Preliminary Drainage Report

PREPARED FOR:

Central Kitsap School District
PO Box 8
9210 Silverdale Way NW
Silverdale, WA 98383

PROJECT:

Central Kitsap
High School and Middle School
3700 NW Anderson Hill Road
Silverdale, WA 98383
2160254.10

PREPARED BY:

Michael Hager, EIT
Project Engineer

REVIEWED BY:

Doreen S. Gavin, PE, LEED AP BD+C
President

DATE:

December 2016

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President

DATE:

December 2016

12/13/2016

DOREEN S. GAVIN
23467

I hereby state that this Preliminary Drainage Report for the Central Kitsap High School and Middle School project has been prepared by me or under my supervision, and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that Kitsap County does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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1.0 Proposed Project Description

This Preliminary Drainage Report accompanies the Conditional Use Permit (CUP) submittal for the proposed redevelopment of the Central Kitsap High School and Middle School sites. The Central Kitsap School District will be replacing several aged buildings at the Central Kitsap High School (CKHS) and Central Kitsap Middle School (CKMS) sites, and forming a centralized, shared, and integrated campus to better serve students, faculty, and the community. The construction and development will occur in multiple phases to accommodate students and maintain educational services during construction of the project.

The schools will be reconstructed and co-located into a new facility of approximately 325,000 square feet in the center of the campus with additional support facilities (i.e., parking and sports fields) for CKHS to the north and west, and CKMS to the south. Both existing schools will be operating during construction of the new school buildings and site improvements.

At build-out, onsite programming facilities for CKHS will include a new football/soccer field with synthetic turf and track, field lighting and seating for 1,500 spectators, two baseball fields, one softball field, one soccer field, and six tennis courts. Additionally, a new concession stand and a restroom facility are also possible. Programming facilities for CKMS will include one multi-purpose athletic field and track. At the CKMS, a bid alternate will be considered for a synthetic turf field and field lighting. Both schools will share a new joint-use performing arts center that will be co-located with the new CKHS gymnasium in the center of the campus.

In the future, the District also intends to construct additional ball fields (potentially synthetic turf) with associated parking at the site of the existing CKHS at the south end of the campus. The future ball field will be accessed via NW Bucklin Hill Road and NW Anderson Hill Road. Including new acquisitions, the project covers an area of approximately 59 acres. The following five tax parcels are included: 172501-4-003-2006, 172501-4-004-2005, 172501-4-001-2006, 172501-4-008-2001, and 172501-4-009-2000.

Construction will occur in phases to accommodate ongoing educational use of the facilities. The first phase will begin construction in April 2017 and the final phase is expected to conclude construction in the fall of 2019. The timing of the demolition of CKHS and construction of accessory ball fields at the south end of the site is undetermined at this time.

There is a moderate hazard slope mapped on the northeast portion of the site. A small portion of the southwest part of the site is mapped as a Category II Critical Aquifer Recharge Area, and just downstream and to the southwest of the site is the mapped 100-year floodplain. A Critical Areas Reconnaissance and Hydrologic Assessment of the project site and downstream drainage area was performed by Ecological Land Services, Inc. The site reconnaissance revealed no wetlands on the project site or in the immediate vicinity. A copy of the report is included in Appendix B.

Vehicular access for CKHS will primarily be via Frontier Road near the current CKMS driveway location, and access for CKMS will be provided via NW Anderson Hill Road at a new driveway, south of the existing Windy Ridge Road driveway. Driveway locations were established to meet sight distance requirements and optimize separation from the Anderson Hill roundabout and from other driveways. Vehicle loops for parents and visitors will be separated for each school, the CKHS loop to the north and the CKMS loop to the south.

The project includes construction of frontage improvements to NW Anderson Hill Road to include a 5-foot wide bike lane, 5-foot wide sidewalk, curb, and gutter. A southbound, left-turn, pocket lane will be added to accommodate access from NW Anderson Hill Road to the CKMS driveway. The frontage improvements will extend from the roundabout to the Bucklin Hill intersection.

Potentially, the south end of the improvements adjacent to the existing CKHS will be constructed in a later phase.

The existing impervious surface area onsite totals 16.22 acres (706,450 square feet). The proposed new and replaced impervious surface area onsite, including the synthetic turf fields, is 22.86 acres (995,800 square feet). The proposed project will add 6.64 acres (289,200 square feet) of new impervious surfaces to the onsite project area. For stormwater calculations, the proposed synthetic fields are included in the impervious area per direction provided by Kitsap County staff. The Existing Conditions Basin Map and Proposed Conditions Basin Map are included in Appendix A. The project is expected to begin construction in spring of 2017.

Utility improvements onsite will consist of a new water main loop connecting to the existing 12-inch line to the west (Frontier Place NW) and to the north of the property. The line will include 12 new fire hydrants and a fire connection to each building. Power and gas will also extend from Frontier Place NW. Sewer will connect to an existing sewer main in Anderson Hill Road.

This project falls under the Kitsap County definition of redevelopment and will be built to the criteria explained in the 2010 Kitsap County *Stormwater Design Manual* (all Minimum Requirements, MRs 1 through 9, for all new and replaced impervious areas). Storm design will incorporate two combination detention/infiltration ponds designed to provide flow control. Water quality will be provided in the form of bioretention facilities, wetponds, and one proprietary device.

2.0 Existing Conditions Summary

The schools are currently located at 3700 NW Anderson Hill Road and 10130 Frontier Place NW in the Silverdale Urban Growth Area of Kitsap County. CKHS is located in the southern portion of the property with access via NW Anderson Hill Road and NW Bucklin Hill Road, and CKMS is located to the north with access via Frontier Place NW. Also located onsite are the District’s transportation/bus barn facility, centralized kitchen, New Frontiers building, daycare portable and alternative high school (accessed via Frontier Place NW), and the Science Kit Building (accessed via NW Anderson Hill Road).

Onsite conditions include several buildings, driveways, parking lots, and athletic fields. While the majority of the site is developed, forested areas still exist along the east property line and to a limited extent along the west side of the project site. In general, the site topography slopes toward the south. The site slopes from a high of elevation 205 feet at the north property line to a low of 90 feet along the south property line, for a total change in elevation of 115 feet across the 2,600-foot length of the parcel. Single-family and multi-family residences border the project parcel to the north and east. County right-of-way borders the project site to the west and south.

A Critical Areas Reconnaissance and Hydrologic Assessment of the project site and downstream drainage area was performed by Ecological Land Services. The site reconnaissance revealed no wetlands on the project site or in the immediate vicinity. A copy of the report is included in Appendix B.

See Appendix A for the Existing Conditions Basin Map.

3.0 Soils

The USGS Geomorphic Map of the Kitsap Peninsula indicates that subsurface conditions at the site are a modified fill or grade sufficient to preclude inference of precursor surface soils. The USDA has the soils mapped as Alderwood across most of the site with some Kapowsin Soils to the south of the site. These soils are generally till soils. The Kitsap County National Resource

Conservation Soil Survey Map of the project site also indicates that the site soil types are mostly Alderwood and Kapowsin. See Exhibit A-7 for the soil survey of the project site.

A Preliminary Geotechnical Engineering Report was prepared for the project by Amec Foster Wheeler Environment & Infrastructure, Inc., dated October 18, 2016, and is included in Appendix B. The soil investigations observed Glacial Till in the majority of the explorations and Advance Outwash in explorations located at the southwest end of the site. Based on a recommendation within the geotechnical engineering report, we assumed an infiltration rate of 2.00 inches per hour (see Appendix B). Additional geotechnical investigations including in place infiltration tests and installation of groundwater observation wells will occur in late December 2016.

4.0 Wells and Septic Systems

A well located at the north end of the site serves a single-family residence. There is also a well located with the two residential parcels recently acquired and incorporated into this project site. Additionally, septic systems are associated with the existing residential lots, onsite and adjacent to the site.

5.0 Fuel tanks

Fuel tanks are located at the existing Transportation Facility, CKHS, CKMS, and at the Science Kit Building. All tanks will be demolished in accordance with State and County regulations for underground storage tanks. The fuel tanks are described below:

Central Kitsap High School: 3700 NW Anderson Hill Road, Silverdale, WA 98383

- One 300-gallon underground storage tank (UST) located on the west side of the auto shop and used for waste oil from the shop. The tank was installed in October 1997.
- Two 8,000-gallon heating oil tanks: Closed in place in 2005 and located next to boiler room.

Transportation Center: 10170 Frontier Place NW, Silverdale, WA 98383

- One 1,100-gallon waste oil storage tank located on the east side of the building, used for waste oil from the shop and installed in October 1997.
- One 12,000-gallon unleaded gasoline storage tank located on the north side of the building, used for District busses and vehicles, and installed in 1977 and upgraded in 1997.
- One 12,000-gallon diesel gasoline storage tank located on the north side of the building, used for District busses and vehicles, and installed in 1977 and upgraded in 1997.

Science Kit Building (former maintenance building; former bus garage): 3790 NW Anderson Hill Road, Silverdale, WA 98383

- One 1,000-gallon unleaded gasoline UST. Closed in place with sand and concrete slurry in 1990.
- One 1,000-gallon diesel UST (some notes say 3,000-gallon).
- One 400-gallon waste oil UST. Notes indicate filled in place.

Central Kitsap Middle School:

- One 8,000-gallon heating oil UST. Notes indicate it was closed in place with sand and concrete slurry. Located east of boiler room.
- One 675-gallon diesel oil UST shown on drawing next to the 8,000-gallon tank.

6.0 Offsite Drainage and Downstream Level 1 Analysis

The onsite drainage for the project site is divided into six separate basins with distinct discharge locations. Three basins are tributary to Strawberry Creek, and three other basins discharge through manmade conveyance to Dyes Inlet. There is little to no onsite run-on to the site. The drainage basin boundaries were determined through site visits and a review of survey drawings and County record drawings.

The drainage basins tributary to Strawberry Creek include three separate basins: Basin-N, Basin-W, and Basin-SW. Basin-N flows to the west into Frontier Place NW and discharges into Koch Creek about 150 feet downstream of the site. Basin-W sheet flows to the southwest and is collected in an onsite system draining toward NW Anderson Hill Road. The drainage is then piped under the County road and discharges into a ditch that flows to Strawberry Creek. Basin-SW flows to the south and connects to the County storm system in Anderson Hill Road, draining south and then west, entering Strawberry Creek about one-quarter mile downstream.

The three drainage basins directly connected to Dyes Inlet include Basin-E, Basin-S, and Basin-S Bucklin Hill Road. All three basins are tributary to the County storm system in Bucklin Hill Road and piped all the way to Dyes Inlet east of Silverdale Way.

Each of the drainage basins, the associated discharge location, and the downstream drainage system are described below and illustrated on Appendix A-2, Downstream Basin Map and Appendix A-3, Existing Conditions Basin Map.

The Level 1 downstream analysis included a review of available resources, visual inspections, and discussions with County personnel. The resources reviewed and the County staff interviewed include:

- Soils Information: Amec Foster Wheeler Environment & Infrastructure, Inc. prepared a Preliminary Geotechnical Engineering Report for the project site, which has been included in Appendix B.
- Kitsap County GIS maps were reviewed that show information for the existing sanitary and storm sewers, contours, easements, and streets. The maps assisted in onsite and offsite mapping of existing utilities and topographic conditions of the study area.
- Design and record drawings for the existing CKHS and CKMS.
- The topographic survey for the project site serves as the background for the design of the project.
- Kitsap County drainage drawings for NW Anderson Hill Road and Bucklin Hill Road.
- Critical Areas Reconnaissance and Hydrologic Assessment report prepared by Ecological Land Services, Inc.
- Meetings with Chuck Smiley, Jennifer Lawrence, and Shawn Alire, Kitsap County stormwater personnel.

6.1 Basin-N

The majority of the site lies in Basin-N. The existing Basin-N is about 27 acres. This basin area includes the Transportation Facility, Middle School Facilities (along with the soccer/football fields, track, and half of the baseball field), Food Service Facilities, and Alternate School Facilities. Existing collection systems drain these areas to the west and into the Frontier Place NW public storm system. Drainage from Basin-N enters the County storm system at two different locations, one immediately west of the Food Services Building and another west of the Alternative High School building. The County storm pipes discharge into nearby Koch Creek near the Anderson Hill Road roundabout. Koch Creek flows southeasterly under Anderson Hill Road and enters Strawberry Creek before Silverdale Loop Road.

6.2 Basin-W

The area includes the southern half of the CKMS baseball field, along with the student upper parking lot, the drive aisle to the upper parking lot, a portion of the drive aisle to the two internal residential lots, the drive aisle parking and the Science Kit Building (a smaller high school located at the west of the site), the high school staff parking lot located at the southwest end of the project site, and the southwest portion of the high school baseball field. Drainage from this basin sheet flows or is collected in an onsite system draining to the southwest toward NW Anderson Hill Road. At NW Anderson Hill Road, the drainage gutter flows or is caught in catch basins and piped to a catch basin located at the access driveway to the Science Kit Building. From this catch basin, the drainage is piped under NW Anderson Hill Road to another catch basin, which outlets in about 10 feet to the west and into a well-vegetated ditch. The ditch travels west through some adjacent residential properties; it appears to be ditched about 500 feet before draining into the confluence of Koch Creek and Strawberry Creek.

6.3 Basin-SW

This basin includes the CKHS staff parking lot, as well as the hillside above, which sheet flows onto the parking lot. Drainage in this basin is collected in an onsite system, includes a short length of detention pipe, and drains to the 12-inch CMP County storm system in NW Anderson Hill Road. The public system is piped to the southeast for about 750 linear feet to the north side of the intersection with Silverdale Loop Road NW, where the drainage heads west in a 12-inch CMP under NW Anderson Hill Road. On the west side of Anderson Hill Road, the drainage pipe opens into a ditch flowing west. A driveway culvert was observed as partially filled with sediment and the roadside ditch is full of vegetation. The ditch and culvert are due for routine County maintenance. On the west side of the driveway, the drainage joins Strawberry Creek and flows south under Silverdale Loop Road. In approximately 2,500 feet, Strawberry Creek flowing southeast enters Dyes Inlet.

6.4 Basin-S

This basin includes the existing football field, track, and hillside above. Record drawings indicate the CKHS football field (Huey Field) is under-drained with perforated pipes connected with catch basins, which also pick up drainage from the track and surrounding grass. The track and field drainage system flows to the northeast of the field into a manhole. The manhole has 12-inch pipe that routes the drainage to the south. The outlet of this system is not apparent, but appears to discharge on the slope and flow east to the ditch located on the west side of Dahl Road. The Dahl Road ditch flows south into a culvert, which connects to the storm system in Bucklin Hill Road. The ditch and culvert appear to need routine maintenance to remove vegetation and sediment. No evidence of flooding or erosion was observed. From this point, the drainage is piped entirely to Dyes Inlet, as described further in Section 6.5, Basin-E.

6.5 Basin–E

This basin includes the two residential properties being redeveloped into this project, as well as the northeast portion of the CKHS baseball field. The residential areas sheet flow into the forested hillside to the east. A ditch alongside Dahl Road NW below this hillside collects and drains the runoff south toward NW Bucklin Hill Road.

The drainage enters the pipe system on the north side of the road and drains the runoff about 800 feet to the east before turning south to an outlet into Dyes Inlet, located just to the east of Bayshore Drive NW. Along Bucklin Hill Road, the conveyance systems consist of 18-, 21-, and 24-inch concrete pipes. To assess the condition of the downstream storm system, County drawings were studied, drainage reports for downstream projects were reviewed, and County personnel were interviewed. From this investigation, it appears the downstream County system is adequately handling storm flows.

6.6 Basin–S Bucklin Hill Road

This basin includes the existing CKHS buildings, driveways, and parking lots. This area is tributary to the Bucklin Hill Road drainage system described above.

6.7 Dispersed Areas

There are some areas shown within the basin limits that will not go to any of the water quality or flow control facilities. These areas are on the periphery of the project site and will disperse into the native vegetation.

7.0 Permanent Stormwater Control Plan

The project will collect stormwater in catch basins, downspouts, area drains, and under drains. The collected stormwater will be routed to stormwater quality control and stormwater quantity control facilities. The proposed stormwater improvements utilize detention and infiltration for flow control. Runoff treatment will be provided through bioretention facilities, wetponds, and one StormFilter, a proprietary device. The existing and developed impervious surfaces for the site are summarized in Appendix C. Western Washington Hydrology Model (WWHM) reports for the analysis are also included in Appendix C.

7.1 Stormwater Quality Control

Enhanced runoff treatment will be provided for surface flows from impervious areas subject to vehicular traffic (PGIS) and from large pollution generating pervious areas (PGPS), which discharge to Strawberry Creek. Additionally, surface runoff from the remaining north driveway to the Transportation Building will be collected and treated in trade for other driveways that are located below the proposed treatment facilities and cannot drain to the treatment facilities. A map of these areas is provided in Appendix C.

Basic runoff treatment will be provided for surface flows from pollution generating areas that discharge to the County drainage system in Bucklin Hill Road. Because drainage from synthetic turf fields and roofs does not require treatment, surface flows from these areas will not be treated. Instead, the drainage from non-pollution generating areas will be collected separately, combined with treated stormwater, and routed to the proposed ponds. Appendix C has maps of the non-pollution-generating surfaces (NPGS) conveyance system and the PGIS and PGPS conveyance systems.

There will be three wetpond facilities. Stormwater from the multipurpose field located in the northeast corner of the site, the north driveway, and the north event parking will drain to Wetpond A. A second facility, Wetpond B, is proposed to treat stormwater from the CKMS roadways and parking lot. A third facility, Wetpond C, will be constructed for treatment of the PGIS in the most southern parking lot that will drain south to the Bucklin Hill Road public system. The wetponds were sized to meet the requirements of Chapter 6 of the 2010 Kitsap County *Stormwater Design Manual*, based on the volume of runoff calculated from the mean annual storm event. The calculations are included in Appendix C and the design criteria are summarized below.

Wetpond A
Tributary Area = 375,988 square feet
Volume of Permanent Pool = 10,905 cubic feet

Wetpond B
Tributary Area = 168,607 square feet
Volume of Permanent Pool = 7,565 cubic feet

Wetpond C
Tributary Area = 111,450 square feet
Volume of Permanent Pool = 5,015 cubic feet

Additional runoff treatment facilities will be provided for drainage from other site areas that are not directed to any of the wetponds. These additional measures will include bioretention cells and proprietary devices. The facilities and devices are sized for the water quality design stormflow - the 91st percentile, 24-hour volume, as calculated from the continuous runoff model, WWHM. Bioretention will provide the enhanced treatment for the basins draining to the creek, and a StormFilter will be provided for a small parking area that will drain to the Bucklin Hill Road public drainage system. Design calculations for the proposed bioretention cells and other treatment facilities are included in Appendix C. Also in Appendix C is a Water Quality Map that shows the different areas going to each water quality facility.

7.2 Oil Control

The project site does not meet the definition of a high use site and therefore oil control is not required. Downturned elbows will be provided in two of the catch basins that are just upstream from each of the infiltration ponds. This will allow some separation of any oils before they reach the ground and give maintenance crews the opportunity to directly remove the oil.

7.3 Stormwater Quantity Flow Control

The flow control standard in Kitsap County code is Minimum Requirement (MR) 7, which specifies that stormwater discharging to streams shall match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 50 percent of the 2-year peak flow up to the full 50-year peak flow. Drainage Basins-N, -W, and -SW are tributary to Strawberry Creek and subject to MR 7.

Drainage Basins-E, -S, and -S Bucklin Hill Road discharge directly to Puget Sound. These basins are exempt from MR 7 if they meet the following criteria.

1. The natural discharge locations are preserved and no surface water is diverted away from other basins discharging to Koch or Strawberry Creek.

2. The downstream drainage course is comprised entirely of a manmade system of conveyance pipes.

3. The Level 1 downstream drainage analysis indicates the downstream system has adequate capacity.

4. The 100-year peak discharge from the redeveloped basin areas will not be increased.

For the basins discharging to a stream, the proposed quantity control method includes detention storage, infiltration into the underlying soils, and a controlled release to the downstream drainage system. Two flow control ponds are proposed: one will be located at the existing Alternative High School building, Pond West, and the second will be located at the CKHS staff parking lot, Pond South. These locations were selected because preliminary geotechnical explorations indicated the soils are suitable for infiltration and because they are located at the downstream end of the basin areas near the natural discharge locations.

The south end of the site where the existing CKHS is located will be redeveloped in a future phase. The District anticipates redeveloping this area with a synthetic turf ball field and associated parking. Preliminary drainage calculations were prepared to size a combination wetpond/detention pond, mitigating stormwater impacts when the parcel redevelops.

An approved continuous hydrologic runoff model, WWHM2012, was used to calculate the pre-developed and post-developed flow durations and peak discharges for all basins under pre-developed and developed conditions. The design criteria for each pond are summarized below and WWHM2012 calculations are included in Appendix C.

West Pond, Alternative High School Site

FC West Pond	
Detention Volume	136,620 cf
Tributary Area	25 ac
Side Slope	3:1
Bottom Length and Width	131 x132 ft
Infiltration Rate	2 iph
Outlet Control Structure	
Orifice #2 Diameter	2.1 in
Orifice #2 Height	2.3 ft
Orifice #1 Diameter	6.25 in
Orifice #1 Height	0 ft
Riser Diameter	18 in

South Pond, High School Parking Lot Site

FC South Pond	
Detention Volume	133,210 cf
Tributary Area	10.8 ac
Side Slope	3:1
Bottom Length and Width	116 x116 ft
Infiltration Rate	2 iph
Outlet Control Structure	
Orifice #3 Diameter	2.9 in
Orifice #3 Height	6.25 ft
Orifice #2 Diameter	4.78 in
Orifice #2 Height	5.67 ft
Orifice #1 Diameter	2 in
Orifice #1 Height	0 ft
Riser Diameter	18 in

Pond C, High School Site

WQ and FC Pond C	
Dead Storage/ WQ Volume	5,015 cf
Live Storage/FC Detention Volume	1,850 cf
Tributary Area	2.14 ac
Side Slope	3:1
Bottom Length and Width	35 x100 ft
Infiltration Rate	2 iph
Outlet Control Structure	
Orifice Diameter	2 in
Orifice Height	0 ft
Riser Diameter	48 in

7.4 Conveyance System

The proposed pipe system is a network of storm drain pipes, catch basins, trench drains, and outfalls. The conveyance systems will be designed to convey a peak stormwater rate resulting from a 100-year frequency storm event using WWHM to calculate the peak flow. From this preliminary engineering analysis, the Uniform Flow Analysis method was used to size the storm pipes. The final engineering analysis will include a Backwater Analysis.

7.5 Onsite Stormwater Management

The project will provide onsite stormwater management Best Management Practices (BMPs) to meet the requirements of new development. This will be accomplished through the use of post-construction soil quality and depth (BMP LID.02) to reduce the hydrologic disruption of the developed site. Additionally, onsite bioretention cells and infiltration will be used to the maximum extent feasible.

7.6 Erosion Control

The Construction Stormwater Pollution Prevention Plan (SWPPP) will provide BMPs to manage pollution-generating activities during construction. The BMPs will address preventing erosion and sediment transport. The Construction SWPPP will also contain BMP measures regarding spill prevention. The BMPs proposed to mitigate the potential for erosion and sedimentation impacts include marked clearing limits, construction entrances, temporary sediment ponds, interceptor swales and check dams, inlet protection for catch basins, plastic coverings for stockpiles and slopes, mulch and temporary hydroseeding, and ATB paving to be installed prior to the wet season. A completed “Construction Site Sediment Transport Potential Worksheet” is included in Appendix D

The District and the contractor will maintain general housekeeping procedures for preventing pollutants in and around the project site. Trash and debris will be collected regularly. A copy of the Construction SWPPP will be required to be kept onsite during and post construction. The contractor will be required to adhere to the requirements set forth in the Construction SWPPP.

8.0 Other Permits

Other permits that may be required for this project include: Conditional Use Permit, Site Development Activity Permit, Construction Stormwater Permit, Building Permit, Clearing and Grading Permit, Kitsap County Public Works Wastewater Permit for sanitary sewer service, water main extension from Silverdale Water District, Health Department approval for food serving, and State Environmental Policy Act (SEPA) approval.

9.0 Conclusion

This analysis is based on data and records either supplied to or obtained by AHBL. These documents are referenced within the text of the analysis. The analysis has been prepared using procedures and practices within the standard accepted practices of the industry.

AHBL, Inc.

Michael Hager, EIT
Project Engineer

MCH/lsk

December 2016

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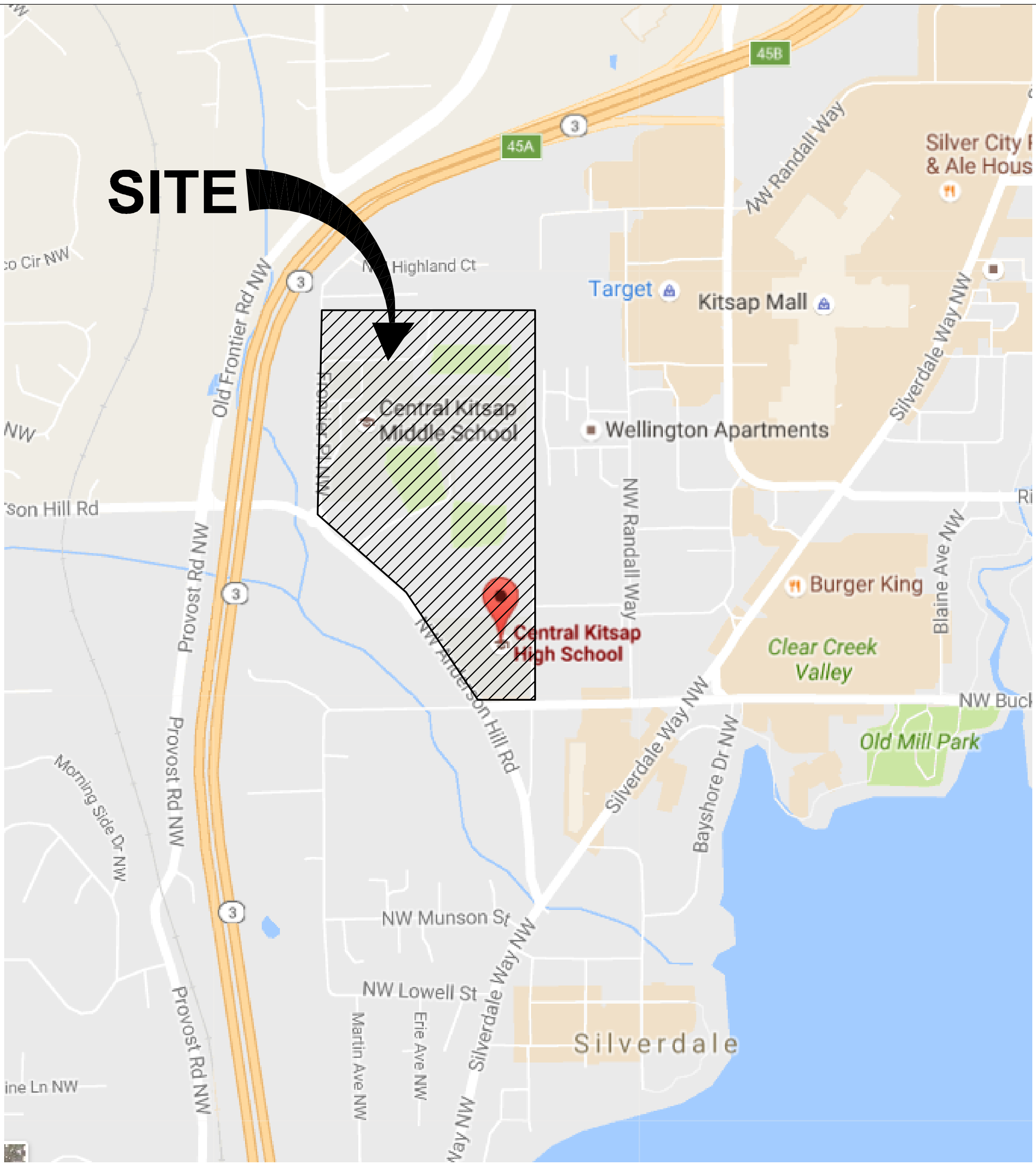
Appendix A

Exhibits



SITE ADDRESS:

3700 NW ANDERSON HILL RD, SILVERDALE, WA 98383

SECTION 17 TOWNSHIP 25N RANGE 1E

PARCEL NUMBER:

172501-4-011-2006
172501-4-008-2001
172501-4-009-2000

AHBL
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors
TACOMA · SEATTLE
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

VICINITY
MAP

A-1

N

AHBL

Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

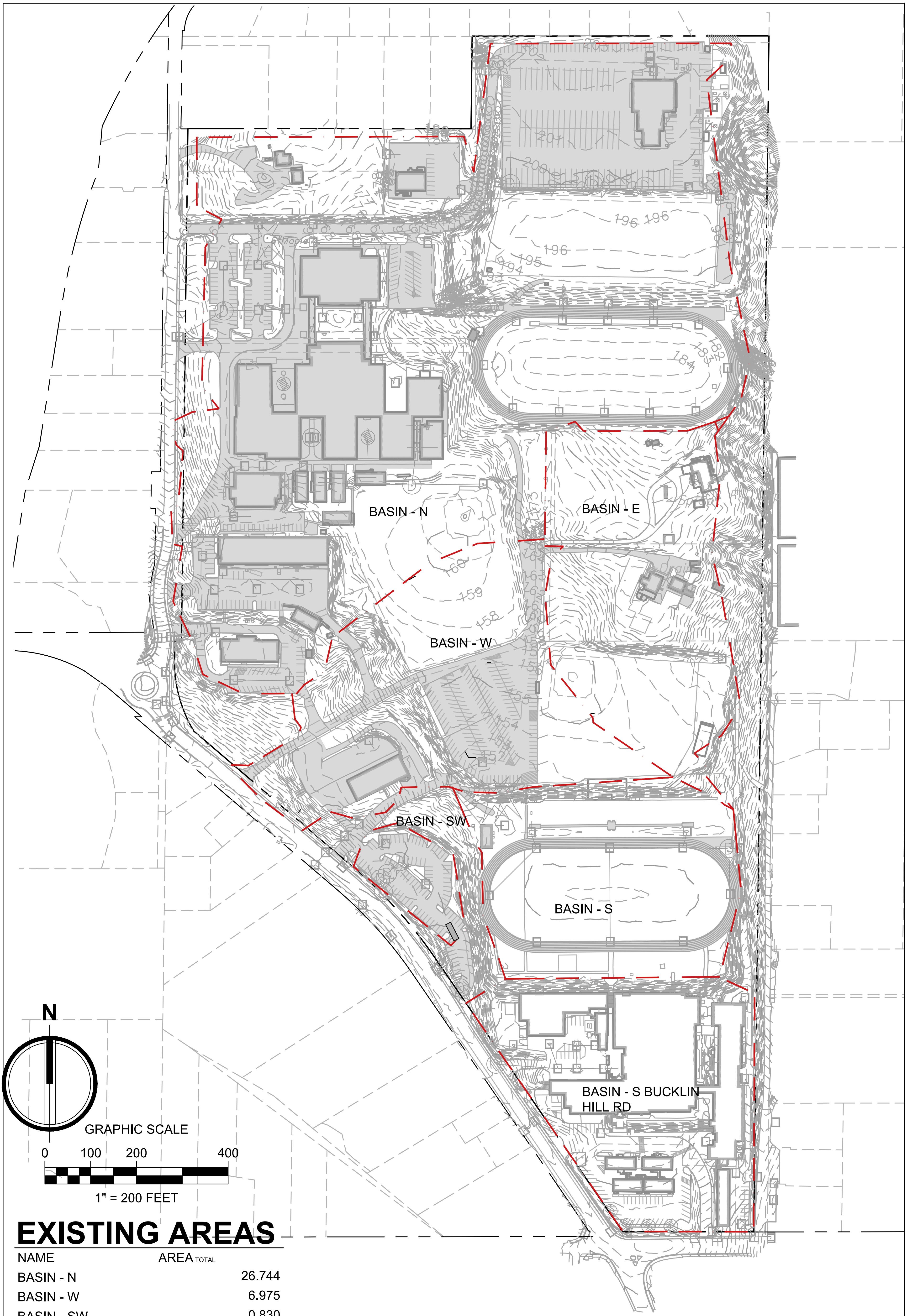
TACOMA · SEATTLE

2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

DOWNSTREAM BASIN MAP

A-2



EXISTING AREAS

NAME	AREA TOTAL
BASIN - N	26.744
BASIN - W	6.975
BASIN - SW	0.830
BASIN - S	11.218
BASIN - E	5.990

▨ = IMPERVIOUS

AHBL
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Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
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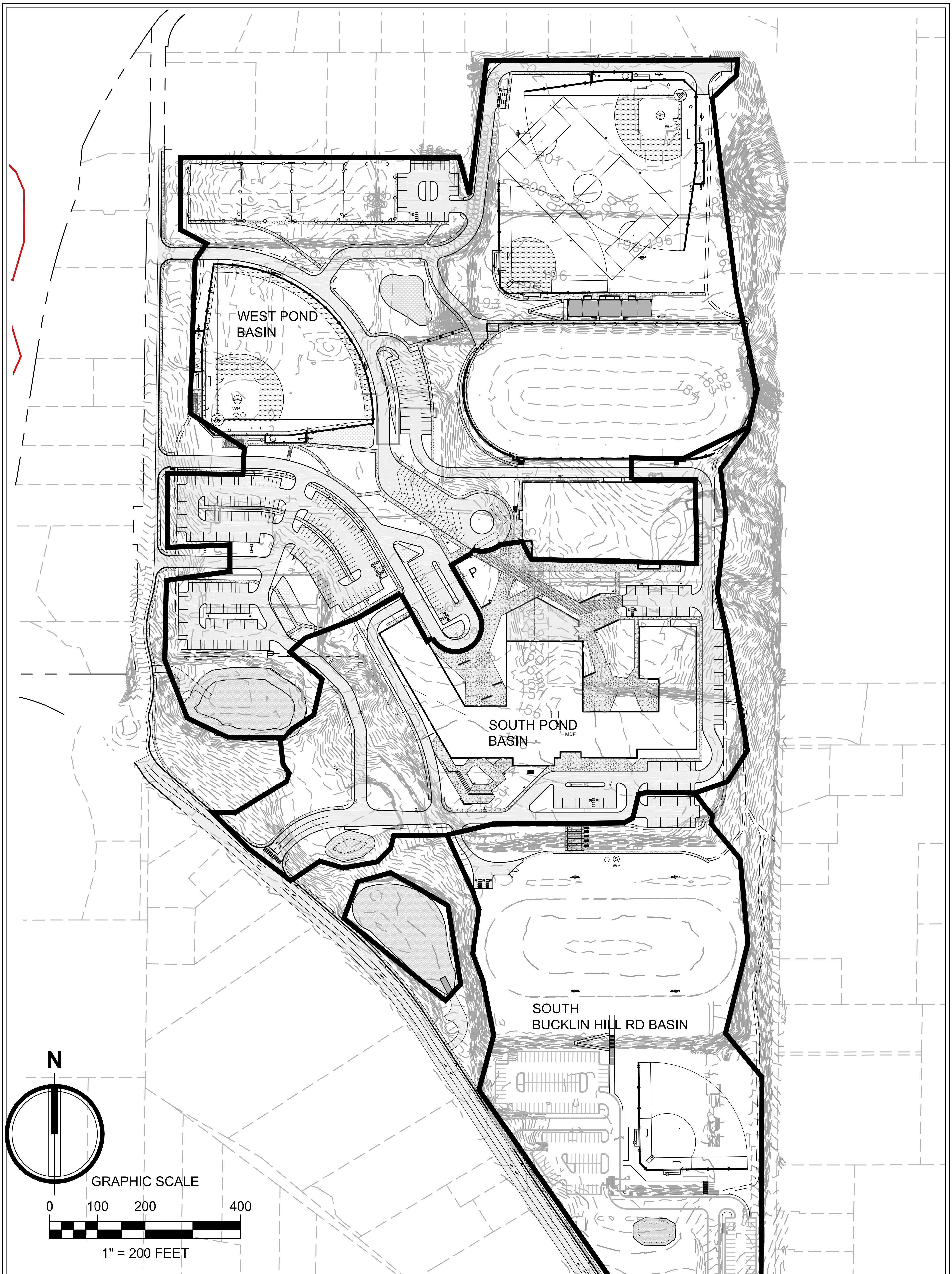
CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

EXISTING CONDITIONS
BASIN MAP

A–3



PROPOSED AREAS

NAME	AREA TOTAL
WEST POND BASIN	25.038
SOUTH POND BASIN	10.812
SOUTH BUCKLIN HILL RD BASIN	9.534

AHBL
TACOMA·SEATTLE
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
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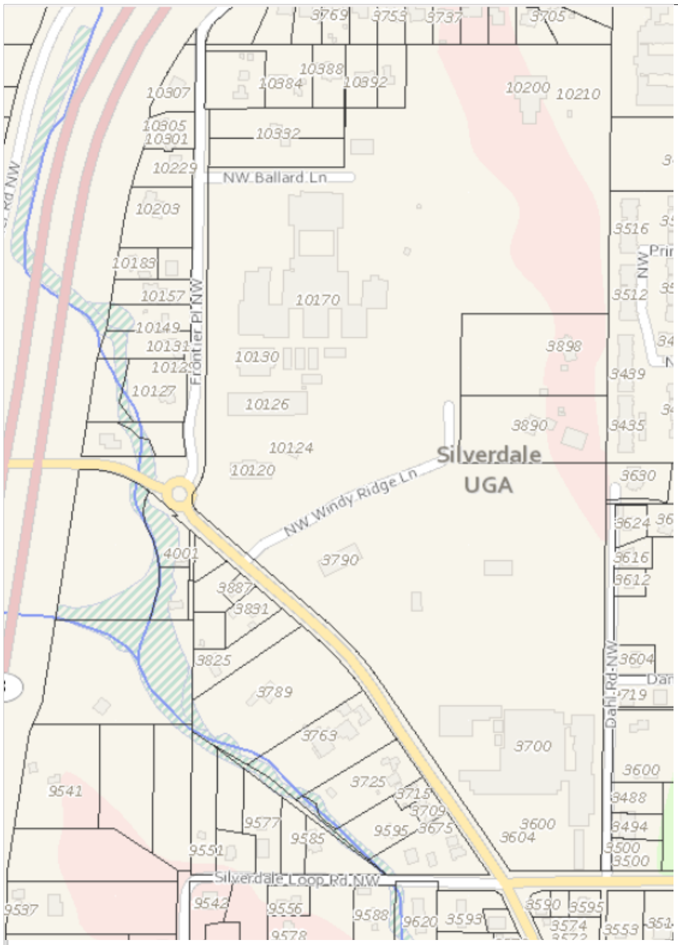
CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

PROPOSED CONDITIONS
BASIN MAP

A-4



Critical Areas

Waterbodies (defined in WAC 222-16-030)

▦ Includes DNR, NWI, and Surveyed Wetlands

Wetlands (DNR, NWI, Surveys)

▦ DNR, NWI, Surveyed Wetlands

FEMA Flood Hazard Areas

▨ 100 Year Floodplain

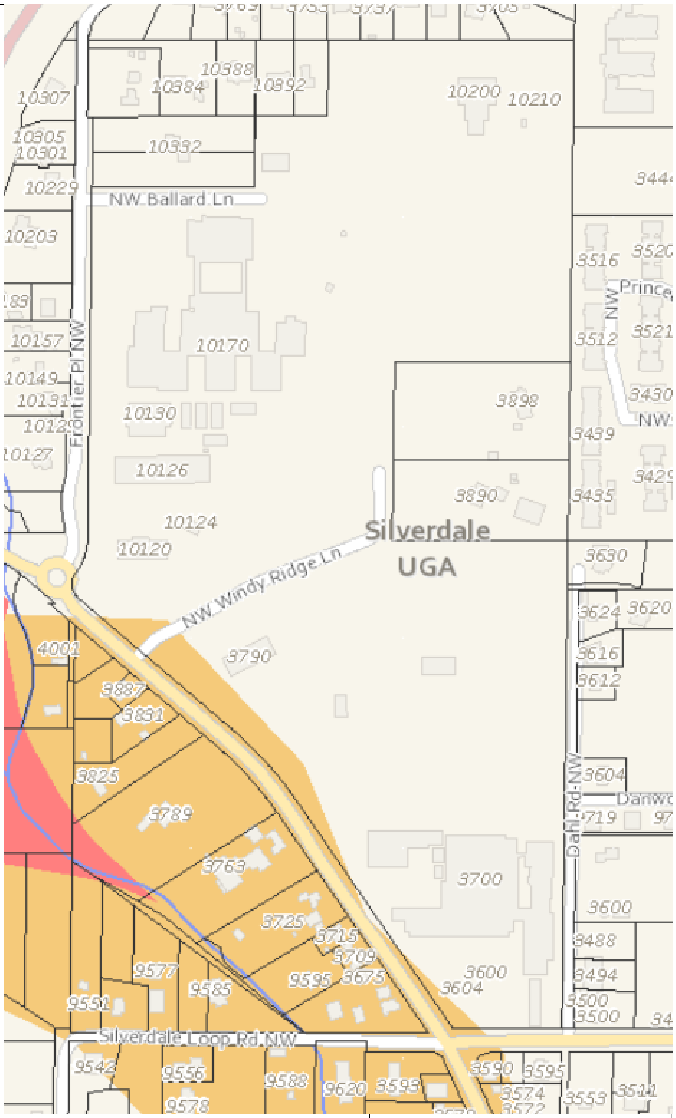
Hydric Soils (SCS Soil Survey)

🟩 Potential Wetlands

Geohazards

🟥 High Hazard Areas

◻ Moderate Hazard Areas



Critical Aquifers

Category I Critical Aquifer Recharge Areas

🟥

Category II Critical Aquifer Recharge Areas

🟧

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CENTRAL KITSAP
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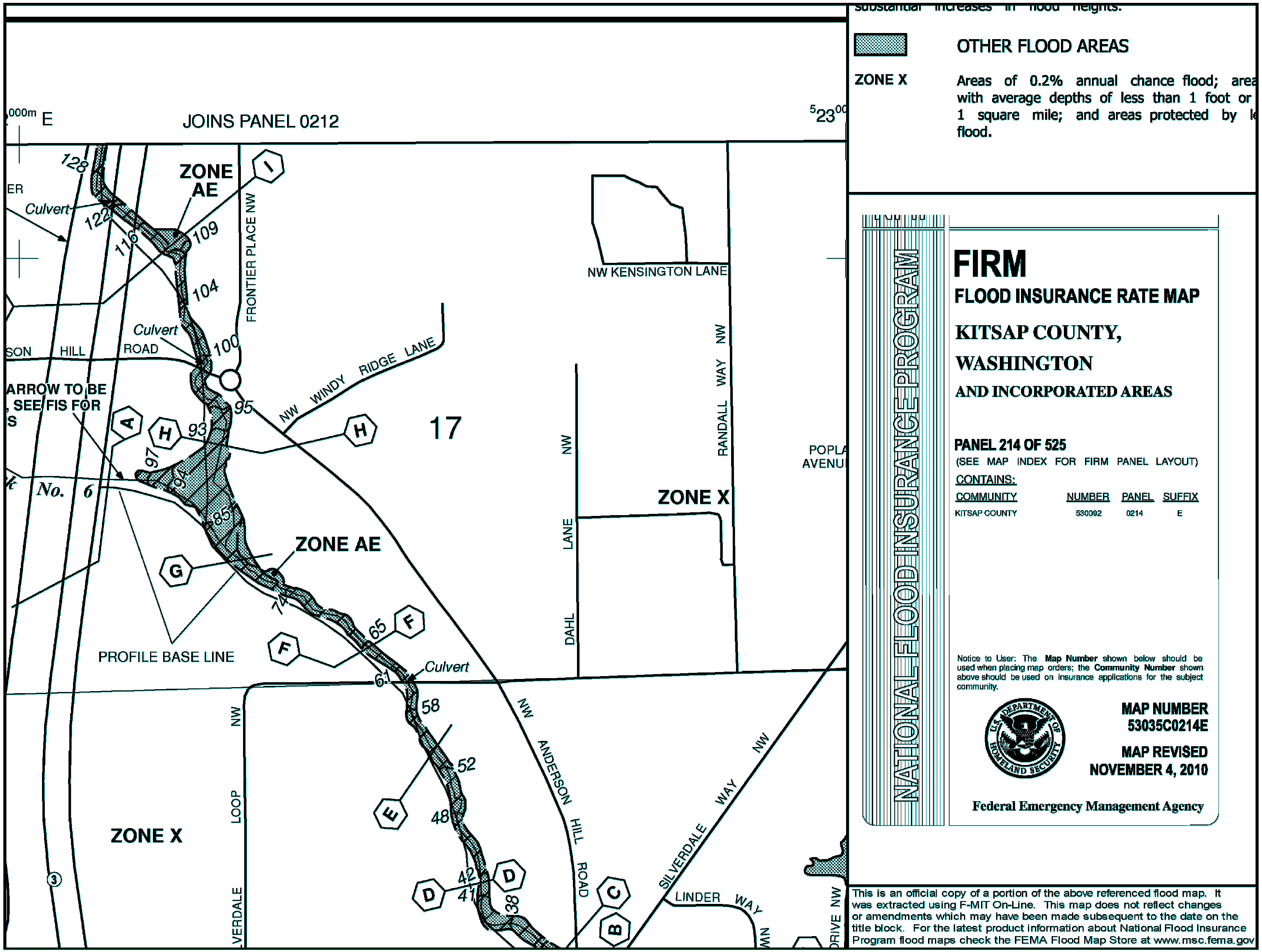
CRITICAL AREAS
MAP

A–5



substantial increases in flood heights.

▨ **OTHER FLOOD AREAS**

ZONE X Areas of 0.2% annual chance flood; area with average depths of less than 1 foot or 1 square mile; and areas protected by l flood.

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
KITSAP COUNTY, WASHINGTON
AND INCORPORATED AREAS

PANEL 214 OF 525

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
KITSAP COUNTY	530092	0214	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
53035C0214E

MAP REVISED
NOVEMBER 4, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

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CENTRAL KITSAP
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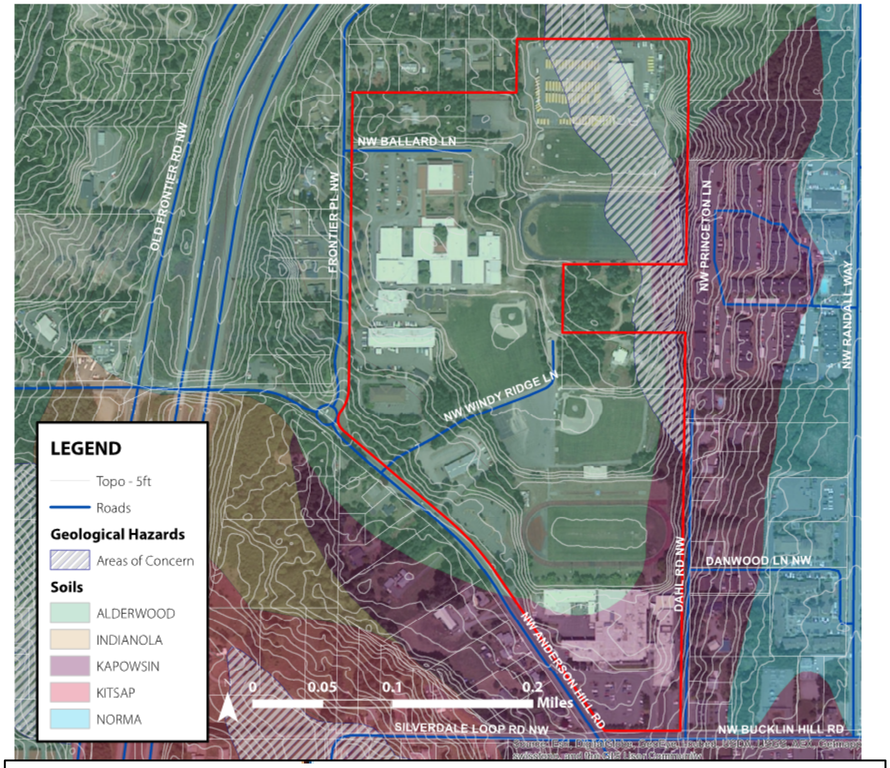
FEMA FLOOD
MAP

A-6



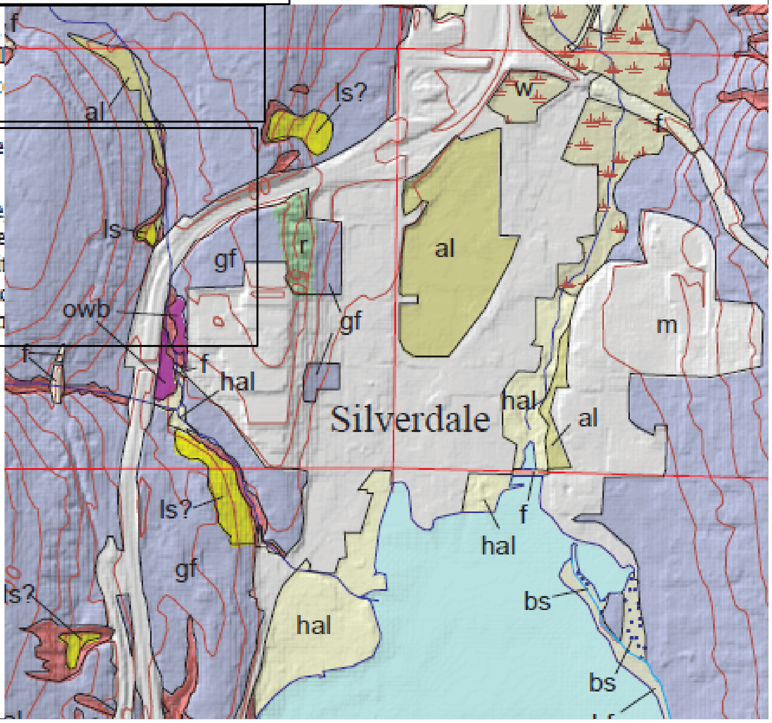
hal — **Holocene alluvial flat**—Stream valley floor. Recognized by low slope, planarity, and position in topographic lows along active drainage paths

gf — **Fluted glaciated surface**—Characterized by well-organized flutes that have elongation ratios (length/width) typically greater than 10. Flutes are typically hundreds of meters wide, heights are 10 to 30 m. Locally, mapped as:

m — **Modified land**—Filled and (or) graded area.
except along major roads and where fill
ficiently extensive to preclude inferenc
Locally, mapped as:

r — **Rilled slope**—Steep older, glaciated surface
minor parallel gullies

ls — **Landslide**—Surface of deep-seated landslide
scarps, bulbous toes, position in hillslope
rumpled surface. Queried where identi
certain. Some landslides, particularly th
upland, may be inactive and stable in cur



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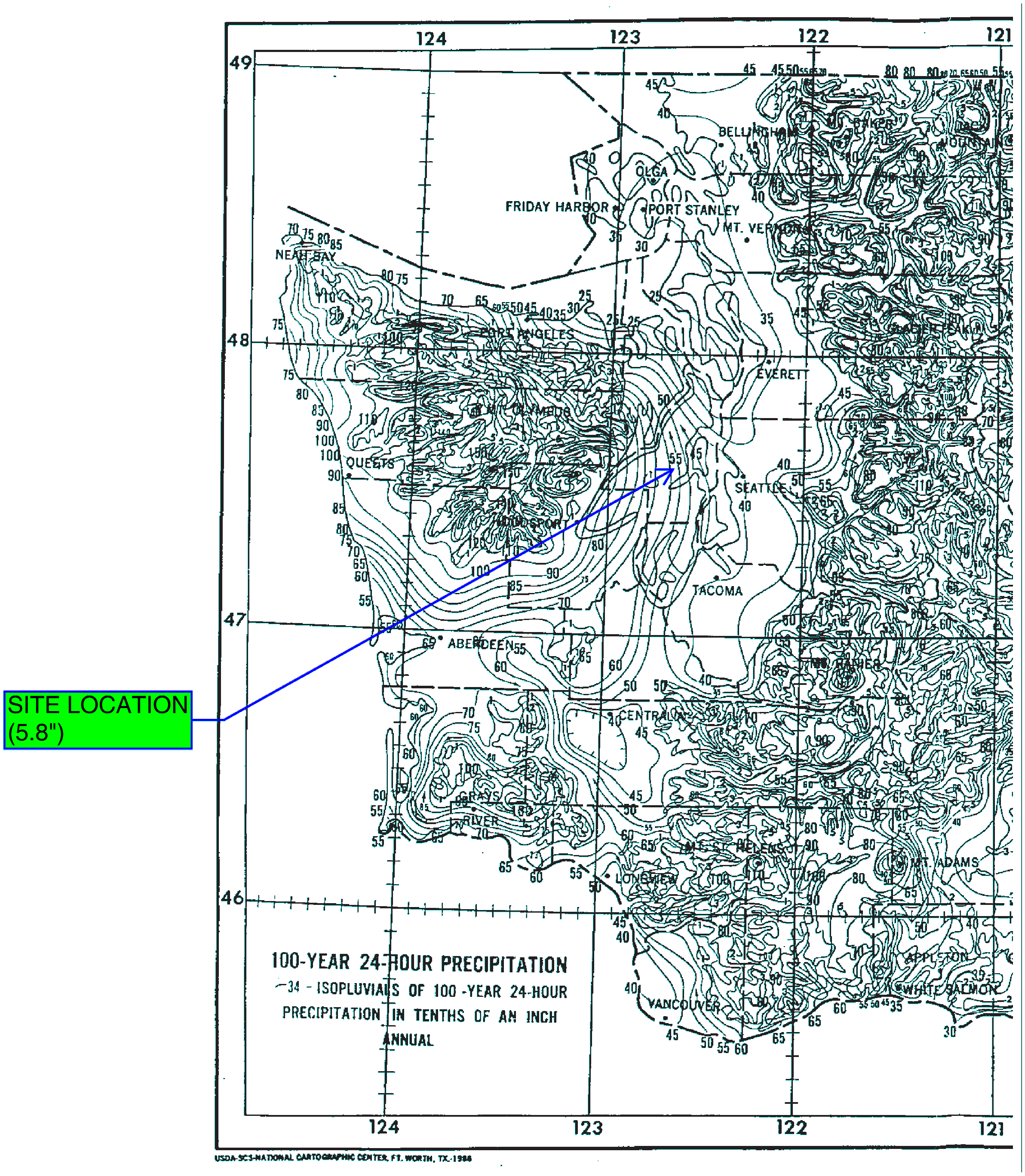
CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

SOILS
MAP

A–7

Western Washington Isopluvial 100-year, 24 hour



USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

Volume III – Hydrologic Analysis and Flow Control BMPs - December 2014
A-5

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CENTRAL KITSAP
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24-HR, 100-YR PRECIPITATION
ISOPLUVIALS MAP

A-8

Appendix B

Preliminary Geotechnical Engineering Report
Amec Foster Wheeler Environment & Infrastructure, Inc., October 18, 2016

Critical Areas Reconnaissance and Hydrologic Assessment
Ecological Land Services, Inc., October 26, 2016

October 18, 2016
Project No. 6-917-18096-0

Ms. Sydney Thiel
Project Manager
Central Kitsap School District #401
9102 Dickey Road NW
Silverdale, Washington 98383

Subject: **Preliminary Geotechnical Engineering Report**
Central Kitsap High School and Middle School Campus Redevelopment
10130 Frontier Place NW and 3700 NW Anderson Hill Road
Silverdale, Washington 98311

Dear Ms. Thiel:

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), is pleased to submit this report describing our preliminary geotechnical engineering evaluation for the Central Kitsap High School and Middle School campus redevelopment. Our report also integrates Amec Foster Wheeler's past exploration work at the project site to supplement our recent subsurface findings. The purpose of our evaluation was to derive preliminary conclusions and recommendations concerning earthwork, foundations, floors, retaining walls, utilities, paving, and stormwater infiltration for the planned campus redevelopment.

