STORM WATER POLLUTION PREVENTION AND SPILL PLAN FOR CONSTRUCTION

FOR

UPS TUMWATER
TUMWATER, WASHINGTON

Prepared for

United Parcel Service
7383 New Market St. SW
Tumwater, WA 98501
Phone: (206) 621-6223

August 30, 2013

Prepared by

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PED Project Number 12026
SWPPP

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

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SITE CONTACT INFORMATION

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PROJECT EROSION LEAD	***24-HOUR CONTACT***	
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Revision Schedule

This storm water pollution prevention plan (SWPPP) should be revised and updated to address changes in site conditions, new or revised government regulations, and additional on-site storm water pollution controls.

All revisions to the SWPPP must be documented on the SWPPP Revision Documentation Form, which should include the information shown below. The authorized facility representative who approves the SWPPP should be an individual at or near the top of the facility's management organization, such as the president, vice president, construction manager, site supervisor, or environmental manager. The signature of this representative attests that the SWPPP revision information is true and accurate. Previous authors and facility representatives are not responsible for the revisions.

SWPPP Revision Documentation Form

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DRAWINGS FOLLOWING REPORT

1 CONSTRUCTION ENVIRONMENTAL SUMMARY

1.1 Summary

Beginning in August 2013, UPS is starting the construction of a project to replace an existing infiltration trench that is failing with a new infiltration system at the same location, in the northwest corner of the site. The subject site is located at 7383 New Market Street SW in Tumwater, Washington. The site is approximately 2.3 acres.

The site has no known environmentally sensitive areas.

This *Storm Water Pollution Prevention Plan* details the steps needed to implement and maintain water quality measures during construction to prevent sediment from discharging into the local stormwater system and subsequent water bodys. This report outlines *Best Management Practices* (BMPs) to implement on site to accommodate the stormwater requirements of the City of Tumwater and to comply with the Washington State Department of Ecology requirements ensuring only clean water leaves the site.

1.1.1 Project Description

The goal of this project is to replace the infiltration gallery that infiltrates the storm water runoff from the western portion of the site with a new system.

The existing infiltration gallery appears to not work effectively at certain times during the rainy season. The gallery pipes may be plugged with sediment due to the age of the system and lack of proper maintenance. Storm water backs up into the parking lot during some storm events.

A new underground infiltration gallery system underneath the landscape area in the northwest corner of the site will be used to discharge stormwater runoff into the ground. The existing infiltration gallery will be removed and replaced with a new system.

The stormwater will be routed through a Hydrodynamic Separator prior to outlet into the new infiltration gallery. This water quality element utilizes a continuous deflective separation technology to screen, separate and trap debris, sediment, and oil and grease from the stormwater runoff.

1.1.2 Existing Site Conditions

The site is located between Tumwater Boulevard (Airdustrial Way) and 73rd Ave SW, west of New Market Street SW. The site drains in two directions and can be defined as two separate basins, East and West. The eastern third of the site drains to the east toward New Market Street SW. The western two-thirds of the site drain to the west.

East Basin:
The eastern portion of the building's roof drains to the east and flows through downspouts that discharge onto the parking surface in front of the building. The surface drainage flows away from the building to the east to a landscape strip between the parking lot and New Market Street. The drainage flows to an existing drywell and is infiltrated into the ground. No improvements are proposed in this basin area.

West Basin:
The western portion of the building's roof drains to the west and flows through downspouts that discharge onto the parking surface. The surface drainage flows away from the building and generally to the west. Surface drainage is collected in two catch basins to the west of the building in the middle of the parking lot. CB1 and CB2 collect all the surface runoff in the west basin and convey the drainage to the north through a system of underground pipes. The pipes are routed through an oil/water separator and continue to the north to the infiltration gallery located north of the parking lot in a landscape area.

Fueling Area:
The fueling area roof drains through a downspout that discharges to the west through an underground pipe that is connected to CB1. The fueling area pavement surface is isolated from the rest of the parking lot and is collected in a catch basin located to the east of the fuel pumps. The drainage is conveyed to the east through an underground pipe that is routed through an oil/water separator. The flow continues to the east and connects to the Sanitary Sewer system. Surface runoff from the fueling area does not flow to the above mentioned infiltration gallery.

Infiltration Gallery:
The existing infiltration gallery identified in a site visit on August 24, 2012, is two parallel 8-inch perforated PVC pipes that run east-west. The gallery is located directly behind the northerly curb line in the northwest landscape area. Pipe ends of two 8-inch pipes were located approximately 100-feet west of the northwest corner of the building. It appears that these pipe ends are the east end of the infiltration gallery. It could not be determined where the west end of the gallery is located, nor the extents of the gallery trench. No records have been found to further identify the dimensions of the existing gallery.

1.1.3 Critical Areas

There are no Critical Areas identified on or adjacent to the site.

1.1.4 Soils

According to the Geotechnical Engineering Report prepared by Geotech Consultants, Inc, the soils beneath the site can be classified as native sand beneath a thin layer of topsoil. The native sand contained very small amounts of silt, was loose to medium dense beneath the surface, and became medium dense beneath about 5 feet. This medium dense native sand was encountered to the maximum depth reached by their explorations of 11 feet. No obstructions were revealed by their explorations. No groundwater seepage was observed in the test pits at the time of observation. The native soils are perfectly suited for stormwater infiltration.

1.1.5 Erosion Problem Areas

There are no Erosion Problem Areas identified on or adjacent to the site.

1.1.6 Construction Sequence

Recommended Construction Sequence:

1. Pre-Construction Meeting.
2. Flag or Fence Clearing Limits.
3. Install Catch Basin Protection if Required.
4. Install Perimeter Protection (Silt Fence, Brush Barrier, Etc).
5. Maintain Erosion control measures in accordance with City of Tumwater Standards and Manufacturers Recommendations.
6. Relocate Erosion Control Measures or Install new Measures so that as site conditions change the erosion and sediment control is always in accordance with the City of Tumwater Erosion and Sediment Control Standards.
7. Cover all areas that will be un-worked for more than seven days during the dry season or two days during the wet season with straw, wood fiber mulch, plastic sheeting or equivalent.
8. Stabilize all areas that reach final grade within seven days.
9. Seed or sod any areas to remain un-worked for more than 30 days.
10. Upon completion of the project, all disturbed areas must be stabilized and best management practices removed if appropriate.

1.1.7 Construction Schedule

Construction is scheduled to begin August 2013 and continue through September 2013.

1.1.8 Financial/Ownership Responsibilities

UPS is responsible for the initiation of bonds and/or other financial securities as required by the City of Tumwater.

1.1.9 Engineering Calculations

See Appendix D for engineering calculations.

2 INTRODUCTION

2.1 Storm water Pollution Prevention Plan Requirements

This Storm water Pollution Prevention Plan (SWPPP) was developed consistent with the requirements of the National Pollutant Discharge Elimination System (NPDES) General Storm water Permit for Construction Activities. This SWPPP meets the requirements of Special Condition S9 of the general permit. The primary consideration determining the adequacy of the SWPPP is compliance with State Surface Water Quality Standards (Chapter 173-201A – see Appendix A).

The Plan, properly implemented, should result in the discharge of water to the environment without the violation of Water Quality Standards.

2.2 Purpose

The purpose of this SWPPP is to:

- Describe best management practices (BMPs) to minimize erosion and sediment runoff at the site
- Identify, reduce, eliminate, or prevent the pollution of storm water
- Prevent violations of surface water quality or groundwater quality standards

2.3 SWPPP Organization

This plan consists of a detailed narrative section and the appendices, which contain illustrations, maps, and drawings. The narrative section includes descriptions of potential pollution problems associated with site features, and then discusses the selection of specific pollution prevention BMPs to reduce or eliminate the threat of causing pollution during the actual construction project. The illustrations, maps, and drawings in the appendices show the site location, topography, sensitive environmental receptors, placement of BMPs, and BMP specifications and performance expectations.

The narrative section of this plan is organized in numbered sections around the 12 required elements of an SWPPP listed below:

1. Preserve Vegetation/Mark Clearing Limits
2. Establishing Construction Access
3. Control Flow Rates
4. Install Sediment Controls
5. Stabilize Soils
6. Protect Slopes
7. Protect Drain Inlets
8. Stabilize Channels and Outlets
9. Control Pollutants
10. Control De-Watering
11. Maintain BMPs
12. Manage the Project

In the narrative section, each of the above elements will be discussed in relation to the specific conditions at the development. BMPs for each element will be screened, resulting in selection of those BMPs deemed most appropriate for use.

Specifications and engineering drawings of the selected BMPs are referenced at the end of each section and can be found in Appendix B.

3 CLEARING LIMITS

3.1 Site Plans

Drawing C05 is a map of the site showing all natural drainages associated with the area. Drawing C02 is a map of the existing and proposed stormwater systems showing the location of all relevant storm water BMPs such as infiltration facilities, storm drains, storm water treatment system locations, etc.

3.2 Marking Clearing Limits

Prior to beginning earth-disturbing activities, including clearing and grading, all clearing limits, easements, setbacks, sensitive areas and their buffers, trees and drainage courses will be clearly marked to prevent environmental damage both on and off site.

3.3 Special Consideration

No special considerations are necessary for this site.

3.4 Suggested BMPs

- BMP C101: Preserving Natural Vegetation
- BMP C103: High Visibility Plastic Fence

4 CONSTRUCTION ACCESS

4.1 Site Access

The main construction access will be established at the north end of the site from the road just to the north of the site (73rd Ave. SW). All construction vehicles exiting the site will be limited to this access.

4.2 Street Cleaning

If sediment is accidentally transported on to the street it will be removed from the street surface on a daily basis. Sediment will be shoveled and/or swept from the street and disposed of in a manner, which prevents contamination with storm water or surface water (e.g., covered soil stockpile). In addition, a street sweeper may be used to maintain clean roads on an as-needed basis.

4.3 Wheel Wash

Based on site conditions and time of year, a temporary truck wheel wash station may be constructed to ensure control of sediment at the construction exit point. The wheel wash system (if needed) will be constructed on the site at a location just prior to where trucks leave the site access and enter the street. The system will consist of an asphalt-lined wash pond for immersing the truck tires as the truck drives through and a small settling pond for settling suspended sediment in wash water cycled out of the system. Wash water may be reused after settling, infiltrated onsite, or transported off site for disposal. Accumulated sediments will be collected periodically, stockpiled for dewatering, then reused onsite.

4.4 Suggested BMPs

- BMP C105: Stabilized Construction Entrance
- BMP C106: Wheel Wash

5 STORM WATER DETENTION

5.1 Primary Storm Water Treatment System

The construction site slopes from east to west and south to north. The site is drained by a piped storm system to an infiltration system at the northwest corner of the site. The infiltration system is designed to provide full infiltration of onsite impervious areas. A Hydrodynamic Separator is proposed upstream of the infiltration system to provide pre-settling, spill control and Basic water quality treatment for the proposed improvement. An oil/water separator is also in place prior to the Hydrodynamic separator to trap and remove oils, other hydrocarbons and floatable debris.

During construction the pit excavated to install the permanent infiltration system can be utilized as a temporary sediment trap. Construction is scheduled for the summer and significant rain is not anticipated. In the event that rain does fall during the construction window the pit will be used as a sediment trap. This will not allow any sediment laden water from flowing off the site, as the native soils are conducive to infiltration and overtopping of the pit is not anticipated.

5.2 Suggested BMPs

See Drawing C02 and C05

- BMP C240: Sediment Trap

6 SEDIMENT CONTROLS

6.1 Site Sediment Control System

Although no stormwater is anticipated to be discharged from the construction site because the permanent facility is an infiltration system, sediment control measures will be installed around the perimeter of the construction site to prevent any sediment from being transported off the site.

Straw bale barriers, sediment barriers or silt fences, and other BMPs intended to trap sediment on site will be constructed as one of the first steps in grading and excavation. These BMPs will be installed before other land-disturbing activities take place.

6.2 Suggested BMPs

- BMP C233 Silt Fence
- BMP C234 Vegetated Strip
- BMP C235 Straw Wattles
- BMP C240 Sediment Trap

7 SOIL STABILIZATION

This section describes the stabilization and structural BMPs that will be implemented to minimize erosion and transport of sediment from the project site into receiving waters. Erosion and sediment control facilities are shown in Drawing C05.

Many of the BMPs listed below are described in the WSDOT Construction Site Erosion and Spill Control Certification Course Manual as well as in Volume 2 of Ecology's Storm Water Management Manual for the Puget Sound Basin and the City of Tumwater Drainage Design and Erosion Control Manual and have been included in Appendix B.

7.1 Soil Stabilization

Stabilization BMPs to be implemented at this site include:

- **Soil Covering.** All exposed soils will be stabilized with vegetation or covered prior to the onset of the rainy season. The primary stabilization method used will be covering soils with an approved matting and/or hydroseeding. This will be done on all exposed surfaces as deemed necessary by the erosion and sediment control lead. All exposed soils will be stabilized to protect surface water quality. Areas of the project, which have not been properly stabilized by vegetation by the onset of the wet season, will be covered with transparent plastic sheeting to prevent sediment transport. Plastic sheeting will also be used as an emergency BMP to cover previously stabilized areas, which begin to erode. Loose straw and mulch covers are not to be used as they may be washed into drainage structures.

- **Stockpile Covering.** All temporary soil stockpiles will be covered with plastic. Long-term stockpiles will be compacted and hydroseeded prior to the onset of wet weather. Clean runoff from covered or stabilized stockpiles will be collected in solid wall drainage pipe and conveyed to a surface water drainage structure.

- **Polymer Soil Treatment.** Areas of the site may also be actively worked throughout the wet season to support the installation of utilities. These areas of exposed soils may be temporarily stabilized with the application of a granular anionic polyacrylamide (PAM). PAM may be applied as an aqueous solution

(0.5 pounds per 1,000 gallons of water) or as a granular solid evenly dispersed over the surface of soils using a seed spreader (3 to 5 pounds of PAM per acre).

- **Maintenance of Existing Vegetation.** Existing and new vegetation will be maintained to the maximum extent practicable to prevent the contamination of storm water with sediment. Vegetated areas beginning to show signs of erosion or soil transport will be covered with plastic sheeting and the clean runoff conveyed to a storm water drain.

- **Outlet Protection.** Adequate energy dissipation, erosion control, and soil stabilization measures (e.g., rock or other energy dissipation techniques) will be provided for all point source discharges of storm water, including run-on discharges and outlets from onsite discharges.

- **Inlet protection.** All existing storm drain inlets, including those made operable during the project, will be properly protected and maintained using approved inlet protection devices.

7.2 Structural BMPs

Structural BMPs. Structural BMPs are practices designed to divert flows from exposed soil, store storm water runoff, and limit runoff and the discharge of pollutants from exposed areas of the project. The goal of structural BMPs on this project is to protect receiving water downstream of the site from turbid water, phosphorus, sediment, oil, and other contaminants, which may mobilize in storm water flows.

- **Temporarily Modified Catchment Structures.** Catch basins, manholes, vaults and swales may have to be modified on a temporary basis so that dirty water can be intercepted before leaving the site. This may be done in several different ways generally resulting in temporarily blocking an outlet structure and installing a pump to transfer the storm water inflow to a settling, infiltration, or treatment system. Automatic float level controllers built into the pump prevent the pump from running dry and conserve power use.

- **Infiltration/Dispersal Systems.** On sites with substantial areas of vegetation and/or porous soils, it may be advantageous to install an infiltration/dispersal system for the disposal of site storm water. This system is comprised of a pump, conveyance piping, and dispersal piping. It is best to follow topographical contours when installing the dispersal piping to avoid ponding and channeling. Dirty water should be allowed to gravity settle at least 24 hours before dispersal to avoid clogging the infiltration area with sediment.

Also, observe the dispersal area frequently when discharging water to prevent over-saturation of soils.

7.3 Suggested BMPs

- BMP C120. Temporary and Permanent Seeding
- BMP C121 Mulching
- BMP C123 Plastic Covering
- BMP C124 Sodding
- BMP C125 Topsoiling
- BMP C126 Polyacrylamide for Soil Erosion Protection
- BMP C140 Dust Control

8 SLOPE PROTECTION

8.1 General Practices

There are no steep slope identified on this site, therefore slope protection is not necessary for this project.

8.2 Suggested BMPs

- Not Applicable

9 DRAIN INLET PROTECTION

9.1 Existing Storm Drains

Existing storm drain inlets will be protected to prevent storm water from entering without first being filtered or treated to remove sediment.

9.2 Newly Constructed Storm Drains

All storm drain inlets made operable during construction will be protected to prevent storm water from entering without first being filtered or treated to remove sediment.

9.3 Suggested BMPs

- BMP C220: Storm Drain Inlet Protection

10 STORM WATER OUTLET PROTECTION

10.1 Treatment System Infiltration

The treatment system will discharge storm water into the ground. An overflow manhole has been provided in the event the infiltration facility fails. At the point where the stormwater potentially overflows the system outlet protection will be provided using riprap to prevent erosion of the surrounding gradient. During construction it is not anticipated that stormwater will leave the site. No further outlet protection will be necessary.

10.2 Suggested BMPs

- BMP C202: Channel Lining
- BMP C209: Outlet Protection

11 SPILL PREVENTION AND RESPONSE

Consistent with the general permit requirements, all potential pollutants other than sediment will be handled and disposed of in a manner that does not cause contamination of storm water. Non-sediment pollutants that may be present during construction activities include:

- Petroleum products including fuel, lubricants, hydraulic fluids, and form oils
- Polymer used for soil stabilization
- Water treatment chemicals (coagulant, acid, sodium bicarbonate)
- Concrete
- Paints
- Fertilizers

These materials, and other materials used during construction with the potential to impact storm water, will be stored, managed, used, and disposed of in a manner that minimizes the potential for releases to the environment and especially into storm water.

Emergency contacts for the project will be posted at the project office and are included at the end of this section.

11.1 General Materials Handling Practices

The following general practices will be used throughout the project to reduce the potential for spills.

- Potential pollutants will be stored and used in a manner consistent with the manufacturer's instructions in a secure location. To the extent practicable, material storage areas should not be located near storm drain inlets and should be equipped with covers, roofs, or secondary containment as needed to prevent storm water from contacting stored materials. Chemicals that are not compatible (such as sodium bicarbonate and hydrochloric acid) shall be stored in segregated areas so that spilled materials cannot combine and react.

- Materials disposal will be in accordance with the manufacturer's instructions and applicable local, state, and federal regulations.

- Materials no longer required for construction will be removed from the site as soon as practicable.

- Adequate garbage, construction waste, and sanitary waste handling and disposal facilities will be provided to the extent necessary to keep the site clear of obstruction and BMPs clear and functional.

11.2 Specific Materials Handling Practices

- All pollutants, including waste materials and demolition debris, that occur on-site during construction will be handled in a way that does not contaminate storm water.

- All chemicals including liquid products, petroleum products, water treatment chemicals, and wastes stored on site will be covered and contained and protected from vandalism.

- Maintenance and repair of all equipment and vehicles involving oil changes, hydraulic system drain down, de-greasing operations, fuel tank drain down and removal, and other activities which may result in the accidental release of contaminants, will be conducted under cover during wet weather and on an impervious surface to prevent the release of contaminants onto the ground. Materials spilled during maintenance operations will be cleaned up immediately and properly disposed of.

- Wheel wash water will be settled and discharged on site by infiltration. Wheel wash water will not be discharged to the storm water system or the storm water treatment system.

- Application of agricultural chemicals, including fertilizers and pesticides, will be conducted in a manner and at application rates that will not result in loss of chemical to storm water runoff. Manufacturers' recommendations will be followed for application rates and procedures.

- pH-modifying sources will be managed to prevent contamination of runoff and storm water collected on site. The most common sources of pH-modifying materials are bulk cement, cement kiln dust (CKD), fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.

11.3 Spill Response

The primary objective in responding to a spill is to quickly contain the material(s) and prevent or minimize their migration into storm water runoff and conveyance systems. If the release has impacted on-site storm water, it is critical to contain the released materials on site and prevent their release into receiving waters.

If a spill of pollutants threatens storm water at the site, the spill response procedures outlined below must be implemented in a timely manner to prevent the release of pollutants.

- The site superintendent will be notified immediately when a spill, or the threat of a spill, is observed. The superintendent will assess the situation and determine the appropriate response.

- If spills represent an imminent threat of escaping ESC facilities and entering the receiving waters, facility personnel will respond immediately to contain the release and notify the superintendent after the situation has been stabilized.

- Spill kits containing materials and equipment for spill response and cleanup will be maintained at the site. Each spill kit may contain:

    - Oil absorbent pads (one bale)
    - Oil absorbent booms (40 feet)
    - 55-gallon drums (2)
    - 9-mil plastic bags (10)
    - Personal protective equipment including gloves and goggles

- If oil sheen is observed on surface water (e.g., settling ponds, detention pond, swales), absorbent pads and/or booms will be applied to contain and remove the oil. The source of the oil sheen will also be identified and removed or repaired as necessary to prevent further releases.

- The site superintendent, or his designee, will be responsible for completing the spill reporting form and for reporting the spill to the appropriate state or local agency (see Forms at the end of this section).

- Facility personnel with primary responsibility for spill response and cleanup will receive training from the site superintendent. This training will include identifying the location of spill kits and other spill response equipment and the use of spill response materials.

- Spill response equipment will be inspected and maintained as necessary to replace any materials used in spill response activities.

11.4 Notification

In the event of a spill, make the appropriate notification(s) consistent with the following procedures:

- Any spill of oil which 1) violates water quality standards, 2) produces a "sheen" on a surface water, or 3) causes a sludge or emulsion must be reported immediately by telephone to the National Response Center Hotline at (800) 424-8802.
- Any oil, hazardous substance, or hazardous waste release which exceeds the reportable quantity must be reported immediately by telephone to the National Response Center Hotline at (800) 424-8802.
- Any spill of oil or hazardous substance to waters of the state must be reported immediately by telephone to the WA State Department of Ecology's 24 Hour Oil/Spill release reporting number (425) 649-7000.
- Any release of a hazardous substance that may be a threat to human health or the environment must be reported to the WA State Department of Ecology's 24 Hour Oil/Spill release reporting number (425) 649-7000 immediately upon discovery.

11.5 Suggested BMPs

- BMP C152 Sawcutting and Surface Pollution Prevention

12 STORM WATER TREATMENT

12.1 Storm Water Collection System

During all phases of construction and grading the contractor will provide storm water collection and conveyance systems to collect and direct sediment contaminated water to temporary sediment traps as needed to prevent offsite discharge of sediment laden storm water. Clean storm water, generated from stabilized and undisturbed portions of the site, will be collected and conveyed to stabilized discharge areas whenever necessary to avoid contact with disturbed portions of the site. All conveyance and collection systems will be constructed consistent with State and local BMP requirements.

12.2 Temporary Sediment Traps

During construction, sediment contaminated storm water will be conveyed to temporary sediment traps, as designed by the project engineer and shown on the temporary erosion and sediment control (TESC) plan. The sediment traps will gravity-settle large particles down to silt size particles. Considering subsurface soil types, it is unlikely that gravity settling alone will remove all suspended particles. If settled storm water does not meet state water quality standards, the storm water will be managed by chemical treatment.

An experienced expert in storm water treatment will perform chemical treatment. Many of the chemicals utilized for this type of treatment (polymers) can be environmentally hazardous.

12.3 Monitoring Chemical Treatment System

As with all effective BMPs, the chemical treatment system requires regular monitoring to assure the overall effectiveness of storm water management. The key monitoring requirements of the chemical treatment water management system include:

- **Sediment Trap Monitoring**

All sediment traps should be visually monitored at least daily during the wet season or as needed to monitor the level and quality of water within the sediment traps. The site operator will designate site personnel to routinely monitor the level of the sediment trap such that the water level is not allowed to reach levels approaching discharge. The sediment traps will also be monitored weekly or as needed for sediment accumulation, functionality, and for other required maintenance. In the event of abnormal conditions, site personal will immediately report the information to the site superintendent for resolution.

- **Water Quality Monitoring**

State water quality standards require treated water to not exceed 5 NTU above the receiving water and the pH to be within 0.3 pH units of the receiving water. Therefore, the Storm water Monitoring Form will be used to record the receiving water background turbidity and pH as well as the quality of water discharged from the site. This information can then be used to document compliance with water quality standards.

12.4 pH Adjustment

The most likely pH upset condition will be high pH resulting from concrete contamination. Acid or dry ice (CO_2) will be required to neutralize the high pH. Begin recirculating the water in the basin to be neutralized while slowly adding acid (dry ice). Acid (dry ice) quantity will be calculated based on a sample test neutralization.

Caution! Hydrochloric and sulfuric acids are powerful acids, which can cause serious, permanent damage to human skin and eyes. See Material Safety Data Sheets in Appendix D. Goggles, gloves, and protective clothing are mandatory when handling acid. An eye wash unit is stationed in the job trailer. Acid must always be stored, moved, and dispensed in the secondary unit containment provided. No more than 5 gallons of acid will be stored on site at any time.

Check pH in the treatment basin frequently after incremental additions of acid or dry ice to ensure the pH is not over-adjusted. Adjust the pH to 7.0 to 7.5. Once the desired pH has been achieved, let the basin settle briefly and check the pH again.

A low pH condition may be treated by adding a 20 percent sodium bicarbonate solution as above. Check the pH after incremental additions of sodium bicarbonate. The sodium bicarbonate quantity may be calculated based on a simple jar test to determine the correct amount for size of the pond.

12.5 Suggested BMPs

- BMP C240 Sediment Trap
- BMP C250 Construction Stormwater
- BMP C251 Construction Stormwater Filtration
- BMP C252 High pH Neutralization Using CO_2
- BMP C253 pH Control for High pH Water

13 BMP MAINTENANCE

13.1 BMP Facility Maintenance

All temporary and permanent erosion and sediment control BMPs will be maintained and repaired as needed to assure continued performance of their intended function. All maintenance and repair will be conducted in accordance with BMPs. Recommended BMP maintenance requirements are listed in Tables 1 and 2 included in this section. Following Tables 1 and 2 is a BMP Inspection Checklist for use in routine inspections of the construction site.

All temporary erosion and sediment control BMPs will be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment will be removed or stabilized on site. Disturbed soil areas resulting from removal of BMPs or vegetation will be permanently stabilized as soon as possible.

13.2 Suggested BMPs

- BMP C150 Materials on Hand

14 PROJECT MANAGEMENT

Implementation and management of the environmental aspects of this project under the SWPPP are the responsibilities of UPS and the prime contractor, Johnson & Maddox Construction. Communication between all parties performing work on the site is essential for proper implementation of the SWPPP. The prime contractor, utility installation contractor, and grading contractor should all be familiar with the SWPPP and their responsibilities under the plan. To help delegate these responsibilities the following outline has been provided:

14.1 Seasonal Work

While not seasonal, some construction activities may need to be postponed if scheduled during ongoing storm events. Activities such as grading and trenching in areas directly adjacent to the drainage basin during rainstorms could easily result in sediment-contaminated storm water running off site. This work would therefore be performed within a window of dry weather predicted on the basis of weather reports.

14.2 Training

The contractor's superintendent and project manager will be familiarized with the major elements of the plan. Construction workers and others at the site will be given appropriate training information at the conclusion of site safety meetings or on an as-needed basis.

14.3 Pre-construction Conference

One or more pre-construction meetings will be held with an explicit agenda item addressing the SWPPP.

14.4 Coordination with Utilities and other Contractors

All contractors providing services on the project which may cause storm water pollution will be given a copy of the SWPPP and appropriate training regarding storm water pollution prevention.

14.5 Subcontractor Oversight

Subcontractor oversight to ensure compliance with the SWPPP will be provided by the prime contractor's superintendent or project manager. Informal, on-the-job tailgate training will be the first level of communication followed by onsite observation of training compliance. Non-compliance with SWPPP policies will trigger a more intensive training session to correct the problem(s). Chronic non-compliance with SWPPP policies may require the intervention of local and/or state regulatory personnel.

14.6 Monitoring/Reporting

Water quality conditions at the site will be monitored by a qualified technician and water quality reports submitted to the proper regulatory authorities on a regular basis. Additional reports such as erosion and sediment control inspections will be the responsibility of the prime contractor or a designated consultant. Spill reports will be completed and submitted by the prime contractor on the project.

14.7 SWPPP Update

The SWPPP will be updated as requested by UPS and the City of Tumwater.

14.8 Standard Notes

1. Approval of this SWPPP does not constitute an approval of permanent road or drainage design (e.g., size and location of roads, pipes, restrictors, channels, retention facilities, utilities, etc.).
2. The implementation of these SWPPPs and the construction, maintenance, replacement, and upgrading of these ESC facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation/landscaping is established.
3. The boundaries of the clearing limits shown on this plan shall be clearly flagged in the field prior to construction. During the construction period, no disturbance beyond the flagged clearing limits shall be permitted. The flagging shall be maintained by the applicant/contractor for the duration of construction.

4. The ESC facilities shown on this plan must be constructed in conjunction with all clearing and grading activities, and in such a manner as to insure that sediment and sediment laden water do not enter the drainage system, roadways, or violate applicable water standards.
5. The ESC facilities shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these ESC facilities shall be upgraded as needed for unexpected storm events and to ensure that sediment and sediment-laden water do not leave the site.
6. The ESC facilities shall be inspected daily by the applicant/contractor and maintained as necessary to ensure their continued functioning.
7. The ESC facilities on inactive sites shall be inspected and maintained a minimum of once a month or within the 48 hours following a major storm event.
8. At no time shall more than 1 foot of sediment be allowed to accumulate within a trapped catch basin. All catch basins and conveyance lines shall be cleaned prior to paving. The cleaning operation shall not flush sediment laden water into the downstream system.
9. Stabilized construction entrances shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures may be required to insure that all paved areas are kept clean for the duration of the project.

14.9 Suggested BMPs

- BMP C153 Material Delivery, Storage and Containment
- BMP C160 Certified Erosion and Sediment Control Lead (CESCL)
- BMP C162 Scheduling
- BMP C180 Small Project Construction Stormwater Pollution Prevention

DRAWINGS

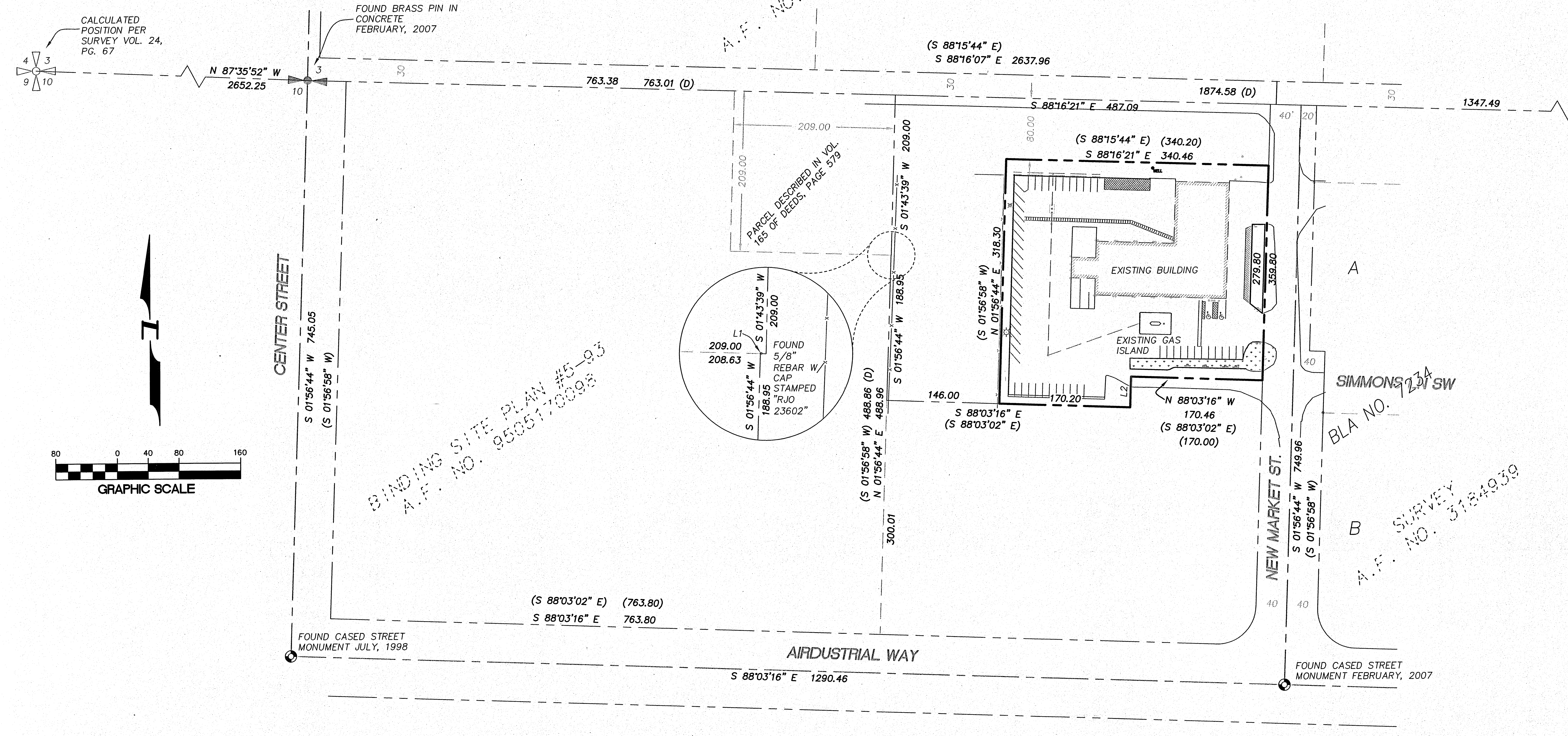
REVISIONS:

SW 1/4, SW 1/4 SEC. 10, T. 17 N., R. 2 W., W.M.

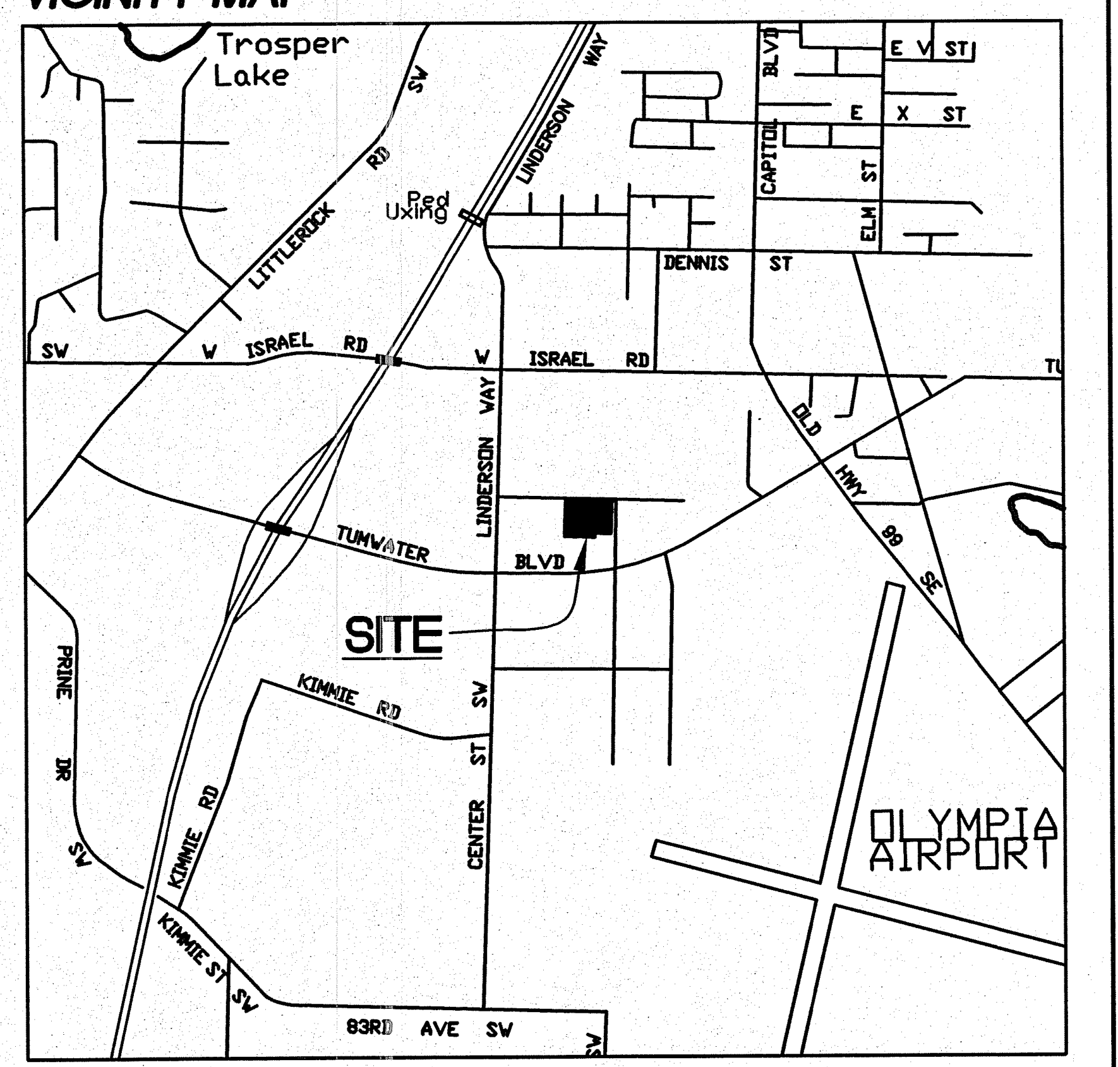
TUMWATER UPS

TUMWATER, WA

(PROJECT NO. 12026)



VICINITY MAP



SHEET INDEX

C01	COVER SHEET
C02	GRADING AND DRAINAGE
C03	DETAILS
C04	DETAILS
C05	DEMOLITION AND TEMPORARY EROSION AND SEDIMENTATION CONTROL PLAN

SURVEY REFERENCES:

BINDING SITE PLAN # 5–93 AS RECORDED MAY 17. 1995 UNDER AUDITOR'S FILE NO. 9505170098

BASIS OF BEARING:

CITY OF TUMWATER COORDINATE SYSTEM BASED UPON THE NORTH LINE OF THE NORTHEAST QUARTER OF SECTION 10, TOWNSHIP 17 NORTH, RANGE 2 WEST, W.M. EQUALS SOUTH 88°16'21" EAST

OWNERS/DEVELOPERS:

UNITED PARCEL SERVICE
7383 NEW MARKET ST SW
TUMWATER, WA 98501
AARON JOHNSON
(206) 621–6233

CIVIL ENGINEER:

PACIFIC ENGINEERING DESIGN, LLC
15445 53RD AVE S.
SEATTLE, WA 98188
JOE HOPPER
PHONE: (206) 431–7970
FAX: (206) 388–1648

SURVEYOR:

HATTON GODAT PANTIER
3910 MARTIN WAY E, SUITE B
PHONE: (360) 943–1599

OWNER OF RECORD:

PORT OF OLYMPIA
7643 OLD HWY 99 SE
TUMWATER, WA 98501

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PROJECT NO.: 12026
DRAWN BY: ENM
ISSUE DATE: 12/12/12
SHEET REV.: 1/25/13

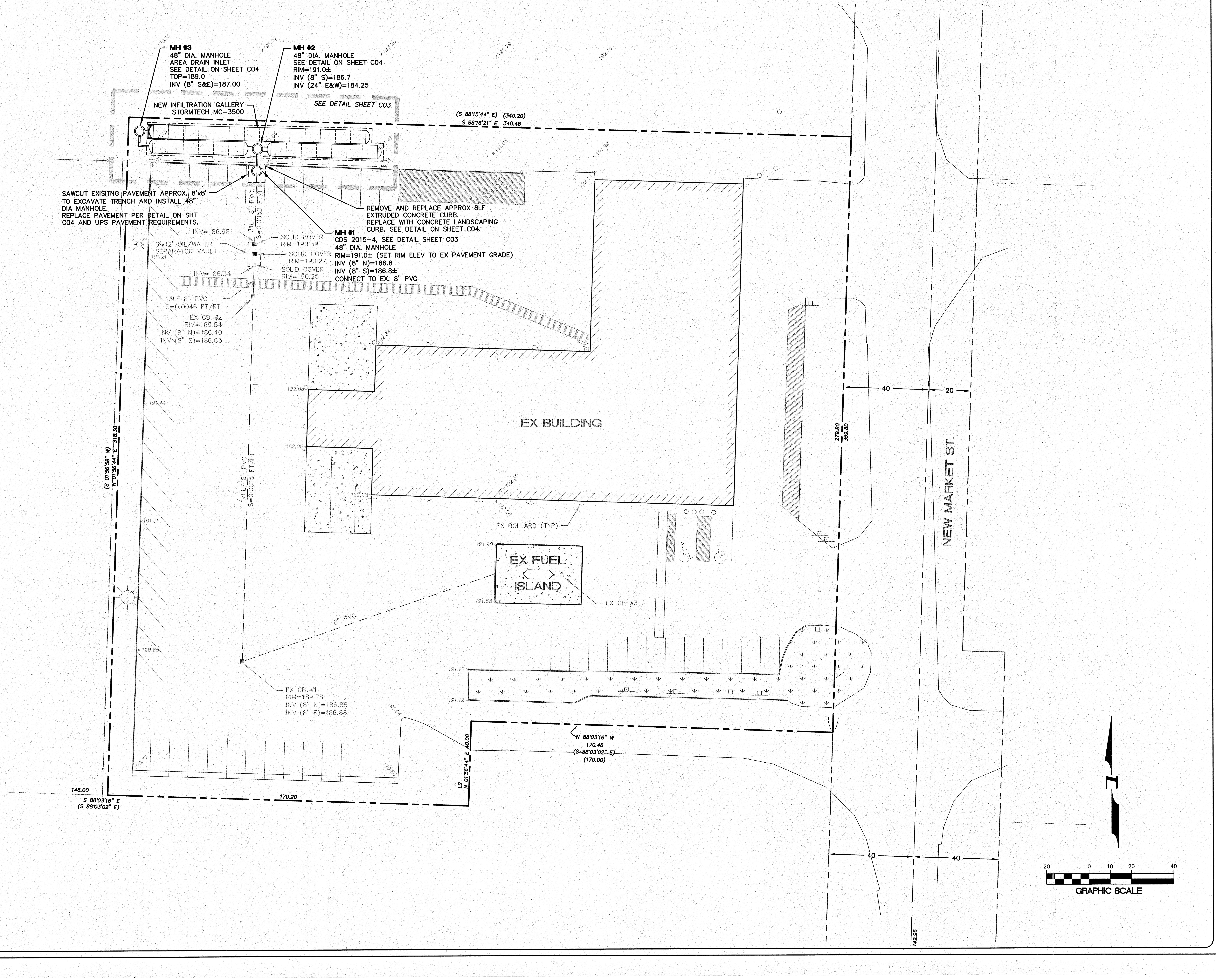
COVER SHEET

12026CV01.DWG

C01

SHEET 01 OF 05

REVISIONS:



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TUMWATER UPS

CITY OF TUMWATER, WA

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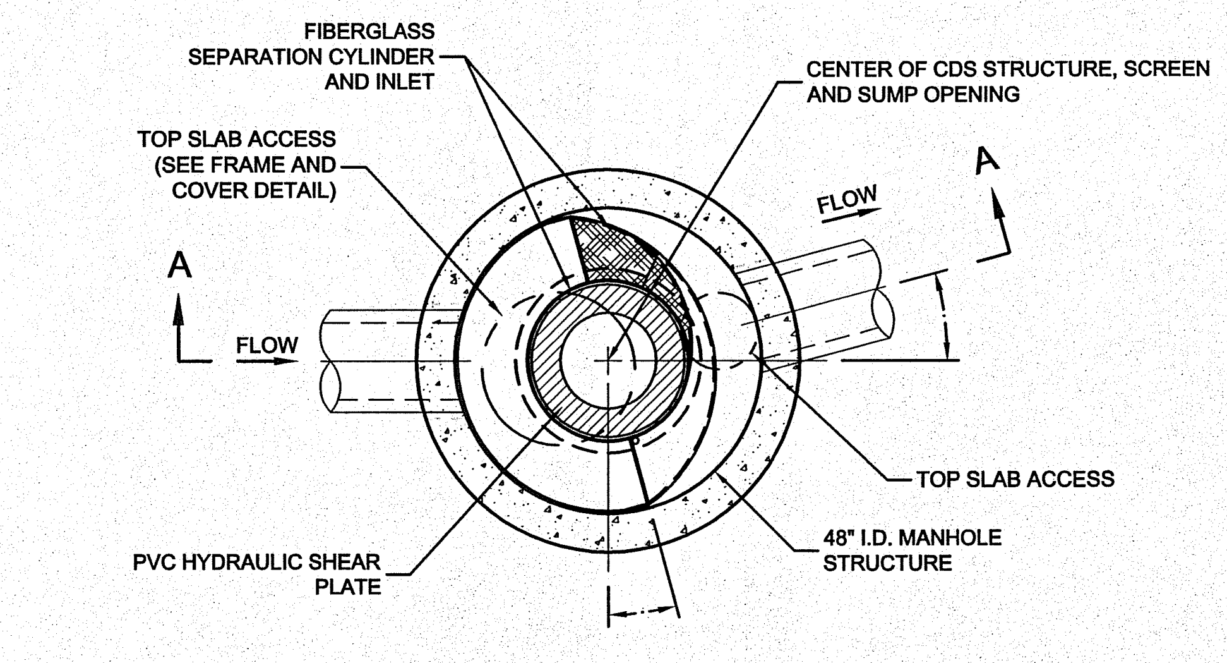
GRADING AND
DRAINAGE

12026GR01.DWG

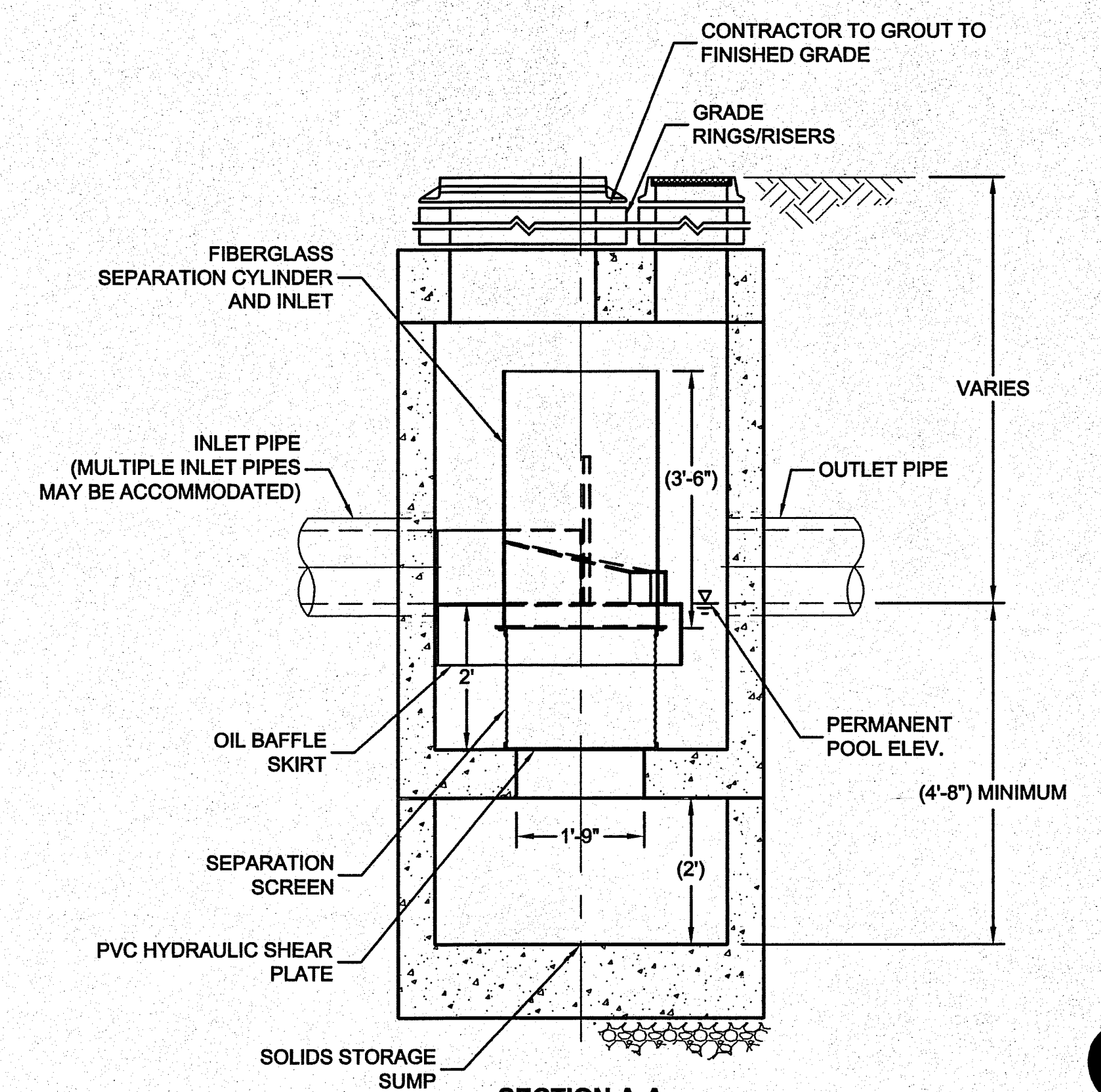
C02

SHEET 02 OF 05

REVISIONS:



PLAN VIEW
N.T.S.



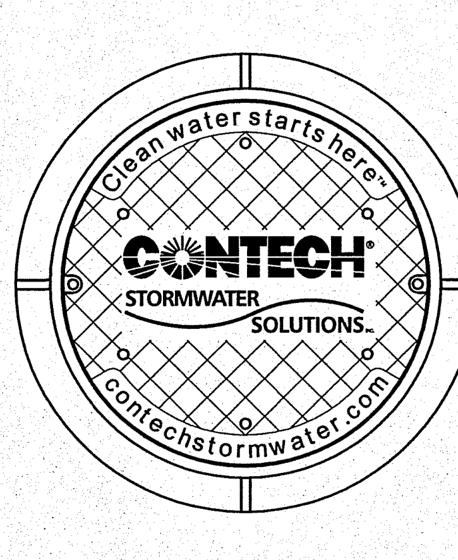
SECTION A-A
N.T.S.

CDS2015-4 DESIGN NOTES

CDS2015-4 RATED TREATMENT CAPACITY IS 0.7 CFS, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 10.0 CFS. IF THE SITE CONDITIONS EXCEED 10.0 CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS2015-4 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

DESIGNATION (MODEL SUFFIX)	CONFIGURATION DESCRIPTION
G	GRATED INLET ONLY (NO INLET PIPE)
GP	GRATED INLET WITH INLET PIPE OR PIPES
K	CURB INLET ONLY (NO INLET PIPE)
KP	CURB INLET WITH INLET PIPE OR PIPES



SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	MH #1
WATER QUALITY FLOW RATE (CFS)	0.169
PEAK FLOW RATE (CFS)	0.186
RETURN PERIOD OF PEAK FLOW (YRS)	100
SCREEN APERTURE (2400 OR 4700)	2400

PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	186.8	PVC	8"
INLET PIPE 2	*	*	*
OUTLET PIPE	186.8	ADS N-12	8"

RIM ELEVATION	191.0

ANTI-FLOTATION BALLAST	WIDTH	HEIGHT
	*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH STORMWATER SOLUTIONS REPRESENTATIVE. www.contechstormwater.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE AND CASTINGS SHALL MEET AASHTO HS20 LOAD RATING.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

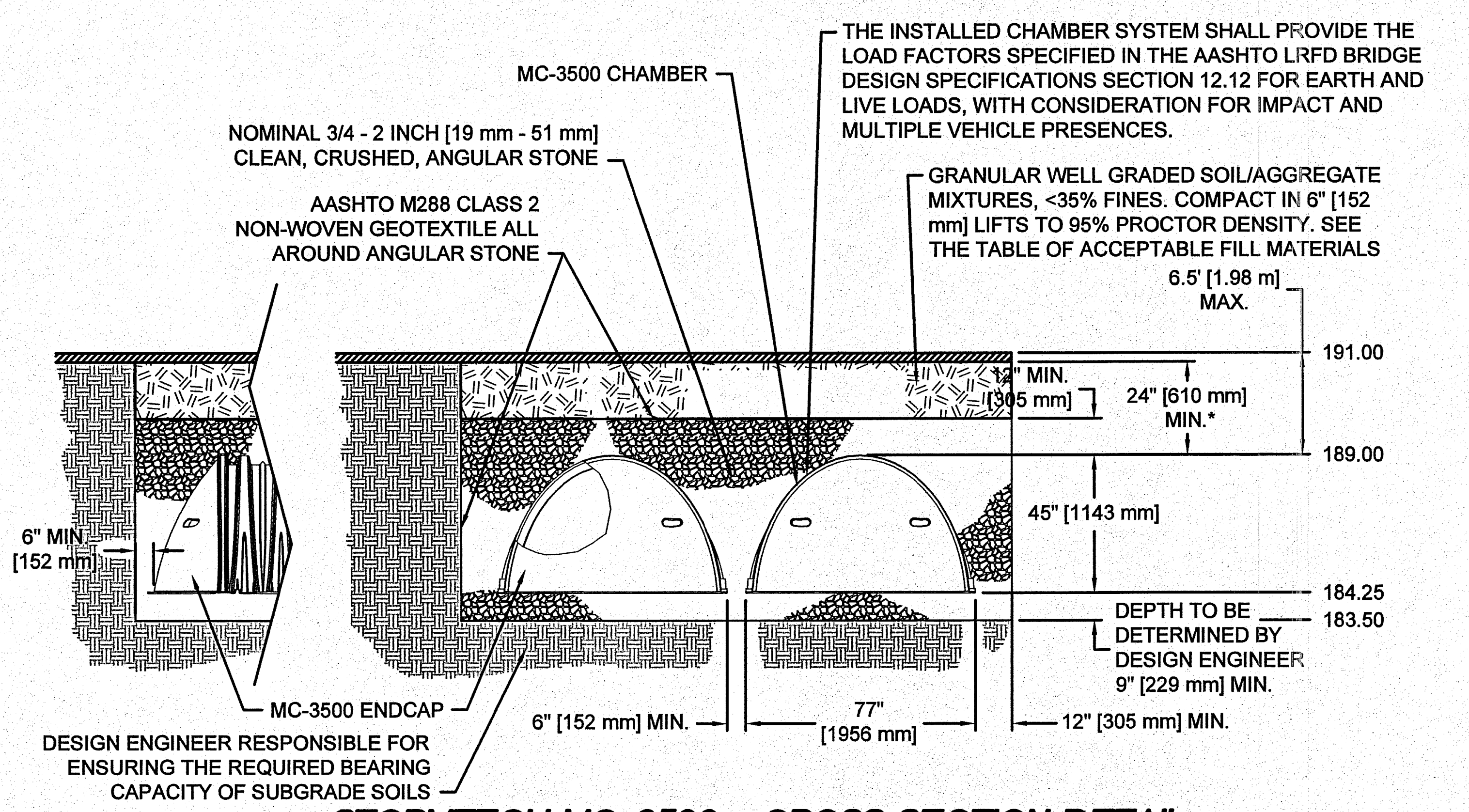
INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CDS®

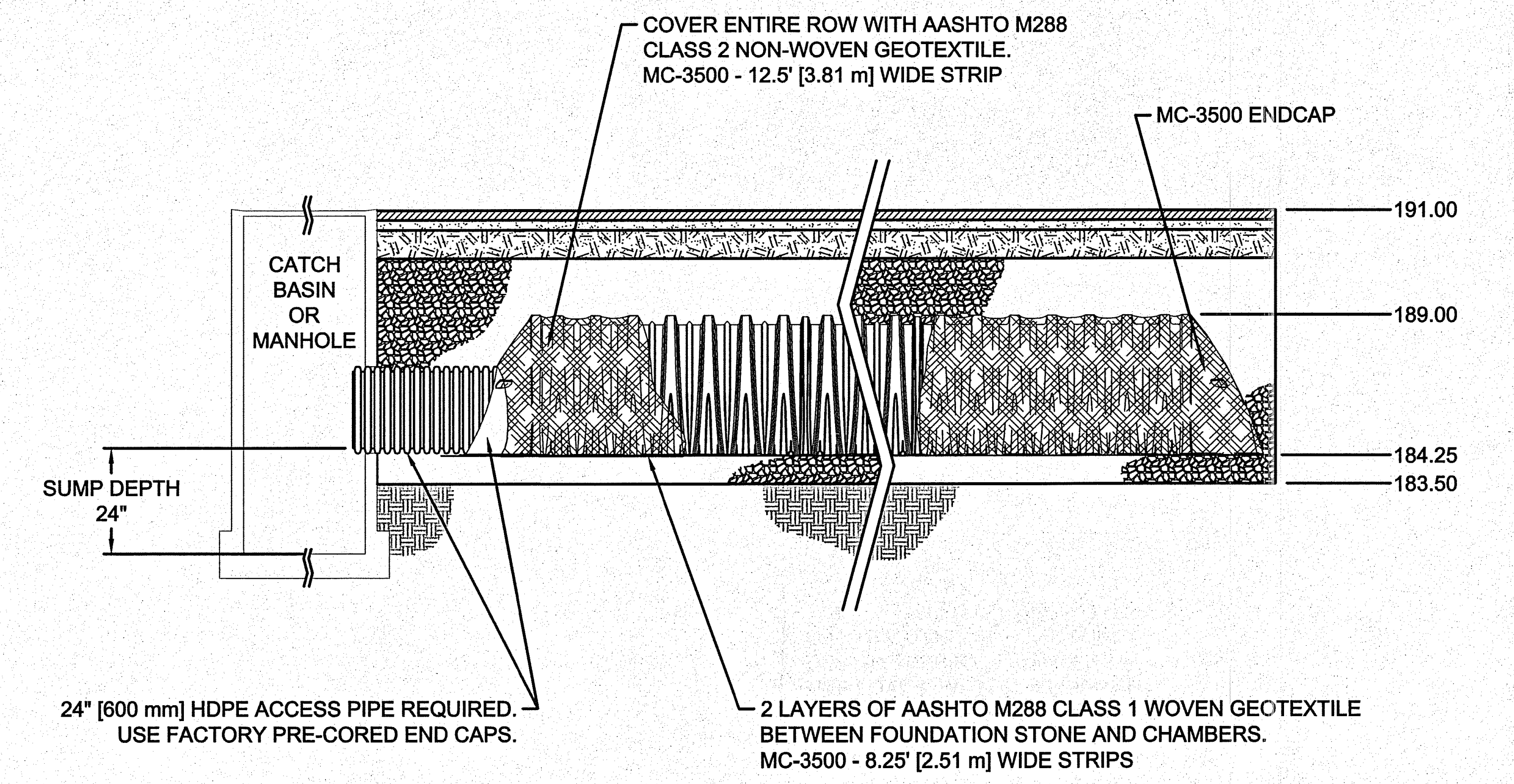
THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH® STORMWATER SOLUTIONS
contechstormwater.com

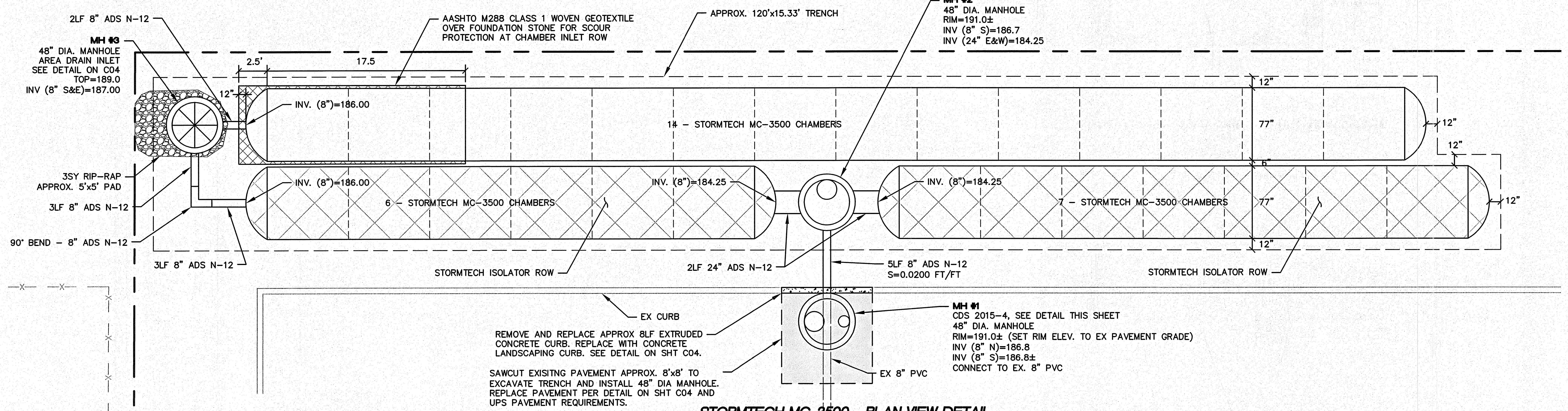
CDS2015-4
PRECAST CONCRETE WATER QUALITY SYSTEM
STANDARD DETAIL



STORMTECH MC-3500 - CROSS SECTION DETAIL
NTS



ISOLATOR ROW DETAIL
NTS



STORMTECH MC-3500 - PLAN VIEW DETAIL
SCALE: 1"=5'

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TUMWATER UPS

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PROJECT NO.: 12026
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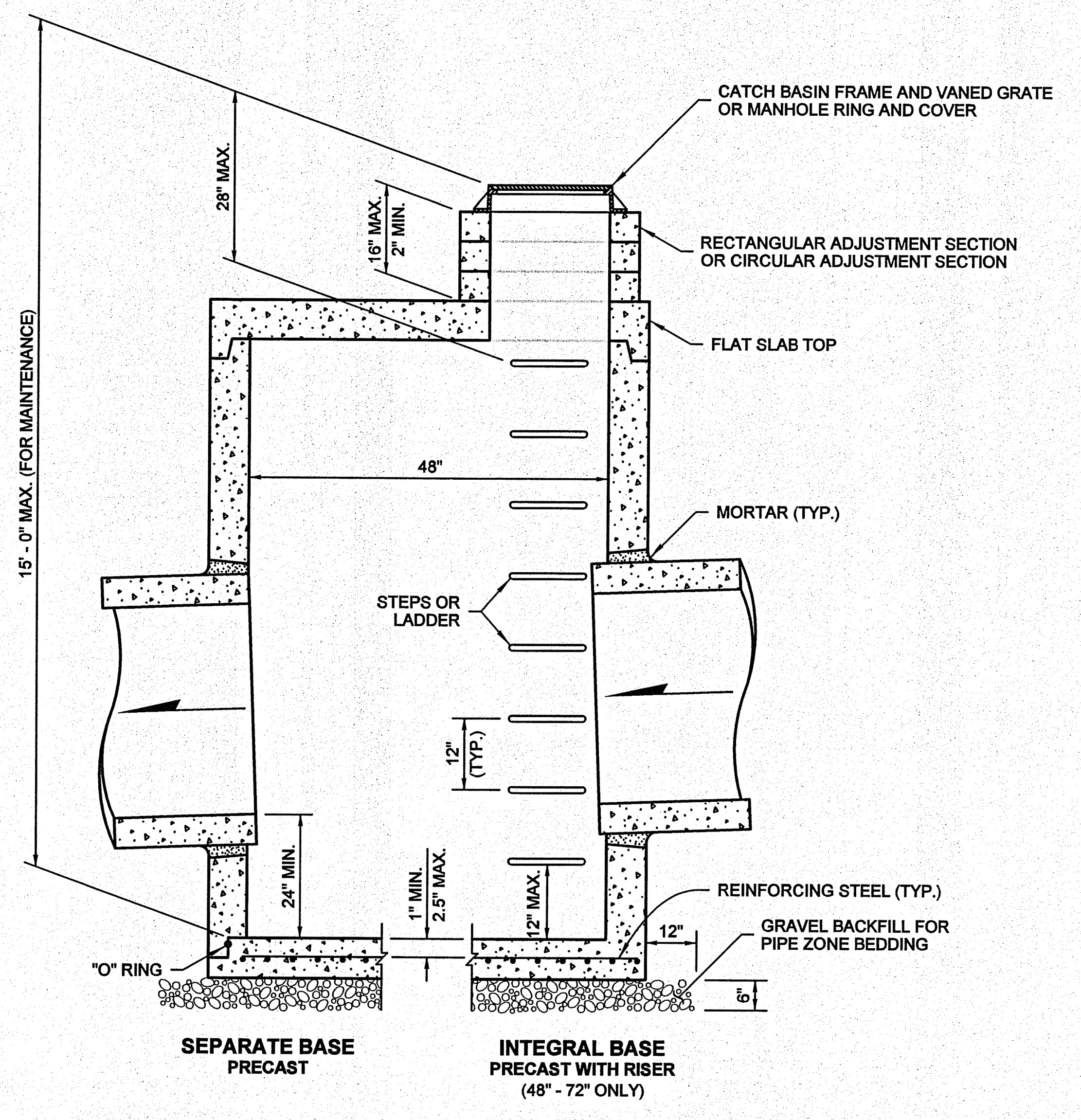
DETAILS

12026GR01.DWG

C03

SHEET 03 OF 05

REVISIONS:

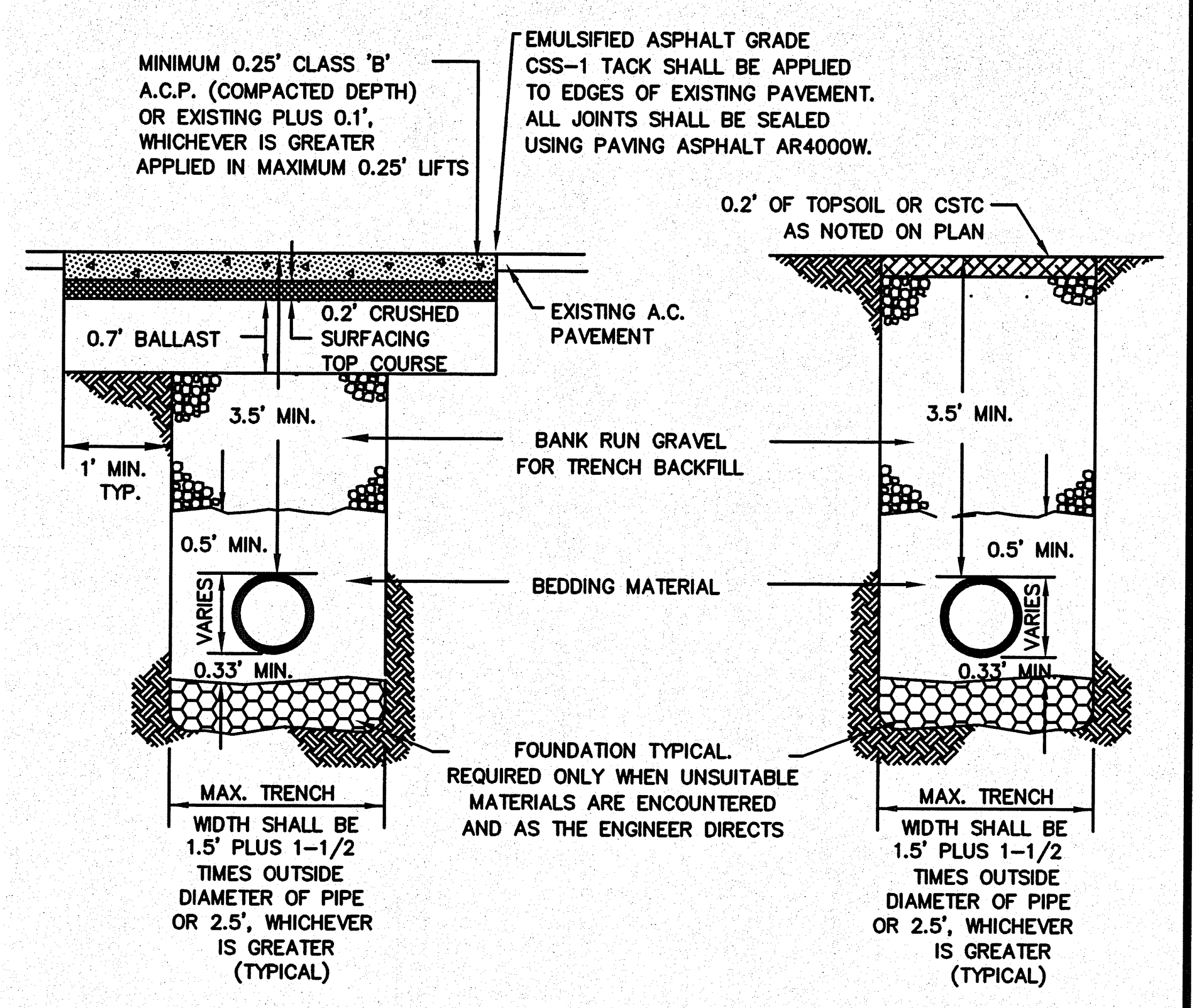


CATCH BASIN TYPE 2

(FROM WSDOT STD PLAN B-10.20-01)

NOTES

1. No steps are required when height is 4' or less.
2. The bottom of the precast catch basin may be sloped to facilitate cleaning.
3. The rectangular frame and grate may be installed with the flange up or down. The frame may be cast into the adjustment section.
4. Knockouts shall have a wall thickness of 2" minimum to 2.5" maximum. Provide a 1.5" minimum gap between the knockout wall and the outside of the pipe. After the pipe is installed, fill the gap with joint mortar in accordance with **Standard Specification 9-04.3.**



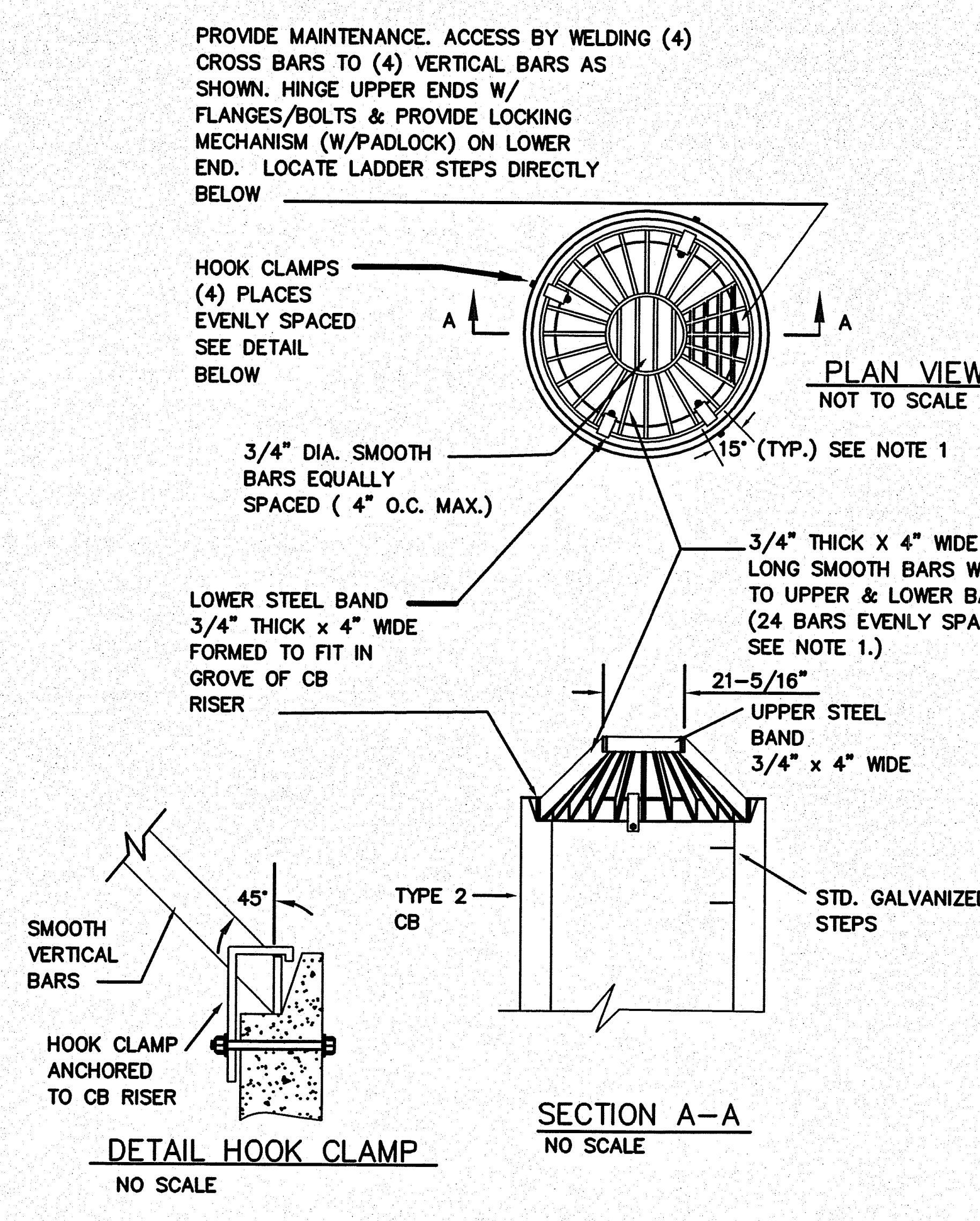
NOTES:

1. ALL MATERIALS EXCEPT A.C.P. AND BEDDING MATERIAL SHALL BE COMPACTED IN 6-INCH MAXIMUM LIFTS TO 95% DENSITY.
2. BEDDING SHALL CONFORM TO SECTION 9-03.16 OF STANDARD SPECIFICATIONS.
3. COMPACTION: BEDDING SHALL BE COMPACTED TO 95% MAX. AS DETERMINED BY ASTM D1557. BACKFILL SHALL BE COMPACTED TO 85% IN UNPAVED AREA, AND 95% IN PAVED OR SHOULDER AREAS AS DETERMINED BY ASTM D1557.
4. ALL MATERIALS, WORKMANSHIP, AND INSTALLATION SHALL BE IN CONFORMANCE WITH THE STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION AS AMENDED BY CITY OF TUMWATER STANDARDS.
5. KEEP TRENCH BOTTOM COMPACTED WITH UNIFORM GRADE. A BELL JOINT SHALL BE REQUIRED AT EACH JOINT FOR PROPER SUPPORT. NO TEMPORARY SUPPORTS, I.E. BLOCKS, WILL BE ALLOWED TO SUPPORT PIPE. TRENCH BOTTOM SHALL BE TO GRADE PRIOR TO PIPE INSTALLATION.

CITY OF TUMWATER TRENCH–PAVEMENT RESTORATION DETAIL	DRAWN BY: SRJ CHECKED BY: JRN	STD. PLAN NO. ST-13 DATE: 05-30-95

(FROM CITY OF TUMWATER DEVELOPMENT GUIDE)

MH #3 - SEE SHEET C02

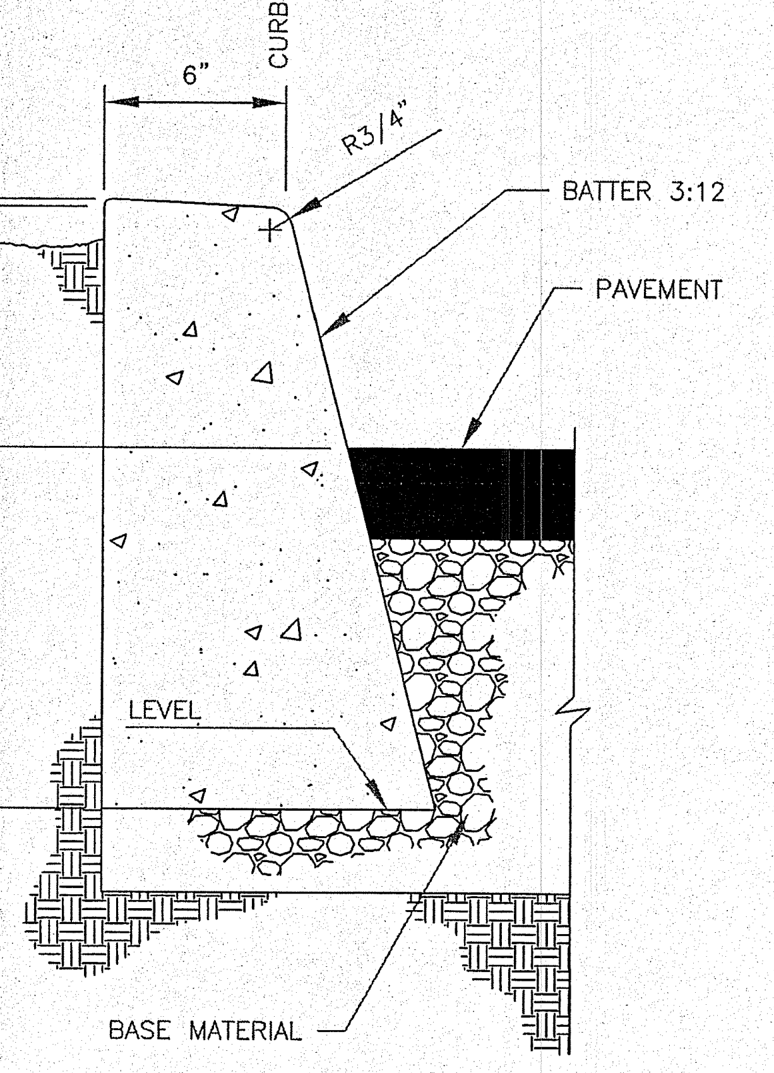


NOTES

1. DIMENSIONS ARE FOR INSTALLATION ON 48" DIA. CB FOR DIFFERENT DIA. CB'S ADJUST DIMENSIONS TO MAINTAIN 45° ANGLE ON "VERTICAL" BARS AND 7" O.C. MAX. SPACING OF BARS AROUND LOWER STEEL BAND.
2. METAL PARTS: CORROSION RESISTANT STEEL PARTS GALVANIZED.

