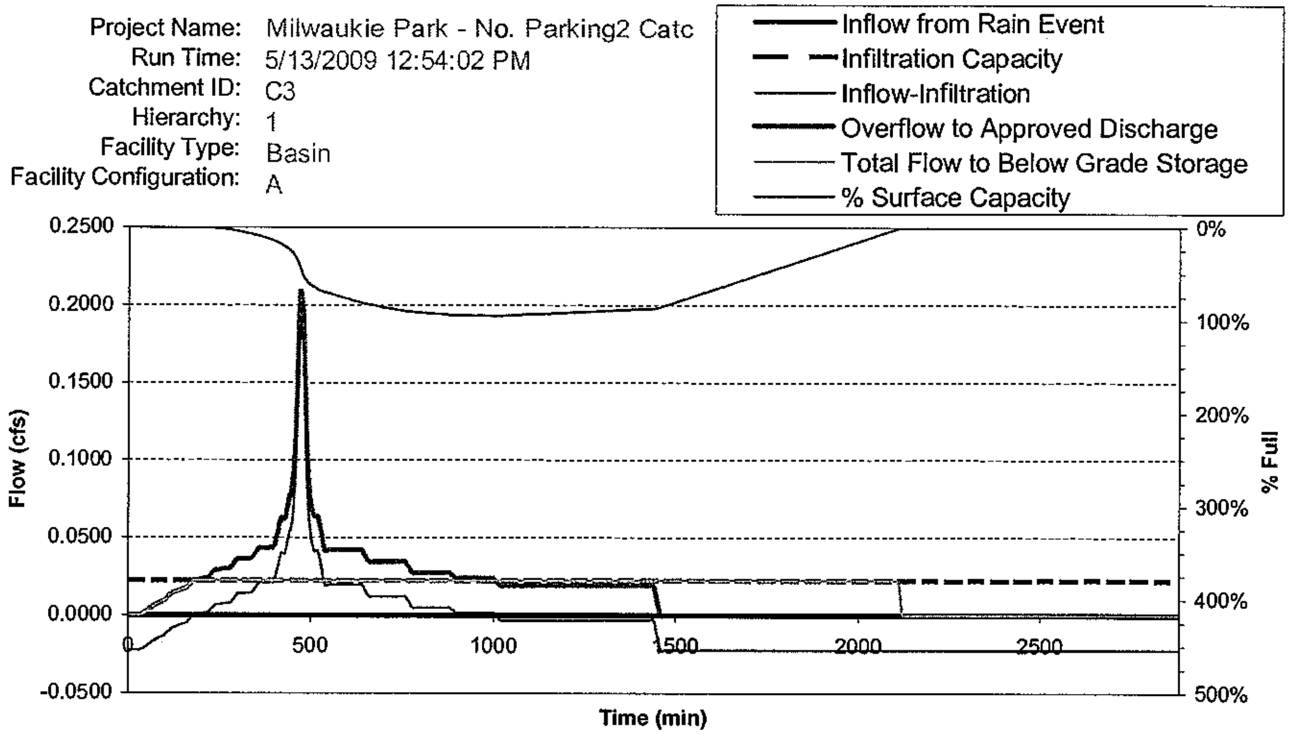
BES - Presumptive Approach Calculator - Ver 1.1

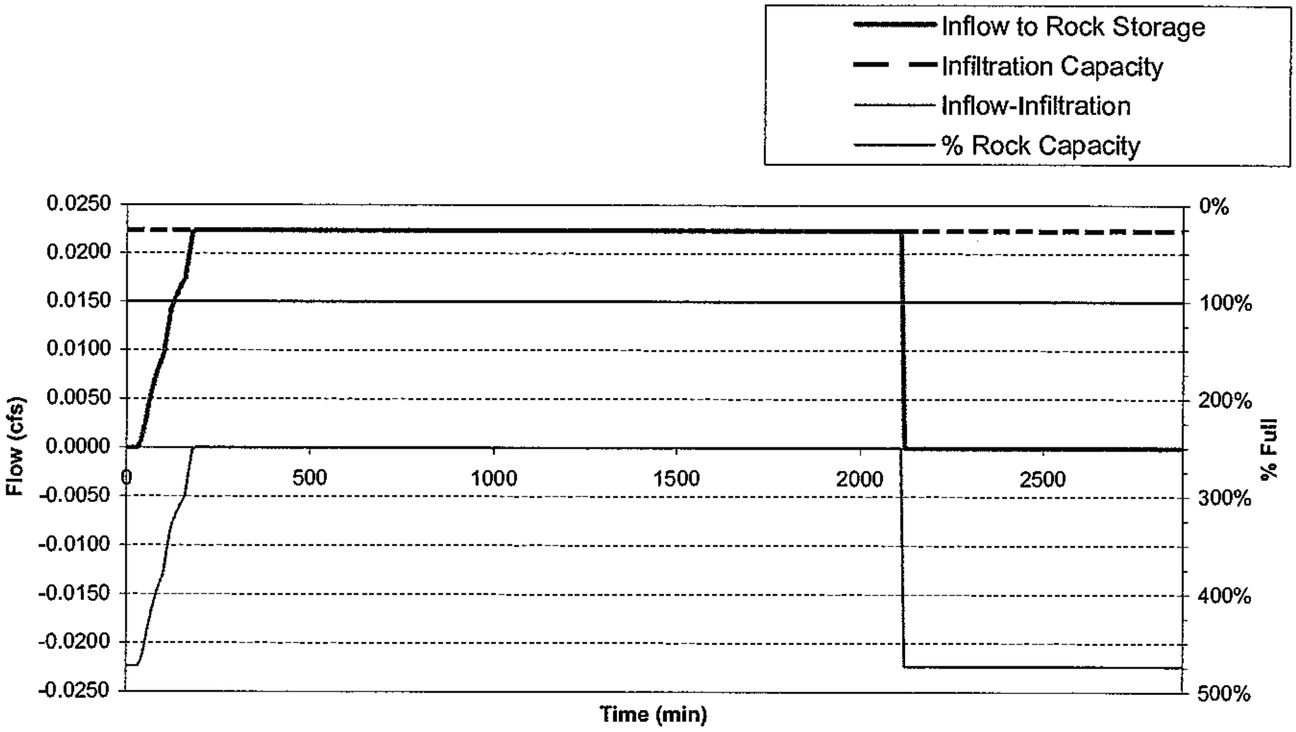
10-yr Con-A&B

10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - No. Parking2 Catc
Run Time: 5/13/2009 12:54:02 PM
Catchment ID: C3
Hierarchy: 1
Facility Type: Basin
Facility Configuration: A



10-yr Event
Below Grade Modeling



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Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: C4
Date: 03/15/09
Permit Number: 0
Run Time: 5/13/2009 12:35:49 PM

Project Name: Milwaukie Park - Access Catch
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	C4	
	Catchment Area	
Impervious Area	3,328	SF
Impervious Area	0.08	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

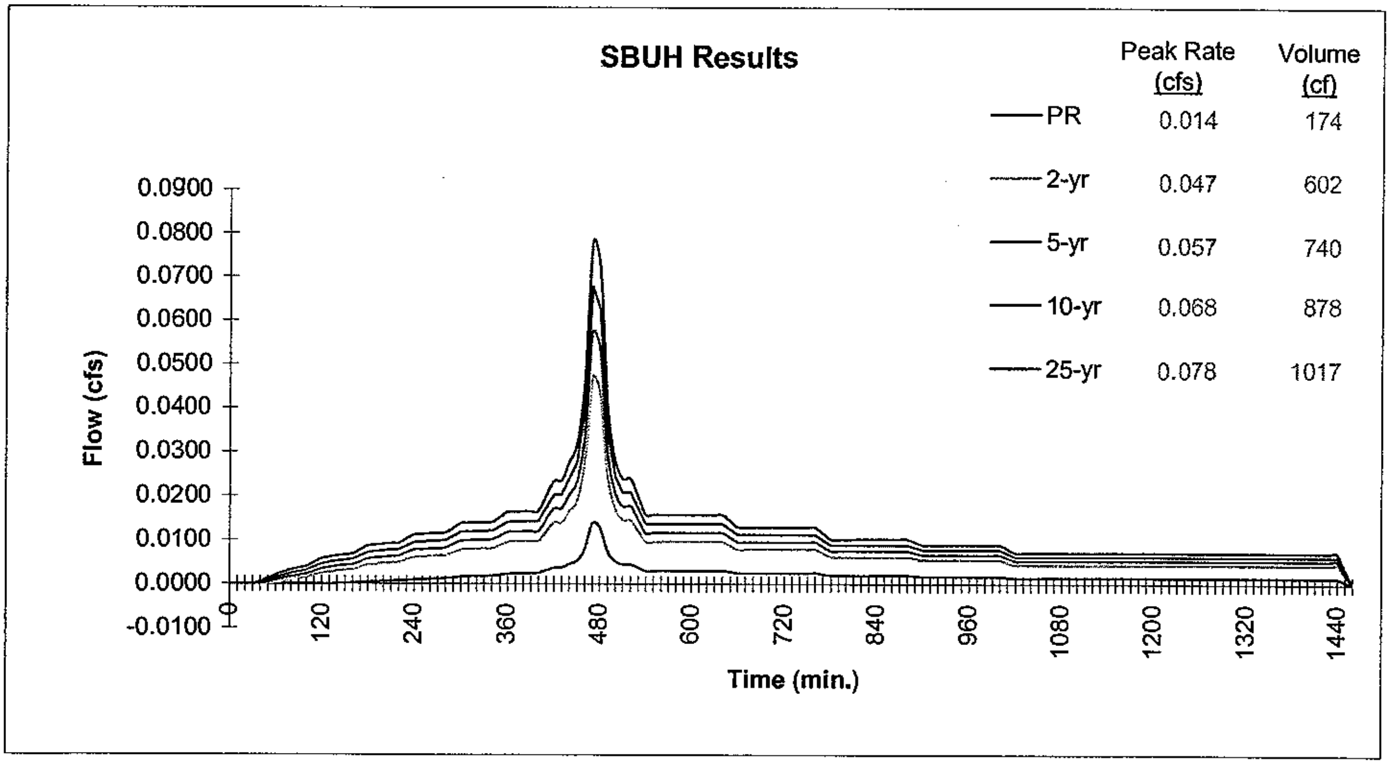
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.014	174
2-yr	0.047	602
5-yr	0.057	740
10-yr	0.068	878
25-yr	0.078	1017

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Presumptive Approach Calculator ver. 1.1

Catchment ID: C4

Run Time: 5/13/2009 12:35:49 PM

Project Name: Milwaukie Park - Access Catch **Catchment ID:** C4 **Date:** 3/15/2009

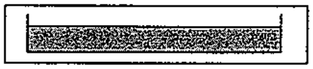
Instructions:
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

Goal Summary:

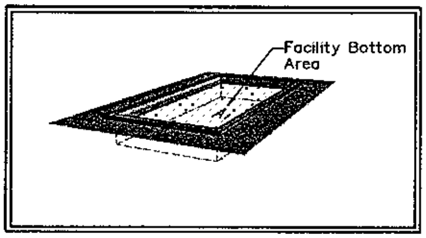
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
I	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

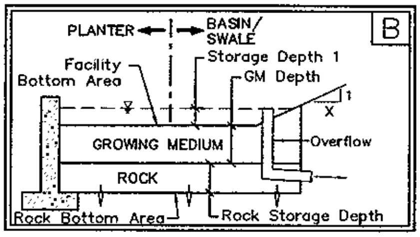
Facility Type = Planter (Flat)



Facility Shape: Rectangle/Square

Facility Configuration: B





Calculation Guide
Max. Rock Stor. Bottom Area
425 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area = 425 sf
Bottom Width = 10.0 ft
Facility Side Slope = 0 to 1
Storage Depth 1 = 12 in
Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 425 cf
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.020 cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area = 425 sf
Rock Storage Depth = 12 in
Rock Void Ratio = 0.3

Rock Storage Capacity = 128 cf
Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.010 cfs

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used
			3%	Rock Cap. Used
10-yr	PASS	0 CF	22%	Surf. Cap. Used
			100%	Rock Cap. Used

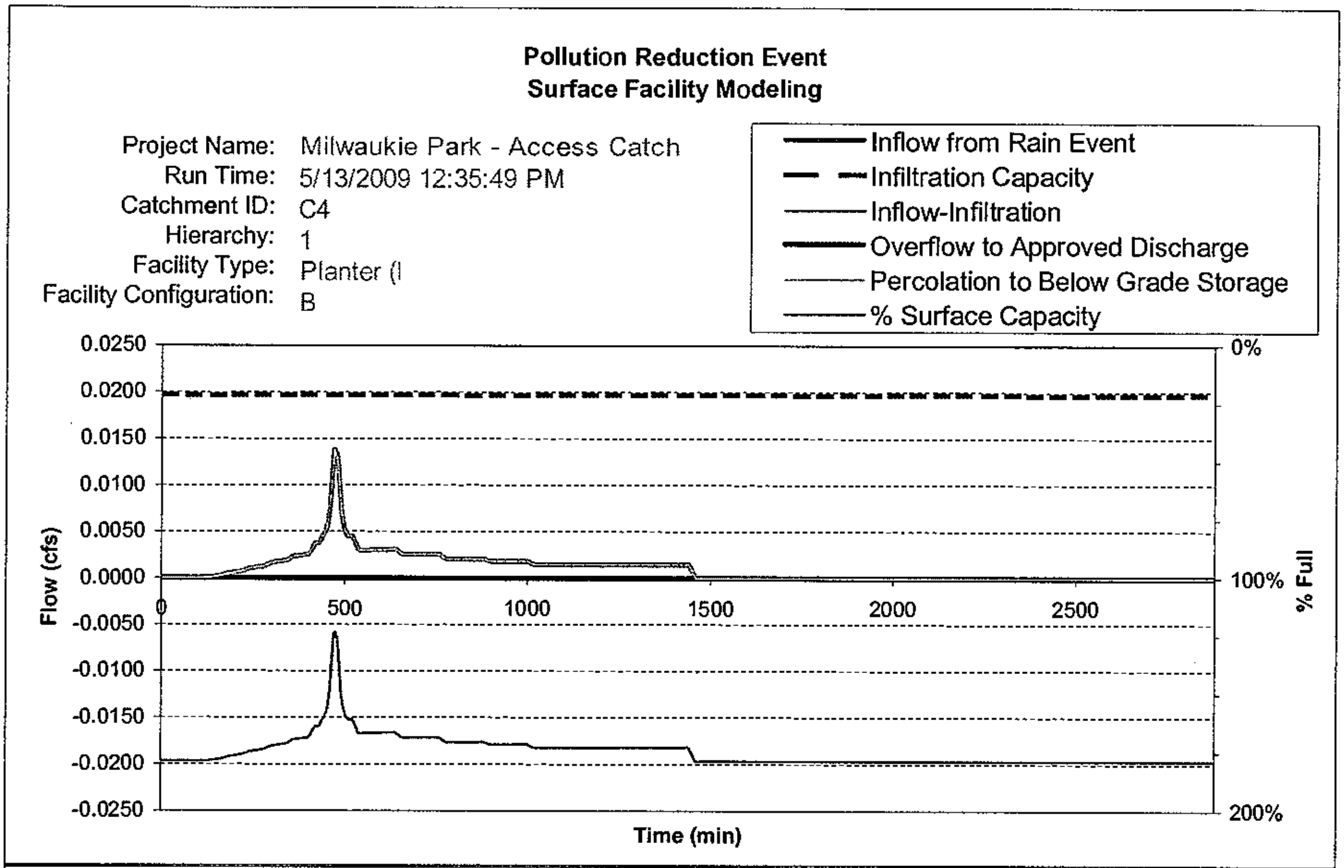
Run PAC

FACILITY FACTS

Total Facility Area Including Freeboard = 425 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.128

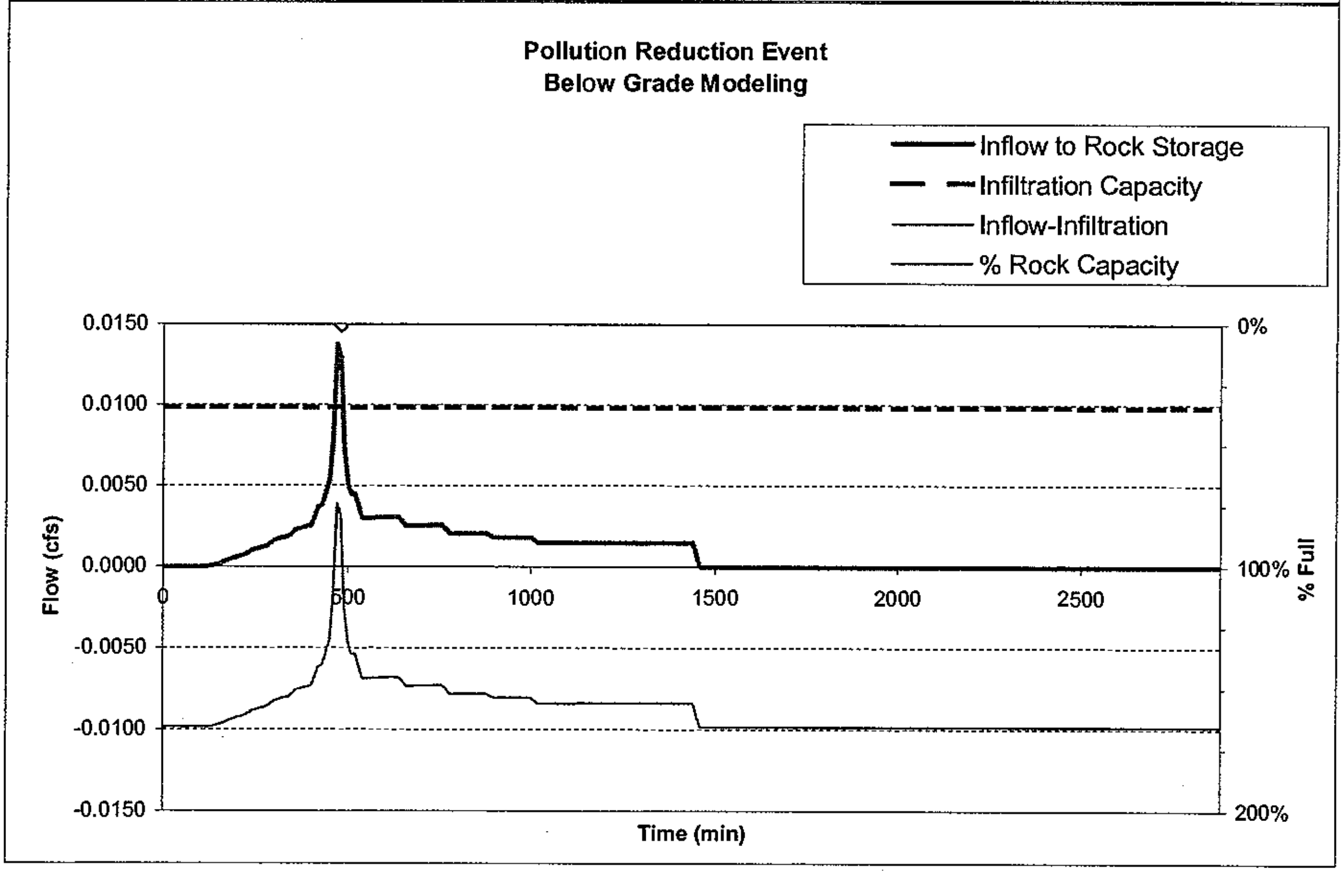
BES - Presumptive Approach Calculator - Ver 1.1

PR Con-A&B



Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - Access Catch
Run Time: 5/13/2009 12:35:49 PM
Catchment ID: C4
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B



Pollution Reduction Event
Below Grade Modeling

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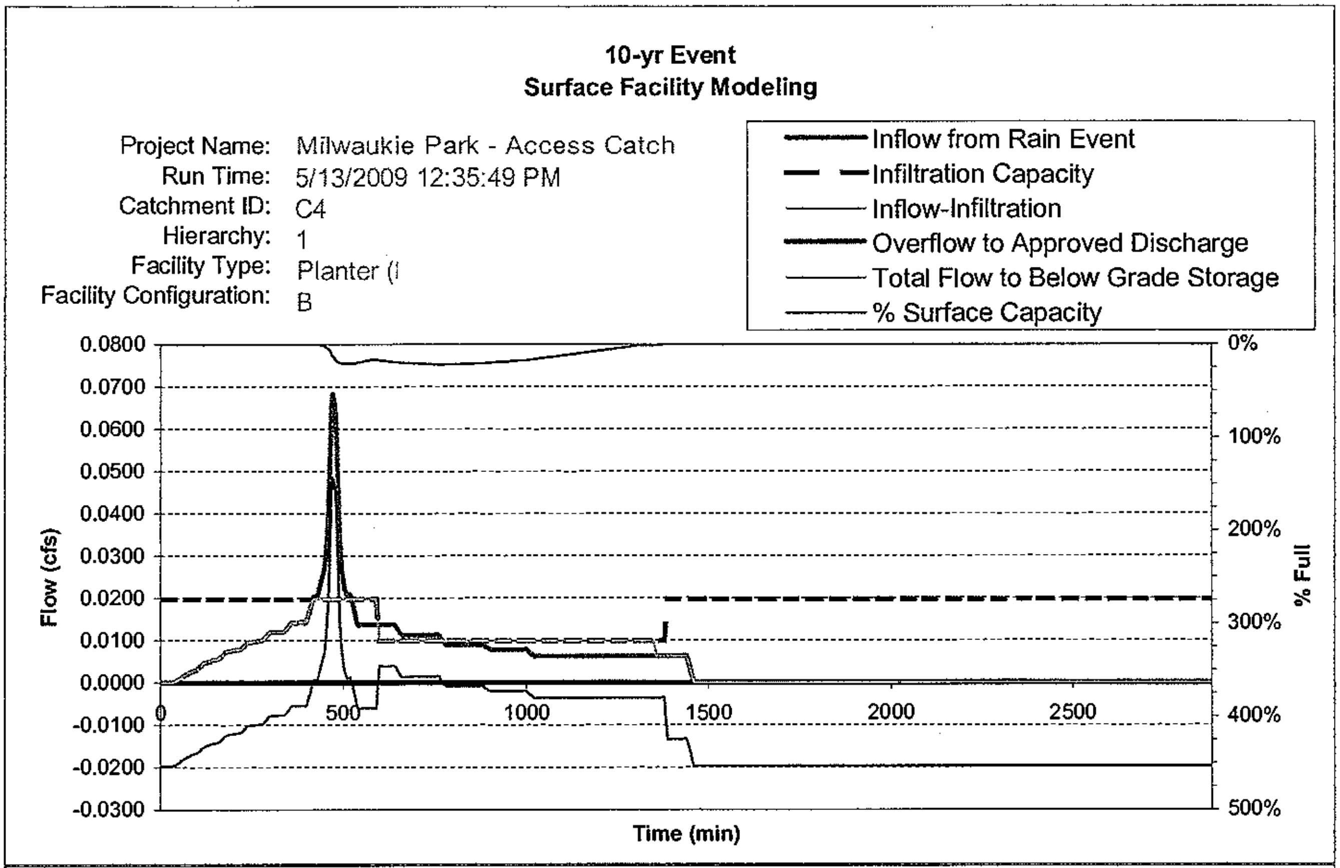
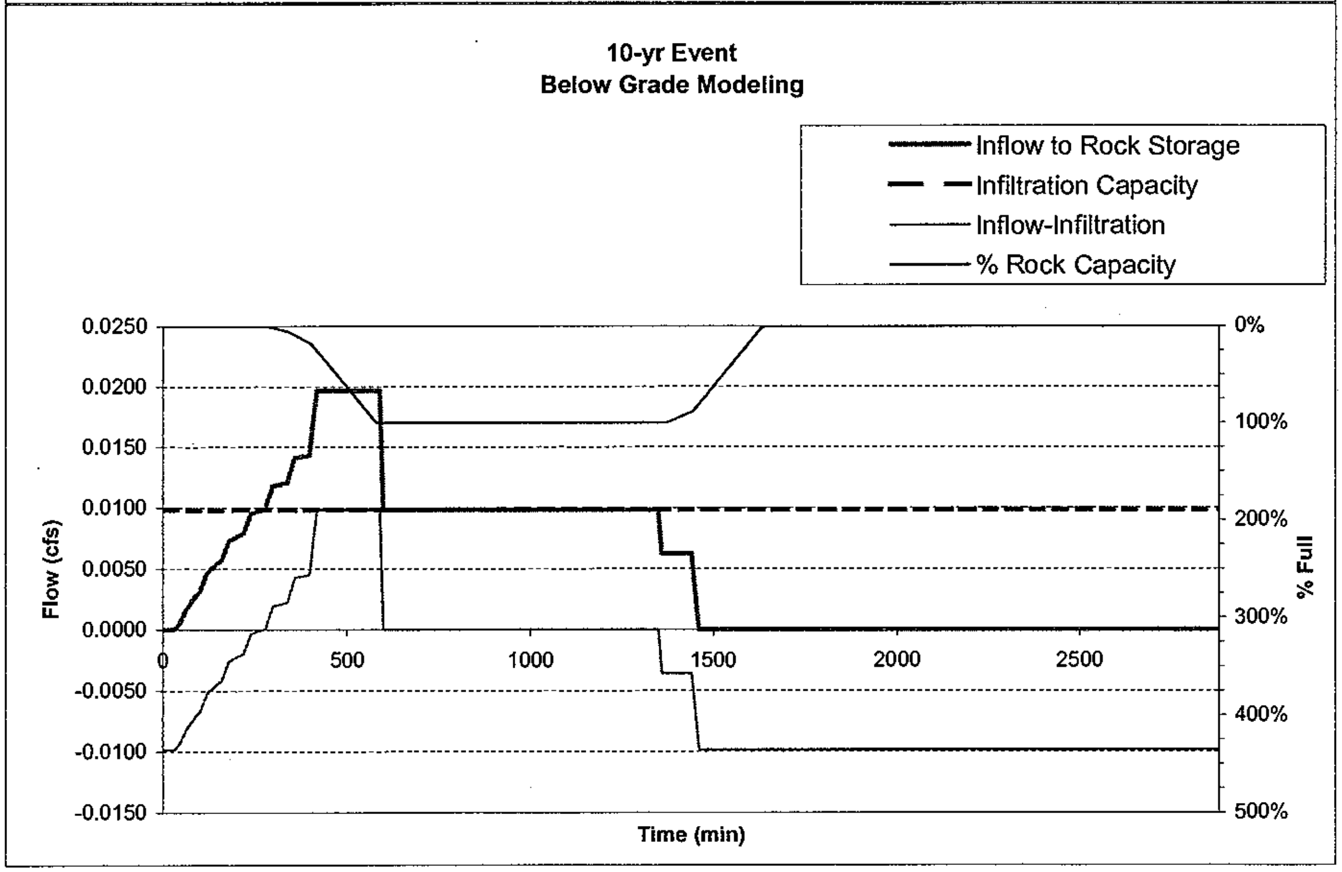
BES - Presumptive Approach Calculator - Ver 1.1



10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - Access Catch
Run Time: 5/13/2009 12:35:49 PM
Catchment ID: C4
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B



10-yr Event
Below Grade Modeling

Printed: 5/13/2009 12:38 PM

Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: N1
Date: 03/15/09
Permit Number: 0
Run Time: 5/14/2009 11:42:05 AM

Project Name: Milwaukie Park - Lower No. Parking Ca
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	N1	
	Catchment Area	
Impervious Area	11,375	SF
Impervious Area	0.26	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

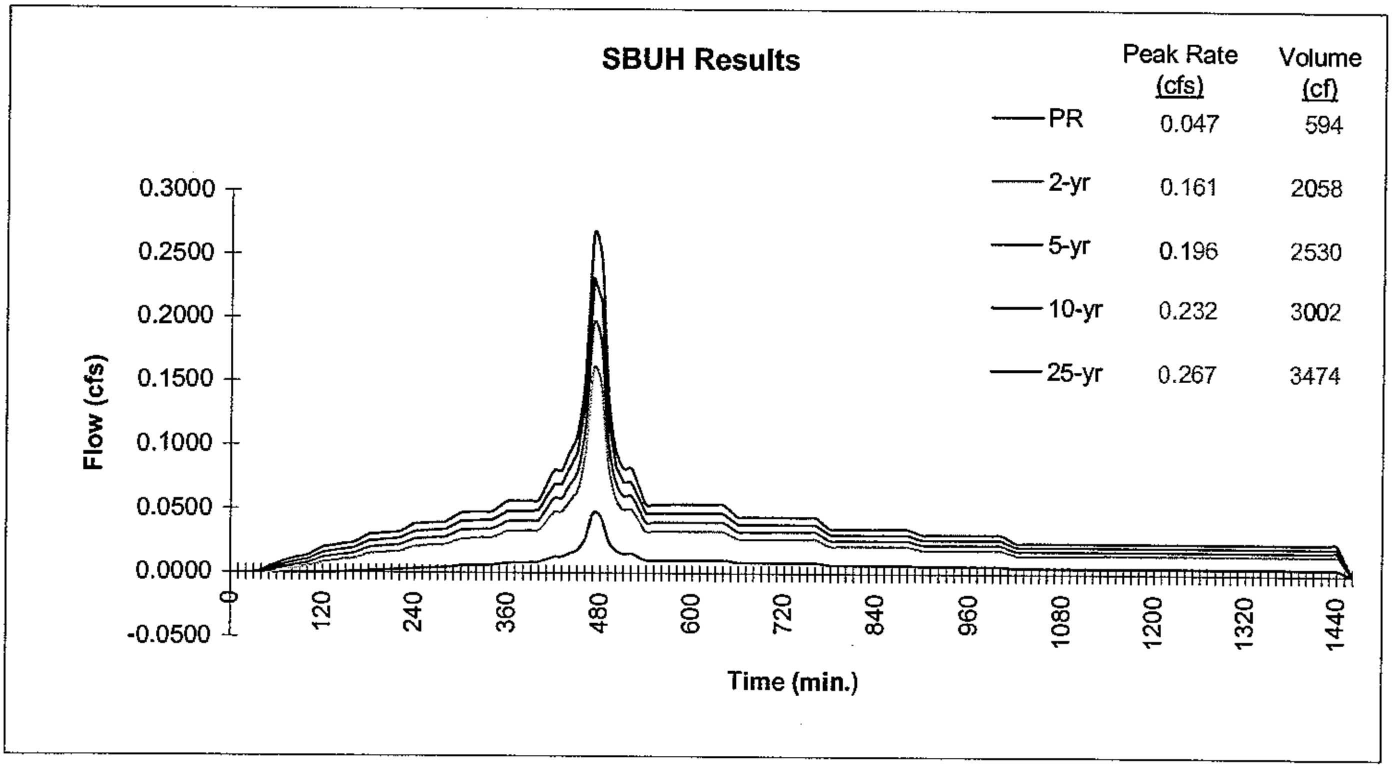
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.047	594
2-yr	0.161	2058
5-yr	0.196	2530
10-yr	0.232	3002
25-yr	0.267	3474

Printed: 5/14/2009 11:45 AM

Presumptive Approach Calculator ver. 1.1

Catchment ID: N1

Run Time: 5/14/2009 11:42:05 AM

Project Name: Milwaukie Park - Lower No. Parking Catch **Catchment ID:** N1 **Date:** 3/15/2009

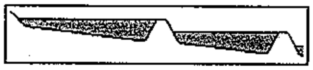
Instructions:
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

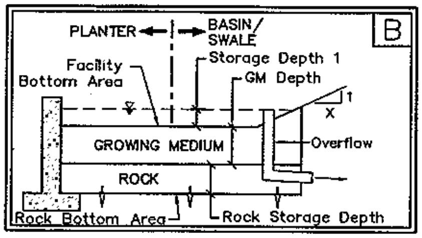
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Planter (Sloped)



Facility Configuration: B



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide
Max. Rock Stor. Bottom Area Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 1,057 sf
Surface Capacity Volume = 907.3 cf

Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 907 cf
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.049 cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area = 994 sf
Rock Storage Depth = 12 in
Rock Void Ratio = 0.3

Rock Storage Capacity = 298 cf
Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.023 cfs

RESULTS		Overflow Volume		
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used
			10%	Rock Cap. Used
10-yr	PASS	0 CF	98%	Surf. Cap. Used
			100%	Rock Cap. Used

Run PAC

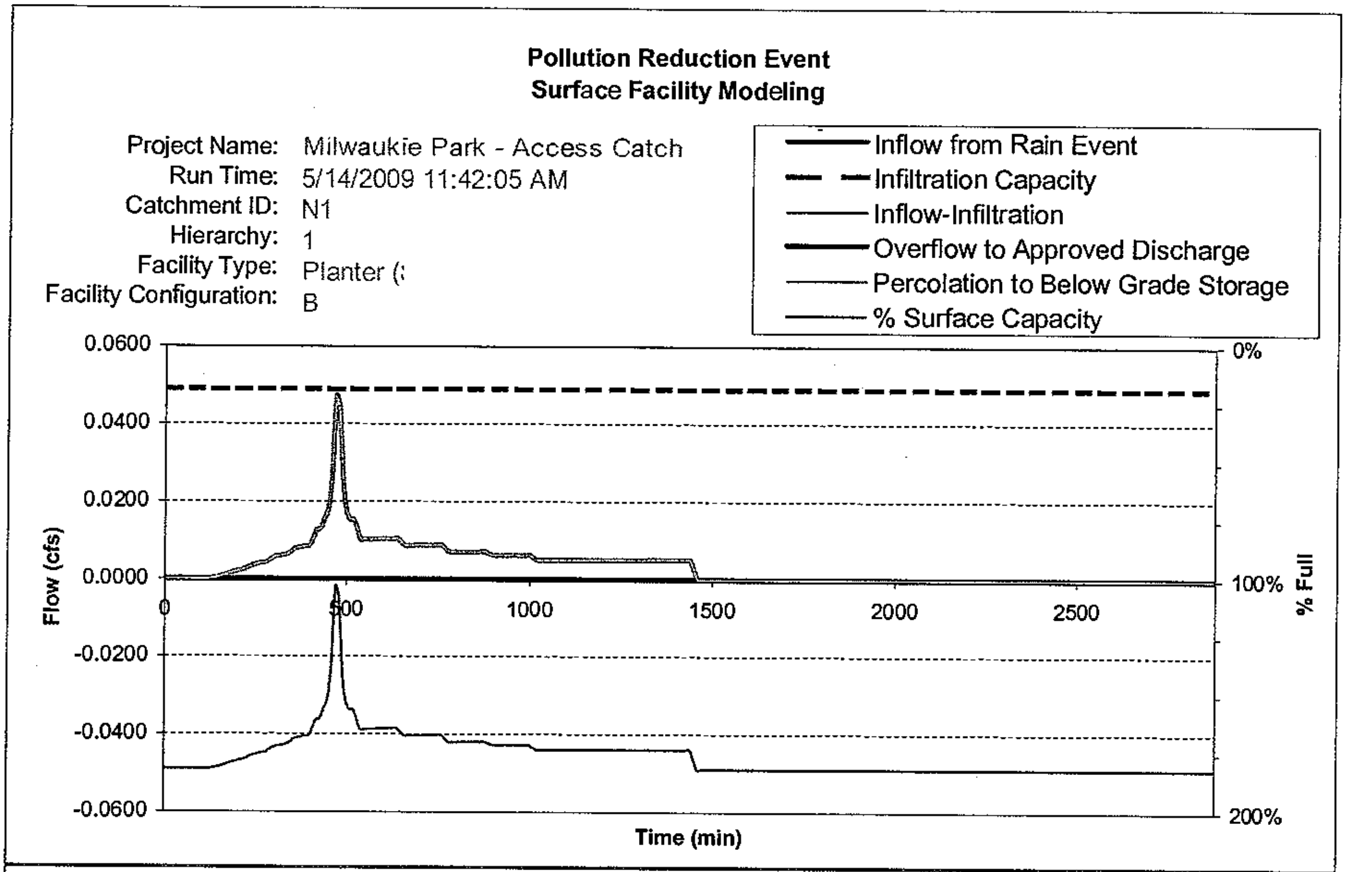
FACILITY FACTS

Total Facility Area Including Freeboard = 1,228 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.108