As outlined in our proposal letter dated July 11, 2016, our scope of work included field exploration, laboratory testing, geotechnical engineering, and report preparation. This report has been prepared for the exclusive use of Central Kitsap School District #401 (CKSD) and their consultants for specific application to this project, in accordance with generally accepted geotechnical engineering practice.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report, or any aspects of the project, please feel free to contact me.

Sincerely,
Amec Foster Wheeler Environment & Infrastructure, Inc.

Todd Wentworth, P.E.
Associate Geotechnical Engineer

11810 North Creek Parkway N
Bothell, Washington 98011
(425) 368-1000 Phone
(425) 368-1001 Facsimile
www.amecfw.com

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

Central Kitsap High School and Middle School Campus Redevelopment

10130 Frontier Place NW and 3700 NW Anderson Hill Road

Silverdale, Washington

Prepared for:

Central Kitsap School District #401
9102 Dickey Road NW
Silverdale, Washington 98383

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
11810 North Creek Parkway N
Bothell, Washington 98011

October 18, 2016

Project No. 6-917-18096-0

EXECUTIVE SUMMARY

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler), performed a preliminary geotechnical engineering evaluation for the Central Kitsap High School and Middle School (CKHS/MS) campus redevelopment project on behalf of Central Kitsap School District #401 (CKSD). This summary of project geotechnical engineering considerations is presented for introductory purposes and should be used only in conjunction with the full text of this report.

Project Description: Currently CKSD is considering three different schematic site plans for the new school campus configuration. In general, a combined high school and middle school building will be centrally located. Athletic fields will be reconfigured and/or improved, and new parking and bus access routes around the new school building will be provided off of NW Anderson Hill Road and Frontier Place NW. Stormwater detention facilities will be located within the southwest area of the campus.

Exploratory Methods: We explored subsurface conditions at the site by drilling 15 borings (B-1 thorough B-15) and advancing five hand augers (HB-1 through HB-5) on August 15 and 16, 2016, at strategic locations across the site. Our borings ranged in depth from 16.5 to 26.5 feet below the ground surface (bgs), while our hand borings ranged from 2.75 to 4.3 feet bgs. This report also includes data from 11 borings and four test pit exploration logs from earlier work at the site and two test pit exploration logs previously advanced adjacent to the east side of the school property.

Soil Conditions: Previous development of the site included cuts and fills to create terraces, as confirmed by our recent explorations which encountered 4 to 8 feet of fill in some of our explorations. The fill was medium dense, silty sand, and appears to be derived from on-site cut soils. The native, intact soil consisted of very dense, gravelly silty sand (Glacial Till) and was encountered in most of the explorations. In the southwest portion of the site, very dense sand (Advance Outwash) was encountered in the southwest portion of the site.

Groundwater Conditions: At the time of exploration (August 15 and 16, 2016), boring B-15, advanced in the southwest parking lot, encountered groundwater at approximately 18 feet below the ground surface. None of the other borings encountered groundwater at the time of drilling, however the drilling was done during the driest season of the year, and groundwater is probably higher during the wet season.

Foundations: For planning purposes, conventional spread footings cast atop the existing medium dense silty sand or newly placed structural fill may be designed for an allowable bearing pressure of 2,500 pounds per square foot (psf). Foundations bearing directly on dense to very dense glacial till or advance outwash can be designed with a bearing capacity of 5,000 psf. All footing subgrades should be verified during construction.

Floors: The new structures will be able to use soil-supported, slab-on-grade floors. The floor section should be designed to include a minimum 4-inch layer of washed crushed rock as a capillary break and a vapor barrier placed on top of the capillary break layer.

Pavements: For preliminary design of access drives and parking lots, we recommend a minimum pavement section of 3 inches of asphalt, over 4 inches of base course for car traffic; and 4 inches of asphalt, over 6 inches of base course for access drives with bus and truck traffic.

Stormwater Infiltration: Stormwater infiltration at the site may be feasible in the advance outwash soils, depending on the planned location and depth of infiltration facilities. For preliminary design, we estimate an infiltration rate of 2 inches per hour. Infiltration is less likely in other areas with glacial till. We recommend in situ testing at specific locations and depths where stormwater infiltration is desired, in order to estimate long-term design infiltration rates. Observation wells should be installed in specific locations of infiltration facilities, so that seasonally high groundwater levels can be measured.

On-site Soil Considerations: The on-site soils have a high percentage of fines (silt and clay), which means compaction can be accomplished only within a narrow range of moisture contents. Therefore, the contractor should take precaution to protect any exposed subgrades. Ideally, earthwork would be scheduled for the summer and fall months, when drier weather would maximize the potential to reuse on-site soils.

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PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
Central Kitsap High School and Middle School Campus Redevelopment
Silverdale, Washington

1.0 SITE AND PROJECT DESCRIPTION

Central Kitsap School District (CKSD) plans to redevelop the existing Central Kitsap High School campus, Central Kitsap Middle School campus, bus maintenance facility, and a number of adjacent parcels(collectively abbreviated as CKHSMS). The high school campus is located at 3700 NW Anderson Hill Road, and the middle school campus is located at 10130 Frontier Place NW in Silverdale, Washington (Figure 1) (Latitude 47.65 N, Longitude 122.70 W).

Figure 2 shows the general layout and existing features of the site. The project site boundaries are generally delineated by NW Anderson Hill Road and Frontier Place NW to the west, single-family residences to the north, apartment complexes and single family residences to the east, and the existing Central Kitsap High School building to the south. The Central Kitsap High School building is not part of the current redevelopment project. The property planned for redevelopment encompasses approximately 56 acres. The middle school campus is in the north end of the site directly south of the NW Ballard Lane access road. The bus facility resides in the northeast corner of the site. Athletic fields dominate the central and eastern portions of the project site. Numerous buildings and parking lots are situated along the west side of the project site. The high school athletic track and football field lie along the southern end of the project site. Along the site's eastern boundary are two residential parcels. Vehicle access to and from the site is provided by NW Anderson Hill Road, Frontier Place NW, and NW Ballard Lane.

The redevelopment plan calls for demolition of all existing buildings except for the high school building at the south end of the site. CKSD has developed three alternative schematic site plans addressing the campus layout for buildings, athletic fields, stormwater detention facilities, parking areas, and vehicle access roads. At the time of our report, CKSD had not selected a preferred site layout. In general, all three schematic plans show a centrally located, combined high school and middle school building, athletic fields at the north and south end of the redevelopment area, vehicle access drives and exits on NW Anderson Hill Road and Frontier Place NW, student car drop-off/pick-up areas adjacent to the new school building to the south and west, and bus loading/unloading areas next to the northeast and northwest corners of the new school building. Parking lots will be situated around the outer perimeter of the school building and new bus loading/unloading areas on the north and west sides of the building. Stormwater detention facilities are planned in the southwest corner of the site.

We assume the majority of the existing underground utilities will be replaced to accommodate the planned redevelopment.

The preliminary conclusions and recommendations contained in this report are based on our understanding of the CKHSMS redevelopment, as derived from verbal information and schematic plans provided by CKSD. Because this report has been prepared prior to finalizing the redevelopment plan, additional geotechnical engineering will be needed to provide more specific information in support of final design of foundations, pavement, retaining walls, stormwater management, and other structural features.

2.0 EXPLORATORY METHODS

Oour recent exploration of the surface and subsurface conditions at the project site was conducted on August 15 and 16, 2016. We also reviewed and incorporated into this report our previous explorations at the site. Our explorations and testing consisted of the following elements:

- Visual surface reconnaissance of the site;
- Fifteen borings (designated B-1 through B-15) advanced at strategic locations across the campus redevelopment footprint to depths ranging from 16.5 to 26.5 feet below ground surface (bgs);
- Five hand borings (designated HB-1 through HB-5) advanced to depths of 2.75 to 4.3 feet bgs at strategic locations within the high school football field;
- Laboratory testing consisting of 10 grain-size distribution analyses, 10 fines analyses using the #200 wash procedure, and 14 moisture content determinations performed on selected soil samples;
- Review of boring and test pit logs from previous explorations conducted on the project site by Amec Foster Wheeler (AGRA, 1999; RZA, 1989, 1991; RZA AGRA, 1993, 1994); and
- Review of published geologic maps and seismic information in the vicinity of the site.

Table 1 summarizes the approximate locations, surface elevations, and termination depths of the recent subsurface explorations performed for this investigation. Figure 2 depicts the approximate locations of these explorations and our previous explorations overlain on a topographical survey conducted by AES Consultants, Inc. (AES). Appendix A presents the field exploration procedures and logs, and Appendix B presents geotechnical laboratory testing procedures and results.

Table 1 Recent Exploration Locations, Elevations, and Depths

Exploration	Location Relative to Existing Site Features	Surface Elevation (feet)[1]	Termination Depth (feet)
B-1	New Frontier Junior High building parking lot	183.5	16.5
B-2	CKMS – East end of upper practice field	195.5	16.5
B-3	CKMS – Football field west goal post	184.0	16.5
B-4	CKMS – Top of slope, 65 feet east of baseball field backstop	172.5	16.5
B-5	CKMS – 43 feet east of food service building northeast corner	156.5	16.5
B-6	CKHS – 16 feet north of vacant home in driveway	173.5	16.5
B-7	CKHS – Northeast corner of fenced garden at vacant home	158.0	16.5
B-8	Kitsap Alternative High School building, 34 feet east of doorway	131.0	16.5
B-9	CKHS – Baseball field parking lot, 55 feet west of backstop	157.0	16.5
B-10	CKHS – 41 feet east of baseball field fence, northeast corner	150.0	16.5
B-11	Career & Technical Building, 27 feet southeast of southeast corner	132.0	26.5
B-12	CKHS – Baseball field, 114 feet southeast of first base	153.5	16.5
B-13	CKHS – 70 feet northeast of long jump, east end	134.0	21.5
B-14	Parcel north of middle school – driveway 43 feet west of building	179.5	16.5
B-15	CKHS – Parking lot west of football field	109.0	26.5
HB-1	CKHS – Football field northwest corner at goal line	134.5	2.75
HB-2	CKHS – Football field northeast corner at goal line	134.5	2.75
HB-3	CKHS – Center of football field	136.0	4.3
HB-4	CKHS – Football field southwest corner at goal line	134.5	3.0
HB-5	CKHS – Football field southeast corner at goal line	134.5	3.2

1. Elevations are interpolated based on topographic survey provided by AES, dated June 16, 2016.

We selected the specific number, locations, and depths of explorations with input from the project design team, based on locations of existing and proposed site features, under the constraints of surface access, underground utility conflicts, and budget. We estimated the location of each exploration by measuring their distance from existing features in the field using a tape measure and scaling these measurements onto the topographic survey supplied to us by AES. We then estimated boring ground surface elevations by interpolating between contour lines shown on the topographic survey. Consequently, the data listed in Table 1 and the locations depicted on Figure 2 should be considered accurate only to the degree permitted by our data sources and implied by our measurement methods.

The explorations performed and used for this evaluation reveal subsurface conditions only at discrete locations across the project site, and actual conditions at other locations could vary. Furthermore, the nature and extent of these variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed, we may need to modify the conclusions and recommendations contained in this preliminary report to reflect actual site conditions encountered.

3.0 SITE CONDITIONS

This section presents our observations, measurements, findings, and interpretations regarding development, surface, soil, groundwater, and seismic conditions at the project site.

3.1 Surface Conditions

The surface conditions described below are based on our site reconnaissance on August 15 and 16, 2016, our review of aerial photos, and the topographic survey by AES dated June 16, 2016.

Existing Topography: Topography across the school property primarily slopes down from north to south over a series of graded benches. The slope grades separating the series of benches across the site generally range between 2H:1V to 3H:1V (horizontal: vertical). Cuts appear to have been performed on the upslope section of the ground surface, with fill placed on the downslope sections to raise grade and create the existing benches for the current development topography. Situated along the majority of the eastern property line is a naturally vegetated strip of land that slopes down to the east. The existing topography is shown on Figure 2.

Surface drainage: Drainage across the site is generally from north to south-southwest following the site topography. However, the series of benches across the site appears to retain surface water within the benches, where the surface water appears to infiltrate into the ground or is collected by a series of catch basins. The collected stormwater is then discharged to the City of Silverdale stormwater system on Frontier Place NW and NW Anderson Hill Road. At the time of our site investigations in mid-August 2016, the ground surfaces we encountered were dry except for areas on the athletic fields that appeared to have been irrigated.

Surface cover: The predominant vegetation across open spaces on the site consists primarily of grass. However, mature fir and cedar trees intermixed with shrubbery and grasses grow within the southwest portion of the site surrounding the Alternative High School and Career and Technical Building, on the residential parcel north of the high school athletic field, on the vegetated slopes along the site's eastern property boundary, on the two parcels north of Central Kitsap Middle School, and around the perimeter of the bus facility. The site hardscape consists of asphalt parking lots, roadways, bus loops, and walkways leading from the buildings to parking lots. A combination of concrete or asphalt walkways were noted around the school building perimeter and for pedestrian access to the athletic fields.

3.2 Soil Conditions

According to the published geologic map for the area (Polenz et al. 2013), soil conditions at the site are characterized by Pleistocene Vashon Lodgment Till (Qgt) with Possession Advance Outwash

(Qgap) along the site’s western edge following NW Anderson Hill Road to the intersection of NW Anderson Hill Road and Frontier Place NW.

Vashon Lodgment Till (referred to in this report as glacial till) consists of a mixture of clay, silt, sand, gravel, cobbles, and isolated boulders, and can be brown in a weathered condition to gray in an unweathered condition. Glacial till soils tends to be very dense and exhibit high shear strength and low compressibility due to overconsolidation by ice during deposition. Glacial till soils can become soft and unworkable when disturbed by excavation, stockpiling, and backfilling, especially when wet.

Possession Advance Outwash (referred to in this report as advance outwash) consists predominantly of sand with some silt, clay, and pebbles. Occasional interbedded silt/clay layers, may occur. Advance outwash is typically brown in a weathered condition to gray in an unweathered condition. Advance outwash is typically dense with low compressibility due to deposition in front of advancing glaciers that then compressed the sand after deposition. Advance outwash can be reused as structural fill.

During our explorations performed on August 15–16, 2016, we observed the following strata:

- Topsoil and Organics: In general, all explorations advanced in non-paved areas encountered approximately 4 to 6 inches of grass/sod over topsoil at the surface.
- Existing Fill: Fill was encountered in borings B-2, B-3, B-5, B-10, B-12, and B-13. The thickness of fill averaged 4.5 feet, however the fill was 8 feet thick in B-2 and B-13. The fill consisted of medium dense, brown, silty sand with variable gravel content. HB-1 through HB-5 encountered 6 to 12 inches of drainage sand; over loose to medium dense, brown to gray, silty sand to the full extent of the hand borings (2.75 to 4.3 feet bgs), except in HB-1 and HB-3, where we encountered native glacial till below the fill at a depth of approximately 2 feet bgs. The fill soils encountered within all of our explorations appeared to be derived from on-site soils, except for the athletic field drainage sand.
- Glacial Till: Glacial till soils were encountered across the site in borings B-1 through B-14. The glacial till was composed of dense to very dense, silty sand. Glacial till was encountered to the full depth of our borings, ranging from 16.5 feet bgs to 21.5 feet bgs. Glacial till soils extended to 9 feet bgs in boring B-8, and to 23 feet bgs in B-11 until encountering advance outwash sands.
- Advance Outwash: Advance outwash composed of very dense, silty, gravelly sand was encountered underlying the glacial till from 9 feet bgs to the boring extent at 16.5 feet in B-8, from 23 bgs feet to the boring extent at 26.5 feet in B-11, and throughout the full extent of the boring to a depth of 26.5 feet bgs in B-15.

Review of lithologic logs from past explorations across the site show similar soil conditions. Exploration logs are presented in Appendix A for the most recent as well as previous explorations conducted at the site.

Select soil samples from our explorations were submitted for geotechnical laboratory testing. The laboratory testing sheets presented in Appendix B graphically present the results. The geotechnical test results produced the following key findings:

- The fill soils had a fines (silt and clay) content ranging from 18 to 28 percent, with a moisture content ranging from 5 to 13 percent. We interpret the fill soils to be derived from site glacial till soils.
- The glacial till soils have a measured fines content ranging from 14 to 37 percent and a moisture content ranging from 3 to 9 percent. We interpret the moisture content of glacial till soils to be near the optimum values for compaction, but highly sensitive to changes in moisture content.
- The advance outwash had a measured fines content ranging from 4 to 14 percent and a moisture content ranging from 1 to 19 percent. We interpret the lower fines content to be advantageous for stormwater infiltration as well as compaction as new structural fill.

3.3 Groundwater Conditions

At the time of our subsurface explorations (August 15 and 16, 2016), we encountered groundwater only in boring B-15 at 18 feet bgs. However, some mottling and oxidation staining were observed within some of the near-surface soil samples collected, indicating perched groundwater conditions resting on or near the surface of the dense to very dense glacial till soils. Perched water was observed on the high school athletic field at the contact horizon between drainage sand and underlying soil subgrade and also retained in the topsoil directly below the grass surface. It appears the perched water in the high school athletic field is influenced by seepage from the athletic field underdrain and irrigation system.

Because our explorations were performed during a period of dry weather, the groundwater conditions may closely represent the yearly low levels; somewhat higher levels probably occur during the winter and early spring months. Throughout the year, groundwater levels would likely fluctuate in response to changing precipitation patterns, construction activities, irrigation, and site utilization. Observation wells would need to be installed to better understand the seasonal high groundwater levels for design of stormwater infiltration and site drainage facilities.

3.4 Seismic Conditions

The soils underlying the site consist of various thicknesses of medium dense fill placed during previous grading, overlying dense sand(glacial till and advance outwash). Due to the lower density of the previously placed fill, we interpret the site to be Site Class D, as defined in the 2012 International Building Code.

Seismic Design Parameters: The 2012 International Building Code (IBC) requires use of Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Response Acceleration for design of structures. Based on detailed U.S. Geological Survey (USGS) hazard mapping for this site (USGS 2015), we recommend the following parameters for structural design, based on a design earthquake with a 2 percent probability of occurrence in 50 years (return interval of 2,475 years):

Use IBC Soil Class D with:

- $S_S = 1.39\ g$
- $S_1 = 0.56\ g$
- $S_{DS} = 0.93\ g$
- $S_{D1} = 0.56\ g$
- $F_a = 1.0$
- $F_v = 1.5$

Where g is the acceleration due to gravity.

Liquefaction Evaluation: The soils underlying the site consist mainly of dense to very dense glacial till or advance outwash. Groundwater was encountered only in our boring at the lowest point of the project footprint in the southwest corner of the site at a depth of 18 feet at the time of drilling, in dense sands. We conclude that the risk of soil liquefaction occurring at this site under the IBC 2012 design earthquake is very low.

4.0 CONCLUSIONS AND RECOMMENDATIONS

This section presents our preliminary geotechnical engineering conclusions and recommendations concerning site preparation, foundations, floors, drainage systems, backfilled walls, utilities, stormwater infiltration, pavement, and structural fill. ASTM International (ASTM) specification codes cited herein refer to the most current applicable ASTM manual. Washington State Department of Transportation (WSDOT) specification codes cited herein refer to the current WSDOT publication M41-10, *Standard Specifications for Road, Bridge, and Municipal Construction 2012* (WSDOT, 2012).

4.1 Site Preparation

Preparation of the project site for construction of the combined high school/middle school building will include the following elements:

- Temporary erosion and sedimentation control;
- Removal of existing building;
- Removal or abandonment of utilities within the planned expansion footprint;
- Clearing, stripping, and grading; and
- Subgrade compaction.

The paragraphs below discuss our geotechnical comments and recommendations concerning site preparation.

Erosion Control Measures: Prior to disturbing the ground surface with earthwork, temporary erosion and sedimentation controls should be implemented. The project civil engineer, in conjunction with the Kitsap County Standards, should prepare plans and specifications to prevent erosion and runoff during construction. The contractor will need to understand that design plans and specifications represent the minimum requirements, and additional measures and modifications may be needed that are specific to the construction activities and the weather.

Demolition: One of the first steps in site preparation will likely consist of decommissioning of some utilities, followed by demolition and removal of the existing building structures, as well as the surrounding pavement and curbs. Any associated underground structural elements or utilities, such as old footings, stem walls, and drain pipes, should be exhumed as part of this demolition operation. Excavations created during demolition should be backfilled and compacted with structural fill in accordance with the recommendations contained herein. Pipes more than 2 feet below any future excavations could be filled with lean mix concrete and left in place. However, if any significant structure is planned over an abandoned utility line, the utility trench backfill should be evaluated and possibly replaced to meet the proposed structural needs.

Subgrade Compaction: Exposed subgrades for footings, floors, pavements, and other structures should be compacted to a dense, unyielding state. Any localized zones of loose granular soils observed within a subgrade should be compacted to a density commensurate with the surrounding soils. Any organic, soft, or pumping soils observed within a subgrade should be overexcavated and replaced with a suitable structural fill.

On-site Soils: We offer the following evaluation of the on-site soils relative to potential use as structural fill.

- *Existing Fill Soils*: The loose to medium dense fill soils appear suitable for reuse if the soil is near optimum moisture content, properly placed, and compacted to project specifications. However, fill soils can vary greatly in fines, organic, and moisture content and should be evaluated for suitability prior to use as structural fill. The fill soil will be difficult or impossible to reuse during wet weather due to the high silt content, and aerating activities may need to be performed during warm weather conditions to reduce moisture content to acceptable levels for reuse of these soils as structural fill.
- *Glacial Till*: The glacial till soils underlying the site appears suitable for reuse if the soil is near optimum moisture content, properly placed, and compacted to project specifications. While dense to very dense in the undisturbed state, glacial till contains a high percentage of fines, and is highly sensitive to disturbance and softening in the presence of excessive moisture. Laboratory testing indicates the glacial till soils at the site range from below to over optimum moisture content for compaction, making reuse of these soils as structural fill difficult except under ideal moisture and weather conditions. Soils with moisture content greater than optimum will require aerating activities during warm weather to reduce the moisture content to acceptable levels for use as structural fill, while soils with moisture content less than optimum will require moisture conditioning to bring the moisture content to an acceptable level for use as structural fill. Moisture content for the majority of the glacial till soil tested appeared to be near optimum, and the soils appeared suitable for use as structural fill at the time of our testing. During wet weather, these soils would be difficult or impossible to compact due to their silt content and moisture sensitivity. On the other hand, if any of the soils become too dry, water may need to be added to achieve near optimum moisture content for achieving proper compaction.
- *Advance Outwash*: The sands and gravelly sand advance outwash deposits were only encountered at the low elevation of the site and therefore may not be an available source for structural fill. However, where encountered, the advance outwash has a relatively low fines content and therefore can be used in a broader range of weather conditions than glacial till.

- Wet-Weather Considerations: As discussed above, most of the on-site soils available from site grading will be difficult to use as structural fill during wet weather. Consequently, the project specifications should include provisions for importing clean, granular fill in case site filling must proceed during wet weather. For general structural fill purposes, we recommend using a well-graded sand or gravel, such as “Ballast” or “Gravel Borrow” per WSDOT 9-03.9(1) and 9-03.14, respectively, except that the percent passing the U.S. No. 200 Sieve should be less than 5 percent.

Permanent Slopes: All permanent cut slopes and fill slopes should be adequately inclined to minimize long-term raveling, sloughing, and erosion. We generally recommend that no slopes be steeper than 2H:1V. For all soil types, the use of flatter slopes (such as 3H:1V) would further reduce long-term erosion potential and facilitate vegetation growth.

Slope Protection: We recommend that a permanent berm, swale, or curb be constructed along the top edge of all permanent slopes to intercept surface flow. Also, a hardy vegetative groundcover should be established as soon as feasible to further protect the slopes from erosion due to runoff water.

4.2 Foundations

In our opinion, conventional spread footings will provide adequate support for the proposed building structures if the subgrades are properly prepared. If foundations are located within the previously placed fill, some excavation and recompaction may be necessary. We offer the following comments and recommendations for the purposes of footing design and construction.

Footing Depths and Widths: For frost and erosion protection, the bottoms of all exterior footings should bear at least 18 inches below adjacent outside grades, whereas the bottoms of interior footings need bear only 12 inches below the surrounding slab surface level. To minimize post-construction settlements, continuous (wall) and isolated (column) footings should be at least 18 inches and 24 inches wide, respectively. Greater depths may be considered to achieve higher soil bearing pressure and lateral resistance

Bearing Subgrades: The following types of subgrade soils are anticipated, depending on location and elevation.

1. Previously placed fill. It appears that the previously placed fill was compacted to a medium dense state. Any new footing subgrades within the previously placed fill should be compacted to verify density. Some over-excavation and replacement may be necessary to create a suitable subgrade.

2. Structural fill. Newly placed structural fill that has been properly compacted, as described in the Structural Fill section of this report, will provide a suitable subgrade.

3. Glacially consolidated soils. The intact, native, glacial till and advance outwash soils are in a dense conditions and will support higher bearing pressures than the above described fill.

Bearing Capacities: For preliminary design, we are providing general recommendations based on the subgrade soil type. Once the location, size, and elevation of the foundations have been determined, we could provide more specific bearing pressures for specific footing locations.

1. Previously placed fill. Once suitable subgrade conditions have been confirmed, the foundations can be designed for an allowable bearing pressure of 2,500 psf.

2. Structural fill. Properly placed and compacted structural fill will also provide an allowable bearing pressure of 2,500 psf.

3. Glacial consolidated soils. The undisturbed glacial till and glacial outwash will provide an allowable bearing pressure of 5,000 psf.

For seismic design or other transient live loading, these pressures may be increased by one third.

Subgrade Verification: We recommend footing subgrades be verified by an Amec Foster Wheeler representative before any concrete is placed. Footings should never be cast on loose, soft, or frozen soil; slough; debris; or surfaces covered by standing water.

Footing Settlements: We estimate that total settlements of properly designed footings will be less than 1 inch and differential settlement between two adjacent footings would be less than ¾ inch. Settlements would be reduced if the actual design bearing pressures are lower than our recommended allowable pressures.

Footing and Stemwall Backfill: To provide erosion protection and lateral load resistance, we recommend all footing excavations be backfilled and compacted on both sides of the footings and stemwalls after the concrete has cured. The excavations should be backfilled with structural fill and compacted to a density of at least 90 percent (based on ASTM D-1557).

Lateral Resistance: Footings and stemwalls that have been properly backfilled as described above will resist lateral movements by means of passive earth pressure and base friction. We recommend using the following design values, which incorporate static and seismic safety factors of at least 1.5 and 1.1, respectively.

Design Parameter	Allowable Value
Static passive pressure	300 pcf
Seismic passive pressure	400 pcf
Base friction coefficient	0.4

Note: pcf = pounds per cubic foot

Base friction can be combined with the respective passive pressure to resist static and seismic loads.

4.3 Slab-on-Grade Floors

In our opinion, soil-supported slab-on-grade floors can be used in the proposed buildings if the subgrades are properly prepared. We offer the following comments and recommendations concerning slab-on-grade floors.

Floor Subbase: All soil-supported slab-on-grade floors should bear on at least medium dense soils or structural fill. Localized overexcavation and replacement of loose soils may be needed depending on the location of the floor slabs. The condition of subgrade soils should be evaluated by an Amec Foster Wheeler representative in case overexcavation of unsuitable soils is needed. Subsequent backfilling and compaction of the structural fill should be observed and verified by an Amec Foster Wheeler representative.

Capillary Break: To reduce the upward wicking of groundwater beneath the floor slab, we recommend a capillary break be placed over the subbase. This capillary break should consist of a 4-inch-thick layer of pea gravel or other clean, uniform gravel, such as “Gravel Backfill for Drains” per WSDOT Standard Specification 9-03.12(4).

Vapor Barrier: We recommend a vapor barrier at least 10 mil thick be placed directly between the capillary break and the floor slab to prevent moisture from migrating upward through the slab. During subsequent casting of the concrete slab, the contractor should exercise care to avoid puncturing this vapor barrier.

Vertical Deflections: Soil-supported slab-on-grade floors can deflect downward when vertical loads are applied due to elastic compression of the subgrade. In our opinion, a subgrade reaction modulus of 200 pounds per cubic inch can be used to estimate these deflections.

4.4 Foundation Drains

The building should be provided with permanent drainage systems to minimize the risk of future moisture problems. We offer the following recommendations and comments for drainage design and construction.

Perimeter Drains: We recommend the new building structures be encircled with a perimeter drain system to collect possible seepage water. This drain should consist of a 4-inch-diameter perforated rigid pipe within an envelope of pea gravel or washed rock, extending at least 6 inches on all sides of the pipe. The gravel envelope should be wrapped with filter fabric to reduce the migration of fines from the surrounding soils. Ideally, the drain invert would be installed no more than 8 inches above or below the base of the perimeter footings.

Runoff Water: Roof-runoff and surface-runoff water should *not* be allowed to flow into the foundation drainage systems. Instead, these sources should flow into separate tightline pipes and be routed away from the buildings to an appropriate location. In addition, final site grades should slope downward away from each building so that runoff water will flow by gravity to suitable collection points, rather than ponding near the buildings. Ideally, the area surrounding the buildings would be capped with concrete, asphalt, or low-permeability (silty) soils to minimize surface-water infiltration next to the footings.

Floor Slab Underdrains: Depending on site grading and building locations, floor slab underdrains may need to be considered. For example, where subgrade excavations intersect a contact with underlying dense glacial soils, there may be a need to intercept and drain perched groundwater. The need for underdrains will be assessed once the final grades and structure locations have been determined.

4.5 Backfilled Walls

We offer the following recommendations for relatively short walls supporting grade changes at the site. Underground vaults could also be designed as backfilled walls.

Footing Depths: For frost and erosion protection, concrete retaining wall footings should bear at least 18 inches below the adjacent ground surface. However, greater depths might be necessary to develop adequate passive resistance and/or bearing resistance in certain cases. Flexible gravity walls, such as gabions and modular block walls, should be embedded at least 8 inches below final grades.

Curtain Drains: To preclude development of hydrostatic pressure behind the backfilled retaining wall, we recommend a curtain drain be placed behind the walls. This curtain drain should consist of pea gravel, washed rock, or some other clean, uniform, well-rounded gravel, extending outward a minimum of 12 inches from the wall and extending upward from the footing drain to within about 12 inches of the ground surface. The curtain drain should connect to a 4-inch-diameter perforated drain pipe behind the heel of the wall, and the drain pipe should discharge away from the wall.

Backfill Soil: Ideally, all retaining wall backfill placed behind the curtain drain would consist of clean, free-draining, granular material, such as "Gravel Backfill for Walls," per WSDOT Standard Specification 9-03.12(2). Alternatively, on-site soils could be used as backfill if they are placed at a moisture content near optimum for compaction.

Backfill Compaction: Because soil compactors place significant lateral pressures on retaining walls, we recommend only small, hand-operated compaction equipment be used within 3 feet of a backfilled wall. In addition, all backfill should be compacted to a density as close as possible to 90 percent of the maximum dry density (based on ASTM D-1557); a greater degree of compaction closely behind the wall would increase the lateral earth pressure, whereas a lesser degree of compaction might lead to excessive post-construction settlements.

Applied Loads: Overturning and sliding loads applied to retaining walls can be classified as static pressures and surcharge pressures. We offer the following specific values for design purposes:

- *Static Pressures*: Yielding (cantilever) retaining walls should be designed to withstand an appropriate active lateral earth pressure, whereas non-yielding (restrained) walls should be designed to withstand an appropriate at-rest lateral earth pressure. These pressures act over the entire back of the wall and vary with the backslope inclination. Assuming a level backslope, we recommend using active and at-rest pressures of 35 pcf and 55 pcf, respectively.
- *Surcharge Pressures*: Static lateral earth pressures acting on a retaining wall should be increased to account for surcharge loadings resulting from any traffic, construction equipment, material stockpiles, or structures located within a horizontal distance equal to the wall height. For simplicity, a traffic surcharge can be modeled as a uniform horizontal pressure of 75 psf acting against the upper 6 feet of the wall.

- *Seismic Pressures*: Static lateral earth pressures acting on a retaining wall should be increased to account for seismic loadings. These pressures act over the entire back of the wall and vary with the backslope inclination, the seismic acceleration, and the wall height. For preliminary design, we recommend these seismic loadings be modeled as uniform *active* pressure of 6H psf (based on a wall height of "H" feet), assuming a level backslope and allowing some deformation during the earthquake. These pressures could be refined during final design when the retaining wall dimensions and locations are known.

Resisting Forces: Static pressures and surcharge pressures are resisted by a combination of passive lateral earth pressure, base friction, and subgrade bearing capacity. Passive pressure acts over the embedded front of the wall (neglecting the upper 1 foot for paved foreslopes, or the upper 2 feet for soil foreslopes) and varies with the foreslope declination, whereas base friction and bearing capacity act along the bottom of the footings. Assuming a level foreslope beyond the wall, the following design values can be used for preliminary design, which incorporate static and seismic safety factors of at least 1.5 and 1.1, respectively.

Design Parameter	**Allowable Value**
Static passive pressure	300 pcf
Seismic passive pressure	400 pcf
Base friction coefficient	0.4
Static bearing capacity	2,500 psf

Base friction can be combined with passive pressure to resist the applied loads.

4.6 Underground Utilities

We expect that underground utilities for the high school and middle school campus redevelopment, such as waterlines, storm drains, sewer pipes, manholes, and catch basins, will be included in the site development. Our comments and recommendations concerning the installation of these utilities are presented below.

<u>Temporary Slopes:</u> Configuration and maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. Temporary excavations should either be shored or sloped in accordance with *Safety Standards for Construction Work,* Part N, Washington Administrative Code (WAC) 296-155-650 through 66411, when workers will be below the surface. For planning purposes, the soil type classification and maximum inclination based on Part N of the *Safety Standards for Construction Work*, WAC 296-155-66401 and -66403, is provided below.

Soil Type	**WAC Soil Type**	**Maximum Inclination**
Existing and new structural fill	C	1½H:1V
Dense advance outwash	B	1H:1V
Dense glacial till	A	3/4H:1V

<u>Bedding Soils</u>: Utility pipes should be bedded on an appropriate material that extends at least 6 inches outward from the pipe in all directions. For level or gently sloping pipes, we recommend

using a clean, uniform, well-rounded material, such as pea gravel or “Gravel Backfill for Pipe Bedding” per WSDOT Standard Specification 9-03.12(3).

<u>Backfill Soils</u>: The on-site soils will be difficult to compact as utility excavation backfill unless the moisture content is kept within a narrow range of the optimum moisture content. During the wet season or during rainy periods, backfill material used for utility trenches and other excavations may need to consist of clean, well-graded granular soils, such as “Gravel Borrow” per WSDOT Standard Specification 9-03.14, except with less than 5 percent passing the U.S. No. 200 sieve. Controlled-density fill (CDF) could be used as a more convenient, but also more expensive, alternative to backfill soil in any weather conditions.

<u>Backfill Compaction</u>: We recommend utility backfill soils be compacted to a density commensurate with surrounding fill or native soils, as well as with the requirements of any overlying structures. CDF backfill does not require compaction but should have a compressive strength commensurate with the application.

4.7 Stormwater Infiltration

We understand it is desired to infiltrate stormwater in the southwest area of the site along the west edge of the property where stormwater detention facilities are shown on the schematic site plans. We reviewed chapter 7.3.4.1 General Requirements for Infiltration Facilities, in the Kitsap County Stormwater Design Manual (Kitsap County 2010), (referred to herein as the Kitsap Stormwater Manual). We have the following comments relative to these criteria:

<u>Permeable soil layer thickness, and separation from the water table:</u> Section 7.3.4.1.A of the Kitsap Stormwater Manual gives a basic requirement of a minimum of 3 feet of permeable soil below the bottom of the infiltration facility and at least 3 feet between the bottom of the facility and the maximum wet-season water table.

Table 2 summarizes the measured depth to groundwater at time of drilling, and the measured thickness of relatively permeable soil encountered above the groundwater table (or above a relatively impervious soil layer).

Table 2 Measured Thickness of Permeable Soil Layers

Exploration	Depth to Groundwater at time of drilling (feet)[1]	Depth to top of permeable layer (feet)	Thickness of permeable layer (feet)	Lower boundary to infiltration (Groundwater or impervious soil)
B-15	18.0	0.5	17.5	Groundwater

1 Groundwater levels at time of drilling: August 16, 2016.

On the basis of these preliminary measurements, the southwest area of the site exhibited the greatest thickness of permeable soil layers above groundwater at this time. However, the groundwater was measured during the dry summer season and is expected to be higher during the wet season. Additional exploration and groundwater monitoring will be needed for final design.

Estimated Infiltration Rate for Preliminary Design: We recommend using a preliminary design infiltration rate of 2 inches per hour for the southwest area of the site. This is based on a soil sample collected 15 feet deep in B-15 drilled in the southwest parking lot. The laboratory grain size distribution of this sample was correlated with Table 5.1 in the Kitsap County Stormwater Manual to estimate this preliminary design rate.

In situ testing: Additional studies will be needed for final design. We recommend installing groundwater observation wells to determine the groundwater table during the wet season. In situ, pilot infiltration testing (PIT) is recommended to provide better estimation of the infiltration rates for final long-term design. Tests should be conducted at the actual planned location of the infiltration facilities and at the infiltrating elevation. These tests should be done once the location and elevation of the facility has been determined, and the testing should be done during the wet season.

4.8 Pavement

We understand new vehicle access roads, parking lots, and bus lanes with student loading/unloading areas will be constructed as part of the campus redevelopment work. Site access will be from NW Anderson Hill Road and Frontier Place NW, with the bus loading/unloading area to the north of the new school, parking lots to the north and west of the new school, and vehicle access roads encompassing the perimeter of the school building. New concrete sidewalks will be constructed across the site for pedestrian access to all school campus amenities. The following comments and recommendations are given for pavement design and construction.

Soil Design Values: Soil design values for subgrade conditions were determined based on field observations, visual classification, laboratory testing, and reference to typical values provided in the WSDOT Pavement Guide, and the Kitsap County Road Standards. Based on grain size analyses performed on representative soil samples, we estimate a California Bearing Ratio (CBR) value of 20 for the underlying subgrade soils. We have interpreted the effective resilient subgrade modulus as 15,000 psi (average to good subgrade).

Traffic Design Values: The calculated pavement sections for the main driveway/bus loop and fire lanes are based on an assumed traffic loading of 35 bus trips per 200 school days over a 20-year design life. Sufficient car traffic volumes are included in the calculations. The calculated pavement section for car and light truck parking areas is based on light to moderate traffic.

Flexible Pavement Sections: A conventional pavement section typically comprises a hot-mix asphalt (HMA) pavement over a crushed rock base (CRB) course, over a suitable subgrade or subbase that consists of granular structural fill. Based on the estimated design values, the following minimum pavement sections are recommended:

	Minimum Thickness (inches)	
Flexible Pavement Section	**Passenger Car Only Areas**	**Heavy Vehicle (Bus) Driveways**
HMA Class ½”	3	4
CRB	4	6

These values represent the recommended minimum thickness of HMA Class ½” asphalt. Other combinations of pavement thickness could be considered upon request.

Rigid Pavement Section: A concrete pavement section typically consists of Portland cement concrete (PCC) pavement over CRB, over a suitable subgrade or subbase that consists of granular structural fill. Based on the estimated design values, a minimum rigid pavement section of 6 inches of PCC over 4 inches CRB is recommended.

Pavement Materials: HMA should conform to WSDOT Standard Specification 5-04. PCC should conform to WSDOT Standard Specification 5-05. CRB should be an imported clean crushed rock meeting the requirements for “Crushed Surfacing Top and Base Course” per WSDOT Standard Specification 9-03.9(3).

Subgrade Preparation: We anticipate minor cuts and/or fills may be needed to achieve pavement design grades. All pavement subgrades should be proof-rolled “wheel-to-wheel” with a loaded dump truck to verify the density, but this is especially important for subgrade above areas where pre-existing fill soils will remain. The proof rolling should be observed by a representative from Amec Foster Wheeler. Any areas of soft, yielding subgrade disclosed during this proof-rolling operation should be overexcavated and replaced with a suitable structural fill, as described subsequently.

Compaction and Verification: Structural fill used to achieve subgrade, subbase material, and base course material should be compacted to at least 95 percent of the Modified Proctor maximum dry density (ASTM D-1557), and all asphalt concrete should be compacted to at least 92 percent of the Rice value (ASTM D-2041). We recommend an Amec Foster Wheeler representative be retained to verify compaction of the subgrade fill and base course before any overlying layer is placed. For the subgrade, compaction is best verified by means of frequent density testing; for the base course, methodology observations and hand-probing are more appropriate than density testing.

Pavement Life and Maintenance: It should be noted that no asphalt pavement is maintenance-free. The above-described pavement sections represent our minimum recommendations for an average level of performance during a 20-year design life; therefore, an average level of maintenance will likely be required. Furthermore, a 20-year pavement life typically assumes that an overlay will be placed after about 10 years. Thicker asphalt, base, and subbase courses would offer better long-term performance, but would cost more initially; thinner courses would be more susceptible to “alligator” cracking and other failure modes. However, pavement design can be considered a compromise between a high initial cost and low maintenance costs, versus a low initial cost and higher maintenance costs.

4.9 Structural Fill

The term *structural fill* refers to any materials used for building pads, as well as materials placed under or against foundations and retaining walls; under slab-on-grade floors, sidewalks, and pavements; and for permanent fill slopes. Our comments, conclusions, and recommendations concerning structural fill are presented in the following paragraphs.

Materials: Typical structural fill materials include sand, gravel, crushed rock, quarry spalls, CDF, lean-mix concrete, well-graded mixtures of sand and gravel (commonly called “gravel borrow” or “pit-run”), and mixtures of silt, sand, and gravel. Soils used for structural fill should not contain any organic matter or debris, or any individual particles greater than approximately 6 inches in diameter, and should have no more than 20 percent fines (silt and clay that passes the U.S. No. 200 sieve).

Fill Placement: Structural fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness, and each lift should be thoroughly compacted with a mechanical vibratory compactor. Other procedures may be appropriate for some materials.

Compaction Criteria: Using the Modified Proctor test (ASTM D1557) as the standard, we recommend structural fill be used for various on-site applications and compacted to the following minimum densities:

Fill Application	Minimum Compaction (percent)
Footing subgrade	95
Footing and stemwall backfill	90
Slab-on-grade floor subgrade	90
Slab on-grade sidewalk subgrade	90
Retaining wall subgrade	90
Retaining wall backfill	90
Asphalt or concrete pavement subgrade	95
Utility trench backfill under pavements/structures	95
Utility trench backfill	90

Subgrade Verification and Compaction Testing: Regardless of material or location, all structural fill should be placed over dense, unyielding subgrades. The condition of all subgrades should be verified by an Amec Foster Wheeler representative before filling or construction begins. In addition, fill soil compaction should be verified by means of in-place density tests performed during fill placement so the adequacy of the soil compaction efforts may be evaluated as earthwork progresses.

Soil Moisture Considerations: 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. For fill placement during wet-weather site work, we recommend using “clean” fill, which refers to soils that have a fines content of 5 percent or less (by weight) based on the soil fraction passing the U.S. No. 4 sieve.

Import Fill and Wet Weather Fill Considerations: As discussed in Section 4.1 (Site Preparation – On-site Soils), the on-site soils would be difficult to reuse as structural fill during wet weather because of high silt content and moisture sensitivity. Alternatively, we recommend using a well-graded sand and gravel, such as “Ballast” or “Gravel Borrow” per WSDOT9-03.9(1) and 9-03.14, respectively, except that the percent passing the U.S. No. 200 sieve should be less than 5 percent.

Concrete and Pavement Recycling: It is anticipated that the project will produce asphalt and concrete rubble. These materials, or similar imported materials, can be considered for reuse during project construction if they are pulverized to appropriate grain sizes. Recycled asphalt can be uniformly blended with pavement base course materials in accordance with WSDOT Standard Specification 9-

03.21(1)E. Recycled concrete can be substituted for up to 100 percent of base course materials below pavements, including CSBC and gravel base. Recycled concrete should be used in accordance with WSDOT Standard Specification 9-03.21(1)B.

5.0 RECOMMENDED ADDITIONAL SERVICES

Because this preliminary report has been prepared prior to design of the Central Kitsap High School and Middle School campus redevelopment, an additional geotechnical study will be needed to complete the design documents. After the specific locations, architectural layouts, and primary structural details of the buildings and associated structures have been established, we should perform a design-phase geotechnical evaluation. This type of evaluation may include advancing additional borings within the specific building footprint, installing groundwater observations wells, performing in-situ infiltration tests, conducting laboratory tests, performing geotechnical engineering analyses, and preparing a *Geotechnical Engineering Report.* Once this information is available and we have reviewed the design, we will submit a proposal to provide the design-phase study.

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7.0 CLOSURE

The preliminary conclusions and recommendations presented in this report are based, in part, on the explorations Amec Foster Wheeler performed and used for this study and on information provided for the proposed project. An additional geotechnical study will be needed as part of the design process to complete the project design documents. In addition, if variations in the subgrade conditions are observed at a later time, we may need to modify this report to reflect those changes. We are available to provide geotechnical engineering throughout the design process and to perform monitoring services throughout construction.

We appreciate the opportunity to be of service on this project. If you have any questions regarding this report, or any aspects of the project, please feel free to contact our office.

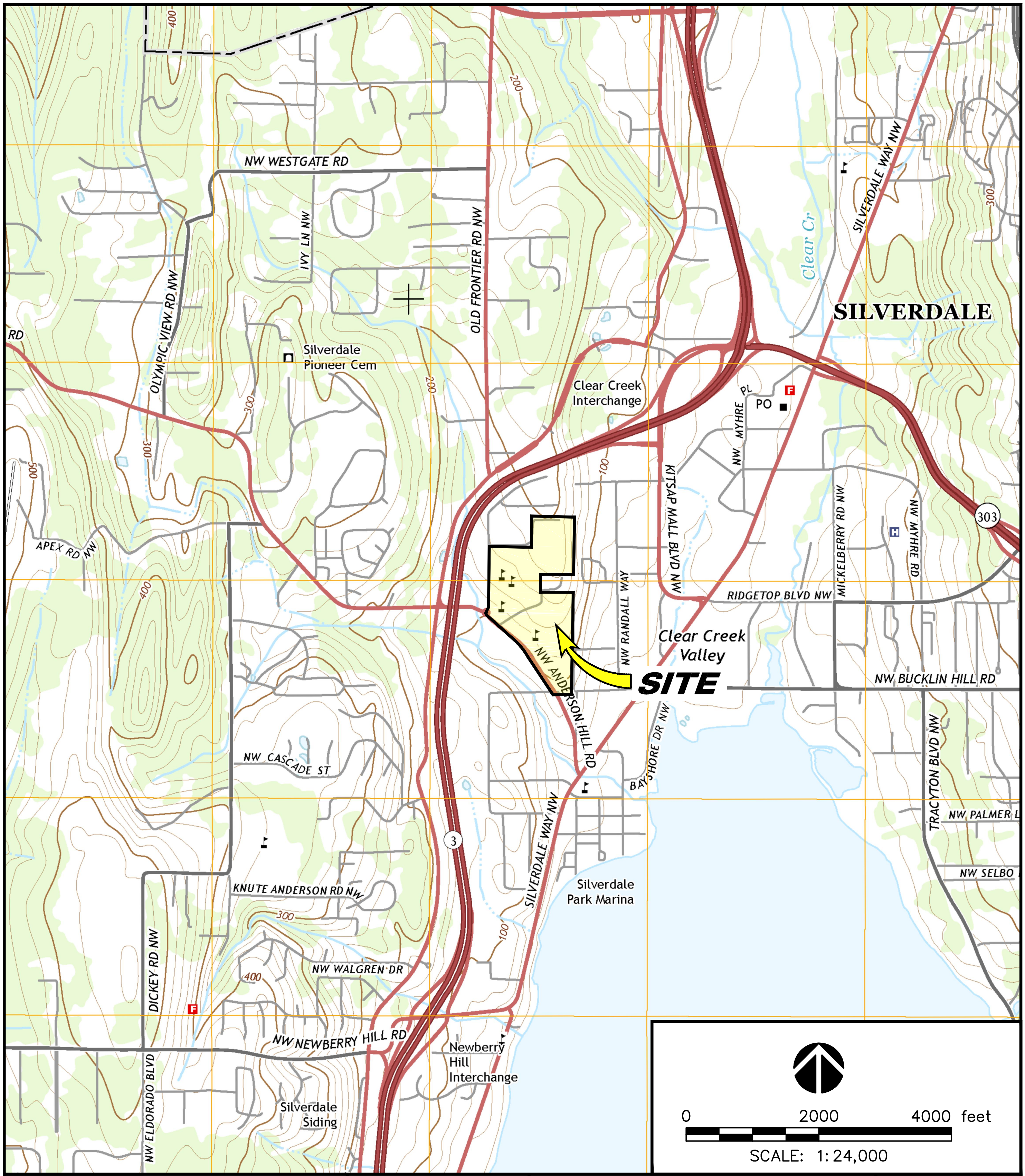
Sincerely,

Amec Foster Wheeler Environment & Infrastructure, Inc.

