Stormwater Plan

Washington State Fair – Barn M Redevelopment

110 9th Avenue SW
Puyallup, WA 98371

Prepared by
JMJ TEAM
905 Main St Suite 200
Sumner, WA 98390
206.596.2020
Justin Jones, PE

April 28, 2025

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Stormwater Plan for the Washington State Fair – Barn M Redevelopment in Puyallup has been prepared by me or under my supervision and meets minimum standards of Washington State Department of Ecology, The City of Puyallup, and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER

____

Justin Jones, PE

4-28-25

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PROJECT OVERVIEW AND MAPS

The Washington State Fair (WSF) is a 98 acre facility located between 15th Avenue SW to the South; Meridian Street to the East; 9th Avenue SW to the North; and Fairview Drive to the West. The 2.04 acre project is to redevelop the demolished Barn M with asphalt/concrete hardscape, synthetic turf and associated utility improvements.

Barn M was an approximate 88,0000 square foot site with a 60,000 square foot exhibit barn with restrooms, offices, food vending spaces, and milking parlors that was demolished in early 2025. The redevelopment of the site will include new domestic water and fire lines, replaced sanitary sewer main, vendor vaults, synthetic turf event space, concrete plaza, and asphalt areas including an area for animal showings under temporary tents graded to drain to a sanitary sewer/stormwater switch system.

EXISTING CONDITIONS SUMMARY

The WSF is made up of two main parcels, and the Barn M Redevelopment project is located on TPN: 0420331121.

The Barn M Redevelopment project site is 88,672 SF. Stormwater runoff in the project area is currently collected by catch basins and roof downspouts. Stormwater runoff from the catch basins and roof downspouts is subsequently conveyed to the 42-inch city main in vacated 5^{th} Street through a private stormwater system.

See Project Area Coverage Tables and Figures Below. Full size Project Area Coverage Figures are available in Appendix A.

PROPOSED CONDITIONS SUMMARY

The Barn M Redevelopment project site proposes the construction of a 19,700 SF synthetic turf field, 1,988 SF concrete plaza, 66,984 asphalt animal show area and asphalt to pave back the area of demolition of Barn M. This will result in 88,672 SF of replaced impervious surfaces within the project area.

The proposed project will trigger minimum requirements 1-5 only as it is a redevelopment project that is less than 50% value of the existing site improvement value. The 69,000 SF barn had a insured replacement value of $4.6M and the project costs are below $2M including hard and soft costs.

Stormwater from the animal show area will drain to the sanitary sewer system through a switch system when tents are in place and to the stormwater system otherwise, The synthetic turf area will drain to a underdrain system that will connect to the storm system. The asphalt walkways will drain to existing and proposed catch basins.

Infiltration testing was performed onsite to obtain a design infiltration rate for on-site soils, See Appendix B. While some of the site contains typical valley soil that infiltrates, much of the redevelopment area is underlain with clay resulting in a higher site variability correction factor and a design infiltration rate of 0.17-inches per hour which is below the required rate for infiltration feasibility.

See Project Area Coverage Tables and Figures below.

Description[a]	Onsite	Offsite	Total
Existing Conditions			
Total Project Area[b] (ft²)	88,672-2.04 ac	0-0 ac	88,672-2.04 ac
Existing hard surface (ft²)		0-0 ac	
Existing vegetation area (ft²)		0-0 ac	
Proposed Conditions			
Total Project Area[b] (ft²)	88,672-2.04 ac	0-0 ac	88,672-2.04 ac
Amount of new hard surface (ft²)	0-0 ac	0-0 ac	0-0ac
Amount of new pollution generating hard surface (PGHS)[c] (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of replaced hard surface (ft²)	88,672-2.04 ac	0-0 ac	88,672-2.04 ac
Amount of replaced PGHS[d] (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of new plus replaced hard surface (ft²)	88,672-2.04 ac	0-0 ac	88,672-2.04 ac
Amount of new + replaced PGHS (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of existing hard surfaces converted to vegetation (ft²)	0-0 ac	0-0 ac	0-0 ac
Amount of Land Disturbed (ft²)	88,672-2.04 ac	0-0 ac	88,672-2.04 ac
Vegetation to Lawn/Landscaped (acres)	0-0 ac	0-0 sf	0-0 ac
Native Vegetation to Pasture (acres)	0-0 sf	0-0 sf	0-0 sf
Existing hard surface to remain unaltered (ft²)	0-0 ac	0-0 ac	0-0 ac
Existing vegetation area to remain unaltered (ft²)	0-0 ac	0-0 ac	0-0 ac

a. All terms are defined in the 2019 Ecology Manual glossary.
b. The total project area in the existing condition should typically match the total project area in the proposed condition.
c. The "amount of new PGHS" should be part of or all of "amount of new hard surfaces"
d. The "amount of replaced PGHS" should be part of or all of the "amount of replaced hard surfaces".

