8.0
APPENDIX

Appendix

a. TIR

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner Highline College

Phone ____

Address ____

____

Project Engineer Martin F. Chase

Company KPFF, Inc.

Phone 206-622-5822

Part 2 PROJECT LOCATION AND DESCRIPTION

Project Name Master Plan

DDES Permit # ____

Location Township 22N

Range 4E

Section SESW, SWSE

Site Address ____

Part 3 TYPE OF PERMIT APPLICATION

- ☐ Landuse Services
  Subdivison / Short Subd. / UPD
- ☐ Building Services
  M/F / Commerical / SFR
- ☐ Clearing and Grading
- ☐ Right-of-Way Use
- ☐ Other ____

Part 4 OTHER REVIEWS AND PERMITS

- ☐ DFW HPA
- ☐ COE 404
- ☐ DOE Dam Safety
- ☐ FEMA Floodplain
- ☐ COE Wetlands
- ☐ Other ____
- ☐ Shoreline Management
- ☐ Structural Rockery/Vault/____
- ☐ ESA Section 7

Part 5 PLAN AND REPORT INFORMATION

Technical Information Report

Type of Drainage Review (circle): (Full) / Targeted / Large Site

Date (include revision dates): 6/6/2016

Date of Final: 11/22/2016

Site Improvement Plan (Engr. Plans)

Type (circle one): Full / Modified / Small Site

Date (include revision dates): x/x/xxxx

Date of Final: ____

Part 6 ADJUSTMENT APPROVALS

Type (circle one): Standard / Complex / Preapplication / Experimental / Blanket

Description: (include conditions in TIR Section 2)

____

____

____

Date of Approval: ____

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 7 MONITORING REQUIREMENTS

Monitoring Required: Yes / (No) (circled)

Start Date: ____________

Completion Date: ____________

Describe: ____________

Part 8 SITE COMMUNITY AND DRAINAGE BASIN

Community Plan : ____________

Special District Overlays: ____________

Drainage Basin: Lower Puget Sound, Masey Creek

Stormwater Requirements: CSWPPP, Level 2 Flow control, WQ Enhanced Water Quality treatment

Part 9 ONSITE AND ADJACENT SENSITIVE AREAS

- [x] River/Stream ____________
- [ ] Lake ____________
- [x] Wetlands ____________
- [ ] Closed Depression ____________
- [ ] Floodplain ____________
- [ ] Other ____________
- [x] Steep Slope ____________
- [ ] Erosion Hazard ____________
- [ ] Landslide Hazard ____________
- [ ] Coal Mine Hazard ____________
- [ ] Seismic Hazard ____________
- [ ] Habitat Protection ____________
- [ ] ____________

Part 10 SOILS

Soil Type	Slopes	Erosion Potential
Arent, Alderwood material (AmC)		

- [ ] High Groundwater Table (within 5 feet)
- [ ] Other ____________
- [ ] Sole Source Aquifer
- [ ] Seeps/Springs

- [ ] Additional Sheets Attached

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 11 DRAINAGE DESIGN LIMITATIONS

REFERENCE	LIMITATION / SITE CONSTRAINT
☐ Core 2 – Offsite Analysis	
☐ Sensitive/Critical Areas	
☒ SEPA	
☐ Other	
☐	

☐ Additional Sheets Attached

Part 12 TIR SUMMARY SHEET (provide one TIR Summary Sheet per Threshold Discharge Area)

Threshold Discharge Area: (name or description)	
Core Requirements (all 8 apply)	
Discharge at Natural Location	Number of Natural Discharge Locations:
Offsite Analysis	Level: (1) / 2 / 3 dated:
Flow Control (incl. facility summary sheet)	Level: 1 / (2) / 3 or Exemption Number ____ Small Site BMPs
Conveyance System	Spill containment located at:
Erosion and Sediment Control	ESC Site Supervisor: Contact Phone: After Hours Phone: NA for Master Plan
Maintenance and Operation	Responsibility: (Private) / Public If Private, Maintenance Log Required: (Yes) / No
Financial Guarantees and Liability	Provided: Yes / No NA for Master Plan
Water Quality (include facility summary sheet)	Type: Basic / Sens. Lake / (Enhanced Basicm) / Bog or Exemption No. Landscape Management Plan: Yes / No
Special Requirements (as applicable)	
Area Specific Drainage Requirements	Type: CDA / SDO / MDP / BP / LMP / Shared Fac. / None Name:
Floodplain/Floodway Delineation	Type: Major / Minor / Exemption / None 100-year Base Flood Elevation (or range): Datum:
Flood Protection Facilities	Describe:
Source Control (comm./industrial landuse)	Describe landuse: Describe any structural controls:

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Oil Control	High-use Site: Yes / No (circled: No) Treatment BMP: ______ Maintenance Agreement: Yes / No with whom? ______
Other Drainage Structures	
Describe:	

Part 13 EROSION AND SEDIMENT CONTROL REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION	MINIMUM ESC REQUIREMENTS AFTER CONSTRUCTION
☐ Clearing Limits	☐ Stabilize Exposed Surfaces
☐ Cover Measures	☐ Remove and Restore Temporary ESC Facilities
☐ Perimeter Protection	☐ Clean and Remove All Silt and Debris, Ensure Operation of Permanent Facilities
☐ Traffic Area Stabilization	☐ Flag Limits of SAO and open space preservation areas
☐ Sediment Retention	☐ Other ______
☐ Surface Water Collection	
☐ Dewatering Control	
☐ Dust Control	
☐ Flow Control	

Part 14 STORMWATER FACILITY DESCRIPTIONS (Note: Include Facility Summary and Sketch)

Flow Control	Type/Description	Water Quality	Type/Description
☒ Detention	Combined wet and detention pond	☐ Biofiltration	______
☐ Infiltration	______	☐ Wetpool	______
☒ Regional Facility	______	☐ Media Filtration	______
☐ Shared Facility	______	☐ Oil Control	______
☒ Flow Control BMPs	______	☐ Spill Control	______
☐ Other	______	☐ Flow Control BMPs	Bioretention with underdrain and CAVFS
		☒ Other	

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

Part 15 EASEMENTS/TRACTS	Part 16 STRUCTURAL ANALYSIS
☐ Drainage Easement	☐ Cast in Place Vault
☐ Covenant	☐ Retaining Wall
☐ Native Growth Protection Covenant	☐ Rockery > 4' High
☐ Tract	☐ Structural on Steep Slope
☐ Other	☐ Other

Part 17 SIGNATURE OF PROFESSIONAL ENGINEER

I, or a civil engineer under my supervision, have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attached Technical Information Report. To the best of my knowledge the information provided here is accurate.

[signature] # 23482 11/22/16

Signed/Date

Highline College

Des Moines, WA

MASTER PLAN

Technical Information Report

November 22, 2016

kpff Consulting Engineers

MASTER PLAN
Technical Information Report

November 22, 2016

Prepared for:

McGranahan Architects
2111 Pacific Avenue, Suite 100
Tacoma, WA 98402

Prepared by:

KPFF Consulting Engineers
1601 Fifth Avenue, Suite 1600
Seattle, WA 98101

KPFF Project No. 1600027.00

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Appendix A:

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SECTION 1 Project Overview

The purpose of this Technical Information Report (TIR) is to assess the drainage, stormwater detention, and water quality treatment requirements associated with the developments outlined in the Highline College Master Plan prepared by McGranahan Architects. The envisioned plan improvements include:

Short Term (through year 2020):

- Building 26 Renovation
- North Extension to the East Parking Lot
- West Parking Lot

Mid Term (through year 2029):

- South Extension to the East Parking Lot
- Loop Road
- Building 23 Renovation
- Grand Stand Seating and Turf
- North Extension to South Parking Lot
- Residence Hall
- Building 16 Replacement
- East Campus Pedestrian Improvement

Note that this TIR looks at the campus as a whole from a master planning perspective to assess the impact on the regional campus stormwater pond volume bank and how the campus can implement natural drainage practices or low-impact development practices. The projects noted above, if implemented, will have separate Technical Information Reports prepared and submitted for building permit when that time comes. These reports will have more detailed information specific to the project site than this report.

Highline College (HC) is located on approximately 72 acres in the City of Des Moines, Washington. It is bounded by South 236th Street to the north, Pacific Highway to the east, South 240th Street to the south, and 20th Avenue South to the west. See Figure 1 below.

Figure 1: Highline College Vicinity Map

This TIR references Technical Information Reports prepared for a previous master plan (2002) and for projects that were constructed on the campus after that master plan. The purpose of referencing the previous Technical Information Reports is that a regional campus stormwater pond constructed in 2000 serves as a detention and water quality bank for future developments. The previous reports outline the progression of the status of available storage volume in the pond after subsequent campus developments, as noted below:

- HCC Surface Water Control Project Final Stormwater Model Report, prepared by Horton Dennis & Associates, Inc. December 16, 1998
- Student Union TIR, prepared by Coughlin Porter Lundeen March 25, 2003
- Regional Detention and Water Quality TIR, prepared by KPFF, April 3, 2003
- Early Childhood Learning Center, prepared by KPFF, April 28, 2003
- Higher Education Center TIR, prepared by MKA, June 12, 2003
- North Parking Lot Redevelopment, prepared by KPFF, August 4, 2004
- 2005 Campus Projects Drainage Report, prepared by KPFF, July 18, 2005
- Building 24A Maintenance /Grounds Facility Improvements, prepared by Reid Middleton, April 2015

DEVELOPMENT SINCE 2005

Two projects have been constructed since the 2005 Campus Projects TIR – the recently completed Maintenance Building 24A, and the West Gravel Parking Lot.

Maintenance Building 24A

A TIR was submitted for the project and stormwater is managed on-site with a detention vault and a filter canister system providing basic water quality treatment. The project does not add or subtract to the storage volume bank for the regional detention pond per discussions with the City Engineer (see meeting minutes in Appendix A).

West Gravel Parking Lot

This parking lot was built in 2005 and is gravel in the existing condition. It is located west of the north parking lot adjacent to the steep slope down towards the ravine at the west edge of the campus. It is approximately 0.70 acres. The area was forested before being developed. A TIR was not submitted for the project and stormwater infrastructure was not part of the project.

MASTER PLAN SHORT-TERM PROJECTS

The following is a summary of the short-term projects envisioned by the current master plan. The short-term project timeline includes projects hopeful to be completed by the year 2020. Please refer to Exhibit B-1 Development Map Short-Term Plan and Exhibit B-15 for Area Calculations.

Building 26 Renovation

This building renovation and addition includes the demolition of Buildings 5 and 11. The former Building 5 and 11 sites will be converted to pervious surfaces. The net total replaced impervious area of these three sites is less than 5,000 square feet, and stormwater management is therefore not required per Section 1.2.3 of the King County Surface Water Design Manual.

North Extension to East Parking Lot

This parking lot is located at the entrance to the campus from Pacific Way near the proposed entrance developed by Sound Transit. It is an extension of the existing East Parking Lot and it includes approximately 1.30 acres of new and replaced impervious surface. Detention will either be provided in a buried pipe/vault or provided by the regional pond. We have provided calculations in this report to show how the pond is affected if this is the preferred method of detaining the stormwater. Water quality treatment will be provided by bioretention or filter cartridges.

West Parking Lot

The West Parking Lot is currently gravel and will be improved by adding asphalt pavement and stormwater improvements. Stormwater management was not designed for the project at the time of development, and detention calculations will therefore assume the existing conditions as forested to account for the gravel lot development. Detention will be provided in the regional pond and water quality treatment will be provided by bioretention or filter cartridges.

MASTER PLAN MID-TERM PROJECTS

The following is a summary of the mid-term projects envisioned by the current master plan. The mid-term project timeline includes projects hopeful to be completed by the year 2029. Please refer to Exhibit B-2 Development Map Mid-Term Plan.

South Extension to East Parking Lot

This parking lot is located at the south end of the East Parking Lot. It is an extension of the parking lot and it includes approximately 0.90 acres of new and replaced impervious surface. Detention will be provided in the regional pond and water quality treatment will be provided by bioretention or filter cartridges.

Loop Road

This one-way road will connect the North Parking Lot to South 240th Street via the West and South parking lots. The length of the road is approximately 600 feet. The total new impervious surface is 0.22 acres. Detention will be provided in the regional pond and water quality treatment will be provided by bioretention or filter cartridges and compost-amended vegetated filter strips.

Building 23 Renovation

This renovation project will include an addition on the east side of the building. Buildings 15 and 18 will be demolished as part of the project. The total new and replaced impervious surface is less than 5,000 square feet and flow control is therefore not required. The project does not include pollution-generating impervious surface, so water quality treatment is not required.

Grand Stand Seating and Turf

The grand stand the artificial turf ball field will be approximately 2 acres. Detention will be provided in the regional pond and water quality treatment will be not be required, since no pollution-generating impervious surface is created. The artificial turf will be modeled per code as 25% impervious and 75% pervious (grass).

North Extension to South Parking Lot

This parking lot is an extension of the South Parking Lot to the north. It includes approximately 0.32 acres of new impervious surface. Detention will be provided in the regional pond and water quality treatment will be provided by bioretention or filter cartridges.

Residence Hall

This project is approximately 3 acres and is located between the tennis courts and the south parking lot. The project will have on-site stormwater facilities and will not use the regional pond for detention storage or water quality treatment. The project will drain to South 240th Street and will not impact the regional pond.

Building 16 Replacement

This project will replace existing Building 16 with a new building in the same location but smaller footprint in the northeast area of the campus.   The total new or replaced impervious surface is 0.64 acres. Detention will be provided in the regional pond and water quality treatment, if needed, will be provided by bioretention or filter cartridges.

East Campus Pedestrian Improvements

This project will replace existing sidewalks along the west edge of the East Parking Lot.   The total new or replaced impervious surface is 0.73 acres. Detention will be provided in the regional pond. Water quality will not be required as there are no new pollution generating surfaces.

Existing Site Topography and Drainage Patterns

Overall the campus topography slopes south and west, which is why the existing regional stormwater pond is located in the southwest corner of the campus. The design of the existing pond is addressed in the Surface Water Control Project Final Stormwater Model Report for Susan Black & Associates, dated December 16, 1998, by Horton Dennis & Associates, Inc.

This multi-cell pond constructed in 2000 was not built as a requirement of development mitigation at the time, but to lessen the stormwater impacts to Massey Creek from existing campus improvements. Currently, the pond is functioning as designed and is in a well maintained condition.

The volume of the pond is 9.92 acre-feet based on a topographic survey after the pond was built and currently modeled in Civil3D software. Note that previous TIR's have listed the existing pond volume at 9.49 acre-feet. To be consistent with past volume calculations, we will use 9.49 acre-feet for this report. See Appendix A, Exhibit A-3 for a plan of the existing stormwater pond.

The SCS Soils Map indicates that the campus is predominantly Arents, Alderwood material (AmC) and can be seen in Appendix A.

The City has requested that the current drainage basin to the pond is modeled to confirm the pond is functioning as designed. This will consist of modeling the actual drainage basin to the pond and routing it through the pond using a stage-storage table based on as-built information. The pond was surveyed in 2003 and this information is used for the model.

The current pond drainage basins and site characteristics are depicted in Exhibits A-11 and A-13 in Appendix A. In order to determine the peak flows from the pond, the stage storage table for the pond was used in the KCRTS calculation (Appendix A, Exhibit 14). The peak outflows are listed in Table 1.

Table 1: Peak Outflows

Peak Outflow	Pond Design (1)	Current Outflows (2)
	(cfs)	(cfs)
2-year	7.25	7.14
10-year	8.04	8.80
100-year	10.39	10.97

(1) Pond Design values from Horton Dennis report

(2) Existing pond outflows from KCRTS calculations, see appendix A, Exhibit A-15.

DEVELOPED SITE TOPOGRAPHY AND DRAINAGE PATTERNS

The developed conditions of these projects will not change the overall topography and drainage patterns of the HC campus. See Exhibit B-2 Development Areas in Appendix B for the developed conditions for each site.

SECTION 2 Conditions and Requirements Summary

The methodology used to analyze the stormwater detention and water quality requirements is based on input from the City of Des Moines and the 2016 King County Surface Water Design Manual (KCSWDM).

The Master Plan envisions the addition or replacement of more than 2,000 square feet of impervious surface and is therefore subject to Full Drainage Review. The eight core requirements and five special requirements apply to all projects contained in the Master Plan on a project-by-project basis.

CORE REQUIREMENT NO. 1 DISCHARGE AT NATURAL LOCATION

The project discharges to Massey Creek and will continue to discharge to Massey Creek.

CORE REQUIREMENT NO. 2 OFF-SITE ANALYSIS

An off-site analysis was performed and is described in Section 3 Off-Site Analysis.

CORE REQUIREMENT NO. 3 FLOW CONTROL

All projects included in this Master Plan are subject to Flow Control per the KCSWDM. Options and recommendations for Flow Control are described in Section 4 Flow Control and Water Quality Facility Analysis and Design.

CORE REQUIREMENT NO. 4 CONVEYANCE SYSTEM

All projects included in this Master Plan are subject to conveyance requirements per the KCSWDM.

CORE REQUIREMENT NO. 5 EROSION AND SEDIMENT CONTROL

All projects included in this Master Plan are subject to Erosion and Sediment Control per the KCSWDM. Erosion and sediment control will be designed on a project-by-project basis and is not included in this report.

CORE REQUIREMENT NO. 6 MAINTENANCE AND OPERATIONS

This TIR includes maintenance requirements for the regional pond (see Appendix E). All projects included in this Master Plan are subject to Maintenance and Operations requirements per the KCSWDM. The detention pond has been maintained by dredging and reducing vegetation using goats. Maintenance records are included in Appendix E.

CORE REQUIREMENT NO. 7 FINANCIAL GUARANTEES AND LIABILITY

Financial Guarantees and Liability is not applicable as no projects will actually be permitted or constructed as part of this report. However, this section will be applicable to projects when they move forward for permit and construction under separate TIR submissions.

CORE REQUIREMENT NO. 8 WATER QUALITY

All projects included in this Master Plan are subject to Enhanced Basic Water Quality Treatment per the KCSWDM. Options and recommendations for Water Quality treatment are described in Section 4 Flow Control and Water Quality Facility Analysis and Design.

SPECIAL REQUIREMENT NO. 1 OTHER ADOPTED REQUIREMENTS

The project site is not part of any adopted plan.

SPECIAL REQUIREMENT NO. 2 FLOOD HAZARD AREA DELINEATION

The project site is located outside FEMA flood plains. The Off-Site Topography Map in Appendix A shows the 100-year FEMA flood plain for Massey Creek downstream of the site.

SPECIAL REQUIREMENT NO. 3 FLOOD PROTECTION FACILITIES

There are no flood protection facilities on site and the Master Plan projects do not rely on any flood protection facilities.

SPECIAL REQUIREMENT NO. 4 SOURCE CONTROL

Individual projects on campus which require commercial building or site development permits are subject to source control regulations in accordance with the King County Stormwater Pollution Prevention Manual and King County Code 9.12.

SPECIAL REQUIREMENT NO. 5 OIL CONTROL

Individual projects on campus which meet the high-use site characteristics are subject to using the oil control treatment menu in the KCSWDM.

SECTION 3 Off-Site Analysis

A Level 1 analysis was performed for the site. Runoff from approximately 60 acres of the HC campus is routed through a piped conveyance system and detained in an existing detention pond located in the southwest portion of the campus. The pond was originally constructed in 2000 to help mitigate the impacts to Massey

Creek from the contributing watershed. The stormwater pond releases stormwater into a ravine at the northwest corner of the campus where the water eventually flows in to Massey Creek.

Some runoff from Campus bypasses the pond. Runoff from about 5 acres at the southeast end of the campus drains to South 240th Street, flowing west in South 240th Street and north in 20th Avenue South discharging in the aforementioned ravine and into Massey Creek. Another 8.8 acres of forest located west of the track drains to the ravine, likewise bypassing the pond.

TASK 1. STUDY AREA DEFINITION AND MAPS

Please see Appendix A for the off-site study area and Massey Creek drainage basin.

TASK 2. RESOURCE REVIEW

KPFF contacted the City of Des Moines and HC regarding drainage complaints and there were none. See Highline College Flooding and Hydrology Map in Appendix A. The King County iMap shows one drainage complaint downstream of the college beyond the extent of this downstream analysis. HC has no drainage issues on site.

TASK 3. FIELD INSPECTION

KPFF Consulting Engineers conducted a field site visit on March 30, 2016, to assess the condition of the off-site system conveying stormwater from the campus to Massey Creek. The detention pond was empty at the time and the outlet pipes from the second and third cell were dry (see Exhibit A-3 Existing Detention Pond Map and Exhibit A-10 for photos in Appendix A).

The outlet pipe from the smaller second cell discharges to a natural ravine. The discharge is regulated by a weir, thus allowing low flows. The beginning of the ravine is shallow and the bottom was dry and heavily vegetated for at least 20 yards past the discharge pipe, with no signs of erosion, at which point seeps from the ground produced a small flow of water. Further along the ravine is very steep with adjacent steep side slopes. The side slopes show signs of erosion; however, plants such as mosses and vines are growing on the bottom of the stream near the low-flow water level, indicating that the stream flow is small enough to maintain vegetation and therefore does not pose a risk in terms of erosion.

The outlet pipe from the main detention third cell is connected approximately 500 feet downstream to a 60-inch-diameter “energy dissipater stilling well” (see Drainage Plan from the 1998 Horton Dennis report in Appendix A) at the bottom of the hill. The structure was overflowing with a constant stream of water at the time of the field visit, even though the detention pond was empty. The water is presumably coming from underground seeps or a stream. The stream enters a wetland on the north side of the Campus access road and then enters a 4 feet diameter concrete culvert under 20th Avenue South. Sandbags have been placed at the outlet end of the culvert, presumably to slow down flows. There are some signs of erosion (exposed tree roots) one foot above the level of the creek. The creek meanders through a residential area with chain link fences on either side of the creek. Access to the creek is limited by the fences and heavy blackberry growth. The creek is far below 16th Avenue South at the intersection of 16th Avenue South and Massey creek. The culvert under 16th Avenue South is protected by tall gabion walls. Our field investigation ended at the intersection of 16th Avenue South and Massey Creek per the Level 1 requirements.

TASK 4. DRAINAGE SYSTEM DESCRIPTIONS AND PROBLEM DESCRIPTIONS

None.

TASK 5. MITIGATION OF EXISTING OR POTENTIAL PROBLEMS

Not applicable.

SECTION 4 Flow Control and Water Quality Facility Analysis and Design

EXISTING SITE HYDROLOGY (PART A)

The existing site hydrology including acreage and land covers for the pond drainage basin is shown on Exhibit A-11 in Appendix A. The existing site hydrology including acreage and land covers for the Master Plan projects are shown on Exhibits B-3, B-5, B-7, B-9, B-11, B-13 B-15 and B-17 in Appendix B.

DEVELOPED SITE HYDROLOGY (PART B)

The developed site hydrology including acreage and land covers for the pond drainage basin is shown on Exhibit A-12 in Appendix A. The developed site hydrology including acreage and land covers for the Master Plan projects are shown in Exhibits B-4, B-6, B-8, B-10, B-12, B-14, B-16 and B-18 in Appendix B.

Water Quality facilities for each Master Plan project is shown in Exhibits D-6 through D-9, Appendix D.

PERFORMANCE STANDARDS (PART C)

All campus projects modeled in this TIR are subject to the Level 2 Flow Control Standard as defined in the 2016 KCSWDM. Level 2 flow control requires maintaining the durations of high flows at their predevelopment levels for all flows greater than one-half of the 2-year peak flow up to the 50-year peak flow. The predevelopment peak flow rates for the 2-year and 10-year runoff events are also intended to be maintained when applying Level 2 flow control.

All projects with new or replaced pollutant generating surfaces will be subject to Enhanced Basic treatment for water quality. New pipe systems must contain (at a minimum) the 25-year peak flow. Existing pipe systems must contain (at a minimum) the 10-year peak flow.

FLOW CONTROL SYSTEM (PART D)

Per the original pond design described in the 1998 Dennis Horton report, all development projects must have two separate detention volume calculations: one that mitigates impacts from pre-developed (forested) conditions to existing conditions and one that mitigates impacts from existing to developed conditions. For project areas where the existing conditions are similar to pre-developed conditions (forested), only one calculation is provided. This is true for the West Parking Lot, the Loop Road and the North Extension to the South Parking Lot projects as they are all forested in the existing condition and therefore only warrant one detention volume calculation. The detention volumes calculated using this method are subtracted from the detention bank provided in the regional pond.

The model used in this report to calculate the storage volume requirements is the King County Runoff Time Series (KCRTS) Version 6.0. A storage volume was calculated for each project with a hypothetical pond having 3:1 side slopes, 4-feet of effective storage depth, a riser diameter of 18-inches and two orifices.

A Civil3D calculation based on the 2003 as-built topography of the pond (Exhibit A-15) shows that the constructed detention pond volume is 9.92 acre-feet. This is 0.43 acre-feet more than the previous pond stage-storage table produced as part of the 2003 Regional Detention Pond TIR using older calculation methods. For the purposes of keeping consistent with previous Technical Information Reports, we will assume the constructed detention pond volume is still 9.49 acre-feet.

All landscaped areas assume grass for detention storage calculations. If bioretention is used at the time of design, the detention storage volumes required will decrease accordingly.

Storage volumes required for development of each new project are as shown in Table 2 below.

Table 2: Detention Storage Volume Requirements

Development Projects	Pre-developed to Existing Conditions	Existing to Developed Conditions
Current Available Pond Storage	*3.718 Ac-Ft*	*2.876 Ac-Ft*
North Extension to East Parking Lot	0.435	0.130
West Parking Lot	0	0.318
South Extension to East Parking Lot	0.116	0.150
Loop Road	0	0.094
Grand Stand Seating and Turf	0.246	0.198
North Extension to South Parking Lot	0	0.144
Building 16 Replacement	0	0.318
East Campus Pedestrian Improvement	0.199	0.062
Available Storage After Master Plan Projects	***2.722 Ac-Ft***	***1.462 Ac-Ft***

As noted in the table above, the existing regional detention pond available storage can accommodate the envisioned master planned campus improvements with additional storage beyond the master plan horizon.

The Pond Storage Summary, Exhibit C-1 in Appendix C lists all projects impacting the pond since its inception.

KCRTS flow control calculations for the projects in the Master Plan are located in Appendix C.

WATER QUALITY SYSTEM (PART E)

The KCSWDM 2016 lists options for Enhanced Basic Water Quality Treatment in Section 6.1.2. The list includes conventional water quality treatment options, which are not planned to be used for the Master Plan, except for the stormfilter treatment train.

In addition, the City of Des Moines accepts Bioretention and Compost-Amended Vegetated Filter Strips (CAVFS) per the DOE SWMMWW as treatment methods.

For Master Plan development, the treatment options are as follows:

- Bioretention with underdrain (BMP T7.30 DOE SWMMWW)

- Compost-Amended Vegetated Filter Strips (CAVFS) (BMP T7.40 DOE SWMMWW)
- Stormfilter Treatment Train (KCSWDM Section 6.5.5)

Water quality calculations were performed using the Water Quality design volume from the DOE SWMMWW Chapter 4 Section 4.1. See Appendix D for Water Quality calculations and exhibits showing conceptual water quality implementation.

A Civil3D calculation based on the 2003 as-built topography of the pond (Exhibit A-15) shows that the constructed water quality pond volume is 0.97 acre-feet. This is 0.53 acre-feet less than the previous pond stage-storage table produced as part of the 2003 Regional Detention Pond TIR using older calculation methods. For the purposes of keeping consistent with previous Technical Information Reports, we will assume the constructed detention pond volume is still 1.50 acre-feet.

Regardless, as the parking lots are modified and upgraded, water quality treatment facilities providing localized enhanced treatment will be provided to adequately treat polluted runoff.

SECTION 5 Conveyance Systems and Design

The storm pipe system for the campus was built in the early 1960s and parts of it have been upgraded. The only significant flooding problem is at the west end of the north parking lot where the north storm drain main is failing and should be replaced. This issue was identified in 2003 in a Campus Utility System Assessment by KPFF. All other significant drainage issues in this assessment have been addressed and the infrastructure repaired.

Other minor drainage issues include minor flooding east of building 7 where the roof drains need to be replaced. A catch basin at the north end of the east parking lot and the connecting pipe to the west have damage from tree roots and need to be replaced. A 6 inch diameter storm pipe between buildings 15 and 16 and south of building 15 needs to be replaced. Roofdrains for building 19 need to be replaced.

In order to evaluate the capacity of the existing storm pipe system to accommodate the Master Plan projects we calculated the 10-year peak flows using KCRTS with a 15-minute time step for the entire pond drainage basin. See conveyance calculations in Appendix F.

The increase in the 10-year peak flow is 1.5 percent, which is neglible. The trunk mains will not be negatively impacted by this increase in flow, however, smaller connecting storm pipes will need to be evaluated and designed for each development project in the Master Plan.

There are several opportunities to promote sustainable stormwater management on Campus. One way to decrease the impact from stormwater is to use creeks and swales instead of underground storm pipes to slow down stormwater runoff. Currently, a dry creek in the center of campus collects roof runoff from the Student Union building, a drainage basin of approximately 1 acre. The creek flows west towards Building 26 before it enters a piped system. This mainly dry creek has capacity for a 10-acre basin per a study by KPFF (Drainage Study dated May 12, 2012). Stormwater pipes can likewise be day-lighted at other locations on campus.

Dispersion, Underground Injection Control (UIC) and infiltration are other sustainable stormwater management options. A geotechnical engineer will have to evaluate these options on a case-by-case basis.

SECTION 6 Special Reports and Studies (Not Applicable)

Not applicable because this report is part of a master plan rather than a proposed construction project.

SECTION 7 Other Permits (Not Applicable)

Not applicable because this report is part of a master plan rather than a proposed construction project.

SECTION 8 CSWPPP Analysis and Design (Not Applicable)

Not applicable because this report is part of a master plan rather than a proposed construction project.

SECTION 9 Bond Quantities, Facilities Summaries, and Declaration of Covenant (Not Applicable)

Not applicable because this report is part of a master plan rather than a proposed construction project.

SECTION 10 Operations and Maintenance Manual

See Appendix E for pond operations and maintenance requirements.

Appendix A

A-1: City of Des Moines Meeting Minutes and Correspondance

A-2: Soils Map

A-3: Existing Detention Pond Map

A-4: SCS Soils

A-5: KCRTS Soils group

A-6: Off-Site Topography Map

A-7: Highline College Flooding and Hydrology Map

A-8: Drainage Plan from the 1998 Horton Dennis Report

A-9: Offsite Analysis Study Area

A-10: Photos from Downstream Field Visit

A-11: Existing Drainage Basin and Site Characteristics

A-12: Developed Drainage Basin and Site Characteristics

A-13: Horton Dennis & Associates HCC Drainage Map

A-14: Existing Detention Pond Stage-Storage Table

A-15: Existing pond discharge calculations

A-16: Existing pond outflows from KCRTS

A-17: Pond Volume Calculations

1601 Fifth Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 kpff.com

HC Master Plan TIR MEETING NOTES

Attendees:	Company:	Date:	3/9/16
Loren Reinhold	City of Des Moines	Job #:	KPFF#1600027
Marty Chase	KPFF	Project:	HC Master Plan
Dina Winkel	KPFF	Subject:	TIR

PURPOSE OF MEETING

To confirm our understanding of the regional pond, discuss water quality treatment requirements and any other requirements from the City before proceeding with the Master Plan TIR.

ITEMS DISCUSSED

I. Confirm that our understanding of the status of the detention bank is correct. Loren said that it would be appropriate to continue using the pond as a detention bank in the same fashion since our 2003 Master Plan TIR on the pond. We compared spreadsheets on our understanding of current storage availability. Our numbers lined up close to one another. He said to include a list of Master Plan projects and their projected pond usage in the TIR. Loren noted that a condition of using the pond as a detention bank would be to keep up on the maintenance of the pond (provide records of maintenance) and provide a stage/storage performance verification of the pond in a live condition. Per NPDES requirements since 2007, maintenance of drainage facilities needs to be documented. Given that we are closing in on spring, we may be past the time to monitor the pond. Loren noted that the approval of the TIR would have a condition that this monitoring occur before the next project (after Bldg 26A).

II. Confirm that enhanced treatment using non-infiltrating raingardens per City of Seattle Standards is acceptable. Loren said check the draft KC drainage manual, which now addresses LID. Loren would like the TIR to address the feasibility of LID on campus.

III. Propose the use of raingardens in place of some of the wetpond volume to provide water quality treatment. Loren said this would be fine because treating at the source is better than at the pond. This new treatment would have to be enhanced rather than basic, however.

IV. Introduce the Thirsty Duck control structure and confirm that this is an acceptable outlet structure for the pond. Loren was not familiar with the Thirsty Duck but was willing to review its merits. KPFF to send him design from our Swedish Edmonds Hospital project, the DOE acceptance of the product and a link to the website that has a video on how it works.

V. Talk about dry wells for flow control. We noted that we won't need to use this because of the detention bank available but will mention it as a tool in the drainage kit.

VI. Explain how we will model the existing pond flows to analyze the function of the pond. Loren said to perform a stage-storage verification of the pond.

VII. Let Loren know an approximate date for a draft TIR and ask how long they'll need to review it. We told Loren that the MP TIR would need to be wrapped up in May.

VIII. Loren noted that there would be no detention credit for building 24A. It is a zero sum gain for the detention bank.

IX. We asked about how to treat demolished buildings. Loren answered that the impervious area can be subtracted from the project they are associated with.

END OF MEETING NOTES

cc:

Dina Winkel

From: Loren Reinhold [LReinhold@desmoineswa.gov]
Sent: Tuesday, April 12, 2016 3:31 PM
To: Dina Winkel
Subject: RE: Highline College pond verification

Follow Up Flag: Follow up
Flag Status: Completed

Hi Dina,

Let's proceed with your proposal to model the drainage basin going to the pond. Also, I would think that the 2003 survey information would still be appropriate to use.

Loren Reinhold, P.E.
Surface Water & Environmental Engineering Manager

City of Des Moines
Planning, Building & Public Works Department
21650 11th Avenue South
Des Moines, WA 98198-6317
Ph: (206) 870-6524

From: Dina Winkel [mailto:Dina.Winkel@kpff.com]
Sent: Tuesday, April 12, 2016 2:12 PM
To: Loren Reinhold <LReinhold@desmoineswa.gov>
Cc: Marty Chase <Marty.Chase@kpff.com>
Subject: Highline College pond verification

Hi, Loren –

This email is to follow up on our phone conversation this afternoon. When we met to talk about the TIR for the Master Plan last month you asked that the College monitor the pond to produce a stage-storage table related to the Seatac rainfall events and compare it to the stage-storage computed in the original KCRTS model. The intent is to verify that the pond is working as designed.

To ensure that data is collected for certain storm events, it would be most efficient to install computer equipment and monitor the pond over an extended period of time. The 2-year event has a fifty percent chance of occurring in any one year, and one year of monitoring might not produce a lot of useful data. In addition, the equipment and analysis required is quite involved.

If the intent is to show the pond is working as designed, it might be more useful to survey the pond and use this information in modeling the actual drainage basin going to the pond. The pond was surveyed in 2003, and we could use this information. Alternatively, the College could have the pond surveyed again to be sure that any changes to the pond were incorporated into the computer model.

Please let me know if you think this would satisfy the intent of the monitoring and how you would like to proceed.

EXHIBIT A-1

Thank you,

Dina Winkel

kpff

Dina Winkel, PE
Civil Engineer
O 206.622.5822 D 206.926.0461

EXHIBIT A-1

Soil Map—King County Area, Washington
(Highline College)

Map Scale: 1:5,190 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

N

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

EXHIBIT A-2

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: King County Area, Washington
Survey Area Data: Version 11, Sep 14, 2015

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

Date(s) aerial images were photographed: Jul 8, 2014—Jul 15, 2014

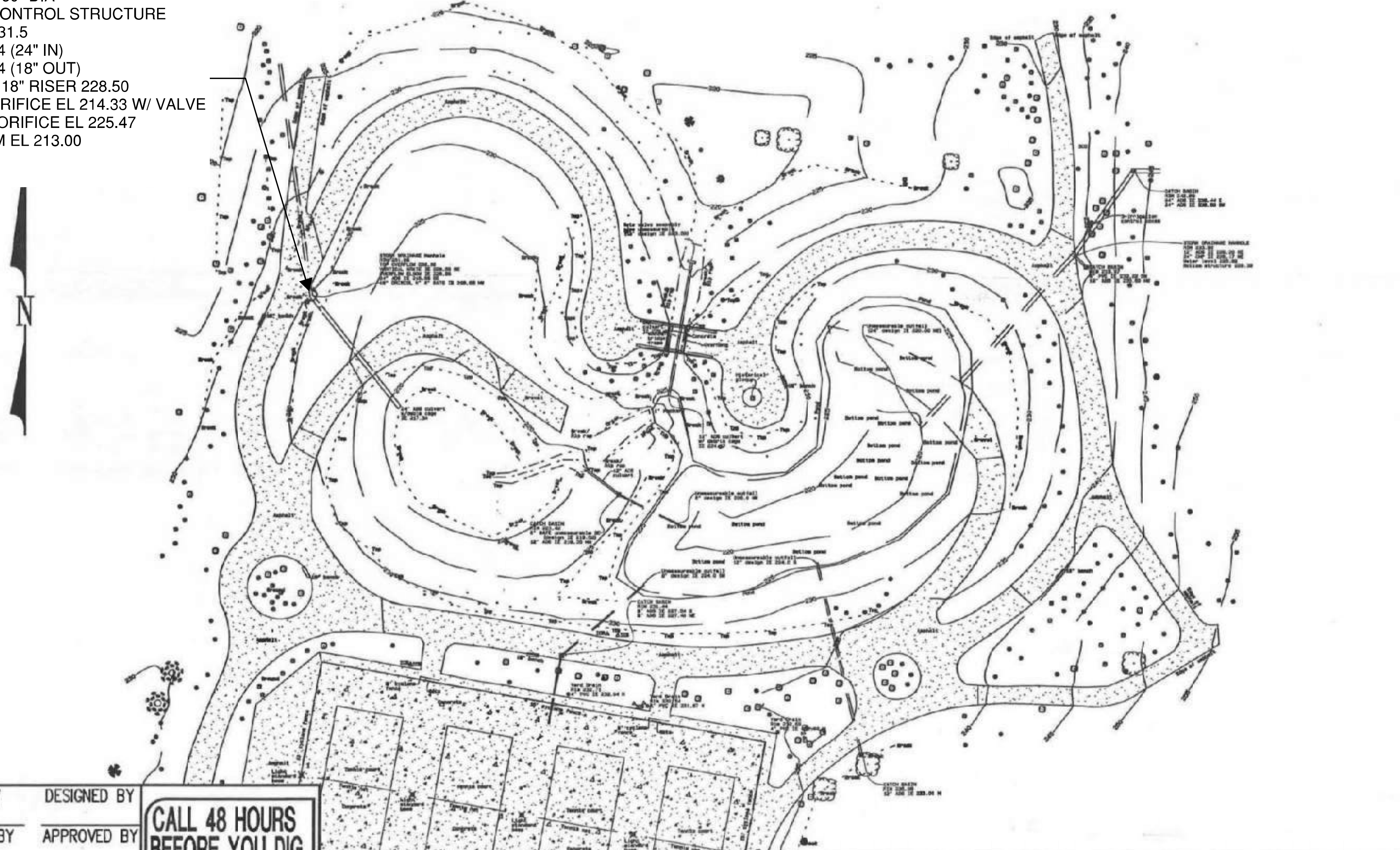
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

King County Area, Washington (WA633)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AgC	Alderwood gravelly sandy loam, 8 to 15 percent slopes	48.0	46.9%
AmC	Arents, Alderwood material, 6 to 15 percent slopes	52.4	51.2%
KpB	Kitsap silt loam, 2 to 8 percent slopes	1.3	1.3%
No	Norma sandy loam	0.5	0.5%
Totals for Area of Interest		**102.3**	**100.0%**

EXHIBIT A-2

From 2016 FIELD MEASUREMENT:
TYPE 2, 60" DIA
FLOW CONTROL STRUCTURE
TOP = 231.5
IE 216.54 (24" IN)
IE 216.54 (18" OUT)
TOP OF 18" RISER 228.50
8" DIA ORIFICE EL 214.33 W/ VALVE
16" DIA ORIFICE EL 225.47
BOTTOM EL 213.00



DRAWN BY	DESIGNED BY	CALL 48 HOURS BEFORE YOU DIG 1-800-424-5555	kpff Consulting Engineers 1601 Fifth Avenue, Suite 1600 Seattle, Washington 98101 (206) 622-5822 Fax (206) 622-8130	HIGHLINE COMMUNITY COLLEGE	EXHIBIT
CHECKED BY	APPROVED BY			EXISTING DETENTION POND MAP	A-3
DATE 03/30/03					
JOB No. : 102315		SCALE: 1" = 50'			

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. See table 6, page 70, for descriptions of woodland groups. Other information is given in tables as follows:

Acreage and extent, table 1, page 9.
Engineering uses of the soils, tables 2 and 3, pages 36 through 55.
Town and country planning, table 4, page 57.
Recreational uses, table 5, page 64.
Estimated yields, table 7, page 79.

Map symbol	Mapping unit	Described on page	Capability unit Symbol	Capability unit Page	Woodland group Symbol
AgB	Alderwood gravelly sandy loam, 0 to 6 percent slopes	10	IVe-2	76	3d2
AgC	Alderwood gravelly sandy loam, 6 to 15 percent slopes	8	IVe-2	76	3d1
AgD	Alderwood gravelly sandy loam, 15 to 30 percent slopes	10	VIe-2	78	3d1
AkF	Alderwood and Kitsap soils, very steep	10	VIIe-1	78	2d1
AmB	Arents, Alderwood material, 0 to 6 percent slopes 1/	10	IVe-2	76	3d2
→ AmC	Arents, Alderwood material, 6 to 15 percent slopes 1/	10	IVe-2	76	3d2
An	Arents, Everett material 1/	11	IVs-1	77	3f3
BeC	Beausite gravelly sandy loam, 6 to 15 percent slopes	11	IVe-2	76	3d2
BeD	Beausite gravelly sandy loam, 15 to 30 percent slopes	12	VIe-2	78	3d1
BeF	Beausite gravelly sandy loam, 40 to 75 percent slopes	12	VIIe-1	78	3d1
Bh	Bellingham silt loam	12	IIIw-2	76	3w2
Br	Briscot silt loam	13	IIw-2	75	3w1
Bu	Buckley silt loam	13	IIIw-2	76	4w1
Cb	Coastal beaches	14	VIIIw-1	78	---
Ea	Earlmont silt loam	14	IIw-2	75	3w2
Ed	Edgewick fine sandy loam	15	IIIw-1	75	2o1
EvB	Everett gravelly sandy loam, 0 to 5 percent slopes	15	IVs-1	77	3f3
EvC	Everett gravelly sandy loam, 5 to 15 percent slopes	16	VIs-1	78	3f3
EvD	Everett gravelly sandy loam, 15 to 30 percent slopes	16	VIe-1	77	3f2
EwC	Everett-Alderwood gravelly sandy loams, 6 to 15 percent slopes	16	VIs-1	78	3f3
InA	Indianola loamy fine sand, 0 to 4 percent slopes	17	IVs-2	77	4s3
InC	Indianola loamy fine sand, 4 to 15 percent slopes	16	IVs-2	77	4s3
InD	Indianola loamy fine sand, 15 to 30 percent slopes	17	VIe-1	76	4s2
KpB	Kitsap silt loam, 2 to 8 percent slopes	17	IIIe-1	75	2d2
KpC	Kitsap silt loam, 8 to 15 percent slopes	18	IVe-1	76	2d2
KpD	Kitsap silt loam, 15 to 30 percent slopes	18	VIe-2	78	2d1
KsC	Klaus gravelly loamy sand, 6 to 15 percent slopes	18	VIs-1	78	3f1
Ma	Mixed alluvial land	18	VIw-2	78	2o1
NeC	Neilton very gravelly loamy sand, 2 to 15 percent slopes	19	VIs-1	78	3f3
Ng	Newberg silt loam	19	IIw-1	74	2o1
Nk	Nooksack silt loam	20	IIw-1	74	2o1
No	Norma sandy loam	20	IIIw-3	76	3w2
Or	Orcas peat	21	VIIIw-1	78	---
Os	Oridia silt loam	21	IIw-2	75	3w1
OvC	Ovall gravelly loam, 0 to 15 percent slopes	22	IVe-2	76	3d1
OvD	Ovall gravelly loam, 15 to 25 percent slopes	23	VIe-2	78	3d1
OvF	Ovall gravelly loam, 40 to 75 percent slopes	23	VIIe-1	78	3d1
Pc	Pilchuck loamy fine sand	23	VIw-1	78	2s1
Pk	Pilchuck fine sandy loam	23	IVw-1	76	2s1
Pu	Puget silty clay loam	24	IIIw-2	76	3w2
Py	Puyallup fine sandy loam	24	IIw-1	74	2o1
RaC	Ragnar fine sandy loam, 6 to 15 percent slopes	25	IVe-3	77	4s1
RaD	Ragnar fine sandy loam, 15 to 25 percent slopes	26	VIe-2	78	4s1
RdC	Ragnar-Indianola association, sloping: 1/	26	--------	--	---
	Ragnar soil	--	IVe-3	77	4s1
	Indianola soil	--	IVs-2	77	4s3
RdE	Ragnar-Indianola association, moderately steep: 1/	26	--------	--	---
	Ragnar soil	--	VIe-2	78	4s1
	Indianola soil	--	VIe-1	77	4s2

U. S. GOVERNMENT PRINTING OFFICE : 1973 O - 468-266

EXHIBIT A-4

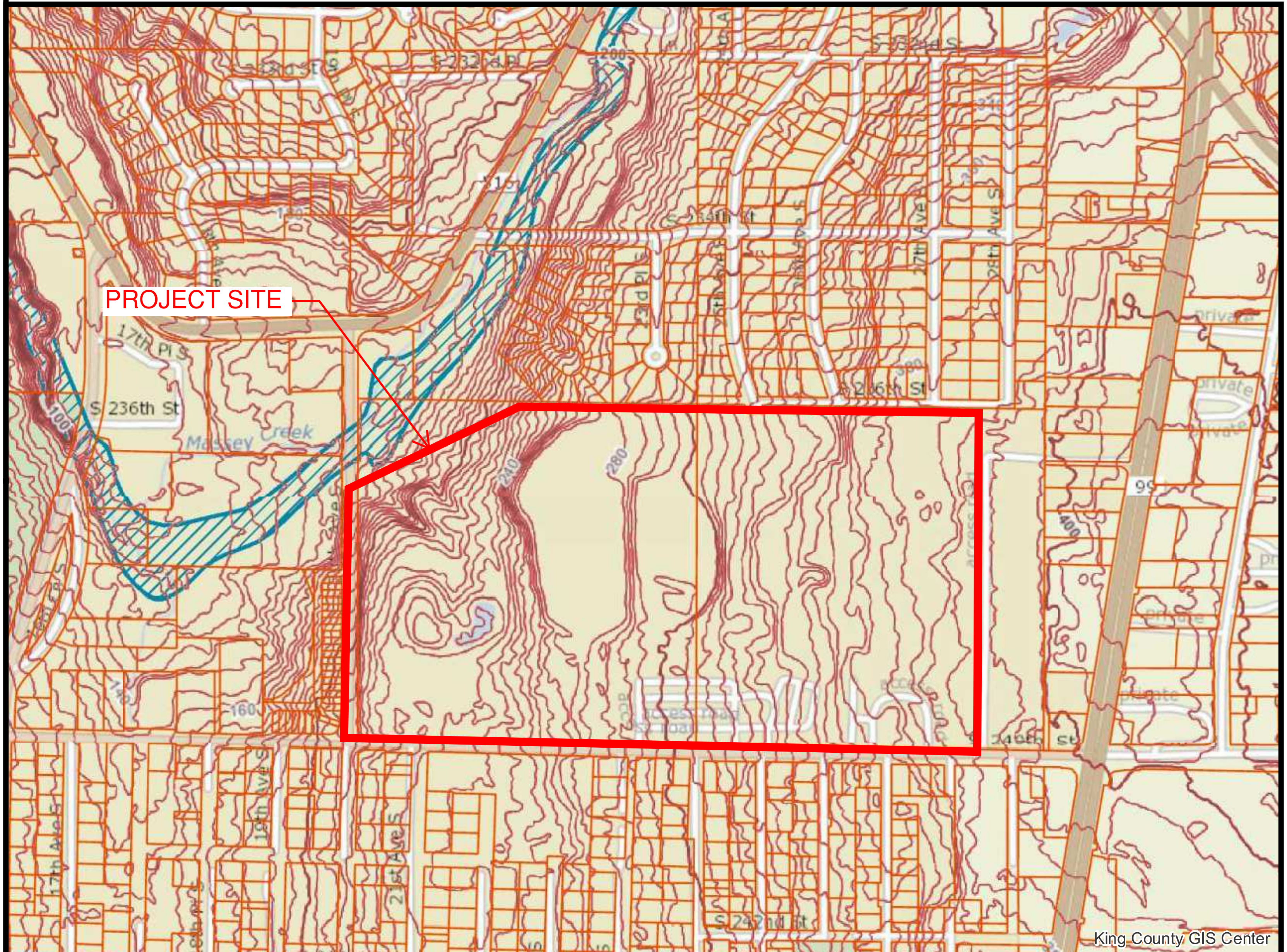
TABLE 3.2.2.B EQUIVALENCE BETWEEN SCS SOIL TYPES AND KCRTS SOIL TYPES

SCS Soil Type	SCS Hydrologic Soil Group	KCRTS Soil Group	Notes
Alderwood (AgB, AgC, AgD)	C	Till	
→ Arents, Alderwood Material (AmB, AmC)	C	Till	
Arents, Everett Material (An)	B	Outwash	1
Beausite (BeC, BeD, BeF)	C	Till	2
Bellingham (Bh)	D	Till	3
Briscot (Br)	D	Till	3
Buckley (Bu)	D	Till	4
Earlmont (Ea)	D	Till	3
Edgewick (Ed)	C	Till	3
Everett (EvB, EvC, EvD, EwC)	A/B	Outwash	1
Indianola (InC, InA, InD)	A	Outwash	1
Kitsap (KpB, KpC, KpD)	C	Till	
Klaus (KsC)	C	Outwash	1
Neilton (NeC)	A	Outwash	1
Newberg (Ng)	B	Till	3
Nooksack (Nk)	C	Till	3
Norma (No)	D	Till	3
Orcas (Or)	D	Wetland	
Oridia (Os)	D	Till	3
Ovall (OvC, OvD, OvF)	C	Till	2
Pilchuck (Pc)	C	Till	3
Puget (Pu)	D	Till	3
Puyallup (Py)	B	Till	3
Ragnar (RaC, RaD, RaC, RaE)	B	Outwash	1
Renton (Re)	D	Till	3
Salal (Sa)	C	Till	3
Sammamish (Sh)	D	Till	3
Seattle (Sk)	D	Wetland	
Shalcar (Sm)	D	Till	3
Si (Sn)	C	Till	3
Snohomish (So, Sr)	D	Till	3
Sultan (Su)	C	Till	3
Tukwila (Tu)	D	Till	3
Woodinville (Wo)	D	Till	3

Notes:

1. Where outwash soils are saturated or underlain at shallow depth (<5 feet) by glacial till, they should be treated as till soils.
2. These are bedrock soils, but calibration of HSPF by King County DNR shows bedrock soils to have similar hydrologic response to till soils.
3. These are alluvial soils, some of which are underlain by glacial till or have a seasonally high water table. In the absence of detailed study, these soils should be treated as till soils.
4. Buckley soils are formed on the low-permeability Osceola mudflow. Hydrologic response is assumed to be similar to that of till soils.

Highline College Offsite Topography



Legend

Parcels

FEMA preliminary 100-year floodplain

The information included on this map has been compiled by King County staff from a variety of sources and is subject to change without notice. King County makes no representations or warranties, express or implied, as to accuracy, completeness, timeliness, or rights to the use of such information. This document is not intended for use as a survey product. King County shall not be liable for any general, special, indirect, incidental, or consequential damages including, but not limited to, lost revenues or lost profits resulting from the use or misuse of the information contained on this map. Any sale of this map or information on this map is prohibited except by written permission of King County.

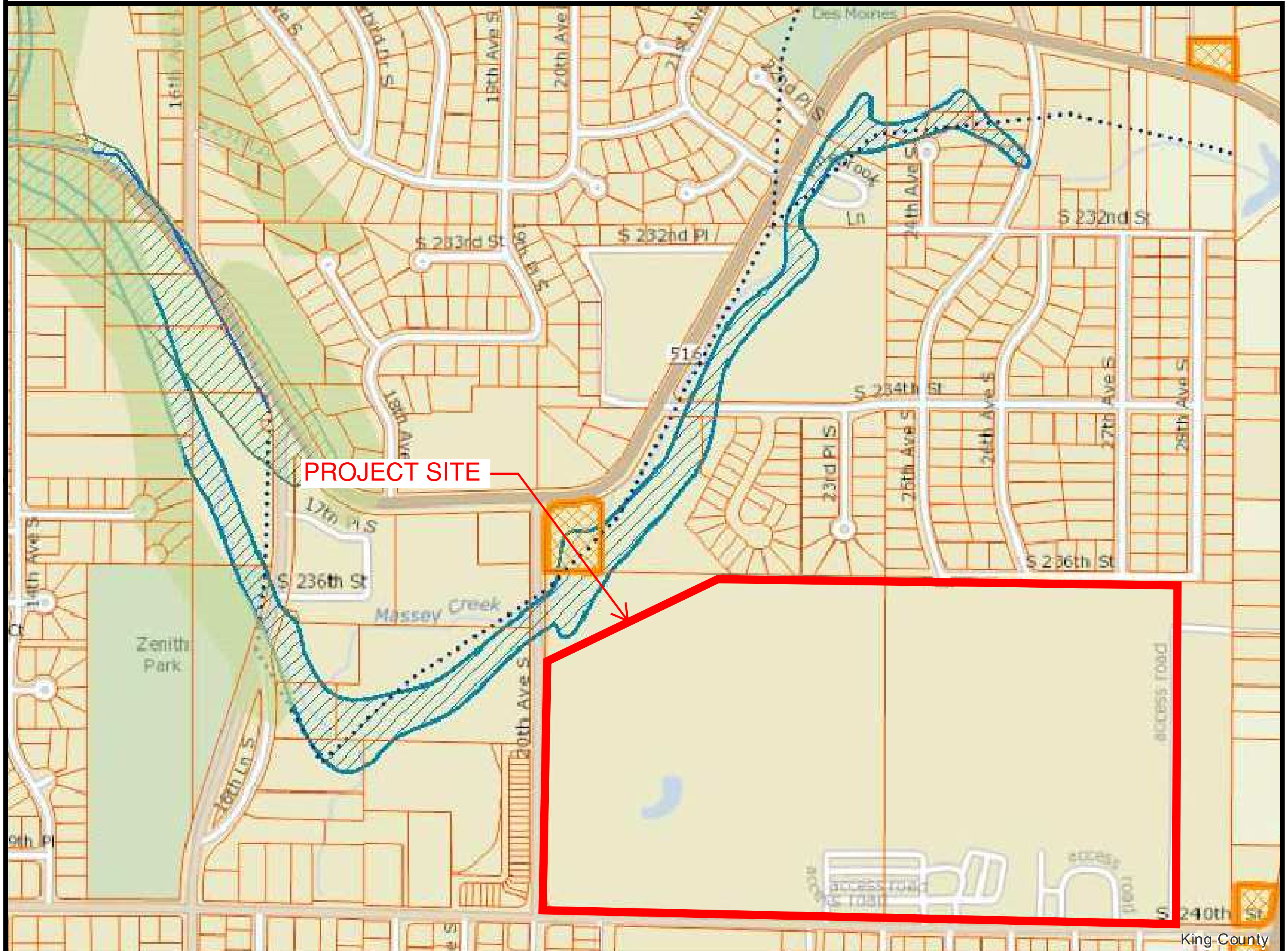
Date: 2/5/2016 Notes:

N

King County
GIS CENTER

EXHIBIT A-6

Highline College Flooding and Hydrology Map



Legend

- Parcels
- Erosion hazard (1990 SAO)
- Landslide hazard (1990 SAO)
- class 1
- class 2 perennial
- class 2 salmonid
- class 3
- unclassified
- Drainage complaints
- FEMA preliminary 100-year floodplain

Date: 2/5/2016

Notes:

N

King County GIS CENTER

EXHIBIT A-7

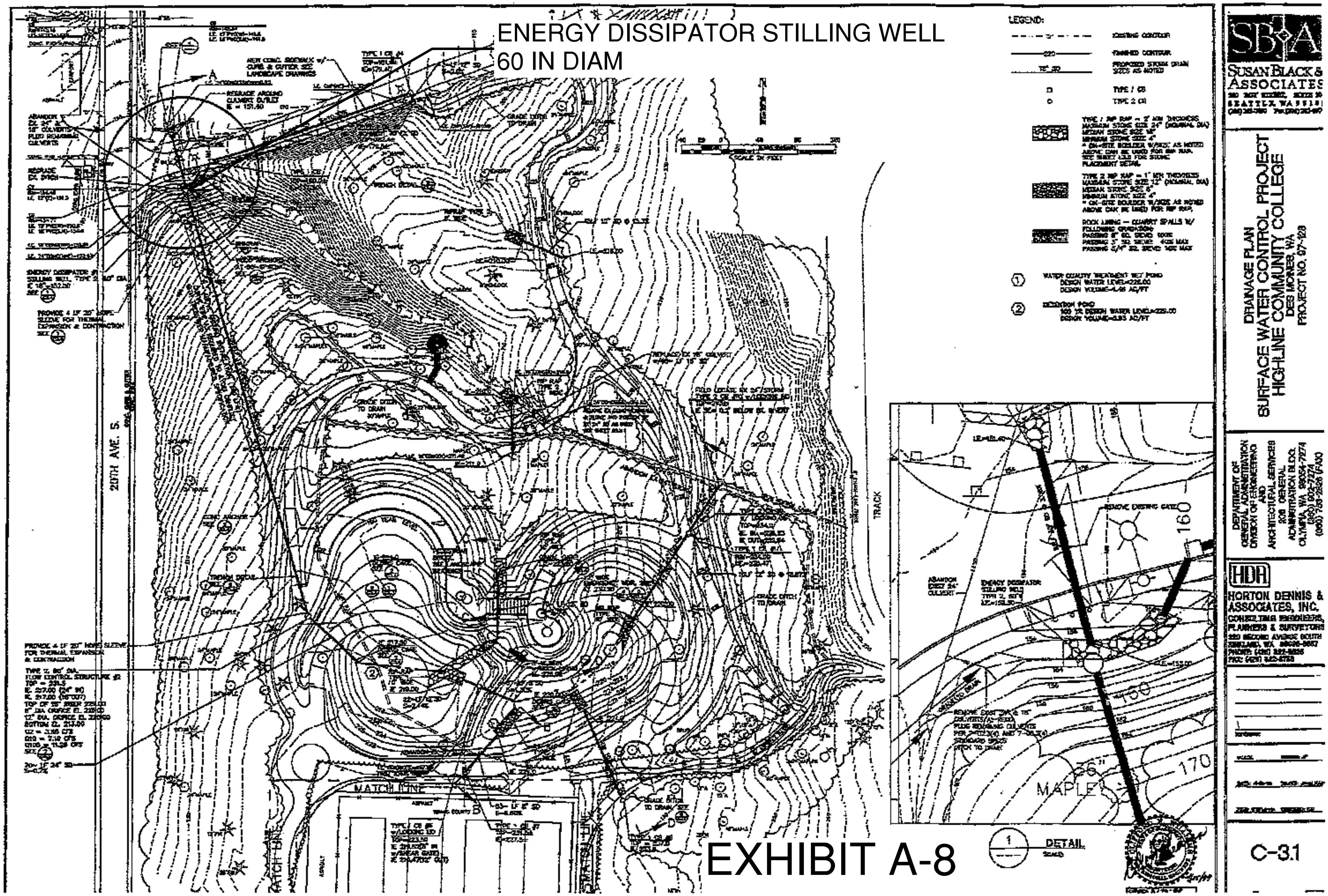
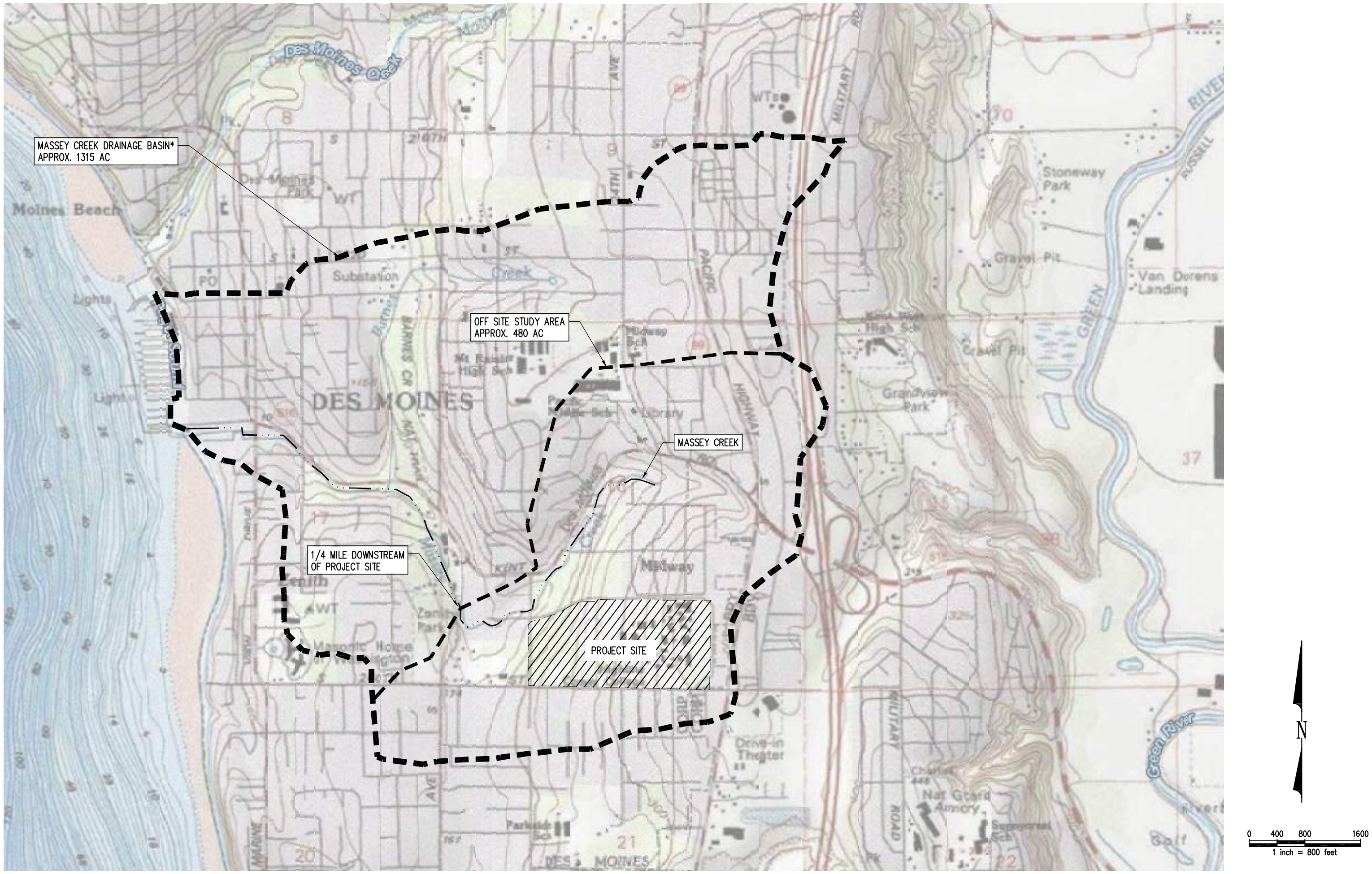

ENERGY DISSIPATOR STILLING WELL
60 IN DIAM
LEGEND:
20TH AVE. S.
TRACK
MATCH LINE
MAPLE
160
170
DETAIL
SUSAN BLACK & ASSOCIATES
DRAINAGE PLAN
SURFACE WATER CONTROL PROJECT
HIGHLINE COMMUNITY COLLEGE
DES MOINES, WA
PROJECT NO. 97-128
DEPARTMENT OF GENERAL ADMINISTRATION
DIVISION OF ENGINEERING AND ARCHITECTURAL SERVICES
206 GENERAL ADMINISTRATION BLDG.
OLYMPIA, WA 98504-7274
(360) 902-7274
(360) 753-2826 (FAX)
HORTON DENNIS & ASSOCIATES, INC.
C-3.1

EXHIBIT A-8



PROJECT SITE = 72 AC (15% OF OFF SITE STUDY AREA)

* SOURCE: DOE QUALITY ASSURANCE PROJECT PLAN DES MOINES, MASSEY, AND McSORLEY CREEKS COPPER AND ZINC WATER QUALITY ASSESSMENT, BY RANDY COOTS, DEC. 2008
TERRAIN FROM NCES WEBSOILSURVEY, USD, FEB 2016

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY | DESIGNED BY | CHECKED BY | APPROVED BY | DATE | JOB No.:

CALL TWO BUSINESS DAYS BEFORE YOU DIG 1-800-424-5555

SCALE:

kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822 www.kpff.com

HIGHLINE COLLEGE 2016 MASTER PLAN
DES MOINES, WA

OFF SITE STUDY AREA

EXHIBIT A-9

Apr 04, 2016 - 4:42pm Xref Filename: \ DrosW Z:\1600001-1600999\1600027 (HC Master Plan TIR)\CADD\Cad exhibit\Off Site Terrain.dwg

1. Outlet pipe from second cell

2. Dry heavily vegetated streambed

3. Vegetation near low flow water level

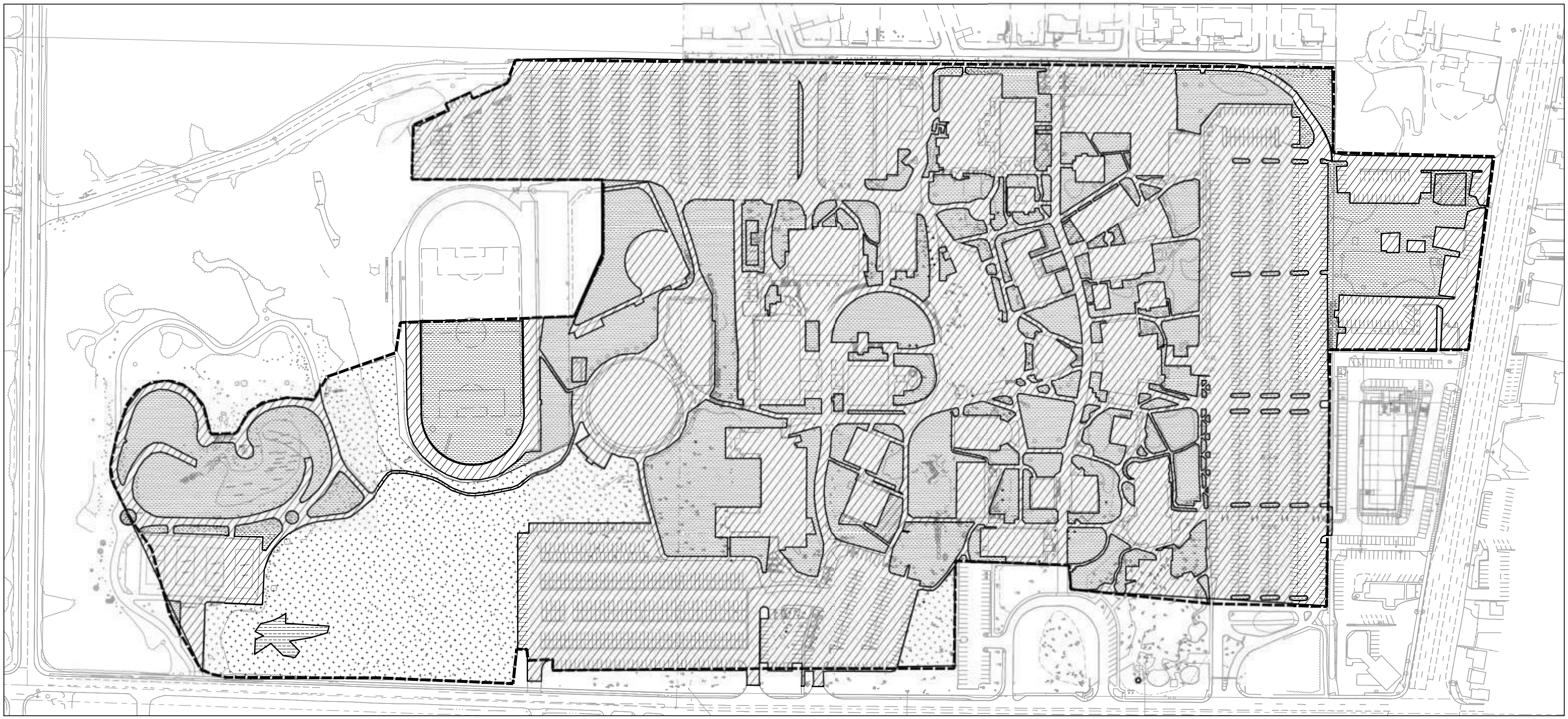
4. Signs of erosion in the ravine at high elevation.


5. Energy dissipater at bottom of hill


6. Outlet of 4' culvert under 16th Ave South


7. Looking south from 16th Ave South


8. Heavily vegetated creek side slopes towards 20th Avenue South.



LEGEND

- FOREST = 6.50 AC
- TILL GRASS = 17.25 AC
- WETLAND = 0.11 AC
- IMPERVIOUS = 32.89 AC
- POND BASIN BOUNDARY

TOTAL BASIN = 56.75 AC

0 50 100 200
1 inch = 100 feet

N

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY DW
DESIGNED BY DW
CHECKED BY MFC
APPROVED BY MFC
DATE 5/4/16
JOB No.: 1600027

CALL TWO BUSINESS DAYS BEFORE YOU DIG 1-800-424-5555

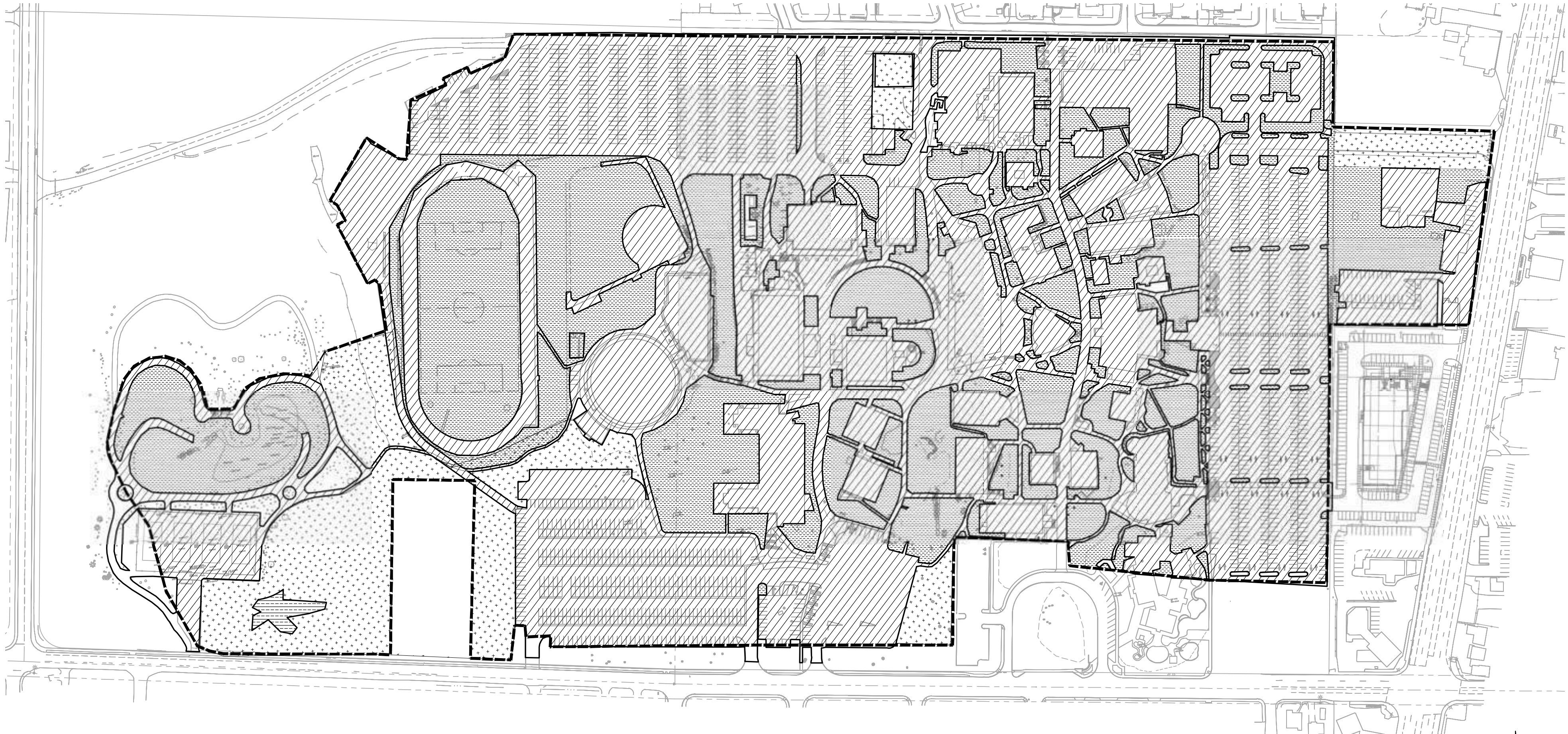
SCALE:

kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822
www.kpff.com

HIGHLINE COLLEGE
DES MOINES, WA

EXISTING DRAINAGE BASIN AND SITE CHARACTERISTICS

EXHIBIT
A–11



LEGEND

FOREST = 5.27 AC
TILL GRASS = 15.88 AC
WETLAND = 0.11 AC
IMPERVIOUS = 37.42 AC
POND BASIN BOUNDARY

TOTAL BASIN = 58.69 AC

0 50 100 200
1 inch = 100 feet

NO.	DATE	BY	CHD.	APPR.	REVISION

DRAWN BY DW
DESIGNED BY DW
CHECKED BY MFC
APPROVED BY MFC
DATE 5/4/16
JOB No.: 1600027

CALL TWO BUSINESS DAYS BEFORE YOU DIG 1-800-424-5555

SCALE:

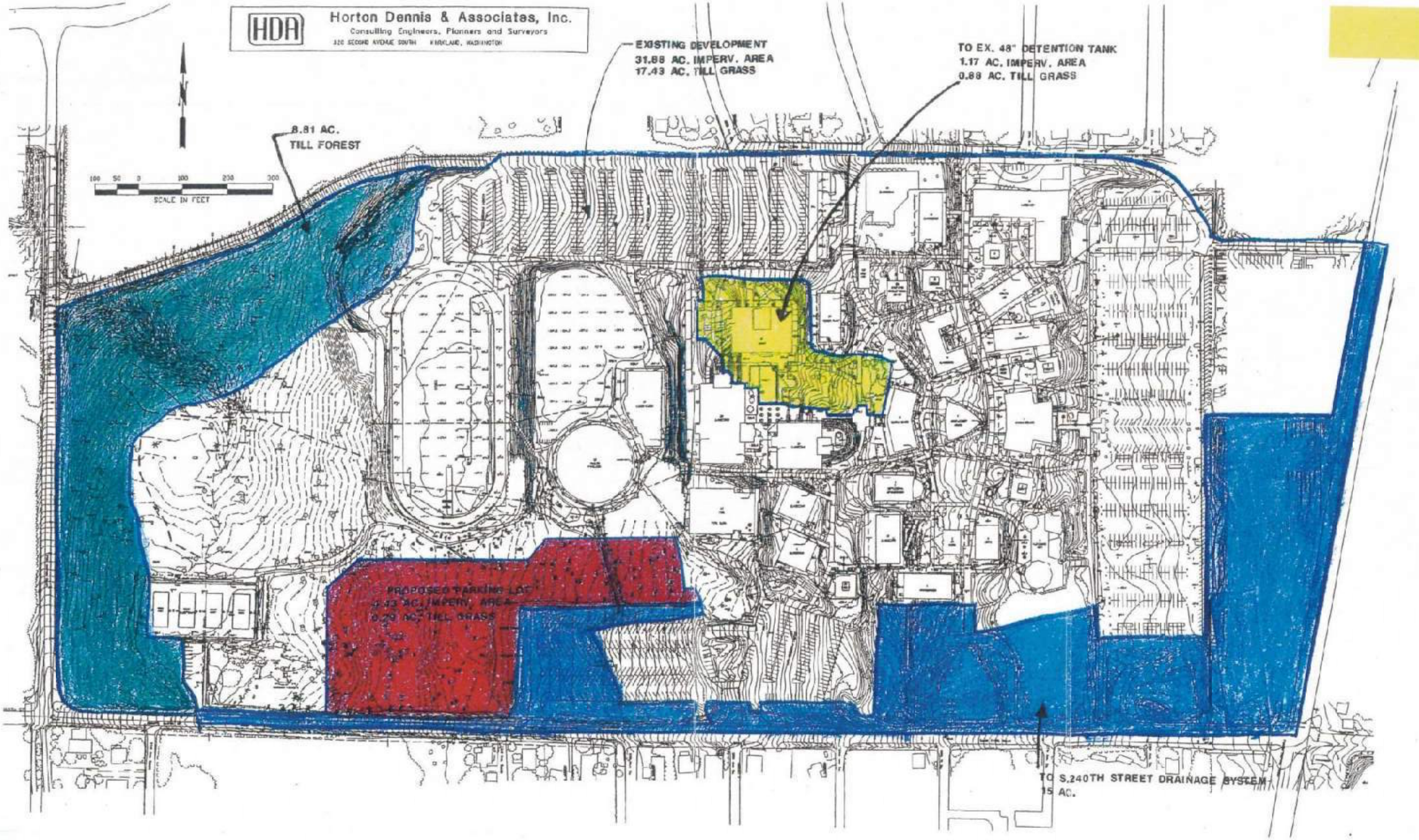
kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822
www.kpff.com

HIGHLINE COLLEGE
DES MOINES, WA

DEVELOPED DRAINAGE BASIN AND SITE CHARACTERISTICS

EXHIBIT
A-12

May 10, 2016 - 9:13am DinaW Z:\1600001-1600999\1600027 (HC Master Plan TIR)\CADD\TIR exhibits\Developed Conditions Map.dwg
Xref Filename: \ HCCxSV-ADDITIONAL \ HCCxSV-HARDSCAPE \ hcc-buildings \ X-HC26-BLDG \ X-HC-LEGAL \ X-HC-SP \ Basin boundary\



HIGHLINE COMMUNITY COLLEGE DRAINAGE MAP

SCALE: 1" = 200'

EXHIBIT A-13

kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822	project HC MP TIR	by DW	A-14
	location Des Moines, WA	date 05/10/16	
	client McGranahan Architects		1600027
	Pond Stage Storage Calculation		

Live Storage

Elevation	Accumulative Storage volume		
ft	cy	cf	ac-ft
217	0.0	0	0.00
218	43.0	1161	0.03
219	179.0	4833	0.11
220	391.0	10557	0.24
221	705.0	19035	0.44
222	1123.0	30321	0.70
223	1633.7	44110	1.01
224	2241.0	60507	1.39
225	2951.3	79685	1.83
226	5125.5	138389	3.18
227	7299.6	197089	4.52
228	9473.8	255793	5.87
229	11647.9	314493	7.22
230	13822.1	373197	8.57
230.5	14909.2	402548	9.24
231	15996.2	431897	**9.92**

Wetpond volume

	1567.3	42317	**0.97**

Storage volumes calculated using surfaces in civil3D based on as-built topography.

Conclusion:

The live storage of the detention pond is 9.92 ac-ft, which is 0.43 ac-ft more volume than calculated in the previous stage-storage calculation in the 2003 Regional Detention and Water Quality Technical Information Report.

The wetpond volume is 0.97 ac-ft and less than the original pond design of 1.5 ac-ft. As the parking lots are modified and upgraded, water quality treatment facilities providing enhanced treatment must be provided to adequately treat polluted runoff.

kpff
1601 5th Avenue, Suite 1600
Seattle, WA 98101
206.622.5822

project: HC MP TIR	by: DW	A-15
location: Des Moines, WA	date: 05/10/16	
client: McGranahan Architects		1600027
Pond Discharge Calculations		

Purpose: This spreadsheet calculates the discharge from the control structure based on the orifice, the riser and the pond stage-storage table. This information is added to KCRTS in the form of a reservoir file, producing pond outflows for the existing drainage basin.

Flow		
Invert out =	216.54	FT
Detention Live Storage =	11.960	FT
Diameter of orifice 1 =	8.000	IN
Q_1 Full Discharge =	6.006	cfs
Height of orifice 2 =	8.930	FT
Diameter of orifice 2 =	16.000	IN
Q_1 at Orifice 2 elev =	5.190	cfs
Q_2 Full Discharge =	12.093	cfs
Q_T =	18.099	cfs
Riser Top =	228.50	FT
Riser Diameter =	18.00	IN

	CONTOUR ELEVATION (FT)	TOTAL VOL (CF)	Q_1 (CFS)	Q_2 (CFS)	Q_{TOP} (CFS)	Q_T (CFS)	
TOP SED STORAGE							
IE OUT	217	0	1.178	0.000	0.000	1.178	ORIFICE
	218	1161	2.099	0.000	0.000	2.099	
	219	4,833	2.724	0.000	0.000	2.724	
	220	10,557	3.231	0.000	0.000	3.231	
	221	19,035	3.668	0.000	0.000	3.668	
	222	30,321	4.058	0.000	0.000	4.058	
	223	44,110	4.414	0.000	0.000	4.414	
	224	60,507	4.744	0.000	0.000	4.744	
	225	79,685	5.052	0.000	0.000	5.052	
	226	138,389	5.342	5.058	0.000	10.399	
	227	197,089	5.617	8.593	0.000	14.210	
	228	255,793	5.879	11.050	0.000	16.929	
	229	314,493	6.131	13.052	5.476	24.659	ORIF + WEIR
	230	373,197	6.372	14.786	28.743	49.901	
	230.5	402548	6.489	15.581	44.476	66.546	
RISER TOP	231	431897	6.604	16.337	62.469	85.410	

From 2009 King County Surface Water Design Manual

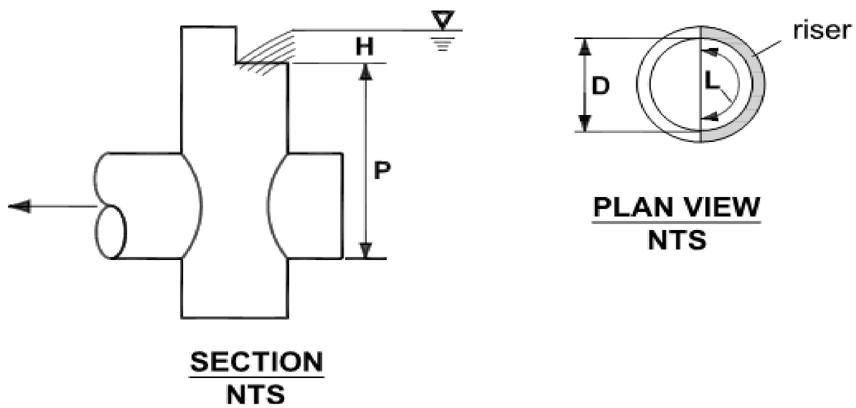
Orifices

Flow through orifice plates in the standard tee section or turn-down elbow may be approximated by the general equation:

$$Q = CA\sqrt{2gh} \quad (5\text{-}4)$$

where
- Q = flow (cfs)
- C = coefficient of discharge (0.62 for plate orifice)
- A = area of orifice (sf)
- h = hydraulic head (ft)
- g = gravity (32.2 ft/sec^2)

FIGURE 5.3.4.E RECTANGULAR, SHARP-CRESTED WEIR



$$Q = C(L - 0.2H)H^{3/2} \quad (5\text{-}6)$$

where
- Q = flow (cfs)
- C = 3.27 + 0.40 H/P (ft)
- H,P are as shown above
- L = length (ft) of the portion of the riser circumference as necessary not to exceed 50% of the circumference
- D = inside riser diameter (ft)

Note that this equation accounts for side contractions by subtracting 0.1H from L for each side of the notch weir.

WEIR = FULL CIRCUMFERENCE; THEREFORE, NO SIDE CONSTRICTIONS
$Q = CxLxH^{3/2}$

Analysis of the existing pond . Refer to Exhibit A-11 for drainage basin information.

KCRTS Input:

```
[C] CREATE a new Time Series
ST
   6.50    0.00    0.000000  Till Forest
   0.00    0.00    0.000000  Till Pasture
  17.25    0.00    0.000000  Till Grass
   0.00    0.00    0.000000  Outwash Forest
   0.00    0.00    0.000000  Outwash Pasture
   0.00    0.00    0.000000  Outwash Grass
   0.11    0.00    0.000000  Wetland
  32.89    0.00    0.000000  Impervious
EXISTING.tsf
 T
  1.00000
```

Flow Frequency Analysis Existing Conditions without flow control

Time Series File:existing.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- -----Flow Frequency Analysis-------

Flow Rate (CFS)	Rank		Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
9.79	6	2/09/01	2:00	**19.68**	1	**100.00**	0.990
7.92	8	1/05/02	16:00	12.39	2	25.00	0.960
11.69	3	2/27/03	7:00	11.69	3	10.00	0.900
8.52	7	8/26/04	2:00	10.38	4	5.00	0.800
10.24	5	10/28/04	16:00	10.24	5	3.00	0.667
10.38	4	1/18/06	16:00	9.79	6	2.00	0.500
12.39	2	10/26/06	0:00	8.52	7	1.30	0.231
19.68	1	1/09/08	6:00	7.92	8	1.10	0.091
Computed Peaks				17.25		50.00	0.980

Flow Frequency Analysis Existing Conditions with flow control provided by the existing pond

Time Series File:outflow.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- -----Flow Frequency Analysis-------

Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
5.28	3	2/09/01 19:00	5.87	**10.97**	1	**100.00**	0.990
4.05	7	1/05/02 17:00	5.32	8.94	2	25.00	0.960
5.13	5	2/27/03 10:00	5.28	8.80	3	10.00	0.900
3.91	8	8/26/04 3:00	5.23	8.60	4	5.00	0.800
4.79	6	10/28/04 19:00	5.13	8.28	5	3.00	0.667

5.32	2	1/18/06 22:00	4.79	7.14	6	2.00	0.500
5.23	4	11/24/06 7:00	4.05	4.98	7	1.30	0.231
5.87	1	1/09/08 11:00	3.91	4.63	8	1.10	0.091
Computed Peaks			5.69	10.28		50.00	0.980

Conclusion:

The existing pond and control structure is working as designed, since the 100-year peak flow is half as big as the 100-year peak flow from the existing conditions without the pond. This meets the requirements outlined in the original 1998 Horton-Dennis Stormwater Pond report.

