

**Track and Field Improvements  
815 21st ST SE  
Puyallup, WA 98372  
Parcel #: 0420352148  
Owner: Cascade Christian Schools**

## DRAINAGE CONTROL REPORT

**Vader**ENGINEERING

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Version 5

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Stormwater Site Plan (SSP)  
("Drainage Report")

Cascade Christian Schools  
815 21st ST SE  
Puyallup, WA 98372

Parcel(s): 0420352148

Permit No: \_\_ PRCCP 20220589

Permit Application March 30, 2022

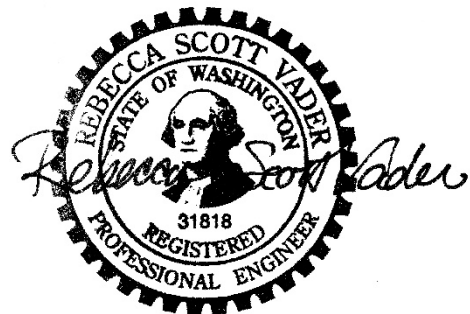
Revisions Resubmitted December 02, 2024

Revised V4 May 19, 2025

Revised V5 Sept 19, 2025

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The following report has been prepared in conformance with sound engineering principles and standards, with the best available site and technical information at the time of investigation. The report contained herein has been prepared by the undersigned Professional Engineer Licensed in the State of Washington.



Rebecca Scott Vader, PE

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## OVERVIEW

This Storm Drainage Report is a supplement to the overall campus Master Plan Drainage Plan, and is submitted as supporting documentation for permits required by the for the construction of the proposed Project, a phase of a larger effort.

Per the current campus CUP, the project must meet the stormwater requirements set in Puyallup's adopted 2009 Stormwater Manual, which references the 2005 Department of Ecology (DOE) Stormwater Management Manual for Western Washington with revisions as adopted by the City of Puyallup, the local jurisdiction in Title 21. The format lays out the section names, the order of presentation, and the contents of each section, as well as the names and content of certain of the figures and tables.

The Drainage Report has a main body, which documents the results of the design processes:

- Step 1: Site Analysis: Collect and Analyze Information on Existing Conditions.
- Step 2: Prepare Preliminary Development Layout.
- Step 3: Perform Offsite Analysis.
- Step 4: Determine the Applicable Minimum Requirements.
- Step 5: Select Permanent Stormwater Controls.
- Step 6: Prepare CSWPPP.
- Step 7: Report on Project.
- Step 8: Have jurisdictional check for compliance.

The appendices to the Report contain the calculations as well as other required documents such as the *Construction Storm Water Pollution Prevention Plan* and the *Maintenance and Source Control Plan*, which in turn contain appended forms, checklists, and other aids.

The facilities are designed in accordance with the City of Puyallup Standards Section 200. LID is the preferred and commonly-used approach to site development.

Note to Reader: Since these reports draw heavily on reference documents, lists, and standards, in certain areas of the report, typical items may be included in the text to indicate that they were considered, but ~~struck through~~ to show that they are not applicable to this project. Correspondingly, tables and lists may have underlined or **bold** text to indicate selected items.

## LIMITATIONS

Work for this project was performed for Cascade Christian Schools and prepared in conformance with sound engineering principles and standards, with the best available site and technical information at the time of investigation. This work is specific to the project, site, and client, and should not be applied to any other purpose without consultation with Vader Engineering.

## EXISTING SITE CONDITIONS

The existing site consists of a junior/senior high school site and parking on the west side near 21<sup>st</sup> ST SE. There is an existing track and field and stormwater detention pond in the center of the campus, and the east side abutting 25<sup>th</sup> ST SE are baseball and softball fields. The proposed Cascade Christian School improvements are a phase of a larger plan of work.

The current stormwater system was designed as part of the previously approved TIR by AHBL dated November 1995, which provided the overall stormwater design for the entire build out of the campus. This TIR was updated in 2016 by Abbey Road Group and confirmed the pond volume, bioswale sizing, and other criteria were still current. These are attached by reference and scanned pdfs provided for convenience.

Access to the campus drainage pond constructed during Phase 1A handles the detention requirements for the project. The storm detention pond was designed to match or fall below discharge at 50% of the 2-year, the 10-year storm, and the 100-year storm. Water Quality treatment for the traffic bearing surfaces is routed through a bioswale.

Stormwater from the developed site is and will remain conveyed through the existing developments storm conveyance system to then a detention pond and released to the storm drain conveyance system in 21<sup>st</sup> Street East through an outlet system onsite. Then surface water is conveyed north to Deer Creek and the Puyallup River on the north side of East Pioneer. Sizing to confirm this capacity was last performed in 2016 by the Abbey Road Group.

Please refer to *Figures 1 – 3*, following, to aid in the description. Please also see works by other professionals done earlier in the Master Plan. Items of note:

- Survey was performed by Abbey Road Group, March 25, 2016
- Soils investigation was performed by Earth Consultants, Inc. July 7, 1995
- Vegetation to be protected by tract or easement: N/A
- The watershed, or basin, where the site is located is geologically within the Deer Creek Basin, which discharges to the Puyallup River and then to Commencement Bay of Puget Sound.
- Notable critical areas mapped, if any, see figures, are discussed below.
- The previously developed commercial site is on a slope of <5% overall.

A site visit was performed 2-11-22 by a representative of Vader Engineering. An extensive, existing drainage system drains the site, as well as conveys bypass drainage from properties upstream to the south and east. According to the previous TIR, the system was first constructed as a 16- inch cedar box culvert. The system has been maintained and upgraded with a 12-inch concrete pipe and most recently an 8-inch perforated pipe. Several laterals connect to the mainline described above. The combined bypass onsite system discharges west to 21<sup>st</sup> through a 48" conveyance<sup>Revision 1</sup> that then drains north to Pioneer Way, where it eventually connects with what is mapped as Unnamed Creek, and referred to previously as Deer Creek.

The existing drainage system is currently well maintained and functions at its designed capacity.

An on-flow basin enters the site at the south end of the track & field, and has a separate drainage bypass system that will not be impacted by this project.

No other reports that impose more restrictive conditions on the drainage were found. More detail is shown in the Offsite Analysis section.

The following tabulates the existing site data:

**Table 1 – Parcel Data**

Addresses:	811 21st ST SE
Parcel Number:	0420352148
Lot Areas:	756,448 SF (17.37 AC) <sup>Revised V4 to include adtl portables parcel</sup>
Total Developed Site:	100% (no native conditions on site)
Project/Clearing Area:	188,500 SF <sup>Revised V4</sup>
Impervious Site* Area:	Please see table 1, below
Zoning:	RS-04/RS-08
Soils (See Appendix):	Briscot Loam Silty sand
Infiltration Rates:	N/A

Utilities at the site: If needed, special installation measures to avoid conflict with stormwater quantity and quality control features are listed with the utility.

Water: City of Puyallup

Sewer: City of Puyallup

Power: Puget Sound Energy (PSE)

Communications: Private provider

Gas: PSE

Fuel Tanks: No evidence of fuel tanks found; tanks not considered likely with site history.

Figure 1 – Vicinity Map  
Property, Roads, Geographic Areas, Watersheds

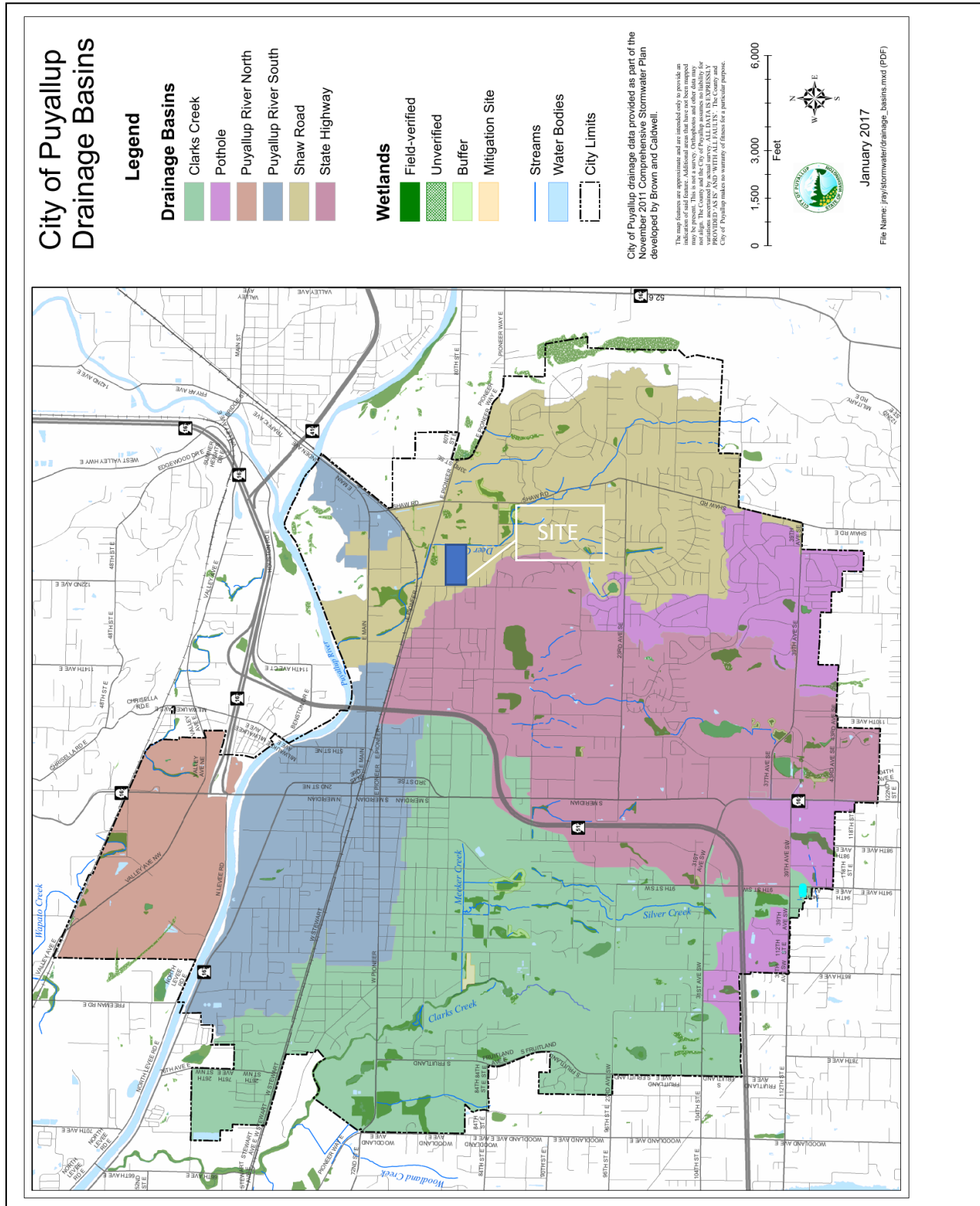
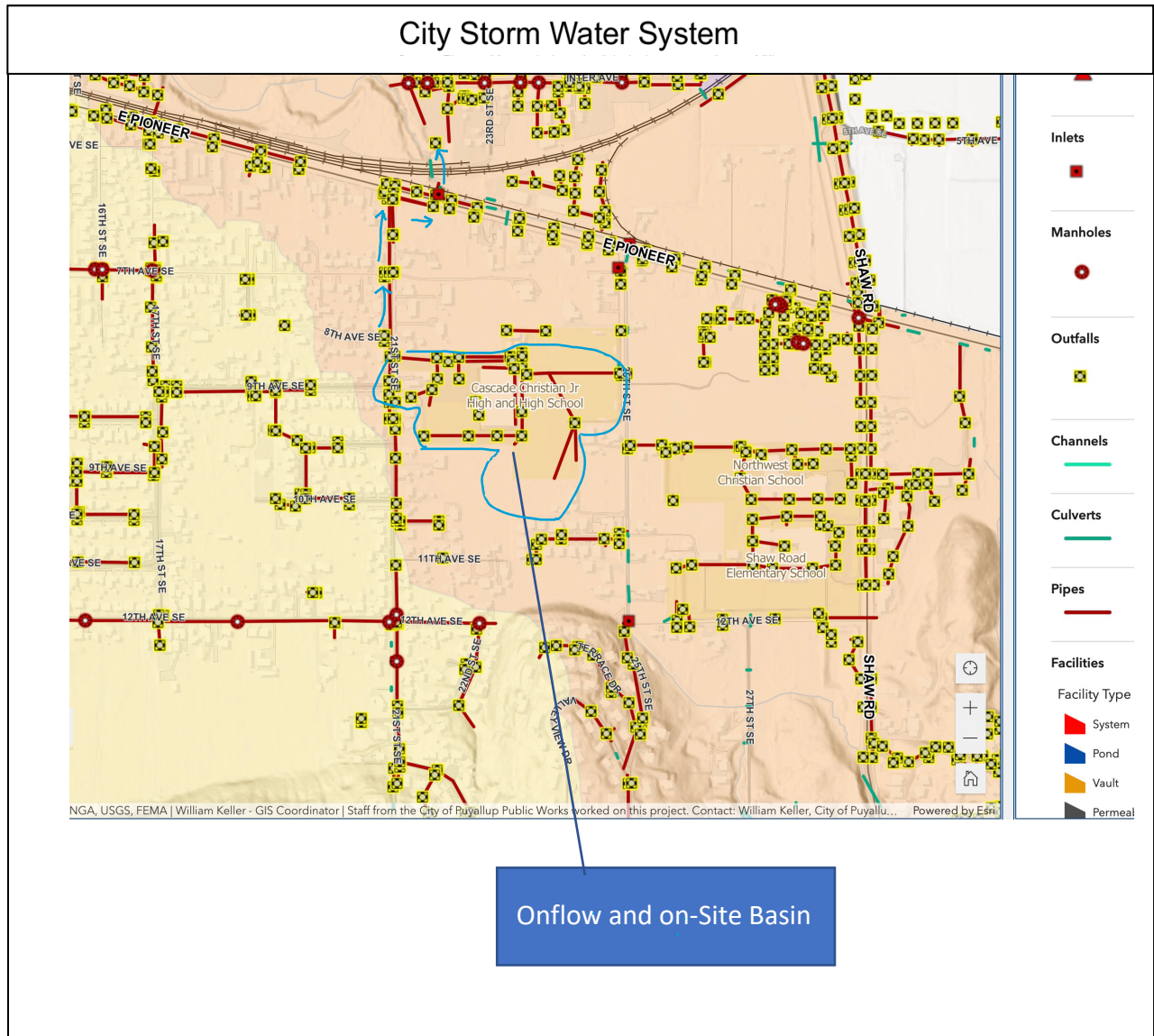
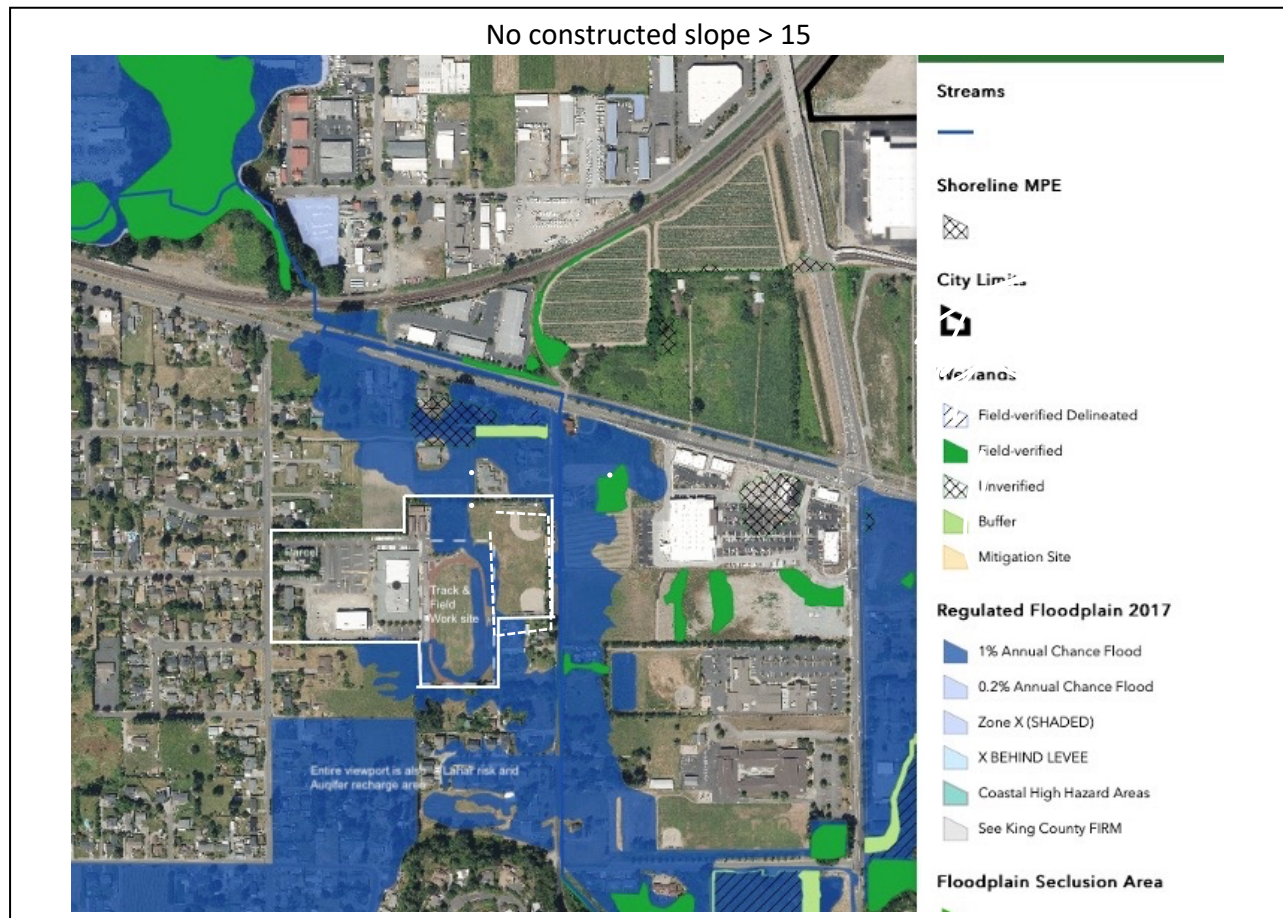


Figure 2 – Basin Map and flow path



**Figure 3 – Critical Areas: Streams, Wetlands, and Floodplains Map**

Revised V4 to include adtl portable parcel

**PROJECT DESCRIPTION:**

The project intends to upgrade the athletic fields from the mid-1990s facilities to a more current material; enlarge the track by 2 lanes to regulation size; enlarge bleacher seating and pedestrian paths; and enlarge the administrative office at 811 21<sup>st</sup> ST SE in the jurisdiction of Puyallup Washington. This project will be on-site work only, retaining current accesses from the public road and served by existing public water, sewer and power, with onsite service extensions. Stormwater will continue to be handled onsite and additional onsite conveyance and detention will be provided.

Please refer to *Figure 4 – Campus Site Plan* and *Figure 5-Site Development* to aid in the project description and show the development layout.

The layout must consider:

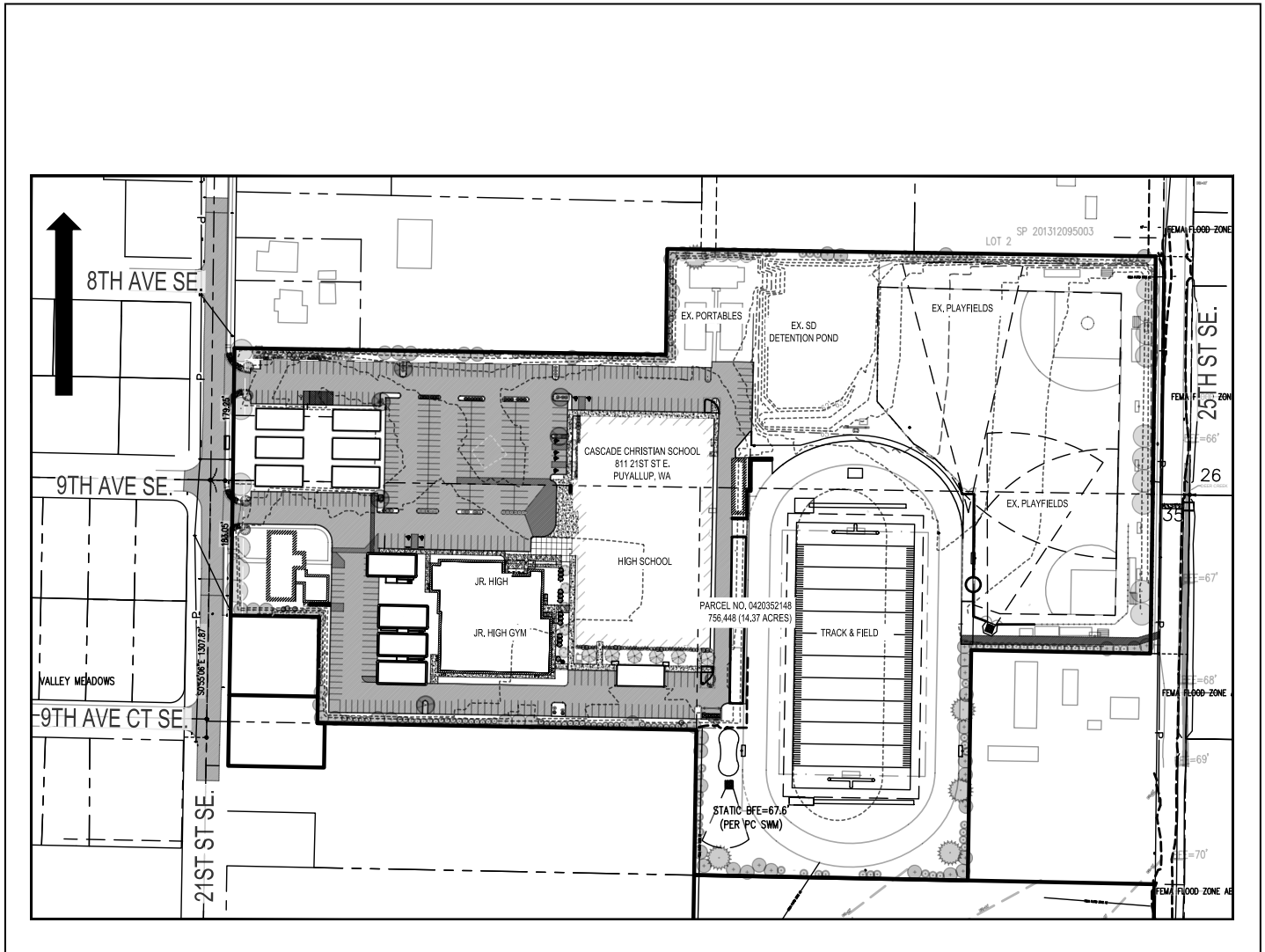
Avoid critical areas: None Avoidable.

Preserve natural (forest) areas: None.

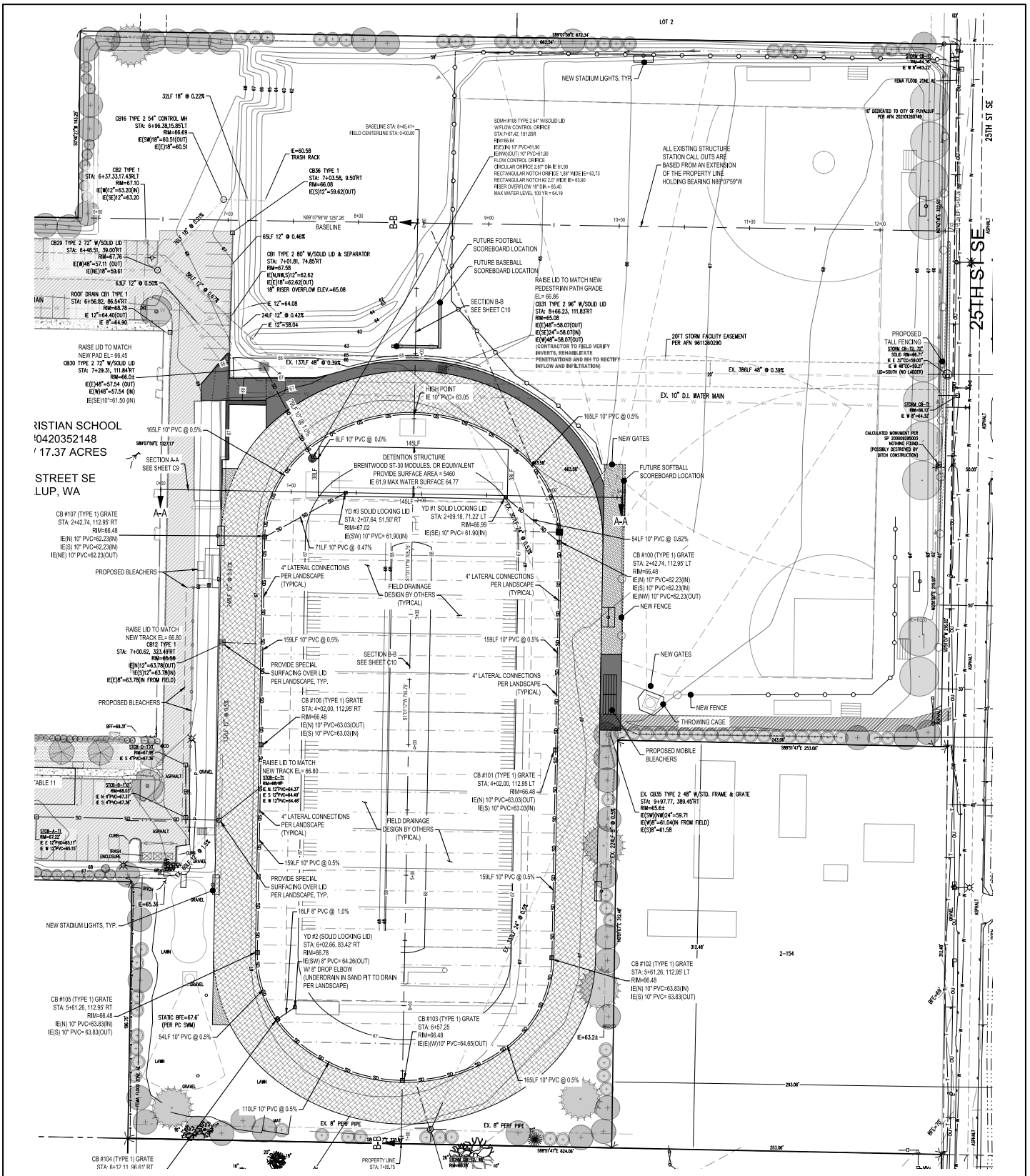
Consider best use of mixed soil types: Locate infiltration where depth and type are favorable.

Minimize impervious areas: Meet landscaping ratios established by jurisdiction.  
Maintain & Use Natural Drainage Patterns: Use Infiltration where possible. Retain constructed conveyances already in place.

Figure 4 – Campus Site Plan



### Figure 5 – Site Development Plan



RISTIAN SCHOOL  
 0420352148  
 / 17.37 ACRES  
 STREET SE  
 LUP, WA

Revision 1, Revision 4

**Table 2 – Basin Summary**

<u>Basin ID</u>	<u>Drains From</u>	<u>Drains To</u>	<u>Future offsite Discharge flow</u>	<u>Length to Facility</u>
Track & Field	Track and field	North drainage pond	no change	N/A

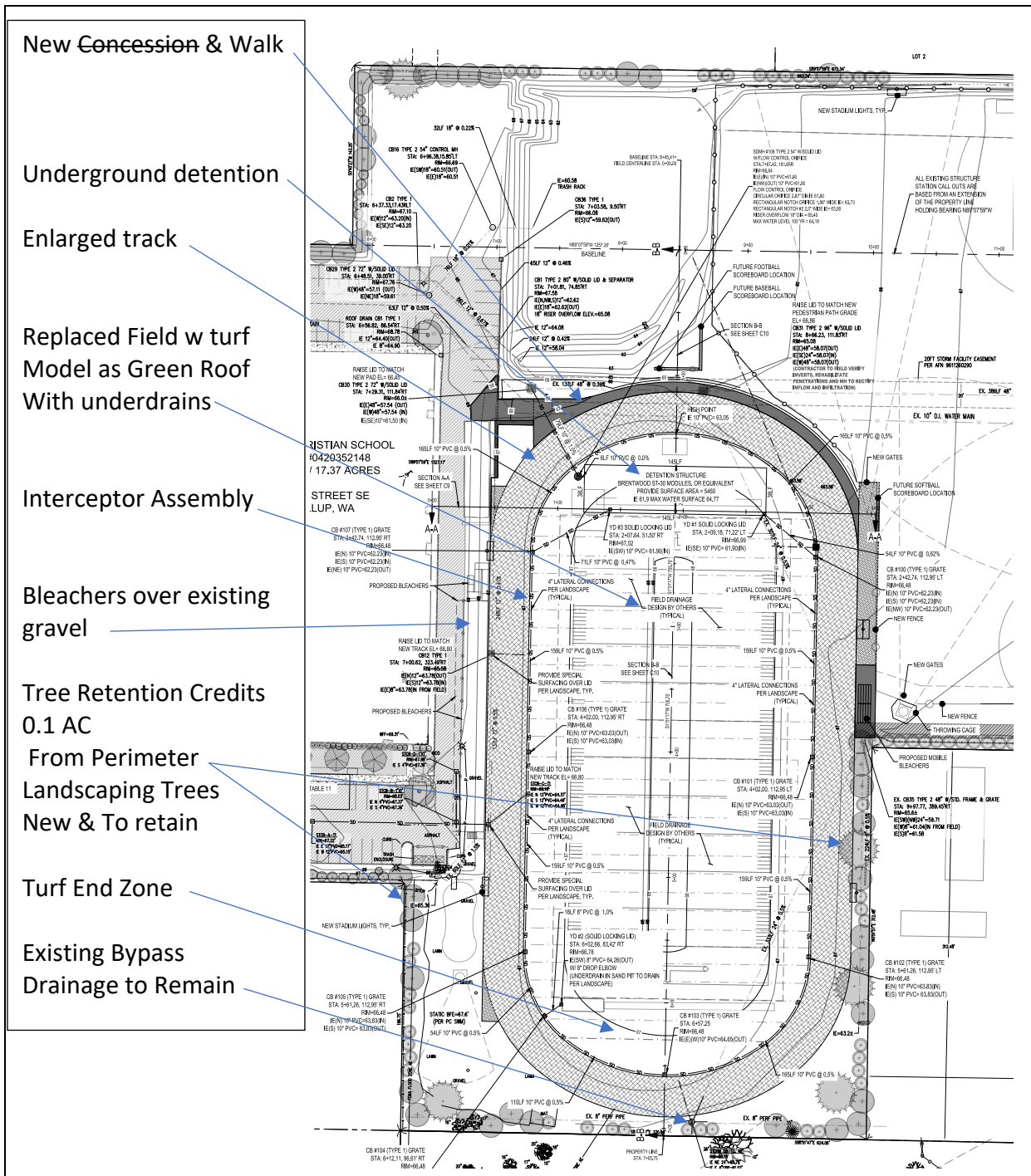
**Table 3 - Schedule of Drainage Feature Locations and Structures**

<b>Stormwater Additions Schedule</b>							
Pipes – PVC SDR 35, Infiltration- Aluminized CMP ALTA2 -16 gauge, or A-2000 PVC							
<b>Designation</b>	<b>Dia.</b>	<b>Material</b>	<b>Discharge</b>	<b>From</b>	<b>To</b>	<b>Slope</b>	<b>Remarks</b>
Track Detention	Brentwood ST-36 Modules 5460 SF			Interceptor	48" outfall	N/A	-Direct connection to outfall pipe to avoid conflict with route around building.
Track & Field Interceptor Assembly	10"	A-2000 PVC or AI CMP	encircling	Under drains	Detention Modules	0.5%	Connector
SD ByPass Re-route	48"	Smooth-walled, water-tight. Shop Drawing required	Same as existing	Eastern offsite/ 25th	Western Offsite/ 21st	0.39%	84 LF and 3 additional SD MH to re-route around concession building.

Revision 1

Revision V4 remove Concession from proposal

Figure 6 – Work Map



Revision 1

## OFFSITE ANALYSIS

### Task 1: Study Area Definitions and Maps

Please refer to Figures above to aid in the description of the Offsite Analysis. The study area was extended to 0.25 miles downstream. Upstream conditions were not studied or changed. Please see the previous TIRs for complete analysis of upstream and the overall parcel.

Emergency services located along the flow path? None

Environmentally Sensitive Areas in flow path? None

### Task 2: Resource Review

The following resources and documents were reviewed in preparing this analysis. Pertinent excerpts from these resources have been included in this study.

1. Stormwater Map for area.
2. Survey filed with the State of Washington.
3. Soil Survey and investigations.
4. Local Project Data from previous phases of the Master Plan.

### Task 3: Field Inspection

Revision 1

Field inspection was performed by a representative of Vader Engineering on 2-11-22. Observations were later updated with the findings on the City records.

An extensive, existing drainage system drains the site. There is a 48" SD that conveys offsite bypass drainage east to west across the project site. Also on site is a south to north 24-inch pipe that is part of the existing bypass drainage system. Onsite drainage is conveyed to and detained in a pond just north of the project area. The on-site drainage joins the upstream bypass in a SDMH just west of the detention pond, and the 48" SD continues West to 21<sup>st</sup> St SE. The SD turns north down 21<sup>st</sup> Street SE and across Pioneer Way to an existing storm manhole on the north side of Pioneer Way.

The Conveyance section will go into further detail for the offsite calculations. There were no apparent deficiencies in the downstream conveyances. No signs of overflow, erosion, sedimentation, etc. were observed in the field.

### Task 4: Downstream Drainage System Description and Existing and Potential Problems

Please see *Figure 7 below* to aid in the following description.

**Figure 7- Downstream Map Pierce GIS Terrain**

The parcel data from Pierce County lists the following categories of possible Site Constraints and refers to City of Puyallup. Figure 3 from Puyallup Maps shows a 1% flood chance along one side of the track, which is acceptable. The entire valley floor area is mapped as an Aquifer Recharge Area, Liquefaction Susceptible Area, and Lahar Hazard Area, which are unavoidable. Pierce County does not map any of the following.

- Erosion Hazard: Not mapped.
- Fish and Wildlife Habitat: Not mapped.

- Floodway: Not mapped.
- Landslide: Not mapped.
- Mine Hazard: Not mapped.
- Resource Land: Not mapped.
- Right-Of-Way Need Area: Not mapped.
- Wetlands: Not mapped.

Bypass drainage from the project which will not be controlled? No.

For emergency overflow or other instances where rainwater may be conveyed downstream, the available flow paths are: North to the existing creek which flows north west to connect to the Puyallup River.

No drainage issues are known to exist within the immediate downstream area, and the street and City storm system are in good condition and relatively new. Both options will be used as overflow pathways for convenient portions of the site.

### **Task 5: Mitigation of Existing or Potential Problems**

The following mitigations are proposed so that no drainage issues are anticipated from this proposed re-development if constructed according the design:

- Erosion Potential: Provide TESC measures until the project is stabilized.

## DETERMINE APPLICABLE MINIMUM REQUIREMENTS

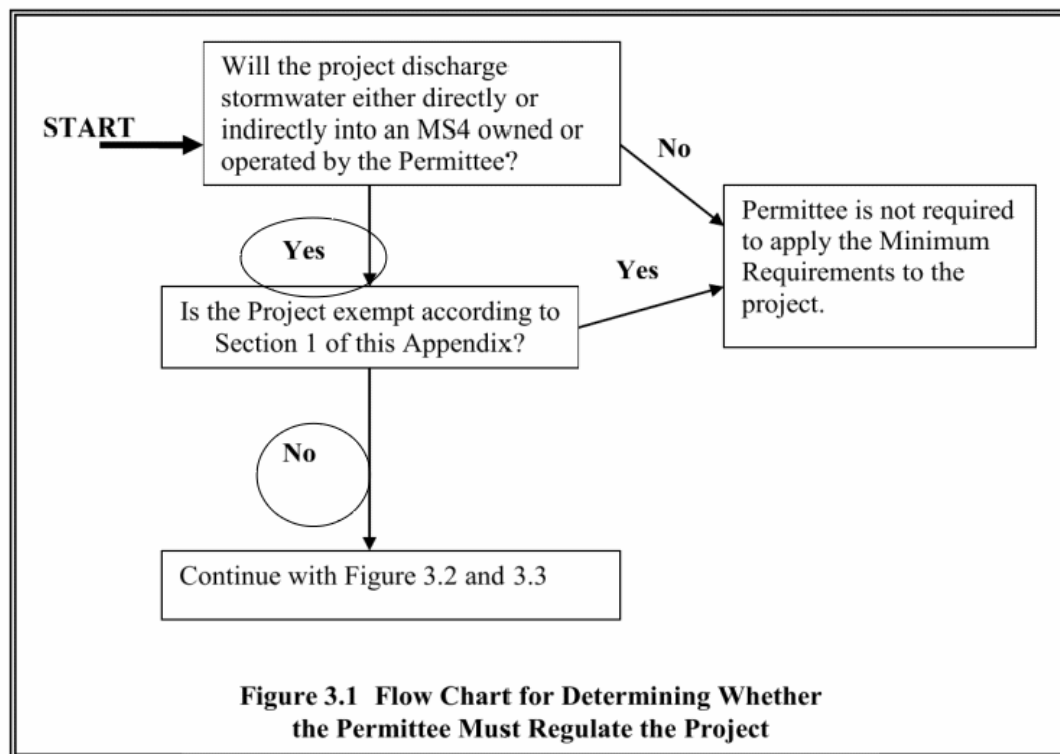
*Western Washington Phase II Municipal Stormwater Permit*

### Section 3. Applicability of the Minimum Requirements

#### 3.1 Thresholds

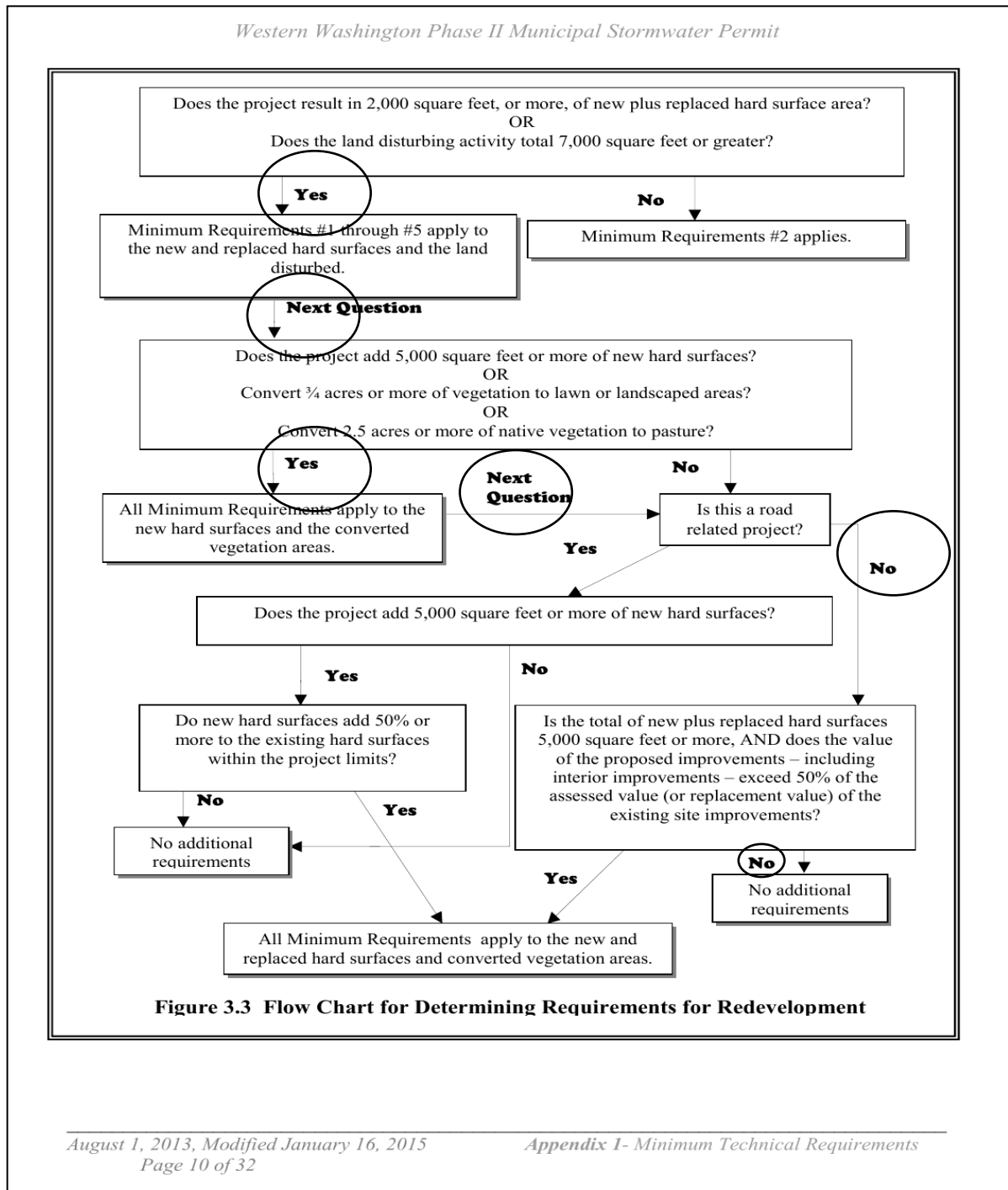
Not all of the Minimum Requirements apply to every development or redevelopment project. The applicability varies depending on the project type and size. This section identifies thresholds that determine the applicability of the Minimum Requirements to projects. Use the flow charts in Figures 3.1, 3.2, and 3.3 to determine which of the Minimum Requirements apply. The Minimum Requirements themselves are presented in Section 4 of this Appendix.

Use the thresholds in sections 3.2 and 3.3 at the time of application for a subdivision, plat, short plat, building permit, or other construction permit. The plat or short plat approval shall identify all stormwater BMPs that are required for each lot. For projects involving only land disturbing activities, (e.g., clearing or grading), the thresholds apply at the time of application for the permit allowing or authorizing that activity. Note the exemption in Section 1 for forest practices other than Class IV General.



Since 35% of this area is already hard surface, the redevelopment flow chart applies. *Figure 8-Flow Chart for Determining Requirements* displays the applicable design analysis for the project.

**Figure 8 – DOE SMMWW: Minimum Requirements for Redevelopment**



## A. MINIMUM REQUIREMENTS SUMMARY

### MINIMUM REQUIREMENT #1: Preparation of Stormwater Site Plans

A set of stormwater drawings submitted with this report constitute the Stormwater Site Plans.

### MINIMUM REQUIREMENT #2: Construction Stormwater Pollution Prevention (CSWPPP)

All new and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into waters. A 13-point *Construction SWPPP* is referenced as *Appendix B* of this report, and provided as a stand-alone document for easier use

### MINIMUM REQUIREMENT #3: Source Control of Pollution

All Known, Available, and Reasonable techniques (AKART) for ongoing protection of stormwater from pollutants sourced from the project are described in the *Operations, Maintenance, and Source Control Manual*. Typical source control measures are proposed for athletic fields.

### MINIMUM REQUIREMENT #4: Preservation of Natural Drainage Systems & Outfall

The stormwater from the site will continue discharge through existing conveyances to the natural location in a manner that does not cause significant adverse impact to the receiving waters and downstream properties.

### MINIMUM REQUIREMENT #5: On-site Stormwater Management

Dispersion and infiltration are not feasible at this site. All impervious areas added or replaced will be routed to detention to control quantity. Pervious surfaces will meet the soil amendment standard. Please refer to Section 5 of this report.

### MINIMUM REQUIREMENT #6: Runoff Treatment

With more than 5,000 SF of pollution-generating hard surface (PGHS) or  $\frac{3}{4}$  Acre of PG Pervious Surface, Treatment is required. Ecology has issued a blanket classification of any and all artificial turf products, regardless of material composition, as pollution generating, so this design incorporates achievement of the Basic Water Quality standard, which is 80% removal of TSS (Total Suspended Solids) for discharges from this project. Please see Step V of the Permanent Controls section for further detail. Revision 4.25.09.04

### MINIMUM REQUIREMENT #7: Flow Control

This project is not Flow Control exempt and must meet the requirements from the 2009 Manual of not exceeding 50% of the 2 year or the 10 or 100-year flow events. Please see Section 5, Permanent Stormwater Controls.

### MINIMUM REQUIREMENT #8: Wetlands Protection

In addition to #7, this requirement applies to projects whose stormwater discharges into a wetland; either directly, or, through a conveyance system. Not Applicable for this system. Please see Section 5, Permanent Stormwater Controls.

**MINIMUM REQUIREMENT #9: Operation and Maintenance**

Stormwater Operations are described in the *Operations Maintenance and Source Control Manual*, referenced as *Appendix C*, and provided as a stand-alone document for future use. A sample log of actions is provided. This is to be kept onsite or in reasonable access to the site and transferred with the property to future owners.

**OPTIONAL GUIDANCE #1: Financial Liability**

Bond and liability assurances will be provided by the proponent or a representative of the proponent (Contractor) prior to start of construction to ensure construction compliance. The owner will be responsible for on-going cost of private maintenance.

**OPTIONAL GUIDANCE #2: Offsite Analysis and Mitigation**

Projects that discharge off site must address potential impacts to water quality, erosion, slope stability and drainage impacts, and propose mitigation for predicted impacts. Previous TIR Analyzed this and determined no mitigation was triggered.

## SELECT PERMANENT STORMWATER CONTROLS

This section addresses the analysis and design of the drainage flow controls and water quality measures. Selection of Flow Control Facilities starts by:

- Following the LID Flow chart to determine the required list, then;
- If using the LID Performance Standard, select any combination of BMPs that achieves performance standard. Move to Step II, if not, then;
- Following the priority listings for that LID List and analyzing the infeasibility criteria to determine the first feasible BMP for each of 3 surface types.
  - Once a BMP is selected it is sized.
  - Placed on the design drawings.
  - No other On-site Stormwater LID BMPs is necessary for that surface.
- Apply any LID credits generated toward
  - Flow control (peak and/or duration matching).
  - Treatment design (basic or enhanced).

Additional analysis of components such as the conveyance system, and in cases with potential for high groundwater, buoyancy resistance, are also addressed in this section.

**Step I: Determine and Read the Applicable Minimum Requirements**

The Flow Chart for LID requirements, *Figure 9*, below, indicates that this project is to either follow List #2, or meet the Performance Standard.

The selection of Flow Control Facilities is made either by the performance method or by following the priority listings for LID List and analyzing the infeasibility criteria to determine the first feasible BMP for each of 3 surface types. Once a BMP is selected it is sized and placed on the design drawings. No other On-site Stormwater Management BMP is necessary for that surface. This repeats until all surfaces are accounted for.

Since this is the last in a series of Master Plan projects that are regulated under the 2009 SWM, the flow control standard is 50% of the Q2, the 10 year, and the 100-year rather than the 50 year (Q50) probability event.