Figure #1 Existing Lot Coverage

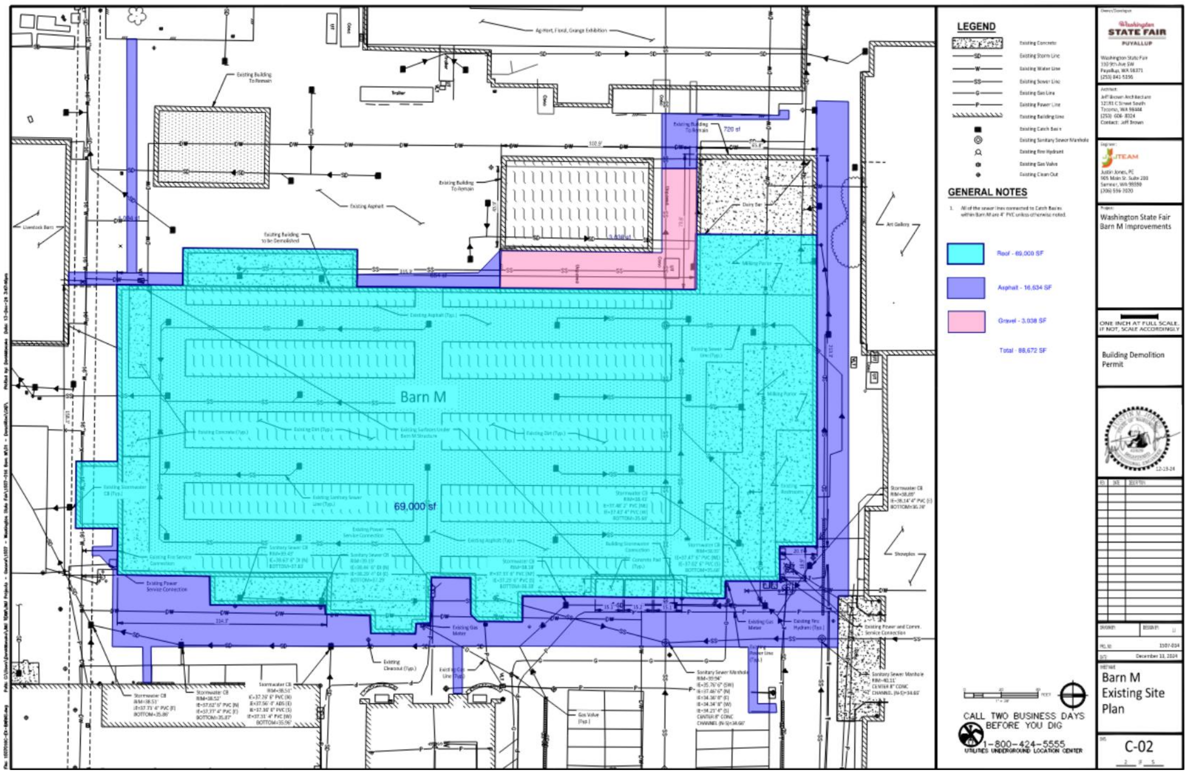
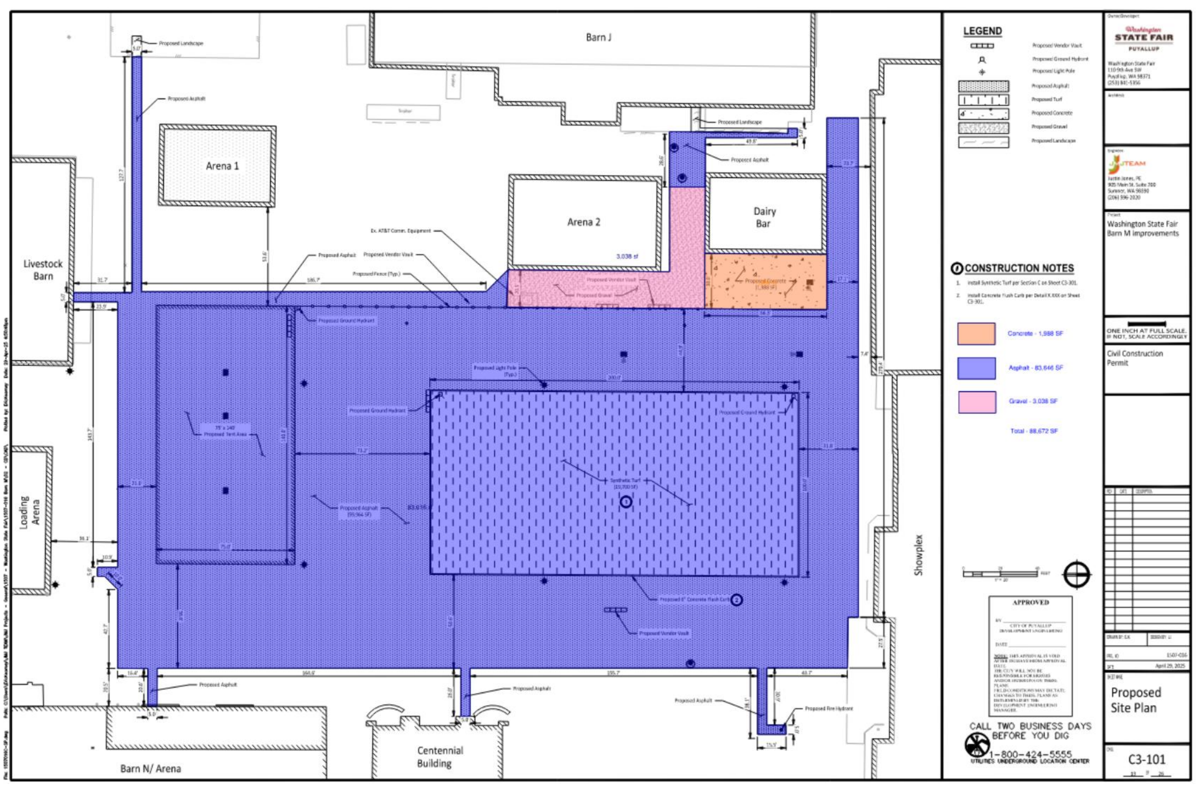


