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February 9, 2023

Bradbury Place LLC
7809 Pacific Ave
Tacoma, WA 98408

Attn: Ken Rody
kgrody54@gmail.com

Soils Report Addendum:
Infiltration Testing & Mounding Analysis
Proposed Multi-Family Development
xxx – 5th Street Southeast
Puyallup, Washington
PN: 0419036002, -6003
Doc ID: EagleWorksLLC.5thStSE.SRa2

INTRODUCTION & SCOPE

This *Soils Report Addendum* is for the proposed multi-family development be located at an unaddressed parcel on 5th Street Southeast in Puyallup, Washington. We have prepared a *Soils Report* for this multi-family development dated May 24, 2019 and an *Addendum* to the *Soils Report* summarizing our seasonal groundwater monitoring dated August 18, 2022. This *Addendum* summarizes the results of our in-situ infiltration testing and mounding analysis for a proposed infiltration trench and pond. The City of Puyallup has adopted the Washington State Department of Ecology 2019 version of the *Stormwater Management Manual for Western Washington* (2019 SWMMWW) for use in stormwater design and management.

We were provided with a preliminary site plan for the stormwater management of the development by Contour Engineering dated February 3, 2023. An infiltration pond with a bottom area of 2,702ft^2 is proposed in the northwest corner of the development. A 42ft (length) x 8ft (width) x 1.5ft (depth) infiltration trench is proposed near the western boundary of the development. The locations of the proposed infiltration facilities are shown on the attached Site & Exploration Plan, Figure 1. Our scope of services included the following:

1. Returning to the site and performing two small scale Pilot Infiltration Tests (small-scale PIT) in accordance with the City of Puyallup adopted stormwater manual 2019 SWMMWW;
2. Competition of a mounding analysis of the infiltration pond using the software MODRET version 6.1, and;
3. Preparing this *Soils Report Addendum* that satisfies the 2019 SWMMWW requirements and summarizes our site observations and conclusions, and our geotechnical recommendations, along with the supporting data.

Subsurface Explorations

On January 19, 2023, a field representative from GeoResources visited the site and monitored the excavation of three test pits to depths of about 9.3 to 10.0 feet below the existing grades, logged

the subsurface conditions encountered in each test pit, and obtained representative soil samples. Two of the test pits were used for small-scale PITs and were over-excavated to the final depth following completion of the tests. The test pits were excavated by a small track-mounted excavator operated by a licensed operator working under subcontract for you. The soil densities presented on the logs were based on the difficulty of excavation and our experience. The number and location of the test pits were selected in the field based on the preliminary location of infiltration facilities for the development provided by the project civil. Following excavation, each test pit was backfilled with the excavated soils and bucket tamped, but not otherwise compacted.

The subsurface explorations excavated as part of this evaluation indicate the subsurface conditions at specific locations only, as actual subsurface conditions can vary across the site. Furthermore, the nature and extent of such variation would not become evident until additional explorations are performed or until construction activities have begun. Based on our experience in the area and extent of prior explorations for this site, it is our opinion that the soils encountered in the explorations are generally representative of the soils at the site.

The soils encountered were visually classified in accordance with the Unified Soil Classification System (USCS) and ASTM D2488. The approximate locations of our test pits are labeled on the attached Figure 1. The USCS is included in Appendix A as Figure A-1, while the descriptive logs of our test pits are included as Figures A-2 and A-3. The locations of each test pit and final depth and elevations are summarized in Table 1.

TABLE 1:
APPROXIMATE LOCATIONS, ELEVATIONS, AND DEPTHS OF EXPLORATIONS

Test Pit	Functional Location	Surface Elevation (feet)	Termination Depth (feet)	Termination Elevation (feet)
TP-101	Infiltration Trench Footprint	404	10.0	394.0
TP-102	Infiltration Pond Footprint	403	8.5	394.5
TP-103	Infiltration Trench Footprint	402	9.3	392.7
Notes:				

Subsurface Conditions

At the locations of our test pits, we encountered relatively uniform subsurface conditions that generally confirmed the mapped stratigraphy and the encountered soils in our previously excavated test pits for this project. Table 2 summarizes observed soil layers and elevations of select soil layers encountered in our test pit explorations.

Topsoil: We encountered about 0.5 to 1.5 feet of brown, dark brown, to black topsoil at all test pit locations.

Weathered Recessional Outwash – Steilacoom Gravel: Mantling the topsoil at all test pit locations, we encountered a loose to medium dense poorly graded gravel with minor to some sand and trace silt to a gravelly sand with some silt in a moist condition. We interpret this soil layer to be weathered recessional outwash, and the soil layer was observed to be about 2.5 feet to 4.0 feet thick.