Figure 9 – DOE SMMWW: Flow Chart for LID MR #5 Requirements

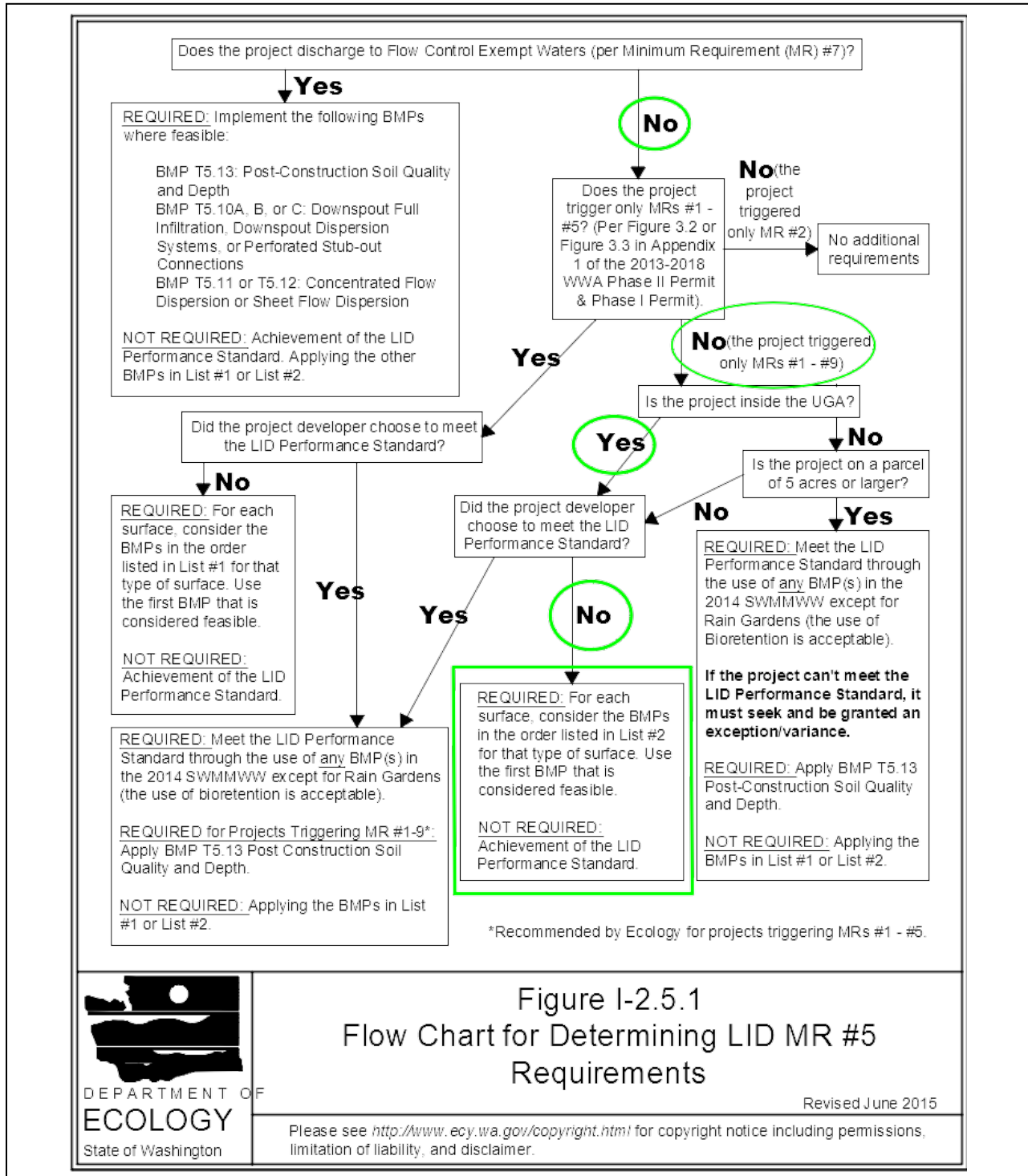


Figure I-2.5.1  
Flow Chart for Determining LID MR #5  
Requirements

Revised June 2015

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## B. Onsite Stormwater Management

The following On-site Stormwater Management BMPs were selected.

**Table 4 - LID BMP Analysis**

BMP	Evaluation & Impact	BMP Credits (if applicable)
<b>Lawn and Landscaped Areas:</b>		
1. <b>Soil preservation and amendment</b> BMP in Volume III, Section 3.1.	Stockpile topsoil and amend and re-spread in pervious areas. Mulch existing Landscaping (Trees) <b>Selected.</b>	Model these areas as Pasture rather than lawn.
<b>Roofs:</b>		
1. <b>Collect &amp; Convey</b>	To Detention	
<b>Other Hard Surfaces:</b>		
1. Track Interceptor	Model as an oversized perforated pipe connection	
1. <b>Field Artificial Turf</b>	Model top 5" of bedding as a Green Roof	

### Step II: Select Source Control BMPS

Source control is applied by project type from the BMPs listed in Vol IV of the SWMMWW. There are Operational BMPS that are presented as Applicable and additional measures presented as Recommended. The Source Control areas for this project are:

- S411 BMPs for Landscaping and Lawn/ Vegetation Management
- S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems
- S421 BMPs for Parking and Storage of Vehicles and Equipment
- S424 BMPs for Roof/ Building Drains at Manufacturing and Commercial Buildings

Please see the *Operations, Maintenance, and Source Control Manual* for this project for more detail about the selected BMPs.

### Step III: Determine threshold Discharge Areas and Applicable Requirements for Treatment, Flow Control, and Wetlands Protection

*Part 1 Read the Definitions.*

Read DOE SWMWW Volume 1 Section 2.3.

*Part 2: Outline the threshold discharge areas.*

The entire onsite project is within 1 discharge area.

*Part 3: Determine amount of Pollution-generating hard surfaces (including pervious pavements, if any) and pollution-generating pervious surfaces*

Revision 4.25.09.05 No traditional new or replaced Pollution Generating Surfaces are expected.

However, the 2019 SWMMWW glossary lists the following definition

Pollution-generating pervious surface (PGPS)

Any pervious surface subject to any of the following:

- vehicular use,
- industrial activities (as further defined in this glossary);
- storage of erodible or leachable materials, wastes or chemicals, and that receive direct rainfall or run-on or blow-in of rainfall,
- use of pesticides and fertilizers, or
- loss of soil.

Typical PGPS include permeable pavement subject to vehicular use, lawns and landscaped areas including: golf courses, parks, cemeteries, and sports fields (natural and artificial turf). Later discussion

Although sports field are listed as an example of a typical PGPS in the DOE 2019 SWMMWW, the field will be constructed with underdrains collecting the interflow before it enters groundwater. Then, because of the underdrains it is subsequently defined and will primarily function as New PGHS.

*Part 4: Compute total effective impervious and converted vegetation areas (in each discharge area, if applicable).*

The Total Effective Impervious and Converted Vegetation Areas are tabulated within the MGS Program output see Appendix A. Credits of 0.1 AC for retained trees within 20 ft of an impervious surface are eliminated from modelling, reducing the impervious post developed area. (BMPT 5.16)<sup>Revision 1.</sup>

*Part 5: Use an approved continuous runoff model (e.g., WWHM) with 15-minute timestep to determine whether there is an 0.15 cfs increase in 100-year return frequency flow. (0.1 cfs increase for 1-hr timestep).*

Before adding infiltration assembly items MGS Flood 4 simulations show that the project would exceed the exemption from flow control rate increase. Continue to next section.

## **Step IV: Select Flow Control BMPs and Facilities**

*Part 1: Determine whether you can infiltrate.*

No, the soils do not meet the needs for Flow Control BMP infiltration. Please see the recommendations in the Soils Report previously submitted.

*Part 2: Use an approved continuous simulation runoff model to size detention. (Refer to Volume III, Chapter 2)*

Flow control was modelled with MGS Flood 4 software in the fully forested and proposed conditions, with onsite management features added to restrict the future runoff rates to no

more than match the forested rates. Inputs to the model are shown in the summary reports attached in Appendix A.

The model simulates a variety of discharges at various probability intervals, including the stipulated reoccurrences for water quality treatment, for flow control matching, and for conveyance sizing. These simulations are then used to size facilities and their outlet control devices within the optimization routine of the model. Following that, outputs are used to size conveyance piping and treatment facilities to achieve water quality requirements, if needed.

The majority of the calculations for this work are internal to the model, so copies of the simulation files are provided to the reviewer electronically for verification and comparison to the summary reports and features shown on the drawings. Otherwise, the accuracy of calculations is presumed given the regulatory requirement to use a specified model.

In this case, a combination of features is proposed to provide flow control, including

- Post-Construction Soil Quality and Depth to reduce runoff from vegetated areas.
- Under turf bedding, with 4" pipes in 1 ft trenches at 15 ft on center, at 0.5% slope.
- Interceptor Assemblies. These are rock filled trenches with perforated distribution pipes used to increase the net porosity of the assembly. These are modelled using the Trench icon in MGS Flood. This feature lies along the interior edge of the track.
- On Site Detention.

This runoff is not subject to water quality treatment as it does not generate from traffic-bearing surfaces.

See notes on Stormwater Plan Sheets, for sizes and locations of these features. More detail about the calculations for volume is presented in Appendix A and in the electronic files.

Flow Control Summary: The new detention will fully mitigate flow from new and replaced pervious areas and hardscapes.

*Step V: Select Treatment Facilities. (Refer to Chapter 2 of Volume V)*

## **Step V: Select Treatment Facilities**

### **Introduction -**

This section follows the 2019 SWMWW Vol III Section 1.2 *Choosing Your Runoff Treatment BMPs* and addresses the treatment of stormwater flowing from the replaced athletic field (artificial turf area) only.

Not addressed here is run-off from existing retained athletic fields, and Traffic-bearing surfaces on campus, which are already collected and treated via a Bioswale. Traffic-bearing surfaces will not be increased, rather will be reduced by the amount covered by the bleacher addition, so no additional treatment is proposed for these surfaces. Revision 1

Revision 4.25.09.04 applies from here to the end of this section

The reason why treatment is being applied is because athletic fields are listed as typical PGPS in the DOE SWMMWW, which is interpreted as a blanket stipulation that all athletic fields are sources of stormwater pollution regardless of materials or operations practices. However, since the field will be constructed with underdrains that collect the interflow before it enters groundwater, this field is subsequently re-defined and will primarily function as Replaced PGHS.

*1: Determine the Receiving Waters and Pollutants of Concern Based on Off-Site Analysis*

The Receiving waters are Deer Creek, a tributary to the lower Puyallup River (Figure 1). There are not Watershed, Basin, Water Clean Up, Ground Water Management of Lake Management Plans that apply to this location and stipulate additional Pollutants of Concern.

*2: Determine if an Oil Control BMP is Required*

No, the conditions triggering Oil Control Treatment are not present at the proposed artificial turf playfield.

Oil Control BMPs are required for areas that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. These types of areas include:

- An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area, or 300 total trip ends per day. Gasoline stations, with or without small food stores, will likely exceed this threshold.
- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil. This petroleum storage and transfer criterion is intended to address regular transfer operations such as gasoline service stations, not occasional filling of heating oil tanks.
- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.). In general, all-day parking areas are not intended to require Oil Control BMPs.
- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

*3: Determine if it is Practicable to Provide Runoff Treatment by Infiltrating into the Native Soil*

No, the upper soils are unengineered fill, and the lower too loamy, and the seasonal groundwater too high, so do not meet the specifications for engineered infiltration. Please see the recommendations in the Soils Report previously submitted. An insignificant amount of infiltration is predicted by the modelling software.

*4: Determine if a Phosphorus Treatment BMP is Required*

No, this site is not in a location where the receiving waters are listed as needing phosphorus removal.

#### *5: Determine if an Enhanced Treatment BMP is Required*

Yes. Enhanced Treatment BMPs, now also referred to as Metals Treatment, increases the number of water quality parameters and is triggered by specific land uses and the aquatic life characteristics of the receiving water body.

This project discharges to a conveyance system that is tributary to fresh waters that have an existing aquatic life use but are not listed as basic receiving waters (Deer Creek).

Although landscaped areas are typically exempt from enhanced/metals treatment, both natural and artificial turf sports fields, regardless of materials, properties, or susceptibilities, are codified as a pollution generating land use.

For TDAs with a mix of polluting and regular land uses, Enhanced Treatment BMPs are required when the runoff from the areas subject to the Enhanced Treatment Performance Goal comprises 50% or more of the total runoff from the TDA (SWMWW Vol III.1.1 pg 430). For this project the runoff Flow Rate from the sports fields, as modelled with MGS Flood, is slightly under half of the overall runoff, as the rubberized track and jump area, bleachers, and walkway surfaces drain faster. The project's total Runoff Volume over time is also modeled under half (682 of 1362 ac-ft), which matches well with the ratio of surfaces in the project. To be conservative, this project will proceed as if future changes to all athletic fields on the campus may eventually apply. The project is intending to demonstrate achievement of the enhanced standard, although it may not strictly apply to this particular action.

#### The Enhanced Treatment Performance Goal

Enhanced Treatment BMPs are intended to provide a higher rate of removal of dissolved metals than Basic Treatment BMPs. Based on a review of dissolved metals removal from Basic Treatment BMPs, a "higher rate of removal" is currently defined as:

- greater than 30% dissolved copper removal (stipulating a dissolved copper influent range of 0.005 to 0.02 mg/l),
  - The maximum dissolved copper level would be  $0.699 * 0.02 \text{ mg/l} = 0.014 \text{ mg/l}$  unless a higher influent copper was documented.
- greater than 60% dissolved zinc removal (stipulating a dissolved zinc influent range of 0.02 to 0.3 mg/l).
  - The maximum dissolved zinc level would be  $0.399 * 0.3 \text{ mg/l} = 0.120 \text{ mg/l}$  unless a higher influent zinc was documented.
- In addition, Enhanced Treatment BMPs are also intended to achieve the Basic Treatment Performance Goal.
  - The Basic Water Quality standard is 80% removal of Total Suspended Solid (TSS).
  - When the levels of suspended solids in the stormwater runoff prior to treatment are 100 NTU or less, a measurement of 20 NTU or less before discharge also achieves the Basic Water Quality standard.

The Enhanced Treatment Performance Goal may be declared achieved if any of the manual-listed enhanced BMP assemblies or 2-item treatment trains is installed and interacts with the water quality design storm, which is either calculated directly by MGS Flood or approximated at 72% of the 2-year storm.

For the artificial turf sports field, the modelled water quality flow rates are:

**Table 5- Water Quality Flow Rates for Replaced Athletic Field**

Water Quality Data		Flow Splitter Calculator	
<b>Compute Water Quality Treatment Volume for Link</b>			
Computed Basic Wet Pond Volume, 91% Exceedance (cu-ft):			7826
Computed Large Wet Pond Volume (Phosphorous Control), 1.5*Basic Volume (cu-ft):			11738
Time to Infiltrate 91% Treatment Volume, (Applies to Infiltration Facilities)			1529.55 hrs
<b>Compute Infiltration/Filteration Statistics</b>			
Total Runoff Volume	682.40 ac-ft	Percent Treated (Infiltrated+Filtered)/Total	17.37%
Total Runoff Infiltrated	118.50 ac-ft 17.37%		
Total Runoff Filtered	0.00 ac-ft 0.00%		
<b>Compute 2-yr Discharge Rate for Link Outflow (cfs)</b>			
			0.453
<b>Compute Water Quality 15-Minute Design Discharge for Link Inflow</b>			
On-Line Facility Design Discharge Rate (cfs):			0.168
Off-Line Facility Design Discharge Rate (cfs):			0.084

However, due to the retrofit nature of this project over an existing sports field on a tightly developed, nearly built out campus, presumptive water quality BMPs sized for this flow do not fit into the site.

Ecology's SWMWW Section I-1.7 *Presumptive versus Demonstrative Approach to Protecting Water Quality* allows either approach. The Presumptive Approach is exactly that, if a method, with materials, configuration and sizing from the Manual is adopted it is

*'presumed to protect water quality and instream habitat, and meet the environmental objectives of the regulations.'*

However, perhaps with an understanding that no manual can contain every possible solution, and that pre-set configurations cannot fit on every possible site, the Demonstrative Approach allows project proponents to demonstrate that the project

*'will not adversely impact water quality by collecting and providing appropriate supporting data to show that the alternative approach is protective of water quality and satisfies State and federal water quality laws, '*

This project proposes to use the Demonstrative Approach for the artificial turf area. The 3 measured items to meet are the copper, zinc, and TSS levels shown above. Below are the details of how this design meets the requirement that Demonstrative stormwater treatment systems are to be properly designed, constructed, maintained and operated to:

1. Prevent pollution of state waters and protect water quality, including compliance with state Water Quality Standards.

The project proposes to meet the Water Quality standard by: a) first, avoiding materials that are pollutant sources such as those leach significant copper and zinc or promote suspension of solids, b) next, avoiding erodibility and filtering solids in situ, then c) also providing settling volume, and finally, d) providing floatables retention. This can be demonstrated through quarterly sampling at the SDMH prior to where the artificial turf drainage system discharges into the 48" SD bypass just north of the track.

- a) There are over a dozen kinds of infill material available for artificial turf. For this project, the specified infill material is **EcoSense™ EPDM**, as provided in the Landscape Architect's specifications. Please see Appendix F for the EPDM material characteristics, which are different than the ground up metal-reinforced tires that are commonly imagined.

Manufacturer technical documentation from FieldTurf is supplied for testing the claim that the infill does not leach significant copper or zinc, and the claim was supported by multiple independent third-party studies. Both laboratory and installed-field leachate testing has been conducted.

In summary, samples of runoff from constructed fields (leachate sampling) were tested using the Synthetic Precipitation Leaching Procedure (SPLP) and quantified contaminant levels below EPA thresholds for freshwater aquatic life and drinking water. Laboratory testing demonstrates that the EPDM infill does not leach metals, organics, (or PFAS compounds) at levels that pose risk to stormwater quality. Please see Appendix F for excerpts from the *Environmental Impact Research Guide* (pages 18–21) for reference.

For avoiding turbidity, using artificial turf carpet and granular infill prevents suspension of typical suspended solids in the stormwater. The fabric of the carpet is much more cohesive, and the infill more granular than loamy soils containing small, plate-like, and easily suspendable silts, clays, and organic fines.

- b) Runoff from the field does not directly discharge over the surface. Precipitation soaks through the carpet-like turf to become shallow interflow in the substrate layers. As liquid travels by gravity down through the sand and gravel substrate layers, it then flows toward the voids created by underdrains bedded in more sand and gravel. Since filtration results from the gap size between particles (porosity), the number of gaps that connect (permeability), and length of filtration path, the in situ design for substrate and bedding will filter the presumed particles in the same manner a prescriptive sand filter does, even though it uses a different layout and gradation.

Unlike presumptive sand filtration configurations, this filtration pathway will not receive biological loading because plants, and the fertilizers and pesticides needed to manage vegetation will not be applied to the field. The absence of biological fouling excludes the

primary clogging mechanism for sand filters and alleviates the need for backwashing over the service life of the artificial turf.

- c) The stormwater once it enters the underdrains, then flows through at least 1 and up to 4 storm drain catch basins constructed per standard detail, which includes a sump. The still water retained in the sump of even a small basic catch basin further prevents, controls and treats stormwater by providing still water below the outlet elevation for settleable solids to drift toward the sump.

Vastly more settling volume is provided in the detention structure, which will function similarly to to the Wetpool BMP since there are relatively long flow paths between inflow and outflow.

- d) Following detention, the tee section of the standard outlet control assembly prevents floatable solids from being discharged.

With prevention, filtration, settling, and floatables control, the proposed design will operate passively, can be maintained with skimming floatables from the FC SDMH #108 as needed, and prevent pollution of waters of the state and achieve the Enhanced WQ standards. This will be demonstrated using the laboratory sampling plan included in Appendix G.

2. Satisfy state requirements for All Known Available and Reasonable methods of prevention, control and Treatment (AKART) of wastes prior to discharge to waters of the State.

The proposal will achieve AKART by providing reasonable prevention, control and treatment as described above.

3. Satisfy the federal technology- based treatment requirements under 40 CFR part 125.3.

This section of the federal register lists rules for permit writers, such as when exemptions to best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), or best available technology economically achievable (BAT) can be applied. These rules include consideration of the total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application; and Non-water quality environmental impacts (including energy requirements) among other engineering and process considerations qualifying or exemptions to rules requiring the use of a particular item of technology rather than rules requiring achievement of a particular environmental outcome.

Our conclusion is that this project proposal complies with item 3 because the Demonstrative Approach is how the State DOE achieves the standard set in 40 CFR part 125.3.

The Demonstrative Approach does require a demonstration of achievement of the standard. The Testing Plan to Demonstrate WQ Achievement for the applicable water quality is included

as Appendix G. This is pulled out of the text so it can be used by operating personnel during the testing windows.

#### *6: Select a Basic Treatment BMP*

Not Applicable: If an Enhanced Treatment BMP or a Phosphorus Treatment BMP have been applied, an additional Basic Treatment BMP is not required per the SWMWW. Phosphorus Treatment and Enhanced Treatment BMPs meet both the Basic Treatment Performance Goal as well as their own respective Performance Goals.

### **Step VI: Review Selection of BMPs and Facilities**

The City of Puyallup is the review jurisdiction and will make a determination of the adequacy of the proposal, recapped as:

- Retain existing systems to maximum extent practicable.
- Minimize new impervious effects by siting over existing hard surfaces.
- Provide detention for flow control and treatment for the new and replaced areas.
- Provide soil amendment and replant disturbed pervious areas.
- Overflows release at existing outfalls.

### **Step VII: Permanent Stormwater Control Plan**

Please see the drawings to aid in the description of the stormwater control plan. The permanent stormwater control plan uses amended soils to reduce runoff from disturbed pervious areas, and underground detention for new roof and pavement areas to meet the Flow Control standard. This section presents the remainder of the stormwater components.

#### HYDROLOGIC ANALYSIS

The hydrologic analysis was performed in Ecology-approved MGSFlood4 and is presented in Appendix A.

#### CONVEYANCE SYSTEM HYDRAULIC ANALYSIS AND DESIGN

Additional conveyance pipes are used in new track interceptor trenches onsite and must carry at least the 25-year flow event as sized interior to the cad program and confirmed with Chezy-Manning's equation. The pipes are generally provided 3 feet of cover under traffic bearing areas, 1 ft under pedestrian areas. Instead of sloping pipes sufficiently to calculate at 3 FPS flow rates (when flowing full) to provide cleaning velocity, the pipes are protected from clogging with the granular bedding of the interceptor trench. Interceptor and underdrain pipes are laid a minimum slope to increase detention capacity.

Conveyance Summary with references and sources of information for:

Channels: Not used except as overflow devices.

Culverts: Not used.

Roof Drains: Not used. Revision 4 concession roof eliminated.

Gutters: Not used. Revision 4 concession roof eliminated.

Nomographs and explanatory tables: Not used.

#### SOIL AMENDMENT ANALYSIS

Any topsoil and duff from the cleared and graded areas will be stockpiled for re-use as soil amendment. The site was previously farmed, then graded for the existing track and field, so there will be less available organic soil than some raw land site. In the event of a topsoil shortfall, amendment mulch will be purchased. The Puyallup Standards for Soil Amendment and Depth is provided on the drawing sheets with the erosion control notes and details.

#### BOUYANCY RESISTANCE

Not applicable, perforated pipe in ground will not significantly displace water, and groundwater was not observed or indicated at the project elevations. Structures are expected to terminate well above highest groundwater.

## **CSWPPP TEMPORARY EROSION AND SEDIMENT CONTROL ANALYSIS AND DESIGN**

Please refer to Appendix B – Construction SWPPP of this report for the full details of the Temporary Erosion and Sediment Control Plan for the construction period. For convenience during construction this is provided as a separate document.

### **Erosion and Sedimentation Control Analysis and Design**

There is more than an acre of disturbance on this project, so a Construction NPDES permit from Washington State Department of Ecology is triggered. Proposed temporary measures possible for this project will include the following BMP's:

- Perimeter protection via filter fences, vegetated buffers, and straw or triangular wattles.
- Stabilized construction entrance (existing paving)
- Cover Measures such as straw mulch, hydroseed or other mulching and planting method to stabilize unworked areas.
- Surface Water Control with permanent conveyance and temporary drainage swales to the detention pond.
- Catch Basin protection for existing catch basins on site, such as filters with gravel outlets.
- Sediment retention from a temporary sediment pond within existing detention pond.
- Maintenance of TESC.

Final stabilization will be hard surfacing and planted landscaping per Landscape Architect plans.

### **Pollution Prevention and Spill Control Criteria**

Basic construction activities that will occur during this project will be subject to the preventative measures to avoid impacting stormwater. During construction, Concrete Handling BMPs will be the primary potential source of pollution beyond sedimentation.

For ongoing source control activities related to the commercial use, maintenance practices, and solid waste, please see the measures presented in Appendix D, *Operations, Maintenance and Source Control*, submitted under its own cover for easier reference by workers.

## REPORT ON PROJECT

### A. SPECIAL REPORTS AND STUDIES

#### Soils Report:

Geotechnical Engineering Study by Earth Consultants, Inc. July 7, 1995

submitted under separate cover as file 2205-CCS-1995.TIR.ApdxD.GeoRpt.pdf

Limited Geotechnical Site Evaluation by Krazan & Associates, Inc March 4, 2008

Submitted under separate cover as file 2205-CCS-AbbeyRD.TIR.GeoLetter.pdf

#### Other Previous TIR and Figures Submitted under separate cover:

Abbey RD.TIR.2016 with files for F1; F4 Pond Calcs; F5 1995 TIR; which

references 1995 TIR Deer Creek Culvert; Apdx A Basins.

Wetlands Delineation: N/A

Fish & Wildlife: N/A

Forest Practices: N/A

Reports and Studies appended to this report include the *Construction Storm Water Pollution Prevention Plan* and the *Operations, Maintenance, and Source Control Plan*. These plans detail specific maintenance activities, frequencies, responsible parties, equipment needs, and triggering conditions for the construction period and ongoing operations, respectively.

### B. OTHER PERMITS

Agency	Permit/Approval	If Applicable, requirements that affect project *
Tacoma-Pierce County Health Department	Onsite Sewage Disposal and Well Permits	
Washington State Department of Transportation (WSDOT)	Developer/Local Agency Agreement	
Ecology	Construction Stormwater General Permit (NPDES NOI)	Apply, notify, and report once coverage begins.
Washington State Department of Fish and Wildlife	Hydraulic Project Approval	
Washington State Department of Ecology	Dam Safety Permit	
United States Army Corps of Engineers	Section 10 Permit	
United States Army Corps of Engineers	Section 401 Certification	

United States Army Corps of Engineers	Section 404 Permit	
Local Jurisdiction	Critical Areas Permit	
Local Jurisdiction	Building Permit	Setbacks, coverage, etc.
Local Jurisdiction	Other Permits	

- If blank, does not apply.

Revision V4 to names of Local and Ecology Permit and applicability

**C. BOND QUANTITIES, FACILITY SUMMARIES AND DECLARATION OF COVENANT**

Bond and liability assurances will be provided by the representative of the Proponent (Contractor) prior to start of construction.

Facility summaries are listed in the *Maintenance Manual*.

*Declaration of Covenants* are Legal instruments employed to guarantee preservation of drainage systems and access for maintenance purposes:

Declaration of Maintenance Access Covenant: Recording # \_\_\_\_\_ TBD

ROW Dedications: None.

Easements: Existing utility easements as called on plan.

**Check Compliance with Applicable Minimum Requirements.**

This analysis was coordinated with the overall master plan, the proposal for the building permit and the recommendations of the geotechnical studies and landscape architect. Compliance checks are made by the jurisdiction at submittal, and by the Erosion Control Lead and Inspector during the construction of the design.

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## Appendix A: Calculations

### Hydrologic Simulation

Report results from MGSFlood 4 simulations for stormwater are inserted below.

The first report is for detention facility sizing for the increased impervious surface from bringing the track to regulation size. This detention facility is set above the design water surface elevation of the primary detention pond, to avoid backwater complications.

Since no new traffic-bearing impervious is added, no water quality features are sized.

Assumptions used:

The addition of 1805 Sf of roof to the office is in an area analyzed as impervious in the Master Drainage Plan. It will continue to drain to the main detention pond, so was not evaluated as de minimis area which will not exceed the performance standard for the redeveloped site.

Post-Development scenario reduced by 0.1 Ac for credit for retained & proposed trees within 20 ft of a new impervious surface.

Since the athletic field and perimeter planting disturbed pervious are open to the native subsoil, not lined, we have elected to use the very minimal infiltration rate of 0.10 in/hr to distinguish between the two conditions, as MGS Flood does not optimize well with absolutely 0.0 infiltration. This is supported by the 1995 geo letter in the "Excess infiltration" remark under the pond design criteria. Another source for this adjustment is Doug Howie, DOE, in email, and, most meaningfully, the instructions in the MGS User Manual.

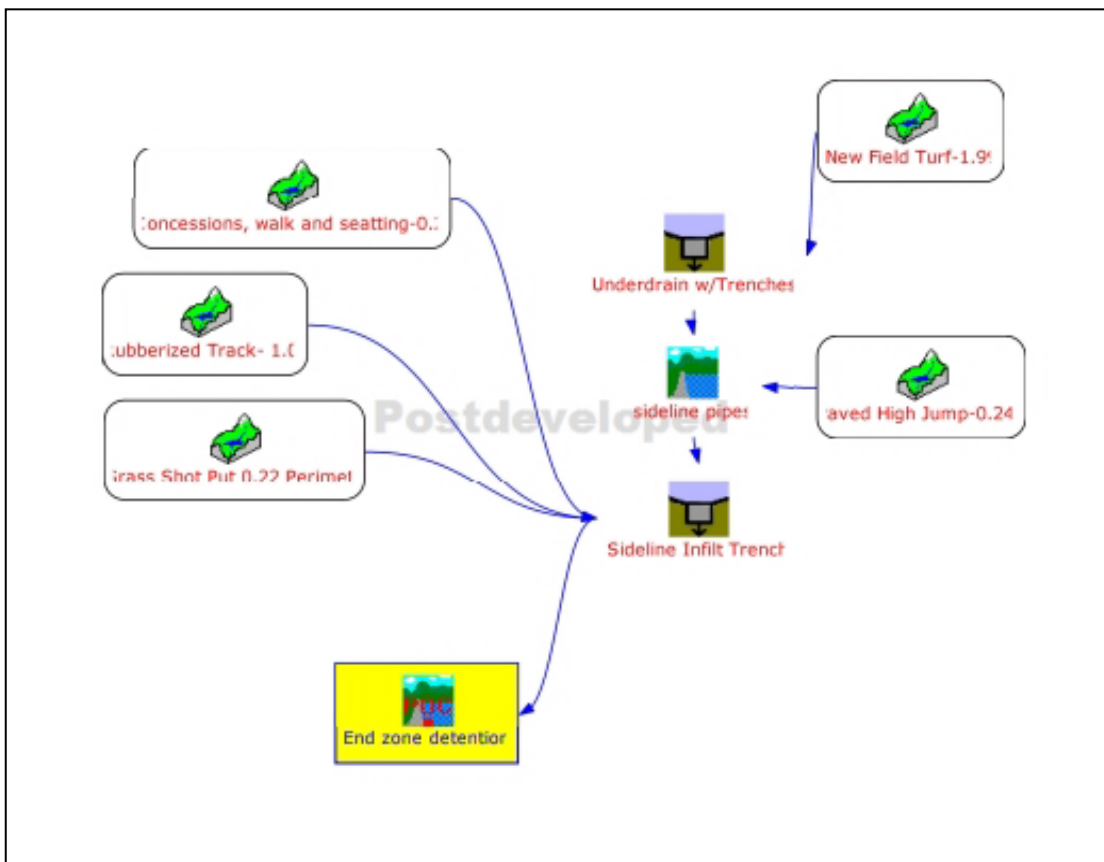
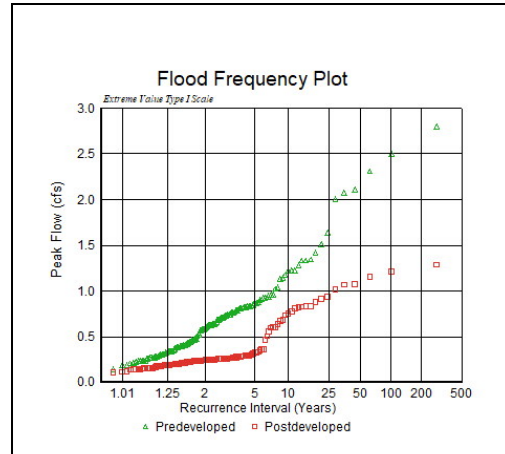
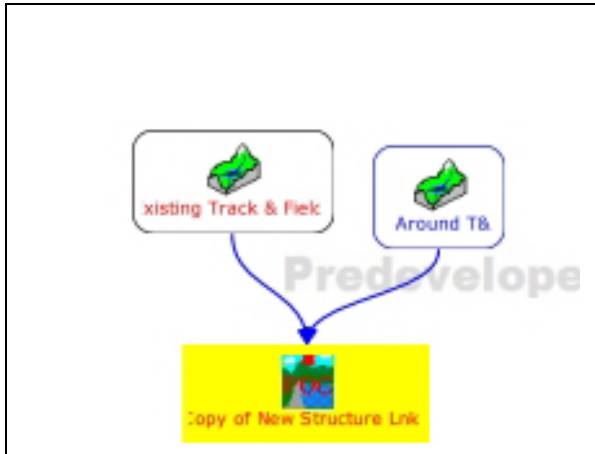
1995 Geo Report by Earth Consultants Inc TP-11 log and Map location

GW about 8 ft below post-filled surface grade in 1995

Silty sandy soils prone to liquefaction (i.e. granular, so use geotextile to separate layers to reduce migration in seasonal high water events.)

Infiltration rates these types of soils 0.1 –

Please see the pre and post scenario figures and report output below.





## **Appendix B CSWPPP - Construction Stormwater Pollution Prevention Plan**

### **Introduction to Construction Storm Water Pollution Prevention Plans**

This report shall be located on the construction site or within reasonable access to the site, and the drawings shall be kept on the construction site at all times, so for convenience is published as a stand-alone document.

The CSWPPP contains the concise, site-specific information about existing conditions constructions schedule, and other pertinent items to supplement what is shown on the drawings.

**Track and Field Improvements**  
**815 21st ST SE**  
**Puyallup, WA 98372**  
**Parcel #: 0420352148**  
**Owner: Cascade Christian Schools**

## **Construction Stormwater Pollution Prevention Plan**

***Vader*ENGINEERING**

253-363-2065 info@vaderengineering.com

Construction Stormwater Pollution Prevention Plan  
(CSWPPP)

Track and Field Improvements  
815 21st ST SE  
Puyallup, WA 98372

Parcel(s): 0420352148

Permit No \_PRCCP 20220589

Application Submitted March 30, 2022  
Revised December 2, 2024  
Revised V4 May 15, 2025  
Approved \_\_\_\_\_,

© Vader Engineering, LLC

Work for this project was performed for Cascade Christian Schools, and prepared in conformance with sound engineering principles and standards, with the best available site and technical information at the time of investigation. This work is specific to the project, site, and client, and should not be applied to any other purpose without consultation with Vader Engineering. The report contained herein has been prepared by the undersigned Professional Engineer(s) Licensed in the State of Washington.



Rebecca Scott Vader, PE

**Proximity Requirement**

*A copy of this CSWPP Plan shall be retained onsite or within reasonable access to the site until construction completes and the site achieves permanent stabilization.*

*A log of preventative activities that indicate what actions were taken to maintain erosion control shall also be kept and be available for inspection.*

**EROSION CONTROL LEAD REQUIREMENT**

The proponent shall be responsible to see that the general contractor identifies an Erosion and Sediment Control Lead for the Construction SWPPP. That individual shall be onsite or on call at all times. If a preconstruction meeting is held, this person shall attend. For sites disturbing 1 acre or more, that lead must be a Certified Lead. Certification may be obtained by an approved training program that meets the erosion and sediment control training criteria established by Ecology. See BMPC160 Certified Erosion and Sediment Control Lead (CESCL) for more information about the duties of the Lead.

CESCL ( Required > 1 ac)

**Lead Name:** \_\_\_\_\_  
**24hr Contact Telephone:** \_\_\_\_\_  
**Fax number:** \_\_\_\_\_  
**Address:** \_\_\_\_\_

If needed: Update

**Lead Name:** \_\_\_\_\_  
**24hr Contact Telephone:** \_\_\_\_\_  
**Fax number:** \_\_\_\_\_  
**Address:** \_\_\_\_\_

Construction Emergency Contact:

**Name:** \_\_\_\_\_  
**24hr Contact Telephone:** \_\_\_\_\_

Owner Emergency Contact:

**Name:** \_\_\_\_\_  
**24hr Contact Telephone:** \_\_\_\_\_

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## Introduction to Construction Storm Water Pollution Prevention Plans

This narrative contains the concise, site-specific information about existing conditions constructions schedule, and other pertinent items to supplement what is shown on the drawings. This report shall be located on the construction site or within reasonable access to the site, and the drawings shall be kept on the construction site at all times.

One primary purpose of the CSWPPP narrative is to describe the scope of self-conducted inspections and set out inspection frequency. This narrative provides a basic template to document the major observations related to implementing the CSWPPP and actions taken to maintain, repair or improve erosions and sedimentation control (TESC) as a result of the ongoing inspections. The site and project descriptions are above in the main body of the text.

Approval of this Construction SWPPP does not constitute an approval of permanent drainage design (e.g., size and location of impervious surfaces, pipes, restrictors, channels, retention, detention/infiltration facilities, utilities, etc.). These are covered under different narratives and plans.

Each site, and some sub-sites, will select which Best Management Practices are expected to protect the receiving waters. For construction sites that eventually discharge to surface water, the primary concern is compliance with Washington State water quality standards. For sites that infiltrate runoff, both the infiltrative capacity of the constructed facilities and the prevention of groundwater pollution will be monitored.

The implementation of this Construction SWPPP and the construction, maintenance, replacement, and upgrading of these Construction SWPPP facilities is the responsibility of the applicant/contractor until all construction is completed and approved and vegetation and/or landscaping is established.

There are 13 elements to a Construction Storm Water Pollution Prevention Plan. However, some elements do not apply to every site. When this is encountered, a justification is provided in the text.

Note to Reader: The CSWPPP is formatted by section, with typical guidance presented at the beginning of a section and project- specific notes added in bold italic text at the end of the section. Adequate TESC control requires continuous adjustments to the stage of construction and weather conditions, so all BMPs are available to the contractor if needed for control.

Since these reports draw heavily on reference documents, lists, and standards, in certain areas of the report, typical items may be included in the text to indicate that they were considered but ~~struck through~~ to show that they are not applicable to this project. Correspondingly, tables and lists may have underlined or **bold** text to indicate selected items.

## Section 1 - General Project Description

This project proposes to re-build a track and field on the site of the one that is smaller than athletic regulation and in need of significant maintenance, add the lighting from the master plan, and to add the adjoining seating and Restrooms/ Concession building. The existing pathways and field entrance will have minor changes for ADA access. The project area totals about 4.3 acres of a larger, developed campus. The balance of the campus that drains to distinct onsite basins will not be modified in the SW management design. No work within a ROW is proposed.

The proponent intends to provide stormwater facilities below ground for the new and replaced areas and retain the use of the existing collection system in the areas remaining unchanged. The project projects no impacts to critical areas so includes no mitigation on or adjacent to the site.

Please refer to the CSWPP Plan Sheets to assist in the description of the project and site and for the full details of the Temporary Erosion and Sediment Control Plan for the construction period. The objective of a CSWPPP is to control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project. The personnel and practices narrated in this CSWPPP describe how that is to be accomplished.

### Table 1 – Parcel Data

Addresses:	815 21st ST SE
Parcel Number:	0420352148
Lot Area:	756,448 SF (17.37 AC)
Total Developed Site:	100% (no native conditions on site)
Project Site Area Total Disturbed:	188,500 SF
Pervious Area Cleared for 'first time'	0
Impervious Area Pre-Project:	6.40 AC
New & Replaced Impervious:	0.84 AC
Net grading /cut /fill:	1769 CY/152 CY/1617 CY
Project Landscaping:	8 Lane Track, Asphalt paths, Artificial Turf Field, Grass, Trees, Shrubs
Soils:	Briscot Loam
Utilities at the site:	Water: City of Puyallup; Sewer: City of Puyallup; Power: PSE;
Communications:	Qwest; Gas: PSE; Cable: Comcast

Current Discharge: Onsite detention pond, discharge via conveyance pipe to Deer Creek, a tributary to the Puyallup River

Proposed Discharge: new detention will discharge via conveyance pipe to Deer Creek.

Permanent stabilization: Artificial turf, Track & Pedestrian paving, Retaining wall, Bleachers, and landscaping.

## Section 2 – Site, Adjacent, and Critical Areas Descriptions

SITE: The project site is near the center of an existing school campus. The project area was previously cleared, graded, developed, and benefits from existing capacity in the Master Planned infrastructure. Please see figure below.

The following tabulates the existing site data:

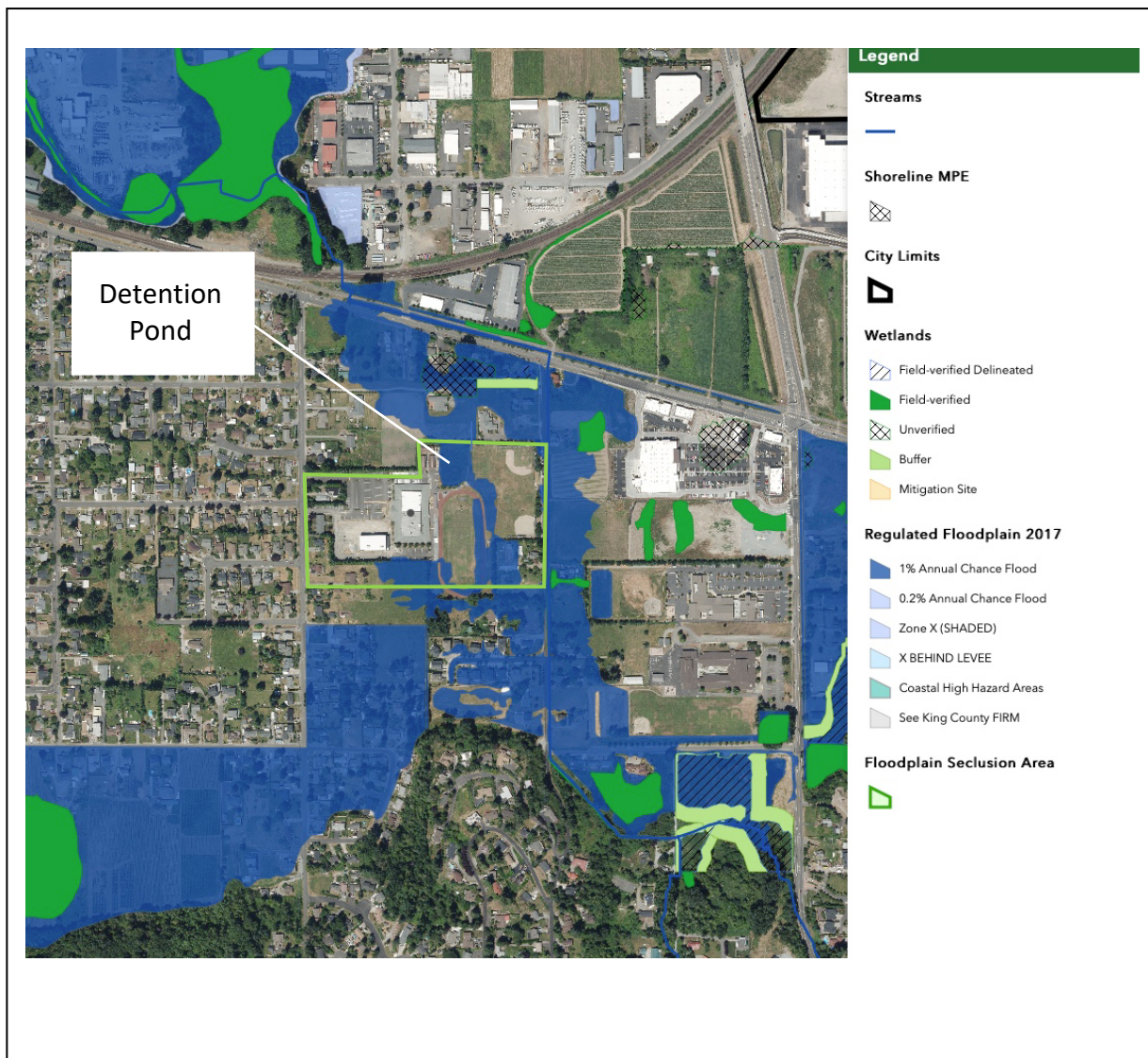
Addresses:	815 21st ST SE
Parcel Number:	0420352148
Lot Areas:	743,764 SF (17.07 AC)
Total Developed Site:	743,764 SF (no native conditions on site)
Project/Clearing Area:	222,000 SF
Impervious Site* Area:	Please see table 1, below
Zoning:	RS-08/RS-04
Soils (See Appendix):	Sandy Loam
Infiltration used?:	Unlined Detention Pond, expect incidental infiltration
Infiltration Rates:	0.1 in/hr for unlined detention ponds (Howie, DOE)
Connecting to right-of-way drainage system?	Onsite connection, which discharges to 21 <sup>st</sup> ST SE

Utilities at the site: If needed, special installation measures to avoid conflict with stormwater quantity and quality control features are listed with the utility.

Water: City of Puyallup  
 Sewer: City of Puyallup  
 Power: PSE  
 Communications: Private provider  
 Gas: PSE

Fuel Tanks: No evidence of fuel tanks found; tanks not considered likely with site history.

Figure 1: Critical Areas Map



Source: City of Puyallup GIS. Map disclaimed as approximate and not surveyed.

**Adjacent Areas:**

- Residential Areas: Residential properties surround the site.
- Roads: 21<sup>st</sup> ST SE (not affected)  
25<sup>th</sup> ST SE (not affected)
- Stream and receiving waters: Overflow to Deer Creek then the Puyallup River.
- Lakes: None.
- Wetlands: None
- Run on to the active project site expected? No, due to constructed drainage and high points.

The drainage discharge to the immediate receiving water is infiltration. The emergency overflow is piped north to deer creek where it enters a well-managed existing drainage system.

Critical Areas:

Inside a mapped Critical Drainage Area?	No.
Constructing within a Critical Area or buffer?	Lahar, Aquifer, and Liquefaction. <sup>Revision V4.</sup>
Within 200 feet of a mapped Critical Area?	Yes, see above
Critical areas for runoff that are down gradient of the project site?	In basin, but Not directly downgradient.
Special requirements for working near or within critical areas:	
No site disturbance proposed in runoff-sensitive critical areas.	