Figure #2 Proposed Lot Coverage

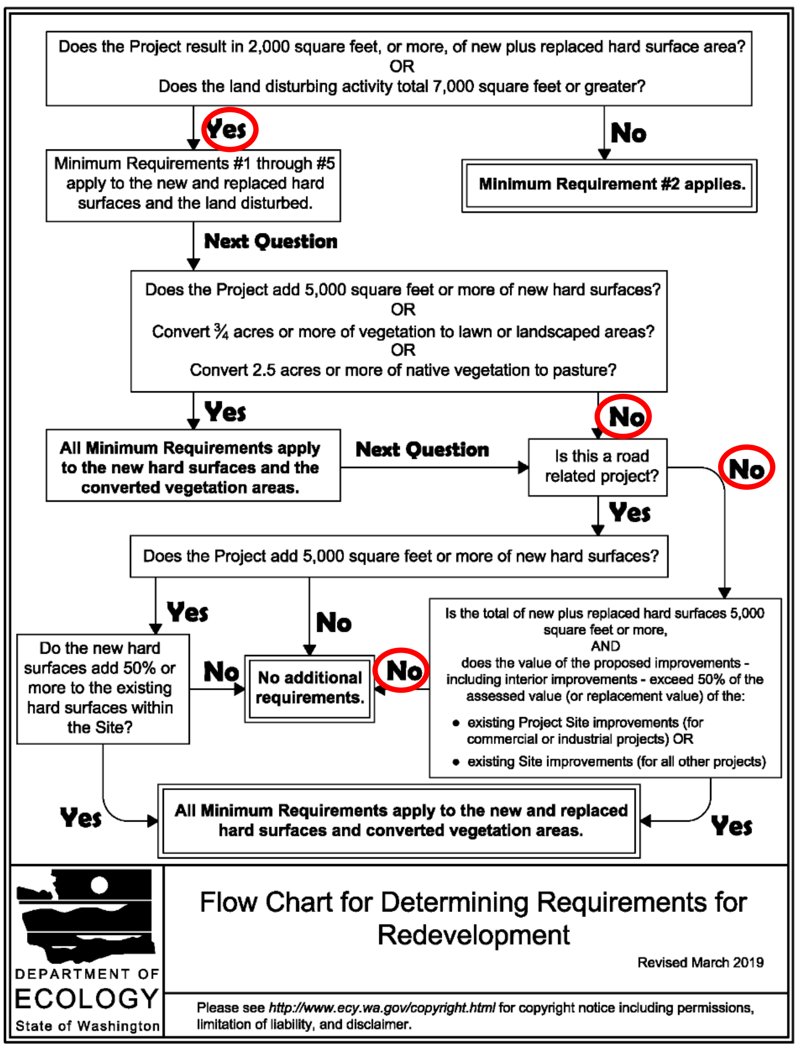


SUMMARY OF MINIMUM REQUIREMENTS

The City of Puyallup utilizes the 2019 Department of Ecology Stormwater Manual for Western Washington (manual) for stormwater design. Volume 1 of this manual describes the Minimum Requirements for stormwater management for a redevelopment site.

The Barn M Redevelopment project site will have 88,672 SF of new and replaced hard surfaces upon project completion, and a total of 88,672 SF of land disturbing activity. The fully developed site will be 100% impervious in the final condition. The project is subject to minimum requirements 1-5. See Chart below.

Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment



2019 Stormwater Management Manual for Western Washington

Volume I - Chapter 3 - Page 90

MINIMUM REQUIREMENT 1: PREPARATION OF STORMWATER SITE PLANS

Preliminary Stormwater Site Plan drawings have been prepared and included with this Preliminary Site Plan submittal. Final stormwater site plans will be submitted with the civil permit drawings.

Stormwater Site Plan drawings have been prepared per the City of Puyallup development codes and the 2019 DOE Manual.

MINIMUM REQUIREMENT 2: CONSTRUCTION STORMWATER POLLUTION PREVENTION

The Barn M Redevelopment project requires a Construction Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will comply with all 12 elements per the Doe manual. The SWPPP will be provided with the construction civil permit and will include the construction NPDES.

Revise to be 13 elements

MINIMUM REQUIREMENT 3: SOURCE CONTROL OF POLLUTION

Source control BMPs will be implemented to minimize stormwater contamination and help comply with the Department of Ecology Stormwater Management Manual for Western Washington. BMP's for the project may include:

- *Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine necessary O & M Improvements.*
- *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.*
- *Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catch basin.*

MINIMUM REQUIREMENT 4: PRESERVATION OF NATURAL DRAINAGE SYSTEMS AND OUTFALLS

There are no natural drainage systems or outfalls within the project site. Stormwater from the sites will discharge through new conveyance systems to the existing conveyance system in vacated 5th Street SE, which flows to Meeker Ditch.

MINIMUM REQUIREMENT 5: ONSITE STORMWATER MANAGEMENT

Minimum Requirement #5 states projects shall utilize either On-Site Stormwater Management BMP's from List #2 or demonstrate compliance with the LID Performance Standard. The LID performance standard requires the site to match predeveloped flows through flow control systems for 50% of the 2-year and 50-year storm events. List #2 requires the evaluation of BMP's in the order listed to determine the most appropriate stormwater management system for landscaped areas, roofs, and hard surfaces.

Each BMP requires varying separation between the bottom of the BMP and the seasonal high groundwater level. Therefore, testing of the stormwater infiltration rate and seasonal high groundwater level was conducted during the wet season . Excavation was conducted to a depth of 4.0-feet. Pilot Infiltration Test (PIT) was conducted in the grass field west of the existing International Village building. The test recorded an infiltration rate of 0.73 inches per hour, and after applying factors of safety the design infiltration rates is 0.17 inches per hour which results in infiltration not feasible for this project, see Appendix B for Infiltration Report.

Groundwater was encountered during the west season in a groundwater monitoring well. The observed groundwater level is 3.3' below the existing grade of the groundwater monitoring well, see groundwater monitoring log in Appendix B. Since the existing grade of the well is 37.25', BMP's must maintain the required separation between the assumed groundwater level of 33.95'.

The following Stormwater BMP's in List #2 were evaluated for feasibility with regards to the Barn M Redevelopment project:

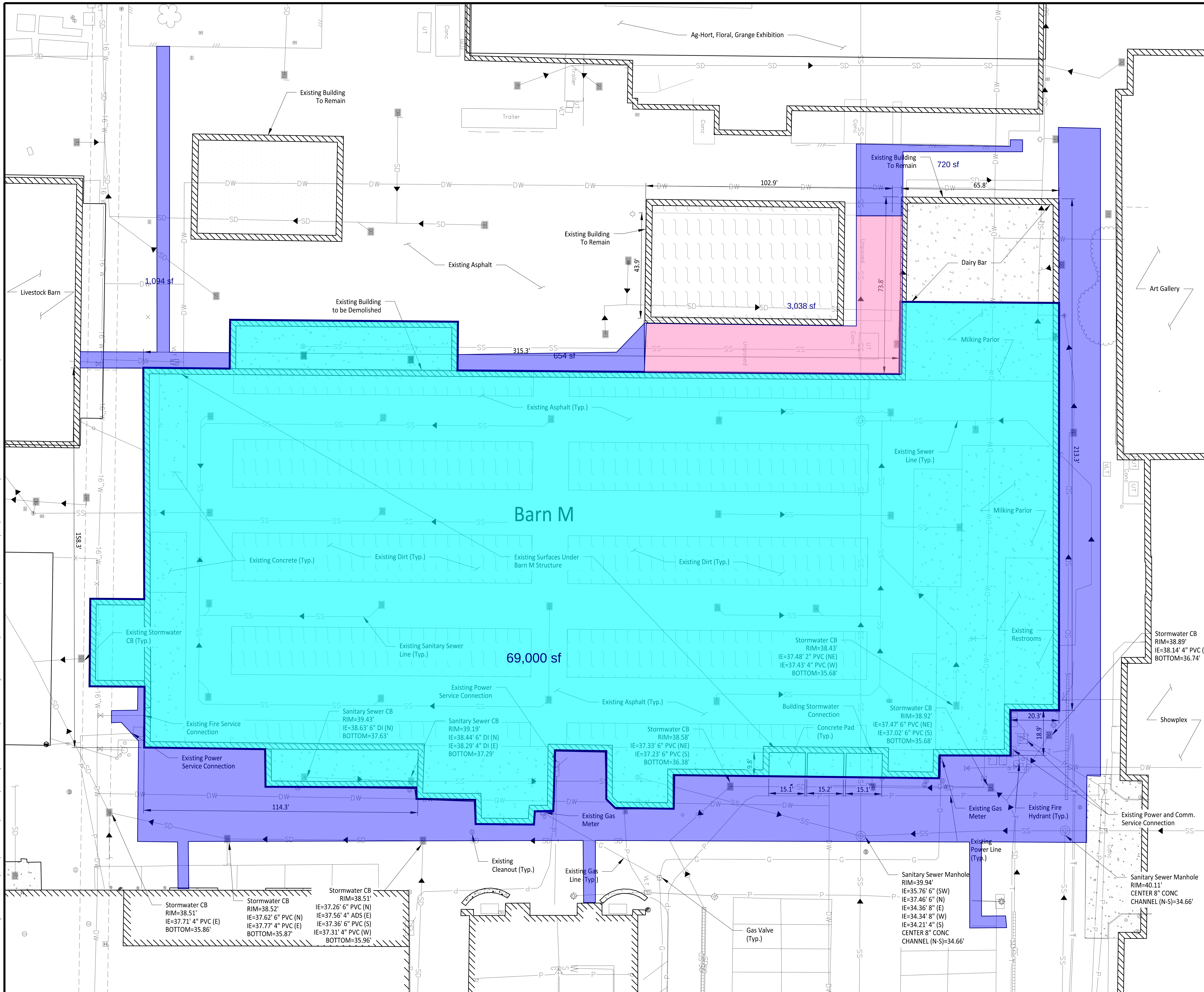
> Clarify in narrative the only surface analyzed is other hard surfaces because there were no other surfaces disturbed in the scope of work.