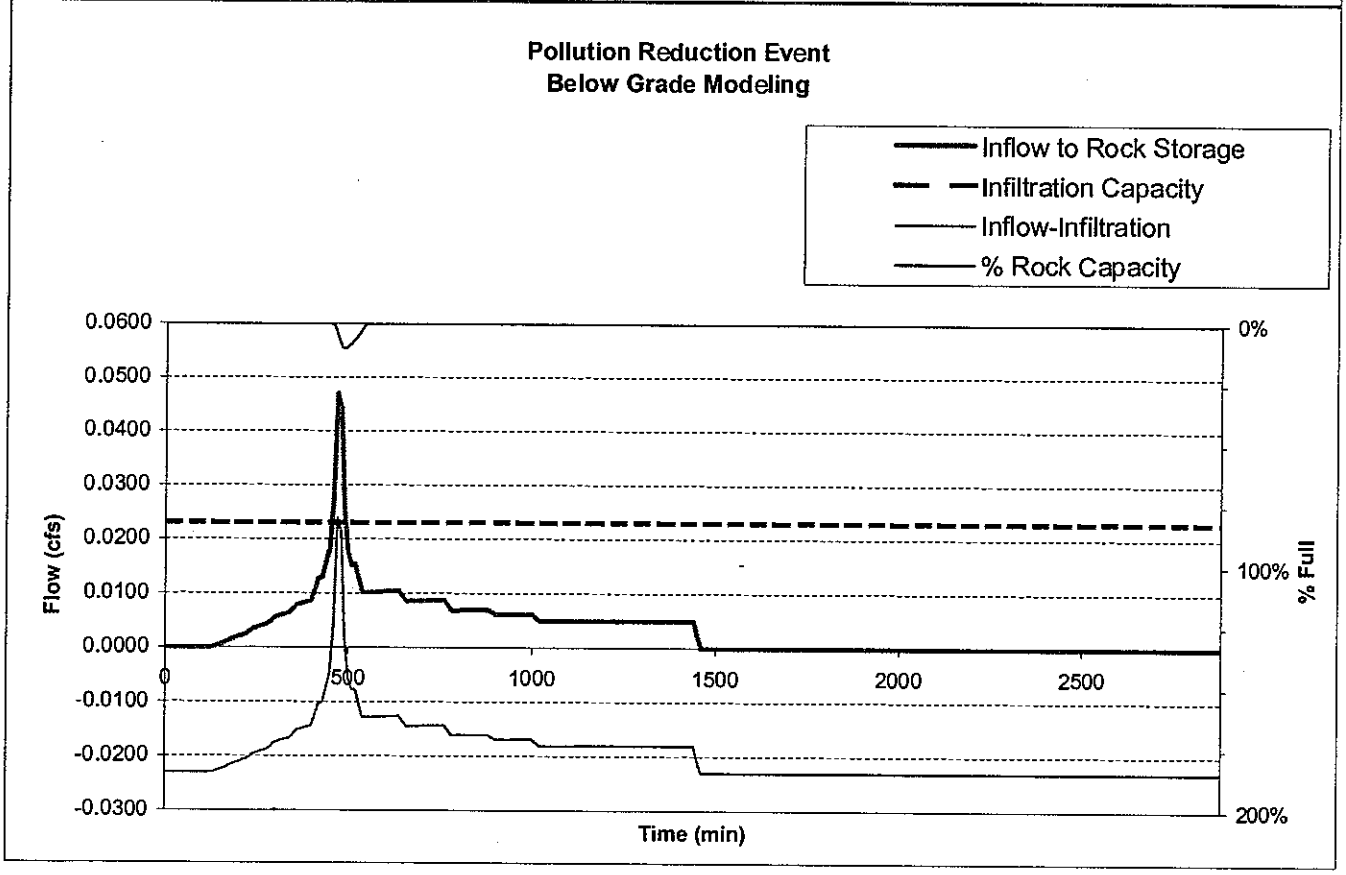
Current data has been exported:

Ramp_Lower_Park_Export.xls5/14/2009 11:45:23 AM

BES - Presumptive Approach Calculator - Ver 1.1

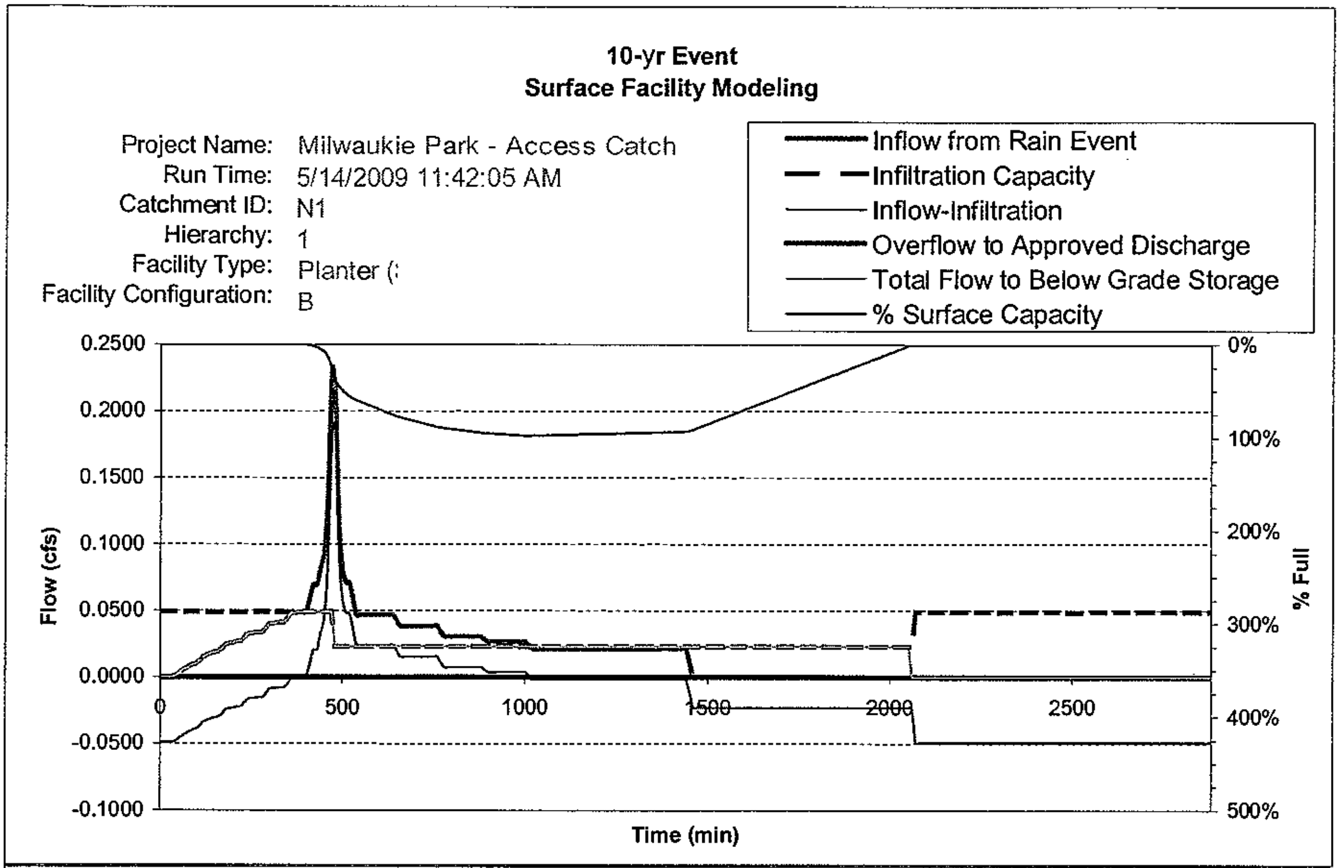


Project Name: Milwaukie Park - Access Catch
Run Time: 5/14/2009 11:42:05 AM
Catchment ID: N1
Hierarchy: 1
Facility Type: Planter (
Facility Configuration: B



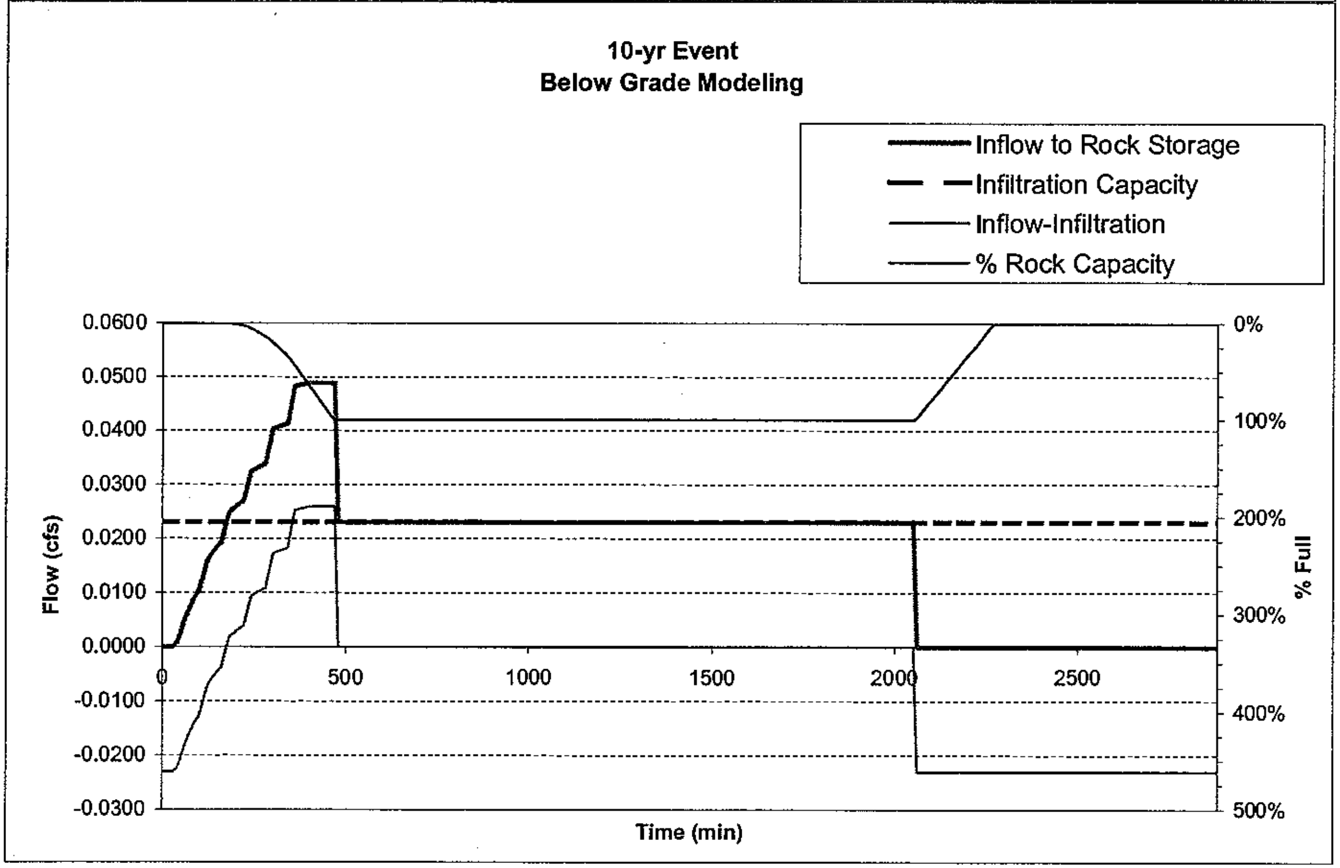
Printed: 5/14/2009 11:45 AM

BES - Presumptive Approach Calculator - Ver 1.1



10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - Access Catch
Run Time: 5/14/2009 11:42:05 AM
Catchment ID: N1
Hierarchy: 1
Facility Type: Planter (:
Facility Configuration: B



10-yr Event
Below Grade Modeling

Printed: 5/14/2009 11:45 AM

Presumptive Approach Calculator Ver 1.1

Instructions:

1. Refer to facility graphics and fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

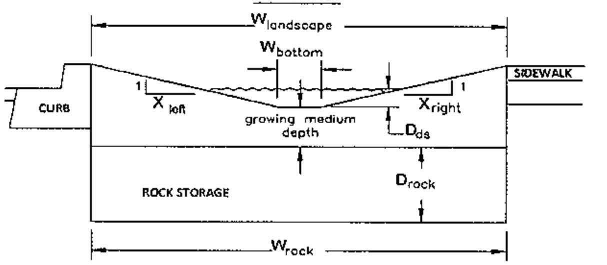
Run Time: 5/14/2009 11:42:05 AM

Project Name: Milwaukie Park - Lower No. Parking Catch

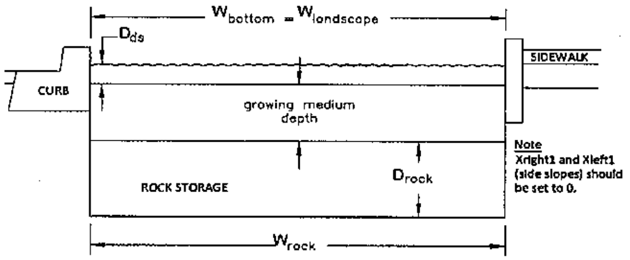
Date: 3/15/2009

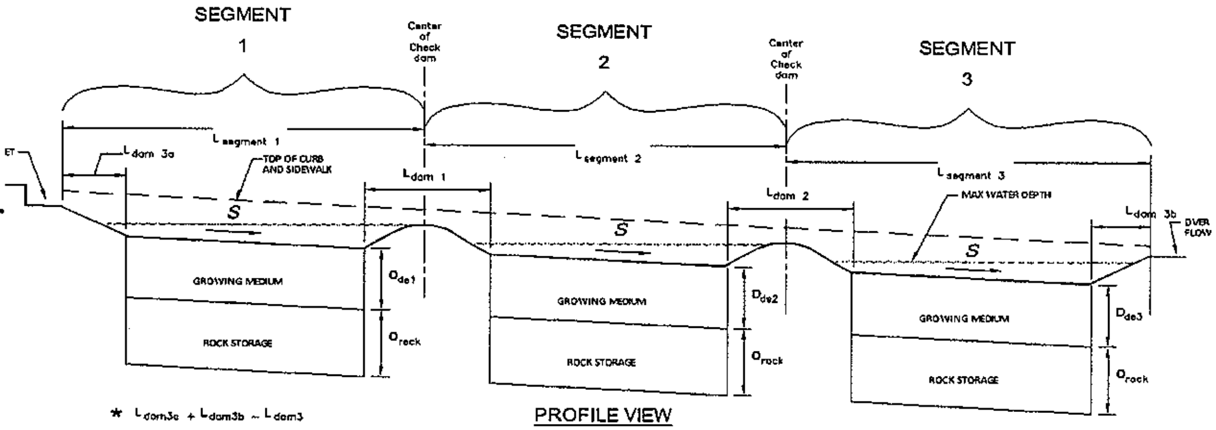
Catchment ID: N1

SWALE



SLOPED PLANTER





PROFILE VIEW

Data Entry

Variable Description	Parameters									Rock Storage Parameters		
	Facility Segment	Length of facility segment	Downstream Check Dam Length	Longitudinal Facility Slope	Bottom Width	Side Slope Right	Side Slope Left	Downstream Depth	Landscape Width	Rock Storage Width	Rock Storage Depth	Rock Void Ratio
Unit		(ft)	(ft)	(ft/ft)	(ft)			(inches)	(ft)	(ft)	(inches)	
Variable Symbol		$L_{segment}$	L_{dam}	S	W_{bottom}	X_{right}:1	X_{left}:1	D_{ds}	$W_{landscape}$	W_{rock}	D_{rock}	v
	1	20	3	0.015	7	0	0	12	7	7	12	0.3
	2	20	2	0.015	7	0	0	12	7	7		
	3	20	2	0.015	7	0	0	12	7	7		
	4	20	2	0.015	7	0	0	12	7	7		
	5	20	2	0.015	7	0	0	12	7	7		
	6	20	2	0.015	7	0	0	12	7	7		
	7	20	2	0.015	7	0	0	12	7	7		
	8	20	3	0.015	7	0	0	12	7	7		
	9											
	10											

Error Messages

Worksheet Calculations

Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: N2
Date: 03/15/09
Permit Number: 0
Run Time: 12/8/2009 12:20:16 PM

Project Name: Milwaukie Park - Bridge to Parking Cat
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	N2	
	Catchment Area	
Impervious Area	6,372	SF
Impervious Area	0.15	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	4	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

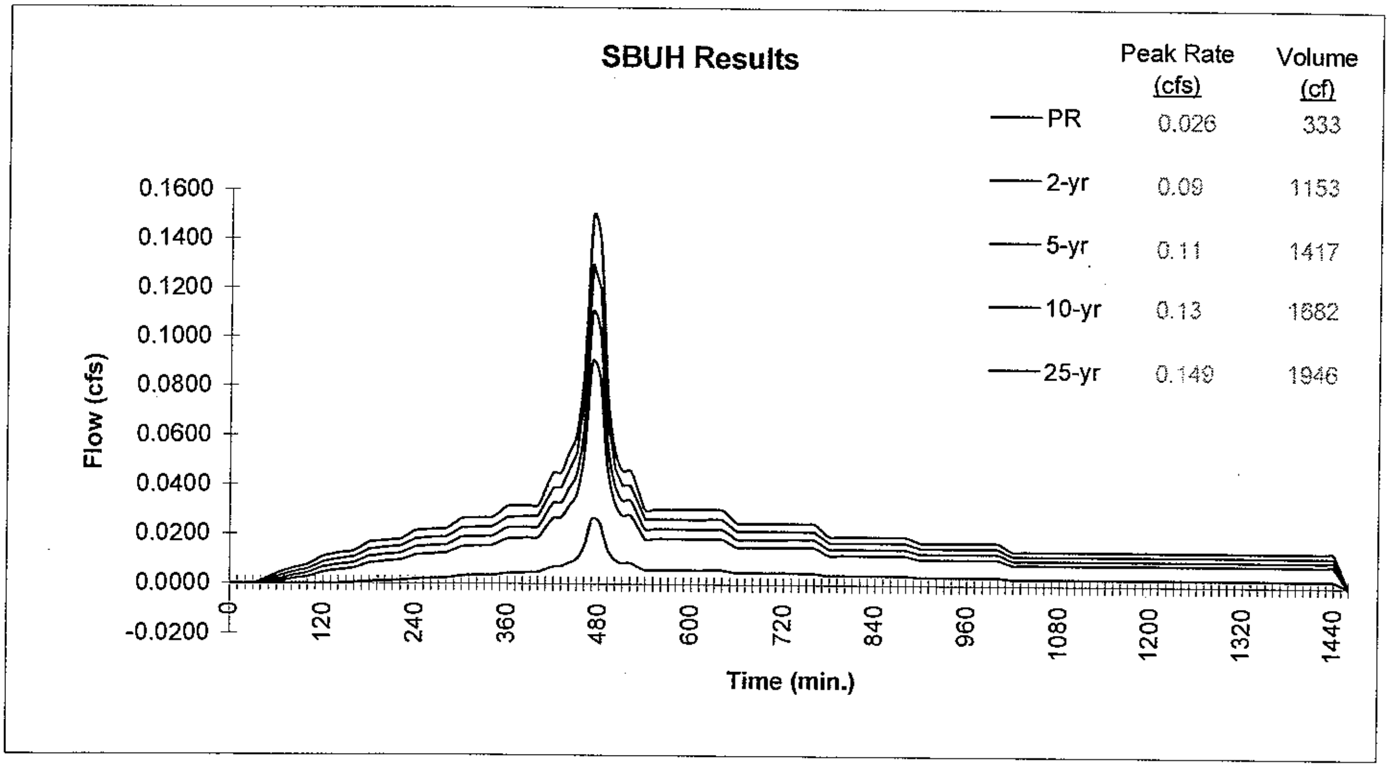
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	2.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



SBUH Results

	Peak Rate (cfs)	Volume (cf)
PR	0.026	333
2-yr	0.09	1153
5-yr	0.11	1417
10-yr	0.13	1682
25-yr	0.149	1946

Printed: 12/8/2009 12:21 PM

Presumptive Approach Calculator ver. 1.1

Catchment ID: N2

Run Time: 12/8/2009 12:20:16 PM

Project Name: Milwaukie Park - Bridge to Parking Catch **Catchment ID:** N2 **Date:** 3/15/2009

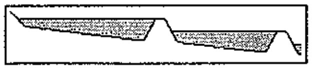
Instructions:
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

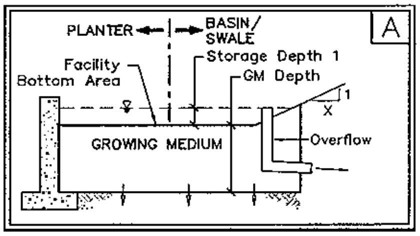
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Planter (Sloped)



Facility Configuration: A



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide
Max. Rock Stor. Bottom Area
Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 481 sf
Surface Capacity Volume = 329.0 cf

BELOW GRADE STORAGE

Rock Storage Bottom Area = 481 sf
Rock Storage Depth = 0 in

Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 329 cf
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.022 cfs

Rock Storage Capacity = 0 cf
Native Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.022 cfs

GM Infiltration Rate Used in PAC

RESULTS

		Overflow Volume		
Pollution Reduction	PASS	0 CF	1%	Surf. Cap. Used
10-yr	PASS	0 CF	100%	Surf. Cap. Used

Run PAC

FACILITY FACTS

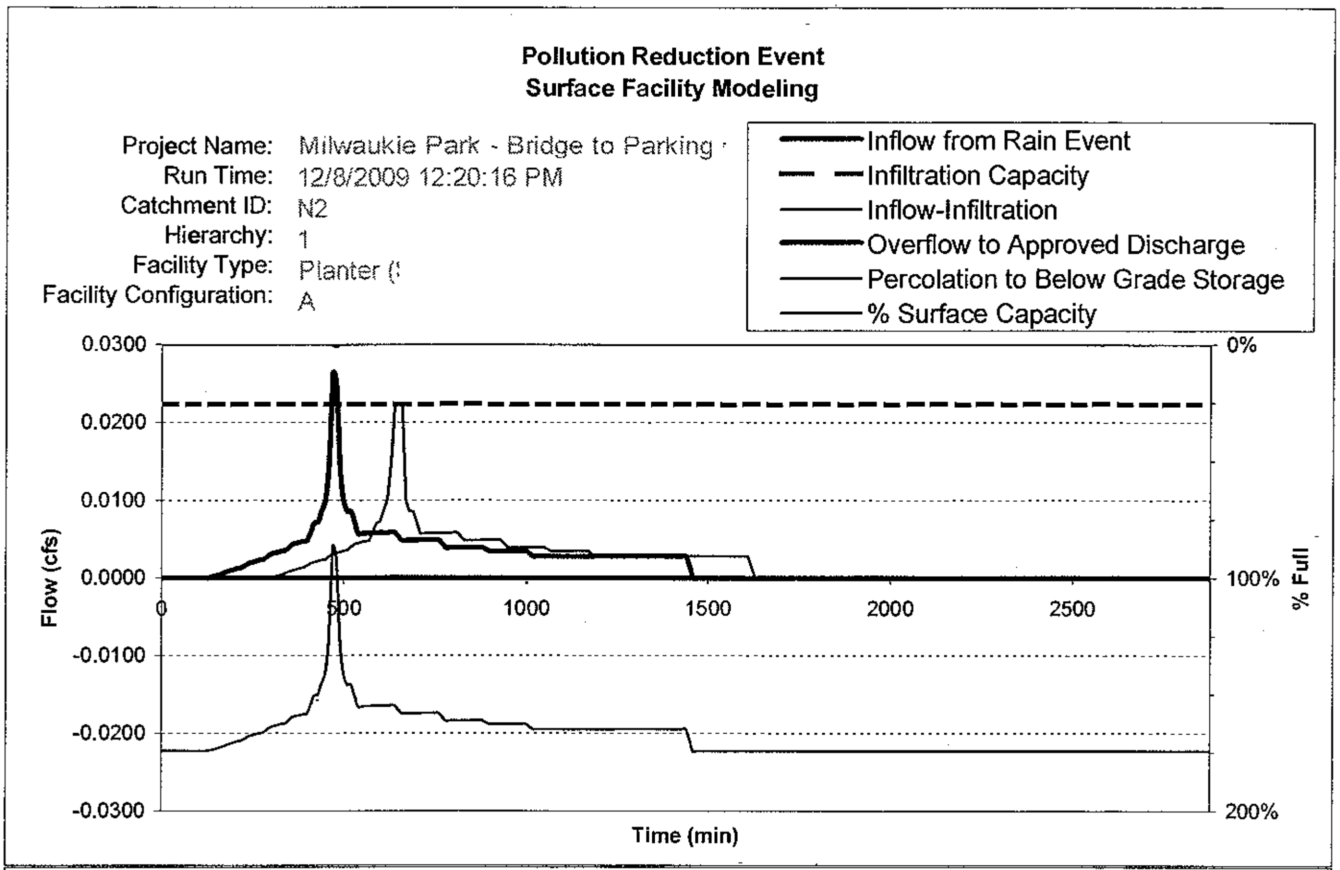
Total Facility Area Including Freeboard = 871 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.137

Current data has been exported:

Brid_Parking2_Export.xls 12/8/2009 12:21:33 PM

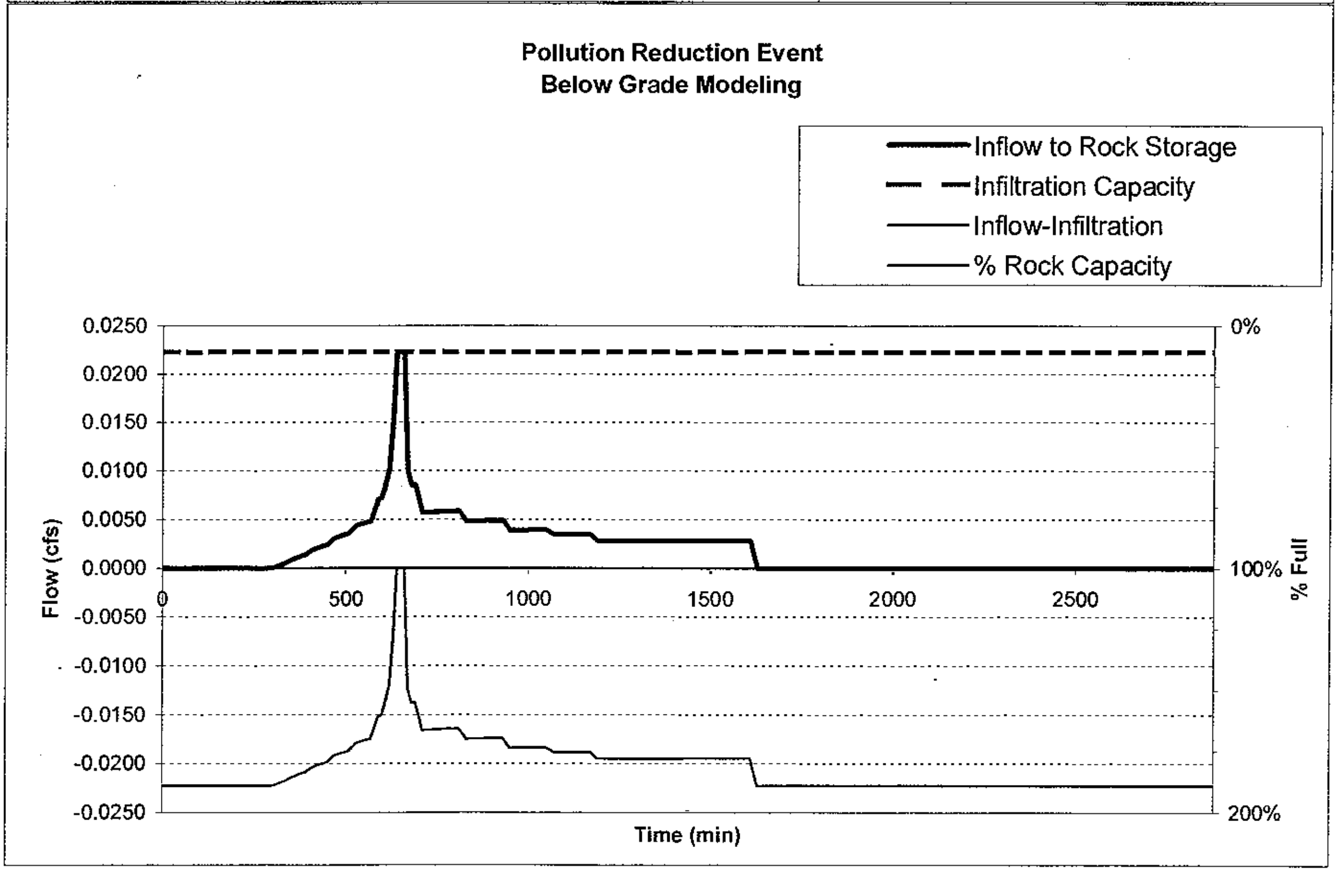
BES - Presumptive Approach Calculator - Ver 1.1

PR Con-A&B



Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - Bridge to Parking
Run Time: 12/8/2009 12:20:16 PM
Catchment ID: N2
Hierarchy: 1
Facility Type: Planter (
Facility Configuration: A

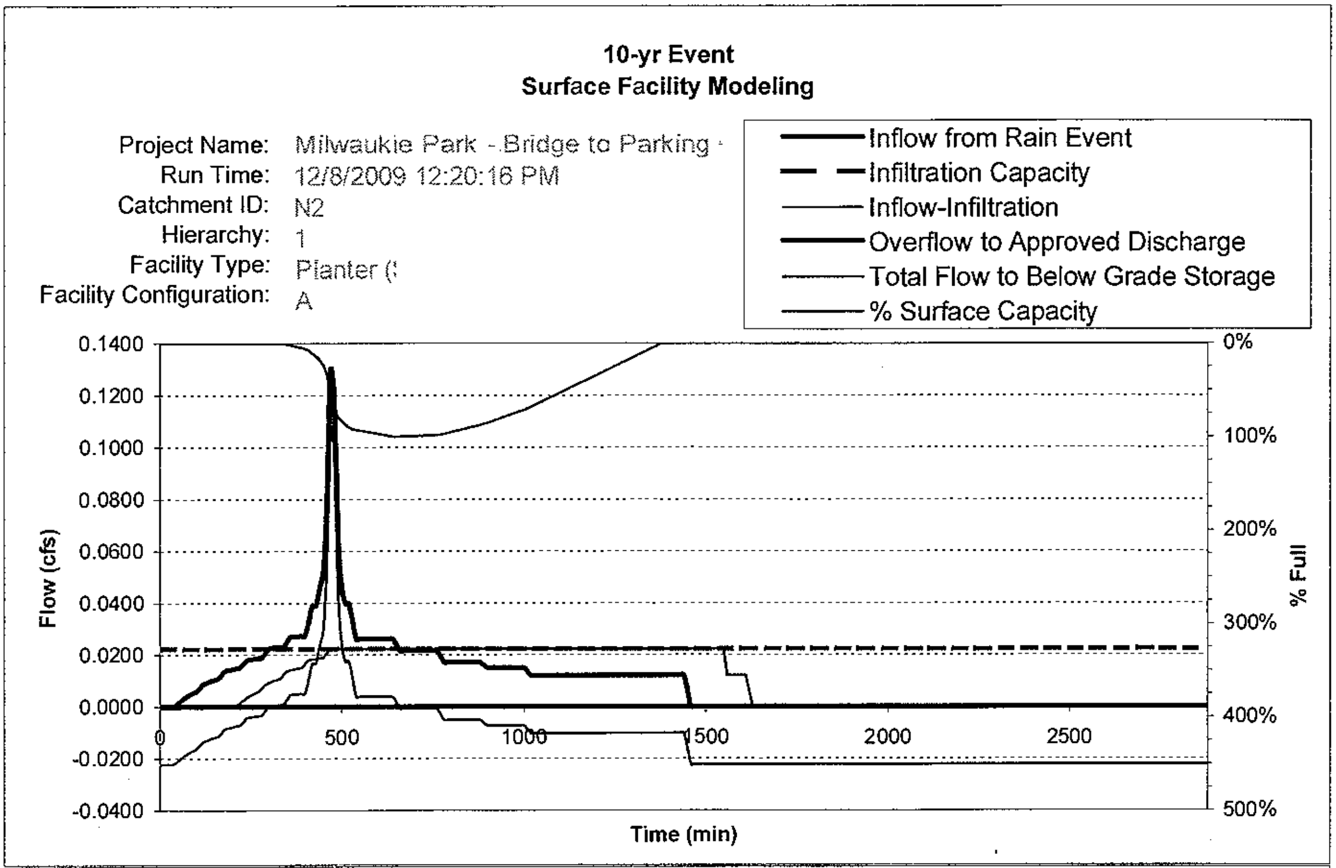


Pollution Reduction Event
Below Grade Modeling

Printed: 12/8/2009 12:21 PM

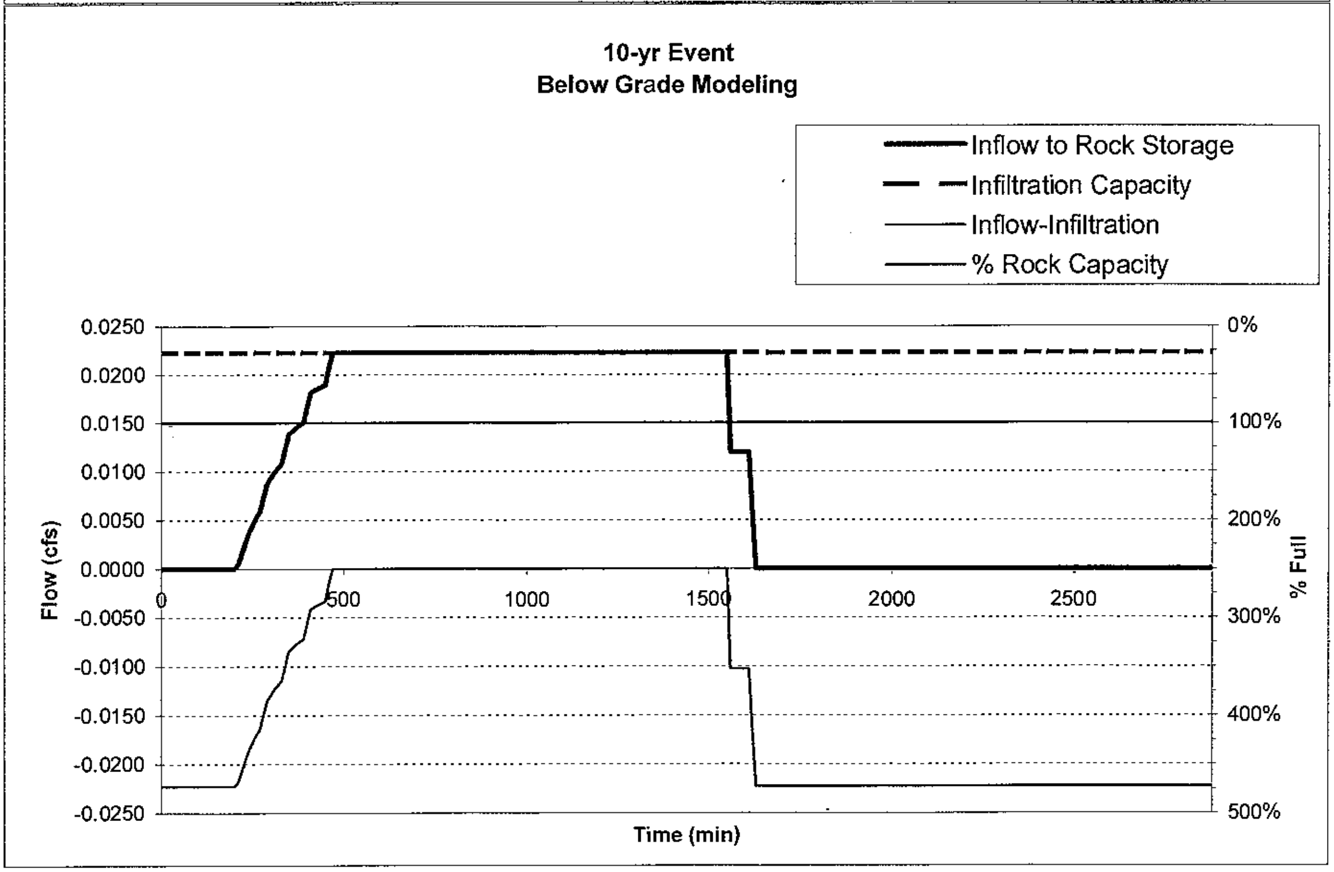
BES - Presumptive Approach Calculator - Ver 1.1

