

# TERRAFORMA

DESIGN GROUP

## STORM DRAINAGE REPORT

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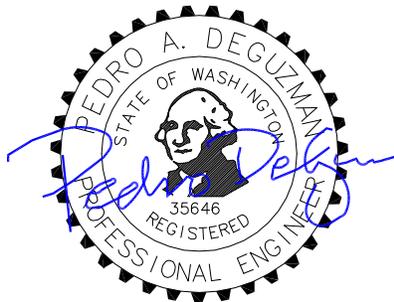
### SAFeway STORE EXPANSION – OLYMPIC PLACE

LOCATION:  
20500 OLYMPIC PLACE  
ARLINGTON, WA 98223

ISSUE DATE:

May 3, 2022

PREPARED FOR:  
Safeway (c/o Albertson's Companies)  
250 East Parkcenter Blvd.  
Boise, ID 83706  
Contact: Mark Palmer  
Phone: (208) 395-3864



5/3/22



CIVIL ENGINEERING

& LANDSCAPE ARCHITECTURE

**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

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**TABLE OF CONTENTS**

1. PROJECT OVERVIEW & MAPS	1
2. EXISTING CONDITIONS SUMMARY	5
3. OFF-SITE ANALYSIS REPORT	7
4. SUMMARY OF MINIMUM REQUIREMENTS	8
5. PERMANENT STORMWATER CONTROL PLAN	10
6. CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN	15
7. SPECIAL REPORTS & STUDIES	15
8. OTHER PERMITS	15
9. OPERATION MAINTENANCE MANUAL, SOURCE CONTROL	15
10. BOND QUANTITIES WORKSHEET	15

APPENDIX A – WWHM CALCULATIONS

APPENDIX B – GEOTECHNICAL REPORT

APPENDIX C - PRELIMINARY CIVIL DESIGN

# **SAFeway STORE EXPANSION – OLYMPIC PLACE PRELIMINARY STORM DRAINAGE REPORT**

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## **SECTION 1 - PROJECT OVERVIEW AND MAPS**

This Preliminary Storm Drainage Report for the **Safeway Store Expansion – Olympic Place** has been submitted to the City of Arlington as part of our Land Use submittal.

**Project Proponent:** Alberston’s Companies

**Property Area:** 4.8 acres

**Site Disturbance Area:** 0.70 acres

**Site Location:** 20500 Olympic Place, Arlington, WA 98223

**SW 1/4 of SE 1/4 of SEC. 11, T31N, R5E  
City of Arlington, Snohomish County**

**Parcel ID:** 00847300000800

**Required Permits:** Land Use Approval, Grading Permit,  
Building Permit

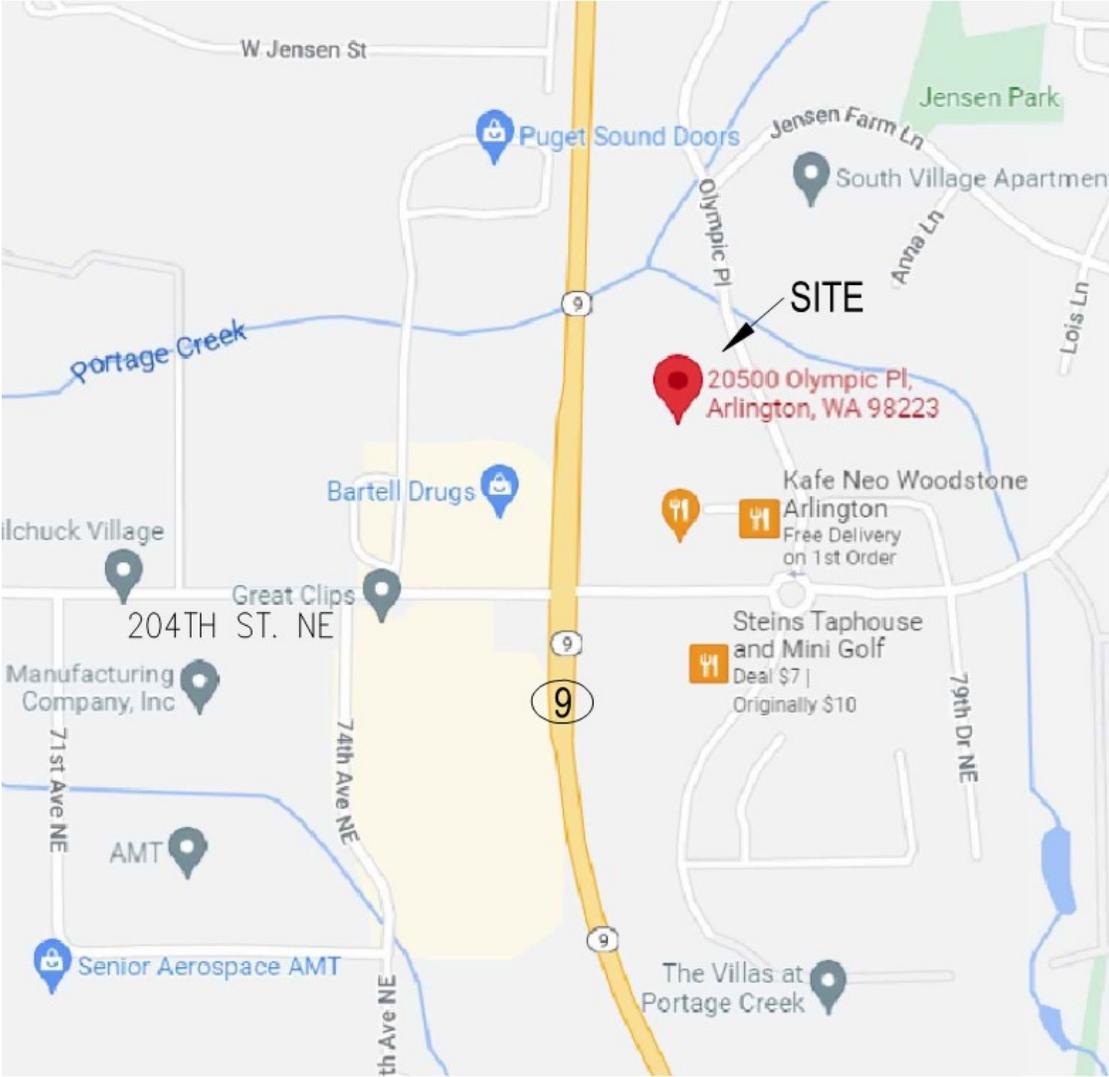
The proposed development consists of a new 10,000 sf store expansion, new 6700 sf parking lot area east of the expansion. Minor walkway, driveway and ADA parking improvements are also proposed. Work includes the proposed site clearing, grading, paving, building structure, drainage, utilities, road improvements and landscaping. The project will result in approximately 0.17 acres in added impervious surface and approximately 22,500 sf of Replaced Hard Surface.

The existing Safeway was original developed in 1998 and includes two (2) infiltration trenches for stormwater management.

The project will require drainage review from the City of Arlington and compliance with the 2014 Washington State Department of Ecology Surface Water Management Manual for Western Washington. Since the development includes greater than 5000 sf of New Impervious Surface, all 9 Min. Technical Requirements apply.

Onsite drainage improvements include a new Filterra treatment vault and a new infiltration gallery for the proposed parking lot and planter area east of the building expansion.

**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**



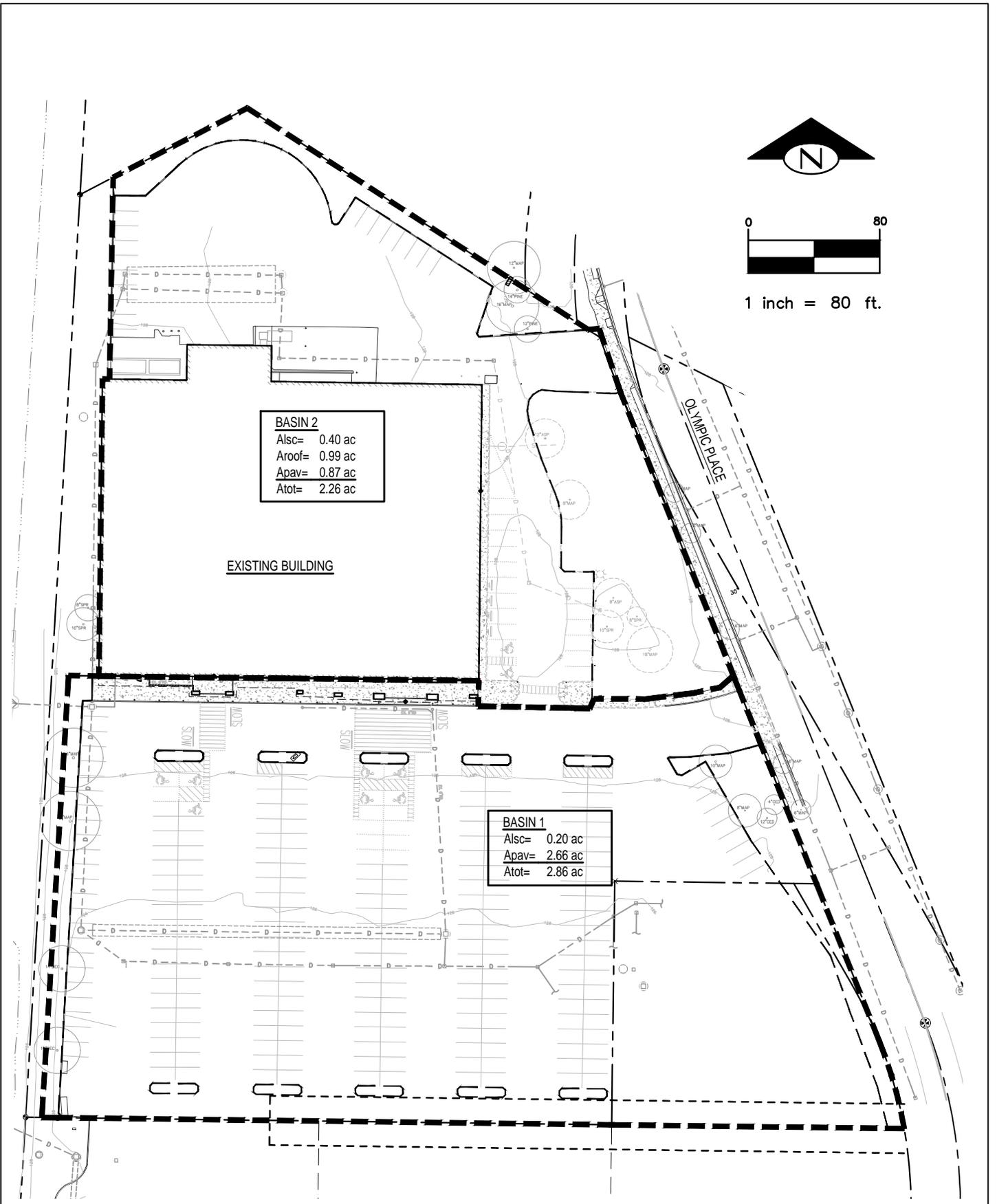
**VICINITY MAP**

SCALE: N.T.S.



**20500 Olympic Place, Arlington, WA 98223**

**SW 1/4 of SE 1/4 of SEC. 11, T31N, R5E, City of Arlington, Snohomish County**

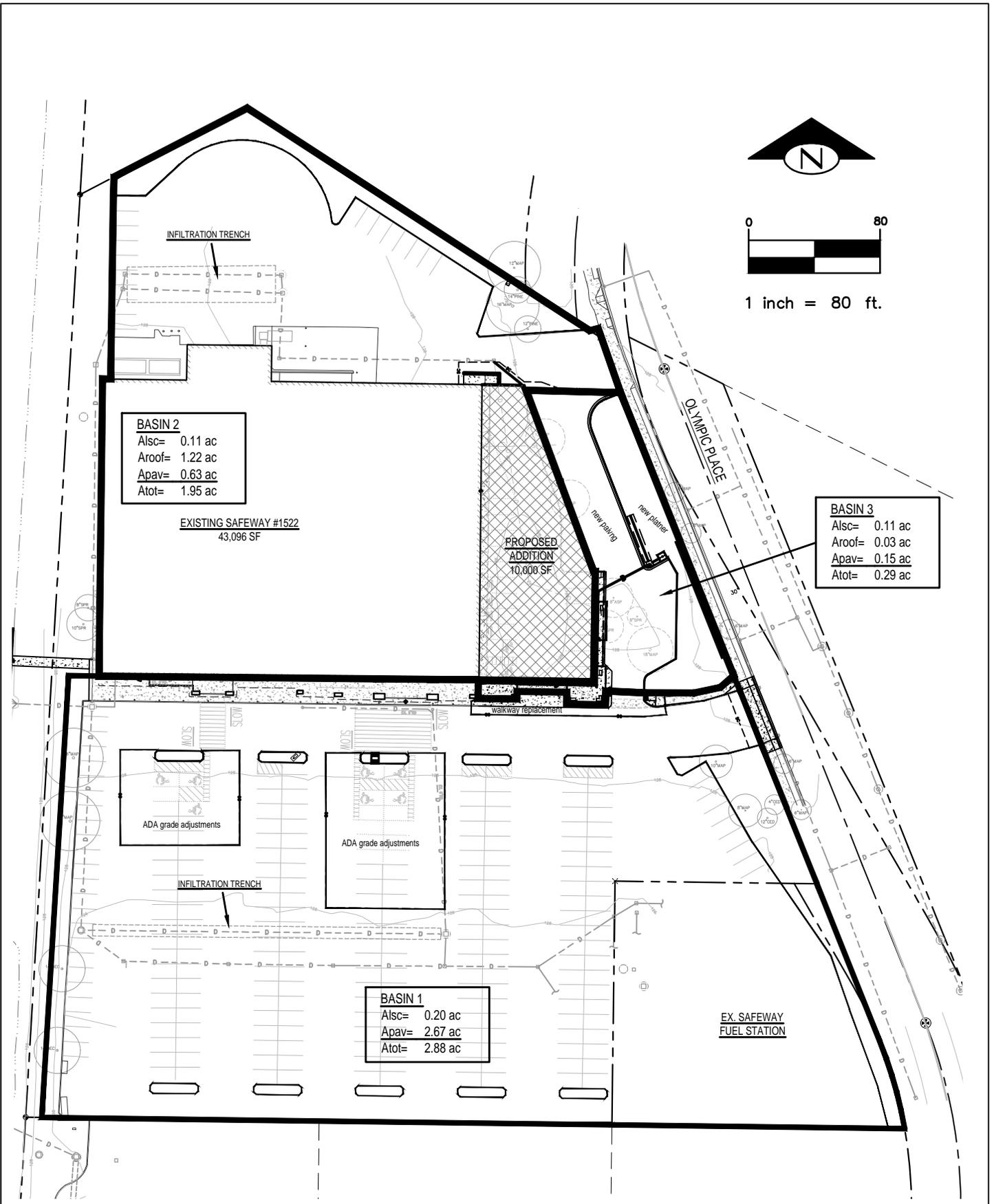


**SAFEWAY - ARLINGTON**  
 20500 OLYMPIC PLACE, ARLINGTON

**DRAINAGE BASIN MAP**  
 - ONSITE EXISTING CONDITIONS

by: Pedro DeGuzman, PE Terraforma Design Group, Inc.

DATE: 5/3/22



**SAFEWAY - ARLINGTON**  
 20500 OLYMPIC PLACE, ARLINGTON

**DRAINAGE BASIN MAP**  
 - ONSITE DEVELOPED CONDITIONS

by: Pedro DeGuzman, PE Terraforma Design Group, Inc.

DATE: 5/3/22

# **SAFeway STORE EXPANSION – OLYMPIC PLACE PRELIMINARY STORM DRAINAGE REPORT**

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## **SECTION 2 - EXISTING CONDITIONS SUMMARY**

The existing 4.8 acre Safeway Store parcel was originally constructed in 1998. The development included a 43,096 sf grocery store and associated drainage, utilities, paving and landscaping. The existing site drainage consists of two (2) large infiltration galleries located on the north and south side of the store. All site drainage is collected and routed to these facilities.

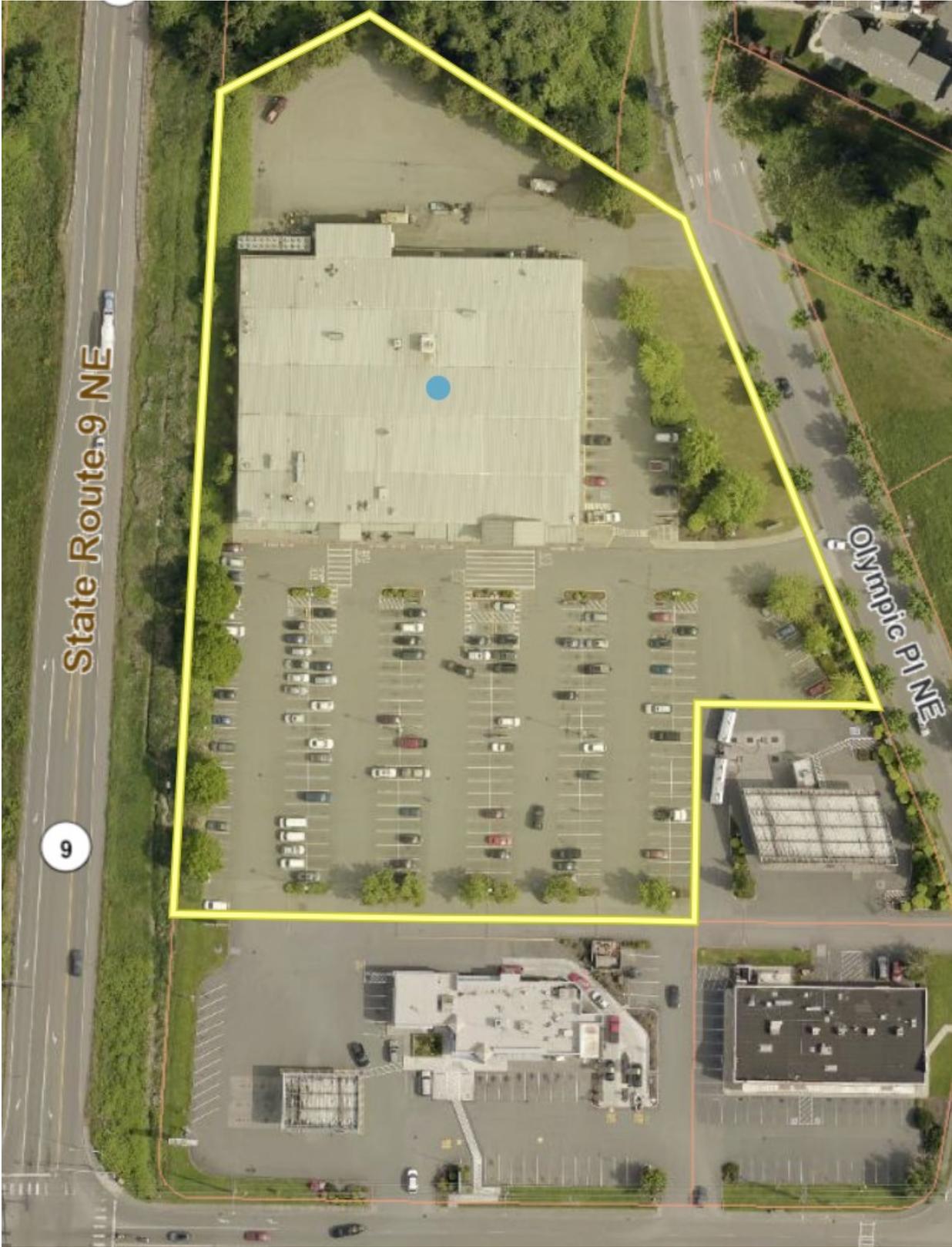
The property is not within the 100-yr floodplain. We do not know of any onsite or nearby wetlands or sensitive areas.

The existing soils are classified as recessional glacial outwash comprised of loose to dense sand and gravel deposits with variable silt content. Groundwater was observed between 10 to 13.5 feet below ground surface (April 2022).

See Appendix B for the geotechnical report including the design infiltration rate.

**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

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**EXISTING SITE AERIAL**

# **SAFEWAY STORE EXPANSION – OLYMPIC PLACE PRELIMINARY STORM DRAINAGE REPORT**

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## **SECTION 3 - OFFSITE ANALYSIS REPORT**

All runoff is self contained onsite with discharge to two (2) existing infiltration trenches.

Development will also include a new pedestrian path along SR-9 to meet the City requirement for pedestrian connectivity from 204th Street NE to the storefront. The SR-9 right-of-way appears to be self-contained within the roadside swale.

# SAFeway STORE EXPANSION – OLYMPIC PLACE PRELIMINARY STORM DRAINAGE REPORT

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## SECTION 4 - SUMMARY OF MINIMUM REQUIREMENTS

**10 Minimum Technical Requirements** as provided within Vol. 1, Section 2 of the DOE Manual:

### Minimum Requirement #1 – Stormwater Site Plan

This Storm Drainage Report and the Civil Plans address the temporary and permanent drainage impacts of the project.

### Minimum Requirement #2 – Construction Stormwater Pollution Prevention Plan

An Erosion Control Plan and Construction Stormwater Pollution Prevention Plan (CSWPPP) will be prepared and submitted with the formal sitework permit submittal.

### Minimum Requirement #3 - Source Control of Pollution

The proposed grocery store use is a relatively low pollution generator. General source control pollution prevention plans and a storm operation and maintenance manual with the final sitework permit submittal.

### Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

The proposed redevelopment will maintain its onsite infiltration drainage pattern.

### Minimum Requirement #5 – On-Site Stormwater Management

As required by the 2014 SWMMWW, On-Site Stormwater Management is required where feasible based on site conditions. Infiltration will be proposed to retain on development runoff. We expect to meet the LID Duration standard such that no further Stormwater Management practices will be required.

BMP T5.13 – Post Construction Soil Quality and Depth will be required for all disturbed area that will remain pervious.

# SAFeway STORE EXPANSION – OLYMPIC PLACE

## PRELIMINARY STORM DRAINAGE REPORT

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### Minimum Requirement #6 – Runoff Treatment

The proposed grocery store will trigger Runoff Treatment for the proposed new parking lot area east of the building. A Filterra vault will be used to provide Enhanced Treatment for our proposed commercial parking lot use.

No new runoff treatment measures are proposed for the existing parking lot to remain.

### Minimum Requirement #7 – Flow Control

The existing site consists of two drainage basins within an infiltration tank & rock gallery serving each basin. The facilities were constructed in 1998 with no known drainage problems known to date.

The proposed store expansion will result in additional impervious area. To account for this, a new storm infiltration trench (Basin #3) is proposed east of the building structure to provide stormwater retention for the proposed new parking area and new landscaping.

Basin 2 will reduce in area slightly and include the new 10,000 sf building expansion. Runoff flowrates to the Basin #2 infiltration trench will decrease slightly.

Basin #1 will increase slightly by 0.02 acres to account for a small basin area change. The stormwater flowrate changes will be insignificant and do not warrant any new flow control measures. Basin #

A new pedestrian path is required by the City from 204th Street. At this time we are proposing a new sidewalk along the east side of SR-9. This results in an additional hard surface area of 1500 sf which will discharge to the existing drainage swale along the east side of SR-9. No flow control measures are proposed for this minor hard surface area increase.

### Minimum Requirement #8 – Wetlands Protection

There are no wetlands within the proposed development area or immediate vicinity.

### Minimum Requirement #9 – Operation and Maintenance

A Stormwater Operation Maintenance Manual and site Source Control measures will be included with our formal sitework permit submittal.

# SAFeway STORE EXPANSION – OLYMPIC PLACE PRELIMINARY STORM DRAINAGE REPORT

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## SECTION 5 - PERMANENT STORMWATER CONTROL PLAN

The proposed development consists of a new 10,000 sf store expansion, new 6700 sf parking lot area east of the expansion. Minor walkway, driveway and ADA parking improvements are also proposed. Work includes the proposed site clearing, grading, paving, building structure, drainage, utilities, road improvements and landscaping.

New Impervious Area: 7400 sf

New + Replaced Hard Surface: 22,500 sf

The drainage report is divided into the following 3 separate drainage basins:

Basin #1	Existing parking lot south of store
Basin #2	Existing roof area, existing northern parking lot, existing eastern parking lot <sup>1</sup>
Basin #3	New eastern parking lot <sup>1</sup>

<sup>1</sup> A new Basin #3 was created to define the new eastern parking lot basin which will have its own runoff treatment and infiltration system. The existing east parking lot will be removed as a part of the redevelopment.

Onsite drainage improvements include a new Filterra treatment vault and a new infiltration gallery for the proposed parking lot and planter area east of the building expansion. No modifications of the existing infiltration galleries are proposed.

At this time, a new concrete pedestrian path is proposed along SR9 to provide access from 204th Street NE to the store entry. The proposed path will replace a portion of the existing asphalt shoulder in SR-9 and a relatively minor additional 1500 sf of impervious area. Runoff will be retained within the existing drainage swale in SR-9. No flow control measures are proposed for this minor hard surface increase. A new 18" dia culvert is proposed at the walkway crossing of the SR-9 drainage swale.

See attached basin data and infiltration system summary. Sizing calculations were provided via the Western Washington Hydrologic Method (WWHM) within Appendix A.

**SAFEWAY STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

<b>LANDCOVER DATA</b>			
<b>Project Name:</b>	SAFEWAY - OLYMPIC PLACE - ARLINGTON		
<b>Project Number:</b>	21043		
<b>DRAINAGE CRITERIA:</b>	CITY OF ARLINGTON		
<b>Step 1) Site Data</b>			
1) General characteristics:			
Basin	1	Soil type	outwash
Development type	retail	Soil Group	A/B
Size (ac.)	2.90	Existing surface	paving, planters
Detention/Retention	Infiltration	Predev Cover	Existing
Treatment Criteria	Basic	Oil Control	No
2) Existing onsite characteristics:			
Landscape	8876	sf =	0.20 acres
Roof	0	sf =	0.00 acres
Paving	115752	sf =	2.66 acres
<b>Total</b>	<b>124628</b>	<b>sf =</b>	<b>2.86 acres</b>
3) Developed onsite characteristics:			
Landscape	8876	sf =	0.20 acres
Roof	0	sf =	0.00 acres
Paving	116378	sf =	2.67 acres
<b>Total</b>	<b>125254</b>	<b>sf =</b>	<b>2.88 acres</b>
<b>Step 2) Discharge Data</b>			
	Existing	Developed	
Q (100yr), cfs	3.60	3.61	
<b>Step 3) Conclusion</b>			
Basin #1 involves a minor amount of redirection of runoff from Basin #2 to Basin #1 totalling just 0.01 acres. This minor increase is not expected to have any impact on the existing southern storm infiltration trench.			
Basin #1 will also include approximately 12,000 sf of minor rock fill and and resurfacing for the frontage walkway and ADA parking slope compliance.			
No stormwater improvements are proposed for this minor resurfacing work.			

