MEMORANDUM

TO:          Mike Nilsson, P.E.
FROM:        Todd R. Whipple, P. E.
DATE:        09-05-2023
PROJECT NO:  22-3376
NAME:        Replat of Crest View Estates 1st Addition
REGARDING:   Strom Drainage Report

This report has been prepared by Elliott Whipple under the direction of the undersigned professional engineer whose seal and signature appears hereon:

INTRODUCTION:
The purpose of this drainage report is to identify drainage impacts resulting from the proposed Crest View Estates Short Plat. This drainage report will describe the drainage infrastructure improvements that are necessary to control and treat the stormwater runoff from the project site. The results reported will demonstrate there is no negative impact to the adjacent properties with the proposed development. The proposed project lies within the City of Spokane and will be designed in accordance with the Spokane Regional Stormwater Manual (SRSM), and treatment methods will be based on equation 6-1d; V=1815A, as outlined in the SRSM, and updated soil, and swale amendments per the 2019 Eastern Washington Stormwater Management Manual (EWSMM).

The proposed project is a 2-lot short plat development on an approximately 0.56 +/- acre site located off Tieton Avenue & Ash Street. The site is currently mostly developed with an existing grassed swale. The site is located within the City of Spokane and lies in the SE 1/4 of Section 24, T 26 N., R 42 E., W.M.

Table 1 -Site Summary

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Volume @ 0.5 ft of depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Required treatment volume</td>
<td>3,113 cf <strong>Generated by this Project</strong></td>
</tr>
<tr>
<td>B</td>
<td>Provided treatment volume</td>
<td>3,570 cf <strong>Provided by this Project</strong></td>
</tr>
<tr>
<td>C</td>
<td>Extra area if Any (A – B)</td>
<td>457 sf/cf <strong>Excess</strong></td>
</tr>
</tbody>
</table>
NARRATIVE:

Project Description:
- Parcel # 26241.0410 & 26241.0310
- Property address: 8903 N ASH ST & 8904 N ASH ST
- NE 1/4 of Section 24, T 26 N., R 42 E., W.M.
- Lot size: 24,393 sf or 0.56± ac
- Bio-retention swales proposed with 12” treatment depth, & 2.5-foot gravel gallery beneath pond
- See Geotech information below for surface soils
- Existing site is vegetated with, field grass, and weeds.

Geotechnical Information:
Per Liberty Geotech Report 04-05-2022
The geologic map indicated that the geologic unit was the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene). In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2021) was reviewed. The soil survey indicates that the soil unit is the Urban land-Seaboldt, warm, disturbed-Brincken, moist, disturbed complex consisting of ashy loam from the ground surface to a depth of 10 inches, loam from 10 inches to 16 inches, sandy loam from 16 inches to 23 inches, extremely gravelly sandy loam from 23 inches to 28 inches, and bedrock from 28 inches to 38 inches. The soil survey describes the soil as loess mixed with minor amounts of volcanic ash over glacifluvial deposits over residuum from basalt.

Per Budinger & Associates Report 09-29-1995
Their recommendations are the following:
“We recommend that accumulated stormwater be discharged to / lowly percolating retention swales utilizing permeability rates of the soil and topsoil or 0.5 in/hr, whichever is slower. Excess stormwater in the southern portion of the site may be discharged to the permeable sand and gravel through an infiltration gallery at a permeability of ks30 ft/day (15 in/hr).”

<table>
<thead>
<tr>
<th>Test Pit</th>
<th>Depth (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP-1</td>
<td>3.0</td>
</tr>
<tr>
<td>TP-2</td>
<td>4.0</td>
</tr>
</tbody>
</table>

The existing pond are not the same elevation. TP-1 is 1-foot +/- lower than TP-2. For this reason bedrock is expected to be the same elevation.

PRE-DEVELOPMENT BASIN INFORMATION:
As shown on the Pre-Developed Basin Map table 1 located in the Appendix, the site gradually slopes to the south at approximately 2% to 5%. Per the original civil engineering plans in 2003 the is conveyed to two (2) existing ponds with a gravel gallery and a discharge structure connected to the gravel galley. From the existing ground contours, it appears that the excess stormwater is absorb into the soil generated in the pre-developed condition.

Per the original storm report in 2003 they accounted for 41-acres of undeveloped grass field runoff to the existing crest view estates subdivision. Since then development has occurred in the 5-mile area and basin 1 has been developed into an existing subdivision, and basin 2 has also had portion of it developed. Leaving a 2.5-acres of undeveloped grass field that is being discharge to Crest view estates, and conveyed along the easter property line in a ditch to a ponds A and B per WCE proposed short plat located along Ash Street and Tieton. The below table reflect this reduction in runoff compared to the Taylor report.