10-yr Con-A&B



10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - Bridge to Parking
Run Time: 12/8/2009 12:20:16 PM
Catchment ID: N2
Hierarchy: 1
Facility Type: Planter (
Facility Configuration: A



10-yr Event
Below Grade Modeling

Printed: 12/8/2009 12:21 PM

Presumptive Approach Calculator Ver 1.1

Instructions:

1. Refer to facility graphics and fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

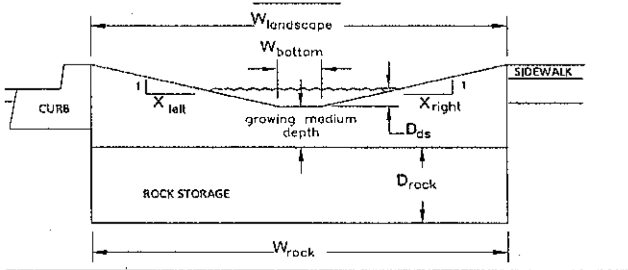
Run Time: 12/8/2009 12:20:16 PM

Project Name: **Milwaukie Park - Bridge to Parking Catch**

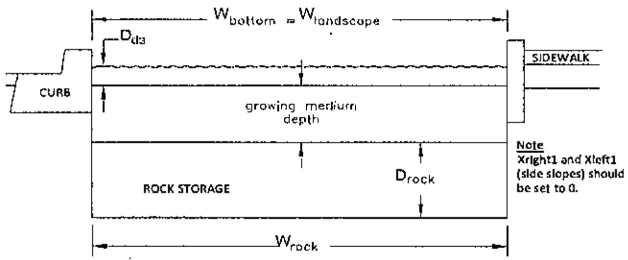
Date: **3/15/2009**

Catchment ID: **N2**

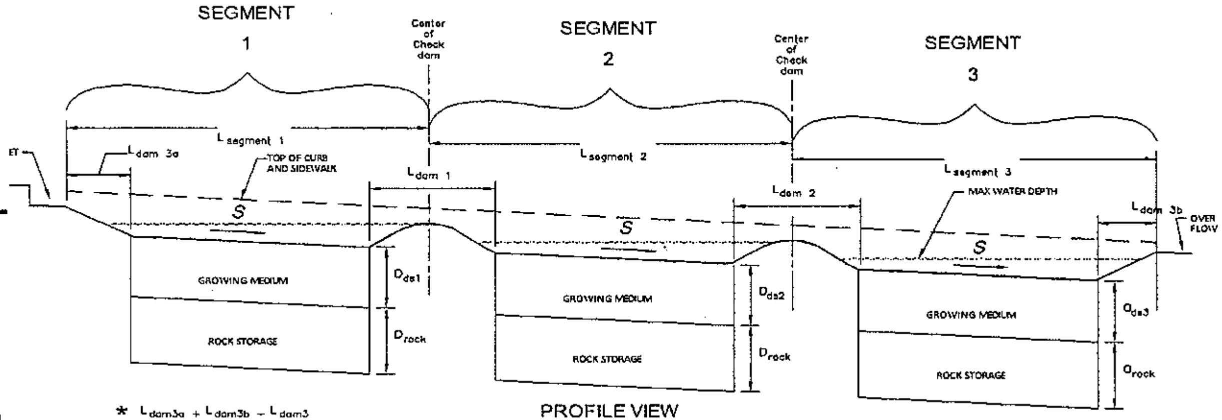
SWALE



SLOPED PLANTER



Note
Xright1 and Xleft1 (side slopes) should be set to 0.



$* \; L_{dam3a} + L_{dam3b} = L_{dam3}$

PROFILE VIEW

Data Entry

	Parameters									Rock Storage Parameters		
Variable Description	Facility Segment	Length of facility segment	Downstream Check Dam Length	Longitudinal Facility Slope	Bottom Width	Side Slope Right	Side Slope Left	Downstream Depth	Landscape Width	Rock Storage Width	Rock Storage Depth	Rock Void Ratio
Unit		(ft)	(ft)	(ft/ft)	(ft)			(inches)	(ft)	(ft)	(inches)	
Variable Symbol		$L_{segment}$	L_{dam}	S	W_{bottom}	X_{right}:1	X_{left}:1	D_{ds}	$W_{landscape}$	W_{rock}	D_{rock}	v
	1	32	3	0.015	4.75	0	3	9	7			
	2	14	5	0.015	4.75	0	3	9	7			
	3	14	5	0.015	4.75	0	3	9	7			
	4	14	5	0.015	4.75	0	3	9	7			
	5	14	5	0.015	4.75	0	3	9	7			
	6	14	5	0.015	4.75	0	3	9	7			
	7	7	5	0.015	4.75	0	3	9	7			
	8											
	9											
	10											

Error Messages

Worksheet Calculations

Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: N3
Date: 03/15/09
Permit Number: 0
Run Time: 5/14/2009 12:37:10 PM

Project Name: Milwaukie Park - Upper No. Parking Ca
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	N3	
	Catchment Area	
Impervious Area	3,429	SF
Impervious Area	0.08	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	2	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

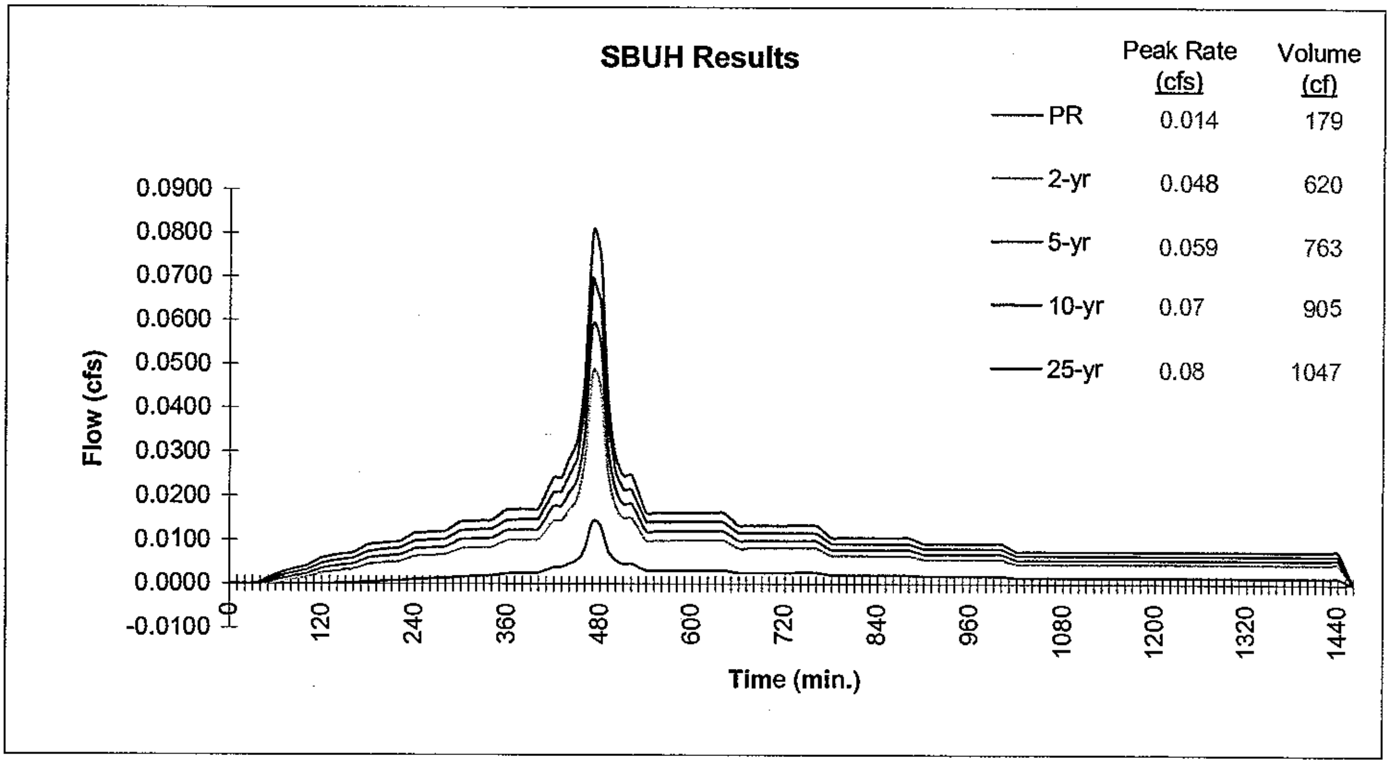
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2	

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	1.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.014	179
2-yr	0.048	620
5-yr	0.059	763
10-yr	0.07	905
25-yr	0.08	1047

Printed: 5/14/2009 12:58 PM

Presumptive Approach Calculator ver. 1.1

Catchment ID: N3

Run Time: 5/14/2009 12:37:10 PM

Project Name: Milwaukie Park - Upper No. Parking Catch **Catchment ID:** N3 **Date:** 3/15/2009

Instructions:

1. Identity which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

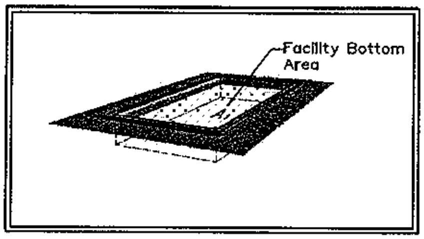
Goal Summary:

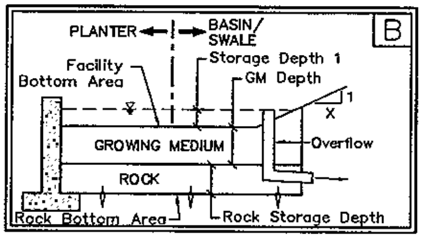
Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Planter (Flat)

Facility Shape: Rectangle/Square

Facility Configuration: B





Calculation Guide
Max. Rock Stor. Bottom Area 522 SF

DATA FOR ABOVE GRADE STORAGE COMPONENT

Facility Bottom Area = 522 sf
Bottom Width = 3.0 ft
Facility Side Slope = 0 to 1
Storage Depth 1 = 3 in <Warning
Growing Medium Depth = 18 in
Freeboard Depth = N/A in

Surface Capacity at Depth 1 = 131 cf
GM Design Infiltration Rate = 2.00 in/hr
Infiltration Capacity = 0.024 cfs

BELOW GRADE STORAGE

Rock Storage Bottom Area = 522 sf
Rock Storage Depth = 12 in
Rock Void Ratio = 0.3

Rock Storage Capacity = 157 cf
Native Design Infiltration Rate = 1.00 in/hr
Infiltration Capacity = 0.012 cfs

RESULTS		Overflow Volume			
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used	Run PAC
			1%	Rock Cap. Used	
10-yr	PASS	0 CF	55%	Surf. Cap. Used	
			100%	Rock Cap. Used	

FACILITY FACTS

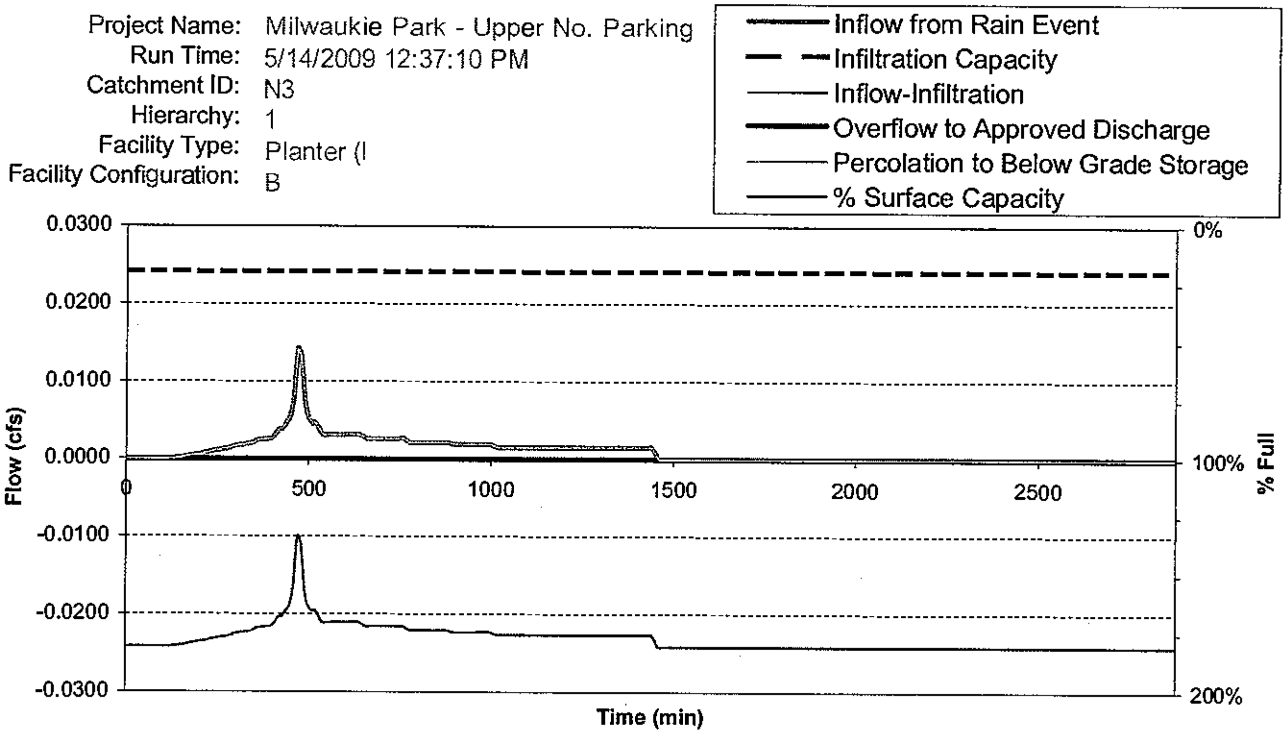
Total Facility Area Including Freeboard = 522 SF
Sizing Ratio (Total Facility Area / Catchment Area) = 0.152

BES - Presumptive Approach Calculator - Ver 1.1

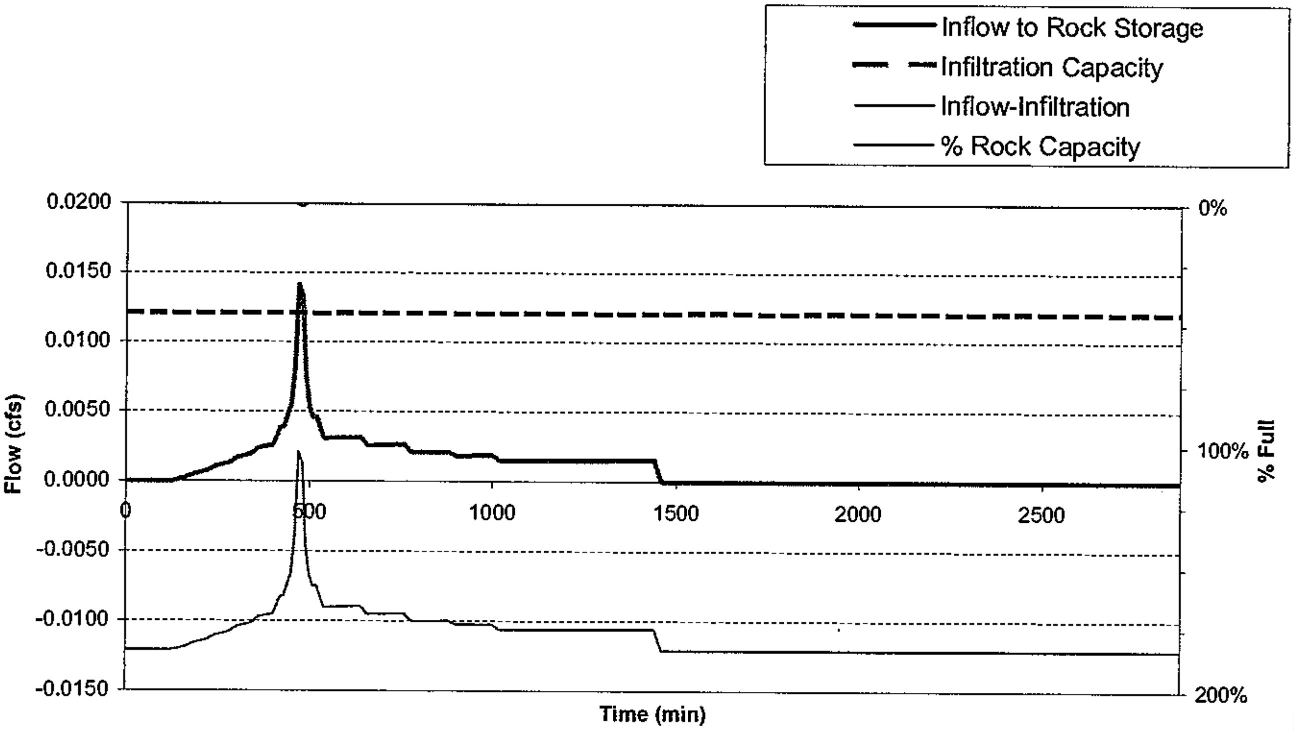
PR Con-A&B

Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - Upper No. Parking
Run Time: 5/14/2009 12:37:10 PM
Catchment ID: N3
Hierarchy: 1
Facility Type: Planter (I
Facility Configuration: B



Pollution Reduction Event
Below Grade Modeling



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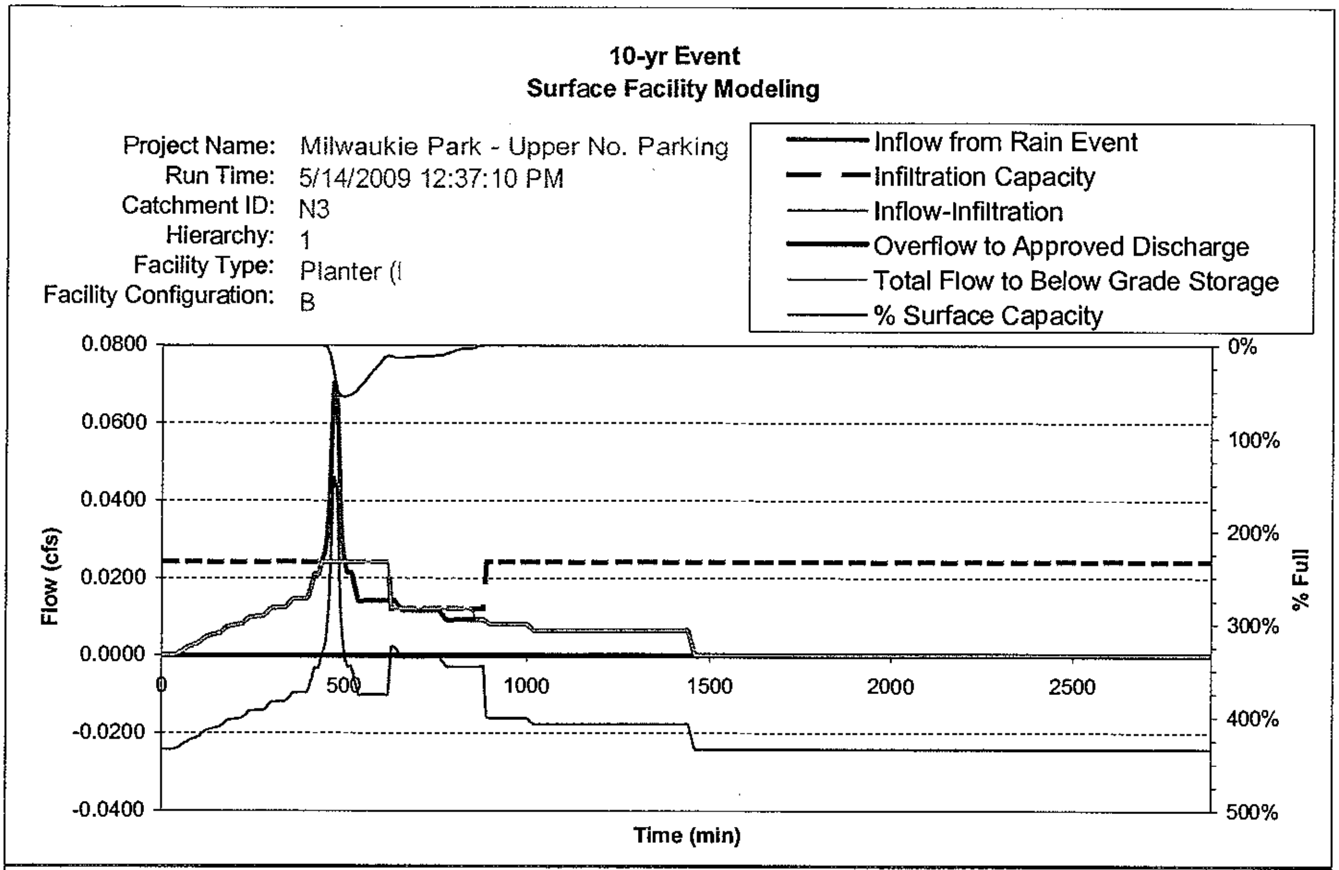
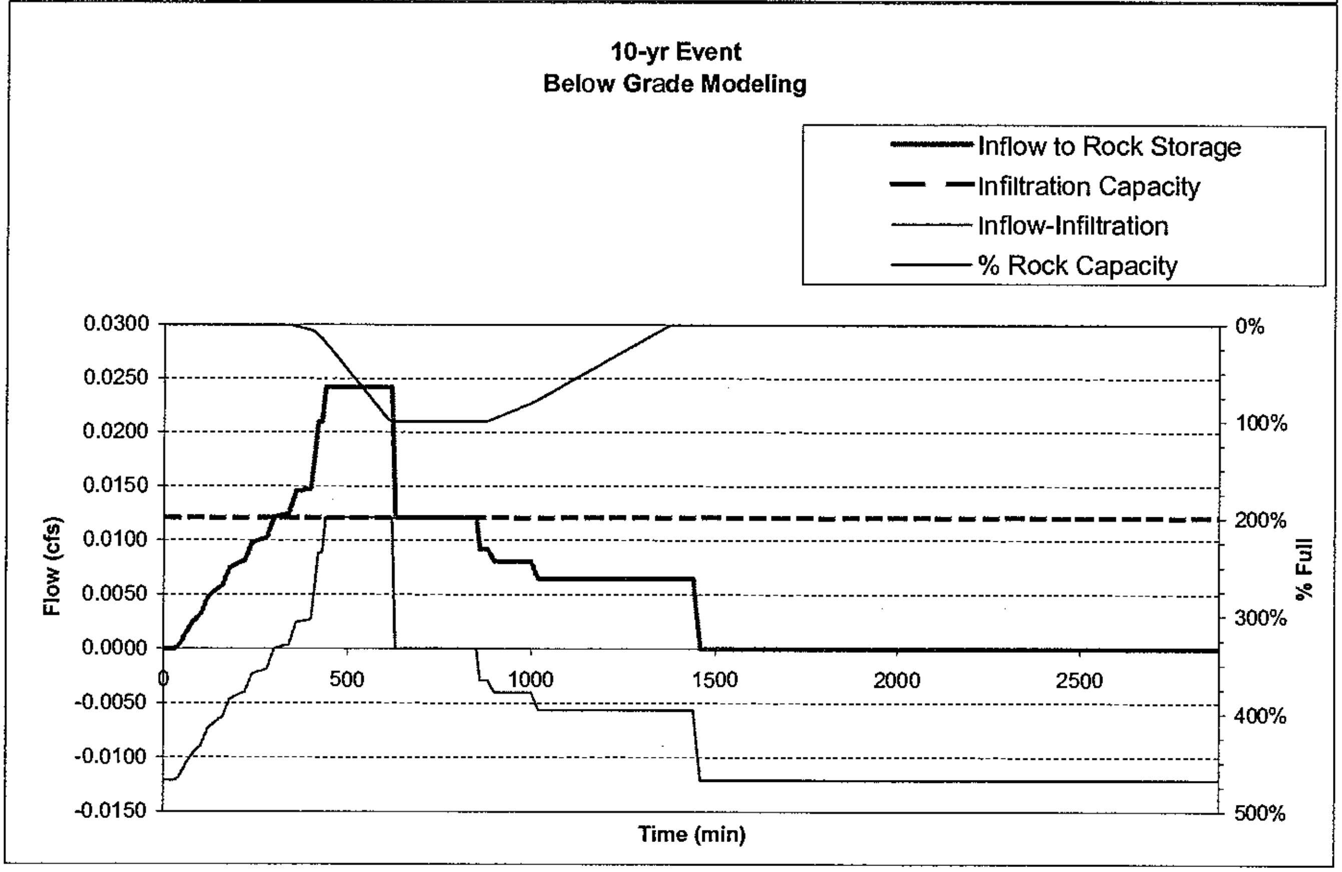
BES - Presumptive Approach Calculator - Ver 1.1

10-yr Con-A&B



Project Name: Milwaukie Park - Upper No. Parking
Run Time: 5/14/2009 12:37:10 PM
Catchment ID: N3
Hierarchy: 1
Facility Type: Planter (
Facility Configuration: B



Printed: 5/14/2009 12:58 PM

Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: P1
Date: 12/10/09
Permit Number: 0
Run Time: 12/10/2009 3:05:27 PM

Project Name: Milwaukie Park - Plaza 1
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	P1	
	Catchment Area	
Impervious Area	10,660	SF
Impervious Area	0.24	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	4	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

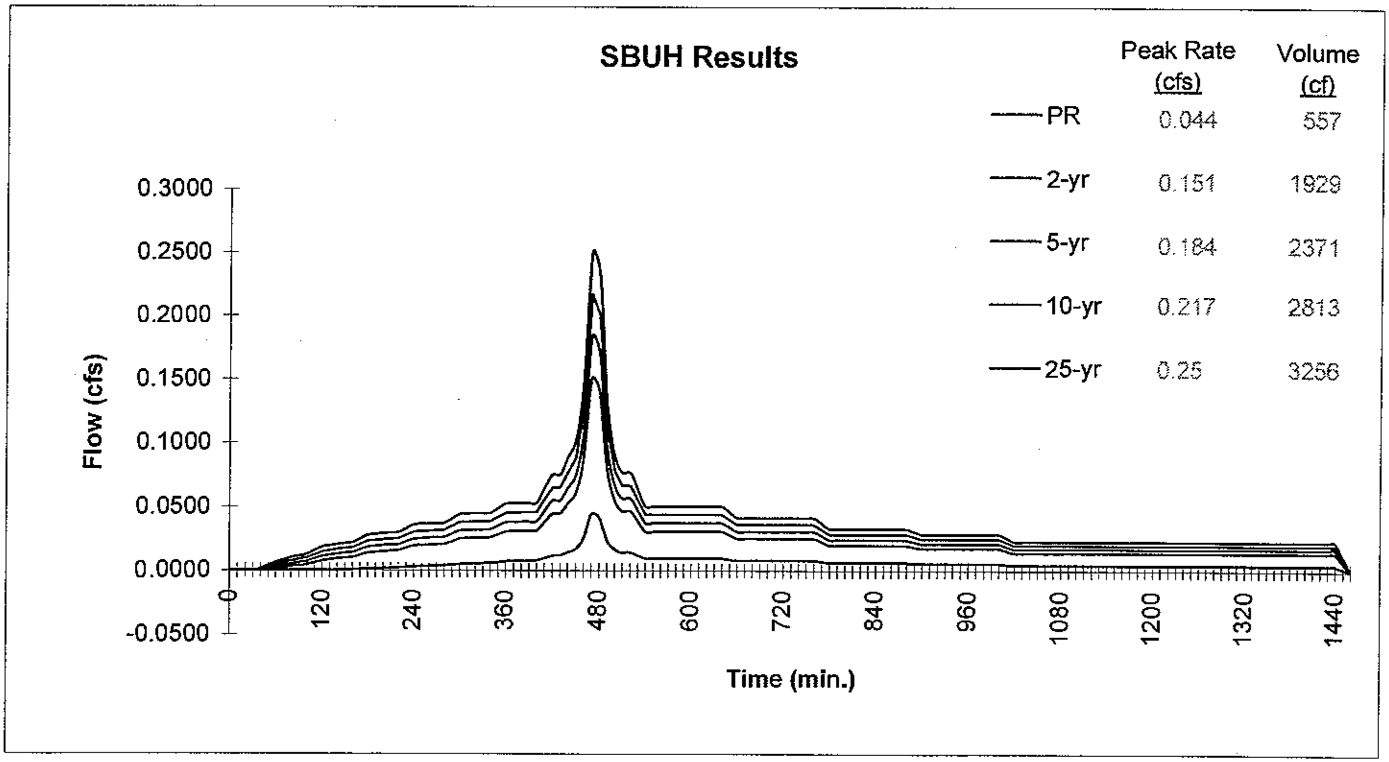
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	2.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.044	557
2-yr	0.151	1929
5-yr	0.184	2371
10-yr	0.217	2813
25-yr	0.25	3256

Printed: 12/10/2009 3:15 PM

Presumptive Approach Calculator ver. 1.1

Catchment ID: P1

Run Time: 12/10/2009 3:05:27 PM

Project Name: Milwaukie Park - Plaza 1 **Catchment ID:** P1 **Date:** 12/10/2009

Instructions:

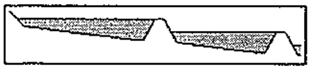
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

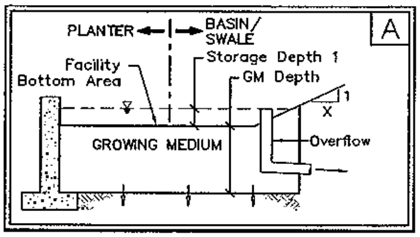
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display...		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Swale



Facility Configuration: A



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide
Max. Rock Stor. Bottom Area Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 788 **sf**
Surface Capacity Volume = 536.4 **cf**

Growing Medium Depth = 18 **in**
Freeboard Depth = N/A **in**

Surface Capacity at Depth 1 = 536 **cf**
GM Design Infiltration Rate = 2.00 **in/hr**
Infiltration Capacity = 0.036 **cfs**

BELOW GRADE STORAGE

Rock Storage Bottom Area = 788 **sf**
Rock Storage Depth = 0 **in**

Rock Storage Capacity = 0 **cf**
Native Design Infiltration Rate = 2.00 **in/hr**
Infiltration Capacity = 0.036 **cfs**

GM Infiltration Rate Used in PAC

RESULTS		Overflow Volume		
Pollution Reduction	PASS	0 CF	1%	Surf. Cap. Used
10-yr	FAIL	33 CF	100%	Surf. Cap. Used

Run PAC

Warning - Data Modified, Re-run Calculator.

