

Appendix A: Additional Site Information

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APPENDIX A – ADDITIONAL SITE INFORMATION

This appendix provides an overview of the study site and the individual treatment features that were studied. Greater detail is available in the project Quality Assurance Project Plan (QAPP; King County 2015).

Echo Lake is a small stormwater-fed lake that drains to the larger Lake Ballinger, and is part of the McAleer Creek basin. The Echo Lake drainage basin is 207¹ acres and comprised of seven stormwater conveyance subbasins. Land use in this basin is predominantly urban, with 30% designated as commercial and 40% as residential landuse (City of Shoreline). Over 56% of the basin is impervious surface (HDR 2011). The Aurora Corridor runs north to south within about 350 feet of the western edge of Echo Lake.

Section 1.1.2 of the project QAPP (King County 2015) provides a detailed account of the changes to stormwater infrastructure in the basin, but a brief description is provided here. The basin did not include any targeted water quality treatment until retrofits were implemented by the City of Shoreline. Retrofitting along the Aurora Corridor from N 185th Street to N 192nd Street was initiated in 2011 and completed in 2012. Retrofitting along the Aurora Corridor from N 192nd Street to N 200th Street began in 2014 and was completed in 2016. The retrofit included a number of best management practice (BMP) installations, but the most numerous were the bioretention planter boxes (BPBs) and Filterra®, which were evaluated in this study. The BPBs were installed to treat 1.02 acres in total and the Filterra were designed to treat 1.86 acres in total. A detention tank system was also added to provide flow control to stormwater in route to Echo Lake through the main outfall.

The retrofit included additional changes to the stormwater system that impacted the comparability of pre- and post-retrofit samples collected to assess system-wide stormwater quality (Section 2.2 of the main report). Drainage from a relatively large subbasin (>70 acres), which previously discharged to a separate outfall, was rerouted in December 2014 to the DTS and now discharges through the main outfall starting. Representative sampling was no longer possible at the main outfall after the retrofit and other nearby construction. Instead, samples from the DTS outlet were used in the comparison. This location does not incorporate drainage from a small subbasin (8 acres) that joins the stormwater line to the main outfall after the DTS outlet point. These changes are also documented in the project QAPP (King County 2015).

Figure A-1 is a map of the study site including details about the stormwater system, and the installations included in the study. Figure A-2 illustrates how the installations are connected within the stormwater system. The following pages include descriptions, illustrations, and sampling strategies for the BPBs, Filterra, and DTS.

¹ The basin used to be 215 acres before the most north-western portion of the stormwater system was rerouted to a different basin as part of the retrofit.

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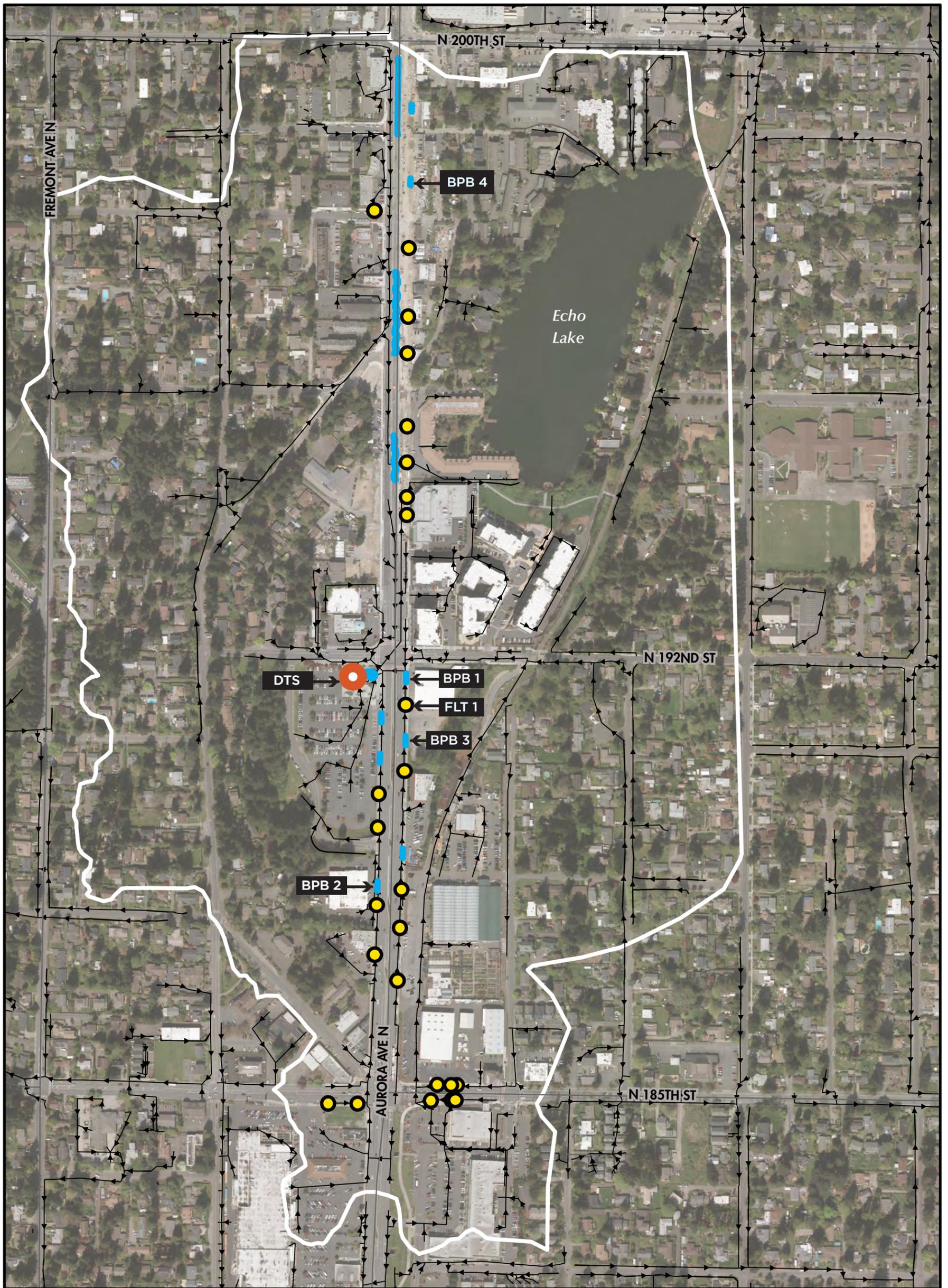
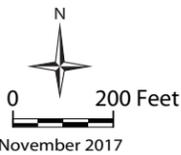