Soils: Please see the *Geotechnical Investigation* by Cobalt Geosciences for more detail on items summarized below:

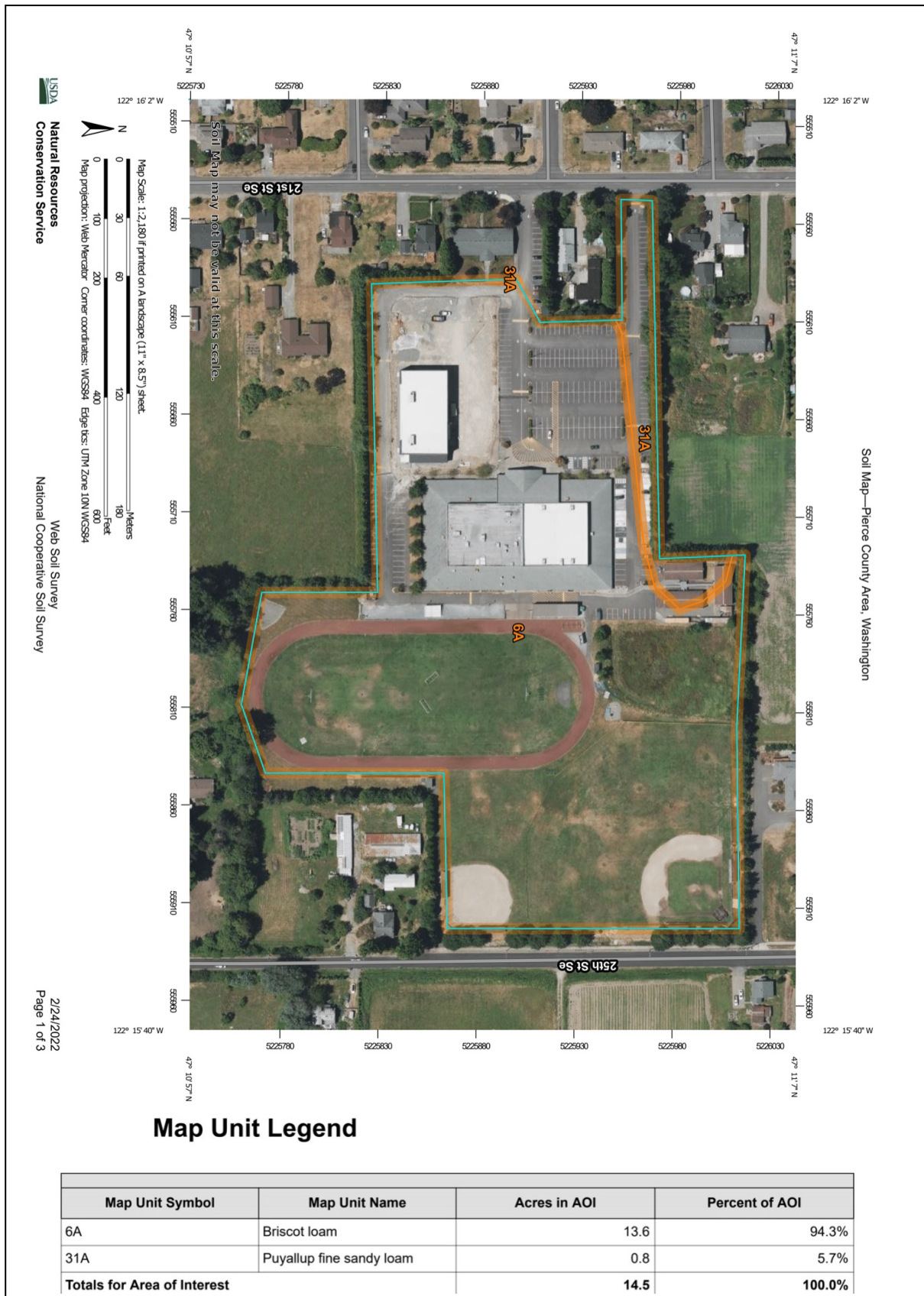
Soil Name(s):	Biscot
Soil Mapping unit:	Loam
Erodibility:	Slight to Moderate
Settleability:	Good due to low fines content
Permeability:	Modest
Depth:	more than 10 ft (limits of observation)
Texture:	Sandy Loam
Soil Structure:	Medium dense to dense

Potential Problems: Silt traces, if present in the soils will be the major contributors to sediment-laden water, as the sand and gravel will settle quickly.

The goal to reduce net fill and import will be pursued with re-using excavated soil as structural fill or topsoil whenever it meets specifications. Imported material meeting specifications for pavement courses, pipe bedding, trench interceptor, turf support, topsoil and structural fill will be used as needed to achieve project goals with the construction conditions.

Unsuitable export, if any, will be to accredited/commercial receiving pit.

Figure 2 – Soils Map and Work Area



USDA  
Natural Resources  
Conservation Service

Web Soil Survey  
National Cooperative Soil Survey

2/24/2022  
Page 1 of 3

## Section 3 - Construction BMPs 13 Elements

The following list describes how each of the required elements is addressed. The types of BMPs selected are discussed below, and the locations, details, and related notes are shown on the drawing sheets. Many of the BMPs have inspection or maintenance components. It is these items that will populate the CSWPPP log kept electronically by the designated inspector. The log will record the date, the recent rainfall events, BMP modifications, and progression of construction, such as permanent stabilization of an area.

Some of the BMPs selected are redundant, however, all CSWPPP BMPs are included to provide flexibility during construction. BMPs may be substituted within type and/or layered across elements or time to achieve the necessary level of control.

### ELEMENT 1: MARK CLEARING LIMITS

Clearing limits are shown on the drawing the CSWPP, also known as TESC Plan, and were selected to fulfill the requirement to limit ground disturbance.:

Before beginning land-disturbing activities, flag or paint the clearing limits. Retain any duff layer, topsoil and groundcover within the clearing limits to the maximum degree practicable. The project limits will be marked by high visibility paint or flagging on the hard surfaces and upgradients, and:

- BMP C233 Silt Fence or
- BMP C 235 Straw Wattles on down gradients and pervious areas.
- BMP C103 High Visibility Fence for in transit areas

Not initially selected or not applicable:

- BMP C101 Preserve Natural Vegetation, (none)
- BMP C102 Buffer Zones.

### ELEMENT 2: ESTABLISH CONSTRUCTION ACCESS

The construction vehicle access and exit shall be limited to one route if possible. To fulfil this requirement, use:

- 
- BMP C107 Construction Road/ Parking Area Stabilization (existing onsite paving)

Check daily during site activity for track out onto ROW. Clean daily or as necessary, more frequently during wet weather, to prevent sediment from entering waters of the state.

- Sediment shall be removed from roads by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area.
- Pavement washing will be allowed only after sediment is removed in this manner. Wastewater shall be controlled by pumping back onsite, or otherwise be prevented from discharging untreated into systems tributary to state surface waters.

- If sediment is tracked offsite, refer to extra measures in the entrance notes on the drawings.

Not initially Selected:

- BMP C105 Stabilized Construction Entrance
- BMP C106 Wheel Wash

***The proposed construction access will be from the onsite pavements and/or the new parking entrance.***

### **ELEMENT 3: CONTROL FLOW RATES**

This project conveys runoff to, and in, constructed components so care is needed to prevent erosive flow rates from accumulating sediment and discharging it in interceptor/infiltration beds before full stabilization is achieved. Protection from internal flow rates may be necessary to avoid gully formation or excessive erosion inside the construction limits, primarily where steeper grades are used.

The controls to meet this requirement are split between large area and channel measures. To reduce formation of runoff, concentration of rivulets, and/or mobilization of fines over Large Areas:

- BMP C120 Temporary and Permanent Seeding
- BMP C121 Mulching
- BMP C122 Nets and Blankets
- BMP C130 Surface Roughening
- ~~BMP C131 Gradient Terraces~~
- 

And to intercept, slow, and re-spread runoff in temporary or permanent Channels:

- BMP C207 Check Dams,
- BMP C235 Wattles,
- BMP 201 and 202 Grass-lined and Blanket or Rock-Lined Channels, and
- ~~BMP C203 Water Bars.~~

Other BMPs of this type and BMPs primarily listed under other elements may be combined or substituted to achieve stable base in onsite conveyances. In the event that prescriptive sizing from the table in Part 4 below becomes ineffective, custom sizing was performed according to the sizing calculations contained in Appendix A of this document.

Check weekly for adequate control of erosion between placements. Sediment retained behind these velocity resistors shall be removed before the accumulated depth exceeds ½ the depth of the device.

#### ELEMENT 4: INSTALL SEDIMENT CONTROLS

Design of Construction Sediment Control was performed in accordance with 2015 SWMMWW Vol II BMP C240 to minimize erosion and avoid discharge of sediment offsite or into onsite sensitive areas.

Sediment controls will be needed for soil stockpiles, at the edges of disturbance, and along the upstream side of interceptor/infiltration ~~or dispersion~~ trenches that are near to upslope disturbances.

Where safe and practical, trench spoils will be placed uphill, or for infiltration or dispersion trenches, removed. Also use:

- ~~BMP C231 Brush Barrier (if brush harvestable onsite or nearby)~~
- BMP C232 Gravel Filter Berm
- BMP C233 Silt Fence
- BMP C234 Vegetated Strip (where available on the east side).
- BMP C235 Wattles placed at the downstream edges of disturbance
- BMPC 251 Construction Stormwater Filtration

These BMPs are not intended to act as a barrier to flows. Check uphill sides for signs of clogging or sediment accumulations more than 1/3 the height of the device. If this occurs, remove the sediment, add another parallel BMP, or replace.

Due to the area of disturbance, to prepare for the event that construction occurs during wet weather and the above do not adequately control sediment, also use:

- BMP C240 Sediment Trap(s)

There are several published approximations available for addressing the needs of sub basins as construction progresses. Sizing of the sediment traps may enlarge a trap above the minimum size shown on the standard drawings. The surface area of the trap is 2080 SF per CFS of inflow from a 2-year runoff event. The 2- year event runoff from either the continuous modelling software or the Rational Method is used to size sediment settling, divided over multiple traps so that each portion of the excavation being worked had a trap before the temporary discharge point. The excavation area is modelled as ½ lawn and ½ impervious to simulate bare soil.

Because this is an extensive site, a larger unit is also selected:

- BMP C241 Temporary Sediment Pond

*(See Form C for sizing)*

*The Temporary Sediment pond has at least a 3:1 length to width ratio. If insufficient, add temporary filter fabric or bale baffles in increase sinuosity to between 3:1 and 6:1*

***The proposed plan is intended as guidance and the Contractor shall be responsible for implementing and maintaining appropriate sediment controls based on changing site conditions.***

## ELEMENT 5: STABILIZE SOILS

All exposed and unworked soils shall be stabilized by application of effective BMPs that protect the soil from the erosive forces of raindrop impact and flowing water, and wind erosion. From October 1 through April 30, no soils shall remain exposed and unworked for more than 2 days. From May 1 to September 30, no soils shall remain exposed and unworked for more than 7 days. Soils shall be stabilized at the end of the shift before a holiday or weekend if needed based on the weather forecast. This applies to all soils on site, whether at final grade or not.

Stabilizing soils will be a key to constructing wet season grading and drainage. A wide selection of stabilization BMPs is proposed in order to meet the varied needs of cut and fill slopes, stockpiles, and surfaces brought near grade but not yet paved, including, but not limited to:

- BMP C120 Temporary and Permanent Seeding
- BMP C121 Mulching
- BMP C122 Nets and Blankets
- BMP C123 Plastic Covering
- BMP C124 Sodding
- BMP C125 Topsoiling/Composting
- BMP C126 Polyacrylamide (PAM) for Soil Erosion Protection
- BMP C130 Surface Roughening
- ~~BMP C 131 Gradient Terraces~~
- BMO C140 Dust Control

All of these BMPs require good contact with the ground and prompt repair of areas that are damaged. Check for rills and re-grade to avoid gully formation.

***The proposed sediment control details and notes are provided on Sheets C3 through C4 of the Plan set.***

## ELEMENT 6: PROTECT SLOPES

This project includes trenching and temporary cuts for foundations that will need protection from erosion during rainfall and storm events. The site soils will erode before stabilization is achieved, so it is important to divert runoff away from slopes with permanent or temporary interceptors.

In addition to the BMPs listed in elements above, if run-on begins to occur, apply above the slope as needed:

- ~~BMP C200 Interceptor Dike and Swale~~
- BMP C205 Subsurface Drains
- BMP C206 Level Spreader
- BMP C 207 Check Dams
- BMP C208 Triangular Silt Dike to prevent gully formation or other erosion of the constructed slopes.

Direct the flow line of these features at grades of .5 to 1% to an outfall above a permanently stabilized vegetated strip or facility which can safely contain the stormwater.

Check outlets and make timely repairs to avoid gully formation. When the area below the diversion is permanently stabilized, remove the BMP and blend the channel with the natural surface.

Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.

~~-Not expected-~~ Revision V4

### **ELEMENT 7: PROTECT DRAIN INLETS**

Provide protection for all storm drain inlets within or down slope of construction until permanent stabilization is achieved. For inlets that are in operation before permanent stabilization of the disturbed drainage area, apply:

- BMP C220 Storm Drain Inlet Protection (any of multiple configurations)

Check inlet protection filters at least weekly and after storm events. Clean or replace clogged inserts or exterior filters. Take care not to wash sediment into storm drains while cleaning but spread removed material evenly over the surrounding land or move to a stockpile and stabilize as appropriate.

#### ***Protection needed at onsite inlets, existing and proposed***

### **ELEMENT 8: STABILIZE CHANNELS AND OUTLETS**

All temporary onsite conveyance channels shall be designed, constructed and stabilized to prevent erosion from the peak 10-minute flow velocity from a Type 1A 10-year 24-hour frequency storm for the developed condition, or alternate method as detailed in the SWMMWW procedure in Vol II Section 3.3.3. Element 8.

Stabilization, including riprap armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches is already provided at the outlet of the conveyance system.

In the event that temporary or permanent channels shows signs of erosion, stabilize with:

- BMP C202 Blanket-lined or Rock-Lined Channels
- ~~BMP C203 Water Bars~~
- ~~BMP C204 Pipe Slope Drains~~
- BMP C205 Subsurface Drains
- BMP C206 Level Spreader
- BMP C207 Check Dams and
- BMP C 208 Triangular Silt Dike (geotextile encased)
- BMP C209 Outlet Protection.

Check on any Channel Stabilization features for inadequate performance, such as erosion at the sides, or sediment accumulation during and after each runoff producing rainfall. If significant erosion occurs between check dams, install a protective liner on that portion of the channel. Remove sediment before it exceeds  $\frac{1}{2}$  the depth of the backwater/sump.

### **ELEMENT 9: CONTROL POLLUTANTS**

All pollutants, including waste materials and demolition debris, that occur on-site shall be handled and disposed of in a manner that does not cause contamination of stormwater. See the Source Control section of the Drainage Report for more information. A copy of the permitted and prohibited discharges list is appended to this report for convenience. Use:

- BMP C151 Concrete Handling
- BMP C153 Material Delivery, Storage and Containment

to prevent pollution from concrete foundation wash waters, petroleum products, detergents, soil stabilizers, fertilizers, asphalt compounds, or paints in the event that they are stored on the project site. Such items stored in their usual and accustomed places in the buildings and places outside the construction area are not subject to these construction provisions.

Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).

Keep material storage areas clean, organized, and supplied with appropriate spill cleanup materials or kits. Further provisions may be necessary for liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117 of 302. In the unlikely event that these are part of the project site, add to the inspection log document the selection of proper storage, secondary containment, adequate spacing, and other items listed in the BMP.

Maintenance and repair of heavy equipment and vehicles, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures, such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Report all spills to 911. Emergency repairs may be performed onsite using temporary plastic placed beneath and, if raining, over the vehicle.

Concrete work and other high pH components need appropriate protections, use where needed:

- BMP C152 Sawcutting and Surfacing Pollution Protection
- BMP C154 Concrete Washout Areas
- ~~BMP C250 Construction Stormwater Chemical Treatment~~
- ~~BMP C251 Construction Stormwater Filtration~~
- ~~BMP C252 High pH Neuralization Using CO<sub>2</sub>~~
- ~~BMP C253 pH Control for High pH Water~~

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

If used, wheel wash, or tire bath wastewater, shall be discharged to a separate onsite treatment system or pumped and hauled to a sanitary sewer facility if allowed by the local wastewater authority.

***The Contractor shall be responsible that no wastes enter the runoff.***

### **ELEMENT 10: CONTROL DE-WATERING**

Other than gravity footing drains to relieve pressure at foundations and retaining walls, permanent dewatering not expected. In the event that permanent dewatering is needed, contact the geotechnical and civil engineers for coordination of outfall. If temporary dewatering is needed, discharge only non-turbid water to the vegetated areas of the site. Use filters to clean turbid water if necessary, including the use of:

- BMP C 236 Vegetative Filtration.
- BMP C240 Sediment Trap

Highly turbid or otherwise compromised dewatering water, such as from concrete pours or clean up, shall be handled separately from stormwater. (BMP C151 Concrete Handling)

All foundation and trench de-watering water, which has similar characteristics to stormwater runoff at the site, shall be discharged into a controlled conveyance system, prior to discharge to a sediment trap or sediment pond. Channels must be stabilized, as specified in Element #8.

~~Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of the receiving waters. These clean waters should not be routed through stormwater sediment ponds. Ongoing dewatering not expected.~~

Other disposal options, depending on site constraints, may include: 1) infiltration, 2) transport offsite in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters, 3) onsite treatment using chemical treatment or other suitable treatment technologies, or 4) sanitary sewer discharge- or 5) use of sedimentation bag with outfall to a vegetated ditch or swale for small volumes of localized dewatering.

***Significant dewatering activities are not expected during this project; however, the Contractor shall be responsible that no wastes enter the runoff.***

### **ELEMENT 11: MAINTAIN BMP'S**

The construction phase erosion and sedimentation BMPs must be maintained until the site is accepted by the jurisdiction as permanently stabilized. The BMP's and any accumulated sediments or waste then need to be removed promptly, within 30 days.

For a construction site of at least 1 acre, (this project disturbs over an acre) a:

- **BMP C160 Certified Erosion and Sediment Control Lead is prescribed**

The Owner/Contractor must identify the inspector charged with visually examining stormwater that discharges from site, if any, for:

- Suspended sediment,
- Turbidity,
- Discoloration, and
- Oil sheen.

This inspector will evaluate the effectiveness of BMPS and determine if maintenance, repair, or improvement is necessary to achieve discharge thresholds.

- BMP C150 Materials On Hand will allow efficient maintenance.

Inspect BMP implementation and maintenance and document in the site log at least once a week and within 24 hours of a precipitation event that causes a stormwater discharge from the property. In the wet season, inspect daily. Any problems shall be addressed within 10 days of the inspection.

The *TEMPORARY EROSION AND SEDIMENTATION CONTROL MAINTENANCE REQUIREMENTS* on the drawings read as follows:

1. Erosion and sedimentation control facilities shall be inspected after each storm event and daily during prolonged rainfall.
2. Necessary repairs or replacement of facilities shall be accomplished promptly.
3. Sediment deposits shall be removed after each storm event or when the level of deposition reaches approximately one-half the maximum potential depth.
4. Sediment deposits remaining in place after the ESC facilities are no longer required shall be dressed to conform to the existing grade, prepared, and seeded.
5. Temporary erosion and sedimentation control facilities shall be maintained by:   \_TBD by Contractor\_\_\_\_\_

## **ELEMENT 12: MANAGE THE PROJECT**

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.
- Schedule major earthwork during the dry season if possible.

If it is determined that the CSWPPP is ineffective in eliminating or significantly minimizing ESC problems, additional BMP measures or modifications will be necessary until the problems are

corrected. BMPs may be selected from the alternatives listed in the Volume 2 of the Stormwater Manual. Revisions shall be made within 7 days following the determination of insufficiency.

Sampling and analysis of the stormwater discharged from a construction site may be necessary on a case-by-case basis to ensure compliance with Discharge and Surface Water Standards:

- **Discharge:** Runoff leaving the construction site shall be free of settleable solids, as measured with an Imhoff Cone and in accordance with Standard Methods for the Examination of Water and Wastewater, most recent edition, American Water Works Association. "Free of settle able solids" shall be defined as measuring less than 2.5 mL/L/hr, for storms up to the water quality design event ( ~ 6-month storm).
- **Surface Water:** For storms up to the water quality design event, turbidity downstream of a construction site may not increase more than 5 NTU, if upstream turbidity is 50 NTU or less, and may not increase more than 10 percent, if upstream turbidity is over 50 NTU. To the extent practicable, samples should be taken far enough downstream so that the construction site discharge has been well-mixed with the surface water.

Whenever inspection and/or monitoring reveals that the BMP's identified in the Construction SWPPP are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, appropriate BMP's or design changes shall be implemented as soon as possible.

In addition to conducting and documenting the daily, weekly, after rainfall and monthly inspections, rainfall-responsive scheduling can reduce the effort necessary to achieve erosion and sedimentation control.

- **BMP C162 Scheduling**

provides for managing the land-disturbing activities by micro scheduling grading to reduce the amount and duration of soil exposed, especially during rainy periods. Small portions of the site may be cleared, brought to grade, and stabilized before clearing the next section.

Per the DOE, the following activities are exempt from the seasonal clearing and grading limitations:

- Routine maintenance and necessary repair of erosion and sediment control BMP's;
- Routine maintenance of public facilities or existing utility structures that do not (a) expose the soil or (b) result in the removal of the soil's vegetative cover; and
- Self-contained project sites, where there is complete infiltration of the water quality design event runoff within the site.

### **ELEMENT 13: PROTECT LOW IMPACT DEVELOPMENT BMPS**

Construct clog-able portions of any Treatment BMPs such as infiltration, dispersion, and filters after the contributing area receives permanent stabilization treatments.

Clean and remove temporary sediment accumulations from CBs and diversion sumps prior to allowing discharge to the surface dispersion pipes.

If discharge of sediment-laden water to vegetation is used as a protection, re-spread sediment before it accumulates to the degree that it smothers the vegetation.

#### 4. Section 4 - Construction Schedule & Phasing

Construction is expected to begin shortly after permits are obtained. To aid in management of reliable construction, the proponent intends to retain a contractor both experienced and familiar with the area and the soils. A contractor based close to the project site will allow site work scheduling to accommodate the weather patterns as much as practical.

For more specifics on the CSWPPP schedule, the following notes from the TESC drawings are shown on the drawings.

##### CONSTRUCTION SEQUENCE:

1. HOLD A PRECONSTRUCTION MEETING WITH THE CITY OF PUYALLUP AND OBTAIN REQUIRED PERMITS.
2. ESTABLISH CLEARING AND GRADING LIMITS.
3. CONSTRUCT TEMPORARY CONSTRUCTION ENTRANCE.
4. CONSTRUCT PERIMETER DITCHES, SILT FENCES, AND OTHER EROSION AND CONTROL DEVICES AS SHOWN ON THE PLAN.
5. CONSTRUCT PROTECTION DEVICES FOR CRITICAL AREAS AND SIGNIFICANT TREES PROPOSED FOR RETENTION.
6. SCHEDULE AN EROSION CONTROL INSPECTION WITH THE CITY OF PUYALLUP.
7. GRADING ACTIVITIES MAY ONLY COMMENCE AFTER ALL DRAINAGE AND EROSION CONTROL MEASURES ARE IN PLACE PER THE APPROVED PLAN.
8. IDENTIFY EROSION CONTROL MEASURES WHICH REQUIRE REGULAR MAINTENANCE.
9. EROSION AND SEDIMENT CONTROLS MAY ONLY BE REMOVED ONCE THE SITE IS STABILIZED TO THE CITY OF PUYALLUP SITE INSPECSTOR'S SATISFACTION.

The project shall be phased where feasible to accomplish soil-exposing activities in the dry season. This project has limited activities –grading, connecting utilities, paving, constructing the building improvements and landscaping, that are expected to occur without interruption.

Grading and Drainage during the wet season requires greater vigilance in erosion and sedimentation control. Manage the land-disturbing activities by micro scheduling grading to reduce the amount and duration of soil exposed, especially during rainy periods.

The building foundation portion of the site is expected to be cleared, set to grade, and stabilized with foundation concrete early in the schedule. Backfill for final grade around the building will occur later. And topsoil and plantings near the end of the project in an advantageous weather window for planting.

Transport of sediment from the construction site will be prevented by directing the discharge from the excavation into sediment control features.

In addition to conducting and documenting the daily, weekly, after rainfall and monthly inspections, rainfall-responsive scheduling can reduce the effort necessary to achieve erosion and sedimentation control.

## Section 5 – Pollution Prevention

The names of the proponent contact, construction emergency contact and onsite temporary erosion and sedimentation control personnel are recorded on the front cover of this document.

During construction, when erosion and sedimentation pollution are at elevated potential, the primary goal is TESC. A certified CESCL is mandated for sites disturbing more than 1 acre.

After stabilization, the prevention of stormwater pollution from the operations and maintenance of the business become important. This is addressed in the Operations, Maintenance, and Source Control report.

## Section 6 – Inspections and Monitoring

All BMPs must be inspected, maintained and repaired as needed to assure continue performance of their intended function. Site inspection shall occur in all areas disturbed by construction activities and at any stormwater discharge point. During inspections, the Contractor shall evaluate and document the effectiveness of the installed BMPs and determine if it is necessary to repair or replace any of the BMPs to improve the quality of stormwater discharges.

All maintenance and repairs shall be documented in the site log. All new BMPs or design changes shall be documented in the SWPPP as soon as possible.

If a project is less than 1 acre and does not discharge to an impaired water body, regular stormwater sampling and reporting to Ecology under the NPDES general construction permit is not triggered.

### **EROSION CONTROL LEAD**

The owner shall identify an Erosion and Sediment Control Lead in the Construction SWPPP and that individual shall be onsite or on call at all times. If a preconstruction meeting is held, this person shall attend. For sites disturbing 1 acre or more, that lead must be a Certified Lead.

Duties and responsibilities of the Lead 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/weekly logs, and inspection reports. Inspection reports should include:
  - Inspection locations, dates and times.
  - Weather information, including conditions during the inspection and recent rainfall events.
  - A summary list of BMPs implemented, including field observations. The list should include the following:

- List of all BMPs in place on the project site
  - BMPs inspected
  - BMPs needing maintenance
  - BMPs failed and needing replacement
  - Recommended replacements or other actions
  - Visual observations or water quality monitoring conducted
  - Monitoring results
  - Comments and notes
- Facilitate, participate in, and take corrective actions resulting from inspections performed by outside agencies or the owner.

***Keep the contact information up to date if the role is assigned to another. If a pre-construction meeting is held, this person shall attend.***

For convenience, inspection report forms follow, and may be reproduced without limitation. A table summarizing how and when to report on the various conditions observed follows the forms.

## **Section 7 – Record Keeping**

The inspection forms may be kept with this document or in a separate log that is also maintained on site or within reasonable access to the site and made available for viewing upon request to jurisdictional personnel. If requested by a jurisdictional agency in writing, a copy of the records shall be submitted within 14 days.

### ***3-year Records Retention Schedule***

The records created as part of implementing and inspecting the CSWPPP shall be retained by the Contractor during the life of the construction project and for at least 3 years following permit coverage. Records may be transferred to Owner following determination of permanent stabilization and BMP removal.

### **Conclusion - Manage the Project**

Erosion and sediment control BMPs for this project have been designed based on the following principles:

- Fit the existing topography, soils, and drainage patterns.
- Emphasize erosion control rather than sediment control.
- Minimize the extent and duration of the area exposed.
- Keep runoff velocities low.
- Retain sediment on site.
- Thoroughly monitor site and maintain all ESC measures.
- Schedule major earthwork during the dry season if possible.

If it is determined that the CSWPPP is ineffective in eliminating or significantly minimizing ESC problems, additional BMP measures or modifications will be necessary until the problems are corrected. BMPs may be selected from the alternatives listed in the SWMMWW. Revisions shall be made within 10 days following the determination of insufficiency.

### Form A -Sample Site Inspection Form

From <http://www.ecy.wa.gov/programs/wq/stormwater/construction/>

Project Name \_\_\_\_\_ Permit # \_\_\_\_\_ Inspection Date \_\_\_\_\_ Time \_\_\_\_\_

Name of Certified Erosion Sediment Control Lead (CESCL) or qualified inspector if *less than one acre*

Print Name: \_\_\_\_\_

Approximate rainfall amount since the last inspection (in inches): \_\_\_\_\_

Approximate rainfall amount in the last 24 hours (in inches): \_\_\_\_\_

Current Weather  Clear  Cloudy  Mist  Rain  Wind  Fog

A. Type of inspection:  Weekly  Post Storm Event  Other

**B. Phase of Active Construction (check all that apply):**

Pre Construction/installation of erosion/sediment controls	<input type="checkbox"/>	Clearing/Demo/Grading	<input type="checkbox"/>	Infrastructure/storm/roads	<input type="checkbox"/>
Concrete pours	<input type="checkbox"/>	Vertical Construction/buildings	<input type="checkbox"/>	Utilities	<input type="checkbox"/>
Offsite improvements	<input type="checkbox"/>	Site temporary stabilized	<input type="checkbox"/>	Final stabilization	<input type="checkbox"/>

**C. Questions:**

1. Were all areas of construction and discharge points inspected? Yes  No
2. Did you observe the presence of suspended sediment, turbidity, discoloration, or oil sheen? Yes  No
3. Was a water quality sample taken during inspection? (refer to permit conditions S4 & S5) Yes  No
4. Was there a turbid discharge 250 NTU or greater, or Transparency 6 cm or less? Yes  No
5. If yes to #4 was it reported to Ecology? Yes  No
6. Is pH sampling required? pH range required is 6.5 to 8.5. Yes  No

**If answering yes to a discharge, describe the event. Include when, where, and why it happened; what action was taken, and when.**

### Form B – BMP Site Inspection

#### **Form B –BMP Site Inspection Form**

Copy this form as needed. Mark N for Not functioning, I for Improvement needed, and P for Performing. This form adapted from the Ecology SWPPP Template.

#### **Inspection of BMPs**

##### **Element 1: Mark Clearing Limits**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

##### **Element 2: Establish Construction Access**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

##### **Element 3: Control Flow Rates**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 4: Install Sediment Controls**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 5: Stabilize Soils**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	


BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 6: Protect Slopes**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 7: Protect Drain Inlets**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 8: Stabilize Channels and Outlets**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 9: Control Pollutants**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 10: Control Dewatering**

BMP:

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 11: Maintain BMPS**

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

**Element 12: Manage the Project**

Location	Inspected		Functioning			Problem/Corrective Action
	Y	N	Y	N	NIP	

## Form C – Sediment Pond Sizing

Sediment Pond Sizing.22.03.26.xlsx

### Import or Calculate Design Inflow Rates

Use returns from MGSFLOOD, skip to next section

If Hydrologic Modelling not required, Use Rational Method

$$Q = CIA$$

Where:

Q is design inflow rate, approximating Cubic feet per second

C is a coefficient selected to represent the land surface condition

I is the rainfall intensity in inches per hour.

A is the area of the basin in acres

Use 2 yr unless 10 yr warranted.

Select 0.5 for dense residential.

See Mapped Intensities.

Calculate from design drawings.

Location	Condition	Event	C coeff	I in/hr	A acres	Q quantity
Pond 1	BareSoil	2 yr	0.5		0	0.0
	Bare soil	10yr	0.5		0	0.0

### Sediment Pond Surface Area Size Calculation and/or Verification Check

Use Published algorithm to calculate required size, and/or check against available size

$$SA = 2 * Q/Vs$$

Where:

SA is Surface Area in square feet

Q is inflow rate in Cubic Feet per Second From above

Vs is Velocity of Settling, for silts, listed at 0.00096 feet per second

Location	Event	Q	SA reqd sf	if verifying, enter pond surface area *			Result
				23	70	1,610	
Pond 1	2 yr	0.8	1,604	23	70	1,610	OK
Pond 1	10 yr	1.3	2,750	30	92	2,760	OK

\* If length/width not at least 3:1, add temporary sinuousation baffles to achieve ratio

### Sediment Pond Dimension Calculation and/or Verification Check

Cells Return Calculated SF at ration for entered width

$$SA \text{ reqd} / \text{width} = \text{length}$$

Where:

Enter value, Minimum width is 7 feet per manual

Acceptable length to width is between 3:1 and 6:1

Location	2 yr		ENTER				Length to Width Ratio			
	SA reqd s	Width >7	3	4	5	6	3	4	5	6
Trap 1	-	30	90	120	150	180				
	AREA PRODUCED	Compare to reqd area and iterate until sufficient	2,700	3,600	4,500	5,400				

#### 3.2.18.4 Maintenance Standards

- Remove sediment from the trap when it reaches 1-foot in depth.
- Repair any damage to the pond embankments or slopes.

Sediment Pond Sizing.22.03.26.xlsx

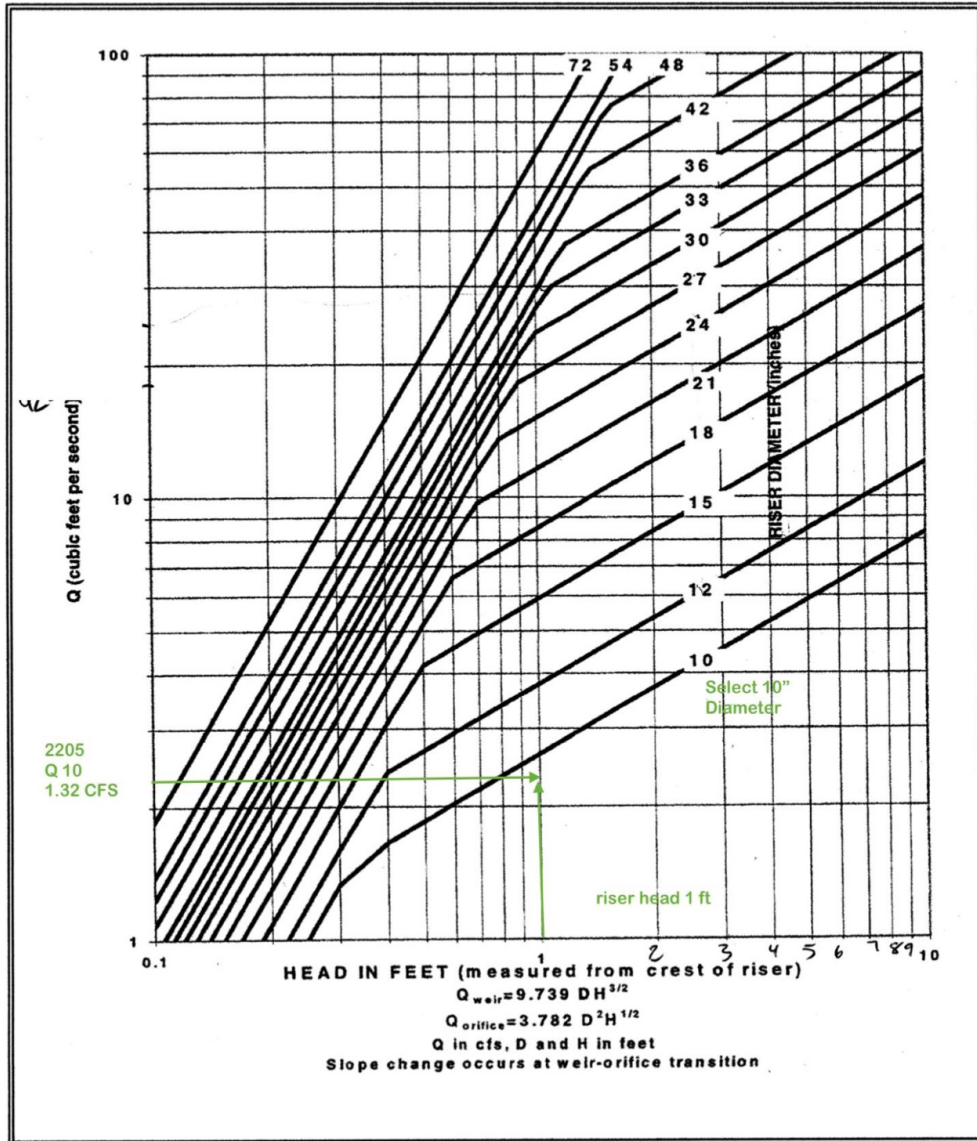


Figure 4.2.21 – Riser Inflow Curves

## MGS FLOOD PROJECT REPORT

**Program Version: MGSFlood 4.55**  
**Program License Number: 201910004**  
**Project Simulation Performed on: 03/29/2022 8:11 PM**  
**Report Generation Date: 03/29/2022 8:13 PM**

Input File Name: 2205.MGS.3.29.ESC.fld  
 Project Name: 2205 CCS Track  
 Analysis Title: ESC Sizing  
 Comments: Half grass Half impervious to approximate bare subgrade

### PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected  
 Climatic Region Number: 15

Full Period of Record Available used for Routing  
 Precipitation Station : 96004005 Puget East 40 in\_5min 10/01/1939-10/01/2097  
 Evaporation Station : 961040 Puget East 40 in MAP  
 Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1  
 HSPF Parameter Region Name : USGS Default

\*\*\*\*\* Default HSPF Parameters Used (Not Modified by User) \*\*\*\*\*

### \*\*\*\*\* WATERSHED DEFINITION \*\*\*\*\*

#### Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	4.252	4.241
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	4.252	4.241

#### -----SCENARIO: PREDEVELOPED

Number of Subbasins: 2

----- Subbasin : Track & Field -----

-----Area (Acres) -----

Till Grass 1.500  
 Impervious 1.502

-----  
 Subbasin Total 3.002

----- Subbasin : Around T&F -----

-----Area (Acres) -----

Till Forest 0.400  
 Till Grass 0.850

-----  
 Subbasin Total 1.250

#### -----SCENARIO: POSTDEVELOPED

Number of Subbasins: 4

----- Subbasin : Rubberized Track-1.01,GrassEnd Zone-0.51 -----

-----Area (Acres) -----

Till Grass 0.750  
 Impervious 0.752

-----

Subbasin Total 1.502

----- Subbasin : New Field Turf-2. -----

-----Area (Acres) -----

Till Grass 1.100  
 Impervious 1.100

-----  
 Subbasin Total 2.200

----- Subbasin : Paved High Jump-0.24 -----

-----Area (Acres) -----

Till Grass 0.120  
 Impervious 0.120

-----  
 Subbasin Total 0.240

----- Subbasin : Concessions, walk and seating-0.299 -----

-----Area (Acres) -----

Till Grass 0.149  
 Impervious 0.150

-----  
 Subbasin Total 0.299

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 1

-----  
**Link Name: Copy of New Structure Lnk2**

Link Type: Structure  
 Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft) : 57.00  
 Riser Crest Elevation (ft) : 60.00  
 Max Pond Elevation (ft) : 61.00  
 Storage Depth (ft) : 3.00  
 Pond Bottom Length (ft) : 190.0  
 Pond Bottom Width (ft) : 135.0  
 Pond Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00  
 Bottom Area (sq-ft) : 25650.  
 Area at Riser Crest El (sq-ft) : 31,824.  
 (acres) : 0.731  
 Volume at Riser Crest (cu-ft) : 86,049.  
 (ac-ft) : 1.975  
 Area at Max Elevation (sq-ft) : 34026.  
 (acres) : 0.781  
 Vol at Max Elevation (cu-ft) : 118,968.  
 (ac-ft) : 2.731

Hydraulic Conductivity (in/hr) : 0.01  
 Massmann Regression Used to Estimate Hydralic Gradient  
 Depth to Water Table (ft) : 5.00  
 Bio-Fouling Potential : Low  
 Maintenance : Average or Better

Riser Geometry

Riser Structure Type : Circular  
 Riser Diameter (in) : 18.00  
 Common Length (ft) : 0.000  
 Riser Crest Elevation : 60.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---  
 Device Type : Circular Orifice  
 Control Elevation (ft) : 57.00  
 Diameter (in) : 5.89  
 Orientation : Horizontal  
 Elbow : Yes

---Device Number 2 ---  
 Device Type : Circular Orifice  
 Control Elevation (ft) : 58.50  
 Diameter (in) : 8.00  
 Orientation : Horizontal  
 Elbow : Yes

\*\*\*\*\* LINK DATA \*\*\*\*\*

-----SCENARIO: POSTDEVELOPED

Number of Links: 3

-----  
**Link Name: Sediment Pond**

Link Type: Structure  
 Downstream Link: None

Prismatic Pond Option Used  
 Pond Floor Elevation (ft) : 58.00  
 Riser Crest Elevation (ft) : 62.00  
 Max Pond Elevation (ft) : 62.50  
 Storage Depth (ft) : 4.00  
 Pond Bottom Length (ft) : 93.0  
 Pond Bottom Width (ft) : 30.0  
 Pond Side Slopes (ft/ft) : L1= 0.01 L2= 0.01 W1= 0.01 W2= 0.01  
 Bottom Area (sq-ft) : 2790.  
 Area at Riser Crest El (sq-ft) : 2,800.  
 (acres) : 0.064  
 Volume at Riser Crest (cu-ft) : 11,180.  
 (ac-ft) : 0.257  
 Area at Max Elevation (sq-ft) : 2801.  
 (acres) : 0.064  
 Vol at Max Elevation (cu-ft) : 12,580.  
 (ac-ft) : 0.289

Hydraulic Conductivity (in/hr) : 0.01  
 Massmann Regression Used to Estimate Hydraulic Gradient  
 Depth to Water Table (ft) : 5.00  
 Bio-Fouling Potential : Low  
 Maintenance : Average or Better

Riser Geometry  
 Riser Structure Type : Circular  
 Riser Diameter (in) : 10.00  
 Common Length (ft) : 0.390  
 Riser Crest Elevation : 62.00 ft

Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1 ---  
 Device Type : Circular Orifice  
 Control Elevation (ft) : 58.00  
 Diameter (in) : 10.00  
 Orientation : Horizontal  
 Elbow : No

**Link Name: 10" Sideline pipes as rectangle**

Link Type: Structure

Downstream Link Name: Sediment Pond

## Prismatic Pond Option Used

Pond Floor Elevation (ft) : 100.00  
 Riser Crest Elevation (ft) : 101.83  
 Max Pond Elevation (ft) : 102.83  
 Storage Depth (ft) : 1.83  
 Pond Bottom Length (ft) : 770.0  
 Pond Bottom Width (ft) : 0.7  
 Pond Side Slopes (ft/ft) : L1= 0.01 L2= 0.01 W1= 0.01 W2= 0.00  
 Bottom Area (sq-ft) : 508.  
 Area at Riser Crest El (sq-ft) : 522.  
                                   (acres) : 0.012  
 Volume at Riser Crest (cu-ft) : 943.  
                                   (ac-ft) : 0.022  
 Area at Max Elevation (sq-ft) : 530.  
                                   (acres) : 0.012  
 Vol at Max Elevation (cu-ft) : 1,469.  
                                   (ac-ft) : 0.034

Hydraulic Conductivity (in/hr) : 0.01  
 Massmann Regression Used to Estimate Hydraulic Gradient  
 Depth to Water Table (ft) : 7.00  
 Bio-Fouling Potential : Low  
 Maintenance : Average or Better

## Riser Geometry

Riser Structure Type : Circular  
 Riser Diameter (in) : 10.00  
 Common Length (ft) : 0.000  
 Riser Crest Elevation : 101.83 ft

## Hydraulic Structure Geometry

Number of Devices: 1

---Device Number 1---

Device Type : Circular Orifice  
 Control Elevation (ft) : 100.00  
 Diameter (in) : 4.00  
 Orientation : Horizontal  
 Elbow : Yes

**Link Name: Sideline Infil Trench**

Link Type: Infiltration Trench

Downstream Link: None

Trench Type : Trench at Toe of Embankment  
 Trench Length (ft) : 384.00  
 Trench Width (ft) : 20.00  
 Trench Depth (ft) : 2.00  
 Trench Bottom Elev (ft) : 100.00  
 Trench Rockfill Porosity (%) : 30.00

Hydraulic Conductivity (in/hr) : 0.10  
 Massmann Regression Used to Estimate Hydraulic Gradient  
 Depth to Water Table (ft) : 5.00  
 Bio-Fouling Potential : Low  
 Maintenance : Average or Better

\*\*\*\*\*FLOOD FREQUENCY AND DURATION STATISTICS\*\*\*\*\*

## -----SCENARIO: PREDEVELOPED

Number of Subbasins: 2

Number of Links: 1

\*\*\*\*\* Link: Copy of New Structure Lnk2 \*\*\*\*\* Link WSEL Stats

WSEL Frequency Data(ft)  
(Recurrence Interval Computed Using Gringorten Plotting Position)  
Tr (yrs) WSEL Peak (ft)

```
=====
```

1.05-Year	57.051
1.11-Year	57.060
1.25-Year	57.070
2.00-Year	57.099
3.33-Year	57.130
5-Year	57.160
10-Year	57.206
25-Year	57.293
50-Year	57.316
100-Year	57.401

-----SCENARIO: POSTDEVELOPED

Number of Subbasins: 4  
Number of Links: 3

\*\*\*\*\* Link: Sediment Pond \*\*\*\*\* Link WSEL Stats

WSEL Frequency Data(ft)  
(Recurrence Interval Computed Using Gringorten Plotting Position)  
Tr (yrs) WSEL Peak (ft)

```
=====
```

1.05-Year	58.025
1.11-Year	58.029
1.25-Year	58.036
2.00-Year	58.070
3.33-Year	58.120
5-Year	58.142
10-Year	58.222
25-Year	58.385
50-Year	58.514
100-Year	58.662

\*\*\*\*\*Groundwater Recharge Summary \*\*\*\*\*

Recharge is computed as input to PerInd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Track & Field	183.316
Subbasin: Around T&F	172.851
Link: Copy of New Structur	2.732
<b>Total:</b>	<b>358.898</b>

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Rubberized Track-1.091.658	
Subbasin: New Field Turf-2.	134.432
Subbasin: Paved High Jump-0.24	14.665
Subbasin: Concessions, walk an	18.209
Link: Sediment Pond	0.125
Link: 10" Sideline pipes a	Not Computed
Link: Sideline Infiltration	Not Computed
<b>Total:</b>	<b>259.089</b>

**Total Predevelopment Recharge is Greater than Post Developed Average Recharge Per Year, (Number of Years= 158)**  
**Predeveloped: 2.272 ac-ft/year, Post Developed: 1.640 ac-ft/year**

\*\*\*\*\*Water Quality Facility Data \*\*\*\*\*

-----SCENARIO: PREDEVELOPED

Number of Links: 1

\*\*\*\*\* Link: Copy of New Structure Lnk2 \*\*\*\*\*

Infiltration/Filtration Statistics-----  
 Inflow Volume (ac-ft): 1182.37  
 Inflow Volume Including PPT-Evap (ac-ft): 1182.37  
 Total Runoff Infiltrated (ac-ft): 2.73, 0.23%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 1180.42  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.23%

-----SCENARIO: POSTDEVELOPED

Number of Links: 3

\*\*\*\*\* Link: Sediment Pond \*\*\*\*\*

Basic Wet Pond Volume (91% Exceedance): 11879. cu-ft  
 Computed Large Wet Pond Volume, 1.5\*Basic Volume: 17818. cu-ft

Infiltration/Filtration Statistics-----  
 Inflow Volume (ac-ft): 1377.42  
 Inflow Volume Including PPT-Evap (ac-ft): 1377.42  
 Total Runoff Infiltrated (ac-ft): 0.12, 0.01%  
 Total Runoff Filtered (ac-ft): 0.00, 0.00%  
 Primary Outflow To Downstream System (ac-ft): 1378.22  
 Secondary Outflow To Downstream System (ac-ft): 0.00  
 Volume Lost to ET (ac-ft): 0.00  
 Percent Treated (Infiltrated+Filtered+ET)/Total Volume: 0.01%

\*\*\*\*\*Compliance Point Results \*\*\*\*\*

Scenario Predeveloped Compliance Link: Copy of New Structure Lnk2  
 Scenario Postdeveloped Compliance Link: Sediment Pond

\*\*\* Point of Compliance Flow Frequency Data \*\*\*  
 Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.772	2-Year	0.707
5-Year	1.026	5-Year	1.004
10-Year	1.322	10-Year	1.255
25-Year	1.779	25-Year	1.654
50-Year	2.352	50-Year	1.910
100-Year	2.747	100-Year	2.170
200-Year	2.850	200-Year	2.281
500-Year	2.976	500-Year	2.424

\*\* Record too Short to Compute Peak Discharge for These Recurrence Intervals

\*\*\*\* Flow Duration Performance \*\*\*\*

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%): 127.0% FAIL  
 Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): 127.0% FAIL  
 Maximum Excursion from Q2 to Q50 (Must be less than 10%): 42.1% FAIL  
 Percent Excursion from Q2 to Q50 (Must be less than 50%): 59.1% FAIL

-----  
 FLOW DURATION DESIGN CRITERIA: FAIL

---

**\*\*\*\* LID Duration Performance \*\*\*\***

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	24.6%	FAIL
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	145.6%	FAIL

---

LID DURATION DESIGN CRITERIA: FAIL

---

End of CSWPPP document.