Konrad H. Moeller, L.E.G.	Todd D. Wentworth, P.E., L.G.
Senior Geologist	Associate Engineer

Reviewed by: James S. Dransfield, P.E.
Principal Geotechnical Engineer

FIGURES



CENTRAL KITSAP SCHOOL DISTRICT

Amec Foster Wheeler
Environment & Infrastructure, Inc.
11810 North Creek Parkway North
Bothell, WA 98011

amec foster wheeler

CENTRAL KITSAP HIGH SCHOOL
AND MIDDLE SCHOOL CAMPUS

SITE LOCATION MAP

DATE
SEPTEMBER 2016

SCALE
1" = 2,000'

PROJECT NO.
6-917-18096-0

FIGURE
1

DRAWN BY: RS CHECKED BY: KM

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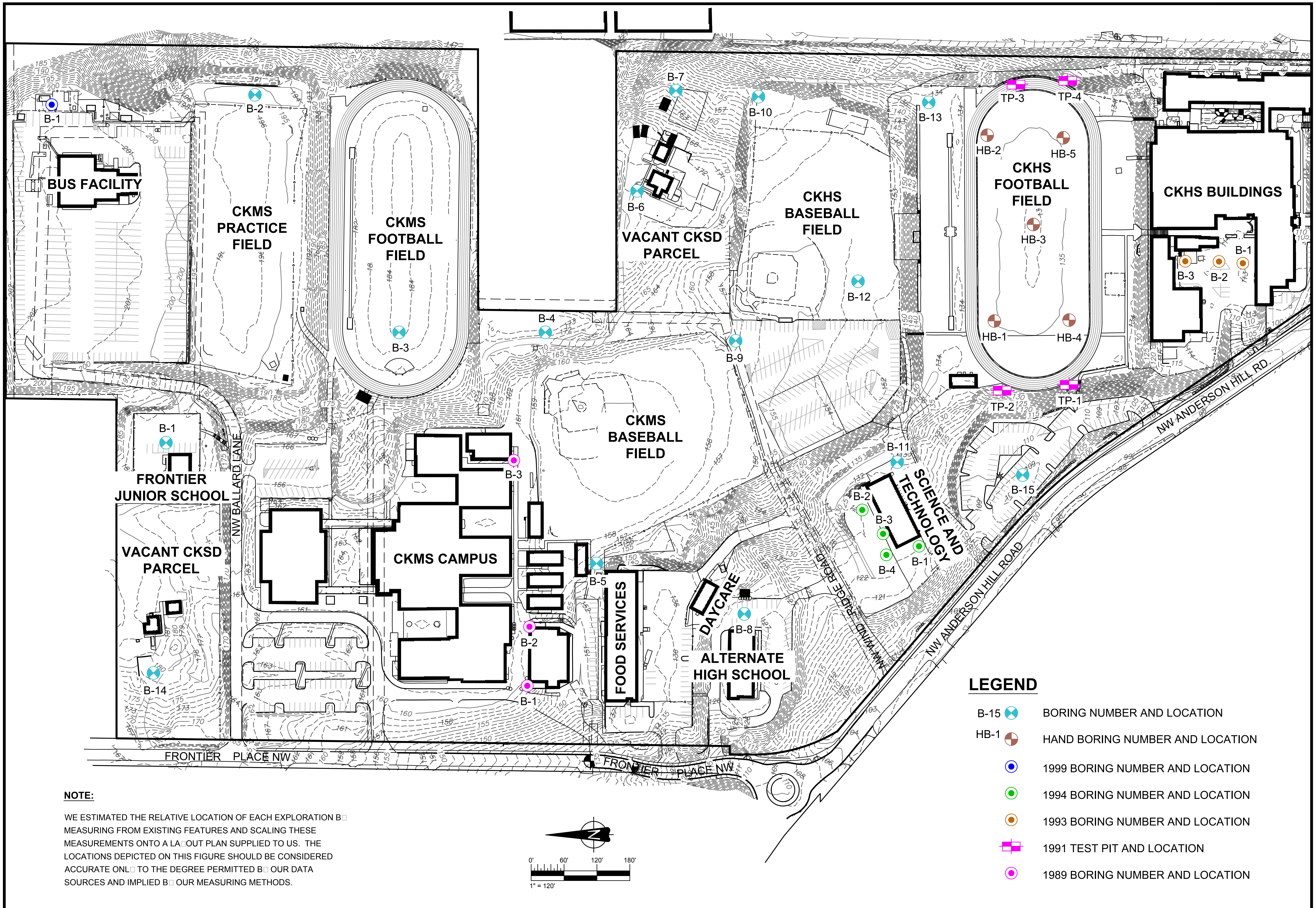


LEGEND

B-15 ●	BORING NUMBER AND LOCATION
HB-1 ●	HAND BORING NUMBER AND LOCATION
●	1999 BORING NUMBER AND LOCATION
●	1994 BORING NUMBER AND LOCATION
●	1993 BORING NUMBER AND LOCATION
▨	1991 TEST PIT AND LOCATION
●	1989 BORING NUMBER AND LOCATION

NOTE:

WE ESTIMATED THE RELATIVE LOCATION OF EACH EXPLORATION BY MEASURING FROM EXISTING FEATURES AND SCALING THESE MEASUREMENTS ONTO A LAYOUT PLAN SUPPLIED TO US. THE LOCATIONS DEPICTED ON THIS FIGURE SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE PERMITTED BY OUR DATA SOURCES AND IMPLIED BY OUR MEASURING METHODS.

NOTE:
SURVEY BASE IS "*TOPOGRAPHY MAP*" BY AES CONSULTANTS, INC.,
DATED JUNE 16th, 2016.

REV	DATE	MONTH	YEAR	REVISION DESCRIPTION	ENG.	APPR.

CENTRAL KITSAP SCHOOL DISTRICT

Amec Foster Wheeler
Environment & Infrastructure, Inc.
11810 North Creek Parkway North
Bothell, WA 98011

CENTRAL KITSAP HIGH SCHOOL AND
MIDDLE SCHOOL CAMPUS

SITE AND EXPLORATION PLAN

DATE SEPTEMBER 2016
SCALE 1" = 120'
PROJECT NO. 6-917-18096-0
FIGURE 2

DRAWN BY: RS CHECKED BY: TDW

G:\91180000\18096 - CKMS\18096-04.dwg - D-Size - Sep. 29, 2016 10:53am - jeffrey.sanders

APPENDIX A

Field Exploration Procedures and Logs

APPENDIX A
FIELD EXPLORATION PROCEDURES AND LOGS
Central Kitsap High School and Middle School Campus Redevelopment
Silverdale, Washington

The following paragraphs describe the procedures used for field explorations and field tests that Amec Foster Wheeler conducted for this project. Descriptive logs of our explorations are enclosed in this appendix and locations shown on Figure A-1.

AUGER BORING PROCEDURES

Exploratory borings were advanced with a hollow-stem auger, using a trailer-mounted drill rig operated by an independent drilling firm working under subcontract to Amec Foster Wheeler. An engineering geologist from Amec Foster Wheeler continuously observed the borings, logged the subsurface conditions, and collected representative soil samples. All samples were stored in watertight containers and later transported to the laboratory for further visual examination and testing. After each boring was completed, the borehole was backfilled with a mixture of bentonite chips and soil cuttings, and the surface was patched with asphalt or concrete (where appropriate).

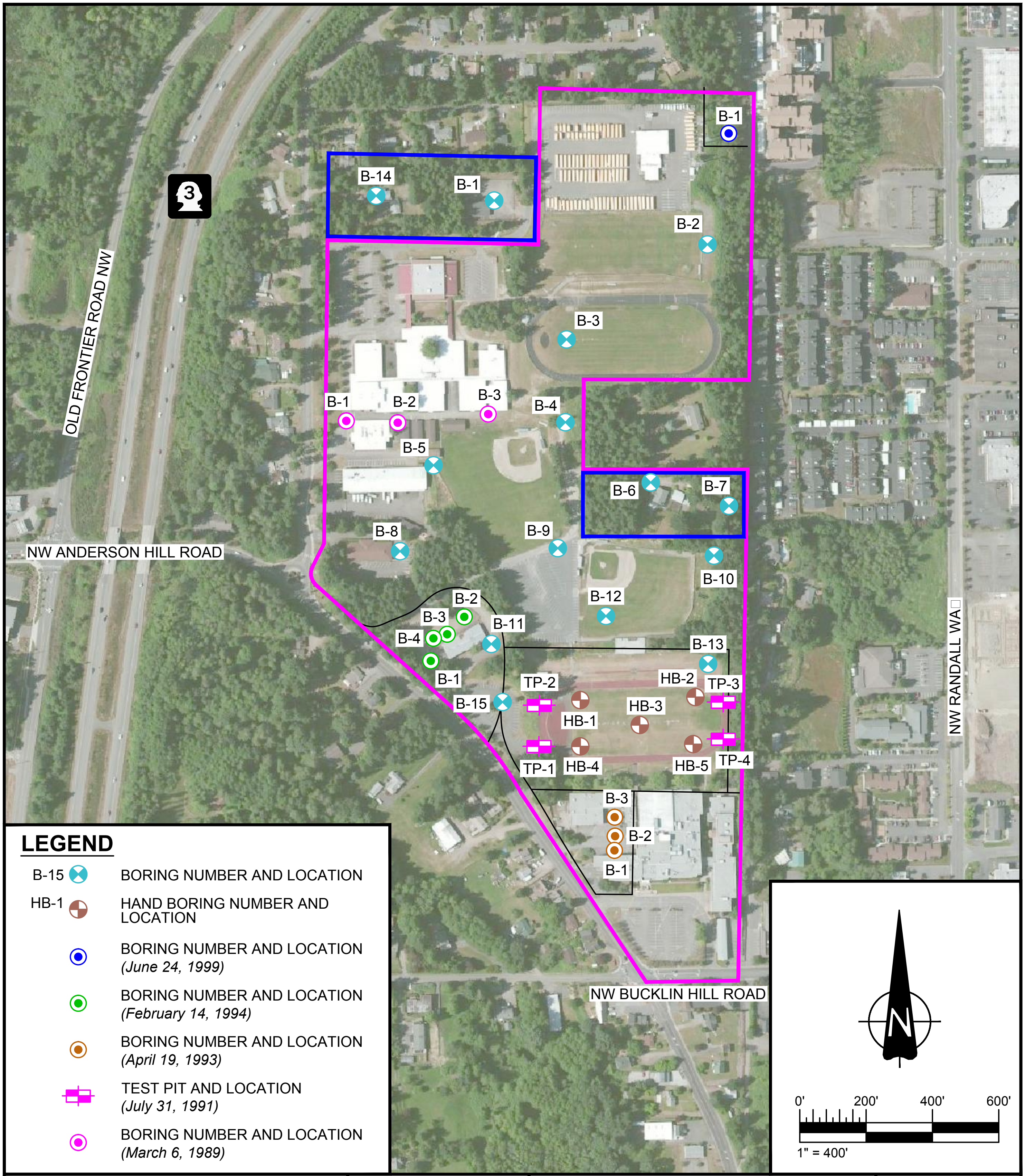
Throughout the drilling operation, soil samples were obtained at 2.5- or 5-foot depth intervals by means of the standard penetration test (SPT) per ASTM D-1586. This testing and sampling procedure consists of driving a standard 2-inch-diameter steel split-spoon sampler 18 inches into the soil with a 140-pound hammer free-falling 30 inches. The number of blows required to drive the sampler through each 6-inch interval was counted, and the total number of blows struck during the final 12 inches was recorded as the standard penetration resistance, or “SPT blow count.” If a total of 50 blows were struck within any 6-inch interval, the driving was stopped and the blow count was recorded as 50 blows for the actual penetration distance. The resulting standard penetration resistance values indicate the relative density of granular soils and the relative consistency of cohesive soils.

The enclosed boring logs describe the vertical sequence of soils and materials encountered in each boring, based primarily on field classifications and supported by subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, boring logs indicate the average contact depth. Where a soil type changed between sample intervals, we inferred the contact depth. The boring logs also graphically indicate the blow count, sample type, sample number, and approximate depth of each soil sample obtained from the borings, as well as any laboratory tests performed on these soil samples. If any groundwater was encountered in a borehole, the approximate groundwater depth is depicted on the boring log. Groundwater depth estimates are typically based on the moisture content of soil samples, the wetted height on the drilling rods, and the water level measured in the borehole after the auger has been extracted.

HAND BORING PROCEDURES

Our exploratory hand borings were advanced with a 3-inch-diameter hand auger operated by an Amec Foster Wheeler geotechnical specialist, who logged the subsurface conditions and obtained representative soil samples. All samples were stored in watertight containers and later transported to a laboratory for further visual examination and testing. After each hand boring was completed, we backfilled the borehole with soil cuttings and tamped the surface. The relative density of granular soils and relative consistency of cohesive soils were generally estimated according to the drilling resistance encountered in each borehole.

The enclosed Hand Boring Logs describe the vertical sequence of soils and materials encountered in each hand boring, based primarily on our field classifications and supported by subsequent laboratory examination and testing. Where a soil contact was observed to be gradational, our logs indicate the average contact depth. Our logs also indicate the approximate depth of any groundwater encountered in the boreholes, as well as all sample numbers and sampling locations.



LEGEND

B-15 ⊗	BORING NUMBER AND LOCATION
HB-1 ◐	HAND BORING NUMBER AND LOCATION
●	BORING NUMBER AND LOCATION *(June 24, 1999)*
●	BORING NUMBER AND LOCATION *(February 14, 1994)*
●	BORING NUMBER AND LOCATION *(April 19, 1993)*
⊞	TEST PIT AND LOCATION *(July 31, 1991)*
●	BORING NUMBER AND LOCATION *(March 6, 1989)*

CENTRAL KITSAP SCHOOL DISTRICT

Amec Foster Wheeler
Environment & Infrastructure, Inc.
11810 North Creek Parkway North
Bothell, WA 98011

amec foster wheeler

CENTRAL KITSAP HIGH SCHOOL
AND MIDDLE SCHOOL CAMPUS

PROPOSED BORINGS

DATE
SEPTEMBER 2016

SCALE
1" = 400'

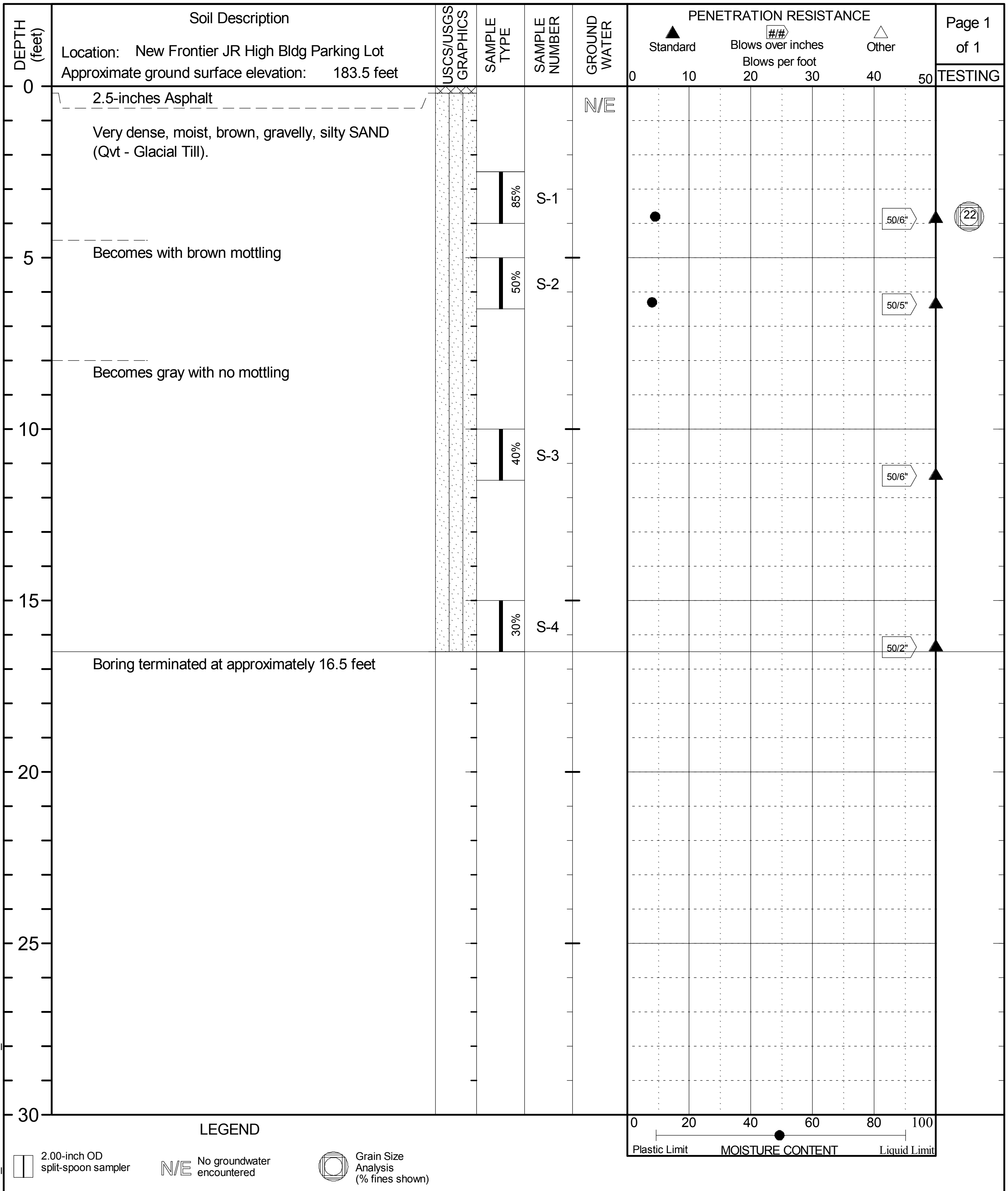
PROJECT NO.
6-917-18096-0

FIGURE
A-1

DRAWN BY: RS CHECKED BY: TDW

C:\Users\jeffrey.sanders\appdata\local\temp\AcPublish_3468\18096-05.dwg - CKMS Aerial - Sep. 22, 2016 9:51am - jeffrey.sanders

PROJECT: *Central Kitsap HS & MS Campus*   JOB No. *6-917-18096-0*   BORING No. *1*



Location: New Frontier JR High Bldg Parking Lot

Approximate ground surface elevation: 183.5 feet

Page 1 of 1

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	2.5-inches Asphalt			N/E		
	Very dense, moist, brown, gravelly, silty SAND (Qvt - Glacial Till).	85%	S-1		50/6"	22
5	Becomes with brown mottling	50%	S-2		50/5"	
	Becomes gray with no mottling					
10		40%	S-3		50/6"	
15		30%	S-4		50/2"	
16.5	Boring terminated at approximately 16.5 feet					

LEGEND

2.00-inch OD split-spoon sampler

N/E No groundwater encountered

Grain Size Analysis (% fines shown)

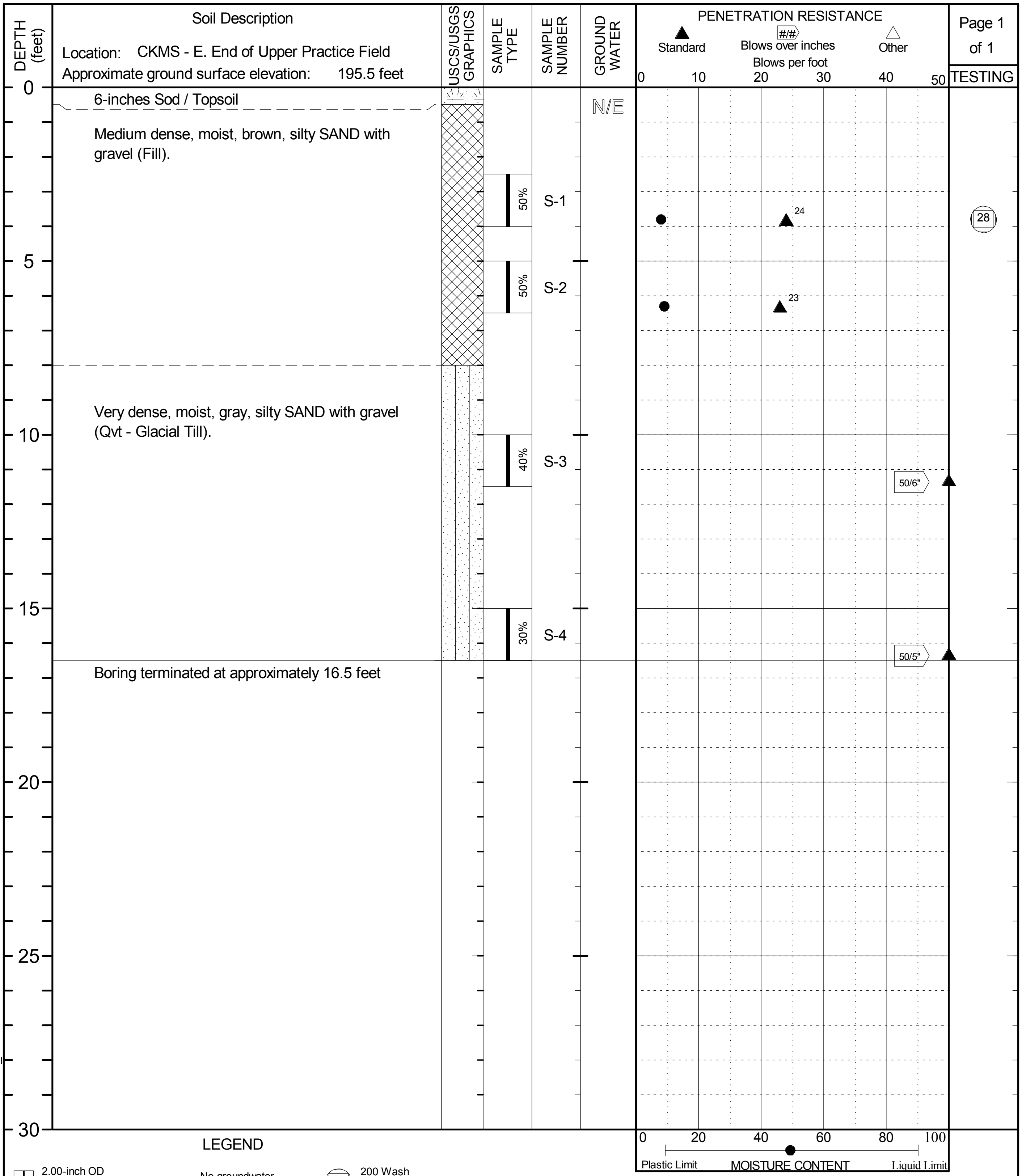
amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA   Hammer Type: Cathead   Date drilled: *August 15, 2016*   Logged By: *FC*

Drilled by: *Geologic Drill*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *2*



Location: CKMS - E. End of Upper Practice Field

Approximate ground surface elevation: 195.5 feet

6-inches Sod / Topsoil

Medium dense, moist, brown, silty SAND with gravel (Fill).

Very dense, moist, gray, silty SAND with gravel (Qvt - Glacial Till).

Boring terminated at approximately 16.5 feet

LEGEND

▯	2.00-inch OD split-spoon sampler
N/E	No groundwater encountered
▢	200 Wash (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

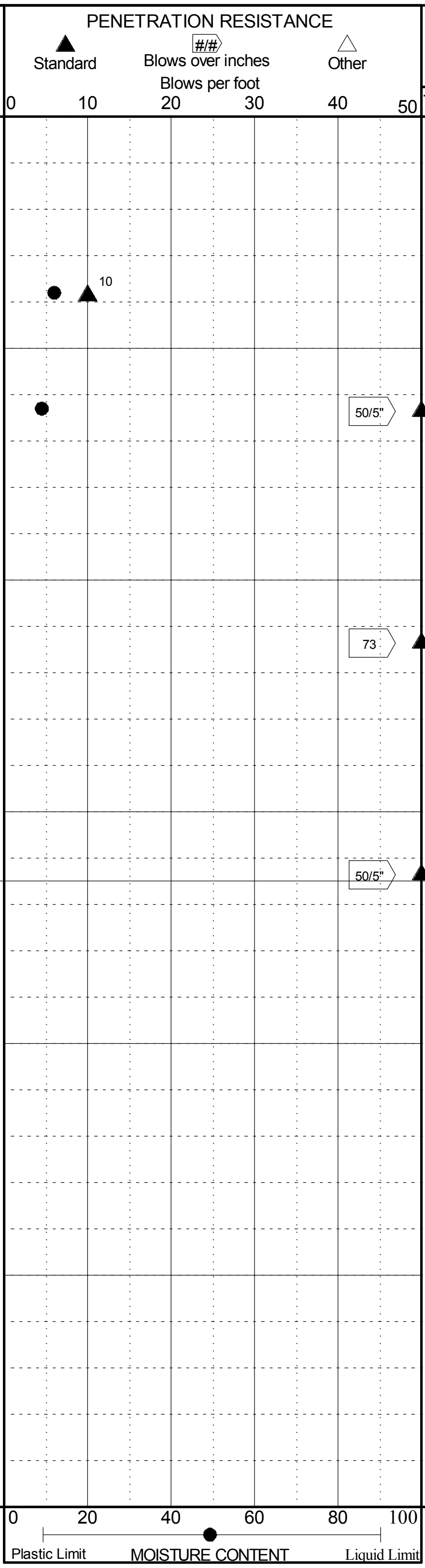
BOTHELL_GEO_2015.GLB BOTHELL_LOG FORMAT 2012 CKSD BORINGS 1 THROUGH 15.GPJ BOTHELL GEO 2010 B&TP.GDT PRINTDATE 9/21/16

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *3*

Location: CKMS - Football Field W. Goal Post
Approximate ground surface elevation: 184.0 feet

Page 1 of 1

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	TESTING
0	6-inches Sod / Topsoil			N/E	
	Medium dense, moist, brown, gravelly, silty SAND (Fill).	80%	S-1		21
5	Very dense, moist, gray with brown mottling, silty SAND with gravel (Qvt - Glacial Till).	70%	S-2		
	Becomes gray with no mottling				
10		90%	S-3		
15		30%	S-4		
	Boring terminated at approximately 16.5 feet				
20					
25					
30					



LEGEND

▯	2.00-inch OD split-spoon sampler
N/E	No groundwater encountered
◎	Grain Size Analysis (% fines shown)

amec foster wheeler
11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *4*

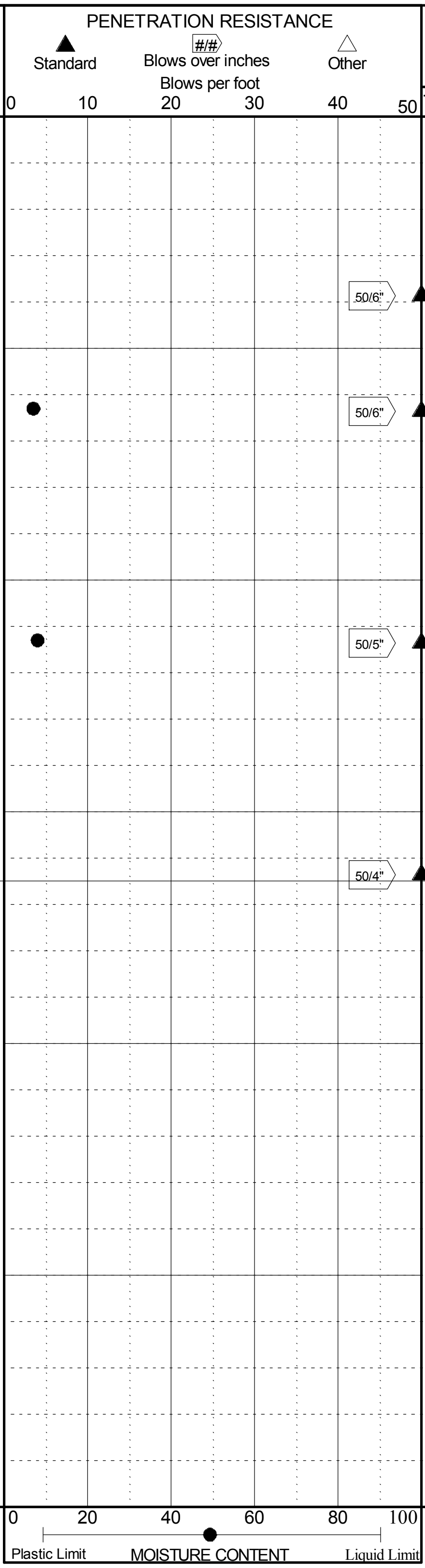
Page 1 of 1

Soil Description

Location: CKMS - Top of Slope 65' E. of Base Ball Field Backstop

Approximate ground surface elevation: 172.5 feet

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	6-inches Sod / Topsoil			N/E		
	Very dense, moist, grayish-brown, gravelly, silty SAND with some gravel (Qvt - Glacial Till).					
		40%	S-1		50/6"	
5	Becomes gray	60%	S-2		50/6"	35
	Becomes with some gravel					
10		40%	S-3		50/5"	37
15		30%	S-4		50/4"	
	Boring terminated at approximately 16.5 feet					
20						
25						
30						



LEGEND

2.00-inch OD split-spoon sampler

N/E No groundwater encountered

Grain Size Analysis (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

BOTHELL_GEO_2015.GLB BOTHELL_LOG FORMAT 2012 CKSD BORINGS 1 THROUGH 15.GPJ BOTHELL GEO 2010 B&TP.GDT PRINTDATE 9/21/16

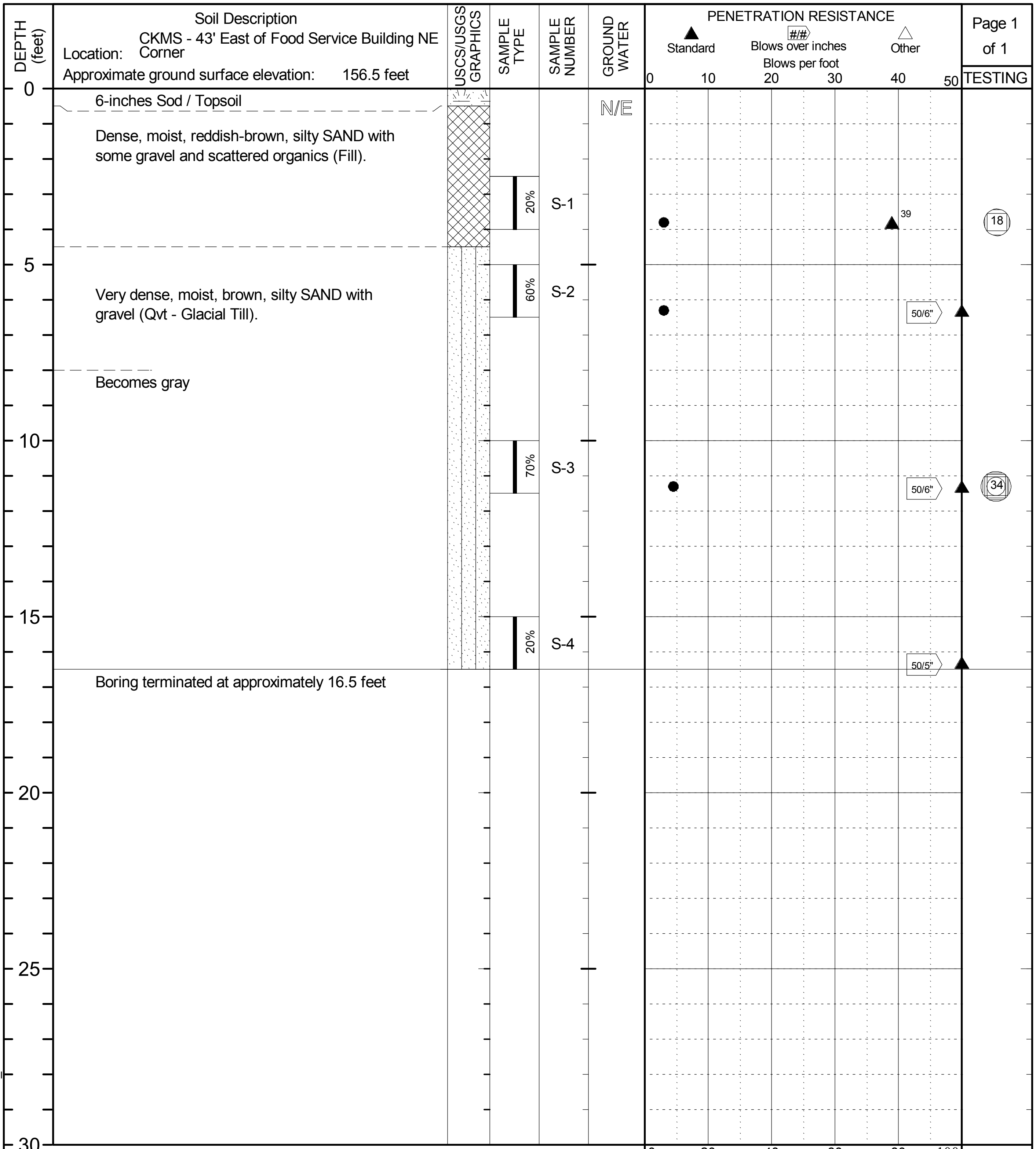
PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *5*

Page 1 of 1

Soil Description

Location: CKMS - 43' East of Food Service Building NE Corner

Approximate ground surface elevation: 156.5 feet



6-inches Sod / Topsoil

Dense, moist, reddish-brown, silty SAND with some gravel and scattered organics (Fill).

Very dense, moist, brown, silty SAND with gravel (Qvt - Glacial Till).

Becomes gray

Boring terminated at approximately 16.5 feet

S-1	20%	39	18
S-2	60%	50/6"	
S-3	70%	50/6"	34
S-4	20%	50/5"	

0 20 40 60 80 100

Plastic Limit MOISTURE CONTENT Liquid Limit

LEGEND

2.00-inch OD split-spoon sampler

N/E No groundwater encountered

200 Wash (% fines shown)

Grain Size Analysis (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 16, 2016* Logged By: *FC*

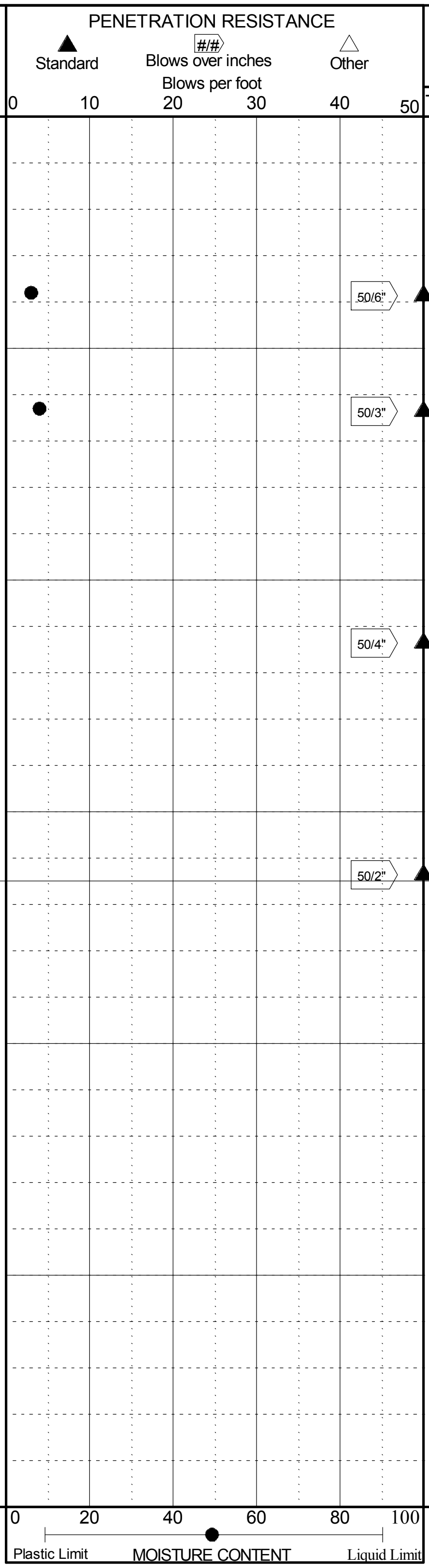
Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *6*

Page 1 of 1

Location: CKHS - 16' N. of Vacant Home within Driveway
Approximate ground surface elevation: 173.5 feet

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	2.5-inches 5/8 inch Crushed Rock			N/E		
	Very dense, moist, gray, gravelly, silty SAND (Qvt - Glacial Till).					
		40%	S-1		50/6"	
5		50%	S-2		50/3"	29
10		30%	S-3		50/4"	
15		15%	S-4		50/2"	
	Boring terminated at approximately 16.5 feet					
20						
25						
30						



LEGEND

▯ 2.00-inch OD split-spoon sampler

N/E No groundwater encountered

◯ 200 Wash (% fines shown)

amec foster wheeler
11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *7*

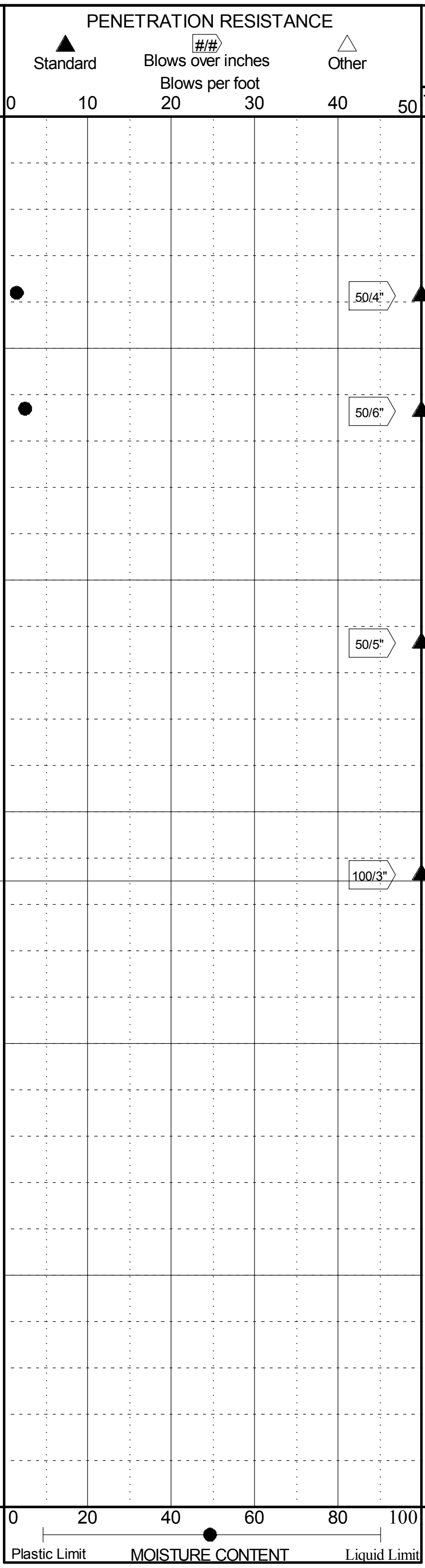
Page 1 of 1

Soil Description

Location: CKHS - Vacant Home at NE Corner of Fenced Garden

Approximate ground surface elevation: 158.0 feet

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	TESTING
0	6-inches Sod / Topsoil			N/E	
	Very dense, moist, tan with gray mottling, silty SAND with some gravel (Qvt - Glacial Till).				
		40%	S-1		
5	Becomes gray with brown mottling				
		80%	S-2		22
	Becomes gray				
10		30%	S-3		
15		0%	S-4		
	Blow Counts Overstated - Rock				
	Boring terminated at approximately 16.5 feet				
20					
25					
30					



LEGEND

- 2.00-inch OD split-spoon sampler
- N/E No groundwater encountered
- 200 Wash (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

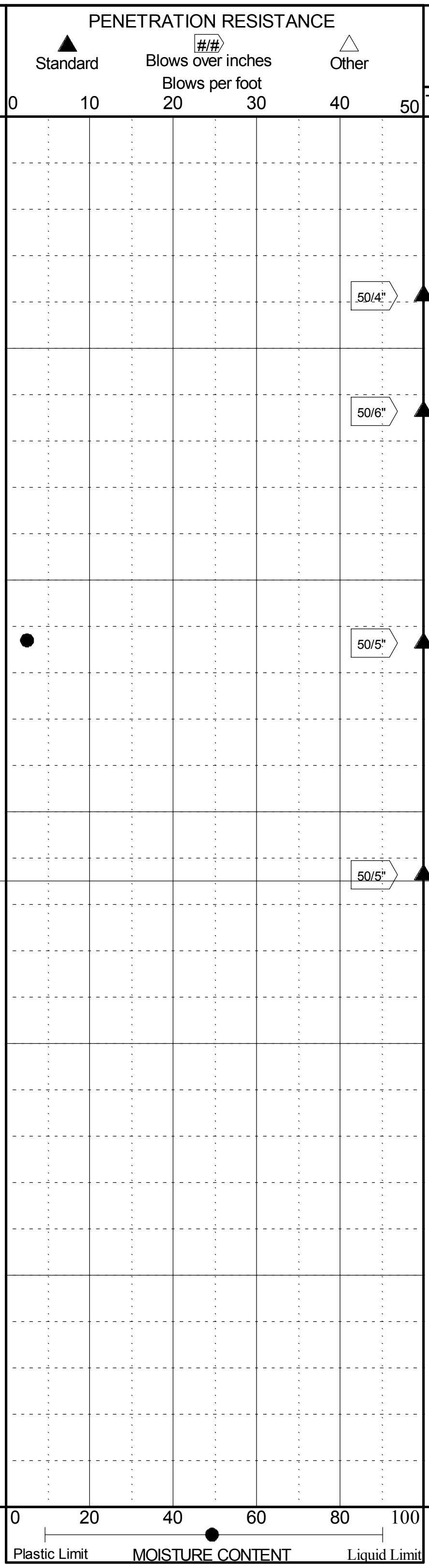
PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *8*

Page 1 of 1

Location: CKSD Alternative HS Bldg - 34' E. of Bldg E. Door

Approximate ground surface elevation: 131.0 feet

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	2.5-inches Asphalt			N/E		
	Very dense, moist, grayish-brown, silty SAND (Qvt - Glacial Till).					
		20%	S-1		50/4"	
5	Becomes gray	50%	S-2		50/6"	
10	Very dense, moist, gray, silty, gravelly SAND with some gravel and trace silt (Qva - Advance Outwash ?).	50%	S-3		50/5"	15
15		50%	S-4		50/5"	
16.5	Boring terminated at approximately 16.5 feet					



LEGEND

- 2.00-inch OD split-spoon sampler
- N/E No groundwater encountered
- Grain Size Analysis (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

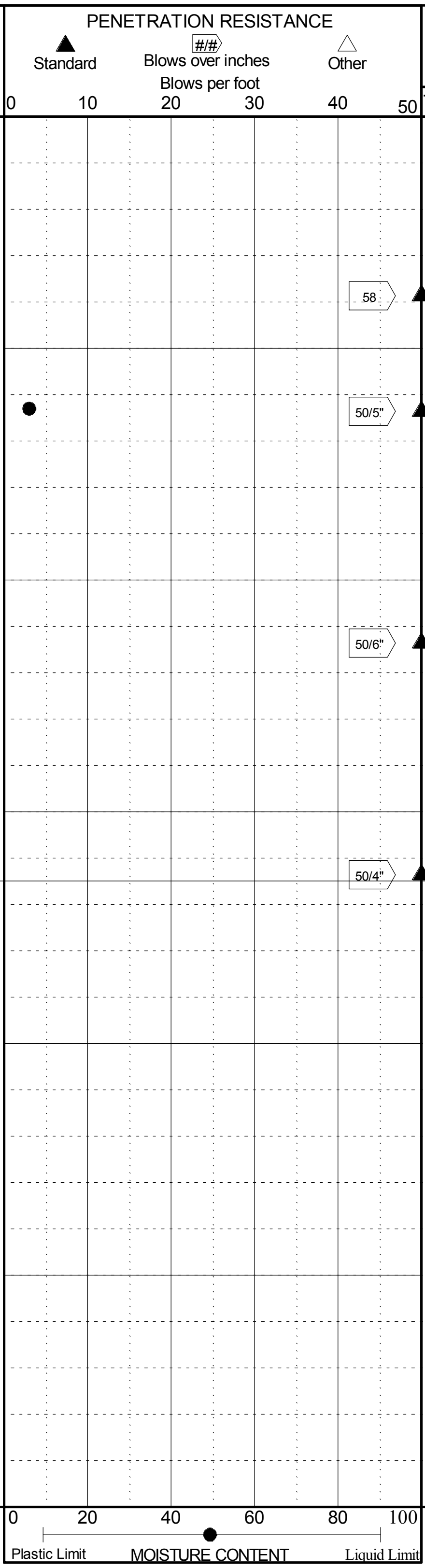
PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *9*

Location: CKHS Base Ball Field Parking Lot - 55' W. of Backstop

Approximate ground surface elevation: 157.0 feet

Page 1 of 1

DEPTH (feet)	Soil Description	USCS/USGS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	3-inches Asphlat over 5-inches Base Course.				N/E		
	Very dense, moist, silty, gravelly SAND (Qvt - Glacial Till).		90%	S-1		58	
5			60%	S-2		50/5"	22
10			60%	S-3		50/6"	
15			30%	S-4		50/4"	
	Boring terminated at approximately 16.5 feet						
20							
25							
30							



LEGEND

▯	2.00-inch OD split-spoon sampler
N/E	No groundwater encountered
◎	Grain Size Analysis (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *10*

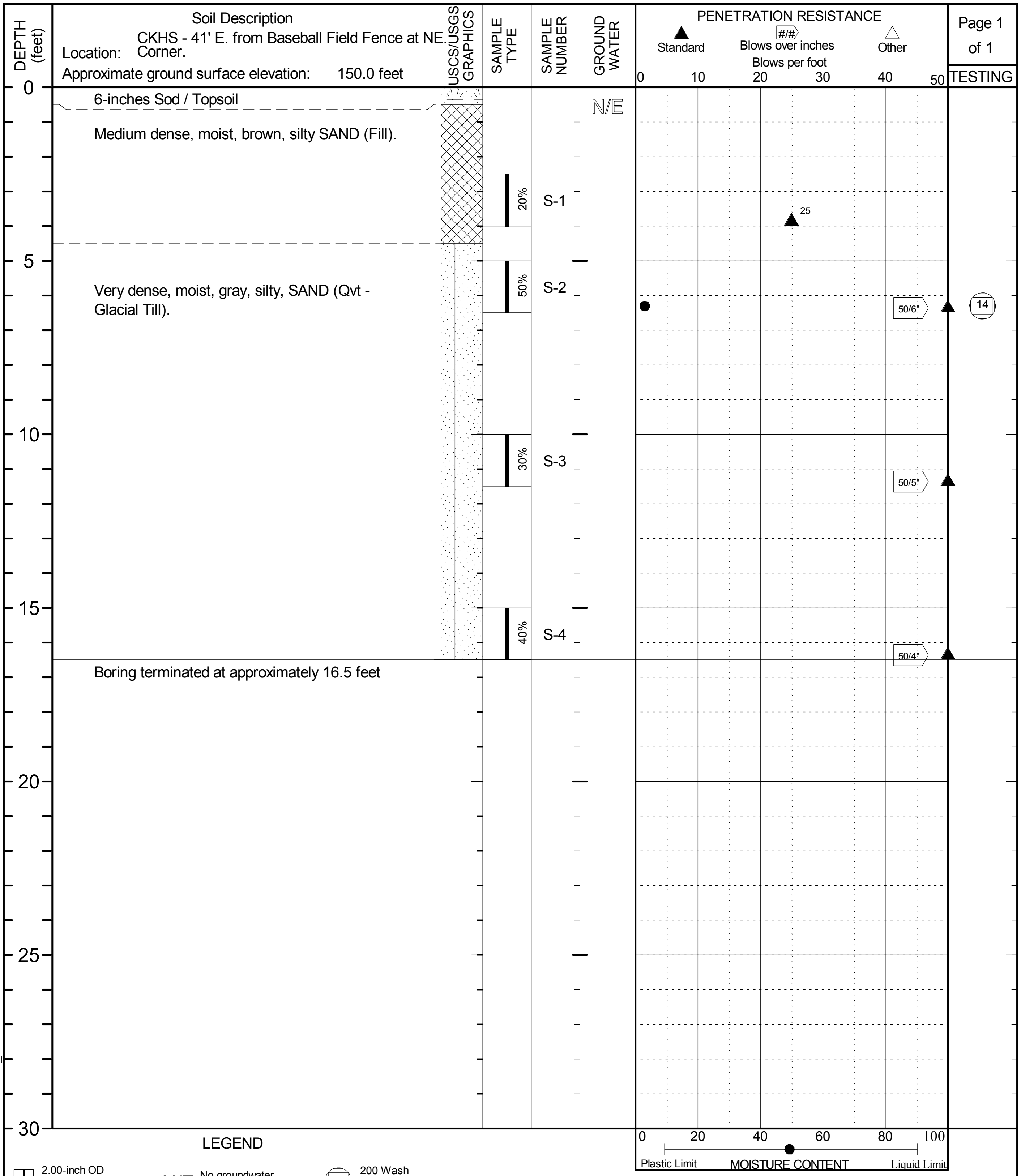
Soil Description

Location: CKHS - 41' E. from Baseball Field Fence at NE. Corner.