CITY OF TUMWATER AREA DRAIN INLET DETAIL	DRAWN BY: SRJ CHECKED BY: JRN	STD. PLAN NO. SR-01 DATE: 05-23-95

(FROM CITY OF TUMWATER DEVELOPMENT GUIDE)



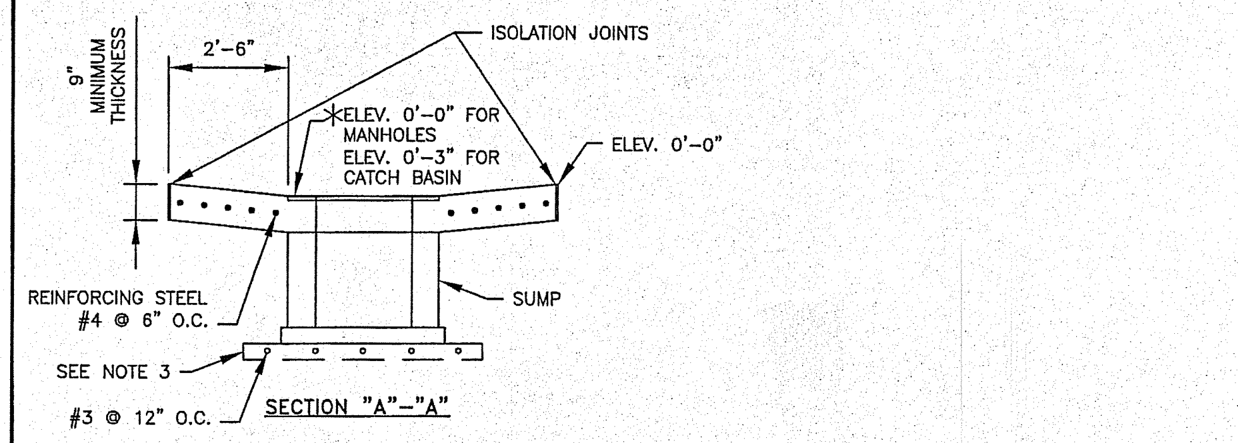
NOTE:
1. DETAIL SHOULD ONLY BE USED FOR LANDSCAPING ISLANDS.
*2. VALIDATE WITH LOCAL CODE.

CONCRETE CURB

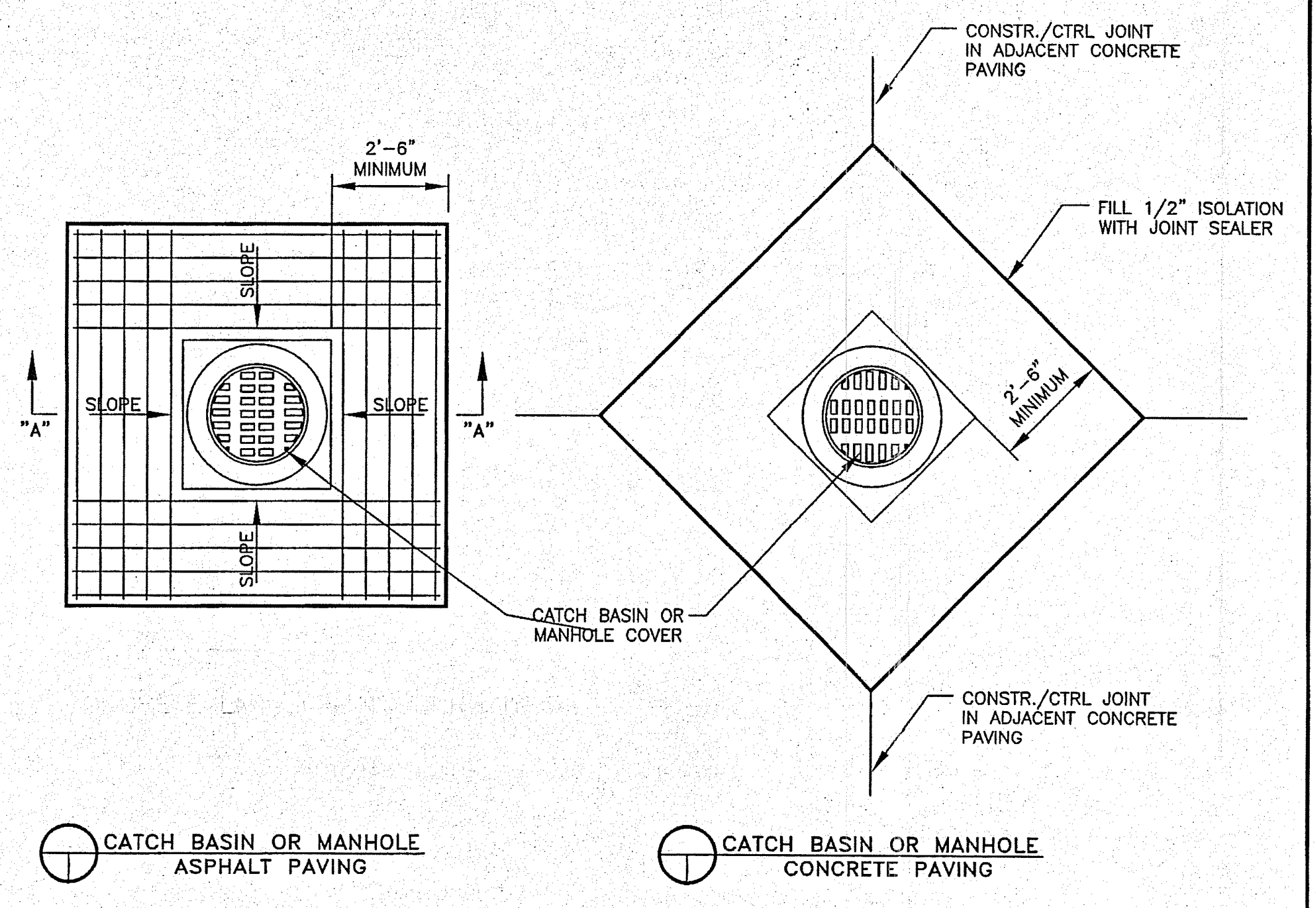
CONSTRUCTION DETAIL

TITLE: CONCRETE LANDSCAPING CURB DETAIL	DWG. DATE: 06-13-03 REV. DATE: 10-26-09 SCALE: NTS REDUCTION: ____	DWG. NO: CURBING04

AUTOCAD DWG – DO NOT CHANGE MANUALLY



NOTE:
1. IN MOST DESIGNS DO NOT LOCATE IN DRIVE AISLE.
2. IF LOCATED IN HEAVY FEEDER FLOW AREA OR BAD SOIL CONDITIONS USE ENLARGED FOUNDATION.
3. SUMP CAN BE CAST-IN-PLACE OR PRE CAST CONSTRUCTION. USE LOCAL PUBLIC WORKS DESIGN. DO NOT USE BRICK.
4. INSTALL JOINT SEALER WHERE CONCRETE SLAB AND ADJOINING ASPHALT PAVING MEET.
5. 1/ 2" ISOLATION JOINTS SHOULD BE USED WHEN CATCH BASINS OR MANHOLES ARE WITH A CONCRETE PAVING AREA. INSTALL 3/ 8" JOINT SEALENT.
6. SPECIFY "HEAVY DUTY" FRAME AND GRATING A(CAST/DUCTILE IRON MEETING H-20 LOADING CRITERIA).
*7. FOR MANHOLE COVER, ELEVATION TO BE 0'-0".
8. DO NOT USE THIS DETAIL FOR FUEL ISLAND.



CONSTRUCTION DETAIL

TITLE: CATCH BASIN DETAIL FOR ASPHALT & CONCRETE PAVING	DWG. DATE: 02-09-87 REV. DATE: 10-09-09 SCALE: NTS REDUCTION: ____	DWG. NO: CATBAS01

AUTOCAD DWG – DO NOT CHANGE MANUALLY

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1/25/13

TUMWATER UPS

CITY OF TUMWATER, WA

FOR:
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(206) 621-6380

PROJECT NO.: 12026
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ISSUE DATE: 12/12/12
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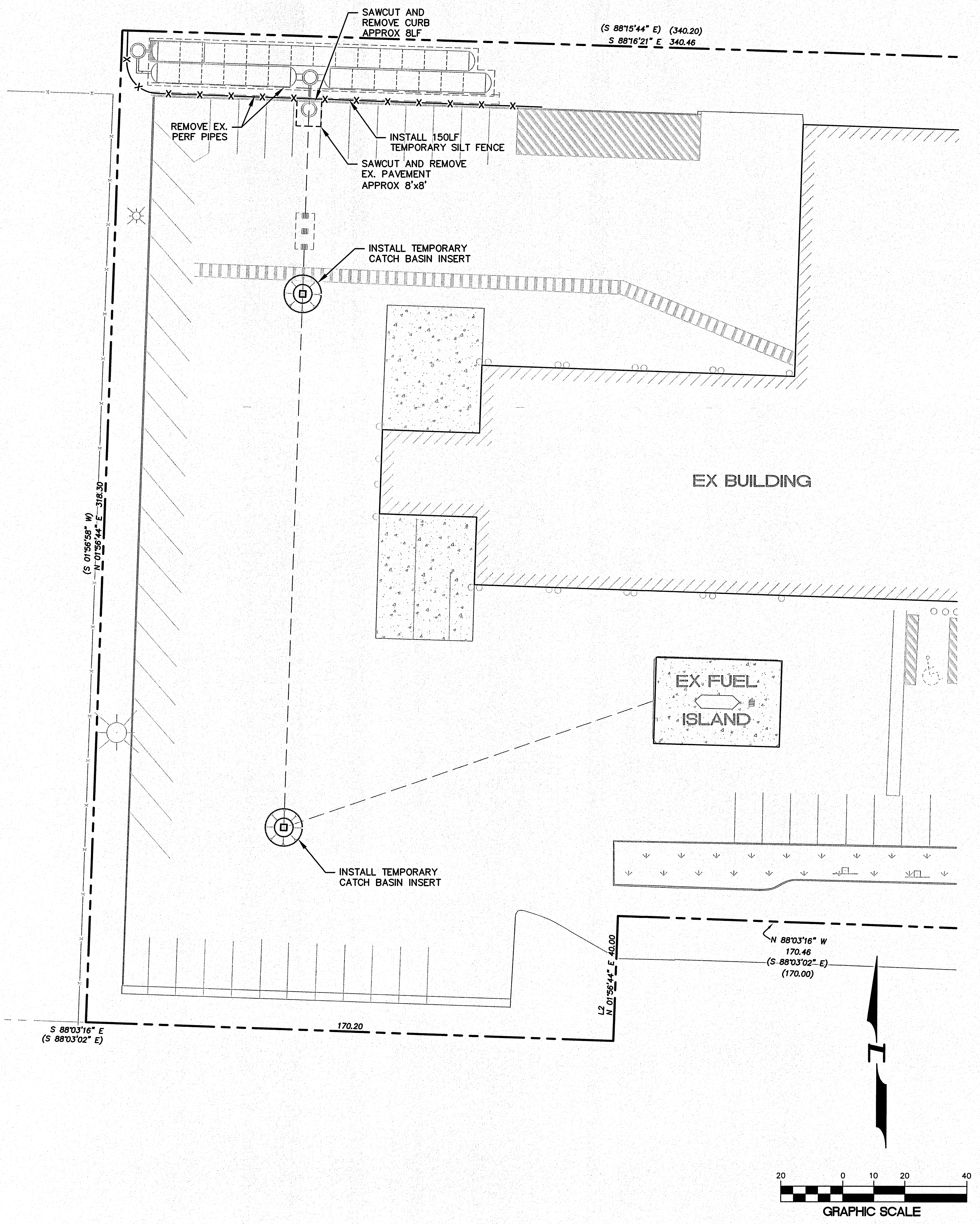
DETAILS

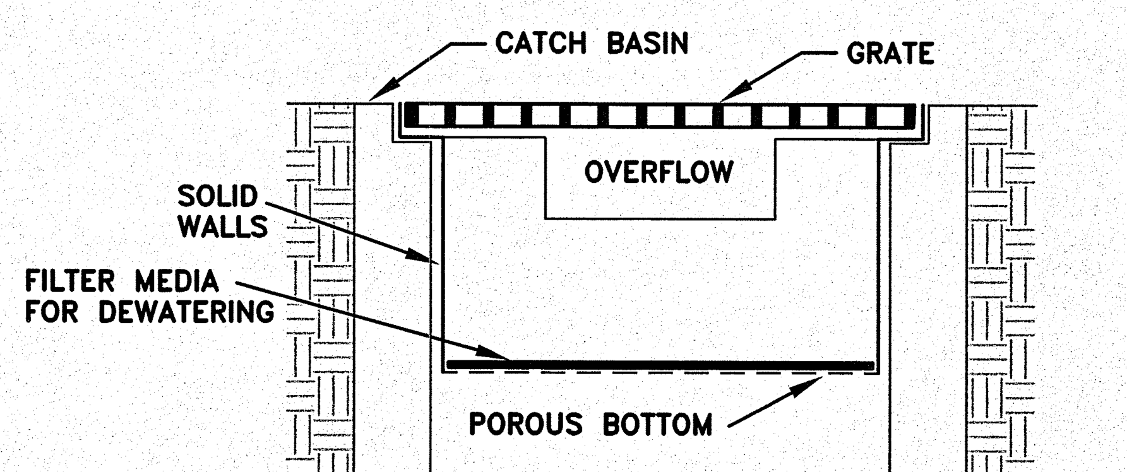
12026GR01.DWG

C04

SHEET 04 OF 05

REVISIONS:





NOTE: THIS DETAIL IS ONLY SCHEMATIC. ANY INSERT IS ALLOWED THAT HAS A MIN. 0.5 C.F. OF STORAGE, THE MEANS TO DEWATER THE STORED SEDIMENT, AN OVERFLOW, AND CAN BE EASILY MAINTAINED.

CATCH BASIN INSERT

NTS

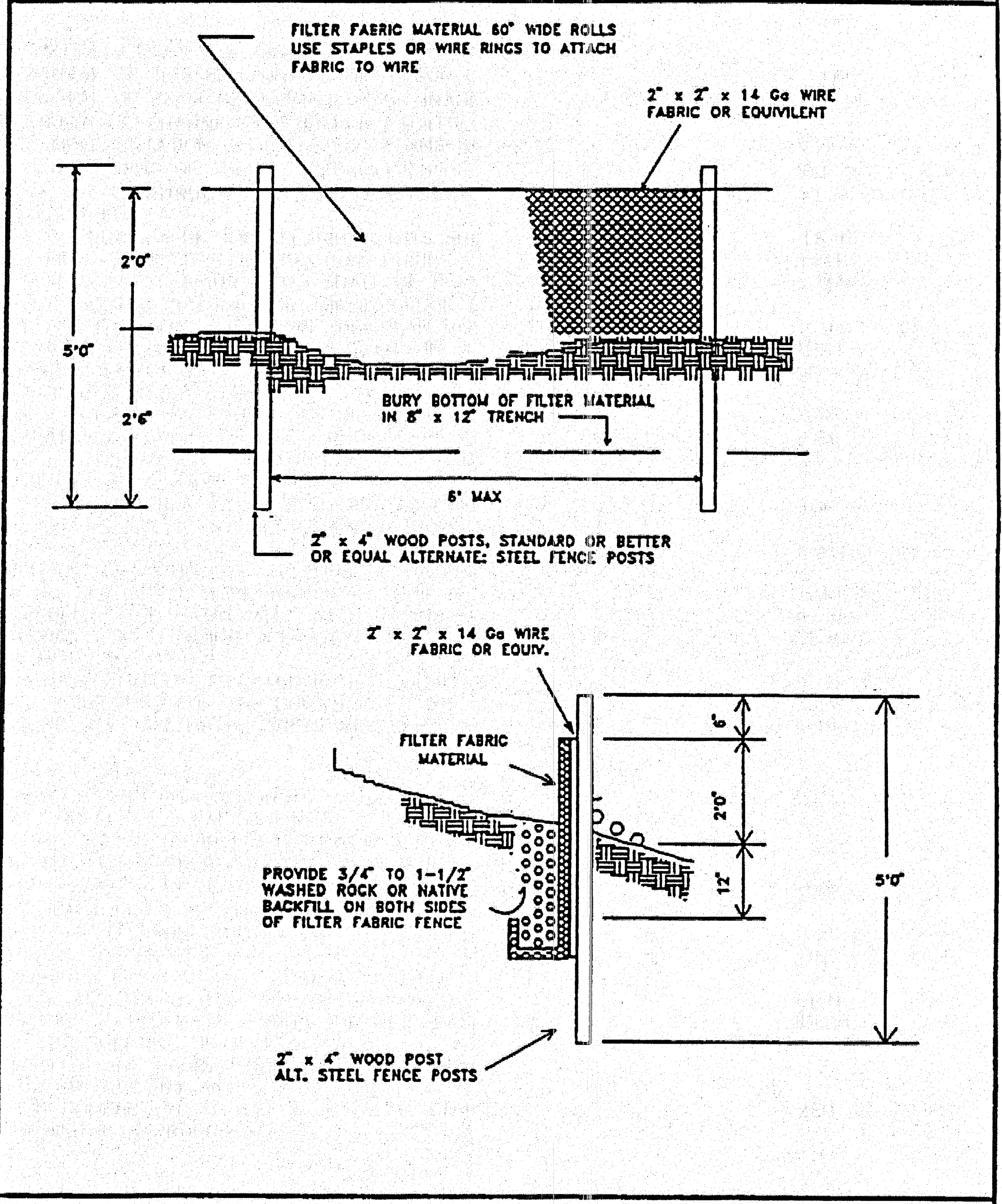
TEMPORARY EROSION AND SEDIMENT CONTROL STANDARD NOTES:

1. APPROVAL OF THIS EROSION/SEDIMENTATION CONTROL (ESC) PLAN DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G. SIZE AND LOCATION OF ROADS, PIPES, RESTRICTORS, CHANNELS, RETENTION FACILITIES, UTILITIES, ETC.).
2. THE IMPLEMENTATION OF THESE ESC PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC FACILITIES IS THE RESPONSIBILITY OF THE APPLICANT/CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.
3. THE BOUNDARIES OF THE CLEARING LIMITS SHOWN ON THIS PLAN SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE APPLICANT/CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
4. THE ESC FACILITIES SHOWN ON THIS PLAN MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO INSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAINAGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.
5. THE ESC FACILITIES SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE
6. CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE ESC FACILITIES SHALL BE UPGRADED AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO ENSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT LEAVE THE SITE.
7. THE ESC FACILITIES SHALL BE INSPECTED DAILY BY THE APPLICANT/CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING.
8. THE ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN THE 48 HOURS FOLLOWING A MAJOR STORM EVENT.
9. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A TRAPPED CATCH BASIN. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
10. STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.

CONSTRUCTION SEQUENCE:

1. PRE-CONSTRUCTION MEETING.
2. FLAG OR FENCE CLEARING LIMITS.
3. INSTALL CATCH BASIN PROTECTION IF REQUIRED.
4. INSTALL PERIMETER PROTECTION (SILT FENCE, BRUSH BARRIER, ETC.).
5. MAINTAIN EROSION CONTROL MEASURES IN ACCORDANCE WITH KING COUNTY STANDARDS AND MANUFACTURER'S RECOMMENDATIONS.
6. RELOCATE EROSION CONTROL MEASURES OR INSTALL NEW MEASURES SO THAT AS SITE CONDITIONS CHANGE THE EROSION AND SEDIMENT CONTROL IS ALWAYS IN ACCORDANCE WITH THE CITY OF TUMWATER EROSION AND SEDIMENT CONTROL STANDARDS.
7. COVER ALL AREAS THAT WILL BE UNWORKED FOR MORE THAN SEVEN DAYS DURING THE DRY SEASON OR TWO DAYS DURING THE WET SEASON WITH STRAW, WOOD FIBER MULCH, COMPOST, PLASTIC SHEETING OR EQUIVALENT.
8. STABILIZE ALL AREAS THAT REACH FINAL GRADE WITHIN SEVEN DAYS.
9. SEED OR SOD ANY AREAS TO REMAIN UNWORKED FOR MORE THAN 30 DAYS.
10. UPON COMPLETION OF THE PROJECT, ALL DISTURBED AREAS MUST BE STABILIZED AND BMPS REMOVED IF APPROPRIATE.

STORM DRAINAGE DESIGN MANUAL | FIG B2



REFERENCE:
KING COUNTY, WASHINGTON, SURFACE WATER DESIGN MANUAL

DATE:
FEB. 1991

FILTER FABRIC FENCE DETAIL

(FROM CITY OF TUMWATER DEVELOPMENT GUIDE)

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REGISTERED PROFESSIONAL ENGINEER
Joseph M. Hopper
1/25/13

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PROJECT NO.: 12026
DRAWN BY: ENM
ISSUE DATE: 12/12/12
SHEET REV.: 1/15/13

DEMOLITION AND TEMPORARY EROSION AND SEDIMENTATION CONTROL PLAN

12026TE01.DWG

C05

SHEET 05 OF 05

APPENDIX A

NPDES STORM WATER PERMIT, AND STATE WATER QUALITY STANDARDS

Issuance Date:	December 1, 2010
Effective Date:	January 1, 2011
Expiration Date:	December 31, 2015

CONSTRUCTION STORMWATER GENERAL PERMIT

National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge General Permit for Stormwater Discharges Associated with Construction Activity

State of Washington
Department of Ecology
Olympia, Washington 98504

In compliance with the provisions of
Chapter 90.48 Revised Code of Washington
(State of Washington Water Pollution Control Act)
and
Title 33 United States Code, Section 1251 et seq.
The Federal Water Pollution Control Act (The Clean Water Act)

Until this permit expires, is modified or revoked, Permittees that have properly obtained coverage under this general permit are authorized to discharge in accordance with the special and general conditions that follow.

Kelly Susewind, P.E., P.G.
Water Quality Program Manager
Washington State Department of Ecology

TABLE OF CONTENTS

LIST OF TABLES

SUMMARY OF PERMIT REPORT SUBMITTALS

Refer to the Special and General Conditions within this permit for additional submittal requirements. Appendix A provides a list of definitions. Appendix B provides a list of acronyms.

Table 1. Summary of Permit Report Submittals

Permit Section	Submittal	Frequency	First Submittal Date
S5.A and S8	High Turbidity/Transparency Phone Reporting	As Necessary	Within 24 hours
S5.B	Discharge Monitoring Report	Monthly*	Within 15 days of applicable monitoring period
S5.F and S8	Noncompliance Notification	As necessary	Immediately
S5.F	Noncompliance Notification – Written Report	As necessary	Within 5 Days of non-compliance
G2.	Notice of Change in Authorization	As necessary	
G6.	Permit Application for Substantive Changes to the Discharge	As necessary	
G8.	Application for Permit Renewal	1/permit cycle	No later than 180 days before expiration
G9.	Notice of Permit Transfer	As necessary	
G20.	Notice of Planned Changes	As necessary	
G22.	Reporting Anticipated Non-compliance	As necessary	

SPECIAL NOTE: *Permittees must submit Discharge Monitoring Reports (DMRs) to the Washington State Department of Ecology monthly, regardless of site discharge, for the full duration of permit coverage. Refer to Section S5.B of this General Permit for more specific information regarding DMRs.

Table 2. Summary of Required On-site Documentation

Document Title	Permit Conditions
Permit Coverage Letter	See Conditions S2, S5
Construction Stormwater General Permit	See Conditions S2, S5
Site Log Book	See Conditions S4, S5
Stormwater Pollution Prevention Plan (SWPPP)	See Conditions S9, S5

SPECIAL CONDITIONS

S1. PERMIT COVERAGE

A. Permit Area

This Construction Stormwater General Permit (CSWGP) covers all areas of Washington State, except for federal and Tribal lands as specified in Special Condition S1.E.3.

B. Operators Required to Seek Coverage Under this General Permit:

1. Operators of the following construction activities are required to seek coverage under this CSWGP:
    a. Clearing, grading and/or excavation that results in the disturbance of one or more acres and discharges stormwater to surface waters of the State; and clearing, grading and/or excavation on sites smaller than one acre that are part of a larger common plan of development or sale, if the common plan of development or sale will ultimately disturb one acre or more and discharge stormwater to surface waters of the State.
        i. This includes forest practices (including, but not limited to, class IV conversions) that are part of a construction activity that will result in the disturbance of one or more acres, and discharge to surface waters of the State (that is, forest practices that prepare a site for construction activities); and
    b. Any size construction activity discharging stormwater to waters of the State that the Department of Ecology ("Ecology"):
        i. Determines to be a significant contributor of pollutants to waters of the State of Washington.
        ii. Reasonably expects to cause a violation of any water quality standard.
2. Operators of the following activities are not required to seek coverage under this CSWGP (unless specifically required under Special Condition S1.B.1.b. above):
    a. Construction activities that discharge all stormwater and non-stormwater to ground water, sanitary sewer, or combined sewer, and have no point source discharge to either surface water or a storm sewer system that drains to surface waters of the State.
    b. Construction activities covered under an Erosivity Waiver (Special Condition S2.C).
    c. Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

C. Authorized Discharges:

1. Stormwater Associated with Construction Activity. Subject to compliance with the terms and conditions of this permit, Permittees are authorized to discharge stormwater associated with construction activity to surface waters of the State or to a storm sewer system that drains to surface waters of the State. (Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.)

2. Stormwater Associated with Construction Support Activity. This permit also authorizes stormwater discharge from support activities related to the permitted construction site (for example, an on-site portable rock crusher, off-site equipment staging yards, material storage areas, borrow areas, etc.) provided:

    a. The support activity relates directly to the permitted construction site that is required to have a NPDES permit; and

    b. The support activity is not a commercial operation serving multiple unrelated construction projects, and does not operate beyond the completion of the construction activity; and

    c. Appropriate controls and measures are identified in the Stormwater Pollution Prevention Plan (SWPPP) for the discharges from the support activity areas.

3. Non-Stormwater Discharges. The categories and sources of non-stormwater discharges identified below are authorized conditionally, provided the discharge is consistent with the terms and conditions of this permit:

    a. Discharges from fire-fighting activities.

    b. Fire hydrant system flushing.

    c. Potable water, including uncontaminated water line flushing.

    d. Pipeline hydrostatic test water.

    e. Uncontaminated air conditioning or compressor condensate.

    f. Uncontaminated ground water or spring water.

    g. Uncontaminated excavation dewatering water (in accordance with S9.D.10).

    h. Uncontaminated discharges from foundation or footing drains.

    i. Water used to control dust. Permittees must minimize the amount of dust control water used.

    j. Routine external building wash down that does not use detergents.

    k. Landscape irrigation water.

    The SWPPP must adequately address all authorized non-stormwater discharges, except for discharges from fire-fighting activities, and must comply with Special

Condition S3. At a minimum, discharges from potable water (including water line flushing), fire hydrant system flushing, and pipeline hydrostatic test water must undergo the following: dechlorination to a concentration of 0.1 parts per million (ppm) or less, and pH adjustment to within 6.5 – 8.5 standard units (su), if necessary.

D. Prohibited Discharges:

The following discharges to waters of the State, including ground water, are prohibited.

1. Concrete wastewater.
2. Wastewater from washout and clean-up of stucco, paint, form release oils, curing compounds and other construction materials.
3. Process wastewater as defined by 40 Code of Federal Regulations (CFR) 122.1 (see Appendix A of this permit).
4. Slurry materials and waste from shaft drilling.
5. Fuels, oils, or other pollutants used in vehicle and equipment operation and maintenance.
6. Soaps or solvents used in vehicle and equipment washing.
7. Wheel wash wastewater, unless discharged according to Special Condition S9.D.9.d.
8. Discharges from dewatering activities, including discharges from dewatering of trenches and excavations, unless managed according to Special Condition S9.D.10.

E. Limits on Coverage

Ecology may require any discharger to apply for and obtain coverage under an individual permit or another more specific general permit. Such alternative coverage will be required when Ecology determines that this CSWGP does not provide adequate assurance that water quality will be protected, or there is a reasonable potential for the project to cause or contribute to a violation of water quality standards.

The following stormwater discharges are not covered by this permit:

1. Post-construction stormwater discharges that originate from the site after completion of construction activities and the site has undergone final stabilization.
2. Non-point source silvicultural activities such as nursery operations, site preparation, reforestation and subsequent cultural treatment, thinning, prescribed burning, pest and fire control, harvesting operations, surface drainage, or road construction and maintenance, from which there is natural runoff as excluded in 40 CFR Subpart 122.
3. Stormwater from any federal project or project on federal land or land within an Indian Reservation except for the Puyallup Reservation. Within the Puyallup

Reservation, any project that discharges to surface water on land held in trust by the federal government may be covered by this permit.

4. Stormwater from any site covered under an existing NPDES individual permit in which stormwater management and/or treatment requirements are included for all stormwater discharges associated with construction activity.

5. Stormwater from a site where an applicable Total Maximum Daily Load (TMDL) requirement specifically precludes or prohibits discharges from construction activity.

S2. APPLICATION REQUIREMENTS

A. Permit Application Forms

1. Notice of Intent Form/Timeline

   a. Operators of new or previously unpermitted construction activities must submit a complete and accurate permit application (Notice of Intent, or NOI) to Ecology.

   b. The operator must submit the NOI at least 60 days before discharging stormwater from construction activities and must submit it on or before the date of the first public notice (see Special Condition S2.B below for details). The 30-day public comment period required by WAC 173-226-130(5) begins on the publication date of the second public notice. Unless Ecology responds to the complete application in writing, based on public comments, or any other relevant factors, coverage under the general permit will automatically commence on the thirty-first day following receipt by Ecology of a completed NOI, or the issuance date of this permit, whichever is later, unless Ecology specifies a later date in writing.

   c. Applicants who propose to discharge to a storm or sewer system operated by Seattle, King County, Snohomish County, Tacoma, Pierce County, or Clark County must also submit a copy of the NOI to the appropriate jurisdiction.

   d. If an applicant intends to use a Best Management Practice (BMP) selected on the basis of Special Condition S9.C.4 (“demonstrably equivalent” BMPs), the applicant must notify Ecology of its selection as part of the NOI. In the event the applicant selects BMPs after submission of the NOI, it must provide notice of the selection of an equivalent BMP to Ecology at least 60 days before intended use of the equivalent BMP.

   e. Permittees must notify Ecology regarding any changes to the information provided on the NOI by submitting an updated NOI. Examples of such changes include, but are not limited to,

      i. changes to the Permittee’s mailing address,

      ii. changes to the on-site contact person information, and

    iii. changes to the area/acreage affected by construction activity.

2. Transfer of Coverage Form

   The Permittee can transfer current coverage under this permit to one or more new operators, including operators of sites within a Common Plan of Development, provided the Permittee submits a Transfer of Coverage Form in accordance with General Condition G9. Transfers do not require public notice.

B. Public Notice

For new or previously unpermitted construction activities, the applicant must publish a public notice at least one time each week for two consecutive weeks, at least 7 days apart, in a newspaper with general circulation in the county where the construction is to take place. The notice must contain:

1. A statement that “The applicant is seeking coverage under the Washington State Department of Ecology’s Construction Stormwater NPDES and State Waste Discharge General Permit."

2. The name, address and location of the construction site.

3. The name and address of the applicant.

4. The type of construction activity that will result in a discharge (for example, residential construction, commercial construction, etc.), and the number of acres to be disturbed.

5. The name of the receiving water(s) (that is, the surface water(s) to which the site will discharge), or, if the discharge is through a storm sewer system, the name of the operator of the system.

6. The statement: "Any persons desiring to present their views to the Washington State Department of Ecology regarding this application, or interested in Ecology’s action on this application, may notify Ecology in writing no later than 30 days of the last date of publication of this notice. Ecology reviews public comments and considers whether discharges from this project would cause a measurable change in receiving water quality, and, if so, whether the project is necessary and in the overriding public interest according to Tier II antidegradation requirements under WAC 173-201A-320. Comments can be submitted to: Department of Ecology, P.O. Box 47696, Olympia, WA 98504-7696 Attn: Water Quality Program, Construction Stormwater.”

C. Erosivity Waiver

Construction site operators may qualify for an erosivity waiver from the CSWGP if the following conditions are met:

1. The site will result in the disturbance of fewer than 5 acres and the site is not a portion of a common plan of development or sale that will disturb 5 acres or greater.

2. Calculation of Erosivity “R” Factor and Regional Timeframe:

    a. The project’s rainfall erosivity factor (“R” Factor) must be less than 5 during the period of construction activity, as calculated using either the Texas A&M University online rainfall erosivity calculator at: http://ei.tamu.edu/ or EPA's calculator at http://cfpub.epa.gov/npdes/stormwater/lew/lewcalculator.cfm. The period of construction activity starts when the land is first disturbed and ends with final stabilization. In addition:

    b. The entire period of construction activity must fall within the following timeframes:

        i. For sites west of the Cascades Crest: June 15 – September 15.

        ii. For sites east of the Cascades Crest, excluding the Central Basin: June 15 – October 15.

        iii. For sites east of the Cascades Crest, within the Central Basin: no additional timeframe restrictions apply. The Central Basin is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches. For a map of the Central Basin (Region 2), refer to http://www.ecy.wa.gov/pubs/ecy070202.pdf.

3. Construction site operators must submit a complete Erosivity Waiver certification form at least one week before disturbing the land. Certification must include statements that the operator will:

    a. Comply with applicable local stormwater requirements; and

    b. Implement appropriate erosion and sediment control BMPs to prevent violations of water quality standards.

4. This waiver is not available for facilities declared significant contributors of pollutants as defined in Special Condition S1.B.1.b.

5. This waiver does not apply to construction activities which include non-stormwater discharges listed in Special Condition S1.C.3.

6. If construction activity extends beyond the certified waiver period for any reason, the operator must either:

    a. Recalculate the rainfall erosivity “R” factor using the original start date and a new projected ending date and, if the “R” factor is still under 5 and the entire project falls within the applicable regional timeframe in Special Condition S2.C.2.b, complete and submit an amended waiver certification form before the original waiver expires; or

b. Submit a complete permit application to Ecology in accordance with Special Condition S2.A and B before the end of the certified waiver period.

S3. COMPLIANCE WITH STANDARDS

A. Discharges must not cause or contribute to a violation of surface water quality standards (Chapter 173-201A WAC), ground water quality standards (Chapter 173-200 WAC), sediment management standards (Chapter 173-204 WAC), and human health-based criteria in the National Toxics Rule (40 CFR Part 131.36). Discharges not in compliance with these standards are not authorized.

B. Prior to the discharge of stormwater and non-stormwater to waters of the State, the Permittee must apply all known, available, and reasonable methods of prevention, control, and treatment (AKART). This includes the preparation and implementation of an adequate Stormwater Pollution Prevention Plan (SWPPP), with all appropriate BMPs installed and maintained in accordance with the SWPPP and the terms and conditions of this permit.

C. Ecology presumes that a Permittee complies with water quality standards unless discharge monitoring data or other site-specific information demonstrates that a discharge causes or contributes to a violation of water quality standards, when the Permittee complies with the following conditions. The Permittee must fully:

1. Comply with all permit conditions, including planning, sampling, monitoring, reporting, and recordkeeping conditions.

2. Implement stormwater BMPs contained in stormwater management manuals published or approved by Ecology, or BMPs that are demonstrably equivalent to BMPs contained in stormwater technical manuals published or approved by Ecology, including the proper selection, implementation, and maintenance of all applicable and appropriate BMPs for on-site pollution control. (For purposes of this section, the stormwater manuals listed in Appendix 10 of the Phase I Municipal Stormwater Permit are approved by Ecology.)

D. Where construction sites also discharge to ground water, the ground water discharges must also meet the terms and conditions of this CSWGP. Permittees who discharge to ground water through an injection well must also comply with any applicable requirements of the Underground Injection Control (UIC) regulations, Chapter 173-218 WAC.

S4. MONITORING REQUIREMENTS, BENCHMARKS AND REPORTING TRIGGERS

Table 3. Summary of Primary Monitoring Requirements

Size of Soil Disturbance[1]	Weekly Site Inspections	Weekly Sampling w/ Turbidity Meter	Weekly Sampling w/ Transparency Tube	Weekly pH Sampling[2]	Requires CESCL Certification?
Sites that disturb less than 1 acre, but are part of a larger Common Plan of Development	Required	Not Required	Not Required	Not Required	No
Sites that disturb 1 acre or more, but fewer than 5 acres	Required	Sampling Required – either method[3]		Required	Yes
Sites that disturb 5 acres or more	Required	Required	Not Required[4]	Required	Yes

A. Site Log Book

The Permittee must maintain a site log book that contains a record of the implementation of the SWPPP and other permit requirements, including the installation and maintenance of BMPs, site inspections, and stormwater monitoring.

B. Site Inspections

The Permittee's (operator's) site inspections must include all areas disturbed by construction activities, all BMPs, and all stormwater discharge points. (See Special Conditions S4.B.3 and B.4 below for detailed requirements of the Permittee's Certified Erosion and Sediment Control Lead [CESCL]).

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[1] Soil disturbance is calculated by adding together all areas affected by construction activity. Construction activity means clearing, grading, excavation, and any other activity that disturbs the surface of the land, including ingress/egress from the site.

[2] If construction activity results in the disturbance of 1 acre or more, and involves significant concrete work (1,000 cubic yards of poured or recycled concrete over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer stormwater collection system that drains to other surface waters of the State, the Permittee must conduct pH monitoring sampling in accordance with Special Condition S4.D.

[3] Sites with one or more acres, but fewer than 5 acres of soil disturbance, must conduct turbidity or transparency sampling in accordance with Special Condition S4.C.

[4] Sites equal to or greater than 5 acres of soil disturbance must conduct turbidity sampling using a turbidity meter in accordance with Special Condition S4.C.

Construction sites one acre or larger that discharge stormwater to surface waters of the State must have site inspections conducted by a certified CESCL. Sites less than one acre may have a person without CESCL certification conduct inspections; sampling is not required on sites that disturb less than an acre.

1. The Permittee must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. The Permittee must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.

   Based on the results of the inspection, the Permittee must correct the problems identified by:

   a. Reviewing the SWPPP for compliance with Special Condition S9 and making appropriate revisions within 7 days of the inspection.

   b. Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period.

   c. Documenting BMP implementation and maintenance in the site log book.

2. The Permittee must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The Permittee may reduce the inspection frequency for temporarily stabilized, inactive sites to once every calendar month.

3. The Permittee must have staff knowledgeable in the principles and practices of erosion and sediment control. The CESCL (sites one acre or more) or inspector (sites less than one acre) must have the skills to assess the:

   a. Site conditions and construction activities that could impact the quality of stormwater, and

   b. Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.

4. The SWPPP must identify the CESCL or inspector, who must be present on site or on-call at all times. The CESCL must obtain this certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (see BMP C160 in the manual referred to in Special Condition S9.C.1 and 2).

5. The Permittee must summarize the results of each inspection in an inspection report or checklist and enter the report/checklist into, or attach it to, the site log book. At a minimum, each inspection report or checklist must include:
    a. Inspection date and time.
    b. Weather information, the general conditions during inspection and the approximate amount of precipitation since the last inspection, and precipitation within the last 24 hours.
    c. A summary or list of all implemented BMPs, including observations of all erosion/sediment control structures or practices.
    d. A description of the locations:
        i. Of BMPs inspected.
        ii. Of BMPs that need maintenance and why.
        iii. Of BMPs that failed to operate as designed or intended, and
        iv. Where additional or different BMPs are needed, and why.
    e. A description of stormwater discharged from the site. The Permittee must note the presence of suspended sediment, turbidity, discoloration, and oil sheen, as applicable.
    f. Any water quality monitoring performed during inspection.
    g. General comments and notes, including a brief description of any BMP repairs, maintenance or installations made following the inspection.
    h. A summary report and a schedule of implementation of the remedial actions that the Permittee plans to take if the site inspection indicates that the site is out of compliance. The remedial actions taken must meet the requirements of the SWPPP and the permit.
    i. The name, title, and signature of the person conducting the site inspection, a phone number or other reliable method to reach this person, and the following statement: "I certify that this report is true, accurate, and complete to the best of my knowledge and belief."

C. <u>Turbidity/Transparency Sampling Requirements</u>

1. Sampling Methods
    a. If construction activity involves the disturbance of 5 acres or more, the Permittee must conduct turbidity sampling per Special Condition S4.C.
    b. If construction activity involves 1 acre or more but fewer than 5 acres of soil disturbance, the Permittee must conduct either transparency sampling **or** turbidity sampling per Special Condition S4.C.

2. Sampling Frequency

   a. The Permittee must sample all discharge locations at least once every calendar week when stormwater (or authorized non-stormwater) discharges from the site or enters any on-site surface waters of the state (for example, a creek running through a site).

   b. Samples must be representative of the flow and characteristics of the discharge.

   c. Sampling is not required when there is no discharge during a calendar week.

   d. Sampling is not required outside of normal working hours or during unsafe conditions.

   e. If the Permittee is unable to sample during a monitoring period, the Permittee must include a brief explanation in the monthly Discharge Monitoring Report (DMR).

   f. Sampling is not required before construction activity begins.

3. Sampling Locations

   a. Sampling is required at all points where stormwater associated with construction activity (or authorized non-stormwater) is discharged off site, including where it enters any on-site surface waters of the state (for example, a creek running through a site).

   b. The Permittee may discontinue sampling at discharge points that drain areas of the project that are fully stabilized to prevent erosion.

   c. The Permittee must identify all sampling point(s) on the SWPPP site map and clearly mark these points in the field with a flag, tape, stake or other visible marker.

   d. Sampling is not required for discharge that is sent directly to sanitary or combined sewer systems.

4. Sampling and Analysis Methods

   a. The Permittee performs turbidity analysis with a calibrated turbidity meter (turbidimeter) either on site or at an accredited lab. The Permittee must record the results in the site log book in nephelometric turbidity units (NTU).

   b. The Permittee performs transparency analysis on site with a 1¾-inch-diameter, 60-centimeter (cm)-long transparency tube. The Permittee will record the results in the site log book in centimeters (cm). Transparency tubes are available from: http://watermonitoringequip.com/pages/stream.html.

Table 4. Monitoring and Reporting Requirements

Parameter	Unit	Analytical Method	Sampling Frequency	Benchmark Value	Phone Reporting Trigger Value
Turbidity	NTU	SM2130 or EPA 180.1	Weekly, if discharging	25 NTU	250 NTU
Transparency	cm	Manufacturer instructions, or Ecology guidance	Weekly, if discharging	33 cm	6 cm

5. Turbidity/Transparency Benchmark Values and Reporting Triggers

The benchmark value for turbidity is 25 NTU or less. The benchmark value for transparency is 33 centimeters (cm). Note: Benchmark values do not apply to discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus; these discharges are subject to a numeric effluent limit for turbidity. Refer to Special Condition S8 for more information.

a. Turbidity 26 – 249 NTU, or Transparency 32 – 7 cm:

If the discharge turbidity is 26 to 249 NTU; or if discharge transparency is less than 33 cm, but equal to or greater than 6 cm, the Permittee must:

i. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.

ii. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.

iii. Document BMP implementation and maintenance in the site log book.

b. Turbidity 250 NTU or greater, or Transparency 6 cm or less:

If a discharge point's turbidity is 250 NTU or greater, or if discharge transparency is less than or equal to 6 cm, the Permittee must complete the reporting and adaptive management process described below.

i. Telephone the applicable Ecology Region's Environmental Report Tracking System (ERTS) number within 24 hours, in accordance with Special Condition S5.F.

- Central Region (Okanogan, Chelan, Douglas, Kittitas, Yakima, Klickitat, Benton): (509) 575-2490

- Eastern Region (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman): (509) 329-3400

- Northwest Region (Kitsap, Snohomish, Island, King, San Juan, Skagit, Whatcom): (425) 649-7000

- Southwest Region (Grays Harbor, Lewis, Mason, Thurston, Pierce, Clark, Cowlitz, Skamania, Wahkiakum, Clallam, Jefferson, Pacific): (360) 407-6300

These numbers are also listed at the following web site: http://www.ecy.wa.gov/programs/wq/stormwater/construction/permit.html

ii. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the date the discharge exceeded the benchmark.

iii. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems within 10 days of the date the discharge exceeded the benchmark. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when the Permittee requests an extension within the initial 10-day response period.

iv. Document BMP implementation and maintenance in the site log book.

v. Continue to sample discharges daily until:

a) Turbidity is 25 NTU (or lower); or

b) Transparency is 33 cm (or greater); or

c) The Permittee has demonstrated compliance with the water quality limit for turbidity:

1) No more than 5 NTU over background turbidity, if background is less than 50 NTU, or

2) No more than 10% over background turbidity, if background is 50 NTU or greater; or

d) The discharge stops or is eliminated.

D. pH Sampling Requirements -- Significant Concrete Work or Engineered Soils

If construction activity results in the disturbance of 1 acre or more, **and** involves significant concrete work (significant concrete work means greater than 1000 cubic yards poured concrete or recycled concrete used over the life of a project) or the use of engineered soils (soil amendments including but not limited to Portland cement-treated base [CTB], cement kiln dust [CKD], or fly ash), and stormwater from the affected area drains to surface waters of the State or to a storm sewer system that drains to surface waters of the state, the Permittee must conduct pH monitoring as set forth below. Note: In addition, discharges to segments of water bodies on Washington State's 303(d) list (Category 5) for high pH are subject to a numeric effluent limit for pH; refer to Special Condition S8.

1. For sites with significant concrete work, the Permittee must begin the pH monitoring period when the concrete is first poured and exposed to precipitation, and continue weekly throughout and after the concrete pour and curing period, until stormwater pH is in the range of 6.5 to 8.5 (su).
2. For sites with engineered soils, the Permittee must begin the pH monitoring period when the soil amendments are first exposed to precipitation and must continue until the area of engineered soils is fully stabilized.
3. During the applicable pH monitoring period defined above, the Permittee must obtain a representative sample of stormwater and conduct pH analysis at least once per week.
4. The Permittee must monitor pH in the sediment trap/pond(s) or other locations that receive stormwater runoff from the area of significant concrete work or engineered soils before the stormwater discharges to surface waters.
5. The benchmark value for pH is 8.5 standard units. Anytime sampling indicates that pH is 8.5 or greater, the Permittee must either:
    a. Prevent the high pH water (8.5 or above) from entering storm sewer systems or surface waters; or
    b. If necessary, adjust or neutralize the high pH water until it is in the range of pH 6.5 to 8.5 (su) using an appropriate treatment BMP such as carbon dioxide (CO_2) sparging or dry ice. The Permittee must obtain written approval from Ecology before using any form of chemical treatment other than CO_2 sparging or dry ice.
6. The Permittee must perform pH analysis on site with a calibrated pH meter, pH test kit, or wide range pH indicator paper. The Permittee must record pH monitoring results in the site log book.

S5. REPORTING AND RECORDKEEPING REQUIREMENTS

A. High Turbidity Phone Reporting

Anytime sampling performed in accordance with Special Condition S4.C indicates turbidity has reached the 250 NTU phone reporting level, the Permittee must call Ecology's Regional office by phone within 24 hours of analysis. The web site is http://www.ecy.wa.gov/programs/wq/stormwater/construction/permit.html. Also see phone numbers in Special Condition S4.C.5.b.i.

B. Discharge Monitoring Reports

Permittees required to conduct water quality sampling in accordance with Special Conditions S4.C (Turbidity/Transparency), S4.D (pH), S8 (303[d]/TMDL sampling), and/or G13 (Additional Sampling) must submit the results to Ecology.

Permittees must submit monitoring data using Ecology's WebDMR program. To find out more information and to sign up for WebDMR go to: http://www.ecy.wa.gov/programs/wq/permits/paris/webdmr.html.

Permittees unable to submit electronically (for example, those who do not have an internet connection) must contact Ecology to request a waiver and obtain instructions on how to obtain a paper copy DMR at:

Mailing Address:
Department of Ecology
Water Quality Program
Attn: Stormwater Compliance Specialist
PO Box 47696
Olympia, WA 98504-7696

Permittees who obtain a waiver not to use WebDMR must use the forms provided to them by Ecology; submittals must be mailed to the address above. Permittees shall submit DMR forms to be received by Ecology within 15 days following the end of each month.

If there was no discharge during a given monitoring period, all Permittees must submit a DMR as required with “no discharge" entered in place of the monitoring results. For more information, contact Ecology staff using information provided at the following web site: http://www.ecy.wa.gov/programs/spills/response/assistancesoil%20map.pdf

C. Records Retention

The Permittee must retain records of all monitoring information (site log book, sampling results, inspection reports/checklists, etc.), Stormwater Pollution Prevention Plan, and any other documentation of compliance with permit requirements for the entire life of the construction project and for a minimum of three years following the termination of permit coverage. Such information must include all calibration and maintenance records, and records of all data used to complete the application for this permit. This period of retention must be extended during the course of any unresolved litigation regarding the discharge of pollutants by the Permittee or when requested by Ecology.

D. Recording Results

For each measurement or sample taken, the Permittee must record the following information:

1. Date, place, method, and time of sampling or measurement.
2. The first and last name of the individual who performed the sampling or measurement.
3. The date(s) the analyses were performed.
4. The first and last name of the individual who performed the analyses.
5. The analytical techniques or methods used.
6. The results of all analyses.

E. Additional Monitoring by the Permittee

If the Permittee monitors any pollutant more frequently than required by this permit using test procedures specified by Special Condition S4 of this permit, the results of this monitoring must be included in the calculation and reporting of the data submitted in the Permittee's DMR.

F. Noncompliance Notification

In the event the Permittee is unable to comply with any part of the terms and conditions of this permit, and the resulting noncompliance may cause a threat to human health or the environment, the Permittee must:

1. Immediately notify Ecology of the failure to comply by calling the applicable Regional office ERTS phone number (find at http://www.ecy.wa.gov/programs/spills/response/assistancesoil%20map.pdf) or refer to Special Condition S4.C.5.b.i.
2. Immediately take action to prevent the discharge/pollution, or otherwise stop or correct the noncompliance, and, if applicable, repeat sampling and analysis of any noncompliance immediately and submit the results to Ecology within five (5) days of becoming aware of the violation.
3. Submit a detailed written report to Ecology within five (5) days, unless requested earlier by Ecology. The report must contain a description of the noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

The Permittee must report any unanticipated bypass and/or upset that exceeds any effluent limit in the permit in accordance with the 24-hour reporting requirement contained in 40 C.F.R. 122.41(l)(6)).

Compliance with these requirements does not relieve the Permittee from responsibility to maintain continuous compliance with the terms and conditions of this permit or the resulting liability for failure to comply. Refer to Section G14 of this permit for specific information regarding non-compliance.

G. Access to Plans and Records

1. The Permittee must retain the following permit documentation (plans and records) on site, or within reasonable access to the site, for use by the operator or for on-site review by Ecology or the local jurisdiction:

   a. General Permit.

   b. Permit Coverage Letter.

   c. Stormwater Pollution Prevention Plan (SWPPP).

   d. Site Log Book.

2. The Permittee must address written requests for plans and records listed above (Special Condition S5.G.1) as follows:

   a. The Permittee must provide a copy of plans and records to Ecology within 14 days of receipt of a written request from Ecology.

   b. The Permittee must provide a copy of plans and records to the public when requested in writing. Upon receiving a written request from the public for the Permittee's plans and records, the Permittee must either:

      i. Provide a copy of the plans and records to the requester within 14 days of a receipt of the written request; or

      ii. Notify the requester within 10 days of receipt of the written request of the location and times within normal business hours when the plans and records may be viewed; and provide access to the plans and records within 14 days of receipt of the written request; or

      Within 14 days of receipt of the written request, the Permittee may submit a copy of the plans and records to Ecology for viewing and/or copying by the requester at an Ecology office, or a mutually agreed location. If plans and records are viewed and/or copied at a location other than at an Ecology office, the Permittee will provide reasonable access to copying services for which a reasonable fee may be charged. The Permittee must notify the requester within 10 days of receipt of the request where the plans and records may be viewed and/or copied.

S6. PERMIT FEES

The Permittee must pay permit fees assessed by Ecology. Fees for stormwater discharges covered under this permit are established by Chapter 173-224 WAC. Ecology continues to assess permit fees until the permit is terminated in accordance with Special Condition S10 or revoked in accordance with General Condition G5.

S7. SOLID AND LIQUID WASTE DISPOSAL

The Permittee must handle and dispose of solid and liquid wastes generated by construction activity, such as demolition debris, construction materials, contaminated materials, and waste materials from maintenance activities, including liquids and solids from cleaning catch basins and other stormwater facilities, in accordance with:

A. Special Condition S3, Compliance with Standards.

B. WAC 173-216-110.

C. Other applicable regulations.

S8. DISCHARGES TO 303(D) OR TMDL WATER BODIES

A. Sampling and Numeric Effluent Limits For Certain Discharges to 303(d)-listed Water Bodies

1. Permittees who discharge to segments of water bodies listed as impaired by the State of Washington under Section 303(d) of the Clean Water Act for turbidity, fine sediment, high pH, or phosphorus, must conduct water quality sampling according to the requirements of this section, and Special Conditions S4.C.2.b-f and S4.C.3.b-d, and must comply with the applicable numeric effluent limitations in S8.C and S8.D.

2. All references and requirements associated with Section 303(d) of the Clean Water Act mean the most current listing by Ecology of impaired waters (Category 5) that exists on January 1, 2011, or the date when the operator’s complete permit application is received by Ecology, whichever is later.

B. Limits on Coverage for New Discharges to TMDL or 303(d)-listed Waters

Operators of construction sites that discharge to a 303(d)-listed water body are not eligible for coverage under this permit *unless* the operator:

1. Prevents exposing stormwater to pollutants for which the water body is impaired, and retains documentation in the SWPPP that details procedures taken to prevent exposure on site; or

2. Documents that the pollutants for which the water body is impaired are not present at the site, and retains documentation of this finding within the SWPPP; or

3. Provides Ecology with data indicating the discharge is not expected to cause or contribute to an exceedance of a water quality standard, and retains such data on site with the SWPPP. The operator must provide data and other technical information to Ecology that sufficiently demonstrate:

    a. For discharges to waters without an EPA-approved or -established TMDL, that the discharge of the pollutant for which the water is impaired will meet in-stream water quality criteria at the point of discharge to the water body; or

    b. For discharges to waters with an EPA-approved or -established TMDL, that there is sufficient remaining wasteload allocation in the TMDL to allow construction stormwater discharge and that existing dischargers to the water body are subject to compliance schedules designed to bring the water body into attainment with water quality standards.

    Operators of construction sites are eligible for coverage under this permit if Ecology issues permit coverage based upon an affirmative determination that the discharge will not cause or contribute to the existing impairment.

C. Sampling and Numeric Effluent Limits for Discharges to Water Bodies on the 303(d) List for Turbidity, Fine Sediment, or Phosphorus

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for turbidity, fine sediment, or phosphorus must conduct turbidity sampling in accordance with Special Condition S4.C.2 and comply with either of the numeric effluent limits noted in Table 5 below.

2. As an alternative to the 25 NTU effluent limit noted in Table 5 below (applied at the point where stormwater [or authorized non-stormwater] is discharged off-site), permittees may choose to comply with the surface water quality standard for turbidity. The standard is: no more than 5 NTU over background turbidity when the background turbidity is 50 NTU or less, or no more than a 10% increase in turbidity when the background turbidity is more than 50 NTU. In order to use the water quality standard requirement, the sampling must take place at the following locations:

    a. Background turbidity in the 303(d)-listed receiving water immediately upstream (upgradient) or outside the area of influence of the discharge.

    b. Turbidity at the point of discharge into the 303(d)-listed receiving water, inside the area of influence of the discharge**.**

3. Discharges that exceed the numeric effluent limit for turbidity constitute a violation of this permit.

4. Permittees whose discharges exceed the numeric effluent limit shall sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

Table 5. Turbidity, Fine Sediment & Phosphorus Sampling and Limits for 303(d)-Listed Waters

Parameter identified in 303(d) listing	Parameter Sampled	Unit	Analytical Method	Sampling Frequency	Numeric Effluent Limit[1]
• Turbidity • Fine Sediment • Phosphorus	Turbidity	NTU	SM2130 or EPA180.1	Weekly, if discharging	25 NTU, at the point where stormwater is discharged from the site; OR In compliance with the surface water quality standard for turbidity (S8.C.1.a)

[1] Permittees subject to a numeric effluent limit for turbidity may, at their discretion, choose either numeric effluent limitation based on site-specific considerations including, but not limited to, safety, access and convenience.

D. Discharges to Water Bodies on the 303(d) List for High pH

1. Permittees who discharge to segments of water bodies on the 303(d) list (Category 5) for high pH must conduct pH sampling in accordance with the table below, and comply with the numeric effluent limit of pH 6.5 to 8.5 su (Table 6).

Table 6. pH Sampling and Limits for 303(d)-Listed Waters

Parameter identified in 303(d) listing	Parameter Sampled/Units	Analytical Method	Sampling Frequency	Numeric Effluent Limit
High pH	pH /Standard Units	pH meter	Weekly, if discharging	In the range of 6.5 – 8.5

2. At the Permittee's discretion, compliance with the limit shall be assessed at one of the following locations:
    a. Directly in the 303(d)-listed water body segment, inside the immediate area of influence of the discharge; or
    b. Alternatively, the permittee may measure pH at the point where the discharge leaves the construction site, rather than in the receiving water.

3. Discharges that exceed the numeric effluent limit for pH (outside the range of 6.5 – 8.5 su) constitute a violation of this permit.

4. Permittees whose discharges exceed the numeric effluent limit shall sample discharges daily until the violation is corrected and comply with the non-compliance notification requirements in Special Condition S5.F.

E. Sampling and Limits for Sites Discharging to Waters Covered by a TMDL or Another Pollution Control Plan

1. Discharges to a water body that is subject to a Total Maximum Daily Load (TMDL) for turbidity, fine sediment, high pH, or phosphorus must be consistent with the TMDL. Refer to http://www.ecy.wa.gov/programs/wq/tmdl/index.html for more information on TMDLs.

    a. Where an applicable TMDL sets specific waste load allocations or requirements for discharges covered by this permit, discharges must be consistent with any specific waste load allocations or requirements established by the applicable TMDL.

        i. The Permittee must sample discharges weekly or as otherwise specified by the TMDL to evaluate compliance with the specific waste load allocations or requirements.

        ii. Analytical methods used to meet the monitoring requirements must conform to the latest revision of the Guidelines Establishing Test Procedures for the Analysis of Pollutants contained in 40 CFR Part 136. Turbidity and pH methods need not be accredited or registered unless conducted at a laboratory which must otherwise be accredited or registered.

    b. Where an applicable TMDL has established a general waste load allocation for construction stormwater discharges, but has not identified specific requirements, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.

    c. Where an applicable TMDL has not specified a waste load allocation for construction stormwater discharges, but has not excluded these discharges, compliance with Special Conditions S4 (Monitoring) and S9 (SWPPPs) will constitute compliance with the approved TMDL.

    d. Where an applicable TMDL specifically precludes or prohibits discharges from construction activity, the operator is not eligible for coverage under this permit.

2. Applicable TMDL means a TMDL for turbidity, fine sediment, high pH, or phosphorus that is completed and approved by EPA before January 1, 2011, or before the date the operator's complete permit application is received by Ecology, whichever is later. TMDLs completed after the operator's complete permit application is received by Ecology become applicable to the Permittee only if they are imposed through an administrative order by Ecology, or through a modification of permit coverage.

S9. STORMWATER POLLUTION PREVENTION PLAN

The Permittee must prepare and properly implement an adequate Stormwater Pollution Prevention Plan (SWPPP) for construction activity in accordance with the requirements of this permit beginning with initial soil disturbance and until final stabilization.

A. The Permittee's SWPPP must meet the following objectives:

1. To implement best management practices (BMPs) to prevent erosion and sedimentation, and to identify, reduce, eliminate or prevent stormwater contamination and water pollution from construction activity.

2. To prevent violations of surface water quality, ground water quality, or sediment management standards.

3. To control peak volumetric flow rates and velocities of stormwater discharges.

B. General Requirements

1. The SWPPP must include a narrative and drawings. All BMPs must be clearly referenced in the narrative and marked on the drawings. The SWPPP narrative must include documentation to explain and justify the pollution prevention decisions made for the project. Documentation must include:

   a. Information about existing site conditions (topography, drainage, soils, vegetation, etc.).

   b. Potential erosion problem areas.

   c. The 12 elements of a SWPPP in Special Condition S9.D.1-12, including BMPs used to address each element.

   d. Construction phasing/sequence and general BMP implementation schedule.

   e. The actions to be taken if BMP performance goals are not achieved—for example, a contingency plan for additional treatment and/or storage of stormwater that would violate the water quality standards if discharged.

   f. Engineering calculations for ponds and any other designed structures.

2. The Permittee must modify the SWPPP if, during inspections or investigations conducted by the owner/operator, or the applicable local or state regulatory authority, it is determined that the SWPPP is, or would be, ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The Permittee must then:

   a. Review the SWPPP for compliance with Special Condition S9 and make appropriate revisions within 7 days of the inspection or investigation.

   b. Immediately begin the process to fully implement and maintain appropriate source control and/or treatment BMPs as soon as possible, addressing the problems no later than 10 days from the inspection or investigation. If installation of necessary treatment BMPs is not feasible within 10 days, Ecology may approve additional time when an extension is requested by a Permittee within the initial 10-day response period,

c. Document BMP implementation and maintenance in the site log book.

The Permittee must modify the SWPPP whenever there is a change in design, construction, operation, or maintenance at the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the State.

C. Stormwater Best Management Practices (BMPs)

BMPs must be consistent with:

1. Stormwater Management Manual for Western Washington (most recent edition), for sites west of the crest of the Cascade Mountains; or
2. Stormwater Management Manual for Eastern Washington (most recent edition), for sites east of the crest of the Cascade Mountains; or
3. Revisions to the manuals listed in Special Condition S9.C.1. & 2., or other stormwater management guidance documents or manuals which provide an equivalent level of pollution prevention, that are approved by Ecology and incorporated into this permit in accordance with the permit modification requirements of WAC 173-226-230; or
4. Documentation in the SWPPP that the BMPs selected provide an equivalent level of pollution prevention, compared to the applicable Stormwater Management Manuals, including:
    a. The technical basis for the selection of all stormwater BMPs (scientific, technical studies, and/or modeling) that support the performance claims for the BMPs being selected.
    b. An assessment of how the selected BMP will satisfy AKART requirements and the applicable federal technology-based treatment requirements under 40 CFR part 125.3.

D. SWPPP – Narrative Contents and Requirements

The Permittee must include each of the 12 elements below in Special Condition S9.D.1-12 in the narrative of the SWPPP and implement them unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the SWPPP.

1. Preserve Vegetation/Mark Clearing Limits
    a. Before beginning land-disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.

b. Retain the duff layer, native top soil, and natural vegetation in an undisturbed state to the maximum degree practicable.

2. Establish Construction Access

   a. Limit construction vehicle access and exit to one route, if possible.

   b. Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking sediment onto roads.

   c. Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.

   d. If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pickup and transport of the sediment to a controlled sediment disposal area.

   e. Conduct street washing only after sediment removal in accordance with Special Condition S9.D.2.d. Control street wash wastewater by pumping back on site or otherwise preventing it from discharging into systems tributary to waters of the State.

3. Control Flow Rates

   a. Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site, as required by local plan approval authority.

   b. Where necessary to comply with Special Condition S9.D.3.a, construct stormwater retention or detention facilities as one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (for example, impervious surfaces).

   c. If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.

4. Install Sediment Controls

   The Permittee must design, install and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants. At a minimum, the Permittee must design, install and maintain such controls to:

   a. Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs must be functional before other land disturbing activities take place.

   b. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.

c. Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Special Condition S9.D.3.a.

d. Locate BMPs intended to trap sediment on site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.

e. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.

f. Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

5. Stabilize Soils

a. The Permittee must stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include, but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base on areas to be paved, and dust control.

b. The Permittee must control stormwater volume and velocity within the site to minimize soil erosion.

c. The Permittee must control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.

d. Depending on the geographic location of the project, the Permittee must not allow soils to remain exposed and unworked for more than the time periods set forth below to prevent erosion:

West of the Cascade Mountains Crest
During the dry season (May 1 - Sept. 30): 7 days
During the wet season (October 1 - April 30): 2 days

East of the Cascade Mountains Crest, except for Central Basin*
During the dry season (July 1 - September 30): 10 days
During the wet season (October 1 - June 30): 5 days

The Central Basin*, East of the Cascade Mountains Crest

During the dry Season (July 1 - September 30): 30 days
During the wet season (October 1 - June 30): 15 days

*Note: The Central Basin is defined as the portions of Eastern Washington with mean annual precipitation of less than 12 inches.

e. The Permittee must stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.

f. The Permittee must stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways, and drainage channels.

g. The Permittee must minimize the amount of soil exposed during construction activity.

h. The Permittee must minimize the disturbance of steep slopes.

i. The Permittee must minimize soil compaction and, unless infeasible, preserve topsoil.

6. Protect Slopes

   a. The Permittee must design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).

   b. The Permittee must divert off-site stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes, and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.

   c. At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.

      i. West of the Cascade Mountains Crest: Temporary pipe slope drains must handle the peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate predicted by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the Western Washington Hydrology Model (WWHM) to predict flows, bare soil areas should be modeled as "landscaped area.”

        ii. East of the Cascade Mountains Crest: Temporary pipe slope drains must handle the expected peak flow velocity from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.

    d. Place excavated material on the uphill side of trenches, consistent with safety and space considerations.

    e. Place check dams at regular intervals within constructed channels that are cut down a slope.

7. Protect Drain Inlets

    a. Protect all storm drain inlets made operable during construction so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.

    b. Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

8. Stabilize Channels and Outlets

    a. Design, construct and stabilize all on-site conveyance channels to prevent erosion from the following expected peak flows:

        i. West of the Cascade Mountains Crest: Channels must handle the peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour frequency storm for the developed condition. Alternatively, the 10-year, 1-hour flow rate indicated by an approved continuous runoff model, increased by a factor of 1.6, may be used. The hydrologic analysis must use the existing land cover condition for predicting flow rates from tributary areas outside the project limits. For tributary areas on the project site, the analysis must use the temporary or permanent project land cover condition, whichever will produce the highest flow rates. If using the WWHM to predict flows, bare soil areas should be modeled as "landscaped area."

        ii. East of the Cascade Mountains Crest: Channels must handle the expected peak flow velocity from a 6-month, 3-hour storm for the developed condition, referred to as the short duration storm.

    b. Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches at the outlets of all conveyance systems.

9. Control Pollutants

    Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants. The Permittee must:

a. Handle and dispose of all pollutants, including waste materials and demolition debris that occur on site in a manner that does not cause contamination of stormwater.

b. Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest tank within the containment structure. Double-walled tanks do not require additional secondary containment.

c. Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.

d. Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland land application, or to the sanitary sewer with local sewer district approval.

e. Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.

f. Use BMPs to prevent contamination of stormwater runoff by pH-modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters. (Also refer to the definition for "concrete wastewater" in Appendix A--Definitions.)

g. Adjust the pH of stormwater if necessary to prevent violations of water quality standards.

h. Assure that washout of concrete trucks is performed offsite or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.

i. Obtain written approval from Ecology before using chemical treatment other than CO_2 or dry ice to adjust pH.

10. Control Dewatering

a. Permittees must discharge foundation, vault, and trench dewatering water, which have characteristics similar to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.

b. Permittees may discharge clean, non-turbid dewatering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Special Condition S9.D.8, provided the dewatering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.

c. Other treatment or disposal options may include:

   i. Infiltration.

   ii. Transport off site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.

   iii. Ecology-approved on-site chemical treatment or other suitable treatment technologies.

   iv. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.

   v. Use of a sedimentation bag with discharge to a ditch or swale for small volumes of localized dewatering.

d. Permittees must handle highly turbid or contaminated dewatering water separately from stormwater.

11. Maintain BMPs

   a. Permittees must maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.

   b. Permittees must remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

12. Manage the Project

   a. Phase development projects to the maximum degree practicable and take into account seasonal work limitations.

   b. Inspection and monitoring -- Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Conduct site inspections and monitoring in accordance with Special Condition S4.

   c. Maintaining an updated construction SWPPP -- Maintain, update, and implement the SWPPP in accordance with Special Conditions S3, S4 and S9.

E. SWPPP – Map Contents and Requirements

The Permittee's SWPPP must also include a vicinity map or general location map (for example, a USGS quadrangle map, a portion of a county or city map, or other appropriate map) with enough detail to identify the location of the construction site and receiving waters within one mile of the site.

The SWPPP must also include a legible site map (or maps) showing the entire construction site. The following features must be identified, unless not applicable due to site conditions:

1. The direction of north, property lines, and existing structures and roads.
2. Cut and fill slopes indicating the top and bottom of slope catch lines.
3. Approximate slopes, contours, and direction of stormwater flow before and after major grading activities.
4. Areas of soil disturbance and areas that will not be disturbed.
5. Locations of structural and nonstructural controls (BMPs) identified in the SWPPP.
6. Locations of off-site material, stockpiles, waste storage, borrow areas, and vehicle/equipment storage areas.
7. Locations of all surface water bodies, including wetlands.
8. Locations where stormwater or non-stormwater discharges off-site and/or to a surface water body, including wetlands.
9. Location of water quality sampling station(s), if sampling is required by state or local permitting authority.
10. Areas where final stabilization has been accomplished and no further construction-phase permit requirements apply.

S10. NOTICE OF TERMINATION

A. The site is eligible for termination of coverage when it has met any of the following conditions:

1. The site has undergone final stabilization, the Permittee has removed all temporary BMPs (except biodegradable BMPs clearly manufactured with the intention for the material to be left in place and not interfere with maintenance or land use), and all stormwater discharges associated with construction activity have been eliminated; or
2. All portions of the site that have not undergone final stabilization per Special Condition S10.A.1 have been sold and/or transferred (per General Condition G9), and the Permittee no longer has operational control of the construction activity; or

3. For residential construction only, the Permittee has completed temporary stabilization and the homeowners have taken possession of the residences.

B. When the site is eligible for termination, the Permittee must submit a complete and accurate Notice of Termination (NOT) form, signed in accordance with General Condition G2, to:

Department of Ecology
Water Quality Program - Construction Stormwater
PO Box 47696
Olympia, Washington 98504-7696

The termination is effective on the date Ecology receives the NOT form, unless Ecology notifies the Permittee within 30 days that termination request is denied because the Permittee has not met the eligibility requirements in Special Condition S10.A.

Permittees transferring the property to a new property owner or operator/permittee are required to complete and submit the Notice of Transfer form to Ecology, but are not required to submit a Notice of Termination form for this type of transaction.

GENERAL CONDITIONS

G1. DISCHARGE VIOLATIONS

All discharges and activities authorized by this general permit must be consistent with the terms and conditions of this general permit. Any discharge of any pollutant more frequent than or at a level in excess of that identified and authorized by the general permit must constitute a violation of the terms and conditions of this permit.

G2. SIGNATORY REQUIREMENTS

A. All permit applications must bear a certification of correctness to be signed:

   1. In the case of corporations, by a responsible corporate officer of at least the level of vice president of a corporation;

   2. In the case of a partnership, by a general partner of a partnership;

   3. In the case of sole proprietorship, by the proprietor; or

   4. In the case of a municipal, state, or other public facility, by either a principal executive officer or ranking elected official.

B. All reports required by this permit and other information requested by Ecology must be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   1. The authorization is made in writing by a person described above and submitted to the Ecology.

   2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters.

C. Changes to authorization. If an authorization under paragraph G2.B.2 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph G2.B.2 above must be submitted to Ecology prior to or together with any reports, information, or applications to be signed by an authorized representative.

D. Certification. Any person signing a document under this section must make the following certification:

   "I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

G3. RIGHT OF INSPECTION AND ENTRY

The Permittee must allow an authorized representative of Ecology, upon the presentation of credentials and such other documents as may be required by law:

A. To enter upon the premises where a discharge is located or where any records are kept under the terms and conditions of this permit.

B. To have access to and copy – at reasonable times and at reasonable cost -- any records required to be kept under the terms and conditions of this permit.

C. To inspect -- at reasonable times – any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required under this permit.

D. To sample or monitor – at reasonable times – any substances or parameters at any location for purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act.

G4. GENERAL PERMIT MODIFICATION AND REVOCATION

This permit may be modified, revoked and reissued, or terminated in accordance with the provisions of Chapter 173-226 WAC. Grounds for modification, revocation and reissuance, or termination include, but are not limited to, the following:

A. When a change occurs in the technology or practices for control or abatement of pollutants applicable to the category of dischargers covered under this permit.

B. When effluent limitation guidelines or standards are promulgated pursuant to the CWA or Chapter 90.48 RCW, for the category of dischargers covered under this permit.

C. When a water quality management plan containing requirements applicable to the category of dischargers covered under this permit is approved, or

D. When information is obtained that indicates cumulative effects on the environment from dischargers covered under this permit are unacceptable.

G5. REVOCATION OF COVERAGE UNDER THE PERMIT

Pursuant to Chapter 43.21B RCW and Chapter 173-226 WAC, the Director may terminate coverage for any discharger under this permit for cause. Cases where coverage may be terminated include, but are not limited to, the following:

A. Violation of any term or condition of this permit.

B. Obtaining coverage under this permit by misrepresentation or failure to disclose fully all relevant facts.

C. A change in any condition that requires either a temporary or permanent reduction or elimination of the permitted discharge.

D. Failure or refusal of the Permittee to allow entry as required in RCW 90.48.090.

E. A determination that the permitted activity endangers human health or the environment, or contributes to water quality standards violations.

F. Nonpayment of permit fees or penalties assessed pursuant to RCW 90.48.465 and Chapter 173-224 WAC.

G. Failure of the Permittee to satisfy the public notice requirements of WAC 173-226-130(5), when applicable.

The Director may require any discharger under this permit to apply for and obtain coverage under an individual permit or another more specific general permit. Permittees who have their coverage revoked for cause according to WAC 173-226-240 may request temporary coverage under this permit during the time an individual permit is being developed, provided the request is made within ninety (90) days from the time of revocation and is submitted along with a complete individual permit application form.

G6. REPORTING A CAUSE FOR MODIFICATION

The Permittee must submit a new application, or a supplement to the previous application, whenever a material change to the construction activity or in the quantity or type of discharge is anticipated which is not specifically authorized by this permit. This application must be submitted at least sixty (60) days prior to any proposed changes. Filing a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not relieve the Permittee of the duty to comply with the existing permit until it is modified or reissued.

G7. COMPLIANCE WITH OTHER LAWS AND STATUTES

Nothing in this permit will be construed as excusing the Permittee from compliance with any applicable federal, state, or local statutes, ordinances, or regulations.

G8. DUTY TO REAPPLY

The Permittee must apply for permit renewal at least 180 days prior to the specified expiration date of this permit.

G9. TRANSFER OF GENERAL PERMIT COVERAGE

Coverage under this general permit is automatically transferred to a new discharger, including operators of lots/parcels within a common plan of development or sale, **if**:

A. A written agreement (Transfer of Coverage Form) between the current discharger (Permittee) and new discharger, signed by both parties and containing a specific date for transfer of permit responsibility, coverage, and liability is submitted to the Director; and

B. The Director does not notify the current discharger and new discharger of the Director's intent to revoke coverage under the general permit. If this notice is not given, the transfer is effective on the date specified in the written agreement.

When a current discharger (Permittee) transfers a portion of a permitted site, the current discharger must also submit an updated application form (NOI) to the Director indicating the remaining permitted acreage after the transfer.