Pond Volume Calculations

Cut/Fill Report

Generated: 2016-05-16 10:59:11

By user: DinaW

Drawing: Z:\1600001-1600999\1600027 (HC Master Plan TIR)\CADD\C3D\Model DWGS\Z:\1600001-1600999\1600027 (HC Master Plan TIR)\CADD\C3D\Model DWGS\HC-TOP OF POND.dwg

Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Wetpond Storage Volume	full	1.00	1.00	13759.80	0.11	1567.28	1567.17<Fill>
Pond Storage Above Wetpond (up to elev 231)	full	1.00	1.00	58702.24	0.00	13044.94	13044.94<Fill>
Pond Storage 2nd cell (up to elev 225)	full	1.00	1.00	25087.12	316.27	2951.26	2634.99<Fill>

Totals

	2d Area (Sq. Ft.)	Cut (Cu. Yd.)	Fill (Cu. Yd.)	Net (Cu. Yd.)
Total	97549.16	316.37	17563.48	17247.11<Fill>

* Value adjusted by cut or fill factor other than 1.0

Wetpond Storage Volume
V= 1567 CY * 27 CF/CY / 43560 CF/AC = 0.971 AC-FT

Detention Pond Storage Volume
V = (13045 CY + 2951 CY) *27 CF/CY / 43560 CF/AC = 9.915 AC-FT

A-17

Appendix B

B-1: Development Map Short-Term Plan

B-2: Development Map Mid Term Plan

B-3: Existing Conditions - North Extensions to East Parking Lot

B-4: Developed Conditions - North Extensions to East Parking Lot

B-5: Existing Conditions - Loop Road and West Parking Lot

B-6: Developed Conditions - West Parking Lot

B-7: Existing Conditions - Grand Stand and Turf

B-8: Developed Conditions - Grand Stand and Turf

B-9: Existing Conditions - Loop Road

B-10: Developed Conditions - Loop Road

B-11: Existing Conditions - North Extension to South Parking Lot

B-12: Developed Conditions - North Extension to South Parking Lot

B-13: Existing Conditions - South Extension to East Parking Lot

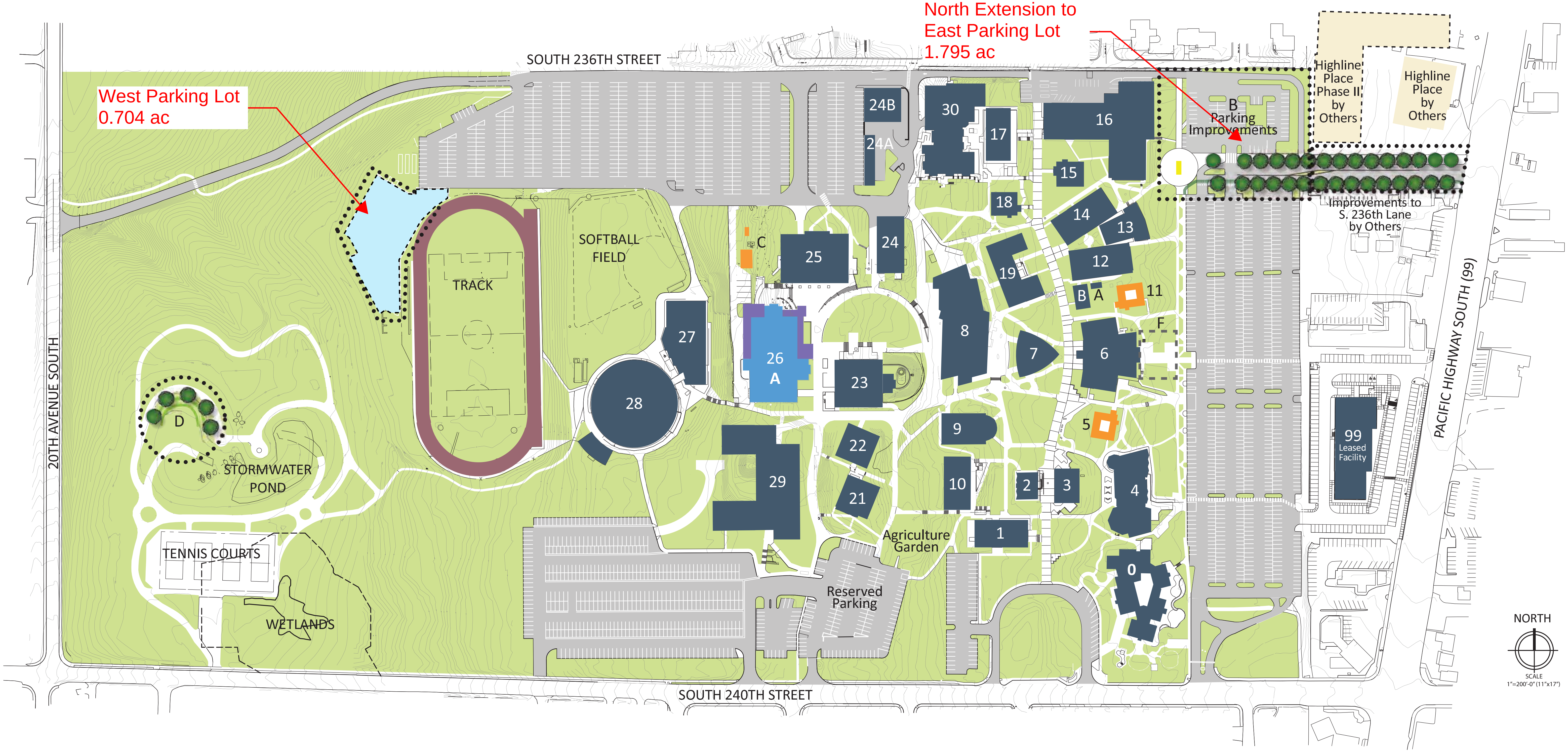
B-14: Developed Conditions - South Extension to East Parking Lot

B-15: Existing Conditions – Building 16 Replacement

B-16: Developed Conditions – Building 16 Replacement

B-17: Existing Conditions – East Campus Pedestrian Improvements

B-18: Developed Conditions – East Campus Pedestrian Improvements



LEGEND

- EXISTING BUILDING
- PROPOSED RENOVATION
- PROPOSED DEMOLITION
- NEW CONSTRUCTION
- EXISTING PARKING
- VERTICAL ELEMENT
- BIKE PATH

SHORT TERM PROJECTS

A - BUILDING 26 HEALTH & LIFE SCIENCES RENOVATION/ADDITION (Includes Demolition of Buildings 5 and 11)

B - PARKING & ENTRANCE IMPROVEMENTS

C - DEMOLITION OF CHILLER PLANT

D - PERMACULTURE AND GARDEN

E - PARKING IMPROVEMENT

F - BUILDING 6 ENTRANCE CANOPY

Exhibit 1
SHORT TERM PLAN

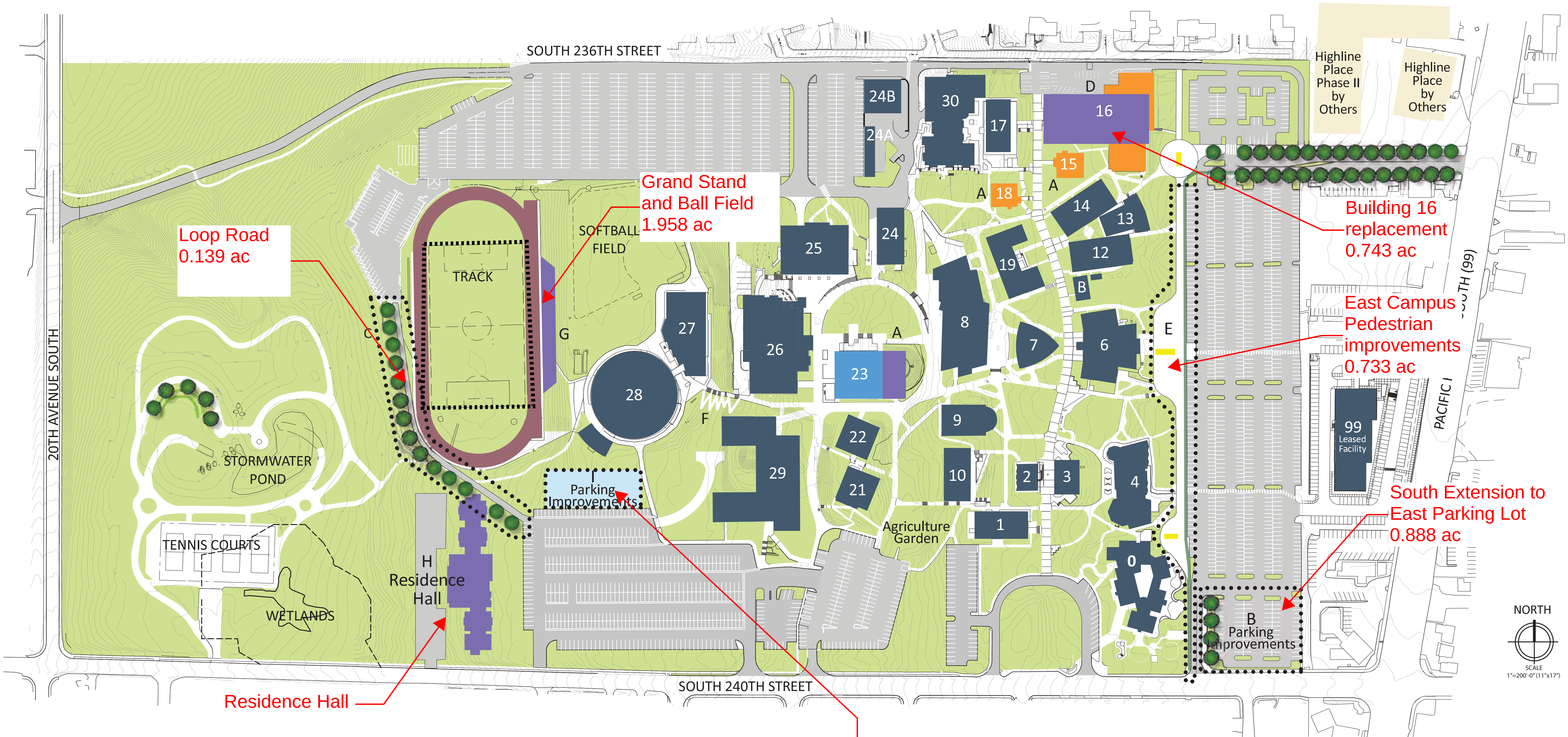
SHORT TERM PLAN 2016-2020

HIGHLINE COLLEGE MASTER PLAN

26 APRIL 2016

kpff

McGRANAHAN architects



LEGEND

- EXISTING BUILDING
- PROPOSED MAJOR RENOVATION
- PROPOSED DEMOLITION
- NEW CONSTRUCTION
- EXISTING PARKING
- VERTICAL ELEMENT
- BIKE PATH

Exhibit 2
MID TERM PLAN

MID TERM PROJECTS

A - RENOVATION BUILDING 23
(Includes replacement of Buildings 15 and 18)
B - PARKING & ENTRANCE IMPROVEMENTS
C - CONNECTOR ROAD AND LANDSCAPE
D - BUILDING 16 REPLACEMENT
E - MAIN PEDESTRIAN IMPROVEMENT
F - ADA ACCESS TO BUILDING 27 & 28
G - GRANDSTAND AND TURF REPLACEMENT
H - RESIDENCE HALL
I - PARKING IMPROVEMENTS

MID TERM PLAN 2021-2029
HIGHLINE COLLEGE MASTER PLAN
26 APRIL 2016

McGRANAHAN architects

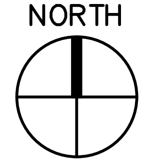
EXISTING CONDITIONS MAP

NORTH EXTENSION TO EAST PARKING LOT

LEGEND

- IMPERVIOUS SURFACE 45,073 SF = 1.04 AC
- PERVIOUS SURFACE, GRASS 2,603 = 0.06 AC
- PERVIOUS SURFACE, FORESTED 26,084 SF = 0.59 AC

TOTAL PROJECT AREA 73,661 SF = 1.69 AC



0 25 50 100

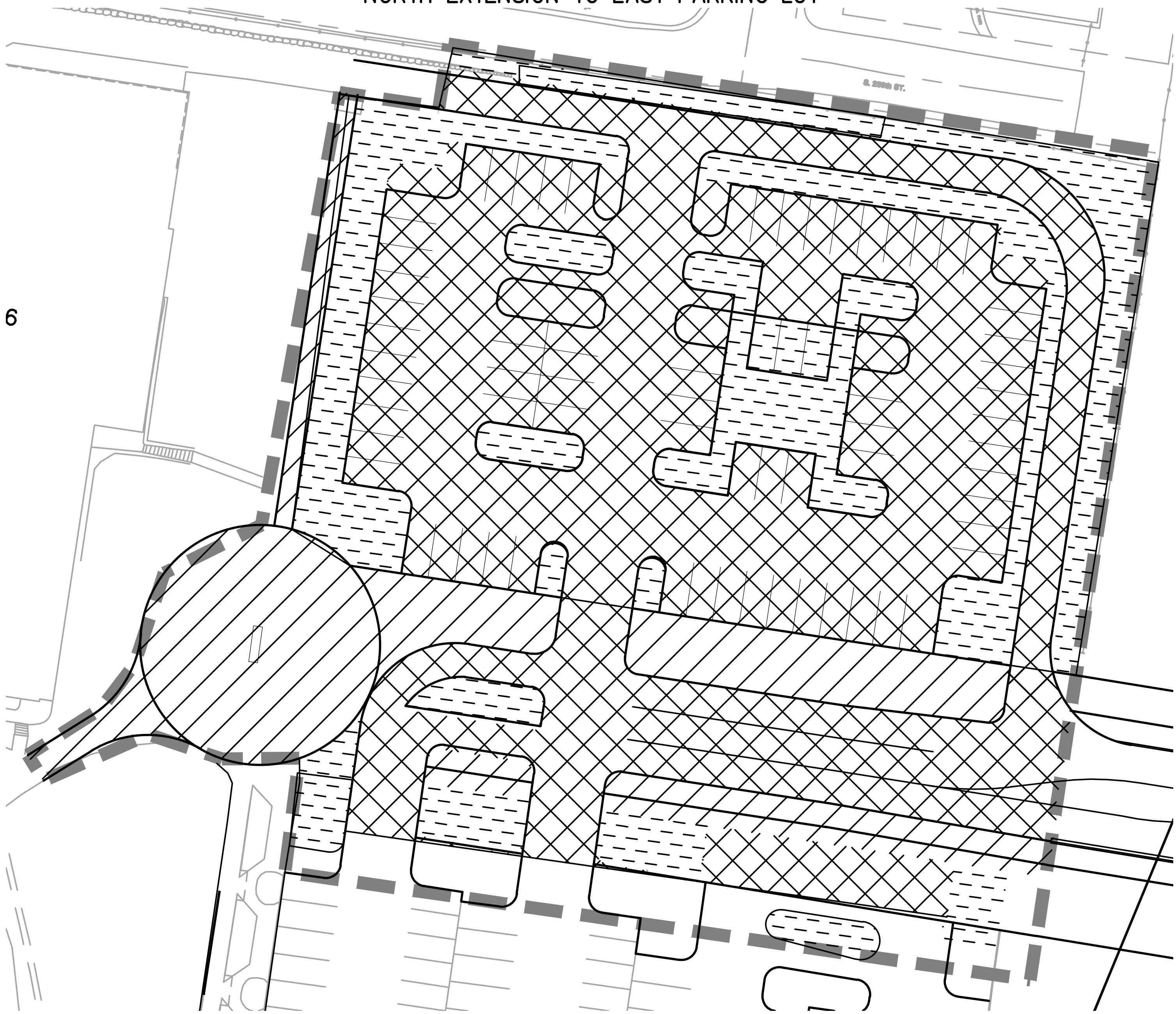
1 inch = 50 feet

kpff

DATE: 04/18/2016

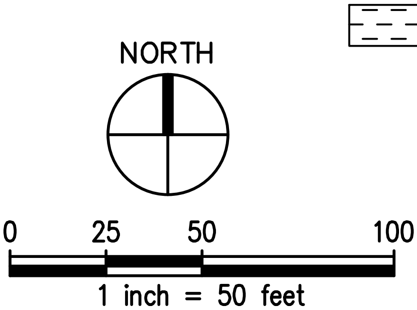
DEVELOPED CONDITIONS MAP

NORTH EXTENSION TO EAST PARKING LOT



LEGEND

(diagonal hatch)	NON-POLLUTION GENERATING IMPERVIOUS SURFACE 13,043 SF = 0.30 AC
(cross hatch)	POLLUTION GENERATING IMPERVIOUS SURFACE 42,882 SF = 0.98 AC
	TOTAL IMPERVIOUS SURFACE 55,605 SF = 1.28 AC
(dashed hatch)	GRASS 17,736 SF = 0.41 AC
	TOTAL PROJECT AREA 73,661 SF = 1.69 AC



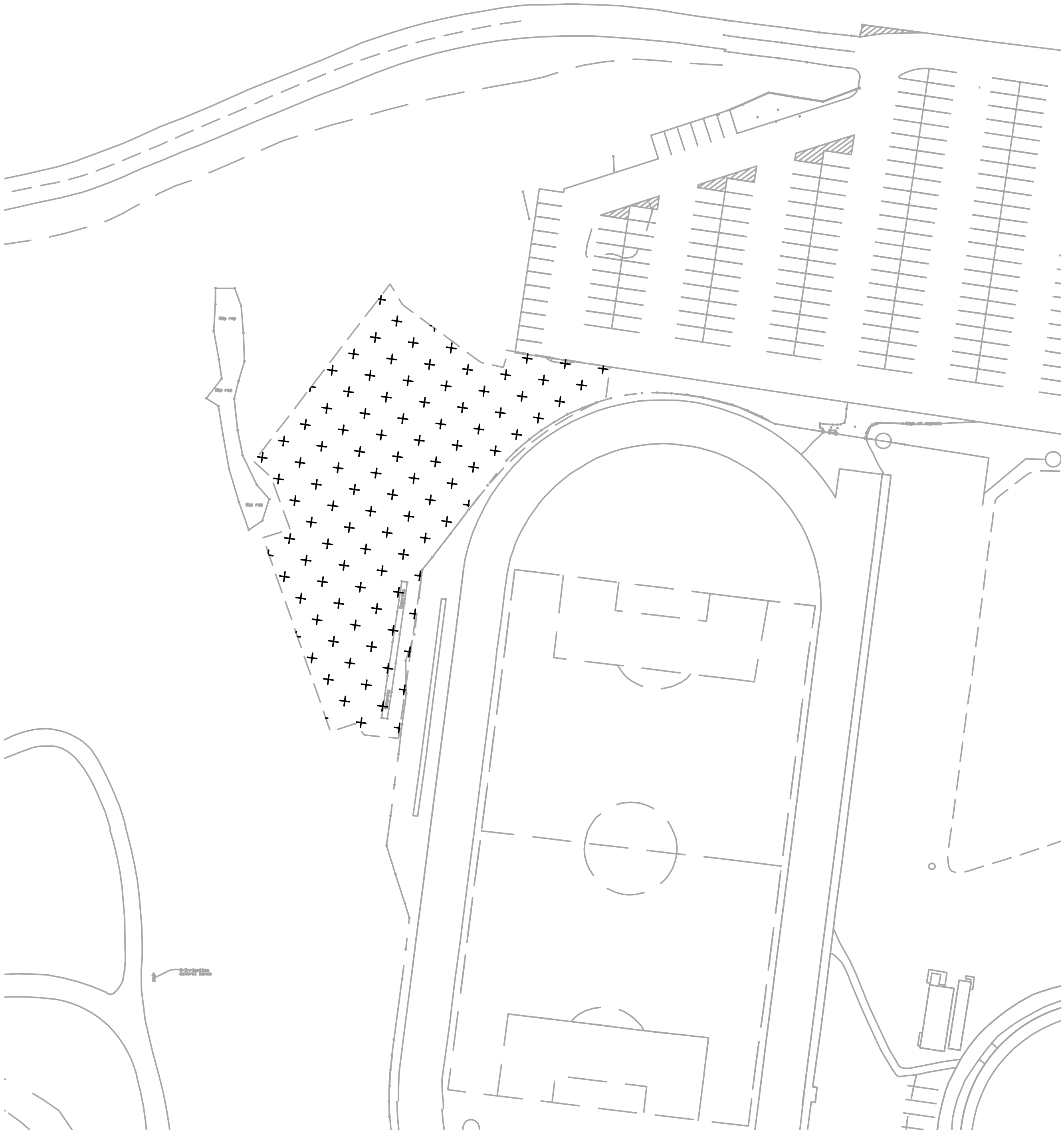
kpff

B-4

DATE: 05/09/2016

EXISTING CONDITIONS MAP

WEST PARKING LOT



LEGEND

FORESTED (PRIOR TO CONSTRUCTION OF GRAVEL PARKING LOT) 30,649 SF = 0.704 AC

NORTH

0 50 100 200

1 inch = 100 feet

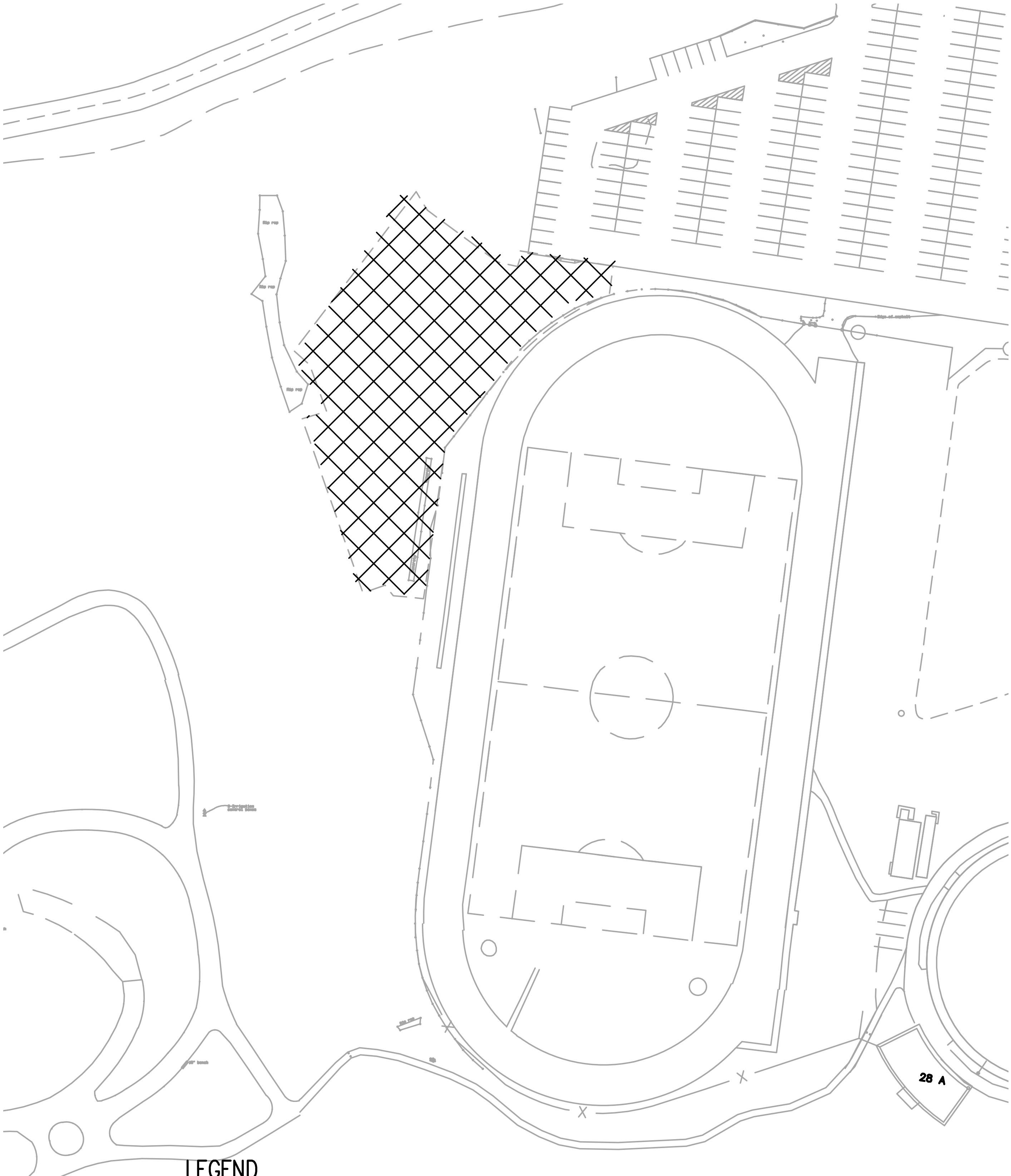
kpff

B-5

DATE: 04/18/2016

DEVELOPED CONDITIONS MAP

WEST PARKING LOT



LEGEND

POLLUTION GENERATING IMPERVIOUS SURFACE 30,649 SF = 0.704 AC

NORTH

0 50 100 200

1 inch = 100 feet

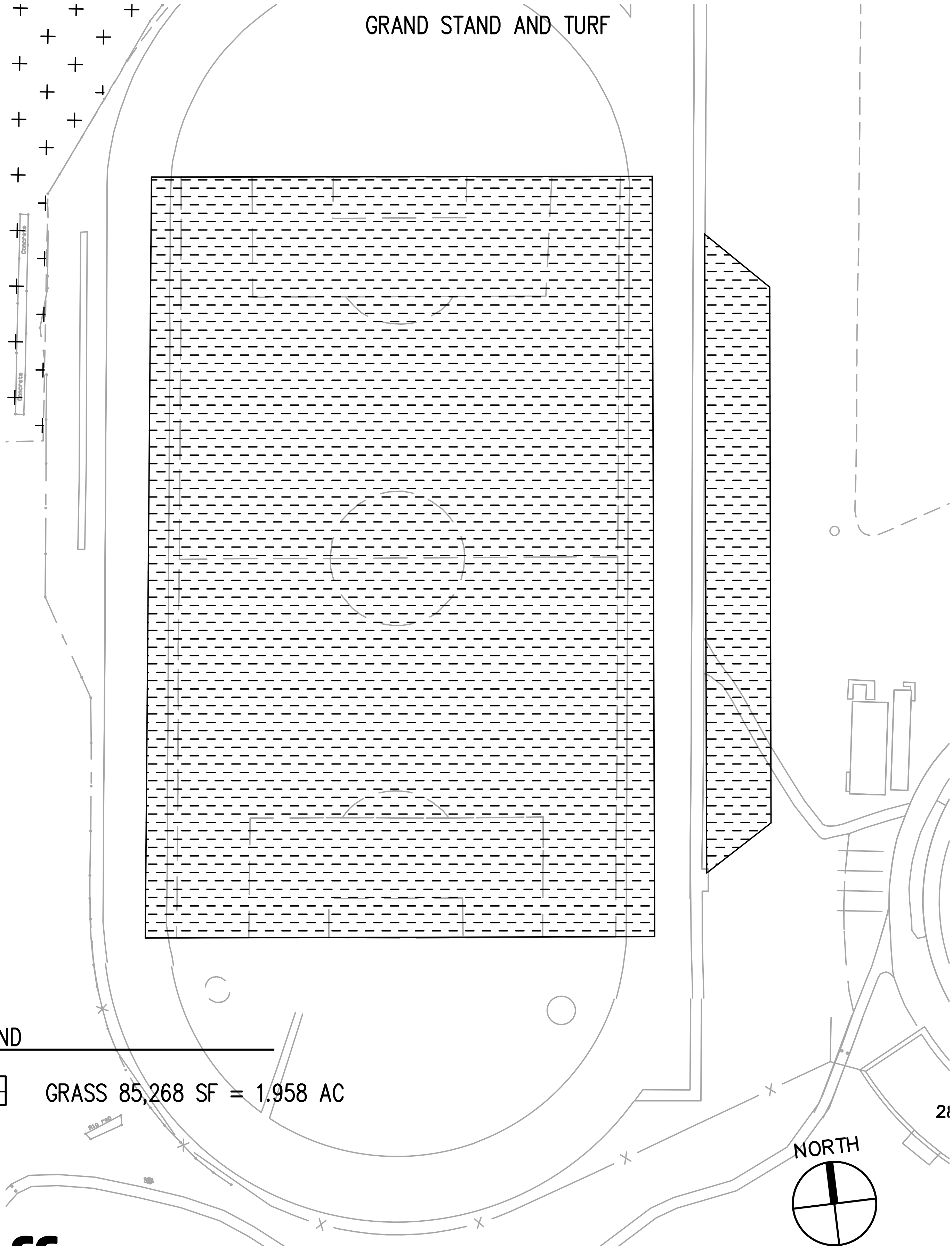
kpff

DATE: 04/29/2016

B-6

EXISTING CONDITIONS MAP

GRAND STAND AND TURF



LEGEND

GRASS 85,268 SF = 1.958 AC

0 30 60 120

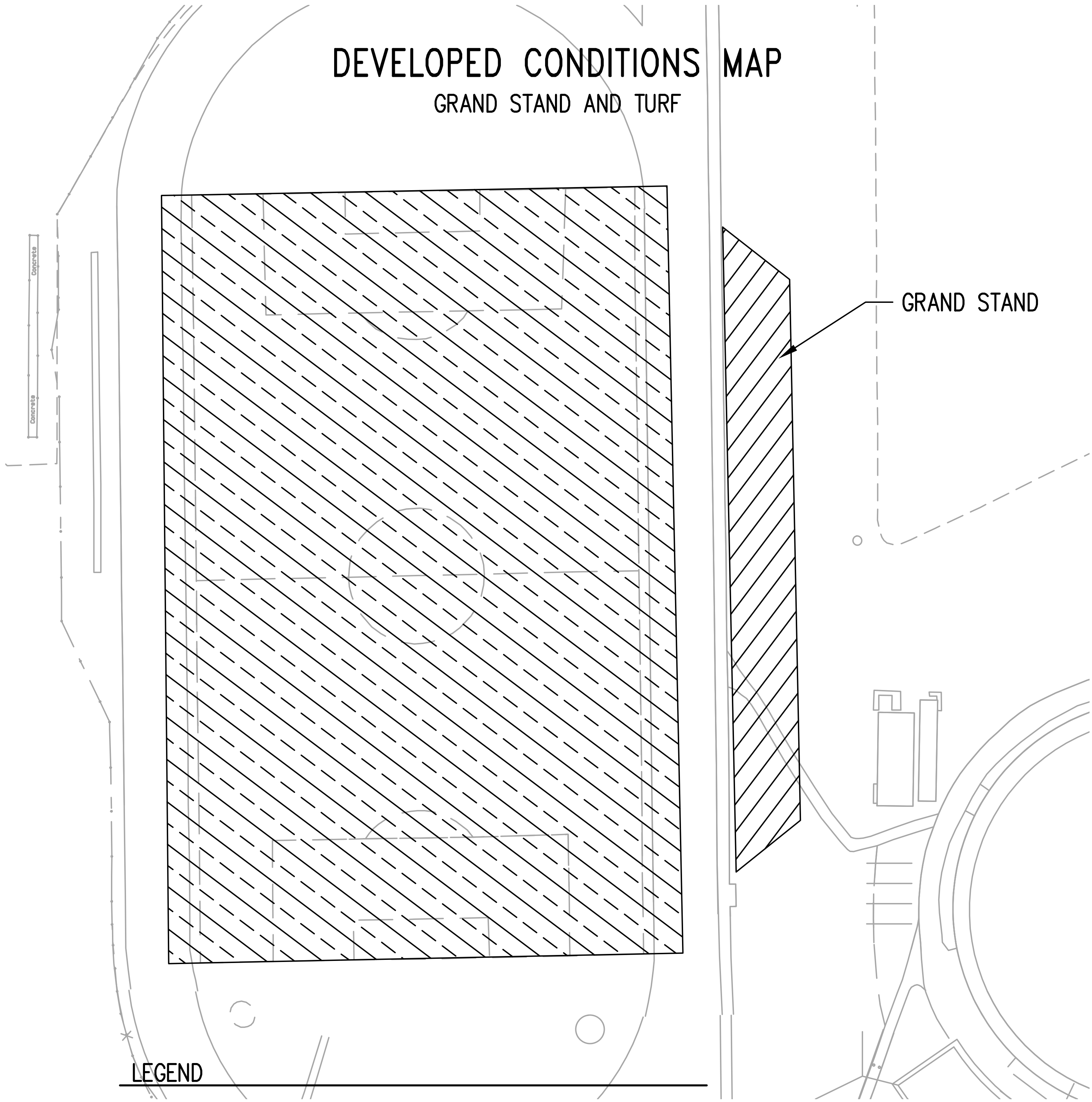
1 inch = 60 feet

kpff

DATE: 04/18/2016

DEVELOPED CONDITIONS MAP

GRAND STAND AND TURF



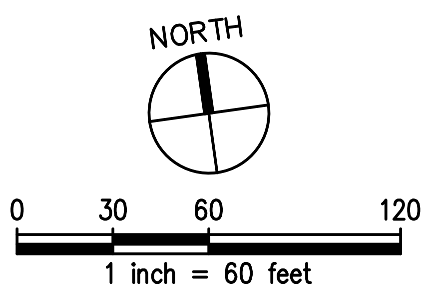
LEGEND

ARTIFICIAL TURF MODELED AS 25% IMPERVIOUS SURFACE (0.445 AC) AND 75% PERVIOUS SURFACE (GRASS 1.336 AC)

GRAND STAND IMPERVIOUS SURFACE 7,697 SF = 0.177 AC

TOTAL IMPERVIOUS SURFACE = 0.622 AC

TOTAL PROJECT AREA = 1.958 AC

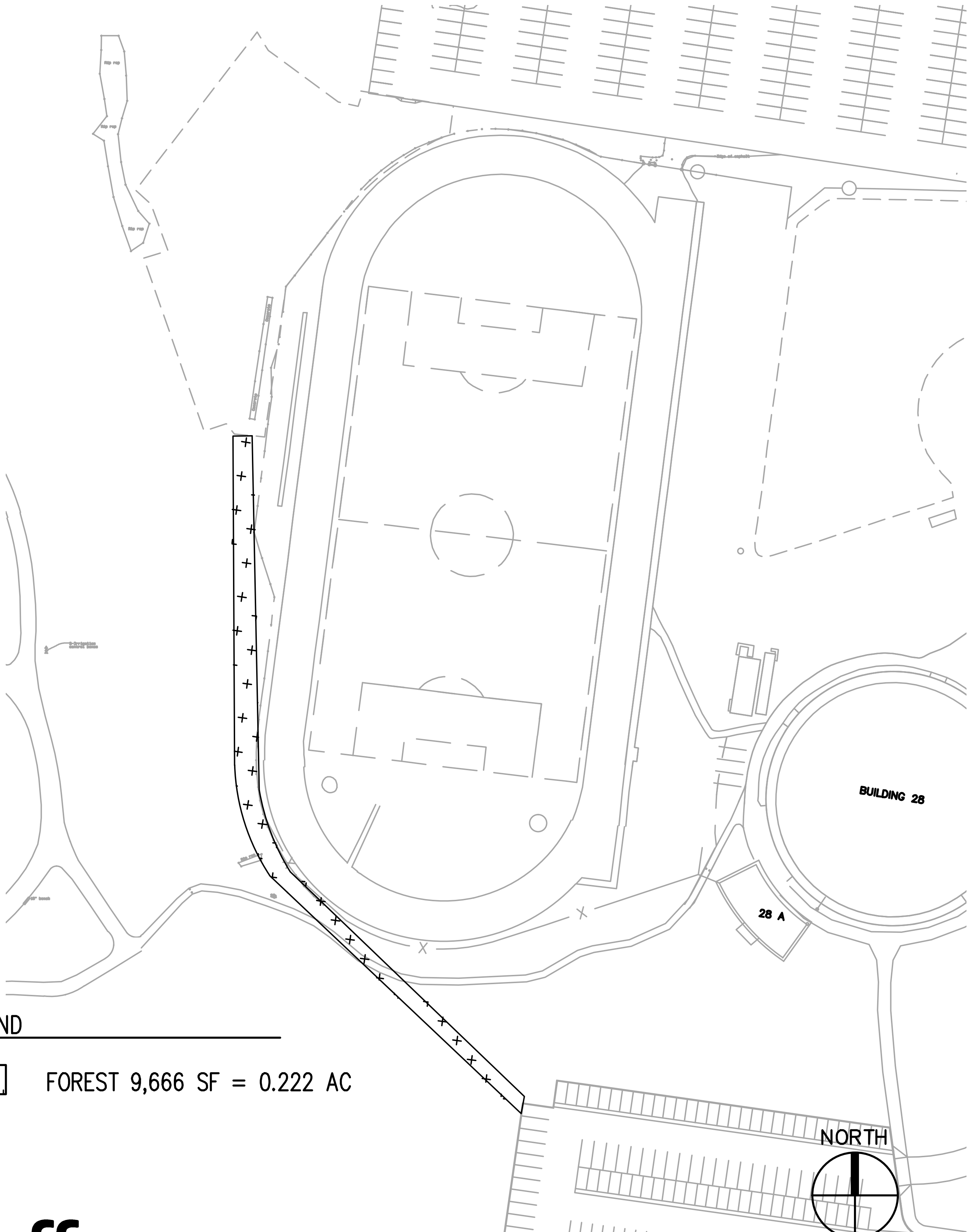


kpff

DATE: 04/28/2016

EXISTING CONDITIONS MAP

LOOP ROAD



LEGEND

FOREST 9,666 SF = 0.222 AC

0 50 100 200

1 inch = 100 feet

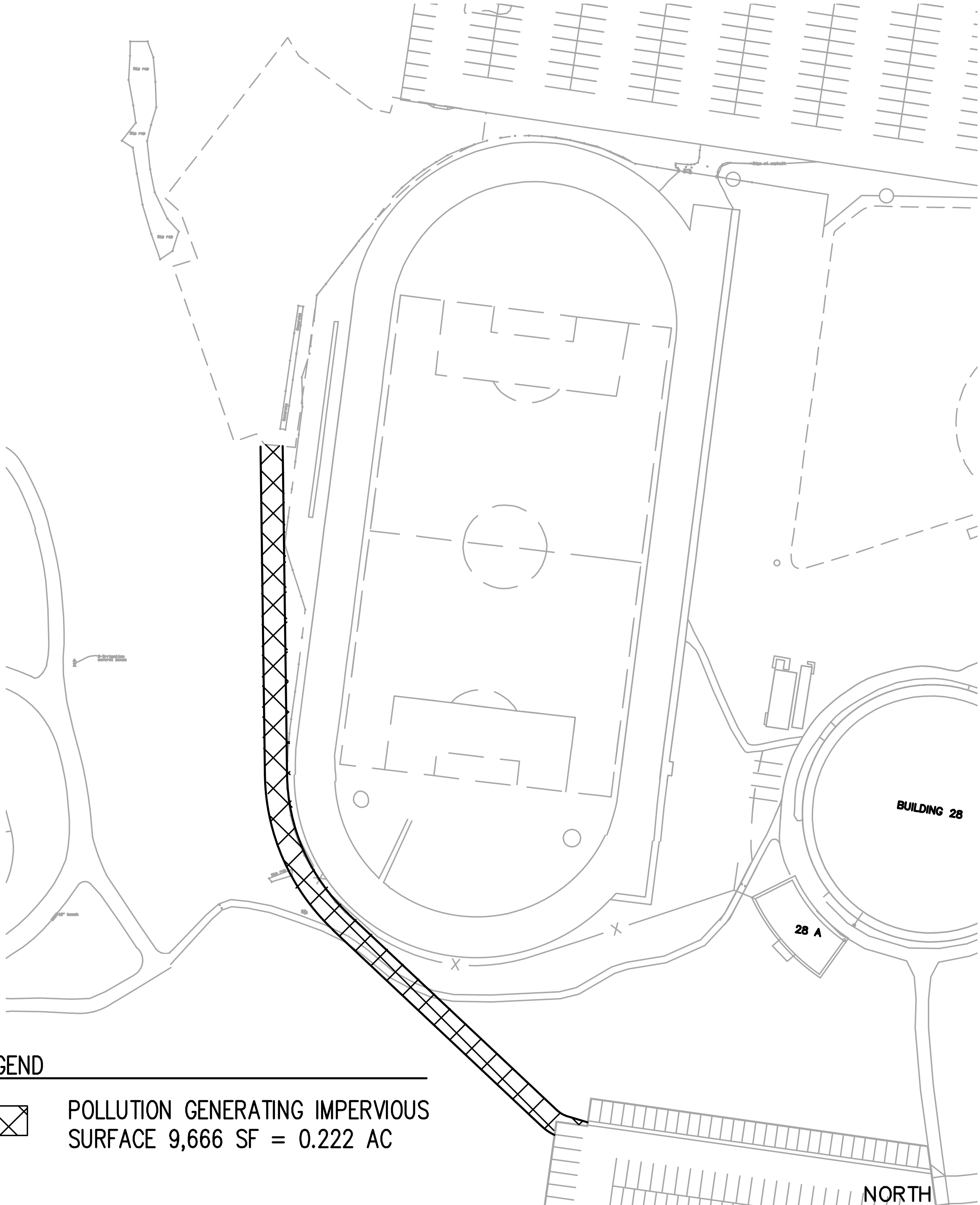
kpff

B-9

DATE: 04/18/2016

DEVELOPED CONDITIONS MAP

LOOP ROAD



LEGEND

POLLUTION GENERATING IMPERVIOUS SURFACE 9,666 SF = 0.222 AC

NORTH

0 50 100 200

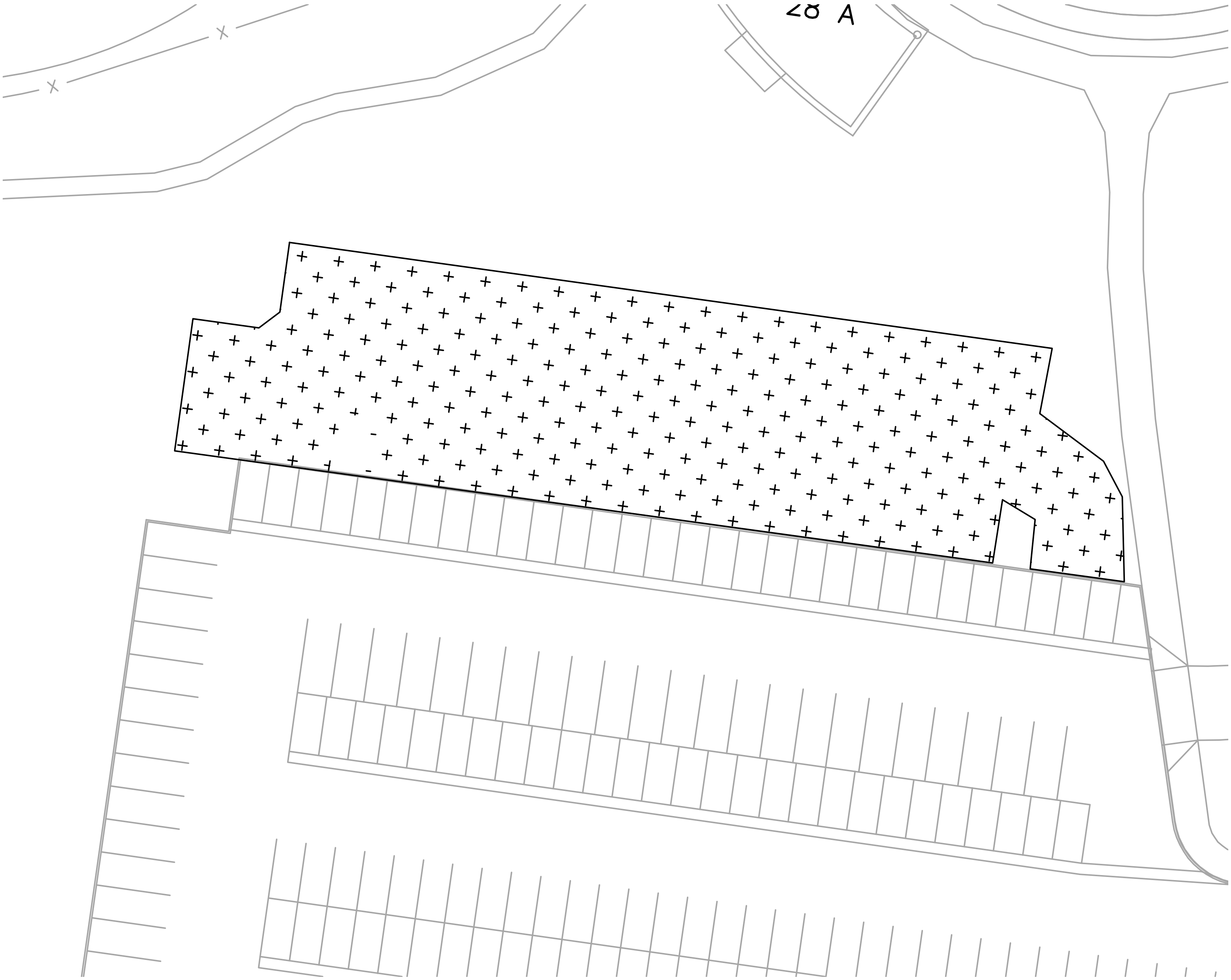
1 inch = 100 feet

kpff

DATE: 04/18/2016

EXISTING CONDITIONS MAP

NORTH EXTENSION TO SOUTH PARKING LOT



LEGEND

FORESTED 13,970 SF = 0.321 AC

NORTH

0 20 40 80

1 inch = 40 feet

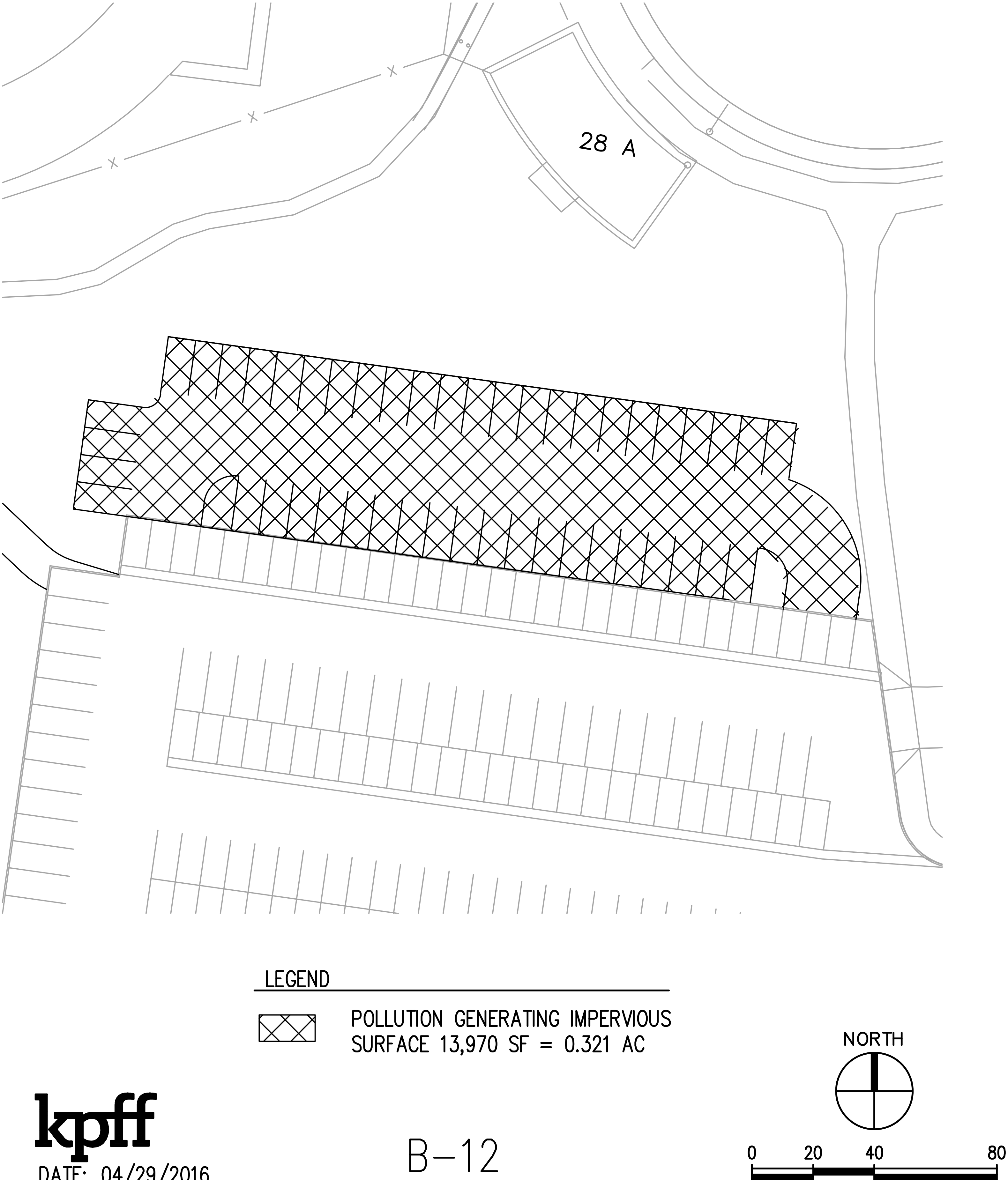
B-11

kpff

DATE: 04/18/2016

DEVELOPED CONDITIONS MAP

NORTH EXTENSION TO SOUTH PARKING LOT

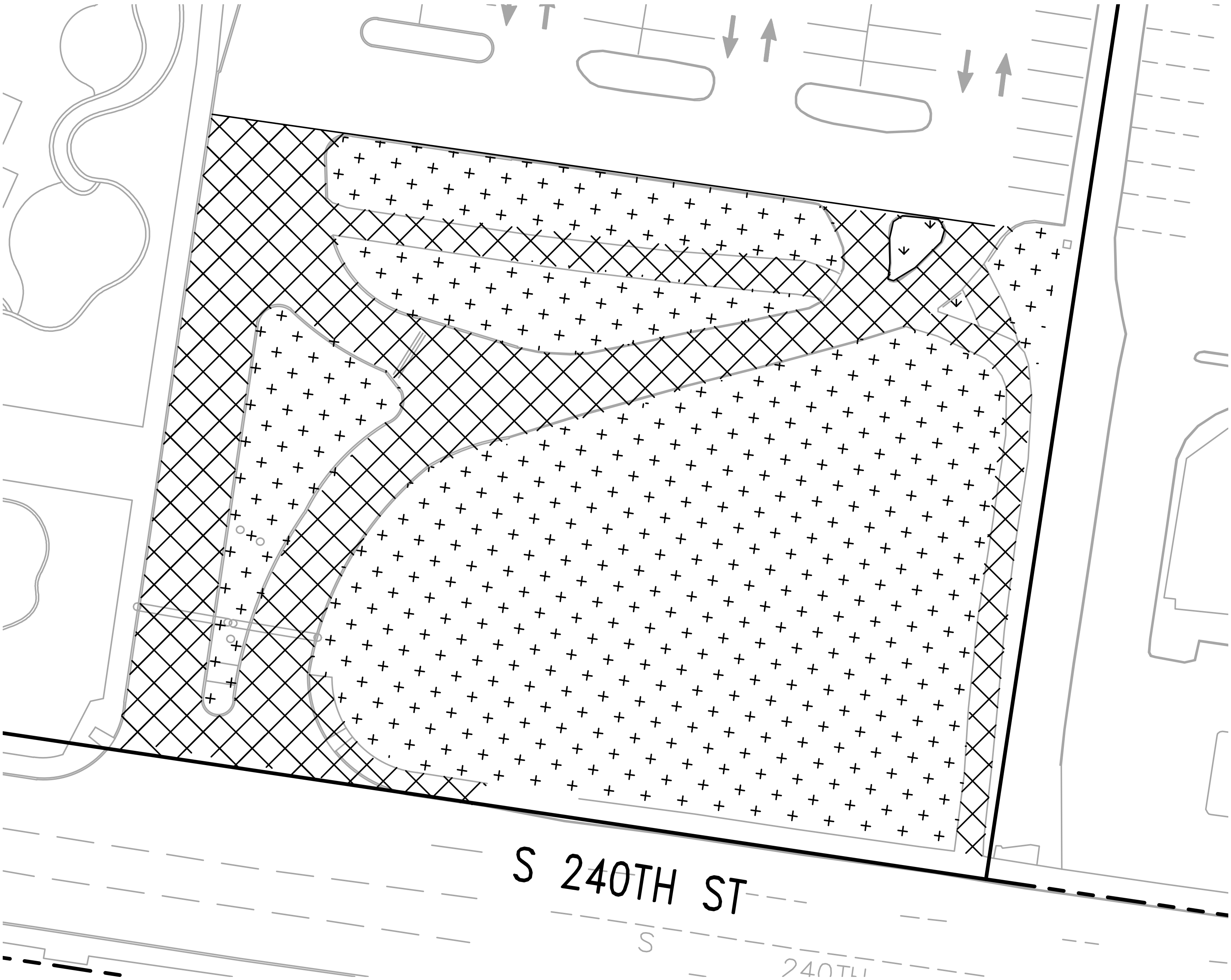


kpff

DATE: 04/29/2016

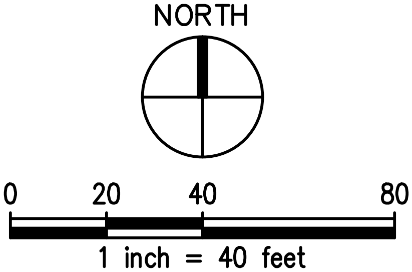
EXISTING CONDITIONS MAP

SOUTH EXTENSION TO EAST PARKING LOT



LEGEND

(crosshatch)	IMPERVIOUS SURFACE 12,957 SF = 0.298 AC
(+ pattern)	FORESTED 25,724 SF = 0.591 AC



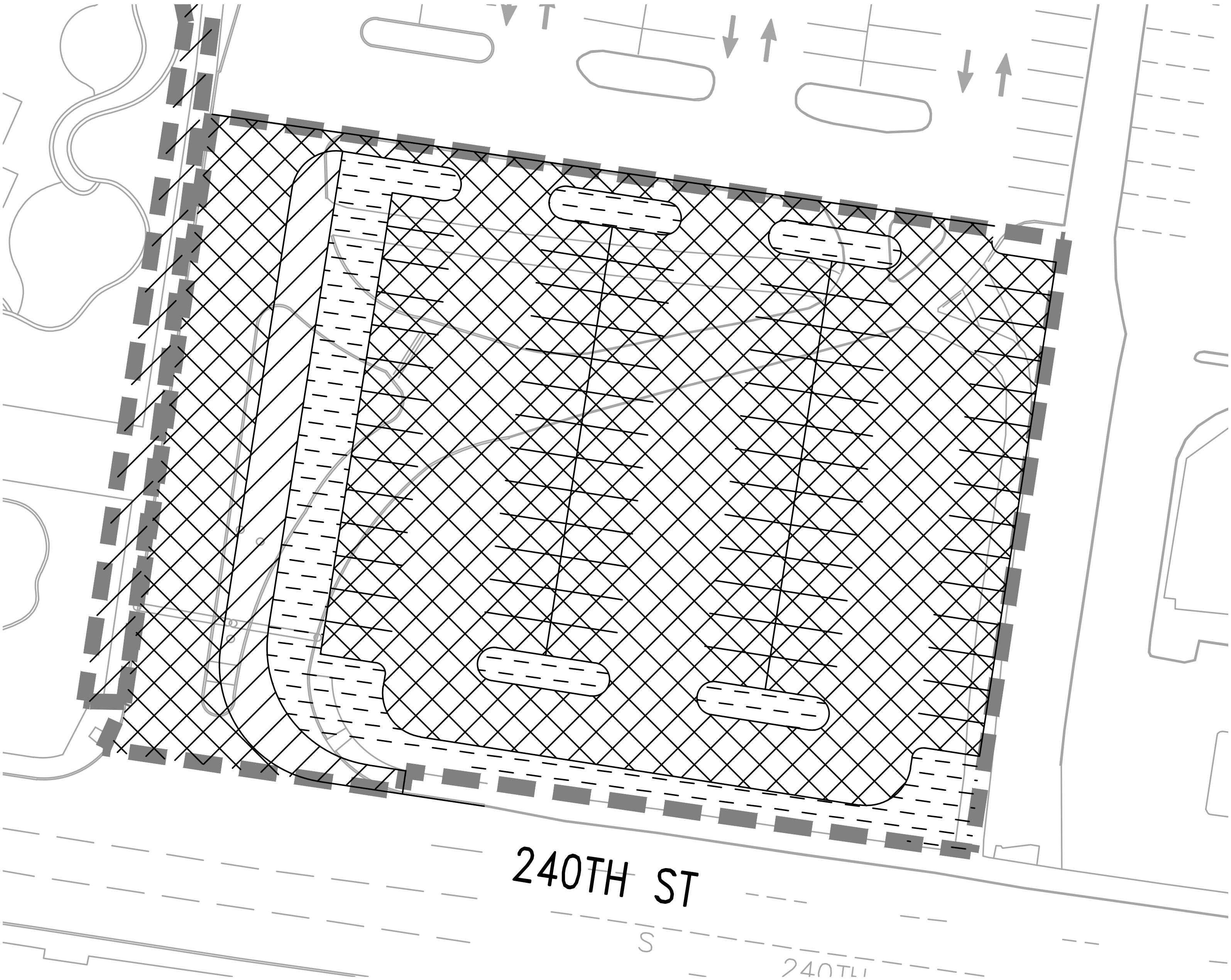
B-13

kpff

DATE: 04/18/2016

DEVELOPED CONDITIONS MAP

SOUTH EXTENSION TO EAST PARKING LOT



LEGEND

NON-POLLUTION GENERATING IMPERVIOUS SURFACE 2,268 SF = 0.052 AC

POLLUTION GENERATING IMPERVIOUS SURFACE 30,919 SF = 0.710 AC

TOTAL IMPERVIOUS SURFACE 32,459 SF = 0.762 AC

GRASS 5,521 SF = 0.126 AC

NORTH

0 20 40 80

1 inch = 40 feet

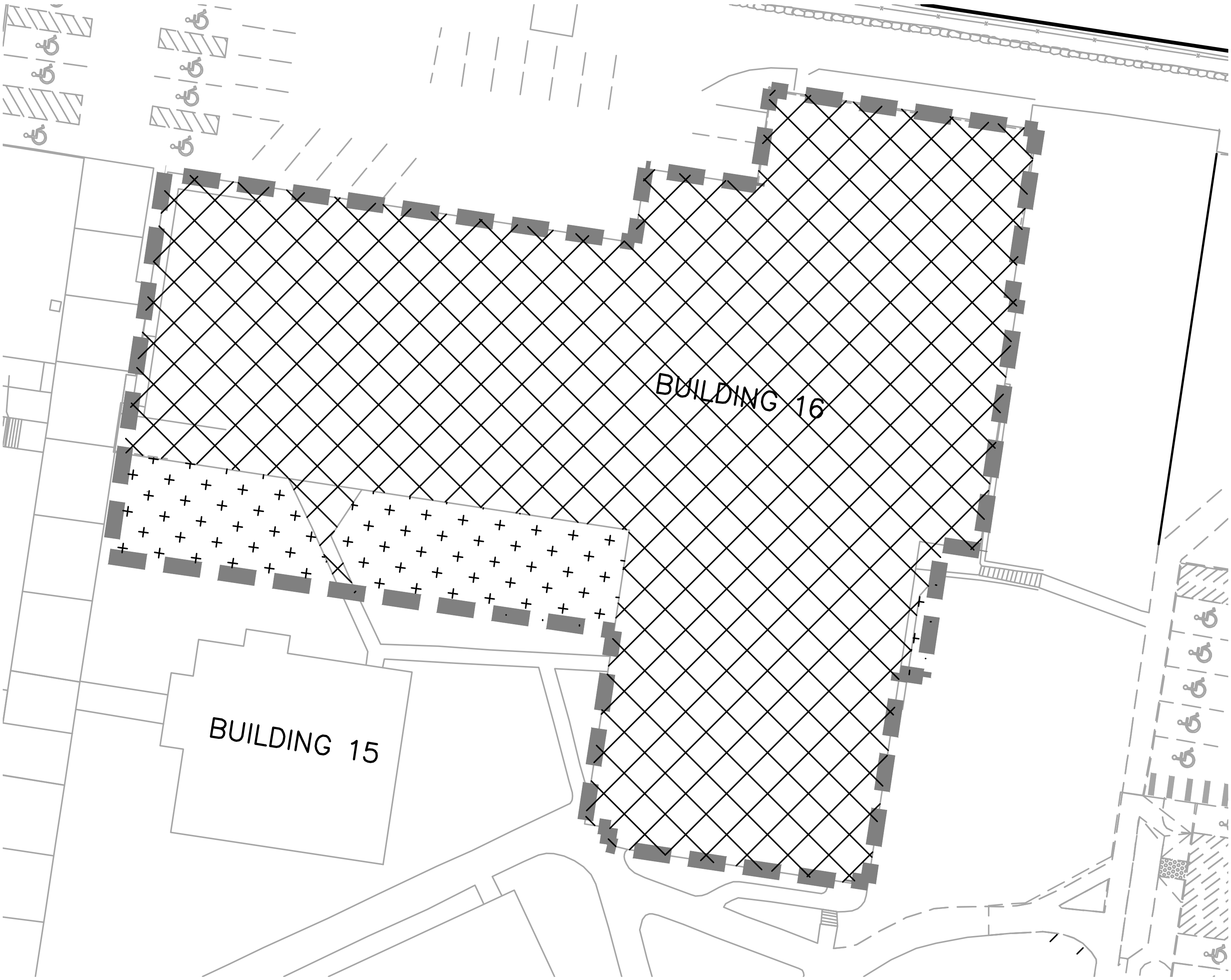
B-14

kpff

DATE: 04/18/2016

EXISTING CONDITIONS MAP

BUILDING 16 REPLACEMENT

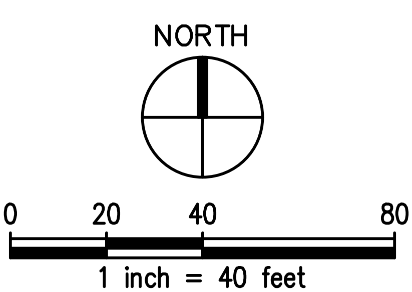


LEGEND

IMPERVIOUS SURFACE 28,672 SF = 0.658 AC

FORESTED 3,696 SF = 0.085 AC

TOTAL PROJECT AREA 32,368 SF = 0.743 AC

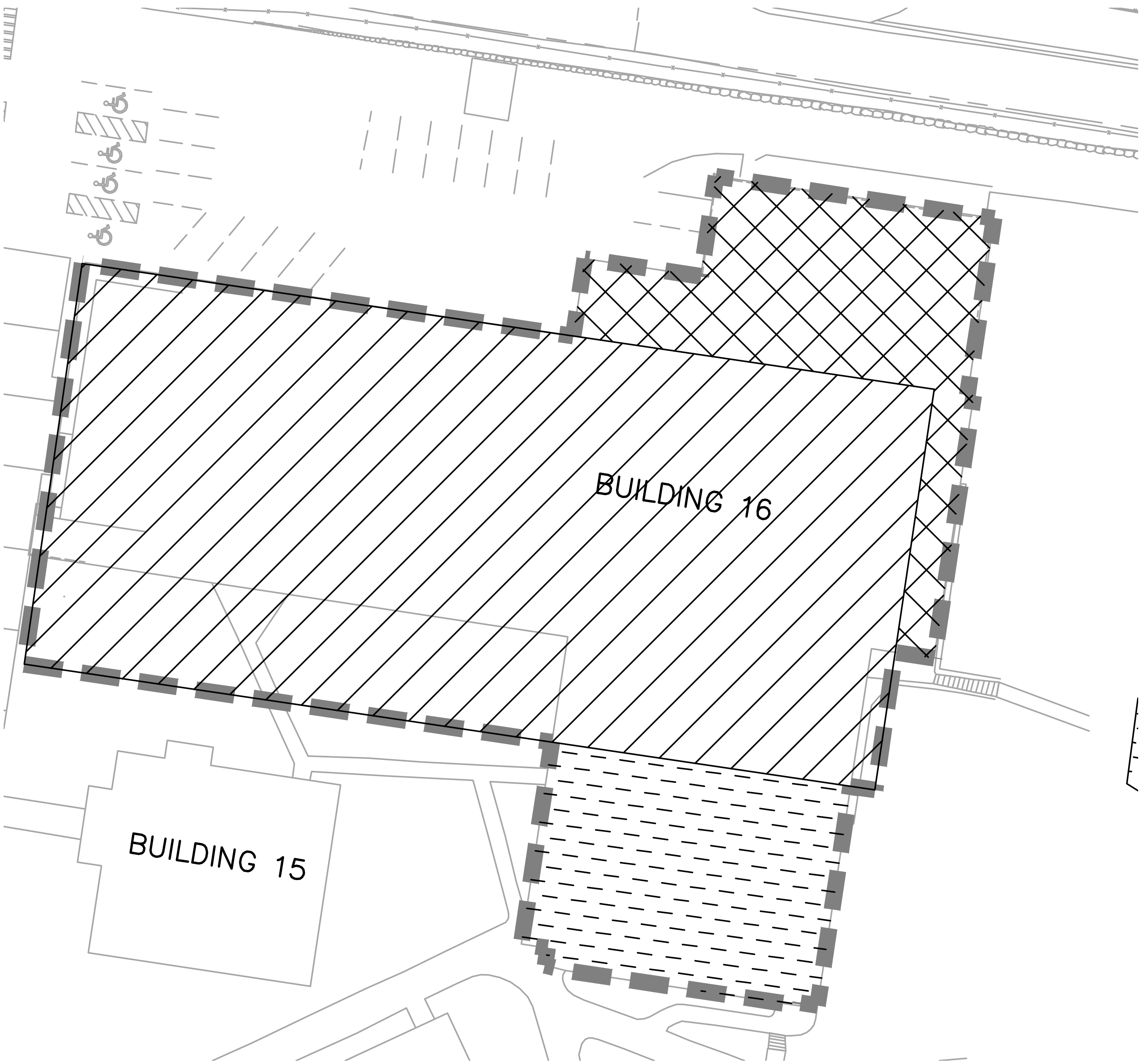


kpff

DATE: 06/06/2016

DEVELOPED CONDITIONS MAP

BUILDING 16 REPLACEMENT



LEGEND

NON-POLLUTION GENERATING IMPERVIOUS SURFACE 23,234 SF = 0.533 AC

POLLUTION GENERATING IMPERVIOUS SURFACE 4,660 SF = 0.107 AC

TOTAL IMPERVIOUS SURFACE 27,894 SF = 0.640 AC

GRASS 4,474 SF = 0.103 AC

TOTAL PROJECT AREA 32,368 SF = 0.743 AC

NORTH

0 20 40 80

1 inch = 40 feet

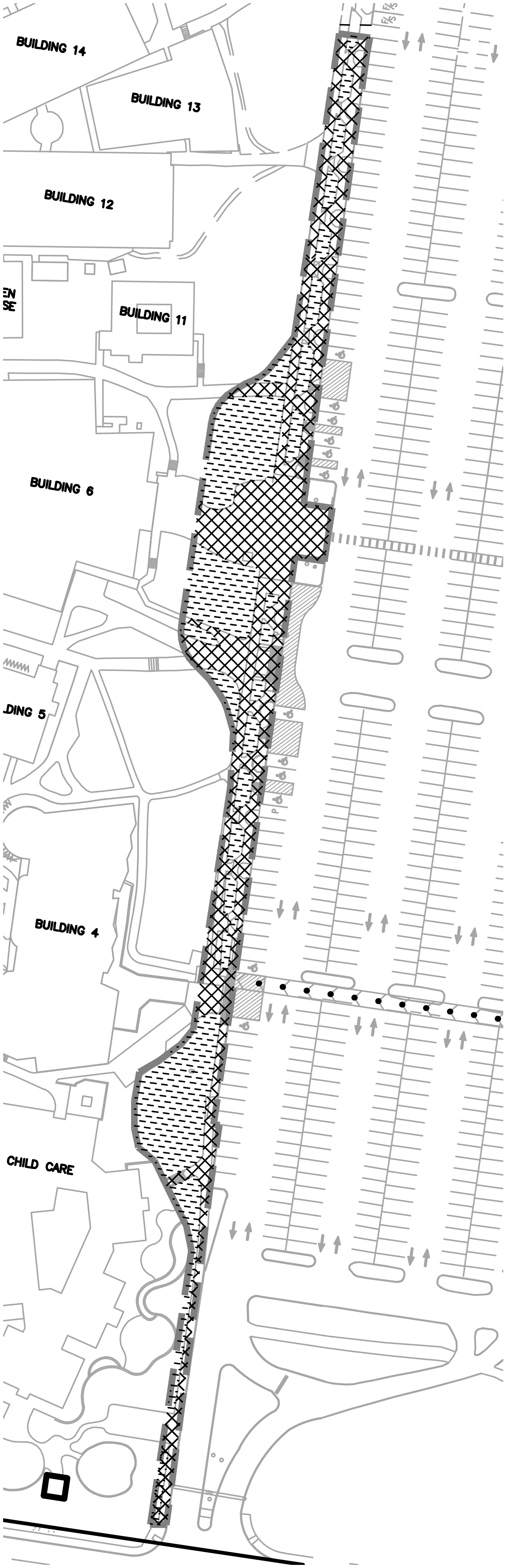
kpff

DATE: 04/29/2016

B-16

EXISTING CONDITIONS MAP

EAST CAMPUS PEDESTRIAN IMPROVEMENTS



LEGEND

(cross-hatch)	IMPERVIOUS SURFACE 17,632 SF = 0.40 AC
(dashed)	PERVIOUS SURFACE, GRASS 14,336 SF = 0.33 AC
	TOTAL PROJECT AREA 31,968 SF = 0.73 AC

kpff

DATE: 06/06/2016

NORTH

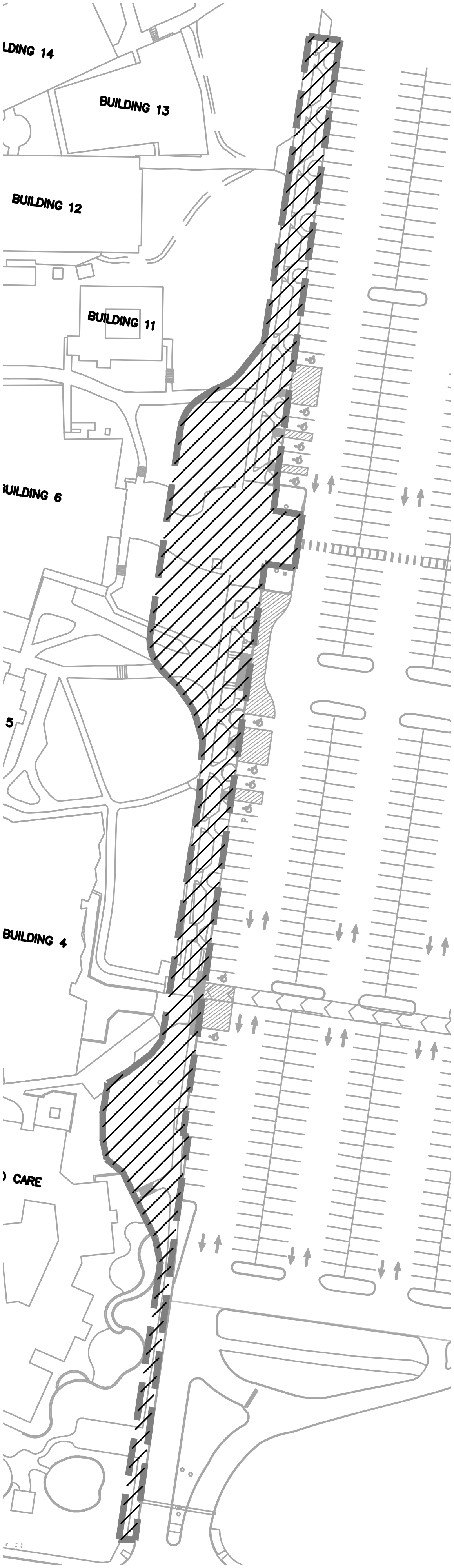
0 20 40 80

1 inch = 40 feet

B–17

DEVELOPED CONDITIONS MAP

EAST CAMPUS PEDESTRIAN IMPROVEMENTS



LEGEND

NON-POLLUTION GENERATING IMPERVIOUS SURFACE
31,968 SF = 0.73 AC

kpff

DATE: 06/06/2016

NORTH

0 20 40 80

1 inch = 40 feet

B-18

Appendix C

C-1: Pond Storage Summary

C-2: KCRTS Level 2 Analysis

kpff 1601 5th Avenue, Suite 1600	project: HC MP TIR	by: MFC	sheet no. C-1
	location:	date:	
	client: Des Moines, WA	11/22/16	job no.
			1600027
	Po*$ S or,+! S-" ",r.		

		Pr!-$!%!&o'!$ o E(#) #*+ Co*$# #o*)		E(#) #*+ o D!%!&o'!$ Co*$# #o*)	
	Pond volume	Used	Available Storage	Used	Available Storage
	9.490		5.337		4.153
DEVELOPMENT USING THE POND SINCE 1998		Ac-Ft	Ac-Ft	Ac-Ft	Ac-Ft
Bldg 30		0.110		0.014	
			5.227		4.139
Childcare bldg		0.240		0.311	
			4.987		3.828
Student Union		0.653		0.179	
			4.334		3.649
Student Union as-built adjustment (May 2003 letter)		0.003		0.000	
			4.331		3.649
HEC and South park lot expansion		0.514		0.641	
			3.817		3.008
North Parking Lot Expansion		0.099		0.132	
Current status (in Ac-Ft)			3.718		2.876
MASTER PLAN PROJECTS					
Shor T!r"					
North Extension to East Parking Lot		0.435		0.130	
			3.283		2.746
West Parking Lot		0.000		0.318	
			3.283		2.428
M#$ T!r"					
South Extension to East Parking Lot		0.116		0.150	
			3.167		2.278
Loop Road		0.000		0.094	
			3.167		2.184

NORTH EXTENSION TO EAST PARKING LOT DEVELOPED BACK TO EXISTING

(NEEPL2)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
X			5,668	0.130

See Figures B-3 and B-4

NORTH EXTENSION TO EAST PARKING LOT
DEVELOPED BACK TO EXISTING

Retention/Detention Facility

Type of Facility: Detention Pond
Side Slope: 3.00 H:1V
Pond Bottom Length: 25.00 ft
Pond Bottom Width: 25.00 ft
Pond Bottom Area: 625. sq. ft
Top Area at 1 ft. FB: 3025. sq. ft
0.069 acres
Effective Storage Depth: 4.00 ft
Stage 0 Elevation: 100.00 ft
Storage Volume: 5668. cu. ft
0.130 ac-ft
Riser Head: 4.00 ft
Riser Diameter: 18.00 inches
Number of orifices: 2

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.00	0.054	
2	3.00	3.00	0.244	6.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	625.
0.01	100.01	6.	0.000	0.003	0.00	628.
0.02	100.02	13.	0.000	0.004	0.00	631.
0.03	100.03	19.	0.000	0.005	0.00	634.
0.04	100.04	25.	0.001	0.006	0.00	637.
0.05	100.05	32.	0.001	0.006	0.00	640.
0.06	100.06	38.	0.001	0.007	0.00	643.
0.07	100.07	45.	0.001	0.007	0.00	646.
0.08	100.08	51.	0.001	0.008	0.00	649.
0.09	100.09	58.	0.001	0.008	0.00	652.
0.19	100.19	124.	0.003	0.012	0.00	683.

0.29	100.29	194.	0.004	0.015	0.00	715.
0.39	100.39	267.	0.006	0.017	0.00	747.
0.49	100.49	344.	0.008	0.019	0.00	781.
0.59	100.59	423.	0.010	0.021	0.00	815.
0.69	100.69	507.	0.012	0.023	0.00	849.
0.79	100.79	593.	0.014	0.024	0.00	884.
0.89	100.89	684.	0.016	0.026	0.00	921.
0.99	100.99	777.	0.018	0.027	0.00	957.
1.09	101.09	875.	0.020	0.028	0.00	995.
1.19	101.19	976.	0.022	0.030	0.00	1033.
1.29	101.29	1082.	0.025	0.031	0.00	1072.
1.39	101.39	1191.	0.027	0.032	0.00	1112.
1.49	101.49	1304.	0.030	0.033	0.00	1152.
1.59	101.59	1421.	0.033	0.034	0.00	1193.
1.69	101.69	1543.	0.035	0.035	0.00	1235.
1.79	101.79	1668.	0.038	0.036	0.00	1277.
1.89	101.89	1798.	0.041	0.037	0.00	1321.
1.99	101.99	1932.	0.044	0.038	0.00	1365.
2.09	102.09	2071.	0.048	0.039	0.00	1409.
2.19	102.19	2214.	0.051	0.040	0.00	1455.
2.29	102.29	2362.	0.054	0.041	0.00	1501.
2.39	102.39	2514.	0.058	0.042	0.00	1548.
2.49	102.49	2672.	0.061	0.043	0.00	1595.
2.59	102.59	2834.	0.065	0.044	0.00	1643.
2.69	102.69	3000.	0.069	0.045	0.00	1692.
2.79	102.79	3172.	0.073	0.045	0.00	1742.
2.89	102.89	3349.	0.077	0.046	0.00	1793.

2.99	102.99	3531.	0.081	0.047	0.00	1844.
3.00	103.00	3549.	0.081	0.047	0.00	1849.
3.03	103.03	3605.	0.083	0.049	0.00	1865.
3.06	103.06	3661.	0.084	0.056	0.00	1880.
3.09	103.09	3718.	0.085	0.068	0.00	1896.
3.13	103.13	3794.	0.087	0.084	0.00	1917.
3.16	103.16	3852.	0.088	0.104	0.00	1932.
3.19	103.19	3910.	0.090	0.127	0.00	1948.
3.22	103.22	3968.	0.091	0.153	0.00	1964.
3.25	103.25	4028.	0.092	0.171	0.00	1980.
3.35	103.35	4228.	0.097	0.194	0.00	2034.
3.45	103.45	4434.	0.102	0.214	0.00	2088.
3.55	103.55	4646.	0.107	0.232	0.00	2144.
3.65	103.65	4863.	0.112	0.249	0.00	2200.
3.75	103.75	5086.	0.117	0.264	0.00	2256.
3.85	103.85	5314.	0.122	0.278	0.00	2314.
3.95	103.95	5549.	0.127	0.292	0.00	2372.
4.00	104.00	5668.	0.130	0.298	0.00	2401.
4.10	104.10	5911.	0.136	0.773	0.00	2460.
4.20	104.20	6160.	0.141	1.630	0.00	2520.
4.30	104.30	6415.	0.147	2.740	0.00	2581.
4.40	104.40	6676.	0.153	4.040	0.00	2642.
4.50	104.50	6944.	0.159	5.520	0.00	2704.
4.60	104.60	7217.	0.166	6.960	0.00	2767.
4.70	104.70	7497.	0.172	7.500	0.00	2830.
4.80	104.80	7783.	0.179	8.000	0.00	2894.
4.90	104.90	8076.	0.185	8.470	0.00	2959.

```
      5.00     105.00       8375.     0.192  8.920      0.00
3025.
      5.10     105.10       8681.     0.199  9.340      0.00
3091.
      5.20     105.20       8993.     0.206  9.750      0.00
3158.
      5.30     105.30       9313.     0.214 10.130      0.00
3226.
      5.40     105.40       9639.     0.221 10.510      0.00
3295.
      5.50     105.50       9972.     0.229 10.870      0.00
3364.
      5.60     105.60      10311.     0.237 11.220      0.00
3434.
      5.70     105.70      10658.     0.245 11.560      0.00
3505.
      5.80     105.80      11012.     0.253 11.890      0.00
3576.
      5.90     105.90      11374.     0.261 12.210      0.00
3648.
      6.00     106.00      11742.     0.270 12.520      0.00
3721.
```

```
 Hyd  Inflow    Outflow         Peak             Storage
            Target    Calc  Stage   Elev   (Cu-Ft)    (Ac-Ft)
  1    0.69 *******    0.66  4.08  104.08      5855.      0.134
  2    0.48    0.38    0.23  3.55  103.55      4641.      0.107
  3    0.42 *******    0.27  3.78  103.78      5148.      0.118
  4    0.39 *******    0.19  3.35  103.35      4222.      0.097
  5    0.37 *******    0.29  3.92  103.92      5488.      0.126
  6    0.35 *******    0.26  3.74  103.74      5059.      0.116
  7    0.33 *******    0.09  3.14  103.14      3822.      0.088
  8    0.29 *******    0.14  3.20  103.20      3929.      0.090
```

```
----------------------------------
Route Time Series through Facility
  Inflow Time Series File:neepl2-dev.tsf
 Outflow Time Series File:NEEPL2-OUT

Inflow/Outflow Analysis
   Peak Inflow Discharge:      0.692 CFS at  6:00 on Jan  9 in Year 8
  Peak Outflow Discharge:      0.664 CFS at  7:00 on Jan  9 in Year 8
    Peak Reservoir Stage:       4.08  Ft
     Peak Reservoir Elev:     104.08  Ft
  Peak Reservoir Storage:    5855.    Cu-Ft
                        :       0.134 Ac-Ft

          Flow Frequency Analysis
  Time Series File:neepl2-out.tsf
  Project Location:Sea-Tac

  ---Annual Peak Flow Rates---      -----Flow Frequency Analysis-------
 Flow Rate  Rank  Time of Peak       - - Peaks - -  Rank  Return  Prob
   (CFS)                             (CFS)    (ft)        Period
```

0.262	5	2/09/01 5:00	0.664	4.08	1	100.00	0.990
0.136	7	1/06/02 4:00	0.288	3.92	2	25.00	0.960
0.268	4	2/27/03 9:00	0.282	3.88	3	10.00	0.900
0.094	8	8/23/04 23:00	0.268	3.78	4	5.00	0.800
0.193	6	10/28/04 19:00	0.262	3.74	5	3.00	0.667
0.288	2	1/18/06 17:00	0.193	3.35	6	2.00	0.500
0.282	3	11/24/06 5:00	0.136	3.20	7	1.30	0.231
0.664	1	1/09/08 7:00	0.094	3.14	8	1.10	0.091
Computed Peaks			0.539	4.05		50.00	0.980

Flow Duration from Time Series File:neepl2-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.004	47389	77.281	77.281	22.719	0.227E+00
0.012	3992	6.510	83.792	16.208	0.162E+00
0.020	3358	5.476	89.268	10.732	0.107E+00
0.028	2811	4.584	93.852	6.148	0.615E-01
0.036	1965	3.205	97.056	2.944	0.294E-01
0.045	1149	1.874	98.930	1.070	0.107E-01
0.053	378	0.616	99.547	0.453	0.453E-02
0.061	33	0.054	99.600	0.400	0.400E-02
0.069	25	0.041	99.641	0.359	0.359E-02
0.077	21	0.034	99.675	0.325	0.325E-02
0.085	23	0.038	99.713	0.287	0.287E-02
0.093	9	0.015	99.728	0.272	0.272E-02
0.101	15	0.024	99.752	0.248	0.248E-02
0.109	7	0.011	99.764	0.236	0.236E-02
0.117	7	0.011	99.775	0.225	0.225E-02
0.126	7	0.011	99.786	0.214	0.214E-02
0.134	6	0.010	99.796	0.204	0.204E-02
0.142	11	0.018	99.814	0.186	0.186E-02
0.150	6	0.010	99.824	0.176	0.176E-02
0.158	9	0.015	99.839	0.161	0.161E-02
0.166	4	0.007	99.845	0.155	0.155E-02
0.174	6	0.010	99.855	0.145	0.145E-02
0.182	16	0.026	99.881	0.119	0.119E-02
0.190	8	0.013	99.894	0.106	0.106E-02
0.198	10	0.016	99.910	0.090	0.897E-03
0.206	9	0.015	99.925	0.075	0.750E-03
0.215	9	0.015	99.940	0.060	0.603E-03
0.223	6	0.010	99.949	0.051	0.506E-03
0.231	5	0.008	99.958	0.042	0.424E-03
0.239	2	0.003	99.961	0.039	0.391E-03
0.247	4	0.007	99.967	0.033	0.326E-03
0.255	5	0.008	99.976	0.024	0.245E-03
0.263	6	0.010	99.985	0.015	0.147E-03
0.271	3	0.005	99.990	0.010	0.978E-04
0.279	3	0.005	99.995	0.005	0.489E-04
0.287	2	0.003	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: neepl2-ex.tsf
New File: neepl2-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.140	0.31E-02	0.19E-02	-38.4	0.31E-02	0.140	0.079	-43.2
0.158	0.22E-02	0.16E-02	-27.7	0.22E-02	0.158	0.118	-25.1
0.177	0.16E-02	0.14E-02	-13.5	0.16E-02	0.177	0.166	-6.2
0.195	0.11E-02	0.99E-03	-7.6	0.11E-02	0.195	0.189	-2.8
0.213	0.65E-03	0.64E-03	-2.5	0.65E-03	0.213	0.213	-0.1
0.232	0.52E-03	0.39E-03	-25.0	0.52E-03	0.232	0.221	-4.5
0.250	0.36E-03	0.31E-03	-13.6	0.36E-03	0.250	0.240	-3.9
0.269	0.28E-03	0.98E-04	-64.7	0.28E-03	0.269	0.252	-6.1
0.287	0.13E-03	0.16E-04	-87.5	0.13E-03	0.287	0.267	-6.8
0.305	0.82E-04	0.00E+00	-100.0	0.82E-04	0.305	0.272	-10.9
0.324	0.65E-04	0.00E+00	-100.0	0.65E-04	0.324	0.273	-15.6
0.342	0.16E-04	0.00E+00	-100.0	0.16E-04	0.342	0.288	-15.8
0.361	0.16E-04	0.00E+00	-100.0	0.16E-04	0.361	0.288	-20.1
0.379	0.16E-04	0.00E+00	-100.0	0.16E-04	0.379	0.288	-24.0

Maximum positive excursion = 0.003 cfs (1.7%)
occurring at 0.208 cfs on the Base Data:neepl2-ex.tsf
and at 0.212 cfs on the New Data:neepl2-out.tsf

Maximum negative excursion = 0.060 cfs (-43.2%)
occurring at 0.140 cfs on the Base Data:neepl2-ex.tsf
and at 0.079 cfs on the New Data:neepl2-out.tsf

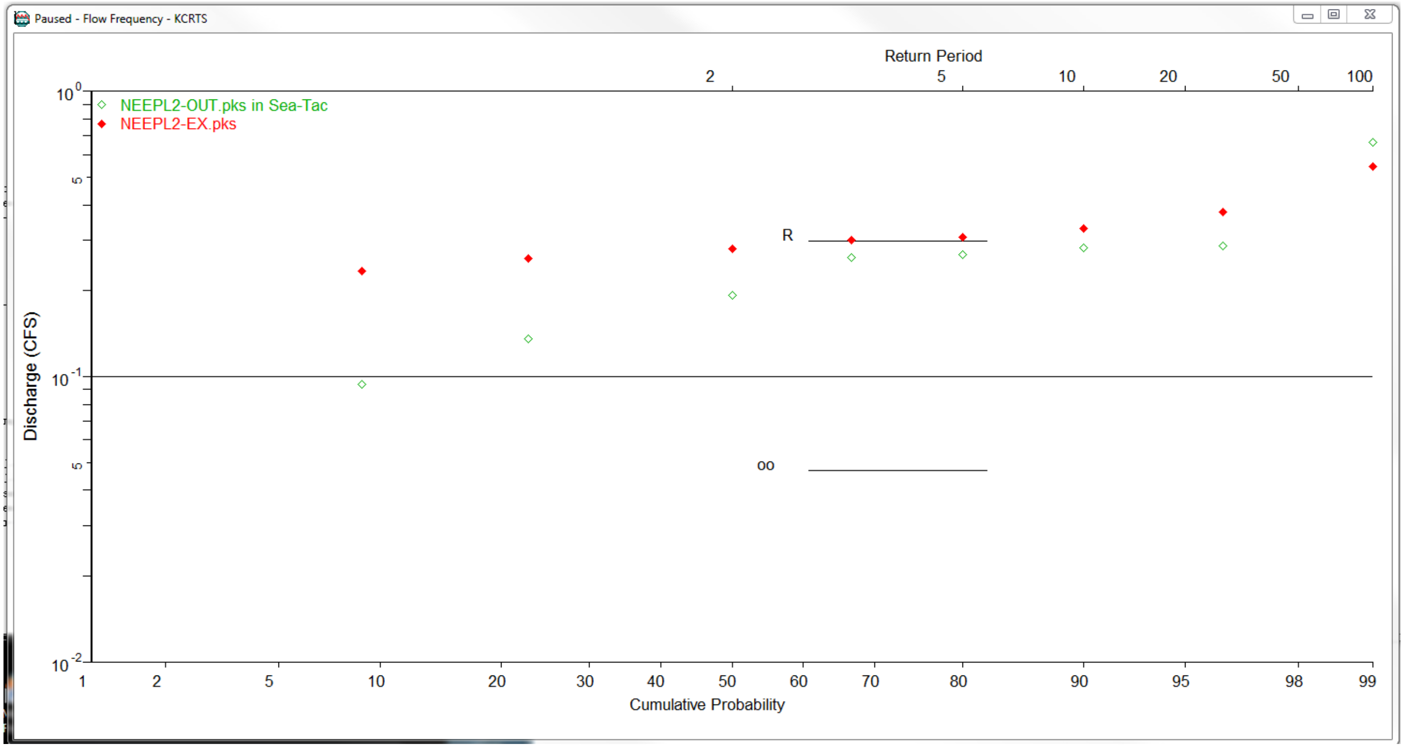
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KCRTS\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.41       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       1.28       0.00       0.000000  Impervious
NEEPL2-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.59       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.06       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       1.04       0.00       0.000000  Impervious
NEEPL2-EX.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
neepl2-ex.tsf
NEEPL2-EX.pks
[P] Compute PEAKS and Flow Frequencies
neepl2-dev.tsf
NEEPL2-DEV.pks
[D] Compute Flow DURATION and Exceedence
neepl2-dev.tsf
NEEPL2-DEV.dur
 F
 F
          36
   0.128000E-01
   0.173500
[D] Compute Flow DURATION and Exceedence
neepl2-ex.tsf
NEEPL2-EX.dur
 F
 F
          36
   0.100000E-01
   0.140000
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

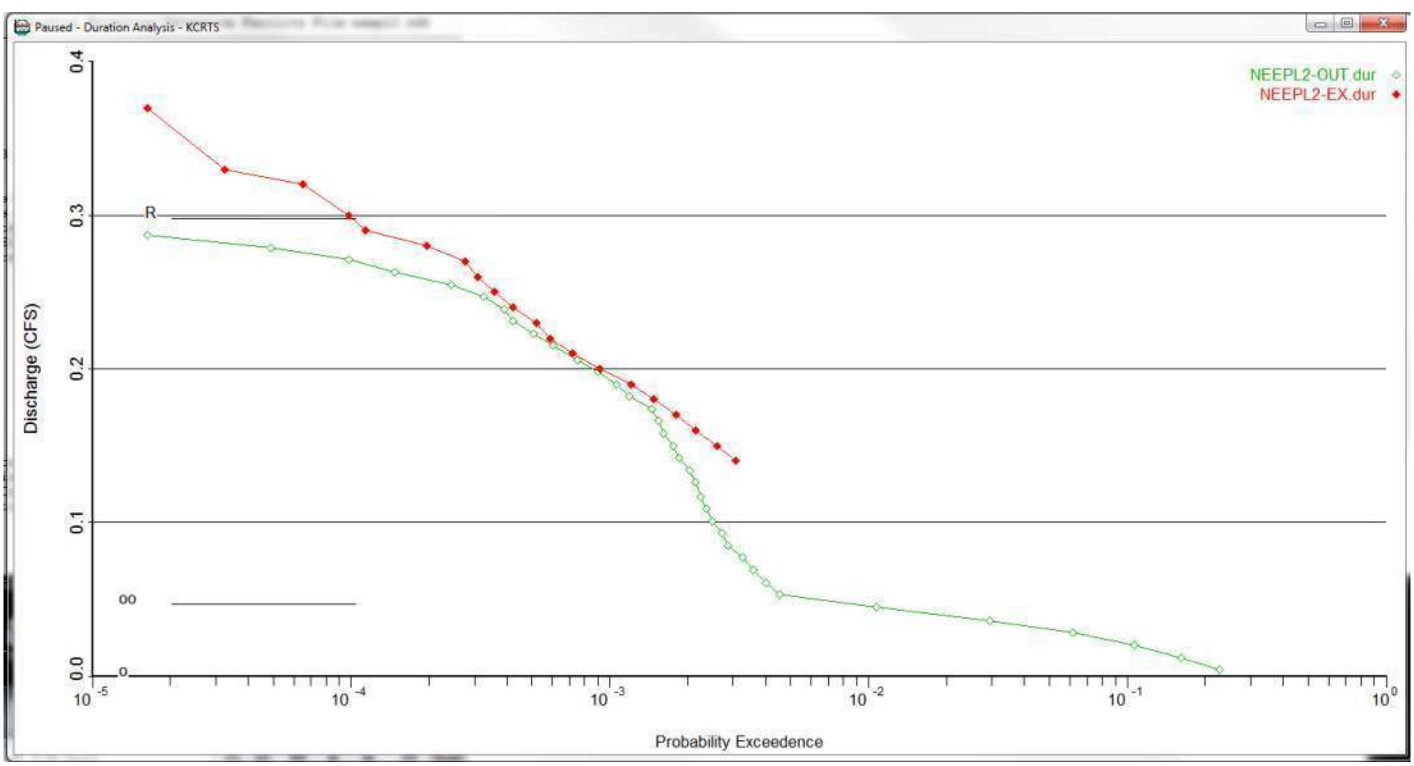
Flow Frequency Analysis
Time Series File:neepl2-ex.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.281	6	2/09/01 2:00	0.547	1	100.00	0.990
0.235	8	1/05/02 16:00	0.379	2	25.00	0.960
0.330	3	2/27/03 7:00	0.330	3	10.00	0.900
0.260	7	8/26/04 2:00	0.309	4	5.00	0.800
0.309	4	10/28/04 16:00	0.301	5	3.00	0.667
0.301	5	1/18/06 16:00	0.281	6	2.00	0.500
0.379	2	10/26/06 0:00	0.260	7	1.30	0.231
0.547	1	1/09/08 6:00	0.235	8	1.10	0.091
Computed Peaks			0.491		50.00	0.980

Flow Frequency Analysis
Time Series File:neepl2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.262	5	2/09/01	5:00	0.664	4.08	1	100.00	0.990
0.136	7	1/06/02	4:00	0.288	3.92	2	25.00	0.960
0.268	4	2/27/03	9:00	0.282	3.88	3	10.00	0.900
0.094	8	8/23/04	23:00	0.268	3.78	4	5.00	0.800
0.193	6	10/28/04	19:00	0.262	3.74	5	3.00	0.667
0.288	2	1/18/06	17:00	0.193	3.35	6	2.00	0.500
0.282	3	11/24/06	5:00	0.136	3.20	7	1.30	0.231
0.664	1	1/09/08	7:00	0.094	3.14	8	1.10	0.091
Computed Peaks				0.539	4.05		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
NEEPL2-OUT.pks in Sea-Tac
NEEPL2-EX.pks
R
oo
Discharge (CFS)
Cumulative Probability
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99


Paused - Duration Analysis - KCRTS
NEEPL2-OUT.dur
NEEPL2-EX.dur
R
oo
Discharge (CFS)
0.0
0.1
0.2
0.3
0.4
Probability Exceedence

NORTH EXTENSION TO EAST PARKING LOT EXISTING BACK TO FORESTED

(NEEPL3)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
		X	18,952	0.435

See Figures B-3 and B-4

NORTH EXTENSION TO EAST PARKING LOT
EXISTING BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	58.00	ft
Pond Bottom Width:	55.00	ft
Pond Bottom Area:	3190.	sq. ft
Top Area at 1 ft. FB:	7480.	sq. ft
	0.172	acres
Effective Storage Depth:	4.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	18952.	cu. ft
	0.435	ac-ft
Riser Head:	4.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.75	0.031	
2	3.00	1.67	0.076	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	3190.
0.01	100.01	32.	0.001	0.001	0.00	3197.
0.02	100.02	64.	0.001	0.002	0.00	3204.
0.03	100.03	96.	0.002	0.003	0.00	3210.
0.04	100.04	128.	0.003	0.003	0.00	3217.
0.05	100.05	160.	0.004	0.004	0.00	3224.
0.06	100.06	193.	0.004	0.004	0.00	3231.
0.16	100.16	519.	0.012	0.006	0.00	3299.
0.26	100.26	853.	0.020	0.008	0.00	3369.
0.36	100.36	1193.	0.027	0.009	0.00	3439.
0.46	100.46	1540.	0.035	0.010	0.00	3509.