- Other Hard Surfaces: (Asphalt, Concrete, Synthetic Turf)
  - <u>Full Dispersion</u>: Full dispersion is feasible if a site maintains 65% of its area in a native vegetated condition. The project does not maintain 65% of the site in a native condition and thus full dispersion was deemed infeasible for hard surface stormwater management.
  - <u>Permeable Pavement:</u> Permeable Pavements were evaluated for the Redevelopment site and were determined to be not feasible for the project based on the following criteria:
    - Infiltration rate of 0.17 in/hr

> Clarify the minimum infiltration rate needed for infiltration.

> Finish the list 2 bmps feasibility narrative. bioretention, sheet flow dispersion, concentrated flow dispersion. If non are feasible after the narrative. conclude with something like "no bmps were found feasible based on the above referenced criteria." Then explain how you intend to convey storm runoff.

APPENDIX A



LEGEND

- Existing Concrete
- Existing Storm Line
- Existing Water Line
- Existing Sewer Line
- Existing Gas Line
- Existing Power Line
- Existing Building Line
- Existing Catch Basin
- Existing Sanitary Sewer Manhole
- Existing Fire Hydrant
- Existing Gas Valve
- Existing Clean Out

GENERAL NOTES

1. All of the sewer lines connected to Catch Basins within Barn M are 4" PVC unless otherwise noted.

- Roof - 69,000 SF
- Asphalt - 16,634 SF
- Gravel - 3,038 SF

Total - 88,672 SF

0 20 40 FEET
1" = 20'

CALL TWO BUSINESS DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

Owner/Developer:
Washington STATE FAIR PUYALLUP
Washington State Fair
110 9th Ave SW
Puyallup, WA 98371
(253) 841-5356

Architect:
Jeff Brown Architecture
12181 C Street South
Tacoma, WA 98444
(253) 606- 8324
Contact: Jeff Brown

Engineer:
JMJTEAM
Justin Jones, PE
905 Main St. Suite 200
Sumner, WA 98390
(206) 596-2020

Project:
Washington State Fair Barn M Improvements

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY

Building Demolition Permit

JUSTIN M. JONES STATE OF WASHINGTON 41829 REGISTERED PROFESSIONAL ENGINEER
12-13-24

REV	DATE	DESCRIPTION

DRAWN BY: | DESIGN BY: JJ
PROJ. NO: 1507-014
DATE: December 13, 2024

SHEET NAME
Barn M Existing Site Plan

DWG. C-02

2 OF 5

File: 15070016C-EX-BARNS.dwg Path: C:\Users\DerekMorrisko\JMJ TEAM\JMJ Projects - General\1507 - Washington State Fair\1507-016 Barn M\01 - Demolition\CAD\ Plotted by: DerekMorrisko Date: 13-Dec-24 3:47:46pm

LEGEND

- Proposed Vendor Vault
- Proposed Ground Hydrant
- Proposed Light Pole
- Proposed Asphalt
- Proposed Turf
- Proposed Concrete
- Proposed Gravel
- Proposed Landscape

CONSTRUCTION NOTES

1. Install Synthetic Turf per Section C on Sheet C3-301.
2. Install Concrete Flush Curb per Detail X.XXX on Sheet C3-301.

Concrete - 1,988 SF

Asphalt - 83,646 SF

Gravel - 3,038 SF

Total - 88,672 SF

0 20 40 FEET
1" = 20'

APPROVED

BY ____________
CITY OF PUYALLUP
DEVELOPMENT ENGINEERING

DATE ____________

NOTE: THIS APPROVAL IS VOID AFTER 180 DAYS FROM APPROVAL DATE.
THE CITY WILL NOT BE RESPONSIBLE FOR ERRORS AND/OR OMISSIONS ON THESE PLANS.
FIELD CONDITIONS MAY DICTATE CHANGES TO THESE PLANS AS DETERMINED BY THE DEVELOPMENT ENGINEERING MANAGER.

CALL TWO BUSINESS DAYS BEFORE YOU DIG
1-800-424-5555
UTILITIES UNDERGROUND LOCATION CENTER

Owner/Developer:
Washington STATE FAIR PUYALLUP
Washington State Fair
110 9th Ave SW
Puyallup, WA 98371
(253) 841-5356

Architect:

Engineer:
JMJTEAM
Justin Jones, PE
905 Main St. Suite 200
Sumner, WA 98390
(206) 596-2020

Project:
Washington State Fair
Barn M Improvements

ONE INCH AT FULL SCALE. IF NOT, SCALE ACCORDINGLY

Civil Construction Permit

REV	DATE	DESCRIPTION

DRAWN BY: EJK | DESIGN BY: JJ

PROJ. NO: 1507-016

DATE: April 29, 2025

SHEET NAME:
Proposed Site Plan

DWG.
C3-101

APPENDIX B

Infiltration Testing Report

Washington State Fair Barn M Improvements

110 9th Ave SW,
Puyallup, WA 98371

Prepared for

Puyallup State Fair
110 9th Ave SW,
Puyallup, WA 98371

Prepared by

JMJ TEAM
905 Main St
Suite 200
Sumner, WA 98390
206.596.2020
Justin Jones, PE

March 11, 2025

JMJTEAM

PROJECT ENGINEER'S CERTIFICATION

I hereby certify that this Infiltration Testing Report for Puyallup State Fair Barn M Improvements has been prepared by me or under my supervision and meets minimum standards of the Department of Ecology Stormwater Management Manual for Western Washington.