Approximate ground surface elevation: 150.0 feet

DEPTH (feet) | USCS/USGS GRAPHICS | SAMPLE TYPE | SAMPLE NUMBER | GROUND WATER | PENETRATION RESISTANCE | Page 1 of 1 | TESTING

Soil Description	Sample Type	Sample Number	Ground Water	Penetration Resistance	Testing
6-inches Sod / Topsoil			N/E		
Medium dense, moist, brown, silty SAND (Fill).	20%	S-1		25	
Very dense, moist, gray, silty, SAND (Qvt - Glacial Till).	50%	S-2		50/6"	14
	30%	S-3		50/5"	
	40%	S-4		50/4"	
Boring terminated at approximately 16.5 feet					



LEGEND

▯ 2.00-inch OD split-spoon sampler

N/E No groundwater encountered

○ 200 Wash (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

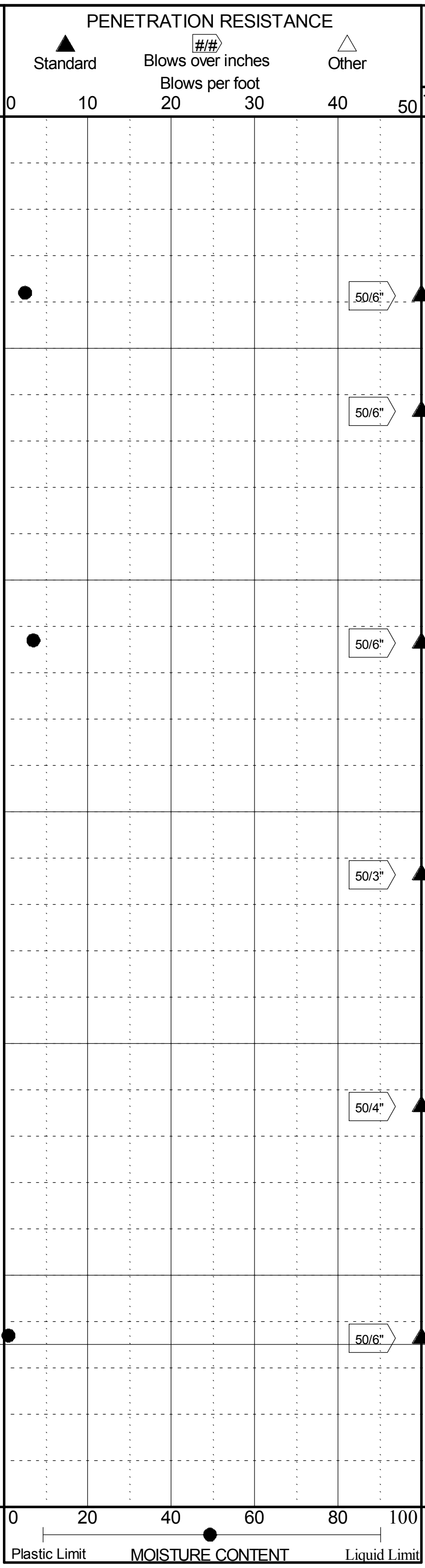
BOTHELL_GEO_2015.GLB BOTHELL_LOG FORMAT 2012 CKSD BORINGS 1 THROUGH 15.GPJ BOTHELL GEO 2010 B&TP.GDT PRINTDATE 9/21/16

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *11*

Page 1 of 1

Location: 27' SE of Career & Technical Bldg SE Corner
Approximate ground surface elevation: 132.0 feet

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	2-inches Asphalt over 4-inches Base Course.			N/E		
	Very dense, moist, grayish-brown, silty SAND with some gravel (Qvt - Glacial Till).	40%	S-1		50/6"	
5		30%	S-2		50/6"	
	Becomes gray					
10		60%	S-3		50/6"	29
	Becomes brownish-gray					
15		30%	S-4		50/3"	
	Becomes gray, silty fine SAND					
20		50%	S-5		50/4"	
	Very dense, moist, gray, gravelly SAND with trace silt (Qva - Advance Outwash).					
25		50%	S-6		50/6"	4
	Boring terminated at approximately 26.5 feet					
30						



LEGEND

▯	2.00-inch OD split-spoon sampler
N/E	No groundwater encountered
◎	Grain Size Analysis (% fines shown)

amec foster wheeler
11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 16, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

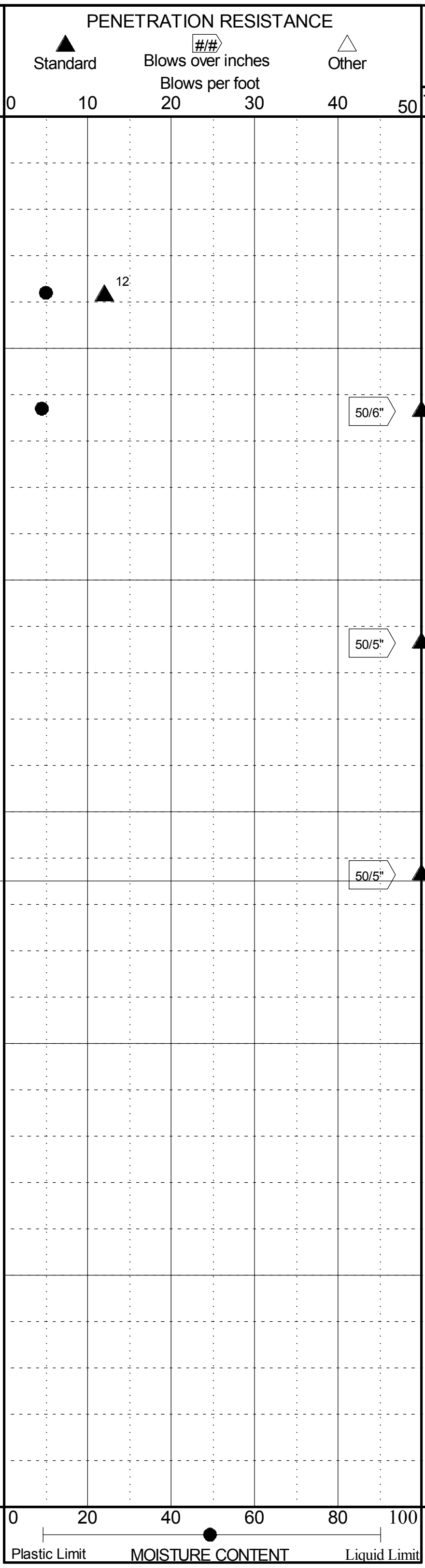
BOTHELL_GEO_2015.GLB BOTHELL_LOG FORMAT 2012 CKSD BORINGS 1 THROUGH 15.GPJ BOTHELL GEO 2010 B&TP.GDT PRINTDATE 9/21/16

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *12*

Location: CKHS - Base Ball Field - 114' SE of 1st Base
Approximate ground surface elevation: 153.5 feet

Page 1 of 1

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	6-inches Sod / Topsoil			N/E		
	Medium dense, moist, brown, silty SAND (Fill).					
		20%	S-1		12	23
5	Very dense, moist, gray with brown mottling, gravelly, silty SAND (Qvt - Glacial Till).	80%	S-2		50/6"	
	Becomes gray					
10		50%	S-3		50/5"	
15		20%	S-4		50/5"	
	Boring terminated at approximately 16.5 feet					
20						
25						
30						



LEGEND

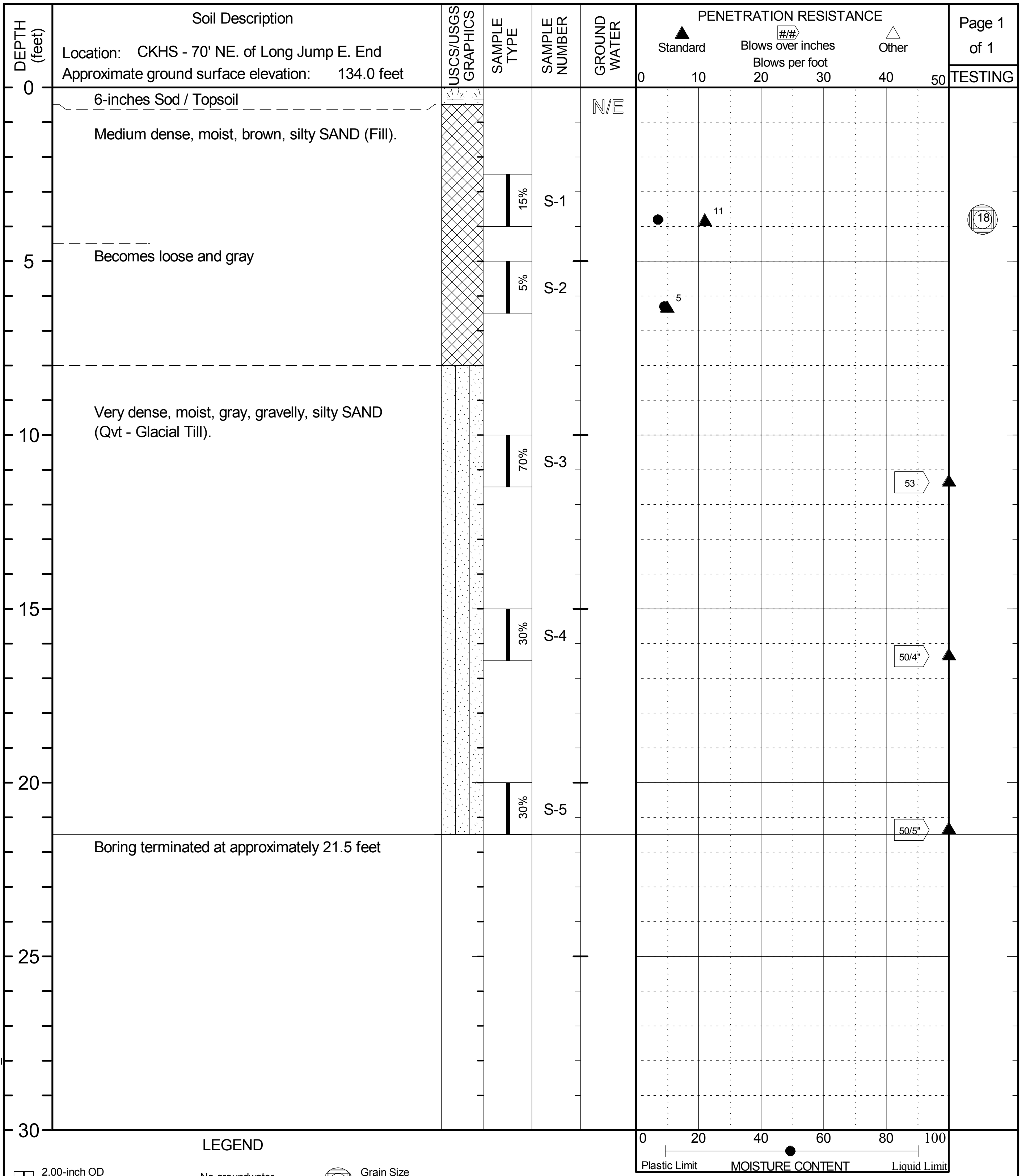
▯	2.00-inch OD split-spoon sampler
N/E	No groundwater encountered
▢	200 Wash (% fines shown)

amec foster wheeler
11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *13*



Location: CKHS - 70' NE. of Long Jump E. End

Approximate ground surface elevation: 134.0 feet

6-inches Sod / Topsoil

Medium dense, moist, brown, silty SAND (Fill).

Becomes loose and gray

Very dense, moist, gray, gravelly, silty SAND (Qvt - Glacial Till).

Boring terminated at approximately 21.5 feet

Sample Type	Sample Number	Blows per foot	Testing
15%	S-1	11	18
5%	S-2	5	
70%	S-3	53	
30%	S-4	50/4"	
30%	S-5	50/5"	

LEGEND

2.00-inch OD split-spoon sampler

N/E No groundwater encountered

Grain Size Analysis (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 16, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

BOTHELL_GEO_2015.GLB BOTHELL_LOG FORMAT 2012 CKSD BORINGS 1 THROUGH 15.GPJ BOTHELL GEO 2010 B&TP.GDT PRINTDATE 9/21/16

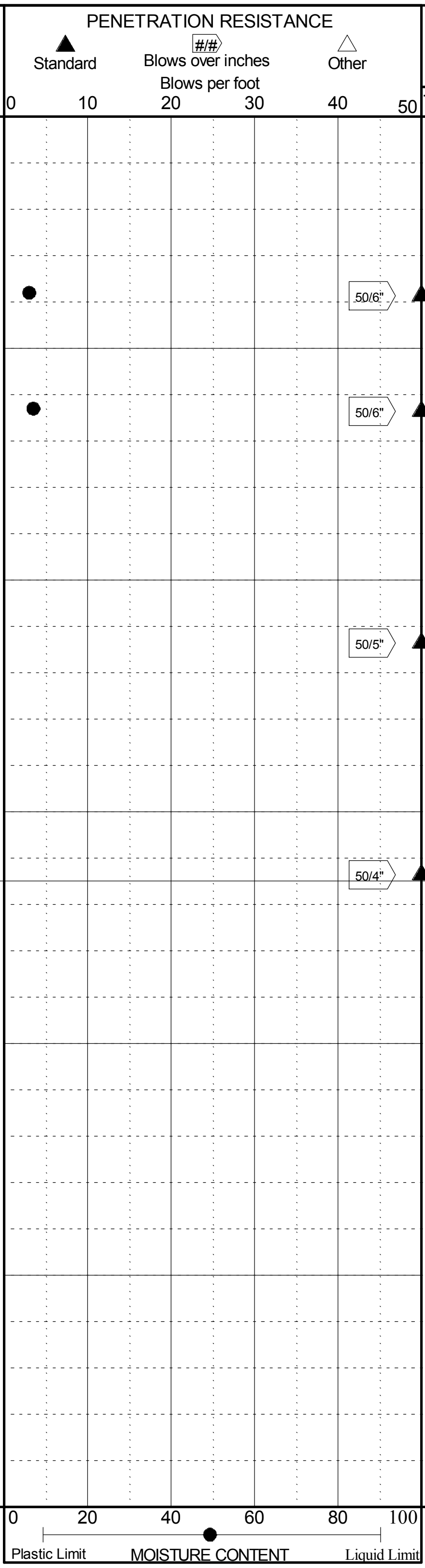
PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *14*

Location: Vacant Parcel N. of CKMS - Driveway 43' W. of Bldg

Approximate ground surface elevation: 179.5 feet

Page 1 of 1

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	2-inches of 5/8 inch Crushed Rock.			N/E		
	Very dense, moist, tan with gray mottling, silty SAND with some gravel (Qvt - Glacial Till).	30%	S-1		50/6"	25
5	Becomes gray with brown mottling	90%	S-2		50/6"	
	Becomes gray					
10		40%	S-3		50/5"	
15		30%	S-4		50/4"	
	Boring terminated at approximately 16.5 feet					
20						
25						
30						



LEGEND

2.00-inch OD split-spoon sampler

N/E No groundwater encountered

200 Wash (% fines shown)

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

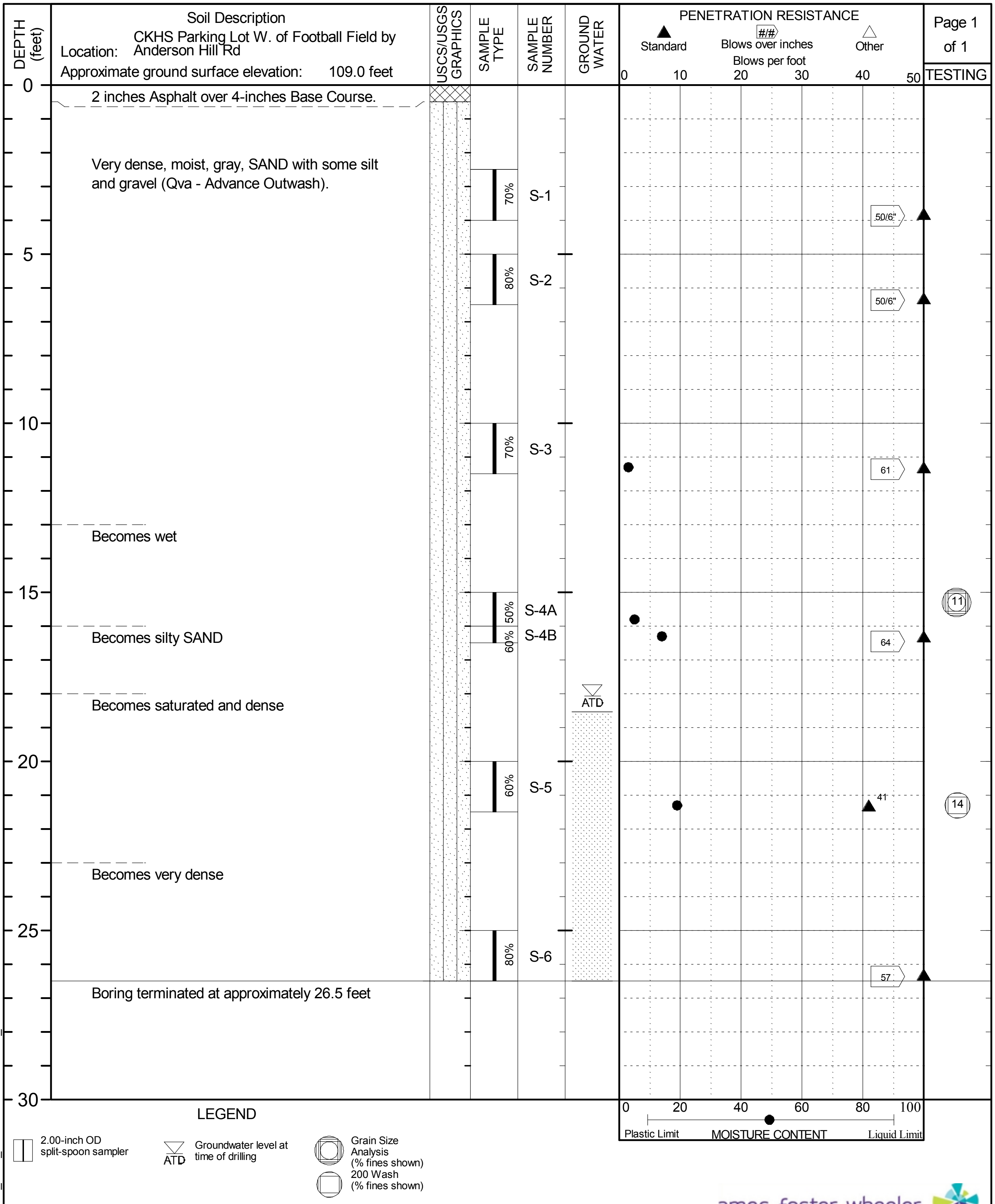
Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 15, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *15*

Location: CKHS Parking Lot W. of Football Field by Anderson Hill Rd

Approximate ground surface elevation: 109.0 feet



2 inches Asphalt over 4-inches Base Course.

Very dense, moist, gray, SAND with some silt and gravel (Qva - Advance Outwash).

Becomes wet

Becomes silty SAND

Becomes saturated and dense

Becomes very dense

Boring terminated at approximately 26.5 feet

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: HSA Hammer Type: Cathead Date drilled: *August 16, 2016* Logged By: *FC*

Drilled by: *Geologic Dril*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *HB-01*

Location: CKHS Football Field NW Corner - Goal Line
Approximate ground surface elevation: 134.5 feet

Page 1 of 1

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER
0	4-inches Grass / Topsoil			
	Drainage SAND	✋	G-1	
	Medium dense, wet, gray, gravelly, silty SAND (Fill). Seepage at contact zone	✋	G-2	P ▽ ATD
	Dense, wet, gray, gravelly, silty SAND (Qvt - Glacial Till).	✋	G-3	
	Boring terminated at approximately 2.75 feet			
5				

PENETRATION RESISTANCE
▲ Standard
#/# Blows over inches
Blows per foot
△ Other
0 10 20 30 40 50
TESTING

0 20 40 60 80 100
Plastic Limit MOISTURE CONTENT Liquid Limit

LEGEND

✋ Grab Sample

P ▽ ATD Perched water level at time of drilling

amec foster wheeler
11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: Hand Auger Hammer Type: N/A Date drilled: *August 16, 2016* Logged By: *KHM*
Drilled by: *KHM*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *HB-02*

DEPTH (feet)	Soil Description Location: CKHS Football Field NE Corner - Goal Line Approximate ground surface elevation: 134.5 feet	USCS/USGS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE ▲ Standard ##/## Blows over inches △ Other Blows per foot 0 10 20 30 40 50	Page 1 of 1 TESTING
0	4-inches Grass / Topsoil				N/E		
	Drainage SAND		✋	G-1			
	Loose, moist, brownish-gray, mottled, silty SAND with some gravel (Fill)		✋	G-2			
	Obstruction at 2.75 Feet - End of Boring						
	Boring terminated at approximately 2.75 feet						
5							

0 20 40 60 80 100

Plastic Limit MOISTURE CONTENT Liquid Limit

LEGEND

✋ Grab Sample

N/E No groundwater encountered

amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: Hand Auger Hammer Type: N/A Date drilled: *August 16, 2016* Logged By: *KHM*

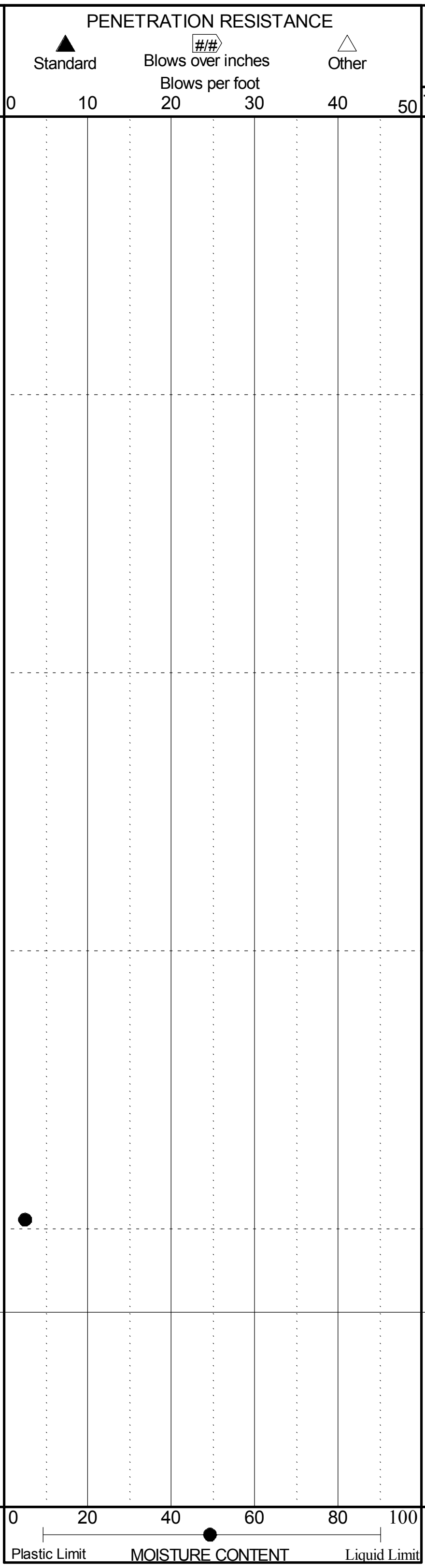
Drilled by: *KHM*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *HB-03*

Page 1 of 1

Location: CKHS Center of Football Field - 50yd Line
Approximate ground surface elevation: 136.0 feet

DEPTH (feet)	Soil Description	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	TESTING
0	6-inches Grass / Topsoil intermixed with Drainage Sand Irregation water trapped in topsoil mix	✋	G-1	P ▽ ATD	
	Drainage SAND	✋	G-2		
	Loose, moist, brownish-gray, silty SAND with some gravel (Fill)				
	Loose to medium dense, moist, gray, silty SAND with some gravel (Qvt - Glacial Till?)	✋	G-3		
	Boring terminated at approximately 4.3 feet				
5					



LEGEND

✋ Grab Sample

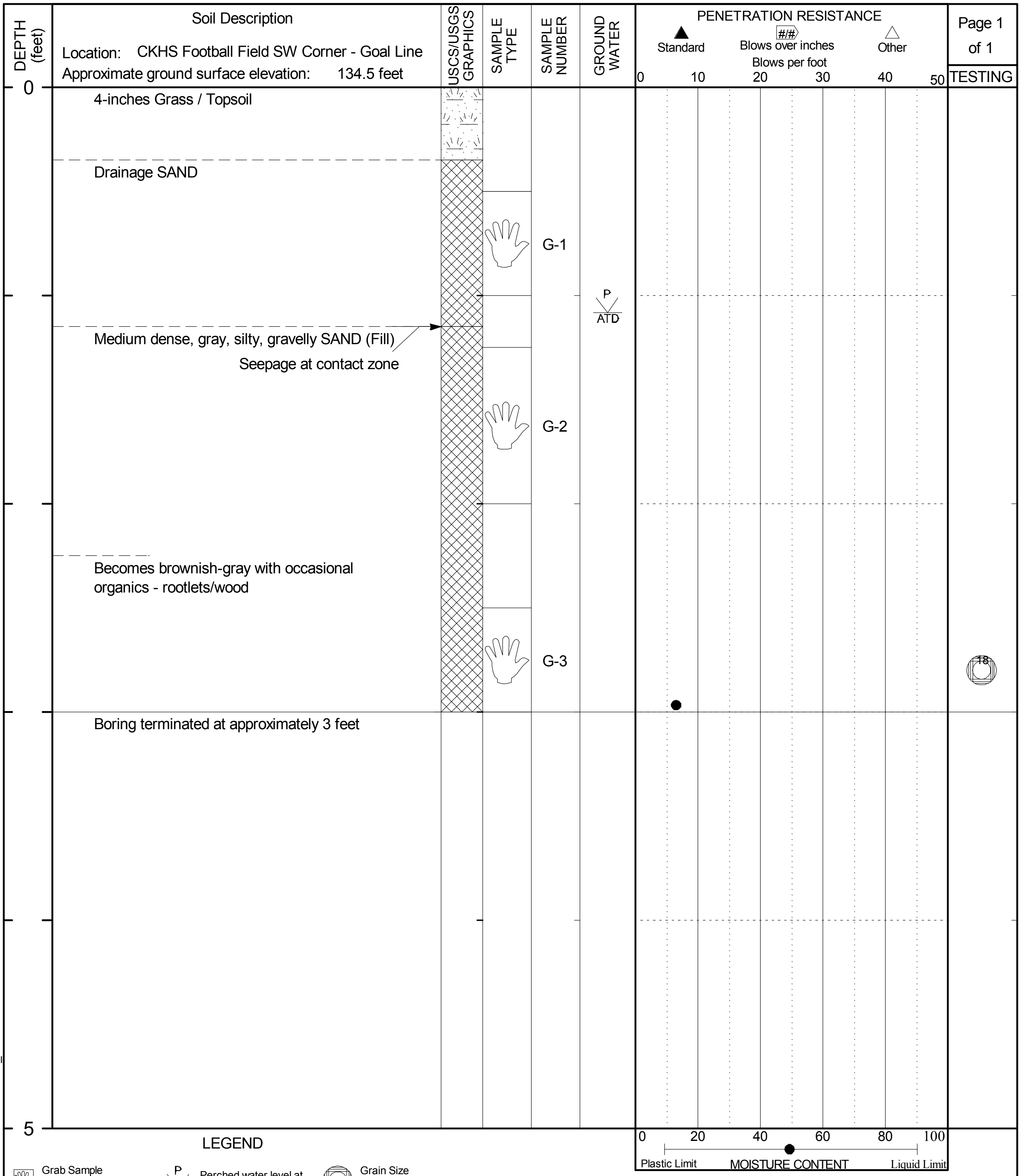
P ▽ ATD Perched water level at time of drilling

amec foster wheeler
11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: Hand Auger Hammer Type: N/A Date drilled: *August 16, 2016* Logged By: *KHM*

Drilled by: *KHM*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *HB-04*



Soil Description

Location: CKHS Football Field SW Corner - Goal Line

Approximate ground surface elevation: 134.5 feet

4-inches Grass / Topsoil

Drainage SAND

Medium dense, gray, silty, gravelly SAND (Fill)

Seepage at contact zone

Becomes brownish-gray with occasional organics - rootlets/wood

Boring terminated at approximately 3 feet

LEGEND

Grab Sample

Perched water level at time of drilling

Grain Size Analysis (% fines shown)

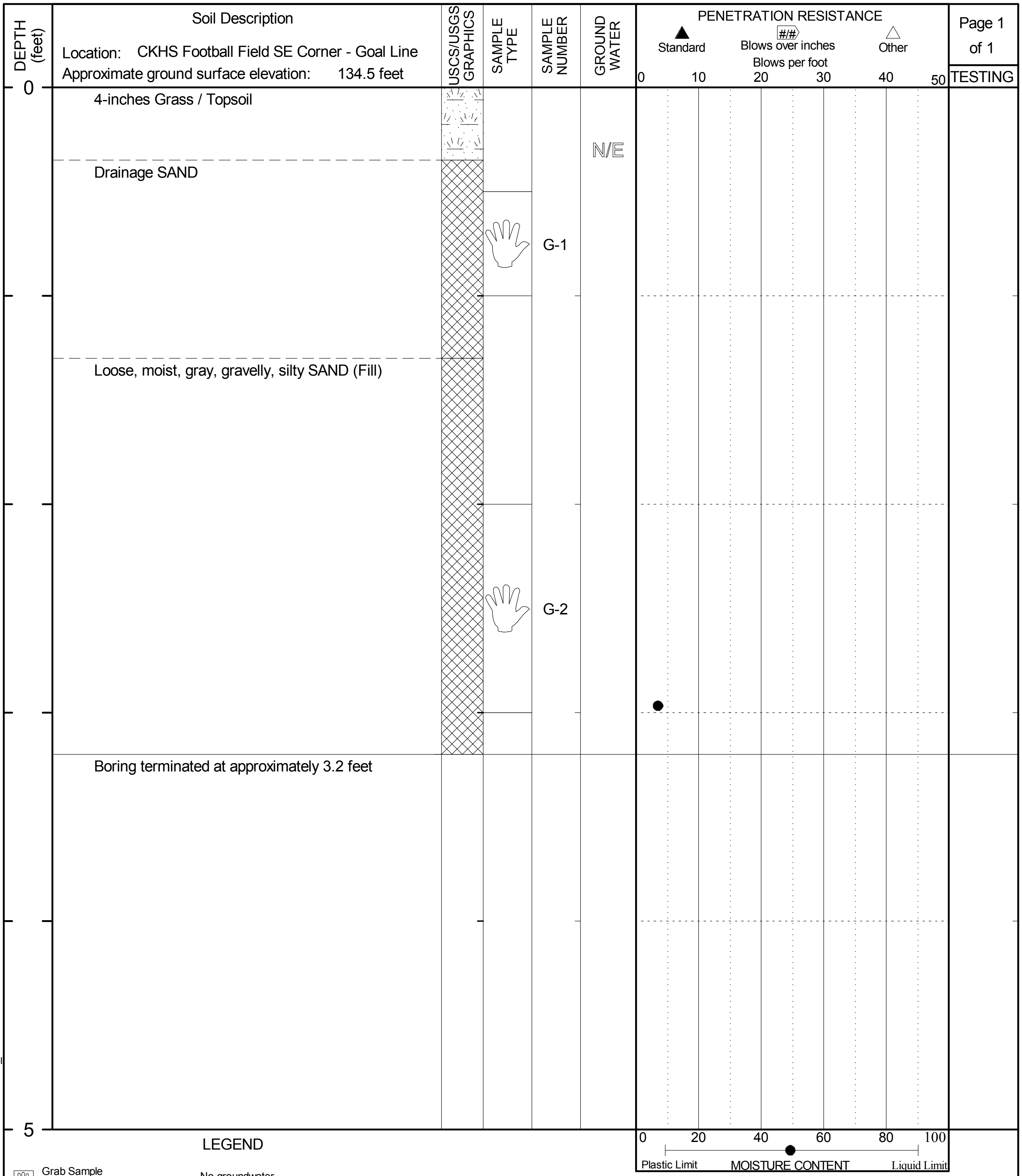
amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: Hand Auger Hammer Type: N/A Date drilled: *August 16, 2016* Logged By: *KHM*

Drilled by: *KHM*

PROJECT: *Central Kitsap HS & MS Campus* JOB No. *6-917-18096-0* BORING No. *HB-05*



Location: CKHS Football Field SE Corner - Goal Line

Approximate ground surface elevation: 134.5 feet

Page 1 of 1

DEPTH (feet)	Soil Description	USCS/USGS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE	TESTING
0	4-inches Grass / Topsoil				N/E		
	Drainage SAND			G-1			
	Loose, moist, gray, gravelly, silty SAND (Fill)			G-2			
	Boring terminated at approximately 3.2 feet						
5							

LEGEND

Grab Sample

N/E No groundwater encountered

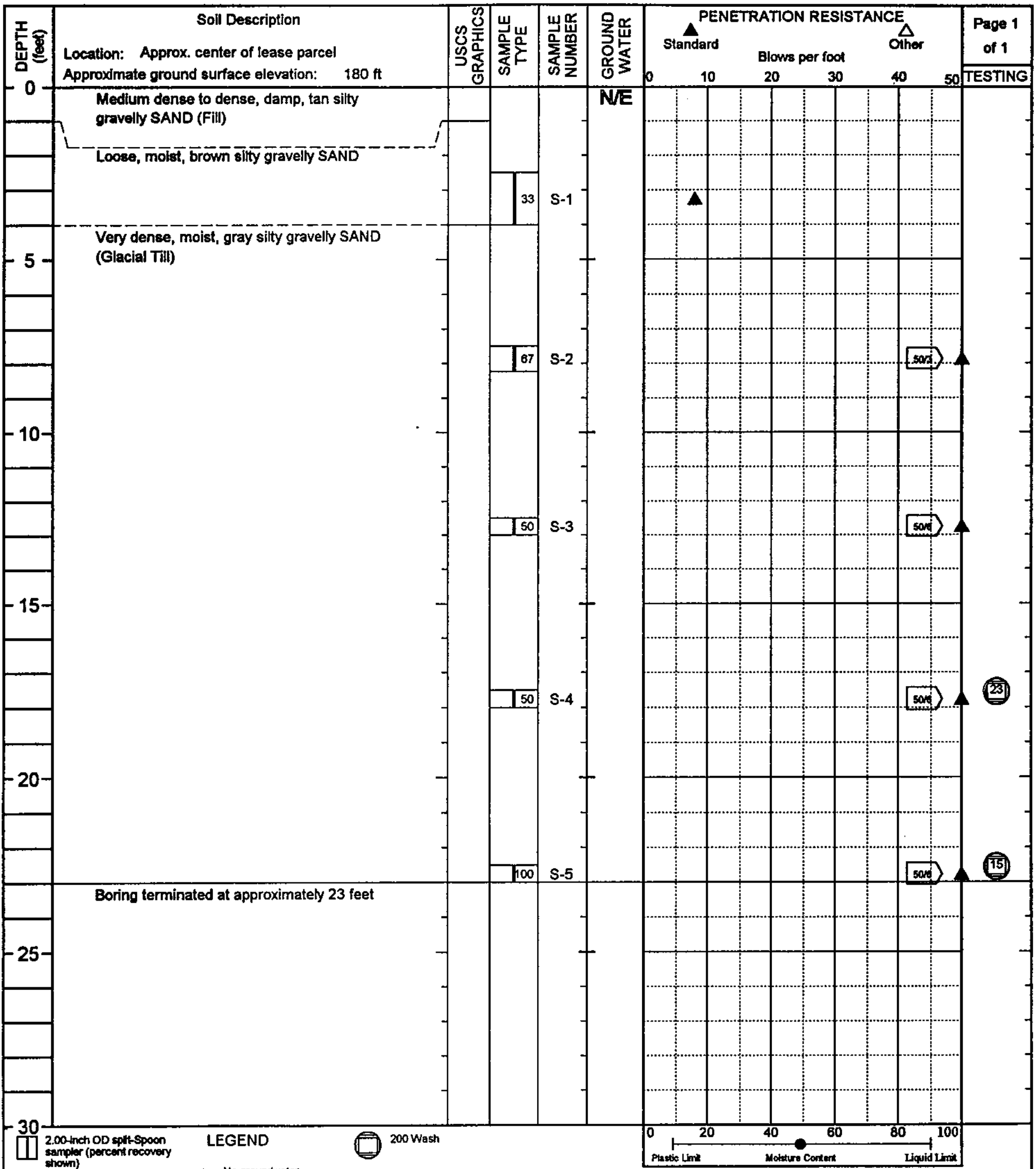
amec foster wheeler

11810 North Creek Parkway N
Bothell, WA 98011

Drilling Method: Hand Auger Hammer Type: N/A Date drilled: *August 16, 2016* Logged By: *KHM*

Drilled by: *KHM*

PROJECT: *Nextel Silverdale WA0285-3* W.O. *9-91M-12987-0* **BORING No.** *B-1*



Location: Approx. center of lease parcel
Approximate ground surface elevation: 180 ft

DEPTH (feet)	Soil Description	USCS GRAPHICS	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	PENETRATION RESISTANCE (Blows per foot)	TESTING
0	Medium dense to dense, damp, tan silty gravelly SAND (Fill)				N/E		
	Loose, moist, brown silty gravelly SAND		33	S-1			
5	Very dense, moist, gray silty gravelly SAND (Glacial Till)						
			67	S-2		50/3	
10							
			50	S-3		50/6	
15							
			50	S-4		50/6	㉓
20							
			100	S-5		50/6	⑮
	Boring terminated at approximately 23 feet						
25							
30							

LEGEND

▯ 2.00-inch OD split-Spoon sampler (percent recovery shown)

N/E No groundwater encountered

⊡ 200 Wash

AGRA
ENGINEERING GLOBAL SOLUTIONS
11335 N.E. 122nd Way Suite 100
Kirkland, Washington 98034-6913

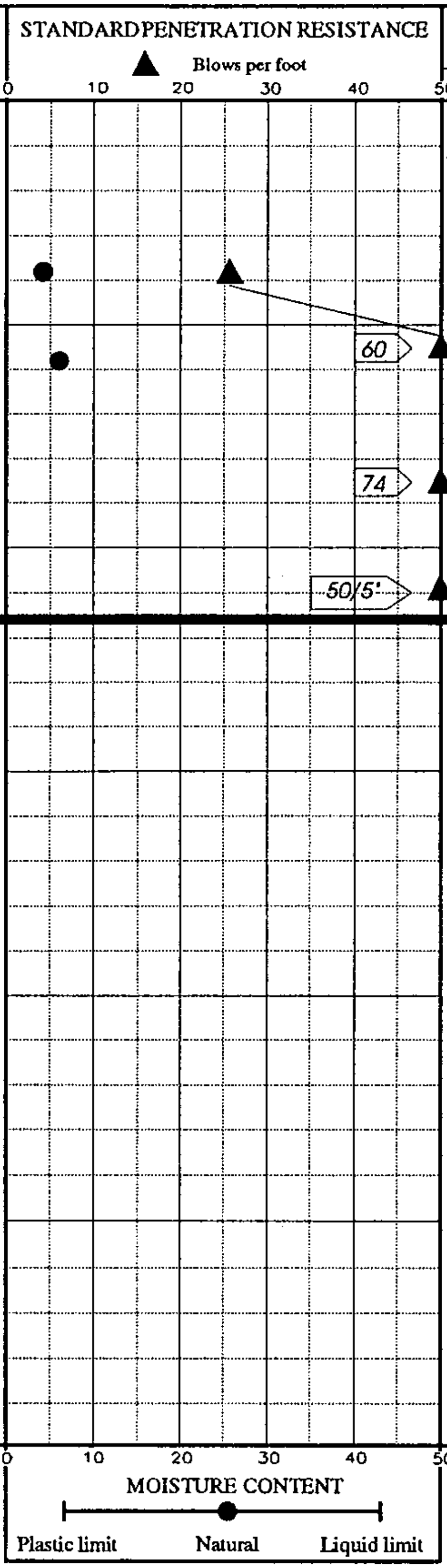
4IN1 12987.GPJ WA4IN1.GDT 6/24/99

Drilling Method: HSA Hammer type: Automatic Date drilled: *18 June 1999* Logged By: *JFV*

PROJECT: Performing Arts Center
Science Kit Center Site W.O. 11-09290-00 BORING NO. B-1

Page 1 of 1

DEPTH (feet)	SOIL DESCRIPTION Approximate ground surface elevation:	SAMPLE TYPE	SAMPLE NUMBER	OVM READING	GROUND WATER	TESTING
0	2" Asphalt paving					
	Medium dense, moist, tan, fine to medium SAND with trace silt					
		I	S-1	0.0		
5	Very dense, moist, tan to gray, medium to coarse SAND with some gravel and trace silt	I	S-2	0.0		
	Very dense, moist, gray, silty, fine to medium SAND with trace gravel	I	S-3	0.0		
10	Some gravel					
		I	S-4	0.0		
	Boring terminated at approximately 11.5 feet					
15						
20						
25						
30						



LEGEND

I 2-inch OD split-spoon sample

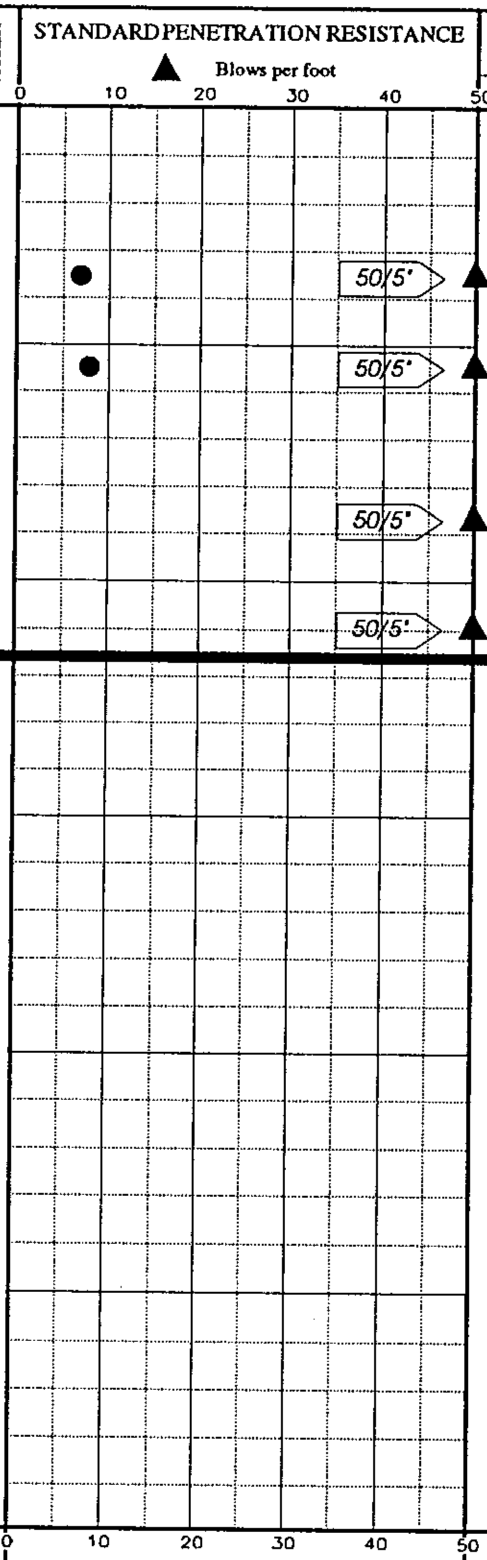
RZA AGRA, Inc
Engineering & Environmental Services
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 06 December 1993 Drilling completed: 06 December 1993 Logged by: KHM

Performing Arts Center

PROJECT: Science Kit Center Site W.O. 11-09290-00 BORING NO. B-2

DEPTH (feet)	SOIL DESCRIPTION Approximate ground surface elevation:	SAMPLE TYPE	SAMPLE NUMBER	OVM READING	GROUND WATER	STANDARD PENETRATION RESISTANCE ▲ Blows per foot	Page 1 of 1 TESTING
0	*Very dense, moist, gray, silty, fine to medium SAND with some gravel*						
		I	S-1	0.0		50/5'	
5							
		I	S-2	0.0		50/5'	
		I	S-3	0.0		50/5'	
10							
		I	S-4	*		50/5'	
	Boring terminated at approximately 11.5 feet						
15							
20							
25							
30							



LEGEND

I 2-inch OD split-spoon sample

* Insufficent sample for OVM reading; however, no odor detected

MOISTURE CONTENT

Plastic limit ├──●──┤ Natural Liquid limit

RZA AGRA, Inc
Engineering & Environmental Services

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 06 December 1993 Drilling completed: 06 December 1993 Logged by: KHM

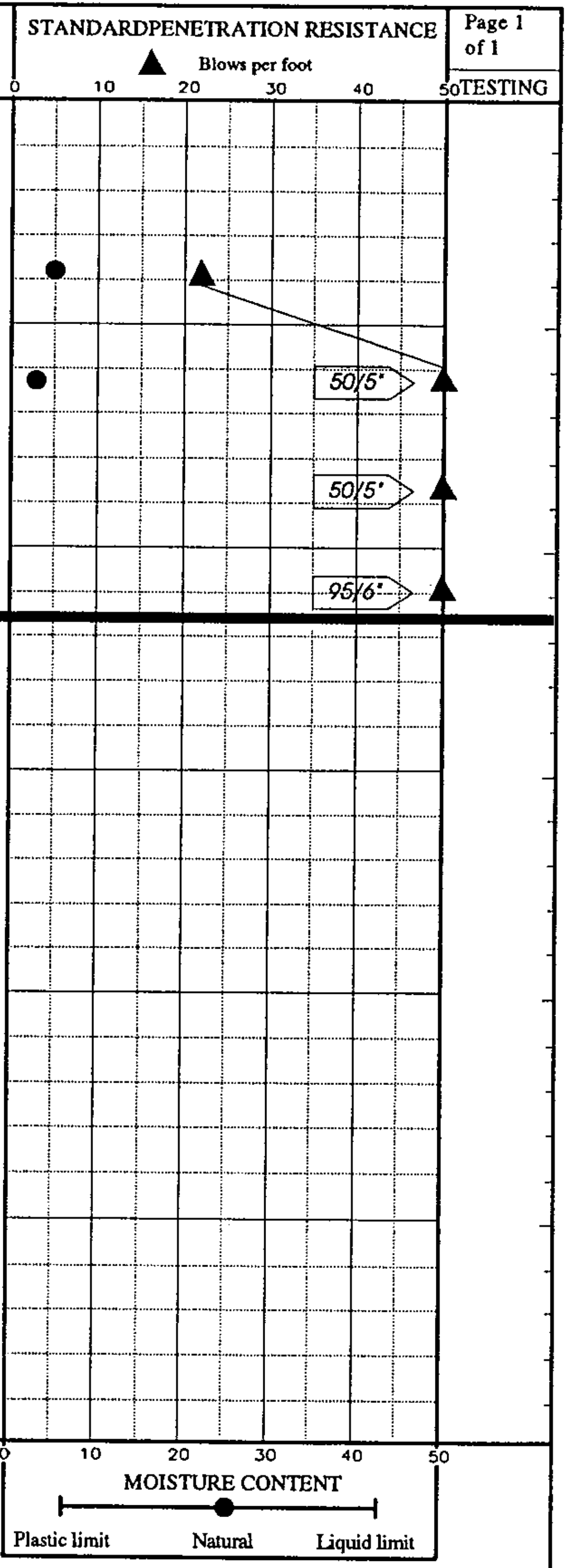
PROJECT: Performing Arts Center
Science Kit Center Site
W.O. 11-09290-00 BORING NO. B-3

Page 1 of 1

Approximate ground surface elevation:

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	OVM READING	GROUND WATER	STANDARD PENETRATION RESISTANCE Blows per foot	TESTING
0	Medium dense, moist, gray, fine to medium SAND with trace gravel and silt						
		I	S-1	*			
5	Very dense, moist, gray, silty, gravelly, fine to medium SAND	I	S-2	0.0		50/5"	
		X	S-3			50/5"	
10	Very dense, moist, gray, silty, fine to medium SAND with some gravel	I	S-4	*		95/6"	

Boring terminated at approximately 11.5 feet



LEGEND

I 2-inch OD split-spoon sample

X Sample not recovered

* Insufficient sample for OVM reading; however, no odor detected

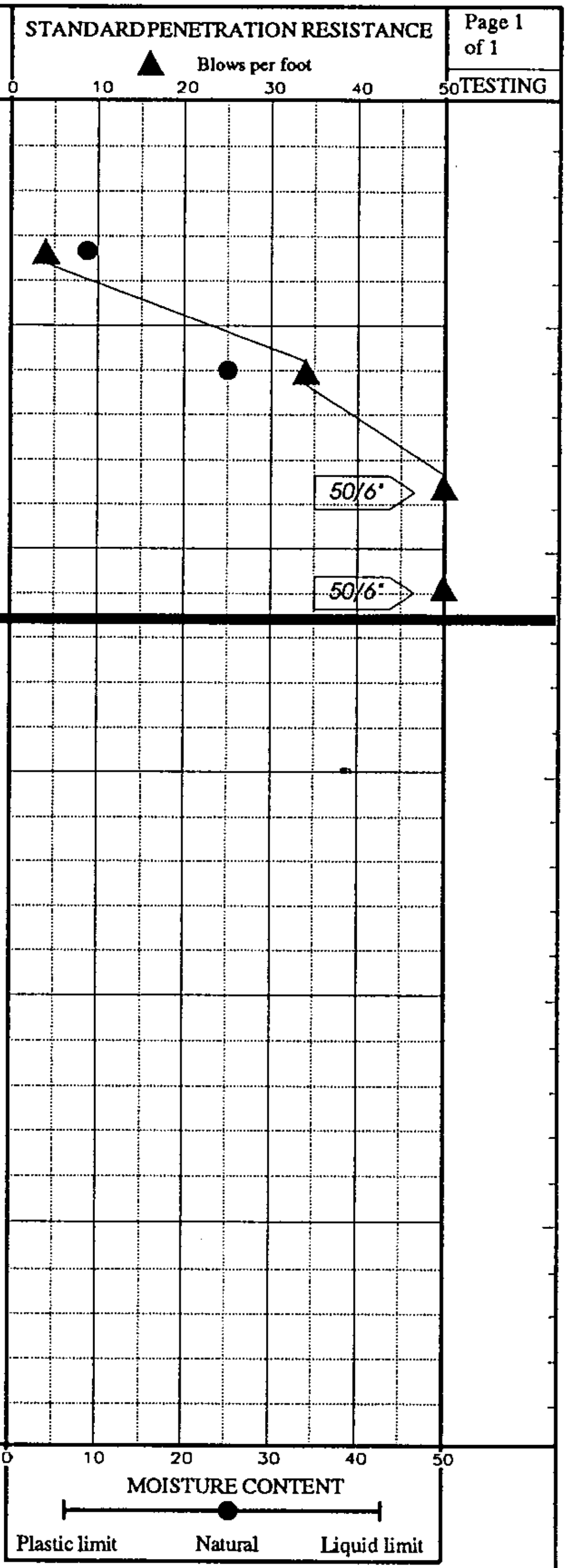
RZA AGRA, Inc
Engineering & Environmental Services
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 06 December 1993 Drilling completed: 06 December 1993 Logged by: KHM

PROJECT: *Performing Arts Center*
Science Kit Center Site
W.O. *11-09290-00* BORING NO. *B-4*

Page 1
of 1

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	OVM READING	GROUND WATER
0	Approximate ground surface elevation:				
	Loose, moist, tan, fine to medium SAND with trace silt (Possible Fill)	I	*S-1*	*0.0*	
5	*Medium dense, moist, mottled gray, silty, fine SAND*	I	*S-2*	*0.0*	
	Very dense, gray, some gravel	I	*S-3*	*0.0*	
10	*Becoming gravelly*	I	*S-4*	*	
	Boring terminated at approximately 11.5 feet				
15					
20					
25					
30					



LEGEND

I 2-inch OD split-spoon sample

* Insufficient sample for OVM reading; however, no odor detected

RZA AGRA, Inc
Engineering & Environmental Services
11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: *06 December 1993* Drilling completed: *06 December 1993* Logged by: *KHM*

PROJECT: Central Kitsap High School
Library Addition

W.O. W-8871

BORING NO. B-1

DEPTH (feet)	SOIL DESCRIPTION Approximate ground surface elevation:	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	STANDARD PENETRATION RESISTANCE ▲ Blows per foot 0 10 20 30 40 50	Page 1 of 1 TESTING
0	5 inch concrete slab overlying a medium dense, damp to moist, light brown, silty, gravelly, SAND with some brick fragments (Fill)					
	Boring terminated at approximately 2 feet atop buried concrete					
5						
10						
15						
20						
25						
30					0 10 20 30 40 50	

LEGEND

I 2-inch OD split-spoon sample

MOISTURE CONTENT

├──●──┤

Plastic limit Natural Liquid limit

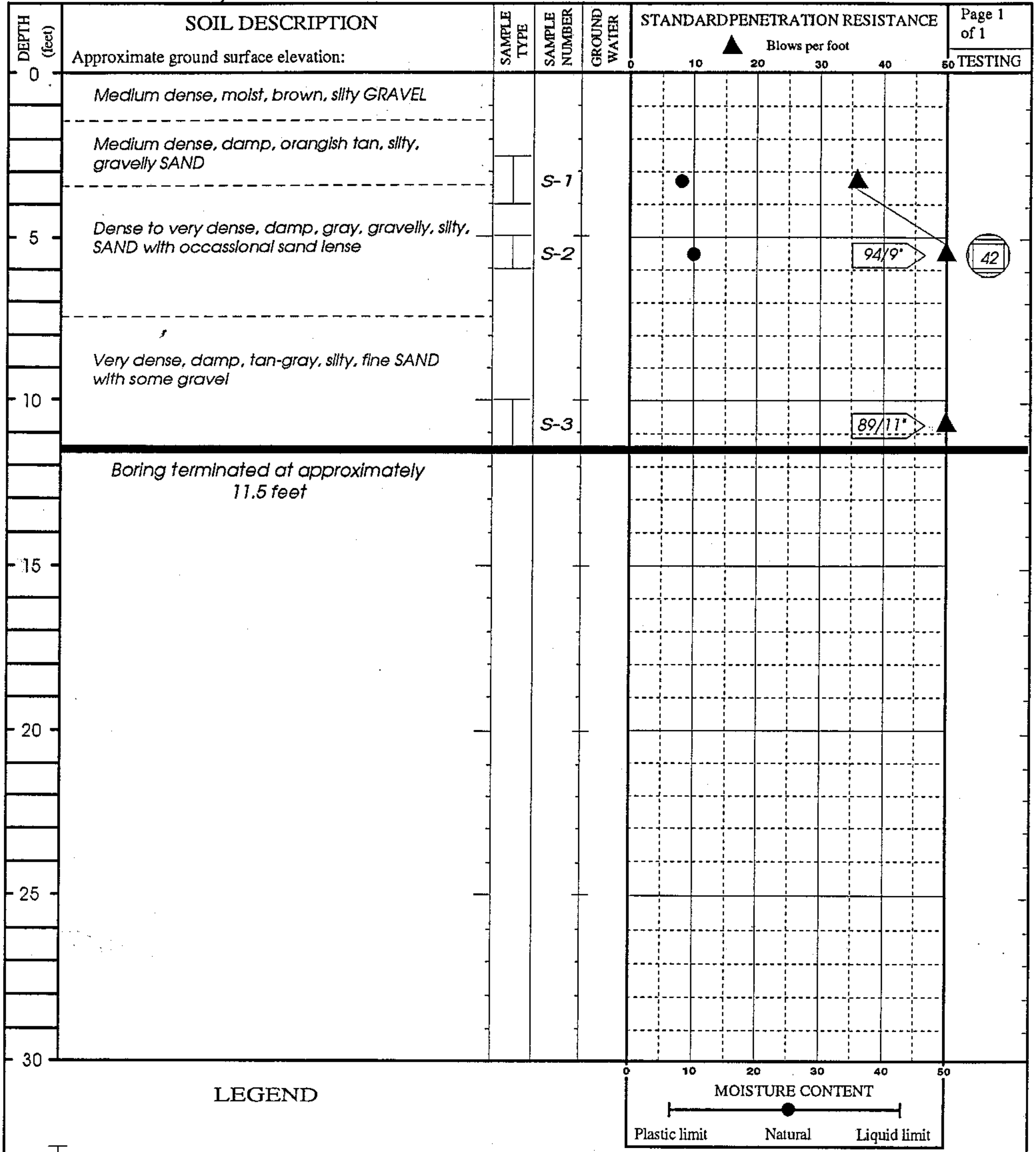
RZA AGRA, Inc
Engineering & Environmental Services

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: 06 April 1993 Drilling completed: 06 April 1993 Logged by: KSS

PROJECT: *Central Kitsap High School Library Addition* W.O. *W-8871* BORING NO. *B-2*

Page 1 of 1



Medium dense, moist, brown, silty GRAVEL

Medium dense, damp, orangish tan, silty, gravelly SAND

Dense to very dense, damp, gray, gravelly, silty, SAND with occassional sand lense

Very dense, damp, tan-gray, silty, fine SAND with some gravel

Boring terminated at approximately 11.5 feet

LEGEND

I 2-inch OD split-spoon sample

17 200 wash (percent fines shown)

RZA AGRA, Inc
Engineering & Environmental Services

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: *06 April 1993* Drilling completed: *06 April 1993* Logged by: *KSS*

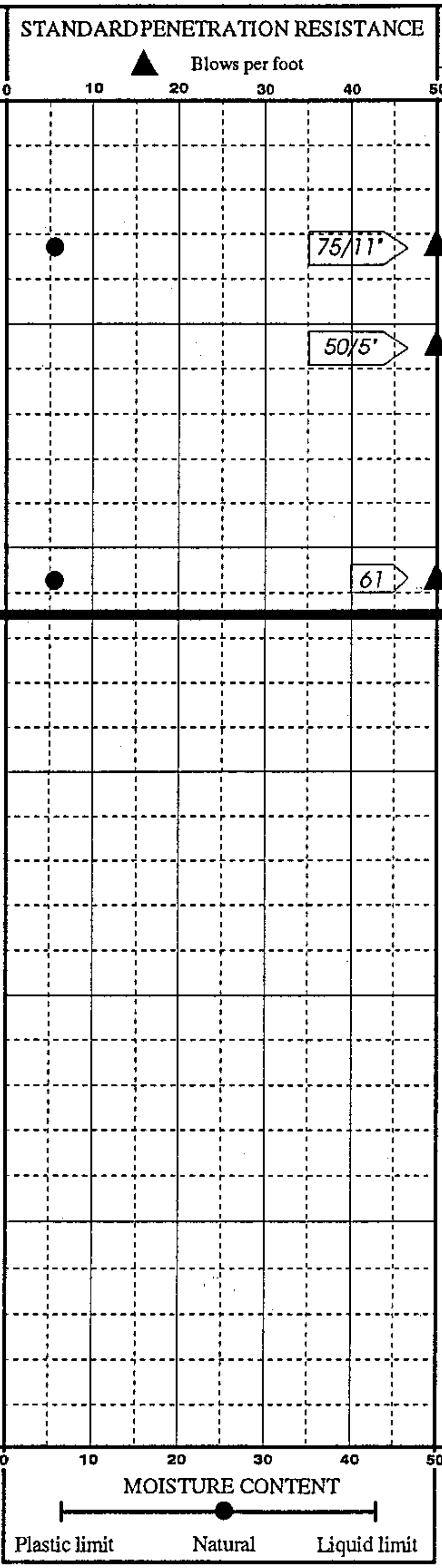
PROJECT: *Central Kitsap High School Library Addition*　　W.O. *W-8871*　　BORING NO. *B-3*

Page 1 of 1

SOIL DESCRIPTION

Approximate ground surface elevation:

DEPTH (feet)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND WATER	STANDARD PENETRATION RESISTANCE (Blows per foot)	TESTING
0	*5 inch concrete slab over a medium dense, damp, tan, gravelly SAND, some silt to silty (Fill)*					
	Medium dense, damp, brown, silty, gravelly SAND	I	S-1		75/11"	
5	*Very dense, damp, gray, silty, gravelly SAND*	I	S-2		50/5"	
	Very dense, damp, tan-gray, silty, fine SAND with some gravel					
10		I	S-3		61	19
	Boring terminated at approximately 11.5 feet					
15						
20						
25						
30						



LEGEND

I 2-inch OD split-spoon sample

(17) 200 wash (percent fines shown)

RZA AGRA, Inc
Engineering & Environmental Services

11335 NE 122nd Way, Suite 100
Kirkland, Washington 98034-6918

Drilling started: *06 April 1993*　　Drilling completed: *06 April 1993*　　Logged by: *KSS*

TEST PIT LOGS

W-7726

Depth (feet)	Soil Classification
	Test Pit TP-1
0.0 - 1.0	Topsoil
1.0 - 3.5	Medium dense, dry to damp, light brown, fine SAND with some silt and gravel
3.5 - 7.0	Dense, damp, grey, gravelly SAND with trace silt
7.0 - 8.0	Dense, dry to damp, grey, fine to medium SAND
	No Seepage
	No Caving
	Test Pit TP-2
0.0 - 1.0	Topsoil with roots
1.0 - 2.5	Dense, damp, grey, gravelly SAND
2.5 - 7.0	Dense, damp, grey, interbedded fine SAND to medium and coarse SAND with trace gravel
	No seepage
	No caving
	Test Pit TP-3
0.0 - 5.0	Dense, damp, grey, silty SAND with some gravel and pockets of organics and roots (Fill)
5.0 - 7.5	Dense, damp, light brown, fine SAND with some silt
7.5 - 8.0	Very dense, damp, grey, silty SAND with some gravel (Glacial Till)
	No seepage
	No caving
	Test Pit TP-4
0.0 - 5.5	Dense, damp, grey, silty SAND with some gravel (Fill)
5.5 - 7.0	Dense, damp, light brown, silty SAND with trace roots
7.0 - 8.0	Very dense, damp, grey, silty SAND with some gravel (Glacial Till)
	No seepage
	No caving

RZA

RITTENHOUSE-ZEMAN & ASSOC., INC.