FACILITY FACTS

Total Facility Area Including Freeboard = **1,508 SF**
Sizing Ratio (Total Facility Area / Catchment Area) = **0.141**

Current data has been exported:

Plaza1_Export.xls 12/10/2009 3:15:51 PM

Presumptive Approach Calculator Ver 1.1

Instructions:

1. Refer to facility graphics and fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

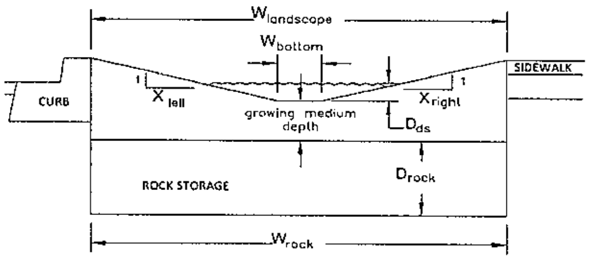
Run Time: 12/10/2009 3:05:27 PM

Project Name: Milwaukie Park - Plaza 1

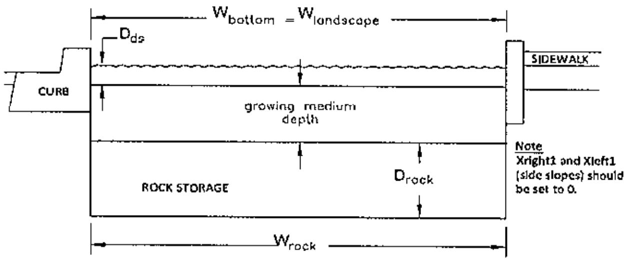
Date: 12/10/2009

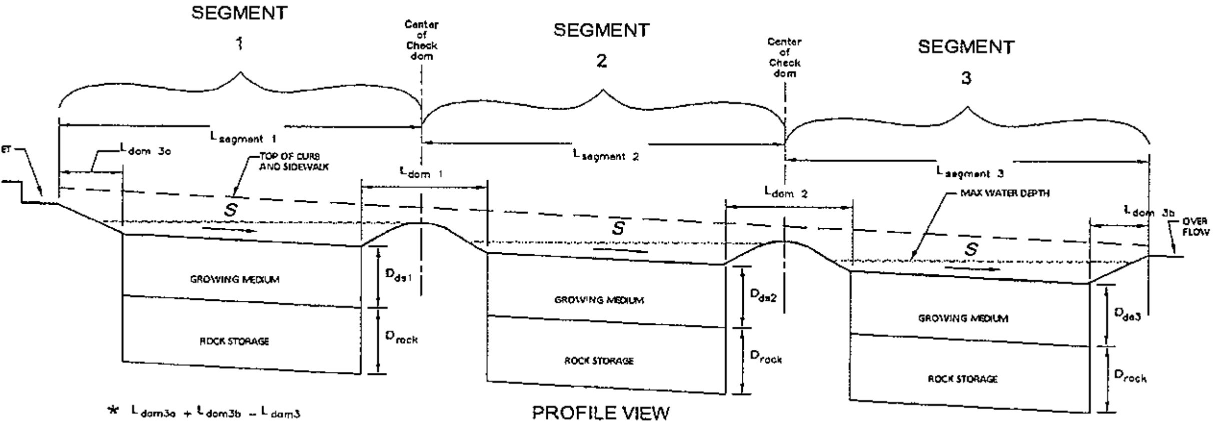
Catchment ID: P1

SWALE



SLOPED PLANTER





PROFILE VIEW

Data Entry

	Parameters									Rock Storage Parameters		
Variable Description	Facility Segment	Length of facility segment	Downstream Check Dam Length	Longitudinal Facility Slope	Bottom Width	Side Slope Right	Side Slope Left	Downstream Depth	Landscape Width	Rock Storage Width	Rock Storage Depth	Rock Void Ratio
Unit		(ft)	(ft)	(ft/ft)	(ft)			(inches)	(ft)	(ft)	(inches)	
Variable Symbol		$L_{segment}$	L_{dam}	S	W_{bottom}	X_{right}:1	X_{left}:1	D_{ds}	$W_{landscape}$	W_{rock}	D_{rock}	v
	1	25	5	0.04	9	2	2	12	14			
	2	25	5	0.04	9	2	2	12	14			
	3	25	5	0.04	9	2	2	12	14			
	4	25	5	0.04	9	2	2	12	14			
	5											
	6											
	7											
	8											
	9											
	10											

Error Messages

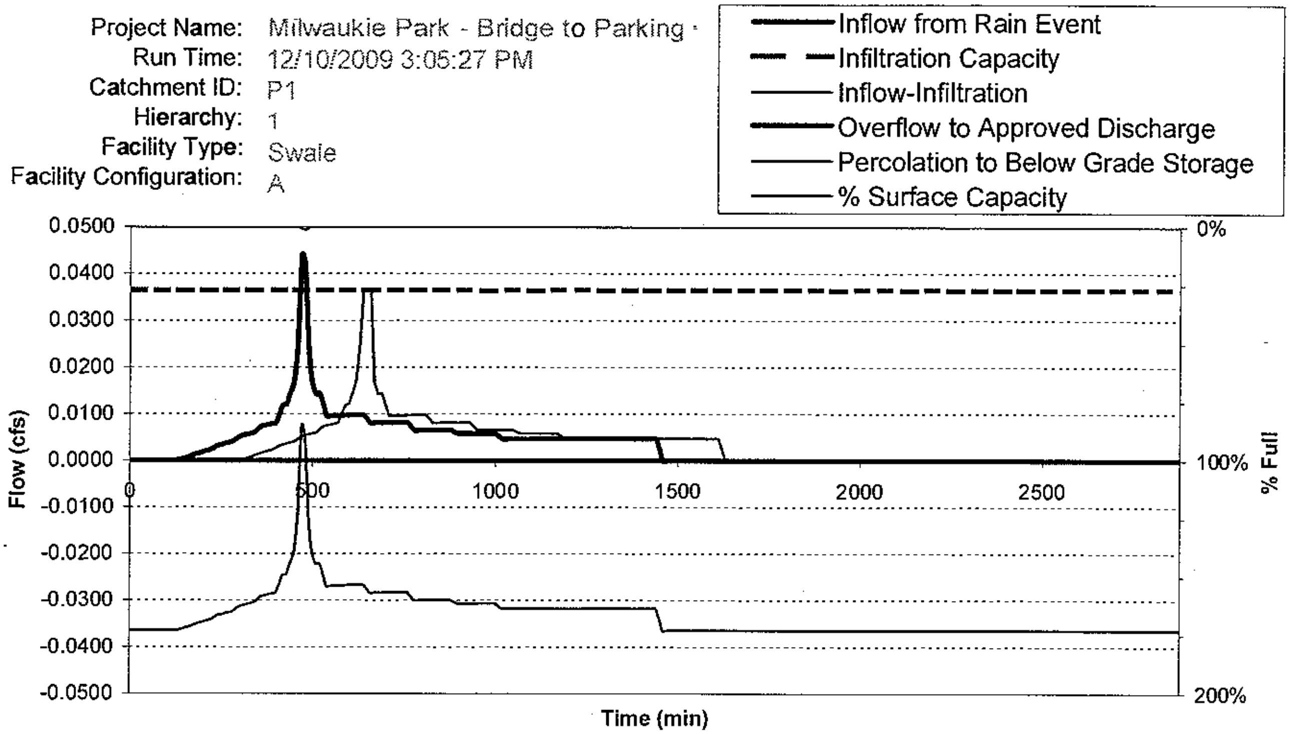
Worksheet Calculations

BES - Presumptive Approach Calculator - Ver 1.1

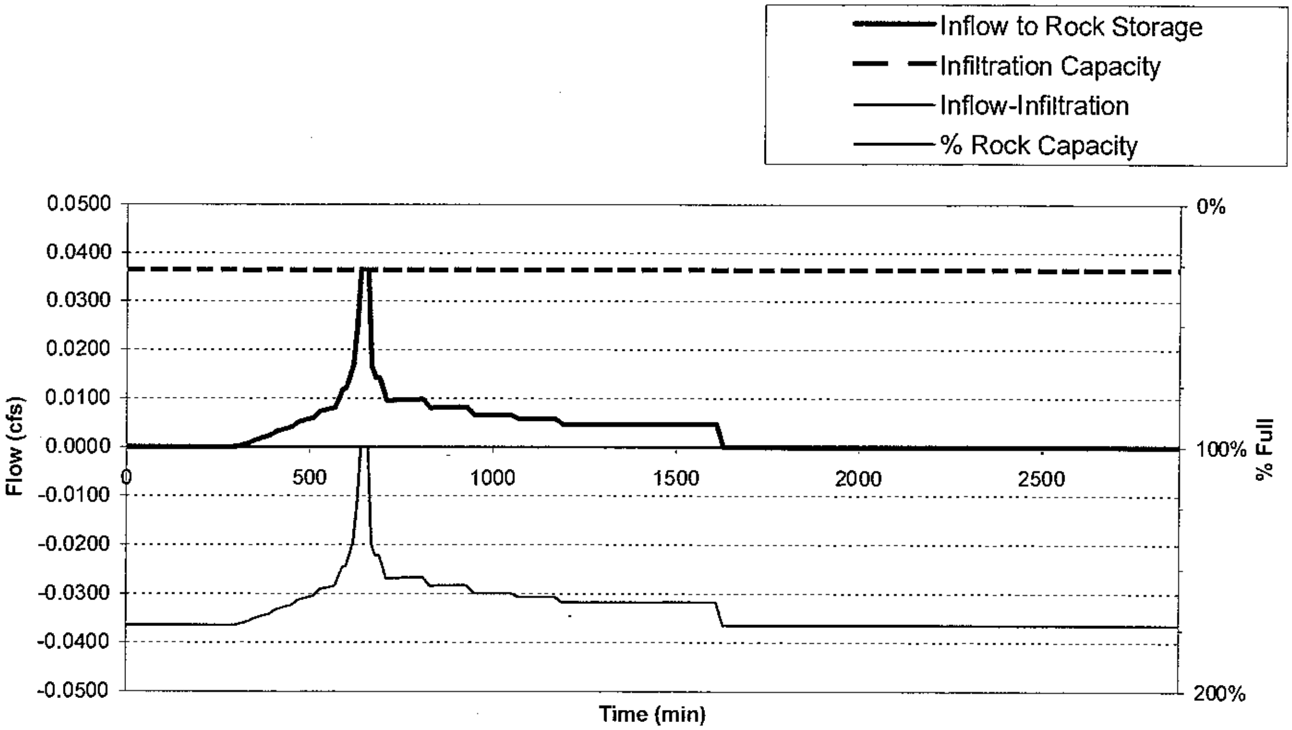
PR Con-A&B

Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - Bridge to Parking
Run Time: 12/10/2009 3:05:27 PM
Catchment ID: P1
Hierarchy: 1
Facility Type: Swale
Facility Configuration: A

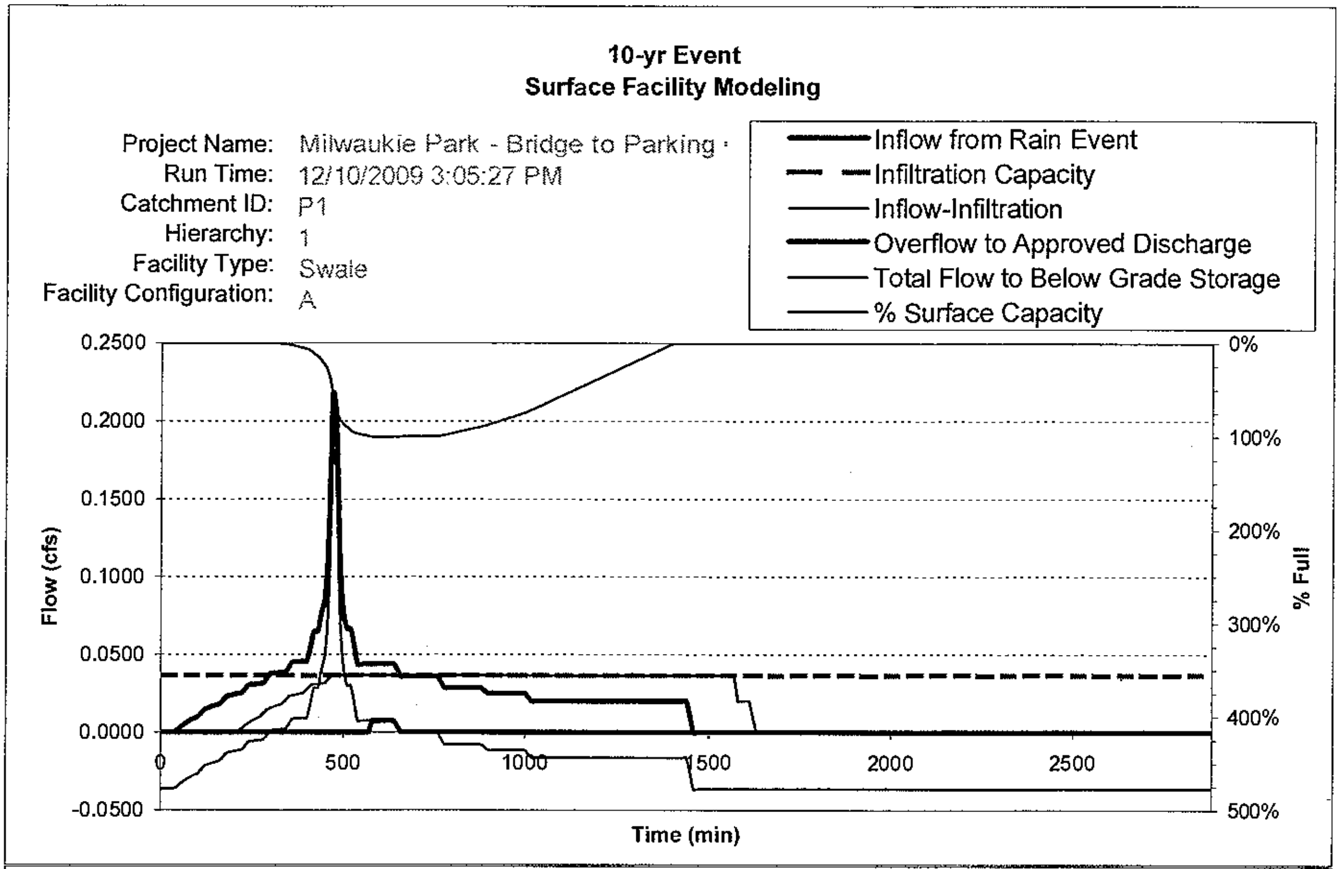


Pollution Reduction Event
Below Grade Modeling



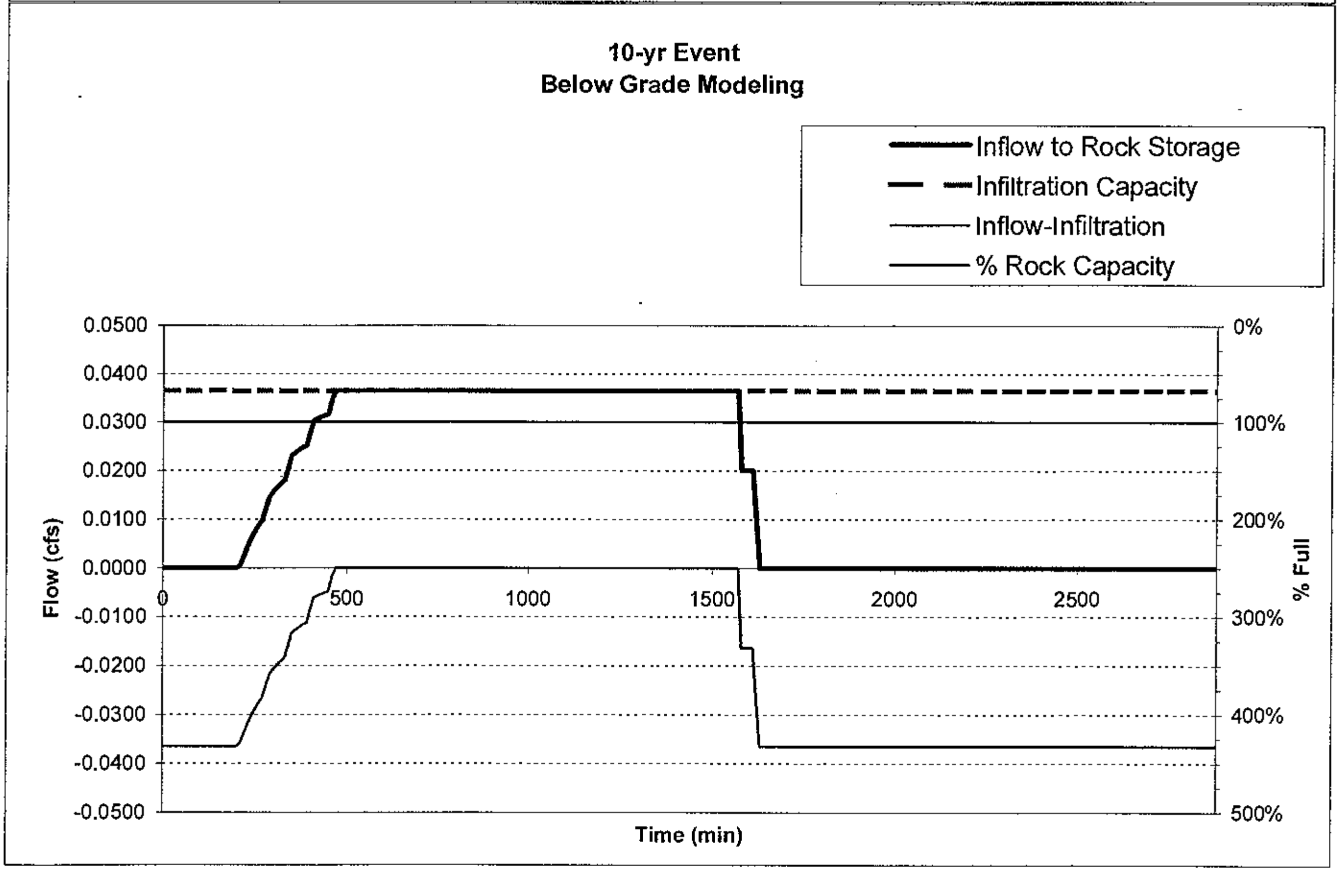
Printed: 12/10/2009 3:15 PM

BES - Presumptive Approach Calculator - Ver 1.1



10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - Bridge to Parking
Run Time: 12/10/2009 3:05:27 PM
Catchment ID: P1
Hierarchy: 1
Facility Type: Swale
Facility Configuration: A



10-yr Event
Below Grade Modeling

Printed: 12/10/2009 3:16 PM

Presumptive Approach Calculator ver. 1.1

Catchment Data

Catchment ID: P2
Date: 12/10/09
Permit Number: 0
Run Time: 12/10/2009 3:21:47 PM

Project Name: Milwaukie Park - Plaza 2
Project Address: -
Milwaukie, OR
Designer: SDH
Company: David Evans and Associates, Inc.

Drainage Catchment Information

Catchment ID	P2	
	Catchment Area	
Impervious Area	2,145	SF
Impervious Area	0.05	ac
Impervious Area Curve Number, CN_{imp}	98	
Time of Concentration, Tc, minutes	5	min.

Site Soils & Infiltration Testing Data

Infiltration Testing Procedure:	Open Pit Falling Head	
Native Soil Field Tested Infiltration Rate (I_{test}):	4	in/hr
Bottom of Facility Meets Required Separation From High Groundwater Per BES SWMM Section 1.4:	Yes	

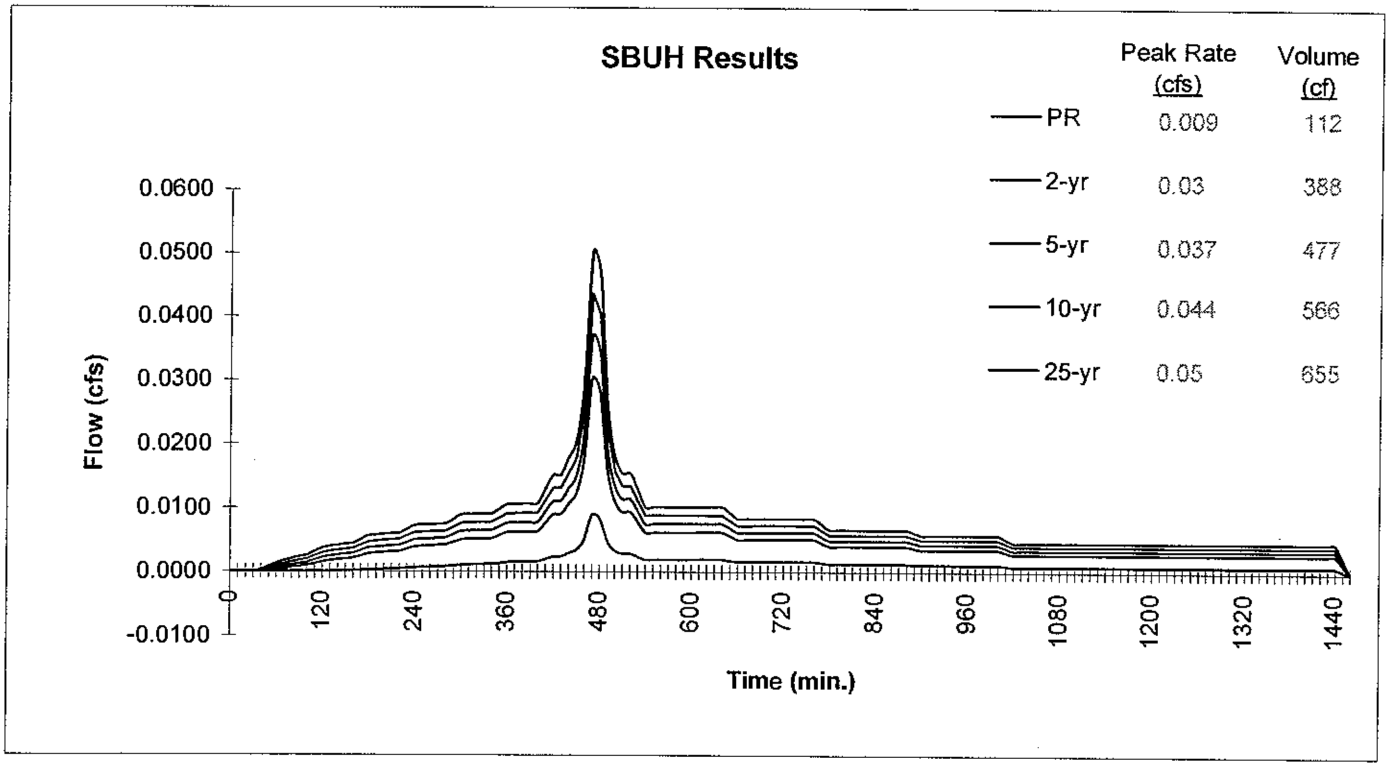
Correction Factor Component

CF_{test} (ranges from 1 to 3)	2

Design Infiltration Rates

I_{dsgn} for Native (I_{test} / CF_{test}):	2.00	in/hr
I_{dsgn} for Imported Growing Medium:	2.00	in/hr

Execute SBUH Calculations



	Peak Rate (cfs)	Volume (cf)
PR	0.009	112
2-yr	0.03	388
5-yr	0.037	477
10-yr	0.044	566
25-yr	0.05	655

Printed: 12/10/2009 3:29 PM

Presumptive Approach Calculator ver. 1.1

Catchment ID: P2

Run Time: 12/10/2009 3:21:47 PM

Project Name: Milwaukie Park - Plaza 2 **Catchment ID:** P2 **Date:** 12/10/2009

Instructions:

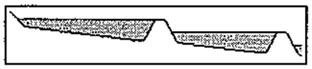
1. Identify which Stormwater Hierarchy Category the facility.
2. Select Facility Type.
3. Identify facility shape of surface facility to more accurately estimate surface volume, except for Swales and sloped planters that use the PAC Sloped Facility Worksheet to enter data.
4. Select type of facility configuration.
5. Complete data entry for all highlighted cells.

Catchment facility will meet Hierarchy Category: 1

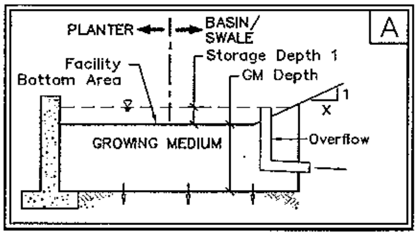
Goal Summary:

Hierarchy Category	SWMM Requirement	RESULTS box below needs to display…		Facility configurations allowed
		Pollution Reduction as a	10-yr (aka disposal) as a	
1	On-site infiltration with a surface infiltration facility.	PASS	PASS	A or B

Facility Type = Swale



Facility Configuration: A



Refer to Sloped Facility Worksheet and enter Variable Parameters

Calculation Guide
Max. Rock Stor. Bottom Area Per Swale Dims

DATA FOR ABOVE GRADE STORAGE COMPONENT

Infiltration Area = 407 **sf**
Surface Capacity Volume = 278.2 **cf**

Growing Medium Depth = 18 **in**
Freeboard Depth = N/A **in**

Surface Capacity at Depth 1 = 278 **cf**
GM Design Infiltration Rate = 2.00 **in/hr**
Infiltration Capacity = 0.019 **cfs**

BELOW GRADE STORAGE

Rock Storage Bottom Area = 407 **sf**
Rock Storage Depth = 0 **in**

Rock Storage Capacity = 0 **cf**
Native Design Infiltration Rate = 2.00 **in/hr**
Infiltration Capacity = 0.019 **cfs**

GM Infiltration Rate Used in PAC

RESULTS		Overflow Volume		
Pollution Reduction	PASS	0 CF	0%	Surf. Cap. Used
10-yr	PASS	0 CF	12%	Surf. Cap. Used

Run PAC

FACILITY FACTS

Total Facility Area Including Freeboard = **748 SF**
Sizing Ratio (Total Facility Area / Catchment Area) = **0.349**

Current data has been exported:

Plaza2_Export.xls 12/10/2009 3:29:06 PM

Presumptive Approach Calculator Ver 1.1

Instructions:

1. Refer to facility graphics and fill in all relevant facility parameters in the Data Entry table below. Data entry cells vary based on Facility Configuration selected on Facility Design Data tab.
2. Delete all facility parameters that may have been entered by the previous iteration that are no longer applicable.

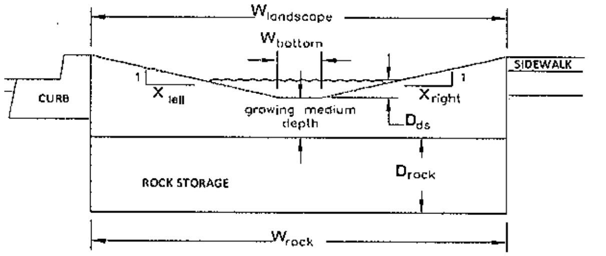
Run Time: 12/10/2009 2:21:47 PM

Project Name: Milwaukie Park - Plaza 2

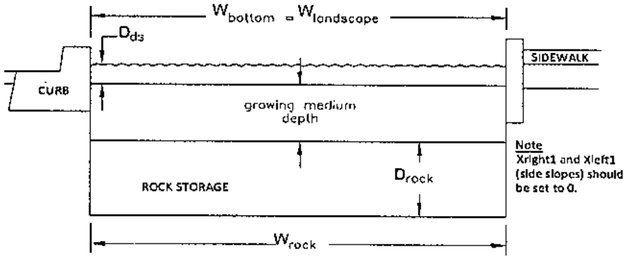
Date: 12/10/2009

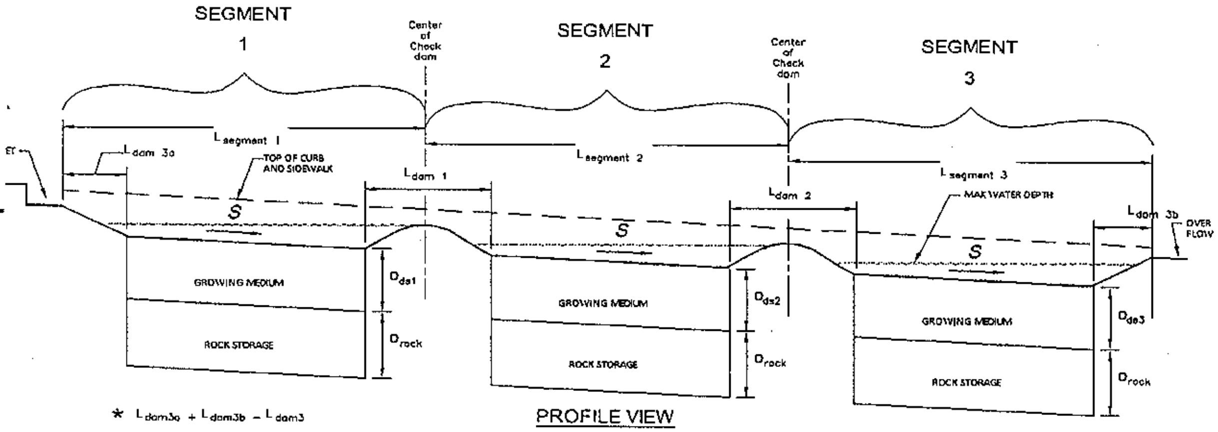
Catchment ID: P2

SWALE



SLOPED PLANTER





PROFILE VIEW

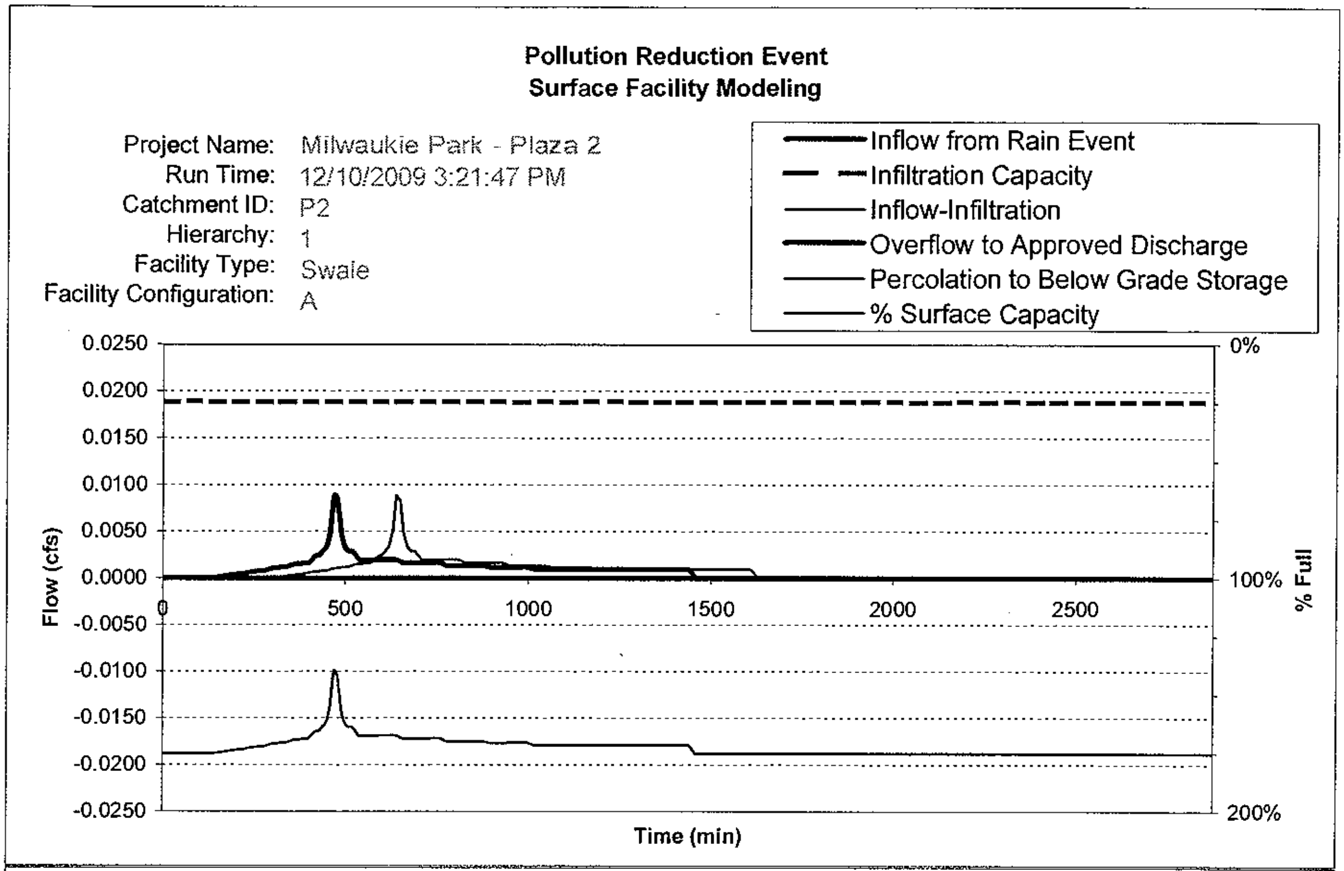
Data Entry

	Parameters									Rock Storage Parameters		
Variable Description	Facility Segment	Length of facility segment	Downstream Check Dam Length	Longitudinal Facility Slope	Bottom Width	Side Slope Right	Side Slope Left	Downstream Depth	Landscape Width	Rock Storage Width	Rock Storage Depth	Rock Void Ratio
Unit		(ft)	(ft)	(ft/ft)	(ft)			(inches)	(ft)	(ft)	(inches)	
Variable Symbol		$L_{segment}$	L_{dam}	S	W_{bottom}	X_{right}:1	X_{left}:1	D_{ds}	$W_{landscape}$	W_{rock}	D_{rock}	V
	1	20	5	0.034	4	2	2	12	8			
	2	20	5	0.034	4	2	2	12	8			
	3	20	5	0.034	4	2	2	12	8			
	4	20	5	0.034	4	2	2	12	8			
	5											
	6											
	7											
	8											
	9											
	10											