<table>
<thead>
<tr>
<th>Pre-Basin</th>
<th>Ponds</th>
<th>Total Basin Area (sf)</th>
<th>Impervious Area (sf)</th>
<th>Pervious Area (sf)</th>
<th>PGIS Area (sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>N/A</td>
<td>312,811</td>
<td>79,800</td>
<td>233,011</td>
<td>79,800</td>
</tr>
<tr>
<td>Total</td>
<td>-</td>
<td>312,811</td>
<td>79,800</td>
<td>233,011</td>
<td>79,800</td>
</tr>
</tbody>
</table>
POST-DEVELOPMENT BASIN INFORMATION:
The Post-Development basins has been divided into 1 basin that contribute to the and existing Pond B, see Table 4,5 and 6 located in within storm drainage report for additional information.

Per the original report they accounted for 41-acres of undeveloped grass field runoff to the existing crest view estates subdivision. Since then development has occurred in the 5-mile area and basin 1 has been developed into an existing subdivision, and basin 2 has also had portion of it developed. Leaving a 2.5-acres of undeveloped grass field that is being discharge to Crest view estates.

Table 4 – Post-Development Project Site Basin Summary

<table>
<thead>
<tr>
<th>Basins</th>
<th>Ponds</th>
<th>Total Basin Area (sf)</th>
<th>Impervious Area (sf)</th>
<th>Pervious Area (sf)</th>
<th>PGIS Area (sf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin A</td>
<td>Pond A</td>
<td>312,811</td>
<td>74,700</td>
<td>238,111</td>
<td>74,700</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-</td>
<td>312,811</td>
<td>74,700</td>
<td>238,111</td>
<td>74,700</td>
</tr>
</tbody>
</table>

Table 5 – Post-Development Project Site Pond Summary

<table>
<thead>
<tr>
<th>Basins</th>
<th>Ponds</th>
<th>(Method 1815A (ae)) Treatment Area/Volume (square feet/cubic feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pond area</td>
</tr>
<tr>
<td>Basin A</td>
<td>Pond B</td>
<td>6,225 sf</td>
</tr>
<tr>
<td>TOTAL</td>
<td>-</td>
<td>6,225 sf</td>
</tr>
</tbody>
</table>

Refer to basin calculations in Appendix for areas and peak flows for all basins.
Critical Areas:
Based on the Critical Area Maps provided by Spokane County, (DNR Streams, Fish and Wildlife, Wetlands, Geo-hazard Area and Critical Aquifer Resource Area), there does not appear to be any critical areas on site. No inventoried wetlands or federal flood zones are present within the project site.

Down-Gradient Analysis:
Tieton Avenue & Ash Street Avenue Analysis:
The stormwater generated from Ash Street and Tieton avenue will continue to flow to the existing curb inlets. The existing curb inlets are not proposed to be removed or changed.

Methodology:
As required by the SRSM, and the EWLID the storm drainage facilities proposed for this site have been sized to attenuate the 10- and 50-year storm events using the Rational Method as outlined in Section 5.5 of the SRSM. Due to the small size of the onsite basins within this analysis, the Rational Method has been used to calculate peak flows and volumes. The peak flows and volumes for these storm events are shown in the calculations that are included within the Appendix of this report.

Water Quality Treatment:
The proposed storm drainage pond has been designed to provide treatment volume based on SWMMEW (Stormwater Management Manual for Eastern Washington) chapter 5.4.3, SSC-6 Soil Physical and Chemical Suitability for Treatment, and Equation 6-1d (V=1815A) of the SRSM, and as outlined in Section 6.7.1. see the below description for bio-infiltration swale.

Results:
As shown in Table 4 within this report we have provided the required treatment volume for the improvements proposed for the development. Table 6 below shows the onsite pond/swale storage summary for the 50-year storm events as well as the peak pond/swale depth.

Table 6 – Project Site Pond/Swale Storage Summary 100-Year Check

<table>
<thead>
<tr>
<th>Basin</th>
<th>50-YR Storm</th>
<th>Required</th>
<th>Provided</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vol. (cf)</td>
<td>Vol. (cf)</td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>13,759 cf</td>
<td>14,016 cf</td>
</tr>
</tbody>
</table>

NOTE: Pond Bottom Infiltration was not accounted for within the Bowstring Calculations

* An infiltration of 5 X 10^-7 cfs/sf was used on the updated bowstring
Operation Characteristics:
Bio-infiltration Swale
The stormwater generated by the existing asphalt and proposed driveways will be conveyed in the existing Ash street gutter, this storm water will be conveyed to the proposed existing pond "B" expansion via a curb inlet and types 2 under walk drain and a proposed catch basin that will have a proposed 8-inch ductile iron conveyance pipe that is interconnected to the updated existing pond “B” bottom. Once the storm water has been attenuated in the existing pond “B” the stormwater will infiltrate through the existing and proposed 12-inches of treatment soil until the depth of 6-inches. Once the stormwater exceeds the height of 6-inches, excess stormwater will spill into a single depth drywell and be discharged underground as required per the Spokane Regional Stormwater Manual, and the Eastern Washington Low Impact Development Guidance Manual.