G10. REMOVED SUBSTANCES

The Permittee must not re-suspend or reintroduce collected screenings, grit, solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of stormwater to the final effluent stream for discharge to state waters.

G11. DUTY TO PROVIDE INFORMATION

The Permittee must submit to Ecology, within a reasonable time, all information that Ecology may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. The Permittee must also submit to Ecology, upon request, copies of records required to be kept by this permit [40 CFR 122.41(h)].

G12. OTHER REQUIREMENTS OF 40 CFR

All other requirements of 40 CFR 122.41 and 122.42 are incorporated in this permit by reference.

G13. ADDITIONAL MONITORING

Ecology may establish specific monitoring requirements in addition to those contained in this permit by administrative order or permit modification.

G14. PENALTIES FOR VIOLATING PERMIT CONDITIONS

Any person who is found guilty of willfully violating the terms and conditions of this permit shall be deemed guilty of a crime, and upon conviction thereof shall be punished by a fine of up to ten thousand dollars ($10,000) and costs of prosecution, or by imprisonment in the discretion of the court. Each day upon which a willful violation occurs may be deemed a separate and additional violation.

Any person who violates the terms and conditions of a waste discharge permit shall incur, in addition to any other penalty as provided by law, a civil penalty in the amount of up to ten thousand dollars ($10,000) for every such violation. Each and every such violation shall be a separate and distinct offense, and in case of a continuing violation, every day's continuance shall be deemed to be a separate and distinct violation.

G15. UPSET

Definition – "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of the following paragraph are met.

A Permittee who wishes to establish the affirmative defense of upset must demonstrate, through properly signed, contemporaneous operating logs or other relevant evidence that: 1) an upset occurred and that the Permittee can identify the cause(s) of the upset; 2) the permitted facility was being properly operated at the time of the upset; 3) the Permittee submitted notice of the upset as required in Special Condition S5.F, and; 4) the Permittee complied with any remedial measures required under this permit.

In any enforcement proceeding, the Permittee seeking to establish the occurrence of an upset has the burden of proof.

G16. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

G17. DUTY TO COMPLY

The Permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

G18. TOXIC POLLUTANTS

The Permittee must comply with effluent standards or prohibitions established under Section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if this permit has not yet been modified to incorporate the requirement.

G19. PENALTIES FOR TAMPERING

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than two years per violation, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this condition, punishment shall be a fine of not more than $20,000 per day of violation, or imprisonment of not more than four (4) years, or both.

G20. REPORTING PLANNED CHANGES

The Permittee must, as soon as possible, give notice to Ecology of planned physical alterations, modifications or additions to the permitted construction activity. The Permittee should be aware that, depending on the nature and size of the changes to the original permit, a new public notice and other permit process requirements may be required. Changes in activities that require reporting to Ecology include those that will result in:

A. The permitted facility being determined to be a new source pursuant to 40 CFR 122.29(b).

B. A significant change in the nature or an increase in quantity of pollutants discharged, including but not limited to: for sites 5 acres or larger, a 20% or greater increase in acreage disturbed by construction activity.

C. A change in or addition of surface water(s) receiving stormwater or non-stormwater from the construction activity.

D. A change in the construction plans and/or activity that affects the Permittee’s monitoring requirements in Special Condition S4.

Following such notice, permit coverage may be modified, or revoked and reissued pursuant to 40 CFR 122.62(a) to specify and limit any pollutants not previously limited. Until such modification is effective, any new or increased discharge in excess of permit limits or not specifically authorized by this permit constitutes a violation.

G21. REPORTING OTHER INFORMATION

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to Ecology, it must promptly submit such facts or information.

G22. REPORTING ANTICIPATED NON-COMPLIANCE

The Permittee must give advance notice to Ecology by submission of a new application or supplement thereto at least forty-five (45) days prior to commencement of such discharges, of any facility expansions, production increases, or other planned changes, such as process modifications, in the permitted facility or activity which may result in noncompliance with permit limits or conditions. Any maintenance of facilities, which might necessitate unavoidable interruption of operation and degradation of effluent quality, must be scheduled during non-critical water quality periods and carried out in a manner approved by Ecology.

G23. REQUESTS TO BE EXCLUDED FROM COVERAGE UNDER THE PERMIT

Any discharger authorized by this permit may request to be excluded from coverage under the general permit by applying for an individual permit. The discharger must submit to the Director an application as described in WAC 173-220-040 or WAC 173-216-070, whichever is applicable, with reasons supporting the request. These reasons will fully document how an individual permit will apply to the applicant in a way that the general permit cannot. Ecology may make specific requests for information to support the request. The Director will either issue an individual permit or deny the request with a statement explaining the reason for the denial. When an individual permit is issued to a discharger otherwise subject to the construction stormwater general permit, the applicability of the construction stormwater general permit to that Permittee is automatically terminated on the effective date of the individual permit.

G24. APPEALS

A. The terms and conditions of this general permit, as they apply to the appropriate class of dischargers, are subject to appeal by any person within 30 days of issuance of this general permit, in accordance with Chapter 43.21B RCW, and Chapter 173-226 WAC.

B. The terms and conditions of this general permit, as they apply to an individual discharger, are appealable in accordance with Chapter 43.21B RCW within 30 days of the effective date of coverage of that discharger. Consideration of an appeal of general permit coverage of an individual discharger is limited to the general permit's applicability or nonapplicability to that individual discharger.

C. The appeal of general permit coverage of an individual discharger does not affect any other dischargers covered under this general permit. If the terms and conditions of this general permit are found to be inapplicable to any individual discharger(s), the matter shall be remanded to Ecology for consideration of issuance of an individual permit or permits.

G25. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit, or application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

G26. BYPASS PROHIBITED

A. Bypass Procedures

Bypass, which is the intentional diversion of waste streams from any portion of a treatment facility, is prohibited for stormwater events below the design criteria for stormwater management. Ecology may take enforcement action against a Permittee for bypass unless one of the following circumstances (1, 2, 3 or 4) is applicable.

1. Bypass of stormwater is consistent with the design criteria and part of an approved management practice in the applicable stormwater management manual.
2. Bypass for essential maintenance without the potential to cause violation of permit limits or conditions.

   Bypass is authorized if it is for essential maintenance and does not have the potential to cause violations of limitations or other conditions of this permit, or adversely impact public health.
3. Bypass of stormwater is unavoidable, unanticipated, and results in noncompliance of this permit.

   This bypass is permitted only if:

   a. Bypass is unavoidable to prevent loss of life, personal injury, or severe property damage. “Severe property damage” means substantial physical damage to property, damage to the treatment facilities which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass.

   b. There are no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, maintenance during normal periods of equipment downtime (but not if adequate backup equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance), or transport of untreated wastes to another treatment facility.

   c. Ecology is properly notified of the bypass as required in Special Condition S5.F of this permit.

4. A planned action that would cause bypass of stormwater and has the potential to result in noncompliance of this permit during a storm event.

   The Permittee must notify Ecology at least thirty (30) days before the planned date of bypass. The notice must contain:

   a. a description of the bypass and its cause

   b. an analysis of all known alternatives which would eliminate, reduce, or mitigate the need for bypassing.

   c. a cost-effectiveness analysis of alternatives including comparative resource damage assessment.

   d. the minimum and maximum duration of bypass under each alternative.

   e. a recommendation as to the preferred alternative for conducting the bypass.

   f. the projected date of bypass initiation.

   g. a statement of compliance with SEPA.

   h. a request for modification of water quality standards as provided for in WAC 173-201A-110, if an exceedance of any water quality standard is anticipated.

   i. steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

5. For probable construction bypasses, the need to bypass is to be identified as early in the planning process as possible. The analysis required above must be considered during preparation of the Stormwater Pollution Prevention Plan (SWPPP) and must be included to the extent practical. In cases where the probable need to bypass is determined early, continued analysis is necessary up to and including the construction period in an effort to minimize or eliminate the bypass.

   Ecology will consider the following before issuing an administrative order for this type bypass:

   a. If the bypass is necessary to perform construction or maintenance-related activities essential to meet the requirements of this permit.

   b. If there are feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, stopping production, maintenance during normal periods of equipment down time, or transport of untreated wastes to another treatment facility.

   c. If the bypass is planned and scheduled to minimize adverse effects on the public and the environment.

After consideration of the above and the adverse effects of the proposed bypass and any other relevant factors, Ecology will approve, conditionally approve, or deny the request. The public must be notified and given an opportunity to comment on bypass incidents of significant duration, to the extent feasible. Approval of a request to bypass will be by administrative order issued by Ecology under RCW 90.48.120.

B. Duty to Mitigate

The Permittee is required to take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

APPENDIX A – DEFINITIONS

AKART is an acronym for "all known, available, and reasonable methods of prevention, control, and treatment." AKART represents the most current methodology that can be reasonably required for preventing, controlling, or abating the pollutants and controlling pollution associated with a discharge.

Applicable TMDL means a TMDL for turbidity, fine sediment, high pH, or phosphorus, which was completed and approved by EPA before January 1, 2011, or before the date the operator's complete permit application is received by Ecology, whichever is later.

Applicant means an operator seeking coverage under this permit.

Best Management Practices (BMPs) means schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the State. BMPs include treatment systems, operating procedures, and practices to control: stormwater associated with construction activity, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Buffer means an area designated by a local jurisdiction that is contiguous to and intended to protect a sensitive area.

Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

Calendar Day A period of 24 consecutive hours starting at 12:00 midnight and ending the following 12:00 midnight.

Calendar Week (same as Week) means a period of seven consecutive days starting at 12:01 a.m. (0:01 hours) on Sunday.

Certified Erosion and Sediment Control Lead (CESCL) means a person who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by Ecology (see BMP C160 in the SWMM).

Clean Water Act (CWA) means the Federal Water Pollution Control Act enacted by Public Law 92-500, as amended by Public Laws 95-217, 95-576, 96-483, and 97-117; USC 1251 et seq.

Combined Sewer means a sewer which has been designed to serve as a sanitary sewer and a storm sewer, and into which inflow is allowed by local ordinance.

Common Plan of Development or Sale means a site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phased projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used in determining permit requirements.

Composite Sample means a mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increases while maintaining a constant time interval between the aliquots.

Concrete wastewater means any water used in the production, pouring and/or clean-up of concrete or concrete products, and any water used to cut, grind, wash, or otherwise modify concrete or concrete products. Examples include water used for or resulting from concrete truck/mixer/pumper/tool/chute rinsing or washing, concrete saw cutting and surfacing (sawing, coring, grinding, roughening, hydro-demolition, bridge and road surfacing). When stormwater comingles with concrete wastewater, the resulting water is considered concrete wastewater and must be managed to prevent discharge to waters of the state, including ground water.

Construction Activity means land disturbing operations including clearing, grading or excavation which disturbs the surface of the land. Such activities may include road construction, construction of residential houses, office buildings, or industrial buildings, and demolition activity.

Contaminant means any hazardous substance that does not occur naturally or occurs at greater than natural background levels. See definition of “hazardous substance” and WAC 173-340-200.

Demonstrably Equivalent means that the technical basis for the selection of all stormwater BMPs is documented within a SWPPP, including:

1. The method and reasons for choosing the stormwater BMPs selected.
2. The pollutant removal performance expected from the BMPs selected.
3. The technical basis supporting the performance claims for the BMPs selected, including any available data concerning field performance of the BMPs selected.
4. An assessment of how the selected BMPs will comply with state water quality standards.
5. An assessment of how the selected BMPs will satisfy both applicable federal technology-based treatment requirements and state requirements to use all known, available, and reasonable methods of prevention, control, and treatment (AKART).

Department means the Washington State Department of Ecology.

Detention means the temporary storage of stormwater to improve quality and/or to reduce the mass flow rate of discharge.

Dewatering means the act of pumping ground water or stormwater away from an active construction site.

Director means the Director of the Washington Department of Ecology or his/her authorized representative.

Discharger means an owner or operator of any facility or activity subject to regulation under Chapter 90.48 RCW or the Federal Clean Water Act.

Domestic Wastewater means water carrying human wastes, including kitchen, bath, and laundry wastes from residences, buildings, industrial establishments, or other places, together with such ground water infiltration or surface waters as may be present.

Ecology means the Washington State Department of Ecology.

Engineered Soils means the use of soil amendments including, but not limited, to Portland cement treated base (CTB), cement kiln dust (CKD), or fly ash to achieve certain desirable soil characteristics.

Equivalent BMPs means operational, source control, treatment, or innovative BMPs which result in equal or better quality of stormwater discharge to surface water or to ground water than BMPs selected from the SWMM.

Erosion means the wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep.

Erosion and Sediment Control BMPs means BMPs intended to prevent erosion and sedimentation, such as preserving natural vegetation, seeding, mulching and matting, plastic covering, filter fences, sediment traps, and ponds. Erosion and sediment control BMPs are synonymous with stabilization and structural BMPs.

Final Stabilization (same as fully stabilized or full stabilization) means the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as riprap, gabions or geotextiles) which prevents erosion.

Ground Water means water in a saturated zone or stratum beneath the land surface or a surface water body.

Hazardous Substance means any dangerous or extremely hazardous waste as defined in RCW 70.105.010 (5) and (6), or any dangerous or extremely dangerous waste as designated by rule under chapter 70.105 RCW; any hazardous sub-stance as defined in RCW 70.105.010(14) or any hazardous substance as defined by rule under chapter 70.105 RCW; any substance that, on the effective date of this section, is a hazardous substance under section 101(14) of the federal cleanup law, 42 U.S.C., Sec. 9601(14); petroleum or petroleum products; and any substance or category of substances, including solid waste decomposition products, determined by the director by rule to present a threat to human health or the environment if released into the environment. The term hazardous substance does not include any of the following when contained in an underground storage tank from which there is not a release: crude oil or any fraction thereof or petroleum, if the tank is in compliance with all applicable federal, state, and local law.

Injection Well means a well that is used for the subsurface emplacement of fluids. (See Well.)

Jurisdiction means a political unit such as a city, town or county; incorporated for local self-government.

National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Federal Clean Water Act, for the discharge of pollutants to surface waters of the State from point sources. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington Department of Ecology.

Notice of Intent (NOI) means the application for, or a request for coverage under this general permit pursuant to WAC 173-226-200.

Notice of Termination (NOT) means a request for termination of coverage under this general permit as specified by Special Condition S10 of this permit.

Operator means any party associated with a construction project that meets either of the following two criteria:

- The party has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications; or
- The party has day-to-day operational control of those activities at a project that are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

Permittee means individual or entity that receives notice of coverage under this general permit.

pH means a liquid’s measure of acidity or alkalinity. A pH of 7 is defined as neutral. Large variations above or below this value are considered harmful to most aquatic life.

pH monitoring period means the time period in which the pH of stormwater runoff from a site must be tested a minimum of once every seven days to determine if stormwater pH is between 6.5 and 8.5.

Point source means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, and container from which pollutants are or may be discharged to surface waters of the State. This term does not include return flows from irrigated agriculture. (See Fact Sheet for further explanation.)

Pollutant means dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, domestic sewage sludge (biosolids), munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste. This term does not include sewage from vessels within the meaning of section 312 of the CWA, nor does it include dredged or fill material discharged in accordance with a permit issued under section 404 of the CWA.

Pollution means contamination or other alteration of the physical, chemical, or biological properties of waters of the State; including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the State as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare; or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or to livestock, wild animals, birds, fish or other aquatic life.

Process wastewater means any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product (40 CFR 122.1).

Receiving water means the water body at the point of discharge. If the discharge is to a storm sewer system, either surface or subsurface, the receiving water is the water body to which the storm system discharges. Systems designed primarily for other purposes such as for ground water drainage, redirecting stream natural flows, or for conveyance of irrigation water/return flows that coincidentally convey stormwater are considered the receiving water.

Representative means a stormwater or wastewater sample which represents the flow and characteristics of the discharge. Representative samples may be a grab sample, a time-proportionate composite sample, or a flow proportionate sample. Ecology's Construction Stormwater Monitoring Manual provides guidance on representative sampling.

Sanitary sewer means a sewer which is designed to convey domestic wastewater.

Sediment means the fragmented material that originates from the weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

Sedimentation means the depositing or formation of sediment.

Sensitive area means a water body, wetland, stream, aquifer recharge area, or channel migration zone.

SEPA (State Environmental Policy Act) means the Washington State Law, RCW 43.21C.020, intended to prevent or eliminate damage to the environment.

Significant Amount means an amount of a pollutant in a discharge that is amenable to available and reasonable methods of prevention or treatment; or an amount of a pollutant that has a reasonable potential to cause a violation of surface or ground water quality or sediment management standards.

Significant concrete work means greater than 1000 cubic yards poured concrete or recycled concrete over the life of a project.

Significant Contributor of Pollutants means a facility determined by Ecology to be a contributor of a significant amount(s) of a pollutant(s) to waters of the State of Washington.

Site means the land or water area where any "facility or activity" is physically located or conducted.

Source control BMPs means physical, structural or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. A few examples of source control BMPs are erosion control practices, maintenance of stormwater facilities, constructing roofs over storage and working areas, and directing wash water and similar discharges to the sanitary sewer or a dead end sump.

Stabilization means the application of appropriate BMPs to prevent the erosion of soils, such as, temporary and permanent seeding, vegetative covers, mulching and matting, plastic covering and sodding. See also the definition of Erosion and Sediment Control BMPs.

Storm drain means any drain which drains directly into a storm sewer system, usually found along roadways or in parking lots.

Storm sewer system means a means a conveyance, or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains designed or used for collecting or conveying stormwater. This does not include systems which are part of a combined sewer or Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

Stormwater means that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a stormwater drainage system into a defined surface water body, or a constructed infiltration facility.

Stormwater Management Manual (SWMM) or Manual means the technical Manual published by Ecology for use by local governments that contain descriptions of and design criteria for BMPs to prevent, control, or treat pollutants in stormwater.

Stormwater Pollution Prevention Plan (SWPPP) means a documented plan to implement measures to identify, prevent, and control the contamination of point source discharges of stormwater.

Surface Waters of the State includes lakes, rivers, ponds, streams, inland waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Temporary Stabilization means the exposed ground surface has been covered with appropriate materials to provide temporary stabilization of the surface from water or wind erosion. Materials include, but are not limited to, mulch, riprap, erosion control mats or blankets and temporary cover crops. Seeding alone is not considered stabilization. Temporary stabilization is not a substitute for the more permanent “final stabilization.”

Total Maximum Daily Load (TMDL) means a calculation of the maximum amount of a pollutant that a water body can receive and still meet state water quality standards. Percentages of the total maximum daily load are allocated to the various pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL calculations must include a "margin of safety" to ensure that the water body can be protected in case there are unforeseen events or unknown sources of the pollutant. The calculation must also account for seasonable variation in water quality.

Treatment BMPs means BMPs that are intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration, and constructed wetlands.

Transparency means a measurement of water clarity in centimeters (cm), using a 60 cm transparency tube. The transparency tube is used to estimate the relative clarity or transparency of water by noting the depth at which a black and white Secchi disc becomes visible when water is released from a value in the bottom of the tube. A transparency tube is sometimes referred to as a “turbidity tube.”

Turbidity means the clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter.

Uncontaminated means free from any contaminant, as defined in MTCA cleanup regulations. See definition of “contaminant” and WAC 173-340-200.

Waste Load Allocation (WLA) means the portion of a receiving water’s loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality based effluent limitation (40 CFR 130.2[h]).

Water quality means the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose.

Waters of the State includes those waters as defined as "waters of the United States" in 40 CFR Subpart 122.2 within the geographic boundaries of Washington State and "waters of the State" as defined in Chapter 90.48 RCW, which include lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and water courses within the jurisdiction of the state of Washington.

Well means a bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension. (See Injection well.)

Wheel wash wastewater means any water used in, or resulting from the operation of, a tire bath or wheel wash (BMP C106: Wheel Wash), or other structure or practice that uses water to physically remove mud and debris from vehicles leaving a construction site and prevent track-out onto roads. When stormwater comingles with wheel wash wastewater, the resulting water is considered wheel wash wastewater and must be managed according to Special Condition S9.D.9.

APPENDIX B – ACRONYMS

AKART	All Known, Available, and Reasonable Methods of Prevention, Control, and Treatment
BMP	Best Management Practice
CESCL	Certified Erosion and Sediment Control Lead
CFR	Code of Federal Regulations
CKD	Cement Kiln Dust
cm	Centimeters
CTB	Cement-Treated Base
CWA	Clean Water Act
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
ESC	Erosion and Sediment Control
FR	Federal Register
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SWMM	Stormwater Management Manual
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
UIC	Underground Injection Control
USC	United States Code
USEPA	United States Environmental Protection Agency
WAC	Washington Administrative Code
WQ	Water Quality
WWHM	Western Washington Hydrology Model

APPENDIX B

STANDARDS AND SPECIFICATIONS FOR SUGGESTED BMPs

3.1 Source Control BMPs

3.1.1 BMP C101: Preserving Natural Vegetation

Purpose

To reduce erosion. Limiting site disturbance is the single most effective method for reducing erosion. For example, conifers hold up to 50 percent of all rain that falls on them during a storm, with the size of the storm playing a large factor. As much as 30 percent of rain, on average, may never reach the ground but is taken up by the tree or evaporates. The rain held in the tree is released slowly to the ground after the storm. Preserving natural vegetation is an important LID technique. It can help protect water quality and preserve the natural hydrology of a site by maintaining the infiltration capacity of soils, reducing impervious surfaces, and reducing fertilizer and irrigation requirements required to establish new vegetation.

Conditions of Use

- Preserve natural vegetation on steep slopes, near perennial and intermittent watercourses or swales, and on building sites in wooded areas.
- Where established native plants or ground cover are present, or where underlying soils have good infiltrative properties (Natural Resource Conservation Service Hydrologic Group A or B) they should be preserved to the extent possible.
- At a minimum, the applicant shall comply with provisions for native vegetation preservation and/or replacement as set forth in applicable Tumwater Municipal Code including critical areas, zoning, grading and forest practices.

Design and Installation Specifications

Natural vegetation can be preserved in natural clumps or as individual trees, shrubs and vines.

The preservation of individual plants is more difficult because heavy equipment is generally used to remove unwanted vegetation. The points to remember when attempting to save individual plants are:

- Is the plant worth saving? Consider the location, species, size, age, vigor, and the work involved.
- Fence or clearly mark areas around trees to be saved. It is preferable to keep ground disturbance at least outside the tree's dripline.

Take the following steps to protect vegetation during construction:

- Map natural resource protection areas on all plans and delineate these areas on the site with silt, construction, or other appropriate fencing to protect soils and vegetation from construction damage.
- Meet and walk property with equipment operators to clarify construction boundaries and limits of disturbance.
- Protect drainage areas during construction. If an area has any type of channel or drainage swale that provides a hydrologic connection to vegetation protection area(s), the channel must also be protected throughout the construction phase by fencing and erosion control measures to prevent untreated runoff from the construction site to flow into the channel.
- Install signs and fences to identify and protect natural resource protection areas.
- Protect trees and tree root systems using the following methods:

  Reduce soil compaction during the construction phase by protecting critical tree root zones that extend beyond the trees canopy or drip line. Determine the critical tree root zone using the tree's diameter breast height (6-inch diameter breast height = 8-foot radius; 10-inch diameter breast height = 10-foot radius, 30-inch diameter breast height = 45-foot radius) (see Figure 3.1).

  Prohibit excavation within the critical tree root zone.

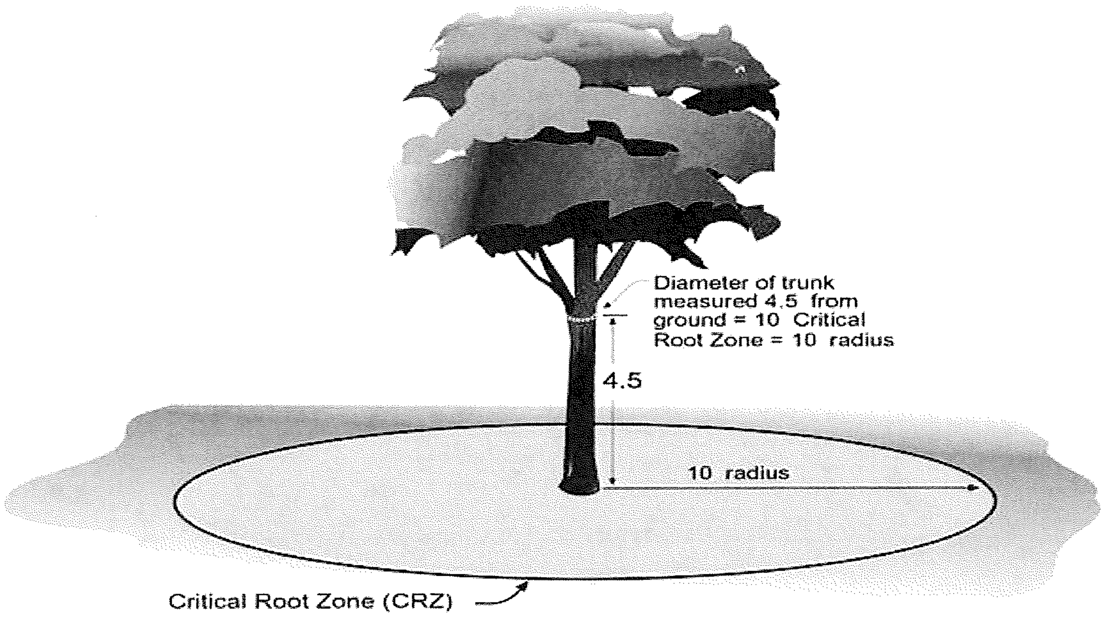
  Prohibit stockpiling or disposal of excavated or construction materials in vegetation retention areas to prevent contaminants from damaging vegetation and soils.

  Avoid excavation or grade changes near trees designated for protection. If raising the grade level around a tree, a dry rock wall or rock well shall be constructed around the tree. The diameter of this wall or well should be at least equal to the diameter of the tree canopy plus 5 feet.

  Restrict trenching in critical tree root zone areas.

  Prevent wounds to tree trunks and limbs during the construction phase.

  Prohibit installation of impervious surfaces in critical root zone areas. Where road or sidewalk surfaces are needed under a tree canopy, use unmortared porous pavers or flagstone (rather than concrete or asphalt) or bridging techniques (see Figure 3.1).



Not to Scale

Figure 3.1. Critical Root Zone (CRZ), in feet.

Prepare tree conservation areas to better withstand the stresses of the construction phase by fertilizing, pruning, and mulching around them well in advance of construction activities.

Problems that can be encountered with a few specific trees include:

- Maple, Dogwood, Red alder, Western hemlock, Western red cedar, and Douglas fir do not readily adjust to changes in environment, so take special care to protect these trees.
- The windthrow hazard of Pacific Silver Fir and Madrona is high, while that of Western hemlock is moderate. The danger of windthrow increases where dense stands have been thinned. Other species (unless they are on shallow, wet soils less than 20 inches deep) have a low windthrow hazard.
- Cottonwoods, maples, and willows have water-seeking roots that can infiltrate and block sewer lines and drain fields. However, these trees thrive in high moisture conditions that other trees would not.
- Thinning operations in pure or mixed stands of Grand Fir, Pacific Silver Fir, Noble Fir, Sitka Spruce, Western Red Cedar, Western Hemlock, Pacific Dogwood, and Red Alder can cause serious disease problems. Disease can become established through damaged limbs, trunks, roots, and freshly cut stumps. Diseased and weakened trees are also susceptible to insect attack.

Maintenance Standards

- Inspect flagged and/or fenced areas regularly to make sure flagging or fencing has not been removed or damaged. If the flagging or fencing has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.
- If tree roots have been exposed or injured, “prune” cleanly with an appropriate pruning saw or lopers directly above the damaged roots and recover with native soils. Treatment of sap flowing trees (fir, hemlock, pine, soft maples) is not advised as sap forms a natural healing barrier.

3.1.4 BMP C103: High Visibility Plastic Fence

Purpose

To: restrict clearing to approved limits, prevent disturbance of sensitive areas and their buffers limit construction traffic to designated construction entrances or roads, and protect areas where survey tape markers may not provide adequate protection.

Conditions of Use

To establish clearing limits plastic fence may be used:

- At the boundary of sensitive areas, their buffers, and other areas required to be left uncleared.
- As necessary to control vehicle access to and on the site.

Design and Installation Specifications

- High visibility plastic fence shall be composed of a high-density polyethylene material and shall be at least 4 feet in height. Posts for the fencing shall be steel or wood and placed every 6 feet on center (maximum) or as needed to ensure rigidity. The fencing shall be fastened to the post every 6 inches with a polyethylene tie. On long continuous lengths of fencing, a tension wire or rope shall be used as a top stringer to prevent sagging between posts. The fence color shall be high visibility orange. The fence tensile strength shall be 360 lbs./ft. using the ASTM D4595 testing method.
- Fences shall not be wired or stapled to trees.

Maintenance Standards

- If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.

3.1.5 BMP C105: Stabilized Construction Entrance

Purpose

To reduce the amount of sediment transported onto paved roads by vehicles or equipment by constructing a stabilized pad of quarry spalls at entrances to construction sites.

Conditions of Use

Construction entrances shall be stabilized wherever traffic will leave a construction site and travel on paved roads or other paved areas within 1,000 feet of the site.

On large commercial, highway, and road projects, the designer should include enough extra materials in the contract to allow for additional stabilized entrances not shown in the initial Construction SWPPP. It is difficult to determine exactly where access to these projects will take place; additional materials will enable the contractor to install them where needed.

Design and Installation Specifications

- See Figure 3.2 for details. Note: the 100 foot minimum length of the entrance shall be reduced to the maximum practicable size when the size or configuration of the site does not allow the full length (100 feet).

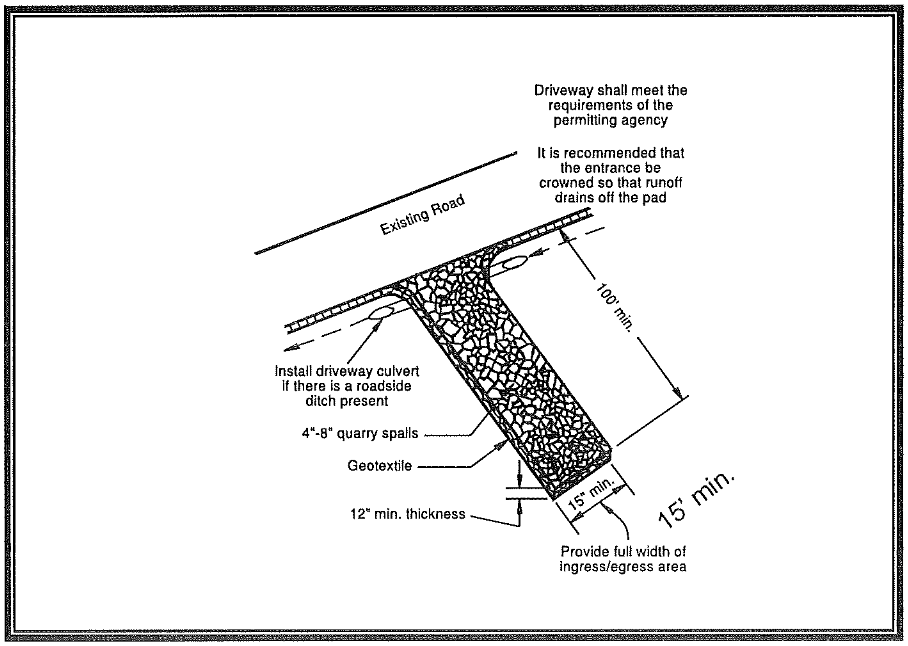


Figure 3.2. Stabilized Construction Entrance.

- A separation geotextile shall be placed under the spalls to prevent fine sediment from pumping up into the rock pad. The geotextile shall meet the following standards:

  Grab Tensile Strength (ASTM D4751): 200 psi min.
  Grab Tensile Elongation (ASTM D4632): 30% max.
  Mullen Burst Strength (ASTM D3786-80a): 400 psi min.
  AOS (ASTM D4751): 20-45 (U.S. standard sieve size).

- Hog fuel (wood-based mulch) may be substituted for (or combined with) quarry spalls in areas that will not be used for permanent roads. Hog fuel is generally less effective at stabilizing construction entrances and should be used only at sites where the traffic is very limited. Hog fuel is not recommended for entrance stabilization in urban areas. The effectiveness of hog fuel is highly variable and usually requires more maintenance than quarry spalls. The inspector may require the use of quarry spalls at any time if the hog fuel is not preventing sediment from being tracked onto pavement, or if hog fuel is being carried onto pavement. Hog fuel is prohibited in permanent roadbeds because organics in the subgrade soils cause degradation of the subgrade support over time.

- Fencing (see BMPs C103) shall be installed as necessary to restrict traffic to the construction entrance.

- Whenever possible, the entrance shall be constructed on a firm, compacted subgrade. This can substantially increase the effectiveness of the pad and reduce the need for maintenance.

Maintenance Standards

- Quarry spalls (or hog fuel) shall be added if the pad is no longer in accordance with the specifications.

- If the entrance is not preventing sediment from being tracked onto pavement, then alternative measures to keep the streets free of sediment shall be used. This may include an increase in the dimensions of the entrance or the installation of a wheel wash.

- Any sediment that is tracked onto pavement shall be removed by shoveling or street sweeping. The sediment collected by sweeping shall be removed or stabilized on site. The pavement shall not be cleaned by washing down the street, except when sweeping is ineffective and there is a threat to public safety. If it is necessary to wash the streets, the construction of a small sump shall be considered. The sediment would then be washed into the sump where it can be controlled.

- Any quarry spalls loosened from the pad that end up on the roadway shall be removed immediately.

- If vehicles are entering or exiting the site at points other than the construction entrance(s), fencing (see BMP C103) shall be installed to control traffic.

- Upon project completion and site stabilization, all construction accesses intended as permanent access for maintenance shall be permanently stabilized.

3.1.6 BMP C106: Wheel Wash

Purpose

To reduce the amount of sediment transported onto paved roads by motor vehicles.

Conditions of Use

When a stabilized construction entrance (see BMP C105) is not preventing sediment from being tracked onto pavement.

- Wheel washing is an effective BMP when installed with careful attention to topography. However, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where water from the dripping truck can run unimpeded into the street, for example.
- Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10-foot x 10-foot sump can be very effective.

Design and Installation Specifications

Suggested details are shown in Figure 3.3. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.

Use a low clearance truck to test wheel wash clearance before paving. Either a belly dump or lowboy will work well.

Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.

Midpoint spray nozzles are only needed in extremely muddy conditions.

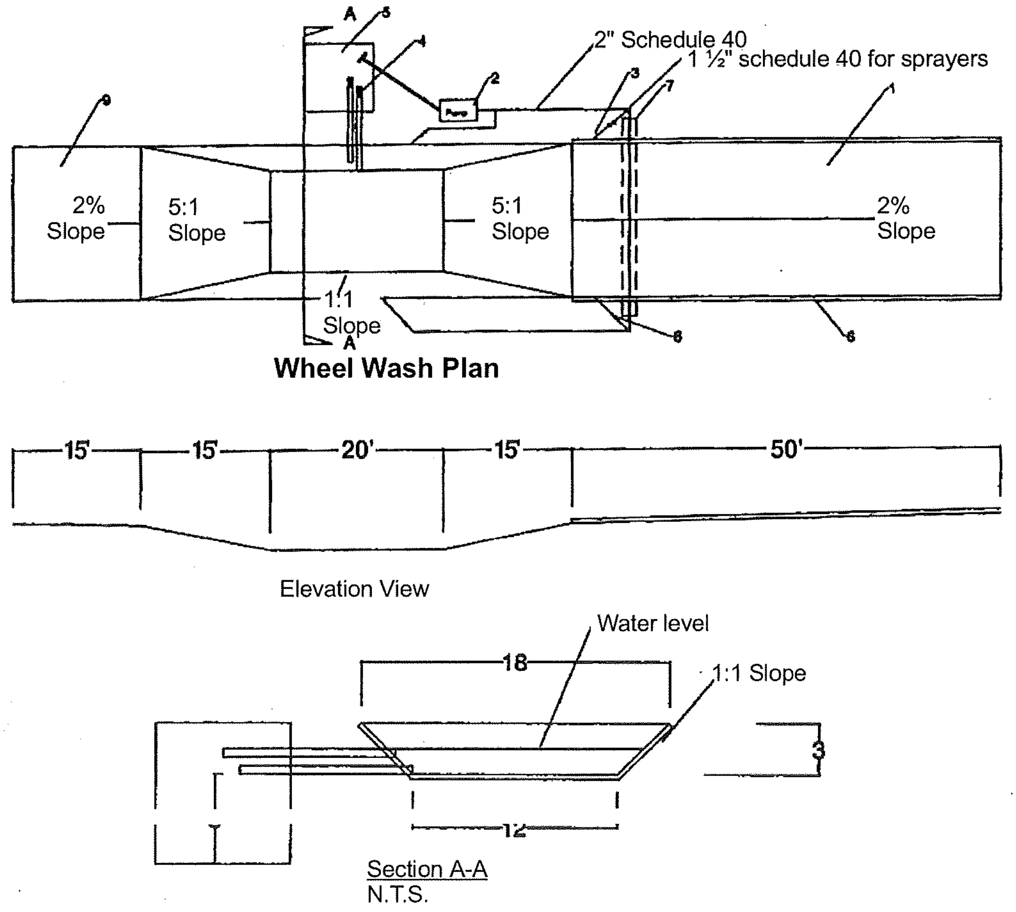
Design wheel wash systems with a small grade change (6 to 12 inches for a 10-foot-wide pond) to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment. Install a drainpipe with a 2- to 3-foot riser on the low side of the pond to allow for easy cleaning and refilling. Polymers may be used to promote coagulation and flocculation in a closed-loop system.

Maintenance Standards

The wheel wash should start each day with fresh water.

Change the wash water a minimum of once per day. On large earthwork jobs where more than 10 to 20 trucks per hour are expected, the wash water will need to be changed more often.

Wheel wash or tire bath wastewater shall be controlled by pumping back on site to an approved infiltration facility, or otherwise must be prevented from discharging into systems tributary to state surface waters. Options include discharge to the sanitary sewer, or discharge to an approved offsite treatment system. For discharges to the sanitary sewer, permits must be obtained from LOTT or local sewer service provider.



Notes:

1. Asphalt construction entrance 6 in. asphalt treated base (ATB).
2. 3-inch trash pump with floats on the suction hose.
3. Midpoint spray nozzles, if needed.
4. 6-inch sewer pipe with butterfly valves. Bottom one is a drain. Locate top pipe's invert 1 foot above bottom of wheel wash.
5. 8 foot x 8 foot sump with 5 feet of catch. Build so can be cleaned with trackhoe.
6. Asphalt curb on the low road side to direct water back to pond.
7. 6-inch sleeve under road.
8. Ball valves.
9. 15 foot. ATB apron to protect ground from splashing water.

Figure 3.3. Wheel Wash.

3.1.8 BMP C120: Temporary and Permanent Seeding

Purpose

To reduce erosion by stabilizing exposed soils. A well-established vegetative cover is one of the most effective methods of reducing erosion.

Conditions of Use

- Seeding shall be used throughout the project on disturbed areas that have reached final grade or that will remain unworked for more than 30 days.
- Install channels that will be vegetated before major earthwork and hydroseed them with a bonded fiber matrix. The vegetation should be well established before water is allowed to flow in the ditch. With channels that will have high flows, install erosion control blankets over the hydroseed. If vegetation cannot be established from seed before water is allowed in the ditch, sod shall be installed in the bottom of the ditch over hydromulch and blankets.
- Retention/detention ponds shall be seeded as required.
- Mulch is required at all times because it protects seeds from heat, moisture loss, and transport due to runoff.
- All disturbed areas shall be reviewed in late August to early September and all seeding should be completed by the end of September. Otherwise, vegetation will not establish itself enough to provide more than average protection.
- At final site stabilization, all disturbed areas not otherwise vegetated or stabilized shall be seeded and mulched. Final stabilization means the completion of all soil disturbing activities at the site and the establishment of a permanent vegetative cover, or equivalent permanent stabilization measures (such as pavement, riprap, gabions or geotextiles) which will prevent erosion.

Design and Installation Specifications

- Seeding should be done during those seasons most conducive to growth and will vary with the climate conditions of the region. Local experience should be used to determine the appropriate seeding periods.
- The optimum seeding windows for western Washington are April 1 through June 30 and September 1 through October 1. Seeding that occurs between July 1 and August 30 requires

irrigation until 75 percent grass cover is established. Seeding that occurs between October 1 and March 30 will require a mulch or plastic cover until 75 percent grass cover is established.

- To prevent seed from being washed away, confirm that all required surface water control measures have been installed.
- The seedbed should be firm and rough. All soil shall be roughened regardless of slope. If compaction is required for engineering purposes, slopes must be track walked before seeding. Backblading or smoothing of slopes greater than 4:1 is not allowed if they are to be seeded.
- New and more effective restoration-based landscape practices rely on deeper incorporation than that provided by a simple single-pass rototilling treatment. Wherever practical, initially rip the subgrade to improve long-term permeability, infiltration, and water inflow qualities. At a minimum, permanent areas shall use soil amendments to achieve organic matter and permeability performance defined in engineered soil/landscape systems. For systems that are deeper than 8 inches, perform the rototilling process in multiple lifts, or the prepared soil system shall be prepared properly and then placed to achieve the specified depth.
- Organic matter is the most appropriate form of "fertilizer" because it provides nutrients (including nitrogen, phosphorus, and potassium) in the least water-soluble form. A natural system typically releases 2 to 10 percent of its nutrients annually. Chemical fertilizers have since been formulated to simulate what organic matter does naturally.
- In general, 10-4-6 N-P-K (nitrogen-phosphorus-potassium) fertilizer can be used at a rate of 90 pounds per acre. Slow-release fertilizers should always be used because they are more efficient and have fewer environmental impacts. It is recommended that areas being seeded for final landscaping conduct soil tests to determine the exact type and quantity of fertilizer needed. This will prevent the over-application of fertilizer. Fertilizer should not be added to the hydromulch machine and agitated more than 20 minutes before it is to be used. If agitated too much, the slow-release coating is destroyed.
- There are numerous products available on the market that take the place of chemical fertilizers. These include several with seaweed extracts that are beneficial to soil microbes and organisms. If 100 percent cottonseed meal is used as the mulch in hydroseed,

chemical fertilizer may not be necessary. Cottonseed meal is a good source of long-term, slow-release, available nitrogen.

- Hydroseed applications shall include a minimum of 1,500 pounds per acre of mulch with 3 percent tackifier, along with the seed and fertilizer. Mulch can be 100 percent cottonseed meal, wood fibers, recycled cellulose, hemp, kenaf, compost, or blends of these. Tackifier shall be plant-based (such as guar or alpha plantago) or chemical-based (such as polyacrylamide or polymers). Any mulch or tackifier product used shall be installed per manufacturer's instructions.

- Mulch is always required for seeding. Mulch can be applied on top of the seed or simultaneously by hydroseeding.

- On steep slopes, use bonded fiber matrix (BFM) or mechanically bonded fiber matrix (MBFM) products. BFM/MBFM products are applied at a minimum rate of 3,000 pounds per acre of mulch with approximately 10 percent tackifier. Application is made so that a minimum of 95 percent soil coverage is achieved. Numerous products are available commercially and should be installed per manufacturer's instructions. Most products require 24 to 36 hours to cure before a rainfall and cannot be installed on wet or saturated soils. Generally, these products come in 40 to 50 pound bags and include all necessary ingredients except for seed and fertilizer.

  BFMs and MBFMs have some advantages over blankets, including:

  No surface preparation required

  Can be installed via helicopter in remote areas

  On slopes steeper than 2.5:1, blanket installers may need to be roped and harnessed for safety

  BFMs and MBFMs are at least $1,000 per acre cheaper to install.

  In most cases, the shear strength of blankets is not a factor when used on slopes, only when used in channels. BFMs and MBFMs are good alternatives to blankets in most situations where vegetation establishment is the goal.

  When installing seed via hydroseeding operations, only about 1/3 of the seed actually ends up in contact with the soil surface. This reduces the ability to establish a good stand of grass quickly. One way to overcome this is to increase seed quantities by up to 50 percent.

Vegetation establishment can also be enhanced by dividing the hydromulch operation into two phases:

Phase 1 – Install all seed and fertilizer with 25 to 30 percent mulch and tackifier onto soil in the first lift;

Phase 2 – Install the rest of the mulch and tackifier over the first lift.

An alternative is to install the mulch, seed, fertilizer, and tackifier in one lift. Then, spread or blow straw over the top of the hydromulch at a rate of about 800 to 1,000 pounds per acre. Hold straw in place with a standard tackifier. Both of these approaches will increase cost moderately but will greatly improve and enhance vegetative establishment. The increased cost may be offset by the reduced need for:

Irrigation
Reapplication of mulch
Repair of failed slope surfaces.

This technique works with standard hydromulch (1,500 pounds per acre minimum) and BFM/MBFMs (3,000 pounds per acre minimum).

- Areas to be permanently landscaped shall provide a healthy topsoil that reduces the need for fertilizers, improves overall topsoil quality, provides for better vegetal health and vitality, improves hydrologic characteristics, and reduces the need for irrigation. This can be accomplished in a number of ways:

Recent research has shown that the best method to improve till soils is to amend these soils with compost. The optimum mixture is approximately two parts soil to one part compost. This equates to 4 inches of compost mixed to a depth of 12 inches in till soils. Increasing the concentration of compost beyond this level can have negative effects on vegetal health, while decreasing the concentrations can reduce the benefits of amended soils. Please note: The compost should meet specifications for Grade A quality compost in Ecology Publication 94-038.

Other soils, such as gravel or cobble outwash soils, may require different approaches. Organics and fines easily migrate through the loose structure of these soils. Therefore, the importation of at least 6 inches of quality topsoil, underlain by some type of filter fabric to prevent the migration of fines, may be more appropriate for these soils.

Areas that already have good topsoil, such as undisturbed areas, do not require soil amendments.

- Areas that will be seeded only and not landscaped may need compost or meal-based mulch included in the hydroseed in order to establish vegetation. Replace native topsoil on the disturbed soil surface before application.
- Seed installed as a temporary measure may be installed by hand if it will be covered by straw, mulch, or topsoil. Seed installed as a permanent measure may be installed by hand on small areas (usually less than 1 acre) that will be covered with mulch, topsoil, or erosion blankets. The seed mixes listed below include recommended mixes for both temporary and permanent seeding. These mixes, with the exception of the wetland mix, shall be applied at a rate of 120 pounds per acre. This rate can be reduced if soil amendments or slow-release fertilizers are used. Consult local suppliers or the local conservation district for recommendations because the appropriate mix depends on a variety of factors, including location, exposure, soil type, slope, and expected foot traffic. Alternative seed mixes approved by the City may be used.

Table 3.1 represents the standard mix for those areas where just a temporary vegetative cover is required.

Table 3.1. Temporary Erosion Control Seed Mix.

	% Weight	% Purity	% Germination
Chewings or annual blue grass *Festuca rubra var. commutata* or *Poa anna*	40	98	90
Perennial rye *Lolium perenne*	50	98	90
Redtop or colonial bentgrass *Agrostis alba* or *Agrostis tenuis*	5	92	85
White dutch clover *Trifolium repens*	5	98	90

Table 3.2 provides just one recommended possibility for landscaping seed.

Table 3.2. Landscaping Seed Mix.

	% Weight	% Purity	% Germination
Perennial rye blend *Lolium perenne*	70	98	90
Chewings and red fescue blend *Festuca rubra var. commutata* or Festuca *rubra*	30	98	90

This turf seed mix in Table 3.3 is for dry situations where there is no need for much water. The advantage is that this mix requires very little maintenance.

Table 3.3. Low-Growing Turf Seed Mix.

	% Weight	% Purity	% Germination
Dwarf tall fescue (several varieties) *Festuca arundinacea var.*	45	98	90
Dwarf perennial rye (Barclay) *Lolium perenne var. barclay*	30	98	90
Red fescue *Festuca rubra*	20	98	90
Colonial bentgrass *Agrostis tenuis*	5	98	90

Table 3.4 presents a mix recommended for bioswales and other intermittently wet areas.

Table 3.4. Bioswale Seed Mix. [a]

	% Weight	% Purity	% Germination
Tall or meadow fescue *Festuca arundinacea* or *Festuca elatior*	75-80	98	90
Seaside/Creeping bentgrass *Agrostis palustris*	10-15	92	85
Redtop bentgrass *Agrostis alba* or *Agrostis gigantea*	5-10	90	80

[a] Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix

The seed mix shown in Table 3.5 is a recommended low-growing, relatively non-invasive seed mix appropriate for very wet areas that are not regulated wetlands. Other mixes may be appropriate, depending on the soil type and hydrology of the area. Recent research suggests that bentgrass (*agrostis* sp.) should be emphasized in wet-area seed mixes. Apply this mixture at a rate of 60 pounds per acre.

Table 3.5. Wet Area Seed Mix. [a]

	% Weight	% Purity	% Germination
Tall or meadow fescue *Festuca arundinacea* or *Festuca elatior*	60-70	98	90
Seaside/Creeping bentgrass *Agrostis palustris*	10-15	98	85
Meadow foxtail *Alepocurus pratensis*	10-15	90	80
Alsike clover *Trifolium hybridum*	1-6	98	90
Redtop bentgrass *Agrostis alba*	1-6	92	85

[a] Modified Briargreen, Inc. Hydroseeding Guide Wetlands Seed Mix

The meadow seed mix in Table 3.6 is recommended for areas that will be maintained infrequently or not at all and where native plant colonization is desired. Likely applications include rural road and utility right-of-way. Seeding should take place in September or very early October in order to obtain adequate establishment prior to the winter months. The appropriateness of clover in the mix may need to be considered, as this can be a fairly invasive species. If the soil is amended, the addition of clover may not be necessary.

Table 3.6. Meadow Seed Mix.

	% Weight	% Purity	% Germination
Redtop or Oregon bentgrass *Agrostis alba* or *Agrostis oregonensis*	20	92	85
Red fescue *Festuca rubra*	70	98	90
White dutch clover *Trifolium repens*	10	98	90

Maintenance Standards

- Any seeded areas that fail to establish at least 80 percent cover (100 percent cover for areas that receive sheet or concentrated flows) shall be reseeded. If reseeding is ineffective, an alternate method, such as sodding, mulching, or nets/blankets shall be used. If winter weather prevents adequate grass growth, this time limit may be relaxed at the discretion of the City when sensitive areas would otherwise be protected.

- After adequate cover is achieved, any areas that experience erosion shall be reseeded and protected by mulch. If the erosion problem is drainage related, the problem shall be fixed and the eroded area reseeded and protected by mulch.
- Seeded areas shall be supplied with adequate moisture, but not to the extent that it causes runoff.

3.1.9 BMP C121: Mulching

Purpose

To provide immediate temporary protection from erosion. Mulch also enhances plant establishment by conserving moisture and holding fertilizer, seed, and topsoil in place, and moderating soil temperatures. There is an enormous variety of mulches, but only the most common types are discussed in this section.

Conditions of Use

As a temporary cover measure, use mulch:

- On disturbed areas that require cover measures for less than 30 days.
- As a cover for seed during the wet season and hot summer months.
- During the wet season on slopes steeper than 3H:1V with more than 10 feet of vertical relief.

Mulch may be applied at any time of the year and must be refreshed periodically.

Design and Installation Specifications

For mulch materials, application rates, and specifications, see Table 3.7. Note: Thicknesses may be increased for disturbed areas in or near sensitive areas or other areas highly susceptible to erosion.

Mulch used within the ordinary high-water mark of surface waters should be selected to minimize potential flotation of organic matter. Composted organic materials have higher specific gravities (densities) than straw, wood, or chipped material.

Maintenance Standards

- The thickness of the cover must be maintained.
- Any areas that experience erosion shall be remulched and/or protected with a net or blanket. If the erosion problem is drainage related, then the problem shall be fixed and the eroded area remulched.

Table 3.7. Mulch Standards and Guidelines.

Mulch Material	Quality Standards	Application Rates	Remarks
Straw	Air-dried; free from undesirable seed and coarse material.	2 to 3 inches thick; 5 bales per 1,000 sf or 2 to 3 tons per acre	Cost-effective when applied with adequate thickness. Hand-application requires greater thickness than blown straw. Straw thickness may be reduced by half when used in conjunction with seeding. In windy areas, straw must be held in place by crimping, using a tackifier, or covering with netting. Blown straw always has to be held in place with a tackifier since light winds will blow it away. Straw, however, has several deficiencies to consider when selecting mulch materials. It often introduces and/or encourages the propagation of weed species and has no significant long-term benefits. Use straw only if mulches with long-term benefits are unavailable. It also should not be used within the ordinary high-water elevation of surface waters (due to flotation).
Hydromulch	No growth inhibiting factors.	Approximately 25 to 30 lbs per 1,000 sf or 1,500 to 2,000 lbs per acre	Shall be applied with hydromulcher. Shall not be used without seed and tackifier unless the application rate is at least doubled. Fibers longer than about 3/4 to 1 inch clog hydromulch equipment. Keep fibers to less than 3/4 inch.
Composted Mulch and Compost	No visible water or dust during handling. Must be purchased from supplier with Solid Waste Handling Permit (unless exempt).	2-inch thick minimum; approximately 100 tons per acre (approximately 800 lbs per yard)	Increase thickness to 3 inches to improve effectiveness. Excellent mulch for protecting final grades until landscaping, because it can be directly seeded or tilled into soil as an amendment. Composted mulch has a coarser size gradation than compost. It is more stable and practical to use in wet areas and during rainy weather conditions.
Chipped Site Vegetation	Average size shall be several inches. Gradations from fines to 6 inches in length for texture, variation, and interlocking properties.	2-inch minimum thickness	A cost-effective way to dispose of debris from clearing and grubbing, and eliminates problems associated with burning. Should not be used on slopes above about 10 percent because of its tendency to be transported by runoff. Not recommended within 200 feet of surface waters. If seeding is expected shortly after mulch, the decomposition of the chipped vegetation may tie up nutrients important to grass establishment.
Wood-based Mulch	No visible water or dust during handling. Must be purchased from a supplier with a Solid Waste Handling Permit or one exempt from solid waste regulations.	2 inches thick; approximately 100 tons per acre (approximately 800 lbs. per cubic yard)	Often called "hog or hogged fuel." It is usable as a material for Stabilized Construction Entrances (BMP C105) and as a mulch. The use of mulch ultimately improves the organic matter in the soil. Special caution is advised regarding the source and composition of wood-based mulches. Its preparation typically does not provide any weed seed control, so evidence of residual vegetation in its composition or known inclusion of weed plants or seeds should be monitored and prevented (or minimized).

3.1.11 BMP C123: Plastic Covering

Purpose

To provide immediate, short-term erosion protection of slopes and disturbed areas.

Conditions of Use

- Plastic covering may be used on disturbed areas that require cover measures for less than 30 days, except as stated below.
- Plastic is particularly useful for protecting cut and fill slopes and stockpiles, but the rapid breakdown of most polyethylene sheeting makes it unsuitable for long-term (greater than 6 months) applications.
- Clear plastic sheeting can be used over newly-seeded areas to create a greenhouse effect and encourage grass growth if the hydroseed was installed too late in the season to establish 75 percent grass cover, or if the wet season started earlier than normal. Clear plastic should not be used for this purpose during the summer months because the resulting high temperatures can kill the grass.
- Due to rapid runoff caused by plastic sheeting, this method shall not be used upslope of areas that might be adversely impacted by concentrated runoff. Such areas include steep and/or unstable slopes.
- Plastic sheeting requires close monitoring and frequent maintenance to ensure proper performance. Water quality standards must be met at all times.
- While plastic is inexpensive to purchase, the added cost of installation, maintenance, removal, and disposal make this an expensive material, up to $1.50-2.00 per square yard.
- Whenever plastic is used to protect slopes, water collection measures must be installed at the base of the slope. These measures include plastic-covered berms, channels, and pipes used to covey clean rainwater away from bare soil and disturbed areas. At no time is clean runoff from a plastic covered slope to be mixed with dirty runoff from a project.
- Other uses for plastic include:

  Temporary ditch liner

  Pond liner in temporary sediment pond

Liner for bermed temporary fuel storage area if plastic is not reactive to the type of fuel being stored

Emergency slope protection during heavy rains

Temporary drainpipe (“elephant trunk”) used to direct water.

Design and Installation Specifications

- Plastic slope cover must be installed as follows:

  Run plastic up and down slope, not across slope

  Plastic may be installed perpendicular to a slope if the slope length is less than 10 feet

  Minimum of 8-inch overlap at seams

  Tape all seams on long or wide slopes, or slopes subject to wind

  Place plastic into a small (12-inch wide by 6-inch deep) slot trench at the top of the slope and backfill with soil to keep water from flowing underneath

  Place sand filled burlap or geotextile bags every 3 to 6 feet along seams and pound a wooden stake through each to hold them in place

  Inspect plastic for rips, tears, and open seams regularly and repair immediately. This prevents high velocity runoff from contacting bare soil which causes extreme erosion.

  Sandbags may be lowered into place tied to ropes. However, all sandbags must be staked in place.

- Plastic sheeting shall have a minimum thickness of 0.06 millimeters.

- If erosion at the toe of a slope is likely, a gravel berm, riprap, or other suitable protection shall be installed at the toe of the slope in order to reduce the velocity of runoff.

Maintenance Standards

- Torn sheets must be replaced and open seams repaired.

- If the plastic begins to deteriorate due to ultraviolet radiation, it must be completely removed and replaced.

- When the plastic is no longer needed, it shall be completely removed.

3.1.12 BMP C124: Sodding

Purpose

To establish permanent turf for immediate erosion protection and stabilize drainage ways where concentrated overland flow will occur.

Conditions of Use

Sodding may be used in the following areas:

- Disturbed areas that require short-term or long-term cover.
- Disturbed areas that require immediate vegetative cover.
- All waterways that require vegetative lining. Waterways may also be seeded rather than sodded, and protected with a net or blanket.

Design and Installation Specifications

Sod shall be free of weeds, of uniform thickness (approximately 1 inch thick), and shall have a dense root mat for mechanical strength.

The following steps are recommended for sod installation:

- Shape and smooth the surface to final grade in accordance with the approved grading plan. The swale needs to be overexcavated 4 to 6 inches below design elevation to allow room for placing soil amendment and sod.
- Amend 4 inches (minimum) of compost into the top 8 inches of the soil if the organic content of the soil is less than ten percent or the permeability is less than 0.6 inches per hour. Compost used should meet Ecology publication 94-038 specifications for Grade A quality compost.
- Fertilize according to the supplier's recommendations.
- Work lime and fertilizer 1 to 2 inches into the soil, and smooth the surface.
- Lay strips of sod beginning at the lowest area to be sodded and perpendicular to the direction of water flow. Wedge strips securely into place. Square the ends of each strip to provide for a close, tight fit. Stagger joints at least 12 inches. Staple on slopes steeper than 3H:1V. Staple the upstream edge of each sod strip.
- Roll the sodded area and irrigate.

- When sodding is carried out in alternating strips or other patterns, seed the areas between the sod immediately after sodding.

Maintenance Standards

If the grass is unhealthy, the cause shall be determined and appropriate action taken to reestablish a healthy groundcover. If it is impossible to establish a healthy groundcover due to frequent saturation, instability, or some other cause, the sod shall be removed, the area seeded with an appropriate mix, and protected with a net or blanket.

3.1.13 BMP C125: Topsoiling

Purpose

To provide a suitable growth medium for final site stabilization with vegetation.

While not a permanent cover practice, topsoiling is an integral component of providing permanent cover in areas with an unsuitable soil surface for plant growth. Native soils and disturbed soils that have been organically amended not only retain much more stormwater, but also serve as effective biofilters for urban pollutants and, by supporting more vigorous plant growth, reduce the water, fertilizer and pesticides needed to support installed landscapes. Topsoil does not include any subsoils but only the material from the top several inches including organic debris.

Conditions of Use

- Leave native soils undisturbed as much as possible. Restore native soils disturbed during clearing and grading as much as possible, to a condition where moisture-holding capacity is equal to or better than the original site conditions. This criterion can be met by using on-site native topsoil, incorporating amendments into on-site soil, or importing blended topsoil.

- Topsoiling is a required procedure when establishing vegetation on shallow soils, and soils of critically low pH (high acid) levels.

- Stripping of existing, properly functioning soil system and vegetation for the purpose of topsoiling during construction is not acceptable. If an existing soil system is functioning properly it shall be preserved in its undisturbed and uncompacted condition.

- Depending on where the topsoil comes from, or what vegetation was on site before disturbance, invasive plant seeds may be included and could cause problems for establishing native plants, landscaped areas, or grasses.

- Topsoil from the site will contain mycorrhizal bacteria that are necessary for healthy root growth and nutrient transfer. These native mycorrhiza are acclimated to the site and will provide optimum conditions for establishing grasses. Use commercially available mycorrhiza products when topsoil is brought in from off-site.

Design and Installation Specifications

If topsoiling is to be done, consider the following:

- Maximize the depth of the topsoil wherever possible to provide the maximum possible infiltration capacity and beneficial growth medium. Topsoil depth shall be at least 8 inches with a minimum organic content of 10 percent dry weight and pH between 6.0 and 8.0 or matching the pH of the undisturbed soil. This can be accomplished either by returning native topsoil to the site and/or incorporating organic amendments. Incorporate organic amendments to a minimum 8-inch depth except where tree roots or other natural features limit the depth of incorporation. Subsoils below the 12-inch depth should be scarified at least 2 inches to avoid stratified layers, where feasible. The decision to either layer topsoil over a subgrade or incorporate topsoil into the underlying layer may vary depending on the planting specified.

- If blended topsoil is imported, then limit fines to 25 percent passing through a 200 sieve.

- The final composition and construction of the soil system will result in a natural selection or favoring of certain plant species over time. For example, recent practices have shown that incorporation of topsoil may favor grasses, while layering with mildly acidic, high-carbon amendments may favor more woody vegetation.

- Locate the topsoil stockpile so that it meets specifications and does not interfere with work on the site. It may be possible to locate more than one pile in proximity to areas where topsoil will be used.

- Allow sufficient time in scheduling for topsoil to be spread prior to seeding, sodding, or planting.

- Care must be taken not to apply to subsoil if the two soils have contrasting textures. Sandy topsoil over clayey subsoil is a particularly poor combination, as water creeps along the junction between the soil layers and causes the topsoil to slough.

- If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method to prevent a lack of bonding is to actually work the topsoil into the layer below for a depth of at least 6 inches.

- Ripping or re-structuring the subgrade may also provide additional benefits regarding the overall infiltration and interflow dynamics of the soil system.

- Field exploration of the site shall be made to determine if there is surface soil of sufficient quantity and quality to justify stripping.

Topsoil shall be friable and loamy (loam, sandy loam, silt loam, sandy clay loam, clay loam). Avoid areas of natural ground water recharge.

- Stripping shall be confined to the immediate construction area. A 4- to 6-inch stripping depth is common, but depth may vary depending on the particular soil. All surface runoff control structures shall be in place prior to stripping.

Stockpiling of topsoil shall occur in the following manner:

- Side slopes of the stockpile shall not exceed 2:1.
- An interceptor dike with gravel outlet and silt fence shall surround all topsoil stockpiles between October 1 and April 30. Between May 1 and September 30, an interceptor dike with gravel outlet and silt fence shall be installed if the stockpile will remain in place for a longer period of time than active construction grading.
- Erosion control seeding or covering with clear plastic or other mulching materials of stockpiles shall be completed within 2 days (October 1 through April 30) or 7 days (May 1 through September 30) of the formation of the stockpile. Native topsoil stockpiles shall not be covered with plastic.
- Topsoil shall not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed sodding or seeding.
- Previously established grades on the areas to be topsoiled shall be maintained according to the approved plan.
- When native topsoil is to be stockpiled and reused the following should apply to ensure that the mycorrhizal bacterial, earthworms, and other beneficial organisms will not be destroyed:

  Topsoil is to be re-installed within 4 to 6 weeks
  Topsoil is not to become saturated with water
  Plastic cover is not allowed.

Maintenance Standards

Inspect stockpiles regularly, especially after large storm events. Stabilize any areas that have eroded.

3.1.14 BMP C126: Polyacrylamide for Soil Erosion Protection

Purpose

A soil binding agent to prevent soil erosion.

Applying Polyacrylamide (PAM) to bare soil in advance of rain significantly reduces erosion and controls sediment in two ways. First, PAM increases the soil's available pore volume, thus increasing infiltration through flocculation and reducing the quantity of stormwater runoff. Second, it increases flocculation of suspended particles and aids in their deposition, thus reducing stormwater runoff turbidity and improving water quality.

Conditions of Use

PAM shall only be applied with approval of the City by means of a variance, and PAM shall not be directly applied to water or allowed to enter a water body. Some PAMs are more toxic and carcinogenic than others. Only the most environmentally safe PAM products should be used, as noted in the following paragraph.

The specific PAM copolymer formulation must be anionic. Cationic PAM shall not be used in any application because of known aquatic toxicity problems. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications. Recent media attention and high interest in PAM has resulted in some entrepreneurial exploitation of the term "polymer." All PAM are polymers, but not all polymers are PAM, and not all PAM products comply with ANSI/NSF Standard 60. PAM use shall be reviewed and approved by the City. The Washington State Department of Transportation (WSDOT) has listed approved PAM products on their web page.

In areas that drain to a sediment pond, PAM can be applied to bare soil under the following conditions:

- During rough grading operations
- Staging areas
- Balanced cut and fill earthwork
- Haul roads prior to placement of crushed rock surfacing
- Compacted soil roadbase
- Stockpiles

- After final grade and before paving or final seeding and planting
- Pit sites
- Sites having a winter shut down. In the case of winter shut down, or where soil will remain unworked for several months, use PAM together with mulch.

Design and Installation Specifications

PAM may be applied in dissolved form with water, or it may be applied in dry, granular or powdered form. The preferred application method is the dissolved form.

PAM is to be applied at a maximum rate of 2/3 pound PAM per 1,000 gallons water (80 mg/L) per 1 acre of bare soil. Table 3.8 can be used to determine the PAM and water application rate for a disturbed soil area. Higher concentrations of PAM **do not** provide any additional effectiveness.

Table 3.8. PAM and Water Application Rates.

Disturbed Area (ac)	PAM (lbs)	Water (gal)
0.50	0.33	500
1.00	0.66	1,000
1.50	1.00	1,500
2.00	1.32	2,000
2.50	1.65	2,500
3.00	2.00	3,000
3.50	2.33	3,500
4.00	2.65	4,000
4.50	3.00	4,500
5.00	3.33	5,000

The Preferred Method:

- Pre-measure the area where PAM is to be applied and calculate the amount of product and water necessary to provide coverage at the specified application rate (2/3 pound PAM/1,000 gallons/acre).
- PAM has high solubility in water, but dissolves very slowly. Dissolve pre-measured dry granular PAM with a known quantity of clean water in a bucket several hours or overnight. Mechanical mixing will help dissolve the PAM. Always add PAM to water - not water to PAM.

- Pre-fill the water truck about 1/8 full with water. The water does not have to be potable, but it must have relatively low turbidity – in the range of 20 NTU or less.
- Add PAM /Water mixture to the truck
- Completely fill the water truck to specified volume.
- Spray PAM/Water mixture onto dry soil until the soil surface is uniformly and completely wetted.

An Alternate Method:

PAM may also be applied as a powder at the rate of 5 lbs. per acre. This must be applied on a day that is dry. For areas less than 5 to 10 acres, a hand-held "organ grinder" fertilizer spreader set to the smallest setting will work. Tractor-mounted spreaders will work for larger areas.

The following shall be used for application of PAM:

- PAM shall be used in conjunction with other BMPs and not in place of other BMPs.
- Do not use PAM on a slope that flows directly into a stream or wetland. The stormwater runoff shall pass through a sediment control BMP prior to discharging to surface waters.
- Do not add PAM to water discharging from site.
- When the total drainage area is greater than or equal to 5 acres, PAM treated areas shall drain to a sediment pond.
- Areas less than 5 acres shall drain to sediment control BMPs, such as a minimum of three check dams per acre. The total number of check dams used shall be maximized to achieve the greatest amount of settlement of sediment prior to discharging from the site. Each check dam shall be spaced evenly in the drainage channel through which stormwater flows are discharged off-site.
- On all sites, the use of silt fence shall be maximized to limit the discharges of sediment from the site.
- All areas not being actively worked shall be covered and protected from rainfall. PAM shall not be the only cover BMP used.
- PAM can be applied to wet soil, but dry soil is preferred due to less sediment loss.

- PAM will work when applied to saturated soil but is not as effective as applications to dry or damp soil.

- Keep the granular PAM supply out of the sun. Granular PAM loses its effectiveness in three months after exposure to sunlight and air.

- Proper application and re-application plans are necessary to ensure total effectiveness of PAM usage.

- PAM, combined with water, is very slippery and can be a safety hazard. Care must be taken to prevent spills of PAM powder onto paved surfaces. During an application of PAM, prevent over-spray from reaching pavement as pavement will become slippery. If PAM powder gets on skin or clothing, wipe it off with a rough towel rather than washing with water-this only makes cleanup messier and take longer.

- PAM designated for these uses should be "water soluble" or "linear" or "non-crosslinked". Cross-linked or water absorbent PAM, polymerized in highly acidic (pH<2) conditions, are used to maintain soil moisture content.

- The PAM anionic charge density may vary from 2 to 30 percent; a value of 18 percent is typical. Studies conducted by the United States Department of Agriculture (USDA)/ARS demonstrated that soil stabilization was optimized by using very high molecular weight (12 to 15 mg/mole), highly anionic (>20 percent hydrolysis) PAM.

- PAM tackifiers are available and being used in place of guar and alpha plantago. Typically, PAM tackifiers should be used at a rate of no more than 0.5 to 1 lb. per 1,000 gallons of water in a hydromulch machine. Some tackifier product instructions say to use at a rate of 3 to 5 lbs. per acre, which can be too much. In addition, pump problems can occur at higher rates due to increased viscosity.

Maintenance Standards

- PAM may be reapplied on actively worked areas after a 48-hour period.

- Reapplication is not required unless PAM treated soil is disturbed or unless turbidity levels show the need for an additional application. If PAM treated soil is left undisturbed a reapplication may be necessary after 2 months. More PAM applications may be required for steep slopes, silty and clayey soils (USDA Classification Type "C" and "D" soils), long grades, and high precipitation areas. When PAM is applied first to bare soil and then covered with straw, a reapplication may not be necessary for several months.

- Loss of sediment and PAM may be a basis for penalties per RCW 90.48.080.

3.1.17 BMP C140: Dust Control

Purpose

To prevent wind transport of dust from disturbed soil surfaces onto roadways, drainage ways, and surface waters.

Conditions of Use

Dust control must be used in areas (including roadways) subject to surface and air movement of dust, where impacts to drainage ways or surface waters are likely.

Design and Installation Specifications

- Vegetate or mulch areas that will not receive vehicle traffic. In areas where planting, mulching, or paving is impractical, apply gravel or landscaping rock.

- Limit dust generation by clearing only those areas where immediate activity will take place, leaving the remaining area(s) in the original condition, if stable. Maintain the original ground cover as long as practical.

- Construct natural or artificial windbreaks or windscreens. These may be designed as enclosures for small dust sources.

- Sprinkle the site with water until surface is wet. Repeat as needed. To prevent carryout of mud onto street, see Stabilized Construction Entrance (BMP C105).

- Irrigation water can be used for dust control. Install irrigation systems as a first step on sites where dust control is a concern.

- Spray exposed soil areas with a dust palliative, following the manufacturer's instructions and cautions regarding handling and application. Oil based products are prohibited from use as a dust suppressant. The City may approve other dust palliatives such as calcium chloride or PAM.

- PAM (BMP C126) added to water at a rate of 0.5 lbs. per 1,000 gallons of water per acre and applied from a water truck is more effective than water alone. This is due to the increased infiltration of water into the soil and reduced evaporation. In addition, small soil particles are bonded together and are not as easily transported by wind. Adding PAM may actually reduce the quantity of water needed for dust control. PAM has also shown to be relatively affordable and thus an extremely cost-effective dust control method.

Techniques that can be used for unpaved roads and lots include:

- Lower speed limits. High vehicle speed increases the amount of dust stirred up from unpaved roads and lots.
- Upgrade the road surface strength by improving particle size, shape, and mineral types that make up the surface and base materials.
- Add surface gravel to reduce the source of dust emission. Limit the amount of fine particles (those smaller than .075 mm) to 10 to 20 percent.
- Use geotextile fabrics to increase the strength of new roads or roads undergoing reconstruction.
- Encourage the use of alternate, paved routes, if available.
- Restrict use by tracked vehicles and heavy trucks to prevent damage to road surface and base.
- Apply chemical dust suppressants using the admix method, blending the product with the top few inches of surface material. Suppressants may also be applied as surface treatments.
- Pave unpaved permanent roads and other trafficked areas.
- Use vacuum street sweepers.
- Remove mud and other dirt promptly so it does not dry and then turn into dust.
- Limit dust-causing work on windy days.
- Contact your local Air Pollution Control Authority for guidance and training on other dust control measures. Compliance with the local Air Pollution Control Authority constitutes compliance with this BMP.

Maintenance Standards

Respray area as necessary to keep dust to a minimum.

3.1.18 BMP C150: Materials on Hand

Purpose

Quantities of erosion prevention and sediment control materials can be kept on the project site at all times for emergency situations such as unexpected heavy summer rains. Having these materials on-site reduces the time needed to implement BMPs when inspections indicate that existing BMPs are not meeting the Construction SWPPP requirements.

Conditions of Use

- Construction projects of any size or type can benefit from having materials on hand. A small commercial development project could have a roll of plastic and some gravel available for immediate protection of bare soil and temporary berm construction. A large earthwork project, such as highway construction, might have several tons of straw, several rolls of plastic, flexible pipe, sandbags, geotextile fabric, and steel "T" posts.

- Materials are stockpiled and readily available before any site clearing, grubbing, or earthwork begins. A large contractor or developer could keep a stockpile of materials that are available to be used on several projects.

- If storage space at the project site is at a premium, the contractor could maintain the materials at their office or yard. The office or yard must be less than an hour from the project site.

Design and Installation Specifications

Depending on project type, size, complexity, and length, materials and quantities will vary. A good minimum that will cover numerous situations includes:

Material	Measure	Quantity
Clear Plastic, 6 mil	100 foot roll	1-2
Drainpipe, 6- or 8-inch diameter	25 foot section	4-6
Sandbags, filled	each	25-50
Straw Bales for mulching,	approx. 50# each	10-20
Quarry Spalls	ton	2-4
Washed Gravel	cubic yard	2-4
Geotextile Fabric	100 foot roll	1-2
Catch Basin Inserts	each	2-4
Steel "T" Posts	each	12-24

Maintenance Standards

- All materials with the exception of the quarry spalls, steel "T" posts, and gravel should be kept covered and out of both sun and rain.

- Re-stock materials used as needed.

3.1.20 BMP C152: Sawcutting and Surfacing Pollution Prevention

Purpose

To minimize and eliminate process water and slurry from entering waters of the State.

Conditions of Use

Anytime sawcutting or surfacing operations take place, these management practices shall be utilized, since sawcutting and surfacing operations generate slurry and process water that contains fine particles and high pH (concrete cutting), both of which can violate the water quality standards in the receiving water. Sawcutting and surfacing operations include, but are not limited to, the following:

- Sawing
- Coring
- Grinding
- Roughening
- Hydro-demolition
- Bridge and road surfacing.

Design and Installation Specifications

- Slurry and cuttings shall be vacuumed during cutting and surfacing operations.

- Slurry and cuttings shall not remain on permanent concrete or asphalt pavement overnight.

- Slurry and cuttings shall not drain to any natural or constructed drainage conveyance.

- Collected slurry and cuttings shall be disposed of in a manner that does not violate groundwater or surface water quality standards.

- Process water that is generated during hydro-demolition, surface roughening or similar operations shall not drain to any natural or constructed drainage conveyance and shall be disposed of in a manner that does not violate groundwater or surface water quality standards.

- Cleaning waste material and demolition debris shall be handled and disposed of in a manner that does not cause contamination of water. If the area is swept with a pick-up sweeper, the material must be hauled out of the area to an appropriate disposal site.

Maintenance Standards

Continually monitor operations to determine whether slurry, cuttings, or process water could enter waters of the state. If inspections show that a violation of water quality standards could occur, stop operations and immediately implement preventive measures such as berms, barriers, secondary containment, and vacuum trucks.

3.1.21 BMP C153: Material Delivery, Storage and Containment

Purpose

To prevent, reduce, or eliminate pollutant discharge from material delivery and storage to the stormwater system or watercourses by minimizing onsite hazardous materials storage, storing materials in a designated area, and installing secondary containment.