Geotechnical / Hydrogeological Consultants

BORING NUMBER B-1 W.O. W-6027

PROJECT NAME Central Kitsap Junior High School

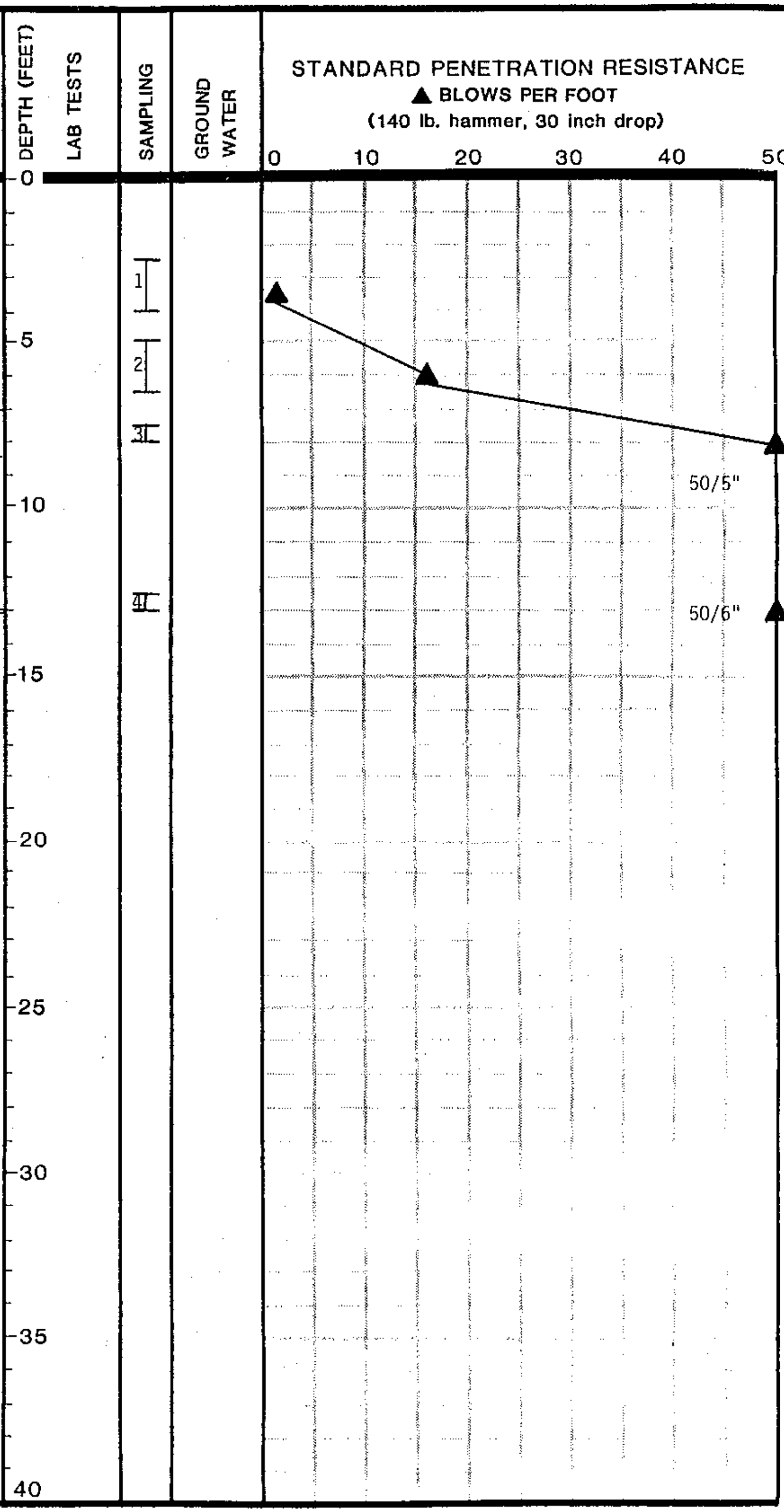
SOIL DESCRIPTION

Ground Surface Elevation Approximately Feet

Very loose to medium dense, moist, brown/gray, silty, fine to medium SAND, with some coarse sand and gravel, trace organics to 4 feet (FILL)

Very dense, moist, gray, silty, fine to medium SAND, with some coarse sand and gravel (GLACIAL TILL)

Completed 22 February 1989
Drilled to 13 feet



SAMPLING

- Ⅰ 2" OD SPLIT SPOON SAMPLE
- Ⅱ 3" OD SHELBY SAMPLE
- ☒ 2.5" ID RING SAMPLE
- B BULK SAMPLE
- * SAMPLE NOT RECOVERED

GROUND WATER

- ▨ SEAL
- DATE
- ▽ ATD WATER LEVEL AT TIME OF DRILLING
- OBSERVATION WELL TIP

LABORATORY TESTS

- ● % WATER CONTENT
- NP NON PLASTIC
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT

1991

RZA

RITTENHOUSE-ZEMAN & ASSOC., INC.
Geotechnical / Hydrogeological Consultants

BORING NUMBER B-2
W.O. W-6027
PROJECT NAME Central Kitsap Junior High School

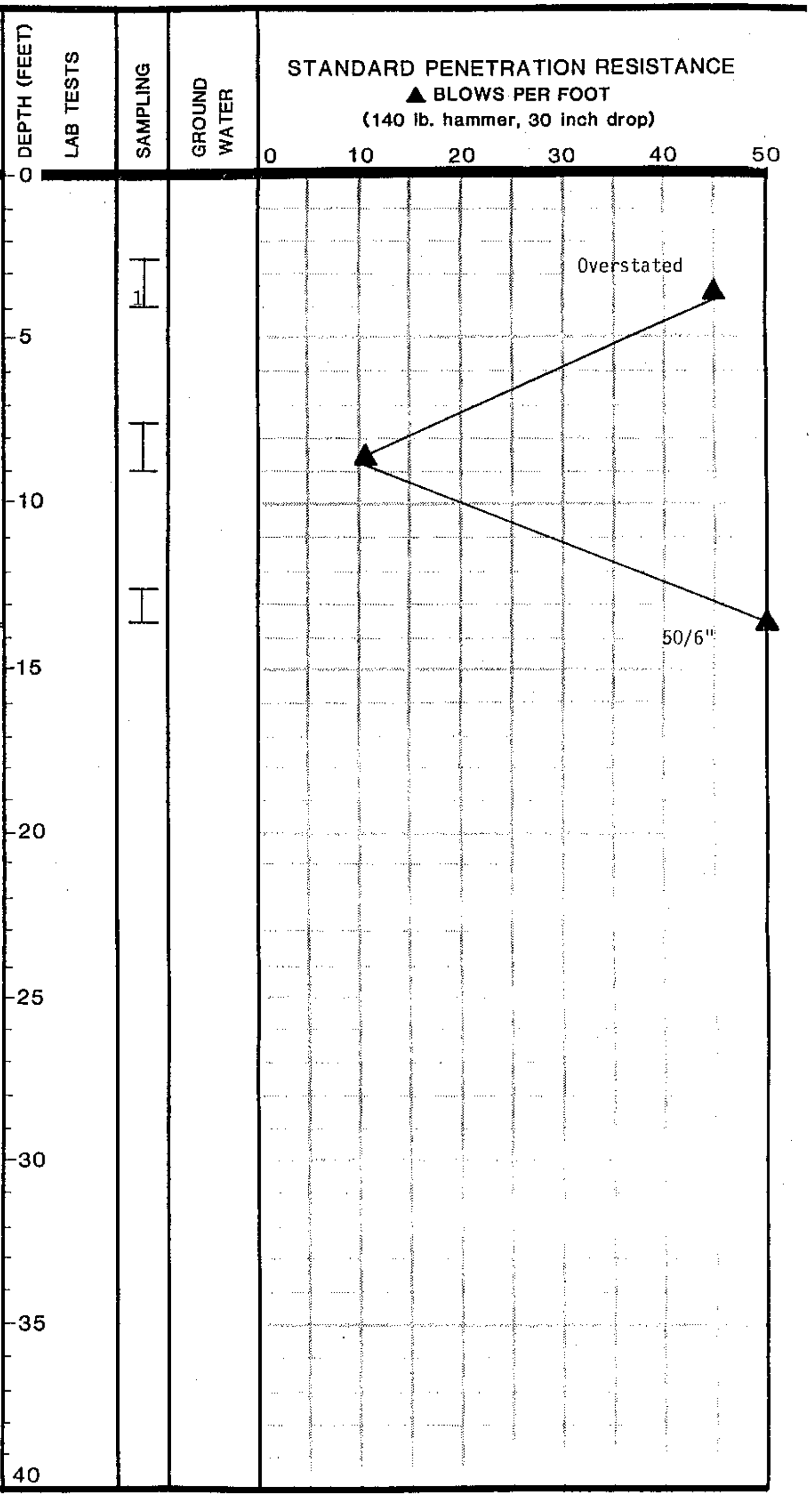
SOIL DESCRIPTION

Ground Surface Elevation Approximately Feet

Loose to medium dense, moist, brown to brown/gray, silty, fine to medium SAND, with some coarse snad and gravel, trace organics and wood fragments (FILL)

Very dense, moist, gray/brown, silty, fine to medium SAND, with some coarse sand and gravel (GLACIAL TILL)

Completed 22 February 1989
Drilled to 13.5 feet



SAMPLING
- Ɪ 2" OD SPLIT SPOON SAMPLE
- Ɪ̲ 3" OD SHELBY SAMPLE
- ☒ 2.5" ID RING SAMPLE
- B BULK SAMPLE
- * SAMPLE NOT RECOVERED

GROUND WATER
- ▨ SEAL
- DATE
- WATER LEVEL AT TIME OF DRILLING ▽ ATD
- OBSERVATION WELL TIP

LABORATORY TESTS
- ● % WATER CONTENT
- NP NON PLASTIC
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT

1991

RZA

RITTENHOUSE-ZEMAN & ASSOC., INC.
Geotechnical / Hydrogeological Consultants

BORING NUMBER B-3 W.O. W-6007
PROJECT NAME Central Kitsap Junior High School

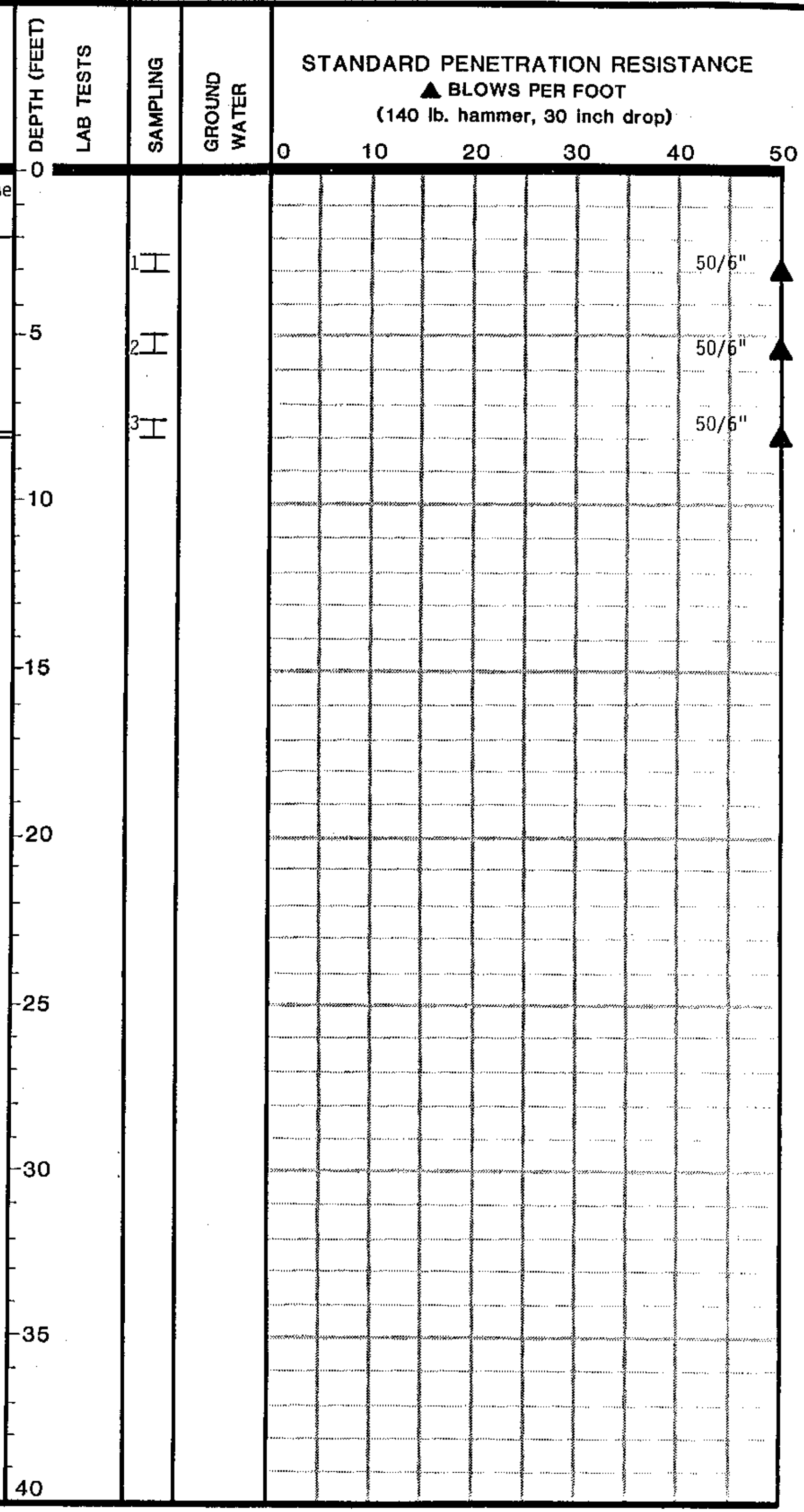
SOIL DESCRIPTION

Ground Surface Elevation Approximately Feet

Medium dense, moist, brown, silty, gravelly, fine to medium SAND, with some coarse sand (Fill)

Very dense, moist, brown/gray, silty, gravelly, fine to medium SAND with some coarse sand (GLACIAL TILL)

Completed 22 February 1989
Derilled to 8 feet



SAMPLING
- I 2" OD SPLIT SPOON SAMPLE
- II 3" OD SHELBY SAMPLE
- ☒ 2.5" ID RING SAMPLE
- B BULK SAMPLE
- * SAMPLE NOT RECOVERED

GROUND WATER
- ▨ SEAL
- DATE
- WATER LEVEL AT TIME OF DRILLING ∇ ATD
- OBSERVATION WELL TIP

LABORATORY TESTS
- ● % WATER CONTENT
- **NP** NON PLASTIC
- LIQUID LIMIT
- NATURAL WATER CONTENT
- PLASTIC LIMIT

APPENDIX B

Geotechnical Laboratory Testing Procedures and Results

APPENDIX B
GEOTECHNICAL LABORATORY TESTING PROCEDURES AND RESULTS
Central Kitsap High School and Middle School Campus Redevelopment
Silverdale, Washington

The following paragraphs describe procedures associated with the laboratory tests conducted for this project. Graphical results of certain laboratory tests are enclosed in this appendix.

VISUAL CLASSIFICATION PROCEDURES

Visual soil classifications were conducted on all samples in the field and on selected samples in the laboratory. All soils were classified in general accordance with the Unified Soil Classification System, which includes color, relative moisture content, primary soil type (based on grain size), and any accessory soil types. The resulting soil classifications are presented on the exploration logs contained in Appendix A.

MOISTURE CONTENT DETERMINATION PROCEDURES

Moisture content determinations were performed on representative samples to aid in identification and correlation of soil types. All determinations were made in general accordance with ASTM D-2216. The results of these tests are shown on the exploration logs contained in Appendix A.

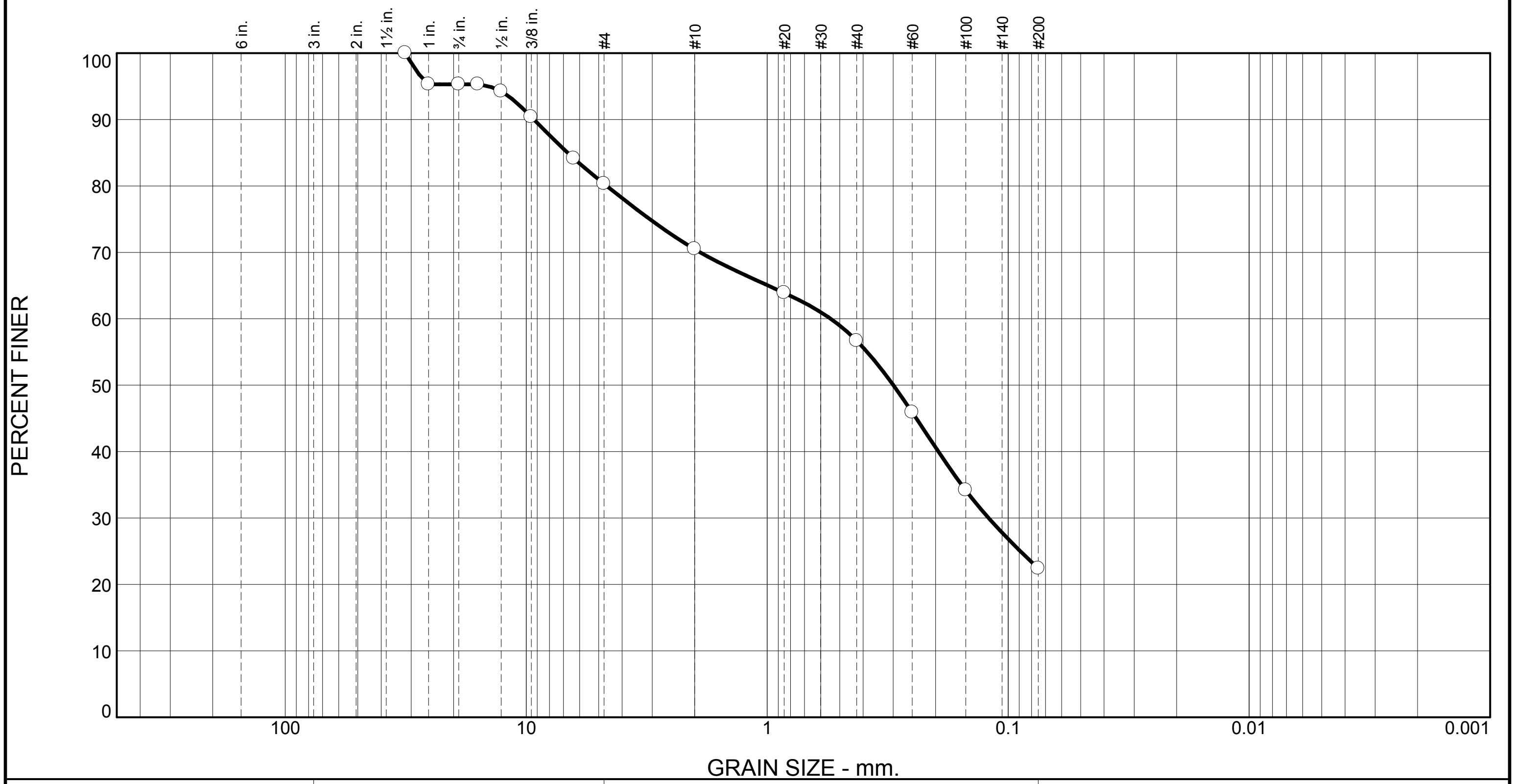
GRAIN-SIZE ANALYSIS PROCEDURES

A grain-size analysis indicates the range of soil particle diameters included in a particular sample. Grain-size analyses were performed on representative samples in general accordance with ASTM D-422. The results of these tests are presented on the enclosed grain-size distribution graphs and were used in soil classifications shown on the exploration logs contained in Appendix A.

200-WASH PROCEDURES

A 200-wash is a procedure in which the fine-grained soil fraction is separated from the sand and gravel by washing the soil on a U.S. No. 200 Sieve. A 200-wash was performed on selected soil samples obtained from our borings in general accordance with ASTM D-1140, Test Method for Amount of Material in Soils Finer than the No. 200 (75-μm) Sieve. The results of these analyses were used in soil classifications shown on the exploration logs presented in Appendix A.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	4.7	15.0	9.8	13.8	34.3	22.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.25"	100.0		
1"	95.3		
3/4"	95.3		
5/8"	95.3		
1/2"	94.3		
3/8"	90.4		
1/4"	84.2		
#4	80.3		
#10	70.5		
#20	63.9		
#40	56.7		
#60	45.9		
#100	34.2		
#200	22.4		

* (no specification provided)

Soil Description

Silty sand with gravel
As Received Moisture: 9.2%

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 9.2904 D_{85}= 6.7329 D_{60}= 0.5449
D_{50}= 0.2996 D_{30}= 0.1206 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-1, S-1
Depth: 2.5-4.0

Date: 9/14/2016

Terracon Consultants, Inc.

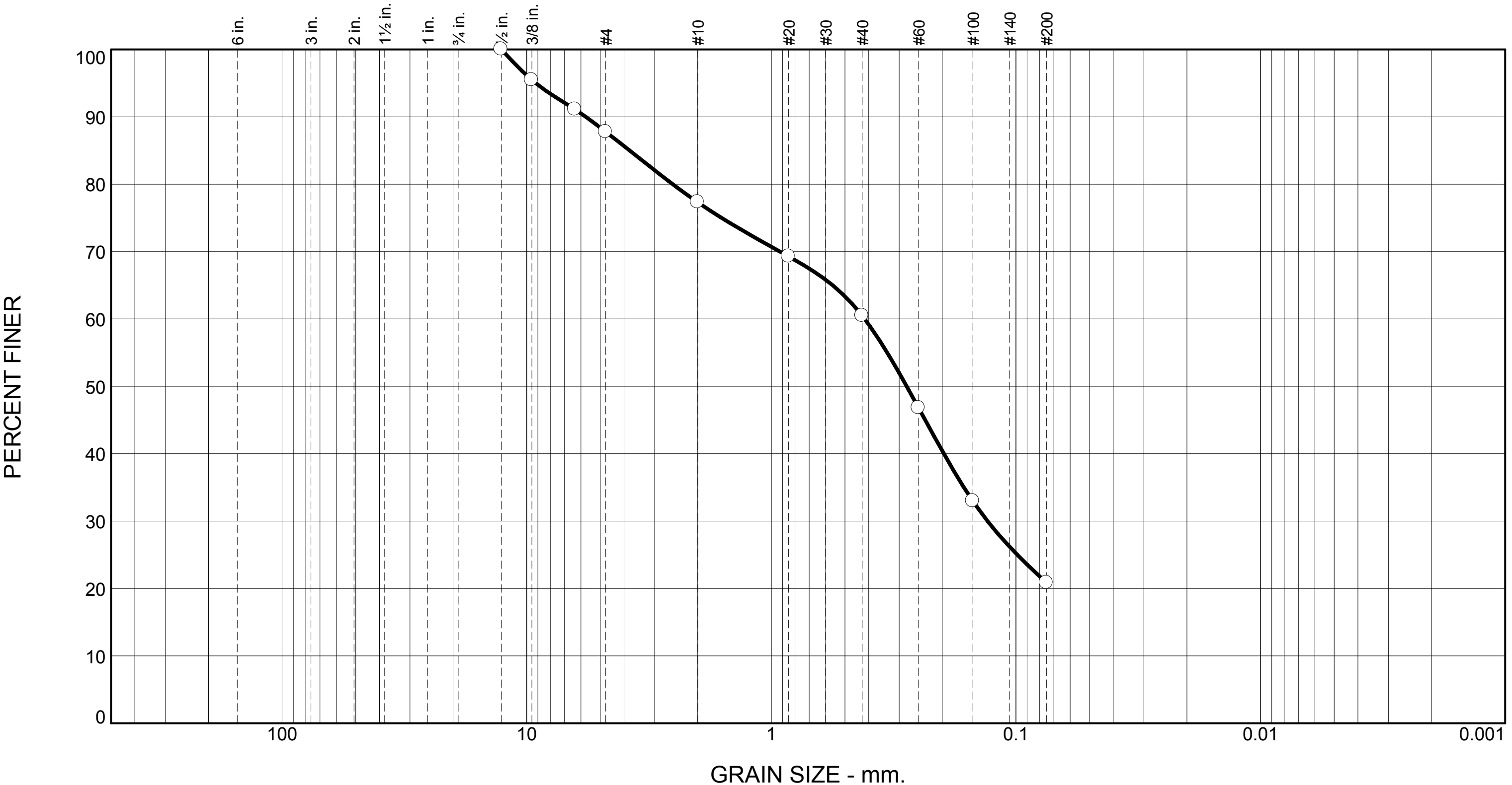
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.2	10.5	16.8	39.7	20.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	95.5		
1/4"	91.1		
#4	87.8		
#10	77.3		
#20	69.3		
#40	60.5		
#60	46.8		
#100	33.0		
#200	20.8		

* (no specification provided)

Soil Description

Silty sand
As Received Moisture: 12.1%

Atterberg Limits

PL= NP
LL= NV
PI=

Coefficients

D_{90}= 5.7417
D_{85}= 3.7952
D_{60}= 0.4153
D_{50}= 0.2796
D_{30}= 0.1306
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-3, S-1
Depth: 2.5-4.0

Date: 9/14/2016

Terracon Consultants, Inc.

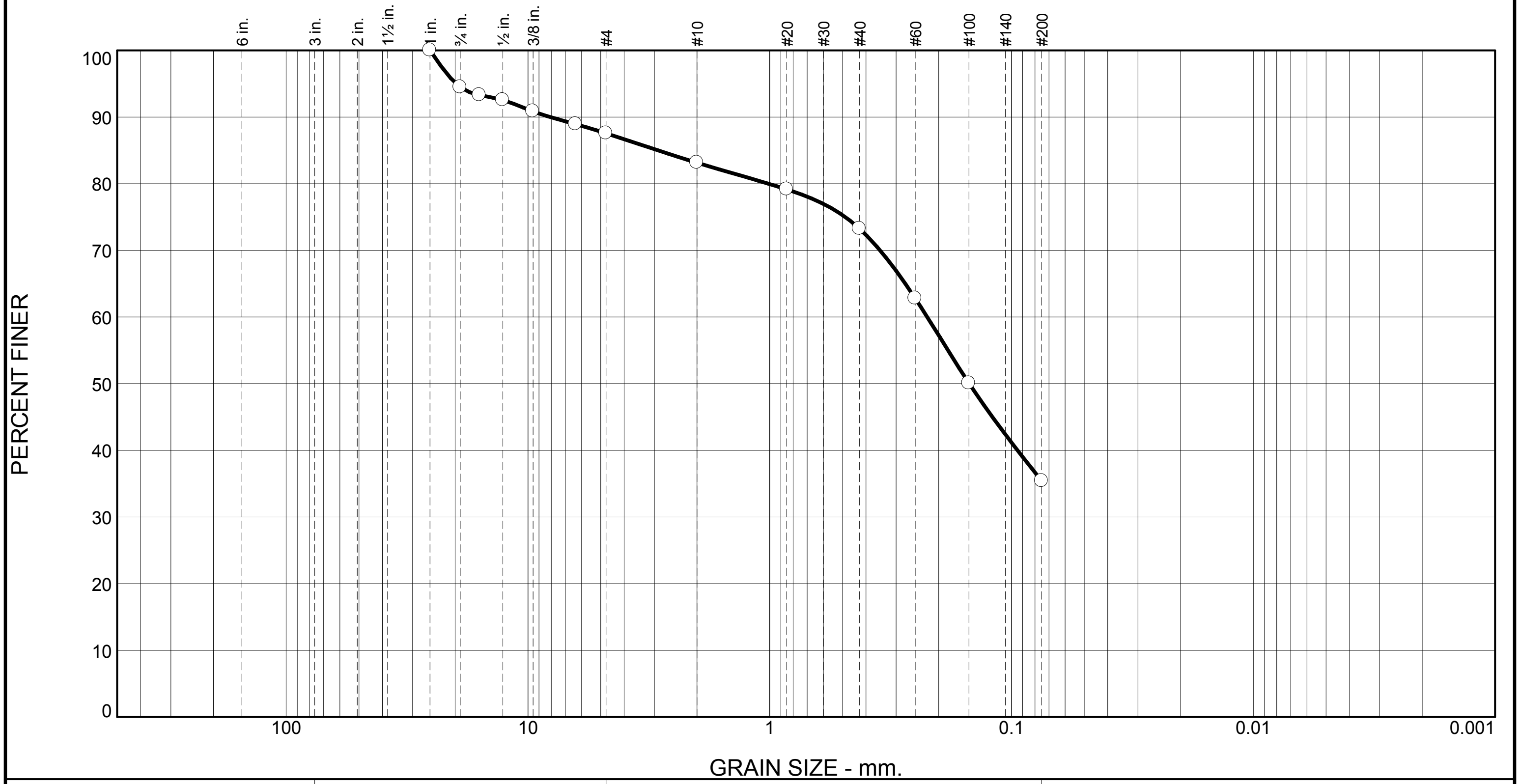
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0
Figure

Tested By: Ryan G
Checked By: Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.5	6.9	4.5	9.9	37.8	35.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	94.5		
5/8"	93.3		
1/2"	92.5		
3/8"	90.8		
1/4"	88.9		
#4	87.6		
#10	83.1		
#20	79.1		
#40	73.2		
#60	62.8		
#100	50.1		
#200	35.4		

* (no specification provided)

Soil Description

Silty sand
As Received Moisture: 7.0%

Atterberg Limits

PL= NP
LL= NV
PI=

Coefficients

D_{90}= 8.0922
D_{85}= 2.8948
D_{60}= 0.2231
D_{50}= 0.1495
D_{30}=
D_{15}=
D_{10}=
C_u=
C_c=

Classification

USCS= SM
AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-4, S-2
Depth: 5-6.5

Date: 9/14/2016

Terracon Consultants, Inc.

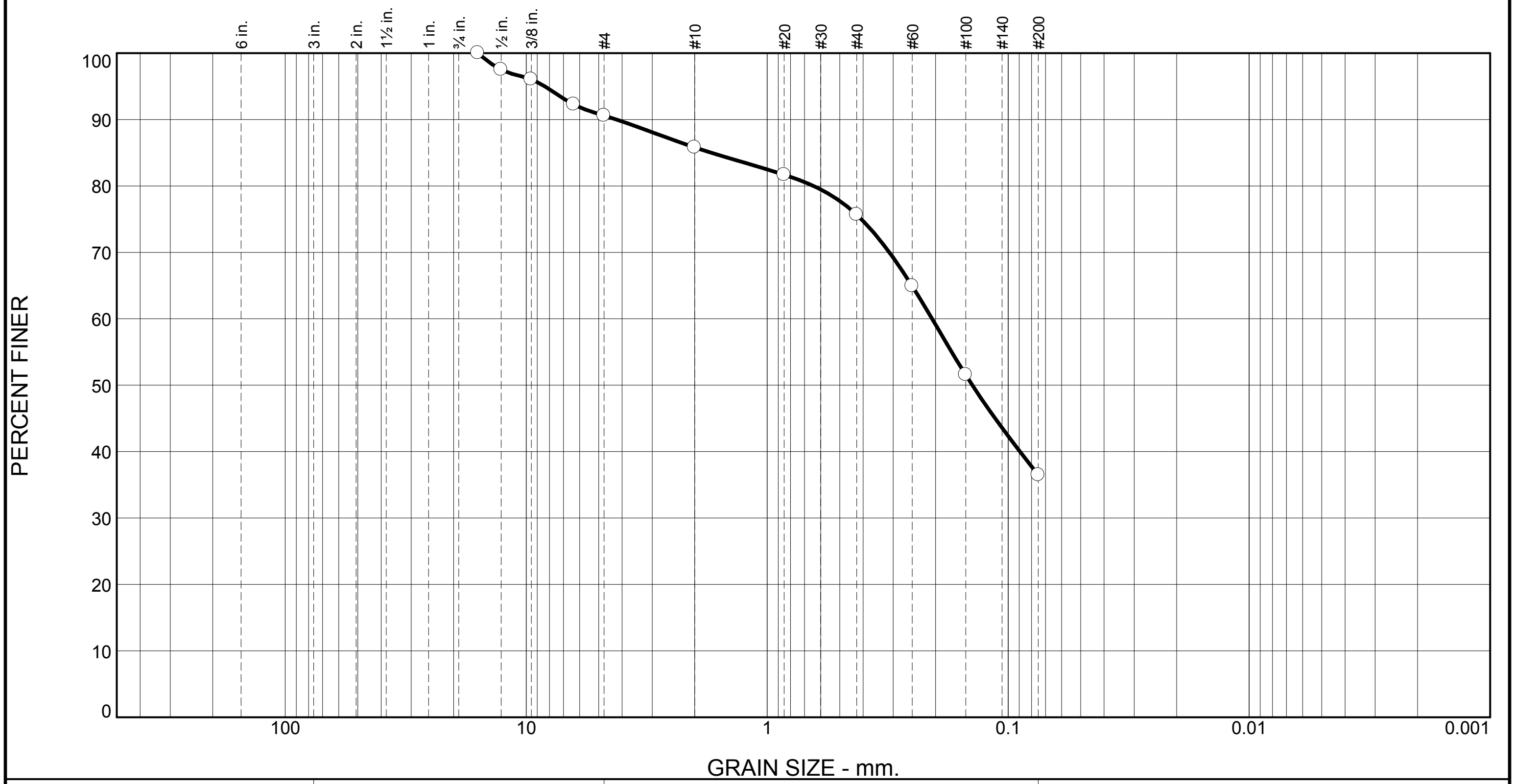
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0
Figure

Tested By: Ryan G
Checked By: Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.4	4.8	10.1	39.2	36.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
5/8"	100.0		
1/2"	97.5		
3/8"	96.0		
1/4"	92.3		
#4	90.6		
#10	85.8		
#20	81.7		
#40	75.7		
#60	64.9		
#100	51.5		
#200	36.5		

* (no specification provided)

Soil Description

Silty sand
As Received Moisture: 7.7%

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

$D_{90}=$ 4.2216 $D_{85}=$ 1.7052 $D_{60}=$ 0.2069
$D_{50}=$ 0.1408 $D_{30}=$ $D_{15}=$
$D_{10}=$ $C_u=$ $C_c=$

Classification

USCS= SM AASHTO= A-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-4, S-3
Depth: 10-11.5

Date: 9/14/2016

Terracon Consultants, Inc.

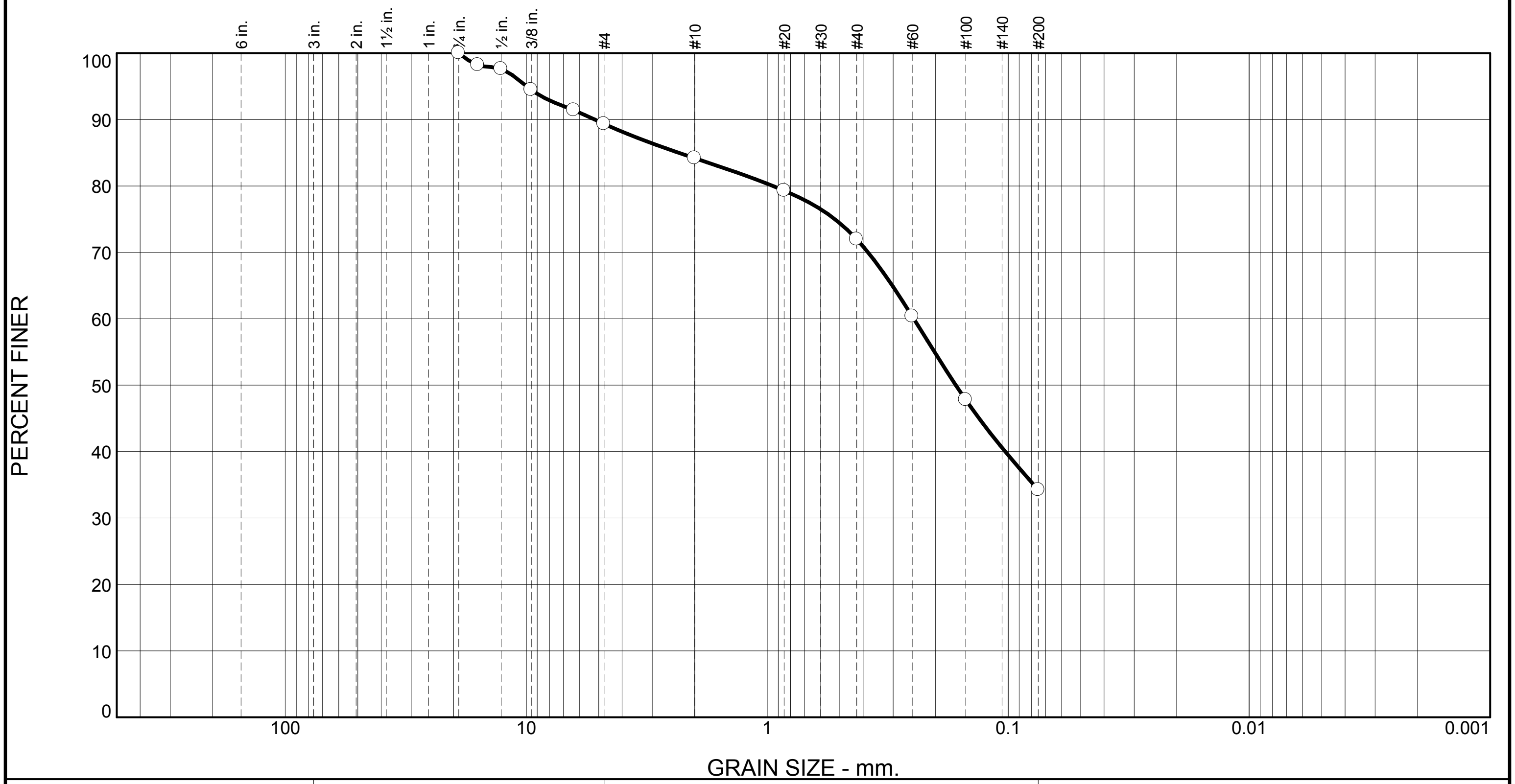
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.7	5.1	12.2	37.8	34.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
5/8"	98.2		
1/2"	97.6		
3/8"	94.5		
1/4"	91.4		
#4	89.3		
#10	84.2		
#20	79.3		
#40	72.0		
#60	60.4		
#100	47.8		
#200	34.2		

* (no specification provided)

Soil Description

Silty sand
As Received Moisture: 8.5%

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 5.2014 D_{85}= 2.3313 D_{60}= 0.2464
D_{50}= 0.1649 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-5, S-3
Depth: 10-11.5

Date: 9/14/2016

Terracon Consultants, Inc.

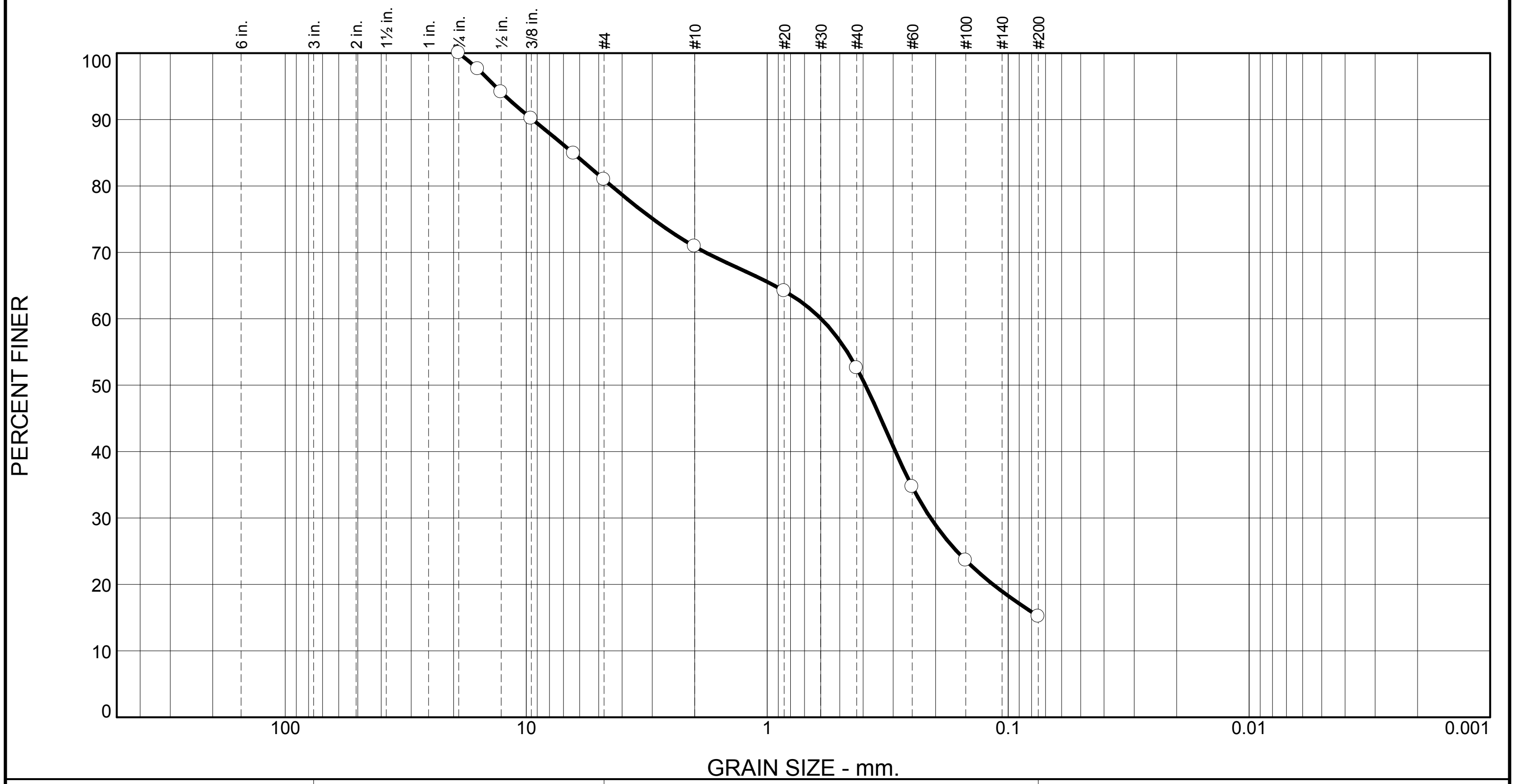
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	19.1	10.0	18.3	37.4	15.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4"	100.0		
5/8"	97.6		
1/2"	94.1		
3/8"	90.2		
1/4"	84.9		
#4	80.9		
#10	70.9		
#20	64.2		
#40	52.6		
#60	34.7		
#100	23.6		
#200	15.2		

* (no specification provided)

Soil Description

Silty sand with gravel
As Received Moisture: 4.7%

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 9.4027 D_{85}= 6.4033 D_{60}= 0.5973
D_{50}= 0.3909 D_{30}= 0.2098 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-8, S-3
Depth: 10-11.5

Date: 9/14/2016

Terracon Consultants, Inc.

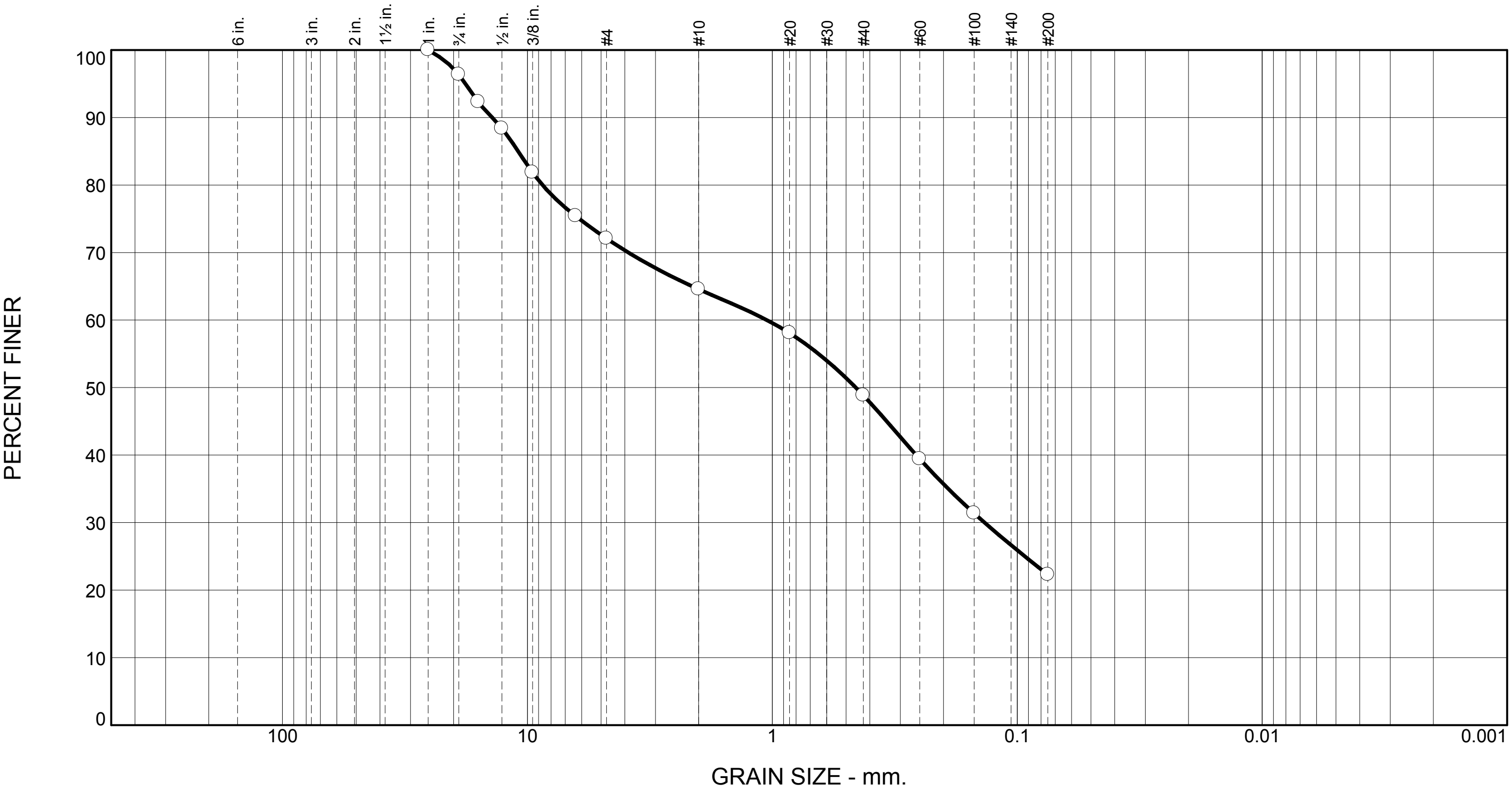
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.6	24.3	7.5	15.8	26.5	22.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	96.4		
5/8"	92.3		
1/2"	88.4		
3/8"	81.9		
1/4"	75.4		
#4	72.1		
#10	64.6		
#20	58.1		
#40	48.8		
#60	39.4		
#100	31.4		
#200	22.3		

* (no specification provided)

Soil Description

Silty sand with gravel
As Received Moisture: 5.8%

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}=	13.9253	D_{85}=	10.9039	D_{60}=	1.0531
D_{50}=	0.4562	D_{30}=	0.1360	D_{15}=	
D_{10}=		C_u=		C_c=	

Classification

USCS= SM AASHTO= A-1-b

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-9, S-2
Depth: 5-6.5

Date: 9/14/2016

Terracon Consultants, Inc.