Undisturbed Recessional Outwash – Steilacoom Gravel: Underlying the weathered recessional outwash soils at all test pit locations was medium dense poorly graded gravel with some sand and trace silt in a moist to wet condition. We interpret this deeper soil layer to be undisturbed recessional outwash, and this soil layer was encountered to the full depth explored at all test pits.

TABLE 2:
APPROXIMATE THICKNESS, DEPTHS, AND ELEVATION OF SOIL TYPES ENCOUNTERED IN EXPLORATIONS

Test Pit	Thickness		Elevation to Undisturbed Recessional Outwash (feet)
	Topsoil (feet)	Weathered Recessional Outwash (feet)	
TP-101	1.5	2.5	400
TP-102	0.5	4.0	398.5
TP-103	0.5	3.5	497.5
Notes:			

Groundwater Conditions

During over-excavation of the small-scale PIT completed in the footprint of the infiltration pond, we observed groundwater seepage at 6.5 feet below the existing grade. A confining layer (glacial till) was originally observed beneath the gravelly recessional outwash in test pits completed within the footprint of the pond. We anticipate that water from the test was perching on the glacial till layer underneath the pond footprint. This glacial till layer was not observed to the full over-excavation depth.

Small-Scale Pilot Infiltration Tests

We performed two small-scale PITs in accordance with the 2019 SWMMWW. The tests were performed within the footprint of a proposed infiltration trench and pond. See the attached Figure 2 for the location of the tests. The geometry of the test pit for the small-scale PIT in the pond footprint (small-scale PIT-1) was measured as 5ft (length) x 4ft (width) x 3 ft (depth) with an area encompassing about 20 square feet. The geometry of the test pit for the small-scale PIT in the trench footprint (small-scale PIT-2) was measured as 4ft (length) x 4ft (width) x 2.8ft (depth) with an area encompassing about 16 square feet. A pre-soak period of 6 hours was performed prior to a water level depth of at least 12 inches being maintained for the steady state period. During the steady state period, we recorded the cumulative volume and instantaneous flow rate necessary to maintain the water level at the same point for 1 hour. After the steady state period, we turned off the water and recorded the rate of infiltration every 15 minutes in inches per hour using a vertical measuring rod. Table 3 summarizes the measurements collected during the falling head period of the tests.

During the falling head period of the small-scale PIT-1 and small-scale PIT-2, we measured a saturated hydraulic conductivity ($K_{sat,\ Measured}$) of **14.7 inches per hour and 60.0 inches per hour**, respectively. See the attached Appendix A for the soil logs associated with the tests. Table 3 summarizes the measured infiltration rate for both tests.

TABLE 3:
MEASURED INFILTRATION RATES FOR FALLING HEAD PERIOD

Test Number	Soil Type at Approximate Bottom of Infiltration Test	Measured Infiltration Rate (in/hr)
Small PIT-1	GP	14.7
Small PIT-2	SP-SM	60.0

Design Infiltration Rate

We applied appropriate correction factors to the measured K_{sat} for site variability (CF_v of 1.0), testing method (CF_t of 0.5 for small-scale PIT), and maintenance (CF_m of 0.9 for siltation biofouling). The resulting design infiltration rate is **27.0 inches per hour for the infiltration trench and 6.6 inches per hour for the infiltration pond**.

We recommend that a representative from our firm be onsite at the time of excavation of the proposed infiltration BMPs used in the stormwater management design to verify that the soils encountered during construction are consistent with the soils observed in our subsurface explorations.

Mounding Analysis

We analyzed the groundwater mounding potential the proposed infiltration pond using software program MODRET groundwater modeling V6.1.4. MODRET uses a finite-difference method to model groundwater flow. The input parameters for the MODRET infiltration module used in the analysis were selected based on the civil design of the infiltration pond and the completion of the small-scale PIT in the footprint of the pond. We determined that using the seepage elevation observed during the over-excavation of the small-scale PIT in the pond was the best estimation of seasonal high groundwater within the footprint of the pond, as no groundwater was recorded during our wet-season groundwater monitoring. As such, the effective aquifer base was lowered to the final depth of the over-excavation.

Data Inputs for MODRET

Precipitation values for a 50-year storm event was used to build a hydrograph input for runoff data, with SCS Type IA (24hr) selected for rainfall distribution. The SCS curve number was selected as 54, corresponding to an impervious area of ½ acre for hydrologic soils group A. The other input parameters for the hydrograph were provided by the project civil. The hydrograph curve is included in Appendix B.

A saturated analysis was completed for this model, as the runoff hydrograph data file automatically incorporates the unsaturated volume and effective time. Below is a list of the parameters used with source of data provided in parentheses.