Error Messages

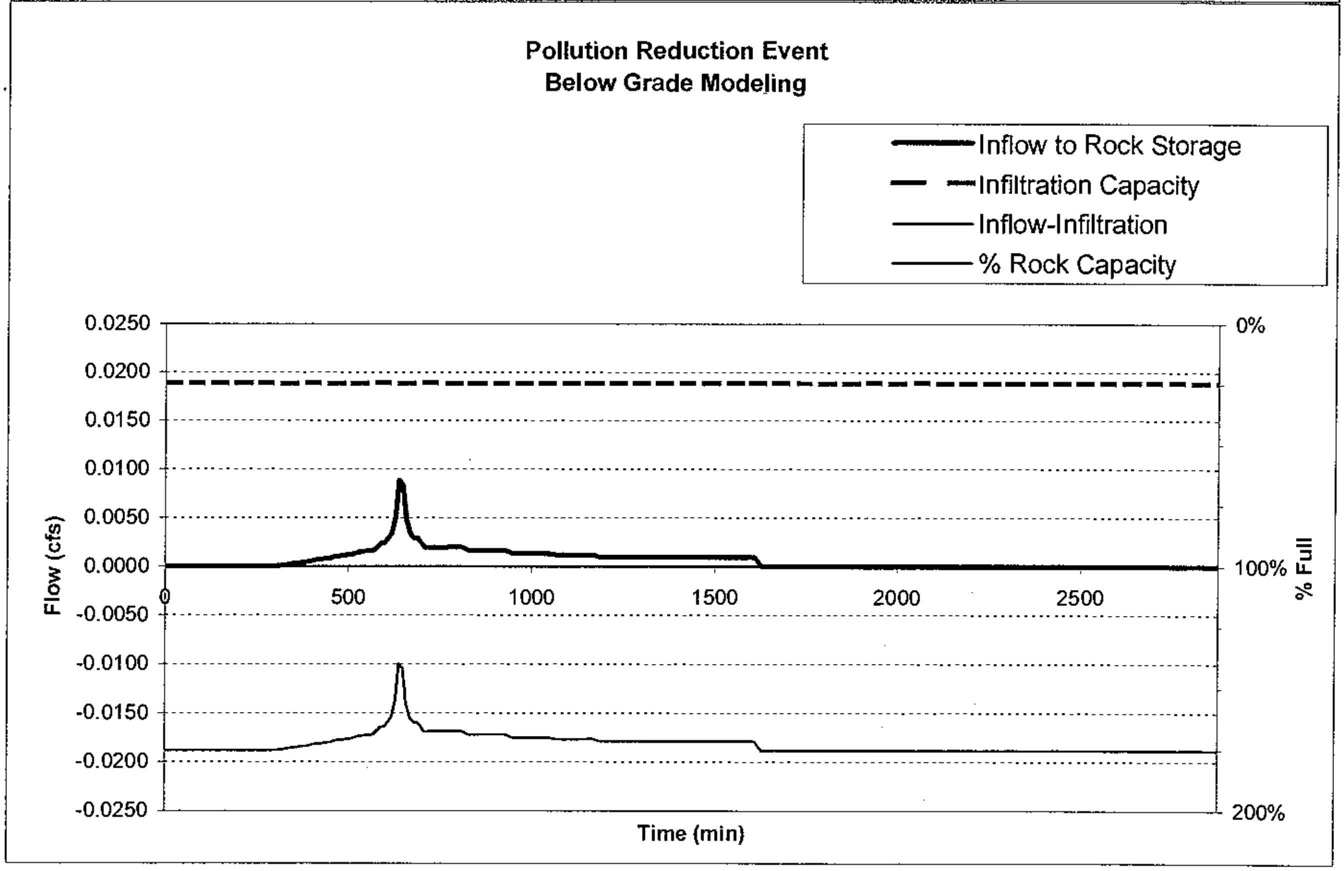
Worksheet Calculations

BES - Presumptive Approach Calculator - Ver 1.1



Pollution Reduction Event
Surface Facility Modeling

Project Name: Milwaukie Park - Plaza 2
Run Time: 12/10/2009 3:21:47 PM
Catchment ID: P2
Hierarchy: 1
Facility Type: Swale
Facility Configuration: A

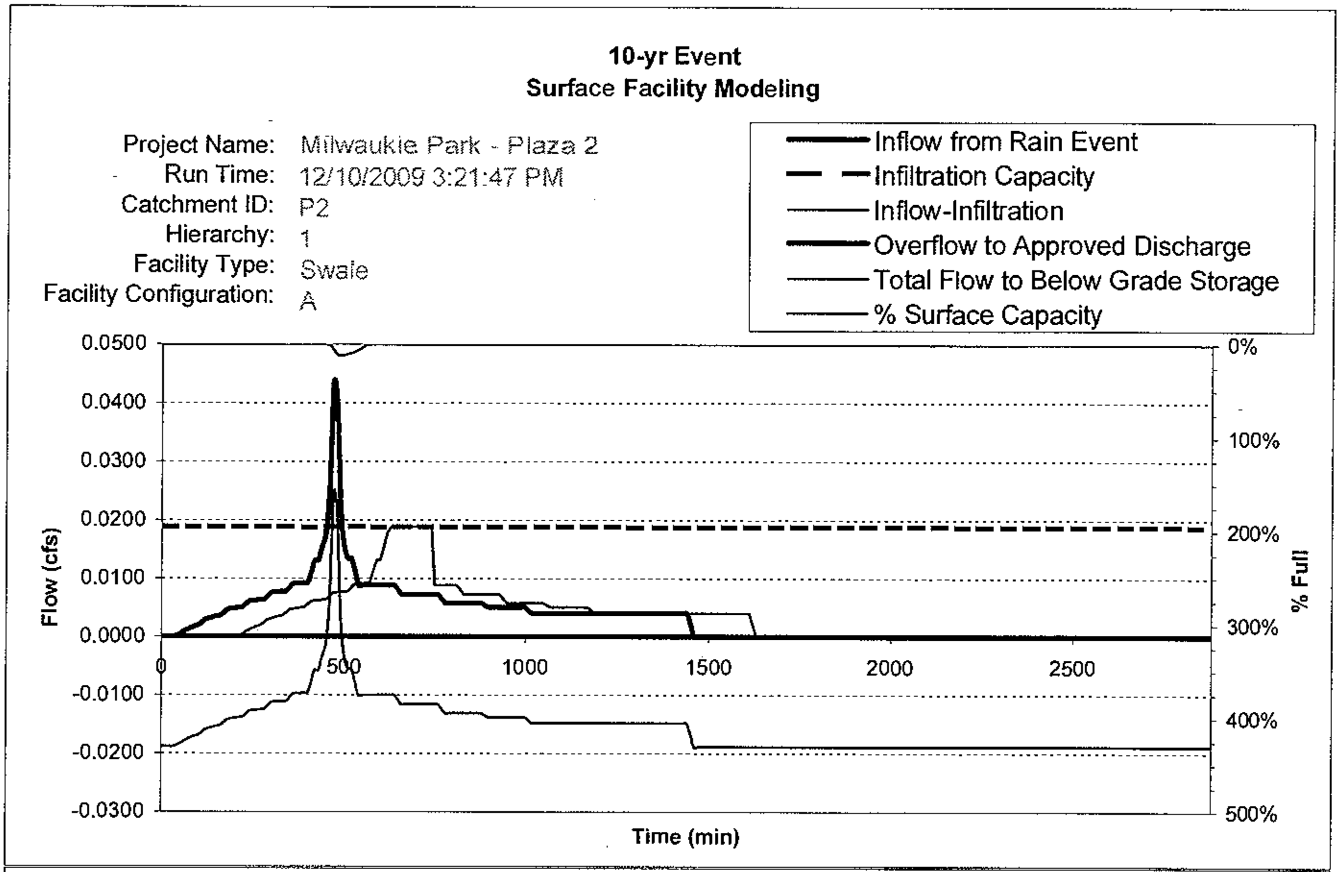


Pollution Reduction Event
Below Grade Modeling

Printed: 12/10/2009 3:29 PM

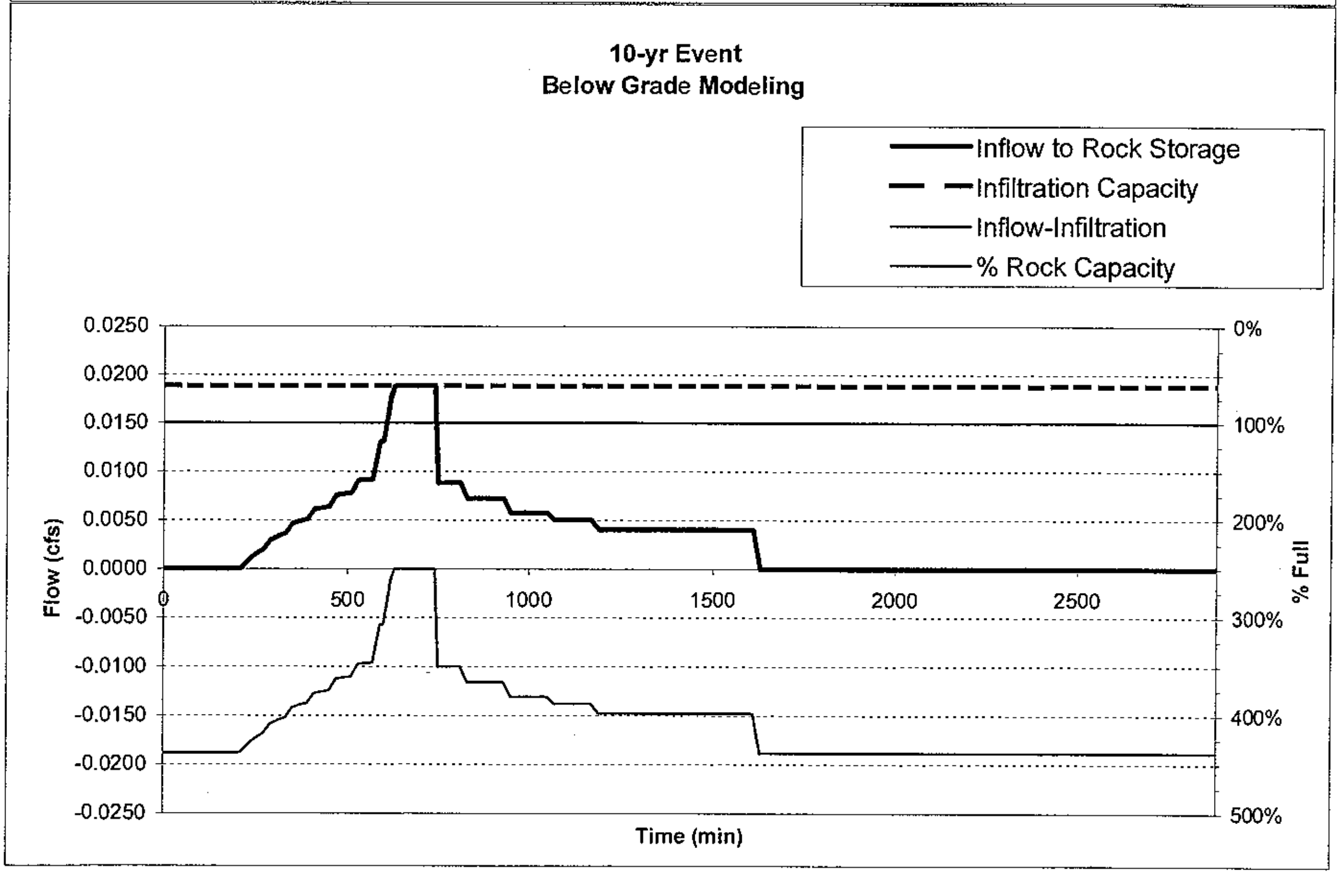
BES - Presumptive Approach Calculator - Ver 1.1

10-yr Con-A&B



10-yr Event
Surface Facility Modeling

Project Name: Milwaukie Park - Plaza 2
Run Time: 12/10/2009 3:21:47 PM
Catchment ID: P2
Hierarchy: 1
Facility Type: Swale
Facility Configuration: A



10-yr Event
Below Grade Modeling

Printed: 12/10/2009 3:29 PM

18328 - Kellogg Creek Bridge Replacement

Existing and Proposed Basin Areas

Basin ID	Drains to	Treated Impervious Area (sq.ft)			Percent Change
		Existing	Proposed	Net Change	
C2	Existing Planter #3	16,320	16,320	0	0%
C3*	Existing Large Pond	10,212	10,212	0	0%
C4	Existing Planter #4	3,328	1,286	-2,042	-61%
South		**29,860**	**27,818**	**-2,042**	**-7%**
N1	Existing Planter #5	11,375	12,209	834	7%
N2	Existing Planter #6	6,372	661	-5,711	-90%
N3	Existing Planter #7	3,429	4,298	869	25%
N4**	Bioretention Basin	-	7,623	7,623	-
North		**21,176**	**24,791**	**3,615**	**17%**

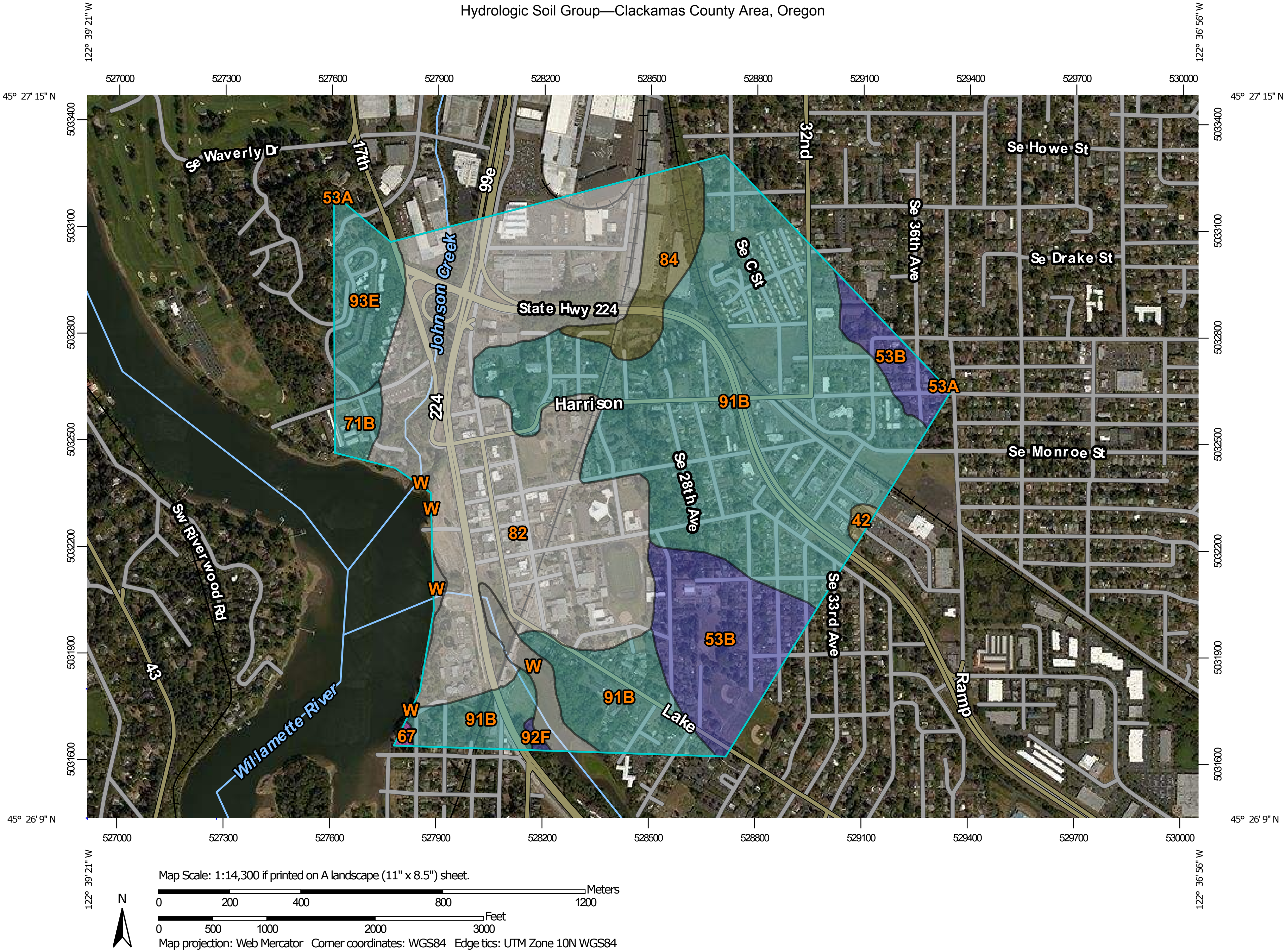
*Composed of C3 and C5 (only C3 in DEA report) - separated for Figures

**Composed of N4 and N5 (4,815 sf and 2,808 sf)

Appendix B

Hydrologic Soil Group and Geotechnical Report

Hydrologic Soil Group—Clackamas County Area, Oregon



Map Scale: 1:14,300 if printed on A landscape (11" x 8.5") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
Area of Interest (AOI)

Soils

Soil Rating Polygons
A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines
A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points
A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features
Streams and Canals

Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background
Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 26, 2014—Sep 5, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
42	Humaquepts, ponded	C/D	1.3	0.3%
53A	Latourell loam, 0 to 3 percent slopes	B	0.1	0.0%
53B	Latourell loam, 3 to 8 percent slopes	B	52.2	10.3%
67	Newberg fine sandy loam	A	0.6	0.1%
71B	Quatama loam, 3 to 8 percent slopes	C	5.5	1.1%
82	Urban land		178.4	35.2%
84	Wapato silty clay loam	C/D	19.5	3.8%
91B	Woodburn silt loam, 3 to 8 percent slopes	C	217.2	42.9%
92F	Xerochrepts and Haploxerolls, very steep	B	0.7	0.1%
93E	Xerochrepts-Rock outcrop complex, moderately steep	C	20.8	4.1%
W	Water		10.0	2.0%
Totals for Area of Interest			**506.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

GEOTECHNICAL ENGINEERING REPORT

Milwaukie Riverfront Park - Phase I
Milwaukie, Oregon
GDI Project: Milwaukie-1

For
Atlas Landscape Architecture

July 24, 2000

Atlas Landscape Architecture
320 SW Sixth Avenue
Portland, OR 97204

Attention: Mr. Gill Williams

Geotechnical Engineering Report
Milwaukie Riverfront Park - Phase I
Milwaukie, Oregon
GDI Project: Milwaukie-1

GeoDesign, Inc. is pleased to submit our report for the Milwaukie Riverfront Park- Phase I in Milwaukie, Oregon. Our services for this project were conducted in accordance with our scope of services dated March 16, 2000, and our subsequent agreement dated June 22, 2000.

We appreciate the opportunity to be of service. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

Don Rondema, PE
Principal

DLR:kt
Attachments
Three copies submitted
Document ID: Milwaukie-1-geor.doc

TABLE OF CONTENTS PAGE NO.

INTRODUCTION

This report presents the results of GeoDesign's geotechnical engineering evaluation of the site of the proposed improvements for Milwaukie Riverfront Park - Phase I in Milwaukie, Oregon. The general location of the site relative to surrounding physical features is shown in Figure 1.

We understand that the improvements for Phase I will include the construction of a path with associated earthwork, landscaping, and other surface features. Subsequent phases will require further cutting and filling, with cuts up to 15.0 feet deep, as well as structures consisting of overlooks, associated paths and stairways, light poles, a pedestrian bridge over Kellogg Creek, and other features.

PURPOSE AND SCOPE

The purpose of our services is to evaluate near surface soil conditions and provide geotechnical recommendations for earthwork, drainage, pavements, and light foundation support, specifically for Phase I of this project. To make the best use of mobilization of drilling equipment, borings were also completed in future phases of the project.

The specific scope of our services includes the following:

START-UP PHASE

- Complete a site reconnaissance to plan explorations.
- Complete four drilled borings to depths of up to 21.5 feet and obtain soil samples at 2.5- to 5.0-foot intervals.
- Obtain representative soil samples from the explorations.
- Complete classification and moisture content testing of obtained samples.

DESIGN DEVELOPMENT

- Provide recommendations for site preparation, grading and drainage, stripping depths, fill type for imported materials, compaction criteria, trench excavation and backfill, use of on-site soils, and dry and wet weather earthwork.
- Recommend pavement thicknesses based on observed soil conditions and stated traffic loads.
- Provide recommendations for soil drainage subdrains including subdrain configuration and material types.
- Provide recommendations for foundation support of light poles and other light structures, including allowable bearing pressures for footings and piers, passive and sliding resistance to lateral loads, and estimated settlements/deflections.
- Provide a written report summarizing the results of our geotechnical evaluation.
- Review project specifications directly related to the preceding scope.

SITE CONDITIONS

SURFACE CONDITIONS

Johnson Creek forms the northern boundary of the proposed Phase I improvement area, and Kellogg Creek lies to the south. The central portion of the site is bisected north-south by the Jefferson Street Boat ramp, which is paved with asphalt concrete along with the associated parking areas to the south. North of Jefferson Street and adjacent to McLoughlin Boulevard lie a number of one- and two-story masonry and wood frame structures, some of which are to be demolished. Areas not covered with asphalt concrete or structures above elevation 10 are generally covered with grasses and landscape materials or separate areas of cottonwood trees. Areas below elevation 10 are generally exposed riverbank soil and rock, with scattered large boulders. Exposed riverbank soil along the Willamette River included silt with some fine sand. Weathered basalt bedrock was observed along the northern bank of Kellogg Creek near the fish ladder. Hard basalt was observed below the streambank vegetation on either side of Johnson Creek.

The site surface generally slopes down from McLoughlin Boulevard to the Willamette River, with an elevation change of about 40 feet on an overall slope averaging 3H:1V (horizontal to vertical). Slope inclinations are greater than 3/4H:1V along most of the south bank of Johnson Creek, and short steep slopes (likely corresponding to high water) are present below about elevation 20 north of Kellogg Creek. Slope cuts, benches for parking, and evidence of filling is present in the paved areas of the boat ramp parking, as well as along the old railroad alignment that is currently a paved bike path paralleling McLoughlin Boulevard.

SUBSURFACE CONDITIONS

We explored subsurface conditions by drilling four borings to depths of 16.5 to 21.5 feet. Detailed boring logs are included in Appendix A. Each of the borings encountered fill, and in landscape and vegetated areas 4 to 6 inches of rooty topsoil. Boring B-1 to the north in Phase I encountered about 4.5 feet of stiff silt fill, while Borings B-2 and B-3 encountered generally medium stiff silt fill and loose sand fill to the 21.5-foot depths explored. In addition, Boring B-2 encountered gravel fill in the top 4 feet (this fill may represent old railroad bed/ballast materials) and a 1-inch thick layer of wood chips at a depth of 20.4 feet. Boring B-4 encountered sand and silt fill to depths of about 9 feet. The fill materials were generally inorganic, although at some depths included trace organics. Cobbles, boulders, and concrete fragments were also encountered in the borings at different depths within the fill.

Native silt and sand soils were encountered beneath the fill in Borings B-1 and B-4. Blowcounts in the native soils ranged from 3 to 13, and moisture contents were less than 20 percent in the cleaner sands and between 30 and 40 percent in the silts and silty sand.

CONCLUSIONS

Based on the results of our explorations, laboratory testing and analyses, it is our opinion that the proposed pathways and light pole foundations can be supported on native medium stiff or stiffer existing non-organic fill soils, or on structural fill that is properly installed during construction. Groundwater was encountered in B-3 at a depth of 20.0 feet. The following paragraphs present specific geotechnical recommendations for design and construction of the proposed facilities.

RECOMMENDATIONS

SITE PREPARATION

In all proposed areas of hard surfacing, foundations or slabs, and for a 2-foot margin around such areas, the existing root zone and organic landscape materials should be stripped and removed. Based on our explorations, the depth of stripping in such areas will be approximately 4 to 6 inches, although greater stripping depths may be required to remove localized zones of loose or organic soil. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or used in landscaped areas.

After stripping and required site cutting have been completed, we recommend that a member of our geotechnical staff probe the subgrade to identify soft or unsuitable areas.

CONSTRUCTION CONSIDERATIONS

Trafficability of the exposed subgrade may be difficult during or after extended wet periods or when the moisture content of the surface soil is more than a few percentage points above optimum moisture content. When wet, the silty soils are easily disturbed and may provide inadequate support for construction equipment. Soils that have been disturbed during site preparation activities, or soft or loose zones identified during probing, should be removed and replaced with compacted structural fill.

STRUCTURAL FILL

On-site Materials

As the existing fill is in many layers, and the site has an extensive history of structures, cuts and fills, and varied uses, we expect that some of the fill materials encountered will contain appreciable organics and oversize materials that may be unsuitable for use in fills. A contingency should be built into the project budget and schedule to allow for such materials. The encountered native silts, sand with some silt, and fills with some or more silt are sensitive to small changes in moisture content and highly susceptible to disturbance when wet. We recommend completing construction in the dry season. If construction is planned for the wet season, careful consideration of the construction methods and schedule should be made to reduce overexcavation of disturbed site soils, and the project budget should reflect the recommendations for wet weather construction contained in this report.

Laboratory testing indicates that the moisture content of the on-site materials is generally greater than the anticipated optimum moisture content required for satisfactory compaction. Therefore, moisture conditioning will be required to achieve adequate compaction. We recommend using imported granular material for structural fill if the on-site material cannot be properly moisture-conditioned.

When used as structural fill, the on-site silts should be placed in lifts with a maximum uncompacted thickness of 6 to 8 inches and be compacted to not less than 92 percent of the maximum dry density, as determined by American Society for Testing and Materials (ASTM) D 1557.

Imported Granular Material

If imported granular material is used as structural fill, this material should consist of pit or quarry-run rock, crushed rock, or crushed gravel and sand that is fairly well-graded between coarse and fine, contains no organic matter or other deleterious materials, has a maximum particle size of 3 inches, and has less than 5 percent passing the U.S. Standard No. 200 Sieve. The percentage of fines can be increased to 12 percent of the material passing the U.S. Standard No. 200 Sieve if placed during dry weather. Imported granular material should be moisture conditioned to the approximate optimum moisture content for compaction, placed in 12-inch thick lifts, and compacted to not less than 95 percent of maximum dry density as determined by ASTM D 1557.

Trench Backfill

Trench backfill for the utility pipe base and pipe zone should consist of well-graded granular material containing no organic or other deleterious material, having a maximum particle size of ¾-inch, and having less than 5 percent pass the U.S. Standard No. 200 Sieve.

Backfill for the pipe base and within the pipe zone should be placed in maximum 12-inch thick lifts and compacted to not less than 90 percent of the maximum dry density, as determined by ASTM D 1557 or as recommended by the pipe manufacturer. Backfill above the pipe zone should be placed in maximum 12-inch-thick lifts and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D 1557. Trench backfill located within 2 feet of finish subgrade elevation should be placed in maximum 12-inch thick lifts and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D 1557.

SHALLOW FOUNDATIONS

We recommend that spread footings bear on the medium stiff to very stiff silts, have a minimum width of 18 inches, and have the base of the footings founded at least 18 inches below the lowest adjacent grade. Continuous wall footings should have a minimum width of 12 inches, and be founded a minimum of 18 inches below the lowest adjacent grade. Drilled piers for light pole foundations should have a minimum diameter of 18 inches.

Footings founded as avove should be proportioned for a maximum allowable soil bearing pressure of 2,800 pounds per square foot (psf). Piers should be designed for at least 3 feet of embedment, and for shaft friction of 800 psf below the top 1 foot. These are net pressures and apply to the total of dead and long-term live loads and may be increased by 50 percent when considering earthquake or wind loads. The weight of the footings and piers, and overlying backfill, can be ignored in calculating footing loads.

For the preceding pressures with loads less than 50 kips for columns or piers and 3 kips per foot for walls, total settlement is anticipated to be less than about 1 inch. Differential settlements should not exceed ½ inch.

Lateral Capacity

We recommend using a passive pressure of 300 pounds per cubic foot for design purposes for footings and piers confined by native silt or structural fill. In order to develop this capacity, concrete must be poured neat in excavations or the adjacent confining material must consist of imported granular fill compacted to 92 percent relative to ASTM D 1557. Adjacent floor slabs, pavements, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance.

A coefficient of friction equal to 0.35 may be used when calculating resistance to sliding at the base of footings.

DRAINAGE CONSIDERATIONS

Although groundwater was not encountered near proposed grades, the site soils consist primarily of silt, and sand with some silt, which generally provide poor drainage. Perched groundwater may develop in these soils during extended wet periods, and may result in cut slope seeps or ponded water in flat areas. Vegetated surfaces subject to pedestrian use should be sloped a minimum of 0.5 percent to allow for surface drainage/runoff. If seeps occur in cut slopes special drainage measures may be necessary to collect the water and prevent slope erosion. Such measures typically include installing a fabric-wrapped perforated pipe into the seeps, embedding it in clean gravel, and routing it to a suitable discharge. Composite drain materials, such as strip drains, can also be used for this purpose. Fabric should be non-woven and have an apparent opening size between a #70 and #100 sieve.

PAVEMENT

The pavement subgrade should be prepared in accordance with the previously described site preparation, construction considerations, and structural fill recommendations. We do not have specific information on the frequency and type of vehicles that will use the area; however, we have assumed that traffic conditions will consist of fewer than 5 trucks and 200 cars per day.

A pavement section consisting of a thickness of at least 2.5 inches of asphalt concrete over at least 8 inches of crushed rock base course should be appropriate in areas where truck traffic is expected. If parking areas are limited to passenger automobiles only, the pavement section can be reduced to 2.5 inches of asphalt concrete over 6 inches of crushed rock. For portland cement concrete (pcc), we recommend a minimum 5.5 inches for plain-jointed pcc overlying 6 inches of crushed rock base.

Our pavement section recommendations are based on a California Bearing Ratio of 5 and the assumption that construction will be completed during a period of extended dry weather. An increased thickness of granular base course will be required if construction occurs during wet weather conditions.

OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to monitor construction at the site to confirm that subsurface conditions are consistent with the site explorations and to confirm that the intent of project plans and specifications relating to earthwork and foundation construction are being met.

LIMITATIONS

We have prepared this report for use by Atlas Landscape Architecture and the City of Milwaukie, and their design teams for the proposed Milwaukie Riverfront Park - Phase I in Milwaukie, Oregon. The data and report can be used for bidding or estimating purposes, but our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Our explorations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, reevaluation will be necessary.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction for the building, the conclusions and recommendations presented may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

◆ ◆ ◆

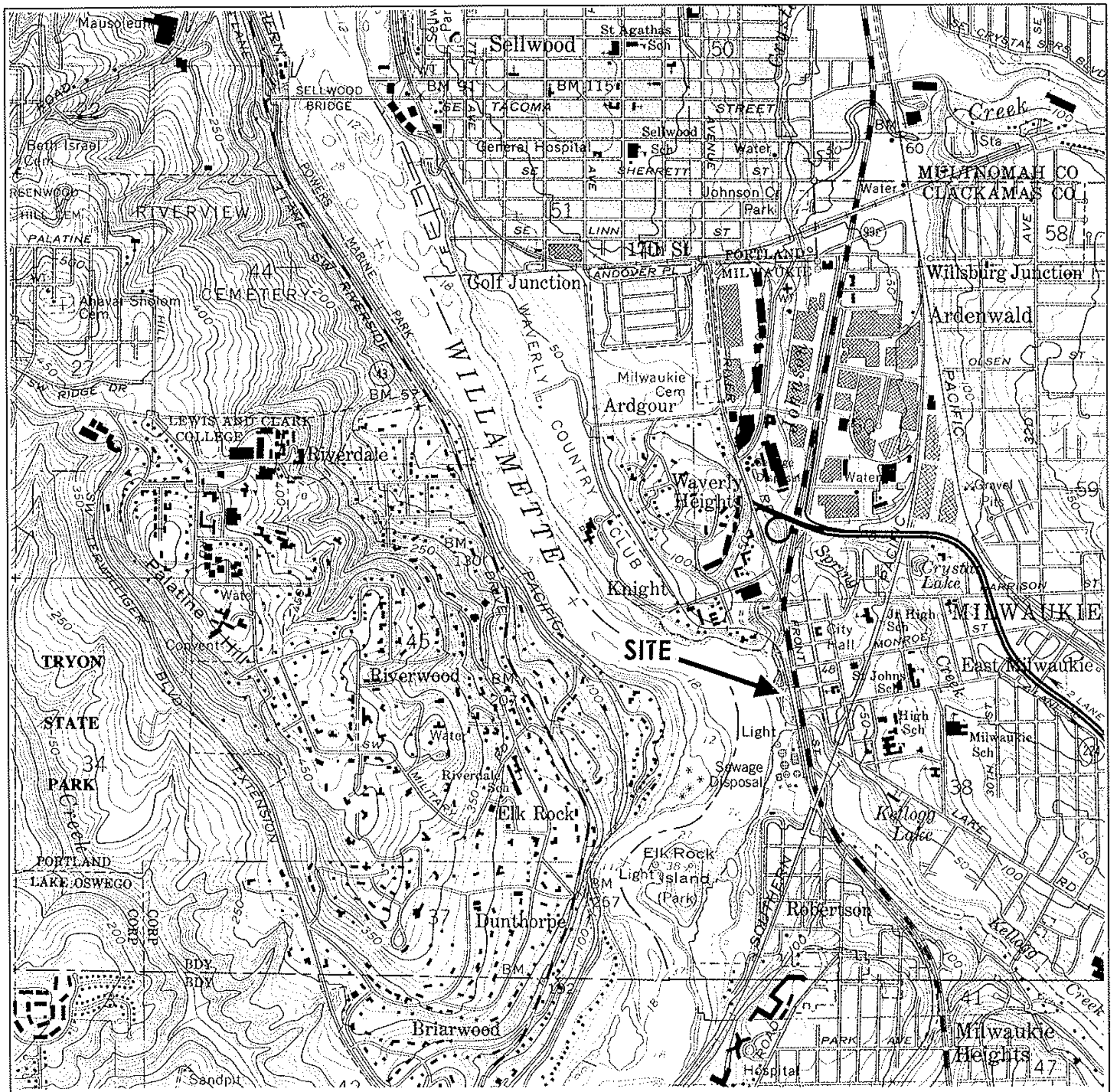
We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

Don Rondema, P.E.
Principal

REGISTERED PROFESSIONAL
ENGINEER
16,073
OREGON
JULY 21, 1992
DON RONDEMA
Expires 12/31/00



USGS TOPOGRAPHIC MAP
LAKE OSWEGO, OR QUAD

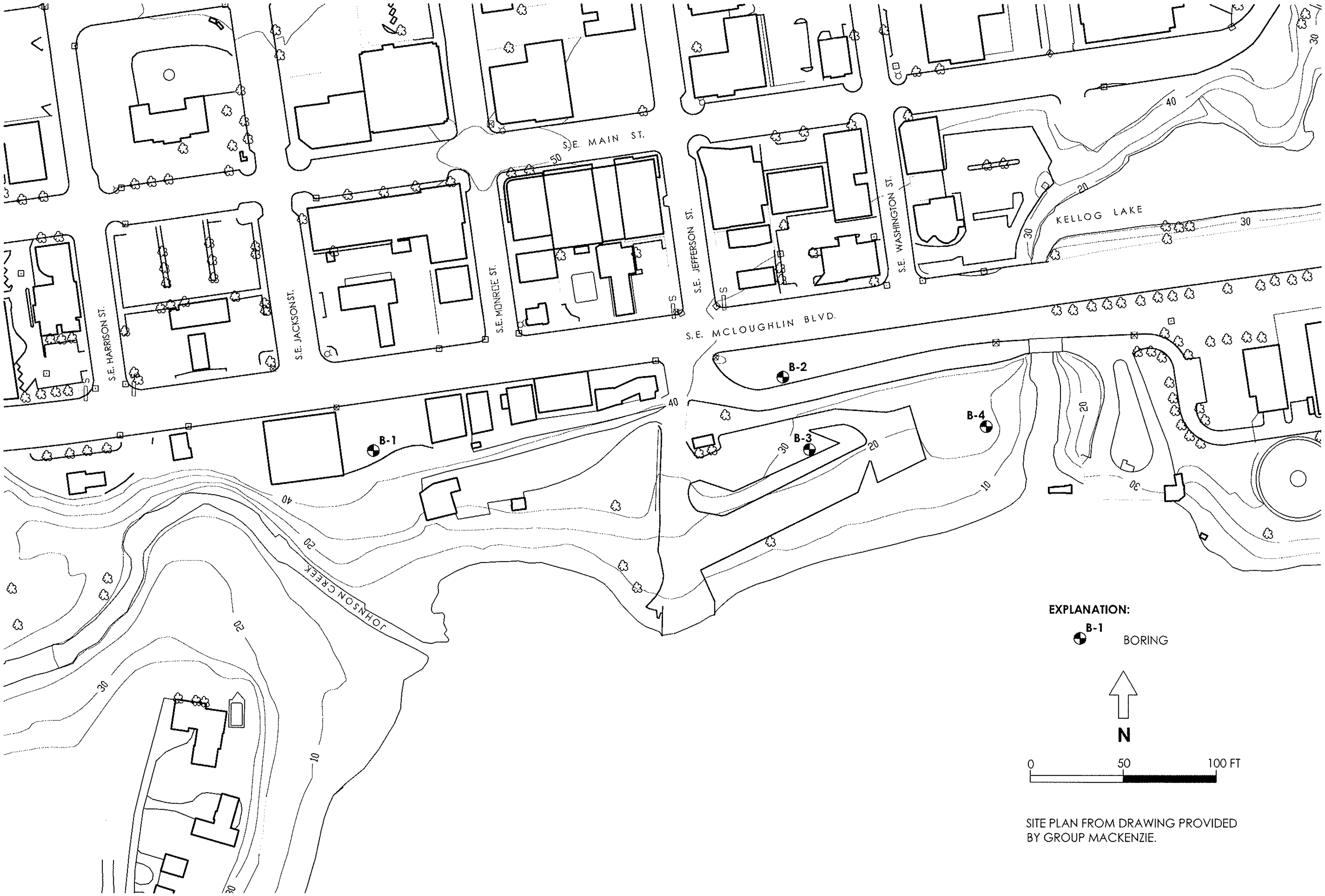
N

0 2000 4000 FT

GEODESIGN INC

VICINITY MAP

MILWAUKIE-1	JULY 2000	FIGURE 1



SITE PLAN FROM DRAWING PROVIDED
BY GROUP MACKENZIE.