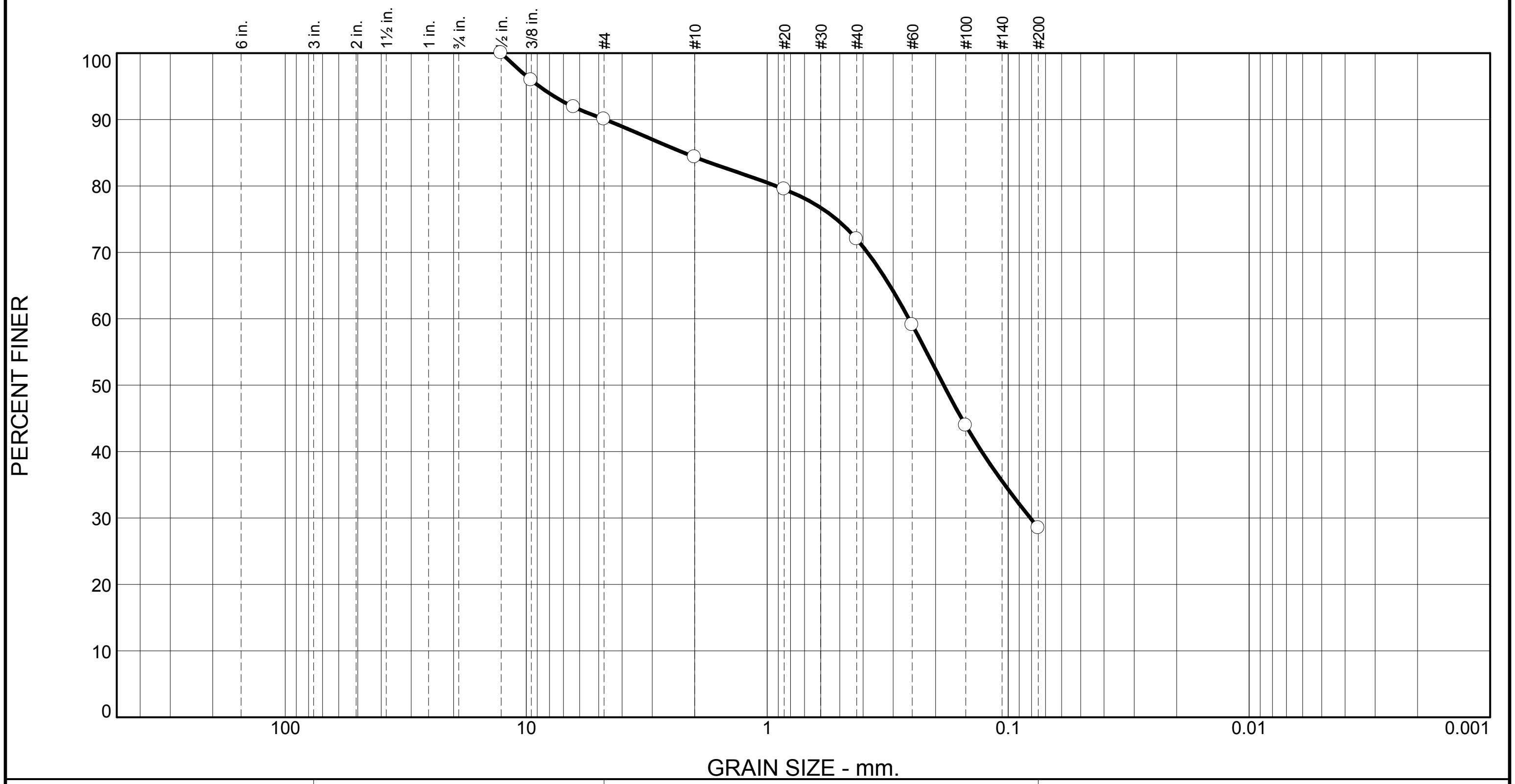
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.0	5.7	12.3	43.5	28.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	95.9		
1/4"	91.9		
#4	90.0		
#10	84.3		
#20	79.5		
#40	72.0		
#60	59.1		
#100	43.9		
#200	28.5		

* (no specification provided)

Soil Description

Silty sand
As Received Moisture: 6.6%

Atterberg Limits

PL= NP LL= NV PI=

Coefficients

D_{90}= 4.7143 D_{85}= 2.2209 D_{60}= 0.2581
D_{50}= 0.1851 D_{30}= 0.0809 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-11, S-3
Depth: 10-11.5

Date: 9/14/2016

Terracon Consultants, Inc.

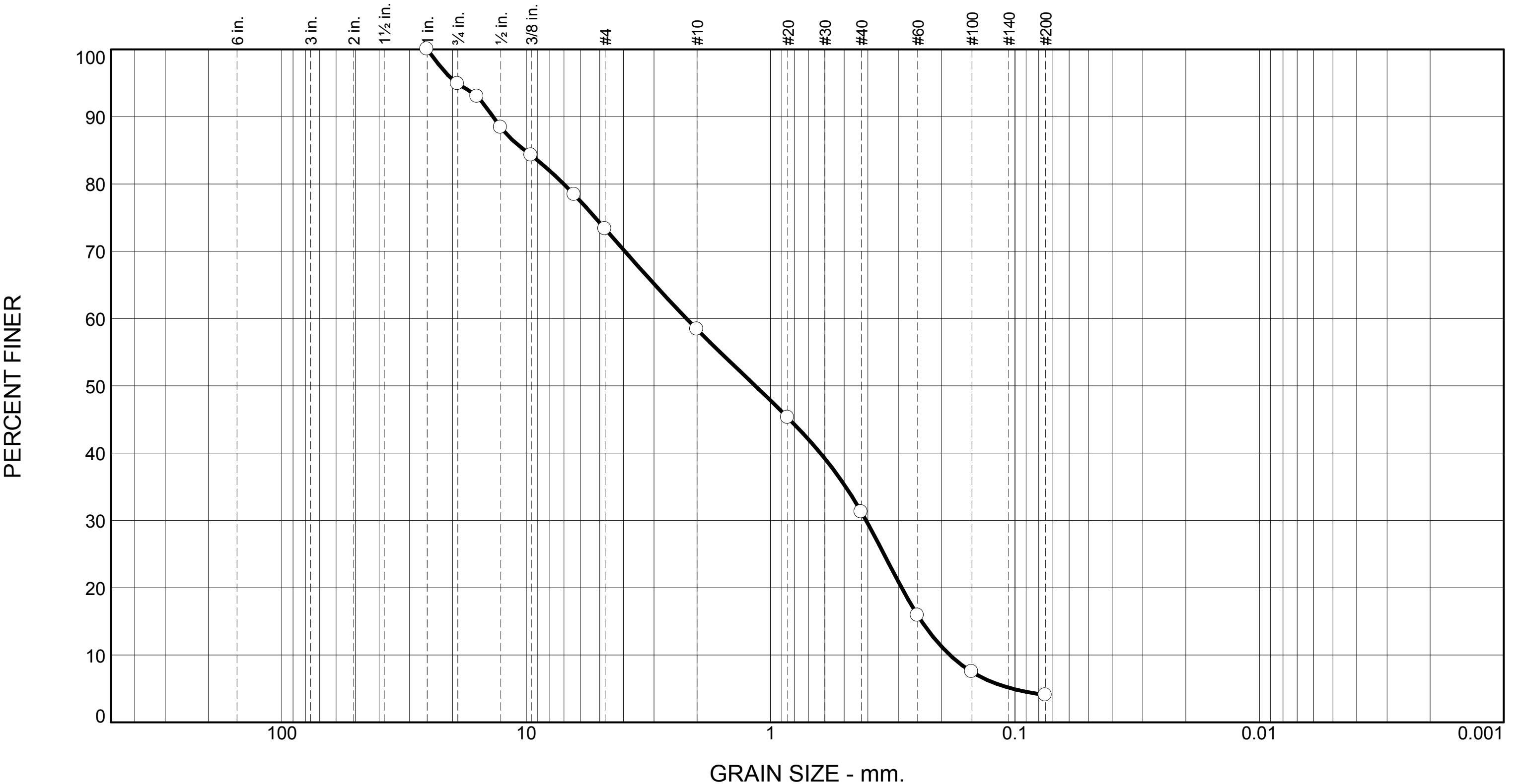
Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	21.6	14.9	27.2	27.2	4.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1"	100.0		
3/4"	94.9		
5/8"	93.0		
1/2"	88.4		
3/8"	84.3		
1/4"	78.4		
#4	73.3		
#10	58.4		
#20	45.3		
#40	31.2		
#60	15.9		
#100	7.5		
#200	4.0		

* (no specification provided)

Soil Description

Poorly graded sand with gravel
As Received Moisture: 0.6%

Atterberg Limits

PL= NP **LL=** NV **PI=**

Coefficients

D_{90}= 13.6798	D_{85}= 10.1238	D_{60}= 2.2101
D_{50}= 1.1544	D_{30}= 0.4064	D_{15}= 0.2409
D_{10}= 0.1846	C_u= 11.97	C_c= 0.40

Classification

USCS= SP **AASHTO=** A-1-b

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-11, S-6
Depth: 25-26.5

Date: 9/14/2016

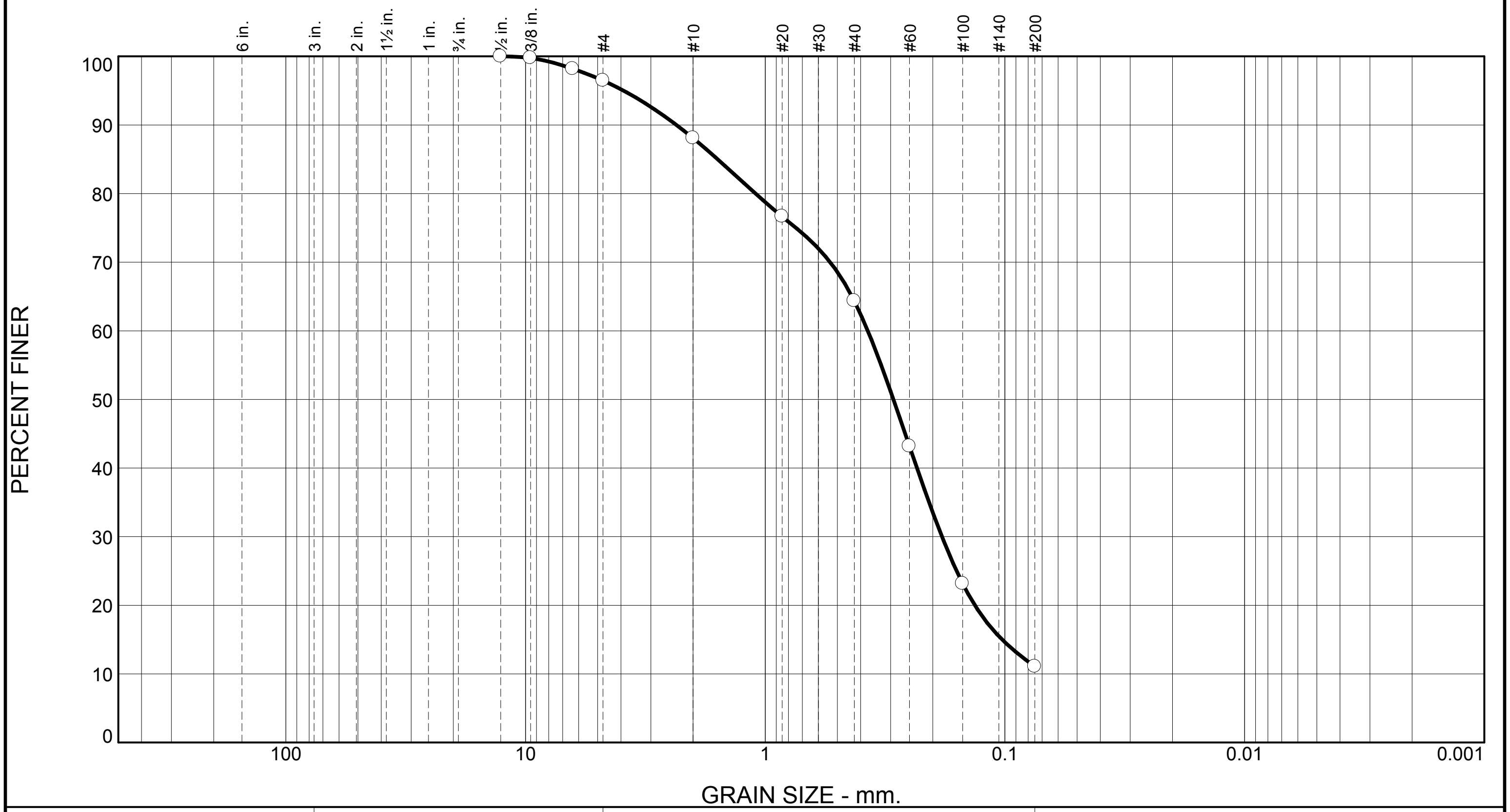
Terracon Consultants, Inc.

Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS
Project No: 6-917-18096-0 **Figure**

Tested By: Ryan G **Checked By:** Jeff W

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.5	8.4	23.7	53.3	11.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8"	99.8		
1/4"	98.2		
#4	96.5		
#10	88.1		
#20	76.6		
#40	64.4		
#60	43.2		
#100	23.1		
#200	11.1		

* (no specification provided)

Soil Description

Poorly graded sand with silt
As Received Moisture: 5.2%

Atterberg Limits

PL= NP
LL= NV
PI=

Coefficients

D_{90}= 2.3471	D_{85}= 1.5800	D_{60}= 0.3733
D_{50}= 0.2919	D_{30}= 0.1830	D_{15}= 0.1027
D_{10}=	C_u=	C_c=

Classification

USCS= SP-SM
AASHTO= A-2-4(0)

Remarks

ASTM: C136, D1140, D2216
Sampled: 8/31/16
Sampled By: Konrad M. & Frank C.

Location: B-15, S-4A
Depth: 15-16

Date: 9/19/2016

Terracon Consultants, Inc.

Mountlake Terrace, WA

Client: Central Kitsap School District
Project: Central Kitsap HS/MS

Project No: 6-917-18096-0
Figure

MOISTURE CONTENT AND MINUS 200 WASH
ASTM: D2216 D1140

Job Name: Central Kitsap HS/MS
Client: Central Kitsap School District
Job Number: 6-917-18096-0
Sample Date: 8/31/2016
Date: 9/14/2016
Sampled By: Frank C. & Konrad M.

Exploration:	B-1	B-2	B-2	B-3	B-5	B-5	B-6	B-6	B-7	B-7
Sample Number:	S-2	S-1	S-2	S-2	S-1	S-2	S-1	S-2	S-1	S-2
Depth:	5-6.5	2.5-4	5-6.5	5-6.5	2.5-4	5-6.5	2.5-4	5-6.5	2.5-4	5-6.5
% Moisture	7.6%	7.6%	9.0%	8.6%	6.2%	5.8%	6.1%	7.5%	3.0%	4.7%
% -200 Wash	N/A	27.65%	N/A	N/A	17.10%	N/A	N/A	29.09%	N/A	21.80%

Exploration:	B-10	B-11	B-12	B-12	B-13	B-13	B-14	B-14	B-15	B-15
Sample Number:	S-2	S-1	S-1	S-2	S-1	S-2	S1	S-2	S-3	S-4B
Depth:	5-6.5	2.5-4	2.5-4	5-6.5	2.5-4	5-6.5	2.5-4	5-6.5	10-11.5	15-16.5
% Moisture	3.2%	4.5%	10.1%	9.2%	6.6%	8.5%	6.0%	7.2%	3.3%	14.1%
% -200 Wash	13.59%	N/A	23.02%	N/A	17.69%	N/A	24.94%	N/A	N/A	N/A

Exploration:	B-15	HB-3	HB-4	HB-5
Sample Number:	S-5	G-3	G-3	G-2
Depth:	20-21.5	2-4.0	2.5-3	2-3.0
% Moisture	18.7%	5.2%	13.0%	7.4%
% -200 Wash	13.97%	N/A	17.95%	N/A

Tested By: Jeff W.
Reveiwed By: Dave D.
Respectfully submitted,

By: Jeff Ward

Terracon
Consulting Engineers & Scientists

Critical Areas Reconnaissance
and
Hydrologic Assessment
for the
Central Kitsap School District
Central Kitsap Middle and High School
Silverdale, Washington

Prepared for:
Central Kitsap School District
PO Box 8
Silverdale, Washington 98383
(360) 271-9207

Prepared by:

Ecological Land Services, Inc.
1157 3rd Avenue, Suite 220
Longview, Washington 98632
(360) 578-1371
Project Number: 2399.02

October 26, 2016

TABLE OF CONTENTS

FIGURES & PHOTOPLATES

SIGNATURE PAGE

The information and data in this report were compiled and prepared under the supervision and direction of the undersigned.

Joanne Bartlett

Joanne Bartlett, PWS
Senior Biologist

INTRODUCTION

Ecological Land Services, Inc. (ELS) was contracted by Central Kitsap School District (CKSD) to complete a critical areas reconnaissance for the Central Kitsap Middle and High School (CKMS and CKHS) Reconstruction project at 10170 Frontier Place NW, parcel number 172501-4-011-2006, within a portion of Section 17, Township 25 North, Range 1 East of the Willamette Meridian, in Silverdale, Washington (Figure 1). This report summarizes the findings of a reconnaissance of the site and downslope areas to identify potential critical areas within the drainage basins of the CKSD property.

METHODOLOGY

The critical areas determination followed the Routine Determination Method in the Western Mountains, Valleys, and Coast Region according to the U.S. Army Corps of Engineers, *Wetland Delineation Manual* (Environmental Laboratory 1987), and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys and Coast Region (Version 2.0)* (U.S. Army Engineer Research and Development Center, 2010).

The Offsite Determination Method examines the parameters—vegetation, soils, and hydrology—to determine if wetlands exist in a given area. For this offsite determination, the presence of vegetation was used to identify the potential presence of critical areas. Hydrology was a secondary parameter examined during the reconnaissance. Soils were not examined for this project because the potential wetlands exist offsite and permission was not given to enter the site to examine the soil conditions. By definition, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. . Wetlands are regulated as “Waters of the United States” by the U.S. Army Corps of Engineers (USACE), as “Waters of the State” by the Washington Department of Ecology (DOE), and locally by Kitsap County.

This project focused on conducting a reconnaissance of areas surrounding the CKHS and CKMS campus to assess whether future activities on the CKSD property will affect local critical areas. The site reconnaissance was conducted on October 11, 2016 and involved walking or driving over most of the campus and observing areas that adjoin the CKSD property. In addition, ELS biologists reviewed historic maps and took photos to document the current conditions. The critical areas maps obtained for the property indicate critical areas are located offsite to the southwest along Anderson Hill Road and offsite to the east along Randall Way. Steep slope critical areas are indicated along the east edge of the property but are not addressed in this report. In addition, the project biologist’s past professional involvement with properties adjoining the CKSD property proved instrumental in conducting this reconnaissance.

SITE DESCRIPTION

This property is located on the west side of Anderson Hill Road and Frontier Place and north of Bucklin Hill Road in Silverdale, Kitsap County (Figure 1). The CKSD property is located at the top of the low ridge with moderately steep slopes down to Anderson Hill Road and Frontier Place to the west and down to Randall Way on the east. CKHS is located at the south end of the property with CKMS toward the north end and the transportation facility at the northeast corner. The athletic facilities, which include practice football and baseball fields, are located between the middle and high schools. The food service buildings are located in the middle of the property and are accessed from Frontier Place. Residential development borders all sides of the CKSD property with commercial property located east along Randall Way and south along Bucklin Hill Road. Most of the CKSD property is developed with areas of forest remaining on the slopes down to the east. Remnant forested areas are located at the entrance to the athletic fields from Anderson Hill Road at Windy Ridge Road and on the east side of the CKSD property (Figure 2).

SOILS

As referenced on the U.S.D.A. Natural Resources Conservation Service (NRCS 2015) website, the soils on the CKSD property is primarily Alderwood gravelly sandy loam, 0 to 8 percent slopes (1) with a smaller area of Kapowsin gravelly ashy loam, 6 to 15 percent slopes (23) at the south end (Figure 3). Offsite to the east, the soils are also mapped as Kapowsin (23) with an area of Norma fine sandy loam (37) mapped across Randall Way. The soils offsite to the west are mapped as Alderwood gravelly sandy loam, 8 to 15 percent slopes (2) and Kapowsin (23). The soils mapped on the CKSD property and the offsite areas immediately adjacent to the property are not classified as hydric and have no inclusions of hydric soil types (NRCS 2015). Norma fine sandy loam is classified as hydric but in the mapped area, wetlands do not currently exist due to commercial development along Randall Way. Areas mapped as hydric soils do not necessarily mean that an area is or is not a wetland—hydrology, hydrophytic vegetation, and hydric soils must all be present to classify an area as a wetland.

NATIONAL WETLAND INVENTORY

National Wetlands Inventory (NWI) maps no wetlands on the CKSD property but indicates a large wetland system offsite to the east and the stream system offsite to the west (Figure 4). The wetland mapping to the east represents historic wetlands that are no longer in existence due to the commercial development on the west side of Silverdale. The stream system mapped to the west is Koch Creek, which flows southerly into to Dyes Inlet after it joins with Strawberry Creek downstream of Anderson Hill Road. NWI maps should be used with discretion because they are used to gather general wetland information about a regional area and therefore are limited in accuracy for smaller areas because of their large scale.

KITSAP COUNTY CRITICAL AREAS INVENTORY

The Kitsap County GIS mapping tool shows the areas of potential wetland as mapped by the NRCS and the NWI, which was laid over the county tax parcel maps (Figure 5). Therefore, potential wetlands are mapped to the east of the CKSD property along Randall Way in the same areas shown on the NRCS map and the NWI. Koch Creek is mapped as indicated on the NWI map but the floodplain of the stream is included on the county map. It does not show potential wetlands associated with the stream. Critical area maps should be used with discretion because they are used to gather general wetland information about a regional area and therefore are limited in accuracy for smaller areas because of their large scale.

CONCLUSIONS

WETLAND RECONNAISSANCE

The site reconnaissance visits revealed no wetlands on the CKSD property or in the areas immediately adjacent to the property because they had all been developed (Photoplate 1). Previous professional work in the Silverdale area conducted by the project biologist revealed wetlands downslope and east of the CKSD property (Figure 2). These wetlands were identified for previous projects completed by the project biologist and include a depressional/slope wetland that begins downslope of the football and baseball fields with existing homes surrounded by conifer forest between the fields and wetland. This wetland extends to the sidewalk of Randall Way and is located just north of the First American Building at 3888 NW Randall Way (Photoplate 3). A second wetland is on the slope below the Vintage at Silverdale Apartments located at 3291 Mt Vintage Way (Photoplate 3). This wetland is a remnant of a once large wetland that was filled and mitigated for in the Clear Creek watershed (Wiltermood 2005).

Critical areas to the west include Koch Creek, which flows southerly toward Anderson Hill Road west of Frontier Place (Photoplate 2). There is a small stream that begins along Frontier Lane across from the food services building. The small stream begins abruptly at the start of a shallow ravine and flows southerly into Koch Creek. Koch Creek then flows under Anderson Hill Road and joins with Strawberry Creek several hundred feet south of the culvert (Photoplate 2). The site reconnaissance revealed that there are no wetlands present along Koch Creek on either side of Anderson Hill Road. The stream channel is at least 5 feet wide and at the time of the reconnaissance, there was rapid flow due to heavy rain events the preceding days (Photoplate 2). The forest on either side of Koch Creek is dense with a low shrub and herbaceous understory.

HYDROLOGIC ASSESSMENT

The wetland areas east of the CKSD property are on sloping terrain and primarily receive groundwater that discharges from the slope. The wetlands may also receive water from runoff generated on the adjacent developed properties but there does not appear to be any runoff directed into these wetlands from the CKSD property. It appears that perhaps some groundwater recharge is occurring on the CKSD property in the form of water from the fields and landscaping that eventually discharges into the wetland. The surface water runoff entering these wetlands appears to originate at the developed properties that are situated between the CKSD property and the wetlands. The wetlands downslope of the CKSD property have been determined to be Waters of the U.S. by the U.S. Army Corps of Engineers because they are connected to Dyes Inlet via culverts (Wiltermood 2005). This information was obtained by the project biologist during the permitting for wetland fill for the Vintage at Silverdale Apartments. The east side of the CKSD property drains easterly toward the wetlands on the adjacent properties.

Koch Creek is separated from the CKSD property by Frontier Place and it appears that some runoff may enter the stream system via the storm sewer system along Anderson Hill Road, which is downslope of the CKSD property. Water from the CKSD property does not enter the short stream west of the food service building because of the curb along the west edge of Frontier Place. Water instead appears to leave the CKSD property and flow down Frontier Place to Anderson Hill Road during severe storm events. It is unclear how it enters the Koch Creek drainage downslope of Anderson Hill Road but it likely enters a storm sewer system. It appears that the north half of the

CKSD property drains southerly into the Koch Creek basin, which joins with Strawberry Creek between Anderson Hill Road and Silverdale Loop Road (Figure 2).

OTHER HABITAT CONSIDERATIONS

The Central Kitsap School District property housing the campuses of the middle and high schools as well as the transportation center is fully developed except for remnant forested areas scattered along the perimeter and just offsite. These forested areas provide minor habitat for local wildlife species particularly those that thrive in highly developed areas including small mammals and birds. Although the school district property lacks natural habitat areas, there are existing features that are beneficial to some species for nesting and perching. One of the tall light standards at the track and field location just north of Central Kitsap High School has proven especially beneficial to local ospreys who have constructed a nest at the very top of the westernmost light standard (Figure 5, Photoplate 4). No ospreys were noted on or near the nest during the visits to the school district property because they have migrated to warmer climates for the winter season.

Osprey nests can be removed outside the nesting season after receiving a permit from the Washington Department of Fish and Wildlife (WDFW). Additional permits may be required from the U.S. Fish and Wildlife Service (USFWS) for nest removal during the nesting season but defers to the WDFW during the non-breeding season (Miller 2016). Replacement of the nest is not required and if voluntary replacement is proposed, a plan showing the nest and location must be submitted. Removal of the nest must be completed by an approved falconry or osprey expert (Murphie 2016). A permit has been issued by WDFW for removal of the osprey nest because it is the non-nesting season and the nest is an impediment to maintenance activities (Attachment 1).

LIMITATIONS

The conclusions listed above are based on standard scientific methodology and best professional judgment. In our opinion, local, state, and federal regulatory agencies should agree with our conclusions; however, this should be considered a preliminary jurisdictional determination and should be used at your own risk until it has been reviewed and approved in writing by the appropriate regulatory agencies.

REFERENCES

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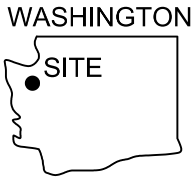
FIGURES AND PHOTOPLATES



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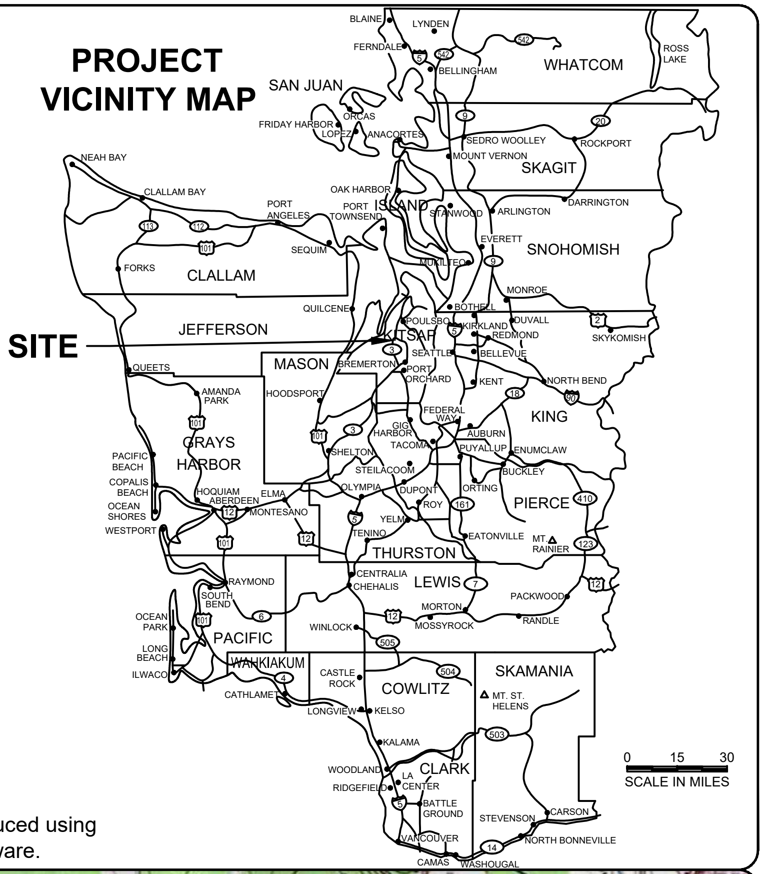
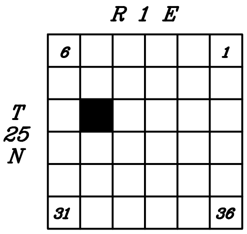
-122.7008° Longitude

LOCATION MAP





NOTE:
USGS topographic quadrangle map reproduced using
MAPTECH Inc., Terrain Navigator Pro software.

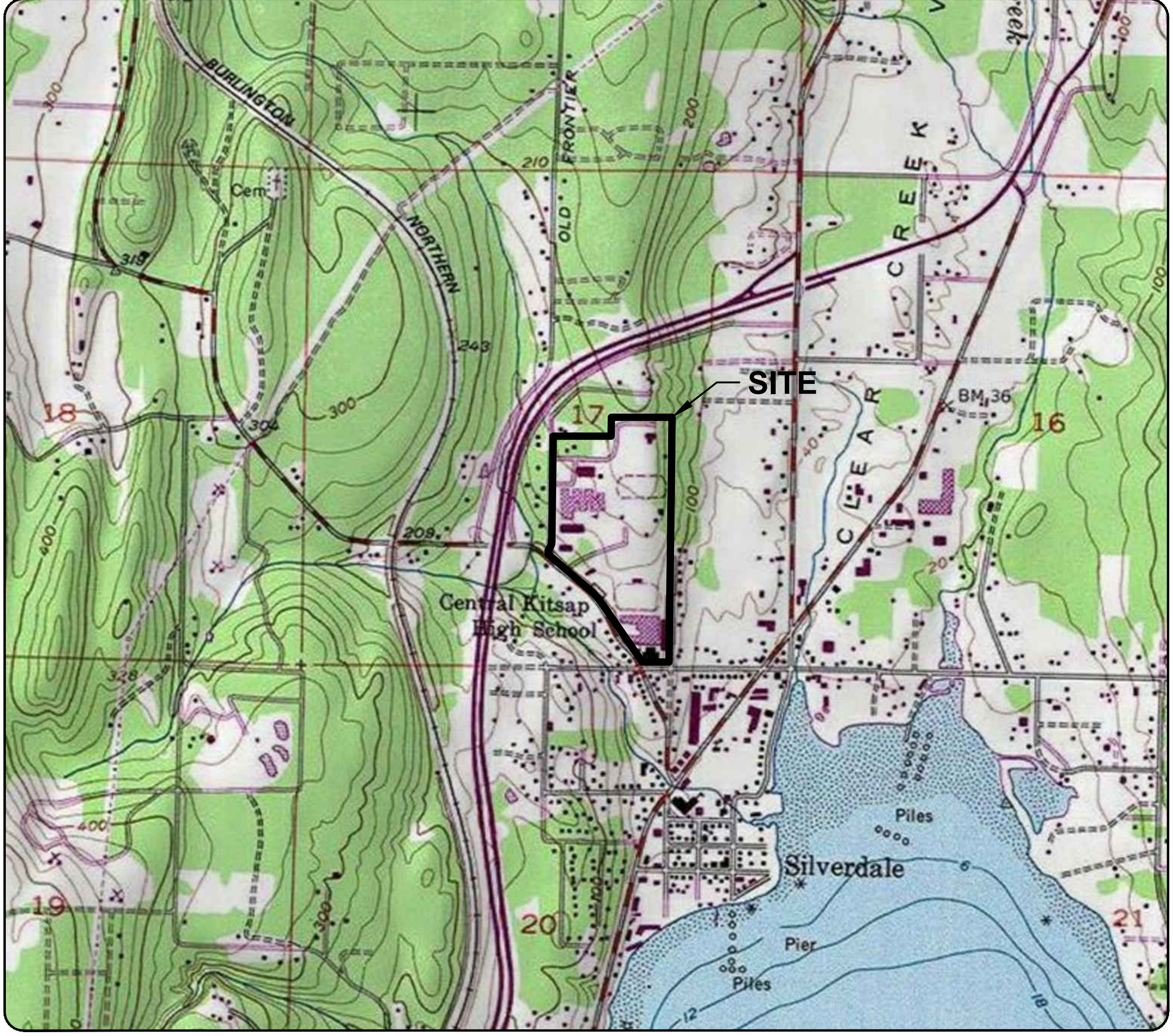


Figure 1
VICINITY MAP
CKHS CKMS Hydrologic Assessment
Central Kitsap School District
Kitsap County, WA
Section 17, Township 25N, Range 1E, W.M.

DATE: 11/7/16
DWN: JLL
REQ. BY:
PRJ. MGR: JB
CHK:
PROJECT NO:
2399.02

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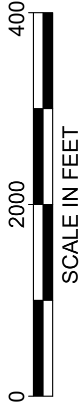

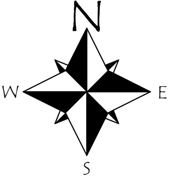

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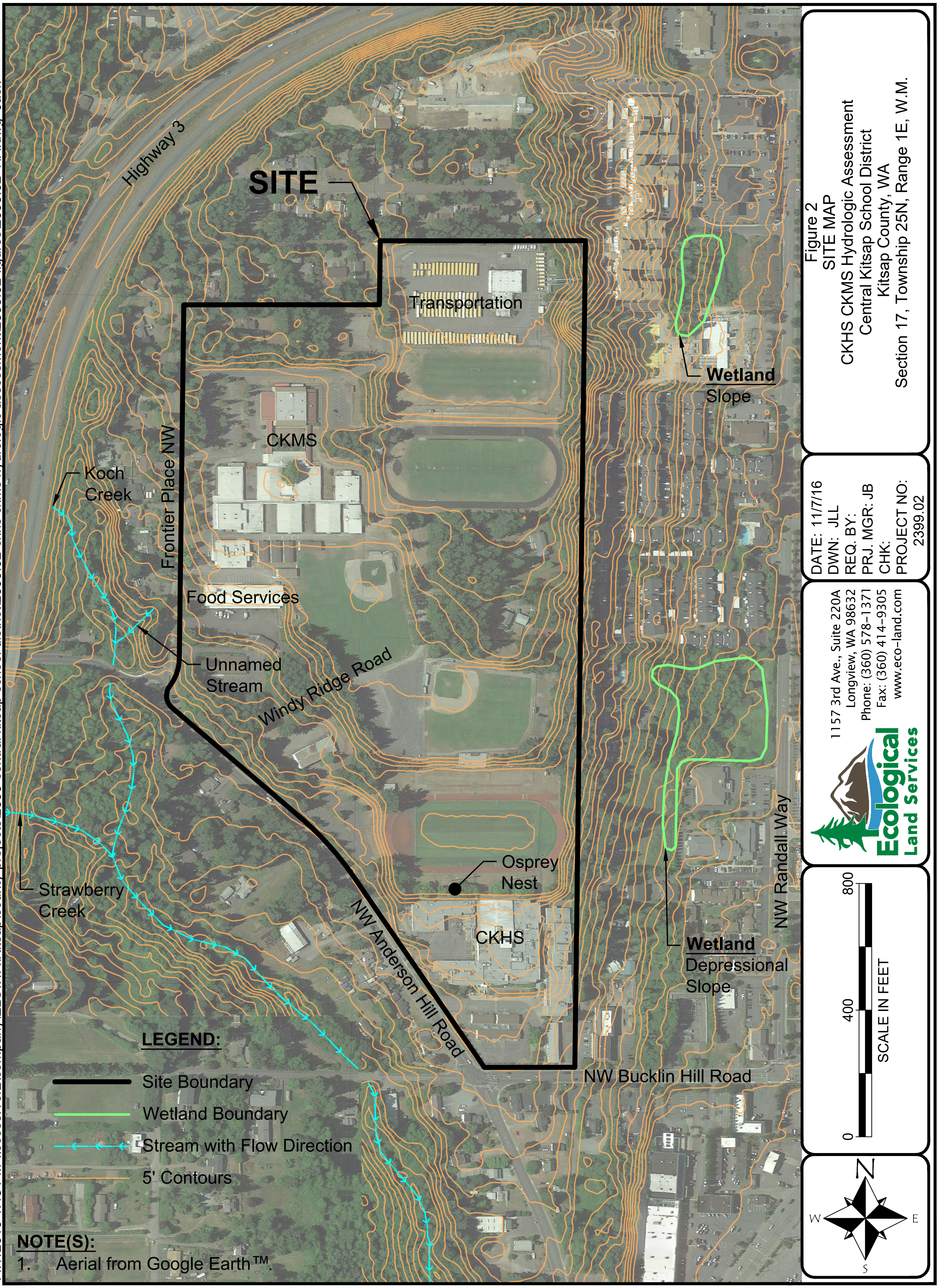

NOTE(S):
1. Aerial from Google Earth™.

Figure 2
SITE MAP
CKHS CKMS Hydrologic Assessment
Central Kitsap School District
Kitsap County, WA
Section 17, Township 25N, Range 1E, W.M.

DATE: 11/7/16
DWN: JLL
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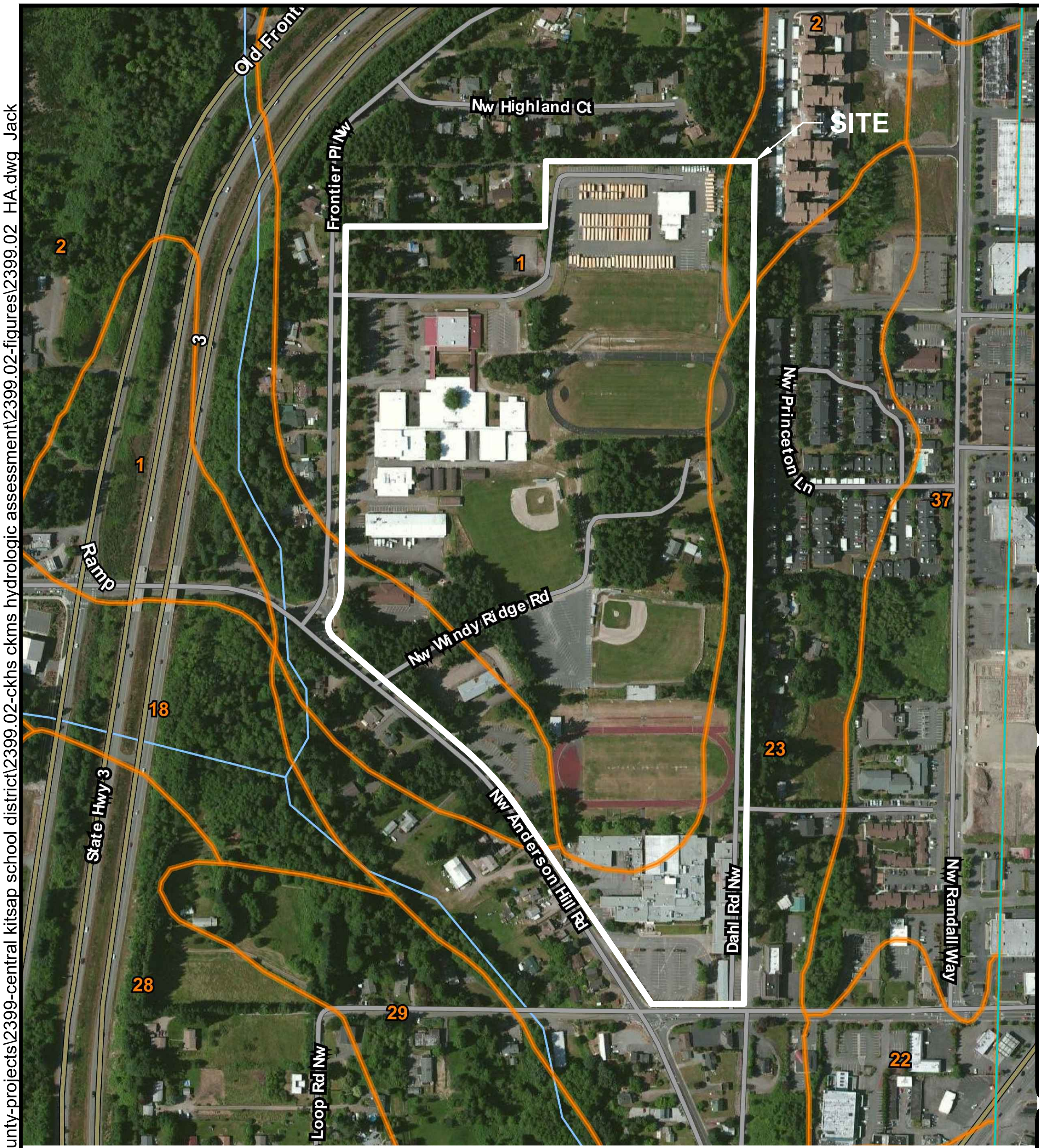

LEGEND:

1 Alderwood gravelly sandy loam, 0 to 8 percent slopes. Not hydric.
2 Alderwood gravelly sandy loam, 8 to 15 percent slopes. Not hydric.
23 Kapowsin gravelly ashy loam, 6 to 15 percent slopes. Not hydric.

OFFSITE EAST

37 Norma fine sandy loam. **Hydric.**

OFFSITE WEST

3 Alderwood gravelly sandy loam, 15 to 30 percent slopes. Not hydric.
18 Indianola loamy sand, 0 to 5 percent slopes. Not hydric.
23 Kapowsin gravelly ashy loam, 6 to 15 percent slopes. Not hydric.

NOTE(S):

1. Map provided on-line by NRCS at web address: *http://websoilsurvey.nrcs.usda.gov/app/*

Figure 3
SOIL SURVEY MAP

CKHS CKMS Hydrologic Assessment
Central Kitsap School District
Kitsap County, WA
Section 17, Township 25N, Range 1E, W.M.

DATE: 11/7/16
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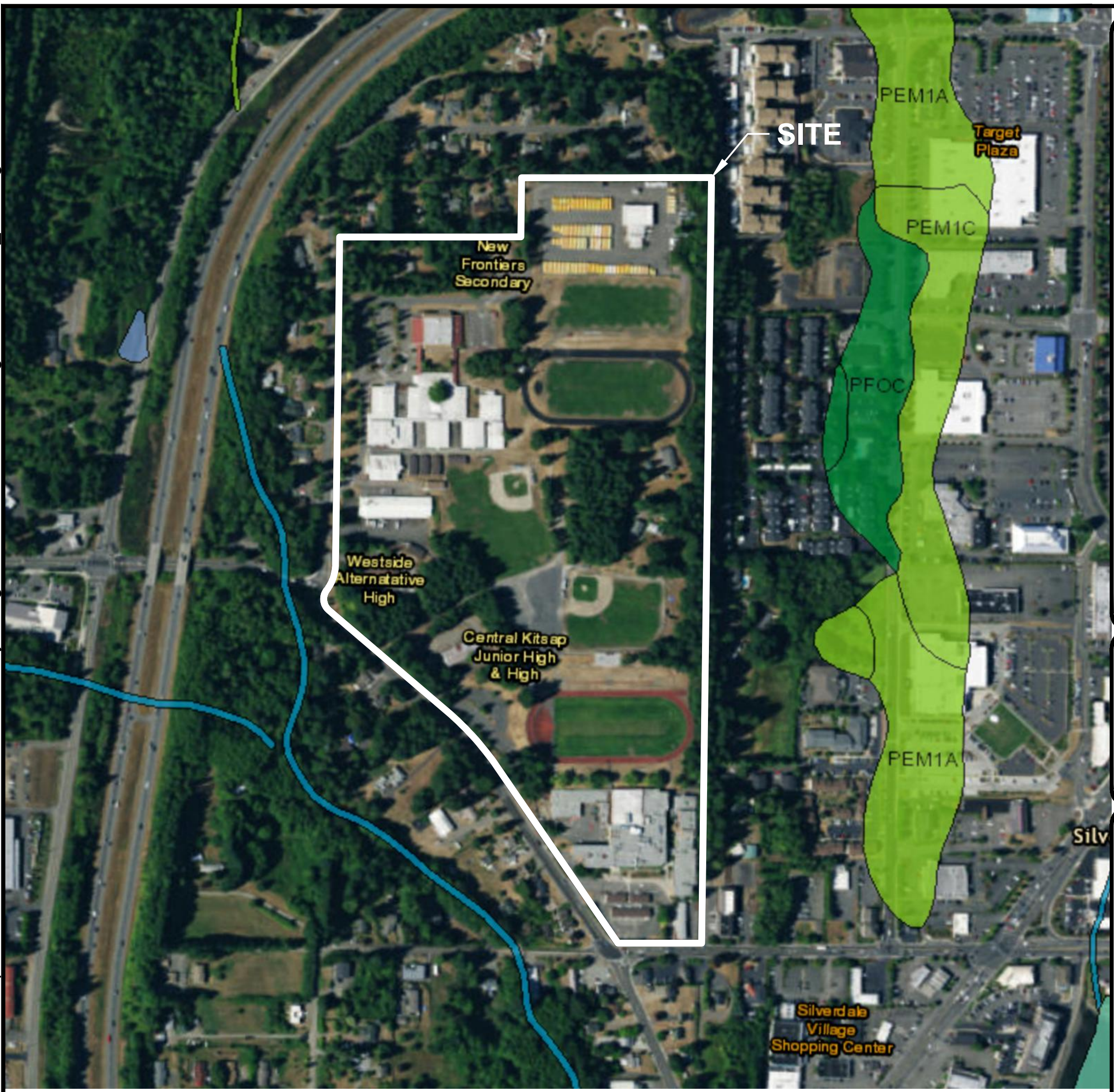

No mapped wetlands indicated onsite by US Fish & Wildlife Service.

LEGEND:

- 🟩 Freshwater Emergent Wetland
- 🟩 Freshwater Forested/Shrub Wetland
- 🟦 Riverine

NOTE(S):

1. Map provided on-line by US Fish & Wildlife Service at web address: *http://www.fws.gov/wetlands/data/index.html*

Figure 4
NATIONAL WETLANDS INVENTORY MAP
CKHS CKMS Hydrologic Assessment
Central Kitsap School District
Kitsap County, WA
Section 17, Township 25N, Range 1E, W.M.

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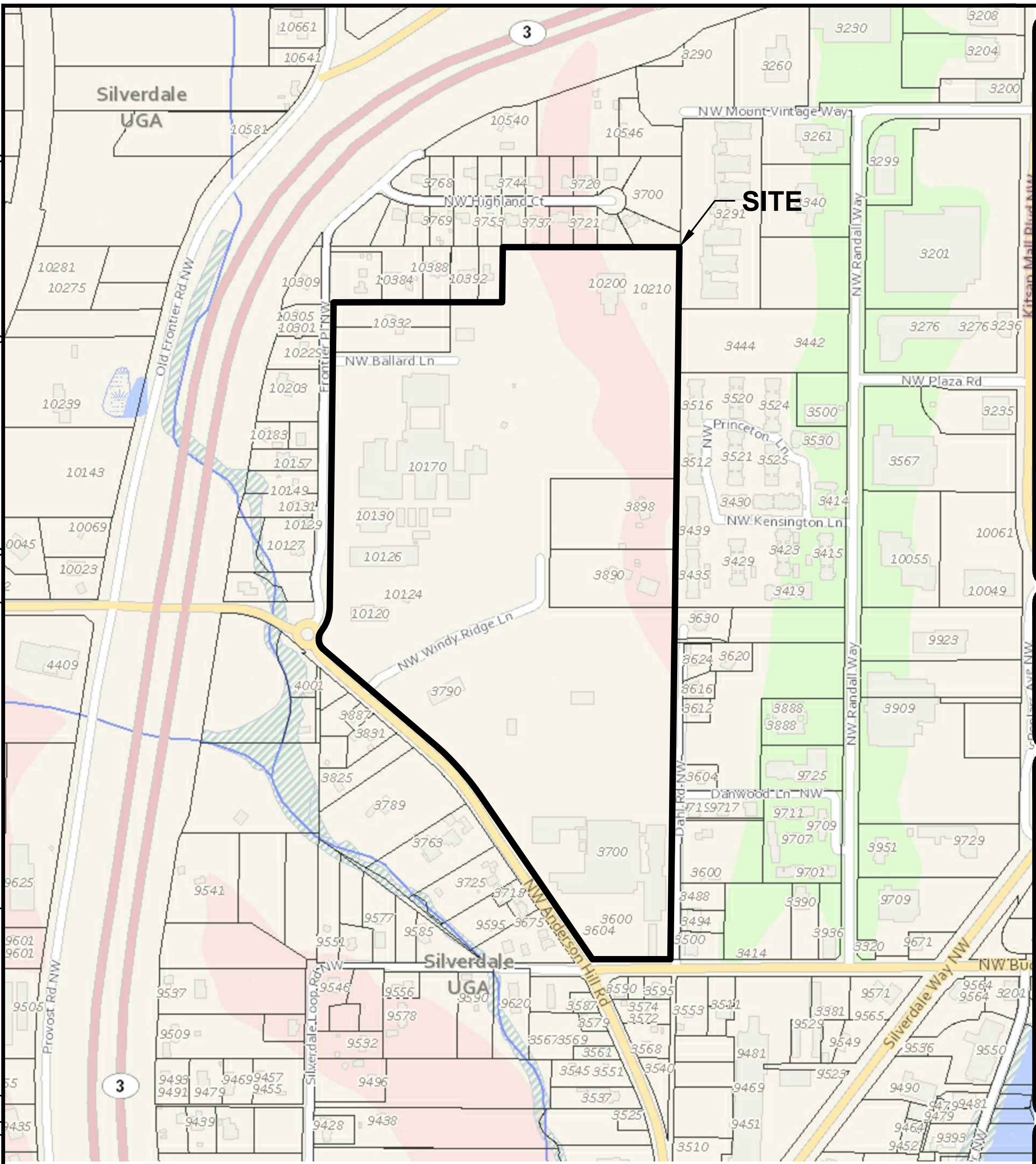

Streams

WA DNR Water Courses

- (S) Designated Shorelines
- (F) Fish Habitat
- (N) Non-fish Habitat
- (U) Unknown

Parcels

Tax Parcels Outlines

☐

Buildings

Building Footprints

▭

Roads

Roads

Local Roads

- 🟥 State Highway
- 🟨 Collector / Arterial
- — Local Roads

Critical Areas

Waterbodies (defined in WAC 222-16-030)

▨ Includes DNR, NWI, and Surveyed Wetlands

Wetlands (DNR, NWI, Surveys)

▨ DNR, NWI, Surveyed Wetlands

FEMA Flood Hazard Areas

▨ 100 Year Floodplain

Hydric Soils (SCS Soil Survey)

🟩 Potential Wetlands

Geohazards

🟥 High Hazard Areas

🟥 Moderate Hazard Areas

NOTE(S):

1. Map provided on-line by Kitsap County at web address: *https://psearch.kitsapgov.com/webappa/*

Figure 5
KITSAP COUNTY CRITICAL AREAS MAP
CKHS CKMS Hydrologic Assessment
Central Kitsap School District
Kitsap County, WA
Section 17, Township 25N, Range 1E, W.M.

DATE: 11/7/16
DWN: JLL
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Photo 1 was taken of the short stream that begins just west of the CKSD administrative building along Frontier Place. This stream is confined to a steep sided, yet short ravine that ends a culvert under Anderson Hill Road.

Photo 2 shows another view of the stream shown in Photo 1.

Photo 3 was taken from the CKSD property and looks southwesterly across Frontier Place toward the start of the short stream in Photos 1 and 2. The stream begins just downslope of the trees in the middle of the photo.

Ecological Land Services	1157 3rd Ave., Suite 220A Longview, WA 98632 (360) 578-1371 Fax: (360) 414-9305	DATE: 10/26/16 DWN: JB PRJ. MGR JB PROJ.#: 2399.02	Photoplate 1 Project Name: CKHS/CKMS Hydrologic Assessment Client: Central Kitsap School District Kitsap County, Washington

Photo 4 was taken from Anderson Hill Road and looks down into Koch Creek before it enters the culvert under the road. The slope down to the stream is dominated by blackberry thickets. There are upland areas on both sides of the creek. The small stream enters Koch Creek about 100 feet from this point.

Photo 5 was taken from the south side of Anderson Hill Road and looks across the road at the culvert crossing.

Photo 6 was taken from along Koch Creek downstream of Anderson Hill Road. There is level upland on both sides of the channel. Water flow in the channel was high and fast due to recent heavy rain events.

Photo 7 was taken from along Randall Way across from the wetland that lies north of the First American Building. The wetland occupies the level grassy area in the middle of the photo (just beyond the road) with a sloping portion in the deciduous trees just beyond the level portion. The tall conifer trees in the upper right background are just downslope and east of the CKSD property.

Photo 8 was taken from the same location as Photo 4 and looks west across Randall Way. As described in the Photo 4 discussion, the level grassy area is composed of depressional wetland with slope wetland conditions in the tree area. The conifer trees beyond the deciduous trees are growing on property adjacent to the CKSD property.

Photo 9 was taken from the southwest corner of the Target property, which is located across Randall Way from the Vintage at Silverdale Apartment complex. The apartments are located just this side of the cell towers and conifers trees in the background with the wetland just downslope of the apartments. The lower portion of this wetland was filled to accommodate future development.

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DATE: 10/26/16
DWN: JB
PRJ. MGR JB
PROJ.#: 2399.02

Photoplate 3
Project Name: CKHS/CKHS
Hydrologic Assessment
Client: Central Kitsap School
District
Kitsap County, Washington

Photo 10 was taken from near the bottom of the light standard atop which the osprey nest has been constructed.

Photo 11 was taken from the parking lot above the track and field location and looks south toward the high school. The light standard on the right houses the osprey nest. The high school building is just beyond the lights.

Photo 12 was taken from the same location as Photo 11. This photo was zoomed in order to show a close up view of the nest.

ATTACHMENT #1

Washington Department of Fish and Wildlife
REGION 6
48 Devonshire Road • Montesano, Washington 98563 • (360) 249-4628 FAX (360) 249-1229

November 21, 2016

Joanne Bartlett
Ecological Land Services
8900 State Highway 3, Suite 201
Bremerton, WA 98312-4982

Dear Joanne Bartlett:

This letter serves as the permit to allow the Central Kitsap School District or its representative to remove an osprey nest from a lighting pole located at 3600 Bucklin Hill Road, Silverdale, WA 98383 in Kitsap County pursuant to RCW 77.15.130 and WAC 232-36-040. This nest has been determined to be impedance to maintenance repair needs. This permit allows the removal outside of the nesting season from October 1, 2016 through March 15, 2017. Additional permits may be required from the US Fish and Wildlife Service for removal of the nest during the nesting season.