- Area of Starting Water Level: 2,072ft^2 (provided by the project civil)
- Pond Volume between bottom and DHWL: 7,588.14ft^3 (provided by the project civil)
- Pond Length to Width Ratio: 1.72 (calculated using the pond length and width dimensions)
- Elevation of Effective Aquifer Base: 394.5 ft (from total depth of test pit used for the small-scale PIT-1)

- Elevation of Seasonal High Groundwater Table: 396.5ft (from seepage observed during over-excavation of the small-scale PIT-1)
- Elevation of Pond Bottom: 401.65ft (provided by the project civil)
- Design High Water Level Elevation: 404.5ft (provided by the project civil)
- Unsaturated Vertical Hydraulic Conductivity: 29.4 ft/day (from the measured rate collected from the small-scale PIT-1)
- Factor of Safety: 1 (no adjustment to the measured rate from the small-scale PIT-1)
- Saturated Horizontal Hydraulic Conductivity: 29.4 ft/day (assumed isotropic soil conditions for the pond)
- Average Effective Storage Coefficient for Saturated Analysis: 0.4 (determined from logged site soils from test pits in and around the footprint of the pond)

Results of Mounding Analysis for Pond

The analysis resulted in a high-water elevation mark of 403.71 feet at the 24-hour mark of the 50-year storm event. A maximum infiltration rate of 5.596 ft/day was determined by the model (this rate is influenced by the storage coefficient), and the total volume infiltrated was 19,592ft^3. The high-water elevation mark is below the design high water elevation for the infiltration pond during a 50-year storm event. Based on our analyses, we do not anticipate any adverse effects to adjacent structures or properties because of groundwater mounding at the infiltration pond. The result of the analysis is provided in Appendix B.

LIMITATIONS

We have prepared this report for use by Bradbury Place LLC and other members of the design team, for use in the design of a portion of this project. The data used in preparing this addendum should be provided to prospective contractors for their bidding or estimating purposes only. Our addendum conclusions and interpretations are based on our subsurface explorations, data from others and limited site reconnaissance, and should not be construed as a warranty of the subsurface conditions.

Variations in subsurface conditions are possible between the explorations and may also occur with time. A contingency for unanticipated conditions should be included in the budget and schedule. Sufficient monitoring, testing and consultation should be provided by our firm during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork and foundation installation activities comply with contract plans and specifications.

The scope of our services does not include services related to environmental remediation and construction safety precautions. Our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

If there are any changes in the loads, grades, locations, configurations or type of facilities to be constructed, the conclusions and recommendations presented in this report may not be fully applicable. If such changes are made, we should be given the opportunity to review our recommendations and provide written modifications or verifications, as appropriate.

◆ ◆ ◆

We have appreciated working for you on this project. Please do not hesitate to call at your earliest convenience if you have any questions or comments.

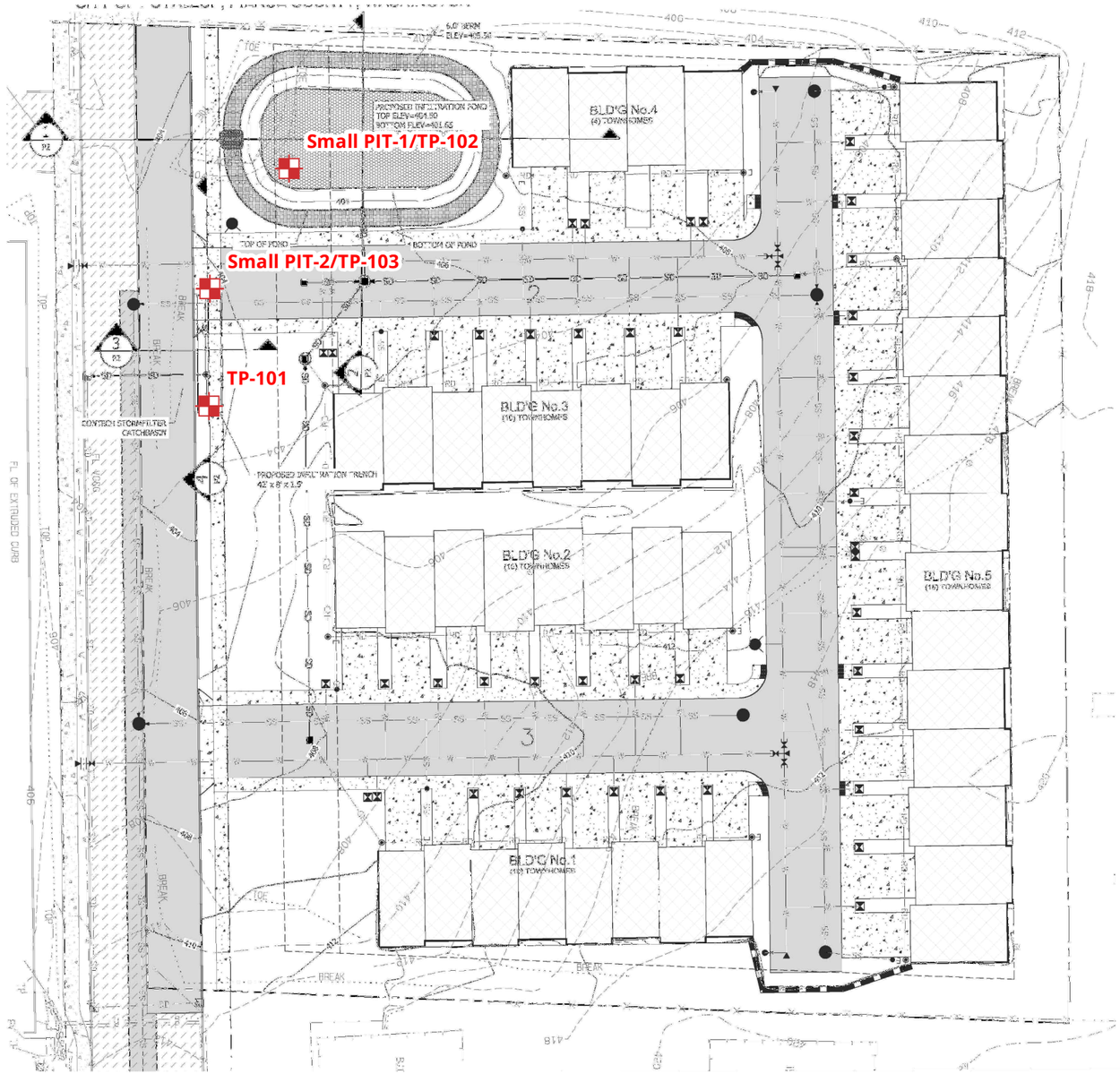
Respectfully submitted,
GeoResources, LLC