GEODESIGN INC

SITE PLAN

MILWAUKIE-1

JULY 2000

FIGURE 2

APPENDIX A

APPENDIX A

FIELD EXPLORATIONS

We explored subsurface conditions at the site by drilling four borings (B-1 through B-4) at the approximate locations shown in Figure 2. Subsurface Technologies drilled the boring with hollow stem auger methods and SPT safety hammer sampling on July 6, 2000.

Boring locations were based on a site plan provided to our office by Gill Williams of Atlas Landscape Architecture. We determined the exploration locations in the field from existing site features. The locations shown on Figure 2 should be considered approximate.

We obtained representative samples of the various soils encountered for geotechnical laboratory testing. Classifications and sampling intervals are shown on the logs included in this appendix.

We classified the materials present in the samplers in the field in accordance with ASTM D 2488. The logs indicate the depths at which the soils or their characteristics change, although the change actually may be gradual. If the change occurred between sample locations, the depth was interpreted.

LABORATORY TESTING

We classified soil samples in the laboratory to confirm field classifications. The laboratory classifications are included in the boring logs if those classifications differed from the field classifications.

We tested the natural moisture content of selected soil samples in general accordance with ASTM D 2216. The moisture contents are included in the boring logs in this appendix.

KEY TO TEST PIT AND BORING LOG SYMBOLS

SYMBOL	SOIL DESCRIPTION
▮	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test
▯	Location of SPT sampling attempt with no sample recovery
◪	Location of sample obtained using thin wall, shelby tube, or Geoprobe® sampler in general accordance with ASTM D 1587
⧄	Location of thin wall, shelby tube, or GeoProbe® sampling attempt with no sample recovery
▦	Location of sample obtained using Dames and Moore sampler and 300 pound hammer or pushed
▤	Location of Dames and Moore sampling attempt (300 pound hammer or pushed) with no sample recovery
⊠	Location of grab sample
█	Rock Coring Interval
▽	Water level

GEOTECHNICAL TESTING EXPLANATIONS

PP	Pocket Penetrometer	LL	Liquid Limit
TOR	Torvane	PI	Plasticity Index
CONSOL	Consolidation	PCF	Pounds Per Cubic Foot
DS	Direct Shear	PSF	Pounds Per Square Foot
P200	Percent Passing U.S. No. 200 Sieve	TSF	Tons Per Square Foot
W	Moisture Content	P	Pushed Sample
DD	Dry Density	OC	Organic Content

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
PID	Photoionization Detector Headspace Analysis	NS	No Visible Sheen
		SS	Slight Sheen
PPM	Parts Per Million	MS	Moderate Sheen
MG/KG	Milligrams Per Kilogram	HS	Heavy Sheen
P	Pushed Sample		

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KEY TO TEST PIT AND
BORING LOG SYMBOLS

TABLE A-1

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL	NAME
Coarse Grained Soils More than 50% retained on No. 200 Sieve	Gravel More than 50% of coarse fraction retained on No. 4 Sieve	Clean Gravel	GW	Well graded, fine to coarse gravel
			GP	Poorly graded gravel
		Gravel with Fines	GM	Silty gravel
			GC	Clayey gravel
	Sand More than 50% of coarse fraction passes No. 4 Sieve	Clean Sand	SW	Well graded, fine to coarse sand
			SP	Poorly graded sand
		Sand with Fines	SM	Silty sand
			SC	Clayey sand
Fine Grained Soils More than 50% passes No. 200 Sieve	Silt and Clay Liquid Limit less than 50%	Inorganic	ML	Low plasticity silt
			CL	Low plasticity clay
		Organic	OL	Organic silt, organic clay
	Silt and Clay Liquid Limit greater than 50%	Inorganic	MH	High plasticity silt
			CH	High plasticity clay, fat clay
		Organic	OH	Organic clay, organic silt
Highly Organic Soils			PT	Peat

SOIL CLASSIFICATION GUIDELINES

GRANULAR SOILS		COHESIVE SOILS		
Relative Density	**Standard Penetration Resistance**	**Consistency**	**Standard Penetration Resistance**	**Unconfined Compressive Strength (tsf)**
Very Loose	0 – 4	Very Soft	Less than 2	Less than 0.25
Loose	4 – 10	Soft	2 - 4	0.25 - 0.50
Medium Dense	10 – 30	Medium Stiff	4 - 8	0.50 - 1.0
Dense	30 – 50	Stiff	8 - 15	1.0 - 2.0
Very Dense	More than 50	Very Stiff	15 - 30	2.0 - 4.0
		Hard	More than 30	More than 4.0

GRAIN SIZE CLASSIFICATION

Boulders	12 - 36 inches
Cobbles	3 - 12 inches
Gravel	¾ - 3 inches (coarse) ¼ - ¾ inches (fine)
Sand	No. 10 - No. 4 Sieve (coarse) No. 10 - No. 40 Sieve (medium) No. 40 - No. 200 Sieve (fine)

Subclassifications	
	Percentage of other material in sample
Clean	0 – 2
Trace	2 – 10
Some	10 - 30
Sandy, Silty, Clayey, etc.	30 - 50

Dry = very low moisture, dry to the touch; Moist = damp, without visible moisture; Wet = saturated, with visible free water.

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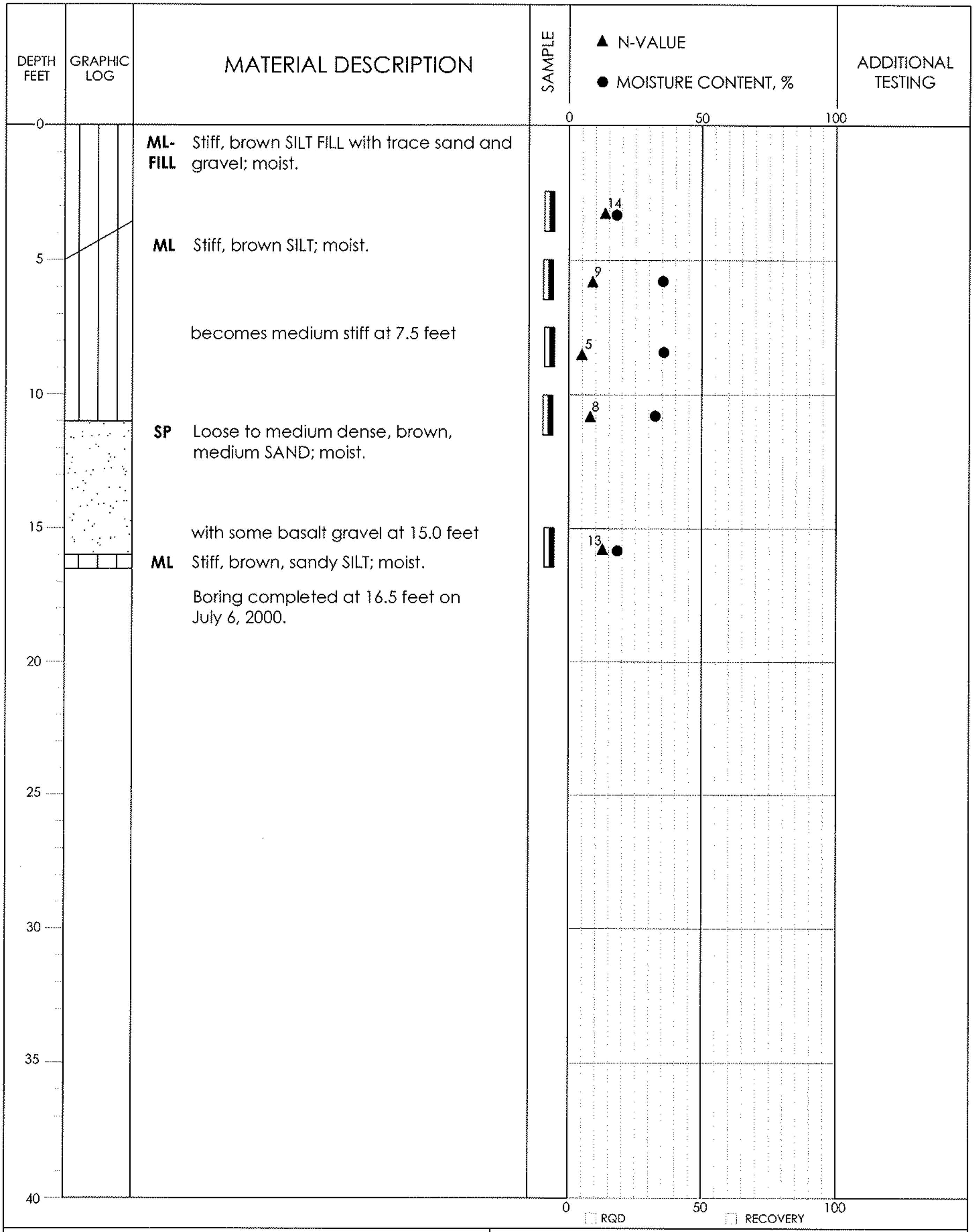
SOIL CLASSIFICATION SYSTEM AND GUIDELINES

TABLE A-2



ML-FILL Stiff, brown SILT FILL with trace sand and gravel; moist.

ML Stiff, brown SILT; moist.

becomes medium stiff at 7.5 feet

SP Loose to medium dense, brown, medium SAND; moist.

with some basalt gravel at 15.0 feet

ML Stiff, brown, sandy SILT; moist.

Boring completed at 16.5 feet on July 6, 2000.

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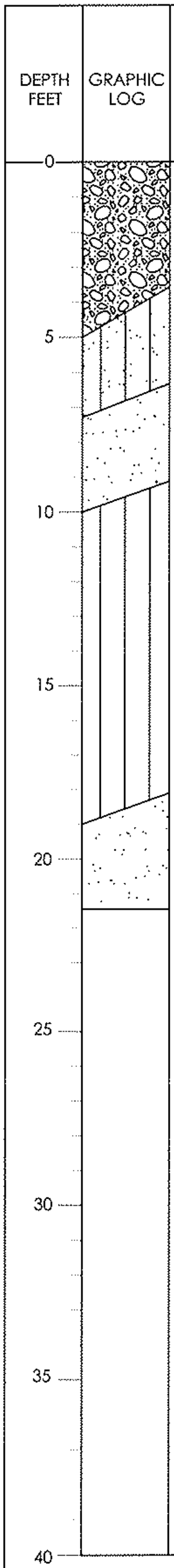
BORING B-1

MILWAUKIE-1	JULY 2000	FIGURE A-1



MATERIAL DESCRIPTION

GW-FILL Loose, brown GRAVEL with some sand and silt; moist.

SM-FILL Very loose, brown, silty fine SAND FILL with occasional gravel; moist.

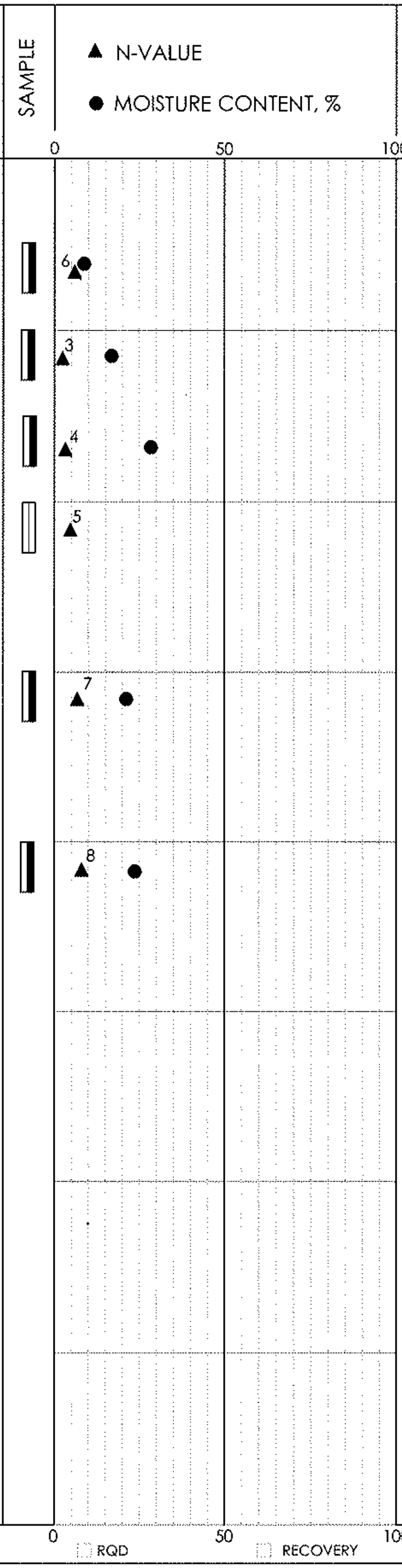
SP-FILL Loose, brown, fine SAND FILL with trace to some silt; moist.

ML-FILL Medium stiff, brown SILT FILL; moist.

becomes sandy with trace gravel and fine organics at 15.0 feet

SP-FILL Loose, brown SAND FILL with some silt; moist.
1-inch thick wood chip layer encountered at 20.4 feet
becomes gray at 20.5 feet

Boring completed at 21.5 feet on July 6, 2000.

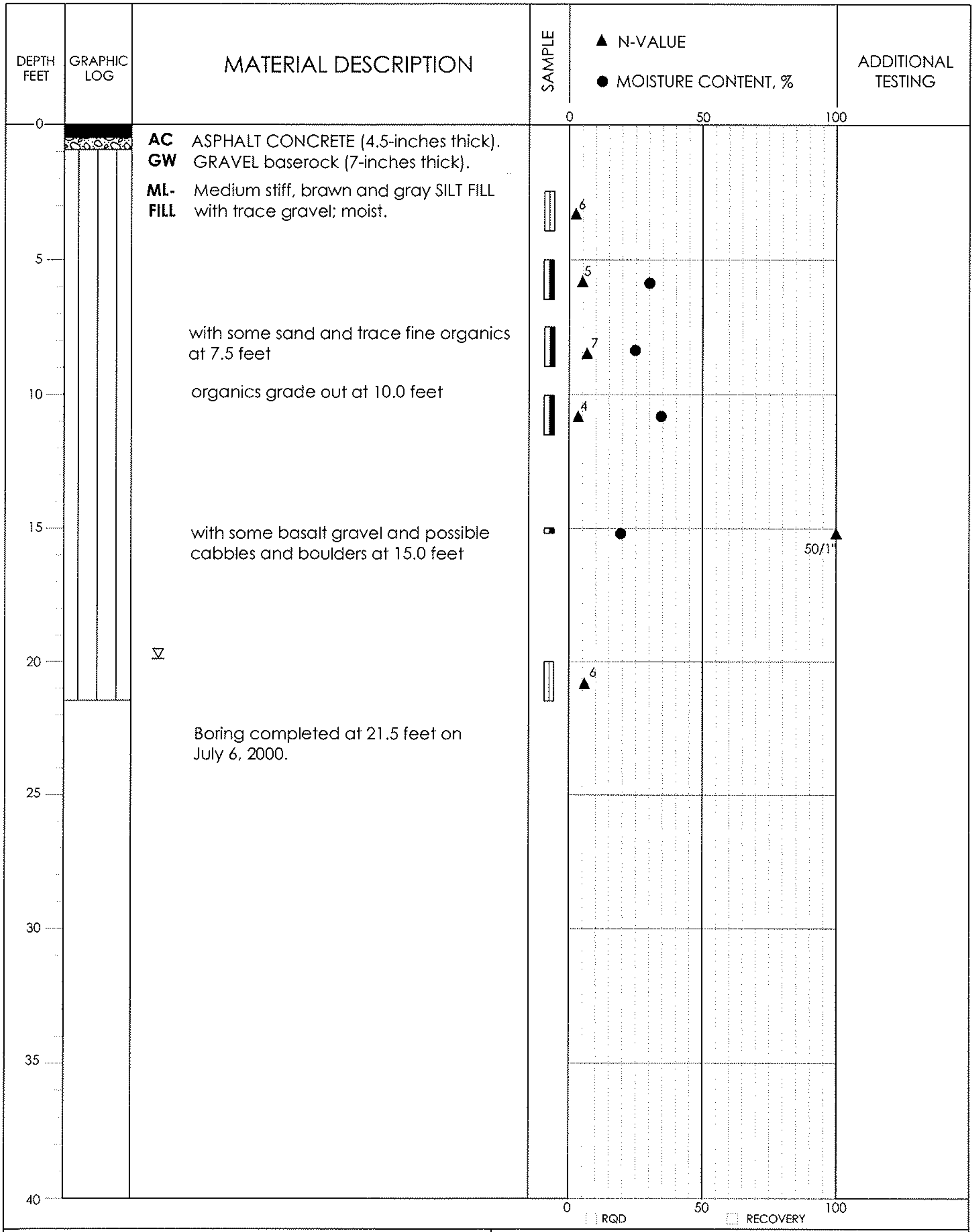


ADDITIONAL TESTING

GEODESIGN INC

BORING B-2

MILWAUKIE-1	JULY 2000	FIGURE A-2



MATERIAL DESCRIPTION

AC ASPHALT CONCRETE (4.5-inches thick).

GW GRAVEL baserock (7-inches thick).

ML-FILL Medium stiff, brawn and gray SILT FILL with trace gravel; moist.

with some sand and trace fine organics at 7.5 feet

organics grade out at 10.0 feet

with some basalt gravel and possible cabbles and boulders at 15.0 feet

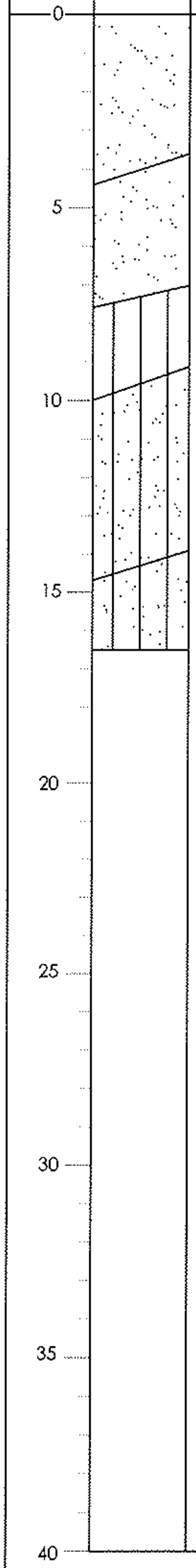
Boring completed at 21.5 feet on July 6, 2000.

GEODESIGN INC

BORING B-3

MILWAUKIE-1	JULY 2000	FIGURE A-3

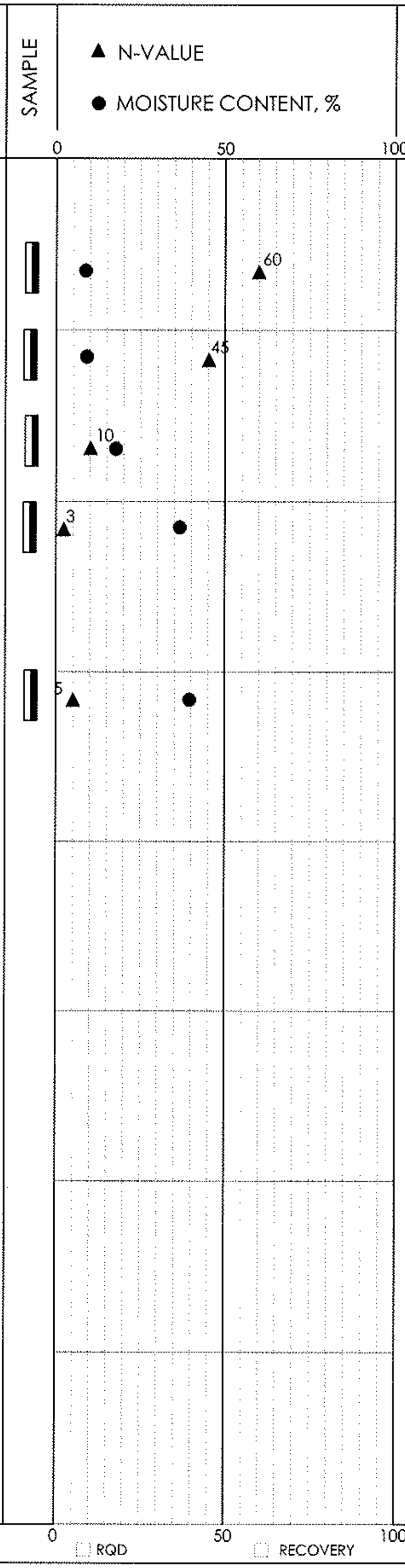
DEPTH FEET | GRAPHIC LOG



MATERIAL DESCRIPTION

SP-FILL	Very dense, brown gravelly SAND FILL with trace organics; dry.
SP-FILL	Dense, brown, medium SAND FILL with trace to some bosalt gravel, concrete and trace organics; moist.
ML-FILL	Stiff, brown mottled SILT FILL with trace to some gravel; moist.
SM	Very loose, gray, silty fine SAND; moist.
SM-SP	Loose, gray, silty SAND grades to medium SAND with trace silt and organics; moist.

Boring completed at 16.5 feet on July 6, 2000.



ADDITIONAL TESTING

GEODESIGN INC

BORING B-4

MILWAUKIE-1	JULY 2000	FIGURE A-4

Appendix C

Curve Number and Time of Concentration

Existing Conditions

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70 ←	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

[3] *Poor*: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Time of Concentration Calculations

Project Name: Kellogg Bridge Emergency Replacement		By: PTK
Project Number: 18328		Checked:
BASIN		**Pre-developed Basin**
SHEET FLOW		
INPUT		
Surface Description (from Table 3-1)		Woods, dense underbrush
Manning's Roughness Coefficient		0.8
Flow Length , L (<300 ft)	ft	106
2-Year, 24-Hour Rainfall, P_2	in	2.29
Land Slope, s	ft/ft	0.076
OUTPUT		
Travel Time	hr	0.45
SHALLOW CONCENTRATED FLOW		
INPUT		
Surface Description (paved or unpaved)		-
Flow Length, L	ft	-
Watercourse Slope, s	ft/ft	-
OUTPUT		
Average Velocity, V	ft/s	-
Travel Time	hr	-
CHANNEL FLOW		
INPUT		
Cross Sectional Flow Area, a	ft^2	-
Wetted Perimeter, p_w	ft	-
Channel Slope, s	ft/ft	-
Manning's Roughness Coefficient		-
Flow Length, L	ft	-
OUTPUT		
Average Velocity, V	ft/s	-
Hydraulic Radius, $r = a/p_w$	ft	-
Travel Time	hr	-
Basin Time of Concentration, T_c	**hrs**	**0.45**
	min	**27.1**

Appendix D

Inlet Capacity Calculations

INLET CAPACITY CALCULATIONS

Grate Inlets (On-grade)

See ODOT Hydraulics Manual, Chapter 13, Appendix D.5.2

Kellogg Bridge Replacement
Project No. 18328
8/15/2017

Definitions:

L = curb-opening lengh
E = the curb-opening interception efficiency (E=0.70 minimum; no more than 30% can bypass inlet)
L_T = curb-opening length required to intercept 100% of the gutter flow (ft)
E_o = ratio of flow in depressed section to total gutter flow
S_e = equivalent cross slope (ft/ft)
a = Gutter depression
S_w' = cross slope of depressed gutter measured from the cross slope of the pavement, S_x

W_p = Width of contributing drainage area (roads, shoulders, sidewalks)(ft)
L_1= first inlet from crest (ft)
L_2= distance to successive inlets (ft)
E = fraction of flow captured by curb inlet
T = Spread

Using 30% Clogging

n = 0.016 Manning's coefficent (0.016 for asphalt pavement)
a = 0 in 0.0000 ft
Width of Depressed Gutter Section, W_d = 4 ft
Sw' = 0.000 ft/ft

Rational Method

Q = CiA
C = 0.9 for concrete/asphaltic pavement
i = 2.1 in/hr, rainfall intensity for 10-year, 5 min event
i = 2.5 in/hr, rainfall intensity for 25-year, 5 min event
From ODOT Hydraulics Manual Appendix 7, Zone 7
A = Section Length x Roadway Width Draining to Inlet (sf)

CB Type: G2 L = 2.35 ft

Street Name	CB Type	Inlet	Station (ft)	Spacing (L1 or L2) (ft)	Longitudinal Roadway Slope (S_L)	Roadway Cross Slope (S_X)	Basin Area (sf)	Q=CiA (cfs)	Qtot (cfs)	T (ft)	Eo	S_e	L_T (ft)	Efficiency for Inlets, E	Capture Qcap (cfs)	Bypass (cfs)	Bypass Outlet
North Parking Lot - Drains West		**HP**	0														
N5	G2		105	105	0.060	0.017	2808	0.142	**0.142**	2.76	See Express Tools Sag Depth Calculation						N4-1
N4-1	G2		135	30	0.080	0.017	4815	0.244	**0.244**	3.18	See Express Tools Sag Depth Calculation						N4-2
N4-2	G2		142	7	0.080	0.017	0	0.010	**0.010**	1.65	See Express Tools Sag Depth Calculation						N/A

Inlet Report

Basin N5

Grate Inlet

Location = On grade
Curb Length (ft) = -0-
Throat Height (in) = -0-
Grate Area (sqft) = -0-
Grate Width (ft) = 1.84
Grate Length (ft) = 2.26

Gutter

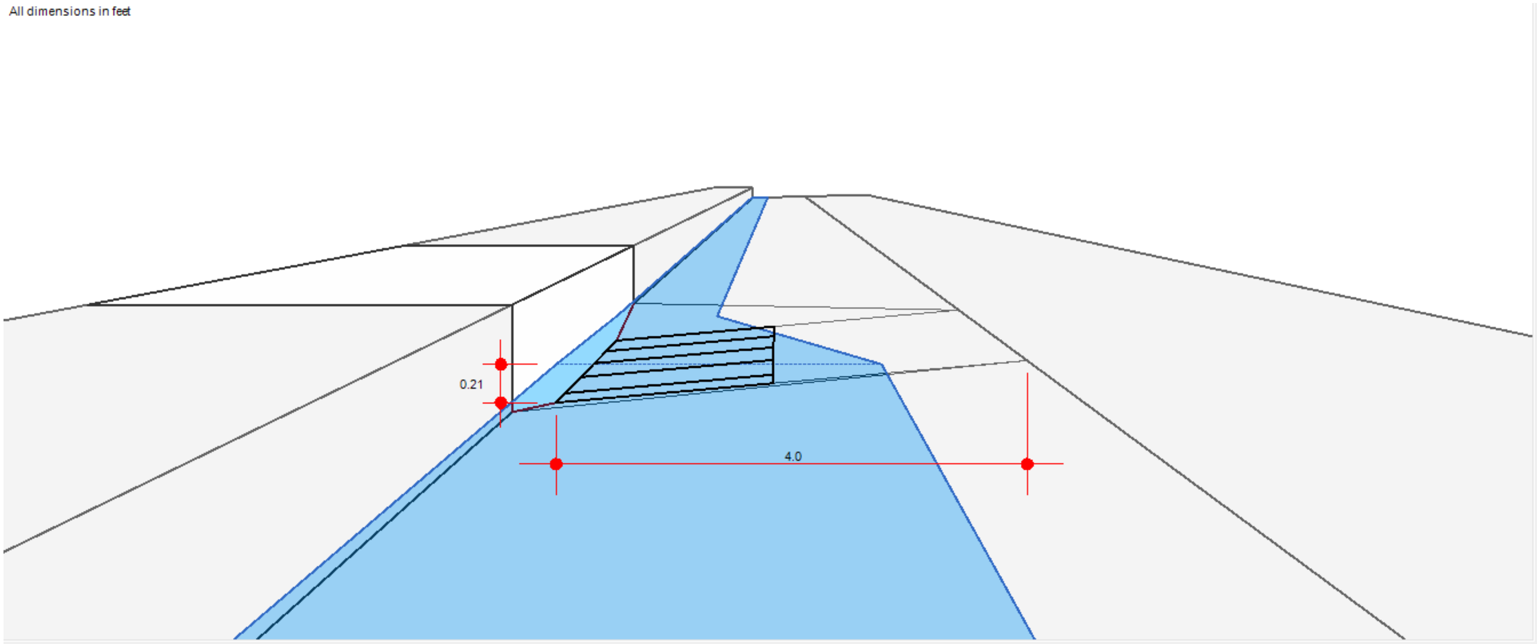
Slope, Sw (ft/ft) = 0.017
Slope, Sx (ft/ft) = 0.017
Local Depr (in) = 2.00
Gutter Width (ft) = 4.00
Gutter Slope (%) = 6.00
Gutter n-value = 0.016

Calculations

Compute by: Known Q
Q (cfs) = 0.14

Highlighted

Q Total (cfs) = 0.14
Q Capt (cfs) = 0.13
Q Bypass (cfs) = 0.01
Depth at Inlet (in) = 2.56
Efficiency (%) = 92
Gutter Spread (ft) = 2.76
Gutter Vel (ft/s) = 2.15
Bypass Spread (ft) = 1.18
Bypass Depth (in) = 0.24



Inlet Report

Basin N4-1

Grate Inlet

Location	= On grade
Curb Length (ft)	= -0-
Throat Height (in)	= -0-
Grate Area (sqft)	= -0-
Grate Width (ft)	= 1.84
Grate Length (ft)	= 2.26

Gutter

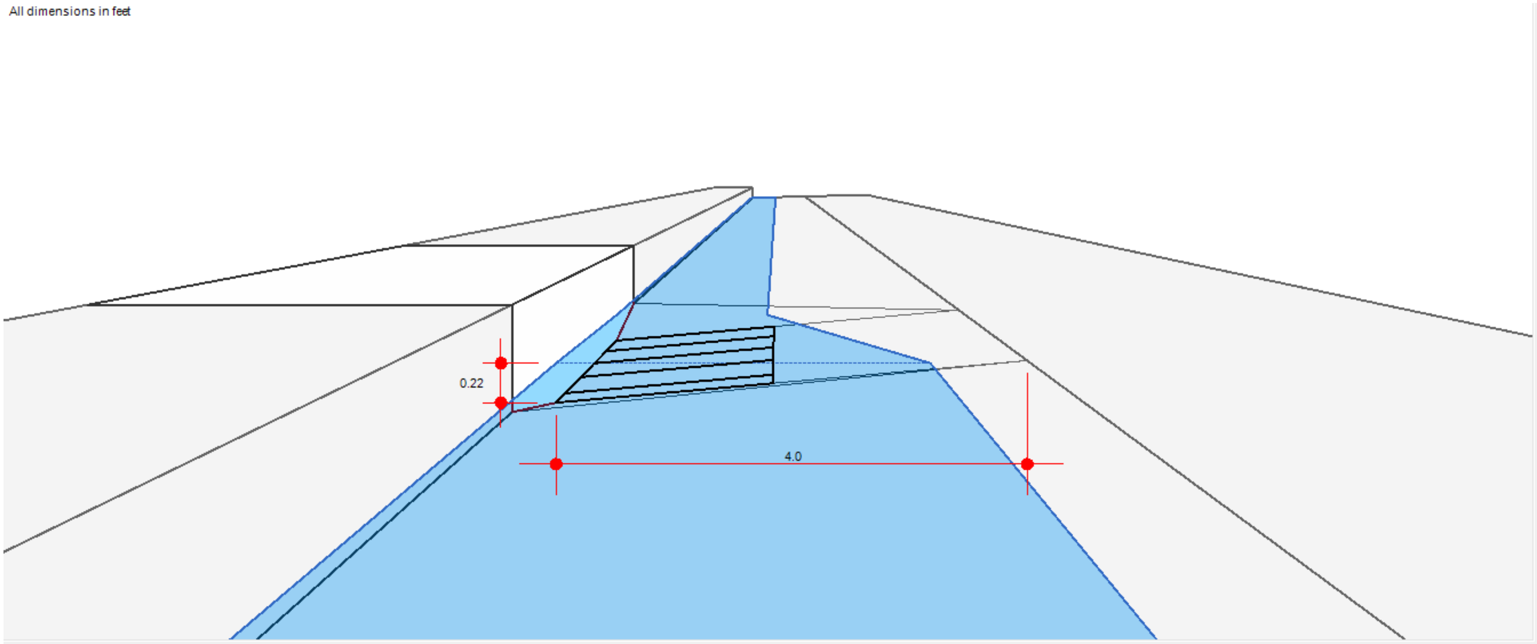
Slope, Sw (ft/ft)	= 0.017
Slope, Sx (ft/ft)	= 0.017
Local Depr (in)	= 2.00
Gutter Width (ft)	= 4.00
Gutter Slope (%)	= 8.00
Gutter n-value	= 0.016

Calculations

Compute by:	Known Q
Q (cfs)	= 0.24

Highlighted

Q Total (cfs)	= 0.24
Q Capt (cfs)	= 0.20
Q Bypass (cfs)	= 0.04
Depth at Inlet (in)	= 2.65
Efficiency (%)	= 84
Gutter Spread (ft)	= 3.18
Gutter Vel (ft/s)	= 2.80
Bypass Spread (ft)	= 1.76
Bypass Depth (in)	= 0.36



Inlet Report

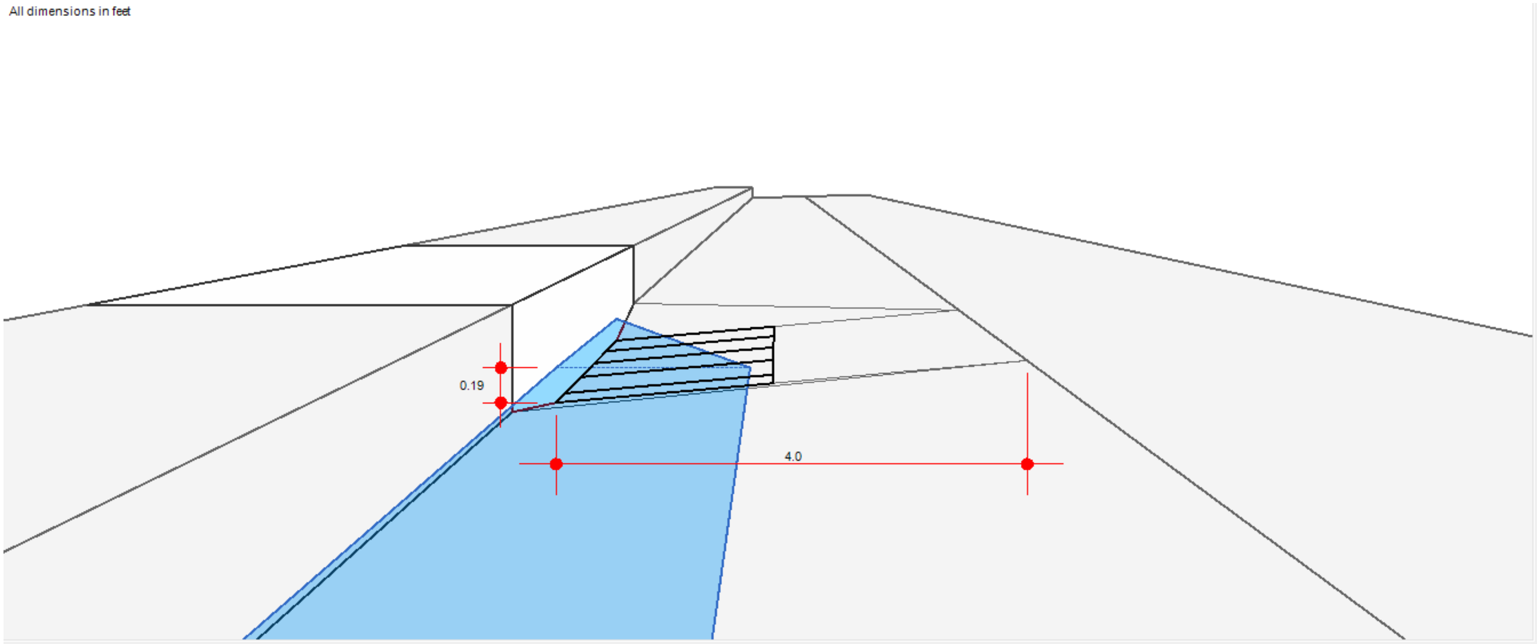
Basin N4-2

Grate Inlet
Location = On grade
Curb Length (ft) = -0-
Throat Height (in) = -0-
Grate Area (sqft) = -0-
Grate Width (ft) = 1.84
Grate Length (ft) = 2.26

Gutter
Slope, Sw (ft/ft) = 0.017
Slope, Sx (ft/ft) = 0.017
Local Depr (in) = 2.00
Gutter Width (ft) = 4.00
Gutter Slope (%) = 8.00
Gutter n-value = 0.016

Calculations
Compute by: Known Q
Q (cfs) = 0.04

Highlighted
Q Total (cfs) = 0.04
Q Capt (cfs) = 0.04
Q Bypass (cfs) = -0-
Depth at Inlet (in) = 2.34
Efficiency (%) = 100
Gutter Spread (ft) = 1.65
Gutter Vel (ft/s) = 1.73
Bypass Spread (ft) = -0-
Bypass Depth (in) = -0-



Appendix E

Presumptive Approach Calculator Output

PAC Report

Project Name
Kellogg Creek Bridge Replacement

Permit No.