Results:
Refer to Table 1 and Pre & Post basin tables in Appendix for Post-Development storm drainage information.
Perpetual Maintenance of Facilities:

There is an existing homeowner association and the swales within the proposed tracts “A” will be maintained by the existing HOA. The City of Spokane will not be liable for any maintenance or operation of the facilities. A maintenance plan will be provided to the owner if requested.

Offsite Easements:

There are no offsite easements required for this property.

Regional Facilities:

There are no known regional facilities that lie within or are affected by the project site.

CONCLUSION:

As required by the City of Spokane and the Spokane Regional Stormwater Manual, the onsite storm drainage facilities for this project will adequately collect, treat and discharge stormwater runoff generated by the site during the 50-year storm event. Also, the storm drainage facilities will contain and discharge the 50-year storm under non frozen conditions. Therefore, this project will have no adverse impact to adjacent and/or downstream properties.

Per the SRSM 2.2.4 Basic requirement No. 4 – Flow control. The proposed ponds as designed can attenuate the 50-year storm as designed. Should a higher order storm occur the proposed onsite pond will overflow to W. Tieton avenue. An overflow path of travel map is attached in the Appendix.
APPENDIX
VICINITY MAP
BASIN MAPS
BASIN SUMMARY SHEET
Whipple Consulting Engineers
Basin Calculation Worksheet

<table>
<thead>
<tr>
<th>WCE No.</th>
<th>Project Name</th>
<th>Date</th>
<th>TEW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crest View Short Plat</td>
<td>9/5/2023</td>
<td></td>
</tr>
</tbody>
</table>

Intensities from SRSM eqn. 5-13, per Table 5-7, Assumes Tc = 5 min

- 1 (2 yr) = 1.418 inches
- 1 (10 yr) = 2.619 inches
- 1 (25 yr) = 3.319 inches
- 1 (50 yr) = 3.843 inches

NOTE:

<table>
<thead>
<tr>
<th>Driveway Area</th>
<th>1,200 sf</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 House Area</td>
<td>1,200 sf</td>
</tr>
</tbody>
</table>

**SPOKANE COUNTY - SRSM - GRASSED PERCOLATION METHOD**

<table>
<thead>
<tr>
<th>Basin</th>
<th>Total</th>
<th>Access/Parking</th>
<th>Sidewalk</th>
<th>Lot #</th>
<th>DV</th>
<th>Buildings</th>
<th>Total</th>
<th>Total</th>
<th>Wtd</th>
<th>PGIS</th>
<th>Pond</th>
<th>Pond</th>
<th>2 yr</th>
<th>10 yr</th>
<th>25 yr</th>
<th>50 yr</th>
<th>100 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>sf</td>
<td>/Street (sf)</td>
<td>sf</td>
<td>#</td>
<td>sf</td>
<td>sf</td>
<td>sf</td>
<td>sf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre Onsite Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre A</td>
<td>312,811</td>
<td>26,700</td>
<td>0</td>
<td>18</td>
<td>21,600</td>
<td>21,600</td>
<td>69,900</td>
<td>242,911</td>
<td>0</td>
<td>69,900</td>
<td>5,825</td>
<td>2,913</td>
<td>3.23</td>
<td>5.97</td>
<td>7.57</td>
<td>8.76</td>
<td>9.99</td>
</tr>
<tr>
<td>Total</td>
<td>312,811</td>
<td>26,700</td>
<td>0</td>
<td>0</td>
<td>21,600</td>
<td>21,600</td>
<td>69,900</td>
<td>242,911</td>
<td>0</td>
<td>69,900</td>
<td>5,825</td>
<td>2,913</td>
<td>3.23</td>
<td>5.97</td>
<td>7.57</td>
<td>8.76</td>
<td>9.99</td>
</tr>
<tr>
<td>Post Onsite Flow</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POST A</td>
<td>312,811</td>
<td>26,700</td>
<td>0</td>
<td>20</td>
<td>24,000</td>
<td>24,000</td>
<td>74,700</td>
<td>238,111</td>
<td>0.33</td>
<td>74,700</td>
<td>6,225</td>
<td>3,113</td>
<td>3.35</td>
<td>6.19</td>
<td>7.84</td>
<td>9.08</td>
<td>10.35</td>
</tr>
<tr>
<td>Total</td>
<td>312,811</td>
<td>26,700</td>
<td>0</td>
<td>20</td>
<td>24,000</td>
<td>24,000</td>
<td>74,700</td>
<td>238,111</td>
<td>0.33</td>
<td>74,700</td>
<td>6,225</td>
<td>3,113</td>
<td>3.35</td>
<td>6.19</td>
<td>7.84</td>
<td>9.08</td>
<td>10.35</td>
</tr>
</tbody>
</table>