Erik Fina, GIT
Senior Staff Geologist

State of Washington
Engineering Geologist
3237
Licensed Geologist
2.9.23
Seth Taylor Mattos

Seth T. Mattos, LEG
Associate

EJF:KSS:EWH/ejf
Doc ID: EagleWorksLLC.5thStSE.SRa2
Attachments: Figure 1: Site & Exploration Plan
Appendix A – Supplemental Subsurface Explorations
Appendix B – Mounding Analysis for Infiltration Pond



Legend

Test Pit/Small PIT Locations

0 20 40 80 120 160 Feet

Excerpt from the preliminary site plan
for Bradbury Place by Contour Engineering
dated February 3, 2023

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Site & Exploration Plan

Proposed Multi-Family Development
xxxx - 5th Street Southeast
Puyallup, Washington
PN: 041903-6002, -6003

Doc ID: EagleWorksLLC.5thStSE.F1	February 2023	Figure 1

Appendix A

Supplemental Subsurface Explorations

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS More than 50% Retained on No. 200 Sieve	GRAVEL More than 50% Of Coarse Fraction Retained on No. 4 Sieve	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND More than 50% Of Coarse Fraction Passes No. 4 Sieve	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% Passes No. 200 Sieve	SILT AND CLAY Liquid Limit Less than 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY Liquid Limit 50 or more	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-90.
2. Soil classification using laboratory tests is based on ASTM D6913.
3. Description of soil density or consistency are based on interpretation of blow count data, visual appearance of soils, and or test data.

SOIL MOISTURE MODIFIERS:

Dry- Absence of moisture, dry to the touch

Moist- Damp, but no visible water

Wet- Visible free water or saturated, usually soil is obtained from below water table

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Unified Soils Classification System

Proposed Multi-Family Development
xxx – 5th Street Southeast
Puyallup, WA
PN: 041903-6002, -6003

Test Pit TP-101

Location: Proposed Infiltration Trench
Approximate Elevation: 404 feet (Vertical Datum NAVD88 Geoid 12B)

Depth (ft)			Soil Type	Soil Description
0	-	1.5	-	Brown to black topsoil
1.5	-	4.0	GP	Reddish brown poorly graded GRAVEL with some sand and trace silt, roots (loose, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
4.0	-	10.0	GP	Grey poorly graded GRAVEL with some sand and trace silt, stratified sand and gravel (loose to medium dense, moist) (Recessional Outwash – Steilacoom Gravel)
				Terminated at 10.0 feet below ground surface. No mottling observed. No caving observed during excavation. No groundwater seepage observed at time of excavation.