**SAFEWAY STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

<b>LANDCOVER DATA</b>			
<b>Project Name:</b>	SAFEWAY - OLYMPIC PLACE - ARLINGTON		
<b>Project Number:</b>	21043		
<b>DRAINAGE CRITERIA:</b>	CITY OF ARLINGTON		
<b>Step 1) Site Data</b>			
1) General characteristics:			
Basin	<b>2</b>	Soil type	outwash
Development type	retail	Soil Group	A/B
Size (ac.)	2.30	Existing surface	paving, planters
Detention/Retention	Infiltration	Predev Cover	Existing
Treatment Criteria	Basic	Oil Control	No
2) Existing onsite characteristics:			
Landscape	17492	sf =	0.40 acres
Roof	43096	sf =	0.99 acres
Paving	37785	sf =	0.87 acres
<b>Total</b>	<b>98373</b>	<b>sf =</b>	<b>2.26 acres</b>
3) Developed onsite characteristics:			
Landscape	4669	sf =	0.11 acres
Roof	53096	sf =	1.22 acres
Paving	27348	sf =	0.63 acres
<b>Total</b>	<b>85113</b>	<b>sf =</b>	<b>1.95 acres</b>
<b>Step 2) Discharge Data</b>			
	Existing	Developed	
Q (100yr), cfs	2.54	2.50	
<b>Step 3) Conclusion</b>			
Basin #2 involves additional roof area due to the building expansion,			
but an overall total basin area reduction 0.31 acres due to a new Basin #3 being created.			
This change will result in a net decrease in basin discharge rates.			
This change will have no negative impact on the existing northern infiltration trench.			

**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

<b>LANDCOVER DATA</b>			
<b>Project Name:</b>	SAFeway - OLYMPIC PLACE - ARLINGTON		
<b>Project Number:</b>	21043		
<b>DRAINAGE CRITERIA:</b>	CITY OF ARLINGTON		
<b>Step 1) Site Data</b>			
1) General characteristics:			
Basin	3	Soil type	outwash
Development type	retail	Soil Group	A/B
Size (ac.)	0.3	Existing surface	paving, planters
Detention/Retention	Infiltration	Predev Cover	Existing
Treatment Criteria	Enhanced	Oil Control	No
2) Existing onsite characteristics: <u>No Existing Basin 3</u>			
3) Developed onsite characteristics:			
<b>New basin establish due to new impervious area and storm facilities</b>			
Landscape	4618	sf =	0.11 acres
Roof	1208	sf =	0.03 acres
Paving	6681	sf =	0.15 acres
<b>Total</b>	<b>12507</b>	<b>sf =</b>	<b>0.29 acres</b>
<b>Step 2) Discharge Data</b>			
	Existing	Developed	
Q (100yr), cfs	0.00	0.25	
<b>Step 3) Conclusion</b>			
Basin #3 is a newly established basin to accommodate new impervious surfaces east of the proposed building expansion.			
Basin #3 will discharge to a new infiltration trench within the east planter area along Olympic Place. Infiltration will be based on a Design Infiltration Rate of 15 in/hr.			
Enhanced Treatment will be provided via a Filterra Vault.			



# **SAFEWAY STORE EXPANSION – OLYMPIC PLACE PRELIMINARY STORM DRAINAGE REPORT**

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## **SECTION 6 - CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN**

An Erosion Control Plan and Construction Stormwater Pollution Prevention Plan is provided with our sitework permit submittal.

## **SECTION 7 - SPECIAL REPORTS & STUDIES**

Geotechnical report provided within Appendix B.

## **SECTION 8 - OTHER PERMITS**

A Department of Ecology Construction Stormwater Permit will not be applied for since our site our site disturbance will not exceed one (1) acre.

## **SECTION 9 - OPERATION MAINTENANCE MANUAL, SOURCE CONTROL**

A Stormwater Operation Maintenance Manual and site Source Control measures will be provided with the final permit submittal.

## **SECTION 10 - BOND QUANTITIES WORKSHEET**

A Bond Quantities Worksheet will be submitted with the sitework permit submittal.

**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

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**APPENDIX A – WWHM CALCULATIONS**

**WWHM2012**  
**PROJECT REPORT**

## General Model Information

Project Name: 21043-WWHM  
Site Name:  
Site Address:  
City:  
Report Date: 5/3/2022  
Gage: Everett  
Data Start: 1948/10/01  
Data End: 2009/09/30  
Timestep: 15 Minute  
Precip Scale: 1.200  
Version Date: 2019/09/13  
Version: 4.2.17

## POC Thresholds

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Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

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Low Flow Threshold for POC2:	50 Percent of the 2 Year
High Flow Threshold for POC2:	50 Year

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Low Flow Threshold for POC3:	50 Percent of the 2 Year
High Flow Threshold for POC3:	50 Year

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Low Flow Threshold for POC4:	50 Percent of the 2 Year
High Flow Threshold for POC4:	50 Year

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## *Landuse Basin Data*

### *Predeveloped Land Use*

#### Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use A B, Lawn, Flat	acre 0.2
Pervious Total	0.2
Impervious Land Use PARKING FLAT	acre 2.66
Impervious Total	2.66
Basin Total	2.86

Element Flows To:		
Surface	Interflow	Groundwater

## Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use A B, Lawn, Flat	acre 0.4
Pervious Total	0.4
Impervious Land Use ROOF TOPS FLAT PARKING FLAT	acre 0.99 0.87
Impervious Total	1.86
Basin Total	2.26

Element Flows To:		
Surface	Interflow	Groundwater

### Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use A B, Forest, Flat	acre 0.29
Pervious Total	0.29
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.29

Element Flows To:		
Surface	Interflow	Groundwater

3WQ

Bypass:	No
GroundWater:	No
Pervious Land Use A B, Lawn, Flat	acre 0.26
Pervious Total	0.26
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.26

Element Flows To:		
Surface	Interflow	Groundwater

## Mitigated Land Use

### Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use A B, Lawn, Flat	acre 0.2
Pervious Total	0.2
Impervious Land Use PARKING FLAT	acre 2.67
Impervious Total	2.67
Basin Total	2.87

Element Flows To:		
Surface	Interflow	Groundwater

## Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use A B, Lawn, Flat	acre 0.11
Pervious Total	0.11
Impervious Land Use ROOF TOPS FLAT PARKING FLAT	acre 1.22 0.63
Impervious Total	1.85
Basin Total	1.96

Element Flows To:		
Surface	Interflow	Groundwater

### Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.11
Pervious Total	0.11
Impervious Land Use	acre
ROOF TOPS FLAT	0.03
PARKING FLAT	0.15
Impervious Total	0.18
Basin Total	0.29

Element Flows To:		
Surface	Interflow	Groundwater
Gravel Trench Bed 1	Gravel Trench Bed 1	

## Basin 3WQ

Bypass: No

GroundWater: No

Pervious Land Use acre  
A B, Lawn, Flat 0.11

Pervious Total 0.11

Impervious Land Use acre  
PARKING FLAT 0.15

Impervious Total 0.15

Basin Total 0.26

Element Flows To:  
Surface Interflow Groundwater

*Routing Elements*  
*Predeveloped Routing*

## Mitigated Routing

### Gravel Trench Bed 1

Bottom Length:	45.00 ft.
Bottom Width:	5.00 ft.
Trench bottom slope 1:	0 To 1
Trench Left side slope 0:	0 To 1
Trench right side slope 2:	0 To 1
Material thickness of first layer:	2
Pour Space of material for first layer:	0.35
Material thickness of second layer:	0
Pour Space of material for second layer:	0
Material thickness of third layer:	0
Pour Space of material for third layer:	0
Infiltration On	
Infiltration rate:	41.7
Infiltration safety factor:	0.36
Total Volume Infiltrated (ac-ft.):	34.302
Total Volume Through Riser (ac-ft.):	0.001
Total Volume Through Facility (ac-ft.):	34.302
Percent Infiltrated:	100
Total Precip Applied to Facility:	0
Total Evap From Facility:	0
Discharge Structure	
Riser Height:	3 ft.
Riser Diameter:	8 in.
Element Flows To:	
Outlet 1	Outlet 2

Gravel Trench Bed Hydraulic Table

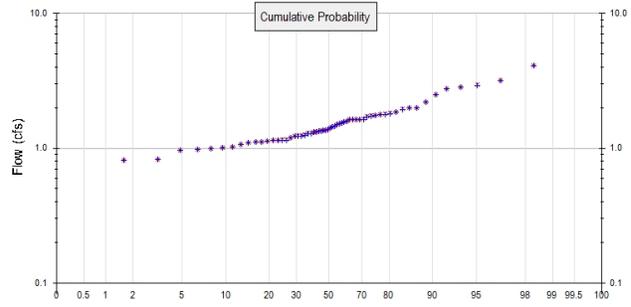
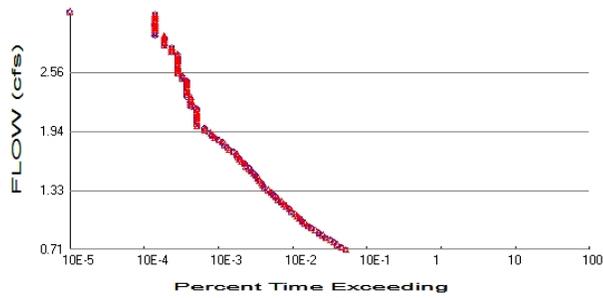
Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.005	0.000	0.000	0.000
0.0333	0.005	0.000	0.000	0.078
0.0667	0.005	0.000	0.000	0.078
0.1000	0.005	0.000	0.000	0.078
0.1333	0.005	0.000	0.000	0.078
0.1667	0.005	0.000	0.000	0.078
0.2000	0.005	0.000	0.000	0.078
0.2333	0.005	0.000	0.000	0.078
0.2667	0.005	0.000	0.000	0.078
0.3000	0.005	0.000	0.000	0.078
0.3333	0.005	0.000	0.000	0.078
0.3667	0.005	0.000	0.000	0.078
0.4000	0.005	0.000	0.000	0.078
0.4333	0.005	0.000	0.000	0.078
0.4667	0.005	0.000	0.000	0.078
0.5000	0.005	0.000	0.000	0.078
0.5333	0.005	0.001	0.000	0.078
0.5667	0.005	0.001	0.000	0.078
0.6000	0.005	0.001	0.000	0.078
0.6333	0.005	0.001	0.000	0.078
0.6667	0.005	0.001	0.000	0.078
0.7000	0.005	0.001	0.000	0.078
0.7333	0.005	0.001	0.000	0.078
0.7667	0.005	0.001	0.000	0.078

0.8000	0.005	0.001	0.000	0.078
0.8333	0.005	0.001	0.000	0.078
0.8667	0.005	0.001	0.000	0.078
0.9000	0.005	0.001	0.000	0.078
0.9333	0.005	0.001	0.000	0.078
0.9667	0.005	0.001	0.000	0.078
1.0000	0.005	0.001	0.000	0.078
1.0333	0.005	0.001	0.000	0.078
1.0667	0.005	0.001	0.000	0.078
1.1000	0.005	0.002	0.000	0.078
1.1333	0.005	0.002	0.000	0.078
1.1667	0.005	0.002	0.000	0.078
1.2000	0.005	0.002	0.000	0.078
1.2333	0.005	0.002	0.000	0.078
1.2667	0.005	0.002	0.000	0.078
1.3000	0.005	0.002	0.000	0.078
1.3333	0.005	0.002	0.000	0.078
1.3667	0.005	0.002	0.000	0.078
1.4000	0.005	0.002	0.000	0.078
1.4333	0.005	0.002	0.000	0.078
1.4667	0.005	0.002	0.000	0.078
1.5000	0.005	0.002	0.000	0.078
1.5333	0.005	0.002	0.000	0.078
1.5667	0.005	0.002	0.000	0.078
1.6000	0.005	0.002	0.000	0.078
1.6333	0.005	0.003	0.000	0.078
1.6667	0.005	0.003	0.000	0.078
1.7000	0.005	0.003	0.000	0.078
1.7333	0.005	0.003	0.000	0.078
1.7667	0.005	0.003	0.000	0.078
1.8000	0.005	0.003	0.000	0.078
1.8333	0.005	0.003	0.000	0.078
1.8667	0.005	0.003	0.000	0.078
1.9000	0.005	0.003	0.000	0.078
1.9333	0.005	0.003	0.000	0.078
1.9667	0.005	0.003	0.000	0.078
2.0000	0.005	0.003	0.000	0.078
2.0333	0.005	0.003	0.000	0.078
2.0667	0.005	0.004	0.000	0.078
2.1000	0.005	0.004	0.000	0.078
2.1333	0.005	0.004	0.000	0.078
2.1667	0.005	0.004	0.000	0.078
2.2000	0.005	0.004	0.000	0.078
2.2333	0.005	0.004	0.000	0.078
2.2667	0.005	0.005	0.000	0.078
2.3000	0.005	0.005	0.000	0.078
2.3333	0.005	0.005	0.000	0.078
2.3667	0.005	0.005	0.000	0.078
2.4000	0.005	0.005	0.000	0.078
2.4333	0.005	0.006	0.000	0.078
2.4667	0.005	0.006	0.000	0.078
2.5000	0.005	0.006	0.000	0.078
2.5333	0.005	0.006	0.000	0.078
2.5667	0.005	0.006	0.000	0.078
2.6000	0.005	0.006	0.000	0.078
2.6333	0.005	0.007	0.000	0.078
2.6667	0.005	0.007	0.000	0.078
2.7000	0.005	0.007	0.000	0.078

2.7333	0.005	0.007	0.000	0.078
2.7667	0.005	0.007	0.000	0.078
2.8000	0.005	0.007	0.000	0.078
2.8333	0.005	0.008	0.000	0.078
2.8667	0.005	0.008	0.000	0.078
2.9000	0.005	0.008	0.000	0.078
2.9333	0.005	0.008	0.000	0.078
2.9667	0.005	0.008	0.000	0.078
3.0000	0.005	0.008	0.000	0.078

# Analysis Results

## POC 1



+ Predeveloped x Mitigated

### Predeveloped Landuse Totals for POC #1

Total Pervious Area: 0.2  
Total Impervious Area: 2.66

### Mitigated Landuse Totals for POC #1

Total Pervious Area: 0.2  
Total Impervious Area: 2.67

Flow Frequency Method: Log Pearson Type III 17B

### Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.418938
5 year	1.914605
10 year	2.276308
25 year	2.772949
50 year	3.172673
100 year	3.598747

### Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.424256
5 year	1.921777
10 year	2.284832
25 year	2.783328
50 year	3.184546
100 year	3.612211

## Annual Peaks

### Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	1.515	1.521
1950	1.641	1.648
1951	1.755	1.762
1952	1.345	1.350
1953	1.714	1.720
1954	2.192	2.200
1955	1.736	1.743
1956	0.750	0.753
1957	1.253	1.257
1958	3.189	3.201

1959	1.288	1.293
1960	1.288	1.293
1961	4.075	4.091
1962	1.622	1.628
1963	1.776	1.783
1964	0.982	0.986
1965	1.236	1.241
1966	1.238	1.243
1967	2.756	2.766
1968	1.456	1.462
1969	2.835	2.846
1970	1.123	1.127
1971	1.537	1.543
1972	1.979	1.986
1973	1.626	1.632
1974	1.983	1.991
1975	1.560	1.566
1976	1.093	1.097
1977	1.114	1.118
1978	0.825	0.828
1979	1.789	1.796
1980	1.230	1.235
1981	1.114	1.118
1982	1.144	1.148
1983	1.497	1.502
1984	1.382	1.387
1985	1.943	1.950
1986	1.843	1.850
1987	1.637	1.643
1988	1.336	1.341
1989	1.349	1.354
1990	1.068	1.072
1991	1.360	1.365
1992	1.314	1.319
1993	1.024	1.028
1994	1.195	1.199
1995	1.009	1.013
1996	1.623	1.629
1997	1.592	1.597
1998	1.809	1.816
1999	0.810	0.813
2000	2.937	2.948
2001	0.988	0.992
2002	0.960	0.964
2003	1.316	1.321
2004	2.483	2.492
2005	1.149	1.153
2006	1.437	1.442
2007	1.421	1.426
2008	1.150	1.154
2009	1.152	1.157

### Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	4.0754	4.0907
2	3.1886	3.2005
3	2.9372	2.9482

4	2.8353	2.8460
5	2.7560	2.7663
6	2.4830	2.4923
7	2.1922	2.2002
8	1.9831	1.9905
9	1.9787	1.9862
10	1.9430	1.9503
11	1.8427	1.8496
12	1.8091	1.8159
13	1.7891	1.7958
14	1.7761	1.7827
15	1.7552	1.7618
16	1.7361	1.7426
17	1.7138	1.7202
18	1.6414	1.6475
19	1.6372	1.6433
20	1.6258	1.6319
21	1.6233	1.6294
22	1.6215	1.6276
23	1.5916	1.5974
24	1.5600	1.5659
25	1.5372	1.5430
26	1.5152	1.5209
27	1.4965	1.5022
28	1.4563	1.4618
29	1.4366	1.4418
30	1.4206	1.4259
31	1.3816	1.3868
32	1.3602	1.3653
33	1.3494	1.3544
34	1.3452	1.3502
35	1.3358	1.3408
36	1.3163	1.3212
37	1.3141	1.3191
38	1.2884	1.2932
39	1.2879	1.2927
40	1.2528	1.2574
41	1.2381	1.2427
42	1.2363	1.2409
43	1.2305	1.2351
44	1.1948	1.1993
45	1.1523	1.1566
46	1.1496	1.1539
47	1.1491	1.1534
48	1.1435	1.1478
49	1.1230	1.1273
50	1.1141	1.1183
51	1.1138	1.1180
52	1.0930	1.0972
53	1.0681	1.0721
54	1.0238	1.0276
55	1.0089	1.0127
56	0.9885	0.9922
57	0.9821	0.9857
58	0.9604	0.9640
59	0.8250	0.8281
60	0.8101	0.8132
61	0.7504	0.7532



## Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.7095	1092	1106	101	Fail
0.7343	959	974	101	Fail
0.7592	848	856	100	Pass
0.7841	758	765	100	Pass
0.8090	682	692	101	Fail
0.8339	590	597	101	Fail
0.8588	539	543	100	Pass
0.8836	478	483	101	Fail
0.9085	426	434	101	Fail
0.9334	378	385	101	Fail
0.9583	338	341	100	Pass
0.9832	308	314	101	Fail
1.0080	284	288	101	Fail
1.0329	265	265	100	Pass
1.0578	246	247	100	Pass
1.0827	230	231	100	Pass
1.1076	207	209	100	Pass
1.1324	190	193	101	Fail
1.1573	172	175	101	Fail
1.1822	164	165	100	Pass
1.2071	148	153	103	Fail
1.2320	136	138	101	Fail
1.2568	124	127	102	Fail
1.2817	117	117	100	Pass
1.3066	110	110	100	Pass
1.3315	99	100	101	Fail
1.3564	89	89	100	Pass
1.3813	84	84	100	Pass
1.4061	80	81	101	Fail
1.4310	76	76	100	Pass
1.4559	72	73	101	Pass
1.4808	67	68	101	Pass
1.5057	63	64	101	Pass
1.5305	58	59	101	Pass
1.5554	56	56	100	Pass
1.5803	51	51	100	Pass
1.6052	48	48	100	Pass
1.6301	43	44	102	Pass
1.6549	41	41	100	Pass
1.6798	39	39	100	Pass
1.7047	37	38	102	Pass
1.7296	34	34	100	Pass
1.7545	30	30	100	Pass
1.7793	28	29	103	Pass
1.8042	26	26	100	Pass
1.8291	24	24	100	Pass
1.8540	21	22	104	Pass
1.8789	19	19	100	Pass
1.9037	17	18	105	Pass
1.9286	16	17	106	Pass
1.9535	14	14	100	Pass
1.9784	14	14	100	Pass
2.0033	11	11	100	Pass
2.0282	11	11	100	Pass

2.0530	11	11	100	Pass
2.0779	11	11	100	Pass
2.1028	11	11	100	Pass
2.1277	11	11	100	Pass
2.1526	11	11	100	Pass
2.1774	11	11	100	Pass
2.2023	9	10	111	Fail
2.2272	9	9	100	Pass
2.2521	9	9	100	Pass
2.2770	9	9	100	Pass
2.3018	8	9	112	Fail
2.3267	8	8	100	Pass
2.3516	8	8	100	Pass
2.3765	8	8	100	Pass
2.4014	8	8	100	Pass
2.4262	8	8	100	Pass
2.4511	8	8	100	Pass
2.4760	8	8	100	Pass
2.5009	7	7	100	Pass
2.5258	7	7	100	Pass
2.5507	6	6	100	Pass
2.5755	6	6	100	Pass
2.6004	6	6	100	Pass
2.6253	6	6	100	Pass
2.6502	6	6	100	Pass
2.6751	6	6	100	Pass
2.6999	6	6	100	Pass
2.7248	6	6	100	Pass
2.7497	6	6	100	Pass
2.7746	5	5	100	Pass
2.7995	5	5	100	Pass
2.8243	5	5	100	Pass
2.8492	4	4	100	Pass
2.8741	4	4	100	Pass
2.8990	4	4	100	Pass
2.9239	4	4	100	Pass
2.9487	3	4	133	Fail
2.9736	3	3	100	Pass
2.9985	3	3	100	Pass
3.0234	3	3	100	Pass
3.0483	3	3	100	Pass
3.0731	3	3	100	Pass
3.0980	3	3	100	Pass
3.1229	3	3	100	Pass
3.1478	3	3	100	Pass
3.1727	3	3	100	Pass

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

## Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

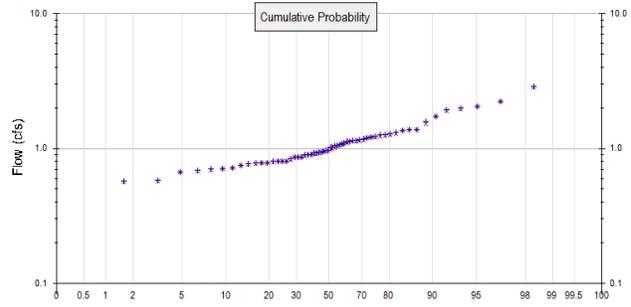
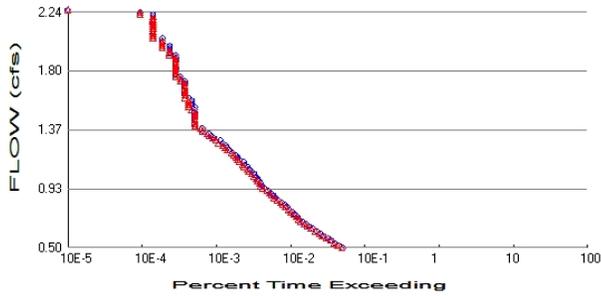
Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

# LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

## POC 2



+ Predeveloped x Mitigated

### Predeveloped Landuse Totals for POC #2

Total Pervious Area: 0.4  
Total Impervious Area: 1.86

### Mitigated Landuse Totals for POC #2

Total Pervious Area: 0.11  
Total Impervious Area: 1.85

Flow Frequency Method: Log Pearson Type III 17B

### Flow Frequency Return Periods for Predeveloped. POC #2

Return Period	Flow(cfs)
2 year	0.9979
5 year	1.34823
10 year	1.604131
25 year	1.95578
50 year	2.239009
100 year	2.541076

### Flow Frequency Return Periods for Mitigated. POC #2

Return Period	Flow(cfs)
2 year	0.986236
5 year	1.330612
10 year	1.581893
25 year	1.926896
50 year	2.204557
100 year	2.500509

## Annual Peaks

### Annual Peaks for Predeveloped and Mitigated. POC #2

Year	Predeveloped	Mitigated
1949	1.060	1.054
1950	1.167	1.139
1951	1.227	1.221
1952	0.941	0.936
1953	1.198	1.192
1954	1.596	1.518
1955	1.214	1.207
1956	0.525	0.522
1957	0.902	0.868
1958	2.232	2.217
1959	0.901	0.896

1960	0.903	0.896
1961	2.862	2.833
1962	1.134	1.128
1963	1.273	1.232
1964	0.704	0.681
1965	0.864	0.860
1966	0.866	0.861
1967	1.927	1.917
1968	1.018	1.013
1969	1.992	1.971
1970	0.785	0.781
1971	1.075	1.069
1972	1.384	1.376
1973	1.137	1.131
1974	1.387	1.379
1975	1.094	1.085
1976	0.764	0.760
1977	0.779	0.775
1978	0.577	0.574
1979	1.278	1.244
1980	0.861	0.856
1981	0.779	0.775
1982	0.800	0.795
1983	1.048	1.041
1984	0.966	0.961
1985	1.359	1.351
1986	1.319	1.278
1987	1.145	1.139
1988	0.934	0.929
1989	0.962	0.936
1990	0.747	0.743
1991	0.951	0.946
1992	0.922	0.914
1993	0.716	0.712
1994	0.835	0.831
1995	0.705	0.702
1996	1.135	1.129
1997	1.176	1.100
1998	1.265	1.258
1999	0.571	0.563
2000	2.054	2.043
2001	0.691	0.687
2002	0.672	0.668
2003	0.920	0.915
2004	1.736	1.727
2005	0.803	0.799
2006	1.048	0.994
2007	1.023	0.985
2008	0.804	0.800
2009	0.806	0.801

### Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #2

Rank	Predeveloped	Mitigated
1	2.8621	2.8330
2	2.2325	2.2173
3	2.0542	2.0427
4	1.9922	1.9709

5	1.9271	1.9167
6	1.7364	1.7269
7	1.5956	1.5176
8	1.3867	1.3792
9	1.3843	1.3761
10	1.3587	1.3513
11	1.3192	1.2782
12	1.2783	1.2582
13	1.2730	1.2438
14	1.2651	1.2318
15	1.2273	1.2207
16	1.2140	1.2074
17	1.1984	1.1919
18	1.1763	1.1394
19	1.1669	1.1386
20	1.1448	1.1307
21	1.1373	1.1290
22	1.1352	1.1278
23	1.1339	1.0999
24	1.0936	1.0847
25	1.0751	1.0691
26	1.0595	1.0538
27	1.0483	1.0406
28	1.0482	1.0129
29	1.0230	0.9942
30	1.0184	0.9847
31	0.9661	0.9609
32	0.9619	0.9460
33	0.9511	0.9364
34	0.9406	0.9355
35	0.9342	0.9290
36	0.9217	0.9155
37	0.9204	0.9136
38	0.9028	0.8958
39	0.9022	0.8957
40	0.9005	0.8684
41	0.8657	0.8611
42	0.8645	0.8598
43	0.8605	0.8557
44	0.8354	0.8309
45	0.8058	0.8014
46	0.8039	0.7995
47	0.8035	0.7992
48	0.7996	0.7953
49	0.7853	0.7811
50	0.7790	0.7748
51	0.7790	0.7746
52	0.7643	0.7602
53	0.7469	0.7429
54	0.7159	0.7120
55	0.7054	0.7016
56	0.7037	0.6875
57	0.6912	0.6811
58	0.6715	0.6679
59	0.5769	0.5738
60	0.5708	0.5629
61	0.5247	0.5219



## Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.4990	1081	1047	96	Pass
0.5165	952	913	95	Pass
0.5341	832	813	97	Pass
0.5517	754	734	97	Pass
0.5693	673	638	94	Pass
0.5868	588	568	96	Pass
0.6044	530	517	97	Pass
0.6220	479	461	96	Pass
0.6396	424	402	94	Pass
0.6571	374	357	95	Pass
0.6747	341	327	95	Pass
0.6923	307	295	96	Pass
0.7099	283	273	96	Pass
0.7274	264	253	95	Pass
0.7450	240	234	97	Pass
0.7626	226	215	95	Pass
0.7802	203	198	97	Pass
0.7977	190	182	95	Pass
0.8153	177	166	93	Pass
0.8329	163	157	96	Pass
0.8505	146	139	95	Pass
0.8681	137	128	93	Pass
0.8856	125	117	93	Pass
0.9032	115	111	96	Pass
0.9208	106	102	96	Pass
0.9384	95	90	94	Pass
0.9559	90	85	94	Pass
0.9735	84	81	96	Pass
0.9911	80	76	95	Pass
1.0087	77	73	94	Pass
1.0262	73	68	93	Pass
1.0438	69	64	92	Pass
1.0614	64	58	90	Pass
1.0790	59	56	94	Pass
1.0965	56	51	91	Pass
1.1141	52	48	92	Pass
1.1317	50	43	86	Pass
1.1493	43	41	95	Pass
1.1669	41	39	95	Pass
1.1844	39	37	94	Pass
1.2020	35	34	97	Pass
1.2196	32	30	93	Pass
1.2372	30	28	93	Pass
1.2547	29	26	89	Pass
1.2723	26	23	88	Pass
1.2899	24	21	87	Pass
1.3075	20	19	95	Pass
1.3250	18	17	94	Pass
1.3426	17	16	94	Pass
1.3602	14	14	100	Pass
1.3778	14	13	92	Pass
1.3953	11	11	100	Pass
1.4129	11	11	100	Pass

1.4305	11	11	100	Pass
1.4481	11	11	100	Pass
1.4656	11	11	100	Pass
1.4832	11	11	100	Pass
1.5008	11	11	100	Pass
1.5184	11	10	90	Pass
1.5360	11	9	81	Pass
1.5535	10	9	90	Pass
1.5711	10	9	90	Pass
1.5887	10	9	90	Pass
1.6063	9	8	88	Pass
1.6238	8	8	100	Pass
1.6414	8	8	100	Pass
1.6590	8	8	100	Pass
1.6766	8	8	100	Pass
1.6941	8	8	100	Pass
1.7117	8	8	100	Pass
1.7293	8	7	87	Pass
1.7469	7	7	100	Pass
1.7644	7	6	85	Pass
1.7820	6	6	100	Pass
1.7996	6	6	100	Pass
1.8172	6	6	100	Pass
1.8348	6	6	100	Pass
1.8523	6	6	100	Pass
1.8699	6	6	100	Pass
1.8875	6	6	100	Pass
1.9051	6	6	100	Pass
1.9226	6	5	83	Pass
1.9402	5	5	100	Pass
1.9578	5	5	100	Pass
1.9754	5	4	80	Pass
1.9929	5	4	80	Pass
2.0105	4	4	100	Pass
2.0281	4	4	100	Pass
2.0457	4	3	75	Pass
2.0632	3	3	100	Pass
2.0808	3	3	100	Pass
2.0984	3	3	100	Pass
2.1160	3	3	100	Pass
2.1336	3	3	100	Pass
2.1511	3	3	100	Pass
2.1687	3	3	100	Pass
2.1863	3	3	100	Pass
2.2039	3	3	100	Pass
2.2214	3	2	66	Pass
2.2390	2	2	100	Pass

## Water Quality

Water Quality BMP Flow and Volume for POC #2

On-line facility volume: 0 acre-feet

On-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

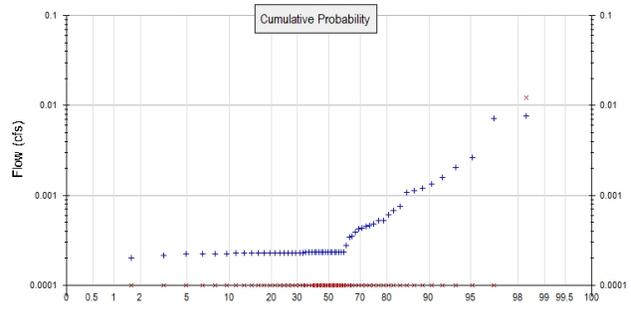
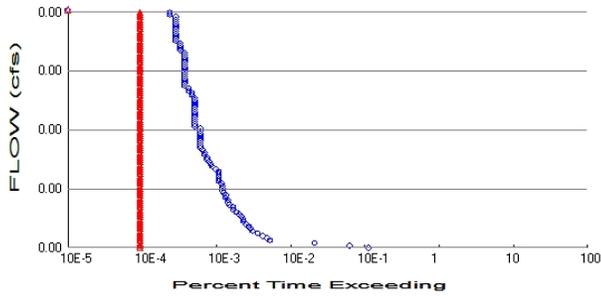
Off-line facility target flow: 0 cfs.