JUSTIN M. JONES
STATE OF WASHINGTON
41829
REGISTERED
PROFESSIONAL ENGINEER

____

Justin Jones, PE

01-30-2025

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SUMMARY

This report details the results of infiltration testing for use in the stormwater system design of Puyallup State Fair Barn M Improvements located within Puyallup, WA. Two Small-Scale Pilot Infiltration Test (PIT) were conducted on site to determine the onsite stormwater infiltration rates. The test hole was excavated and backfilled by a licensed contractor and the PIT was completed in accordance with the Department of Ecology (ECY) Stormwater Management Manual for Western Washington (Stormwater Manual).

The PIT process evaluates the infiltration within a 12 SF area by first measuring the rate of water required to maintain a constant water elevation of approximately 12-inches in the test pit, and second by measuring the drawdown rate of the water within the test pit. The drawdown is done using a data logger.

The field data is then analyzed, and a factor of safety applied to determine the stormwater design infiltration rate. A design infiltration rate of 0.17 inches per hour was determined, which is below the 0.3 minimum required for onsite infiltration. Below is a summary of the results.

Test Pit Location

Summary of Results

Per the PIT, the site soil is suitable for stormwater infiltration. Soil evaluations were not taken as the designated stormwater BMP is not intended to treat pollution generating surfaces.

Testing	Test PIT	Results	ECY Threshold
Ground Water	Pit Depth	4.0-feet	N/A
	Test Hole 1 Groundwater Level	Groundwater Observed at 48”	N/A
Infiltration Rate	Infiltration Rate Factor of Safety	0.45	N/A
	Test Hole 1 Infiltration Rates	Uncorrected: 0.73 inches per hour	≥ 0.3 inches per hour
		Design: 0.32 Inches per hour	

JMJTEAM

INFILTRATION TEST PROCEDURES

Below is the process taken for the Small-Scale PIT:

- ☐ Identify PIT locations based on the site survey of existing buildings and utilities as well as the potential locations of infiltration facilities based on the preliminary site plan.
- ☐ Obtain public and private utility locates. Prior to the PIT utility locates will be called to ensure there are no utilities present in the PIT locations.
- ☐ Excavation of PIT holes (approximately 3-feet x 4-feet 4-feet deep). A 3-feet x 4-feet x2-feet tall wood box is inserted into the test hole to ensures that the bottom surface area is exactly 12 SF. The box is backfilled to the top edge to ensure stability and infiltration only through the bottom of the test hole for the duration of the PIT.
- ☐ A soil sample is collected from the bottom of the hole to test treatment capability. A lab tests the cation exchange rate and organic matter content of soils. Lab results confirm if the soil is suitable for treatment based on Stormwater Manual criteria.
- ☐ A float system with a water hose connection is set into the center of the test hole. The float system is equipped with a leveling plate, a measuring ruler for visual inspection of water levels and a perforated pipe housing for the data collector.
- ☐ Using water transfer tanks or hose spigot as available, the test hole is filled to a 12-inch water depth that is maintained. The presoak period ensures that the soils have been fully saturated before conducting the PIT. A 1-hour stabilization test is performed after the presoak period to confirm soil stabilization. If the test yields 4 constant gallon per minute (GPM) readings that are conducted every 15-minutes, the stabilization of the soil is confirmed.
- ☐ A 1-hour GPM test is conducted per the Stormwater Manual. Using a water meter accurate to the nearest tenth of a gallon, a GPM flow rate is recorded every 15-minutes while the water level is maintained at a 12-inch depth. An infiltration rate (in/hr) can be determined using the GPM flow rate and the 12 SF bottom surface area of the hole.
- ☐ A drawdown test is performed per Stormwater Manual to determine the drawdown infiltration capability of the soil. A CRS451V (Pressure Transducer) is placed into the test hole and set to take pressure (PSI) readings every 10-minutes. The water source is shutoff, and the pressure transducer will measure water drawdown for a 2-hour period. At the end of the period the sensors are removed from the test hole, the data is collected using a PC interface module and the HydroSci program to communicate with the sensor to retrieve the data.
- ☐ The wood box and the float system are removed from the test hole.
- ☐ Over excavate test hole to confirm there is no ground water mounding.
- ☐ The test pit is then backfilled and restored to prior state of excavation.

FINDINGS AND RECOMMENDATIONS

Groundwater Conditions

The Stormwater Manual specifies minimum separations between the seasonal high groundwater elevation and the bottom of the infiltration facility based on different best management practices (BMP):

- **Downspout Infiltration:** 1-foot
- **Permeable Pavement:** 1-foot
- **Infiltration Gallery:** 1-foot
- **Bioretention:** 3-foot

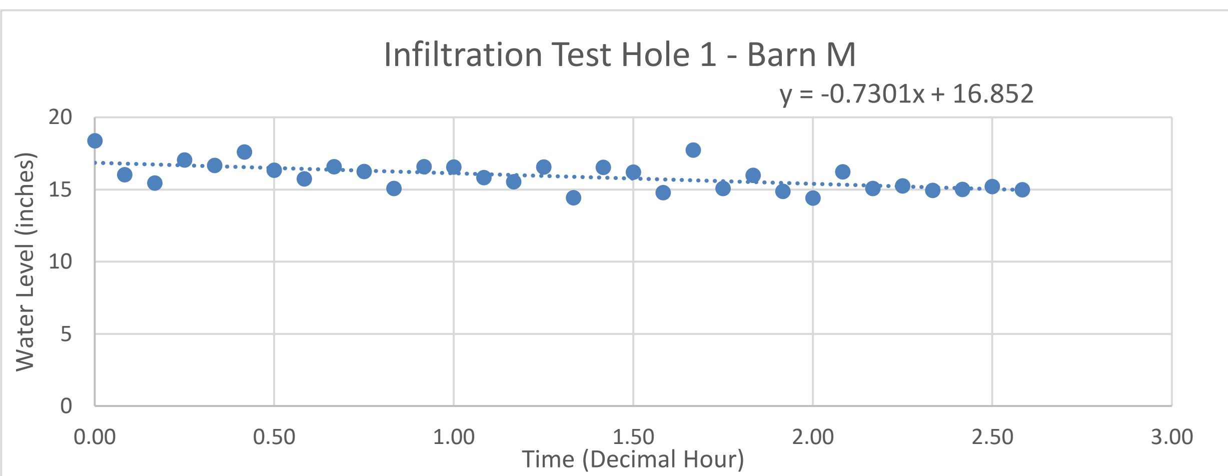
With known groundwater conditions for each test hole, there is adequate spacing between groundwater and BMPs. An overflow should be installed with BMP in case of large storm events.