Page inserted for duplex print spacing.

## **Appendix C: O&M – OPERATIONS, MAINTENANCE & SOURCE CONTROL MANUAL**

### **Retention Requirement**

*A copy of this Manual shall be retained onsite or within reasonable access to the site, and shall be transferred with the property to the new owner. To facilitate retention and transmission, this document is published as a stand-alone text titled Operations, Maintenance, and Source Control Manual.*

*A log of maintenance activity that indicate what actions were taken shall also be kept and be available for inspection.*

**Track and Field Improvements**  
**815 21st ST SE**  
**Puyallup, WA 98372**  
**Parcel #: 0420352148**  
**Owner: Cascade Christian Schools**

**Stormwater Operations, Maintenance  
& Source Control Manual**

Stormwater Owner’s designated Facility Manager:

\_\_\_\_\_

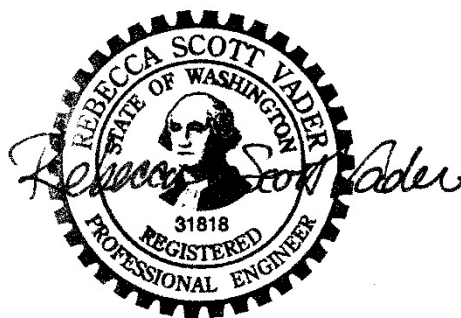
Address: \_\_\_\_\_

\_\_\_\_\_

Phone Cell: \_\_\_\_\_

Email: \_\_\_\_\_

Permit # PRCCP 20220589



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## Introduction to Maintenance and Source Control Manuals

This Stormwater Operations, Maintenance, and Source Control Manual is a required element of the overall Stormwater Drainage Narrative submitted as supporting documentation for permits required by the jurisdiction for the construction of the proposed Project, and as an aid and a reference to the property owner and future facility manager. The manual and appendices contain forms, checklists, and other aids for use after construction and throughout the operations period.

To keep stormwater quality intact and infrastructure in good condition, new projects use both Operational and Source Control Best Management Practices (BMPs) to preclude damage to the stormwater systems and Maintenance practices to preserve the function of the stormwater components. Routine, scheduled maintenance extends the time between major repairs or replacements.

This manual describes what maintenance conditions to check for, and how often to check, for the various facilities that make up the stormwater system on this site. Private facility owners are responsible for ensuring that their stormwater facilities are maintained and continue to function as designed. Maintenance may be done in-house, by a maintenance contractor, or a mix of parties.

Stormwater management facilities are most effective coupled with good operations procedures. Good operations, such as educating facility users of proper storage and disposal of chemicals and potential pollutants, procedures for spill cleanup, proper use of fertilizers and other vegetation management products, and maintenance of equipment to prevent release of pollutants to the stormwater system, are termed Source Control BMPs.

Source control BMPs are addressed for the expected activities on the site. If the use of the site changes, the selection of source controls will need to be updated to match.

This is completed using the format set forth in Volume V of the *2012 Department of Ecology (DOE) Stormwater Management Manual for Western Washington*, as adopted and amended by the City of Puyallup. Maintenance checklists are from *City of Puyallup Site Management Plan for Stormwater Operations and Maintenance (SMP)*, unless otherwise noted.<sup>Revision V4.</sup>

Since these reports draw heavily on reference documents, lists, and standards, in certain areas of the report, typical items may be included in the text to indicate that they were considered but ~~struck through~~ to show that they are not applicable to this project. Correspondingly, lists may also have underlined or **Bold** text to indicated selected items.

## 1. Maintenance Importance and Intent

Private facility owners are responsible for ensuring that their stormwater facilities are maintained and continue to function as designed. This section addresses the operations, maintenance, and source control deriving from the areas of concern constructed by the proposed project, and is intended to be a living document used by both the facility owner, the tenant/site operator, and the individuals performing the work, even if a third party.

“The importance of maintenance for the proper functioning of stormwater control facilities cannot be over-emphasized. A substantial portion of failures (clogging of filters, resuspension of sediments, loss of storage capacity, etc.) are due to inadequate maintenance. Stormwater BMP maintenance is essential to ensure that BMPs function as intended throughout their full life cycle.”

The fundamental goal of maintenance activities is to ensure the entire flow regime designed for this site continues to function as designed. For this site these include:

- Maintain ability to safely convey design stormwater flows.
- Maintain stormwater runoff quality.
- Clearly identify systems so they can be protected.
- Keep maintenance costs low.
- Prevent large-scale or expensive stormwater system failures.
- Prevent water quality violations or damage to downstream features.

The intent of this section and manual is to pass on to the responsible party(s) all the information critical to understand the design of the system, risks and considerations for proper use, suggestions for maintenance frequencies, and cost so that realistic budgets can be established.

### Annual Cost of Maintenance

Costs to maintenance the facilities vary by type, but the budgeting rule of thumb is that annual costs will be 5 to 10% of the Stormwater facility's total capital cost if provided by contractors. Once vegetation is established (where used), routine measures are estimated to have an annual cost of \$200 to \$600 per acre of facility, with the remaining costs credited toward funding eventual replacement of decayed stormwater features.

Cascade Christian Schools is expected to accomplish these duties with direct employees and may supplement with contractors from time to time to meet operational needs.

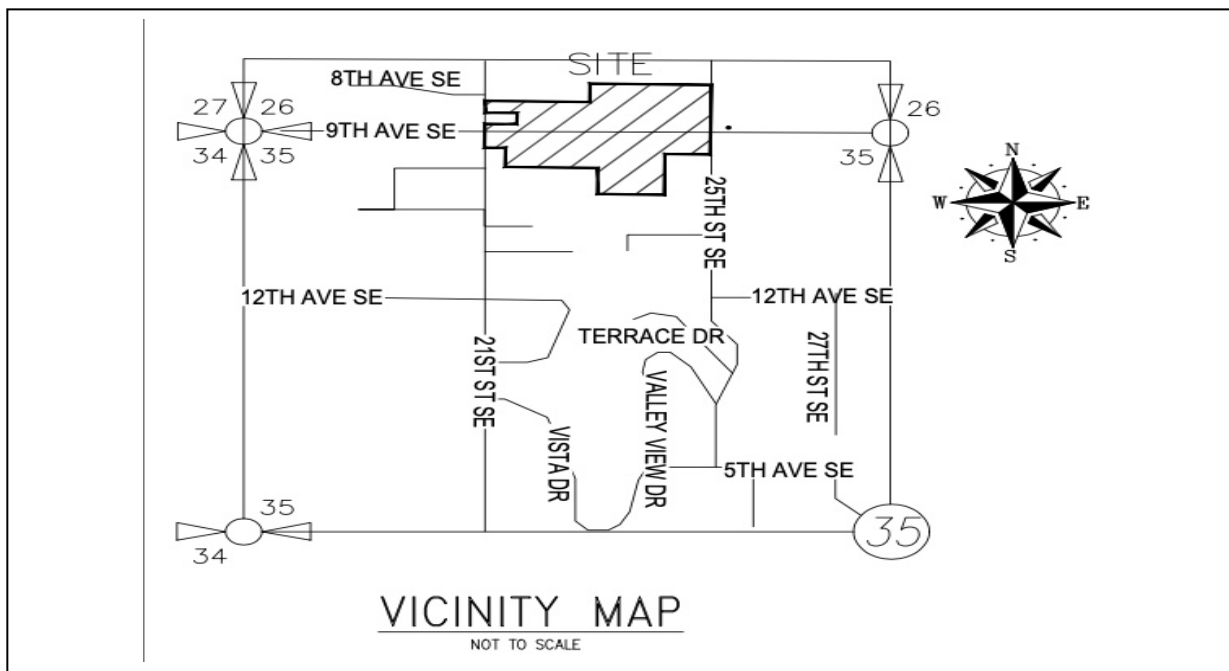
Routine, scheduled maintenance extends the time between major repairs or replacements. Most facilities have life expectancies of 25 to 50 years, with longer life spans achievable by conscientious maintenance.

## 2. Project Location and Access Description

This project is to construct a small building and parking lot. It is a stand-alone project and an addition to a completed facility.

Addresses:	815 21st ST SE, Puyallup, WA 98372
Cross Street	21 <sup>st</sup> ST SE
Directions to Facilities	Use Internal Drive aisles
Parcel Number:	0420352148
Outfall:	Infiltration in detention pond, overflow to Deer Creek

Figure 1 Vicinity Map



This project proposes to re-build a track and field on the site of the one that is smaller than athletic regulation and in need of significant maintenance, add the lighting from the master plan, and to add the adjoining seating. The existing pathways and field entrance will have minor changes for ADA access. The project area totals about 4.3 acres of a larger, developed campus. The balance of the campus that drains to distinct onsite basins will not be modified in the SW management design. No work within a ROW is proposed.

The proponent intends to provide stormwater facilities below ground for the new and replaced areas and retain the use of the existing collection system in the areas remaining unchanged. The project projects no impacts to critical areas so includes no mitigation on or adjacent to the site.

Improvements in the Right of Way are not expected, but if constructed will be maintained by the City of Puyallup and are not addressed here.

### 3. Facility Purpose and Performance Mechanisms

The following chart describes the stormwater BMPs and conveyance systems, and how these systems are designed to manage the volume, rate, and quality of stormwater runoff from the project.

**Table: BMPs and Conveyance Purposes**

<b>BMP or Conveyance</b>	<b>Volume Management</b>	<b>Rate Management</b>	<b>Quality Management</b>
<b>Soil Amendment Mulch</b>	Absorbs more precipitation than compacted or organic poor soils.	Increases time to first runoff and Decreases overall runoff volume.	Increases Biological activity – Caution, also leaches excess nutrients.
<b>Dispersion, Partial or Full</b>	Promotes evaporation and transpiration by Spreading volume over large area.	Increases time to first runoff and Decreases overall runoff volume.	Increases Biological activity—Caution, also leaches excess nutrients.
<b>Catch Basins</b>	Collects excess surface water.	None.	Settles out sediment and traps floating debris so discharge is cleaner.
<b>Pipe</b>	Carries flows to suitable discharge structure.	Pipe size and slope selected to carry volumes.	None.
<b>Detention Assembly (Pond, Vault, Pipe Array)</b>	Temporarily stores volume.	Controls release rate.	Only if wet pool is included or soils achieve quality.
<b>Treatment Assembly (filters, separators, dead storage, etc)</b>	None.	None.	Traps sediment and floating debris, filters and absorbs some dissolved elements.
<b>Pervious Pavements</b>	Absorbs Precipitation.	Increases time to first runoff and Decreases overall runoff volume.	Depends mostly on underlying native soils. Some Filtration.
<b>Infiltration Trenches Pond Drywell</b>	Absorbs precipitation.	Increases time to first runoff and Decreases overall runoff volume.	Depends mostly on underlying native soils. Some Filtration.
<b>Bioretention, Rain Gardens</b>	Absorbs precipitation.	Increases time to first runoff	Promotes biological sorption and filtration.

## 4. Description of Facilities Requiring Maintenance

A list of all stormwater structures and BMPs requiring maintenance is provided below, and shown graphically on Figure C-2 (existing) and C-3 (new on 2019 plans). All of the stormwater structures and BMPs requiring maintenance are the responsibility of the landowner.

**Table: Facilities Requiring Maintenance**

<b>BMP or Stormwater Structure</b>	<b>Purpose</b>	<b>Functions by</b>	<b>Maintenance Requirement</b>
Soil Amendment Mulch	Reduce runoff quantity and improve quality.	Gravity, storage capacity, and biological activity.	Keep Porosity and organic content high.
Roof Gutters and Downspouts Revision V4	<del>Carries flows to suitable discharge structure.</del>	<del>Gravity and channelization.</del>	<del>Keep Clean and free flowing.</del>
Catch Basins (CB) and Storm Drain Man Holes (SDMH)	Collects excess surface water, settles out sediment and traps floating debris.	Still water over sump capacity.	Keep Clean and free flowing.
Pipes	Carries flows to suitable discharge structure.	Gravity and channelization.	Keep Clean and free flowing.
Treatment	Improve water quality	Gravity, biologic action, filtration.	Keep Clean and free flowing.
<b>Infiltration Trenches</b> And/or Permeable Paving	Reduce runoff quantity and/or improve quality	<del>Gravity, storage capacity, and infiltration</del>	<del>Keep clean and retain porosity.</del>
Detention Assembly	Reduce runoff rate by storing water temporarily.	Gravity and storage capacity.	Keep clean and retain volume.

Maintenance checklists for stormwater structures and BMPs requiring maintenance are attached as a list at the end of this text.

**Table: Stormwater Additions Schedule**

<b>Stormwater Additions Schedule</b>							
Pipes – PVC SDR 35, Infiltration- Aluminized CMP ALTA2 -16 gauge, or A-2000 PVC							
<b>Designation</b>	<b>Dia.</b>	<b>Material</b>	<b>Discharge</b>	<b>From</b>	<b>To</b>	<b>Slope</b>	<b>Remarks</b>
Track Detention	Brentwood ST-36 Modules 5460 SF			Interceptor	48" outfall	N/A	-Direct connection to outfall pipe to avoid conflict with route around building.
Track & Field Interceptor Assembly	10"	A-2000 PVC or AI CMP	encircling	Under drains	Detention Modules	0.5%	Connector
SD ByPass Re-route	48"	Smooth-walled, water-tight. Shop Drawing required	Same as existing	Eastern offsite/ 25th	Western Offsite/ 21st	0.39%	84 LF and 3 additional SD MH to re-route around concession building.

Revision 1

## 5. Ownership and Responsible Parties

This section of the Maintenance and Source Control Manual identifies the party (or parties) the owner has made responsible for maintenance and operation of all stormwater structures and BMPs requiring maintenance. When the facility is in operation, keep the following up to date.

Stormwater Facility Manager:

Address:

Phone

Email:

Name of Maintenance Contractor:

Address:

Phone:

Cell:

Email:

Contact Person:

Space for Update Name of Maintenance Contractor:

Address:

Phone:

Cell:

Email:

Contact Person:

Space for Update Name of Maintenance Contractor:

Address:

Phone:

Cell:

Email:

Contact Person:

The ultimate responsibility rests with the owner:

Cascade Christian Schools

811 21st ST Se

Puyallup, WA 98372

253-606-1854

## 6. Project History

This project is a re-build and expansion of a track and field with lighting and seating. The stormwater facilities constructed under that permit are functioning and will be retained, and additional detention added. The new stormwater system will connect to the existing system, and overflows, if any, will discharge to Deer Creek. Please see the existing and new stormwater site plan figure above.

## 7. Maintenance and Inspection Plan and Instructions

This plan and instructions outline conditions for determining if maintenance actions are required, as identified through inspection. However, they are not intended to be measures of the facility's required condition at all times between inspections. Exceedance of these conditions at any time between inspections or maintenance activity does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance presented in the checklists shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

The purpose of the items in the Stormwater Structures list is to collect runoff and excess subsurface drainage and, if necessary, move it to a treatment BMP so that the acceptable quality is attained before discharge. These structures all function by gravity flow, and do not require active processes to function. Maintenance is needed to keep them clean and free-draining. Stormwater Structures on this project will consist of:

- Catch Basins,
- Conveyance Pipes,
- Detention Vault
- Track Interceptor

The purpose of items in the BMP list is to control outlet flow rates and/or to restore the water quality by removing natural sediment, deposited particles, liquid drips, and other substances from the runoff before it leaves the site. For this site, the BMPs are a mix of constructed and natural functions. They are passive and function by a combination of gravity, filtration, and microbial action. Maintenance is needed to prevent them from being overtaken by other uses. BMPs on this project will consist of:

- Existing Bioswale
- Mulch beds in soil areas

### A. Pollution Source Control Measures

Pollution source control is the application of pollution prevention practices on a developed site to reduce contamination of stormwater runoff at its source. BMPs and resource management systems are designed to reduce the amount of contaminants used, and potentially discharged to the environment, so that stormwater is of good quality.

### Potential Pollutant Generating Sources

This section of the Maintenance and Source Control Manual contains pollution source controls that are specifically applicable to the proposed uses on site.

- S411 BMPs for Landscaping and Lawn/ Vegetation Management
- S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems
- S421 BMPs for Parking and Storage of Vehicles and Equipment
- S424 BMPs for Roof/ Building Drains at Manufacturing and Commercial Buildings

## S411 BMPs for Landscaping and Lawn/ Vegetation Management

### Operational BMPS

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Do not dispose of collected vegetation into waterways or storm sewer systems.
- Conduct mulch-mowing whenever practicable.
- Dispose of grass clippings, leaves, sticks, or other collected vegetation, by composting, if feasible.
- Use mulch or other erosion control measures on soils exposed for more than one week during the dry season or two days during the rainy season.
- Store and maintain appropriate oil and chemical spill cleanup materials in readily accessible locations when using oil or other chemicals. Ensure that employees are familiar with proper spill cleanup procedures.
- Till fertilizers into the soil rather than dumping or broadcasting onto the surface. Determine the proper fertilizer application rate for the types of soil and vegetation encountered.
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Use manual and/or mechanical methods of vegetation removal rather than applying herbicides, where practical.
- Post notices and delineate the spray area prior to the application, as required by the local jurisdiction or by Ecology.
- Conduct spray applications during weather conditions as specified in the label direction and applicable local and state regulations. Do not apply during rain or immediately before expected rain.

Recommended Additional Operational BMPs for the use of pesticides:

- Consider alternatives to the use of pesticides such as covering or harvesting weeds, substitute vegetative growth, and manual weed control/moss removal.
- Consider the use of soil amendments, such as compost, that are known to control some common diseases in plants, such as Pythium root rot, ashy stem blight, and parasitic

nematodes. The following are three possible mechanisms for disease control by compost addition (USEPA Publication 530-F-9-044):

1. Successful competition for nutrients by antibiotic production;
2. Successful predation against pathogens by beneficial microorganism; and
3. Activation of disease-resistant genes in plants by composts.

Installing an amended soil/landscape system can preserve both the plant system and the soil system more effectively. This type of approach provides a soil/landscape system with adequate depth, permeability, and organic matter to sustain itself and continue working as an effective stormwater infiltration system and a sustainable nutrient cycle.

- Once a pesticide is applied, evaluate its effectiveness for possible improvement. Records should be kept showing the effectiveness of the pesticides considered.
- Rinseate from equipment cleaning and/or triple-rinsing of pesticide containers should be used as product or recycled into product.

#### **S417 BMPs for Maintenance of Stormwater Drainage and Treatment Systems**

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and oil from stormwater collection, conveyance, and treatment systems to obtain proper operation.

#### **Operational BMPS**

Maintain stormwater treatment facilities per the operations and maintenance (O&M) procedures presented in Section 4.6 of Volume V in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O&M improvements.
- Promptly repair any deterioration threatening the structural integrity of stormwater facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways. Ensure adequacy of storm sewer capacities and prevent heavy sediment discharges to the sewer system.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to an appropriate local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin.

However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT Type 1L basins) may

have as little as 12 inches sediment storage below the invert. These catch basins need frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.

- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catchbasin.
- Post warning signs; “Dump No Waste - Drains to Ground Water,” “Streams,” “Lakes,” or emboss on or adjacent to all storm drain inlets where possible.
- Disposal of sediments and liquids from the catch basins must comply with “Recommendations for Management of Street Wastes” described in Appendix IV-G of this volume.

#### **S421 BMPs for Parking and Storage of Vehicles and Equipment**

Of the Potential Pollutant Generating Sources listed for S421 Parking and Storage of Vehicles and Equipment, the following pollutant sources are not expected at this site:

- Not a Defined “High-Use” site
  - < 100 ADT/1,000 SF for gross building area
  - < 25 diesel vehicles over 10 tones gross weight.

#### **Operational BMPS**

Clean parking lot by sweeping. Do not hose down into stormwater system.

#### **Storage of Solid Wastes**

Improper storage of recycling, yard waste, and trash can lead not only to water pollution problems, but problems with neighborhood pets and vermin as well. Following the BMPs listed below can help keep the property a clean and healthy place.

All recycling and waste containers kept outside should have lids. If the lid is damaged, repair or replace it as soon as possible. If the container is supplied by your hauler, please call to have the lid repaired or replaced

- Leaking containers should be replaced. If your container is supplied by your hauler, contact the hauler to have damaged containers replaced.
- Store containers under cover if possible, or on grassy areas.
- Inspect the storage area regularly to pick up loose scraps of material and dispose of them properly.

- Reduce waste where possible.

#### **S424 BMPs for Roof/ Building Drains at Manufacturing and Commercial Buildings**

Pollutant Control Approach: Evaluate the potential sources of stormwater pollutants and apply source control BMPs where feasible.

#### **Operational BMPS**

- If leachates and/or emissions from buildings are suspected sources of stormwater pollutants, then sample and analyze the stormwater draining from the building.
- Sweep the area routinely to remove any zinc residuals.
- If a roof/building stormwater pollutant source is identified, implement appropriate source control measures such as air pollution control equipment, selection of materials, operational changes, material recycle, process changes, etc.

#### **Structural Source Control BMPs:**

- Paint/coat the galvanized surfaces as described in Ecology Publication # 08-10-025.

## O & M Appendix A: Maintenance Checklists

Maintenance instructions are intended to explain to future property owners the purpose of each flow control element (BMP) and how it must be maintained and operated. A set of minimum maintenance instructions is provided for each flow control BMP selected. Maintenance checklists are from *City of Puyallup Site Management Plan for Stormwater Operations and Maintenance (SMP)*, unless otherwise noted.<sup>Revision V4.</sup>

Support information is supplied in this section from Volume V of Department of Ecology *Stormwater Management Manual for Western Washington*, issued December 2024.

Maintenance timelines vary according to the severity of the impact.

### **Emergency Action:**

Where maintenance and repair is necessary to correct health or safety problems, to prevent harmful materials from entering the stormwater system, or to remove harmful materials that have entered the stormwater system, such work shall be completed by the owner or operator of the stormwater system or stormwater facility within 24 hours of discovery of the need for maintenance or repair.

See section 5 for the emergency contact phone number.

### **Triggered Maintenance:**

When maintenance and repair is found necessary to prevent water quality degradation, such work shall be completed within 14 calendar days of discovery of the need for maintenance or repair.

### **Routine Maintenance:**

For other related problems, maintenance or repairs shall be completed within 30 calendar days of discovery or repair.

### **Maintenance and Inspection Record Keeping:**

Maintenance performed shall be logged either on this document and its copies, or in an electronic format that may be printed or transmitted to another party.

City of Puyallup's template Stormwater Annual Inspection Report is attached below, followed by checklists for the stormwater features.

**Annual Inspection Report**

City of Puyallup – Stormwater BMP Facilities Inspection and Maintenance Log

Return Form to:  
 Stormwater Engineer/ City of Puyallup  
 333 South Meridian  
 Puyallup, WA 98371

Facility Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Begin Date: \_\_\_\_\_ End Date: \_\_\_\_\_

Date	BMP ID#	BMP facility Description	Inspected By	Cause for Inspection	Exceptions Noted	Notes / Actions Taken

**Instructions:**

Record all inspections and maintenance for all treatment BMP's on this form. Use additional log sheets and/or attach extended comments or documentation as necessary. Submit a copy of the completed log with the Annual Independent Inspector Report to the City, and start a new log at that time. Checklists provided should be used prior to filling out this form. If you have any questions on how to complete your inspection, please contact City staff.

**BMP ID #**- always use ID# from the Operation and Maintenance Manual.

**Inspected by**- Note all inspections and maintenance on this form, including the required independent annual inspection.

**Cause for Inspection**- Note if the inspection is routine, pre-rainy season, post storm, annual, or in response to a noted problem or complaint.

**Exceptions Noted**- Note any condition that requires correction or indicates a need for maintenance.

**Notes / Actions Taken**- Describe any maintenance done and need for follow up.

## Catch Basin

Catch Basin			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		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.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin.
	Structure Damage to Frame and/or Top Slab	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.
		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.
	Fractures or Cracks in	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.

	Basin Walls/ Bottom	Grout fillet has separated or cracked 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.	Pipe is regouted and secure at basin wall.
	Settlement/ Misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present.  • Identify and remove source	No contaminants or pollutants present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread. One or more bolts are missing.	Mechanism opens with proper tools. All bolts are seated and no bolts are missing. Cover is secure.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure (Intent is to keep cover from sealing off access to maintenance).	Cover can be removed by one maintenance person.
Metal Grates (If Applicable)	Grate Opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.
Oil/Debris Trap (If Applicable)	Dislodged	Oil or debris trap is misaligned with or dislodged from the outlet pipe.	Trap is connected to and aligned with outlet pipe.

## Compost-Amended Soil

Compost-Amended Soil			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Soil Media	Soils Waterlogged or Not Infiltrating	Soils become waterlogged, or otherwise do not appear to be infiltrating.	Soils have been aerated or amended such that infiltration occurs and soils to not remain completely saturated, per design specifications.
	Erosion/Scouring	Areas of potential erosion are visible, such as gullies or scouring.	Any eroded areas have been repaired, and sources of erosion addressed to prevent further soil erosion.
Vegetation	Vegetation in Poor Health	Less than 75% of planted vegetation is healthy with a generally good appearance.	At least 75% of planted vegetation is healthy with generally good appearance. Any conditions found that were deleterious to plant health have been corrected where possible.  Routine maintenance schedule has been updated as necessary to ensure continued plant health and satisfactory appearance.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public.  Any evidence of noxious weeds as defined by State or local regulations.	No danger of poisonous vegetation where maintenance personnel or the public might normally be.  Eradication of Class A weeds as required by State law. Control of other listed weeds as directed by local policies.  Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds Present	Other weeds (not listed on City/State noxious weed lists) are present on site.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.

## Conveyance Pipe

Conveyance Pipe			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present. <ul style="list-style-type: none"> <li>Identify and remove source.</li> </ul>	No contaminants or pollutants present.
	Obstructions, Including Roots	Root enters or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Sediment and Debris	Sediment depth is greater than 20% of pipe diameter.	Pipe has been cleaned and is free of sediment/ debris. (Upstream debris traps installed where applicable.)
	Debris Barrier or Trash Rack Missing	Stormwater pipes > than 18 inches need debris barrier.	Debris barrier present on all stormwater pipes 18 inches and greater.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.

## Detention Pond

Detention Pond			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
General	Trash and Debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet. In general, there should be no visual evidence of dumping.  If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Site is free of trash and debris.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public.  Any evidence of noxious weeds as defined by State or local regulations.	No danger of poisonous vegetation where maintenance personnel or the public might normally be.  Eradication of Class A weeds as required by State law. Control of other listed weeds as directed by local policies.  Apply requirements of adopted IPM policy for the use of herbicides.
	Vegetation Growth and Hazard Trees	Vegetation growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vacuuming, or equipment movements). If trees are not interfering with access or maintenance, do not remove.  Dead, diseased, or dying trees are identified. (Use a certified Arborist to determine health of tree or removal requirements.)	Vegetation does not hinder maintenance activities. Harvested vegetation should be recycled into mulch or other beneficial uses (e.g., alders for firewood).  Remove hazard trees.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. (Coordinate removal/cleanup with local water quality response agency.)	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired.
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies.)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site.  Apply insecticides in compliance with adopted IPM Plan.

Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.  Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.  If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% (typically 6" to 12") of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation.  If settlement is apparent, measure berm to determine amount of settlement.  Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernible water flow through pond berm. Ongoing erosion with potential for erosion to continue.  (Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
	Tree Growth	Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.  Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.  If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.

Emergency Overflow/ Spillway	Tree Growth	Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.	Trees removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Rock Missing	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of flow path of spillway.	Rocks and pad depth are restored to design standards.

## Energy Dissipater / Outfall Protection

Energy Dissipaters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
<b>External:</b>			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad has been replaced to design function.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad has been replaced to design function.
	Sediment	Sediment on top of rock pad exceeds 10% of the surface.	Rock pad has been cleared of sediment.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations.	No danger of poisonous vegetation where maintenance personnel or the public might normally be. Eradication of Class A weeds as required by State law. Control of other listed weeds as directed by local policies. Apply requirements of adopted IPM policy for the use of herbicides.
	Other Weeds	Other weeds (not listed on State noxious weed lists) are present on the rock pad.	Weeds have been removed per the routine maintenance schedule, following IPM protocols.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe is free of sediment and meets design specifications.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench has been repaired or modified such that it does not discharge at concentrated points and meets design function.
	Perforations Plugged	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe has been cleaned or replaced and <25% of perforations are plugged.
	Water Flows Out Top of "Distributor" Catch Basin	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt per design specifications or redesigned to meet approved City standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Gabions	Damaged Mesh	Mesh of gabion broken, twisted or deformed so structure is weakened or rock may fall out.	Mesh is intact, no rock missing.
	Corrosion	Gabion mesh shows corrosion through more than 1/4 of its gage.	All gabion mesh capable of containing rock and retaining designed form.

Energy Dissipaters			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
	Collapsed or Deformed Baskets	Gabion basket shape deformed due to any cause.	All gabion baskets intact, structure stands as designed.
	Missing Rock	Any rock missing that could cause gabion to lose structural integrity.	No rock missing.
<b>Internal:</b>			
Manhole/ Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.

## Facility Discharge Points (Outfall)

Facility Discharge Point (Outfall)			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Monitoring	Contaminants in Discharge Water	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present.  • Identify and remove source.	Effluent discharge from facility is clear.
	Receiving Area Saturated	Water in receiving area is causing substrate to become saturated and unstable.	Receiving area is sound and not saturated.
	Ditch or Stream Banks Eroding (via Off Site Assessment)	Erosion, scouring, or headcuts in ditch or stream banks downstream of facility discharge point due to flow channelization or higher flows.	Ditch or stream banks are stable.
	Access	Vegetation is overgrown and there is no access to the outfall.	Vegetation is removed and/or path is cleared to access the outfall.
	Stains or Deposits	Stains or deposits present within the discharge area that are not natural occurring.	No stains or deposits exist and the source has been eliminated, unless the source is determined to be natural occurring.
	Stormwater Flow	Flow exists during the summer dry months when no flows should be present.	Source of the flows has been eliminated or source has been determined to be groundwater interflow.
General	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design function.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design function.
	Obstructions, Including Roots	Roots or debris enters pipe or deforms pipe, reducing flow.	Roots have been removed from pipe (using mechanical methods; do not put root-dissolving chemicals in storm sewer pipes). If necessary, vegetation over the line removed.
	Pipe Rusted or Deteriorated	Any part of the pipe that is broken, crushed, or deformed more than 20% or any other failure to the piping.	Pipe repaired or replaced to design standards.

## Field Inlet

Field Inlet			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
General	Trash and Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the field inlet by more than 10%.	No trash or debris located immediately in front of field inlet or on grate opening.
		Trash or debris (in the field inlet) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the field inlet.
		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.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the field inlet.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the field inlet.
	Structure Damage to Frame and/or Top Slab	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.
		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.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked 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 field inlet through cracks.	Pipe is regouted and secure at basin wall.
	Settlement/ Misalignment	Basin has settled more than 1 inch or has rotated more than 2 inches out of	Basin replaced or repaired to design standards.

Field Inlet			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
	Vegetation Inhibiting System	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. Sheen, obvious oil, or other contaminants present.  • Identify and remove source.	No contaminants or pollutants present.
Metal Grates	Grate Not in Place	Cover is missing or only partially in place. Any open field inlet requires maintenance.	Field inlet cover is closed.
	Grate Opening Unsafe	Grate with opening wider than 3 inches.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

## Grounds

Grounds (Landscaping)			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Site	Trash or litter	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Trees and Shrubs	Hazard	Any tree or limb of a tree identified as having a potential to fall and cause property damage or threaten human life. A hazard tree identified by a qualified arborist must be removed as soon as possible.	No hazard trees in facility.
	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	No blown down vegetation or knocked over vegetation. Trees or shrubs free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; dead or diseased trees removed.

Perforated Stub-Out			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Preventative	Blocking, obstructions	Debris or trash limiting flow into perforated pipe system or outfall of BMP is plugged or otherwise nonfunctioning.	Outfall of BMP is receiving designed flows from perforated pipe connection.
Inflow	Inflow impeded	Inflow into the perforated pipe is partially or fully blocked or altered to prevent flow from getting into the pipe.	Inflow to the perforated pipe is unimpeded.
Pipe Trench Area	Surface compacted	Ground surface over the perforated pipe trench is compacted or covered with impermeable material.	Ground surface over the perforated pipe is not compacted and free of any impervious cover.
Outflow	Outflow impeded	Outflow from the perforated pipe into the public drainage system is blocked.	Outflow to the public drainage system is unimpeded.
Outfall Area	Erosion or landslides	Existence of the perforated pipe is causing or exasperating erosion or landslides.	Perforated pipe system is sealed off and an alternative BMP is implemented.
Inspection	Frequency	Annually and prior to and following significant storms.	Perforated pipe system is operating as designed.

Roadside Ditch Maintenance			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Trash and debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet. In general, there should be no visual evidence of dumping.  If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Ditches are free of trash and debris.
	Poisonous Plants and Noxious Weeds	Any poisonous plants or nuisance vegetation which may constitute a hazard to maintenance personnel or the public.  Any evidence of noxious weeds as defined by State or local regulations.	No danger of poisonous vegetation where maintenance personnel or the public might normally be.  Eradication of Class A weeds as required by State law. Control of other listed weeds as directed by local policies.  Apply requirements of adopted IPM policy for the use of herbicides.
	Vegetation Growth and Hazard Trees	Vegetation is impeding flow of water through the ditch, causing line of sight issues, does not allow maintenance access, or interferes with maintenance activity (i.e., slope mowing, silt removal, vacuuming, or equipment movements). If trees are not interfering with access or maintenance, do not remove.  Dead, diseased, or dying trees are identified. (Use a certified Arborist to determine health of tree or removal requirements.)	Vegetation does not hinder maintenance activities. Harvested vegetation should be recycled into mulch or other beneficial uses (e.g., alders for firewood).  Remove hazard trees.
	Poor Vegetation Coverage	When grass is sparse or bare or eroded patches occur in more than 10% of the ditch bottom.	Grass coverage has been restored to good condition and meets design function.
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants. (Coordinate removal/cleanup with local water quality response agency.)	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired.
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies.)

Roadside Ditch Maintenance			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted City O&M policies.
	Side Slope Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.  Any erosion observed on a compacted berm embankment.	Slopes have been stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.  If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
	Sediment	Sediment depth exceeds 2 inches in 10% of the ditch or affects inletting or outletting condition of the ditch.	Sediment cleaned out to designed ditch shape and depth; ditch reseeded if necessary to control erosion.
	Ponding	Standing water present for more than 48 hrs. and no inflow observed.	Ditch line is regraded to ensure positive grade in the direction of flow.
	Rock lining out of place or missing (if applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

Sheet Flow and Concentrated Flow Dispersion			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
General	Pests	Signs of pest infestations (IPM protocol threshold(s) are exceeded), including rodent holes or mounds that disturb dispersion flow paths.	Pests are not present or engaged in activities that present a significant public health risk or compromise to the intended design function of the facility. Pests that have exceeded acceptable thresholds have been addressed using appropriate IPM measures.
Dispersion Trench	Concentrated Discharge	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" from edge of trench; intent is to prevent erosion damage).	Water is discharging as a sheet flow and any disruptive material (e.g. trash, debris, sediment accumulation) has been removed from trench surface.
	Surface of Trench	Accumulated trash, debris, or sediment on drain rock surface impedes sheet flow from facility. Vegetation/moss present on drain rock surface impedes sheet flow from facility.	Surface of drain rock is free of trash, debris, and sediment accumulation. Rock surface is open, free of vegetation buildup, and drains freely.
	Damage to or Trash/Sediment Accumulation Around Pipes	Accumulation of trash, debris, or sediment in driveway drains and area drains, etc. Pipe from sump to trench has accumulated sediment or is plugged. Cracked, collapsed, broken, or misaligned drain pipes.	Trash, debris, and sediment is cleared from dispersion trench components Pipes are free of damage or defects that hinder system from functioning according to design.
Rock Pad	General	Only one layer of rock exists above native soil in area 6 square feet or larger, or any exposure of native soil. Soil erosion in or adjacent to rock pad.	Rock pad has been repaired or replaced to meet design standards.
Dispersal Area	Erosion or Sediment Accumulation	Erosion (gullies/ rills) greater than 2 inches deep in dispersal area. Accumulated sediment or debris to extent that blocks or channelizes flow path.	Cause of erosion has been eliminated and the damaged area has been repaired and stabilized.
	Standing Water After Storm Event	Standing surface water in dispersion area remains for more than 3 days after the end of a storm event.	Standing water drains within 72 hours of a storm event.
	Transition Zone Erosion and Sizing	Adjacent soil erosion; uneven surface creating concentrated flow discharge; or less than two feet of width.	Transition zone meets design criteria and does not exhibit erosion or other evidence of concentrated flows.
	Poor Vegetation Cover	Poor vegetation cover such that erosion is occurring.	Vegetation has been properly watered and established to meet facility design specifications.
	Excessive Vegetation Cover	Vegetation inhibits dispersed flow along flow path.	Vegetation has been weeded, trimmed, pruned, or thinned to meet facility design criteria.

## Downspout Splash Block

Downspout Splash Block			
Drainage System Feature	Potential Defect	Conditions When Maintenance Is Needed	Minimum Performance Standard
Note: table spans multiple pages.			
General	Pests	Signs of pest infestations (IPM protocol threshold(s) are exceeded), including rodent holes or mounds that disturb dispersion flow paths.	Pests are not present or engaged in activities that present a significant public health risk or compromise to the intended design function of the facility. Pests that have exceeded acceptable thresholds have been addressed using appropriate IPM measures.
	Inspection Frequency	Annually and after large storms.	Rain harvesting equipment is functioning normally.
Splash Block	Water Directed Towards Building	Water is being directed towards building structure.	Water is directed away from foundations and other building structures.
	Downspout water misdirected	Water coming from the downspout is not discharging to the dispersal area.	Water is discharging normally to the dispersal area.
	Dislodged	Splash block moved from outlet of downspout.	Splash block correctly positioned to catch discharge from downspout.
	Trash and Debris	Trash and debris accumulated on the splash block.	Splash block site free of any trash or debris.
	Erosion	Water coming off the splash block causing erosion.	
		Water disrupts soil media.	Water is dispersed into soil/mulch/plantings in a manner that does not create erosion or other issues due to concentrated flows.

Dispersal Area	Erosion or Sediment Accumulation	Erosion (gullies/ rills) greater than 2 inches deep in dispersal area. Accumulated sediment or debris to extent that blocks or channelizes flow path.	Cause of erosion has been eliminated and the damaged area has been repaired and stabilized.
	Standing Water After Storm Event	Standing surface water in dispersion area remains for more than 3 days after the end of a storm event.	Standing water drains within 72 hours of a storm event.
	Transition Zone Erosion and Sizing	Adjacent soil erosion; uneven surface creating concentrated flow discharge; or less than two feet of width.	Transition zone meets design criteria and does not exhibit erosion or other evidence of concentrated flows.
	Poor Vegetation Cover	Poor vegetation cover such that erosion is occurring.	Vegetation has been properly watered and established to meet facility design specifications.
	Excessive Vegetation Cover	Vegetation inhibits dispersed flow along flow path.	Vegetation has been weeded, trimmed, pruned, or thinned to meet facility design criteria.

End of document.

*Page inserted for duplex print spacing.*

## Appendix D Soils Information

Please see the Geotechnical Engineering Study  
By Earth Consultants, Inc  
July 7, 1995  
submitted under separate cover as file  
2205-CCS)1995.TIR.ApdxD.GeoRpt.pdf

And

Limited Geotechnical Site Evaluation  
By Krazan & Associates, Inc  
March 4, 2008  
Submitted under separate cover as file  
2205-CCS-AbbeyRD.TIR.GeoLetter.pdf

Note: Site-specific soils information is useful for determining infiltration rates, foundation designs, and other vulnerabilities on sites, such as potential for slope failure (landslides). These investigations supplement published general information, such soil maps, topography when the site is near a steep slope, or when there are mapped wetlands and areas high groundwater or restrictive layers that do not offer much potential for infiltration.

## **Appendix E: Previous Master Plan TIR**

Previously provided, please see separate document to limit file size.

## **Appendix F: Artificial Turf Information**

Infill Options Technical Information

Environmental Impact Research Guide

**Infill Options Technical Information**

There are over a dozen kinds of infill material available for artificial turf. For this project, the specified infill material is **EcoSense™ EPDM**, as provided in the Landscape Architect's specifications. An attachment listing the various infill choices is included below. All FieldTurf infill materials meet or exceed the stringent EN 71-3 requirements used in validating the safety of children's toys and materials.

The specified material is reprinted below for ease of reading.

**EcoSense – EPDM Technical Overview****The Economic Alternative**

EcoSense, sourced locally in the U.S., is one of the most cost-efficient alternatives to SBR. Made from post-industrial recycled products, these reclaimed materials are ground-up to create a new, clean, ecofriendly infill and another alternative to crumb rubber.

# INFILL OPTIONS FOR YOUR NEEDS

Not only does infill provide safety protection with appropriate cushioning to absorb impact, but it also sets the foundation for a field's performance level by offering traction for players to cut, plant and release — just the same as they would on natural grass. With the vast amount of alternative infill options available (cork, coconut, thermoplastics...), it's key to ensure that the material has been tested and performs in the long-term for your program. All FieldTurf infill materials meet or exceed the stringent EN 71-3 requirements used in validating the safety of children's toys and materials.

[FIND YOUR FIELDTURF EXPERT](#)



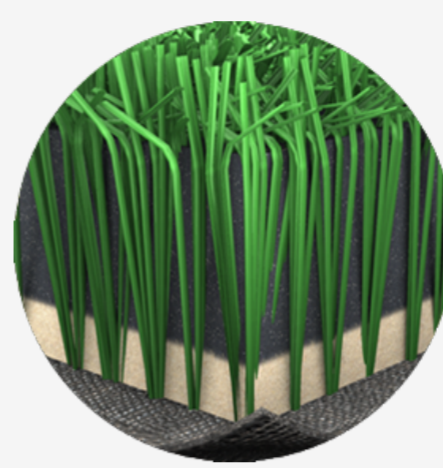
## CRYOGENIC RUBBER

[Overview](#) [Technical](#)

recycled tires are cryogenically frozen then shattered into small, smooth-edged particles. This smooth shape facilitates a consistent flow of water through the infill without raising and displacing any rubber while allowing rubber and sand to remain in suspension in a layered system - the optimal mix for a safe and consistent playing surface.

## AMBIENT RUBBER

[Overview](#) [Technical](#)

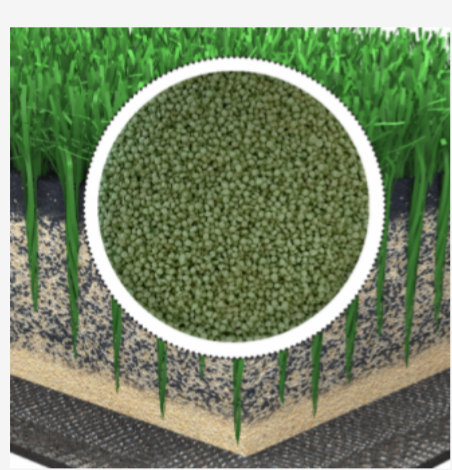


### Best-In-Class

Ambient (SBR) Rubber is an environmental, cost-efficient, and durable solution that has withstood the test of time. Processed through a rubber cracker mill at ambient temperature, the result is a more jagged rubber granule than its cryogenic cousin, creating a looser infill with air pockets

## COOLPLAY

[Overview](#) [Technical](#)



### High Performance. Low Temperature.

FieldTurf's exclusive and innovative extruded composite (EC) top dressing allows the CoolPlay system to deliver the same behavior and overall stability as FieldTurf's Elite system fields found in the world's most famous stadiums. CoolPlay takes nothing away

## PURESELECT - OLIVE

[Overview](#) [Technical](#)



PureSelect is a **USDA Certified Biobased Product** made from olive cores (patent pending). It is designed to offer all the natural benefits of a natural infill system without the drawbacks. Available with a CoolPlay top-layer, the system is environmentally friendly and provides heat reduction benefits.

## PUREFILL - CORK

[Overview](#) [Technical](#)



### Proven Performance

PureFill cork infill is a natural infill that is environment friendly and non-toxic. It is a recyclable and sustainable product that is harvested from the cork oak tree every nine years, without harming the trees.

## PUREGEO - COCONUT

[Overview](#) [Technical](#)

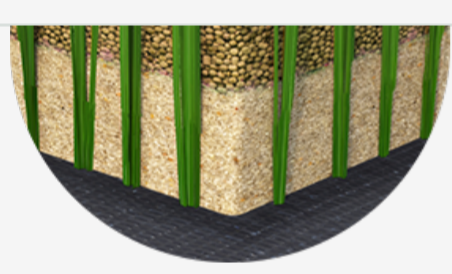


### Natural Design

Made from coconut peat and cork, our infill provides natural-like playing characteristics all while offering heat reduction benefits and an aesthetic that is close to natural turf. Proven and reliable, this option is a great fit if you're searching for something more...natural!

## PURECOB - CORN COB

[Overview](#) [Technical](#)



This environmentally friendly, biodegradable performance infill is crafted from the woody-ring portion of corn cobs, a natural by-product of field corn production. With a commitment to sustainability and local sourcing, PureCob is proudly harvested and processed in the United States, marking a significant step forward in eco-conscious sports field design

## TRUEBLEND

[Overview](#) [Technical](#)



### Naturally Fused.

Made from natural cork and premier-grade elastomers, TrueBlend is produced by fusing these materials into one. The result is an infill that provides natural-like playing characteristics, aesthetics and the added benefit of easy upkeep. Natural materials and sophisticated engineering

## ECOMAX - TPE

[Overview](#) [Technical](#)



### Thermo Engineered

An extruded composite of thermoplastic elastomer (TPE), the EcoMax granules deliver an impact absorbing infill that offers safe and comfortable performance. Compared to other "Eco" infill technologies on the market, the EcoMax pellet offers the best value in terms of durability, price and

## ECOSENSE - EPDM

[Overview](#) [Technical](#)

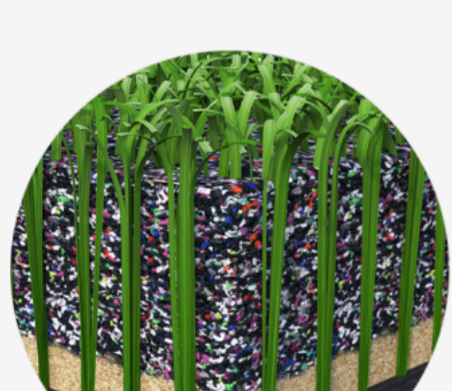


### The Economic Alternative

EcoSense, sourced locally in the U.S., is one of the most cost-efficient alternatives to SBR. Made from post-industrial recycled products, these reclaimed materials are ground-up to create a new, clean, ecofriendly infill and another alternative to crumb rubber.