Created
8/16/17 11:27 AM

Project Address
11211 SE McLoughlin Blvd
Milwaukie, OR, OR 97222

Designer
Evan C. Deal

Last Modified
8/16/17 11:27 AM

Company
Otak, Inc.

Report Generated
8/16/17 11:27 AM

Project Summary

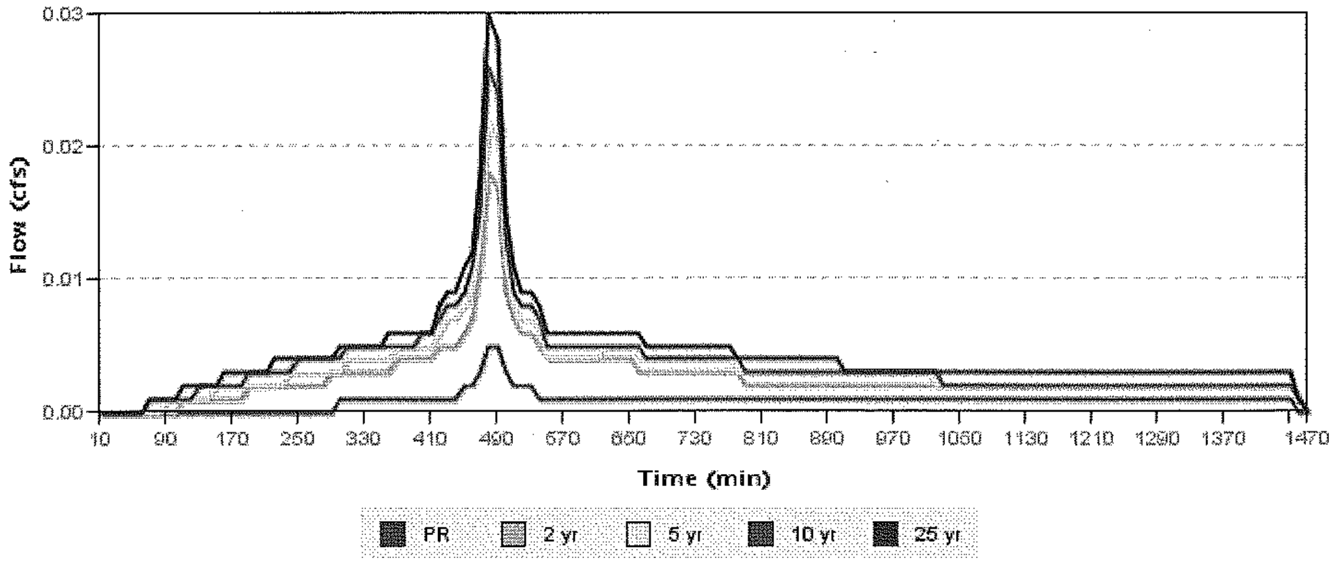
Replacement of existing bridge over Kellogg Creek adjacent to 99E.

Catchment Name	Impervious Area (sq ft)	Native Soil Design Infiltration Rate	Hierarchy Category	Facility Type	Facility Config	Facility Size (sq ft)	Facility Sizing Ratio	PR Results	Flow Control Results
Modified C4	1286	2.00	1	Planter (Flat)	B	263	20.5%	Pass	Not Used
Modified N1	12209	2.00	1	Planter (Sloped)	B		9%	Pass	Not Used
Modified N3	4298	2.00	1	Planter (Flat)	B	524	12.2%	Pass	Not Used
HydroCAD sized North Planter	7623	4.00	3	Planter (Flat)	B	200	2.6%	Pass	Not Used

Catchment Modified C4

Site Soils & Infiltration Testing Data	Infiltration Testing Procedure	**Open Pit Falling Head**
	Native Soil Infiltration Rate (I_{test})	**2.00**
Correction Factor	CF_{test}	**2**
Design Infiltration Rates	Native Soil (I_{dsgn})	**1.00 in/hr**
	Imported Growing Medium	**2.00 in/hr**
Catchment Information	Hierarchy Category	**1**
	Hierarchy Description	**On-site infiltration with a surface infiltration facility**
	Pollution Reduction Requirement	**Pass**
	10-year Storm Requirement	**Pass**
	Flow Control Requirement	**Pass**
	Impervious Area	**1286 sq ft** **0.030 acre**
	Time of Concentration (Tc)	**5**
	Post-Development Curve Number (CN_{post})	**98**

SBUH Results



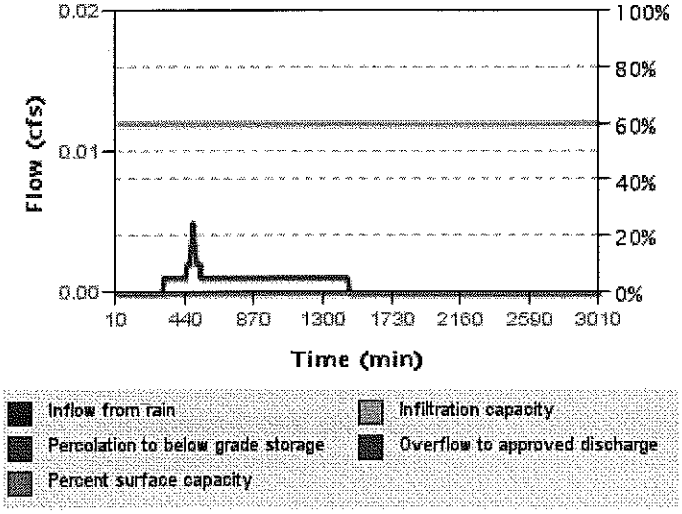
	Peak Rate (cfs)	Volume (cf)
PR	0.005	67.197
2 yr	0.018	232.696
5 yr	0.022	285.996

10 yr	0.026	339.374
25 yr	0.03	392.804

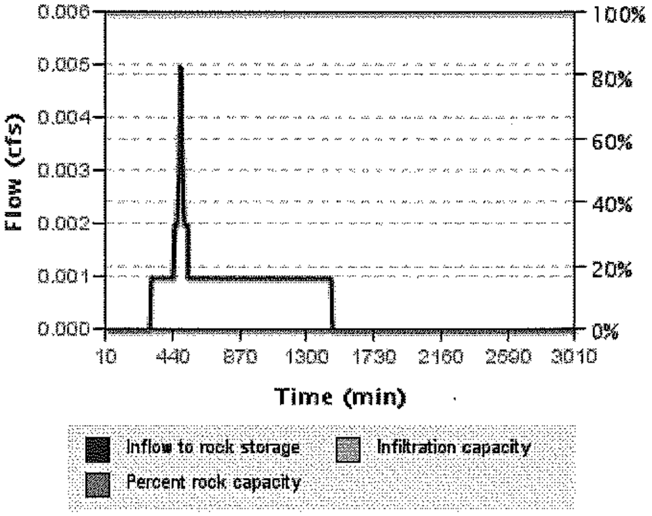
Facility Modified C4

Facility Details	Facility Type	**Planter (Flat)**
	Facility Configuration	**B: Infl. with rock storage (RS)**
	Facility Shape	**Planter**
	Above Grade Storage Data	
	Bottom Area	**263 sq ft**
	Bottom Width	**10.00 ft**
	Storage Depth 1	**12.0 in**
	Growing Medium Depth	**18 in**
	Surface Capacity at Depth 1	**263.0 cu ft**
	Design Infiltration Rate for Native Soil	**0.006 in/hr**
	Infiltration Capacity	**0.012 cfs**
	Below Grade Storage Data	
	Rock Storage Depth	**12 in**
	Rock Porosity	**0.30 in**
Facility Facts	Total Facility Area Including Freeboard	**263.00 sq ft**
	Sizing Ratio	**20.5%**
Pollution Reduction Results	Pollution Reduction Score	**Pass**
	Overflow Volume	**0.000 cf**
	Surface Capacity Used	**0%**
	Rock Capacity Used	**0%**
10 Year Results	10 Year Score	**Pass**
	Overflow Volume	**0.000 cf**
	Surface Capacity Used	**7%**
	Rock Capacity Used	**55%**

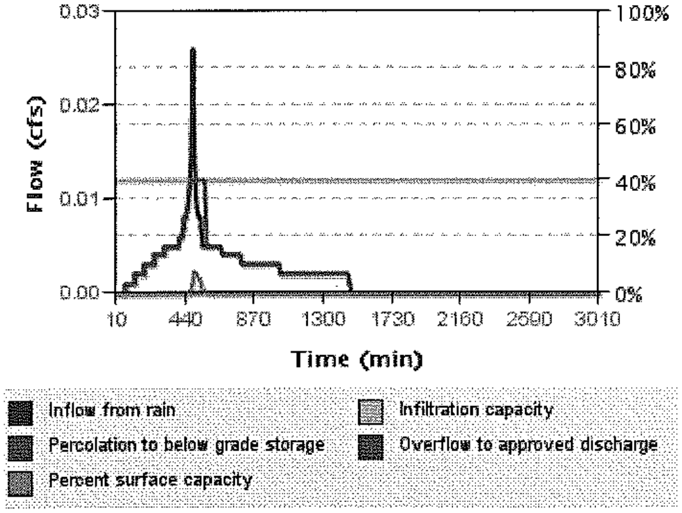
Pollution Reduction Event Surface Facility Modeling



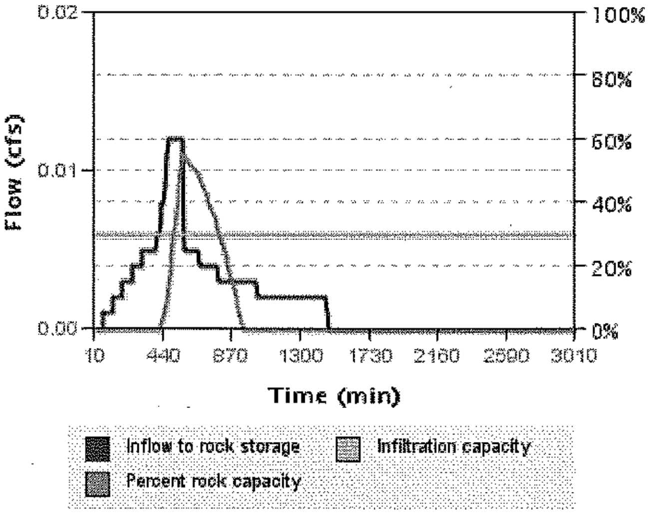
Pollution Reduction Event Below Grade Modeling



10 Year Event Surface Facility Modeling



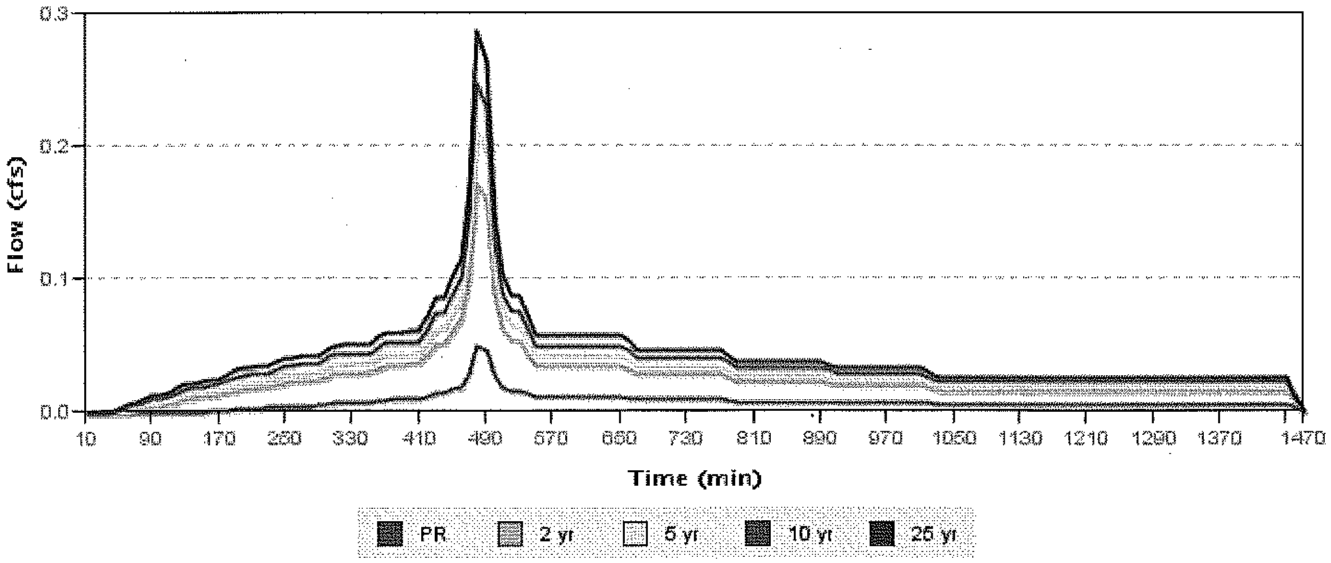
10 Year Event Below Grade Modeling



Catchment Modified N1

Site Soils & Infiltration Testing Data	Infiltration Testing Procedure	**Open Pit Falling Head**
	Native Soil Infiltration Rate (I_{test})	**2.00**
Correction Factor	CF_{test}	**2**
Design Infiltration Rates	Native Soil (I_{dsgn})	**1.00 in/hr**
	Imported Growing Medium	**2.00 in/hr**
Catchment Information	Hierarchy Category	**1**
	Hierarchy Description	**On-site infiltration with a surface infiltration facility**
	Pollution Reduction Requirement	**Pass**
	10-year Storm Requirement	**Pass**
	Flow Control Requirement	**Pass**
	Impervious Area	**12209 sq ft** **0.280 acre**
	Time of Concentration (Tc)	**5**
	Post-Development Curve Number (CN_{post})	**98**

SBUH Results



	Peak Rate (cfs)	Volume (cf)
PR	0.05	637.955
2 yr	0.172	2209.168
5 yr	0.211	2715.178

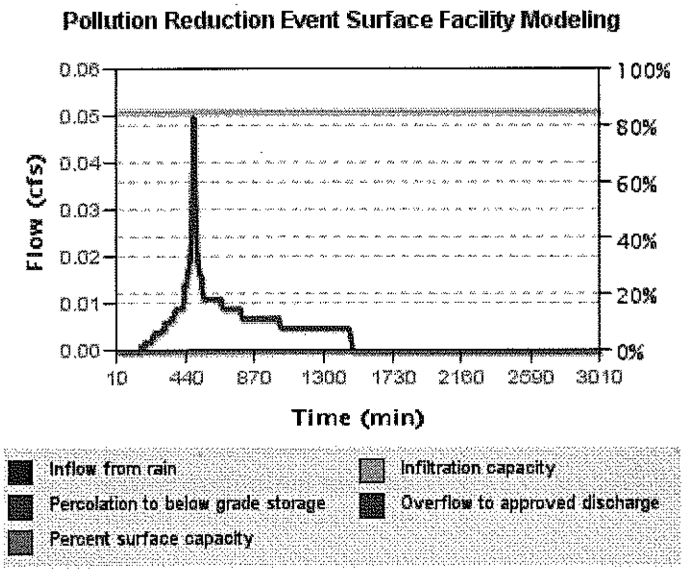
10 yr	0.248	3221.946
25 yr	0.286	3729.19

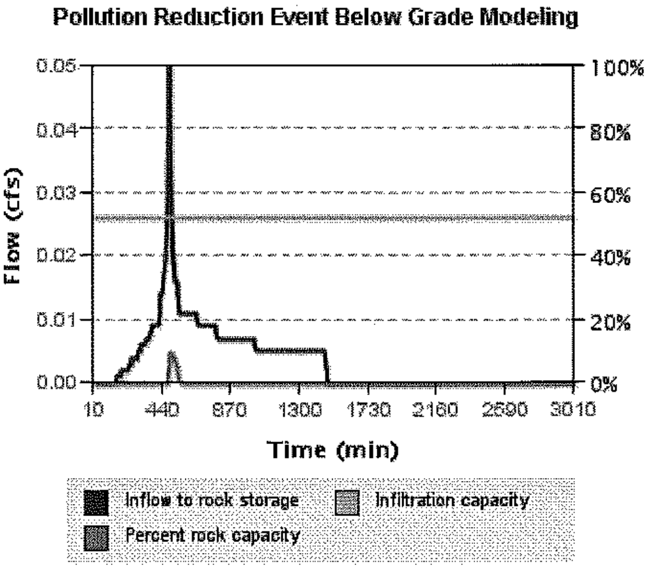
Facility Modified N1

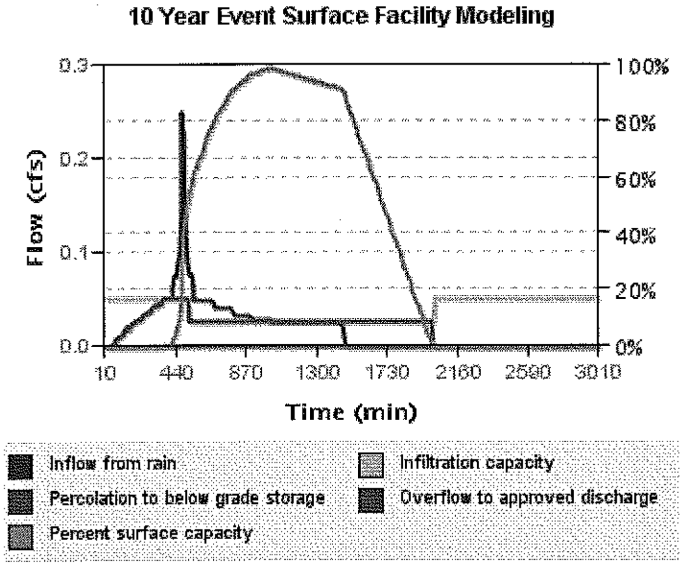
Facility Details	Facility Type	**Planter (Sloped)**
	Facility Configuration	**B: Infl. with rock storage (RS)**
	Facility Shape	**Sloped**
	Above Grade Storage Data	
	Growing Medium Depth	**18 in**
	Surface Capacity at Depth 1	**909.5 cu ft**
	Design Infiltration Rate for Native Soil	**0.013 in/hr**
	Infiltration Capacity	**0.051 cfs**
	Below Grade Storage Data	
	Rock Storage Depth	**12 in**
	Rock Porosity	**0.30 in**
Facility Facts	Total Facility Area Including Freeboard	**1102.50 sq ft**
	Sizing Ratio	**9%**
Pollution Reduction Results	Pollution Reduction Score	**Pass**
	Overflow Volume	**0.000 cf**
	Surface Capacity Used	**0%**
	Rock Capacity Used	**23%**
10 Year Results	10 Year Score	**Fail**
	Overflow Volume	**920.458 cf**
	Surface Capacity Used	**100%**
	Rock Capacity Used	**100%**

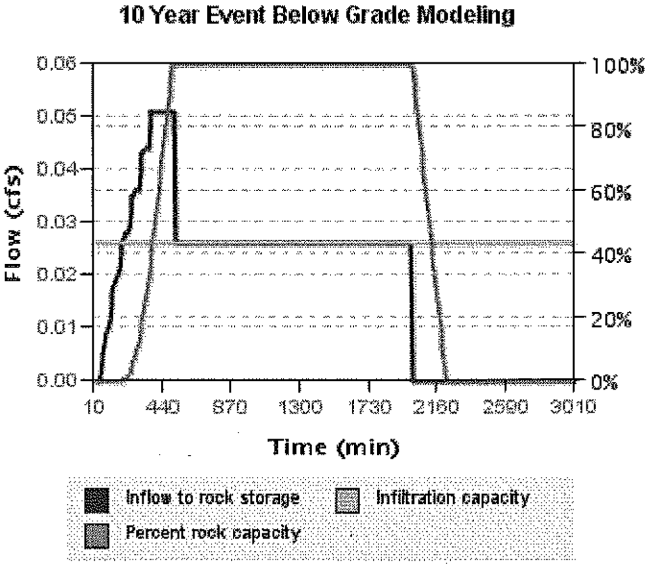
Sloped Facility Worksheet

#	Segment Length (ft)	Check Dam Length (ft)	Slope, v/h (ft/ft)	Bottom Width (ft)	Right Side Slope, h/v (ft/ft)	Left Side Slope, h/v (ft/ft)	Downstream Depth (in)	Landscape Width (ft)	Rock Storage Width (ft)
1	22.50	0.50	0.0150	7.00	0.0	0.0	12.0	7.00	7.00
2	22.50	0.50	0.0150	7.00	0.0	0.0	12.0	7.00	7.00
3	22.50	0.50	0.0150	7.00	0.0	0.0	12.0	7.00	7.00
4	22.50	0.50	0.0150	7.00	0.0	0.0	12.0	7.00	7.00
5	22.50	0.50	0.0150	7.00	0.0	0.0	12.0	7.00	7.00
6	22.50	0.50	0.0150	7.00	0.0	0.0	12.0	7.00	7.00
7	22.50	0.00	0.0150	7.00	0.0	0.0	12.0	7.00	7.00


Pollution Reduction Event Surface Facility Modeling


Pollution Reduction Event Below Grade Modeling

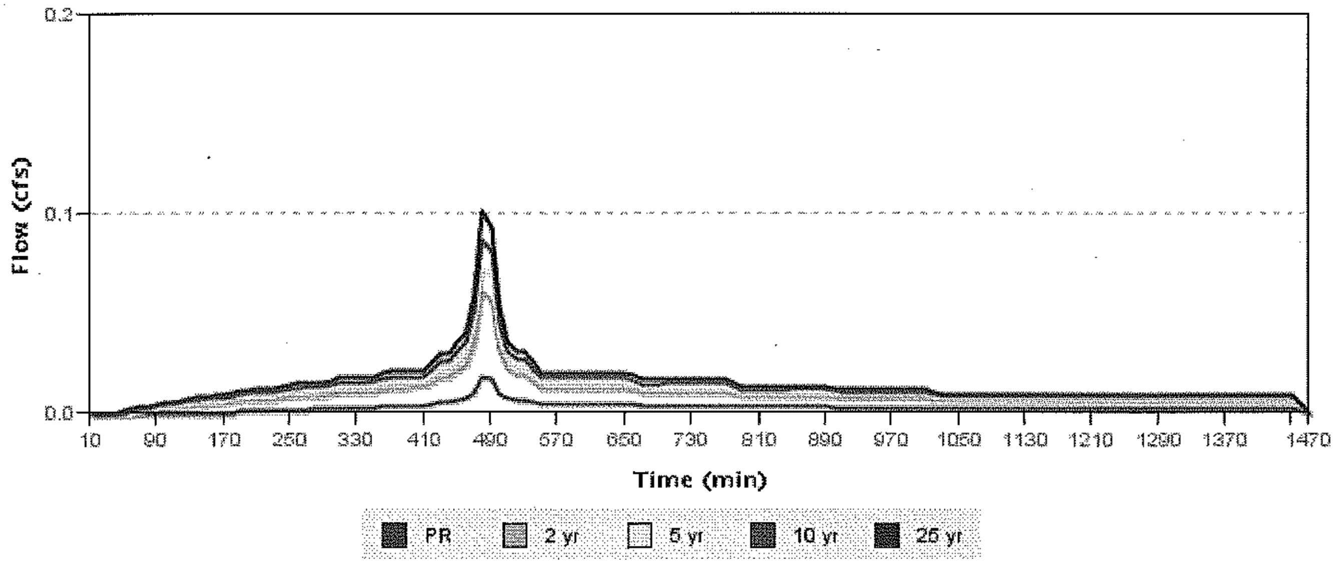

10 Year Event Surface Facility Modeling


10 Year Event Below Grade Modeling

Catchment Modified N3

Site Soils & Infiltration Testing Data	Infiltration Testing Procedure	**Open Pit Falling Head**
	Native Soil Infiltration Rate (I_{test})	**2.00**
Correction Factor	CF_{test}	**2**
Design Infiltration Rates	Native Soil (I_{dsgn})	**1.00 in/hr**
	Imported Growing Medium	**2.00 in/hr**
Catchment Information	Hierarchy Category	**1**
	Hierarchy Description	**On-site infiltration with a surface infiltration facility**
	Pollution Reduction Requirement	**Pass**
	10-year Storm Requirement	**Pass**
	Flow Control Requirement	**Pass**
	Impervious Area	**4298 sq ft** **0.099 acre**
	Time of Concentration (Tc)	**5**
	Post-Development Curve Number (CN_{post})	**98**

SBUH Results



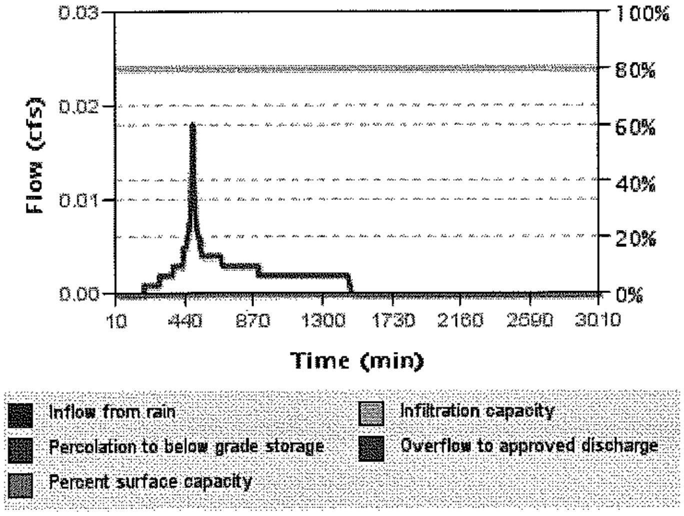
	Peak Rate (cfs)	Volume (cf)
PR	0.018	224.583
2 yr	0.061	777.705
5 yr	0.074	955.839

10 yr	0.087	1134.239
25 yr	0.101	1312.807

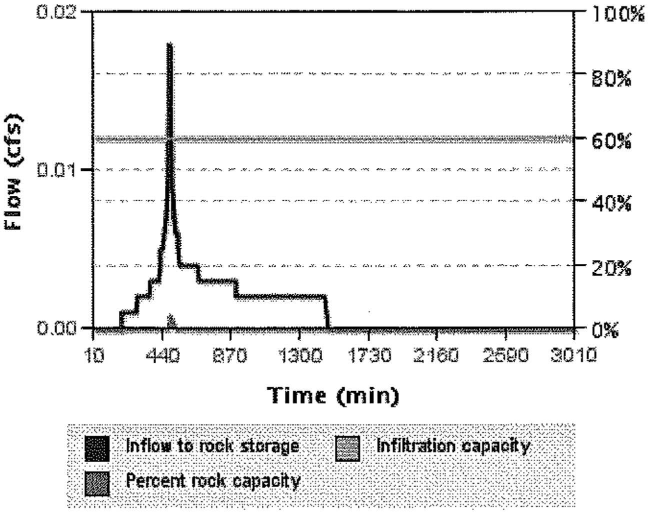
Facility Modified N3

Facility Details	Facility Type	**Planter (Flat)**
	Facility Configuration	**B: Infl. with rock storage (RS)**
	Facility Shape	**Planter**
	Above Grade Storage Data	
	Bottom Area	**524 sq ft**
	Bottom Width	**3.00 ft**
	Storage Depth 1	**3.0 in** ⚠
	Growing Medium Depth	**18 in**
	Surface Capacity at Depth 1	**131.0 cu ft**
	Design Infiltration Rate for Native Soil	**0.006 in/hr**
	Infiltration Capacity	**0.024 cfs**
	Below Grade Storage Data	
	Rock Storage Depth	**12 in**
	Rock Porosity	**0.30 in**
Facility Facts	Total Facility Area Including Freeboard	**524.00 sq ft**
	Sizing Ratio	**12.2%**
Pollution Reduction Results	Pollution Reduction Score	**Pass**
	Overflow Volume	**0.000 cf**
	Surface Capacity Used	**0%**
	Rock Capacity Used	**12%**
10 Year Results	10 Year Score	**Fail**
	Overflow Volume	**379.897 cf**
	Surface Capacity Used	**100%**
	Rock Capacity Used	**100%**

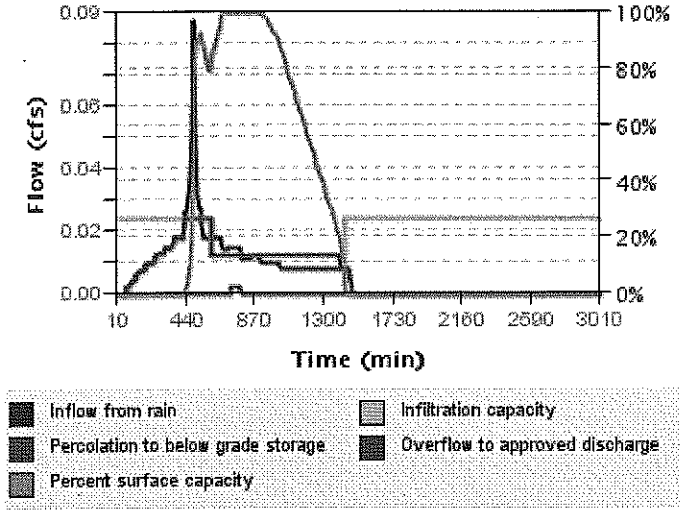
⚠ Indicates value is outside of recommended range