Field Measured Infiltration Rate

The infiltration rate was collected using two methods during the PIT. The first method is to measure the gallons per minute flowrate required to maintain a constant water level in the test pit. The average of the flowrate measurements taken over an hour timeframe.

The second method is to measure the drawdown rate of the test pit. Measurements were taken both visually and with a data logger. The average of the drawdown measurements resulted in an infiltration rate of resulted in the following infiltration rates:

- Test Hole 1: 0.73 inches per hour



Design Infiltration Rate

Per the Stormwater Manual a minimum design infiltration rate of 0.3 inches per hour is required for onsite infiltration. The design infiltration rate takes the field measured infiltration rate and applies a factor of safety based on three correction factors. The three corrections are based on site variability, test method, and degree of influent control (See Appendix D).

Issue	Partial Correction Factor
Site variability and number of locations tested	CF_v = 0.33 to 1.0
Test Method	
• Large-scale PIT • Small-scale PIT • Other small-scale (e.g. Double ring, falling head) • Grain Size Method	CF_t = 0.75 = 0.50 = 0.40 = 0.40
Degree of influent control to prevent siltation and bio-buildup	CF_m = 0.9

Total Correction Factor, $CF_T = CF_v \times CF_t \times CF_m$

Per the Stormwater Manual, a site variability correction of 0.5 is used due to extensive amounts of clay found throughout the site. A correction of 0.5 for the small-scale PIT and 0.9 for the degree of influent are also used. A total correction factor of 0.225 is applied to the measured infiltration rate yielding a recommended design infiltration rates as follows:

- Test Hole 1: 0.17 inches per hour (Infiltration not feasible)

Treatment Suitability

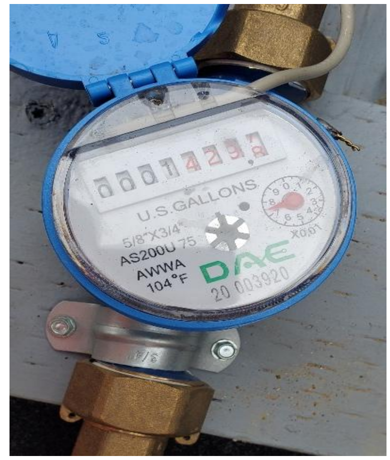
Per the Stormwater Manual the soils that stormwater is infiltrated into may be used for treatment of pollution generating surfaces if the soil meets specific requirements. Otherwise, a treatment layer is required to treat pollution generating surfaces. The treatment threshold of the infiltrated soil per the Stormwater Manual is a Cation Exchange Capacity greater than or equal to 5 milliequivalents CEC/100g and a minimum of 1.0% organic content.

This project does not propose to manage pollution generating hard surfaces runoff through an infiltration facility; therefore soil suitability was not evaluated.

TEST PIT PHOTO DOCUMENTATION – TEST HOLE 1

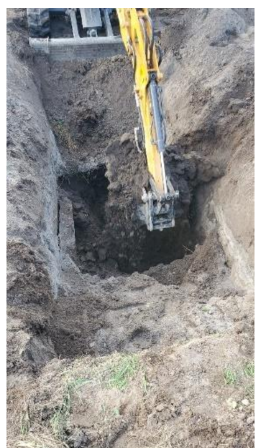
3-feet x 4-feet x 18-inches

Test Pit Pre-soak at 12-inches



1-hour GPM Test

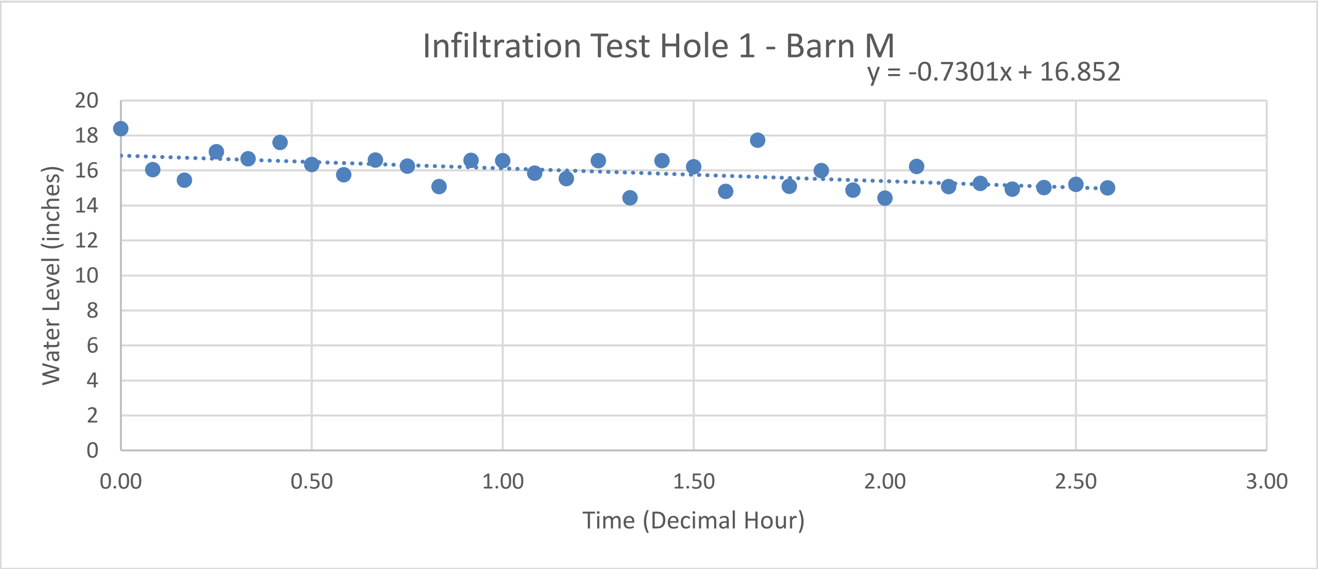
Pressure Transducer Drawdown Test



Over Excavation to observe if Groundwater is Mounding

Backfill Test Hole

APPENDIX A


Infiltration Test Hole 1 - Barn M
y = -0.7301x + 16.852
Water Level (inches)
20
18
16
14
12
10
8
6
4
2
0
0.00
0.50
1.00
1.50
2.00
2.50
3.00
Time (Decimal Hour)