0.56	100.56	1895.	0.043	0.011	0.00	3581.
0.66	100.66	2257.	0.052	0.012	0.00	3653.
0.76	100.76	2626.	0.060	0.013	0.00	3726.
0.86	100.86	3002.	0.069	0.014	0.00	3800.
0.96	100.96	3385.	0.078	0.015	0.00	3874.
1.06	101.06	3777.	0.087	0.016	0.00	3949.
1.16	101.16	4175.	0.096	0.016	0.00	4025.
1.26	101.26	4582.	0.105	0.017	0.00	4101.
1.36	101.36	4996.	0.115	0.018	0.00	4179.
1.46	101.46	5417.	0.124	0.018	0.00	4257.
1.56	101.56	5847.	0.134	0.019	0.00	4335.
1.66	101.66	6284.	0.144	0.020	0.00	4415.
1.76	101.76	6730.	0.154	0.020	0.00	4495.
1.86	101.86	7183.	0.165	0.021	0.00	4576.
1.96	101.96	7645.	0.176	0.021	0.00	4657.
2.06	102.06	8115.	0.186	0.022	0.00	4739.
2.16	102.16	8593.	0.197	0.022	0.00	4822.
2.26	102.26	9079.	0.208	0.023	0.00	4906.
2.36	102.36	9574.	0.220	0.023	0.00	4991.
2.46	102.46	10078.	0.231	0.024	0.00	5076.
2.56	102.56	10589.	0.243	0.024	0.00	5162.
2.66	102.66	11110.	0.255	0.025	0.00	5248.
2.76	102.76	11639.	0.267	0.025	0.00	5336.
2.86	102.86	12177.	0.280	0.026	0.00	5424.
2.96	102.96	12724.	0.292	0.026	0.00	5512.
3.00	103.00	12945.	0.297	0.026	0.00	5548.
3.02	103.02	13056.	0.300	0.027	0.00	5566.

3.03	103.03	13112.	0.301	0.029	0.00	5575.
3.05	103.05	13224.	0.304	0.032	0.00	5593.
3.07	103.07	13336.	0.306	0.036	0.00	5611.
3.09	103.09	13448.	0.309	0.041	0.00	5629.
3.10	103.10	13504.	0.310	0.047	0.00	5638.
3.12	103.12	13617.	0.313	0.054	0.00	5656.
3.14	103.14	13731.	0.315	0.055	0.00	5674.
3.24	103.24	14302.	0.328	0.065	0.00	5765.
3.34	103.34	14883.	0.342	0.072	0.00	5856.
3.44	103.44	15474.	0.355	0.079	0.00	5948.
3.54	103.54	16073.	0.369	0.085	0.00	6041.
3.64	103.64	16682.	0.383	0.090	0.00	6135.
3.74	103.74	17300.	0.397	0.095	0.00	6229.
3.84	103.84	17928.	0.412	0.100	0.00	6324.
3.94	103.94	18565.	0.426	0.104	0.00	6420.
4.00	104.00	18952.	0.435	0.107	0.00	6478.
4.10	104.10	19605.	0.450	0.573	0.00	6575.
4.20	104.20	20267.	0.465	1.420	0.00	6673.
4.30	104.30	20939.	0.481	2.520	0.00	6771.
4.40	104.40	21621.	0.496	3.820	0.00	6870.
4.50	104.50	22313.	0.512	5.290	0.00	6970.
4.60	104.60	23015.	0.528	6.720	0.00	7071.
4.70	104.70	23727.	0.545	7.250	0.00	7172.
4.80	104.80	24450.	0.561	7.750	0.00	7274.
4.90	104.90	25182.	0.578	8.210	0.00	7377.
5.00	105.00	25925.	0.595	8.650	0.00	7480.
5.10	105.10	26678.	0.612	9.070	0.00	7584.

5.20	105.20	27442.	0.630	9.470	0.00	7689.
5.30	105.30	28216.	0.648	9.850	0.00	7795.
5.40	105.40	29001.	0.666	10.220	0.00	7901.
5.50	105.50	29796.	0.684	10.580	0.00	8008.
5.60	105.60	30602.	0.703	10.920	0.00	8116.
5.70	105.70	31419.	0.721	11.260	0.00	8224.
5.80	105.80	32247.	0.740	11.580	0.00	8333.
5.90	105.90	33086.	0.760	11.900	0.00	8443.
6.00	106.00	33936.	0.779	12.200	0.00	8554.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.55	*******	0.13	4.01	104.01	18988.	0.436
2	0.28	0.11	0.10	3.79	103.79	17642.	0.405
3	0.29	*******	0.07	3.35	103.35	14935.	0.343
4	0.33	*******	0.08	3.49	103.49	15784.	0.362
5	0.30	*******	0.03	3.06	103.06	13254.	0.304
6	0.18	*******	0.02	2.52	102.52	10404.	0.239
7	0.23	*******	0.02	2.09	102.09	8253.	0.189
8	0.26	*******	0.02	1.81	101.81	6952.	0.160

Route Time Series through Facility
Inflow Time Series File:neepl3-ex.tsf
Outflow Time Series File:NEEPL3-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.546 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.133 CFS at 12:00 on Jan 9 in Year 8
Peak Reservoir Stage: 4.01 Ft
Peak Reservoir Elev: 104.01 Ft
Peak Reservoir Storage: 18988. Cu-Ft
: 0.436 Ac-Ft

Flow Frequency Analysis
Time Series File:neepl3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.098	2	2/09/01 20:00	0.133	4.01	1	100.00	0.990
0.022	7	12/29/01 10:00	0.098	3.80	2	25.00	0.960
0.082	3	3/06/03 22:00	0.082	3.49	3	10.00	0.900
0.020	8	8/26/04 7:00	0.073	3.35	4	5.00	0.800

0.024	6	1/08/05	3:00	0.033	3.06	5	3.00	0.667
0.033	5	1/19/06	3:00	0.024	2.52	6	2.00	0.500
0.073	4	11/24/06	8:00	0.022	2.09	7	1.30	0.231
0.133	1	1/09/08	12:00	0.020	1.81	8	1.10	0.091
Computed Peaks				0.121	4.00		50.00	0.980

Flow Duration from Time Series File:neepl3-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.002	34808	56.765	56.765	43.235	0.432E+00
0.004	4376	7.136	63.901	36.099	0.361E+00
0.007	5416	8.832	72.733	27.267	0.273E+00
0.010	5191	8.465	81.199	18.801	0.188E+00
0.012	4149	6.766	87.965	12.035	0.120E+00
0.015	2406	3.924	91.888	8.112	0.811E-01
0.018	1805	2.944	94.832	5.168	0.517E-01
0.021	1372	2.237	97.069	2.931	0.293E-01
0.023	961	1.567	98.637	1.363	0.136E-01
0.026	660	1.076	99.713	0.287	0.287E-02
0.029	22	0.036	99.749	0.251	0.251E-02
0.031	18	0.029	99.778	0.222	0.222E-02
0.034	14	0.023	99.801	0.199	0.199E-02
0.037	7	0.011	99.812	0.188	0.188E-02
0.040	5	0.008	99.821	0.179	0.179E-02
0.042	3	0.005	99.826	0.174	0.174E-02
0.045	6	0.010	99.835	0.165	0.165E-02
0.048	3	0.005	99.840	0.160	0.160E-02
0.051	1	0.002	99.842	0.158	0.158E-02
0.053	4	0.007	99.848	0.152	0.152E-02
0.056	8	0.013	99.861	0.139	0.139E-02
0.059	11	0.018	99.879	0.121	0.121E-02
0.061	6	0.010	99.889	0.111	0.111E-02
0.064	6	0.010	99.899	0.101	0.101E-02
0.067	4	0.007	99.905	0.095	0.946E-03
0.070	8	0.013	99.918	0.082	0.815E-03
0.072	7	0.011	99.930	0.070	0.701E-03
0.075	9	0.015	99.945	0.055	0.554E-03
0.078	8	0.013	99.958	0.042	0.424E-03
0.080	5	0.008	99.966	0.034	0.342E-03
0.083	5	0.008	99.974	0.026	0.261E-03
0.086	2	0.003	99.977	0.023	0.228E-03
0.089	2	0.003	99.980	0.020	0.196E-03
0.091	4	0.007	99.987	0.013	0.130E-03
0.094	2	0.003	99.990	0.010	0.978E-04
0.097	4	0.007	99.997	0.003	0.326E-04

Duration Comparison Anaylsis
Base File: neepl3-for.tsf
New File: neepl3-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.023	0.94E-02	0.13E-01	43.1	0.94E-02	0.023	0.024	3.4
0.030	0.64E-02	0.24E-02	-62.8	0.64E-02	0.030	0.025	-15.6

0.036	0.50E-02	0.19E-02	-62.0	0.50E-02	0.036	0.026	-28.2
0.043	0.37E-02	0.17E-02	-53.1	0.37E-02	0.043	0.026	-38.7
0.049	0.29E-02	0.16E-02	-44.9	0.29E-02	0.049	0.026	-46.5
0.055	0.22E-02	0.14E-02	-36.8	0.22E-02	0.055	0.031	-43.3
0.062	0.15E-02	0.11E-02	-25.3	0.15E-02	0.062	0.054	-12.1
0.068	0.10E-02	0.91E-03	-11.1	0.10E-02	0.068	0.063	-6.8
0.074	0.62E-03	0.59E-03	-5.3	0.62E-03	0.074	0.073	-1.9
0.081	0.34E-03	0.34E-03	0.0	0.34E-03	0.081	0.081	0.0
0.087	0.21E-03	0.21E-03	0.0	0.21E-03	0.087	0.088	0.7
0.094	0.16E-03	0.11E-03	-30.0	0.16E-03	0.094	0.091	-2.8
0.100	0.11E-03	0.00E+00	-100.0	0.11E-03	0.100	0.094	-6.4
0.106	0.16E-04	0.00E+00	-100.0	0.16E-04	0.106	0.098	-8.3

Maximum positive excursion = 0.001 cfs (3.4%)
occurring at 0.023 cfs on the Base Data:neepl3-for.tsf
and at 0.024 cfs on the New Data:neepl3-out.tsf

Maximum negative excursion = 0.024 cfs (-47.3%)
occurring at 0.051 cfs on the Base Data:neepl3-for.tsf
and at 0.027 cfs on the New Data:neepl3-out.tsf

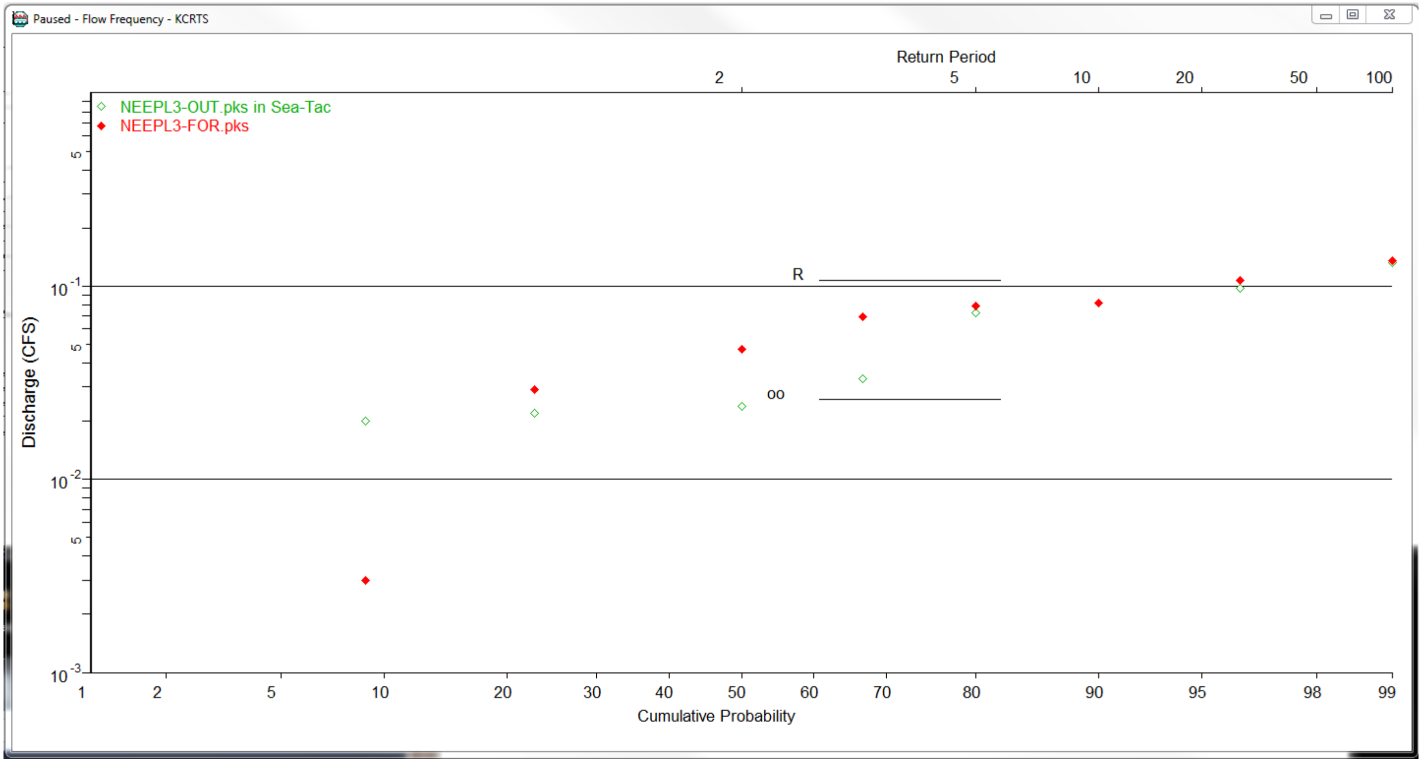
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KCRTS\
[C] CREATE a new Time Series
ST
       1.69       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
NEEPL3-FOR.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.59       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.06       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       1.04       0.00       0.000000  Impervious
NEEPL3-EX.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
neepl3-ex.tsf
NEEPL3-EX.pks
[P] Compute PEAKS and Flow Frequencies
neepl3-for.tsf
NEEPL3-FOR.pks
[D] Compute Flow DURATION and Exceedence
neepl3-for.tsf
NEEPL3-FOR.dur
 F
 F
          36
   0.290000E-02
   0.235000E-01
[D] Compute Flow DURATION and Exceedence
neepl3-ex.tsf
NEEPL3-EX.dur
 F
 F
          17
   0.100000E-01
   0.140500E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

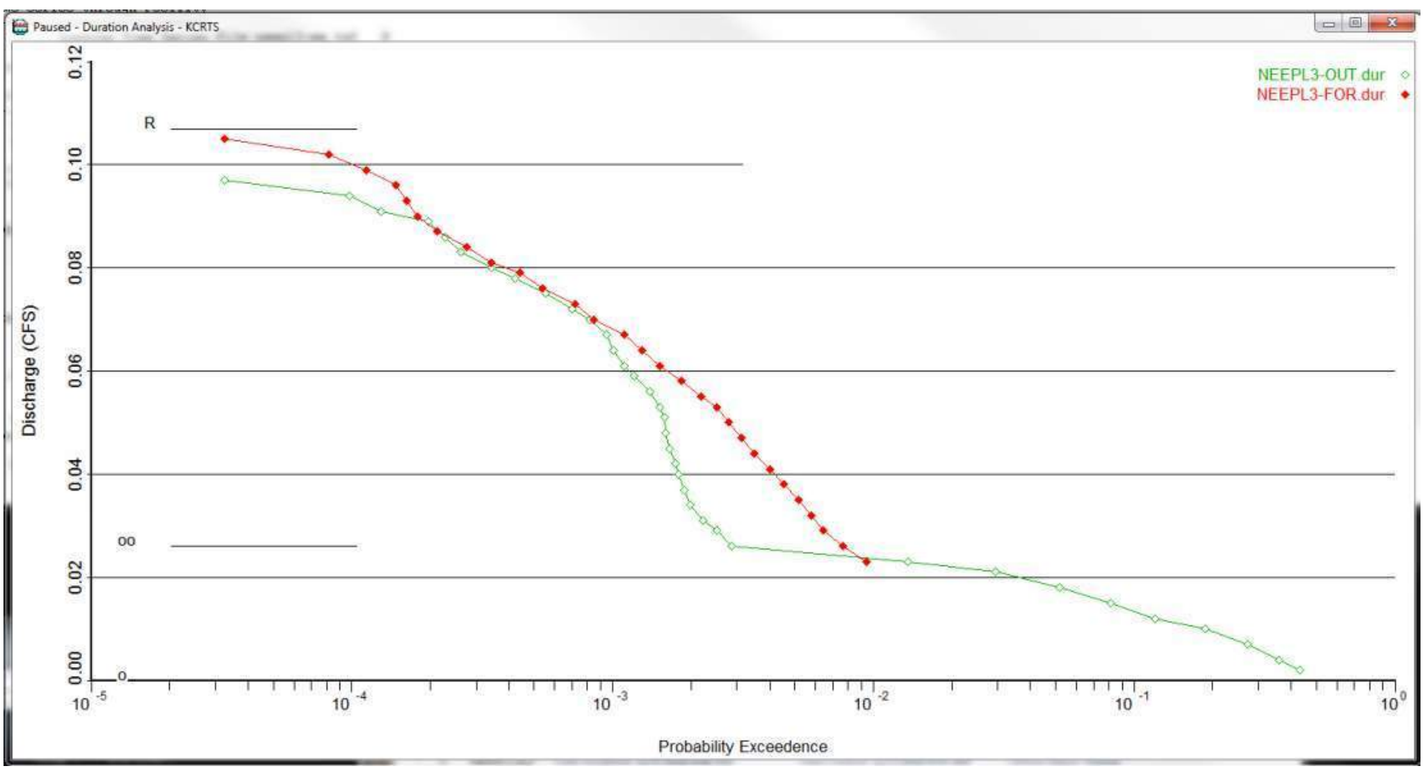
Flow Frequency Analysis
Time Series File:neepl3-for.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.107	2	2/09/01 18:00	0.136	1	100.00	0.990
0.029	7	1/06/02 3:00	0.107	2	25.00	0.960
0.079	4	2/28/03 3:00	0.082	3	10.00	0.900
0.003	8	3/24/04 20:00	0.079	4	5.00	0.800
0.047	6	1/05/05 8:00	0.069	5	3.00	0.667
0.082	3	1/18/06 20:00	0.047	6	2.00	0.500
0.069	5	11/24/06 4:00	0.029	7	1.30	0.231
0.136	1	1/09/08 9:00	0.003	8	1.10	0.091
Computed Peaks			0.126		50.00	0.980

Flow Frequency Analysis
Time Series File:neepl3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.098	2	2/09/01 20:00	0.133	4.01	1	100.00	0.990
0.022	7	12/29/01 10:00	0.098	3.80	2	25.00	0.960
0.082	3	3/06/03 22:00	0.082	3.49	3	10.00	0.900
0.020	8	8/26/04 7:00	0.073	3.35	4	5.00	0.800
0.024	6	1/08/05 3:00	0.033	3.06	5	3.00	0.667
0.033	5	1/19/06 3:00	0.024	2.52	6	2.00	0.500
0.073	4	11/24/06 8:00	0.022	2.09	7	1.30	0.231
0.133	1	1/09/08 12:00	0.020	1.81	8	1.10	0.091
Computed Peaks			0.121	4.00		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
NEEPL3-OUT.pks in Sea-Tac
NEEPL3-FOR.pks
R
oo
Discharge (CFS)
Cumulative Probability
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99


Paused - Duration Analysis - KCRTS
NEEPL3-OUT.dur
NEEPL3-FOR.dur
R
oo
Discharge (CFS)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Probability Exceedence

WEST PARKING LOT
DEVELOPED BACK TO FORESTED (WEST1)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
	X		13,845	0.318

See Figures B-5 and B-6

WEST PARKING LOT
DEVELOPED BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	65.00	ft
Pond Bottom Width:	53.00	ft
Pond Bottom Area:	3445.	sq. ft
Top Area at 1 ft. FB:	6853.	sq. ft
	0.157	acres
Effective Storage Depth:	3.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	13845.	cu. ft
	0.318	ac-ft
Riser Head:	3.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.50	0.012	
2	2.20	1.10	0.029	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	3445.
0.01	100.01	35.	0.001	0.001	0.00	3452.
0.02	100.02	69.	0.002	0.001	0.00	3459.
0.03	100.03	104.	0.002	0.001	0.00	3466.
0.04	100.04	138.	0.003	0.001	0.00	3473.
0.05	100.05	173.	0.004	0.001	0.00	3480.
0.15	100.15	525.	0.012	0.003	0.00	3552.
0.25	100.25	884.	0.020	0.003	0.00	3624.
0.35	100.35	1250.	0.029	0.004	0.00	3697.
0.45	100.45	1623.	0.037	0.005	0.00	3771.
0.55	100.55	2004.	0.046	0.005	0.00	3845.

0.65	100.65	2392.	0.055	0.005	0.00	3920.
0.75	100.75	2788.	0.064	0.006	0.00	3996.
0.85	100.85	3191.	0.073	0.006	0.00	4073.
0.95	100.95	3603.	0.083	0.007	0.00	4150.
1.05	101.05	4021.	0.092	0.007	0.00	4228.
1.15	101.15	4448.	0.102	0.007	0.00	4307.
1.25	101.25	4883.	0.112	0.008	0.00	4386.
1.35	101.35	5325.	0.122	0.008	0.00	4466.
1.45	101.45	5776.	0.133	0.008	0.00	4547.
1.55	101.55	6235.	0.143	0.008	0.00	4629.
1.65	101.65	6702.	0.154	0.009	0.00	4711.
1.75	101.75	7177.	0.165	0.009	0.00	4794.
1.85	101.85	7661.	0.176	0.009	0.00	4878.
1.95	101.95	8153.	0.187	0.009	0.00	4962.
2.05	102.05	8653.	0.199	0.010	0.00	5048.
2.15	102.15	9162.	0.210	0.010	0.00	5134.
2.20	102.20	9420.	0.216	0.010	0.00	5177.
2.21	102.21	9472.	0.217	0.010	0.00	5186.
2.22	102.22	9524.	0.219	0.011	0.00	5194.
2.23	102.23	9576.	0.220	0.012	0.00	5203.
2.25	102.25	9680.	0.222	0.014	0.00	5220.
2.26	102.26	9732.	0.223	0.016	0.00	5229.
2.27	102.27	9785.	0.225	0.019	0.00	5238.
2.28	102.28	9837.	0.226	0.020	0.00	5246.
2.29	102.29	9890.	0.227	0.020	0.00	5255.
2.39	102.39	10419.	0.239	0.025	0.00	5343.
2.49	102.49	10958.	0.252	0.028	0.00	5431.

2.59	102.59	11506.	0.264	0.031	0.00	5520.
2.69	102.69	12062.	0.277	0.034	0.00	5610.
2.79	102.79	12628.	0.290	0.037	0.00	5701.
2.89	102.89	13202.	0.303	0.039	0.00	5792.
2.99	102.99	13786.	0.316	0.041	0.00	5884.
3.00	103.00	13845.	0.318	0.041	0.00	5893.
3.10	103.10	14439.	0.331	0.505	0.00	5986.
3.20	103.20	15042.	0.345	1.350	0.00	6079.
3.30	103.30	15655.	0.359	2.450	0.00	6173.
3.40	103.40	16277.	0.374	3.740	0.00	6268.
3.50	103.50	16909.	0.388	5.210	0.00	6364.
3.60	103.60	17550.	0.403	6.640	0.00	6460.
3.70	103.70	18201.	0.418	7.170	0.00	6557.
3.80	103.80	18861.	0.433	7.670	0.00	6655.
3.90	103.90	19532.	0.448	8.130	0.00	6754.
4.00	104.00	20212.	0.464	8.570	0.00	6853.
4.10	104.10	20902.	0.480	8.980	0.00	6953.
4.20	104.20	21603.	0.496	9.380	0.00	7054.
4.30	104.30	22313.	0.512	9.760	0.00	7155.
4.40	104.40	23034.	0.529	10.130	0.00	7257.
4.50	104.50	23765.	0.546	10.490	0.00	7360.
4.60	104.60	24506.	0.563	10.830	0.00	7464.
4.70	104.70	25257.	0.580	11.160	0.00	7568.
4.80	104.80	26019.	0.597	11.480	0.00	7673.
4.90	104.90	26792.	0.615	11.800	0.00	7779.
5.00	105.00	27575.	0.633	12.100	0.00	7885.

Hyd Inflow Outflow Peak Storage

		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.33	*******	0.04	2.90	102.90	13277.	0.305
2	0.17	0.04	0.04	2.85	102.85	12955.	0.297
3	0.26	*******	0.03	2.54	102.54	11220.	0.258
4	0.20	*******	0.03	2.70	102.70	12111.	0.278
5	0.18	*******	0.01	2.10	102.10	8889.	0.204
6	0.13	*******	0.01	1.84	101.84	7592.	0.174
7	0.15	*******	0.01	1.91	101.91	7932.	0.182
8	0.18	*******	0.01	1.47	101.47	5866.	0.135

Route Time Series through Facility
Inflow Time Series File:west1-dev.tsf
Outflow Time Series File:WEST1-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.333 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.039 CFS at 14:00 on Jan 9 in Year 8
Peak Reservoir Stage: 2.90 Ft
Peak Reservoir Elev: 102.90 Ft
Peak Reservoir Storage: 13278. Cu-Ft
: 0.305 Ac-Ft

Flow Frequency Analysis
Time Series File:west1-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.038	2	2/09/01 20:00	0.039	2.90	1	100.00	0.990
0.009	6	1/07/02 4:00	0.038	2.86	2	25.00	0.960
0.034	3	3/06/03 22:00	0.034	2.70	3	10.00	0.900
0.008	8	8/26/04 8:00	0.029	2.54	4	5.00	0.800
0.009	7	1/08/05 5:00	0.010	2.10	5	3.00	0.667
0.010	5	1/19/06 0:00	0.009	1.91	6	2.00	0.500
0.029	4	11/24/06 8:00	0.009	1.84	7	1.30	0.231
0.039	1	1/09/08 14:00	0.008	1.47	8	1.10	0.091
Computed Peaks			0.039	2.89		50.00	0.980

Flow Duration from Time Series File:west1-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.001	23454	38.249	38.249	61.751	0.618E+00
0.002	8337	13.596	51.844	48.156	0.482E+00
0.003	3067	5.002	56.846	43.154	0.432E+00
0.004	7780	12.688	69.534	30.466	0.305E+00
0.005	3112	5.075	74.609	25.391	0.254E+00
0.006	6423	10.475	85.083	14.917	0.149E+00
0.007	2698	4.400	89.483	10.517	0.105E+00
0.008	4355	7.102	96.585	3.415	0.341E-01
0.009	1465	2.389	98.974	1.026	0.103E-01
0.010	427	0.696	99.671	0.329	0.329E-02
0.011	17	0.028	99.698	0.302	0.302E-02

0.012	19	0.031	99.729	0.271	0.271E-02
0.013	10	0.016	99.746	0.254	0.254E-02
0.014	6	0.010	99.755	0.245	0.245E-02
0.015	4	0.007	99.762	0.238	0.238E-02
0.016	5	0.008	99.770	0.230	0.230E-02
0.017	4	0.007	99.777	0.223	0.223E-02
0.019	6	0.010	99.786	0.214	0.214E-02
0.020	3	0.005	99.791	0.209	0.209E-02
0.021	11	0.018	99.809	0.191	0.191E-02
0.022	9	0.015	99.824	0.176	0.176E-02
0.023	4	0.007	99.830	0.170	0.170E-02
0.024	7	0.011	99.842	0.158	0.158E-02
0.025	5	0.008	99.850	0.150	0.150E-02
0.026	10	0.016	99.866	0.134	0.134E-02
0.027	8	0.013	99.879	0.121	0.121E-02
0.028	10	0.016	99.896	0.104	0.104E-02
0.029	10	0.016	99.912	0.088	0.881E-03
0.030	12	0.020	99.932	0.068	0.685E-03
0.031	8	0.013	99.945	0.055	0.554E-03
0.032	9	0.015	99.959	0.041	0.408E-03
0.033	4	0.007	99.966	0.034	0.342E-03
0.034	6	0.010	99.976	0.024	0.245E-03
0.035	3	0.005	99.980	0.020	0.196E-03
0.036	4	0.007	99.987	0.013	0.130E-03
0.037	3	0.005	99.992	0.008	0.815E-04

Duration Comparison Anaylsis
Base File: west1-for.tsf
New File: west1-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.010	0.87E-02	0.76E-02	-12.5	0.87E-02	0.010	0.010	-4.1
0.013	0.61E-02	0.27E-02	-56.3	0.61E-02	0.013	0.010	-20.8
0.015	0.48E-02	0.24E-02	-50.0	0.48E-02	0.015	0.010	-34.4
0.018	0.37E-02	0.22E-02	-40.0	0.37E-02	0.018	0.010	-44.0
0.021	0.28E-02	0.19E-02	-32.0	0.28E-02	0.021	0.012	-43.1
0.023	0.22E-02	0.16E-02	-24.8	0.22E-02	0.023	0.018	-20.7
0.026	0.15E-02	0.13E-02	-8.9	0.15E-02	0.026	0.025	-3.2
0.029	0.95E-03	0.91E-03	-3.4	0.95E-03	0.029	0.028	-0.4
0.031	0.60E-03	0.55E-03	-8.1	0.60E-03	0.031	0.031	-1.6
0.034	0.34E-03	0.28E-03	-19.0	0.34E-03	0.034	0.033	-1.0
0.036	0.21E-03	0.13E-03	-38.5	0.21E-03	0.036	0.035	-4.3
0.039	0.16E-03	0.00E+00	-100.0	0.16E-03	0.039	0.036	-7.4
0.042	0.98E-04	0.00E+00	-100.0	0.98E-04	0.042	0.037	-10.7
0.044	0.16E-04	0.00E+00	-100.0	0.16E-04	0.044	0.038	-13.8

Maximum positive excursion = 0.000 cfs (1.1%)
occurring at 0.029 cfs on the Base Data:west1-for.tsf
and at 0.029 cfs on the New Data:west1-out.tsf

Maximum negative excursion = 0.009 cfs (-46.7%)
occurring at 0.019 cfs on the Base Data:west1-for.tsf
and at 0.010 cfs on the New Data:west1-out.tsf

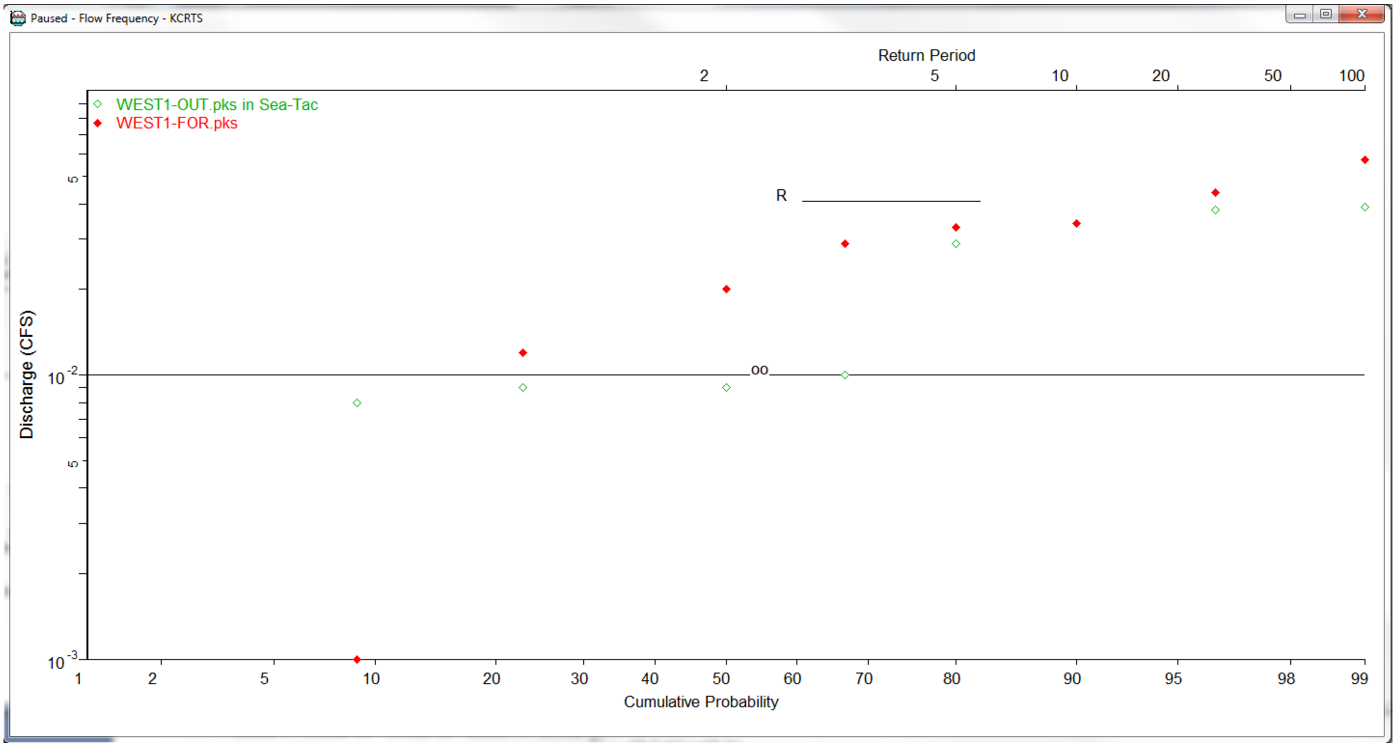
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KCRTS\
[C] CREATE a new Time Series
ST
       0.70       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
WEST1-FOR.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.70       0.00       0.000000  Impervious
WEST1-DEV.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
west1-dev.tsf
WEST1-DEV.pks
[P] Compute PEAKS and Flow Frequencies
west1-for.tsf
WEST1-FOR.pks
[D] Compute Flow DURATION and Exceedence
west1-for.tsf
west1-for.dur
 F
 F
          36
   0.120000E-02
   0.100000E-01
[D] Compute Flow DURATION and Exceedence
west1-dev.tsf
WEST1-DEV.dur
 F
 F
          36
   0.630000E-02
   0.880000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

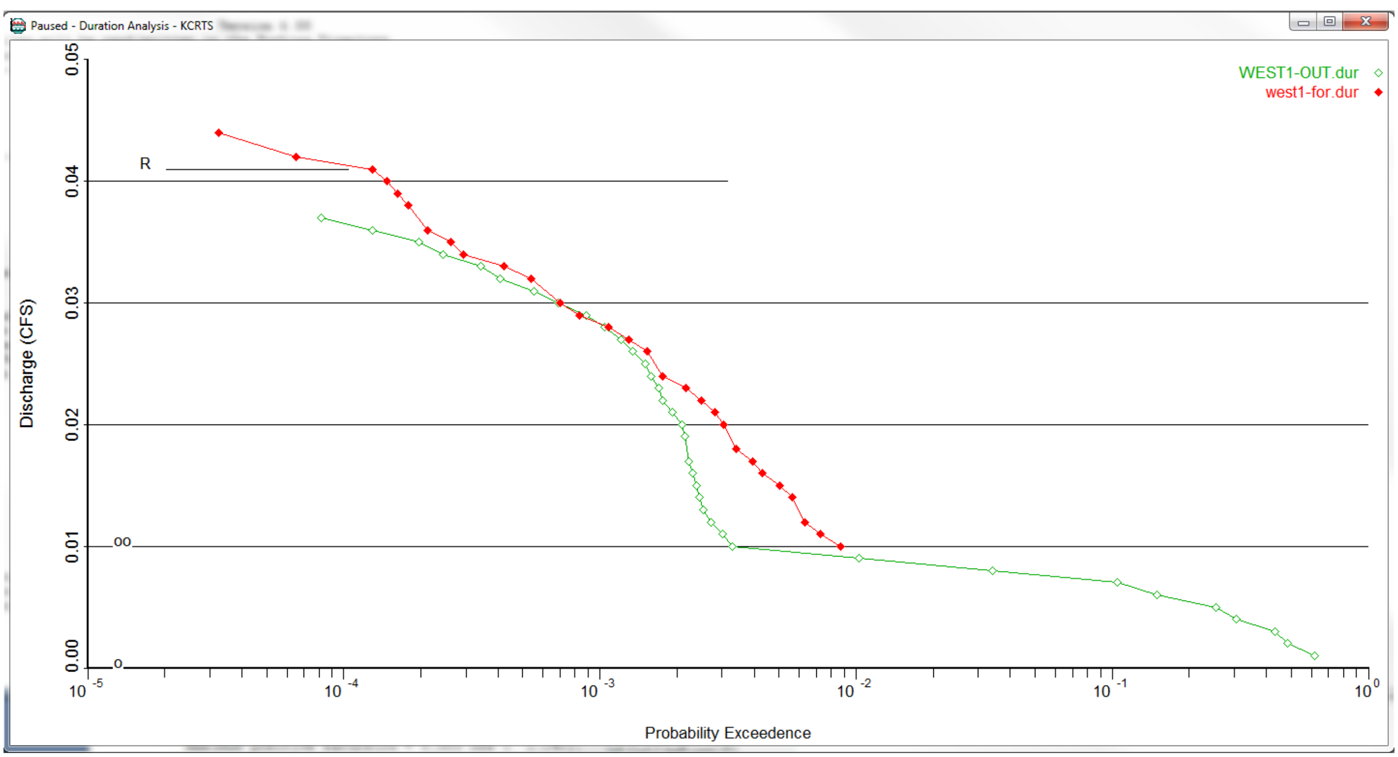
Flow Frequency Analysis
Time Series File:west1-for.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.044	2	2/09/01 18:00	0.057	1	100.00	0.990
0.012	7	1/06/02 3:00	0.044	2	25.00	0.960
0.033	4	2/28/03 3:00	0.034	3	10.00	0.900
0.001	8	3/24/04 20:00	0.033	4	5.00	0.800
0.020	6	1/05/05 8:00	0.029	5	3.00	0.667
0.034	3	1/18/06 20:00	0.020	6	2.00	0.500
0.029	5	11/24/06 4:00	0.012	7	1.30	0.231
0.057	1	1/09/08 9:00	0.001	8	1.10	0.091
Computed Peaks			0.053		50.00	0.980

Flow Frequency Analysis
Time Series File:west1-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.038	2	2/09/01 20:00	0.039	2.90	1	100.00	0.990
0.009	6	1/07/02 4:00	0.038	2.86	2	25.00	0.960
0.034	3	3/06/03 22:00	0.034	2.70	3	10.00	0.900
0.008	8	8/26/04 8:00	0.029	2.54	4	5.00	0.800
0.009	7	1/08/05 5:00	0.010	2.10	5	3.00	0.667
0.010	5	1/19/06 0:00	0.009	1.91	6	2.00	0.500
0.029	4	11/24/06 8:00	0.009	1.84	7	1.30	0.231
0.039	1	1/09/08 14:00	0.008	1.47	8	1.10	0.091
Computed Peaks			0.039	2.89		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
WEST1-OUT.pks in Sea-Tac
WEST1-FOR.pks
R
oo
Discharge (CFS)
5
10 -2
5
10 -3
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
Cumulative Probability


Paused - Duration Analysis - KCRTS
WEST1-OUT.dur
west1-for.dur
R
oo
o
Discharge (CFS)
0.05
0.04
0.03
0.02
0.01
0.00
10 -5
10 -4
10 -3
10 -2
10 -1
10 0
Probability Exceedence

SOUTH EXTENSION TO EAST PARKING LOT

DEVELOPED BACK TO EXISTING

(SEEPL2)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
X			6,516	0.150

See Figures B-13 and B-14

SOUTH EXTENSION TO EAST PARKING LOT
DEVELOPED BACK TO EXISTING

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	46.00	ft
Pond Bottom Width:	30.00	ft
Pond Bottom Area:	1380.	sq. ft
Top Area at 1 ft. FB:	3780.	sq. ft
	0.087	acres
Effective Storage Depth:	3.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	6516.	cu. ft
	0.150	ac-ft
Riser Head:	3.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.12	0.059	
2	2.25	1.50	0.053	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	1380.
0.01	100.01	14.	0.000	0.004	0.00	1385.
0.02	100.02	28.	0.001	0.005	0.00	1389.
0.03	100.03	42.	0.001	0.006	0.00	1394.
0.05	100.05	70.	0.002	0.007	0.00	1403.
0.06	100.06	84.	0.002	0.008	0.00	1407.
0.07	100.07	98.	0.002	0.009	0.00	1412.
0.08	100.08	112.	0.003	0.010	0.00	1417.
0.09	100.09	126.	0.003	0.010	0.00	1421.
0.19	100.19	271.	0.006	0.015	0.00	1468.
0.29	100.29	420.	0.010	0.018	0.00	1515.

0.39	100.39	574.	0.013	0.021	0.00	1563.
0.49	100.49	732.	0.017	0.024	0.00	1612.
0.59	100.59	896.	0.021	0.026	0.00	1662.
0.69	100.69	1065.	0.024	0.028	0.00	1712.
0.79	100.79	1238.	0.028	0.030	0.00	1763.
0.89	100.89	1417.	0.033	0.032	0.00	1814.
0.99	100.99	1601.	0.037	0.034	0.00	1867.
1.09	101.09	1791.	0.041	0.035	0.00	1920.
1.19	101.19	1985.	0.046	0.037	0.00	1974.
1.29	101.29	2185.	0.050	0.039	0.00	2028.
1.39	101.39	2391.	0.055	0.040	0.00	2083.
1.49	101.49	2602.	0.060	0.041	0.00	2139.
1.59	101.59	2819.	0.065	0.043	0.00	2196.
1.69	101.69	3041.	0.070	0.044	0.00	2253.
1.79	101.79	3270.	0.075	0.045	0.00	2312.
1.89	101.89	3504.	0.080	0.047	0.00	2370.
1.99	101.99	3744.	0.086	0.048	0.00	2430.
2.09	102.09	3990.	0.092	0.049	0.00	2490.
2.19	102.19	4242.	0.097	0.050	0.00	2551.
2.25	102.25	4396.	0.101	0.051	0.00	2588.
2.27	102.27	4448.	0.102	0.051	0.00	2601.
2.28	102.28	4474.	0.103	0.053	0.00	2607.
2.30	102.30	4526.	0.104	0.056	0.00	2619.
2.31	102.31	4552.	0.105	0.059	0.00	2625.
2.33	102.33	4605.	0.106	0.063	0.00	2638.
2.34	102.34	4631.	0.106	0.068	0.00	2644.
2.36	102.36	4684.	0.108	0.072	0.00	2657.

2.38	102.38	4738.	0.109	0.074	0.00	2669.
2.47	102.47	4980.	0.114	0.082	0.00	2726.
2.57	102.57	5256.	0.121	0.089	0.00	2790.
2.67	102.67	5538.	0.127	0.095	0.00	2854.
2.77	102.77	5827.	0.134	0.101	0.00	2919.
2.87	102.87	6122.	0.141	0.106	0.00	2985.
2.97	102.97	6424.	0.147	0.110	0.00	3052.
3.00	103.00	6516.	0.150	0.112	0.00	3072.
3.10	103.10	6827.	0.157	0.578	0.00	3140.
3.20	103.20	7144.	0.164	1.430	0.00	3208.
3.30	103.30	7468.	0.171	2.520	0.00	3277.
3.40	103.40	7799.	0.179	3.820	0.00	3347.
3.50	103.50	8138.	0.187	5.300	0.00	3417.
3.60	103.60	8483.	0.195	6.730	0.00	3488.
3.70	103.70	8835.	0.203	7.260	0.00	3560.
3.80	103.80	9195.	0.211	7.750	0.00	3633.
3.90	103.90	9562.	0.220	8.220	0.00	3706.
4.00	104.00	9936.	0.228	8.660	0.00	3780.
4.10	104.10	10318.	0.237	9.080	0.00	3855.
4.20	104.20	10707.	0.246	9.480	0.00	3930.
4.30	104.30	11104.	0.255	9.860	0.00	4006.
4.40	104.40	11508.	0.264	10.230	0.00	4083.
4.50	104.50	11921.	0.274	10.590	0.00	4161.
4.60	104.60	12341.	0.283	10.930	0.00	4239.
4.70	104.70	12768.	0.293	11.260	0.00	4318.
4.80	104.80	13204.	0.303	11.590	0.00	4398.
4.90	104.90	13648.	0.313	11.900	0.00	4479.

5.00 105.00 14100. 0.324 12.210 0.00
4560.

Hyd	Inflow	Outflow Target	Calc	Peak Stage	Elev	Storage (Cu-Ft)	(Ac-Ft)
1	0.39	*******	0.24	3.03	103.03	6601.	0.152
2	0.28	0.11	0.10	2.77	102.77	5840.	0.134
3	0.21	*******	0.09	2.65	102.65	5489.	0.126
4	0.20	*******	0.10	2.72	102.72	5689.	0.131
5	0.24	*******	0.07	2.38	102.38	4730.	0.109
6	0.23	*******	0.05	1.90	101.90	3537.	0.081
7	0.19	*******	0.04	1.29	101.29	2191.	0.050
8	0.17	*******	0.04	1.20	101.20	2003.	0.046

Route Time Series through Facility
Inflow Time Series File:seepl2-dev.tsf
Outflow Time Series File:SEEPL2-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.387 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.239 CFS at 10:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.03 Ft
Peak Reservoir Elev: 103.03 Ft
Peak Reservoir Storage: 6601. Cu-Ft
: 0.152 Ac-Ft

Flow Frequency Analysis
Time Series File:seepl2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.098	3	2/09/01 19:00	0.239	3.03	1	100.00	0.990
0.037	8	1/06/02 5:00	0.101	2.77	2	25.00	0.960
0.074	5	3/06/03 20:00	0.098	2.72	3	10.00	0.900
0.039	7	8/24/04 0:00	0.094	2.65	4	5.00	0.800
0.047	6	1/05/05 10:00	0.074	2.38	5	3.00	0.667
0.094	4	1/18/06 22:00	0.047	1.90	6	2.00	0.500
0.101	2	11/24/06 6:00	0.039	1.29	7	1.30	0.231
0.239	1	1/09/08 10:00	0.037	1.20	8	1.10	0.091
Computed Peaks			0.193	3.02		50.00	0.980

Flow Duration from Time Series File:seepl2-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.001	47994	78.268	78.268	21.732	0.217E+00
0.004	1951	3.182	81.450	18.550	0.186E+00
0.007	2697	4.398	85.848	14.152	0.142E+00
0.010	1215	1.981	87.829	12.171	0.122E+00
0.013	1836	2.994	90.824	9.176	0.918E-01
0.016	1147	1.871	92.694	7.306	0.731E-01
0.018	1186	1.934	94.628	5.372	0.537E-01

0.021	840	1.370	95.998	4.002	0.400E-01
0.024	588	0.959	96.957	3.043	0.304E-01
0.027	525	0.856	97.813	2.187	0.219E-01
0.030	363	0.592	98.405	1.595	0.159E-01
0.033	271	0.442	98.847	1.153	0.115E-01
0.035	214	0.349	99.196	0.804	0.804E-02
0.038	98	0.160	99.356	0.644	0.644E-02
0.041	104	0.170	99.525	0.475	0.475E-02
0.044	87	0.142	99.667	0.333	0.333E-02
0.047	64	0.104	99.772	0.228	0.228E-02
0.049	70	0.114	99.886	0.114	0.114E-02
0.052	19	0.031	99.917	0.083	0.832E-03
0.055	3	0.005	99.922	0.078	0.783E-03
0.058	1	0.002	99.923	0.077	0.766E-03
0.061	1	0.002	99.925	0.075	0.750E-03
0.064	2	0.003	99.928	0.072	0.718E-03
0.066	0	0.000	99.928	0.072	0.718E-03
0.069	1	0.002	99.930	0.070	0.701E-03
0.072	3	0.005	99.935	0.065	0.652E-03
0.075	8	0.013	99.948	0.052	0.522E-03
0.078	2	0.003	99.951	0.049	0.489E-03
0.080	3	0.005	99.956	0.044	0.440E-03
0.083	3	0.005	99.961	0.039	0.391E-03
0.086	5	0.008	99.969	0.031	0.310E-03
0.089	2	0.003	99.972	0.028	0.277E-03
0.092	3	0.005	99.977	0.023	0.228E-03
0.095	5	0.008	99.985	0.015	0.147E-03
0.097	4	0.007	99.992	0.008	0.815E-04
0.100	3	0.005	99.997	0.003	0.326E-04

Duration Comparison Anaylsis
Base File: seepl2-ex.tsf
New File: seepl2-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.044	0.32E-02	0.32E-02	1.5	0.32E-02	0.044	0.044	0.2
0.049	0.24E-02	0.13E-02	-46.6	0.24E-02	0.049	0.046	-5.5
0.054	0.19E-02	0.80E-03	-57.4	0.19E-02	0.054	0.048	-11.4
0.059	0.14E-02	0.77E-03	-45.3	0.14E-02	0.059	0.049	-17.7
0.064	0.11E-02	0.72E-03	-37.1	0.11E-02	0.064	0.049	-22.9
0.069	0.93E-03	0.70E-03	-24.6	0.93E-03	0.069	0.051	-26.8
0.074	0.59E-03	0.54E-03	-8.3	0.59E-03	0.074	0.074	-0.6
0.079	0.44E-03	0.47E-03	7.4	0.44E-03	0.079	0.082	3.6
0.084	0.33E-03	0.36E-03	10.0	0.33E-03	0.084	0.086	2.1
0.089	0.21E-03	0.28E-03	30.8	0.21E-03	0.089	0.093	3.9
0.094	0.13E-03	0.15E-03	12.5	0.13E-03	0.094	0.095	1.2
0.099	0.82E-04	0.33E-04	-60.0	0.82E-04	0.099	0.098	-1.7
0.104	0.33E-04	0.00E+00	-100.0	0.33E-04	0.104	0.101	-3.2
0.109	0.16E-04	0.00E+00	-100.0	0.16E-04	0.109	0.101	-7.5

Maximum positive excursion = 0.004 cfs (4.1%)
occurring at 0.089 cfs on the Base Data:seepl2-ex.tsf
and at 0.093 cfs on the New Data:seepl2-out.tsf

```
Maximum negative excursion = 0.019 cfs (-26.8%)
occurring at 0.070 cfs on the Base Data:seepl2-ex.tsf
and at 0.051 cfs on the  New Data:seepl2-out.tsf
```

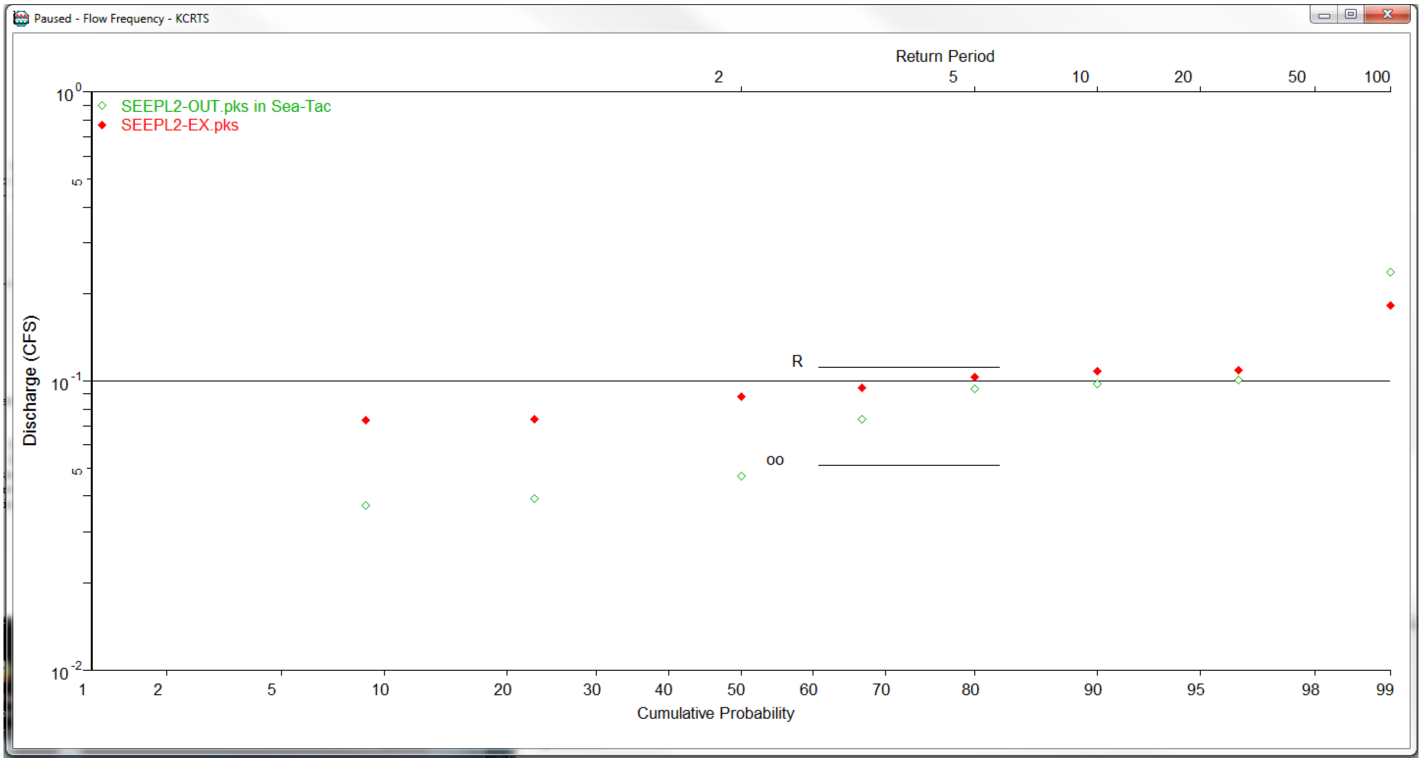
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.13       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.76       0.00       0.000000  Impervious
SEEPL2-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.59       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.30       0.00       0.000000  Impervious
SEEPL2-EX.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
seepl2-ex.tsf
SEEPL2-EX.pks
[P] Compute PEAKS and Flow Frequencies
seepl2-dev.tsf
SEEPL2-DEV.pks
[D] Compute Flow DURATION and Exceedence
seepl2-dev.tsf
SEEPL2-DEV.dur
 F
 F
          36
   0.720000E-02
   0.980000E-01
[D] Compute Flow DURATION and Exceedence
seepl2-ex.tsf
SEEPL2-EX.dur
 F
 F
          36
   0.330000E-02
   0.440000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

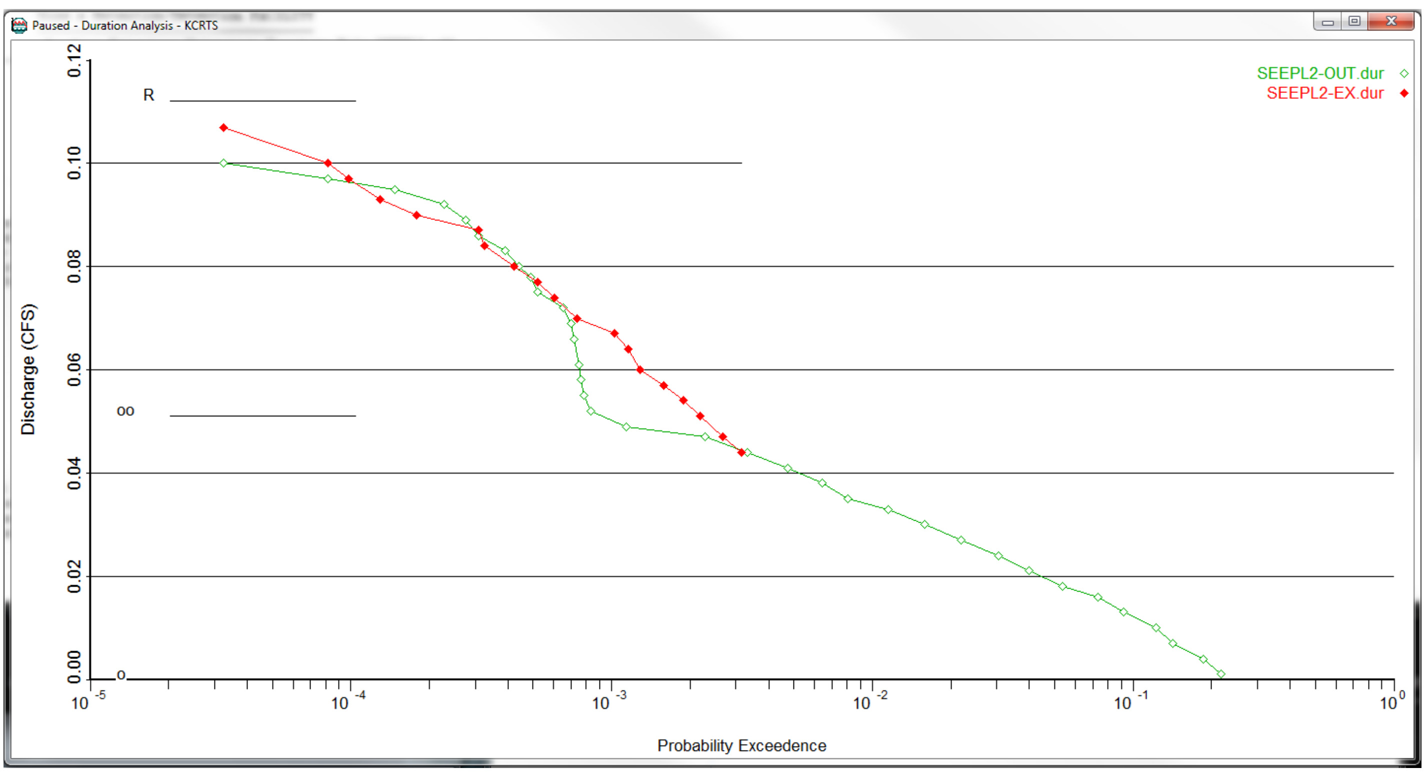
Flow Frequency Analysis
Time Series File:seepl2-ex.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.095	5	2/09/01 2:00	0.182	1	100.00	0.990
0.073	8	1/05/02 16:00	0.109	2	25.00	0.960
0.109	2	2/27/03 7:00	0.108	3	10.00	0.900
0.074	7	8/26/04 2:00	0.103	4	5.00	0.800
0.088	6	10/28/04 16:00	0.095	5	3.00	0.667
0.103	4	1/18/06 16:00	0.088	6	2.00	0.500
0.108	3	10/26/06 0:00	0.074	7	1.30	0.231
0.182	1	1/09/08 6:00	0.073	8	1.10	0.091
Computed Peaks			0.158		50.00	0.980

Flow Frequency Analysis
Time Series File:seepl2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.098	3	2/09/01 19:00	0.239	3.03	1	100.00	0.990
0.037	8	1/06/02 5:00	0.101	2.77	2	25.00	0.960
0.074	5	3/06/03 20:00	0.098	2.72	3	10.00	0.900
0.039	7	8/24/04 0:00	0.094	2.65	4	5.00	0.800
0.047	6	1/05/05 10:00	0.074	2.38	5	3.00	0.667
0.094	4	1/18/06 22:00	0.047	1.90	6	2.00	0.500
0.101	2	11/24/06 6:00	0.039	1.29	7	1.30	0.231
0.239	1	1/09/08 10:00	0.037	1.20	8	1.10	0.091
Computed Peaks			0.193	3.02		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
SEEPL2-OUT.pks in Sea-Tac
SEEPL2-EX.pks
Discharge (CFS)
Cumulative Probability
R
oo


Paused - Duration Analysis - KCRTS
SEEPL2-OUT.dur
SEEPL2-EX.dur
Discharge (CFS)
Probability Exceedence
R
oo

SOUTH EXTENSION TO EAST PARKING LOT EXISTING BACK TO FORESTED

(SEEPL3)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
		X	5,054	0.116

See Figures B-13 and B-14

SOUTH EXTENSION TO EAST PARKING LOT
EXISTING BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	42.00	ft
Pond Bottom Width:	23.50	ft
Pond Bottom Area:	987.	sq. ft
Top Area at 1 ft. FB:	3135.	sq. ft
	0.072	acres
Effective Storage Depth:	3.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	5054.	cu. ft
	0.116	ac-ft
Riser Head:	3.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.55	0.014	
2	2.25	1.30	0.040	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	987.
0.01	100.01	10.	0.000	0.001	0.00	991.
0.02	100.02	20.	0.000	0.001	0.00	995.
0.03	100.03	30.	0.001	0.002	0.00	999.
0.04	100.04	40.	0.001	0.002	0.00	1003.
0.05	100.05	50.	0.001	0.002	0.00	1007.
0.15	100.15	153.	0.004	0.003	0.00	1047.
0.25	100.25	259.	0.006	0.004	0.00	1088.
0.35	100.35	370.	0.008	0.005	0.00	1129.
0.45	100.45	485.	0.011	0.005	0.00	1171.
0.55	100.55	604.	0.014	0.006	0.00	1214.

0.65	100.65	728.	0.017	0.007	0.00	1258.
0.75	100.75	856.	0.020	0.007	0.00	1302.
0.85	100.85	988.	0.023	0.008	0.00	1347.
0.95	100.95	1125.	0.026	0.008	0.00	1393.
1.05	101.05	1267.	0.029	0.008	0.00	1439.
1.15	101.15	1413.	0.032	0.009	0.00	1487.
1.25	101.25	1564.	0.036	0.009	0.00	1535.
1.35	101.35	1720.	0.039	0.010	0.00	1583.
1.45	101.45	1881.	0.043	0.010	0.00	1633.
1.55	101.55	2047.	0.047	0.010	0.00	1683.
1.65	101.65	2217.	0.051	0.011	0.00	1733.
1.75	101.75	2393.	0.055	0.011	0.00	1785.
1.85	101.85	2575.	0.059	0.011	0.00	1837.
1.95	101.95	2761.	0.063	0.011	0.00	1890.
2.05	102.05	2953.	0.068	0.012	0.00	1944.
2.15	102.15	3150.	0.072	0.012	0.00	1998.
2.25	102.25	3352.	0.077	0.012	0.00	2054.
2.26	102.26	3373.	0.077	0.013	0.00	2059.
2.28	102.28	3414.	0.078	0.014	0.00	2070.
2.29	102.29	3435.	0.079	0.016	0.00	2076.
2.30	102.30	3456.	0.079	0.018	0.00	2081.
2.32	102.32	3497.	0.080	0.021	0.00	2093.
2.33	102.33	3518.	0.081	0.025	0.00	2098.
2.34	102.34	3539.	0.081	0.027	0.00	2104.
2.36	102.36	3582.	0.082	0.028	0.00	2115.
2.46	102.46	3796.	0.087	0.034	0.00	2172.
2.56	102.56	4016.	0.092	0.039	0.00	2229.

2.66	102.66	4242.	0.097	0.043	0.00	2287.
2.76	102.76	4473.	0.103	0.046	0.00	2346.
2.86	102.86	4711.	0.108	0.050	0.00	2405.
2.96	102.96	4954.	0.114	0.053	0.00	2466.
3.00	103.00	5054.	0.116	0.054	0.00	2490.
3.10	103.10	5306.	0.122	0.519	0.00	2551.
3.20	103.20	5564.	0.128	1.370	0.00	2613.
3.30	103.30	5828.	0.134	2.460	0.00	2676.
3.40	103.40	6099.	0.140	3.760	0.00	2739.
3.50	103.50	6376.	0.146	5.230	0.00	2804.
3.60	103.60	6660.	0.153	6.660	0.00	2868.
3.70	103.70	6950.	0.160	7.190	0.00	2934.
3.80	103.80	7247.	0.166	7.680	0.00	3000.
3.90	103.90	7550.	0.173	8.150	0.00	3067.
4.00	104.00	7860.	0.180	8.590	0.00	3135.
4.10	104.10	8177.	0.188	9.000	0.00	3203.
4.20	104.20	8501.	0.195	9.400	0.00	3273.
4.30	104.30	8832.	0.203	9.780	0.00	3343.
4.40	104.40	9169.	0.210	10.150	0.00	3413.
4.50	104.50	9514.	0.218	10.510	0.00	3485.
4.60	104.60	9866.	0.226	10.850	0.00	3557.
4.70	104.70	10225.	0.235	11.180	0.00	3629.
4.80	104.80	10592.	0.243	11.510	0.00	3703.
4.90	104.90	10966.	0.252	11.820	0.00	3777.
5.00	105.00	11348.	0.261	12.130	0.00	3852.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.18	*******	0.13	3.02	103.02	5095.	0.117

2	0.10	0.06	0.05	3.00	103.00	5050.	0.116
3	0.11	*******	0.04	2.61	102.61	4121.	0.095
4	0.11	*******	0.04	2.55	102.55	3989.	0.092
5	0.10	*******	0.04	2.49	102.49	3856.	0.089
6	0.09	*******	0.01	2.19	102.19	3238.	0.074
7	0.07	*******	0.01	1.57	101.57	2084.	0.048
8	0.07	*******	0.01	1.11	101.11	1352.	0.031

Route Time Series through Facility
Inflow Time Series File:seepl3-ex.tsf
Outflow Time Series File:SEEPL3-OUT

Inflow/Outflow Analysis

Peak Inflow Discharge: 0.183 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.132 CFS at 9:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.02 Ft
Peak Reservoir Elev: 103.02 Ft
Peak Reservoir Storage: 5095. Cu-Ft
: 0.117 Ac-Ft

Flow Frequency Analysis
Time Series File:seepl3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.054	2	2/09/01 20:00	0.132	3.02	1	100.00	0.990
0.010	7	12/28/01 18:00	0.054	3.00	2	25.00	0.960
0.041	3	3/06/03 22:00	0.041	2.61	3	10.00	0.900
0.009	8	8/26/04 6:00	0.038	2.55	4	5.00	0.800
0.012	6	1/06/05 15:00	0.035	2.49	5	3.00	0.667
0.035	5	1/18/06 23:00	0.012	2.19	6	2.00	0.500
0.038	4	11/24/06 8:00	0.010	1.57	7	1.30	0.231
0.132	1	1/09/08 9:00	0.009	1.11	8	1.10	0.091
Computed Peaks			0.106	3.01		50.00	0.980

Flow Duration from Time Series File:seepl3-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.001	40836	66.595	66.595	33.405	0.334E+00
0.002	5566	9.077	75.672	24.328	0.243E+00
0.004	5060	8.252	83.924	16.076	0.161E+00
0.005	4103	6.691	90.615	9.385	0.939E-01
0.007	1352	2.205	92.820	7.180	0.718E-01
0.008	2149	3.505	96.324	3.676	0.368E-01
0.010	605	0.987	97.311	2.689	0.269E-01
0.011	923	1.505	98.816	1.184	0.118E-01
0.013	474	0.773	99.589	0.411	0.411E-02
0.014	49	0.080	99.669	0.331	0.331E-02
0.016	16	0.026	99.695	0.305	0.305E-02
0.017	11	0.018	99.713	0.287	0.287E-02
0.019	17	0.028	99.741	0.259	0.259E-02

0.020	10	0.016	99.757	0.243	0.243E-02
0.022	5	0.008	99.765	0.235	0.235E-02
0.023	4	0.007	99.772	0.228	0.228E-02
0.025	2	0.003	99.775	0.225	0.225E-02
0.026	4	0.007	99.781	0.219	0.219E-02
0.028	11	0.018	99.799	0.201	0.201E-02
0.029	12	0.020	99.819	0.181	0.181E-02
0.031	7	0.011	99.830	0.170	0.170E-02
0.032	8	0.013	99.843	0.157	0.157E-02
0.034	9	0.015	99.858	0.142	0.142E-02
0.035	13	0.021	99.879	0.121	0.121E-02
0.037	13	0.021	99.901	0.099	0.995E-03
0.038	11	0.018	99.918	0.082	0.815E-03
0.040	9	0.015	99.933	0.067	0.669E-03
0.041	14	0.023	99.956	0.044	0.440E-03
0.043	3	0.005	99.961	0.039	0.391E-03
0.044	4	0.007	99.967	0.033	0.326E-03
0.046	3	0.005	99.972	0.028	0.277E-03
0.047	2	0.003	99.976	0.024	0.245E-03
0.048	3	0.005	99.980	0.020	0.196E-03
0.050	1	0.002	99.982	0.018	0.179E-03
0.051	4	0.007	99.989	0.011	0.114E-03
0.053	3	0.005	99.993	0.007	0.652E-04

Duration Comparison Anaylsis
Base File: seepl3-for.tsf
New File: seepl3-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.012	0.94E-02	0.42E-02	-55.5	0.94E-02	0.012	0.012	-4.1
0.016	0.62E-02	0.30E-02	-50.9	0.62E-02	0.016	0.012	-24.0
0.019	0.49E-02	0.25E-02	-48.5	0.49E-02	0.019	0.012	-37.2
0.022	0.36E-02	0.23E-02	-36.3	0.36E-02	0.022	0.014	-39.4
0.026	0.28E-02	0.22E-02	-22.4	0.28E-02	0.026	0.017	-32.7
0.029	0.22E-02	0.18E-02	-16.5	0.22E-02	0.029	0.027	-9.1
0.033	0.15E-02	0.15E-02	2.2	0.15E-02	0.033	0.033	1.1
0.036	0.98E-03	0.11E-02	11.7	0.98E-03	0.036	0.037	2.2
0.039	0.62E-03	0.72E-03	15.8	0.62E-03	0.039	0.040	1.6
0.043	0.34E-03	0.36E-03	4.8	0.34E-03	0.043	0.044	2.9
0.046	0.21E-03	0.28E-03	30.8	0.21E-03	0.046	0.048	5.5
0.049	0.16E-03	0.20E-03	20.0	0.16E-03	0.049	0.051	2.5
0.053	0.11E-03	0.82E-04	-28.6	0.11E-03	0.053	0.052	-1.0
0.056	0.16E-04	0.00E+00	-100.0	0.16E-04	0.056	0.054	-3.6

Maximum positive excursion = 0.003 cfs (7.1%)
occurring at 0.047 cfs on the Base Data:seepl3-for.tsf
and at 0.050 cfs on the New Data:seepl3-out.tsf

Maximum negative excursion = 0.009 cfs (-41.4%)
occurring at 0.021 cfs on the Base Data:seepl3-for.tsf
and at 0.012 cfs on the New Data:seepl3-out.tsf

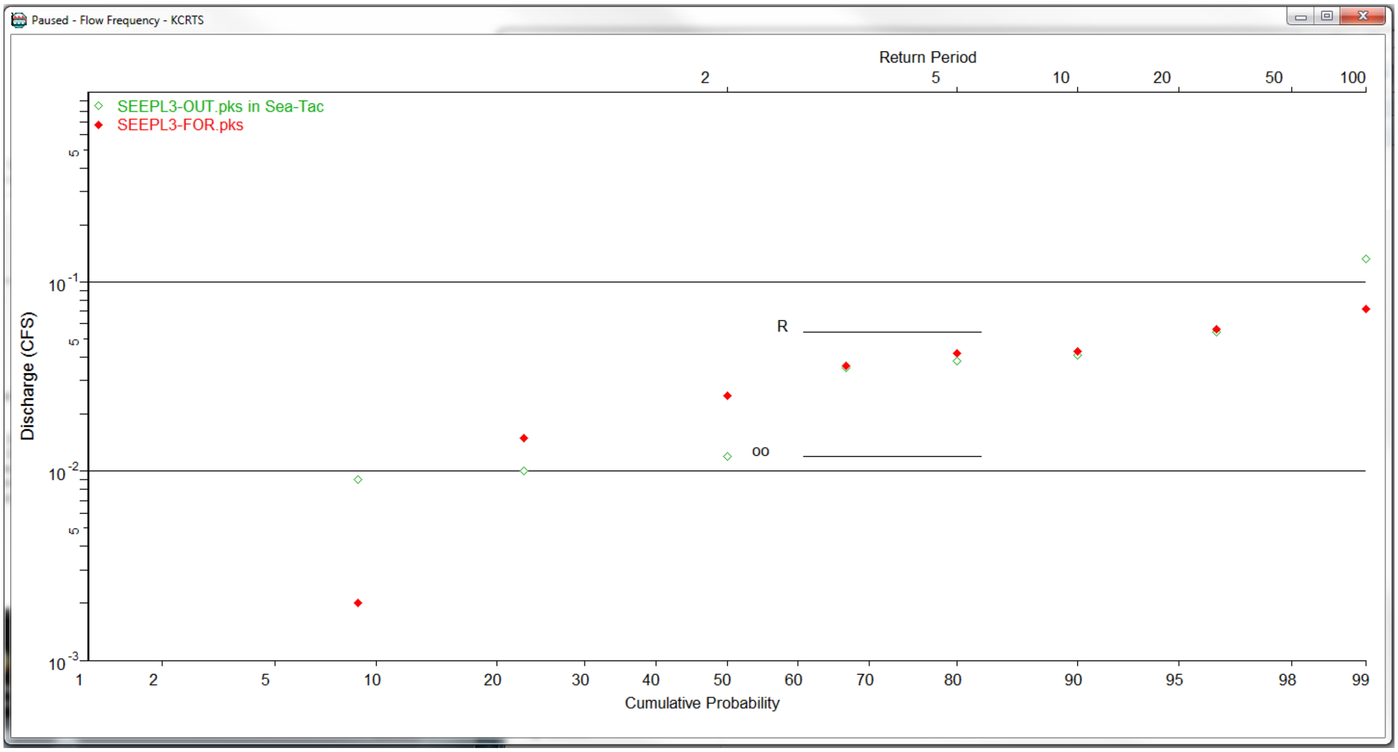
Flow Frequency Analysis
Time Series File:seepl3-ex.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
0.095	5	2/09/01	2:00	0.182	1	100.00	0.990
0.073	8	1/05/02	16:00	0.109	2	25.00	0.960
0.109	2	2/27/03	7:00	0.108	3	10.00	0.900
0.074	7	8/26/04	2:00	0.103	4	5.00	0.800
0.088	6	10/28/04	16:00	0.095	5	3.00	0.667
0.103	4	1/18/06	16:00	0.088	6	2.00	0.500
0.108	3	10/26/06	0:00	0.074	7	1.30	0.231
0.182	1	1/09/08	6:00	0.073	8	1.10	0.091
Computed Peaks				0.158		50.00	0.980

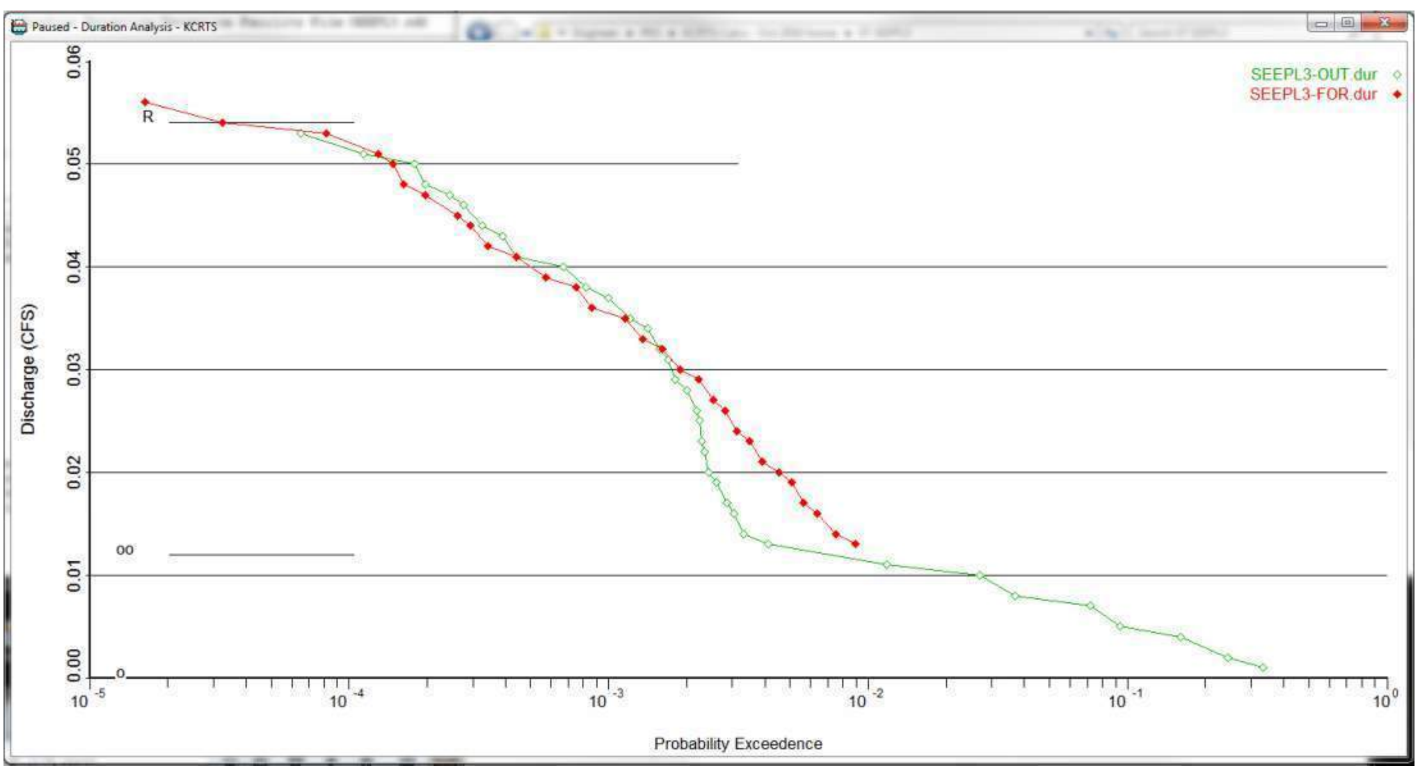
SEEPL3-OUT.pks

Flow Frequency Analysis
Time Series File:seepl3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.054	2	2/09/01 20:00	0.132	3.02	1	100.00	0.990
0.010	7	12/28/01 18:00	0.054	3.00	2	25.00	0.960
0.041	3	3/06/03 22:00	0.041	2.61	3	10.00	0.900
0.009	8	8/26/04 6:00	0.038	2.55	4	5.00	0.800
0.012	6	1/06/05 15:00	0.035	2.49	5	3.00	0.667
0.035	5	1/18/06 23:00	0.012	2.19	6	2.00	0.500
0.038	4	11/24/06 8:00	0.010	1.57	7	1.30	0.231
0.132	1	1/09/08 9:00	0.009	1.11	8	1.10	0.091
Computed Peaks			0.106	3.01		50.00	0.980



Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
SEEPL3-OUT.pks in Sea-Tac
SEEPL3-FOR.pks
R
oo
Discharge (CFS)
Cumulative Probability
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99



Paused - Duration Analysis - KCRTS
SEEPL3-OUT.dur
SEEPL3-FOR.dur
R
oo
Discharge (CFS)
0.06
0.05
0.04
0.03
0.02
0.01
0.00
Probability Exceedence

LOOP ROAD

DEVELOPED BACK TO FORESTED

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
	X		4,094	0.094

See Figures B-9 and B-10

LOOP ROAD
DEVELOPED BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	85.00	ft
Pond Bottom Width:	10.00	ft
Pond Bottom Area:	850.	sq. ft
Top Area at 1 ft. FB:	3286.	sq. ft
	0.075	acres
Effective Storage Depth:	2.50	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	4094.	cu. ft
	0.094	ac-ft
Riser Head:	2.50	ft
Riser Diameter:	12.00	inches
Number of orifices:	1	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.30	0.004	

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	850.
0.01	100.01	9.	0.000	0.000	0.00	856.
0.02	100.02	17.	0.000	0.000	0.00	861.
0.03	100.03	26.	0.001	0.000	0.00	867.
0.13	100.13	115.	0.003	0.001	0.00	925.
0.23	100.23	211.	0.005	0.001	0.00	983.
0.33	100.33	312.	0.007	0.001	0.00	1042.
0.43	100.43	419.	0.010	0.002	0.00	1102.
0.52	100.52	521.	0.012	0.002	0.00	1156.
0.63	100.63	652.	0.015	0.002	0.00	1223.
0.73	100.73	777.	0.018	0.002	0.00	1285.
0.83	100.83	909.	0.021	0.002	0.00	1348.