Adjusted for 15 min: 0 cfs.

# LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

# POC 3



+ Predeveloped    x Mitigated

## Predeveloped Landuse Totals for POC #3

Total Pervious Area:     0.29  
 Total Impervious Area:   0

## Mitigated Landuse Totals for POC #3

Total Pervious Area:     0.11  
 Total Impervious Area:   0.18

Flow Frequency Method:   Log Pearson Type III 17B

## Flow Frequency Return Periods for Predeveloped. POC #3

Return Period	Flow(cfs)
2 year	0.000333
5 year	0.000722
10 year	0.001158
25 year	0.002023
50 year	0.002989
100 year	0.004335

## Flow Frequency Return Periods for Mitigated. POC #3

Return Period	Flow(cfs)
2 year	0
5 year	0
10 year	0
25 year	0
50 year	0
100 year	0

## Annual Peaks

### Annual Peaks for Predeveloped and Mitigated. POC #3

Year	Predeveloped	Mitigated
1949	0.000	0.000
1950	0.001	0.000
1951	0.000	0.000
1952	0.000	0.000
1953	0.000	0.000
1954	0.002	0.000
1955	0.001	0.000
1956	0.000	0.000
1957	0.000	0.000
1958	0.000	0.000
1959	0.001	0.000

1960	0.000	0.000
1961	0.001	0.012
1962	0.000	0.000
1963	0.000	0.000
1964	0.001	0.000
1965	0.000	0.000
1966	0.000	0.000
1967	0.000	0.000
1968	0.000	0.000
1969	0.000	0.000
1970	0.000	0.000
1971	0.001	0.000
1972	0.000	0.000
1973	0.000	0.000
1974	0.001	0.000
1975	0.000	0.000
1976	0.001	0.000
1977	0.000	0.000
1978	0.000	0.000
1979	0.000	0.000
1980	0.000	0.000
1981	0.000	0.000
1982	0.000	0.000
1983	0.000	0.000
1984	0.000	0.000
1985	0.000	0.000
1986	0.002	0.000
1987	0.001	0.000
1988	0.000	0.000
1989	0.000	0.000
1990	0.000	0.000
1991	0.000	0.000
1992	0.000	0.000
1993	0.000	0.000
1994	0.000	0.000
1995	0.000	0.000
1996	0.003	0.000
1997	0.007	0.000
1998	0.000	0.000
1999	0.000	0.000
2000	0.000	0.000
2001	0.000	0.000
2002	0.000	0.000
2003	0.000	0.000
2004	0.000	0.000
2005	0.000	0.000
2006	0.008	0.000
2007	0.000	0.000
2008	0.000	0.000
2009	0.000	0.000

### Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #3

Rank	Predeveloped	Mitigated
1	0.0077	0.0122
2	0.0072	0.0000
3	0.0026	0.0000
4	0.0020	0.0000

5	0.0016	0.0000
6	0.0013	0.0000
7	0.0012	0.0000
8	0.0011	0.0000
9	0.0011	0.0000
10	0.0008	0.0000
11	0.0007	0.0000
12	0.0006	0.0000
13	0.0005	0.0000
14	0.0005	0.0000
15	0.0005	0.0000
16	0.0005	0.0000
17	0.0005	0.0000
18	0.0004	0.0000
19	0.0004	0.0000
20	0.0004	0.0000
21	0.0004	0.0000
22	0.0003	0.0000
23	0.0003	0.0000
24	0.0002	0.0000
25	0.0002	0.0000
26	0.0002	0.0000
27	0.0002	0.0000
28	0.0002	0.0000
29	0.0002	0.0000
30	0.0002	0.0000
31	0.0002	0.0000
32	0.0002	0.0000
33	0.0002	0.0000
34	0.0002	0.0000
35	0.0002	0.0000
36	0.0002	0.0000
37	0.0002	0.0000
38	0.0002	0.0000
39	0.0002	0.0000
40	0.0002	0.0000
41	0.0002	0.0000
42	0.0002	0.0000
43	0.0002	0.0000
44	0.0002	0.0000
45	0.0002	0.0000
46	0.0002	0.0000
47	0.0002	0.0000
48	0.0002	0.0000
49	0.0002	0.0000
50	0.0002	0.0000
51	0.0002	0.0000
52	0.0002	0.0000
53	0.0002	0.0000
54	0.0002	0.0000
55	0.0002	0.0000
56	0.0002	0.0000
57	0.0002	0.0000
58	0.0002	0.0000
59	0.0002	0.0000
60	0.0002	0.0000
61	0.0002	0.0000



## Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0002	2376	2	0	Pass
0.0002	1321	2	0	Pass
0.0002	449	2	0	Pass
0.0003	112	2	1	Pass
0.0003	103	2	1	Pass
0.0003	89	2	2	Pass
0.0003	77	2	2	Pass
0.0004	66	2	3	Pass
0.0004	61	2	3	Pass
0.0004	58	2	3	Pass
0.0005	54	2	3	Pass
0.0005	50	2	4	Pass
0.0005	49	2	4	Pass
0.0005	47	2	4	Pass
0.0006	43	2	4	Pass
0.0006	40	2	5	Pass
0.0006	36	2	5	Pass
0.0007	36	2	5	Pass
0.0007	32	2	6	Pass
0.0007	31	2	6	Pass
0.0007	31	2	6	Pass
0.0008	29	2	6	Pass
0.0008	29	2	6	Pass
0.0008	27	2	7	Pass
0.0009	26	2	7	Pass
0.0009	26	2	7	Pass
0.0009	26	2	7	Pass
0.0009	25	2	8	Pass
0.0010	23	2	8	Pass
0.0010	23	2	8	Pass
0.0010	23	2	8	Pass
0.0011	23	2	8	Pass
0.0011	23	2	8	Pass
0.0011	21	2	9	Pass
0.0011	19	2	10	Pass
0.0012	18	2	11	Pass
0.0012	17	2	11	Pass
0.0012	16	2	12	Pass
0.0012	16	2	12	Pass
0.0013	15	2	13	Pass
0.0013	15	2	13	Pass
0.0013	14	2	14	Pass
0.0014	13	2	15	Pass
0.0014	13	2	15	Pass
0.0014	13	2	15	Pass
0.0014	13	2	15	Pass
0.0015	13	2	15	Pass
0.0015	13	2	15	Pass
0.0015	13	2	15	Pass
0.0016	13	2	15	Pass
0.0016	13	2	15	Pass
0.0016	11	2	18	Pass
0.0016	11	2	18	Pass

0.0017	11	2	18	Pass
0.0017	11	2	18	Pass
0.0017	11	2	18	Pass
0.0018	11	2	18	Pass
0.0018	11	2	18	Pass
0.0018	11	2	18	Pass
0.0018	11	2	18	Pass
0.0019	11	2	18	Pass
0.0019	11	2	18	Pass
0.0019	11	2	18	Pass
0.0020	11	2	18	Pass
0.0020	10	2	20	Pass
0.0020	10	2	20	Pass
0.0020	9	2	22	Pass
0.0021	9	2	22	Pass
0.0021	8	2	25	Pass
0.0021	8	2	25	Pass
0.0022	8	2	25	Pass
0.0022	8	2	25	Pass
0.0022	8	2	25	Pass
0.0022	8	2	25	Pass
0.0023	8	2	25	Pass
0.0023	8	2	25	Pass
0.0023	8	2	25	Pass
0.0024	8	2	25	Pass
0.0024	8	2	25	Pass
0.0024	8	2	25	Pass
0.0024	8	2	25	Pass
0.0025	8	2	25	Pass
0.0025	8	2	25	Pass
0.0025	7	2	28	Pass
0.0026	7	2	28	Pass
0.0026	7	2	28	Pass
0.0026	7	2	28	Pass
0.0026	6	2	33	Pass
0.0027	6	2	33	Pass
0.0027	6	2	33	Pass
0.0027	6	2	33	Pass
0.0028	6	2	33	Pass
0.0028	6	2	33	Pass
0.0028	6	2	33	Pass
0.0028	6	2	33	Pass
0.0029	6	2	33	Pass
0.0029	6	2	33	Pass
0.0029	6	2	33	Pass
0.0030	5	2	40	Pass
0.0030	5	2	40	Pass

## Water Quality

Water Quality BMP Flow and Volume for POC #3

On-line facility volume: 0.0218 acre-feet

On-line facility target flow: 0.0351 cfs.

Adjusted for 15 min: 0.0351 cfs.

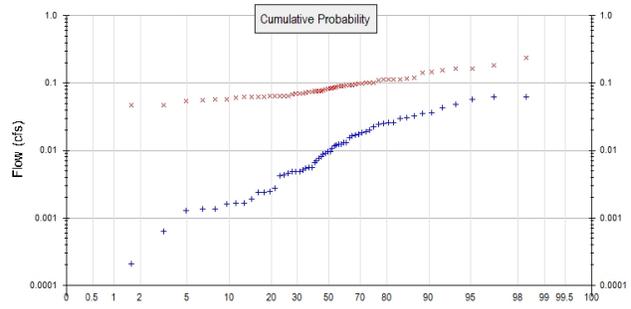
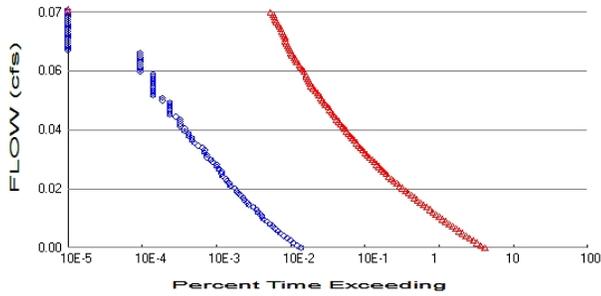
Off-line facility target flow: 0.0198 cfs.

Adjusted for 15 min: 0.0198 cfs.

# LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Gravel Trench Bed 1 POC	<input type="checkbox"/>	31.22			<input type="checkbox"/>	100.00			
Total Volume Infiltrated		31.22	0.00	0.00		100.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

# POC 4



+ Predeveloped    x Mitigated

## Predeveloped Landuse Totals for POC #4

Total Pervious Area:     0.26  
 Total Impervious Area:   0

## Mitigated Landuse Totals for POC #4

Total Pervious Area:     0.11  
 Total Impervious Area:   0.15

Flow Frequency Method:   Log Pearson Type III 17B

## Flow Frequency Return Periods for Predeveloped. POC #4

Return Period	Flow(cfs)
2 year	0.009128
5 year	0.024388
10 year	0.038055
25 year	0.058232
50 year	0.074699
100 year	0.09192

## Flow Frequency Return Periods for Mitigated. POC #4

Return Period	Flow(cfs)
2 year	0.082702
5 year	0.112368
10 year	0.133685
25 year	0.162583
50 year	0.185572
100 year	0.209845

## Annual Peaks

### Annual Peaks for Predeveloped and Mitigated. POC #4

Year	Predeveloped	Mitigated
1949	0.000	0.085
1950	0.019	0.100
1951	0.013	0.099
1952	0.009	0.076
1953	0.013	0.097
1954	0.063	0.147
1955	0.043	0.102
1956	0.006	0.042
1957	0.026	0.081
1958	0.017	0.181
1959	0.013	0.073

1960	0.012	0.073
1961	0.035	0.235
1962	0.001	0.091
1963	0.031	0.112
1964	0.017	0.062
1965	0.002	0.070
1966	0.002	0.070
1967	0.012	0.155
1968	0.008	0.082
1969	0.017	0.164
1970	0.005	0.063
1971	0.023	0.087
1972	0.011	0.112
1973	0.005	0.092
1974	0.026	0.112
1975	0.006	0.089
1976	0.013	0.062
1977	0.001	0.063
1978	0.003	0.047
1979	0.057	0.120
1980	0.010	0.069
1981	0.010	0.063
1982	0.008	0.064
1983	0.024	0.085
1984	0.002	0.078
1985	0.026	0.110
1986	0.036	0.116
1987	0.016	0.092
1988	0.007	0.075
1989	0.018	0.083
1990	0.009	0.060
1991	0.005	0.077
1992	0.005	0.075
1993	0.004	0.058
1994	0.002	0.067
1995	0.005	0.057
1996	0.033	0.092
1997	0.063	0.114
1998	0.002	0.102
1999	0.004	0.047
2000	0.020	0.166
2001	0.000	0.056
2002	0.002	0.054
2003	0.001	0.074
2004	0.002	0.140
2005	0.005	0.065
2006	0.048	0.098
2007	0.030	0.091
2008	0.007	0.065
2009	0.001	0.065

### Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #4

Rank	Predeveloped	Mitigated
1	0.0633	0.2345
2	0.0627	0.1809
3	0.0570	0.1658
4	0.0479	0.1635

5	0.0434	0.1554
6	0.0363	0.1474
7	0.0352	0.1401
8	0.0327	0.1201
9	0.0311	0.1156
10	0.0296	0.1138
11	0.0261	0.1120
12	0.0256	0.1118
13	0.0255	0.1118
14	0.0245	0.1096
15	0.0228	0.1025
16	0.0200	0.1021
17	0.0192	0.0998
18	0.0183	0.0990
19	0.0172	0.0976
20	0.0170	0.0967
21	0.0166	0.0923
22	0.0155	0.0919
23	0.0131	0.0916
24	0.0129	0.0914
25	0.0126	0.0914
26	0.0126	0.0890
27	0.0122	0.0867
28	0.0118	0.0855
29	0.0109	0.0851
30	0.0097	0.0831
31	0.0096	0.0821
32	0.0090	0.0806
33	0.0087	0.0779
34	0.0080	0.0767
35	0.0077	0.0759
36	0.0071	0.0754
37	0.0066	0.0752
38	0.0057	0.0742
39	0.0056	0.0734
40	0.0054	0.0726
41	0.0052	0.0698
42	0.0049	0.0697
43	0.0049	0.0694
44	0.0048	0.0674
45	0.0046	0.0650
46	0.0043	0.0648
47	0.0042	0.0648
48	0.0028	0.0645
49	0.0025	0.0633
50	0.0024	0.0629
51	0.0024	0.0628
52	0.0019	0.0618
53	0.0017	0.0616
54	0.0016	0.0602
55	0.0016	0.0577
56	0.0014	0.0569
57	0.0014	0.0557
58	0.0013	0.0542
59	0.0006	0.0473
60	0.0002	0.0468
61	0.0002	0.0423



## Duration Flows

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0046	296	88485	29893	Fail
0.0053	263	77748	29561	Fail
0.0060	233	68936	29586	Fail
0.0067	214	61471	28724	Fail
0.0074	192	54905	28596	Fail
0.0081	171	49151	28743	Fail
0.0088	157	44104	28091	Fail
0.0095	147	39655	26976	Fail
0.0102	131	35719	27266	Fail
0.0109	122	32254	26437	Fail
0.0116	112	29153	26029	Fail
0.0124	104	26330	25317	Fail
0.0131	93	23720	25505	Fail
0.0138	88	21410	24329	Fail
0.0145	83	19333	23292	Fail
0.0152	77	17603	22861	Fail
0.0159	74	16005	21628	Fail
0.0166	67	14459	21580	Fail
0.0173	58	13105	22594	Fail
0.0180	55	11935	21700	Fail
0.0187	51	10848	21270	Fail
0.0194	49	9841	20083	Fail
0.0201	45	9028	20062	Fail
0.0209	42	8226	19585	Fail
0.0216	40	7495	18737	Fail
0.0223	38	6859	18050	Fail
0.0230	33	6263	18978	Fail
0.0237	32	5739	17934	Fail
0.0244	30	5245	17483	Fail
0.0251	29	4817	16610	Fail
0.0258	26	4432	17046	Fail
0.0265	25	4111	16444	Fail
0.0272	25	3814	15256	Fail
0.0279	23	3544	15408	Fail
0.0287	22	3305	15022	Fail
0.0294	22	3091	14050	Fail
0.0301	19	2836	14926	Fail
0.0308	18	2659	14772	Fail
0.0315	16	2462	15387	Fail
0.0322	16	2293	14331	Fail
0.0329	15	2129	14193	Fail
0.0336	15	1986	13239	Fail
0.0343	14	1863	13307	Fail
0.0350	12	1741	14508	Fail
0.0357	11	1633	14845	Fail
0.0364	10	1536	15360	Fail
0.0372	10	1446	14460	Fail
0.0379	9	1370	15222	Fail
0.0386	9	1280	14222	Fail
0.0393	8	1210	15125	Fail
0.0400	8	1139	14237	Fail
0.0407	7	1068	15257	Fail
0.0414	7	1005	14357	Fail
0.0421	7	944	13485	Fail

0.0428	7	891	12728	Fail
0.0435	6	838	13966	Fail
0.0442	5	791	15820	Fail
0.0449	5	760	15200	Fail
0.0457	5	719	14380	Fail
0.0464	5	682	13639	Fail
0.0471	5	633	12660	Fail
0.0478	5	601	12020	Fail
0.0485	4	568	14200	Fail
0.0492	4	544	13600	Fail
0.0499	3	513	17100	Fail
0.0506	3	490	16333	Fail
0.0513	3	455	15166	Fail
0.0520	3	427	14233	Fail
0.0527	3	404	13466	Fail
0.0534	3	386	12866	Fail
0.0542	3	374	12466	Fail
0.0549	3	361	12033	Fail
0.0556	3	350	11666	Fail
0.0563	3	341	11366	Fail
0.0570	2	323	16150	Fail
0.0577	2	308	15400	Fail
0.0584	2	287	14350	Fail
0.0591	2	279	13950	Fail
0.0598	2	258	12900	Fail
0.0605	2	246	12300	Fail
0.0612	2	241	12050	Fail
0.0619	2	225	11250	Fail
0.0627	2	213	10650	Fail
0.0634	0	208	n/a	Fail
0.0641	0	202	n/a	Fail
0.0648	0	193	n/a	Fail
0.0655	0	186	n/a	Fail
0.0662	0	183	n/a	Fail
0.0669	0	181	n/a	Fail
0.0676	0	176	n/a	Fail
0.0683	0	170	n/a	Fail
0.0690	0	164	n/a	Fail
0.0697	0	156	n/a	Fail
0.0704	0	150	n/a	Fail
0.0712	0	145	n/a	Fail
0.0719	0	138	n/a	Fail
0.0726	0	132	n/a	Fail
0.0733	0	127	n/a	Fail
0.0740	0	124	n/a	Fail
0.0747	0	114	n/a	Fail

The development has an increase in flow durations from 1/2 Predeveloped 2 year flow to the 2 year flow or more than a 10% increase from the 2 year to the 50 year flow.

The development has an increase in flow durations for more than 50% of the flows for the range of the duration analysis.

## Water Quality

Water Quality BMP Flow and Volume for POC #4

On-line facility volume: 0.0182 acre-feet

On-line facility target flow: 0.0293 cfs.

Adjusted for 15 min: 0.0293 cfs.

Off-line facility target flow: 0.0166 cfs.

Adjusted for 15 min: 0.0166 cfs.

# LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

## *Model Default Modifications*

Total of 0 changes have been made.

### *PERLND Changes*

No PERLND changes have been made.

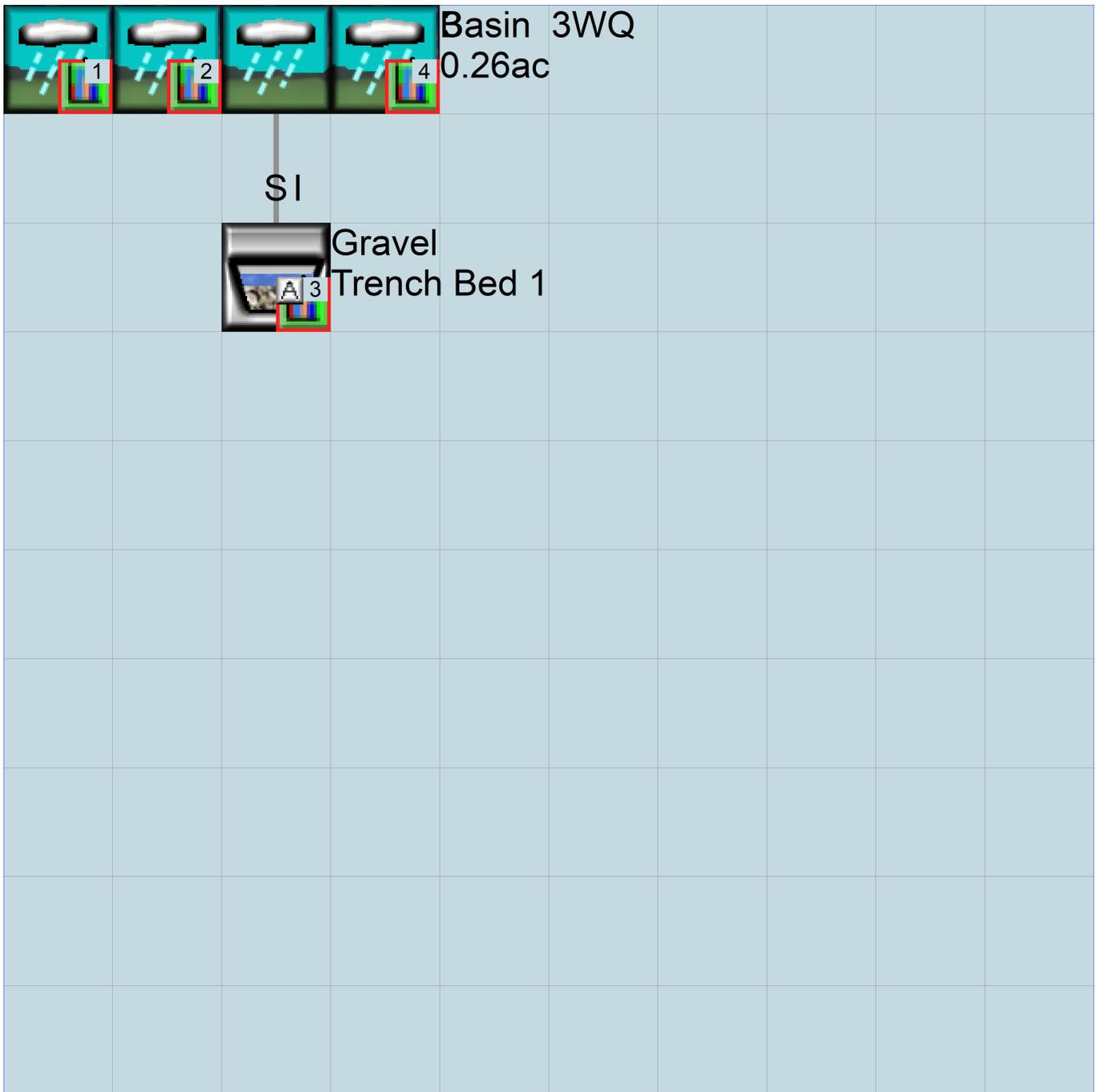
### *IMPLND Changes*

No IMPLND changes have been made.