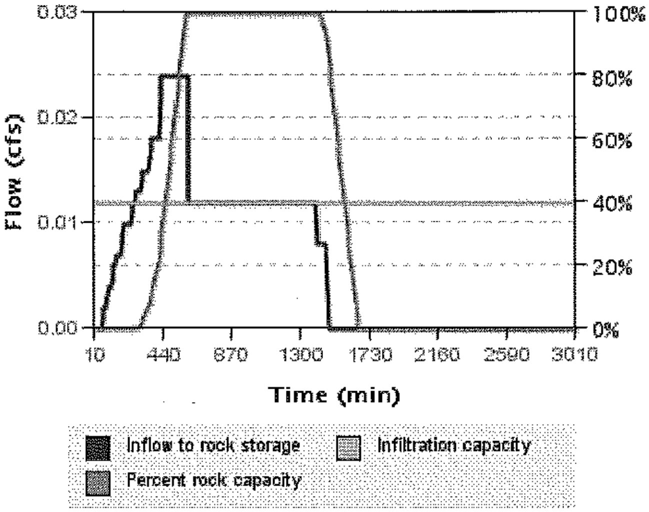
Pollution Reduction Event Surface Facility Modeling



Pollution Reduction Event Below Grade Modeling



10 Year Event Surface Facility Modeling

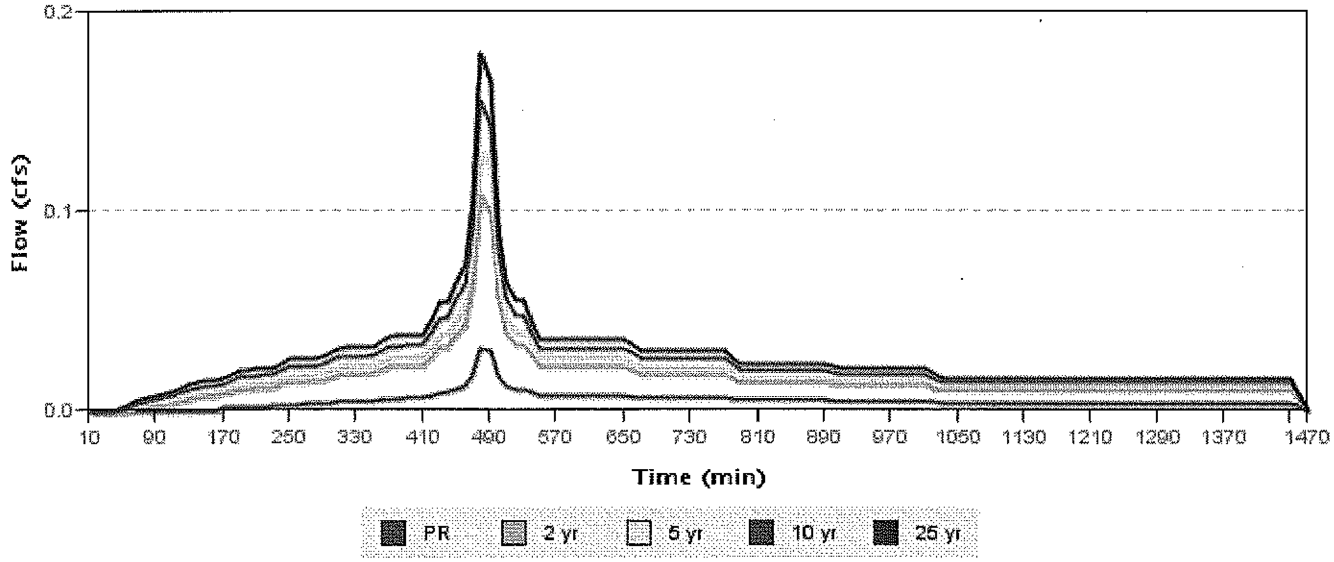


10 Year Event Below Grade Modeling

Catchment HydroCAD sized North Planter

Site Soils & Infiltration Testing Data	Infiltration Testing Procedure	**Open Pit Falling Head**
	Native Soil Infiltration Rate (I_{test})	**4.00**
Correction Factor	CF_{test}	**2**
Design Infiltration Rates	Native Soil (I_{dsgn})	**2.00 in/hr**
	Imported Growing Medium	**2.00 in/hr**
Catchment Information	Hierarchy Category	**3**
	Disposal Point	**A**
	Hierarchy Description	**Off-site flow to drainageway, river, or storm-only pipe system**
	Pollution Reduction Requirement	**Pass**
	10-year Storm Requirement	**N/A**
	Flow Control Requirement	**N/A**
	Impervious Area	**7623 sq ft** **0.175 acre**
	Time of Concentration (Tc)	**5**
	Pre-Development Curve Number (CN_{pre})	**72**
	Post-Development Curve Number (CN_{post})	**98**

SBUH Results

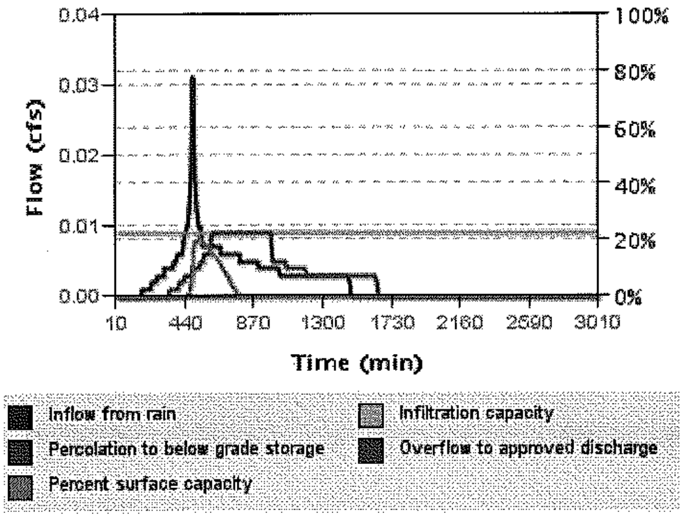


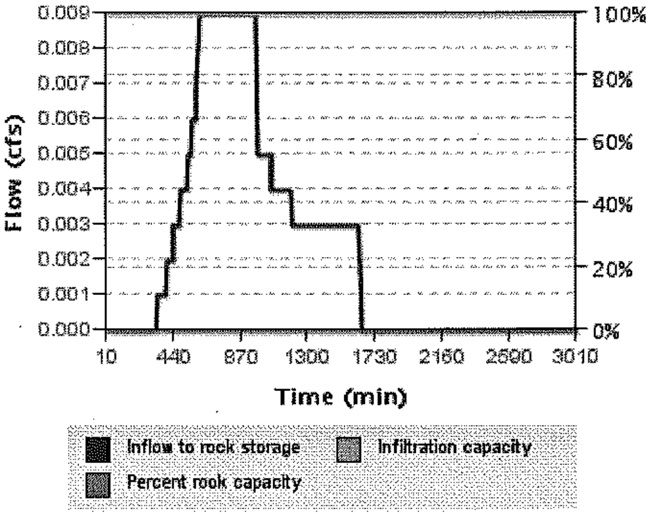
	Pre-Development Rate and Volume		Post-Development Rate and Volume	
	Peak Rate (cfs)	**Volume (cf)**	**Peak Rate (cfs)**	**Volume (cf)**
PR	0	0.44	0.031	398.323

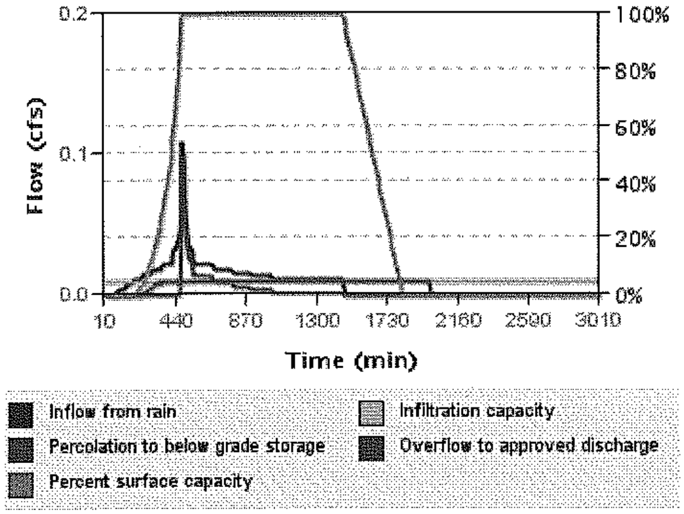
2 yr	0.009	303.338	0.108	1379.35
5 yr	0.022	475.961	0.131	1695.291
10 yr	0.036	670.855	0.155	2011.704
25 yr	0.052	883.254	0.179	2328.415

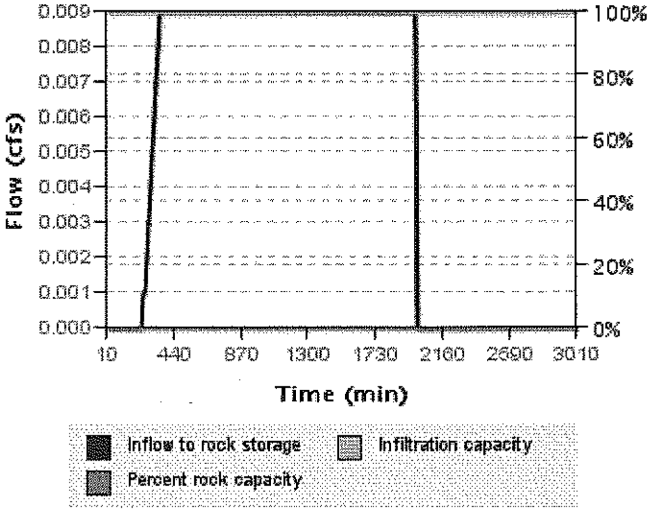
Facility HydroCAD sized North Planter

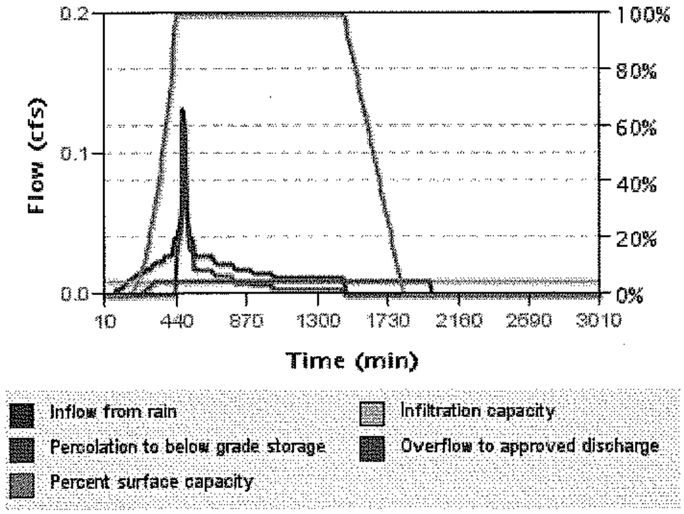
Facility Details	Facility Type	**Planter (Flat)**
	Facility Configuration	**B: Infl. with rock storage (RS)**
	Facility Shape	**Planter**
	Above Grade Storage Data	
	Bottom Area	**200 sq ft**
	Bottom Width	**10.00 ft**
	Storage Depth 1	**12.0 in**
	Growing Medium Depth	**18 in**
	Surface Capacity at Depth 1	**200.0 cu ft**
	Design Infiltration Rate for Native Soil	**0.009 in/hr**
	Infiltration Capacity	**0.009 cfs**
	Below Grade Storage Data	
	Rock Storage Depth	**12 in**
	Rock Porosity	**0.30 in**
Facility Facts	Total Facility Area Including Freeboard	**200.00 sq ft**
	Sizing Ratio	**2.6%**
Pollution Reduction Results	Pollution Reduction Score	**Pass**
	Overflow Volume	**0.000 cf**
	Surface Capacity Used	**20%**
	Rock Capacity Used	**0%**
Flow Control Results	Flow Control Score	**Not Used**
	Overflow Volume	**1048.391 cf**
	Surface Capacity Used	**100%**
	Rock Capacity Used	**0%**

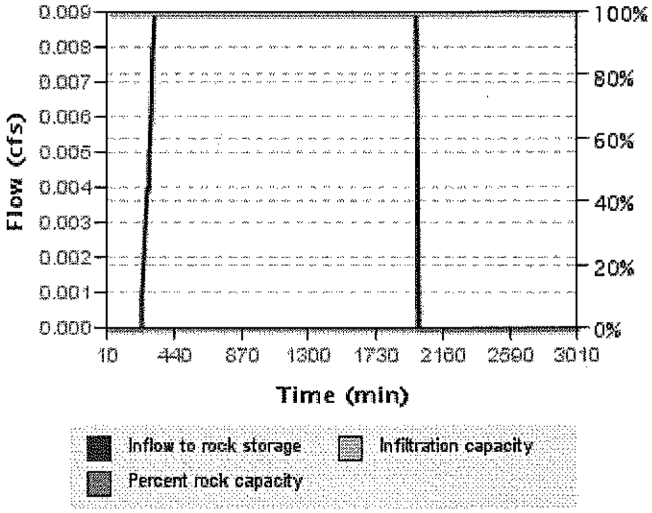

Pollution Reduction Event Surface Facility Modeling


Pollution Reduction Event Below Grade Modeling

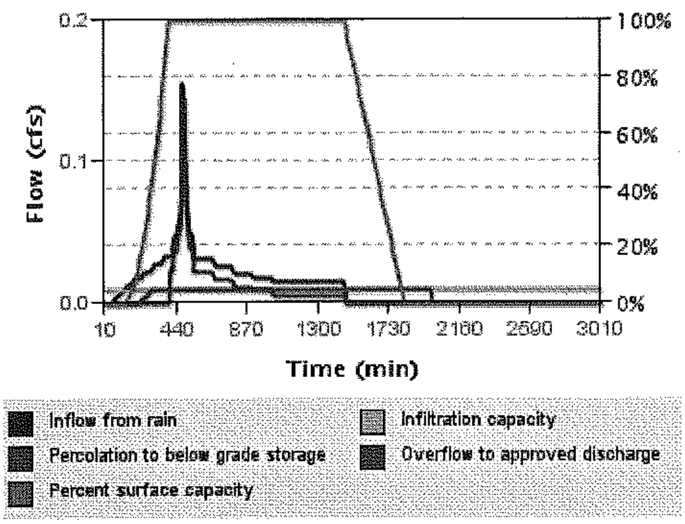

2 Year Event Surface Facility Modeling


2 Year Event Below Grade Modeling

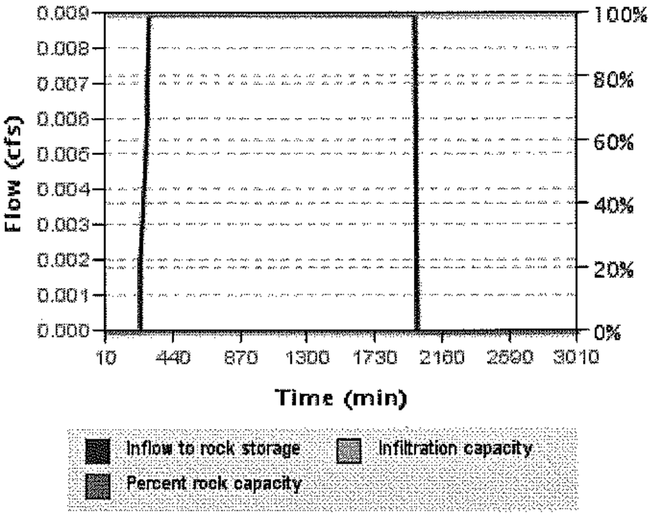

5 Year Event Surface Facility Modeling


5 Year Event Below Grade Modeling

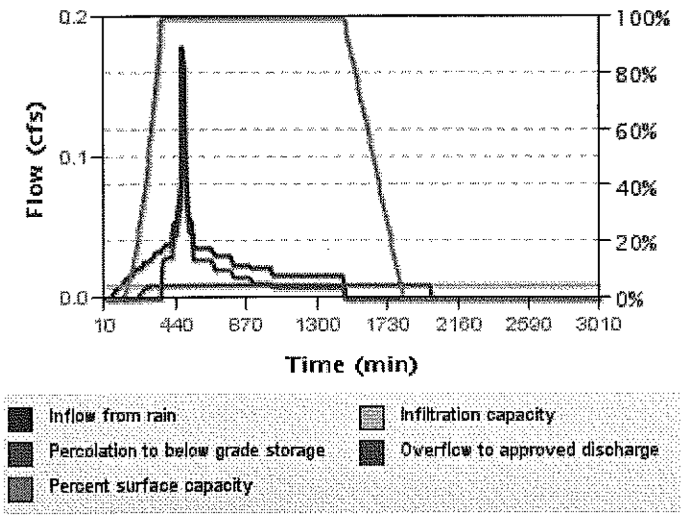
10 Year Event Surface Facility Modeling



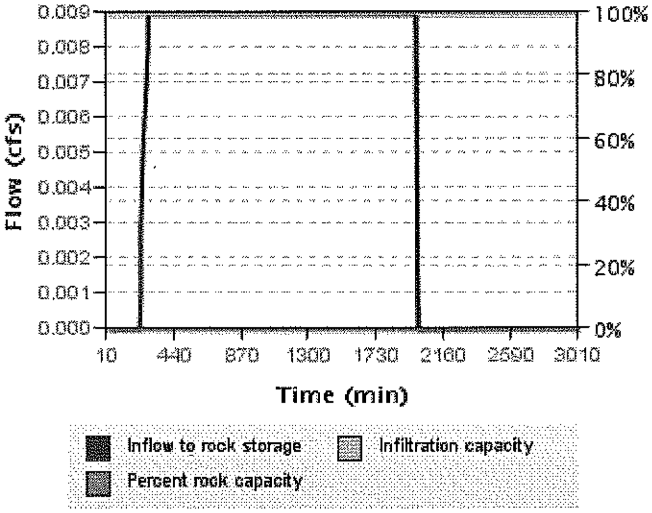
10 Year Event Below Grade Modeling



25 Year Event Surface Facility Modeling



25 Year Event Below Grade Modeling



Appendix F

XP-SWMM Output

XP-SWMM Routing Table

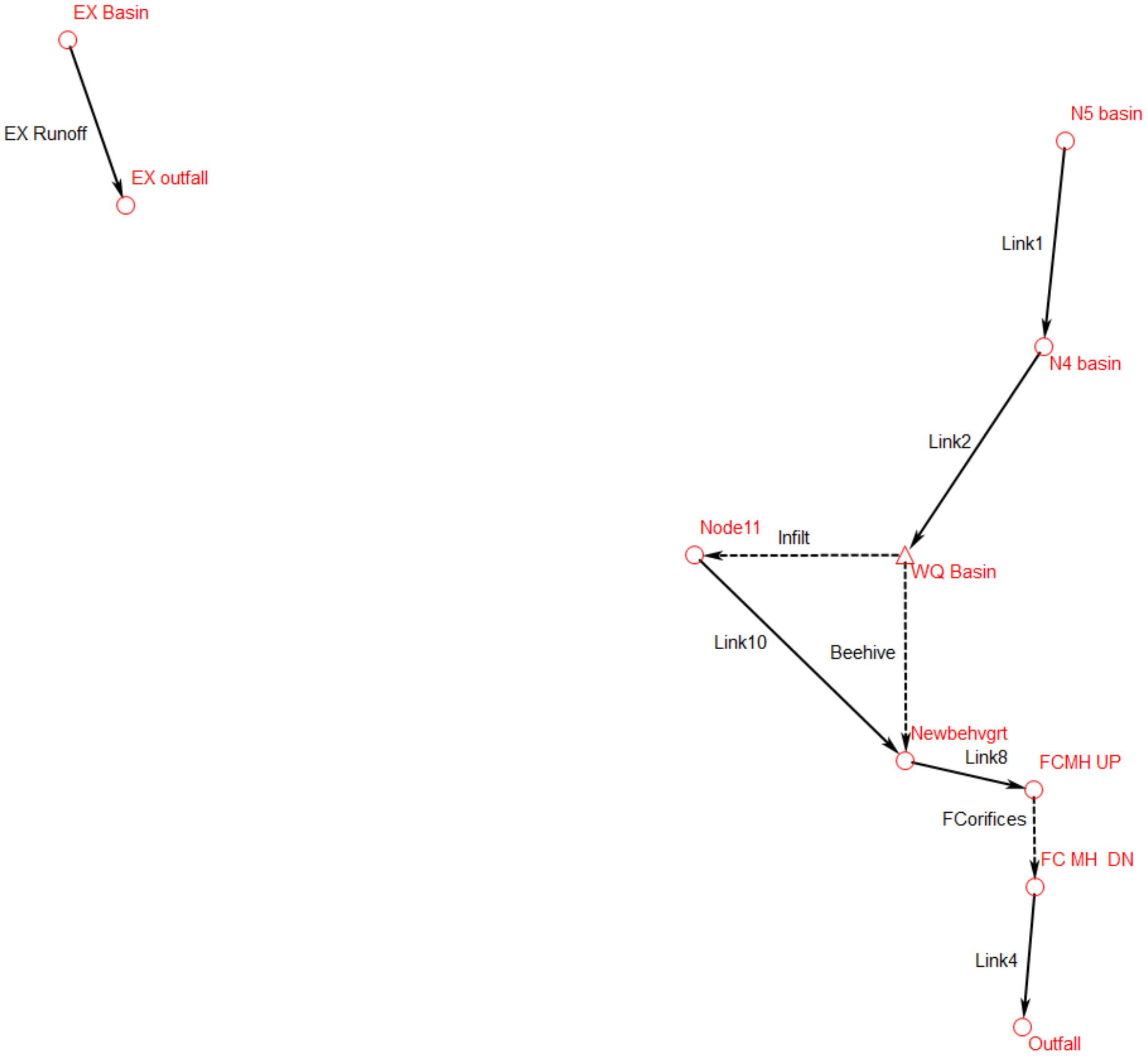
18328 Kellogg Creek Emergency Bridge Replacement

Routing Table				
Manhole ID	**Impervious Area (ac)**	**Pervious Area (ac)**	**Total Area (ac)**	**Drainage Basin**
CB1	0.06	N/A	0.064	N5
CB3	0.11	N/A	0.111	N4

XP-SWMM Layout

Kellogg Creek Emergency Bridge Replacement

Existing & Proposed Conditions



XP-SWMM RUNOFF DATA

Kellogg Creek Emergency Bridge Replacement

Existing & Proposed Conditions

SCS Type 1A 2-, 5-, 10-, 25-, 100-Year Storm Events									
XP-SWMM Input Data						XP-SWMM Output Data			
Node Name	Storm	Total Area (ac)	Impervious %	Curve Number	Tc (min)	Max. Rainfall Intensity (in/hr)	Unit Hydrograph Method	Infiltration Depth (in)	Surface Runoff Flow (cfs)
N5 basin	2-YR	0.06	100	98	5	0.74	Santa Barbara	0.00	0.04
N5 basin	5-YR	0.06	100	98	5	0.89	Santa Barbara	0.00	0.05
N5 basin	10-YR	0.06	100	98	5	1.00	Santa Barbara	0.00	0.06
N5 basin	25-YR	0.06	100	98	5	1.16	Santa Barbara	0.00	0.07
N5 basin	100-YR	0.06	100	98	5	1.42	Santa Barbara	0.00	0.09
N4 basin	2-YR	0.11	100	98	5	0.74	Santa Barbara	0.00	0.07
N4 basin	5-YR	0.11	100	98	5	0.89	Santa Barbara	0.00	0.09
N4 basin	10-YR	0.11	100	98	5	1.00	Santa Barbara	0.00	0.10
N4 basin	25-YR	0.11	100	98	5	1.16	Santa Barbara	0.00	0.12
N4 basin	100-YR	0.11	100	98	5	1.42	Santa Barbara	0.00	0.15
EX Basin	2-YR	0.18	0	70	27.1	0.74	Santa Barbara	1.97	0.00
EX Basin	5-YR	0.18	0	70	27.1	0.89	Santa Barbara	2.21	0.01
EX Basin	10-YR	0.18	0	70	27.1	1.00	Santa Barbara	2.37	0.01
EX Basin	25-YR	0.18	0	70	27.1	1.16	Santa Barbara	2.58	0.02
EX Basin	100-YR	0.18	0	70	27.1	1.42	Santa Barbara	2.85	0.04

XP-SWMM HYDRAULICS DATA

Kellogg Creek Emergency Bridge Replacement

Existing & Proposed Conditions

SCS Type 1A 2-, 5-, 10-, 25-, 100-Year Storm Events																				
Location				Conduit Properties				Conduit Profile								Conduit Results				
Link Name	Storm	Node Limits		Diameter		Length	Slope	Ground Elevation (ft)		Invert Elevation (ft)		Max. Water Elevation (ft)		Freeboard (ft)		Design Flow	Max. Flow	Max. Velocity	Max. Depth	y/d0
		From	To	in	ft	ft	%	US	DS	US	DS	US	DS	US	DS	(cfs)	(cfs)	(ft/s)	(ft)	
Link1	2-YR	N5 basin	N4 basin	10	0.83	29.50	2.8	31.84	30.52	27.98	27.16	28.04	27.36	3.80	3.16	3.61	0.04	2.24	0.20	0.24
Link1	5-YR	N5 basin	N4 basin	10	0.83	29.50	2.8	31.84	30.52	27.98	27.16	28.05	27.53	3.79	2.99	3.61	0.05	2.38	0.37	0.45
Link1	10-YR	N5 basin	N4 basin	10	0.83	29.50	2.8	31.84	30.52	27.98	27.16	28.05	27.55	3.79	2.97	3.61	0.06	2.44	0.39	0.47
Link1	25-YR	N5 basin	N4 basin	10	0.83	29.50	2.8	31.84	30.52	27.98	27.16	28.06	27.58	3.78	2.94	3.61	0.07	3.23	0.42	0.51
Link1	100-YR	N5 basin	N4 basin	10	0.83	29.50	2.8	31.84	30.52	27.98	27.16	28.07	27.59	3.77	2.93	3.61	0.08	2.71	0.43	0.52
Link2	2-YR	N4 basin	WQ Basin	10	0.83	22.27	0.6	30.52	28.00	27.04	26.91	27.36	27.36	3.16	0.64	1.66	0.12	1.76	0.45	0.55
Link2	5-YR	N4 basin	WQ Basin	10	0.83	22.27	0.6	30.52	28.00	27.04	26.91	27.53	27.53	2.99	0.47	1.66	0.14	1.86	0.62	0.75
Link2	10-YR	N4 basin	WQ Basin	10	0.83	22.27	0.6	30.52	28.00	27.04	26.91	27.55	27.55	2.97	0.45	1.66	-0.22	1.68	0.64	0.77
Link2	25-YR	N4 basin	WQ Basin	10	0.83	22.27	0.6	30.52	28.00	27.04	26.91	27.58	27.57	2.94	0.43	1.66	0.22	1.45	0.66	0.80
Link2	100-YR	N4 basin	WQ Basin	10	0.83	22.27	0.6	30.52	28.00	27.04	26.91	27.59	27.58	2.93	0.42	1.66	0.23	1.30	0.67	0.81
Beehive	2-YR	WQ Basin	Newbehvgrt	0	0.00	0.00	0.0	28.00	28.02	0.00	0.00	27.36	24.07	0.64	3.95	0.00	0.00	0.00	0.00	0.00
Beehive	5-YR	WQ Basin	Newbehvgrt	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.53	24.30	0.47	3.72	0.00	0.02	0.00	0.00	0.00
Beehive	10-YR	WQ Basin	Newbehvgrt	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.55	24.54	0.45	3.48	0.00	0.07	0.00	0.00	0.00
Beehive	25-YR	WQ Basin	Newbehvgrt	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.57	25.00	0.43	3.02	0.00	0.23	0.00	0.00	0.00
Beehive	100-YR	WQ Basin	Newbehvgrt	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.58	25.80	0.42	2.22	0.00	0.25	0.00	0.00	0.00
Infilt	2-YR	WQ Basin	Node11	0	0.00	0.00	0.0	28.00	28.02	0.00	0.00	27.36	24.27	0.64	3.75	0.00	0.01	0.51	3.34	1.34
Infilt	5-YR	WQ Basin	Node11	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.53	24.31	0.47	3.71	0.00	0.01	0.51	3.51	1.40
Infilt	10-YR	WQ Basin	Node11	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.55	24.54	0.45	3.48	0.00	0.01	0.51	3.53	1.41
Infilt	25-YR	WQ Basin	Node11	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.57	25.02	0.43	3.00	0.00	0.01	0.51	3.56	1.42
Infilt	100-YR	WQ Basin	Node11	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	27.58	25.82	0.42	2.20	0.00	0.01	0.51	3.56	1.43
Link4	2-YR	FC MH DN	Outfall	10	0.83	30.20	1.0	28.00	28.00	23.64	23.35	23.69	23.39	4.31	4.61	2.12	0.01	1.05	0.05	0.05
Link4	5-YR	FC MH DN	Outfall	10	0.83	30.20	1.0	28.00	28.00	23.64	23.35	23.70	23.40	4.30	4.60	2.12	0.02	1.18	0.06	0.07
Link4	10-YR	FC MH DN	Outfall	10	0.83	30.20	1.0	28.00	28.00	23.64	23.35	23.70	23.41	4.30	4.59	2.12	0.02	1.25	0.06	0.07
Link4	25-YR	FC MH DN	Outfall	10	0.83	30.20	1.0	28.00	28.00	23.64	23.35	23.71	23.42	4.29	4.58	2.12	0.03	1.37	0.07	0.08
Link4	100-YR	FC MH DN	Outfall	10	0.83	30.20	1.0	28.00	28.00	23.64	23.35	23.71	23.42	4.29	4.58	2.12	0.04	1.45	0.07	0.09
EX Runoff	2-YR	EX Basin	EX outfall	24	2.00	100.00	5.0	30.00	30.00	15.00	10.00	15.01	10.00	14.99	20.00	50.59	0.00	3.59	0.01	0.00
EX Runoff	5-YR	EX Basin	EX outfall	24	2.00	100.00	5.0	30.00	30.00	15.00	10.00	15.01	10.00	14.99	20.00	50.59	0.01	3.55	0.01	0.01
EX Runoff	10-YR	EX Basin	EX outfall	24	2.00	100.00	5.0	30.00	30.00	15.00	10.00	15.02	10.01	14.98	19.99	50.59	0.01	4.94	0.02	0.01
EX Runoff	25-YR	EX Basin	EX outfall	24	2.00	100.00	5.0	30.00	30.00	15.00	10.00	15.03	10.01	14.97	19.99	50.59	0.02	3.13	0.03	0.01
EX Runoff	100-YR	EX Basin	EX outfall	24	2.00	100.00	5.0	30.00	30.00	15.00	10.00	15.04	10.02	14.96	19.98	50.59	0.04	3.20	0.04	0.02
Link8	2-YR	Newbehvgrt	FCMH UP	10	0.83	23.00	0.6	28.02	28.02	24.02	23.89	24.07	23.93	3.95	4.09	1.63	0.01	0.85	0.05	0.06
Link8	5-YR	Newbehvgrt	FCMH UP	10	0.83	23.00	0.6	28.02	28.02	24.02	23.89	24.30	24.30	3.72	3.72	1.63	0.02	0.99	0.41	0.50
Link8	10-YR	Newbehvgrt	FCMH UP	10	0.83	23.00	0.6	28.02	28.02	24.02	23.89	24.54	24.54	3.48	3.48	1.63	0.04	1.13	0.65	0.78
Link8	25-YR	Newbehvgrt	FCMH UP	10	0.83	23.00	0.6	28.02	28.02	24.02	23.89	25.00	25.07	3.02	2.95	1.63	0.41	1.38	1.18	1.42
Link8	100-YR	Newbehvgrt	FCMH UP	10	0.83	23.00	0.6	28.02	28.02	24.02	23.89	25.80	25.88	2.22	2.14	1.63	0.53	1.39	1.99	2.40
FCorifices	2-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	28.02	28.00	0.00	0.00	23.93	23.69	4.09	4.31	0.00	0.00	0.00	0.00	0.00

XP-SWMM HYDRAULICS DATA

Kellogg Creek Emergency Bridge Replacement

Existing & Proposed Conditions

SCS Type 1A 2-, 5-, 10-, 25-, 100-Year Storm Events																				
Location				Conduit Properties				Conduit Profile								Conduit Results				
Link Name	Storm	Node Limits		Diameter		Length	Slope	Ground Elevation (ft)		Invert Elevation (ft)		Max. Water Elevation (ft)		Freeboard (ft)		Design Flow	Max. Flow	Max. Velocity	Max. Depth	y/d0
		From	To	in	ft	ft	%	US	DS	US	DS	US	DS	US	DS	(cfs)	(cfs)	(ft/s)	(ft)	
FCorifices	5-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	24.30	23.70	3.72	4.30	0.00	0.00	0.00	0.00	0.00
FCorifices	10-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	24.54	23.70	3.48	4.30	0.00	0.00	0.00	0.00	0.00
FCorifices	25-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	25.07	23.71	2.95	4.29	0.00	0.00	0.00	0.00	0.00
FCorifices	100-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	25.88	23.71	2.14	4.29	0.00	0.00	0.00	0.00	0.00
FCorifices	2-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	28.02	28.00	0.00	0.00	23.93	23.69	4.09	4.31	0.01	0.01	18.24	2.03	25.49
FCorifices	5-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	24.30	23.70	3.72	4.30	0.01	0.02	6.59	2.40	30.09
FCorifices	10-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	24.54	23.70	3.48	4.30	0.01	0.02	7.58	2.64	33.04
FCorifices	25-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	25.07	23.71	2.95	4.29	0.01	0.03	5.44	3.17	39.73
FCorifices	100-YR	FCMH UP	FC MH DN	0	0.00	0.00	0.0	0.00	0.00	0.00	0.00	25.88	23.71	2.14	4.29	0.01	0.04	5.48	3.98	49.89
Link10	2-YR	Node11	Newbehvgrt	4	0.33	30.00	0.6	28.02	28.02	24.20	24.02	24.27	24.07	3.75	3.95	0.15	0.01	0.98	0.07	0.21
Link10	5-YR	Node11	Newbehvgrt	4	0.33	30.00	0.6	28.02	28.02	24.20	24.02	24.31	24.30	3.71	3.72	0.15	0.01	1.02	0.28	0.84
Link10	10-YR	Node11	Newbehvgrt	4	0.33	30.00	0.6	28.02	28.02	24.20	24.02	24.54	24.54	3.48	3.48	0.15	0.01	1.04	0.52	1.55
Link10	25-YR	Node11	Newbehvgrt	4	0.33	30.00	0.6	28.02	28.02	24.20	24.02	25.02	25.00	3.00	3.02	0.15	0.04	1.04	0.98	2.95
Link10	100-YR	Node11	Newbehvgrt	4	0.33	30.00	0.6	28.02	28.02	24.20	24.02	25.82	25.80	2.20	2.22	0.15	0.06	1.04	1.78	5.33