0.93	100.93	1047.	0.024	0.002	0.00	1411.
1.03	101.03	1191.	0.027	0.002	0.00	1475.
1.13	101.13	1342.	0.031	0.003	0.00	1540.
1.23	101.23	1499.	0.034	0.003	0.00	1606.
1.33	101.33	1663.	0.038	0.003	0.00	1672.
1.43	101.43	1833.	0.042	0.003	0.00	1739.
1.53	101.53	2011.	0.046	0.003	0.00	1806.
1.63	101.63	2195.	0.050	0.003	0.00	1875.
1.73	101.73	2386.	0.055	0.003	0.00	1944.
1.83	101.83	2584.	0.059	0.003	0.00	2014.
1.93	101.93	2788.	0.064	0.003	0.00	2084.
2.03	102.03	3000.	0.069	0.003	0.00	2155.
2.13	102.13	3220.	0.074	0.004	0.00	2227.
2.23	102.23	3446.	0.079	0.004	0.00	2300.
2.33	102.33	3680.	0.084	0.004	0.00	2374.
2.43	102.43	3921.	0.090	0.004	0.00	2448.
2.50	102.50	4094.	0.094	0.004	0.00	2500.
2.60	102.60	4348.	0.100	0.312	0.00	2575.
2.70	102.70	4609.	0.106	0.875	0.00	2651.
2.80	102.80	4878.	0.112	1.600	0.00	2728.
2.90	102.90	5155.	0.118	2.400	0.00	2806.
3.00	103.00	5439.	0.125	2.680	0.00	2884.
3.10	103.10	5731.	0.132	2.930	0.00	2963.
3.20	103.20	6032.	0.138	3.170	0.00	3043.
3.30	103.30	6340.	0.146	3.390	0.00	3123.
3.40	103.40	6656.	0.153	3.590	0.00	3204.
3.50	103.50	6981.	0.160	3.790	0.00	3286.

3.60	103.60	7314.	0.168	3.970	0.00
3369.					
3.70	103.70	7655.	0.176	4.150	0.00
3452.					
3.80	103.80	8004.	0.184	4.320	0.00
3536.					
3.90	103.90	8362.	0.192	4.480	0.00
3621.					
4.00	104.00	8728.	0.200	4.640	0.00
3706.					
4.10	104.10	9103.	0.209	4.790	0.00
3792.					
4.20	104.20	9487.	0.218	4.940	0.00
3879.					
4.30	104.30	9879.	0.227	5.080	0.00
3967.					
4.40	104.40	10280.	0.236	5.220	0.00
4055.					
4.50	104.50	10690.	0.245	5.350	0.00
4144.					

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.10	*******	0.02	2.50	102.50	4106.	0.094
2	0.05	0.01	0.02	2.50	102.50	4105.	0.094
3	0.08	*******	0.00	2.25	102.25	3488.	0.080
4	0.06	*******	0.00	1.90	101.90	2730.	0.063
5	0.07	*******	0.00	2.41	102.41	3882.	0.089
6	0.07	*******	0.00	1.64	101.64	2215.	0.051
7	0.06	*******	0.00	1.42	101.42	1820.	0.042
8	0.05	*******	0.00	1.62	101.62	2185.	0.050

Route Time Series through Facility
Inflow Time Series File:lr1-dev.tsf
Outflow Time Series File:LR1-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.105 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.019 CFS at 12:00 on Jan 9 in Year 8
Peak Reservoir Stage: 2.50 Ft
Peak Reservoir Elev: 102.50 Ft
Peak Reservoir Storage: 4106. Cu-Ft
: 0.094 Ac-Ft

Flow Frequency Analysis
Time Series File:lr1-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.017	2	2/10/01 17:00	0.019	2.50	1	100.00	0.990
0.003	7	1/07/02 4:00	0.017	2.50	2	25.00	0.960

0.004	3	3/06/03 23:00	0.004	2.41	3	10.00	0.900
0.003	8	8/26/04 7:00	0.004	2.25	4	5.00	0.800
0.003	6	1/08/05 5:00	0.003	1.90	5	3.00	0.667
0.003	5	1/19/06 0:00	0.003	1.64	6	2.00	0.500
0.004	4	11/24/06 9:00	0.003	1.62	7	1.30	0.231
0.019	1	1/09/08 12:00	0.003	1.42	8	1.10	0.091
Computed Peaks			0.018	2.50		50.00	0.980

Flow Duration from Time Series File:lr1-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.000	185	0.302	0.302	99.698	0.997E+00
0.001	32744	53.399	53.700	46.300	0.463E+00
0.001	11268	18.376	72.076	27.924	0.279E+00
0.002	1683	2.745	74.821	25.179	0.252E+00
0.002	10689	17.432	92.252	7.748	0.775E-01
0.002	490	0.799	93.051	6.949	0.695E-01
0.003	379	0.618	93.669	6.331	0.633E-01
0.003	3559	5.804	99.473	0.527	0.527E-02
0.004	61	0.099	99.573	0.427	0.427E-02
0.004	257	0.419	99.992	0.008	0.815E-04
0.005	1	0.002	99.993	0.007	0.652E-04
0.005	0	0.000	99.993	0.007	0.652E-04
0.006	1	0.002	99.995	0.005	0.489E-04
0.006	0	0.000	99.995	0.005	0.489E-04
0.007	0	0.000	99.995	0.005	0.489E-04
0.007	0	0.000	99.995	0.005	0.489E-04
0.007	0	0.000	99.995	0.005	0.489E-04
0.008	0	0.000	99.995	0.005	0.489E-04
0.008	0	0.000	99.995	0.005	0.489E-04
0.009	0	0.000	99.995	0.005	0.489E-04
0.009	1	0.002	99.997	0.003	0.326E-04
0.010	0	0.000	99.997	0.003	0.326E-04
0.010	1	0.002	99.998	0.002	0.163E-04
0.011	0	0.000	99.998	0.002	0.163E-04
0.011	0	0.000	99.998	0.002	0.163E-04
0.011	0	0.000	99.998	0.002	0.163E-04
0.012	0	0.000	99.998	0.002	0.163E-04
0.012	0	0.000	99.998	0.002	0.163E-04
0.013	0	0.000	99.998	0.002	0.163E-04
0.013	0	0.000	99.998	0.002	0.163E-04
0.014	0	0.000	99.998	0.002	0.163E-04
0.014	0	0.000	99.998	0.002	0.163E-04
0.015	0	0.000	99.998	0.002	0.163E-04
0.015	0	0.000	99.998	0.002	0.163E-04
0.015	0	0.000	99.998	0.002	0.163E-04
0.016	0	0.000	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: lr1-for.tsf
New File: lr1-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change

0.003	0.98E-02	0.63E-01	539.3	0.98E-02	0.003	0.003	0.8
0.004	0.69E-02	0.42E-02	-38.9	0.69E-02	0.004	0.003	-21.5
0.005	0.51E-02	0.65E-04	-98.7	0.51E-02	0.005	0.003	-26.9
0.006	0.37E-02	0.49E-04	-98.7	0.37E-02	0.006	0.004	-27.9
0.006	0.30E-02	0.49E-04	-98.3	0.30E-02	0.006	0.004	-37.4
0.007	0.22E-02	0.49E-04	-97.8	0.22E-02	0.007	0.004	-44.7
0.008	0.15E-02	0.49E-04	-96.7	0.15E-02	0.008	0.004	-50.4
0.009	0.11E-02	0.33E-04	-97.1	0.11E-02	0.009	0.004	-55.1
0.010	0.64E-03	0.33E-04	-94.9	0.64E-03	0.010	0.004	-59.0
0.011	0.29E-03	0.16E-04	-94.4	0.29E-03	0.011	0.004	-62.3
0.012	0.23E-03	0.16E-04	-92.9	0.23E-03	0.012	0.004	-65.1
0.012	0.15E-03	0.16E-04	-88.9	0.15E-03	0.012	0.004	-67.5
0.013	0.82E-04	0.16E-04	-80.0	0.82E-04	0.013	0.005	-65.1
0.014	0.16E-04	0.16E-04	0.0	0.16E-04	0.014	0.017	20.3

Maximum positive excursion = 0.003 cfs (22.8%)
occurring at 0.014 cfs on the Base Data:lr1-for.tsf
and at 0.017 cfs on the New Data:lr1-out.tsf

Maximum negative excursion = 0.009 cfs (-69.3%)
occurring at 0.013 cfs on the Base Data:lr1-for.tsf
and at 0.004 cfs on the New Data:lr1-out.tsf

Route Time Series through Facility
Inflow Time Series File:lr1-dev.tsf
Outflow Time Series File:LR1-OUT

Inflow/Outflow Analysis

Peak Inflow Discharge:	0.105 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge:	0.019 CFS at 12:00 on Jan 9 in Year 8
Peak Reservoir Stage:	2.50 Ft
Peak Reservoir Elev:	102.50 Ft
Peak Reservoir Storage:	4106. Cu-Ft
:	0.094 Ac-Ft

Flow Frequency Analysis
Time Series File:lr1-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.017	2	2/10/01 17:00	0.019	2.50	1	100.00	0.990
0.003	7	1/07/02 4:00	0.017	2.50	2	25.00	0.960
0.004	3	3/06/03 23:00	0.004	2.41	3	10.00	0.900
0.003	8	8/26/04 7:00	0.004	2.25	4	5.00	0.800
0.003	6	1/08/05 5:00	0.003	1.90	5	3.00	0.667
0.003	5	1/19/06 0:00	0.003	1.64	6	2.00	0.500
0.004	4	11/24/06 9:00	0.003	1.62	7	1.30	0.231
0.019	1	1/09/08 12:00	0.003	1.42	8	1.10	0.091
Computed Peaks			0.018	2.50		50.00	0.980

Flow Duration from Time Series File:lr1-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.000	185	0.302	0.302	99.698	0.997E+00
0.001	32744	53.399	53.700	46.300	0.463E+00
0.001	11268	18.376	72.076	27.924	0.279E+00
0.002	1683	2.745	74.821	25.179	0.252E+00
0.002	10689	17.432	92.252	7.748	0.775E-01
0.002	490	0.799	93.051	6.949	0.695E-01
0.003	379	0.618	93.669	6.331	0.633E-01
0.003	3559	5.804	99.473	0.527	0.527E-02
0.004	61	0.099	99.573	0.427	0.427E-02
0.004	257	0.419	99.992	0.008	0.815E-04
0.005	1	0.002	99.993	0.007	0.652E-04
0.005	0	0.000	99.993	0.007	0.652E-04
0.006	1	0.002	99.995	0.005	0.489E-04
0.006	0	0.000	99.995	0.005	0.489E-04
0.007	0	0.000	99.995	0.005	0.489E-04
0.007	0	0.000	99.995	0.005	0.489E-04
0.007	0	0.000	99.995	0.005	0.489E-04
0.008	0	0.000	99.995	0.005	0.489E-04
0.008	0	0.000	99.995	0.005	0.489E-04
0.009	0	0.000	99.995	0.005	0.489E-04
0.009	1	0.002	99.997	0.003	0.326E-04
0.010	0	0.000	99.997	0.003	0.326E-04
0.010	1	0.002	99.998	0.002	0.163E-04
0.011	0	0.000	99.998	0.002	0.163E-04
0.011	0	0.000	99.998	0.002	0.163E-04
0.011	0	0.000	99.998	0.002	0.163E-04
0.012	0	0.000	99.998	0.002	0.163E-04
0.012	0	0.000	99.998	0.002	0.163E-04
0.013	0	0.000	99.998	0.002	0.163E-04
0.013	0	0.000	99.998	0.002	0.163E-04
0.014	0	0.000	99.998	0.002	0.163E-04
0.014	0	0.000	99.998	0.002	0.163E-04
0.015	0	0.000	99.998	0.002	0.163E-04
0.015	0	0.000	99.998	0.002	0.163E-04
0.015	0	0.000	99.998	0.002	0.163E-04
0.016	0	0.000	99.998	0.002	0.163E-04

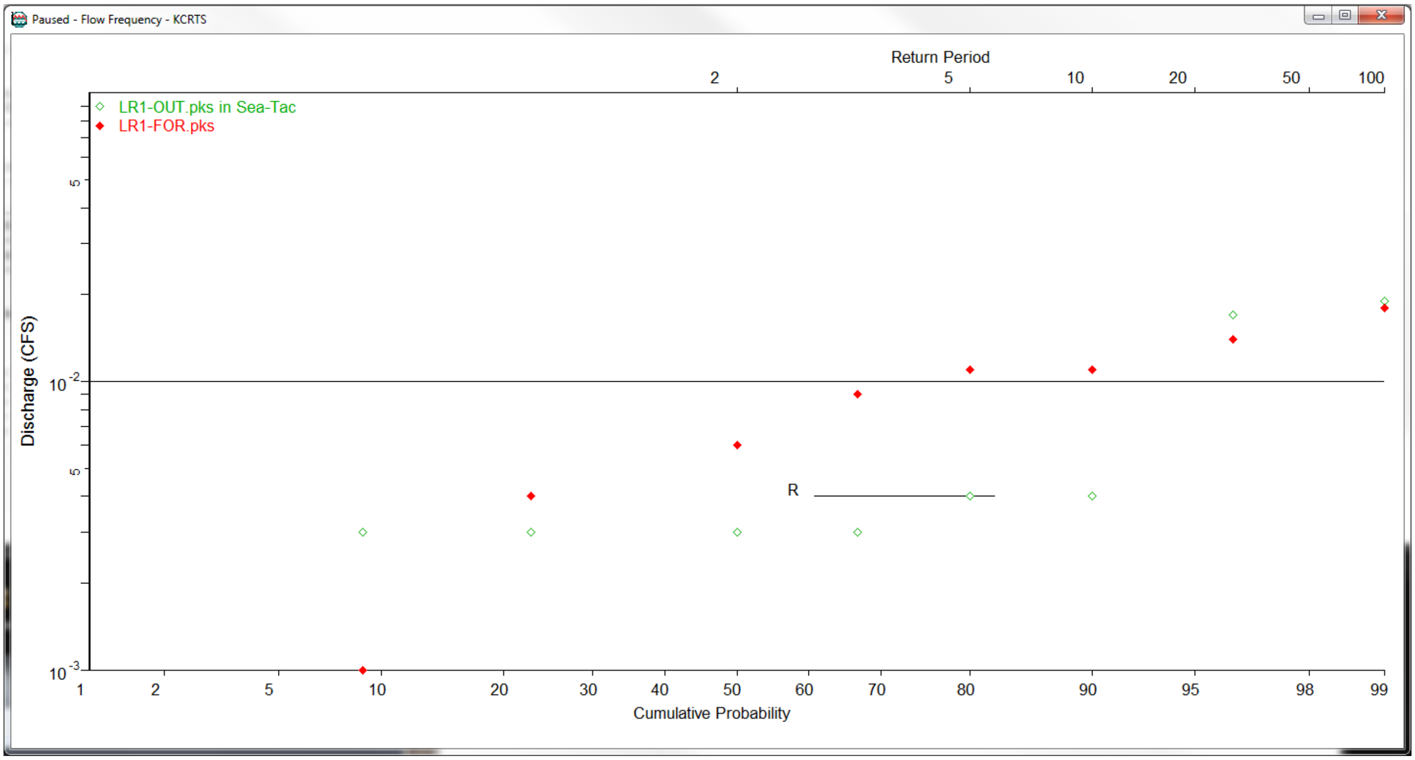
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.22       0.00       0.000000  Impervious
LR1-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.22       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
LR1-FOR.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
lr1-for.tsf
LR1-FOR.pks
[P] Compute PEAKS and Flow Frequencies
lr1-dev.tsf
LR1-DEV.pks
[D] Compute Flow DURATION and Exceedence
lr1-dev.tsf
LR1-DEV.dur
 F
 F
          36
   0.275000E-01
   0.200000E-02
[D] Compute Flow DURATION and Exceedence
lr1-for.tsf
LR1-FOR.dur
 F
 F
          36
   0.400000E-03
   0.300000E-02
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

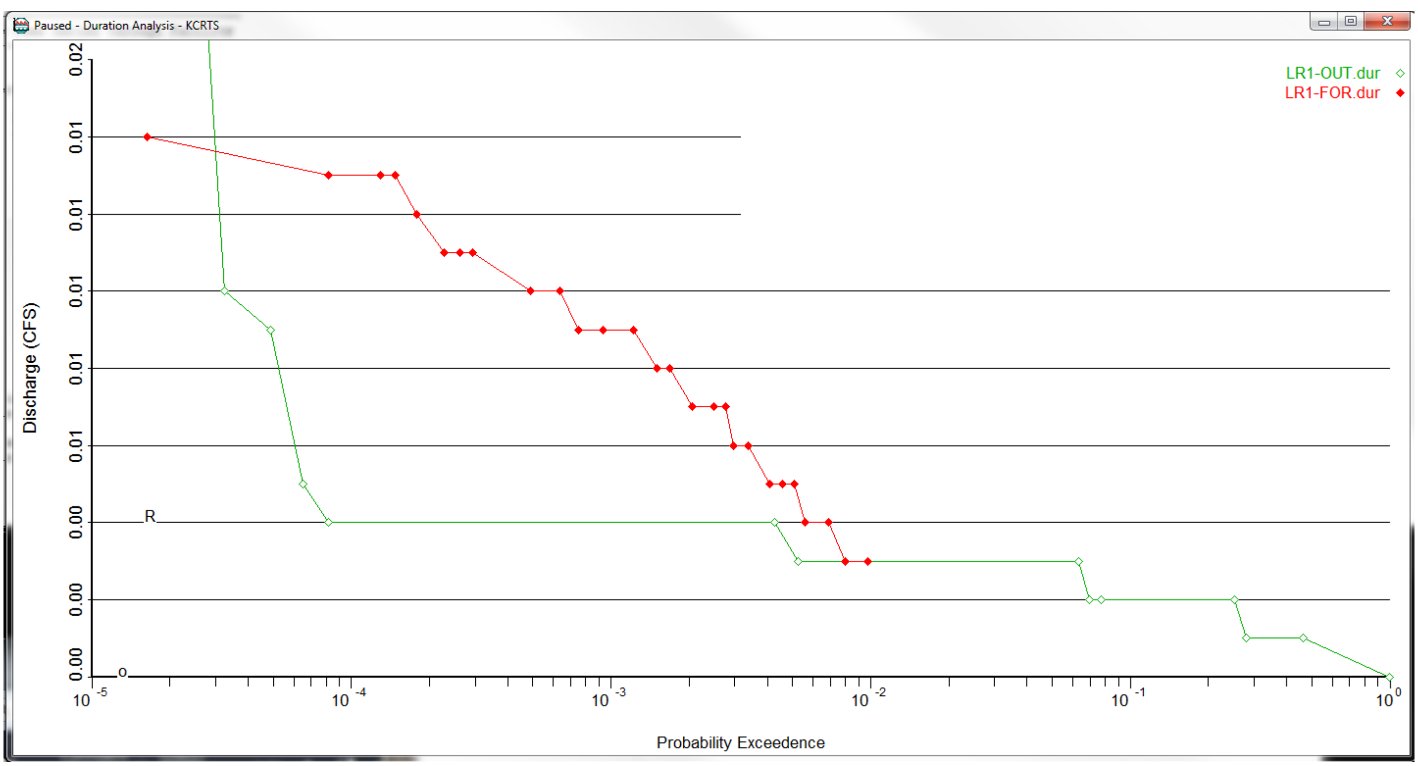
Flow Frequency Analysis
Time Series File:lr1-for.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.014	2	2/09/01 18:00	0.018	1	100.00	0.990
0.004	7	1/06/02 3:00	0.014	2	25.00	0.960
0.011	3	2/28/03 3:00	0.011	3	10.00	0.900
0.001	8	3/24/04 20:00	0.011	4	5.00	0.800
0.006	6	1/05/05 8:00	0.009	5	3.00	0.667
0.011	4	1/18/06 20:00	0.006	6	2.00	0.500
0.009	5	11/24/06 4:00	0.004	7	1.30	0.231
0.018	1	1/09/08 9:00	0.001	8	1.10	0.091
Computed Peaks			0.017		50.00	0.980

Flow Frequency Analysis
Time Series File:lr1-out.tsf
Project Location:Sea-Tac

---Annual	Peak Flow Rates---		-----Flow Frequency	Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
0.017	2	2/10/01 17:00	0.019	2.50	1	100.00	0.990
0.003	7	1/07/02 4:00	0.017	2.50	2	25.00	0.960
0.004	3	3/06/03 23:00	0.004	2.41	3	10.00	0.900
0.003	8	8/26/04 7:00	0.004	2.25	4	5.00	0.800
0.003	6	1/08/05 5:00	0.003	1.90	5	3.00	0.667
0.003	5	1/19/06 0:00	0.003	1.64	6	2.00	0.500
0.004	4	11/24/06 9:00	0.003	1.62	7	1.30	0.231
0.019	1	1/09/08 12:00	0.003	1.42	8	1.10	0.091
Computed Peaks			0.018	2.50		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
LR1-OUT.pks in Sea-Tac
LR1-FOR.pks
Discharge (CFS)
R
Cumulative Probability
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99


Paused - Duration Analysis - KCRTS
LR1-OUT.dur
LR1-FOR.dur
Discharge (CFS)
R
Probability Exceedence

GRAND STAND AND TURF

DEVELOPED BACK TO EXISTING

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
X			8,640	0.198

See Figures B-7 and B-8

GRAND STAND AND TURF
DEVELOPED BACK TO EXISTING

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	84.00	ft
Pond Bottom Width:	10.00	ft
Pond Bottom Area:	840.	sq. ft
Top Area at 1 ft. FB:	4560.	sq. ft
	0.105	acres
Effective Storage Depth:	4.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	8640.	cu. ft
	0.198	ac-ft
Riser Head:	4.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.00	0.054	
2	3.00	2.30	0.143	6.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	840.
0.01	100.01	8.	0.000	0.003	0.00	846.
0.02	100.02	17.	0.000	0.004	0.00	851.
0.03	100.03	26.	0.001	0.005	0.00	857.
0.04	100.04	34.	0.001	0.006	0.00	863.
0.05	100.05	43.	0.001	0.006	0.00	868.
0.06	100.06	51.	0.001	0.007	0.00	874.
0.07	100.07	60.	0.001	0.007	0.00	880.
0.08	100.08	69.	0.002	0.008	0.00	885.
0.09	100.09	78.	0.002	0.008	0.00	891.
0.19	100.19	170.	0.004	0.012	0.00	948.

0.29	100.29	268.	0.006	0.015	0.00	1007.
0.39	100.39	371.	0.009	0.017	0.00	1065.
0.49	100.49	481.	0.011	0.019	0.00	1125.
0.59	100.59	596.	0.014	0.021	0.00	1185.
0.69	100.69	718.	0.016	0.023	0.00	1246.
0.79	100.79	846.	0.019	0.024	0.00	1308.
0.89	100.89	979.	0.022	0.026	0.00	1370.
0.99	100.99	1120.	0.026	0.027	0.00	1434.
1.09	101.09	1266.	0.029	0.028	0.00	1498.
1.19	101.19	1419.	0.033	0.030	0.00	1562.
1.29	101.29	1579.	0.036	0.031	0.00	1627.
1.39	101.39	1745.	0.040	0.032	0.00	1694.
1.49	101.49	1917.	0.044	0.033	0.00	1760.
1.59	101.59	2097.	0.048	0.034	0.00	1828.
1.69	101.69	2283.	0.052	0.035	0.00	1896.
1.79	101.79	2476.	0.057	0.036	0.00	1965.
1.89	101.89	2676.	0.061	0.037	0.00	2035.
1.99	101.99	2883.	0.066	0.038	0.00	2105.
2.09	102.09	3097.	0.071	0.039	0.00	2176.
2.19	102.19	3318.	0.076	0.040	0.00	2248.
2.29	102.29	3547.	0.081	0.041	0.00	2320.
2.39	102.39	3782.	0.087	0.042	0.00	2394.
2.49	102.49	4025.	0.092	0.043	0.00	2468.
2.59	102.59	4276.	0.098	0.044	0.00	2542.
2.69	102.69	4534.	0.104	0.045	0.00	2618.
2.79	102.79	4799.	0.110	0.045	0.00	2694.
2.89	102.89	5073.	0.116	0.046	0.00	2771.

2.99	102.99	5354.	0.123	0.047	0.00	2848.
3.00	103.00	5382.	0.124	0.047	0.00	2856.
3.02	103.02	5439.	0.125	0.048	0.00	2872.
3.05	103.05	5526.	0.127	0.053	0.00	2895.
3.07	103.07	5584.	0.128	0.060	0.00	2911.
3.10	103.10	5672.	0.130	0.069	0.00	2934.
3.12	103.12	5730.	0.132	0.081	0.00	2950.
3.14	103.14	5790.	0.133	0.095	0.00	2966.
3.17	103.17	5879.	0.135	0.107	0.00	2990.
3.19	103.19	5939.	0.136	0.111	0.00	3005.
3.29	103.29	6243.	0.143	0.127	0.00	3085.
3.39	103.39	6556.	0.151	0.140	0.00	3166.
3.49	103.49	6877.	0.158	0.151	0.00	3247.
3.59	103.59	7205.	0.165	0.162	0.00	3329.
3.69	103.69	7542.	0.173	0.171	0.00	3411.
3.79	103.79	7888.	0.181	0.180	0.00	3495.
3.89	103.89	8241.	0.189	0.189	0.00	3579.
3.99	103.99	8603.	0.198	0.197	0.00	3663.
4.00	104.00	8640.	0.198	0.198	0.00	3672.
4.10	104.10	9012.	0.207	0.667	0.00	3758.
4.20	104.20	9392.	0.216	1.520	0.00	3844.
4.30	104.30	9780.	0.225	2.620	0.00	3931.
4.40	104.40	10178.	0.234	3.920	0.00	4019.
4.50	104.50	10584.	0.243	5.400	0.00	4107.
4.60	104.60	10999.	0.253	6.830	0.00	4196.
4.70	104.70	11423.	0.262	7.370	0.00	4286.
4.80	104.80	11856.	0.272	7.860	0.00	4377.

4.90	104.90	12299.	0.282	8.330	0.00	4468.
5.00	105.00	12750.	0.293	8.770	0.00	4560.
5.10	105.10	13211.	0.303	9.190	0.00	4653.
5.20	105.20	13681.	0.314	9.600	0.00	4746.
5.30	105.30	14160.	0.325	9.980	0.00	4840.
5.40	105.40	14649.	0.336	10.350	0.00	4935.
5.50	105.50	15147.	0.348	10.710	0.00	5031.
5.60	105.60	15655.	0.359	11.060	0.00	5127.
5.70	105.70	16172.	0.371	11.400	0.00	5224.
5.80	105.80	16700.	0.383	11.720	0.00	5322.
5.90	105.90	17237.	0.396	12.040	0.00	5421.
6.00	106.00	17784.	0.408	12.350	0.00	5520.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.58	*******	0.48	4.06	104.06	8863.	0.203
2	0.28	0.22	0.15	3.49	103.49	6886.	0.158
3	0.26	*******	0.16	3.61	103.61	7289.	0.167
4	0.33	*******	0.15	3.47	103.47	6799.	0.156
5	0.27	*******	0.17	3.69	103.69	7545.	0.173
6	0.16	*******	0.07	3.10	103.10	5663.	0.130
7	0.19	*******	0.04	2.34	102.34	3671.	0.084
8	0.18	*******	0.03	1.39	101.39	1752.	0.040

Route Time Series through Facility
Inflow Time Series File:gst2-dev.tsf
Outflow Time Series File:GST2-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.576 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.480 CFS at 9:00 on Jan 9 in Year 8
Peak Reservoir Stage: 4.06 Ft
Peak Reservoir Elev: 104.06 Ft
Peak Reservoir Storage: 8863. Cu-Ft
: 0.203 Ac-Ft

Flow Frequency Analysis
Time Series File:gst2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- -----Flow Frequency Analysis-------

Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.171	2	2/09/01 19:00	0.480	4.06	1	100.00	0.990
0.042	7	12/28/01 18:00	0.171	3.69	2	25.00	0.960
0.148	5	2/28/03 6:00	0.164	3.62	3	10.00	0.900
0.032	8	8/24/04 0:00	0.151	3.49	4	5.00	0.800
0.068	6	1/05/05 15:00	0.148	3.47	5	3.00	0.667
0.151	4	1/18/06 22:00	0.068	3.10	6	2.00	0.500
0.164	3	11/24/06 6:00	0.042	2.34	7	1.30	0.231
0.480	1	1/09/08 9:00	0.032	1.39	8	1.10	0.091
Computed Peaks			0.377	4.04		50.00	0.980

Flow Duration from Time Series File:gst2-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.002	44163	72.021	72.021	27.979	0.280E+00
0.007	5286	8.620	80.641	19.359	0.194E+00
0.012	3176	5.179	85.820	14.180	0.142E+00
0.017	2523	4.114	89.935	10.065	0.101E+00
0.022	1882	3.069	93.004	6.996	0.700E-01
0.026	1400	2.283	95.287	4.713	0.471E-01
0.031	1037	1.691	96.978	3.022	0.302E-01
0.036	717	1.169	98.147	1.853	0.185E-01
0.041	423	0.690	98.837	1.163	0.116E-01
0.046	357	0.582	99.419	0.581	0.581E-02
0.050	164	0.267	99.687	0.313	0.313E-02
0.055	33	0.054	99.741	0.259	0.259E-02
0.060	25	0.041	99.781	0.219	0.219E-02
0.065	16	0.026	99.808	0.192	0.192E-02
0.070	17	0.028	99.835	0.165	0.165E-02
0.074	9	0.015	99.850	0.150	0.150E-02
0.079	2	0.003	99.853	0.147	0.147E-02
0.084	3	0.005	99.858	0.142	0.142E-02
0.089	6	0.010	99.868	0.132	0.132E-02
0.093	2	0.003	99.871	0.129	0.129E-02
0.098	5	0.008	99.879	0.121	0.121E-02
0.103	2	0.003	99.883	0.117	0.117E-02
0.108	5	0.008	99.891	0.109	0.109E-02
0.113	5	0.008	99.899	0.101	0.101E-02
0.117	5	0.008	99.907	0.093	0.930E-03
0.122	4	0.007	99.914	0.086	0.864E-03
0.127	4	0.007	99.920	0.080	0.799E-03
0.132	5	0.008	99.928	0.072	0.718E-03
0.137	4	0.007	99.935	0.065	0.652E-03
0.141	7	0.011	99.946	0.054	0.538E-03
0.146	8	0.013	99.959	0.041	0.408E-03
0.151	7	0.011	99.971	0.029	0.294E-03
0.156	6	0.010	99.980	0.020	0.196E-03
0.160	2	0.003	99.984	0.016	0.163E-03
0.165	5	0.008	99.992	0.008	0.815E-04
0.170	4	0.007	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: gst2-ex.tsf
New File: gst2-out.tsf

Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.048	0.72E-02	0.36E-02	-50.2	0.72E-02	0.048	0.045	-6.1
0.061	0.49E-02	0.21E-02	-57.1	0.49E-02	0.061	0.046	-24.2
0.074	0.30E-02	0.15E-02	-50.3	0.30E-02	0.074	0.051	-31.3
0.088	0.18E-02	0.13E-02	-26.8	0.18E-02	0.088	0.067	-24.3
0.101	0.11E-02	0.12E-02	4.3	0.11E-02	0.101	0.104	2.9
0.115	0.75E-03	0.96E-03	28.3	0.75E-03	0.115	0.131	14.6
0.128	0.41E-03	0.80E-03	96.0	0.41E-03	0.128	0.146	14.1
0.141	0.28E-03	0.54E-03	94.1	0.28E-03	0.141	0.151	6.7
0.155	0.18E-03	0.20E-03	9.1	0.18E-03	0.155	0.159	2.4
0.168	0.82E-04	0.49E-04	-40.0	0.82E-04	0.168	0.167	-0.7
0.182	0.33E-04	0.00E+00	-100.0	0.33E-04	0.182	0.169	-6.7
0.195	0.33E-04	0.00E+00	-100.0	0.33E-04	0.195	0.169	-13.1
0.208	0.16E-04	0.00E+00	-100.0	0.16E-04	0.208	0.171	-18.1
0.222	0.16E-04	0.00E+00	-100.0	0.16E-04	0.222	0.171	-23.0

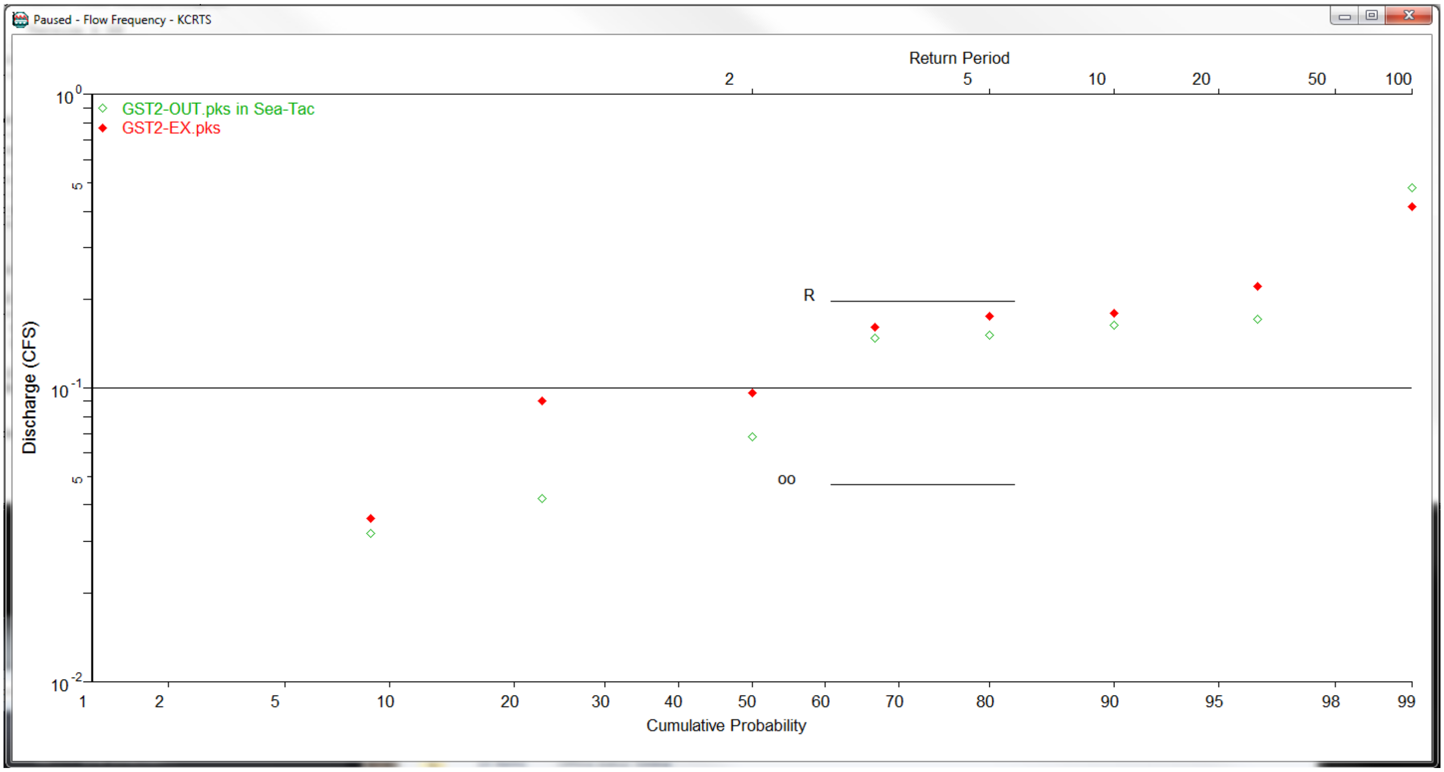
Maximum positive excursion = 0.019 cfs (16.1%)
occurring at 0.117 cfs on the Base Data:gst2-ex.tsf
and at 0.136 cfs on the New Data:gst2-out.tsf

Maximum negative excursion = 0.023 cfs (-32.5%)
occurring at 0.071 cfs on the Base Data:gst2-ex.tsf
and at 0.048 cfs on the New Data:gst2-out.tsf

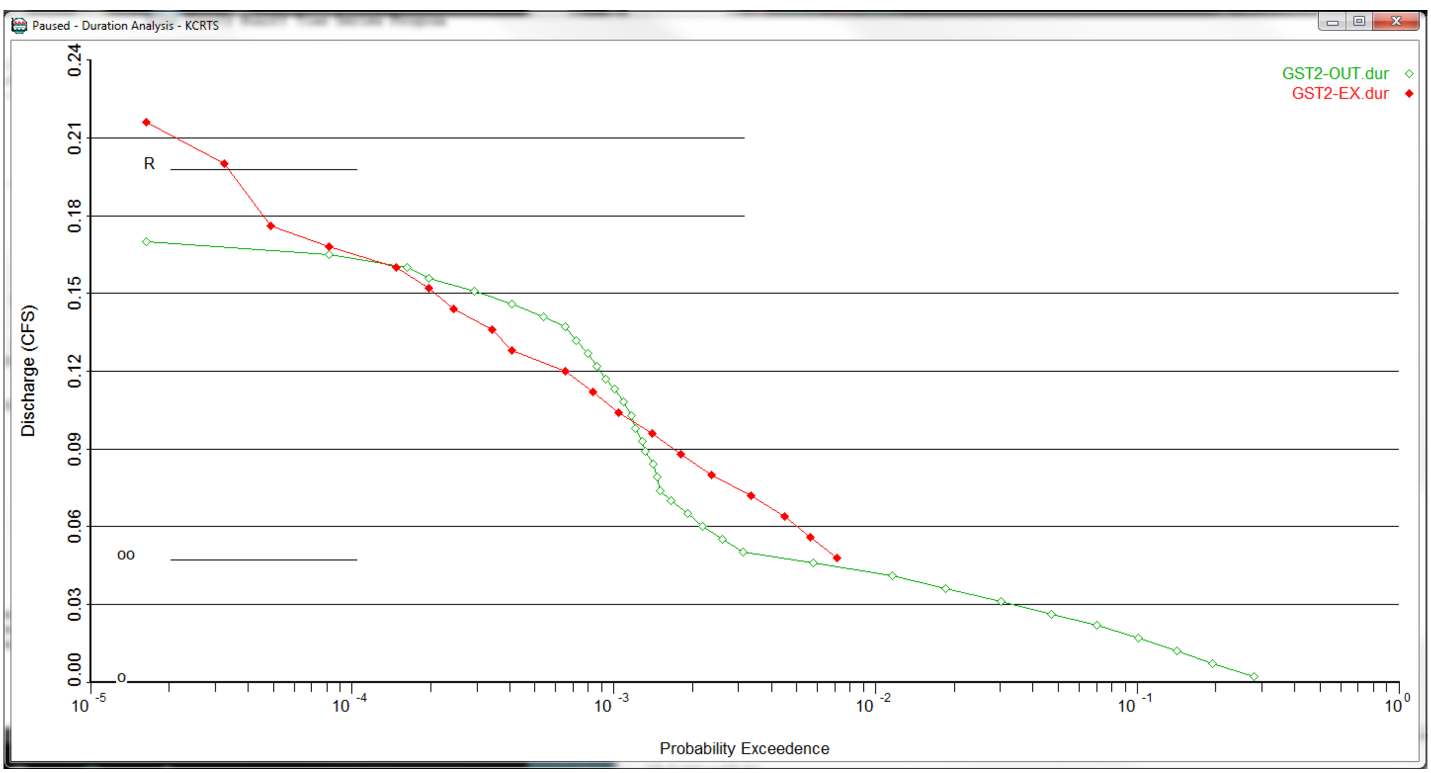
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00      0.00      0.000000  Till Forest
       0.00      0.00      0.000000  Till Pasture
       1.34      0.00      0.000000  Till Grass
       0.00      0.00      0.000000  Outwash Forest
       0.00      0.00      0.000000  Outwash Pasture
       0.00      0.00      0.000000  Outwash Grass
       0.00      0.00      0.000000  Wetland
       0.62      0.00      0.000000  Impervious
GST2-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.00      0.00      0.000000  Till Forest
       0.00      0.00      0.000000  Till Pasture
       1.96      0.00      0.000000  Till Grass
       0.00      0.00      0.000000  Outwash Forest
       0.00      0.00      0.000000  Outwash Pasture
       0.00      0.00      0.000000  Outwash Grass
       0.00      0.00      0.000000  Wetland
       0.00      0.00      0.000000  Impervious
GST2-EX.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
gst2-ex.tsf
GST2-EX.pks
[P] Compute PEAKS and Flow Frequencies
gst2-dev.tsf
GST2-DEV.pks
[D] Compute Flow DURATION and Exceedence
gst2-dev.tsf
GST2-DEV.dur
 F
 F
          36
   0.109000E-01
   0.112000
[D] Compute Flow DURATION and Exceedence
gst2-ex.tsf
GST2-EX.dur
 F
 F
          36
   0.800000E-02
   0.480000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

Flow Frequency Analysis
Time Series File:gst2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.171	2	2/09/01 19:00	0.480	4.06	1	100.00	0.990
0.042	7	12/28/01 18:00	0.171	3.69	2	25.00	0.960
0.148	5	2/28/03 6:00	0.164	3.62	3	10.00	0.900
0.032	8	8/24/04 0:00	0.151	3.49	4	5.00	0.800
0.068	6	1/05/05 15:00	0.148	3.47	5	3.00	0.667
0.151	4	1/18/06 22:00	0.068	3.10	6	2.00	0.500
0.164	3	11/24/06 6:00	0.042	2.34	7	1.30	0.231
0.480	1	1/09/08 9:00	0.032	1.39	8	1.10	0.091
Computed Peaks			0.377	4.04		50.00	0.980



Paused - Flow Frequency - KCRTS
Return Period
GST2-OUT.pks in Sea-Tac
GST2-EX.pks
Discharge (CFS)
Cumulative Probability



Paused - Duration Analysis - KCRTS
GST2-OUT.dur
GST2-EX.dur
Discharge (CFS)
Probability Exceedence

GRAND STAND AND TURF
EXISTING BACK TO FORESTED

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
		X	10,728	0.246

See Figures B-7 and B-8

GRAND STAND AND TURF
EXISTING BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	160.00	ft
Pond Bottom Width:	12.00	ft
Pond Bottom Area:	1920.	sq. ft
Top Area at 1 ft. FB:	6624.	sq. ft
	0.152	acres
Effective Storage Depth:	3.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	10728.	cu. ft
	0.246	ac-ft
Riser Head:	3.00	ft
Riser Diameter:	18.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.80	0.030	
2	2.25	2.00	0.094	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	1920.
0.01	100.01	19.	0.000	0.002	0.00	1930.
0.02	100.02	39.	0.001	0.002	0.00	1941.
0.03	100.03	58.	0.001	0.003	0.00	1951.
0.04	100.04	78.	0.002	0.004	0.00	1961.
0.05	100.05	97.	0.002	0.004	0.00	1972.
0.06	100.06	117.	0.003	0.004	0.00	1982.
0.07	100.07	137.	0.003	0.004	0.00	1992.
0.17	100.17	341.	0.008	0.007	0.00	2096.
0.27	100.27	556.	0.013	0.009	0.00	2201.
0.37	100.37	782.	0.018	0.011	0.00	2307.

0.47	100.47	1018.	0.023	0.012	0.00	2413.
0.57	100.57	1264.	0.029	0.013	0.00	2520.
0.67	100.67	1522.	0.035	0.014	0.00	2628.
0.77	100.77	1790.	0.041	0.015	0.00	2736.
0.87	100.87	2069.	0.047	0.016	0.00	2845.
0.97	100.97	2359.	0.054	0.017	0.00	2955.
1.07	101.07	2660.	0.061	0.018	0.00	3065.
1.17	101.17	2972.	0.068	0.019	0.00	3177.
1.27	101.27	3295.	0.076	0.020	0.00	3289.
1.37	101.37	3630.	0.083	0.020	0.00	3401.
1.47	101.47	3976.	0.091	0.021	0.00	3515.
1.57	101.57	4333.	0.099	0.022	0.00	3629.
1.67	101.67	4701.	0.108	0.022	0.00	3744.
1.77	101.77	5082.	0.117	0.023	0.00	3859.
1.87	101.87	5473.	0.126	0.024	0.00	3976.
1.97	101.97	5877.	0.135	0.024	0.00	4093.
2.07	102.07	6292.	0.144	0.025	0.00	4210.
2.17	102.17	6719.	0.154	0.026	0.00	4329.
2.25	102.25	7069.	0.162	0.026	0.00	4424.
2.27	102.27	7158.	0.164	0.027	0.00	4448.
2.29	102.29	7247.	0.166	0.030	0.00	4472.
2.31	102.31	7337.	0.168	0.034	0.00	4496.
2.33	102.33	7427.	0.170	0.040	0.00	4520.
2.35	102.35	7517.	0.173	0.047	0.00	4544.
2.37	102.37	7609.	0.175	0.056	0.00	4568.
2.40	102.40	7746.	0.178	0.065	0.00	4604.
2.42	102.42	7838.	0.180	0.071	0.00	4628.

2.44	102.44	7931.	0.182	0.074	0.00	4652.
2.54	102.54	8403.	0.193	0.086	0.00	4774.
2.64	102.64	8886.	0.204	0.096	0.00	4895.
2.74	102.74	9382.	0.215	0.104	0.00	5018.
2.84	102.84	9890.	0.227	0.112	0.00	5141.
2.94	102.94	10410.	0.239	0.120	0.00	5265.
3.00	103.00	10728.	0.246	0.124	0.00	5340.
3.10	103.10	11268.	0.259	0.593	0.00	5465.
3.20	103.20	11821.	0.271	1.440	0.00	5591.
3.30	103.30	12386.	0.284	2.540	0.00	5718.
3.40	103.40	12965.	0.298	3.840	0.00	5845.
3.50	103.50	13556.	0.311	5.320	0.00	5973.
3.60	103.60	14159.	0.325	6.750	0.00	6102.
3.70	103.70	14776.	0.339	7.280	0.00	6231.
3.80	103.80	15406.	0.354	7.780	0.00	6361.
3.90	103.90	16048.	0.368	8.250	0.00	6492.
4.00	104.00	16704.	0.383	8.690	0.00	6624.
4.10	104.10	17373.	0.399	9.110	0.00	6756.
4.20	104.20	18055.	0.414	9.510	0.00	6889.
4.30	104.30	18751.	0.430	9.890	0.00	7023.
4.40	104.40	19460.	0.447	10.260	0.00	7158.
4.50	104.50	20183.	0.463	10.620	0.00	7293.
4.60	104.60	20919.	0.480	10.970	0.00	7429.
4.70	104.70	21668.	0.497	11.300	0.00	7566.
4.80	104.80	22432.	0.515	11.630	0.00	7703.
4.90	104.90	23209.	0.533	11.940	0.00	7841.
5.00	105.00	24000.	0.551	12.250	0.00	7980.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.41	*******	0.19	3.01	103.01	10799.	0.248
2	0.17	0.12	0.11	2.83	102.83	9847.	0.226
3	0.22	*******	0.08	2.49	102.49	8183.	0.188
4	0.16	*******	0.08	2.49	102.49	8160.	0.187
5	0.18	*******	0.07	2.44	102.44	7925.	0.182
6	0.10	*******	0.04	2.31	102.31	7358.	0.169
7	0.09	*******	0.02	1.75	101.75	4992.	0.115
8	0.02	*******	0.01	0.38	100.38	808.	0.019

Route Time Series through Facility
Inflow Time Series File:gst3-ex.tsf
Outflow Time Series File:GST3-OUT

Inflow/Outflow Analysis

```
   Peak Inflow Discharge:      0.414 CFS at  6:00 on Jan  9 in Year 8
  Peak Outflow Discharge:      0.186 CFS at 10:00 on Jan  9 in Year 8
    Peak Reservoir Stage:       3.01  Ft
     Peak Reservoir Elev:     103.01  Ft
  Peak Reservoir Storage:   10799.    Cu-Ft
                        :       0.248 Ac-Ft
```

Flow Frequency Analysis
Time Series File:gst3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.111	2	2/10/01 3:00	0.186	3.01	1	100.00	0.990
0.023	7	12/30/01 3:00	0.111	2.83	2	25.00	0.960
0.080	3	3/07/03 5:00	0.080	2.49	3	10.00	0.900
0.011	8	3/03/04 21:00	0.080	2.49	4	5.00	0.800
0.035	6	1/07/05 1:00	0.074	2.44	5	3.00	0.667
0.074	5	1/19/06 13:00	0.035	2.31	6	2.00	0.500
0.080	4	11/24/06 20:00	0.023	1.75	7	1.30	0.231
0.186	1	1/09/08 10:00	0.011	0.38	8	1.10	0.091
Computed Peaks			0.161	3.01		50.00	0.980

Flow Duration from Time Series File:gst3-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.002	42776	69.759	69.759	30.241	0.302E+00
0.005	5318	8.673	78.431	21.569	0.216E+00
0.008	3259	5.315	83.746	16.254	0.163E+00
0.011	2409	3.929	87.674	12.326	0.123E+00
0.014	2748	4.481	92.156	7.844	0.784E-01
0.017	1727	2.816	94.972	5.028	0.503E-01
0.020	1021	1.665	96.637	3.363	0.336E-01
0.023	875	1.427	98.064	1.936	0.194E-01
0.026	666	1.086	99.150	0.850	0.850E-02

0.030	104	0.170	99.320	0.680	0.680E-02
0.033	80	0.130	99.450	0.550	0.550E-02
0.036	53	0.086	99.537	0.463	0.463E-02
0.039	43	0.070	99.607	0.393	0.393E-02
0.042	19	0.031	99.638	0.362	0.362E-02
0.045	23	0.038	99.675	0.325	0.325E-02
0.048	15	0.024	99.700	0.300	0.300E-02
0.051	8	0.013	99.713	0.287	0.287E-02
0.054	10	0.016	99.729	0.271	0.271E-02
0.058	8	0.013	99.742	0.258	0.258E-02
0.061	8	0.013	99.755	0.245	0.245E-02
0.064	9	0.015	99.770	0.230	0.230E-02
0.067	9	0.015	99.785	0.215	0.215E-02
0.070	10	0.016	99.801	0.199	0.199E-02
0.073	16	0.026	99.827	0.173	0.173E-02
0.076	24	0.039	99.866	0.134	0.134E-02
0.079	26	0.042	99.909	0.091	0.913E-03
0.082	14	0.023	99.932	0.068	0.685E-03
0.085	2	0.003	99.935	0.065	0.652E-03
0.089	2	0.003	99.938	0.062	0.620E-03
0.092	3	0.005	99.943	0.057	0.571E-03
0.095	2	0.003	99.946	0.054	0.538E-03
0.098	3	0.005	99.951	0.049	0.489E-03
0.101	5	0.008	99.959	0.041	0.408E-03
0.104	6	0.010	99.969	0.031	0.310E-03
0.107	5	0.008	99.977	0.023	0.228E-03
0.110	7	0.011	99.989	0.011	0.114E-03

Duration Comparison Anaylsis
Base File: gst3-for.tsf
New File: gst3-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.027	0.95E-02	0.82E-02	-14.2	0.95E-02	0.027	0.026	-2.9
0.034	0.63E-02	0.50E-02	-19.9	0.63E-02	0.034	0.031	-10.6
0.042	0.50E-02	0.36E-02	-26.6	0.50E-02	0.042	0.035	-17.3
0.049	0.37E-02	0.30E-02	-21.0	0.37E-02	0.049	0.041	-17.0
0.057	0.29E-02	0.26E-02	-9.1	0.29E-02	0.057	0.052	-9.0
0.064	0.22E-02	0.23E-02	4.4	0.22E-02	0.064	0.066	2.5
0.071	0.15E-02	0.19E-02	28.6	0.15E-02	0.071	0.075	4.7
0.079	0.10E-02	0.96E-03	-6.3	0.10E-02	0.079	0.078	-0.6
0.086	0.62E-03	0.64E-03	2.6	0.62E-03	0.086	0.089	3.5
0.094	0.34E-03	0.55E-03	61.9	0.34E-03	0.094	0.103	9.7
0.101	0.21E-03	0.39E-03	84.6	0.21E-03	0.101	0.108	6.3
0.109	0.16E-03	0.18E-03	10.0	0.16E-03	0.109	0.109	0.4
0.116	0.98E-04	0.00E+00	-100.0	0.98E-04	0.116	0.111	-4.7
0.123	0.16E-04	0.00E+00	-100.0	0.16E-04	0.123	0.111	-9.8

Maximum positive excursion = 0.010 cfs (11.1%)
occurring at 0.092 cfs on the Base Data:gst3-for.tsf
and at 0.102 cfs on the New Data:gst3-out.tsf

Maximum negative excursion = 0.009 cfs (-18.7%)

occurring at 0.048 cfs on the Base Data:gst3-for.tsf
and at 0.039 cfs on the New Data:gst3-out.tsf

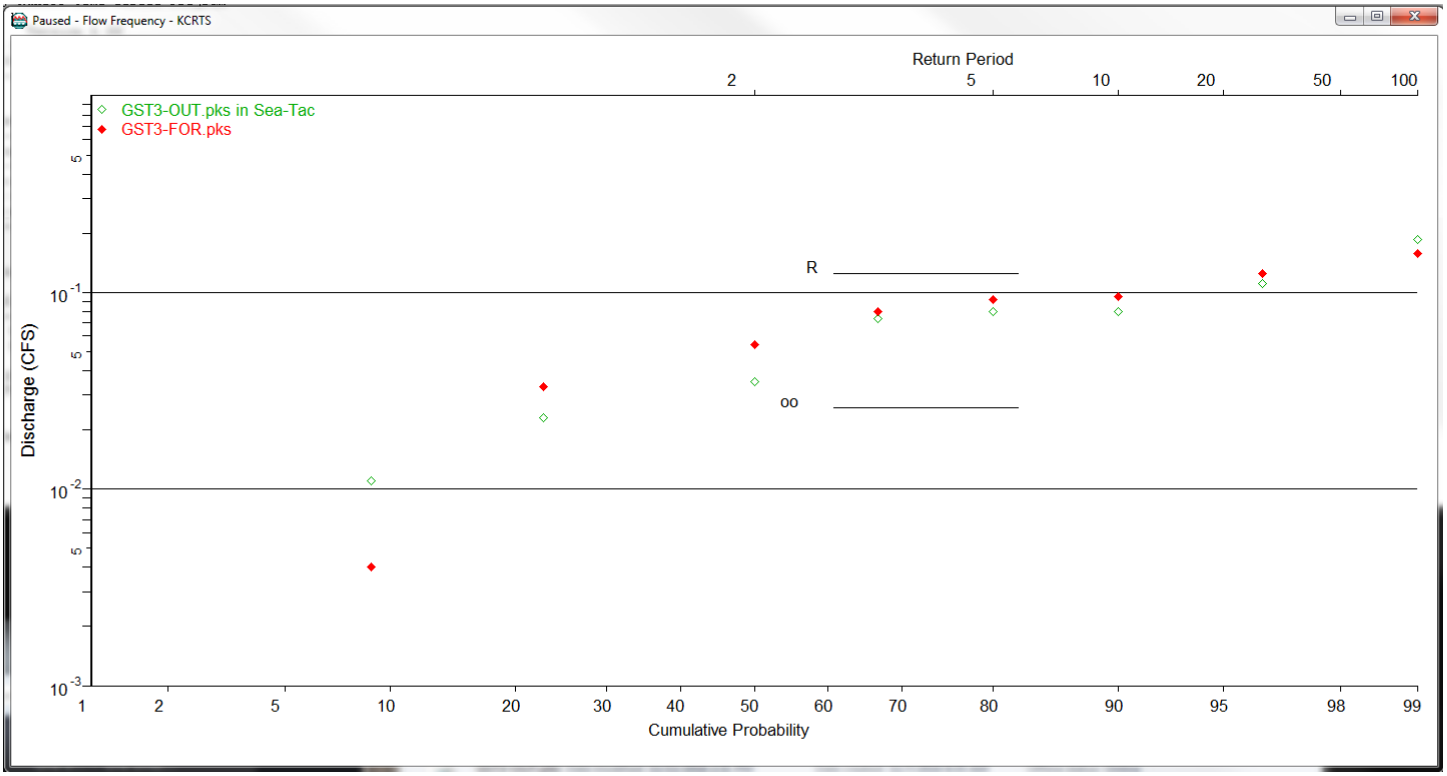
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       1.96       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
GST3-EX.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       1.96       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
GST3-FOR.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
gst3-for.tsf
GST3-FOR.pks
[P] Compute PEAKS and Flow Frequencies
gst3-ex.tsf
GST3-EX.pks
[D] Compute Flow DURATION and Exceedence
gst3-ex.tsf
GST3-EX.dur
 F
 F
          36
   0.800000E-02
   0.480000E-01
[D] Compute Flow DURATION and Exceedence
gst3-for.tsf
GST3-FOR.dur
 F
 F
          36
   0.340000E-02
   0.270000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

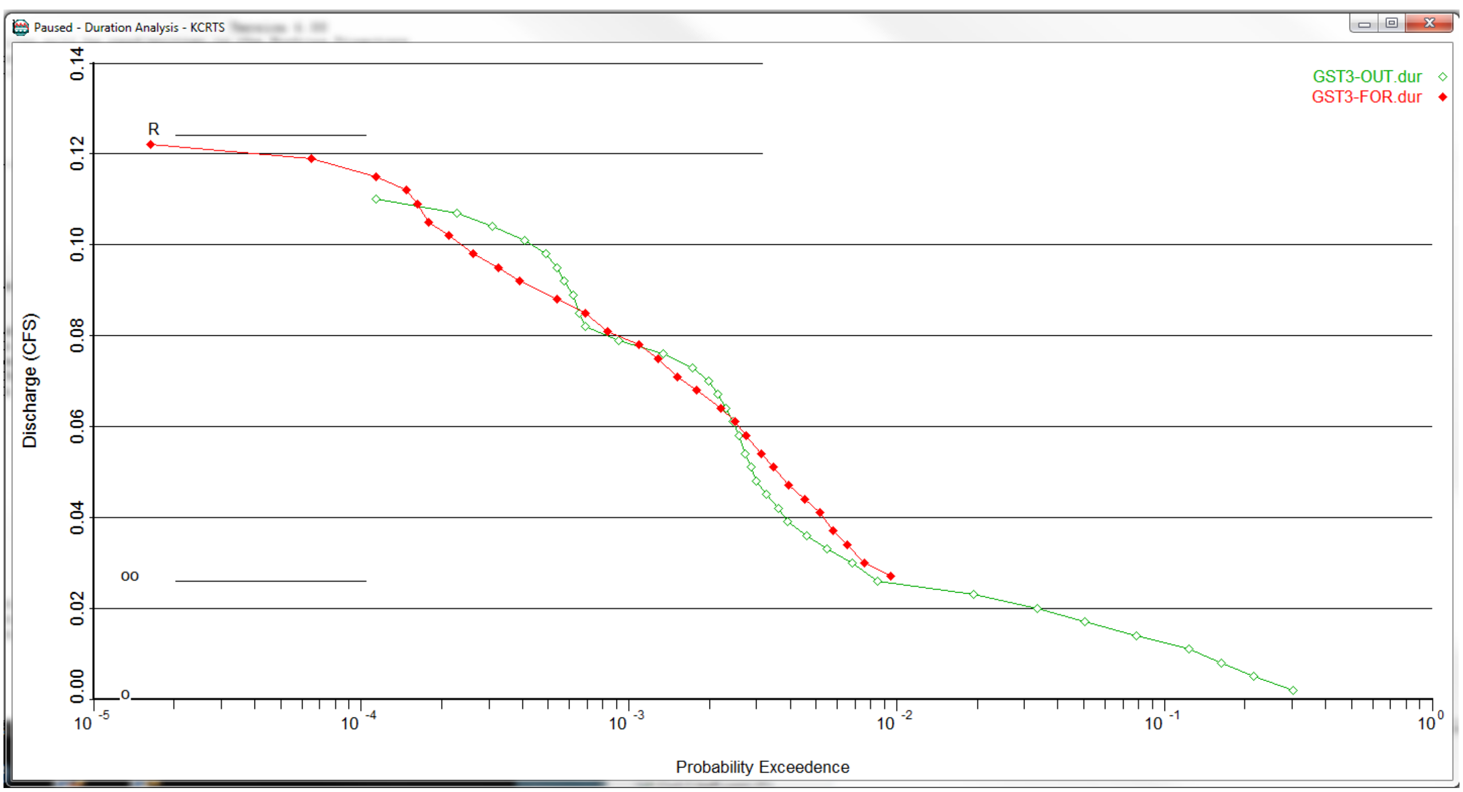
Flow Frequency Analysis
Time Series File:gst3-for.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.124	2	2/09/01 18:00	0.158	1	100.00	0.990
0.033	7	1/06/02 3:00	0.124	2	25.00	0.960
0.092	4	2/28/03 3:00	0.095	3	10.00	0.900
0.004	8	3/24/04 20:00	0.092	4	5.00	0.800
0.054	6	1/05/05 8:00	0.080	5	3.00	0.667
0.095	3	1/18/06 21:00	0.054	6	2.00	0.500
0.080	5	11/24/06 4:00	0.033	7	1.30	0.231
0.158	1	1/09/08 9:00	0.004	8	1.10	0.091
Computed Peaks			0.146		50.00	0.980

Flow Frequency Analysis
Time Series File:gst3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.111	2	2/10/01	3:00	0.186	3.01	1	100.00	0.990
0.023	7	12/30/01	3:00	0.111	2.83	2	25.00	0.960
0.080	3	3/07/03	5:00	0.080	2.49	3	10.00	0.900
0.011	8	3/03/04	21:00	0.080	2.49	4	5.00	0.800
0.035	6	1/07/05	1:00	0.074	2.44	5	3.00	0.667
0.074	5	1/19/06	13:00	0.035	2.31	6	2.00	0.500
0.080	4	11/24/06	20:00	0.023	1.75	7	1.30	0.231
0.186	1	1/09/08	10:00	0.011	0.38	8	1.10	0.091
Computed Peaks				0.161	3.01		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
GST3-OUT.pks in Sea-Tac
GST3-FOR.pks
R
oo
Discharge (CFS)
Cumulative Probability
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99


Paused - Duration Analysis - KCRTS
GST3-OUT.dur
GST3-FOR.dur
R
oo
o
Discharge (CFS)
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Probability Exceedence

NORTH EXTENSION TO SOUTH PARKING LOT DEVELOPED BACK TO FORESTED

(NESPL1)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
	X		6,281	0.144

See Figures B-11 and B-12

NORTH EXTENSION TO SOUTH PARKING LOT
DEVELOPED BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	40.00	ft
Pond Bottom Width:	45.00	ft
Pond Bottom Area:	1800.	sq. ft
Top Area at 1 ft. FB:	4026.	sq. ft
	0.092	acres
Effective Storage Depth:	2.50	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	6281.	cu. ft
	0.144	ac-ft
Riser Head:	2.50	ft
Riser Diameter:	12.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.40	0.007	
2	2.25	1.50	0.031	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	1800.
0.01	100.01	18.	0.000	0.000	0.00	1805.
0.02	100.02	36.	0.001	0.001	0.00	1810.
0.03	100.03	54.	0.001	0.001	0.00	1815.
0.13	100.13	238.	0.005	0.002	0.00	1867.
0.23	100.23	428.	0.010	0.002	0.00	1919.
0.33	100.33	622.	0.014	0.003	0.00	1972.
0.43	100.43	822.	0.019	0.003	0.00	2026.
0.53	100.53	1027.	0.024	0.003	0.00	2080.
0.63	100.63	1238.	0.028	0.003	0.00	2136.
0.73	100.73	1455.	0.033	0.004	0.00	2191.

0.83	100.83	1677.	0.038	0.004	0.00	2248.
0.93	100.93	1904.	0.044	0.004	0.00	2305.
1.03	101.03	2138.	0.049	0.004	0.00	2363.
1.13	101.13	2377.	0.055	0.005	0.00	2422.
1.23	101.23	2622.	0.060	0.005	0.00	2482.
1.33	101.33	2873.	0.066	0.005	0.00	2542.
1.43	101.43	3131.	0.072	0.005	0.00	2603.
1.53	101.53	3394.	0.078	0.005	0.00	2665.
1.63	101.63	3664.	0.084	0.006	0.00	2727.
1.73	101.73	3939.	0.090	0.006	0.00	2790.
1.83	101.83	4222.	0.097	0.006	0.00	2854.
1.93	101.93	4510.	0.104	0.006	0.00	2918.
2.03	102.03	4805.	0.110	0.006	0.00	2984.
2.13	102.13	5107.	0.117	0.006	0.00	3050.
2.23	102.23	5415.	0.124	0.006	0.00	3116.
2.25	102.25	5478.	0.126	0.007	0.00	3130.
2.27	102.27	5540.	0.127	0.007	0.00	3143.
2.28	102.28	5572.	0.128	0.008	0.00	3150.
2.30	102.30	5635.	0.129	0.011	0.00	3163.
2.31	102.31	5667.	0.130	0.014	0.00	3170.
2.33	102.33	5730.	0.132	0.018	0.00	3184.
2.34	102.34	5762.	0.132	0.023	0.00	3191.
2.36	102.36	5826.	0.134	0.027	0.00	3204.
2.38	102.38	5890.	0.135	0.028	0.00	3218.
2.47	102.47	6183.	0.142	0.036	0.00	3279.
2.50	102.50	6281.	0.144	0.037	0.00	3300.
2.60	102.60	6615.	0.152	0.351	0.00	3369.

2.70	102.70	6955.	0.160	0.919	0.00	3439.
2.80	102.80	7303.	0.168	1.650	0.00	3510.
2.90	102.90	7657.	0.176	2.450	0.00	3582.
3.00	103.00	8019.	0.184	2.730	0.00	3654.
3.10	103.10	8388.	0.193	2.990	0.00	3727.
3.20	103.20	8764.	0.201	3.230	0.00	3801.
3.30	103.30	9148.	0.210	3.450	0.00	3875.
3.40	103.40	9539.	0.219	3.660	0.00	3950.
3.50	103.50	9938.	0.228	3.860	0.00	4026.
3.60	103.60	10345.	0.237	4.050	0.00	4103.
3.70	103.70	10759.	0.247	4.220	0.00	4180.
3.80	103.80	11181.	0.257	4.400	0.00	4258.
3.90	103.90	11610.	0.267	4.560	0.00	4337.
4.00	104.00	12048.	0.277	4.720	0.00	4416.
4.10	104.10	12494.	0.287	4.880	0.00	4496.
4.20	104.20	12947.	0.297	5.030	0.00	4577.
4.30	104.30	13409.	0.308	5.170	0.00	4659.
4.40	104.40	13879.	0.319	5.310	0.00	4741.
4.50	104.50	14357.	0.330	5.450	0.00	4824.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.15	*******	0.02	2.34	102.34	5747.	0.132
2	0.08	0.02	0.01	2.28	102.28	5563.	0.128
3	0.08	*******	0.01	2.06	102.06	4906.	0.113
4	0.08	*******	0.01	1.69	101.69	3820.	0.088
5	0.09	*******	0.01	2.08	102.08	4955.	0.114
6	0.05	*******	0.00	1.36	101.36	2940.	0.068
7	0.08	*******	0.00	1.17	101.17	2463.	0.057
8	0.07	*******	0.00	1.27	101.27	2720.	0.062

Route Time Series through Facility
  Inflow Time Series File:nespl1-dev.tsf
 Outflow Time Series File:NESPL1-OUT

Inflow/Outflow Analysis

Peak Inflow Discharge:	0.152 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge:	0.021 CFS at 13:00 on Jan 9 in Year 8
Peak Reservoir Stage:	2.34 Ft
Peak Reservoir Elev:	102.34 Ft
Peak Reservoir Storage:	5747. Cu-Ft
:	0.132 Ac-Ft

Flow Frequency Analysis

Time Series File:nespl1-out.tsf

Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.010	2	2/09/01 21:00	0.021	2.34	1	100.00	0.990
0.005	7	1/07/02 3:00	0.010	2.29	2	25.00	0.960
0.006	3	3/06/03 23:00	0.006	2.08	3	10.00	0.900
0.005	8	8/26/04 7:00	0.006	2.06	4	5.00	0.800
0.005	6	1/05/05 16:00	0.006	1.69	5	3.00	0.667
0.006	5	1/19/06 0:00	0.005	1.36	6	2.00	0.500
0.006	4	11/24/06 9:00	0.005	1.29	7	1.30	0.231
0.021	1	1/09/08 13:00	0.005	1.17	8	1.10	0.091
Computed Peaks			0.017	2.33		50.00	0.980

Flow Duration from Time Series File:nespl1-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.000	76	0.124	0.124	99.876	0.999E+00
0.000	30131	49.137	49.261	50.739	0.507E+00
0.001	2603	4.245	53.506	46.494	0.465E+00
0.001	437	0.713	54.219	45.781	0.458E+00
0.001	2999	4.891	59.110	40.890	0.409E+00
0.001	2209	3.602	62.712	37.288	0.373E+00
0.002	1693	2.761	65.473	34.527	0.345E+00
0.002	1317	2.148	67.621	32.379	0.324E+00
0.002	5622	9.168	76.789	23.211	0.232E+00
0.002	870	1.419	78.208	21.792	0.218E+00
0.003	809	1.319	79.527	20.473	0.205E+00
0.003	778	1.269	80.796	19.204	0.192E+00
0.003	6517	10.628	91.424	8.576	0.858E-01
0.003	256	0.417	91.841	8.159	0.816E-01
0.004	226	0.369	92.210	7.790	0.779E-01
0.004	219	0.357	92.567	7.433	0.743E-01
0.004	2301	3.752	96.319	3.681	0.368E-01
0.005	202	0.329	96.649	3.351	0.335E-01
0.005	168	0.274	96.923	3.077	0.308E-01
0.005	1296	2.114	99.036	0.964	0.964E-02
0.005	49	0.080	99.116	0.884	0.884E-02
0.006	57	0.093	99.209	0.791	0.791E-02
0.006	34	0.055	99.265	0.735	0.735E-02
0.006	426	0.695	99.959	0.041	0.408E-03
0.006	2	0.003	99.962	0.038	0.375E-03

0.007	1	0.002	99.964	0.036	0.359E-03
0.007	1	0.002	99.966	0.034	0.342E-03
0.007	9	0.015	99.980	0.020	0.196E-03
0.007	1	0.002	99.982	0.018	0.179E-03
0.008	1	0.002	99.984	0.016	0.163E-03
0.008	1	0.002	99.985	0.015	0.147E-03
0.008	0	0.000	99.985	0.015	0.147E-03
0.008	1	0.002	99.987	0.013	0.130E-03
0.009	1	0.002	99.989	0.011	0.114E-03
0.009	1	0.002	99.990	0.010	0.978E-04
0.009	0	0.000	99.990	0.010	0.978E-04

Duration Comparison Anaylsis
Base File: nespl1-for.tsf
New File: nespl1-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.004	0.87E-02	0.34E-01	287.6	0.87E-02	0.004	0.005	18.4
0.006	0.64E-02	0.75E-02	16.6	0.64E-02	0.006	0.006	4.7
0.007	0.49E-02	0.33E-03	-93.3	0.49E-02	0.007	0.006	-13.6
0.008	0.36E-02	0.15E-03	-95.9	0.36E-02	0.008	0.006	-26.5
0.009	0.27E-02	0.65E-04	-97.6	0.27E-02	0.009	0.006	-36.1
0.011	0.21E-02	0.00E+00	-100.0	0.21E-02	0.011	0.006	-43.4
0.012	0.14E-02	0.00E+00	-100.0	0.14E-02	0.012	0.006	-49.2
0.013	0.98E-03	0.00E+00	-100.0	0.98E-03	0.013	0.006	-54.0
0.014	0.59E-03	0.00E+00	-100.0	0.59E-03	0.014	0.006	-57.9
0.016	0.31E-03	0.00E+00	-100.0	0.31E-03	0.016	0.007	-55.1
0.017	0.20E-03	0.00E+00	-100.0	0.20E-03	0.017	0.007	-57.9
0.018	0.15E-03	0.00E+00	-100.0	0.15E-03	0.018	0.008	-54.4
0.019	0.82E-04	0.00E+00	-100.0	0.82E-04	0.019	0.009	-51.7
0.020	0.16E-04	0.00E+00	-100.0	0.16E-04	0.020	0.010	-50.7

Maximum positive excursion = 0.001 cfs (18.4%)
occurring at 0.004 cfs on the Base Data:nespl1-for.tsf
and at 0.005 cfs on the New Data:nespl1-out.tsf

Maximum negative excursion = 0.009 cfs (-59.8%)
occurring at 0.015 cfs on the Base Data:nespl1-for.tsf
and at 0.006 cfs on the New Data:nespl1-out.tsf

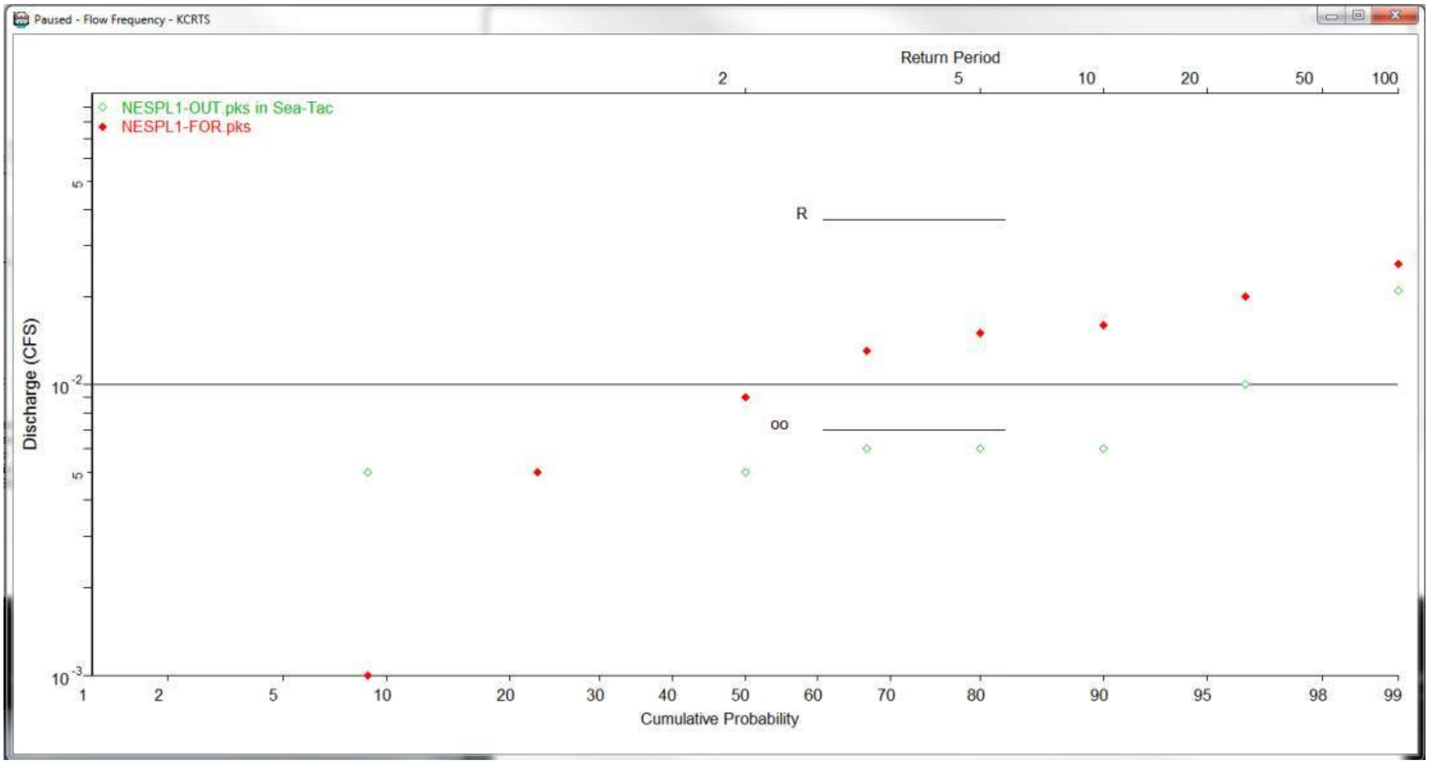
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.32       0.00       0.000000  Impervious
NESPL1-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.32       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
NESPL1-FOR.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
nespl1-for.tsf
NESPL1-FOR.pks
[P] Compute PEAKS and Flow Frequencies
nespl1-dev.tsf
NESPL1-DEV.pks
[D] Compute Flow DURATION and Exceedence
nespl1-dev.tsf
NESPL1-DEV.dur
 F
 F
          36
   0.290000E-02
   0.400000E-01
[D] Compute Flow DURATION and Exceedence
nespl1-for.tsf
NESPL1-FOR.dur
 F
 F
          36
   0.560000E-03
   0.450000E-02
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

Flow Frequency Analysis
Time Series File:nespl1-for.tsf
Project Location:Sea-Tac

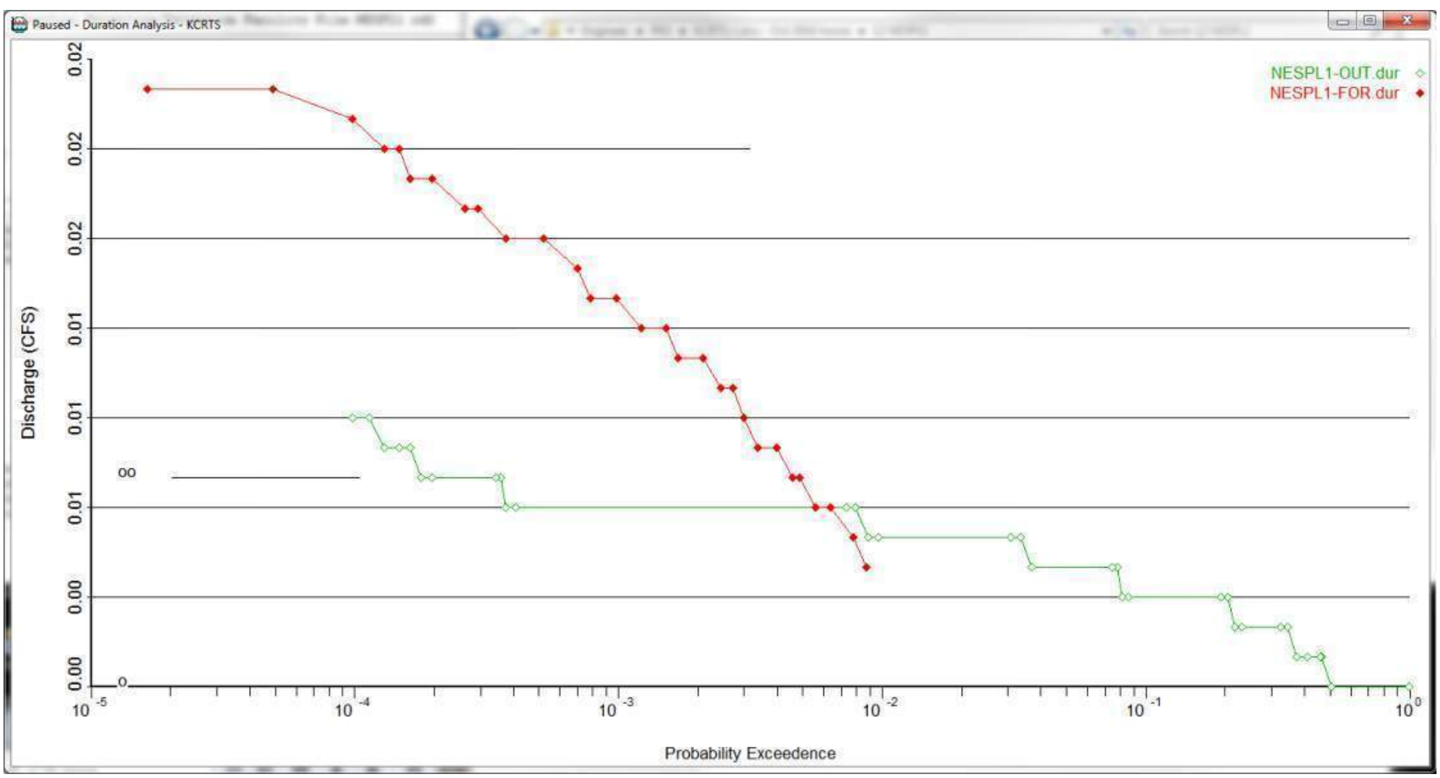
---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.020	2	2/09/01 18:00	0.026	1	100.00	0.990
0.005	7	1/05/02 16:00	0.020	2	25.00	0.960
0.015	4	2/28/03 3:00	0.016	3	10.00	0.900
0.001	8	3/24/04 20:00	0.015	4	5.00	0.800
0.009	6	1/05/05 8:00	0.013	5	3.00	0.667
0.016	3	1/18/06 21:00	0.009	6	2.00	0.500
0.013	5	11/24/06 5:00	0.005	7	1.30	0.231
0.026	1	1/09/08 9:00	0.001	8	1.10	0.091
Computed Peaks			0.024		50.00	0.980

Flow Frequency Analysis
Time Series File:nespl1-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.010	2	2/09/01 21:00	0.021	2.34	1	100.00	0.990
0.005	7	1/07/02 3:00	0.010	2.29	2	25.00	0.960
0.006	3	3/06/03 23:00	0.006	2.08	3	10.00	0.900
0.005	8	8/26/04 7:00	0.006	2.06	4	5.00	0.800
0.005	6	1/05/05 16:00	0.006	1.69	5	3.00	0.667
0.006	5	1/19/06 0:00	0.005	1.36	6	2.00	0.500
0.006	4	11/24/06 9:00	0.005	1.29	7	1.30	0.231
0.021	1	1/09/08 13:00	0.005	1.17	8	1.10	0.091
Computed Peaks			0.017	2.33		50.00	0.980



Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
NESPL1-OUT.pks in Sea-Tac
NESPL1-FOR.pks
Discharge (CFS)
10 -2
10 -3
R
oo
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
Cumulative Probability



Paused - Duration Analysis - KCRTS
NESPL1-OUT.dur
NESPL1-FOR.dur
Discharge (CFS)
0.02
0.02
0.02
0.01
0.01
0.01
0.00
0.00
oo
o
10 -5
10 -4
10 -3
10 -2
10 -1
10 0
Probability Exceedence

BUILDING 16 REPLACEMENT

DEVELOPED BACK TO FORESTED

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
	X		13,832	0.318

See Figures B-15 and B-16

BUILDING 16 REPLACEMENT
DEVELOPED BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond
Side Slope:	3.00 H:1V
Pond Bottom Length:	50.00 ft
Pond Bottom Width:	43.00 ft
Pond Bottom Area:	2150. sq. ft
Top Area at 1 ft. FB:	5840. sq. ft
	0.134 acres
Effective Storage Depth:	4.00 ft
Stage 0 Elevation:	100.00 ft
Storage Volume:	13832. cu. ft
	0.318 ac-ft
Riser Head:	4.00 ft
Riser Diameter:	12.00 inches
Number of orifices:	2

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.45	0.011	
2	3.00	1.11	0.033	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	(ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	2150.
0.01	100.01	22.	0.000	0.001	0.00	2156.
0.02	100.02	43.	0.001	0.001	0.00	2161.
0.03	100.03	65.	0.001	0.001	0.00	2167.
0.04	100.04	86.	0.002	0.001	0.00	2172.
0.14	100.14	307.	0.007	0.002	0.00	2229.
0.24	100.24	532.	0.012	0.003	0.00	2286.
0.34	100.34	764.	0.018	0.003	0.00	2344.
0.44	100.44	1001.	0.023	0.004	0.00	2402.
0.54	100.54	1244.	0.029	0.004	0.00	2462.
0.64	100.64	1493.	0.034	0.004	0.00	2522.

0.74	100.74	1749.	0.040	0.005	0.00	2583.
0.84	100.84	2010.	0.046	0.005	0.00	2644.
0.94	100.94	2278.	0.052	0.005	0.00	2706.
1.04	101.04	2551.	0.059	0.006	0.00	2769.
1.14	101.14	2831.	0.065	0.006	0.00	2833.
1.24	101.24	3118.	0.072	0.006	0.00	2897.
1.34	101.34	3411.	0.078	0.006	0.00	2962.
1.44	101.44	3710.	0.085	0.007	0.00	3028.
1.54	101.54	4017.	0.092	0.007	0.00	3095.
1.64	101.64	4329.	0.099	0.007	0.00	3162.
1.74	101.74	4649.	0.107	0.007	0.00	3230.
1.84	101.84	4975.	0.114	0.007	0.00	3299.
1.94	101.94	5309.	0.122	0.008	0.00	3368.
2.04	102.04	5649.	0.130	0.008	0.00	3438.
2.14	102.14	5996.	0.138	0.008	0.00	3509.
2.24	102.24	6351.	0.146	0.008	0.00	3581.
2.34	102.34	6712.	0.154	0.008	0.00	3653.
2.44	102.44	7081.	0.163	0.009	0.00	3726.
2.54	102.54	7458.	0.171	0.009	0.00	3800.
2.64	102.64	7841.	0.180	0.009	0.00	3874.
2.74	102.74	8233.	0.189	0.009	0.00	3949.
2.84	102.84	8631.	0.198	0.009	0.00	4025.
2.94	102.94	9038.	0.207	0.009	0.00	4102.
3.00	103.00	9285.	0.213	0.010	0.00	4148.
3.01	103.01	9327.	0.214	0.010	0.00	4156.
3.02	103.02	9368.	0.215	0.011	0.00	4163.
3.03	103.03	9410.	0.216	0.012	0.00	4171.