## ECOGRIND - SHOGRIND

[Overview](#) [Technical](#)



### Sole Choice

EcoGrind is one of the most cost-efficient alternatives to SBR. Made from post-industrial recycled products, these reclaimed materials are ground-up to create a new, clean, eco-friendly infill and another alternative to crumb rubber. EcoGrind is the ideal solution for high use facilities looking for a

#### Why FieldTurf

#### Sports

#### Products

#### Articles

Cost Analysis

Football

Turf Systems

Proven Safety

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Trusted

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## NEWS

Lake Erie Rubber / August 11, 2022

# WHAT IS EPDM RUBBER? PROPERTIES, APPLICATIONS, & USES



## WHAT IS EPDM RUBBER?

Ethylene propylene diene monomer, or EPDM, is a type of synthetic rubber that is commonly used across many industries. Developed in the early 1960s, it is made from ethylene, propylene, and diene monomers and is a very versatile and durable type of rubber with many applications. While natural rubber may deteriorate with exposure to sunlight and ozone and become brittle over time, some synthetic rubbers like EPDM are designed to be able to withstand more extreme conditions and can last much longer.

There are many applications for [EPDM rubber molding](#) due to its durability, flexibility, ability to withstand a wide range of temperatures, and many other properties. This includes flexible connectors, water gaskets, O-rings, grommets, and a variety of automotive parts, as well as many other outdoor applications. It is also the only rubber that is used for making full roofing systems.

## PROPERTIES OF EPDM RUBBER

There are many advantageous properties of EPDM that make it a great choice for many applications. There are, as with any polymer, disadvantages as well. Be sure you understand all of the pros and cons of EPDM before choosing it for your application.

## ADVANTAGES

EPDM is durable, flexible, and resistant to UV exposure, ozone, aging, weathering, acids, and many other chemicals. It is also one of the most water-resistant rubber materials. This durability makes it a very common choice for many different outdoor applications. Additionally, unlike many other types of rubber, it does not bloom, meaning its color doesn't fade when exposed to the elements. EPDM can last for decades if properly taken care of.

EPDM also has a very wide temperature operating range. It can withstand temperatures as low as -60°F(-51°C), and as high as 350°F(177°C). Unlike many other polymers, it can be exposed to a range of cycling temperatures and will not degrade. EPDM also processes well for injection, compression, or transfer molding.

## DISADVANTAGES

EPDM is one of the best rubber polymers, but it still has its disadvantages. While it does well in extreme temperatures, it does not possess good flame resistance. It also does not have good resistance to mineral oils or petroleum oils. If exposed to these elements for an extended period, EPDM will deteriorate. It is also difficult to make a strong rubber-to-metal bond with EPDM.

## COMMON APPLICATIONS OF EPDM RUBBER

EPDM is one of the most commonly used rubber polymers and has a wide range of applications. As previously stated, its durability and overall ability to withstand the elements make it a great choice for many outdoor applications. Some examples of EPDM applications include:

- Automotive – EPDM is used for many different car parts, including seals for doors and windows, brake systems, bumpers, windshield wipers, and various hoses and tubes.
- Locomotive – EPDM is used to make flexible connectors used in locomotives. Its flexibility, temperature resistance, resistance to ozone, and resistance to weathering mean it can last a long time.
- Construction – EPDM is used for roofing, sealants, garage door seals, pool liners, and many other applications in construction.
- Industrial – EPDM is used for water gaskets, O-rings, grommets, electrical insulation, and weather stripping.

## CONTACT US TODAY

EPDM is one of the most commonly used rubbers, and maybe the right choice for your application. [Contact us today](#) to see how we can help you make the best choice possible for your needs.

### CONTACT US

FILL OUT THIS SHORT FORM AND SOMEONE FROM OUR TEAM WILL REACH OUT






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#### COMPARING EPDM VS. NEOPRENE: FINDING THE BEST RUBBER FOR YOUR APPLICATION

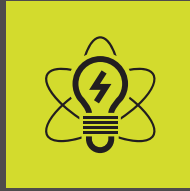
[JANUARY 8, 2025](#)

## CONTACT US TODAY

### CONTACT US

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## Environmental Impact Research Guide



# **ENVIRONMENTAL IMPACT RESEARCH GUIDE**

.....

**KEEPING ATHLETES  
& COMMUNITIES SAFE**

We understand that converting to artificial turf from natural grass, or replacing an existing surface, is an important and involved project for your organization and community.

.....

With over 25 years of experience in artificial turf and sports construction, FieldTurf has one of the most knowledgeable and experienced teams in the industry. Our unwavering dedication to quality has guided our commitment to delivering surfaces that make a difference for athletes and their communities.

In this guide, you'll find answers to common environmental, health, and athlete impact questions relating to artificial turf. As a company, we've always been committed to trusting the science. Along with information from our team of experts, the comprehensive collection of data and answers in this guide are supported by leading independent and third-party research.

Keeping your athletes & communities safe has been and will always be our first priority. Every day, we push the boundaries of research and innovation to engineer the most advanced artificial turf systems in the industry.



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## WHAT ARE THE BENEFITS OF ARTIFICIAL TURF OVER GRASS?

Synthetic turf offers a range of benefits over natural grass fields.

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One of the most beneficial aspects of synthetic turf is that it helps preserve water, making it an environmentally conscious choice for communities and organizations seeking to reduce water usage. The Salt Lake County Council in Murray City, Utah, estimated that converting to synthetic turf would save **2 million gallons of water per year per field**, which equates to over 16 million gallons of water over the field's expected lifetime.

With no need for pesticides, line painting, or chemicals for maintenance, synthetic turf helps protect the broader community's health by reducing the need for products containing harsh ingredients or volatile compounds, reducing the potential for spillover of these compounds into surrounding neighborhoods, ecosystems, or habitats. With no gas-powered mowers required to maintain them, synthetic turf fields reduce greenhouse gas emissions during their overall maintenance and use lifecycle.

Synthetic turf also provides increased availability of fields, meaning more hours of use are open to athletes and communities for sport and play.

Synthetic turf is made of recycled materials, helping divert waste from local landfills. One of the main components of a standard field is (SBR) styrene-butadiene rubber which is made from granulated post-consumer automotive tires.

With a wide range of benefits, synthetic turf is a smart choice for facilities and their communities.

.....

Source: <https://www.abc4.com/news/local-news/salt-lake-county-council-approves-converting-three-murray-sports-fields-to-artificial-turf/>



## HOW CAN I MAKE MY FIELDTURF PROJECT MORE SUSTAINABLE?

Building for tomorrow: it's our sustainability commitment.

.....

That means our innovation isn't limited to product specs. Our promise to keep players safe on our turf has naturally evolved into an obsession – one with a singular focus to completely eliminate its potential to harm not just people but the environment, too.

Now in everything we do, we strive for the lowest impact on people and the planet – from our zero turf to landfill commitment, to circular design, to the utmost care for those who play on and handle our products.

FieldTurf's industry-leading sustainability program, Sustain The Game, is proof of our commitment.

We understand that sustainability is a complex, multifaceted topic, so we've prepared a collection of answers to popular questions:

### CAN FIELDTURF FIELDS BE RECYCLED?

Yes, FieldTurf surfaces can be 100% recyclable, and we have successfully recycled numerous fields across the country.

When AMB Sports and Entertainment embarked on replacing the surface at Mercedes-Benz Stadium in 2022, the organization trusted FieldTurf to ensure all components of the field avoided being sent to landfills in the replacement of the surface. The carpet material was successfully turned into composite wood products and other materials, and the infill was cleaned and separated for reuse.

### HOW IS A FIELDTURF FIELD RECYCLED?

Artificial turf is made of common materials, including polyethylene, polypropylene, and nylon, while infill is made of either natural materials, sand, and (SBR) styrene-butadiene rubber. All of these are recyclable or compostable.



The first step to recycling an aged field is to remove the carpet and send the rolls to one of our Tarkett Sports recycling facilities to extract the infill, clean it, and separate it for reuse. The carpet is then sent to a specialized recycling partner to be cut, processed, and through the use of a proprietary process that upcycles the material into a high-grade polyurethane & polypropylene blend, the carpet can be transformed into various products like composite nailer boards, planters, and park benches.

## HOW DOES FIELDTURF MANAGE JOB SITE WASTE?

Under our Goal Zero commitment, FieldTurf will divert 100% of its manufacturing and job site waste in North America by the target date of 2025. The initiative is an industry-first. To achieve the goal, FieldTurf is working with suppliers, employees, and partners to ensure full alignment. FieldTurf is calling on everyone, including customers and other turf manufacturers, to join their mission to achieve Goal Zero and work toward eliminating waste to landfills.

## HOW CAN I REDUCE THE CARBON IMPACT OF MY PROJECT?

With the FieldTurf Carbon Offset Program, you can now calculate the exact emissions from the manufacturing, transport, and installation of the surface and offset them, so your project achieves carbon neutrality.

Offsets are provided through the Carbonfund Foundation's Carbonfree® Partner Program. This program funds third-party validated and verified renewable energy, forestry, and energy efficiency projects supporting a low-carbon transition for the planet.

## WHAT BENEFITS DO FIELDTURF FIELDS DELIVER ANNUALLY?

**FieldTurf fields are making a real difference every year.**

- Over 16 billion gallons of water are saved annually
- Over 17 million tires are recycled into raw materials to build new fields annually, diverting them from landfills.
- Over 65 million pounds of infill is re-used in new fields through onsite re-use and infill regeneration..
- Over 4 million pounds of fertilizer is saved annually, eliminating potentially negative impacts on plant, animal, and human environments.

*Data representing 2023 achievements.*



## ARE THERE POTENTIAL HEALTH RISKS FROM EXPOSURE TO (SBR) STYRENE-BUTADIENE RUBBER IN ARTIFICIAL TURF FIELDS?

The majority of FieldTurf systems are designed with styrene-butadiene rubber (SBR) infill, otherwise known as crumb rubber, made of reclaimed tires.

.....

Recycled crumb rubber, used in various everyday products and surfaces such as children's toys, surgical gloves, food packaging, playgrounds, and running tracks, has been scientifically proven to be a safe material.

More than 110 technical studies conducted by government bodies in the U.S. and Europe, along with several world health organizations, leading universities, and independent scientific bodies, have concluded that there is no health risk posed by using recycled SBR.

You can find the following recent studies and additional attachments that confirm the safety of crumb rubber for us in sports fields.

### U.S. Environmental Protection Agency (Largest US study ever on tire crumb rubber)

[Synthetic Turf Field Recycled Tire Crumb Rubber Characterization Research Final Report: Part 1 – Tire Crumb Rubber Characterization](#)

[Synthetic Turf Field Recycled Tire Crumb Rubber Characterization Research Final Report: Part 2 – Tire Crumb Exposure Characterization](#)

**Did not find increased risk between crumb rubber and natural grass fields:**

*“Recycled tire crumb rubber infill field users and natural grass field users experienced similar differences in pre-and post-activity PAH concentrations, including for hydroxynaphthalene.”*



Chemicals found in synthetic turf fields are also often found in surface soil at natural grass playing fields:

*“As described previously [EPA and CDC/ATSDR 2019], while there is concern about chemical exposures resulting from the use of recycled tire in synthetic turf fields, it is important to consider that some PAHs and other chemicals are also found in surface soil and may be present in other types of fields, including natural grass fields. **For example, metals (including lead) and PAHs (including benzo[a]pyrene) of potential concern at synthetic turf fields with tire crumb rubber infill are also often found in surface soil present at natural grass playing fields [EPA and CDC/ATSDR 2019].**”*

Chemicals are present, but low risk:

*“Support the conclusion that although chemicals are present (as expected) in the tire crumb rubber and exposures can occur, they are likely limited”*

*“For metals, only small fractions (average mean about 3% for gastric fluid and <1% for saliva and sweat plus sebum) are released from tire crumb rubber into simulated biological fluids compared to a default assumption of 100% bioaccessibility.”*

No difference found in presence of metals pre-and-post activity:

*“The concentrations of metals in whole blood and serum were compared in samples collected from study participants pre- and post-activity. Significant differences were not observed in the means and geometric means between the pre- and post-activity samples for football or soccer players.”*

[Washington State Department of Health Study](#)

**“We did not find the number of cancers among soccer players”**

– Washington State Department of Health Study

One of the most comprehensive human health studies came from the State of Washington Department of Health and researchers at the University of Washington School of Public Health, which had formed a project team to investigate issues specifically related to soccer playing and cancer. Their findings were very reassuring.



*“We know that crumb rubber is made from tires that contain chemicals that have been shown to cause cancer. However, what is critical to consider are the routes of exposure and the potential dose someone receives. The available research suggests exposures from crumb rubber are very low and will not cause cancer among soccer players. The Washington State Department of Health recommends that people who enjoy soccer continue to play regardless of the type of field surface.”*

#### THEY CONCLUDED:

*“We did not find the number of cancers among soccer players, select and premier players, or goalkeepers reported to the project team to be higher than expected based on Washington cancer rates for people of the same ages.”*

[European risk assessment study on synthetic turf rubber infill – Part 3: Exposure and risk characterization](#)

**“No health concerns were found for synthetic turf with ELT-derived infill materials”**

– European Risk Assessment Study on Synthetic Turf Rubber Infill (ERASSTRI)

The European Risk Assessment Study On Synthetic Turf Rubber Infill (ERASSTRI) is one of the most comprehensive multinational exposure studies to be conducted. The study involved researchers collecting various samples from indoor and outdoor synthetic turf fields and rubber recycling facilities across Europe, looked at different exposure possibilities and concluded that “no health concerns were found for synthetic turf with ELT-derived infill materials.”

#### THE THREE-PART, PEER-REVIEWED, 20-MONTH STUDY:

- **Examined Wide Variety of Sources:** The study analyzed 86 crumb rubber samples from synthetic turf fields and rubber recycling facilities in 14 European countries.
- **Included Comprehensive Bioaccessibility Analysis:** The study analyzed the migration of crumb rubber infill into artificial body fluids (sweat, saliva, and gastric fluid), as well as particles in the air above and around 17 synthetic turf fields in six European countries.
- **Conducted Complete Health Risk Analysis:** Calculated for oral, dermal, and inhalation routes using their extensive database obtained from infill sample collection, risk assessment analysis, and exposure measurements, carcinogenic and non-carcinogenic health risk characterizations indicated no health concerns.



*“Calculated cancer risks for exposure to polycyclic aromatic hydrocarbons were below 1:1 million. Risk characterization ratios (RCRs) for non-carcinogenic substances were below 1, indicating no health concerns. For 2-hydroxybenzothiazole no toxicological data were found from which to derive a substance-specific reference value. A threshold-of-toxicological concern approach revealed maximum RCRs slightly above 1, which is acceptable, given the conservatism of the approach. ERASSTRI substantially improved the data available for assessing human health risks from using ELT-derived infill material. Overall, no health concerns could be identified for the use of synthetic turfs with ELT-derived infill material.”*

[Comprehensive Multipathway Risk Assessment of Chemicals Associated With Recycled Crumb Rubber in Synthetic Turf Fields](#)

**THE STUDY CONCLUDED:**

- Estimated non-cancer hazards and cancer risks for all the evaluated scenarios were within US EPA guidelines. In addition, cancer risk levels for users of synthetic turf fields were comparable to or lower than those associated with natural soil fields.
- For most scenarios, cancer risks were higher for natural soil fields.
- The use of synthetic turf fields containing recycled rubber infill would not result in unacceptable risks or hazards to adults or children under US EPA’s risk assessment guidelines.

**“Methods:** All available North American data on the chemical composition of recycled rubber, as well as air sampling data collected on or near synthetic turf fields, were identified via a literature search. Ingestion, dermal contact, and inhalation pathways were evaluated according to US Environmental Protection Agency (US EPA) guidance, and exposure scenarios for adults, adolescents, and children were considered.

**Results:** Estimated non-cancer hazards and cancer risks for all the evaluated scenarios were within US EPA guidelines. In addition, cancer risk levels for users of synthetic turf fields were comparable to or lower than those associated with natural soil fields.

**Conclusions:** This HHRA’s results add to the growing body of literature that suggests recycled rubber infill in synthetic turf poses negligible risks to human health. This comprehensive assessment provides data that allow stakeholders to make informed decisions about installing and using these fields.”,



## [District of Columbia Study on the Safety of Synthetic Materials Currently Used in Construction and District Public Recreational Spaces](#)

This recently published study, which was undertaken to fulfill the requirements of the District of Columbia's Safe Fields and Playgrounds Act of 2018, identified and assessed the health and safety effects of all synthetic materials used in the construction of District recreational spaces. The study, conducted by the District of Columbia's Department of Energy and Environment (DOEE) and the Department of Health (DOH), compared laboratory test results from samples of natural grass and soils against samples of synthetic turf materials. The analysis revealed that comparable levels of carcinogenic chemicals such as arsenic and polycyclic aromatic hydrocarbons (PAHs) were present in both natural grass / soils samples and some of the artificial turf samples, while the majority of artificial turf samples contained few to no toxic chemicals at all.

In particular, FieldTurf's carpet and infill was found to contain the same levels of arsenic and PAHs as the natural grass and soil samples, while FieldTurf's grass carpet alone was found to contain no likely carcinogenic chemicals of potential concern.

### **OVERALL THE STUDY CONCLUDED THAT:**

*"Available broad-based evidence does not indicate that playing on synthetic/artificial turf will result in exposure to contaminants at levels that pose a significant risk to human health, provided such areas are properly installed and maintained, and users follow simple hygienic practices (e.g., washing hands, avoiding eating on the artificial field, and, to the extent practicable, removing as much dusty materials from shoes and clothing before going indoors)."*



## IS THERE A POTENTIAL HEALTH RISK OF AIR QUALITY WITH ARTIFICIAL TURF?

Researchers have refuted the false claim that exposure to styrene-butadiene rubber (SBR) can be carcinogenic, from their study (Milone & MacBroom, engineering, landscape architecture, and environmental science firm based in Connecticut, December 2008, “Evaluation of the Environmental Effects of Synthetic Turf Athletic Fields”)

.....

*“Under favorable conditions for vapor generation, no detectable concentrations of volatile nitrosamines or 4-(tert-octyl) phenol existed in the air column at a height of four feet above the tested synthetic playing surfaces or in the air either upwind or downwind of the fields.”*

Other studies have affirmed these findings, including [a study across five fields in Connecticut](#) (Ginsberg G, Toal B, Simcox N, Bracker A, Golembiewski B, Kurland T, Hedman C. Human health risk assessment of synthetic turf fields based upon investigation of five fields in Connecticut. J Toxicol Environ Health), however, even though **outdoor and indoor synthetic turf fields are not associated with elevated adverse health risks**, proper installation of indoor fields should include guidance from an architect, designer or HVAC expert regarding the adequacy of ventilation for your installation, best-practice oversight that is commonly required for all indoor construction investments:

*“Cancer and noncancer risk levels were at or below de minimis levels of concern. The scenario with the highest exposure was children playing on the indoor field. The acute hazard index (HI) for this scenario approached unity, suggesting a potential concern, although there was great uncertainty with this estimate. The main contributor was benzothiazole, a rubber-related semivolatile organic chemical (SVOC) that was 14-fold higher indoors than outdoors. Based on these findings, outdoor and indoor synthetic turf fields are not associated with elevated adverse health risks. However, it would be prudent for building operators to provide adequate ventilation to prevent a buildup of rubber-related volatile organic chemicals (VOC) and SVOC on indoor fields. The current results are generally consistent with the findings from studies conducted by New York City, New York State, the U.S. Environmental Protection Agency (EPA), and Norway, which tested different kinds of fields and under a variety of weather conditions.”*



## IS THERE A POTENTIAL HEAT RISK ASSOCIATED WITH ARTIFICIAL TURF VERSUS GRASS FIELDS?

First, it's important to note that when it comes to surface temperature, artificial turf and natural grass fields vary.

.....

Like all plants, grass, through the process of photosynthesis, makes oxygen that produces a cooling effect at surface level.

However, [research](#) by industry-leading expert civil engineering and landscape architecture firm Milone and Macbroom found that beyond the surface, ambient heat between artificial turf and grass largely trends to the same median temperature. At the height of 5ft, the temperature of the two surfaces is virtually the same.

This highlights the importance of looking beyond surface-level temperature to gain a more comprehensive understanding of the conditions of a field.

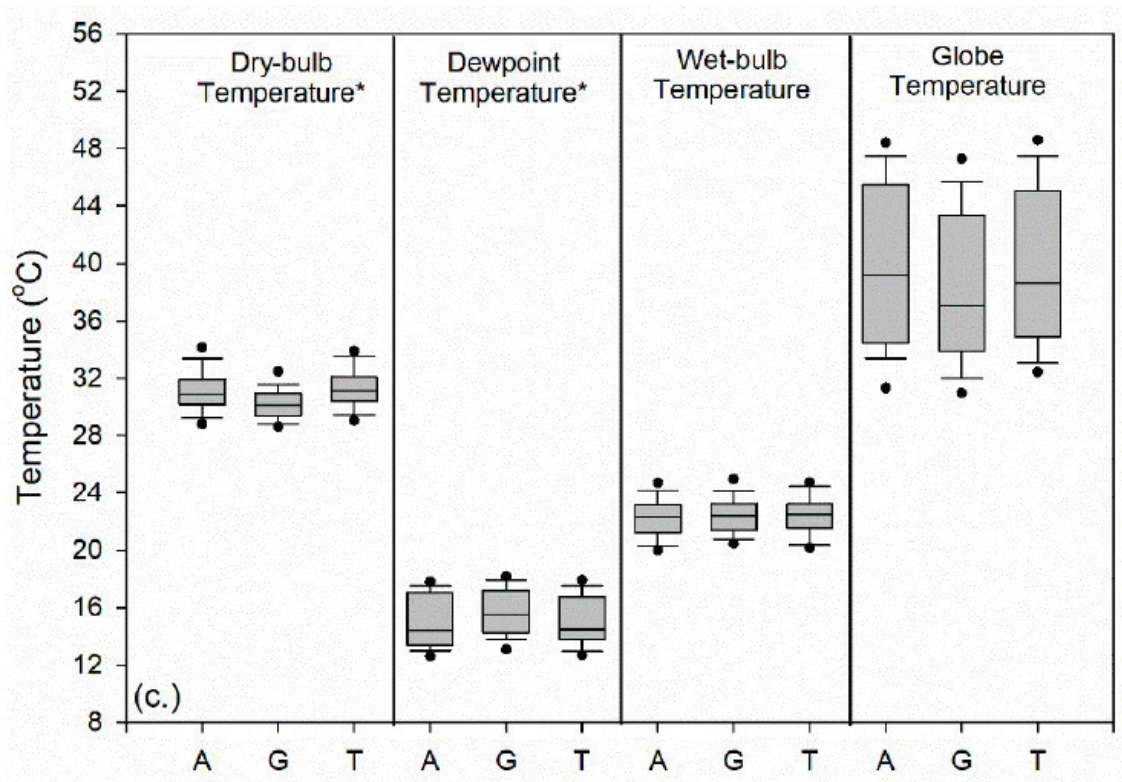
TIME OF DAY (HRS))	AMBIENT TEMPERATURE	NATURAL GRASS		SYNTHETIC TURF	
		AIR TEMPERATURE 2' ABOVE SURFACE	AIR TEMPERATURE 5' ABOVE SURFACE	AIR TEMPERATURE 2' ABOVE SURFACE	AIR TEMPERATURE 5' ABOVE SURFACE
	°F	°F	°F	°F	°F
12:00	101	99	101	103	101
12:30	101	99.7	101	104	101
13:00	103	100	103	104	101
13:30	102	101	102	103	101
14:00	101	100	101	103	101
14:30	99	97	99	104	101
15:00	99	100	99	104	101

*Chart data sourced from TABLE 1 and TABLE 2 of research.*



A study by Andrew Grundstein, Department of Geography, University of Georgia and Earl Cooper, Department of Kinesiology, University of Georgia, collected matched wet-bulb globe temperature (WBGT) data over three commonly used athletic surfaces (grass, artificial turf, and hardcourt tennis) across an athletic complex on the campus of the University of Georgia in Athens, GA, and concluded:

*“Our study indicates that in a humid, subtropical climate over a well-watered grass field, there is no difference in WBGT when compared to artificial turf and hardcourt tennis surfaces.”*



A = ARTIFICIAL TURF • G= NATURAL GRASS • T = TENNIS COURT



## IS THERE POTENTIAL RISKS OF HEAT ISLANDS WITH ARTIFICIAL TURF?

“Heat islands” often happen in urbanized areas that experience higher temperatures than rural and suburban settings.

.....

The temperature differences can be caused by a combination of built environments and our urban activities, such as transportation, energy consumption, and building construction.

It is possible for heat islands to negatively impact human health, by causing discomfort and even heat-related illnesses. But it’s not just parking lots. Any built environment can make a heat island. And that could include both built-and-designed artificial turf and natural grass fields.

The temperature of the field and risk of heat island can be influenced by a variety of factors, such as the amount of shade in the area, the presence of nearby buildings or water features, and the prevailing winds. These factors can create microclimates that affect the temperature of the surface.

The results of the temperature measurements obtained from the fields studied in Connecticut (Milone and Macbroom) indicate that solar heating of the materials used in the construction of artificial turf playing surfaces does happen and is most pronounced in the polyethylene and polypropylene fibers used to replicate natural grass (the carpet), rather than the crumb rubber particles (the infill).

Most FieldTurf systems are designed with more infill and a lower face weight (amount of fiber per square foot) than competitive synthetic turf systems, which could help mitigate the risk heat island.

Rapid cooling of the fibers was noted if the sunlight was interrupted or filtered by clouds. Even more significant cooling was noted if water was applied to the synthetic fibers as a cooling tactic in quantities as low as one ounce per square foot. The elevated temperatures noted for the fibers generally resulted in an air temperature increase of fewer than five degrees, even during periods of calm to low climate-and-weather related temperature.



So even though we've established that artificial turf can be hotter at the surface than natural grass—artificial turf also cools down quickly and retains limited heat, so none of the negative impacts attributed to heat islands, such as driving up energy demand for air conditioning or creating conditions that can lead to heat stroke should be attributed to artificial turf.

That being said, it is important to note that the heat island effect is a complex phenomenon that is influenced by many factors, including land use patterns, building materials, and weather conditions. There are many other strategies that can be employed to mitigate this effect, such as using cool roofing materials and promoting the use of public transportation.



## DOES ARTIFICIAL TURF POSE A RISK OF PROMOTING MRSA/STAPH INFECTIONS?

MRSA stands for methicillin-resistant Staphylococcus aureus, a type of bacteria that is resistant to several antibiotics.

.....

In the community (where you live, work, shop, and go to school), MRSA most often causes skin infections. It sometimes causes pneumonia (lung infection) and other infections. If left untreated, MRSA infections can become severe and cause sepsis—the body’s extreme response to an infection.

Anyone can get MRSA. The risk increases with activities or places that involve crowding, skin-to-skin contact, and shared equipment or supplies. Some of the people who carry MRSA can go on to get an MRSA infection. Non-intact skin, such as when there are abrasions or incisions, is often the site of an MRSA infection. Athletes, daycare and school students, military personnel in barracks, and those who receive inpatient medical care or have surgery or medical devices inserted in their bodies are at higher risk of MRSA infection.

Research has proven that **synthetic turf does not play a role in promoting MRSA/staph.**

Researchers at Penn State (study: [Human health issues on synthetic turf in the USA](#)) confirmed that staph is not an issue on artificial turf, and in fact, natural grass harbors more bacteria.

*“In conclusion, there are generally lower numbers of total microbes present in the infill or fibers of the synthetic turf systems tested compared to natural turfgrass rootzones and Staphylococcus aureus bacterium were not found on any of the playing surfaces. Staphylococcus aureus bacterium was found on towels and other devices used by athletes.*

*Under non-extreme temperatures and very limited light conditions present during the indoor portion of this study, S. aureus survived on both synthetic and natural turfgrass for multiple days. However, the bacteria do not appear to thrive under these conditions as the numbers of surviving bacteria decrease significantly with time.”*

*Based on the findings of the S. aureus survey, concern that infilled synthetic turf harbours and provides a breeding ground for S. aureus bacteria is unwarranted within the context of this study. S. aureus bacteria were found on a number of surfaces that athletes commonly come into contact with, such as towels and blocking pads; however, the tested synthetic turf did not contain any S. aureus.”*



## DOES ARTIFICIAL TURF POSE A RISK OF WATER CONTAMINATION DUE TO WATER RUN-OFF?

Water run-off refers to the movement of water across any surface and into surrounding areas.

.....

Run-off is always a concern because water can carry a range of contaminants such as heavy metals, chemicals, and fertilizers which can impact the environment and public health by potentially contaminating surface water and groundwater sources. This contaminated water also has the potential to enter rivers, lakes, or other bodies of water, and ultimately find its way into drinking water sources. This can have serious consequences for both the environment and human health, making it important to carefully manage and monitor the water run-off.

Any surface can pose an issue—even pesticide-treated or fertilized natural grass produces run-off that could be concerning:

### [Environmental Implications of Excess Fertilizer and Manure on Water Quality](#)

*“When nutrients and other pollutants associated with animal manures and commercial fertilizers are not managed properly, they can affect plant and animal life (including humans) negatively. Some of these impacts include algae blooms causing the depletion of oxygen in surface waters, pathogens and nitrates in drinking water, and the emission of odors and gases into the air.”*

**For artificial turf, water run-off does not typically contain heavy metals, organics, or zinc, and crumb rubber (infill) also does not have a significant impact on groundwater quality.**

[A 2014 study was conducted by CDM Smith](#) and the Massachusetts Department of Environmental Protection to evaluate the potential impacts of water run-off from artificial turf fields on water quality.

As part of this study, a sample of turf was collected from an active section of the field in June 2013. The sample was then tested using the synthetic precipitation leaching procedure (SPLP), a standardized method for determining the release of contaminants from solid materials into the water.



By using this method, the researchers were able to assess the potential for contaminants to leach out of the artificial turf and impact the surrounding environment:

*“Water samples were collected from the field and water samples were tested for arsenic, cadmium, lead, mercury and zinc and were compared to criteria from the U.S. Environmental Protection Agency (EPA) for freshwater aquatic life and drinking water. Based on the results of the sampling effort, the athletic field is not a source of metal concentrations”.*

In another [study from the New York State Department of Health](#) in May 2009 (An Assessment Of Chemical Leaching, Releases To Air And Temperature At Crumb-Rubber-Infilled Synthetic Turf Fields) collected thirty-two samples of groundwater in relation to artificial turf run-off and no organics or zinc were detected.

*“The dilution-attenuation factor (DAF) from the NYSDEC’s soil cleanup guidance for hazardous remediation sites was applied and demonstrated that crumb rubber may be used as an infill without significant impact on groundwater quality.”*

In another study, the Town of Wilton, CT, Found Very Low Levels of PFAS From Turf

*“The sampling test results showed:*

- No PFAS chemicals detected in the stormwater discharge points from the artificial turf fields.*
- Some very low level PFAS chemical compounds in the surface water bodies tested.*



## WHAT ARE PFAS AND DO FIELDTURF SYSTEMS CONTAIN THEM?

The following provides an overview of PFAS, the extensive testing we have done on numerous FieldTurf carpets, and the results and evidence that show our products are safe.

.....

We take PFAS concerns seriously and have had our products thoroughly assessed by outside experts. As always, we are fully committed to prioritizing athlete safety – and we believe this is a key reason why we are a market leader for synthetic turf fields

### WHAT ARE PFAS?

There is a lot of misinformation about PFAS, and it's critical to cut through the confusion. PFAS (per- and polyfluoroalkyl substances) are everywhere: they are long-lasting chemicals that you can find in many types of consumer products, such as fast-food containers, microwave popcorn bags, candy wrappers, personal care products such as shampoo and dental floss, and cosmetics such as nail polish and eye makeup.

The term PFAS can refer to more than 10,000 different chemicals used in commerce, including fluoropolymers. Roughly 30 have been identified as posing potential health concerns. Most PFAS are likely only present at very low levels in the environment.

### FIELDTURF COMMISSIONED EXTENSIVE INDEPENDENT TESTING OF OUR PRODUCTS

Our holistic approach to Protect People & Planet is stitched into the fabric of how we do business and sits at the heart of our day-to-day decision-making. That's why we voluntarily submitted our products for rigorous testing by an outside lab. The approach they used and the results are summarized below.

**In short, we cast a wide net in terms of testing and the results show that there are only occasional trace amounts of PFAS in our products – and these amounts fall below U.S. Environmental Protection Agency's limits for soil.**



## APPROACH:

- Extensive laboratory testing was conducted with three of our carpets (FieldTurf Core Synthetic Turf Carpet, FieldTurf Classic HD Synthetic Turf Carpet, and FieldTurf Revolution 360 Turf Carpet) for more than 70 different PFAS compounds using methods designed to detect even very low levels. This is the largest list of PFAS compounds that is currently available from commercial laboratories and includes those that have been identified as potential health concerns.
- In addition, a special process (called a TOP assay) was used to simulate the potential effects of “weathering” these products to evaluate any release of PFAS compounds over time as they degrade. The TOP assay involves heating the products and oxidizing them with a strong chemical. This process is significantly more aggressive than conditions a normal field would experience on a daily basis – especially because any PFAS compounds potentially present in some synthetic turf products are essentially locked inside the products and are highly resistant to wear. Put another way, even though any potential PFAS would be trapped inside the product, the TOP assay artificially exposes them and allows testing.
- These methods ensured we were not just looking for the most commonly addressed compounds (PFOA and PFOS) and we made sure to get highly specific results – right down to the sample detection limits.

## RESULTS:

- Low levels of some PFAS compounds, below laboratory reporting limits, were identified in some FieldTurf products – but the specific PFAS compounds detected are not on the EPA’s RCRA “Hazardous Constituent” list, and the levels reported are lower than even the most stringent EPA soil screening health guideline levels for PFAS compounds. As part of our rigorous testing process, one of our products was tested twice (called a “duplicate”) to determine whether or not the results were reproducible (see Tables 3 and 4). This is a standard quality control practice for laboratory testing.
- Under the EPA’s definition of PFAS compounds, the fluoropolymers used in some of FieldTurf synthetic turf products are likely considered to be PFAS. This is also true for any synthetic turf product made from or with fluoropolymers, regardless of manufacturer. However, the laboratory testing of FieldTurf products made with fluoropolymers (which are designed to resist degradation) found that little (if any) PFAS would leach from these types of materials over time – and this was only after the aggressive TOP assay process was used.
- Data validation of the laboratory results showed that in fact laboratory contamination, not the product samples, was the source of the majority of detections. The remaining detections are extremely low level (below the reporting limits in most cases) and non-reproducible, raising the question as to whether these low levels are actually related to the product or also laboratory errors.



On an additional note, we also urge you to consider testing using sampling from a field recently installed in the City of Portsmouth (MA), which concluded, *“Based on this evaluation, the detection of very low levels of a limited number of PFAS in the synthetic turf components does not represent a human health risk to those using the synthetic turf ballfields.”*

## PFAS IN NATURAL SOILS

As a result of their use in many different products, low levels of many PFAS are found in natural soils, even in remote areas. The low levels of the PFAS compounds detected in some FieldTurf products are similar to PFAS levels found in a national study that evaluated the presence of PFAS in normal soils (including parks). Further, the testing of FieldTurf products did not detect any of the two PFAS compounds of most concern (PFOA and PFOS), which are commonly found in natural soils.

## KNOW WHAT YOU ARE PURCHASING

When considering who to choose for a synthetic turf field, you should feel empowered to ask detailed questions about the PFAS testing that has been done on the materials and know exactly what you are purchasing. Be careful of products that offer limited testing results, for instance those that only test for a few PFAS compounds (such as PFOA and PFOS) or have elevated reporting limits.

We have confidence in the safety of our products because we had them **independently and thoroughly evaluated**. We took this approach to ensure that you can closely scrutinize our products and get the most accurate information possible.



## WHAT HAS A HIGHER CARBON FOOTPRINT, ARTIFICIAL TURF OR NATURAL GRASS?

When it comes to comparing greenhouse gas emissions, it's important to consider the total lifetime of artificial turf vs natural grass.

.....

On the overall balance of things, artificial turf is assumed to produce a higher carbon footprint than natural grass due to manufacturing and disposal over the total course of its lifetime, even though there are much more emissions from the maintenance of natural grass.

Because the manufacturing and disposal of artificial turf can generate high emissions, FieldTurf is working to reduce the footprint of its manufacturing facilities and innovate to provide end-of-life options that divert used fields away from landfills by recycling them back into useful materials.

**Carbon intensity also plays a role in comparing both field solutions.**

[A study by the Zurich University of Applied Sciences](#) conducted a lifecycle analysis for different types of fields ranging from natural turf with and without drainage, hybrid turf, and artificial turf unfilled and filled.

They measured the carbon intensity of greenhouse gases for each option per hour of use, noting that the hours of use vary significantly between the natural turf and artificial turf (with more play time on artificial turf).

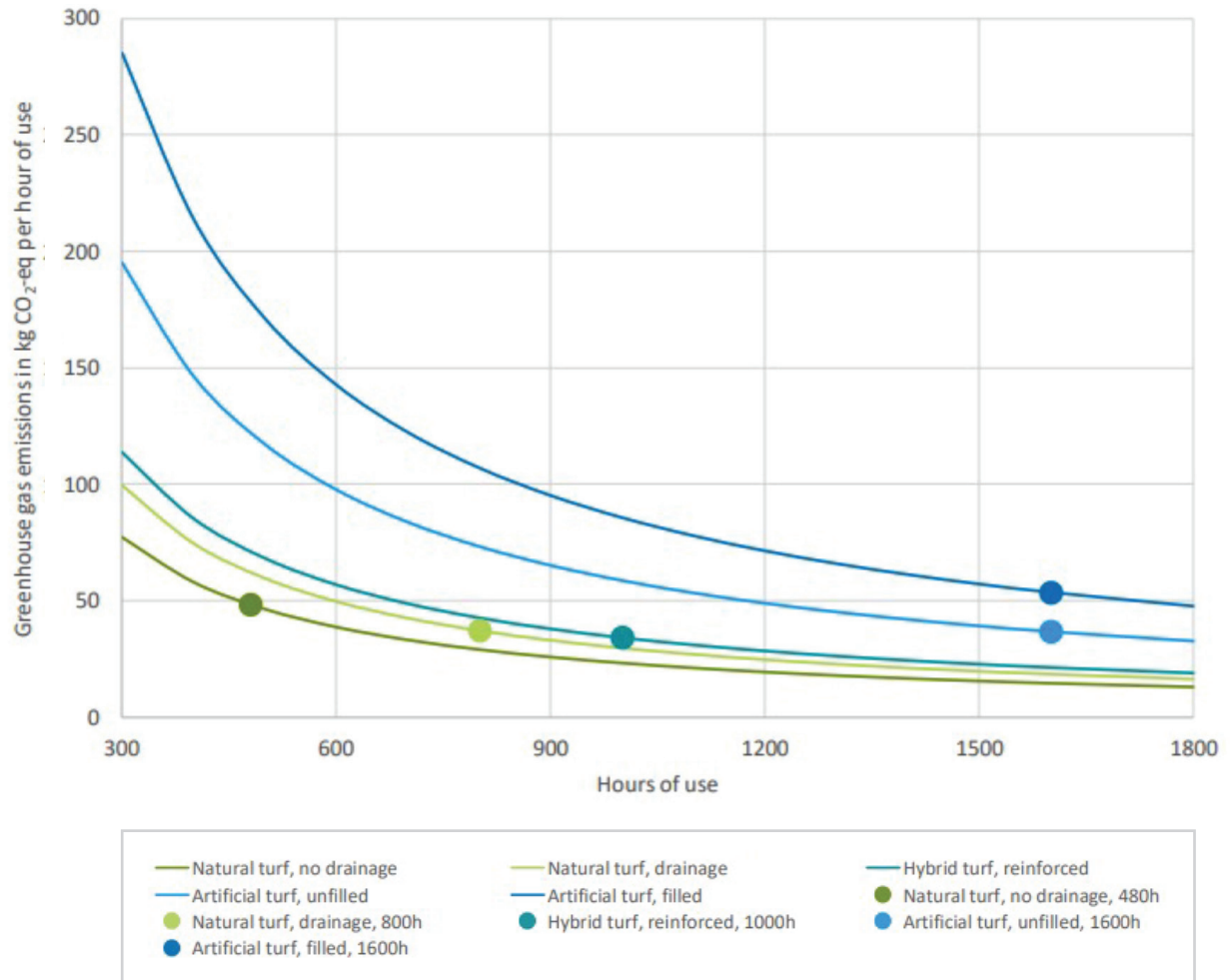
The results show that kgCO<sub>2</sub>e per hour of use begins to converge as hours of use increase.

For example, you may only be able to get 500 hours of use from the natural turf without drainage (lowest footprint option), while you may be able to get 1600 hours of use from the artificial turf filled (highest footprint option)—**yet the greenhouse gas footprint per hour of use for both field types would be the same.**



The annual usage time not only depends on the turf type, but also on other factors like the existing infrastructure for lighting that allows for longer daily usage of the sports fields

Greenhouse gas emissions in kg CO<sub>2</sub>-eq according to IPCC (2013) per hour of use, depending on the total hours of use per year visualized for the natural, hybrid, and artificial turf sports fields under study; data points indicate the theoretical hours of use.



## DOES PLAYING ON ARTIFICIAL TURF INCREASE THE RISK OF PLAYER INJURIES?

Keeping your athletes safe has been and will always be FieldTurf's first priority.

.....

When reviewing artificial turf and player safety, it's crucial to remember that not all turf is created equal.

### THE FIELDTURF DIFFERENCE:

- FieldTurf's heavyweight infill systems were proven to deliver a lower incidence of total injuries.
- FieldTurf's unique wide-gauge design delivers leading cleat release times

FieldTurf is the only artificial turf company with systems reviewed by published peer-reviewed research.

### STUDY HIGHLIGHTS:

#### [COLLEGE FOOTBALL](#)

##### FIELDTURF VS NATURAL GRASS

3-year study

##### FieldTurf systems led to:

- 13% Fewer Muscle Strains / Tears
- 11% Fewer Concussions
- 31% Fewer Ligament Tears
- 24% Fewer High Ankle Sprains
- 21% Fewer Severe Injuries
- 23% Fewer Injuries on 4-8+ Year Old Surface

#### [HIGH SCHOOL FOOTBALL](#)

##### FIELDTURF VS NATURAL GRASS

5-year study

##### FieldTurf systems led to:

- 44% Fewer Concussion Injuries Combined
- 43 % Fewer ACL Injuries Combined
- 25% Less Time Lost to Long-Term Injuries (22+ Days)
- 16% Less Time Lost to Short-Term Injuries (1-2 Days)



## HIGH SCHOOL FOOTBALL

### HEAVYWEIGHT INFILL VS OTHER INFILL WEIGHT SURFACES

7-year study

RECIPIENT OF THE 2016 AMERICAN ORTHOPAEDIC SOCIETY FOR SPORTS MEDICINE SPORTS TRAUMA AND OVERUSE PREVENTION (STOP) SPORTS INJURIES AWARD FOR TOP RESEARCH ON YOUTH SPORTS INJURY PREVENTION

Systems with >9 lbs per square foot of infill compared to all other infill weight surfaces led to:

- 19%-29% lower incidence of total injuries
- 35%-55% lower incidence of Substantial injuries
- 19%-26% lower incidence of severe injuries
- 32%-47% lower incidence of player-to-turf injuries
- 17%-22% lower incidence of Ligament Sprains and Tears
- 58%-63% lower incidence of injuries on surfaces aged 8+ years, vs systems with 0-5.9 lbs per square foot

### FIELDTURF RESEARCH SPOTLIGHT

Independent and third-party multi-year research is validating our effort to provide athletes with the safest field possible.

FieldTurf has been actively collaborating with the University of Calgary researchers for many years on advanced traction research projects, as well as working with Penn State University's Center for Sports Surface Research on a variety of research studies.

Our latest venture, the [Smart Team Project](#). The FieldTurf Innovation & Performance Center (FIPC) has sourced the latest and most advanced technology in athlete monitoring, analytics, and sports surfacing to connect its partner school.

With the help of advanced biometrics and real-time analytics, the SmartTeam Project will collect millions of data points obtained through athlete monitoring wearables, video analytics, and surface testing. The project's mission is to translate the findings into tangible learnings that could result in meaningful change for athletes.



The technology will record in-depth athlete biometrics (heart rate, speed, distance, player load), head impacts in real-time and monitor recovery, strain, and sleep. The SmartTeam Project will leverage an advanced video analysis tool and connect to the world's only smart field technology to monitor field activity and maintenance. This technology will enable the recording of live events and overlay them with precise field surface conditions obtained through a battery of industry testing

Every day, FieldTurf pushes the boundaries of research and innovation to engineer the most advanced artificial turf system in the industry.



## WHICH OFFERS THE GREATEST VALUE: ARTIFICIAL TURF OR NATURAL GRASS?

A high-quality natural grass field can only be utilized for a fraction of the time an artificial turf field can be utilized.

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Artificial turf can be played on for 3,000 hours/year, whereas a natural grass field can be utilized for 300 – 600 hours to maintain its best playable condition.

FOR EXAMPLE, THE MONTGOMERY COUNTY WORK GROUP CONCLUDED:

“Despite the higher up-front and future replacement costs, an artificial turf MCPS Stadium field provides a substantially lower net cost per hour of use than any of the natural grass options because of the substantially increased hours of use and additional revenue generated from that increased use.”

20 YEAR COST SUMMARY						
20 YEAR NET COSTS		Artificial Turf	Bermuda (Sand Base)	Kentucky BG (Sand Base)	Bermuda (Native Soil)	Cool Season (Native Soil)
	Initial Capital Cost	1,125,000	530,000	580,000	150,000	75,000
	20 Year Replacement Cost*	1,280,000	150,000	175,000	100,000	60,000
	20 Year Maintenance / Other Costs	206,000	1,000,000	1,000,000	900,000	500,000
	20 Year Total Costs	2,611,000	1,680,000	1,755,000	1,150,000	635,000
	20 Year Revenue - MCPS**	1,600,000	-	-	-	-
	20 Year Net Cost - MCPS	1,011,000	1,680,000	1,755,000	1,150,000	635,000

COST PER HOUR OF USE	ANNUAL HOURS OF USE	2,300	600	500	400	300
	20 YEAR NET COST PER HOUR OF USE - MCPS	21.98	140.00	175.50	143.75	105.83

\*Assumes two artificial turf carpet replacements (after years 8 and 16) and one major natural grass rehab after year 12.  
\*\*No revenue assumed for natural grass fields since MCPS would reserve these fields only for MCPS team games and practices.



In 2020, a report prepared by Atlanta-based planning, engineering and landscape architecture firm Eberly & Associates for Woodward Academy in East Point, GA, sheds significant light on the topic.

The firm combined initial installation and annual maintenance costs for a new baseball field at a college-preparatory school with an estimated annual hour of usage to perform a 10-year lifecycle and hourly cost analysis of both artificial turf and natural grass.

The report concluded that over 10 years, the cost per hour of a synthetic turf was less expensive than natural grass.

	SYNTHETIC TURF	NATURAL GRASS
TOTAL COST	\$895,041	\$550,102
ASSUMPTION OF AVAILABLE USE	48 WEEKS/YEAR - 42 HRS/WEEK	40 WEEKS/YEAR - 20 HRS/WEEK
TOTAL AVAILABLE HOURS	2,016 HOURS	800 HOURS
COST PER HOUR	\$44.40	\$68.76

Maintenance costs for grass were estimated at \$23,000 per year, while annual maintenance costs for synthetic turf were estimated at \$5,000.