Figure A-1
Current Stormwater Conveyance System in the Echo Lake Drainage Basin





King County
 Department of Natural Resources and Parks
 Water and Land Resources Division



0 200 Feet
 November 2017

Note: The information included on this map has been compiled by 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. 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.

GIS File: \\dnrp1\projects\wrd\15032\ShorelineStormwaterMapAerial.mxd 3/12/2015 HK
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Figure A-2

Echo Lake Basin Stormwater Treatment

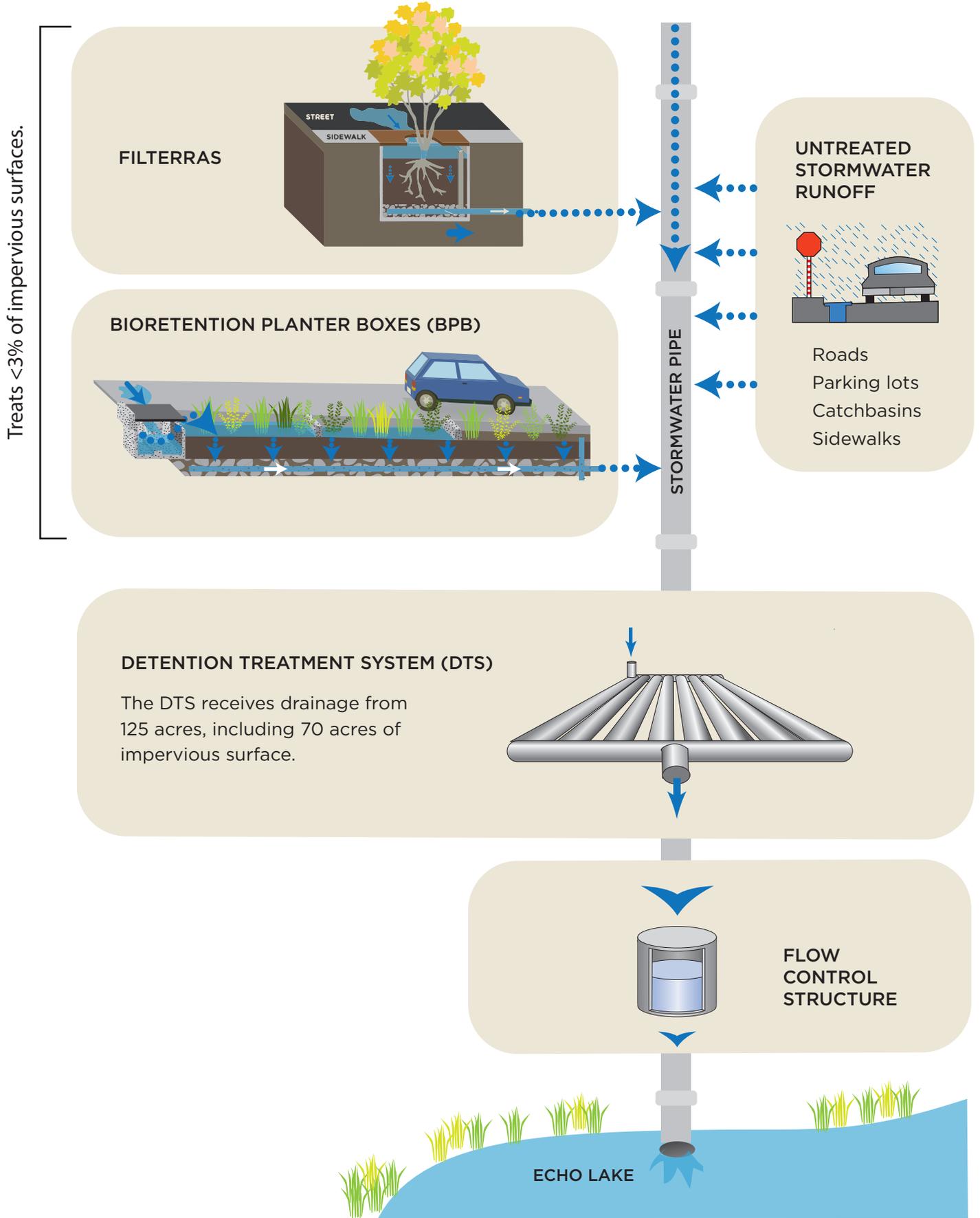


Table A-1. Bioretention planter box design and comparability to Stormwater Management Manual for Western Washington (SWMMWW)

Installation Type	Design Description	2012 SWMMWW Citation	Design Deviation
Bioretention Planter Box	Designed soil mix (40% cedar grove compost, 60% mineral aggregate, by volume), planted with trees, shrubs, and grasses within a vertical walled concrete and cement container. The planter boxes are completely impervious, and include an underdrain. Each feature treats between 0.05 and 0.13 acres. These are designed for enhanced treatment (basic and dissolved metals treatment)	BMP T7.30	No, follows 2005 and 2012 SWMMWW