3.05	103.05	9493.	0.218	0.014	0.00	4187.
3.06	103.06	9535.	0.219	0.016	0.00	4195.
3.07	103.07	9577.	0.220	0.018	0.00	4202.
3.08	103.08	9619.	0.221	0.019	0.00	4210.
3.09	103.09	9662.	0.222	0.020	0.00	4218.
3.10	103.10	9704.	0.223	0.020	0.00	4226.
3.20	103.20	10130.	0.233	0.025	0.00	4304.
3.30	103.30	10565.	0.243	0.028	0.00	4383.
3.40	103.40	11007.	0.253	0.031	0.00	4463.
3.50	103.50	11457.	0.263	0.034	0.00	4544.
3.60	103.60	11916.	0.274	0.036	0.00	4625.
3.70	103.70	12382.	0.284	0.038	0.00	4707.
3.80	103.80	12857.	0.295	0.040	0.00	4790.
3.90	103.90	13340.	0.306	0.042	0.00	4874.
4.00	104.00	13832.	0.318	0.044	0.00	4958.
4.10	104.10	14332.	0.329	0.354	0.00	5043.
4.20	104.20	14841.	0.341	0.919	0.00	5129.
4.30	104.30	15358.	0.353	1.650	0.00	5215.
4.40	104.40	15884.	0.365	2.440	0.00	5302.
4.50	104.50	16418.	0.377	2.730	0.00	5390.
4.60	104.60	16962.	0.389	2.980	0.00	5479.
4.70	104.70	17514.	0.402	3.220	0.00	5568.
4.80	104.80	18075.	0.415	3.440	0.00	5658.
4.90	104.90	18646.	0.428	3.650	0.00	5749.
5.00	105.00	19225.	0.441	3.840	0.00	5840.
5.10	105.10	19814.	0.455	4.030	0.00	5932.
5.20	105.20	20411.	0.469	4.200	0.00	6025.

5.30	105.30	21019.	0.483	4.380	0.00	6119.
5.40	105.40	21635.	0.497	4.540	0.00	6213.
5.50	105.50	22261.	0.511	4.700	0.00	6308.
5.60	105.60	22897.	0.526	4.850	0.00	6404.
5.70	105.70	23542.	0.540	5.000	0.00	6500.
5.80	105.80	24197.	0.555	5.140	0.00	6597.
5.90	105.90	24862.	0.571	5.280	0.00	6695.
6.00	106.00	25536.	0.586	5.420	0.00	6794.

Hyd	Inflow	Outflow		Peak		Storage	
		Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.32	*******	0.04	3.80	103.80	12870.	0.295
2	0.16	0.05	0.04	3.76	103.76	12681.	0.291
3	0.24	*******	0.03	3.33	103.33	10705.	0.246
4	0.20	*******	0.04	3.62	103.62	11998.	0.275
5	0.18	*******	0.01	2.80	102.80	8486.	0.195
6	0.12	*******	0.01	2.58	102.58	7621.	0.175
7	0.14	*******	0.01	2.68	102.68	8002.	0.184
8	0.16	*******	0.01	1.93	101.93	5281.	0.121

Route Time Series through Facility
Inflow Time Series File:b161-dev.tsf
Outflow Time Series File:B161-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.324 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.040 CFS at 15:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.80 Ft
Peak Reservoir Elev: 103.80 Ft
Peak Reservoir Storage: 12870. Cu-Ft
: 0.295 Ac-Ft

Flow Frequency Analysis
Time Series File:b161-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate	Rank	Time of Peak	- - Peaks	- -	Rank	Return	Prob
(CFS)			(CFS)	(ft)		Period	
0.040	2	2/09/01 20:00	0.040	3.80	1	100.00	0.990
0.009	6	1/07/02 4:00	0.040	3.79	2	25.00	0.960
0.036	3	3/06/03 22:00	0.036	3.62	3	10.00	0.900
0.008	8	8/26/04 8:00	0.029	3.33	4	5.00	0.800
0.009	7	1/08/05 5:00	0.009	2.80	5	3.00	0.667
0.009	5	1/19/06 2:00	0.009	2.68	6	2.00	0.500

0.029	4	11/24/06 8:00	0.009	2.59	7	1.30	0.231
0.040	1	1/09/08 15:00	0.008	1.93	8	1.10	0.091
Computed Peaks			0.040	3.80		50.00	0.980

Flow Duration from Time Series File:b161-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.001	24813	40.465	40.465	59.535	0.595E+00
0.002	7228	11.787	52.252	47.748	0.477E+00
0.003	3955	6.450	58.702	41.298	0.413E+00
0.004	5532	9.022	67.723	32.277	0.323E+00
0.005	9015	14.702	82.425	17.575	0.176E+00
0.006	3915	6.385	88.810	11.190	0.112E+00
0.007	2932	4.781	93.591	6.409	0.641E-01
0.008	2333	3.805	97.396	2.604	0.260E-01
0.009	1289	2.102	99.498	0.502	0.502E-02
0.010	84	0.137	99.635	0.365	0.365E-02
0.012	14	0.023	99.658	0.342	0.342E-02
0.013	11	0.018	99.675	0.325	0.325E-02
0.014	13	0.021	99.697	0.303	0.303E-02
0.015	11	0.018	99.715	0.285	0.285E-02
0.016	8	0.013	99.728	0.272	0.272E-02
0.017	5	0.008	99.736	0.264	0.264E-02
0.018	4	0.007	99.742	0.258	0.258E-02
0.019	9	0.015	99.757	0.243	0.243E-02
0.020	18	0.029	99.786	0.214	0.214E-02
0.021	12	0.020	99.806	0.194	0.194E-02
0.022	8	0.013	99.819	0.181	0.181E-02
0.024	4	0.007	99.826	0.174	0.174E-02
0.025	5	0.008	99.834	0.166	0.166E-02
0.026	9	0.015	99.848	0.152	0.152E-02
0.027	9	0.015	99.863	0.137	0.137E-02
0.028	10	0.016	99.879	0.121	0.121E-02
0.029	10	0.016	99.896	0.104	0.104E-02
0.030	3	0.005	99.901	0.099	0.995E-03
0.031	9	0.015	99.915	0.085	0.848E-03
0.032	6	0.010	99.925	0.075	0.750E-03
0.033	8	0.013	99.938	0.062	0.620E-03
0.034	9	0.015	99.953	0.047	0.473E-03
0.036	7	0.011	99.964	0.036	0.359E-03
0.037	9	0.015	99.979	0.021	0.212E-03
0.038	4	0.007	99.985	0.015	0.147E-03
0.039	4	0.007	99.992	0.008	0.815E-04

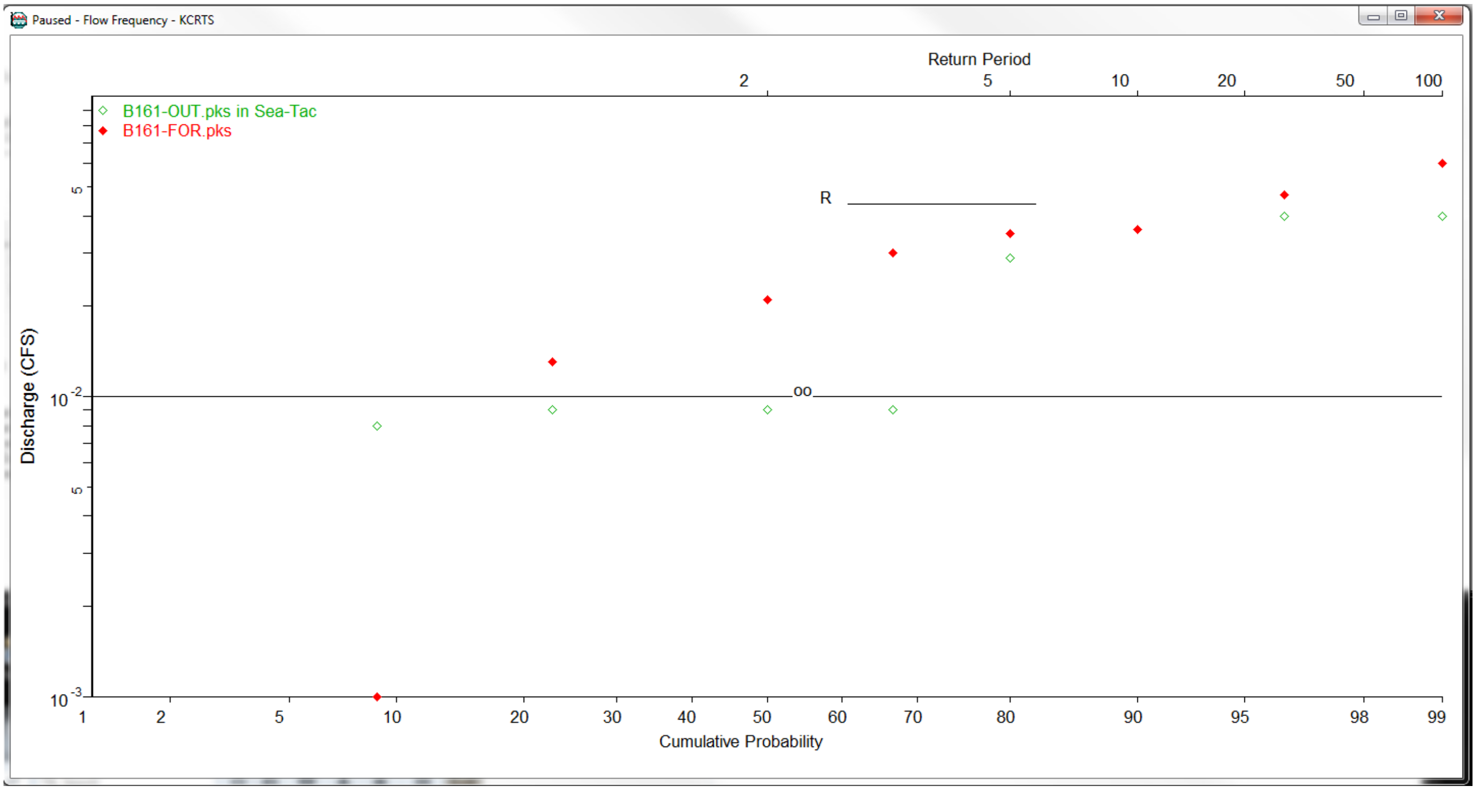
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.10       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.64       0.00       0.000000  Impervious
B161-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.74       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
B161-FOR.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
b161-for.tsf
B161-FOR.pks
[P] Compute PEAKS and Flow Frequencies
b161-dev.tsf
B161-DEV.pks
[D] Compute Flow DURATION and Exceedence
b161-dev.tsf
B161-DEV.dur
 F
 F
          36
   0.600000E-02
   0.820000E-01
[D] Compute Flow DURATION and Exceedence
b161-for.tsf
B161-FOR.dur
 F
 F
          36
   0.130000E-02
   0.105000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

Flow Frequency Analysis
Time Series File:b161-for.tsf
Project Location:Sea-Tac

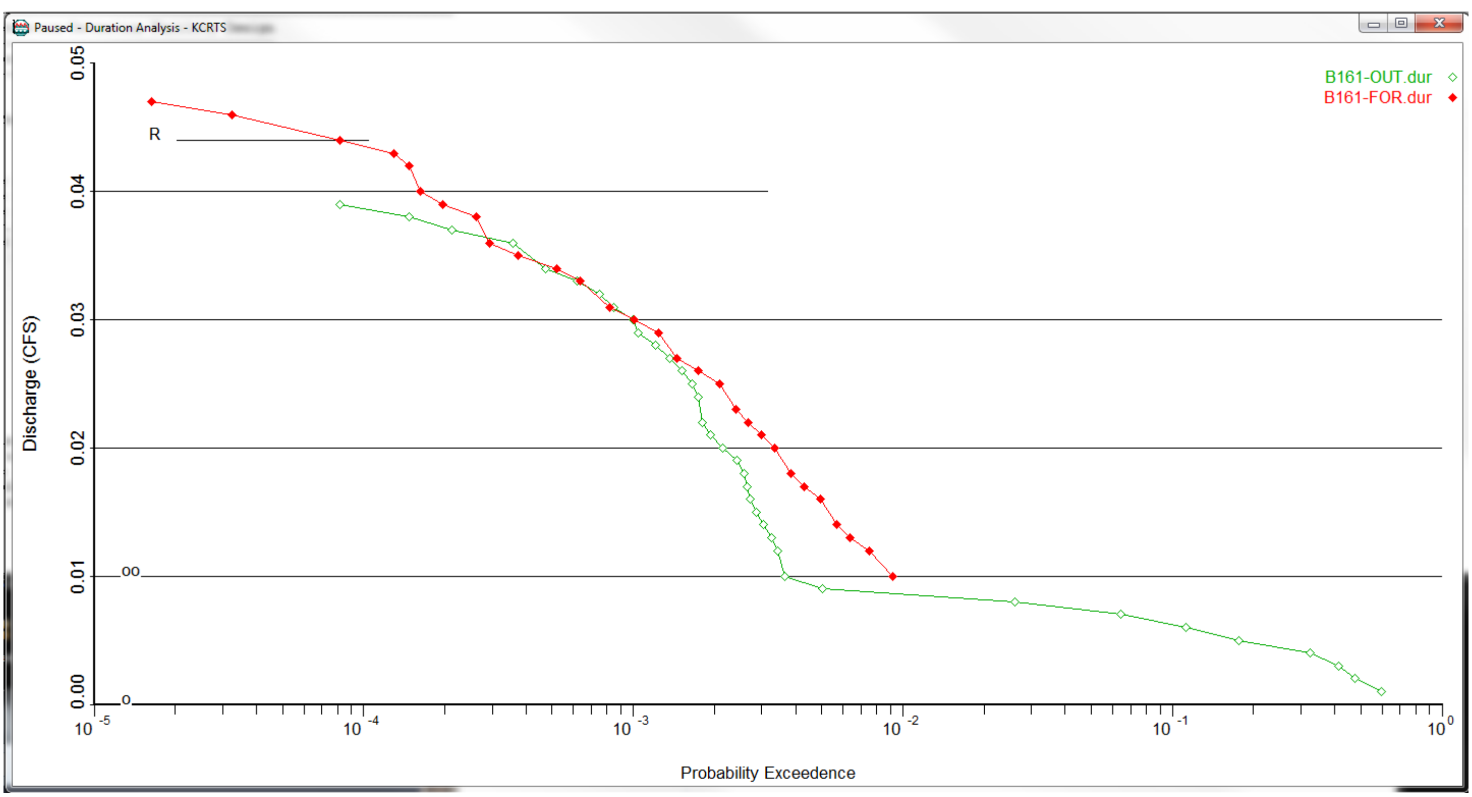
---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
0.047	2	2/09/01 18:00	0.060	1	100.00	0.990
0.013	7	1/06/02 4:00	0.047	2	25.00	0.960
0.035	4	2/28/03 3:00	0.036	3	10.00	0.900
0.001	8	3/24/04 20:00	0.035	4	5.00	0.800
0.021	6	1/05/05 8:00	0.030	5	3.00	0.667
0.036	3	1/18/06 21:00	0.021	6	2.00	0.500
0.030	5	11/24/06 4:00	0.013	7	1.30	0.231
0.060	1	1/09/08 9:00	0.001	8	1.10	0.091
Computed Peaks			0.056		50.00	0.980

Flow Frequency Analysis
Time Series File:b161-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.040	2	2/09/01 20:00	0.040	3.80	1	100.00	0.990
0.009	6	1/07/02 4:00	0.040	3.79	2	25.00	0.960
0.036	3	3/06/03 22:00	0.036	3.62	3	10.00	0.900
0.008	8	8/26/04 8:00	0.029	3.33	4	5.00	0.800
0.009	7	1/08/05 5:00	0.009	2.80	5	3.00	0.667
0.009	5	1/19/06 2:00	0.009	2.68	6	2.00	0.500
0.029	4	11/24/06 8:00	0.009	2.59	7	1.30	0.231
0.040	1	1/09/08 15:00	0.008	1.93	8	1.10	0.091
Computed Peaks			0.040	3.80		50.00	0.980



Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
B161-OUT.pks in Sea-Tac
B161-FOR.pks
R
oo
Discharge (CFS)
10 -2
10 -3
5
5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
Cumulative Probability



Paused - Duration Analysis - KCRTS
B161-OUT.dur
B161-FOR.dur
R
oo
o
Discharge (CFS)
0.05
0.04
0.03
0.02
0.01
0.00
10 -5
10 -4
10 -3
10 -2
10 -1
10 0
Probability Exceedence

EAST CAMPUS PEDESTRIAN IMPROVEMENTS
DEVELOPED BACK TO EXISTING
(EPED2)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
X			2,691	0.062

See Figures B-17 and B-18

EAST CAMPUS PEDESTRIAN IMPROVEMENTS
DEVELOPED BACK TO EXISTING

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	21.00	ft
Pond Bottom Width:	20.00	ft
Pond Bottom Area:	420.	sq. ft
Top Area at 1 ft. FB:	1980.	sq. ft
	0.045	acres
Effective Storage Depth:	3.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	2691.	cu. ft
	0.062	ac-ft
Riser Head:	3.00	ft
Riser Diameter:	12.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	1.30	0.079	
2	2.25	1.73	0.070	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	420.
0.01	100.01	4.	0.000	0.005	0.00	422.
0.03	100.03	13.	0.000	0.008	0.00	427.
0.04	100.04	17.	0.000	0.009	0.00	430.
0.05	100.05	21.	0.000	0.011	0.00	432.
0.07	100.07	30.	0.001	0.012	0.00	437.
0.08	100.08	34.	0.001	0.013	0.00	440.
0.09	100.09	39.	0.001	0.014	0.00	442.
0.11	100.11	48.	0.001	0.015	0.00	447.
0.21	100.21	94.	0.002	0.021	0.00	473.
0.31	100.31	142.	0.003	0.025	0.00	500.

0.41	100.41	194.	0.004	0.029	0.00	527.
0.51	100.51	248.	0.006	0.033	0.00	555.
0.61	100.61	305.	0.007	0.036	0.00	583.
0.71	100.71	365.	0.008	0.039	0.00	613.
0.81	100.81	427.	0.010	0.041	0.00	643.
0.91	100.91	493.	0.011	0.044	0.00	674.
1.01	101.01	562.	0.013	0.046	0.00	705.
1.11	101.11	634.	0.015	0.048	0.00	737.
1.21	101.21	710.	0.016	0.050	0.00	770.
1.31	101.31	788.	0.018	0.052	0.00	804.
1.41	101.41	870.	0.020	0.054	0.00	838.
1.51	101.51	956.	0.022	0.056	0.00	874.
1.61	101.61	1045.	0.024	0.058	0.00	909.
1.71	101.71	1138.	0.026	0.060	0.00	946.
1.81	101.81	1234.	0.028	0.062	0.00	983.
1.91	101.91	1335.	0.031	0.063	0.00	1021.
2.01	102.01	1439.	0.033	0.065	0.00	1060.
2.11	102.11	1547.	0.036	0.067	0.00	1099.
2.21	102.21	1659.	0.038	0.068	0.00	1139.
2.25	102.25	1704.	0.039	0.069	0.00	1156.
2.27	102.27	1728.	0.040	0.070	0.00	1164.
2.29	102.29	1751.	0.040	0.072	0.00	1172.
2.30	102.30	1763.	0.040	0.075	0.00	1176.
2.32	102.32	1786.	0.041	0.080	0.00	1184.
2.34	102.34	1810.	0.042	0.085	0.00	1193.
2.36	102.36	1834.	0.042	0.092	0.00	1201.
2.38	102.38	1858.	0.043	0.099	0.00	1209.

2.39	102.39	1870.	0.043	0.102	0.00	1214.
2.49	102.49	1994.	0.046	0.112	0.00	1256.
2.59	102.59	2121.	0.049	0.121	0.00	1299.
2.69	102.69	2253.	0.052	0.129	0.00	1342.
2.79	102.79	2390.	0.055	0.136	0.00	1387.
2.89	102.89	2531.	0.058	0.143	0.00	1432.
2.99	102.99	2676.	0.061	0.149	0.00	1477.
3.00	103.00	2691.	0.062	0.149	0.00	1482.
3.10	103.10	2842.	0.065	0.463	0.00	1529.
3.20	103.20	2997.	0.069	1.030	0.00	1576.
3.30	103.30	3157.	0.072	1.770	0.00	1624.
3.40	103.40	3322.	0.076	2.560	0.00	1673.
3.50	103.50	3491.	0.080	2.850	0.00	1722.
3.60	103.60	3666.	0.084	3.110	0.00	1772.
3.70	103.70	3846.	0.088	3.350	0.00	1823.
3.80	103.80	4031.	0.093	3.570	0.00	1875.
3.90	103.90	4221.	0.097	3.780	0.00	1927.
4.00	104.00	4416.	0.101	3.980	0.00	1980.
4.10	104.10	4617.	0.106	4.170	0.00	2034.
4.20	104.20	4823.	0.111	4.350	0.00	2088.
4.30	104.30	5034.	0.116	4.520	0.00	2143.
4.40	104.40	5252.	0.121	4.690	0.00	2199.
4.50	104.50	5474.	0.126	4.850	0.00	2256.
4.60	104.60	5703.	0.131	5.010	0.00	2313.
4.70	104.70	5937.	0.136	5.160	0.00	2371.
4.80	104.80	6177.	0.142	5.300	0.00	2430.
4.90	104.90	6423.	0.147	5.450	0.00	2490.

5.00 105.00 6675. 0.153 5.590 0.00
2550.

Hyd	Inflow	Outflow Target	Calc	Peak Stage	Elev	Storage (Cu-Ft)	(Ac-Ft)
1	0.34	*******	0.31	3.05	103.05	2769.	0.064
2	0.19	0.15	0.14	2.81	102.81	2416.	0.055
3	0.19	*******	0.14	2.84	102.84	2457.	0.056
4	0.21	*******	0.13	2.66	102.66	2211.	0.051
5	0.18	*******	0.12	2.55	102.55	2077.	0.048
6	0.22	*******	0.10	2.41	102.41	1895.	0.044
7	0.18	*******	0.06	1.79	101.79	1213.	0.028
8	0.16	*******	0.06	1.75	101.75	1179.	0.027

Route Time Series through Facility
Inflow Time Series File:eped2-dev.tsf
Outflow Time Series File:EPED2-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.345 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.312 CFS at 8:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.05 Ft
Peak Reservoir Elev: 103.05 Ft
Peak Reservoir Storage: 2769. Cu-Ft
: 0.064 Ac-Ft

Flow Frequency Analysis
Time Series File:eped2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates--- Flow Rate (CFS)	Rank	Time of Peak	-----Flow Frequency Analysis------- - - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.118	5	2/09/01 7:00	0.312	3.05	1	100.00	0.990
0.061	8	1/05/02 18:00	0.139	2.84	2	25.00	0.960
0.126	4	2/27/03 9:00	0.137	2.81	3	10.00	0.900
0.062	7	8/23/04 21:00	0.126	2.66	4	5.00	0.800
0.104	6	10/28/04 19:00	0.118	2.55	5	3.00	0.667
0.137	3	1/18/06 17:00	0.104	2.41	6	2.00	0.500
0.139	2	11/24/06 5:00	0.062	1.79	7	1.30	0.231
0.312	1	1/09/08 8:00	0.061	1.75	8	1.10	0.091
Computed Peaks			0.254	3.03		50.00	0.980

Flow Duration from Time Series File:eped2-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.002	52339	85.354	85.354	14.646	0.146E+00
0.006	2328	3.796	89.150	10.850	0.108E+00
0.010	1359	2.216	91.367	8.633	0.863E-01
0.014	974	1.588	92.955	7.045	0.705E-01
0.018	888	1.448	94.403	5.597	0.560E-01
0.021	644	1.050	95.453	4.547	0.455E-01
0.025	620	1.011	96.464	3.536	0.354E-01

0.029	456	0.744	97.208	2.792	0.279E-01
0.033	327	0.533	97.741	2.259	0.226E-01
0.037	368	0.600	98.341	1.659	0.166E-01
0.041	258	0.421	98.762	1.238	0.124E-01
0.045	153	0.250	99.012	0.988	0.988E-02
0.049	153	0.250	99.261	0.739	0.739E-02
0.053	118	0.192	99.454	0.546	0.546E-02
0.057	86	0.140	99.594	0.406	0.406E-02
0.060	71	0.116	99.710	0.290	0.290E-02
0.064	73	0.119	99.829	0.171	0.171E-02
0.068	33	0.054	99.883	0.117	0.117E-02
0.072	18	0.029	99.912	0.088	0.881E-03
0.076	0	0.000	99.912	0.088	0.881E-03
0.080	0	0.000	99.912	0.088	0.881E-03
0.084	2	0.003	99.915	0.085	0.848E-03
0.088	6	0.010	99.925	0.075	0.750E-03
0.092	0	0.000	99.925	0.075	0.750E-03
0.095	5	0.008	99.933	0.067	0.669E-03
0.099	2	0.003	99.936	0.064	0.636E-03
0.103	5	0.008	99.945	0.055	0.554E-03
0.107	7	0.011	99.956	0.044	0.440E-03
0.111	6	0.010	99.966	0.034	0.342E-03
0.115	2	0.003	99.969	0.031	0.310E-03
0.119	4	0.007	99.976	0.024	0.245E-03
0.123	2	0.003	99.979	0.021	0.212E-03
0.127	3	0.005	99.984	0.016	0.163E-03
0.131	4	0.007	99.990	0.010	0.978E-04
0.134	1	0.002	99.992	0.008	0.815E-04
0.138	4	0.007	99.998	0.002	0.163E-04

Duration Comparison Anaylsis
Base File: eped2-dev.tsf
New File: eped2-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.063	0.77E-02	0.22E-02	-72.0	0.77E-02	0.063	0.048	-23.0
0.070	0.63E-02	0.98E-03	-84.4	0.63E-02	0.070	0.050	-27.6
0.077	0.50E-02	0.88E-03	-82.2	0.50E-02	0.077	0.054	-29.5
0.084	0.39E-02	0.85E-03	-78.2	0.39E-02	0.084	0.057	-31.7
0.091	0.33E-02	0.75E-03	-77.2	0.33E-02	0.091	0.059	-34.8
0.098	0.27E-02	0.65E-03	-76.0	0.27E-02	0.098	0.061	-37.6
0.105	0.23E-02	0.49E-03	-78.4	0.23E-02	0.105	0.062	-40.3
0.112	0.19E-02	0.34E-03	-81.6	0.19E-02	0.112	0.063	-43.1
0.118	0.15E-02	0.24E-03	-83.5	0.15E-02	0.118	0.066	-44.1
0.125	0.12E-02	0.20E-03	-83.3	0.12E-02	0.125	0.068	-45.7
0.132	0.82E-03	0.82E-04	-90.0	0.82E-03	0.132	0.087	-34.5
0.139	0.64E-03	0.00E+00	-100.0	0.64E-03	0.139	0.100	-28.1
0.146	0.52E-03	0.00E+00	-100.0	0.52E-03	0.146	0.104	-29.2
0.153	0.44E-03	0.00E+00	-100.0	0.44E-03	0.153	0.108	-29.5

There is no positive excursion

Maximum negative excursion = 0.059 cfs (-46.1%)

occurring at 0.128 cfs on the Base Data:eped2-dev.tsf
and at 0.069 cfs on the New Data:eped2-out.tsf
Duration Comparison Anaylsis
   Base File: eped2-ex.tsf
    New File: eped2-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.063	0.25E-02	0.20E-02	-20.3	0.25E-02	0.063	0.062	-2.1
0.070	0.19E-02	0.98E-03	-48.3	0.19E-02	0.070	0.063	-9.5
0.077	0.14E-02	0.88E-03	-34.9	0.14E-02	0.077	0.067	-12.6
0.084	0.99E-03	0.85E-03	-14.8	0.99E-03	0.084	0.069	-17.1
0.091	0.70E-03	0.75E-03	7.0	0.70E-03	0.091	0.094	3.6
0.098	0.55E-03	0.65E-03	17.6	0.55E-03	0.098	0.103	5.8
0.105	0.44E-03	0.47E-03	7.4	0.44E-03	0.105	0.108	3.1
0.112	0.28E-03	0.34E-03	23.5	0.28E-03	0.112	0.117	5.1
0.119	0.21E-03	0.24E-03	15.4	0.21E-03	0.119	0.125	5.0
0.126	0.16E-03	0.18E-03	10.0	0.16E-03	0.126	0.127	1.0
0.133	0.98E-04	0.82E-04	-16.7	0.98E-04	0.133	0.131	-1.0
0.140	0.49E-04	0.00E+00	-100.0	0.49E-04	0.140	0.136	-2.7
0.147	0.33E-04	0.00E+00	-100.0	0.33E-04	0.147	0.137	-6.4
0.154	0.16E-04	0.00E+00	-100.0	0.16E-04	0.154	0.139	-9.4

Maximum positive excursion = 0.009 cfs (9.3%)
occurring at 0.093 cfs on the Base Data:eped2-ex.tsf
and at 0.102 cfs on the New Data:eped2-out.tsf

Maximum negative excursion = 0.015 cfs (-17.7%)
occurring at 0.085 cfs on the Base Data:eped2-ex.tsf
and at 0.070 cfs on the New Data:eped2-out.tsf

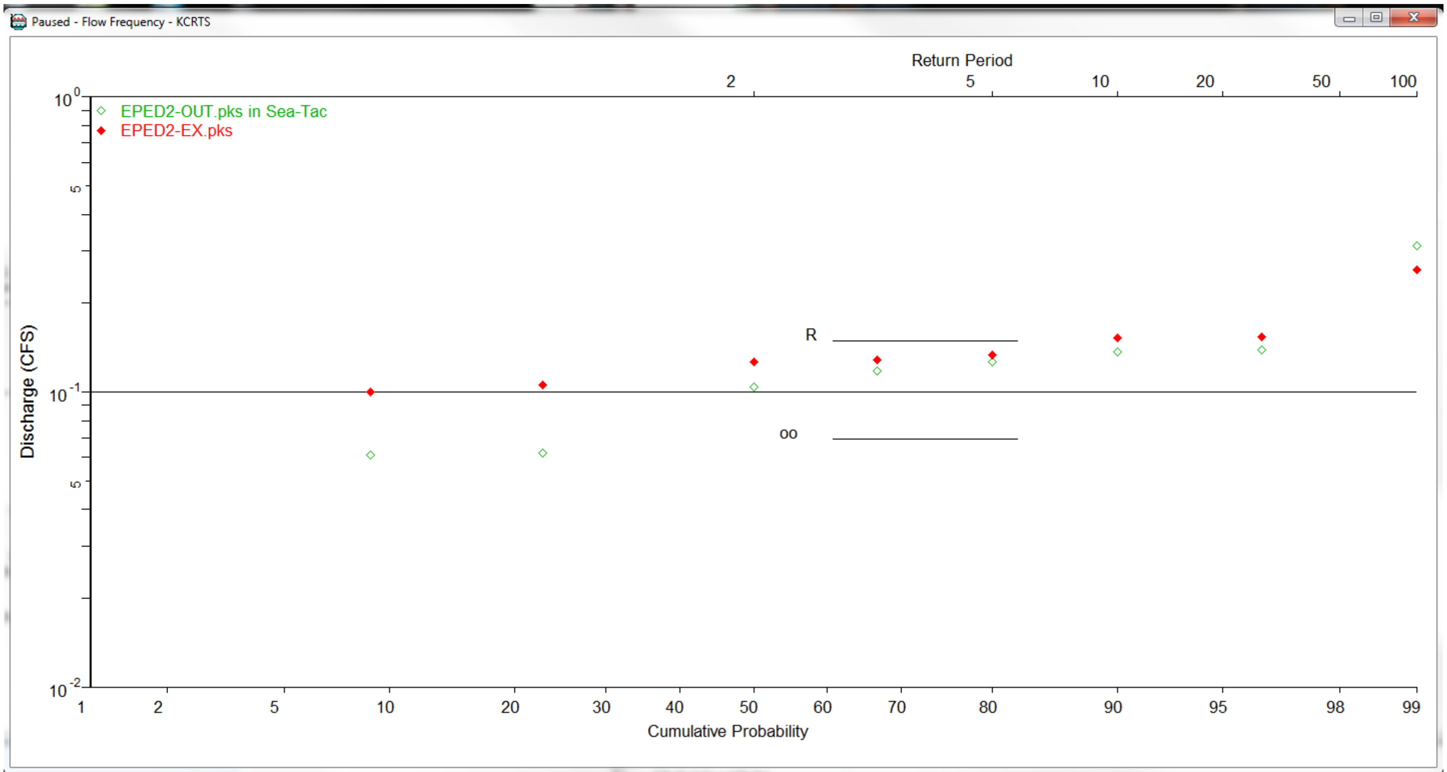
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.73       0.00       0.000000  Impervious
EPED2-DEV.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.33       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.40       0.00       0.000000  Impervious
EPED2-EX.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
eped2-ex.tsf
EPED2-EX.pks
[P] Compute PEAKS and Flow Frequencies
eped2-dev.tsf
EPED2-DEV.pks
[D] Compute Flow DURATION and Exceedence
eped2-dev.tsf
EPED2-DEV.dur
 F
 F
          36
   0.650000E-02
   0.910000E-01
[D] Compute Flow DURATION and Exceedence
eped2-ex.tsf
EPED2-EX.dur
 F
 F
          36
   0.460000E-02
   0.630000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

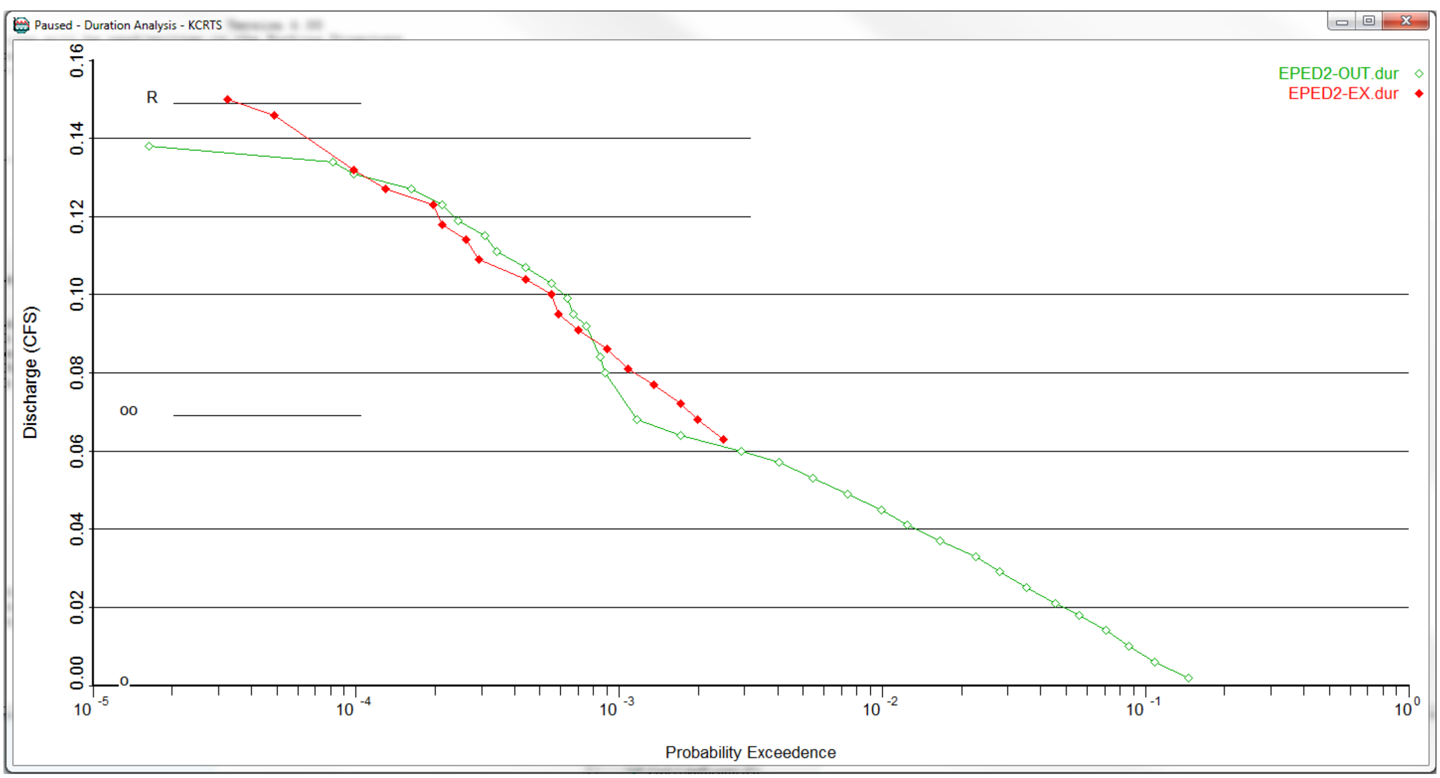
Flow Frequency Analysis
Time Series File:eped2-ex.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
0.126	6	2/09/01	2:00	0.259	1	100.00	0.990
0.100	8	1/05/02	16:00	0.154	2	25.00	0.960
0.152	3	2/27/03	7:00	0.152	3	10.00	0.900
0.106	7	8/26/04	2:00	0.134	4	5.00	0.800
0.128	5	10/28/04	16:00	0.128	5	3.00	0.667
0.134	4	1/18/06	16:00	0.126	6	2.00	0.500
0.154	2	10/26/06	0:00	0.106	7	1.30	0.231
0.259	1	1/09/08	6:00	0.100	8	1.10	0.091
Computed Peaks				0.224		50.00	0.980

Flow Frequency Analysis
Time Series File:eped2-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.118	5	2/09/01 7:00	0.312	3.05	1	100.00	0.990
0.061	8	1/05/02 18:00	0.139	2.84	2	25.00	0.960
0.126	4	2/27/03 9:00	0.137	2.81	3	10.00	0.900
0.062	7	8/23/04 21:00	0.126	2.66	4	5.00	0.800
0.104	6	10/28/04 19:00	0.118	2.55	5	3.00	0.667
0.137	3	1/18/06 17:00	0.104	2.41	6	2.00	0.500
0.139	2	11/24/06 5:00	0.062	1.79	7	1.30	0.231
0.312	1	1/09/08 8:00	0.061	1.75	8	1.10	0.091
Computed Peaks			0.254	3.03		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
EPED2-OUT.pks in Sea-Tac
EPED2-EX.pks
R
oo
Discharge (CFS)
Cumulative Probability


Paused - Duration Analysis - KCRTS
EPED2-OUT.dur
EPED2-EX.dur
R
oo
Discharge (CFS)
Probability Exceedence

EAST CAMPUS PEDESTRIAN IMPROVEMENTS
EXISTING BACK TO FORESTED
(EPED3)

PEAKS/DURATIONS MATCHED		
2YR PEAK	10YR PEAK	DURATIONS, ½ 2YR – 50YR PEAKS
X	X	X

SITE CONDITIONS			VOLUME	
DEVELOPED BACK TO EXISTING	DEVELOPED BACK TO FORESTED	EXISTING BACK TO FORESTED	CUBIC FEET	AC-FT
		X	8,661	0.199

See Figures B-17 and B-18

EAST CAMPUS PEDESTRIAN IMPROVEMENTS
EXISTING BACK TO FORESTED

Retention/Detention Facility

Type of Facility:	Detention Pond	
Side Slope:	3.00	H:1V
Pond Bottom Length:	56.00	ft
Pond Bottom Width:	35.00	ft
Pond Bottom Area:	1960.	sq. ft
Top Area at 1 ft. FB:	4720.	sq. ft
	0.108	acres
Effective Storage Depth:	3.00	ft
Stage 0 Elevation:	100.00	ft
Storage Volume:	8661.	cu. ft
	0.199	ac-ft
Riser Head:	3.00	ft
Riser Diameter:	12.00	inches
Number of orifices:	2	

Orifice #	Height (ft)	Diameter (in)	Full Head Discharge (CFS)	Pipe Diameter (in)
1	0.00	0.49	0.011	
2	2.25	1.18	0.033	4.0

Top Notch Weir: None
Outflow Rating Curve: None

Stage (ft)	Elevation (ft)	Storage (cu. ft)	Storage (ac-ft)	Discharge (cfs)	Percolation (cfs)	Surf Area (sq. ft)
0.00	100.00	0.	0.000	0.000	0.00	1960.
0.01	100.01	20.	0.000	0.001	0.00	1965.
0.02	100.02	39.	0.001	0.001	0.00	1971.
0.03	100.03	59.	0.001	0.001	0.00	1976.
0.04	100.04	79.	0.002	0.001	0.00	1982.
0.14	100.14	280.	0.006	0.002	0.00	2037.
0.24	100.24	486.	0.011	0.003	0.00	2093.
0.34	100.34	698.	0.016	0.004	0.00	2150.
0.44	100.44	916.	0.021	0.004	0.00	2207.
0.54	100.54	1140.	0.026	0.005	0.00	2265.
0.64	100.64	1369.	0.031	0.005	0.00	2324.

0.74	100.74	1605.	0.037	0.006	0.00	2384.
0.84	100.84	1846.	0.042	0.006	0.00	2444.
0.94	100.94	2094.	0.048	0.006	0.00	2505.
1.04	101.04	2347.	0.054	0.007	0.00	2567.
1.14	101.14	2607.	0.060	0.007	0.00	2629.
1.24	101.24	2873.	0.066	0.007	0.00	2692.
1.34	101.34	3146.	0.072	0.008	0.00	2756.
1.44	101.44	3424.	0.079	0.008	0.00	2821.
1.54	101.54	3710.	0.085	0.008	0.00	2886.
1.64	101.64	4002.	0.092	0.008	0.00	2952.
1.74	101.74	4300.	0.099	0.009	0.00	3019.
1.84	101.84	4605.	0.106	0.009	0.00	3087.
1.94	101.94	4918.	0.113	0.009	0.00	3155.
2.04	102.04	5236.	0.120	0.009	0.00	3224.
2.14	102.14	5562.	0.128	0.010	0.00	3293.
2.24	102.24	5895.	0.135	0.010	0.00	3364.
2.25	102.25	5929.	0.136	0.010	0.00	3371.
2.26	102.26	5963.	0.137	0.010	0.00	3378.
2.27	102.27	5996.	0.138	0.011	0.00	3385.
2.29	102.29	6064.	0.139	0.012	0.00	3399.
2.30	102.30	6098.	0.140	0.014	0.00	3406.
2.31	102.31	6132.	0.141	0.017	0.00	3413.
2.32	102.32	6166.	0.142	0.020	0.00	3420.
2.34	102.34	6235.	0.143	0.021	0.00	3435.
2.35	102.35	6269.	0.144	0.022	0.00	3442.
2.36	102.36	6304.	0.145	0.023	0.00	3449.
2.46	102.46	6652.	0.153	0.028	0.00	3521.

2.56	102.56	7008.	0.161	0.032	0.00	3594.
2.66	102.66	7371.	0.169	0.035	0.00	3667.
2.76	102.76	7742.	0.178	0.038	0.00	3741.
2.86	102.86	8119.	0.186	0.041	0.00	3816.
2.96	102.96	8505.	0.195	0.043	0.00	3892.
3.00	103.00	8661.	0.199	0.044	0.00	3922.
3.10	103.10	9057.	0.208	0.354	0.00	3999.
3.20	103.20	9461.	0.217	0.920	0.00	4076.
3.30	103.30	9872.	0.227	1.650	0.00	4154.
3.40	103.40	10292.	0.236	2.440	0.00	4233.
3.50	103.50	10719.	0.246	2.730	0.00	4312.
3.60	103.60	11154.	0.256	2.990	0.00	4392.
3.70	103.70	11597.	0.266	3.220	0.00	4473.
3.80	103.80	12049.	0.277	3.440	0.00	4555.
3.90	103.90	12508.	0.287	3.650	0.00	4637.
4.00	104.00	12976.	0.298	3.850	0.00	4720.
4.10	104.10	13452.	0.309	4.030	0.00	4804.
4.20	104.20	13937.	0.320	4.210	0.00	4888.
4.30	104.30	14430.	0.331	4.380	0.00	4973.
4.40	104.40	14931.	0.343	4.540	0.00	5059.
4.50	104.50	15442.	0.354	4.700	0.00	5146.
4.60	104.60	15961.	0.366	4.860	0.00	5233.
4.70	104.70	16488.	0.379	5.000	0.00	5321.
4.80	104.80	17025.	0.391	5.150	0.00	5410.
4.90	104.90	17571.	0.403	5.290	0.00	5500.
5.00	105.00	18125.	0.416	5.430	0.00	5590.

Hyd Inflow Outflow Peak Storage

	Target	Calc	Stage	Elev	(Cu-Ft)	(Ac-Ft)
1	0.26	*******	0.14	3.03	103.03	8785.	0.202
2	0.13	0.05	0.04	2.87	102.87	8164.	0.187
3	0.13	*******	0.03	2.57	102.57	7050.	0.162
4	0.15	*******	0.04	2.70	102.70	7537.	0.173
5	0.13	*******	0.01	2.30	102.30	6097.	0.140
6	0.08	*******	0.01	2.11	102.11	5460.	0.125
7	0.10	*******	0.01	1.90	101.90	4786.	0.110
8	0.11	*******	0.01	1.26	101.26	2935.	0.067

Route Time Series through Facility
Inflow Time Series File:eped3-ex.tsf
Outflow Time Series File:EPED3-OUT

Inflow/Outflow Analysis
Peak Inflow Discharge: 0.259 CFS at 6:00 on Jan 9 in Year 8
Peak Outflow Discharge: 0.141 CFS at 10:00 on Jan 9 in Year 8
Peak Reservoir Stage: 3.03 Ft
Peak Reservoir Elev: 103.03 Ft
Peak Reservoir Storage: 8785. Cu-Ft
: 0.202 Ac-Ft

Flow Frequency Analysis
Time Series File:eped3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks (CFS)	- - (ft)	Rank	Return Period	Prob
0.042	2	2/09/01 20:00	0.141	3.03	1	100.00	0.990
0.009	7	1/07/02 4:00	0.042	2.90	2	25.00	0.960
0.036	3	3/06/03 22:00	0.036	2.70	3	10.00	0.900
0.007	8	8/26/04 8:00	0.032	2.57	4	5.00	0.800
0.010	6	1/08/05 5:00	0.014	2.30	5	3.00	0.667
0.014	5	1/19/06 10:00	0.010	2.11	6	2.00	0.500
0.032	4	11/24/06 8:00	0.009	1.90	7	1.30	0.231
0.141	1	1/09/08 10:00	0.007	1.26	8	1.10	0.091
Computed Peaks			0.108	3.02		50.00	0.980

Flow Duration from Time Series File:eped3-out.tsf

Cutoff CFS	Count	Frequency %	CDF %	Exceedence_Probability %	
0.001	29505	48.116	48.116	51.884	0.519E+00
0.002	9825	16.023	64.139	35.861	0.359E+00
0.003	4769	7.777	71.916	28.084	0.281E+00
0.004	5364	8.748	80.664	19.336	0.193E+00
0.005	3655	5.961	86.624	13.376	0.134E+00
0.006	3282	5.352	91.977	8.023	0.802E-01
0.008	1674	2.730	94.706	5.294	0.529E-01
0.009	1578	2.573	97.280	2.720	0.272E-01
0.010	1093	1.782	99.062	0.938	0.938E-02
0.011	290	0.473	99.535	0.465	0.465E-02
0.012	63	0.103	99.638	0.362	0.362E-02

0.013	15	0.024	99.662	0.338	0.338E-02
0.014	20	0.033	99.695	0.305	0.305E-02
0.016	9	0.015	99.710	0.290	0.290E-02
0.017	7	0.011	99.721	0.279	0.279E-02
0.018	1	0.002	99.723	0.277	0.277E-02
0.019	7	0.011	99.734	0.266	0.266E-02
0.020	5	0.008	99.742	0.258	0.258E-02
0.021	17	0.028	99.770	0.230	0.230E-02
0.022	16	0.026	99.796	0.204	0.204E-02
0.024	11	0.018	99.814	0.186	0.186E-02
0.025	12	0.020	99.834	0.166	0.166E-02
0.026	7	0.011	99.845	0.155	0.155E-02
0.027	8	0.013	99.858	0.142	0.142E-02
0.028	6	0.010	99.868	0.132	0.132E-02
0.029	8	0.013	99.881	0.119	0.119E-02
0.030	10	0.016	99.897	0.103	0.103E-02
0.032	7	0.011	99.909	0.091	0.913E-03
0.033	10	0.016	99.925	0.075	0.750E-03
0.034	7	0.011	99.936	0.064	0.636E-03
0.035	10	0.016	99.953	0.047	0.473E-03
0.036	9	0.015	99.967	0.033	0.326E-03
0.037	5	0.008	99.976	0.024	0.245E-03
0.038	3	0.005	99.980	0.020	0.196E-03
0.040	3	0.005	99.985	0.015	0.147E-03
0.041	3	0.005	99.990	0.010	0.978E-04

Duration Comparison Anaylsis
Base File: eped-for.tsf
New File: eped3-out.tsf
Cutoff Units: Discharge in CFS

	-----Fraction of Time-----			---------Check of Tolerance-------			
Cutoff	Base	New	%Change	Probability	Base	New	%Change
0.010	0.95E-02	0.91E-02	-3.4	0.95E-02	0.010	0.010	-1.4
0.013	0.65E-02	0.35E-02	-46.2	0.65E-02	0.013	0.010	-21.3
0.016	0.50E-02	0.29E-02	-41.1	0.50E-02	0.016	0.010	-33.7
0.018	0.37E-02	0.27E-02	-25.8	0.37E-02	0.018	0.012	-34.3
0.021	0.29E-02	0.23E-02	-20.1	0.29E-02	0.021	0.016	-26.3
0.024	0.22E-02	0.18E-02	-18.2	0.22E-02	0.024	0.022	-9.1
0.027	0.15E-02	0.15E-02	-1.1	0.15E-02	0.027	0.027	-0.3
0.029	0.10E-02	0.12E-02	14.1	0.10E-02	0.029	0.030	3.1
0.032	0.62E-03	0.85E-03	36.8	0.62E-03	0.032	0.034	5.9
0.035	0.34E-03	0.47E-03	38.1	0.34E-03	0.035	0.036	3.2
0.038	0.21E-03	0.23E-03	7.7	0.21E-03	0.038	0.038	1.6
0.041	0.16E-03	0.11E-03	-30.0	0.16E-03	0.041	0.039	-2.8
0.043	0.98E-04	0.00E+00	-100.0	0.98E-04	0.043	0.041	-5.4
0.046	0.16E-04	0.00E+00	-100.0	0.16E-04	0.046	0.042	-9.3

Maximum positive excursion = 0.002 cfs (7.4%)
occurring at 0.030 cfs on the Base Data:eped-for.tsf
and at 0.032 cfs on the New Data:eped3-out.tsf

Maximum negative excursion = 0.006 cfs (-35.0%)
occurring at 0.018 cfs on the Base Data:eped-for.tsf
and at 0.012 cfs on the New Data:eped3-out.tsf

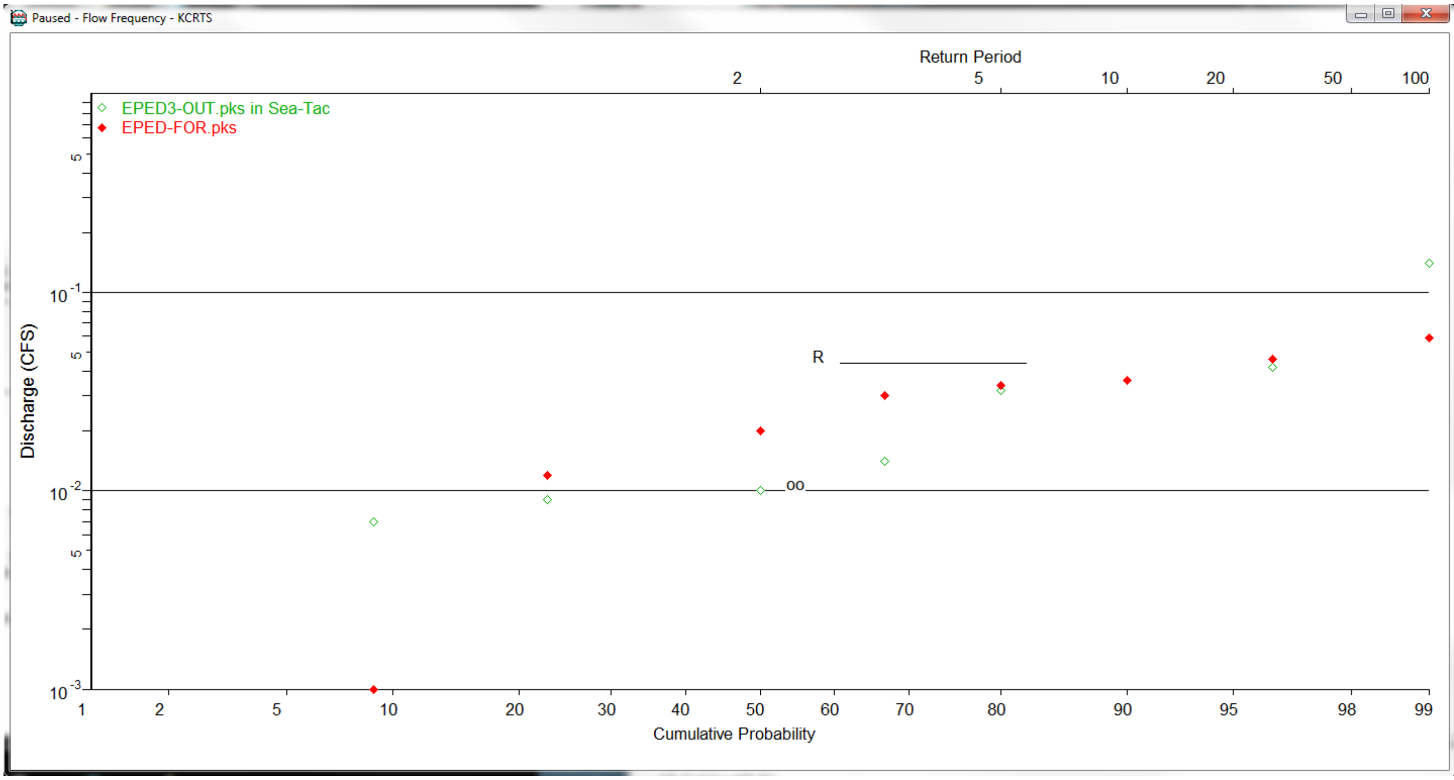
```
   KCRTS Program...File Directory:
C:\KC_SWDM\KC_DATA\
[C] CREATE a new Time Series
ST
       0.00       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.33       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.40       0.00       0.000000  Impervious
EPED3-EX.tsf
 T
    1.00000
 T
[C] CREATE a new Time Series
ST
       0.73       0.00       0.000000  Till Forest
       0.00       0.00       0.000000  Till Pasture
       0.00       0.00       0.000000  Till Grass
       0.00       0.00       0.000000  Outwash Forest
       0.00       0.00       0.000000  Outwash Pasture
       0.00       0.00       0.000000  Outwash Grass
       0.00       0.00       0.000000  Wetland
       0.00       0.00       0.000000  Impervious
EPED-FOR.tsf
 T
    1.00000
 T
[T] Enter the Analysis TOOLS Module
[P] Compute PEAKS and Flow Frequencies
eped-for.tsf
EPED-FOR.pks
[P] Compute PEAKS and Flow Frequencies
eped3-ex.tsf
EPED3-EX.pks
[D] Compute Flow DURATION and Exceedence
eped3-ex.tsf
EPED3-EX.dur
 F
 F
          36
   0.460000E-02
   0.630000E-01
[D] Compute Flow DURATION and Exceedence
eped-for.tsf
EPED-FOR.dur
 F
 F
          36
   0.130000E-02
   0.100000E-01
[R] RETURN to Previous Menu
[X] eXit KCRTS Program
```

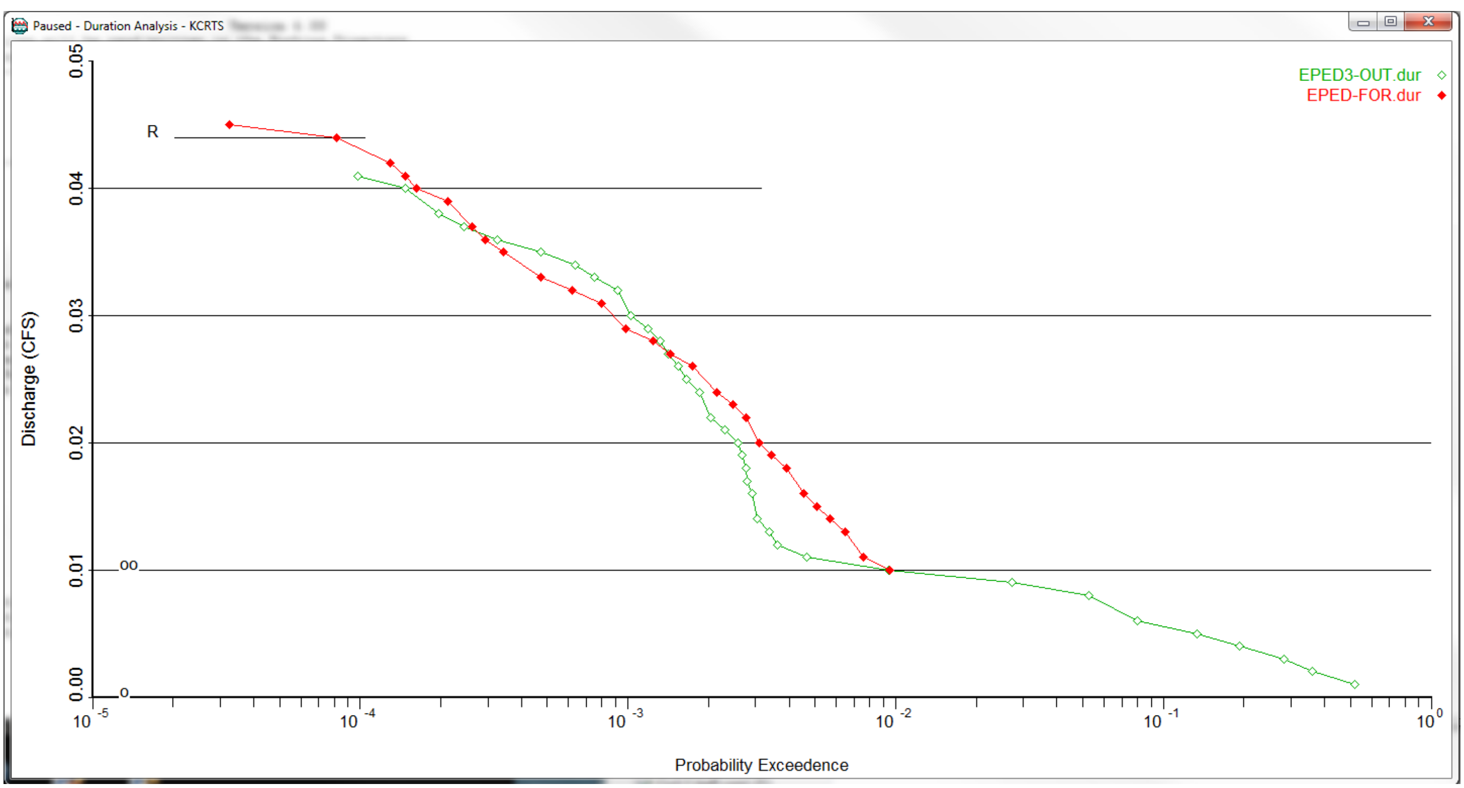
Flow Frequency Analysis
Time Series File:eped3-ex.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---				-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak		- - Peaks - - (CFS)	Rank	Return Period	Prob
0.126	6	2/09/01	2:00	0.259	1	100.00	0.990
0.100	8	1/05/02	16:00	0.154	2	25.00	0.960
0.152	3	2/27/03	7:00	0.152	3	10.00	0.900
0.106	7	8/26/04	2:00	0.134	4	5.00	0.800
0.128	5	10/28/04	16:00	0.128	5	3.00	0.667
0.134	4	1/18/06	16:00	0.126	6	2.00	0.500
0.154	2	10/26/06	0:00	0.106	7	1.30	0.231
0.259	1	1/09/08	6:00	0.100	8	1.10	0.091
Computed Peaks				0.224		50.00	0.980

Flow Frequency Analysis
Time Series File:eped3-out.tsf
Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------				
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	(ft)	Rank	Return Period	Prob
0.042	2	2/09/01 20:00	0.141	3.03	1	100.00	0.990
0.009	7	1/07/02 4:00	0.042	2.90	2	25.00	0.960
0.036	3	3/06/03 22:00	0.036	2.70	3	10.00	0.900
0.007	8	8/26/04 8:00	0.032	2.57	4	5.00	0.800
0.010	6	1/08/05 5:00	0.014	2.30	5	3.00	0.667
0.014	5	1/19/06 10:00	0.010	2.11	6	2.00	0.500
0.032	4	11/24/06 8:00	0.009	1.90	7	1.30	0.231
0.141	1	1/09/08 10:00	0.007	1.26	8	1.10	0.091
Computed Peaks			0.108	3.02		50.00	0.980


Paused - Flow Frequency - KCRTS
Return Period
2
5
10
20
50
100
EPED3-OUT.pks in Sea-Tac
EPED-FOR.pks
Discharge (CFS)
R
oo
Cumulative Probability
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99


Paused - Duration Analysis - KCRTS
EPED3-OUT.dur
EPED-FOR.dur
Discharge (CFS)
0.05
0.04
0.03
0.02
0.01
0.00
R
oo
o
Probability Exceedence

Appendix D

D-1: Bioretention Calculations

D-2: CAVFS Calculation

D-3: Seatac Rainfall

D-4: Bioretention with Underdrain Standard Detail

D-5: CAVFS Standard Detail

D-6: Water Quality Facility Sketches - North Extention to East Parking Lot

D-7: Water Quality Facility Sketches - West Parking Lot

D-8: Water Quality Facility Sketches - Loop Road

D-9: Water Quality Facility Sketches - South Extension to East Parking Lot

D-9: Water Quality Facility Sketches - North Extension to South Parking Lot

kpff 1601 5th Avenue, Suite 1600 Seattle, WA 98101 206.622.5822	project: HC MP TIR	by: DW	
	location: Des Moines, WA	date: 04/29/16	
	client: McGranahan Architects		job no. 1600027
	Bioretention Calculations		

The Water Quality Design Storm (WQDS) is the 24 hr 6 month storm event for Seatac. See Table D1: Seatac 24 Hour Rainfall Event.
Seatac 24 hour 6-month rainfall event: 1.32"

	Developed conditions Pollution Generating Impervious Area [acre]	Required Treatment Volume [cf]	Bioretention Cell Top Surface Area [sf]
Short term			
North Extension to East Parking Lot	0.94	4504	5405
West Parking Lot	0.70	3354	4140
Mid term			
South Extension to East Parking Lot	0.71	3402	3828
North Extension to South Parking Lot	0.32	1533	1920
Loop road*	0.14	671	880

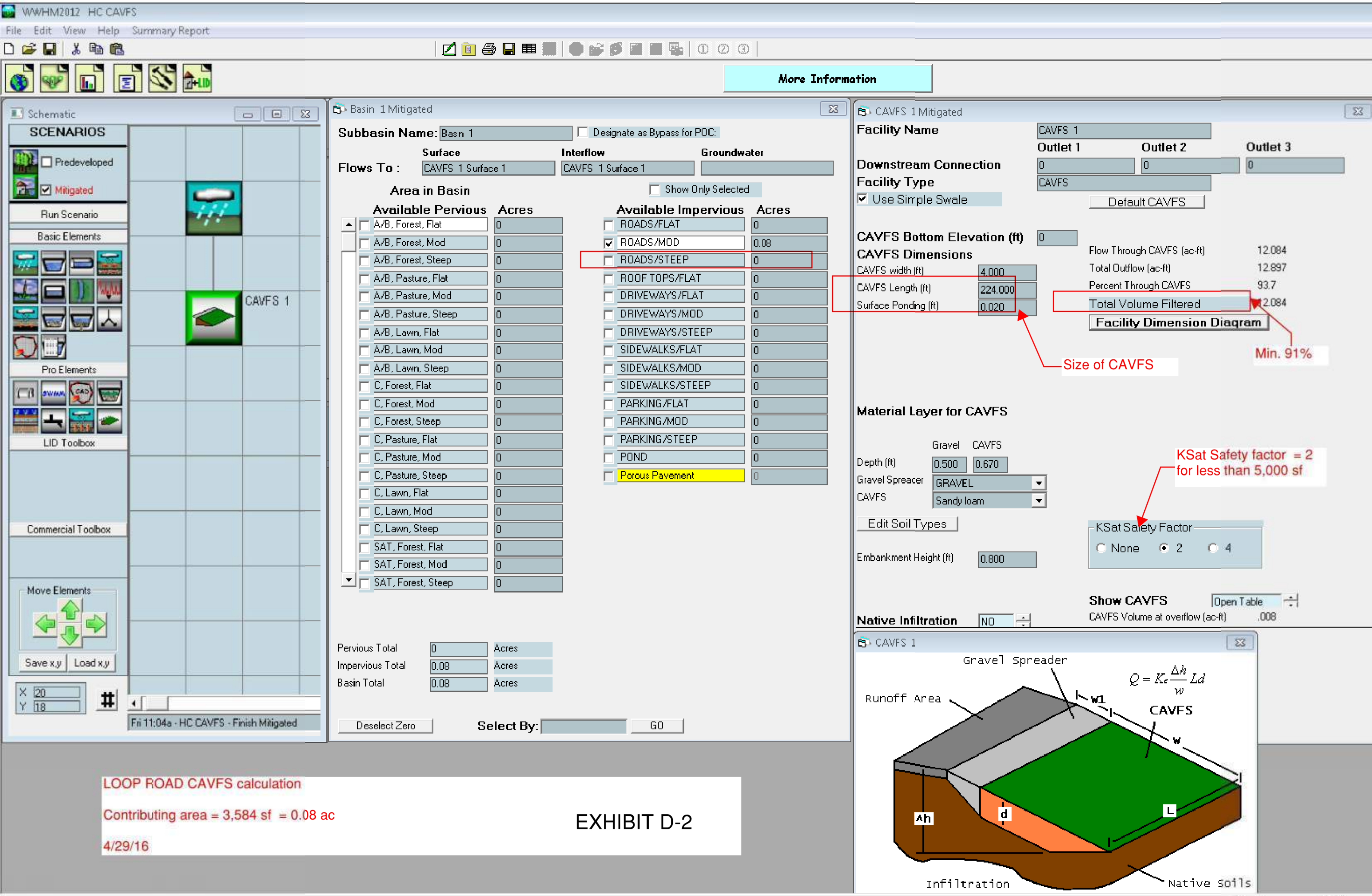
* For the Loop road, 0.14 ac is treated with bioretention cells, the remainder is treated with CAVFS.

<u>Assumptions</u>
Bioretention is non-infiltrating with underdrains, 12" deep and has 6" freeboard per WA DOE BMP T7.30.

<u>Equations</u>
Required Treatment Volume = PGIS * WQDS
Volume of bioretention V=h/3*((A+a+(A*a)^2)

<u>Definitions</u>
PGIS = Pollution Generating Impervious Surface
WQDS = Water Quality Design Storm Event
A = Bioretention Cell Top Surface Area
a = Bottom area of bioretention cell

EXHIBIT D-1



LOOP ROAD CAVFS calculation

Contributing area = 3,584 sf = 0.08 ac

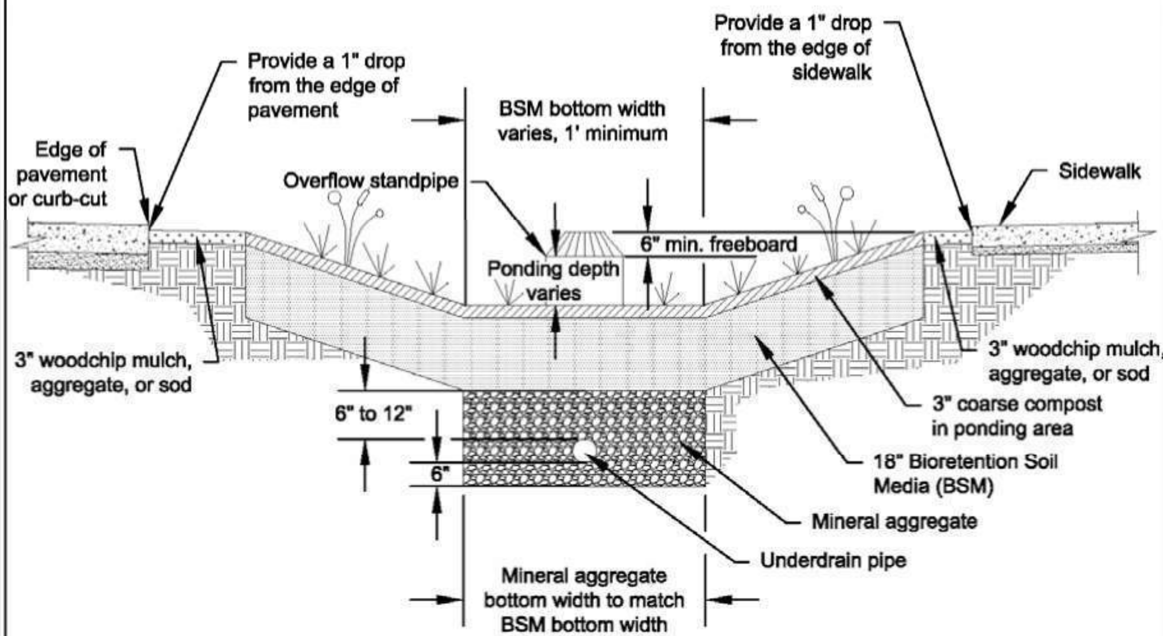
4/29/16

EXHIBIT D-2

Table B.1.24 Hour Rainfall Amounts and Comparisons for Selected USGS Stations								
	Station Name	**6 Month Storm Inches**	**6 Month % Rainfall Volume**	**2 Year Storm Inches**	**6 Month/ 2 year %**	**90% Rainfall Inches**	**95% Rainfall Inches**	**Mean Annual Precip. Inches**
35	Omak	0.66	85.89%	0.98	67.3%	0.79	0.98	11.97
36	Packwood	2.41	88.70%	3.52	68.5%	2.51	3.20	55.20
37	Pomeroy	0.75	89.29%	1.02	73.5%	0.78	0.98	16.04
38	Port Angeles	1.12	88.39%	1.66	67.5%	1.19	1.56	25.46
39	Port Townsend	0.77	90.56%	1.14	67.5%	0.76	0.95	19.13
40	Prosser	0.48	83.82%	0.74	64.9%	0.61	0.78	7.90
41	Quilcene	2.53	88.81%	3.40	74.4%	2.61	3.15	54.88
42	Quincy	0.53	82.12%	0.81	65.4%	0.68	0.90	8.07
43	Sea-Tac	1.32	91.13%	1.83	72.1%	1.27	1.63	38.10
44	Seattle JP	1.30	92.05%	1.74	74.7%	1.20	1.49	38.60
45	Sedro Woolley	1.50	92.07%	2.01	74.6%	1.41	1.80	46.97
46	Shelton	2.15	91.49%	3.13	68.7%	2.05	2.55	64.63
47	Smyrna	0.52	83.16%	0.76	68.4%	0.63	0.75	7.96
48	Spokane	0.68	89.54%	0.96	70.8%	0.70	0.88	16.04
49	Sunnyside	0.45	82.22%	0.73	61.6%	0.63	0.76	6.80
50	Tacoma	1.21	92.18%	1.61	75.2%	1.12	1.37	36.92
51	Toledo	1.36	92.73%	2.10	64.8%	1.25	1.68	50.18
52	Vancouver	1.35	91.32%	1.93	69.9%	1.28	1.62	38.87
53	Walla Walla	0.90	88.60%	1.23	73.2%	0.94	1.18	19.50
54	Waterville	0.67	84.43%	1.04	64.4%	0.81	1.05	11.47
55	Wauna	1.82	91.37%	2.50	72.8%	1.72	2.18	51.61
56	Wenatchee	0.58	81.97%	0.92	63.0%	0.80	1.04	8.93
57	Winthrop	0.75	85.36%	1.13	66.4%	0.94	1.13	14.28
58	Yakima	0.53	81.44%	0.85	62.4%	0.72	1.03	8.16

Table D1: Seatac 24 Hour Rainfall Event

EXHIBIT D-3



Notes:
1. Scarify subgrade 3" min. before bioretention soil installation
2. Compact BSM to 85% per ASTM 1577

DEPARTMENT OF
ECOLOGY
State of Washington

Figure 7.4.1b
Typical Bioretention w/Underdrain

Revised November 2014

EXHIBIT D-4

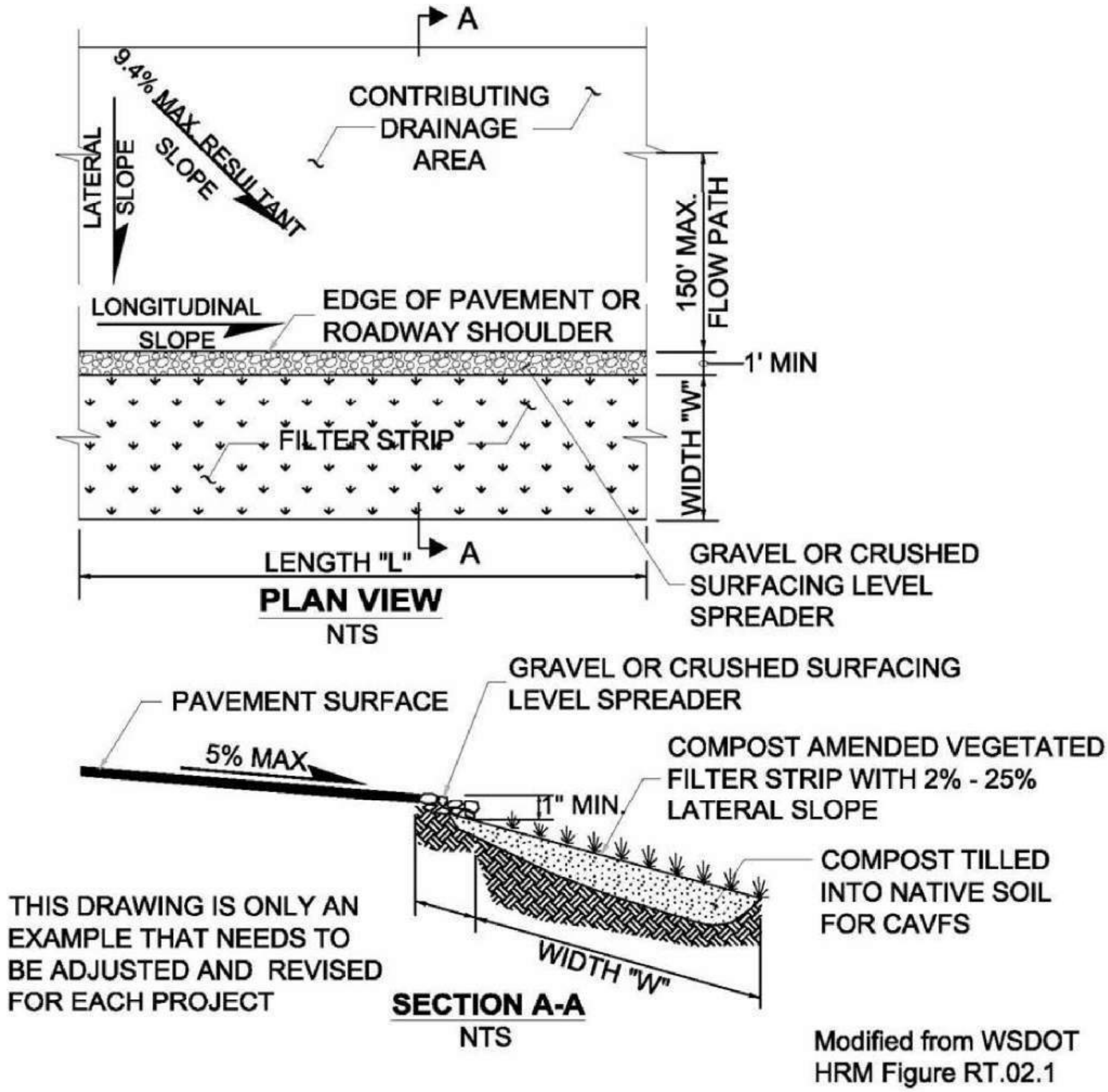


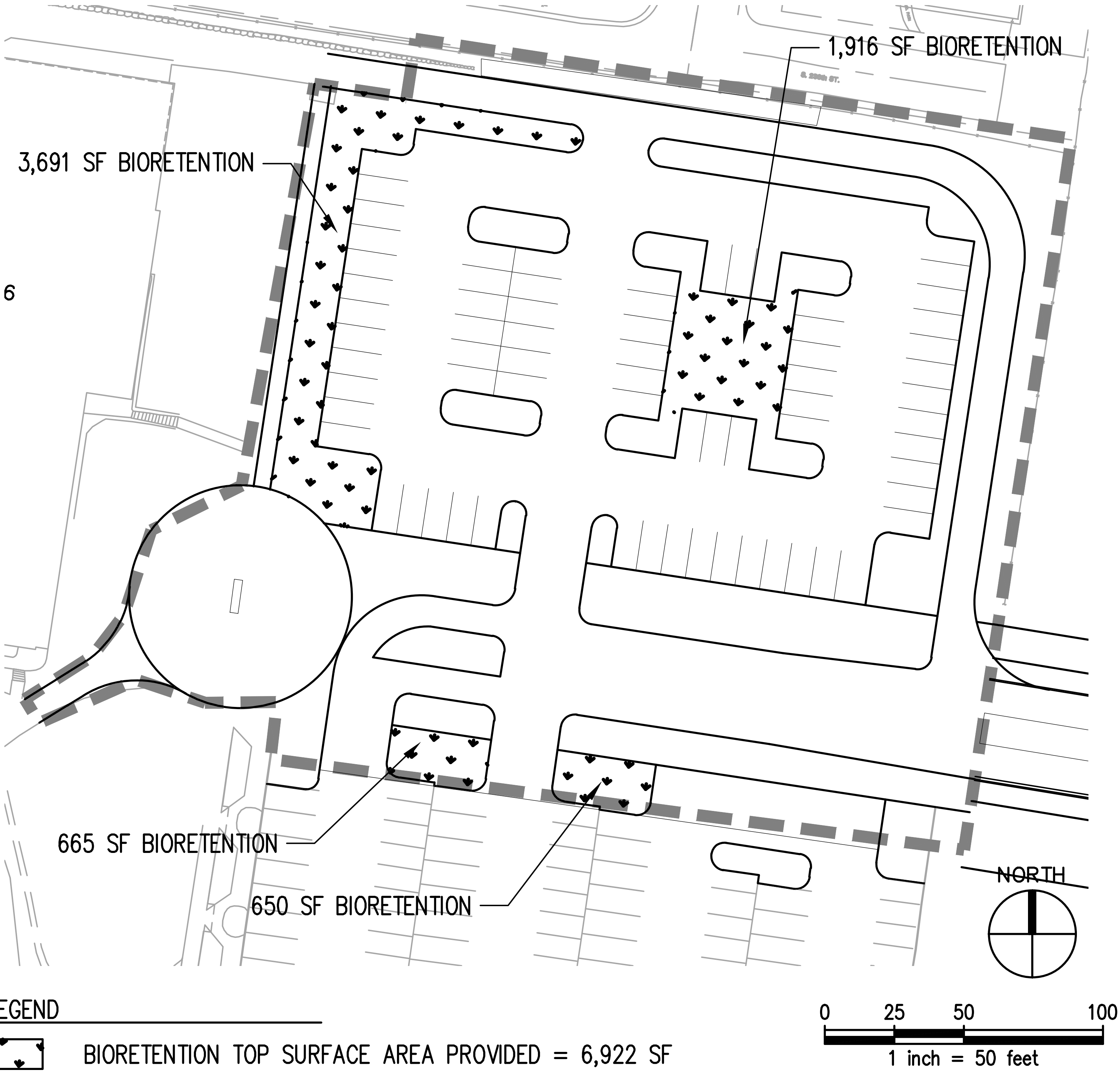
Figure 7.4.3 – Example of a Compost Amended Vegetated Filter Strip (CAVFS)

Applications CAVFS can be used to meet basic runoff treatment and enhanced runoff treatment objectives. It has practical application in areas where there is space for roadside embankments that can be built to the CAVFS specifications.

EXHIBIT D-5

WATER QUALITY TREATMENT

NORTH EXTENSION TO EAST PARKING LOT



LEGEND

BIORETENTION TOP SURFACE AREA PROVIDED = 6,922 SF

BIORETENTION TOP SURFACE AREA REQUIRED = 5,405 SF

BIORETENTION DESIGN FOR INFORMATION ONLY. OTHER METHODS OF PROVIDING BASIC ENHANCED TREATMENT ARE ACCEPTABLE.

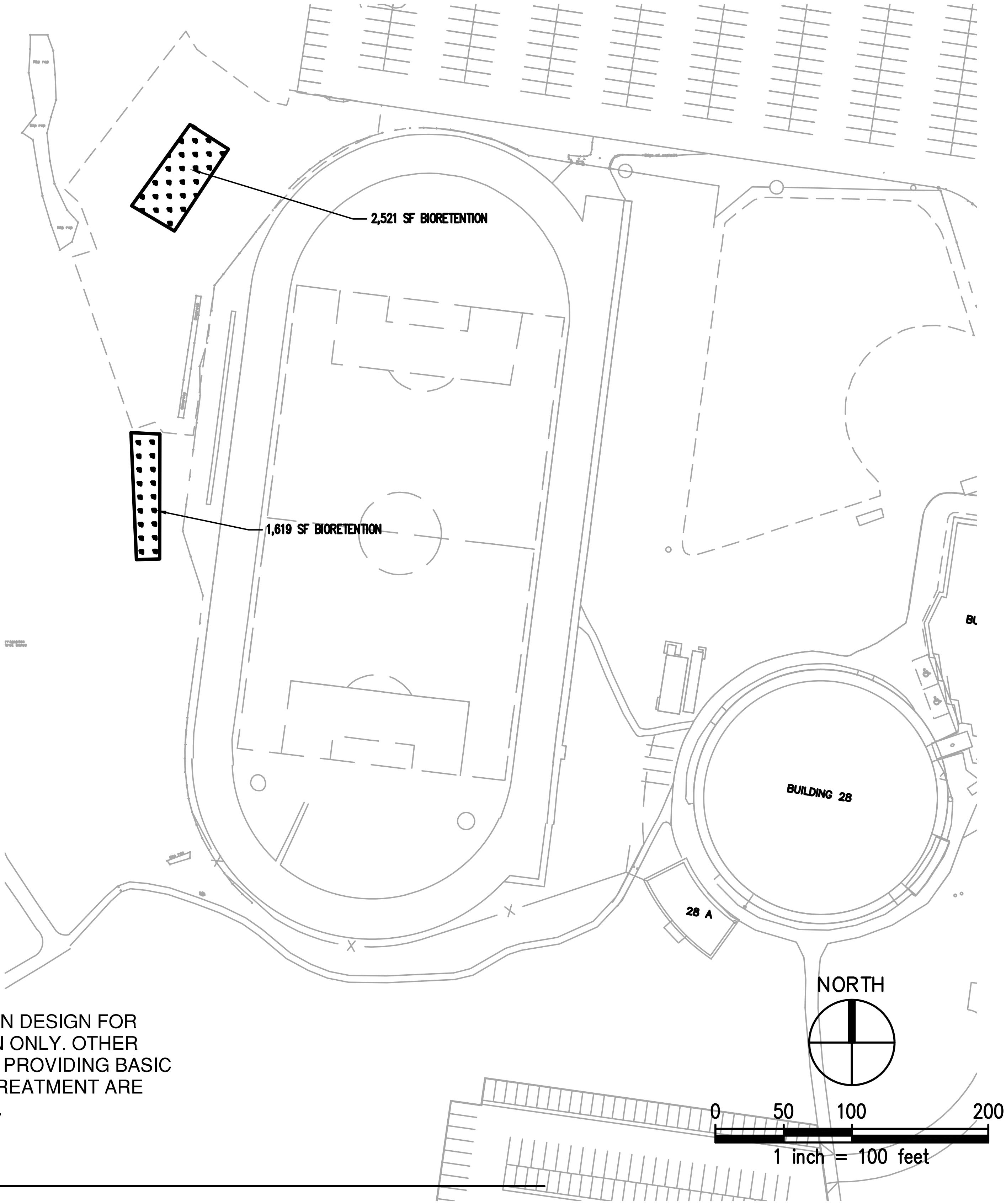
EXHIBIT D-6

kpff

DATE: 04/29/2016

WATER QUALITY TREATMENT

WEST PARKING LOT



BIORETENTION DESIGN FOR INFORMATION ONLY. OTHER METHODS OF PROVIDING BASIC ENHANCED TREATMENT ARE ACCEPTABLE.