*“The availability-of-use calculation varies among researchers and manufacturers, but generally it is thought that with weather issues (i.e. drainage from large rain events) and maintenance requirements – which include actual field maintenance and resting a natural field from use – a synthetic field would have anywhere from two to three times greater availability of use,”* the report concludes.

The results of the firm’s analysis indicate that even though upfront costs for a synthetic turf baseball field might be higher than grass, turf will pay long-term dividends in the form of less maintenance and extended use over a 10-year period. Cost isn’t the only factor to consider when examining artificial turf vs natural grass for baseball.



## HOW ARTIFICIAL TURF IS MAKING A DIFFERENCE FOR ATHLETES, SCHOOLS, AND COMMUNITIES

### Synthetic Turf Increases Access To Play In Wet And Chilly Washington.

*“Those teams who had access to turf fields played, while those that didn’t had to reschedule.”*

(Tim Martinez, [“Martinez: Turf fields benefit most, but not all,”](#) The Columbian, 4/18/23)

.....

### Julie Souza, Deputy Mayor and Councilmember, Rye City, Souza Says Set The Record Straight on Artificial Turf.

*“Natural Grass Can’t Do the Job. The current, failed field cancels play over 40% of the time because (a) it doesn’t recover from rain and (b) a natural grass playing surface cannot be maintained under heavy use.”*

*“We asked Princeton’s Graydon whether, given the use hours needed, we should consider a new natural grass field. His response: “Even with the most durable grass, you might as well put dirt down. You won’t be able to maintain [grass].”*

*“Natural grass can only be safely and properly maintained at 10 to 15 hours of weekly use. Rye uses the field 36 to 45 hours per week. The only safe and durable surface that supports that level of use is synthetic turf.”*

(MyRye.com, [“LETTER: Souza Says Set The Record Straight on Artificial Turf”](#), myrye.com, 01/30/24)

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### Jerry Riddle, Father, artificial turf helps daughter have a sense of belonging.

*He said having a new turf field will help his 17-year-old daughter, Sarah, who has Asperger’s Syndrome be able to have a sense of belonging, while having fun on the baseball field.*

(Star Conner, [Local Little League baseball team in Davie County raising \\$500,000 for players with special needs and disabilities](#), WXII12.com, 04/11/24)

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**John Boynton, Carlisle-MA Community Member, Renovates Surfaces With Artificial Turf, After Due Diligence.**

*“All four of my kids do play on these fields. It’s a tremendous opportunity for them to get outside, be active—I’m convinced that they are safe. We found that there is actually twenty years of research that has been undertaken into this specific question and we determined that the science really has spoken clearly.”*

(Safe Fields Alliance, [“The Truth About Crumb Rubber and Artificial Turf.”](#) Youtube, 2/1/16)

.....

**Jim Dorsey, GA High School Athletic Director, Synthetic Turf Does Not Cause A Health Concern And Works Great.**

*“We presently have three artificial turf fields. Our first fields went in about thirteen or fourteen years ago. My course of action, primarily, was just to research studies that I could find on the internet dealing with this issue and based on their findings, there was just no correlation whatsoever that I could find on any of the things that I read that pointed to the fact that crumb rubber could be an issue. You know, my children went to school here, played on these surfaces while they were here. We have thousands of kids that come through, not only just our students here at McEachern High School but our youth leagues, our middle school programs utilize our fields day in – we literally have thousands of kids that have played on our fields over this twelve, thirteen year span and I’ve absolutely had no issues whatsoever.”*

(Recycled Rubber Facts, [“The Many Benefits Of Recycled Rubber.”](#) Recycled Rubber Facts, 2019)

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**Artificial Turf Fields Allowed Football Teams In Vicksburg, MS To Play Extended Seasons Without Worrying About Field Weather Damage.**

*“It’s hard to deny, however, the functional appeal of turf, especially after Week 1 of the high school football season. In the days leading up to the 2019 Red Carpet Bowl, it allowed Warren Central’s Viking Stadium to serve as a central practice facility for both its primary tenants and Vicksburg High’s team. Construction crews are still installing the turf at VHS’ Memorial Stadium, and doing work on the adjacent practice field. The Gators have been bussing to the nearby City Park softball fields and Vicksburg Junior High for practices.”*

(Ernest Bowker, [“Artificial Turf Brings Plenty Of Peace To Mind,”](#) Vicksburg Post, 8/29/19)

.....



**Turf Is A Safe Cost-Effective Option For Kids Of All Ages.**

*“Kids stand a higher risk for these injuries in football due to the conditions of the fields. The maintenance cost to upkeep these fields and repair them as grass fields is enormous even with volunteers doing most of the work. Turf is a much safer and cost-effective option when considering that it can bring in revenue with more than just football.”*

(Jackson, Blake, [“Letter: Artificial Turf Is Safer, Cheaper Than Grass.”](#) State Journal, 12/9/19)

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**Scott Stueber, NY School District Athletic Director, Claims Turf Repairs Have Attracted More Students To Athletics.**

*“‘The grass fields on all three schools were in disrepair,’ Scott Stueber, the district’s athletic director, said. ‘I think the new turf fields have helped all the teams, not just football, and now the field looks cleaner and the kids can take pride in their facilities.’ Coaches for the district’s varsity football teams said the turf fields offered players better footing, and with it, more speed and agility, in games and practices. The fields have also reportedly increased the number of students wanting to play football, and made more frequent practices possible.”*

(Nicole Alcindor, [“Turf Fields Earn High Marks.”](#) LIHerald, 1/2/20)

.....

**Chris Wagner, NY High School Coach, Says Turf Is Safer And Provides A More Consistent, Better Quality Surface.**

*“‘I think the turf field is safer – there’s less injury because there are no rocks or stones – it’s a more consistent surface and, rain or shine, we can play,’ North High School head coach Chris Wagner said. ‘The sidelines, numbers and yard lines are perfect on turf fields, which makes the game more organized.’ Although this was Wagner’s first year of coaching at North, he has coached football at other schools for 40 years. He said he noticed a difference when he played with teams on grass fields. Artificial turf, he said, has a number of advantages over grass fields, including built-in drainage systems, which prevent puddles and mud – conditions, Wagner said, that negatively affect traction and the quality of play on natural grass.”*

(Nicole Alcindor, [“Turf Fields Earn High Marks.”](#) LIHerald, 1/2/20)

.....



**Joe Guastafeste, NY High School Coach, Claims Turf Fields Can Properly Accommodate Multiple Sports Safely.**

*“At South, head varsity coach Joe Guastafeste said that prior to the installation of the artificial turf, the football field was also used as a baseball field. The dual configuration, he said, led to the mixing of clay from the baseball diamond and mud from the football field, which resulted in exceptionally slippery conditions. ‘Our [grass] field was known as the most dangerous field throughout Nassau County because grass would mix with clay, [there would be] constant puddles and there was always dangerous and uneven terrain,’ Guastafeste explained. The turf field, he added, solved those problems.”*

(Nicole Alcindor, [“Turf Fields Earn High Marks.”](#) LIHerald, 1/2/20)

.....

**Michael Rubino, NY High School Football Coach, Claims Turf Lengthens Sports Season.**

*“Central’s varsity football coach and athletic director, Michael Rubino, said his team likes artificial turf because it allowed for more practices. ‘We always had to hope for a dry and sunny day,’ Rubino said, recalling the seasons on natural grass. ‘Now, if it rains or snows the night before, with turf, guys can train more effectively and efficiently because turf fields remain the same in December as it is in the summer.’”*

(Nicole Alcindor, [“Turf Fields Earn High Marks,”](#) LIHerald, 1/2/20)

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**John Germano, NJ High School Athletic Director, Supports Turf Fields Extended Use.**

*“Over the years, Egg Harbor Township, Ocean City and St. Augustine Prep have installed turf fields. Schools are making the move because they find value in the investment, district officials said. The districts are able to save on maintenance, play during inclement weather and use the fields as much as they want, which also benefits local recreation programs. ‘It’s nonstop use for both our high school and our rec programs. It’s great,’ Germano said.”*

(Zac Spencer, [“Barnegat Joins Schools Moving Toward Artificial Turf Fields,”](#) Atlantic City Press, 2/21/20)

.....



**Mike Pellegrino, NJ Athletic Director, Claims Athletic Programs Compete To Get Playing Time On Turf Fields.**

*“The only problem with a field that can take that much abuse is scheduling all the teams that want to play on it, said Mike Pellegrino, Egg Harbor Township athletic director. ‘Sometimes we’re trying to fit 11 games on the field in a six-day span,’ he said. ‘They all want to showcase and play under the lights. As an athletic director, it makes your days much longer.’”*

(Zac Spencer, [“Barnegat Joins Schools Moving Toward Artificial Turf Fields.”](#) Atlantic City Press, 2/21/20)

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**PA Superintendent Prefers Turf Because Lower Maintenance Costs Create Long-Term Cost Savings.**

*“The recommendations for the artificial surface and other renovations would total about \$1.8 million, according to Superintendent Shannon Wagner. A combination of hearing from parents, students, and the community along with more research led to the administration to go with the artificial turf, Wagner said. While preliminary estimates showed artificial turf cost substantially more than natural sod to install, that isn’t the case over a decade when considering maintenance costs. In the long run artificial turf costs less than grass, Wagner said.”*

(Mary Ann Thomas, [“Burrell Administration Recommends Artificial Turf For Buccaneers Stadium.”](#) TRIB Live, 3/11/20)

.....

**American Legion Field at Bartlett High School in Anchorage, AK, hasn’t let a little snow get in the way of its [#baseball](#) and [#softball](#) schedules.**

*“While weather conditions have led to cancellations at several of the area’s non-FieldTurf fields, our turf system, combined with the tremendous efforts of snow removal crews, have helped Bartlett High maintain its status as a reliable game day host.” (4/22/23)*

.....

**Michael Bass (Alvin ISD Athletic Director) loves their FieldTurf at Freedom Field**

*“The great thing about a turf field is that it eliminates having the cost of having to do fertilizer, mowing to maintain, and insecticide, so you save yourself every year approximately \$100,000 – \$150,000, probably even more nowadays. “*

(@SportsDissected on YouTube, Video, 10/01/22)

.....



**Bobby Cruz, Director – United Independent School District Loves FieldTurf’s Exceptional Drainage**

*“We had some unusually heavy rains hit us here in Laredo and our kids were able to practice immediately after the storms. In fact, they wanted to practice in the afternoon on the same day after getting 9 inches of rain in one day. We could have easily done it but the streets were flooded and we didn’t want to risk putting kids on the roads, so we waited until the next day. ALL of our outdoor programs utilized the field.”*

(LinkedIn, post, 08/01/22).

.....

**Antonio Arserio the Mayor of the City of Margate discusses the Reopening of Vinson Park after major renovations.**

*“It’s probably the biggest game changer out of all our parks in our city”*

(@cityofmargatefla on YouTube, [Link](#), 04/23/22)



# FINAL REPORT

## Artificial Turf Study

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Leachate and Stormwater Characteristics



**Connecticut Department of Environmental Protection**  
**July 2010**

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## APPENDICES

Appendix A: Stormwater Sampling and Analysis Documentation

Appendix B: Stormwater Treatment Measures, UNH Fact Sheets

## **1. PROJECT OVERVIEW**

In December 2008, four Connecticut State agencies, the University of Connecticut Health Center, The Connecticut Agricultural Experiment Station, the Connecticut Department of Environmental Protection and the Connecticut Department of Public Health, agreed to jointly develop and implement a study to evaluate the health and environmental impacts associated with artificial turf fields. The overall objectives of the study were to:

1. Identify comprehensively substances, including organic compounds and elements, which derive from the crumb rubber infill used on synthetic turf fields, as well as currently available alternative infill products, through off-gassing and leaching pathways;
2. Establish the level of chemical variability for infill at individual synthetic turf fields and between different synthetic fields in Connecticut;
3. Measure levels of off-gassed compounds and airborne particulate matter in the normal breathing zone of children during a "simulated worse-case scenario" at athletic field(s) in Connecticut (inhalation risk);
4. Measure levels of leached compounds in storm water runoff collected in actual field conditions (environmental risk); and
5. Utilize collected data to make environmental and public health risk assessments regarding outdoor artificial turf fields.

The Department of Environmental Protection ("DEP") was specifically tasked with: (1) collecting stormwater runoff samples from the four artificial turf fields selected for the study; (2) analyzing the stormwater samples for levels of compounds leached from the artificial turf materials; (3) scientifically evaluating the laboratory analysis results; and (4) developing an environmental risk assessment for the artificial turf fields.

This report is not intended to be a comprehensive investigation of the environmental risks associated with artificial turf fields, but a basic assessment of water quality data collected from a limited number of fields during a three-month period. It should be understood, that the ultimate conclusions in the report are based on eight stormwater sampling events, essentially a "snapshot", of an ongoing chemical and physical process.

## **2. SITE SELECTION**

The four artificial turf fields selected for DEP's stormwater sampling plan were the same fields sampled in the summer of 2009 by the University of Connecticut Health Center for airborne contaminants. Specific field selection criteria included: crumb rubber infill, owner permission, installation date, different manufacturers and site location. The owners of the selected four fields provided engineered drainage plans to DEP. DEP staff reviewed the drainage plans and established sampling points that only collected stormwater draining from the artificial turf field.

## **3. ARTIFICIAL TURF FIELD SYSTEMS**

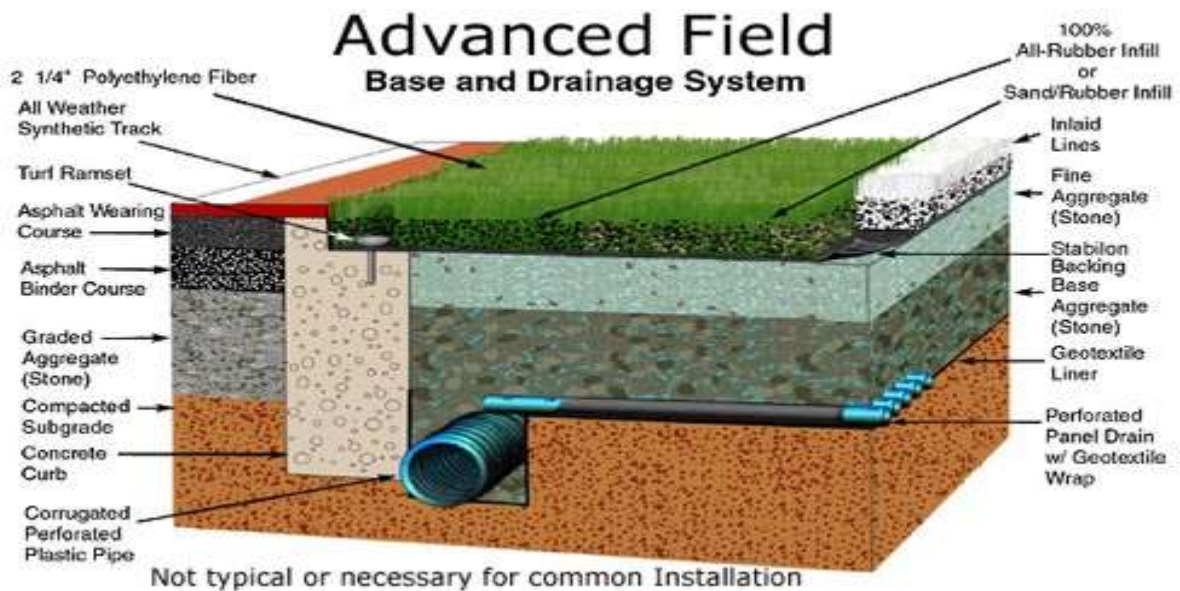
The artificial turf fields selected were installed by different engineering, synthetic turf and construction companies, but are similar in general design. The fields are composed of a top layer

of polyethylene or polypropylene grass fibers, with a crumb rubber (sometimes intermixed with sand) infill layer, and underlain by crushed stone/gravel with a piped drainage system (see Figures 1 and 2 below).

**Figure 1.**



**Figure 2.** (source: [www.suncountysystems.com/.../syntheticgrass.jpg](http://www.suncountysystems.com/.../syntheticgrass.jpg))



The critical field component for this study is the infill layer, which includes crumb rubber materials produced from recycled tires. The infill layer can be composed of entirely styrene-butadiene rubber (SBR) granules, produced by ambient and/or cryogenic grinding process, or intermixed with quartz crystals (sand). The assumption for this study, and the sampling plan, is that precipitation lands on the surface of the artificial turf field, flows downward through the infill and rock/gravel layers, collects in the subsurface drain pipes and then ultimately discharges from the field. The artificial turf drainage pipes often discharge to existing subsurface drainage

systems at catch basin and/or manhole connections. The subsurface drainage pipes utilized under the fields can be solid or perforated.

#### 4. SAMPLING PROTOCOLS

DEP staff reviewed EPA protocols and previous artificial turf leaching studies and established the following stormwater sampling plan:

##### 1. Sampling Plan

- a. One sampling station was established at each of the four artificial turf fields;
- b. The sampling stations were located at a point where runoff was only from the artificial turf field;
- c. The size of the drainage area (in square feet) to each sampling station was calculated;
- d. Grab samples were collected and delivered to the laboratory by qualified individuals during the fall of 2009; and
- e. Samples were analyzed by an EPA certified laboratory.

##### 2. Storm Event Criteria

- a. Samples were collected from discharges resulting from a storm event that was greater than 0.1 inch in magnitude and that occurred approximately 72 hours after any previous storm event of 0.1 inch or greater;
- b. Grab samples were collected during the first 30 minutes of a storm event discharge, or as close thereto as possible, and were completed as soon as possible;
- c. The following information was collected for the storm events monitored:
  - i. The date, temperature, time of the start of the discharge, time of sampling, and magnitude (in inches) of the storm event sampled; and
  - ii. The duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event.

##### 3. Sampling Procedures

- a. Grab sample collection, chain of custody and laboratory delivery were performed in accordance with the EPA NPDES Stormwater Sampling Guidance Document (EPA 833-B-92-001, 7/92); <http://www.epa.gov/npdes/pubs/owm0093.pdf>
- b. Laboratory analysis of grab samples included the following:
  - i. Acute Toxicity 48 hour LC50 *Daphnia pulex* & 48 hour and 96 hour LC50 *Pimephales promelas* (EPA 821-R-02-012).
  - ii. EPA Method 130.1, Hardness, Total (mg/L as CaCO<sub>3</sub>)
  - iii. EPA Method 150.2, pH
  - iv. EPA Method 200.7, (Antimony, Arsenic, Barium, Cadmium, Chromium, Cobalt, Copper, Lead, Manganese, Mercury, Molybdenum, Nickel, Selenium, Thallium, Vanadium and Zinc)
  - v. EPA Method 624, Volatile Organic Compounds
  - vi. EPA Method 625, Semivolatile Organic Compounds (TIC's for Benzothiazole, Butylated hydroxyanisole (BHA), n-hexadecane and 4-(t-octyl) phenol.

## 5. FIELD SAMPLING METHODS

In September of 2009, the stormwater sampling plan was implemented at the four artificial turf fields: Field A, Field B and Field D all constructed in 2007; and Field C constructed in 2005. Stormwater samples were successfully collected from Fields A, C and D. Field B was visited during five precipitation events and no discharge from the established sampling station was observed. A total of eight stormwater samples were collected from Fields A, C and D between 9/11/09 and 12/3/09. Based on DEP staff observations, Fields B and C did not appear to regularly discharge runoff during or after precipitation events, while Fields A and D discharged during and after every precipitation event monitored. For the one sample collected from Field C, DEP staff was fortunate to experience an extremely hard (downpour) rain event that exceeded the infiltration rate of the perforated underdrain system. DEP staff reviewed the engineered drainage plans and determined that Fields B and C utilized perforated drainage pipes causing the stormwater to normally infiltrate into the soil beneath the fields. Fields A and D utilized solid drainage pipes, which discharge the stormwater to local drainage systems at the sites, similar to an impervious surface.

For each precipitation event, stormwater collected at the fields was sampled for total metals, hardness, pH, volatile organic compounds, semi-volatile organic compounds (including rubber Tentatively Identified Compounds found by The Connecticut Agricultural Experiment Station in a 2007 study), pesticides/ polychlorinated biphenyls (PCBs) and acute aquatic toxicity (48 hours for *Daphnia pulex* (Dp) and 96 hours for *Pimephales promelas* (Pp)). Stormwater samples were analyzed at the Connecticut Department of Public Health Laboratory, Environmental Chemistry Division, Inorganic Chemistry Section, 10 Clinton Street Hartford, CT 06106 for pH, Hardness and Total Metals; at Phoenix Environmental Laboratories, Inc. 587 East Middle Turnpike, Manchester, CT 06040 for volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs; and at GZA GeoEnvironmental, Inc., 120 Mountain Avenue, Bloomfield, CT 06002 for acute toxicity. A summary of the tests performed on the samples collected are shown in Table A below.

Table A

Location	Date	pH	Hardness	Metals	Volatiles	Semivolatiles	Pesticides and PCBs	Aquatic Toxicity LC50		
								Dp 48 hrs	Pp 48 hrs	Pp 96 hrs
Field C	9/11/09			√	√	√	√			
Field A	9/27/09	√	√	√	√	√	√			√
Field A	10/7/09	√	√	√	√	√	√			√
Field A	10/18/09	√	√	√	√	√	√		√	
Field D	10/18/09	√	√	√	√	√	√		√	
Field D	10/28/09	√	√	√	√	√	√			√
Field D	11/20/09	√	√	√	√	√		√		√
Field D	12/3/09	√	√	√	√	√	√	√		√

## **6. DEP STORMWATER SAMPLING RESULTS**

### **a) Method 624/Method 625 and Tentatively Identified Compounds(TICs):**

No standard volatile or semi-volatile organic compounds were detected in any sample using the EPA 624 and 625 analytical methods. All samples were analyzed for non-standard semi-volatile organic compounds, including the following rubber compounds benzothiazole, butylated hydroxyanisole (BHA), n-hexadecane and 4-(t-octyl) phenol. The semi-volatile analysis detected the analytical peaks of twenty-two compounds, of which nine were tentatively identified (see Table B below). The concentrations of these compounds ranged from 1 ug/l to 150 ug/l. The grey columns in Table B correspond to the three stormwater samples determined to be acutely toxic. Table C details the aquatic toxicity information found for the other tentatively identified compounds listed in Table B.

### **b) Pesticides and PCBs (Method 608)**

#### **Pesticides**

Pesticides were detected in the samples of stormwater collected on September 11, 2009 from Field C and on October 28, 2009 from Field D. DEET and heptachlor were detected at estimated concentrations of 6.9 ug/l and 0.18 ug/l, respectively. It is assumed that these substances were not derived from the artificial turf, but were a result of pesticide applications at the site.

#### **PCBs**

No PCBs were detected during the stormwater sampling events.

### **c) pH, Hardness and Metals:**

The results from the pH, hardness and metals analysis conducted on the stormwater runoff from the fields are presented in the table below.

#### **pH**

The pH of the stormwater samples ranged from 6.6 to 8.0. The pH of stormwater in Connecticut is generally considered to be between 5.6 and 6.0. Based on this fact, the pH of the stormwater samples are more alkaline than expected. It is possible that the crushed stone used as a sub-base in the fields affected the pH of the stormwater as it drained through the field.

The pH alone does not exhibit toxic effects unless it falls below 5 or is higher than 10. However, metals are often more soluble and toxic at lower pH's. The observed neutral pH in the stormwater may have reduced the concentrations and toxicity of the metals leaching from the fields.

TABLE B

Location: Sample # Sample date			Field C A	Field A B	Field A C	Field A E	Field D D	Field D F	Field D G	Field D H
Parameter: Tentatively identified Compounds	CAS#		9/11/2009	9/27/2009	10/7/2009	10/18/2009	10/18/2009	10/28/2009	11/20/2009	12/3/2009
Heptachlor Retention Times (min)							<0.10	0.18	NT	<0.05
3.55			6.2							
5.04					150					
6.12			4.3							
6.63										9.5
6.81					4.1					
6.83	2- propyl-methyl pentanoic acid	22632-59-3			14	6.6				
6.85	Benzothiazole	95-16-9		1	4.9					
6.88					6.1					
7.07									5.1	
7.08	methyl 2alpha -D-xylofuranoside	32469-86-6				5.8				
7.10	2 ethyltetra hydro thiopene	1551-32-2				28				
7.13	4-methyl4-Heptanol	598-01-6				7.4				
7.15	2- butyl tetrathydrothiopene	1613-49-6				12				
7.77										10
7.96								6.6		
8.13					7.4					
8.23									7	
9.48	Benzamide, N-N- diethyl-3- methyl	134-62-3	6.9							
9.56	2(3H)- Benzo thiazolone	934-34-9			5.7					
10.28						4.1				
12.60	2-2-7 trimethyl-3-Octyne	55402-13-6					4.5			
16.88			8.4							

TABLE C

Location: Sample # Sample date			Max Concentration	Location	Acute Water Quality Criteria	Chronic Water Quality Criteria	Comments
Parameter: Tenatively identified Heptachlor Compounds	CAS#						
Retention Times (min)							
3.55			0.18	D	0.26	.0038	CT WQS 2002
5.04			6.2	A			
			150	A			
6.12			4.3	D			
6.63			9.5	A			
6.81			4.1	A			
6.83	2- propyl-methyl pentanoic acid	22632-59-3	14	A	2812.5	312.5	Toxicity info on pentanoic acid tier 2
6.85	Benzothiazole	95-16-9	4.9	A			One data point tier 2
6.88			6.1	A			
7.07			5.1	D			
7.08	methyl 2alpha -D-xylofuranoside	32469-86-6	5.8	A			No data
7.10	2 ethyltetra hydro thiopene	1551-32-2	28	A			No data
7.13	4-methyl4-Heptanol	598-01-6	7.4	A			No data on Heptanol either
7.15	2- butyl tetrathydrothiopene	1613-49-6	12	A			No data
7.77			10	D			
7.96			6.6	D			
8.13			7.4	A			
8.23			7	D			
9.48	Benzamide, N-N- diethyl-3- methyl	134-62-3	6.9	C	89.3	9.9	DEET tier 2
9.56	2(3H)- Benzo thiazolone	934-34-9	5.7	A	47.3	8.1	Different CAS # 149304 tier 2
10.28			4.1	A			
12.60	2-2-7 trimethyl-3-Octyne	55402-13-6	4.5	D			No data
16.88			8.4				

## Hardness

The hardness of the stormwater samples ranged from 8 to 59 mg/L. Hardness in the range of 0 to 60 mg/L is generally termed “soft”. Hardness can also influence the toxicity of metals; the greater the hardness, the less toxic the metals. It is not expected that the observed hardness had much effect on metal concentrations in the stormwater.

## Metals

The metal parameters which had results reported above the detection limit are listed in Table C below. Silver, molybdenum, thallium and beryllium were analyzed but were below the detection limit for every sample. In Table C, the values bolded and underlined exceed Connecticut’s acute aquatic life criteria. Metal concentrations in excess of the acute aquatic life criteria for more than one hour could cause mortality to the more sensitive organisms in the receiving surface waters. The values bolded meet or exceed Connecticut’s chronic aquatic life criteria. Average metal concentrations which exceed the chronic life criteria for more than 4 continuous days are expected to impact the ability of organisms to survive, reproduce or grow. EPA recommends that neither of these criteria be exceeded more than once in three years (EPA TSD EPA/505/2-90-001). The samples highlighted in grey also exhibited acute toxicity. Since stormwater is an intermittent discharge, the acute criteria for aquatic toxicity are more applicable. A review of the data indicates that only zinc consistently violates the acute criteria.

TABLE D

Location	Sample #	Sample date	pH	Hardness	Conductivity	Cu ug/l	Zn ug/l	Ba ug/l	Fe ug/l	Al ug/l	V ug/l
Field C 2005	A	9/11/09	6.6	NA	18	4	<u>150</u>	4	320	<b>210</b>	40
Field A 2007	B	9/27/09	6.6	8	20	1.5	<u>130</u>	1.5	20	25	1.5
Field A 2007	C	10/7/09	7.5	29	65	1.5	10	6	50	<b>160</b>	5
Field A 2007	E	10/18/09	7.5	39	86	1.5	20	7	20	60	1.5
Field D 2007	D	10/18/09	7.6	53	130	5	<u>260</u>	<b>220</b>	170	<b>120</b>	6
Field D 2007	F	10/28/09	7.9	59	157	4	50	8	80	80	8
Field D 2007	G	11/20/09	8	56	153	4	30	7	160	<b>110</b>	9
Field D 2007	H	12/3/09	8	58	147	4	20	5	170	<b>100</b>	8

acute standard	<5.0					<u>14.3</u>	<u>65</u>	<u>2000</u>		<u>780</u>	<u>150</u>
chronic standard	<5.0					4.8	65	220	1000	87	44
	>10										
	>10										

#### d) Aquatic Toxicity

The toxicity tests conducted on the stormwater measured both an LC50 value (the concentration of stormwater that is lethal to 50% of the test organisms) and an NOAEL (No Observable Acute Effect Level, the concentration of stormwater where no acute toxicity is observed). Toxicity tests conducted on the samples of stormwater collected indicate that 3 out of 8 sampling events were acutely toxic. Acute toxicity is observed when there is less than 90% survival of the test organisms in the undiluted effluent. The frequency of occurrence for acute toxicity was at least one sample per field. Where both *Pimephales promelas*(Pp) and *Daphnia pulex*(Dp) toxicity tests were conducted, the fathead minnow (*Pimephales promelas*) seemed to be slightly more sensitive to the contaminants in the stormwater discharge. Due to laboratory issues, the test duration for the fish, *Pimephales promelas*, for the October 18, 2009 Field A and Field D samples was limited to only 48 hours. If the test duration was extended to 96 hours, both samples could have had an LC50 value less than the 100% reported. The results for the aquatic toxicity testing conducted are shown in Table E below.

TABLE E

Location:	Sample #	Sample date	Dp % Surv 100%	Dp LC50	Dp NOAEL	Pp % Surv in 100%	Pp LC50	Pp NOAEL
Field C 2005	A	9/11/2009	65.0	>100	12.5	NT	NT	NT
Field A 2007	B	9/27/2009	70.0	>100	50	45	93.89	50
Field A 2007	C	10/7/2009	100.0	>100	100	100	>100	100
Field A 2007	E	10/18/2009	100.0	>100	100	96	>100	100
Field D 2007	D	10/18/2009	70.0	>100	6.25	50	100	25
Field D 2007	F	10/28/2009	100.0	>100	100	95	>100	100
Field D 2007	G	11/20/2009	100.0	>100	100	100.0	>100	100
Field D 2007	H	12/3/2009	100.0	>100	100	95	>100	100

acutely toxic

#### 7. CAES LABORATORY HEADSPACE AND LEACHING RESULTS

The CAES performed both headspace (off-gassing) and SPLP (Standard Precipitation Leaching Procedure) evaluations on seventeen samples of crumb rubber materials used as infill for artificial turf fields. These studies indicated the primary contaminants likely to be found in the stormwater coming from these sites. Organic compounds were identified by head space analysis, with results shown in Table F below. The other organic compounds detected from the crumb rubber infill, but not quantified in the analysis, included hexadecane, fluoranthene, phenanthrene and pyrene.

TABLE F. (Table 2. From CAES 2009) Concentration (ng /ml) of Volatile Compounds in Headspace Over Crumb Rubber Samples Analyzed at CAES (average of two analyses per sample)

DEP Sample ID	1-methyl naphthalene	2-methyl naphthalene	4-(t-octyl)-phenol	benzothiazole	butylated hydroxytoluene	naphthalene	butylated hydroxyanisole
A1001	0.13	0.19	0.28	3.98	n.d.	0.42	0.50
A1002	0.11	0.15	0.31	5.59	n.d.	0.31	0.61
A1003	0.03	0.07	0.19	8.67	n.d.	0.10	0.68
A1004	0.04	0.07	0.31	6.52	0.15	0.16	0.69
A1005	0.08	0.09	0.23	2.35	0.09	0.23	0.46
A1006	0.08	0.14	0.31	4.89	0.12	0.23	0.75
A1007	0.13	0.20	0.52	3.50	n.d.	0.23	0.69
A1008	0.06	0.10	0.18	1.93	n.d.	0.22	0.43
A1009	0.03	0.06	0.13	2.89	0.13	0.08	0.50
A1010	0.07	0.11	0.22	4.91	0.13	0.20	0.64
A1011	0.04	0.06	0.30	3.94	0.16	0.11	0.62
A1012	0.08	0.14	0.46	2.70	0.13	0.28	0.64
A1013	0.09	0.12	0.45	4.45	n.d.	0.30	0.65
A1014	0.10	0.15	0.49	4.25	n.d.	0.31	0.65
B1002	n.d.	n.d.	0.43	1.21	0.67	0.09	0.36
B1009	n.d.	n.d.	0.07	1.29	0.48	0.06	0.35
B1010	n.d.	n.d.	0.06	1.03	0.40	0.05	0.34

CAES also performed simulated weathering experiments on the crumb rubber samples to determine trends in organic compound emissions over time. The weathering test results show that, except for 4-(t-octyl)-phenol, all other detected volatile compounds significantly decreased in concentration after only 20 days of outdoor exposure. By the end of the eight week study, benzothiazole, butylated hydroxyanisole and 4-(t-octyl)-phenol were detected at the highest concentrations. The results are shown in Table G. below.

TABLE G: (Table 9 from CAES, 2009) Concentrations (ng /ml) of Volatile Compounds in Headspace Over Crumb Rubber Samples Aged at CAES (average of two analyses per sample)

Sample ID (week)	benzothiazole	1-methyl naphthalene	2-methyl naphthalene	naphthalene	4-(t-octyl)-phenol	butylated hydroxyanisole
T0	3.75	0.12	0.24	0.40	0.35	0.77
T1	1.95	0.05	0.09	0.12	0.28	0.45
T2	0.97	0.04	0.06	0.06	0.31	0.40
T3	1.56	0.04	0.07	0.08	0.31	0.44
T4	1.77	0.04	0.08	0.08	0.30	0.43
T5	1.59	0.05	0.07	0.10	0.30	0.48
T6	1.20	0.04	0.06	0.05	0.25	0.36
T7	0.99	0.04	0.06	0.04	0.24	0.33
T8	1.17	0.05	0.05	0.06	0.23	0.41

CAES also performed an SPLP test on the same seventeen samples of the crumb rubber infill material. The resulting leachate was then analyzed for metals and organic compounds. Based on communications with CAES, the leachate contained the same organic compounds that were identified in the head space analyses, however, only benzothiazole concentrations were estimated for the test. A summary of compounds detected and their concentrations are listed in Table H below. Based on these results, the predominant contaminant leaching from artificial turf fields is

zinc, followed by barium, manganese and lead. It should be noted some metals associated with tires and rubber products were not analyzed in this experiment, such as iron and vanadium.

In Table H, the values which exceed Connecticut’s acute aquatic life criteria are highlighted in yellow. The summary shows that zinc is present in the leachate at concentrations about 500 times greater than the toxicity criteria. The leachate study indicates that there is a high potential for the artificial turf to leach acutely toxic levels of metals especially copper and zinc. Certain samples of crumb rubber also leached acutely toxic levels of cadmium, barium, manganese and lead.

TABLE H

	Benzothiazole	Cr	Mn	Ni	Cu	Zn	As	Cd	Ba	Pb
ug/l										
<b>average</b>	0.153	6.24	263.16	19.88	22.31	34170.5	3.35	1.60	313.88	11.57
<b>80<sup>th</sup></b>	0.209	11.28	348.45	27.48	20.41	50269.8	1.50	0.50	463.62	7.77
<b>Max</b>	0.268	31.47	1443.19	57.15	143.32	71535.5	27.94	17.01	502.91	69.90
<b>Acute</b>	21333.000	323	616	260.5	14.3	65	340	2.02	2000	30
<b>Chronic</b>	3200.000	42		28.9	4.8	65	150	1.35	220	1.2

## 8. DISCUSSION

### a) Potential Contaminants

The analyses performed on the stormwater samples were focused on compounds previously documented to leach from crumb rubber material derived from recycled tires, primarily volatile organic compounds, semi-volatile organic compounds and metals. The stormwater samples were also assessed for whole effluent toxicity. Other potential parameters of concern in the stormwater were identified from the results of the CAES off-gassing and leaching laboratory studies performed on the crumb rubber material.

### b) Organic compounds

The stormwater generated at the artificial turf sites did not include many readily identifiable, volatile or semi-volatile organic compounds, as evidenced by no detections using EPA Methods 625 and 624. Additional semi-volatile compound investigations were performed on the stormwater samples, resulting in nine tentatively identified compounds and thirteen unidentified chromatograph peaks. Benzothiazole, which CAES also detected in their leaching analysis, was identified in the September 27 and October 7, 2009 samples from Field A at concentrations of 1 and 4.9 ug/l, respectively. Of the compounds that were tentatively identified such as benzothiazole, pentanoic acid, and thiopenes, none of these compounds are considered particularly toxic to aquatic organisms at the estimated concentrations.

Although it is not possible to determine the potential impact of the unidentified semi-volatile compounds, it is important to note, that the six highest concentrations of the unidentified semi-volatile compounds detected (150 ug/l, 28 ug/l, 14 ug/l, 12 ug/l, 10 ug/l and 9.5 ug/l) did not correspond to the three acutely toxic samples of stormwater determined in the study.

The results from the CAES laboratory headspace, leaching and simulated weathering tests suggest that benzothiazole, 4-(t-octyl)-phenol, 1-methyl naphthalene, 2-methyl naphthalene, naphthalene, butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) are the likely semi-volatile compounds to be found in the stormwater discharge from artificial turf fields. The test results also suggest that Benzothiazole, 4-(t-octyl)-phenol and butylated hydroxytoluene (BHT) would be the most persistent SVOCs in the crumb rubber as the artificial turf fields aged.

Comparing the VOCs and SVOCs results to EPA's Maximum Contaminant Levels for drinking water (MCLs) and DEP's Remediation Standards Regulations, Section 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies (June 1996), no exceedences of groundwater standards have been identified.

Based on our results, no VOCs or SVOCs have been identified as risks to surface and groundwater resources.

### **c) Metals**

The laboratory leaching analyses performed by CAES as part of the State of Connecticut Artificial Turf Study detected the following metals: arsenic (As), barium (Ba), cadmium (Cd), chromium (Cr), lead (Pb), manganese (Mn), nickel (Ni), and zinc (Zn). Zinc was present in concentrations orders of magnitude greater than the other metals. CAES's leaching analyses indicated that both copper (Cu) and zinc (Zn) concentrations exceeded acute aquatic toxicity criteria for 80% of the tests, with limited (<20%) exceedences of acute criteria for cadmium (Cd), manganese (Mn) and lead (Pb).

The stormwater analysis results show that the artificial turf fields in our study leached significantly less contaminants, specifically zinc and copper, than predicted by the CAES leaching test results. The lower metal concentrations observed in the stormwater could be a result of alkaline pHs, the weathering (2-4 years since installation) of the crumb rubber infill, or the conservative approach inherent in the SPLP methodology.

The stormwater analysis results showed that zinc was the only metal to exceed the acute aquatic toxicity criteria (65 ug/l), with one exceedence at each of the three study fields. The overall mean concentration of zinc in the stormwater samples analyzed was 84 ug/l, with a maximum of 260 ug/l and a minimum of 10 ug/l. The stormwater analysis results showed that aluminum, barium, copper and zinc all exceeded chronic aquatic toxicity criteria at least once during the sampling. Since chronic toxicity criteria apply to four days of continuous discharge, these exceedences are not of significant concern for these intermittent discharges.

No metal concentrations exceeded EPA's and DEP's drinking water standards. However, the concentration of zinc in three stormwater samples did exceed the surface water protection

criteria of 123 ug/l established in the Appendix D to Sections 22a-133k-1 through 22a-133k-3 of the Regulations of Connecticut State Agencies Surface-water Protection Criteria for Substances in Ground Water (June 1996). Since the mean concentration of zinc in the stormwater samples (84 ug/l) is below the surface water protection criteria, the discharge from the artificial turf fields to groundwater is intermittent, and zinc is immobilized in soils by adsorption, absorption and precipitation, the potential for impacts to surface waters being recharged by this groundwater is minimal.

Based on our results, zinc has been identified as a potential risk to surface waters. No other metals have been identified as a risk to groundwater or surface waters.

## **9. ENVIRONMENTAL RISK ASSESSMENT**

### **a) Potential Risk to Surface Waters**

The only potential risk to surface waters identified in the stormwater collected from the artificial turf fields is zinc, since it was the only chemical parameter that was detected above the acute aquatic life criteria of 65 ug/l. Acute toxicity is assumed to occur when the zinc concentration in-stream exceeds 65ug/l for one hour in any three year period. In three of the eight stormwater samples analyzed, zinc concentrations were detected at 130, 150 and 260 ug/l, well above the acute aquatic life criteria. It is important to note, that the three stormwater samples with acutely toxic levels of zinc were also determined to exhibit aquatic toxicity (<90% survivorship) for both species *Pimephales promelas* and *Daphnia pulex* in the whole effluent toxicity testing.

Other than the acute aquatic toxicity criteria, there are no specific zinc standards or permit limits that are applicable to artificial turf fields. For industrial sites that discharge to surface waters, DEP has set a stormwater general permit guideline (Section 5 (c) (1) (F) (i) of the General Permit) for total zinc of 200 ug/l. This industrial stormwater total zinc guideline assumes a default 5:1 dilution factor for the receiving surface water at the 7Q10 flow. The 7Q10 is the lowest flow expected to occur for seven continuous days at a frequency of every 10 years. The 7Q10 flow is the critical low flow used when evaluating toxicity and toxic impacts (CT WQS 2002). Based on the results of our study, the stormwater discharges from artificial turf fields would not be expected to regularly exceed this zinc limit.

However, the estimated 7Q10 flows for the receiving watercourse from Fields A, C and D did not meet the 5:1 dilution factor for stormwater discharges from artificial turf football fields (57,600 square feet), assuming a one inch rain storm over one hour with direct discharge to the watercourse over an hour. It is important to note, that this a conservative approach, which assumes the watercourse receives no other stormwater runoff from its representative watershed. For the three receiving streams in the study, the highest dilution factor at the DEP estimated 7Q10 flow was equivalent to a 0.14:1 ratio. Given this dilution ratio of the receiving streams in the study, there is a potential for acute toxicity due to zinc loading.

Since zinc concentrations in stormwater from artificial turf fields may pose a risk to surface waters, especially to smaller watercourses, it is important to note that these fields are not the only sources of stormwater runoff in any given watershed. During the sampling at Fields A, C and D,

DEP staff observed stormwater runoff, generated by acres of parking lots, roadways and buildings, entering the same drainage systems that collected runoff from the artificial turf fields. Based on these observations, it appears that stormwater runoff from the artificial turf fields is combined with the runoff from the adjacent impervious surfaces prior to ultimate discharge at the site.

This is an interesting phenomenon, since the levels of zinc in urban runoff are comparable to the concentrations detected in the discharge from artificial turf fields. It has been well established that urban runoff contains many contaminants such as nutrients, suspended solids, hydrocarbons and heavy metals, including zinc. The average concentration of zinc in urban stormwater runoff has been estimated at 129 ug/l in recent studies (Smullen 1998). EPA's Nationwide Urban Runoff Program (NURP) has collected runoff data and determined that for urban sites the median concentrations of total zinc ranged from 179 -226 ug/l. The National Stormwater Quality Database (NSQD, version 1.1), dated February 16, 2004, compiled zinc concentration data in runoff from various land uses across the United States, which is shown in Table L below.

TABLE I

<b>Land Uses</b>	<b>Zinc Total (ug/l) Median</b>
Overall (All Uses)	117
Residential	73
Mixed Residential	99.5
Commercial	150
Mixed Commercial	135
Industrial	210
Mixed Industrial	160
Institutional	305
Freeways	200
Mixed Freeways	90
Open Space	40
Mixed Open Space	88
<b>CT Artificial Turf Stormwater</b>	<b>84 (mean)</b>

Since zinc concentrations in the runoff from artificial turf fields are consistent with those associated with urban runoff, it would be a logical step to apply the same best management practices (BMPs) to mitigate the toxicity effects to surface waters. The 2005 Stormwater Management Manual for Western Washington specifically recommends the following BMPs to remove dissolved zinc (and other metals) from stormwater runoff: stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures. The 2004 Connecticut Stormwater Quality Manual suggest the same measures since these treatment practices incorporate biological removal mechanisms that are more effective in removing pollutants than systems that strictly rely on gravity or physical separation of particles in the stormwater. The 2004 Connecticut Stormwater Quality Manual further recommends a treatment train approach, which provides a series of BMPs each designed to provide targeted pollution control benefits.

The University of New Hampshire Stormwater Center has field tested many of these stormwater BMPs that demonstrate significant removal of dissolved zinc. For example, the Retention Pond, Subsurface Gravel Wetland and Bioretention System (Bio II) stormwater treatment measures, over a two year period, removed between 90% and 100% of the soluble zinc, based on a median annual influent Event Mean Concentrations (EMC) of 60ug/l (see Appendix B for fact sheets). The three highest zinc concentrations detected in the stormwater from artificial turf fields in our study were 130, 150 and 260 ug/l, respectively. Assuming 80% removal of zinc from the stormwater prior to discharge to surface waters, all three of the highest zinc concentrations would meet the acute aquatic toxicity criteria (26, 30 and 52 ug/l, respectively). To mitigate the risk to aquatic life and surface waters, the DEP strongly recommends that the aforementioned stormwater best management practices be incorporated into the design of the drainage system for artificial turf fields.

## **10. ENVIRONMENTAL RISK ASSESSMENT IN RECENT STUDIES**

Several other studies were conducted to determine the risk to surface waters and groundwater from the stormwater discharges from artificial turf fields. Since artificial turf fields can either discharge to groundwater or surface water, the ecological risks must be evaluated for both potential pathways. This was confirmed by Nillson et al (2008), that drainage from artificial turf fields can enter the environment by either seeping through the underlying soil and potentially contaminate the groundwater, or alternatively, by stormwater runoff entering the adjacent watercourses.

### **a) Overall Surface Water Contamination Risk**

#### **1) Organic Compounds**

The studies conducted by Plesser (2004) indicated that concentrations of the common polycyclic aromatic hydrocarbons (PAHs) anthracene, fluoranthene and pyrene, as well as nonylphenols, would exceed the limits for freshwater specified in the Canadian Environmental Quality Guidelines. Torsten (2005) from the Norwegian Institute for Water Research (2005) also predicted that concentrations of alkyl phenols and octylphenol in particular would exceed the limits for environmental effects in the scenario which was allowed a 10:1 dilution of run-off. Torsten (2005) further determined that the leaching of chemicals from the materials in the artificial turf system would decrease slowly, so that environmental effects could occur over many years. However, Torsten (2005) anticipated only localized impacts due to the relatively small concentration of the leaching pollutants. The SVOCs analysis of the stormwater in our study, utilizing EPA Method 625, and a specific search for 4-(t-octyl)-phenol, detected no anthracene, fluoranthene, pyrene or standard phenol compounds.

Kolitzus (2006) detected no appreciable PAHs concentrations in the runoff analyzed from artificial surface systems. The PAHs that were found above detection limit were ubiquitous substances in the environment. The PAH concentrations in the unbound supporting layer were determined to be in the range of analytic determination limit (0.02 µg/l). The sum of all 16 PAHs was 0.1 to 0.3 µg/l. Similarly, in a recent New York study (Lim et al 2009), no standard organics were detected utilizing EPA Method 624 and 625 in the stormwater sample collected. The

SVOC analysis of the stormwater in our study, utilizing EPA Method 625, detected no standard PAHs.