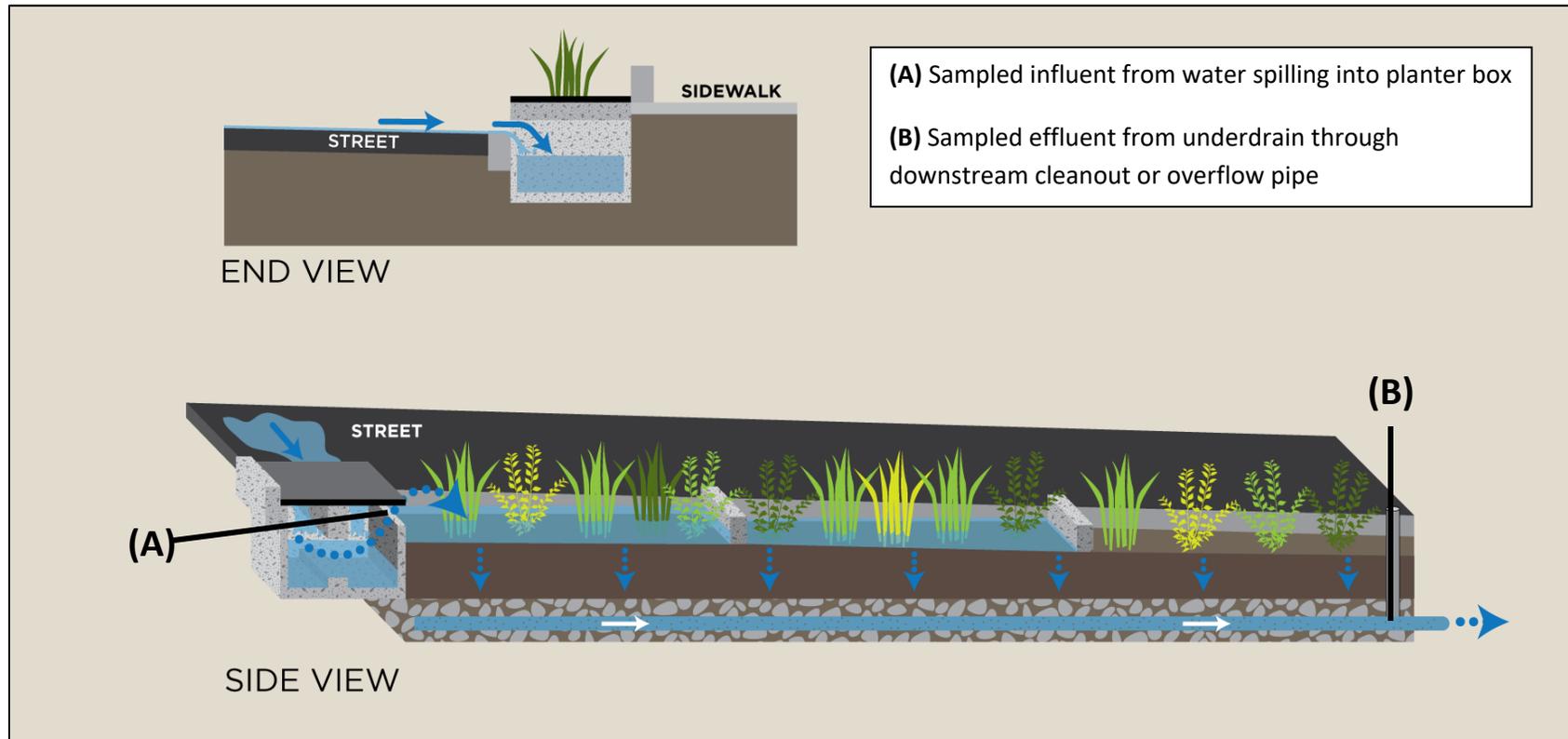


Figure A-3. Bioretention Planter Box Design and Sampling Strategy

Table A-2. Filterra® design and comparability to Stormwater Management Manual for Western Washington (SWMMWW)

Installation Type	Design Description	2012 SWMMWW Citation	Design Deviation
Filterra®	Proprietary soil mix planted with a single tree. Higher infiltration rates than bioretention. Are concrete-lined and underdrained. These are intended for enhanced and phosphorus treatment. Each feature treats between 0.05 and 0.23 acres.	Section 12.5; GULD for Americast Filterra® ¹	No

¹GULD – general use level designation; http://www.ecy.wa.gov/programs/wq/stormwater/newtech/use_designations/FILTERRAguld.pdf