Q = CIA (cfs)
## WHIPPLE CONSULTING ENGINEERS

**POND VOLUME CALC SHEET**

**Project:** 22-3376  
**Designer:** TEW  
**Date:** 9/5/2023

| Basins | Ponds/Swales | Bottom Area (sf) | Treatment Area (w/ Side Slopes) | Squared Side (lf) | Pond Bottom Elevation at Drywell (ft) | Pond Drywell Elevation (avg) | Pond Inlet Elevation (avg) | Conic Volume to Rim (cf) | Side Slope Volume to Rim (cf) | Total Volume to Rim (cf) | Conic Volume to Inlet (cf) | Side Slope Volume to Inlet (cf) | Total Volume to Inlet (cf) |
|--------|--------------|------------------|---------------------------------|-------------------|-------------------------------------|----------------------------|---------------------------|--------------------------|----------------------------|------------------------------|-----------------------------|----------------------------|------------------------------|------------------------------|
| A      | A            | 6,890            | 7,139                           | 83.01             | 1000.00                             | 1000.50                    | 1001.80                   | 3,445                    | 125                        | 3,570                        | 12,402                      | 1,614                      | 14,016                      |
|        |              |                  |                                 |                   |                                     |                            |                           |                          |                            |                              |                             |                             |                             |                              |
|        |              |                  |                                 |                   |                                     |                            |                           |                          |                            |                              |                             |                             |                             |                              |
| Totals |              | 6,890            | 7,139                           |                   |                                     |                            |                           |                          |                            |                              |                             |                             | 3,570                        | 14,016                      |

* LID ponds do not calculate side slopes.
50 – YEAR STORM EVENT BOWSTRING CALCULATIONS
### PEAK FLOW CALCULATION
#### 50-Year Design Storm

#### CREST VIEW EST. S.PLAT

**BASIN: A**

- **Total Area:** 312,811 SF
- **Impervious Area:** 74,700 SF
- **Pervious Area:** 238,111 SF
- **W/ / C:** 0.33

#### WCE Applicable Travel Time Ground Cover Coefficients

- **K** (k/hr): 420
- **K** (K): 420
- **Slope:** 0.0040
- **Travel Time:** 9.52 Minutes
- **Reach 1:** Offsite also applicable for Pre-Developed Ty

#### Reaches

1. **Reaches 1:** Offsite also applicable for Pre-Developed Ty
   - **Length:** 800.00
   - **K:** 420.00
   - **Slope:** 0.0040
   - **Travel Time:** 9.52 Minutes

2. **Reach 2:** Finished Lot from House to Street
   - **Length:** 700.00
   - **K:** 2400.00
   - **Slope:** 0.0040
   - **Travel Time:** 1.68 Minutes

3. **Reach 3:** Gutter Flow to Inlet/Catch Basin
   - **Length:** 60.00
   - **K:** 3000.00
   - **Slope:** 0.0040
   - **Travel Time:** 0.14 Minutes

4. **Reach 4:** Pipe Flow/Pipe Reach (only need one if no Dia change)
   - **Length:** 0.00
   - **K:** 3000.00
   - **Slope:** 0.0040
   - **Travel Time:** 0.00 Minutes

5. **Reach 5:** Pipe Flow/Additional pipe reaches for other Dia
   - **Length:** 0.00
   - **K:** 3900.00
   - **Slope:** 0.0040
   - **Travel Time:** 0.00 Minutes

#### Detention Basin

- ** detention basin: DEW**
- **DESIGNER: TEW**
- **DATE: 5-Sep-23**

| Time Increment (min) | 10 |
| Time of Conc. (min) | 11.35 |
| Outflow (cfs) | 5,000.00 |
| Design Year Flow | 80 |
| Area (acres) | 7.18 |
| Impervious Area (sq ft) | 7470 |
| C Factor | 0.33 |
| Area * C | 2.363 |

#### PGIS Area

- **PGIS Area:** 7470

#### Rainfall Intensity Coefficients for Spokane

- **M_0:** 10.68
- **N_0:** 0.635

| Rainfall (weighted c) | Flow | 9.08 cfs |
| Flow (time of concentration) | 5.40 cfs |
| Time (min) | 11.35 | 925 |
| Intens. (cfs/ft) | 5.40 | 0 |
| Q (cfs) | 0 |
| Vol. (cu ft) | 0 |
| Vol. Out (cu ft) | 0 |
| Storage (cu ft) | 0 |

| Time (min) | 11.35 | 925 |
| Intens. (cfs/ft) | 5.40 | 0 |
| Q (cfs) | 0 |
| Vol. (cu ft) | 0 |
| Vol. Out (cu ft) | 0 |
| Storage (cu ft) | 0 |

---

*Whipple Consulting Engineers*

---

*1815A: TREATMENT REQUIREMENTS*

- **Minimum 1815A Volume Required:** 3,113 cu ft

*Provided Treatment Volume - Min. 3,570 cu ft*

STORAGE REQ. - 50 YEAR DESIGN STORM

- **Maximum Storage Required by Bowstring:** 13,759 cu ft

*Provided Pond Storage Volume to Inlet - Min. 14,016 cu ft

*Provided Drywell/Gallery Storage Volume: 14,016 cu ft*

**Total Provided Volume:** 14,016 cu ft
GEOTECHNICAL REPORT
Geotechnical Engineering Report
Crestview Estates 1st Addition
Ash Street and Tieton Avenue
Spokane County, Washington