Appendix  
Predeveloped Schematic



Mitigated Schematic



# Predeveloped UCI File

RUN

GLOBAL

WVHM4 model simulation  
START 1948 10 01 END 2009 09 30  
RUN INTERP OUTPUT LEVEL 3 0  
RESUME 0 RUN 1 UNIT SYSTEM 1  
END GLOBAL

FILES

<File>	<Un#>	<-----File Name----->	***
<-ID->			***
WDM	26	21043-WVHM.wdm	
MESSU	25	Pre21043-WVHM.MES	
	27	Pre21043-WVHM.L61	
	28	Pre21043-WVHM.L62	
	30	POC21043-WVHM1.dat	
	31	POC21043-WVHM2.dat	
	32	POC21043-WVHM3.dat	
	33	POC21043-WVHM4.dat	

END FILES

OPN SEQUENCE

INGRP INDELT 00:15  
PERLND 7  
IMPLND 11  
IMPLND 4  
PERLND 1  
COPY 501  
COPY 502  
COPY 503  
COPY 504  
DISPLY 1  
DISPLY 2  
DISPLY 3  
DISPLY 4

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INFO1

#	-	#	<-----Title----->	***	TRAN	PIVL	DIG1	FIL1	PYR	DIG2	FIL2	YRND
1			Basin 1		MAX				1	2	30	9
2			Basin 2		MAX				1	2	31	9
3			Basin 3		MAX				1	2	32	9
4			3WQ		MAX				1	2	33	9

END DISPLY-INFO1

END DISPLY

COPY

TIMESERIES

#	-	#	NPT	NMN	***
1			1	1	
501			1	1	
502			1	1	
503			1	1	
504			1	1	

END TIMESERIES

END COPY

GENER

OPCODE

# # OPCD \*\*\*

END OPCODE

PARM

# # K \*\*\*

END PARM

END GENER

PERLND

GEN-INFO

<PLS ><-----Name----->NBLKS Unit-systems Printer \*\*\*

```

# - # User t-series Engr Metr ***
          in out ***
7 A/B, Lawn, Flat 1 1 1 1 27 0
1 A/B, Forest, Flat 1 1 1 1 27 0
END GEN-INFO
*** Section PWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC ***
7 0 0 1 0 0 0 0 0 0 0 0 0 0
1 0 0 1 0 0 0 0 0 0 0 0 0 0
END ACTIVITY

```

```

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL PYR
# - # ATMP SNOW PWAT SED PST PWG PQAL MSTL PEST NITR PHOS TRAC *****
7 0 0 4 0 0 0 0 0 0 0 0 0 0 1 9
1 0 0 4 0 0 0 0 0 0 0 0 0 0 1 9
END PRINT-INFO

```

```

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG VCS VUZ VMN VIFW VIRC VLE INFC HWT ***
7 0 0 0 0 0 0 0 0 0 0 0
1 0 0 0 0 0 0 0 0 0 0 0
END PWAT-PARM1

```

```

PWAT-PARM2
<PLS > PWATER input info: Part 2 ***
# - # ***FOREST LZSN INFILT LSUR SLSUR KVARY AGWRC
7 0 5 0.8 400 0.05 0.3 0.996
1 0 5 2 400 0.05 0.3 0.996
END PWAT-PARM2

```

```

PWAT-PARM3
<PLS > PWATER input info: Part 3 ***
# - # ***PETMAX PETMIN INFEXP INFILD DEEPFR BASETP AGWETP
7 0 0 2 2 0 0 0
1 0 0 2 2 0 0 0
END PWAT-PARM3

```

```

PWAT-PARM4
<PLS > PWATER input info: Part 4 ***
# - # CEPSC UZSN NSUR INTFW IRC LZETP ***
7 0.1 0.5 0.25 0 0.7 0.25
1 0.2 0.5 0.35 0 0.7 0.7
END PWAT-PARM4

```

```

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
          ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS SURS UZS IFWS LZS AGWS GWVS
7 0 0 0 0 3 1 0
1 0 0 0 0 3 1 0
END PWAT-STATE1

```

END PERLND

IMPLND

```

GEN-INFO
<PLS ><-----Name-----> Unit-systems Printer ***
# - # User t-series Engr Metr ***
          in out ***
11 PARKING/FLAT 1 1 1 27 0
4 ROOF TOPS/FLAT 1 1 1 27 0
END GEN-INFO
*** Section IWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****

```

```

# - # ATMP SNOW IWAT SLD IWG IQAL ***
11      0      0      1      0      0      0
4        0      0      1      0      0      0
END ACTIVITY

```

```

PRINT-INFO
<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT SLD IWG IQAL *****
11      0      0      4      0      0      0      1      9
4        0      0      4      0      0      0      1      9
END PRINT-INFO

```

```

IWAT-PARM1
<PLS > IWATER variable monthly parameter value flags ***
# - # CSNO RTOP VRS VNN RTLI ***
11      0      0      0      0      0
4        0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS > IWATER input info: Part 2 ***
# - # *** LRSUR SLSUR NSUR RETSC
11      400      0.01      0.1      0.1
4        400      0.01      0.1      0.1
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS > IWATER input info: Part 3 ***
# - # ***PETMAX PETMIN
11      0      0
4        0      0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # *** RETS SURS
11      0      0
4        0      0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->          <--Area-->          <-Target->          MBLK          ***
<Name> #           <-factor-->          <Name> #           Tbl#          ***
Basin 1***
PERLND 7           0.2           COPY 501         12
PERLND 7           0.2           COPY 501         13
IMPLND 11         2.66          COPY 501         15
Basin 2***
PERLND 7           0.4           COPY 502         12
PERLND 7           0.4           COPY 502         13
IMPLND 4           0.99          COPY 502         15
IMPLND 11         0.87          COPY 502         15
Basin 3***
PERLND 1           0.29          COPY 503         12
PERLND 1           0.29          COPY 503         13
3WQ***
PERLND 7           0.26          COPY 504         12
PERLND 7           0.26          COPY 504         13

```

```

*****Routing*****
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #   <Name> # #<-factor-->strg <Name> # #   <Name> # #   ***
COPY 501 OUTPUT MEAN 1 1 48.4 DISPLY 1 INPUT TIMSER 1
COPY 502 OUTPUT MEAN 1 1 48.4 DISPLY 2 INPUT TIMSER 1
COPY 503 OUTPUT MEAN 1 1 48.4 DISPLY 3 INPUT TIMSER 1

```



<Volume>	<-Grp>	<-Member-><--Mult-->	<-factor-->	<Target>	<-Grp>	<-Member->***
<Name>		<Name> #		<Name>		<Name> # #***
MASS-LINK		12				
PERLND	PWATER	SURO	0.083333	COPY	INPUT	MEAN
END MASS-LINK		12				
MASS-LINK		13				
PERLND	PWATER	IFWO	0.083333	COPY	INPUT	MEAN
END MASS-LINK		13				
MASS-LINK		15				
IMPLND	IWATER	SURO	0.083333	COPY	INPUT	MEAN
END MASS-LINK		15				

END MASS-LINK

END RUN

# Mitigated UCI File

RUN

GLOBAL

WVHM4 model simulation  
START 1948 10 01 END 2009 09 30  
RUN INTERP OUTPUT LEVEL 3 0  
RESUME 0 RUN 1 UNIT SYSTEM 1  
END GLOBAL

FILES

<File>	<Un#>	<-----File Name----->	***
<-ID->			***
WDM	26	21043-WVHM.wdm	
MESSU	25	Mit21043-WVHM.MES	
	27	Mit21043-WVHM.L61	
	28	Mit21043-WVHM.L62	
	30	POC21043-WVHM1.dat	
	31	POC21043-WVHM2.dat	
	33	POC21043-WVHM4.dat	
	32	POC21043-WVHM3.dat	

END FILES

OPN SEQUENCE

INGRP INDELT 00:15  
PERLND 7  
IMPLND 11  
IMPLND 4  
RCHRES 1  
COPY 501  
COPY 502  
COPY 504  
COPY 3  
COPY 503  
DISPLY 1  
DISPLY 2  
DISPLY 4  
DISPLY 3

END INGRP

END OPN SEQUENCE

DISPLY

DISPLY-INFO1

#	-	#	<-----Title----->	***	TRAN	PIVL	DIG1	FIL1	PYR	DIG2	FIL2	YRND
1			Basin 1		MAX				1	2	30	9
2			Basin 2		MAX				1	2	31	9
4			Basin 3WQ		MAX				1	2	33	9
3			Gravel Trench Bed 1		MAX				1	2	32	9

END DISPLY-INFO1

END DISPLY

COPY

TIMESERIES

#	-	#	NPT	NMN	***
1			1	1	
501			1	1	
502			1	1	
504			1	1	
3			1	1	
503			1	1	

END TIMESERIES

END COPY

GENER

OPCODE

#	#	OPCD	***
---	---	------	-----

END OPCODE

PARM

#	#	K	***
---	---	---	-----

END PARM

END GENER

PERLND

```

GEN-INFO
<PLS ><-----Name----->NBLKS      Unit-systems      Printer ***
# - #                               User  t-series  Engr Metr ***
                               in  out      ***
7      A/B, Lawn, Flat              1    1    1    1    27    0
END GEN-INFO
*** Section PWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL  MSTL  PEST  NITR  PHOS  TRAC  ***
7      0      0      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

```

```

PRINT-INFO
<PLS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW PWAT  SED  PST  PWG  PQAL  MSTL  PEST  NITR  PHOS  TRAC  *****
7      0      0      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

```

```

PWAT-PARM1
<PLS > PWATER variable monthly parameter value flags ***
# - # CSNO RTOP UZFG  VCS  VUZ  VNN  VIFW  VIRC  VLE  INFC  HWT ***
7      0      0      0      0      0      0      0      0      0      0      0
END PWAT-PARM1

```

```

PWAT-PARM2
<PLS > PWATER input info: Part 2          ***
# - # ***FOREST      LZSN      INFILT      LRSUR      SLSUR      KVARV      AGWRC
7      0      5      0.8      400      0.05      0.3      0.996
END PWAT-PARM2

```

```

PWAT-PARM3
<PLS > PWATER input info: Part 3          ***
# - # ***PETMAX      PETMIN      INFEXP      INFILD      DEEPFR      BASETP      AGWETP
7      0      0      2      2      0      0      0
END PWAT-PARM3

```

```

PWAT-PARM4
<PLS > PWATER input info: Part 4          ***
# - #      CEPSC      UZSN      NSUR      INTFW      IRC      LZETP ***
7      0.1      0.5      0.25      0      0.7      0.25
END PWAT-PARM4

```

```

PWAT-STATE1
<PLS > *** Initial conditions at start of simulation
ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
# - # *** CEPS      SURS      UZS      IFWS      LZS      AGWS      GWVS
7      0      0      0      0      3      1      0
END PWAT-STATE1

```

END PERLND

IMPLND

```

GEN-INFO
<PLS ><-----Name----->      Unit-systems      Printer ***
# - #                               User  t-series  Engr Metr ***
                               in  out      ***
11     PARKING/FLAT              1    1    1    27    0
4      ROOF TOPS/FLAT           1    1    1    27    0
END GEN-INFO
*** Section IWATER***

```

```

ACTIVITY
<PLS > ***** Active Sections *****
# - # ATMP SNOW IWAT  SLD  IWG IQAL  ***
11     0      0      1      0      0      0
4      0      0      1      0      0      0
END ACTIVITY

```

PRINT-INFO

```

<ILS > ***** Print-flags ***** PIVL  PYR
# - # ATMP SNOW IWAT  SLD  IWG IQAL  *****
11      0      0      4      0      0      0      1      9
4        0      0      4      0      0      0      1      9
END PRINT-INFO

```

```

IWAT-PARM1
<PLS >  IWATER variable monthly parameter value flags  ***
# - # CSNO RTOP  VRS  VNN RTLI  ***
11      0      0      0      0      0
4        0      0      0      0      0
END IWAT-PARM1

```

```

IWAT-PARM2
<PLS >      IWATER input info: Part 2      ***
# - # ***  LSUR      SLSUR      NSUR      RETSC
11      400      0.01      0.1      0.1
4        400      0.01      0.1      0.1
END IWAT-PARM2

```

```

IWAT-PARM3
<PLS >      IWATER input info: Part 3      ***
# - # ***PETMAX      PETMIN
11      0      0
4        0      0
END IWAT-PARM3

```

```

IWAT-STATE1
<PLS > *** Initial conditions at start of simulation
# - # ***  RETS      SURS
11      0      0
4        0      0
END IWAT-STATE1

```

END IMPLND

```

SCHEMATIC
<-Source->      <--Area-->      <-Target->      MBLK      ***
<Name> #      <-factor-->      <Name> #      Tbl#      ***
Basin 3***
PERLND 7      0.11      RCHRES 1      2
PERLND 7      0.11      RCHRES 1      3
IMPLND 4      0.03      RCHRES 1      5
IMPLND 11     0.15      RCHRES 1      5
Basin 1***
PERLND 7      0.2      COPY 501      12
PERLND 7      0.2      COPY 501      13
IMPLND 11     2.67     COPY 501      15
Basin 2***
PERLND 7      0.11     COPY 502      12
PERLND 7      0.11     COPY 502      13
IMPLND 4      1.22     COPY 502      15
IMPLND 11     0.63     COPY 502      15
Basin 3WQ***
PERLND 7      0.11     COPY 504      12
PERLND 7      0.11     COPY 504      13
IMPLND 11     0.15     COPY 504      15

*****Routing*****
PERLND 7      0.11     COPY 3      12
IMPLND 4      0.03     COPY 3      15
IMPLND 11     0.15     COPY 3      15
PERLND 7      0.11     COPY 3      13
RCHRES 1      1      COPY 503      17
END SCHEMATIC

```

```

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> #      <Name> # #<-factor-->strg <Name> # #      <Name> # #      ***
COPY 501 OUTPUT MEAN 1 1 48.4      DISPLY 1      INPUT TIMSER 1

```

```

COPY 502 OUTPUT MEAN 1 1 48.4 DISPLY 2 INPUT TIMSER 1
COPY 504 OUTPUT MEAN 1 1 48.4 DISPLY 4 INPUT TIMSER 1
COPY 503 OUTPUT MEAN 1 1 48.4 DISPLY 3 INPUT TIMSER 1

```

```

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # #<-factor->strg <Name> # # <Name> # # ***
END NETWORK

```

RCHRES

```

GEN-INFO
RCHRES      Name      Nexits  Unit Systems  Printer      ***
# - #<-----><----> User T-series  Engl Metr LKFG      ***
              in out
1      Gravel Trench Be-012  2      1      1      1      28      0      1
END GEN-INFO
*** Section RCHRES***

```

ACTIVITY

```

<PLS > ***** Active Sections *****
# - # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
1      1      0      0      0      0      0      0      0      0      0
END ACTIVITY

```

PRINT-INFO

```

<PLS > ***** Print-flags ***** PIVL  PYR
# - # HYDR ADCA CONS HEAT SED  GQL  OXRX NUTR PLNK PHCB PIVL  PYR  *****
1      4      0      0      0      0      0      0      0      0      0      1      9
END PRINT-INFO

```

HYDR-PARM1

```

RCHRES  Flags for each HYDR Section      ***
# - # VC A1 A2 A3  ODFVFG for each *** ODGTFG for each  FUNCT for each
      FG FG FG FG  possible exit *** possible exit  possible exit
      * * * * * * * * * * * * * * * * * * * * * * *
1      0 1 0 0      4 5 0 0 0      0 0 0 0 0      2 2 2 2 2
END HYDR-PARM1

```

HYDR-PARM2

```

# - # FTABNO      LEN      DELTH      STCOR      KS      DB50      ***
<---><-----><-----><-----><-----><----->
1      1      0.01      0.0      0.0      0.5      0.0
END HYDR-PARM2

```

HYDR-INIT

```

RCHRES  Initial conditions for each HYDR section      ***
# - # *** VOL      Initial value of COLIND      Initial value of OUTDGT
      *** ac-ft      for each possible exit      for each possible exit
<-----><-----> <---><---><---><---> *** <---><---><---><--->
1      0      4.0 5.0 0.0 0.0 0.0      0.0 0.0 0.0 0.0 0.0
END HYDR-INIT

```

END RCHRES

SPEC-ACTIONS

END SPEC-ACTIONS

FTABLES

```

FTABLE      1
92      5
Depth      Area      Volume  Outflow1  Outflow2  Velocity  Travel Time***
(ft)      (acres) (acre-ft) (cfs)      (cfs)      (ft/sec)  (Minutes)***
0.000000  0.005165  0.000000  0.000000  0.000000
0.033333  0.005165  0.000060  0.000000  0.078188
0.066667  0.005165  0.000121  0.000000  0.078188
0.100000  0.005165  0.000181  0.000000  0.078188
0.133333  0.005165  0.000241  0.000000  0.078188
0.166667  0.005165  0.000301  0.000000  0.078188
0.200000  0.005165  0.000362  0.000000  0.078188
0.233333  0.005165  0.000422  0.000000  0.078188
0.266667  0.005165  0.000482  0.000000  0.078188
0.300000  0.005165  0.000542  0.000000  0.078188

```

0.333333	0.005165	0.000603	0.000000	0.078188
0.366667	0.005165	0.000663	0.000000	0.078188
0.400000	0.005165	0.000723	0.000000	0.078188
0.433333	0.005165	0.000783	0.000000	0.078188
0.466667	0.005165	0.000844	0.000000	0.078188
0.500000	0.005165	0.000904	0.000000	0.078188
0.533333	0.005165	0.000964	0.000000	0.078188
0.566667	0.005165	0.001024	0.000000	0.078188
0.600000	0.005165	0.001085	0.000000	0.078188
0.633333	0.005165	0.001145	0.000000	0.078188
0.666667	0.005165	0.001205	0.000000	0.078188
0.700000	0.005165	0.001265	0.000000	0.078188
0.733333	0.005165	0.001326	0.000000	0.078188
0.766667	0.005165	0.001386	0.000000	0.078188
0.800000	0.005165	0.001446	0.000000	0.078188
0.833333	0.005165	0.001507	0.000000	0.078188
0.866667	0.005165	0.001567	0.000000	0.078188
0.900000	0.005165	0.001627	0.000000	0.078188
0.933333	0.005165	0.001687	0.000000	0.078188
0.966667	0.005165	0.001748	0.000000	0.078188
1.000000	0.005165	0.001808	0.000000	0.078188
1.033333	0.005165	0.001868	0.000000	0.078188
1.066667	0.005165	0.001928	0.000000	0.078188
1.100000	0.005165	0.001989	0.000000	0.078188
1.133333	0.005165	0.002049	0.000000	0.078188
1.166667	0.005165	0.002109	0.000000	0.078188
1.200000	0.005165	0.002169	0.000000	0.078188
1.233333	0.005165	0.002230	0.000000	0.078188
1.266667	0.005165	0.002290	0.000000	0.078188
1.300000	0.005165	0.002350	0.000000	0.078188
1.333333	0.005165	0.002410	0.000000	0.078188
1.366667	0.005165	0.002471	0.000000	0.078188
1.400000	0.005165	0.002531	0.000000	0.078188
1.433333	0.005165	0.002591	0.000000	0.078188
1.466667	0.005165	0.002652	0.000000	0.078188
1.500000	0.005165	0.002712	0.000000	0.078188
1.533333	0.005165	0.002772	0.000000	0.078188
1.566667	0.005165	0.002832	0.000000	0.078188
1.600000	0.005165	0.002893	0.000000	0.078188
1.633333	0.005165	0.002953	0.000000	0.078188
1.666667	0.005165	0.003013	0.000000	0.078188
1.700000	0.005165	0.003073	0.000000	0.078188
1.733333	0.005165	0.003134	0.000000	0.078188
1.766667	0.005165	0.003194	0.000000	0.078188
1.800000	0.005165	0.003254	0.000000	0.078188
1.833333	0.005165	0.003314	0.000000	0.078188
1.866667	0.005165	0.003375	0.000000	0.078188
1.900000	0.005165	0.003435	0.000000	0.078188
1.933333	0.005165	0.003495	0.000000	0.078188
1.966667	0.005165	0.003555	0.000000	0.078188
2.000000	0.005165	0.003728	0.000000	0.078188
2.033333	0.005165	0.003900	0.000000	0.078188
2.066667	0.005165	0.004072	0.000000	0.078188
2.100000	0.005165	0.004244	0.000000	0.078188
2.133333	0.005165	0.004416	0.000000	0.078188
2.166667	0.005165	0.004588	0.000000	0.078188
2.200000	0.005165	0.004761	0.000000	0.078188
2.233333	0.005165	0.004933	0.000000	0.078188
2.266667	0.005165	0.005105	0.000000	0.078188
2.300000	0.005165	0.005277	0.000000	0.078188
2.333333	0.005165	0.005449	0.000000	0.078188
2.366667	0.005165	0.005622	0.000000	0.078188
2.400000	0.005165	0.005794	0.000000	0.078188
2.433333	0.005165	0.005966	0.000000	0.078188
2.466667	0.005165	0.006138	0.000000	0.078188
2.500000	0.005165	0.006310	0.000000	0.078188
2.533333	0.005165	0.006482	0.000000	0.078188
2.566667	0.005165	0.006655	0.000000	0.078188
2.600000	0.005165	0.006827	0.000000	0.078188
2.633333	0.005165	0.006999	0.000000	0.078188

```

2.666667 0.005165 0.007171 0.000000 0.078188
2.700000 0.005165 0.007343 0.000000 0.078188
2.733333 0.005165 0.007515 0.000000 0.078188
2.766667 0.005165 0.007688 0.000000 0.078188
2.800000 0.005165 0.007860 0.000000 0.078188
2.833333 0.005165 0.008032 0.000000 0.078188
2.866667 0.005165 0.008204 0.000000 0.078188
2.900000 0.005165 0.008376 0.000000 0.078188
2.933333 0.005165 0.008549 0.000000 0.078188
2.966667 0.005165 0.008721 0.000000 0.078188
3.000000 0.005165 0.008893 0.000000 0.078188
3.033333 0.005165 0.009065 0.042996 0.078188

```

```

END FTABLE 1
END FTABLES

```

EXT SOURCES

```

<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member-> ***
<Name> # <Name> # tem strg<-factor->strg <Name> # # <Name> # # ***
WDM 2 PREC ENGL 1.2 PERLND 1 999 EXTNL PREC
WDM 2 PREC ENGL 1.2 IMPLND 1 999 EXTNL PREC
WDM 1 EVAP ENGL 0.76 PERLND 1 999 EXTNL PETINP
WDM 1 EVAP ENGL 0.76 IMPLND 1 999 EXTNL PETINP

```

END EXT SOURCES

EXT TARGETS

```

<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name> # <Name> # #<-factor->strg <Name> # <Name> tem strg strg***
COPY 1 OUTPUT MEAN 1 1 48.4 WDM 701 FLOW ENGL REPL
COPY 501 OUTPUT MEAN 1 1 48.4 WDM 801 FLOW ENGL REPL
COPY 2 OUTPUT MEAN 1 1 48.4 WDM 702 FLOW ENGL REPL
COPY 502 OUTPUT MEAN 1 1 48.4 WDM 802 FLOW ENGL REPL
RCHRES 1 HYDR RO 1 1 1 WDM 1000 FLOW ENGL REPL
RCHRES 1 HYDR O 1 1 1 WDM 1001 FLOW ENGL REPL
RCHRES 1 HYDR O 2 1 1 WDM 1002 FLOW ENGL REPL
RCHRES 1 HYDR STAGE 1 1 1 WDM 1003 STAG ENGL REPL
COPY 3 OUTPUT MEAN 1 1 48.4 WDM 703 FLOW ENGL REPL
COPY 503 OUTPUT MEAN 1 1 48.4 WDM 803 FLOW ENGL REPL
COPY 4 OUTPUT MEAN 1 1 48.4 WDM 704 FLOW ENGL REPL
COPY 504 OUTPUT MEAN 1 1 48.4 WDM 804 FLOW ENGL REPL

```

END EXT TARGETS

MASS-LINK

```

<Volume> <-Grp> <-Member-><--Mult--> <Target> <-Grp> <-Member->***
<Name> <Name> # #<-factor-> <Name> <Name> # #***
MASS-LINK 2
PERLND PWATER SURO 0.083333 RCHRES INFLOW IVOL
END MASS-LINK 2

MASS-LINK 3
PERLND PWATER IFWO 0.083333 RCHRES INFLOW IVOL
END MASS-LINK 3

MASS-LINK 5
IMPLND IWATER SURO 0.083333 RCHRES INFLOW IVOL
END MASS-LINK 5

MASS-LINK 12
PERLND PWATER SURO 0.083333 COPY INPUT MEAN
END MASS-LINK 12

MASS-LINK 13
PERLND PWATER IFWO 0.083333 COPY INPUT MEAN
END MASS-LINK 13

MASS-LINK 15
IMPLND IWATER SURO 0.083333 COPY INPUT MEAN
END MASS-LINK 15

MASS-LINK 17

```

RCHRES        OFLOW  OVOL    1                    COPY                    INPUT  MEAN  
  END MASS-LINK    17

END MASS-LINK

END RUN

*Predeveloped HSPF Message File*

*Mitigated HSPF Message File*

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**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

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**APPENDIX B – GEOTECHNICAL REPORT**



# Geotechnical Engineering Report

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**Albertsons – Safeway Store #1522 Expansion  
Arlington, Snohomish County, Washington**

April 19, 2022

Terracon Project No. 81225052

**Prepared for:**

Albertsons Companies, Inc.  
Boise, ID

**Prepared by:**

Terracon Consultants, Inc.  
Mountlake Terrace, Washington



April 19, 2022



Albertsons Companies, Inc.  
250 E Parkcenter Blvd  
Boise, ID 83706

Attn: Mark Palmer – Sr. Development Manager  
P: (208) 395-3864  
E: mark.palmer@albertsons.com

Re: Geotechnical Engineering Report  
Albertsons – Safeway Store #1522 Expansion  
20500 Olympic Place  
Arlington, Snohomish County, Washington  
Terracon Project No. 81225052

Dear Mr. Palmer:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P81225052 dated March 17, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, the design and construction of building foundations, floor slabs, stormwater management, and pavements for the proposed project.