No permit is required to install an exclusionary device after the nest is removed. Nor is the installation of exclusionary device required. Although not required, a follow-up report on the success of any exclusionary device installed would be appreciated.

A copy of this permit must be on site while the nest is being removed.

If you have any questions regarding the conditions of this permit, please contact me by telephone at (360) 790-8687 or by e-mail at bryan.murphie@dfw.wa.gov.

Sincerely,
Bryan L Murphie
Bryan Murphie
Wildlife Biologist

cc: Brian Calkins
Sgt. Ted Jackson

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE

SPECIAL PERMIT

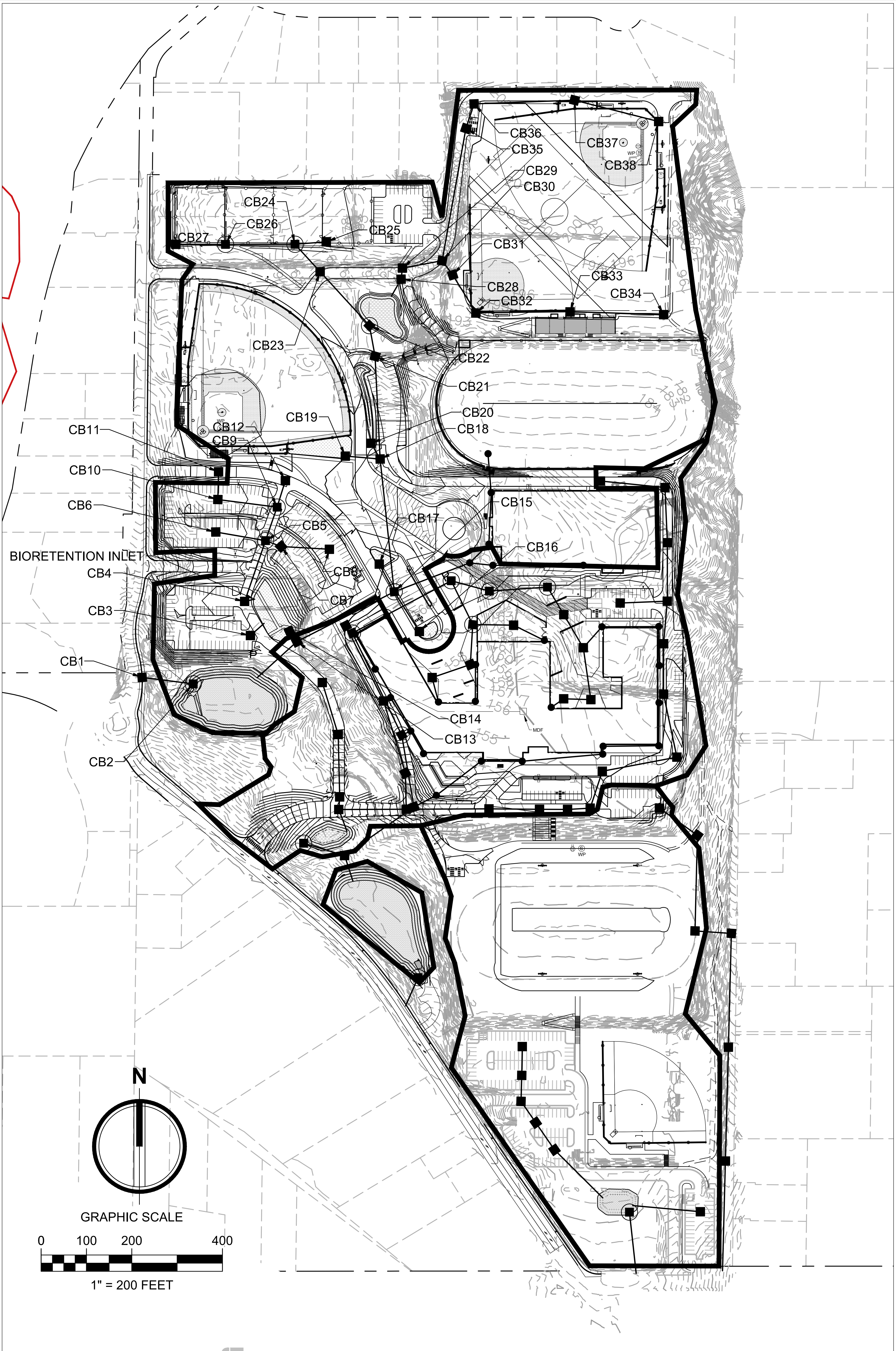
OSPREY NEST REMOVAL PERMIT

LOCATION #: Kitsap County	**PERMIT #:** NA	
LOCATION NAME: Central Kitsap High School	**SPECIES:** OSPREY	**YEAR:** 2016
TOWER OWNER: Central Kitsap High School	**PERMITEE:** Central Kitsap High School or representative	
ADDRESS: 3600 Bucklin Hill Road	**ADDRESS:** 3600 Bucklin Hill Road	
CITY: Silverdale, WA 98383	**CITY:** Silverdale	**ZIP:** 98383
NATURE OF DAMAGE: Impedance to maintenance repair needs	**STATE:** WA	
MITIGATION AGREEMENT: See attached letter	**VALID DATES:** October 1, 2016 to March 15, 2017	

THIS PERMIT AND THE ENCLOSED LETTER MUST BE ON THE SITE WHILE THE NEST IS BEING REMOVED

Appendix C

Exhibits



AHBL
TACOMA·SEATTLE

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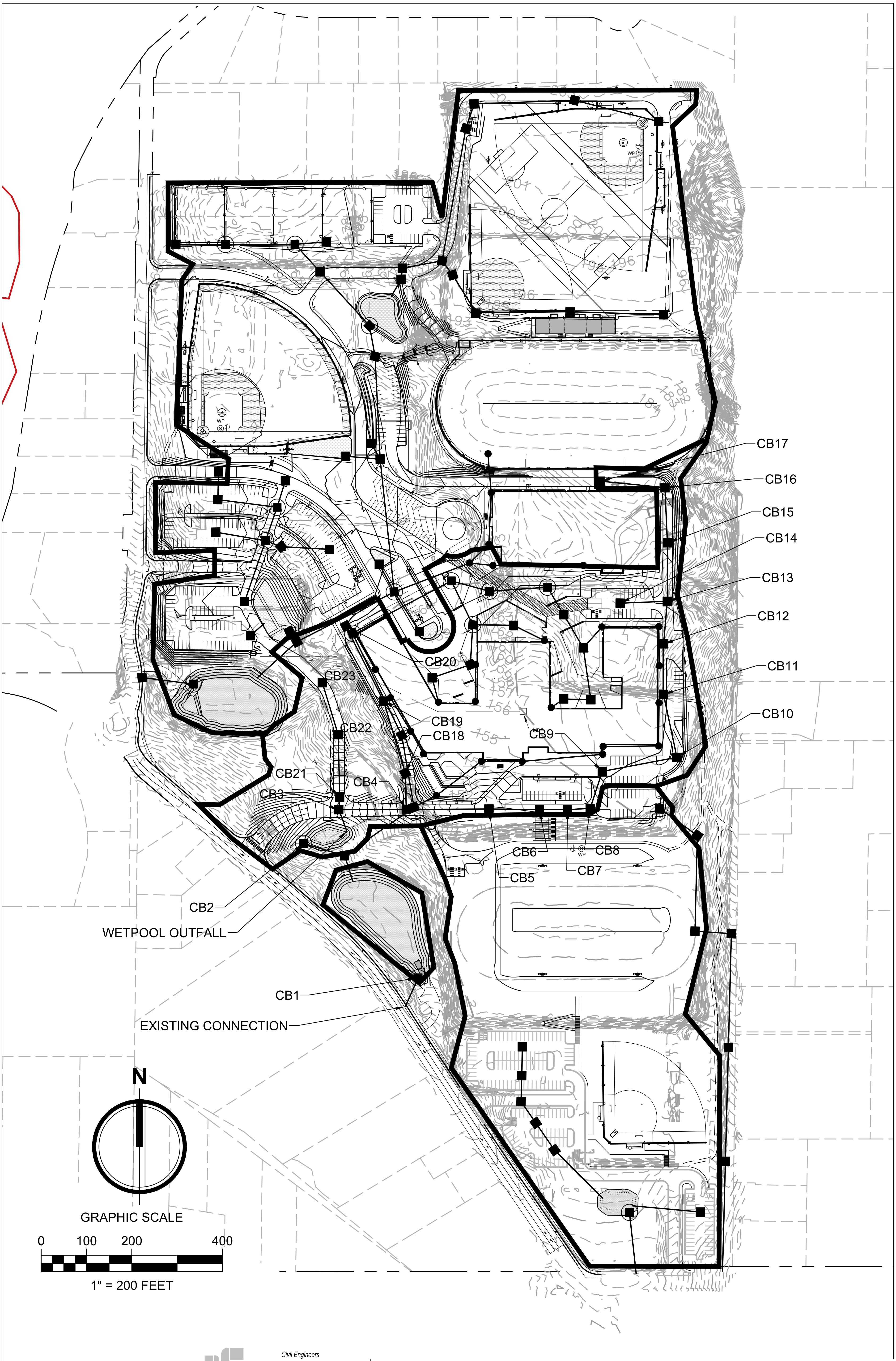
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
Neighbors

2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

WEST POND
CONVEYANCE MAP

C-1



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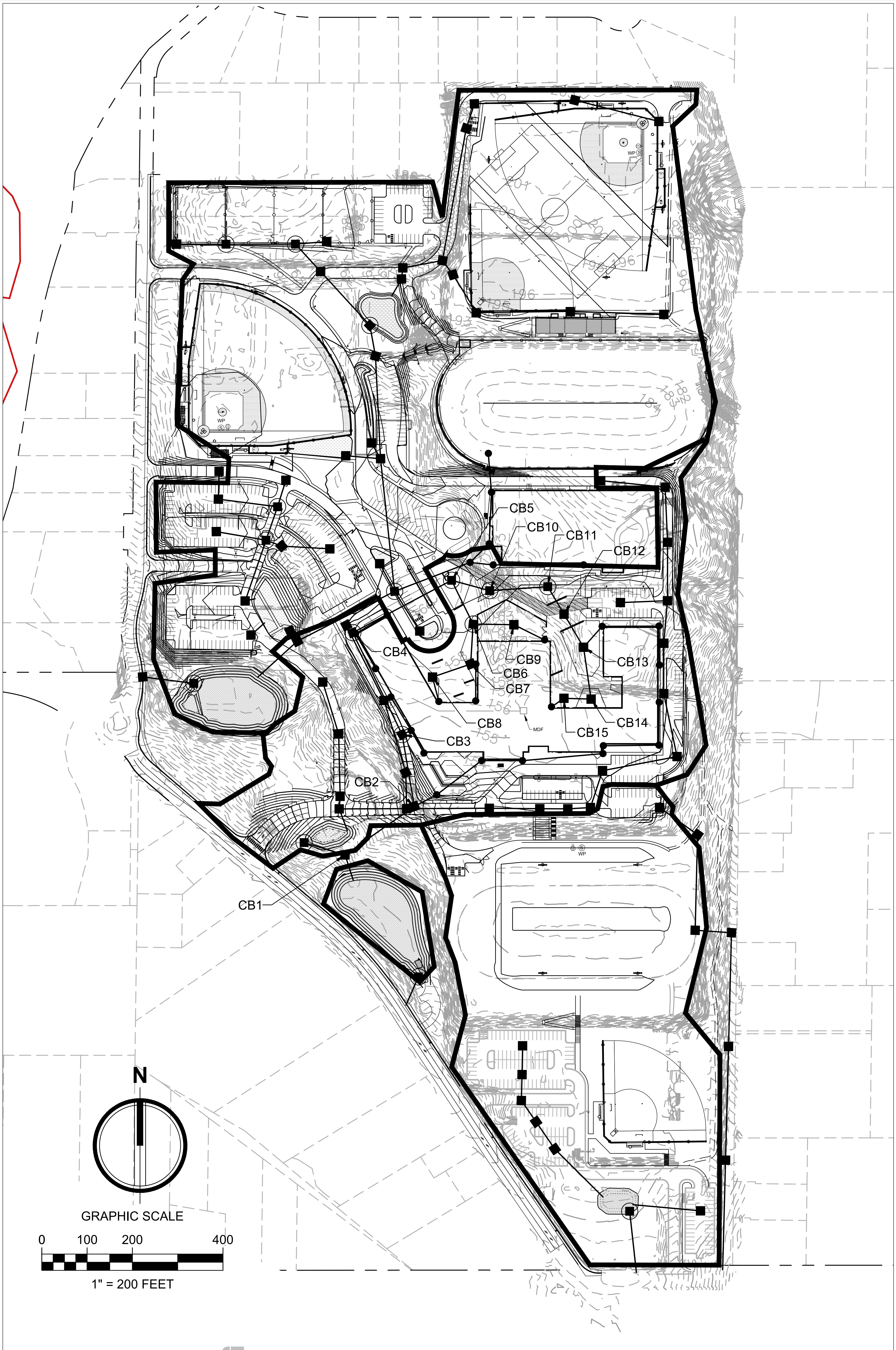
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

SOUTH POND
PGS CONVEYANCE MAP

C-2



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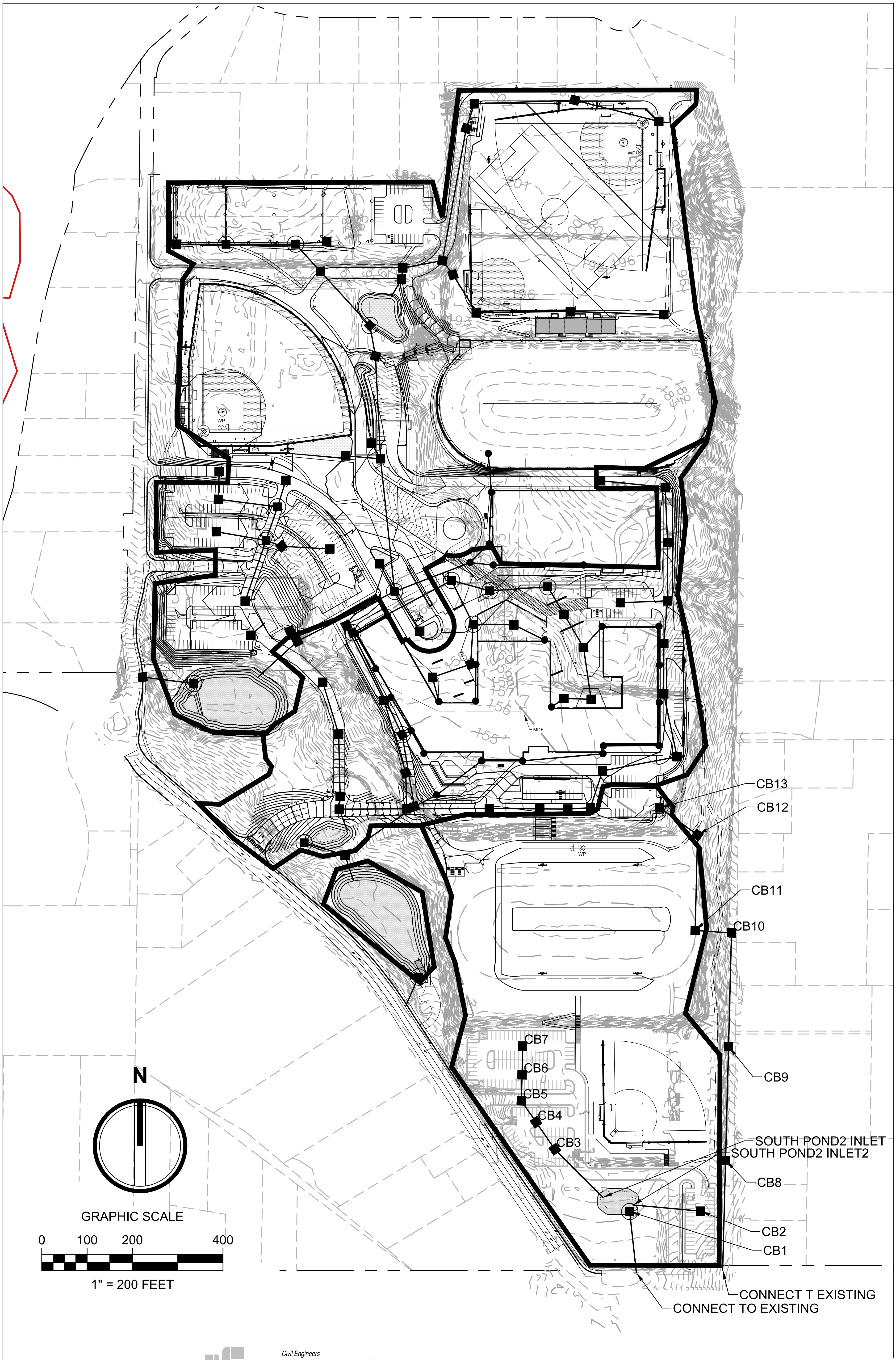
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

SOUTH POND
NON PGS & TREATED CONVEYANCE MAP

C-3



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Structural Engineers
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Community Planners
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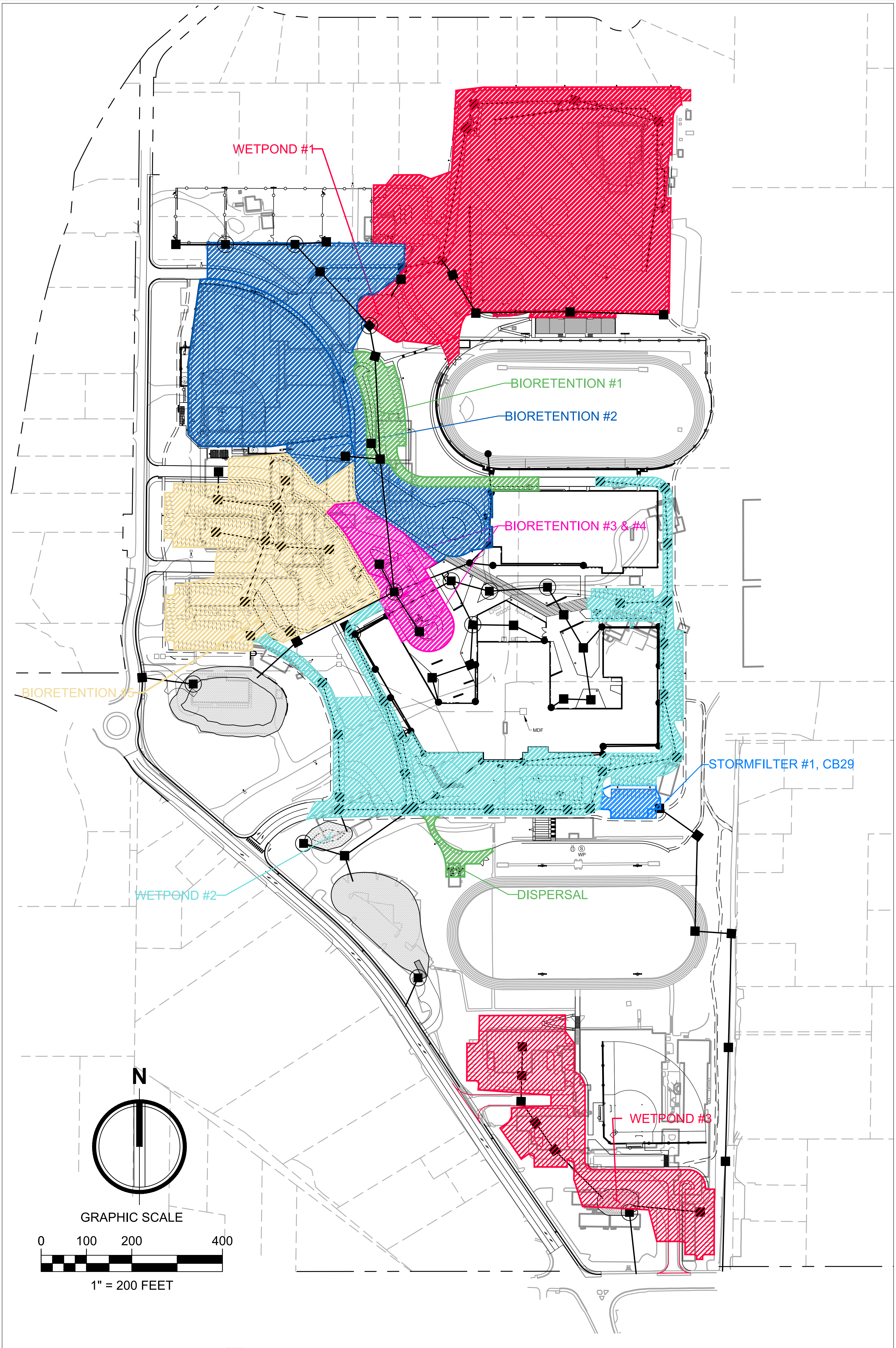
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

SOUTH POND #2 (BUCKLIN HILL RD)
CONVEYANCE MAP

C-4



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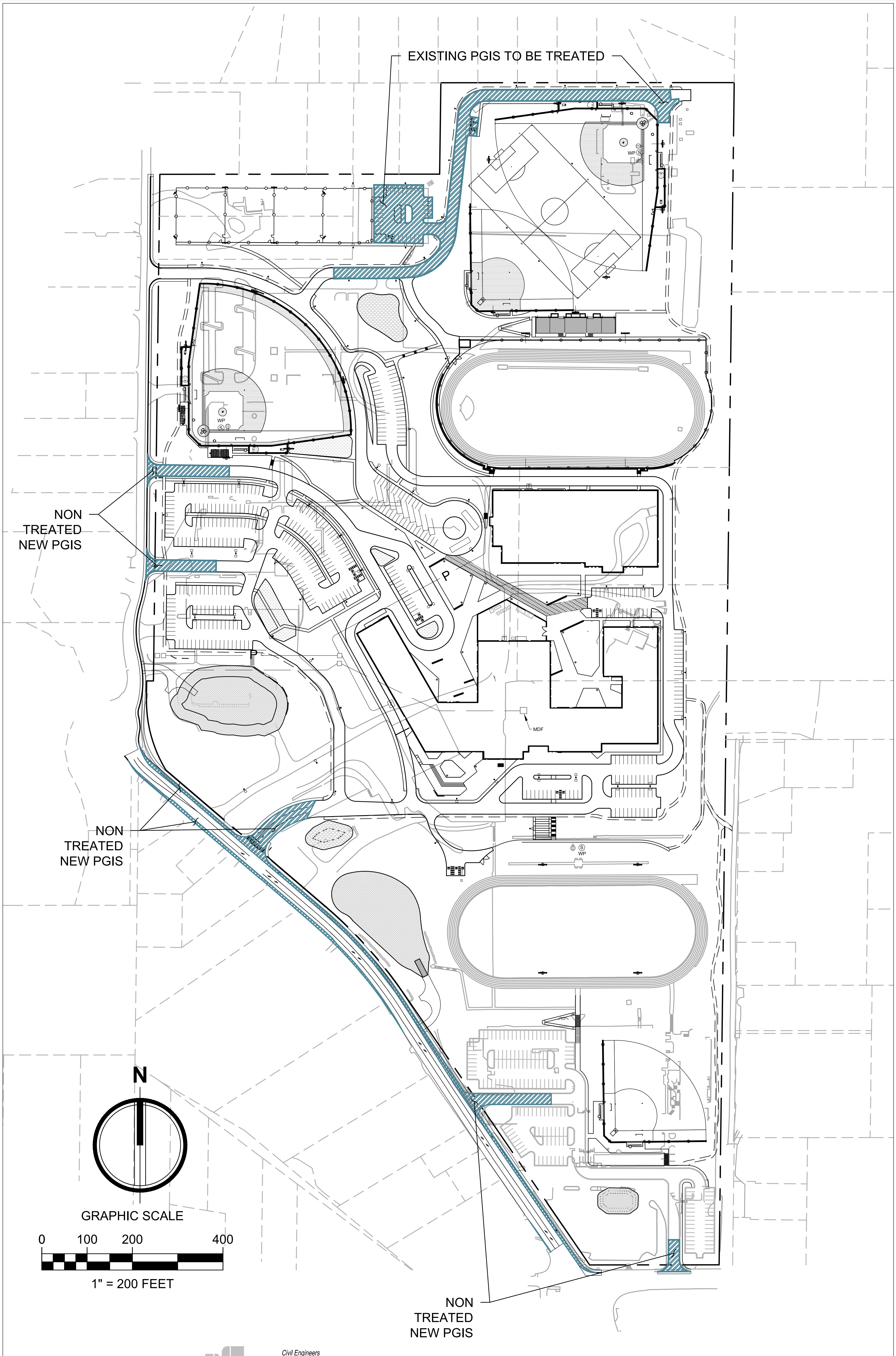
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

WATER QUALITY
BASIN AREAS MAP

C-5



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Structural Engineers
Landscape Architects
Community Planners
Land Surveyors
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316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

CENTRAL KITSAP
HIGH SCHOOL & MIDDLE SCHOOL

WATER QUALITY
TRADED AREAS MAP

C-6

WWHM2012

PROJECT REPORT

WEST POND CALCULATIONS

C7

General Model Information

Project Name:	West Pond(8'd ato orf)
Site Name:	
Site Address:	
City:	
Report Date:	12/6/2016
Gage:	Quilcene
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.00 (adjusted)
Version Date:	2016/03/03
Version:	4.2.12

POC Thresholds

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

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Landuse Basin Data

Predeveloped Land Use

BASIN N - TO KOCH FOREST

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	5.357
C, Forest, Flat	22.286
Pervious Total	27.643
Impervious Land Use	acre
Impervious Total	0
Basin Total	27.643

Element Flows To:

Surface	Interflow	Groundwater

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Mitigated Land Use

To West Pond

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	10.838
C, Lawn, Mod	1.921
Pervious Total	12.759
Impervious Land Use	acre
PARKING FLAT	11.802
PARKING MOD	0.327
POND	0.15
Impervious Total	12.279
Basin Total	25.038

Element Flows To:

Surface	Interflow	Groundwater
WEST Pond	WEST Pond	

C7

Mitigated Routing

WEST Pond

Bottom Length: 131.00 ft.
Bottom Width: 132.00 ft.
Depth: 7 ft.
Volume at riser head: 3.1364 acre-feet.
Infiltration On
Infiltration rate: 2
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 2683.04
Total Volume Through Riser (ac-ft.): 1609.261
Total Volume Through Facility (ac-ft.): 4292.301
Percent Infiltrated: 62.51
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 6 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 6.25 in. Elevation:0 ft.
Orifice 2 Diameter: 2.1 in. Elevation:2.3 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.397	0.000	0.000	0.000
0.0778	0.399	0.031	0.295	0.800
0.1556	0.402	0.062	0.418	0.800
0.2333	0.405	0.093	0.512	0.800
0.3111	0.408	0.125	0.591	0.800
0.3889	0.411	0.157	0.661	0.800
0.4667	0.414	0.189	0.724	0.800
0.5444	0.416	0.221	0.782	0.800
0.6222	0.419	0.254	0.836	0.800
0.7000	0.422	0.286	0.886	0.800
0.7778	0.425	0.319	0.934	0.800
0.8556	0.428	0.353	0.980	0.800
0.9333	0.431	0.386	1.024	0.800
1.0111	0.434	0.420	1.065	0.800
1.0889	0.437	0.454	1.106	0.800
1.1667	0.440	0.488	1.145	0.800
1.2444	0.443	0.522	1.182	0.800
1.3222	0.446	0.557	1.218	0.800
1.4000	0.449	0.592	1.254	0.800
1.4778	0.452	0.627	1.288	0.800
1.5556	0.455	0.662	1.322	0.800
1.6333	0.458	0.697	1.354	0.800
1.7111	0.461	0.733	1.386	0.800
1.7889	0.464	0.769	1.417	0.800
1.8667	0.467	0.805	1.448	0.800

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1.9444	0.470	0.842	1.478	0.800
2.0222	0.473	0.879	1.507	0.800
2.1000	0.476	0.916	1.536	0.800
2.1778	0.479	0.953	1.564	0.800
2.2556	0.482	0.990	1.592	0.800
2.3333	0.486	1.028	1.641	0.800
2.4111	0.489	1.066	1.685	0.800
2.4889	0.492	1.104	1.724	0.800
2.5667	0.495	1.142	1.760	0.800
2.6444	0.498	1.181	1.794	0.800
2.7222	0.501	1.220	1.826	0.800
2.8000	0.504	1.259	1.858	0.800
2.8778	0.508	1.299	1.889	0.800
2.9556	0.511	1.338	1.919	0.800
3.0333	0.514	1.378	1.948	0.800
3.1111	0.517	1.418	1.977	0.800
3.1889	0.520	1.459	2.005	0.800
3.2667	0.524	1.499	2.033	0.800
3.3444	0.527	1.540	2.060	0.800
3.4222	0.530	1.581	2.087	0.800
3.5000	0.533	1.623	2.114	0.800
3.5778	0.537	1.664	2.140	0.800
3.6556	0.540	1.706	2.166	0.800
3.7333	0.543	1.748	2.191	0.800
3.8111	0.547	1.791	2.216	0.800
3.8889	0.550	1.833	2.241	0.800
3.9667	0.553	1.876	2.265	0.800
4.0444	0.557	1.920	2.289	0.800
4.1222	0.560	1.963	2.313	0.800
4.2000	0.563	2.007	2.337	0.800
4.2778	0.567	2.051	2.360	0.800
4.3556	0.570	2.095	2.383	0.800
4.4333	0.573	2.139	2.406	0.800
4.5111	0.577	2.184	2.429	0.800
4.5889	0.580	2.229	2.451	0.800
4.6667	0.584	2.275	2.474	0.800
4.7444	0.587	2.320	2.496	0.800
4.8222	0.590	2.366	2.517	0.800
4.9000	0.594	2.412	2.539	0.800
4.9778	0.597	2.458	2.560	0.800
5.0556	0.601	2.505	2.582	0.800
5.1333	0.604	2.552	2.603	0.800
5.2111	0.608	2.599	2.624	0.800
5.2889	0.611	2.647	2.644	0.800
5.3667	0.615	2.694	2.665	0.800
5.4444	0.618	2.742	2.685	0.800
5.5222	0.622	2.790	2.705	0.800
5.6000	0.625	2.839	2.725	0.800
5.6778	0.629	2.888	2.745	0.800
5.7556	0.632	2.937	2.765	0.800
5.8333	0.636	2.986	2.785	0.800
5.9111	0.640	3.036	2.804	0.800
5.9889	0.643	3.086	2.824	0.800
6.0667	0.647	3.136	3.116	0.800
6.1444	0.650	3.186	3.731	0.800
6.2222	0.654	3.237	4.518	0.800
6.3000	0.658	3.288	5.401	0.800
6.3778	0.661	3.340	6.305	0.800

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6.4556	0.665	3.391	7.153	0.800
6.5333	0.668	3.443	7.879	0.800
6.6111	0.672	3.495	8.442	0.800
6.6889	0.676	3.548	8.841	0.800
6.7667	0.679	3.600	9.215	0.800
6.8444	0.683	3.653	9.540	0.800
6.9222	0.687	3.707	9.851	0.800
7.0000	0.691	3.760	10.15	0.800
7.0778	0.694	3.814	10.43	0.800

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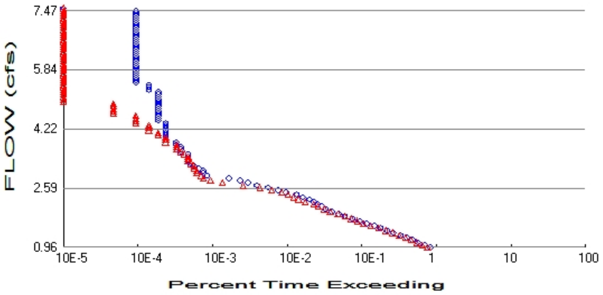
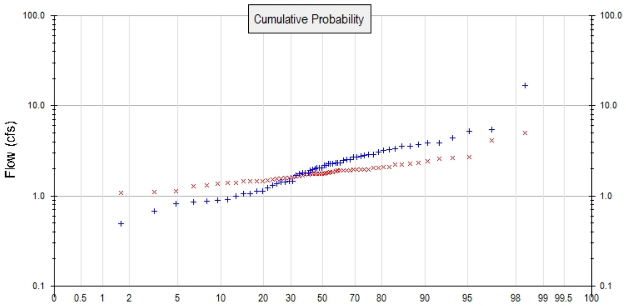
Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 27.643
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 12.759
Total Impervious Area: 12.279

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.928992
5 year	3.288279
10 year	4.397283
25 year	6.049373
50 year	7.470972
100 year	9.063551

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.745657
5 year	2.239388
10 year	2.585867
25 year	3.046919
50 year	3.407852
100 year	3.784222

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	3.541	2.418
1950	1.126	1.450
1951	2.533	1.938
1952	1.126	1.763
1953	1.682	1.549
1954	3.895	1.908
1955	3.183	2.319
1956	16.887	1.910
1957	2.745	1.737
1958	3.910	1.765

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1959	3.571	2.557
1960	2.036	1.973
1961	5.246	1.584
1962	1.451	1.861
1963	1.782	1.777
1964	1.431	1.471
1965	1.000	0.843
1966	4.421	1.447
1967	2.549	2.089
1968	2.674	1.589
1969	2.065	1.615
1970	2.196	1.977
1971	3.305	2.051
1972	2.876	1.808
1973	1.757	1.665
1974	2.500	1.916
1975	2.319	1.848
1976	2.861	1.953
1977	1.418	1.278
1978	2.279	1.456
1979	1.978	1.842
1980	1.374	1.545
1981	1.225	1.384
1982	0.921	1.367
1983	2.164	4.133
1984	0.811	1.074
1985	0.430	1.451
1986	2.010	1.803
1987	1.788	1.733
1988	1.313	1.743
1989	0.879	1.130
1990	0.862	1.312
1991	1.801	2.203
1992	2.337	2.060
1993	1.065	1.386
1994	2.673	2.664
1995	2.317	1.924
1996	2.801	1.940
1997	2.053	1.778
1998	2.266	1.750
1999	3.742	2.717
2000	1.057	1.772
2001	0.487	1.947
2002	5.466	2.276
2003	3.236	4.954
2004	0.884	1.510
2005	1.467	1.690
2006	3.073	2.071
2007	1.926	1.645
2008	2.254	2.226
2009	0.681	1.106

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	16.8866	4.9537
2	5.4663	4.1335
3	5.2455	2.7170

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4	4.4212	2.6644
5	3.9097	2.5572
6	3.8946	2.4185
7	3.7415	2.3193
8	3.5708	2.2756
9	3.5406	2.2261
10	3.3055	2.2033
11	3.2360	2.0889
12	3.1826	2.0714
13	3.0725	2.0595
14	2.8760	2.0508
15	2.8611	1.9771
16	2.8006	1.9733
17	2.7447	1.9528
18	2.6736	1.9474
19	2.6729	1.9397
20	2.5489	1.9377
21	2.5329	1.9244
22	2.4996	1.9164
23	2.3372	1.9098
24	2.3194	1.9083
25	2.3174	1.8614
26	2.2785	1.8477
27	2.2662	1.8425
28	2.2536	1.8079
29	2.1963	1.8026
30	2.1641	1.7783
31	2.0645	1.7775
32	2.0533	1.7719
33	2.0361	1.7646
34	2.0095	1.7631
35	1.9776	1.7501
36	1.9264	1.7435
37	1.8009	1.7367
38	1.7880	1.7331
39	1.7817	1.6895
40	1.7568	1.6652
41	1.6823	1.6449
42	1.4672	1.6151
43	1.4514	1.5889
44	1.4312	1.5839
45	1.4184	1.5493
46	1.3741	1.5448
47	1.3132	1.5103
48	1.2251	1.4709
49	1.1257	1.4562
50	1.1256	1.4505
51	1.0653	1.4499
52	1.0567	1.4469
53	0.9995	1.3855
54	0.9207	1.3841
55	0.8839	1.3665
56	0.8788	1.3116
57	0.8624	1.2778
58	0.8107	1.1295
59	0.6815	1.1060
60	0.4869	1.0743
61	0.4298	0.8433

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Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.9645	17751	16168	91	Pass
1.0302	14724	13755	93	Pass
1.0959	12192	11623	95	Pass
1.1617	10166	9794	96	Pass
1.2274	8500	8194	96	Pass
1.2931	7054	6791	96	Pass
1.3588	5715	5572	97	Pass
1.4245	4678	4479	95	Pass
1.4903	3814	3589	94	Pass
1.5560	3127	2825	90	Pass
1.6217	2492	2248	90	Pass
1.6874	1989	1865	93	Pass
1.7532	1603	1550	96	Pass
1.8189	1261	1271	100	Pass
1.8846	1045	1024	97	Pass
1.9503	844	801	94	Pass
2.0160	702	677	96	Pass
2.0818	619	553	89	Pass
2.1475	544	483	88	Pass
2.2132	489	371	75	Pass
2.2789	423	304	71	Pass
2.3447	345	260	75	Pass
2.4104	284	220	77	Pass
2.4761	207	180	86	Pass
2.5418	163	132	80	Pass
2.6075	119	92	77	Pass
2.6733	84	55	65	Pass
2.7390	64	29	45	Pass
2.8047	50	20	40	Pass
2.8704	35	16	45	Pass
2.9362	18	15	83	Pass
3.0019	16	13	81	Pass
3.0676	16	13	81	Pass
3.1333	14	12	85	Pass
3.1990	12	12	100	Pass
3.2648	11	11	100	Pass
3.3305	10	10	100	Pass
3.3962	10	10	100	Pass
3.4619	10	10	100	Pass
3.5277	10	9	90	Pass
3.5934	8	8	100	Pass
3.6591	8	7	87	Pass
3.7248	8	7	87	Pass
3.7905	7	7	100	Pass
3.8563	7	5	71	Pass
3.9220	5	5	100	Pass
3.9877	5	5	100	Pass
4.0534	5	4	80	Pass
4.1192	5	4	80	Pass
4.1849	5	3	60	Pass
4.2506	5	3	60	Pass
4.3163	5	3	60	Pass
4.3820	5	2	40	Pass

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4.4478	4	2	50	Pass
4.5135	4	2	50	Pass
4.5792	4	2	50	Pass
4.6449	4	1	25	Pass
4.7106	4	1	25	Pass
4.7764	4	1	25	Pass
4.8421	4	1	25	Pass
4.9078	4	1	25	Pass
4.9735	4	0	0	Pass
5.0393	4	0	0	Pass
5.1050	4	0	0	Pass
5.1707	4	0	0	Pass
5.2364	4	0	0	Pass
5.3021	3	0	0	Pass
5.3679	3	0	0	Pass
5.4336	3	0	0	Pass
5.4993	2	0	0	Pass
5.5650	2	0	0	Pass
5.6308	2	0	0	Pass
5.6965	2	0	0	Pass
5.7622	2	0	0	Pass
5.8279	2	0	0	Pass
5.8936	2	0	0	Pass
5.9594	2	0	0	Pass
6.0251	2	0	0	Pass
6.0908	2	0	0	Pass
6.1565	2	0	0	Pass
6.2223	2	0	0	Pass
6.2880	2	0	0	Pass
6.3537	2	0	0	Pass
6.4194	2	0	0	Pass
6.4851	2	0	0	Pass
6.5509	2	0	0	Pass
6.6166	2	0	0	Pass
6.6823	2	0	0	Pass
6.7480	2	0	0	Pass
6.8138	2	0	0	Pass
6.8795	2	0	0	Pass
6.9452	2	0	0	Pass
7.0109	2	0	0	Pass
7.0766	2	0	0	Pass
7.1424	2	0	0	Pass
7.2081	2	0	0	Pass
7.2738	2	0	0	Pass
7.3395	2	0	0	Pass
7.4053	2	0	0	Pass
7.4710	2	0	0	Pass

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Disclaimer

Legal Notice

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

C7

WWHM2012

PROJECT REPORT

SOUTH POND CALCULATIONS

C8

General Model Information

Project Name: South Pond (orf)
Site Name:
Site Address:
City:
Report Date: 12/5/2016
Gage: Quilcene
Data Start: 1948/10/01
Data End: 2009/09/30
Timestep: 15 Minute
Precip Scale: 0.00 (adjusted)
Version Date: 2016/03/03
Version: 4.2.12

POC Thresholds

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

C8

Landuse Basin Data

Predeveloped Land Use

BASIN S - TO STRAWBERRY

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	3.72
C, Forest, Steep	1.236
C, Forest, Flat	4.085
Pervious Total	9.041
Impervious Land Use	acre
Impervious Total	0
Basin Total	9.041

Element Flows To:

Surface	Interflow	Groundwater

C8

Mitigated Land Use

To South Pond

Bypass:	No
GroundWater:	No

Pervious Land Use	acre
C, Forest, Mod	0.626
C, Lawn, Flat	1.174
Pervious Total	1.8

Impervious Land Use	acre
ROOF TOPS FLAT	3.999
PARKING FLAT	4.513
PARKING MOD	0.5
Impervious Total	9.012
Basin Total	10.812

Element Flows To:

Surface	Interflow	Groundwater
South Pond	South Pond	

C8

Mitigated Routing

South Pond

Bottom Length: 116.12 ft.
Bottom Width: 116.12 ft.
Depth: 8 ft.
Volume at riser head: 3.0580 acre-feet.
Infiltration On
Infiltration rate: 2
Infiltration safety factor: 1
Total Volume Infiltrated (ac-ft.): 1933.691
Total Volume Through Riser (ac-ft.): 163.981
Total Volume Through Facility (ac-ft.): 2097.672
Percent Infiltrated: 92.18
Total Precip Applied to Facility: 0
Total Evap From Facility: 0
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 7 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 2.02 in. Elevation:0 ft.
Orifice 2 Diameter: 4.78 in. Elevation:5.669 ft.
Orifice 3 Diameter: 2.9 in. Elevation:6.25 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.309	0.000	0.000	0.000
0.0889	0.312	0.027	0.033	0.624
0.1778	0.315	0.055	0.046	0.624
0.2667	0.318	0.083	0.057	0.624
0.3556	0.321	0.112	0.066	0.624
0.4444	0.323	0.140	0.073	0.624
0.5333	0.326	0.169	0.080	0.624
0.6222	0.329	0.198	0.087	0.624
0.7111	0.332	0.228	0.093	0.624
0.8000	0.335	0.258	0.099	0.624
0.8889	0.338	0.288	0.104	0.624
0.9778	0.341	0.318	0.109	0.624
1.0667	0.344	0.348	0.114	0.624
1.1556	0.347	0.379	0.119	0.624
1.2444	0.350	0.410	0.123	0.624
1.3333	0.353	0.441	0.127	0.624
1.4222	0.356	0.473	0.132	0.624
1.5111	0.359	0.505	0.136	0.624
1.6000	0.362	0.537	0.140	0.624
1.6889	0.365	0.569	0.143	0.624
1.7778	0.369	0.602	0.147	0.624
1.8667	0.372	0.635	0.151	0.624
1.9556	0.375	0.668	0.154	0.624
2.0444	0.378	0.702	0.158	0.624

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2.1333	0.381	0.735	0.161	0.624
2.2222	0.384	0.769	0.165	0.624
2.3111	0.387	0.804	0.168	0.624
2.4000	0.391	0.838	0.171	0.624
2.4889	0.394	0.873	0.174	0.624
2.5778	0.397	0.909	0.177	0.624
2.6667	0.400	0.944	0.180	0.624
2.7556	0.404	0.980	0.183	0.624
2.8444	0.407	1.016	0.186	0.624
2.9333	0.410	1.052	0.189	0.624
3.0222	0.413	1.089	0.192	0.624
3.1111	0.417	1.126	0.195	0.624
3.2000	0.420	1.163	0.198	0.624
3.2889	0.423	1.200	0.200	0.624
3.3778	0.427	1.238	0.203	0.624
3.4667	0.430	1.276	0.206	0.624
3.5556	0.433	1.315	0.208	0.624
3.6444	0.437	1.354	0.211	0.624
3.7333	0.440	1.393	0.213	0.624
3.8222	0.443	1.432	0.216	0.624
3.9111	0.447	1.471	0.219	0.624
4.0000	0.450	1.511	0.221	0.624
4.0889	0.454	1.552	0.223	0.624
4.1778	0.457	1.592	0.226	0.624
4.2667	0.461	1.633	0.228	0.624
4.3556	0.464	1.674	0.231	0.624
4.4444	0.468	1.716	0.233	0.624
4.5333	0.471	1.757	0.235	0.624
4.6222	0.475	1.799	0.238	0.624
4.7111	0.478	1.842	0.240	0.624
4.8000	0.482	1.884	0.242	0.624
4.8889	0.485	1.927	0.244	0.624
4.9778	0.489	1.971	0.247	0.624
5.0667	0.492	2.014	0.249	0.624
5.1556	0.496	2.058	0.251	0.624
5.2444	0.500	2.103	0.253	0.624
5.3333	0.503	2.147	0.255	0.624
5.4222	0.507	2.192	0.257	0.624
5.5111	0.511	2.238	0.259	0.624
5.6000	0.514	2.283	0.262	0.624
5.6889	0.518	2.329	0.351	0.624
5.7778	0.522	2.375	0.470	0.624
5.8667	0.525	2.422	0.543	0.624
5.9556	0.529	2.469	0.602	0.624
6.0444	0.533	2.516	0.652	0.624
6.1333	0.536	2.563	0.696	0.624
6.2222	0.540	2.611	0.737	0.624
6.3111	0.544	2.660	0.831	0.624
6.4000	0.548	2.708	0.898	0.624
6.4889	0.551	2.757	0.955	0.624
6.5778	0.555	2.806	1.005	0.624
6.6667	0.559	2.856	1.052	0.624
6.7556	0.563	2.906	1.096	0.624
6.8444	0.567	2.956	1.137	0.624
6.9333	0.571	3.007	1.177	0.624
7.0222	0.575	3.058	1.268	0.624
7.1111	0.578	3.109	1.839	0.624
7.2000	0.582	3.160	2.691	0.624

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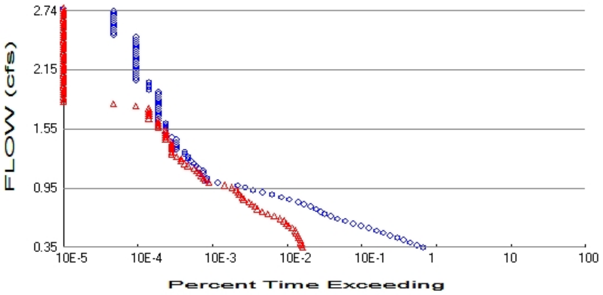
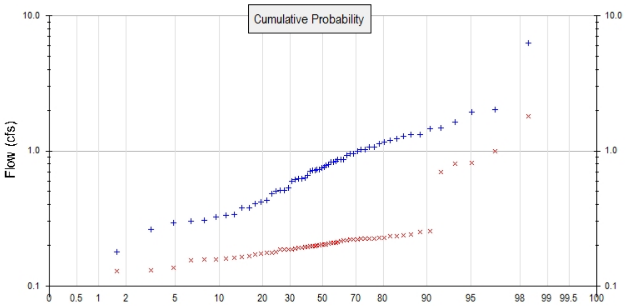
7.2889	0.586	3.212	3.695	0.624
7.3778	0.590	3.265	4.739	0.624
7.4667	0.594	3.317	5.711	0.624
7.5556	0.598	3.370	6.514	0.624
7.6444	0.602	3.424	7.096	0.624
7.7333	0.606	3.477	7.490	0.624
7.8222	0.610	3.532	7.931	0.624
7.9111	0.614	3.586	8.298	0.624
8.0000	0.618	3.641	8.648	0.624
8.0889	0.622	3.696	8.983	0.624

C8

Analysis Results

POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	9.041
Total Impervious Area:	0

Mitigated Landuse Totals for POC #1

Total Pervious Area:	1.8
Total Impervious Area:	9.012

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.701386
5 year	1.200549
10 year	1.609045
25 year	2.219021
50 year	2.74495
100 year	3.335049

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.206372
5 year	0.321476
10 year	0.421345
25 year	0.579795
50 year	0.72503
100 year	0.897072

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	1.323	0.228
1950	0.408	0.162
1951	0.947	0.241
1952	0.427	0.186
1953	0.592	0.186
1954	1.453	0.221
1955	1.203	0.224
1956	6.281	0.190
1957	1.023	0.223
1958	1.474	0.196

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1959	1.281	0.817
1960	0.721	0.222
1961	1.939	0.187
1962	0.507	0.210
1963	0.654	0.237
1964	0.530	0.167
1965	0.338	0.101
1966	1.631	0.174
1967	0.953	0.228
1968	0.989	0.203
1969	0.743	0.197
1970	0.782	0.224
1971	1.234	0.196
1972	1.072	0.202
1973	0.623	0.200
1974	0.865	0.254
1975	0.867	0.191
1976	1.060	0.196
1977	0.510	0.165
1978	0.859	0.207
1979	0.707	0.217
1980	0.502	0.189
1981	0.421	0.157
1982	0.331	0.155
1983	0.762	1.806
1984	0.293	0.136
1985	0.164	0.160
1986	0.719	0.212
1987	0.624	0.180
1988	0.483	0.219
1989	0.303	0.132
1990	0.305	0.194
1991	0.629	0.232
1992	0.790	0.233
1993	0.380	0.157
1994	0.931	0.694
1995	0.829	0.222
1996	1.024	0.225
1997	0.726	0.215
1998	0.835	0.201
1999	1.319	0.998
2000	0.378	0.187
2001	0.179	0.207
2002	2.030	0.204
2003	1.158	0.807
2004	0.324	0.171
2005	0.611	0.176
2006	1.124	0.206
2007	0.728	0.176
2008	0.826	0.252
2009	0.262	0.128

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	6.2809	1.8062
2	2.0301	0.9980
3	1.9388	0.8173

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4	1.6314	0.8067
5	1.4743	0.6945
6	1.4534	0.2540
7	1.3226	0.2524
8	1.3194	0.2406
9	1.2809	0.2369
10	1.2342	0.2335
11	1.2028	0.2321
12	1.1580	0.2278
13	1.1244	0.2277
14	1.0719	0.2246
15	1.0604	0.2244
16	1.0243	0.2238
17	1.0232	0.2234
18	0.9894	0.2224
19	0.9529	0.2222
20	0.9469	0.2214
21	0.9312	0.2191
22	0.8667	0.2171
23	0.8646	0.2149
24	0.8588	0.2116
25	0.8354	0.2101
26	0.8286	0.2073
27	0.8263	0.2073
28	0.7901	0.2055
29	0.7819	0.2037
30	0.7620	0.2032
31	0.7426	0.2022
32	0.7282	0.2008
33	0.7261	0.1996
34	0.7213	0.1970
35	0.7193	0.1962
36	0.7073	0.1961
37	0.6544	0.1957
38	0.6286	0.1943
39	0.6241	0.1907
40	0.6229	0.1904
41	0.6112	0.1890
42	0.5924	0.1872
43	0.5301	0.1869
44	0.5100	0.1863
45	0.5068	0.1861
46	0.5017	0.1796
47	0.4828	0.1763
48	0.4274	0.1759
49	0.4207	0.1741
50	0.4076	0.1715
51	0.3797	0.1668
52	0.3781	0.1646
53	0.3378	0.1615
54	0.3313	0.1602
55	0.3244	0.1574
56	0.3053	0.1567
57	0.3032	0.1549
58	0.2929	0.1357
59	0.2620	0.1316
60	0.1793	0.1281
61	0.1643	0.1005

C8

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3507	14211	343	2	Pass
0.3749	11633	333	2	Pass
0.3991	9482	326	3	Pass
0.4232	7783	319	4	Pass
0.4474	6355	307	4	Pass
0.4716	5095	299	5	Pass
0.4958	4173	286	6	Pass
0.5200	3341	275	8	Pass
0.5442	2656	249	9	Pass
0.5684	2077	222	10	Pass
0.5925	1635	206	12	Pass
0.6167	1268	193	15	Pass
0.6409	1013	172	16	Pass
0.6651	816	143	17	Pass
0.6893	675	117	17	Pass
0.7135	600	99	16	Pass
0.7376	519	85	16	Pass
0.7618	437	79	18	Pass
0.7860	357	71	19	Pass
0.8102	301	65	21	Pass
0.8344	228	56	24	Pass
0.8586	180	53	29	Pass
0.8828	134	49	36	Pass
0.9069	99	47	47	Pass
0.9311	74	44	59	Pass
0.9553	58	39	67	Pass
0.9795	47	31	65	Pass
1.0037	25	19	76	Pass
1.0279	18	17	94	Pass
1.0520	18	16	88	Pass
1.0762	16	15	93	Pass
1.1004	16	14	87	Pass
1.1246	16	13	81	Pass
1.1488	14	12	85	Pass
1.1730	13	10	76	Pass
1.1971	12	9	75	Pass
1.2213	11	8	72	Pass
1.2455	10	8	80	Pass
1.2697	10	7	70	Pass
1.2939	9	6	66	Pass
1.3181	9	6	66	Pass
1.3423	7	6	85	Pass
1.3664	7	6	85	Pass
1.3906	7	6	85	Pass
1.4148	7	6	85	Pass
1.4390	7	5	71	Pass
1.4632	6	5	83	Pass
1.4874	5	5	100	Pass
1.5115	5	5	100	Pass
1.5357	5	5	100	Pass
1.5599	5	4	80	Pass
1.5841	5	4	80	Pass
1.6083	5	4	80	Pass