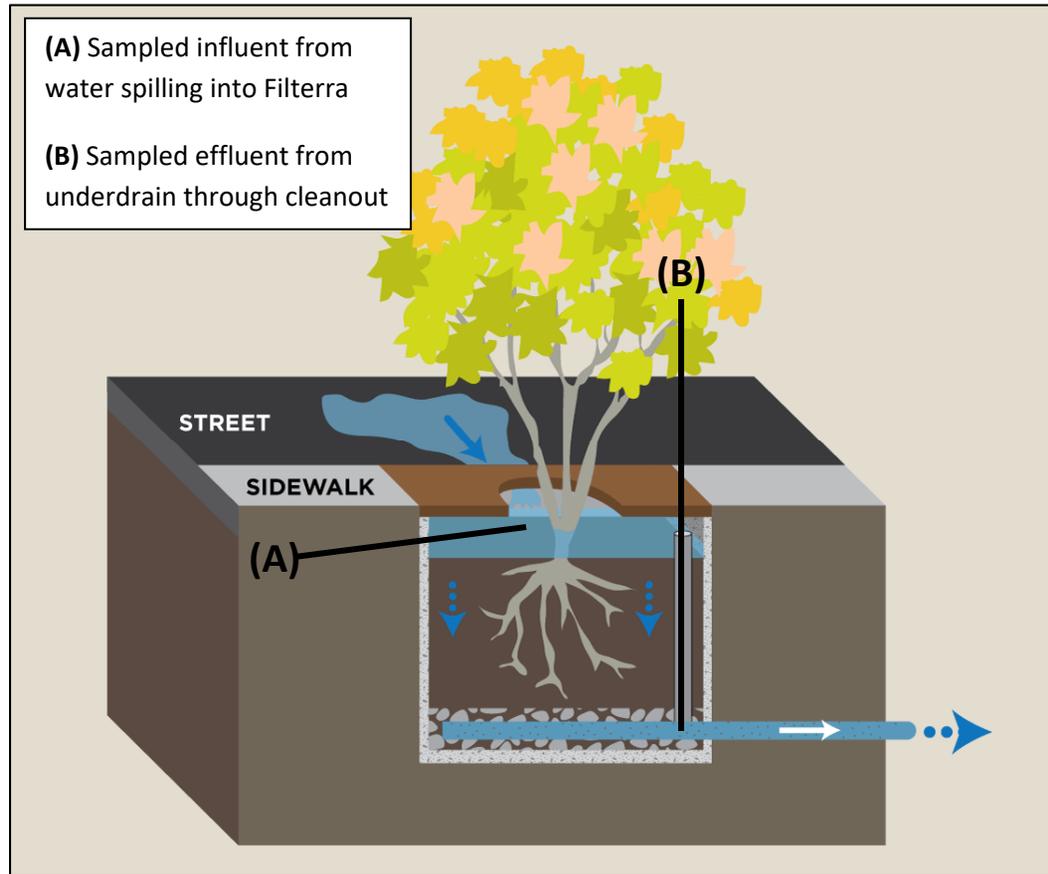


Figure A-4. Filterra Design and Sampling Strategy

Table A-3. Detention tank system design and comparability to Stormwater Management Manual for Western Washington (SWMMWW)

Installation Type	Design Description	2012 SWMMWW Citation	Design Deviation
DTS	Detention tank with a system of eight-foot diameter corrugated metal pipes, for a total length of 350 feet. The total capacity is 17,600 cubic feet. The tank is followed by a multiple orifice restrictor. This system is designed to handle all flow for the drainage basin (125 acres), but will provide flow control for 1.58 acres (total net new impervious surface).	Sections 3.2.2 and 3.2.4	TBD*

The final pages of this appendix include drainage details for the BPBs, Filterra, and DTS, with one page each.

Appendix A References

City of Shoreline. Land.gdb.zip. December 11, 2017. <http://www.shorelinewa.gov/our-city/maps-gis/download-gis-data>.

HDR. 2011. Aurora Corridor Improvement Project: N 185th Street to N 205th Street, Update: N 192nd Street to N 205th Street, Drainage Report. Prepared for the City of Shoreline.

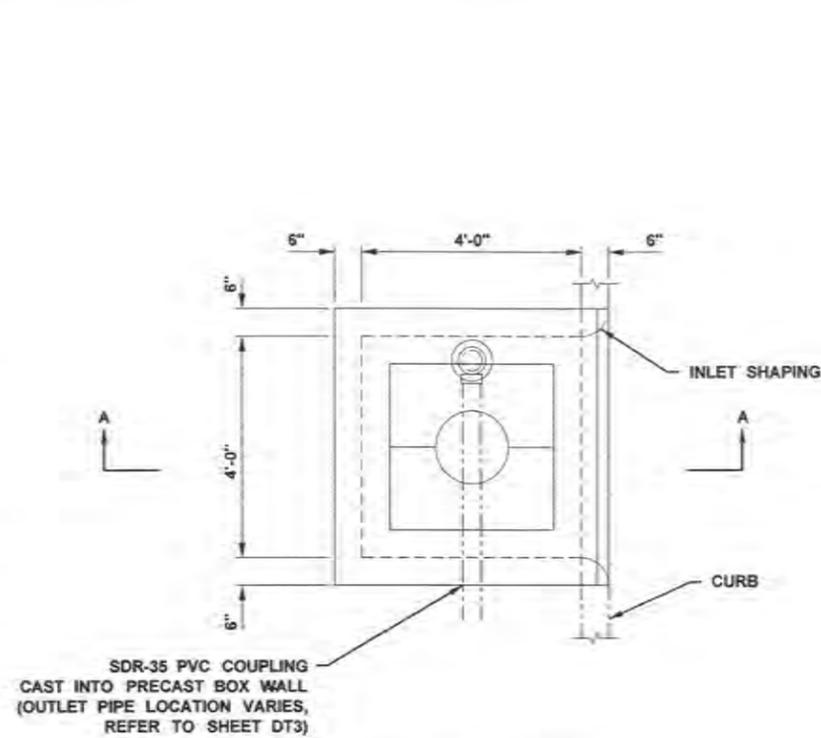
King County. 2015. Quality Assurance Project Plan for Monitoring Stormwater Retrofit in the Echo Lake Drainage Basin – RSMP Effectiveness Study. Prepared by Carly Greyell, Water and Land Resources Division. Seattle, Washington.