Prepared For:
Austin J Fuller
Whipple Consulting Engineers, Inc.
21 South Pines Road
Spokane Valley, Washington 99206

Prepared By:

Liberty Geotechnical Engineering, Inc.
3012 N Sullivan Rd
Spokane Valley, Washington 99216
(509) 213-0400

Report Date: April 5, 2022
Job Number: 21425
Table of Contents

1.0 EXECUTIVE SUMMARY 2
2.0 PROPOSED CONSTRUCTION 2
3.0 GEOTECHNICAL EXPLORATION 2
   3.1 Geology, Topography, and Current Site Use 3
   3.2 Summary of Soil and Rock Encountered During Exploration 3
   3.3 Estimated Groundwater and Bedrock Elevations 3
4.0 GEOTECHNICAL RECOMMENDATIONS 4
   4.1 Earthwork 4
      4.1.1 Subgrade Preparation 4
      4.1.2 Earthwork Soil Products, Compaction, and Testing Frequency 4
   4.2 Drainage and Stormwater Infiltration Recommendations 5
5.0 DESIGN REVIEW AND CONSTRUCTION OBSERVATIONS 5
   5.1 Geotechnical Consultant versus Geotechnical Inspector 5
   5.2 Revisions and Transfer of Geotechnical Recommendations 6
7.0 REFERENCES 6

Appendices
Appendix A: Exploration Site Plan
Appendix B: Subsurface Exploration Logs
Appendix C: Photo Log
1.0 EXECUTIVE SUMMARY

The following geotechnical engineering report has been prepared for Crestview Estates 1st Addition in Ash Street, Spokane County, Washington. The following items have been identified at the project site and proposed construction that should be carefully considered during design and construction:

- Standing water was observed within the existing drywells located at the site. This may be due to fluctuations of groundwater and perching between the topsoil or undocumented fill, and bedrock at the site.
- Swales consisting of single or double-depth drywells were not feasible across the site due to the limiting layer of shallow bedrock. Drainage retention swales are recommended to treat and retain the stormwater.
- The area appears to be a stormwater disposal facility. Drain rock, filter fabric and drywells were observed in the area.
- Undocumented fill was observed in both test pits to a depth of 1 ½- to 2-feet below the ground surface. Undocumented fill may be reused as Embankment Fill provided it meets the requirements of Table 4.1.2.A of this report.

Liberty Geotech should be involved in the design development and earthwork construction to help ensure that the report recommendations are incorporated into the design and construction. Liberty Geotech is available to discuss these items further in-person or via a conference call.

2.0 PROPOSED CONSTRUCTION

The proposed construction consists of a stormwater drainage facility. Stormwater disposal will consist of swales and typical single or double-depth drywells position within the swale areas. The recommendations included in this report are based on a plat map prepared by Taylor Engineering, Inc. dated October 10, 2003.

3.0 GEOTECHNICAL EXPLORATION

Subsurface exploration was performed by excavating two test pits with a SANY SY26U mini-excavator. Subsurface exploration was performed at the project site on December 2, 2021. The test pits were excavated through the topsoil, undocumented fill, and bedrock and terminated on the rock surface. The contractor or client is recommended to notify Liberty Geotech if the soil conditions are different from those described in the following sections.

Throughout this report, test pits are abbreviated TP and are hyphenated with a numbering system that corresponds to Appendix A: Exploration Site Plan and Appendix B: Subsurface Exploration Results. The test pits depicted in Appendix A were located using the accuracy of a cell phone location system. The locations were not surveyed and the accuracy is expected to be
within 10-feet of the depicted location. Also, the elevation of each test pit was estimated using Google Earth™ mapping service with the GWS84 EGM96 geoid.

3.1 Geology, Topography, and Current Site Use

The Geologic map of the Spokane Northwest 7.5-minute quadrangle, Spokane County, Washington (Derkey, 2004) was reviewed to determine the geologic deposit at the site. The geologic map indicated that the geologic unit was the Priest Rapids Member of the Wanapum Basalt, Columbia River Basalt Group (middle Miocene). In addition, the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Web Soil Survey (NRCS, 2021) was reviewed. The soil survey indicates that the soil unit is the Urban land-Seaboldt, warm, disturbed-Brincken, moist, disturbed complex consisting of ashy loam from the ground surface to a depth of 10 inches, loam from 10 inches to 16 inches, sandy loam from 16 inches to 23 inches, extremely gravelly sandy loam from 23 inches to 28 inches, and bedrock from 28 inches to 38 inches. The soil survey describes the soil as loess mixed with minor amounts of volcanic ash over glaciofluvial deposits over residuum from basalt.