LEGEND

BIORETENTION TOP SURFACE AREA PROVIDED = 4,140 SF

BIORETENTION TOP SURFACE AREA REQUIRED = 4,140 SF

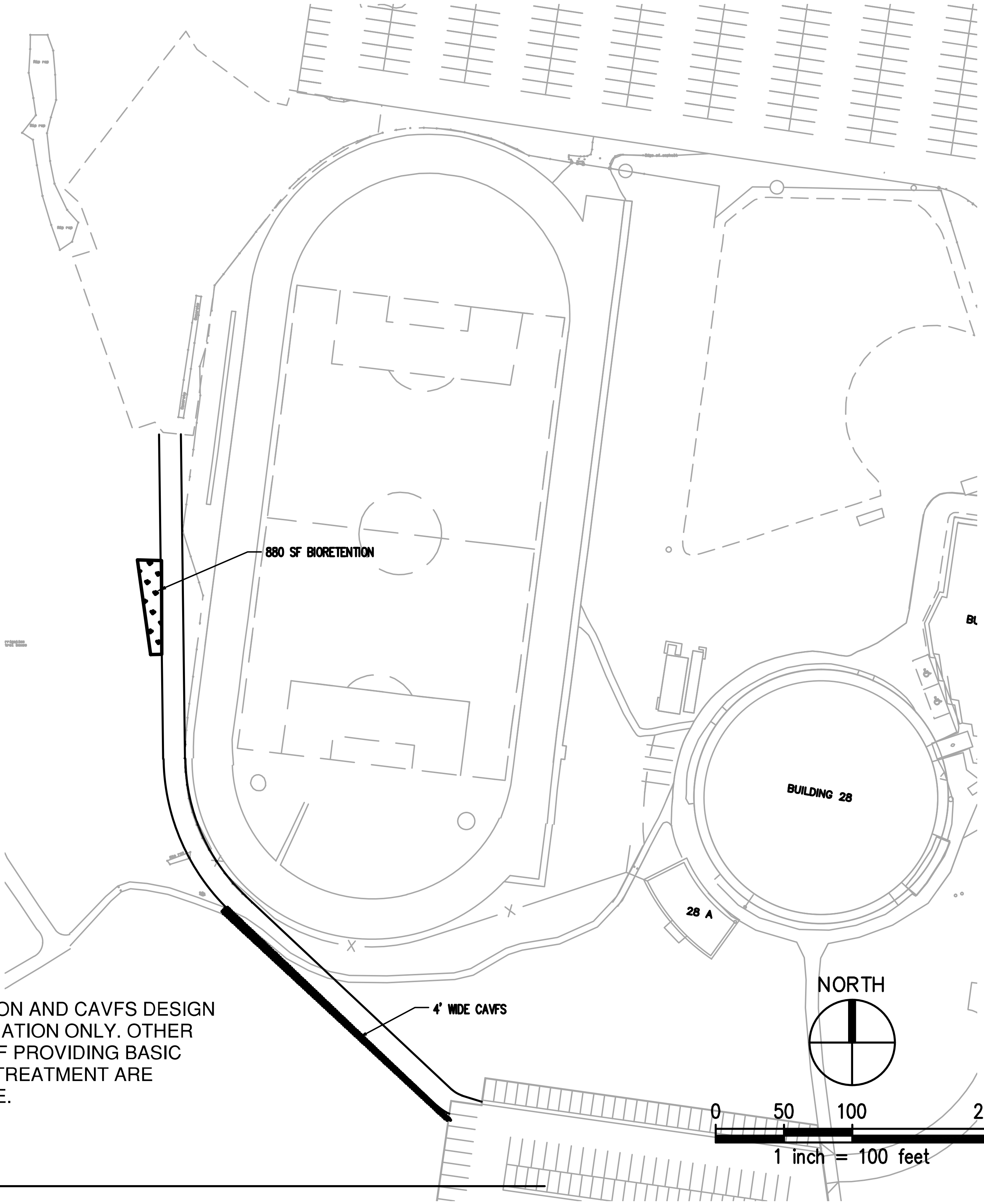
kpff

EXHIBIT D-7

DATE: 04/29/2016

WATER QUALITY TREATMENT

LOOP ROAD



BIORETENTION AND CAVFS DESIGN FOR INFORMATION ONLY. OTHER METHODS OF PROVIDING BASIC ENHANCED TREATMENT ARE ACCEPTABLE.

LEGEND

BIORETENTION TOP SURFACE AREA PROVIDED = 880 SF

BIORETENTION TOP SURFACE AREA REQUIRED = 880 SF

AREA TREATED BY CAVFS = 3,585 SF

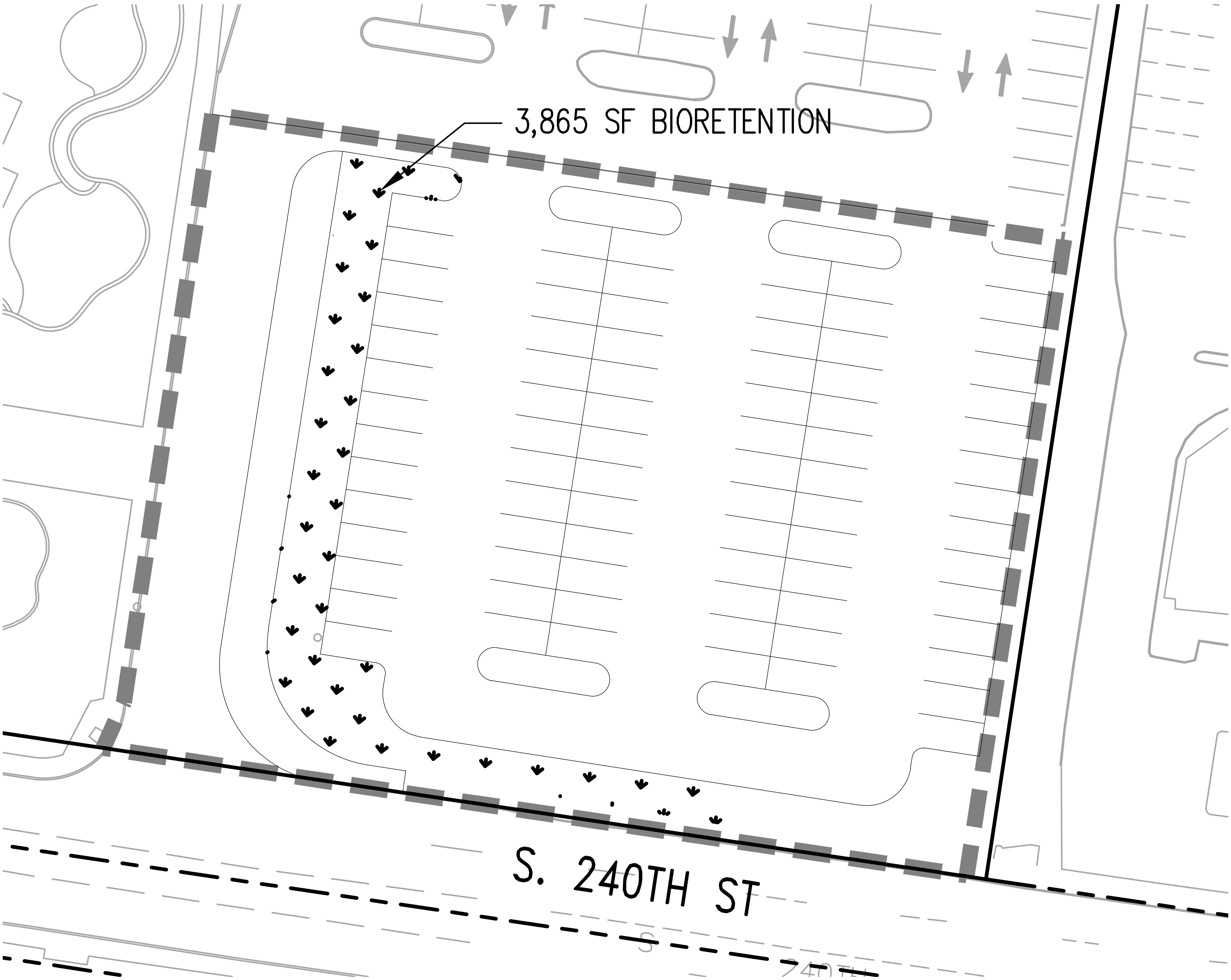
EXHIBIT D-8

kpff

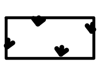
DATE: 04/29/2016

WATER QUALITY TREATMENT

SOUTH EXTENSION TO EAST PARKING LOT



LEGEND



BIORETENTION TOP SURFACE AREA PROVIDED = 3,865 SF

BIORETENTION TOP SURFACE AREA REQUIRED = 3,828 SF

BIORETENTION DESIGN FOR INFORMATION ONLY. OTHER METHODS OF PROVIDING BASIC ENHANCED TREATMENT ARE ACCEPTABLE.

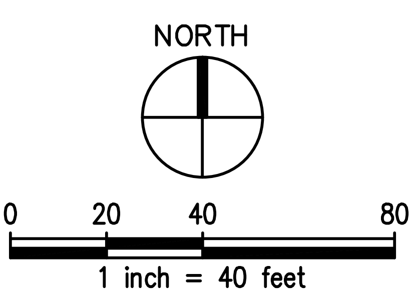


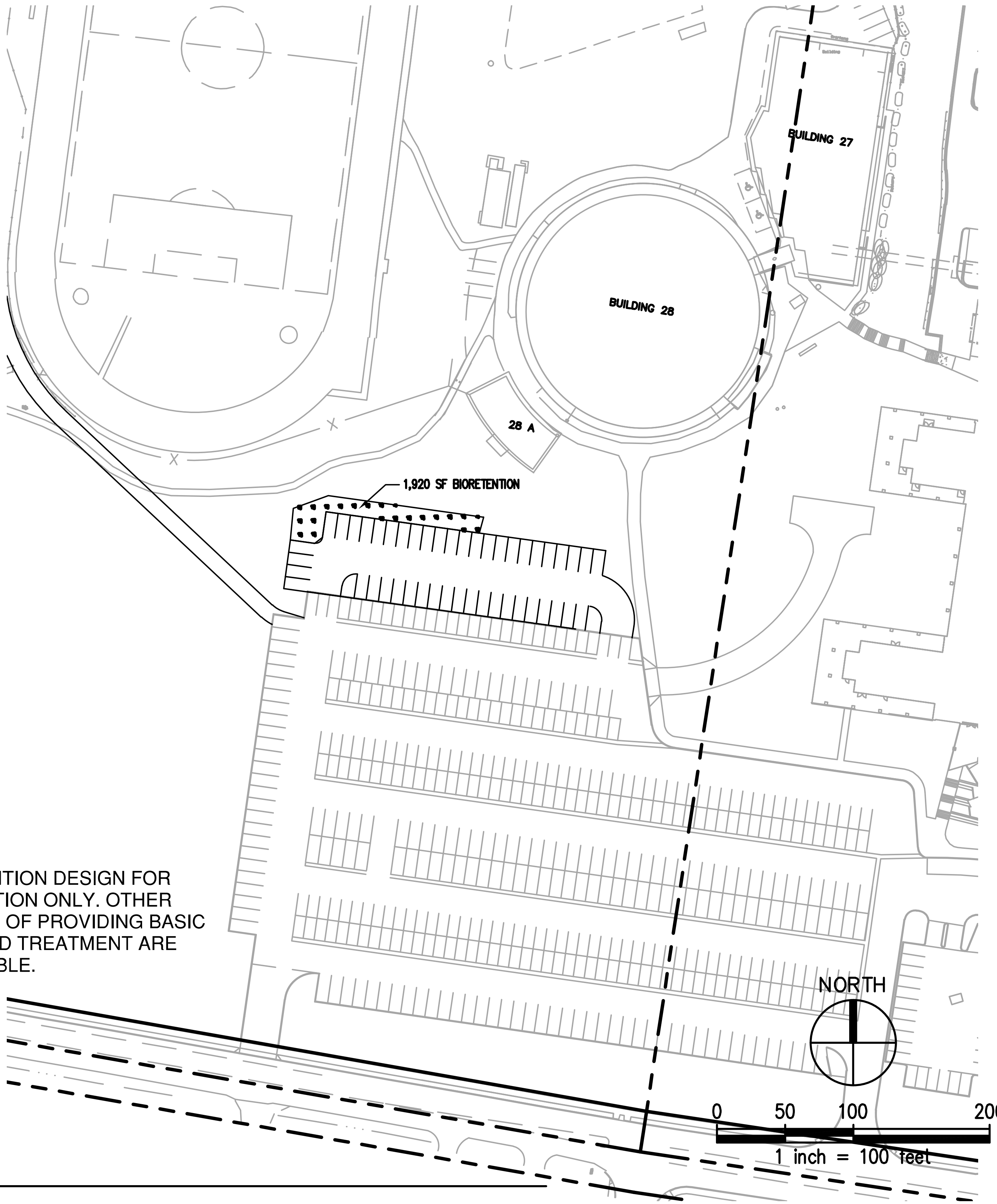
EXHIBIT D-9

kpff

DATE: 04/18/2016

WATER QUALITY TREATMENT

NORTH EXTENSION TO SOUTH PARKING LOT



BIORETENTION DESIGN FOR INFORMATION ONLY. OTHER METHODS OF PROVIDING BASIC ENHANCED TREATMENT ARE ACCEPTABLE.

LEGEND

BIORETENTION TOP SURFACE AREA PROVIDED = 1,920 SF

BIORETENTION TOP SURFACE AREA REQUIRED = 1,920 SF

EXHIBIT D-10

kpff

DATE: 05/02/2016

Appendix E

E-1: Pond Operations and Maintenance Requirements

E-2: Highline College Stormwater Management Plan and Cost Tracker

E-3: King County Maintenance Requirement

Storm Water Management Plan educational Presentation 2012

Background:

Why do we need a plan? In order to be in compliance with the Clean Air Act of 1977/ Water quality Act of 1987.

Specifically the Department of Ecology requires organizations that have their own Stormwater infrastructures to establish methods for controlling the introduction of pollutants into the Municipal Separate Storm Sewer System ("MS4") in order to comply with the requirements of the National Pollutant Discharge Elimination System ("NPDES") permit process

HCC's ILLICIT DISCHARGE DETECTION AND ELIMINATION PROCEDURES

(1) **Purpose/Intent** – **The purpose of having this plan is to provide for the health, safety, and general welfare of the students, staff, faculty and visitors of Highline Community College through the regulation of non-storm water discharges to the storm drainage while at the same time practicing sustainable practices to protect the region's water quality and local environment..**

on January 17, 2007 the Department of Ecology issued the Phase II Municipal Stormwater Permit ("the Phase II Permit") for Western Washington that regulates discharges from Highline Community College's (HCC) separate storm sewer system located within the City of Des Moines; and

on February 16 2007, HCC submitted a Notice of Intent, applying for coverage under the Phase II Permit; and

April 8 2009, the Department of Ecology granted HCC the requested coverage issuing permit #WAR04-5712.

The objectives of this plan are:

1. **To regulate the contribution of pollutants to MS4 by storm water discharges by any user.**
2. **To prohibit Illicit Connections and Discharges to the MS4.**
3. **To establish legal authority to carry out all inspections, surveillance and monitoring procedures to ensure compliance with this policy.**

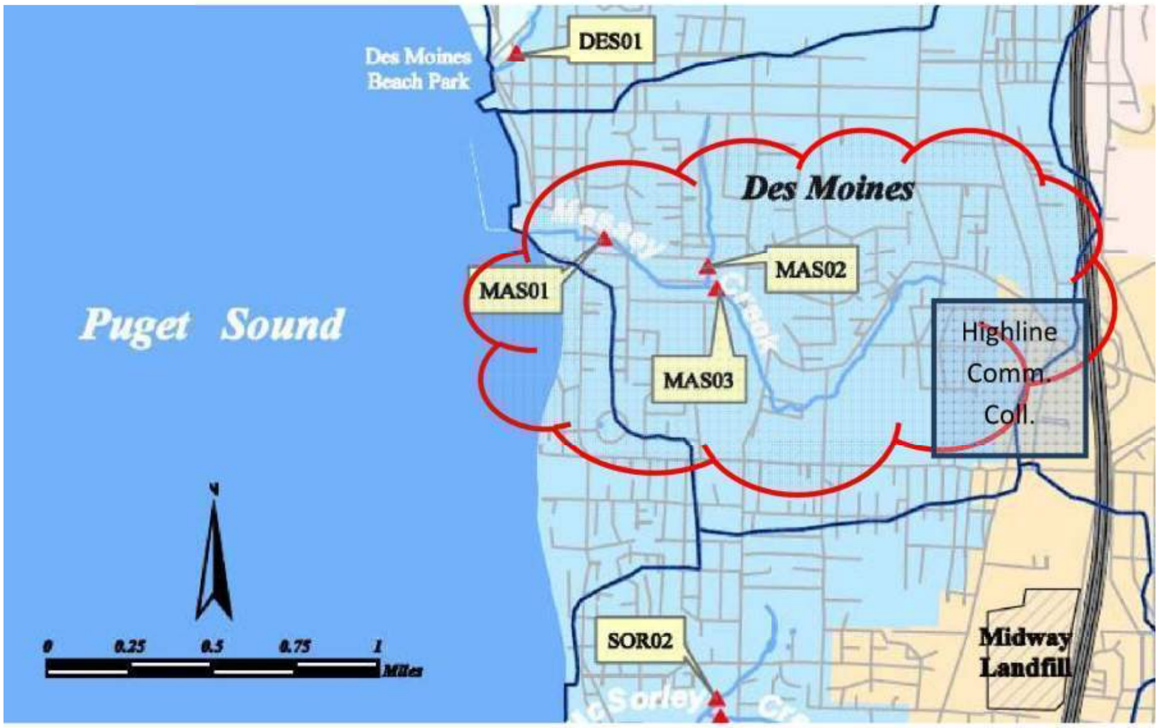
The City of Des Moines has been given the authority by King County to assess and charge us a permit fee for our impervious or semi-impervious services here on campus, the mast and specifically for the retention pond. **The annual cost for this discharge fee is between $90-100K.**

HCC's Stormwater retention pond was designed and constructed in 1999 to provide storm detention and water quality treatment and future expansion of the 80 acre campus (currently we have approximately 15 acres of parking lots). In addition, the pond and control structure has been sized in

EXHIBIT E-1

conformance with the City of Des Moines' requirements to assist in reducing flood levels and erosion in Massey Creek.

Storm drains ultimately lead straight to rivers, lakes and streams. In our case, HCC's retention pond water drains into and helps create Massey Creek which directly drains into the Puget Sound without any additional treatment.



Stormwater runoff is a major source of surface water pollution. Runoff can pick up contaminants on the ground, including sediment, oil, gas, fertilizer, litter, ice melt residue and waste.

The plan requires the college to educate employees, students and the community about what is allowed and what is not allowed regarding discharges into storm drains and use best management practices to create and maintain Stormwater facilities. The plan also required the creation of standard operating procedures and annual inspections/maintenance of out falls and retention facilities (the retention pond).

We have included some before and after picture below that illustrates the over-growth that naturally overcomes the pond in a short period and what we have done recently to maintain the proper performance/design of this retention facility.

These next three pictures illustrate the overgrowth of trees and bushes in and around the pond. Dead vegetation falls to the bottom of the pond building up sediment that displaces the water collection capability and potentially clogging drains and outflows to and from the pond.

BEFORE:

With the use of goats to keep the natural low laying vegetation we limit the need and the high cost of bringing in heavy equipment. We typically have been using the goats to keep the bushes and small trees under control in between the need to dredge the pond.

Vegetation Control using goats:

AFTER Dredging:

Removing the brush, cat tails and then dredging the pond to remove sediment and restoring the original design specifications.

The facilities department has spent approximately $25,000 over the last three years conducting natural vegetation control (use of goats) and dredging out the pond in order to maintain the retention pond facilities.

How can HCC be fined and factoids?

By not having a plan in place, failure to maintain Stormwater facilities and to mitigate illicit discharges (allowing materials that are illegal to enter or storm drains).

This brings me to the biggest problem we have here on campus as a threat to this program.

Oil/Gas and trash in the parking lots and around the campus is a major problem. – As oil/gas and litter is swept into the storm drains it is introduced directly to the retention pond and indirectly back into the streams that empty into the sound or into natural aquifers.

We spend about 5 labor hours a day picking up litter in and around campus. 1300 hours annually with an additional total labor cost (direct and indirect cost of approximately $25k annually).

How can employees, students and the public help?

If there was one area that students and employees could directly help regarding the greening of this campus it would be to reducing littering. Leaking oil from cars is also bad but is much harder to notice, address and incentivize behavioral change (maintain their vehicles better).

As part of the college's educational efforts to students, employees and the public we have created and provide handouts outlining our HCC Storm Water "Illicit Discharge" procedures and how to avoid unwanted contamination from entering our storm water facilities. This flyer can be found on the Facilities web page at the following link:

http://facilities.highline.edu/stormwater/storm.water.mgmt.flyer.pdf

Cost tracker for Implementing or Creating the Storm Water Management Plan							
Description		**Cost**	**labor hours**	**Materials**	**Other**		**Total Costs**
Advertising for comments of the HCC SWMP 1st year in newspaper		$ 55.00					$ 55.00
Inspecting/labeling all SW inlets on campus		$ 18.00	15	$ 25.00			$ 295.00
Plan preperation (Director) (2011)		$ 34.00	6				$ 204.00
Educational presentations (Director)		$ 34.00	1				$ 34.00
Creation of Illicit Detection and Elimination Procedures		$ 34.00	6				$ 204.00
Updating 2nd year Annual report		$ 34.00	6	$ 10.00			$ 214.00
Conducted Wetlands/retention pond study with AHBL		$ 3,500.00	1				$ 3,500.00
Goat vegitation management June 2011							
Goat vegitation management Sept 2011							
2012							
Dredging and pond clean out (MW Ccascade) Sept		$ 5,000.00	1				$ 5,000.00
Goat Vegitation management June 2012		$ 3,500.00	1				$ 3,500.00
Goat Vegitation management Sept 2012		$ 3,500.00	1				$ 3,500.00
Goat Vegitation management May 2013		$ 3,500.00	1				$ 3,500.00
Goat Vegitation management Aug. 2013		$ 3,500.00	1				$ 3,500.00
Secondary pond clearing/Maint		$ 9,746.00	1				$ 9,746.00
Vactoring of storm basins and facilities		$ 9,000.00	1				$ 9,000.00
Goat Vegitation management May 2014		$ 3,500.00	1				$ 3,500.00
Storm pipe repairs on campus 2014		$ 71,638.00	1				$ 71,638.00
Installation of Bldg 24B Detention vault 57,000 gallons and filters 2016		$ 125,000.00					
Pond valve replacement 2016-17 (not conducted yet)							
Total spent							$ 117,390.00

EXHIBIT E-2

NO. 4 – CONTROL STRUCTURE/FLOW RESTRICTOR

Maintenance Component	Defect or Problem	Condition When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Structure	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the structure opening or is blocking capacity of the structure by more than 10%.	No Trash or debris blocking or potentially blocking entrance to structure.
		Trash or debris in the structure that exceeds 1/3 the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the structure.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Sediment	Sediment exceeds 60% of the depth from the bottom of the structure to the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section or is within 6 inches of the invert of the lowest pipe into or out of the structure or the bottom of the FROP-T section.	Sump of structure contains no sediment.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering structure through cracks, or maintenance person judges that structure is unsound.	Structure is sealed and structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering structure through cracks.	No cracks more than 1/4 inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Structure has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Ladder rungs missing or unsafe	Ladder is unsafe due to missing rungs, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
FROP-T Section	Damage	T section is not securely attached to structure wall and outlet pipe structure should support at least 1,000 lbs of up or down pressure.	T section securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight or show signs of deteriorated grout.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes—other than designed holes—in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or missing	Cleanout gate is missing.	Replace cleanout gate.

EXHIBIT E-3

NO. 8 – ENERGY DISSIPATERS

Maintenance Component	Defect or Problem	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed.
Site	Trash and debris	Trash and/or debris accumulation.	Dissipater clear of trash and/or debris.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Rock Pad	Missing or moved Rock	Only one layer of rock exists above native soil in area five square feet or larger or any exposure of native soil.	Rock pad prevents erosion.
Dispersion Trench	Pipe plugged with sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not discharging water properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench).	Water discharges from feature by sheet flow.
	Perforations plugged.	Over 1/4 of perforations in pipe are plugged with debris or sediment.	Perforations freely discharge flow.
	Water flows out top of "distributor" catch basin.	Water flows out of distributor catch basin during any storm less than the design storm.	No flow discharges from distributor catch basin.
	Receiving area over-saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Gabions	Damaged mesh	Mesh of gabion broken, twisted or deformed so structure is weakened or rock may fall out.	Mesh is intact, no rock missing.
	Corrosion	Gabion mesh shows corrosion through more than ¼ of its gage.	All gabion mesh capable of containing rock and retaining designed form.
	Collapsed or deformed baskets	Gabion basket shape deformed due to any cause.	All gabion baskets intact, structure stands as designed.
	Missing rock	Any rock missing that could cause gabion to loose structural integrity.	No rock missing.
Manhole/Chamber	Worn or damaged post, baffles or side of chamber	Structure dissipating flow deteriorates to ½ or original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure is in no danger of failing.
	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch or any evidence of soil entering the structure through cracks, or maintenance inspection personnel determines that the structure is not structurally sound.	Manhole/chamber is sealed and structurally sound.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No soil or water enters and no water discharges at the joint of inlet/outlet pipes.

NO. 12 – ACCESS ROADS

Maintenance Component	Defect or Problem	Condition When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standards size garbage can).	Roadway drivable by maintenance vehicles.
		Debris which could damage vehicle tires or prohibit use of road.	Roadway drivable by maintenance vehicles.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Blocked roadway	Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10- to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.	At least 12-foot of width on access road.
Road Surface	Erosion, settlement, potholes, soft spots, ruts	Any surface defect which hinders or prevents maintenance access.	Road drivable by maintenance vehicles.
	Vegetation on road surface	Trees or other vegetation prevent access to facility by maintenance vehicles.	Maintenance vehicles can access facility.
Shoulders and Ditches	Erosion	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.
Modular Grid Pavement	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damaged or missing	Access surface compacted because of broken on missing modular block.	Access road surface restored so road infiltrates.

NO. 16 – WETPOND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
Site	Trash and debris	Any trash and debris accumulated on the wetpond site.	Wetpond site free of any trash or debris.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Side Slopes of Dam, Berm, internal berm or Embankment	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents removed or destroyed and dam or berm repaired.
	Tree growth	Tree growth threatens integrity of dams, berms or slopes, does not allow maintenance access, or interferes with maintenance activity. If trees are not a threat to dam, berm or embankment integrity, are not interfering with access or maintenance or leaves do not cause a plugging problem they do not need to be removed.	Trees do not hinder facility performance or maintenance activities.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted slope.	Slopes stabilized using appropriate erosion control measures. If erosion is occurring on compacted slope, a licensed civil engineer should be consulted to resolve source of erosion.
Top or Side Slopes of Dam, Berm, Internal berm or Embankment	Settlement	Any part of a dam, berm or embankment that has settled 4 inches lower than the design elevation.	Top or side slope restored to design dimensions. If settlement is significant, a licensed civil engineer should be consulted to determine the cause of the settlement.
	Irregular surface on internal berm	Top of berm not uniform and level.	Top of berm graded to design elevation.
Pond Areas	Sediment accumulation (except first wetpool cell)	Accumulated sediment that exceeds 10% of the designed pond depth.	Sediment cleaned out to designed pond shape and depth.
	Sediment accumulation (first wetpool cell)	Sediment accumulations in pond bottom that exceeds the depth of sediment storage (1 foot) plus 6 inches.	Sediment storage contains no sediment.
	Liner damaged (If Applicable)	Liner is visible or pond does not hold water as designed.	Liner repaired or replaced.
	Water level (first wetpool cell)	First cell empty, doesn't hold water.	Water retained in first cell for most of the year.
	Algae mats (first wetpool cell)	Algae mats develop over more than 10% of the water surface should be removed.	Algae mats removed (usually in the late summer before Fall rains, especially in Sensitive Lake Protection Areas.)
Gravity Drain	Inoperable valve	Valve will not open and close.	Valve opens and closes normally.
	Valve won't seal	Valve does not seal completely.	Valve completely seals closed.
Emergency Overflow Spillway	Tree growth	Tree growth impedes flow or threatens stability of spillway.	Trees removed.

NO. 16 – WETPOND

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance Is Performed
	Rock missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. Rip-rap on inside slopes need not be replaced.	Spillway restored to design standards.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

Appendix F

F-1: KCRTS Conveyance Calculations

Conveyance Calculations

Date: 5/6/16

Refer to Exhibit A-11 for existing drainage basin areas.

[C] CREATE a new Time Series

ST

6.16	0.00	0.000000	Till Forest
0.00	0.00	0.000000	Till Pasture
16.25	0.00	0.000000	Till Grass
0.00	0.00	0.000000	Outwash Forest
0.00	0.00	0.000000	Outwash Pasture
0.00	0.00	0.000000	Outwash Grass
0.11	0.00	0.000000	Wetland
34.23	0.00	0.000000	Impervious

HC-EX.tsf

T

1.00000

Refer to Exhibit A-12 for developed drainage basin areas.

[C] CREATE a new Time Series

ST

5.78	0.00	0.000000	Till Forest
0.00	0.00	0.000000	Till Pasture
25.70	0.00	0.000000	Till Grass
0.00	0.00	0.000000	Outwash Forest
0.00	0.00	0.000000	Outwash Pasture
0.00	0.00	0.000000	Outwash Grass
0.11	0.00	0.000000	Wetland
34.30	0.00	0.000000	Impervious

HC-DEV.tsf

T

1.00000

Flow Frequency Analysis

Time Series File:hc-ex.tsf

Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
34.63	2	12/08/02 17:15	**22.65**	3	**10.00**	0.900

Flow Frequency Analysis

Time Series File:hc-dev.tsf

Project Location:Sea-Tac

---Annual Peak Flow Rates---			-----Flow Frequency Analysis-------			
Flow Rate (CFS)	Rank	Time of Peak	- - Peaks - - (CFS)	Rank	Return Period	Prob
36.78	2	12/08/02 17:15	**23.00**	3	**10.00**	0.900

b. traffic and parking study

TENW
Transportation Engineering NorthWest

MEMORANDUM

DATE: June 1, 2016

TO: Joan Ramsey, AIA, McGranahan Architects

FROM: Michael J Read, P.E., Principal, TENW

SUBJECT: Highline College Master Plan – Parking, Trip Generation, and Site Access Study
TENW Project No. 3356

This memorandum summarizes the results of a campus parking and utilization surveys conducted at the Highline College (HC) campus by Transportation Engineering Northwest, LLC (TENW) and IDAX Data Solutions in February 2016 for the College, and evaluates parking, traffic demand, and site access changes proposed as part the HC Master Plan efforts. The following is documented in this memorandum:

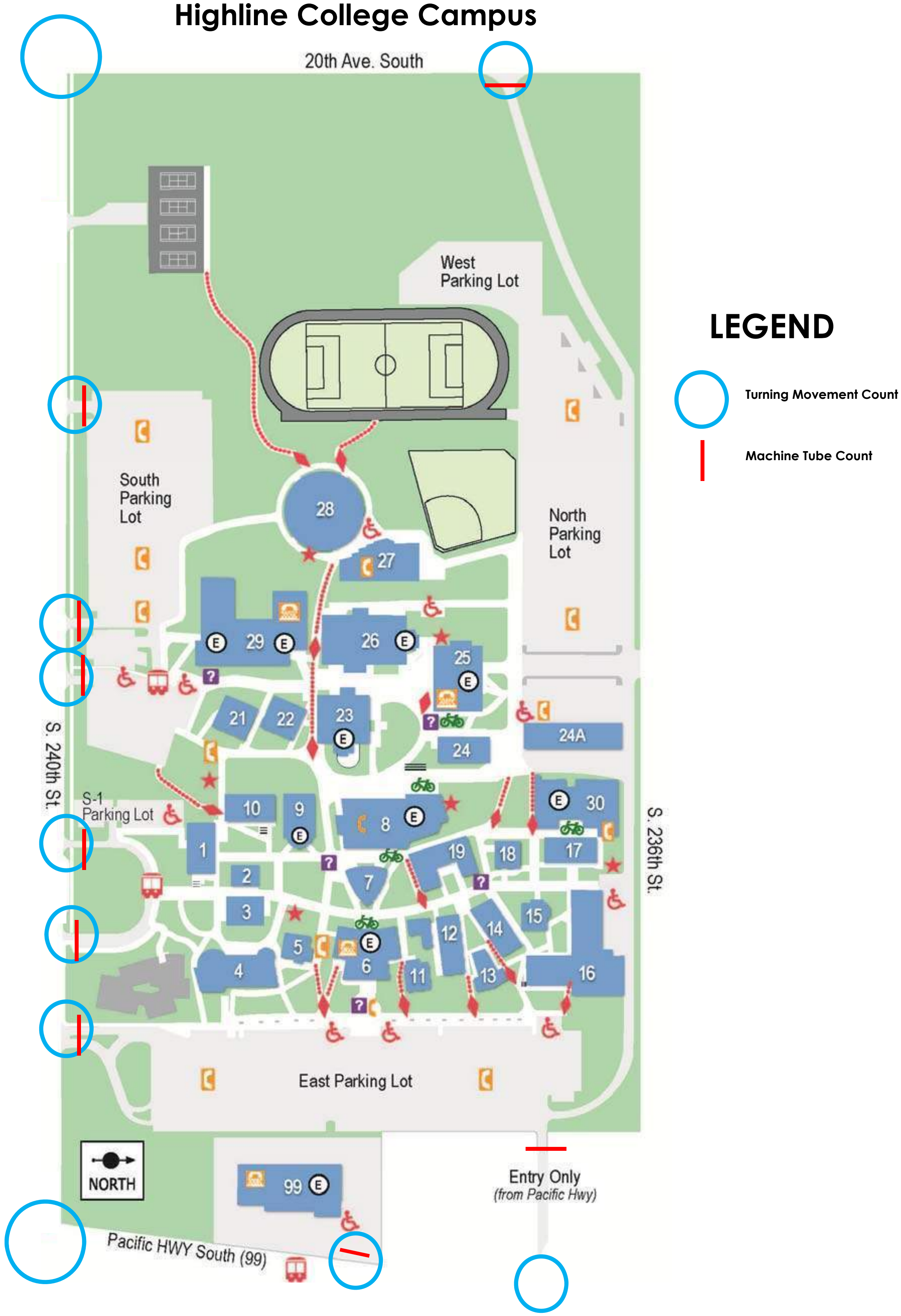
- Survey methodology and types of data collected,
- Existing vehicular trip generation and access distribution,
- Existing parking supply and demand at the campus, and
- Site utilization characteristics, parking management strategies, site access changes, and other indices that will be used to evaluate future access and parking needs in the context of master planning needs of HC.

Survey Methodology

The main purpose of the HC Parking and Trip Generation Study was to provide a detailed understanding of utilization of existing parking supply available to the campus, to determine what demand profiles are currently exhibited, and to gather other utilization characteristics necessary to support and identify future parking and access needs in the context of master planning efforts by the College. In addition to peak spot parking counts, vehicular trip generation during a continuous 3-day period were conducted to determine the overall distribution or access/egress patterns of existing students, employees, and guests to the campus. To support the overall Traffic Impact Analysis that the City of Des Moines will require, peak hour turning movements at all site access driveways and at five off-site intersections.

To accomplish this data need, machine tube counters were placed at nine separate locations throughout the Campus to capture all entering/exiting vehicles as well as internal distribution of traffic (see Figure 1 for locations of 3-day count locations using machine tube counters as well as locations of peak hour turning movement counts in the immediate vicinity of the Campus). In addition, traffic volume for all movements at each driveway location were tabulated to evaluate intersection operations and traffic delays and direct counts of parking occupancy levels by TENW staff were made during peak class periods to determine the utilization and adequacy of existing on-site parking supply. In addition, based on field work prior to the HC Parking and Trip Generation Study, off-site was generated within the Lowe's Home Improvement store complex on the southeast quadrant of the Pacific Highway (SR 99) and S 240th Street signalized intersection as well as an existing gravel lot and access roadway between Pacific Highway (SR 99) and the HC Campus along S 236th Place (private). As such, periodic sweeps through the HC campus also included this off-site supply to determine the full magnitude of off campus parking impacts currently generated.

Figure 1 – Machine Tube and Turning Movement Count Locations at Highline College Campus



Observation Periods

Several weeks after the beginning of Winter Quarter in 2016, TENW began the parking and trip generation surveys. Survey days included continuous 3-day traffic counts entering/leaving the campus from Tuesday, February 2nd through Thursday, February 4th, 2016. All a.m. peak hour and p.m. peak hour counts were performed on Tuesday, February 2nd, 2016. Parking count sweeps were performed by TENW staff on both Wednesday, February 3rd, and Thursday, February 4th, 2016. These counts were taken to identify utilization differences internal to the campus during peak class periods as well as identify and observe other general parking conditions on-site/off-site, circulation and pedestrian functionality during peak periods, and other general transportation conditions in the site vicinity.

Peak hourly volumes generated by the campus occurs between approximately 8:00 a.m. and 9:00 a.m. during the a.m. peak period of adjacent street traffic (an average of1,584 a.m. peak hour trips) and from approximately 5:00 p.m. to 6:00 p.m. during the p.m. peak period of adjacent street traffic (with an average of 876 p.m. peak hour trips). The peak hour of the entire campus throughout the course of the study occurs in the morning during peak arrivals of classes by students and faculty.

To provide a comparative trip generation rate for a college campus, typically two different types of indices are considered: 1) total gross floor area of buildings provide on the campus, and 2) student population levels. Each of these is a measure of the size or capacity of buildings for students and staff, or a measure of peak students that can be served on campus simultaneously. For the Highline College campus, these distinct "capacity" or utilization figures in Winter Quarter of 2016 include approximately 573,230 square-feet in gross floor area of buildings on the campus (including the adjacent leased Outreach Center) with a 2,825 (Source: Highline College Administration, February 2016) peak student headcount population that occurs at 10:00 a.m. Based on these two indices, existing peak hour trip generation rates are calculated in Table 1. As shown, peak hour trip generation per 1,000 square-feet in gross floor area range from approximately 1.53 trips/1,000 square-feet during the p.m. peak hour and 2.76 trips/1,000 square-feet during the a.m. peak hour. On a per student basis, trip generation rates range from 0.31 trips per student in the p.m. peak hour to 0.56 trips per student during the a.m. peak hour.

Table 1
Observed Trip Generation Rates of Highline College Campus - Winter Quarter 2016

Index	Vehicle Trips	Index Measure	Trip Generation Rate
AM Peak Hour			
Gross Floor Area	1,584	573,230	2.76 trips/1,000 SF
Student Headcount	1,584	2,825	0.56 trips/student
PM Peak Hour			
Gross Floor Area	876	573,230	1.53 trips/1,000 SF
Student Headcount	876	2,825	0.31 trips/student

Source: TENW summary of data collected by IDax Data Solutions, February 2016. Source data provided as **Attachment A**.

These observed vehicle trip generation rates would be considered consistent with published rates in *Trip Generation Manual, 9th Edition*, Institute of Transportation Engineers (ITE), 2012, for Junior/Community College land uses during the a.m. peak hour, but are approximately 40 percent lower than published average rates during the p.m. peak hour. Trip generation rates of 2.54 trips/1,000 square-feet in gross floor area during the p.m. peak hour and 2.99 trips/1,000 square-feet in gross floor area during the a.m. peak hour are published by ITE.

Campus Parking Demand

Generally, existing parking areas currently identified by Highline College (parking lots noted in Figure 1) were used as the basis for parking zone observations by TENW. Parking "outside" these zones (i.e., off campus) was also noted during data collection efforts. Currently, there are approximately 2,271 vehicle stalls provided on-site at the Highline College Campus, with 52 stalls designated as ADA. Within the four main parking areas identified on Figure 1 (North Lot, South Lot, East Lot, and Outreach Center Lot), 2,124 stalls are provided. The remaining 147 stalls are scattered throughout the site, immediately adjacent to specific buildings for employees, staff, and other stall types. As is typically, stalls immediately adjacent to buildings were at or near 100 percent occupancy, with up to 8 illegally parked vehicles noted on average within the main South lot. The most western portion of the North Lot was observed with an average of 10 empty stalls during parking sweeps, which is typical given its proximity to the main campus. During the course of the surveys, the West gravel lot was unavailable for general campus parking.

Figure 2 overviews the existing configuration of parking throughout the Highline College campus and the location of observed "off-campus" parking observed in the site vicinity. Table 2 summarizes parking counts collected by TENW in February 2016. As shown, with observed "off-campus parking", average peak demand was approximately 2,387 stalls at 11:00 a.m., resulting in a utilization rate of approximately 105 percent. Based on peak average observations, an existing peak parking demand rate of 4.16 stalls per 1,000 square-feet of gross floor area was determined or indexed to student headcount, a peak parking demand rate of 0.84 stalls/student.

Table 2
Highline College Campus Parking Utilization
Winter Quarter 2016

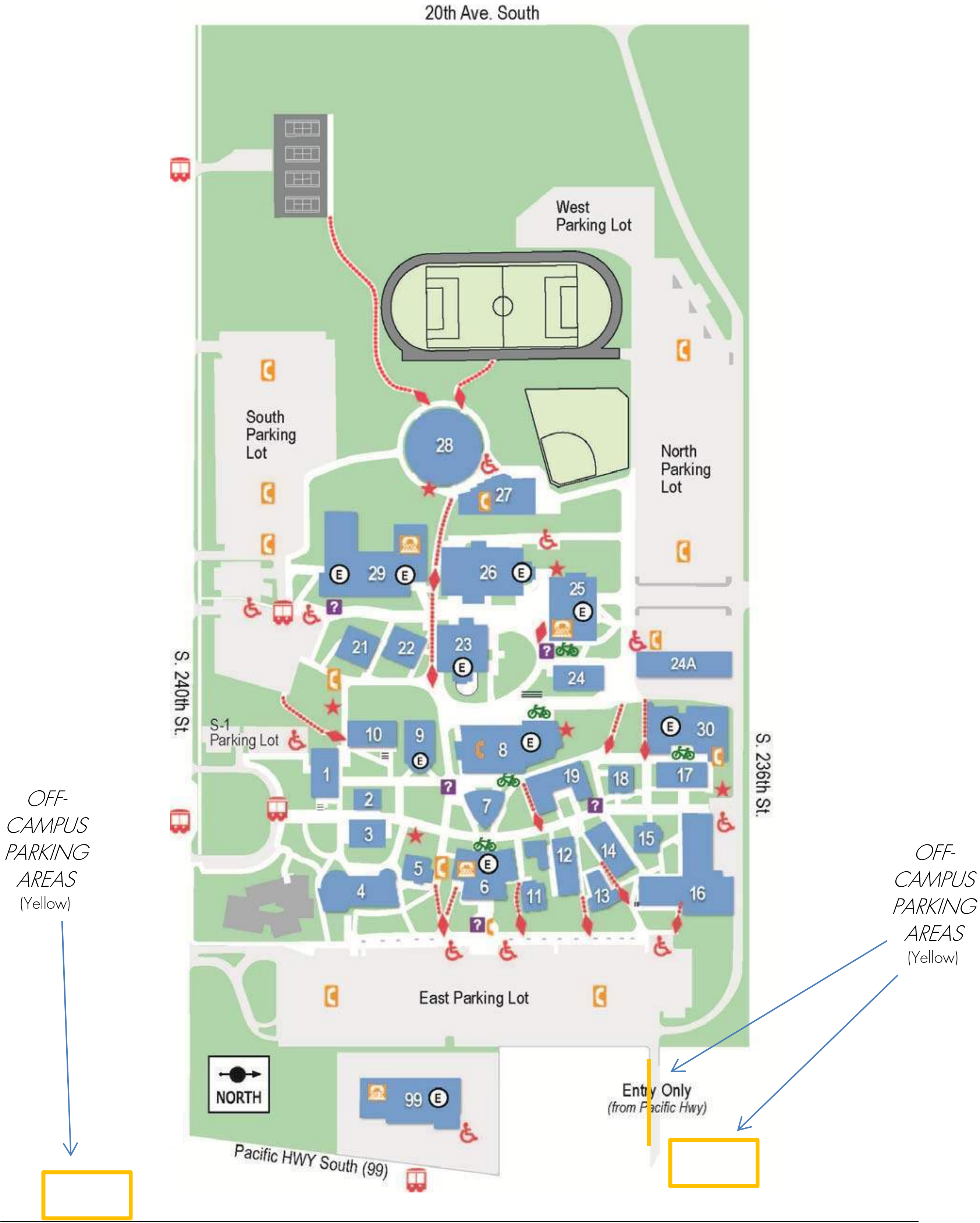
Parking Lot	Average Peak Observed Demand	Percent Utilization
Average Weekday 10:00 to 11:00 AM		
North Lot	767	98.8%
East Lot	623	99.7%
South Lot	582	100.9%
Outreach Center	146	100.0%
Other Campus Misc.	144	98.0%
Off-Site (SR 99)	~50	n/a
Off-Site (Lowe's)	~75	n/a
Total	2,387	105.1%

Source: TENW summary of data collected by observations February 2016.

Increased Traffic and Parking Demand by Master Plan Phase

As part of its campus Master Plan, Highline College has two main phases: Short Term from 2016-2020 and Mid Term from 2021 to 2029. Although there is a potential for future student housing within the campus boundary, as this is a public-private development (privately funded and built), there is not adequate information at this time to determine traffic or parking demand of this component, so it has been excluded

Figure 2 – Parking Areas at Highline College Campus



at this time and would be addressed as part of a private development application if built in the future. Known campus/educational components of the Master Plan by phase include:

<u>Short-Term (2016-2020)</u>
Building 26 Renovation/Expansion
Removal of Buildings 5, 11, and 25A (all faculty offices)
Net Increase in Gross Floor Area of 5,532 square-feet
No Change in Student Capacity
Parking Lot/Entry Reconfiguration to Accommodate 236th Street and Sound Transit Station Area Access
Parking Lot/Entry Changes Eliminate 45 Parking Stalls; Existing Western Gravel Lot Will be Paved to Mitigate for this Loss by 2020 and would Add 60+/- Stalls (A net increase of 15 stalls to campus)

<u>Mid-Term (2021-2029)</u>
Building 23 Renovation/Expansion
Removal of Buildings 15, 16, and 18
Net Increase in Gross Floor Area of 19,412 square-feet
Increase in Study Capacity 120 students
Provide Additional Parking in East Lot Adjacent to S 240th Street (81 stalls)

Trip generation and parking demand rates based on observed conditions were applied to each of these Master Plan phases, considering both changes in floor area and increased student count. As there is no change in student capacity in the Short Term (and therefore no increase in traffic or parking demand), this index was the selected rate to apply. In addition, for the Mid Term plan, application of these rates resulted in slightly higher traffic and parking demands, and therefore, is conservative.

Attachment A provides a summary table of existing trip generation and parking generation rates of the Highline College campus and applies these rates to each Master Plan phase to estimate future traffic and parking generation rates. Shaded cells within the table indicate the selected trip/parking generation rates best applicable to the Master Plan phases. As shown, no change in trip or parking demands is expected under the Short Term phase (given there are no changes in student capacity), while under the Mid Term phase, a net increase of 67 a.m. peak hour trips and 37 p.m. peak hour trips are estimated with the net increase in student capacity of 120 students as part of Building 23 expansion. Under the Mid Term phase an estimated 101 new parking stalls of peak demand would also be generated by increased student/faculty demands.

Sound Transit LRT Adjustments

Detailed ridership estimates prepared by Sound Transit for the future Light Rail station at 236th/SR 99 indicate 65 p.m. peak hour person trips (see Attachment B). This figure represents approximately 7.5 percent of all p.m. peak hour trips currently generated by the campus. Adjusting for average vehicle occupancy, TENW has estimated this would result in a trip reduction of approximately 57 p.m. peak hour trips and approximately 103 a.m. peak hour trips. As these reductions in trips would be more than offset the net increase in traffic and parking demand generated the Highline Campus under the Master Plan phases, a net decrease in overall trips generated by the College is estimated at 36 a.m. peak hour trips and 20 fewer p.m. peak hour trips by the horizon year of 2029. *As noted previously, this does not account for the future potential student housing project on campus, which would be entitled under a separate SEPA process.*

Site Access Modification/Traffic Operations

As noted previously, Sound Transit is building a new light rail station area (with transit center and park-and-ride facility) immediately east of Highline College at 236th Street S and Pacific Highway (SR 99). As part of this station area, a new signalized intersection would be constructed at this intersection and a 3-lane access roadway that provides two-way circulation built to the College campus boundary within the East Parking Lot. A reconfiguration of this East parking Lot and campus entry is conceptually shown in Attachment C.

Campus site access traffic counts during peak hours of adjacent street traffic and of adjacent intersections were used as the basis for evaluating traffic operations with and without the proposed Highline College campus access changes planned by Sound Transit. Attachment D contains the existing turning movement counts at the existing Campus access driveways and the signalize intersection of Pacific Highway (SR 99) and S 240th Street that would be directly affected by the proposed HC campus access modifications by Sound Transit. For 2020 volumes, existing counts were factored by 1.08 using the Synchro growth factor to adjust for background growth not-related to the HC campus. To remain conservative, although the trip generation analysis shows that with the new ST light-rail station overall campus trips would be reduced more than the net increase by 2029, no adjustments were made to existing campus trips to remain conservative. Existing peak hour volumes were adjusted however, to reflect the redistribution of trips away from the access onto S 240th Street from the East Parking lot onto the new S 236th Street signalized intersection. This adjustment included 95 a.m. peak hour trips (15 entering and 80 exiting) and 100 p.m. peak hour trips (85 exiting and 15 entering).

Table 3 summarizes intersection level of service or operations at the two main HC campus driveways that serve the East Parking Lot as well as the adjacent signalized intersection of Pacific Highway (SR 99) and S 240th Street. Two scenarios are analyzed:

- 2016 Existing Conditions (AM Peak Hour/PM Peak Hour)
- 2020 Conditions with Sound Transit Modifications on S 236th Street (AM Peak Hour/PM Peak Hour)

Attachment E provides detailed level of service summary sheets as well as a tabular range of LOS grades per the 2010 Highway Capacity Manual. The City of Des Moines standard is LOS D or better. As shown, no significant changes in intersection operating levels of service would occur as a result of the ST access modifications on S 236th Street into the East Parking lot of the HC campus, with the exception of southbound left turn exiting volumes at the East Parking lot driveway onto S 240th Street which would improve from LOS C to LOS B due to redistribution of traffic.

If you have any questions, please feel free to contact me at (206) 361-7333, ext. 101 or mikeread@tenw.com.

Table 3
Sound Transit HC Access Improvements - Level of Service Impacts

	2016 AM Peak Hour Without Project			2020 AM Peak Hour With ST Access Project		
Study Intersection	LOS	Delay (sec)	V/C Ratio	LOS	Delay (sec)	V/C Ratio
Signalized Intersections						
S 240th Street at Pacific Highway (SR 99)	D	37.3	0.77	D	38.1	0.82
S 236th Street at Pacific Highway (SR 99)	--	--	--	B	17.1	0.64
Stop Controlled Intersections						
HC Campus Drive at Pacific Highway (SR 99)						
Eastbound stop controlled approach	B	11.3	0.02	--	--	--
HC Campus Drive at S 240th Street						
Southbound stop controlled approach	C	16.4	0.23	B	14.9	0.05

	2016 PM Peak Hour Without Project			2020 PM Peak Hour With ST Access Project		
Study Intersection	LOS	Delay (sec)	V/C Ratio	LOS	Delay (sec)	V/C Ratio
Signalized Intersections						
S 240th Street at Pacific Highway (SR 99)	D	52.9	0.81	D	51.2	0.82
S 236th Street at Pacific Highway (SR 99)	--	--	--	B	11.1	0.47
Stop Controlled Intersections						
HC Campus Drive at Pacific Highway (SR 99)						
Eastbound stop controlled approach	B	14.2	0.01	--	--	--
HC Campus Drive at S 240th Street						
Southbound stop controlled approach	C	15.8	0.24	B	14.1	0.05

Source: TENW using Synchro 6.0.

ATTACHMENT A

Trip and Parking Generation by Master Plan Phase

Application of Trip Generation/Parking Generation Rates on Growth Phases (HC Growth Only - No Campus Housing)

Index	Vehicle Trips	Index Measure	Trip Generation Rate	Parking Generation Rate	Short Term (2016-2020) + 5,532 SF or 0 students		Mid Term (2021-2029) + 19,412 SF or 120 students	
			AM Peak Hour		***Trip Demand***	***Parking Demand***	***Trip Demand***	***Parking Demand***
Gross Floor Area	1,584	573,230	2.76 trips/1,000 SF	4.16 stalls trips/1,000 SF	15	23	54	81
Student Headcount	1,584	2,825	0.56 trips/student	0.84 trips/student	0	0	67	101
							LRT Adjustments	
							-103	-103
							Net Increase in Traffic	
							-36	-2
			PM Peak Hour					
Gross Floor Area	876	573,230	1.53 trips/1,000 SF	n/a	8	n/a	30	n/a
Student Headcount	876	2,825	0.31 trips/student		0		37	
							LRT Adjustments	
							-57	-57
							Net Increase in Traffic	
							-20	-57

Note: LRT Adjustments Provided by Sound Transit - 65 PM Peak Hour Trips or Approximately 7.5% Mode Share. Adjustments for Average Vehicle Occupancy by TENW Reduced this by 15%.
Shaded cells indicate the selected indices for trip generation purposes and respresent the worse-case scenario.

As shown, without student capacity increases in the Short Term, no increase in traffic or parking demand would occur. Under the Mid Term growth scenario, increased traffic and parking demand would be offset by the adjacent Sound Transit LRT station at SR 99/236th Street.

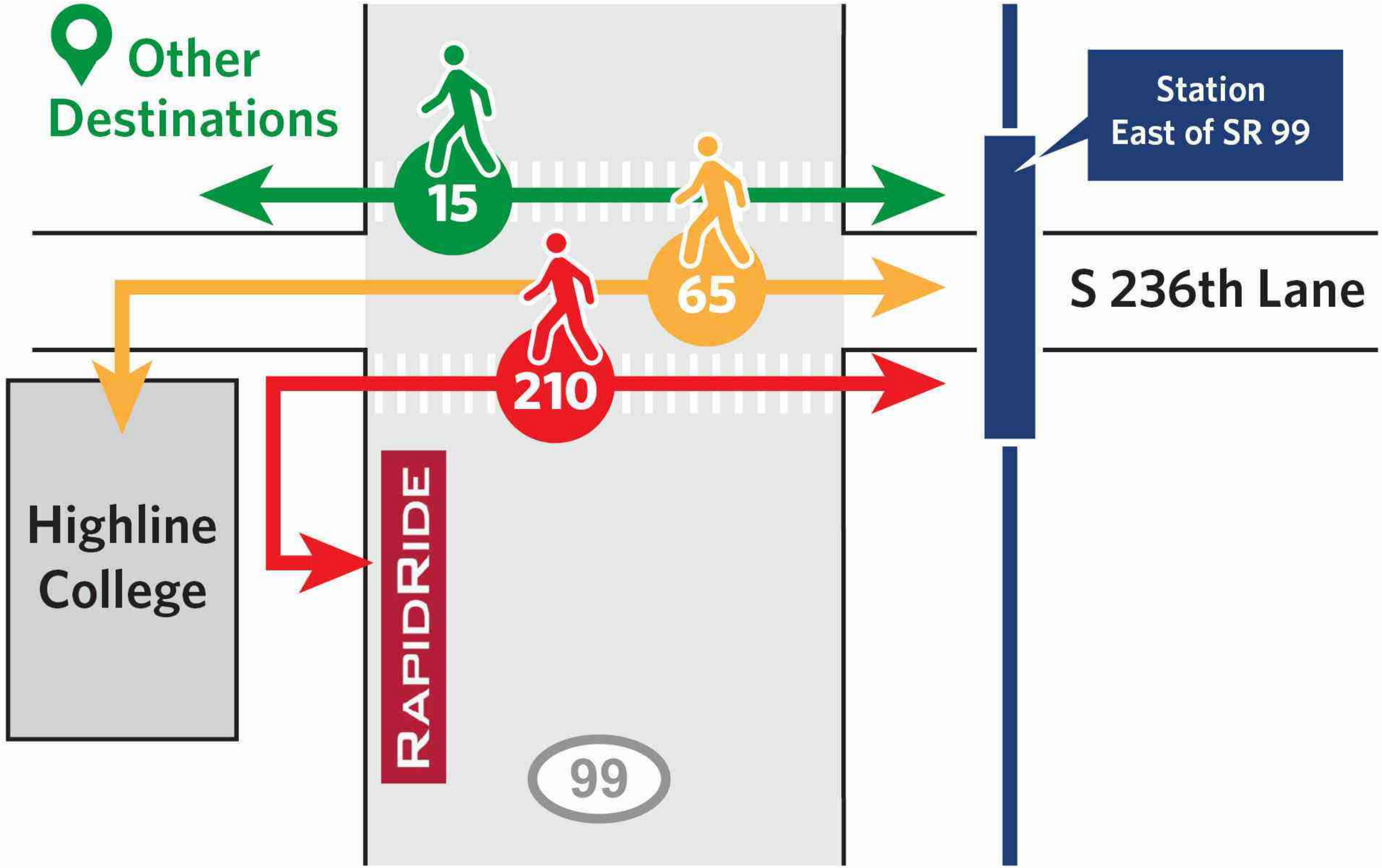
ATTACHMENT B

Sound Transit LRT Ridership Forecasts for Highline College

SR 99 Pedestrian Crossings

Year 2035 PM Peak Hour

Pedestrian Crossings Analysis

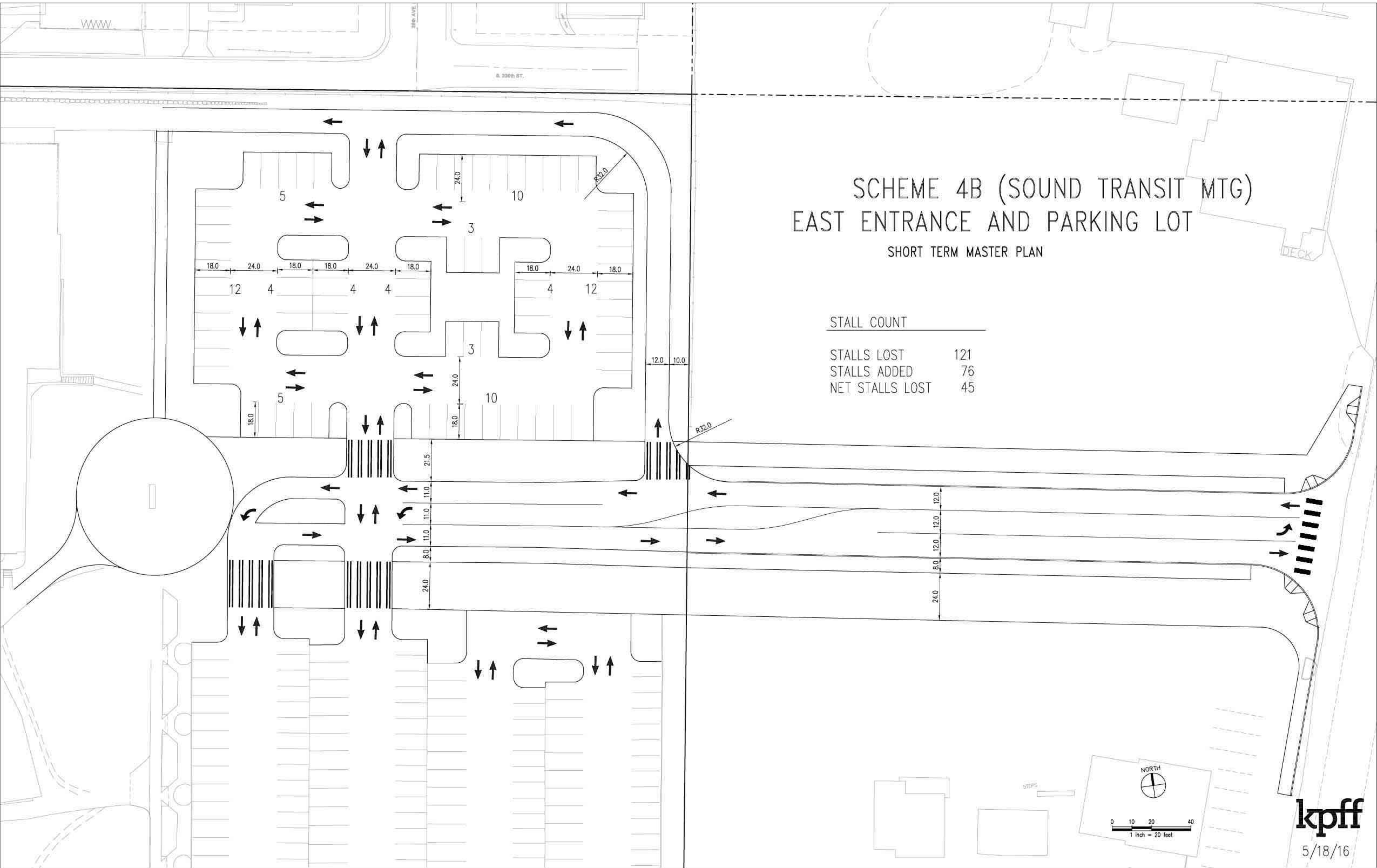


Note: Assumes pedestrians could use either crosswalk.

ATTACHMENT C

Sound Transit Camus Access Changes to East Parking Lot

SCHEME 4B (SOUND TRANSIT MTG)
EAST ENTRANCE AND PARKING LOT
SHORT TERM MASTER PLAN



STALL COUNT	
STALLS LOST	121
STALLS ADDED	76
NET STALLS LOST	45

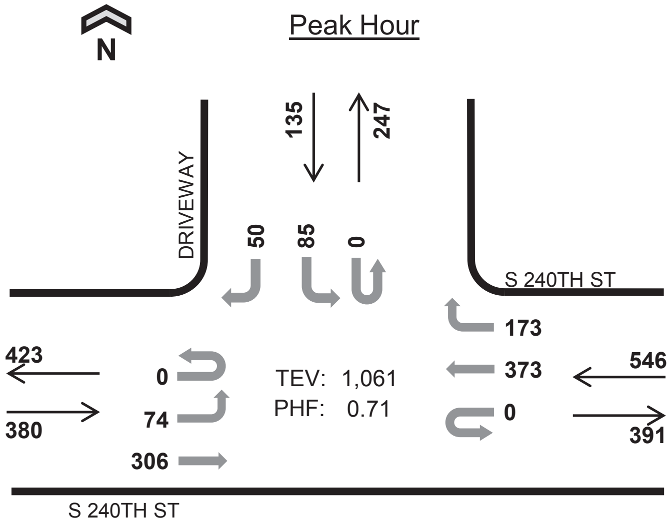
ATTACHMENT D

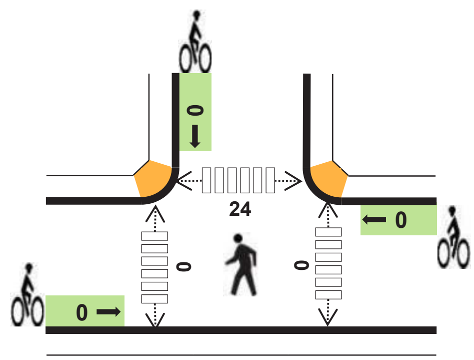
2016 AM/PM Peak Hour Traffic Counts at Campus Access Driveways Impacted by ST Access Modifications

DRIVEWAY
S 240TH ST

Date: Tue, Feb 02, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 8:00 AM to 9:00 AM

Peak Hour





	HV %:	PHF
EB	2.4%	0.81
WB	1.5%	0.77
NB	-	-
SB	0.0%	0.44
TOTAL	1.6%	0.71

Two-Hour Count Summaries

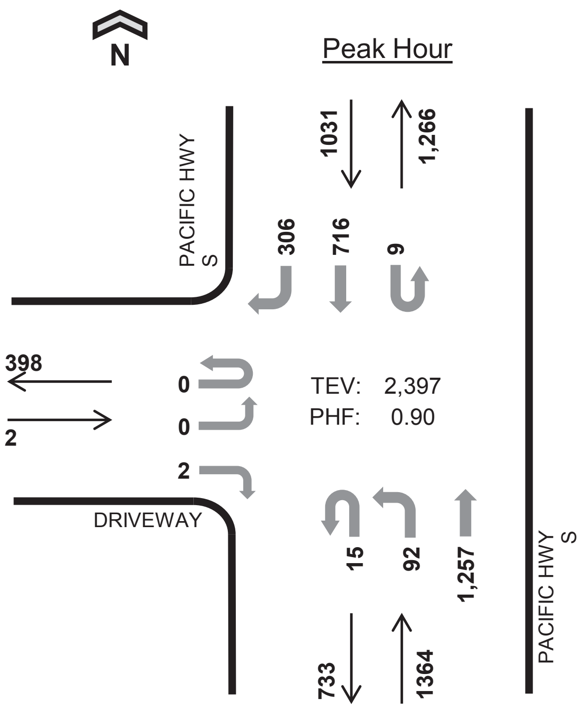
Interval Start	S 240TH ST Eastbound				S 240TH ST Westbound				0 Northbound				DRIVEWAY Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	3	60	0	0	0	43	14	0	0	0	0	0	3	0	1	124	0
7:15 AM	0	10	77	0	0	0	66	21	0	0	0	0	0	8	0	3	185	0
7:30 AM	0	19	84	0	0	0	62	41	0	0	0	0	0	5	0	2	213	0
7:45 AM	0	55	80	0	0	0	94	55	0	0	0	0	0	23	0	10	317	839
8:00 AM	**0**	**19**	**76**	**0**	**0**	**0**	**72**	**52**	**0**	**0**	**0**	**0**	**0**	**13**	**0**	**9**	**241**	956
8:15 AM	**0**	**9**	**61**	**0**	**0**	**0**	**69**	**28**	**0**	**0**	**0**	**0**	**0**	**14**	**0**	**1**	**182**	953
8:30 AM	**0**	**19**	**78**	**0**	**0**	**0**	**104**	**43**	**0**	**0**	**0**	**0**	**0**	**16**	**0**	**5**	**265**	1,005
8:45 AM	**0**	**27**	**91**	**0**	**0**	**0**	**128**	**50**	**0**	**0**	**0**	**0**	**0**	**42**	**0**	**35**	**373**	**1,061**
Count Total	0	161	607	0	0	0	638	304	0	0	0	0	0	124	0	66	1,900	0
Peak Hour	**0**	**74**	**306**	**0**	**0**	**0**	**373**	**173**	**0**	**0**	**0**	**0**	**0**	**85**	**0**	**50**	**1,061**	**0**

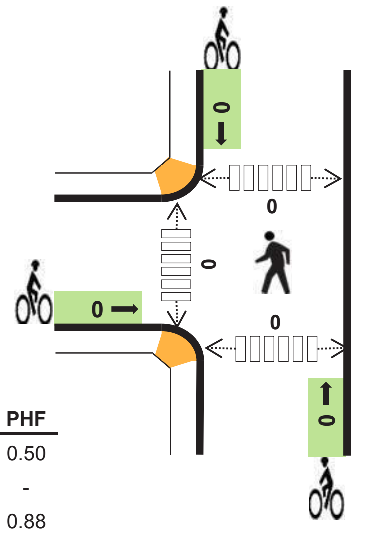
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	1	3	0	0	*4*	0	0	0	0	*0*	0	0	0	0	*0*
7:15 AM	2	3	0	0	*5*	0	0	0	0	*0*	0	0	1	0	*1*
7:30 AM	1	4	0	0	*5*	0	0	0	0	*0*	0	0	11	0	*11*
7:45 AM	2	4	0	0	*6*	0	0	0	0	*0*	0	0	12	0	*12*
8:00 AM	**3**	**3**	**0**	**0**	***6***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**5**	**0**	***5***
8:15 AM	**0**	**3**	**0**	**0**	***3***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**5**	**0**	***5***
8:30 AM	**3**	**2**	**0**	**0**	***5***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**8**	**0**	***8***
8:45 AM	**3**	**0**	**0**	**0**	***3***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**6**	**0**	***6***
Count Total	15	22	0	0	*37*	0	0	0	0	*0*	0	0	48	0	*48*
Peak Hr	**9**	**8**	**0**	**0**	***17***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**24**	**0**	***24***

PACIFIC HWY S
DRIVEWAY

Date: Tue, Feb 02, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:45 AM to 8:45 AM





	HV %:	PHF
EB	0.0%	0.50
WB	-	-
NB	4.0%	0.88
SB	4.5%	0.84
TOTAL	4.2%	0.90

Two-Hour Count Summaries

Interval Start	DRIVEWAY Eastbound UT	LT	TH	RT	0 Westbound UT	LT	TH	RT	PACIFIC HWY S Northbound UT	LT	TH	RT	PACIFIC HWY S Southbound UT	LT	TH	RT	15-min Total	Rolling One Hour
7:00 AM	0	0	0	0	0	0	0	0	1	3	433	0	0	0	100	19	556	0
7:15 AM	0	0	0	0	0	0	0	0	4	5	421	0	1	0	98	31	560	0
7:30 AM	0	0	0	0	0	0	0	0	0	17	380	0	2	0	119	52	570	0
7:45 AM	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**	**45**	**338**	**0**	**1**	**0**	**179**	**96**	**663**	2,349
8:00 AM	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**2**	**17**	**330**	**0**	**1**	**0**	**170**	**66**	**587**	2,380
8:15 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3**	**7**	**322**	**0**	**4**	**0**	**159**	**49**	**544**	2,364
8:30 AM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**23**	**267**	**0**	**3**	**0**	**208**	**95**	**603**	**2,397**
8:45 AM	0	0	0	4	0	0	0	0	5	34	313	0	5	0	199	83	643	2,377
Count Total	0	0	0	6	0	0	0	0	25	151	2,804	0	17	0	1,232	491	4,726	0
Peak Hour	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**15**	**92**	**1,257**	**0**	**9**	**0**	**716**	**306**	**2,397**	**0**

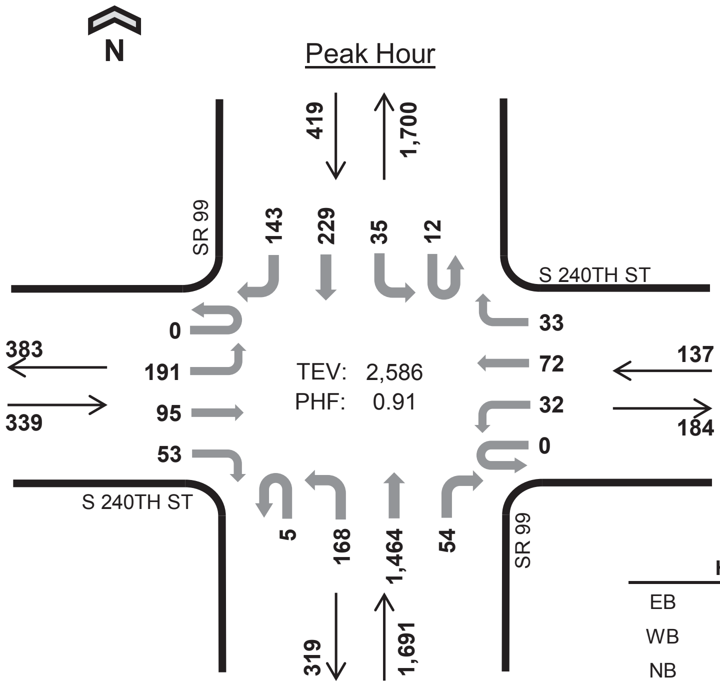
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

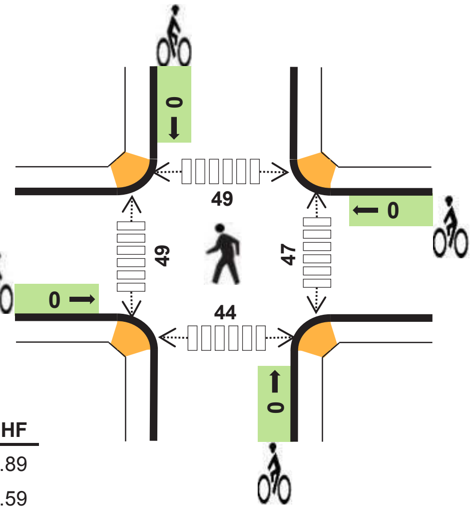
Interval Start	Heavy Vehicle Totals EB	WB	NB	SB	Total	Bicycles EB	WB	NB	SB	Total	Pedestrians (Crossing Leg) East	West	North	South	Total
7:00 AM	0	0	10	7	*17*	0	0	0	0	*0*	0	1	0	0	*1*
7:15 AM	0	0	8	9	*17*	0	0	0	0	*0*	0	0	0	0	*0*
7:30 AM	0	0	13	5	*18*	0	0	0	0	*0*	0	2	0	0	*2*
7:45 AM	**0**	**0**	**10**	**6**	***16***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:00 AM	**0**	**0**	**16**	**15**	***31***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:15 AM	**0**	**0**	**11**	**13**	***24***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	*0*
8:30 AM	**0**	**0**	**17**	**12**	***29***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***
8:45 AM	0	0	5	6	*11*	0	0	0	0	*0*	0	1	0	0	*1*
Count Total	0	0	90	73	*163*	0	0	0	0	*0*	0	4	0	0	*4*
Peak Hr	**0**	**0**	**54**	**46**	***100***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**0**	**0**	***0***

Mark Skaggs: (425) 250-0777 mark.skaggs@idaxdata.com

SR 99
S 240TH ST

Date: Tue, Feb 02, 2016
Count Period: 7:00 AM to 9:00 AM
Peak Hour: 7:00 AM to 8:00 AM





	HV %:	PHF
EB	1.8%	0.89
WB	6.6%	0.59
NB	2.8%	0.95
SB	7.2%	0.73
TOTAL	3.6%	0.91

Two-Hour Count Summaries

Interval Start	S 240TH ST Eastbound				S 240TH ST Westbound				SR 99 Northbound				SR 99 Southbound				15-min Total	Rolling One Hour
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
7:00 AM	0	45	19	5	0	10	10	5	2	30	380	17	3	9	45	20	600	0
7:15 AM	0	47	29	10	0	6	12	10	2	38	396	10	3	9	54	27	653	0
7:30 AM	0	54	27	8	0	9	9	8	0	48	346	10	3	11	59	33	625	0
7:45 AM	0	45	20	30	0	7	41	10	1	52	342	17	3	6	71	63	708	2,586
8:00 AM	0	52	22	16	0	0	7	8	3	44	260	10	0	15	84	58	579	2,565
8:15 AM	0	32	14	17	0	13	6	11	4	55	246	12	2	14	79	45	550	2,462
8:30 AM	0	47	24	13	0	15	22	11	1	53	228	8	1	19	91	68	601	2,438
8:45 AM	0	69	27	27	0	9	26	14	3	53	223	10	7	15	93	72	648	2,378
Count Total	0	391	182	126	0	69	133	77	16	373	2,421	94	22	98	576	386	4,964	0
Peak Hour	0	191	95	53	0	32	72	33	5	168	1,464	54	12	35	229	143	2,586	0

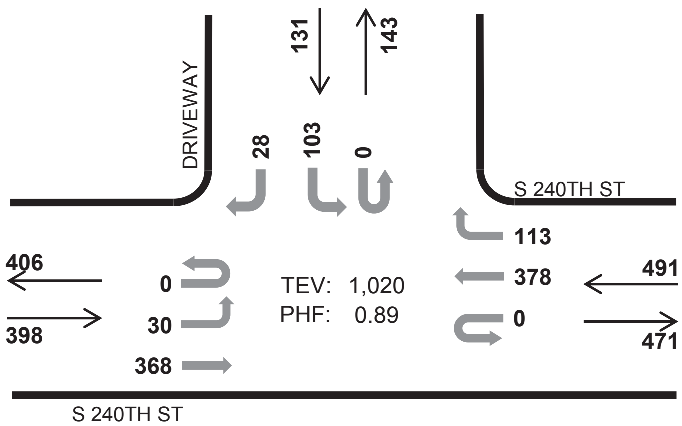
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

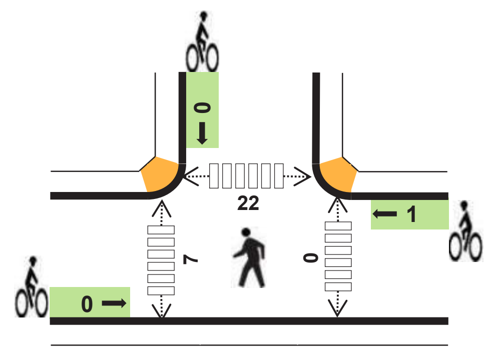
Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
7:00 AM	1	2	14	4	*21*	0	0	0	0	*0*	1	6	4	7	*18*
7:15 AM	2	3	9	13	*27*	0	0	0	0	*0*	13	1	14	14	*42*
7:30 AM	1	3	13	6	*23*	0	0	0	0	*0*	19	19	15	2	*55*
7:45 AM	2	1	11	7	*21*	0	0	0	0	*0*	14	23	16	21	*74*
8:00 AM	3	2	20	15	*40*	0	0	0	0	*0*	11	5	12	3	*31*
8:15 AM	1	2	10	11	*24*	0	0	0	0	*0*	10	4	12	5	*31*
8:30 AM	4	3	9	13	*29*	0	0	0	0	*0*	18	43	24	32	*117*
8:45 AM	2	3	8	6	*19*	0	0	0	0	*0*	26	17	26	6	*75*
Count Total	16	19	94	75	*204*	0	0	0	0	*0*	112	118	123	90	*443*
Peak Hour	6	9	47	30	*92*	0	0	0	0	*0*	47	49	49	44	*189*

DRIVEWAY
S 240TH ST

Date: Tue, Feb 02, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 5:00 PM to 6:00 PM

Peak Hour





	HV %:	PHF
EB	2.0%	0.81
WB	1.0%	0.76
NB	-	-
SB	1.5%	0.82
TOTAL	1.5%	0.89

Two-Hour Count Summaries

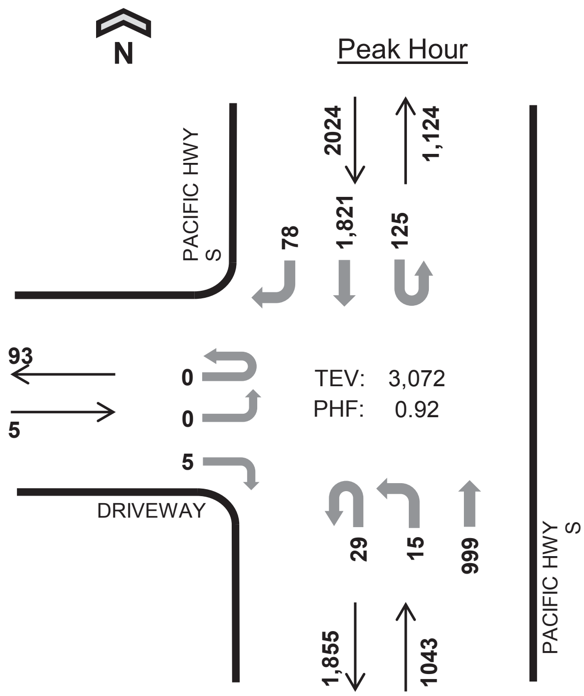
Interval Start	S 240TH ST				S 240TH ST				0				DRIVEWAY				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	10	99	0	0	0	99	23	0	0	0	0	0	27	0	7	265	0
4:15 PM	0	14	90	0	0	0	72	24	0	0	0	0	0	35	0	3	238	0
4:30 PM	0	5	89	0	0	0	77	19	0	0	0	0	0	26	0	7	223	0
4:45 PM	0	6	81	0	0	0	76	8	0	0	0	0	0	21	0	3	195	921
5:00 PM	**0**	**4**	**86**	**0**	**0**	**0**	**87**	**13**	**0**	**0**	**0**	**0**	**0**	**29**	**0**	**10**	**229**	885
5:15 PM	**0**	**7**	**90**	**0**	**0**	**0**	**89**	**16**	**0**	**0**	**0**	**0**	**0**	**20**	**0**	**5**	**227**	874
5:30 PM	**0**	**12**	**111**	**0**	**0**	**0**	**93**	**32**	**0**	**0**	**0**	**0**	**0**	**32**	**0**	**8**	**288**	939
5:45 PM	**0**	**7**	**81**	**0**	**0**	**0**	**109**	**52**	**0**	**0**	**0**	**0**	**0**	**22**	**0**	**5**	**276**	**1,020**
Count Total	0	65	727	0	0	0	702	187	0	0	0	0	0	212	0	48	1,941	0
Peak Hour	**0**	**30**	**368**	**0**	**0**	**0**	**378**	**113**	**0**	**0**	**0**	**0**	**0**	**103**	**0**	**28**	**1,020**	**0**

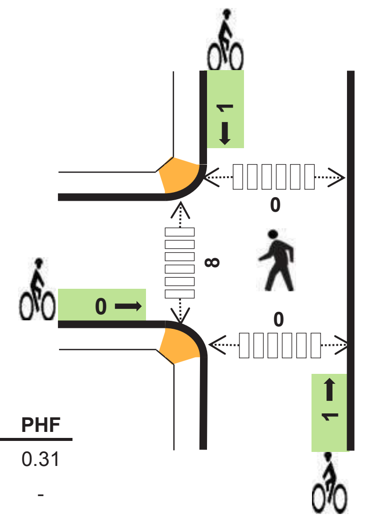
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	3	2	0	0	*5*	0	1	0	0	*1*	0	0	4	0	*4*
4:15 PM	2	1	0	0	*3*	0	0	0	0	*0*	0	0	2	0	*2*
4:30 PM	2	1	0	0	*3*	0	0	0	0	*0*	0	0	6	0	*6*
4:45 PM	0	3	0	0	*3*	0	0	0	0	*0*	0	1	2	0	*3*
5:00 PM	**2**	**2**	**0**	**1**	***5***	**0**	**0**	**0**	**0**	***0***	**0**	**0**	**4**	**0**	*4*
5:15 PM	**2**	**1**	**0**	**0**	***3***	**0**	**0**	**0**	**0**	***0***	**0**	**1**	**8**	**0**	*9*
5:30 PM	**2**	**1**	**0**	**1**	***4***	**0**	**1**	**0**	**0**	***1***	**0**	**0**	**5**	**0**	*5*
5:45 PM	**2**	**1**	**0**	**0**	***3***	**0**	**0**	**0**	**0**	***0***	**0**	**6**	**5**	**0**	***11***
Count Total	15	12	0	2	*29*	0	2	0	0	*2*	0	8	36	0	*44*
Peak Hr	**8**	**5**	**0**	**2**	***15***	**0**	**1**	**0**	**0**	***1***	**0**	**7**	**22**	**0**	***29***

PACIFIC HWY S
DRIVEWAY

Date: Tue, Feb 02, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 5:00 PM to 6:00 PM





	HV %:	PHF
EB	0.0%	0.31
WB	-	-
NB	2.4%	0.83
SB	1.7%	0.97
TOTAL	1.9%	0.92

Two-Hour Count Summaries

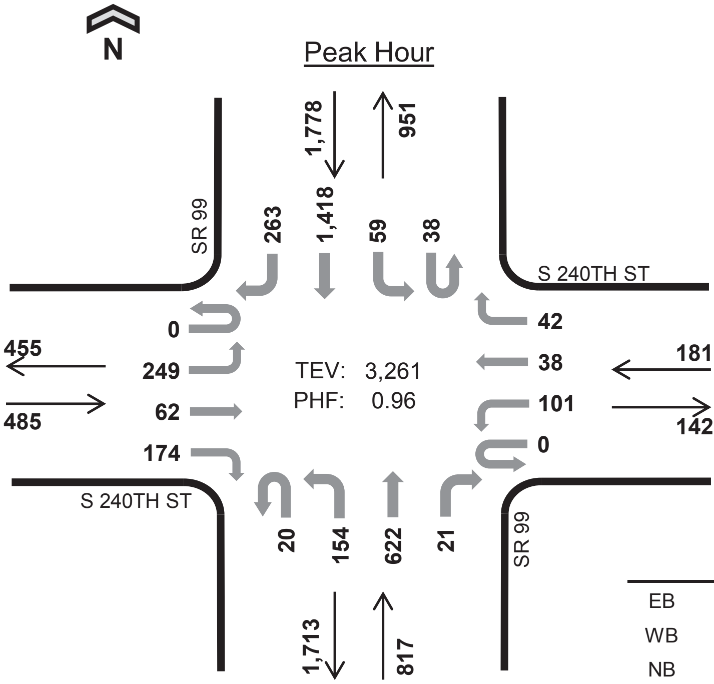
Interval Start	DRIVEWAY				0				PACIFIC HWY S				PACIFIC HWY S				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	0	0	1	0	0	0	0	2	1	245	0	18	0	454	24	745	0
4:15 PM	0	0	0	0	0	0	0	0	8	2	243	0	23	0	444	25	745	0
4:30 PM	0	0	0	2	0	0	0	0	5	5	257	0	31	0	435	27	762	0
4:45 PM	0	0	0	0	0	0	0	0	1	2	203	0	30	0	418	12	666	2,918
5:00 PM	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**3**	**2**	**220**	**0**	**29**	**0**	**482**	**8**	**745**	2,918
5:15 PM	**0**	**0**	**0**	**4**	**0**	**0**	**0**	**0**	**8**	**2**	**242**	**0**	**24**	**0**	**452**	**17**	**749**	2,922
5:30 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**7**	**298**	**0**	**40**	**0**	**467**	**17**	**838**	2,998
5:45 PM	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**9**	**4**	**239**	**0**	**32**	**0**	**420**	**36**	**740**	**3,072**
Count Total	0	0	0	8	0	0	0	0	45	25	1,947	0	227	0	3,572	166	5,990	0
Peak Hour	**0**	**0**	**0**	**5**	**0**	**0**	**0**	**0**	**29**	**15**	**999**	**0**	**125**	**0**	**1,821**	**78**	**3,072**	**0**

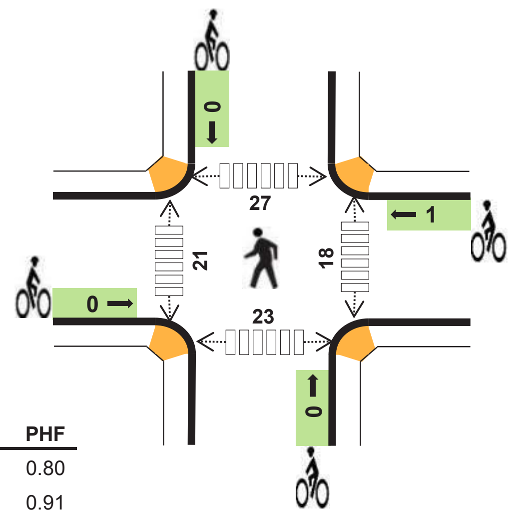
Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	0	0	6	8	*14*	0	0	0	0	*0*	0	3	0	0	*3*
4:15 PM	0	0	12	10	*22*	0	0	0	0	*0*	0	0	0	0	*0*
4:30 PM	0	0	11	10	*21*	0	0	0	0	*0*	0	1	0	0	*1*
4:45 PM	0	0	4	10	*14*	0	0	1	0	*1*	0	3	0	0	*3*
5:00 PM	**0**	**0**	**8**	**11**	***19***	**0**	**0**	**0**	**0**	***0***	**0**	**2**	**0**	**0**	*2*
5:15 PM	**0**	**0**	**3**	**7**	***10***	**0**	**0**	**0**	**0**	***0***	**0**	**2**	**0**	**0**	*2*
5:30 PM	**0**	**0**	**7**	**8**	***15***	**0**	**0**	**1**	**1**	**2**	**0**	**1**	**0**	**0**	*1*
5:45 PM	**0**	**0**	**7**	**8**	***15***	**0**	**0**	**0**	**0**	***0***	**0**	**3**	**0**	**0**	*3*
Count Total	0	0	58	72	*130*	0	0	2	1	*3*	0	15	0	0	*15*
Peak Hr	**0**	**0**	**25**	**34**	***59***	**0**	**0**	**1**	**1**	**2**	**0**	**8**	**0**	**0**	*8*

SR 99
S 240TH ST

Date: Tue, Feb 02, 2016
Count Period: 4:00 PM to 6:00 PM
Peak Hour: 5:00 PM to 6:00 PM





	HV %:	PHF
EB	2.1%	0.80
WB	2.8%	0.91
NB	1.8%	0.95
SB	2.0%	0.93
TOTAL	2.0%	0.96

Two-Hour Count Summaries

Interval Start	S 240TH ST				S 240TH ST				SR 99				SR 99				15-min Total	Rolling One Hour
	Eastbound				Westbound				Northbound				Southbound					
	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT	UT	LT	TH	RT		
4:00 PM	0	64	20	48	0	30	19	12	8	37	164	8	8	17	320	44	799	0
4:15 PM	0	54	14	42	0	22	10	13	2	43	181	8	8	13	359	41	810	0
4:30 PM	0	59	14	54	0	25	9	10	4	40	168	5	10	18	346	37	799	0
4:45 PM	0	52	17	30	0	15	6	7	6	24	164	10	12	20	375	48	786	3,194
5:00 PM	**0**	**71**	**11**	**47**	**0**	**30**	**12**	**8**	**3**	**18**	**150**	**7**	**10**	**17**	**347**	**59**	**790**	3,185
5:15 PM	**0**	**53**	**15**	**35**	**0**	**27**	**6**	**17**	**8**	**38**	**166**	**4**	**13**	**15**	**394**	**54**	**845**	3,220
5:30 PM	**0**	**74**	**17**	**60**	**0**	**21**	**9**	**10**	**7**	**35**	**170**	**3**	**8**	**15**	**318**	**68**	**815**	3,236
5:45 PM	**0**	**51**	**19**	**32**	**0**	**23**	**11**	**7**	**2**	**63**	**136**	**7**	**7**	**12**	**359**	**82**	**811**	**3,261**
Count Total	0	478	127	348	0	193	82	84	40	298	1,299	52	76	127	2,818	433	6,455	0
Peak Hour	**0**	**249**	**62**	**174**	**0**	**101**	**38**	**42**	**20**	**154**	**622**	**21**	**38**	**59**	**1,418**	**263**	**3,261**	**0**

Note: Two-hour count summary volumes include heavy vehicles but exclude bicycles in overall count.