CONSTRUCTION NOTES

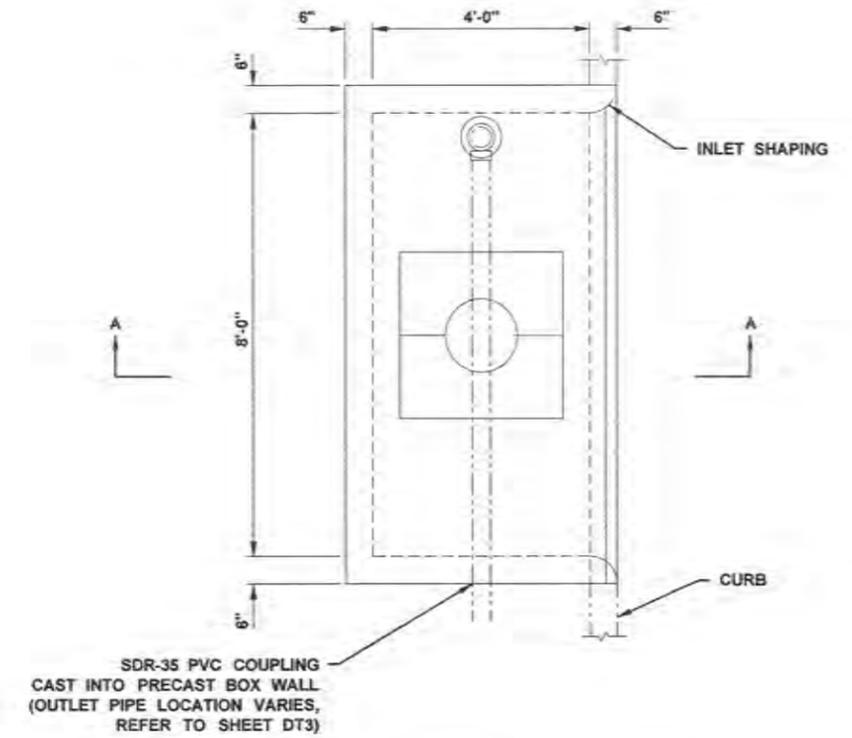
- 1) EACH UNIT SHALL BE CONSTRUCTED AT THE LOCATIONS AND ELEVATIONS ACCORDING TO THE SIZES SHOWN ON THE APPROVED DRAWINGS. ANY MODIFICATIONS TO THE ELEVATION OR LOCATION SHALL BE AT THE DIRECTION OF AND APPROVED BY THE ENGINEER.
- 2) IF THE FILTERRA IS STORED BEFORE INSTALLATION, THE TOP SLAB MUST BE PLACED ON THE BOX USING THE 2X4 WOOD PROVIDED, TO PREVENT ANY CONTAMINATION FROM THE SITE. ALL INTERNAL FITTINGS SUPPLIED (IF ANY), MUST BE LEFT IN PLACE AS PER THE DELIVERY.
- 3) THE UNIT SHALL BE PLACED ON A COMPACTED SUB-GRADE WITH A MINIMUM 6-INCH GRAVEL BASE MATCHING THE FINAL GRADE OF THE CURB LINE IN THE AREA OF THE UNIT. THE UNIT IS TO BE PLACED SUCH THAT THE UNIT AND TOP SLAB MATCH THE GRADE OF THE CURB IN THE AREA OF THE UNIT. COMPACT UNDISTURBED SUB-GRADE MATERIALS TO 95% OF MAXIMUM DENSITY AT +1 - 2% OF OPTIMUM MOISTURE. UNSUITABLE MATERIAL BELOW SUB-GRADE SHALL BE REPLACED TO THE SITE ENGINEER'S APPROVAL.
- 4) OUTLET CONNECTIONS SHALL BE ALIGNED AND SEALED TO MEET THE APPROVED DRAWINGS WITH MODIFICATIONS NECESSARY TO MEET SITE CONDITIONS AND LOCAL REGULATIONS.
- 5) ONCE THE UNIT IS SET, THE INTERNAL WOODEN FORMS AND PROTECTIVE MESH COVER MUST BE LEFT INTACT. REMOVE ONLY THE TEMPORARY WOODEN SHIPPING BLOCKS BETWEEN THE BOX AND TOP SLAB. THE TOP LID SHOULD BE SEALED ONTO THE BOX SECTION BEFORE BACKFILLING, USING A NON SHRINK GROUT, BUTYL RUBBER OR SIMILAR WATERPROOF SEAL. THE BOARDS ON TOP OF THE LID AND BOARDS SEALED IN THE UNIT'S THROAT MUST NOT BE REMOVED. THE SUPPLIER (AMERICAST OR ITS AUTHORIZED DEALER) WILL REMOVE THESE SECTIONS AT THE TIME OF ACTIVATION. BACKFILLING SHOULD BE PERFORMED IN A CAREFUL MANNER, BRINGING THE APPROPRIATE FILL MATERIAL UP IN 6" LIFTS ON ALL SIDES. PRECAST SECTIONS SHALL BE SET IN A MANNER THAT WILL RESULT IN A WATERTIGHT JOINT. IN ALL INSTANCES, INSTALLATION OF FILTERRA UNIT SHALL CONFORM TO ASTM SPECIFICATION C891 "STANDARD PRACTICE FOR INSTALLATION OF UNDERGROUND PRECAST UTILITY STRUCTURES", UNLESS DIRECTED OTHERWISE IN CONTRACT DOCUMENTS.
- 6) CURB AND GUTTER CONSTRUCTION (WHERE PRESENT) SHALL ENSURE THAT THE FLOW-LINE OF THE FILTERRA UNITS IS AT A GREATER ELEVATION THAN THE FLOW-LINE OF THE BYPASS STRUCTURE OR RELIEF (DROP INLET, CURB CUT OR SIMILAR). FAILURE TO COMPLY WITH THIS GUIDELINE MAY CAUSE FAILURE AND/OR DAMAGE TO THE FILTERRA ENVIRONMENTAL DEVICE.
- 7) EACH FILTERRA UNIT MUST RECEIVE ADEQUATE IRRIGATION TO ENSURE SURVIVAL OF THE LIVING SYSTEM DURING PERIODS OF DRIER WEATHER. THIS MAY BE ACHIEVED THROUGH A PIPED SYSTEM, GUTTER FLOW OR THROUGH THE TREE GRATE.
- 8) EACH FILTERRA UNIT SHALL USE THE UA CHINOOK ORNAMENTAL GRATE.