The two lots have existing drainage swales and both with a single-depth drywell. According to the historical aerial images, the earthwork construction for the residential development within the site's vicinity was between 2003 to 2006. The existing swales and drywells appeared to be placed within the site during that time. In addition, based on the topography obtained from Google Earth™, the site is relatively level with approximately five to seven feet of relief across the site.

3.2 Summary of Soil and Rock Encountered During Exploration

The soil encountered during the exploration is generally consistent with the geologic research. However, both test pits observed undocumented fill to depths of 2 ½- to 3-feet below the ground surface. The test pits encountered one foot of topsoil overlying a separation fabric overlying drain rock with a separation fabric overlying bedrock.

3.3 Estimated Groundwater and Bedrock Elevations

Groundwater was not observed in both test pits. However, there was standing water at the drywells during the exploration. This may be due to fluctuations of groundwater and perching between the topsoil and bedrock at the site.

According to the well logs in the vicinity of the site (Ecology), the static water level is approximately 37-feet below the ground surface. Seasonal and annual fluctuations in groundwater levels should be anticipated.

Both test pits met refusal due to basalt bedrock to depths ranging from three to four feet below the ground surface. In TP-2, residual bedrock was observed 2 ½-feet below the ground surface.
4.0 GEOTECHNICAL RECOMMENDATIONS

4.1 Earthwork

The following recommendations should be considered by the general contractors and earthwork subcontractors prior to providing a cost estimate for the earthwork on the project.

4.1.1 Subgrade Preparation

Clear and grub all vegetation, strip all topsoil. Topsoil and undocumented fill removal are estimated to be one to three feet across the site.

Liberty Geotech should be contacted once the subgrade areas have been exposed to review the subgrade conditions.

4.1.2 Earthwork Soil Products, Compaction, and Testing Frequency

Different soil products should be used for different applications. The following table presents recommendations for anticipated earthwork construction:

**Table 4.1.2.A - Soil product selection.**

<table>
<thead>
<tr>
<th>Soil Product</th>
<th>Project Use</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment Fill</td>
<td>Utility trench backfill</td>
<td>Soil classified as:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- GP-GM or GW-GM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- GM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- SP-SM or SW-SM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- SM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- ML</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil should have less than 6% organic deleterious material, and all material larger than 3-inches in diameter.</td>
</tr>
</tbody>
</table>

The following table provides compaction recommendations specific to ASTM D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort. All fill products should be compacted in lifts of soil not exceeding 12 inches measured prior to compaction.

**Table 4.1.2.B - Compaction recommendation.**

<table>
<thead>
<tr>
<th>Project Use</th>
<th>Recommended Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior wall backfill.</td>
<td>92 percent of the maximum dry density of Modified Proctor.</td>
</tr>
<tr>
<td>Utility trench backfills.</td>
<td></td>
</tr>
<tr>
<td>Non-structural fill areas.</td>
<td>80 to 85 percent of the maximum</td>
</tr>
</tbody>
</table>
Vegetated areas. dry density of Modified Proctor.

If more than 30 percent of native or imported Structural Fill material is retained on the ¾" sieve, ASTM D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort is not recommended to be used. In this case, a soil-specific method specification can be developed. A nuclear density gauge can be used during earthwork operations to establish a moisture and compaction method that provides an acceptable maximum dry density. Method specification earthwork operations are recommended to have full-time soil testing to ensure adequate compaction.

The soil products are recommended to have passing compaction testing results at the following frequency to ensure the soil is uniformly meeting compaction requirements. Failing test results should be retested after additional compactive effort and, if necessary, water is added. At least 90% of the compaction testing results must achieve the required maximum dry density.

Table 4.1.2.C - Testing Frequency.

<table>
<thead>
<tr>
<th>Project Use</th>
<th>Testing Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility trenches for every two vertical feet of trench backfill.</td>
<td>100 lineal feet and a minimum of 2 tests.</td>
</tr>
</tbody>
</table>

The jurisdictional requirements should be conformed to if there is a conflict with the requirements of Table 5.1.2.C. Excavations deeper than four feet must have adequate trenching protection or be sloped back in accordance with state and federal requirements in order to be compaction tested.

4.2 Drainage and Stormwater Infiltration Recommendations

Drainage retention swales may be utilized to treat and retain stormwater. The following recommendations should be used by the civil engineer to retention swales:

- The depth to a restrictive layer is at least three feet below the ground surface based on the shallow bedrock encountered at the site during the exploration.
- Swales should be located 10-feet from the edge of buildings and concrete hardscapes to minimize the effects of retention.

5.0 DESIGN REVIEW AND CONSTRUCTION OBSERVATIONS

5.1 Geotechnical Consultant versus Geotechnical Inspector

In order to retain Liberty Geotech as the geotechnical engineer of record, the client must contact Liberty Geotech or require their contractor to contact Liberty Geotech to perform the observations and notifications that are recommended within this report. Liberty Geotech is not the engineer of record and has no liability for the construction or design based on this report if
observations and material testing are not performed and meet the recommendations contained within this report. In addition, Liberty Geotech’s liability is limited to the authorized proposal dated November 24, 2021.