Conditions of Use

These procedures are suitable for use at all construction sites with delivery and storage of the following materials:

- Petroleum products such as fuel, oil and grease
- Soil stabilizers and binders (e.g., Polyacrylamide)
- Fertilizers, pesticides and herbicides
- Detergents
- Asphalt and concrete compounds
- Hazardous chemicals such as acids, lime, adhesives, paints, solvents and curing compounds
- Any other material that may be detrimental if released to the environment.

Design and Installation Specifications

To minimize risk, do the following:

- Locate temporary storage area away from vehicular traffic, near the construction entrance(s), and away from waterways or storm drains.
- Supply Material Safety Data Sheets (MSDS) for all stored materials. Chemicals should be kept in their original labeled containers.
- Minimize on-site hazardous material storage.
- Handle hazardous materials as infrequently as possible.
- During the wet weather season (October 1 – April 30), consider storing materials in a covered area.

- Store materials in secondary containments such as earthen dike, a horse trough, or even a children's wading pool for non-reactive materials such as detergents, oil, grease, and paints. Small amounts of material may be secondarily contained in "bus boy" trays or concrete mixing trays.

- Do not store chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and, when possible, in secondary containment.

- If drums must be kept uncovered, store them at a slight angle to reduce ponding of rainwater on the lids to reduce corrosion. Domed plastic covers are inexpensive and snap to the top of drums, preventing water from collecting.

Material Storage Areas and Secondary Containment Practices:

- Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be stored in approved containers and drums and shall not be overfilled. Containers and drums shall be stored in temporary secondary containment facilities.

- Temporary secondary containment facilities shall provide for a spill containment volume able to contain precipitation from a 25-year, 24-hour storm event, <u>plus</u> 10 percent of the total enclosed container volume of all containers, <u>or</u> 110 percent of the capacity of the largest container within its boundary, whichever is greater.

- Secondary containment facilities shall be impervious to the materials stored therein for a minimum contact time of 72 hours.

- Secondary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks, accumulated rainwater and spills shall be collected and placed into drums. These liquids shall be handled as hazardous waste unless testing determines them to be non-hazardous.

- Provide sufficient separation between stored containers to allow for spill cleanup and emergency response access.

- During the wet weather season (October 1 – April 30), each secondary containment facility shall be covered during non-working days, prior to and during rain events.

- Keep material storage areas clean, organized and equipped with an ample supply of appropriate spill clean-up material (spill kit).

- The spill kit should include, at a minimum:

  1-Water Resistant Nylon Bag
  3-Oil Absorbent Socks 3” x 4’
  2-Oil Absorbent Socks 3” x 10’
  12-Oil Absorbent Pads 17” x 19”
  1-Pair Splash Resistant Goggles
  3-Pair Nitrile Gloves
  10-Disposable Bags with Ties
  Instructions.

3.1.22 BMP C160: Certified Erosion and Sediment Control Lead

Purpose

To ensure compliance with all local, state, and federal erosion and sediment control and water quality requirements by designating a Certified Erosion and Sediment Control Lead (CESCL).

Conditions of Use

A CESCL shall be made available on projects disturbing ground 1 acre or larger and that discharge stormwater to surface waters of the state

- The CESCL shall:

  Have a current certificate proving attendance in an erosion and sediment control training course that meets the minimum ESC training and certification requirements established by Ecology (see details below).

  Ecology will maintain a list of ESC training and certification providers at: www.ecy.wa.gov/programs/wq/stormwater.

  OR

  Be a Certified Professional in Erosion and Sediment Control (CPESC); for additional information go to: www.cpesc.net.

Specifications

Certification shall remain valid for 3 years.

- The CESCL shall have authority to act on behalf of the contractor or developer and shall be available, on call, 24 hours per day throughout the period of construction.
- The Construction SWPPP shall include the name, telephone number, fax number, and address of the designated CESCL.
- A CESCL may provide inspection and compliance services for multiple construction projects in the same geographic region.

Duties and responsibilities of the CESCL shall include, but are not limited to the following:

- Maintaining permit file on site at all times which includes the SWPPP and any associated permits and plans.

- Directing BMP installation, inspection, maintenance, modification, and removal.

- Updating all project drawings and the Construction SWPPP with changes made.

- Keeping daily logs, and inspection reports. Inspection reports should include:

  Inspection date/time.

  Weather information; general conditions during inspection and approximate amount of precipitation since the last inspection.

  A summary or list of all BMPs implemented, including observations of all erosion/sediment control structures or practices. The following shall be noted:

    Locations of BMPs inspected

    Locations of BMPs that need maintenance

    Locations of BMPs that failed to operate as designed or intended

    Locations of where additional or different BMPs are required.

  Visual monitoring results, including a description of discharged stormwater. The presence of suspended sediment, turbid water, discoloration, and oil sheen shall be noted, as applicable.

  Any water quality monitoring performed during inspection.

  General comments and notes, including a brief description of any BMP repairs, maintenance or installations made as a result of the inspection.

- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

3.1.24 BMP C162: Scheduling

Purpose

To reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

Conditions of Use

The construction sequence schedule is an orderly listing of all major land-disturbing activities together with the necessary erosion and sedimentation control measures planned for the project. This type of schedule guides the contractor on work to be done before other work is started so that serious erosion and sedimentation problems can be avoided.

Following a specified work schedule that coordinates the timing of land-disturbing activities and the installation of control measures is perhaps the most cost-effective way of controlling erosion during construction. The removal of surface ground cover leaves a site vulnerable to accelerated erosion. Construction procedures that limit land clearing, provide timely installation of erosion and sedimentation controls, and restore protective cover quickly can significantly reduce the erosion potential of a site.

Design Considerations

- Avoid rainy periods.
- Schedule projects to disturb only small portions of the site at any one time. Complete grading as soon as possible. Immediately stabilize the disturbed portion before grading the next portion. Practice staged seeding in order to revegetate cut and fill slopes as the work progresses.

3.1.25 BMP C180: Small Project Construction Stormwater Pollution Prevention

Purpose

To minimize or eliminate the discharge of sediment and other pollutants from small construction projects.

Conditions of Use

On small construction projects, those adding or replacing less than 2,000 square feet of impervious surface or clearing less than 7,000 square feet.

Design and Installation Specifications

- Plan and implement proper clearing and grading of the site. It is most important only to clear the areas needed, thus keeping exposed areas to a minimum. Phase clearing so that only those areas that are actively being worked are uncovered.

  Note: Flag clearing limits in the lot or area prior to initiating clearing.

- Soil shall be managed in a manner that does not permanently compact or deteriorate the final soil and landscape system. If disturbance and/or compaction occur the impact must be corrected at the end of the construction activity. This shall include restoration of soil depth, soil quality, permeability, and percent organic matter. Construction practices must not cause damage to or compromise the design of permanent landscape or infiltration areas.

- Locate excavated basement soil a reasonable distance behind the curb, such as in the backyard or side yard area. This will increase the distance eroded soil must travel to reach the storm sewer system. Cover soil piles until the soil is either used or removed. Locate piles so that sediment does not run into the street or adjoining yards.

- Backfill basement walls as soon as possible and rough grade the lot. This will eliminate large soil mounds, which are highly erodible, and prepares the lot for temporary cover, which will further reduce erosion potential.

- Remove excess soil from the site as soon as possible after backfilling. This will eliminate any sediment loss from surplus fill.

- If a lot has a soil bank higher than the curb, install a trench or berm, moving the bank several feet behind the curb. This will reduce the occurrence of gully and rill erosion while providing a storage and settling area for stormwater.
- Stabilize the construction entrance where traffic will leave the construction site and travel on paved roads or other paved areas within 1,000 feet of the site.
- Provide for periodic street cleaning to remove any sediment that may have been tracked out. Remove sediment by shoveling or sweeping and carefully removed to a suitable disposal area where it will not be re-eroded.
- Utility trenches that run up and down slopes must be backfilled within 7 days. Cross-slope trenches may remain open throughout construction to provide runoff interception and sediment trapping, provided that they do not convey turbid runoff off site.

3.2.3 BMP C202: Channel Lining

Purpose

To protect erodable channels by providing a channel liner using blankets or riprap.

Conditions of Use

Channel lining must be used when natural soils or vegetated stabilized soils in a channel are not adequate to prevent channel erosion.

- When a permanent ditch or pipe system is to be installed and a temporary measure is needed.
- In almost all cases, synthetic and organic coconut blankets are more effective than riprap for protecting channels from erosion. Blankets can be used with and without vegetation. Blanketed channels can be designed to handle any expected flow and longevity requirement. Some synthetic blankets have a predicted life span of 50 years or more, even in sunlight.
- Other reasons why blankets are better than rock include the availability of blankets over rock. In many areas of the state, rock is not easily obtainable or is very expensive to haul to a site. Blankets can be delivered anywhere. Rock requires the use of dump trucks to haul and heavy equipment to place. Blankets usually only require laborers with hand tools, and sometimes a backhoe.
- The Federal Highway Administration recommends not using flexible liners whenever the slope exceeds 10 percent or the shear stress exceeds 8 lbs/ft^2.

Design and Installation Specifications

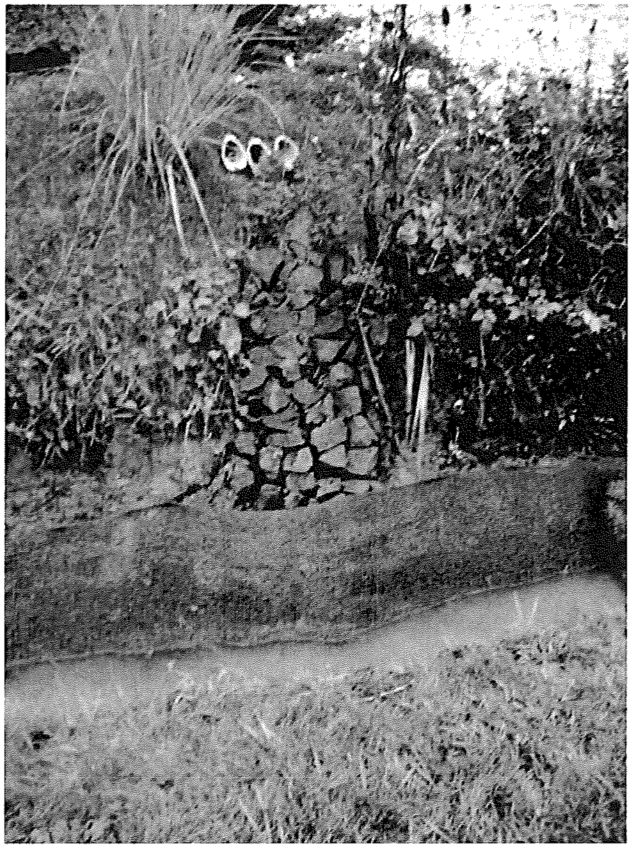
See BMP C122 for information on blankets.

Since riprap is used where erosion potential is high, construction must be sequenced so that the riprap is put in place with the minimum possible delay.

- Disturbance of areas where riprap is to be placed should be undertaken only when final preparation and placement of the riprap can follow immediately behind the initial disturbance. Where riprap is used for outlet protection, the riprap should be placed before or in conjunction with the construction of the pipe or channel so that it is in place when the pipe or channel begins to operate.

- The designer, after determining the riprap size that will be stable under the flow conditions, shall consider that size to be a minimum size and then, based on riprap gradations actually available in the area, select the size or sizes that equal or exceed the minimum size. The possibility of drainage structure damage by children shall be considered in selecting a riprap size, especially if there is nearby water or a gully in which to toss the stones.
- Stone for riprap shall consist of field stone or quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended.
- Rubble concrete may be used provided it has a density of at least 150 pounds per cubic foot, and otherwise meets the requirement of this standard and specification.
- A lining of engineering filter fabric (geotextile) shall be placed between the riprap and the underlying soil surface to prevent soil movement into or through the riprap. The geotextile should be keyed in at the top of the bank.
- Filter fabric shall not be used on slopes greater than 1-1/2:1 as slippage may occur. Use it in conjunction with a layer of coarse aggregate (granular filter blanket) when the riprap to be placed is 12 inches and larger.

3.2.10 BMP C209: Outlet Protection



Purpose

To prevent scour at conveyance outlets and minimize the potential for downstream erosion by reducing the velocity of concentrated stormwater flows.

Conditions of Use

Outlet protection is required at the outlets of all ponds, pipes, ditches, or other conveyances, and where runoff is conveyed to a natural or manmade drainage feature such as a stream, wetland, lake, or ditch.

Design and Installation Specifications

The receiving channel at the outlet of a culvert shall be protected from erosion by rock lining a minimum of 6 feet downstream and extending up the channel sides a minimum of 1 foot above the maximum tailwater elevation or 1 foot above the crown, whichever is higher. For large pipes (more than 18 inches in diameter), the outlet protection lining of the channel is lengthened to four times the diameter of the culvert.

- Standard wingwalls, and tapered outlets and paved channels should also be considered when appropriate for permanent culvert outlet protection. (See WSDOT Hydraulic Manual, available through WSDOT Engineering Publications.)
- Organic or synthetic erosion blankets, with or without vegetation, are usually more effective than rock, cheaper, and easier to install. Materials can be chosen using manufacturer product specifications. ASTM test results are available for most products and the designer can choose the correct material for the expected flow.
- With low flows, vegetation (including sod) can be effective.
- The following guidelines shall be used for riprap outlet protection:

  If the discharge velocity at the outlet is less than 5 fps (pipe slope less than 1 percent), use 2-inch to 8-inch riprap. Minimum thickness is 1 foot.

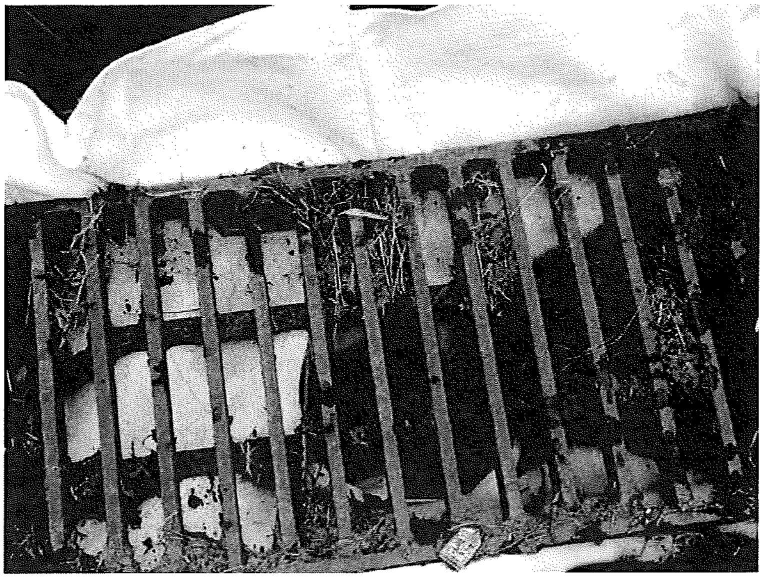
  For 5 to 10 fps discharge velocity at the outlet (pipe slope less than 3 percent), use 24-inch to 4-foot riprap. Minimum thickness is 2 feet.

  For outlets at the base of steep slope pipes (pipe slope greater than 10 percent), an engineered energy dissipater shall be used.
- Filter fabric or erosion control blankets should always be used under riprap to prevent scour and channel erosion.
- New pipe outfalls can provide an opportunity for low-cost fish habitat improvements. For example, an alcove of low-velocity water can be created by constructing the pipe outfall and associated energy dissipater back from the stream edge and digging a channel, over-widened to the upstream side, from the outfall. Overwintering juvenile and migrating adult salmonids may use the alcove as shelter during high flows. Bank stabilization, bioengineering, and habitat features may be required for disturbed areas. See Volume III for more information on outfall system design.

Maintenance Standards

- Inspect and repair as needed.
- Add rock as needed to maintain the intended function.
- Clean energy dissipater if sediment builds up.

3.2.11 BMP C220: Storm Drain Inlet Protection



Purpose

Inlet protection prevents coarse sediment from entering drainage systems prior to permanent stabilization of a disturbed area.

Conditions of Use

Use this BMP where storm drain inlets are to be made operational before permanent stabilization of the disturbed drainage area. Provide protection for all storm drain inlets downslope and within 500 feet of a disturbed or construction area, unless the runoff that enters the catch basin will be conveyed to a sediment pond or trap. Inlet protection may be used anywhere to protect the drainage system. It is likely that the drainage system will still require cleaning.

Table 3.9 lists several options for inlet protection. All of the methods for storm drain inlet protection are prone to plugging and require a high frequency of maintenance. Limit drainage areas to 1 acre or less. Emergency overflows may be required where stormwater ponding would cause a hazard. If an emergency overflow is provided, additional end-of-pipe treatment may be required.

Table 3.9. Storm Drain Inlet Protection.

Type of Inlet Protection	Emergency Overflow	Applicable for Paved/Earthen Surfaces	Conditions of Use
Drop Inlet Protection			
Excavated drop inlet protection	Yes, temporary flooding will occur	Earthen	Applicable for heavy flows. Easy to maintain. Large Area Requirement: 30' X 30'/acre.
Rock socks and gravel	Yes	Paved or Earthen	Applicable for heavy concentrated flows.
Gravel and wire drop inlet protection	No		Applicable for heavy concentrated flows. Will pond. Can withstand traffic.
Catch basin filters	Yes	Paved or Earthen	Frequent maintenance required.
Curb Inlet Protection			
Curb inlet protection with a wooden weir	Small capacity overflow	Paved	Used for sturdy, more compact installation.
Rock socks and gravel	Yes	Paved	Sturdy, but limited filtration.
Culvert Inlet Protection			
Culvert inlet sediment trap			18 month expected life.

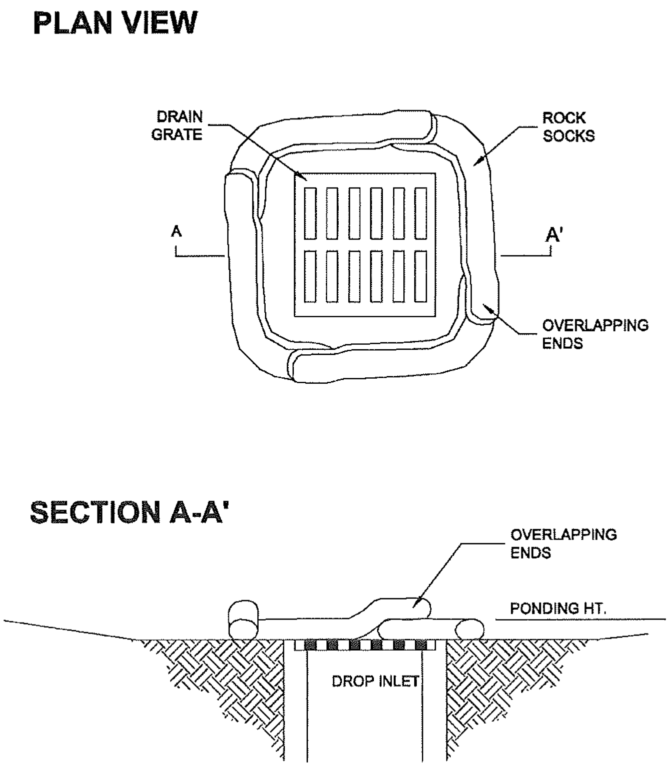
Design and Installation Specifications

Excavated Drop Inlet Protection – An excavated impoundment around the storm drain. Sediment settles out of the stormwater prior to entering the storm drain.

- Depth 1 to 2 feet as measured from the crest of the inlet structure.
- Side Slopes of excavation no steeper than 2:1.
- Minimum volume of excavation 35 cubic yards.
- Shape basin to fit site with longest dimension oriented toward the longest inflow area.
- Install provisions for draining to prevent standing water problems.
- Clear the area of all debris.
- Grade the approach to the inlet uniformly.
- Drill weep holes into the side of the inlet.
- Protect weep holes with screen wire and washed aggregate.
- Seal weep holes when removing structure and stabilizing area.
- It may be necessary to build a temporary dike to the down slope side of the structure to prevent bypass flow.

Rock Sock Drop Inlet Protection – A barrier formed around the storm drain inlet with overlapping rock socks. See Figure 3.14.

- Rock socks are bags made out of burlap or geotextile fabric approximately 40 inches long and 6 inches in diameter. They are filled with 1/2 inch round rock to 24 inch length and a weight of 16 to 20 pounds.
- Use loosely woven material, such as burlap for filtration and a tight weave geotextile for diversion.
- Completely circle inlet with rock socks.
- Overlap ends to prevent gaps.
- Rock socks may be stacked if required, but should be replaced with gravel filled sandbags for large flows.


PLAN VIEW

SECTION A-A'

NOTES:
1. Drop inlet sediment barriers are to be used for small, nearly level drainage areas (less that 5%).

Figure 3.14. Rock Sock Drop Inlet Protection.

Curb Inlet Protection with Wooden Weir – Barrier formed around a curb inlet with a wooden frame and gravel.

- Wire mesh with 1/2-inch openings.
- Extra strength filter cloth.
- Construct a frame.
- Attach the wire and filter fabric to the frame.
- Pile coarse washed aggregate against wire/fabric.
- Place weight on frame anchors.

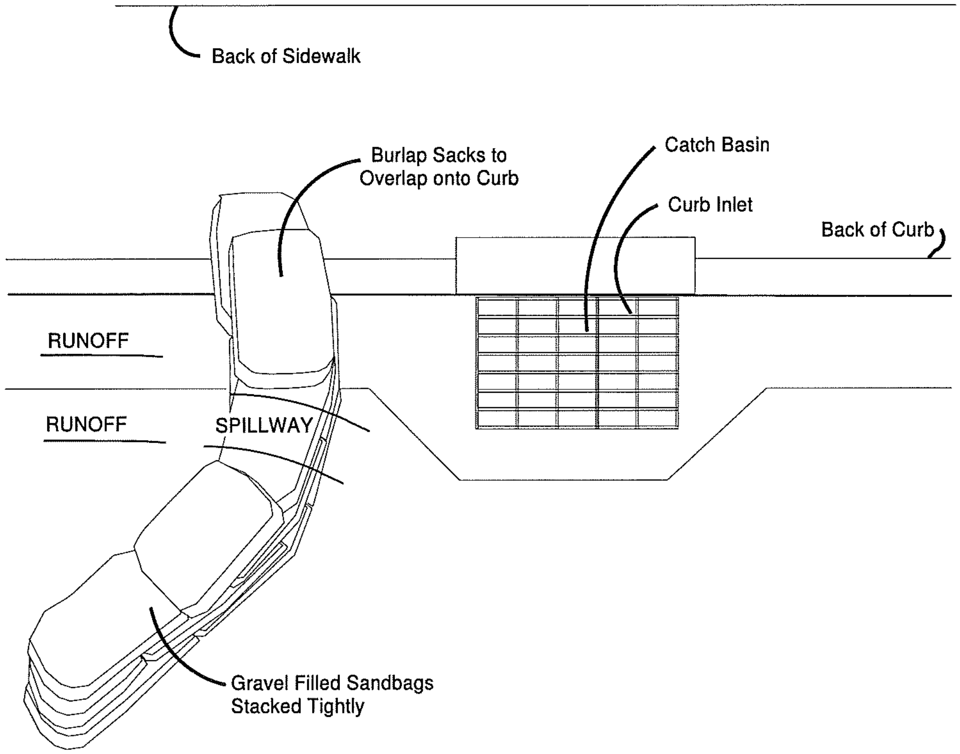
Curb and Gutter Sediment Barrier – Sandbag or rock berm (riprap and aggregate) 3 feet high and 3 feet wide in a horseshoe shape. See Figure 3.15.

- Construct a horseshoe shaped berm, faced with coarse aggregate if using riprap, 3 feet high and 3 feet wide, at least 2 feet from the inlet.
- Construct a horseshoe shaped sedimentation trap on the outside of the berm sized to sediment trap standards for protecting a culvert inlet.

Maintenance Standards

- Inspect catch basin filters frequently, especially after storm events. If the insert becomes clogged, it should be cleaned or replaced.
- For systems using stone filters: If the stone filter becomes clogged with sediment, the stones must be pulled away from the inlet and cleaned or replaced. Since cleaning of gravel at a construction site may be difficult, an alternative approach would be to use the clogged stone as fill and put fresh stone around the inlet.

Plan View



NOTES:

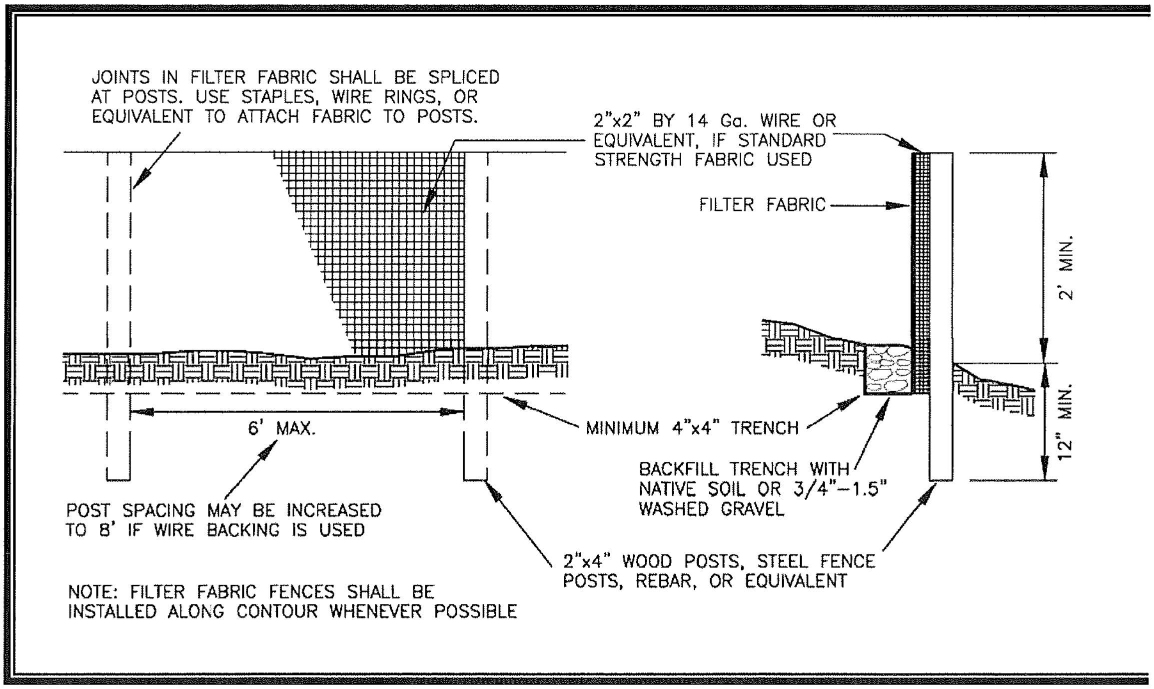
1. Place curb type sediment barriers on gently sloping street segments, where water can pond and allow sediment to separate from runoff.
2. Sandbags of either burlap or woven `geotextile' fabric, are filled with gravel, layered and packed tightly.
3. Leave a one sandbag gap in the top row to provide a spillway for overflow.
4. Inspect barriers and remove sediment after each storm event. Sediment and gravel must be removed from the traveled way immediately.

Figure 3.15. Curb and Gutter Barrier.

3.2.12 BMP C233: Silt Fence

Purpose

To reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow. See Figure 3.16 for details on silt fence construction.



NOTE: FILTER FABRIC FENCES SHALL BE INSTALLED ALONG CONTOUR WHENEVER POSSIBLE

Figure 3.16. Silt Fence.

Conditions of Use

- Silt fence may be used downslope of all disturbed areas.
- Silt fence is not intended to treat concentrated flows, nor is it intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a silt fence, rather than by a sediment pond, is when the area draining to the fence is one acre or less and flow rates are less than 0.5 cfs.
- Silt fences should not be constructed in streams or used in V-shaped ditches. They are not an adequate method of silt control for anything deeper than sheet or overland flow.

Design and Installation Specifications

- Drainage area of 1 acre or less or in combination with sediment basin in a larger site.

- Maximum slope steepness (normal (perpendicular) to fence line) 1:1.

- Maximum sheet or overland flow path length to the fence of 100 feet.

- No flows greater than 0.5 cfs.

- The geotextile used shall meet the following standards. All geotextile properties listed below are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in Table 3.10):

Table 3.10. Geotextile Standards.

Polymeric Mesh AOS (ASTM D4751)	0.60 mm maximum for film wovens (#30 sieve). 0.30 mm maximum for all other geotextile types (#50 sieve). 0.15 mm minimum for all fabric types (#100 sieve).
Water Permittivity (ASTM D4491)	0.02 sec^{-1} minimum
Grab Tensile Strength (ASTM D4632)	180 lbs. Minimum for extra strength fabric. 100 lbs minimum for standard strength fabric.
Grab Tensile Strength (ASTM D4632)	30% maximum
Ultraviolet Resistance (ASTM D4355)	70% minimum

- Standard strength fabrics shall be supported with wire mesh, chicken wire, 2-inch x 2-inch wire, safety fence, or jute mesh to increase the strength of the fabric. Silt fence materials are available that have synthetic mesh backing attached.

- Filter fabric material shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life at a temperature range of 0°F. to 120°F.

- 100 percent biodegradable silt fence is available that is strong, long lasting, and can be left in place after the project is completed, if permitted by local regulations.

- Standard Notes for construction plans and specifications follow. Refer to Figure 3.16 for standard silt fence details.

- The contractor shall install and maintain temporary silt fences at the locations shown in the Plans. The silt fences shall be constructed in the areas of clearing, grading, or drainage prior to starting those activities. A silt fence shall not be considered temporary if the silt fence must function beyond the life of the contract. The silt fence shall prevent soil carried by runoff water from going beneath, through, or over the top of the silt fence, but shall allow the water to pass through the fence.

- The minimum height of the top of silt fence shall be 2 feet and the maximum height shall be 2-1/2 feet above the original ground surface.

- The geotextile shall be sewn together at the point of manufacture, or at an approved location as determined by the Engineer, to form geotextile lengths as required. All sewn seams shall be located at a support post. Alternatively, two sections of silt fence can be overlapped, provided the Contractor can demonstrate, to the satisfaction of the Engineer, that the overlap is long enough and that the adjacent fence sections are close enough together to prevent silt laden water from escaping through the fence at the overlap.

- The geotextile shall be attached on the up-slope side of the posts and support system with staples, wire, or in accordance with the manufacturer's recommendations. The geotextile shall be attached to the posts in a manner that reduces the potential for geotextile tearing at the staples, wire, or other connection device. Silt fence back-up support for the geotextile in the form of a wire or plastic mesh is dependent on the properties of the geotextile selected for use. If wire or plastic back-up mesh is used, the mesh shall be fastened securely to the up-slope of the posts with the geotextile being up-slope of the mesh back-up support.

- The geotextile at the bottom of the fence shall be buried in a trench to a minimum depth of 4 inches below the ground surface. The trench shall be backfilled and the soil tamped in place over the buried portion of the geotextile, such that no flow can pass beneath the fence and scouring cannot occur. When wire or polymeric back-up support mesh is used, the wire or polymeric mesh shall extend into the trench a minimum of 3 inches.

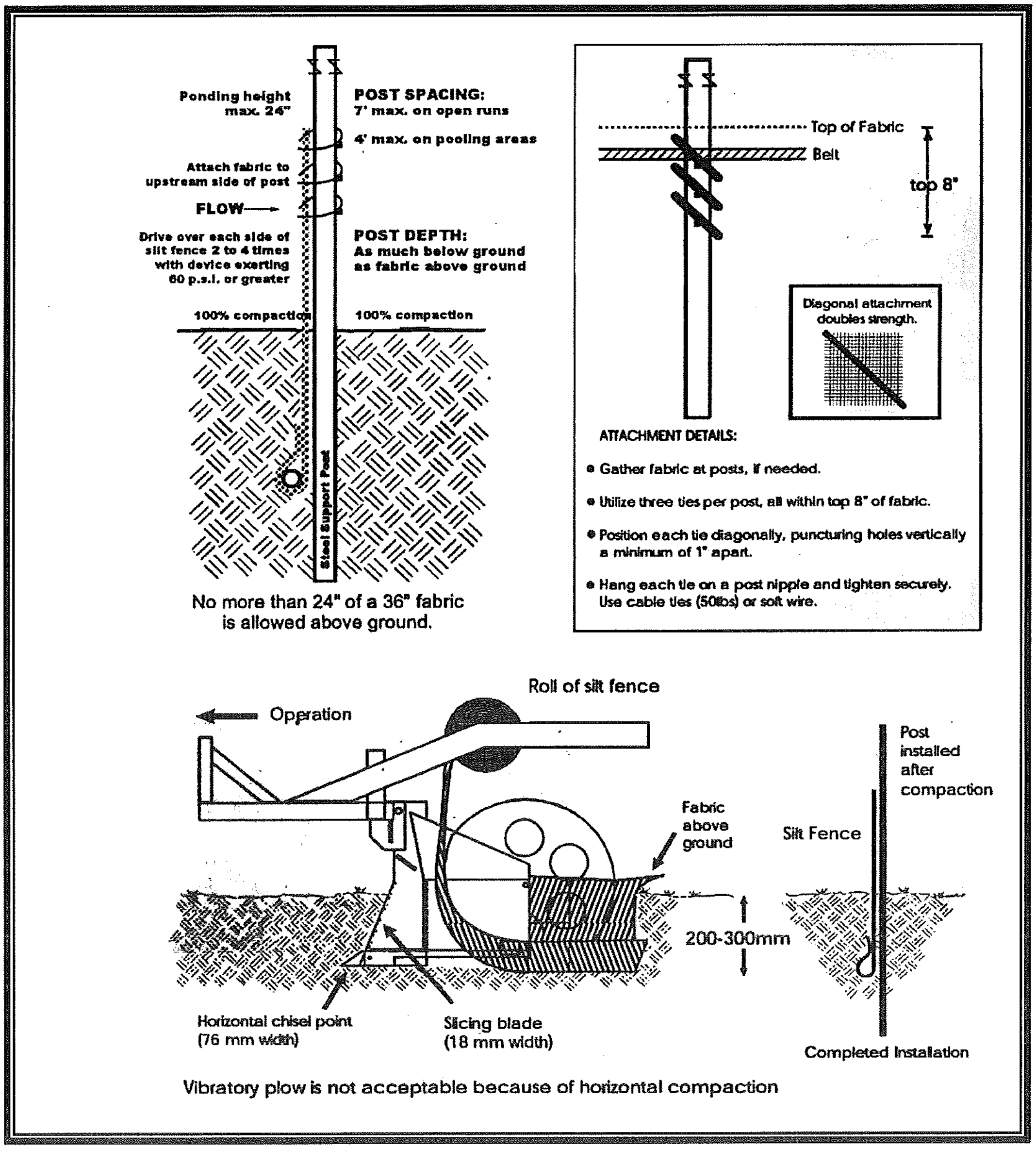
- The fence posts shall be placed or driven a minimum of 18 inches. A minimum depth of 12 inches is allowed if topsoil or other soft subgrade soil is not present and a minimum depth of 18 inches cannot be reached. Fence post depths shall be increased by 6 inches if the fence is located on slopes of 3:1 or steeper and the slope is perpendicular to the fence. If required post depths cannot be obtained, the posts shall be adequately secured by bracing or guying to prevent overturning of the fence due to sediment loading.

- Silt fences shall be located on contour as much as possible, except at the ends of the fence, where the fence shall be turned uphill such that the silt fence captures the runoff water and prevents water from flowing around the end of the fence.
- If the fence must cross contours, with the exception of the ends of the fence, gravel check dams placed perpendicular to the back of the fence shall be used to minimize concentrated flow and erosion along the back of the fence. The gravel check dams shall be approximately 1 foot deep at the back of the fence. It shall be continued perpendicular to the fence at the same elevation until the top of the check dam intercepts the ground surface behind the fence. The gravel check dams shall consist of crushed surfacing base course, gravel backfill for walls, or shoulder ballast. The gravel check dams shall be located every 10 feet along the fence where the fence must cross contours. The slope of the fence line where contours must be crossed shall not be steeper than 3:1.
- Wood, steel or equivalent posts shall be used. Wood posts shall have minimum dimensions of 2 inches by 2 inches by 3 feet minimum length, and shall be free of defects such as knots, splits, or gouges. Steel posts shall consist of either size No. 6 rebar or larger, ASTM A 120 steel pipe with a minimum diameter of 1 inch, U, T, L, or C shape steel posts with a minimum weight of 1.35 lbs./ft. or other steel posts having equivalent strength and bending resistance to the post sizes listed. The spacing of the support posts shall be a maximum of 6 feet.
- Fence back-up support, if used, shall consist of steel wire with a maximum mesh spacing of 2 inches, or a prefabricated polymeric mesh. The strength of the wire or polymeric mesh shall be equivalent to or greater than 180 lbs. grab tensile strength. The polymeric mesh must be as resistant to ultraviolet radiation as the geotextile it supports.
- Silt fence installation using the slicing method specification details follow. Refer to Figure 3.17 for slicing method details.
- The base of both end posts must be at least 2 to 4 inches above the top of the silt fence fabric on the middle posts for ditch checks to drain properly. Use a hand level or string level, if necessary, to mark base points before installation.

- Install posts 3 to 4 feet apart in critical retention areas and 6 feet apart in standard applications.

- Install posts 24 inches deep on the downstream side of the silt fence, and as close as possible to the fabric, enabling posts to support the fabric from upstream water pressure.

- Install posts with the nipples facing away from the silt fence fabric.



No more than 24" of a 36" fabric is allowed above ground.

ATTACHMENT DETAILS:

- Gather fabric at posts, if needed.
- Utilize three ties per post, all within top 8" of fabric.
- Position each tie diagonally, puncturing holes vertically a minimum of 1" apart.
- Hang each tie on a post nipple and tighten securely. Use cable ties (50lbs) or soft wire.

Vibratory plow is not acceptable because of horizontal compaction

Figure 3.17. Silt Fence Installation by Slicing Method.

- Attach the fabric to each post with three ties, all spaced within the top 8 inches of the fabric. Attach each tie diagonally 45 degrees through the fabric, with each puncture at least 1 inch vertically apart. In addition, position each tie to hang on a post nipple when tightening to prevent sagging.

- Wrap approximately 6 inches of fabric around the end posts and secure with three ties.
- No more than 24 inches of a 36-inch fabric is allowed above ground level.
- The rope lock system must be used in all ditch check applications.
- The installation should be checked and corrected for any deviation before compaction. Use a flat-bladed shovel to tuck fabric deeper into the ground if necessary.
- Compaction is vitally important for effective results. Compact the soil immediately next to the silt fence fabric with the front wheel of the tractor, skid steer, or roller exerting at least 60 pounds per square inch. Compact the upstream side first and then each side twice for a total of four trips.

Maintenance Standards

- Any damage shall be repaired immediately.
- If concentrated flows are evident uphill of the fence, they must be intercepted and conveyed to a sediment pond.
- It is important to check the uphill side of the fence for signs of the fence clogging and acting as a barrier to flow and then causing channelization of flows parallel to the fence. If this occurs, replace the fence or remove the trapped sediment.
- Sediment deposits shall either be removed when the deposit reaches approximately one-third the height of the silt fence, or a second silt fence shall be installed.
- If the filter fabric (geotextile) has deteriorated due to ultraviolet breakdown, it shall be replaced.

3.2.13 BMP C234: Vegetated Strip

Purpose

To reduce the transport of coarse sediment from a construction site by providing a temporary physical barrier to sediment and reducing the runoff velocities of overland flow.

Conditions of Use

- Vegetated strips may be used downslope of all disturbed areas.
- Vegetated strips are not intended to treat concentrated flows, nor are they intended to treat substantial amounts of overland flow. Any concentrated flows must be conveyed through the drainage system to a sediment pond. The only circumstance in which overland flow can be treated solely by a strip, rather than by a sediment pond, is when the following criteria are met (see Table 3.11):

Table 3.11. Vegetated Strips.

Average Slope	Slope Percent	Contributing Flowpath Length
1.5H:1V or less	67% or less	100 feet
2H:1V or less	50% or less	115 feet
4H:1V or less	25% or less	150 feet
6H:1V or less	16.7% or less	200 feet
10H:1V or less	10% or less	250 feet

Design and Installation Specifications

- The vegetated strip shall consist of a continuous strip of dense vegetation with a permeable topsoil and have a minimum 25-foot long flowpath. Grass-covered, landscaped areas are generally not adequate because the volume of sediment overwhelms the grass. Ideally, vegetated strips shall consist of undisturbed native growth with a well-developed soil that allows for infiltration of runoff.
- The slope within the strip shall not exceed 4H:1V.
- The uphill boundary of the vegetated strip shall be delineated with clearing limits.

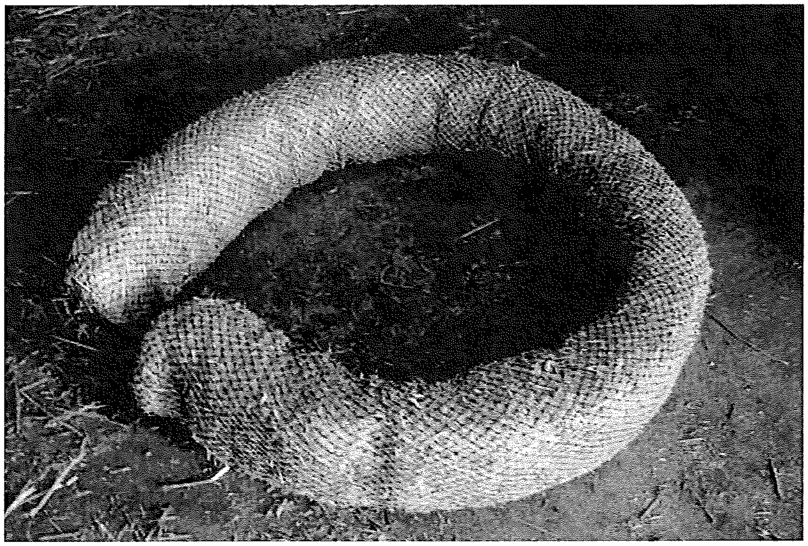
Maintenance Standards

- Any areas damaged by erosion or construction activity shall be seeded immediately and protected by mulch.

- If more than 5 feet of the original vegetated strip width has had vegetation removed or is being eroded, sod must be installed.

- If there are indications that concentrated flows are traveling across the buffer, surface water controls must be installed to reduce the flows entering the buffer, or additional perimeter protection must be installed.

3.2.14 BMP C235: Straw Wattles



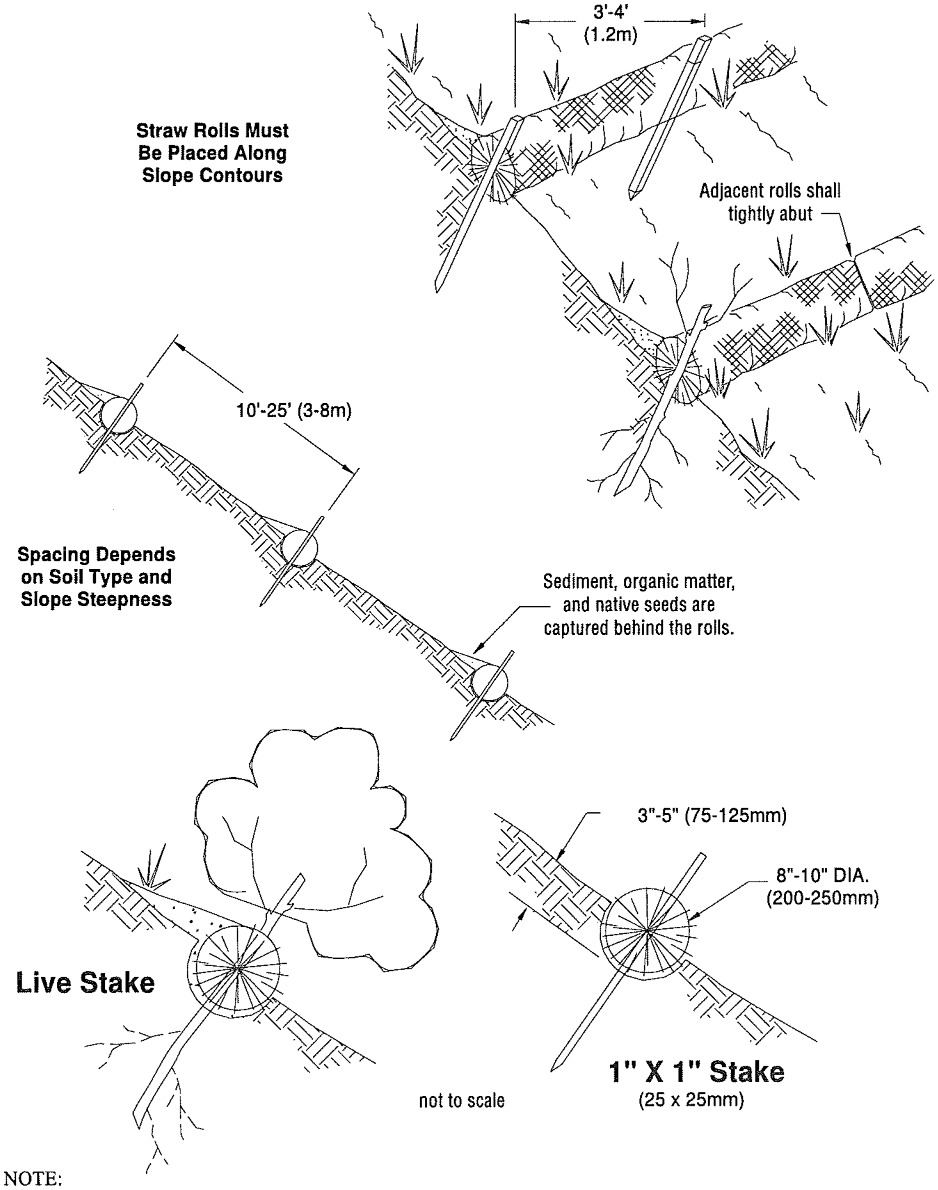
Purpose

To reduce the velocity and spread the flow of rill and sheet runoff, and to capture and retain sediment.

Straw wattles are temporary erosion and sediment control barriers consisting of straw wrapped in biodegradable tubular plastic or similar material. They are typically 8 to 10 inches in diameter and 25 to 30 feet in length. The wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes. See Figure 3.18 for typical construction details.

Conditions of Use

- Disturbed areas that require immediate erosion protection.
- Exposed soils during the period of short construction delays, or over winter months.
- On slopes requiring stabilization until permanent vegetation can be established.
- Straw wattles are effective for one to two wet seasons.
- If conditions are appropriate, wattles can be staked to the ground using willow cuttings for added revegetation.
- Rilling can occur beneath wattles if not properly entrenched and water can pass between wattles if not tightly abutted together.



NOTE:
1. Straw roll installation requires the placement and secure staking of the roll in a trench, 3"-5" (75-125mm) deep, dug on contour. runoff must not be allowed to run under or around roll.

Figure 3.18. Straw Wattles.

Design Criteria

- It is critical that wattles are installed perpendicular to the flow direction and parallel to the slope contour.
- Narrow trenches should be dug across the slope on contour to a depth of 3 to 5 inches on clay soils and soils with gradual slopes. On loose soils, steep slopes, and areas with high rainfall, dig

trenches to a depth of 5 to 7 inches, or 1/2 to 2/3 of the thickness of the wattle.

- Start building trenches and installing wattles from the base of the slope and work up. Spread excavated material evenly along the uphill slope and compacted using hand tamping or other methods.
- Construct trenches on contours at intervals of 10 to 25 feet apart depending on the steepness of the slope, soil type, and rainfall. The steeper the slope the closer together the trenches.
- Install the wattles snugly into the trenches and abut tightly end to end. Do not overlap the ends.
- Install stakes at each end of the wattle, and at 4-foot centers along entire length of wattle.
- If required, install pilot holes for the stakes using a straight bar to drive holes through the wattle and into the soil.
- At a minimum, wooden stakes should be approximately 3/4 x 3/4 x 24 inches. Willow cuttings or 3/8-inch rebar can also be used for stakes.

Maintenance Standards

- Drive stakes through the middle of the wattle, leaving 2 to 3 inches of the stake protruding above the wattle.
- Wattles may require maintenance to ensure they are in contact with soil and thoroughly entrenched, especially after significant rainfall on steep sandy soils.
- Inspect the slope after significant storms and repair any areas where wattles are not tightly abutted or water has scoured beneath the wattles.

3.2.15 BMP C240: Sediment Trap

Purpose

To collect and store sediment from sites cleared and/or graded during construction.

A sediment trap is a small temporary ponding area using a gravel outlet. Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area.

Conditions of Use

Prior to leaving a construction site, stormwater runoff must pass through a sediment pond or trap or other appropriate sediment removal best management practice. Non-engineered sediment traps may be used on-site prior to an engineered sediment trap or sediment pond to provide additional sediment removal capacity.

It is intended for use on sites where the tributary drainage area is less than 3 acres, with no unusual drainage features, and a projected build-out time of 6 months or less. The sediment trap is a temporary measure (with a design life of approximately 6 months) and shall be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps are only effective in removing sediment down to about the medium silt size fraction. Runoff with sediment of finer grades (fine silt and clay) will pass through untreated, emphasizing the need to control erosion to the maximum extent first.

Whenever possible, sediment-laden water shall be discharged into onsite, relatively level, vegetated areas (see BMP C234 – Vegetated Strip). This is the only way to effectively remove fine particles from runoff unless chemical treatment or filtration is used. This can be particularly useful after initial treatment in a sediment trap. The areas of release must be evaluated on a site-by-site basis in order to determine appropriate locations for and methods of releasing runoff. Vegetated wetlands shall not be used for this purpose. Frequently, it may be possible to pump water from the collection point at the downhill end of the site to an upslope vegetated area. Pumping shall only augment the treatment system, not replace it, because of the possibility of pump failure or runoff volume in excess of pump capacity.

All projects that are constructing permanent facilities for runoff quantity control should use the rough-graded or final-graded permanent facilities for traps. This includes combined facilities and infiltration facilities. If infiltration facilities are to be used, the sides and bottom of the facility must only be rough excavated to a minimum of 2 feet above final grade. Final grading of the infiltration facility shall occur only when all contributing drainage areas are fully stabilized. When permanent facilities are used as temporary sedimentation facilities, the surface area requirement of a sediment trap or pond must be met. If the surface area requirements are larger than the surface area of the permanent facility, then the trap or pond shall be enlarged to comply with the surface area requirement. The permanent pond shall also be divided into two cells as required for sediment ponds.

Either a permanent control structure or the temporary control structure (described in BMP C241, Temporary Sediment Pond) can be used. If a permanent control structure is used, it may be advisable to partially restrict the lower orifice with gravel to increase residence time while still allowing dewatering of the pond. A shut-off valve may be added to the control structure to allow complete retention of stormwater in emergency situations. In this case, an emergency overflow weir must be added.

A skimmer may be used for the sediment trap outlet if approved by the City.

Design and Installation Specifications

- See Figures 3.19 and 3.20 for details.
- If permanent runoff control facilities are part of the project, use them for sediment retention.

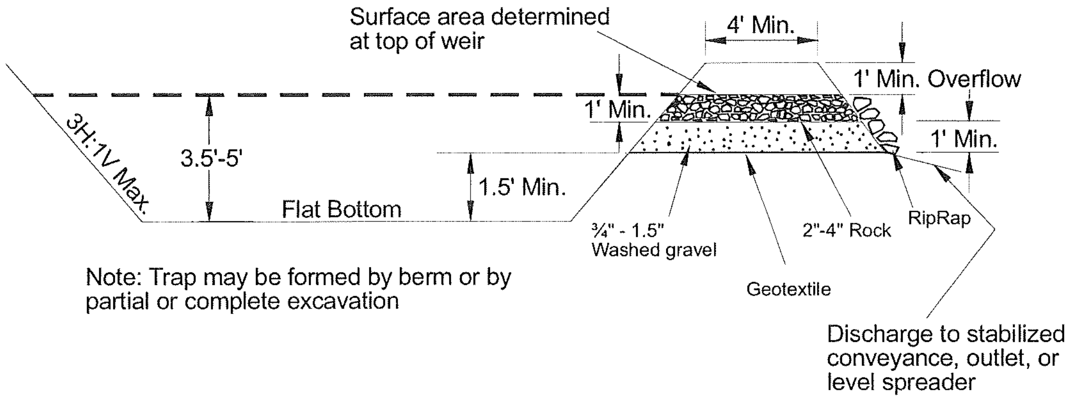


Figure 3.19. Cross-Section of Sediment Trap.

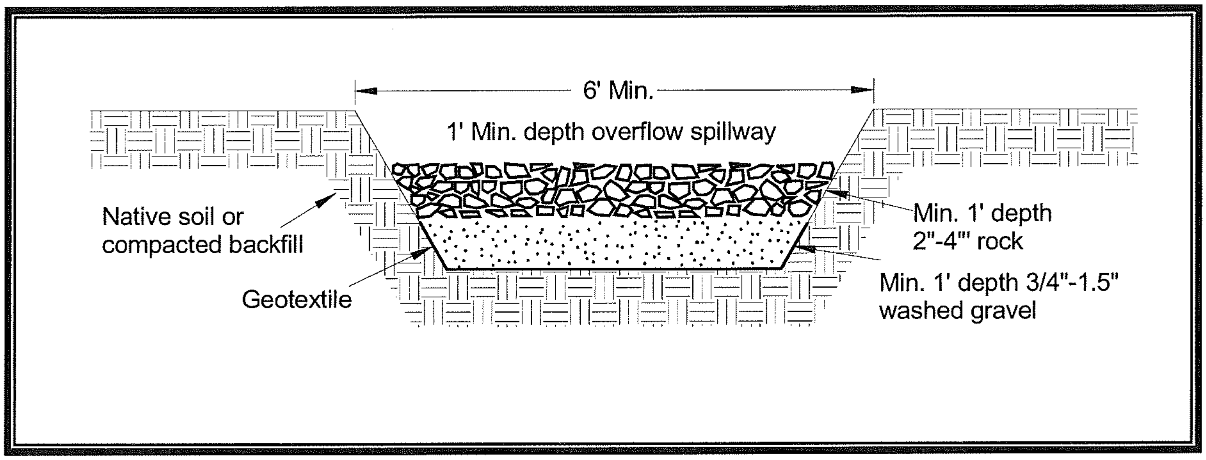


Figure 3.20. Sediment Trap Outlet.

- To determine the sediment trap geometry, first calculate the design surface area (*SA*) of the trap, measured at the invert of the weir. Use the following equation:

$$SA = FS(Q_2/V_S)$$

Where: Q_2 = Design inflow (cfs) based on the 2-year recurrence interval flow rate. Use a 15-minute time step using an approved continuous runoff model for the developed (unmitigated) site. If the time of concentration is less than 30-minutes, a 5-minute time step may be required. The 10-year recurrence interval peak flow shall be used if the project size, expected timing and duration of construction, or downstream conditions warrant a higher level of protection. If no hydrologic analysis is required, the rational method may be used.

V_S = The settling velocity of the soil particle of interest. The 0.02 mm (medium silt) particle with an assumed density of 2.65 g/cm^3 has been selected as the particle of interest and has a settling velocity (V_s) of 0.00096 ft/sec.

FS = A safety factor of 2 to account for non-ideal settling.

Therefore, the equation for computing surface area becomes:

$$SA = 2 \text{ x } Q_2/0.00096$$

OR

2,080 square feet per cfs of inflow

Note: Even if permanent facilities are used, they must still have a surface area that is at least as large as that derived from the above formula. If they do not, the pond must be enlarged.

- To aid in determining sediment depth, all sediment traps shall have a staff gauge with a prominent labeled mark for each 1-foot interval above the bottom of the trap.
- Sediment traps may not be feasible on utility projects due to the limited work space or the short-term nature of the work. Portable tanks may be used in place of sediment traps for utility projects.

Maintenance Standards

- Sediment shall be removed from the trap when it reaches 1 foot in depth.
- Any damage to the pond embankments or slopes shall be repaired.

3.2.17 BMP C250: Construction Stormwater Chemical Treatment

Purpose

Turbidity is difficult to control once fine particles are suspended in stormwater runoff from a construction site. Sedimentation ponds are effective at removing larger particulate matter by gravity settling, but are ineffective at removing smaller particulates such as clay and fine silt. Sediment ponds are typically designed to remove sediment no smaller than medium silt (0.02 mm). Chemical treatment may be used to reduce the turbidity of stormwater runoff.

Conditions of Use

Chemical treatment can reliably provide exceptional reductions of turbidity and associated pollutants. Very high turbidities can be reduced to levels comparable to what is found in streams during dry weather. Traditional BMPs used to control soil erosion and sediment loss from sites under development may not be adequate to ensure compliance with the water quality standard for turbidity in the receiving water. Chemical treatment may be required to protect streams from the impact of turbid stormwater discharges, especially when construction is to proceed through the wet season.

Formal written approval from Ecology and the City is required for the use of chemical treatment regardless of site size. The intention to use Chemical Treatment shall be indicated on the Notice of Intent for coverage under the General Construction Permit. Chemical treatment systems should be designed as part of the Construction SWPPP, not after the fact. Chemical treatment may be used to correct problem sites in limited circumstances with formal written approval from Ecology and the City.

The SEPA review authority must be notified at the application phase of the project review (or the time that the SEPA determination on the project is performed) that chemical treatment is proposed. If it is added after this stage, an addendum will be necessary and may result in project approval delay.

Design and Installation Specifications

See Appendix II-B for background information on chemical treatment.

Criteria for Chemical Treatment Product Use: Chemically treated stormwater discharged from construction sites must be nontoxic to aquatic organisms. The Chemical Technology Assessment Protocol (CTAPE) must be used to evaluate chemicals proposed for stormwater treatment.

Only chemicals approved by Ecology under the CTAPE may be used for stormwater treatment. The approved chemicals, their allowable application techniques (batch treatment or flow-through treatment), allowable application rates, and conditions of use can be found at the Department of Ecology Emerging Technologies website: <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html>.

Treatment System Design Considerations: The design and operation of a chemical treatment system should take into consideration the factors that determine optimum, cost-effective performance. It is important to recognize the following:

- Only Ecology approved chemicals may be used and must follow approved dose rates.
- The pH of the stormwater must be in the proper range for the polymers to be effective, which is typically 6.5 to 8.5.
- The coagulant must be mixed rapidly into the water to ensure proper dispersion.
- A flocculation step is important to increase the rate of settling, to produce the lowest turbidity, and to keep the dosage rate as low as possible.
- Too little energy input into the water during the flocculation phase results in flocs that are too small and/or insufficiently dense. Too much energy can rapidly destroy floc as it is formed.
- Care must be taken in the design of the withdrawal system to minimize outflow velocities and to prevent floc discharge. Discharge from a batch treatment system should be directed through a physical filter such as a vegetated swale that would catch any unintended floc discharge. Currently, flow-through systems always discharge through the chemically enhanced sand filtration system.
- System discharge rates must take into account downstream conveyance integrity.

Polymer Batch Treatment Process Description:

A batch chemical treatment system consists of the stormwater collection system (either temporary diversion or the permanent site drainage system), an untreated stormwater storage pond, pumps, a chemical feed system, treatment cells, and interconnecting piping.

The batch treatment system shall use a minimum of two lined treatment cells in addition to the untreated stormwater storage pond. Multiple treatment cells allow for clarification of treated water while other cells are being filled or emptied. Treatment cells may be ponds or tanks. Ponds with constructed earthen embankments greater than 6 feet high require special engineering analyses.

Stormwater is collected at interception point(s) on the site and is diverted by gravity or by pumping to an untreated stormwater storage pond or other untreated stormwater holding area. The stormwater is stored until treatment occurs. It is important that the holding pond be large enough to provide adequate storage.

The first step in the treatment sequence is to check the pH of the stormwater in the untreated stormwater storage pond. The pH is adjusted by the application of carbon dioxide or a base until the stormwater in the storage pond is within the desired pH range, 6.5 to 8.5. When used, carbon dioxide is added immediately downstream of the transfer pump. Typically sodium bicarbonate (baking soda) is used as a base, although other bases may be used. When needed, base is added directly to the untreated stormwater storage pond. The stormwater is recirculated with the treatment pump to provide mixing in the storage pond. Initial pH adjustments should be based on daily bench tests. Further pH adjustments can be made at any point in the process.

Once the stormwater is within the desired pH range (dependant on polymer being used), the stormwater is pumped from the untreated stormwater storage pond to a treatment cell as polymer is added. The polymer is added upstream of the pump to facilitate rapid mixing.

After polymer addition, the water is kept in a lined treatment cell for clarification of the sediment-floc. In a batch mode process, clarification typically takes from 30 minutes to several hours. Prior to discharge samples are withdrawn for analysis of pH and turbidity. If both are acceptable, the treated water is discharged.

Several configurations have been developed to withdraw treated water from the treatment cell. The original configuration is a device that withdraws the treated water from just beneath the water surface using a float with adjustable struts that prevent the float from settling on the cell bottom. This reduces the possibility of picking up sediment-floc from the bottom of the pond. The struts are usually set at a minimum clearance of about 12 inches; that is, the float will come within 12 inches of the bottom of the cell. Other systems have used vertical guides or cables which constrain the float, allowing it to drift up and down with the water level. More recent designs have an H-shaped array of pipes, set on the horizontal.

This scheme provides for withdrawal from four points rather than one. This configuration reduces the likelihood of sucking settled solids from the bottom. It also reduces the tendency for a vortex to form. Inlet diffusers, a long floating or fixed pipe with many small holes in it, are also an option.

Safety is a primary concern. Design should consider the hazards associated with operations, such as sampling. Facilities should be designed to reduce slip hazards and drowning. Tanks and ponds should have life rings, ladders, or steps extending from the bottom to the top.

Polymer Flow-Through Treatment Process Description:

At a minimum, a flow-through chemical treatment system consists of the stormwater collection system (either temporary diversion or the permanent site drainage system), an untreated stormwater storage pond, and the chemically enhanced sand filtration system.

Stormwater is collected at interception point(s) on the site and is diverted by gravity or by pumping to an untreated stormwater storage pond or other untreated stormwater holding area. The stormwater is stored until treatment occurs. It is important that the holding pond be large enough to provide adequate storage.

Stormwater is then pumped from the untreated stormwater storage pond to the chemically enhanced sand filtration system where polymer is added. Adjustments to pH may be necessary before chemical addition. The sand filtration system continually monitors the stormwater for turbidity and pH. If the discharge water is ever out of an acceptable range for turbidity or pH, the water is recycled to the untreated stormwater pond where it can be retreated.

For batch treatment and flow-through treatment, the following equipment should be located in a lockable shed:

- The chemical injector
- Secondary non-corrosive containment for acid, caustic, buffering compound, and treatment chemical
- Emergency shower and eyewash
- Monitoring equipment.

System Sizing

Certain sites are required to implement flow control for the developed sites. These sites must also control stormwater release rates during construction. Generally, these are sites that discharge stormwater directly, or indirectly, through a conveyance system, into a fresh water. System sizing is dependent on flow control requirements.

Sizing Criteria for Batch Treatment Systems for Flow Control Exempt Water Bodies

The total volume of the untreated stormwater storage pond and treatment ponds or tanks must be large enough to treat the volume of stormwater that is produced during multiple day storm events. It is recommended that at a minimum the untreated stormwater storage pond be sized to hold 1.5 times the runoff volume of the 10-year, 24-hour storm event. Bypass should be provided around the chemical treatment system to accommodate extreme storm events.

Primary settling should be encouraged in the untreated stormwater storage pond. A forebay with access for maintenance may be beneficial.

There are two opposing considerations in sizing the treatment cells. A larger cell is able to treat a larger volume of water each time a batch is processed. However, the larger the cell the longer the time required to empty the cell. A larger cell may also be less effective at flocculation and therefore require a longer settling time. The simplest approach to sizing the treatment cell is to multiply the allowable discharge flow rate times the desired drawdown time. A 4-hour drawdown time allows one batch per cell per 8-hour work period, given 1 hour of flocculation followed by 2 hours of settling.

If the discharge is directly to a lake, flow control exempt receiving water listed in Volume I, or to an infiltration system, there is no discharge flow limit.

Ponds sized for flow control water bodies must at a minimum meet the sizing criteria for flow control exempt waters.

Sizing Criteria for Flow-Through Treatment Systems for Flow Control Exempt Water Bodies:

When sizing storage ponds or tanks for flow-through systems for flow control exempt water bodies, the treatment system capacity should be a factor. The untreated stormwater storage pond or tank should be sized to hold 1.5 times the runoff volume of the 10-year, 24-hour storm event minus the treatment system flowrate for an 8-hour period. For a chitosan-enhanced sand filtration system, the treatment system flowrate should be sized using a hydraulic loading rate between 6 to 8 gpm/ft^2. Other hydraulic loading rates may be more appropriate for other systems. Bypass should be provided around the chemical treatment system to accommodate extreme storms.

Sizing Criteria for Flow Control Water Bodies

Sites that must implement flow control for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from 50 percent of the 2-year recurrence interval flow through the 10-year flow as predicted by an approved continuous runoff model. The pre-developed condition to be matched shall be the land cover condition immediately prior to the development project. This restriction on release rates can affect the size of the storage pond and treatment cells.

The following is how WWHM can be used to determine the release rates from the chemical treatment systems:

- Determine the pre-developed flow durations to be matched by entering the land use area under the "Pre-developed" scenario in WWHM. The default flow range is from 50 percent of the 2-year recurrence interval flow through the 10-year flow.
- Enter the post developed land use area in the "Developed Unmitigated" scenario in WWHM.
- Copy the land use information from the "Developed Unmitigated" to "Developed Mitigated" scenario.
- While in the "Developed Mitigated" scenario, add a pond element under the basin element containing the post-developed land use areas. This pond element represents information on the available untreated stormwater storage and discharge from the chemical treatment system. In cases where the discharge from the chemical treatment system is controlled by a pump, a stage/storage/ discharge (SSD) table representing the pond must be generated outside WWHM and imported into WWHM. WWHM can route the runoff from the post-developed condition through this SSD table (the pond) and determine compliance with the flow duration standard. This would be an iterative design procedure where if the initial SSD table proved to be inadequate, the designer would have to modify the SSD table outside WWHM and re-import in WWHM and route the runoff through it again. The iteration will continue until a pond that complies with the flow duration standard is correctly sized.

Notes on SSD table characteristics:

- The pump discharge rate would likely be initially set at just below 50 percent of the 2-year recurrence interval flow from the pre-developed condition. As runoff coming into the untreated stormwater storage pond increases and the available untreated stormwater storage volume gets used up, it would be necessary to increase the pump discharge rate above 50 percent of the 2-year recurrence interval flow. The increase(s) above 50 percent of the 2-year recurrence interval flow must be such that they provide some relief to the untreated stormwater storage needs but at the same time will not cause violations of the flow duration standard at the higher flows. The final design SSD table will identify the appropriate pumping rates and the corresponding stage and storages.

- When building such a flow control system, the design must ensure that any automatic adjustments to the pumping rates will be as a result of changes to the available storage in accordance with the final design SSD table.

It should be noted that the above procedures would be used to meet the flow control requirements. The chemical treatment system must be able to meet the runoff treatment requirements. It is likely that the discharge flow rate of 50 percent of the 2-year recurrence interval or more may exceed the treatment capacity of the system. If that is the case, the untreated stormwater discharge rate(s) (i.e., influent to the treatment system) must be reduced to allow proper treatment. Any reduction in the flows would likely result in the need for a larger untreated stormwater storage volume.

- If the discharge is to a municipal storm drainage system, the allowable discharge rate may be limited by the capacity of the public system. It may be necessary to clean the municipal storm drainage system prior to the start of the discharge to prevent scouring solids from the drainage system. If the municipal storm drainage system discharges to a water body not on the flow control exempt list, the project site is subject to flow control requirements.
- If system design does not allow you to discharge at the slower rates as described above and if the site has a retention or detention pond that will serve the planned development, the discharge from the treatment system may be directed to the permanent retention/detention pond to comply with the flow control requirement. In this case, the untreated stormwater storage pond and treatment system will be sized according to the sizing criteria for flow-through treatment systems for flow control exempt water bodies described earlier except all discharge (water passing through the treatment system and stormwater bypassing the treatment system) will be directed into the permanent retention/detention pond. If site constraints make locating the untreated stormwater storage pond difficult, the permanent

retention/detention pond may be divided to serve as the untreated stormwater storage pond and the post-treatment flow control pond. A berm or barrier must be used in this case so the untreated water does not mix with the treated water. Both untreated stormwater storage requirements, and adequate post-treatment flow control must be achieved. The post-treatment flow control pond's revised dimensions must be entered into the WWHM and the WWHM must be run to confirm compliance with the flow control requirement.

Maintenance Standards

Monitoring: At a minimum, the following monitoring shall be conducted. Test results shall be recorded on a daily log kept on site. Additional testing may be required by the NPDES Permit based on site conditions:

Operational Monitoring

- Total volume treated and discharged
- Flow must be continuously monitored and recorded at not greater than 15-minute intervals
- Type and amount of chemical used for pH adjustment, if any
- Quantity of chemical used for treatment
- Settling time.

Compliance Monitoring

- Influent and effluent pH and turbidity must be continuously monitored and recorded at not greater than 15-minute intervals.
- pH and turbidity of the receiving water.

Biomonitoring

- Treated stormwater must be non-toxic to aquatic organisms. Treated stormwater must be tested for aquatic toxicity or residual chemical content. Frequency of biomonitoring will be determined by Ecology.
- Residual chemical tests must be approved by Ecology prior to their use.

- If testing treated stormwater for aquatic toxicity, you must test for acute (lethal) toxicity. Bioassays shall be conducted by a laboratory accredited by Ecology, unless otherwise approved by Ecology. Acute toxicity tests shall be conducted per the CTAPE protocol.

- Discharge Compliance: Prior to discharge, treated stormwater must be sampled and tested for compliance with pH and turbidity limits. These limits may be established by the Construction Stormwater General Permit or a site-specific discharge permit. Sampling and testing for other pollutants may also be necessary at some sites. The pH must be within the range of 6.5 to 8.5 standard units and not cause a change in the pH of the receiving water of more than 0.2 standard units.

- Treated stormwater samples and measurements shall be taken from the discharge pipe or another location representative of the nature of the treated stormwater discharge. Samples used for determining compliance with the water quality standards in the receiving water shall not be taken from the treatment pond prior to decanting. Compliance with the water quality standards is determined in the receiving water.

- Operator Training: Each contractor who intends to use chemical treatment shall be trained by an experienced contractor on an active site.

Standard BMPs:

- Surface stabilization BMPs should be implemented on site to prevent significant erosion. All sites shall use a truck wheel wash to prevent tracking of sediment off site.

Sediment Removal and Disposal:

- Sediment shall be removed from the storage or treatment cells as necessary. Typically, sediment removal is required at least once during a wet season and at the decommissioning of the cells. Sediment remaining in the cells between batches may enhance the settling process and reduce the required chemical dosage.

- Sediment that is known to be non-toxic may be incorporated into the site away from drainages.

3.2.18 BMP C251: Construction Stormwater Filtration

Purpose

To remove sediment from runoff originating from disturbed areas of the site.

Conditions of Use

Traditional BMPs used to control soil erosion and sediment loss from sites under development may not be adequate to ensure compliance with the water quality standard for turbidity in the receiving water. Filtration may be used in conjunction with gravity settling to remove sediment as small as fine silt (0.5 µm). The reduction in turbidity will be dependent on the particle size distribution of the sediment in the stormwater. In some circumstances, sedimentation and filtration may achieve compliance with the water quality standard for turbidity.

The use of construction stormwater filtration does not require approval from Ecology or Tumwater as long as treatment chemicals are not used. Filtration in conjunction with polymer treatment requires testing under the Chemical Technology Assessment Protocol – Ecology (CTAPE) before it can be initiated. Approval from Tumwater and the appropriate regional Ecology office must be obtained at each site where polymers use is proposed prior to use. For more guidance on stormwater chemical treatment see BMP C250.

Design and Installation Specifications

Background Information

Filtration with sand media has been used for over a century to treat water and wastewater. The use of sand filtration for treatment of stormwater has developed recently, generally to treat runoff from streets, parking lots, and residential areas. The application of filtration to construction stormwater treatment is currently under development.

Two types of filtration systems may be applied to construction stormwater treatment: rapid and slow. Rapid sand filters are the typical system used for water and wastewater treatment. They can achieve relatively high hydraulic flow rates, on the order of 2 to 20 gpm/sf, because they have automatic backwash systems to remove accumulated solids. In contrast, slow sand filters have very low hydraulic rates, on the order of 0.02 gpm/sf, because they do not have backwash systems. To date, slow sand filtration has generally been used to treat stormwater. Slow sand filtration is mechanically simple in comparison to rapid sand filtration but requires a much larger filter area.

Filtration Equipment. Sand media filters are available with automatic backwashing features that can filter to 50 µm particle size. Screen or bag filters can filter down to 5 µm. Fiber wound filters can remove particles down to 0.5 µm. Sequence filters from the largest to the smallest pore opening. Sediment removal efficiency will be related to particle size distribution in the stormwater.

Treatment Process Description. Stormwater is collected at interception point(s) on the site and is diverted to a sediment pond or tank for removal of large sediment and storage of the stormwater before it is treated by the filtration system. The stormwater is pumped from the trap, pond, or tank through the filtration system in a rapid sand filtration system. Slow sand filtration systems are designed as flow through systems using gravity.

If large volumes of concrete are being poured, pH adjustment may be necessary.

Sizing Criteria for Flow-Through Treatment Systems for Flow Control

Exempt Water Bodies:

When sizing storage ponds or tanks for flow-through systems for flow control exempt water bodies the treatment system capacity should be a factor. The untreated stormwater storage pond or tank should be sized to hold 1.5 times the runoff volume of the 10-year, 24-hour storm event minus the treatment system flowrate for an 8-hour period. For a chitosan-enhanced sand filtration system, the treatment system flowrate should be sized using a hydraulic loading rate between 6 to 8 gpm/ft^2. Other hydraulic loading rates may be more appropriate for other systems. Bypass should be provided around the chemical treatment system to accommodate extreme storms.

Sizing Criteria for Flow Control Water Bodies:

Sites that must implement flow control for the developed site condition must also control stormwater release rates during construction. Construction site stormwater discharges shall not exceed the discharge durations of the pre-developed condition for the range of pre-developed discharge rates from 50 percent of the 2-year recurrence interval flow through the 10-year flow as predicted by an approved continuous runoff model. The pre-developed condition to be matched shall be the land cover condition immediately prior to the development project. This restriction on release rates can affect the size of the storage pond, the filtration system, and the flow rate through the filter system.

The following is how WWHM can be used to determine the release rates from the filtration systems:

- Determine the pre-developed flow durations to be matched by entering the land use area under the "Pre-developed" scenario in WWHM. The default flow range is from 50 percent of the 2-year recurrence interval flow through the 10-year flow.

- Enter the post developed land use area in the "Developed Unmitigated" scenario in WWHM.

- Copy the land use information from the "Developed Unmitigated" to "Developed Mitigated" scenario.

- There are two possible ways to model stormwater filtration systems:

The stormwater filtration system uses an untreated stormwater storage pond/tank and the discharge from this pond/tank is pumped to one or more filters. In-line filtration chemicals would be added to the flow right after the pond/tank and before the filter(s). Because the discharge is pumped, WWHM cannot generate a stage/storage/discharge (SSD) table for this system. This system is modeled the same way as described in BMP C250 and is as follows:

> While in the "Developed Mitigated" scenario, add a pond element under the basin element containing the post-developed land use areas. This pond element represents information on the available untreated stormwater storage and discharge from the filtration system. In cases where the discharge from the filtration system is controlled by a pump, a stage/storage/ discharge (SSD) table representing the pond must be generated outside WWHM and imported into WWHM. WWHM can route the runoff from the post-developed condition through this SSD table (the pond) and determine compliance with the flow duration standard. This would be an iterative design procedure where if the initial SSD table proved to be out of compliance, the designer would have to modify the SSD table outside WWHM and re-import in WWHM and route the runoff through it again. The iteration will continue until a pond that enables compliance with the flow duration standard is designed.

Notes on SSD table characteristics:

The pump discharge rate would likely be initially set at just below one-half if the 2-year recurrence interval flow from the pre-developed condition. As runoff coming into the untreated stormwater storage pond increases and the available untreated stormwater storage volume gets used up, it would be necessary to increase the pump discharge rate above 50 percent of the 2-year recurrence interval flow. The increase(s) above 50 percent of the 2-year must be such that they provide some relief to the untreated stormwater storage needs but at the same time they will not cause violations of the flow duration standard at the higher flows. The final design SSD table will identify the appropriate pumping rates and the corresponding stage and storages.