ACTIVATION

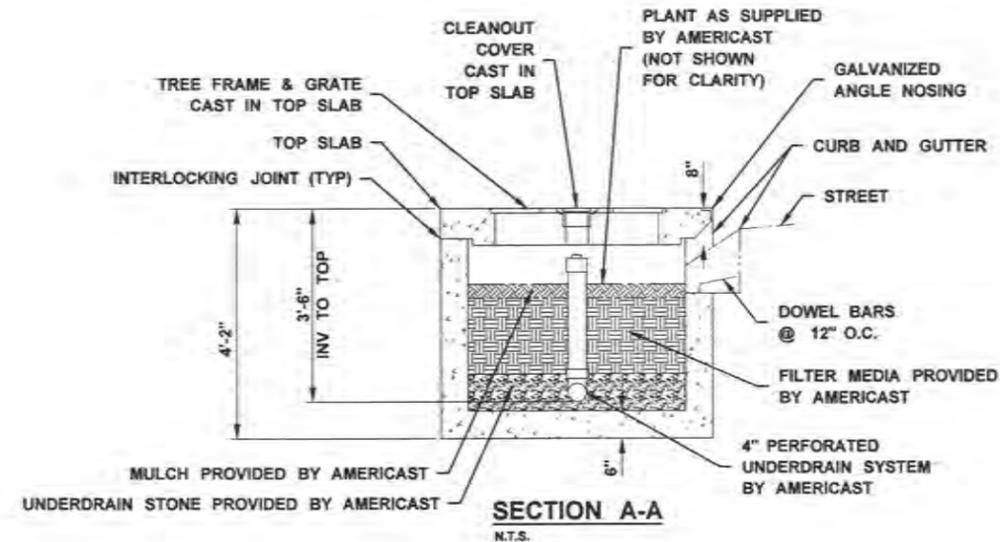
- 1) ACTIVATION OF THE FILTERRA UNIT IS PERFORMED ONLY BY THE SUPPLIER. PURCHASER IS RESPONSIBLE FOR FILTERRA INLET PROTECTION AND SUBSEQUENT CLEAN OUT COST. THIS PROCESS CANNOT COMMENCE UNTIL THE PROJECT SITE IS FULLY STABILIZED AND CLEANED (FULL LANDSCAPING, GRASS COVER, FINAL PAVING AND STREET SWEEPING COMPLETE), NEGATING THE CHANCE OF CONSTRUCTION MATERIALS CONTAMINATING THE FILTERRA SYSTEM. CARE SHALL BE TAKEN DURING CONSTRUCTION NOT TO DAMAGE THE PROTECTIVE THROAT AND TOP PLATES.
- 2) ACTIVATION INCLUDES INSTALLATION OF PLANT(S) AND MULCH LAYERS AS NECESSARY.



PLAN VIEW - 4'x4' FILTERRA
N.T.S.



PLAN VIEW - 4'x8' FILTERRA
N.T.S.