Test Pit TP-102/Small PIT-1

Location: Proposed Infiltration Pond
Approximate Elevation: 403 feet (Vertical Datum NAVD88 Geoid 12B)

Depth (ft)			Soil Type	Soil Description
0	-	0.5	-	Dark brown topsoil
0.5	-	4.5	GP	Reddish brown to grey sandy poorly graded GRAVEL with trace silt, roots, light iron-oxide staining/discoloration (loose to medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
4.5	-	8.5	GP	Dark grey poorly graded GRAVEL with some sand and silt (medium dense, moist to wet) (Recessional Outwash – Steilacoom Gravel)
				Terminated at 8.5 feet below ground surface. Light mottling observed at 0.5 to 1.5 feet BGS. Slight caving observed at 6.5 feet BGS. Moderate groundwater seepage observed at 6.5 feet BGS following over-excavation of Small PIT.

Logged by: MMM/EJF **Excavated on: January 20, 2023**

Test Pit TP-103/Small PIT-2

Location: Proposed Infiltration Trench
Approximate Elevation: 402 feet (Vertical Datum NAVD88 Geoid 12B)

Depth (ft)			Soil Type	Soil Description
0	-	1.0	-	Dark brown topsoil
1.0	-	2.5	SM	Reddish brown silty SAND with gravel (loose, dry to moist) (Weathered Recessional Outwash)
2.5	-	4.5	SP-SM	Brown gravelly SAND with some silt and cobbles (loose to medium dense, moist) (Weathered Recessional Outwash - Steilacoom Gravel)
4.5	-	9.3	GP	Dark grey poorly graded GRAVEL with some sand and trace silt (medium dense, moist) (Recessional Outwash – Steilacoom Gravel)
				Terminated at 9.25 feet below ground surface.
				No mottling observed at time of excavation.
				Moderate caving observed at 7.5 feet BGS.
				No groundwater seepage observed.