Interval Start	Heavy Vehicle Totals					Bicycles					Pedestrians (Crossing Leg)				
	EB	WB	NB	SB	Total	EB	WB	NB	SB	Total	East	West	North	South	Total
4:00 PM	2	1	4	6	*13*	0	1	0	0	*1*	4	2	7	8	*21*
4:15 PM	2	1	9	9	*21*	0	0	0	0	*0*	10	2	10	4	*26*
4:30 PM	2	0	10	10	*22*	0	1	0	0	*1*	14	0	4	5	*23*
4:45 PM	0	0	5	11	*16*	0	0	0	2	*2*	3	3	3	9	*18*
5:00 PM	**3**	**1**	**4**	**10**	***18***	**0**	**0**	**0**	**0**	***0***	**7**	**2**	**6**	**12**	*27*
5:15 PM	**2**	**2**	**3**	**10**	***17***	**0**	**0**	**0**	**0**	***0***	**4**	**8**	**6**	**5**	*23*
5:30 PM	**3**	**2**	**4**	**7**	***16***	**0**	**1**	**0**	**0**	***1***	**4**	**8**	**4**	**4**	*20*
5:45 PM	**2**	**0**	**4**	**8**	***14***	**0**	**0**	**0**	**0**	***0***	**3**	**3**	**11**	**2**	*19*
Count Total	16	7	43	71	*137*	0	3	0	2	*5*	49	28	51	49	*177*
Peak Hour	**10**	**5**	**15**	**35**	***65***	**0**	**1**	**0**	**0**	***1***	**18**	**21**	**27**	**23**	***89***

Mark Skaggs: (425) 250-0777 mark.skaggs@idaxdata.com

ATTACHMENT E

Intersection Level of Service Summary Sheets

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95	1.00		1.00
Frt	1.00	0.95		1.00	0.95			1.00	1.00	0.85		1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (prot)	1770	1762		1770	1775			1770	3539	1583		1770
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (perm)	1770	1762		1770	1775			1770	3539	1583		1770
Volume (vph)	191	95	53	32	72	33	5	168	1464	54	12	35
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	208	103	58	35	78	36	5	183	1591	59	13	38
RTOR Reduction (vph)	0	22	0	0	18	0	0	0	0	31	0	0
Lane Group Flow (vph)	208	139	0	35	96	0	0	188	1591	28	0	51
Turn Type	Prot			Prot			Prot	Prot		Perm	Prot	Prot
Protected Phases	7	4		3	8		5	5	2		1	1
Permitted Phases										2		
Actuated Green, G (s)	11.0	21.0		6.0	16.0			17.0	43.0	43.0		4.0
Effective Green, g (s)	11.0	21.0		6.0	16.0			17.0	43.0	43.0		4.0
Actuated g/C Ratio	0.12	0.23		0.07	0.18			0.19	0.48	0.48		0.04
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Grp Cap (vph)	216	411		118	316			334	1691	756		79
v/s Ratio Prot	c0.12	c0.08		0.02	0.05			c0.11	c0.45			0.03
v/s Ratio Perm										0.02		
v/c Ratio	0.96	0.34		0.30	0.30			0.56	0.94	0.04		0.65
Uniform Delay, d1	39.3	28.7		40.0	32.2			33.1	22.3	12.5		42.3
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00		0.99
Incremental Delay, d2	52.3	2.2		6.3	2.5			6.7	11.7	0.1		34.2
Delay (s)	91.6	30.9		46.3	34.6			39.8	34.0	12.6		76.2
Level of Service	F	C		D	C			D	C	B		E
Approach Delay (s)		65.1			37.4				33.9			
Approach LOS		E			D				C			

Intersection Summary			
HCM Average Control Delay	37.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBT	SBR
Lane Configurations		
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	4.0
Lane Util. Factor	0.95	1.00
Frt	1.00	0.85
Flt Protected	1.00	1.00
Satd. Flow (prot)	3539	1583
Flt Permitted	1.00	1.00
Satd. Flow (perm)	3539	1583
Volume (vph)	229	143
Peak-hour factor, PHF	0.92	0.92
Adj. Flow (vph)	249	155
RTOR Reduction (vph)	0	103
Lane Group Flow (vph)	249	52
Turn Type		Perm
Protected Phases	6	
Permitted Phases		6
Actuated Green, G (s)	30.0	30.0
Effective Green, g (s)	30.0	30.0
Actuated g/C Ratio	0.33	0.33
Clearance Time (s)	4.0	4.0
Lane Grp Cap (vph)	1180	528
v/s Ratio Prot	0.07	
v/s Ratio Perm		0.03
v/c Ratio	0.21	0.10
Uniform Delay, d1	21.5	20.7
Progression Factor	1.01	1.05
Incremental Delay, d2	0.4	0.4
Delay (s)	22.2	22.1
Level of Service	C	C
Approach Delay (s)	28.2	
Approach LOS	C	

Intersection Summary

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Sign Control	Stop				Free	Free	
Grade	0%				0%	0%	
Volume (veh/h)	0	2	15	92	1257	716	306
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	2	0	100	1366	778	333
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	None						
Median storage veh)							
Upstream signal (ft)					1016		
pX, platoon unblocked			0.00				
vC, conflicting volume	1600	426	0	1111			
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	1600	426	0	1111			
tC, single (s)	6.8	6.9	0.0	4.1			
tC, 2 stage (s)							
tF (s)	3.5	3.3	0.0	2.2			
p0 queue free %	100	100	0	84			
cM capacity (veh/h)	81	577	0	624			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3
Volume Total	2	100	455	455	455	311	311	488
Volume Left	0	100	0	0	0	0	0	0
Volume Right	2	0	0	0	0	0	0	333
cSH	577	624	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.16	0.27	0.27	0.27	0.18	0.18	0.29
Queue Length 95th (ft)	0	14	0	0	0	0	0	0
Control Delay (s)	11.3	11.9	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	B						
Approach Delay (s)	11.3	0.8				0.0		
Approach LOS	B							

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	39.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	74	306	373	173	85	50
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	80	333	405	188	92	54
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					TWLTL	
Median storage veh)					1	
Upstream signal (ft)			458			
pX, platoon unblocked						
vC, conflicting volume	593				899	405
vC1, stage 1 conf vol					405	
vC2, stage 2 conf vol					493	
vCu, unblocked vol	593				899	405
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	92				77	92
cM capacity (veh/h)	983				408	645

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	80	333	405	188	92	54
Volume Left	80	0	0	0	92	0
Volume Right	0	0	0	188	0	54
cSH	983	1700	1700	1700	408	645
Volume to Capacity	0.08	0.20	0.24	0.11	0.23	0.08
Queue Length 95th (ft)	7	0	0	0	22	7
Control Delay (s)	9.0	0.0	0.0	0.0	16.4	11.1
Lane LOS	A				C	B
Approach Delay (s)	1.8		0.0		14.4	
Approach LOS					B	

Intersection Summary			
Average Delay	2.5		
Intersection Capacity Utilization	38.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95	1.00		1.00
Frt	1.00	0.89		1.00	0.92			1.00	1.00	0.85		1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (prot)	1770	1657		1770	1716			1770	3539	1583		1770
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (perm)	1770	1657		1770	1716			1770	3539	1583		1770
Volume (vph)	249	62	174	101	38	42	20	154	622	21	38	59
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	259	65	181	105	40	44	21	160	648	22	40	61
RTOR Reduction (vph)	0	111	0	0	36	0	0	0	0	14	0	0
Lane Group Flow (vph)	259	135	0	105	48	0	0	181	648	8	0	101
Turn Type	Prot			Prot			Prot	Prot		Perm	Prot	Prot
Protected Phases	7	4		3	8		5	5	2		1	1
Permitted Phases										2		
Actuated Green, G (s)	13.0	18.0		11.0	16.0			9.0	34.0	34.0		11.0
Effective Green, g (s)	13.0	18.0		11.0	16.0			9.0	34.0	34.0		11.0
Actuated g/C Ratio	0.14	0.20		0.12	0.18			0.10	0.38	0.38		0.12
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Grp Cap (vph)	256	331		216	305			177	1337	598		216
v/s Ratio Prot	c0.15	c0.08		0.06	0.03			c0.10	0.18			0.06
v/s Ratio Perm										0.01		
v/c Ratio	1.01	0.41		0.49	0.16			1.02	0.48	0.01		0.47
Uniform Delay, d1	38.5	31.4		36.9	31.3			40.5	21.3	17.5		36.8
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2	59.3	3.7		7.6	1.1			73.7	1.3	0.0		7.1
Delay (s)	97.8	35.0		44.5	32.4			114.2	22.6	17.6		43.9
Level of Service	F	D		D	C			F	C	B		D
Approach Delay (s)		67.2			39.1				41.9			
Approach LOS		E			D				D			

Intersection Summary			
HCM Average Control Delay	52.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBT	SBR
Lane Configurations	↑↑	↱
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	4.0
Lane Util. Factor	0.95	1.00
Frt	1.00	0.85
Flt Protected	1.00	1.00
Satd. Flow (prot)	3539	1583
Flt Permitted	1.00	1.00
Satd. Flow (perm)	3539	1583
Volume (vph)	1418	263
Peak-hour factor, PHF	0.96	0.96
Adj. Flow (vph)	1477	274
RTOR Reduction (vph)	0	155
Lane Group Flow (vph)	1477	119
Turn Type		Perm
Protected Phases	6	
Permitted Phases		6
Actuated Green, G (s)	36.0	36.0
Effective Green, g (s)	36.0	36.0
Actuated g/C Ratio	0.40	0.40
Clearance Time (s)	4.0	4.0
Lane Grp Cap (vph)	1416	633
v/s Ratio Prot	c0.42	
v/s Ratio Perm		0.07
v/c Ratio	1.04	0.19
Uniform Delay, d1	27.0	17.5
Progression Factor	1.01	1.02
Incremental Delay, d2	36.0	0.7
Delay (s)	63.1	18.5
Level of Service	E	B
Approach Delay (s)	55.5	
Approach LOS	E	

Intersection Summary

Movement	EBL	EBR	NBU	NBL	NBT	SBT	SBR
Lane Configurations							
Sign Control	Stop				Free	Free	
Grade	0%				0%	0%	
Volume (veh/h)	0	5	29	15	999	1821	78
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	0	5	0	16	1041	1897	81
Pedestrians							
Lane Width (ft)							
Walking Speed (ft/s)							
Percent Blockage							
Right turn flare (veh)							
Median type	None						
Median storage veh)							
Upstream signal (ft)					1016		
pX, platoon unblocked			0.00				
vC, conflicting volume	2316	673	0	1978			
vC1, stage 1 conf vol							
vC2, stage 2 conf vol							
vCu, unblocked vol	2316	673	0	1978			
tC, single (s)	6.8	6.9	0.0	4.1			
tC, 2 stage (s)							
tF (s)	3.5	3.3	0.0	2.2			
p0 queue free %	100	99	0	95			
cM capacity (veh/h)	30	398	0	289			

Direction, Lane #	EB 1	NB 1	NB 2	NB 3	NB 4	SB 1	SB 2	SB 3
Volume Total	5	16	347	347	347	759	759	461
Volume Left	0	16	0	0	0	0	0	0
Volume Right	5	0	0	0	0	0	0	81
cSH	398	289	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.01	0.05	0.20	0.20	0.20	0.45	0.45	0.27
Queue Length 95th (ft)	1	4	0	0	0	0	0	0
Control Delay (s)	14.2	18.2	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B	C						
Approach Delay (s)	14.2	0.3				0.0		
Approach LOS	B							

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	30	386	378	113	103	28
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	31	402	394	118	107	29
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					TWLTL	
Median storage veh)					1	
Upstream signal (ft)			458			
pX, platoon unblocked						
vC, conflicting volume	511				858	394
vC1, stage 1 conf vol					394	
vC2, stage 2 conf vol					465	
vCu, unblocked vol	511				858	394
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				76	96
cM capacity (veh/h)	1054				439	655

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	31	402	394	118	107	29
Volume Left	31	0	0	0	107	0
Volume Right	0	0	0	118	0	29
cSH	1054	1700	1700	1700	439	655
Volume to Capacity	0.03	0.24	0.23	0.07	0.24	0.04
Queue Length 95th (ft)	2	0	0	0	24	3
Control Delay (s)	8.5	0.0	0.0	0.0	15.8	10.8
Lane LOS	A				C	B
Approach Delay (s)	0.6		0.0		14.7	
Approach LOS					B	

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	37.3%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
3: S 240th St & International Blvd - SR 99 6/1/2016

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95	1.00		1.00
Frt	1.00	0.96		1.00	0.95			1.00	1.00	0.85		1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (prot)	1770	1783		1770	1775			1770	3539	1583		1770
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (perm)	1770	1783		1770	1775			1770	3539	1583		1770
Volume (vph)	126	95	38	32	72	33	5	153	1479	54	12	35
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor (vph)	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%
Adj. Flow (vph)	148	112	45	38	85	39	6	180	1736	63	14	41
RTOR Reduction (vph)	0	16	0	0	18	0	0	0	0	31	0	0
Lane Group Flow (vph)	148	141	0	38	106	0	0	186	1736	33	0	55
Turn Type	Prot			Prot			Prot	Prot		Perm	Prot	Prot
Protected Phases	7	4		3	8		5	5	2		1	1
Permitted Phases										2		
Actuated Green, G (s)	9.0	19.0		6.0	16.0			16.0	45.0	45.0		4.0
Effective Green, g (s)	9.0	19.0		6.0	16.0			16.0	45.0	45.0		4.0
Actuated g/C Ratio	0.10	0.21		0.07	0.18			0.18	0.50	0.50		0.04
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Grp Cap (vph)	177	376		118	316			315	1770	792		79
v/s Ratio Prot	c0.08	c0.08		0.02	0.06			c0.11	c0.49			0.03
v/s Ratio Perm										0.02		
v/c Ratio	0.84	0.38		0.32	0.34			0.59	0.98	0.04		0.70
Uniform Delay, d1	39.8	30.4		40.1	32.3			34.0	22.1	11.5		42.4
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2	35.1	2.9		7.1	2.8			7.9	17.3	0.1		40.3
Delay (s)	74.9	33.3		47.1	35.2			41.9	39.4	11.6		82.7
Level of Service	E	C		D	D			D	D	B		F
Approach Delay (s)		53.5			38.0				38.7			
Approach LOS		D			D				D			

Intersection Summary			
HCM Average Control Delay	38.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	74.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBT	SBR
Lane Configurations		
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	4.0
Lane Util. Factor	0.95	1.00
Frt	1.00	0.85
Flt Protected	1.00	1.00
Satd. Flow (prot)	3539	1583
Flt Permitted	1.00	1.00
Satd. Flow (perm)	3539	1583
Volume (vph)	244	143
Peak-hour factor, PHF	0.92	0.92
Growth Factor (vph)	108%	108%
Adj. Flow (vph)	286	168
RTOR Reduction (vph)	0	106
Lane Group Flow (vph)	286	62
Turn Type		Perm
Protected Phases	6	
Permitted Phases		6
Actuated Green, G (s)	33.0	33.0
Effective Green, g (s)	33.0	33.0
Actuated g/C Ratio	0.37	0.37
Clearance Time (s)	4.0	4.0
Lane Grp Cap (vph)	1298	580
v/s Ratio Prot	0.08	
v/s Ratio Perm		0.04
v/c Ratio	0.22	0.11
Uniform Delay, d1	19.6	18.8
Progression Factor	1.00	1.00
Incremental Delay, d2	0.4	0.4
Delay (s)	20.0	19.1
Level of Service	C	B
Approach Delay (s)	26.5	
Approach LOS	C	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBL	SBT
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.91		1.00	0.91
Frt	1.00	0.85		1.00	0.85			1.00	1.00		1.00	0.96
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00		0.95	1.00
Satd. Flow (prot)	1770	1583		1770	1583			1770	5070		1770	4857
Flt Permitted	0.82	1.00		1.00	1.00			0.95	1.00		0.95	1.00
Satd. Flow (perm)	1521	1583		1863	1583			1770	5070		1770	4857
Volume (vph)	65	0	17	10	0	40	15	107	1192	25	25	716
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Growth Factor (vph)	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%
Adj. Flow (vph)	76	0	20	12	0	47	18	126	1399	29	29	841
RTOR Reduction (vph)	0	18	0	0	45	0	0	0	2	0	0	93
Lane Group Flow (vph)	76	2	0	12	2	0	0	144	1426	0	29	1107
Turn Type	pm+pt			pm+pt			Prot	Prot			Prot	
Protected Phases	7	4		3	8		5	5	2		1	6
Permitted Phases	4			8								
Actuated Green, G (s)	7.6	4.9		3.8	3.0			9.6	35.2		3.1	28.7
Effective Green, g (s)	7.6	4.9		3.8	3.0			9.6	35.2		3.1	28.7
Actuated g/C Ratio	0.13	0.08		0.06	0.05			0.16	0.59		0.05	0.48
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	204	129		117	79			283	2974		91	2323
v/s Ratio Prot	c0.02	0.00		0.00	0.00			c0.08	c0.28		0.02	0.23
v/s Ratio Perm	c0.03			0.01								
v/c Ratio	0.37	0.01		0.10	0.03			0.51	0.48		0.32	0.48
Uniform Delay, d1	23.9	25.3		26.5	27.1			23.0	7.1		27.4	10.6
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	1.00
Incremental Delay, d2	1.1	0.0		0.4	0.2			1.4	0.6		2.0	0.7
Delay (s)	25.1	25.4		26.9	27.3			24.5	7.7		29.5	11.3
Level of Service	C	C		C	C			C	A		C	B
Approach Delay (s)		25.1			27.2				9.2			11.7
Approach LOS		C			C				A			B

Intersection Summary			
HCM Average Control Delay	11.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	50.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBR
Lane Configurations	
Ideal Flow (vphpl)	1900
Total Lost time (s)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Volume (vph)	306
Peak-hour factor, PHF	0.92
Growth Factor (vph)	108%
Adj. Flow (vph)	359
RTOR Reduction (vph)	0
Lane Group Flow (vph)	0
Turn Type	
Protected Phases	
Permitted Phases	
Actuated Green, G (s)	
Effective Green, g (s)	
Actuated g/C Ratio	
Clearance Time (s)	
Vehicle Extension (s)	
Lane Grp Cap (vph)	
v/s Ratio Prot	
v/s Ratio Perm	
v/c Ratio	
Uniform Delay, d1	
Progression Factor	
Incremental Delay, d2	
Delay (s)	
Level of Service	
Approach Delay (s)	
Approach LOS	

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	74	306	373	158	15	50
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	87	359	438	185	18	59
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					TWLTL	
Median storage veh)					1	
Upstream signal (ft)			458			
pX, platoon unblocked						
vC, conflicting volume	623				971	438
vC1, stage 1 conf vol					438	
vC2, stage 2 conf vol					533	
vCu, unblocked vol	623				971	438
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	91				95	91
cM capacity (veh/h)	958				382	619

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	87	359	438	185	18	59
Volume Left	87	0	0	0	18	0
Volume Right	0	0	0	185	0	59
cSH	958	1700	1700	1700	382	619
Volume to Capacity	0.09	0.21	0.26	0.11	0.05	0.09
Queue Length 95th (ft)	7	0	0	0	4	8
Control Delay (s)	9.1	0.0	0.0	0.0	14.9	11.4
Lane LOS	A				B	B
Approach Delay (s)	1.8		0.0		12.2	
Approach LOS					B	

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	39.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.95	1.00		1.00
Frt	1.00	0.89		1.00	0.92			1.00	1.00	0.85		1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (prot)	1770	1660		1770	1717			1770	3539	1583		1770
Flt Permitted	0.95	1.00		0.95	1.00			0.95	1.00	1.00		0.95
Satd. Flow (perm)	1770	1660		1770	1717			1770	3539	1583		1770
Volume (vph)	174	62	164	101	38	42	20	139	637	21	38	59
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%
Adj. Flow (vph)	196	70	184	114	43	47	22	156	717	24	43	66
RTOR Reduction (vph)	0	105	0	0	39	0	0	0	0	14	0	0
Lane Group Flow (vph)	196	149	0	114	51	0	0	178	717	10	0	109
Turn Type	Prot			Prot			Prot	Prot		Perm	Prot	Prot
Protected Phases	7	4		3	8		5	5	2		1	1
Permitted Phases										2		
Actuated Green, G (s)	10.0	18.0		8.0	16.0			9.0	37.0	37.0		11.0
Effective Green, g (s)	10.0	18.0		8.0	16.0			9.0	37.0	37.0		11.0
Actuated g/C Ratio	0.11	0.20		0.09	0.18			0.10	0.41	0.41		0.12
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0		4.0
Lane Grp Cap (vph)	197	332		157	305			177	1455	651		216
v/s Ratio Prot	c0.11	c0.09		0.06	0.03			c0.10	0.20			0.06
v/s Ratio Perm										0.01		
v/c Ratio	0.99	0.45		0.73	0.17			1.01	0.49	0.02		0.50
Uniform Delay, d1	40.0	31.6		39.9	31.4			40.5	19.6	15.7		37.0
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00	1.00		1.00
Incremental Delay, d2	62.8	4.3		25.2	1.2			69.1	1.2	0.0		8.2
Delay (s)	102.8	36.0		65.2	32.6			109.6	20.8	15.7		45.1
Level of Service	F	D		E	C			F	C	B		D
Approach Delay (s)		65.1			50.8				37.8			
Approach LOS		E			D				D			

Intersection Summary			
HCM Average Control Delay	51.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	85.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SBT	SBR
Lane Configurations		
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	4.0
Lane Util. Factor	0.95	1.00
Frt	1.00	0.85
Flt Protected	1.00	1.00
Satd. Flow (prot)	3539	1583
Flt Permitted	1.00	1.00
Satd. Flow (perm)	3539	1583
Volume (vph)	1428	263
Peak-hour factor, PHF	0.96	0.96
Growth Factor (vph)	108%	108%
Adj. Flow (vph)	1606	296
RTOR Reduction (vph)	0	154
Lane Group Flow (vph)	1606	142
Turn Type		Perm
Protected Phases	6	
Permitted Phases		6
Actuated Green, G (s)	39.0	39.0
Effective Green, g (s)	39.0	39.0
Actuated g/C Ratio	0.43	0.43
Clearance Time (s)	4.0	4.0
Lane Grp Cap (vph)	1534	686
v/s Ratio Prot	c0.45	
v/s Ratio Perm		0.09
v/c Ratio	1.05	0.21
Uniform Delay, d1	25.5	15.9
Progression Factor	1.00	1.00
Incremental Delay, d2	36.3	0.7
Delay (s)	61.8	16.6
Level of Service	E	B
Approach Delay (s)	54.3	
Approach LOS	D	

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBU	NBL	NBT	NBR	SBU	SBL
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0			4.0
Lane Util. Factor	1.00	1.00		1.00	1.00			1.00	0.91			1.00
Frt	1.00	0.86		1.00	0.85			1.00	1.00			1.00
Flt Protected	0.95	1.00		0.95	1.00			0.95	1.00			0.95
Satd. Flow (prot)	1770	1599		1770	1586			1770	5085			1770
Flt Permitted	1.00	1.00		0.67	1.00			0.95	1.00			0.95
Satd. Flow (perm)	1863	1599		1242	1586			1770	5085			1770
Volume (vph)	75	1	15	85	1	100	29	30	924	0	5	40
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Growth Factor (vph)	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%	108%
Adj. Flow (vph)	84	1	17	96	1	112	33	34	1040	0	6	45
RTOR Reduction (vph)	0	17	0	0	99	0	0	0	0	0	0	0
Lane Group Flow (vph)	84	1	0	96	14	0	0	67	1040	0	0	51
Turn Type	pm+pt			pm+pt			Prot	Prot			Prot	Prot
Protected Phases	7	4		3	8		5	5	2		1	1
Permitted Phases	4			8								
Actuated Green, G (s)	5.2	2.0		15.2	8.0			7.2	37.6			5.2
Effective Green, g (s)	5.2	2.0		15.2	8.0			7.2	37.6			5.2
Actuated g/C Ratio	0.07	0.03		0.22	0.11			0.10	0.54			0.07
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0			4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0			3.0
Lane Grp Cap (vph)	134	46		339	181			182	2731			131
v/s Ratio Prot	c0.03	0.00		c0.04	0.01			c0.04	0.20			0.03
v/s Ratio Perm	0.02			c0.02								
v/c Ratio	0.63	0.03		0.28	0.08			0.37	0.38			0.39
Uniform Delay, d1	31.5	33.1		22.8	27.7			29.3	9.4			30.9
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00			1.00
Incremental Delay, d2	8.8	0.3		0.5	0.2			1.3	0.4			1.9
Delay (s)	40.3	33.3		23.3	27.9			30.5	9.8			32.8
Level of Service	D	C		C	C			C	A			C
Approach Delay (s)		39.1			25.8				11.1			
Approach LOS		D			C				B			

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	SBT	SBR
Lane Configurations	↑↑↑	
Ideal Flow (vphpl)	1900	1900
Total Lost time (s)	4.0	
Lane Util. Factor	0.91	
Frt	0.99	
Flt Protected	1.00	
Satd. Flow (prot)	5054	
Flt Permitted	1.00	
Satd. Flow (perm)	5054	
Volume (vph)	1821	78
Peak-hour factor, PHF	0.96	0.96
Growth Factor (vph)	108%	108%
Adj. Flow (vph)	2049	88
RTOR Reduction (vph)	5	0
Lane Group Flow (vph)	2132	0
Turn Type		
Protected Phases	6	
Permitted Phases		
Actuated Green, G (s)	35.6	
Effective Green, g (s)	35.6	
Actuated g/C Ratio	0.51	
Clearance Time (s)	4.0	
Vehicle Extension (s)	3.0	
Lane Grp Cap (vph)	2570	
v/s Ratio Prot	c0.42	
v/s Ratio Perm		
v/c Ratio	0.83	
Uniform Delay, d1	14.6	
Progression Factor	1.00	
Incremental Delay, d2	3.3	
Delay (s)	17.9	
Level of Service	B	
Approach Delay (s)	18.2	
Approach LOS	B	

Intersection Summary

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Volume (veh/h)	30	386	378	98	18	28
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Hourly flow rate (vph)	34	434	425	110	20	32
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					TWLTL	
Median storage veh)					1	
Upstream signal (ft)			458			
pX, platoon unblocked						
vC, conflicting volume	536				927	425
vC1, stage 1 conf vol					425	
vC2, stage 2 conf vol					502	
vCu, unblocked vol	536				927	425
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)					5.4	
tF (s)	2.2				3.5	3.3
p0 queue free %	97				95	95
cM capacity (veh/h)	1032				414	629

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	SB 1	SB 2
Volume Total	34	434	425	110	20	32
Volume Left	34	0	0	0	20	0
Volume Right	0	0	0	110	0	32
cSH	1032	1700	1700	1700	414	629
Volume to Capacity	0.03	0.26	0.25	0.06	0.05	0.05
Queue Length 95th (ft)	3	0	0	0	4	4
Control Delay (s)	8.6	0.0	0.0	0.0	14.1	11.0
Lane LOS	A				B	B
Approach Delay (s)	0.6		0.0		12.2	
Approach LOS					B	

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	36.9%	ICU Level of Service	A
Analysis Period (min)	15		

Intersection Levels of Service

Level of service calculations for intersections were based on methodology and procedures outlined in the 2010 update of the *Highway Capacity Manual*, Special Report 209, Transportation Research Board (HCM 2010).

LOS generally refers to the degree of congestion on a roadway or intersection. It is a measure of vehicle operating speed, travel time, travel delays, and driving comfort. A letter scale from A to F generally describes intersection LOS. At signalized intersections, LOS A represents free-flow conditions (motorists experience little or no delays), and LOS F represents forced-flow conditions where motorists experience an average delay in excess of 80 seconds per vehicle.

The LOS reported for signalized intersections represents the average control delay (sec/veh) and can be reported for the overall intersection, for each approach, and for each lane group (additional v/c ratio criteria apply to lane group LOS only).

The LOS reported at stop-controlled intersections is based on the average control delay and can be reported for each controlled minor approach, controlled minor lane group, and controlled major-street movement (and for the overall intersection at all-way stop controlled intersections. Additional v/c ratio criteria apply to lane group or movement LOS only).

Table 1 outlines the current HCM 2010 LOS criteria for signalized and stop-controlled intersections based on these methodologies.

Table 1
LOS Criteria for Signalized and Two-Way Stop Controlled Intersections[1]

SIGNALIZED INTERSECTIONS			TWO-WAY STOP-CONTROLLED INTERSECTIONS		
	LOS by Volume-to Capacity (V/C) Ratio[2]			LOS by Volume-to Capacity (V/C) Ratio[3]	
Control Delay (sec/veh)	≤ 1.0	> 1.0	Control Delay (sec/veh)	≤ 1.0	> 1.0
≤ 10	A	F	≤ 10	A	F
> 10 to ≤ 20	B	F	> 10 to ≤ 15	B	F
> 20 to ≤ 35	C	F	> 15 to ≤ 25	C	F
> 35 to ≤ 55	D	F	> 25 to ≤ 35	D	F
> 55 to ≤ 80	E	F	> 35 to ≤ 50	E	F
> 80	F	F	> 50	F	F

1 Source: HCM2010 Highway Capacity Manual, Transportation Research Board, 2010.

2 For approach-based and intersection-wide assessments at signals, LOS is defined solely by control delay.

3 For two-way stop controlled intersections, the LOS criteria apply to each lane on a given approach and to each approach on the minor street. LOS is not calculated for major-street approaches or for the intersection as a whole.

c. campus cultural study

CULTURAL RESOURCES REPORT COVER SHEET

Author: Artifacts Consulting, Inc.

Title of Report: Highline College, Cultural Resources Survey

Date of Report: May 2016

County: King Section: 16 Township: 22 Range: 04E
Quad: Des Moines Acres: 80

PDF of report submitted (REQUIRED) **X** Yes

Historic Property Inventory Forms to be Approved Online? **X** Yes

Archaeological Site(s)/Isolate(s) Found or Amended? **X** No

TCP(s) found? **X** No

Replace a draft? **X** No

Satisfy a DAHP Archaeological Excavation Permit requirement? **X** No

Were Human Remains Found? **X** No

DAHP Archaeological Site #:

_____
_____
_____
_____
_____
_____
_____
_____
_____

- Submission of PDFs is required.
- Please be sure that any PDF submitted to DAHP has its cover sheet, figures, graphics, appendices, attachments, correspondence, etc., compiled into one single PDF file.
- Please check that the PDF displays correctly when opened.

HIGHLINE COLLEGE

Intensive Level Survey Documentation and Illustrated Historic Context Statement





ARTIFACTS CONSULTING, INC.

MAY 2016

HIGHLINE COLLEGE

WASHINGTON STATE DEPARTMENT OF ARCHAEOLOGY
AND HISTORIC PRESERVATION

(This page): Aerial view of Highline College. Courtesy Highline College.

(Previous page, clockwise from upper left): Courtesy Highline College.
All historic photographs illustrating this section are courtesy Highline College unless otherwise noted.

HIGHLINE COLLEGE

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Historic Preservation
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1

INTRODUCTION

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EXECUTIVE SUMMARY

The survey covered the entire campus with the following results.

- 29 intensive-level inventory forms completed and recorded in WISAARD
    - » 17 new intensive-level forms
    - » 6 previous reconnaissance-level forms updated to intensive level
    - » 6 previous intensive-level forms updated
- The period of significance for the campus is 1964–1967, encompassing the start and completion of the initial campus development and related second phase of growth that continued architectural forms and styles from the first phase.
- 1 potential National Register of Historic Places (NRHP) historic district at the local level of significance. The potential district is eligible under criteria A and C and includes the buildings built in 1964 and 1967 as part of the campus development that share historical associations and design features. DAHP had previously determined 10 of the buildings recommended for inclusion in the district to be NRHP eligible.
    - » 20 historic, contributing
    - » 1 historic, individual and contributing
    - » 1 historic, non-contributing
    - » 2 non-historic, non-contributing
    - » 8 historic, not NRHP-eligible buildings
    - » 5 non-historic buildings

CREDITS AND ACKNOWLEDGEMENTS

Preparation of this report would not have been possible without the support from the following entities and individuals: Barry Holldorf, Director of Facilities and Operations at Highline College; Karen Herndon, Melissa Sell, Alla Chikh, and Lisa Skari; Phil Stairs and Midori Okazaki at Puget Sound Regional Archives; and Joan Rumsey, McGranahan Architects, project coordination.

PROJECT BACKGROUND

Highline College retained Artifacts Consulting, Inc. as subcontractor to McGranahan Architects to complete this survey and documentation of the campus. This documentation fulfills stipulations-mitigation measures required by DAHP. A memorandum of understanding (MOU) is currently in process between the Department of Archaeology and Historic Preservation (DAHP) and Highline College. This MOU stems from compliance with the Governor's Executive Order 0505. Highline College utilized capital funding through the State Legislature for the removal of buildings 5 and 11. DAHP determined these buildings to be eligible for listing to the National Register of Historic Places (NRHP) and determined that the proposed demolition would have an adverse impact.

The survey and documentation extended to the full over 77-acre campus. Refer to survey area below for details.

Artifacts personnel conducting the survey and documentation all hold a Master's of Science in Historic Preservation and have extensive survey and documentation experience. All Artifacts personnel exceed the Secretary of the Interior's Professional Qualifications Standards, used by the National Park Service, and published in the Code of Federal Regulations, 36 CFR Part 61. The qualifications define minimum education and experience required to perform identification, evaluation, registration, and treatment activities. Personnel and tasks performed during the project listed below.

- Spencer Howard, managing partner, project manager, field work, research, GIS mapping, writing
- Katie Chase, partner, field work, research, writing, production
- Susan Johnson, associate, field work, research, writing, HPI forms

Copies of the inventory forms and report reside with DAHP and Highline College. Inventory forms are publicly accessible online through the Washington Information System for Architectural and Archaeological Records Data (WISAARD) at fortress.wa.gov/dahp/wisaardp3/.

RESEARCH DESIGN

Research design addresses the survey area, objectives, expectations, and methodology employed in the survey and documentation process. How this information will be integrated by Highline College into their planning process is discussed at the end. This study addresses only built environment properties—no evaluation of pre-historic or historic archaeology was conducted as part of this study. All work followed the Washington State Standards for Cultural Resource Reporting.

Survey Area

The survey area extends to the full 80-acre campus site, which is the area of potential effect. Surveying the complete land holding at one time will facilitate predictability in ongoing capital planning and management by Highline College.

Thematically the survey focuses on properties built by Highline College as part of the college's establishment and development. Temporally these focus on the early 1960s through the 1970s.

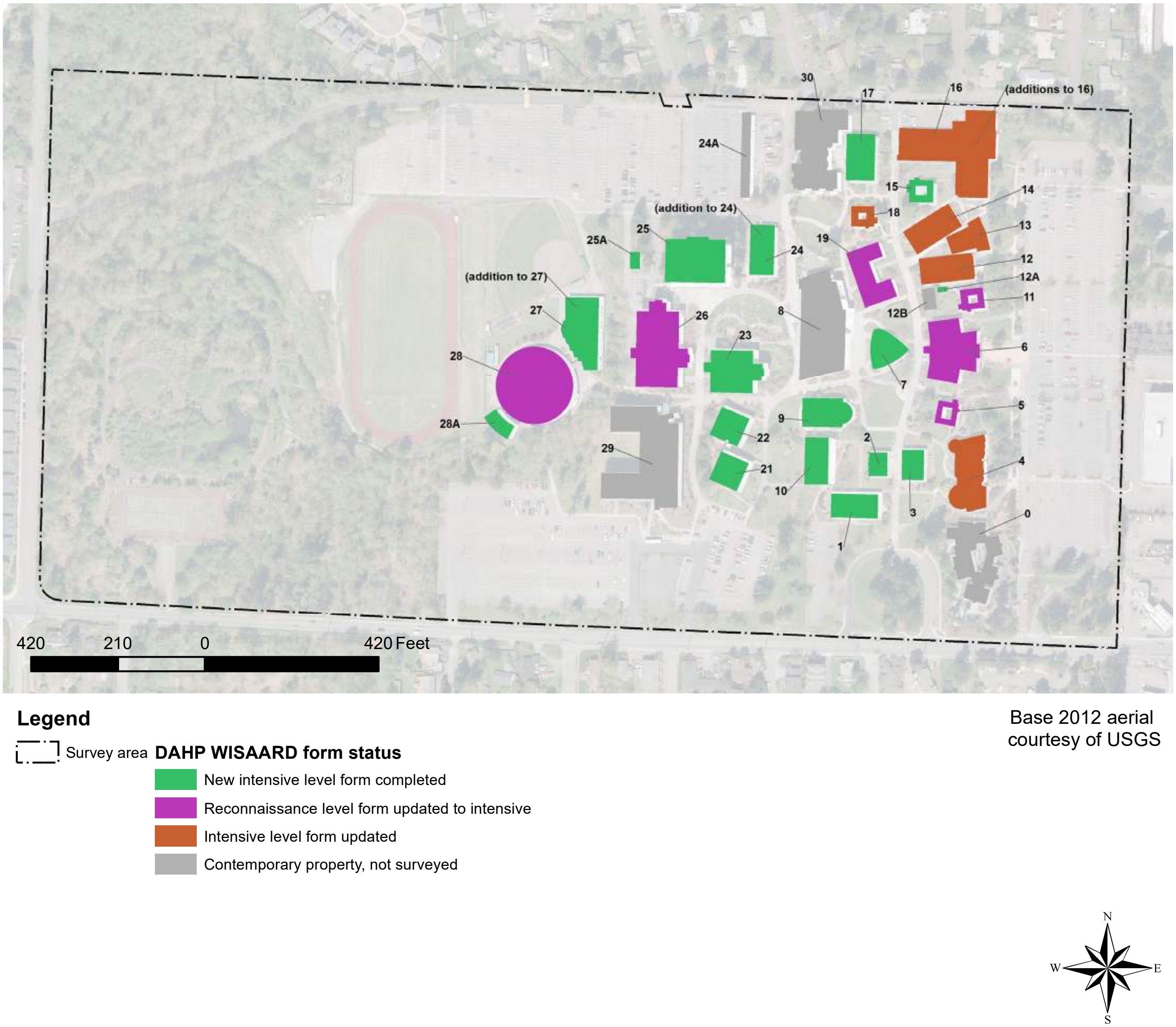
The survey area is in King County, within the Des Moines quadrangle. The site is roughly bounded by South 240th Street along the south, 20th Avenue South along the west, South 236th Street along the north, and State Route 99 along the east.

Section: 21 Township: 22 Range: 04E

There are currently no National Register of Historic Places- or Washington Heritage Register-listed built environment properties within or adjacent to the survey area. There are no recorded archaeology-related properties within or adjacent to the survey area.

Historic property inventory forms had been prepared for:

- Property ID: 673034, Building 26, reconnaissance level, recorded in 2013, 110713-08-KI DAHP determined not eligible on 11/7/2013
- Property ID: 673157, Building 28, reconnaissance level, recorded in 2013, 111913-02-COMM DAHP determined eligible on 11/19/2013
- Property ID: 670403, Building 19, reconnaissance level, recorded in 2013, 032113-04-COMM DAHP determined eligible on 11/18/2013
- Property ID: 670397, Building 6, reconnaissance level, recorded in 2013, 032113-04-COMM DAHP determined eligible on 11/18/2013



Map 1.1. Survey Area
Boundaries for the survey and which forms were completed and uploaded to WISAARD.

- Property ID: 673155, Building 11, reconnaissance level, recorded in 2013, 111813-60-KI DAHP determined eligible on 11/19/2013
- Property ID: 673141, Building 5, reconnaissance level, recorded in 2013, 111813-60-KI DAHP determined eligible on 11/19/2013
- Property ID: 673141, Building 4, intensive level, recorded in 2012, 081612-01-FAA DAHP determined on 11/25/2013

DAHP determined the following properties eligible for NRHP listing (102912-18-FTA) on 3/14/2014; these were completed as part of an FTA project to expand light rail from SeaTac into Federal Way that inventoried more than 400 properties along the route:

- Property ID: 674172, Building 18
- Property ID: 674174, Building 16
- Property ID: 674171, Building 14
- Property ID: 674170, Building 13
- Property ID: 674169, Building 12

Cultural resource surveys around the survey area encompass roadway work, pre-historic, and historic surveys:

- NADB: 1352086, Historic Resources Survey and Inventory, Kent, reconnaissance level, recorded in 2008; ends at the city limits and does not include Highline College
- NADB: 1340493, Pacific Highway South HOV Lanes Cultural Resources Assessment, recorded in 2001; follows SR99 right of way and does not include Highline College
- NADB: 1686409, Archaeological Survey and Assessment of the Proposed Lakeridge Highline View Estates Subdivision (TPN 6929693575), Des Moines, recorded in 2015; ends at South 240th Street and does not include Highline College
- 2014 U.S. Federal Transit Administration survey along the proposed SeaTac to Federal Way light rail route. (102912-18-FTA)

Objectives

The objective is to provide a comprehensive historical context, survey, and documentation of built environment properties and their potential eligibility. This data will provide a baseline to support future planning and capital fund request applications as the college continues to grow and develop.

This survey supports the following goal in the State Historic Preservation Plan:

- Goal 3. Strengthen policies and planning processes to enhance informed and cross disciplinary decision-making for managing cultural and historic resources.
  - » A. Position historic preservation to be more fully integrated into land use decision-making processes.
  - » B. Establish policies and provide tools to improve protection of cultural and historic resources.
  - » C. Improve planning, management and funding of historic and cultural resources on state-owned and managed lands.

Expectations

We expect a concentration of potential NRHP-eligible properties grouped at the core of the campus master plan, along the east portion of the campus, with some possible outlying individual properties within the broader survey area. Given the growth and development pressure on the campus, we expect a moderate level of alterations to buildings, circulation features, and landscaping.

Methodology

Highline College provided access to scans of the original and alteration drawings for the buildings and site, as well as an AutoCAD base map for the campus. Highline College provided a substantial volume of scanned historic slides, photographs, and primary archival materials. Highline College holdings constitute the majority of primary materials on the original design of and alterations to the buildings. Other repositories visited include the state archives, state historical society, and Seattle and Tacoma Public libraries. Materials were collected and digitized to form the project archive.

Field work consisted of three Artifacts personnel digitally photographing the buildings, circulation routes, and landscape features, while completing inventory forms for the properties. For the field work, we worked from a GIS base map that we developed from the AutoCAD file. Construction dates identified through research focused on the buildings and features 38 years of age and older (built before 1979). Personnel used the GaiaGPS application in the field to track survey routes and photograph locations for circulation and site features.

Integration with Planning Process

The eligibility recommendations derived from this survey and documentation process will be used by Highline College in their project planning and capital fund requests to:

- Streamline the Governor's Executive Order 0505 compliance on future projects.
- Identify where programming and preservation goals might conflict, allowing consideration of avoidance alternatives or early discussions on mitigation to occur.

2

HISTORIC CONTEXT

Undated aerial photograph of Highline Campus.

SIGNIFICANCE STATEMENT

Highline College, established in 1961, is a public higher education institution located in Des Moines, Washington. It was started as a junior college within the Highline School District, with classes beginning in the fall of 1961 in facilities in Glacier High School. Today, the college encompasses an 80-acre site overlooking Puget Sound. The campus is significant as the first community college in King County and as an example of architect Ralph Burkhard's educational designs.

The campus's areas of significance are architecture and education. The period of significance for the campus is 1964–1967, the timeframe within which the majority of the buildings on campus were constructed. While one building, Building 7, at Highline College exhibits enough integrity to warrant individual listing, the campus as a whole appears eligible for inclusion on the National Register of Historic Places (NRHP) as a historic district under criteria A and C. The campus is significant under Criterion A for its association with post-World War II higher education in Washington, and under Criterion C as an example of the work of Ralph Burkhard, a well-respected architect who designed numerous school campuses during the post-World War II period.

The campus does not appear eligible under Criterion B as any individual's involvement with the campus would be too recent and no one person's involvement has risen to the level of exceptional significance. The campus does not appear eligible under Criterion D as it has not yielded, and does not appear likely to yield, information important to history or prehistory.

The campus maintains a moderate degree of integrity, retaining its original location, setting, feeling, association, and much of its design, materials, and workmanship. The original design for the campus included circulation networks and distinct covered walkways in addition to the buildings. Some alterations have been made to the original buildings, and new buildings have been added to the campus, but overall, these changes do not detract from the campus's significance.

HISTORICAL DEVELOPMENT

Background Information

The Highline School District established Highline College as a junior college in 1961, after receiving approval from the State Board of Education following the passage of Senate Bill 296, which allowed school districts to run junior college programs. The district created the program to expand its secondary education offerings and respond to increased population growth.

The Development of Community Colleges in the United States[1]

Formal education has been a significant part of the American story since the nation's colonial days. Early on, education in the United States consisted of two divisions—primary education for young children and university education for young adults. After the nation's founding, education continued to be emphasized, and the number of public schools in the country increased. In the 1840s, elementary education became compulsory and normal schools (colleges specifically for the training of teachers) soon grew.[2] During the 19th century, secondary schools and college preparatory schools were added to fill the gap in education between primary school and college. College education also expanded during the 19th century, particularly with the passage of the Morrill Acts of 1862 and 1890.[3] According to Arthur M. Cohen in American Community Colleges, the Morrill Acts led to the establishment of publicly supported universities in every state. Cohen states, "Although many were agricultural institutes or teacher-training colleges, little resembling modern universities, they did provide a lower-cost alternative to private colleges."[4] And as access to education increased, so did the number and types of programs

1. The background information on community colleges in the United States and in Washington State previously appeared in DAHP Level II documentation on Green River Community College and Everett Community College, also prepared by Artifacts Consulting, Inc.

2. George A. Delaney, *The Development of the Washington Community College Act of 1967*, Doctoral dissertation (Seattle, WA: Department of Education, University of Washington, 1990), 5.

3. The 1862 Morrill Act, officially titled "An Act donating Public Lands to the several States and Territories which may provide Colleges for the Benefit of Agriculture and the Mechanic Arts," provided each state 30,000 acres of Federal land per Congressional member. The states then sold the land, using the proceeds to fund public colleges in their states, with specific emphasis on agriculture and the mechanical arts. These land grants funded sixty-nine colleges. The 1890 Morrill Act extended the funding for public universities, with an aim towards southern states to prevent racial discrimination in admissions. Full text of the 1862 Morrill Act (Public Law 37-108) available through the Library of Congress, http://www.loc.gov/rr/program/bib/ourdocs/Morrill.html

4. Arthur Cohen, *The American Community College* (San Francisco, CA: Jossey-Bass, 2008), 2.

Undated aerial photograph of Highline Campus, focused in on southwest quadrant.

offered. The increasing diversity in educational opportunities in the last half of the 19th century paved the way for the development of junior and technical colleges.

The junior college movement began during the second half of the 1800s, largely encouraged by university leaders who sought to clarify the type and level of education provided at the university level. Many university educators believed the freshman and sophomore years of college, when students primarily studied general education courses, should be an extension of secondary education. Junior colleges, when first founded, were meant to complement the university system rather than replace it.[5] However, as junior colleges grew in importance and enrollment, their curriculums began to include vocational training in addition to general education. In 1920 the American Association of Junior Colleges (now the American Association of Community Colleges) was founded and in July 1923 the American Council on Education adopted accreditation standards for two-year schools. Higher education enrollment, including in junior colleges, dropped off substantially during World War II, but increased significantly following the end of the war as veterans returned and, with the passage of the G.I. Bill (which designates money for service members and veterans to pursue secondary education or training), had funds available for education. After World War II, junior colleges continued to shift more towards including occupational coursework and technical training, in addition to core lower division coursework for

5. Brinton Sprague, *The Development of General Education in Washington Community Colleges, 1915-1980*, Doctoral dissertation (Seattle, WA: College of Education, University of Washington, 1987), 1.

transfer credits.[6] This expanded curriculum led to labeling these new institutions as "community colleges" rather than junior colleges.

Beginning in 1947, the U.S. birth rate increased by 37 percent, swelling from 2.7 million births to about 3.7 million and resulting in the generation known as baby boomers. [7] This population growth meant more students sought higher education during the 1950s and 1960s and the number of community colleges increased to meet the demand. Additionally, community colleges were in a unique admittance position, according to Dr. William K. Ramstad, president of Shoreline Community College: "Unlike the state colleges and universities, the community colleges are required to admit any state resident who successfully has completed high school or is 18 or older."[8] Community colleges continued to grow and by the end of the 20th century, there were nearly 1,200 community colleges established in the United States.[9]

Washington State Community Colleges

Following the national trend, junior colleges were established in the state of Washington to provide general education offerings. Everett Junior College was Washington's first junior college, established in 1915 with the financial support of the Everett School District. Like other early junior colleges, such as Joliet Junior College in Illinois, Everett Junior College was supported by a secondary school (high school) rather than operating as its own standalone program or tied to a four-year college. The University of Washington eventually agreed to recognize the school, and its students' credits, with stipulations: that the junior college classes be separate from the high school classes and that all faculty possess at least a Master's degree.[10] Although Everett Junior College closed in 1923 due to the local high school's need for that space as well as a lack of funds, eight other junior colleges were established in Washington between 1925 and 1939. These included: Centralia Junior College (1925), Mount Vernon Junior College (1926), Yakima Valley College (1928), Grays Harbor Junior College (1930), Spokane Valley Junior College (1933), Clark College in Vancouver (1933), Lower Columbia College in Longview (1934), and Wenatchee Valley College (1939).

The growth of junior colleges in the state resulted in the formation of the Washington Junior College Association in October 1933. In 1941 the first legislation in the state regarding junior colleges was passed. House Bill 102 became law on April 1, 1941. The law defined the junior

6. Sprague, 2.

7. Constantine Angelos, "County Community Colleges May Turn Away 9,000," *The Seattle Times*, September 20, 1965, 4.

8. Angelos, "County Community Colleges May Turn Away 9,000."

9. "Community Colleges Past to Present." American Association of Community Colleges, http://www.aacc.nche.edu/AboutCC/history/Pages/pasttopresent.aspx (accessed February 4, 2014).

10. Delaney, 81.

college as “an institution above the high school level which was organized into academic and vocational curricula not to exceed two years in length.”[11] Furthermore, the legislation set the number of authorized junior colleges in the state to twelve and stipulated that no junior college could exist in a county with another higher education institution. Consequently, this meant the closure of Spokane Valley Junior College in 1942.

Like other colleges around the country, Washington’s junior colleges experienced a spike in enrollment following the end of World War II, with the student population increasing nine-fold between the 1944–45 and 1949–50 academic years.[12] Despite the increased enrollment, junior colleges lagged behind other higher education institutions in the state in funding, facilities, and faculty. Although the 1941 legislation established junior colleges as state-authorized institutions of education, it lacked a mechanism to allow junior colleges to build their own facilities. Additional legislation was passed in 1945 to begin to remedy this problem—House Bill 262. This bill stated that “junior colleges were to be considered as grades thirteen and fourteen of public education in the state and that two-year colleges could join the school districts in which they were located…to use school district building funds to create and improve their facilities.”[13] Yakima Valley College became the first junior college in the state to have its own buildings, moving into their new accommodations in 1948. More two-year colleges opened during the late 1940s and through the 1950s, including Clark College in Vancouver (reopened in 1945), Bremerton Junior College (1945, name changed to Olympic College in 1947), and Columbia Basin College in Pasco (1955).

In 1961, the Washington State Legislature signed Senate Bill 296 into law, defining community colleges in the state. The law states, “A community college shall be an institution established with the approval of the state board of education and maintained and operated by a school district, offering two year post high school curricula of general education or vocational-technical education, or both.”[14] This law also revoked the previous restrictions on the number and location of community colleges, instead delegating the responsibilities for approving new institutions to the State Board of Education.[15] Following this legislation, 16 more community colleges were established in Washington between 1961 and 1970, many of which were concentrated in the more populous areas of Western Washington—locations previously off-limits due to the pre-existence of other higher education institutions: Peninsula Community College in Port Angeles (1961); Highline Community College in Midway (1961); Big Bend Community College in Moses Lake (1962); Olympia Vocational Technical College (1962, later renamed South Puget

11. Sprague, 81.

12. Sprague, 115.

13. Sprague, 116.

14. Washington State Legislature, Session Laws, 1961, Chapter 198 [S. B. 296], 1904. Accessed through the Washington State Legislature’s Office of the Code Reviser website, http://www.leg.wa.gov/CodeReviser/Pages/session_laws.aspx.

15. Session Laws, 1961, Chapter 198 [S. B. 296], Section 2, 1905.

Map of current (2016) community college campuses in Washington State. Courtesy the Washington State Board for Community and Technical College.

Sound); Spokane Community College (reopened in 1963); Green River Community College in Auburn (1963); Tacoma Community College (1963); Bellevue Community College (1966); Seattle Central Community College (1966); Edmonds Community College (1967); Fort Steilacoom Community College (1967, later renamed Pierce College); North Seattle Community College (1970); Spokane Falls Community College (1970); South Seattle Community College (1970); and Whatcom Community College (1970). These new two-year colleges brought the state's total number of community colleges to 26.

Over the next 40 years, additional community and technical colleges, as well as branch campuses of the colleges, were founded in the state. As of 2016, there are 34 community colleges throughout the state of Washington. The largest concentration of community colleges (17 of the 34 campuses) are along the I-5 corridor between Everett and Tacoma.[16]

Development Periods

Highline College may seem to be a relatively recent addition to the collection of higher educational institutions in the state of Washington, but it celebrated its 50th anniversary in 2011. The primary development period for Highline College is 1961–1967, which begins with the college's establishment as a community college and ends with the second phase of initial construction completed in 1967. Research and survey work identified the following development periods:

- 1867–1888: Euro-American settlement near present-day Des Moines
- 1889–1945: Early Des Moines development
- 1946–1960: Population boom and road to incorporation

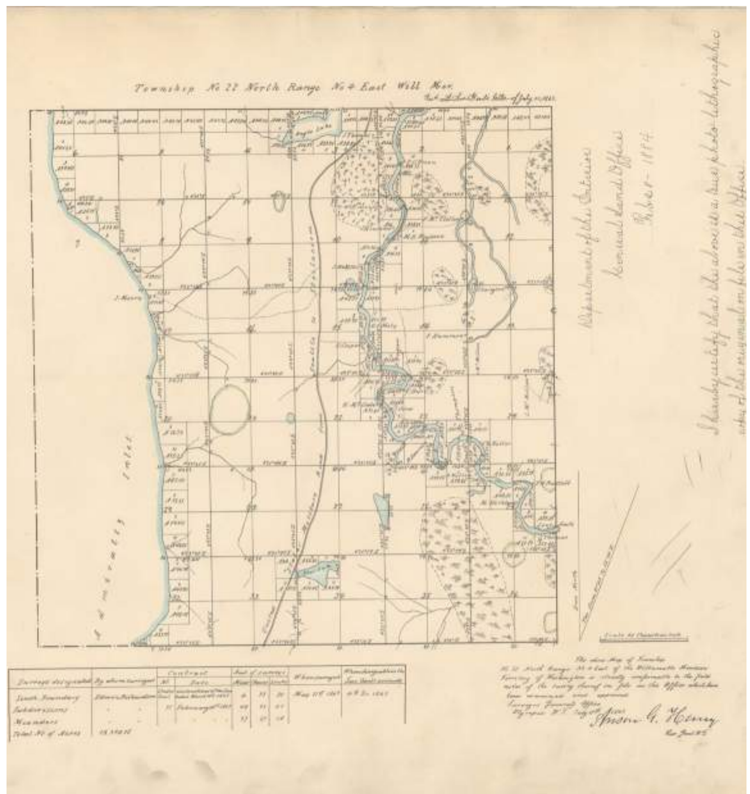
16. "Washington State Community and Technical Colleges," Washington State Board for Community and Technical Colleges, http://www.sbctc.edu/our-colleges/explore-colleges/default.aspx (accessed May 4, 2016).

- 1961–1967: Highline College establishment and early construction
- 1968–1978: First Master Plan
- 1979–2003: Continued growth
- 2004–Present: Current conditions

The development periods related to Highline College will be summarized in subsequent sections, but expanded on in the next section, "Highline College."

Before 1866: Prehistory to Early Contact

During this broad period of time, Native Americans of the Coast Salish or Puget Salish inhabited the Puget Sound watershed. While there is no indication that any tribes lived in the area occupied by present-day Des Moines, the Duwamish and Upper Puyallup people did utilize the area for harvesting shellfish and fishing from the many streams and creeks emptying into Puget Sound.[17] Today, their descendants are members of the Muckleshoot and Duwamish tribes. Contact with Euro-Americans intensely affected the lives of the Salish people, with settlements and treaties creating conflict over land and new diseases devastating their population. In 1833, the Hudson Bay Company established Fort Nisqually and U.S. Navy Lieutenant Charles Wilkes and his crew explored the Puget Sound in 1841. King County, along with Pierce County, was formed out of Thurston County by the Oregon Ter-



July 1863 Cadastral Survey map of Township 22N, Range 4E. Highline College is located in Section 16. Courtesy Bureau of Land Management - Oregon State Office, Land Status and Cadastral Survey Records.

17. Richard T. Kennedy, ed., *One Hundred Years of the "Waterland" Community: A History of Des Moines, Washington* (Des Moines, WA: City of Des Moines, 1989), 7.

ritorial Legislature in 1852; the Territory of Washington was established out of the Territory of Oregon in 1853. The Treaty of Point Elliot (signed in 1855, ratified in 1859) guaranteed hunting and fishing rights and reservations to all tribes who had a representative sign the treaty in exchange for more than 54,000 acres of ancestral lands, which included much of King County.[18] Military Road, stretching from Fort Vancouver to Seattle, was completed in 1860 and became the first road established in King County.

No extant buildings or structures from this development period were identified within this study.

1867–1888: Euro-American Settlement near present-day Des Moines

Euro-American settlers had started arriving in the surrounding regions in the 1850s, but John Moore (d. 1899) arrived in the area in 1867 and claimed 154 acres of waterfront property. In accordance with the Homestead Act of 1862, Moore received his homestead claim certificate, No. 285, in 1872, after residing on the land for five years and building a cabin. Moore's claim encompassed much of the land that would become downtown Des Moines. Moore was eventually declared insane and sent to an asylum in 1879; King County solid Moore's land to John Murray in 1881 for $10. Murray sold the land to Fountain Chezum in 1886; by this point, a sawmill operated on the property.

No extant buildings or structures from this development period were identified within this study.

1889—1945: Early Des Moines Development

In 1889, Fountain Chezum sold the entirety of John Moore's original 154-acre claim to F.A. Basher from Des Moines, Iowa. Along with three other investors—Orin Watts Barlow, Charles M. Johnson, and John W. Kleeb—Basher established the Des Moines Improvement Company. The company filed a plat for the Town of Des Moines on the northern 120 acres of Moore's claim.[19] Plats sold quickly, keeping pace with development in the Puget Sound area in the early 1890s. In 1889 residents also successfully petitioned the King County Commissioners to establish a Des Moines Election Precinct. The precinct was bounded by Puget Sound on the west, S. 192nd Street on the north, 32nd Avenue S. to the east, and S. 256th Street to the south.[20] This

18. Duwamish Tribe, "Point Elliot Treaty," Duwamish Tribe, http://www.duwamishtribe.org/elliottreaty.html (accessed May 2, 2016).

19. Artifacts Consulting, Inc., "Covenant Beach Bible Camp," National Reigster of Historic Places nomination (2006).

20. Kennedy, *One Hundred Years*, 16.

area includes the present-day site of Highline College.

1937 aerial view of Section 16, Township 22N, Range 4E. The curved road running along the right edge of the image is Pacific Highway; S 240th Street is the straight road along the bottom edge of the image. The site of the future Highline College is in the forested area left of Pacific Highway and above S 240th Street. Courtesy King County Road Services.

In addition to platting the town, the Des Moines Improvement Company took over ownership of the existing sawmill, recognizing the advantageous proximity to a deep water harbor and forest stands. The company then sold the sawmill to William Van Gasken. Other mills sprang up in the vicinity, including James Markwell's shingle mill. Together, the Van Gasken and Markwell mills represented a significant force in the local economy.[21] The town of Des Moines continued to develop, with stores and a hotel opening downtown, and soon it enjoyed regular passenger and freight service from the Mosquito Fleet. Growth slowed in the community following the Panic of 1893, the result of a significant decline of the New York stock market. That put pressure on banks, as investors tried to cash out their accounts; banks called in their loans and limited their outward flow of cash, effectively curtailing new development and construction. Despite this economic setback, the area began to rebound in the early 1900s.

Increased transportation options opened up the town and surrounding area for further development. The Seattle-Tacoma Interurban (operated by the Puget Sound Electric Railway) began electric rail service between Seattle and downtown Tacoma in 1902, running through the Green River Valley. The railway provided service to numerous communities along its route, including Renton, Kent, and Auburn. Located five miles east of developing Des Moines, the railway offered locals another way to travel through the region and inland farmers a convenient shipping method for smaller goods like milk and produce.[22] The closest stations to Des Moines were

21. Ibid.

22. HistoryLink.org, "Interurban train service between Seattle and Tacoma ends on December 30, 1928," HistoryLink.org—The Free Online Encyclopedia of Washington State History, by Alan J. Stein, http://www.historylink.org/index.cfm?DisplayPage=output.cfm&file_id=2671, 2000 (accessed May 3, 2016).

Map 2.1. Building Overlay, 1937 Aerial
Highline College building footprints overlaid on 1937 aerial.

Kent and O'Brien.[23] The expansion and construction of roads throughout King County helped populate the Des Moines area, with the construction of Pacific Highway (State Route 99) spurring more significant development. Completed in 1928, Pacific Highway runs north–south, just east of the current Highline College campus. Farmers were able to more easily get their goods to Seattle and Tacoma and businesses began to crop up along the highway. Despite the infrastructure improvements, the land surrounding present-day Highline College remained largely undeveloped through the first few decades of the 20th century.

23. Kennedy, *One Hundred Years*, 24.

Upper left: 1938 aerial view of Boeing Field. Upper right: ca. 1938 photograph of the Boeing 314 Clipper with Mt. Rainier in the background. Both images courtesy the Washington State Archives, Digital Archives.
Right: ca. 1950 photograph of the Seattle-Tacoma Airport (opened in 1949). Courtesy Des Moines Historical Society.

The area's population increased in the years leading up to World War II as workers flooded the area in response to the production efforts occurring at Boeing Airplane Co. (previously Pacific Aero Products Co.). In 1917, Boeing moved its airplane production facility from Lake Union to the former Heath Shipyard, south of Seattle and near the Duwamish River. This move had a significant impact on neighboring towns as company employees began to populate the area. The Des Moines area remained primarily rural through the 1910s and into the 1930s; the census records from 1910, 1920, and 1930 list local occupations as primarily small farmers, auto mechanics, carpenters, railroad engineers, and laborers. By the 1940 census, though, the impact of Boeing in the community could be seen as an increasing number of residents listed "airplane factory" as their industry.[24]

1946–1960: Population Boom and Road to Incorporation

The King County population grew significantly following the end of World War II in 1946, as veterans returned home and started their families. Between 1940 and 1950, King County

24. Department of Commerce—Bureau of the Census, "Washington—King County—Des Moines," Sixteenth Census of the United States (1940). The 1940 census records for the Des Moines enumeration district filled 32 pages. The authors counted at least 25 residents who listed their occupation as related to the airplane industry.

grew from 504,980 residents to 732,992; by 1960, 935,014 people lived in King County.[25] The population boom strongly impacted the Highline School District, which was formed in 1941 to serve Des Moines-area residents. Over the next few decades, the student body served by the district more than doubled.[26] Even with this growth, Des Moines remained unincorporated through most of the 1950s. By the end of the decade, however, annexation pressure from neighboring Kent led the community to petition for incorporation. The City of Des Moines incorporated in 1959, but the land on which Highline College stands remained in unincorporated King County.

1961–1967: Highline College Establishment and Early Construction

This period begins with the passage of Senate Bill 296 in 1961, which allowed the creation of junior colleges throughout the state. Highline College was founded the same year, and began meeting in classrooms and portables at Glacier High School. The district hired architect Ralph Burkhard to design a campus for the new college and construction began in 1963. The first round of buildings was completed in 1964 with students attending classes on the new campus in fall 1964. A second phase of construction was completed in 1967.

Highline College

The following section describes the history and development of Highline College, from its inception and initial construction through later phases of development.

1961–1967: Highline College Establishment and Early Construction

Discussions about the possible establishment of a junior college in the Highline-Renton area began in the mid-1950s. Advocates believed an extension of the secondary education system would alleviate enrollment pressure at the University of Washington and other colleges in the region. One such advocate, State Senator Andy Hess of Burien, chairman of the State Senate Committee on Education, proposed an emphasis on vocational subjects, which would benefit local industry employers. [27] But even with Hess's support, junior college proponents had to overcome the state law that prohibited the establishment of a junior college in a county with a preexisting higher education institution. Although denied the opportunity to form their own

25. Washington State Office of Financial Management. http://www.ofm.wa.gov/pop/april1/hseries/default.asp

26. Kennedy, *One Hundred Years,* 113.

27. Ross Cunningham, "Burien Senator to Urge Junior College for South King County," *The Seattle Times*, January 23, 1957, 2.

Map 2.2. Building Overlay, 1965 Aerial
Highline College building footprints overlaid on 1965 aerial.

junior college, the Highline School District began making plans to extend their secondary education program offerings with the support of superintendent Carl Jensen, administrator Dr. Rodney Berg, and Pete Armentrout, a Boeing Airplane Co. executive.[28] The district established an extended secondary education program in 1959, with enrollment numbers ranging between 500 and 600 students by 1961.

In 1961, the state passed Senate Bill 296, which allowed junior colleges to form. But even with this decision allowing for new junior colleges, only two new institutions were allowed for the next biennium. A Highline junior college seemed a natural choice for one of the two new

28. Johnsrud, "Experience Bolsters Highline Junior-College Bid," *The Seattle Times*, April 17, 1961, 3.

institutions, and the school district moved forward with the presumption that they would soon have a new school, even putting forth a bond issue before votes. The district put a $2.3 million bond issue with a $10 million special levy before voters in May 1961 to construct a junior college campus, anticipating its application's approval from the State Board of Education. In the meantime, classes would be held in classrooms and portable facilities at the new Glacier High School.[29] Just prior to the vote, a King County Area Advisory Board on Junior Colleges unanimously recommended to the State Board of Education that Highline be the location for a new junior college.[30] Even with this support, the special levy and bond issue did not pass due to low voter turnout, and a June decision for the junior college establishment was postponed by the State Board of Education until late July. The school district continued on, though, with plans for an extended secondary program—albeit one closely aligned with a junior-college curriculum and operation.

Carl Jensen (left) and Dr. Rodney Berg (right). Courtesy *The Seattle Times*.

Through late May and June of 1961, the State Board of Education worked through proposed regulations for where new junior colleges could be located. The board adopted the following regulations:

- The school must serve students within a 25-mile commuting radius or less than an hour of travel time
- The surrounding area must have a minimum of 8,700 students in grades 1 through 12, with 2,200 in grades 9 through 12
- An annual graduating class of 450 students, minimum
- Potential for a minimum of 300 full-time students by the second year of the new junior college, increasing to 500 within five years[31]

29. Byron Johnsrud, "Highline Votes May 23 on Junior-College Bonds," *The Seattle Times*, April 16, 1961, 14.
30. Byron Johnsrud, "Highline Junior College Recommended," *The Seattle Times,* May 17, 1961, 18.
31. "Junior-College 'Ground Rules' Adopted," *The Seattle Times*, June 27, 1961, 21.

Left: Students signing up for courses at the new junior college. Courtesy *The Seattle Times.*

Above: Dr. Melvin A. Allan, first president of Highline Junior College.

The Highline School District met these regulations and the State Board of Education authorized the district to establish Highline Junior College on July 28, 1961—the first junior college in King County.[32] A junior college in Moses Lake was also authorized. Of the eight other school districts in King County that applied for authorization from the board, Highline was the only district ready to open its school in fall of 1961. With authorization from the state, the school district prepared another special levy to go before its electorate in September 1961 to construct the first buildings for the new junior college campus.

The Highline School District named Dr. Rodney Berg, the district's administrator of post-high school education, as the new junior college's first president. Berg's role was short-lived, however, as he was soon hired as the new president of Everett Junior College, leaving Highline by October 1, 1961.[33] Charles Carpenter from the University of Colorado at Boulder was named as acting president upon Berg's departure.[34] Despite this hiccup, classes for the new junior college began on September 25th for nearly 400 students, in facilities at Glacier High School (2450 S. 142nd Street). The new college began with a teaching staff of 16 and with curriculum covering business administration, humanities, foreign languages, creative arts, and social sciences.[35] The vocational program was still in development, but was set to include electronics, drafting, techni-

32. "Junior College O.K'd for Highline," *The Seattle Times,* July 27, 1961, 14.

33. Byron Johnsrud, "Highline Educator Named President of Everett J.C.," The Seattle Times, August 9, 1961, 9; Bryon Johnsrud, "Highline J.C. Has Opening Day Jitters," *The Seattle Times*, August 16, 1961, 48.

34. "Acting College Head Named at Highline," *The Seattle Times*, October 2, 1961, 2.

35. Johnsrud, "400 Students to Begin Classes at Highline J.C. Tomorrow," *The Seattle Times*, September 17, 1961, 18.

Left: Construction underway on the Highline campus. The lecture hall (building 7) with its distinct roof form is visible in the foreground.

Right: 1973 view of Building 6 and associated breezeway.

cal mathematics, and offset printing. In the midst of the college's first year of courses, the college named Dr. Melvin A. Allan of Western Washington State College as president of Highline Junior College. Highline quickly became a success, with enrollment increasing by 66 percent in its first year.[36]

Planning and Construction, 1961–1967

As classes were underway at the new Highline College, the Highline School Board began seeking out a site to construct the campus. District voters passed the special levy to fund construction in September 1961. The board selected an 80-acre site outside of Des Moines city limits, just east of the town of Zenith and west of Midway. The state of Washington owned the property and Highline struck a deal to acquire the tract through a 99 year renewable lease.[37] The board also hired architect Ralph Burkhard to design the campus and Dr. Arnold Tjomsland, a former building expert with the State Department of Education, served as a consultant.[38] The school board approved plans for the campus in 1962.

Plans for the campus included an arts and crafts building, a technical arts building, multipurpose building for classrooms, library, teacher office building, business building, science and technology building, general classroom building, utilities building, swimming pool building, fieldhouse, and a student center with lounge and dining services, student offices, and counseling offices.[39] Construction was divided into two phases: The first phase included construction of the

36. "Enrollment Up 66 Per Cent at Highline J.C.," *The Seattle Times*, October 12, 1962, 39.

37. "State to Review Plans for Highline College," *The Seattle Times*, August 12, 1962, 32.

38. "Zenith Site Sought for Highline J.C.," *The Seattle Times*, November 17, 1961, 44; Byron Johnsrud, "Board O.K's 1st Highline College Units," The Seattle Times, August 1, 1962, 35.

39. Johnsrud, "Board O.K's 1st Highline College Units."

Map 2.3. Building Overlay, 1968 Aerial
Highline College building footprints overlaid on 1968 aerial.

library, fieldhouse, administration building, lecture hall, theater, and classroom and laboratory facilities for arts and crafts, sciences, and business administration. The swimming pool facility, gym, auditorium, and additional classrooms were slated for the second phase.[40] The groundbreaking ceremony for the campus occurred on August 12, 1963, with completion anticipated for the first phase of construction by fall 1964. Earley Construction Co. of Tacoma was awarded the general contract, with Pease & Sons receiving the mechanical contract and Carl T. Madsen, Inc., receiving the electrical contract.

The new campus, although not entirely complete due to construction delays—especially following a strike by the Plumbers and Pipefitters Union—opened for students in September 1964. The buildings were constructed of pre-stressed, pre-cast concrete with exposed Chehalis marble facing.[41] Concrete umbrella walkways provided shelter to students and faculty walking between

40. “Junior College: Highline Groundbreaking Set,” *The Seattle Times*, August 11, 1963, 66.

41. “New Highline College to Open,” *The Seattle Times*, August 30, 1964, 58.

Upper: First graduating class from Highline Community College.
Lower: First faculty members of Highline.

buildings. Burkhard's design won a national citation for exceptional design from the American Association of School Administrators in 1966; the jury called Burkhard's design an "exciting educational environment."[42]

The second phase of construction, for 11 additional buildings, began in summer 1966. Burkhard also designed these buildings. Knudson Construction Co., of Mountlake Terrace, served as general contractor, Totem Electric of Tacoma, installed the electrical systems, and Bergh-Griggs Co. of Tacoma, the mechanical systems. Andersen-Bjornstad-Kane was the structural engineer with Alexander H. Hargis as the mechanical and electrical engineer.[43] Construction was completed by 1986. In the meantime, the state legislature passed the Community College Act in 1967, creating Community College District 9 and allowing Highline to separate from the Highline School District. At this point, Highline College became Highline Community College and part of the State Board of Community and Technical Colleges (SBCTC). Dr. Allan continued as the college's president through this entire period.

Ten buildings remain from this period.

1968–1978: First Master Plan

The college continued to grow during its first several years of operation. Between 1966 and 1970, the college's enrollment increased from 3,500 to 7,100 and faculty numbers grew from

42. "Highline College Wins Design Award," *The Seattle Times,* February 6, 1966, 36.

43. "Work Begins at Highline," *The Seattle Times*, July 3, 1966, 17.

Above: 1970 photograph of the interior of Building 1.

Right: June 1977 construction photograph of Price-designed library.

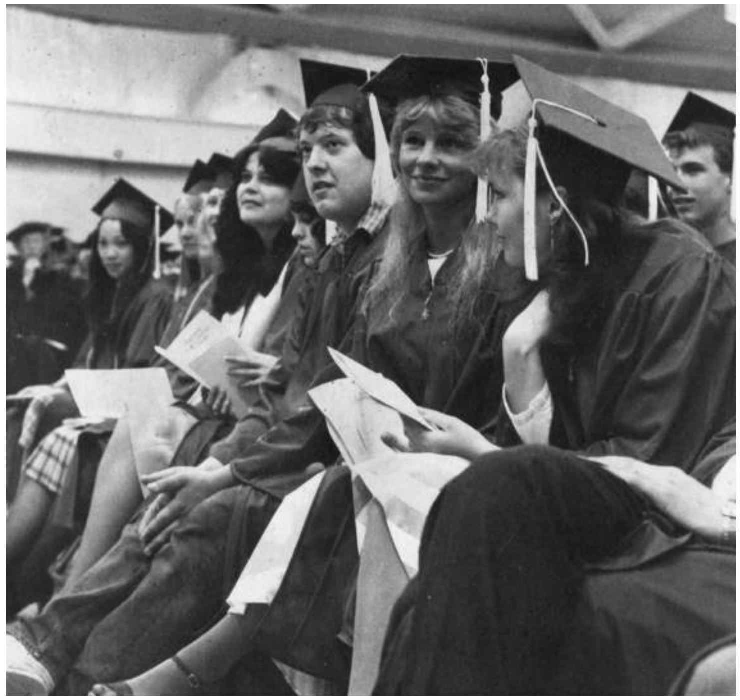
85 to 141.[44] In 1969, the college purchased property near the Des Moines marina to operate diving, sailing, marine biology, and marina management classes.[45] During this time, Dr. Allan left the college and Dr. Orville Carnahan began his tenure has president (1971–1976). Dr. Shirley B Gordon, one of the first instructors at the community college, was awarded the presidency in 1976.

In response to its own growth, the college hired the Tacoma architectural firm Robert Billsbrough Price & Associates to complete a master plan for the campus. The master plan was completed in 1971 and called for siting of buildings to take advantage of the sweeping views of Puget Sound (which, coincidentally, were better revealed once woods around the campus were cut down).[46] The architecture firm then went on to design three additional buildings for the campus, sited west and down the slope from the original Burkhard-designed campus. The first two buildings were constructed by 1976, a two-story classroom building and a three-story one. The third building, a new, six-level, 79,000-square-foot library, opened in March 1978,

44. "Highline College Reorganizes," *The Seattle Times*, December 6, 1970, 24.

45. "Highline Buys Property Near Des Moines," *The Seattle Times*, June 24, 1969, 46.

46. Alf Collins, "Two College Buildings are Blind," *The Seattle Times*, March 7, 1976, G-1.



Above: The college's welding program.
Right: Students at the 1985 graduation.

constructed for $3.4 million. The new buildings marked a significant departure in style from the Burkhard designs. A significant issue for the campus (both presently in 2016 and back in the 1970s) is its proximity to the Seattle-Tacoma International Airport and the resulting noise pollution. The designs for the new buildings had limited windows to eliminate noise infiltration and vibration inside the buildings.

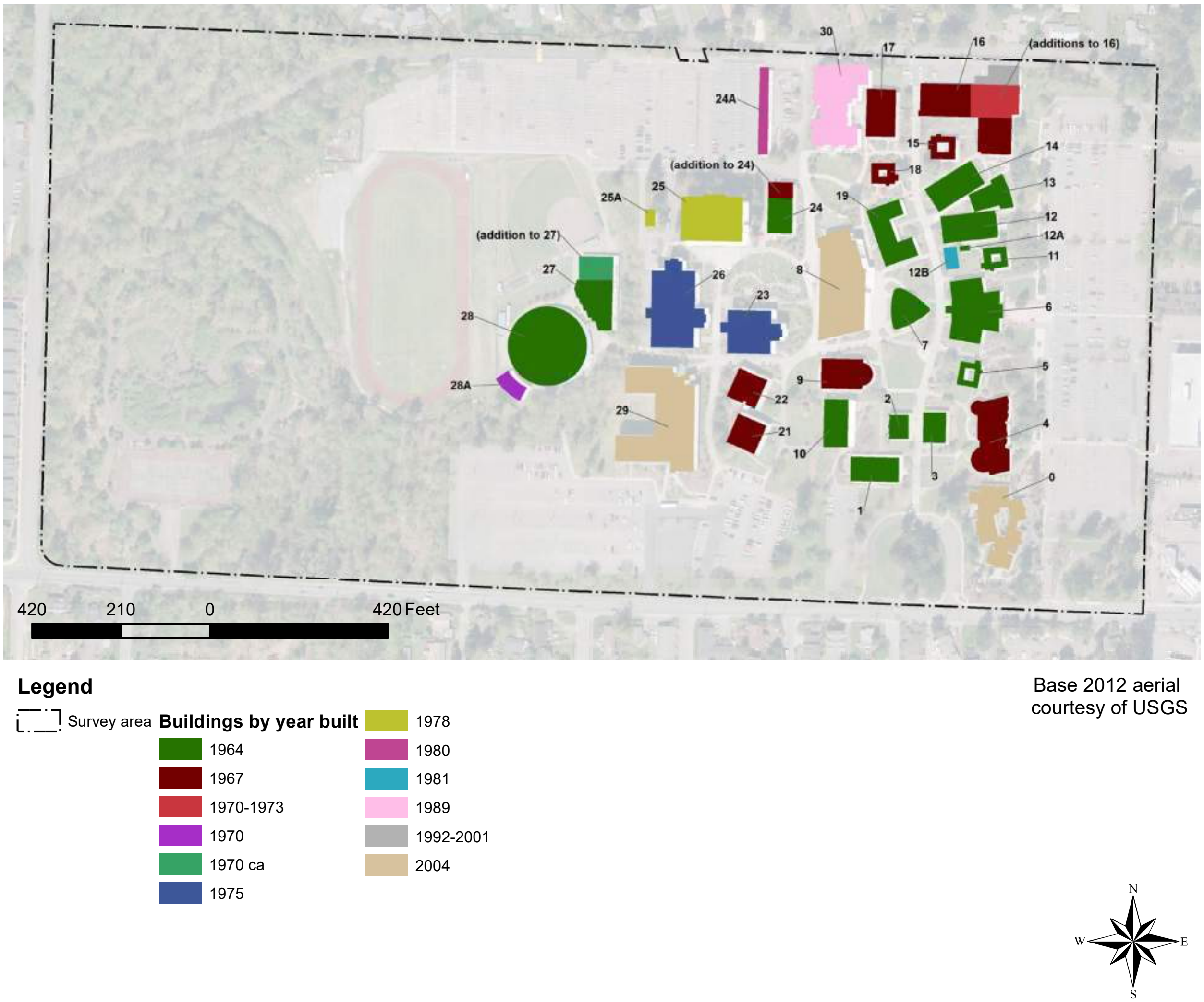
Two other buildings were constructed during this period, a chiller plant (25A) in 1978 and a maintenance/grounds building (24A) in ca. 1980.

Five buildings remain from this period.

1979–2003: Continued Growth

As Highline continued to grow and develop, so did neighboring Des Moines. Several annexations occurred between 1960 and 1988. Highline's location became incorporated within Des Moines after the 1984 South Des Moines annexation.[47] Limited construction occurred on the campus during this period. A new greenhouse was completed in 1981. Most notably, the Instructional Computing Center (Building 30) was constructed in 1990. The college spent $3.1 million on the three-story building to house state-of-the-art computer equipment. The computing center building was remodeled in 2000. Dr. Edward M. Command replaced Dr. Shirley B.

47. Kennedy, *One Hundred Years*, 43.



Map 2.4. Buildings, Dates of Construction
Highline College buildings color-coded by date of construction.

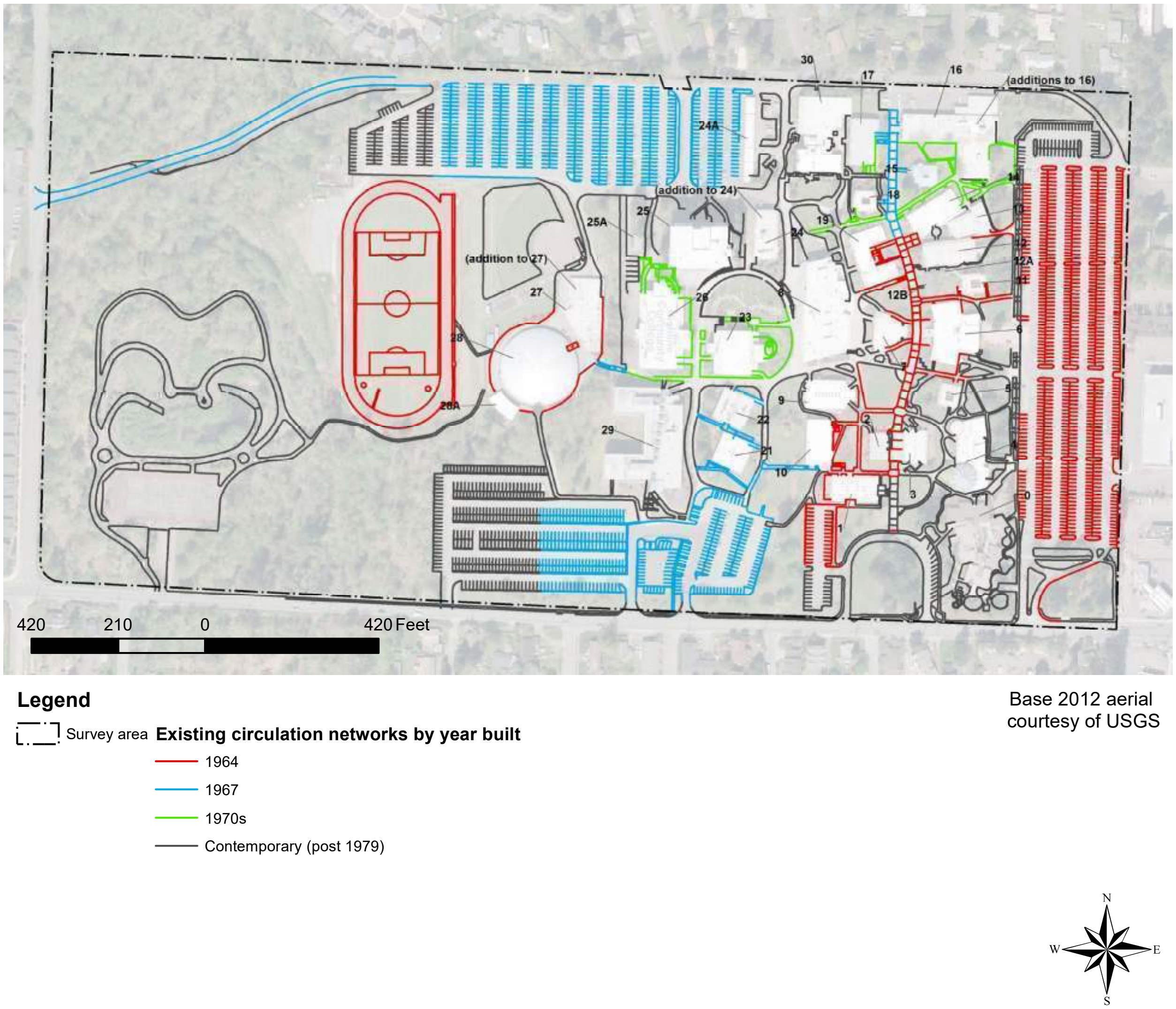
Gordon as president in 1990 and served until 2000. Dr. Priscilla J. Bell became president in 2000.

Two buildings remain from this period.

2004–Present: Current Conditions

In 2004, construction on three new buildings was completed on campus. These buildings included the Higher Education Center, Childcare Center, and the Student Union.