Project Location:	Puyallup State Fair Barn M							
Date of Test:		2/19/2025	Test start					
Test Pit Dimensions:		Width (feet)	3	Length (feet)	4	Depth (inches)	24	
Presoak:	12 hours at 12"							
Weather Conditions:	Cloudy	52° F						
Infiltration Test:								
		Water Column Maintained (inches):	12					
		Gallons Per Inch:	7.48					
		Time(Minutes)	**Volume (gallons)**	**Flow Rate (GPM)**			**Flow (Gallons)**	**Infiltration Rate (in/hr)**
				Meter Start	Meter End	Flow (Gallons)		
Drawdown Test (Sensor):								
Sensor Name:		JMJ 02 (**CRS451V Sensors from Campbell Scientic**)						
Time (Decimal Hours)	**Record Measurement Interval**	**Time Stamp**	**Record #**	**Reading (PSI)**	**Level (in)**			
0.0000	0	4:05 PM	0	0.6630507	18.3797654			
0.0833	5	4:15 PM	1	0.5785586	16.03764439			
0.1667	10	4:25 PM	2	0.5572405	15.44670666			
0.2500	15	4:35 PM	3	0.6154814	17.06114441			
0.3333	20	4:45 PM	4	0.6012944	16.66788077			
0.4167	25	4:55 PM	5	0.6347529	17.59535039			
0.5000	30	5:05 PM	6	0.5894251	16.33886377			
0.5833	35	5:15 PM	7	0.5681682	15.7496225			
0.6667	40	5:25 PM	8	0.5984511	16.58906449			
0.7500	45	5:35 PM	9	0.5864033	16.25509948			
0.8333	50	5:45 PM	10	0.5437605	15.07304106			
0.9167	55	5:55 PM	11	0.598312	16.58520864			
1.0000	60	6:05 PM	12	0.5974992	16.56267782			
1.0833	65	6:15 PM	13	0.5714533	15.84068548			
1.1667	70	6:25 PM	14	0.5603845	15.53385834			
1.2500	75	6:35 PM	15	0.5976012	16.56550526			
1.3333	80	6:45 PM	16	0.5204656	14.42730643			
1.4167	85	6:55 PM	17	0.5970697	16.55077208			
1.5000	90	7:05 PM	18	0.5850075	16.2164079			
1.5833	95	7:15 PM	19	0.5338969	14.79962207			
1.6667	100	7:25 PM	20	0.6396102	17.72999474			
1.7500	105	7:35 PM	21	0.5442991	15.08797105			
1.8333	110	7:45 PM	22	0.5767291	15.98693065			
1.9167	115	7:55 PM	23	0.5368064	14.88027341			
2.0000	120	8:05 PM	24	0.5201635	14.41893222			
2.0833	125	8:15 PM	25	0.5855744	16.23212237			
2.1667	130	8:25 PM	26	0.5440212	15.08026766			
2.2500	135	8:35 PM	27	0.5502297	15.25236728			
2.3333	140	8:45 PM	28	0.5389059	14.93847155			
2.4167	145	8:55 PM	29	0.5416116	15.01347355			
2.5000	150	9:05 PM	30	0.5485572	15.20600558			
2.5833	155	9:15 PM	31	0.541056	14.99807232			
						Average Infiltration Rate:	**0.73**	
						Factor of Safety:	**0.45**	
						Design Infiltration Rate:	**0.33**	

APPENDIX B

PRODUCT

CAMPBELL® SCIENTIFIC
WHEN MEASUREMENTS MATTER

CRS451V

Stainless-Steel Vented Stand-Alone Pressure Transducer

Pressure Transducer Combined with a Recorder

High resolution and accuracy

Overview

The CRS451V consists of a submersible water-level and water-temperature sensor with its own time clock and memory to store the collected data—in a compact stainless-steel case. This data logging capability frees users to place the sensor in remote sites and let it collect data for long periods. HydroSci software is included and elegantly supports test setup, data retrieval, and data display. Long battery life and rugged construction mean you can trust the CRS451V to collect important data. Low cost and ease of use make it a good choice in a variety of applications. The CRS456V is the same as this, but with a titanium case.

Benefits and Features

- Sensors and data-collection features in one instrument case
- Rugged stainless-steel case protects piezoresistive sensor
- Quality construction ensures product reliability
- Fully temperature-compensated
- Fast scan rate
- Large data-storage capacity
- Long battery life
- Easy-to-use software

Detailed Description

The CRS451V has several pressure range options.

HydroSci software is available for download. This software simplifies the process of configuring the CRS451V. Users can configure the CRS451V to monitor surface water, ground water, or a standard pump test.

HydroSci software will display the data in tabular or graphical formats.

Specifications

Venting	Vented	Measurement Time	< 1.0 s

APPENDIX C

INFILTRATION TEST

The Washington State Department of Ecology Stormwater Manual provides testing procedures and best practices, which are described below.

- Testing should occur between December 1 and April 1.
- The horizontal and vertical locations of the PIT shall be surveyed by a licensed land surveyor and accurately shown on the design drawings.
- Excavate the test pit to the estimated elevation of the proposed infiltration into the native soil. Note that for some proposed BMPs, such as and BMP T5.15: Permeable Pavements, this will be below the proposed finished grade. If the native soils will have to meet a minimum subgrade compaction requirement (for example, the road subgrade if using BMP T5.15: Permeable Pavements), compact the native soil to that requirement prior to testing. Lay back the slopes sufficiently to avoid caving and erosion during the test. Alternatively, consider shoring the sides of the test pit.
- The horizontal surface area of the bottom of the test pit should be approximately 100 square feet. Document the size and geometry of the test pit.
- Install a vertical measuring rod (long enough to measure the ponded water depth, minimum 5- ft. long) marked in half-inch increments in the center of the pit bottom.
- Use a rigid 6-inch diameter pipe with a splash plate on the bottom to convey water to the test pit and reduce side-wall erosion or excessive disturbance of the test pit bottom. Excessive erosion and bottom disturbance will result in clogging of the infiltration receptor and yield lower than actual infiltration rates.
- Add water to the pit at a rate that will maintain a water level between 6 and 12 inches above the bottom of the pit. A rotameter can be used to measure the flow rate into the pit.