5.2 Revisions and Transfer of Geotechnical Recommendations

Liberty Geotech should be notified to update recommendations if the proposed development changes or subsurface soil or groundwater conditions vary from those described in this report. This report cannot be relied upon by property owners adjacent to this property without confirmation of their specific site soil conditions. Also, the report recommendations cannot be transferred to other business entities or subsequent property owners without written authorization. No warranty or certification of construction is provided with this report. Liberty Geotech should review the final construction drawings to confirm the incorporation of the recommendations of this report.

7.0 REFERENCES

ACI Committee 302. “Guide for Concrete Floor and Slab Construction.” ACI 302.1R-15. American Concrete Institute, P.O. Box 19150 Redford Station, Detroit, Michigan 48219.


APPENDIX A

Exploration Site Plan
APPENDIX B
Subsurface Exploration Logs
<table>
<thead>
<tr>
<th>MAJOR DIVISIONS</th>
<th>GRAPHIC SYMBOL</th>
<th>USC'S GROUP SYMBOL</th>
<th>SOIL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>COURSE GRAINED SOIL</td>
<td>GRAVEL</td>
<td>CLEAN GRAVEL</td>
<td>GW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GP</td>
<td>POORLY-GRADED GRAVEL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GM</td>
<td>SILTY GRAVEL, SILTY GRAVEL WITH SAND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GC</td>
<td>CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND</td>
</tr>
<tr>
<td></td>
<td>SAND</td>
<td>CLEAN SAND</td>
<td>SW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SP</td>
<td>POORLY-GRADED SAND</td>
</tr>
<tr>
<td></td>
<td>SAND WITH FINES</td>
<td>SM</td>
<td>SILTY SAND</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SC</td>
<td>CLAYEY SAND</td>
</tr>
<tr>
<td>FINE GRAINED SOIL</td>
<td>SILT AND CLAY LIQUID LIMIT LESS THAN 50%</td>
<td>ML</td>
<td>INELASTIC SILT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CL</td>
<td>LEAN CLAY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OL</td>
<td>ORGANIC SILT</td>
</tr>
<tr>
<td></td>
<td>SILT AND CLAY LIQUID LIMIT GREATER THAN 50%</td>
<td>MH</td>
<td>ELASTIC SILT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CH</td>
<td>FAT CLAY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OH</td>
<td>ORGANIC CLAY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PT</td>
<td>PEAT</td>
</tr>
</tbody>
</table>

ABBREVIATIONS:
BGS - BELOW EXISTING GROUND SURFACE
N.E. - NOT ENCOUNTERED
<table>
<thead>
<tr>
<th>USCS DESCRIPTION</th>
<th>ELEVATION (FT)</th>
<th>DEPTH (FT)</th>
<th>LITHOLOGY</th>
<th>SAMPLE INTERVAL</th>
<th>POCKET PEN. (TSP)</th>
<th>% PASSING NO 200 DRY</th>
<th>DENSITY (PCF)</th>
<th>MOISTURE CONTENT (%)</th>
<th>VOID RATIO (%)</th>
<th>ADDITIONAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDOCUMENTED FILL - Well-Graded Gravel (GW) Medium Dense, Black, Moist</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Test pit terminated at 3-feet bgs due to bedrock.</td>
</tr>
</tbody>
</table>

Client: Whipple Consulting Engineers, Inc.  
Test Pit Number: 1  
Project: Crestview Estates 1st Addition  
Project Number: 21425  
Equipment: SANY SY26U  
Date Excavated: 12/2/2021  
Depth to Groundwater: NE  
Logged By: TMC  
Sheet: 1 of 2
<table>
<thead>
<tr>
<th>USCS DESCRIPTION</th>
<th>ELEVATION (FT)</th>
<th>DEPTH (FT)</th>
<th>LITHOLOGY</th>
<th>SAMPLE INTERVAL</th>
<th>POCKET PEN. (TSP)</th>
<th>% PASSING NO. 200</th>
<th>DENSITY (PCF)</th>
<th>MOISTURE CONTENT (%)</th>
<th>VOID RATIO (%)</th>
<th>ADDITIONAL NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNDOCUMENTED FILL - Poorly-Graded Gravel (GP) Medium Dense, Black, Moist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEDROCK - Well-Graded Gravel (GW) Very Dense, Black, Dry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Test pit terminated at 4-feet bgs due to bedrock.</td>
</tr>
</tbody>
</table>

Client: Whipple Consulting Engineers, Inc.  Test Pit Number: 2
Project: Crestview Estates 1st Addition  Project Number: 21425
Equipment: SANY SY26U  Date Excavated: 12/2/2021
Depth to Groundwater: NE  Logged By: TMC