In 2014, the Highline Community College Board of Trustees voted to change the college's name back to Highline College. This vote came on the heels of state approval of the college's addition



Map 2.5. Circulation Networks, Dates of Construction
Highline College circulation networks color-coded by date of construction.

of four Bachelor or Applied Science degree programs.[48]

Highline College is now one of the largest higher education institutes in the state, with more than 15,000 students and 350,000 alumni.[49]

Three buildings remain from this period.

48. Highline Community College, "Highline Will Revert to Original Name," Media Release, June 13, 2014, https://communications.highline.edu/news/NRs/13-14_NRs/Highline_will_revert_to_original_name_061314.php.

49. Highline College, "Highline History," Highline College, https://www.highline.edu/about-us/highline-history/ (accessed May 6, 2016).

Architects

Ralph H. Burkhard (1908–1993)

Architect Ralph Burkhard. Courtesy the Department of Architectural Licensing, via DoCoMoMo WeWa.

Ralph H. Burkhard created a successful career for himself as an award-winning architect, well-known for his educational building designs. Born on July 18, 1908 in Bar Harbor, Maine, Burkhard attended Syracuse University, receiving a bachelor's degree in architecture in 1930, and earning his master's degree in architecture in 1931 from the Massachusetts Institute of Technology (MIT). In addition to his architectural degrees, Burkhard pursued studies in structural engineering and sculpture, enrolling at the Beaux Arts Institute of Design in New York City between 1932 and 1933.

For the first decade of Burkhard's career he designed for several architecture firms, primarily working in New York, Maine, and Washington, D.C. He moved to Seattle in May of 1943 to work for the Boeing Company as a mechanical engineer on the Boeing C-97 Stratofreighter project. Burkhard set up his own architectural practice in Seattle following the end of World War II, quickly establishing himself as an innovative and modern designer. The schools he designed during his career in the Pacific Northwest include: the Mountlake Terrace High School (1959) and Melody Hill Elementary School (1958) in Mountlake; Kenmore Elementary School (1955), Bothell High School gymnasium (1957), and Arrowhead Elementary School (1957) in Bothell; Foster Junior-Senior High School (1951) in Seattle; the Education Building (1958), Nicholson Pavilion (1959), and Courson and Muzzall Halls (1966) at Central Washington University in Ellensburg; Highline College (1964–1967); and A.A. Cleveland Hall (1963) at Washington State University in Pullman.[50]

Burkhard created distinctively Modern designs, earning numerous awards throughout his career, including a Seattle AIA Honor Award for Southgate Elementary School in 1951, a National Honor Award for Foster Junior-Senior High School in 1953, and other local AIA awards for

50. "Burkhard, Ralph H.," Pacific Coast Architecture Database (PCAD), https://digital.lib.washington.edu/architect/architects/5587/ (accessed November 13, 2012); "Burkhard, Ralph H.," Docomomo Wewa, http://www.docomomo-wewa.org/architects_detail.php?id=80 (accessed November 13, 2012).

Clark's Cleaners in 1955 and the Nicholson Pavilion in 1959.[51] His design for the gymnasium at Mountlake Terrace High School was the first major project on the West Coast to utilize triangular Glu-laminated beams.

Burkhard continued to design buildings through at least the early 1970s. A long-time resident of Burien's Normandy Park neighborhood, he passed away on December 30, 1993, at the age of 85.

Robert Billsbrough Price[52]

Born in Tacoma, Washington in 1915, Robert Billsbrough Price was perhaps the best-known architect in the Tacoma area from the 1950s into the 1970s, primarily for his contemporary Northwest residences, education-related buildings, and assorted commercial buildings. However, Price completed a wide range of work in various modernist styles and materials.

Architect Robert Price. Courtesy the Department of Architectural Licensing, via DoCoMoMo WeWa.

A graduate of Stadium High School, Price attended the University of Puget Sound and began taking classes towards an architectural degree at the University of Washington. His studies were suspended during World War II, when he served in the Naval Air Corps in England, Pearl Harbor, Australia, India, and China. After the war, Price completed a bachelor's degree in architecture from the University of Washington (1946) and a master's from the Massachusetts Institute of Technology (1948).

After briefly working for Seattle architect James C. Gardiner, Price co-founded a new practice in Tacoma with his wife, Joan. His work spanned a variety of building types, but his schools and education-related buildings comprised the bulk of his career portfolio. Beginning with Sherman Elementary in 1954, numerous projects followed in Western Washington during the 1950s, 1960s, and 1970s. These included John S. Baker Junior High School in Tacoma (1955); George R. Curtis Junior High School in University Place (1957); Hunt Junior High School (1958), with Halprin as landscape architect; Hoyt Elementary School (designed ca. 1957, built 1958,

51. "Burkhard, Ralph H.," Docomomo Wewa.

52. Artifacts Consulting, Inc. Curran House: Historic Structure Report, commissioned by the Friends of the Curran House Committee (May 2010), 23-30. Biography on Price condensed from the Curran House report.

awards received); Puyallup Jr. High School (ca. 1959); Aberdeen Senior High School (ca. 1960); Mount Tahoma High School in Tacoma (1961, demolished 2007); Olson Physical Education Building at Pacific Lutheran University (1969); and the College Recreation Center (1972) and the Recreation Pavilion (1973) at Evergreen State College in Olympia (1973). The Price firm also designed additional buildings and/or renovations to existing ones at Evergreen, Pacific Lutheran, the University of Washington, and Western Washington University.

From 1968 to 1981, Price served as vice chairman of the King County Design Commission. He also served three years on the University of Washington's design commission. In his lifetime, Price received 59 national, regional, and local awards honoring his architectural design excellence. He belonged to numerous groups, including the Tacoma Society of Architects, the Washington State Council of Architects, the Tacoma Art League, Allied Arts, Associated General Contractors of Tacoma, and both the Washington State and Southwest Washington chapters of the AIA. He passed away in September 1981.

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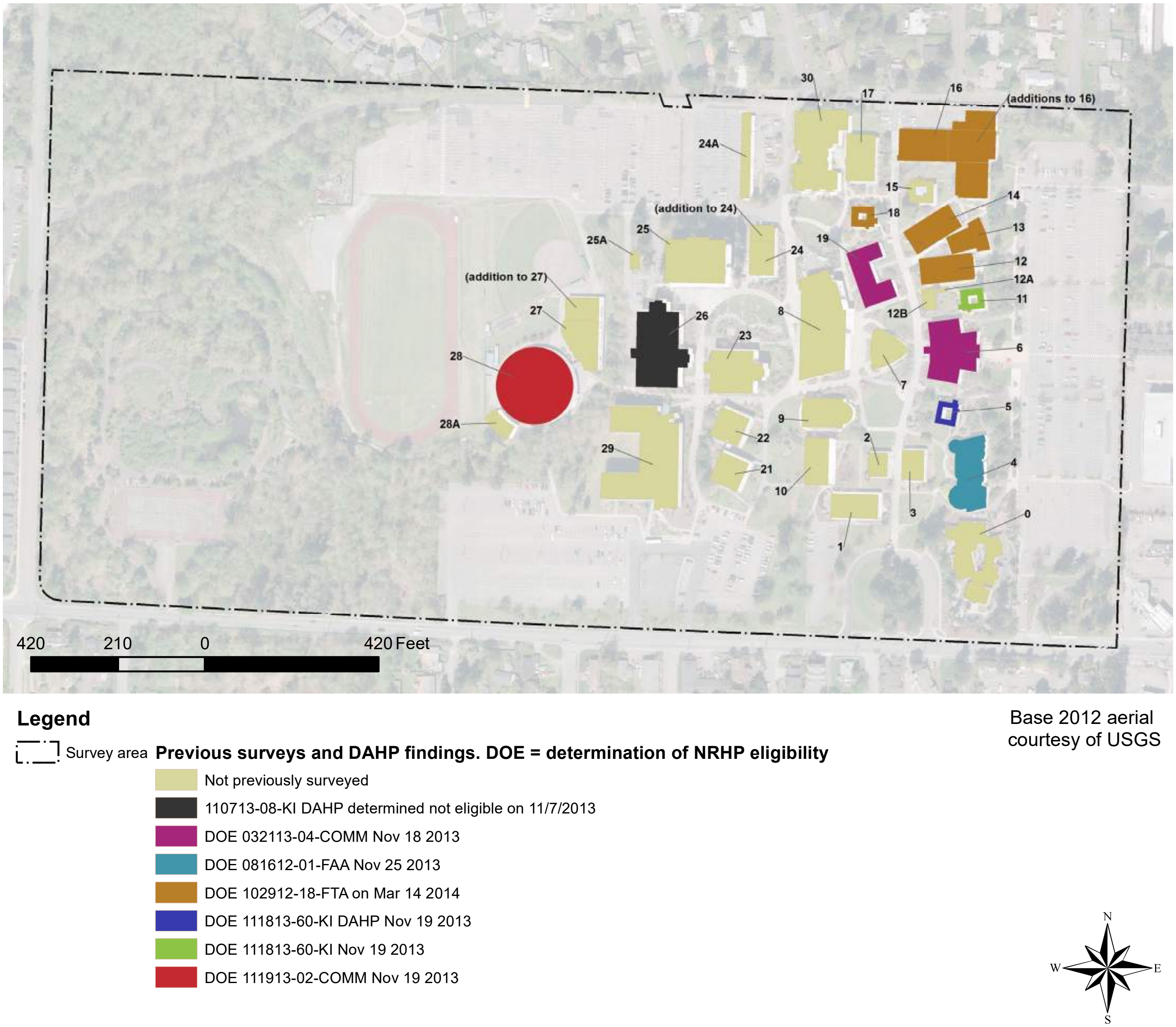
3

SURVEY RESULTS



Map 3.1. Previous Surveys

Map indicating which buildings at Highline College have been previously surveyed and the subsequent findings from the Department of Archaeology and Historic Preservation (DAHP).

FINDINGS

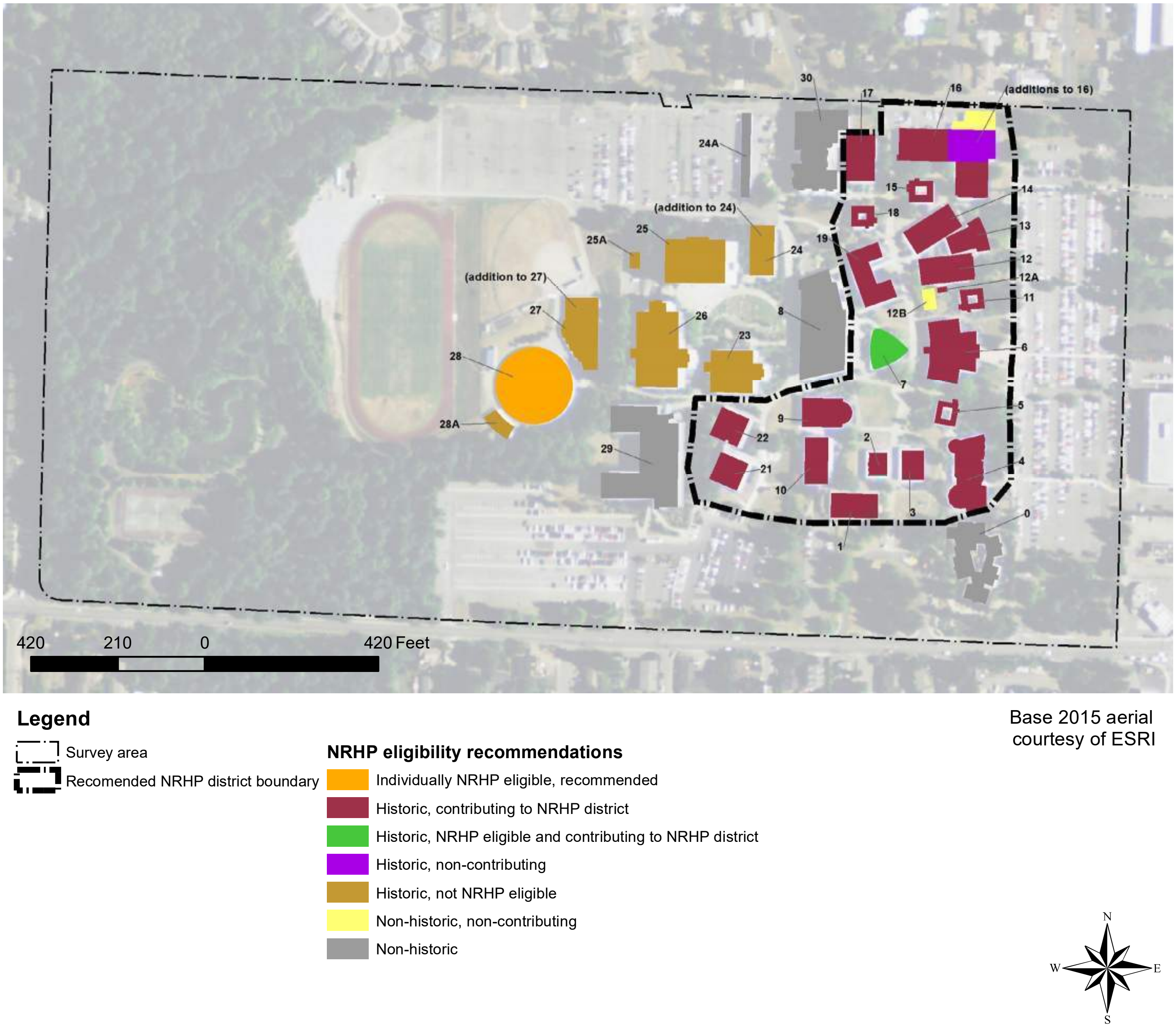
The Highline College campus has experienced multiple expansions, growing the campus westward. The original core continues to convey a unity of design and provide a distinct point of entry for students entering the campus from the east parking lot.

The findings were consistent with expectations relative to integrity and quality of design and the level of architectural firms involved in the original planning and design. The following survey findings convey eligibility recommendations for the campus, based on field work and archival research.

Although the 50 year cut off as of 2016 is 1966, properties built in 1967 were treated as being 50 years of age in order to better inform future planning efforts.

Status definitions used on the map legends for buildings, circulation, and landscape features—note that all categories are recommended based on field work, archival research, and our professional experience:

- **Historic, individual and contributing**, recommended: "Historic" indicates properties built before 1979. "Individual" indicates the property is potentially individually eligible for listing to the NRHP based on either or both its architectural and historical significance and role in the development of Highline College. "Contributing" indicates the property resides within and supports the architectural and historical significance of the recommended NRHP historic district.
- **Historic, contributing**, recommended: built before 1979 and resides within and supports the architectural and historical significance of the recommended NRHP historic district.
- **Historic, not NRHP eligible**, recommended: built before 1979, not potentially individually NRHP eligible and is outside of the recommended NRHP historic district (and the intervening space between the property and district lacks sufficient integrity to extend the district to include the property).
- **Historic, non-contributing**, recommended: built before 1979 and within the potential NRHP historic district, but non-contributing due to the extent of alterations.
- **Non-historic**: Properties built in or after 1979, and not within a potential historic district.
- **Non-historic, non-contributing**: built in or after 1979, resides within but does not support architectural or historical significance of the recommended NRHP historic district.



Map 3.2. National Register of Historic Places Eligibility Recommendations, Buildings

National Register of Historic Places (NRHP) eligibility recommendations for Highline College buildings within the survey boundaries.

Above: Building 7, south and west facades.

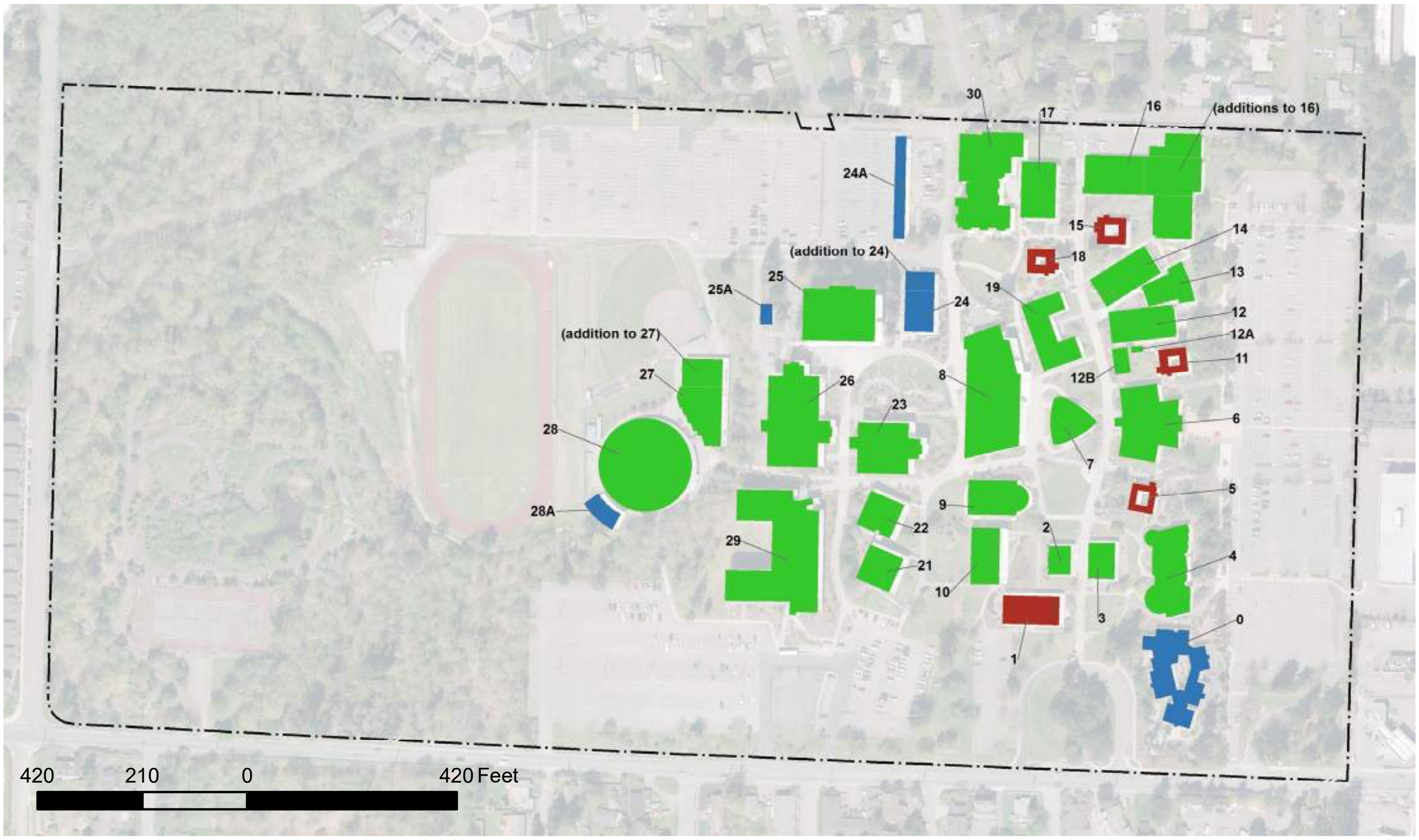
Right: Detail of panels, Building 7. All contemporary images courtesy Artifacts Consulting, Inc., 2016, unless otherwise noted.

District: The core area within the Highline College campus is recommended as potentially eligible for inclusion on the NRHP as a district listing at the local level of significance under criteria A and C. The period of significance for the campus is 1964–1967, encompassing the initial construction to start the campus and the next phase of development that continued the architectural styles, materials, and design work of the first phase by architect Ralph Burkhard. Refer to the district status map page 48 for the recommended boundary and contributing properties.

- Under criterion A, area of significance of education, for its association with post-World War II higher education in Washington.
- Under Criterion C, area of significance of architecture, as an example of the work of Ralph Burkhard, a well-respected architect who designed numerous school campuses during the post-World War II period.

Individual: Only one academic building rises to the level of potential individual NRHP eligibility due to the quality of its design and construction. Refer to the map page 48 for recommended properties:

- Building 7, under criteria A and C, due to its architectural design, materials, prominent location within the core of the campus, and role as the main lecture hall. This building retains a high level of integrity of location, design, setting, materials, workmanship, feeling, and association.



Legend

Survey area

Building functions

Academic

Faculty

Service

Base 1968 aerial
courtesy of King County Road Services

Map 3.3. Building Functions

Highline College buildings color-coded by building function (academic, faculty, and service).

Left: Building 28, looking west.

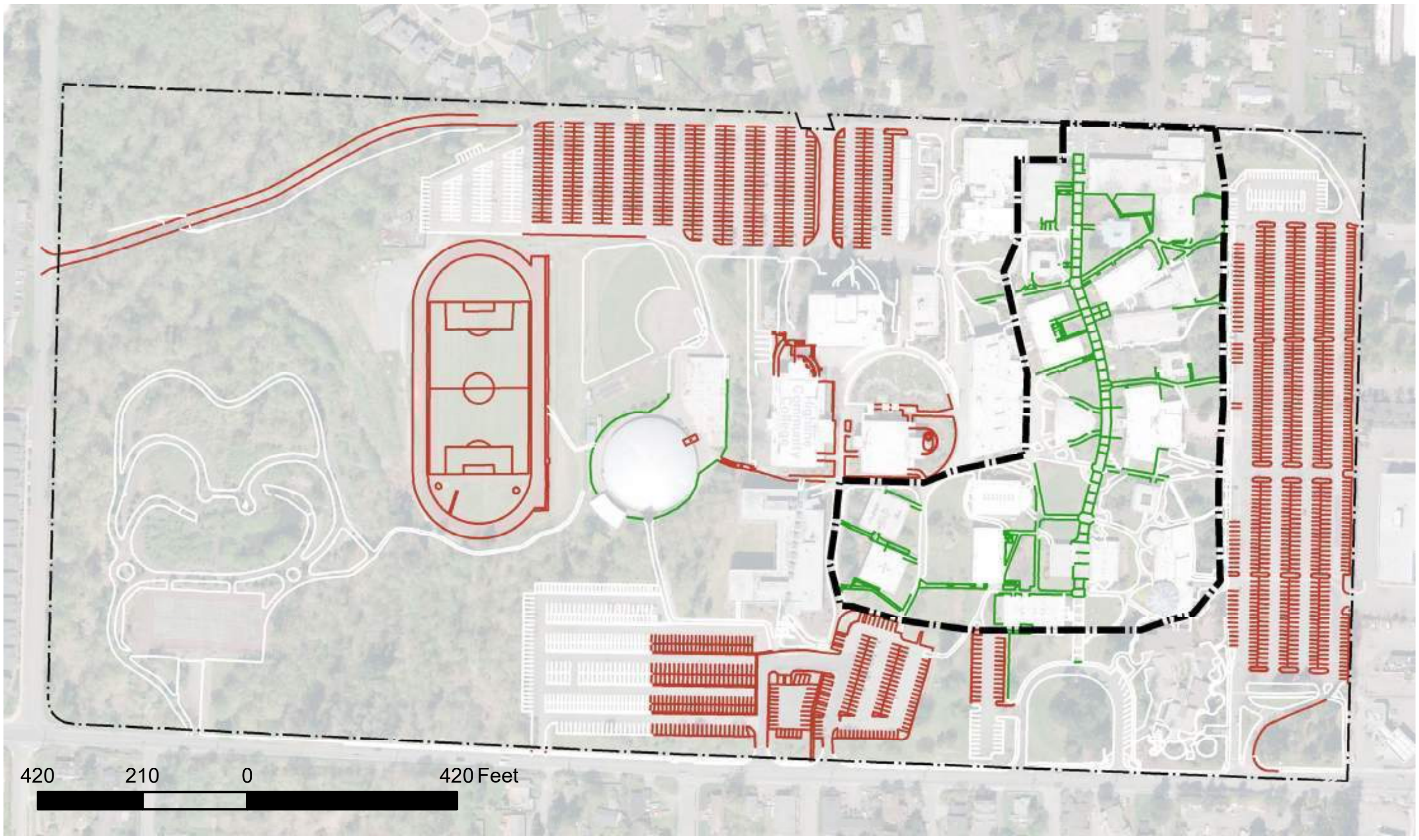
Right: Building 12, illustrates soffit detail.

Buildings

Buildings within the core campus directly support the character and quality of design, setting, feeling and association that characterize Highline College. Two functional types support Highline College, academic, and service. This is a commuter oriented campus and consequently does not have residential facilities. Overall the buildings retain a moderate level of integrity of location, design, setting, materials, workmanship, feeling, and association. There have been several alterations (including extensive interior alterations and window replacements on most buildings), building removal, and contemporary infill development.

Refer to the building status map page 48 and the table below page 64 for recommended NRHP eligibility details.

- Historic, contributing to NRHP district:
    - » Contributing buildings designed for academic functions, within the core campus established as part of the original design, with a direct role in the visual and physical character and educational role of Highline College. Many of these may have experienced alterations; however, collectively they continue to convey the original design, setting, materials, workmanship, feeling, and association that is characteristic of the period of significance.
- Historic, NRHP eligible contributing to NRHP district:
    - » Buildings designed for academic functions that could potentially achieve NRHP listing as individual properties, based on their high level of architectural significance, as well as contribute to a potential historic district.
- Historic, not NRHP eligible and/or non-contributing:
    - » Buildings designed for academic and service functions, either outside of the core campus, having an indirect role in the experience and educational role of Highline College, or within the core campus but have been substantially altered.



Legend

Survey area

Recomended NRHP district boundary

NRHP eligibility recommendations

Historic, non-contributing

Historic, not NRHP eligible

Non-historic, non-contributing (shown as white lines)

Base 2012 aerial
courtesy of USGS

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Map 3.4. National Register of Historic Places Eligibility Recommendations, Circulation Networks

National Register of Historic Places (NRHP) eligibility recommendations for Highline College circulation networks within the survey boundaries.

- Non-historic and/or non-contributing:
  - » Buildings added as part of subsequent development periods that departed from the original designs, materials, and locations. These can occur both within and outside of the potential historic district.

Academic: Core buildings designed and built to provide education facilities for students enrolled at Highline College. These reflect the highest level of material and design, while also being directly related to the educational mission of Highline College. They constitute the majority of properties on the campus. Refer to the Building Function map.

Faculty: Buildings designed and built to provide office and support facilities for professors teaching at Highline College. These include the administration building as well as faculty offices. These reflect a high level of materials and design, while also being directly related to the educational mission of Highline College. They are smaller in scale and serve a supporting role to the academic buildings. Refer to the Building Function map.

Service: Buildings designed and built to support the operation of Highline College. Relative to the academic buildings, these exhibit comparable materials and a simplified level of design for a more utilitarian character that blended into the overall campus. They tended to be located at the outer edges of the campus. Refer to the Building Function map.

Circulation

Circulation into and within the campus is a successful functional component. Those features within the core campus directly support the character and quality of design, setting, feeling, and association. As circulation features move away from the core campus, their influence on the visual and physical character becomes more indirect. The following observations and recommendations stem from a comparison of the original landscape design drawings and historic aerials. Overall circulation features retain a low level of integrity of location, design, setting, materials, workmanship, feeling, and association. There has been one alteration—adding a hip roof to a directory—along with some non-compatible efforts to replicate original brick paving (in front of the Seminar

Sidewalk leading to Building 4.

I building), and loss of circulation features and the addition of contemporary features due to development. Refer to the circulation status map page 52 for recommended NRHP eligibility details.

- NRHP district contributing:
  - No circulation features are recommended as contributing due to the extent of material and design alterations. Only fragmented sections of original concrete paving remain. The majority of walkways have received new paving and/or have had their alignments altered.
- Historic, non-contributing:
  - Circulation within the core campus originally had a direct role in the visual and physical experience and navigation of the campus. Due to the extent of alterations, however, they are not recommended as contributing. This includes arterial and connecting walkways.
- Historic, not NRHP eligible:
  - Circulation features outside of the recommended historic district. These were added between 1964 and 1967; however, they have been substantially altered and/or originally feature minimal utilitarian design features.

Walkways: These provide pedestrian circulation within the campus. Vehicles are restricted to the parking areas around the perimeter of the campus, making walking the primary means of circulation within the campus. Materials consist of concrete and painted metal. Alterations include the removal of the canopies, allowance of vehicle travel within the campus, and the replacement of most of the concrete surfaces. Although many of the walkways remain in their original locations, the loss of original materials and design features influenced the recommendation for non-contributing status.

- **Arterial walkway**: This consists of the main curvilinear, north–south walkway extending from the south to the north end of the campus. Academic buildings are arranged on either side of and facing the walkway. Smaller connecting walkways extend between the building entrances and the arterial walkway. Alterations expanded arterial walkways to include an east–west route down to buildings 26 and 29; and a second north–south route on the east and west sides of building 8, extending down to the building 25, and out to the north parking lot. Also an arterial was added along east side of buildings 29 and 26 connecting to building 25.
- **Connecting walkways**: These consist of walkways linking the parking areas to the arterial walkway, and connecting from the arterial walkway to the buildings. These are smaller in scale than the arterial walkway. There are direct flights of concrete stairs with painted metal railings at steeper grade sections.

Left: Contemporary view of walkway canopy example.

Above: Historic view of walkway canopy example.

- **Walkway canopies**: These segmental concrete covers (also called umbrellas in the original drawings) built as part of the 1964 development phase provided students shelter from the rain when walking between buildings. Only the canopy between the field house and locker room remains. The other covered walkways were removed between 2005 and 2016.
    - » Originally between buildings 2 and 3, removed.
    - » Originally along the arterial walkway, removed. As part of the 1964 development phase these extended north only to buildings 12 and 14. As part of the 1970s development, the walkway and associated canopy were extended north to connect with building 15.
    - » Originally from the arterial walkway to the west edge of buildings 12 and 14, removed.
    - » Originally between the field house and associated locker room, remains

Roads: These provide vehicular access to and within the campus and are paved with asphalt. Roads are categorized by their role and whether they existed prior to Highline College. Materials consist of asphalt and gravel. Contemporary road additions to the site include the service road along the north side of the campus added after 1968, and the U-shaped entrance loop addition off the south end of the campus. Alterations to the roads and their lack of a direct role in shaping the design of the campus layout influenced their recommended non-contributing status.

- **Direct role**: no roads having a direct influence on the campus layout and design were added as part of the Highline College construction.

- **Indirect role**: roads added as part of the Highline College construction. These provide supporting roles for Highline College. These include:
  - » West access road, added as part of the 1967 north parking lot development. This road provided vehicular access to the campus from 20th Avenue South (which was built between 1965 and 1967).
- **Existing roads**: Only one road passed through the site and another ran along what would become the south edge of the campus. The small gravel road, a former segment of what is today 25th Avenue South, existed within the site prior to Highline College development; however, this road segment was removed as part of the site development. South 240th Street existed along the south edge of the future campus site; this street would become the main connection to the campus.


Parking lot example.

Parking: The campus design placed parking along the north, south, and east sides. Pedestrian walkways from these parking areas led directly into the campus academic core. The parking areas are characterized by open asphalt expanses with rows of parking. No trees or landscaping were planted within the parking areas. Materials consist of asphalt. Due to the lack of original design features and the extent of alterations, the parking areas are not recommended as NRHP eligible or potentially contributing to the historic district.

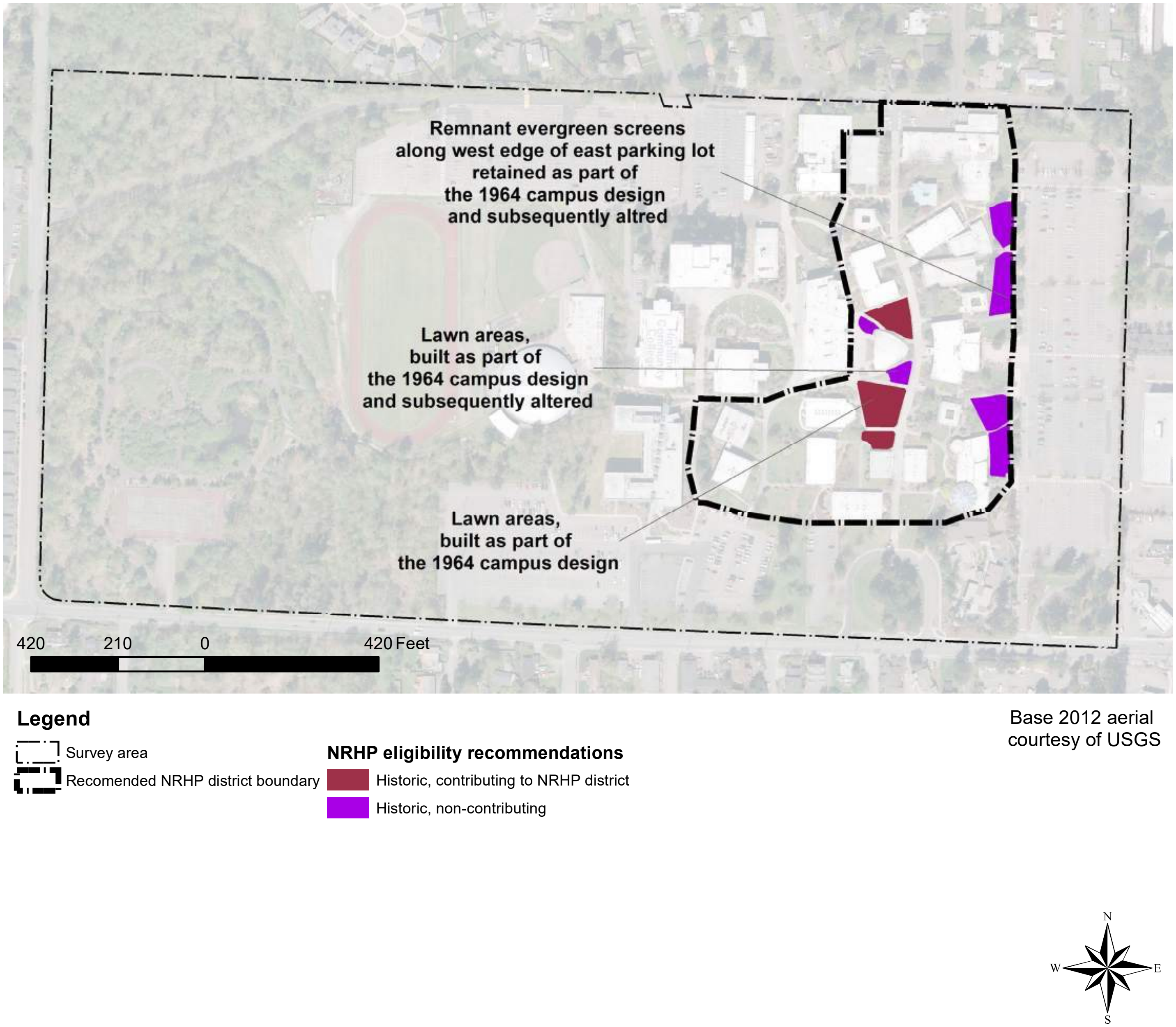
- **East** parking lot, built as part of the 1964 phase of campus development. Accessed from the parking lot's south end via South 240th Street, and a second access road that ran diagonally out from the southwest side of the parking lot to South 240th Street. Subsequent alterations removed this diagonal access road, and expanded the lot to the north.
- **West** parking area; the north portion of this area was constructed as part of the 1964 phase of campus development. Subsequent alterations widened this parking area to the west and extended it to the south.
- **North** parking lot, built as part of the 1967 phase of campus development. The eastern two-thirds of the lot were initially built, with later expansions extending the lot west to its current size.
- **South** parking lot, built as part of the 1967 phase of campus development. The access driveway from South 240th Street and the eastern two-thirds of the lot were

initially built. Subsequent expansions extended the lot to the west and added the westernmost driveway access to South 240th Street.

Landscape

Landscape is a secondary component of Highline College visual and physical character. The following observations and recommendations stem from a comparison of existing features and historic aerials predating Highline College construction. Overall landscape features retain a low level of integrity of location, design, setting, materials, workmanship, feeling, and association. There has been a loss of open lawn areas, the addition of trees and shrubs, and designed planting features within the campus. Refer to the landscape status map page 58 for recommended NRHP eligibility details.

- Historic, contributing to NRHP district:
  - Lawn within the core campus, established as part of the original 1964 design.
- Historic, non-contributing:
  - Lawn within the core campus, established as part of the original 1964 design, but extensively altered through subsequent plantings.
  - Existing vegetation along the west edge of the east parking lot providing the screen between the parking area and academic buildings and retained as part of the 1964 development period.
  - Shrubs around building 1 developed as part of the 1964 development period due to the extent of alterations. (Not shown on map.)
  - Trees within the campus planted as part of the 1964 and 1967 development periods. (Not shown on map.)
- Historic, not NRHP eligible:
  - Trees within the campus planted as part of the 1964 and 1967 development periods. (Not shown on map.)
  - Athletic fields developed as part of the 1964 development period. (Not shown on map.)
- Non-historic, non-contributing:
  - Trees, lawn and shrubs planted as part of subsequent development periods that departed from the original species and structure types.



Map 3.5. National Register of Historic Places Eligibility Recommendations, Landscape
National Register of Historic Places (NRHP) eligibility recommendations for Highline College landscape elements within the survey boundaries.

Trees: comprise a secondary landscape element on the campus. Landscaping as part of the 1964 development instead focused on open lawn expanses between buildings.

- 1964 development phase utilized existing trees around the campus perimeter; however, within the campus, few to no trees were planted. Most notable were the retention of evergreen trees along the east side of campus between the buildings and the east parking lot to provide a visual buffer between the two functions.
- 1967 development phase introduced trees to the campus. Plantings occurred along the edges of the main lawn areas, and along the former diagonal access road at the south end of campus. This diagonal row of trees remains today, although the associated road was replaced with a U-shaped loop road as part of subsequent development.


Mature tree example.

Lawn: These areas provided an important textural contrast along the concrete walkways and the marblecrete-clad buildings. They also afforded seating and activity areas for students.

» Central lawn area, developed as part of the 1964 development phase, originally extended around all sides of building 7, and to the south to building 2. Building 9 was later constructed in a west extension of this area.

» Lawn aprons in front of building aprons around the central core, developed as part of the 1964 development phase. These were in front of Buildings 5, 6, 11, 12, 19, 14.

» South lawn area entry approach added post 1965 as an extension to the original lawn area south of building 1 and building 3. This added extension was part of a larger reconfiguring of the campus south entrance.

Ornamental: Few ornamental plantings were included as part of the original 1964 development period. The following areas stem from the original 1964 development period.

- South, former main campus entrance. A former access road entered the site from South 240th Street and angled diagonally across the south edge of campus to connect with the east parking area. Subsequent alterations removed this road; however, originally the southwest corner of this road, along the west parking area, featured ornamental plantings and decorative rock features.

Lighting: Provided a supporting role within the campus to illuminate walkways. As part of the 1964 development period, lights with slender metal column posts and broad flat cover fixtures were installed along walkways. Alterations replaced all of these with tall goose-neck fixtures and posts with flat projecting light fixtures.

Shrubs: These provided a supporting landscape feature on the campus. They were not widely used as part of the 1964 development phase, but grew in use over subsequent development periods. The following shrub and planting areas stem from the original 1964 development period:

- Building 1, foundation plantings around the building, and a patio extension at the west end with views out to the Puget Sound. Shrubs provided a screening feature along the north and south sides of this patio.

Atrium planting example.

- Atrium planting areas in buildings 5, 11, 15, and 18. These consisted of a central planting area surrounded by an exposed aggregate walkway. Offices opened to the atrium with a balcony at the second floor level. Originally these featured skylights. Later alterations removed the skylight coverings exposing the interior. Alterations added a roof over building 15 covering the atrium.
- East parking lot, along the west edge. Shrubs were used as understory plantings below the existing trees as part of maintaining a visual screen between the parking area and the campus buildings.

Existing vegetation: Existing tree stands existed throughout the majority of the site. Development in the 1964 phase used these as screens around the perimeter, even retaining trees along the east side between the campus and the parking lot.

Sports Areas: These provide recreation facilities for Highline College students. They typically feature concrete and lawn. Sports areas include:


Athletic field.

- **Athletic field**, north of building 28, cleared as part of the 1964 development phase to create an open field area. Subsequent alterations installed the baseball area.
- **Track,** west of building 28, developed as part of the 1967 development phase. Subsequent alterations installed the additional track and field equipment and contemporary track material.
- **Tennis courts**, added by 1991 in the southwest corner of the site, consist of four courts. Originally accessed by automobile from South 240th Street. Subsequent alterations between 1992 and 2002 include a series of trails, a pond off the north side of the courts, and a connecting pathway to building 28.

DEVELOPMENT TRENDS

Growth and development to accommodate growing enrollment will be an ongoing stewardship concern relative to the buildings and historic landscape and circulation features. Integration of new development in a compatible manner can both support and enhance the existing historic features as well as the overall character and experience of Highline College.

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Table 3.1. Highline College Buildings

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
0	Childcare Center	Non-historic	2004	Not surveyed		Service	N/A	
1	Administration Building	Historic, contributing	1964	New intensive level form completed		Faculty	Burkhard, Ralph H.	
2	Art Studio (currently the Conference Center)	Historic, contributing	1964	New intensive level form completed		Academic	Burkhard, Ralph H.	
3	Crafts Building	Historic, contributing	1964	New intensive level form completed		Academic	Burkhard, Ralph H.	
4	Performing Arts Building	Historic, contributing	1967	Intensive level form updated	DOE 081612-01-FAA Nov 25 2013	Academic	Burkhard, Ralph H.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
5	Faculty A Building	Historic, contributing	1964	Reconnaissance level form updated to intensive	DOE 111813-60-KI DAHP Nov 19 2013	Faculty	Burkhard, Ralph H.	
6	Library (currently Student Services)	Historic, contributing	1964	Reconnaissance level form updated to intensive	DOE 032113-04-COMM Nov 18 2013	Academic	Burkhard, Ralph H.	
7	Lecture Room	Historic, individual and contributing	1964	New intensive level form completed		Academic	Burkhard, Ralph H.	
8	Student Union Building	Non-historic	2004	Not surveyed		Academic	Burkhard, Ralph H.	
9	Instructional Guidance Center	Historic, contributing	1967	New intensive level form completed		Academic	Burkhard, Ralph H.	
10	Classroom A Building	Historic, contributing	1964	New intensive level form completed		Academic	Burkhard, Ralph H.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
11	Faculty B Building	Historic, contributing	1964	Reconnaissance level form updated to intensive	DOE 111813-60-KI Nov 19 2013	Faculty	Burkhard, Ralph H.	
12	Sciences Lab, Biological Sciences	Historic, contributing	1964	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Academic	Burkhard, Ralph H.	
13	Science Lecture Rooms	Historic, contributing	1964	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Academic	Burkhard, Ralph H.	
14	Science Building	Historic, contributing	1964	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Academic	Burkhard, Ralph H.	
15	Faculty C Building	Historic, contributing	1967	New intensive level form completed		Faculty	Burkhard, Ralph H.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
16	Engineering and Shops (Occupational Classrooms)	Historic, contributing	1967	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Academic	Burkhard, Ralph H.	
17	Classroom B Building	Historic, contributing	1967	New intensive level form completed		Academic	Burkhard, Ralph H.	
18	Faculty D Building	Historic, contributing	1967	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Faculty	Burkhard, Ralph H.	
19	Classroom E Building	Historic, contributing	1964	Reconnaissance level form updated to intensive	DOE 032113-04-COMM Nov 18 2013	Academic	Burkhard, Ralph H.	
21	Classroom C Building	Historic, contributing	1967	New intensive level form completed		Academic	Burkhard, Ralph H.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
22	Classroom D Building	Historic, contributing	1967	New intensive level form completed		Academic	Burkhard, Ralph H.	
23	Service Occupations	Historic, not NRHP eligible	1975	New intensive level form completed		Academic	Price, Robert B.	
24	Boiler Plant (currently Physical Plant)	Historic, not NRHP eligible	1964	New intensive level form completed		Service	Burkhard, Ralph H.	
25	Library	Historic, not NRHP eligible	1978	New intensive level form completed		Academic	Price, Robert B.	
26	Health Occupations	Historic, not NRHP eligible	1975	Reconnaissance level form updated to intensive	110713-08-KI DAHP determined not eligible on 11/7/2013	Academic	Price, Robert B.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
27	Locker Rooms Building	Historic, not NRHP eligible	1964	New intensive level form completed		Academic	Burkhard, Ralph H.	
28	Fieldhouse	Historic, not NRHP eligible	1964	Reconnaissance level form updated to intensive	DOE 111913-02-COMM Nov 19 2013	Academic	Burkhard, Ralph H.	
29	Higher Education Center	Non-historic	2004	Not surveyed		Academic	N/A	
30	Instructional Computer Center	Non-historic	1989	Not surveyed		Academic	N/A	
12A	Greenhouse A Building	Historic, contributing	1964	New intensive level form completed		Academic	Burkhard, Ralph H.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
12B	Greenhouse B Building	Non-historic, non-contributing	1981	Not surveyed		Academic	Bittman, Richard	
24A	Maintenance Building	Non-historic	1980	Not surveyed		Service	Price, Robert B.	
25A	Chiller Plant	Historic, not NRHP eligible	1978	New intensive level form completed		Service	Price, Robert B.	
28A	Fieldhouse Storage	Historic, not NRHP eligible	1970	New intensive level form completed		Service	Burkhard, Ralph H.	
NA	Engineering and Shops, addition	Historic, non-contributing	1970-1973	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Academic	Burkhard, Ralph H.	
NA	Locker Room, addition	Historic, not NRHP eligible	1970 ca	New intensive level form completed		Academic	Burkhard, Ralph H.	

ID	Name	Status	Year Built	Survey	DAHP notes	Function	Architect	Photograph
NA	Physical Plant, addition	Historic, not NRHP eligible	1967	New intensive level form completed		Service	Burkhard, Ralph H.	
NA	Engineering and Shops, addition	Non-historic, non-contributing	1992-2001	Intensive level form updated	DOE 102912-18-FTA on Mar 14 2014	Academic	N/A	

d. greenhouse gas emissions plan

Highline College

Strategy for Reducing Greenhouse Gas Emissions

Nov. 8, 2021

1. Background

In 2009, the Legislature and Governor adopted the State Agency Climate Leadership Act (Engrossed Second Substitute Senate Bill 5560 – Chapter 519, Laws of 2009). The Act committed state agencies to lead by example in reducing their greenhouse gas (GHG) emissions to:

- 15 percent below 2005 levels by 2020.
- 36 percent below 2005 by 2035.
- 57.5 percent below 2005 levels (or 70 percent below the expected state government emissions that year, whichever amount is greater.)

The Act, codified in RCW 70.235.050-070 directed agencies to annually measure their greenhouse gas emissions, estimate future emissions, track actions taken to reduce emissions, and develop a strategy to meet the reduction targets. The strategy is required by law in RCW 70.235.050 section (3):

> *By June 30, 2011, each state agency shall submit to the department a strategy to meet the requirements in subsection (1) of this section* [greenhouse gas reduction targets]. *The strategy must address employee travel activities, teleconferencing alternatives, and include existing and proposed actions, a timeline for reductions, and recommendations for budgetary and other incentives to reduce emissions, especially from employee business travel.*

Starting in 2012 and every two years after each state agency is required to report to Ecology the actions taken to meet the emission reduction targets under the strategy for the preceding biennium.

- **Highline College will commit to operate in a sustainable manner that simultaneously meets the economic, environmental, and social equity responsibilities of the College. The College will actively pursue currently implemented and innovative methods of sustainability in all three areas. Such practices will be applied throughout the campus, as a part of College's relevant instructional practices, purchasing procedures, and resource management.**

2. Greenhouse Gas Emissions from Agency Operations

A. Direct sources of GHG emissions from building and fleet energy use

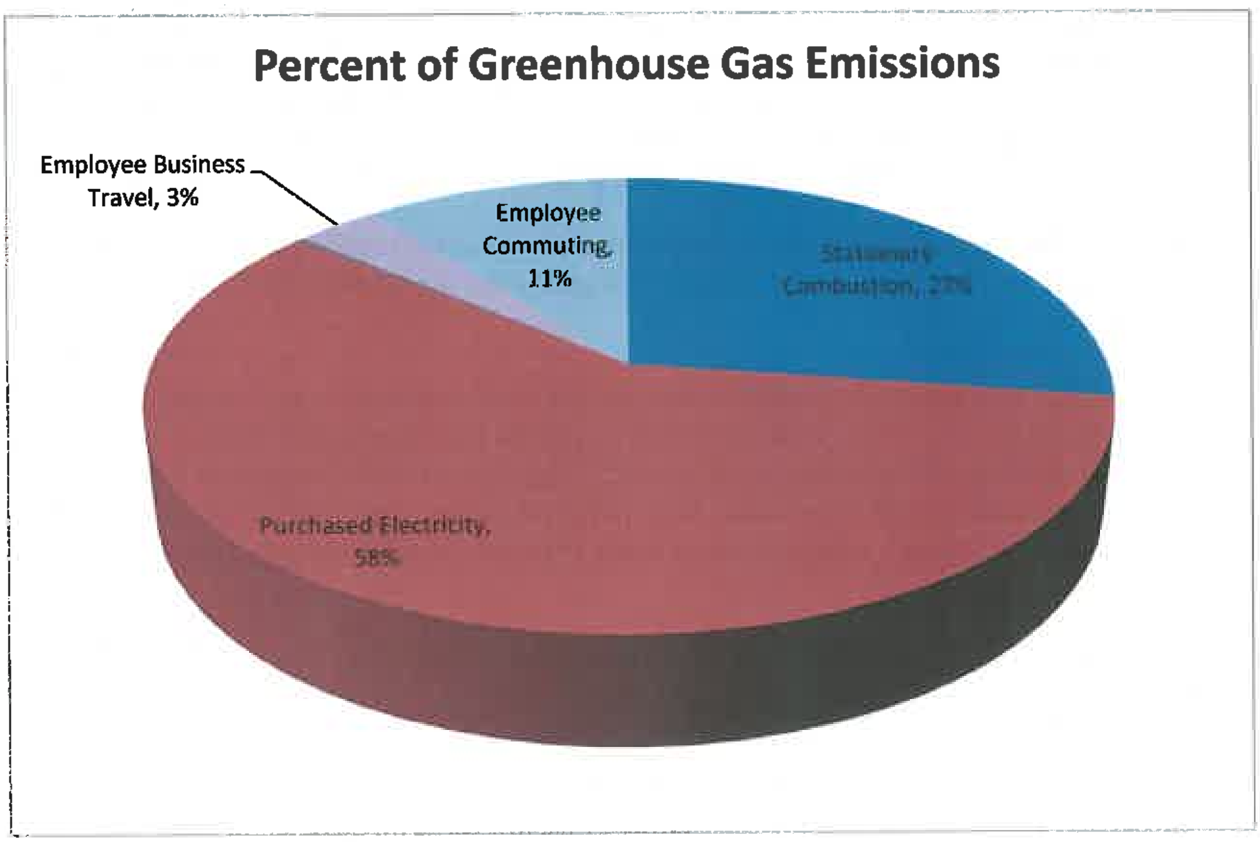
Year	Greenhouse Gas Emissions (metric tons carbon dioxide equivalent, $MTCO_2e$)
2005	6,286.3
2009 (or most recent year)	(Do not include business travel or commuting emission here) 6,773.8
2020 (projected)	7,763.1
2035 (projected)	9,006.7

(Note: Figures do not include GHG emissions from buildings owned by General Administration. However, they do include GHG emissions from use of the GA Motor Pool.)

The projected 2020 and 2035 GHG emission levels can be found on the projection tool. Or agencies can use their internal agency estimates.

B. Main sources of direct GHG emissions

- **Insert pie chart or briefly describe source and percent of GHG emissions from building and fleet energy use for 2009 or the most recent year**



C. Greenhouse Gas Reduction Targets

Year	GHG Reduction Target ($MTCO_2e$)
2020 (15% below 2005)	**5,343.4**
2035 (36% below 2005)	**4,023.2**
2050 (57.5% below 2005)	**3,671.7**

D. Level of GHG Reduction Needed to Meet Targets

Note 2050 is not included below because the estimate would be highly uncertain. This strategy should focus on meeting the 2020 and 2035 targets.

Agencies that are not expecting to grow need to reduce from the most current year to the targeted level. Subtract the most recent year emissions (2009 or 2010) from the targets in part C above.

Agencies that are growing need to account for future growth to achieve the targets. These agencies should use the projected 2020 and 2035 emissions from the projection tool, or use internal agency projection estimates to determine the amount of GHG reduction needed.

Year	Amount of GHG Reduction Needed to meet Targets ($MTCO_2e$)
2020	**1,430.4**
2035	**2,750.6**

3. Overarching Strategies (if applicable)

The agency identified several cross-cutting strategies to help in reducing GHG emissions:

(Examples may include the following)

- Improve tracking of information used to quantify GHG emissions
- Integrate GHG reduction goals and actions into sustainability efforts and track progress
- Monitor progress, implementation, and develop strategies
- Education/Outreach

4. Greenhouse Gas Reduction Strategies for Direct Emission Sources (Building and Fleet Energy Use)

A. Strategies and Actions with Low to No Cost

Where possible, include estimates of GHG reduction, cost, payback using emission reduction tool. Add the reduction and cost estimates and insert totals.

Strategies and Actions	GHG Reduction Estimate Annual ($MTCO_2e$)	Upfront Cost Estimate ($)	Payback Period Estimate (Years)	Date to Imple-ment Estimate
Building Energy Use				
Reduce energy consumption by 9.5% • Behavioral changes • RCM program • Set environment temp/set temp pts./ loading bldgs./scheduling • Sub-metering • Utilizing Energy Star IT software	597.2	$5,000	2	11-13 biennium
Replacement of Mechanical systems in Capital and Improvement Projects (some info specifics reported below).		Varies Annually But from 2011-2021 Est. about	3-26 years	2011-2021 Attached sheet
Fleet Energy Use				
TOTALS:	597.2		N/A	N/A

B. Strategies and Actions with Payback up-to Twelve Years (or other time period determined by your agency)

Strategies and Actions	GHG Reduction Estimate ($MTCO_2e$)	Upfront Cost Estimate ($)	Payback Period Estimate (Years)	Date to Imple-ment Estimate
Building Energy Use				
Reduce energy consumption by 9%				
• 3% DDC Upgrade	188.59	$320,000	12	11-13 biennium
• 2% VFD Replacement/high efficiency motors/pumps	125.73	$133,943	10	10-11
• 2% Recommission selected Bldgs..	125.73	$70,000	6	13-15 biennium
• 2% Replacement w/CFL bulbs & sink aerators	125.73	$4,000	5	10-13

• Decoupling of Heating Water piping delivery to more efficient local Gas fired Boilers in Bldgs. 21/22, 27 and 28	233.30	$1.1MM	18	17-19
• Installation of 3 DOAS/VRF new systems on Bldgs. 4,12 and 26.	651.15	$3.3 MM	25	11-21
Fleet Energy Use				
TOTALS:	565.78		N/A	N/A

C. Strategies and Actions with High Cost and Long Payback (more than 12 years or other time period determined by your agency)

Strategies and Actions	GHG Reduction Estimate ($MTCO_2e$)	Upfront Cost Estimate ($)	Payback Period Estimate (Years)	Date to Imple-ment Estimate
Building Energy Use				
Reduce energy consumption by 4%				
• 3% Adopting LEED Principles – Bldg. 4 Remodel	188.59	$100,000	15	11-13 biennium
• 1% Alternative Energy Programs: Solar pre-heat water	62.86	$100,000	15	15-17 biennium
• 2% Decoupling the Domestic Hot water plant delivery to individual building Hot water tanks or Inline Hot water tanks reducing 24/7 heating of 1000 gallons of domestic water.	37 or reduction of 5757 Therms/year	$240,000	25	20-22
Summary sheet attached describing all projects and phases of energy reduction actions (ESCO)	From report out sheet – 5,100,411 kWh/yr.	$9.9MM	27	2011-2020
Fleet Energy Use				
TOTALS:	251.45		N/A	N/A

5. Greenhouse Gas Reduction Strategies for Other Emission Sources (Employee Business Travel and Commuting)

The agency also quantified greenhouse gas emissions from employee commuting and business travel. GHG emissions from these sources were not included in the 2005 baseline because of insufficient data, and are therefore are not included in the reduction targets. Also, the agency has less operational control over these sources. The agency evaluated these sources separately in this strategy and identified reduction strategies for these sources.

Source of GHG Emissions	GHG Emissions, 2009 (or most recent year) ($MTCO_2e$)
Business Travel	10 (No Travel Covid Operations 2021)
Employee Commuting	100 (2021 COVID Limited Operations)

Note that finding information on GHG reduction, cost, and payback may be difficult. If you don't have rough information leave these blank.

Strategies and Actions	GHG Reduction Estimate ($MTCO_2e$)	Upfront Cost Estimate ($)	Payback Period Estimate (Years)	Date to Imple-ment Estimate
Employee Business Travel				
Employee Commuting				
Reduce commuting by 2% based on CTR Survey 2009-10	16.54	$0	2	11-13 biennium
Opening of Metro's Rapid Ride bus routes adjacent to the campus	1.1	$0 (may be an incentive for Ride sharing that the College may have an investment in)	0	2015
TOTALS:	17.64		N/A	N/A

6. Additional Sustainability Strategies and Actions (If applicable)

If applicable, include additional sustainability actions related to waste reduction, recycling, composting, environmentally preferred purchasing, water use reduction, reduction of toxic products, or any other sustainability efforts.

Strategies and Actions	Co-benefits for GHG Reduction	Implementation Date Estimate
Continue ESCO Improvements on Campus infrastructure and investing in replacing end of life non-efficient mechanical systems when conducting Capital and local funded projects.	Replacing non-efficient systems with new systems.	2020 – 2026
Continue to enhance and improve the implementation of controls down to individual pieces of equipment and building Jace controllers.	Better control and scheduling of facilities that currently have failed or did not have this type of Infrastructure	2019-2027

7. Next Steps and Recommendations

Highline College was built in 1964 as the least expensive community college. By design with inexpensively built one-two story buildings spread throughout an open campus, the cost to maintain and capture building efficiencies is difficult. With that stated, the College will need capital funding to reach any real level of renovation/replacement that meets any sort of energy efficient measurement. In the effort to do the best we can to meet the goals of this unfunded Senate Bill 5560 –Chapter 519, laws of 2009/ RCW 70.235.050-070 Highline Community College is committed to CO_2e reduction targets as stated in our plan.

The next steps that the College will take will be a mix of behavioral change (how users use energy), mechanical (building systems) and structural improvements (capital renovations/replacements) and other activities. Behavioral changes will include programs like the PSE RCM program, creation of a college "Green" team, participation in the Commute Trip Reduction (CTR) and employee/student outreach and educational programs which attempt to change the way people use energy on/off campus or commute to and from work/classes. The College has already implemented an Executive level review for training travel and will continue to adopt technology as an alternative to physical travel.

As a compliment to the behavioral changes, the College has already begun evaluating buildings and energy related systems to understand how energy is being used and developing ongoing "Facility Action Plans" aimed at reducing energy, waste streams and water management. These building and mechanical system improvements will take some funding above the normal operational budgets presently in place to implement. The costs of these energy related projects, even with rebates, are typically high cost activities that have

ROI's outside of 5 but more likely 10-15 years to payback on investments. With the Senate Bill 5560 the College will be looking to the state to help either through operational or capital budget funding to assist with implementing these higher cost goals. The College has already begun investigating the use of a State ESPC (performance based contracting) in concert with Federal or State matching energy grants as another supplemental program to aid in meeting our stated goals. It will be imperative that grants and state funding be provided to assist Highline College with meeting its aggressive reduction goals. Lastly, the College is committed to LEED principles and, if appropriated dollars to renovate, build or replace facilities, the College is committed to the purchasing of high efficiency systems that use/require less energy that will also aid with reducing greenhouse gas emissions and create a more sustainable campus.

Projections predicted our costs for this specific campus to accomplish this reduction of ~1500 MTCO2e by 2020 would be estimated to be in the range of $500,000- $1,500,000 dollars. From 2011 through 2019 the college has spent upwards of $9.9 MM dollars (with an additional $2.2 MM in rebates/grants) with an estimated annual saving in utilities of return savings of $436,265/year. These specific ESCO projects alone result in an annual savings of 5,100,411 kWh/yr. and over 2,381 Metric tons of Carbon saved.

This plan is updated Bi-annually and distributed as necessary. The Facilities Department is the spearhead for the campus CO_2e reductions but will continue to work with and rely on cooperation from employees, students, guests and projects improvements in order to be successful.

Barry Holldorf
Director of Facilities
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Des Moines WA 98198-9800
206-878-3710, X3793
bholldorf@highline.edu

When finalized, e-mail to joanna.ekrem@ecy.wa.gov, Hedia.adelsman@ecy.wa.gov, and Karisa.duffey@ecy.wa.gov. The file name should include the agency acronym, the word GHG strategy, and the submission date – for example, ECY GHG Strategy June 30 2011.doc.

Highline College 2019 Annual Saving Summary

Annual Electrical Savings	5,100,411	kWh/yr
Annual Gas Savings	(22,350)	Therms/yr
Annual Cost Savings	**$436,265**	**Dollars/yr**

Weather Adjusted Electrical and Gas Savings Summary from 7/18/2018 thru 7/18/2019
Baseline year 7/20/2011 thru 7/18/2012

Saving Summary from 2011 to Date

Total Electrical Savings	31,865,302	kWh Saved Since 2011
Total Gas Savings	(270,477)	Therms Saved Since 2011
Total Cost Savings	**$2,578,178**	**Dollars Saved Since 2011**

Rebates & Grants: **$ 2,639,084** ESCO Rebates and Grants Secured to Date

ESCO Projects: **$ 9,961,620** ESCO Projects Contracted to Date

Addressed Failing Infrastructure and Maintenance Needs

2019 CONSERVATION EQUIVALENCIES:

Metric Tons of Carbon Saved: 2,381

Acres of Trees Planted: **590**
Based on 2019 Savings

Gallons of Gasoline Saved[2]: **584,399**

Tons of Coal Saved[3]: **8,565,091**

Notes:
1. One ton of CO2 occupies 19,642ft3 of volume the equivalent of a sphere with a diameter of 33ft.
2. Calculated using EIA Table 7.3 2018 (139,762 Btu/Gal).
3. Calculated using EIA Table 7.3 2018 (9,536 Btu/Pound).

References:

1. DES Energy Program – Environmental Impact/Emissions Reductions Associated with Energy Efficiency Improvements or Renewable Electricity Production, 2/9/2016.
2. Energy Information Administration (2008 to 2018) Table 7.3 Average Quality of Fossil Fuel Receipts for the Electric Power Industry. https://www.eia.gov/electricity/annual/html/epa_07_03.html

EXPERIENCE

DEPARTMENT OF ENTERPRISE SERVICES (DES)

State Qualified Energy Services Company (ESCO) since 2009 Contact: Doug Kilpatrick / 360-407-9380

HIGHLINE COLLEGE

Des Moines, Washington

Contact: Barry Holldorf 206-878-3710

Over the past decade, MacDonald-Miller and Highline College have successfully performed nine significant phases of conservation and infrastructure renewal projects under the Washington State Energy Savings Performance Contracting (ESPC) program. We are currently executing on the tenth scope of work (Ph9). In all, we have executed $9,961,620 of conservation and infrastructure renewal projects that are delivering 2,065,365 kWh/year and 111,591 therms/year for a total annual savings of $238,014. Additionally, we have secured over $2,639,084 in federal, state, and local utility incentives that have been applied to reduce Highline's capital investment costs.

$9,961,620 Investment | $2,639,084 Combined Savings & Rebates

Energy Conservation Projects:

Phase 0: Replaced failing burner controls on B3, a Cleaver Brooks CB-200-30HW boiler. Autoflame Mk7 burner controls and Exhaust Gas Analyzer were installed to optimize boiler efficiency, allow integration into building automation system and meet emissions standards.

Phase 1: Replaced failing burner controls on B1 & B2, a Cleaver Brooks CB-100-30HW boilers. Autoflame Mk7 burner controls and Exhaust Gas Analyzer were installed to optimize boiler efficiency, allow integration into building automation system and meet emissions standards. Migrate campus building automation system communications backbone to one controls platform. Upgrade campus exterior lighting to LED.

Building 4 upgrade HVAC to VRF, retrofit interior lighting to LED, replace windows and roofing for increased R value and noise reduction in educational spaces. Building 4 is identified as a historically significant building and required close coordination with the preservation oversight authority. MacDonald-Miller acted as the turn-key design-build-optimize prime contractor. We were responsible for contracting with the architecture and engineering firms as well as all the abatement contractor and subcontracting companies.

Phase 2: Migrate Buildings 6, 8, 19, 25, 28 & 29 to campus standard building automation controls platform. Implement classroom scheduling and demand shedding.

Phase 3: Building 6, remove rooftop fluid cooler, install new fluid cooler on new ground pad reworking piping systems to reconnect to interior distribution systems. Migrate buildings 7 and 24A to campus standard building automation controls platform. Implement classroom scheduling.

Phase 4: Building 6, replace 11 failing heat pumps. Building 27 remove from campus heating water loop and install condensing boiler, replace HVAC and install campus standard building automation controls platform. Implement classroom scheduling. Building 28, remove from campus heating water loop, replace hydronic AHUs with gas fired AHU's.

Phase 5: Remove Buildings 23 and 25 from campus chiller loop, install new local chillers at each building and reconnect to internal distribution systems. Upgrade Building 23's electrical system to include new transformer for load of new chiller. Upgrade building 25 Mechanical systems to allow for demand control ventilation. Remove building 27 from domestic heating water loop and install local domestic heating water boilers. Demo failed campus chiller and decommission chilled water loop.

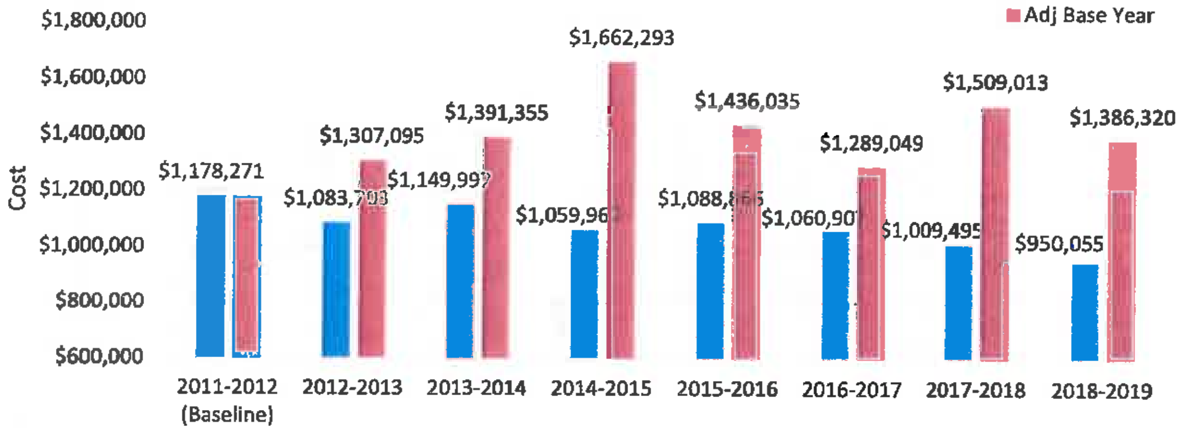
Phase 6: Remove buildings 21, 22 & 29 from failed buried campus heating water loop. Install new natural gas services for local condensing boilers and reconnect to interior distribution systems. Decommission failed campus heating water loop serving these buildings. Install local domestic heating water system for building 29.

Phase 7: Building 1 – Upgrade failed Heat pumps and heat vent units.

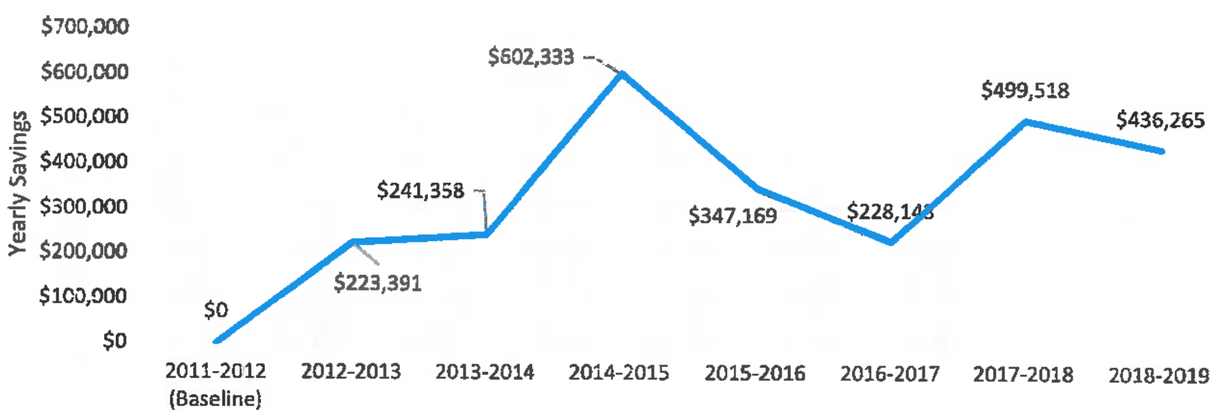
Phase 8: Migrate buildings 21, 22 & 23 to campus standard building automation controls platform. Implement classroom scheduling. Upgrade Building 23 mechanical penthouse allow for demand control ventilation. Building 24 decommission boiler 3 in central heating plant, replace failed loop pumps, upgrade HVAC for office spaces. Upgrade Greenhouse mechanical systems and integrate into campus standard controls platform. Building 28 LED lighting retrofit for athletic facility.

Phase 9: Upgrade all existing controls, valves, and actuators in buildings 2, 7, 12, 14, 17, & 23 to campus standard building automation controls platform. Replace domestic hot water piping and add point-of-use water heaters for buildings 7, 13, 14, 15, 16, and 18. Repair piping leaks in campus heating water loop.

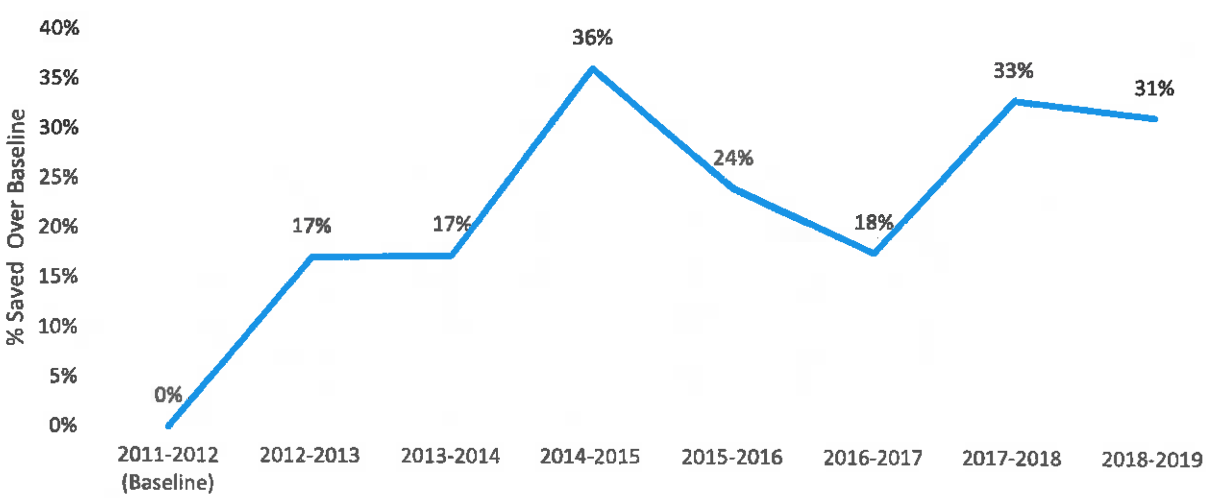
Adjusted Cost Each Year (August-July)

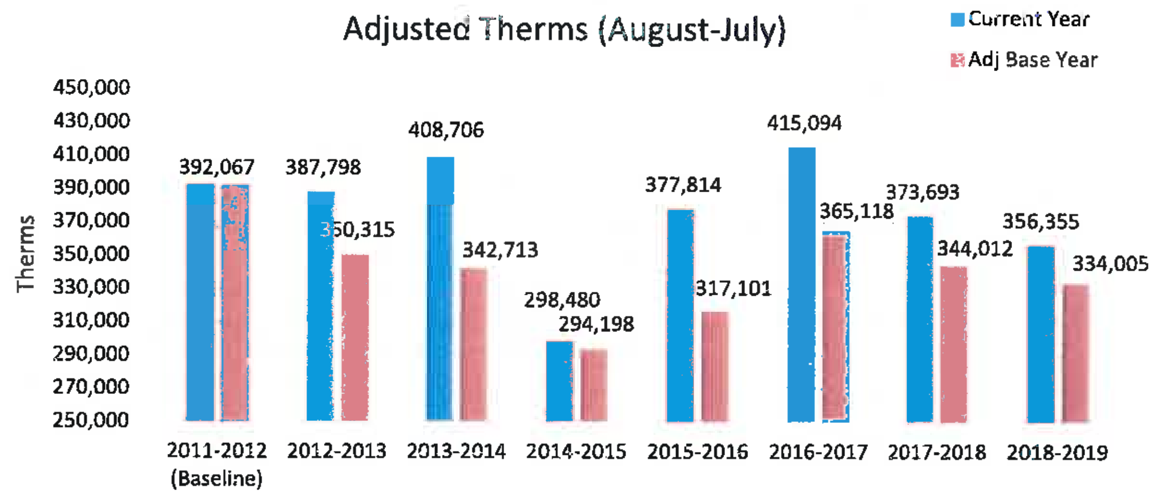


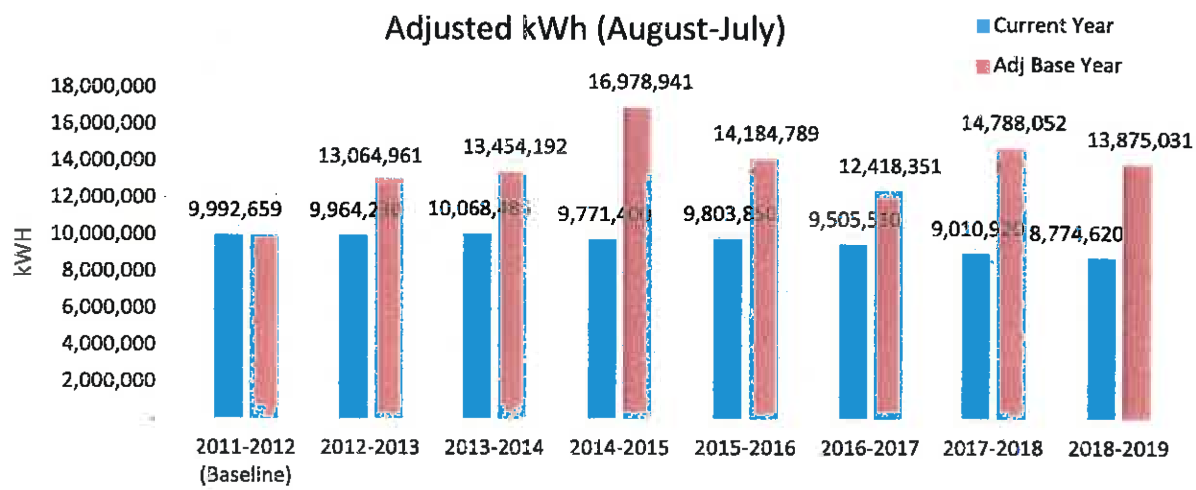
Adjusted Savings Each Year (August-July)

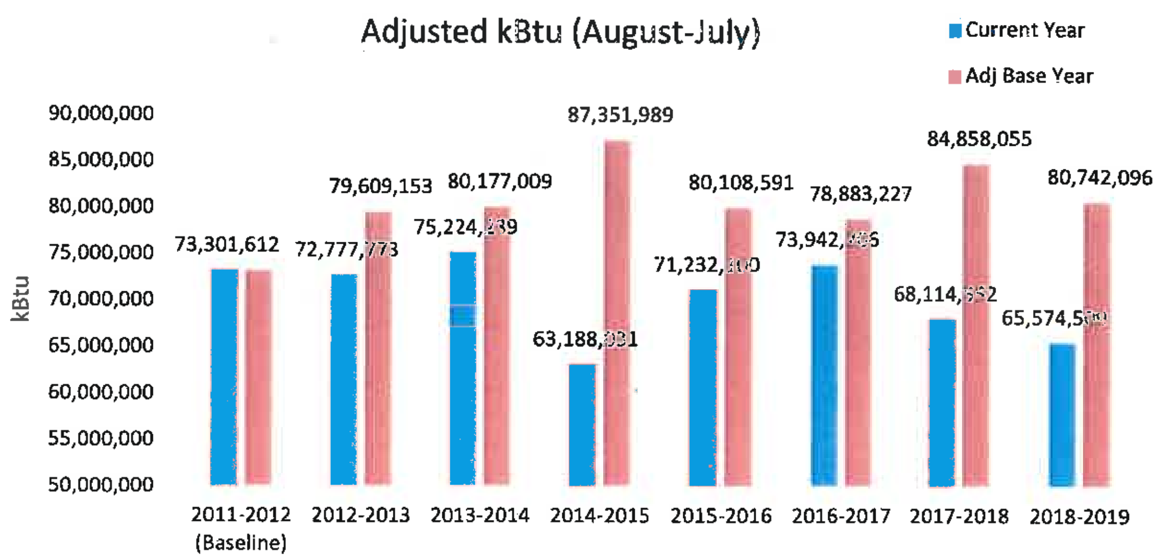


% Saved Over Baseline




Adjusted Therms (August-July)
Current Year
Adj Base Year
Therms
450,000
430,000
410,000
390,000
370,000
350,000
330,000
310,000
290,000
270,000
250,000
392,067
387,798
408,706
342,713
298,480
294,198
377,814
317,101
415,094
365,118
373,693
344,012
356,355
334,005
2011-2012 (Baseline)
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019


Adjusted kWh (August-July)
Current Year
Adj Base Year
kWH
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
9,992,659
13,064,961
13,454,192
16,978,941
14,184,789
12,418,351
14,788,052
8,774,620
13,875,031
2011-2012 (Baseline)
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019


Adjusted kBtu (August-July)
Current Year
Adj Base Year
kBtu
90,000,000
85,000,000
80,000,000
75,000,000
70,000,000
65,000,000
60,000,000
55,000,000
50,000,000
73,301,612
79,609,153
80,177,009
87,351,989
80,108,591
78,883,227
84,858,055
80,742,096
2011-2012 (Baseline)
2012-2013
2013-2014
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019

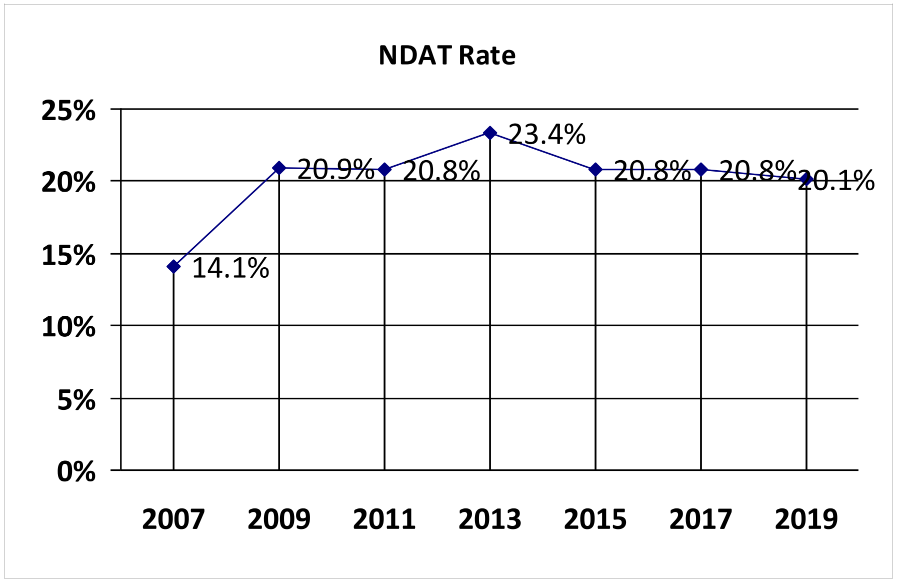
e. commute trip reduction plan

Site Analysis Report for: State of Washington Highline College E80184

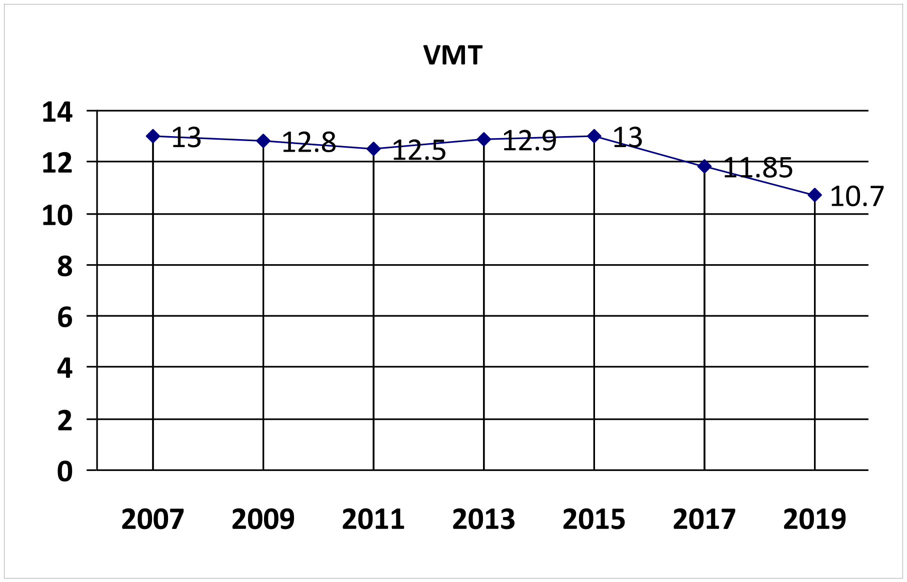
Prepared by: Anne Ward-Ryan 12/23/2015

Worksite Performance

Goal: INCREASE Non Drive Alone Travel Rate / Target = 2019 value

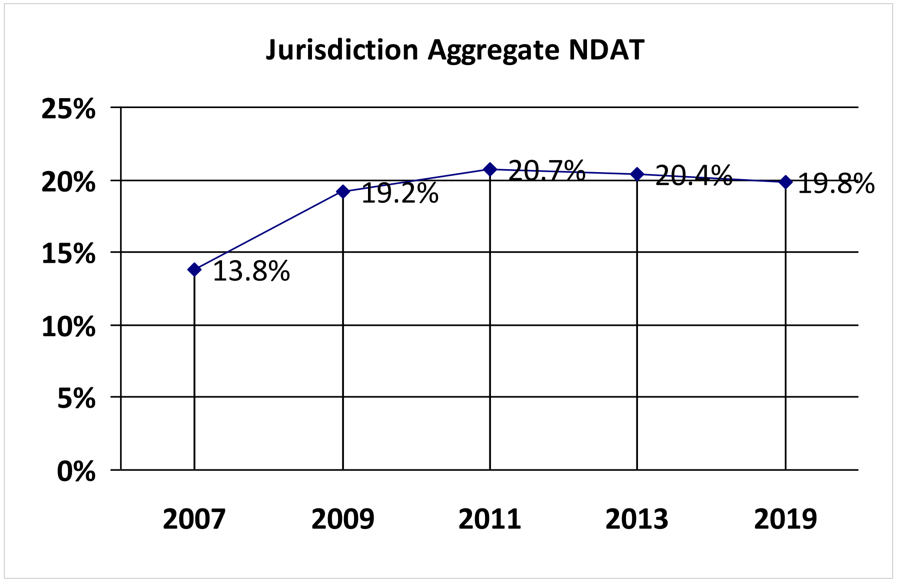


Goal: DECREASE Vehicle Miles Traveled / Target = 2019 value

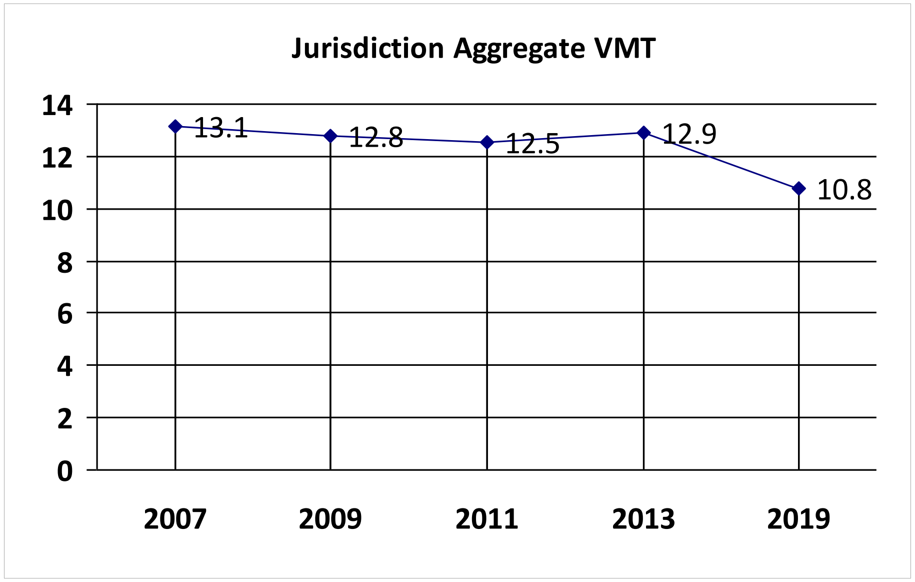


Aggregate values Des Moines

Goal: INCREASE Non Drive Alone Travel Rate / Target = 2019 value



Goal: DECREASE Vehicle Miles Traveled / Target = 2019 value



Site Analysis Report for: State of Washington Highline College E80184

Prepared by: Anne Ward-Ryan 12/23/2015

Program Information

Subsidies & Incentives

Do you provide passes?		Other incentives?		
Passes provided	No	Bus	Yes	$54.00
Trip value		Rail	No	
Monthly value		Carpool	No	
Co-pay? $	%	Vanpool	No	
Does the pass apply toward:		Vanshare	No	
Train / VanPool / VanShare		Ferry	No	
		Walk	No	
Pre-tax option?	No	Bike	No	

Parking

Owned	On Site		Owned	Off Site
Spaces	410	HOV 210	Spaces	HOV
Leased	On Site		Leased	Off Site
Spaces	80	HOV 0	Spaces	HOV

Do employees pay when they...

Drive alone	Yes	On Site $15	Off Sit	
Carpool	Yes	On Site $10	Off Sit	
Vanpool	Yes	On Site $10	Off Sit	
Other nearby parking		Free? No	Paid? No	

Miscellaneous

Amenities on site or within 3 block		Do you offer the following:		Services at the worksite?		Telework/CWW options:			
Bus Stop	Onsite	Guaranteed Ride Home	Yes	Shuttle	No	3/36	No	4/40	Yes
Ferry	No	Covered Bike parking	No	Internal Circulato	No	9/80	No	Other	Yes
Bike lane/trail	No	Uncovered bike parkin	Yes	Bike share	No	Flextime	Yes	Telework	Yes
Pedestrian trai	Onsite	Lockers Yes / Showers	Yes	Internal Ridematc	No				
Train	No	Non-SOV loading zone	No	Rideshare onlin	Yes				

Site Analysis Recommendations

Keep up the good work. You have made progress on your 2015 CTR survey.

f. project team list

Project Team List

Highline College

Facilities Team:
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