In surface systems with EPDM and recycled rubber infill, Kolitzus (2006) found several aromatic amino complexes and benzothiazole detected in the range of 10 – 300 µg/l. These concentrations were similar to the results of simulated normal tire wear tests. Lim et al (2009) reported a semi-volatile rubber compound, benzothiazole, at 1,000 ug/l as a Tentatively Identified Compound (TIC) in one stormwater sample. The SVOC analysis of the stormwater in our study, utilizing EPA Method 625, detected no standard aromatic amines, but further TIC analysis did detect identified and unidentified organic compounds. Benzothiazole was detected in two stormwater samples at estimated concentrations of 1.0 and 4.9 ug/l, respectively, which is significantly lower than concentrations found by Lim et al (2009). The Connecticut acute and chronic toxicity benchmark for benzothiazole are 21,333 ug/l and 3,200 ug/l, respectively, based on available toxicity information. The estimated concentrations of benzothiazole are insignificant compared to both the acute and chronic toxicity criteria. Also, a number of unidentified organic compounds were detected during the SVOC TIC analysis at concentrations ranging from 1 ug/l to 150 ug/l, with a median concentration of 6.6 ug/l. The 10/7/09 Field C stormwater sample, which the maximum unidentified compound concentration of 150 ug/l was detected in, was not found to be acutely toxic.

The results from our study appear to be consistent with the results from Kolitzus (2006) and Lim et al (2009), including the detection of benzothiazole in the stormwater samples. Overall, our study did not identify any organic compounds at sufficient concentrations to be considered a potential contamination risk to surface waters.

## **2) Metals**

Based on our analysis of the stormwater collected from the artificial turf fields, zinc is the only metal detected in concentrations which could pose a risk to surface water resources. This finding is consistent with many recent studies which analyzed leachate and stormwater from crumb rubber infill, which indicate that zinc is the primary contaminant of concern coming from artificial turf sites. In sites with limited dilution both the Norwegian Pollution Control Authority (2005) and Verschoor (2007) conclude that the concentration of zinc in the leachate would exceed applicable water quality standards. The Norwegian Pollution Control Authority classifies artificial turf runoff as Environmental Quality Class V (very strongly polluted water) due to the high concentration of zinc in the leachate. The risk assessment conducted by Norwegian Institute for Water Research (2005) shows that the concentration of zinc poses a significant local risk of environmental effects in surface water which receives run-off from artificial turf fields.

Verschoor (2007) also conducted a risk assessment concluding that the estimated concentrations of zinc in the drainage water from artificial football fields to be between 1100-1600 µg/L. This concentration exceeded the Dutch legal criterion for surface water Maximum Permissible Chronic Concentration (MPC) of 40 ug/l by a factor of 27-40. Verschoor explained that drainage water concentrations would be diluted in the receiving surface waters, but indicated that zinc in “small ditches” could exceed MPA (Maximum Permissible Acute). Verschoor espoused a general discharge impact rule that only 10% of the permissible concentration of a contaminant (=

4 ug/l) may be consumed by a particular source. This would imply that the concentration of zinc in smaller receiving water would exceed the water quality criteria by a factor of 45-80.

Verschoor identified zinc as a potential eco-toxicological risk to surface water, but did indicate that if the crumb rubber were to be replaced by infill materials with a lower zinc emission, the pollutant concentrations in runoff and adjacent surface water should drop quickly.

Lim et al (2009) conducted a mathematical assessment of the risks to aquatic life from crumb rubber leachate based on the SPLP test results for zinc, aniline and phenol. Based on these concentrations, NYSDEC's Division of Fish, Wildlife and Marine Resources concluded that there may be a potential aquatic life impact due to zinc being release from crumb rubber solely derived from truck tires. However, New York State also concluded that an impact is unlikely if the crumb rubber material is from mixed tires and concentrations of zinc from a column test were used rather than the SPLP. It should be noted, that for the column test to better simulate field conditions, the material in the column must reflect local soil conditions and pH.

Several recent studies analyzed stormwater samples collected from artificial turf fields for metals. Lim et al (2009) and Kolitzus (2006) detected concentrations of zinc at 59.5 ug/l and 20 ug/l, respectively. Milone and MacBroome (2008), conducted field studies and detected zinc in the stormwater from four of the six sampling dates, with a maximum concentration of 31 ug/l which is below acute aquatic toxicity criteria of 65 ug/l.

The zinc concentrations in our stormwater samples were significantly higher than those of Lim, Kolitzus and Milone and MacBroom, with three of the eight the samples tested exceeding acute surface water quality criteria. If not mitigated with appropriate stormwater treatment measures, the zinc concentrations found in our study could contribute to the environmental risk of aquatic organisms in surface waters.

### **3) Aquatic Toxicity**

Wik (2006) studied the toxicity of various tire brands and determined that different formulas for rubber contributed to varying degrees of toxicity in the leachates to *Daphnia magna*. By conducting a toxicity identification evaluation on various tire leachates (EPA 600/6-91/003), Wik determined that although zinc was prevalent, the semi-volatile non polar organics also heavily influenced the toxicity of the resulting leachate. Passing the simulated tire leachates through carbon filters was the only manipulation that consistently reduced toxicity. Compared to the results from Milone and MacBroom (2008), this study reported significantly higher levels of both aquatic toxicity and zinc. This study found that three of the eight stormwater samples tested were acutely toxic to both the invertebrate (*Daphnia pulex*) and the fathead minnow (*Pimephales promelas*). These acutely toxic samples directly coincided with the exceedences of the acute aquatic life criteria for zinc. Consequently, zinc seems to be the primary pollutant of concern. This study indicates that there is risk associated with whole effluent toxicity and zinc.

#### **b) Overall Groundwater Contamination Risk**

Stormwater from the fields can impact groundwater directly by percolating through the artificial turf via an "open" underground drainage system (perforated pipes, coarse bedding materials, stone trenches). The stormwater discharges to the underlying soil layers, and ultimately, enters

the ground water. Based on the nature of the underlying soil and the depth to groundwater, the field stormwater is likely to physically and chemically interact with a mineral soil layer (vadose zone) prior to encountering groundwater. This stormwater/soil interaction would be affected by pH, volume of stormwater and soil characteristics, such as moisture, chemistry, mineralogy, soil texture, hydraulic conductivity and drainage class. These interactions would likely influence the concentrations of contaminants found in the groundwater.

There are two primary concerns with the contamination of groundwater in the environment - the threat to drinking water and the threat to surface water resources via groundwater recharge. Several other studies were conducted on the crumb rubber fill from 2004 to 2009; (Plesser(2004), Nillson et al (2008), the Norwegian Institute for Water Research (2005) , Verschoor, A.J., RIVM Report 601774011/2007(2007) Study, (Milone & MacBroom Study 2007),NYSDEC May 2009 an Kolitzus, Hans J. (2006). These studies compared the relative concentration of contaminants found in laboratory leachates and/or artificial turf generated stormwater with various drinking water and aquatic life criteria.

### **1) Organic Compounds**

It should be noted that substances, to a varying degree, will be absorbed by the sand/clay layers which the drainage water passes. Although Nillson et al (2008) found that concentrations of nonylphenols in the contact water from leaching tests were in the order of 20-800 times above the threshold values for drinking water, it was uncertain as to whether this concentration would be significant in the actual groundwater. The EPA aquatic life acute criteria for nonylphenol for freshwater and saltwater resources are 28 ug/l and 7.0 ug/l, respectively. It is important to note that nonylphenol has been associated with the disruption of fish endocrine systems at concentrations below EPA's criteria. No data was available for phthalates and nonylphenols under such realistic conditions from lysimeter data. Nillson determined that the assessment of the impact on water systems also requires more realistic lysimeter tests or measurements on drainage water from artificial turf fields over time.

Plesser (2004) compared leachate results with Canadian Environmental Quality Guidelines for ground water. Groundwater guidelines are developed for both protection of drinking water and protection of surface water via groundwater recharge. Plesser identified anthracene, fluoranthene, pyrene and nonylphenols as compounds in the leachate that could exceed the more protective criteria for groundwater. Plesser also concluded that analyzing possible paths and changes in leaching properties over time is necessary to determine the degree to which the concentrations of these compounds are actually harmful to people and the environment.

Lim et al (2009) conducted a leachate (SPLP) test on rubber crumble material, and analyzed for zinc, phenol and aniline. The results from recent leaching studies indicated a potential for release of aniline, benzothiazole, phenol, and zinc to the groundwater. However, concentrations of the organic contaminants analyzed were below levels that would impose a risk to drinking water. Lim also collected 32 groundwater samples from wells installed downgradient of four artificial turf fields and analyzed them for SVOCs, including aniline and benzothiazole, using SW-846 Method 8270C. The wells were installed in sandy textured soils with depth to the groundwater ranging from 8.3 to 70 feet. All test results were below the limit of detection for all

groundwater samples analyzed. Based on test results of 32 samples, no organics were detected in the groundwater at the turf fields.

Our results are consistent with the leachate and groundwater sampling results in Lim et al (2009). The concentrations of organic compounds in our study did not exceed groundwater protection criteria.

## **2) Metals**

In general, metals are immobilized in soils by adsorption, absorption and precipitation. All of these, mechanisms impede movement of the metals to ground water. Metal-soil interaction is such that when metals are introduced at the soil surface, downward transportation does not occur to any great extent unless the metal retention capacity of the soil is overloaded, or metal interaction with the associated waste matrix enhances mobility.

Zinc is the most prevalent contaminant in the leachate and stormwater studies. In several of these studies, zinc concentrations measured in leachate exceeded drinking water standards. Most of the zinc in soil is absorbed to the soil as zinc hydroxide or oxide and does not dissolve in water. Zinc does show moderate mobility under relatively acid soil conditions (pH 5–7) because of increased solubility and formation of soluble complexes with organic ligands (Elliott et al. 1986; Stevenson and Fitch, 1986; Klamberg et al. 1989). Zinc is retained in an exchangeable form at low pH in iron and manganese oxide dominated soils but becomes non-exchangeable as the pH was increased above 5.5 (Stahl and James, 1991). Therefore, depending on the acidity of the soil and water, some zinc may reach groundwater.

Nillson et al (2008) determined that although leachate concentrations of zinc were in excess of the drinking water quality standards, similar concentrations were not observed in (field) lysimeter tests. Nillson concluded that the concentration of zinc in the lysimeter tests were a more accurate reflection of zinc in the groundwater and, therefore, zinc concentrations would not exceed drinking water standards.

Lim et al (2009) was the only study that did not report concentrations of zinc in the SPLP leachate that exceeded drinking water standards.

Verschoor (2007) concluded that, for the majority of situations, the risks of zinc to public health are minimal since it is not very toxic to humans and the World Health Organization (WHO) drinking water criteria was not exceeded in tests. However, Verschoor (2007) did note that in sandy areas discharges to groundwater may exceed Dutch Intervention Values by a factor of 1.5 to 2.2. In sandy soils, infiltration of water with dissolved zinc will result in weak binding of zinc to the soil matrix and could cause protection criteria to be exceeded by a factor of 12. Verschoor concluded that zinc was a potential eco-toxicological risk to groundwater and soil.

Plesser (2004) and CAES (2009) indicated that zinc was the most likely contaminant to exceed drinking water standards in the leachate. All studies indicate that, although compounds were present in the leachate or stormwater, it was uncertain as to what affect the underlying soils and groundwater would have on the actual concentration of contaminants in the groundwater. Actual groundwater testing may be necessary to determine the impact.

The leachate results reported by CAES showed zinc concentrations up to ten times the drinking water standards and up to 500 times the surface water protection criteria. Our study detected concentrations of zinc in the stormwater significantly lower than CAES results, with no exceedences of drinking water standards and no significant concerns for groundwater quality. It is important to note that no groundwater samples were collected for our study.

## 11. CONCLUSIONS

The DEP concludes that there is a potential risk to surface waters and aquatic organisms associated with whole effluent and zinc toxicity of stormwater runoff from artificial turf fields. Zinc concentrations in the stormwater may cause exceedences of the acute aquatic toxicity criteria for receiving surface waters, especially smaller watercourses. The DEP suggests that use of stormwater treatment measures, such as stormwater treatment wetlands, wet ponds, infiltration structures, compost filters, sand filters and biofiltration structures, may reduce the concentrations of zinc in the stormwater runoff from artificial turf fields to levels below the acute aquatic toxicity criteria. Individual artificial turf field owners may want to evaluate the stormwater drainage systems at the fields and the hydrologic and water quality characteristics of any receiving waters to determine the appropriateness of a stormwater treatment measure.

This study did not identify any significant risks to groundwater protection criteria in the stormwater runoff from artificial turf fields. It is important to note, that the DEP study did not directly collect and analyze groundwater at these artificial turf fields. Consequently, this conclusion regarding consistency with groundwater protection criteria is an extrapolation of the stormwater results collected and the evaluation of data presented in recent studies, such as Nillson et al (2008) and Lim et al (2009). To make a final conclusion regarding the overall risk from exposure to groundwater affected by stormwater runoff from artificial turf fields, further sampling and analysis of groundwater at the artificial turf fields would be required.

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## **Appendix G: Testing Plan for Demonstration of WQ Achievement**

This testing plan is intended to demonstrate that the artificial turf field proposed for Cascade Christina Schools will achieve the applicable Water Quality parameters for Enhanced, or Metals Treatment. This treatment level is required for a facility that is classified as commercial, eventually discharging a natural water body with aquatic use, when the waterbody is not listed as a major water body. (As the stormwater permittee, the City of Puyallup has the authority to determine if educational uses are classed as residential-like or commercial-like uses, because education, parks, etc are not specifically classified by State statute.)

The testing plan proposed is similar to the testing plans developed for an industrial stormwater general permit, in that it lists the Applicable Parameters, Testing Location & Schedule, and Reporting & Response . This plan is a subset of a larger drainage plan that contains information about the physical characteristics of the site, the uses of the site, the selection and sizing of stormwater features to be installed, and how they operate and are maintained, so those are not repeated here.

#### Applicable Parameters

Following is a listing of the applicable water quality parameters and the maximum concentration that constitutes achievement under the assumed influent concentrations.

**Table 1. Maximum concentrations and percent removal needed by treatment**

Parameter	Assumed Influent	Stipulated removal*	Max Pass concentration
copper, total (mg/L)	0.005 to 0.02	30%	<b>0.014</b>
zinc, total (mg/L)	0.02 to 0.3	60%	<b>0.120</b>
turbidity (NTU)	100	80%	20

- greater than 30% dissolved copper removal (assuming a dissolved copper influent range of 0.005 to 0.02 mg/l),
  - The maximum dissolved copper level would be  $0.699 * 0.02 \text{ mg/l} = 0.014 \text{ mg/l}$  unless a higher influent copper was documented.
- greater than 60% dissolved zinc removal (assuming a dissolved zinc influent range of 0.02 to 0.3 mg/l).
  - The maximum dissolved zinc level would be  $0.399 * 0.3 \text{ mg/l} = 0.120 \text{ mg/l}$  unless a higher influent zinc was documented.
- In addition, Enhanced Treatment BMPs are also intended to achieve the Basic Treatment Performance Goal.
  - The Basic Water Quality standard is 80% removal of Total Suspended Solid (TSS). In the event that there are low levels of suspended solids in the stormwater runoff prior to treatment, a measurement of 20 NTU or less before discharge also achieves the Basic Water Quality standard.

### Testing Location & Schedule

The water collected from the playfield discharges to the 48" public Bypass underground near the NW edge of the running track. The closest upstream location to sample the discharge is at the Flow control SDMH #108. This location is indicated on the attached figure.

Important NOTE: **Use a pole to collect the sample**, as illustrated in the figure.  
Do not enter the SDMH unless needed and trained for confined space entry.

The details of how to plan for, collect, and process stormwater samples are presented in the annotated *Stormwater Sampling Guide*, published by the WA Department of Ecology in 2015. This guide was intended for Industrial General Stormwater Permit, so not all the parameters apply. For instance, there is not a reasonable expectation that the field will be a source of extreme pH or liquid oil leak. The project is not industrial so not required to sample storm drain solids or for trace metals other than the copper and zinc identified in the prescriptive approach.

Testing will be quarterly, beginning within 90 days of the completed installation of the artificial turf field. Samples will be collected for analysis within 24 hours of a measurable rainfall event that produces a discharge from the site. The first measurable rainfall event after the summer dry season is not representative for turbidity, and is not an eligible sampling event.

Testing will be conducted at least once quarterly for at least 4 quarters preferably with at least 3 weeks remaining in the quarter in case repeat sampling is necessary. Completion or continuation of testing will be as described in the reporting section.

If field QC samples are collected (as outlined in Reporting & Response), they should be collected from the Long Jump Sand Pit Yard Drain #2 (in the SW) to avoid impacts from sources stemming from the materials of the surrounding field, and/or from an in-field CB such as #106 about midfield.

### Reporting & Response

The recipient of the testing results will be the City of Puyallup rather than the WQWebDMR that is used for construction sites over 1 ac or industrial sites. The actions to take based on various testing results are outlined below.

Initial testing - If all 4 quarters show the water quality parameters are met, then this will be confirmed by repeating 4 quarters of testing. After 2 years of no-exceedance results, the site will have Demonstrated Achievement of WQ and the testing will be complete.

If a parameter is exceeded in the first round of testing, testing for that parameter will be repeated and expanded to as close to the source (IE field) as possible to determine potential source control measures. This testing will take place at the alternate sampling locations to confirm or exclude the playfield surface as the source.

Samples from presumably “clean sources” like the sand pit are used to determine if there are WQ exceedances present before the stipulated source of the pollution. If so, the assumed inflow level needs to be checked.

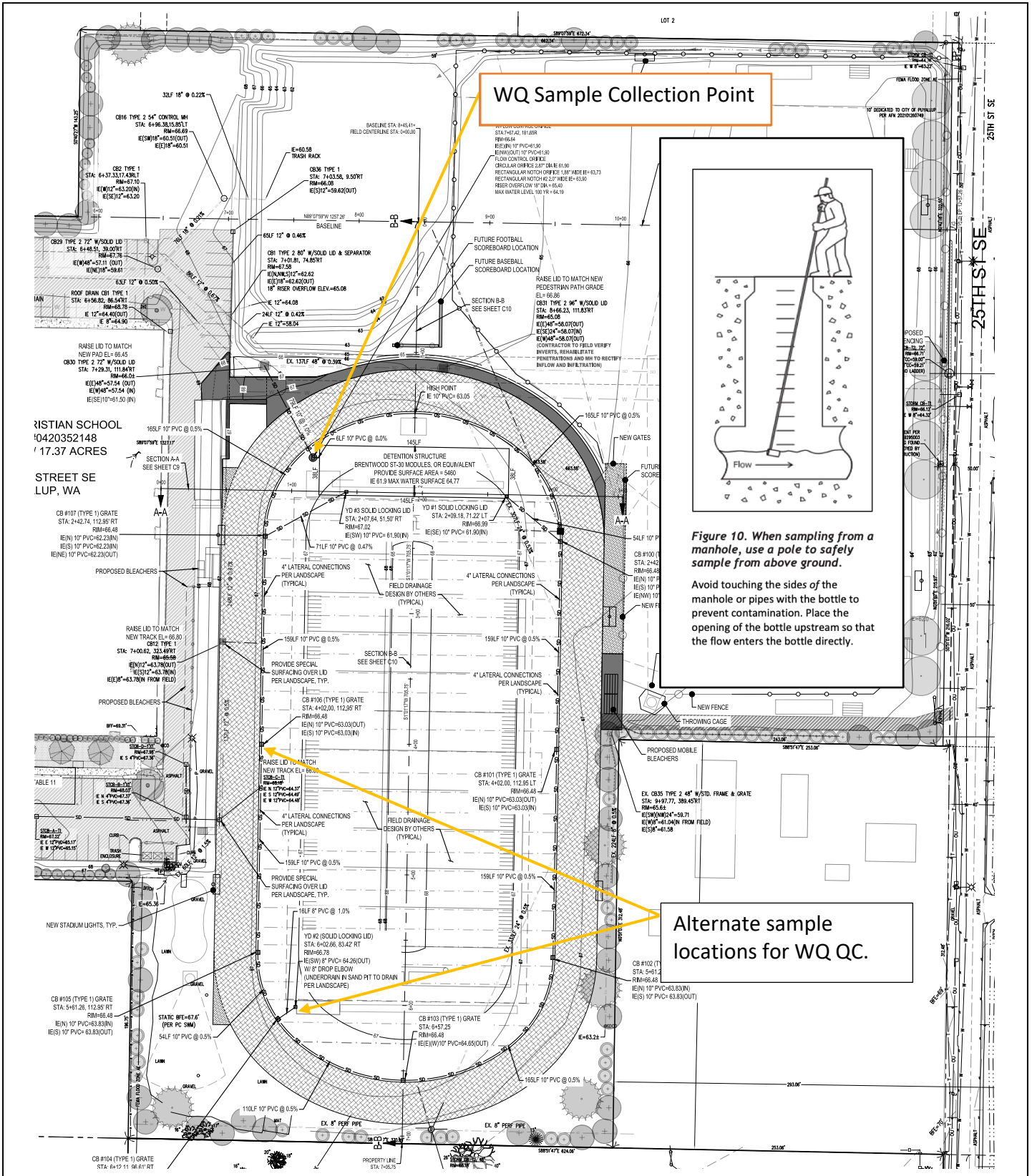
Sampled from stipulated “sources” like mid-field are used to determine if the inflow concentration of a parameter is higher than the assumed level listed in Table 1 above. If the inflow has a higher concentration, compare it to the discharge concentration to determine if the % of removal is achieved. Follow the response plan for either achievement or exceedance.

If the repeat tests show achievement of the WQ limit, then the results for that quarter will be averaged according to the instructions on page 38 of the Stormwater Sampling Guide. If the average shows achievement of the WQ Limits, proceed along the achievement response path.

If the repeated tests confirm exceedance, then mitigation measures are begun.

1. The first level of mitigations are operational, such as cleaning, to alleviate any exceedances caused by buildup. If this level is needed, another 4 quarters of testing is needed to confirm attainment.
2. If exceedance is still evident for, the second level of mitigation are physical items that do not require reconstruction, such as WQ filter inserts, retrofit of infill materials, etc. If this level is needed, another 4 quarters of testing is needed to confirm attainment.
3. The third level of mitigation for WQ exceedances is to construct additional treatment. A new drainage design and report is needed at that time.

Figure – Sampling Location





DEPARTMENT OF  
**ECOLOGY**  
State of Washington

## **Stormwater Sampling Manual**

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### **A guide for the Industrial Stormwater General Permit**

December 2015

Publication No. 15-03-044

## Publication information

This report is available on the Department of Ecology's website at <https://fortress.wa.gov/ecy/publications/SummaryPages/1503044.html>

This guidance is an update to *How to do Stormwater Sampling* which was originally developed by Ecology's Environmental Assessment Program in 2002 and then updated in 2010. This most recent update was made in accordance with the new Industrial Stormwater General Permit that became effective on January 2, 2015.

Suggested Citation:

Washington State Department of Ecology. 2015. Stormwater Sampling Manual: A guide for the Industrial Stormwater General Permit. Washington State Department of Ecology, Olympia, WA. 41 p. Publication No. 15-03-044.

<https://fortress.wa.gov/ecy/publications/summarypages/1503044.html>

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# Introduction

The Industrial Stormwater General Permit (ISGP) applies to all facilities conducting industrial activities that discharge stormwater to a surface water body or to a storm sewer system that drains to a surface water body.

*The purpose of this guide is to help those who operate facilities do their own sampling.*

The permit requires that facilities conduct sampling of stormwater and report the results to the Washington State Department of Ecology (Ecology). These requirements are outlined in the permit under “Special Condition S4. General Sampling Requirements.” This *Stormwater Sampling Manual* supports the sampling portion of the general permit but does not substitute for it.

Sources of pollutants that may enter surface water, sediments, or groundwater can be identified by sampling stormwater discharges. The results from sampling will help facilities develop their Stormwater Pollution Prevention Plan, determine if the existing plan is adequate, and implement or assess best management practices.

The purpose of this manual is to help those who operate facilities do their own sampling. The manual provides a step-by-step procedure of what facilities need to do to sample, gather, and report data in order to describe the quality of stormwater leaving the facility.



## Summary of Stormwater Sampling Guidance Manual

- 1. Decide what to sample** – sample turbidity, pH, zinc, copper, a visible oil sheen, and additional parameters as per the permit; check your permit coverage letter.
- 2. Select and contact a lab** – verify analytical methods, detection limits, sample preservation, and data reporting requirements.
- 3. Decide how you will sample** – identify sample locations; make sure you sample only your stormwater; verify if you have to sample petroleum hydrocarbons; obtain sampling supplies.
- 4. Plan your sampling events** – choose sampling times; check weather forecasts.
- 5. Conduct sampling** – review guidance on how to sample; take notes; read through *Special Considerations* in this manual.

Discuss any questions or issues with the Department of Ecology.

## Advance Planning for Stormwater Sampling

### Deciding what to sample

Before beginning your sampling, you'll need to determine the specific pollutants (water quality parameters) you are required to sample and test for. All facilities must monitor for turbidity, pH, zinc, copper, and the presence of a visible oil sheen. Your parameters are based on:

- ◆ The standard set of parameters for all facilities (turbidity, pH, zinc, copper and visible oil sheen).
- ◆ The industrial activities at your site, often classified by your facility's Standard Industrial Classification (SIC) code.
- ◆ Whether your facility discharges to an impaired (303(d) listed) water body, Puget Sound Sediment Cleanup Site, or a water body with a TMDL or other water cleanup plan.
- ◆ Any additional parameters Ecology assigned to your facility by administrative order.

Ecology listed the required parameters for your facility in the permit coverage letter mailed to you when the permit was issued. Your required parameters are also shown on your facility's Discharge Monitoring Report (DMR) data entry screen ([WQWebDMR](#)). Contact Ecology if you have any questions about the required parameters for your facility.

*All facilities must monitor for turbidity, pH, zinc, copper, and a visible oil sheen.*

## Selecting a lab to test your sample

*Contact the lab well ahead of time.*

Having identified the parameters you will need tested, the next step is to select a lab to perform the tests. You are required to select a lab accredited by Ecology. The lab must be accredited for each analytical method required by the permit for each parameter. Accreditation assures Ecology that the lab is able to do quality testing using the analytical methods specified under

Monitoring Requirements in your permit. To ensure the lab can meet the required detection and reporting limits, send the lab a copy of relevant quantitation levels from Appendix C, highlighting your parameters of interest. You can search for an accredited lab on Ecology's [website](#)<sup>1</sup>.

---

## Contacting the lab in advance

You should contact the lab well ahead of time. They will be providing you with the sampling bottles you'll need. For some water quality parameters, such as Total Petroleum Hydrocarbons (TPH), it is not only desirable but necessary to collect the sample directly into a specially-cleaned container, so you will need to have bottles from the lab on hand before you sample. You can also ask your lab to send narrow-range pH paper (with a resolution not greater than  $\pm 0.5$  SU) along with your sample bottles.

Note that not all facilities are required to collect TPH samples. Page 26 of the permit lists the industrial activities and SIC codes that require TPH sampling. Also, your permit coverage letter contains a sampling summary that will indicate whether TPH sampling is required based on the SIC codes Ecology has on file for your facility. If there is a discrepancy between the permit and your permit coverage letter, the permit takes precedence. Contact Ecology if you have any questions or need to correct an error in your sampling requirements.

### Typical Sampling Information

Parameter	Bottle Type	Minimum Sample Required	Holding Time	Preservation
Turbidity	500 ml wide-mouthed poly	100 ml	48 hours	Cool to 4 °C
Total Zinc	1 liter (L) bottle cleaned according to protocol	500 ml	6 months	HNO <sub>3</sub> to pH<2 Cool to 4 °C
Total Copper	500 ml HDPE	Dependent on the lab	6 months	HNO <sub>3</sub> to pH<2 Cool to 4 °C

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<sup>1</sup> <https://fortress.wa.gov/ecy/laboratorysearch/>

Discuss with the lab the analytical methods they will use, as specified in the sample parameter tables included in S5. A and S5. B of the general permit (pages 23 - 25) and shown in Appendix C of this manual. The lab will give you helpful information and explanations that go beyond the scope of this guide. If you must meet effluent limits listed in S5.C, *Landfills and Airports Subject to Effluent Limitation Guidelines* (pages 25- 27) carefully review them with the lab.

## Issues you may want to cover with the lab

- ◆ **Confirmation that the lab is accredited** for the testing methods the permit requires.
- ◆ **The type and size of bottle** that will be supplied for each water quality parameter to be sampled and tested.
- ◆ **How full** to fill the bottle.
- ◆ **Any safety concerns** with materials supplied by the lab.
- ◆ **What you need to know about preserving your samples:** For some tests, a preservative is necessary. The table of *Typical Sampling Information* (see page 7) provides information for preserving zinc, turbidity, and copper samples—three water quality parameters that must be monitored under the Industrial Stormwater General Permit. Make a note of the parameters for which bottles will have preservative inside. The preservative is a substance that stabilizes certain chemicals at the time of sampling so that a valid test can be done later. It is critical that you use the correct bottles because tests requiring preservative will not be valid without the correct preservative. In some cases, the wrong preservative will interfere with a test. It is important not to lose the preservative that comes in the bottles supplied by the lab, so fill preserved bottles slowly to ensure no overflow occurs resulting in preservative loss. In many cases, the preservatives listed in the table come pre-measured in the sampling bottles. Chemicals have their own scientific notation. Nitric acid for example is HNO<sub>3</sub>. Temperature is measured in degrees Celsius (°C). Typical United States thermometers measure temperature in Fahrenheit (F) and 4 °C is about 39 °F. For your purposes, *Cooling to 4 °C* means putting the samples on crushed ice or packed with blue ice in an ice chest so they will be kept just above freezing. Cooling the sample is also a means of preserving it.
- ◆ **The kind of labels** the lab will supply for the bottles and how the labels should be filled out. The labels or tags you use to identify the samples you take must be waterproof, and if you write on them, the writing must be waterproof also.
- ◆ **The Chain of Custody (COC) form** from the lab and the process to complete these before sampling the first time.
- ◆ **A description of forms** or other paperwork to submit to the lab with the samples and how to fill them out.
- ◆ **Whether the lab will supply pH paper**, sample bottles, tags, or labels for the bottles, and blank forms.
- ◆ **How bottles** and other supplies from the lab will be delivered to you.
- ◆ **The holding times** for each water quality parameter to be sampled and tested. A holding time is the maximum time allowed between taking the sample and doing the lab analysis. If you exceed holding time, the sample analysis is not acceptable.

*Ask questions –  
the lab can help.*

- ◆ **How and when you will deliver samples to the lab.** Plan with the lab how you will get the samples to them in time to begin analysis before the parameter with the shortest holding time reaches that holding time. The fastest way to deliver samples to the lab may be in person, but it may be possible to ship samples (cooled in an insulated ice-chest) and still meet holding times. Some labs will provide a courier service. If you deliver samples in person, you can pick up bottles and supplies for the next quarter at the same time.
- ◆ **How to read the lab reports for the sample results.** Sampling requirements tend to use scientific words and units of measure. Metric units are used to measure weight, volume, and distance. Liquid volumes use liters (*L*) and milliliters (*mL*), not *quarts* and *cups*. Be aware that some parameters (e.g., zinc and copper) need to be reported on your DMR as  $\mu\text{g/L}$  (micrograms per liter), while other parameters need to be reported as  $\text{mg/L}$  (milligrams per liter). Most labs report concentrations in the same units that need to be reported on the DMR. However, in some cases, you may need to convert from  $\text{mg/L}$  to  $\mu\text{g/L}$ , in order to properly report the correct results on your DMR. For example if a lab were to report total copper values of  $0.035 \text{ mg/L}$ , you would need to convert from  $\text{mg/L}$  to  $\mu\text{g/L}$ ; move the decimal 3 places to the right, and report  $35.0 \mu\text{g/L}$ . Ensure the lab uses data qualifiers (or flags) for data near the method detection limit that are consistent with Appendix B of this document. Be sure to have the lab explain any words or expressions that you do not understand.
- ◆ **Summing data for total values.** You will be asked to report total values for organic parameters (total PCBs, PAH compounds, and Northwest Total Petroleum Hydrocarbons (NWTPH-Dx)). Ensure you understand the appropriate way to sum and average data that are close to the method detection limit (Appendix B). Work with the lab to help you report summed values.

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## Deciding how you will take the sample

Section S4.B.1(d) on page 19 of the Industrial Stormwater General Permit states that a grab, time-proportionate, or flow-proportionate sample may be taken. A grab sample is a single sample *grabbed* by filling up a container, either by hand or with the container attached to a pole. It is the simplest type of sample to collect, and it is expected that most permit holders will choose to collect grab samples. Ecology provides standard operating procedures (SOP) for obtaining grab samples ([Lowe et al., 2009](#))<sup>2</sup>. As we will discuss in the next section, NWTPH (herein called TPH-Dx) samples must be collected as grab samples.

*Practice sampling  
before you do the  
real thing.*

Some permit holders may choose to better represent water quality parameters other than TPH-Dx by collecting time-proportionate or flow-proportionate samples. These samples consist of a number of subsamples taken at intervals rather than a single grab sample. Time-proportionate or flow-proportionate sampling can accurately define pollutant loading during various times of

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<sup>2</sup> [http://www.ecy.wa.gov/programs/eap/qa/Agency/ECY\\_WQ\\_SOP\\_GrabSampling\\_v1\\_0ECY001.pdf](http://www.ecy.wa.gov/programs/eap/qa/Agency/ECY_WQ_SOP_GrabSampling_v1_0ECY001.pdf)

discharge throughout a storm event and determine whether or not higher pollution is occurring during first flush of the storm.

A time-proportionate sample is one made up of a number of small samples (subsamples) of equal volume collected at regular time intervals combined into a single large sample. A flow-proportionate sample is one made up of a number of subsamples where each subsample is collected in such a way as to represent a given amount of stormwater discharge. Time-proportionate and flow-proportionate samples provide the advantage of including a number of smaller samples (subsamples) in the sample so that the stormwater discharge is better represented than with a grab sample.

Time-proportionate and flow-proportionate samples can be collected either by hand or with automated equipment. Automated equipment can provide unstaffed sample collection outside of normal business hours. Additional information regarding requirements for automated stormwater sampling is available [online](#)<sup>3</sup>. Collecting time-proportionate or flow-proportionate samples by hand is somewhat difficult and collecting them with automated equipment involves additional expenses, such as the installation of a flow meter for automated sampling.

Permittees who collect time-proportionate or flow-proportionate samples (or collect more than one grab sample during a 24-hour period) must calculate and report quarterly averages to Ecology according to Condition S4.B.6.c on page 21 of the permit.

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## **Collecting total petroleum hydrocarbons – diesel fraction (TPH-Dx) samples**

In addition to the requirement for all permit holders to monitor for a visible oil sheen, the general permit requires that facilities with the following industrial activities and SIC codes collect TPH-Dx samples: Primary Metals (33xx), Metals Mining (10xx), Automobile Salvage and Scrap Recycling (5015 and 5093), Metals Fabricating (34xx), Hazardous Waste Treatment, Storage and Disposal Facilities and Dangerous Waste Recyclers subject to the provisions of Resource Conservation and Recovery Act (RCRA) Subtitle C, Air Transportation (45xx), Transportation (40xx – 44xx, except 4221-4225), and Petroleum Bulk Stations and Terminals (5171). Because of the particular way TPH-Dx samples must be collected, this requirement may govern your overall approach to sampling.

For some parameters other than TPH-Dx, it is possible to sample in difficult situations by filling a container and transferring it to the sample bottle to be sent to the lab. TPH-Dx samples, however, must be collected from the stormwater source directly. The sample cannot be transferred from another container because oil and grease tends to stick to the inside surfaces of containers. Since you must sample directly into the TPH-Dx bottle (grab sample), taking grab

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<sup>3</sup> [http://www.ecy.wa.gov/programs/eap/qa/Agency/ECY\\_WQ\\_SOP\\_AutomatedSampling\\_v1\\_0ECY002.pdf](http://www.ecy.wa.gov/programs/eap/qa/Agency/ECY_WQ_SOP_AutomatedSampling_v1_0ECY002.pdf)

samples may be the easiest way to collect additional samples for the other parameters. Take samples by collecting stormwater directly from the discharge into the bottles supplied by the lab, filling each bottle one after another.

Because TPH-Dx samples cannot be transferred between containers, a sample cannot be formed from separate grab samples combined together. If more than one TPH-Dx sample is desired from a sampling site during a storm event, additional TPH-Dx grab samples must be collected and analyzed separately.

TPH-Dx samples must be collected directly and not through the tubing of an automatic sampler; therefore, those using automatic samplers will still have to grab TPH-Dx samples by hand. This is also true for facilities that must sample for fecal coliform. An exception to sampling through tubing is the use of a peristaltic pump to sample below catch basin inserts (see *Special Sampling Considerations*).

*TPH-Dx samples must be collected directly into the bottle you send to the lab.*



When reporting NWTPH-Dx results, ensure that the lab sums all fractions in the diesel range to give one total value of TPH-Dx. This includes the #2 diesel oil and motor oil fractions which some labs may report as diesel fraction and heavy oil fraction. If your lab reported these fractions separately, you must add them together when you report NWTPH-Dx on your DMR. For more information on NWTPH-Dx see [Ecology's guidance document](#)<sup>4</sup>.

This is a potentially confusing aspect of sampling and reporting, so contact Ecology if you have any questions.

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## Determining which discharges to sample

The first step in selecting sampling points is to consider the areas draining your facility. The site map in your *Stormwater Pollution Prevention Plan* (SWPPP) will show the drainage areas for each discharge point.

The next step is to determine where the runoff from each drainage area is discharged from your facility. If there are separate drainage areas with separate discharge points, stormwater must be sampled at each discharge point unless the *substantially identical discharge point* criteria is met, which would allow you to consolidate sample locations.

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<sup>4</sup> <https://fortress.wa.gov/ecy/publications/summarypages/97602.html>

Section S4.B.2 on page 19 of the Industrial Stormwater General Permit describes the requirements for selecting sampling points:

### **S4.B.2. sample location(s)**

- ◆ The Permittee shall designate each sampling location at the point where it discharges stormwater associated with industrial activity off-site.
- ◆ The Permittee is not required to sample onsite discharges to ground (e.g., infiltration) or sanitary sewer discharges, unless specifically required by Ecology order (*Condition G12, page 48*).
- ◆ The Permittee shall sample each distinct point of discharge off-site except as otherwise exempt from monitoring as a *substantially identical discharge point* per S3.B.5.b (*page 18*). If applicable, the Permittee is only required to monitor applicable parameters at one of the *substantially identical discharge point*.

In general, your stormwater discharge samples will be taken where your facility's stormwater is discharged off-site. If your facility discharges stormwater collected over areas that are used for similar activities and have similar site conditions, and there is reason to believe pollutant types will be similar in such areas, a single sampling point can be used to represent several discharge points.

*Take time to get ready for sampling.*

The Industrial Stormwater General Permit allows you to sample at only one discharge point when multiple discharge points from your facility have similar industrial activities, best management practices (BMPs), exposed materials, and impervious surfaces that could affect stormwater percolation into the ground. Discharge points that have these similar characteristics are called *substantially identical discharge points*, and you can choose to monitor only one of the *substantially identical discharge points* rather than all of them.

If your facility has multiple discharge points from areas with different industrial activities, BMPs, exposed materials, or impervious surfaces, the discharge points would not be considered substantially identical, and therefore you would need to sample all of the discharge points. For example, if one portion of the site is used to store raw materials and discharges separately from another portion of the site where vehicle maintenance (e.g., fueling, lubrication, etc.) takes place, the stormwater discharge points would not be substantially identical and both discharge points would need to be sampled.

If you determine that some of your discharge points do not need to be sampled, the Sampling Plan in your SWPPP needs to include documentation for each discharge point not sampled per Condition S4.B.2.c, including:

- a) The location of which discharge points the Permittee does not sample because the pollutant concentrations are substantially identical to a discharge point being sampled.
- b) General industrial activities conducted in the drainage area of each discharge point.
- c) Best management practices conducted in the drainage area of each discharge point.

- d) Exposed materials located in the drainage area of each discharge point that are likely to be significant contributors of pollutants to stormwater discharges.
- e) Impervious surfaces in the drainage area that could affect the percolation of stormwater runoff into the ground (e.g., asphalt, crushed rock, grass).
- f) Reasons why the Permittee expects the discharge points to discharge substantially identical effluents.

If you add, remove, or relocate discharge or sample points from your facility, you must notify Ecology by submitting an [Industrial Stormwater General Permit Discharge/Sample Point Update Form](#)<sup>5</sup>. This enables Ecology to update the site-specific information in the Permit and Reporting Information System (PARIS) database so that your DMR data entry screen is accurate. If you have any questions, contact Ecology.

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## Selecting sampling points

Three types of sampling points are usually not too difficult to access and the flow within them tends to be fast enough, with enough turbulence, to allow you to collect well mixed, representative samples. These include:

- ◆ Pipes discharging your facility’s stormwater off-site.
- ◆ Ditches carrying your facility’s stormwater off-site.
- ◆ Manhole access to storm drains carrying your facility’s stormwater, so you can lower a sample bottle attached to a pole into the manhole.

In general, manhole access on your property may be simpler and safer than access off property and more readily verifiable as carrying only your facility’s stormwater. Contact the municipality beforehand to discuss sampling from the manhole and associated safety issues, particularly for manholes in areas with vehicular traffic.

*Manhole access can be a good sample point if it can be accessed safely from your facility.*

In some cases, portions of industrial stormwater runoff leave a site as sheet flow. Specific approaches to sampling of pipes, ditches, manholes, grated storm drains, and sheet flow will be covered in the final section of this guide manual.

Make sure your sampling points will provide for sampling only the stormwater that comes from your facility. If the stormwater in a pipe (storm drain) contains water from other properties, move your sampling point upstream to a point where the flow is from your facility only. If it is not possible to sample only flow from your facility, document the reason for this and provide information concerning the source of the flow you are sampling.

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<sup>5</sup> <https://fortress.wa.gov/ecy/publications/summarypages/ecy070373.html>

If possible, the stormwater your facility samples must not be a mixture of your facility's stormwater with other water. Some examples of situations where a sample would be of a mixture of water sources—and where you should not sample—are listed below:

Examples of mixed water sources situations in which you should not sample:

- ◆ **A ditch** that carries additional stormwater from properties upstream. In this case, the stormwater from your facility is mixed with other water and you must find a location or locations where only your facility's stormwater can be sampled.
- ◆ **A stormwater drain** or pipe (culvert) discharges to a creek or other receiving water, the pipe being partially submerged where it discharges into the receiving water (outfall). In this case, this final discharge point will not be able to be used as a sampling point because the stormwater flow is mixed with the receiving water.
- ◆ **A manhole** to a storm drain that carries stormwater, not only from your facility but also from other stormwater sources. If you are grabbing a sample from a manhole, make sure that the flow in that pipe is entirely from your facility, that the pipe is not submerged or partly submerged and that you are otherwise not prevented from collecting stormwater from your facility only. If you are not sure that a storm drain carries only flow from your facility, the municipality may have storm drain plans to help you determine this.

It is important to sample flow from only your facility if possible, because otherwise it is not *representative*. In other words, it wouldn't accurately characterize the stormwater runoff generated at your facility. If you discharge stormwater to a stormwater conveyance system that includes stormwater from other sources, you need to sample before your stormwater commingles with stormwater from other sources. However, if stormwater runs onto your property in an uncontrolled fashion (for example, sheet flow) from adjacent property, into areas of industrial activity on your site so that it becomes a part of the stormwater discharge from your site, it may be necessary to include it in your sample. If you are concerned about this off-site source, you could evaluate the possibility of diverting or otherwise preventing the run-on from commingling with your site's runoff. If that's not possible, you probably need to find a better, more representative, sampling location.

It is a good idea to observe the sampling point(s) you have chosen during actual stormwater runoff conditions to see how readily stormwater can be sampled there. Keep in mind that changing tides and flow conditions in receiving waters, including flood stages, may occur during storm events. This may cause a pipe that is discharging your facility's stormwater to become submerged or partly submerged, preventing you from sampling during some conditions.



## Obtaining supplies for sampling

The supplies you will want to have on hand before sampling include:

- ◆ Sampling bottles from the accredited lab, including a few extra of each type.
- ◆ When needed, a pole to hold sample bottles and filament strapping tape or rubber bands.
- ◆ New powder-free disposable nitrile or latex gloves. These are sold by medical and lab suppliers. Do not use powdered gloves as the powder may contain metals that could contaminate samples being analyzed for metals such as zinc.
- ◆ Foul-weather gear.
- ◆ One or more coolers, depending on the number of samples to be stored and transported or shipped.
- ◆ A bound notebook to serve as a field book for keeping records concerning sampling. Notebooks with waterproof pages are available for these field notes at office supply stores. The information to be included in the notes will be described in the *Keeping Records* section of this guide. You may find it helpful to create a standardized form containing the information in this as well.

## Planning Just Prior to Stormwater Sampling

There are a few things to keep in mind before actually sampling.

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### Being prepared

It is important to assemble everything that will be needed for the sampling event ahead of time because opportunities to sample during storm events often come with little advance notice. Complete the identification tags and Lab Services Required form as far as possible. Place the tags, lab form, field notebook, permanent ink pen, meter, and pH paper in the cooler with the sample bottles.

Have resealable plastic bags or other means on hand to keep the pH paper dry. If you are using a turbidity meter or pH meter, be prepared to protect them from the rain. Have foul-weather gear ready and available. It will be necessary to keep sufficient ice onsite or plan to purchase ice that day.

*Sample during the first  
12 hours of a  
stormwater discharge.*

---

### Choosing when to sample

The permit requires that you sample the discharge from each designated location at least once per quarter:

1st Quarter = January, February, and March

3rd Quarter = July, August, and September

2nd Quarter = April, May, and June

4th Quarter = October, November, and December

You will need to sample the *first fall storm event* each year. The permit defines the *first fall storm event* as the first time after October 1st that precipitation occurs and results in a stormwater discharge from the facility. Note that you are not required to sample storm events that outside of normal business hours or in unsafe conditions. If the first fall storm event occurs outside normal business hours (e.g., weekend), sample the next discharge that occurs during normal business hours.

Collect samples within the first 12 hours of stormwater discharge. If you are not able to collect a sample within the first 12 hours, collect the sample as soon as possible. In the sampling records, keep documentation explaining why you could not collect samples within the first 12 hours.

In some cases, you may be unable to determine when the discharge began (e.g., when arriving at a facility on a Monday morning) and unable to determine if the sample was collected within first 12 hours of discharge. If this occurs, you must record that in their on-site sampling notes.

If your facility receives an accumulation of snow, the snowmelt runoff from the facility could be considered a stormwater discharge for purposes of sampling.

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## Check weather forecasts

Keeping up with the weather forecast and planning so that sampling can be carried out on short notice are the keys to successful sampling.

Local forecasts, including televised satellite and radar images can give an indication of the expected intensity of coming storms. The National Weather Service is an excellent source of information on upcoming storms. It also includes local current radar and satellite images. Their website is: <http://www.wrh.noaa.gov/index.php>. A number of commercial websites, such as <http://www.weather.com/> and <http://www.accuweather.com/> also provide weather information and forecasts.