Based on our analyses, we estimate up to about 4½ inches of total post-liquefaction settlement following a major, strong-motion earthquake. If the structural engineer determines that the estimated settlement is tolerable, then shallow foundations bearing on native soils is acceptable; otherwise, we recommend ground improvement via aggregate piers. Should ground improvement prove necessary, we recommend consultation with a ground improvement specialty contractor to develop a design that meets the project needs.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,  
**Terracon Consultants, Inc.**

for

Zachary L. Koehn, P.E.  
Project Engineer

David A. Baska, Ph.D., P.E.  
Senior Engineering Consultant

## REPORT TOPICS

INTRODUCTION.....	1
SITE CONDITIONS.....	1
PROJECT DESCRIPTION.....	2
GEOTECHNICAL CHARACTERIZATION.....	3
GEOTECHNICAL OVERVIEW.....	5
SEISMIC CONSIDERATIONS.....	7
LIQUEFACTION.....	7
GROUND IMPROVEMENT.....	8
EARTHWORK.....	9
SHALLOW FOUNDATIONS.....	13
FLOOR SLABS.....	16
STORMWATER MANAGEMENT.....	18
PAVEMENTS.....	19
CORROSIVITY.....	22
FIELD RESISTIVITY.....	23
GENERAL COMMENTS.....	23
ATTACHMENTS.....	25

## ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES  
SITE LOCATION AND EXPLORATION PLANS  
EXPLORATION RESULTS  
HISTORICAL EXPLORATION RESULTS  
SUPPORTING INFORMATION

**Note:** Refer to each individual Attachment for a listing of contents.

## REPORT SUMMARY

Topic <sup>1</sup>	Overview Statement <sup>2</sup>
<p><b>Project Description</b></p>	<p>The proposed improvements shown on the preliminary site plan include a building expansion of about 10,000 square feet which is located on the east side of the existing Safeway building. As included in the expansion are revisions to the nearby parking lot and drive aisles.</p> <p>Expected loads:</p> <ul style="list-style-type: none"> <li>■ Interior columns footings: about 100 to 150 kips</li> <li>■ Continuous perimeter footings: average 4 kips per linear foot (klf)</li> <li>■ Slab-on-grade: 150 pounds per square foot (assumed)</li> </ul> <p>Expected traffic for pavement areas:</p> <ul style="list-style-type: none"> <li>■ Parking lots: EDLA of 10 (73,000 ESALs)</li> <li>■ Driveway: EDLA of 30 (219,000 ESALs)</li> </ul>
<p><b>Geotechnical Characterization</b></p>	<p>About 2 inches asphalt over 6 inches base course within paved area.                  About 5 inches topsoil within landscape area.                  Existing fill was observed at B-01 only to about 1½ feet below ground surface (bgs). Loose to medium dense, dark brown, fine-grained sand with silt and gravel up to about 7 feet bgs was observed at all exploration locations. Organics and cobbles were observed in this unit.                  Loose to dense, brown, medium to coarse grained sand and gravel with variable silt content up to about 18½ feet bgs. Cobbles were observed in this unit.                  Medium dense to very dense, brown, medium-grained poorly graded sand with silt were observed to at least 51½ feet below.                  Cobbles may be abundant in the near-surface soils.                  Groundwater was encountered between 10 to 13½ feet bgs.</p>
<p><b>Earthwork</b></p>	<p>Remove topsoil and existing fill where encountered.                  On-site granular soils can be reused for structural fill with some handling.                  At the foundation level, the soils in their native state would be marginal for directly supporting shallow foundations, namely continuous and spread footings. Therefore, support of building bearing on at least two feet of compacted structural fill over native soil is recommended.                  Restore grades with compacted structural fill if overexcavation performed for foundation, floor slab, and pavements.                  Near-surface, fine-grained soils can be considered moisture sensitive and may become unstable when exposed to excessive moisture.</p>
<p><b>Shallow Foundations</b></p>	<p>Shallow foundations will be sufficient for the anticipated loading.                  Allowable bearing pressure on structural fill over native soils and improved ground scenarios are presented in <b>Shallow Foundation</b> section.                  Expected settlements: &lt; 1-inch total, &lt; 2/3-inch differential                  Detect and remove zones of fill as noted in <b>Earthwork</b></p>
<p><b>Ground Improvement</b></p>	<p>A total seismic-induced settlement of 2 to 4½ inches, and differential settlement of about 3 inches are estimated. Ground improvement can be used to mitigate the effects of the liquefaction hazard. Consultation with a ground improvement specialty contractor should occur prior to final design. If the estimated post-liquefaction induced settlement is deemed tolerable by the structural engineer, then ground improvement will not be required.</p>
<p><b>Stormwater Management</b></p>	<p>We understand that an infiltration trench is being considered for the management of stormwater runoff at the east side of the future expansion. Per email communication with the Civil Engineer, the base of the infiltration trench is about 6 feet below the existing ground surface.</p>

# Geotechnical Engineering Report



Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

<b>Pavements</b>	With subgrade prepared as noted in <b>Earthwork</b> Concrete: <ul style="list-style-type: none"><li>■ 5½ inches Portland Cement Concrete (PCC) over 4 inches crushed aggregate base</li></ul> Asphalt: <ul style="list-style-type: none"><li>■ 3 inches Asphaltic Concrete (AC) over 8 inches granular base in parking lots</li><li>■ 4 inches AC over 8 inches granular base in driveways</li></ul>
<b>General Comments</b>	This section contains important information about the limitations of this geotechnical engineering report. <ol style="list-style-type: none"><li>1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.</li><li>2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.</li></ol>

**Geotechnical Engineering Report**  
**Albertsons – Safeway Store #1522 Expansion**  
**20500 Olympic Place**  
**Arlington, Snohomish County, Washington**  
**Terracon Project No. 81225052**  
**April 19, 2022**

**INTRODUCTION**

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the existing Safeway store expansion to be located at 20500 Olympic Place in Arlington, Snohomish County, Washington. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Seismic considerations and liquefaction
- Ground improvement
- Foundation design and construction
- Floor slab design and construction
- Stormwater management
- Pavement design and construction
- Corrosivity and resistivity

The geotechnical engineering Scope of Services for this project included the advancement of five (5) soil borings to depths ranging from approximately 15 to 51½ feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs and as separate graphs in the **Exploration Results** section.

**SITE CONDITIONS**

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
<b>Parcel Information</b>	The project is located at 20500 Olympic Place in Arlington, Snohomish County, Washington. The site coordinates are: Latitude: 48.1825 Longitude: -122.1280 See <b>Site Location</b>

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052



Item	Description
<b>Existing Improvements</b>	An existing Safeway grocery store (#1522) with about 42,728 square feet footprint at the northern portion of the site, a Safeway fuel station at the southeastern portion of the site, parking and drive aisles, a few scattered landscape islands within the parking area to the south of the existing building, and relatively large landscape area along the eastern side of the site.
<b>Current Ground Cover</b>	Primarily asphalt and concrete pavement with landscape areas.
<b>Existing Topography</b> (from Civil Site Plan)	Within the proposed development area, the site is relatively level with elevations ranging between 128 and 129 feet.
<b>Geology</b>	The subsurface conditions consist of the Marysville sand member, which locally at the site is a thicker, recessional glacial outwash unit comprised primarily of loose to dense sand and gravel deposits with variable silt content. Groundwater is observed between 10 to 13½ feet below ground surface.

## PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
<b>Information Provided</b>	<ul style="list-style-type: none"><li>■ Email request for proposal prepared by Albertsons dated March 09, 2022.</li><li>■ Preliminary site plan dated November 11, 2021</li><li>■ Geotechnical Engineer Services proposal prepared by ZipperGeo dated January 6, 2021.</li><li>■ Civil Plan prepared by TerraForma dated March 01, 2022</li><li>■ Email communication with the Civil Engineer dated March 17, 2022</li></ul>
<b>Project Description</b>	The proposed improvement shown on the preliminary site plan include a building expansion located on the east side of the existing Safeway building with associated nearby parking lot and drive aisles. An infiltration trench is being considered for the management of stormwater runoff at the east side of the future expansion.
<b>Proposed Structure</b>	The grocery store expansion will be located at the east side of the existing building.
<b>Building Construction</b>	The grocery store expansion is expected to be a single-story with a footprint of about 10,000 square feet. The store consists of concrete masonry block exterior walls, a concrete slab-on-grade interior floor, with steel interior columns supporting a steel truss roof.
<b>Finished Floor Elevation</b>	The finish floor elevation for the proposed grocery store expansion is anticipated to be consistent with the existing Safeway.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

Item	Description
<b>Maximum Loads</b>	<ul style="list-style-type: none"> <li>■ Interior columns footings: about 100 to 150 kips</li> <li>■ Continuous perimeter footings: average 4 kips per linear foot (klf)</li> <li>■ Slabs: 150 pounds per square foot (assumed)</li> </ul> <p>These loads do not include snow loads, which may be required in some locations.</p>
<b>Grading/Slopes</b>	We assume grading will be minimal for site leveling and clearing/grubbing.
<b>Pavements</b>	<p>Associated paved driveway and parking to the building expansion will be constructed on about 6,300 square feet of parcel.</p> <p>We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered, and the pavement design period is assumed to be 20 years. Traffic loads are as follow (20-year ESALs in parentheses):</p> <ul style="list-style-type: none"> <li>■ Parking lots: EDLA of 10 (73,000 ESALs)</li> <li>■ Driveway: EDLA of 30 (219,000 ESALs)</li> </ul>
<b>Applicable Building Code and Minimum Design Load Standard</b>	<p>2018 International Building Code (2018 IBC)</p> <p>2016 ASCE Standard ASCE/SEI 7-16 (ASCE 7-16)</p>

## GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Exploration Results** section of this report. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Soil Layer <sup>1</sup>	Layer Name	USCS	General Description
Surface	Topsoil/Pavement	--	<p>About 2 inches asphalt over 6 inches base course within the paved area.</p> <p>About 5 inches topsoil within the landscape area.</p> <p>Existing fill consisting of silty sand with gravel was observed at B-01 only to about 1½ feet below ground surface (bgs).</p>
1 <sup>2</sup>	<b>Sand with silt and gravel</b>	SP-SM	<p>Poorly graded sand with silt with variable gravel content was encountered at all soil borings. This unit is loose to medium dense, fine grained, dark brown, with organics. Organic content within this layer was tested to be ranged between 2 and 4%. Cobbles was observed in this unit. The depth to the bottom of this unit ranged from 4 ½ to 7 feet bgs.</p>

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

2 <sup>3</sup>	<b>Sand and Gravel</b>	GW-GM, GW, GP, SP-SM	<p>Brown Sand and Gravel with variable silt content was encountered at all soil borings. This unit generally underlays Soil Layer 1 and the depth to the bottom of this unit ranged from 13 to 18 ½ feet bgs. Composition of the soils varied:</p> <ul style="list-style-type: none"> <li>■ Well Graded gravel with sand and variable silt content, sub-rounded to subangular, medium dense to dense</li> <li>■ Poorly graded gravel with sand, trace silt, sub-rounded to subangular, medium dense to dense</li> <li>■ Poorly graded sand with silt and gravel, loose to dense, fine to coarse grained</li> </ul>
3 <sup>4</sup>	<b>Sand with silt</b>	SP-SM	<p>This unit generally underlays Soil Layer 2 and consists of medium to very dense poorly graded sand with silt, trace gravel, fine to coarse grained, brown. The depth to the bottom of this unit was observed as deep as 51½ feet bgs.</p>

1. This summary is based on Terracon field exploration and is for convenience only. It should be used in conjunction with the entire report for design purposes.
2. This unit was encountered at all soil borings.
3. B-05 was terminated in this unit.
4. This unit was encountered at all soil borings except B-05, these borings were terminated in this unit.

## Groundwater Conditions

The boreholes were observed while drilling and at completion for the presence and level of groundwater. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are summarized below.

Boring Number	Approximate Depth to Groundwater (feet) <sup>1</sup>
B-01 <sup>2,3</sup>	13½
B-02 <sup>5</sup>	13
B-03 <sup>6</sup>	10.7
B-04 <sup>6</sup>	10
B-05 <sup>6</sup>	11.8

1. Below ground surface
2. Inferred from change in sample moisture or from evidence of free water on drilling equipment while drilling.
3. Water level measurement not attempted due to drilling method of boring advancement.
4. Measured using a water level indicator.
5. Measured while drilling.
6. Measured at the completion of the drilling.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

## **GEOTECHNICAL OVERVIEW**

The site is underlain primarily by cohesionless, granular soils that appear to have been deposited erratically as glacial outwash. This mode of deposition results in the variable soil density observed. The combination of the variable density and relatively shallow groundwater renders the site susceptible to liquefaction during a design-level seismic event. The free-field estimate of total liquefaction-induced settlement is about 2 to 4½ inches. We estimate the differential settlement will be on the order of 3 inches. Should the structural engineer determine that this magnitude of settlement is tolerable, then the structures can be founded on shallow foundations bearing on native soils and/or structural fill. Otherwise, we recommend ground improvement via aggregate piers beneath the foundation elements. Further discussion of liquefaction is provided in the **Liquefaction** and **Ground Improvement** section.

About 1½ feet of existing, undocumented fill was encountered at B-01 only. Per current site plan, the building footprint appears to be within the area where existing fill was observed. Support of footings, floor slabs, or pavement on or above existing fill soils, is not recommended. There is inherent risk for the owner that compressible fill or unsuitable material, within or buried by the fill, will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill. Due to the relatively thin thickness of the existing fill, we recommended that all existing fill, if encountered, be removed beneath the proposed building and pavement areas.

In addition, per current site plan, Soil Layer 1 will be the bearing soils at the foundation level. However, organics and cobbles were observed in this unit. Organic content within this layer was estimated to range from about 2 and 4%. Terracon should observe the subgrades following grading to aid the contractor in identifying the presence of existing fill and deleterious materials. If existing fill and deleterious materials are observed, or areas are observed to be deflecting excessively, perform overexcavation per Terracon's field recommendations at the time of construction. Compacted structural fill or suitable existing on-site materials can be used to restore the grade.

Based on our interpretation of the exploration results, we suspect that the presence of gravels and cobbles within the Soil Layers 1 and 2 influenced the penetration testing results and that the soils are more consistent with a loose to medium dense state rather than dense to very dense, as the raw blow-counts would suggest. The soils in their native state would be marginal for directly

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

supporting shallow foundations, namely continuous and spread footings. Therefore, support of building bearing on at least two feet of compacted structural fill over native soil is recommended.

Additionally, cobble-sized particles present at the subgrade surface could present a localized hard spot that could lead to cracking of foundations or floor slabs. The presence of cobble-sized particles immediately beneath the slab or footing may lead to a non-uniform subgrade behavior. Recommendations presented in the **Earthwork** section are intended to reduce the risks associated with the presence of cobbles.

The near-surface fine-grained sand (Soil Layer 1) that are exposed after stripping of the topsoil, existing fill, and deleterious/unsuitable material are likely to be moisture sensitive (about 8% passing the #200 sieve) and could become unstable when exposed to excessive moisture and/or disturbance with typical earthwork and construction traffic. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. If possible, the grading should be performed during the warmer and drier times of the year. If grading is performed during the winter months, fill placement and compaction will be difficult and an increased risk for possible undercutting and replacement of unstable subgrade will persist. Additional site preparation recommendations, including subgrade improvement and fill placement are provided in **Earthwork** section.

The **Shallow Foundations** section addresses options for support of the building bearing on structural fill over loose to medium dense native soil (Soil Layer 1) and improved ground. The **Floor Slabs** section addresses slab-on-grade support on medium dense native soil and the above two scenarios as well.

Recommendations for flexible and rigid pavement systems are provided in the **Pavements** section.

Specific conclusions and recommendations regarding these geotechnical considerations, as well as other geotechnical aspects of design and construction of foundation systems and other earthwork related phases of the project are outlined in the following sections. The recommendations contained in this report are based upon the results of field and laboratory testing, engineering analyses, and our current understanding of the proposed project. ASTM and Washington State Department of Transportation (WSDOT) specification codes cited herein respectively refer to the current manual published by the American Society for Testing & Materials and the current edition of the *Standard Specifications for Road, Bridge, and Municipal Construction, (M41-12)*.

The **General Comments** section provides an understanding of the report limitations.

## SEISMIC CONSIDERATIONS

Description <sup>1</sup>	Value
<b>2018 International Building Code (IBC) Site Classification</b>	F <sup>3</sup>
<b>Site Latitude</b>	48.1825
<b>Site Longitude</b>	-122.1280
<b>S<sub>s</sub> – Short Period Spectral Acceleration<sup>2</sup></b>	1.038 g
<b>S<sub>1</sub> – 1-Second Period Spectral Acceleration<sup>2</sup></b>	0.371 g
<b>PGA - ASCE 7, Peak Ground Acceleration</b>	0.441 g

1. The IBC requires a site profile extending to a depth of 100 feet for seismic site classification. Borings were extended to a maximum depth of 51½ feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.
2. These values were obtained using online seismic design maps and tools provided by OSHPD (<https://seismicmaps.org/>).
3. If the fundamental period of vibration for the building is equal to or less than 0.5 seconds, Site Class D may be used to determine the values of F<sub>a</sub> and F<sub>v</sub> per ASCE 7-16 Section 20.3.1.

### Surface-Fault Rupture

The hazard of damage from onsite fault rupture appears to be low based on review of the USGS Earthquake Hazards Program Quaternary Faults and Folds Database available online (<https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf>) accessed on March 25, 2021. The closest mapped fault is the Darrington-Devils Mountain fault, which lies approximately 11 miles to the northeast.

### LIQUEFACTION

Liquefaction is the phenomenon where saturated soils develop high pore water pressures during seismic shaking and lose their strength characteristics. This phenomenon generally occurs in areas of high seismicity, where groundwater is shallow and loose granular soils or relatively non-plastic fine-grained soils are present.

The site geology and subsurface groundwater conditions is relatively consistent with some nearby, previously performed soil borings (approximately 700 feet to the southwest). Based on the results of our previous findings and soil boring B-01, the hazard of liquefaction of the site soils is moderate for this site during a design level earthquake and is most likely to trigger between 10 and 30 feet below the ground surface. Due to the absence of a sloping ground, the risk of lateral spreading is low while the risk of flow sliding is negligible.

Liquefaction potential was evaluated using LiqSVs (v.2.2.1.8) developed by Geogismiki Software. A mean-moment magnitude of 6.9 was assumed along with a peak site-modified ground acceleration (PGA) of 0.53g. Based on these assumed seismic parameters, we evaluated soil borings within our

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

site, and the nearby historical soil boring to estimate a free-field, seismic-induced total settlement of about 2 and 4½ inches. We estimate that this magnitude of settlement will result in approximately 3 inches of differential settlement for the site, and lateral spreading displacements are estimated to be less than ¼-foot.

Per ASCE 7-16, Table 12.13-3 for a 40-foot span and risk category II, a differential settlement threshold of about 4½ inches is allowable for “*other multi-story structures.*” The differential settlement estimated for the area of the addition appears to be below the threshold allowed by the code. Although the addition is not a multi-story structure, it is a relatively tall single-story building and we assume it is more analogous to a multi-story structure than a single-story. The Structural Engineer should review this assumption as well as the magnitudes of seismic-induced settlements presented herein and assess if mitigation of liquefaction hazard is necessary.

Vertical settlements deemed excessive by the structural engineer can be reduced using ground improvement. Ground improvement via aggregate piers are installed with the intent to densify the ground, increase soil stiffness, and embed in denser material that is not expected to liquefy. However, the ground located outside the aggregate pier improvements will be subject to liquefaction-induced settlement. Therefore, we recommend any utilities connected to the proposed structures be designed with flexible connections to reduce damage during a seismic event. Foundation recommendations are provided in the **Shallow Foundations** section. Discussion of aggregate piers is provided in the **Ground Improvement** section.

## GROUND IMPROVEMENT

Mitigation of excessive settlement from static loading and/or seismic-induced ground motions (e.g., seismic-induced settlement) can generally be accomplished through ground improvement. Though many options for ground improvement exist, in our option, aggregate piers are likely to be the most cost efficient.

We estimate that the thickness of liquefiable soil is about 20 feet and results in a post-liquefaction differential settlement on the order of 3 inches. Should the structural engineer determine the life safety objective cannot be achieved, or if it is desired to reduce the post-liquefaction settlement and potential building damage, then ground improvement via aggregate piers is recommended. The aggregate pier field should extend outside the building footprint by 5 feet or at least 10 percent of the building footprint, whichever is greater. Assuming damage to the floor slab is acceptable, ground improvement beneath the foundation elements rather than under the entire building footprint could be considered to help reduce costs.

It is recommended that a ground improvement contractor be consulted for design of the ground improvement system and the structural engineer consulted to provide the tolerable post-liquefaction displacements. Recommendations for spread footings with seismic ties are provided in the **Shallow Foundations** section.

## **EARTHWORK**

Earthwork is anticipated to include clearing and grubbing, overexcavation, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

### **Existing Fill and Deleterious/Unsuitable Materials**

As noted in **Geotechnical Characterization**, existing fill to about 1½ feet bgs was encountered at B-01 only, which is within the proposed building expansion area per the current site plan. Although existing fill was not encountered at any of the other locations, the previous construction activities for the existing development suggest other areas of existing fill may be present. Support of footings, floor slabs, and pavement on or above existing fill soils, is not recommended. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill. We recommend that all existing fill, if encountered, be removed beneath the proposed building and pavement area.

In addition, as mentioned in **Geotechnical Overview** section, Soil Layer 1 includes cobbles and about 2 to 4% of organics, which is considered for foundation subgrades. Exposed subgrades should be reviewed by the Geotechnical Engineer for appropriate control of organic content.

Terracon should observe the subgrades following grading to aid the contractor in identifying the presence of existing fill and deleterious materials. If existing fill and deleterious materials are observed, or areas are observed to be deflecting excessively, perform overexcavation per Terracon's field recommendations at the time of construction. Compacted structural fill or suitable existing on-site materials can be used to restore the grade.

### **Site Preparation**

Prior to placing fill, existing vegetation and root mat, overexcavation of unsuitable soil should be removed. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas. Cobble and boulder-sized particles exposed at subgrade surfaces should be removed prior to placing fill.

The subgrade should be proofrolled with an adequately loaded vehicle such as a fully-loaded tandem-axle dump truck. The proofrolling should be performed under the observation of the Geotechnical Engineer. Areas excessively deflecting under the proofroll should be delineated and subsequent recommendations provided by the Geotechnical Engineer. Excessively wet or dry material should either be removed or moisture conditioned and recompacted or replaced with compacted fill as recommended herein.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

### Fill Material Types

Fill required to achieve design grade should be classified as structural fill and common fill. Structural fill is material used below, or within 10 feet of structures and apertures, pavements, and constructed slopes. Common fill is material used to achieve grade outside of these areas. Earthen materials used for structural and common fill should meet the following material property requirements:

Fill Type	Recommended Materials	Acceptable Location for Placement
Structural Fill	9-03.9(1) <i>Ballast</i> <sup>1</sup> 9-03.9(3) <i>Crushed Surfacing Base Course</i> <sup>1</sup> 9-03.12(1)A <i>Gravel Backfill for Foundations Class A</i> <sup>1</sup> 9-03.14(1) <i>Gravel Borrow</i> <sup>1</sup> On-site Soils (i.e. Soil Layers 2 and 3) <sup>2,3</sup>	Beneath and adjacent to structural slabs, foundations, building appurtenances, and pavement subgrades
Common Fill	Section 9-03.14(3) <i>Common Borrow</i> <sup>1</sup> On-site Soils (i.e. Soil layers 1 with some handling, 2, and 3) <sup>2,3</sup>	Grade filling, utility trench backfill outside the building foundation and appurtenances
Free-Draining Granular Fill	Structural Fill <sup>4</sup> 9-03.9(2) <i>Permeable Ballast</i> <sup>1</sup> 9-03.12(2) <i>Gravel Backfill for Walls</i> <sup>1</sup> 9-03.12(4) <i>Gravel Backfill for Drains</i> <sup>1</sup>	Backfilling in wet weather, drainage layers for walls, sump drains, footing drains <sup>5</sup>

1. WSDOT Standard Specifications

2. Structural and common fill should consist of approved materials free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

3. May contain local areas of higher fines content that could make this material moisture sensitive. Particles with a nominal diameter greater than about 3 in. should be removed.

4. Material provided must be specified to be less than 5-percent passing the #200 sieve for the portion of material passing the #4 sieve.

5. Minimum particle size must be greater than drain pipe perforations.

Other earthen materials may be suitable for use in addition to the options presented in the table above. All materials should be approved by the Geotechnical Engineer prior to use.

### Fill Compaction Requirements

Structural and common fill should meet the following compaction requirements.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

Item	Structural and Free-Draining Fill	Common Fill
<b>Maximum Lift Thickness</b>	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as Structural fill
<b>Minimum Compaction Requirements</b> <sup>1</sup>	95% of max. below foundations and floor slabs and within 2 foot of finished pavement subgrade 92% of max. above foundations and more than 2 feet below finished pavement subgrade	92% of maximum dry density
<b>Water Content Range</b> <sup>1</sup>	Typically within 2% of optimum	As required to achieve min. compaction requirements

1. Maximum density and optimum water content as determined by the modified Proctor test (ASTM D 1557).

### Utility Trench Backfill

All trenches should be wide enough to allow for compaction around the haunches of the pipe. If water is encountered in the excavations, it should be removed prior to fill placement. The presence of cobbles may present challenges with respect to trench stability. Nested cobbles in trench side walls may become loosened during trench that could influence trench stability. The utility contractor should be prepared to contend with the likely presence of cobbles in utility trench alignments.

Placement and compaction of recommended materials for utility trench backfill should be in accordance with the recommendations presented herein for **Earthwork**. In our opinion, the initial lift thickness should not exceed one foot unless recommended by the manufacturer to protect utilities from damage by compacting equipment. Light, hand-operated compaction equipment in conjunction with thinner fill lift thicknesses may be utilized on backfill placed above utilities if damage resulting from heavier compaction equipment is of concern.

Flexible connections for utilities that pass through building foundations are recommended to reduce potential stress associated with differential settlement that may occur between the building foundation and the improvements located outside of the building footprint.

### Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. Gutters and downspouts should be routed into tightline pipes that discharge either directly into a municipal storm drain or to an alternative drainage facility. Splash-blocks should also be considered below hose bibs and water spigots.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

Site grades should be established such that surface water is directed away from foundation and pavement subgrades to prevent an increase in the water content of the soils. Adequate positive drainage diverting water from structures, open cuts, and slopes should be established to prevent erosion, ground loss, and instability. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Where paving or flatwork abuts the structure a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

### Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations. Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

### Construction Observation and Testing

The earthwork efforts should be monitored under the observation of the Geotechnical Engineer. Monitoring should include documentation of adequate removal of vegetation and topsoil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should recommend mitigation options.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

Where ground improvement has been implemented, footing subgrades should be observed by the Geotechnical Engineer for the presence of the aggregate piers to confirm installation has occurred per plan. Any improperly located aggregate piers should be reinstalled or the footing widened such that the footings bear firm on the aggregate piers or leveling pad. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should recommend mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

### Wet Weather Earthwork

The near-surface soils have variable fines content based on our visual observations and lab testing and are considered moisture sensitive. The soils will exhibit low to moderate erosion potential and may be transported by running water. Silt fences and other best-management practices will be necessary to control erosion and sediment transport during construction.

The suitability of soils used for structural fill depends primarily on their grain-size distribution and moisture content when they are placed. As the fines content (the soil fraction passing the U.S. No. 200 Sieve) increases, soils become more sensitive to small changes in moisture content. Soils containing more than about 5 percent fines (by weight) cannot be consistently compacted to a firm, unyielding condition when the moisture content is more than 2 percentage points above or below optimum. Optimum moisture content is the moisture content at which the maximum dry density for the material is achieved in the laboratory by the ASTM D1557 test procedure.

If inclement weather or in situ soil moisture content prevents the use of on-site material as structural fill, we recommend use of materials specified in **Fill Material Types** for free-draining granular fill.

Stockpiled soils should be protected with polyethylene sheeting anchored to withstand local wind conditions and preservation of the soil's moisture content.

## SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork**, the following design parameters are applicable for shallow foundations.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

### Design Parameters – Compressive Loads

Description	Spread Footing	Wall Footing
<b>Net Allowable Bearing Pressure</b> <sup>1,2</sup> <i>Footing Widths less Than 5 feet:</i>		
■ <b>2-ft of compacted structural fill over native soil</b>	3,000 psf	2,500 psf
■ <b>Ground improvement (preliminary)</b>	4,000 to 6,000 psf	4,000 to 6,000 psf
<i>Footing Widths 5 to 10 feet</i> <sup>3</sup> :		
■ <b>2-ft of compacted structural fill over native soil</b>	2,500 psf	1,500 psf
■ <b>Ground improvement (preliminary)</b>	4,000 to 6,000 psf	4,000 to 6,000 psf
<b>Minimum Dimensions</b>	24 inches	18 inches
<b>Minimum Embedment Below Finished Grade</b> <sup>4</sup>	18 inches	18 inches
<b>Approximate Static Total Settlement From Foundation Loads For Condition Specified</b> <sup>5</sup>	<1 inch	<1 inch
<b>Estimated Static Differential Settlement From Foundation Loads</b> <sup>5</sup>	About 2/3 of total settlement	
<b>Ultimate Passive Pressure</b> <sup>6,7</sup>		
■ <b>Compacted Structural Fill</b>	400 pcf (equivalent fluid unit weight)	
<b>Ultimate Coefficient of Sliding Friction</b> <sup>8</sup>	0.40	

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. These bearing pressures can be increased by 1/3 for transient loads unless those loads have been factored to account for transient conditions. Assumes that exterior grades are relatively level adjacent to the structure.
2. Values provided are for maximum loads noted in **Project Description**. Assumes the foundation elevation remains 6 feet above the groundwater table year-round. Values for ground improvement should be verified by a ground improvement specialty contractor prior to final design.
3. Bearing capacity analyses for footings width greater than 10 feet were not performed, contact Terracon for additional recommendations if footings widths greater than this size are considered.
4. For frost protection and to reduce the effects of seasonal moisture variations in the subgrade soils. For perimeter footing and footings beneath unheated areas. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
5. Differential settlements are as measured over a span of 50 feet. We should review the settlement estimates after the foundation plan has been prepared by the structural engineer.
6. Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face.
7. Passive resistance in the upper 2 feet of the soil profile should be neglected.
8. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.