Logged by: MMM **Excavated on: January 20, 2023**

Appendix B

Mounding Results for Infiltration Pond

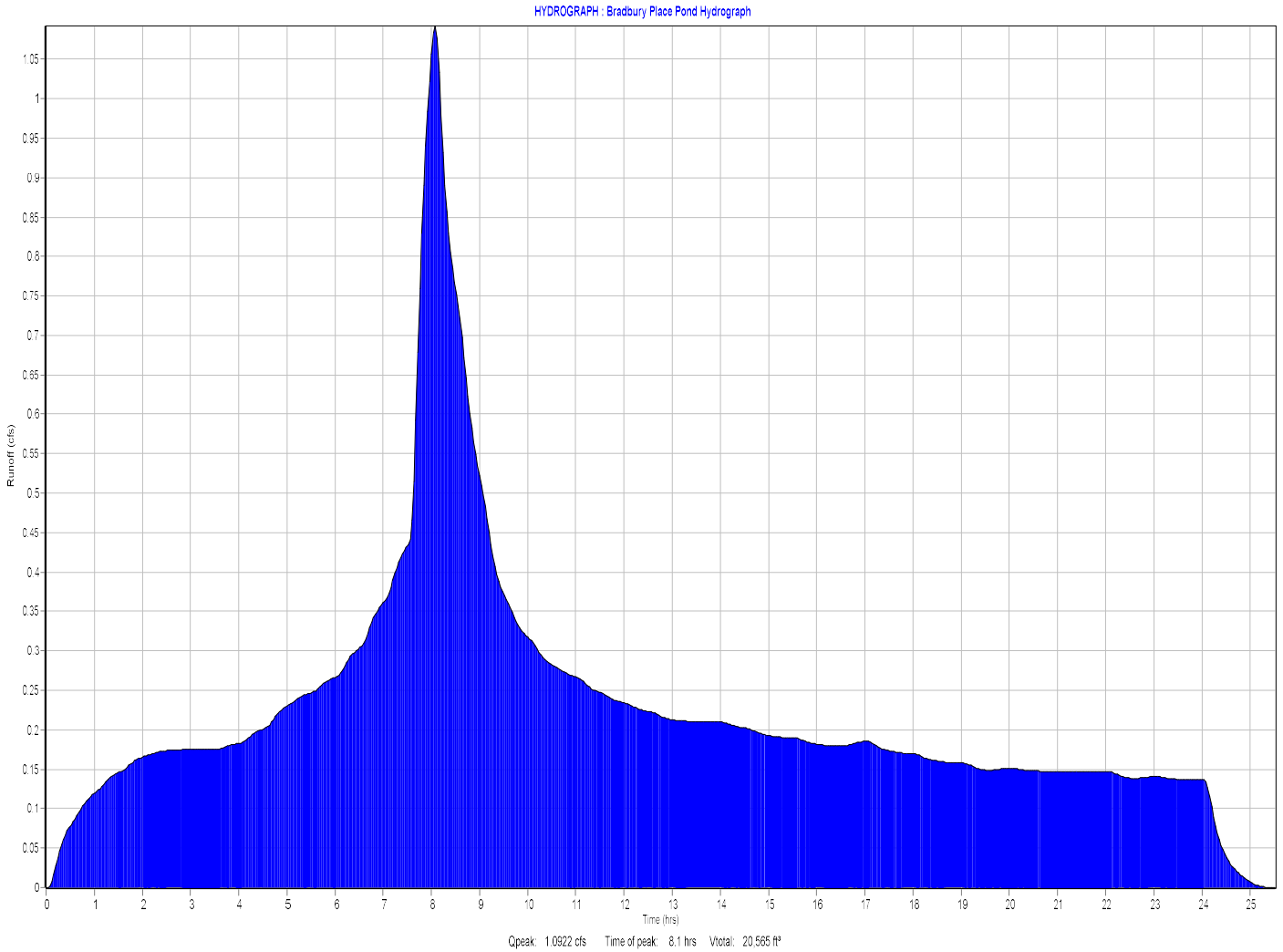
MODRET

HYDROGRAPH DATA INPUT - SCS UNIT METHOD

Project Name : Bradbury Place Pond Hydrograph
Rainfall Distribution : SCS Type IA (24 hrs)

Contributing Basin Area	2.20 ac.
SCS Curve Number	54.00
Time of Concentration	13.90 min.
Rainfall Depth	3.50 in.
Shape Factor	256
Percent DCIA	71.00 %

Analysis Date: 2/6/2023


HYDROGRAPH : Bradbury Place Pond Hydrograph
Runoff (cfs)
Time (hrs)
Qpeak: 1.0922 cfs
Time of peak: 8.1 hrs
Vtotal: 20.565 ft³

MODRET

SUMMARY OF UNSATURATED & SATURATED INPUT PARAMETERS

PROJECT NAME : Bradbury Infiltration Pond
HYDROGRAPH RUNOFF DATA USED
UNSATURATED ANALYSIS EXCLUDED

Pond Bottom Area	2,702.00 ft²
Pond Volume between Bottom & DHWL	7,588.14 ft³
Pond Length to Width Ratio (L/W)	1.72
Elevation of Effective Aquifer Base	394.50 ft
Elevation of Seasonal High Groundwater Table	396.50 ft
Elevation of Starting Water Level	401.65 ft
Elevation of Pond Bottom	401.65 ft
Design High Water Level Elevation	404.50 ft
Avg. Effective Storage Coefficient of Soil for Unsaturated Analysis	0.40
Unsaturated Vertical Hydraulic Conductivity	29.40 ft/d
Factor of Safety	1.00
Saturated Horizontal Hydraulic Conductivity	29.40 ft/d
Avg. Effective Storage Coefficient of Soil for Saturated Analysis	0.40
Avg. Effective Storage Coefficient of Pond/Exfiltration Trench	1.00
Time Increment During Storm Event	24.00 hrs
Time Increment After Storm Event	24.00 hrs
Total Number of Increments After Storm Event	14.00

Runoff Hydrograph File Name: Bradbury Place Pond 2.SCS

Time of Peak Runoff: 8.08 hrs

Rate of Peak Runoff: 1.09 cfs

Hydraulic Control Features:

	Top	Bottom	Left	Right
Groundwater Control Features - Y/N	N	N	N	N
Distance to Edge of Pond	0.00	0.00	0.00	0.00
Elevation of Water Level	0.00	0.00	0.00	0.00
Impervious Barrier - Y/N	N	N	N	N
Elevation of Barrier Bottom	0.00	0.00	0.00	0.00

Analysis Date: 2/8/2023

MODRET

SUMMARY OF RESULTS

PROJECT NAME : Bradbury Infiltration Pond

CUMULATIVE TIME (hrs)	WATER ELEVATION (feet)	INSTANTANEOUS INFILTRATION RATE (cfs)	AVERAGE INFILTRATION RATE (cfs)	CUMULATIVE OVERFLOW (ft^3)
00.00 - 0.04	396.500	0.000 *		
			0.00000	
0.04	396.500	0.23153		
			0.17245	
24.04	403.710	0.11338		0.00
			0.05430	
48.04	401.948	0.02715		0.00
			0.00000	
72.04	401.028	0.00000		0.00
			0.00000	
96.04	400.433	0.00000		0.00
			0.00000	
120.04	400.006	0.00000		0.00
			0.00000	
144.04	399.679	0.00000		0.00
			0.00000	
168.04	399.417	0.00000		0.00
			0.00000	
192.04	399.202	0.00000		0.00
			0.00000	
216.04	399.023	0.00000		0.00
			0.00000	
240.04	398.869	0.00000		0.00
			0.00000	
264.04	398.736	0.00000		0.00
			0.00000	
288.04	398.618	0.00000		0.00
			0.00000	
312.04	398.513	0.00000		0.00