When evaluating a weather forecast, consider indications of expected intensity, for example *90% chance* rather than *30% chance* and *rain* rather than *showers*. In addition to intensity, consider the predicted duration of the storm. It will be very helpful to spend time observing rain events at your site with attention to how rain intensity relates to stormwater discharges from your site, before you begin sampling.



Once the decision has been made to attempt to sample a storm event, the personnel who will be sampling must be notified and they should prepare to sample. If it does rain, they must be at the sampling sites before stormwater begins discharging so they can document the time of discharge and be ready to sample.

*Take notes. It's important to write down your observations.*

## Conducting Sampling at Your Facility

*Have your sampling kit ready to go.*

After you have selected a storm event and it begins raining, the personnel conducting the sampling must prepare their equipment and go to the sampling site(s). They will be collecting grab samples at the sampling site(s), placing the samples in picnic coolers containing ice, and keeping notes in a field book. Sampling for the first time may require working

out some logistics, but once personnel perform these duties, they will not find future sampling as challenging.

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### Checklist for sampling

Because stormwater sampling is not a daily part of the workload of a facility, it is a good idea to keep a checklist of things to have prepared before sampling and to do during sampling. You can make the checklist by jotting down the things you did for the first sampling event to remember for subsequent sampling events. If necessary, update this checklist based on the experience you gain with each sampling event.

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### Visible oil sheen, zinc, copper, turbidity, and pH

If there is a visible oil sheen at the point of discharge from your facility, that is considered a benchmark exceedance that needs to be reported on your quarterly DMR. A rainbow-colored sheen on the surface of stormwater may indicate the presence of oil. However, not all sheens on the water are oil sheens. Some sheens result from natural processes, such as rotting vegetation or the bacterial breakdown of iron. How do you tell the difference between an oil sheen and a naturally occurring sheen? Try to break up the sheen with a stick. An oil sheen will swirl, elongate, and reform. A sheen resulting from a natural process will typically break up into irregular platelets that do not reform and have a mirror-like appearance.



*You must measure  
pH in the field.*

Turbidity can be measured directly in the field using a handheld meter, or sampled and analyzed in the lab. You must measure pH in the field using either a calibrated pH meter or pH paper rather than sending it to a lab. This is due to the short (15 minute) holding time for pH. You can get pH paper from a distributor of scientific/lab supplies or through the same lab that will be doing your sample analysis. Zinc, copper, and other parameters required by the permit (other than turbidity and pH) are measured by sending bottled samples to a lab for analysis.

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## How to fill sample bottles

This section and an illustrated appendix at the end of this guide describe how to collect a sample properly. Collecting a grab sample can be as simple as holding a bottle under the stormwater falling from a pipe and filling the bottle properly. Still, the person doing the sampling must use care in applying the principles outlined below so that the sample will be representative of the water being sampled. Additional information regarding grab sampling is available in Ecology's standard operating procedures (SOPs) for grab sampling [online](#)<sup>6</sup>.

## Simple principles of good grab sample collection

- ◆ Wear new, disposable, powder-free gloves when sampling.
- ◆ Grab samples with the stormwater entering directly into bottles supplied by your lab. Do not transfer the samples from a container that may not be specifically cleaned for collecting lab samples. Metal contamination of ordinary containers is common and household detergents often contain phosphorus, a tested parameter for some industries. Again, transferring the sample from another container is not an option for TPH-Dx samples under any circumstances.
- ◆ When holding the sample bottle your lab has provided, keep your hands away from the opening in order to prevent contaminating the sample.
- ◆ Always hold the bottle with its opening facing upstream (into the flow of water) so that the water enters directly into the bottle and does not first flow over the bottle or your hands.
- ◆ Sample where the water has a moderate flow and, if possible, some turbulence, so that the stormwater discharge will be well-mixed and the sample will be representative. Sampling in still water should be avoided. Include in your field book a note about the sample location and how briskly the water appears to be moving.
- ◆ Sample from a central portion of the stormwater flow, avoiding touching the bottom of channels or pipes to avoid stirring up solid particles.
- ◆ Do not rinse or overfill the bottles. The bottles supplied by your lab for some parameters (e.g., metals and TPH-Dx) will include small amounts of liquid preservative (generally a few

*Get the best sample  
you can.*

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<sup>6</sup> [http://www.ecy.wa.gov/programs/eap/qa/Agency/ECY\\_WQ\\_SOP\\_GrabSampling\\_v1\\_0ECY001.pdf](http://www.ecy.wa.gov/programs/eap/qa/Agency/ECY_WQ_SOP_GrabSampling_v1_0ECY001.pdf)

drops). Fill the bottle to about ½ inch from the top (not quite full) to ensure that no preservative is lost.

- ◆ As soon as the sample is collected, cap the bottle and label it. It is important that the bottles are labeled correctly so that the lab will be able to identify samples by sample site and ensure proper preservation for each parameter. It is a good idea to place sample bottles in resealable bags. Place the samples in a picnic cooler partially filled with ice. Plan to maintain ice in the picnic cooler until the samples arrive at the lab. Remember to make certain that the samples will be delivered to the lab soon enough for the lab to meet holding times.
- ◆ TPH-Dx sampling raises additional concerns:
  - ◇ TPH-Dx sampling requires special attention. TPH-Dx samples must be collected directly into the sample bottles supplied by the lab because oil and grease floats on water and tends to stick to the sides of containers. Do not rinse the sampling bottles beforehand or pour the sample from another container. Do not fill the bottle completely and do not pour out some of the sample if the bottle is overfilled by mistake. If you do overfill a bottle, use a new bottle instead to collect your sample. Because you only get one try at filling a TPH-Dx bottle, it is a good idea to have plenty of extra bottles on hand.
  - ◇ TPH-Dx samples must be collected as the stormwater falls from a pipe or from a running, turbulent stream of flow when possible so the source will be well mixed. When the samples must be collected from a water surface, the person holding the bottle should plunge the bottle mouth below the surface and then in a sweeping arc bring it upwards through the water surface again. This motion ensures the water surface is broken twice by the mouth of the bottle. When sampling an oil/water separator, collect the sample in the afterbay or just prior to discharge from the separator. Be sure to note in your field book how you collected your samples as this is especially important for the TPH-Dx sample.

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## Keeping records

Section S9 on page 39 of the general permit specifies requirements for reporting and recordkeeping. In order to comply with the requirement that lab reports include sampling date and sampling location, you will need to supply this information to the lab when submitting samples. You can do this by using the sample location as the field station identification on your labels or sample tags.

You should purchase a notebook for use in the field. Water-resistant “rite in the rain” notebooks serve the purpose well.

Section S4.B3 on page 20 of the permit requires that you record *Sample Documentation* for the following:

- a) Sample date.
- b) Sample time.
- c) A notation describing if the Permittee collected the sample within the first 12 hours of stormwater discharge events.

**d)** An explanation of why the Permittee could not collect a sample within the first 12 hours of a stormwater discharge event, if it was not possible; or, if it is unknown (e.g., discharge was occurring during start of regular business hours), an explanation of why the Permittee does not know if a sample was collected within or outside the first 12 hours of stormwater discharge.

**e)** Sample location (using SWPPP identifying number).

**f)** Method of sampling and method of sample preservation, if applicable.

**g)** Name of the individual who performed the sampling.

**h)** Weather conditions.

Although not required, it would also be beneficial to record the following information:

- ◆ Weather preceding the sampling event:
  - ◇ How many days/weeks/months since last significant rainfall.
  - ◇ Estimate of time it began raining.
  - ◇ Estimate of time that discharge began at the sampling point.
  - ◇ Amount (inches) and/or intensity of precipitation.
  - ◇ Whether discharge includes ice or snowmelt runoff.



- ◆ How you collected the sample, example, *from a ditch by hand* or *from a manhole with the bottles on a pole*.

- ◆ The number and types (parameters) of samples collected.

~~◆ Field measurement results, such as pH or visible oil sheen.~~

- ◆ Any unusual circumstances that may affect the sample results.

Entries in the field book must be made with ink. If you make an error in the field book, cross it out with a single line rather than whitening it out or erasing. Number the pages of the field book consecutively. To ensure that the bound field book is a complete record, do not rip pages from it.

Section S9 in the general permit also requires preservation of laboratory documentation. Along with required information from the laboratories as found in Section S4.B4, your clear and detailed field notes such as date, time, and location of each sample collected are essential for laboratory records.

# Special Sampling Considerations

Safety must be the primary consideration in sampling. Samples should never be collected in a way that compromises the safety of the sampler. In cases where there is a physical hazard, such as a trip hazard or when sampling near deep water bodies, samplers should work in pairs. Do not wade in water where it is unsafe to do so (e.g., the estimated depth in feet times the velocity in feet per second is equal to or greater than 8), as swift currents can lead to drowning accidents. Be aware of the slip hazard common near the banks of water bodies and decide whether a bank is too steep to negotiate safely. Safety comes down to individual judgment.

*Don't take risks.  
Know how to  
sample safely.*

Never put yourself in a position you consider to be unsafe. Samples can be collected easily in some locations, but not all stormwater discharges are as readily sampled as the flow in a ditch or from a pipe falling into a receiving water. Below are some situations you may encounter and suggested approaches for handling them. We focus mainly on methods for collecting samples directly by hand or with a bottle attached to a pole. When sampling in these or other situations, keep in mind the steps outlined in the section, *How to Fill Sample Bottles*. Additional information is available in Ecology's standard operating procedures (SOPs) for stormwater sampling available [online](#)<sup>7</sup>.

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## ~~Sampling stormwater discharges from a pipe into a receiving water~~

~~If stormwater is being discharged from your facility through a pipe into a ditch, creek, or other receiving water, it can be readily sampled as it falls from the pipe before it reaches the receiving water if the discharge pipe is safely accessible and not submerged. Hold the bottles with the bottle opening facing upstream into the flow and be sure not to overfill them. You may need to fasten the collection bottles to a pole to reach the pipe. Attaching a bottle to a pole is described in the section below, *Sampling from a Manhole* and shown in Appendix A.~~

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## Sampling from a manhole

When sampling from the manhole of a municipal storm drain, remember to contact the municipality beforehand. Be sure to discuss safety concerns when talking to the municipality about sampling. Open a manhole with a hook or pick axe, exercising care not to drop the manhole cover on hands or feet. ***Do not, under any circumstances, enter the manhole unless trained to safely enter confined spaces***, but you can sample the flow in a manhole from above ground by taping the sampling bottles, one at a time, to a pole and lowering the pole into the manhole (see photos in Appendix A).

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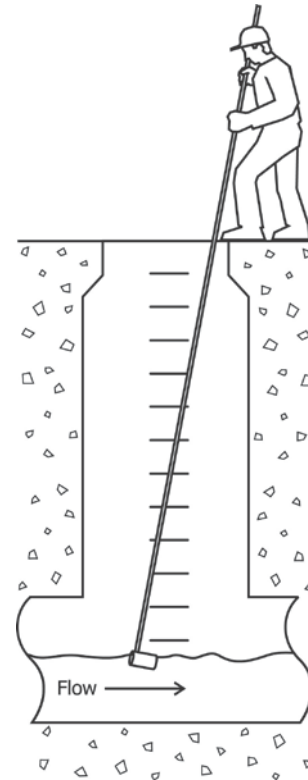
<sup>7</sup> <http://www.ecy.wa.gov/programs/eap/quality.html>

Each bottle can be fastened to the pole by holding the bottle against it and wrapping tape tightly around the bottom and the top of the bottle as you hold the bottle firmly to the pole. Filament strapping tape works well for this purpose as it is waterproof and strong. Rubber bands and zip-ties are also a possibility. Commercially available sampling extension poles are also available from a number of suppliers and relatively inexpensive.

If the flow in the storm drain is shallow, the bottle may have to be positioned horizontally with the bottle's opening somewhat higher than its bottom. When sampling in a manhole, be careful not to scrape the bottle against the sides of the pipe to avoid picking up extra solids in your sample.

Collecting into bottles for TPH samples with a pole is done by plunging the bottle on the pole below the water surface and back upwards. This must be done as a single motion and only once. Because you only get one try at getting a good TPH grab sample, it may take some practice and extra bottles to collect the amount of sample you need without overfilling the bottle.

Collecting samples, other than TPH, into bottles with preservative can be done by quickly plunging the pole into the flow repeating if necessary until the bottle is most but not all of the way full. If you overfill the bottle, remove it, tape a clean bottle to the pole, and try again. When collecting samples with a pole, be sure to follow clean principles by keeping the pole downstream of the bottle while sampling.



*When sampling from a manhole, use a pole to safely sample from above ground. Avoid touching the sides of the manhole or pipes with the bottle to prevent contamination. Place the opening of the bottle upstream so that the flow enters the bottle directly.*

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## Sampling from a storm drain with a filter or insert

When sampling a storm drain or catch basin that has been retrofitted with a stormwater insert or filter, the goal is to get a sample that represents post-filter stormwater. There are 3 possible scenarios for sampling, in order of preference:

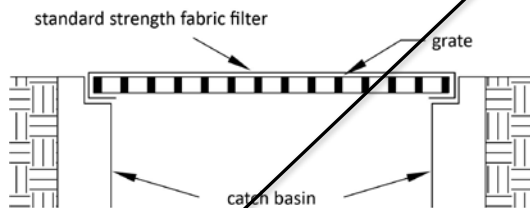
1. Use an available sample port or access point in the conveyance line after the filter but prior to discharge or mixing with stormwater from other sites.
2. If the insert or filter has a sample port or overflow port, remove the grate, reach through the port and collect the sample of water flowing through the insert or filter.
3. If the insert or filter is situated above a sump, use a pole or tubing to access the water while taking care not to disturb accumulated solids. Make sure the sump is collecting water only from your site. Using tubing with a peristaltic pump is permitted; however, if TPH-Dx is being sampled ensure that the tubing is Teflon-lined. All tubing should be purged using 3 times the tubing volume prior to sampling.

Make every attempt to avoid disturbing the filtration device. But if this must be done to access a sampling location, allow sufficient time for any disturbance of solids or material around the grate or device to settle or wash away (e.g., 10 minutes). This may apply if you have a series of catch basins on-site and are sampling the last in the series prior to discharge; if so, you may want to remove the grate and filter for ease of access.

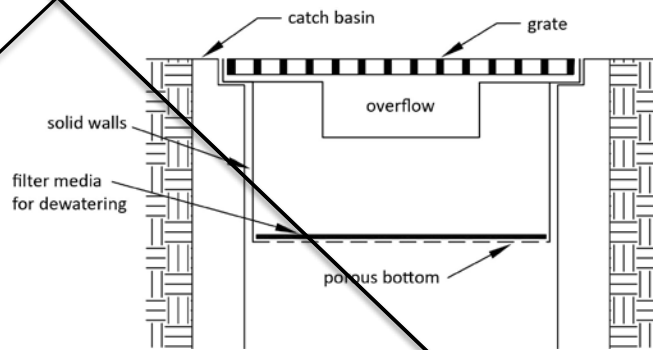
## Sampling from a drainage ditch or swale

If a drainage ditch carries stormwater flow from your facility offsite, and if it carries no flow other than the flow from your facility, you can sample the water in the ditch simply by placing the bottle where the stormwater is freely flowing, with the bottle opening facing upstream. If you cannot reach a freely flowing portion of the ditch by hand, you may need to attach the bottles, one at a time, to a pole for sampling. Follow the procedure outlined in the section, *How to Fill Sample Bottles*.

If the flow is carried in a small ditch or swale, you can install a barrier device in the channel or deepen a small area so you can gain enough depth of flow to sample directly into the bottles. Make sure to allow for sufficient time after disturbing the bottom so that the solids resulting from muddying the water will not become part of your sample.



Simple filter fabric fitted over a catch basin grate (King County, 2009).



Schematic figure of a catch basin insert with an overflow opening that could be used for sampling (King County, 2009).

## Sampling sheet flow

It is not always possible to sample stormwater runoff in locations such as ditches or pipes where the flow is concentrated. Sometimes the permittee has no choice but to select sample locations for which sheet flow is sampled before it becomes concentrated. Approaches to sampling sheet flow are described below and illustrated in the figures that follow.

In some cases, a stormwater discharge from a facility is not concentrated at any point and leaves the property in the form of sheet flow as it runs off a work area or driveway or grassy area. In this case the flow may be too shallow for the collection bottle to be filled with sample. It is often possible to find a way to collect the stormwater runoff in these situations.

One way to concentrate sheet flow is to install a barrier device or trough, gutter, strip drain/trench drain, or ditch to intercept and concentrate stormwater flow. As with other sample sites, the flow should be moving and somewhat turbulent so the samples will be well-mixed. Be sure that any excavation you do does not expose the stormwater to be sampled to newly worked soil surfaces that the runoff may erode, increasing the solids in your samples. You may want to consider lining the trough, gutter, or ditch with plastic or PVC. Be sure not to introduce materials such as metals that include zinc that may contaminate the samples. Sheet flow on paved areas can be concentrated and collected by constructing small bumps, similar to speed bumps.

Another way to collect samples from sheet flow is to use a special peristaltic hand pump to pump samples from shallow surface flows. If being used to collect TPH samples, ensure the tubing is Teflon-lined.

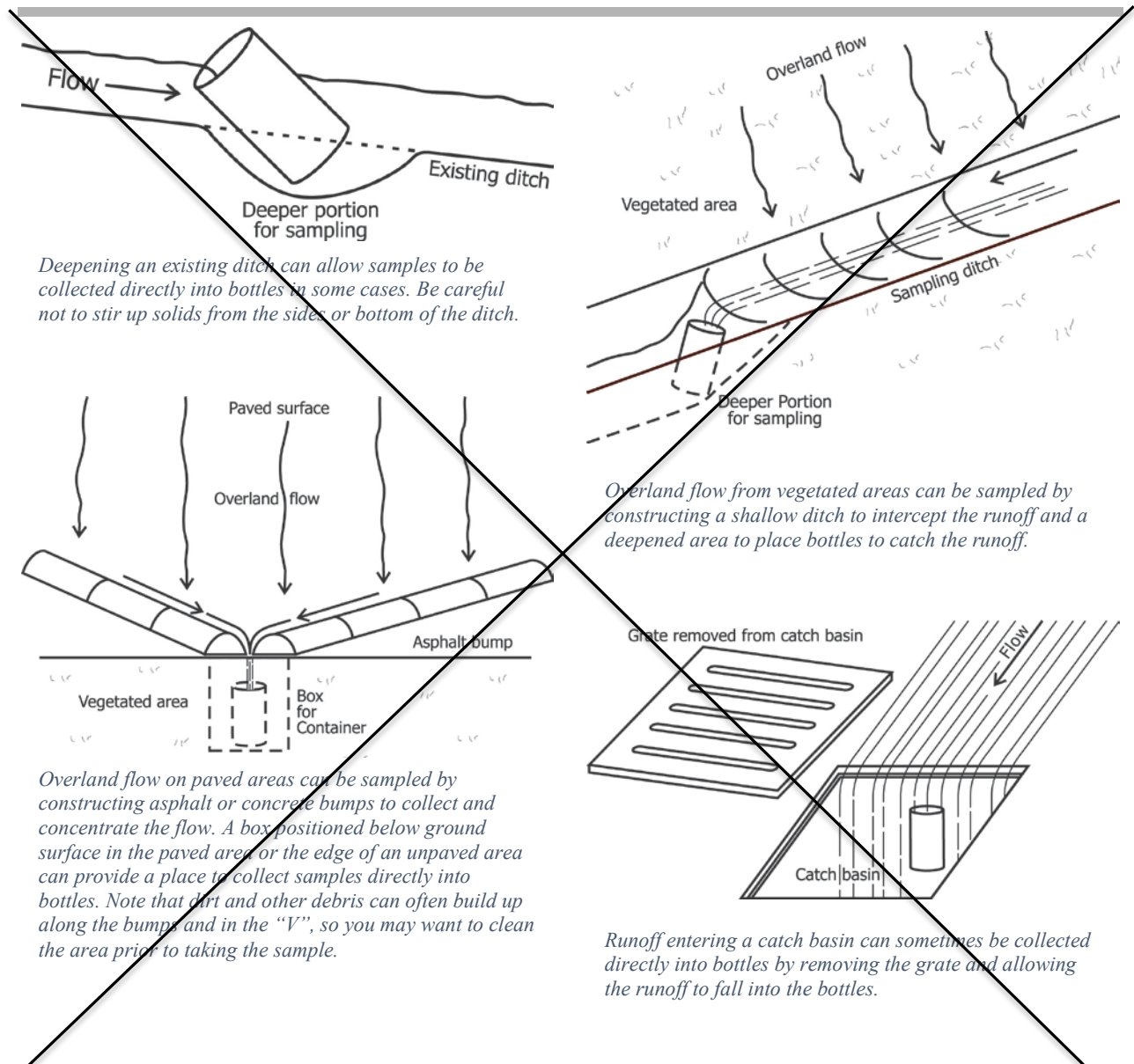
An additional resource for guidance on sampling sheet flow can be found on the Minnesota Pollution Control Agency [website](#)<sup>8</sup>. There is a YouTube video and guidance document detailing the use of a plastic bag to collect and sample sheet flow. It should be noted that the use of plastic could affect the collection of organics samples, so this technique must be described in field notes if it is used.

Roger Bannerman of the Wisconsin Department of Natural Resources has developed simple devices to grab samples of sheet flow from paved areas, rooftops, and lawns (Bannerman et al., 1993). Though the devices are intended to be used for simple, automatic sampling or for pouring a container of collected sample into other sample bottles, the ways in which the devices intercept and concentrate flows can be adopted for direct grab sampling.

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<sup>8</sup> <http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/industrial-stormwater/industrial-stormwater-steps-to-compliance/industrial-stormwater-steps-to-compliance-step-9-inspect-monthly-report-annually.html>

The following figures illustrate the methods of sampling sheet flow discussed above:



## Sampling from a stormwater detention pond or other BMP

When stormwater from a facility discharges after flowing through a detention pond or other treatment system, sample as the stormwater flows out at the discharge point. Ponds may hold stormwater for a time before discharge begins. Attempt to sample within the first 12 hours from when the pond begins to discharge, and follow the previous guidance when that is not possible, or it is unknown.

## Sampling storm drain solids

Beginning in 2015, facilities that discharge to a Puget Sound Sediment Cleanup Site, either directly or indirectly through a stormwater drainage system, must sample their storm drain solids for a list of physical and chemical parameters. At least once prior to October 1, 2016, facilities must collect and sample storm drain solids from a representative catch basin, sump, pipe, or other feature within the storm drain system that corresponds to the discharge point(s) where Total Suspended Solid (TSS) samples are collected per Condition S6.C.1 (pages 29-30).

Similar to sampling stormwater runoff, the most appropriate location and method for the collection of storm drain solids will depend on the site. Solids must be collected from within the storm drain system as outlined under the permit section S6.C.2 (pages 31-34). The recommended method to collect samples of storm drain solids is a grab or composite of catch basin, sump, or conveyance line accumulations. Sampling the forebay of an oil-water separator can also be used to characterize stormwater solids. The necessary parameters and procedures for analysis of solids are found in Table 8 of the permit (Condition S6.C.2.e (pages 32,34).

A description of materials and estimated volume of sample necessary for analysis can be found in the *Storm Drain Solids Sampling* table below. Materials that are necessary include: latex or nitrile gloves, labeled lab-supplied glass and plastic jars, stainless steel spoon and bowl (organics samples), and thick plastic spoon and bowl (metals and conventionals sample). Spoons and bowls must be cleaned with soap prior to use and in between samples. If possible stainless steel equipment should be rinsed with solvent (hexane) and wrapped in aluminum foil prior to use. Solvents must only be used if the appropriate safety considerations can be met (i.e., appropriate storage of solvent, proper ventilation, and disposal of waste solvent).

### Storm Drain Solids Sampling

Parameter group	Individual parameters	Mixing bowl and spoon	Cleaning the bowl	Estimated volume of sample
Conventionals	Percent total solids, total organic carbon, and grain size	Plastic or stainless steel	Soap	~ 250ml (8 oz) glass or plastic jar for each individual parameter
Metals	Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc	Plastic	Soap	1 – 250ml (8 oz) glass jar
Organics	PAHs, PCBs, and TPH-Dx	Stainless steel	Soap and solvent	~ 250ml (8 oz) glass jar w/ Teflon lined cap for each individual parameter

Catch basin solid grab samples do not need to be sampled during a storm, in fact they should be collected following storms when there is little water overlying the solids in the catch basin, sump or area of accumulation in the conveyance line. If there is overlying water, siphon or pump the water off without disturbing the solids; leave a thin layer of water intact.

Wearing gloves, sample the area of accumulated solids, using the spoons, and collect them in the bowls. Sample a representative portion of the solids in the area of accumulation (i.e., dig below surface if there are a few inches of accumulation) and enough to fill the required jars. Mix and blend the sample in the bowl and fill the required sample jars for all parameters. Metals sample jars should be filled from the plastic bowl and organics sample jars from the stainless steel bowl. Document the field conditions and appearance of the sample. Pack the samples in a Ziploc bag; put on ice, in a cooler, and send to the lab for analysis.

If there are no spots of solids accumulation in the storm drain system, consider using in-line storm drain solids traps. Further guidance on in-line solids traps can be found elsewhere ([Lubliner, 2012](#))<sup>9</sup>. Contact Ecology if you have any questions concerning sampling in-line storm drain solids.

Under section S6.C.2.f of the general permit, all storm drain solids sampling data shall be reported to Ecology on a Solids Monitoring Report (SMR) along with a copy of the laboratory report. Make sure all required and recommended information as listed above is recorded in field notes and on laboratory documents. There can be variability among the samples collected using different methods, so it is important to document exactly how and where the sample was collected.

## Ecology Wants to Hear from You

If you have suggestions on how Ecology can improve this guidance document, if you have developed innovative sampling techniques, or if you just want to comment on stormwater sampling, contact:

Jeff Killelea  
Water Quality Specialist  
(360) 407-6127  
[jeff.killelea@ecy.wa.gov](mailto:jeff.killelea@ecy.wa.gov)

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<sup>9</sup> <https://fortress.wa.gov/ecy/publications/summarypages/1203053.html>

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# Glossary, Acronyms, and Abbreviations

## Glossary

**303(d)-listed water body:** Water body as listed as Category 5 on Washington State's Water Quality Assessment.

**Average:** Arithmetic mean, which is equal to the sum of the measurements divided by the number of measurements.

**Best Management Practices (BMPs - general definition):** 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: facility site *runoff*, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. In the permit BMPs are further categorized as operational source control, structural source control, *erosion* and *sediment* control, and *treatment BMPs*.

**Benchmark:** A *pollutant* concentration used as a permit threshold, below which a pollutant is considered unlikely to cause a water quality violation, and above which it may. When pollutant concentrations exceed benchmarks, corrective action requirements take effect. Benchmark values are not *water quality standards* and are not numeric effluent limitations; they are indicator values.

**Daily Average:** The average measurement of the pollutant throughout a period of 24 consecutive hours starting at 12:01 A.M. and ending at the following 12:00 P.M. (midnight).

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

**Discharge [of a pollutant]:** Any addition of any *pollutant* or combination of pollutants to waters of the United States from any point source. This definition includes additions of pollutants into waters of the United States from: surface *runoff* that is collected or channeled by man; discharges through pipes, sewers, or other conveyances owned by a State, *municipality*, or other person which do not lead to a treatment works; and discharges through pipes, sewers, or other conveyances, leading into privately owned treatment works.

**Discharge point:** The location where a discharge leaves the Permittee's facility. *Discharge point* also includes the location where a discharge enters the ground on-site (e.g., infiltration BMP).

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

**Facility:** Any source (including land or appurtenances thereto) that is subject to regulation under the permit. See Special Condition S1.

**First fall storm event:** The first time on or after October 1st of each year that precipitation occurs and results in a *stormwater discharge* from a *facility*. This storm event tends to wash off and discharge pollutants that accumulate during the preceding dry months.

**General Permit:** A permit which covers multiple *dischargers* of a point source category within a designated geographical area, in lieu of individual permits being issued to each *discharger*.

**Groundwater:** Water in a saturated zone or stratum beneath the land surface or a surface water body.

**Industrial Activity:** (1) The 10 categories of industrial activities identified in *40 CFR* 122.26(b)(14)(i-ix and xi), (2) any *facility* conducting any activities described in Table 1, or (3) any facility identified by *Ecology* as a *significant contributor of pollutants*.

**Landfill:** An area of land or an excavation in which wastes are placed for permanent disposal, and which is not a *land application site*, surface impoundment, injection well, or waste pile.

**Municipality:** A political unit such as a city, town, or county; incorporated for local self-government.

**Outfall:** The point where a discharge from a facility enters a receiving water body or receiving waters.

**Pollutant:** The *discharge* of any of the following to *waters of the state*: 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 Federal Water Pollution Control Act (FWPCA) nor does it include dredged or fill material discharged in accordance with a permit issued under section 404 of the FWPCA.

**Pollution:** 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.

**Puget Sound Sediment Cleanup Site:** Category 4B (Sediment) portions of Budd Inlet (Inner), Commencement Bay (Inner), Commencement Bay (Outer), Dalco Passage and East Passage, Duwamish Waterway (including East and West Waterway), Eagle Harbor, Elliot Bay, Hood Canal (North), Liberty Bay, Rosario Strait, Sinclair Inlet, and Thea Foss Waterway; Category 5 (Sediment) portions of the Duwamish Waterway (including East and West Waterway), and Port Gardner and Inner Everett Harbor; and Port Angeles Harbor sediment cleanup area, as mapped on Ecology's Industrial Stormwater General Permit (ISGP) website. All references to Category 4B and 5 pertain to the 2012 EPA-approved Water Quality Assessment.

**Quantitation Level (QL) also known as Minimum Level of Quantitation (ML):** The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that all method-specified sample weights, volumes, and cleanup procedures have been employed.

**Regular Business Hours:** Those timeframes when the *facility* is engaged in its primary production process, but does not include additional shifts or weekends when partial staffing is at the site primarily for maintenance and incidental production activities. *Regular business hours* do not include periods of time that the *facility* is inactive and *unstaffed*.

**Representative [sample]:** A sample of the *discharge* that accurately characterizes *stormwater runoff* generated in the designated drainage area of the *facility*.

**Runoff:** That portion of rainfall or snowmelt water not absorbed into the ground that becomes surface flow.

**Sanitary Sewer:** A sewer which is designed to convey *domestic wastewater*.

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

**Standard Industrial Classification (SIC):** The statistical classification standard underlying all establishment-based federal economic statistics classified by industry as reported in the 1987 SIC Manual by the Office of Management and Budget.

**Stormwater:** 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 Drainage System:** Constructed and natural features that function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate or divert *stormwater*.

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

**Substantially Identical Discharge Point:** A discharge point that shares the following characteristics with another discharge point: (1) the same general industrial activities conducted in the drainage area of the *discharge* point, (2) the same *Best Management Practices* conducted in the drainage area of the discharge point, (3) the same type of exposed materials located in the drainage area of the *discharge* point that are likely to be significant contributors of *pollutants* to *stormwater discharges*, and (4) the same type of impervious surfaces in the drainage area that could affect the percolation of *stormwater runoff* into the ground (e.g., asphalt, crushed rock, grass).

**Unstaffed:** The *facility* has no assigned staff. A site may be *unstaffed* even when security personnel are present, provided that *pollutant* generating activities are not included in their duties.

**Vehicle:** A motor-driven conveyance that transports people or freight, such as an automobile, truck, train, or airplane.

**Vehicle Maintenance:** The rehabilitation, mechanical repairing, painting, fueling, and/or lubricating of a motor-driven conveyance that transports people or freight, such as an automobile, truck, train, or airplane.

## Acronyms and Abbreviations

BMP	Best management practice
DMR	Discharge Monitoring Report
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FWPCA	Federal Water Pollution Control Act
ISGP	Industrial Stormwater General Permit
ML	Minimum level of quantitation
N	Nitrogen
NWTPH-Dx	Northwest Total Petroleum Hydrocarbons – Diesel fraction
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
QL	Quantitation level
SIC	Standard Industrial Classification
SWPPP	Stormwater Pollution Prevention Plan
TPH	Total Petroleum Hydrocarbon

# Appendices

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## Appendix A - Proper and Improper Methods of Sampling



***DO** always wear gloves when taking.*



***DO NOT** allow bottle lids to touch ground. Keep lids clean to prevent contamination.*



***DO NOT** touch openings of bottles. Keep bottles clean to prevent contamination.*



***DO NOT** sample in stagnant areas with little flow. **DO NOT** stir up bottom sediments or allow foreign materials to enter the sample bottle. (**DO** be careful to grab a clean sample in cases where stormwater runoff is shallow.) If the runoff is so shallow that it is not possible to sample without the sample being contaminated in the process, then find an alternative way to sample.*



***DO** attach a bottle to a pole for sampling in manholes or when a hand sample would be in stagnant water. A boathook is used in this example and the bottle is attached to it with filament strapping tape.*



*If the water is too shallow to sample with the bottle upright on the pole, try taping it on sideways, but tilted up slightly.*



***DO** sample with the opening of the bottle facing upstream, into the flow so the water will enter directly into the bottle. This is true when sampling either by hand or with a pole. **DO** sample water that is rapidly flowing rather than stagnant.*



***DO NOT** sample with the bottle opening facing downstream, when using a pole or sampling by hand. Water flowing past your container, pole, or hand and into the container can be contaminated by such contact.*



***DO** collect samples without overfilling the bottles.*



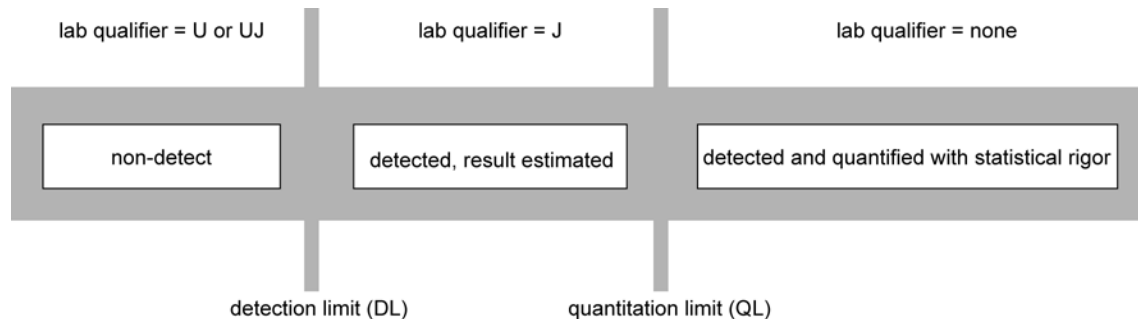
***DO NOT** allow water to overfill the bottle, particularly not for sample bottles with preservative. TPH samples must be collected from water falling into the bottle when possible, or otherwise in a single swoop.*

## Appendix B - Guidance on Results near Lab Detection Limits

Water quality criteria and permit limits based on those criteria may be set at very low concentrations. Lab methods approved for use in National Pollutant Discharge Elimination System (NPDES) permitting are sometimes not capable of measuring chemical concentrations at these low levels. Labs use many different terms to describe these levels. Ecology's Water Quality program uses the following terms for NPDES permitting.

**Detection Limit (DL):** the minimum concentration of an analyte (substance) that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero as determined by the procedure given in 40 CFR part 136, Appendix B of the Clean Water Act (amended in 1977).

**Quantitation Limit (QL):** the smallest detectable concentration of analyte greater than the detection level (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose (US EPA, 2007).



### Reporting using WQWebDMR

Currently the Construction Stormwater general permit and the Industrial Stormwater general permit require permittees to submit Discharge Monitoring Reports (DMR) electronically using WQWebDMR with some limited exceptions. As Ecology reissues both general and individual permits, it is including permit conditions requiring the use of WebDMR. To obtain an exception under the stormwater permits, the permittee must apply for a waiver. See Ecology's Water Quality Stormwater Permits webpage for more details.

<http://www.ecy.wa.gov/programs/wq/stormwater/index.html>.

Below is some guidance for reporting analytical values on a DMR. If a permit or DMR conflicts with this guidance, follow the instructions in the permit or DMR.

- ◆ Report single analytical values below detection as *less than the detection level (DL)* by entering < followed by the numeric value of the DL (e.g. < 2.0) on the DMR.

- ◆ Report single analytical values between the DL and QL by entering the estimated value, the qualifier for estimated value/below quantitation level (J) and any additional information in the comments. Submit a copy of the lab report as an attachment to the DMR.
- ◆ Report single analytical values above the QL by entering the numeric value.
- ◆ Calculate average values (unless otherwise specified in a permit) using:
  - ◇ The reported numeric value for those parameters measured above the QL or between the DL and QL.
  - ◇ One-half the DL (for values reported below the DL) if the lab detected the parameter in another sample from the same monitoring point for the reporting period.
  - ◇ Zero (for values reported below the DL) if the lab did not detect the parameter in another sample for the reporting period.

Calculate total values (e.g., Total PCBs, TPH-Dx) (unless otherwise specified in a permit) using:

- ◆ The reported numeric value for all individual compounds or isomers measured above the QL or between the DL and QL.
- ◆ One-half the DL (for values reported below the DL) if the lab detected the individual compound or isomer in another sample from the same monitoring point for the reporting period.
- ◆ Zero (for values reported below the DL) if the lab did not detect the individual compound or isomer in another sample for the reporting period.

If all individual compounds or isomers in the sample were not detected, report *less than the detection level (DL)* by entering < followed by the numeric value of the highest individual DL (e.g. < 2.0) on the DMR.

For all analytical values reported, if the method used did not meet the minimum DL and QL identified in the permit, report the actual DL and QL in the comments or in the location provided.

When dilutions are performed in the analysis, report the adjusted DL and QL as appropriate. Submit a copy of the lab report as an attachment to the DMR.

When required, lab reports must provide the following information: date sampled, sample location, date of analysis, parameter name, CAS number, analytical method/number, DL, QL, reporting units, and concentration detected. The lab report must also include information on the chain of custody, Quality Assurance/Quality Control (QA/QC) results, and documentation of accreditation for the parameter.

## Appendix C - Tables from the Industrial Stormwater General Permit

**Table 2: Benchmarks and Sampling Requirements Applicable to All Facilities**

Parameter	Units	Benchmark Value	Analytical Method	Laboratory Quantitation Level <sup>a</sup>	Minimum Sampling Frequency <sup>b</sup>
Turbidity	NTU	25	EPA 180.1	0.5	1/quarter
pH	Standard units	Between 5.0 – 9.0	Meter/paper <sup>c</sup>	±0.5	1/quarter
Oil Sheen	Yes/No	No visible oil sheen	N/A	N/A	1/quarter
Copper, Total	µg/L	Western WA: 14 Eastern WA: 32	EPA 200.8	2.0	1/quarter
Zinc, Total	µg/L	117	EPA 200.8	2.5	1/quarter

<sup>a</sup>. The Permittee shall ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternate method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. Any Permittee using an alternative method must report the test method and QL on the DMR. If the Permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR.

<sup>b</sup>. 1/quarter means at least one sample taken each quarter, year-round.

<sup>c</sup>. Permittees shall use either a calibrated pH meter or narrow-range pH indicator paper with a resolution not greater than ± 0.5 SU.

**Table 3: Additional Benchmarks and Sampling Requirements Applicable to Specific Industries.**

Parameter	Units	Benchmark Value	Analytical Method	Laboratory Quantitation Level <sup>a</sup>	Minimum Sampling Frequency <sup>b</sup>
<b>1. Chemical and Allied Products (28xx), Food and Kindred Products (20xx)</b>					
Biological Oxygen Demand (BOD)	mg/L	30	SM 5210B	2	1/quarter
Nitrate + Nitrite Nitrogen, as N	mg/L	0.68	SM 4500; NO3-E/F/H	0.1	1/quarter
Phosphorus, Total	mg/L	2.0	EPA 365.1	0.1	1/quarter
<b>2. Primary Metals (33xx), Metals Mining (10xx), Automobile Salvage and Scrap Recycling (5015 and 5093), Metals Fabricating (34xx)</b>					
Lead, Total	µg/L	81.6	EPA 200.8	0.5	1/quarter
Petroleum Hydrocarbons (Diesel Fraction)	mg/L	10	NWTPH-Dx	0.1	1/quarter
<b>3. Hazardous Waste Treatment, Storage and Disposal Facilities and Dangerous Waste Recyclers subject to the provisions of Resource Conservation and Recovery Act (RCRA) Subtitle C</b>					
Chemical Oxygen Demand (COD)	mg/L	120	SM 5220-D	10	1/quarter
Total Ammonia (as N)	mg/L	2.1	SM 4500; NH3-GH	0.3	1/quarter
Total Suspended Solids (TSS)	mg/L	100	SM 2540-D	5	1/quarter
Arsenic, Total	µg/L	150	EPA 200.8	0.5	1/quarter
Cadmium, Total	µg/L	2.1	EPA 200.8	0.25	1/quarter
Cyanide, Total	µg/L	22	EPA 335.4	10	1/quarter
Lead, Total	µg/L	81.6	EPA 200.8	0.5	1/quarter
Magnesium, Total	µg/L	64	EPA 200.8	50	1/quarter
Mercury, Total	µg/L	1.4	EPA 1631E	0.0005	1/quarter
Selenium, Total	µg/L	5.0	EPA 200.8	1.0	1/quarter
Silver, Total	µg/L	3.8	EPA 200.8	0.2	1/quarter
Petroleum Hydrocarbons (Diesel Fraction)	mg/L	10	NWTPH-Dx	0.1	1/quarter
<b>4. Air Transportation (45xx) <sup>c</sup></b>					
Total Ammonia (as N)	mg/L	2.1	SM 4500; NH3-GH	0.3	1/quarter
Biological Oxygen Demand (BOD)	mg/L	30	SM 5210B	2	1/quarter
Chemical Oxygen Demand (COD)	mg/L	120	SM 5220-D	10	1/quarter
Nitrate + Nitrite Nitrogen, as N	mg/L	0.68	SM 4500; NO3-E/F/H	0.1	1/quarter
Petroleum Hydrocarbons (Diesel Fraction)	mg/L	10	NWTPH-Dx	0.1	1/quarter
<b>5. Timber Product Industry (24xx), Paper and Allied Products (26xx)</b>					
Chemical Oxygen Demand (COD)	mg/L	120	SM 5220-D	10	1/quarter
Total Suspended Solids (TSS)	mg/L	100	SM 2540-D	5	1/quarter
<b>6. Transportation (40xx – 44xx, except 4221-25), Petroleum Bulk Stations and Terminals (5171)</b>					
Petroleum Hydrocarbons (Diesel Fraction)	mg/L	10	NWTPH-Dx	0.1	1/quarter

<sup>a</sup>. The Permittee shall ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternate method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. Any Permittee using an alternative method must report the test method and QL on the DMR. If the Permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR.

<sup>b</sup>. 1/quarter means at least one sample taken each quarter, year-round.

<sup>c</sup>. For airports where a single Permittee, or a combination of permitted facilities use more than 100,000 gallons of glycol-based deicing chemicals and/or 100 tons or more of urea on an average annual basis, monitor these additional five parameters in those *discharge points* that collect runoff from areas where deicing activities occur (SIC 4512-4581).

**Table 5: Effluent Limit Applicable to Airports Subject to 40 CFR Part 449.**

Parameter	Units	Benchmark Value <sup>a</sup>	Analytical Method <sup>b</sup>	Laboratory Quantitation Level <sup>c</sup>	Minimum Sampling Frequency <sup>d</sup>
Total Ammonia (as N)	mg/L	14.7	SM 4500; NH <sub>3</sub> -GH	0.3	1/quarter

<sup>a</sup>. Maximum daily effluent limit means the highest allowable daily discharge. The daily discharge means the discharge of a pollutant measured during a calendar day. The daily discharge is the average measurement of the pollutant over the day.

<sup>b</sup>. Or other equivalent EPA-approved method with the same or lower quantitation level.

<sup>c</sup>. The Permittee shall ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternate method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. Any Permittee using an alternative method must report the test method and QL on the DMR. If the Permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR.

<sup>d</sup>. 1/quarter means at least one sample taken each quarter, year-round.

**Table 7: Benchmarks and Sampling Requirements Applicable to Discharges to Puget Sound Sediment Cleanup Sites that are not Category 5 for Sediment Quality.**

Parameter	Units	Benchmark Value <sup>a</sup>	Analytical Method	Laboratory Quantitation Level <sup>b</sup>	Minimum Sampling Frequency <sup>c</sup>
Total Suspended Solids (TSS)	mg/L	30	SM 2540-D	5	1/quarter

<sup>a</sup>. Permittees sampling more than once per quarter shall average the sample results and compare the average value to the benchmark to determine if the discharge has exceeded the benchmark value. However, if Permittees collect more than one sample during a 24-hour period, they must first calculate the daily average of the individual grab sample results collected during that 24-hour period; then use the daily average to calculate a quarterly average.

<sup>b</sup>. The Permittee shall ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternate method from 40 CFR Part 136 is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. Any Permittee using an alternative method must report the test method and QL on the DMR. If the Permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific method detection level (MDL) and QL on the DMR.

<sup>c</sup>. 1/quarter means at least one sample taken each quarter, year-round.

**Table 8: Sampling and Analytical Procedures for Storm Drain Solids.**

Analyte	Method in Solids	Quantitation Level <sup>a</sup>
<b>Conventional Parameters</b>		
Percent total solids	SM 2540G, or ASTM Method D 2216	N/A
Total organic carbon	Puget Sound Estuary Protocols (PSEP 1997), or EPA 9060	0.1%
Grain size	Ecology Method Sieve and Pipette (ASTM 1997), ASTM D422, or PSEP 1986/2003	N/A
<b>Metals</b>		
Antimony, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.2 mg/kg dw
Arsenic, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.1 mg/kg dw
Beryllium, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.2 mg/kg dw
Cadmium, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.2 mg/kg dw
Chromium, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.5 mg/kg dw
Copper, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.2 mg/kg dw
Lead, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.2 mg/kg dw
Mercury, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.005 mg/kg dw
Nickel, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.1 mg/kg dw
Selenium, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.5 mg/kg dw
Silver, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.1 mg/kg dw
Thallium, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	0.2 mg/kg dw
Zinc, Total	EPA Method 200.8 (ICP/MS), EPA Method 6010, or EPA Method 6020	5.0 mg/kg dw
<b>Organics</b>		
PAH compounds <sup>c</sup>	EPA Method 8270D	70 µg/kg dw
PCBs (aroclor)s, Total <sup>d</sup>	EPA Method 8082	10 µg/kg dw
<b>Petroleum Hydrocarbons</b>		
NWTPH-Dx	NWTPH-Dx	25.0-100 mg/kg dw

<sup>a</sup>. The Permittee shall ensure laboratory results comply with the quantitation level (QL) specified in the table. However, if an alternate method is sufficient to produce measurable results in the sample, the Permittee may use that method for analysis. Any Permittee using an alternative method must report the test method and QL on S6.C.2.f the sediment monitoring report. All results shall be reported. For values below the QL, or where a QL is not specified, report results at the method detection level (MDL) from the lab and the qualifier of “U” for undetected at that concentration. If the Permittee is unable to obtain the required QL due to matrix effects, the Permittee must report the matrix-specific MDL and QL on the DMR.

<sup>b</sup>. dw = dry weight.

<sup>c</sup>. PAH compounds include: 1-methylnaphthalene, 2-methylnaphthalene, 2-chloronaphthalene, acenaphthylene, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b, k)fluoranthene, benzo(ghi)perylene, dibenzo(a,h)anthracene, dibenzofuran, carbazole, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

<sup>d</sup>. Total = sum of PCB aroclors 1016+1221+1232+1242+1248+1254+1260.

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