PRECAST FILTERRA® UNIT
NARROW WIDTH CONFIGURATION

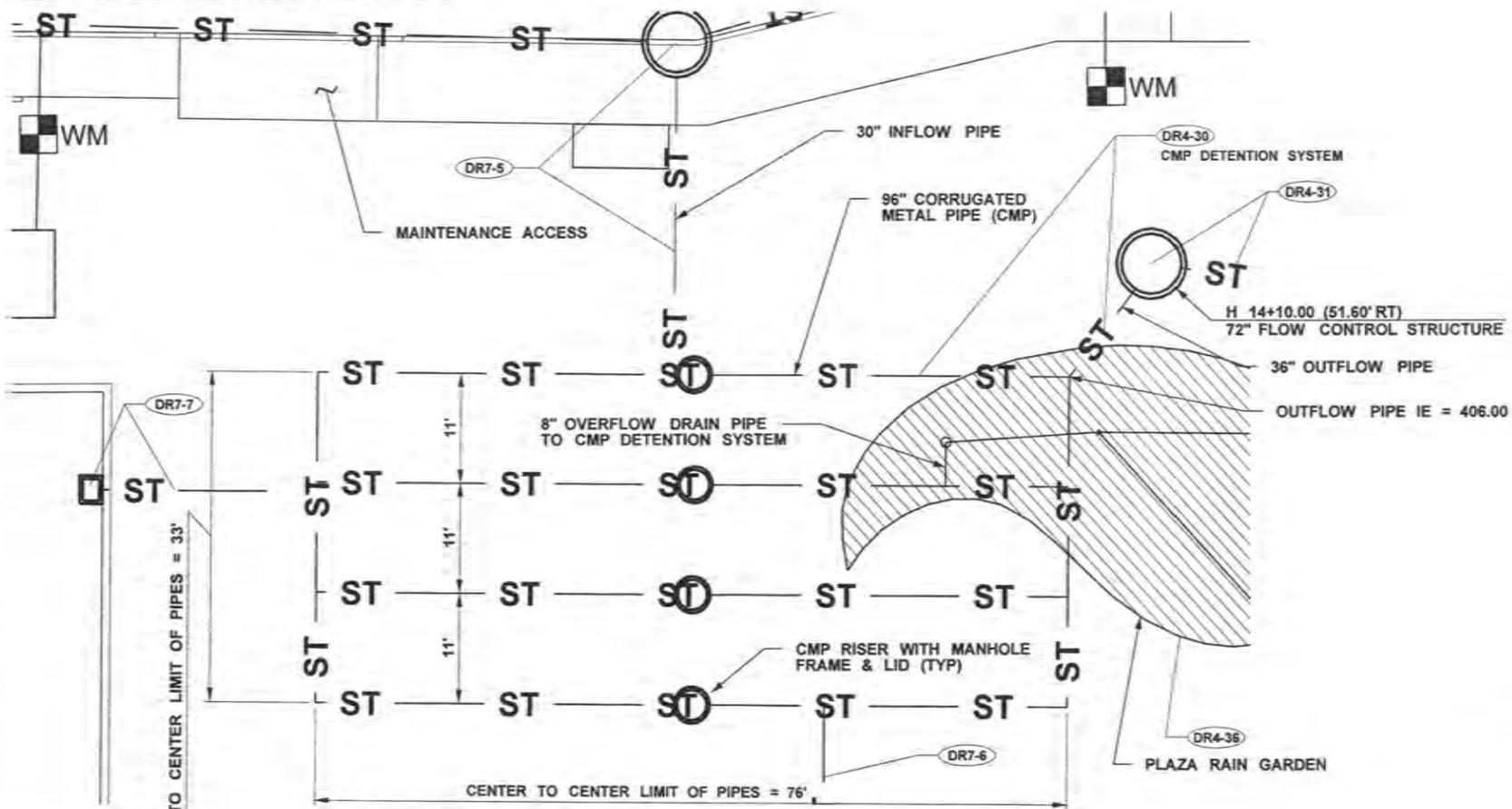
FILTERRA DETAIL

ProjectWise Vault: DIR

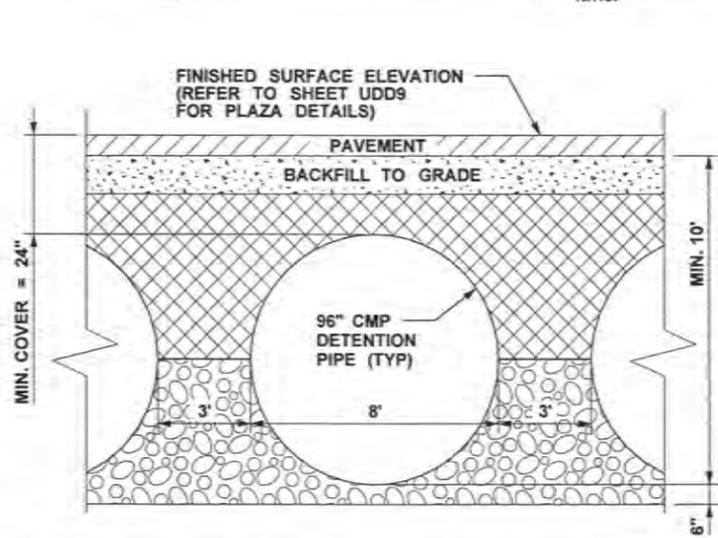
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TIME	1:13:12 PM			10	WA						DT2
DATE	9/2/2010			JOB NUMBER							SHEET
PLOTTED BY	cwillcox			124463							105
DESIGNED BY	MJS			CONTRACT NO.							OF
ENTERED BY	BRG			CON0050153							389
CHECKED BY	LJL			LOCATION NO.							SHEETS
PROJ. ENGR.	PAF										
REGIONAL ADM.		REVISION		DATE	BY						

GENERAL NOTES

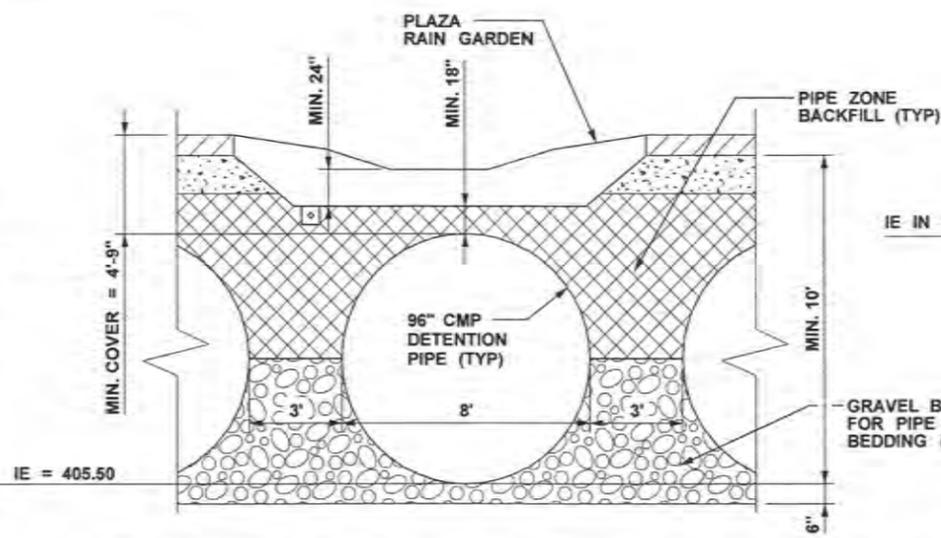
1. UNLESS OTHERWISE NOTED, ALL DIMENSIONS ARE IN FEET.
2. SEE SHEETS UDD9 - UDD11 FOR PLAZA DETAILS.
3. SEE SHEET DT6 FOR PLAZA RAINGARDEN DETAILS.
4. SEE SHEET DT7 FOR CMP DETENTION SYSTEM MANHOLE CAP DETAIL.