Analysis Date: 2/8/2023

MODRET

SUMMARY OF RESULTS

PROJECT NAME : Bradbury Infiltration Pond

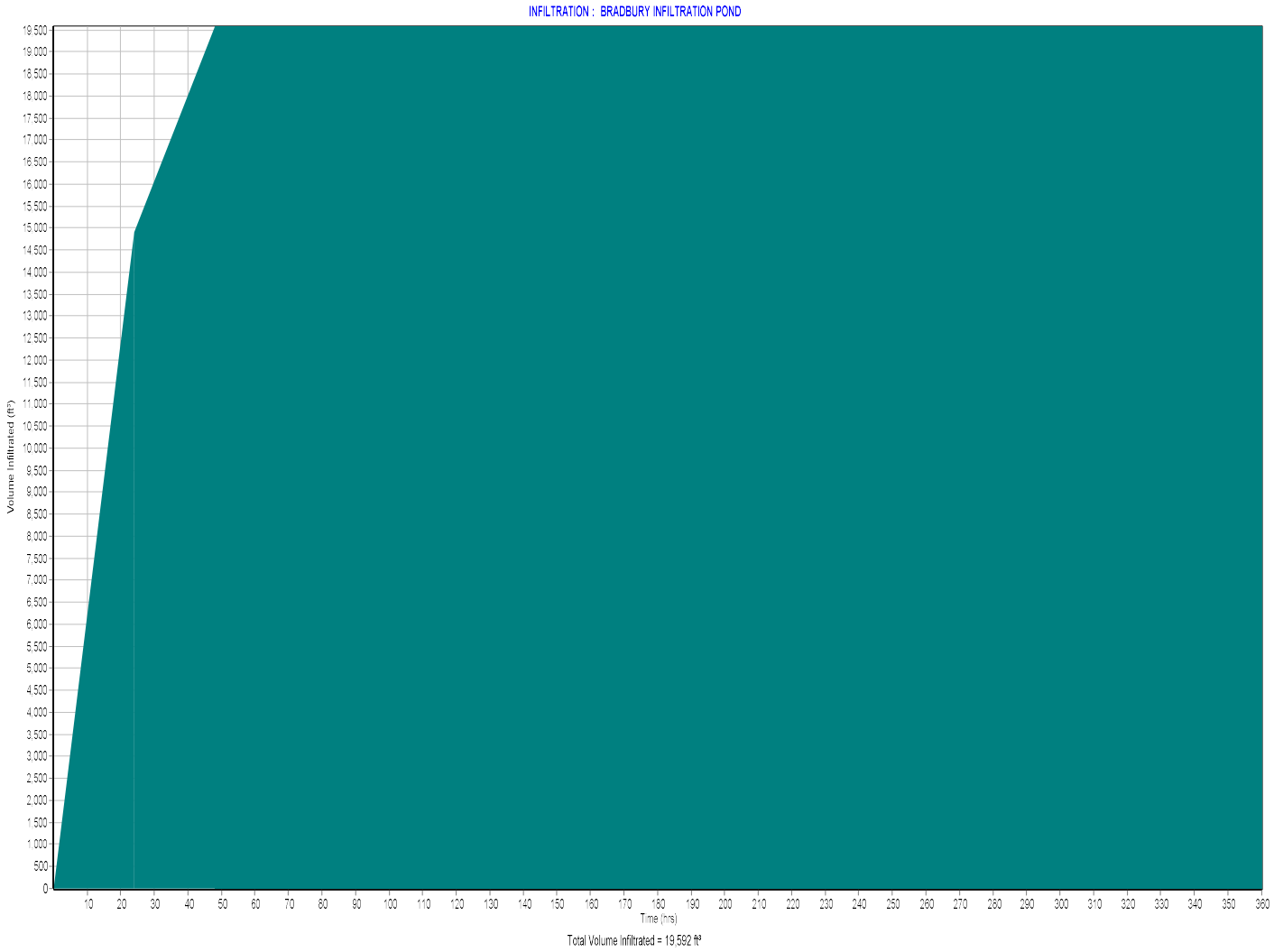
CUMULATIVE TIME (hrs)	WATER ELEVATION (feet)	INSTANTANEOUS INFILTRATION RATE (cfs)	AVERAGE INFILTRATION RATE (cfs)	CUMULATIVE OVERFLOW (ft^3)
			0.00000	
336.04	398.420	0.00000		0.00
			0.00000	
360.04	398.335			0.00