The depth should not exceed the proposed maximum depth of water expected in the completed BMP. For infiltration BMPs serving large drainage areas, designs with multiple feet of standing water can have infiltration tests with greater than 1 foot of standing water.

- Every 15-30 min, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point on the measuring rod.
- Keep adding water to the pit until one hour after the flow rate into the pit has stabilized (constant flow rate; a goal of 5% or less variation in the total flow) while maintaining the same pond water level. The total of the pre-soak time plus one hour after the flow rate has stabilized should be no less than 6 hours.
- After the flow rate has stabilized for at least one hour, turn off the water and record the rate of infiltration (the drop rate of the standing water) in inches per hour from the measuring rod data, until the pit is empty. Consider running this falling head phase of the test several times to estimate the

dependency of the infiltration rate with head.

- At the conclusion of testing, over-excavate the pit to see if the test water is mounded on shallow restrictive layers or if it has continued to flow deep into the subsurface. The depth of excavation varies depending on soil type and depth to the hydraulic restricting layer, and is determined by the engineer or certified soils professional. Mounding is an indication that a mounding analysis is necessary.

DATA ANALYSIS

Calculate and record the initial K_{sat} rate in inches per hour in 30 minutes or one-hour increments until one hour after the flow has stabilized.

Use statistical/trend analysis to obtain the hourly flow rate when the flow stabilizes. This would be the lowest hourly flow rate. *Example:*

The area of the bottom of the test pit is 8.5-ft. by 11.5-ft. (97.75 sq. ft.).

Water flow rate was measured and recorded at intervals ranging from 15 to 30 minutes throughout the test. Between 400 minutes and 1,000 minutes the flow rate stabilized between 10 and 12.5 gallons per minute or 600 to 750 gallons per hour, or 80.2 to 100 ft^3 per hour. Dividing this rate by the surface area gives an initial K_{sat} of 9.8 to 12.3 inches per hour.

K_{sat} Determination Option 2: Small Scale Pilot Infiltration Test (PIT)

A small-scale PIT can be substituted for Ksat Determination Option 1: Large Scale Pilot Infiltration Test (PIT) in any of the following instances:

- The drainage area to the infiltration BMP is less than 1 acre.
- The testing is for BMP T7.30: Bioretention or BMP T5.15: Permeable Pavements that either serve small drainage areas and/or are widely dispersed throughout a project site.
- The site has a high infiltration rate (>4 in/hr), making a large scale PIT difficult, and the site geo- technical investigation suggests uniform subsurface characteristics.

INFILTRATION TEST

Use the same procedures described above in Ksat Determination Option 1: Large Scale Pilot Infiltration Test (PIT), with the following changes:

- The horizontal surface area of the bottom of the test pit should be 12 to 32 square feet. It may be circular or rectangular. Document the size and geometry of the test pit.
- The rigid pipe with a splash plate used to convey water to the pit may be a 3-inch diameter pipe for pits on the smaller end of the recommended surface area, or a 4-inch pipe for pits on the larger end of the recommended surface area.
- Pre-soak period: Add water to the pit so that there is standing water for at least 6 hours. Maintain the pre-soak water level at least 12 inches above the bottom of the pit.
- At the end of the pre-soak period, add water to the pit at a rate that will maintain a 6-12 inch water level above the bottom of the pit over a full hour. The depth should not exceed the proposed maximum depth of water expected in the completed facility.
- Every 15 minutes, record the cumulative volume and instantaneous flow rate in gallons per minute necessary to maintain the water level at the same point (between 6 inches and 1 foot) on the measuring rod. The specific depth should be the same as the maximum designed ponding depth (usually 6 – 12 inches).

After one hour, turn off the water and record the rate of infiltration (the drop rate of the standing water) in inches per hour from the measuring rod data, until the pit is empty.

- A self-logging pressure sensor may also be used to determine water depth and drain-down.
- At the conclusion of testing, over-excavate the pit to see if the test water is mounded on shallow restrictive layers or if it has continued to flow deep into the subsurface. The depth of excavation varies depending on soil type and depth to the hydraulic restricting layer, and is determined by the engineer or certified soils professional. The soils professional should judge whether a mounding analysis is necessary.

APPENDIX D

CALCULATED DESIGN INFILTRATION RATE:

Site variability and number of locations tested (CF_v) - The number of locations tested must be capable of producing a picture of the subsurface conditions that fully represents the conditions throughout the proposed location of the infiltration BMP. The partial correction factor used for this issue depends on the level of uncertainty that adverse subsurface conditions may occur. If the range of uncertainty is low - for example, conditions are known to be uniform through previous exploration and site geological factors

- one pilot infiltration test (or grain size analysis location) may be adequate to justify a partial correction factor at the high end of the range.

If the level of uncertainty is high, a partial correction factor near the low end of the range may be appropriate. This might be the case where the site conditions are highly variable due to conditions such as a deposit of ancient landslide debris, or buried stream channels. In these cases, even with many explorations and several pilot infiltration tests (or several grain size test locations), the level of uncertainty may still be high.

A partial correction factor near the low end of the range could be assigned where conditions have a more typical variability, but few explorations and only one pilot infiltration test (or one grain size analysis location) is conducted. That is, the number of explorations and tests conducted do not match the degree of site variability anticipated.

- **Uncertainty of test method (CF_t)** accounts for uncertainties in the testing methods. For the full scale PIT method, CF_t = 0.75; for the small-scale PIT method, CF_t = 0.50; for smaller-scale infiltration tests such as the double-ring infiltrometer test, CF_t = 0.40; for grain size analysis, CF_t = 0.40. These values are intended to represent the difference in each test's ability to estimate the actual saturated hydraulic conductivity. The assumption is the larger the scale of the test, the more reliable the result.
- **Degree of influent control to prevent siltation and bio-buildup (CF_m)** Even with a pre-settling basin or a basic treatment BMP for pre-treatment, the soil's initial infiltration rate will gradually decline as more and more stormwater, with some amount of suspended material, passes through the soil profile. The maintenance schedule calls for removing sediment when the BMP is infiltrating at only 90% of its design capacity. Therefore, a correction factor, CF_m, of 0.9 is called for.

APPENDIX C

Western Washington Fair Association
Statement of Values
November 11, 2024 to November 11, 2025

Bldg #	Building Name	Description	Building	Rents	Total Values	Year Built	Sq Ft
M	Dairy Barn Complex	1 story, wood frame, wood siding exterior walls, concrete slab, asphalt shingle roof; building service includes electrical, plumbing, fire alarm & sprinklers	$4,604,911	N/A	$4,604,911	1935	66,778