### Construction Adjacent to Existing Building

Differential settlement between the additions and the existing building is expected to approach the magnitude of the total settlement of the addition. Expansion joints should be provided between

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

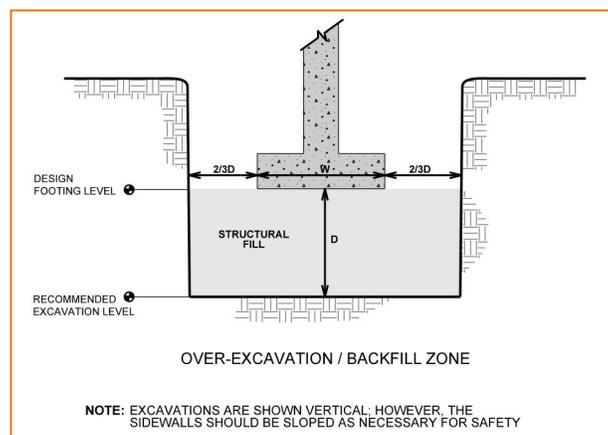
the existing building and the proposed addition to accommodate differential movements between the two structures. Underground piping between the two structures should be designed with flexible couplings and utility knockouts in foundation walls should be oversized, so minor deflections in alignment do not result in breakage or distress. Care should be taken during excavation adjacent to existing foundations, to avoid disturbing existing foundation bearing soils.

New footings should bear at or near the bearing elevation of immediately adjacent existing foundations. Depending upon their locations and current loads on the existing footings, footings for the new addition could cause settlement of adjacent walls. To reduce this concern and risk, clear distances at least equal to the new footing widths should be maintained between the addition's footings and footings supporting the existing building.

### Foundation Construction Considerations

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

Footing locations should be overexcavated at least 2 feet and backfill with compacted structural fill. If unsuitable/deleterious bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils and backfilled with structural fill as recommended in the **Earthwork** section. This is illustrated on the sketch below:



### Foundation Drains

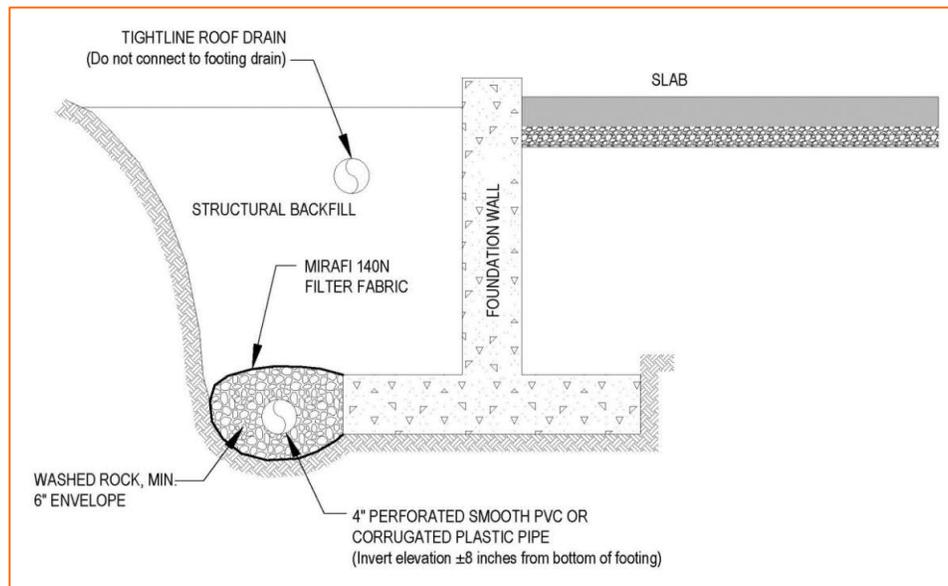
We recommend the building be **encircled with a perimeter foundation** drain to collect exterior seepage water. This drain should consist of a 4-inch diameter perforated pipe within an envelope of washed rock, extending at least 6 inches on all sides of the pipe. The washed rock should conform to WSDOT Section 9-03.12(4), Gravel Backfill for Drains or 9-03.12(5), Gravel Backfill

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

for Drywells. The washed rock envelope should be wrapped with filter fabric (such as Mirafi 140N, or equal) to reduce the migration of fines from the surrounding soil. Ideally, the drain invert would be installed no more than 8 inches above or below the base of the perimeter footings. The perimeter foundation drain should **not** be connected to roof downspout drains and should be constructed to discharge into the site storm water system or other appropriate outlet. These recommendations are summarized in the figure below.



## FLOOR SLABS

Depending upon the finished floor elevation, unsuitable soils (e.g., existing fill, loose native soils) may be encountered at the floor slab subgrade level. These soils should be replaced with structural fill, so the floor slab is supported on at least 2 feet of compacted suitable natural soils or structural fill.

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

### Floor Slab Design Parameters

Item	Description
<b>Floor Slab Support</b> <sup>1</sup>	Minimum 6 inches of free-draining of either of the following: <ul style="list-style-type: none"> <li>■ washed drain rock</li> <li>■ 9-03.12(1)A <i>Gravel Backfill for Foundations Class A</i> (compacted to at least 95% of ASTM D 1557)<sup>3,4</sup></li> </ul>

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

Item	Description
<b>Estimated Modulus of Subgrade Reaction</b> <sup>2</sup>	Medium Dense Native Soil: <ul style="list-style-type: none"> <li>■ 120 pounds per square inch per inch (psi/in) for point loads</li> <li>■ 80 psi/in for distributed loads</li> </ul> 2 feet Structural Fill: <ul style="list-style-type: none"> <li>■ 270 pounds per square inch per inch (psi/in) for point loads</li> <li>■ 150 psi/in for distributed loads</li> </ul> Ground improvement: <ul style="list-style-type: none"> <li>■ 380 pounds per square inch per inch (psi/in) for point loads</li> <li>■ 190 psi/in for distributed loads</li> </ul>
<ol style="list-style-type: none"> <li>1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.</li> <li>2. Values of modulus of subgrade reaction are estimated for subgrade conditions where non-yielding, medium dense native soils are present, at least 2 feet of compacted structural fill over native soil, or ground improvement has been performed.</li> <li>3. Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve).</li> <li>4. WSDOT Standard Specifications</li> </ol>	

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual. Joints or cracks should be sealed with a water-proof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

### Floor Slab Construction Considerations

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should approve the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

## **STORMWATER MANAGEMENT**

We understand that an infiltration trench is being considered for the management of stormwater runoff. Based on communication with the Civil Engineer, the stormwater management design will be completed the 2019 Washington Department of Ecology Stormwater Management Manual for Manual for Western Washington (SWMMWW). Per SWMMWW, for a site with soils not consolidated by glacial advance, an infiltration rate can be determined using a correlation to grain size distribution of representative soil samples. The analysis method performed is based on the methodology proposed by Massman (2003) as presented in the SWMMWW. The subsurface conditions consist of a geologic unit known locally as the Marysville Sand Member, which to our understanding, has not been consolidated by glacial advance. Therefore, an estimation of the design infiltration rate using a grain size analysis method is suitable.

Based on email communication with the Civil Engineer, the base of the infiltration trench is proposed to be about 6 feet bgs. Based on the subsurface conditions observed at soil boring B-5, the soil unit at this depth consisted primarily of medium to coarse-grained, poorly graded sand with silt and gravel. This unit is identified as an infiltrating unit.

The subsurface conditions at the proposed infiltration trench location were relatively consistent with other soil borings. As a result, to assess the feasibility of potential stormwater management via infiltration, an infiltration rate was estimated via sieve analysis results of soil samples recovered between 6 and 7½ feet bgs within the proposed infiltration trench area. Based on the analysis presented in the SWMMWW, a design infiltration rate of 15 inches per hour is estimated. This value is adjusted per the SWMMWW which applies correction factors for methodology, siltation/biofouling, and site variability of 0.4, 0.9, and 1.0, respectively.

To demonstrate that the hydraulic properties of the deeper and shallower portion of the sand and gravel unit are comparable, two additional sieve analysis were performed on sample collected from 7½ to 9, and 9 to 10½ feet bgs. The design infiltration rates are estimated to be much higher, 57 and 37 inches per hour, respectively. Though these values are not recommended as design values, the results suggest that the deeper portion is not as hydraulically restrictive as shallower portion of the unit which is where the base of the infiltration trench is proposed. Therefore, the infiltration rate estimated obtained for the shallower portion is appropriate for all depths above the water table.

Based on the results from the analysis methodology presented in the SWMMWW, and observations of subsurface conditions via soil borings, we recommend the following:

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

- Infiltration facility depth no shallower than 6 feet bgs if the proposed depth is shallower, the trench can be overexcavated to 6 feet bgs and backfill with using free-draining material such as washed drain rock.
- Design infiltration rate of 15 inches per hour.
- The Geotechnical Engineer should observe the soils at the base of the infiltration facility and compare with the soils observed at the exploration location (i.e. B-05).
- Where soil units with lower permeability are present (e.g., interbedded silt layers), perform overexcavation as needed to hydraulically connect the base of the infiltration system with the clean sand infiltrating unit.
- In areas where overexcavation is necessary, backfilling should be performed using free-draining material such as washed drain rock.

In general, and based on the subsurface information collected to date, management of surface water through stormwater infiltration appears suitable in the general vicinity of where infiltration testing was performed. We recommend retaining Terracon during construction to aid the contractor in identifying the infiltrating unit.

## PAVEMENTS

### General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in **Project Description** and in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

The standard equivalent single-axle load (ESAL) was estimated using 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). The assumed traffic loading for flexible and rigid pavement areas on the traffic loads as follows:

- Parking lots: EDLA of 10 (73,000 ESALs)
- Driveway: EDLA of 30 (219,000 ESALs)

A 20-year design life is assumed. If traffic volumes will exceed the assumed values, Terracon should be notified in order to provide pavement sections designed for higher levels of traffic. For design purposes, we have assumed a CBR value of 10. Any imported or borrow source fill placed below the proposed pavements should have a CBR value of at least 10. A modulus of subgrade reaction of 190 lbs per cubic inch (pci) was assumed for compacted subgrade for concrete pavement design.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

## Pavement Design

Design of Asphaltic Concrete (AC) pavements are based on the 1993 AASHTO guidelines. Minimum recommended pavement section thicknesses are presented below:

Minimum AC Pavement Section (inches)			
Layer	Thickness (inches)		Compaction/Material Specification
	Parking Lots	Driveway	
Compacted Subgrade <sup>1</sup>	12		95% of Modified Proctor Maximum Dry Density; -2 to +2% Optimum Moisture Content
Crushed Aggregate Base	8		WSDOT: 9-03.9(3) Base Course
Asphalt Thickness <sup>2</sup>	3	4	WSDOT: 9-03.8(2) ½-inch HMA PG58H-22 asphalt binder

1. May vary based on observations following proof-rolling.

2. Asphalt surface course only

We recommend that Portland cement concrete (PCC, rigid) pavement be used where rigid pavements are appropriate. These areas include but are not limited to entrance and exit sections, dumpster pads, or any areas where extensive wheel maneuvering or repeated loading are expected. The rigid pavement pads should be large enough to support the wheels of the truck which will bearing the haul load. The minimum thickness of PCC pavement should be 5½ inches and underlain by a minimum of 4 inches of crushed aggregate base course (use WSDOT 9.03.9(3)). Adequate reinforcement and number of longitudinal and transverse control joints should be placed in the rigid pavement in accordance with ACI requirements. Although not required for structural support, the base course layer is recommended to help reduce potential for slab curl, shrinkage cracking, subgrade “pumping” through joints, and provide a workable surface. These thicknesses assume the subgrade is properly prepared and compacted as noted above. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

The minimum pavement sections outlined above were determined based on post-construction traffic loading conditions. These pavement sections do not account for heavy construction traffic during development. A partially constructed structural section that is subjected to heavy construction traffic can result in pavement deterioration and premature distress or failure. Our experience indicates that this pavement construction practice can result in pavements that will not perform as intended. Considering this information, several alternatives are available to mitigate the impact of heavy construction traffic prior to pavement construction. These include using thicker sections to account for the construction traffic after paving; using some method of

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

soil stabilization to improve the support characteristics of the pavement subgrade; routing heavy construction traffic around paved areas; or delaying paving operations until as near the end of construction as is feasible.

### Pavement Drainage

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

We recommend drainage be included at the bottom of crushed aggregate base (when used) at the storm structures to aid in removing water that may enter this layer. Drainage could consist of small diameter weep holes excavated around the perimeter of the storm structures. The weep holes should be excavated at the elevation of the crushed aggregate base and soil interface. The excavation should be covered with crushed aggregate encompassed in Mirafi 140NL, or an approved equivalent, which will aid in reducing the amount of fines that enter the storm system.

### Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install joint sealant and seal cracks immediately.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

## CORROSIVITY

The table below lists the results of laboratory soluble sulfate, soluble chloride, electrical resistivity, and pH testing. The values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction.

Analyte Tested	Test Method	Test Results for Shallow Utilities		
		C-01 (B-01, 0 to 5 ft)	C-02 (B-02, 0 to 5 ft)	C-03 (B-04, 0 to 5 ft)
pH	AWWA 4500H	7.17	8.30	8.32
Water Soluble Sulfates (mg/kg)	ASTM C1580	112	2,738	176
Sulfides (mg/kg)	AWWA 4500-S D	Nil	Nil	Nil
Chlorides (mg/kg)	ASTM D512	97	127	50
Red-Ox <sup>1</sup> (mV)	AWWA 2580	+723	+721	+735
Total Salts (mg/kg)	AWWA 2540	889	1,074	105
Resistivity (ohm-cm)	ASTM G57	2,716	2,037	12,610

AWWA = American Water Works Association

ASTM = American Society for Testing and Materials

1. Reduction-Oxidation potential (positive values indicates an oxidizing environment)

Results of soluble sulfate testing indicate samples of the on-site soils tested possess negligible sulfate concentrations when classified in accordance with Table 4.3.1 of the ACI Design Manual. Concrete should be designed in accordance with the provisions of the ACI Design Manual, Section 318, Chapter 4.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

## FIELD RESISTIVITY

In the table below is a summary of the filed resistivity testing results. The method used is 4-point Wenner method (ASTM G57).

Electrode Spacing a (ft)	Electrode Depth b (in)	NE-SW		NW-SE	
		Apparent Resistance R (Ω)	Apparent Resistivity ρ (Ω-m)	Apparent Resistance R (Ω)	Apparent Resistivity ρ (Ω-m)
1	6	415.0	79,481	460.0	88,099
2	6	185.0	70,860	180.0	68,945
3	6	106.5	61,188	108.5	62,337
5	6	59.0	56,496	58.5	56,017
7.5	6	41.5	59,608	42.5	61,044
10	6	34.5	66,071	29.5	56,496
15	6	26.5	76,126	25.5	73,253
20	6	19.0	72,774	19.5	74,689
30	6	11.0	63,199	11.5	66,071
40	6	4.6	35,238	5.8	44,431
50	6	1.9	18,194	1.2	11,491

1. Performed on April 1, 2022 within the landscape area to the east of the existing Safeway grocery store.

The above results should be provided to the electrical engineer to assess in the influence of the soil conductivity on below ground utilities and groundings.

## GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

## ATTACHMENTS

## EXPLORATION AND TESTING PROCEDURES

### Field Exploration

Number of Explorations	Type of Exploration	Exploration Depth (feet) <sup>1</sup>	Planned Location <sup>2</sup>
1	Soil Boring	51½	Planned building area
1	Soil Boring	26½	Planned building area
2	Soil Borings	21½	Planned Parking/driveway area
1	Soil Boring	15	Planned Infiltration trench

1. Below ground surface.

2. The approximate locations of the proposed explorations are shown on the attached Exploration Site Plan.

**Boring Layout and Elevations:** Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ±10 feet) and approximate elevations were obtained by interpolation from the Google Earth. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

**Soil Boring Procedures:** We advanced soil borings with a truck-mounted drill rig using hollow stem augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter within the planned building and parking/driveway area. Soil sampling is typically performed using split-barrel sampling procedures. In the split barrel sampling procedure, a standard 2-inch outer diameter split barrel sampling spoon is driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. Continuous sampling was performed at planned infiltration trench area. Soil sampling is performed using split-barrel sampling procedures with 3-inch outer diameter split barrel sampling spoon (Modified California sampler). We observed and recorded groundwater levels during drilling and sampling. Per Washington State law, all borings were backfilled with granular bentonite after their completion.

The sampling depths, penetration distances, and other sampling information was recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs and the test pits logs as part of standard operations. These field logs included visual classifications of the materials encountered during the exploration and our interpretation of the subsurface conditions between samples. Final logs were prepared from the field logs. The final logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

## Geotechnical Engineering Report

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington

April 19, 2022 ■ Terracon Project No. 81225052

**Field Electrical Resistivity Testing:** We characterized electrical resistivity for design of electrical grounding system by performing electrical resistivity testing in the field using the Wenner 4-pin method along two transects (NE-SW and NW-SE). This is a non-displacement test method and resulted in little to no property disturbance.

## Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D422 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
- ASTM D1140 Standard Test Method for determining the Amount of Material Finer than 75- $\mu$ m (No.200) Sieve in Soils by Washing
- ASTM D2974 Standard Test Method for Moisture, Ash and Organic Matter of Peat and Other Organic Soils
- Corrosivity testing for pH, water soluble sulfates, sulfides, chlorides, reduction-oxidation total salts, and resistivity (ASTM and AWWA testing standards)

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

- 10 – ASTM D2216 (Water Content)
- 2 – ASTM D6913 (Grain Size Distribution)
- 3 – ASTM D422 (Grain Size Distribution with Hydrometer)
- 3 – ASTM D1140 (No. 200)
- 2 – ASTM D2974 (Organic Content)
- 3 – Corrosivity Suites

## **SITE LOCATION AND EXPLORATION PLANS**

### **Contents:**

Site Location Plan

Exploration Plan

## SITE LOCATION PLAN

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington  
April 19, 2022 ■ Terracon Project No. 81225052

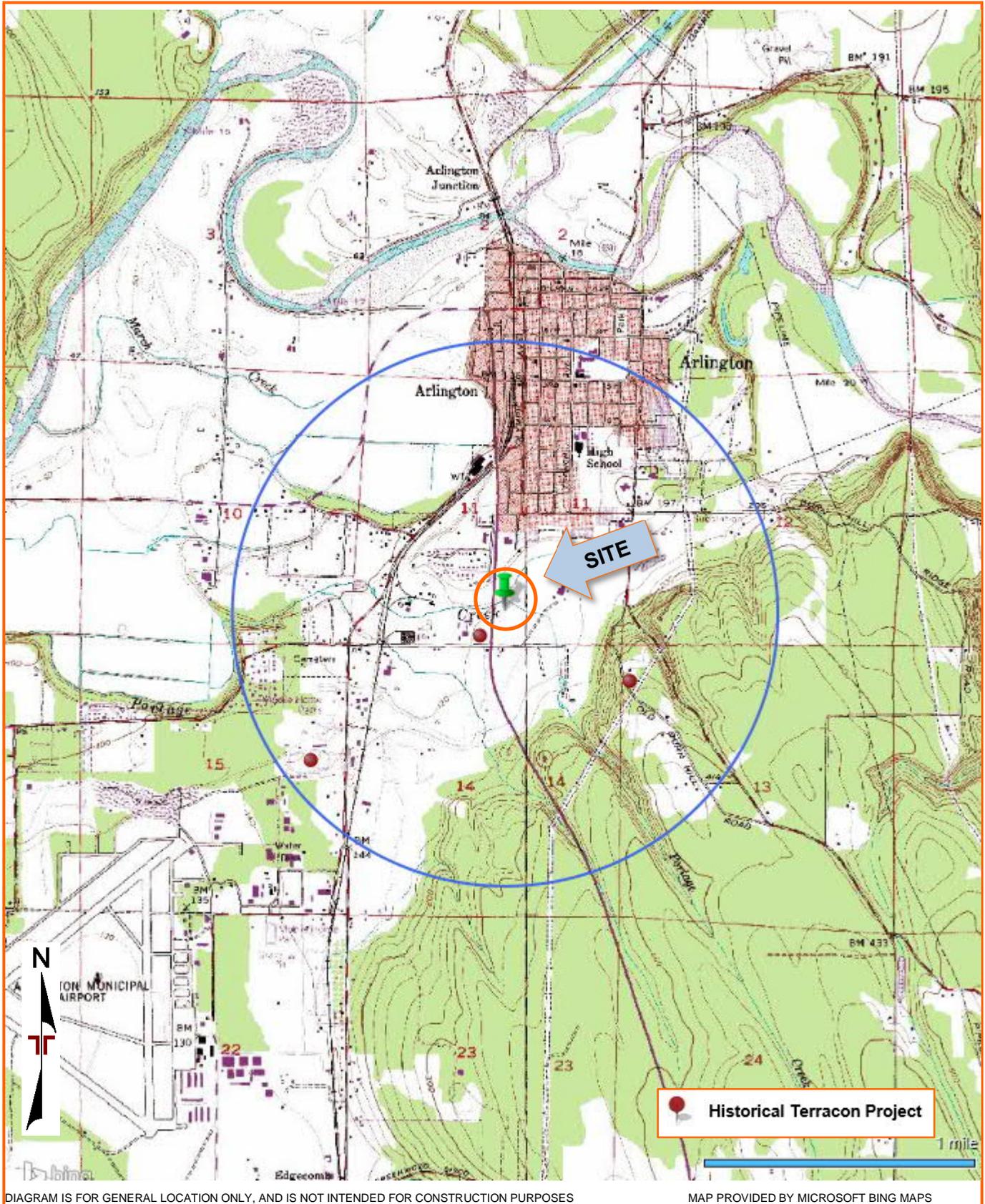


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

**EXPLORATION PLAN**

Albertsons – Safeway Store #1522 Expansion ■ Arlington, Snohomish County, Washington  
April 19, 2022 ■ Terracon Project No. 81225052

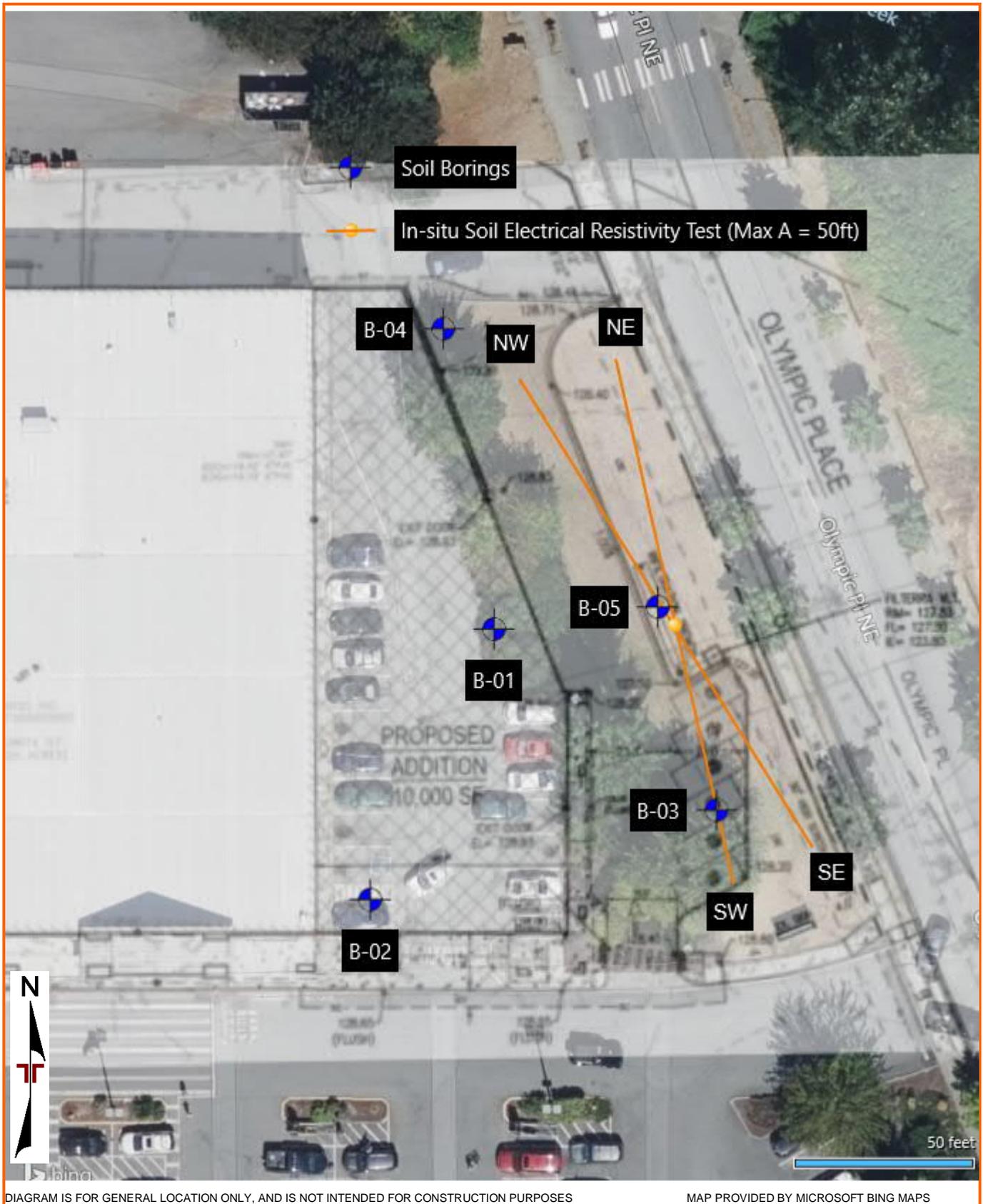


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

## **EXPLORATION RESULTS**

### **Contents:**

GeoModel

Boring Logs (B-01 through B-05)

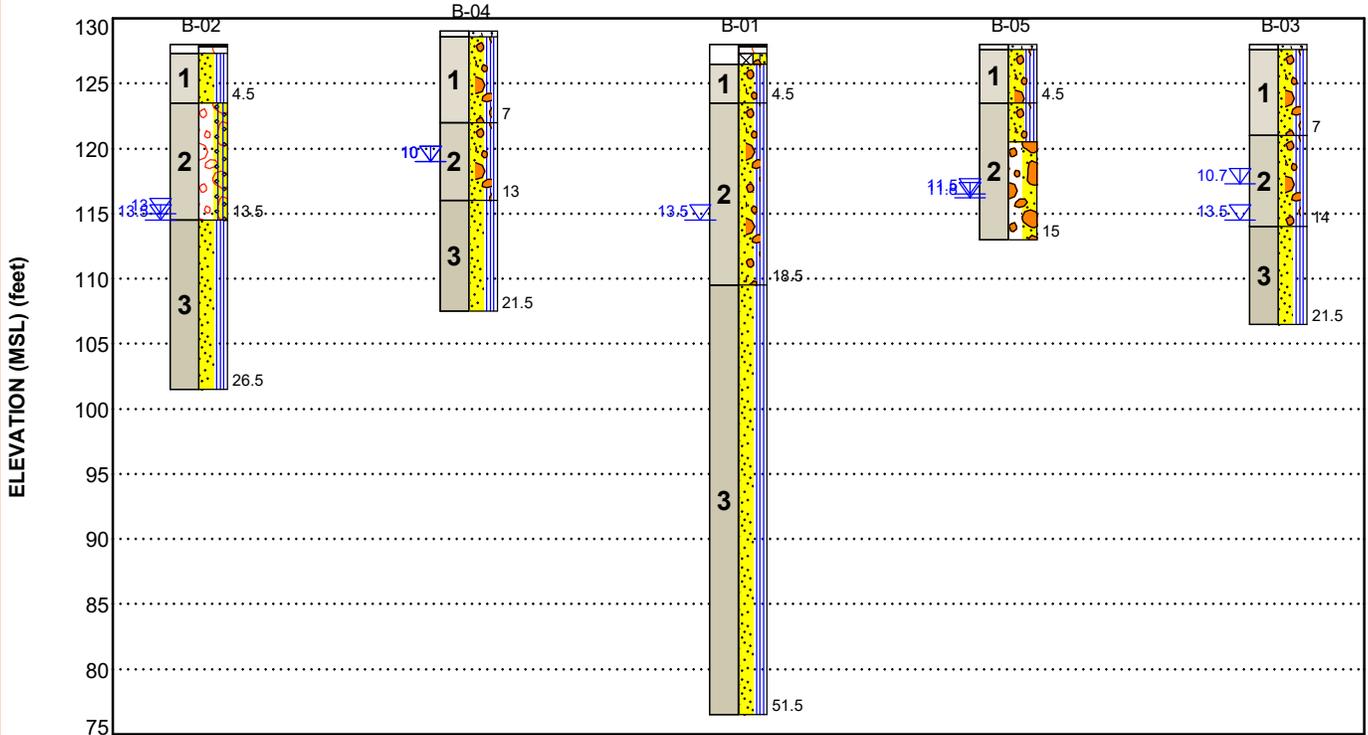
Grain Size Distribution

Corrosivity

In-situ Soil Electrical Resistivity

# GEOMODEL

Albertsons - Safeway Store #1522 Expansion ■ Arlington, WA  
 Terracon Project No. 81225052



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Sand with silt and gravel	Sand with silt and gravel, with organics, dark brown, fine grained, loose to medium dense
2	Sand and Gravel	Sand and gravel with variable silt content, brown, loose to very dense
3	Sand with silt	Sand with silt, trace gravel, brown, medium dense to very dense

### LEGEND

- Asphalt
- Poorly-graded Sand with Silt and Gravel
- Poorly-graded Sand with Silt
- Silty Sand with Gravel
- Well-graded Gravel with silt and sand
- Topsoil
- Poorly-graded Gravel with Sand

- First Water Observation
- Second Water Observation

Groundwater levels are temporal. The levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

**NOTES:**  
 Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.  
 Numbers adjacent to soil column indicate depth below ground surface.