When building such a flow control system, the design must ensure that any automatic adjustments to the pumping rates will be as a result of changes to the available storage in accordance with the final design SSD table.

The stormwater filtration system uses a storage pond/tank and the discharge from this pond/tank gravity flows to the filter. This is usually a slow sand filter system and it is possible to model it in WWHM as a Filter element or as a combination of Pond and Filter element placed in series. The stage/storage/ discharge table(s) may then be generated within WWHM as follows:

While in the "Developed Mitigated" scenario, add a Filter element under the basin element containing the post-developed land use areas. The length and width of this filter element would have to be the same as the bottom length and width of the upstream untreated stormwater storage pond/tank.

In cases where the length and width of the filter is not the same as those for the bottom of the upstream untreated stormwater storage tank/pond, the treatment system may be modeled as a Pond element followed by a Filter element. By having these two elements, WWHM would then generate a SSD table for the storage pond which then gravity flows to the Filter element. The Filter element downstream of the untreated stormwater storage pond would have a storage component through the media, and an overflow component for when the filtration capacity is exceeded.

WWHM can route the runoff from the post-developed condition through the treatment systems in 4b and determine compliance with the flow duration standard. This would be an iterative design procedure where if the initial sizing estimates for the treatment system proved to be inadequate, the designer would have to modify the system and route the runoff through it again. The iteration would continue until compliance with the flow duration standard is achieved.

- It should be noted that the above procedures would be used to meet the flow control requirements. The filtration system must be able to meet the runoff treatment requirements. It is likely that the discharge flow rate of 50 percent of the 2-year recurrence interval flow or more may exceed the treatment capacity of the system. If that is the case, the untreated stormwater discharge rate(s) (i.e., influent to the treatment system) must be reduced to allow proper treatment. Any reduction in the flows would likely result in the need for a larger untreated stormwater storage volume.
- If system design does not allow you to discharge at the slower rates as described above and if the site has a retention or detention pond that will serve the planned development, the discharge from the treatment system may be directed to the permanent retention/detention pond to comply with the flow control requirements. In this case, the untreated stormwater storage pond and treatment system will be sized according to the sizing criteria for flow-through treatment systems for flow control exempt waterbodies described earlier except all discharges (water passing through the treatment system and stormwater bypassing the treatment system) will be directed into the permanent retention/detention pond. If site constraints make locating the untreated stormwater storage pond difficult, the permanent retention/detention pond may be divided to serve as the untreated stormwater discharge pond and the post-treatment flow control pond. A berm or barrier must be used in this case so the untreated water does not mix with the treated water. Both untreated stormwater storage requirements, and adequate post-treatment flow control must be achieved. The post-treatment flow control pond's revised dimensions must be entered into the WWHM and the WWHM must be run to confirm compliance with the flow control requirement.

Maintenance Standards

Rapid sand filters typically have automatic backwash systems that are triggered by a pre-set pressure drop across the filter. If the backwash water volume is not large or substantially more turbid than the stormwater stored in the holding pond or tank, backwash return to the pond or tank may be appropriate. However, land application or another means of treatment and disposal may be necessary.

- Screen, bag, and fiber filters must be cleaned and/or replaced when they become clogged.
- Sediment shall be removed from the storage and/or treatment ponds as necessary. Typically, sediment removal is required once or twice during a wet season and at the decommissioning of the ponds.

3.2.19 BMP C252: High pH Neutralization Using CO_2

Description

When pH levels in stormwater rise above 8.5, it is necessary to lower the pH levels to the acceptable range of 6.5 to 8.5, this process is called pH neutralization. The pH neutralization involves the use of solid or compressed carbon dioxide gas in water requiring neutralization. Neutralized stormwater may be discharged to surface waters under the General Construction NPDES Permit but neutralized process water must be managed to prevent discharge to surface waters. Process wastewater includes wastewaters such as concrete truck wash-out, hydro-demolition, or saw-cutting slurry.

Reason for pH Neutralization

- A pH level range of 6.5 to 8.5 is typical for most natural watercourses, and this neutral pH is required for the survival of aquatic organisms. Should the pH rise or drop out of this range, fish and other aquatic organisms may become stressed and may die.
- Calcium hardness can contribute to high pH values and cause toxicity that is associated with high pH conditions. A high level of calcium hardness in waters of the state is not allowed.
- The water quality standard for pH in Washington State is in the range of 6.5 to 8.5. Groundwater standard for calcium and other dissolved solids in Washington State is less than 500 mg/l.

Causes of High pH

High pH at construction sites is most commonly caused by the contact of stormwater with poured or recycled concrete, cement, mortars, and other Portland cement or lime-containing construction materials. (See BMP C151: Concrete Handling for more information on concrete handling procedures.) The principal caustic agent in cement is calcium hydroxide (free lime).

Advantages of CO_2 Sparging

- Rapidly neutralizes high pH water
- Cost effective and safer to handle than acid compounds
- CO_2 is self-buffering. It is difficult to overdose and create harmfully low pH levels.
- Material is readily available.

The Chemical Process

- When carbon dioxide (CO_2) is added to water (H_2O), carbonic acid (H_2CO_3) is formed which can further dissociate into a proton (H^+) and a bicarbonate anion (HCO_3^-) as shown below:

$$CO_2 + H_2O \longleftrightarrow H_2C0_3 \longleftrightarrow H^+ + HCO_3^-$$

- The free proton is a weak acid that can lower the pH. Water temperature has an effect on the reaction as well. The colder the water temperature is the slower the reaction occurs and the warmer the water temperature is the quicker the reaction occurs. Most construction applications in Washington State have water temperatures in the 50°F or higher range so the reaction is almost simultaneous.

Treatment Procedures

- High pH water may be treated using continuous treatment, continuous discharge systems. These manufactured systems continuously monitor influent and effluent pH to ensure that pH values are within an acceptable range before being discharged. All systems must have fail safe automatic shut off switches in the event that pH is not within the acceptable discharge range. Only trained operators may operate manufactured systems. System manufacturers often provide trained operators or training on their devices.

- The following procedure may be used when not using a continuous discharge system:

  Prior to treatment, Tumwater must be notified.

  Every effort should be made to isolate the potential high pH water in order to treat it separately from other stormwater on-site.

  Water should be stored in an acceptable storage facility, detention pond, or containment cell prior to treatment.

  Transfer water to be treated to the treatment structure. Ensure that treatment structure size is sufficient to hold the amount of water that is to be treated. Do not fill tank completely, allow at least 2 feet of freeboard.

  The operator samples the water for pH and notes the clarity of the water. As a rule of thumb, less CO_2 is necessary for clearer water. This information should be recorded.

In the pH adjustment structure, add CO_2 until the pH falls in the range of 6.9 to 7.1. Remember that pH water quality standards apply so adjusting pH to within 0.2 pH units of receiving water (background pH) is recommended. It is unlikely that pH can be adjusted to within 0.2 pH units using dry ice. Compressed carbon dioxide gas should be introduced to the water using a carbon dioxide diffuser located near the bottom of the tank; this will allow carbon dioxide to bubble up through the water and diffuse more evenly.

Slowly release the water to discharge making sure water does not get stirred up in the process. Release about 80 percent of the water from the structure leaving any sludge behind.

Discharge treated water through a pond or drainage system.

Excess sludge needs to be disposed of properly as concrete waste. If several batches of water are undergoing pH treatment, sludge can be left in treatment structure for the next batch treatment. Dispose of sludge when it fills 50 percent of tank volume.

- Sites that must implement flow control for the developed site must also control stormwater release rates during construction. All treated stormwater must go through a flow control facility before being released to surface waters which require flow control.

Safety and Materials Handling

- All equipment should be handled in accordance with OSHA rules and regulations
- Follow manufacturer guidelines for materials handling.

Operator Records

- Each operator should provide:

  A diagram of the monitoring and treatment equipment

  A description of the pumping rates and capacity the treatment equipment is capable of treating.

- Each operator should keep a written record of the following:

  Client name and phone number

  Date of treatment

  Weather conditions

Project name and location

Volume of water treated

pH of untreated water

Amount of CO_2 needed to adjust water to a pH range of 6.9 to 7.1

pH of treated water

Discharge point location and description.

A copy of this record should be given to the client/contractor who should retain the record for 3 years.

3.2.20 BMP C253: pH Control for High pH Water

Description

When pH levels in stormwater rise above 8.5, it is necessary to lower the pH levels to the acceptable range of 6.5 to 8.5; this process is called pH neutralization. Stormwater with pH levels exceeding water quality standards may be treated by infiltration, dispersion in vegetation or compost, pumping to a sanitary sewer, disposal at a permitted concrete batch plant with pH neutralization capabilities, or carbon dioxide sparging. BMP C252 gives guidelines for carbon dioxide sparging, the other methods are presented below.

Reason for pH Neutralization

A pH level between 6.5 and 8.5 is typical for most natural watercourses, and this pH range is required for the survival of aquatic organisms. Should the pH rise or drop out of this range, fish and other aquatic organisms may become stressed and may die.

Causes of High pH

High pH levels at construction sites are most commonly caused by the contact of stormwater with poured or recycled concrete, cement, mortars, and other Portland cement or lime-containing construction materials. (See BMP C151: Concrete Handling for more information on concrete handling procedures.) The principal caustic agent in cement is calcium hydroxide (free lime).

Disposal Methods

Infiltration

- Infiltration is only allowed if soil type allows all water to infiltrate (no surface runoff) without causing or contributing to a violation of surface or groundwater quality standards.

- Infiltration techniques should be consistent with Volume V, Chapter 6.

Dispersion

- Use Volume III, sheet flow or concentrated flow dispersion.

Sanitary Sewer Disposal

- Tumwater approval is required prior to disposal via the sanitary sewer.

Concrete Batch Plant Disposal

- Only permitted facilities may accept high pH water
- Facility should be contacted before treatment to ensure they can accept the high pH water.

Stormwater Discharge

- Any pH treatment options that generate treated water that must be discharged off site are subject to flow control requirements. Sites that must implement flow control for the developed site must also control stormwater release rates during construction. All treated stormwater must go through a flow control facility before being released to surface waters which require flow control.

APPENDIX C

SITE INSPECTION FORMS AND SITE LOGS

Emergency Phone Numbers

Fire, Police, Ambulance	911
Owner:	
General Contractor	Office: Site
	Mobile #
Subcontractors	
Sub #1)	Office:
Sub #2	
Sub #3	
Sub #4	
City or County Contact	
State Ecology Dept.	

Spill Report Form

LOCATION:____

Date:__________________ Time:______________________

Regulatory agencies notified (date, time, person, agency, and how):__________________

Material spilled:____

Quantity spilled:____

Source:____

Cause:____

Extent of injuries (if any):____

Adverse environmental impact (if any):____

Immediate remedial actions taken at time of spill:____

Measures taken or planned to prevent recurrence:____

Additional comments:____

This report prepared by: ______________________________
(Signature)

________________________ ______________________________

Storm water Monitoring Form

PROJECT:	**CONTRACTOR:**
RECEIVING WATER:	**MONITOR PERFORMED BY:**

Monitoring date:______________________________Time:__________________________

Current weather conditions:____

Previous 24-hour weather conditions:____

SAMPLING POINT	TURBIDITY (NTU)
Up-Stream	
Adjacent	
Downstream	

Comments:____

____

____

____

____

____

Sampler's Signature:__________________________   ______________________________

signature   print name

Table 1

BMP Maintenance and Inspection Schedule
(Source Control BMPs)

UPS Tumwater
Tumwater, WA

BMP Designation	BMP Name	Recommended Maintenance	Recommended Schedule of Maintenance
C101	Preserving Natural Vegetation	Inspect flagged areas to make sure flagging has not been removed. If tree roots have been exposed or injured, recover and/or seal them.	Daily
C102	Buffer Zones	Inspect the area frequently to make sure flagging remains in place and the area remains undisturbed.	Daily
C103	Plastic or Metal Fence	If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.	Daily
C104	Stake and Wire Fence	If the fence has been damaged or visibility reduced, it shall be repaired or replaced immediately and visibility restored.	Daily
C105	Stabilized Construction Entrance and Tire Wash	Quarry spalls (or hog fuel) shall be added if the pad is no longer in accordance with the specifications. If the rock (or hog fuel) entrance is not working to keep streets clean, then install wheel wash, sweep streets, or wash streets if wash water can be collected.	Daily
C106	Wheel Wash	Wheel wash water shall not be discharged into a storm drain or the site's storm water collection system. Use closed-loop recirculation, land application, or discharge to sanitary sewer (by permit).	Daily
C107	Const. Road Stabilization	Inspect stabilized areas regularly, especially after large storm events. Add rock (hog fuel), gravel, etc. as needed to maintain a stable surface which won't erode.	Daily
C120	Temporary & Permanent Seeding	Re-seed areas failing to establish 80% cover within one month (during growing season). If re-seeding is ineffective, use sodding or nets/blankets. Eroded areas shall be corrected, re-planted, and irrigated as required.	Inspect to ensure growth weekly
C121	Mulching	Maintain specified thickness of mulch cover. Eroded areas must be corrected and re-mulched. Drainage problems must be corrected.	Weekly and following storms

BMP Designation	BMP Name	Recommended Maintenance	Recommended Schedule of Maintenance
C122	Nets and Blankets	Inspect to ensure good contact with ground and no erosion of soils. Replace damaged material and re-staple where required. Correct erosion problems immediately.	Weekly and following storms
C123	Plastic Covering	Replace torn sheets and repair open seams. Replace deteriorated plastic sheets. Dispose of plastic when no longer needed.	Weekly
C124	Sodding	If sod is unhealthy correct problem. If sod can't be established seed area and use net or blanket to stabilize soils.	Weekly and following storms
C125	Top Soiling	Inspect stockpiles regularly, especially after large storm events. Stabilize areas that have eroded.	Weekly and following storms
C126	Polyacrylamide Application	Reapply PAM to actively worked soils at 48-hr. intervals not to exceed 7 application per month. Reapply PAM to undisturbed soils at 2-month intervals.	Daily
C130	Surface Roughening	Seed roughened surfaces as soon as possible. Re-grade and re-seed any areas beginning to erode.	Weekly and following storms
C131	Gradient Terraces	Maintenance should be performed as needed.	Annually and following large storm events
C140	Dust Control	Re-apply dust control measures as necessary to keep dust to a minimum.	Daily during dry weather

Table 2

BMP Maintenance and Inspection Schedule
(Runoff, Conveyance, and Treatment BMPs)

UPS Tumwater
Tumwater, WA

BMP Designation	BMP Name	Recommended Maintenance	Recommended Schedule of Maintenance
C200	Interceptor Dike & Swale	Inspect to insure structural integrity. Repair as needed	Weekly and following storms
C201	Grass-Lined Channels	During growth period, inspect grass after rainstorms. Remove accumulated sediments. Inspect outlets to prevent scouring and erosion.	Weekly and following storms
C202	Riprap Channel Lining	Inspect to ensure underlain soils are not eroding. Inspect for slippage on slopes.	Weekly and following storms
C204	Pipe Slope Drains	Check inlets for undercutting and outlets for erosion after rainstorms. Inspect pipe for damage. Check pipe for clogging debris.	Weekly and following storms
C205	Subsurface Drains	Check to ensure drains are not clogged with sediment or plant roots. Prevent heavy truck traffic from crushing piping.	Monthly
C206	Level Spreader	Check to ensure proper functioning after rainstorms. Prevent traffic from crossing the spreader. Repair if damaged.	Weekly and following storms
C207	Check Dams	Remove sediment when one half the sump depth. Check for erosion around edges of dams.	Weekly and following storms
C209	Outlet Protection	Inspect and repair as needed. Add rock as needed. Clean energy dissipator if sediment builds up.	Weekly and following storms
C220	Storm Drain Inlet Protection	Replace clogged filter fabric. Clean sediment from stone filters. Do not wash collected sediments into storm drains – remove to soil stockpile.	Weekly and following storms
C230	Straw Bale Barrier	Inspect daily during rainy periods. Check for undercutting, end runs, and damaged bales. Remove accumulated sediment when one half the barrier height.	Daily during prolonged rainy periods.
C231	Brush Barrier	Inspect daily during rainy periods. Check for undercutting, end runs, and damaged sections. Remove accumulated sediment.	Weekly and following storms

BMP Designation	BMP Name	Recommended Maintenance	Recommended Schedule of Maintenance
C232	Silt Fence	Repair damaged fencing immediately. Intercept concentrated flows and reroute. Remove sediment accumulations at 6-inches. Replace deteriorated fencing material. Properly dispose of used fencing.	Weekly and following storms
C233	Vegetated Strip	Re-seed damaged areas immediately. Install sod to replace eroded vegetation. Reroute concentrated flows through vegetated strip	Weekly and following storms
C240	Sediment Trap	Remove sediment when it reaches a depth of one foot. Repair damage to trap embankments and slopes.	Weekly and following storms
C241	Sediment Pond	Remove sediment when it reaches a depth of one foot. Repair damage to pond embankments and slopes.	Weekly and following storms
C250	Storm water Chemical Treatment	See Monitoring in Section 11	As required

Erosion and Sediment Control Inspection Form
Erosion Prevention

Inspector(s):______________________________Date:_______________

Site Name and Location:____

Current Weather Conditions:_____________ Last 24 Hours:_____________

BMP Designation	O.K	Not O.K.	BMP Condition, Corrective Action, General Notes
Construction Access Trackout? Street Clean?			
Soil Stabilization Signs of Erosion: Gullies? Slope Failures? Rills?			
Slope Protection Plastic Condition? Grass Growing? Hydroseed Condition? Matting?			
Perimeter Control Clearing Limits Marked? Silt Fences? Swales?			
Conveyances Stable Ditches? Check Dams Intact? Sand Bags? Slope Drains?			
TESC Management Revisions Required?			
Water Management Infiltration System? lean and Dirty Water Separated Offsite Water Bypassing?			
Outlet Protection Stabilized?			

Erosion and Sediment Control Inspection Form

Sediment Control

BMP Designation	O.K	Not O.K.	BMP Condition, Corrective Action, General Notes
Storm water Detention And Monitoring			
BMP Maintenance			
Inlet Protection			
Dust Control			
Spill Prevention			
Condition of Discharge Water			

Comments:

APPENDIX D

ENGINEERING CALCULATIONS

SEE ATTACHED DRAINAGE REPORT

Drainage Report

Stormwater Infiltration Gallery

for

United Parcel Service – Tumwater
(UIC 23315)

7383 New Market Street SW
Tumwater, WA 98501

Prepared By:
Pacific Engineering Design, LLC
15445 53rd Ave S., Suite 100
Seattle, WA 98188
Phone: (206) 431-7970
Fax: (206) 388-1648

Joseph M. Hopper, P.E.

JOSEPH M. HOPPER
41823
12/12/12

December 12, 2012 PED Job No. 12026

Facility:
UPS-Tumwater (WATUM)

WSDOE Underground Injection Control (UIC) Site Number:
23315

Facility Address:
7383 New Market Street SW, Tumwater, WA 98501

County:
Thurston

UPS Facility Contact:
Mr. Aaron Johnson, UPS Plant Engineering Manager-Washington District
Address: 4455 7th Avenue South, Seattle, WA 98108-1796
Office Phone: 206-621-6233
Email: ajohnson1@ups.com

Design Consulting Team Contacts:

Pacific Engineering Design, LLC
Joe Hopper, P.E.
Address: 15445 53rd Ave. South, Suite 100, Seattle, WA. 98188
Office Phone: 206-431-7970
Email: jhopper@paceng.com

Environmental Compliance Tools, LLC (ECTools)
Robin Sandell, CPSWQ
Address: 1403 W 3rd Ave, Durango CO 81301
Mobile: 303-929-7889
Email: rmsandell@ectonline.us

Report Status:
Final

TABLE OF CONTENTS

Appendix

- 11"x17" Construction Plans.
- SWPPP Site and Drainage Map, rev. date: 2/28/10.
- UPS Tumwater Basin Area Breakdown.
- Western Washington Hydrology Model (WWHM) Project Report.
- StormTech® MC-3500 Facility Sizing Spreadsheet
- WSDOE UIC Table: Design Requirements for Infiltration Trenches used for Flow Control (Soils not considered a Treatment BMP), dated September 2008.
- WSDOE UIC Program: Registration Letter, Dated: December 1, 2004.
- WSDOE UIC Program: Registration Form, Dated: February 9, 2004.
- UIC Well Assessment Special Protection Areas and Local Resource Evaluation Summary Table, Rev. Date: 2/23/11, pg. 1 of 1.
- UIC Well Assessment High Threat to Groundwater Evaluation Summary Table, Rev. Date: 2/28/11, pgs. 1-3 of 3.
- Washington State Department of Health – Wellhead Protection Zone Map, Rev. Date: 2/11/11.
- Washington State Department of Health – Surface Water Intake Protection Area Map, Rev. Date: 2/11/11.
- US EPA Designated Sole Aquifers in EPA Region 10, Idaho, Oregon, Washington, Dated: 7/21/2008.
- City of Tumwater Well Field Map.

- StormTech® MC-3500 Design Manual.
- StormTech® MC-3500 Technical Specifications
- StormTech® MC-3500 Construction Guide
- StormTech® Isolator™ Row O&M Manual
- Contech® CDS® Guide: Operation, Design, Performance and Maintenance
- Contech® CDS® CDS2015-4 Standard Detail
- Contech® CDS® Inspection and Maintenance Guide
- Contech® Storm Water Treatment Device Specifications
- Geotechnical Engineering Report, Geotech Consultants, Inc. Dated: 10/18/12.
- City of Tumwater Drainage Design & Erosion Control Manual, Appendix III-A, Methods for Determining Design Infiltration Rates.
- City of Tumwater Drainage Design & Erosion Control Manual, Appendix V-C, Maintenance Guidelines.
    - Table C-4. Maintenance Checklist for Infiltration Basins, Infiltration Trenches, and Bioinfiltration Swale.
    - Table C-13. Maintenance Checklist for Catch Basins and Inlets.
    - Table C-14. Maintenance Checklist for Energy Dissipators.

I. Project Overview

The site is located northwest of the Port of Olympia Airport. The site is more specifically located at 7383 New Market Street SW in Tumwater, Washington. The site is leased from the Port of Olympia by United Parcel Service to house a package distribution facility.

The goal of this project is to replace the infiltration gallery that infiltrates the storm water runoff from the western portion of the site with a new system.

The existing infiltration gallery appears to not work effectively at certain times during the rainy season. The gallery pipes may be plugged with sediment due to the age of the system and lack of proper maintenance. Storm water backs up into the parking lot during some storm events.

The site has been registered with the Washington State Department of Ecology (WSDOE) Underground Injection Control (UIC) Program. UIC Registration with WSDOE took place in 2004 and the site is listed as UIC site number 23315.

Existing Site Conditions

The site is located between Tumwater Boulevard (Airdustrial Way) and 73rd Ave SW, west of New Market Street SW. The site drains in two directions and can be defined as two separate basins, East and West. The eastern third of the site drains to the east toward New Market Street SW. The western two-thirds of the site drain to the west.

East Basin:
The eastern portion of the building's roof drains to the east and flows through downspouts that discharge onto the parking surface in front of the building. The surface drainage flows away from the building to the east to a landscape strip between the parking lot and New Market Street. The drainage flows to an existing drywell and is infiltrated into the ground. No improvements are proposed in this basin area.

West Basin:
The western portion of the building's roof drains to the west and flows through downspouts that discharge onto the parking surface. The surface drainage flows away from the building and generally to the west. Surface drainage is collected in two catch basins to the west of the building in the middle of the parking lot. CB1 and CB2 collect all the surface runoff in the west basin and convey the drainage to the north through a system of underground pipes. The pipes are routed through an oil/water separator and continue to the north to the infiltration gallery located north of the parking lot in a landscape area.

Fueling Area:
The fueling area roof drains through a downspout that discharges to the west through an underground pipe that is connected to CB1. The fueling area pavement surface is isolated from

the rest of the parking lot and is collected in a catch basin located to the east of the fuel pumps. The drainage is conveyed to the east through an underground pipe that is routed through an oil/water separator. The flow continues to the east and connects to the Sanitary Sewer system. Surface runoff from the fueling area does not flow to the above mentioned infiltration gallery.

Infiltration Gallery:

The existing infiltration gallery identified in a site visit on August 24, 2012, is two parallel 8-inch perforated PVC pipes that run east-west. The gallery is located directly behind the northerly curb line in the northwest landscape area. Pipe ends of two 8-inch pipes were located approximately 100-feet west of the northwest corner of the building. It appears that these pipe ends are the east end of the infiltration gallery. It could not be determined where the west end of the gallery is located, nor the extents of the gallery trench. No records have been found to further identify the dimensions of the existing gallery.

Proposed Infiltration and Water Quality Facility

Infiltration Gallery:

An underground infiltration gallery system underneath the landscape area in the northwestern portion of the site will be used to discharge stormwater runoff into the ground. The existing infiltration gallery will be removed and replaced with a new system. The proposed system includes 27 StormTech® MC-3500 chambers. The first series of chambers will be wrapped in filter fabric to create an "Isolator Row", a proprietary water quality treatment element incorporating the StormTech® chambers, to remove sediment from the stormwater prior to infiltration.

CDS® Hydrodynamic Separator:

After the stormwater flows through the existing oil/water separator and prior to discharging to the proposed infiltration gallery, the stormwater will be routed through a Contech® CDS® Hydrodynamic Separator. This water quality element utilizes a patented continuous deflective separation technology to screen, separate and trap debris, sediment, and oil and grease from the stormwater runoff.

II. Flow Control and Water Quality Analysis

Hydraulic Analysis

The design for the proposed infiltration facility utilizes City of Tumwater drainage analysis standards. This requires using a continuous flow model such as the Western Washington Hydrology Model (WWHM).

Existing Conditions:
The total basin area for the West Basin is 1.53-acres. Existing site conditions as modeled reflect the pre-developed historic condition of the site. The calculations assume existing site conditions to be forested.

Existing condition:
Total Area = 1.53 acres
Impervious Area = 0.00 acres
Pervious Area (A/B Forest Flat) = 1.53 acres

Existing peak runoff rates:
Q_2 year = 0.0019 cfs.
Q_{10} year = 0.007 cfs.
Q_{100} year = 0.078 cfs.

Developed Conditions:
Developed site conditions as modeled reflect the current developed condition of the site. The proposal is to replace the existing infiltration facility with a new facility, no other new development activities are proposed.

Developed condition drainage area to proposed StormTech® chamber infiltration system:
Total Area = 1.53 acres
Impervious Area (Parking) = 1.20 acres
Impervious Area (Roof Flat) = 0.30 acres
Pervious Area (A/B Lawn Flat) = 0.03 acres

Developed peak runoff rates before infiltration:
Q_2 year = 0.050 cfs.
Q_{10} year = 0.096 cfs.
Q_{100} year = 0.186 cfs.

Infiltration Facility Design

The infiltration facility has been sized to detain up to the 100-year storm event in accordance with City of Tumwater drainage standards.

Washington State Department of Ecology's Western Washington Hydrology Model (WWHM) program was used to calculate the runoff rates and size the infiltration facility. Design infiltration rate used was 10in/hr. (see Geotechnical Engineering Report, Geotech Consultants, Inc., Dated: 10/18/12 in the appendix)

StormTech® Chamber Detention/Infiltration System:
Based on the calculations the live storage required for detention prior to infiltration is 5,174 cubic feet in accordance with WWHM modeling requirements in the 2009 DOE Stormwater Manual. The proposed system includes 27 StormTech® MC-3500 chambers (total 2 rows, 1 isolator row, 1 standard row) and a 120'Lx15'Wx5.5'H infiltration trench. The proposed design will provide at least 5,294 cubic feet of live storage (including storage in the trench, manifold pipes and manholes) between elevations 183.50 to 189.00'. (See WWHM Project Report and StormTech® Provided Calculations in the Appendix)

Water Quality Facility Design

Water Quality Volumes:

Water Quality Design Storm Volume per City of Tumwater's 2009 Drainage Design & Erosion Control Manual, Volume III, Chapter 2.1.3.:

> ***Preceding detention facilities or when detention facilities are not required:*** *The flow rate at or below which 91 percent of the runoff volume, as estimated by an approved continuous runoff model, shall be used as the design flow rate.*

Q_{100} year = 0.186 cfs x 91% = 0.169 cfs

The existing stormwater system will be intercepted prior to discharging to the StormTech® Chamber detention/infiltration system. Stormwater flows will be directed through a Contech® CDS® CDS2015-4 hydrodynamic separator.

Contech® CDS® Stormwater Treatment System:
Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated. Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped. Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection. During the flow events

exceeding the design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.

The maximum treatment capacity of the CDS separator specified above is 0.7cfs. The calculated 100 year storm event is 0.186cfs, so the CDS separator can convey the maximum flow rate from the site. The diversion weir in the CDS Separator will be sized to treat the Water Quality Treatment Volume of 0.169cfs and will safely convey or bypass flows greater than the 100 year peak flows.

III. Temporary Erosion and Sedimentation Control

Erosion and sedimentation control will be provided by utilizing BMPs selected from the 2010 City of Tumwater Drainage Design & Erosion Control Manual. These BMPs include, but are not necessarily limited to, silt fencing around the limits of construction, construction safety fencing as needed, plastic sheeting of stockpiles, straw mulch, hydro-seeding, and catch basin protection to prevent migration of soils from the construction area to surrounding catch basins.

A Temporary Sedimentation and Erosion Control Plan is included as part of the final construction documents detailing the means by which sediment and erosion control will be handled during construction. Notes, details and maintenance specifications of all BMPs are included on the plans.

Appendix

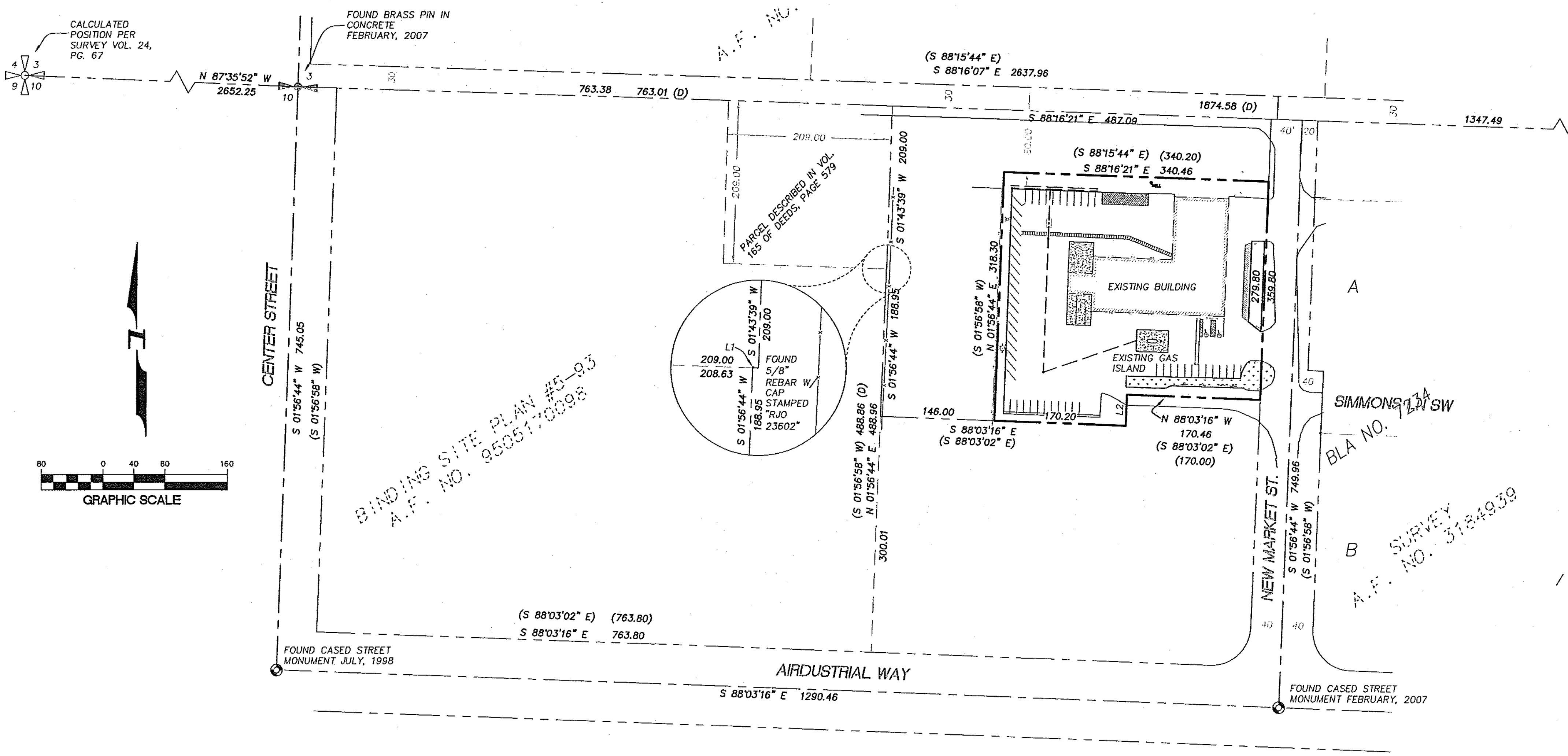
REVISIONS:

SW 1/4, SW 1/4 SEC. 10, T. 17 N., R. 2 W., W.M.

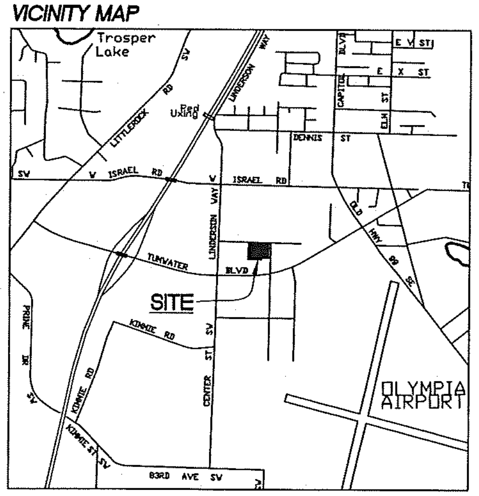
TUMWATER UPS

TUMWATER, WA

(PROJECT NO. 12026)



VICINITY MAP



SHEET INDEX

C01	COVER SHEET
C02	GRADING AND DRAINAGE
C03	DETAILS
C04	TEMPORARY EROSION AND SEDIMENTATION CONTROL PLAN

SURVEY REFERENCES:

BINDING SITE PLAN # 5-93 AS RECORDED MAY 17. 1995 UNDER AUDITOR'S FILE NO. 9505170098

BASIS OF BEARING:

CITY OF TUMWATER COORDINATE SYSTEM BASED UPON THE NORTH LINE OF THE NORTHEAST QUARTER OF SECTION 10, TOWNSHIP 17 NORTH, RANGE 2 WEST, W.M. EQUALS SOUTH 88°16'21" EAST

OWNERS/DEVELOPERS:

UNITED PARCEL SERVICE
7383 NEW MARKET ST SW
TUMWATER, WA 98501
AARON JOHNSON
(206) 621-6233

CIVIL ENGINEER:

PACIFIC ENGINEERING DESIGN, LLC
15445 53RD AVE S.
SEATTLE, WA 98188
JOE HOPPER
PHONE: (206) 431-7970
FAX: (206) 388-1648

SURVEYOR:

HATTON GODAT PANTIER
3910 MARTIN WAY E, SUITE B
PHONE: (360) 943-1599

OWNER OF RECORD:

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7643 OLD HWY 99 SE
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JOSEPH M. HOPPER
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CITY OF TUMWATER, WA

TUMWATER UPS

FOR:
UNITED PARCEL SERVICE
7383 NEW MARKET ST SW
TUMWATER, WA 98501
AARON JOHNSON
(206) 621-6233

PROJECT NO.: 12026
DRAWN BY: ENM
ISSUE DATE: 12/12/12
SHEET REV.:

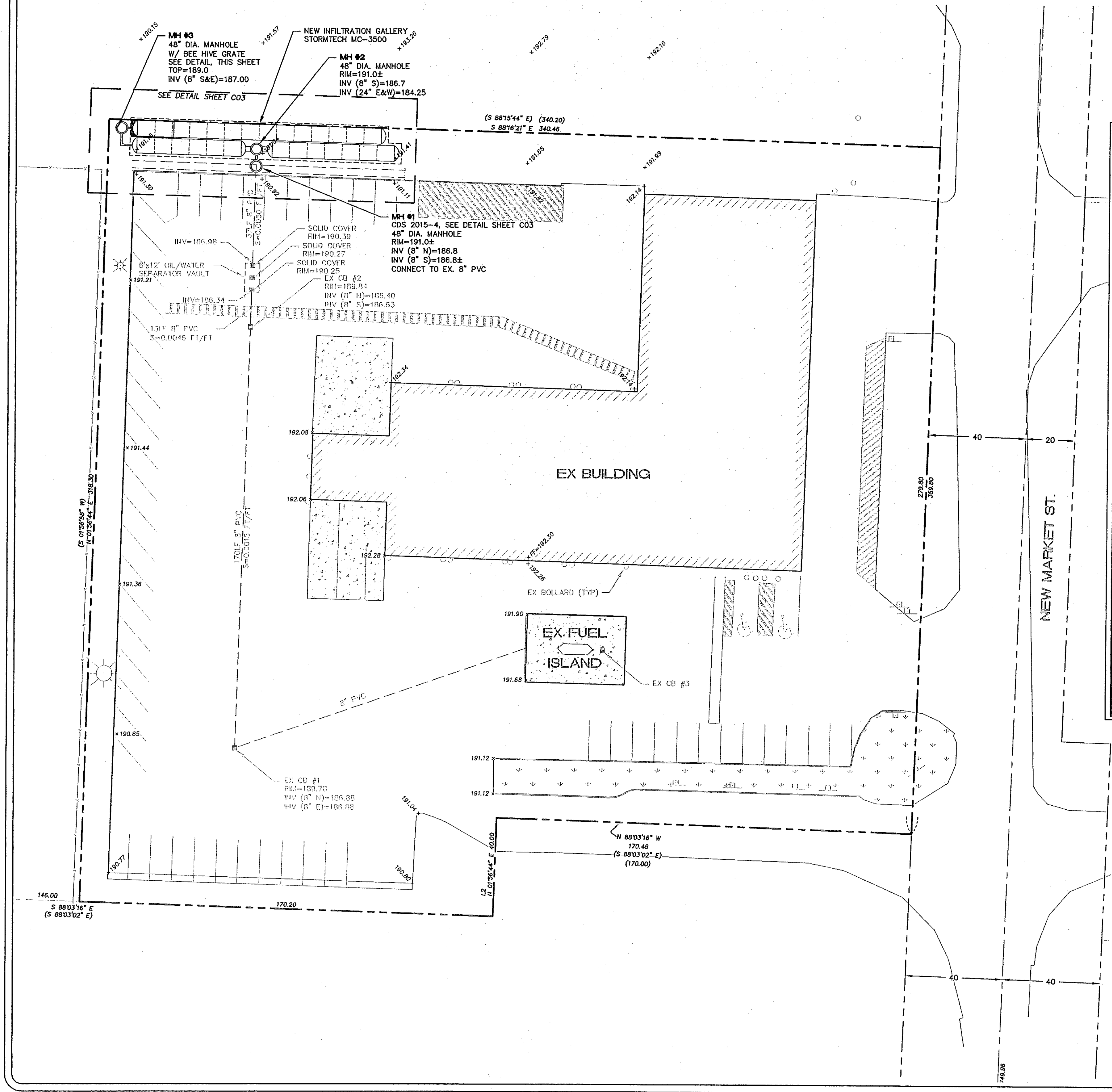
COVER SHEET

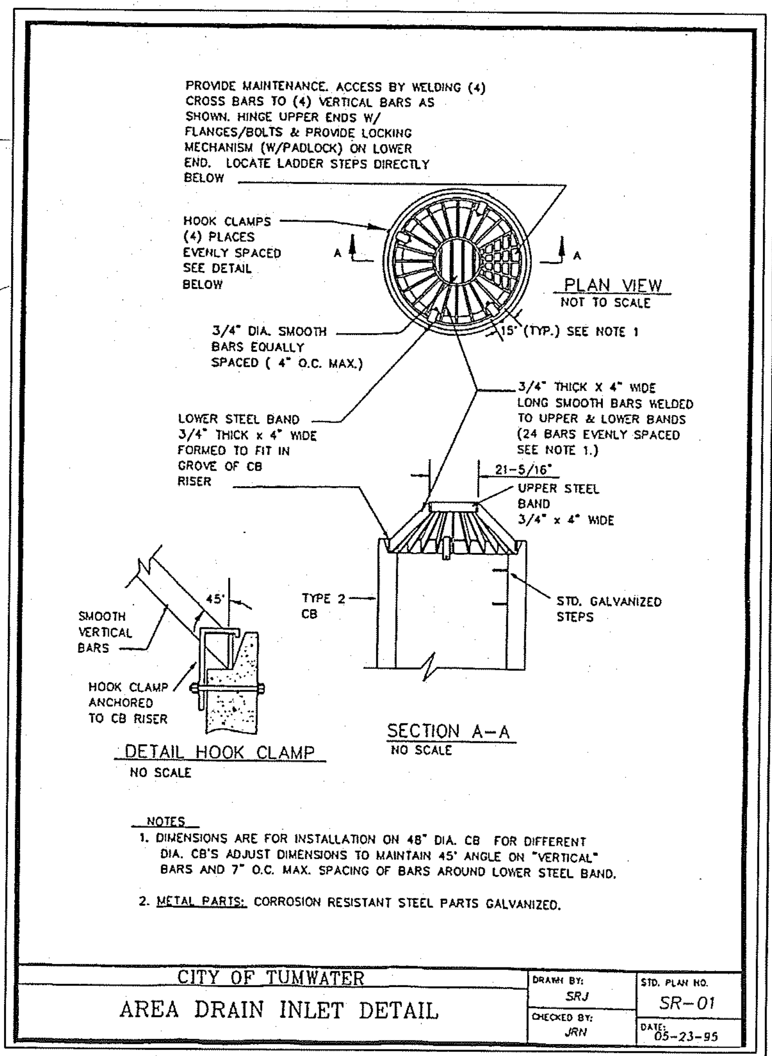
12026CV01.DWG

C01

SHEET 01 OF 04

REVISIONS:





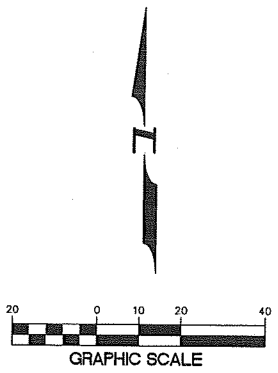
NOTES

1. DIMENSIONS ARE FOR INSTALLATION ON 48" DIA. CB FOR DIFFERENT DIA. CB'S ADJUST DIMENSIONS TO MAINTAIN 45° ANGLE ON "VERTICAL" BARS AND 7" O.C. MAX. SPACING OF BARS AROUND LOWER STEEL BAND.

2. METAL PARTS: CORROSION RESISTANT STEEL PARTS GALVANIZED.

CITY OF TUMWATER AREA DRAIN INLET DETAIL	DRAWN BY: SRJ CHECKED BY: JRN	STD. PLAN NO. SR-01 DATE: 05-23-95

(FROM CITY OF TUMWATER DEVELOPMENT GUIDE)



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TUMWATER UPS

CITY OF TUMWATER, WA

FOR:
UNITED PARCEL SERVICE
4455 7TH AVE S
SEATTLE, WA 98108
TREAIR SMITH - FACILITY SUPERVISOR
(206) 621-6380

PROJECT NO.: 12026
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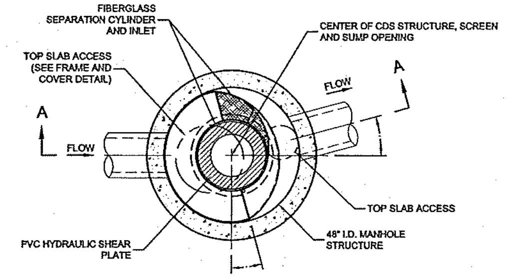
GRADING AND DRAINAGE

12026GR01.DWG

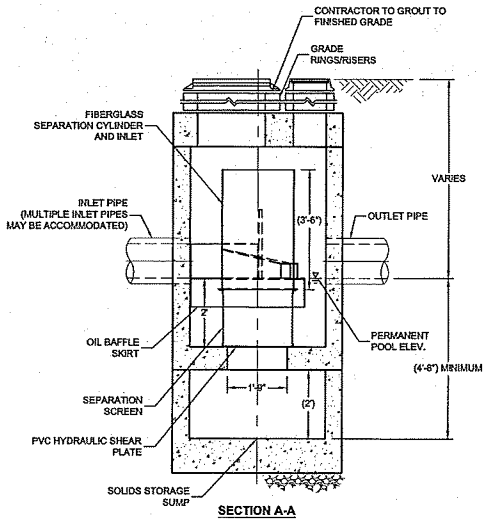
C02

SHEET 02 OF 04

REVISIONS:



PLAN VIEW
N.T.S.



SECTION A-A
N.T.S.

CDS2015-4 DESIGN NOTES

CDS2015-4 RATED TREATMENT CAPACITY IS 0.7 CFS, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 10.0 CFS. IF THE SITE CONDITIONS EXCEED 10.0 CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS2015-4 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

DESIGNATION (MODEL SUFFIX)	CONFIGURATION DESCRIPTION
G	GRATED INLET ONLY (NO INLET PIPE)
GP	GRATED INLET WITH INLET PIPE OR PIPES
K	CURB INLET ONLY (NO INLET PIPE)
KP	CURB INLET WITH INLET PIPE OR PIPES

SITE SPECIFIC DATA REQUIREMENTS

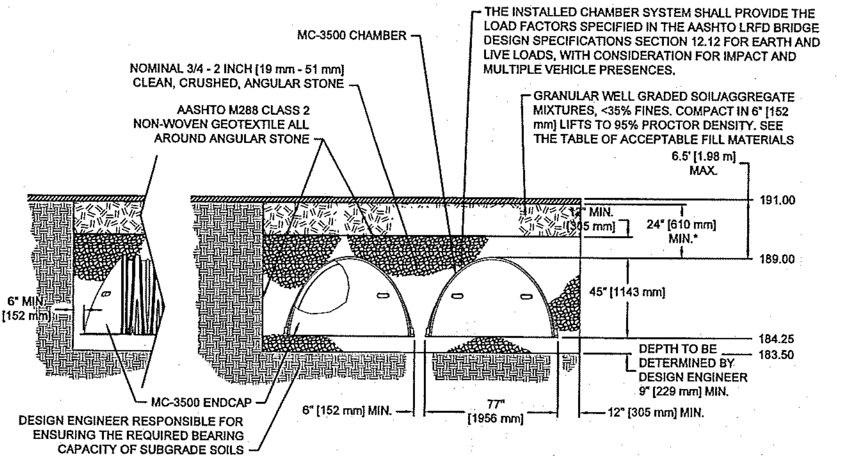
STRUCTURE ID			MH #1
WATER QUALITY FLOW RATE (CFS)			0.169
PEAK FLOW RATE (CFS)			0.186
RETURN PERIOD OF PEAK FLOW (YRS)			100
SCREEN APERTURE (2400 OR 4700)			2400
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	186.8	PVC	8"
INLET PIPE 2	*	*	*
OUTLET PIPE	186.8	ADS N-12	8"
RIM ELEVATION			191.0
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			
* PER ENGINEER OF RECORD			

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH STORMWATER SOLUTIONS REPRESENTATIVE. www.contechstormwater.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE AND CASTINGS SHALL MEET AASHTO HS20 LOAD RATING.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

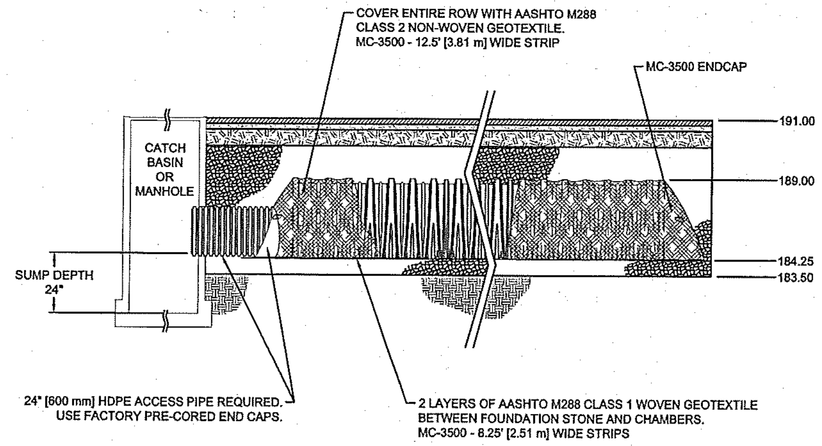
INSTALLATION NOTES
1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

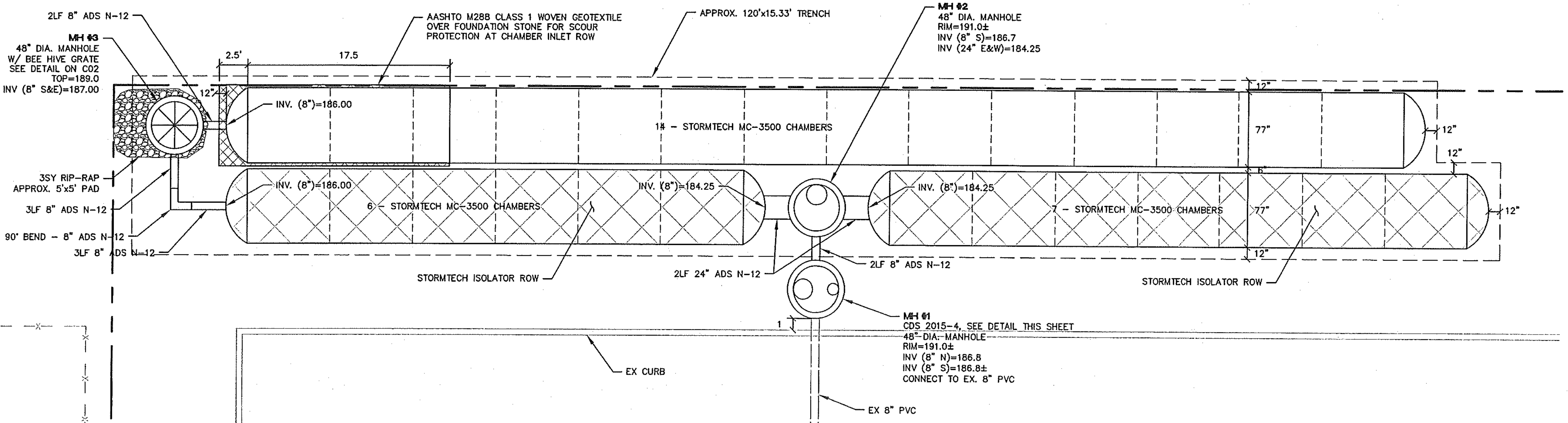
CDS2015-4
PRECAST CONCRETE WATER QUALITY SYSTEM
STANDARD DETAIL



STORMTECH MC-3500 - CROSS SECTION DETAIL
NTS



ISOLATOR ROW DETAIL
NTS



STORMTECH MC-3500 - PLAN VIEW DETAIL
SCALE: 1"=5'

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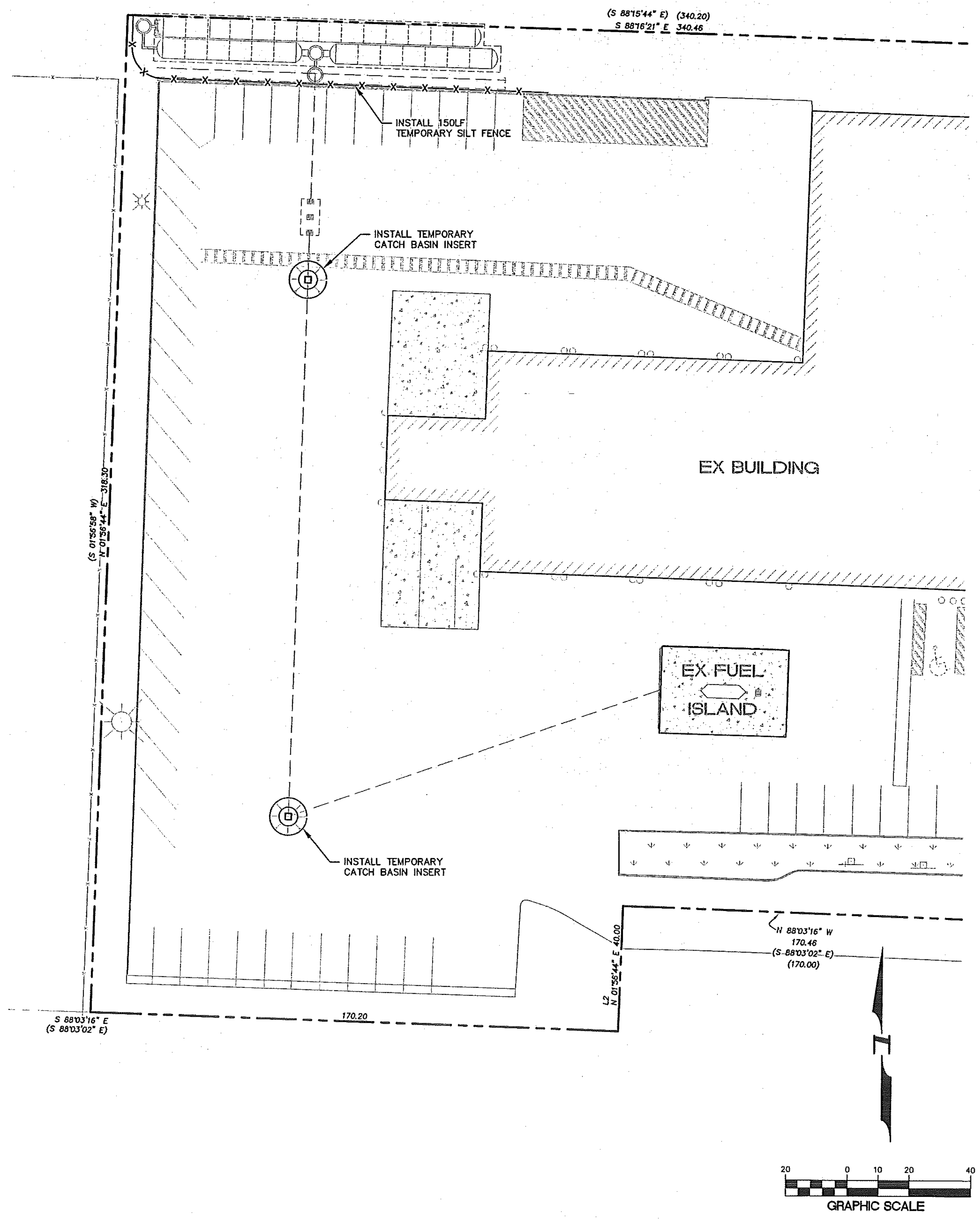
DETAILS

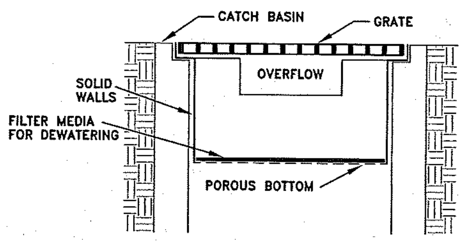
12026GR01.DWG

C03

SHEET 03 OF 04

REVISIONS:





NOTE: THIS DETAIL IS ONLY SCHEMATIC. ANY INSERT IS ALLOWED THAT HAS A MIN. 0.5 C.F. OF STORAGE, THE MEANS TO DEWATER THE STORED SEDIMENT, AN OVERFLOW, AND CAN BE EASILY MAINTAINED.

CATCH BASIN INSERT

NTS

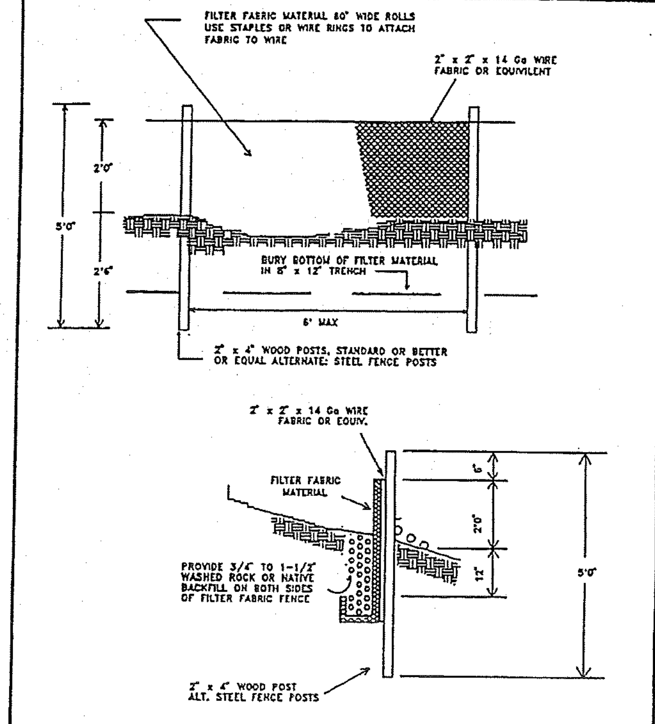
TEMPORARY EROSION AND SEDIMENT CONTROL STANDARD NOTES:

1. APPROVAL OF THIS EROSION/SEDIMENTATION CONTROL (ESC) PLAN DOES NOT CONSTITUTE AN APPROVAL OF PERMANENT ROAD OR DRAINAGE DESIGN (E.G. SIZE AND LOCATION OF ROADS, PIPES, RESTRICTORS, CHANNELS, RETENTION FACILITIES, UTILITIES, ETC.).
2. THE IMPLEMENTATION OF THESE ESC PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC FACILITIES IS THE RESPONSIBILITY OF THE APPLICANT/CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.
3. THE BOUNDARIES OF THE CLEARING LIMITS SHOWN ON THIS PLAN SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE APPLICANT/CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
4. THE ESC FACILITIES SHOWN ON THIS PLAN MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO INSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAINAGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.
5. THE ESC FACILITIES SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE
6. CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE ESC FACILITIES SHALL BE UPGRADED AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO ENSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT LEAVE THE SITE.
7. THE ESC FACILITIES SHALL BE INSPECTED DAILY BY THE APPLICANT/CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING.
8. THE ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE A MONTH OR WITHIN THE 48 HOURS FOLLOWING A MAJOR STORM EVENT.
9. AT NO TIME SHALL MORE THAN ONE FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A TRAPPED CATCH BASIN. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
10. STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.

CONSTRUCTION SEQUENCE:

1. PRE-CONSTRUCTION MEETING.
2. FLAG OR FENCE CLEARING LIMITS.
3. INSTALL CATCH BASIN PROTECTION IF REQUIRED.
4. INSTALL PERIMETER PROTECTION (SILT FENCE, BRUSH BARRIER, ETC.).
5. MAINTAIN EROSION CONTROL MEASURES IN ACCORDANCE WITH KING COUNTY STANDARDS AND MANUFACTURER'S RECOMMENDATIONS.
6. RELOCATE EROSION CONTROL MEASURES OR INSTALL NEW MEASURES SO THAT AS SITE CONDITIONS CHANGE THE EROSION AND SEDIMENT CONTROL IS ALWAYS IN ACCORDANCE WITH THE CITY OF TUMWATER EROSION AND SEDIMENT CONTROL STANDARDS.
7. COVER ALL AREAS THAT WILL BE UNWORKED FOR MORE THAN SEVEN DAYS DURING THE DRY SEASON OR TWO DAYS DURING THE WET SEASON WITH STRAW, WOOD FIBER MULCH, COMPOST, PLASTIC SHEETING OR EQUIVALENT.
8. STABILIZE ALL AREAS THAT REACH FINAL GRADE WITHIN SEVEN DAYS.
9. SEED OR SOD ANY AREAS TO REMAIN UNWORKED FOR MORE THAN 30 DAYS.
10. UPON COMPLETION OF THE PROJECT, ALL DISTURBED AREAS MUST BE STABILIZED AND BMPS REMOVED IF APPROPRIATE.

STORM DRAINAGE DESIGN MANUAL | FIG B2



REFERENCE:
KING COUNTY, WASHINGTON, SURFACE WATER DESIGN MANUAL

DATE:
FEB. 1991

FILTER FABRIC FENCE DETAIL

(FROM CITY OF TUMWATER DEVELOPMENT GUIDE)

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PROJECT NO.: 12026
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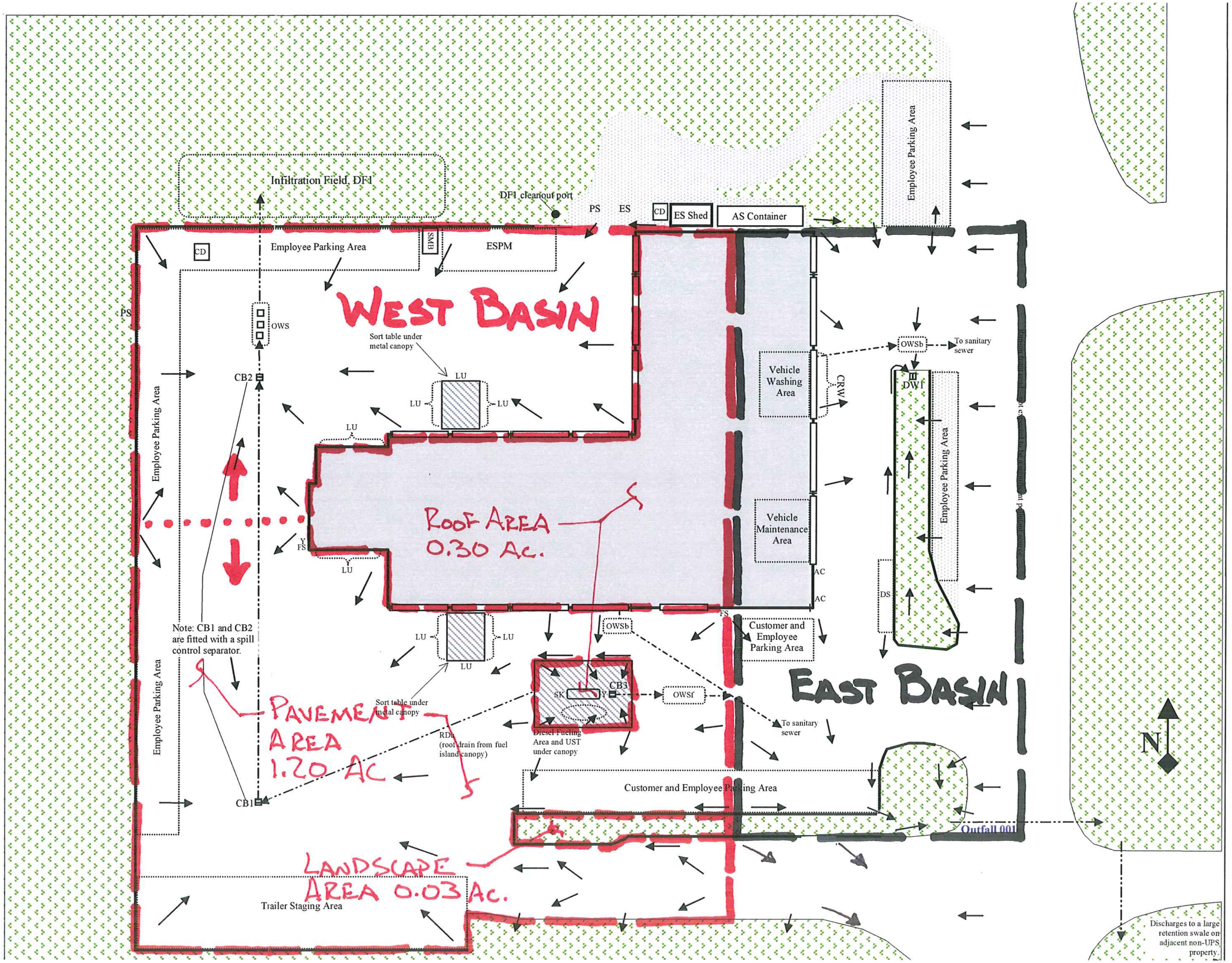
TEMPORARY EROSION AND SEDIMENTATION CONTROL PLAN

12026TE01.DWG

C04

SHEET 04 OF 04



UPS-Tumwater
Site and Drainage Map

⟶	Stormwater flow direction
▣	Storm sewer drain inlets
▯	Drywell
-·-·→	Underground separate storm sewer pipe
- - -→	Underground sanitary sewer pipe
⁘	Grass/vegetated area
▭	Overhead doors (vehicle entrance/exit)
+	RDa
░	Dirt/gravel surface

Acronym List:

AS: Automotive shop storage
CBx: Catch basin with numerical designator
CD: Covered dumpster
DFx: Drain field with numerical designator
DS: Dolly staging area
DWx: Drywell with numerical designator
ES: General equipment storage
ESPM: Equipment storage prior to maintenance area
LU: External loading/unloading area - against flush loading docks
OWSb: Oil/water separator for building floor drains (discharges to the municipal sanitary sewer system)
OWSf: Oil/water separator for fueling area stormwater discharge (discharges to the municipal sanitary sewer system)
PS: Pallet storage area (significant storage)
RDa: Roof drains that discharge aboveground
RDu: Roof drains that discharge underground
SK: Spill kit
Y: Yard trashcan – ***General*** location (covered)
UST: Underground storage tank

Allowable Non-Stormwater Discharges Present at Facility:

AC: Air conditioner condensate
CRW: Clean rinse water drag-out area
FS: Fire suppression system test discharge (potable water)

Map Notes:

- A spill control separator (elbow) has been installed in CB1 and CB2.
- **Vehicle and Floor Washing Wastewater Disposal**: The floor drains in the indoor loading/unloading, vehicle maintenance and vehicle washing areas discharge to the municipal sanitary sewer system.
- **Vehicle Maintenance:** Vehicle maintenance is performed inside the building. All vehicle maintenance materials are stored inside except scrap metal. Scrap metal is stored in a leak-free covered bin. The used oil aboveground storage tank (AST) is located inside the shop and is ~300 gallons. Transfers from the used oil AST generally only occur one to two times per year and the tanker truck parks inside the shop during the transfer. Spill cleanup material is available in the shop area (additional spill equipment is located nearby in the fueling area). Trained spill responders are available on-site to respond to spills. Mechanics are trained in spill prevention practices and spill response.
- All surfaces are paved unless otherwise indicated.

Rev. Date: 2/28/10
Not to Scale

JOB ____ #

CALCULATED BY ____ DATE ____

UPS TUMWATER BASIN AREAS

AREA CONTRIBUTING TO INFILTRATION GALLERY

PERVIOUS: LANDSCAPE = 1195 SF ~ 0.03 AC.

IMPERVIOUS: ROOF = 13,174 SF = 0.30 AC.
PAVEMENT = 52,196 SF = 1.20 AC.

TOTAL AREA = 66,565 SF = 1.53 AC.

DESIGN INFILTRATION RATE = 10 IN/HR

SOIL TYPE = OUTWASH : CLASS A/B

WWHM3 SIZING = 15.33 FT W x 90 FT L x 3.75 FT H
= 5,174 CF

STORMTECH SIZING = MC-3500 CHAMBERS - 27
40% VOIDS IN STONE

= 5,049 CF

ADDITIONAL TRENCH AREA = 4'x7'x 5.5' = 154cf
x 40% VOIDS

61 cf

STORAGE WITHIN PIPES & MANHOLES

2-48" DIA MANHOLE = 69 cf x2 = 138cf

4 LF-24" PIPE = 25 cf

10 LF - 8" PIPE = 21 cf

184 cf

TOTAL STORAGE:

REQUIRED (PER WWHM) = 5,174 cf

PROVIDED = STORMTECH TRENCH: 5049cf
ADDITIONAL TRENCH: 61 cf
PIPES & MANHOLES: 184cf

5,294 cf

Western Washington Hydrology Model
PROJECT REPORT

Project Name: Tumwater UPS
Site Address: 7383 New Market Street
City : Tumwater
Report Date : 10/4/2012
Gage : Olympia
Data Start : 1955/10/01
Data End : 1999/09/30
Precip Scale: 1.11
WWHM3 Version:

PREDEVELOPED LAND USE

Name : UPS Tumwater Predev
Bypass: No

GroundWater: No

Pervious Land Use	**Acres**
A B, Forest, Flat	1.53

Impervious Land Use	**Acres**

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : UPS Tumwater Dev
Bypass: No

GroundWater: No

Pervious Land Use	**Acres**
A B, Lawn, Flat	.03

Impervious Land Use	**Acres**
ROOF TOPS FLAT	0.3
PARKING FLAT	1.2

Element Flows To:

Surface	**Interflow**	**Groundwater**
Infiltration Gallery,	Infiltration Gallery,	

Name : Infiltration Gallery
Width : 15.33 ft.
Length : 90 ft.
Depth: 3.75ft.
Infiltration On
Infiltration rate : 20
Infiltration saftey factor : 0.5
Wetted surface area On
Discharge Structure
Riser Height: 3.75 ft.
Riser Diameter: 12 in.

Element Flows To:

Outlet 1	Outlet 2

Vault Hydraulic Table

Stage(ft)	Area(acr)	Volume(acr-ft)	Dschrg(cfs)	Infilt(cfs)
183.5	0.032	0.000	0.000	0.000
183.5	0.032	0.001	0.000	0.321
183.6	0.032	0.003	0.000	0.323
183.6	0.032	0.004	0.000	0.325
183.7	0.032	0.005	0.000	0.328
183.7	0.032	0.007	0.000	0.330
183.8	0.032	0.008	0.000	0.332
183.8	0.032	0.009	0.000	0.334
183.8	0.032	0.011	0.000	0.336
183.9	0.032	0.012	0.000	0.338
183.9	0.032	0.013	0.000	0.340
184.0	0.032	0.015	0.000	0.342
184.0	0.032	0.016	0.000	0.344
184.0	0.032	0.017	0.000	0.346
184.1	0.032	0.018	0.000	0.348
184.1	0.032	0.020	0.000	0.350
184.2	0.032	0.021	0.000	0.352
184.2	0.032	0.022	0.000	0.354
184.3	0.032	0.024	0.000	0.356
184.3	0.032	0.025	0.000	0.358
184.3	0.032	0.026	0.000	0.360
184.4	0.032	0.028	0.000	0.362
184.4	0.032	0.029	0.000	0.364
184.5	0.032	0.030	0.000	0.366
184.5	0.032	0.032	0.000	0.368
184.5	0.032	0.033	0.000	0.370
184.6	0.032	0.034	0.000	0.372
184.6	0.032	0.036	0.000	0.374
184.7	0.032	0.037	0.000	0.376
184.7	0.032	0.038	0.000	0.378
184.8	0.032	0.040	0.000	0.380
184.8	0.032	0.041	0.000	0.382
184.8	0.032	0.042	0.000	0.384
184.9	0.032	0.044	0.000	0.386
184.9	0.032	0.045	0.000	0.388
185.0	0.032	0.046	0.000	0.390
185.0	0.032	0.048	0.000	0.393
185.0	0.032	0.049	0.000	0.395
185.1	0.032	0.050	0.000	0.397
185.1	0.032	0.051	0.000	0.399
185.2	0.032	0.053	0.000	0.401
185.2	0.032	0.054	0.000	0.403
185.3	0.032	0.055	0.000	0.405
185.3	0.032	0.057	0.000	0.407
185.3	0.032	0.058	0.000	0.409
185.4	0.032	0.059	0.000	0.411
185.4	0.032	0.061	0.000	0.413
185.5	0.032	0.062	0.000	0.415
185.5	0.032	0.063	0.000	0.417
185.5	0.032	0.065	0.000	0.419
185.6	0.032	0.066	0.000	0.421
185.6	0.032	0.067	0.000	0.423
185.7	0.032	0.069	0.000	0.425
185.7	0.032	0.070	0.000	0.427
185.8	0.032	0.071	0.000	0.429
185.8	0.032	0.073	0.000	0.431
185.8	0.032	0.074	0.000	0.433
185.9	0.032	0.075	0.000	0.435
185.9	0.032	0.077	0.000	0.437
186.0	0.032	0.078	0.000	0.439
186.0	0.032	0.079	0.000	0.441
186.0	0.032	0.081	0.000	0.443

186.1	0.032	0.082	0.000	0.445
186.1	0.032	0.083	0.000	0.447
186.2	0.032	0.084	0.000	0.449
186.2	0.032	0.086	0.000	0.451
186.3	0.032	0.087	0.000	0.453
186.3	0.032	0.088	0.000	0.456
186.3	0.032	0.090	0.000	0.458
186.4	0.032	0.091	0.000	0.460
186.4	0.032	0.092	0.000	0.462
186.5	0.032	0.094	0.000	0.464
186.5	0.032	0.095	0.000	0.466
186.5	0.032	0.096	0.000	0.468
186.6	0.032	0.098	0.000	0.470
186.6	0.032	0.099	0.000	0.472
186.7	0.032	0.100	0.000	0.474
186.7	0.032	0.102	0.000	0.476
186.8	0.032	0.103	0.000	0.478
186.8	0.032	0.104	0.000	0.480
186.8	0.032	0.106	0.000	0.482
186.9	0.032	0.107	0.000	0.484
186.9	0.032	0.108	0.000	0.486
187.0	0.032	0.110	0.000	0.488
187.0	0.032	0.111	0.000	0.490
187.0	0.032	0.112	0.000	0.492
187.1	0.032	0.113	0.000	0.494
187.1	0.032	0.115	0.000	0.496
187.2	0.032	0.116	0.000	0.498
187.2	0.032	0.117	0.000	0.500
187.3	0.032	0.119	0.000	0.502
187.3	0.032	0.120	0.083	0.504
187.3	0.000	0.000	0.234	0.000

MITIGATED LAND USE

ANALYSIS RESULTS

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.001928
5 year	0.007144
10 year	0.014372
25 year	0.030626
50 year	0.050234
100 year	0.078722

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.050038
5 year	0.075113
10 year	0.09582
25 year	0.127313
50 year	0.155091
100 year	0.186975

Yearly Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1957	0.015	0.000
1958	0.001	0.000
1959	0.001	0.000
1960	0.002	0.000
1961	0.004	0.000
1962	0.004	0.000
1963	0.000	0.000
1964	0.010	0.000
1965	0.005	0.000
1966	0.003	0.000
1967	0.000	0.000

1968	0.005	0.000
1969	0.001	0.000
1970	0.001	0.000
1971	0.000	0.000
1972	0.006	0.000
1973	0.033	0.000
1974	0.000	0.000
1975	0.007	0.000
1976	0.000	0.000
1977	0.005	0.000
1978	0.000	0.000
1979	0.004	0.000
1980	0.000	0.000
1981	0.002	0.000
1982	0.004	0.000
1983	0.005	0.000
1984	0.002	0.000
1985	0.002	0.000
1986	0.000	0.000
1987	0.004	0.000
1988	0.011	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.005	0.000
1992	0.062	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.007	0.000
1997	0.015	0.000
1998	0.012	0.000
1999	0.000	0.000
2000	0.011	0.000

Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.0618	0.0000
2	0.0331	0.0000
3	0.0154	0.0000
4	0.0148	0.0000
5	0.0118	0.0000
6	0.0113	0.0000
7	0.0107	0.0000
8	0.0102	0.0000
9	0.0073	0.0000
10	0.0067	0.0000
11	0.0059	0.0000
12	0.0053	0.0000
13	0.0050	0.0000
14	0.0050	0.0000
15	0.0049	0.0000
16	0.0047	0.0000
17	0.0043	0.0000
18	0.0039	0.0000
19	0.0039	0.0000
20	0.0037	0.0000
21	0.0035	0.0000
22	0.0029	0.0000
23	0.0022	0.0000
24	0.0019	0.0000
25	0.0018	0.0000
26	0.0015	0.0000
27	0.0015	0.0000
28	0.0011	0.0000
29	0.0007	0.0000
30	0.0006	0.0000
31	0.0004	0.0000
32	0.0004	0.0000
33	0.0003	0.0000
34	0.0003	0.0000
35	0.0003	0.0000

36	0.0003	0.0000
37	0.0003	0.0000
38	0.0003	0.0000
39	0.0003	0.0000
40	0.0003	0.0000
41	0.0003	0.0000
42	0.0003	0.0000
43	0.0003	0.0000
44	0.0003	0.0000

POC #1
The Facility PASSED

The Facility PASSED.