Sheet: 2 of 2
APPENDIX C

Photo Log
Appendix C: Photo Log

PHOTO 5: TP-1 STANDING WATER WITHIN DRYWELL

PHOTO 6: TP-2 LOCATION

PHOTO 7: TP-2 EXCAVATED SOILS AND BOULDERS

PHOTO 8: GEOFABRIC WITHIN TP-2
TAYLOR 1996 STORM REPORT
DRAINAGE REPORT
FOR
CRESTVIEW ESTATES

Taylor Engineering, Inc.
Civil Design and Land Planning
# TABLE OF CONTENTS

Project Description ................................................................. Page 1
Methodology ............................................................................. Page 1
Soils ......................................................................................... Page 1
Topographic Data ................................................................. Page 1
Demographic Data ............................................................... Page 2
Rainfall Data ........................................................................... Page 2
Methods of Runoff Control .............................................. Page 2
Methods of Disposal .......................................................... Page 2
Peak Flow, Volume, and Disposal Calculations .................. Page 3-5
  a. Hydrology Computations ........................................... Page 3, 4
  b. Inlet Capacities ......................................................... Page 5
  c. Ditch Capacities ......................................................... Page 5
Remarks .............................................................................. Page 5

# ATTACHMENTS

Vicinity Map ........................................................................... Attachment “A”
Soils Map ............................................................................... Attachment “B”
Geotechnical Report .......................................................... Attachment “C”
Road Plans
UIC
Underground Injection Control

Non-Municipal Stormwater

For UIC stormwater wells used along roads and in parking lots not owned by a county or city.

Registration Status

Site Number: 38047
Authorization Status: Pending
Comments:

Facility/Site Information

Facility Name: CrEview Homeowners Association
Address: 400 N Ash Street
PO Box/Suite/Building: 
City: Spokane
State: WA 99208
Phone: 509-458-5542
County: Spokane

Contact Information

Well Owner

Name: Terry Tombari
Organization: CrEview Homeowners Association
Address: 8205 N Division St
PO Box/Suite/Building: 
City: Spokane
State: WA 99208
Email: terry@tombariproperties.com
Phone: 509-458-5542

Property Owner

Name: Terry Tombari
Organization: CrEview Homeowners Association
Address: 8205 N Division St
PO Box/Suite/Building: 
City: Spokane
State: WA 99208
Email: terry@tombariproperties.com
Phone: 509-458-5542

Technical Contact

Name: Elliott Whipple
Organization: Whipple Consulting Engineers
Address: 21 S Pines Rd
PO Box/Suite/Building: 
City: Spokane Valley
State: WA 99206
Email: ewhipple@whipplece.com
Phone: 509-893-2617

Main Well Information

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Right-of-Way Location</th>
<th>Construction Date</th>
<th>EPA Well Type</th>
<th>Status</th>
<th>UIC Construction Type</th>
<th>Depth of UIC Well (ft.)</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Google Map Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>Stormwater (residential, paved streets, roofs, parking lots)</td>
<td>6-1-2003</td>
<td>Proposed Manhole with perforated pipe</td>
<td>4</td>
<td>47.738940 -117.438900</td>
<td>47.738940,-117.438900</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Right-of-way Location</th>
<th>Construction Date</th>
<th>EPA Well Type</th>
<th>Status</th>
<th>UIC Construction Type</th>
<th>Depth of UIC Well (ft.)</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Google Map Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Stormwater (residential, paved streets, roof, parking lots)</td>
<td>6/1/2003</td>
<td>Proposed</td>
<td>Manhole with perforated pipe</td>
<td>4</td>
<td>47.739003</td>
<td>-117.435650</td>
<td><a href="https://google.com/maps/place/47.739003,-117.435650/@47.739003,-">https://google.com/maps/place/47.739003,-117.435650/@47.739003,-</a></td>
<td></td>
</tr>
</tbody>
</table>

**Main Well Information (cont.)**

<table>
<thead>
<tr>
<th>Well Name</th>
<th>IT constructed in accordance with approved stormwater manual?</th>
<th>Within 1000 feet of surface water?</th>
<th>Within 100 feet of a drinking water well or spring?</th>
<th>Is High Susceptible Aquifer?</th>
<th>Is Confining Layer Present?</th>
<th>Zoning</th>
<th>Within a Ground Water Protection Area?</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Residential</td>
<td>Critical Aquifer Recharge Area</td>
</tr>
<tr>
<td>01</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Residential</td>
<td>Critical Aquifer Recharge Area</td>
</tr>
</tbody>
</table>

**Documents**

<table>
<thead>
<tr>
<th>Document Type</th>
<th>Document</th>
<th>Uploaded By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous Support Documents</td>
<td>ENG - Street, 2003070, ASH, STRONG, STREET PLAN AND PROFILE.pdf</td>
<td>whipple on 9/5/2023 11:52:10 AM</td>
</tr>
<tr>
<td>UIC Drainage Plans</td>
<td></td>
<td>Choose File</td>
</tr>
</tbody>
</table>
I hereby certify that the information contained in the above referenced registration is true and correct to the best of my knowledge.

Elliott Whipple  
Name of legally authorized representative

Signature of legally authorized representative

Title

Date 09/05/2023