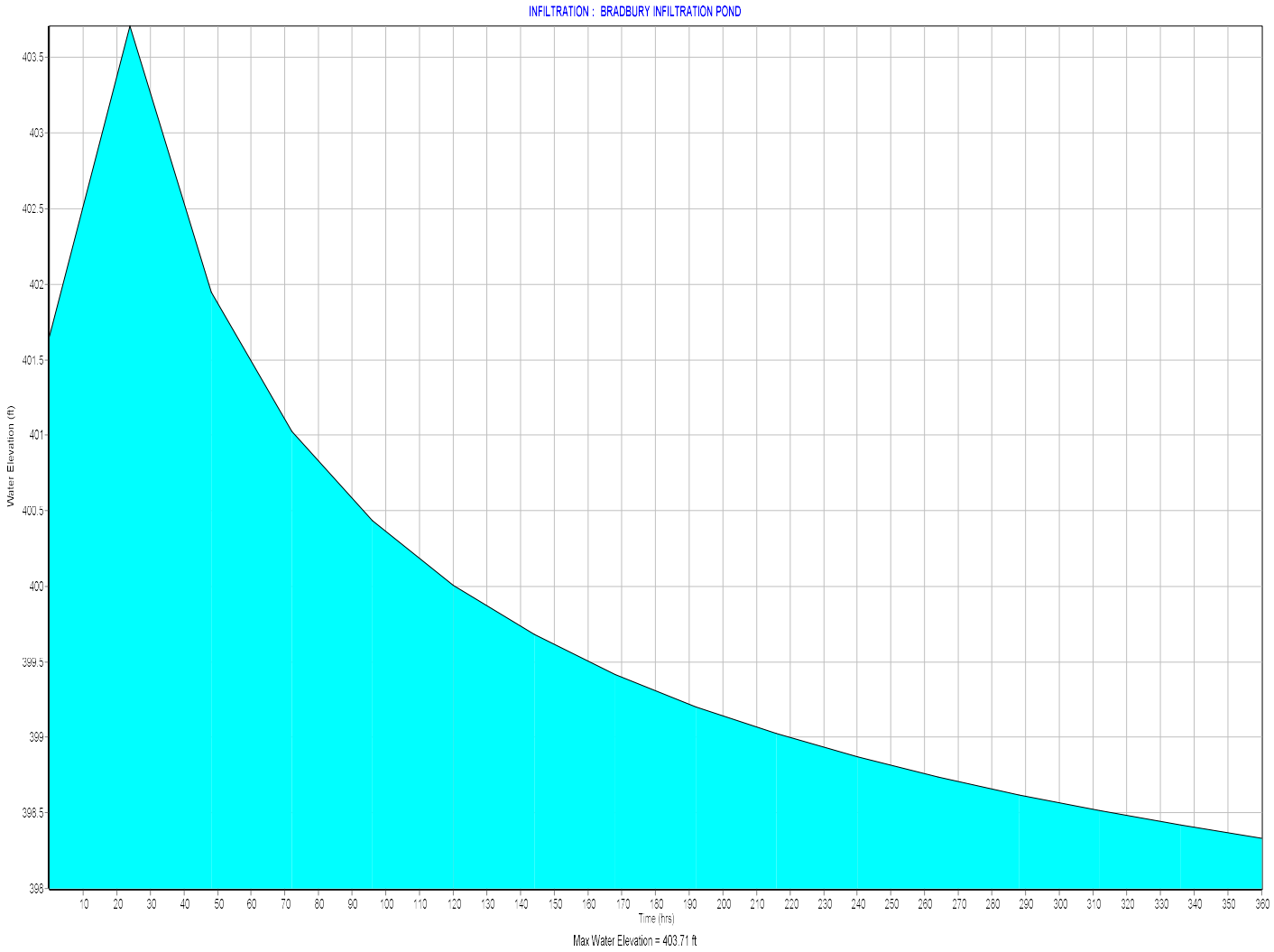
Maximum Water Elevation: 403.710 feet @ 24.04 hours Recovery @ 288.040 hours

* Time increment when there is no runoff

Maximum Infiltration Rate: 5.596 ft/day

Analysis Date: 2/8/2023


INFILTRATION : BRADBURY INFILTRATION POND
Volume Infiltrated (ft³)
19,500
19,000
18,500
18,000
17,500
17,000
16,500
16,000
15,500
15,000
14,500
14,000
13,500
13,000
12,500
12,000
11,500
11,000
10,500
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360
Time (hrs)
Total Volume Infiltrated = 19,592 ft³


INFILTRATION : BRADBURY INFILTRATION POND
Water Elevation (ft)
403.5
403
402.5
402
401.5
401
400.5
400
399.5
399
398.5
398
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360
Time (hrs)
Max Water Elevation = 403.71 ft