Flow(CFS)	Predev	Dev	Percentage	Pass/Fail
0.0010	497	0	0	Pass
0.0015	345	0	0	Pass
0.0020	268	0	0	Pass
0.0025	211	0	0	Pass
0.0030	161	0	0	Pass
0.0035	131	0	0	Pass
0.0040	102	0	0	Pass
0.0044	85	0	0	Pass
0.0049	72	0	0	Pass
0.0054	65	0	0	Pass
0.0059	63	0	0	Pass
0.0064	53	0	0	Pass
0.0069	46	0	0	Pass
0.0074	41	0	0	Pass
0.0079	37	0	0	Pass
0.0084	34	0	0	Pass
0.0089	28	0	0	Pass
0.0094	26	0	0	Pass
0.0099	25	0	0	Pass
0.0104	22	0	0	Pass
0.0109	19	0	0	Pass
0.0114	16	0	0	Pass
0.0119	14	0	0	Pass
0.0124	14	0	0	Pass
0.0129	13	0	0	Pass
0.0134	12	0	0	Pass
0.0139	12	0	0	Pass
0.0144	12	0	0	Pass
0.0149	11	0	0	Pass
0.0154	11	0	0	Pass
0.0159	10	0	0	Pass
0.0164	10	0	0	Pass
0.0169	10	0	0	Pass
0.0174	9	0	0	Pass
0.0179	9	0	0	Pass
0.0184	9	0	0	Pass
0.0189	8	0	0	Pass
0.0194	8	0	0	Pass
0.0199	8	0	0	Pass
0.0204	8	0	0	Pass
0.0209	7	0	0	Pass
0.0214	7	0	0	Pass
0.0219	7	0	0	Pass
0.0224	6	0	0	Pass
0.0229	6	0	0	Pass
0.0234	6	0	0	Pass
0.0239	6	0	0	Pass
0.0244	6	0	0	Pass
0.0249	6	0	0	Pass
0.0254	6	0	0	Pass
0.0258	5	0	0	Pass
0.0263	5	0	0	Pass
0.0268	5	0	0	Pass
0.0273	5	0	0	Pass

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0.0278    4      0      0      Pass
0.0283    4      0      0      Pass
0.0288    4      0      0      Pass
0.0293    4      0      0      Pass
0.0298    4      0      0      Pass
0.0303    4      0      0      Pass
0.0308    3      0      0      Pass
0.0313    3      0      0      Pass
0.0318    3      0      0      Pass
0.0323    3      0      0      Pass
0.0328    3      0      0      Pass
0.0333    2      0      0      Pass
0.0338    2      0      0      Pass
0.0343    2      0      0      Pass
0.0348    2      0      0      Pass
0.0353    2      0      0      Pass
0.0358    2      0      0      Pass
0.0363    2      0      0      Pass
0.0368    2      0      0      Pass
0.0373    2      0      0      Pass
0.0378    2      0      0      Pass
0.0383    2      0      0      Pass
0.0388    2      0      0      Pass
0.0393    2      0      0      Pass
0.0398    2      0      0      Pass
0.0403    2      0      0      Pass
0.0408    2      0      0      Pass
0.0413    2      0      0      Pass
0.0418    2      0      0      Pass
0.0423    2      0      0      Pass
0.0428    2      0      0      Pass
0.0433    2      0      0      Pass
0.0438    2      0      0      Pass
0.0443    2      0      0      Pass
0.0448    2      0      0      Pass
0.0453    2      0      0      Pass
0.0458    1      0      0      Pass
0.0463    1      0      0      Pass
0.0468    1      0      0      Pass
0.0472    1      0      0      Pass
0.0477    1      0      0      Pass
0.0482    1      0      0      Pass
0.0487    1      0      0      Pass
0.0492    1      0      0      Pass
0.0497    1      0      0      Pass
0.0502    1      0      0      Pass
_____________________________________________________

 The Development Has an increase in flow durations for
more than  50% of the flows for the range of the
duration analysis.
_____________________________________________________