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1.6325	4	4	100	Pass
1.6567	4	3	75	Pass
1.6808	4	3	75	Pass
1.7050	4	3	75	Pass
1.7292	4	3	75	Pass
1.7534	4	3	75	Pass
1.7776	4	2	50	Pass
1.8018	4	1	25	Pass
1.8259	4	0	0	Pass
1.8501	4	0	0	Pass
1.8743	4	0	0	Pass
1.8985	4	0	0	Pass
1.9227	4	0	0	Pass
1.9469	3	0	0	Pass
1.9710	3	0	0	Pass
1.9952	3	0	0	Pass
2.0194	3	0	0	Pass
2.0436	2	0	0	Pass
2.0678	2	0	0	Pass
2.0920	2	0	0	Pass
2.1162	2	0	0	Pass
2.1403	2	0	0	Pass
2.1645	2	0	0	Pass
2.1887	2	0	0	Pass
2.2129	2	0	0	Pass
2.2371	2	0	0	Pass
2.2613	2	0	0	Pass
2.2854	2	0	0	Pass
2.3096	2	0	0	Pass
2.3338	2	0	0	Pass
2.3580	2	0	0	Pass
2.3822	2	0	0	Pass
2.4064	2	0	0	Pass
2.4306	2	0	0	Pass
2.4547	2	0	0	Pass
2.4789	2	0	0	Pass
2.5031	1	0	0	Pass
2.5273	1	0	0	Pass
2.5515	1	0	0	Pass
2.5757	1	0	0	Pass
2.5998	1	0	0	Pass
2.6240	1	0	0	Pass
2.6482	1	0	0	Pass
2.6724	1	0	0	Pass
2.6966	1	0	0	Pass
2.7208	1	0	0	Pass
2.7450	1	0	0	Pass

C8

Disclaimer

Legal Notice

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

C8

WWHM2012

PROJECT REPORT

C9

General Model Information

Project Name:	South Bucklin Hill Rd
Site Name:	
Site Address:	
City:	
Report Date:	12/2/2016
Gage:	Quilcene
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.80
Version Date:	2016/03/03
Version:	4.2.12

POC Thresholds

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

C9

Landuse Basin Data

Predeveloped Land Use

Bucklin Hill Rd

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	1
C, Lawn, Flat	5.605
C, Lawn, Mod	1
Pervious Total	7.605
Impervious Land Use	acre
PARKING FLAT	5.95
Impervious Total	5.95
Basin Total	13.555

Element Flows To:

Surface	Interflow	Groundwater

C9

Mitigated Land Use

Future to Bucklin Hilll Rd

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Mod	1
C, Lawn, Flat	3.629
Pervious Total	4.629
Impervious Land Use	acre
PARKING FLAT	4.905
Impervious Total	4.905
Basin Total	9.534

Element Flows To:

Surface	Interflow	Groundwater

C9

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.572
Pervious Total	0.572
Impervious Land Use	acre
PARKING FLAT	1.569
Impervious Total	1.569
Basin Total	2.141

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

C9

Mitigated Routing

Trapezoidal Pond 1

Bottom Length: 100.00 ft.
Bottom Width: 35.00 ft.
Depth: 1.5 ft.
Volume at riser head: 0.0425 acre-feet.
Side slope 1: 3 To 1
Side slope 2: 3 To 1
Side slope 3: 3 To 1
Side slope 4: 3 To 1
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 48 in.
Orifice 1 Diameter: 2 in. Elevation:0 ft.
Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.080	0.000	0.000	0.000
0.0167	0.080	0.001	0.014	0.000
0.0333	0.081	0.002	0.019	0.000
0.0500	0.081	0.004	0.024	0.000
0.0667	0.081	0.005	0.028	0.000
0.0833	0.081	0.006	0.031	0.000
0.1000	0.082	0.008	0.034	0.000
0.1167	0.082	0.009	0.037	0.000
0.1333	0.082	0.010	0.039	0.000
0.1500	0.083	0.012	0.042	0.000
0.1667	0.083	0.013	0.044	0.000
0.1833	0.083	0.015	0.046	0.000
0.2000	0.084	0.016	0.048	0.000
0.2167	0.084	0.017	0.050	0.000
0.2333	0.084	0.019	0.052	0.000
0.2500	0.085	0.020	0.054	0.000
0.2667	0.085	0.022	0.056	0.000
0.2833	0.085	0.023	0.057	0.000
0.3000	0.086	0.024	0.059	0.000
0.3167	0.086	0.026	0.061	0.000
0.3333	0.086	0.027	0.062	0.000
0.3500	0.087	0.029	0.064	0.000
0.3667	0.087	0.030	0.065	0.000
0.3833	0.087	0.032	0.067	0.000
0.4000	0.087	0.033	0.068	0.000
0.4167	0.088	0.035	0.070	0.000
0.4333	0.088	0.036	0.071	0.000
0.4500	0.088	0.038	0.072	0.000
0.4667	0.089	0.039	0.074	0.000
0.4833	0.089	0.041	0.075	0.000
0.5000	0.089	0.042	0.076	0.000
0.5167	0.090	0.044	0.169	0.000
0.5333	0.090	0.045	0.337	0.000
0.5500	0.090	0.047	0.555	0.000
0.5667	0.091	0.048	0.812	0.000

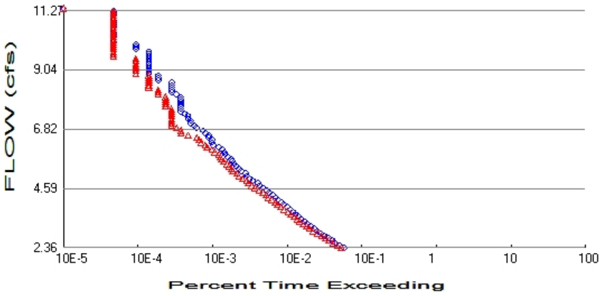
C9

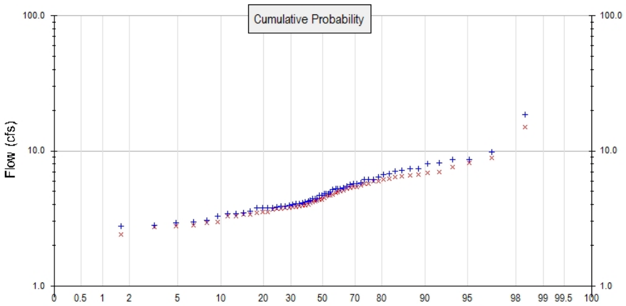
0.5833	0.091	0.050	1.103	0.000
0.6000	0.091	0.051	1.426	0.000
0.6167	0.092	0.053	1.775	0.000
0.6333	0.092	0.054	2.151	0.000
0.6500	0.092	0.056	2.551	0.000
0.6667	0.093	0.057	2.974	0.000
0.6833	0.093	0.059	3.417	0.000
0.7000	0.093	0.060	3.882	0.000
0.7167	0.094	0.062	4.366	0.000
0.7333	0.094	0.064	4.868	0.000
0.7500	0.094	0.065	5.389	0.000
0.7667	0.095	0.067	5.926	0.000
0.7833	0.095	0.068	6.480	0.000
0.8000	0.095	0.070	7.050	0.000
0.8167	0.096	0.072	7.636	0.000
0.8333	0.096	0.073	8.236	0.000
0.8500	0.096	0.075	8.851	0.000
0.8667	0.097	0.076	9.479	0.000
0.8833	0.097	0.078	10.12	0.000
0.9000	0.097	0.080	10.77	0.000
0.9167	0.098	0.081	11.44	0.000
0.9333	0.098	0.083	12.12	0.000
0.9500	0.098	0.085	12.81	0.000
0.9667	0.099	0.086	13.51	0.000
0.9833	0.099	0.088	14.22	0.000
1.0000	0.099	0.089	14.94	0.000
1.0167	0.100	0.091	15.67	0.000
1.0333	0.100	0.093	16.42	0.000
1.0500	0.100	0.094	17.16	0.000
1.0667	0.101	0.096	17.92	0.000
1.0833	0.101	0.098	18.69	0.000
1.1000	0.101	0.100	19.46	0.000
1.1167	0.102	0.101	20.24	0.000
1.1333	0.102	0.103	21.03	0.000
1.1500	0.102	0.105	21.82	0.000
1.1667	0.103	0.106	22.62	0.000
1.1833	0.103	0.108	23.43	0.000
1.2000	0.103	0.110	24.24	0.000
1.2167	0.104	0.112	25.05	0.000
1.2333	0.104	0.113	25.87	0.000
1.2500	0.104	0.115	26.69	0.000
1.2667	0.105	0.117	27.51	0.000
1.2833	0.105	0.119	28.34	0.000
1.3000	0.105	0.120	29.16	0.000
1.3167	0.106	0.122	29.99	0.000
1.3333	0.106	0.124	30.83	0.000
1.3500	0.107	0.126	31.66	0.000
1.3667	0.107	0.127	32.49	0.000
1.3833	0.107	0.129	33.32	0.000
1.4000	0.108	0.131	34.15	0.000
1.4167	0.108	0.133	34.98	0.000
1.4333	0.108	0.135	35.81	0.000
1.4500	0.109	0.136	36.63	0.000
1.4667	0.109	0.138	37.45	0.000
1.4833	0.109	0.140	38.27	0.000
1.5000	0.110	0.142	39.09	0.000
1.5167	0.110	0.144	39.90	0.000

C9

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1

Total Pervious Area:	7.605
Total Impervious Area:	5.95

Mitigated Landuse Totals for POC #1

Total Pervious Area:	5.201
Total Impervious Area:	6.474

Flow Frequency Method:	Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	4.723465
5 year	6.5298
10 year	7.872811
25 year	9.744794
50 year	11.271617
100 year	12.916305

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	4.452301
5 year	6.033271
10 year	7.167021
25 year	8.701491
50 year	9.920509
100 year	11.206148

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	8.590	8.093
1950	3.884	3.767
1951	6.414	6.117
1952	4.655	4.514
1953	3.970	3.857
1954	7.147	6.513
1955	8.063	7.583
1956	18.663	15.061
1957	6.166	5.738
1958	7.421	5.690

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1959	5.717	5.218
1960	3.291	2.995
1961	8.177	6.382
1962	3.445	3.381
1963	4.933	4.699
1964	3.856	3.746
1965	2.216	2.011
1966	8.573	6.829
1967	5.225	5.049
1968	5.260	4.876
1969	4.092	3.275
1970	5.715	5.434
1971	5.799	5.552
1972	5.294	4.966
1973	3.463	3.278
1974	4.799	4.599
1975	4.245	4.171
1976	5.473	5.113
1977	3.048	2.794
1978	4.208	3.864
1979	4.104	3.915
1980	3.556	3.456
1981	3.780	3.707
1982	4.397	4.353
1983	6.130	5.994
1984	2.808	2.735
1985	3.873	3.938
1986	3.803	3.545
1987	4.828	4.655
1988	3.780	3.550
1989	2.939	2.937
1990	2.777	2.762
1991	4.416	4.356
1992	4.022	3.952
1993	3.422	3.393
1994	5.601	5.301
1995	3.805	3.685
1996	4.849	4.012
1997	4.274	4.116
1998	4.067	3.806
1999	6.667	6.260
2000	4.419	4.317
2001	5.207	5.396
2002	9.777	8.907
2003	7.371	6.944
2004	4.681	4.233
2005	6.142	5.990
2006	7.030	6.610
2007	6.777	6.671
2008	5.214	4.720
2009	2.956	2.401

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	18.6628	15.0612
2	9.7768	8.9073
3	8.5896	8.0925

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4	8.5733	7.5832
5	8.1768	6.9436
6	8.0625	6.8288
7	7.4209	6.6714
8	7.3711	6.6098
9	7.1466	6.5129
10	7.0302	6.3823
11	6.7772	6.2604
12	6.6672	6.1167
13	6.4137	5.9937
14	6.1656	5.9895
15	6.1422	5.7380
16	6.1303	5.6898
17	5.7992	5.5523
18	5.7165	5.4340
19	5.7147	5.3964
20	5.6006	5.3013
21	5.4730	5.2183
22	5.2937	5.1129
23	5.2600	5.0488
24	5.2253	4.9661
25	5.2144	4.8762
26	5.2067	4.7201
27	4.9332	4.6987
28	4.8491	4.6547
29	4.8277	4.5989
30	4.7991	4.5137
31	4.6805	4.3557
32	4.6546	4.3526
33	4.4194	4.3165
34	4.4158	4.2331
35	4.3968	4.1713
36	4.2739	4.1162
37	4.2453	4.0123
38	4.2079	3.9524
39	4.1039	3.9376
40	4.0916	3.9149
41	4.0666	3.8638
42	4.0221	3.8571
43	3.9703	3.8059
44	3.8840	3.7672
45	3.8725	3.7463
46	3.8556	3.7070
47	3.8051	3.6852
48	3.8025	3.5496
49	3.7804	3.5446
50	3.7803	3.4560
51	3.5559	3.3934
52	3.4627	3.3811
53	3.4445	3.2779
54	3.4225	3.2745
55	3.2906	2.9948
56	3.0482	2.9370
57	2.9561	2.7945
58	2.9387	2.7623
59	2.8082	2.7351
60	2.7765	2.4011
61	2.2158	2.0112

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Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
2.3617	1227	1137	92	Pass
2.4517	1079	995	92	Pass
2.5417	946	880	93	Pass
2.6317	859	773	89	Pass
2.7217	760	689	90	Pass
2.8117	680	620	91	Pass
2.9017	606	549	90	Pass
2.9917	535	475	88	Pass
3.0817	483	423	87	Pass
3.1717	444	389	87	Pass
3.2617	396	351	88	Pass
3.3517	362	311	85	Pass
3.4417	329	287	87	Pass
3.5317	303	264	87	Pass
3.6217	274	237	86	Pass
3.7117	257	219	85	Pass
3.8017	237	193	81	Pass
3.8917	212	174	82	Pass
3.9817	193	157	81	Pass
4.0717	181	147	81	Pass
4.1617	163	133	81	Pass
4.2517	149	118	79	Pass
4.3417	135	111	82	Pass
4.4317	123	101	82	Pass
4.5217	114	89	78	Pass
4.6117	101	79	78	Pass
4.7017	91	72	79	Pass
4.7917	86	64	74	Pass
4.8817	74	61	82	Pass
4.9717	67	54	80	Pass
5.0617	62	48	77	Pass
5.1517	59	45	76	Pass
5.2417	52	40	76	Pass
5.3317	48	38	79	Pass
5.4217	44	36	81	Pass
5.5117	42	33	78	Pass
5.6017	39	30	76	Pass
5.6917	38	28	73	Pass
5.7817	34	27	79	Pass
5.8717	32	26	81	Pass
5.9617	31	23	74	Pass
6.0517	29	21	72	Pass
6.1417	26	18	69	Pass
6.2317	22	17	77	Pass
6.3217	21	15	71	Pass
6.4117	21	14	66	Pass
6.5017	19	13	68	Pass
6.5917	19	10	52	Pass
6.6817	17	8	47	Pass
6.7717	16	8	50	Pass
6.8617	13	7	53	Pass
6.9517	12	6	50	Pass
7.0417	11	6	54	Pass

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7.1317	11	6	54	Pass
7.2217	10	6	60	Pass
7.3117	10	6	60	Pass
7.4017	9	6	66	Pass
7.4917	8	6	75	Pass
7.5817	8	6	75	Pass
7.6717	8	5	62	Pass
7.7617	8	5	62	Pass
7.8517	8	5	62	Pass
7.9417	8	5	62	Pass
8.0317	8	5	62	Pass
8.1217	7	4	57	Pass
8.2117	6	4	66	Pass
8.3017	6	4	66	Pass
8.3917	6	3	50	Pass
8.4817	6	3	50	Pass
8.5717	6	3	50	Pass
8.6617	4	3	75	Pass
8.7516	4	3	75	Pass
8.8416	4	3	75	Pass
8.9316	3	2	66	Pass
9.0216	3	2	66	Pass
9.1116	3	2	66	Pass
9.2016	3	2	66	Pass
9.2916	3	2	66	Pass
9.3816	3	2	66	Pass
9.4716	3	2	66	Pass
9.5616	3	1	33	Pass
9.6516	3	1	33	Pass
9.7416	3	1	33	Pass
9.8316	2	1	50	Pass
9.9216	2	1	50	Pass
10.0116	2	1	50	Pass
10.1016	1	1	100	Pass
10.1916	1	1	100	Pass
10.2816	1	1	100	Pass
10.3716	1	1	100	Pass
10.4616	1	1	100	Pass
10.5516	1	1	100	Pass
10.6416	1	1	100	Pass
10.7316	1	1	100	Pass
10.8216	1	1	100	Pass
10.9116	1	1	100	Pass
11.0016	1	1	100	Pass
11.0916	1	1	100	Pass
11.1816	1	1	100	Pass
11.2716	1	1	100	Pass

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Disclaimer

Legal Notice

Clear Creek Solutions, Inc.
6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

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WWHM2012

PROJECT REPORT

BIORETENTION CALCULATIONS

C10

General Model Information

Project Name:	ADDED TENNIS PARKING
Site Name:	
Site Address:	
City:	
Report Date:	11/23/2016
Gage:	Quilcene
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	0.80
Version Date:	2016/03/03
Version:	4.2.12

POC Thresholds

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

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BIORETENTION #1

Mitigated Land Use

EVENT PARKING

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.141
Pervious Total	0.141
Impervious Land Use	acre
PARKING FLAT	0.492
Impervious Total	0.492
Basin Total	0.633

Element Flows To:

Surface	Interflow	Groundwater
Surface MIDDLE RG	Surface MIDDLE RG	

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Mitigated Routing

BIORETENTION #1

MIDDLE RG

Bottom Length: 30.00 ft.
Bottom Width: 30.50 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW
Material thickness of second layer: 0.83
Material type for second layer: GRAVEL
Material thickness of third layer: 0
Material type for third layer: GRAVEL
Underdrain used
Underdrain Diameter (feet): 0.5
Orifice Diameter (in.): 6
Offset (in.): 0.17
Flow Through Underdrain (ac-ft.): 116.851
Total Outflow (ac-ft.): 126.673
Percent Through Underdrain: 92.25
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.0449	0.0000	0.0000	0.0000
0.0366	0.0446	0.0002	0.0000	0.0000
0.0732	0.0442	0.0003	0.0000	0.0000
0.1098	0.0437	0.0005	0.0000	0.0000
0.1464	0.0433	0.0006	0.0000	0.0000
0.1830	0.0428	0.0008	0.0001	0.0000
0.2196	0.0424	0.0010	0.0001	0.0000
0.2562	0.0420	0.0011	0.0002	0.0000
0.2927	0.0416	0.0013	0.0003	0.0000
0.3293	0.0411	0.0016	0.0004	0.0000
0.3659	0.0407	0.0020	0.0006	0.0000
0.4025	0.0403	0.0023	0.0007	0.0000
0.4391	0.0399	0.0027	0.0010	0.0000
0.4757	0.0394	0.0030	0.0012	0.0000
0.5123	0.0390	0.0034	0.0015	0.0000
0.5489	0.0386	0.0038	0.0018	0.0000
0.5855	0.0382	0.0042	0.0022	0.0000
0.6221	0.0378	0.0045	0.0026	0.0000
0.6587	0.0374	0.0049	0.0031	0.0000
0.6953	0.0370	0.0053	0.0036	0.0000
0.7319	0.0366	0.0057	0.0041	0.0000
0.7685	0.0362	0.0061	0.0047	0.0000
0.8051	0.0358	0.0065	0.0053	0.0000
0.8416	0.0354	0.0069	0.0060	0.0000
0.8782	0.0350	0.0073	0.0068	0.0000
0.9148	0.0346	0.0078	0.0075	0.0000
0.9514	0.0342	0.0082	0.0084	0.0000
0.9880	0.0338	0.0086	0.0093	0.0000
1.0246	0.0334	0.0091	0.0102	0.0000

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BIORETENTION #1

1.0612	0.0330	0.0095		
1.0978	0.0327	0.0099		
1.1344	0.0323	0.0104	0.0123	0.0000
1.1710	0.0319	0.0109	0.0134	0.0000
1.2076	0.0315	0.0113	0.0146	0.0000
1.2442	0.0311	0.0118	0.0159	0.0000
1.2808	0.0308	0.0123	0.0172	0.0000
1.3174	0.0304	0.0127	0.0185	0.0000
1.3540	0.0300	0.0132	0.0200	0.0000
1.3905	0.0297	0.0137	0.0215	0.0000
1.4271	0.0293	0.0142	0.0230	0.0000
1.4637	0.0290	0.0147	0.0244	0.0000
1.5003	0.0286	0.0153	0.0246	0.0000
1.5369	0.0282	0.0158	0.0263	0.0000
1.5735	0.0279	0.0163	0.0281	0.0000
1.6101	0.0275	0.0169	0.0299	0.0000
1.6467	0.0272	0.0175	0.0318	0.0000
1.6833	0.0269	0.0180	0.0318	0.0000
1.7199	0.0265	0.0186	0.0318	0.0000
1.7565	0.0262	0.0192	0.0318	0.0000
1.7931	0.0258	0.0198	0.0318	0.0000
1.8297	0.0255	0.0203	0.0318	0.0000
1.8663	0.0252	0.0209	0.0318	0.0000
1.9029	0.0248	0.0215	0.0318	0.0000
1.9395	0.0245	0.0221	0.0318	0.0000
1.9760	0.0242	0.0228	0.0318	0.0000
2.0126	0.0238	0.0234	0.0318	0.0000
2.0492	0.0235	0.0240	0.0318	0.0000
2.0858	0.0232	0.0246	0.0318	0.0000
2.1224	0.0229	0.0253	0.0318	0.0000
2.1590	0.0226	0.0259	0.0318	0.0000
2.1956	0.0222	0.0266	0.0318	0.0000
2.2322	0.0219	0.0272	0.0318	0.0000
2.2688	0.0216	0.0279	0.0318	0.0000
2.3054	0.0213	0.0286	0.0318	0.0000
2.3300	0.0210	0.0290	0.0318	0.0000

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
2.3300	0.0449	0.0290	0.0000	0.1302	0.0000
2.3666	0.0454	0.0307	0.0000	0.1302	0.0000
2.4032	0.0458	0.0324	0.0000	0.1333	0.0000
2.4398	0.0463	0.0341	0.0000	0.1364	0.0000
2.4764	0.0467	0.0358	0.0000	0.1395	0.0000
2.5130	0.0472	0.0375	0.0000	0.1426	0.0000
2.5496	0.0476	0.0392	0.0000	0.1457	0.0000
2.5862	0.0481	0.0410	0.0000	0.1488	0.0000
2.6227	0.0485	0.0427	0.0000	0.1519	0.0000
2.6593	0.0490	0.0445	0.0000	0.1550	0.0000
2.6959	0.0495	0.0463	0.0000	0.1581	0.0000
2.7325	0.0499	0.0481	0.0000	0.1612	0.0000
2.7691	0.0504	0.0500	0.0000	0.1643	0.0000
2.8057	0.0509	0.0518	0.0000	0.1674	0.0000
2.8423	0.0514	0.0537	0.0145	0.1705	0.0000
2.8789	0.0518	0.0556	0.1146	0.1736	0.0000
2.9155	0.0523	0.0575	0.2642	0.1767	0.0000
2.9521	0.0528	0.0594	0.4479	0.1798	0.0000
2.9887	0.0533	0.0614	0.6558	0.1829	0.0000

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BIORETENTION #1

3.0253	0.0538	0.0633	0.8784	[illegible]	[illegible]
3.0619	0.0543	0.0653	1.1060	[illegible]	[illegible]
3.0985	0.0548	0.0673	1.3287	[illegible]	[illegible]
3.1351	0.0553	0.0693	1.5373	0.1953	0.0000
3.1716	0.0557	0.0713	1.7234	0.1984	0.0000
3.2082	0.0562	0.0734	1.8811	0.2015	0.0000
3.2448	0.0567	0.0754	2.0076	0.2046	0.0000
3.2814	0.0572	0.0775	2.1048	0.2077	0.0000
3.3180	0.0578	0.0796	2.1808	0.2108	0.0000
3.3300	0.0579	0.0803	2.2813	0.2118	0.0000

C10

Mitigated Land Use

BIORETENTION #2

BUS DOFF, DRIVE & BB FIELD

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	3.806
Pervious Total	3.806
Impervious Land Use	acre
PARKING FLAT	1.317
Impervious Total	1.317
Basin Total	5.123

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

C10

Mitigated Routing

BIORETENTION #2

Bioretention 1

Bottom Length:	100.00 ft.
Bottom Width:	48.00 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW
Material thickness of second layer:	0.83
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	6
Offset (in.):	0.17
Flow Through Underdrain (ac-ft.):	743.812
Total Outflow (ac-ft.):	809.27
Percent Through Underdrain:	91.91

Discharge Structure

Riser Height: 0.5 ft.

Riser Diameter: 12 in.

Element Flows To:

Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.1622	0.0000	0.0000	0.0000
0.0366	0.1616	0.0008	0.0000	0.0000
0.0732	0.1607	0.0016	0.0000	0.0000
0.1098	0.1598	0.0032	0.0000	0.0000
0.1464	0.1589	0.0049	0.0000	0.0000
0.1830	0.1581	0.0065	0.0000	0.0000
0.2196	0.1572	0.0081	0.0000	0.0000
0.2562	0.1563	0.0098	0.0000	0.0000
0.2927	0.1554	0.0115	0.0000	0.0000
0.3293	0.1546	0.0132	0.0000	0.0000
0.3659	0.1537	0.0149	0.0000	0.0000
0.4025	0.1528	0.0166	0.0000	0.0000
0.4391	0.1520	0.0183	0.0000	0.0000
0.4757	0.1511	0.0200	0.0000	0.0000
0.5123	0.1503	0.0218	0.0000	0.0000
0.5489	0.1494	0.0235	0.0000	0.0000
0.5855	0.1485	0.0253	0.0000	0.0000
0.6221	0.1477	0.0271	0.0000	0.0000
0.6587	0.1468	0.0288	0.0000	0.0000
0.6953	0.1460	0.0306	0.0000	0.0000
0.7319	0.1452	0.0325	0.0000	0.0000
0.7685	0.1443	0.0343	0.0000	0.0000
0.8051	0.1435	0.0361	0.0000	0.0000
0.8416	0.1426	0.0379	0.0000	0.0000
0.8782	0.1418	0.0398	0.0000	0.0000
0.9148	0.1410	0.0417	0.0000	0.0000
0.9514	0.1401	0.0435	0.0000	0.0000
0.9880	0.1393	0.0454	0.0000	0.0000
1.0246	0.1385	0.0473	0.0000	0.0000

C10

BIORETENTION #2

1.0612	0.1377	0.0493		
1.0978	0.1368	0.0512		
1.1344	0.1360	0.0531	0.0000	0.0000
1.1710	0.1352	0.0551	0.0000	0.0000
1.2076	0.1344	0.0570	0.0000	0.0000
1.2442	0.1336	0.0590	0.0000	0.0000
1.2808	0.1328	0.0610	0.0000	0.0000
1.3174	0.1319	0.0630	0.0000	0.0000
1.3540	0.1311	0.0650	0.0000	0.0000
1.3905	0.1303	0.0670	0.0000	0.0000
1.4271	0.1295	0.0690	0.0000	0.0000
1.4637	0.1287	0.0711	0.0000	0.0000
1.5003	0.1279	0.0732	0.0000	0.0000
1.5369	0.1271	0.0754	0.0000	0.0000
1.5735	0.1263	0.0776	0.0000	0.0000
1.6101	0.1256	0.0798	0.0000	0.0000
1.6467	0.1248	0.0820	0.0000	0.0000
1.6833	0.1240	0.0842	0.0000	0.0000
1.7199	0.1232	0.0865	0.0000	0.0000
1.7565	0.1224	0.0887	0.0000	0.0000
1.7931	0.1216	0.0910	0.0000	0.0000
1.8297	0.1209	0.0932	0.0000	0.0000
1.8663	0.1201	0.0955	0.0000	0.0000
1.9029	0.1193	0.0978	0.0000	0.0000
1.9395	0.1185	0.1002	0.0000	0.0000
1.9760	0.1178	0.1025	0.0000	0.0000
2.0126	0.1170	0.1048	0.0000	0.0000
2.0492	0.1162	0.1072	0.0000	0.0000
2.0858	0.1155	0.1095	0.0000	0.0000
2.1224	0.1147	0.1119	0.0000	0.0000
2.1590	0.1140	0.1143	0.0000	0.0000
2.1956	0.1132	0.1167	0.0000	0.0000
2.2322	0.1124	0.1191	0.0000	0.0000
2.2688	0.1117	0.1216	0.0000	0.0000
2.3054	0.1109	0.1240	0.0000	0.0000
2.3300	0.1102	0.1257	0.0000	0.0000

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Infilt(cfs)
2.3300	0.1622	0.1257	0.0000	0.6829	0.0000
2.3666	0.1631	0.1316	0.0000	0.6829	0.0000
2.4032	0.1640	0.1376	0.0000	0.6992	0.0000
2.4398	0.1648	0.1436	0.0000	0.7155	0.0000
2.4764	0.1657	0.1497	0.0001	0.7317	0.0000
2.5130	0.1666	0.1558	0.0003	0.7480	0.0000
2.5496	0.1675	0.1619	0.0005	0.7642	0.0000
2.5862	0.1684	0.1680	0.0009	0.7805	0.0000
2.6227	0.1693	0.1742	0.0014	0.7968	0.0000
2.6593	0.1702	0.1804	0.0021	0.8130	0.0000
2.6959	0.1712	0.1867	0.0029	0.8293	0.0000
2.7325	0.1721	0.1929	0.0039	0.8456	0.0000
2.7691	0.1730	0.1993	0.0050	0.8618	0.0000
2.8057	0.1739	0.2056	0.0064	0.8781	0.0000
2.8423	0.1748	0.2120	0.0079	0.8944	0.0000
2.8789	0.1757	0.2184	0.0096	0.9106	0.0000
2.9155	0.1767	0.2248	0.0115	0.9269	0.0000
2.9521	0.1776	0.2313	0.0137	0.9432	0.0000
2.9887	0.1785	0.2378	0.0161	0.9594	0.0000

C10

BIORETENTION #2

3.0253	0.1794	0.2444	0.0187		
3.0619	0.1804	0.2510	0.0215		
3.0985	0.1813	0.2576	0.0246	1.0082	0.0000
3.1351	0.1822	0.2642	0.0280	1.0245	0.0000
3.1716	0.1832	0.2709	0.0316	1.0407	0.0000
3.2082	0.1841	0.2776	0.0354	1.0570	0.0000
3.2448	0.1850	0.2844	0.0396	1.0733	0.0000
3.2814	0.1860	0.2912	0.0440	1.0895	0.0000
3.3180	0.1869	0.2980	0.0487	1.1058	0.0000
3.3300	0.1872	0.3003	0.0537	1.1111	0.0000

C10

Mitigated Land Use

BIORETENTION #3 & #4

HS DROPOFF - FULL

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	0.3
Pervious Total	0.3
Impervious Land Use	acre
PARKING FLAT	0.6
PARKING MOD	0.027
Impervious Total	0.627
Basin Total	0.927

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

C10

Mitigated Routing

BIORETENTION #3 & #4

Bioretention 1

Bottom Length: 50.00 ft.
Bottom Width: 26.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW
Material thickness of second layer: 0.83
Material type for second layer: GRAVEL
Material thickness of third layer: 0
Material type for third layer: GRAVEL
Underdrain used
Underdrain Diameter (feet): 0.5
Orifice Diameter (in.): 6
Offset (in.): 0.17
Flow Through Underdrain (ac-ft.): 164.738
Total Outflow (ac-ft.): 177.404
Percent Through Underdrain: 92.86
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 12 in.
Element Flows To:
Outlet 1 Outlet 2

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.0587	0.0000	0.0000	0.0000
0.0366	0.0584	0.0002	0.0000	0.0000
0.0732	0.0578	0.0007	0.0000	0.0000
0.1098	0.0573	0.0011	0.0000	0.0000
0.1464	0.0568	0.0016	0.0000	0.0000
0.1830	0.0563	0.0020	0.0001	0.0000
0.2196	0.0558	0.0025	0.0001	0.0000
0.2562	0.0553	0.0029	0.0003	0.0000
0.2927	0.0548	0.0034	0.0004	0.0000
0.3293	0.0543	0.0039	0.0006	0.0000
0.3659	0.0538	0.0044	0.0008	0.0000
0.4025	0.0533	0.0049	0.0011	0.0000
0.4391	0.0528	0.0054	0.0014	0.0000
0.4757	0.0523	0.0059	0.0017	0.0000
0.5123	0.0518	0.0064	0.0021	0.0000
0.5489	0.0513	0.0069	0.0026	0.0000
0.5855	0.0508	0.0074	0.0031	0.0000
0.6221	0.0503	0.0079	0.0037	0.0000
0.6587	0.0498	0.0085	0.0044	0.0000
0.6953	0.0493	0.0090	0.0051	0.0000
0.7319	0.0488	0.0096	0.0058	0.0000
0.7685	0.0484	0.0101	0.0067	0.0000
0.8051	0.0479	0.0107	0.0076	0.0000
0.8416	0.0474	0.0112	0.0085	0.0000
0.8782	0.0469	0.0118	0.0096	0.0000
0.9148	0.0465	0.0124	0.0107	0.0000
0.9514	0.0460	0.0130	0.0119	0.0000
0.9880	0.0455	0.0136	0.0132	0.0000
1.0246	0.0451	0.0141	0.0145	0.0000

C10

BIORETENTION #3 & #4

1.0612	0.0446	0.0148		
1.0978	0.0441	0.0154		
1.1344	0.0437	0.0160		
1.1710	0.0432	0.0166	0.0191	0.0000
1.2076	0.0428	0.0172	0.0208	0.0000
1.2442	0.0423	0.0179	0.0225	0.0000
1.2808	0.0419	0.0185	0.0244	0.0000
1.3174	0.0414	0.0191	0.0263	0.0000
1.3540	0.0410	0.0198	0.0284	0.0000
1.3905	0.0406	0.0205	0.0305	0.0000
1.4271	0.0401	0.0211	0.0327	0.0000
1.4637	0.0397	0.0218	0.0347	0.0000
1.5003	0.0392	0.0225	0.0350	0.0000
1.5369	0.0388	0.0232	0.0374	0.0000
1.5735	0.0384	0.0240	0.0399	0.0000
1.6101	0.0379	0.0247	0.0425	0.0000
1.6467	0.0375	0.0255	0.0451	0.0000
1.6833	0.0371	0.0262	0.0451	0.0000
1.7199	0.0367	0.0270	0.0451	0.0000
1.7565	0.0363	0.0277	0.0451	0.0000
1.7931	0.0358	0.0285	0.0451	0.0000
1.8297	0.0354	0.0293	0.0451	0.0000
1.8663	0.0350	0.0301	0.0451	0.0000
1.9029	0.0346	0.0309	0.0451	0.0000
1.9395	0.0342	0.0317	0.0451	0.0000
1.9760	0.0338	0.0325	0.0451	0.0000
2.0126	0.0334	0.0333	0.0451	0.0000
2.0492	0.0330	0.0342	0.0451	0.0000
2.0858	0.0326	0.0350	0.0451	0.0000
2.1224	0.0322	0.0358	0.0451	0.0000
2.1590	0.0318	0.0367	0.0451	0.0000
2.1956	0.0314	0.0375	0.0451	0.0000
2.2322	0.0310	0.0384	0.0451	0.0000
2.2688	0.0306	0.0393	0.0451	0.0000
2.3054	0.0302	0.0402	0.0451	0.0000
2.3300	0.0298	0.0408	0.0451	0.0000

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
2.3300	0.0587	0.0408	0.0000	0.1850	0.0000
2.3666	0.0592	0.0429	0.0000	0.1850	0.0000
2.4032	0.0598	0.0451	0.0000	0.1894	0.0000
2.4398	0.0603	0.0473	0.0000	0.1938	0.0000
2.4764	0.0608	0.0495	0.0000	0.1982	0.0000
2.5130	0.0614	0.0517	0.0000	0.2026	0.0000
2.5496	0.0619	0.0540	0.0000	0.2070	0.0000
2.5862	0.0624	0.0563	0.0000	0.2114	0.0000
2.6227	0.0630	0.0586	0.0000	0.2158	0.0000
2.6593	0.0635	0.0609	0.0000	0.2202	0.0000
2.6959	0.0641	0.0632	0.0000	0.2246	0.0000
2.7325	0.0646	0.0656	0.0000	0.2290	0.0000
2.7691	0.0652	0.0680	0.0000	0.2334	0.0000
2.8057	0.0657	0.0703	0.0000	0.2378	0.0000
2.8423	0.0663	0.0728	0.0145	0.2422	0.0000
2.8789	0.0668	0.0752	0.1146	0.2466	0.0000
2.9155	0.0674	0.0777	0.2642	0.2510	0.0000
2.9521	0.0679	0.0801	0.4479	0.2554	0.0000
2.9887	0.0685	0.0826	0.6558	0.2598	0.0000

C10

BIORETENTION #3 & #4

3.0253	0.0691	0.0851	0.8784	[illegible]	[illegible]
3.0619	0.0696	0.0877	1.1060	[illegible]	[illegible]
3.0985	0.0702	0.0902	1.3287	[illegible]	[illegible]
3.1351	0.0708	0.0928	1.5373	0.2775	0.0000
3.1716	0.0714	0.0954	1.7234	0.2819	0.0000
3.2082	0.0719	0.0980	1.8811	0.2863	0.0000
3.2448	0.0725	0.1007	2.0076	0.2907	0.0000
3.2814	0.0731	0.1034	2.1048	0.2951	0.0000
3.3180	0.0737	0.1060	2.1808	0.2995	0.0000
3.3300	0.0739	0.1069	2.2813	0.3009	0.0000

C10

Mitigated Land Use

BIORETENTION #5

FAN PARKING AREA

Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Lawn, Flat	0.6
C, Lawn, Mod	0.6
Pervious Total	1.2

Impervious Land Use	acre
PARKING FLAT	2
PARKING MOD	0.3
Impervious Total	2.3

Basin Total	3.5

Element Flows To:

Surface	Interflow	Groundwater
Surface retention 1	Surface retention 1	

C10

Mitigated Routing

BIORETENTION #5

Bioretention 1

Bottom Length:	105.00 ft.
Bottom Width:	49.75 ft.
Material thickness of first layer:	1.5
Material type for first layer:	SMMWW
Material thickness of second layer:	0.83
Material type for second layer:	GRAVEL
Material thickness of third layer:	0
Material type for third layer:	GRAVEL
Underdrain used	
Underdrain Diameter (feet):	0.5
Orifice Diameter (in.):	6
Offset (in.):	0.17
Flow Through Underdrain (ac-ft.):	599.467
Total Outflow (ac-ft.):	658.376
Percent Through Underdrain:	91.05

Discharge Structure

Riser Height:	0.5 ft.
Riser Diameter:	12 in.

Element Flows To:

Outlet 1	Outlet 2

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.1199	0.0000	0.0000	0.0000
0.0366	0.1199	0.0017	0.0000	0.0000
0.0732	0.1199	0.0035	0.0000	0.0000
0.1098	0.1199	0.0052	0.0000	0.0000
0.1464	0.1199	0.0069	0.0001	0.0000
0.1830	0.1199	0.0087	0.0003	0.0000
0.2196	0.1199	0.0104	0.0006	0.0000
0.2562	0.1199	0.0121	0.0010	0.0000
0.2927	0.1199	0.0139	0.0016	0.0000
0.3293	0.1199	0.0156	0.0023	0.0000
0.3659	0.1199	0.0173	0.0032	0.0000
0.4025	0.1199	0.0191	0.0042	0.0000
0.4391	0.1199	0.0208	0.0055	0.0000
0.4757	0.1199	0.0225	0.0069	0.0000
0.5123	0.1199	0.0243	0.0086	0.0000
0.5489	0.1199	0.0260	0.0105	0.0000
0.5855	0.1199	0.0277	0.0126	0.0000
0.6221	0.1199	0.0295	0.0149	0.0000
0.6587	0.1199	0.0312	0.0175	0.0000
0.6953	0.1199	0.0329	0.0203	0.0000
0.7319	0.1199	0.0347	0.0234	0.0000
0.7685	0.1199	0.0364	0.0268	0.0000
0.8051	0.1199	0.0381	0.0304	0.0000
0.8416	0.1199	0.0399	0.0343	0.0000
0.8782	0.1199	0.0416	0.0386	0.0000
0.9148	0.1199	0.0433	0.0431	0.0000
0.9514	0.1199	0.0451	0.0479	0.0000
0.9880	0.1199	0.0468	0.0530	0.0000
1.0246	0.1199	0.0485	0.0584	0.0000

C10

BIORETENTION #5

1.0612	0.1199	0.0503	[illegible]	[illegible]
1.0978	0.1199	0.0520	[illegible]	[illegible]
1.1344	0.1199	0.0537	[illegible]	[illegible]
1.1710	0.1199	0.0555	0.0767	0.0000
1.2076	0.1199	0.0572	0.0834	0.0000
1.2442	0.1199	0.0589	0.0905	0.0000
1.2808	0.1199	0.0607	0.0980	0.0000
1.3174	0.1199	0.0624	0.1058	0.0000
1.3540	0.1199	0.0641	0.1140	0.0000
1.3905	0.1199	0.0659	0.1225	0.0000
1.4271	0.1199	0.0676	0.1314	0.0000
1.4637	0.1199	0.0693	0.1395	0.0000
1.5003	0.1199	0.0712	0.1407	0.0000
1.5369	0.1199	0.0730	0.1504	0.0000
1.5735	0.1199	0.0748	0.1604	0.0000
1.6101	0.1199	0.0766	0.1708	0.0000
1.6467	0.1199	0.0784	0.1814	0.0000
1.6833	0.1199	0.0803	0.1814	0.0000
1.7199	0.1199	0.0821	0.1814	0.0000
1.7565	0.1199	0.0839	0.1814	0.0000
1.7931	0.1199	0.0857	0.1814	0.0000
1.8297	0.1199	0.0875	0.1814	0.0000
1.8663	0.1199	0.0894	0.1814	0.0000
1.9029	0.1199	0.0912	0.1814	0.0000
1.9395	0.1199	0.0930	0.1814	0.0000
1.9760	0.1199	0.0948	0.1814	0.0000
2.0126	0.1199	0.0967	0.1814	0.0000
2.0492	0.1199	0.0985	0.1814	0.0000
2.0858	0.1199	0.1003	0.1814	0.0000
2.1224	0.1199	0.1021	0.1814	0.0000
2.1590	0.1199	0.1039	0.1814	0.0000
2.1956	0.1199	0.1058	0.1814	0.0000
2.2322	0.1199	0.1076	0.1814	0.0000
2.2688	0.1199	0.1094	0.1814	0.0000
2.3054	0.1199	0.1112	0.1814	0.0000
2.3300	0.1199	0.1124	0.1814	0.0000

Bioretention Hydraulic Table

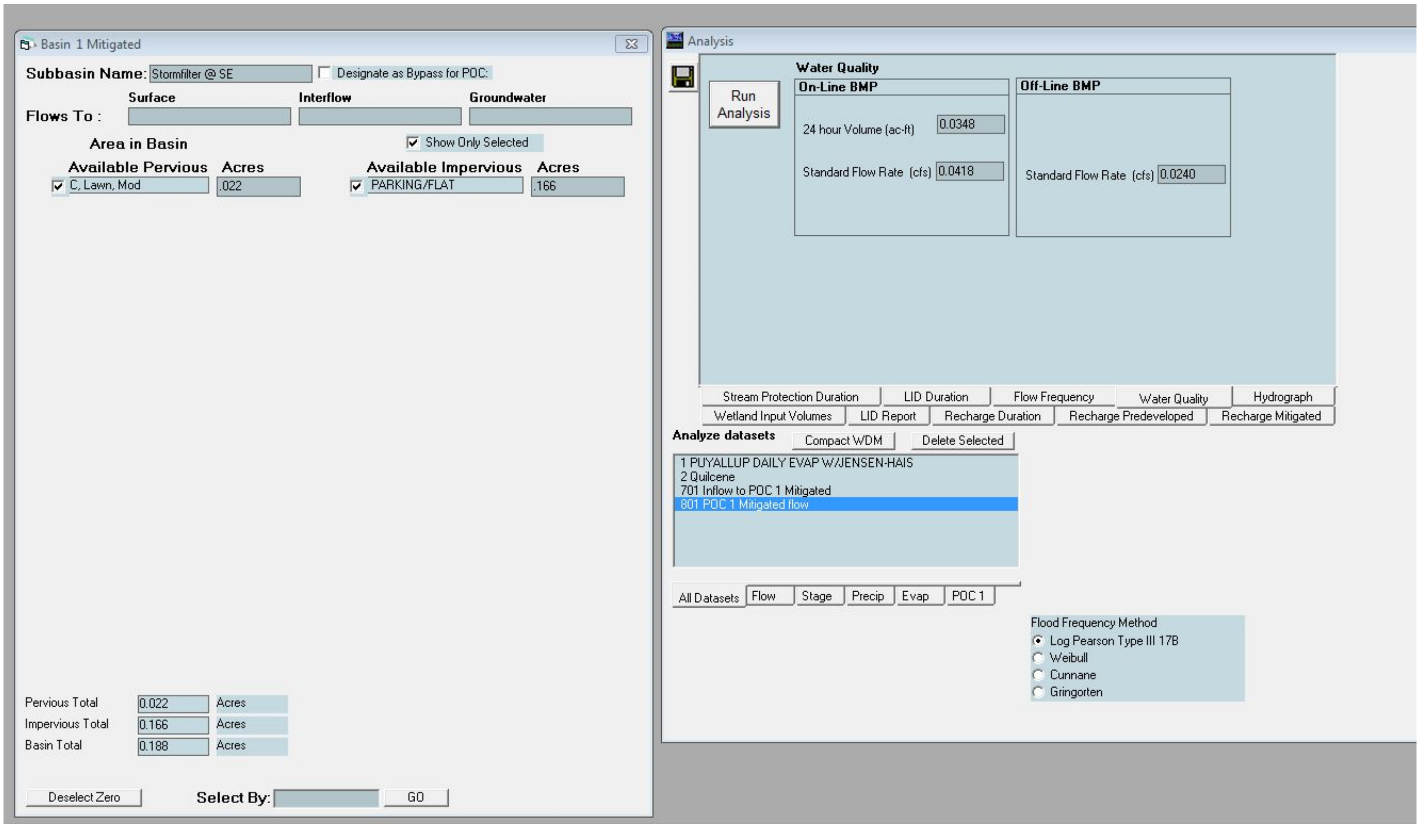
Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
2.3300	0.1199	0.1124	0.0000	0.7432	0.0000
2.3666	0.1199	0.1168	0.0000	0.7432	0.0000
2.4032	0.1199	0.1212	0.0000	0.7609	0.0000
2.4398	0.1199	0.1256	0.0000	0.7786	0.0000
2.4764	0.1199	0.1300	0.0000	0.7963	0.0000
2.5130	0.1199	0.1344	0.0000	0.8140	0.0000
2.5496	0.1199	0.1388	0.0000	0.8317	0.0000
2.5862	0.1199	0.1432	0.0000	0.8494	0.0000
2.6227	0.1199	0.1476	0.0000	0.8671	0.0000
2.6593	0.1199	0.1519	0.0000	0.8848	0.0000
2.6959	0.1199	0.1563	0.0000	0.9025	0.0000
2.7325	0.1199	0.1607	0.0000	0.9202	0.0000
2.7691	0.1199	0.1651	0.0000	0.9379	0.0000
2.8057	0.1199	0.1695	0.0000	0.9556	0.0000
2.8423	0.1199	0.1739	0.0145	0.9733	0.0000
2.8789	0.1199	0.1783	0.1146	0.9910	0.0000
2.9155	0.1199	0.1827	0.2642	1.0087	0.0000
2.9521	0.1199	0.1870	0.4479	1.0264	0.0000
2.9887	0.1199	0.1914	0.6558	1.0441	0.0000

C10

BIORETENTION #5

3.0253	0.1199	0.1958	0.8784	[illegible]	[illegible]
3.0619	0.1199	0.2002	1.1060	[illegible]	[illegible]
3.0985	0.1199	0.2046	1.3287	1.0972	0.0000
3.1351	0.1199	0.2090	1.5373	1.1149	0.0000
3.1716	0.1199	0.2134	1.7234	1.1326	0.0000
3.2082	0.1199	0.2178	1.8811	1.1503	0.0000
3.2448	0.1199	0.2222	2.0076	1.1680	0.0000
3.2814	0.1199	0.2265	2.1048	1.1857	0.0000
3.3180	0.1199	0.2309	2.1808	1.2034	0.0000
3.3300	0.1199	0.2324	2.2813	1.2092	0.0000

C10



Basin 1 Mitigated

Subbasin Name: Stormfilter @ SE
☐ Designate as Bypass for POC:

Flows To : Surface: / Interflow: / Groundwater:

Area in Basin
☑ Show Only Selected

Available Pervious	Acres	Available Impervious	Acres
☑ C, Lawn, Mod	.022	☑ PARKING/FLAT	.166

Pervious Total	0.022	Acres
Impervious Total	0.166	Acres
Basin Total	0.188	Acres

Analysis

Water Quality

On-Line BMP
24 hour Volume (ac-ft) 0.0348
Standard Flow Rate (cfs) 0.0418

Off-Line BMP
Standard Flow Rate (cfs) 0.0240

Analyze datasets
1 PUYALLUP DAILY EVAP W/JENSEN-HAIS
2 Quilcene
701 Inflow to POC 1 Mitigated
801 POC 1 Mitigated flow

Flood Frequency Method
● Log Pearson Type III 17B
○ Weibull
○ Cunnane
○ Gringorten

CENTRAL KITSAP HIGH SCHOOL AND MIDDLE SCHOOL

STORMFILTER CALCULATIONS

Project CKHSMS
Subject WETPOOL SETTLING BASIN
With/To
Address
Date 11/29/2016

Project No. 2160254.10
Phone
Fax #
Faxed Pages
By M. HAGER

☐ Page 1 of 1
☐ Calculations
☐ Fax
☐ Memorandum
☐ Meeting Minutes
☐ Telephone Memo

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

Neighbors

$$V_{OL,RUNOFF} = (0.9\,A_{imp} + 0.25\,A_{TG} + 0.10\,A_{TF} + 0.01\,A_{OUT}) \times R = V_R$$

$$R_{AW} = 0.52\,in = 0.043\,ft$$

$$V_{OL,BASIN} = f V_R$$

$$f = 1.5$$

To ~~WEST~~ NORTH POND

Wetpond A

$A_{imp} = 115{,}528$ SF
$A_{tg} = 260{,}460$ SF

$\therefore$ $V_R = 7{,}270$ CF

$\boxed{V_B = 10{,}905 \text{ CF}}$

To South Pond

Wetpond B

$A_{imp} = 121{,}807$ SF
$A_{tg} = 19{,}600$ SF
$A_{TF} = 27{,}200$ SF

$\therefore$ $V_R = 5{,}041$ CF

$\boxed{V_B = 7{,}565 \text{ CF}}$

To South Pond #2 (Bucklin Hill)

Wetpond C

$A_{imp} = 76{,}750$
$A_{tg} = 34{,}700$

$\therefore$ $V_R = 3{,}343$ CF

$\boxed{V_B = 5{,}015 \text{ CF}}$

C12

If this does not meet with your understanding, please contact us in writing within seven days. THANK YOU.

Appendix D

Construction Site Sediment Transport Potential Worksheet

Construction Site Sediment Transport Potential Worksheet

A. Existing slope of site (average, weighted by aerial extent): Points

2% or less	0
>2-5%	5
>5-10%	15
>10-15%	30
>15%	50

B. Site Area to be cleared and/or graded:

<5,000 sq. ft.	0
5,000 sq. ft. – 1 acre	30
>1 acres	50

C. Quantity of cut and/or fill on site:

<500 cubic yards	0
500 – 5,000 cubic yards	5
>5,000 – 10,000 cubic yards	10
>10,000 – 20,000 cubic yards	25
>20,000 cubic yards	40

D. Runoff potential of predominant soils(Natural Resources Conservation Service):

Hydrologic soil group A	0
Hydrologic soil group B	10
Hydrologic soil group C	20
Hydrologic soil group D	40

E. Erosion Potential of predominant soils (Unified Classification System):

GW, GP, SW, SP soils	0
Dual classifications (GW-GM, GP-GM, GW-GC, GP-GC, SW-SM, SW-SC, SP-SM, SP-SC)	10
GM, GC, SM, SC soils	20
ML, CL, MH, CH soils	40

F. Surface or Groundwater entering site identified and intercepted[1]:

Yes	0
No	25

G. Depth of cut or height of fill >10 feet:

[✓ Yes .... 25]

No 0

H. Clearing and grading will occur in the wet season (October 1 – May 1):

Yes 50

[✓ No ....0]

TOTAL POINTS.. 140

1 If no surface or groundwater enters site, give 0 points.