# BORING LOG NO. B-01

**PROJECT:** Albertsons - Safeway Store #1522 Expansion

**CLIENT:** Albertsons Companies, Inc.  
Boise, ID

**SITE:** 20500 Olympic Place  
Arlington, WA

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 48.1825° Longitude: -122.1273°  Approximate Surface Elev.: 128 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)	PERCENT FINES
		DEPTH	ELEVATION (Ft.)							
	0.2	ASPHALT, about 2"	128+/-							
	0.7		127.5+/-							
	1.5	AGGREGATE BASE COURSE, about 6"	126.5+/-							
1		FILL - SILTY SAND WITH GRAVEL (SM), grayish brown POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), fine grained, dark brown, damp, medium dense, with organics and fine to medium size roots @ S-1: O.C.=3.8%	4.5		X	9	11-5-6 N=11	S-1	13.8	
		POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), medium to coarse grained, brown, damp, medium dense to dense  @S-3: trace organics  moist	5		X	6	11-16-21 N=37	S-2		
		wet	10		X	12	9-12-14 N=26	S-3		
2			15	▽						
			18.5		X	13	13-26-25 N=51	S-5	12.5	8
		POORLY GRADED SAND WITH SILT (SP-SM), trace gravel, fine to medium grained, brown, wet, medium dense to very dense  decrease in gravel content water added to mitigate heave silt content and grain size decreasing with depth  color change to grayish brown	20		X	9	9-23-25 N=48	S-6		
3			25		X	14	17-28-45 N=73	S-7		
			30							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic (ETR=78.9%)

Advancement Method:  
Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

@ S-1, S-2, S-3, S-4, S-5 : rock fragments present, blow counts may be overstated.

Abandonment Method:  
Boring backfilled with bentonite  
Surface capped with concrete

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from the Civil Plan.

**WATER LEVEL OBSERVATIONS**

▽ Inferred from change in sample moisture



21905 64th Ave W, Ste 100  
Mountlake Terrace, WA

Boring Started: 03-21-2022

Boring Completed: 03-21-2022

Drill Rig: Truck-mounted 02-54610

Driller: Cascade Drilling

Project No.: 81225052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATATEMPLATE.GDT\_4/14/22

# BORING LOG NO. B-01

**PROJECT: Albertsons - Safeway Store #1522 Expansion**

**CLIENT: Albertsons Companies, Inc. Boise, ID**

**SITE: 20500 Olympic Place  
Arlington, WA**

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 48.1825° Longitude: -122.1273°  Approximate Surface Elev.: 128 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)	PERCENT FINES
		<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, fine to medium grained, brown, wet, medium dense to very dense ( <i>continued</i> ) transitions to SAND (SP)	35	X		14	14-27-30 N=57	S-8		
			40	X		8	14-50/6" N=50/6"	S-10		
			45	X		12	10-14-21 N=35	S-11		
			50	X		16	7-9-18 N=27	S-12	24.2	5
			51.5							
		<b>Boring Terminated at 51.5 Feet</b>								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic (ETR=78.9%)

Advancement Method: Hollow Stem Auger	See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (if any).  See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.  Elevations were interpolated from the Civil Plan.	Notes:
Abandonment Method: Boring backfilled with bentonite Surface capped with concrete		
<b>WATER LEVEL OBSERVATIONS</b> ▽ Inferred from change in sample moisture		
21905 64th Ave W, Ste 100 Mountlake Terrace, WA		Boring Started: 03-21-2022 Boring Completed: 03-21-2022 Drill Rig: Truck-mounted 02-54610 Driller: Cascade Drilling Project No.: 81225052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATA TEMPLATE.GDT 4/14/22

# BORING LOG NO. B-02

**PROJECT: Albertsons - Safeway Store #1522 Expansion**

**CLIENT: Albertsons Companies, Inc. Boise, ID**

**SITE: 20500 Olympic Place  
Arlington, WA**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATATEMPLATE.GDT\_4/14/22

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 48.1822° Longitude: -122.1274°  Approximate Surface Elev.: 128 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)	PERCENT FINES
		DEPTH	ELEVATION (Ft.)							
		0.2' <b>ASPHALT</b> , about 2"	128+/-							
		0.7' <b>AGGREGATE BASE COURSE</b> , about 6"	127.5+/-							
1		<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , trace gravel, fine grained, dark brown, moist, loose, trace organics and cobbles	4.5			1	4-3-5 N=8	S-1		
2		<b>WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)</b> , subrounded to subangular, brown, damp, medium dense to dense silt content decreasing with depth	13.5			9	10-26-13 N=39	S-2	5.9	8
						7	11-16-19 N=35	S-3		
						10	14-16-12 N=28	S-4		
				▽						
3		<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , medium to coarse grained, brown, wet, medium dense silt content decreasing with depth	26.5			18	6-8-10 N=18	S-5		
						15	11-7-13 N=20	S-6		
						14	6-9-11 N=20	S-7		
		<b>Boring Terminated at 26.5 Feet</b>	101.5+/-							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic (ETR=78.9%)

Advancement Method:  
Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

@ S-2, S-3, S-4 : rock fragments present, blow counts may be overstated.

Abandonment Method:  
Boring backfilled with bentonite  
Surface capped with concrete

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from the Civil Plan.

**WATER LEVEL OBSERVATIONS**

- ▽ Inferred from change in sample moisture
- ▽ Measured while drilling



21905 64th Ave W, Ste 100  
Mountlake Terrace, WA

Boring Started: 03-21-2022

Boring Completed: 03-21-2022

Drill Rig: Truck-mounted 02-54610

Driller: Cascade Drilling

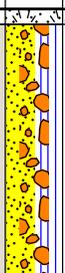
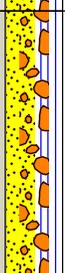
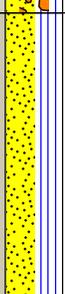
Project No.: 81225052

# BORING LOG NO. B-03

**PROJECT: Albertsons - Safeway Store #1522 Expansion**

**CLIENT: Albertsons Companies, Inc. Boise, ID**

**SITE: 20500 Olympic Place  
Arlington, WA**

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 48.1823° Longitude: -122.1270°  Approximate Surface Elev.: 128 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)	PERCENT FINES
		DEPTH: 0.4 ELEVATION (Ft.): 127.5+/-								
1		<b>SANDY SILT (ML)</b> , dark brown, moist, with abundant fine roots and organics <b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)</b> , trace organics, fine grained, dark brown, moist, medium dense	0.4 to 7.0							
			5			9	5-6-7 N=13	S-1	10.5	10
			7.0							
2		<b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)</b> , with cobbles, fine to coarse grained, grayish brown to brown, moist, dense  wet	7.0 to 14.0							
			10			1	10-26-31 N=57	S-2		
			10			14	4-18-28 N=46	S-3		
			14.0							
3		<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , fine to medium grained, brown, wet, medium dense	14.0 to 21.5							
			15			0	16-19-18 N=37	S-4		
			15			10	13-23-25	S-5		
			20			4	9-11-12 N=23	S-6		
			21.5			13	4-6-12 N=18	S-7		
		<b>Boring Terminated at 21.5 Feet</b>								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic (ETR=78.9%)

Advancement Method:  
Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

@ S-2 and S-4: rock fragments present, blow counts may be overstated.  
S-5 was sampled by 3-inch diameter sampler

Abandonment Method:  
Boring backfilled with bentonite chips upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from the Civil Plan.

**WATER LEVEL OBSERVATIONS**

-  Inferred from change in sample moisture
-  Measured at completion of drilling



Boring Started: 03-22-2022

Boring Completed: 03-22-2022

Drill Rig: Truck-mounted 02-54610

Driller: Cascade Drilling

Project No.: 81225052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATATEMPLATE.GDT 4/14/22

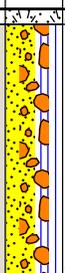
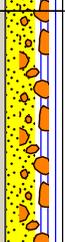
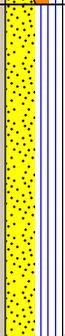
# BORING LOG NO. B-04

**PROJECT: Albertsons - Safeway Store #1522 Expansion**

**CLIENT: Albertsons Companies, Inc. Boise, ID**

**SITE: 20500 Olympic Place  
Arlington, WA**

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATA TEMPLATE.GDT 4/14/22

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 48.1827° Longitude: -122.1274°  Approximate Surface Elev.: 129 (Ft.) +/-	DEPTH (Ft.)	ELEVATION (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)	PERCENT FINES
			0.4	128.5+/-							
1		<b>SANDY SILT (ML)</b> , dark brown, moist, with abundant fine roots and organics <b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)</b> , with organics, fine grained, dark brown, moist, medium dense fine to medium size roots to about 1 foot below ground surface silt content increasing with depth @ S-1: O.C.=1.9%	7.0	122+/-			13	3-12-13 N=25	S-1	11.3	
2		<b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)</b> , with cobbles, fine to coarse grained, brown, moist, loose to medium dense, change in layer inferred due to lack of sample recovery  wet	13.0	116+/-	▽		0	3-3-5 N=8	S-3		
							0	4-3-9 N=12	S-4		10
3		<b>POORLY GRADED SAND WITH SILT (SP-SM)</b> , fine to medium grained, brown, wet, medium dense to very dense	21.5	107.5+/-			10	2-6-11 N=17	S-5		
		<b>Boring Terminated at 21.5 Feet</b>					14	12-18-27 N=45	S-6		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic (ETR=78.9%)

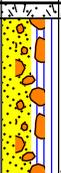
Advancement Method: Hollow Stem Auger	See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (if any).  See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.  Elevations were interpolated from the Civil Plan.	Notes: @ S-2: rock fragments present, blow counts may be overstated.
Abandonment Method: Boring backfilled with bentonite chips upon completion.		
<b>WATER LEVEL OBSERVATIONS</b> ▽ Inferred from change in sample moisture ▽ Measured at completion of drilling	 21905 64th Ave W, Ste 100 Mountlake Terrace, WA	Boring Started: 03-22-2022 Boring Completed: 03-22-2022  Drill Rig: Truck-mounted 02-54610 Driller: Cascade Drilling  Project No.: 81225052

# BORING LOG NO. B-05

**PROJECT: Albertsons - Safeway Store #1522 Expansion**

**CLIENT: Albertsons Companies, Inc. Boise, ID**

**SITE: 20500 Olympic Place  
Arlington, WA**

MODEL LAYER	GRAPHIC LOG	LOCATION See <a href="#">Exploration Plan</a> Latitude: 48.1825° Longitude: -122.1271°  Approximate Surface Elev.: 128 (Ft.) +/-	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE ID	WATER CONTENT (%)	PERCENT FINES
		ELEVATION (Ft.)								
1		0.4 <b>SANDY SILT (ML)</b> , dark brown, moist, with abundant fine roots and organics	127.5+/-							
		4.5 <b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)</b> , trace organics, fine to coarse grained, dark brown, moist, (medium dense)	123.5+/-							
2		7.5 <b>POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)</b> , with cobbles, medium to coarse grained, brown, damp to moist, (loose to medium dense)	120.5+/-	5	10		32-12-14	S-1		
				7		7-8-8	S-2			
				10		16-20-17	S-3	3.9	7	
				6		16-31-29	S-4	3.7	3	
				10		21-23-26	S-5	5.7	4	
				8	15	8		22-33-41	S-6	
				8		8-27-27	S-7			
				10		17-19-22	S-8			
		<b>Boring Terminated at 15 Feet</b>								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic (ETR=78.9%)

Advancement Method:  
Hollow Stem Auger

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

Samples were sampled by three inches diameter sampler sampling was performed using a 3-inch outside diameter sampler sampling was performed using a 3-inch outside diameter sampler

Abandonment Method:  
Boring backfilled with bentonite chips upon completion.

See [Supporting Information](#) for explanation of symbols and abbreviations.

Elevations were interpolated from the Civil Plan.

**WATER LEVEL OBSERVATIONS**

- Inferred from change in sample moisture*
- Measured at completion of drilling*



21905 64th Ave W, Ste 100  
Mountlake Terrace, WA

Boring Started: 03-22-2022

Boring Completed: 03-22-2022

Drill Rig: Truck-mounted 02-54610

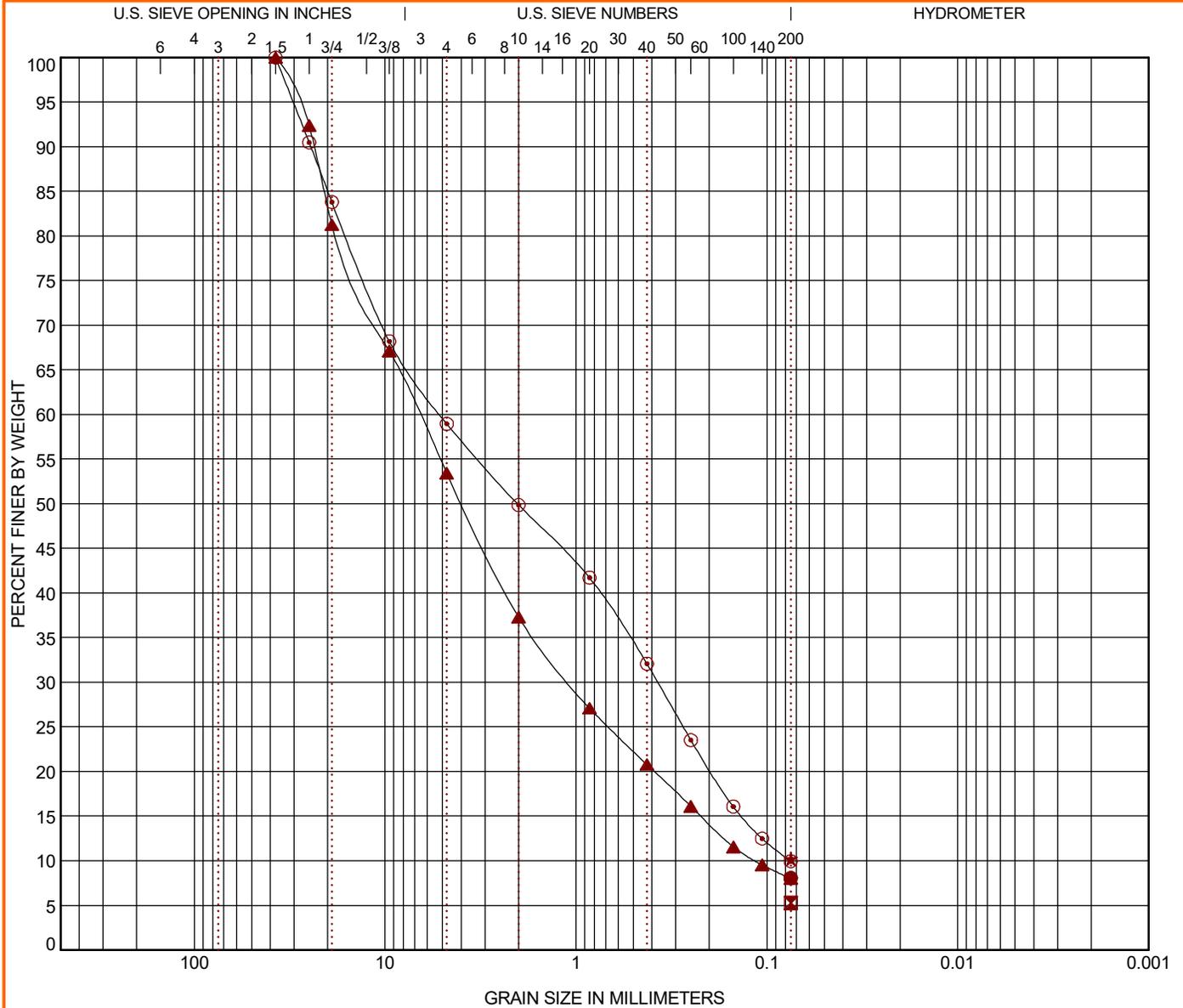
Driller: Cascade Drilling

Project No.: 81225052

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL\_81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATA TEMPLATE.GDT 4/14/22

# GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu			
● B-01	15 - 16.5	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)	12.5								
☒ B-01	50 - 51.5	POORLY GRADED SAND WITH SILT (SP-SM)	24.2								
▲ B-02	5 - 6.5	WELL GRADED GRAVEL WITH SILT AND SAND (GW-GM)	5.9				1.55	57.67			
★ B-03	2.5 - 4	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)	10.5								
⊙ B-04	5 - 6.5	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)	12.5				0.36	68.02			
Boring ID	Depth (Ft)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-01	15 - 16.5	0.075								8.1	
☒ B-01	50 - 51.5	0.075								5.3	
▲ B-02	5 - 6.5	37.5	6.625	1.084	0.115	0.0	46.6	45.4		8.0	
★ B-03	2.5 - 4	0.075								10.2	
⊙ B-04	5 - 6.5	37.5	5.138	0.374	0.076	0.0	41.0	49.0		9.9	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATATEMPLATE.GDT 4/15/22

PROJECT: Albertsons - Safeway Store #1522  
Expansion

SITE: 20500 Olympic Place  
Arlington, WA



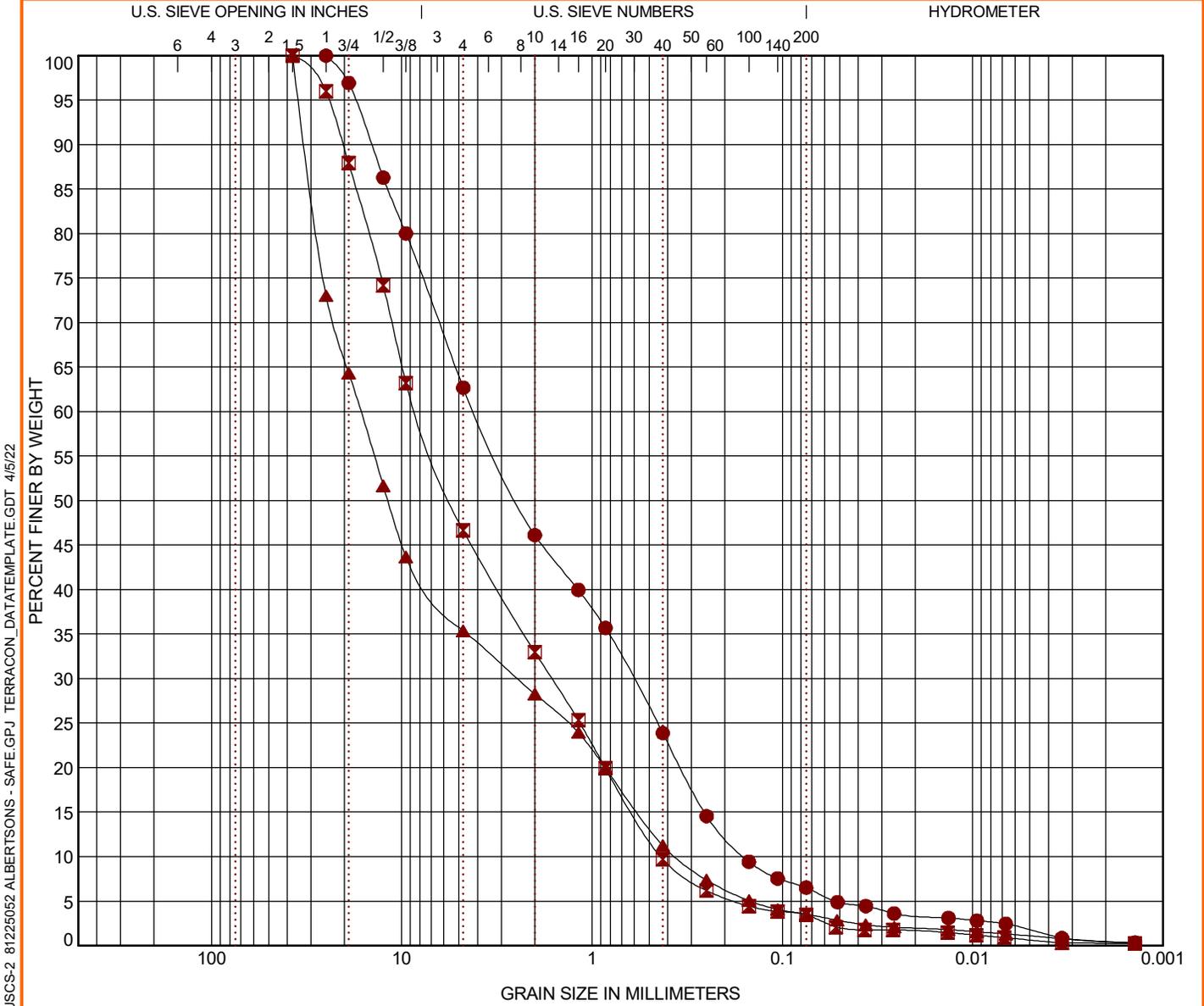
21905 64th Ave W, Ste 100  
Mountlake Terrace, WA

PROJECT NUMBER: 81225052

CLIENT: Albertsons Companies, Inc.  
Boise, ID

# GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth (Ft)	USCS Classification	WC (%)	LL	PL	PI	Cc	Cu
● B-05	6 - 7.5	POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM)	3.9				0.56	25.97
■ B-05	7.5 - 9	POORLY GRADED GRAVEL WITH SAND (GP)	3.7				0.74	19.13
▲ B-05	9 - 10.5	WELL GRADED GRAVEL WITH SAND (GW)	5.7				1.03	45.86

Boring ID	Depth (Ft)	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-05	6 - 7.5	25	4.128	0.609	0.159	0.0	37.3	56.2	4.8		1.8
■ B-05	7.5 - 9	37.5	8.299	1.631	0.434	0.0	53.4	43.2	2.8		0.6
▲ B-05	9 - 10.5	37.5	16.458	2.471	0.359	0.0	64.6	31.8	2.4		1.1

PROJECT: Albertsons - Safeway Store #1522 Expansion

SITE: 20500 Olympic Place  
Arlington, WA



PROJECT NUMBER: 81225052

CLIENT: Albertsons Companies, Inc.  
Boise, ID

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 81225052 ALBERTSONS - SAFE.GPJ TERRACON\_DATATEMPLATE.GDT 4/15/22

**Client**

Albertsons Companies, Inc.