Water Quality BMP Flow and Volume for POC  1.
On-line facility volume:  0.2685 acre-feet
On-line facility target flow:  0.01 cfs.
Adjusted for 15 min:  0.6505  cfs.
Off-line facility target flow:  0.1638 cfs.
Adjusted for 15 min:  0.3698 cfs.
_____________________________________________________
```

Project:

StormTech
Detention • Retention • Recharge
Subsurface Stormwater Management™

Chamber Model - MC-3500
Units - **Imperial** Click Here for Metric
Number of Chambers - 27
Number of End Caps - 6
Voids in the stone (porosity) - 40 %
Base of Stone Elevation - 183.50 ft
Amount of Stone Above Chambers - 12 in
Amount of Stone Below Chambers - 9 in

☐ Include Perimeter Stone in Calculations

Height of System *(inches)*	Incremental Single Chamber *(cubic feet)*	Incremental Single End Cap *(cubic feet)*	Incremental Chambers *(cubic feet)*	Incremental End Cap *(cubic feet)*	Incremental Stone *(cubic feet)*	Incremental Chamber, End *(cubic feet)*	Cumulative System (cubic feet)	Elevation (feet)
66	0.00	0.00	0.00	0.00	47.91	47.91	5049.43	189.00
65	0.00	0.00	0.00	0.00	47.91	47.91	5001.52	188.92
64	0.00	0.00	0.00	0.00	47.91	47.91	4953.61	188.83
63	0.00	0.00	0.00	0.00	47.91	47.91	4905.71	188.75
62	0.00	0.00	0.00	0.00	47.91	47.91	4857.80	188.67
61	0.00	0.00	0.00	0.00	47.91	47.91	4809.89	188.58
60	0.00	0.00	0.00	0.00	47.91	47.91	4761.98	188.50
59	0.00	0.00	0.00	0.00	47.91	47.91	4714.08	188.42
58	0.00	0.00	0.00	0.00	47.91	47.91	4666.17	188.33
57	0.00	0.00	0.00	0.00	47.91	47.91	4618.26	188.25
56	0.00	0.00	0.00	0.00	47.91	47.91	4570.35	188.17
55	0.00	0.00	0.00	0.00	47.91	47.91	4522.45	188.08
54	0.06	0.00	1.56	0.00	47.28	48.84	4474.54	188.00
53	0.20	0.01	5.32	0.06	45.76	51.13	4425.70	187.92
52	0.31	0.01	8.35	0.06	44.54	52.96	4374.56	187.83
51	0.61	0.02	16.48	0.12	41.27	57.87	4321.61	187.75
50	0.98	0.04	26.39	0.24	37.26	63.89	4263.74	187.67
49	1.20	0.05	32.51	0.30	34.78	67.60	4199.85	187.58
48	1.39	0.07	37.48	0.42	32.75	70.65	4132.26	187.50
47	1.54	0.09	41.70	0.54	31.01	73.25	4061.61	187.42
46	1.68	0.10	45.47	0.60	29.48	75.55	3988.35	187.33
45	1.81	0.12	48.83	0.72	28.09	77.64	3912.81	187.25
44	1.92	0.14	51.94	0.84	26.80	79.57	3835.17	187.17
43	2.03	0.16	54.75	0.96	25.62	81.33	3755.59	187.08
42	2.13	0.18	57.38	1.08	24.52	82.98	3674.26	187.00
41	2.21	0.20	59.80	1.20	23.51	84.51	3591.28	186.92
40	2.30	0.21	62.17	1.26	22.54	85.97	3506.77	186.83
39	2.38	0.24	64.30	1.44	21.61	87.35	3420.80	186.75
38	2.46	0.26	66.36	1.56	20.74	88.66	3333.45	186.67
37	2.53	0.27	68.27	1.62	19.95	89.84	3244.80	186.58
36	2.60	0.29	70.09	1.74	19.18	91.00	3154.95	186.50
35	2.66	0.32	71.82	1.92	18.41	92.15	3063.95	186.42
34	2.72	0.33	73.45	1.98	17.74	93.16	2971.80	186.33
33	2.78	0.35	74.98	2.10	17.08	94.16	2878.64	186.25
32	2.83	0.37	76.46	2.22	16.43	95.12	2784.48	186.17
31	2.88	0.39	77.85	2.34	15.83	96.02	2689.36	186.08
30	2.93	0.41	79.22	2.46	15.24	96.92	2593.34	186.00
29	2.98	0.43	80.45	2.58	14.70	97.72	2496.42	185.92
28	3.02	0.45	81.63	2.70	14.17	98.51	2398.70	185.83
27	3.07	0.46	82.77	2.76	13.69	99.23	2300.19	185.75
26	3.11	0.48	83.87	2.88	13.21	99.96	2200.97	185.67
25	3.14	0.49	84.90	2.94	12.77	100.61	2101.01	185.58
24	3.18	0.51	85.87	3.06	12.34	101.26	2000.39	185.50
23	3.21	0.52	86.76	3.12	11.96	101.84	1899.13	185.42
22	3.25	0.54	87.62	3.24	11.56	102.43	1797.30	185.33
21	3.28	0.54	88.45	3.24	11.23	102.92	1694.87	185.25
20	3.31	0.56	89.24	3.36	10.87	103.47	1591.95	185.17
19	3.33	0.57	89.97	3.42	10.55	103.94	1488.48	185.08
18	3.36	0.58	90.68	3.48	10.25	104.40	1384.54	185.00
17	3.38	0.58	91.35	3.48	9.98	104.80	1280.14	184.92
16	3.41	0.60	91.96	3.60	9.68	105.25	1175.33	184.83
15	3.43	0.60	92.55	3.60	9.45	105.60	1070.09	184.75
14	3.45	0.61	93.11	3.66	9.20	105.97	964.49	184.67
13	3.47	0.61	93.65	3.66	8.99	106.29	858.52	184.58
12	3.49	0.62	94.16	3.72	8.76	106.64	752.23	184.50
11	3.51	0.63	94.69	3.78	8.52	106.99	645.60	184.42
10	3.53	0.63	95.44	3.78	8.22	107.44	538.61	184.33
9	0.00	0.00	0.00	0.00	47.91	47.91	431.17	184.25
8	0.00	0.00	0.00	0.00	47.91	47.91	383.26	184.17
7	0.00	0.00	0.00	0.00	47.91	47.91	335.35	184.08
6	0.00	0.00	0.00	0.00	47.91	47.91	287.45	184.00
5	0.00	0.00	0.00	0.00	47.91	47.91	239.54	183.92
4	0.00	0.00	0.00	0.00	47.91	47.91	191.63	183.83
3	0.00	0.00	0.00	0.00	47.91	47.91	143.72	183.75
2	0.00	0.00	0.00	0.00	47.91	47.91	95.82	183.67
1	0.00	0.00	0.00	0.00	47.91	47.91	47.91	183.58

Design requirements for infiltration trenches used for flow control (soils not considered a treatment BMP)

Requirements	Infiltration trenches located in **Western WA** (from SMMWW)	Infiltration trenches located in **Eastern WA** (from SMMEW, but does not include section 5.6)
Separation between ground water/ impermeable layer and base of trench	5 ft.	5 ft.
Soil type	None required	None required
Treatment required, must use Ecology approved BMP*	Solids removal; except for NPGIS** Oil control for high use sites, SMMWW, Vol 5, p. 2-3	Solids removal, except for NPGIS Oil control for high use and high ADT*** roads, see p. 2-22.
Short term Infiltration rate for treatment	No minimum	No minimum
Long term Infiltration rate	No minimum	No minimum
In ground water protection area? (well head or critical aquifer recharge area)	Check WA State DOH website GIS tool, http://www.doh.wa.gov/ehp/dw/swaphome.htm, to determine if trench is in a well head protection area. If yes, contact local DOH for local ordinances pertaining to stormwater.	Check WA State DOH website GIS tool, http://www.doh.wa.gov/ehp/dw/swaphome.htm If yes, contact local DOH for local ordinances pertaining to stormwater.
Operation and maintenance	Volume IV, SMMWW	Chapter 8 of SMMEW

*BMP – Best Management Practice, must be approved by Ecology. For approved BMPS go to http://www.ecy.wa.gov/programs/wq/grndwtr/uic/TreatmentOpts-EandWwa.pdf

**NPGIS – non pollutant generating impervious surface, see definition in either SMMEW or SMMWW, http://www.ecy.wa.gov/programs/wq/stormwater/tech.html

***ADT - Average Daily Traffic

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
TTY 711 or 800-833-6388 (For the Speech or Hearing Impaired)

December 1, 2004

Mr. Marvin Lock
District Environmental Coordinator
UPS, Plant Engineering
4455 7th Avenue South
Seattle, WA 98108

Dear Mr. Lock:

RE: Registration with the Underground Injection Control (UIC) Program, UPS-Kennewick, 6504 W. Okanogan Ave, Kennewick, WA

This letter is to acknowledge receipt of your registration forms to register the UPS Facilities listed below. All of the UIC wells are used to manage stormwater from the sites.

The goal of the UIC Program is to protect ground water by regulating discharges to UIC wells. UIC wells should not receive fluids that contain hazardous substances or from polluted source areas. Based on the information provided, the best management practices applied at the sites are presumed to protect ground water quality, and unless there is site specific information to indicate otherwise the non-endangerment requirements of the UIC program have been met.

The sites are registered as;

Site	UIC site number	Number of UIC wells at site
UPS Burlington	23311	1
UPS Kennewick	23312	5
UPS Moses Lake	23313	2
UPS Spokane Hub	23314	29
UPS Tumwater	23315	2
UPS Yakima	23316	7

The Yakima site states that the depth of the UIC wells are approximately 5 feet and the depth to ground water is approximately 3-10 feet. UIC wells need to have a separation between the bottom of the well and the top of the aquifer. If the well is located in the water table and water is in the well during the dry months of the year then the well needs to be retrofitted.

Please refer to the UIC site number for each location in all future correspondence. Also contact us if the wells are closed and describe the closure method.

Please call me at (360) 407-6143 or email me at maha461@ecy.wa.gov if you have any questions. Additional information on the UIC Program can also be found at our website http://www.ecy.wa.gov/programs/wq/grndwtr/uic/index.html.

Sincerely,

MSHansen

Mary Shaleen-Hansen
Water Quality Program

Cc: Robin Sandell

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

For Department of Ecology Use									
UIC Site ID		WRIA		WQMA		Date Entered		Confirmation Mailed	

UNDERGROUND INJECTION CONTROL PROGRAM REGISTRATION FORM

Please send completed form to: UIC Coordinator, Water Quality Program, WA Department of Ecology, P.O. Box 47600, Olympia, WA 98504-7600

A. Facility/Site Information:

1. Facility Name: UPS – Tumwater

2. Address: 7383 New Market St SW

City/State/Zip: Tumwater, WA 98501-6567 County: Thurston

Telephone #: 360-357-6675

Cross Streets: North/South ______ East/West ______

3. Latitude: 46° 58′ 50″ N Longitude: 122° 54′ 48″ W Meridian (E/W): ______

4. Township ______ Range: ______ Section: ______ ¼ Section ______ ¼ ¼ Section: ______

5. Nature of business and materials handled: Small parcel delivery service. Industrial activities performed at the facility include: Vehicle maintenance; vehicle washing; vehicle fueling; fuel storage (UST: gasoline); scrap metal storage; loading/unloading; and dumpster for trash storage.

6. Pollution prevention/treatment methods: Vehicle maintenance is primarily performed indoors; all vehicle wash water discharges to the sanitary sewer system; vehicle fuelers are trained in pollution prevention and spill response; ***Oil Spill Response Plan*** has been developed and implemented at the facility; spill response equipment is available; personnel trained in spill response are available during facility operating hours; trained UPS personnel attend fuel drops; fueling equipment is maintained in good condition; the fueling area is covered; storm water run-off from fueling area passes through an oil/water separator prior to discharging to the sanitary sewer system; storm water run-off from facility paved areas passes through an oil/water separator prior to discharging to a drain field; the storm water oil/water separators are periodically cleaned and inspected; scrap metal bin is covered; dumpster lids are kept closed; and good housekeeping practices are implemented.

7. Has a permit been issued for the site? No ☒ Yes, NPDES ☐ State Waste Discharge ☐

Issued By: ______

B. Owner/Operator Information:

1. Owner Name: UPS (Attention: Plant Engineering)

Owner Address: 4455 7th Avenue South

City/State/Zip: Seattle, WA 98108

Telephone #: 206-621-6261 (Marvin Lock, District Environmental Coordinator)

2. Operator/Contact Name: UPS – Plant Engineering

Operator/Contact Address: 4455 7th Avenue South

City/State/Zip: Seattle, WA 98108

Telephone #: 206-621-6261 (Marvin Lock, District Environmental Coordinator)

C. UIC Well and Ground Water Information:

1. Number of UIC wells: Active 2 Under Construction 0 Temporarily Abandoned 0 Permanently Abandoned 0
2. Depth of UIC well (feet): 1 dry well: ~ 8 ft
1 Drain Field: < 6 ft 3. Well Type(s) (see table below): 5D4: 2 wells
4. Depth to ground water (feet): Unknown Based on: Well Log ☐ Measurement ☐ Estimate ☐
   Date of Measurement:
5. Distance to nearest drinking water source (feet): Unknown (Note: no drinking water wells located on-site)
   Distance to nearest surface water source (feet): 7,000 – 8,000 feet: Percival Creek to the NW; Deschutes River to the NE.
6. Date well installation: Dry well: June 1972; Drain Field: June 1987
7. Date of well closure (if applicable): Not applicable
   Well closure method (if applicable): Not applicable
8. Injected fluid type, i.e., stormwater: Storm water

E. Remediation/ Clean up Sites (if applicable): THIS SECTION IS NOT APPLICABLE TO FACILITY

1. Type of remediation site CERCLA ☐ RCRA ☐ MTCA Independent ☐ MTCA Order ☐ Other ☐
2. Groundwater quality (including contaminant levels): N/A
3. Brief description of site geology: N/A
4. Injection process, including volume amounts (gals): N/A

EPA Well Types

5A19 Cooling Water Return	5R21 Aquifer Recharge	5W31 Septic System (well disposal)	5X28 Motor
5D2 Stormwater	5W9 Untreated Sewage	5W32 Septic System (drainfield)	Vehicle Waste
5D4 Industrial Storm Runoff	5W10 Cesspool	5A7 Closed Loop Heat Pump Ret.	
5G30 Special Drainage Water	5W11 Septic System (gen) 5W20 Industrial Process Water	5X26 Aquifer Remediation 5X27 Other Wells	
5A6 Geothermal Heat			

Completed by Robin Sandell (Address: 6462 Quartz Circle, Arvada, CO 80007; Phone: 303-403-1098; Email: rmsandell@earthlink.net)

Date February 9, 2004

To expedite the registration of your facility, please fill out this form in its entirety.

To receive this document in a different format, contact Mary Shaleen Hansen at (360) 407-6143 (Voice) or 711 or 1-800-833-6388 (TTY). E-mail can be sent to maha461@ecy.wa.gov.

UIC Well Assessment Special Protection Areas and Local Resource Evaluation Summary Table

Facility Name: UPS-Tumwater
Facility Address: 7383 New Market St SW, Tumwater, WA 98501
County: Thurston
Ecology UIC Site Number: 23315
Number of Registered UIC Wells: There are a total of one (1) stormwater drainage drywell and one (1) stormwater drainage drain field located at this facility. Both are registered as Class V UIC stormwater drainage wells and were built prior to February 2, 2006 (i.e., they are existing UIC wells).
Rev. Date: 2/23/11

	Evaluation Summary	**Additional Requirements for Special Protection Areas:**
Wellhead Protection Area (WHPZ)	The facility is located in a both a WHPZ. The WHPZs located in the vicinity of the facility are shown on the **Washington Department of Health – Wellhead Protection Zone Map** for this facility in Appendix C. The facility is also located in a WHPZ established by the City of Tumwater.	City of Tumwater Ordinance: Chapter 16.26 Wellhead Protection.
Surface Water Intake Protection Area (SWIPA)	The facility is not located in a SWIPA. The SWIPAs located in the vicinity of the facility are shown on the **Washington Department of Health – Surface Water Intake Protection Area Map** for this facility in Appendix C.	Not applicable. The facility is not in a SWIPA.
Critical Aquifer Recharge Area (CARA) and **Local Requirements Summary**	Mr. Andy Deffobis, Thurston County Associate Planner (360-786-5467, deffoba@co.thurston.wa.us), was contacted on 2/22/11 by Ms. Robin Sandell, ECTools, to determine if the facility was located in any special groundwater or surface water protection areas and if any Thurston County ordinances applied to the facility's UIC wells. Mr. Deffobis indicated that since the facility was located inside the Tumwater City Limits and was not in an Urban Growth Area there were no Thurston County Regulations that apply. Mr. Dan Smith, City of Tumwater, Water Resources Program Manager (360-754-4140; desmith@ci.tumwater.wa.us) was contacted on 2/22/11 by Ms. Robin Sandell, ECTools, to determine if the facility was located in any special groundwater or surface water protection areas and if any City of Tumwater ordinances applied to the facility's UIC wells. Mr. Smith indicated that the facility is located in one of the City's wellhead protection areas with either a 6-month or 1-year time of travel and is located in the City's aquifer protection overlay.	Mr. Dan Smith, Water Resources Program Manager, indicated that several ordinances did apply to operation of the UIC wells at the facility (Chapter 13.12.020 - Stormwater Management; Chapter 16.24 Aquifer Protection Standards; Chapter 16.26 Wellhead Protection). These codes were downloaded from the City's Web Site on 2/22/11 and any applicable requirements will be integrated into the Groundwater Protection Best Management Practices Plan.
Sole Source Aquifer (SSA)	The facility is not located in a Sole Source Aquifer as seen by the EPA Region 10 Sole Source Aquifer Regional Map in Appendix C.	Not applicable. The facility is not in a SSA.
Nearby Wells	The facility drinking water source is the public water supply system. Several public water supply wells, operated by the City of Tumwater, are located within 1,000 feet of the facility. Approximate distances from the facility to the City of Tumwater Water Supply Wells: Well #10 ~ 440 ft to the west; Well #15: ~ 640 ft directly east; Well #9: ~960 ft to the south.	City of Tumwater Ordinance: Chapter 16.24 Aquifer Protection Standards; Chapter 16.26 Wellhead Protection
Surface Water	The facility is not located within 1000 feet of any surface water body.	Not applicable. The UICs located at this facility are not within 1,000 feet of a surface water body.

UIC Well Assessment High Threat to Groundwater Evaluation Summary Table

Facility Name: UPS-Tumwater
Facility Address: 7383 New Market St SW, Tumwater, WA 98501
County: Thurston
Ecology UIC Site Number: 23315
Number of Registered UIC Wells: There are a total of one (1) stormwater drainage drywell and one (1) stormwater drainage drain field located at this facility. Both are registered as Class V UIC stormwater drainage wells and were built prior to February 2, 2006 (i.e., they are existing UIC wells).
Rev. Date: 2/28/11

	DW1[1]	**DF1**[1]
Prohibited Discharges[2]	None	None
Pollutant Loading[3]	UIC does not receive a "high pollutant load". High-use assessment summary: • Trip count is <threshold. • No fueling • No petroleum storage • No outdoor hazardous material storage.	UIC may receive a "high pollutant load". High-use and potential pollutant sources assessment summary: • Trip count is <threshold. • Fuel storage in underground storage tank. Petroleum transfer is > 1,500 gal/yr. (High Use) • No outdoor hazardous material storage. • Vehicle Fueling: Vehicles are fueled in the drainage area to DF1. The fuel tanker truck may park in the drainage area to DF1. (High Use)
Vadose Zone Treatment Capacity[4]	Not applicable – UIC doesn't receive high pollutant load	Based on recent well logs (2008) in close proximity to the facility (across the street), the vadose zone in this area consists of fine to medium sand. Table 5.2 of the **Ecology Guidance for UIC Wells that Manage Stormwater** indicates that the vadose zone treatment capacity for this type of material is medium and a minimum thickness of 10 ft is needed for treatment. There is >10 ft of vadose zone between the bottom of the UIC wells at this facility and the water table during some periods of the year and there may be <10 ft during at other periods of the year.
UIC Inspection for Groundwater[5]	Date, Result: 9/18/08, Dry (ECTools[5])	Not applicable.
UIC Depth	~8 feet	< 6 feet
Depth to Groundwater[6]	Based on local well logs and information from Mr. Dan Smith, City of Tumwater, Water Resources Program Manager, depth to groundwater is approximately 14 - 20 feet depending on time of year and groundwater cycles.	Based on local well logs and information from Mr. Dan Smith, City of Tumwater, Water Resources Program Manager, depth to groundwater is approximately 14 - 20 feet depending on time of year and groundwater cycles.
BMPs Implemented[7]	BMPs #1 to #7	BMPs #1 to #5, #8, #9

UIC Well Assessment High Threat to Groundwater Evaluation Summary Table

Table Footnotes:

[1] DWx: Drywell with numerical designation. DFx: Drain field with numerical designator. CBx: Catch basin with numerical designator.

[2] Prohibited Discharges: Those discharges listed as prohibited in **the Ecology Guidance for UIC Wells that Manage Stormwater**, Section 2.2.

[3] High Pollutant Loading: The activities performed in the drainage area to the drywell were evaluated to determine if any of these activities were listed in Table 5.3 of the **Ecology Guidance for UIC Wells that Manage Stormwater** as contributing high pollutant loading. Only "High Use Sites" were investigated further, as none of the other activities/areas listed in Table 5.3 for high pollutant loading apply to this facility. Refer to the Site and Drainage Map for the activities performed in the drainage area for each drywell.

[4] Vadose Zone Treatment Capacity: Not applicable if the pollutant loading to the drywell is not high.

[5] ECTools: Environmental Compliance Tools, LLC. WSE: Western States Environmental.

[6] Depth to groundwater was determined using well logs in close proximity to the facility.

[7] BMPs implemented for each drywell, except as noted:

BMP #1: Development and implementation of a Groundwater Protection Best Management Practices Plan (GWP BMPP) that includes source control BMPs (e.g., exposure minimization, good housekeeping, preventative maintenance, spill control, employee training, routine inspections).

BMP #2: Semi-annual (spring and fall) surface sweeping using a high efficiency vacuum street sweeper.

BMP #3: Minimum of annual storm sewer system and drywell cleaning, including evacuating and cleaning the oil/water separator pre-treating runoff from CB1 and CB2 to DF1. (Note: additional cleaning will be done based on inspection findings).

BMP #4: Quarterly facility inspections to ensure source control BMPs are being properly implemented, to ensure treatment controls are in good condition and operating properly and to inspect the condition of the drywells.

BMP #5: The following BMP will be implemented by 6/30/11. Storm drain inserts will be installed in DW1 and CB1 and CB2, which both discharge to DF1. Note: The inserts will be inspected during the quarterly site inspections and cleaned as needed. The inserts will be, inspected, cleaned and replaced as needed during the semi-annual surface sweeping.

BMP #6: Vehicle Maintenance: Vehicle maintenance is performed inside the building. All vehicle maintenance materials are stored inside except scrap metal. Scrap metal is stored in a leak-free covered bin. The used oil aboveground storage tank (AST) is located inside the shop and is ~300 gallons. Transfers from the used oil AST generally only occur one to two times per year and the tanker truck parks inside the shop during the transfer. Spill cleanup material is available in the shop area (additional spill equipment is located nearby in the fueling area). Trained spill responders are available on-site to respond to spills. Mechanics are trained in spill prevention practices and spill response.

BMP #7: Vehicle Maintenance: The following BMPs will be implemented by 6/30/11. A storm drain cover will be added to the automotive shop spill kit and the automotive mechanics and spill responders will be trained to cover DW1 should a spill occur that could impact the drywell. The automotive mechanics will be trained to cover DW1 if a spill could impact the drywell during tanker truck transfers from the used oil tank. All drums must be placed on spill pallets, or in equivalent spill containment, if a spill from the drums could flow outdoors or into a floor drain.

BMP #8: Fueling Area BMPs: CB1 and CB2 are designed with sediment settling sumps and spill control separators to prevent pollutants from discharging from the fueling area to the drain field (DF1). An oil/water separator further treats stormwater discharging from CB2 to the drain field, DF1. A spill kit is available in the fueling area and trained spill responders are available on-site to respond to spills. Fuelers are trained in spill prevention practices and spill response. The fuel storage underground storage tank is compliant with all applicable regulations. The fuel dispensers are compliant with all applicable regulations and are inspected regularly to ensure proper function and to prevent spills and leaks.

UIC Well Assessment High Threat to Groundwater Evaluation Summary Table

BMP #9: Fueling Area BMPs: The following BMPs will be implemented by 6/30/11. Drain covers will be included in the fueling area spill kit and the UPS Certified Fuel Drop Receivers will be trained to place the drain covers over CB1 during all fuel drops. The tanker truck will be restricted from parking outside the drainage area of CB1 and/or the drainage area of CB3, which is in the fueling area and discharges to the municipal sanitary sewer system.

BMP #10: Description of Fueling System and Control Measures: The fuel storage tank is a double-walled fiberglass reinforced plastic underground storage tank with double-walled fiberglass reinforced plastic piping. The interstitial space of the piping drains back to the piping sump on top of the tank. The dispensers have secondary containment sumps underneath them that also drain back to the piping sump on the top of the tank. The monitoring consists of an Automatic Tank Gauge for primary leak detection from the tank, and the interstitial space between the inner and outer walls of the tank is filled with brine, and its level is monitored (both low and high) as a secondary leak detection method for the tank. The piping sump on top of the tank is also monitored to detect leaks in the piping or from the dispenser containment sump.

All sensors are tied into a Veeder Root TLS350 monitoring console with a dedicated phone line. The console sounds an audible alarm and dials out to a monitoring service in the event of there being a loss of volume from the tank, change in brine level of the tank interstitial space, liquid detected in the piping sump or an overfill of the tank (>95%). The monitoring service sends emailed alerts when any of the sensors are activated, and the console also sends a fax to the District UPS Plant Engineering Office any time one of the sensors are activated.

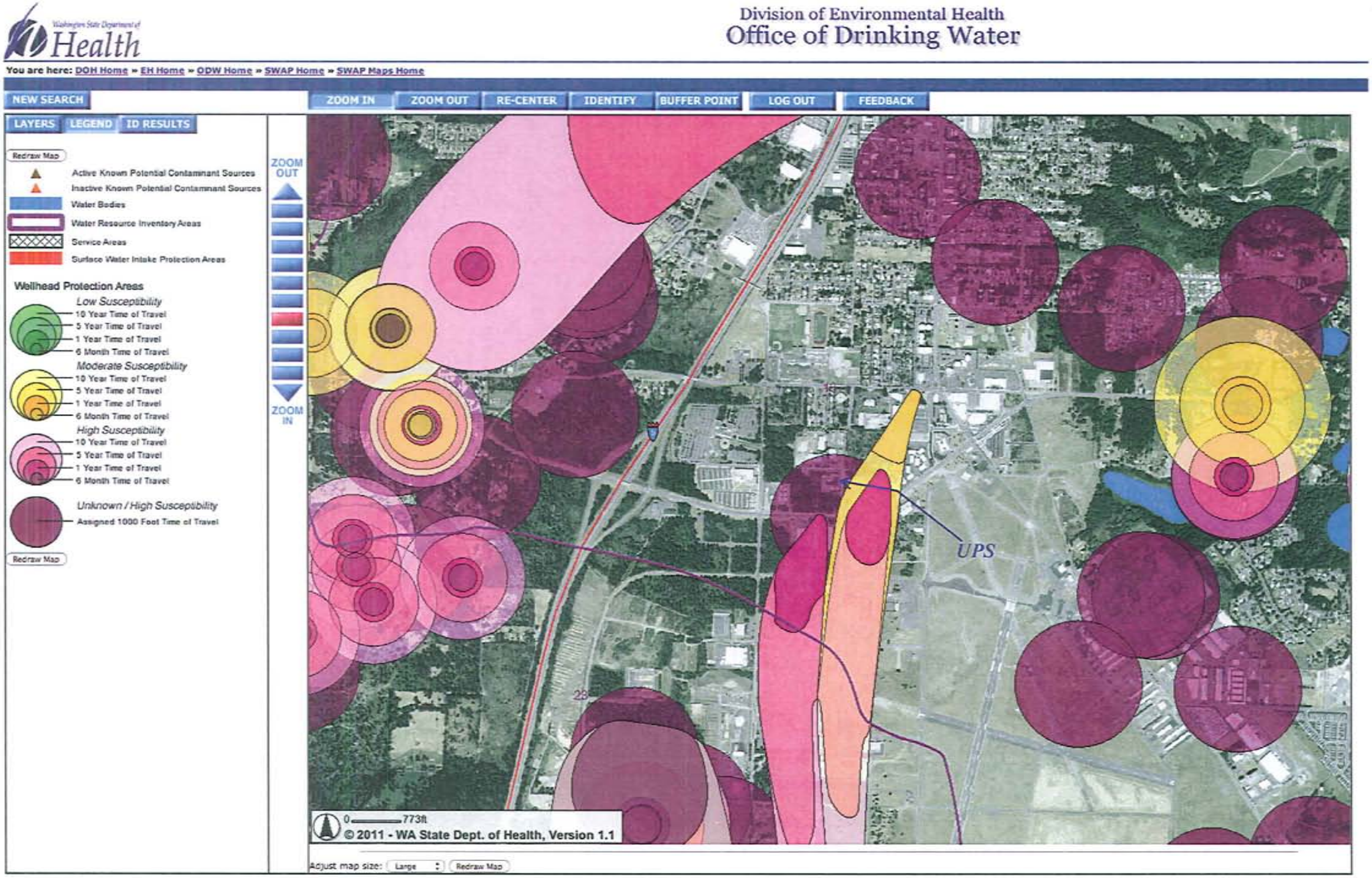
Overfill prevention consists of a ball valve in the vent pipe of the tank that closes at 90% restricting the escape of air from the tank - thereby limiting inflow of fuel. There is a secondary overfill protection in the form of a float valve on the tank's fill tube that closes off at 95% preventing any further filling of the tank. The tank monitoring console is also configured to alarm and send an email and a fax alert any time the tank is filled to the 95% capacity mark

The dispensers have a timer on them to limit the spill potential from a damaged hose. Gasoline timers are set to 3 minutes and diesel timers are set to 5 minutes. Dispensers also have shear valves to shut off fuel flow in case a dispenser is hit and sheared off its base.

The entire installation is inspected semi-annually and the annual inspection includes testing meter accuracy, flow rate, and leak detection.

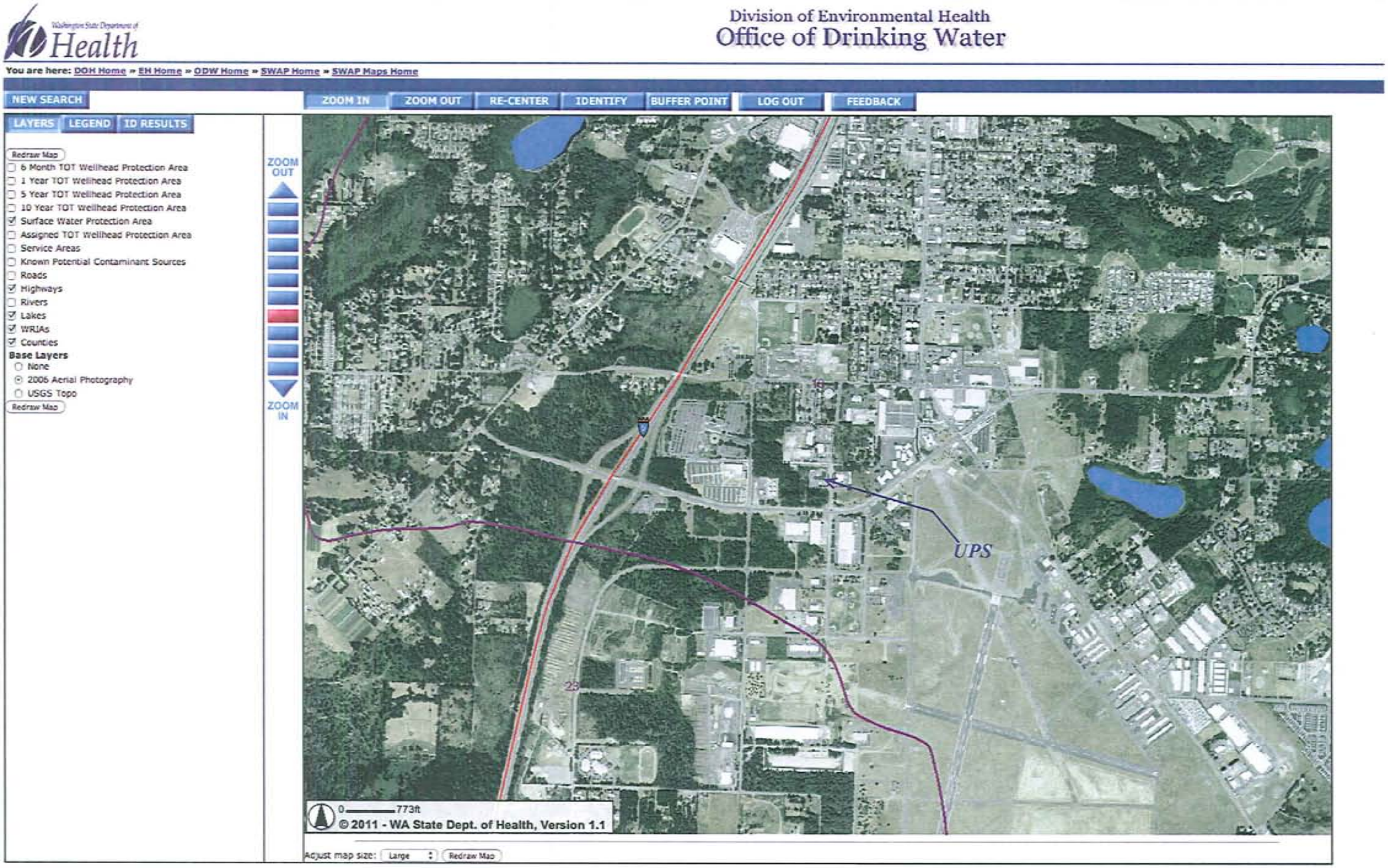
WASHINGTON STATE DEPARTMENT OF HEALTH – WELLHEAD PROTECTION ZONE MAP

Facility: UPS – Tumwater
Address: 7383 New Market St SW, Tumwater, WA 98501
Rev. Date: 2/11/11
Conclusion: The facility's UIC wells are located in a wellhead protection zone.



WASHINGTON STATE DEPARTMENT OF HEALTH – SURFACE WATER INTAKE PROTECTION AREA MAP

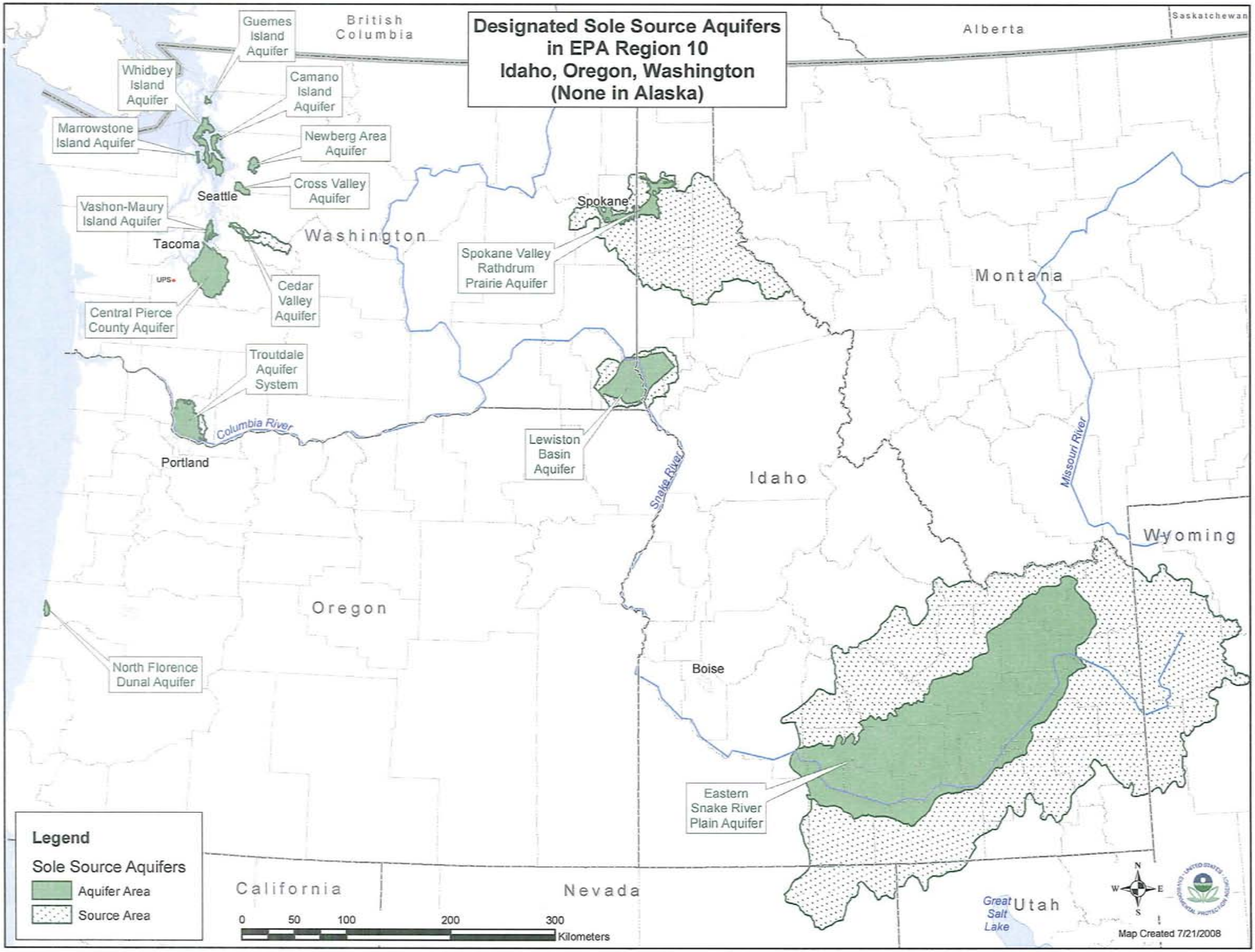
Facility: UPS – Tumwater
Address: 7383 New Market St SW, Tumwater, WA 98501
Rev. Date: 2/11/11
Conclusion: There are no surface water intake protection areas within 1000 feet of the facility.



☐ 6 Month TOT Wellhead Protection Area
☐ 1 Year TOT Wellhead Protection Area
☐ 5 Year TOT Wellhead Protection Area
☐ 10 Year TOT Wellhead Protection Area
☑ Surface Water Protection Area
☐ Assigned TOT Wellhead Protection Area
☐ Service Areas
☐ Known Potential Contaminant Sources
☐ Roads
☑ Highways
☐ Rivers
☑ Lakes
☑ WRIAs
☑ Counties

Base Layers
○ None
● 2006 Aerial Photography
○ USGS Topo

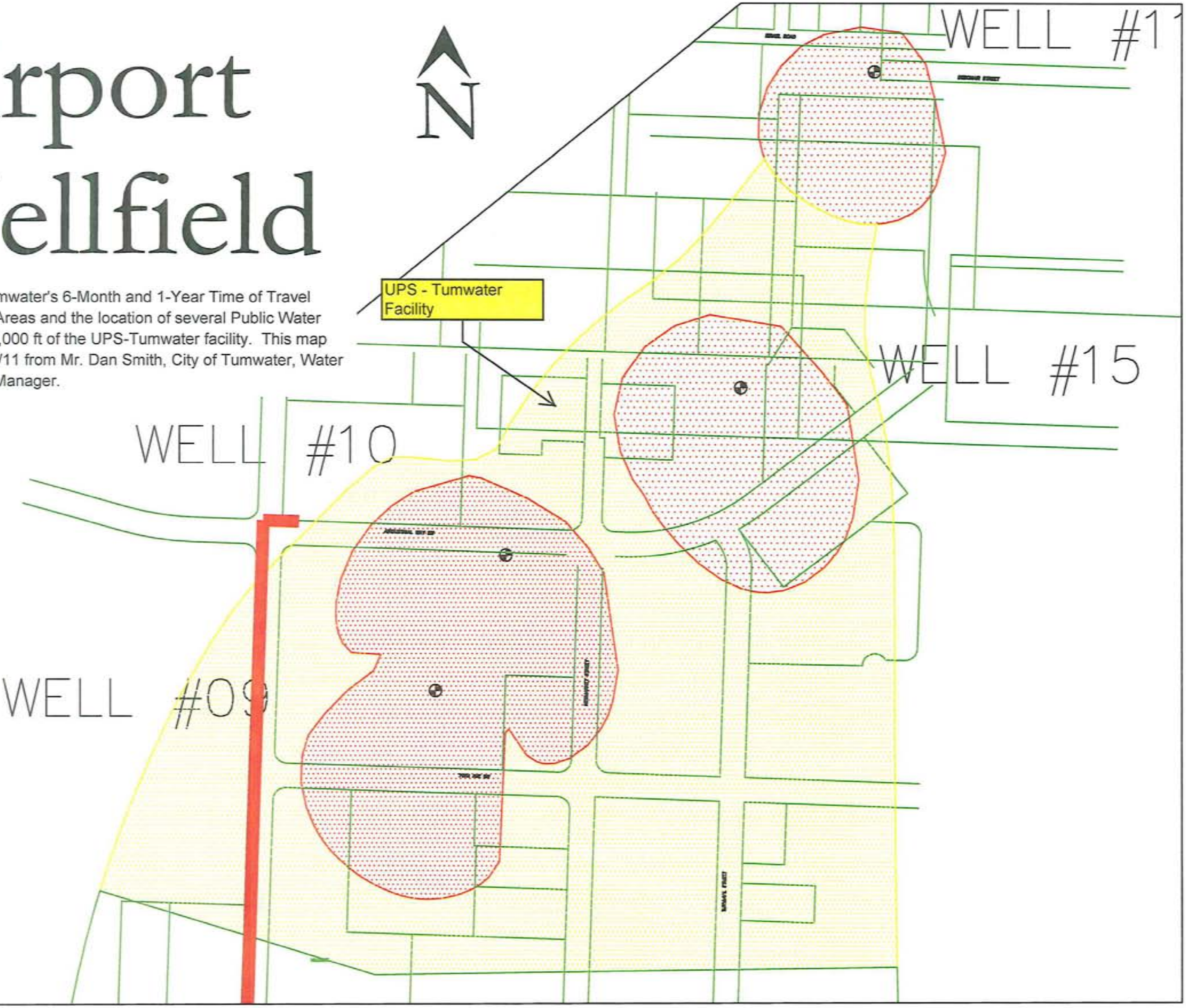
Adjust map size: Large



Designated Sole Source Aquifers in EPA Region 10 Idaho, Oregon, Washington (None in Alaska)

Airport Wellfield

Map of the City of Tumwater's 6-Month and 1-Year Time of Travel Wellhead Protection Areas and the location of several Public Water Supply Wells within 1,000 ft of the UPS-Tumwater facility. This map was received on 2/23/11 from Mr. Dan Smith, City of Tumwater, Water Resources Program Manager.



StormTech®
Detention • Retention • Recharge
Subsurface Stormwater Management℠

MC-3500 Chamber

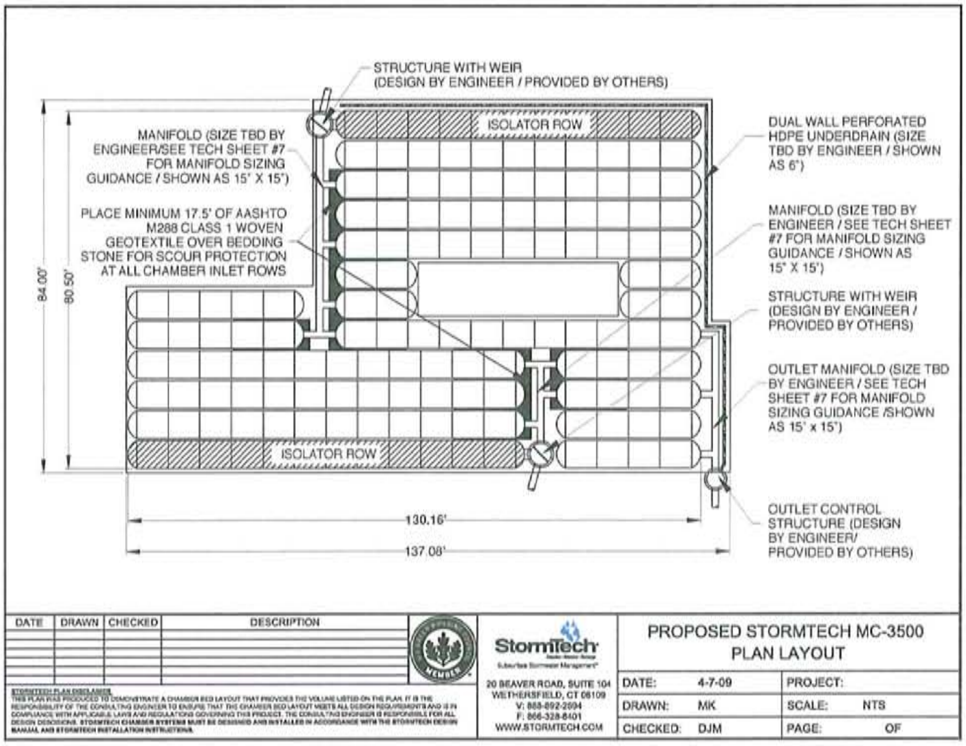
MC-3500 Design Manual

StormTech® Chamber Systems for Stormwater Management

U.S. Green Building Council
Member

Table of Contents

StormTech Technical Services Department assists design professionals in specifying StormTech stormwater systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. The Technical Department can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete vaults and other manufactured stormwater detention/retention products. Please note that it is the responsibility of the design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing a project.



This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

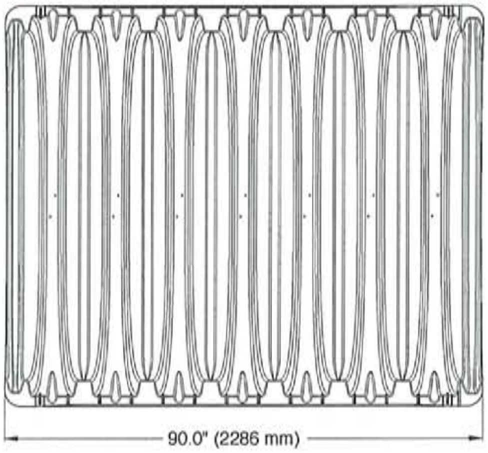
1.0 Product Information

Figure 1

StormTech MC-3500 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	90" (2286 mm) x 77" (1956 mm) x 45" (1143 mm)
Chamber Storage	113.0 ft^3 (3.20 m^3)
Min. Installed Storage*	176.8 ft^3 (5.01 m^3)
Weight	124 lbs (56.2 kg)



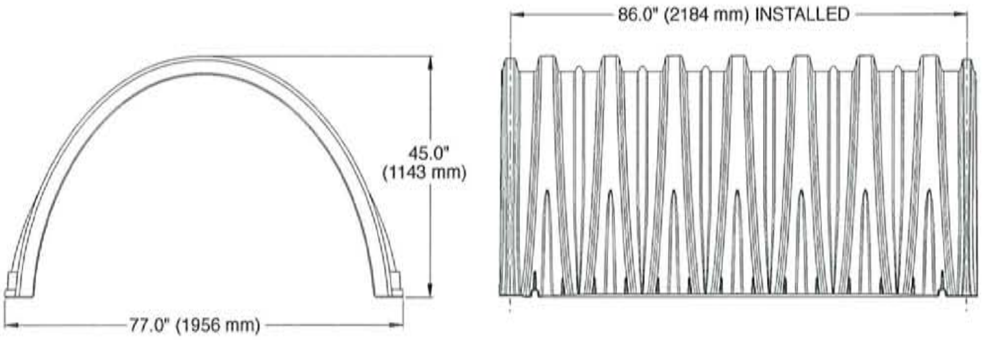
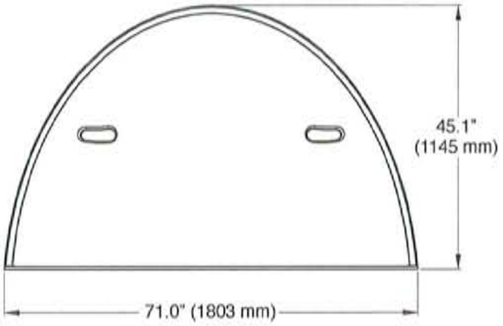


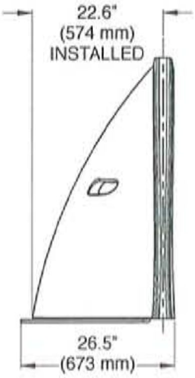
Figure 2

StormTech MC-3500 End Cap (not to scale)

Nominal End Cap Specifications

Size (L x W x H)	26.5" (673 mm) x 71" (1803 mm) x 45.1" (1145 mm)
End Cap Storage	15.6 ft^3 (0.44 m^3)
Min. Installed Storage*	45.6 ft^3 (1.29 m^3)
Weight	43 lbs (19.5 kg)





* This assumes a minimum of 12" (305 mm) of stone above, 9" (229 mm) of stone below and 6" (152 mm) of stone between the chambers/end caps and 40% stone porosity. The end cap minimum installed storage also includes the stone storage located in the 6" (152 mm) stone perimeter.

1.0 Product Information

1.1 PRODUCT DESIGN

StormTech's commitment to thorough product testing programs, materials evaluation and adherence to national standards has resulted in another superior product. Like other StormTech chambers, the MC-3500 is designed to meet the full scope of design requirements of Section 12.12 of the AASHTO LRFD Bridge Design Specifications and produced to the requirements of the American Society of Testing Materials (ASTM) International specification F 2418 "Standard Specification for Polypropylene (PP) Corrugated Stormwater Collection Chambers".

The StormTech MC-3500 chamber provides the full AASHTO safety factors for live loads and permanent earth loads. The ASTM F 2418 standard is linked to the AASHTO LRFD Bridge Design Specifications Section 12.12 design standard. ASTM F 2418 requires that the safety factors included in the AASHTO guidance are achieved as a prerequisite to meeting ASTM F 2418. StormTech chambers are also designed in accordance with ASTM F 2787 "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers" which provides specific guidance on how to design thermoplastic chambers in accordance with AASHTO Section 12.12. The three standards provide both the assurance of product quality and safe structural design.

The design of a larger chamber in the same tradition of our other chambers required the collaboration of experts in soil-structure interaction, plastics and manufacturing. Years of extensive research, including laboratory testing and field verification, were required to produce a chamber that is ready to meet both the rigors of installation and the longevity expected by engineers and owners.

This MC-3500 Design Manual provides the details and specifications necessary for consulting engineers to design stormwater management systems using the MC-3500 chamber. It provides specifications for storage capacities, layout dimensions as well as requirements for design to ensure a long service life. The basic design concepts for foundation and backfill materials, subgrade bearing capacities and row spacing remain equally as pertinent for the MC-3500 as the SC-740 and SC-310 chamber systems. However, since many design values and dimensional requirements are different for the MC-3500 than the SC-740 and SC-310 chambers, design manuals and installation instructions are not interchangeable.

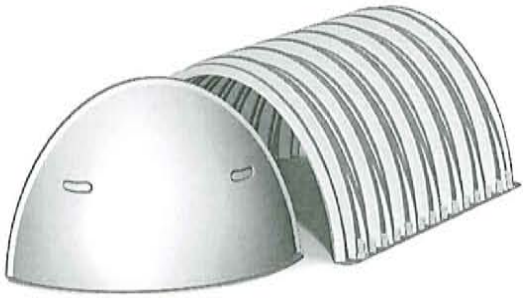
This manual includes only those details, dimensions, cover limits, etc for the MC-3500 and is intended to be a stand-alone design guide for the MC-3500 chamber. Installation Instructions specifically for the MC-3500 have also been published.

1.2 TECHNICAL SUPPORT

The StormTech Technical Services Department is available to assist the engineer with the layout of MC-3500 chamber systems and answer questions regarding all the StormTech chamber models. Call the Technical Services Department, email us at techinfo@stormtech.com or contact your local StormTech representative.

1.3 MC-3500 CHAMBER

All StormTech chambers are designed to the full scope of AASHTO requirements without repeating end walls or other structural reinforcing. StormTech's continuously curved, elliptical arch and the surrounding angular backfill are the key components of the structural system. With the addition of patent pending integral stiffening ribs **(Figure 3)**, the MC-3500 is assured to provide a long, safe service life. Like other StormTech chambers, the MC-3500 is produced from high quality, impact modified virgin polypropylene which is tested for short-term and long-term mechanical properties.



With the MC-3500, one chamber type is used for the start, middle and end of rows. Rows are formed by overlapping the *upper joint corrugation* of the next chamber over the *lower joint corrugation* of the previous chamber **(Figure 4)**.

The MC-3500 is designed with an optimized joining system. The height and width of the end corrugations have been designed to provide the required structural safety factors while providing an unobstructed flow path down each row.

1.0 Product Information

To assist the contractor, StormTech chambers are molded with simple assembly instructions and arrows that indicate the direction in which to build rows. The corrugation valley immediately adjacent to the lower joint corrugation is marked "Overlap Here - Lower Joint." The corrugation valley immediately adjacent to the upper joint corrugation is marked "Build This Direction - Upper Joint."

Two people can safely and efficiently carry and place chambers without cumbersome connectors, special tools or heavy equipment. Each row of MC-3500 chambers must begin and end with a joint corrugation. Field cutting is not recommended. For system layout assistance contact StormTech.

1.4 MC-3500 END CAP

The MC-3500 end cap is very easy to install. The MC-3500 end cap is designed with a corrugation joint that fits over the top of either end of the chamber. The *end cap joint* is simply set over the top of either of the upper or lower chamber joint corrugations **(Figure 5)**. Three (3) screws fasten the end cap to the chamber to maintain a positive connection during backfilling. Handles are molded into the end cap to enable one person to carry and set the end cap in place.

1.5 MC-3500 PRE-CORED END CAPS

End caps with pre-cored 18" and 24" bottom connections and 15" top connections are standard parts. Other pre-cored end cap configurations are available by special order. See StormTech details.

Figure 3 – Chamber and End Cap Components

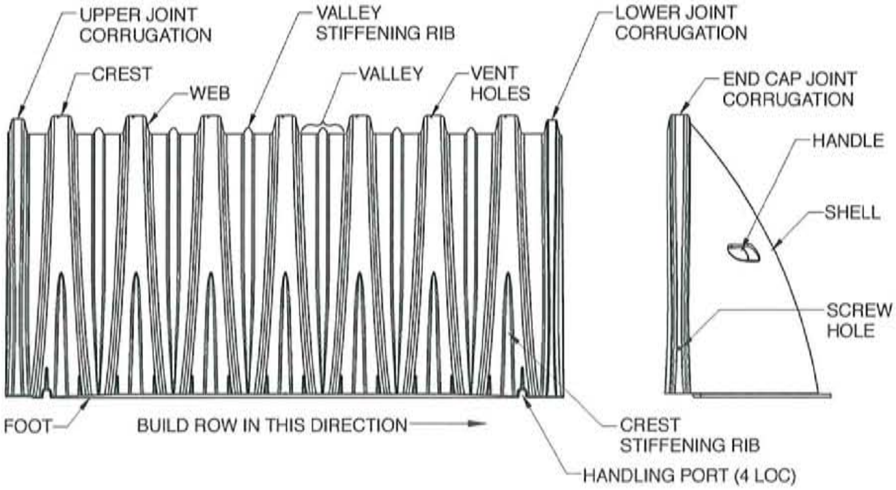


Figure 4 – Chamber Joint Overlap

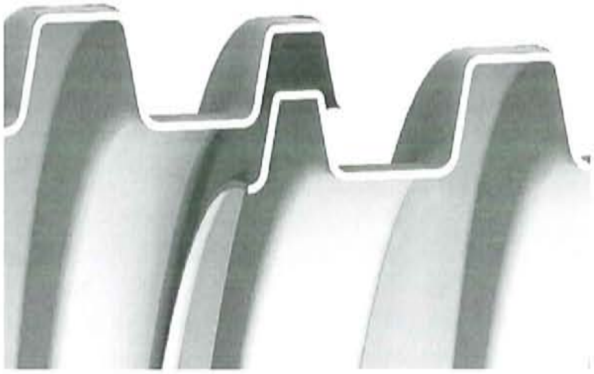
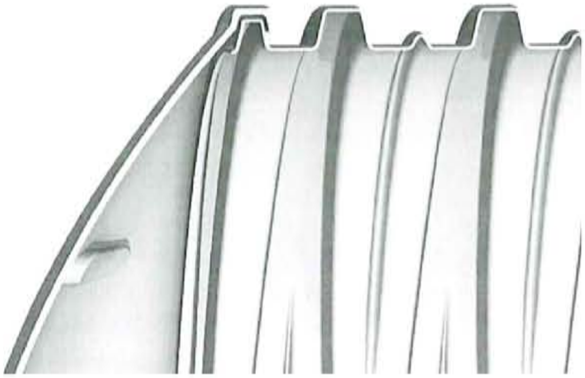


Figure 5 – End Cap Joint Overlap

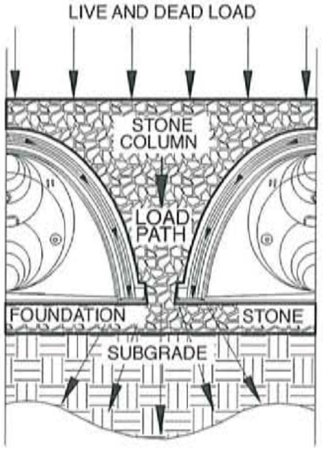


2.0 Foundations for Chambers

2.1 FOUNDATION REQUIREMENTS

StormTech MC-3500 chamber systems can be installed in various soil types. The subgrade bearing capacity and the cover height over the chambers determine the required depth of clean, crushed, angular foundation stone below the chambers. Foundation stone, also called bedding, is the stone between the subgrade soils and the feet of the chamber. Flexible structures are designed to transfer a significant portion of both live and dead loads through the surrounding soils. Chamber systems accomplish this by creating load paths through the columns of embedment stone between and around the rows of chambers. This creates load concentrations at the base of the columns between the rows. The foundation stone spreads out the concentrated loads to distributed loads that can be supported by the subgrade soils.

Since increasing the cover height (top of chamber to finished grade) causes increasing soil load, a greater depth of foundation stone is necessary to distribute the load to the subgrade soils. **Table 1** specifies the minimum required foundation depths for varying cover heights and allowable subgrade bearing capacities. The table is based on StormTech service loads and standard 6" (152 mm) row spacing for the MC-3500. The minimum required foundation depth is 9" (229 mm).



2.2 WEAKER SOILS

StormTech has not provided guidance for subgrade bearing capacities less than 2000 pounds per square foot [(2.0 ksf) (96 kPa)]. These soils are often highly variable, may contain organic materials and could be more sensitive to moisture. A geotechnical engineer must be consulted if soils with bearing capacities less than 2000 psf (96 kPa) are present.

Table 1 – Minimum Required Foundation Depth in Inches (mm)

Cover	Minimum Bearing Resistance for Service Loads ksf (kPa)																								
Hgt. ft (m)	4.4 (211)	4.3 (206)	4.2 (201)	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
2.0 (0.61)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)
2.5 (0.76)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)
3.0 (0.91)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)
3.5 (1.07)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)
4.0 (1.22)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)
4.5 (1.37)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)
5.0 (1.52)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)	36 (914)
5.5 (1.68)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)
6.0 (1.83)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	18 (457)	24 (610)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	42 (1067)
6.5 (1.98)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	24 (457)	24 (610)	24 (610)	24 (610)	24 (610)	30 (762)	30 (762)	30 (762)	36 (914)	36 (914)	42 (1067)	42 (1067)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

3.0 Required Materials/Row Separation

3.1 FOUNDATION AND EMBEDMENT STONE

The stone surrounding the chambers consists of the *foundation* stone below the chambers and *embedment* stone surrounding the chambers. The foundation stone and embedment stone are important components of the structural system and also provide open void space for stormwater storage. **Table 2** provides the stone specifications that achieve both structural requirements and a porosity of 40% for stormwater storage. **Figure 6** specifies the extents of each backfill stone location.

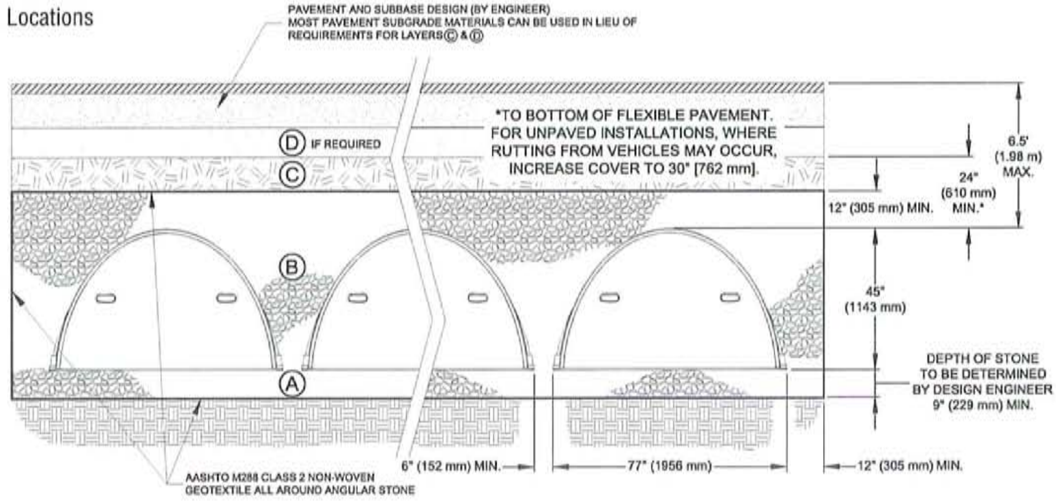
TABLE 2 – Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation[1]	Compaction/Density Requirement
Ⓓ Fill Material for layer 'D' starts from the top of the 'C' layer to the bottom of flexible pavement or unpaved finished grade above. Note that the pavement subbase may be part of the 'D' layer.	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	Prepare per engineer's plans. Paved installations may have stringent material and preparation requirements.
Ⓒ Fill Material for layer 'C' starts from the top of the embedment stone ('B' layer) to 24" (610 mm) above the top of the chamber. Note that pavement subbase may be part of the 'C' layer.	Granular well-graded soil/aggregate mixtures, <35% fines. Most pavement subbase materials can be used in lieu of this layer. (AASHTO M145 A-1, A-2, A-3)	3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	Begin compaction after 24" (610 mm) of material over the chambers is reached. Compact additional layers in 12" (305 mm) max. lifts to a min. 95% Standard Proctor density. See MC-3500 Installation Instructions for acceptable compaction equipment loads.
Ⓑ Embedment Stone surrounding chambers from the foundation stone to the 'C' layer above.	Clean, crushed, angular stone, nominal size distribution 3/4 - 2" (19 mm - 51 mm)	3, 357, 4, 467, 5, 56, 57	No compaction required.
Ⓐ Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone, nominal size distribution 3/4 - 2" (19 mm - 51 mm)	3, 357, 4, 467, 5, 56, 57	Plate compact or roll to achieve a 95% Standard Proctor Density.[2]

PLEASE NOTE:

1. ***The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "clean, crushed, angular no. 4 (AASHTO M43) stone."***
2. ***As an alternate to Proctor Testing and field density measurements on open graded stone, StormTech compaction requirements are met for 'A' location materials when placed and compacted in 9" (229 mm) (max) lifts using two full passes with an appropriate compactor.***

FIGURE 6 – Fill Material Locations



Once layer 'C' is placed any soil/material can be placed in layer 'D' up to the finished grade. Most pavement subbase soils can be used to replace the materials requirements of layer 'C' or 'D' at the design engineer's discretion.

3.0 Required Materials/Row Separation

3.2 FILL ABOVE CHAMBERS

Refer to **Table 2** and **Figure 6** for acceptable fill material above the clean, crushed, angular stone. StormTech requires a minimum of 24" (610 mm) from the top of the chamber to the bottom of flexible pavement. For non-paved installations where rutting from vehicles may occur StormTech requires a minimum of 30" (762 mm) from top of chamber to finished grade.

3.3 GEOTEXTILE SEPARATION

A non-woven geotextile meeting AASHTO M288 Class 2 separation requirements must be installed to completely envelope the system and prevent soil intrusion into the crushed, angular stone. Overlap adjacent geotextile rolls per AASHTO M288 separation guidelines. See **Table 3** for a list of acceptable geotextiles.

TABLE 3 – Some Suitable Geotextiles

Manufacturer	AASHTO M288 Class 2 Non-Woven*	AASHTO M288 Class 1 Woven**
Belton Industries	———	Beltech 977
Carthage Mills	FX-60HS, FX-80HS	FX-66
GSE Lining Technology	NW6, NW8	——
Maccaferri	MacTex MX245, MacTex MX275	——
Pavco-Amanco	NT3000M, NT4000M	TR 4000
Propex	Geotex 651, Geotex 861, Geotex 601, Geotex 701, Geotex 801	Geotex 315ST, Geotex 2x2HF, Geotex 250ST
SKAPS Industries	GT 160NW, GT 180NW	W315
Tencate Mirafi	Mirafi 160N, Mirafi 180N	Mirafi 600X, Filterweave 403, Filterweave 404, Geolon HP570, Geolon HP665, Geolon HP770
TNS Advanced Tech.	R060, R070, R080, R100	——
US Fabrics	US 205NW, US 160NW	US 315

*AASHTO M288 Class 2 Non-Woven Geotextile Application: 1. Separation layer between angular stone and surrounding soils to prevent fines intrusion. 2. Filter layer over the chambers of the StormTech Isolator™ Row to prevent fines migration out of row while maintaining adequate hydraulic flows.

**AASHTO M288 Class 1 Woven Geotextile Application: 1. Filtration/stabilization layer for the angular stone foundation of the StormTech Isolator™ Row to prevent scouring of the stone base during the JetVac maintenance procedure, modest hydraulic flows maintained. 2. At each inlet row to prevent scouring of the foundation stone.

3.4 PARALLEL ROW SEPARATION/ PERPENDICULAR BED SEPARATION

Parallel Row Separation

The minimum installed spacing between parallel rows after backfilling is 6" (152 mm) (measurement taken between the outside edges of the feet). Spacers may be used for layout convenience. Row spacing wider than the minimum 6" (152 mm) may be specified.

Increasing the spacing between chamber rows may allow the application of StormTech chambers with either less foundation stone or with weaker subgrade soils. This may be a good option where vertical restrictions on site prevent the use of a deeper foundation.

Perpendicular Bed Separation

When beds are laid perpendicular to each other, a minimum installed spacing of 36" (914 mm) between beds is required.

Spacers for row separation.

4.1 GENERAL

StormTech subsurface chamber systems offer the flexibility for a variety of inlet and outlet configurations. Contact the StormTech Technical Services Department or your local StormTech representative for assistance configuring inlet and outlet connections.

The open graded stone around and under the MC-3500 provides significant conveyance capacity ranging from approximately 0.8 cfs (23 l/s) to 13 cfs (368 l/s) per chamber. The actual conveyance capacity is dependent upon stone size, depth of foundation stone and head of water. Although the high conveyance capacity of the open graded stone is an important component of the flow network, StormTech recommends that a system of inlet and outlet manifolds be designed to distribute and convey the peak flow through the chamber system.

It is the responsibility of the design engineer to provide the design flow rates and storage volumes for the stormwater system and to ensure that the final design meets all conveyance and storage requirements. However, StormTech will work with the design engineer to assist with manifold and chamber layouts that meet the design objectives.

4.2 THE ISOLATOR™ ROW

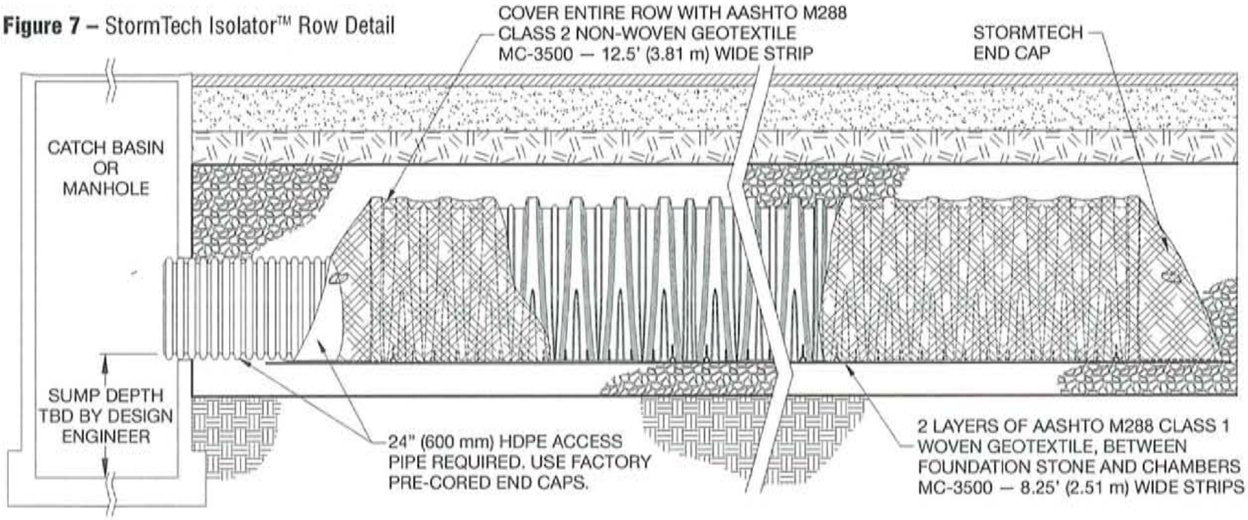
The Isolator Row is a patented system that inexpensively captures total suspended solids (TSS) and debris and provides easy access for inspection and maintenance. A double layer of woven geotextile between the bottom of the chambers and the foundation stone provides the filter media that satisfies most contaminant removal objectives. Each installed MC-3500 chamber and MC-3500 end cap provides 43.2 ft² (4.0 m²) and 7.5 ft² (0.7 m²) of bottom filter area respectively. Flow through Isolator Row chamber and end cap joints is filtered by a nonwoven geotextile that covers the chambers and end caps.

The Isolator Row can be configured for maintenance objectives or, in some regulatory jurisdictions, for water quality objectives. For water quality applications, Isolator Rows can be sized based on water quality volume or flow rate.

All Isolator Rows require: 1) a manhole for maintenance access, 2) a means of diversion of flows to the Isolator Row and 3) a high flow bypass. Flow diversion can be accomplished by either a weir in the upstream access manhole or simply by feeding the Isolator Row at a lower elevation than the high flow bypass. Contact StormTech for assistance sizing Isolator Rows.

When additional stormwater treatment is required, StormTech systems can be configured using a treatment train approach where other stormwater BMPs are located in series.

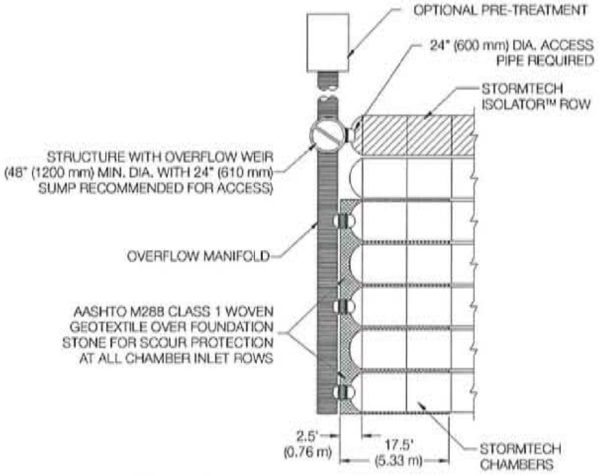
Figure 7 – StormTech Isolator™ Row Detail



NOTE: For many applications, the non-woven geotextile over the MC-3500 chambers can be eliminated or substituted with the AASHTO Class I woven geotextile. Contact your StormTech representative for assistance.

4.0 Hydraulics

Figure 8 – Typical Inlet Configuration With Isolator Row and Scour Protection



4.3 INLET MANIFOLDS

The primary function of the inlet manifold is to convey and distribute flows to a sufficient number of rows in the chamber bed such that there is ample conveyance capacity to pass the peak flows without creating an unacceptable backwater condition in upstream piping or scour the foundation stone under the chambers.

Manifolds are connected to MC-3500 end caps either at the top or bottom of the end cap. High inlet flow rates from either connection location produce a shear scour potential of the foundation stone. Inlet flows from top inlets also produce impingement scour potential. Scour potential is reduced when standing water is present over the foundation stone. However, for safe design across the wide range of applications, StormTech assumes minimal standing water at the time the design flow occurs.

To minimize scour potential, StormTech recommends the installation of woven scour protection fabric at each inlet row. This enables a protected transition zone from the concentrated flow coming out of the inlet pipe to a uniform flow across the entire width of the chamber for both top and bottom connections.

Allowable flow rates for design are dependent upon: the elevation of inlet pipe, foundation stone size and scour protection. With an appropriate scour protection geotextile installed from the end cap to at least 15' (4.57 m) in front of the inlet pipe, for both top and bottom feeds, the flow rates listed in **Table 4** can be used for all StormTech specified foundation stone gradations.

TABLE 4 – Allowable Inlet Flows With 15' (4.57 m) of Scour Protection for the MC-3500 Chamber

Inlet Pipe Diameter Inches (mm)	Allowable Maximum Flow Rate cfs (l/s)
12 (300)	2 (57)
15 (375)	3.5 (99)
18 (450)	5.5 (156)
24 (600)	8.5 (241)

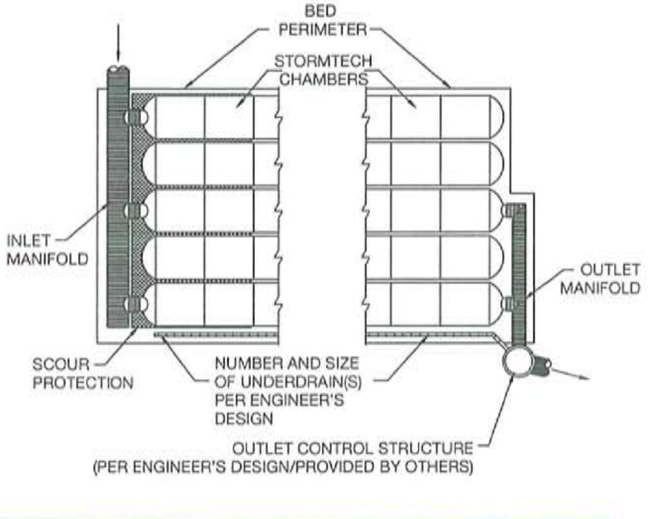
4.4 OUTLET MANIFOLDS

The primary function of the outlet manifold is to convey peak flows from the chamber system to the outlet control structure. Outlet manifolds are often sized for attenuated flows. They may be smaller in diameter and have fewer row connections than inlet manifolds. In some applications however, the intent of the outlet piping is to convey an unattenuated bypass flow rate and manifolds may be sized similar to inlet manifolds.

Since chambers are generally flowing at or near full at the time of the peak outlet flow rate, scour is generally not governing and outlet manifold sizing is based on pipe flow equations. In most cases, StormTech recommends that outlet manifolds connect the same rows that are connected to an inlet manifold. This provides a continuous flow path through open conduits to pass the peak flow without dependence on passing peak flows through stone.

The primary function of the underdrains is to draw down water stored in the stone below the invert of the manifold. Underdrains are generally not sized for conveyance of the peak flow.

Figure 9 – Typical Inlet, Outlet and Underdrain Configuration



5.0 Cumulative Storage Volumes

Tables 5 and **6** provide cumulative storage volumes for the MC-3500 chamber and end cap. These tables can be used to calculate the stage–storage relationship for the retention or detention system. Digital spreadsheets in which the number of chambers and end caps can be input for quick cumulative storage calculations are available at www.stormtech.com. For assistance with site-specific calculations or input into routing software, contact the StormTech Technical Services Department.

TABLE 5 – MC-3500 Incremental Storage Volume Per Chamber

Assumes 40% stone porosity. Calculations are based upon a 9" (229 mm) stone base under the chambers, 12" (305 mm) of stone above chambers, and 6" (152 mm) spacing between chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
66 (1676)	0	176.88 (5.009)
65 (1651)	0	175.22 (4.962)
64 (1626)	Stone 0	173.57 (4.915)
63 (1600)	Cover 0	171.92 (4.868)
62 (1575)	0	170.27 (4.821)
61 (1549)	0	168.61 (4.775)
60 (1524)	0	166.96 (4.728)
59 (1499)	0	165.31 (4.681)
58 (1473)	0	163.66 (4.634)
57 (1448)	0	162.01 (4.588)
56 (1422)	0	160.35 (4.541)
55 (1397)	0	158.70 (4.494)
54 (1372)	113.04 (3.201)	157.05 (4.447)
53 (1346)	112.98 (3.199)	155.36 (4.399)
52 (1321)	112.78 (3.194)	153.59 (4.349)
51 (1295)	112.47 (3.185)	151.75 (4.297)
50 (1270)	111.86 (3.168)	149.73 (4.240)
49 (1245)	110.89 (3.140)	147.50 (4.177)
48 (1219)	109.68 (3.106)	145.12 (4.109)
47 (1194)	108.29 (3.066)	142.64 (4.039)
46 (1168)	106.75 (3.023)	140.06 (3.966)
45 (1143)	105.07 (2.975)	137.39 (3.891)
44 (1118)	103.26 (2.924)	134.66 (3.813)
43 (1092)	101.33 (2.869)	131.85 (3.734)
42 (1067)	99.31 (2.812)	128.98 (3.652)
41 (1041)	97.18 (2.752)	126.05 (3.569)
40 (1016)	94.97 (2.689)	123.07 (3.485)
39 (991)	92.66 (2.624)	120.04 (3.399)
38 (965)	90.28 (2.556)	116.96 (3.312)
37 (940)	87.82 (2.487)	113.83 (3.223)
36 (914)	85.30 (2.415)	110.66 (3.134)
35 (889)	82.70 (2.342)	107.45 (3.043)
34 (864)	80.04 (2.267)	104.20 (2.951)
33 (838)	77.32 (2.189)	100.92 (2.858)
32 (813)	74.54 (2.111)	97.60 (2.764)
31 (787)	71.71 (2.031)	94.25 (2.669)
30 (762)	68.83 (1.949)	90.87 (2.573)
29 (737)	65.89 (1.866)	87.45 (2.476)
28 (711)	62.91 (1.782)	84.01 (2.379)
27 (686)	59.89 (1.696)	80.55 (2.281)
26 (660)	56.82 (1.609)	77.05 (2.182)
25 (635)	53.72 (1.521)	73.54 (2.082)
24 (610)	50.57 (1.432)	70.00 (1.982)
23 (584)	47.39 (1.342)	66.44 (1.881)
22 (559)	44.18 (1.251)	62.86 (1.780)
21 (533)	40.93 (1.159)	59.26 (1.678)
20 (508)	37.66 (1.066)	55.64 (1.576)
19 (483)	34.35 (0.973)	52.01 (1.473)
18 (457)	31.02 (0.878)	48.35 (1.369)
17 (432)	27.66 (0.783)	44.69 (1.265)
16 (406)	24.28 (0.688)	41.00 (1.161)
15 (381)	20.87 (0.591)	37.31 (1.056)
14 (356)	17.45 (0.494)	33.60 (0.951)
13 (330)	14.00 (0.396)	29.88 (0.846)
12 (305)	10.53 (0.298)	26.15 (0.740)
11 (279)	7.04 (0.199)	22.40 (0.634)
10 (254)	3.53 (0.100)	18.64 (0.528)
9 (229)	0	14.87 (0.421)
8 (203)	0	13.22 (0.374)
7 (178)	0	11.57 (0.328)
6 (152)	Stone 0	9.91 (0.281)
5 (127)	Foundation 0	8.26 (0.234)
4 (102)	0	6.61 (0.187)
3 (76)	0	4.96 (0.140)
2 (51)	0	3.30 (0.094)
1 (25)	0	1.65 (0.047)

NOTE: Add 1.65 ft^3 (0.047 m^3) of storage for each additional inch (25 mm) of stone foundation.

Contact StormTech for cumulative volume spreadsheets in digital format.

5.0 Cumulative Storage Volumes

TABLE 6 – MC-3500 Incremental Storage Volume Per End Cap

Assumes 40% stone porosity. Calculations are based upon a 9" (229 mm) stone base under the end caps, 12" (305 mm) of stone above end caps, 6" (152 mm) of spacing between end caps and 6" (152 mm) of stone perimeter.

Depth of Water in System Inches (mm)	Cumulative End Cap Storage ft^3 (m^3)	Total System Cumulative Storage ft^3 (m^3)
66 (1676)	↑ 0	45.65 (1.293)
65 (1651)	0	45.10 (1.277)
64 (1626)	Stone 0	44.55 (1.262)
63 (1600)	Cover 0	44.00 (1.246)
62 (1575)	0	43.45 (1.230)
61 (1549)	0	42.90 (1.215)
60 (1524)	0	42.35 (1.199)
59 (1499)	0	41.80 (1.184)
58 (1473)	0	41.25 (1.168)
57 (1448)	0	40.70 (1.153)
56 (1422)	0	40.15 (1.137)
55 (1397)	↓ 0	39.61 (1.122)
54 (1372)	15.64 (0.443)	39.06 (1.106)
53 (1346)	15.64 (0.443)	38.51 (1.090)
52 (1321)	15.63 (0.443)	37.95 (1.075)
51 (1295)	15.62 (0.442)	37.40 (1.059)
50 (1270)	15.60 (0.442)	36.84 (1.043)
49 (1245)	15.56 (0.441)	36.26 (1.027)
48 (1219)	15.51 (0.439)	35.68 (1.010)
47 (1194)	15.44 (0.437)	35.09 (0.994)
46 (1168)	15.35 (0.435)	34.49 (0.977)
45 (1143)	15.25 (0.432)	33.88 (0.959)
44 (1118)	15.13 (0.428)	33.26 (0.942)
43 (1092)	14.99 (0.424)	32.62 (0.924)
42 (1067)	14.83 (0.420)	31.98 (0.905)
41 (1041)	14.65 (0.415)	31.32 (0.887)
40 (1016)	14.45 (0.409)	30.65 (0.868)
39 (991)	14.24 (0.403)	29.97 (0.849)
38 (965)	14.00 (0.396)	29.28 (0.829)
37 (948)	13.74 (0.389)	28.58 (0.809)
36 (914)	13.47 (0.381)	27.86 (0.789)
35 (889)	13.18 (0.373)	27.14 (0.769)
34 (864)	12.86 (0.364)	26.40 (0.748)
33 (838)	12.53 (0.355)	25.65 (0.726)
32 (813)	12.18 (0.345)	24.89 (0.705)
31 (787)	11.81 (0.335)	24.12 (0.683)
30 (762)	11.42 (0.323)	23.34 (0.661)
29 (737)	11.01 (0.312)	22.54 (0.638)
28 (711)	10.58 (0.300)	21.73 (0.615)
27 (686)	10.13 (0.287)	20.92 (0.592)
26 (680)	9.67 (0.274)	20.09 (0.569)
25 (610)	9.19 (0.260)	19.25 (0.545)
24 (609)	8.70 (0.246)	18.41 (0.521)
23 (584)	8.19 (0.232)	17.55 (0.497)
22 (559)	7.67 (0.217)	16.69 (0.473)
21 (533)	7.13 (0.202)	15.82 (0.448)
20 (508)	6.59 (0.187)	14.94 (0.423)
19 (483)	6.03 (0.171)	14.06 (0.398)
18 (457)	5.46 (0.155)	13.17 (0.373)
17 (432)	4.88 (0.138)	12.27 (0.347)
16 (406)	4.30 (0.122)	11.37 (0.322)
15 (381)	3.70 (0.105)	10.46 (0.296)
14 (356)	3.10 (0.088)	9.55 (0.270)
13 (330)	2.49 (0.071)	8.64 (0.245)
12 (305)	1.88 (0.053)	7.72 (0.219)
11 (279)	1.26 (0.036)	6.80 (0.192)
10 (254)	0.63 (0.018)	5.87 (0.166)
9 (229)	↑ 0	4.95 (0.140)
8 (203)	0	4.40 (0.124)
7 (178)	0	3.85 (0.109)
6 (152)	0	3.30 (0.093)
5 (127)	Stone 0	2.75 (0.078)
4 (102)	Foundation 0	2.20 (0.062)
3 (76)	0	1.65 (0.047)
2 (51)	0	1.10 (0.031)
1 (25)	↓ 0	0.55 (0.016)

NOTE: Add 0.55 ft^3 (0.016 m^3) of storage for each additional inch (25 mm) of stone foundation.

Contact StormTech for cumulative volume spreadsheets in digital format.

6.0 MC-3500 Chamber System Sizing

The following steps provide the calculations necessary for preliminary sizing of an MC-3500 chamber system. For custom bed configurations to fit specific sites, contact the StormTech Technical Services Department or your local StormTech representative.

1) Determine the amount of storage volume (V_S) required. It is the design engineer's sole responsibility to determine the storage volume required.

TABLE 7 – Storage Volume Per Chamber/End Cap ft^3 (m^3)

	Bare Unit Storage	**Chamber/End Cap and Stone Volume — Stone Foundation Depth in. (mm)**			
MC-3500	**ft^3 (m^3)**	**9 (229)**	**12 (305)**	**15 (381)**	**18 (457)**
Chamber	113 (3.20)	176.8 (5.01)	181.8 (5.15)	186.8 (5.29)	191.7 (5.43)
End Cap	15.6 (0.44)	45.6 (1.29)	47.3 (1.34)	48.9 (1.39)	50.6 (1.43)

NOTE: Assumes 40% porosity for the stone plus the chamber/end cap volume. End cap volume assumes 6" (152 mm) stone perimeter.

2) Determine the number of chambers (C) required.
To calculate the number of chambers required for adequate storage, divide the storage volume (Vs) by the storage volume of the chamber (from **Table 7**), as follows: **C = Vs / Storage Volume per Chamber**

3) Determine the number of end caps required.
The number of end caps (EC) required depends on the number of rows required by the project. Once the number of chamber rows is determined, multiply the number of chamber rows by 2 to determine the number of end caps required. **EC = No. of Chamber Rows x 2**

NOTE: Additional end caps may be required for systems having inlet locations within the chamber bed.

4) Determine additional storage provided by end caps.
End Caps will provide additional storage to the project. Multiply the number of end caps (EC) by the storage volume per end cap (ECs) to determine the additional storage (As) provided by the end caps. **As = EC x ECs**

5) Adjust number of chambers (C) to account for additional end cap storage (As). The original number of chambers (C) can now be reduced due to the additional storage in the end caps. Divide the additional storage (As) by the storage volume per chamber to determine the number of chambers that can be removed. **Number of chambers to remove = As/ volume per chamber**

NOTE: Additional storage exists in the stone perimeter as well as in the inlet and outlet manifold systems. Contact StormTech's Technical Services Department for assistance with determining the number of chambers and end caps required for your project.

6) Determine the required bed size (S).
The size of the bed will depend on the number of chambers and end caps required:
MC-3500 area per chamber = 49.6 ft^2 (4.6 m^2)
MC-3500 area per end cap = 13.0 ft^2 (1.2 m^2)

S = (C x area per chamber) + (EC x area per end cap)

NOTE: It is necessary to add 12" (305 mm) of stone perimeter parallel to the chamber rows and 6" (152 mm) of stone perimeter from the base of all end caps. The additional area due to perimeter stone is not included in the area numbers above.

7) Determine the amount of stone (V_{St}) required.
To calculate the total amount of clean, crushed, angular stone required, multiply the number of chambers (C) and the number of end caps (EC) by the selected weight of stone from **Table 8.**

NOTE: Clean, crushed, angular stone is also required around the perimeter of the system.

TABLE 8 – Amount of Stone Per Chamber/End Cap

ENGLISH tons (yds^3)	**Stone Foundation Depth**			
	9"	**12"**	**15"**	**18"**
MC-3500	8.4 (5.9 yd^3)	9.0 (6.4 yd^3)	9.7 (6.8 yd^3)	10.3 (7.3 yd^3)
End Cap	3.9 (2.8 yd^3)	4.2 (2.9 yd^3)	4.4 (3.1 yd^3)	4.6 (3.2 yd^3)
METRIC kg (m^3)	**229 mm**	**305 mm**	**381 mm**	**457 mm**
MC-3500	7620 (4.5 m^3)	8164 (4.9 m^3)	8800 (5.2 m^3)	9344 (5.6 m^3)
End Cap	3538 (2.1 m^3)	3810 (2.2 m^3)	3992 (2.4 m^3)	4173 (2.4 m^3)

NOTE: Assumes 12" (305 mm) of stone above, 6" (152 mm) row spacing, and 6" (152 mm) of perimeter stone in front of end caps.

8) Determine the volume of excavation (Ex) required.
Each additional foot of cover will add a volume of excavation of 1.8 yd^3 (1.4 m^3) per MC-3500 chamber and 0.6 yd^3 (0.5 m^3) per MC-3500 end cap.

TABLE 9 – Volume of Excavation Per Chamber/End Cap in yd^3 (m^3)

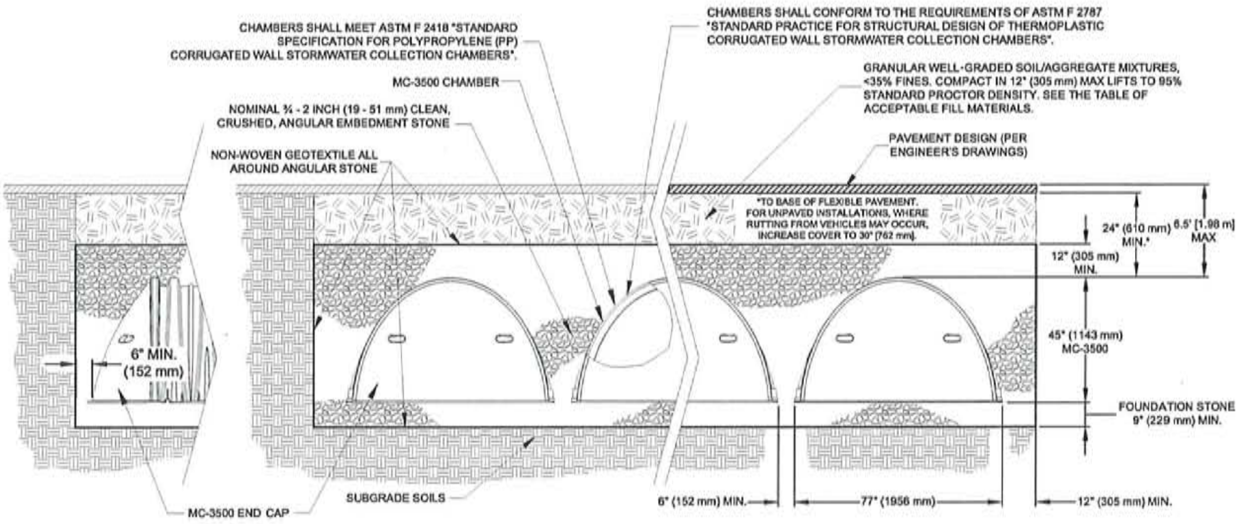
	Stone Foundation Depth			
	9" (229 mm)	**12" (305 mm)**	**15" (381 mm)**	**18" (457 mm)**
MC-3500	11.9 (9.1)	12.4 (9.5)	12.9 (9.9)	13.3 (10.2)
End Cap	4.0 (3.1)	4.1 (3.1)	4.3 (3.3)	4.4 (3.4)

NOTE: Assumes 6" (152 mm) of separation between chamber rows, 6" (152 mm) of perimeter in front of end caps, and 24" (610 mm) of cover. The volume of excavation will vary as the depth of cover increases.

9) Determine the area of geotextile (F) required.
The bottom, top and sides of the bed must be covered with a non-woven geotextile (filter fabric) that meets AASHTO M288 Class 2 requirements. The area of the sidewalls must be calculated and a 24" (610 mm) overlap must be included for all seams. Geotextiles typically come in 15 foot (4.57 m) wide rolls.

7.0 Structural Cross Section and Specifications

Figure 10 – MC-3500 Structural Cross Section Detail – (not to scale)



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

MC-3500 STORMWATER CHAMBER SPECIFICATIONS:

1. Chambers shall be StormTech MC-3500 or approved equal.
2. Chambers shall be made from virgin, impact-modified polypropylene copolymers.
3. Chamber rows shall provide continuous, unobstructed internal space with no internal panels that would impede flow.
4. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for: 1) long-duration dead loads and 2) short-duration live loads, based on the AASHTO Design Truck with consideration for impact and multiple vehicle presences.
5. Chambers shall conform to the requirements of ASTM F 2418, "Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers."
6. Chambers shall conform to the requirements of ASTM F 2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers."
7. Only chambers that are approved by the engineer will be allowed. The contractor shall submit (3 sets) of the following to the engineer for approval before delivering chambers to the project site:
    - A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met. The 50-year creep modulus data specified in ASTM F 2418 must be used as part of the AASHTO structural evaluation to verify long-term performance
    - Structural cross section detail on which the structural cross section is based.
8. The installation of chambers shall be in accordance with the manufacturer's latest Installation Instructions.

Detail drawings available in AutoCad Rev. 2000 format at www.stormtech.com.

8.0 General Notes

1. StormTech LLC ("StormTech") requires installing contractors to use and understand the latest **StormTech MC-3500 Installation Instructions** prior to beginning system installation.
2. StormTech offers installation consultations to installing contractors. Contact our Technical Service Department or local StormTech representative at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can then answer questions or address comments on the StormTech chamber system and inform the Installing contractor of the minimum installation requirements before beginning the system's construction. Call 860-529-8188 to speak to a Technical Service Representative or visit www.stormtech.com to receive a copy of our Installation Instructions.
3. StormTech requirements for systems with pavement design (asphalt, concrete pavers, etc.): Minimum cover is 24" (610 mm) not including pavement; Maximum cover is 6.5' (1.98 m) including pavement. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is 30" (762 mm), maximum cover is 6.5' (1.98 m).
4. The contractor must report any discrepancies with the bearing capacity of the subgrade materials to the design engineer.
5. AASHTO M288 Class 2 non-woven geotextile (filter fabric) must be used as indicated in the project plans.
6. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of StormTech MC-3500 Installation Instructions.
7. Backfilling over the chambers must follow requirements as indicated in the most current version of StormTech MC-3500 Installation Instructions.
8. The contractor must refer to StormTech MC-3500 Installation Instructions for a Table of Acceptable Vehicle Loads at various depths of cover. This information is also available at the StormTech website: www.stormtech.com. The contractor is responsible for preventing vehicles that exceed StormTech requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.
9. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.
10. STORMTECH PRODUCT WARRANTY IS LIMITED. Contact StormTech for warranty information.

A Family of Products and Services for the Stormwater Industry:

- MC-3500 Chambers and End Caps
- SC-310 Chambers and End Caps
- SC-740 Chambers and End Caps
- SC and MC Fabricated End Caps
- Fabricated Manifold Fittings
- Patented Isolator Row for Maintenance and Water Quality
- Chamber Separation Spacers
- In-House System Layout Assistance
- On-Site Educational Seminars
- Worldwide Technical Sales Group
- Centralized Product Applications Department
- Research and Development Team
- Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Web Site

StormTech provides state of the art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that "Saves Valuable Land and Protects Water Resources."

Please contact one of our inside project application professionals or Regional Product Managers (RPMs) to discuss your particular application. A wide variety of technical support material is available in print, electronic media or from our website at www.stormtech.com. For any questions, please call StormTech at 888-892-2694.

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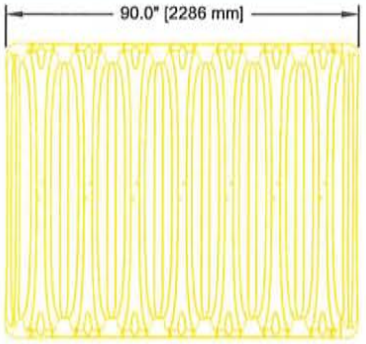
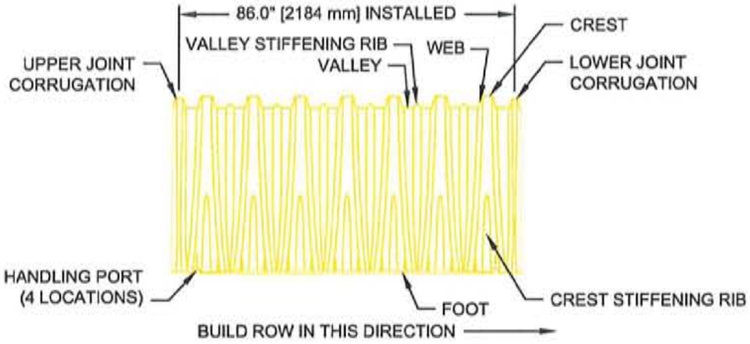
StormTech products are covered by one or more of the following patents: U.S. Patents: 5,401,459; 5,511,903; 5,716,163; 5,588,778; 5,839,844; Canadian Patents: 2,158,418 Other U.S. and Foreign Patents Pending

MADE IN THE USA

S171009



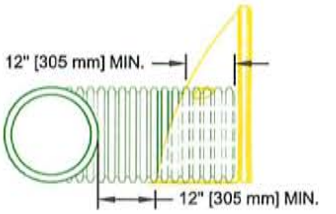


NOMINAL MC-3500 CHAMBER SPECIFICATIONS

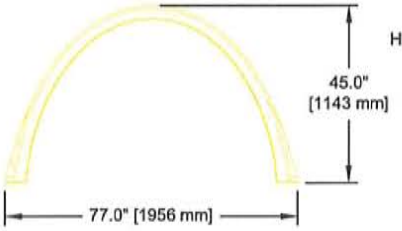
SIZE (L x W x H)	90" x 77" x 45" [2286 mm x 1956 mm x 1143 mm]
CHAMBER STORAGE	109.9 ft³ [3.11 m³]
MINIMUM INSTALLED STORAGE	178.9 ft³ [5.06 m³]
WEIGHT	134 lbs. [60.8 kg]

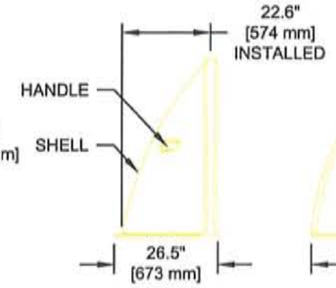
NOMINAL MC-3500 END CAP SPECIFICATIONS

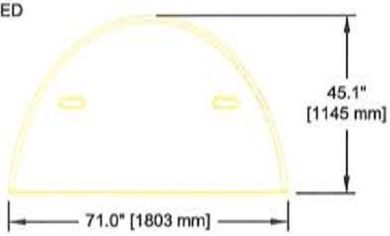
SIZE (L x W x H)	26.5" x 71" x 45.1"[673 mm x 1803 mm x 1145 mm]
ENDCAP STORAGE	15.6 ft³ [0.44 m³]
MINIMUM INSTALLED STORAGE	46.9 ft³ [1.33 m³]
WEIGHT	43 lbs. [19.5 kg]

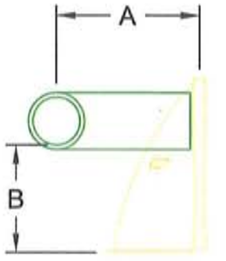


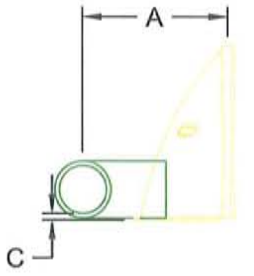
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN THE END CAP OPENING.











PART NUMBERS ENDING WITH "B" ARE FOR STUBS AT BOTTOM OF END CAP.
PART NUMBERS ENDING WITH "T" ARE FOR STUBS AT TOP OF END CAP.

PART#	STUB	B	C
MC3500TEPE12T	12" [300 mm]	26.36" (670 mm)	N/A
MC3500TEPE12B	12" [300 mm]	N/A	1.35" [34 mm]
MC3500TEPE15T	15" [375 mm]	23.39" [594 mm]	N/A
MC3500TEPE15B	15" [375 mm]	N/A	1.50" [38 mm]
MC3500TEPE18T	18" [450 mm]	20.03" [509 mm]	N/A
MC3500TEPE18B	18" [450 mm]	N/A	1.77" [45 mm]
MC3500TEPE24T	24" [600 mm]	14.48" [368 mm]	N/A
MC3500TEPE24B	24" [600 mm]	N/A	2.06" [52 mm]

NOTE: ALL DIMENSIONS ARE NOMINAL

CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12" - 24" SIZE ON SIZE AND 15" THROUGH 48" ECCENTRIC MANIFOLDS.

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MC-3500 TECHNICAL SPECIFICATIONS

SCALE:	NTS
DATE:	04/25/12
DRAWN BY:	JLM
CHECKED:	

MC-3500/MC-4500

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StormTech Construction Guide

REQUIRED MATERIALS AND EQUIPMENT LIST

- Acceptable fill materials per **Table 1**
- Woven and non-woven geotextiles
- StormTech solid end caps and pre-cored end caps
- StormTech chambers
- MC-3500 end cap screws (2 ½" [64mm] coarse thread – 3 per end cap)
- MC-4500 chamber joint screws (Fastenal #12-11 x 1" slotted hex washer head sheet metal screw, type A, zinc/steel [SKU 1131123] - 6 per joint)
- StormTech manifolds and fittings

NOTE: MC-3500 chamber pallets are 77" x 90" (2.0 m x 2.3 m) and weigh about 2010 lbs. (912 kg) and MC-4500 pallets are 100" x 52" (2.5 m x 1.3 m) and weight about 840 lbs. (381 kg). Unloading chambers requires 72" (1.8 m) (min.) forks and/or tie downs (straps, chains, etc).

IMPORTANT: This installation guide provides the minimum requirements for proper installation of large chambers. Non-adherence to this guide may result in damage to chambers during installation. Replacement of damaged chambers during or after backfilling is costly and very time consuming. It is recommended that all installers are familiar with this guide, and that the contractor inspects the chambers for distortion, damage and joint integrity as work progresses.

Requirements for System Installation

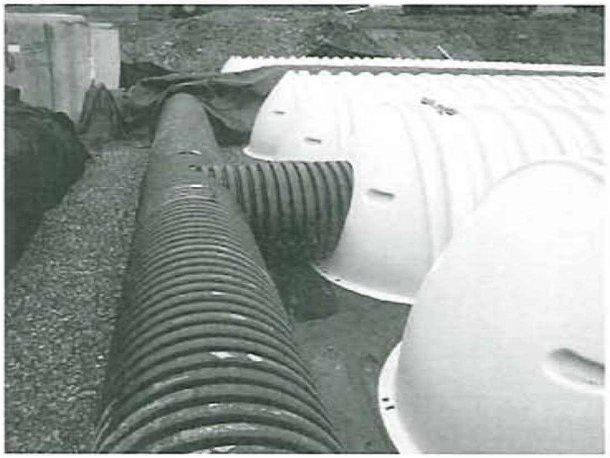
Excavate bed and prepare subgrade per engineer's plans.

Place non-woven geotextile over prepared soils and up excavation walls.

Place clean, crushed, angular stone foundation 9" (229 mm) min. Install underdrains if required. Compact to achieve a flat surface.

Manifold, Scour Fabric and Chamber Assembly

Install manifolds and lay out woven scour geotextile at inlet rows [min. 17.5 ft (5.33 m)] at each inlet end cap. Place a continuous piece (no seams) along entire length of Isolator® Row(s).

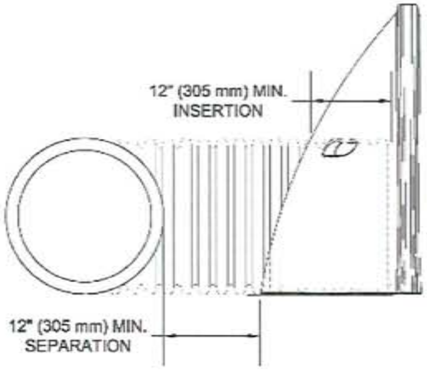


Align the first chamber and end cap of each row with inlet pipes. Each MC-3500 end cap must be fastened to chambers with three 2½" (64 mm) coarse thread screws before backfilling. Contractor may choose to postpone stone placement around end chambers and leave ends of rows open for easy inspection of chambers during the backfill process.

Continue installing chamber rows by overlapping chamber end corrugations. Chamber joints are labeled "Lower Joint— Overlap Here" and "Build This Direction—Upper Joint." Place non-woven geotextile over Isolator Row chambers (if specified).

Maintain minimum - 9" (229 mm) spacing between rows

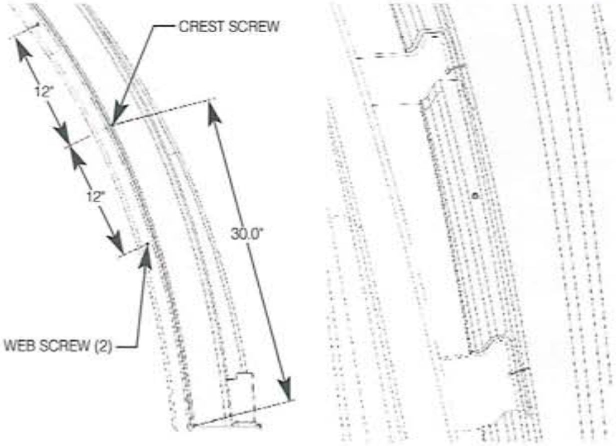
Manifold Insertion



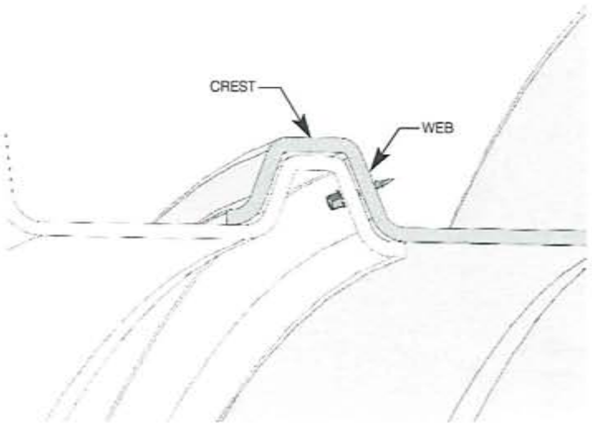
NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN THE END CAP OPENING.

Insert inlet and outlet manifolds a minimum 12" (305 mm) into chamber end caps. Manifold header should be a minimum 12" (305 mm) from base of end cap.

MC-4500 Joint Assembly

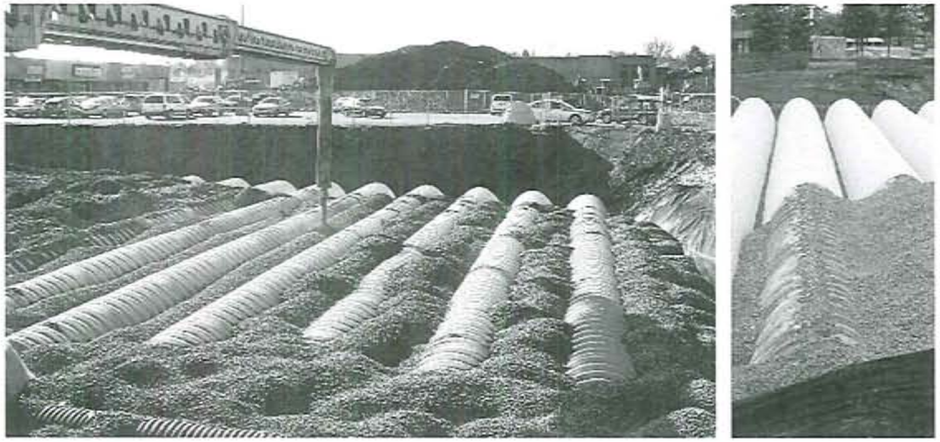


Install (6) screws (Fastenal #12-11x1") at each MC-4500 joint at locations shown. 3 screws on each side of joint. Care must be taken to avoid overtightening and/or "stripping" of screws.



Install the (2) web screws from the inside of the MC-4500 chamber 12" (305 mm) above and below the crest screw.

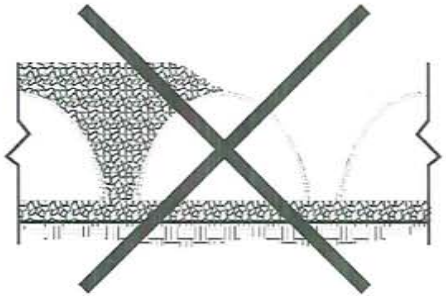
Initial Anchoring of Chambers – Embedment Stone



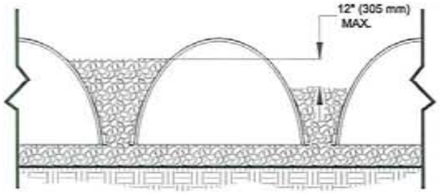
Initial embedment shall be spotted along the centerline of the chamber evenly anchoring the lower portion of the chamber. This is best accomplished with a stone conveyor or excavator reaching along the row.

No equipment shall be operated on the bed at this stage of the installation. Excavators must be located off the bed. Dump trucks shall not dump stone directly on to the bed. Dozers or loaders are not allowed on the bed at this time.

Backfill of Chambers – Embedment Stone

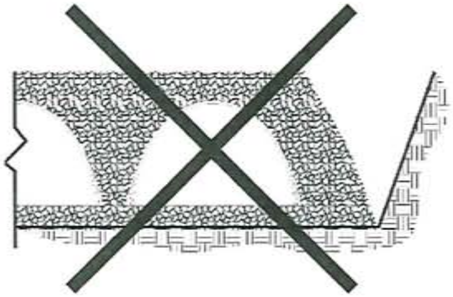


UNEVEN BACKFILL

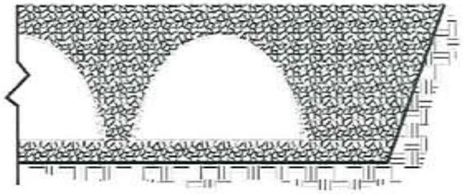


EVEN BACKFILL

Backfill chambers evenly. Stone column height should never differ by more than 12" (305 mm) between adjacent chamber rows or between chamber rows and perimeter.



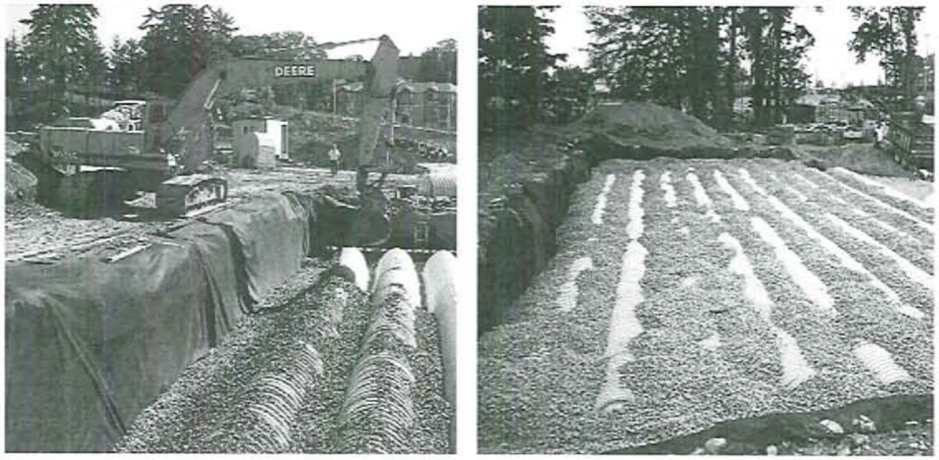
PERIMETER NOT BACKFILLED



PERIMETER FULLY BACKFILLED

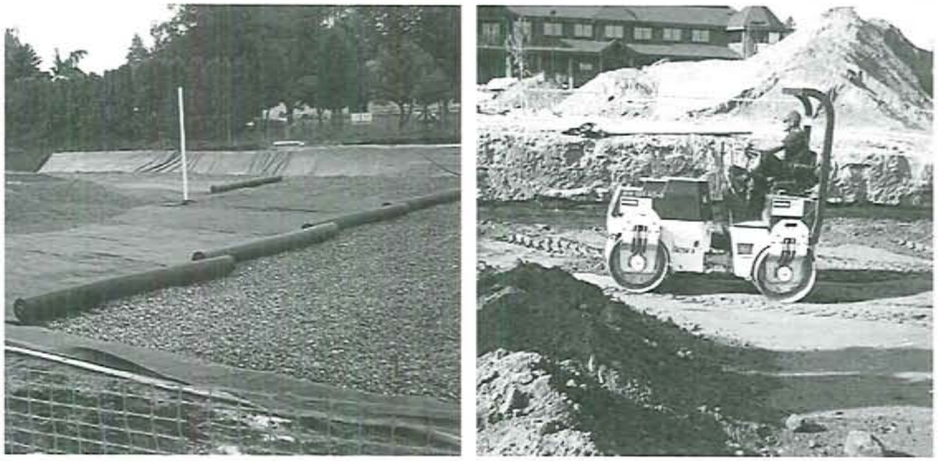
Perimeter stone must be brought up evenly with chamber rows. Perimeter must be fully backfilled, with stone extended horizontally to the excavation wall.

Backfill of Chambers – Embedment Stone and Cover Stone



Continue evenly backfilling between rows and around perimeter until embedment stone reaches tops of chambers. Perimeter stone must extend horizontally to the excavation wall for both straight or sloped sidewalls. **Only after chambers have been backfilled to top of chamber and with a minimum 12" (305 mm) of cover stone on top of chambers can small dozers be used over the chambers for backfilling remaining cover stone.**

Final Backfill of Chambers – Fill Material



Install non-woven geotextile over stone. Geotextile must overlap 24" (610 mm) min. where edges meet. Compact at 24" (610 mm) of fill. Roller travel parallel with rows.

Small dozers and skid loaders may be used for cover stone backfill in accordance with ground pressure limits in Table 2. Dozers must push material parallel to rows only. Never push perpendicular to rows. StormTech recommends that the contractor inspect chambers before placing final backfill. Any chambers damaged by construction shall be removed & replaced.

StormTech Isolator Row Detail

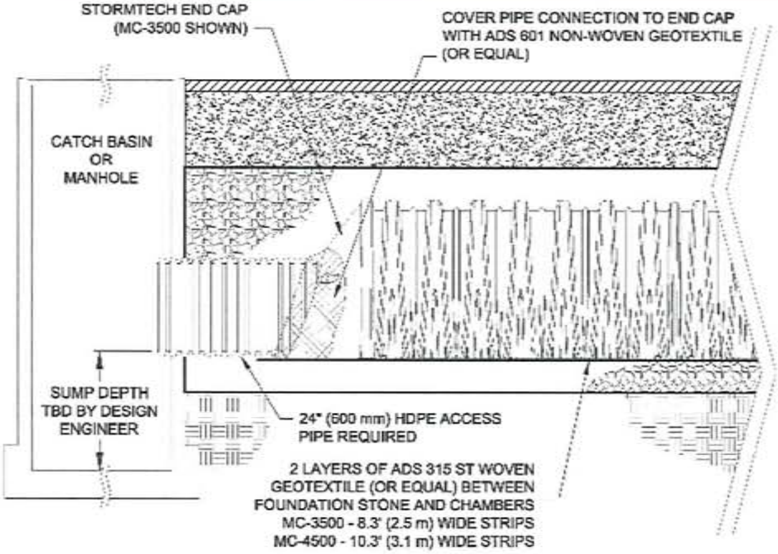


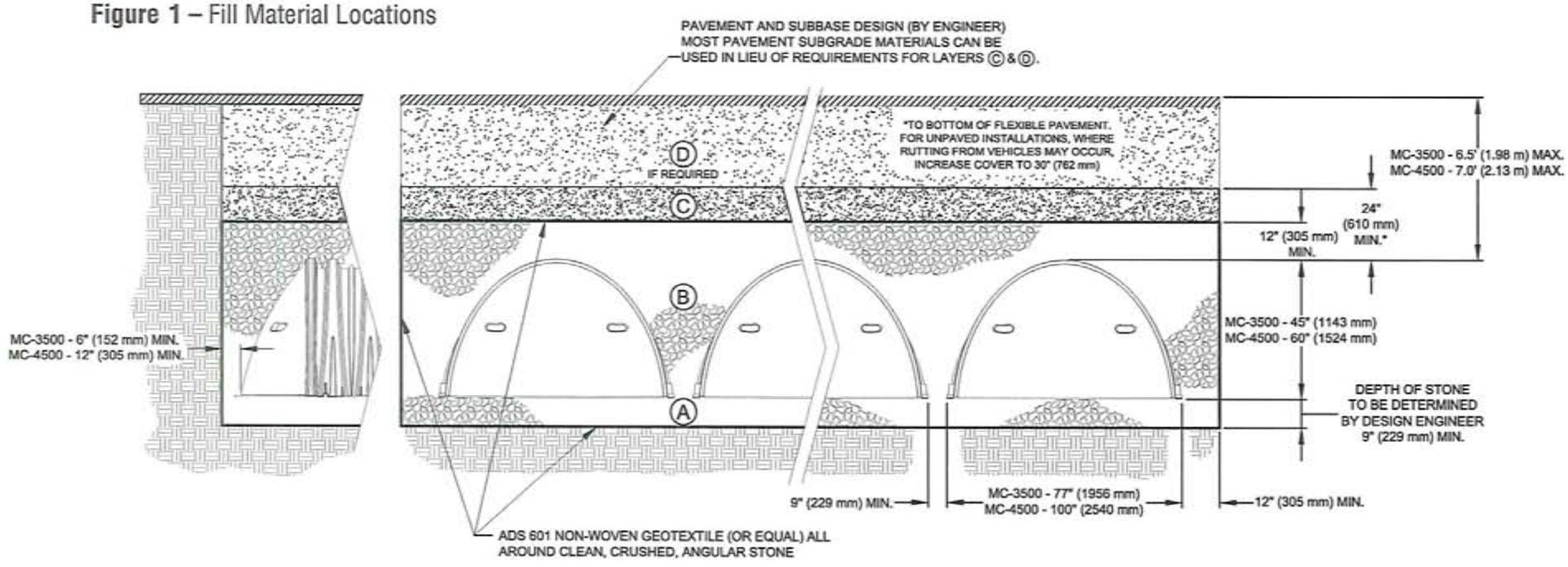
Table 1 – Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation[1]	Compaction/Density Requirement