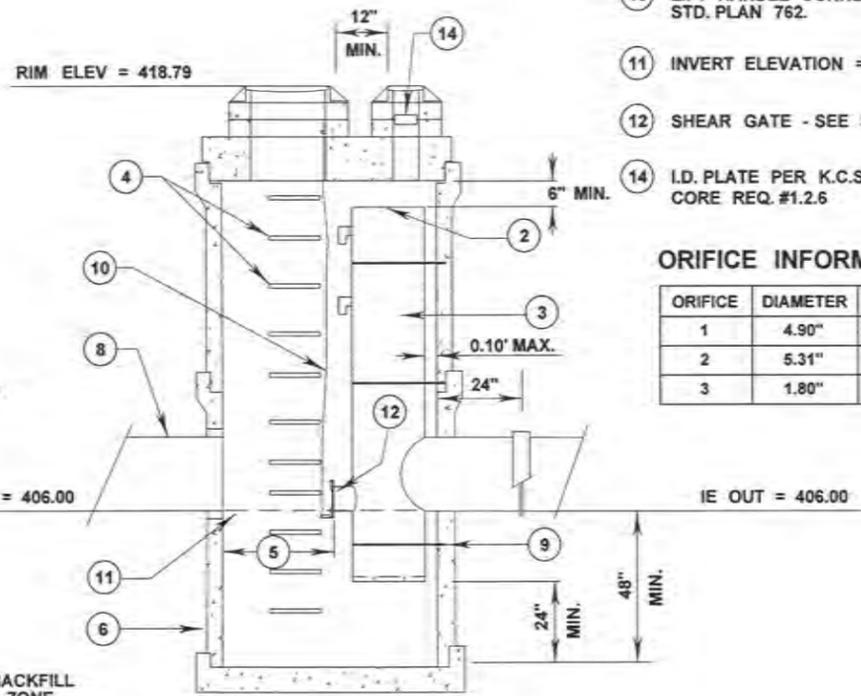
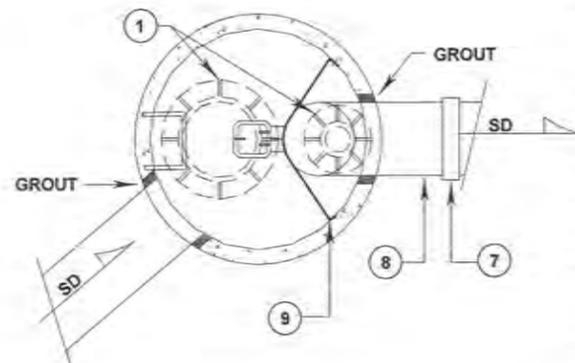
CMP DETENTION SYSTEM - PLAN VIEW (DR4-30)
N.T.S.



CMP DETENTION SYSTEM - TYPICAL SECTION VIEW
N.T.S.



CMP DETENTION SYSTEM - SECTION VIEW AT RAIN GARDEN
N.T.S.



FLOW CONTROL STRUCTURE DETAILS (DR4-31)
N.T.S.

NOTES:

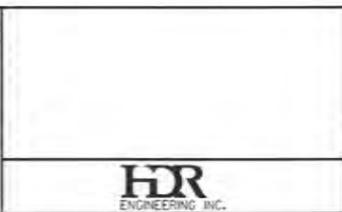
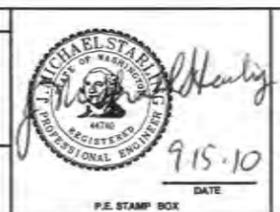
1. INSTALL 1-18" AND 1-24" DIA. MH. ACCESS PER STND DWG 716, ONE SO THAT THE LIFT GATE IS VISIBLE AND THE STEPS ARE CLEAR AND DIRECTLY ACCESSIBLE. THE OTHER IS OVER THE RESTRICTOR UNIT.
2. OVERFLOW ELEVATION = 412.00
3. RESTRICTOR UNIT - SEE SHORELINE STD. PLAN 761.
4. POLYPROPYLENE PLASTIC STEP
5. MIN CLEARANCE = 36"
6. 72" TYPE 2 CB
7. BAND STRAP WITH GASKET
8. SEE PLAN AND SPECIFICATIONS FOR SIZE AND TYPE OF PIPE ENTERING AND EXITING CB.
9. SECURE RESTRICTOR TO CB WITH 8 GA ALUMINUM STRAPS BOLT TO CB WALL WITH STAINLESS STEEL ANCHOR BOLTS. ONE STRAP ABOVE AND BELOW OUTLET REQUIRED, INTERMEDIATE STRAPS REQUIRED FOR RESTRICTOR RISERS GREATER THAN 12' ABOVE OUTLET.
10. LIFT HANDLE CONNECTOR - SEE SHORELINE STD. PLAN 762.
11. INVERT ELEVATION = 406.00
12. SHEAR GATE - SEE SHORELINE STD. PLAN 762.
14. I.D. PLATE PER K.C.S.W.D.M. CORE REQ. #1.2.6

ORIFICE INFORMATION

ORIFICE	DIAMETER	HEIGHT	ELEVATION
1	4.90"	0.000 ft	404.00
2	5.31"	4.002 ft	408.00
3	1.80"	4.500 ft	408.50

ProjectWise Vault: DR

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DATE	9/14/2010	CONTRACT NO.	CON0050153				
PLOTTED BY	cwllcox	REVISION		DATE	BY		
DESIGNED BY	BRG						
ENTERED BY	BRG						
CHECKED BY	LJL						
PROJ. ENGR.	PAF						
REGIONAL ADM.							



AURORA CORRIDOR IMPROVEMENT PROJECT N 185TH ST - N 192ND ST		PLOTS DT5
DRAINAGE DETAILS		
SHEET 108 OF 389 SHEETS		

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