**Project**

Albertsons - Safeway Store #1522 Expansion

**Sample Submitted By:** Terracon (81)

**Date Received:** 3/25/2022

**Lab No.:** 22-0276

**Results of Corrosion Analysis**

<b>Sample Number</b>	C-01	C-02	C-03
<b>Sample Location</b>	B-01	B-02	B-04
<b>Sample Depth (ft.)</b>	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, ASTM G 51	7.17	8.30	8.32
Water Soluble Sulfate (SO <sub>4</sub> ), ASTM C 1580 (mg/kg)	112	2738	176
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil
Chlorides, ASTM D 512, (mg/kg)	97	127	50
Red-Ox, ASTM G 200, (mV)	+723	+721	+735
Total Salts, AWWA 2520 B, (mg/kg)	889	1074	105
Saturated Minimum Resistivity, ASTM G 57, (ohm-cm)	2716	2037	12610

**Analyzed By:**



Nathan Campo  
Engineering Technician II

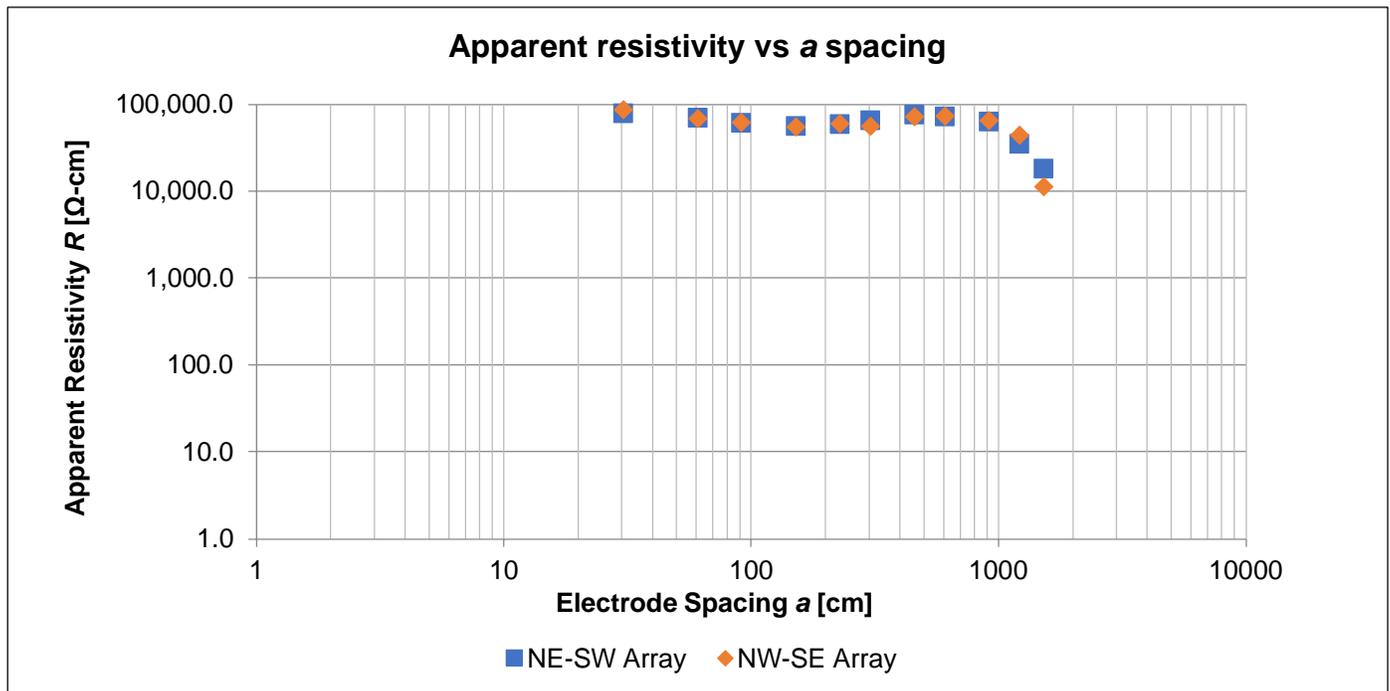
## FIELD ELECTRICAL RESISTIVITY TEST DATA

Albertsons - Safeway Store #1522 Expansion ■ Arlington, Sonohomish County, WA  
 April 19, 2022 ■ Terracon Project No. 81225052



<b>Array Loc.</b>	In-Situ Electrical Resistivity Test		
<b>Instrument</b>	Nilsson 400 Soil Resistivity Meter	<b>Weather</b>	Cloudy
<b>Serial #</b>	S/N 4-9489	<b>Ground Cond.</b>	Relatively flat, Landscape area, Sod
<b>Cal. Check</b>	February 17, 2022	<b>Tested By</b>	Xiaoyi Tan
<b>Test Date</b>	April 1, 2022	<b>Method</b>	Venner 4-pin (ASTM G57-06 (2012); IEEE 81-2012)
<b>Notes &amp; Conflicts</b>	Moist grass, sod		

Electrode Spacing <i>a</i>		Electrode Depth <i>b</i>		NE-SW Test		NW-SE Test	
[feet]	[centimeters]	[inches]	[centimeters]	Measured Resistance <i>R</i>	Apparent Resistivity $\rho$	Measured Resistance <i>R</i>	Apparent Resistivity $\rho$
				$\Omega$	[ $\Omega$ -cm]	$\Omega$	[ $\Omega$ -cm]
1	30	6	15	415.0	79481	460.0	88099
2	61	6	15	185.0	70860	180.0	68945
3	91	6	15	106.5	61188	108.5	62337
5	152	6	15	59.0	56496	58.5	56017
7.5	229	6	15	41.5	59608	42.5	61044
10	305	6	15	34.5	66071	29.5	56496
15	457	6	15	26.5	76126	25.5	73253
20	610	6	15	19.0	72774	19.5	74689
30	914	6	15	11.0	63199	11.5	66071
40	1219	6	15	4.6	35238	5.8	44431
50	1524	6	15	1.9	18194	1.2	11491



## **HISTORICAL EXPLORATION RESULTS**

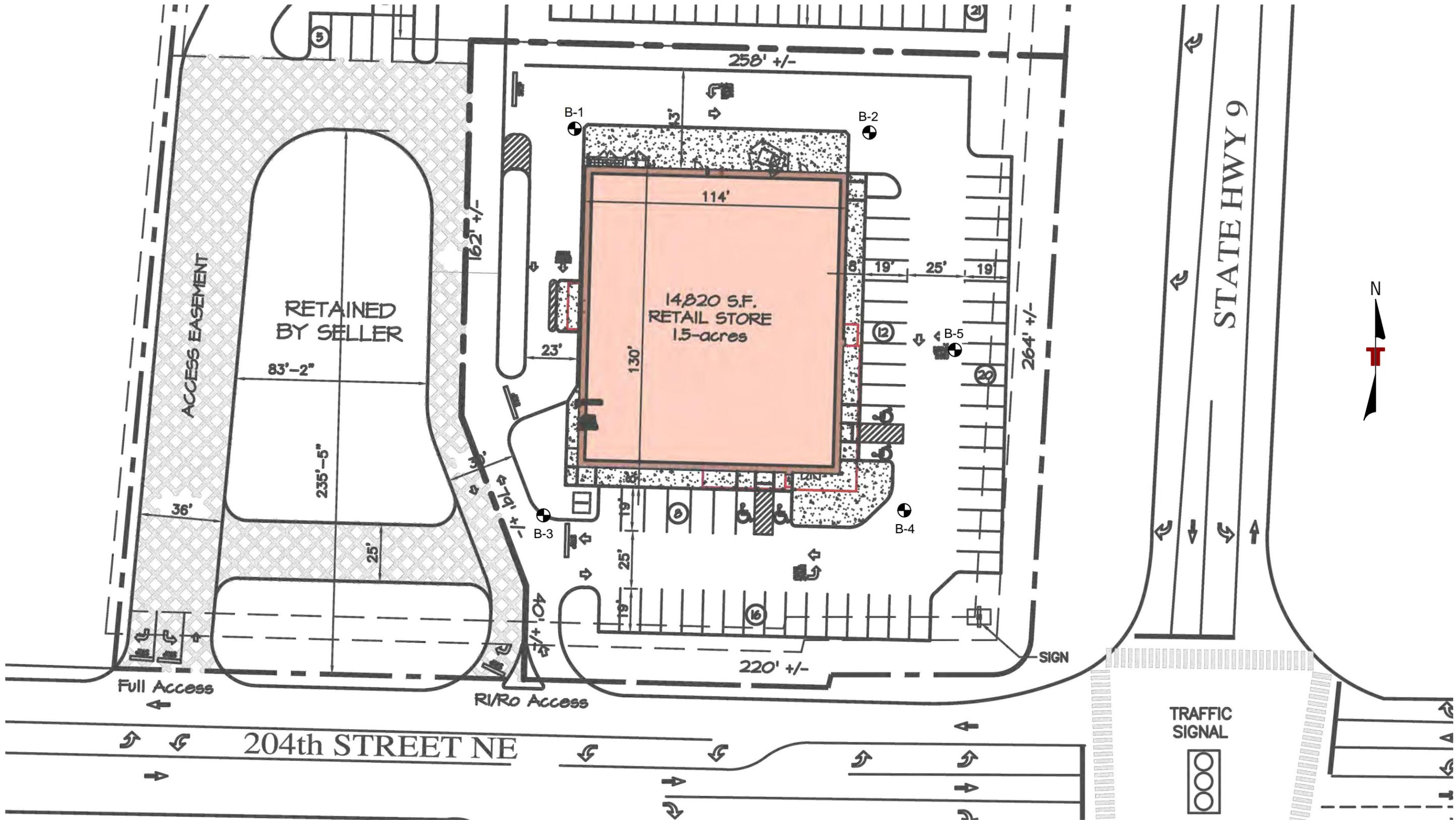
### **Contents:**

Exploration Locations

Boring Logs (B-1 through B-5)

Grain Size Distribution

Organic Content



Basemap PDF file provided by CAP Arlington LLC and modified by Terracon.

**LEGEND:**  
 B-1 BORING NUMBER AND APPROXIMATE LOCATION



Project Mng:	RMS	Project No.	81135070
Drawn By:	RMS	Scale:	AS SHOWN
Checked By:	RMS	File No.	Exhibit A-1.dwg
Approved By:	JMB	Date:	October 2013

**Terracon**  
 Consulting Engineers and Scientists  
 21905 64th Avenue W, Ste 100 Mountlake Terrace, WA 98043  
 PH. (425) 771-3304 FAX. (425) 771-3549

**SITE AND EXPLORATION PLAN**  
 Proposed Walgreens  
 204th Street NE and Highway 9  
 Arlington, Snohomish County, Washington

EXHIBIT  
 A-1

# BORING LOG NO. B-1

**PROJECT:** Arlington Walgreens

**CLIENT:** CAP Arlington, LLC  
Greenville, South Carolina

**SITE:** 204th Street NE & Highway 9  
Arlington, Washington

GRAPHIC LOG	LOCATION See Exhibit A-1	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	Surface Elev.: 98.5 (Ft.)								
	ELEVATION (Ft.)								
GRAVELLY SAND (SP-SM), with silt, brown, medium dense to dense, moist to wet		5	X		12	9-12-16 N=28	S-1	4	6
GRAVELLY SAND (SP-SM), with silt, brown, medium dense to dense, moist to wet		5	X		12	9-14-26 N=40	S-2	4	
GRAVELLY SAND (SP-SM), with silt, brown, medium dense to dense, moist to wet		10	X		6	5-6-7 N=13	S-3		
SAND (SP), trace silt and gravel, brown-yellow, medium dense, wet to saturated		15	▽						
SAND (SP), trace silt and gravel, brown-yellow, medium dense, wet to saturated		15	X		14	5-6-8 N=14	S-4		
SAND (SP), trace silt and gravel, brown-yellow, medium dense, wet to saturated		20	X		14	7-9-16 N=25	S-5		
<b>Boring Terminated at 21.5 Feet</b>									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:  
Hollow Stem Auger

See Exhibit A-2 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with bentonite chips upon completion

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

**WATER LEVEL OBSERVATIONS**

▽ 14' While Drilling



Boring Started: 9/27/2013

Boring Completed: 9/27/2013

Drill Rig: B-61 TRUCK

Driller: Environmental Drilling, Inc.

Project No.: 81135070

Exhibit: A-3

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

# BORING LOG NO. B-2

**PROJECT:** Arlington Walgreens

**CLIENT:** CAP Arlington, LLC  
Greenville, South Carolina

**SITE:** 204th Street NE & Highway 9  
Arlington, Washington

GRAPHIC LOG	LOCATION See Exhibit A-1	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	Surface Elev.: 98.5 (Ft.)								
	ELEVATION (Ft.)								
GRAVELLY SAND (SP-SM), with silt, brown, medium dense, moist to wet		5	X		12	9-12-17 N=29	S-1		
GRAVELLY SAND (SP-SM), with silt, brown, medium dense, moist to wet		5	X		12	10-11-14 N=25	S-2	4	
SAND (SP), with silt and trace gravel, brown-yellow, medium dense, wet		10	X		14	5-4-6 N=10	S-3	9	
SAND (SP), with silt and trace gravel, brown-yellow, medium dense, wet		15	X		18	5-8-10 N=18	S-4	10	4
grades to saturated		20	▽						
grades to saturated		20	X		18	4-5-16 N=21	S-5		
grades to saturated		25	X		18	5-7-11 N=18	S-6		
grades to saturated		30							

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:  
Hollow Stem Auger

See Exhibit A-2 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with bentonite chips upon completion

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

**WATER LEVEL OBSERVATIONS**

▽ 18' While Drilling



Boring Started: 9/27/2013

Boring Completed: 9/27/2013

Drill Rig: B-61 TRUCK

Driller: Environmental Drilling, Inc.

Project No.: 81135070

Exhibit: A-4

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

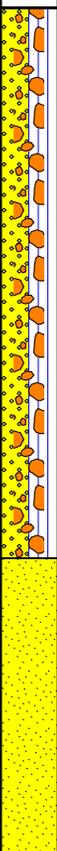


# BORING LOG NO. B-3

**PROJECT:** Arlington Walgreens

**CLIENT:** CAP Arlington, LLC  
Greenville, South Carolina

**SITE:** 204th Street NE & Highway 9  
Arlington, Washington

GRAPHIC LOG	LOCATION See Exhibit A-1	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	Surface Elev.: 99 (Ft.)								
	ELEVATION (Ft.)								
DEPTH									
	<p><b>GRAVELLY SAND (SW-SM)</b>, with silt, brown, medium dense to dense, moist to wet</p> <p>(overstated blowcount on rock)</p>	5				7-10-9 N=19	S-1		
		10				22-25-28 N=53	S-2	6	7
		15				9-14-16 N=30	S-3		
		20				6-6-6 N=12	S-4		
		21.5				3-4-6 N=10	S-5		
	<b>Boring Terminated at 21.5 Feet</b>								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:  
Hollow Stem Auger

See Exhibit A-2 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with bentonite chips upon completion

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

**WATER LEVEL OBSERVATIONS**

*Not Encountered*



21905 64th Ave. W, Suite 100  
Mountlake Terrace, Washington

Boring Started: 9/27/2013

Boring Completed: 9/27/2013

Drill Rig: B-61 TRUCK

Driller: Environmental Drilling, Inc.

Project No.: 81135070

Exhibit: A-5

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

# BORING LOG NO. B-4

**PROJECT:** Arlington Walgreens

**CLIENT:** CAP Arlington, LLC  
Greenville, South Carolina

**SITE:** 204th Street NE & Highway 9  
Arlington, Washington

GRAPHIC LOG	LOCATION See Exhibit A-1	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	Surface Elev.: 100 (Ft.)								
	ELEVATION (Ft.)								
	DEPTH								
5.5	<b>SILT (ML)</b> , with clay, trace sand, dark brown, soft, moist	94.5			12	1-1-2 N=3	S-1		
15.0	<b>GRAVELLY SAND (SP-SM)</b> , trace silt, brownish-gray, dense, moist	85			14	29-29-20 N=49	S-2	8	
21.5	<b>SAND (SP)</b> , trace silt and gravel, brown-yellow, medium dense, wet	78.5			8	16-20-21 N=41	S-3		
21.5	grades to saturated	78.5	▽		16	5-5-6 N=11	S-4		
21.5	<b>Boring Terminated at 21.5 Feet</b>	78.5	▽		10	6-4-7 N=11	S-5		

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:  
Hollow Stem Auger

See Exhibit A-2 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with bentonite chips upon completion

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

**WATER LEVEL OBSERVATIONS**

▽ 20.5' While Drilling



Boring Started: 9/27/2013

Boring Completed: 9/27/2013

Drill Rig: B-61 TRUCK

Driller: Environmental Drilling, Inc.

Project No.: 81135070

Exhibit: A-6

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

# BORING LOG NO. B-5

**PROJECT:** Arlington Walgreens

**CLIENT:** CAP Arlington, LLC  
Greenville, South Carolina

**SITE:** 204th Street NE & Highway 9  
Arlington, Washington

GRAPHIC LOG	LOCATION See Exhibit A-1	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (in.)	FIELD TEST RESULTS	SAMPLE NUMBER	WATER CONTENT (%)	PERCENT FINES
	Surface Elev.: 100 (Ft.) ELEVATION (Ft.)								
	<b>TOPSOIL</b>	1.5		X	6	8-4-3 N=7	S-1	4	4
	<b>GRAVELLY SAND (SP-SM)</b> , with organics, trace silt, brownish-gray, medium dense, moist  (overstated blowcount on rock)			X	12	17-29-18 N=47	S-2		
		10.5		X	14	10-12-15 N=27	S-3		
	<b>Boring Terminated at 10.5 Feet</b>								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic SPT Hammer

Advancement Method:  
Hollow Stem Auger

See Exhibit A-2 for description of field procedures

Notes:

Abandonment Method:  
Borings backfilled with bentonite chips upon completion

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

**WATER LEVEL OBSERVATIONS**

*Not Encountered*



21905 64th Ave. W, Suite 100  
Mountlake Terrace, Washington

Boring Started: 9/27/2013

Boring Completed: 9/27/2013

Drill Rig: B-61 TRUCK

Driller: Environmental Drilling, Inc.

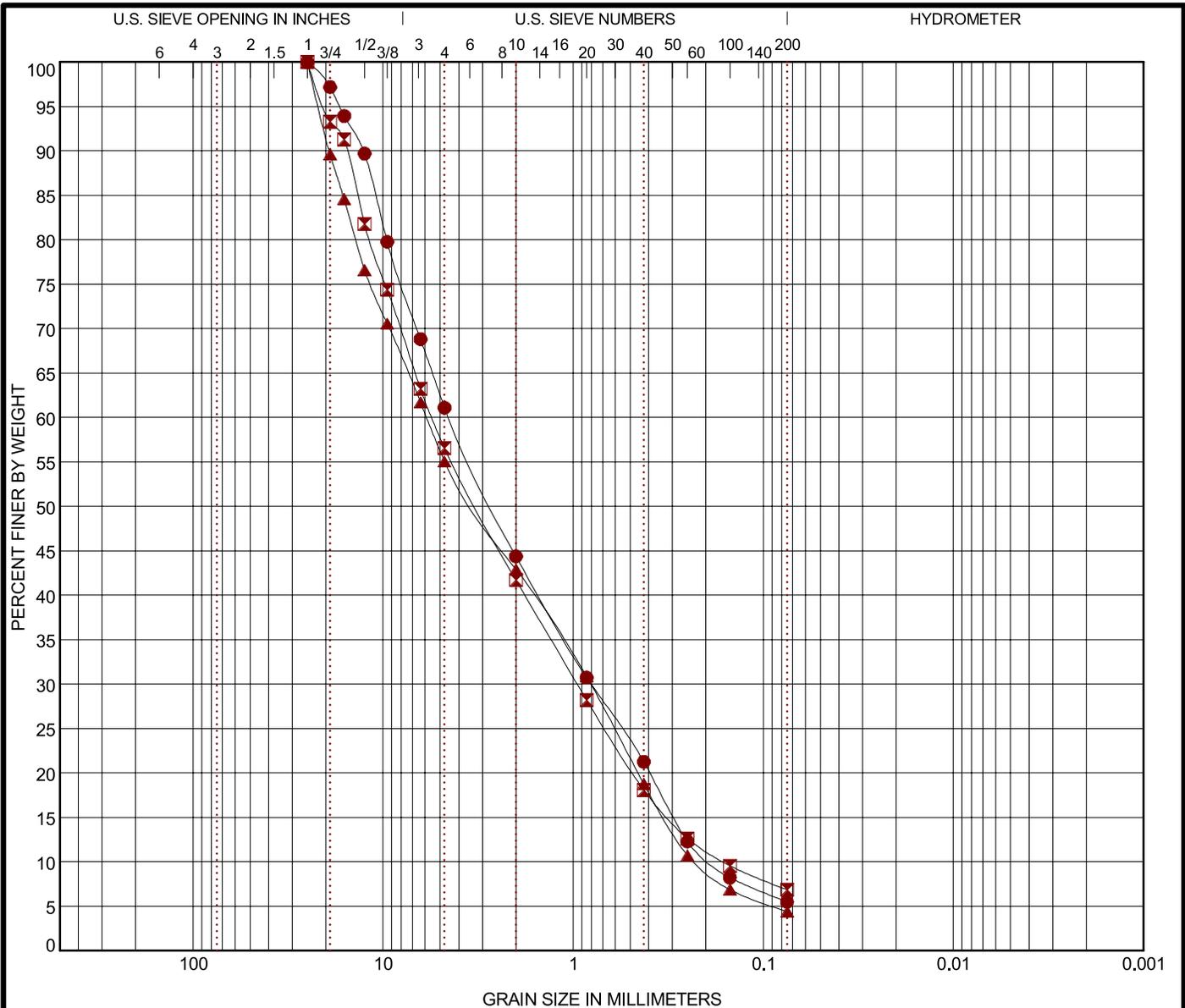
Project No.: 81135070

Exhibit: A-7

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT.

# GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification	LL	PL	PI	Cc	Cu
● B-1	2.5	GRAVELLY SAND (SP-SM), with silt				0.77	23.99
■ B-3	5.0	GRAVELLY SAND (SW-SM), with silt				1.02	34.22
▲ B-5	0.5	GRAVELLY SAND (SP-SM), with silt				0.49	25.91

Boring ID	Depth	D <sub>100</sub>	D <sub>60</sub>	D <sub>30</sub>	D <sub>10</sub>	%Gravel	%Sand	%Silt	%Clay
● B-1	2.5	25	4.485	0.805	0.187	38.9	55.6	5.5	
■ B-3	5.0	25	5.512	0.951	0.161	43.4	49.7	6.9	
▲ B-5	0.5	25	5.889	0.808	0.227	44.9	50.6	4.4	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 81135070 BORING LOGS 30SEP2013.GPJ FENCE PROJECT +8-13.GPJ 10/10/13

PROJECT: Proposed Walgreens	 21905 64th Ave. W, Suite 100 Mountlake Terrace, Washington	PROJECT NUMBER: 81135070
SITE: 204th Street NE & Highway 9 Arlington, Washington		CLIENT: CAP Arlington, LLC Greenville, South Carolina
		EXHIBIT: B-2



**Project Name: Arlington Walgreens**

**Date: 10/2/2013**

**Project Number: 81135070**

**Client: CAP**

**Report of Determination**  
**Organic Content ASTM D2974/ D2216**

<b>Sample:</b>	<b>S-2</b>
<b>Location:</b>	<b>B-5</b>
<b>Depth:</b>	<b>4'</b>
<b>Organic Content, percent:</b>	<b>9.63%</b>
<b>Moisture Content:</b>	<b>31.2%</b>

**Tested by: NT**  
**Reviewed by: JW**

**Respectfully submitted,**

**By Jeff Ward**

## **SUPPORTING INFORMATION**

### **Contents:**

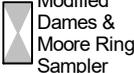
General Notes

Unified Soil Classification System

# GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Albertsons - Safeway Store #1522 Expansion ■ Arlington, WA  
Terracon Project No. 81225052

SAMPLING	WATER LEVEL	FIELD TESTS
 Modified Dames & Moore Ring Sampler  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered  Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	<b>N</b> Standard Penetration Test Resistance (Blows/Ft.)  <b>(HP)</b> Hand Penetrometer  <b>(T)</b> Torvane  <b>(DCP)</b> Dynamic Cone Penetrometer  <b>UC</b> Unconfined Compressive Strength  <b>(PID)</b> Photo-Ionization Detector  <b>(OVA)</b> Organic Vapor Analyzer

**DESCRIPTIVE SOIL CLASSIFICATION**

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

**LOCATION AND ELEVATION NOTES**

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See [Exploration and Testing Procedures](#) in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

**STRENGTH TERMS**

RELATIVE DENSITY OF COARSE-GRAINED SOILS <small>(More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance</small>		CONSISTENCY OF FINE-GRAINED SOILS <small>(50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance</small>		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

**RELEVANCE OF SOIL BORING LOG**

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>				Soil Classification		
				Group Symbol	Group Name <sup>B</sup>	
<b>Coarse-Grained Soils:</b> More than 50% retained on No. 200 sieve	<b>Gravels:</b> More than 50% of coarse fraction retained on No. 4 sieve	<b>Clean Gravels:</b> Less than 5% fines <sup>C</sup>	$Cu \geq 4$ and $1 \leq Cc \leq 3$ <sup>E</sup>	GW	Well-graded gravel <sup>F</sup>	
			$Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ <sup>E</sup>	GP	Poorly graded gravel <sup>F</sup>	
		<b>Gravels with Fines:</b> More than 12% fines <sup>C</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>F, G, H</sup>	
			Fines classify as CL or CH	GC	Clayey gravel <sup>F, G, H</sup>	
	<b>Sands:</b> 50% or more of coarse fraction passes No. 4 sieve	<b>Clean Sands:</b> Less than 5% fines <sup>D</sup>	$Cu \geq 6$ and $1 \leq Cc \leq 3$ <sup>E</sup>	SW	Well-graded sand <sup>I</sup>	
			$Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ <sup>E</sup>	SP	Poorly graded sand <sup>I</sup>	
		<b>Sands with Fines:</b> More than 12% fines <sup>D</sup>	Fines classify as ML or MH	SM	Silty sand <sup>G, H, I</sup>	
			Fines classify as CL or CH	SC	Clayey sand <sup>G, H, I</sup>	
<b>Fine-Grained Soils:</b> 50% or more passes the No. 200 sieve	<b>Silts and Clays:</b> Liquid limit less than 50	<b>Inorganic:</b>	$PI > 7$ and plots on or above "A" line	CL	Lean clay <sup>K, L, M</sup>	
			$PI < 4$ or plots below "A" line <sup>J</sup>	ML	Silt <sup>K, L, M</sup>	
		<b>Organic:</b>	Liquid limit - oven dried	< 0.75	OL	Organic clay <sup>K, L, M, N</sup>
			Liquid limit - not dried			Organic silt <sup>K, L, M, O</sup>
	<b>Silts and Clays:</b> Liquid limit 50 or more	<b>Inorganic:</b>	$PI$ plots on or above "A" line	CH	Fat clay <sup>K, L, M</sup>	
			$PI$ plots below "A" line	MH	Elastic Silt <sup>K, L, M</sup>	
		<b>Organic:</b>	Liquid limit - oven dried	< 0.75	OH	Organic clay <sup>K, L, M, P</sup>
			Liquid limit - not dried			Organic silt <sup>K, L, M, Q</sup>
<b>Highly organic soils:</b>	Primarily organic matter, dark in color, and organic odor			PT	Peat	

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve.

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

<sup>F</sup> If soil contains  $\geq 15\%$  sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains  $\geq 30\%$  plus No. 200 predominantly sand, add "sandy" to group name.

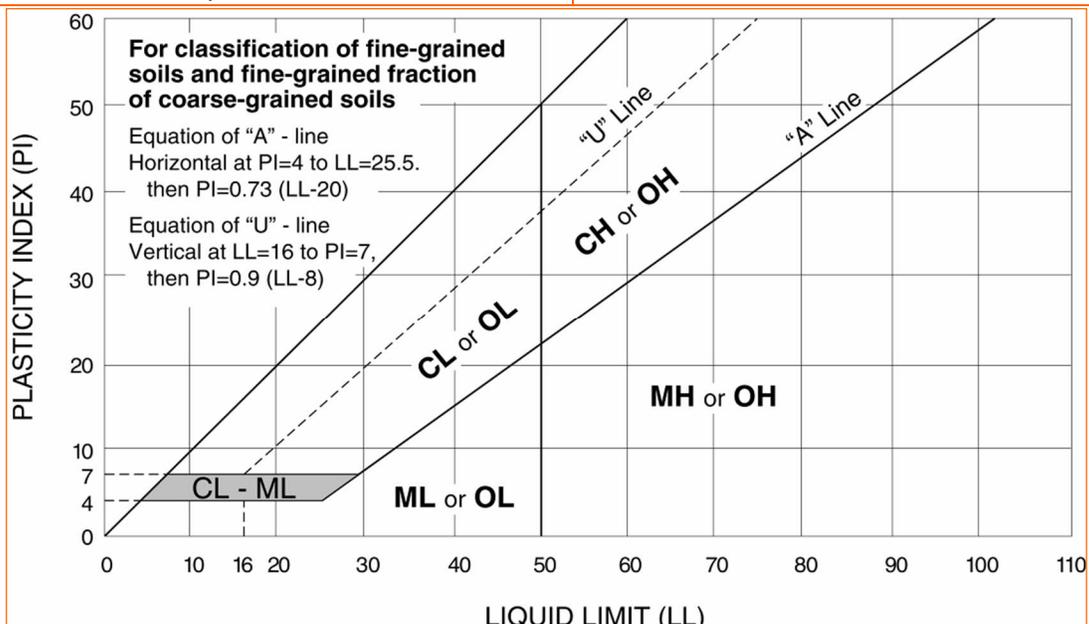
<sup>M</sup> If soil contains  $\geq 30\%$  plus No. 200, predominantly gravel, add "gravelly" to group name.

<sup>N</sup>  $PI \geq 4$  and plots on or above "A" line.

<sup>O</sup>  $PI < 4$  or plots below "A" line.

<sup>P</sup>  $PI$  plots on or above "A" line.

<sup>Q</sup>  $PI$  plots below "A" line.



**SAFeway STORE EXPANSION – OLYMPIC PLACE  
PRELIMINARY STORM DRAINAGE REPORT**

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**APPENDIX C – PRELIMINARY CIVIL DESIGN**