Ⓓ Fill Material for layer 'D' starts from the top of the 'C' layer to the bottom of flexible pavement or unpaved finished grade above. Note that the pavement subbase may be part of the 'D' layer.	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	Prepare per engineer's plans. Paved installations may have stringent material and preparation requirements.
Ⓒ Fill Material for layer 'C' starts from the top of the embedment stone ('B' layer) to 24" (610 mm) above the top of the chamber. Note that pavement subbase may be part of the 'C' layer.	Granular well-graded soil/aggregate mixtures, <35% fines. Most pavement subbase materials can be used in lieu of this layer. (AASHTO M145 A-1, A-2, A-3)	3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	Begin compaction after min. 24" (610 mm) of material over the chambers is reached. Compact additional layers in 12" (305 mm) max. lifts to a min. 95% Standard Proctor density. (See Tables 2 and 3 for maximum roller loads).
Ⓑ Embedment Stone surrounding chambers from the foundation stone to the 'C' layer above.	Clean, crushed, angular stone nominal particle size distribution 3/4 - 2" (19 mm - 51 mm)	3, 4	No compaction required.
Ⓐ Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone, nominal size distribution 3/4-2" (19 mm - 51 mm)	3, 4	Plate compact or roll to achieve a 95% Standard Proctor Density.[2]

PLEASE NOTE:

1. ***The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "clean, crushed, angular no. 4 (AASHTO M43) stone."***
2. ***As an alternate to Proctor Testing and field density measurements in the 'A' location, StormTech compaction requirements are met for 'A' location materials when placed and compacted in 9" (229 mm) (max.) lifts using two full passes with an appropriate compactor.***

Figure 1 – Fill Material Locations



Once layer 'C' is placed any soil/material can be placed in layer 'D' up to the finished grade. Most pavement subbase soils can be used to replace the materials requirements of layer 'C' or 'D' at the design engineer's discretion.

Table 2 – Maximum Allowable Construction Vehicle Loads[6]

Material Location	Fill Depth over Chambers in. [mm]	Maximum Allowable Wheel Loads		Maximum Allowable Track Loads		Maximum Allowable Roller Loads
		Max Axle Load for Trucks[1,2] lbs [kN]	Max Wheel Load for Loaders lbs [kN]	Track Width in. [mm]	Max Ground Pressure[3] psf [kPa]	Max Drum Weight or Dynamic Force lbs [kN]
Ⓓ Final Fill Material	36" [914] Compacted	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	3420 [164] 2350 [113] 1850 [89] 1510 [72] 1310 [63]	38,000 [169]
Ⓒ Initial Fill Material	24" [610] Compacted	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2480 [119] 1770 [85] 1430 [68] 1210 [58] 1070 [51]	20,000 [89]
	24" [610] Loose/Dumped	24,000 [107]	12,000 [53]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2245 [107] 1625 [78] 1325 [63] 1135 [54] 1010 [48]	16,000 [71]
	18" [457]	24,000 [107]	12,000 [53]	12" [305] 18" [457] 24" [610] 30" [762]	2010 [96] 1480 [71] 1220 [58] 1060 [51]	5,000 [22] (static loads only)[5]
Ⓑ Embedment Stone	12" [305]	NOT ALLOWED	NOT ALLOWED	12" [305] 18" [457] 24" [610] 30" [762]	1100 [53] 715 [34] 660 [32] 580 [28]	NOT ALLOWED
	6" [152]	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED

Table 3 – Placement Methods and Descriptions

Material Location	Placement Methods/ Restrictions	Wheel Load Restrictions	Track Load Restrictions	Roller Load Restrictions
		See Table 2 for Maximum Construction Loads		
Ⓓ Final Fill Material	A variety of placement methods may be used. All construction loads must not exceed the maximum limits in Table 2.	36" (914 mm) minimum cover required for dump trucks to dump over chambers.		Roller travel parallel to rows only until 36" (914 mm) compacted cover is reached.
Ⓒ Initial Fill Material	Excavator positioned off bed recommended. Small excavator allowed over chambers. Small dozer allowed.	Asphalt can be dumped into paver when compacted pavement subbase reaches 24" (610 mm) above top of chambers.	Dozers to push parallel to rows.[4]	Use dynamic force of roller only after compacted fill depth reaches 24" (610 mm) over chambers. Roller travel parallel to chamber rows only.
Ⓑ Embedment Stone	No equipment allowed on bare chambers. Use excavator or stone conveyor positioned off bed or on foundation stone to evenly fill around all chambers to at least the top of chambers.	No wheel loads allowed. Material must be dumped outside the limits of the chamber bed.	Small LGP track dozers & skid loaders allowed to spread embedment stone with at least 12" (305 mm) stone under tracks at all times. Dozers to push parallel to rows only	No rollers allowed.
Ⓐ Foundation Stone	No StormTech restrictions. Contractor responsible for any conditions or requirements by others relative to subgrade bearing capacity, dewatering or protection of subgrade.			

NOTES:

1. 36" (914 mm) of stabilized cover materials over the chambers is required for full dump truck travel and dumping.

2. During paving operations, dump truck axle loads on 24" (610 mm) of cover may be necessary. Precautions should be taken to avoid rutting of the road base layer, to ensure that compaction requirements have been met, and that a minimum of 24" (610 mm) of cover exists over the chambers. Contact StormTech for additional guidance on allowable axle loads during paving.

3. Ground pressure for track dozers is the vehicle operating weight divided by total ground contact area for both tracks. Excavators will exert higher ground pressures based on loaded bucket weight and boom extension. Excavators shall not operate on chamber beds until the total backfill reaches 3 feet (914 mm).

4. Mini-excavators can be used with at least 12" (305 mm) of stone over the chambers and are limited by the maximum ground pressures in Table 2 based on a full bucket at maximum boom extension.

5. StormTech does not require compaction of initial fill at 18" (457 mm) of cover. However, requirements by others for 6" (152 mm) lifts may necessitate the use of small compactors at 18" (457 mm) of cover.

6. Storage of materials such as construction materials, equipment, spoils, etc. should not be located over the StormTech system. The use of equipment over the StormTech system not covered in Table 2 (ex. soil mixing equipment, cranes, etc) is limited. Please contact StormTech for more information.

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Subsurface Stormwater Management℠

Isolator™ Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator™ Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR™ ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-740 or MC-3500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

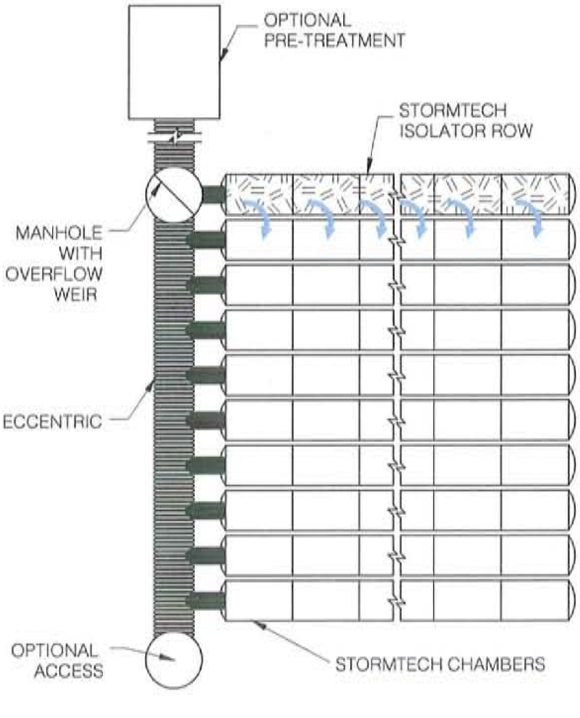
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

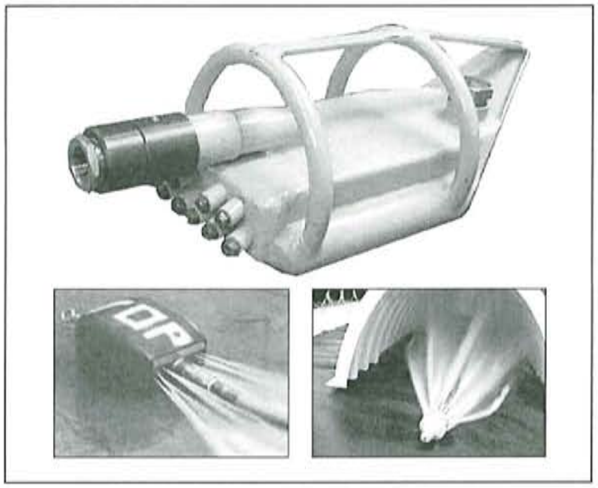
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

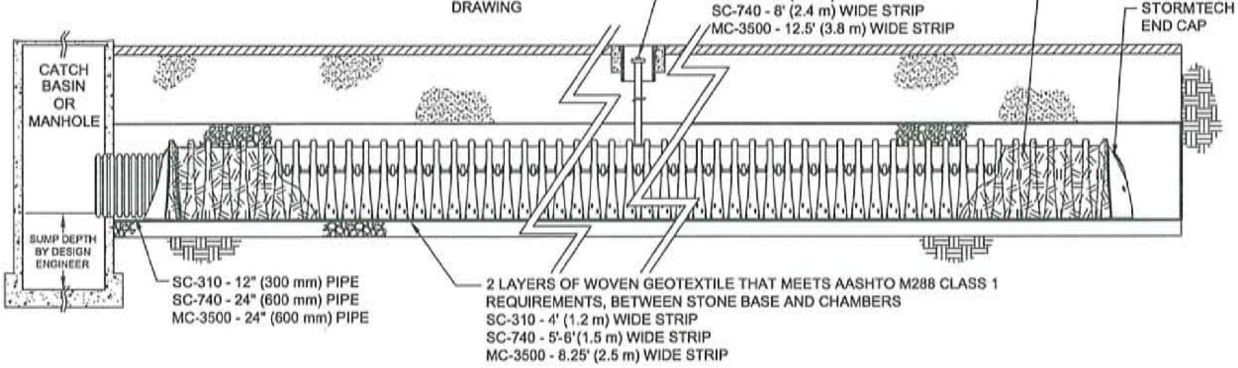
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

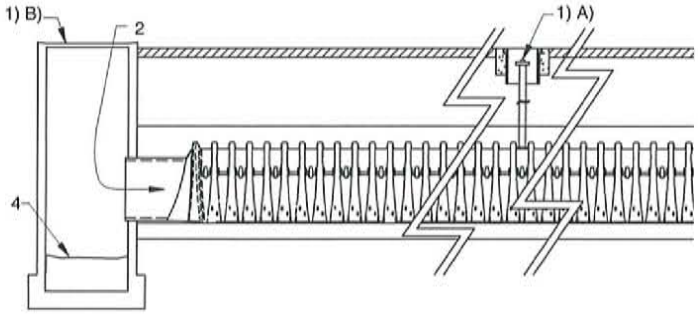
Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



3.0 Isolator Row Step By Step Maintenance Procedures

StormTech Isolator Row (not to scale)



Step 1) Inspect Isolator Row for sediment

- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    - 1. Mirrors on poles or cameras may be used to avoid a confined space entry
    - 2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process

- A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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StormTech products are covered by one or more of the following patents: U.S. Patents: 5,401,459; 5,511,903; 5,716,163; 5,588,778; 5,839,844; Canadian Patents: 2,158,418 Other U.S. and Foreign Patents Pending Printed in U.S.A.

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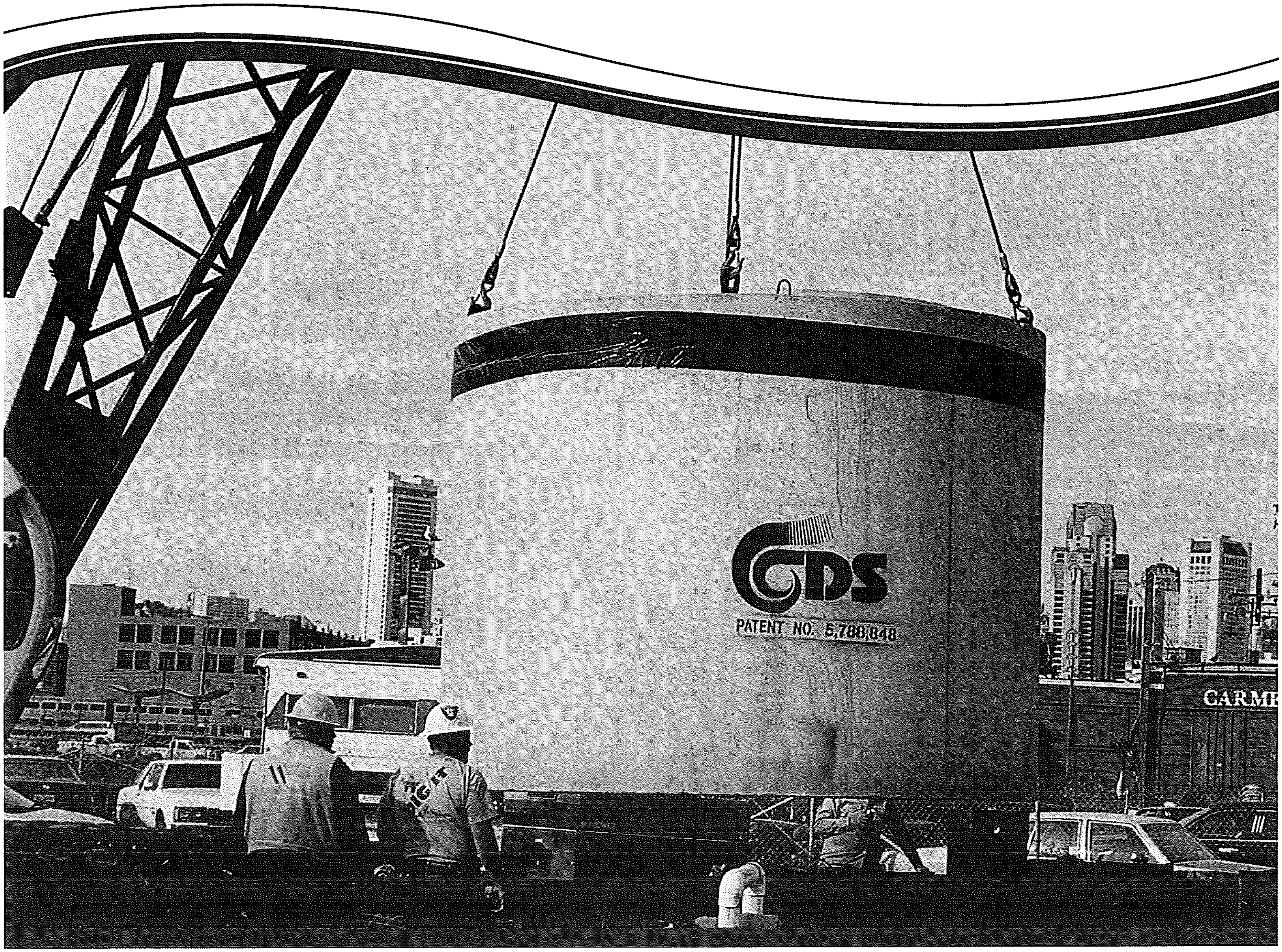
CONTECH®
CONSTRUCTION PRODUCTS INC.

CDS Guide
Operation, Design, Performance and Maintenance



CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs. Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs. The pollutant removal capacity of the CDS system has been proven in lab and field testing.

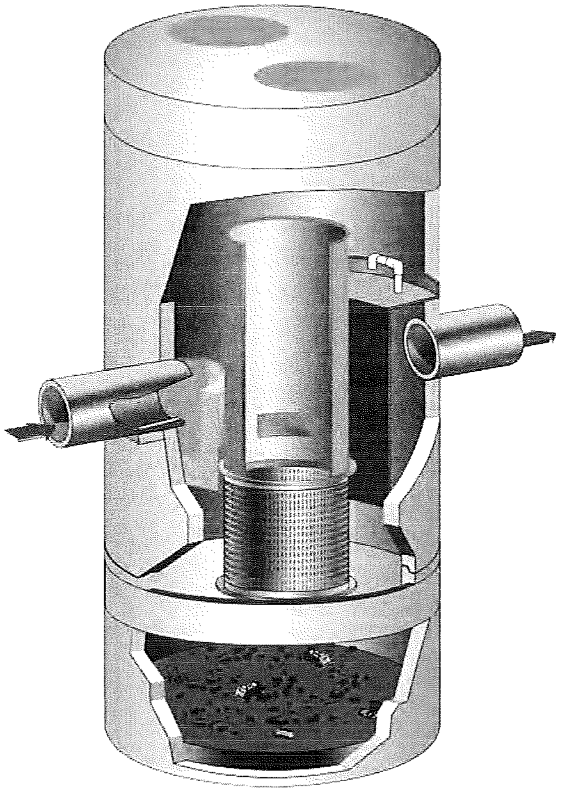
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall MethodTM and Probabalistic Method are used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125-microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75-microns (μm).

Water Quality Flow Rate Method

In many cases, regulations require that a specific flow rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval (i.e. the six-month storm) or a water quality depth (i.e. 1/2-inch of rainfall).

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the treatment flow rate around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and reduces the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore they are variable based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabalistic Rational Method

The Probabalistic Rational Method is a sizing program CONTECH developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic rational method is an extension of the rational method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (i.e.: 2-year storm event). Under this method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus helping to prevent re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

CDS hydraulic capacity is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. As needed, the crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulics.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS unit (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This full-scale CDS unit was evaluated under controlled laboratory conditions of pumped influent and the controlled addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSD) of the test materials were analyzed using standard method "Gradation ASTM D-422 with Hydrometer" by a certified laboratory. UF Sediment is a mixture of three different U.S. Silica Sand products referred as: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (uniform coefficient Cu averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003). The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

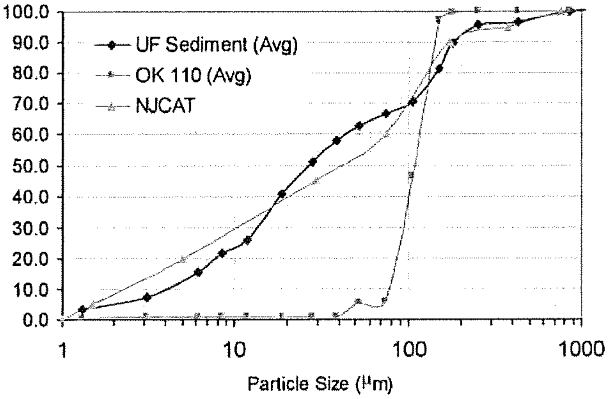


Figure 1. Particle size distributions for the test materials, as compared to the NJCAT/NJDEP theoretical distribution.

Tests were conducted to quantify the CDS unit (1.1 cfs (31.3-L/s) design capacity) performance at various flow rates, ranging from 1% up to 125% of the design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC – ASTM Standard Method D3977-97) and particle size distribution analysis.

Results and Modeling

Based on the testing data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve for the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation assuming sandy-silt type of inorganic components of SSC. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand).

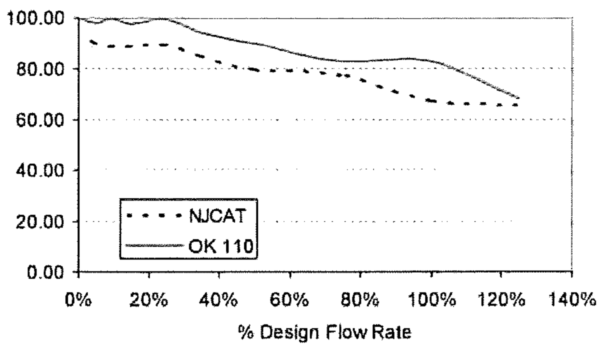


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (WADOE, 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). Supported by the laboratory data, the model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at 100% of design flow rate, for this particle size distribution (d50 = 125 μm).

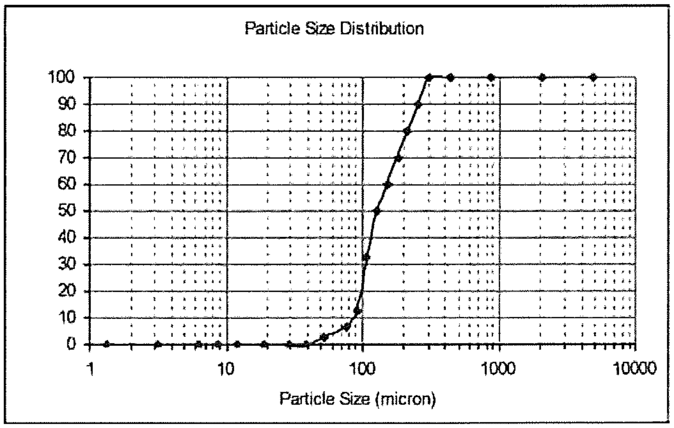


Figure 3. PSD with d50 = 125 microns, used to model performance for Ecology submittal.

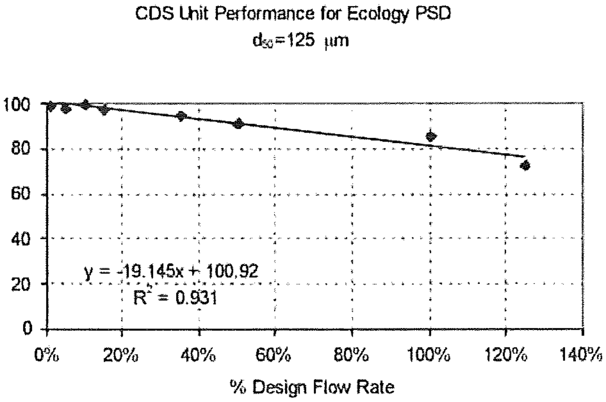


Figure 4. Modeled performance for CDS unit with 2400 microns screen, using Ecology PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, e.g., unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help insure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Additionally, installations should be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions to inlet and/or separation screen. The inspection should also identify evidence of vector infestation and accumulations of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If sorbent material is used for enhanced removal of hydrocarbons then the level of discoloration of the sorbent material should also

be identified during inspection. It is useful and often required as part of a permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (screen/cylinder) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained behind the screen. For units possessing a sizable depth below grade (depth to pipe), a single manhole access point would allow both sump cleanout and access behind the screen.

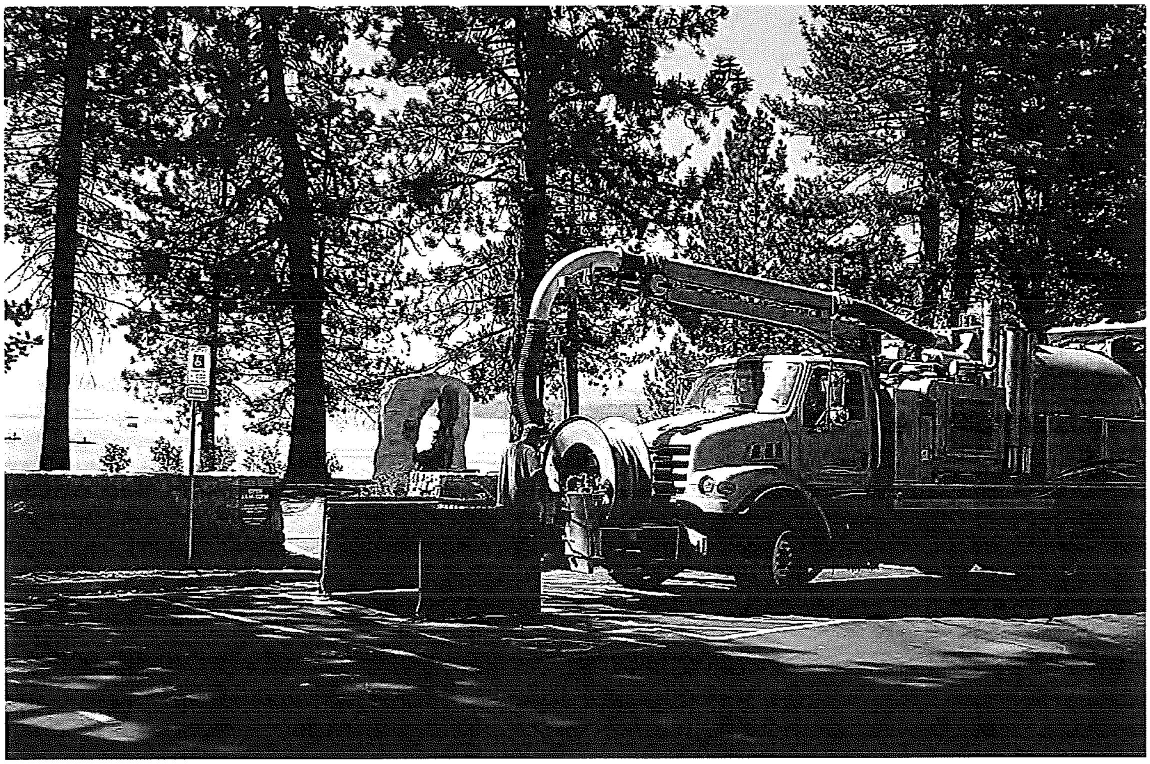
The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine if the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of the CDS systems should be done during dry weather conditions when no flow is entering the system. Cleanout of the CDS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should be pumped out also if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash can be netted out if you wish to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

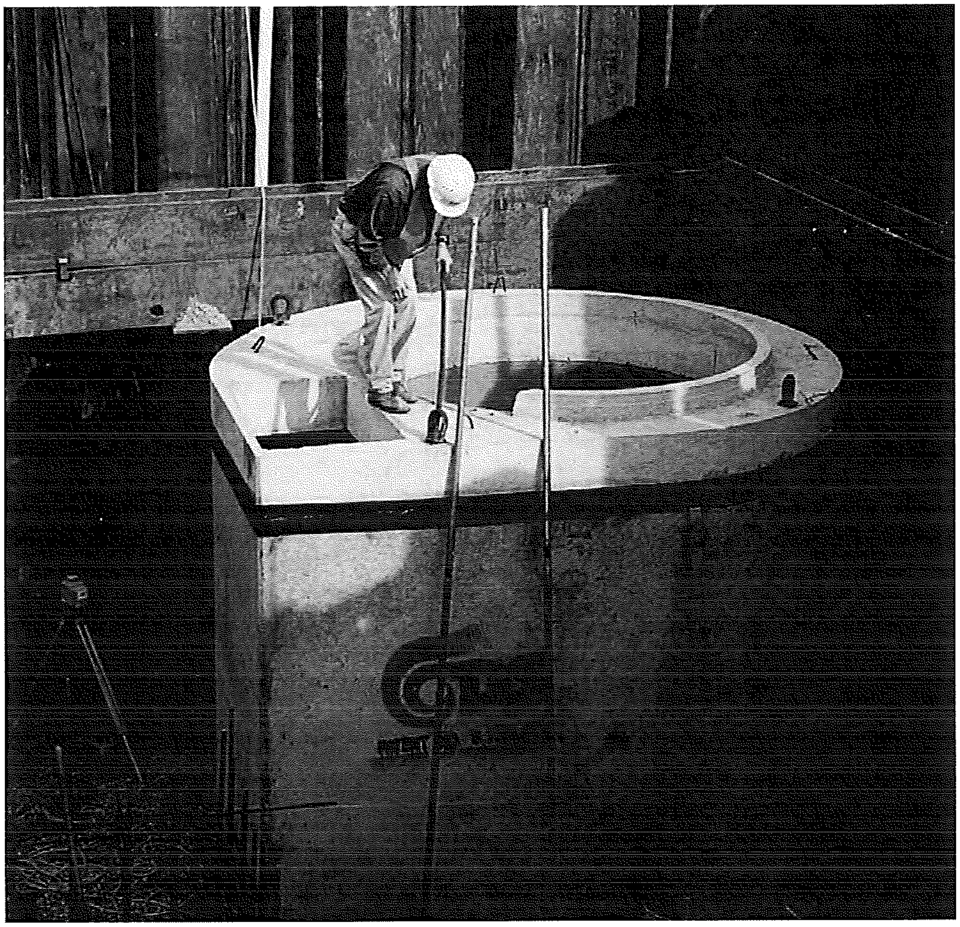
Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. Confined Space Entry procedures need to be followed. Disposal of all material removed from the CDS system should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. **Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

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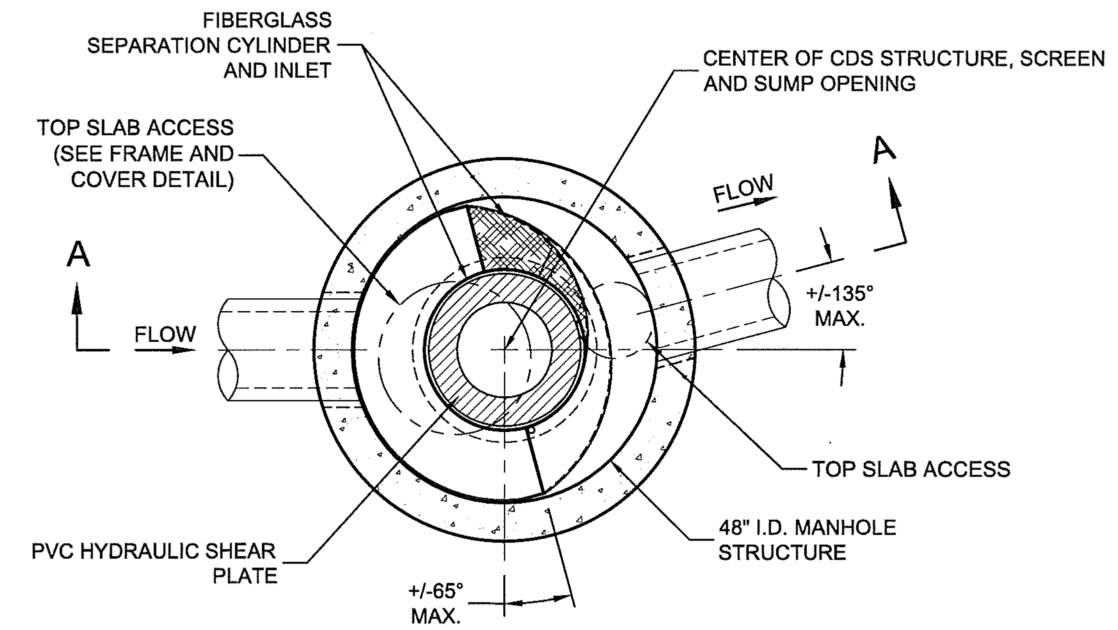


PLAN VIEW
N.T.S.

CDS2015-4 DESIGN NOTES

CDS2015-4 RATED TREATMENT CAPACITY IS 0.7 CFS, OR PER LOCAL REGULATIONS. MAXIMUM HYDRAULIC INTERNAL BYPASS CAPACITY IS 10.0 CFS. IF THE SITE CONDITIONS EXCEED 10.0 CFS, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED.

THE STANDARD CDS2015-4 CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

DESIGNATION (MODEL SUFFIX)	CONFIGURATION DESCRIPTION
G	GRATED INLET ONLY (NO INLET PIPE)
GP	GRATED INLET WITH INLET PIPE OR PIPES
K	CURB INLET ONLY (NO INLET PIPE)
KP	CURB INLET WITH INLET PIPE OR PIPES

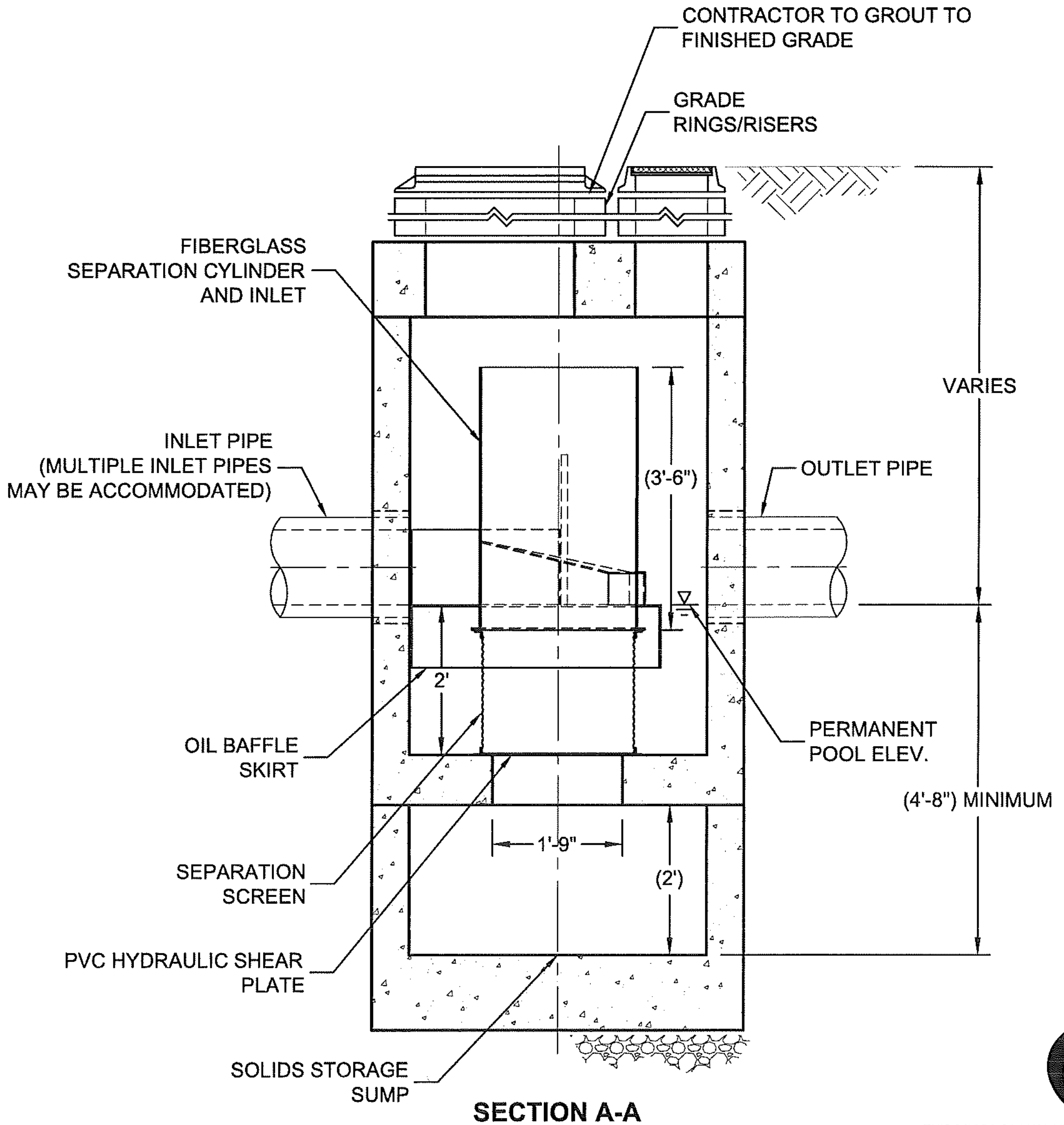
FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS)			*
PEAK FLOW RATE (CFS)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*

NOTES/SPECIAL REQUIREMENTS:

* PER ENGINEER OF RECORD



SECTION A-A
N.T.S.

GENERAL NOTES

1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. DIMENSIONS MARKED WITH ( ) ARE REFERENCE DIMENSIONS. ACTUAL DIMENSIONS MAY VARY.
3. FOR FABRICATION DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHTS, PLEASE CONTACT YOUR CONTECH STORMWATER SOLUTIONS REPRESENTATIVE. www.contechstormwater.com
4. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING.
5. STRUCTURE AND CASTINGS SHALL MEET AASHTO HS20 LOAD RATING.
6. PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.

INSTALLATION NOTES

1. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
2. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE (LIFTING CLUTCHES PROVIDED).
3. CONTRACTOR TO ADD JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS, AND ASSEMBLE STRUCTURE.
4. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT PIPES. MATCH PIPE INVERTS WITH ELEVATIONS SHOWN.
5. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 5,788,848; 6,641,720; 6,511,595; 6,581,783; RELATED FOREIGN PATENTS, OR OTHER PATENTS PENDING.

CONTECH STORMWATER SOLUTIONS
contechstormwater.com

CDS2015-4
PRECAST CONCRETE WATER QUALITY SYSTEM STANDARD DETAIL

CONTECH®
CONSTRUCTION PRODUCTS INC.

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

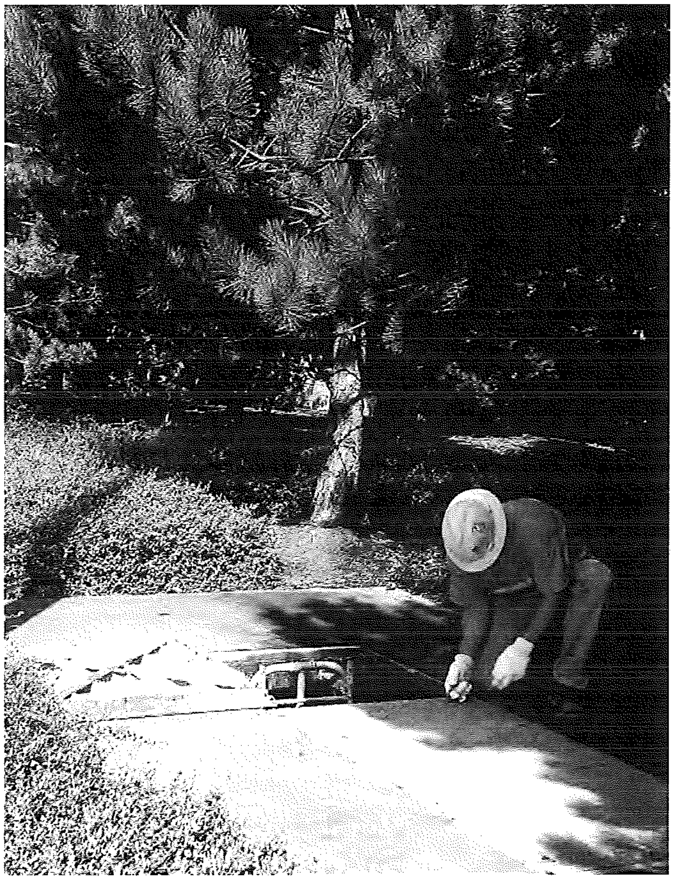
The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

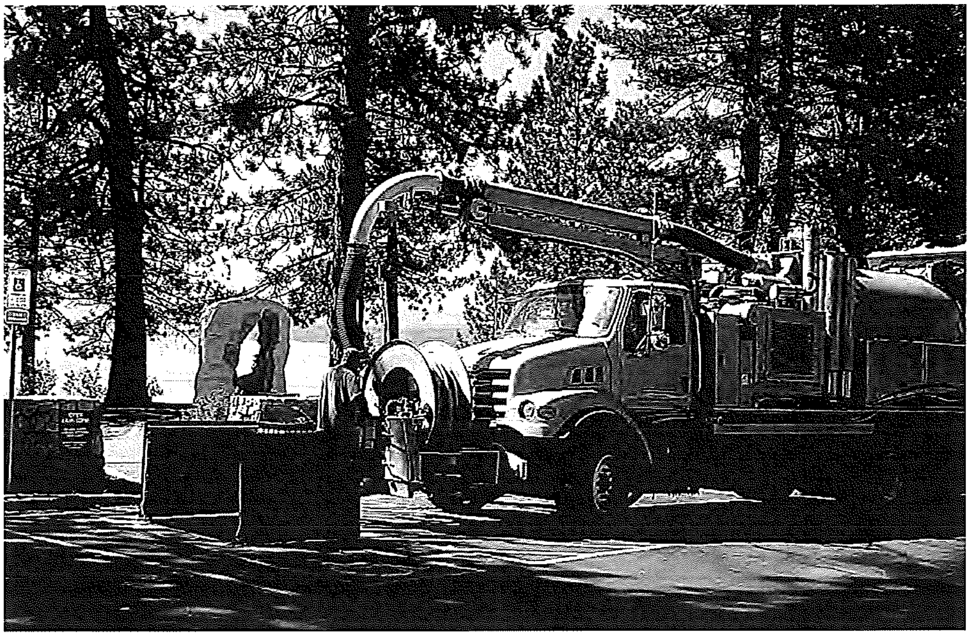
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.



CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	yd3	m3
CDS2015-4	4	1.2	3.0	0.9	0.5	0.4
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities



Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

CONTECH Construction Products Inc. provides site solutions for the civil engineering industry. CONTECH's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other CONTECH division offerings, visit contech-cpi.com or call 800.338.1122

Nothing in this catalog should be construed as an expressed warranty or an implied warranty of merchantability or fitness for any particular purpose. See the CONTECH standard quotation or acknowledgement for applicable warranties and other terms and conditions of sale.

The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; 7,517,450 related foreign patents or other patents pending.

CONTECH®
CONSTRUCTION PRODUCTS INC.
800.925.5240
contechstormwater.com

CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than eighteen inches the system should be cleaned out. **Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SECTION [_____]

STORM WATER TREATMENT DEVICE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.

B. Related Sections

Section 02240:	Dewatering
Section 02260:	Excavation Support and Protection
Section 02315:	Excavation and Fill
Section 02340:	Soil Stabilization

1.2 QUALITY ASSURANCES

A. Inspection

All components shall be subject to inspection by the Engineer at the place of manufacture and/or installation. All components are subject to be rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair. Final acceptance of the component is contingent upon the discretion of the Engineer.

B. Warranty

The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall be notified of repair/replacement issues in writing within the referenced warranty period. The manufacturer shall, upon its determination of repair, correct or replace any manufacturer originated defects identified by written notice within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

C. Manufacturer's Performance Certificate

The SWTD manufacturer shall submit to the Engineer of Record a “Manufacturer's Performance Certification” certifying that each SWTD is capable of achieving the specified removal efficiencies as listed in these specifications. The certification shall be supported by independent third-party research.

1.3 SUBMITTALS

A. Shop Drawings

The contractor shall prepare and submit shop drawings in accordance with Section **[_____]** of the contract documents. The shop drawings shall detail horizontal and vertical dimensioning, reinforcement and joint type and locations.

PART 2 – PRODUCTS

2.1 MATERIALS AND DESIGN

A. Precast Concrete Components

Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

1. Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
2. Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
3. Cement shall be Type III Portland Cement conforming to ASTM C 150;
4. Aggregates shall conform to ASTM C 33;
5. Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185 or A 497, respectively;
6. Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990 and
7. Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

B. Internal Components and Appurtenances

Internal Components and appurtenances shall conform to the following:

1. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
2. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
3. Fiberglass components shall conform to the National Bureau of Standards PS-15 and coated with an isophalic polyester gelcoat and
4. Access system(s) conform to the following:
    a. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.
    b. Hatch systems shall be designed to withstand AASHTO H-20 loadings. Hatch systems not subject to direct traffic shall be manufactured of Grade 5086 aluminum. Hatch systems subject to

direct traffic loads shall be manufactured of steel conforming to ASTM A 36-93a, supplied with a hot-dip galvanized finish conforming to ASTM A 123 and access doors bolted to the frame.

2.2 PERFORMANCE

A. Removal Efficiencies

1. The SWTD shall be capable of achieving an 80 percent average annual reduction in the total suspended solid load.
2. The SWTD shall be capable of capturing and retaining 100 percent of pollutants greater than or equal to 2.4 millimeters (mm) regardless of the pollutant's specific gravity (i.e.: floatable and neutrally buoyant materials) for flows up to the device's rated-treatment capacity. The SWTD shall be designed to retain all previously captured pollutants addressed by this subsection under all flow conditions.
3. The SWTD shall be capable of capturing and retaining total petroleum hydrocarbons. The SWTD shall be capable of achieving a removal efficiency of 92 and 78 percent when the device is operating at 25 and 50 percent of its rated-treatment capacity. These removal efficiencies shall be based on independent third-party research for influent oil concentrations representative of storm water runoff (20 ± 5 mg/L). The SWTD shall be greater than 99 percent effective in controlling dry-weather accidental oil spills.

   The SWTD shall be capable of utilizing sorbent media to enhance removal and retention of petroleum based pollutants.

B. Hydraulic Capacity

4. The SWTD shall provide a rated-treatment capacity, which is consistent with governing water treatment regulations. At its rated-treatment capacity, the device shall be capable of achieving greater than 65 percent removal of particles typically found in roadside sediments. This removal efficiency shall be supported by independent third-party research utilizing samples consistent with the NURP gradation or finer.
5. The SWTD shall maintain the peak conveyance capacity of the drainage network as defined by the Engineer.

C. Storage Capacity

1. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. The sump chamber shall be separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 20 inches in diameter.

2. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills. The minimum storage capacity provided by the SWTD shall be in accordance with the volume listed in Table 1 below.

TABLE 1

CDS Model	Treatment Capacity (cfs)/(L/s)	Minimum Sump Storage Capacity (yd^3)/(m^3)	Minimum Oil Storage Capacity (gal)/(L)
CDS2015-G	0.7 (19.8)	0.5 (0.4)	70 (265)
CDS2015-4	0.7 (19.8)	0.5 (1.4)	70 (265)
CDS2015	0.7(19.8)	1.3 (1.0)	92 (348)
CDS2020	1.1 (31.2)	1.3 (1.0)	131 (496)
CDS2025	1.6 (45.3)	1.3 (1.0)	143 (541)
CDS3020	2.0 (56.6)	2.1 (1.6)	146 (552)
CDS3030	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS3035	3.8 (106.2)	2.1 (1.6)	234 (885)
CDS4030	4.5 (127.4)	5.6 (4.3)	407 (1540)
CDS4040	6.0 (169.9)	5.6 (4.3)	492 (1862)
CDS4045	7.5 (212.4)	5.6 (4.3)	534 (2012)
CDS2020-D	1.1 (31.2)	1.3 (1.0)	131 (495)
CDS3020-D	2.0 (56.6)	2.1 (1.6)	146 (552)
CDS3030-D	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS3035-D	3.8 (106.2)	2.1 (1.6)	234 (885)
CDS4030-D	4.5 (127.4)	4.3 (3.3)	328 (1241)
CDS4040-D	6.0 (169.9)	4.3 (3.3)	396 (1499)
CDS4045-D	7.5 (212.4)	4.3 (3.3)	430 (1627)
CDS5640-D	9.0 (254.9)	5.6 (4.3)	490 (1854)
CDS5653-D	14.0 (396.5)	5.6 (4.3)	599 (2267)
CDS5668-D	19.0 (538.1)	5.6 (4.3)	733 (2774)
CDS5678-D	25.0 (708.0)	5.6 (4.3)	814 (3081)
CDS3030-DV	3.0 (85.0)	2.1 (1.6)	205 (776)
CDS5042-DV	9.0 (254.9)	1.9 (1.5)	294 (1112)
CDS5050-DV	11.0 (311.5)	1.9 (1.5)	367 (1389)
CDS7070-DV	26.0 (736.3)	3.3 (2.5)	914 (3459)
CDS10060-DV	30.0 (849.6)	5.0 (3.8)	792 (2997)
CDS10080-DV	50.0 (1416.0)	5.0 (3.8)	1057 (4000)
CDS100100-DV	64.0 (1812.5)	5.0 (3.8)	1320 (4996)

D. Alternate Treatment Technologies and Sizing Criteria

The sizing criteria for treatment systems must conform to the recommended loading rate and 3rd party testing data requirements as mentioned below:

1. CDS Screening Systems – designed for full treatment of the runoff rate at a loading rate not to exceed the critical flow in the inlet, in order to achieve 80% TSS removal efficiency. (80% TSS removal based on a average particles size of 63 micron)
2. Vortex separation systems – designed for full treatment of the runoff rate at a loading rate not to exceeding 24 gpm/ft2, in order to achieve 80% TSS removal efficiency. The hydraulic capacity should not exceed a loading rate of 100 gpm/ft2 to prevent scouring of previously captured particles. 80% TSS removal based on a average particles size of 63 micron)
3. Gravity systems – designed for full treatment of the runoff rate at a loading rate not to exceeding 10 gpm/ft2, in order to achieve 80% TSS removal efficiency. The gravity units will not exceed luminar flow condition parameters in the treatment unit but will provide a bypass system to prevent turbulence from accruing in the system. (See "Stokes Law" for gravity settling requirements of particles. 80% TSS removal based on a average particles size of 63 micron)

Additionally, the performance of the unit must be evaluated by a third party and verified in a program that allows a more-or-less direct comparison to other technologies. Performance should be third party verified, and removal efficiencies across the spectrum of particle sizes reported, at a range of hydraulic loading rates varying over a range of at least 25 to 125% of the manufacturer's advertised 'water treatment' loading rate.

2.3 MANUFACTURER

The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a CDS® device manufactured by:

CONTECH Stormwater Solutions
9025 Centre Pointe Dr., Suite 400
West Chester, OH 45069
(866) 551-8325 (toll free)

PART 3 – EXECUTION

3.1 HANDLING AND STORAGE

1. The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be born by the contractor.

3.2 INSTALLATION

1. The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
2. The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner which leaves no sharp points or edges.

END OF SECTION

GEOTECH
CONSULTANTS, INC.

13256 Northeast 20th Street, Suite 16
Bellevue, Washington 98005
(425) 747-5618 FAX (425) 747-8561

October 18, 2012

JN 12276

United Parcel Service
C/o Pacific Engineering Design
15445 – 53rd Avenue South
Seattle, Washington

via email: jhopper@paceng.com

Attention: Joe Hopper

Subject: ***Stormwater Infiltration Considerations***
Existing UPS Facility
7383 New Market Street Southwest
Tumwater, Washington

Dear Mr. Hopper:

We are pleased to present this geotechnical engineering report in regards to stormwater infiltration on the property in Tumwater, Washington. The scope of our services consisted of exploring site surface and subsurface conditions, and then developing this report to provide recommendations for design and maintenance of on-site infiltration systems. This work was authorized by your acceptance of our proposal, P-8456, dated August 27, 2012.

We understand that the existing stormwater infiltration facility located in the undeveloped grass area north of the existing asphalt parking lot is no longer functioning properly, and the system backs up during periods of heavy precipitation causing minor flooding to occur in the northwestern parking lot. Thus, a new infiltration system is being considered for stormwater conveyance in the northern portion of the site.

If the scope of the project changes from what we have described above, we should be provided with revised plans in order to determine if modifications to the recommendations and conclusions of this report are warranted.

SITE CONDITIONS

SURFACE CONDITIONS

The attached Plate 1 illustrates the location of the site in Tumwater. The irregularly shaped property is located along the western side of New Market Street Southwest, just south of 73rd Avenue Southwest. The subject site is currently developed with a one-story, L-shaped commercial building located near the center of the site. Asphalt parking covers nearly the entire area surrounding the building. The property is currently being used as a United Parcel Service (UPS) distribution center and truck parking. The entire property is mostly level, with the parking lot sloped only slightly for drainage. The north side of the property is covered with low growing grass and a few sparse small trees. The areas to the west and south are covered with thick vegetation and sparse large trees.

We understand that the existing stormwater system on-site collects runoff from both the asphalt parking lot surrounding the building and the roof of the existing building. This water is then directed to an infiltration facility to the north of the existing parking lot, buried in the grass area just north of the parking lot. Before entering the infiltration system, the stomwater is directed through a series of three sediment tanks of various retention depths. During our site visit, we observed the condition inside the sediment tanks. The tanks each held water at a level a few feet beneath the outfall pipe. The water in each tank appeared murky, and was relatively viscous when extending a steel tape to the bottom of the tank. After exiting the last basin, the water enters an infiltration facility consisting of two parallel, 8-inch-diameter, perforated PVC pipes. Based on observations made in the field, the pipes appear to be surrounded in gravel, which in turn is wrapped in non-woven drainage fabric. Also, the infiltration trenches appear to be approximately 6 feet beneath the existing ground surface and about 50 to 70 feet in length, with two cleanouts extending above the ground surface at the eastern extent of the pipes. We also inspected the conditions of the cleanout pipes. Water staining was observed in both cleanout pipes, at the same elevation near the top of the pipes. These stains were also relatively dirty; indicating that unclean water was likely backed up in the cleanout pipes for an extended period.

SUBSURFACE CONDITIONS

The subsurface conditions were explored by excavating three test pits at the approximate locations shown on the Site Exploration Plan, Plate 2. Our exploration program was based on the proposed construction, anticipated subsurface conditions and those encountered during exploration, and the scope of work outlined in our proposal.

The test pits were excavated on September 14, 2012 with a rubber-tired backhoe. A geotechnical engineer from our staff observed the excavation process, logged the test pits, and obtained representative samples of the soil encountered. "Grab" samples of selected subsurface soil were collected from the backhoe bucket. The Test Pit Logs are attached to this report as Plates 3 through 5.

Soil Conditions

The soil revealed in the test pits at the surface of the site near the existing infiltration system consisted of native sand beneath a thin layer of topsoil. The native sand contained very small amounts of silt, was loose to medium dense beneath the surface, and became medium dense beneath about 5 feet. This medium dense native sand was encountered to the maximum depth reached by our explorations of 11 feet in Test Pit 1.

No obstructions were revealed by our explorations. However, debris, buried utilities, and old foundation and slab elements are commonly encountered on sites that have had previous development.

Groundwater Conditions

No groundwater seepage was observed in our test pits; for only a short time period. It should be noted that groundwater levels vary seasonally with rainfall and other factors. However, we did not observe clear evidence of groundwater at or above 11 feet in the test pits.

The stratification lines on the logs represent the approximate boundaries between soil types at the exploration locations. The actual transition between soil types may be gradual, and subsurface conditions can vary between exploration locations. The logs provide specific subsurface information only at the locations tested. The relative densities and moisture descriptions indicated on the test pit logs are interpretive descriptions based on the conditions observed during excavation.

The compaction of backfill was not in the scope of our services. Loose soil will therefore be found in the area of the test pits. If this presents a problem, the backfill will need to be removed and replaced with structural fill during construction.

PERCOLATION TESTING

As part of our study, we preformed two in-situ infiltration tests at the locations of Test Pits 2 and 3. These tests were performed in general accordance with the EPA falling head percolation test procedure as modified for Thurston County, as described in Appendix III-A of the City of Tumwater Drainage Design & Erosion Control Manual. These tests were conducted at elevations of approximately 6.0 and 6.5 feet beneath the existing surface of the site. A percolation rate was observed for a period of approximately 2 hours, following a pre-soak period. The lowest percolation rate recorded during this time period for either location was over 90 inches/hour. Several measured rates were higher than this.

INFILTRATION CONSIDERATIONS

The results of our percolation testing and observations of the soil conditions indicate that the on-site soils were relatively permeable. Based on our observations made during our site visit, it appears unlikely that the failure of the on-site infiltration system is not due to the on-site soils; it is more likely that the infiltration facility became clogged with silt, oils, and other debris over time, limiting the permeability of the infiltration trenches.

Based on the observations of the test pits and the results of our percolation tests, infiltration of stormwater collected throughout the site is a feasible method of stormwater disposal at the subject site. However, due to the nature of the use of the subject site as a parcel distribution center housing many large trucks and including a truck wash station, the stormwater system is likely subject to an excessive runoff of silt, oils, and other viscous material. Therefore, special measures should be implemented that help insure oils, silts, and other foreign materials are separated out from the stormwater prior to directing the water to an infiltration facility. Additionally, frequent maintenance and cleaning of the stormwater system will be necessary to remove built-up solids within the system. At a minimum, the system should include multiple cleanout locations to allow access for maintenance and cleaning. Additionally, it may be prudent to install an emergency overflow pipe that daylights to an appropriate off-site location or conveyance system to protect against flooding should the infiltration facility become clogged or backed-up.

Based on Appendix III-A of the City of Tumwater Drainage and & Erosion Control Manual, multiple methods are acceptable for estimating the infiltration rate to be used for design of infiltration facilities. These methods include one simple method based on field percolation testing and another based on the gradation of the on-site soils. As previously discussed, we performed multiple in-situ percolation tests near the location of the existing infiltration facility. The lowest recorded infiltration rate during testing was approximately 90 inches per hour. The City of Tumwater recommends applying the following correction factors to the measured rate during testing.

$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$ where

$I_{measured}$ = infiltration rate measured during testing
$F_{testing}$ = 0.50 (for EPA method used)
$F_{geometry}$ = accounts for influence of facility geometry and depth to water table or impervious layer (assumed 1.0 for this calculation)
$F_{plugging}$ = 0.8 (for fine sands and loamy sands)

Based on this equation and the minimum design infiltration rate for the subject site would be 36.0 inches/hour. The City of Tumwater states that in no case may the design infiltration rate exceed 30 inches/hour.

Using Simple Method 2 outlined in the stormwater manual, the soil is classified using either the USDA Soil Texture Classification or ASTM Gradation Testing. We performed sieve testing on two representative samples obtained from the test pits conducted at the site. The results of these sieve tests are attached as Plate 5. Based on the USDA soil classification, the site soil would generally be classified as sand to loamy sand. The corresponding recommended design infiltration rate would be anywhere from 1 to 4 inches/hour if reduced correction factors are used. Based on the ASTM gradation, the recommended design infiltration rate would correspond to 2 inches/hour.

Recommended Design Infiltration Rate

We feel that the percolation rate measured by our on-site testing and the subsequent design infiltration rate is relatively fair representative of the actual infiltration rates of the site soils. However, based on the nature of the site and recommended values based on soil classification, we feel a reduced value is more appropriate. Therefore, for design of infiltration facilities on-site, we recommend using a design infiltration rate of 10 inches per hour.

LIMITATIONS

The conclusions and recommendations contained in this report are based on site conditions as they existed at the time of our site visit. If the subsurface conditions encountered during construction are significantly different from those anticipated, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. Unanticipated conditions are commonly encountered on construction sites. Such unexpected conditions frequently require making additional expenditures to attain a properly constructed project.

This report has been prepared for the exclusive use of United Parcel Service, its representatives for specific application to this project and site. Our recommendations and conclusions are based on the site materials observed and on previous experience with sites that have similar observed conditions. The conclusions and recommendations are professional opinions derived in accordance with current standards of practice within the limited scope of our services. No warranty is expressed or implied.

We trust that this report meets your immediate needs for the proposed development. Please contact us if we can be of further service.
The following plates are attached to complete this report:

Plate 1	Vicinity Map
Plate 2	Site Exploration Plan
Plates 3 - 4	Test Pit Logs
Plate 5	Grain-Size Analysis

Respectfully submitted,

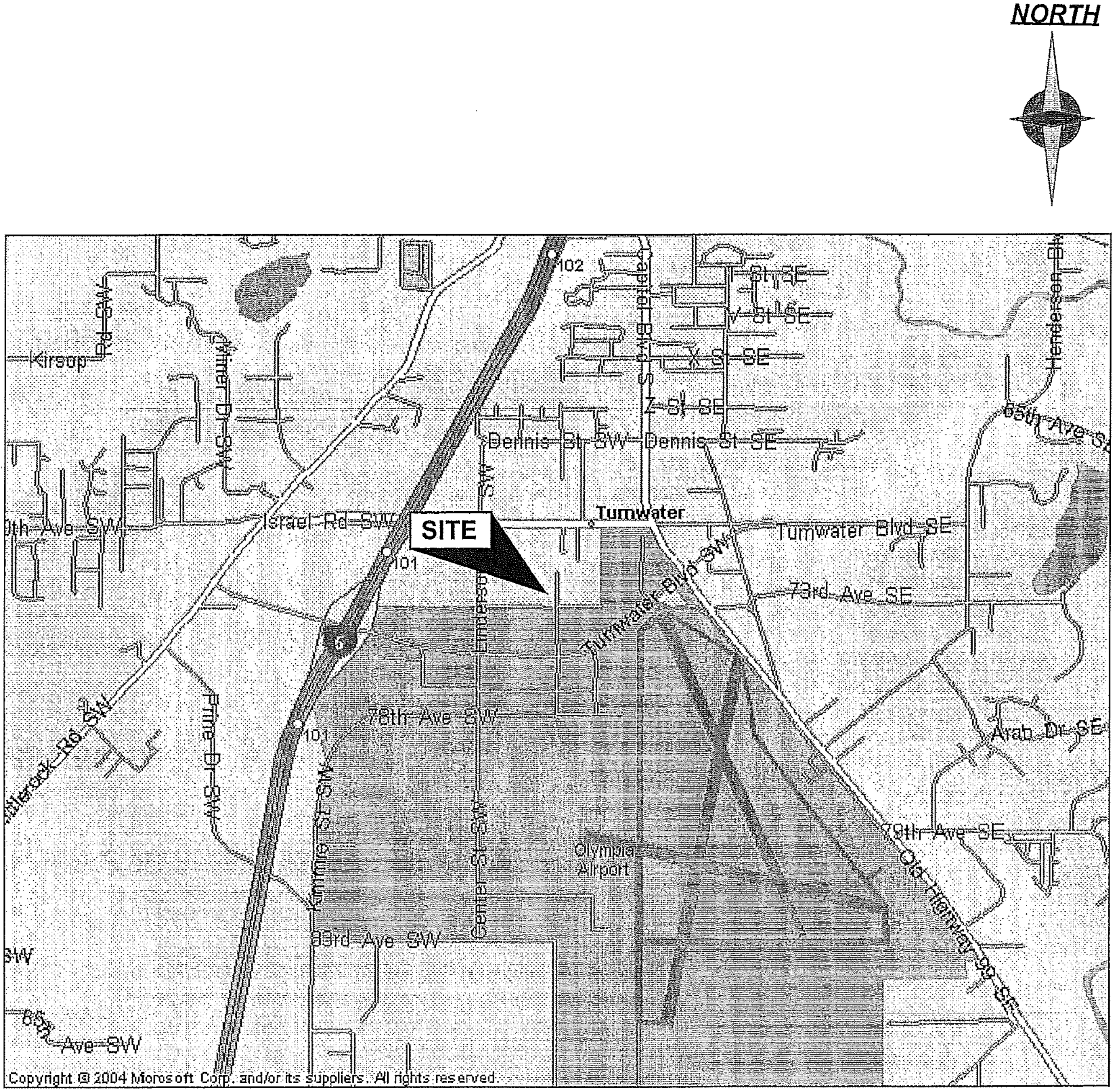
GEOTECH CONSULTANTS, INC.

Jason L. Hinds
Geotechnical Engineering

D. ROBERT WARD

D. Robert Ward, P.E.
Principal

JLH/DRW: jyb



(Source: Microsoft Streets and Trips, 2004)

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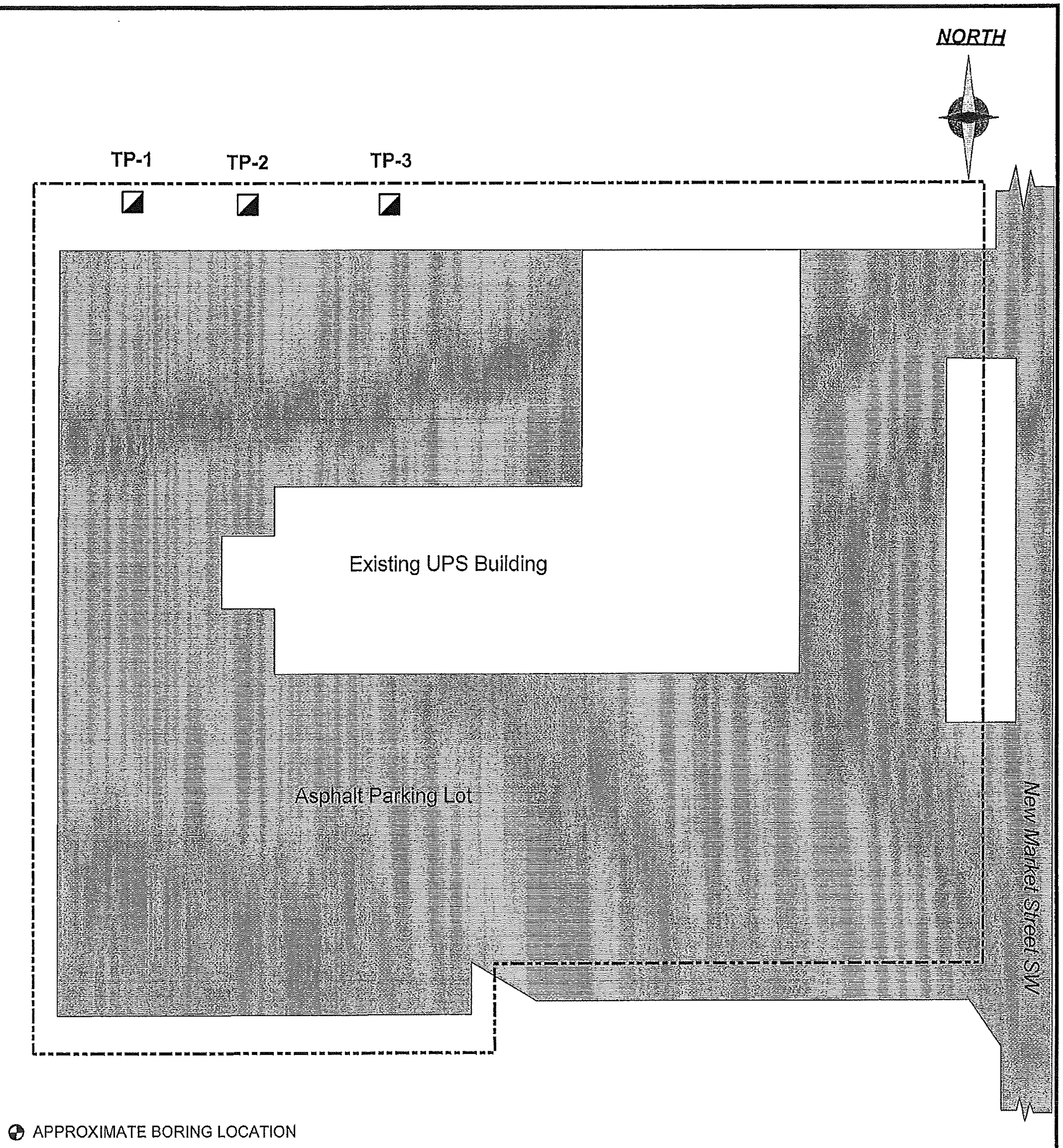
VICINITY MAP

7383 New Market Street Southwest
Tumwater, Washington

Job No: 12276	Date: Sept. 2012		Plate: 1



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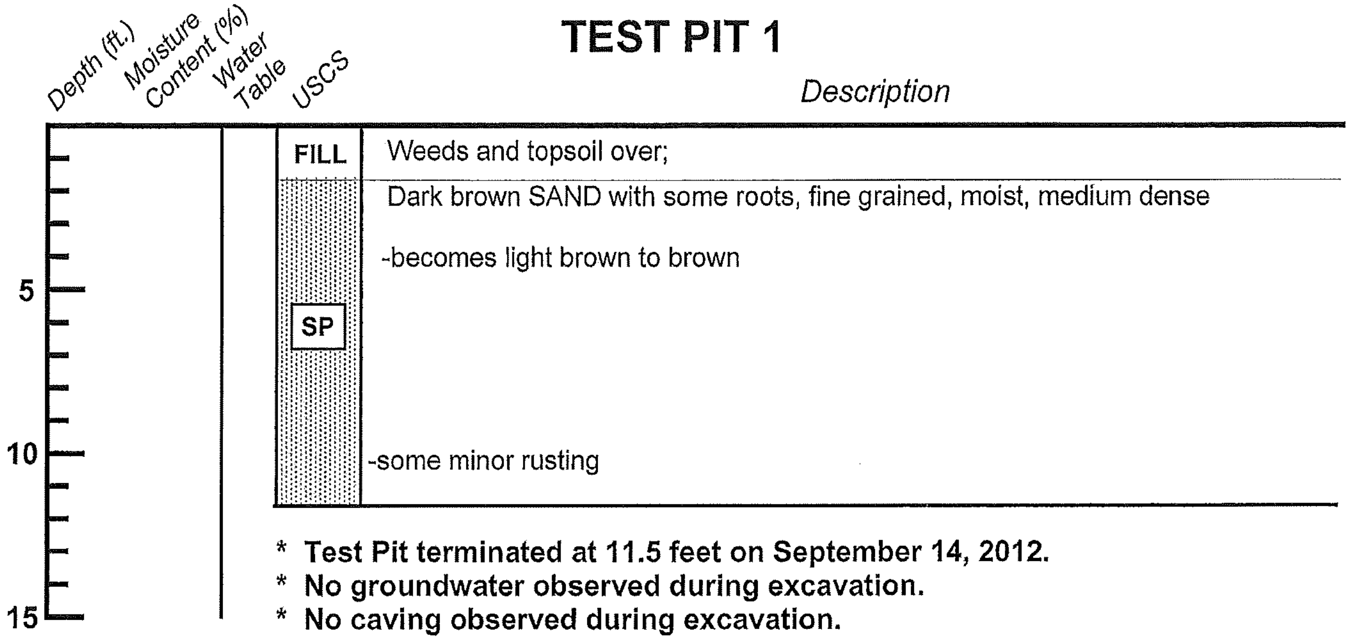
CONSULTANTS, INC.

SITE EXPLORATION PLAN

7383 New Market Street Southwest
Tumwater, Washington

Job No: 12276	*Date:* Sept. 2012	No Scale	*Plate:* 2

TEST PIT 1



Weeds and topsoil over;

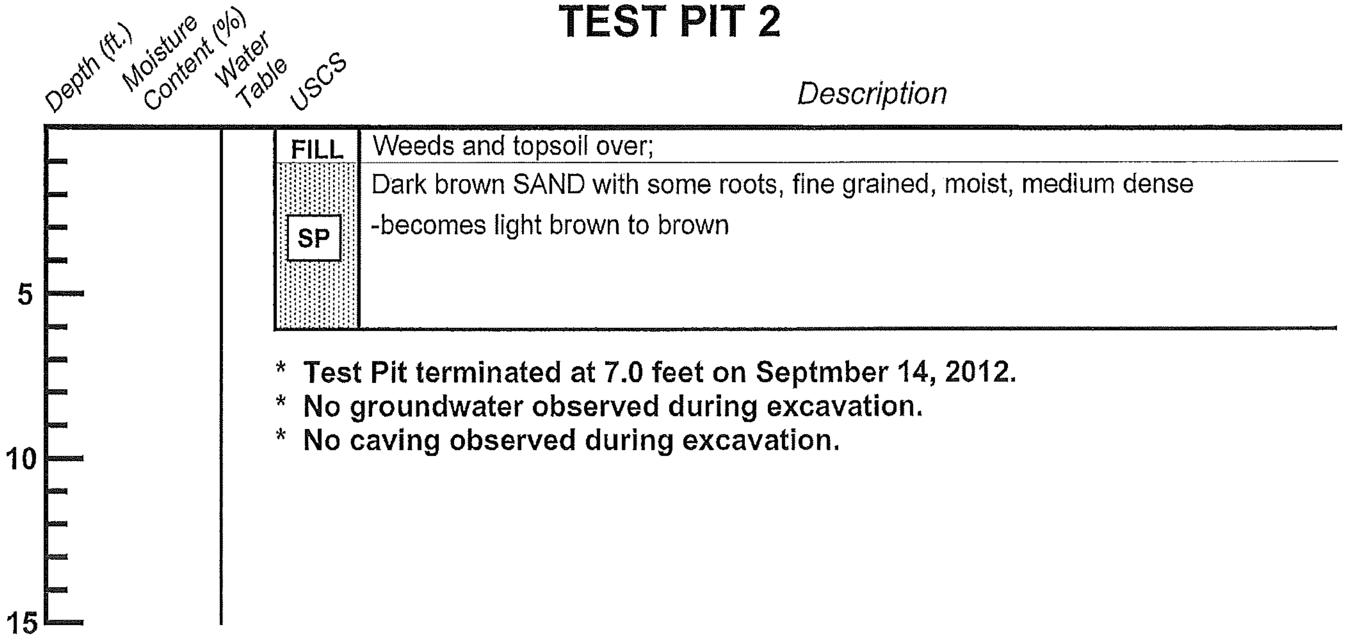
Dark brown SAND with some roots, fine grained, moist, medium dense

-becomes light brown to brown

-some minor rusting

- * **Test Pit terminated at 11.5 feet on September 14, 2012.**
- * **No groundwater observed during excavation.**
- * **No caving observed during excavation.**

TEST PIT 2



Weeds and topsoil over;

Dark brown SAND with some roots, fine grained, moist, medium dense

-becomes light brown to brown

- * **Test Pit terminated at 7.0 feet on Septmber 14, 2012.**
- * **No groundwater observed during excavation.**
- * **No caving observed during excavation.**

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TEST PIT LOG

7383 New Market Street Southwest
Tumwater, Washington

Job	Date:	Logged by:	Plate:
12276	Sept. 2012	JLH	3

TEST PIT 3

Depth (ft.)	Moisture Content (%)	Water Table	USCS	Description
			FILL	Weeds and topsoil over;
			SP	Dark brown SAND, fine grained, moist, medium dense -light brown to tan
5				
10				
15				

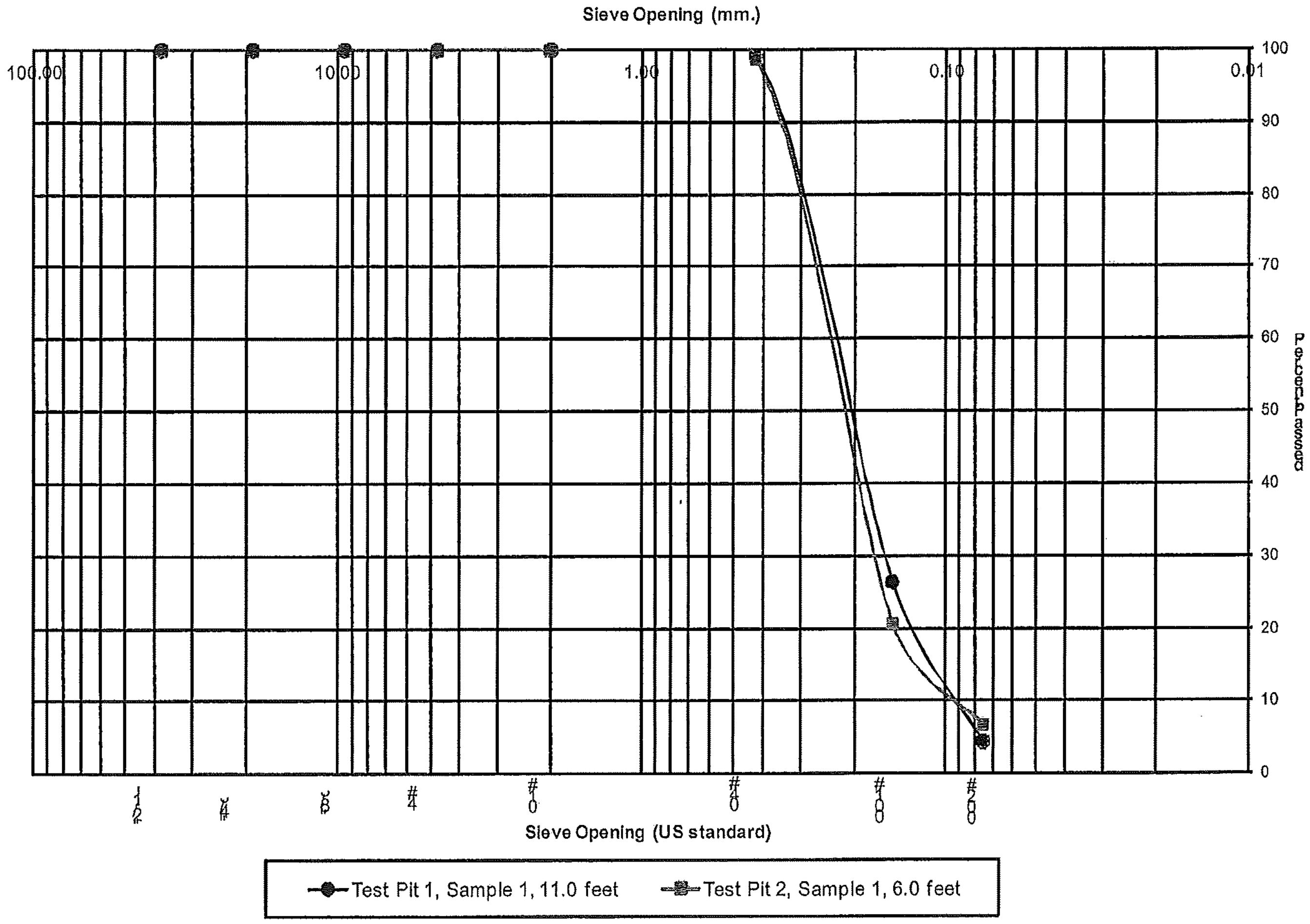
- * **Test Pit terminated at 6 feet on September 14, 2012.**
- * **No groundwater observed during excavation.**
- * **No caving observed during excavation.**

GEOTECH
CONSULTANTS, INC.

TEST PIT LOG

7383 New Market Street Southwest
Tumwater, Washington

Job	*Date:*	*Logged by:*	*Plate:*
12276	Sept. 2012	JLH	4



GEOTECH
CONSULTANTS, INC.

SIEVE ANALYSIS

7383 New Market Street Southwest
Tumwater, Washington

Job No: 12276	*Date:* Sept. 2012		*Plate:* 5

Appendix III-A
Methods for Determining Design Infiltration Rates

This appendix provides details on methods to estimate the design infiltration rate for infiltration facilities. The methods described include:

- Simple Method 1 – Field Testing Procedures
- Simple Method 2 – Soil Property Relationships
- Detailed Method – Based on Massmann (2003).

Simple Method 1 – Field Testing Procedures (In-Situ)

1. Excavate to the bottom elevation of the proposed infiltration facility.

2. Measure the infiltration rate of the underlying soil using either the EPA falling head percolation test procedure as modified for Thurston County (described below), the EPA falling head percolation test procedure as modified by Clark County (2008), the double ring infiltrometer test (ASTM D3385), or the Department of Ecology large scale Pilot Infiltration Test (PIT) described below and presented in the *Stormwater Management Manual for Western Washington* (Ecology 2005).

3. Fill test hole or apparatus with water and maintain at depths above the test elevation for saturation periods specific to the appropriate test.

4. Following the saturation period, the infiltration rate shall be determined in accordance with the specified test procedures.

5. Perform the minimum required number of infiltration tests at the proposed infiltration facility location as specified by the jurisdictions stormwater drainage manual and recommendations of the geotechnical professional.

6. Determine a representative infiltration rate.

For all field testing procedures, apply safety factor to obtain design infiltration rate (see next section).

Safety Factor for Field Measurements

The following equation incorporates safety factors to account for uncertainties related to testing, depth to the water table or impervious strata, infiltration receptor geometry, and long-term reductions in permeability due to biological activity and accumulation of fine sediment.

This equation estimates the maximum design infiltration rate, I_{design}. Depending on site conditions, additional reduction of the design infiltration rate may be appropriate. **In no case may the design infiltration rate exceed 30 inches/hour.**

$$I_{design} = I_{measured} \times F_{testing} \times F_{geometry} \times F_{plugging}$$

$F_{testing}$ accounts for uncertainties in the testing methods. For the EPA method, the SDI (ASTM D3385) method, or large-scale PIT testing, $F_{testing} = 0.50$.

$F_{geometry}$ accounts for the influence of facility geometry and depth to the water table or impervious strata on the actual infiltration rate. A shallow water table or impervious layer reduces the effective infiltration rate of a large pond, but this would not be reflected in a small scale test. $F_{geometry}$ must be between 0.25 and 1.0 as determined by the following equation: $F_{geometry} = 4\ D/W + 0.05$

Where: D = Depth from the bottom of the proposed facility to the maximum wet season water table or nearest impervious layer, whichever is less

W = Width of facility

$F_{plugging}$ accounts for reductions in infiltration rates over the long term due to plugging of soils. This factor is:

- 0.7 for loams and sandy loams
- 0.8 for fine sands and loamy sands
- 0.9 for medium sands
- 1.0 for coarse sands or cobbles, or any soil type in an infiltration facility preceded by a water quality facility (not including a pre-treatment unit or forebay for course sediment removal).

Falling Head Percolation Test Procedure (as Modified for Thurston County) (Source: EPA, *On-site Wastewater Treatment and Disposal Systems,* 1980)

1. **Number and Location of Tests**

   A minimum of three tests shall be performed within the area proposed for an infiltration facility. Tests shall be spaced uniformly throughout the area. For larger facilities or if soil conditions are highly variable, more tests may be required (see minimum testing requirements in Volume III).

2. **Preparation of Test Hole** (as modified for Thurston County)

   The diameter of each test hole is 8 inches, dug or bored to the proposed bottom elevation of the infiltration facility or to the most limiting soil horizon. To expose a natural soil surface, the bottom of the hole is scratched with a sharp pointed instrument and the loose material is removed from the test hole. A 6-inch-inner-diameter, 4-foot long, PVC pipe is set into the hole and pressed 6 inches into the soil, then 2 inches of 1/2- to 3/4-inch rock are placed in the pipe to protect the bottom from scouring when water is added.

3. **Soaking Period**

   The pipe is carefully filled with at least 12 inches of clear water. The depth of water must be maintained for at least 4 hours and preferably overnight if clay soils are present. A funnel with an attached hose or similar device may be used to prevent water from washing down the sides of the hole. Automatic siphons or float valves may be employed to automatically maintain the water level during the soaking period. It is extremely important that the soil be allowed to soak for a sufficiently long period of time to allow the soil to swell if accurate results are to be obtained.

   In sandy soils with little or no clay, soaking is not necessary. If, after filling the pipe twice with 12 inches of water, the water seeps completely away in less than 10 minutes, the test can proceed immediately.

4. Percolation Rate Measurement

   Except for sandy soils, percolation rate measurements are made at least 15 hours but no more than 30 hours after the soaking period began. The water level is adjusted to 6 inches above the gravel (or 8 inches above the bottom of the hole). At no time during the test is the water level allowed to rise more than 6 inches above the gravel. Immediately after adjustment, the water level is measured from a fixed reference point to the nearest 1/16th-inch, at 30 minute intervals. The test is continued until two successive water level drops do not vary by more than 1/16th-inch within a 90 minute period. At least three measurements are to be made.

   After each measurement, the water level is readjusted to the 6-inch level. The last water level drop is used to calculate the percolation rate.

   In sandy soils or soils in which the first 6 inches of water added after the soaking period seeps away in less than 30 minutes, water level measurements are made at 10-minute intervals for a 1-hour period. The last water level drop is used to calculate the percolation rate.

5. Percolation Rate Calculation

   The percolation rate is calculated for each test site by dividing the time interval used between measurements by the magnitude of the last water level drop. This calculation results in a percolation rate in minutes/inch. To calculate the percolation rate for the area, average the rates obtained from each hole. (If tests in the area vary by more than 20 minutes/inch, variations in soil type are indicated. Under these circumstances, percolation rates should not be averaged.) The percolation rate in minutes/inch should be converted to infiltration rate in inches/hour and then to **compute the design infiltration rate (I_{design}), the final infiltration rates must then be adjusted by the appropriate correction factors outlined previously.**

   Example: If the last measured drop in water level after 30 minutes is 5/8-inch, then:

   percolation rate = (30 minutes)/(5/8 inch) = 48 minutes/inch. Convert this to inches per hour by inverting & multiplying by 60: infiltration rate – 1/48*60 = 1.25 inches/hour. (At a minimum, a safety factor "$F_{testing}$" of 0.5 is be applied to all field methods for determining infiltration rates.)

Washington Department of Ecology Infiltration Pit Method

The Pilot Infiltration Test (PIT) consists of a relatively large-scale infiltration test to better approximate infiltration rates for design of stormwater infiltration facilities. The PIT reduces some of the scale errors associated with relatively small-scale tests such as the Modified Falling Head Percolation Test, double ring infiltrometer or "stove-pipe" infiltration tests. It is not a standard test but rather a practical field procedure recommended by Ecology's Technical Advisory Committee. Following is a step-by-step description of the testing procedure.

Infiltration Test

1. Excavate the test pit to the depth of the bottom of the proposed infiltration facility. Lay back the slopes sufficiently to avoid caving and erosion during the test.

2. The horizontal surface area of the bottom of the test pit should be approximately 100 square feet. For small drainages and where

water availability is a problem smaller areas may be considered as determined by the site professional.

3. Accurately document the size and geometry of the test pit.

4. Install a vertical measuring rod (minimum 5 feet long) marked in half-inch increments in the center of the pit bottom.

5. Use a rigid 6-inch diameter pipe with a splash plate on the bottom to convey water to the pit and reduce side-wall erosion or excessive disturbance of the pond bottom. Excessive erosion and bottom disturbance will result in clogging of the infiltration receptor and yield lower than actual infiltration rates.

6. Add water to the pit at a rate that will maintain a water level between 3 and 4 feet above the bottom of the pit. A rotameter can be used to measure the flow rate into the pit.

Note: A water level of 3 to 4 feet provides for easier measurement and flow stabilization control. However, the depth must not exceed the proposed maximum depth of water expected in the completed facility.

7. Every 15 to 30 minutes, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point (between 3 and 4 feet) on the measuring rod.

8. Add water to the pit until 1 hour after the flow rate into the pit has stabilized (constant flow rate) while maintaining the same pond water level (usually 17 hours).

9. After the flow rate has stabilized, turn off the water and record the rate of infiltration in inches per hour from the measuring rod data, until the pit is empty.

Data Analysis

Calculate and record the infiltration rate in inches per hour in 30 minute or one-hour increments until 1 hour after the flow has stabilized.

Note: Use statistical/trend analysis to obtain the hourly flow rate when the flow stabilizes. This would be the lowest hourly flow rate.

To compute the design infiltration rate (I_{design}), apply appropriate correction factors outlined previously.

Example:

The area of the bottom of the test pit is 8.5 feet by 11.5 feet.

Water flow rate was measured and recorded at intervals ranging from 15 to 30 minutes throughout the test. Between 400 minutes and 1,000 minutes, the flow rate stabilized between 10 and 12.5 gallons per minute or 600 to 750 gallons per hour. Divide the flow rate by the area of the test pit and convert to inches per hour to get an average of (9.8 + 12.3) / 2 = 11.1 inches per hour.

To compute the design infiltration rate (I_{design}), the infiltration rate must then be adjusted by the appropriate correction factors outlined previously.

Simple Method 2 – Soil Property Relationships

USDA Soil Textural Classification

Infiltration rates may be estimated from soil grain size distribution (gradation) data using the United States Department of Agriculture (USDA) textural analysis approach. Conduct the grain size distribution test in accordance with the USDA test procedure (Soil Survey Manual, USDA, October 1993, page 136). This manual only considers soil passing the #10 sieve (2 mm) (US Standard) to determine percentages of sand, silt, and clay for use in Figure A-1.

Short-term (field) infiltration rates, required correction factors, and design (long-term) infiltration rates based on gradations from soil samples and textural analysis are summarized in Table A.1. With prior approval by Tumwater, the correction factors may be reduced (to a minimum of 2.0) if there is little soil variability, there will be a high degree of long-term facility maintenance, and there is adequate pre-treatment to reduce total suspended solids in influent stormwater.

Table A.1. Recommended Infiltration Rates based on USDA Soil Textural Classification

	*Short-Term Infiltration Rate (in./hr)	Correction Factor, CF	Estimated Design (Long-term) Infiltration Rate (in./hr)
Clean sandy gravels and gravelly sands (i.e., 90% of the total soil sample is retained in the #10 sieve)	20	2	10
Sand	8	4	2
Loamy Sand	2	4	0.5
Sandy Loam	1	4	0.25
Loam	0.5	4	0.13

Source: *Stormwater Management Manual for Western Washington* (Ecology 2005).
*From WEF/ASCE, 1998.

ASTM Gradation Testing

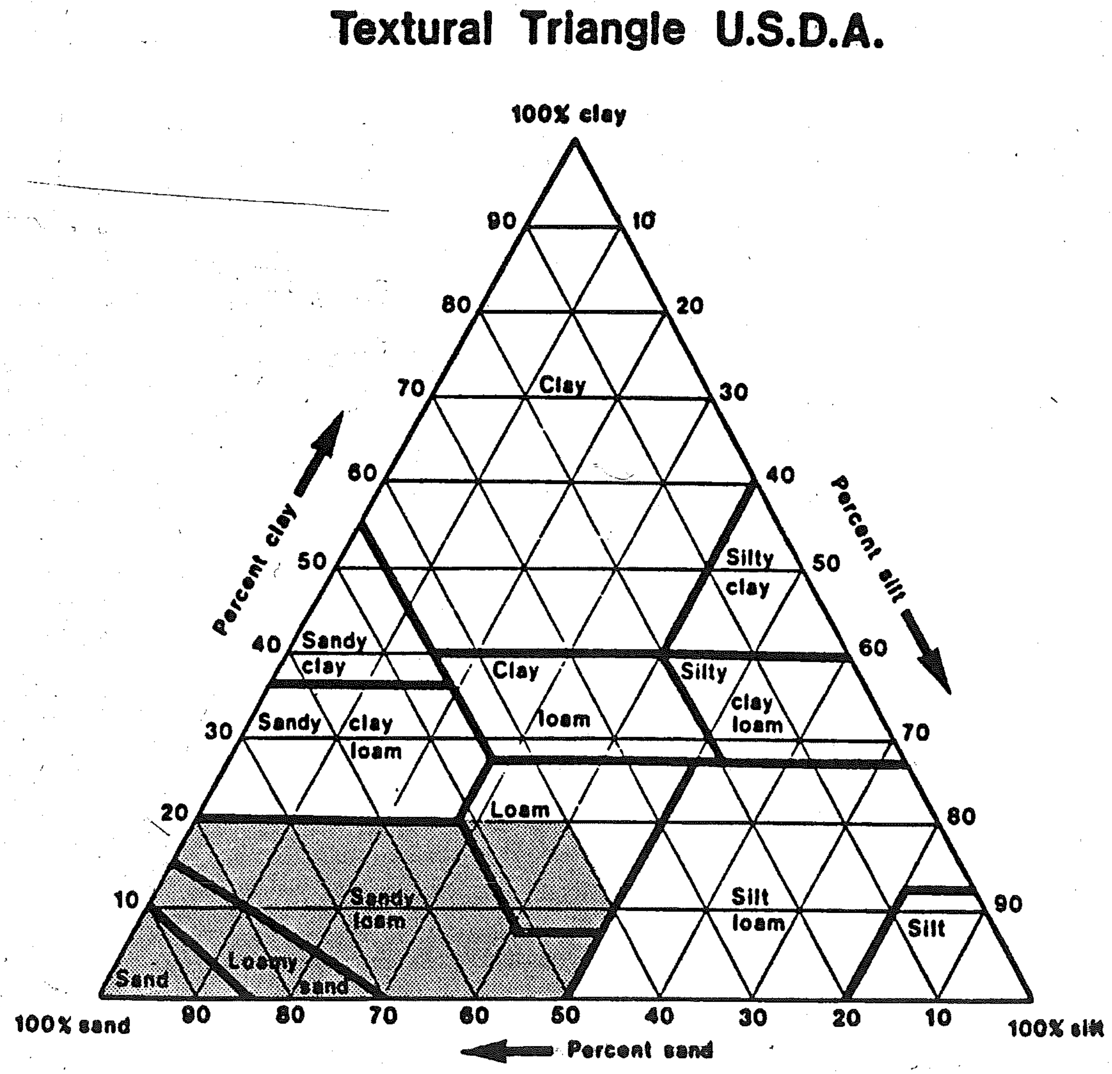
For sites with soils that would be classified as sands or sandy gravels ($D_{10} \geq 0.05$ mm, US Standard Sieve), Table A.2 may be used to estimate design infiltration rates. These rates may need to be reduced if the site is highly variable, or if maintenance and influent characteristics are not well controlled.

For finer soils ($D_{10} < 0.05$ mm, US Standard Sieve), consult Volume III of the *Stormwater Management Manual for Western Washington* (Ecology 2005).

Table A.2. Alternative Recommended Infiltration Rates based on ASTM Gradation Testing

D_{10} Size from ASTM D422 Soil Gradation Test (mm)	Estimated Design (Long-Term) Infiltration Rate (in./hr)
≥ 0.4	9
0.3	6.5
0.2	3.5
0.1	2.0
0.05	0.8

Source: *Stormwater Management Manual for Western Washington* (Ecology 2005).



Shaded area is applicable for design of infiltration BMPs
Source: U.S. Department of Agriculture

Figure A-1. USDA Textural Triangle.

Detailed Method

The detailed method described below is based on Massmann (2003)

Determine the Saturated Hydraulic Conductivity

For each defined layer below the pond to a depth below the pond bottom of 2.5 times the maximum depth of water in the pond, but not less than

6 feet, estimate the saturated hydraulic conductivity (K_{sat}) in centimeters per second (cm/s) using the following relationship (see Massmann 2003, and Massmann et al. 2003):

$$\log_{10}(K_{sat}) = -1.57 + 1.90D_{10} + 0.015D_{60} - 0.013D_{90} - 2.08f_{fines} \qquad (1)$$

Where, D_{10}, D_{60} and D_{90} are the grain sizes in millimeters (mm) for which 10 percent, 60 percent and 90 percent of the sample is more fine and f_{fines} is the fraction of the soil (by weight) that passes the number-200 sieve.

If the licensed professional conducting the investigation determines that deeper layers will influence the rate of infiltration for the facility, soil layers at greater depths must be considered when assessing the site's hydraulic conductivity characteristics. Massmann (2003) indicates that where the water table is deep, soil or rock strata up to 100 feet below an infiltration facility can influence the rate of infiltration. Note that only the layers near and above the water table or low permeability zone (e.g., a clay, dense glacial till, or rock layer) need to be considered, as the layers below the ground water table or low permeability zone do not significantly influence the rate of infiltration.

Also note that this equation for estimating hydraulic conductivity assumes minimal compaction consistent with the use of tracked (i.e., low to moderate ground pressure) excavation equipment. If the soil layer being characterized has been exposed to heavy compaction, or is heavily over consolidated due to its geologic history (e.g., overridden by continental glaciers), the hydraulic conductivity for the layer could be approximately an order of magnitude less than what would be estimated based on grain size characteristics alone (Pitt 2003). In such cases, compaction effects must be taken into account when estimating hydraulic conductivity. For clean, uniformly graded sands and gravels, the reduction in K_{sat} due to compaction will be much less than an order of magnitude. For well-graded sands and gravels with moderate to high silt content, the reduction in K_{sat} will be close to an order of magnitude. For soils that contain clay, the reduction in K_{sat} could be greater than an order of magnitude.

For critical designs (facilities that pose a high risk of flooding and property damage in the event of clogging or other failure), the in-situ saturated conductivity of a specific layer can be obtained through field tests such as the packer permeability test (above or below the water table), the piezocone (below the water table), an air conductivity test (above the water table), or through the use of a pilot infiltration test (PIT) as described in Appendix III-A. Note that some field tests provide a direct estimate of infiltration rate, which is the product of hydraulic conductivity and hydraulic gradient (see Equation 5). In this case, the infiltration rate must be divided by the hydraulic gradient to calculate the hydraulic conductivity. This issue will need to be evaluated on a case-by-case basis when interpreting the results of field tests to ensure an accurate estimate of K_{sat}. It is important to recognize that the gradient in the test may not be the same as the gradient likely to occur in the full-scale infiltration facility in the long-term (i.e., when ground water mounding is fully developed).

Once the saturated hydraulic conductivity for each layer has been identified, determine the effective average saturated hydraulic conductivity below the pond. Hydraulic conductivity estimates from different layers can be combined into an equivalent hydraulic conductivity (K_{equiv}) using the harmonic mean:

$$K_{equiv} = \frac{d}{\sum \frac{d_i}{K_i}} \qquad (2)$$

Where:

d is the total depth of the soil column

d_i is the thickness of layer "i" in the soil column

K_i is the saturated hydraulic conductivity of layer "i" in the soil column.

The depth of the soil column, d, typically would include all layers between the pond bottom and the water table. However, for sites with very deep water tables (>100 feet) where ground water mounding to the base of the pond is not likely to occur, it is recommended that the total depth of the soil column in Equation 2 be limited to approximately 20 times the depth of pond. This is to ensure that the most important and relevant layers are included in the hydraulic conductivity calculations. Deep layers that are not likely to affect the infiltration rate near the pond bottom should not be included in Equation 2.

Equation 2 may over-estimate the effective hydraulic conductivity value at sites with low conductivity layers immediately beneath the infiltration pond. For sites where the lowest conductivity layer is within five feet of the base of the pond, it is suggested that this lowest hydraulic conductivity value be used as the equivalent hydraulic conductivity rather than the value from Equation 2.

The harmonic mean given by Equation 2 is the appropriate effective hydraulic conductivity for flow that is perpendicular to stratigraphic layers, and will produce conservative results when flow has a significant horizontal component such as could occur due to ground water mounding.

Calculate the Hydraulic Gradient

The steady state hydraulic gradient (i) is calculated as follows:

$$i = \frac{D_{wt} + D_{pond}}{138.62(K^{0.1})} \times CF_{size} \qquad (3)$$

Where:

D_{wt} is the depth from the base of the infiltration facility to the water table in feet

K is the saturated hydraulic conductivity in feet/day

D_{pond} is the depth of water in the facility in feet (see Massmann et al. 2003, for the development of this equation)

CF_{size}, is the correction for pond size. The correction factor was developed for ponds with bottom areas between 0.6 and 6 acres in size. For small ponds (ponds with area equal to 2/3 acre), the correction factor is equal to 1.0. For large ponds (ponds with area equal to 6 acres), the correction factor is 0.2, as shown in Equation 4.

$$CF_{size} = 0.73(A_{pond})^{-0.76} \qquad (4)$$

Where, A_{pond} is the area of pond bottom in acres.

This equation generally will result in a calculated gradient of less than 1.0 for moderate to shallow ground water depths (or to a low permeability layer) below the facility, and conservatively accounts for the development of a ground water mound.

A more detailed ground water mounding analysis using a program such as MODFLOW will usually result in a gradient that is equal to or greater than the gradient calculated using Equation 3. If the calculated gradient is greater than 1.0, the water table is considered to be deep, and a maximum gradient of 1.0 must be used. Typically, a depth to ground water of 100 feet or more is required to obtain a gradient of 1.0 or more using this equation.

Since the gradient is a function of depth of water in the facility, the gradient will vary as the pond fills during the season. The gradient could be calculated as part of the stage-discharge calculation used in the continuous runoff models. As of the date of this update, neither the WWHM or MGSFlood have that capability. However, updates to those models may soon incorporate the capability. Until that time, use a steady-state hydraulic gradient that corresponds with a ponded depth of ¼ of the maximum ponded depth – as measured from the basin floor to the overflow.

Calculate the Infiltration Rate using Darcy's Law

$$f = K\left(\frac{dh}{dz}\right) = Ki \qquad (5)$$

Where:

f is the specific discharge or infiltration rate of water through a unit cross-section of the infiltration facility (L/t)

K is the hydraulic conductivity (L/t)

dh/dz (= "i") is the hydraulic gradient (L/L)

Adjustments to Infiltration Rate

Adjustments to the infiltration rate calculated above are required to adjust for biofouling, siltation and pond aspect ratio.

To account for reductions in the rate resulting from long-term siltation and biofouling, take into consideration the degree of long-term maintenance and performance monitoring anticipated, the degree of influent control (e.g., pre-settling ponds biofiltration swales, etc.), and the potential for siltation, litterfall, moss buildup, etc. based on the surrounding environment.

It should be assumed that an average to high degree of maintenance will be performed on these facilities. A low degree of maintenance should be considered only when there is no other option (e.g., access problems). The infiltration rate estimated in the step above is multiplied by the reduction factors summarized in Table A.2.

Table A.2 Infiltration Rate Reduction Factors to Account for Biofouling and Siltation Effects for Ponds (Massmann, 2003)

Potential for Biofouling	Degree of Long-Term Maintenance/Performance Monitoring	Infiltration Rate Reduction Factor, $CF_{silt/bio}$
Low	Average to High	0.9
Low	Low	0.6

High	Average to High	0.5
High	Low	0.2

The values in this table assume that final excavation of the facility to the finished grade is deferred until all disturbed areas in the upgradient drainage area have been stabilized or protected (e.g., construction runoff is not allowed into the facility after final excavation of the facility).

Ponds located in shady areas where moss and litterfall from adjacent vegetation can build up on the pond bottom and sides, the upgradient drainage area will remain in a disturbed condition long-term, and no pretreatment (e.g., pre-settling ponds, biofiltration swales, etc.) is provided, are one example of a situation with a high potential for biofouling.

A low degree of longterm maintenance includes, for example, situations where access to the facility for maintenance is very difficult or limited, or where there is minimal control of the party responsible for enforcing the required maintenance. A low degree of maintenance should be considered only when there is no other option.

Adjustment for Pond Aspect Ratio

Adjust the infiltration rate for the effect of pond aspect ratio by multiplying the infiltration rate determined above by the aspect ratio correction factor CF_{aspect} as shown in the following equation:

$$CF_{aspect} = 0.02A_r + 0.98 \qquad (6)$$

Where, A_r is the aspect ratio for the pond (length/width). In no case shall CF_{aspect} be greater than 1.4. The final infiltration rate will therefore be as follows:

$$f = K \times i \times CF_{aspect} \times CF_{silt/bio} \qquad (7)$$

The rates calculated based on Equation 7 are long-term design rates. No additional reduction factor or factor of safety is needed.

Appendix V-C – Maintenance Guidelines

This appendix provides facility-specific maintenance standards. The standards are intended to provide conditions for determining, through inspection, if maintenance actions are required. Failure to meet these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, the inspection and maintenance schedules must be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

Instructions for Use of Maintenance Checklists

The following pages contain maintenance tables for most of the BMPs included in Volume V. Where private developers, rather than Tumwater staff, are responsible for facility maintenance, they should plan to complete a checklist for all system components on the following schedule:

(M) Monthly from October through April.

Annually, once in late summer (preferably September)

(S) Storm-based, after any major storm (use 1 inch in 24 hours as a guideline).

The tables contained in this appendix may be used as checklists. Maintenance personnel may use photocopies of these pages and check off items inspected and problems noted during each inspection. Actions taken and corrective action recommended should also be noted.

Table C-4. Maintenance Checklist for Infiltration Basins (BMP IN.01), Infiltration Trenches (BMP IN.02), and Bioinfiltration Swale (BMP IN.03)

Frequency	Drainage Systems Feature	√	Problem	Conditions to Check For	Conditions that Shall Exist
M,S	General		Trash and Debris buildup in pond	Dumping of yard wastes such as grass clippings and branches into basin. Unsightly accumulation of non-degradable materials such as glass, plastic, metal, foam, and coated paper.	Remove trash and debris and dispose as prescribed by Tumwater Department of Water and Waste Management.
M			Poisonous Vegetation	Any poisonous vegetation which may constitute a hazard to the public. Examples of poisonous vegetation include: tansy ragwort, poison oak, stinging nettles, devilsclub.	Remove poisonous vegetation. Do not spray chemicals on vegetation without obtaining guidance from the City.
M,S			Fire Hazard or Pollution	Presence of chemicals such as natural gas, oil, and gasoline, obnoxious color, odor, or sludge noted.	Find sources of pollution and eliminate them. Water is free from noticeable color, odor, or contamination.
M			Vegetation not growing or is overgrown	Grass cover is sparse and weedy or is overgrown. Plants are sparse or invasive species are present.	Selectively thatch, aerate, and reseed ponds. Grass cutting unnecessary unless dictated by aesthetics. Contact the Cooperative Extension Service for direction on invasive species such as purple loosestrife and reed canary grass. Pond bottoms shall have uniform dense coverage of desired plant species.
M			Rodent Holes	If the facility is constructed with a dam or berm, look for rodent holes or any evidence of water piping through the dam or berm.	Rodents destroyed and dam or berm repaired. Contact the Tumwater Public Health and Social Services Department for guidance.
M			Insects	When insects such as wasps and hornets interfere with maintenance activities, or when mosquitoes become a nuisance.	Insects destroyed or removed from site. Contact Cooperative Extension Service for guidance.

Frequency	Drainage Systems Feature	√	Problem	Conditions to Check For	Conditions that Shall Exist
A	Storage Area		Sediment buildup in system	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Sediment is removed and/or facility is cleaned so that infiltration system works according to design. A sediment trapping area is installed to reduce sediment transport into infiltration area.
A			Storage area drains slowly (more than 48 hours) or overflows	A soil texture test indicates facility is not working at its designed capabilities or was incorrectly designed.	Additional volume is added through excavation to provide needed storage. Soil is aerated and rototilled to improve drainage. Contact the City for information on its requirements regarding excavation.
M			Sediment trapping area	Any sediment and debris filling area to 10 percent of depth from sump bottom to bottom of outlet pipe or obstructing flow into the connector pipe.	Clean out sump to design depth.
One time			Sediment trapping area not present	Stormwater enters infiltration area directly without treatment.	Add a trapping area by constructing a sump for settling of solids. Segregate settling area from rest of facility. Contact City for more guidance.
M	Rock filters		Sediment and debris	By visual inspection little or no water flows through filter during heavy rain storms.	Replace gravel in rock filter.

If you are unsure whether a problem exists, please contact Tumwater and ask for technical assistance.

Key:
A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms

Table C-13. Maintenance Checklist for Catch Basins and Inlets

Frequency	Drainage Systems Feature	√	Problem	Conditions to Check For	Conditions that Shall Exist
M,S	General		Trash and Debris	Trash, debris, and sediment in or on basin	No trash or debris located immediately in front of catch basin opening. Grate is kept clean and allows water to enter.
M				Sediment or debris (in the basin) that exceeds 1/3 the depth from the bottom of basin to invert of the lowest pipe into or out of the basin.	No sediment or debris in the catch basin. Catch basin is dug out and clean.
M,S				Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
M			Structural Damage to Frame and/or Top Slab	Corner of frame extends more than 3/4 inch past curb face into the street (if applicable).	Frame is even with curb.
M				Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
M				Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached.	Frame is sitting flush on the riser rings or top slab and firmly attached.
A			Cracks in Basin Walls/ Bottom	Cracks wider than 1/2 inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards. Contact a professional engineer for evaluation.
A				Cracks wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than 1/4 inch wide at the joint of inlet/outlet pipe.

Frequency	Drainage Systems Feature	√	Problem	Conditions to Check For	Conditions that Shall Exist
A			Settlement/ Misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards. Contact a professional engineer for evaluation.
M			Vegetation	Vegetation growing across and blocking more than 10 percent of the basin opening.	No vegetation blocking opening to basin.
M			Vegetation	Vegetation growing in inlet/outlet pipe joints that is more than 6 inches tall and less than 6 inches apart.	No vegetation or root growth present.

If you are unsure whether a problem exists, please contact Tumwater and ask for technical assistance.

Key:
A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms

Table C-14. Maintenance Checklist for Energy Dissipators

Frequency	Drainage Systems Feature	√	Problem	Conditions to Check For	Conditions that Shall Exist
A	Rock pad		Missing or moved rock	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil.	Replace rocks to design standard.
A	Rock-filled trench for discharge from pond		Missing or moved rock	Trench is not full of rock.	Add large rock (~30 lbs each) so that rock is visible above edge of trench.
M	Dispersion trench		Pipe plugged with sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed.
M			Perforations plugged	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Clean or replace perforated pipe.
M,S			Not discharging water properly	Visual evidence of water discharging at concentrated points along trench (under normal conditions, there should be a "sheet flow" of water along trench.) Intent is to prevent erosion damage.	Trench must be rebuilt or redesigned to standards. Pipe is provably plugged or damaged and needs replacement.
M,S			Water flows out top of "distributor" catch basin	Maintenance person observes water flowing out during any storm less than the design storm or it is causing or appears likely to cause damage.	Facility must be rebuilt or redesigned to standards. Pipe is probably plugged or damaged and needs replacement.
M,S			Receiving area over-saturated	Water in receiving area is causing or has potential of causing landslide.	Stabilize slope with grass or other vegetation, or rock if condition is severe.

If you are unsure whether a problem exists, please contact Tumwater and ask for technical assistance.

Key:
A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms