EDMONDS SCHOOL DISTRICT NO. 15

ENVIRONMENTAL CHECKLIST

Spruce Elementary School

April 2018
Revised June 2021

SHOCKEY
PLANNING GROUP, Inc.

Project

Edmonds School District No. 15
Spruce Elementary School

Applicant

Edmonds School District No. 15
Attn: ~~Matt Finch~~ Taine Wilton
20420 68th Avenue West
Lynnwood, Washington 98036

Environmental Consultant

SHOCKEY PLANNING GROUP
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Phone: (425) 258-9308

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ENVIRONMENTAL CHECKLIST

A. BACKGROUND

1. **Name of proposed project, if applicable:** Spruce Elementary School

2. **Name of applicant:** Edmonds School District No. 15

3. **Address and phone number of applicant and contact person:**

Applicant Contact: **Edmonds School District No. 15**
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4. **Date checklist prepared:** September 5, 2017, revised April 17, 2018 and issued April 24, 2018. An Addendum was issued on June 10, 2021.

5. **Agency requesting checklist:** The City of Lynnwood (City) is the agency with permitting jurisdiction. The Edmonds School District No. 15 is the Lead Agency for SEPA compliance in accordance with WAC 197-11-050.

6. **Proposed timing or schedule (including phasing, if applicable):**

Phase 1 construction would commence in summer of 2018 and be completed by fall of 2019. The exact timing of Phase 2 is anticipated to begin construction in July 2021 ~~be within the next 2 years and~~ tak~~i~~ng approximately 12 months to complete.

7. **Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.**

   Aside from the phasing identified, there are no plans for future additions, expansions or further activity with the exception of the possible placement of portable classrooms in the future if they are needed. A rezone and comprehensive plan amendment will be submitted to the City of Lynnwood for the two parcels that were added to the project.

8. **List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.**

   The following reports/information are incorporated by reference, and some are attached as appendices:

Traffic Impact Analysis (2017)	Gibson Traffic Consultants
Subsurface Exploration and Preliminary Geotechnical Engineering Report	Associate Earth Sciences, Inc.
Geotechnical Addendum – Additional Exploration	Associated Earth Sciences, Inc.
Geotechnical Report Addendum	Associated Earth Sciences, Inc.
Preliminary Stormwater Site Plan Report	AHBL
Stormwater Site Plan Report	AHBL
Regulated Building Material Assessment Report	Argus Pacific
Limited Underground Storage Tank Assessment	Argus Pacific
Regulated Building Materials Assessment Report (residential structures)	Argus Pacific
Spruce Elementary School Updated Traffic Analysis (2019)	Gibson Traffic Consultants
Initial Arborist Report (Residential Property 2019)	Layton Tree Consulting, LLC

9. **Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.**

   There are no applications pending for governmental approvals.

10. **List any government approvals or permits that will be needed for your proposal, if known.**

    The following permits/approvals have been identified for this proposal:

SEPA Threshold Determination	Edmonds School District No. 15
Design Review Board	City of Lynnwood
Grading Permit	City of Lynnwood
Building Permit	City of Lynnwood
Right-of-Way Permit	City of Lynnwood
Rezone Application	City of Lynnwood
Comprehensive Plan Amendment	City of Lynnwood
Boundary Line Elimination/Adjustment	City of Lynnwood
Air Quality Permit	Puget Sound Clean Air Agency (PSCAA)
Notice of Intent (NPDES)	Washington State Department of Ecology

    Other permits may be identified during the review and permitting process.

11. **Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.).**

The Edmonds School District proposes to replace Spruce Elementary School at its existing location in a phased process. The new facility would include a one story gymnasium and commons in Phase 1 and a Phase 2 addition and replacement of a two-story main classroom and library building. The students would be moved off-site during the Phase 2 construction period. The covered play structure would be removed during Phase 1 along with two residential structures ~~and~~ all other structures would be removed during Phase 2. A new playground and associated play equipment; site improvements to the existing grass play field; revised and expanded parking; improved circulation across new and existing sites including ~~and~~ access for buses, cars, and emergency vehicles; and improved neighborhood pedestrian connections and security and safety would be part of the completed Phase 2 work. Stormwater features such as rain gardens and bioretention cells would also be constructed. See ***Figure 1 – Site Plan***.

The new classroom and library addition ~~building~~ would be built on the north east portion of the site and the existing structures would be replaced with a parking lot at the completion of Phase 2. New parent vehicle access would enter the site at the newly acquired residential property located in the southwest corner of the property. A temporary parking lot would be provided as part of the Phase 1 work to meet the minimum parking requirements.

The total square footage of demolition would be approximately ~~44,820~~ 47,620 square feet (sf), which includes 41,620 sf of buildings, ~~and~~ 3,200 sf of covered play area and 2,800 sf of residential structures. The total square footage of construction would be approximately ~~80,100~~ 82,848 sf, which includes two floors of building areas, a covered play area, a mechanical mezzanine and roof overhangs. The new building footprint would be ~~49,220~~ 49,778 sf and includes the covered play sf.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

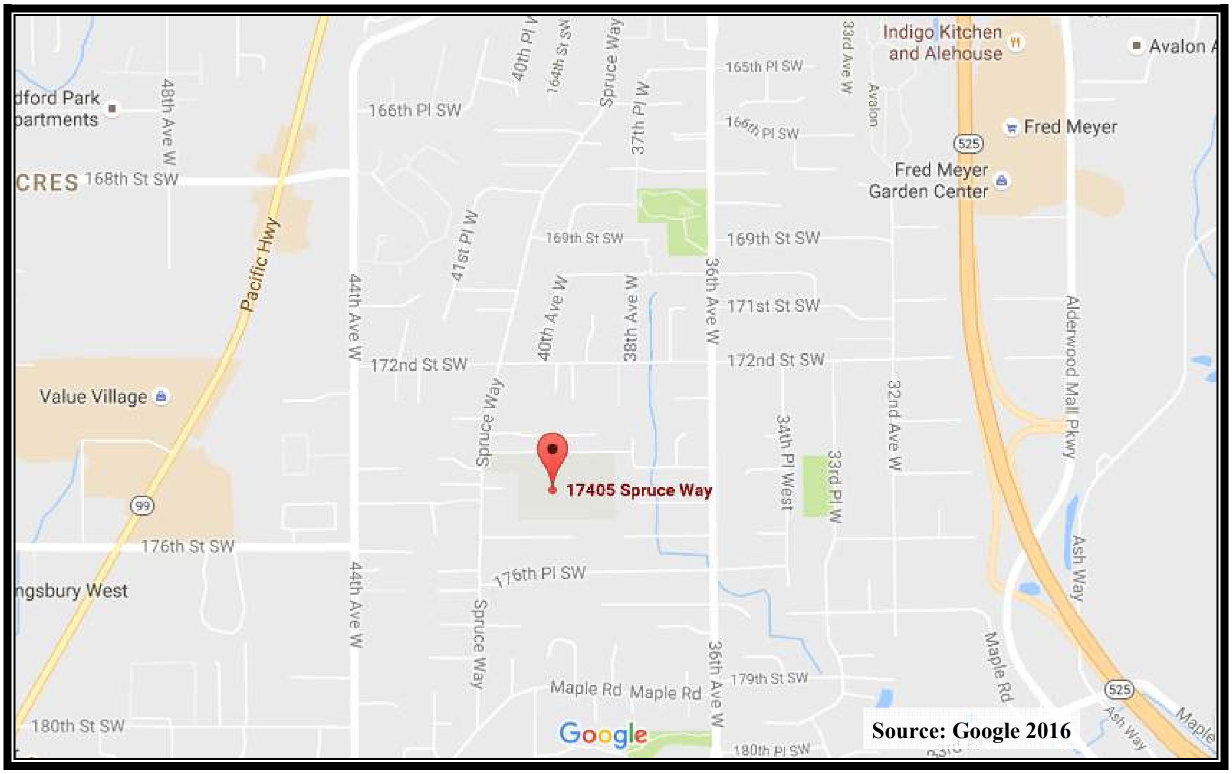
Spruce Elementary School is located at 17405 Spruce Way, Lynnwood, Washington. The Snohomish County Tax Parcel Number is: 00372700301502 and is located in the SW ¼ of Section 10, Township 27 North, Range 04 East, W.M. and totals 9.06 acres. The District has acquired additional property located at 17501 Spruce Way consisting of Snohomish County Tax Parcel Numbers 00372700301501 and 00372700301504 that will also be developed as part of Phase 2. This additional area adds 0.67 acres to the 9.06 acres for a total of 9.73 acres. See ***Figure 2 – Vicinity Map, Figure 3 – Parcel Map,*** and ***Appendix A – Legal Description***.

SPRUCE ELEMENTARY SCHOOL / 2019.05.22

0 30' 60' 120'

N

bassetti architects



Source: Google 2016

Figure 2 - Vicinity Map

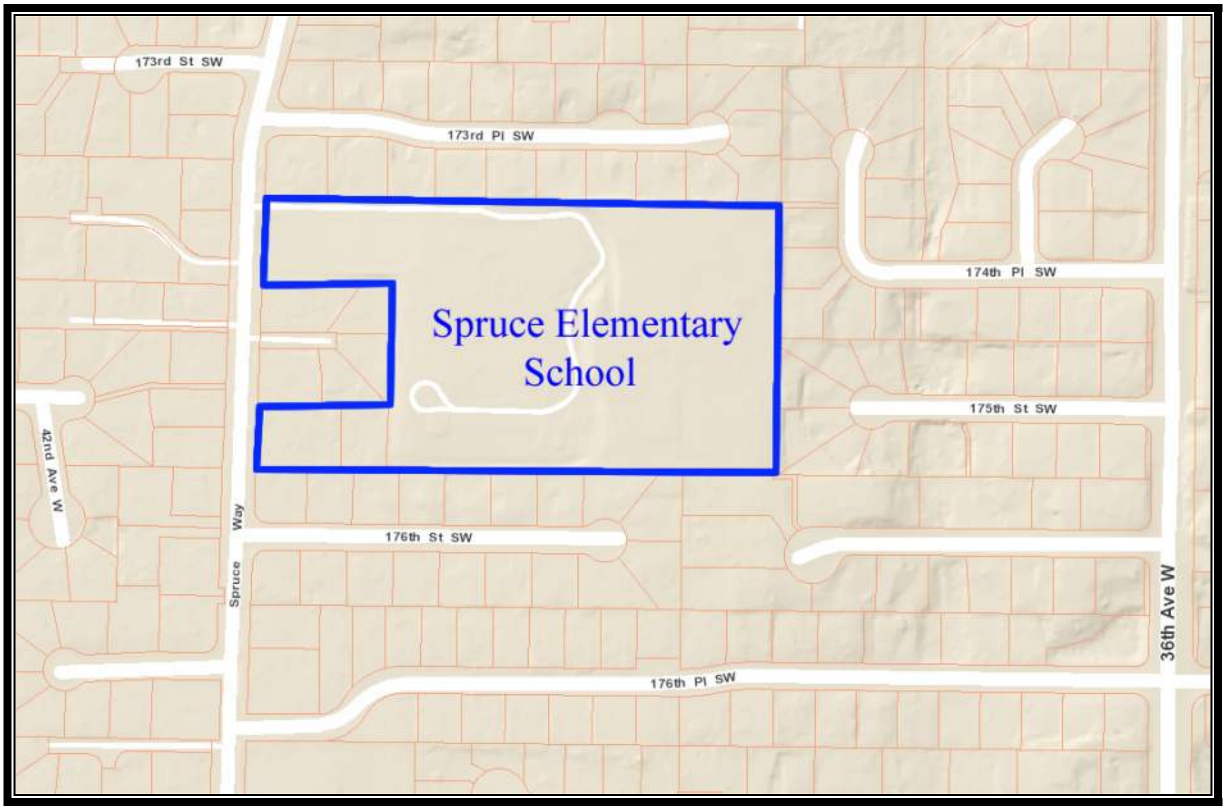


Figure 3 – Parcel Map

B. ENVIRONMENTAL ELEMENTS

1. EARTH

a. General description of the site (circle one): [✓ Flat], rolling, hilly, steep slopes, mountainous, other.

The site topography slopes gently down toward the west and south ~~east~~, but is generally flat.

b. What is the steepest slope on the site (approximate percent slope)?

There are portions on the edge of the site between the existing school building and the playfields to the east that are 40% slopes.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

According to ***Appendix C – Revised Subsurface Exploration, Geologic Hazards and Preliminary Geotechnical Engineering Report and Geotechnical Report Addendum,*** the site consists primarily of surficial topsoil and fill underlain by Vashon Lodgment Till. The United States Department of Agriculture, Natural Resources Conservation Service (USDA, NRCS) maps one soil on site: Alderwood-Urban land complex, 2 to 8 percent slopes. Alderwood-Urban land is not considered prime farmland by the USDA (***Data obtained from USDA, NRCS Web Soil Survey on 7/26/16 and 1/3/2020 http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx*****)**.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

There are no surface indications or history of unstable soils in the immediate vicinity.

e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.

Phase 1 includes approximately 4,500 CY of excavation and 4,500 CY of fill for site construction. Phase 2 is estimated to include an additional ~~13,000~~ 8,750 CY of cut and ~~16,000~~ 11,900 CY of fill. While the source of fill that would be imported for the proposal is unknown, it is anticipated that clean fill material would be sourced from a permitted quarry or materials site.

f. Could erosion occur as a result of clearing, construction, or use? If so, generally describe.

Erosion is possible as a result of clearing and construction, and according to the project geologist, the erosion potential is high. The contractor would be required to prevent erosion during construction per the Construction Stormwater General Permit issued by the Department of Ecology, and by utilizing Best Management Practices from the Department of Ecology Stormwater Management Manual for Western Washington, as required for use by the City of Lynnwood Municipal Code (LMC). Permanent surfacing, including hardscape and landscaping, would be provided to prevent erosion after construction. The District would provide source controls, like maintaining landscaping, to prevent erosion during use of the site.

g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?

Phase 1 would result in an impervious surface area of 60.2%, this would be reduced to ~~55.4~~ 55% after the completion of Phase 2.

h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any:

Temporary and permanent soil stabilization would occur through seeding/sodding, mulching, and plastic covering. Dust controls would include watering soils to prevent blowing of dust. Slopes would be protected through interceptor swales, check dams and pipe slope drains. Inlet protection would be provided.

To mitigate the erosion hazards and potential for off-site sediment transport, the project geotechnical engineer has recommended the following:

1. During the local wet season (October 1st through March 31st), exposed soil should not remain uncovered for more than 2 days unless it is actively being worked. Ground-cover measures include erosion control matting, plastic sheeting, straw mulch, crushed rock or recycled concrete or mature hydro seed.
2. Route surface water away from work areas.
3. Keep staging areas and travel areas clean and free of track-out.
4. Cover work areas and stockpiled soil when not in use.
5. Complete earthwork during dry weather and site conditions, if possible.

For additional information see ***Appendix C – Subsurface Exploration and Preliminary Geotechnical Engineering Report Preliminary Design Recommendations and Geotechnical Report Addendum.***

2. AIR

a. What types of emissions to the air would result from the proposal (i.e., dust, automobile, odors, industrial wood smoke) during construction, operation and maintenance when the project is completed? If any, generally describe and give approximate quantities if known.

Construction of the project would result in temporary, localized increases in pollutant emissions from construction activities and equipment. For example, dust from excavation and grading would contribute to ambient concentrations of suspended particulate matter. Construction contractor(s) would have to comply with the Puget Sound Clean Air Agency's (PSCAA) Regulation I, Section 9.15 requiring reasonable precautions to minimize dust emissions. Reasonable controls may include applying water or dust suppressants during dry weather, and vehicle washing and street cleaning to prevent dirt, mud and other debris deposits on paved roadways open to the public.

The PSCAA, in connection with the Washington State Department of Ecology (Ecology), conducts air quality monitoring at several sites around Puget Sound. According to PSCAA's 20~~15~~17 *Air Quality Data Summary* (the most recently available), fine particle levels in Puget Sound met the Environmental Protection Agency's health-based standard of 35 micrograms per cubic meter in 201~~5~~7. However, air quality within King, Kitsap, Pierce, and Snohomish Counties continued to exceed the EPA standard for particulate (PM) air quality of 25 micrograms per cubic meter. Ozone levels remain a concern in our region.

b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.

There are no off-site emissions or odors that would affect the proposal. Land uses in the vicinity are primarily residential. The predominate source of air pollution in the project area is traffic on nearby roads and the use of wood burning stoves and fireplaces. As a result, pollutants are mainly particulates (from wood stoves, fireplaces, outdoor burning, and roads) and ozone and carbon monoxide from vehicular traffic. Emissions from vehicles on nearby roads would not have an impact on the proposal.

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Under PSCAA's Regulation I, Section 9.15, contractor(s) working on construction projects are required to take all reasonable precautions to avoid or minimize fugitive dust emissions. These precautions and control measures may include street cleaning to prevent dirt, mud and other debris deposits on paved roadways open to the public. With such control measures in place, the potential from on-site air quality impacts is minimal. Construction related traffic would need to be coordinated with peak flow times, so as to alleviate congestion and reduce emissions.

3. WATER

a. Surface Water:

1) Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

There are no surface water bodies on the subject property. The City of Lynnwood maps a Fish and Wildlife Conservation Area (stream) east of the site (Tunnel Creek) (***Data obtained from City of Lynnwood website on 7/26/17 <u>and on 1/3/2020</u>***). There are also tributaries to Scriber Creek northwest of the site.

2) **Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.**

   The proposal would not require work within 200 feet of the streams mentioned above.

3) **Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.**

   No fill or dredge would occur.

4) **Will the proposal require surface water withdrawals or diversions? Give general description, purpose, and approximate quantities if known.**

   No surface water withdrawals or division would occur as a result of the proposed project.

5) **Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.**

   The site does not lie within a 100-year floodplain.

6) **Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.**

   No waste material would be discharged into the ground. The site would be served by a public sewer system.

b. Ground Water:

1) **Will groundwater be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give general description, purpose, and approximate quantities if known.**

   No groundwater withdrawals would occur.

2) **Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (for example: Domestic sewage; industrial, containing the following chemicals...; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be**

served (if applicable), or the number of animals or humans the system(s) are expected to serve.

No waste material would be discharged into the ground. The site would be served by a public sewer system.

c. Water Runoff (including stormwater):

1) Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.

The source of runoff would include roadway runoff from driveways and parking lots, and surface runoff from building roofs and hardscapes such as play fields and paved play areas.

Existing Conditions
The northwest portion of the site (Threshold Discharge Area (TDA) A) drains to the northwest via sheet flow and existing conveyance prior to discharging to an existing ditch located within Spruce Way. Stormwater from TDA A enters the public conveyance system and flows northwest towards Highway 99. The southwest portion of the site (TDA B) collects into a swale located along the southern edge of the site and discharges to a catch basin located at the southwest corner of the site, which flows west to Spruce Way, discharging to the existing ditch that flows to the south. Stormwater from TBA B enters the public conveyance system and flows southwest towards Highway 99. The third TDA (TDA C) sheet flows to the eastern and southern borders of the site. Stormwater from TDA C enters the public conveyance system which then discharges to Tunnel Creek.

Existing stormwater conveyance serves the existing elementary school and surrounding pedestrian areas. No conveyance is located to the east on the upper portion of the site, except for downspouts that serve the covered play area. All storm conveyance is collected in TDA A and discharges to a swale along Spruce Way. Currently, there are no water quality or flow control systems located onsite.

Developed Conditions – Phase 1
During Phase 1, the proposal is to demolish the existing play areas east of the elementary school and develop the upper field to the east. The existing fire lane, elementary school, and parking are to be retained. A new building, play areas, and temporary parking will be constructed east of the existing school. A fire lane would be constructed around the new portion of the building. The frontage along Spruce Way would be reconstructed to meet City of Lynnwood Standards. New utility infrastructure would be provided to serve the proposed improvements. Future portables have been identified and included in the stormwater calculations.

The existing stormwater infrastructure to the west (TDA A and B) would be retained. During Phase 1, stormwater improvements would be provided for the east (TDA C) only. Stormwater improvements for TDA A and B would be provided in Phase 2 when that portion of the site is developed. Improvements for storm in TDA C include onsite stormwater management, flow control, and water quality systems, and mitigation would be provided for new and replaced surface. Onsite stormwater management would include post-construction soil quality, Silva Cells (underground bioretention), and dispersion. Flow control would be in the southeast corner of the site. Water quality would be provided for the temporary parking to the north using a compost amended filter strip and for the service area with a Silva Cell underground bioretention cell.

Developed Condition – Phase 2

During Phase 2, the project proposes to demolish the existing Spruce Elementary School, portables to the south, temporary and permanent parking and the existing fire lane. Portions of the existing drive entrance to the west would be retained and expanded to serve the new school building. A new building addition ~~wing~~ would be constructed, connecting to the newly constructed Phase 1 building. New parking would be provided to the west, with parent vehicle loop ~~drop-off~~ and bus loop for drop-off and pick-up. A new play field would be constructed south of the new parking lot. The majority of Phase 1 elements constructed would be retained, excluding the temporary parking to the north. New utility infrastructure would be provided to serve the proposed Phase 2 improvements.

The existing stormwater flow control facility constructed in Phase 1 would be preserved to serve Phase 2, TDA C. The existing stormwater conveyance within TDA A would be demolished and upgraded. ~~New stormwater improvements would include onsite stormwater management, flow control, and water quality systems, and would provide mitigation for new and replaced surfaces. Onsite stormwater management would include post-construction soil quality, bioretention cells, and Silva Cell bioretention. Flow control for TDA A would be provided with below grade 6 foot diameter pipe.~~ An open stormwater pond combined with a stormwater wetland and underground detention pipe would be constructed to provide flow control and water quality treatment for TDA A. The constructed wetland comprises of an open pond, flow control structure, and an emergency overflow structure. The constructed wetland would encourage infiltration and evapotranspiration. A bioretention cell combined with underground detention pipe would be constructed to provide flow control and water quality treatment for TDA B. ~~Flow control for TDA B would be provided with a pond. Water quality would be provided for the pollution generating impervious surface (PGIS) in TDA A using a bioretention cell. Water quality would be provided for the PGIS in TDA B using Silva Cells (underground bioretention cells).~~

Construction runoff would be treated prior to discharge from the site per the Construction Stormwater General Permit issued by the Department of Ecology.

For additional information see ***Appendix C – Preliminary Stormwater Site Plan Report*** and ***Stormwater Site Plan Report.***

2) **Could waste materials enter ground or surface waters? If so, generally describe.**

No waste materials would enter ground or surface waters. Sanitary sewer is part of the existing and proposed infrastructure.

3) **Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe.**

No. The proposal would convey stormwater to match the existing drainage patterns of the site.

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

The proposal would use multiple stormwater treatment best management practices (BMPs) to mimic forested pre-developed conditions and treat for Enhanced Basic water quality standards.

Flow Control

In Phase 1, design flow control for TDA C would be provided. Due to site constraints, the flow control for TDA A and TDA B would be constructed during Phase 2. The post-developed condition has been modeled in MGSFlood to confirm the design from Phase 1 meets the Phase 2 developed conditions. The flow control riser would be replaced based on the updated modeling results in Phase 2. ~~In addition, because flow control volumes required in TDA C Phase 2 are slightly more than Phase 1, the proposal is to install the necessary volume for Phase 2 during Phase 1. The flow control restrictor would be adjusted in Phase 2, such that durations are met for both Phase 1 and Phase 2.~~ Flow control in TDA C for Phase 1 would be provided using a pond that is interconnected with a 6-foot diameter pipe.

Flow control for Phase 2 in TDA A would be implemented by constructing a pond system combined with a 6-foot diameter detention tank under the northwesterly parking area. The flow control restrictor tee within the control manhole has been sized to mitigate peak flows modeled in MGSFlood. ~~provided using a 6-foot diameter pipe that would be located under the parking lot located to the west. TDA B flow control would be provided using a pond located in the southeast corner of the site.~~ Flow control in TBA B would be implemented by a detention pond in the northwest corner of the site with a flow control structure.

Flow control for Phase 2 in TDA C would have been constructed during Phase 1 and consists of a pond and interconnected pipe. ~~Phase 2 would adjust the flow control restrictor such that durations are matched for both Phase 1 and Phase 2.~~

Water Quality Treatment

In Phase 1 of the project, pollution generating surfaces in TDA C include the temporary parking lot to the north and the service yard to the south. A compost amended filter strip would be provided for the temporary parking lot. A Silva Cell bioretention system would be provided for the service yard.

In Phase 2, pollution generating surfaces in TDA A include the school bus loop drop-off area, the north half of the parking lot and the fire lane to the east. The runoff generated by these areas would be treated by the wetland located downstream of the detention system, which would also provide treatment for the non-target and bypass pollution generating surfaces. The non-target areas are treated to help offset areas that bypass the system. ~~the north half of the parking lot and parent drop-off area in TDA A would require water quality treatment. TDA A would be treated through the use of bioretention cells that are located at the western entrance of the site and in the center island of the parent drop-off zone. If additional water quality features are required, additional Silva Cells would be provided.~~

In Phase 2, the south half of the parking area would require water quality treatment. TDA B would be treated through a bioretention system located near the south entrance. The playfield would be covered by natural grass and therefore water quality is not required. ~~the use of Silva Cells located throughout the parking lot.~~

TDA C in Phase 2 includes the removal of the temporary parking area and replacement with non-pollution generating surfaces. The remaining pollution generating surface in TDA C includes the service yard on the south side of the school. The Silva Cell constructed in Phase 1, for the service yard would remain. The design of this system has been confirmed during the modeling for Phase 2.

See ***Appendix C – Preliminary Stormwater Site Plan Report*** and ***Stormwater Site Plan Report*** for additional information.

The project is required to have a Construction Stormwater NPDES permit through the Washington State Department of Ecology. A Stormwater Pollution Prevention Plan (SWPPP) and Temporary Erosion Sedimentation Control (TESC) Plan would be developed to meet the required elements of the NPDES permit and the Ecology Stormwater Management Manual for Western Washington. To reduce impacts from runoff water during construction, measures taken by the Contractor to protect water quality and control flows may include but are not limited to:

- Marking the clearing limits with high visibility fencing and providing perimeter protection with silt fencing or similar BMPs;
- Preserving native vegetation to remain with protective fencing;
- Installing stabilized construction entrances at the entry/exit points to the site, and stabilized construction roads and parking;
- Constructing temporary sediment traps or ponds to control construction stormwater flow rates.

The permanent Stormwater Control plan would maintain the existing points of discharge and so would not impact drainage patterns.

4. PLANTS

a. Check the types of vegetation found on the site:

✓ deciduous tree: alder, maple, aspen, other: ___________
✓ evergreen tree: fir, cedar, pine, other: _____________
✓ shrubs
✓ grass
__ pasture
__ crop or grain
__ orchards, vineyards or other permanent crops
__ wet soil plants: cattail, buttercup, bulrush, skunk cabbage, other: _________
__ water plants: water lily, eelgrass, milfoil, other: __________
__ other types of vegetation

b. What kind and amount of vegetation will be removed or altered?

There are not many on-site trees, and many of them are around the site perimeter. A number of trees within the internal portion of the site, as well as the residential parcel, would be removed to accommodate the proposed buildings, see ***Figure 4 – Concept Planting Plans***. In addition, shrubs and grass would also be removed.

c. List threatened and endangered species known to be on or near the site, if any:

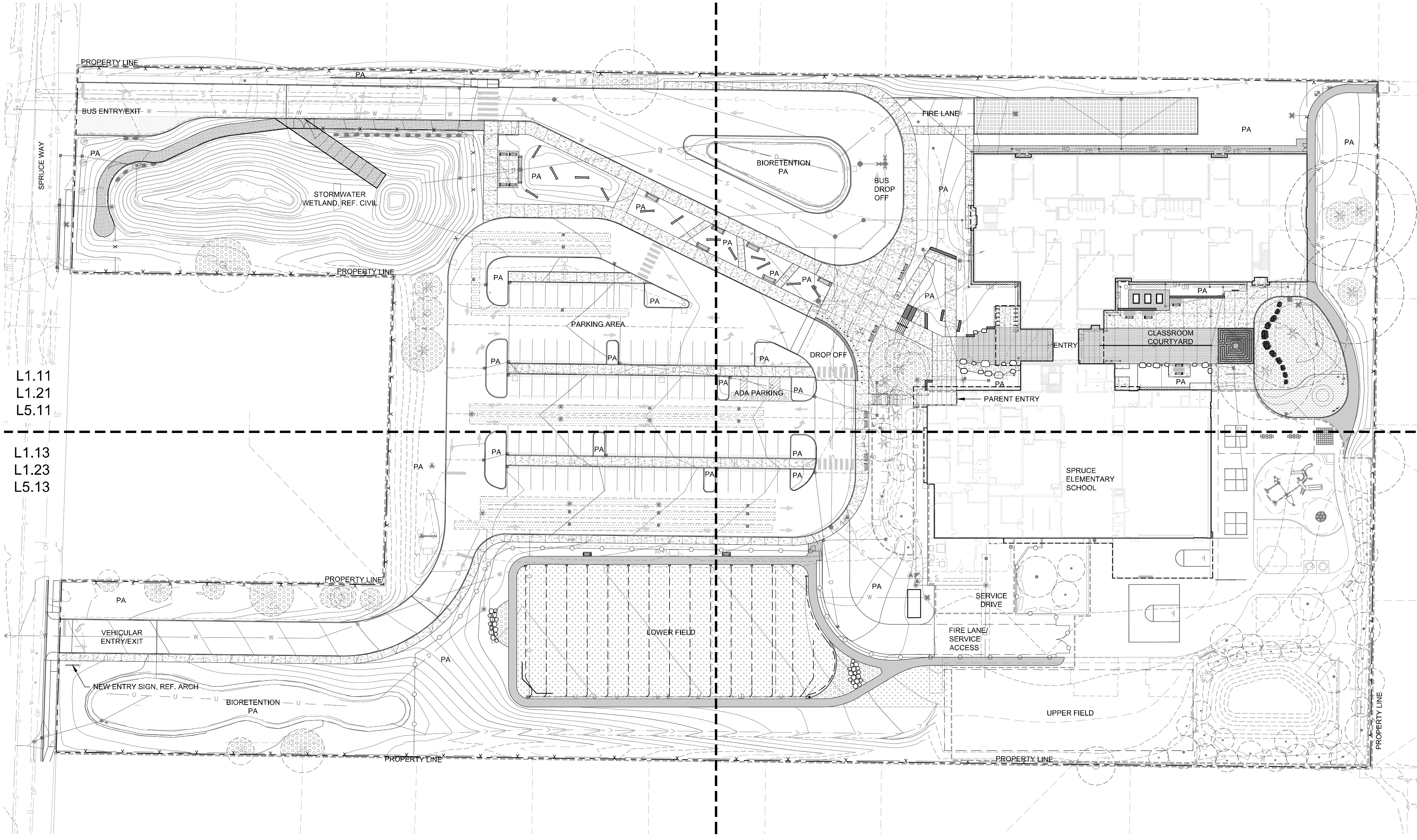
A query request was made on July 26, 2017 and again on January 3, 2020, to the Washington Department of Natural Resources (WDNR) Natural Heritage Program database, which was last updated ~~February 6, 2017~~ November 18. 2019, and there are no records or known occurrences of priority plant species on or immediately adjacent to the site.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any:

Proposed plantings for the final Phase 2 condition are shown on ***Figure 4 – Concept Planting Plans***. These include the installation of ~~40~~ 53 large deciduous trees, ~~90~~ 20 small to medium deciduous trees, ~~18~~ 15 multi-stem trees as well as ~~15~~ 14 medium to large coniferous trees. In addition, areas would be hydro seeded and shrubs and other understory would be installed. Areas include parking areas, around buildings and playfields. The proposal would be in compliance with the City of Lynnwood requirements, rain garden plantings for stormwater treatment; parking lot plantings which include new parking lot trees and low plantings as required by the City of Lynnwood; meadow areas around the perimeter of the site with new trees to supplement existing remaining trees; a formal green with ornamental flowering trees; and turf field areas for active recreation.

e. List all noxious weeds and invasive species known to be on or near the site.

Washington State Class C noxious weed Himalayan blackberry (*Rubus armeniacus*) is found on the site; however, this weed is not regulated by Snohomish County.



1 LANDSCAPE SITE PLAN

SCALE: 1" = 30'

0 15' 30' 60' 90'

ABBREVIATIONS

ADA	AMERICANS WITH DISABILITIES ACT	NIC	NOT IN CONTRACT
BR	BOTTOM OF RAMP	PA	PLANTING AREA
BW	BOTTOM OF WALL	REF	REFERENCE
CIP	CAST-IN-PLACE	ROW	RIGHT-OF-WAY
DBH	DIAMETER AT BREAST HEIGHT	QTY	QUANTITY
EX	EXISTING	SF	SQUARE FEET
EXIST	EXISTING	STL	STEEL
FOIC	FURNISHED BY OWNER, INSTALLED BY CONTRACTOR	TPZ	TREE PROTECTION ZONE
HT	HEIGHT	TR	TOP OF RAMP
LA	LANDSCAPE ARCHITECT	TW	TOP OF WALL
		TYP	TYPICAL
		UNO	UNLESS NOTED OTHERWISE

GENERAL NOTES

1. CONTRACTOR TO RESTORE AND REPLACE ALL FENCING IMPACTED BY CONSTRUCTION WITH NEW 6' HT. FENCING TO MATCH FINISH OF ADJACENT FENCING.
2. REFERENCE CIVIL DRAWINGS FOR GRADING PLANS.

LEGEND

— - — -	PROPERTY LINE
— — —	LIMIT OF WORK LINE
▬ ▬ ▬	SHEET MATCHLINE
○	EXISTING TREES TO REMAIN

LANDSCAPE SHEET LIST

Sheet Number	Sheet Title
L1.00	LANDSCAPE SITE PLAN
L1.11	LANDSCAPE MATERIALS PLAN - NW
L1.12	LANDSCAPE MATERIALS PLAN - NE
L1.13	LANDSCAPE MATERIALS PLAN - SW
L1.14	LANDSCAPE MATERIALS PLAN - SE
L1.21	LANDSCAPE LAYOUT PLAN - NW
L1.22	LANDSCAPE LAYOUT PLAN - NE
L1.23	LANDSCAPE LAYOUT PLAN - SW
L1.24	LANDSCAPE LAYOUT PLAN - SE
L1.30	ENLARGEMENT PLAN
L1.40	LAYOUT ENLARGEMENT PLAN
L3.10	WALL ELEVATIONS
L3.20	DETAILS
L3.21	DETAILS
L3.22	DETAILS
L3.23	DETAILS
L4.00	IRRIGATION SCHEDULE
L4.10	IRRIGATION PLAN
L4.20	IRRIGATION DETAILS
L5.00	PLANTING MAINTENANCE SCHEDULE
L5.01	PLANTING SCHEDULE
L5.11	PLANTING PLAN - NW
L5.12	PLANTING PLAN - NE
L5.13	PLANTING PLAN - SW
L5.14	PLANTING PLAN - SE
L5.20	PLANTING DETAILS
L5.21	PLANTING DETAILS
L5.30	SOIL AMENDMENT PLAN

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STATE OF WASHINGTON
VINITA SIDHU
NO 949 EXP. 05/27/2022
LANDSCAPE ARCHITECT

#	REVISIONS	DATE

EDMONDS SCHOOL DISTRICT

SPRUCE ELEMENTARY SCHOOL PHASE 2

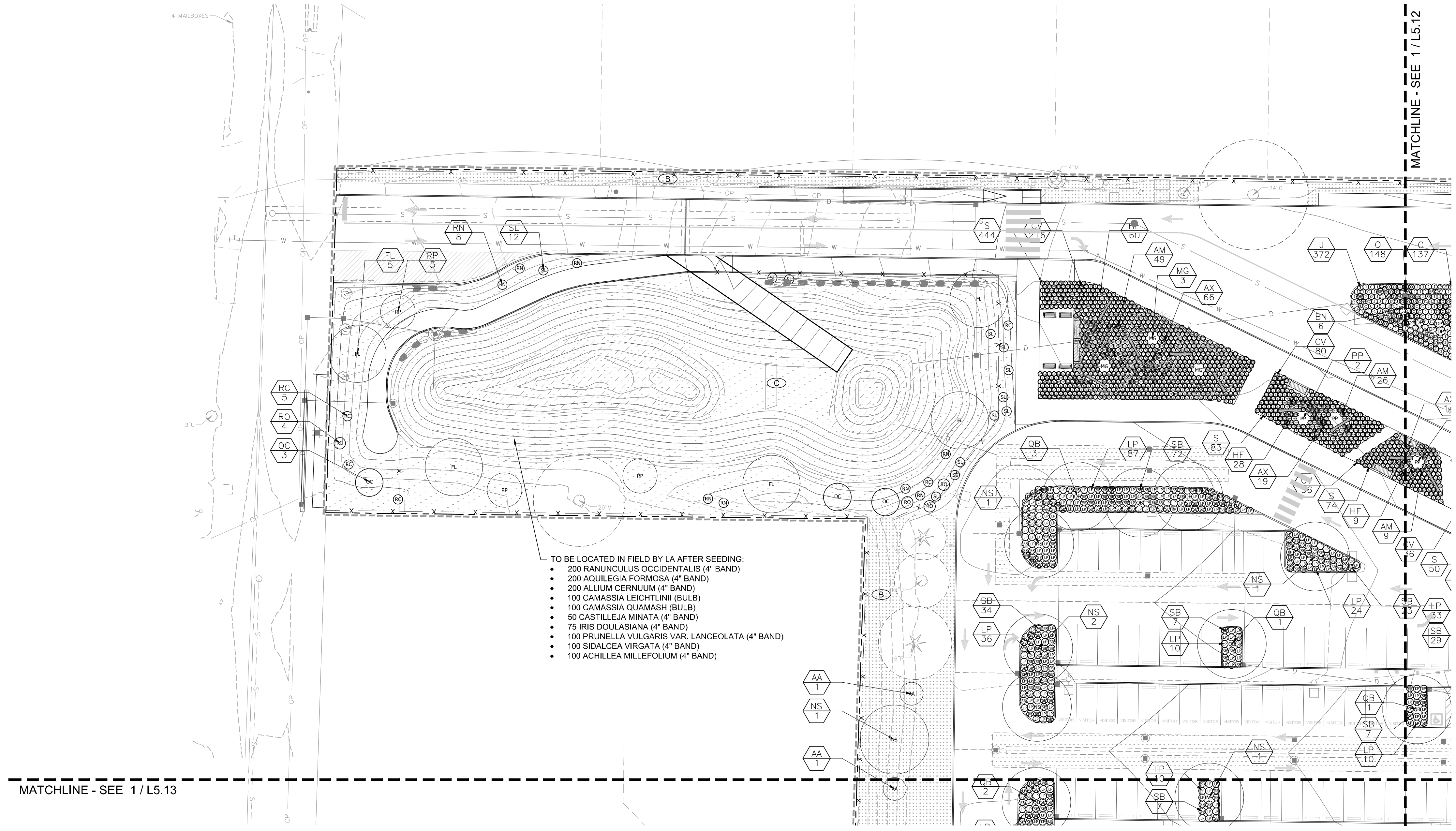
17405 Spruce Way
Lynnwood, WA 98037

JOB NO:	16989.00
ISSUE DATE:	05/24/2021

Jurisdiction Stamp Area

LANDSCAPE SITE PLAN

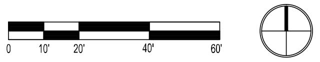
L1.00



TO BE LOCATED IN FIELD BY LA AFTER SEEDING:
- 200 RANUNCULUS OCCIDENTALIS (4" BAND)
- 200 AQUILEGIA FORMOSA (4" BAND)
- 200 ALLIUM CERNUUM (4" BAND)
- 100 CAMASSIA LEICHTLINII (BULB)
- 100 CAMASSIA QUAMASH (BULB)
- 50 CASTILLEJA MINATA (4" BAND)
- 75 IRIS DOULASIANA (4" BAND)
- 100 PRUNELLA VULGARIS VAR. LANCEOLATA (4" BAND)
- 100 SIDALCEA VIRGATA (4" BAND)
- 100 ACHILLEA MILLEFOLIUM (4" BAND)

1 PLANTING PLAN - NW

SCALE: ########



PLANT SCHEDULE NW

TREES	CODE	QTY	BOTANICAL NAME	COMMON NAME	COND	SIZE
AA	AA	1	AMELANCHIER ALNIFOLIA	SERVICEBERRY	B & B	MULTI-STEMMED, 3-5
BN	BN	1	BETULA NIGRA	RIVER BIRCH	B & B	2.5"CAL
FL	FL	5	FRAXINUS LATIFOLIA	OREGON ASH	B & B	3"CAL
MG	MG	3	METASEQUOIA GLYPTOSTROBOIDES	DAWN REDWOOD	B & B	EVEN MIX OF 8-12` HT
NS	NS	5	NYSSA SYLVATICA	SOUR GUM	B & B	2.5"CAL
PP	PP	2	PARROTIA PERSICA	PERSIAN PARROTIA	B & B	1.5"CAL
QB	QB	4	QUERCUS BICOLOR	SWAMP WHITE OAK	B & B	2.5"CAL
RP	RP	3	RHAMNUS PURSHIANA	CASCARA	B & B	1.5"CAL

SHRUBS	CODE	QTY	BOTANICAL NAME	COMMON NAME	CONT
✿	AX	87	ALLIUM X `WINDY CITY`	WINDY CITY ALLIUM	5 GAL
AF	AF	4	AQUILEGIA FORMOSA	WESTERN COLUMBINE	4"POT
✿	AM	77	ASTER X FRIKARTII `MONCH`	MONCH ASTER	#1
●	CV	316	CALLUNA VULGARIS `SPRING TORCH`	SCOTCH HEATHER	#1
O	O	16	CAREX DENSA	DENSE SEDGE	#1
C	C	10	CAREX PACHYSTACHYA	CHAMISSO SEDGE	#1
DP	DP	1	DARMERA PELTATA	INDIAN RHUBARB	#2
HF	HF	89	HELLEBORUS FOETIDUS	BEARSFOOT HELLEBORE	#1
I	I	8	IRIS DOUGLASIANA	DOUGLAS IRIS	#1
J	J	27	JUNCUS PATENS `ELK BLUE`	SPREADING RUSH	#1
LP	LP	157	LONICERA PILEATA	HONEYSUCKLE	#5
OC	OC	3	OEMLERIA CERASIFORMIS	INDIAN PLUM	#15
RO	RO	4	RHODODENDRON OCCIDENTALE	WESTERN AZALEA	#5
RN	RN	8	RIBES NEVADENSE	SIERRA CURRANT	#5
RC	RC	5	RIBES SANGUINEUM GLUTINOSUM `CLAREMONT`	FLOWERING CURRANT	#5
S	S	564	SESLERIA AUTUMNALIS	AUTUMN MOOR GRASS	#1
SB	SB	141	SPIRAEA BETULIFOLIA	BIRCH LEAF SPIREA	#3
SL	SL	12	SPIRAEA BETULIFOLIA LUCIDA	SHINY LEAF SPIREA	#5

AQUATIC	QTY	BOTANICAL NAME	COMMON NAME	CONT	SPACING
▨	334	NUPHAR POLYSEPALUM	SPATTERDOCK	2" CONT.	48" o.c.

SEEDING SCHEDULE

SYMBOL	TYPE	QUANTITY
A	HYDROSEED TURF GRASS	23,208 SF
B	HYDROSEED LOW GROW GRASS MIX	57,698 SF
C	HYDROSEED BIOFILTER MIX	48,983 SF

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VINITA SIDHU
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#	REVISIONS	DATE

EDMONDS SCHOOL DISTRICT

SPRUCE ELEMENTARY SCHOOL PHASE 2

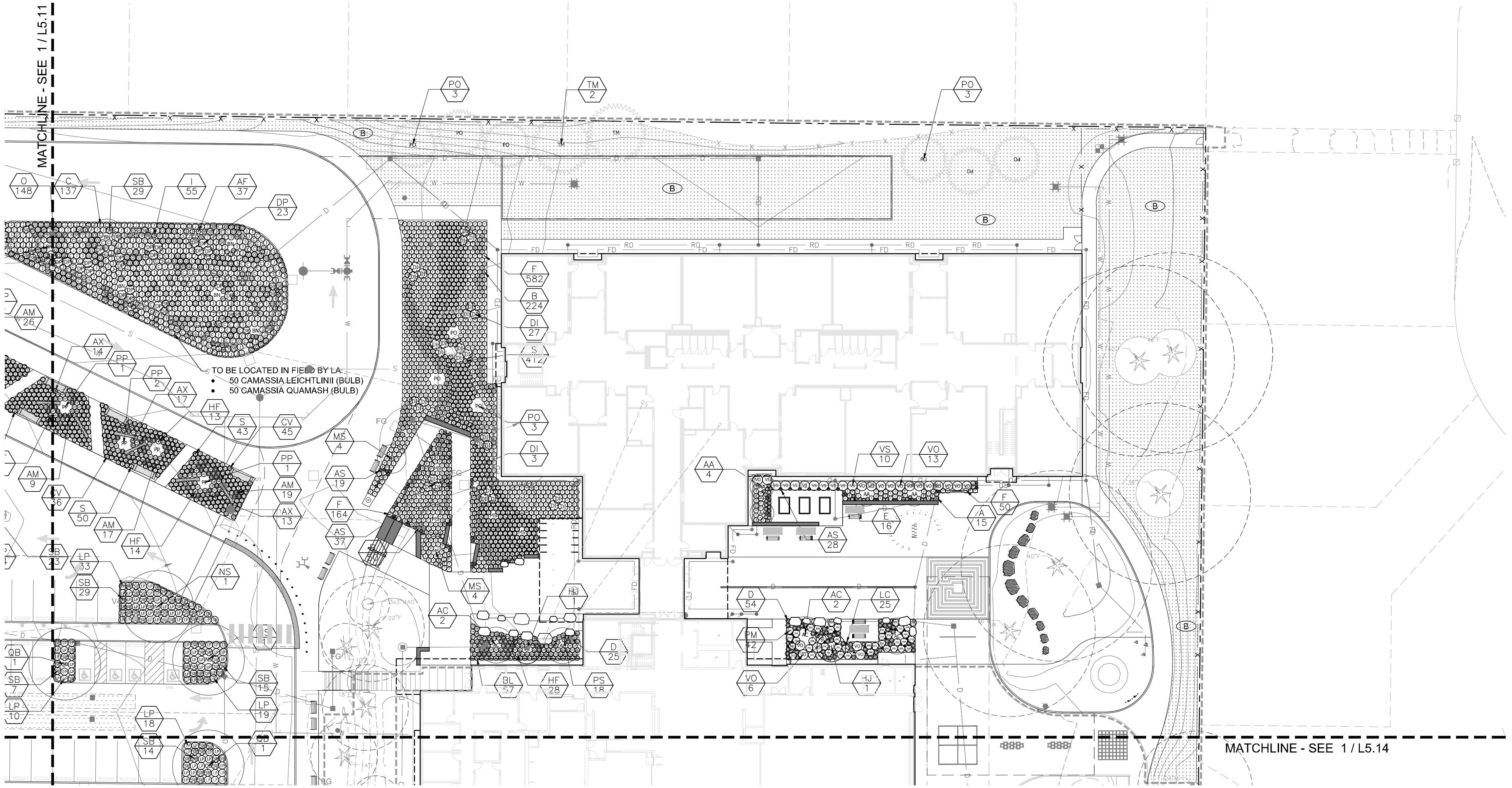
17405 Spruce Way
Lynnwood, WA 98037

JOB NO: 16989.00
ISSUE DATE: 05/24/2021

Jurisdiction Stamp Area

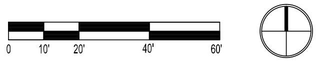
PLANTING PLAN - NW

L5.11



1 PLANTING PLAN - NE

SCALE: 1" = 20'



PLANT SCHEDULE NE

TREES	CODE	QTY	BOTANICAL NAME	COMMON NAME	COND	SIZE
AC	AC	4	ACER CIRCINATUM	VINE MAPLE	B & B	MULTI-STEMMED, 3-5 STEMS, 8` HT. MIN.
AA	AA	4	AMELANCHIER ALNIFOLIA	SERVICEBERRY	B & B	MULTI-STEMMED, 3-5 STEMS
BN	BN	5	BETULA NIGRA	RIVER BIRCH	B & B	2.5"CAL
MS	MS	8	MALUS TRANSITORIA `SCHMIDCUTLEAF`	GOLDEN RAINDROPS FLOWERING CRABAPPLE	B & B	2"CAL
NS	NS	2	NYSSA SYLVATICA	SOUR GUM	B & B	2.5"CAL
PP	PP	4	PARROTIA PERSICA	PERSIAN PARROTIA	B & B	1.5"CAL
PO	PO	9	PICEA OMORIKA	SERBIAN SPRUCE	B & B	EVEN MIX OF 8-12` HT
QB	QB	1	QUERCUS BICOLOR	SWAMP WHITE OAK	B & B	2.5"CAL
TM	TM	2	TSUGA MERTENSIANA	MOUNTAIN HEMLOCK	B & B	EVEN MIX OF 8-12` HT

SHRUBS	CODE	QTY	BOTANICAL NAME	COMMON NAME	CONT
⊙	A	15	ACHILLEA X `MOONSHINE`	MOONSHINE YARROW	#1
⊙	AS	84	ALLIUM SENESCENS GLAUCUM	ORNAMENTAL ONION	BULB
⊙	AX	42	ALLIUM X `WINDY CITY`	WINDY CITY ALLIUM	5 GAL
⊙	AF	33	AQUILEGIA FORMOSA	WESTERN COLUMBINE	4"POT
⊙	AM	43	ASTER X FRIKARTII `MONCH`	MONCH ASTER	#1
⊙	BL	57	BLECHNUM SPICANT	DEER FERN	#1
⊙	B	274	BOUTELOUA GRACILIS `BLONDE AMBITION`	BLUE GRAMA	#1
⊙	CV	97	CALLUNA VULGARIS `SPRING TORCH`	SCOTCH HEATHER	#1
O	O	132	CAREX DENSA	DENSE SEDGE	#1
C	C	127	CAREX PACHYSTACHYA	CHAMISSO SEDGE	#1
DP	DP	22	DARMERA PELTATA	INDIAN RHUBARB	#2
DI	DI	30	DIERAMA PULCHERRIMUM	ANGEL`S FISHING ROD	#5
⊙	D	79	DRYOPTERIS ERYTHROSORA	AUTUMN FERN	#1
⊙	E	16	ECHINACEA PURPUREA `BRAVADO`	BRAVADO CONEFLOWER	#1
F	F	796	FESTUCA MAIREI	ATLAS FESCUE	#1
HJ	HJ	2	HAMAMELIS X INTERMEDIA `JELENA`	YELLOW ORANGE WITCH HAZEL	5 GAL
⊙	HF	63	HELLEBORUS FOETIDUS	BEARSFOOT HELLEBORE	#1
⊙	I	47	IRIS DOUGLASIANA	DOUGLAS IRIS	#1
J	J	344	JUNCUS PATENS `ELK BLUE`	SPREADING RUSH	#1
▲	LC	25	LILIUM COLUMBIANUM	TIGER LILY	BULB
LP	LP	62	LONICERA PILEATA	HONEYSUCKLE	#5
PM	PM	42	POLYSTICHUM MUNITUM	WESTERN SWORD FERN	#1
⊙	PS	18	POLYSTICHUM SETIFERUM `PLUMOSOMULTILOBUM`	SOFT SHIELD FERN	#1
⊙	S	543	SESLERIA AUTUMNALIS	AUTUMN MOOR GRASS	#1
SB	SB	75	SPIRAEA BETULIFOLIA	BIRCH LEAF SPIREA	#3
VO	VO	19	VACCINIUM OVATUM	EVERGREEN HUCKLEBERRY	#3
VS	VS	10	VACCINIUM X `SUNSHINE BLUE`	BLUEBERRY	#5

SEEDING SCHEDULE

SYMBOL	TYPE	QUANTITY
A	HYDROSEED TURF GRASS	23,208 SF
B	HYDROSEED LOW GROW GRASS MIX	57,698 SF
C	HYDROSEED BIOFILTER MIX	48,983 SF

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VINITA SIDHU
NO. 949 EXP. 05/27/2022

#	REVISIONS	DATE

EDMONDS SCHOOL DISTRICT

SPRUCE
ELEMENTARY
SCHOOL
PHASE 2

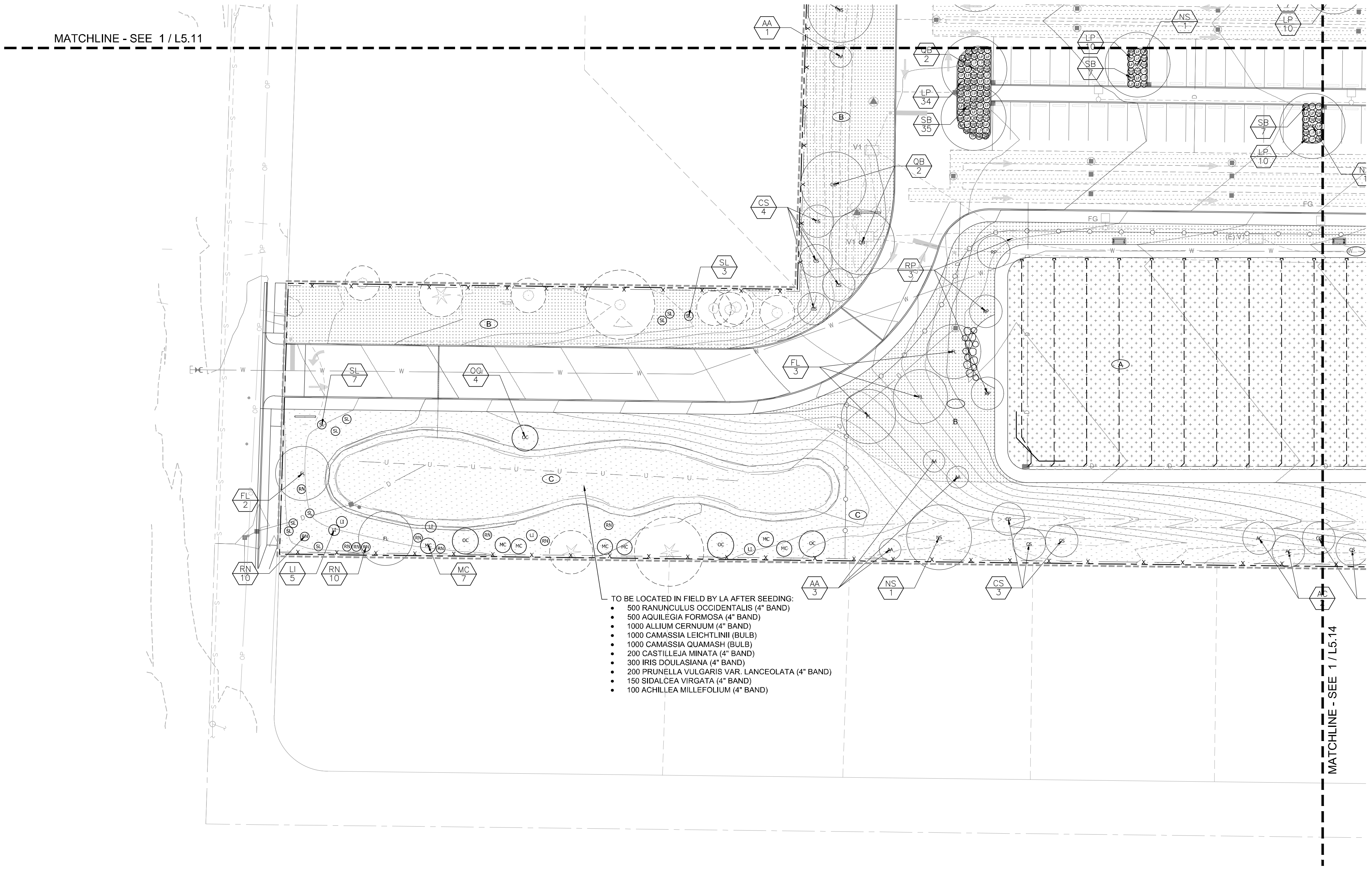
17405 Spruce Way
Lynnwood, WA 98037

JOB NO: 16989.00
ISSUE DATE: 05/24/2021

Jurisdiction Stamp Area

PLANTING PLAN - NE

L5.12



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- 500 RANUNCULUS OCCIDENTALIS (4" BAND)
- 500 AQUILEGIA FORMOSA (4" BAND)
- 1000 ALLIUM CERNUUM (4" BAND)
- 1000 CAMASSIA LEICHTLINII (BULB)
- 1000 CAMASSIA QUAMASH (BULB)
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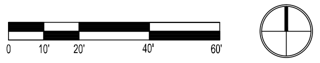
- 300 IRIS DOULASIANA (4" BAND)
- 200 PRUNELLA VULGARIS VAR. LANCEOLATA (4" BAND)
- 150 SIDALCEA VIRGATA (4" BAND)
- 100 ACHILLEA MILLEFOLIUM (4" BAND)

1 PLANTING PLAN - SW

SCALE: ########



PLANT SCHEDULE SW

TREES	CODE	QTY	BOTANICAL NAME	COMMON NAME	COND	SIZE
AC	AC	2	ACER CIRCINATUM	VINE MAPLE	B & B	MULTI-STEMMED, 3-5 STEMS, 8` HT. MIN.
AA	AA	4	AMELANCHIER ALNIFOLIA	SERVICEBERRY	B & B	MULTI-STEMMED, 3-5 STEMS
CS	CS	8	CORNUS X `STARLIGHT`	STARLIGHT DOGWOOD	B & B	2.5"CAL
FL	FL	5	FRAXINUS LATIFOLIA	OREGON ASH	B & B	3"CAL
NS	NS	3	NYSSA SYLVATICA	SOUR GUM	B & B	2.5"CAL
QB	QB	4	QUERCUS BICOLOR	SWAMP WHITE OAK	B & B	2.5"CAL
RP	RP	3	RHAMNUS PURSHIANA	CASCARA	B & B	1.5"CAL

SHRUBS	CODE	QTY	BOTANICAL NAME	COMMON NAME	CONT
LI	LI	5	LONICERA INVOLUCRATA	TWINBERRY	#5
LP	LP	54	LONICERA PILEATA	HONEYSUCKLE	#5
MC	MC	7	MYRICA CALIFORNICA	PACIFIC WAX MYRTLE	#15
OC	OC	4	OEMLERIA CERASIFORMIS	INDIAN PLUM	#15
RN	RN	10	RIBES NEVADENSE	SIERRA CURRANT	#5
SB	SB	49	SPIRAEA BETULIFOLIA	BIRCH LEAF SPIREA	#3
SL	SL	10	SPIRAEA BETULIFOLIA LUCIDA	SHINY LEAF SPIREA	#5

SEEDING SCHEDULE

SYMBOL	TYPE	QUANTITY
A	HYDROSEED TURF GRASS	23,208 SF
B	HYDROSEED LOW GROW GRASS MIX	57,698 SF
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EDMONDS SCHOOL DISTRICT

SPRUCE ELEMENTARY SCHOOL PHASE 2

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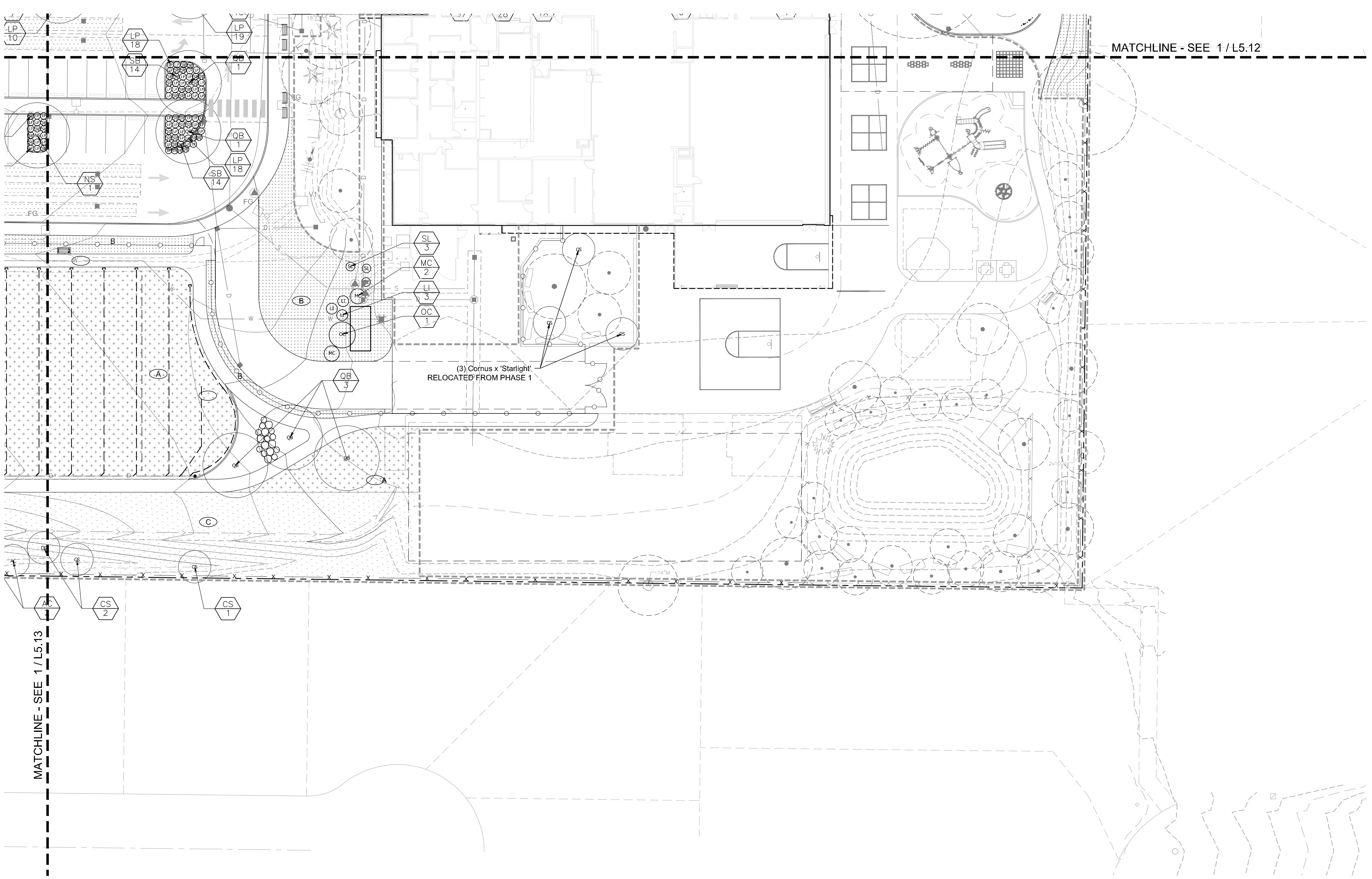
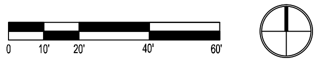
Jurisdiction Stamp Area

PLANTING PLAN - SW

L5.13





1 PLANTING PLAN - SE

SCALE: 1" = 20'

PLANT SCHEDULE SE

TREES	CODE	QTY	BOTANICAL NAME	COMMON NAME	COND	SIZE
CS	CS	*5	CORNUS X `STARLIGHT` (*3 TO BE RELOCATED FROM PH 1)	STARLIGHT DOGWOOD	B & B	2.5"CAL
QB	QB	5	QUERCUS BICOLOR	SWAMP WHITE OAK	B & B	2.5"CAL
SHRUBS	**CODE**	**QTY**	**BOTANICAL NAME**	**COMMON NAME**	**CONT**	
LI	LI	3	LONICERA INVOLUCRATA	TWINBERRY	#5	
LP	LP	36	LONICERA PILEATA	HONEYSUCKLE	#5	
MC	MC	2	MYRICA CALIFORNICA	PACIFIC WAX MYRTLE	#15	
OC	OC	1	OEMLERIA CERASIFORMIS	INDIAN PLUM	#15	
SB	SB	28	SPIRAEA BETULIFOLIA	BIRCH LEAF SPIREA	#3	
SL	SL	3	SPIRAEA BETULIFOLIA LUCIDA	SHINY LEAF SPIREA	#5	

SEEDING SCHEDULE

SYMBOL	TYPE	QUANTITY
A	HYDROSEED TURF GRASS	23,208 SF
B	HYDROSEED LOW GROW GRASS MIX	57,698 SF
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CONFORMED SET

PLANTING PLAN - SE

L5.14

5. ANIMALS

a. <u>List</u> any birds and <u>other</u> animals which have been observed on or near the site or are known to be on or near the site. Examples include:

birds:	hawk, heron, eagle, <u>songbirds</u>, other:
mammals:	deer, bear, elk, beaver, other: <u>rodents</u>
fish:	bass, salmon, trout, herring, shellfish, other:

b. List any threatened and endangered species known to be on or near the site.

A query request of the Washington Department of Fisheries and Wildlife (WDFW) database for threatened, endangered, and priority species and habitats was made on July 26, 2017 <u>and again on January 3, 20202</u>. WDFW did not identify any threatened or endangered species on the subject site or in the immediate vicinity. There is an area approximately 250 feet to the northwest of the site that is listed as a being a freshwater forested/shrub wetland and contains Priority Habitat Species.

c. Is the site part of a migration route? If so, explain.

Western Washington is part of the Pacific Flyway. However, due to the extensive urban residential development patterns surrounding the site, it would most likely not be utilized by any species other than those more tolerant of urban development activities.

d. Proposed measures to preserve or enhance wildlife, if any:

Proposed landscaping would provide cover for animals. <u>Bioretention areas would increase wetland habitat for water fowl.</u>

e. List any invasive animal species known to be on or near the site.

There are no known invasive animal species known to be on or near the site.

6. ENERGY AND NATURAL RESOURCES

a. What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.

Natural gas provides the heating for the building, domestic hot water and some kitchen cooking equipment needs. Electricity supplies the rest of the building's needs, such as for lighting and equipment/plug loads.

b. Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.

The proposal would not affect the potential use of solar energy by adjacent properties. The proposed structure would not be tall enough to block sunlight from those properties.

c. What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any:

High-efficiency condensing boilers, an additive bid alternate to provide a heated pump for space heating needs is proposed, heat recovery on the ventilation systems, high efficiency LED lighting and innovative controls and systems metering/monitoring are proposed.

7. ENVIRONMENTAL HEALTH

a. Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur as a result of this proposal? If so describe.

During construction, it is possible that hazardous materials from equipment and vehicles could occur. A spill prevention and control plan would be prepared and implemented by the selected contractor to assist in minimizing the potential of accidental release of contaminants into the environment.

1) Describe any known or possible contamination at the site from present or past uses.

There is no known contamination to the site on the Washington State Department of Ecology's on-line database for hazardous sites (***Data obtained from Ecology Facility/Site mapping service on 7/26/17 and January 3, 2020: https://fortress.wa.gov/ecy/facilitysite/SearchData/ShowSearch.aspx?ModuleType=FacilitySite&RecordSearchMode=New*).**

2) Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.

The existing school building contains known asbestos and lead paint. There is also an existing 10,000 gallon heating oil underground storage tank on-site. It is located south of the existing student drop off area and is proposed to be removed. There are no known leaks; though soil around the tank would be tested during demolition as a precaution. The existing residential buildings are known to contain asbestos and lead paint as well.

3) Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

Other than cleaning supply chemicals, no toxic or hazardous chemicals would be stored on site.

During construction, it is anticipated that gasoline and other petroleum products could be stored onsite for fueling and maintenance of construction equipment.

4) Describe special emergency services that might be required.

No special emergency services would be required. Adequate circulation for fire trucks and other emergency services would be provided.

5) Proposed measures to reduce or control environmental health hazards, if any:

Environmental health hazards are not anticipated, therefore no mitigation measures are proposed. The contractor shall follow the recommendations of the Abatement and Demolition Plan to control exposure of workers to deleterious materials.

b. Noise

1) What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other?

The area is primarily residential and park space. Noise from nearby traffic would be audible, but would not affect the proposed development.

2) What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site.

Activity	Leq (in decibels)*
Clearing	71
Grading	63-76
Paving	60-76
Building Erection	60-72
Finishing	62-77

Types of Equipment	Range of Noise Levels
Bulldozer	65-84
Dump Truck	70-82
Paver	74-76
Generators	59-70
Compressors	62-69

* Decibels – The decibel (abbreviated dBA) is the unit used to measure the intensity of sound.

These noise levels would be short-term and in many cases, of short duration. Noise generated from construction is exempt from City noise regulations. Sound levels for various long-term noise sources include:

Noise Sources	Sound Level at 100 feet (dBA)
Automobile Starting	50-55
Closing Car Door	50-55
Loud Voices	50
Automobile/Bus/Truck Traffic	50

Noise levels would be consistent with an educational facility and be consistent with the City's noise regulations.

3) Proposed measures to reduce or control noise impacts, if any:

No impacts are anticipated, therefore no mitigation is proposed.

8. LAND AND SHORELINE USE

a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe.

The site is the current location of Spruce Elementary School the two additional added parcels contain single family residential structures. The adjacent properties are single family residential on all sides. The proposal would not have an impact on current land uses nearby.

b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses as a result of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?

The site has not been used recently as working farmlands or working forest lands.

1) Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how:

The proposal would not affect or be affected by working farm or forest land normal business operations, as none of these land uses are located in the immediate vicinity.

c. Describe any structures on the site.

There are several structures associated with the school that house classrooms and offices. There is also one open, covered play area. The residential property contains two single family homes and other outbuildings.

d. Will any structures be demolished? If so, what?

Upon the completion of Phase 2, all of the buildings described above would have been demolished. Phase 1 includes the demolition of ~~just~~ the covered play structure and residential structures.

e. What is the current zoning classification of the site?

The school site is zoned P-1 (Public). The residential parcels are zoned RS-8 (Residential 8400 SF). A rezone request of these parcels to RS-8 will be submitted to the City of Lynnwood for approval.

f. What is the current comprehensive plan designation of the site?

The school site is designated as PF (Public Facilities) by the Comprehensive Plan. The residential parcels are designated as SF-1 (Low-Density Single Family). A request for a Comprehensive Plan Designation Amendment to PF will be submitted to the City of Lynnwood for approval.

g. If applicable, what is the current shoreline master program designation of the site?

Not applicable.

h. Has any part of the site been classified as a critical area by the city or county? If so, specify.

No part of the site has been classified as a critical area by the City.

i. Approximately how many people would reside or work in the completed project?

Approximately 65 staff members would work in the completed school, including teachers, administrative staff, and custodial and service staff. There is a flexible number of parent volunteers that is not accounted for in this total.

j. Approximately how many people would the completed project displace?

Only temporary displacement of students and staff during Phase 2 construction would occur. Students and staff would be relocated off-site ~~(the location will be determined at a later date)~~ to former Alderwood Middle School during the construction of Phase 2. The individuals living in the single family residential structures moved to other locations permanently.

k. Proposed measures to avoid or reduce displacement impacts, if any:

No measures are proposed, as all employees would be relocated to the new school once it has been constructed and Phase 2 is complete. All employees have been given proper notice of the pending demolition and temporary relocation. The individuals living in the single family homes were given an extended period of time to find an alternative place to live.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any:

Spruce Elementary School is a legal conforming use in the P-1 zoning designation. A request for a Comprehensive Plan Amendment and Rezone will be submitted to the City of Lynnwood to ensure that the zoning and designation are consistent with the school use for the two additional parcels. The Edmonds School District adopted a Capital Facilities Plan (CFP) in 2016 for the years 2016 – 2021 in order to assess existing school facility capacities and outline a number of improvements for its facilities. The modernization of Spruce Elementary School is included in the CFP, upon further assessment, it was determined that total replacement was in the best interest of the District and the students the school serves.

The proposal would enhance the City's Comprehensive Plan and the Community Livability Element in Policies: P-3.3, LU-6-A, and LU-6-E. The school would provide Recreation Open Space Goal RPOS-3 of the Comprehensive Plan as neighborhood resident would benefit from the improved site amenities, linking trails and pathways, safe connection to school and potential community use space.

The City of Lynnwood Comprehensive Plan (LCP) supports the location of schools within residential areas, provided the use does not generate "adverse land use or environmental impacts" (Policy LU-26). The LCP also recognizes the importance of schools to the future of the City. It not only emphasizes the role of schools as learning centers, but as community gathering spaces; proponents of arts (Policy CC-14.13 and 14.14) and active living (Policy CC-11.1); and as increasingly important to the promotion of sustainable food systems (Policy CC-12.5) and environmentally sustainable communities through the establishment of school food gardens (Policy CC-17.12).

m. Proposed measures to ensure the proposal is compatible with nearby agricultural and forest lands of long-term commercial significance, if any:

There are no measures proposed as there are no nearby agricultural or forest lands of long-term significance.

9. HOUSING

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

No housing units would be provided.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

~~No~~ Two housing units have been ~~would be~~ eliminated.

c. Proposed measures to reduce or control housing impacts, if any:

~~No impacts are anticipated; therefore no measures are proposed.~~ Advance notification to the residents living there was provided to allow them time to find alternative living arrangements.

10. AESTHETICS

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The maximum height of the tallest proposed structure is 42 feet. The principal exterior material for the proposed buildings is primarily vertical metal panels in 3 to 4 colors. The pattern of the metal panels helps to break up the surface and reduce glare. There is a concrete masonry unit (CMU) base and CMU bounce walls near the covered play building.

b. What views in the immediate vicinity would be altered or obstructed?

Views in the immediate vicinity would be altered by the view of the new school building, no obstructions would occur. Parcels abutting the proposed access driveway would notice a change in views as well.

c. Proposed measures to reduce or control aesthetic impacts, if any:

No impacts are anticipated, therefore no mitigation is proposed.

11. LIGHT AND GLARE

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

The parking area, building lighting and vehicle lighting would produce a minimal source of light. Light from these sources would occur in the morning hours prior to the start of school until sunrise and during evening events. Any site lighting would be designed to minimize spillage beyond the site. No lighting of the play field is proposed.

The proposal includes 15’ tall LED full cut-off site lighting along the entry drive. Parking areas will have 25’ tall LED full cut-off poles, and 15’ tall LED full cut-off poles near the east portion of the parking areas, adjacent to the building. Details regarding the fixtures and the site photometrics can be found on ***Figure 5 – Electrical Site Plan – Site Lighting Photometrics – Phase 2***.

FIXTURE SCHEDULE:

E1 - 15' TALL LED FULL CUT OFF SITE LIGHTING POLE FIXTURE - TYPE 3 DISTRIBUTION WITH BACK LIGHT CONTROL OPTICS AND HOUSE SIDE SHIELD - OCCUPANCY SENSOR FUNCTION 50%-100% DURING ON HOURS
E2 - 15' TALL LED FULL CUT OFF SITE LIGHTING POLE FIXTURE - LEFT CORNER TYPE DISTRIBUTION WITH BACK LIGHT CONTROL OPTICS AND HOUSE SIDE SHIELD - OCCUPANCY SENSOR FUNCTION 50%-100% DURING ON HOURS
E3 - LED FULL CUT OFF TYPE 3 DISTRIBUTION WALL MOUNTED FIXTURE WITH OCCUPANCY SENSOR FUNCTION 50%-100% DURING ON HOURS
E4 - LED RECESSED LED FULL CUT OFF DOWNLIGHT
E6 - 15' TALL LED FULL CUT OFF SITE LIGHTING POLE FIXTURE - TYPE 3 DISTRIBUTION OCCUPANCY SENSOR FUNCTION 50%-100% DURING ON HOURS
E7 - 25' TALL LED FULL CUT OFF SITE LIGHTING POLE FIXTURE - TYPE 2 DISTRIBUTION - OCCUPANCY SENSOR FUNCTION 50%-100% DURING ON HOURS
E11 - LED IN-GRADE SIGN LIGHTING FIXTURE
E12 - FLAG POLE LED SPOT LIGHTING FIXTURE

SITE LIGHTING PHOTOMETRIC DATA:

Calc Pts

Main Plaza and Entry
Illuminance (Fc)
Average=4.63 Maximum=69.0 Minimum=0.9 Avg/Min=5.14 Max/Min=76.67

North Bus Loop
Illuminance (Fc)
Average=2.01 Maximum=7.0 Minimum=0.6 Avg/Min=4.00 Max/Min=12.07

North Ped Pathway
Illuminance (Fc)
Average=2.04 Maximum=6.9 Minimum=0.3 Avg/Min=6.80 Max/Min=23.00

North Property Line
Illuminance (Fc)
Average=0.00 Maximum=0.0 Minimum=0.0 Avg/Min=N.A. Max/Min=N.A.

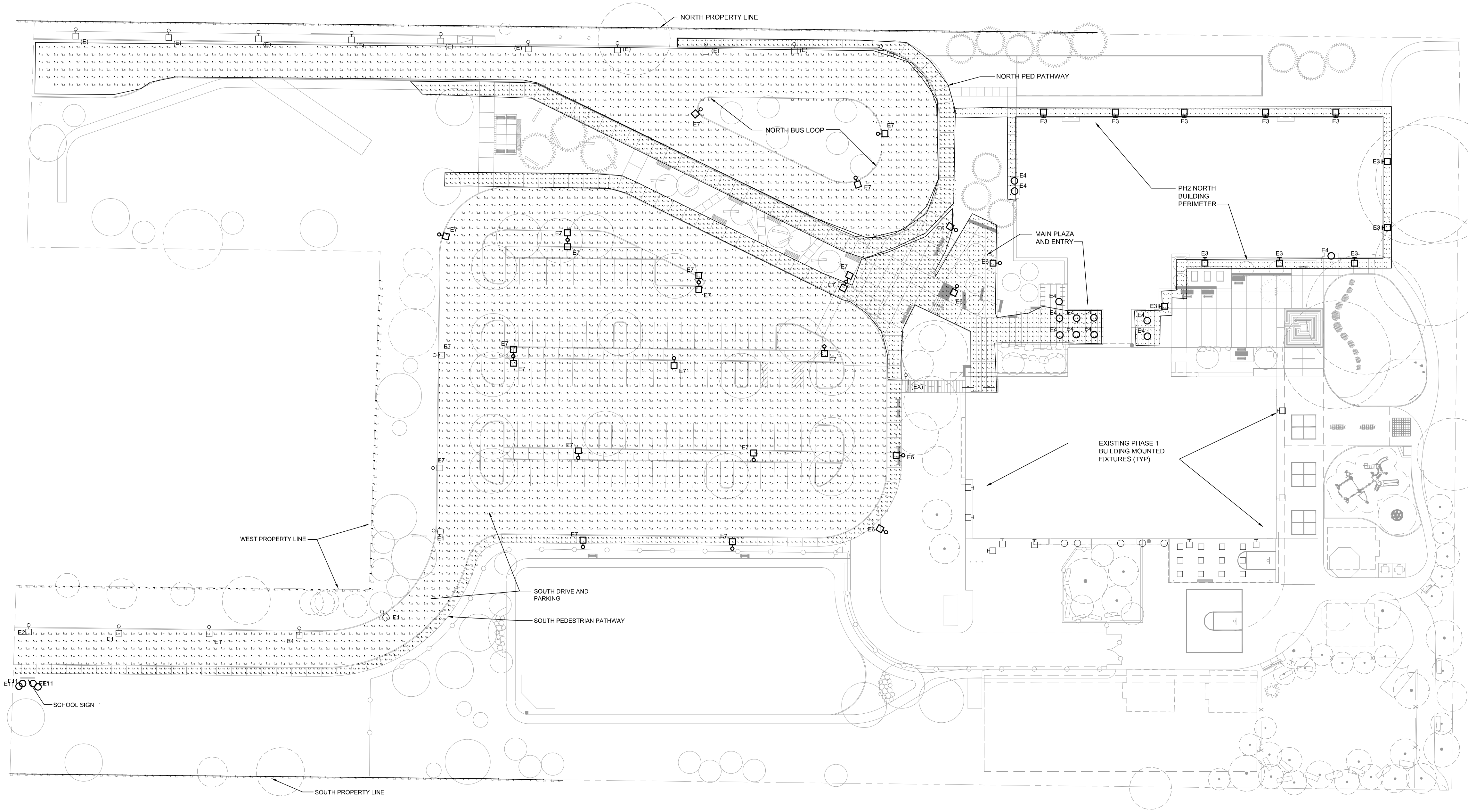
PH2 North Building Perimeter
Illuminance (Fc)
Average=9.55 Maximum=71.7 Minimum=0.6 Avg/Min=15.92 Max/Min=119.50

South Drive and Parking
Illuminance (Fc)
Average=3.39 Maximum=9.7 Minimum=0.6 Avg/Min=5.65 Max/Min=16.17

South Ped Pathway
Illuminance (Fc)
Average=1.99 Maximum=6.2 Minimum=0.5 Avg/Min=3.98 Max/Min=12.40

South Property Line
Illuminance (Fc)
Average=0.00 Maximum=0.0 Minimum=0.0 Avg/Min=N.A. Max/Min=N.A.

West Property Line
Illuminance (Fc)
Average=0.00 Maximum=0.0 Minimum=0.0 Avg/Min=N.A. Max/Min=N.A.



2/8/2017 10:50:08 AM

1 ELECTRICAL SITE PLAN - SITE LIGHTING PHOTOMETRICS - PHASE 2
1" = 30'-0"

bassetti architects

71 Columbia Street, Suite 500
Seattle, Washington 98104
T (206) 340 9500 F (206) 340 9519

CIVIL ENGINEER
AHBL
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Seattle WA 98101
T (206) 267 2425

LANDSCAPE ARCHITECT
Site Workshop
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Seattle, WA 98109
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STRUCTURAL ENGINEER
CPL
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Seattle, WA 98104
T (206)343 0460

MECHANICAL ENGINEER
Metrix
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Renton, WA 9805
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ELECTRICAL ENGINEER
Hargis Engineers
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FOOD SERVICE CONSULTANT
Halliday Associates, Inc.
656 NW Norwood Street
Camas, WA 98607
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ACOUSTICAL CONSULTANT
SSA
222 Etruria Street, Suite 100
Seattle Wa 98109
T (206) 839 0819

BRENDON M. INMAN
40443
2/3/20

#	REVISIONS	DATE

PH2

N

EDMONDS SCHOOL DISTRICT

SPRUCE
ELEMENTARY
SCHOOL

17405 Spruce Way
Lynnwood, WA 98037

JOB NO: 16989.00
ISSUE DATE: 02/11/2020

Jurisdiction Stamp Area

SEPA ADDENDUM

ELECTRICAL
SITE PLAN - SITE
LIGHTING
PHOTOMETRICS

E1.00L-PH2

b. Could light or glare from the finished project be a safety hazard or interfere with views?

No, other than vehicle lights, no other lights (i.e. parking lot lighting and building lights) would be aimed outward.

c. What existing off-site sources of light or glare may affect your proposal?

Light and glare from the adjacent roadway and residences would not have an impact on this proposal.

d. Proposed measures to reduce or control light and glare impacts, if any:

The proposed lighting for the new buildings would be directed in a downward direction, to reduce light and glare. The light and glare would be minimized by fencing and landscape buffers, and therefore the adjacent properties would not be adversely affected by the proposal.

12. RECREATION

a. What designated and informal recreational opportunities are in the immediate vicinity?

Spruce Park is located less than ½ mile to the north of the school site, Stadler Ridge Park is less than ⅓ of a mile to the east and Maple Mini-Park is less than ½ mile to the south. The elementary school itself provides recreational opportunities associated with the athletic fields and play equipment during non-school hours.

b. Would the proposed project displace any existing recreational uses? If so, describe.

Temporary displacement of the on-site recreational opportunities would occur during construction for safety purposes.

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

No permanent measures are anticipated, therefore no measures are proposed.

13. HISTORIC AND CULTURAL PRESERVATION

a. Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers located on or near the site? If so, specifically describe.

The existing Spruce Elementary School was constructed in 1966 and received two new classrooms in 2013 and three portables in 2014 and another two portables in 2016. While over 45 years in age, there is no indication that the school embodies unique construction methods or design elements that would support listing the building on national, state or local preservation registers. The original architect of the school was Ralph Burkhard. In 1979 a modernization and addition to the original school occurred and was designed by Robert A. Bezzo. A full modernization of the school occurred in 1987 by Burr Lawrence Rising Architects. In 2009, Greene Gasaway redesigned the flat roof structures to sloped roofs with metal roofing. There have been several other classroom additions and improvements to the school over the years as well. The residential properties contained one-story structures constructed in 1956 and are also therefore older than 45 years old.

According to the Washington State Department of Archaeology and Historic Preservation (DAHP): Washington Information System for Architectural & Archaeological Records Data (WISAARD), review of historic registers indicates that there are no properties listed on or determined eligible for listing on the National Register of Historic Places or Washington Heritage Register on or adjacent to the school site.

b. Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources.

There are no known landmarks, feature or other evidence of Indian or historic use or occupation. The WISAARD site classifies the project area as “Moderately Low Risk” for encountering subsurface cultural resources. No professional studies were conducted.

c. Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc.

Review of the DAHP WISSARD on-line data base as well as review of historic mapping was used.

d. Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.

No cultural resources have been identified in the project area. If cultural resources are inadvertently discovered during construction, work at the site would halt and the State’s Historic Preservation Officer would be notified.

14. TRANSPORTATION

a. Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on-site plans, if any.

The site is accessed via Spruce Way. ~~No change in access is proposed.~~ Spruce Way is considered an arterial street. The acquisition of additional property has allowed the District to propose a second access to the site, south of the existing driveway. Bus traffic would be separated from staff and parent drop-off/pick-up traffic. The school's existing parent/staff access would be modified and repurposed to serve the bus loop. The parent/staff access would move approximately 250 feet to the south access point across the residential lots.

b. Is the site or affected geographic area currently served by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop?

Community Transit services the area surrounding Spruce Elementary. There are several bus stops (Route 112) located within .2 miles of the school directly on 44th Ave W. This route will transport riders in about a 5 minute ride south to the Lynnwood Terrace Transit Center or north to the Swamp Creek Park & Ride Center. From either of the Centers, access is available to other Community Transit or Sound Transit routes. Route 112 runs about every 30 minutes from approximately 6:00am to 9:00pm. The Edmonds School District ~~also~~ provides bus transportation for ~~some~~ the majority of the students.

c. How many additional parking spaces would the completed project or non-project proposal have? How many would the project or proposal eliminate?

The completed project would add additional parking spaces. The existing school site includes 58 parking spaces. The proposed project (Phases 1 and 2) would have a total of ~~90~~ 96 parking stalls.

d. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private).

~~No new or improvements to the existing roads, street or pedestrian system are required.~~ The project would provide street improvements to Spruce Way at the north and south entrance of the school. Street improvements include new sidewalk, curb, gutter as well as pavement widening. Improvements to the existing drainage system include replacing the existing ditch and culverts with catch basins and pipes. The project would retain the existing paved trails and sidewalks in the vicinity.

e. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.

The proposed project would not occur in the immediate vicinity of water, rail or air transportation.

f. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?

According to the *Traffic Impact Analysis* (see ***Appendix D),*** the reconstruction of Spruce Elementary School is estimated to generate a total of 140.8 new average daily trips with 50.3 trips (24. inbound/25.9 outbound) during the AM peak-hour and 29.8 trips (12.2 inbound/17.6 outbound) during the school PM peak-hour. During the street peak-hour between 4 and 6 PM, it is anticipated that there would be an increase of 13.8 PM peak-hour trips (6.8 inbound/7.0 outbound). The number of buses servicing the school is not anticipated to change. ~~Neither of the school's access points are planning on moving, however, the north access would be repurposed to serve the bus loop, while the south access would serve for the parent drop-off/pick-up and parking.~~ The school's existing parent/staff access would turn into the bus access point, while a new parent/staff access would move approximately 250 feet to the south at the new residential lots. Additionally, the parent vehicle student drop-off/pick-up area would expand to allow for additional drop-off/pick-up of simultaneous vehicles while allowing other vehicles to bypass the stopped vehicles safely.

In the ~~2020~~ 2021 future with reconstruction analysis provided in the *Traffic Impact Analysis* (see ***Appendix D***), all off site study intersection would continue to operate at LOS ~~C~~ B or better during the AM peak-hour and ~~LOS B or better during the~~ School PM peak-hour. ~~The main parent access for the school, the south driveway,~~ All access points would operate at LOS B or better. ~~during the AM peak-hour and School PM peak-hour with the westbound leg (school driveway) operating as the critical approach. The bus loop, utilizing the north driveway, is anticipated to operate at acceptable LOS C during the AM peak-hour and LOS B in the School PM peak-hour.~~

g. Will the proposal interfere with, affect or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe.

The proposal would not interfere with or be impacted by the movement of agricultural and forest products on roads or streets in the area.

h. Proposed measures to reduce or control transportation impacts, if any:

According to the *Traffic Impact Analysis* (see ***Appendix D***), no measures are proposed to reduce or control transportation impacts as part of the proposal. It is anticipated that in ~~2020~~ 2021 future conditions all off-site study intersections would continue to operate at LOS C or better during the AM and LOS ~~C~~ B or better during the school PM peak-hour, which meets the City's Intersection Standards used for SEPA impact evaluation.

15. PUBLIC SERVICES

a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? If so, generally describe:

The site would continue to be served by the Lynnwood Police South Snohomish County Fire District No. 1 Fire Departments. Both public services can adequately serve the site.

b. Proposed measures to reduce or control direct impacts on public services, if any.

Fire hydrants would be located to provide 300 foot hose length coverage around the proposed building.

16. UTILITIES

a. Circle utilities currently available at the site: [✓ electricity], [✓ natural gas], [✓ water], [✓ refuse service], [✓ telephone], [✓ sanitary sewer], septic system, other: _____________

b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

Electricity	Snohomish County PUD
Natural Gas	Puget Sound Energy
Sewer	City of Lynnwood
Telephone/Internet	Integra/Frontier
Water	City of Lynnwood/Alderwood Water & Wastewater District

Gas service is already provided to the existing school building and will be extended from the existing gas service location onsite. Proposed gas service would be coordinated with Puget Sound Energy (PSE).

To serve the new school, a water main would be constructed around the building footprint to provide sufficient fire coverage. Fire sprinkler and domestic service would extend from the new water main to the building mechanical/fire sprinkler room. The water services would either be taken from the City of Lynnwood and/or Alderwood Water and Wastewater District.

Sanitary sewer would be extended as needed for new sanitary sewer lateral lines. Most of the stormwater from the site would pass through conveyance, flow control, and water quality treatment facilities before discharging to stormwater ponds on the southeast and northwest potion of the site.

C. SIGNATURE

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.

Signature: Camie
Applicant Representative

Name of signee: Camie Anderson

Position and Agency/Organization: Senior Associate, Shockey Planning Group, Inc.

Date submitted: June 4, 2021

Appendix A
Legal Description

Spruce Elementary School

17405 Spruce Way, Lynnwood, WA
Snohomish County Tax ID #: 00372700301502

ALDERWOOD MANOR 02 BLK 003 D-02 - LOT 15 BLK 3 LESS W 245FT AS MEAS PLWW LN LOT 15 TGW LOT 16 LESS S 100FT OF W 245FT THOF & LESS PTN TO SNO CO PER QCD 354-282 TGW W 1 AC OF LOT 3 & TGW WLY 1 AC LOT 4

17501 Spruce Way, Lynnwood, WA
Snohomish County Tax ID #'s: 03372700301501 and 00372700301504

ALDERWOOD MANOR 02 BLK 003 D-01 W 160FT FDP TH PTN OF S1/2 TR 15 DAF BEG AT THE SWCOR OF SD TR 15 TH NLY ALG THE W LN 124.63FT M/L TO THE NW COR OF SD S1/2 OFTR 15 TH ELY S89*34 20E ALG THE N LN OF SD S1/2 DIST OF 500FT TH SLY PLW W LNDIST 115.3FT M/L TO S LN OF TR 15 TH WLYALG S LN 500FT M/L TO SW COR & POB EXC THE W 10FT THOF

ALDERWOOD MANOR 02 BLK 003 D-04 - E 85FT OF W 245FT OF THAT PTN S1/2 TR 15 BLK 3 DAF - BEG SWCOR SD TR 15 TH NLY ALG W LN 124.63FT M/L TO NW COR SD S1/2 TR 15 TH S89*34 20E 500FT TH SLY PLT W LN 115.3FT M/L TO S LN TH WLY ALG S LN 500FT M/L TOSW COR & POB

Appendix B
Geotechnical Report <u>and Geotechnical Report Addendum</u>

associated
earth sciences
incorporated

January 14, 2015
Project No. KE140562A

Edmonds School District No. 15
20420 68th Avenue West
Lynnwood, Washington 98124

Attention: Mr. Matthew Finch

Subject: Subsurface Exploration and Preliminary Geotechnical Engineering Report
Proposed Renovations and Additions
Spruce Elementary School
Lynnwood, Washington

Dear Mr. Finch:

We are pleased to present these copies of our preliminary geotechnical engineering report for the referenced project. This report summarizes the results of our subsurface exploration, geologic hazards, and geotechnical engineering studies, and offers preliminary recommendations for the design and development of the proposed project. At the time this report was prepared, the site was in the early planning stage and no project design or detailed concept drawings had been prepared. We recommend that we be allowed to review the recommendations contained in this report and modify them, if necessary, when a project plan has been developed.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

DRAFT

Kurt D. Merriman, P.E.
Senior Principal Engineer

KDM/pc – KE140562A2 – Projects\20140562\KE\WP

Geotechnical Engineering

Associated Earth Sciences, Inc.

Serving the Pacific Northwest Since 1981

Water Resources

Subsurface Exploration and
Preliminary Geotechnical Engineering Report

PROPOSED RENOVATIONS AND ADDITIONS
SPRUCE ELEMENTARY SCHOOL

Environmental Assessments
and Remediation

Lynnwood, Washington

Prepared for

Edmonds School District No. 15

Sustainable Development Services

Project No. KE140562A
January 14, 2015

Geologic Assessments

SUBSURFACE EXPLORATION AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PROPOSED RENOVATIONS AND ADDITIONS SPRUCE ELEMENTARY SCHOOL

Lynnwood, Washington

Prepared for:
Edmonds School District No. 15
20420 68th Avenue West
Lynnwood, Washington 98124

Prepared by:
Associated Earth Sciences, Inc.
911 5th Avenue
Kirkland, Washington 98033
425-827-7701
Fax: 425-827-5424

January 14, 2015
Project No. KE140562A

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazards, and preliminary geotechnical engineering studies for the proposed renovations and additions to the Spruce Elementary School. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of exploration borings completed for this study are shown on the "Site and Exploration Plan," Figure 2. Logs of the subsurface explorations and copies of laboratory test results completed for this study are included in the Appendix.

1.1 Purpose and Scope

The purpose of this study was to provide geotechnical engineering design recommendations to be utilized in the preliminary design of the project. This study included a review of selected available geologic literature, advancing three hollow-stem auger soil borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water. Geotechnical engineering studies were completed to establish recommendations for the type of suitable foundations and floors, allowable foundation soil bearing pressure, anticipated foundation and floor settlement, pavement recommendations, and drainage considerations. At the time this report was prepared, infiltration of storm water on-site was not planned and our study was not structured to support storm water infiltration. Based on exploration data contained in this report, storm water infiltration using conventional shallow infiltration strategies is not feasible. This report summarizes our fieldwork and offers preliminary geotechnical engineering recommendations based on our present understanding of the project. We recommend that we be allowed to review the recommendations presented in this report and revise them, if needed, when a project design has been developed.

1.2 Authorization

Authorization to proceed with this study was granted by means of a District purchase order. Our work was completed in general accordance with our scope of work and cost proposal, dated October 1, 2014. This report has been prepared for the exclusive use of Edmonds School District No. 15 and their agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The project site is that of the existing Spruce Elementary School. The project will include renovation of portions of the existing building, and building additions. At the time this report was prepared, several design concepts were under consideration. Likely areas of new construction include the open landscaped courtyard near the center of the existing building, and existing landscape areas south and east of the existing school buildings.

The existing facility includes an existing group of school buildings near the center of the site, with paved parking areas to the west, play areas to the east, and portable classrooms to the south. Site topography in the building area slopes gently down to the south and west, and appears to have been graded to its current configuration during earlier site development. Slopes near the south property boundary are likely man-made slopes constructed during earlier site development and are approximately 5 feet tall and inclined approximately 2H:1V (Horizontal:Vertical). A slope east of the existing school buildings is inclined approximately 2H:1V and rises approximately 6 to 10 feet to the existing playfields on the east part of the site. Some of these man-made slopes appear to meet the definition for steep slope geologically critical areas in accordance with *Lynnwood Municipal Code* (LMC). Because the slopes are relatively short, relatively gently inclined, and are man-made slopes constructed during earlier site development, we anticipate that any prescriptive buffers or setbacks associated with the slopes can be exempted through provisions of LMC Section 17.10.092.

3.0 SUBSURFACE EXPLORATION

Our subsurface exploration completed for this project included advancing three hollow-stem auger soil borings. The conclusions and recommendations presented in this report are based on the explorations completed for this study. The locations and depths of the explorations were completed within site and budget constraints.

3.1 Exploration Borings

The exploration borings were completed by advancing hollow-stem auger tools with a limited-access, track-mounted drill rig. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. The exploration borings were continuously observed and logged by a representative from our firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM):D 1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations may not become fully evident until construction.

4.1 Stratigraphy

Surficial Topsoil

Exploration borings encountered approximately 8 to 12 inches of topsoil and grass. Topsoil is not suitable for structural support, and should be stripped from structural areas. Excavated topsoil may be suitable for reuse in landscape areas.

Fill

Existing fill was encountered in one of our exploration borings (EB-3) to a depth of approximately 3 feet below the existing ground surface. The existing fill was observed to be very loose to medium dense. The existing fill was of a similar texture to the existing undisturbed soils on-site. The existing fill is loose and will require removal or other remedial preparation below planned building areas and remedial preparation below planned paving. Excavated existing fill is suitable for reuse in structural fill applications if specifically allowed by project specifications, and if any organic or other deleterious materials are removed. Excavated existing fill material is expected to be wetter than optimum moisture content for compaction purposes and will require drying during dry site and weather conditions prior to use in compacted fills.

Lodgement Till

Each of the exploration borings encountered native sediments consisting of very dense silty sand with gravel interpreted as Vashon lodgement till. Lodgement till was deposited at the base of an active continental glacier and was compacted by the weight of the overlying glacial ice. Lodgement till is suitable for structural support when properly prepared. Excavated lodgement till material is suitable for use in structural fill applications if suitable moisture conditions are achieved prior to compaction, and if such reuse is specifically allowed by project plans and specifications. At the time of exploration, we estimate that most or all of the lodgement till soils that we observed were above optimum moisture content for compaction purposes, and therefore, will require drying during favorable weather prior to compaction in structural fill applications.

Our interpretations of subsurface conditions on-site are different from a published geologic map of the area, as represented by the J.P. Minard, 1983, *Geologic Map of the Edmonds East and part of the Edmonds West Quadrangles, Washington: U.S. Geological Survey, Miscellaneous Field Studies Map MF-1541*. The published map indicates that the site is in an area characterized by Vashon lodgement till at the ground surface.

4.2 Hydrology

No ground water was observed in our exploration borings. Ground water is expected to occur seasonally at this site “perched” above the underlying lodgement till sediments, and possibly above existing fills. Perched ground water occurs when vertical infiltration is impeded by less-permeable soil layers, resulting in horizontal flow. The quantity and duration of perched ground water flow from an excavation will vary, depending on season, soil gradation, and adjacent topography. Ground water conditions should be expected to vary in response to changes in precipitation, on- and off-site land usage, and other factors.

4.3 Laboratory Testing

As a part of our investigation, we completed one laboratory grain-size analysis. A copy of the grain-size analysis report is included in the Appendix.

4.4 Infiltration Potential

The site is underlain by existing fill in some locations that is not suitable for use as an infiltration receptor. Native sediments at shallow depth at this site consist of lodgement till. Lodgement till is not suitable for use as a storm water infiltration receptor, and therefore conventional shallow infiltration strategies are not recommended. Deeper infiltration strategies might be feasible. Our study was not structured to investigate the feasibility of deeper infiltration strategies such as Underground Injection Control (UIC) wells and pit drains. We are available to discuss such a feasibility assessment on request.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and ground and surface water conditions, as observed and discussed herein. The discussion will be limited to slope stability, seismic, and erosion issues.

5.0 SLOPE HAZARDS AND MITIGATIONS

In our opinion, slopes at the south edge of the site and between the existing school buildings and the play fields to the east may meet City of Lynnwood criteria for treatment as geologically critical areas as defined in LMC Section 17.10.030. The definition includes any slope inclined more than 40 percent without a requirement for a minimum height. Code section 17.10.092 offers a mechanism to allow modification of critical slopes. Because the observed subsurface conditions consist primarily of very dense glacially consolidated sediments, the existing slopes are relatively gently inclined, the existing slopes are relatively short, and the existing slopes were created during earlier site grading we anticipate that that the project can be planned without assuming any buffers or setbacks for existing slopes. It is possible that additional analyses will be required at some future time to support a specific site development proposal once detailed plans are developed. No detailed slope stability analysis was completed for this preliminary study, and none is warranted, in our opinion.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The City of Lynnwood critical areas code does not include a definition for seismic hazard areas. Seismic design procedures consistent with the 2012 *International Building Code* (IBC) are expected to be used for this project. The following discussion is a general assessment of seismic hazards that is intended to be useful to the District in terms of understanding seismic issues, and to the structural engineer for final structural design.

Earthquakes occur regularly in the Puget Lowland. The majority of these events are small and are usually not felt by people. However, large earthquakes do occur, as evidenced by the 1949, 7.2-magnitude event; the 2001, 6.8-magnitude event; and the 1965, 6.5-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and

4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. Earthquakes that are generated at such depths usually do not result in fault rupture at the ground surface. Current research indicates that surficial ground rupture is possible in areas close to the South Whidbey Island Fault Zone. Although our current understanding of this fault zone is limited and is an active area of research, the site appears to lie within the currently understood limits of the fault zone and therefore surface rupture due to a seismic event in the future cannot be ruled out. Because the project will include renovations and additions to an existing school, and because it is difficult to quantify surface rupture risks and difficult to mitigate such risks if they do exist, our analysis did not include a detailed analysis of the potential for surface rupture due to a seismic event. We are available to discuss the issue of surface rupture risk and possible responses on request.

6.2 Seismically Induced Landslides

It is our opinion that the potential risk of damage to the proposed development by seismically induced slope failures is low due to the lack of substantial slopes and the prevalence of relatively competent, glacially consolidated soils.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

The subsurface conditions encountered at the site pose low risk of liquefaction due to the lack of observed shallow ground water, and the high density of the lodgement till. No detailed liquefaction analysis was completed as part of this study, and none is warranted, in our opinion.

6.4 Ground Motion

Structural design for the project should follow 2012 IBC standards. The 2012 IBC defines Site Classification by reference to Table 20.3.-1 of the *American Society of Civil Engineers* publication ASCE 7, the current version of which is ASCE 7-10. In our opinion, the subsurface conditions at the site are consistent with a Site Classification of "C" as defined in the referenced documents.

7.0 EROSION HAZARDS AND MITIGATIONS

The following discussion addresses Washington State Department of Ecology (Ecology) erosion control regulations that will be applicable to the project. We anticipate that if the project complies with State requirements, it will also be acceptable with respect to City of Lynnwood requirements.

As of October 1, 2008, Ecology Construction Storm Water General Permit (also known as the National Pollutant Discharge Elimination System [NPDES] permit) requires weekly Temporary Erosion and Sedimentation Control (TESC), turbidity and pH monitoring for all sites 1 or more acres in size that discharge storm water to surface waters of the state. If the project will disturb more than 1 acre, we anticipate that these inspection and reporting requirements will be triggered. The following recommendations are related to general erosion potential and mitigation.

The erosion potential of the site soils is high. Maintaining cover measures atop disturbed ground typically provides the greatest reduction to the potential generation of turbid runoff and sediment transport. During the local wet season (October 1st through March 31st), exposed soil should not remain uncovered for more than 2 days unless it is actively being worked. Ground-cover measures can include erosion control matting, plastic sheeting, straw mulch, crushed rock or recycled concrete, or mature hydroseed.

Project planning and construction should follow local standards of practice with respect to temporary erosion and sedimentation control. Best management practices (BMPs) should include but not be limited to:

- Provide storm drain inlet protection;
- Route surface water away from work areas;
- Keep staging areas and travel areas clean and free of track-out;
- Cover work areas and stockpiled soils when not in use;
- Complete earthwork during dry weather and site conditions, if possible.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Some portions of the site are underlain by a layer of surficial existing fill that is loose and variable. Existing fill is not suitable for support of new foundations and warrants remedial preparation where it occurs below paving and similar lightly loaded structures. Structural fill or native sediments are suitable for support of shallow foundations, floor slabs, and paving with proper preparation.

9.0 SITE PREPARATION

Existing structures, paving, buried utilities, vegetation, topsoil, and any other deleterious materials should be removed where they are located below planned construction areas. All disturbed soils resulting from demolition activities should be removed to expose underlying undisturbed native sediments and replaced with structural fill, as needed. All excavations below final grade made for demolition activities should be backfilled, as needed, with structural fill. Erosion and surface water control should be established around the clearing limits to satisfy local requirements.

Once demolition has been completed, existing fill should be addressed. The observed thickness of existing fill ranged up to approximately 3 feet. We recommend that existing fill below building areas be removed and replaced with Structural Fill. It is important to include remedial preparation of the existing fill in the bid documents in a way that encourages competitive pricing and reduces the potential for claims of unanticipated conditions. We are available to review project specification sections related to geotechnical issues if requested to do so.

Below planned on-site paving, existing fill should be exposed, proof-rolled, and compacted to 95 percent of the modified Proctor maximum dry density. If a firm and unyielding condition is achieved, no further remedial preparation would be needed. If yielding conditions are encountered, existing fill would be partially removed and replaced with imported structural fill. The depth of replacement of the existing fill below paving should be determined at the time of construction when field conditions are known.

9.1 Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access may be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased, if drainage efforts are not accomplished in a timely sequence. If an effective drainage system is not utilized, project delays and increased costs could be incurred due to the greater quantities of wet and unsuitable fill, or poor access and unstable conditions.

We anticipate that perched ground water could be encountered in excavations completed during construction. We do not anticipate the need for extensive dewatering in advance of excavations. The contractor should be prepared to intercept any ground water seepage entering the excavations and route it to a suitable discharge location.

Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building area. We recommend that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeters be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the structures.

9.2 Subgrade Protection

To the extent that it is possible, existing pavement should be used for construction staging areas. If building construction will proceed during the winter, we recommend the use of a working surface of sand and gravel, crushed rock, or quarry spalls to protect exposed soils, particularly in areas supporting concentrated equipment traffic. In winter construction staging areas and areas that will be subjected to repeated heavy loads, such as those that occur during construction of masonry walls, a minimum thickness of 12 inches of quarry spalls or 18 inches of pit run sand and gravel is recommended. If subgrade conditions are soft and silty, a geotextile separation fabric, such as Mirafi 500X or approved equivalent, should be used between the subgrade and the new fill. For building pads where floor slabs and foundation construction will be completed in the winter, a similar working surface should be used, composed of at least 6 inches of pit run sand and gravel or crushed rock. Construction of working surfaces from advancing fill pads could be used to avoid directly exposing the subgrade soils to vehicular traffic.

Foundation subgrades may require protection from foot and equipment traffic and ponding of runoff during wet weather conditions. Typically, compacted crushed rock or a lean-mix concrete mat placed over a properly prepared subgrade provides adequate subgrade protection. Foundation concrete should be placed and excavations backfilled as soon as possible to protect the bearing surface.

9.3 Proof-Rolling and Subgrade Compaction

Following the recommended demolition, site stripping, existing fill removal, and planned excavation, the stripped subgrade within the building and paving areas should be proof-rolled with heavy, rubber-tired construction equipment, such as a fully loaded tandem-axle dump truck. Proof-rolling should be performed prior to structural fill placement or foundation excavation. The proof-roll should be monitored by the geotechnical engineer so that any soft or yielding subgrade soils can be identified. Any soft/loose, yielding soils should be removed to a stable subgrade. The subgrade should then be scarified, adjusted in moisture content, and recompacted to the required density. Proof-rolling should only be attempted if soil moisture contents are at or near optimum moisture content. Proof-rolling of wet subgrades could result in further degradation. Low areas and excavations may then be raised to the planned finished grade with compacted structural fill. Subgrade preparation and selection, placement, and compaction of structural fill should be performed under engineering-controlled conditions in accordance with the project specifications.

9.4 Overexcavation/Stabilization

Construction during extended wet weather periods could create the need to overexcavate exposed soils if they become disturbed and cannot be recompacted due to elevated moisture content and/or weather conditions. Even during dry weather periods, soft/wet soils, which may need to be overexcavated, may be encountered in some portions of the site. If overexcavation is necessary, it should be confirmed through continuous observation and testing by Associated Earth Sciences, Inc. (AESI). Soils that have become unstable may require remedial measures in the form of one or more of the following:

1. Drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry and warm weather.

2. Removal of affected soils to expose a suitable bearing subgrade and replacement with compacted structural fill.

3. Mechanical stabilization with a coarse crushed aggregate compacted into the subgrade, possibly in conjunction with a geotextile.

4. Soil/cement admixture stabilization.

9.5 Wet Weather Conditions

If construction proceeds during an extended wet weather construction period and the moisture-sensitive site soils become wet, they will become unstable. Therefore, the bids for site grading operations should be based upon the time of year that construction will proceed. It is expected that in wet conditions additional soils may need to be removed and/or other stabilization methods used, such as a coarse crushed rock working mat, to develop a stable condition if silty subgrade soils are disturbed in the presence of excess moisture. The severity of construction disturbance will be dependent, in part, on the precautions that are taken by the contractor to protect the moisture- and disturbance-sensitive site soils. If overexcavation is necessary, it should be confirmed through continuous observation and testing by a representative of our firm.

9.6 Temporary and Permanent Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the existing fill can be made at a maximum slope of 1.5H:1V or flatter. Temporary slopes in unsaturated lodgement till sediments may be planned at 1H:1V. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. If ground water seepage is encountered in cut slopes, or if surface water is not routed away from temporary cut slope faces, flatter slopes will be required. In addition, WISHA/OSHA regulations should be followed at all times. Permanent cut and structural fill slopes that are not intended to be exposed to surface water should be designed at inclinations of 2H:1V or flatter. All permanent cut or fill slopes should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM:D 1557, and the slopes should be protected from erosion by sheet plastic until vegetation cover can be established during favorable weather.

9.7 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill or foundation components. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill or foundation components. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

10.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type and placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer, the upper 12 inches of exposed ground in areas to receive fill should be recompacted to 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. If the subgrade contains silty soils and too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. Use of soils from the site in structural fill applications is acceptable if the material meets the project specifications for the intended use, and if specifically allowed by project specifications. In the case of roadway and utility trench filling, structural fill should be placed and compacted in accordance with current City of Lynnwood codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the roadway edges before sloping down at an angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions, and is only permitted if specifically allowed by project plans and specifications. The native and existing fill soils present on-site contained significant amounts of silt and are considered highly moisture-sensitive. Existing fill can contain construction/demolition materials and/or significant organic content in which case they are not suitable for reuse in structural fill applications. If fill is placed during wet weather or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction with at least 25 percent retained on the No. 4 sieve.

A representative from our firm should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses, and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the District in developing a suitable monitoring and testing program.

11.0 FOUNDATIONS

Spread footings may be used for building support when founded directly on undisturbed lodgement till, or on structural fill placed above suitable native deposits, as previously discussed. If foundations will be underlain by a combination of very dense native sediments and new structural fill, we recommend that an allowable bearing pressure of 3,500 pounds per square foot (psf) be used for design purposes, including both dead and live loads. Higher foundation soil bearing pressures are possible for foundations supported entirely on undisturbed lodgement till, however we do not expect that higher bearing pressures will be needed. If higher foundation soil bearing pressures are needed, we should be allowed to offer situation-specific recommendations.

Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum, and no footing should be founded in or above organic or loose soils. All footings should have a minimum width of 18 inches.

It should be noted that the area bound by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as described above should be on the order of ¾ inch or less. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the governing municipality. Perimeter footing drains should be provided, as discussed under the "Drainage Considerations" section of this report.

11.1 Drainage Considerations

Foundations should be provided with foundation drains. Drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed pea gravel. The drains should be constructed with sufficient gradient to allow gravity discharge away from the proposed buildings. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the proposed structures to achieve surface drainage.

12.0 FLOOR SUPPORT

Floor slabs can be supported on suitable native sediments, or on structural fill placed above suitable native sediments. Floor slabs should be cast atop a minimum of 4 inches of clean, washed, crushed rock or pea gravel to act as a capillary break. Areas of subgrade that are disturbed (loosened) during construction should be compacted to a non-yielding condition prior to placement of capillary break material. Floor slabs should also be protected from dampness by an impervious moisture barrier at least 10 mils thick. The moisture barrier should be placed between the capillary break material and the concrete slab.

13.0 FOUNDATION WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed to resist active lateral earth pressure represented by an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an at-rest equivalent fluid of 50 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

As required by the 2012 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 5H and 10H psf, where H is the wall height in feet, for the “active” and “at-rest” loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils, or imported structural fill compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in settlement of the slab-on-grade or other structures supported above the walls. Thus, the compaction level is critical and must be tested by our firm during placement. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum, 1-foot-wide blanket drain to within 1 foot of finish grade for the full wall height using imported, washed gravel against the walls.

13.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the natural glacial soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters:

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

14.0 PAVEMENT RECOMMENDATIONS

Pavement areas should be prepared in accordance with the "Site Preparation" section of this report. If the stripped native soil or existing fill pavement subgrade can be compacted to 95 percent of ASTM:D 1557 and is firm and unyielding, no additional overexcavation is required. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

The pavement sections included in this report section are for driveway and parking areas on-site, and are not applicable to right-of-way improvements. We understand that right-of-way paving will be limited to small patches and miscellaneous work that does not require a detailed pavement thickness analysis.

Pavement subgrades underlain by existing fill should be prepared in accordance with the "Site Preparation" section of this report. The exposed ground should be recompacted to 95 percent of ASTM:D 1557. If required, structural fill may then be placed to achieve desired subbase grades. Upon completion of the recompaction and structural fill, a pavement section consisting of 2½ inches of asphaltic concrete pavement (ACP) underlain by 4 inches of 1¼-inch Crushed Surfacing Base Course is the recommended minimum in areas of planned passenger car driving and parking. In heavy traffic areas, a minimum pavement section consisting of 3 inches of ACP underlain by 2 inches of $^5/_8$-inch crushed surfacing top course and 4 inches of 1¼-inch Crushed Surfacing Base Course is recommended. The crushed rock courses must be compacted to 95 percent of the maximum density, as determined by ASTM:D 1557. All paving materials should meet gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications.

Depending on construction staging and desired performance, the Crushed Surfacing Base Course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a native or structural fill subgrade compacted to a minimum of 95 percent relative density, and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected. The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

Our report is preliminary since project plans had not been developed at the time this report was written. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, we can confirm that our earthwork and foundation recommendations have been properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering services during construction. The integrity of the foundation system depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

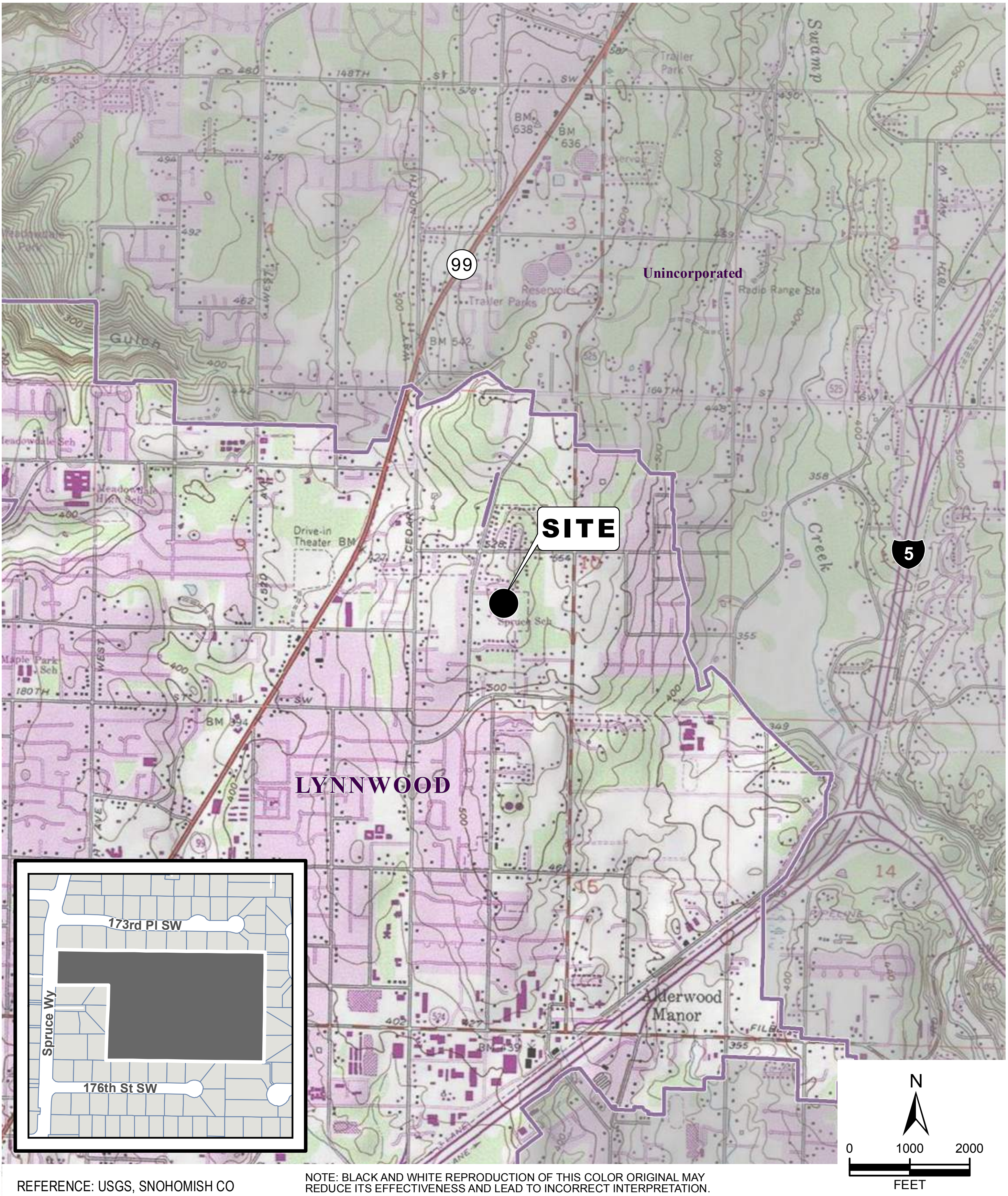
DRAFT

____
Bruce W. Guenzler, L.E.G.
Senior Project Geologist

DRAFT

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Exploration Plan
	Appendix:	Exploration Logs
		Laboratory Testing Results



REFERENCE: USGS, SNOHOMISH CO

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

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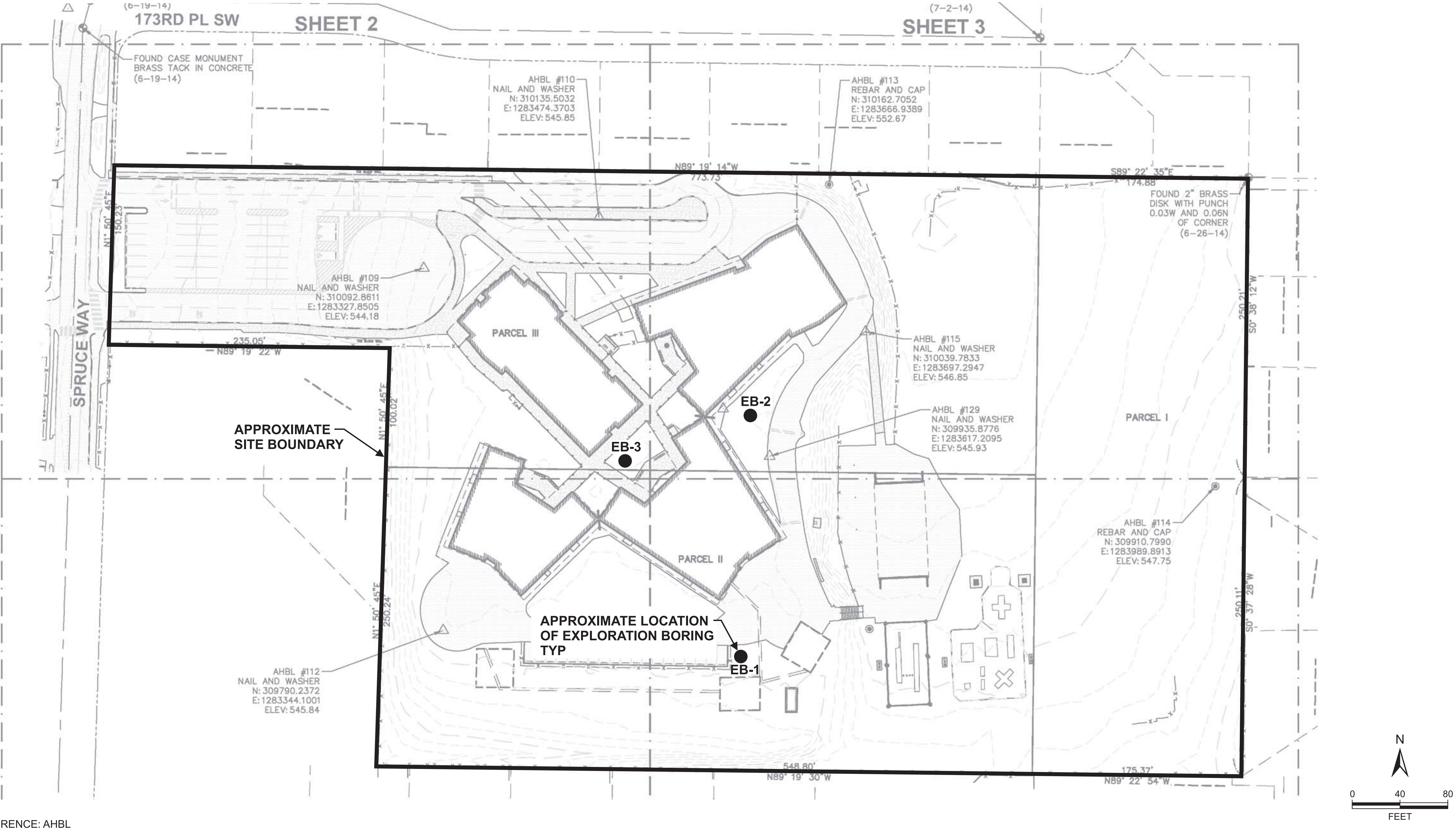
VICINITY MAP

SPRUCE ELEMENTARY SCHOOL
LYNNWOOD, WASHINGTON

FIGURE 1

DATE 12/14

PROJ. NO. KE140562A



REFERENCE: AHBL

140562 Lynnwood Elementary School \ 140562 Site and Exploration Plan.cdr

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SITE AND EXPLORATION PLAN

SPRUCE ELEMENTARY SCHOOL
LYNNWOOD, WASHINGTON

FIGURE 2

DATE 12/14

PROJ. NO. KE140562A

APPENDIX

Coarse-Grained Soils - More than 50%(1) Retained on No. 200 Sieve	Gravels - More than 50%(1) of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines (5)	**GW**	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines (5)	**GM**	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%(1) or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines (5)	**SW**	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines (5)	**SM**	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50% (1) or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT(2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT(2) blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

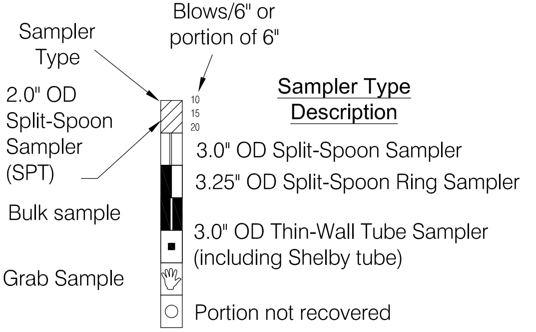
(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

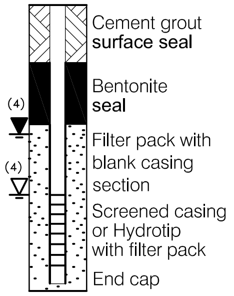
Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols



Sampler Type Description

3.0" OD Split-Spoon Sampler
3.25" OD Split-Spoon Ring Sampler
3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
Portion not recovered



(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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EXPLORATION LOG KEY

FIGURE A1

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-1	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) 545
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
			Grass / Topsoil					
			Lodgement Till					
		S-1	Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			15 25 50/5"	▲50/5"	
5		S-2	Gradation as above.			17 39 50/5"	▲50/5"	
10		S-3	Gradation as above.			30 50/3"	▲50/3"	
			Bottom of exploration boring at 11 feet Ground water not encountered.					

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ☒ Grab Sample
- ☐ No Recovery
- ▐ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-2	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) 546
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Lodgement Till					
		S-1		Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			19 41 50/4"	▲50/4"	
5		S-2		Gradation as above.			29 36 37	▲73	
10		S-3		Gradation as above.			27 40 50/4"	▲50/4"	
				Bottom of exploration boring at 11.5 feet Ground water not encountered.					

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
▨ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-3	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) 544
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
			Grass / Topsoil					
			Fill Loose, very moist, gray, silty SAND (SM). Hand dug to 2 1/2 feet.					
		S-1	**Lodgement Till** Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			12 23 50/5"	▲50/5"	
5		S-2	Gradation as above.			18 35 50/5"	▲50/5"	
10		S-3	Gradation generally as above, but with a thin seam (~ 1/2 inch) of fine sand, trace silt.			20 38 45	▲83	
			Bottom of exploration boring at 11.5 feet Ground water not encountered.					

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level ()
☐ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

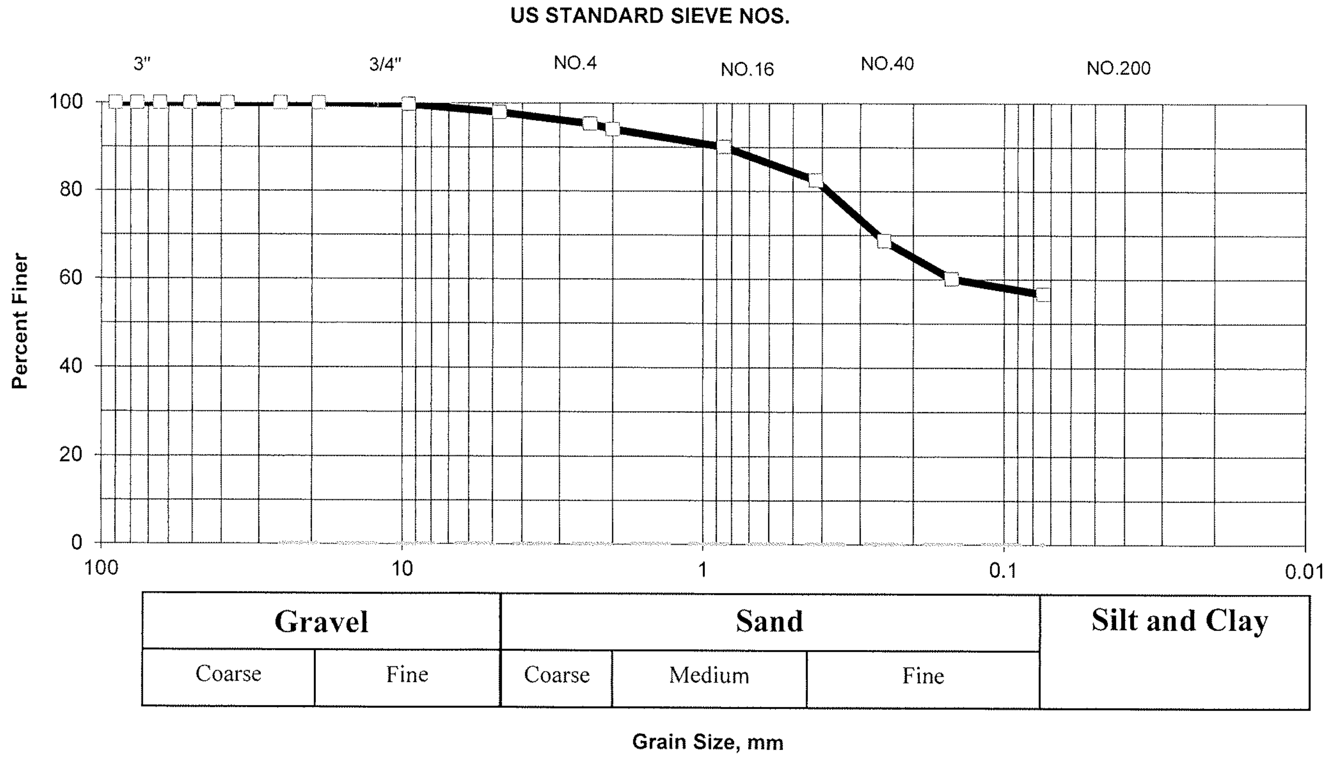
Logged by: BWG
Approved by:

GRAIN SIZE ANALYSIS - MECHANICAL

Date Sampled	Project	Project No.		Soil Description
12/22/2014	**Spruce Elementary**	**KE140562A**		**Sandy silt trace gravel**
Tested By	Location	EB/EP No	Depth	Intended Use / Specification
MS	**Onsite**	**EB-3**	**5'**	

Wt. of moisture wet sample + Tare	331.5	Total Sample Tare	467.72
Wt. of moisture dry Sample + Tare	309.94	Total Sample wt + tare	1137.57
Wt. of Tare	100	Total Sample Wt	669.9
Wt. of moisture Dry Sample	209.94	Total Sample Dry Wt	607.5
Moisture %	10%		

Sieve No.	Diam. (mm)	Wt. Retained (g)	% Retained	% Passing	Specification Requirements	
					Minimum	Maximum
3.5	90		-	100.00	-	-
3	76.1		-	100.00	-	-
2.5	64		-	100.00	-	-
2	50.8		-	100.00	-	-
1.5	38.1		-	100.00	-	-
1	25.4		-	100.00		
3/4	19		-	100.00		
3/8	9.51	1.64	0.27	99.73		
#4	4.76	12.66	2.08	97.92		
#8	2.38	28.22	4.65	95.35		
#10	2	35.84	5.90	94.10		
#20	0.85	59.99	9.88	90.12		
#40	0.42	106.07	17.46	82.54		
#60	0.25	189.97	31.27	68.73		
#100	0.149	242.13	39.86	60.14		
#200	0.074	263.19	43.33	56.67		



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December 4, 2019
Project No. 20140562E002

Edmonds School District No. 15
20420 68th Avenue West
Lynnwood, Washington 98124

Attention: Ms. Taine Wilton

Subject: Geotechnical Report Addendum
Spruce Elementary School
17405 Spruce Way
Lynnwood, Washington

References: "Subsurface Exploration, and Geotechnical Engineering Report, New Spruce Elementary School," prepared by Associated Earth Sciences, Inc. (AESI), dated April 18, 2017 (Project No. KE140562A).

Dear Ms. Wilton:

This letter-report addendum presents the results of supplemental subsurface exploration and analysis completed for the Spruce Elementary School Campus located at 17405 Spruce Way in Lynnwood, Washington. This addendum was prepared to provide supplemental recommendations for design and construction of the Spruce Elementary School Project - Phase 2. Specific items addressed in this addendum include subsurface conditions in our recent explorations, recommendations for drainage mitigation of existing pavement, and recommendations for stormwater pond construction. The subsurface data provided in this addendum supplements exploration data previously presented in our referenced geotechnical report. This addendum was prepared for the exclusive use of the Edmonds School District, and their authorized agents, for specific application to this project. No other warranty, express or implied, is made.

INTRODUCTION

Phase 1 of the new Spruce Elementary School Project began construction in the summer of 2018. Phase 1 construction was focused on the east half of the project site and included the new school building and surrounding improvements. AESI provided observation and testing services during Phase 1 construction of the new Spruce Elementary School from July 18, 2018 to April 10, 2019. Phase 2 construction will be focused mainly on the west half of the project site and will include new stormwater ponds, utilities, paved drive lanes and parking areas, and sidewalks. The site location is shown on Figure 1, "Vicinity Map." The approximate locations of the explorations completed for this study, as well as previous explorations completed are shown on the "Existing Site and Exploration Plan," Figure 2.

The Edmonds School District has recently acquired two adjacent residential lots which make up the southwest portion of the project site, see Figure 2. The larger residential lot currently consists of a single-family residence, detached garage, accessory dwelling unit, gravel driveway, and utilities. The smaller lot consists of maintained grass area and other landscaping. We understand that a new paved entrance and stormwater pond will be located in the vicinity of these recently acquired lots.

SUBSURFACE CONDITIONS

Exploration Borings

Four exploration borings (EB-11 through EB-14) were completed for this study with a track-mounted hollow-stem auger drill rig on April 2, 2019. The explorations were completed in locations requested by the design team. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. The exploration borings were continuously observed and logged by a representative from our firm. The exploration logs presented in Appendix A are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM) D-1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing.

Exploration Pits

Three exploration pits (EP-1 through EP-3) were completed on the residential lots recently acquired by the Edmonds School District on November 7, 2019. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the pits were studied and classified in the field by a geologist from AESI. After logging the exposed soils, the exploration pits were backfilled with the excavated soil and lightly tamped with the excavator bucket. The various types of materials and sediments encountered in the explorations, as well as the depths where characteristics of these materials changed, are indicated on the exploration logs included in Appendix A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field.

Stratigraphy

Our explorations generally encountered native lodgement till near the surface or overlain by existing fill soils. The explorations completed for this study were generally consistent with previously completed explorations at the site as well as our observations during construction of Phase 1. The following section presents more detailed subsurface information organized from the shallowest (youngest) to the deepest (oldest) sediment types. Copies of the exploration logs are included in Appendix A.

Topsoil

Exploration borings EB-11 and EB-12 encountered 4 inches and 3 inches of sod and topsoil at the surface, respectively. The exploration pits EP-1 through EP-3 encountered approximately 12 inches of sod and topsoil. Observed topsoil thickness are shown on the attached subsurface exploration logs. Due to their high organic content, these materials are not considered suitable for pavement support, or support of other hardscapes.

Asphalt

Explorations EB-13 and EB-14 encountered 3 inches and 4 inches of asphalt at the surface, respectively. In EB-13, the asphalt was directly over existing fill soils and in EB-14, the asphalt was underlain by 4 inches of a gravel base.

Fill

Fill soils were encountered directly below the ground surface in explorations EB-11 through EB-14. The fill generally consisted of loose to medium dense, silty, sand with trace to some gravel, and contained scattered organic debris in areas. The fill extended to depths ranging from 4.5 to 8 feet below the surface.

Vashon Lodgement Till

Underlying the fill or encountered near the surface in the explorations completed for this study, we encountered sediments generally consisting of unsorted, dense, silty sand with gravel. We interpret these sediments to be representative of Vashon lodgement till. The Vashon lodgement till was deposited directly from basal, debris-laden, glacial ice during Vashon time. The high relative density characteristic of the Vashon lodgement till is due to its consolidation by the massive weight of the glacial ice from which it was deposited. Where encountered, the lodgement till extended beyond the maximum depths explored of approximately 10 to 21.5 feet.

Geologic Map Review

Review of the regional geologic map titled*, Geologic Map of the Edmonds East and Part of the Edmonds West Quadrangles, Washington,* U.S. Geological Survey (USGS), Miscellaneous Field Studies Map MF-1541, by J.P. Minard (1983) indicates that the subject site is underlain by Vashon lodgement till. Our interpretation of the sediments encountered in our explorations is in general agreement with the geologic map. The explorations completed for this study encountered Vashon lodgement till underlying existing fill soils.

Groundwater

Groundwater seepage was not encountered in any of the explorations completed for this study. Groundwater is expected to occur seasonally at this site “perched” above the underlying lodgement till sediments, and possibly above existing fills. Perched groundwater occurs when vertical infiltration is impeded by less-permeable soil layers, resulting in horizontal flow. The quantity and duration of perched groundwater flow from an excavation will vary, depending on season, soil gradation, and adjacent topography. Groundwater conditions should be expected to vary in response to changes in precipitation, on- and off-site land usage, and other factors.

RECOMMENDATIONS

Existing Pavement Drainage

Exploration EB-14 was completed in the western parking lot area near an area where groundwater is known to seep through the pavement. This exploration encountered approximately 4 inches of asphalt overlying 4 inches of gravel base placed on top of existing fill. No groundwater seepage was observed in this exploration. Exploration boring EB-10, completed for our previous study, was drilled approximately 50 feet northwest of EB-14 within existing pavement and encountered 4 inches of pavement placed directly on existing fill soils. Perched groundwater was encountered in EB-10 at 4 feet below the surface.

Our explorations within the existing parking lot indicate that the crushed rock base is not continuous under the asphalt. With no continuous rock subbase, there is no continuous drainage pathway under the existing pavement which can cause perched groundwater to become trapped under the pavement and daylight through voids in the pavement. This can result in faster deterioration and softening of the subgrade during traffic loading as well as damage from freeze-thaw action.

We understand most of the northwest parking lot area will become landscaped areas or bioretention facilities, including the location where groundwater seepage through the asphalt has been observed. Entry and exit lanes comprised of the existing asphalt will be located to the north and south of the landscaped bioretention areas. For drainage mitigation of the paved drive lanes, we have provided options below that range from a “Do Nothing” approach to demolishing the asphalt and constructing a new pavement section.

Do Nothing Approach

The “Do Nothing” approach would provide no drainage mitigation for the existing pavement. The existing pavement would have similar performance and condition as currently exhibited. Risks associated with pavement deterioration due to perched water and wet subgrades would remain.

Overlay

A new asphalt overlay could be laid over the existing asphalt for the drive lane areas. A new overlay would improve the existing asphalt surface conditions, would marginally extend the life of the drive lanes, and is a cheaper option than constructing a new pavement section. However, this option does not mitigate poor asphalt drainage and risks associated with pavement deterioration due to perched water and wet subgrades would remain.

New Pavement Section

For this approach the existing asphalt is demolished and a new pavement section is constructed for the drive lanes. The new pavement section should follow our recommendations provided in our referenced report which provides a gravel subbase under the asphalt allowing for improved and more continuous drainage.

Stormwater Pond

Exploration pits in the proposed location of the southwest stormwater pond, generally encountered sod/topsoil overlying native lodgement till. We understand that the pond will partially be cut into native lodgement till sediments with fills up to 5 feet thick needed to achieve top of berm elevation.

1. Pond berm embankments must be constructed on native lodgement till free of loose surface soil materials, roots, and other organic debris.

2. Pond berm embankments greater than 4 feet in height must be constructed by excavating a key equal to 50 percent of the berm embankment cross-sectional height.

3. The berm embankment shall be constructed of soil placed in 6-inch lifts compacted to at least 95 percent of maximum dry density, within 2 percentage points of the optimum moisture content, modified Proctor method ASTM D-1557. Density tests shall be performed for each lift to confirm compliance with this specification.

4. Compacted lodgement till or existing fill soils may be used for construction of the pond berm if they are free of organics and other deleterious materials and are placed as described in number 3 above.

5. An impermeable liner will be needed to prevent infiltration of water through the pond berms. Lodgement till generally works well as an impermeable pond liner. If lodgement till will be used as an impermeable pond liner it should have the following characteristics: a minimum of 20 percent silt and clay (passing the #200 sieve), a minimum of 70 percent and maximum of 100 percent sand (passing the #4 sieve), and a maximum particle size of 6 inches. Compacted till liners should have a minimum thickness of 18 inches and should be placed as described in number 3 above.

The result of a Proctor test completed on a sample of lodgement till collected from EP-2 is included in Appendix B.

CONCLUSION

We appreciate this opportunity to have been of service to you with your project. Should you have any questions, or require additional information, please do not hesitate to call.

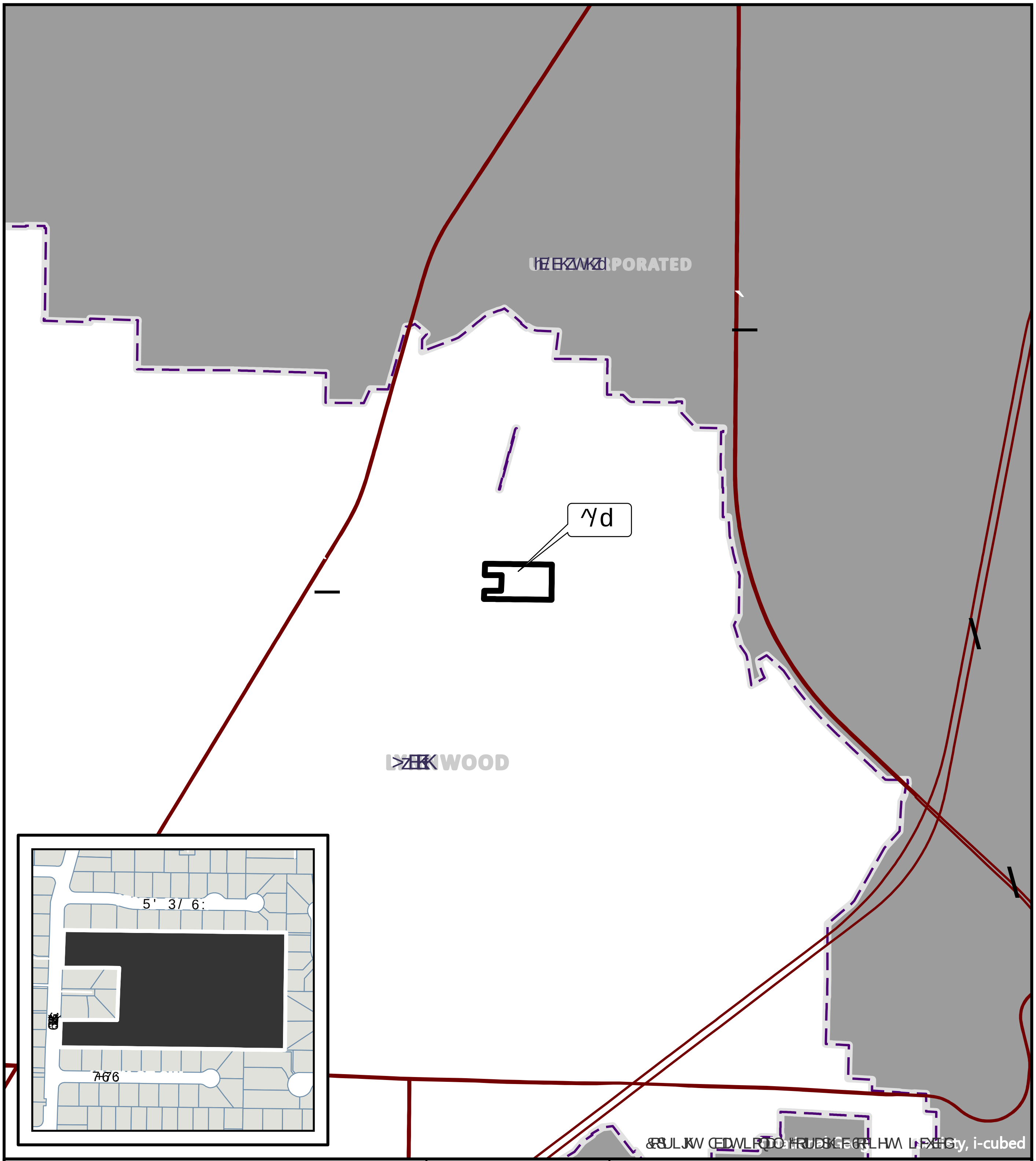
Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

KURT D. MERRIMAN
23580
12-4-19

Anthony W. Romanick, P.E.
Senior Project Engineer

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments:	Figure 1.	Vicinity Map
	Figure 2.	Existing Site and Exploration Plan
	Appendix A.	Exploration Logs
	Appendix B.	Laboratory Analysis



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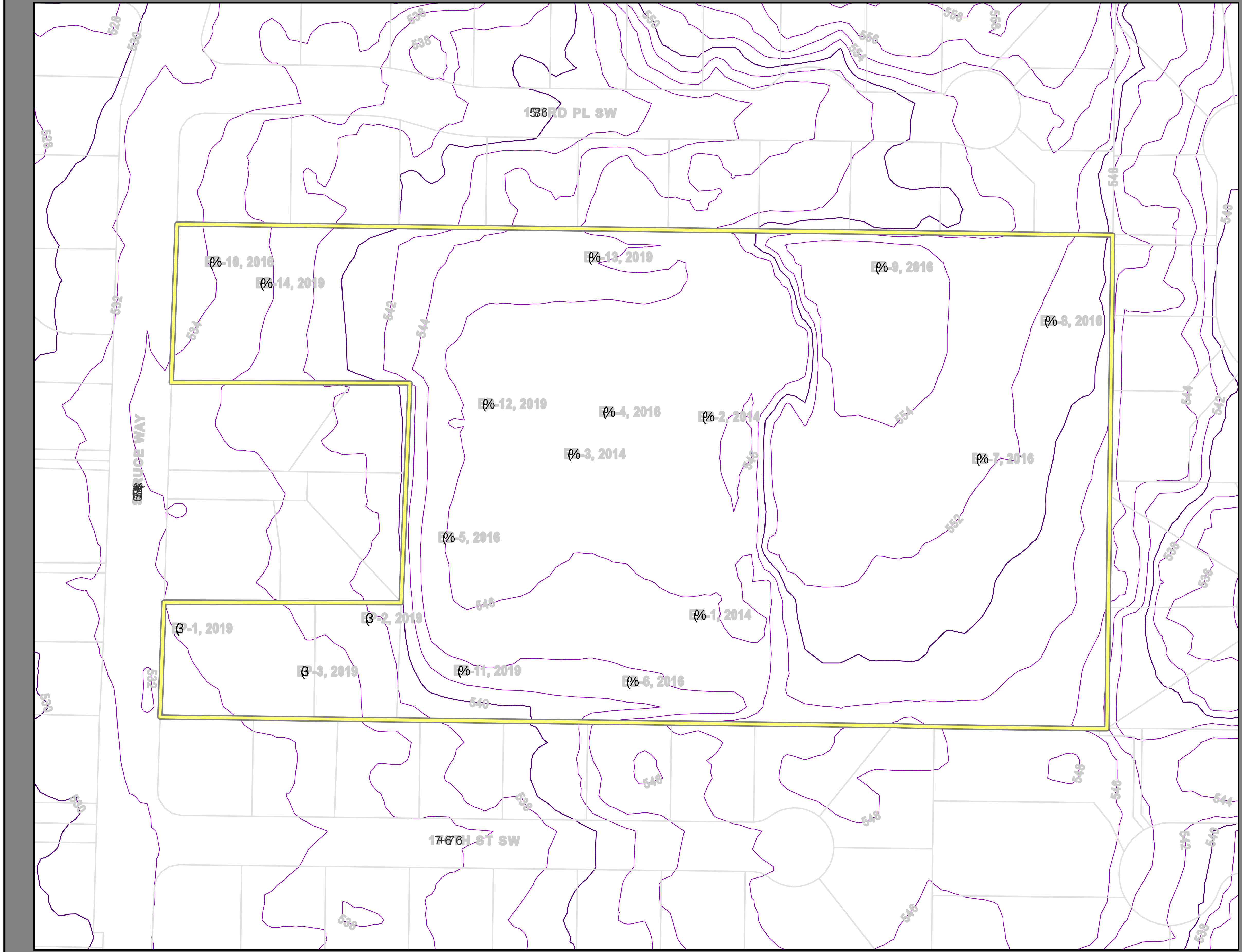

▭ SITE

EXPLORATION BORING

EXPLORATION PIT

▭ PARCEL

∿ CONTOUR 10 FT

∿ CONTOUR 2 FT

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APPENDIX A

Exploration Logs

Coarse-Grained Soils - More than 50%(1) Retained on No. 200 Sieve	Gravels - More than 50%(1) of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines(5)	**GW**	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines(5)	**GM**	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%(1) or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines(5)	**SW**	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines(5)	**SM**	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%(1) or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT(2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT(2) blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

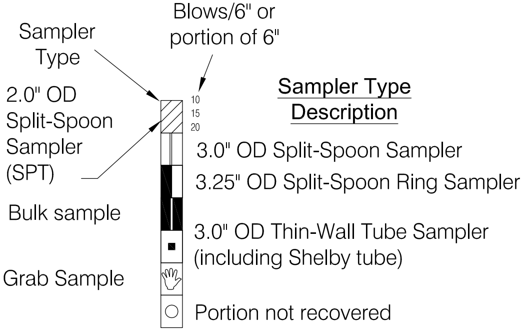
(3) Estimated Percentage

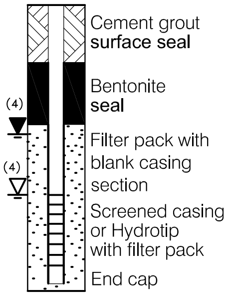
Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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EXPLORATION LOG KEY

FIGURE A1

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-1	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"
Ground Surface Elevation (ft) 545
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Lodgement Till					
		S-1		Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			15 25 50/5"	▲50/5"	
5		S-2		Gradation as above.			17 39 50/5"	▲50/5"	
10		S-3		Gradation as above.			30 50/3"	▲50/3"	
				Bottom of exploration boring at 11 feet Ground water not encountered.					
15									
20									
25									
30									
35									

Sampler Type (ST):

2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
3" OD Split Spoon Sampler (D & M)	Ring Sample	▽ Water Level ()
Grab Sample	Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-2	1 of 1

Project Name: Spruce Elem
Location: Lynnwood, WA
Driller/Equipment: Geologic Drill - HSA SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 546
Datum: AHBL July 2014
Date Start/Finish: 12/22/14,12/22/14
Hole Diameter (in): 7 inches

Depth (ft)	ST	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
0			**Grass / Topsoil**					
			Lodgement Till					
	▯	S-1	Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			19 41 50/4"	▲50/4"	
5	▯	S-2	Gradation as above.			29 36 37	▲73	
10	▯	S-3	Gradation as above.			27 40 50/4"	▲50/4"	
			Bottom of exploration boring at 11.5 feet Ground water not encountered.					

Blows/Foot scale: 10, 20, 30, 40

Depth scale: 5, 10, 15, 20, 25, 30, 35

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

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Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-3	1 of 1

Project Name: Spruce Elem
Location: Lynnwood, WA
Driller/Equipment: Geologic Drill - HSA SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 544
Datum: AHBL July 2014
Date Start/Finish: 12/22/14,12/22/14
Hole Diameter (in): 7 inches

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
0		**Grass / Topsoil**		
		Fill Loose, very moist, gray, silty SAND (SM). Hand dug to 2 1/2 feet.		
	S-1	**Lodgement Till** Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).	12 23 50/5"	50/5"
5	S-2	Gradation as above.	18 35 50/5"	50/5"
10	S-3	Gradation generally as above, but with a thin seam (~ 1/2 inch) of fine sand, trace silt.	20 38 45	83
		Bottom of exploration boring at 11.5 feet Ground water not encountered.		

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ☐ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-4	1 of 1

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / SPT
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 8/30/16,8/30/16
Hole Diameter (in): 4.25 inches

Depth (ft)	ST	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Grass / Topsoil					
			Vashon Lodgement Till					
		S-1	Dense, moist, tannish brown, gravelly, fine to medium SAND, some silt; broken gravel in sampler; contains organics; blow counts overstated due to gravel (SP).			17 13 27	40	
5		S-2	Very dense, moist, grayish tan, silty, fine to medium SAND, some gravel; contains interbed of fine to medium SAND, trace silt (SM-SP).			24 50/6"		
10		S-3	Very dense, moist, tannish gray, silty, fine to medium SAND, some gravel; unsorted (SM).			26 50/6"		
15		S-4	As above.			50/5"	50/5"	
20		S-5	As above.			50/5"	50/5"	
			Bottom of exploration boring at 20.5 feet No ground water encountered.					
25								
30								
35								

Blows/Foot: 10 20 30 40

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-5	1 of 1

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 8/30/16,8/30/16
Hole Diameter (in): 4.25 inches

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
0		**Grass / Topsoil**		
		Fill		
	S-1	Medium dense, moist, gray, silty, fine SAND, grades to silty, fine to medium SAND, some gravel; contains organics; unsorted (SM).	11 10 9	19
5	S-2	Medium dense, very moist, tannish gray, silty, fine SAND, trace gravel (SM).	4 6 8	14
10	S-3	Medium dense, very moist, gray, silty, fine SAND, trace gravel (SM).	4 7 9	16
		Driller notes harder drilling at 13 feet.		
		Vashon Lodgement Till		
15	S-4	Very dense, moist, tan, silty, fine to medium SAND; unsorted (SM).	32 50/5"	
		Bottom of exploration boring at 16 feet No ground water encountered.		
20				
25				
30				
35				

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-6	1 of 1

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 8/30/16,8/30/16
Hole Diameter (in): 4.25 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Vashon Lodgement Till					
		S-1		Very dense, moist, tan, silty, fine SAND, some gravel; unsorted (SM).			15 25 46	▲61	
5		S-2		As above.			26 35 49	▲84	
10		S-3		As above.			50/6"	▲50/6"	
15				Bottom of exploration boring at 15.5 feet No ground water encountered.					
20									
25									
30									
35									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-7	1 of 1

Project Name	Spruce Elementary School	Ground Surface Elevation (ft)	
Location	Lynnwood, WA	Datum	N/A
Driller/Equipment	GDI / SPT	Date Start/Finish	8/30/16,8/30/16
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	4.25 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Grass / Topsoil					
			Vashon Lodgement Till					
		S-1	Medium dense, moist, tan, silty, fine to medium SAND, some gravel; oxidized; unsorted (SM).			6 14 13	27	
5		S-2	Medium dense, moist, tan, silty, fine SAND, some gravel; unsorted (SM).			20 10 9	19	
10		S-3	As above.			6 14 18	32	
15		S-4	Very dense, very moist, gray, silty, fine to medium SAND, some gravel; unsorted (SM).			15 23 50/5"		
20		S-5	As above.			36 45 50/3"		
			Bottom of exploration boring at 21.5 feet No ground water encountered.					
25								
30								
35								

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

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Approved by: CJK

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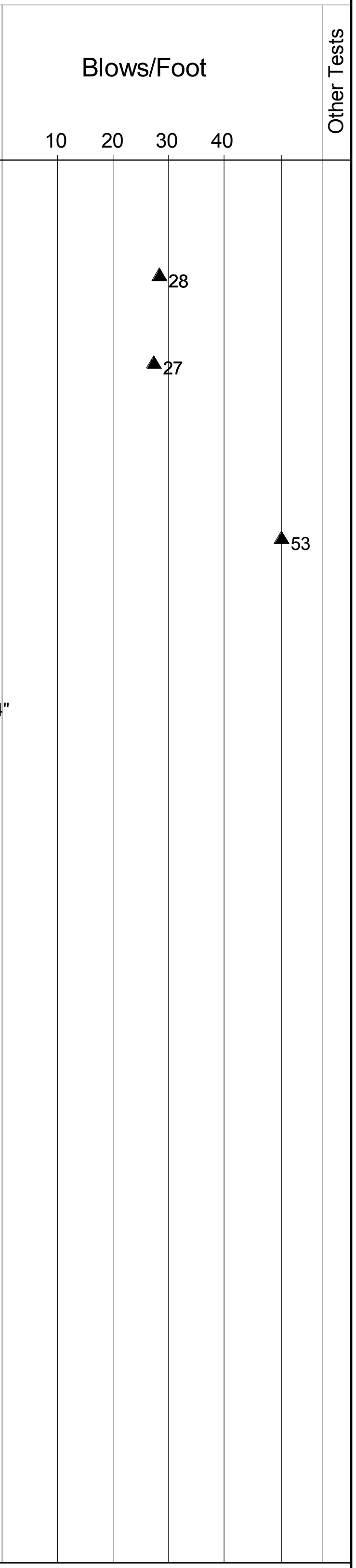
Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-8	1 of 1

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / SPT
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 8/30/16,8/30/16
Hole Diameter (in): 4.25 inches

Depth (ft)	ST	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"
0			**Grass / Topsoil**			
			Vashon Lodgement Till			
	▯	S-1	Medium dense, moist, tan, silty, fine to medium SAND, some gravel; broken gravel in sampler; blow counts may be overstated due to rock (SM).			7 16 12
5	▯	S-2	Medium dense, moist, tan, silty, fine to medium SAND, some gravel; unsorted (SM).			21 11 16
10	▯	S-3	Dense, moist, gray, silty, fine to medium SAND, some gravel; unsorted (SM).			11 21 32
15	▯	S-4				29 50/4"
			Bottom of exploration boring at 16 feet No ground water encountered.			
20						
25						
30						
35						

Other Tests



Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-9	1 of 1

Project Name	Spruce Elementary School	Ground Surface Elevation (ft)	
Location	Lynnwood, WA	Datum	N/A
Driller/Equipment	GDI / SPT	Date Start/Finish	8/30/16,8/30/16
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	4.25 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Vashon Lodgement Till					
		S-1		Medium dense, moist, tan, silty, fine SAND, some gravel; unsorted (SM).			9 12 16	▲28	
5		S-2		Becomes dense.			12 23 30	▲53	
10		S-3		As above.			12 36 50	▲86	
				Bottom of exploration boring at 10.5 feet No ground water encountered.					
15									
20									
25									
30									
35									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture	**Logged by:** AWR
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()	**Approved by:** CJK
☐ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)	

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-10	1 of 2

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / Truck Mounted / SPT
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~533.5
Datum: N/A
Date Start/Finish: 12/21/16,12/22/16
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
			Asphalt - 4 inches **Vashon Lodgement Till**					
			Possible perched water at 4 feet.					
5	▯	S-1	Dense, moist, tannish gray, silty, fine SAND, some gravel; unsorted; light mottling (SM). Static water measure on 12/22/16 at 8 am with boring advanced to 40 feet. Water measured at 5.38 feet.		▼	9 13 19	▲32	
10	▯	S-2	Very dense, moist, tannish gray, silty, fine SAND, some gravel; unsorted (SM).			29 35 50	▲85	
			Driller added water to help lift cuttings.					
15	▯	S-3	As above.			18 44 50/4"	▲94/10"	
20	▯	S-4	Contains trace to some medium sand.			50/6"	▲50/6"	
25	▯	S-5				50/6"	▲50/6"	
30	▯	S-6				50/4"	▲50/4"	
35	▯	S-7	Blow count overstated due to rock.			26 50/2"	▲50/2"	

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)
▯ 3" OD Split Spoon Sampler (D & M)
✋ Grab Sample
☐ No Recovery
◧ Ring Sample
▨ Shelby Tube Sample
M - Moisture
▽ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK / JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-10	2 of 2

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / Truck Mounted / SPT
Hammer Weight/Drop: 140# / 30"
Ground Surface Elevation (ft): ~533.5
Datum: N/A
Date Start/Finish: 12/21/16,12/22/16
Hole Diameter (in): 8 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
		S-8		No recovery; blow count overstated due to rock.			50/2"	▲50/2"	
45	⊏⊐	S-9		Very dense, moist to very moist, gray, silty, fine SAND, some gravel; unsorted (SM).			50/3"	▲50/3"	
50	⊏⊐	S-10					50/6"	▲50/6"	
55									
60	⊏⊐	S-11					100/4"	▲100/4"	
				Bottom of exploration boring at 61 feet Refusal at 61 feet.					
65									
70									
75									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK / JHS

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Exploration Log

Project Number	Exploration Number	Sheet
140562E002	EB-11	1 of 1

Project Name Spruce Elementary School
Location Lynwood, WA
Driller/Equipment Geologic Drill Partners / Mini Track
Hammer Weight/Drop 140# / 30
Ground Surface Elevation (ft) 543
Datum NAVD 88
Date Start/Finish 4/2/19,4/2/19
Hole Diameter (in) 6

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Sod / Topsoil - 4 inches					
			Fill					
		S-1	Slightly moist, brown to dark brown, silty, fine to medium SAND, trace to some gravel; scattered organics (rootlets) (SM).			1 1 2	3	
		S-2	Dry to slightly moist, brown, silty, fine SAND, trace gravel; scattered organics (rootlets) (SM).			2 3 3	6	
5		S-3	Slightly moist to moist, brown with some oxidation staining to orange red, silty, fine to medium SAND, some gravel; minor organics (rootlets); unsorted (SM).			6 8 9	17	
		S-4	Moist, brown, silty, fine to medium SAND, trace gravel; scattered organics (SM).			5 8 17	25	
			Vashon Lodgement Till					
			Moist, brown with oxidation staining to red, silty, fine tom medium SAND, trace to some gravel; unsorted (SM).					
10		S-5	Slightly moist, gray, silty, fine to medium SAND, some gravel; unsorted (SM).			10 20 32	52	
15		S-6	As above (SM).			44 42 50/5"	50/5"	
20		S-7	Slightly moist to moist, gray, silt, fine to medium SAND, some gravel; unsorted; broken gravel in spoon (SM).			20 50/5"	50/5"	
			Bottom of exploration boring at 21.5 feet. No groundwater encountered.					

Blows/Foot: 10 20 30 40

Sampler Type (ST):

◫ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
◫ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
☐ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: BCY
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
140562E002	EB-12	1 of 1

Project Name: Spruce Elementary School
Location: Lynwood, WA
Driller/Equipment: Geologic Drill Partners / Mini Track
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): 544
Datum: NAVD 88
Date Start/Finish: 4/2/19,4/2/19
Hole Diameter (in): 6

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
				Sod / Topsoil - 3 inches					
		S-1		**Fill** Dry to slightly moist, brown to dark brown with minor oxidation staining, silty, fine to medium SAND, some gravel; scattered organics (SM).			4 6 6	12	
		S-2		Dry to slightly moist, brown to dark brown, silty, SAND, some gravel; scattered organics (rootlets) (SM).			5 7 6	13	
5		S-3		Moist, brown to dark brown with minor oxidation staining to red, sandy, SILT, some gravel; scattered organics (SM).			4 4 4	8	
		S-4		Moist, olive gray with oxidation staining, silty, fine to medium SAND, some gravel; minor scattered organics (SM). **Vashon Lodgement Till** Slightly moist, gray with oxidation staining in upper foot, silty, fine to medium SAND, some gravel; beds (1/8 inch thick) of medium sand (SM).			6 11 22	33	
10		S-5					19 38 50/5"	50/5"	
15									
20									

Bottom of exploration boring at 11.5 feet.
No groundwater encountered.

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture
∇ Water Level ()
▼ Water Level at time of drilling (ATD)

Logged by: BCY
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
140562E002	EB-13	1 of 1

Project Name Spruce Elementary School
Location Lynwood, WA
Driller/Equipment Geologic Drill Partners / Mini Track
Hammer Weight/Drop 140# / 30
Ground Surface Elevation (ft) 544
Datum NAVD 88
Date Start/Finish 4/2/19,4/2/19
Hole Diameter (in) 6

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Asphalt - 3 inches					
		S-1		**Fill** Moist, brown, medium to coarse SAND, some gravel, trace silt (SP). Slightly moist, gray with some dark brown, silty, fine to medium SAND, some gravel (SM).			12 7 11	▲18	
		S-2		As above; scattered organics.			3 2 3	▲5	
5		S-3		Moist to very moist, gray and brown, silty, fine to medium SAND, trace gravel; scattered organics present (SM).			1 1 3	▲4	
		S-4		**Vashon Lodgement Till** Driller notes harder drilling. Slightly moist, brownish gray, silty, fine to medium SAND, some gravel; minor broken gravel present in spoon (SM).			17 33 50/4"	▲50/4"	
10		S-5		As above.			18 36 50/5"	▲50/5"	
				Bottom of exploration boring at 11.5 feet. No groundwater encountered.					
15									
20									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
☐ Grab Sample	▱ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: BCY
Approved by: JHS

associated earth sciences incorporated

Exploration Log

Project Number	Exploration Number	Sheet
140562E002	EB-14	1 of 1

Project Name: Spruce Elementary School
Location: Lynwood, WA
Driller/Equipment: Geologic Drill Partners / Mini Track
Hammer Weight/Drop: 140# / 30
Ground Surface Elevation (ft): 535
Datum: NAVD 88
Date Start/Finish: 4/2/19,4/2/19
Hole Diameter (in): 6

Depth (ft)	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
		Asphalt - 4 inches					
		Gravel - 4 inches					
	S-1	**Fill** Moist, orange and brown, silty, fine to medium SAND, trace gravel (SM).			7 3 3	6	
	S-2	Moist, grayish brown with oxidation staining to orange, silty, fine to medium SAND, trace to some gravel; unsorted (SM).			4 4 4	8	
5	S-3	**Vashon Lodgement Till** Drilling stiffens. Slightly moist, gray to brownish gray, silty, fine to medium SAND, some gravel; unsorted (SM).			12 20 24	44	
	S-4	Slightly moist, gray, silty, fine to medium SAND, some gravel; unsorted (SM).			21 44 50/5"	50/5"	
10		Bottom of exploration boring at 10 feet. No groundwater encountered.					
15							
20							

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ∇ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BCY
Approved by: JHS

EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Sod / Topsoil - ~12 inches
1	**Vashon Lodgement Till**
2	Medium dense, moist, brownish gray to brown minor to moderate oxidation, very silty, fine to medium SAND, some gravel; minor rootlets; unsorted (SM).
3	
4	Color turns more gray with less oxidation and no rootlets at 4 feet. Minimal to no oxidation at 4.5 feet.
5	Digging becomes harder at ~5 feet.
6	
7	Bottom of exploration pit at depth 7 feet No seepage. No caving.
8	
9	
10	

Spruce Elementary
Lynnwood, WA

Logged by: TG

Approved by: JHS

associated earth sciences incorporated

Project No. 20140562E002

11/7/19

EXPLORATION PIT NO. EP-2

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION**
	Sod / Topsoil - ~12 inches
1	**Vashon Lodgement Till**
2	Medium dense, moist, brownish gray with minor to moderate oxidation, very silty, fine to medium SAND, trace gravel; minor rootlets; unsorted (SM). Digging becomes more difficult at 2.5 feet.
3	Color turns more light gray to light brownish gray, ranges to some gravel, and no rootlets.
4	
5	
6	
7	
8	
9	Bottom of exploration pit at depth 9 feet No seepage. No caving.
10	

Spruce Elementary
Lynnwood, WA

Logged by: TG

Approved by: JHS

associated earth sciences incorporated

Project No. 20140562E002

11/7/19

EXPLORATION PIT NO. EP-3

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.

DESCRIPTION

Sod / Topsoil - ~12 inches

1

Vashon Lodgement Till

2

Medium dense, moist, light brownish gray to brownish gray with moderate oxidation, very silty, fine SAND, trace gravel; minor rootlets; unsorted (SM).

3

4

Digging becomes more difficult at 4 feet.

Less oxidation, more medium sand, and ranges to some gravel.

5

Minimal to no oxidation and ranges to gravelly.

6

7

Bottom of exploration pit at depth 6.5 feet
No seepage. No caving.

8

9

10

Spruce Elementary
Lynnwood, WA

Logged by: TG
Approved by: JHS

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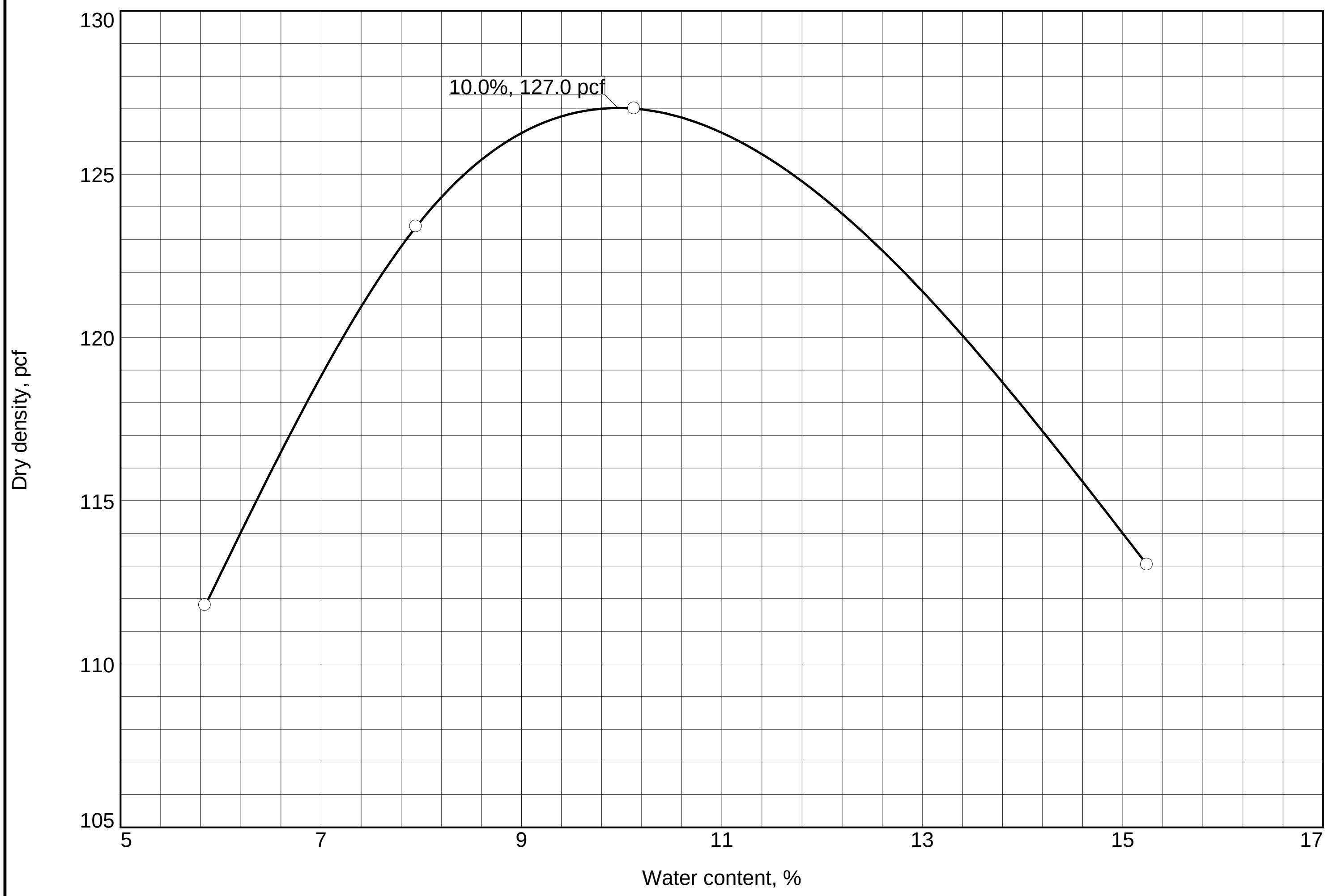
Project No. 20140562E002

11/7/19

APPENDIX B

Laboratory Analysis

COMPACTION TEST REPORT



Test specification: ASTM D 1557-12 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
3'					NV			

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 127.0 pcf Optimum moisture = 10.0 %	Vashon Lodgement Till

Project No. 140562 E002 **Client:** Edmonds SD

Project: Spruce ES

Date: 11/11/19

○ **Location:** Onsite - Capital Projects Office **Sample Number:** EP-2

associated earth sciences incorporated

Remarks:

Field Moisture: 7.9%

Figure

Tested By: ALM **Checked By:** AWR

Appendix C
Storm Drainage Report <u>and Stormwater Site Plan Report</u>

Stormwater Site Plan Report

PREPARED FOR:

Bassetti Architects
71 Columbia Street, Suite 500
Seattle, WA 98104

PROJECT:

Spruce Elementary School
17405 Spruce Way
Lynnwood, WA 98037
2140275.10

PREPARED BY:

Jared McDonald, EIT
Project Engineer

REVIEWED BY:

Douglas G. Tapp, PE
Principal

Bethany P. Steadman, PE
Senior Engineer

DATE:

September 2017

Civil Engineers ● Structural Engineers ● Landscape Architects ● Community Planners ● Land Surveyors

Stormwater Site Plan Report

PREPARED FOR:

Bassetti Architects
71 Columbia Street, Suite 500
Seattle, WA 98104

PROJECT:

Spruce Elementary School
17405 Spruce Way
Lynnwood, WA 98037
2140275.10

PREPARED BY:

Jared McDonald, EIT
Project Engineer

REVIEWED BY:

Douglas G. Tapp, PE
Principal

Bethany P. Steadman, PE
Senior Engineer

DATE:

September 2017

9/8/2017

DOUGLAS G. TAPP

35702

I hereby state that this Stormwater Site Plan Report for Spruce Elementary School 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 City of Lynnwood does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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Offsite Analysis Drainage System Tables

B-1............ TDA A – Northwest TDA Drainage Table
B-2............ TDA B – Southwest TDA Drainage Table
B-3............ TDA C – East TDA Drainage Table

Appendix C

Field Inspection Photos

Appendix D

Subsurface Exploration and Preliminary Geotechnical Engineering Report

By Associated Earth Sciences, Inc., dated January 14, 2015

Geotechnical Addendum – Additional Explorations

By Associated Earth Sciences, Inc., dated September 26, 2016

Appendix E

Permanent Stormwater Control Calculations

E-1............ Phase 1 TDA C Flow Control Calculations
E-2............ Phase 2 TDA A Flow Control Calculations
E-3............ Phase 2 TDA B Flow Control Calculations

1.0 Project Overview

1.1 General Description of Project

The project site is located on the existing Spruce Elementary School site (17405 Spruce Way, Lynnwood, Washington) and encompasses one tax parcel (00372700301502). The parcel is bounded by residential developments to the south, east, and north; to the west, the project is bounded by a few homes and Spruce Way. Due to budget and constraints the project site work is to be split into two phases, Phase 1 and Phase 2. During Phase 1, the project site is 4.29 acres and, during Phase 2, the project site is 8.58 acres. See Exhibit A-1 for the Site Vicinity Map.

During Phase 1, the project proposes the demolition of play areas and play structures east of the existing elementary school and the construction of admin, commons, and gymnasium. Site improvement elements include a building, outdoor play areas, play field, fire lane, and temporary parking, as well as utility infrastructure supporting the improvements and future expansion. The existing school to the west of Phase 1 construction will be retained, along with the parking to the south and northwest.

In Phase 2, the project proposes the demolition of the existing elementary school and construction of the library and classroom wing that will be attached to the structure constructed during Phase 1, as well as tenant improvements to the Phase 1 structure. Site elements include preserving the majority of elements constructed during Phase 1, demolishing the temporary parking, a building, a play field, parking to the west, and a drop-off area, as well as utility infrastructure supporting the new improvements. During Phase 2, the portables constructed prior to Phase 1 will be either removed or relocated to the designated “future” portable location.

The project site is located in the City of Lynnwood and is subject to the 2012 Washington State Department of Ecology *Stormwater Management Manual for Western Washington amended in 2014 (Drainage Manual)*, City of Lynnwood Standard Plans, and Lynnwood Municipal Code (LMC) Chapter 13.40, Stormwater Management. This report has been prepared to document how the project meets Minimum Requirements 1 through 9, as outlined in the *Drainage Manual*.

1.2 Existing Conditions

A. Phase 1 / Phase 2

The project site is the eastern upper plateau of the property and is partially developed in the current condition. It includes an existing covered play area and two uncovered existing play areas. The majority of the project site is lawn with trees.

The existing site is topographically separated into an upper and lower plateau, with a 6 to 8 foot tall slope running through the center of the site. The northwest portion of the site (Threshold Discharge Area (TDA) A) drains to the northwest via sheet flow and existing conveyance prior to discharging to an existing ditch located within Spruce Way. The southwest portion of the site (TDA B) collects into a swale located along the southern edge of the site and discharges to a catch basin located at the southwest corner of the site, which flows west to Spruce Way, discharging to the existing ditch that flows to the south. The third TDA (TDA C) sheet flows to the eastern and southern borders of the site.

Existing stormwater conveyance serves the existing elementary school and surrounding pedestrian areas. No conveyance is located to the east on the upper portion of the site, except for downspouts that serve the covered play area. All storm conveyance is collected in TDA A and discharges to a swale along Spruce Way. Currently, there are no water quality or flow control systems located onsite.

There are no known critical areas or wetlands located onsite. The geotechnical report titled, "Subsurface Exploration and Preliminary Geotechnical Engineering Report" by Associated Earth Sciences, Inc., dated January 14, 2015 (see Appendix D), is supplemented with additional information titled, "Geotechnical Addendum – Additional Explorations" by Associated Earth Sciences, Inc., dated September 26, 2016. The geotechnical report found fill primarily in the southwest portion of the site, approximately 13 feet of fill. Vashon Lodgement Till was found throughout the site.

See Exhibits A-2a and A-2b for the Phase 1 and Phase 2 Existing Conditions Maps.

1.3 Developed Conditions

A. Phase 1

During Phase 1, the project proposes to demolish the existing play areas east of the elementary school and develop the upper field to the east. The existing fire lane, elementary school, and parking are to be retained. A new building, play areas, and temporary parking will be constructed east of the existing school. A fire lane will be constructed around the new building. The frontage along Spruce Way will be reconstructed to meet City of Lynnwood Standards. New utility infrastructure will be provided to serve the proposed improvements. Future portables have been identified and included in stormwater calculations.

The existing stormwater infrastructure to the west (serves TDA A) will be retained. During Phase 1, stormwater improvements will be provided for TDA C only. Stormwater improvements for TDA A and TDA B will be provided in Phase 2 due to site constraints. Improvements for storm in TDA C include onsite stormwater management, flow control, and water quality systems, and mitigation will be provided for new and replaced surface. Onsite stormwater management will include post-construction soil quality, Silva Cells (underground bioretention), and dispersion. Flow control will be provided with below grade 6-foot diameter pipes interconnected to a pond that is to be located in the southeast corner of the site. Water quality will be provided for the temporary parking to the north using a compost amended vegetated filter strip (CAVFS) and for the service with a Silva Cell bioretention cell. See Section 4.0 for more details on the Permanent Stormwater Control Plan.

See Exhibit A-3a for the Phase 1 Developed Conditions Map.

B. Phase 2

During Phase 2, the project proposes to demolish the existing Spruce Elementary School, portables to the south, temporary and permanent parking, and existing fire lane. Portions of the existing drive entrance to the west will be retained and expanded to serve the new school building. A new building wing will be constructed, connecting to the newly constructed Phase 1 building. New parking will be provided to the west, with parent drop-off and bus drop. A new play field will be constructed south of the new parking lot. The majority of Phase 1 elements constructed will be retained, excluding the temporary parking to the north. New utility infrastructure will be provided to serve the proposed Phase 2 improvements.

The existing stormwater flow control facility constructed in Phase 1 will be preserved to serve Phase 2, TDA C. The existing stormwater conveyance within TDA A will be demolished and upgraded. New stormwater improvements will include onsite stormwater management, flow control, and water quality systems, and will provide mitigation for new and replaced surfaces. Onsite stormwater management will include post-construction soil quality, bioretention cells, and Silva Cell bioretention. Flow control for TDA A will be provided with below-grade 6-foot diameter pipe. Flow control for TDA B will be provided with a pond. Water quality will be provided for the pollution generating impervious surface (PGIS) in TDA A using a bioretention cell. Water quality will be provided for the PGIS in TDA B using Silva Cells. See Section 4.0 for more details on the Permanent Stormwater Control Plan.

See Exhibit A-3b for the Phase 2 Developed Conditions Map.

1.4 Project Classification

A. Phase 1

Per LMC Section 13.40.050, the project is classified as a Large Project since it disturbs more than 1 acre of land and is required to provide a Detailed Drainage Plan. Per the *Drainage Manual*, the project is classified as a Redevelopment Project and all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas.

B. Phase 2

Per LMC Section 13.40.050, the project is classified as a Large Project since it disturbs more than 1 acre of land and is required to provide a Detailed Drainage Plan. Per the *Drainage Manual*, the project is classified as a Redevelopment Project and all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas.

2.0 Minimum Requirements

A. Phase 1

Phase 1 is considered a Redevelopment project. Because the project will be broken into two phases, we are requesting that the Minimum Requirements for TDA A and TDA B be addressed during Phase 2. In Phase 1, TDA C is subject to Minimum Requirements (MRs) 1 through 9 for all new and replaced hard surfaces and converted vegetation areas. See Exhibit A-3a, Phase 1 Developed Conditions Map, for areas.

Below is a summary of how the project will meet MRs 1 through 9 for TDA C.

- MR 1 – Preparation of Stormwater Site Plans: This Stormwater Site Plan Report provides the narrative and analysis for the stormwater site plan and accompanies engineered drawings. Both have been developed by a licensed civil engineer and per Volume I, Chapter 3 of the *Drainage Manual*.
- MR 2 – Construction Stormwater Pollution Prevention: A Construction Stormwater Pollution Prevention Plan (CSWPPP) will be prepared in conformance to Volume II from the *Drainage Manual*. The CSWPPP will be submitted separately. A narrative has been provided in Section 5.1, outlining how the project meets the 13 Elements. The contractor will be responsible for maintaining the CSWPPP during construction and conforming to the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSWGP) requirements.
- MR 3 – Source Control of Pollution: Source Control of Pollution Best Management Practices (BMPs) have been selected for use post construction and are discussed in Section 5.2. Source Control BMPs are included in the Operation and Maintenance Manual for the owner’s reference.
- MR 4 – Preservation of Natural Drainage Systems and Outfalls: The existing drainage patterns will be preserved to the maximum extent feasible. The developed threshold discharge basins have been divided to match the existing threshold discharge basins as closely as possible. The developed areas in Phase 1 do not match the existing areas due to site constraints. The developed conditions in Phase 2 will address this issue and the

basin area will match the existing areas. TDA C will be collected and conveyed to the southeast natural discharge point.

- MR 5 – Onsite Stormwater Management: The project has provided Onsite Stormwater Management to the maximum extent feasible, as required by List 2, found in Section 2.5.5 of the *Drainage Manual* for TDA C.
- MR 6 – Runoff Treatment: Phase 1 provides water quality treatment for the new temporary parking lot and service yard that satisfies basic enhanced treatment due to the project draining to a fish-bearing water body. The project does not meet the requirements of a high-use site, and therefore does not need to provide treatment per the oil control treatment menu. The project does not drain to a phosphorus sensitive lake and does not need to provide treatment per the phosphorus treatment menu. See Section 4.4 for analysis of how the project will meet these performance standards.
- MR 7 – Flow Control: Phase 1 of the project provides flow control for TDA C. Because Phase 2 TDA C requires additional flow control volume, the project will construct in Phase 1 a flow control system to satisfy the requirements of both Phase 1 and Phase 2. Flow control will match durations of the fully forested, pre-developed condition for 50 percent of the 2-year peak flow up to the full 50-year peak flow for all new and replaced surfaces. Flow control calculations and BMPs can be reviewed in Section 4.0.
- MR 8 – Wetlands Protection: This project does not directly or indirectly discharge to a wetland, and therefore MR 8 does not apply to this project.
- MR 9 – Operation and Maintenance: An Operations and Maintenance Manual is provided in Appendix H.

B. Phase 2

Phase 2 is considered a Redevelopment project. In Phase 2, the MRs will be applied to all three TDAs to satisfy the *Drainage Manual* requirements. Phase 2 has three TDAs, all of which are subject to MRs 1 through 9 for all new and replaced hard surfaces and converted vegetation areas.

Below is a summary of how the project will meet MRs 1 through 9 for TDAs A, B, and C.

- MR 1 – Preparation of Stormwater Site Plans: This Stormwater Site Plan Report provides the narrative and analysis for the stormwater site plan and accompanies engineered drawings. Both have been developed by a licensed civil engineer and per Volume I, Chapter 3, of the *Drainage Manual*.
- MR 2 – Construction Stormwater Pollution Prevention: A Construction Stormwater Pollution Prevention Plan (CSWPPP) will be prepared in conformance to Volume II from the *Drainage Manual*. The CSWPPP will be submitted separately. A narrative has been provided in Section 5.1, outlining how the project meets the 13 Elements. The contractor will be responsible for maintaining the CSWPPP during construction and conforming to the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSWGP) requirements.
- MR 3 – Source Control of Pollution: Source Control of Pollution BMPs have been selected for use post construction and are discussed in Section 5.2. Source Control BMPs are included in the Operation and Maintenance Manual for the owner’s reference.
- MR 4 – Preservation of Natural Drainage Systems and Outfalls: The existing drainage patterns will be preserved to the maximum extent feasible. The developed threshold discharge basin areas have been divided to match the existing threshold discharge basin areas and to discharge to the existing discharge locations. TDA A will be collected to the flow control system and discharged to the public storm system that runs along Spruce Way.

TDA B will be collected in a pond and then discharged to the existing catch basin located at the southwest corner of the site. TDA C will be collected in a combination flow control system, including a pond and 6-foot diameter pipe, and then conveyed to 176th Street SW to the existing public storm system.

- MR 5 – Onsite Stormwater Management: The project has provided Onsite Stormwater Management to the maximum extent feasible, as required by List 2, found in Section 2.5.5 of the *Drainage Manual* for TDAs A, B, and C.
- MR 6 – Runoff Treatment: Phase 2 provides water quality treatment per the basic enhanced treatment menu based on the project draining to a fish-bearing water body. The project does not meet the requirements of a high-use site, and therefore does not need to provide treatment per the oil control treatment menu. The project does not drain to a phosphorus sensitive lake and does not need to provide treatment per the phosphorus treatment menu. See Section 4.4 for analysis of how the project will meet these performance standards.
- MR 7 – Flow Control: Phase 2 of the project provides flow control for TDAs A and B. TDA C will have had its required flow control volume constructed in Phase 1; the flow restrictor will be replaced to match revised durations in Phase 2. Flow control will match durations of the fully forested, pre-developed condition for 50 percent of the 2-year peak flow up to the full 50-year peak flow for all new and replaced surfaces. Flow control calculations and BMPs can be reviewed in Section 4.0.
- MR 8 – Wetlands Protection: This project does not directly or indirectly discharge to a wetland, and therefore MR 8 does not apply to this project.
- MR 9 – Operation and Maintenance: An Operations and Maintenance Manual will be provided in Appendix H.

3.0 Offsite Analysis

3.1 Task 1 – Define and Map the Study Area

The project site for the Spruce Elementary School Modernization is located at 17405 Spruce Way, Lynnwood, Washington (Parcel No. 00372700301502). See Exhibit A-1 for the Site Vicinity Map. Three separate TDAs have been observed onsite (TDAs A, B, and C). These observations coincide with the topographic and existing condition represented in the survey. See Exhibits A-2a and A-2b for the Existing Conditions Maps.

TDA A includes the northwest portion of the site. The existing condition of this area includes the existing buildings, parking lot, drop-off area, sidewalks, and covered play area. TDA A slopes toward the northwest, causing the runoff to sheet flow toward the west until reaching a ditch on the east side of Spruce Way. This drainage ditch is where the downstream analysis begins.

Surface runoff from the southwest portion of the school's site is tributary to TDA B. A swale adjacent to the southern property line intercepts sheet flow. Discharge from the swale is tight lined west through a neighboring property within a drainage easement. The conveyance pipe daylights into a drainage ditch along Spruce Way. This is the beginning of the downstream analysis for TDA B.

TDA C includes the grass field in the east portion of the property. TDA C slopes to the east. Runoff leaving the east property line sheet flows toward neighboring parcels, where the stormwater either is collected or continues to sheet flow to the public right-of-way. Stormwater enters the public conveyance system tributary to Tunnel Creek. Although the stormwater enters the public conveyance system at different locations, all systems drain to Tunnel Creek within

0.25 mile, and are therefore considered to be in the same TDA. For analysis purposes, the northwest corner of the site will be considered the discharge point to TDA C.

The field inspection (Task 3) of the qualitative downstream analysis was performed on January 16, 2017, starting at the three existing points of discharge from the project site.

- The discharge point of TDA A is located adjacent to the west property line at Spruce Way.
- The discharge point for TDA B is located at the southwest property corner, two parcels south along Spruce Way.
- The discharge point of TDA C begins at the southeast corner of the property, but the east property line was analyzed and found to drain to the conveyance along 38th Avenue West and/or 175th Street SW, both of which discharge to Tunnel Creek within 0.25 mile.

The three downstream systems were walked for approximately 1 mile to document the existing conditions (see Task 4 for drainage system documentation) and to perform the below tasks. See Exhibits A-4a, A-4b, and A-4c for maps of the three downstream drainage systems.

Below are summaries of the offsite analysis tasks and the results of these tasks.

See Exhibit A-4 for the Downstream Study Maps, which include topography, the project site, existing discharge point(s), the study area, and the downstream flow path(s).

3.2 Task 2 – Resource Review

The following resources were reviewed prior to the field inspection to discover any existing or potential problems in the study area:

- *Basin Plans:* The project is located in the Swamp Creek Basin located in the Lake Washington Watershed (see Exhibit A-5 for the Basin Map). No known City of Lynnwood adopted basin plans are in effect.
- *Groundwater Management Area Plans:* No known adopted groundwater management area plans are in effect at this time.
- *Drainage Inventory Maps:* Drainage inventory maps from the City of Lynnwood website were consulted to help map the downstream flow path. See Exhibits A-6a, A-6b, and A-6c for the Drainage Inventory Maps applicable to the project.
- *SnoScape or iMap or other GIS data:* SnoScape was consulted to review critical areas located at or near the project site or the downstream. SnoScape did not indicate any critical areas. The City of Lynnwood Environmentally Sensitive Areas Map was consulted and indicated that there were two critical areas, labeled “Fish and Wildlife Conservation Area,” downstream from the project site. See Exhibits A-7a and A-7b for the two maps that were consulted.
- *WDFW PHS Maps:* The Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) Map identified no wetland or other sensitive area located within the downstream of the project. See Exhibit A-8 for a copy of the WDFW PHS Map.
- *303(d) Listed Water Bodies:* The 303(d) Listed Water Bodies Map was consulted to identify any water quality concerns downstream of the project site. There are no impaired waterbodies located within 1 mile of the project site. According to the map, there is a

Category 5 waterbody beyond 1 mile from the site. The Category 5 waterbody is Scriber Creek, Listing ID 70236. See Exhibit A-9 for a copy of the 303(d) Listed Water Bodies Map.

- *Flood Insurance Rate Maps (FIRM):* The project site is located outside of the 500-year floodplain per FIRM No. 53061C1310 E, included as Exhibit A-10.
- *Soils:* Per the geotechnical report, soils for the project site are typically Vashon lodgment till (see Appendix D for a copy of the report). The Web Soil Survey was consulted for a soil map of the downstream. See Exhibit A-11 for a copy of the map. The downstream is typically classified as Alderwood-Urban land complex with slopes typically between 2 to 8 percent.

Research of drainage complaints provided the following drainage complaints that relate to the project site's downstream; field inspection observations are made in brackets [].

- *Tenant Complaint – Plaza 44 Apartments (08-04-2016):* Lower apartments flooded due to a high volume of runoff from the culvert that overflowed and entered the building. This event occurred roughly two years ago in the winter. [Catch basin located outside the apartments look to be undersized, but could not be inspected due to the catch basin being locked.]

3.3 Task 3 – Field Inspection

3.3.1 Upstream Field Inspection

Because the project site is located at the top of a ridge, little to no upstream drainage is expected. The north boundary for TDA C does have a slight potential run-on drainage from the backyards of the surround residences. These areas can continue to run-on and will not impact improvements.

3.3.2 Downstream Field Inspection

A qualitative field inspection was performed starting at the existing points of discharge from the project site. The downstream systems were walked for approximately 1 mile to document the systems and to perform the below tasks. See Task 4 for drainage system documentation. See Exhibit A-4 for maps of the downstream drainage system.

Below are summaries of the field inspection tasks and the results of these tasks:

- *Investigate problems reported or observed during the resource review*
    - No problems were identified during the resource review for the downstream analysis.
- *Locate existing/potential constrictions or capacity deficiencies in the drainage system*
    - TDA A: Pipes consistently increase from 12-inch to 36-inch until reaching the conveyance system along Highway 99. A possible constriction is located in the ditch two parcels north of the site along Spruce Way. The channel is laden with heavy silt and gravel at the inlet.
    - TDA B: Pipes consistently increase from 12-inch to 24-inch until reaching the conveyance system along Highway 99. A possible constriction is located in the ditch on the east side of Spruce Way at its intersection with 178th Place SW. Trees have been trimmed and the branches have been placed in the open channel.

    - TDA C: Pipe constrictions were not observed up to 1 mile downstream of the project site.

- *Identify existing/potential flooding problems*
    - No existing or potential flooding problems were identified during the field inspection.
- *Identify significant destruction of aquatic habitat (e.g., siltation, stream incision)*
    - No problems were identified during the field inspection in TDA A or TDA B.
    - Downstream of TDA C, an orange color was observed in Tunnel Creek.
- *Collect qualitative data on features such as land use, impervious surface, topography, soils, presence of streams, wetlands*
    - Area surrounding the project site is typically developed residential properties. Topography ranged from 1 to 15 percent along the downstream. Soils are typically Alderwood-Urban land complex per USDA.
- *Collect information on pipe sizes, channel characteristics, drainage structure:*
    - See Task 4 below for a narrative of the system. See Appendix B for the drainage system table collating this data.
- *Verify tributary drainage areas identified in task 1:*
    - The field investigation confirmed the TDAs identified in Task 1 and the existing points of discharge for these areas.
- *Contact the local government office with drainage review authority, neighboring property owners, and residents about drainage problems:*
    - No drainage reports were recorded by the City.
    - *Tenant Complaint – Plaza 44 Apartments (2014±):* We spoke to a tenant on the day of our inspection, who mentioned that the lower apartments flooded due to a high volume of runoff from the culvert that overflowed and entered the building. This event occurred roughly two years ago in the winter.
- *Note date and weather at time of inspection*
    - Field inspection was completed on January 16, 2016. The weather was clear and sunny, with temperatures around 48°F. The study area was wet, with some standing water

3.4 Task 4 – Drainage System Description and Existing/Predicted Problems

See Exhibits A-4a, A-4b, and A-4c for the Downstream Study Maps. See Appendix B for tables collating the qualitative data collected during the field investigation. Tables assign symbols to each drainage component and are referenced below and on the system map, and photos of particular areas are included in Appendix C. See below for a description of the downstream and existing or predicted problems.

3.4.1 TDA A (Northwest Basin)

Stormwater from TDA A discharges via sheet flow from the Spruce Elementary School parking lot (A-1 through A-3) into the ditch (A-4) located on the east side of Spruce Way. This is where the downstream analysis begins.

Stormwater flows north roughly 300 feet through a series of culverts and ditches until reaching a catch basin at 173rd Place SW and Spruce Way. From the catch basin at 173rd Place SW, the drainage crosses Spruce Way and 173rd Street SW. The discharge from the catch basin at 173rd and Spruce Way daylights into a heavily vegetated ravine. The drainage weaves its way through properties until it is diverted across 172nd Street SW via a culvert. After crossing 172nd Street, the drainage daylights into a ravine and weaves its way through heavy vegetation toward the northwest. The drainage then crosses 44th Avenue West at its intersection with Cobblestone Drive. From the west side of 44th Avenue West, the stormwater daylights into a vegetated stream/ditch until intersecting with the conveyance system along Highway 99.

3.4.2 TDA B (Southwest Basin)

Stormwater from TDA B discharges to a catch basin located in the southwest corner of the site. From that catch basin, the stormwater is routed west in an easement and daylights into a ditch located on the east side of Spruce Way. This ditch is where the downstream analysis begins.

The drainage continues to flow south through a series of ditches and culvert for approximately 1,500 feet until reaching an eastbound culvert just north of Spruce Way's intersection with Maple Road. The stormwater crosses Maple Road in a culvert that then daylights into a drainage swale. From the swale, the stormwater crosses Maple Road and enters a tight lined conveyance system on the south side of Maple Road. The stormwater continues down Maple Road, which changes its name to 181st Place SW, for approximately 2,370 linear feet. A water quality facility was observed on the west side of the 181st Place SW intersection with 48th Avenue West. 181st Place SW dead ends, but the stormwater continues west through the dead end, and daylights into a heavily vegetated stream/ditch. After approximately 750 linear feet, the stormwater enters the conveyance system along Highway 99.

3.4.3 TDA C (East Basin)

Stormwater from TDA C sheet flows to the parcels adjacent to the east property line, where it either is picked up by the parcel's onsite conveyance or continues to sheet flow to the conveyance system along 174th Place SW, 175th Street SW, and 176th Street SW. Because these discharge points are within 0.25 mile of each other, they are considered the same point of discharge. All three streets discharge their stormwater to Tunnel Creek.

Tunnel Creek flows south, crossing 175th Street SW, 176th Street SW, and 176th Place SW. After crossing 36th Avenue West, Tunnel Creek weaves its way through the backyards of properties toward the southeast. The creek crosses 179th Street SW and 33rd Place West, and then heads east where it is picked up by the drainage system on the north side of 33rd Avenue West. This portion of 33rd Avenue West is tributary to Swamp Creek.

4.0 Permanent Stormwater Control Plan

The project meets MRs 5 through 7 by providing a permanent stormwater control plan, including Onsite Stormwater Management BMPs, flow control facilities, and water quality facilities. During Phase 1 of the project, MRs 5 through 7 for TDA C will be met and, by the end of Phase 2, MRs 5 through 7 will be met for TDA A and TDA B.

4.1 Site Hydrology

The site hydrology is determined by the type of land coverage, soil type, and slope. Onsite soils are Vashon Lodgement till, which is categorized as a Class C soil for modeling purposes. Landscape areas will meet BMP T5.12 post-construction soil quality and depth. Per the *Drainage Manual*, page 5-10 from Volume V, these areas shall be modeled as pasture. See Exhibit A-2a and A-2b for the Existing Conditions Maps and Exhibit A-3a and A-3b for the Developed Conditions Maps.

A. Phase 1

TDA C will be provided with flow control and water quality to meet the minimum requirements. The minimum requirements for TDA A and TDA B will be addressed during Phase 2 of the project. The threshold discharge area boundaries between existing and developed conditions do not match for Phase 1; however, the flow control requirements in the Western Washington Hydrology Model (WWHM) take this into account for Phase 1 TDA C calculations. This will be corrected in Phase 2.

The areas shown below were used in WWHM2012 for sizing of stormwater flow control facilities for TDA C. The mitigated areas are areas tributary to the flow control system, whereas the bypass area does not drain to the flow control system.

Table 1 – Land Cover Summary for Target Areas in TDA C Phase 1 for Flow Control

	C, Forest (mod)	C, Pasture (flat)	C, Pasture (mod)	Impervious (flat)	Impervious (mod)	Bypass	Total
Pre-Developed	3.11 ac	-	-	-	-	**-**	**3.11 ac**
Total Developed Areas	-	0.94 ac	0.31 ac	1.47 ac	0.49 ac	0.2 ac	**3.41 ac**

B. Phase 2

TDAs A, B, and C require flow control and water quality in Phase 2 of the project. The threshold discharge area boundaries in the developed conditions have been adjusted to match existing conditions. The areas shown below were used in WWHM2012 for sizing of stormwater flow control facilities for TDA A. The mitigated areas are areas tributary to the flow control system, whereas the bypass area does not drain to the flow control system. TDA C flow control volume will be constructed in Phase 1. The control structure will be revised in Phase 2.

Table 2 – Land Cover Summary for Target Areas in TDA A Phase 2 for Flow Control

	C, Forest	C, Pasture (flat)	C, Pasture (mod)	C, Pasture (steep)	Impervious (flat)	Impervious (mod)	Bypass	Total
Pre-Developed	3.78 ac	-	-	-	-	-	**-**	**3.78 ac**
Total Developed Areas	-	0.57 ac	0.42 ac	0.05 ac	1.74 ac	0.44 ac	0.56 ac	**3.78 ac**

Table 3 – Land Cover Summary for Target Areas in TDA B Phase 2 for Flow Control

	C, Forest	C, Pasture (flat)	C, Pasture (mod)	C, Pasture (steep)	Impervious (flat)	Impervious (mod)	Bypass	Total
Pre-Developed	1.80 ac	-	-	-	-	-	**-**	**1.80 ac**
Total Developed Areas	-	0.28 ac	0.14 ac	0.05 ac	0.94 ac	0.23 ac	0.16 ac	**1.80 ac**

Table 4 – Land Cover Summary for Target Areas in TDA C Phase 2 for Flow Control

	C, Forest	C, Pasture (flat)	C, Pasture (mod)	C, Pasture (steep)	Impervious (flat)	Impervious (mod)	Bypass	Total
Pre-Developed	3.00 ac	-	-	-	-	-	**-**	**3.00 ac**
Total Developed Areas	-	0.51 ac	0.09 ac	-	1.95 ac	0.22 ac	0.23 ac	**3.00 ac**

4.2 Onsite Stormwater Management

A. Phase 1

MR 5 was evaluated using the “Flow Chart for Determining LID MR #5 Requirements” from Section 2.5.5, Volume I, of the *Drainage Manual*. Projects that trigger MRs 1 through 5 are required to use List 1 to fulfill MR 5. Projects that trigger MRs 1 through 9 are required to use List 2.

TDA A will implement Onsite Stormwater Management during Phase 2 of the project.

TDA B will implement Onsite Stormwater Management during Phase 2 of the project.

TDA C is required to fulfill List 2 in Section 2.5.5, Volume 1, of the *Drainage Manual*. During Phase 1 of the project, we plan to implement the required BMPs to the maximum extent feasible. In Phase 2, further implementation of Onsite Stormwater Management will be applied. Based on the requirements from List 2, Table 5 summarizes the BMP consideration for each surface and the feasibility determination for the work in this subbasin.

Table 5 – Onsite Stormwater Management BMP Feasibility (TDA C)

Surface Type	Area (acres)	List #2 Feasibility Review (**Bold Determined Feasible and Provided**)	Justification
Landscaping	0.97	**1. Post Construction Soil (BMP T5.13)**	**1. BMP T5.13 is proposed for all proposed landscaped areas.**
Roof	0.54	~~1. Full Dispersion or Downspout Full Infiltration Systems~~ ~~2. Bioretention~~ ~~3. Downspout Dispersion~~ ~~4. Perforated Stub-out Connections~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. There is a lack of usable space for a rain garden/bioretention facility to treat the roof during Phase 1. 3. A vegetated flow path of 50 feet cannot be provided between the

			structure and a slope steeper than 15% or other impervious surfaces. 4. Do not have adequate space to provide perforated stubout connections and many locations of perforated stubouts would be above slopes that are greater than 15%.
North East Temporary Parking	0.43	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ **3. Bioretention** 4. Sheet Flow Dispersion	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils and thus permeable pavement is infeasible. **3. A 315 linear foot Compost-Amended Vegetated Filter Strip is provided (see Appendix E-6).**
Service Yard	0.12	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ 3. **Bioretention** ~~4.~~ Sheet Flow Dispersion	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils and thus permeable pavement is infeasible. **3. An 11-foot by 11-foot Silva Cell is provided (see Appendix E-5).**
Other Hard Surfaces	1.04	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ ~~3. Bioretention~~ ~~4. Sheet Flow Dispersion~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils and thus permeable pavement is infeasible. 3. There is a lack of usable space for a rain garden/bioretention facility to treat the roof during Phase 1. 4. Sheet Flow Dispersion is not feasible, as there is not a 50-foot vegetated path available.

B. Phase 2

Onsite Stormwater Management BMPs include post-construction soil amendments per BMP T5.13, Silva Cells bioretention, and bioretention cells. Final Onsite Stormwater Management BMP calculations will be provided during the Phase 2 permitting process.

4.3 Flow Control

A. Phase 1

In Phase 1, design flow control for TDA C will be provided. Due to site constraints, the flow control for TDA A and TDA B will be constructed during Phase 2. In addition, because flow control volumes required in TDA C Phase 1 are slightly more than Phase 2, there will be adequate detention volume for Phase 2 of the project. The flow control restrictor will be adjusted in Phase 2, such that durations are met for both Phase 1 and Phase 2.

Flow control in TDA C will be provided using a pond that is interconnected with a 6-foot diameter pipe. We are also evaluating the use of a 2GH Vortex Flow Regulator to make the detention system for TDA C more efficient. Those calculations and sizing will be provided prior to final approval. Current calculations are based on a conventional flow control riser. Calculations and WWHM modeling can be found in Appendix E. Below is a summary of the required flow control system.

Table 6 – Phase 1 TDA C - Flow Control Facility Summary

Facility Type	Pond connected to 6-foot Diameter Pipe
Required Total Volume – Phase 1	35,364 cf
Provided Total Volume in Pond	**14,706.7 cf**
Provided Total Volume in Pipe	**21,365 cf**
Live Storage Depth	5 ft
Provided Total Volume in Pipe + Pond	**36,072 cf**

B. Phase 2

TDA A requires flow control to be provided per MR 7. Flow control will be provided using 6-foot diameter pipe that will be located under the parking lot located to the west. Below is a summary of the required and provided flow control system. See Appendix E for the WWHM 2012 Report.

Table 7 – Phase 2 TDA A - Flow Control Facility Summary

Facility Type	Pond connected to 6-foot Diameter Pipe
Required Total Volume	55,951 cf
Provided Total Volume in Pipe	**55,951 cf**
Live Storage Depth	5 ft

TDA B requires flow control to be provided per MR 7. Flow control will be provided using a pond located in the southeast corner of the site. Below is a summary of the required and provided flow control system. See Appendix E for the WWHM 2012 Report.

Table 8 – Phase 2 TDA B - Flow Control Facility Summary

Facility Type	Pond connected to 6-foot Diameter Pipe
Required Total Volume	16,653 cf
Available Total Volume in Pond	**40,722 cf**
Live Storage Depth	6 ft

TDA C requires flow control to be provided per MR 7. Flow control volume for TDA C will have been constructed during Phase 1 and consists of a pond and interconnected pipe. Phase 2 will adjust the flow control restrictor such that durations are matched for both Phase 1 and Phase 2. Stage storage calculations will be provided with the final building permit submittal. Below is a summary of the required and provided flow control system. See Appendix E for the WWHM 2012 Report.

Table 9 – Phase 2 TDA C - Flow Control Facility Summary

Facility Type	Pond connected to 6-foot Diameter Pipe
Required Total Volume	33,985 cf
Provided Total Volume in Pond	**14,706.7 cf**
Provided Total Volume in Pipe	**21,365 cf**
Live Storage Depth	5 ft
Provided Total Volume in Pipe + Pond	**36,072 cf**

4.4 Water Quality Treatment

A. Phase 1

TDA A will implement water quality during Phase 2 of the project.

TDA B will implement water quality during Phase 2 of the project.

TDA C: In Phase 1 of the project, pollution generating surfaces in TDA C include the temporary parking to the north and the service yard to the south. A compost amended vegetated filter strip (CAVFS) will provide treatment for the temporary parking lot. A Silva Cell bioretention system will be provided for the service yard.

See Appendix E, E-5 and E-6, for WWHM2012 modeling reports as well as a letter from DeepRoot Partners confirming that the Silva Cell is acceptable as BMP T7.30. See the table below for a summary of the water quality facility sizes.

Table 10 – Water Quality Facilities Summary

TDA C – Silva Cell	Facility Type	Silva Cell
	Required Infiltration %	91%
	Provided Infiltration %	91.83%
	Required Bottom Area	121 SF
	Provided Bottom Area	121 SF
TDA C – CAVFS	Facility Type	CAVFS
	Required Infiltration %	91%
	Provided Infiltration %	91.22%
	Required Length	315 LF
	Provided Length	315 LF

B. Phase 2

TDA A: In Phase 2 of the project, the north half of the parking and parent drop-off area in TDA A will require water quality treatment. TDA A will be treated through the use of bioretention cells that are located at the western entrance of the site and in the center island of the parent drop-off zone. If additional water quality features are required, additional Silva Cells and BayFilters will be provided. Water quality treatment calculations for Phase 2 TDA A will be provided during the Phase 2 permitting process.

TDA B: In Phase 2 of the project, the south half of the parking area will require water quality treatment. TDA B will be treated through the use of Silva Cells located throughout the parking lot. Water quality treatment calculations for Phase 2 TDA B will be provided during the Phase 2 permitting process.

TDA C: In Phase 2, the temporary parking will be replaced with non-pollution generation surfaces. The Silva Cell for the service yard will remain.

4.5 Stormwater Conveyance Analysis and Design

A. Phase 1

Conveyance analysis and design will be performed using King County Backwater Analysis (KCBW) and the outputs from the WWHM2012 model. Results will be provided in the final Phase 1 report.

B. Phase 2

Conveyance analysis and design will be performed using KCBW and the outputs from the WWHM2012 model. Results will be provided in the final Phase 2 report.

5.0 Stormwater Pollution Prevention

The project will provide temporary and permanent BMPs per the Construction Stormwater Pollution Prevention Plan (CSWPPP) outlined in Section 5.1 to meet MR 2. The CSWPPP narrative provided below will be further developed in a separate report and maintained by the contractor during Phase 1 and Phase 2 construction. An Erosion and Sediment Control Plan will be provided with the permit drawings. In addition, the project will provide Source Control of Pollution BMPs, both during construction and post construction, as outlined in Section 5.2 and to meet MR 3.

5.1 Construction Stormwater Pollution Prevention Plan Narrative

The project will provide both temporary and permanent BMPs during construction to meet MR 2 per the *Drainage Manual*, Volume II. The narrative and plan will be provided to the contractor, who will be responsible for meeting the requirements of the NPDES CSWGP, including maintaining and managing the CSWPPP for both Phase 1 and Phase 2 construction.

Thirteen Required Elements

1. Preserve Vegetation/Mark Clearing Limits – The contractor shall mark clearing limits as delineated on the Temporary Erosion and Sedimentation Control (TESC) plan prior to construction. The contractor shall use the following BMPS:

    - BMP C101: Preserving Natural Vegetation
    - BMP C102: Buffer Zones
    - BMP C103: High Visibility Plastic or Metal Fence
    - BMP C104: Stake and Wire Fence

2. Establish Construction Access – Construction entrances and road/parking areas shall comply with the following BMPs:

    - BMP C105: Stabilized Construction Entrance
    - BMP C106: Wheel Wash
    - BMP C107: Construction Road/Parking Area Stabilization

3. Control Flow Rates – Flow rates will be controlled by use of temporary facilities, including temporary sediment ponds per BMP C241 and/or portable sedimentation tanks. Calculations for sizing the temporary facilities are provided in Appendix G for Phase 1 and

Phase 2. The outlets from the facilities will be monitored and/or plugged to prevent downstream discharge of pollution.

4. Install Sediment Controls – The contractor shall install a combination of the following BMPs for controlling sediment:

   - BMP C233: Silt Fence
   - BMP C234: Vegetated Strip
   - BMP C235: Straw Wattles
   - BMP C241: Temporary Sediment Pond
   - BMP 250: Construction Stormwater Chemical Treatment
   - BMP 251: Construction Stormwater Filtration

5. Stabilize Soils – The contractor shall provide temporary and permanent soil stabilization BMPs per the following:

   - BMP C120: Temporary and Permanent Seeding
   - BMP C121: Mulching
   - BMP C123: Plastic Covering
   - BMP C124: Sodding
   - BMP C125: Topsoiling
   - BMP C140: Dust Control

6. Protect Slopes – Slopes shall be protected per the following BMPs:

   - BMP C120: Temporary and Permanent Seeding
   - BMP C200: Interceptor Dike and Swale
   - BMP C204: Pipe Slope Drains
   - BMP C206: Level Spreader
   - BMP C207: Check Dams

7. Protect Drain Inlets – Inlet protection per BMP C220 shall be provided at all proposed and existing catch basins within the project limits and immediately downstream.

8. Stabilize Channels and Outlets – All temporary and permanent channels shall be stabilized and protected per BMP C202: Channel Lining and BMP C209: Outlet Protection.

9. Control Pollutants – The contractor shall provide BMPs to control pollutants at the source, including BMP C151: Concrete handling and C152: Sawcutting and Surfacing Pollution Prevention. Contractor shall also provide source controls, as outlined in Section 5.2.

10. Control Dewatering – All sediment-laden water from excavation dewatering will be directed to sediment controls per Element 4 above.

11. Maintain BMPs – The contractor shall be responsible for implementing, inspecting, and maintaining all BMPs. BMPs shall be inspected on a regular basis and within 24 hours of a storm event, and maintained as necessary. Inspection and maintenance records shall be kept onsite. All temporary BMPs shall be removed within 30 days after achieving final site stabilization or when BMPs are no longer necessary.

12. Manage the Project – The contractor shall be responsible for managing the project, including phasing work to limit areas of disturbance, inspecting and monitoring BMPs as outlined in Element 11, and maintaining an updated TESC plan. The TESC plan and

inspection/maintenance reports shall be kept onsite. The TESC plan shall be updated to reflect changing site conditions.

13. Protect Low Impact Development BMPs – The contractor shall be responsible for implementing, inspecting, and maintaining all BMPs. BMPs shall be inspected on a regular basis and maintained as necessary. Inspection and maintenance records shall be kept onsite.

5.2 Source Control of Pollution BMPs

In addition to the above construction BMPs, the project will provide the following permanent Source Control of Pollution BMPs per Volume IV of the *Drainage Manual*.

Source Control BMPs:

- BMPs for Landscaping and Lawn/Vegetation Management
- BMPs for Maintenance of Stormwater Drainage and Treatment Systems
- BMPs for Parking and Storage of Vehicles and Equipment
- BMPs for Roof/Building Drains at Manufacturing and Commercial Buildings

A full copy of each of these sections will be provided in Appendix H and to the owner as part of the Operation and Maintenance Manual.

6.0 Special Reports and Studies

See Appendix D for the following information:

- Subsurface Exploration and Preliminary Geotechnical Engineering Report by Associated Earth Sciences, Inc., dated January 14, 2015.

- Geotechnical Addendum – Additional Explorations by Associated Earth Sciences, Inc., dated September 26, 2016.

7.0 Other Permits

A Construction Stormwater General Permit (CSWGP) permit through the Washington State Department of Ecology will be required for the project. SEPA is required and will be submitted through a separate permit.

8.0 Operation and Maintenance Manual

Onsite stormwater management, flow control, water quality, and conveyance systems are maintained and operated by the owner. An Operation and Maintenance Manual was developed for the permanent stormwater controls and is provided in Appendix H. The Operation and Maintenance Manual includes the following items: description of facilities, identification and description of maintenance tasks, frequency of each task, and maintenance activity logs. In addition, copies of Source Controls are included in the Operation and Maintenance Manual, which is provided.

9.0 Declaration of Covenant for Privately Maintained Stormwater Facilities

A declaration of covenant can be provided, if required.

10.0 Bond Quantities Worksheet

A Bond Quantities Worksheet for this project has not been included. Per the Revised Code of Washington (RCW), schools cannot use capital funds to post bonds. The necessary bonds for construction will be posted by the contractor, if required.

11.0 Conclusion

This project will be broken into two phases and, after completion of Phase 2, the project will meet the requirements of the 2012 Washington State Department of Ecology *Stormwater Management Manual for Western Washington amended in 2014 (Drainage Manual)*, City of Lynnwood Standard Plans, and Lynnwood Municipal Code (LMC) Chapter 13.40, Stormwater Management. This report documents how the project site will meet Minimum Requirements (MRs) 1 through 9.

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.

Jared McDonald, EIT
Project Engineer

JMM/lsk

September 2017

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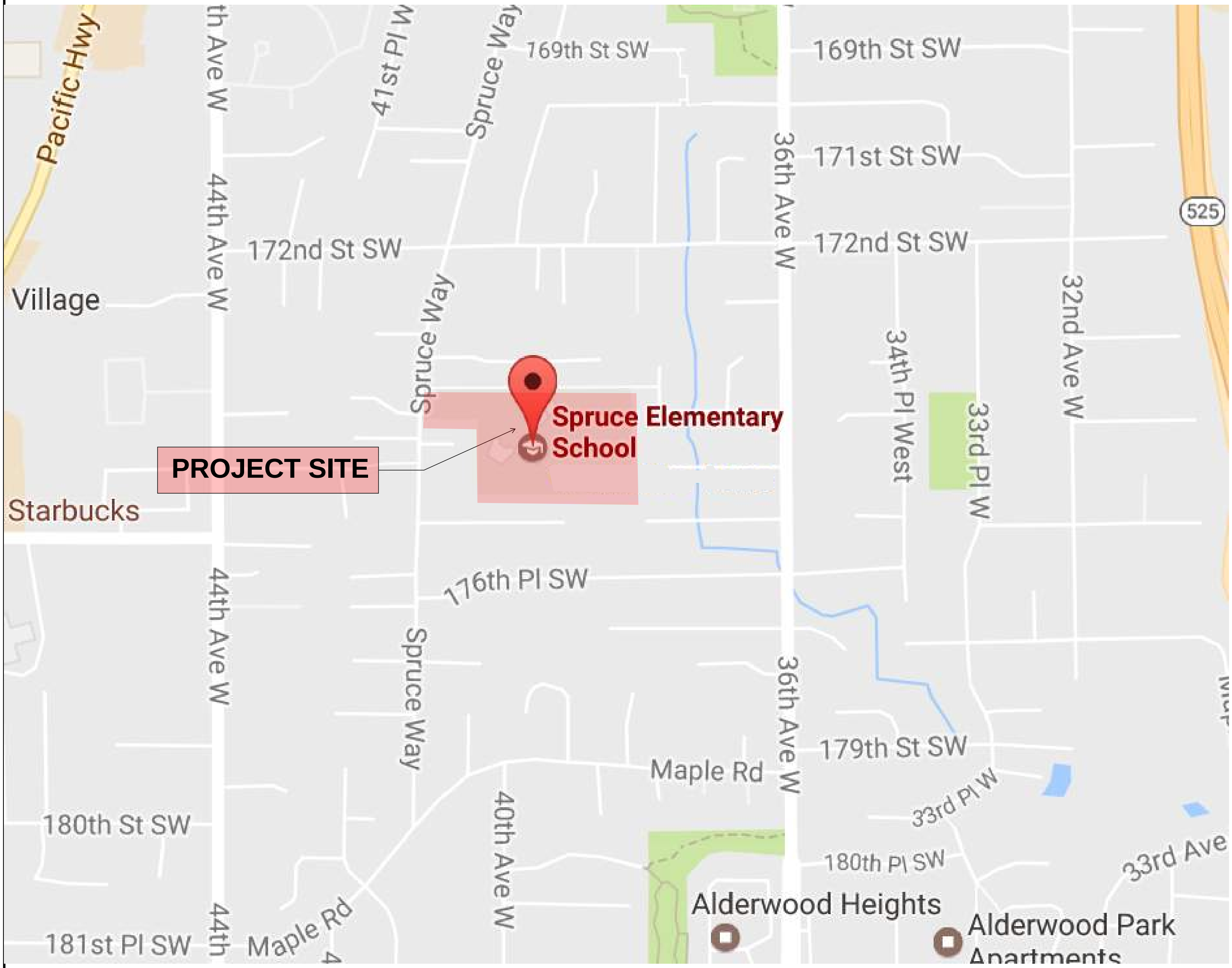
Appendix A

Maps

N



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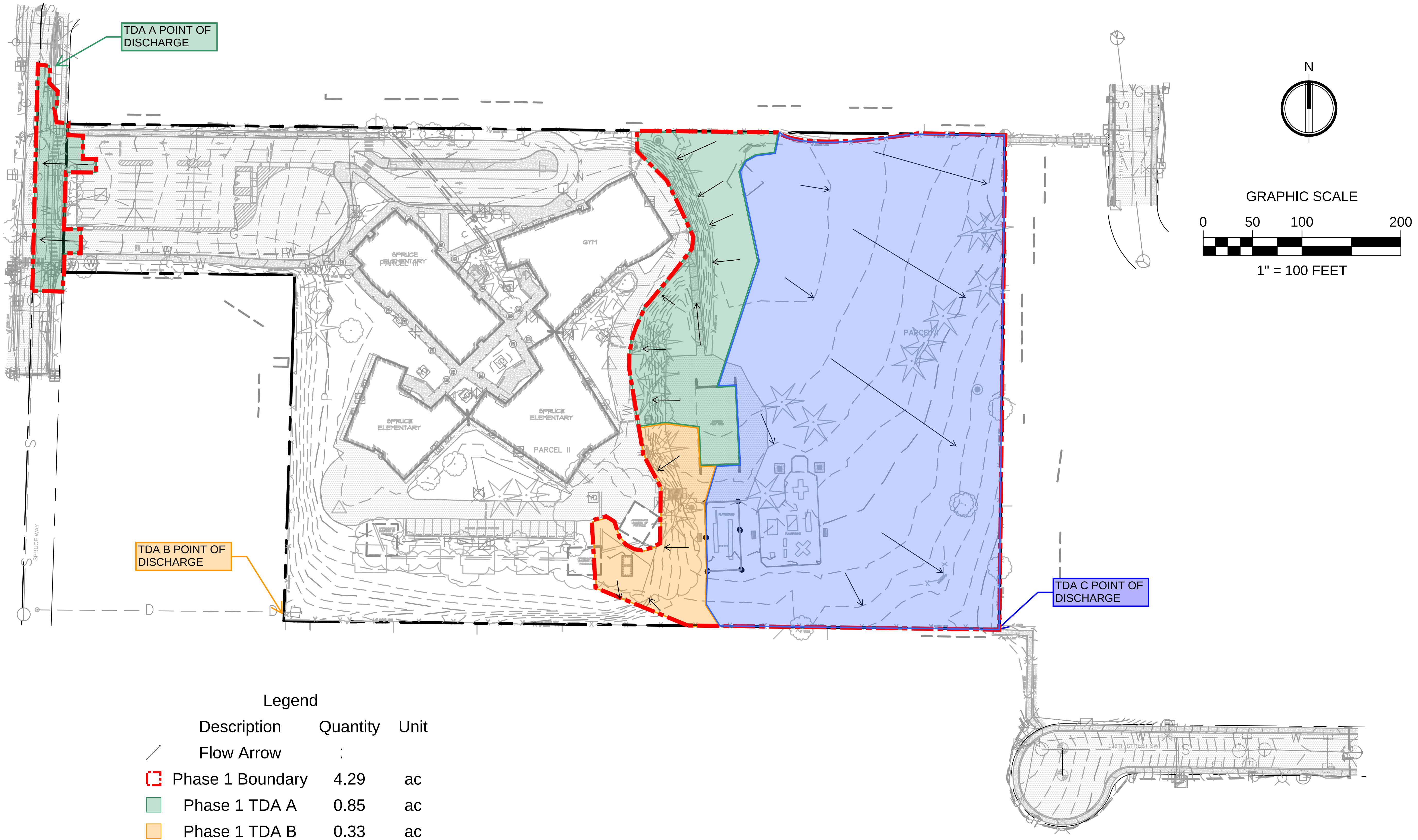
SPRUCE WAY ELEMENTARY SCHOOL

Site Vicinity Map

A-1



Legend

	Description	Quantity	Unit
↗	Flow Arrow		
🟥	Phase 1 Boundary	4.29	ac
🟩	Phase 1 TDA A	0.85	ac
🟧	Phase 1 TDA B	0.33	ac
🟦	Phase 1 TDA C	3.11	ac

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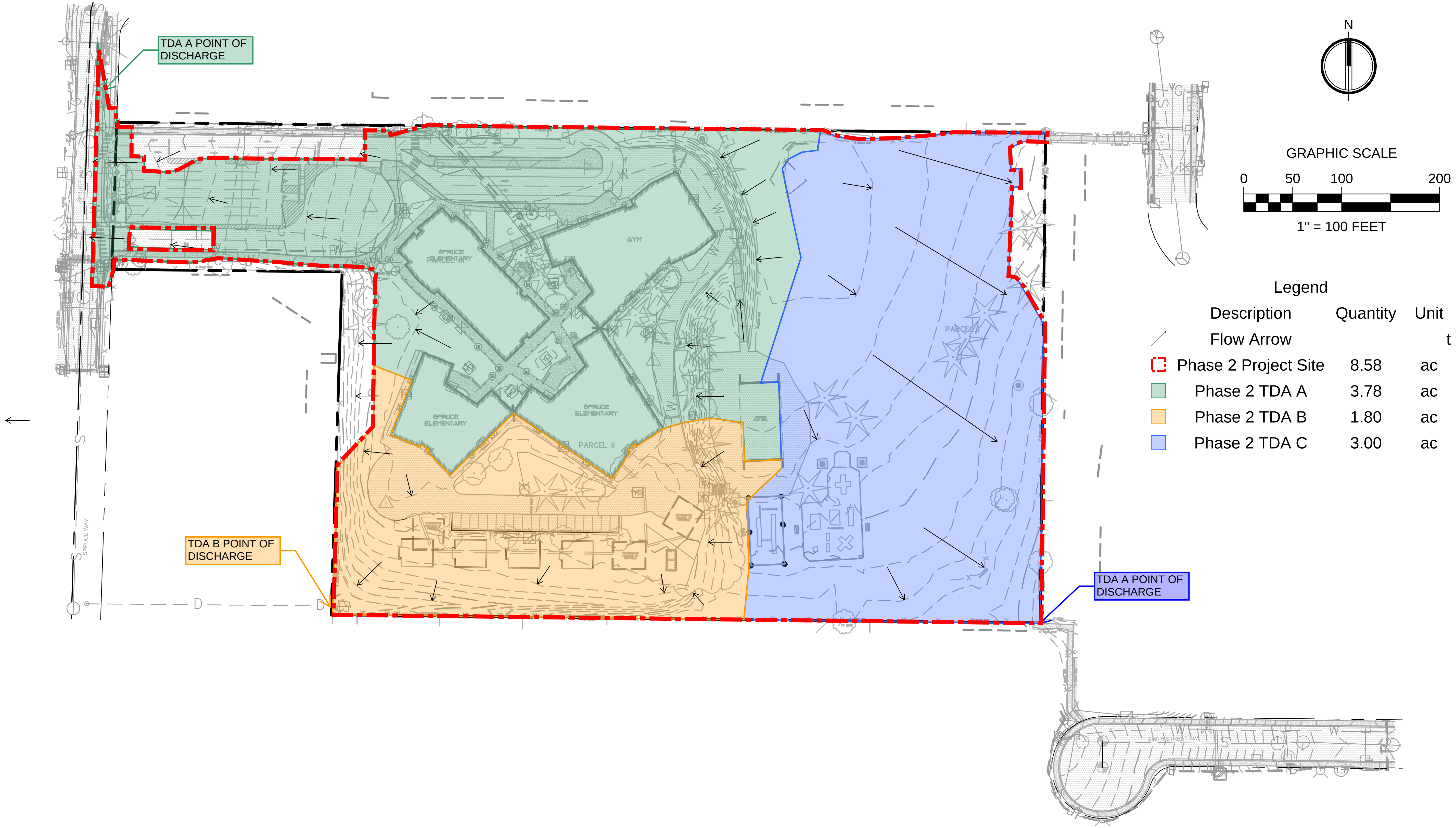
Spruce Elementary School

Existing Conditions Map - Phase 1

JOB NO. **2140275**

DATE: **July 2017**

A-2a



Legend

Description	Quantity	Unit
⟋ Flow Arrow		t
🟥 Phase 2 Project Site	8.58	ac
🟩 Phase 2 TDA A	3.78	ac
🟧 Phase 2 TDA B	1.80	ac
🟦 Phase 2 TDA C	3.00	ac

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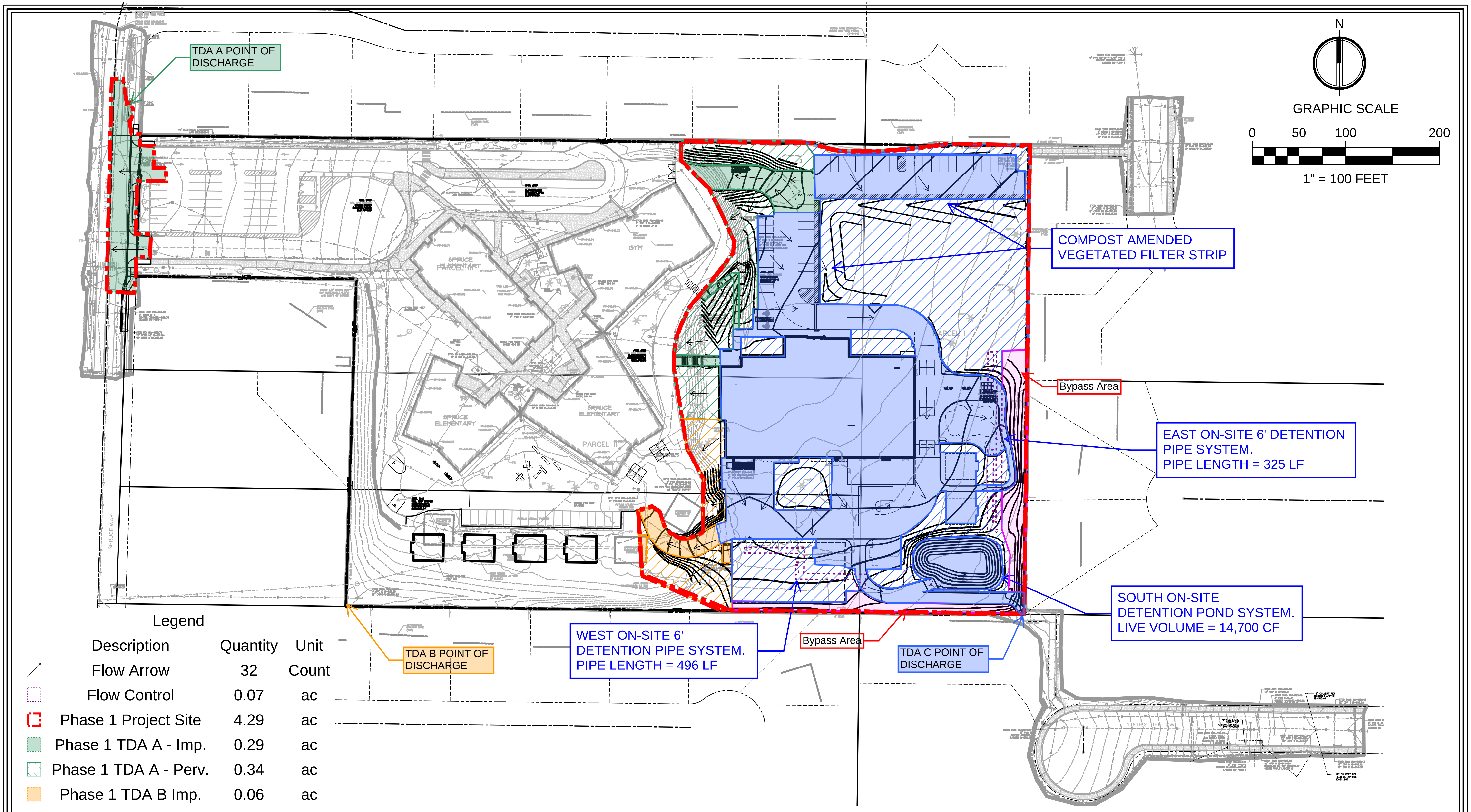
Spruce Elementary School

Existing Conditions Map - Phase 2

JOB NO. **2140275**

DATE: **July 2017**

A-2b



Legend

	Description	Quantity	Unit
↗	Flow Arrow	32	Count
⬚	Flow Control	0.07	ac
⬚	Phase 1 Project Site	4.29	ac
▨	Phase 1 TDA A - Imp.	0.29	ac
▨	Phase 1 TDA A - Perv.	0.34	ac
▨	Phase 1 TDA B Imp.	0.06	ac
▨	Phase 1 TDA B Perv.	0.19	ac
▨	Phase 1 TDA C - Per.	1.25	ac
■	Phase 1 TDA C Imp.	1.96	ac
□	TDA C Bypass Area	0.20	ac

AHBL

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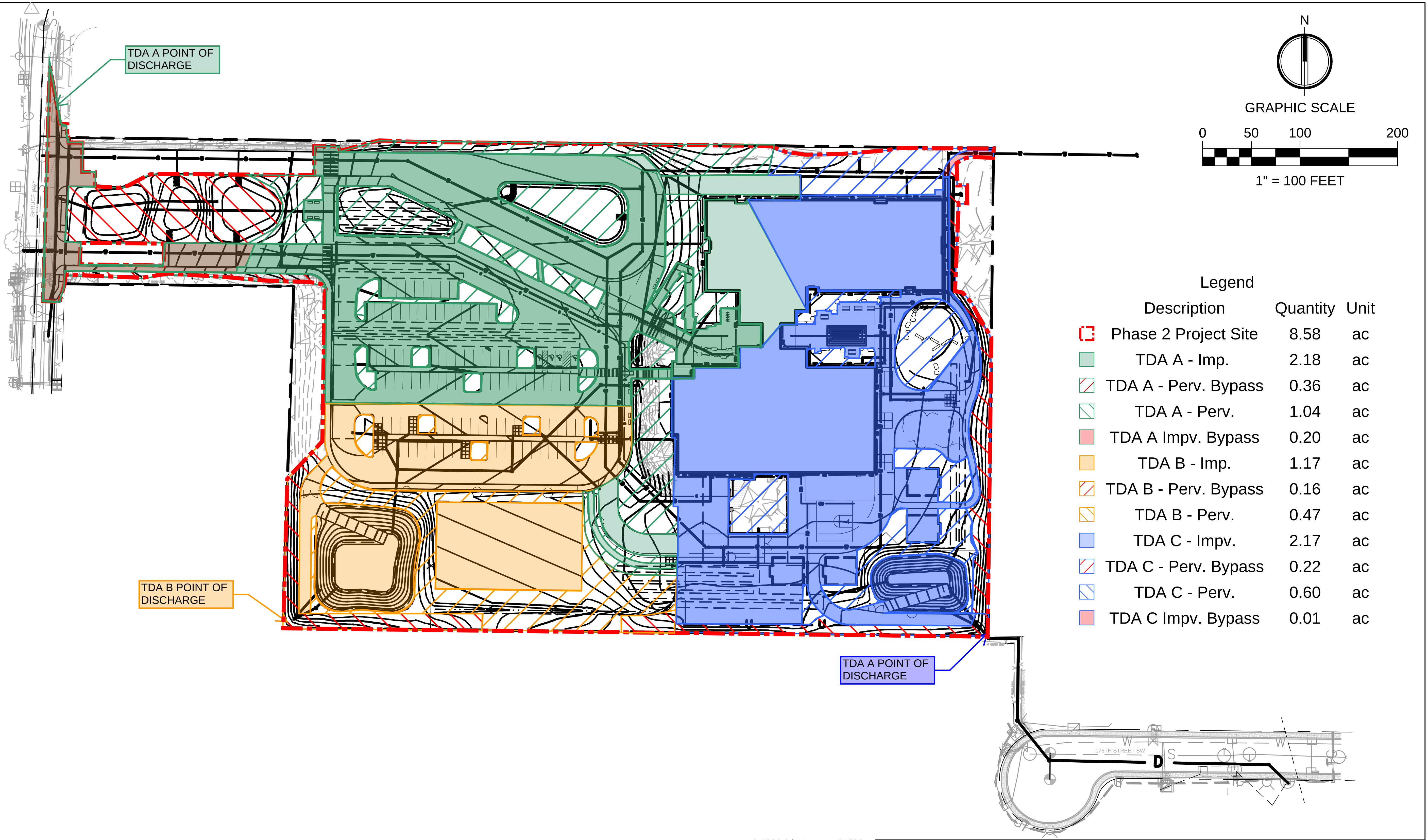
Spruce Elementary School

Developed Condition Map - Phase 1

JOB NO.
2140275

DATE:
July 2017

A-3a



Legend

	Description	Quantity	Unit
⬚	Phase 2 Project Site	8.58	ac
🟩	TDA A - Imp.	2.18	ac
▨	TDA A - Perv. Bypass	0.36	ac
▨	TDA A - Perv.	1.04	ac
🟥	TDA A Impv. Bypass	0.20	ac
🟧	TDA B - Imp.	1.17	ac
▨	TDA B - Perv. Bypass	0.16	ac
▨	TDA B - Perv.	0.47	ac
🟦	TDA C - Impv.	2.17	ac
▨	TDA C - Perv. Bypass	0.22	ac
▨	TDA C - Perv.	0.60	ac
🟥	TDA C Impv. Bypass	0.01	ac

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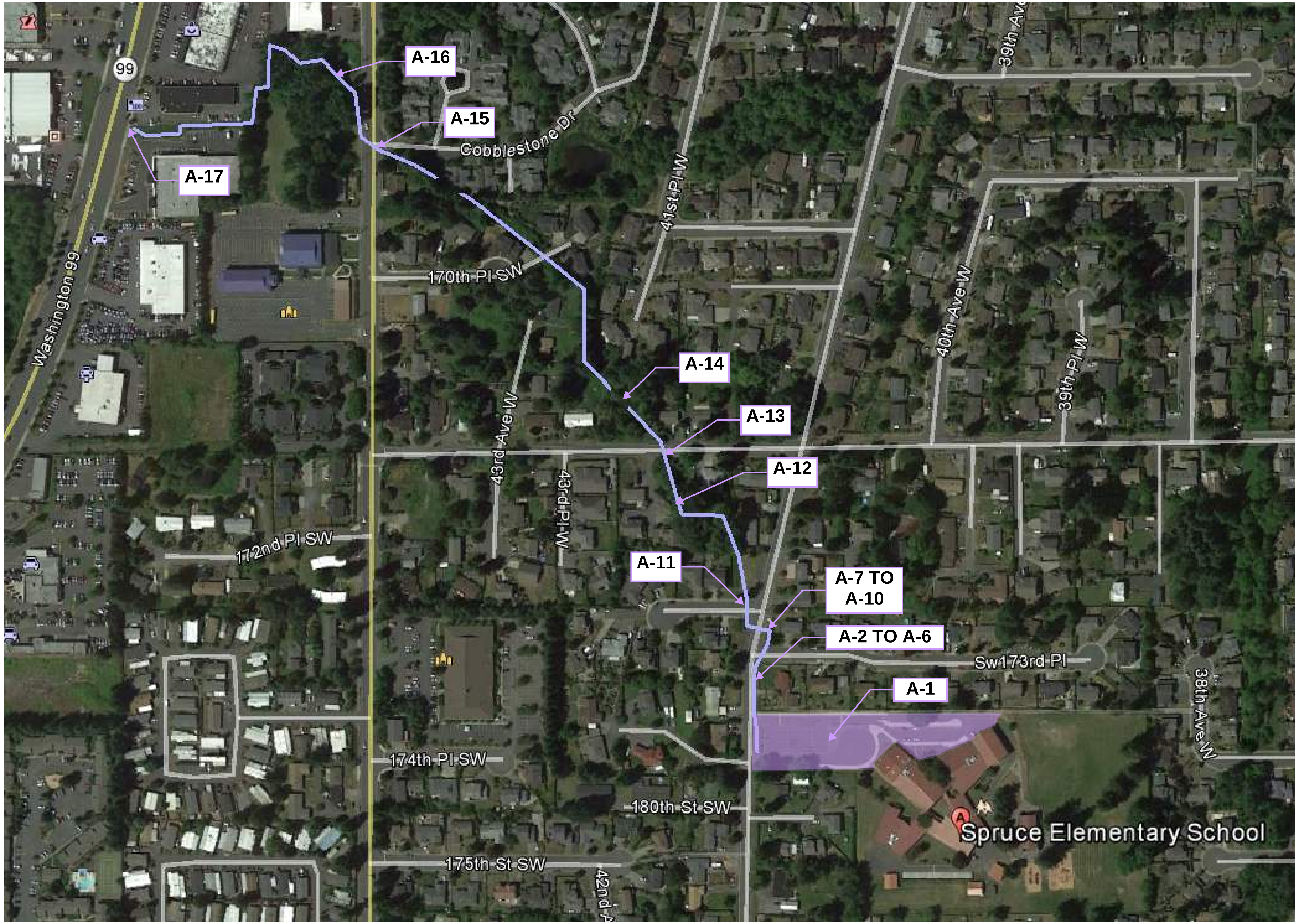
Spruce Elementary School

Developed Condition Map - Phase 2

JOB NO.
2140275

DATE:
July 2017

A-3b



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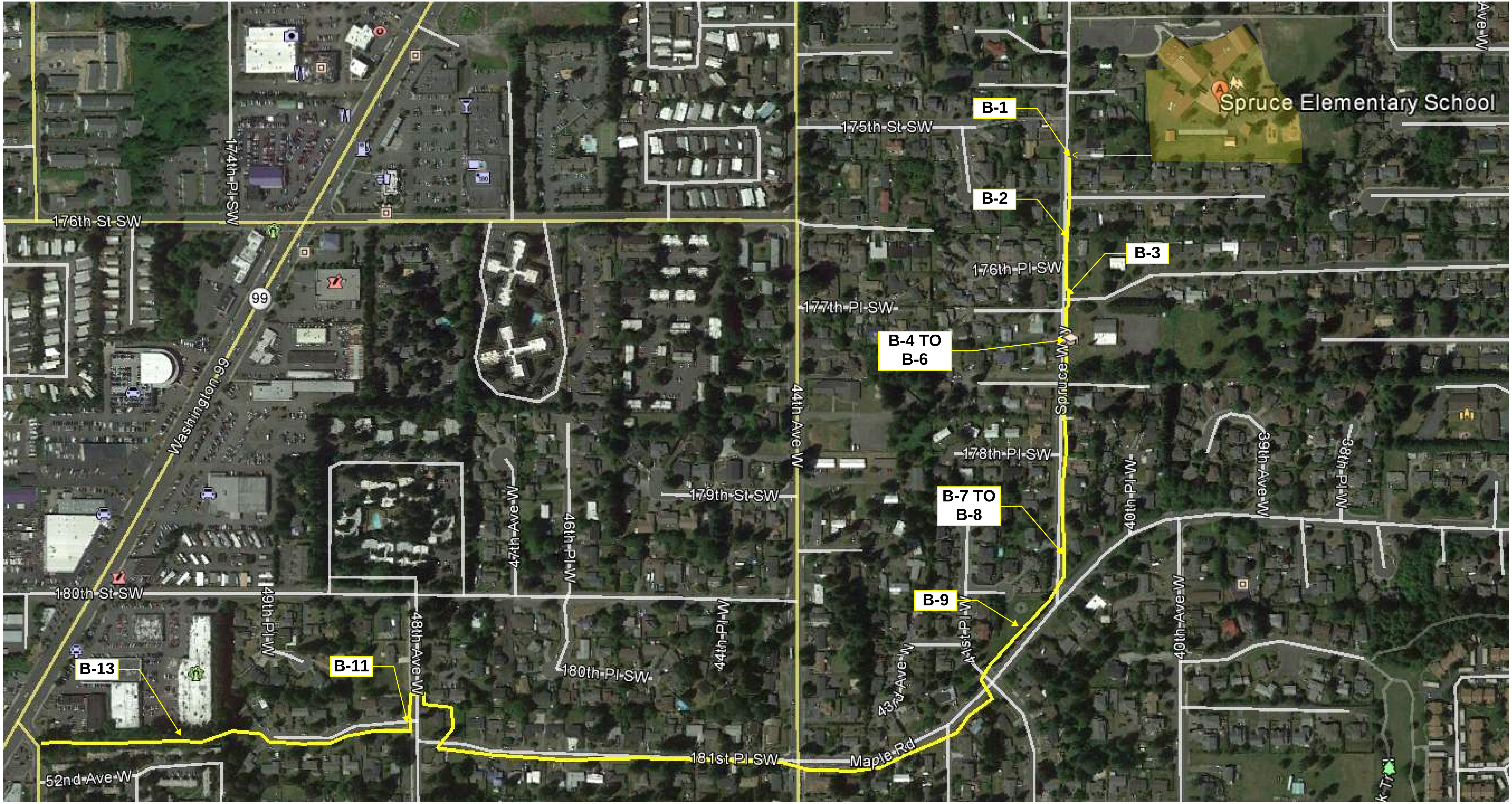
SPRUCE ELEMENTARY SCHOOL

TDA A: DOWNSTREAM STUDY MAP

JOB NO.
2140275

DATE:
02/27/17

A-4a



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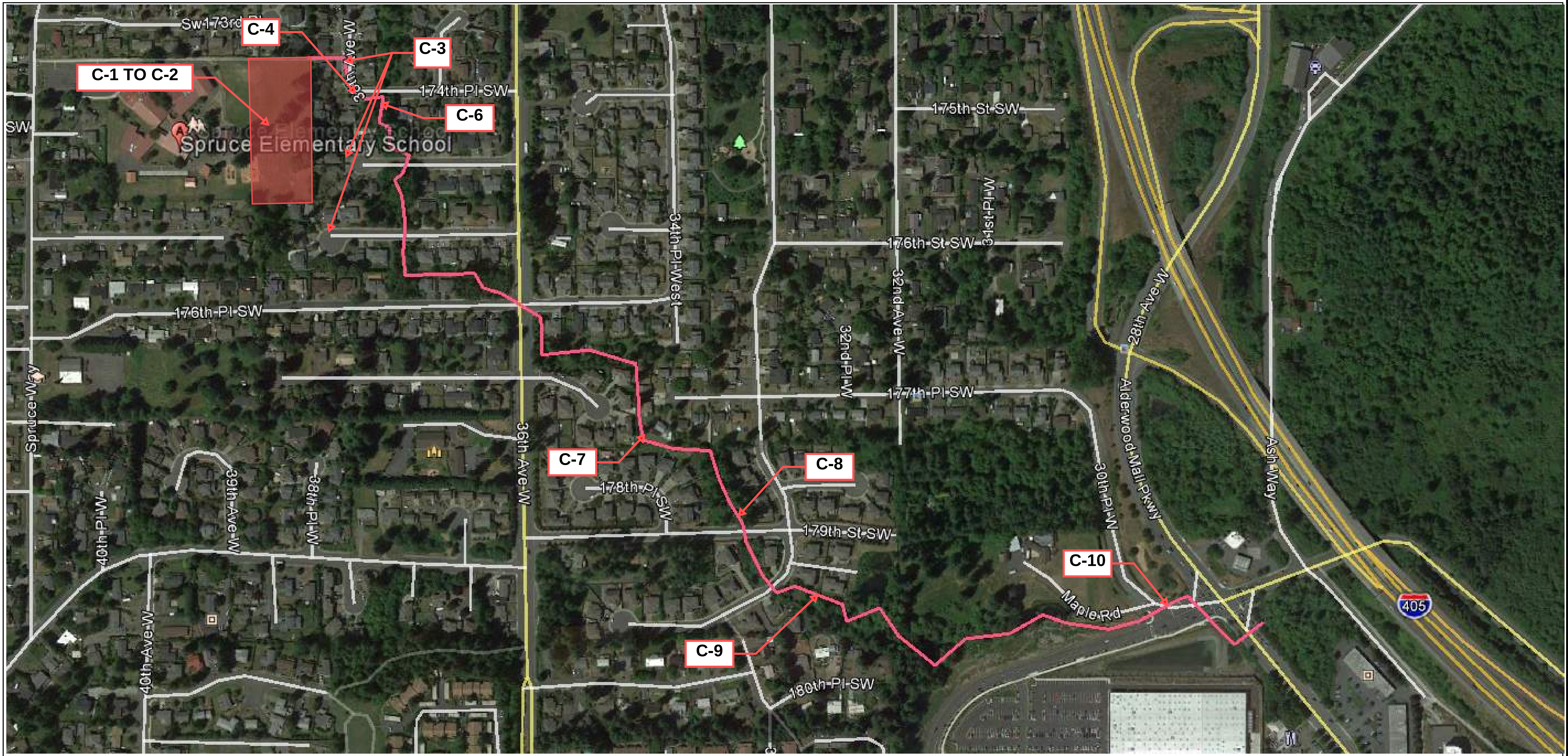
TDA B: DOWNSTREAM STUDY MAP

JOB NO. **2140275**

DATE: **02/27/17**

A-4b



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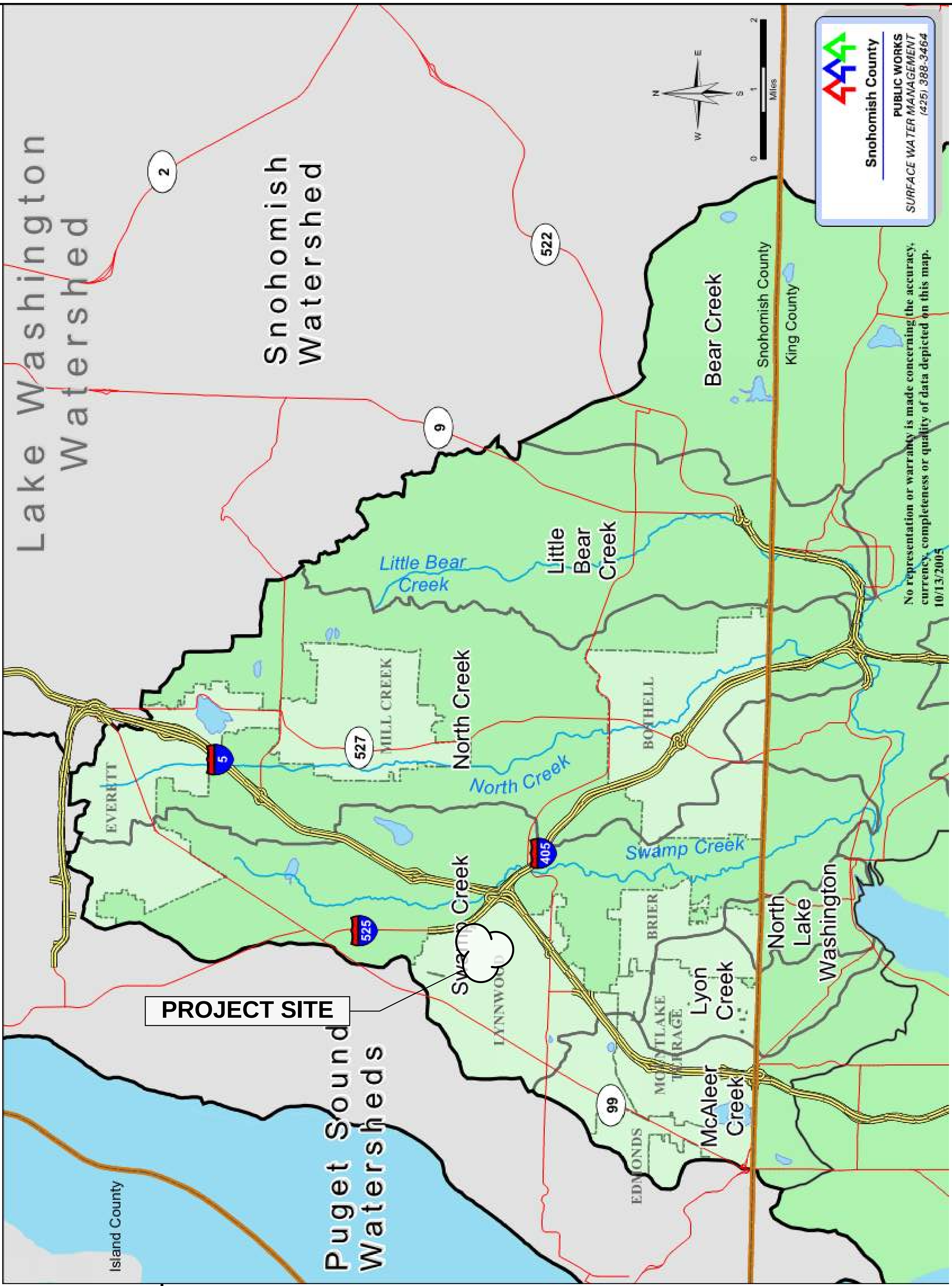
TDA C: DOWNSTREAM STUDY MAP

JOB NO. 2140275

DATE: 02/27/17

A-4c



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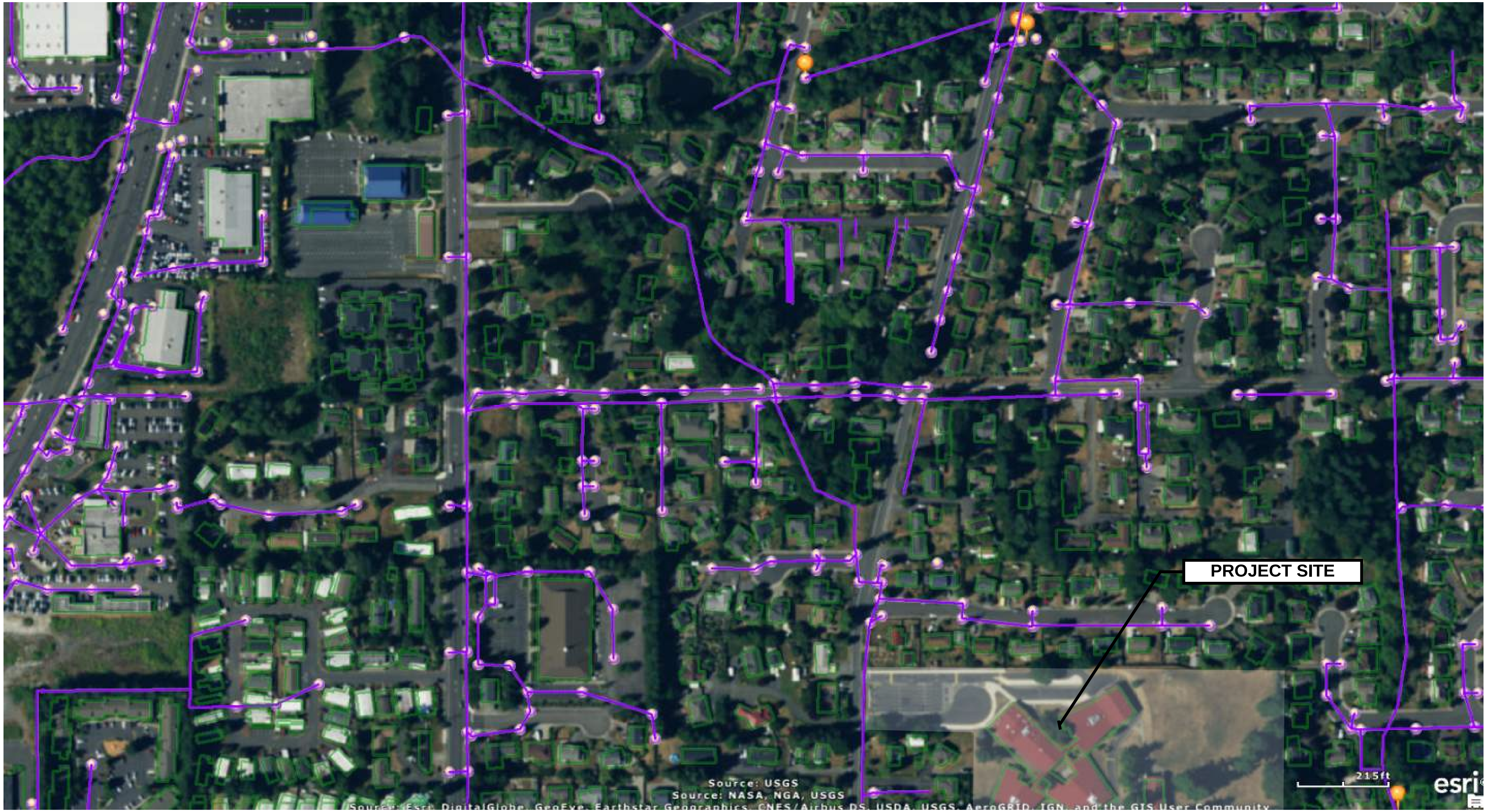
Spruce Elementary School

Basin Map

A-5



LEGEND

● STORM STRUCTURE

— STORM PIPE

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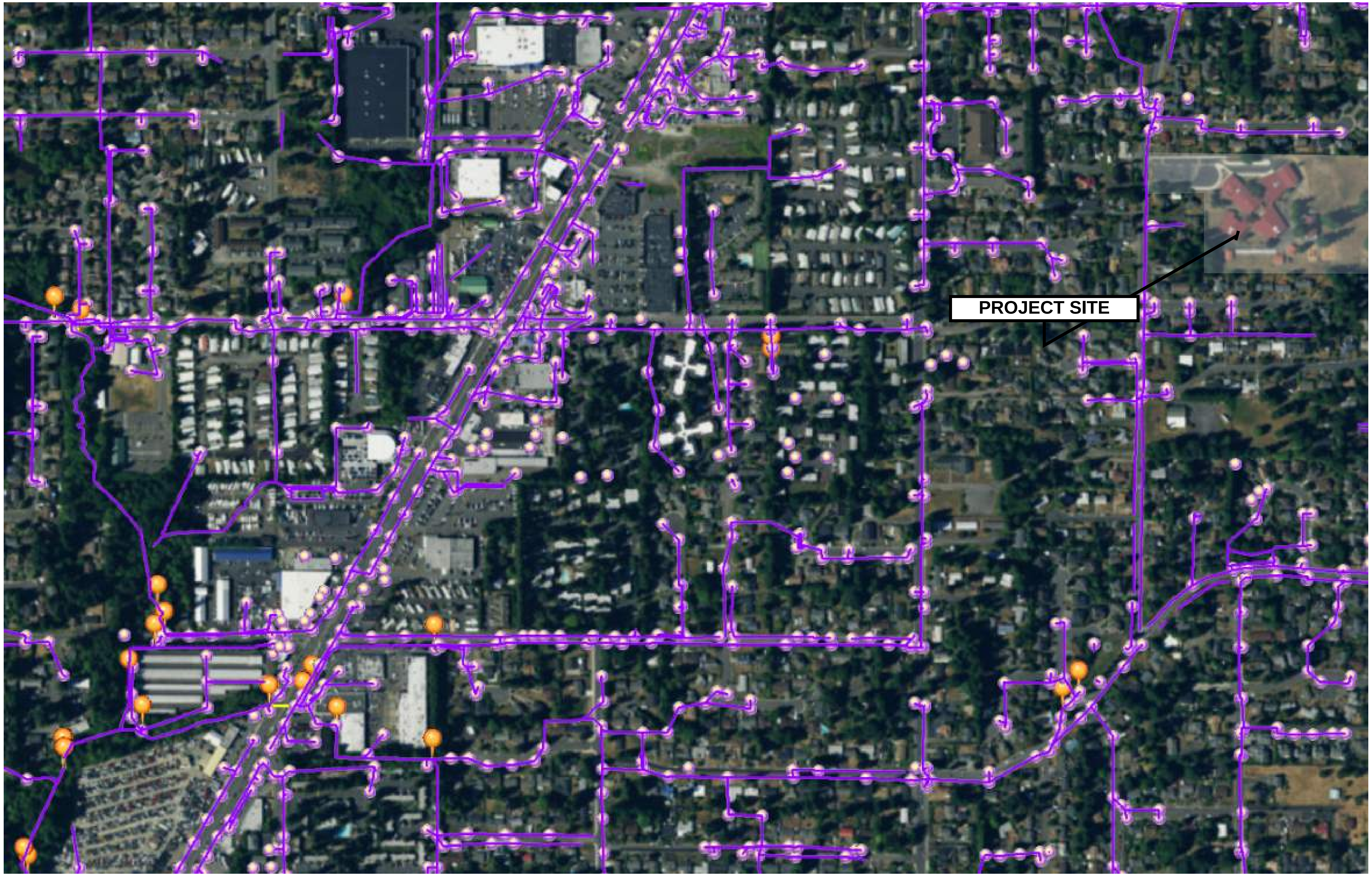
SPRUCE ELEMENTARY SCHOOL

DRAINAGE INVENTORY MAP
TDA: A

A-6a



LEGEND

● STORM STRUCTURE

— STORM PIPE

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SPRUCE ELEMENTARY
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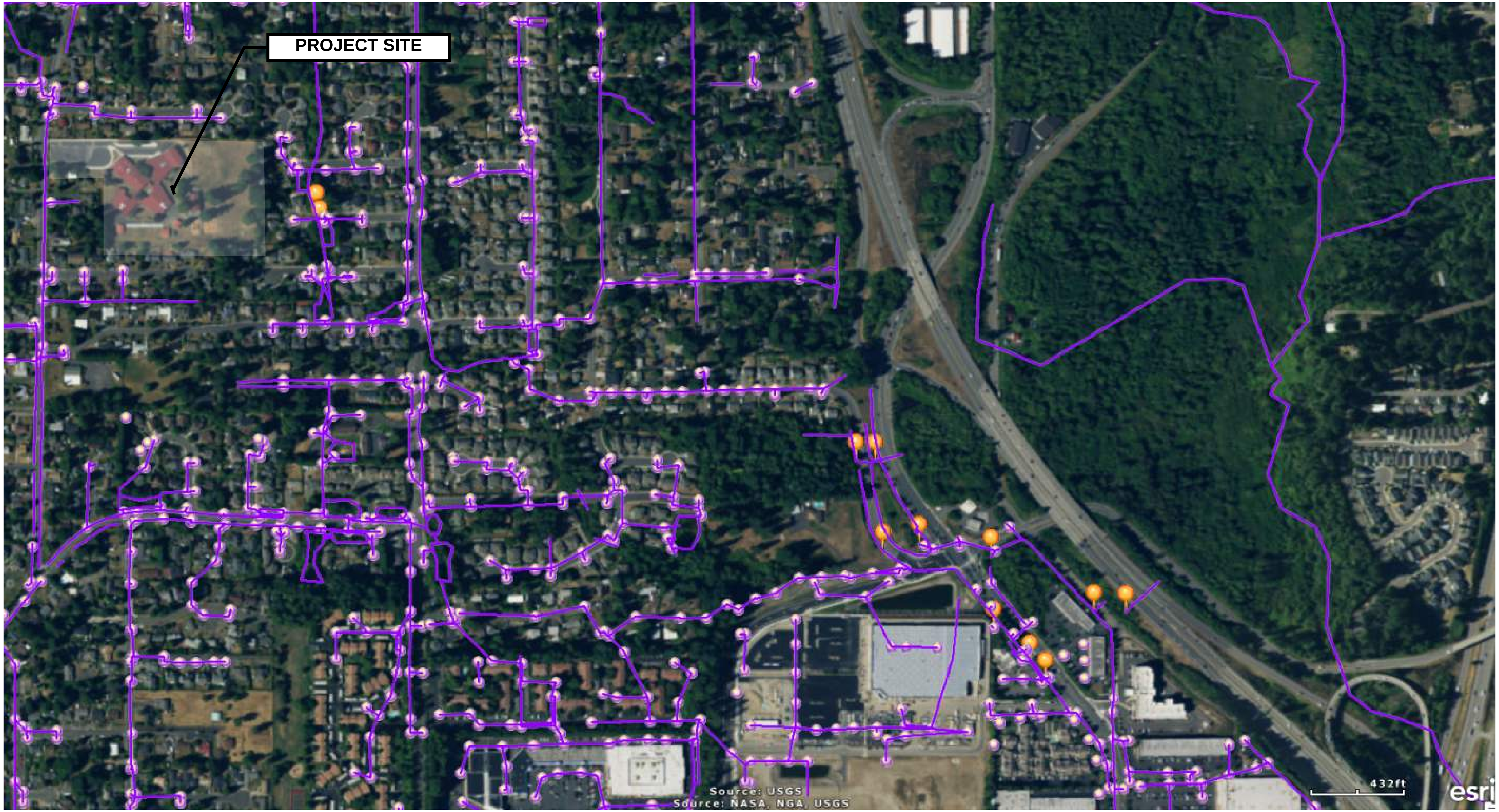
DRAINAGE INVENTORY MAP
TDA B

A-6B



LEGEND

● STORM STRUCTURE

— STORM PIPE

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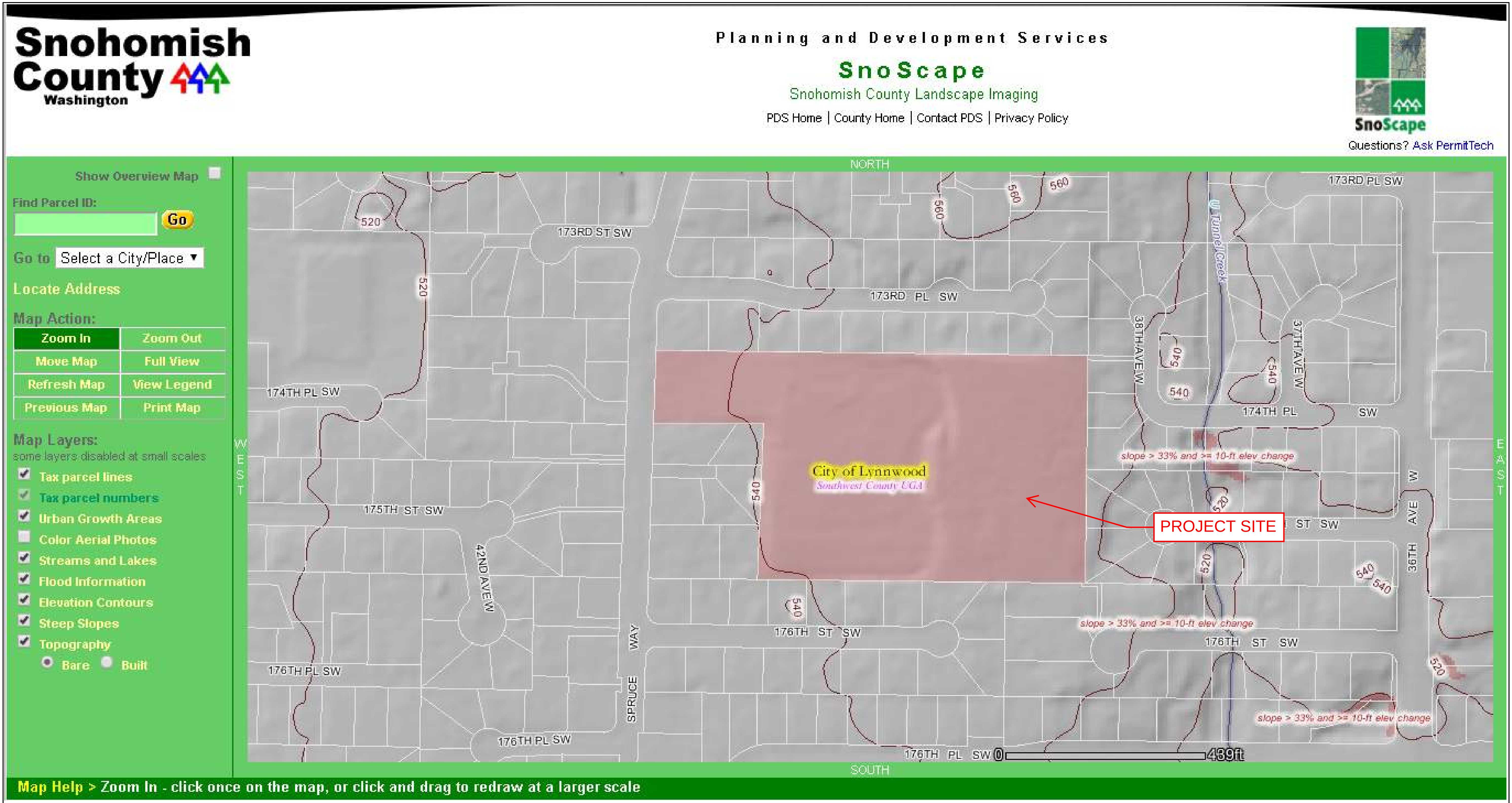
DRAINAGE INVENTORY MAP
TDA C

A-6C



☐ Show Overview Map

Go to: Select a City/Place

☑ Tax parcel lines
☑ Tax parcel numbers
☑ Urban Growth Areas
☐ Color Aerial Photos
☑ Streams and Lakes
☑ Flood Information
☑ Elevation Contours
☑ Steep Slopes
☑ Topography
● Bare ○ Built

Map Help > Zoom In - click once on the map, or click and drag to redraw at a larger scale

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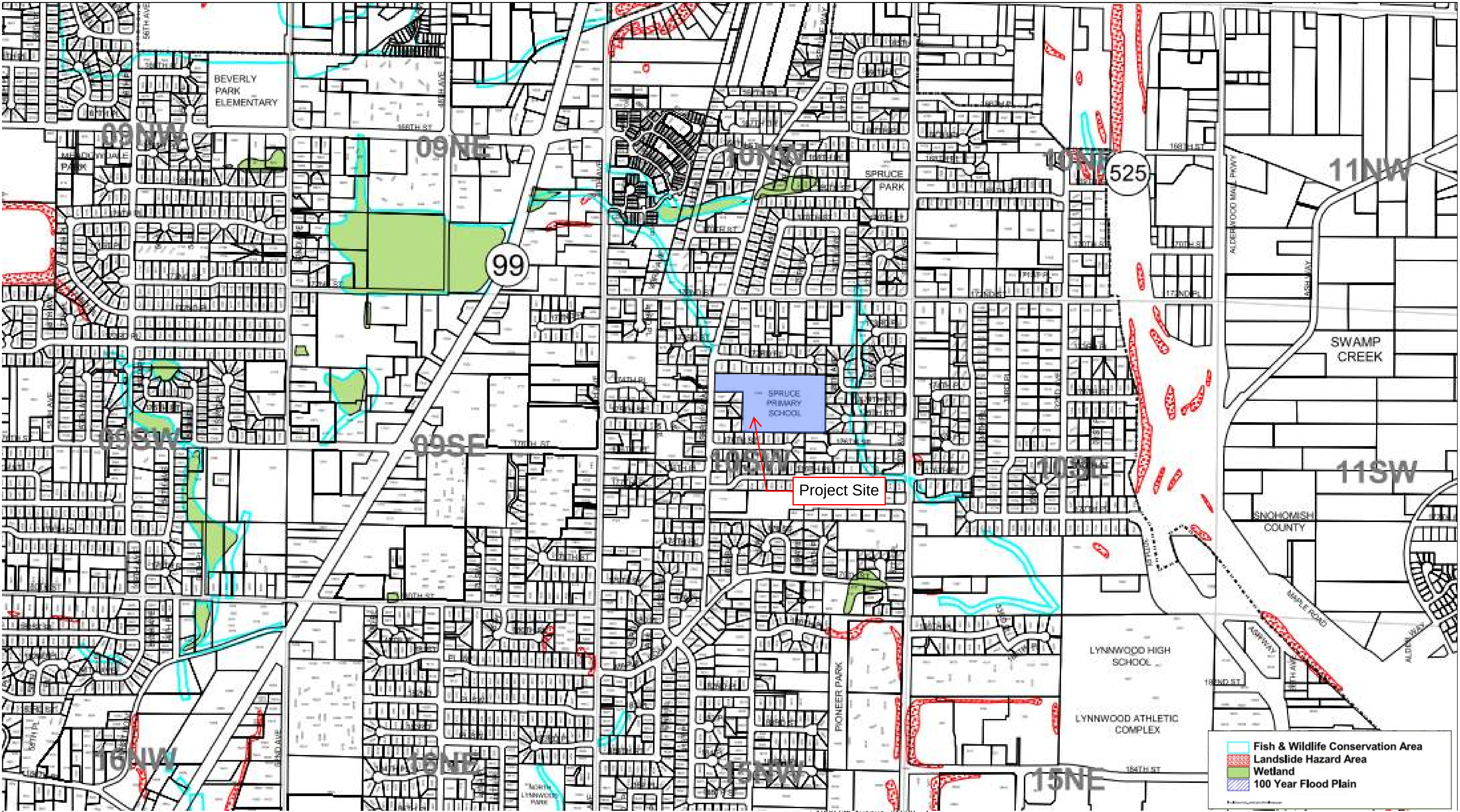
SPRUCE WAY ELEMENTARY SCHOOL

SNOSCAPE MAP

JOB NO.
2140275.10

DATE:
02/27/17

A-7a



400 0 400 800 1200 1600 2000 2400 2800 Feet

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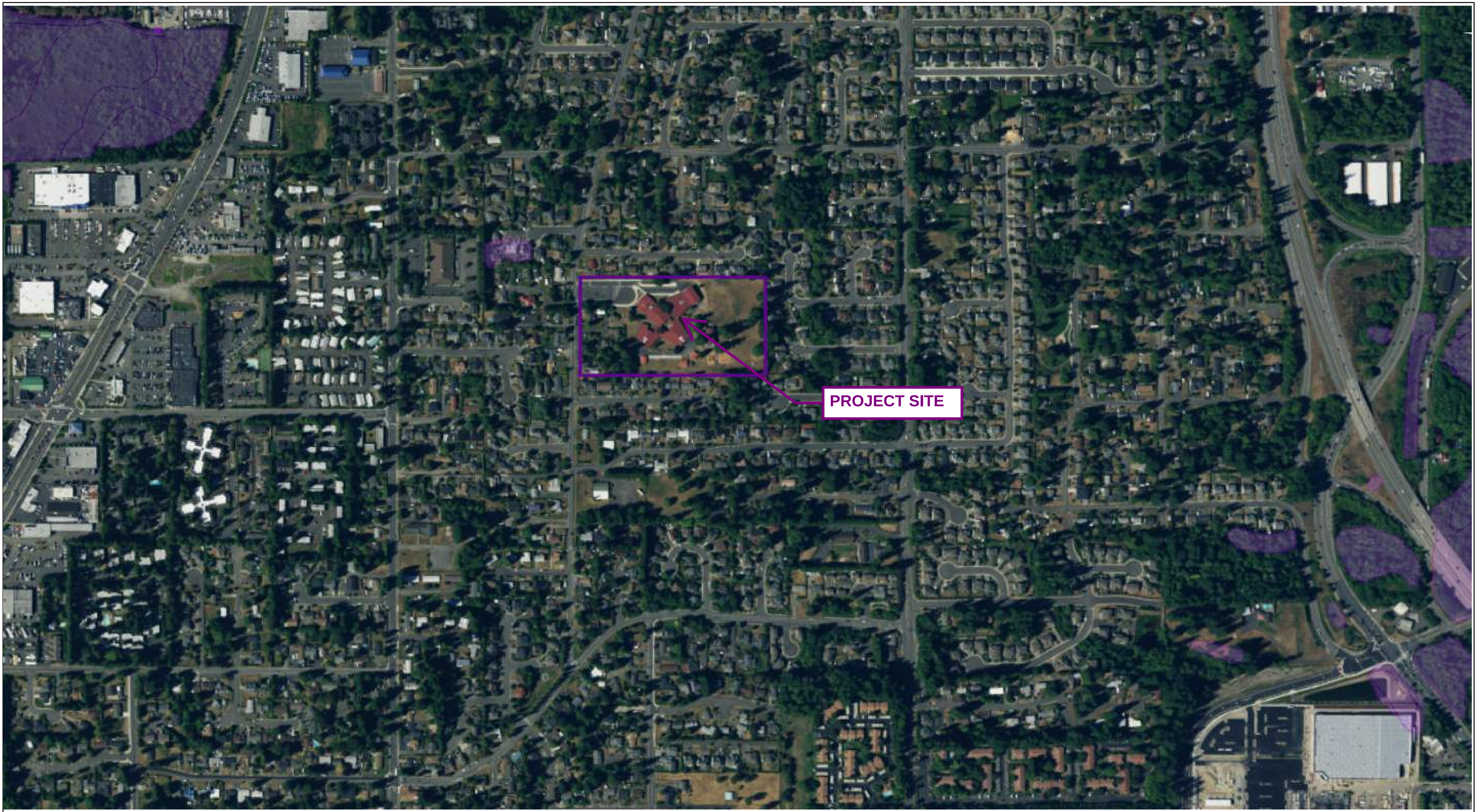
SPRUCE WAY ELEMENTARY SCHOOL

CITY OF LYNNWOOD
SENSITIVE AREAS

JOB NO.
2140275.10

DATE:
02/27/17

A-7b



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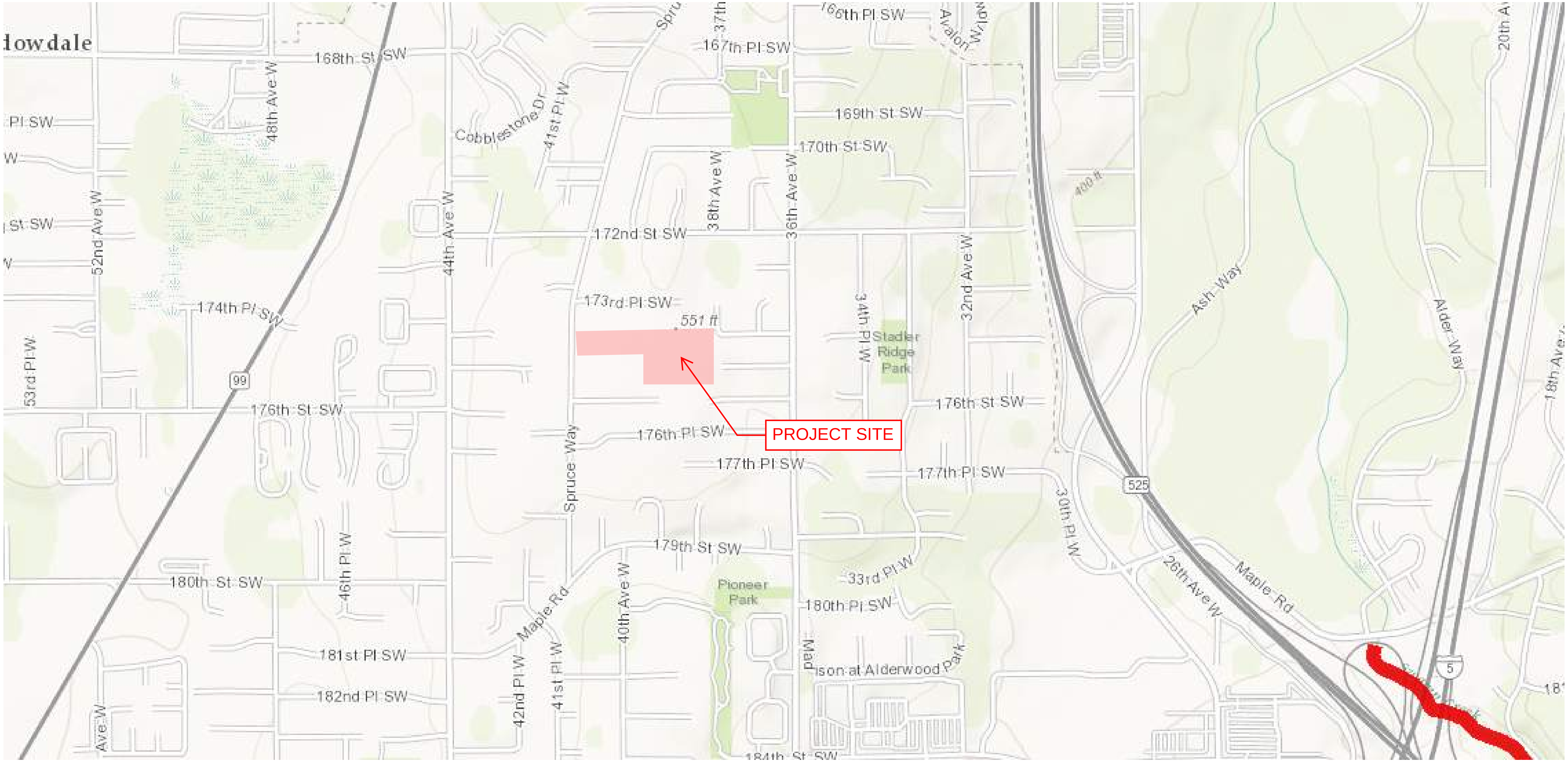
WDFW Priority Habitats and Species Map

JOB NO. 2140275.10

DATE: 02/27/17

A-8



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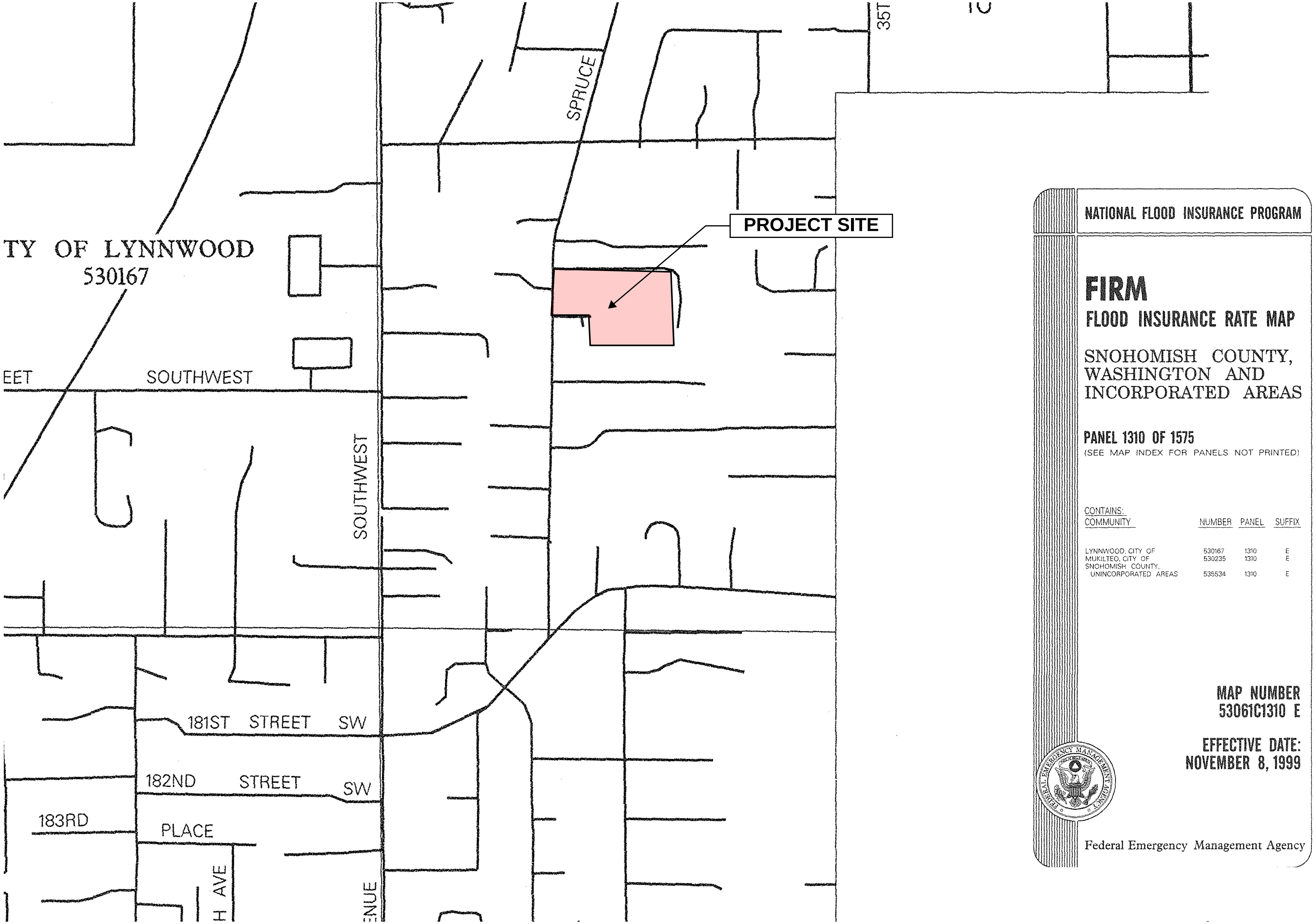
303(d) WATER BODIES MAP

JOB NO.
2140275.10

DATE:
02/27/17

A-9



NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

SNOHOMISH COUNTY,
WASHINGTON AND
INCORPORATED AREAS

PANEL 1310 OF 1575
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LYNNWOOD, CITY OF	530167	1310	E
MUKILTEO, CITY OF	530235	1310	E
SNOHOMISH COUNTY, UNINCORPORATED AREAS	535534	1310	E

MAP NUMBER
53061C1310 E

EFFECTIVE DATE:
NOVEMBER 8, 1999

Federal Emergency Management Agency

AHBL

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SPRUCE WAY ELEMENTARY SCHOOL

FIRM MAP

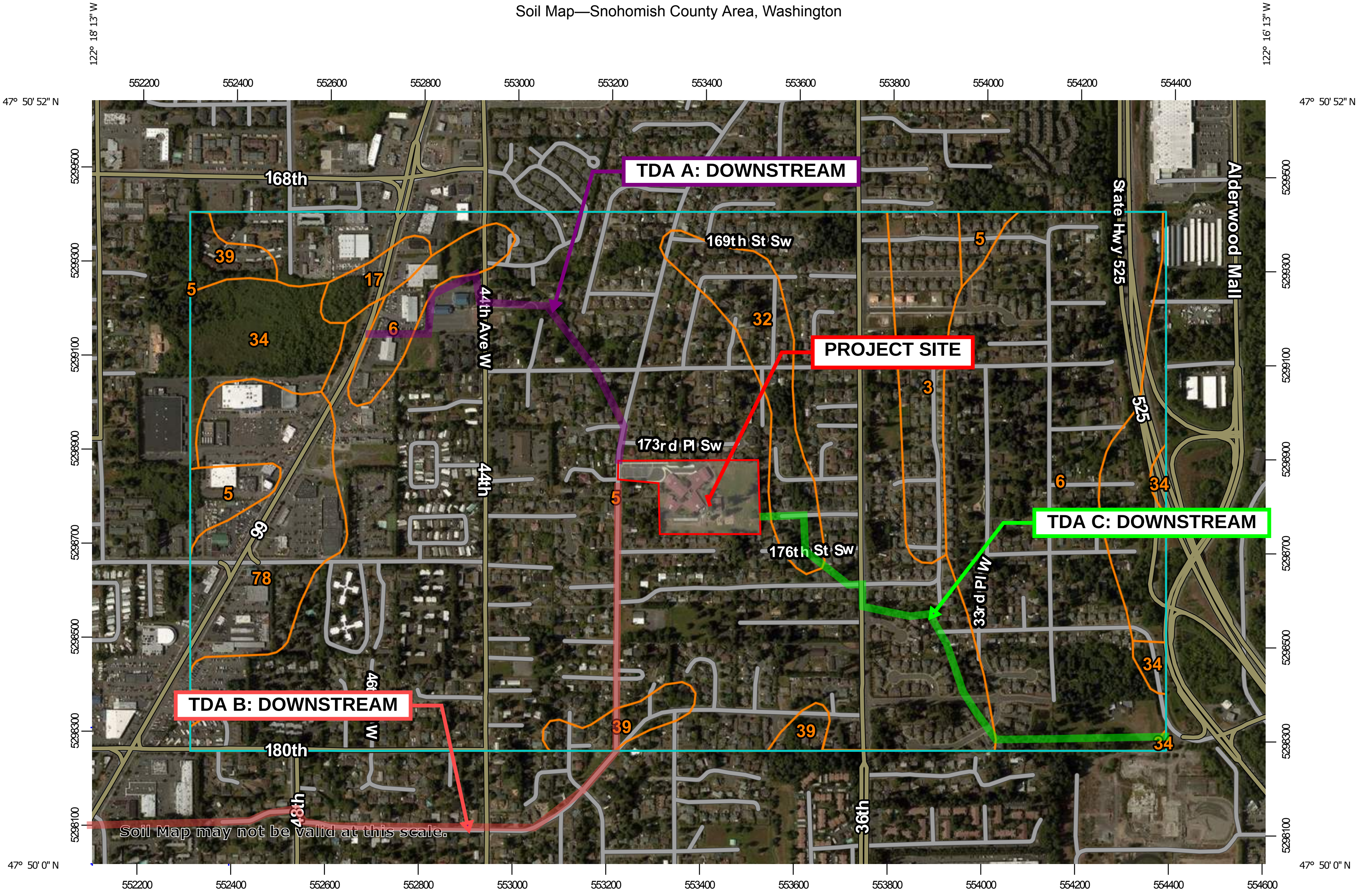
JOB NO. **2140275**

DATE: **02/27/17**

A-10

A-11 Web Soil Survey

Soil Map—Snohomish County Area, Washington



Map Scale: 1:11,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- ▭ Soil Map Unit Polygons
- Soil Map Unit Lines
- 🟧 Soil Map Unit Points

Special Point Features

- Blowout
- ⊠ Borrow Pit
- Clay Spot
- ◇ Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- ◎ Miscellaneous Water
- ○ Perennial Water
- ∨ Rock Outcrop
- + Saline Spot
- Sandy Spot
- Severely Eroded Spot
- ◇ Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- △ Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 14, Sep 8, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 7, 2014—Jul 8, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Snohomish County Area, Washington (WA661)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	Alderwood gravelly sandy loam, 15 to 30 percent slopes	20.0	3.4%
5	Alderwood-Urban land complex, 2 to 8 percent slopes	367.6	62.1%
6	Alderwood-Urban land complex, 8 to 15 percent slopes	113.8	19.2%
17	Everett very gravelly sandy loam, 0 to 8 percent slopes	5.0	0.8%
32	McKenna gravelly silt loam, 0 to 8 percent slopes	18.6	3.1%
34	Mukilteo muck	19.9	3.4%
39	Norma loam	12.0	2.0%
78	Urban land	35.3	6.0%
Totals for Area of Interest		**592.1**	**100.0%**

Appendix B

Offsite Analysis Drainage System Tables

Figure B-1: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA A - Northwest Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A-1	Sheet Flow	Runoff Sheet Flows west from SES to Spruce Way	4%	0			
A-2	Ditch	Stormwater is conveyed north through a ditch	1%	60			
A-3	12" Concrete Pipe	Stormwater is piped from ditch to ditch using a 12" concrete pipe	1%	105			
A-4	Ditch	Stormwater is conveyed north through a ditch	1%	137			
A-5	12" Concrete Pipe	Stormwater is piped from ditch to ditch using a 12" concrete pipe	1%	164			
A-6	Ditch	Stormwater is conveyed north through a ditch	1%	209			
A-7	12" Concrete Pipe	Stormwater exits the ditch in a 12" concrete pipe that crosses 173rd place and empties into a type 1 catch basin	1%	278			
A-8	12" Concrete Pipe	Stormwater is conveyed north through a 12" concrete pipe to a type 2 catch basin.	1%	309			
A-9	12" CMP	Drainage is conveyed west to a catch basin in the east flowline along Spruce Way	1%	321			
A-10	12" CMP	Stromwater is conveyed west to a type 2 catch basin on the west side of the street.	1%	887			
A-11	12" CMP	Drainage is piped across 173rd Street SW and empties into a swale in the NW corner of the 173rd Street and Spruce Way intersection	20%	426			

Figure B-1: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA A - Northwest Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A-12	Creek/Ditch	Drainage weaves its way northwest between properties in a creek/ditch to a catch basin on the south side of 172rd St.	20%	935			
A-13	18" CMP	Drainage is piped across 172rd Street Street to a type 1 catch basin on the north side of the street.	10%	961			
A-14	Creek/Ditch	Drainage weaves its way northwest between properties in a creek/ditch and emptlies into a catch basin at the intersection of Coblestone Driveway and 44th AVE West	5%	2017			
A-15	18" CMP	Drainage crosses to the west side of 44th AVE W into what is presumed to be a type 2 catch basin. The catch basin was not observed.	2%	2071			
A-16	36" CMP	Stormwater is piped into a creek/ditch	15%	2183			
A-17	Creek/Ditch	The runoff is convey out of the wetland into the public storm system in SR 99.	5%	3004			

Figure B-1: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA A - Northwest Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts

Figure B-1: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA B - Southwest Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
B-1	4" PVC	Runoff is conveyed west in a storm easement from SES to a ditch along Spruce Way.	4%	0			
B-2	12" Concrete Culvert	Stormwater is discharged to the south end of a culvert and connects into a catch basin	1%	286			
B-3	12" CPEP	Stormwater is piped throug the catch basin and connects into another catch basin on Spruce Way.	1%	471			
B-4 - B-6	12" CPEP pipe to ditch to 12" culverts	Stormwater is piped through the catch basin and discharges to a ditch along Spruce Way. The ditch is intermittently separated by culverts at driveway locations.	1%	1398			
B-7 - B-8	Ditches and 12" Concrete culverts	Stromwater goes through a series of ditches and culverts until Spruce Way intersects with Maple Road. A concrete culvert directs the stormwater across Spruce Way to a catch basin.	1%	1439			
B-9	12" CMP with trash grate	Stormwater connects from the catch basin to a detention facility owned by the City of Lynnwood on Maple Road.	1%	1893			
B-10	24" Concrete	Drainage flows west along the south side of Maple Road through a series of catch basins and 24" concrete pipe.	2%	4237			
B-11	24" Concrete Pipe	Drainage is directed into a Contech storm system on the corner of 181st Pl SW and 48th Ave W	2%	4237			
B-12	24" Concrete Pipe	Drainage flows west along the south side of 181st Pl W.	2%	2889			
B-13	Ditch/Creek	Drainage flows west until joining the conveyance system along Hwy 99.	20%	5834			

Figure B-1: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA B - Southwest Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts

Figure B-3: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA C - Southeast Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
C-1	Sheet Flow	A small portion of the northeast corner of the site sheet flows east from SES towards the properties adjacent to 38th AVE West.	10%	0			
C-2	Sheet Flow	The runoff either sheet flows through the property or is picked up by the onsite conveyance. In any event, the stormwater discharges to the catch basin within the west side of 38th AVE West.	5%	60			
C-3	12" Concrete Pipe	Stormwater flows along the gutter to a catch basin on the west side of 38th AVE West.	5%	210			
C-4	12" Concrete Pipe	Drainage is tight lined east to another catch basin	5%	293			
C-5	15" Concrete Pipe	Drainage is tight lined south to tunnel creek	5%	321			
C-6	Creek	Drainage flow south within Tunnel Creek, crossing 175th Street SW, and 176th Street SW. The creek flows in a culvert from the NW corner of 176th Place SW and 36th AVE W and daylights into the southeast corner.	1%	1614			
C-7	Creek	The daylighted creek continues to weave through properties in the southeast direction crossing 179th St SW in a culvert	1%	2939			
C-8	Creek	From the culvert, the creek again weaves through properties in the southeast direction crossing 33rd Pl W in a culvert.	1%	3159			
C-9	Creek	After crossing 33rd Pl W, the creek flows east to its intersection with the north side of 33rd AVE West.	1%	4545			
C-10	Creek	Stormwater flows beside 33rd AVE to a culvert which conveys the creek east across Alderwood Parkway.	1%	5248			

Figure B-3: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
TDA C - Southeast Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts

Figure B-3: OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE

TDA C - Southeast Drainage Basin

Basin: Swamp Creek

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map and photos	Type: sheet flow, swale, stream, channel pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensitive area, volume	%	1 mi = 5,280 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts

Appendix C

Field Inspection Photos

APPENDIX-C


A-2


A-3


A-4


A-5

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SPRUCE ELEMENTARY SCHOOL

FIELD INSPECTION PHOTOS - TDA A

DRAWN BY: Name
DATE: Date
JOB NO.: Job No.

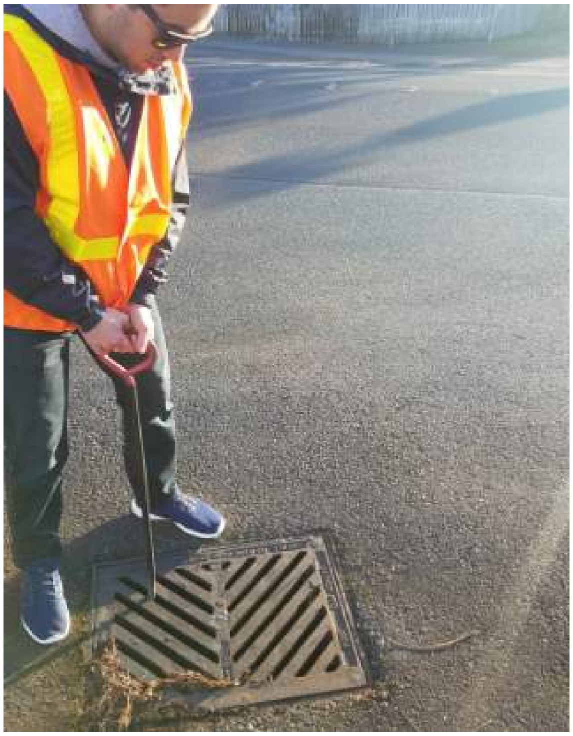
CSK-01

APPENDIX-C

A-6

A-7

A-8



A-9

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SPRUCE ELEMENTARY SCHOOL

FIELD INSPECTION PHOTOS - TDA A

DRAWN BY: Name

DATE: Date

JOB NO.: Job No.

CSK-02

APPENDIX-C


A-10


A-11


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A-15

AHBL 1200 6th Avenue, Suite 1620 Seattle, WA 98101 206.267.2425 TEL 206.267.2429 FAX	**SPRUCE ELEMENTARY SCHOOL** **FIELD INSPECTION PHOTOS - TDA A**		**CSK-03**
	DRAWN BY: Name	DATE: Date	JOB NO.: Job No.

A-16

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SPRUCE ELEMENTARY SCHOOL

FIELD INSPECTION PHOTOS - TDA A

DRAWN BY: Name
DATE: Date
JOB NO.: Job No.

CSK-04

APPENDIX-C

B-1

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SPRUCE ELEMENTARY SCHOOL

FIELD INSPECTION PHOTOS - TDA B

DRAWN BY: Name | DATE: Date | JOB NO.: Job No.

CSK-01

APPENDIX-C

B-5

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FIELD INSPECTION PHOTOS - TDA B

DRAWN BY: Name	DATE: Date	JOB NO.: Job No.

CSK-02

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FIELD INSPECTION PHOTOS - TDA B

DRAWN BY: Name
DATE: Date
JOB NO.: Job No.

CSK-03

C-6

C-10

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SPRUCE ELEMENTARY SCHOOL

FIELD INSPECTION PHOTOS - TDA C

DRAWN BY: Name	DATE: Date	JOB NO.: Job No.

CSK-01

Appendix D

Subsurface Exploration and Preliminary Geotechnical Engineering Report

By Associated Earth Sciences, Inc., dated January 14, 2015

Geotechnical Addendum – Additional Explorations

By Associated Earth Sciences, Inc., dated September 26, 2016

associated
earth sciences
incorporated

January 14, 2015
Project No. KE140562A

Edmonds School District No. 15
20420 68th Avenue West
Lynnwood, Washington 98124

Attention: Mr. Matthew Finch

Subject: Subsurface Exploration and Preliminary Geotechnical Engineering Report
Proposed Renovations and Additions
Spruce Elementary School
Lynnwood, Washington

Dear Mr. Finch:

We are pleased to present these copies of our preliminary geotechnical engineering report for the referenced project. This report summarizes the results of our subsurface exploration, geologic hazards, and geotechnical engineering studies, and offers preliminary recommendations for the design and development of the proposed project. At the time this report was prepared, the site was in the early planning stage and no project design or detailed concept drawings had been prepared. We recommend that we be allowed to review the recommendations contained in this report and modify them, if necessary, when a project plan has been developed.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

DRAFT

Kurt D. Merriman, P.E.
Senior Principal Engineer

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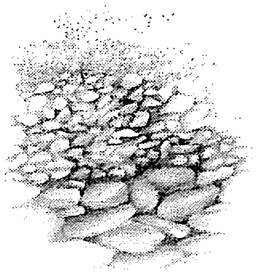
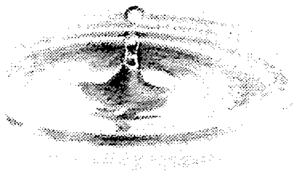


Geotechnical Engineering



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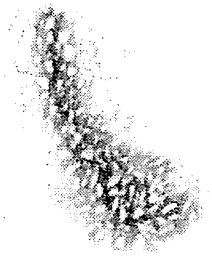

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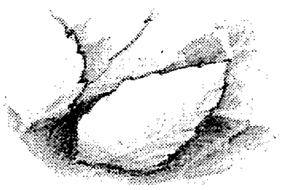

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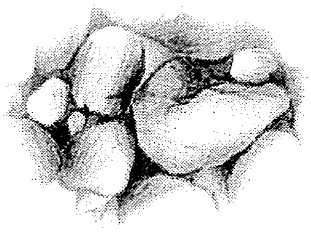

Geologic Assessments

Associated Earth Sciences, Inc.

Serving the Pacific Northwest Since 1981

Subsurface Exploration and
Preliminary Geotechnical Engineering Report

PROPOSED RENOVATIONS AND ADDITIONS SPRUCE ELEMENTARY SCHOOL

Lynnwood, Washington

Prepared for

Edmonds School District No. 15

Project No. KE140562A
January 14, 2015

SUBSURFACE EXPLORATION AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PROPOSED RENOVATIONS AND ADDITIONS SPRUCE ELEMENTARY SCHOOL

Lynnwood, Washington

Prepared for:
Edmonds School District No. 15
20420 68th Avenue West
Lynnwood, Washington 98124

Prepared by:
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January 14, 2015
Project No. KE140562A

I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazards, and preliminary geotechnical engineering studies for the proposed renovations and additions to the Spruce Elementary School. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of exploration borings completed for this study are shown on the "Site and Exploration Plan," Figure 2. Logs of the subsurface explorations and copies of laboratory test results completed for this study are included in the Appendix.

1.1 Purpose and Scope

The purpose of this study was to provide geotechnical engineering design recommendations to be utilized in the preliminary design of the project. This study included a review of selected available geologic literature, advancing three hollow-stem auger soil borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow ground water. Geotechnical engineering studies were completed to establish recommendations for the type of suitable foundations and floors, allowable foundation soil bearing pressure, anticipated foundation and floor settlement, pavement recommendations, and drainage considerations. At the time this report was prepared, infiltration of storm water on-site was not planned and our study was not structured to support storm water infiltration. Based on exploration data contained in this report, storm water infiltration using conventional shallow infiltration strategies is not feasible. This report summarizes our fieldwork and offers preliminary geotechnical engineering recommendations based on our present understanding of the project. We recommend that we be allowed to review the recommendations presented in this report and revise them, if needed, when a project design has been developed.

1.2 Authorization

Authorization to proceed with this study was granted by means of a District purchase order. Our work was completed in general accordance with our scope of work and cost proposal, dated October 1, 2014. This report has been prepared for the exclusive use of Edmonds School District No. 15 and their agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The project site is that of the existing Spruce Elementary School. The project will include renovation of portions of the existing building, and building additions. At the time this report was prepared, several design concepts were under consideration. Likely areas of new construction include the open landscaped courtyard near the center of the existing building, and existing landscape areas south and east of the existing school buildings.

The existing facility includes an existing group of school buildings near the center of the site, with paved parking areas to the west, play areas to the east, and portable classrooms to the south. Site topography in the building area slopes gently down to the south and west, and appears to have been graded to its current configuration during earlier site development. Slopes near the south property boundary are likely man-made slopes constructed during earlier site development and are approximately 5 feet tall and inclined approximately 2H:1V (Horizontal:Vertical). A slope east of the existing school buildings is inclined approximately 2H:1V and rises approximately 6 to 10 feet to the existing playfields on the east part of the site. Some of these man-made slopes appear to meet the definition for steep slope geologically critical areas in accordance with *Lynnwood Municipal Code* (LMC). Because the slopes are relatively short, relatively gently inclined, and are man-made slopes constructed during earlier site development, we anticipate that any prescriptive buffers or setbacks associated with the slopes can be exempted through provisions of LMC Section 17.10.092.

3.0 SUBSURFACE EXPLORATION

Our subsurface exploration completed for this project included advancing three hollow-stem auger soil borings. The conclusions and recommendations presented in this report are based on the explorations completed for this study. The locations and depths of the explorations were completed within site and budget constraints.

3.1 Exploration Borings

The exploration borings were completed by advancing hollow-stem auger tools with a limited-access, track-mounted drill rig. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. The exploration borings were continuously observed and logged by a representative from our firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM):D 1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected applicable geologic literature. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations may not become fully evident until construction.

4.1 Stratigraphy

Surficial Topsoil

Exploration borings encountered approximately 8 to 12 inches of topsoil and grass. Topsoil is not suitable for structural support, and should be stripped from structural areas. Excavated topsoil may be suitable for reuse in landscape areas.

Fill

Existing fill was encountered in one of our exploration borings (EB-3) to a depth of approximately 3 feet below the existing ground surface. The existing fill was observed to be very loose to medium dense. The existing fill was of a similar texture to the existing undisturbed soils on-site. The existing fill is loose and will require removal or other remedial preparation below planned building areas and remedial preparation below planned paving. Excavated existing fill is suitable for reuse in structural fill applications if specifically allowed by project specifications, and if any organic or other deleterious materials are removed. Excavated existing fill material is expected to be wetter than optimum moisture content for compaction purposes and will require drying during dry site and weather conditions prior to use in compacted fills.

Lodgement Till

Each of the exploration borings encountered native sediments consisting of very dense silty sand with gravel interpreted as Vashon lodgement till. Lodgement till was deposited at the base of an active continental glacier and was compacted by the weight of the overlying glacial ice. Lodgement till is suitable for structural support when properly prepared. Excavated lodgement till material is suitable for use in structural fill applications if suitable moisture conditions are achieved prior to compaction, and if such reuse is specifically allowed by project plans and specifications. At the time of exploration, we estimate that most or all of the lodgement till soils that we observed were above optimum moisture content for compaction purposes, and therefore, will require drying during favorable weather prior to compaction in structural fill applications.

Our interpretations of subsurface conditions on-site are different from a published geologic map of the area, as represented by the J.P. Minard, 1983, *Geologic Map of the Edmonds East and part of the Edmonds West Quadrangles, Washington: U.S. Geological Survey, Miscellaneous Field Studies Map MF-1541*. The published map indicates that the site is in an area characterized by Vashon lodgement till at the ground surface.

4.2 Hydrology

No ground water was observed in our exploration borings. Ground water is expected to occur seasonally at this site "perched" above the underlying lodgement till sediments, and possibly above existing fills. Perched ground water occurs when vertical infiltration is impeded by less-permeable soil layers, resulting in horizontal flow. The quantity and duration of perched ground water flow from an excavation will vary, depending on season, soil gradation, and adjacent topography. Ground water conditions should be expected to vary in response to changes in precipitation, on- and off-site land usage, and other factors.

4.3 Laboratory Testing

As a part of our investigation, we completed one laboratory grain-size analysis. A copy of the grain-size analysis report is included in the Appendix.

4.4 Infiltration Potential

The site is underlain by existing fill in some locations that is not suitable for use as an infiltration receptor. Native sediments at shallow depth at this site consist of lodgement till. Lodgement till is not suitable for use as a storm water infiltration receptor, and therefore conventional shallow infiltration strategies are not recommended. Deeper infiltration strategies might be feasible. Our study was not structured to investigate the feasibility of deeper infiltration strategies such as Underground Injection Control (UIC) wells and pit drains. We are available to discuss such a feasibility assessment on request.

II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and ground and surface water conditions, as observed and discussed herein. The discussion will be limited to slope stability, seismic, and erosion issues.

5.0 SLOPE HAZARDS AND MITIGATIONS

In our opinion, slopes at the south edge of the site and between the existing school buildings and the play fields to the east may meet City of Lynnwood criteria for treatment as geologically critical areas as defined in LMC Section 17.10.030. The definition includes any slope inclined more than 40 percent without a requirement for a minimum height. Code section 17.10.092 offers a mechanism to allow modification of critical slopes. Because the observed subsurface conditions consist primarily of very dense glacially consolidated sediments, the existing slopes are relatively gently inclined, the existing slopes are relatively short, and the existing slopes were created during earlier site grading we anticipate that that the project can be planned without assuming any buffers or setbacks for existing slopes. It is possible that additional analyses will be required at some future time to support a specific site development proposal once detailed plans are developed. No detailed slope stability analysis was completed for this preliminary study, and none is warranted, in our opinion.

6.0 SEISMIC HAZARDS AND MITIGATIONS

The City of Lynnwood critical areas code does not include a definition for seismic hazard areas. Seismic design procedures consistent with the 2012 *International Building Code* (IBC) are expected to be used for this project. The following discussion is a general assessment of seismic hazards that is intended to be useful to the District in terms of understanding seismic issues, and to the structural engineer for final structural design.

Earthquakes occur regularly in the Puget Lowland. The majority of these events are small and are usually not felt by people. However, large earthquakes do occur, as evidenced by the 1949, 7.2-magnitude event; the 2001, 6.8-magnitude event; and the 1965, 6.5-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and

4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

6.1 Surficial Ground Rupture

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. Earthquakes that are generated at such depths usually do not result in fault rupture at the ground surface. Current research indicates that surficial ground rupture is possible in areas close to the South Whidbey Island Fault Zone. Although our current understanding of this fault zone is limited and is an active area of research, the site appears to lie within the currently understood limits of the fault zone and therefore surface rupture due to a seismic event in the future cannot be ruled out. Because the project will include renovations and additions to an existing school, and because it is difficult to quantify surface rupture risks and difficult to mitigate such risks if they do exist, our analysis did not include a detailed analysis of the potential for surface rupture due to a seismic event. We are available to discuss the issue of surface rupture risk and possible responses on request.

6.2 Seismically Induced Landslides

It is our opinion that the potential risk of damage to the proposed development by seismically induced slope failures is low due to the lack of substantial slopes and the prevalence of relatively competent, glacially consolidated soils.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities, accompanied by a shallow water table.

The subsurface conditions encountered at the site pose low risk of liquefaction due to the lack of observed shallow ground water, and the high density of the lodgement till. No detailed liquefaction analysis was completed as part of this study, and none is warranted, in our opinion.

6.4 Ground Motion

Structural design for the project should follow 2012 IBC standards. The 2012 IBC defines Site Classification by reference to Table 20.3.-1 of the *American Society of Civil Engineers* publication ASCE 7, the current version of which is ASCE 7-10. In our opinion, the subsurface conditions at the site are consistent with a Site Classification of "C" as defined in the referenced documents.

7.0 EROSION HAZARDS AND MITIGATIONS

The following discussion addresses Washington State Department of Ecology (Ecology) erosion control regulations that will be applicable to the project. We anticipate that if the project complies with State requirements, it will also be acceptable with respect to City of Lynnwood requirements.

As of October 1, 2008, Ecology Construction Storm Water General Permit (also known as the National Pollutant Discharge Elimination System [NPDES] permit) requires weekly Temporary Erosion and Sedimentation Control (TESC), turbidity and pH monitoring for all sites 1 or more acres in size that discharge storm water to surface waters of the state. If the project will disturb more than 1 acre, we anticipate that these inspection and reporting requirements will be triggered. The following recommendations are related to general erosion potential and mitigation.

The erosion potential of the site soils is high. Maintaining cover measures atop disturbed ground typically provides the greatest reduction to the potential generation of turbid runoff and sediment transport. During the local wet season (October 1st through March 31st), exposed soil should not remain uncovered for more than 2 days unless it is actively being worked. Ground-cover measures can include erosion control matting, plastic sheeting, straw mulch, crushed rock or recycled concrete, or mature hydroseed.

Project planning and construction should follow local standards of practice with respect to temporary erosion and sedimentation control. Best management practices (BMPs) should include but not be limited to:

- Provide storm drain inlet protection;
- Route surface water away from work areas;
- Keep staging areas and travel areas clean and free of track-out;
- Cover work areas and stockpiled soils when not in use;
- Complete earthwork during dry weather and site conditions, if possible.

III. PRELIMINARY DESIGN RECOMMENDATIONS

8.0 INTRODUCTION

Some portions of the site are underlain by a layer of surficial existing fill that is loose and variable. Existing fill is not suitable for support of new foundations and warrants remedial preparation where it occurs below paving and similar lightly loaded structures. Structural fill or native sediments are suitable for support of shallow foundations, floor slabs, and paving with proper preparation.

9.0 SITE PREPARATION

Existing structures, paving, buried utilities, vegetation, topsoil, and any other deleterious materials should be removed where they are located below planned construction areas. All disturbed soils resulting from demolition activities should be removed to expose underlying undisturbed native sediments and replaced with structural fill, as needed. All excavations below final grade made for demolition activities should be backfilled, as needed, with structural fill. Erosion and surface water control should be established around the clearing limits to satisfy local requirements.

Once demolition has been completed, existing fill should be addressed. The observed thickness of existing fill ranged up to approximately 3 feet. We recommend that existing fill below building areas be removed and replaced with Structural Fill. It is important to include remedial preparation of the existing fill in the bid documents in a way that encourages competitive pricing and reduces the potential for claims of unanticipated conditions. We are available to review project specification sections related to geotechnical issues if requested to do so.

Below planned on-site paving, existing fill should be exposed, proof-rolled, and compacted to 95 percent of the modified Proctor maximum dry density. If a firm and unyielding condition is achieved, no further remedial preparation would be needed. If yielding conditions are encountered, existing fill would be partially removed and replaced with imported structural fill. The depth of replacement of the existing fill below paving should be determined at the time of construction when field conditions are known.

9.1 Site Drainage and Surface Water Control

The site should be graded to prevent water from ponding in construction areas and/or flowing into excavations. Exposed grades should be crowned, sloped, and smooth drum-rolled at the end of each day to facilitate drainage. Accumulated water must be removed from subgrades and work areas immediately prior to performing further work in the area. Equipment access may be limited, and the amount of soil rendered unfit for use as structural fill may be greatly increased, if drainage efforts are not accomplished in a timely sequence. If an effective drainage system is not utilized, project delays and increased costs could be incurred due to the greater quantities of wet and unsuitable fill, or poor access and unstable conditions.

We anticipate that perched ground water could be encountered in excavations completed during construction. We do not anticipate the need for extensive dewatering in advance of excavations. The contractor should be prepared to intercept any ground water seepage entering the excavations and route it to a suitable discharge location.

Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building area. We recommend that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeters be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided, unless provisions are included for collection and disposal of surface water adjacent to the structures.

9.2 Subgrade Protection

To the extent that it is possible, existing pavement should be used for construction staging areas. If building construction will proceed during the winter, we recommend the use of a working surface of sand and gravel, crushed rock, or quarry spalls to protect exposed soils, particularly in areas supporting concentrated equipment traffic. In winter construction staging areas and areas that will be subjected to repeated heavy loads, such as those that occur during construction of masonry walls, a minimum thickness of 12 inches of quarry spalls or 18 inches of pit run sand and gravel is recommended. If subgrade conditions are soft and silty, a geotextile separation fabric, such as Mirafi 500X or approved equivalent, should be used between the subgrade and the new fill. For building pads where floor slabs and foundation construction will be completed in the winter, a similar working surface should be used, composed of at least 6 inches of pit run sand and gravel or crushed rock. Construction of working surfaces from advancing fill pads could be used to avoid directly exposing the subgrade soils to vehicular traffic.

Foundation subgrades may require protection from foot and equipment traffic and ponding of runoff during wet weather conditions. Typically, compacted crushed rock or a lean-mix concrete mat placed over a properly prepared subgrade provides adequate subgrade protection. Foundation concrete should be placed and excavations backfilled as soon as possible to protect the bearing surface.

9.3 Proof-Rolling and Subgrade Compaction

Following the recommended demolition, site stripping, existing fill removal, and planned excavation, the stripped subgrade within the building and paving areas should be proof-rolled with heavy, rubber-tired construction equipment, such as a fully loaded tandem-axle dump truck. Proof-rolling should be performed prior to structural fill placement or foundation excavation. The proof-roll should be monitored by the geotechnical engineer so that any soft or yielding subgrade soils can be identified. Any soft/loose, yielding soils should be removed to a stable subgrade. The subgrade should then be scarified, adjusted in moisture content, and recompacted to the required density. Proof-rolling should only be attempted if soil moisture contents are at or near optimum moisture content. Proof-rolling of wet subgrades could result in further degradation. Low areas and excavations may then be raised to the planned finished grade with compacted structural fill. Subgrade preparation and selection, placement, and compaction of structural fill should be performed under engineering-controlled conditions in accordance with the project specifications.

9.4 Overexcavation/Stabilization

Construction during extended wet weather periods could create the need to overexcavate exposed soils if they become disturbed and cannot be recompacted due to elevated moisture content and/or weather conditions. Even during dry weather periods, soft/wet soils, which may need to be overexcavated, may be encountered in some portions of the site. If overexcavation is necessary, it should be confirmed through continuous observation and testing by Associated Earth Sciences, Inc. (AESI). Soils that have become unstable may require remedial measures in the form of one or more of the following:

1. Drying and recompaction. Selective drying may be accomplished by scarifying or windrowing surficial material during extended periods of dry and warm weather.

2. Removal of affected soils to expose a suitable bearing subgrade and replacement with compacted structural fill.

3. Mechanical stabilization with a coarse crushed aggregate compacted into the subgrade, possibly in conjunction with a geotextile.

4. Soil/cement admixture stabilization.

9.5 Wet Weather Conditions

If construction proceeds during an extended wet weather construction period and the moisture-sensitive site soils become wet, they will become unstable. Therefore, the bids for site grading operations should be based upon the time of year that construction will proceed. It is expected that in wet conditions additional soils may need to be removed and/or other stabilization methods used, such as a coarse crushed rock working mat, to develop a stable condition if silty subgrade soils are disturbed in the presence of excess moisture. The severity of construction disturbance will be dependent, in part, on the precautions that are taken by the contractor to protect the moisture- and disturbance-sensitive site soils. If overexcavation is necessary, it should be confirmed through continuous observation and testing by a representative of our firm.

9.6 Temporary and Permanent Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, we anticipate that temporary, unsupported cut slopes in the existing fill can be made at a maximum slope of 1.5H:1V or flatter. Temporary slopes in unsaturated lodgement till sediments may be planned at 1H:1V. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. If ground water seepage is encountered in cut slopes, or if surface water is not routed away from temporary cut slope faces, flatter slopes will be required. In addition, WISHA/OSHA regulations should be followed at all times. Permanent cut and structural fill slopes that are not intended to be exposed to surface water should be designed at inclinations of 2H:1V or flatter. All permanent cut or fill slopes should be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by ASTM:D 1557, and the slopes should be protected from erosion by sheet plastic until vegetation cover can be established during favorable weather.

9.7 Frozen Subgrades

If earthwork takes place during freezing conditions, all exposed subgrades should be allowed to thaw and then be recompacted prior to placing subsequent lifts of structural fill or foundation components. Alternatively, the frozen material could be stripped from the subgrade to reveal unfrozen soil prior to placing subsequent lifts of fill or foundation components. The frozen soil should not be reused as structural fill until allowed to thaw and adjusted to the proper moisture content, which may not be possible during winter months.

10.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type and placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer, the upper 12 inches of exposed ground in areas to receive fill should be recompacted to 90 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. If the subgrade contains silty soils and too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of the modified Proctor maximum density using ASTM:D 1557 as the standard. Use of soils from the site in structural fill applications is acceptable if the material meets the project specifications for the intended use, and if specifically allowed by project specifications. In the case of roadway and utility trench filling, structural fill should be placed and compacted in accordance with current City of Lynnwood codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the roadway edges before sloping down at an angle of 2H:1V.

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 72 hours in advance to perform a Proctor test and determine its field compaction standard. Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions, and is only permitted if specifically allowed by project plans and specifications. The native and existing fill soils present on-site contained significant amounts of silt and are considered highly moisture-sensitive. Existing fill can contain construction/demolition materials and/or significant organic content in which case they are not suitable for reuse in structural fill applications. If fill is placed during wet weather or if proper compaction cannot be obtained, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction with at least 25 percent retained on the No. 4 sieve.

A representative from our firm should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses, and any problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the District in developing a suitable monitoring and testing program.

11.0 FOUNDATIONS

Spread footings may be used for building support when founded directly on undisturbed lodgement till, or on structural fill placed above suitable native deposits, as previously discussed. If foundations will be underlain by a combination of very dense native sediments and new structural fill, we recommend that an allowable bearing pressure of 3,500 pounds per square foot (psf) be used for design purposes, including both dead and live loads. Higher foundation soil bearing pressures are possible for foundations supported entirely on undisturbed lodgement till, however we do not expect that higher bearing pressures will be needed. If higher foundation soil bearing pressures are needed, we should be allowed to offer situation-specific recommendations.

Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum, and no footing should be founded in or above organic or loose soils. All footings should have a minimum width of 18 inches.

It should be noted that the area bound by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area that has not been compacted to at least 95 percent of ASTM:D 1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded as described above should be on the order of ¾ inch or less. However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the governing municipality. Perimeter footing drains should be provided, as discussed under the "Drainage Considerations" section of this report.

11.1 Drainage Considerations

Foundations should be provided with foundation drains. Drains should consist of rigid, perforated, polyvinyl chloride (PVC) pipe surrounded by washed pea gravel. The drains should be constructed with sufficient gradient to allow gravity discharge away from the proposed buildings. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain. In planning, exterior grades adjacent to walls should be sloped downward away from the proposed structures to achieve surface drainage.

12.0 FLOOR SUPPORT

Floor slabs can be supported on suitable native sediments, or on structural fill placed above suitable native sediments. Floor slabs should be cast atop a minimum of 4 inches of clean, washed, crushed rock or pea gravel to act as a capillary break. Areas of subgrade that are disturbed (loosened) during construction should be compacted to a non-yielding condition prior to placement of capillary break material. Floor slabs should also be protected from dampness by an impervious moisture barrier at least 10 mils thick. The moisture barrier should be placed between the capillary break material and the concrete slab.

13.0 FOUNDATION WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed to resist active lateral earth pressure represented by an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an at-rest equivalent fluid of 50 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

As required by the 2012 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 5H and 10H psf, where H is the wall height in feet, for the "active" and "at-rest" loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils, or imported structural fill compacted to 90 percent of ASTM:D 1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in settlement of the slab-on-grade or other structures supported above the walls. Thus, the compaction level is critical and must be tested by our firm during placement. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum, 1-foot-wide blanket drain to within 1 foot of finish grade for the full wall height using imported, washed gravel against the walls.

13.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the natural glacial soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters:

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

14.0 PAVEMENT RECOMMENDATIONS

Pavement areas should be prepared in accordance with the "Site Preparation" section of this report. If the stripped native soil or existing fill pavement subgrade can be compacted to 95 percent of ASTM:D 1557 and is firm and unyielding, no additional overexcavation is required. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

The pavement sections included in this report section are for driveway and parking areas on-site, and are not applicable to right-of-way improvements. We understand that right-of-way paving will be limited to small patches and miscellaneous work that does not require a detailed pavement thickness analysis.

Pavement subgrades underlain by existing fill should be prepared in accordance with the "Site Preparation" section of this report. The exposed ground should be recompacted to 95 percent of ASTM:D 1557. If required, structural fill may then be placed to achieve desired subbase grades. Upon completion of the recompaction and structural fill, a pavement section consisting of 2½ inches of asphaltic concrete pavement (ACP) underlain by 4 inches of 1¼-inch Crushed Surfacing Base Course is the recommended minimum in areas of planned passenger car driving and parking. In heavy traffic areas, a minimum pavement section consisting of 3 inches of ACP underlain by 2 inches of $^5/_8$-inch crushed surfacing top course and 4 inches of 1¼-inch Crushed Surfacing Base Course is recommended. The crushed rock courses must be compacted to 95 percent of the maximum density, as determined by ASTM:D 1557. All paving materials should meet gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications.

Depending on construction staging and desired performance, the Crushed Surfacing Base Course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a native or structural fill subgrade compacted to a minimum of 95 percent relative density, and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected. The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

Our report is preliminary since project plans had not been developed at the time this report was written. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, we can confirm that our earthwork and foundation recommendations have been properly interpreted and implemented in the design.

We are also available to provide geotechnical engineering services during construction. The integrity of the foundation system depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know, and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

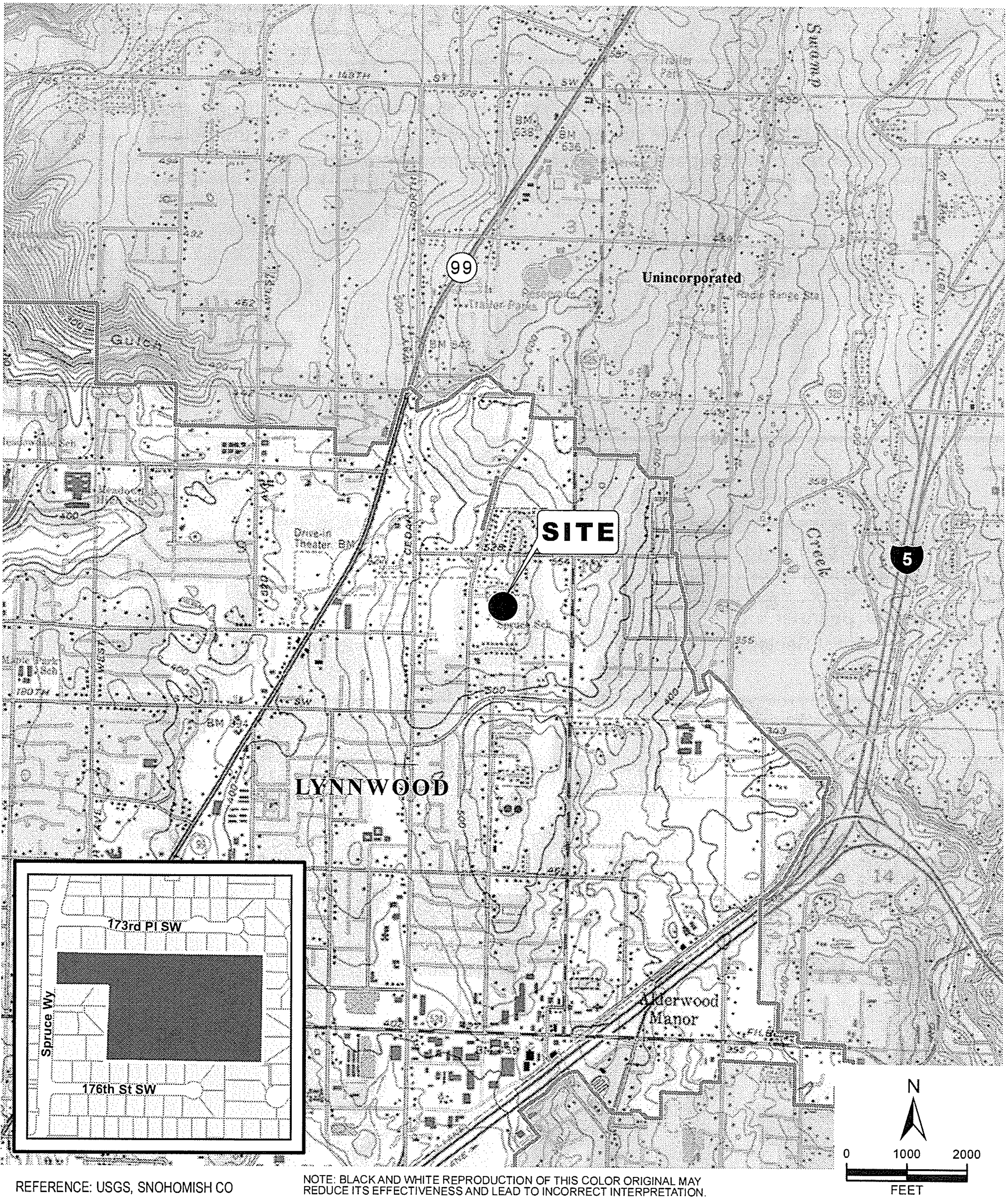
DRAFT

Bruce W. Guenzler, L.E.G.
Senior Project Geologist

DRAFT

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Exploration Plan
	Appendix:	Exploration Logs
		Laboratory Testing Results



REFERENCE: USGS, SNOHOMISH CO

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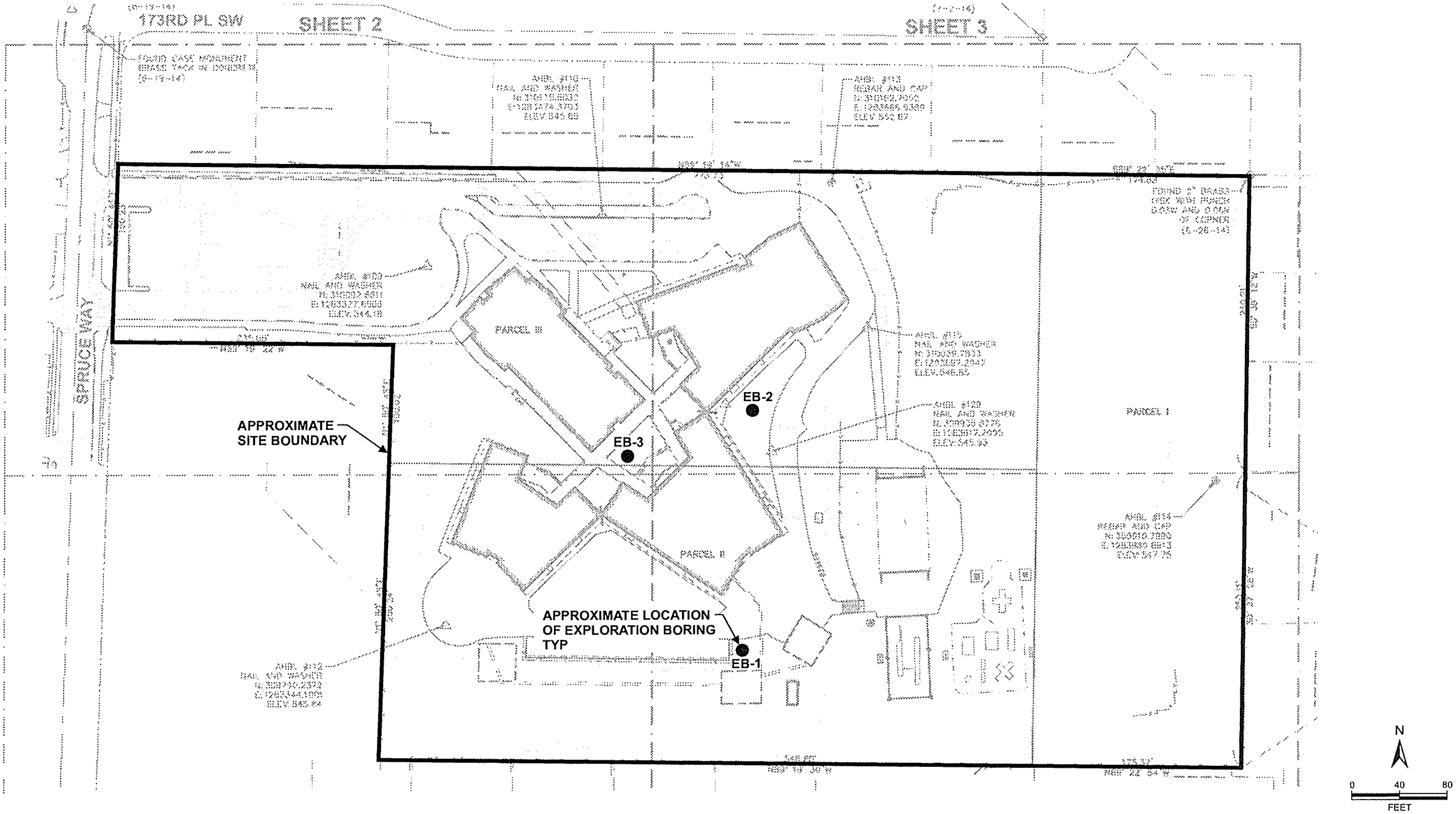
VICINITY MAP

SPRUCE ELEMENTARY SCHOOL
LYNNWOOD, WASHINGTON

FIGURE 1

DATE 12/14

PROJ. NO. KE140562A



REFERENCE: AHBL

140562 Lynnwood Elementary School \ 140562 Site and Exploration Plan.cdr

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SITE AND EXPLORATION PLAN
SPRUCE ELEMENTARY SCHOOL
LYNNWOOD, WASHINGTON

FIGURE 2
DATE 12/14
PROJ. NO. KE140562A

APPENDIX

Coarse-Grained Soils - More than 50%(1) Retained on No. 200 Sieve	Gravels - More than 50%(1) of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines(5)	▨	**GW**	Well-graded gravel and gravel with sand, little to no fines
			▨	**GP**	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines(5)	▨	**GM**	Silty gravel and silty gravel with sand
			▨	**GC**	Clayey gravel and clayey gravel with sand
	Sands - 50%(1) or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines(5)	▨	**SW**	Well-graded sand and sand with gravel, little to no fines
			▨	**SP**	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines(5)	▨	**SM**	Silty sand and silty sand with gravel
			▨	**SC**	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%(1) or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		▨	**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			▨	**CL**	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			▨	**OL**	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		▨	**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			▨	**CH**	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			▨	**OH**	Organic clay or silt of medium to high plasticity
Highly Organic Soils			▨	**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT(2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT(2) blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

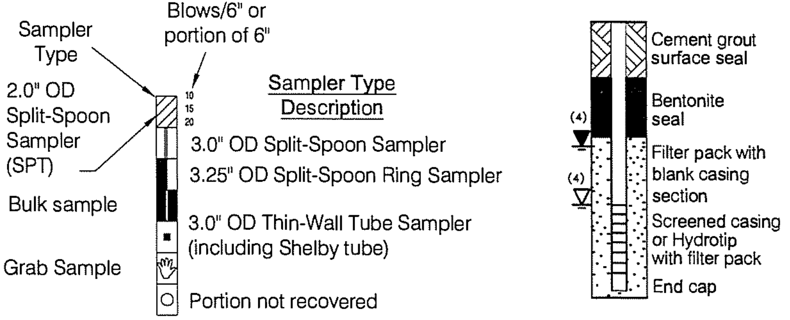
(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols



(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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EXPLORATION LOG KEY

FIGURE A1

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-1	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) 545
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Lodgement Till					
		S-1		Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			15 25 50/5"	▲50/5"	
5		S-2		Gradation as above.			17 39 50/5"	▲50/5"	
10		S-3		Gradation as above.			30 50/3"	▲50/3"	
				Bottom of exploration boring at 11 feet Ground water not encountered.					

Sampler Type (ST):
- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- Ring Sample
- Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

AESIBOR 140562.GPJ December 26, 2014

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-2	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) 546
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
0			**Grass / Topsoil**					
			Lodgement Till					
			Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).					
		S-1				19 41 50/4"	50/4"	
5			Gradation as above.					
		S-2				29 36 37	73	
10			Gradation as above.					
		S-3				27 40 50/4"	50/4"	

Bottom of exploration boring at 11.5 feet
Ground water not encountered.

Sampler Type (ST):
- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ▮ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ∇ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by:

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-3	1 of 1

Project Name	Spruce Elem	Ground Surface Elevation (ft)	544
Location	Lynnwood, WA	Datum	AHBL July 2014
Driller/Equipment	Geologic Drill - HSA SPT	Date Start/Finish	12/22/14,12/22/14
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	7 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Fill Loose, very moist, gray, silty SAND (SM). Hand dug to 2 1/2 feet.					
		S-1		**Lodgement Till** Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			12 23 50/5"	50/5"	
5		S-2		Gradation as above.			18 35 50/5"	50/5"	
10		S-3		Gradation generally as above, but with a thin seam (~ 1/2 inch) of fine sand, trace silt.			20 38 45	83	
				Bottom of exploration boring at 11.5 feet Ground water not encountered.					

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	▮ Ring Sample	▽ Water Level ()
Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: BWG

Approved by:

GRAIN SIZE ANALYSIS - MECHANICAL

Date Sampled	Project	Project No.		Soil Description
12/22/2014	**Spruce Elementary**	**KE140562A**		**Sandy silt trace gravel**
Tested By	Location	EB/EP No	Depth	Intended Use / Specification
MS	**Onsite**	**EB-3**	**5'**	

Wt. of moisture wet sample + Tare	331.5	Total Sample Tare	467.72
Wt. of moisture dry Sample + Tare	309.94	Total Sample wt + tare	1137.57
Wt. of Tare	100	Total Sample Wt	669.9
Wt. of moisture Dry Sample	209.94	Total Sample Dry Wt	607.5
Moisture %	10%		

					Specification Requirements	
Sieve No.	Diam. (mm)	Wt. Retained (g)	% Retained	% Passing	Minimum	Maximum
3.5	90		-	100.00	-	-
3	76.1		-	100.00	-	-
2.5	64		-	100.00	-	-
2	50.8		-	100.00	-	-
1.5	38.1		-	100.00	-	-
1	25.4		-	100.00		
3/4	19		-	100.00		
3/8	9.51	1.64	0.27	99.73		
#4	4.76	12.66	2.08	97.92		
#8	2.38	28.22	4.65	95.35		
#10	2	35.84	5.90	94.10		
#20	0.85	59.99	9.88	90.12		
#40	0.42	106.07	17.46	82.54		
#60	0.25	189.97	31.27	68.73		
#100	0.149	242.13	39.86	60.14		
#200	0.074	263.19	43.33	56.67		

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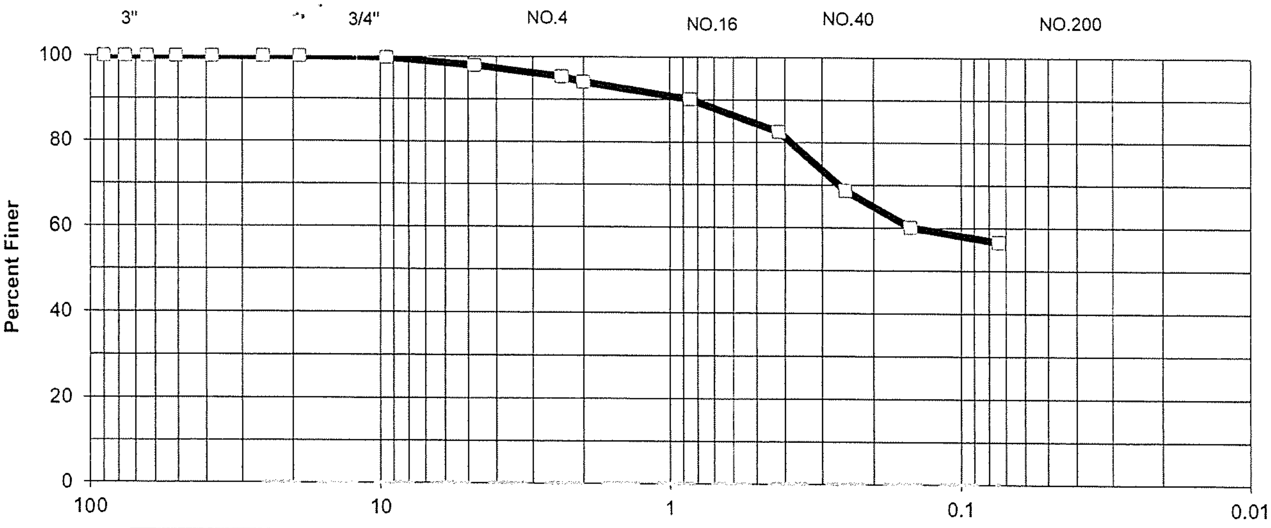

Gravel		Sand			Silt and Clay
Coarse	Fine	Coarse	Medium	Fine	

Grain Size, mm

ASSOCIATED EARTH SCIENCES, INC.

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September 26, 2016
Project No. KE140562A

Edmonds School District #15
Capital Projects Office
20420 68th Avenue West
Lynnwood, Washington 98036

Attention: Mr. Matthew Finch

Subject: Geotechnical Addendum – Additional Explorations
Spruce Elementary School
17405 Spruce Way
Lynnwood, Washington

Dear Mr. Finch:

Associated Earth Sciences, Inc. (AESI) has completed supplemental subsurface explorations at the existing Spruce Elementary School located in Lynnwood, Washington (Figure 1). We have previously issued a "Subsurface Exploration and Preliminary Geotechnical Engineering Report," dated January 14, 2015, for the subject project. During our previous study, we completed three exploratory borings and encountered loose existing fill soils to a maximum depth of 3 feet below the surface in one of our borings (EB-3). Underlying the fill soils in EB-3 and underlying the topsoil in the other borings our previous exploration encountered dense, native, glacial till soils. We have been requested to complete additional explorations to the south and east of the existing school buildings.

This study included advancing six additional borings and reviewing previously published geologic literature of the site and surrounding areas. The purpose of this assessment was to provide information regarding soil characteristics/classification to aid in foundation design for the proposed project.

SITE DESCRIPTION

The project site is that of the existing Spruce Elementary School located at 17405 Spruce Way in Lynnwood, Washington. The existing facility includes an existing group of school buildings near the center of the site, with paved parking areas to the west, play areas to the east, and portable classrooms to the south. Site topography in the building area slopes gently down to the south and west, and appears to have been graded to its current configuration during earlier site development.

At the time this report was published the project design was still in the conceptual phase. We understand that the project will likely include renovation of portions of the existing building, and building additions. Likely areas of new construction include the open landscaped courtyard near the center of the existing building, and existing landscape areas south the existing school buildings as well as, the grass field east of the existing school buildings.

EXPLORATION BORINGS

Six exploration borings were completed on August 30, 2016 at the project site. The borings were in addition to the previous three completed on December 22, 2014. During the drilling process, samples were obtained at generally 2.5- to 5-foot-depth intervals. The exploration borings were continuously observed and logged by a representative from our firm. The locations of our explorations are shown on the "Site and Exploration Plan," Figure 2. The exploration logs presented in Appendix A are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM) D-1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split-barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 is recorded within one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils; these values are plotted on the attached exploration boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and laboratory testing.

SUBSURFACE CONDITIONS

Subsurface conditions were inferred from the field explorations accomplished for this study, a visual reconnaissance of the site, and published geologic maps of the area. The encountered stratigraphy is described below and is provided in detail on the attached exploration pit logs.

Surficial Topsoil

Exploration borings encountered approximately 6 to 8 inches of topsoil and grass. Topsoil is not suitable for structural support, and should be stripped from structural areas. Excavated topsoil may be suitable for reuse in landscape areas if allowed by project documents.

Fill

Existing fill was encountered in exploration boring EB-5 to a depth of approximately 13 feet below the existing ground surface. The existing fill was observed to be medium dense, silty, fine sand with trace to some gravel. A hydrocarbon odor was detected by AESI as the auger reached a depth of 8 feet below the surface. AESI took samples of the cuttings to get tested for possible contaminants. Testing results indicated that the fill soil contained hydrocarbons as gasoline and diesel in concentrations below required cleanup levels as defined by the Department of Ecology's (Ecology) Model Toxic Control Act (MTCA) Method A cleanup levels for unrestricted sites. We recommend further studies are completed to delineate the extent of the encountered contaminants, if project elements are proposed in the vicinity of EB-5. Results of the environmental testing are included in Appendix B.

Furthermore, existing fill will require removal or other remedial preparation below planned building areas and remedial preparation below planned paving. Excavated existing fill is suitable for reuse in structural fill applications if specifically allowed by project specifications, and if any organic or other deleterious materials are removed. Excavated existing fill material is expected to be wetter than optimum moisture content for compaction purposes and will require drying during dry site and weather conditions prior to use in compacted fills.

Vashon Lodgement Till

Each of the exploration borings encountered native sediments consisting of very dense, silty sand with gravel interpreted as Vashon lodgement till. Lodgement till was deposited at the base of an active continental glacier and was compacted by the weight of the overlying glacial ice. Lodgement till is suitable for structural support when properly prepared. Excavated lodgement till material is suitable for use in structural fill applications if suitable moisture conditions are achieved prior to compaction, and if such reuse is specifically allowed by project plans and specifications. At the time of exploration, we estimate that most or all of the lodgement till soils that we observed were above optimum moisture content for compaction purposes, and therefore, will require drying during favorable weather prior to compaction in structural fill applications.

Our interpretations of subsurface conditions onsite are in general agreement with the published geologic map of the area, as represented by the J.P. Minard, 1983, *Geologic Map of the Edmonds East and part of the Edmonds West Quadrangles, Washington: U.S. Geological*

Survey, Miscellaneous Field Studies Map MF-1541. The published map indicates that the site is in an area characterized by Vashon lodgement till at the ground surface.

No ground water was encountered in any of our additional explorations. . It should be noted that the occurrence and level of ground water seepage at the site may vary in response to such factors as changes in season, precipitation, and site use.

CONCLUSIONS AND RECOMMENDATIONS

Foundations

Based on our explorations, native lodgement till with the ability to support the 3,500 pounds per square foot (psf) bearing pressure given in our initial report were generally encountered near the surface with the exception of EB-5. EB-5 encountered existing fill soils to a depth of approximately 12 feet below the surface. The existing fill soils encountered in EB-5 contained hydrocarbon contaminants in concentrations under the Ecology MTCA cleanup levels. The fill soils in EB-5 are overlying the dense native, glacial till soils. Existing fill soils are not suitable for foundation support and may need remedial preparation under new pavement. Design and construction recommendations presented in our above-referenced report should be followed.

We have enjoyed working with you on this study and are confident that these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

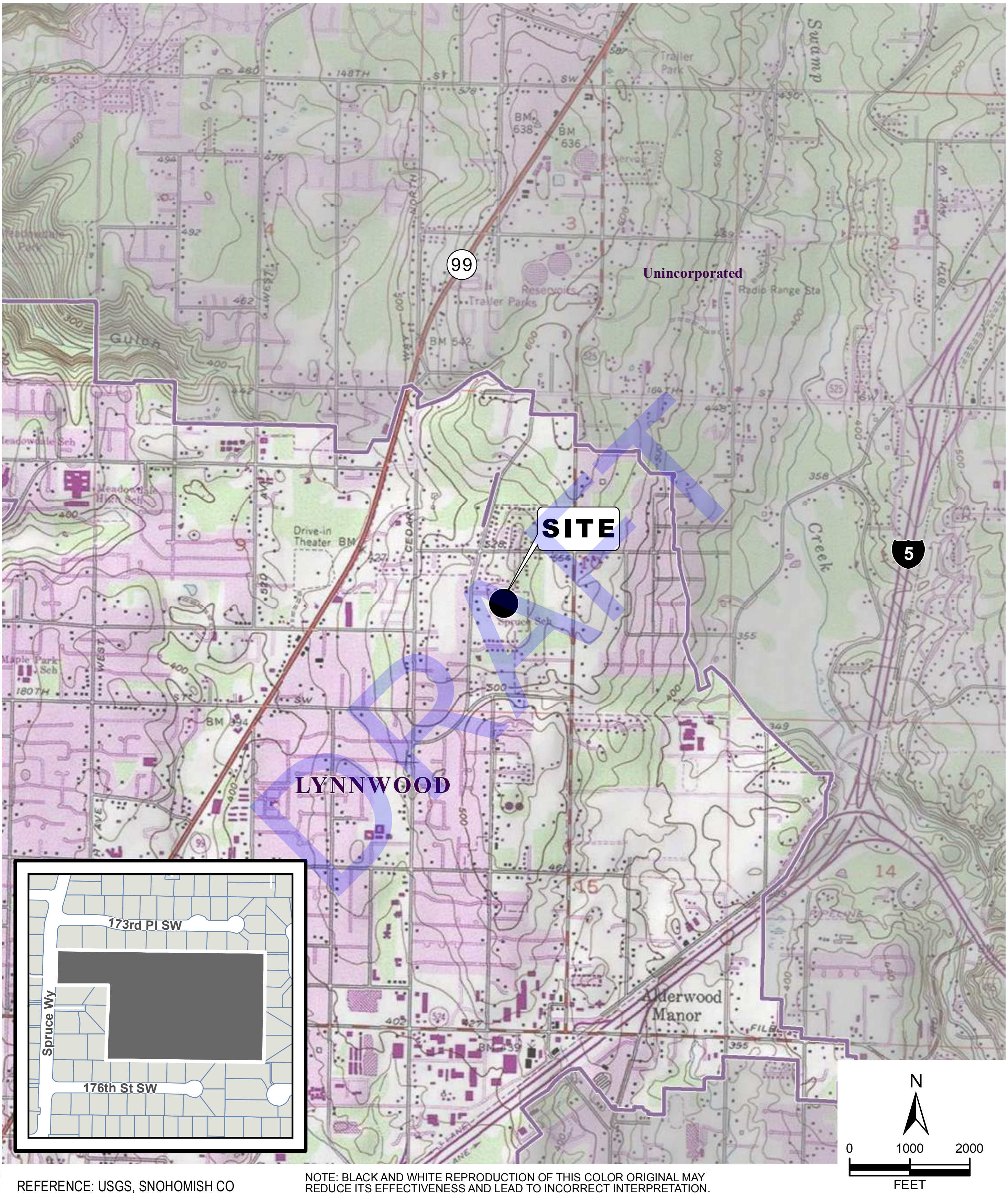
DRAFT

Anthony Romanick, P.E.
Senior Staff Engineer

DRAFT

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Exploration Plan
	Appendix A:	Exploration Logs
	Appendix B:	Environmental Test Results



REFERENCE: USGS, SNOHOMISH CO

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

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VICINITY MAP

SPRUCE ELEMENTARY SCHOOL
LYNNWOOD, WASHINGTON

FIGURE 1

DATE 12/14

PROJ. NO. KE140562A

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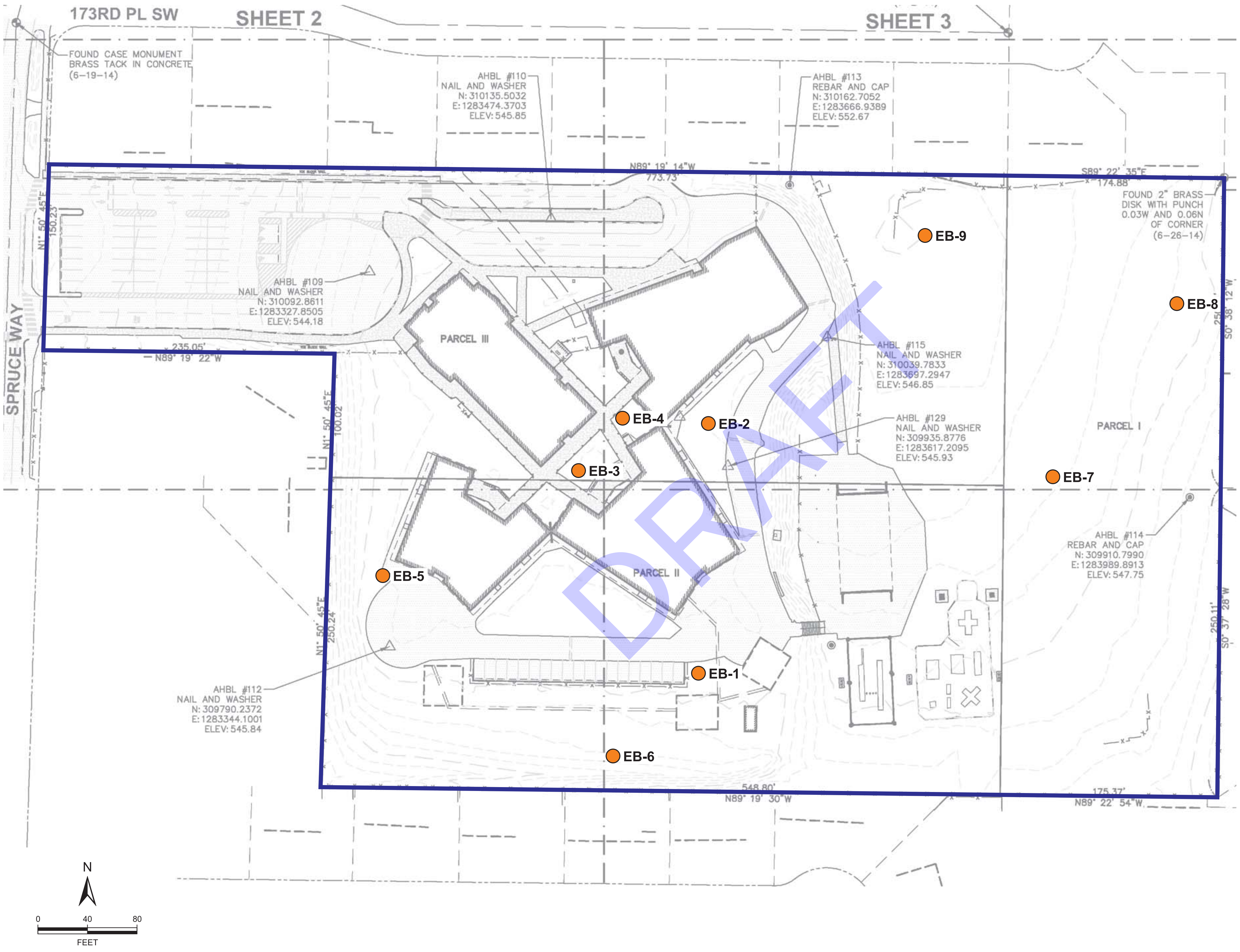

LEGEND:

▬	SITE BOUNDARY
● EB	EXPLORATION BORING

CONTOUR INTERVAL = 1'

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

NOTES:
1. BASE MAP REFERENCE: AHBL, SPRUCE ELEMENTARY SCHOOL, TOPOGRAPHIC AND BOUNDARY SURVEY, SHEET 1 OF 5, 7/14/14.

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SITE AND EXPLORATION PLAN

SPRUCE ELEMENTARY SCHOOL
LYNNWOOD, WASHINGTON

PROJ NO.	DATE:	FIGURE:
KE140562A	9/16	2

140562 Spruce Elementary School \ 140562 Site Explr 9-16.cdr

APPENDIX A

Exploration Logs

Coarse-Grained Soils - More than 50%(1) Retained on No. 200 Sieve	Gravels - More than 50%(1) of Coarse Fraction Retained on No. 4 Sieve	≤5% Fines(5)	**GW**	Well-graded gravel and gravel with sand, little to no fines
			GP	Poorly-graded gravel and gravel with sand, little to no fines
		≥12% Fines(5)	**GM**	Silty gravel and silty gravel with sand
			GC	Clayey gravel and clayey gravel with sand
	Sands - 50%(1) or More of Coarse Fraction Passes No. 4 Sieve	≤5% Fines(5)	**SW**	Well-graded sand and sand with gravel, little to no fines
			SP	Poorly-graded sand and sand with gravel, little to no fines
		≥12% Fines(5)	**SM**	Silty sand and silty sand with gravel
			SC	Clayey sand and clayey sand with gravel
Fine-Grained Soils - 50%(1) or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50		**ML**	Silt, sandy silt, gravelly silt, silt with sand or gravel
			CL	Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay
			OL	Organic clay or silt of low plasticity
	Silts and Clays Liquid Limit 50 or More		**MH**	Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt
			CH	Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel
			OH	Organic clay or silt of medium to high plasticity
Highly Organic Soils			**PT**	Peat, muck and other highly organic soils

Terms Describing Relative Density and Consistency

	Density	SPT(2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50

	Consistency	SPT(2) blows/foot
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

(3) Estimated Percentage

Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols

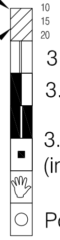
Sampler Type

Blows/6" or portion of 6"

2.0" OD Split-Spoon Sampler (SPT)

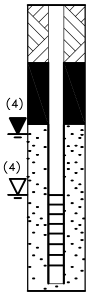
Bulk sample

Grab Sample



Sampler Type Description

3.0" OD Split-Spoon Sampler
3.25" OD Split-Spoon Ring Sampler
3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
Portion not recovered



Cement grout surface seal
Bentonite seal
Filter pack with blank casing section
Screened casing or Hydrotip with filter pack
End cap

(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)

(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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EXPLORATION LOG KEY

FIGURE A1

blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-1	1 of 1

Project Name: Spruce Elem
Location: Lynnwood, WA
Driller/Equipment: Geologic Drill - HSA SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft): 545
Datum: AHBL July 2014
Date Start/Finish: 12/22/14,12/22/14
Hole Diameter (in): 7 inches

Depth (ft)	ST	Samples	DESCRIPTION	Blows/6"	Blows/Foot
0			**Grass / Topsoil**		
			Lodgement Till		
3	▯	S-1	Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).	15 25 50/5"	▲50/5"
5	▯	S-2	Gradation as above.	17 39 50/5"	▲50/5"
10	▯	S-3	Gradation as above.	30 50/3"	▲50/3"
11			Bottom of exploration boring at 11 feet Ground water not encountered.		

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-2	1 of 1

Project Name	Spruce Elem	Ground Surface Elevation (ft)	546
Location	Lynnwood, WA	Datum	AHBL July 2014
Driller/Equipment	Geologic Drill - HSA SPT	Date Start/Finish	12/22/14,12/22/14
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	7 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Grass / Topsoil					
			Lodgement Till					
		S-1	Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			19 41 50/4"	50/4"	
5		S-2	Gradation as above.			29 36 37	73	
10		S-3	Gradation as above.			27 40 50/4"	50/4"	
			Bottom of exploration boring at 11.5 feet Ground water not encountered.					
15								
20								
25								
30								
35								

Blows/Foot scale: 10 20 30 40

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-3	1 of 1

Project Name Spruce Elem
Location Lynnwood, WA
Driller/Equipment Geologic Drill - HSA SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft) 544
Datum AHBL July 2014
Date Start/Finish 12/22/14,12/22/14
Hole Diameter (in) 7 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot 10 20 30 40	Other Tests
				Grass / Topsoil					
				Fill Loose, very moist, gray, silty SAND (SM). Hand dug to 2 1/2 feet.					
		S-1		**Lodgement Till** Very dense, very moist, gray, silty fine gravelly fine to coarse SAND; nonstratified (SM).			12 23 50/5"	▲50/5"	
5		S-2		Gradation as above.			18 35 50/5"	▲50/5"	
10		S-3		Gradation generally as above, but with a thin seam (~ 1/2 inch) of fine sand, trace silt.			20 38 45	▲83	
				Bottom of exploration boring at 11.5 feet Ground water not encountered.					
15									
20									
25									
30									
35									

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ▐ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: BWG
Approved by: JHS

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-4	1 of 1

Project Name Spruce Elementary School
Location Lynnwood, WA
Driller/Equipment GDI / SPT
Hammer Weight/Drop 140# / 30"

Ground Surface Elevation (ft)
Datum N/A
Date Start/Finish 8/30/16,8/30/16
Hole Diameter (in) 4.25 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Grass / Topsoil					
				Vashon Lodgement Till					
		S-1		Dense, moist, tannish brown, gravelly, fine to medium SAND, some silt; broken gravel in sampler; contains organics; blow counts overstated due to gravel (SP).			17 13 27	40	
5		S-2		Very dense, moist, grayish tan, silty, fine to medium SAND, some gravel; contains interbed of fine to medium SAND, trace silt (SM-SP).			24 50/6"		
10		S-3		Very dense, moist, tannish gray, silty, fine to medium SAND, some gravel; unsorted (SM).			26 50/6"		
15		S-4		As above.			50/5"	50/5"	
20		S-5		As above.			50/5"	50/5"	
				Bottom of exploration boring at 20.5 feet No ground water encountered.					
25									
30									
35									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	▐ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-5	1 of 1

Project Name	Spruce Elementary School	Ground Surface Elevation (ft)	
Location	Lynnwood, WA	Datum	N/A
Driller/Equipment	GDI / SPT	Date Start/Finish	8/30/16,8/30/16
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	4.25 inches

Depth (ft)	Samples	DESCRIPTION	Blows/6"	Blows/Foot
		Grass / Topsoil		
		Fill		
	S-1	Medium dense, moist, gray, silty, fine SAND, grades to silty, fine to medium SAND, some gravel; contains organics; unsorted (SM).	11 10 9	▲19
5	S-2	Medium dense, very moist, tannish gray, silty, fine SAND, trace gravel (SM).	4 6 8	▲14
10	S-3	Medium dense, very moist, gray, silty, fine SAND, trace gravel (SM).	4 7 9	▲16
		Driller notes harder drilling at 13 feet.		
		Vashon Lodgement Till		
15	S-4	Very dense, moist, tan, silty, fine to medium SAND; unsorted (SM).	32 50/5"	
		Bottom of exploration boring at 16 feet No ground water encountered.		
20				
25				
30				
35				

Blows/Foot scale: 10 20 30 40

Other columns: S T, Graphic Symbol, Well Completion, Water Level, Other Tests

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- ✋ Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-6	1 of 1

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 8/30/16,8/30/16
Hole Diameter (in): 4.25 inches

Depth (ft)	S T	Samples	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
			Grass / Topsoil					
			Vashon Lodgement Till					
		S-1	Very dense, moist, tan, silty, fine SAND, some gravel; unsorted (SM).			15 25 46	▲61	
5		S-2	As above.			26 35 49	▲84	
10		S-3	As above.			50/6"	▲50/6"	
15								
			Bottom of exploration boring at 15.5 feet No ground water encountered.					
20								
25								
30								
35								

Blows/Foot scale: 10 20 30 40

Sampler Type (ST):

- ▯ 2" OD Split Spoon Sampler (SPT)
- ▯ 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- ☐ No Recovery
- ◧ Ring Sample
- ▨ Shelby Tube Sample
- M - Moisture
- ▽ Water Level ()
- ▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-7	1 of 1

Project Name: Spruce Elementary School
Location: Lynnwood, WA
Driller/Equipment: GDI / SPT
Hammer Weight/Drop: 140# / 30"

Ground Surface Elevation (ft):
Datum: N/A
Date Start/Finish: 8/30/16,8/30/16
Hole Diameter (in): 4.25 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot (10 20 30 40)	Other Tests
				Grass / Topsoil					
				Vashon Lodgement Till					
		S-1		Medium dense, moist, tan, silty, fine to medium SAND, some gravel; oxidized; unsorted (SM).			6 14 13	▲27	
5		S-2		Medium dense, moist, tan, silty, fine SAND, some gravel; unsorted (SM).			20 10 9	▲19	
10		S-3		As above.			6 14 18	▲32	
15		S-4		Very dense, very moist, gray, silty, fine to medium SAND, some gravel; unsorted (SM).			15 23 50/5"		
20		S-5		As above.			36 45 50/3"		
				Bottom of exploration boring at 21.5 feet No ground water encountered.					
25									
30									
35									

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▱ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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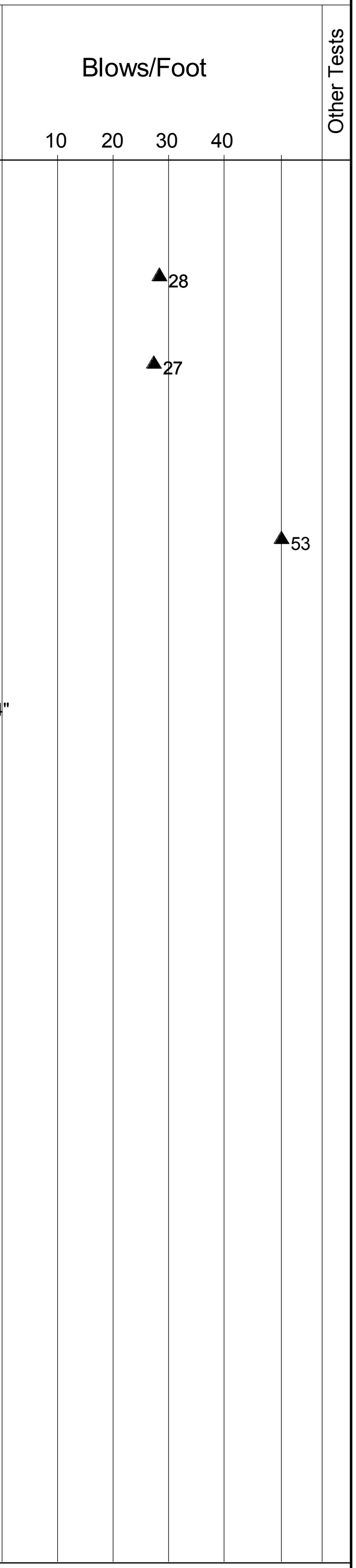
Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-8	1 of 1

Project Name	Spruce Elementary School	Ground Surface Elevation (ft)	
Location	Lynnwood, WA	Datum	N/A
Driller/Equipment	GDI / SPT	Date Start/Finish	8/30/16,8/30/16
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	4.25 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"	Blows/Foot	Other Tests
				Grass / Topsoil					
				Vashon Lodgement Till					
		S-1		Medium dense, moist, tan, silty, fine to medium SAND, some gravel; broken gravel in sampler; blow counts may be overstated due to rock (SM).			7 16 12	28	
5		S-2		Medium dense, moist, tan, silty, fine to medium SAND, some gravel; unsorted (SM).			21 11 16	27	
10		S-3		Dense, moist, gray, silty, fine to medium SAND, some gravel; unsorted (SM).			11 21 32	53	
15		S-4					29 50/4"		
				Bottom of exploration boring at 16 feet No ground water encountered.					
20									
25									
30									
35									



Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

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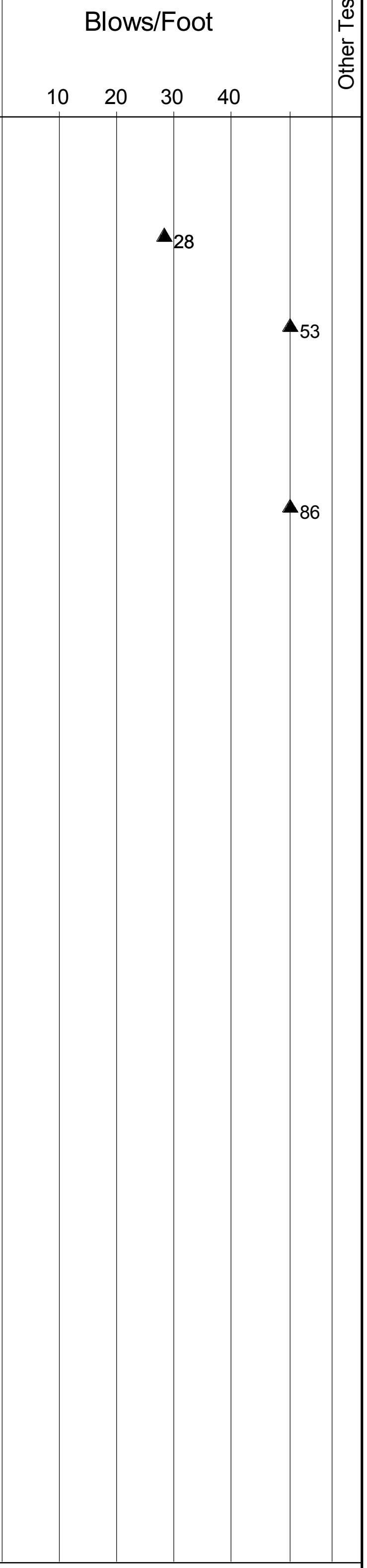
Exploration Log

Project Number	Exploration Number	Sheet
KE140562A	EB-9	1 of 1

Project Name	Spruce Elementary School	Ground Surface Elevation (ft)	
Location	Lynnwood, WA	Datum	N/A
Driller/Equipment	GDI / SPT	Date Start/Finish	8/30/16,8/30/16
Hammer Weight/Drop	140# / 30"	Hole Diameter (in)	4.25 inches

Depth (ft)	S T	Samples	Graphic Symbol	DESCRIPTION	Well Completion	Water Level	Blows/6"
				Grass / Topsoil			
				Vashon Lodgement Till			
	▯	S-1		Medium dense, moist, tan, silty, fine SAND, some gravel; unsorted (SM).			9 12 16
5	▯	S-2		Becomes dense.			12 23 30
10	▯	S-3		As above.			12 36 50
				Bottom of exploration boring at 10.5 feet No ground water encountered.			
15							
20							
25							
30							
35							



Other Tests

Sampler Type (ST):

▯ 2" OD Split Spoon Sampler (SPT)	☐ No Recovery	M - Moisture
▯ 3" OD Split Spoon Sampler (D & M)	◧ Ring Sample	▽ Water Level ()
✋ Grab Sample	▨ Shelby Tube Sample	▼ Water Level at time of drilling (ATD)

Logged by: AWR
Approved by: CJK

APPENDIX B

Environmental Test Results

FRIEDMAN & BRUYA, INC.

ENVIRONMENTAL CHEMISTS

James E. Bruya, Ph.D.
Yelena Aravkina, M.S.
Michael Erdahl, B.S.
Arina Podnozova, B.S.
Eric Young, B.S.

3012 16th Avenue West
Seattle, WA 98119-2029
(206) 285-8282
fbi@isomedia.com
www.friedmanandbruya.com

September 9, 2016

Jon Sondergaard, Project Manager
Associated Earth Sciences, Inc.
911 5th Avenue, Suite 100
Kirkland, WA 98033

Dear Mr Sondergaard:

Included are the results from the testing of material submitted on August 31, 2016 from the Spruce Elementary, PO KE140562A, F&BI 608592 project. There are 18 pages included in this report. Any samples that may remain are currently scheduled for disposal in 30 days. If you would like us to return your samples or arrange for long term storage at our offices, please contact us as soon as possible.

We appreciate this opportunity to be of service to you and hope you will call if you have any questions.

Sincerely,

FRIEDMAN & BRUYA, INC.

Michael Erdahl
Project Manager

Enclosures
AE10909R.DOC

CASE NARRATIVE

This case narrative encompasses samples received on August 31, 2016 by Friedman & Bruya, Inc. from the Associated Earth Sciences Spruce Elementary, PO KE140562A, F&BI 608592 project. Samples were logged in under the laboratory ID's listed below.

Laboratory ID	Associated Earth Sciences
608592 -01	EB-5

Sample EB-5 was extracted from a 4 ounce jar. The data were flagged accordingly.

The 8270D calibration standard for benzoic acid, 2,4-dinitrophenol, and 4,6-dinitro-2-methylphenol did not pass the acceptance criteria. The data were flagged accordingly. In addition, the relative percent difference for 4-chloroaniline by 8270D exceeded the acceptance criteria. 4-Chloroaniline was not detected in the sample, therefore the data were acceptable.

All other quality control requirements were acceptable.

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592
Date Extracted: 08/31/13
Date Analyzed: 08/31/16

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS GASOLINE USING METHOD NWTPH-Gx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Gasoline Range	Surrogate (% Recovery) (Limit 50-150)
EB-5 pc 608592-01	18	100
Method Blank 06-1806 MB	<2	92

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592
Date Extracted: 08/31/16
Date Analyzed: 08/31/16

RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL AND MOTOR OIL USING METHOD NWTPH-Dx

Results Reported on a Dry Weight Basis
Results Reported as mg/kg (ppm)

Sample ID Laboratory ID	Diesel Range (C_{10}-C_{25})	Motor Oil Range (C_{25}-C_{36})	Surrogate (% Recovery) (Limit 53-144)
EB-5 608592-01	91 x	<250	71
Method Blank 06-1791 MB2	<50	<250	86

Analysis For Semivolatile Compounds By EPA Method 8270D SIM

Client Sample ID:	EB-5	Client:	Associated Earth Sciences
Date Received:	08/31/16	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	09/07/16	Lab ID:	608592-01 1/5
Date Analyzed:	09/07/16	Data File:	090718.D
Matrix:	Soil	Instrument:	GCMS6
Units:	mg/kg (ppm) Dry Weight	Operator:	ya

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	84	31	163
Benzo(a)anthracene-d12	1726 ip	24	168

Compounds:	Concentration mg/kg (ppm)
Naphthalene	<0.01
Acenaphthylene	<0.01
Acenaphthene	<0.01
Fluorene	<0.01
Phenanthrene	<0.01
Anthracene	<0.01
Fluoranthene	<0.01
Pyrene	<0.01
Benz(a)anthracene	<0.01
Chrysene	<0.01
Benzo(a)pyrene	<0.01
Benzo(b)fluoranthene	<0.01
Benzo(k)fluoranthene	<0.01
Indeno(1,2,3-cd)pyrene	<0.01
Dibenz(a,h)anthracene	<0.01
Benzo(g,h,i)perylene	<0.01

Analysis For Semivolatile Compounds By EPA Method 8270D SIM

Client Sample ID:	Method Blank	Client:	Associated Earth Sciences
Date Received:	Not Applicable	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	09/07/16	Lab ID:	06-1841 mb 1/5
Date Analyzed:	09/07/16	Data File:	090717.D
Matrix:	Soil	Instrument:	GCMS6
Units:	mg/kg (ppm) Dry Weight	Operator:	ya

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
Anthracene-d10	87	31	163
Benzo(a)anthracene-d12	91	24	168

Compounds:	Concentration mg/kg (ppm)
Naphthalene	<0.01
Acenaphthylene	<0.01
Acenaphthene	<0.01
Fluorene	<0.01
Phenanthrene	<0.01
Anthracene	<0.01
Fluoranthene	<0.01
Pyrene	<0.01
Benz(a)anthracene	<0.01
Chrysene	<0.01
Benzo(a)pyrene	<0.01
Benzo(b)fluoranthene	<0.01
Benzo(k)fluoranthene	<0.01
Indeno(1,2,3-cd)pyrene	<0.01
Dibenz(a,h)anthracene	<0.01
Benzo(g,h,i)perylene	<0.01

Analysis For Semivolatile Compounds By EPA Method 8270D

Client Sample ID:	EB-5	Client:	Associated Earth Sciences
Date Received:	08/31/16	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	09/07/16	Lab ID:	608592-01 1/5
Date Analyzed:	09/07/16	Data File:	090706.D
Matrix:	Soil	Instrument:	GCMS8
Units:	mg/kg (ppm) Dry Weight	Operator:	ya

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
2-Fluorophenol	98	56	115
Phenol-d6	96	54	113
Nitrobenzene-d5	97	31	164
2-Fluorobiphenyl	90	47	133
2,4,6-Tribromophenol	100	35	141
Terphenyl-d14	78	24	188

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
Phenol	<0.5	Hexachlorocyclopentadiene	<0.15
Bis(2-chloroethyl) ether	<0.05	2,4,6-Trichlorophenol	<0.5
2-Chlorophenol	<0.5	2,4,5-Trichlorophenol	<0.5
1,3-Dichlorobenzene	<0.05	2-Chloronaphthalene	<0.05
1,4-Dichlorobenzene	<0.05	2-Nitroaniline	<0.25
1,2-Dichlorobenzene	<0.05	Dimethyl phthalate	<0.5
Benzyl alcohol	<0.5	2,6-Dinitrotoluene	<0.25
Bis(2-chloroisopropyl) ether	<0.05	3-Nitroaniline	<5
2-Methylphenol	<0.5	2,4-Dinitrophenol	<1.5 ca
Hexachloroethane	<0.05	Dibenzofuran	<0.05
N-Nitroso-di-n-propylamine	<0.05	2,4-Dinitrotoluene	<0.25
3-Methylphenol + 4-Methylphenol	<1	4-Nitrophenol	<1.5
Nitrobenzene	<0.05	Diethyl phthalate	<0.5
Isophorone	<0.05	4-Chlorophenyl phenyl ether	<0.05
2-Nitrophenol	<0.5	N-Nitrosodiphenylamine	<0.05
2,4-Dimethylphenol	<0.5	4-Nitroaniline	<5
Benzoic acid	<2.5 ca	4,6-Dinitro-2-methylphenol	<1.5 ca
Bis(2-chloroethoxy)methane	<0.05	4-Bromophenyl phenyl ether	<0.05
2,4-Dichlorophenol	<0.5	Hexachlorobenzene	<0.05
1,2,4-Trichlorobenzene	<0.05	Pentachlorophenol	<0.5
Hexachlorobutadiene	<0.05	Carbazole	<0.5
4-Chloroaniline	<5	Di-n-butyl phthalate	<0.5
4-Chloro-3-methylphenol	<0.5	Benzyl butyl phthalate	<0.5
2-Methylnaphthalene	<0.05	Bis(2-ethylhexyl) phthalate	<0.8
1-Methylnaphthalene	<0.05	Di-n-octyl phthalate	<0.5

Analysis For Semivolatile Compounds By EPA Method 8270D

Client Sample ID:	Method Blank	Client:	Associated Earth Sciences
Date Received:	Not Applicable	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	09/07/16	Lab ID:	06-1840 mb
Date Analyzed:	09/07/16	Data File:	090705.D
Matrix:	Soil	Instrument:	GCMS8
Units:	mg/kg (ppm) Dry Weight	Operator:	ya

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
2-Fluorophenol	94	56	115
Phenol-d6	93	54	113
Nitrobenzene-d5	97	31	164
2-Fluorobiphenyl	93	47	133
2,4,6-Tribromophenol	83	35	141
Terphenyl-d14	105	24	188

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
Phenol	<0.1	Hexachlorocyclopentadiene	<0.03
Bis(2-chloroethyl) ether	<0.01	2,4,6-Trichlorophenol	<0.1
2-Chlorophenol	<0.1	2,4,5-Trichlorophenol	<0.1
1,3-Dichlorobenzene	<0.01	2-Chloronaphthalene	<0.01
1,4-Dichlorobenzene	<0.01	2-Nitroaniline	<0.05
1,2-Dichlorobenzene	<0.01	Dimethyl phthalate	<0.1
Benzyl alcohol	<0.1	2,6-Dinitrotoluene	<0.05
Bis(2-chloroisopropyl) ether	<0.01	3-Nitroaniline	<1
2-Methylphenol	<0.1	2,4-Dinitrophenol	<0.3 ca
Hexachloroethane	<0.01	Dibenzofuran	<0.01
N-Nitroso-di-n-propylamine	<0.01	2,4-Dinitrotoluene	<0.05
3-Methylphenol + 4-Methylphenol	<0.2	4-Nitrophenol	<0.3
Nitrobenzene	<0.01	Diethyl phthalate	<0.1
Isophorone	<0.01	4-Chlorophenyl phenyl ether	<0.01
2-Nitrophenol	<0.1	N-Nitrosodiphenylamine	<0.01
2,4-Dimethylphenol	<0.1	4-Nitroaniline	<1
Benzoic acid	<0.5 ca	4,6-Dinitro-2-methylphenol	<0.3 ca
Bis(2-chloroethoxy)methane	<0.01	4-Bromophenyl phenyl ether	<0.01
2,4-Dichlorophenol	<0.1	Hexachlorobenzene	<0.01
1,2,4-Trichlorobenzene	<0.01	Pentachlorophenol	<0.1
Hexachlorobutadiene	<0.01	Carbazole	<0.1
4-Chloroaniline	<1	Di-n-butyl phthalate	<0.1
4-Chloro-3-methylphenol	<0.1	Benzyl butyl phthalate	<0.1
2-Methylnaphthalene	<0.01	Bis(2-ethylhexyl) phthalate	<0.16
1-Methylnaphthalene	<0.01	Di-n-octyl phthalate	<0.1

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	EB-5 pc	Client:	Associated Earth Sciences
Date Received:	08/31/16	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	08/31/16	Lab ID:	608592-01
Date Analyzed:	09/01/16	Data File:	083153.D
Matrix:	Soil	Instrument:	GCMS4
Units:	mg/kg (ppm) Dry Weight	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	100	62	142
Toluene-d8	94	55	145
4-Bromofluorobenzene	107	65	139

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
Dichlorodifluoromethane	<0.5	1,3-Dichloropropane	<0.05
Chloromethane	<0.5	Tetrachloroethene	<0.025
Vinyl chloride	<0.05	Dibromochloromethane	<0.05
Bromomethane	<0.5	1,2-Dibromoethane (EDB)	<0.05
Chloroethane	<0.5	Chlorobenzene	<0.05
Trichlorofluoromethane	<0.5	Ethylbenzene	<0.05
Acetone	<0.5	1,1,1,2-Tetrachloroethane	<0.05
1,1-Dichloroethene	<0.05	m,p-Xylene	<0.1
Hexane	<0.25	o-Xylene	<0.05
Methylene chloride	<0.5	Styrene	<0.05
Methyl t-butyl ether (MTBE)	<0.05	Isopropylbenzene	<0.05
trans-1,2-Dichloroethene	<0.05	Bromoform	<0.05
1,1-Dichloroethane	<0.05	n-Propylbenzene	<0.05
2,2-Dichloropropane	<0.05	Bromobenzene	<0.05
cis-1,2-Dichloroethene	<0.05	1,3,5-Trimethylbenzene	<0.05
Chloroform	<0.05	1,1,2,2-Tetrachloroethane	<0.05
2-Butanone (MEK)	<0.5	1,2,3-Trichloropropane	<0.05
1,2-Dichloroethane (EDC)	<0.05	2-Chlorotoluene	<0.05
1,1,1-Trichloroethane	<0.05	4-Chlorotoluene	<0.05
1,1-Dichloropropene	<0.05	tert-Butylbenzene	<0.05
Carbon tetrachloride	<0.05	1,2,4-Trimethylbenzene	<0.05
Benzene	<0.03	sec-Butylbenzene	<0.05
Trichloroethene	<0.02	p-Isopropyltoluene	25 ve
1,2-Dichloropropane	<0.05	1,3-Dichlorobenzene	<0.05
Bromodichloromethane	<0.05	1,4-Dichlorobenzene	<0.05
Dibromomethane	<0.05	1,2-Dichlorobenzene	<0.05
4-Methyl-2-pentanone	<0.5	1,2-Dibromo-3-chloropropane	<0.5
cis-1,3-Dichloropropene	<0.05	1,2,4-Trichlorobenzene	<0.25
Toluene	<0.05	Hexachlorobutadiene	<0.25
trans-1,3-Dichloropropene	<0.05	Naphthalene	<0.05
1,1,2-Trichloroethane	<0.05	1,2,3-Trichlorobenzene	<0.25
2-Hexanone	<0.5		

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	EB-5 pc	Client:	Associated Earth Sciences
Date Received:	08/31/16	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	08/31/16	Lab ID:	608592-01 1/10
Date Analyzed:	09/01/16	Data File:	090108.D
Matrix:	Soil	Instrument:	GCMS4
Units:	mg/kg (ppm) Dry Weight	Operator:	VM

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	99	62	142
Toluene-d8	97	55	145
4-Bromofluorobenzene	106	65	139

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
Dichlorodifluoromethane	<5	1,3-Dichloropropane	<0.5
Chloromethane	<5	Tetrachloroethene	<0.25
Vinyl chloride	<0.5	Dibromochloromethane	<0.5
Bromomethane	<5	1,2-Dibromoethane (EDB)	<0.5
Chloroethane	<5	Chlorobenzene	<0.5
Trichlorofluoromethane	<5	Ethylbenzene	<0.5
Acetone	<5	1,1,1,2-Tetrachloroethane	<0.5
1,1-Dichloroethene	<0.5	m,p-Xylene	<1
Hexane	<2.5	o-Xylene	<0.5
Methylene chloride	<5	Styrene	<0.5
Methyl t-butyl ether (MTBE)	<0.5	Isopropylbenzene	<0.5
trans-1,2-Dichloroethene	<0.5	Bromoform	<0.5
1,1-Dichloroethane	<0.5	n-Propylbenzene	<0.5
2,2-Dichloropropane	<0.5	Bromobenzene	<0.5
cis-1,2-Dichloroethene	<0.5	1,3,5-Trimethylbenzene	<0.5
Chloroform	<0.5	1,1,2,2-Tetrachloroethane	<0.5
2-Butanone (MEK)	<5	1,2,3-Trichloropropane	<0.5
1,2-Dichloroethane (EDC)	<0.5	2-Chlorotoluene	<0.5
1,1,1-Trichloroethane	<0.5	4-Chlorotoluene	<0.5
1,1-Dichloropropene	<0.5	tert-Butylbenzene	<0.5
Carbon tetrachloride	<0.5	1,2,4-Trimethylbenzene	<0.5
Benzene	<0.3	sec-Butylbenzene	<0.5
Trichloroethene	<0.2	p-Isopropyltoluene	29
1,2-Dichloropropane	<0.5	1,3-Dichlorobenzene	<0.5
Bromodichloromethane	<0.5	1,4-Dichlorobenzene	<0.5
Dibromomethane	<0.5	1,2-Dichlorobenzene	<0.5
4-Methyl-2-pentanone	<5	1,2-Dibromo-3-chloropropane	<5
cis-1,3-Dichloropropene	<0.5	1,2,4-Trichlorobenzene	<2.5
Toluene	<0.5	Hexachlorobutadiene	<2.5
trans-1,3-Dichloropropene	<0.5	Naphthalene	<0.5
1,1,2-Trichloroethane	<0.5	1,2,3-Trichlorobenzene	<2.5
2-Hexanone	<5		

Analysis For Volatile Compounds By EPA Method 8260C

Client Sample ID:	Method Blank	Client:	Associated Earth Sciences
Date Received:	Not Applicable	Project:	Spruce Elementary, PO KE140562A
Date Extracted:	08/31/16	Lab ID:	06-1797 mb
Date Analyzed:	08/31/16	Data File:	083106A.D
Matrix:	Soil	Instrument:	GCMS4
Units:	mg/kg (ppm) Dry Weight	Operator:	JS

Surrogates:	% Recovery:	Lower Limit:	Upper Limit:
1,2-Dichloroethane-d4	99	62	142
Toluene-d8	95	55	145
4-Bromofluorobenzene	106	65	139

Compounds:	Concentration mg/kg (ppm)	Compounds:	Concentration mg/kg (ppm)
Dichlorodifluoromethane	<0.5	1,3-Dichloropropane	<0.05
Chloromethane	<0.5	Tetrachloroethene	<0.025
Vinyl chloride	<0.05	Dibromochloromethane	<0.05
Bromomethane	<0.5	1,2-Dibromoethane (EDB)	<0.05
Chloroethane	<0.5	Chlorobenzene	<0.05
Trichlorofluoromethane	<0.5	Ethylbenzene	<0.05
Acetone	<0.5	1,1,1,2-Tetrachloroethane	<0.05
1,1-Dichloroethene	<0.05	m,p-Xylene	<0.1
Hexane	<0.25	o-Xylene	<0.05
Methylene chloride	<0.5	Styrene	<0.05
Methyl t-butyl ether (MTBE)	<0.05	Isopropylbenzene	<0.05
trans-1,2-Dichloroethene	<0.05	Bromoform	<0.05
1,1-Dichloroethane	<0.05	n-Propylbenzene	<0.05
2,2-Dichloropropane	<0.05	Bromobenzene	<0.05
cis-1,2-Dichloroethene	<0.05	1,3,5-Trimethylbenzene	<0.05
Chloroform	<0.05	1,1,2,2-Tetrachloroethane	<0.05
2-Butanone (MEK)	<0.5	1,2,3-Trichloropropane	<0.05
1,2-Dichloroethane (EDC)	<0.05	2-Chlorotoluene	<0.05
1,1,1-Trichloroethane	<0.05	4-Chlorotoluene	<0.05
1,1-Dichloropropene	<0.05	tert-Butylbenzene	<0.05
Carbon tetrachloride	<0.05	1,2,4-Trimethylbenzene	<0.05
Benzene	<0.03	sec-Butylbenzene	<0.05
Trichloroethene	<0.02	p-Isopropyltoluene	<0.05
1,2-Dichloropropane	<0.05	1,3-Dichlorobenzene	<0.05
Bromodichloromethane	<0.05	1,4-Dichlorobenzene	<0.05
Dibromomethane	<0.05	1,2-Dichlorobenzene	<0.05
4-Methyl-2-pentanone	<0.5	1,2-Dibromo-3-chloropropane	<0.5
cis-1,3-Dichloropropene	<0.05	1,2,4-Trichlorobenzene	<0.25
Toluene	<0.05	Hexachlorobutadiene	<0.25
trans-1,3-Dichloropropene	<0.05	Naphthalene	<0.05
1,1,2-Trichloroethane	<0.05	1,2,3-Trichlorobenzene	<0.25
2-Hexanone	<0.5		

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR TPH AS GASOLINE USING METHOD NWTPH-Gx

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Gasoline	mg/kg (ppm)	20	90	90	71-131	0

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FROM THE ANALYSIS OF SOIL SAMPLES FOR TOTAL PETROLEUM HYDROCARBONS AS DIESEL EXTENDED USING METHOD NWTPH-Dx

Laboratory Code: 608551-01 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet Wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Diesel Extended	mg/kg (ppm)	5,000	<50	87	86	64-133	1

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Diesel Extended	mg/kg (ppm)	5,000	90	58-147

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR PAHS BY EPA METHOD 8270D SIM

Laboratory Code: Laboratory Control Sample 1/5

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Naphthalene	mg/kg (ppm)	0.17	90	91	58-121	1
Acenaphthylene	mg/kg (ppm)	0.17	85	86	54-121	1
Acenaphthene	mg/kg (ppm)	0.17	87	89	54-123	2
Fluorene	mg/kg (ppm)	0.17	90	90	56-127	0
Phenanthrene	mg/kg (ppm)	0.17	88	89	55-122	1
Anthracene	mg/kg (ppm)	0.17	86	83	50-120	4
Fluoranthene	mg/kg (ppm)	0.17	87	82	54-129	6
Pyrene	mg/kg (ppm)	0.17	83	97	53-127	16
Benz(a)anthracene	mg/kg (ppm)	0.17	87	89	51-115	2
Chrysene	mg/kg (ppm)	0.17	86	91	55-129	6
Benzo(b)fluoranthene	mg/kg (ppm)	0.17	86	89	56-123	3
Benzo(k)fluoranthene	mg/kg (ppm)	0.17	89	88	54-131	1
Benzo(a)pyrene	mg/kg (ppm)	0.17	83	81	51-118	2
Indeno(1,2,3-cd)pyrene	mg/kg (ppm)	0.17	86	85	49-148	1
Dibenz(a,h)anthracene	mg/kg (ppm)	0.17	88	84	50-141	5
Benzo(g,h,i)perylene	mg/kg (ppm)	0.17	86	87	52-131	1

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR SEMIVOLATILES BY EPA METHOD 8270D

Laboratory Code: 608592-01 1/5 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Acceptance Criteria
Phenol	mg/kg (ppm)	0.33	<0.5	107	50-150
Bis(2-chloroethyl) ether	mg/kg (ppm)	0.33	<0.05	102	50-150
2-Chlorophenol	mg/kg (ppm)	0.33	<0.5	102	44-133
1,3-Dichlorobenzene	mg/kg (ppm)	0.33	<0.05	94	50-150
1,4-Dichlorobenzene	mg/kg (ppm)	0.33	<0.05	94	50-150
1,2-Dichlorobenzene	mg/kg (ppm)	0.33	<0.05	95	50-150
Benzyl alcohol	mg/kg (ppm)	0.33	<0.5	102	50-150
Bis(2-chloroisopropyl) ether	mg/kg (ppm)	0.33	<0.05	96	50-150
2-Methylphenol	mg/kg (ppm)	0.33	<0.5	101	42-143
Hexachloroethane	mg/kg (ppm)	0.33	<0.05	100	31-132
N-Nitroso-di-n-propylamine	mg/kg (ppm)	0.33	<0.05	104	50-150
3-Methylphenol + 4-Methylphenol	mg/kg (ppm)	0.33	<1	103	10-250
Nitrobenzene	mg/kg (ppm)	0.33	<0.05	104	50-150
Isophorone	mg/kg (ppm)	0.33	<0.05	100	50-150
2-Nitrophenol	mg/kg (ppm)	0.33	<0.5	116	29-152
2,4-Dimethylphenol	mg/kg (ppm)	0.33	<0.5	99	16-163
Benzoic acid	mg/kg (ppm)	0.5	<2.5	102	10-250
Bis(2-chloroethoxy)methane	mg/kg (ppm)	0.33	<0.05	103	50-150
2,4-Dichlorophenol	mg/kg (ppm)	0.33	<0.5	104	39-145
1,2,4-Trichlorobenzene	mg/kg (ppm)	0.33	<0.05	95	50-150
Hexachlorobutadiene	mg/kg (ppm)	0.33	<0.05	91	50-150
4-Chloroaniline	mg/kg (ppm)	0.66	<5	67	23-110
4-Chloro-3-methylphenol	mg/kg (ppm)	0.33	<0.5	105	50-150
2-Methylnaphthalene	mg/kg (ppm)	0.33	<0.05	98	50-150
1-Methylnaphthalene	mg/kg (ppm)	0.33	<0.05	98	50-150
Hexachlorocyclopentadiene	mg/kg (ppm)	0.33	<0.15	102	10-151
2,4,6-Trichlorophenol	mg/kg (ppm)	0.33	<0.5	108	38-149
2,4,5-Trichlorophenol	mg/kg (ppm)	0.33	<0.5	99	50-150
2-Chloronaphthalene	mg/kg (ppm)	0.33	<0.05	96	50-150
2-Nitroaniline	mg/kg (ppm)	0.33	<0.25	105	50-150
Dimethyl phthalate	mg/kg (ppm)	0.33	<0.5	101	50-150
2,6-Dinitrotoluene	mg/kg (ppm)	0.33	<0.25	99	50-150
3-Nitroaniline	mg/kg (ppm)	0.66	<5	71	23-119
2,4-Dinitrophenol	mg/kg (ppm)	0.33	<1.5	68	10-162
Dibenzofuran	mg/kg (ppm)	0.33	<0.05	96	47-149
2,4-Dinitrotoluene	mg/kg (ppm)	0.33	<0.25	101	50-150
4-Nitrophenol	mg/kg (ppm)	0.33	<1.5	81	10-179
Diethyl phthalate	mg/kg (ppm)	0.33	<0.5	107	50-150
4-Chlorophenyl phenyl ether	mg/kg (ppm)	0.33	<0.05	94	50-150
N-Nitrosodiphenylamine	mg/kg (ppm)	0.33	<0.05	100	50-150
4-Nitroaniline	mg/kg (ppm)	0.66	<5	82	32-135
4,6-Dinitro-2-methylphenol	mg/kg (ppm)	0.33	<1.5	81	10-170
4-Bromophenyl phenyl ether	mg/kg (ppm)	0.33	<0.05	99	50-150
Hexachlorobenzene	mg/kg (ppm)	0.33	<0.05	95	50-150
Pentachlorophenol	mg/kg (ppm)	0.33	<0.5	110	12-160
Carbazole	mg/kg (ppm)	0.33	<0.5	89	50-150
Di-n-butyl phthalate	mg/kg (ppm)	0.33	<0.5	101	50-150
Benzyl butyl phthalate	mg/kg (ppm)	0.33	<0.5	109	50-150
Bis(2-ethylhexyl) phthalate	mg/kg (ppm)	0.33	<0.8	122	10-250
Di-n-octyl phthalate	mg/kg (ppm)	0.33	<0.5	144	54-161

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR SEMIVOLATILES BY EPA METHOD 8270D

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Percent Recovery LCSD	Acceptance Criteria	RPD (Limit 20)
Phenol	mg/kg (ppm)	0.33	99	90	51-119	10
Bis(2-chloroethyl) ether	mg/kg (ppm)	0.33	99	87	60-112	13
2-Chlorophenol	mg/kg (ppm)	0.33	97	88	59-114	10
1,3-Dichlorobenzene	mg/kg (ppm)	0.33	97	85	62-113	13
1,4-Dichlorobenzene	mg/kg (ppm)	0.33	97	85	61-114	13
1,2-Dichlorobenzene	mg/kg (ppm)	0.33	97	85	61-113	13
Benzyl alcohol	mg/kg (ppm)	0.33	99	89	50-119	11
Bis(2-chloroisopropyl) ether	mg/kg (ppm)	0.33	95	85	59-113	11
2-Methylphenol	mg/kg (ppm)	0.33	94	86	58-115	9
Hexachloroethane	mg/kg (ppm)	0.33	98	88	63-114	11
N-Nitroso-di-n-propylamine	mg/kg (ppm)	0.33	99	91	62-114	8
3-Methylphenol + 4-Methylphenol	mg/kg (ppm)	0.33	96	88	54-120	9
Nitrobenzene	mg/kg (ppm)	0.33	104	92	59-114	12
Isophorone	mg/kg (ppm)	0.33	97	87	61-113	11
2-Nitrophenol	mg/kg (ppm)	0.33	91	89	59-114	2
2,4-Dimethylphenol	mg/kg (ppm)	0.33	84	75	54-107	11
Benzoic acid	mg/kg (ppm)	0.5	99	96	43-150	3
Bis(2-chloroethoxy)methane	mg/kg (ppm)	0.33	98	86	60-114	13
2,4-Dichlorophenol	mg/kg (ppm)	0.33	98	89	57-118	10
1,2,4-Trichlorobenzene	mg/kg (ppm)	0.33	98	86	56-112	13
Hexachlorobutadiene	mg/kg (ppm)	0.33	94	82	60-116	14
4-Chloroaniline	mg/kg (ppm)	0.66	63	50	10-126	23 vo
4-Chloro-3-methylphenol	mg/kg (ppm)	0.33	100	90	59-115	11
2-Methylnaphthalene	mg/kg (ppm)	0.33	98	86	60-115	13
1-Methylnaphthalene	mg/kg (ppm)	0.33	99	87	70-130	13
Hexachlorocyclopentadiene	mg/kg (ppm)	0.33	98	89	41-107	10
2,4,6-Trichlorophenol	mg/kg (ppm)	0.33	92	86	47-119	7
2,4,5-Trichlorophenol	mg/kg (ppm)	0.33	95	87	61-121	9
2-Chloronaphthalene	mg/kg (ppm)	0.33	95	85	58-114	11
2-Nitroaniline	mg/kg (ppm)	0.33	102	91	55-119	11
Dimethyl phthalate	mg/kg (ppm)	0.33	103	93	58-116	10
2,6-Dinitrotoluene	mg/kg(ppm)	0.33	103	92	57-119	11
3-Nitroaniline	mg/kg (ppm)	0.66	83	72	10-143	14
2,4-Dinitrophenol	mg/kg (ppm)	0.33	85	80	40-122	6
Dibenzofuran	mg/kg (ppm)	0.33	98	86	56-115	13
2,4-Dinitrotoluene	mg/kg (ppm)	0.33	105	93	53-126	12
4-Nitrophenol	mg/kg (ppm)	0.33	91	86	40-124	6
Diethyl phthalate	mg/kg (ppm)	0.33	108	96	57-116	12
4-Chlorophenyl phenyl ether	mg/kg (ppm)	0.33	98	85	54-119	14
N-Nitrosodiphenylamine	mg/kg (ppm)	0.33	95	85	54-113	11
4-Nitroaniline	mg/kg (ppm)	0.66	80	76	47-109	5
4,6-Dinitro-2-methylphenol	mg/kg (ppm)	0.33	88	85	55-147	3
4-Bromophenyl phenyl ether	mg/kg (ppm)	0.33	100	89	56-116	12
Hexachlorobenzene	mg/kg (ppm)	0.33	97	87	57-115	11
Pentachlorophenol	mg/kg (ppm)	0.33	91	86	45-123	6
Carbazole	mg/kg (ppm)	0.33	93	85	57-116	9
Di-n-butyl phthalate	mg/kg (ppm)	0.33	108	101	56-118	7
Benzyl butyl phthalate	mg/kg (ppm)	0.33	104	100	56-122	4
Bis(2-ethylhexyl) phthalate	mg/kg (ppm)	0.33	108	102	56-155	6
Di-n-octyl phthalate	mg/kg (ppm)	0.33	102	95	58-120	7

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR VOLATILES BY EPA METHOD 8260C

Laboratory Code: 608577-04 (Matrix Spike)

Analyte	Reporting Units	Spike Level	Sample Result (Wet wt)	Percent Recovery MS	Percent Recovery MSD	Acceptance Criteria	RPD (Limit 20)
Dichlorodifluoromethane	mg/kg (ppm)	2.5	<0.5	25	24	10-142	4
Chloromethane	mg/kg (ppm)	2.5	<0.5	51	48	10-126	6
Vinyl chloride	mg/kg (ppm)	2.5	<0.05	59	55	10-138	7
Bromomethane	mg/kg (ppm)	2.5	<0.5	66	62	10-163	6
Chloroethane	mg/kg (ppm)	2.5	<0.5	79	75	10-176	5
Trichlorofluoromethane	mg/kg (ppm)	2.5	<0.5	66	63	10-176	5
Acetone	mg/kg (ppm)	12.5	<0.5	79	79	10-163	0
1,1-Dichloroethene	mg/kg (ppm)	2.5	<0.05	70	66	10-160	6
Hexane	mg/kg (ppm)	2.5	<0.25	66	59	10-137	11
Methylene chloride	mg/kg (ppm)	2.5	<0.5	85	81	10-156	5
Methyl t-butyl ether (MTBE)	mg/kg (ppm)	2.5	<0.05	79	76	21-145	4
trans-1,2-Dichloroethene	mg/kg (ppm)	2.5	<0.05	72	68	14-137	6
1,1-Dichloroethane	mg/kg (ppm)	2.5	<0.05	81	77	19-140	5
2,2-Dichloropropane	mg/kg (ppm)	2.5	<0.05	83	79	10-158	5
cis-1,2-Dichloroethene	mg/kg (ppm)	2.5	<0.05	75	71	25-135	5
Chloroform	mg/kg (ppm)	2.5	<0.05	79	75	21-145	5
2-Butanone (MEK)	mg/kg (ppm)	12.5	<0.5	83	83	19-147	0
1,2-Dichloroethane (EDC)	mg/kg (ppm)	2.5	<0.05	79	76	12-160	4
1,1,1-Trichloroethane	mg/kg (ppm)	2.5	<0.05	72	68	10-156	6
1,1-Dichloropropene	mg/kg (ppm)	2.5	<0.05	75	71	17-140	5
Carbon tetrachloride	mg/kg (ppm)	2.5	<0.05	67	65	9-164	3
Benzene	mg/kg (ppm)	2.5	<0.03	78	74	29-129	5
Trichloroethene	mg/kg (ppm)	2.5	<0.02	74	71	21-139	4
1,2-Dichloropropane	mg/kg (ppm)	2.5	<0.05	84	81	30-135	4
Bromodichloromethane	mg/kg (ppm)	2.5	<0.05	76	73	23-155	4
Dibromomethane	mg/kg (ppm)	2.5	<0.05	79	76	23-145	4
4-Methyl-2-pentanone	mg/kg (ppm)	12.5	<0.5	77	75	24-155	3
cis-1,3-Dichloropropene	mg/kg (ppm)	2.5	<0.05	78	74	28-144	5
Toluene	mg/kg (ppm)	2.5	<0.05	85	80	35-130	6
trans-1,3-Dichloropropene	mg/kg (ppm)	2.5	<0.05	87	82	26-149	6
1,1,2-Trichloroethane	mg/kg (ppm)	2.5	<0.05	90	86	10-205	5
2-Hexanone	mg/kg (ppm)	12.5	<0.5	106	102	15-166	4
1,3-Dichloropropane	mg/kg (ppm)	2.5	<0.05	92	88	31-137	4
Tetrachloroethene	mg/kg (ppm)	2.5	<0.025	84	80	20-133	5
Dibromochloromethane	mg/kg (ppm)	2.5	<0.05	81	78	28-150	4
1,2-Dibromoethane (EDB)	mg/kg (ppm)	2.5	<0.05	86	83	28-142	4
Chlorobenzene	mg/kg (ppm)	2.5	<0.05	86	82	32-129	5
Ethylbenzene	mg/kg (ppm)	2.5	<0.05	86	81	32-137	6
1,1,1,2-Tetrachloroethane	mg/kg (ppm)	2.5	<0.05	79	75	31-143	5
m,p-Xylene	mg/kg (ppm)	5	<0.1	87	82	34-136	6
o-Xylene	mg/kg (ppm)	2.5	<0.05	84	81	33-134	4
Styrene	mg/kg (ppm)	2.5	<0.05	86	82	35-137	5
Isopropylbenzene	mg/kg (ppm)	2.5	<0.05	85	81	31-142	5
Bromoform	mg/kg (ppm)	2.5	<0.05	73	70	21-156	4
n-Propylbenzene	mg/kg (ppm)	2.5	<0.05	92	88	23-146	4
Bromobenzene	mg/kg (ppm)	2.5	<0.05	90	85	34-130	6
1,3,5-Trimethylbenzene	mg/kg (ppm)	2.5	<0.05	89	85	18-149	5
1,1,2,2-Tetrachloroethane	mg/kg (ppm)	2.5	<0.05	94	90	28-140	4
1,2,3-Trichloropropane	mg/kg (ppm)	2.5	<0.05	98	95	25-144	3
2-Chlorotoluene	mg/kg (ppm)	2.5	<0.05	91	87	31-134	4
4-Chlorotoluene	mg/kg (ppm)	2.5	<0.05	89	85	31-136	5
tert-Butylbenzene	mg/kg (ppm)	2.5	<0.05	87	84	30-137	4
1,2,4-Trimethylbenzene	mg/kg (ppm)	2.5	<0.05	87	84	10-182	4
sec-Butylbenzene	mg/kg (ppm)	2.5	<0.05	87	84	23-145	4
p-Isopropyltoluene	mg/kg (ppm)	2.5	<0.05	87	83	21-149	5
1,3-Dichlorobenzene	mg/kg (ppm)	2.5	<0.05	89	85	30-131	5
1,4-Dichlorobenzene	mg/kg (ppm)	2.5	<0.05	88	85	29-129	3
1,2-Dichlorobenzene	mg/kg (ppm)	2.5	<0.05	91	86	31-132	6
1,2-Dibromo-3-chloropropane	mg/kg (ppm)	2.5	<0.5	89	89	11-161	0
1,2,4-Trichlorobenzene	mg/kg (ppm)	2.5	<0.25	86	83	22-142	4
Hexachlorobutadiene	mg/kg (ppm)	2.5	<0.25	76	75	10-142	1
Naphthalene	mg/kg (ppm)	2.5	<0.05	90	87	14-157	3
1,2,3-Trichlorobenzene	mg/kg (ppm)	2.5	<0.25	85	83	20-144	2

Date of Report: 09/09/16
Date Received: 08/31/16
Project: Spruce Elementary, PO KE140562A, F&BI 608592

QUALITY ASSURANCE RESULTS FOR THE ANALYSIS OF SOIL SAMPLES FOR VOLATILES BY EPA METHOD 8260C

Laboratory Code: Laboratory Control Sample

Analyte	Reporting Units	Spike Level	Percent Recovery LCS	Acceptance Criteria
Dichlorodifluoromethane	mg/kg (ppm)	2.5	43	10-146
Chloromethane	mg/kg (ppm)	2.5	67	27-133
Vinyl chloride	mg/kg (ppm)	2.5	79	22-139
Bromomethane	mg/kg (ppm)	2.5	79	38-114
Chloroethane	mg/kg (ppm)	2.5	96	10-163
Trichlorofluoromethane	mg/kg (ppm)	2.5	86	10-196
Acetone	mg/kg (ppm)	12.5	101	52-141
1,1-Dichloroethene	mg/kg (ppm)	2.5	89	47-128
Hexane	mg/kg (ppm)	2.5	91	43-142
Methylene chloride	mg/kg (ppm)	2.5	106	42-132
Methyl t-butyl ether (MTBE)	mg/kg (ppm)	2.5	95	60-123
trans-1,2-Dichloroethene	mg/kg (ppm)	2.5	88	67-127
1,1-Dichloroethane	mg/kg (ppm)	2.5	97	68-115
2,2-Dichloropropane	mg/kg (ppm)	2.5	96	52-170
cis-1,2-Dichloroethene	mg/kg (ppm)	2.5	90	72-113
Chloroform	mg/kg (ppm)	2.5	94	66-120
2-Butanone (MEK)	mg/kg (ppm)	12.5	103	57-123
1,2-Dichloroethane (EDC)	mg/kg (ppm)	2.5	95	56-135
1,1,1-Trichloroethane	mg/kg (ppm)	2.5	85	62-131
1,1-Dichloropropene	mg/kg (ppm)	2.5	90	69-128
Carbon tetrachloride	mg/kg (ppm)	2.5	83	60-139
Benzene	mg/kg (ppm)	2.5	93	68-114
Trichloroethene	mg/kg (ppm)	2.5	88	64-117
1,2-Dichloropropane	mg/kg (ppm)	2.5	101	72-127
Bromodichloromethane	mg/kg (ppm)	2.5	92	72-130
Dibromomethane	mg/kg (ppm)	2.5	95	70-120
4-Methyl-2-pentanone	mg/kg (ppm)	12.5	93	45-145
cis-1,3-Dichloropropene	mg/kg (ppm)	2.5	93	75-136
Toluene	mg/kg (ppm)	2.5	100	66-126
trans-1,3-Dichloropropene	mg/kg (ppm)	2.5	104	72-132
1,1,2-Trichloroethane	mg/kg (ppm)	2.5	107	75-113
2-Hexanone	mg/kg (ppm)	12.5	128	33-152
1,3-Dichloropropane	mg/kg (ppm)	2.5	110	72-130
Tetrachloroethene	mg/kg (ppm)	2.5	99	72-114
Dibromochloromethane	mg/kg (ppm)	2.5	97	74-125
1,2-Dibromoethane (EDB)	mg/kg (ppm)	2.5	103	74-132
Chlorobenzene	mg/kg (ppm)	2.5	102	76-111
Ethylbenzene	mg/kg (ppm)	2.5	100	64-123
1,1,1,2-Tetrachloroethane	mg/kg (ppm)	2.5	93	69-135
m,p-Xylene	mg/kg (ppm)	5	101	78-122
o-Xylene	mg/kg (ppm)	2.5	99	77-124
Styrene	mg/kg (ppm)	2.5	101	74-126
Isopropylbenzene	mg/kg (ppm)	2.5	98	76-127
Bromoform	mg/kg (ppm)	2.5	88	56-132
n-Propylbenzene	mg/kg (ppm)	2.5	108	74-124
Bromobenzene	mg/kg (ppm)	2.5	108	72-122
1,3,5-Trimethylbenzene	mg/kg (ppm)	2.5	104	76-126
1,1,2,2-Tetrachloroethane	mg/kg (ppm)	2.5	112	56-143
1,2,3-Trichloropropane	mg/kg (ppm)	2.5	119	61-137
2-Chlorotoluene	mg/kg (ppm)	2.5	108	74-121
4-Chlorotoluene	mg/kg (ppm)	2.5	105	75-122
tert-Butylbenzene	mg/kg (ppm)	2.5	103	73-130
1,2,4-Trimethylbenzene	mg/kg (ppm)	2.5	102	76-125
sec-Butylbenzene	mg/kg (ppm)	2.5	102	71-130
p-Isopropyltoluene	mg/kg (ppm)	2.5	101	70-132
1,3-Dichlorobenzene	mg/kg (ppm)	2.5	104	75-121
1,4-Dichlorobenzene	mg/kg (ppm)	2.5	104	74-117
1,2-Dichlorobenzene	mg/kg (ppm)	2.5	106	76-121
1,2-Dibromo-3-chloropropane	mg/kg (ppm)	2.5	110	58-138
1,2,4-Trichlorobenzene	mg/kg (ppm)	2.5	101	64-135
Hexachlorobutadiene	mg/kg (ppm)	2.5	89	50-153
Naphthalene	mg/kg (ppm)	2.5	107	63-140
1,2,3-Trichlorobenzene	mg/kg (ppm)	2.5	103	63-138

Data Qualifiers & Definitions

a - The analyte was detected at a level less than five times the reporting limit. The RPD results may not provide reliable information on the variability of the analysis.

b - The analyte was spiked at a level that was less than five times that present in the sample. Matrix spike recoveries may not be meaningful.

ca - The calibration results for the analyte were outside of acceptance criteria. The value reported is an estimate.

c - The presence of the analyte may be due to carryover from previous sample injections.

cf - The sample was centrifuged prior to analysis.

d - The sample was diluted. Detection limits were raised and surrogate recoveries may not be meaningful.

dv - Insufficient sample volume was available to achieve normal reporting limits.

f - The sample was laboratory filtered prior to analysis.

fb - The analyte was detected in the method blank.

fc - The compound is a common laboratory and field contaminant.

hr - The sample and duplicate were reextracted and reanalyzed. RPD results were still outside of control limits. Variability is attributed to sample inhomogeneity.

hs - Headspace was present in the container used for analysis.

ht – The analysis was performed outside the method or client-specified holding time requirement.

ip - Recovery fell outside of control limits. Compounds in the sample matrix interfered with the quantitation of the analyte.

j - The analyte concentration is reported below the lowest calibration standard. The value reported is an estimate.

J - The internal standard associated with the analyte is out of control limits. The reported concentration is an estimate.

jl - The laboratory control sample(s) percent recovery and/or RPD were out of control limits. The reported concentration should be considered an estimate.

js - The surrogate associated with the analyte is out of control limits. The reported concentration should be considered an estimate.

lc - The presence of the analyte is likely due to laboratory contamination.

L - The reported concentration was generated from a library search.

nm - The analyte was not detected in one or more of the duplicate analyses. Therefore, calculation of the RPD is not applicable.

pc - The sample was received with incorrect preservation or in a container not approved by the method. The value reported should be considered an estimate.

ve - The analyte response exceeded the valid instrument calibration range. The value reported is an estimate.

vo - The value reported fell outside the control limits established for this analyte.

x - The sample chromatographic pattern does not resemble the fuel standard used for quantitation.

608592

SAMPLE CHAIN OF CUSTODY

ME 08/31/16

CI

Send Report To Jon Sondergaard
Company AESI
Address 911 Fifth Ave
City, State, ZIP Kirkland, WA 98033
Phone # 425-827-7701 Fax #

SAMPLERS (*signature*)

PROJECT NAME/NO.	PO#
Spruce Elementary	KE140562A

REMARKS

Page # 1 of 1

TURNAROUND TIME
☑ Standard (2 Weeks)
☐ RUSH
Rush charges authorized by

SAMPLE DISPOSAL
☑ Dispose after 30 days
☐ Return samples
☐ Will call with instructions

						ANALYSES REQUESTED												
Sample ID	Lab ID	Date Sampled	Time Sampled	Sample Type	# of containers	TPH-Diesel	TPH-Gasoline	BTEX by 8021B	VOCs by8260	SVOCs by 8270	HFS							Notes
EB-5	01	8/30/16	1100	S	1	X	X	X	X	X								

Samples received at 5 °C

Friedman & Bruya, Inc.
3012 16th Avenue West
Seattle, WA 98119-2029
Ph. (206) 285-8282
Fax (206) 283-5044

	SIGNATURE	PRINT NAME	COMPANY	DATE	TIME
Relinquished by:		Jon Sondergaard	AESI	8/31/16	
Received by:	Bill Gleason	Bill Gleason	FEDEX	8/31/16	11:56
Relinquished by:					
Received by:		Nhan Phan	FeBT	8/31/16	1350

FORMS\COC\COC.DOC

Appendix E

Permanent Stormwater Control Calculations

E-1

Project SPRUCE ES PHASE I
Subject CONVERT POND → PIPE
With/To
Address
Date 9/8/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. McDONALD

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

AHBL

Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors

☐ GIVEN
- ☐ RAN WWHM ON TDA C-PHASE 1
- ☐ TDA C TO HAVE POND AND PIPE INTERCONNECTED
  - ☐ EVENTUALLY WILL NEED STAGE STORAGE AND WILL PROVIDE @ FINAL SUBMITTAL
- ☐ MODELED TDA C AS POND
- ☐ NEED TO DETERMINE PIPE LENGTH

☐ SOLVE
- ☐ VOLUME AVAILABLE IN POND IN TDA C PHAS 1
  - ☐ LIVE STORAGE BOTTOM SURFACE AREA:
  - ☐ LIVE STORAGE TOP SURFACE AREA:
  - ☐ DEPTH: 5 FT
  - ☐ USING AVERAGE END AREA TO SOLVE FOR VOLUME
    = $\boxed{14706.7 \text{ CF}}$

☐ VOLUME REQUIRED BY WWHM MODEL - USING POND
- ☐ VOLUME @ RISER HEAD: 0.8185 ACRE-FT → $\boxed{35,364.1 \text{ CF}}$

☐ VOLUME REMAINING FOR PIPES
- ☐ 35,364.1 CF - 14,706.7 CF = $\boxed{20,657.4 \text{ CF}}$

☐ LENGTH REQUIRED OF 6' Ø PIPE
- ☐ USING EXCEL CALC (SEE ATTACHED)
  - ☐ LENGTH REQUIRED: 794 LF

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

WWHM2012
PROJECT REPORT

Project Name: 20170906-Spruce ES - PH 1
Site Name: Spruce ES
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 9/8/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA C - Predeveloped
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Forest, Mod	**3.11**
Pervious Total	**3.11**

Impervious Land Use	**acre**
Impervious Total	**0**
Basin Total	**3.11**

Element Flows To:

Surface	**Interflow**	**Groundwater**

MITIGATED LAND USE

Name : TDA C - Developed
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Mod	.31
C, Pasture, Flat	.94
Pervious Total	1.25

Impervious Land Use	**acre**
DRIVEWAYS FLAT	1.47
DRIVEWAYS MOD	0.49
Impervious Total	1.96
Basin Total	3.21

Element Flows To:

Surface	**Interflow**	**Groundwater**
Trapezoidal Pond 1	Trapezoidal Pond 1	

Name : TDA - C Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Steep	.2
Pervious Total	0.2

Impervious Land Use	**acre**
Impervious Total	0
Basin Total	0.2

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : Trapezoidal Pond 1
Bottom Length: 69.00 ft.
Bottom Width: 69.00 ft.
Depth: 6 ft.
Volume at riser head: 0.8185 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: 5 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.344 ft.
Notch Height: 0.250 ft.
Orifice 1 Diameter: 0.8 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	0.109	0.000	0.000	0.000
0.0667	0.110	0.007	0.004	0.000
0.1333	0.111	0.014	0.006	0.000
0.2000	0.113	0.022	0.007	0.000
0.2667	0.114	0.029	0.009	0.000
0.3333	0.115	0.037	0.010	0.000
0.4000	0.117	0.045	0.011	0.000
0.4667	0.118	0.053	0.011	0.000
0.5333	0.119	0.061	0.012	0.000
0.6000	0.121	0.069	0.013	0.000
0.6667	0.122	0.077	0.014	0.000
0.7333	0.123	0.085	0.014	0.000
0.8000	0.125	0.093	0.015	0.000
0.8667	0.126	0.102	0.016	0.000
0.9333	0.127	0.110	0.016	0.000
1.0000	0.129	0.119	0.017	0.000
1.0667	0.130	0.127	0.017	0.000
1.1333	0.131	0.136	0.018	0.000
1.2000	0.133	0.145	0.019	0.000
1.2667	0.134	0.154	0.019	0.000
1.3333	0.136	0.163	0.020	0.000
1.4000	0.137	0.172	0.020	0.000
1.4667	0.139	0.181	0.021	0.000
1.5333	0.140	0.190	0.021	0.000
1.6000	0.141	0.200	0.022	0.000
1.6667	0.143	0.209	0.022	0.000
1.7333	0.144	0.219	0.022	0.000
1.8000	0.146	0.229	0.023	0.000
1.8667	0.147	0.238	0.023	0.000
1.9333	0.149	0.248	0.024	0.000
2.0000	0.150	0.258	0.024	0.000
2.0667	0.152	0.268	0.025	0.000
2.1333	0.153	0.279	0.025	0.000
2.2000	0.155	0.289	0.025	0.000
2.2667	0.156	0.299	0.026	0.000
2.3333	0.158	0.310	0.026	0.000
2.4000	0.159	0.320	0.026	0.000
2.4667	0.161	0.331	0.027	0.000
2.5333	0.162	0.342	0.027	0.000
2.6000	0.164	0.353	0.028	0.000

```
2.6667      0.165      0.364      0.028      0.000
2.7333      0.167      0.375      0.028      0.000
2.8000      0.169      0.386      0.029      0.000
2.8667      0.170      0.397      0.029      0.000
2.9333      0.172      0.409      0.029      0.000
3.0000      0.173      0.420      0.030      0.000
3.0667      0.175      0.432      0.030      0.000
3.1333      0.177      0.444      0.030      0.000
3.2000      0.178      0.456      0.031      0.000
3.2667      0.180      0.468      0.031      0.000
3.3333      0.181      0.480      0.031      0.000
3.4000      0.183      0.492      0.032      0.000
3.4667      0.185      0.504      0.032      0.000
3.5333      0.186      0.517      0.032      0.000
3.6000      0.188      0.529      0.033      0.000
3.6667      0.190      0.542      0.033      0.000
3.7333      0.191      0.554      0.033      0.000
3.8000      0.193      0.567      0.033      0.000
3.8667      0.195      0.580      0.034      0.000
3.9333      0.196      0.593      0.034      0.000
4.0000      0.198      0.606      0.034      0.000
4.0667      0.200      0.620      0.035      0.000
4.1333      0.202      0.633      0.035      0.000
4.2000      0.203      0.647      0.035      0.000
4.2667      0.205      0.660      0.035      0.000
4.3333      0.207      0.674      0.036      0.000
4.4000      0.208      0.688      0.036      0.000
4.4667      0.210      0.702      0.036      0.000
4.5333      0.212      0.716      0.037      0.000
4.6000      0.214      0.730      0.037      0.000
4.6667      0.216      0.745      0.037      0.000
4.7333      0.217      0.759      0.037      0.000
4.8000      0.219      0.774      0.050      0.000
4.8667      0.221      0.788      0.083      0.000
4.9333      0.223      0.803      0.128      0.000
5.0000      0.225      0.818      0.181      0.000
5.0667      0.226      0.833      0.455      0.000
5.1333      0.228      0.848      0.953      0.000
5.2000      0.230      0.864      1.587      0.000
5.2667      0.232      0.879      2.306      0.000
5.3333      0.234      0.895      3.065      0.000
5.4000      0.236      0.910      3.815      0.000
5.4667      0.237      0.926      4.509      0.000
5.5333      0.239      0.942      5.108      0.000
5.6000      0.241      0.958      5.585      0.000
5.6667      0.243      0.974      5.938      0.000
5.7333      0.245      0.991      6.198      0.000
5.8000      0.247      1.007      6.523      0.000
5.8667      0.249      1.024      6.782      0.000
5.9333      0.251      1.040      7.031      0.000
6.0000      0.253      1.057      7.272      0.000
6.0667      0.255      1.074      7.504      0.000
```

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:3.11
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.45
Total Impervious Area:1.96

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.069286
5 year	0.106062
10 year	0.1325
25 year	0.167993
50 year	0.195829
100 year	0.224787

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.042559
5 year	0.074682
10 year	0.105264
25 year	0.157824
50 year	0.209578
100 year	0.274579

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.038	0.034
1950	0.074	0.039
1951	0.066	0.032
1952	0.051	0.032
1953	0.039	0.028
1954	0.198	0.055
1955	0.102	0.142
1956	0.088	0.182
1957	0.101	0.041
1958	0.071	0.049
1959	0.075	0.036
1960	0.063	0.038
1961	0.066	0.054
1962	0.058	0.033
1963	0.083	0.034
1964	0.059	0.031
1965	0.066	0.037
1966	0.036	0.033
1967	0.081	0.036
1968	0.095	0.040

1969	0.094	0.059
1970	0.052	0.035
1971	0.084	0.136
1972	0.065	0.035
1973	0.053	0.038
1974	0.116	0.045
1975	0.052	0.031
1976	0.050	0.034
1977	0.042	0.031
1978	0.053	0.033
1979	0.115	0.040
1980	0.061	0.033
1981	0.049	0.031
1982	0.063	0.041
1983	0.108	0.041
1984	0.065	0.069
1985	0.093	0.046
1986	0.221	0.387
1987	0.095	0.119
1988	0.052	0.037
1989	0.052	0.028
1990	0.069	0.040
1991	0.073	0.038
1992	0.056	0.038
1993	0.036	0.027
1994	0.034	0.037
1995	0.070	0.041
1996	0.131	0.044
1997	0.249	0.615
1998	0.044	0.034
1999	0.064	0.037
2000	0.038	0.039
2001	0.012	0.023
2002	0.067	0.043
2003	0.049	0.032
2004	0.077	0.043
2005	0.057	0.038
2006	0.168	0.079
2007	0.132	0.045
2008	0.178	0.173
2009	0.056	0.037

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.2490	0.6152
2	0.2212	0.3866
3	0.1976	0.1816
4	0.1783	0.1733
5	0.1677	0.1418
6	0.1318	0.1361
7	0.1310	0.1195
8	0.1161	0.0789
9	0.1154	0.0691
10	0.1078	0.0589
11	0.1016	0.0548

12	0.1011	0.0539
13	0.0952	0.0491
14	0.0948	0.0462
15	0.0938	0.0451
16	0.0932	0.0447
17	0.0883	0.0443
18	0.0841	0.0427
19	0.0833	0.0426
20	0.0813	0.0414
21	0.0771	0.0413
22	0.0754	0.0409
23	0.0737	0.0408
24	0.0734	0.0404
25	0.0715	0.0400
26	0.0702	0.0398
27	0.0690	0.0392
28	0.0673	0.0390
29	0.0664	0.0382
30	0.0662	0.0381
31	0.0659	0.0380
32	0.0655	0.0379
33	0.0649	0.0375
34	0.0641	0.0374
35	0.0634	0.0372
36	0.0630	0.0372
37	0.0605	0.0370
38	0.0588	0.0365
39	0.0575	0.0365
40	0.0567	0.0363
41	0.0560	0.0351
42	0.0559	0.0349
43	0.0531	0.0341
44	0.0526	0.0340
45	0.0524	0.0339
46	0.0523	0.0337
47	0.0520	0.0333
48	0.0520	0.0331
49	0.0507	0.0328
50	0.0501	0.0327
51	0.0490	0.0324
52	0.0489	0.0319
53	0.0443	0.0318
54	0.0419	0.0312
55	0.0390	0.0312
56	0.0382	0.0310
57	0.0377	0.0308
58	0.0365	0.0277
59	0.0360	0.0275
60	0.0341	0.0266
61	0.0116	0.0229

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0346	20674	18873	91	Pass
0.0363	18354	11890	64	Pass
0.0379	16309	6844	41	Pass
0.0395	14429	3978	27	Pass
0.0412	12882	2543	19	Pass
0.0428	11479	2007	17	Pass
0.0444	10243	1741	16	Pass
0.0460	9137	1549	16	Pass
0.0477	8185	1421	17	Pass
0.0493	7272	1319	18	Pass
0.0509	6494	1233	18	Pass
0.0526	5831	1121	19	Pass
0.0542	5251	1010	19	Pass
0.0558	4755	963	20	Pass
0.0574	4295	925	21	Pass
0.0591	3861	895	23	Pass
0.0607	3459	874	25	Pass
0.0623	3067	851	27	Pass
0.0639	2714	830	30	Pass
0.0656	2449	809	33	Pass
0.0672	2209	786	35	Pass
0.0688	2008	760	37	Pass
0.0705	1842	740	40	Pass
0.0721	1707	720	42	Pass
0.0737	1571	694	44	Pass
0.0753	1456	673	46	Pass
0.0770	1362	639	46	Pass
0.0786	1289	601	46	Pass
0.0802	1212	581	47	Pass
0.0819	1145	563	49	Pass
0.0835	1074	548	51	Pass
0.0851	996	532	53	Pass
0.0867	934	517	55	Pass
0.0884	893	507	56	Pass
0.0900	849	499	58	Pass
0.0916	809	484	59	Pass
0.0933	761	474	62	Pass
0.0949	720	467	64	Pass
0.0965	689	458	66	Pass
0.0981	664	452	68	Pass
0.0998	641	439	68	Pass
0.1014	625	432	69	Pass
0.1030	603	416	68	Pass
0.1047	586	406	69	Pass
0.1063	571	397	69	Pass
0.1079	554	383	69	Pass
0.1095	540	376	69	Pass
0.1112	523	367	70	Pass
0.1128	510	361	70	Pass
0.1144	484	345	71	Pass
0.1161	465	334	71	Pass
0.1177	450	320	71	Pass
0.1193	439	306	69	Pass
0.1209	424	293	69	Pass
0.1226	412	283	68	Pass

0.1242	403	274	67	Pass
0.1258	390	264	67	Pass
0.1274	376	255	67	Pass
0.1291	365	245	67	Pass
0.1307	357	236	66	Pass
0.1323	343	229	66	Pass
0.1340	335	222	66	Pass
0.1356	323	216	66	Pass
0.1372	311	208	66	Pass
0.1388	304	202	66	Pass
0.1405	300	194	64	Pass
0.1421	293	186	63	Pass
0.1437	285	179	62	Pass
0.1454	277	172	62	Pass
0.1470	269	170	63	Pass
0.1486	259	166	64	Pass
0.1502	251	159	63	Pass
0.1519	244	158	64	Pass
0.1535	236	152	64	Pass
0.1551	228	148	64	Pass
0.1568	213	141	66	Pass
0.1584	206	136	66	Pass
0.1600	198	133	67	Pass
0.1616	191	130	68	Pass
0.1633	185	126	68	Pass
0.1649	178	125	70	Pass
0.1665	168	119	70	Pass
0.1682	163	115	70	Pass
0.1698	155	113	72	Pass
0.1714	148	108	72	Pass
0.1730	141	105	74	Pass
0.1747	132	100	75	Pass
0.1763	126	98	77	Pass
0.1779	119	96	80	Pass
0.1795	115	90	78	Pass
0.1812	111	87	78	Pass
0.1828	108	85	78	Pass
0.1844	104	81	77	Pass
0.1861	101	81	80	Pass
0.1877	98	79	80	Pass
0.1893	91	78	85	Pass
0.1909	87	75	86	Pass
0.1926	77	72	93	Pass
0.1942	70	71	101	Pass
0.1958	67	70	104	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

```
LID Technique                 Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent       Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
Trapezoidal Pond  1 POC            N     333.65                                       N       0.00
Total Volume Infiltrated                 333.65         0.00      0.00                        0.00
0.00           0%            No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

PIPE VOLUME CALCULATION

TDA-C

9/8/2017

PIPE DIAMETER =	6	LF		
PIPE RADIUS =	3	LF		
DEAD STOR DEPTH =	0.5	LF		
FREEBOARD DEPTH =	0.5	LF		
H AT CENTER OF PIPE =	3	LF		
LENGTH OF PIPE =	794	LF		
LIVE STORAGE VOLUME =	20663	CF		
LIVE STORAGE GOAL =	20657	CF	5% BUMP	
EQUIV. LENGTH OF PIPE =	794	LF	833	LF

	H ABOVE IE (FT)	Y (LF)	X (LF)	TRIANGLE (SF)	SECTOR (SF)	CROSS SECTIONAL A PIPE (SF)
BASE OF LIVE STORAGE	0.50	2.50	1.66	4.15	5.27	1.13
TOP OF LIVE STORAGE	5.50	-2.50	1.66	-4.15	23.00	27.15
					TOTAL LIVE STORAGE CROSS SECTIONAL AREA =	26.02

E-2

Project SPRUCE ES PHASE II
Subject TDA A
With/To
Address
Date 8/1/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. McDONALD

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

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

☐ GIVEN
- ☐ RAN WWHM ON TDA A PHASE II
- ☐ TDA A HAS PIPE ONLY
- ☐ ASSUMED IN WWHM
  - ☐ EXISTING: 70% FLAT, 15% MOD, 15% STEEP
  - ☐ PROPOSED
    - ☐ IMPERV: 80% FLAT, 20% MOD
    - ☐ PERV: 55% FLAT, 40% MOD, 5% STEEP
    - ☐ BYPASS IMPERV: 80% FLAT, 20% MOD
    - ☐ BYPASS PERV: 40% FLAT, 30% MOD, 30% STEEP
- ☐ PIPE DIAMETER: 6 FT

☐ SOLVE
- ☐ PER WWHM REQUIRED VOLUME
  - ☐ LENGTH REQUIRED $\boxed{2150 \text{ LF}}$
- ☐ PIPE DIAMETER @ BOTTOM ORIFICE IS LESS THAN 0.5"
  - ☐ HAD TO REDUCE SIZE TO MAKE WORK
- ☐ WILL PROVIDE WWHM FAILING WITH BOTTOM ORIFICE @ 0.5" AND WORKING AT SMALLER SIZE

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

WWHM2012
PROJECT REPORT

Project Name: Spruce ES -TDA A - Phase II
Site Name: Spruce ES - Phase II - TDA A
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA A Phase II
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	2.64
C, Forest, Mod	.57
C, Forest, Steep	.57
Pervious Total	3.78

Impervious Land Use	acre
Impervious Total	0
Basin Total	3.78

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Phase II TDA A
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Flat	**.57**
C, Pasture, Mod	**.42**
C, Pasture, Steep	**.05**
Pervious Total	**1.04**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**1.74**
DRIVEWAYS MOD	**0.44**
Impervious Total	**2.18**
Basin Total	**3.22**

Element Flows To:

Surface	**Interflow**	**Groundwater**
TDA A - Tank	TDA A - Tank	

Name : Phase II TDA A Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Flat	**.14**
C, Pasture, Mod	**.11**
C, Pasture, Steep	**.11**
Pervious Total	**0.36**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**0.16**
DRIVEWAYS MOD	**0.04**
Impervious Total	**0.2**
Basin Total	**0.56**

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : TDA A - Tank
Tank Name: TDA A - Tank

Dimensions

Depth: 6 ft.

Tank Type : Circular

Diameter : 6 ft.

Length : 2150 ft.

Discharge Structure

Riser Height: 5.5 ft.

Riser Diameter: 18 in.

Orifice 1 Diameter: 0.05 in. **Elevation:** 0.5 ft.

Orifice 2 Diameter: 0.7 in. **Elevation:** 0.75 ft.

Orifice 3 Diameter: 1.5 in. **Elevation:** 4 ft.

Element Flows To:

Outlet 1 **Outlet 2**

Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.0667	0.062	0.002	0.000	0.000
0.1333	0.087	0.007	0.000	0.000
0.2000	0.106	0.014	0.000	0.000
0.2667	0.122	0.021	0.000	0.000
0.3333	0.135	0.030	0.000	0.000
0.4000	0.147	0.040	0.000	0.000
0.4667	0.158	0.050	0.000	0.000
0.5333	0.168	0.061	0.000	0.000
0.6000	0.177	0.072	0.000	0.000
0.6667	0.186	0.084	0.000	0.000
0.7333	0.194	0.097	0.000	0.000
0.8000	0.201	0.110	0.003	0.000
0.8667	0.208	0.124	0.004	0.000
0.9333	0.214	0.138	0.005	0.000
1.0000	0.220	0.152	0.006	0.000
1.0667	0.226	0.167	0.007	0.000
1.1333	0.231	0.183	0.008	0.000
1.2000	0.236	0.198	0.009	0.000
1.2667	0.241	0.214	0.009	0.000
1.3333	0.246	0.230	0.010	0.000
1.4000	0.250	0.247	0.010	0.000
1.4667	0.254	0.264	0.011	0.000
1.5333	0.258	0.281	0.011	0.000
1.6000	0.261	0.298	0.012	0.000
1.6667	0.265	0.316	0.012	0.000
1.7333	0.268	0.334	0.013	0.000
1.8000	0.271	0.352	0.013	0.000
1.8667	0.274	0.370	0.014	0.000
1.9333	0.276	0.388	0.014	0.000
2.0000	0.279	0.407	0.014	0.000
2.0667	0.281	0.425	0.015	0.000
2.1333	0.283	0.444	0.015	0.000
2.2000	0.285	0.463	0.016	0.000
2.2667	0.287	0.482	0.016	0.000

2.3333	0.288	0.502	0.016	0.000
2.4000	0.290	0.521	0.017	0.000
2.4667	0.291	0.540	0.017	0.000
2.5333	0.292	0.560	0.017	0.000
2.6000	0.293	0.579	0.018	0.000
2.6667	0.294	0.599	0.018	0.000
2.7333	0.295	0.618	0.018	0.000
2.8000	0.295	0.638	0.019	0.000
2.8667	0.295	0.658	0.019	0.000
2.9333	0.296	0.678	0.019	0.000
3.0000	0.296	0.697	0.020	0.000
3.0667	0.296	0.717	0.020	0.000
3.1333	0.295	0.737	0.020	0.000
3.2000	0.295	0.757	0.020	0.000
3.2667	0.295	0.776	0.021	0.000
3.3333	0.294	0.796	0.021	0.000
3.4000	0.293	0.815	0.021	0.000
3.4667	0.292	0.835	0.022	0.000
3.5333	0.291	0.854	0.022	0.000
3.6000	0.290	0.874	0.022	0.000
3.6667	0.288	0.893	0.022	0.000
3.7333	0.287	0.912	0.023	0.000
3.8000	0.285	0.931	0.023	0.000
3.8667	0.283	0.950	0.023	0.000
3.9333	0.281	0.969	0.023	0.000
4.0000	0.279	0.988	0.024	0.000
4.0667	0.276	1.006	0.040	0.000
4.1333	0.274	1.025	0.046	0.000
4.2000	0.271	1.043	0.052	0.000
4.2667	0.268	1.061	0.056	0.000
4.3333	0.265	1.079	0.060	0.000
4.4000	0.261	1.096	0.064	0.000
4.4667	0.258	1.114	0.067	0.000
4.5333	0.254	1.131	0.070	0.000
4.6000	0.250	1.148	0.073	0.000
4.6667	0.246	1.164	0.076	0.000
4.7333	0.241	1.180	0.079	0.000
4.8000	0.236	1.196	0.081	0.000
4.8667	0.231	1.212	0.084	0.000
4.9333	0.226	1.227	0.086	0.000
5.0000	0.220	1.242	0.088	0.000
5.0667	0.214	1.257	0.090	0.000
5.1333	0.208	1.271	0.093	0.000
5.2000	0.201	1.284	0.095	0.000
5.2667	0.194	1.298	0.097	0.000
5.3333	0.186	1.310	0.099	0.000
5.4000	0.177	1.322	0.101	0.000
5.4667	0.168	1.334	0.103	0.000
5.5333	0.158	1.345	0.201	0.000
5.6000	0.147	1.355	0.608	0.000
5.6667	0.135	1.365	1.182	0.000
5.7333	0.122	1.373	1.866	0.000
5.8000	0.106	1.381	2.613	0.000
5.8667	0.087	1.387	3.375	0.000
5.9333	0.062	1.392	4.104	0.000
6.0000	0.000	1.395	4.756	0.000
6.0667	0.000	0.000	5.297	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:3.78
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.4
Total Impervious Area:2.38

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.087862
5 year	0.130973
10 year	0.161365
25 year	0.201584
50 year	0.232749
100 year	0.264878

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.112784
5 year	0.160171
10 year	0.198408
25 year	0.255429
50 year	0.304857
100 year	0.360806

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.052	0.113
1950	0.098	0.134
1951	0.079	0.112
1952	0.063	0.101
1953	0.053	0.121
1954	0.215	0.204
1955	0.131	0.155
1956	0.114	0.127
1957	0.127	0.112
1958	0.091	0.234
1959	0.092	0.094
1960	0.084	0.099
1961	0.086	0.300
1962	0.076	0.108
1963	0.100	0.141

1964	0.079	0.083
1965	0.084	0.079
1966	0.047	0.081
1967	0.107	0.183
1968	0.126	0.110
1969	0.115	0.243
1970	0.068	0.092
1971	0.099	0.137
1972	0.086	0.147
1973	0.068	0.118
1974	0.129	0.140
1975	0.068	0.122
1976	0.066	0.091
1977	0.055	0.081
1978	0.068	0.078
1979	0.133	0.150
1980	0.079	0.091
1981	0.064	0.085
1982	0.083	0.083
1983	0.124	0.118
1984	0.084	0.106
1985	0.114	0.149
1986	0.278	0.174
1987	0.122	0.122
1988	0.069	0.094
1989	0.061	0.110
1990	0.088	0.082
1991	0.094	0.088
1992	0.071	0.106
1993	0.049	0.077
1994	0.045	0.077
1995	0.090	0.085
1996	0.165	0.113
1997	0.308	0.645
1998	0.058	0.125
1999	0.081	0.091
2000	0.047	0.190
2001	0.016	0.072
2002	0.086	0.115
2003	0.063	0.085
2004	0.100	0.169
2005	0.074	0.082
2006	0.179	0.170
2007	0.152	0.135
2008	0.233	0.122
2009	0.071	0.096

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3075	0.6455
2	0.2781	0.3002
3	0.2325	0.2428
4	0.2150	0.2343
5	0.1790	0.2036
6	0.1650	0.1900

7	0.1518	0.1828
8	0.1329	0.1736
9	0.1309	0.1702
10	0.1287	0.1693
11	0.1271	0.1547
12	0.1259	0.1498
13	0.1241	0.1492
14	0.1218	0.1475
15	0.1150	0.1407
16	0.1140	0.1404
17	0.1137	0.1375
18	0.1073	0.1351
19	0.1005	0.1344
20	0.1001	0.1274
21	0.0991	0.1246
22	0.0976	0.1222
23	0.0937	0.1222
24	0.0922	0.1216
25	0.0905	0.1208
26	0.0903	0.1184
27	0.0879	0.1176
28	0.0864	0.1155
29	0.0859	0.1132
30	0.0855	0.1132
31	0.0843	0.1125
32	0.0843	0.1116
33	0.0838	0.1099
34	0.0827	0.1098
35	0.0815	0.1079
36	0.0794	0.1061
37	0.0789	0.1058
38	0.0785	0.1008
39	0.0756	0.0986
40	0.0742	0.0961
41	0.0712	0.0945
42	0.0711	0.0941
43	0.0689	0.0916
44	0.0684	0.0915
45	0.0680	0.0914
46	0.0677	0.0907
47	0.0677	0.0879
48	0.0655	0.0854
49	0.0643	0.0851
50	0.0633	0.0846
51	0.0633	0.0833
52	0.0608	0.0833
53	0.0583	0.0824
54	0.0546	0.0823
55	0.0526	0.0814
56	0.0516	0.0814
57	0.0494	0.0786
58	0.0470	0.0784
59	0.0469	0.0773
60	0.0449	0.0768
61	0.0164	0.0725

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0439	20369	17062	83	Pass
0.0458	18296	15379	84	Pass
0.0477	16444	13890	84	Pass
0.0497	14771	12611	85	Pass
0.0516	13246	11447	86	Pass
0.0535	11944	10399	87	Pass
0.0554	10737	9490	88	Pass
0.0573	9730	8658	88	Pass
0.0592	8821	7901	89	Pass
0.0611	7948	7204	90	Pass
0.0630	7120	6566	92	Pass
0.0649	6389	5953	93	Pass
0.0668	5794	5409	93	Pass
0.0687	5238	4934	94	Pass
0.0706	4765	4519	94	Pass
0.0725	4338	4137	95	Pass
0.0744	3944	3786	95	Pass
0.0764	3593	3476	96	Pass
0.0783	3243	3148	97	Pass
0.0802	2900	2847	98	Pass
0.0821	2618	2565	97	Pass
0.0840	2361	2282	96	Pass
0.0859	2150	2032	94	Pass
0.0878	1986	1793	90	Pass
0.0897	1834	1577	85	Pass
0.0916	1674	1398	83	Pass
0.0935	1563	1245	79	Pass
0.0954	1463	1097	74	Pass
0.0973	1371	950	69	Pass
0.0992	1295	820	63	Pass
0.1011	1224	728	59	Pass
0.1031	1156	651	56	Pass
0.1050	1093	588	53	Pass
0.1069	1011	521	51	Pass
0.1088	933	467	50	Pass
0.1107	886	427	48	Pass
0.1126	846	388	45	Pass
0.1145	808	352	43	Pass
0.1164	776	315	40	Pass
0.1183	742	286	38	Pass
0.1202	711	271	38	Pass
0.1221	683	243	35	Pass
0.1240	654	232	35	Pass
0.1259	629	220	34	Pass
0.1279	605	194	32	Pass
0.1298	588	178	30	Pass
0.1317	576	167	28	Pass
0.1336	564	161	28	Pass
0.1355	548	153	27	Pass
0.1374	537	150	27	Pass

0.1393	524	143	27	Pass
0.1412	513	137	26	Pass
0.1431	503	135	26	Pass
0.1450	489	131	26	Pass
0.1469	474	126	26	Pass
0.1488	453	121	26	Pass
0.1507	433	115	26	Pass
0.1526	419	107	25	Pass
0.1546	404	106	26	Pass
0.1565	393	103	26	Pass
0.1584	376	102	27	Pass
0.1603	369	99	26	Pass
0.1622	354	98	27	Pass
0.1641	341	95	27	Pass
0.1660	329	93	28	Pass
0.1679	323	90	27	Pass
0.1698	317	89	28	Pass
0.1717	310	86	27	Pass
0.1736	306	83	27	Pass
0.1755	297	80	26	Pass
0.1774	295	79	26	Pass
0.1793	286	79	27	Pass
0.1813	279	77	27	Pass
0.1832	274	75	27	Pass
0.1851	269	74	27	Pass
0.1870	264	74	28	Pass
0.1889	259	74	28	Pass
0.1908	254	72	28	Pass
0.1927	243	69	28	Pass
0.1946	236	69	29	Pass
0.1965	226	68	30	Pass
0.1984	217	66	30	Pass
0.2003	212	62	29	Pass
0.2022	208	62	29	Pass
0.2041	198	59	29	Pass
0.2060	190	58	30	Pass
0.2080	182	56	30	Pass
0.2099	178	55	30	Pass
0.2118	171	54	31	Pass
0.2137	167	54	32	Pass
0.2156	156	53	33	Pass
0.2175	152	51	33	Pass
0.2194	147	51	34	Pass
0.2213	142	50	35	Pass
0.2232	134	47	35	Pass
0.2251	128	47	36	Pass
0.2270	122	45	36	Pass
0.2289	115	45	39	Pass
0.2308	110	45	40	Pass
0.2327	105	45	42	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

```
LID Technique                 Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent       Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
TDA A - Tank POC                   N     355.56                                        N      0.00
Total Volume Infiltrated                 355.56         0.00      0.00                    0.00
0.00          0%             No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: Spruce ES -TDA A - Phase II
Site Name: Spruce ES - Phase II - TDA A
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA A Phase II
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	2.64
C, Forest, Mod	.57
C, Forest, Steep	.57
Pervious Total	3.78

Impervious Land Use	acre
Impervious Total	0
Basin Total	3.78

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Phase II TDA A
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.57
C, Pasture, Mod	.42
C, Pasture, Steep	.05
Pervious Total	1.04

Impervious Land Use	acre
DRIVEWAYS FLAT	1.74
DRIVEWAYS MOD	0.44
Impervious Total	2.18
Basin Total	3.22

Element Flows To:

Surface	Interflow	Groundwater
TDA A - Tank	TDA A - Tank	

Name : Phase II TDA A Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	acre
C, Pasture, Flat	.14
C, Pasture, Mod	.11
C, Pasture, Steep	.11
Pervious Total	0.36

Impervious Land Use	acre
DRIVEWAYS FLAT	0.16
DRIVEWAYS MOD	0.04
Impervious Total	0.2
Basin Total	0.56

Element Flows To:

Surface	Interflow	Groundwater

Name : TDA A - Tank
Tank Name: TDA A - Tank

Dimensions
Depth: 6 ft.
Tank Type : Circular
Diameter : 6 ft.
Length : 2150 ft.
Discharge Structure
Riser Height: 5.5 ft.
Riser Diameter: 18 in.
Orifice 1 Diameter: 0.5 in. **Elevation:** 0.5 ft.
Orifice 2 Diameter: 0.7 in. **Elevation:** 0.75 ft.
Orifice 3 Diameter: 1.5 in. **Elevation:** 4 ft.

Element Flows To:
Outlet 1 **Outlet 2**

Tank Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.000	0.000	0.000	0.000
0.0667	0.062	0.002	0.000	0.000
0.1333	0.087	0.007	0.000	0.000
0.2000	0.106	0.014	0.000	0.000
0.2667	0.122	0.021	0.000	0.000
0.3333	0.135	0.030	0.000	0.000
0.4000	0.147	0.040	0.000	0.000
0.4667	0.158	0.050	0.000	0.000
0.5333	0.168	0.061	0.001	0.000
0.6000	0.177	0.072	0.002	0.000
0.6667	0.186	0.084	0.002	0.000
0.7333	0.194	0.097	0.003	0.000
0.8000	0.201	0.110	0.006	0.000
0.8667	0.208	0.124	0.008	0.000
0.9333	0.214	0.138	0.010	0.000
1.0000	0.220	0.152	0.011	0.000
1.0667	0.226	0.167	0.012	0.000
1.1333	0.231	0.183	0.013	0.000
1.2000	0.236	0.198	0.014	0.000
1.2667	0.241	0.214	0.015	0.000
1.3333	0.246	0.230	0.016	0.000
1.4000	0.250	0.247	0.017	0.000
1.4667	0.254	0.264	0.017	0.000
1.5333	0.258	0.281	0.018	0.000
1.6000	0.261	0.298	0.019	0.000
1.6667	0.265	0.316	0.020	0.000
1.7333	0.268	0.334	0.020	0.000
1.8000	0.271	0.352	0.021	0.000
1.8667	0.274	0.370	0.022	0.000
1.9333	0.276	0.388	0.022	0.000
2.0000	0.279	0.407	0.023	0.000
2.0667	0.281	0.425	0.023	0.000
2.1333	0.283	0.444	0.024	0.000
2.2000	0.285	0.463	0.024	0.000
2.2667	0.287	0.482	0.025	0.000

2.3333	0.288	0.502	0.025	0.000
2.4000	0.290	0.521	0.026	0.000
2.4667	0.291	0.540	0.026	0.000
2.5333	0.292	0.560	0.027	0.000
2.6000	0.293	0.579	0.027	0.000
2.6667	0.294	0.599	0.028	0.000
2.7333	0.295	0.618	0.028	0.000
2.8000	0.295	0.638	0.029	0.000
2.8667	0.295	0.658	0.029	0.000
2.9333	0.296	0.678	0.030	0.000
3.0000	0.296	0.697	0.030	0.000
3.0667	0.296	0.717	0.031	0.000
3.1333	0.295	0.737	0.031	0.000
3.2000	0.295	0.757	0.032	0.000
3.2667	0.295	0.776	0.032	0.000
3.3333	0.294	0.796	0.032	0.000
3.4000	0.293	0.815	0.033	0.000
3.4667	0.292	0.835	0.033	0.000
3.5333	0.291	0.854	0.034	0.000
3.6000	0.290	0.874	0.034	0.000
3.6667	0.288	0.893	0.034	0.000
3.7333	0.287	0.912	0.035	0.000
3.8000	0.285	0.931	0.035	0.000
3.8667	0.283	0.950	0.035	0.000
3.9333	0.281	0.969	0.036	0.000
4.0000	0.279	0.988	0.036	0.000
4.0667	0.276	1.006	0.052	0.000
4.1333	0.274	1.025	0.059	0.000
4.2000	0.271	1.043	0.065	0.000
4.2667	0.268	1.061	0.069	0.000
4.3333	0.265	1.079	0.073	0.000
4.4000	0.261	1.096	0.077	0.000
4.4667	0.258	1.114	0.080	0.000
4.5333	0.254	1.131	0.084	0.000
4.6000	0.250	1.148	0.087	0.000
4.6667	0.246	1.164	0.090	0.000
4.7333	0.241	1.180	0.092	0.000
4.8000	0.236	1.196	0.095	0.000
4.8667	0.231	1.212	0.098	0.000
4.9333	0.226	1.227	0.100	0.000
5.0000	0.220	1.242	0.102	0.000
5.0667	0.214	1.257	0.105	0.000
5.1333	0.208	1.271	0.107	0.000
5.2000	0.201	1.284	0.109	0.000
5.2667	0.194	1.298	0.111	0.000
5.3333	0.186	1.310	0.113	0.000
5.4000	0.177	1.322	0.115	0.000
5.4667	0.168	1.334	0.117	0.000
5.5333	0.158	1.345	0.216	0.000
5.6000	0.147	1.355	0.624	0.000
5.6667	0.135	1.365	1.198	0.000
5.7333	0.122	1.373	1.881	0.000
5.8000	0.106	1.381	2.628	0.000
5.8667	0.087	1.387	3.390	0.000
5.9333	0.062	1.392	4.119	0.000
6.0000	0.000	1.395	4.771	0.000
6.0667	0.000	0.000	5.313	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:3.78
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:1.4
Total Impervious Area:2.38

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.087862
5 year	0.130973
10 year	0.161365
25 year	0.201584
50 year	0.232749
100 year	0.264878

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.112694
5 year	0.15051
10 year	0.178449
25 year	0.217195
50 year	0.248662
100 year	0.28245

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.052	0.117
1950	0.098	0.138
1951	0.079	0.110
1952	0.063	0.106
1953	0.053	0.123
1954	0.215	0.205
1955	0.131	0.138
1956	0.114	0.118
1957	0.127	0.121
1958	0.091	0.237
1959	0.092	0.094
1960	0.084	0.101
1961	0.086	0.303
1962	0.076	0.108
1963	0.100	0.145

1964	0.079	0.085
1965	0.084	0.077
1966	0.047	0.083
1967	0.107	0.186
1968	0.126	0.116
1969	0.115	0.248
1970	0.068	0.096
1971	0.099	0.122
1972	0.086	0.153
1973	0.068	0.122
1974	0.129	0.144
1975	0.068	0.123
1976	0.066	0.096
1977	0.055	0.086
1978	0.068	0.085
1979	0.133	0.154
1980	0.079	0.097
1981	0.064	0.087
1982	0.083	0.091
1983	0.124	0.121
1984	0.084	0.099
1985	0.114	0.132
1986	0.278	0.158
1987	0.122	0.128
1988	0.069	0.094
1989	0.061	0.113
1990	0.088	0.086
1991	0.094	0.086
1992	0.071	0.104
1993	0.049	0.080
1994	0.045	0.083
1995	0.090	0.081
1996	0.165	0.120
1997	0.308	0.203
1998	0.058	0.127
1999	0.081	0.077
2000	0.047	0.190
2001	0.016	0.076
2002	0.086	0.073
2003	0.063	0.083
2004	0.100	0.174
2005	0.074	0.086
2006	0.179	0.164
2007	0.152	0.140
2008	0.233	0.107
2009	0.071	0.103

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.3075	0.3035
2	0.2781	0.2483
3	0.2325	0.2374
4	0.2150	0.2046
5	0.1790	0.2029
6	0.1650	0.1896

7	0.1518	0.1863
8	0.1329	0.1740
9	0.1309	0.1643
10	0.1287	0.1578
11	0.1271	0.1537
12	0.1259	0.1533
13	0.1241	0.1452
14	0.1218	0.1444
15	0.1150	0.1401
16	0.1140	0.1383
17	0.1137	0.1376
18	0.1073	0.1322
19	0.1005	0.1283
20	0.1001	0.1274
21	0.0991	0.1232
22	0.0976	0.1229
23	0.0937	0.1217
24	0.0922	0.1217
25	0.0905	0.1215
26	0.0903	0.1206
27	0.0879	0.1202
28	0.0864	0.1176
29	0.0859	0.1173
30	0.0855	0.1157
31	0.0843	0.1130
32	0.0843	0.1103
33	0.0838	0.1079
34	0.0827	0.1073
35	0.0815	0.1061
36	0.0794	0.1042
37	0.0789	0.1027
38	0.0785	0.1006
39	0.0756	0.0991
40	0.0742	0.0967
41	0.0712	0.0963
42	0.0711	0.0955
43	0.0689	0.0938
44	0.0684	0.0936
45	0.0680	0.0910
46	0.0677	0.0870
47	0.0677	0.0862
48	0.0655	0.0860
49	0.0643	0.0857
50	0.0633	0.0855
51	0.0633	0.0852
52	0.0608	0.0846
53	0.0583	0.0831
54	0.0546	0.0827
55	0.0526	0.0827
56	0.0516	0.0815
57	0.0494	0.0797
58	0.0470	0.0774
59	0.0469	0.0767
60	0.0449	0.0763
61	0.0164	0.0735

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0439	20369	15201	74	Pass
0.0458	18296	12735	69	Pass
0.0477	16444	10701	65	Pass
0.0497	14771	9022	61	Pass
0.0516	13246	7745	58	Pass
0.0535	11944	6699	56	Pass
0.0554	10737	5835	54	Pass
0.0573	9730	5127	52	Pass
0.0592	8821	4558	51	Pass
0.0611	7948	4057	51	Pass
0.0630	7120	3593	50	Pass
0.0649	6389	3208	50	Pass
0.0668	5794	2883	49	Pass
0.0687	5238	2541	48	Pass
0.0706	4765	2280	47	Pass
0.0725	4338	2052	47	Pass
0.0744	3944	1853	46	Pass
0.0764	3593	1689	47	Pass
0.0783	3243	1534	47	Pass
0.0802	2900	1379	47	Pass
0.0821	2618	1244	47	Pass
0.0840	2361	1121	47	Pass
0.0859	2150	1001	46	Pass
0.0878	1986	895	45	Pass
0.0897	1834	803	43	Pass
0.0916	1674	724	43	Pass
0.0935	1563	662	42	Pass
0.0954	1463	604	41	Pass
0.0973	1371	560	40	Pass
0.0992	1295	520	40	Pass
0.1011	1224	478	39	Pass
0.1031	1156	449	38	Pass
0.1050	1093	427	39	Pass
0.1069	1011	409	40	Pass
0.1088	933	381	40	Pass
0.1107	886	362	40	Pass
0.1126	846	349	41	Pass
0.1145	808	331	40	Pass
0.1164	776	317	40	Pass
0.1183	742	302	40	Pass
0.1202	711	285	40	Pass
0.1221	683	267	39	Pass
0.1240	654	242	37	Pass
0.1259	629	225	35	Pass
0.1279	605	210	34	Pass
0.1298	588	191	32	Pass
0.1317	576	175	30	Pass
0.1336	564	160	28	Pass
0.1355	548	145	26	Pass
0.1374	537	136	25	Pass

0.1393	524	129	24	Pass
0.1412	513	114	22	Pass
0.1431	503	102	20	Pass
0.1450	489	92	18	Pass
0.1469	474	84	17	Pass
0.1488	453	77	16	Pass
0.1507	433	68	15	Pass
0.1526	419	58	13	Pass
0.1546	404	53	13	Pass
0.1565	393	49	12	Pass
0.1584	376	46	12	Pass
0.1603	369	40	10	Pass
0.1622	354	38	10	Pass
0.1641	341	34	9	Pass
0.1660	329	29	8	Pass
0.1679	323	28	8	Pass
0.1698	317	24	7	Pass
0.1717	310	22	7	Pass
0.1736	306	21	6	Pass
0.1755	297	19	6	Pass
0.1774	295	17	5	Pass
0.1793	286	16	5	Pass
0.1813	279	13	4	Pass
0.1832	274	11	4	Pass
0.1851	269	8	2	Pass
0.1870	264	7	2	Pass
0.1889	259	7	2	Pass
0.1908	254	6	2	Pass
0.1927	243	6	2	Pass
0.1946	236	6	2	Pass
0.1965	226	6	2	Pass
0.1984	217	6	2	Pass
0.2003	212	6	2	Pass
0.2022	208	6	2	Pass
0.2041	198	5	2	Pass
0.2060	190	4	2	Pass
0.2080	182	4	2	Pass
0.2099	178	4	2	Pass
0.2118	171	4	2	Pass
0.2137	167	4	2	Pass
0.2156	156	4	2	Pass
0.2175	152	4	2	Pass
0.2194	147	4	2	Pass
0.2213	142	4	2	Pass
0.2232	134	4	2	Pass
0.2251	128	4	3	Pass
0.2270	122	4	3	Pass
0.2289	115	4	3	Pass
0.2308	110	4	3	Pass
0.2327	105	4	3	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

```
LID Technique                 Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent      Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
__________________________________________________________________________________________________
TDA A - Tank POC                  N      355.57                                        N      0.00
Total Volume Infiltrated                 355.57         0.00      0.00                        0.00
0.00          0%           No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

E-3

Project SPRUCE ES PHASE II
Subject TDA B
With/To
Address
Date 8/1/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. McDONALD

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

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

☐ GIVEN
- ☐ RAN WWHM ON TDA B PHASE II
- ☐ TDA B HAS POND ONLY
- ☐ ASSUMED IN WWHM
  - ☐ EXISTING: 80% FLAT 5% MOD, 15% STEEP
  - ☐ PROPOSED:
    - ☐ IMPERV: 80% FLAT 20% MOD
    - ☐ PERV : 60% FLAT, 30% MOD, 10% STEEP
    - ☐ PERV BYPASS: 40% MOD, 60% STEEP
- ☐ POND DEPTH: 6 FT (7 FT W/FREE BOARD)

☐ SOLVE
- ☐ PER WWHM REQUIRED VOLUME
  - VOLUME @ RISER HEAD: 0.3823 ACRE-FT → $\boxed{16653\ FT^3}$

- ☐ VOLUME AVAILABLE IN POND IN TDA B PHASE II
  - ☐ LIVE STORAGE BOTTOM SURFACE AREA: 3382 FT^5
  - ☐ LIVE STORAGE TOP SURFACE AREA: 10192 FT^3
  - ☐ DEPTH: 6 FT (7 FT W/FREEBOARD
  - ☐ USING AVERAGE END AREA TO SOLVE FOR VOLUME

☐ $$\left(\frac{3382+10192}{2}\right)\cdot 6\ FT = \boxed{40722\ FT^3}$$

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

WWHM2012
PROJECT REPORT

Project Name: Spruce ES - Phase II - TDA B
Site Name: Spruce ES Phase II
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA B - Phase II
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	1.44
C, Forest, Mod	.09
C, Forest, Steep	.27
Pervious Total	1.8

Impervious Land Use	acre
Impervious Total	0
Basin Total	1.8

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : TDA B - Phase II
Bypass: No

```
GroundWater: No

Pervious Land Use           acre
 C, Pasture, Flat             .28
 C, Pasture, Mod              .14
 C, Pasture, Steep            .05

Pervious Total                0.47

Impervious Land Use         acre
 DRIVEWAYS FLAT               0.94
 DRIVEWAYS MOD                0.23

Impervious Total              1.17

Basin Total                   1.64
```

```
Element Flows To:
Surface                Interflow                Groundwater
Trapezoidal Pond  1    Trapezoidal Pond  1
```

```
Name   : TDA B - Phase II - Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use           acre
 C, Pasture, Mod              .06
 C, Pasture, Steep            .1

Pervious Total                0.16

Impervious Land Use         acre

Impervious Total              0

Basin Total                   0.16
```

```
Element Flows To:
Surface                Interflow                Groundwater
```

```
Name   : Trapezoidal Pond  1
Bottom Length: 33.13 ft.
Bottom Width: 33.13 ft.
Depth: 7 ft.
Volume at riser head: 0.3823 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: 6 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.160 ft.
Notch Height: 0.229 ft.
Orifice 1 Diameter: 0.573 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	0.025	0.000	0.000	0.000
0.0778	0.025	0.002	0.002	0.000
0.1556	0.026	0.004	0.003	0.000
0.2333	0.027	0.006	0.004	0.000
0.3111	0.028	0.008	0.005	0.000
0.3889	0.028	0.010	0.005	0.000
0.4667	0.029	0.012	0.006	0.000
0.5444	0.030	0.015	0.006	0.000
0.6222	0.031	0.017	0.007	0.000
0.7000	0.032	0.020	0.007	0.000
0.7778	0.032	0.022	0.007	0.000
0.8556	0.033	0.025	0.008	0.000
0.9333	0.034	0.027	0.008	0.000
1.0111	0.035	0.030	0.009	0.000
1.0889	0.036	0.033	0.009	0.000
1.1667	0.037	0.036	0.009	0.000
1.2444	0.037	0.039	0.009	0.000
1.3222	0.038	0.041	0.010	0.000
1.4000	0.039	0.045	0.010	0.000
1.4778	0.040	0.048	0.010	0.000
1.5556	0.041	0.051	0.011	0.000
1.6333	0.042	0.054	0.011	0.000
1.7111	0.043	0.057	0.011	0.000
1.7889	0.044	0.061	0.011	0.000
1.8667	0.045	0.064	0.012	0.000
1.9444	0.046	0.068	0.012	0.000
2.0222	0.047	0.071	0.012	0.000
2.1000	0.048	0.075	0.012	0.000
2.1778	0.049	0.079	0.013	0.000
2.2556	0.050	0.083	0.013	0.000
2.3333	0.051	0.087	0.013	0.000
2.4111	0.052	0.091	0.013	0.000
2.4889	0.053	0.095	0.014	0.000
2.5667	0.054	0.099	0.014	0.000
2.6444	0.055	0.103	0.014	0.000
2.7222	0.056	0.108	0.014	0.000

2.8000	0.057	0.112	0.014	0.000
2.8778	0.058	0.116	0.015	0.000
2.9556	0.059	0.121	0.015	0.000
3.0333	0.060	0.126	0.015	0.000
3.1111	0.061	0.130	0.015	0.000
3.1889	0.062	0.135	0.015	0.000
3.2667	0.063	0.140	0.016	0.000
3.3444	0.065	0.145	0.016	0.000
3.4222	0.066	0.150	0.016	0.000
3.5000	0.067	0.155	0.016	0.000
3.5778	0.068	0.161	0.016	0.000
3.6556	0.069	0.166	0.017	0.000
3.7333	0.070	0.172	0.017	0.000
3.8111	0.072	0.177	0.017	0.000
3.8889	0.073	0.183	0.017	0.000
3.9667	0.074	0.188	0.017	0.000
4.0444	0.075	0.194	0.017	0.000
4.1222	0.076	0.200	0.018	0.000
4.2000	0.078	0.206	0.018	0.000
4.2778	0.079	0.212	0.018	0.000
4.3556	0.080	0.219	0.018	0.000
4.4333	0.081	0.225	0.018	0.000
4.5111	0.083	0.231	0.018	0.000
4.5889	0.084	0.238	0.019	0.000
4.6667	0.085	0.244	0.019	0.000
4.7444	0.087	0.251	0.019	0.000
4.8222	0.088	0.258	0.019	0.000
4.9000	0.089	0.265	0.019	0.000
4.9778	0.091	0.272	0.019	0.000
5.0556	0.092	0.279	0.020	0.000
5.1333	0.093	0.286	0.020	0.000
5.2111	0.095	0.294	0.020	0.000
5.2889	0.096	0.301	0.020	0.000
5.3667	0.098	0.309	0.020	0.000
5.4444	0.099	0.316	0.020	0.000
5.5222	0.100	0.324	0.020	0.000
5.6000	0.102	0.332	0.021	0.000
5.6778	0.103	0.340	0.021	0.000
5.7556	0.105	0.348	0.021	0.000
5.8333	0.106	0.356	0.029	0.000
5.9111	0.108	0.365	0.049	0.000
5.9889	0.109	0.373	0.076	0.000
6.0667	0.111	0.382	0.354	0.000
6.1444	0.112	0.391	0.949	0.000
6.2222	0.114	0.399	1.717	0.000
6.3000	0.115	0.408	2.582	0.000
6.3778	0.117	0.417	3.467	0.000
6.4556	0.118	0.426	4.297	0.000
6.5333	0.120	0.436	5.005	0.000
6.6111	0.121	0.445	5.549	0.000
6.6889	0.123	0.455	5.930	0.000
6.7667	0.124	0.464	6.286	0.000
6.8444	0.126	0.474	6.594	0.000
6.9222	0.128	0.484	6.887	0.000
7.0000	0.129	0.494	7.168	0.000
7.0778	0.131	0.504	7.439	0.000

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:1.8
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.63
Total Impervious Area:1.17

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.04165
5 year	0.06191
10 year	0.076162
25 year	0.094994
50 year	0.109568
100 year	0.124578

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.027988
5 year	0.055314
10 year	0.083833
25 year	0.136929
50 year	0.193067
100 year	0.267814

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.025	0.022
1950	0.046	0.024
1951	0.037	0.020
1952	0.030	0.020
1953	0.025	0.018
1954	0.099	0.037
1955	0.062	0.070
1956	0.054	0.180
1957	0.061	0.027
1958	0.043	0.030
1959	0.044	0.024
1960	0.040	0.024
1961	0.041	0.034
1962	0.036	0.022
1963	0.047	0.023
1964	0.038	0.021

1965	0.040	0.024
1966	0.022	0.020
1967	0.051	0.023
1968	0.060	0.026
1969	0.053	0.042
1970	0.032	0.022
1971	0.047	0.078
1972	0.041	0.023
1973	0.032	0.023
1974	0.060	0.029
1975	0.032	0.020
1976	0.031	0.022
1977	0.026	0.019
1978	0.033	0.021
1979	0.062	0.026
1980	0.037	0.022
1981	0.031	0.020
1982	0.039	0.026
1983	0.058	0.027
1984	0.040	0.078
1985	0.054	0.028
1986	0.132	0.366
1987	0.058	0.164
1988	0.033	0.023
1989	0.028	0.017
1990	0.042	0.025
1991	0.045	0.024
1992	0.034	0.024
1993	0.024	0.018
1994	0.021	0.023
1995	0.043	0.025
1996	0.078	0.029
1997	0.145	0.596
1998	0.028	0.021
1999	0.039	0.023
2000	0.022	0.024
2001	0.008	0.016
2002	0.041	0.025
2003	0.030	0.021
2004	0.048	0.027
2005	0.035	0.024
2006	0.083	0.037
2007	0.071	0.029
2008	0.111	0.283
2009	0.034	0.023

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.1455	0.5957
2	0.1319	0.3659
3	0.1107	0.2835
4	0.0994	0.1801
5	0.0831	0.1642
6	0.0780	0.0782
7	0.0711	0.0778

8	0.0622	0.0700
9	0.0620	0.0419
10	0.0605	0.0373
11	0.0599	0.0366
12	0.0598	0.0338
13	0.0580	0.0300
14	0.0580	0.0293
15	0.0541	0.0288
16	0.0539	0.0286
17	0.0534	0.0278
18	0.0511	0.0271
19	0.0476	0.0271
20	0.0470	0.0270
21	0.0465	0.0264
22	0.0465	0.0264
23	0.0446	0.0261
24	0.0437	0.0254
25	0.0430	0.0254
26	0.0428	0.0249
27	0.0418	0.0243
28	0.0411	0.0242
29	0.0409	0.0239
30	0.0407	0.0239
31	0.0401	0.0238
32	0.0401	0.0237
33	0.0399	0.0237
34	0.0394	0.0235
35	0.0388	0.0234
36	0.0376	0.0233
37	0.0374	0.0232
38	0.0374	0.0232
39	0.0360	0.0231
40	0.0353	0.0230
41	0.0339	0.0228
42	0.0339	0.0227
43	0.0328	0.0217
44	0.0326	0.0217
45	0.0323	0.0216
46	0.0323	0.0216
47	0.0322	0.0216
48	0.0312	0.0208
49	0.0305	0.0208
50	0.0301	0.0208
51	0.0301	0.0206
52	0.0285	0.0204
53	0.0278	0.0203
54	0.0260	0.0203
55	0.0250	0.0202
56	0.0246	0.0199
57	0.0235	0.0194
58	0.0224	0.0181
59	0.0223	0.0176
60	0.0214	0.0173
61	0.0078	0.0156

Stream Protection Duration

POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0208	20585	18923	91	Pass
0.0217	18533	11888	64	Pass
0.0226	16688	7110	42	Pass
0.0235	14987	4502	30	Pass
0.0244	13462	2926	21	Pass
0.0253	12166	2180	17	Pass
0.0262	10934	1728	15	Pass
0.0271	9909	1459	14	Pass
0.0280	8996	1333	14	Pass
0.0289	8147	1205	14	Pass
0.0298	7311	1083	14	Pass
0.0307	6547	1023	15	Pass
0.0316	5942	968	16	Pass
0.0325	5390	923	17	Pass
0.0334	4894	887	18	Pass
0.0343	4455	856	19	Pass
0.0352	4064	834	20	Pass
0.0361	3696	808	21	Pass
0.0370	3347	782	23	Pass
0.0379	3016	755	25	Pass
0.0388	2712	737	27	Pass
0.0396	2451	719	29	Pass
0.0405	2224	704	31	Pass
0.0414	2048	687	33	Pass
0.0423	1892	673	35	Pass
0.0432	1740	657	37	Pass
0.0441	1609	644	40	Pass
0.0450	1512	631	41	Pass
0.0459	1410	620	43	Pass
0.0468	1330	609	45	Pass
0.0477	1255	597	47	Pass
0.0486	1184	587	49	Pass
0.0495	1129	575	50	Pass
0.0504	1050	566	53	Pass
0.0513	966	555	57	Pass
0.0522	907	545	60	Pass
0.0531	867	532	61	Pass
0.0540	828	522	63	Pass
0.0549	794	506	63	Pass
0.0558	764	500	65	Pass
0.0567	728	487	66	Pass
0.0576	698	475	68	Pass
0.0585	674	463	68	Pass
0.0594	644	448	69	Pass
0.0603	619	433	69	Pass
0.0612	601	413	68	Pass
0.0621	584	404	69	Pass
0.0630	570	389	68	Pass
0.0639	558	377	67	Pass
0.0647	545	367	67	Pass
0.0656	532	359	67	Pass

0.0665	519	348	67	Pass
0.0674	510	336	65	Pass
0.0683	501	329	65	Pass
0.0692	488	326	66	Pass
0.0701	469	313	66	Pass
0.0710	447	306	68	Pass
0.0719	428	287	67	Pass
0.0728	416	275	66	Pass
0.0737	402	270	67	Pass
0.0746	388	260	67	Pass
0.0755	376	254	67	Pass
0.0764	366	239	65	Pass
0.0773	354	230	64	Pass
0.0782	336	220	65	Pass
0.0791	327	209	63	Pass
0.0800	323	203	62	Pass
0.0809	316	199	62	Pass
0.0818	310	194	62	Pass
0.0827	306	191	62	Pass
0.0836	297	187	62	Pass
0.0845	294	184	62	Pass
0.0854	286	180	62	Pass
0.0863	279	177	63	Pass
0.0872	274	170	62	Pass
0.0881	270	168	62	Pass
0.0890	264	164	62	Pass
0.0898	261	162	62	Pass
0.0907	254	159	62	Pass
0.0916	243	158	65	Pass
0.0925	236	156	66	Pass
0.0934	227	152	66	Pass
0.0943	220	150	68	Pass
0.0952	213	147	69	Pass
0.0961	208	147	70	Pass
0.0970	200	144	72	Pass
0.0979	191	143	74	Pass
0.0988	183	143	78	Pass
0.0997	178	140	78	Pass
0.1006	172	140	81	Pass
0.1015	167	138	82	Pass
0.1024	159	135	84	Pass
0.1033	153	131	85	Pass
0.1042	149	130	87	Pass
0.1051	143	128	89	Pass
0.1060	136	126	92	Pass
0.1069	130	126	96	Pass
0.1078	124	126	101	Pass
0.1087	118	124	105	Pass
0.1096	112	123	109	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**

Adjusted for 15 min: 0 **cfs.**

LID Report

```
LID Technique                 Used for    Total Volume   Volume    Infiltration  Cumulative
Percent     Water Quality  Percent      Comment
                              Treatment?  Needs          Through   Volume        Volume
Volume                     Water Quality
                                          Treatment      Facility  (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                 Credit
_____________________________________________________________________________________________
Trapezoidal Pond  1 POC             N      187.09                                      N      0.00
Total Volume Infiltrated                   187.09         0.00      0.00                      0.00
0.00          0%             No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes

No changes have been made.

E-4

Project SPRUCE ES PHASE II
Subject TDA C
With/To
Address
Date 8/1/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. McDONALD

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

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

☐ GIVEN
- ☐ RAN WWHM ON TDA C PHASE II
- ☐ TDA C TO HAVE POND AND PIPE INTERCONNECTED
  - ☐ EVENTUALLY WILL NEED STAGE STORAGE TABLE
- ☐ MODELED TDA C AS POND
- ☐ NEED TO DETERMINE PIPE LENGTH
- ☐ ASSUME EXISTING: 90% FLAT, 10% MOD
- ☐ ASSUME DEVELOPED:
  - ☐ BYPASS IMPERV - 100% FLAT
  - ☐ BYPASS PERV - 60% STEEP, 40% MOD
  - ☐ IMPERV - 90% FLAT, 10% MOD
  - ☐ PERV - 85% FLAT, 15% MOD

☐ SOLVE
- ☐ VOLUME AVAILABLE IN POND W/ TDA C - PHASE II
  - ☐ USING CALC FROM PHASE I: $\boxed{14{,}657.5\ FT^3}$
- ☐ VOLUME REQUIRED BY WWHM MODEL - USING POND
  - ☐ VOLUME @ RISER HEAD: 0.7802 ACRE-FT → $\boxed{33985\ FT^3}$
- ☐ VOLUME REMAINING FOR PIPES
  - ☐ $33985\ FT^3 - 14{,}657.5\ FT^3 = \boxed{19327.5\ FT^3}$
- ☐ LENGTH REQUIRE OF 6' Ø PIPE
  - ☐ USING EXCEL CALC SEE ATTACHED
    - ☐ LENGTH REQUIRED: $\boxed{743\ LF}$
    - ☐ 10% BUMP → 817 ≈ $\boxed{820\ LF}$

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

WWHM2012
PROJECT REPORT

Project Name: Spruce ES - Phase II - TDA C
Site Name: Spruce ES - Phase II TDA C
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/2/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : Phase II - TDA c
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Flat	2.7
C, Forest, Mod	.3
Pervious Total	3

Impervious Land Use	acre
Impervious Total	0
Basin Total	3

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : Phase II - TDA C
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Flat	**.51**
C, Pasture, Mod	**.09**

Pervious Total **0.6**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**1.95**
DRIVEWAYS MOD	**0.22**

Impervious Total **2.17**

Basin Total **2.77**

Element Flows To:

Surface	**Interflow**	**Groundwater**
TDA C - Pond	TDA C - Pond	

Name : Phase II - TDA C - Bypass
Bypass: Yes

GroundWater: No

Pervious Land Use	**acre**
C, Pasture, Steep	**.13**
C, Pasture, Mod	**.09**

Pervious Total **0.22**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**0.01**

Impervious Total **0.01**

Basin Total **0.23**

Element Flows To:

Surface	**Interflow**	**Groundwater**

Name : TDA C - Pond
Bottom Length: 66.99 ft.
Bottom Width: 66.99 ft.
Depth: 6 ft.
Volume at riser head: 0.7802 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: 5 ft.
Riser Diameter: 18 in.
Notch Type: Rectangular
Notch Width: 0.001 ft.
Notch Height: 2.170 ft.
Orifice 1 Diameter: 0.726 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	0.103	0.000	0.000	0.000
0.0667	0.104	0.006	0.003	0.000
0.1333	0.105	0.013	0.005	0.000
0.2000	0.106	0.021	0.006	0.000
0.2667	0.108	0.028	0.007	0.000
0.3333	0.109	0.035	0.008	0.000
0.4000	0.110	0.042	0.009	0.000
0.4667	0.111	0.050	0.009	0.000
0.5333	0.113	0.057	0.010	0.000
0.6000	0.114	0.065	0.011	0.000
0.6667	0.115	0.072	0.011	0.000
0.7333	0.117	0.080	0.012	0.000
0.8000	0.118	0.088	0.012	0.000
0.8667	0.119	0.096	0.013	0.000
0.9333	0.121	0.104	0.013	0.000
1.0000	0.122	0.112	0.014	0.000
1.0667	0.123	0.120	0.014	0.000
1.1333	0.125	0.129	0.015	0.000
1.2000	0.126	0.137	0.015	0.000
1.2667	0.127	0.145	0.016	0.000
1.3333	0.129	0.154	0.016	0.000
1.4000	0.130	0.163	0.016	0.000
1.4667	0.131	0.171	0.017	0.000
1.5333	0.133	0.180	0.017	0.000
1.6000	0.134	0.189	0.018	0.000
1.6667	0.136	0.198	0.018	0.000
1.7333	0.137	0.207	0.018	0.000
1.8000	0.138	0.216	0.019	0.000
1.8667	0.140	0.226	0.019	0.000
1.9333	0.141	0.235	0.019	0.000
2.0000	0.143	0.245	0.020	0.000
2.0667	0.144	0.254	0.020	0.000
2.1333	0.146	0.264	0.020	0.000
2.2000	0.147	0.274	0.021	0.000
2.2667	0.149	0.284	0.021	0.000
2.3333	0.150	0.294	0.021	0.000
2.4000	0.152	0.304	0.022	0.000

2.4667	0.153	0.314	0.022	0.000
2.5333	0.155	0.324	0.022	0.000
2.6000	0.156	0.335	0.023	0.000
2.6667	0.158	0.345	0.023	0.000
2.7333	0.159	0.356	0.023	0.000
2.8000	0.161	0.366	0.023	0.000
2.8667	0.162	0.377	0.024	0.000
2.9333	0.164	0.388	0.024	0.000
3.0000	0.165	0.399	0.025	0.000
3.0667	0.167	0.410	0.025	0.000
3.1333	0.169	0.421	0.025	0.000
3.2000	0.170	0.433	0.026	0.000
3.2667	0.172	0.444	0.026	0.000
3.3333	0.173	0.456	0.027	0.000
3.4000	0.175	0.467	0.027	0.000
3.4667	0.176	0.479	0.028	0.000
3.5333	0.178	0.491	0.028	0.000
3.6000	0.180	0.503	0.029	0.000
3.6667	0.181	0.515	0.029	0.000
3.7333	0.183	0.527	0.030	0.000
3.8000	0.185	0.539	0.030	0.000
3.8667	0.186	0.552	0.030	0.000
3.9333	0.188	0.564	0.031	0.000
4.0000	0.190	0.577	0.032	0.000
4.0667	0.191	0.590	0.032	0.000
4.1333	0.193	0.602	0.033	0.000
4.2000	0.195	0.615	0.033	0.000
4.2667	0.196	0.628	0.035	0.000
4.3333	0.198	0.642	0.036	0.000
4.4000	0.200	0.655	0.036	0.000
4.4667	0.201	0.668	0.037	0.000
4.5333	0.203	0.682	0.038	0.000
4.6000	0.205	0.696	0.039	0.000
4.6667	0.207	0.709	0.039	0.000
4.7333	0.208	0.723	0.040	0.000
4.8000	0.210	0.737	0.041	0.000
4.8667	0.212	0.751	0.041	0.000
4.9333	0.214	0.765	0.042	0.000
5.0000	0.216	0.780	0.043	0.000
5.0667	0.217	0.794	0.317	0.000
5.1333	0.219	0.809	0.815	0.000
5.2000	0.221	0.824	1.448	0.000
5.2667	0.223	0.838	2.167	0.000
5.3333	0.225	0.853	2.926	0.000
5.4000	0.226	0.868	3.676	0.000
5.4667	0.228	0.884	4.370	0.000
5.5333	0.230	0.899	4.969	0.000
5.6000	0.232	0.914	5.446	0.000
5.6667	0.234	0.930	5.799	0.000
5.7333	0.236	0.945	6.059	0.000
5.8000	0.237	0.961	6.384	0.000
5.8667	0.239	0.977	6.643	0.000
5.9333	0.241	0.993	6.892	0.000
6.0000	0.243	1.009	7.132	0.000
6.0667	0.245	1.026	7.365	0.000

```
_____________________________________________________________________

                     ANALYSIS RESULTS

                Stream Protection Duration

_____________________________________________________________________

Predeveloped Landuse Totals for POC #1
Total Pervious Area:3
Total Impervious Area:0
_____________________________________________________________________

Mitigated Landuse Totals for POC #1
Total Pervious Area:0.82
Total Impervious Area:2.18
_____________________________________________________________________

Flow Frequency Return Periods for Predeveloped.  POC #1
Return Period          Flow(cfs)
2 year                   0.064612
5 year                   0.095903
10 year                  0.117371
25 year                  0.145099
50 year                  0.166102
100 year                 0.187352

Flow Frequency Return Periods for Mitigated.  POC #1
Return Period          Flow(cfs)
2 year                   0.04467
5 year                   0.093184
10 year                  0.145963
25 year                  0.247867
50 year                  0.35914
100 year                 0.511282
_____________________________________________________________________

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated.  POC #1
Year         Predeveloped    Mitigated
1949            0.036           0.032
1950            0.071           0.039
1951            0.058           0.030
1952            0.046           0.032
1953            0.038           0.027
1954            0.147           0.061
1955            0.097           0.200
1956            0.085           0.357
1957            0.095           0.041
1958            0.064           0.048
1959            0.069           0.034
1960            0.061           0.036
1961            0.064           0.055
1962            0.056           0.030
1963            0.068           0.036
1964            0.057           0.030
1965            0.064           0.035
```

1966	0.035	0.032
1967	0.078	0.034
1968	0.092	0.038
1969	0.071	0.066
1970	0.050	0.034
1971	0.072	0.161
1972	0.063	0.035
1973	0.050	0.040
1974	0.090	0.048
1975	0.051	0.029
1976	0.048	0.032
1977	0.040	0.028
1978	0.050	0.032
1979	0.093	0.043
1980	0.057	0.034
1981	0.046	0.029
1982	0.061	0.042
1983	0.088	0.041
1984	0.063	0.189
1985	0.084	0.052
1986	0.207	0.645
1987	0.091	0.271
1988	0.051	0.040
1989	0.043	0.030
1990	0.067	0.040
1991	0.071	0.038
1992	0.054	0.037
1993	0.035	0.025
1994	0.033	0.037
1995	0.068	0.043
1996	0.119	0.044
1997	0.226	0.991
1998	0.043	0.032
1999	0.062	0.038
2000	0.034	0.043
2001	0.011	0.021
2002	0.065	0.048
2003	0.047	0.031
2004	0.074	0.043
2005	0.055	0.036
2006	0.130	0.065
2007	0.110	0.047
2008	0.172	0.407
2009	0.054	0.037

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.2263	0.9915
2	0.2065	0.6453
3	0.1721	0.4071
4	0.1472	0.3571
5	0.1305	0.2710
6	0.1186	0.2001
7	0.1101	0.1893
8	0.0966	0.1614

9	0.0947	0.0661
10	0.0926	0.0646
11	0.0919	0.0612
12	0.0915	0.0554
13	0.0904	0.0516
14	0.0878	0.0483
15	0.0853	0.0483
16	0.0840	0.0478
17	0.0785	0.0467
18	0.0744	0.0438
19	0.0716	0.0435
20	0.0711	0.0433
21	0.0711	0.0428
22	0.0708	0.0427
23	0.0692	0.0421
24	0.0684	0.0412
25	0.0678	0.0411
26	0.0666	0.0400
27	0.0650	0.0398
28	0.0645	0.0398
29	0.0639	0.0390
30	0.0636	0.0384
31	0.0632	0.0379
32	0.0627	0.0376
33	0.0618	0.0373
34	0.0612	0.0369
35	0.0608	0.0368
36	0.0582	0.0361
37	0.0567	0.0360
38	0.0567	0.0360
39	0.0556	0.0354
40	0.0547	0.0353
41	0.0541	0.0344
42	0.0539	0.0343
43	0.0506	0.0337
44	0.0505	0.0336
45	0.0503	0.0321
46	0.0503	0.0321
47	0.0501	0.0320
48	0.0482	0.0319
49	0.0473	0.0316
50	0.0464	0.0316
51	0.0457	0.0312
52	0.0433	0.0304
53	0.0428	0.0303
54	0.0404	0.0299
55	0.0377	0.0296
56	0.0363	0.0292
57	0.0352	0.0286
58	0.0348	0.0284
59	0.0340	0.0267
60	0.0329	0.0246
61	0.0112	0.0207

Stream Protection Duration
POC #1

The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0323	22415	22629	100	Pass
0.0337	20283	16976	83	Pass
0.0350	18324	13364	72	Pass
0.0364	16525	10970	66	Pass
0.0377	14906	8943	59	Pass
0.0391	13471	7219	53	Pass
0.0404	12228	5593	45	Pass
0.0418	11090	4348	39	Pass
0.0431	9999	3234	32	Pass
0.0445	9105	2436	26	Pass
0.0458	8267	1787	21	Pass
0.0472	7471	1376	18	Pass
0.0485	6757	1057	15	Pass
0.0499	6154	871	14	Pass
0.0512	5608	746	13	Pass
0.0526	5146	680	13	Pass
0.0539	4714	633	13	Pass
0.0553	4327	610	14	Pass
0.0566	3955	587	14	Pass
0.0580	3574	561	15	Pass
0.0593	3253	547	16	Pass
0.0607	2941	537	18	Pass
0.0620	2642	524	19	Pass
0.0634	2425	516	21	Pass
0.0647	2218	507	22	Pass
0.0661	2035	498	24	Pass
0.0674	1891	488	25	Pass
0.0688	1760	479	27	Pass
0.0701	1650	469	28	Pass
0.0715	1533	462	30	Pass
0.0729	1439	454	31	Pass
0.0742	1359	451	33	Pass
0.0756	1290	444	34	Pass
0.0769	1223	438	35	Pass
0.0783	1162	436	37	Pass
0.0796	1110	426	38	Pass
0.0810	1046	421	40	Pass
0.0823	979	413	42	Pass
0.0837	928	408	43	Pass
0.0850	888	401	45	Pass
0.0864	858	394	45	Pass
0.0877	822	387	47	Pass
0.0891	782	382	48	Pass
0.0904	743	370	49	Pass
0.0918	709	359	50	Pass
0.0931	679	352	51	Pass
0.0945	659	348	52	Pass
0.0958	641	345	53	Pass
0.0972	622	341	54	Pass
0.0985	606	338	55	Pass
0.0999	590	332	56	Pass
0.1012	578	331	57	Pass

0.1026	565	328	58	Pass
0.1039	551	322	58	Pass
0.1053	541	319	58	Pass
0.1066	526	316	60	Pass
0.1080	516	314	60	Pass
0.1093	498	313	62	Pass
0.1107	475	311	65	Pass
0.1120	462	310	67	Pass
0.1134	448	305	68	Pass
0.1147	438	301	68	Pass
0.1161	429	299	69	Pass
0.1174	417	298	71	Pass
0.1188	404	292	72	Pass
0.1202	396	290	73	Pass
0.1215	386	285	73	Pass
0.1229	375	279	74	Pass
0.1242	362	277	76	Pass
0.1256	356	273	76	Pass
0.1269	348	266	76	Pass
0.1283	339	262	77	Pass
0.1296	329	252	76	Pass
0.1310	320	249	77	Pass
0.1323	310	248	80	Pass
0.1337	306	244	79	Pass
0.1350	298	238	79	Pass
0.1364	295	234	79	Pass
0.1377	288	230	79	Pass
0.1391	282	224	79	Pass
0.1404	274	220	80	Pass
0.1418	268	217	80	Pass
0.1431	260	213	81	Pass
0.1445	252	209	82	Pass
0.1458	245	208	84	Pass
0.1472	238	204	85	Pass
0.1485	232	202	87	Pass
0.1499	225	197	87	Pass
0.1512	212	193	91	Pass
0.1526	204	191	93	Pass
0.1539	198	188	94	Pass
0.1553	193	182	94	Pass
0.1566	188	178	94	Pass
0.1580	182	175	96	Pass
0.1593	175	173	98	Pass
0.1607	167	171	102	Pass
0.1620	162	168	103	Pass
0.1634	156	163	104	Pass
0.1648	149	159	106	Pass
0.1661	144	153	106	Pass

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

PIPE VOLUME CALCULATION

TDA-C

8/1/2017

PIPE DIAMETER =	6	LF		
PIPE RADIUS =	3	LF		
DEAD STOR DEPTH =	0.5	LF		
FREEBOARD DEPTH =	0.5	LF		
H AT CENTER OF PIPE =	3	LF		
LENGTH OF PIPE =	743	LF		
LIVE STORAGE VOLUME =	19336	CF		
LIVE STORAGE GOAL =	19328	CF	15% BUMP	
EQUIV. LENGTH OF PIPE =	743	LF	817	LF

	H ABOVE IE (FT)	**Y (LF)**	**X (LF)**	**TRIANGLE (SF)**	**SECTOR (SF)**	**CROSS SECTIONAL A PIPE (SF)**
BASE OF LIVE STORAGE	0.50	2.50	1.66	4.15	5.27	1.13
TOP OF LIVE STORAGE	5.50	-2.50	1.66	-4.15	23.00	27.15
					TOTAL LIVE STORAGE CROSS SECTIONAL AREA =	26.02

E-5

Project SPRUCE ES PHASE I
Subject WATER QUALITY
With/To
Address
Date 9/6/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. MCDONALD

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

AHBL

Civil Engineers

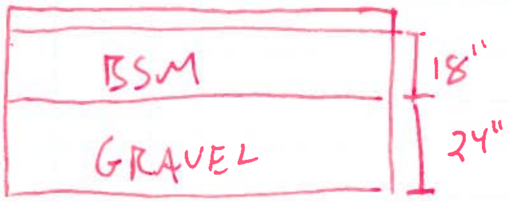
Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

- ☐ SILVA CELL
  - ☐ ASSUMPTIONS
    - ☐ RAN WWHM
    - ☐ NEED WQ TO PASS @ 91%
  - ☐ RESULTS
    - ☐ 11' x 11' - PLAN VIEW
    - ☐ SEE WWHM
    - ☐ PROFILE:



WWHM2012
PROJECT REPORT

Project Name: 20170906-Spruce ES - Silva Cells
Site Name: Spruce ES
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 9/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA C - Predeveloped- Silva Cells
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	.12
Pervious Total	0.12

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.12

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : TDA C - Developed-Silva Cell
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
DRIVEWAYS FLAT	0.12
Impervious Total	0.12
Basin Total	0.12

Element Flows To:

Surface	Interflow	Groundwater
Surface Silva Cell	Surface Silva Cell	

Name : Silva Cell
Bottom Length: 11.00 ft.
Bottom Width: 11.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW
Material thickness of second layer: 2
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.): 6
Flow Through Underdrain (ac-ft.): 17.2
Total Outflow (ac-ft.): 18.73
Percent Through Underdrain: 91.83
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 24 in.

} TYPE 1 CB

Element Flows To:

Outlet 1	Outlet 2

Silva Cell Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0028	0.0000	0.0000	0.0000
0.0495	0.0028	0.0001	0.0000	0.0000
0.0989	0.0028	0.0001	0.0000	0.0000
0.1484	0.0028	0.0002	0.0000	0.0000
0.1978	0.0028	0.0002	0.0000	0.0000
0.2473	0.0028	0.0003	0.0000	0.0000
0.2967	0.0028	0.0003	0.0000	0.0000
0.3462	0.0028	0.0004	0.0000	0.0000

0.3956	0.0028	0.0004	0.0000	0.0000
0.4451	0.0028	0.0005	0.0000	0.0000
0.4945	0.0028	0.0005	0.0000	0.0000
0.5440	0.0028	0.0006	0.0000	0.0000
0.5934	0.0028	0.0007	0.0000	0.0000
0.6429	0.0028	0.0007	0.0000	0.0000
0.6923	0.0028	0.0008	0.0000	0.0000
0.7418	0.0028	0.0008	0.0000	0.0000
0.7912	0.0028	0.0009	0.0000	0.0000
0.8407	0.0028	0.0009	0.0000	0.0000
0.8901	0.0028	0.0010	0.0000	0.0000
0.9396	0.0028	0.0010	0.0000	0.0000
0.9890	0.0028	0.0011	0.0000	0.0000
1.0385	0.0028	0.0011	0.0000	0.0000
1.0879	0.0028	0.0012	0.0003	0.0000
1.1374	0.0028	0.0012	0.0004	0.0000
1.1868	0.0028	0.0013	0.0005	0.0000
1.2363	0.0028	0.0014	0.0006	0.0000
1.2857	0.0028	0.0014	0.0007	0.0000
1.3352	0.0028	0.0015	0.0008	0.0000
1.3846	0.0028	0.0015	0.0009	0.0000
1.4341	0.0028	0.0016	0.0011	0.0000
1.4835	0.0028	0.0016	0.0012	0.0000
1.5330	0.0028	0.0017	0.0014	0.0000
1.5824	0.0028	0.0017	0.0016	0.0000
1.6319	0.0028	0.0018	0.0018	0.0000
1.6813	0.0028	0.0019	0.0020	0.0000
1.7308	0.0028	0.0019	0.0022	0.0000
1.7802	0.0028	0.0020	0.0025	0.0000
1.8297	0.0028	0.0020	0.0027	0.0000
1.8791	0.0028	0.0021	0.0030	0.0000
1.9286	0.0028	0.0021	0.0033	0.0000
1.9780	0.0028	0.0022	0.0036	0.0000
2.0275	0.0028	0.0023	0.0039	0.0000
2.0769	0.0028	0.0023	0.0042	0.0000
2.1264	0.0028	0.0024	0.0042	0.0000
2.1758	0.0028	0.0024	0.0042	0.0000
2.2253	0.0028	0.0025	0.0042	0.0000
2.2747	0.0028	0.0025	0.0042	0.0000
2.3242	0.0028	0.0026	0.0042	0.0000
2.3736	0.0028	0.0027	0.0042	0.0000
2.4231	0.0028	0.0027	0.0042	0.0000
2.4725	0.0028	0.0028	0.0042	0.0000
2.5220	0.0028	0.0028	0.0042	0.0000
2.5714	0.0028	0.0029	0.0042	0.0000
2.6209	0.0028	0.0029	0.0042	0.0000
2.6703	0.0028	0.0030	0.0042	0.0000
2.7198	0.0028	0.0031	0.0042	0.0000
2.7692	0.0028	0.0031	0.0042	0.0000
2.8187	0.0028	0.0032	0.0042	0.0000
2.8681	0.0028	0.0032	0.0042	0.0000
2.9176	0.0028	0.0033	0.0042	0.0000
2.9670	0.0028	0.0033	0.0042	0.0000
3.0165	0.0028	0.0034	0.0042	0.0000
3.0659	0.0028	0.0035	0.0042	0.0000
3.1154	0.0028	0.0035	0.0042	0.0000
3.1648	0.0028	0.0036	0.0042	0.0000

3.2143	0.0028	0.0036	0.0042	0.0000
3.2637	0.0028	0.0037	0.0042	0.0000
3.3132	0.0028	0.0037	0.0042	0.0000
3.3626	0.0028	0.0038	0.0042	0.0000
3.4121	0.0028	0.0039	0.0042	0.0000
3.4615	0.0028	0.0039	0.0042	0.0000
3.5000	0.0028	0.0040	0.0042	0.0000

Surface Silva Cell Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
3.5000	0.0028	0.0040	0.0000	0.0174	0.0000
3.5495	0.0028	0.0041	0.0000	0.0174	0.0000
3.5989	0.0028	0.0042	0.0000	0.0179	0.0000
3.6484	0.0028	0.0044	0.0000	0.0185	0.0000
3.6978	0.0028	0.0045	0.0000	0.0190	0.0000
3.7473	0.0028	0.0046	0.0000	0.0196	0.0000
3.7967	0.0028	0.0048	0.0000	0.0201	0.0000
3.8462	0.0028	0.0049	0.0000	0.0207	0.0000
3.8956	0.0028	0.0051	0.0000	0.0212	0.0000
3.9451	0.0028	0.0052	0.0000	0.0218	0.0000
3.9945	0.0028	0.0053	0.0000	0.0223	0.0000
4.0440	0.0028	0.0055	0.1956	0.0229	0.0000
4.0934	0.0028	0.0056	0.6052	0.0235	0.0000
4.1429	0.0028	0.0057	1.1428	0.0240	0.0000
4.1923	0.0028	0.0059	1.7799	0.0246	0.0000
4.2418	0.0028	0.0060	2.4970	0.0251	0.0000
4.2912	0.0028	0.0062	3.2771	0.0257	0.0000
4.3407	0.0028	0.0063	4.1040	0.0262	0.0000
4.3901	0.0028	0.0064	4.9611	0.0268	0.0000
4.4396	0.0028	0.0066	5.8312	0.0273	0.0000
4.4890	0.0028	0.0067	6.6973	0.0279	0.0000
4.5000	0.0028	0.0067	7.5423	0.0280	0.0000

Name : Surface Silva Cell

Element Flows To:

Outlet 1	**Outlet 2**
Silva Cell	

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.12
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0

Total Impervious Area:0.12

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.002673
5 year	0.004092
10 year	0.005113
25 year	0.006482
50 year	0.007556
100 year	0.008673

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.039649
5 year	0.056655
10 year	0.069355
25 year	0.087106
50 year	0.101608
100 year	0.117244

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.001	0.037
1950	0.003	0.057
1951	0.003	0.046
1952	0.002	0.039
1953	0.002	0.028
1954	0.008	0.049
1955	0.004	0.043
1956	0.003	0.027
1957	0.004	0.047
1958	0.003	0.084
1959	0.003	0.044
1960	0.002	0.037
1961	0.003	0.129
1962	0.002	0.041
1963	0.003	0.070
1964	0.002	0.029
1965	0.003	0.022
1966	0.001	0.022
1967	0.003	0.085
1968	0.004	0.061
1969	0.004	0.074
1970	0.002	0.032
1971	0.003	0.044
1972	0.003	0.075
1973	0.002	0.029
1974	0.004	0.077
1975	0.002	0.036
1976	0.002	0.040
1977	0.002	0.032
1978	0.002	0.028
1979	0.004	0.069
1980	0.002	0.024

```
1981           0.002          0.038
1982           0.002          0.036
1983           0.004          0.037
1984           0.003          0.028
1985           0.004          0.052
1986           0.009          0.046
1987           0.004          0.063
1988           0.002          0.029
1989           0.002          0.022
1990           0.003          0.026
1991           0.003          0.035
1992           0.002          0.034
1993           0.001          0.031
1994           0.001          0.023
1995           0.003          0.036
1996           0.005          0.044
1997           0.010          0.059
1998           0.002          0.048
1999           0.002          0.032
2000           0.001          0.063
2001           0.000          0.028
2002           0.003          0.023
2003           0.002          0.033
2004           0.003          0.093
2005           0.002          0.037
2006           0.006          0.036
2007           0.005          0.051
2008           0.007          0.041
2009           0.002          0.027
```

```
Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated.  POC #1
Rank      Predeveloped        Mitigated
1          0.0096              0.1291
2          0.0085              0.0926
3          0.0076              0.0849
4          0.0069              0.0840
5          0.0065              0.0766
6          0.0051              0.0755
7          0.0051              0.0736
8          0.0045              0.0704
9          0.0045              0.0686
10         0.0042              0.0634
11         0.0039              0.0626
12         0.0039              0.0610
13         0.0037              0.0591
14         0.0037              0.0568
15         0.0036              0.0521
16         0.0036              0.0514
17         0.0034              0.0491
18         0.0032              0.0482
19         0.0032              0.0470
20         0.0031              0.0462
21         0.0030              0.0458
22         0.0029              0.0444
23         0.0028              0.0443
```

24	0.0028	0.0441
25	0.0028	0.0427
26	0.0027	0.0413
27	0.0027	0.0407
28	0.0026	0.0405
29	0.0026	0.0391
30	0.0026	0.0376
31	0.0025	0.0372
32	0.0025	0.0371
33	0.0025	0.0367
34	0.0025	0.0366
35	0.0024	0.0365
36	0.0024	0.0363
37	0.0023	0.0362
38	0.0023	0.0355
39	0.0022	0.0353
40	0.0022	0.0342
41	0.0022	0.0330
42	0.0022	0.0319
43	0.0020	0.0318
44	0.0020	0.0316
45	0.0020	0.0311
46	0.0020	0.0292
47	0.0020	0.0291
48	0.0020	0.0287
49	0.0020	0.0285
50	0.0019	0.0283
51	0.0019	0.0282
52	0.0019	0.0275
53	0.0017	0.0274
54	0.0016	0.0273
55	0.0015	0.0260
56	0.0015	0.0238
57	0.0015	0.0229
58	0.0014	0.0226
59	0.0014	0.0223
60	0.0013	0.0218
61	0.0004	0.0217

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0013	20668	18587	89	Pass
0.0014	18360	11308	61	Pass
0.0015	16294	8066	49	Pass
0.0015	14429	6278	43	Pass
0.0016	12876	5204	40	Pass
0.0017	11486	4483	39	Pass
0.0017	10243	3998	39	Pass
0.0018	9133	3670	40	Pass
0.0018	8185	3339	40	Pass
0.0019	7270	3093	42	Pass

0.0020	6498	2851	43	Pass
0.0020	5831	2684	46	Pass
0.0021	5251	2509	47	Pass
0.0022	4753	2374	49	Pass
0.0022	4295	2160	50	Pass
0.0023	3863	2060	53	Pass
0.0023	3459	1950	56	Pass
0.0024	3069	1868	60	Pass
0.0025	2714	1775	65	Pass
0.0025	2449	1689	68	Pass
0.0026	2209	1622	73	Pass
0.0027	2008	1552	77	Pass
0.0027	1844	1486	80	Pass
0.0028	1707	1419	83	Pass
0.0028	1569	1360	86	Pass
0.0029	1456	1308	89	Pass
0.0030	1362	1241	91	Pass
0.0030	1291	1178	91	Pass
0.0031	1212	1134	93	Pass
0.0032	1145	1088	95	Pass
0.0032	1074	1050	97	Pass
0.0033	996	996	100	Pass
0.0033	934	952	101	Pass
0.0034	893	913	102	Pass
0.0035	849	882	103	Pass
0.0035	809	842	104	Pass
0.0036	761	792	104	Pass
0.0037	720	756	104	Pass
0.0037	689	724	105	Pass
0.0038	664	697	104	Pass
0.0038	641	672	104	Pass
0.0039	623	648	104	Pass
0.0040	603	620	102	Pass
0.0040	586	597	101	Pass
0.0041	570	579	101	Pass
0.0042	554	561	101	Pass
0.0042	540	545	100	Pass
0.0043	524	524	100	Pass
0.0044	510	506	99	Pass
0.0044	484	490	101	Pass
0.0045	466	476	102	Pass
0.0045	450	449	99	Pass
0.0046	439	429	97	Pass
0.0047	424	408	96	Pass
0.0047	412	385	93	Pass
0.0048	403	359	89	Pass
0.0049	390	345	88	Pass
0.0049	376	330	87	Pass
0.0050	365	318	87	Pass
0.0050	357	307	85	Pass
0.0051	343	298	86	Pass
0.0052	335	287	85	Pass
0.0052	323	281	86	Pass
0.0053	311	271	87	Pass
0.0054	304	264	86	Pass
0.0054	300	258	86	Pass
0.0055	293	253	86	Pass

```
0.0055     285      245      85      Pass
0.0056     277      237      85      Pass
0.0057     268      233      86      Pass
0.0057     259      225      86      Pass
0.0058     251      217      86      Pass
0.0059     243      207      85      Pass
0.0059     236      203      86      Pass
0.0060     229      196      85      Pass
0.0060     213      190      89      Pass
0.0061     206      181      87      Pass
0.0062     198      176      88      Pass
0.0062     191      174      91      Pass
0.0063     185      170      91      Pass
0.0064     178      168      94      Pass
0.0064     168      164      97      Pass
0.0065     163      161      98      Pass
0.0066     155      158      101     Pass
0.0066     148      151      102     Pass
0.0067     141      144      102     Pass
0.0067     132      137      103     Pass
0.0068     126      133      105     Pass
0.0069     120      130      108     Pass
0.0069     115      125      108     Pass
0.0070     110      119      108     Pass
0.0071     108      112      103     Pass
0.0071     104      107      102     Pass
0.0072     101      105      103     Pass
0.0072     98       96       97      Pass
0.0073     92       93       101     Pass
0.0074     86       89       103     Pass
0.0074     77       83       107     Pass
0.0075     70       75       107     Pass
0.0076     67       70       104     Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

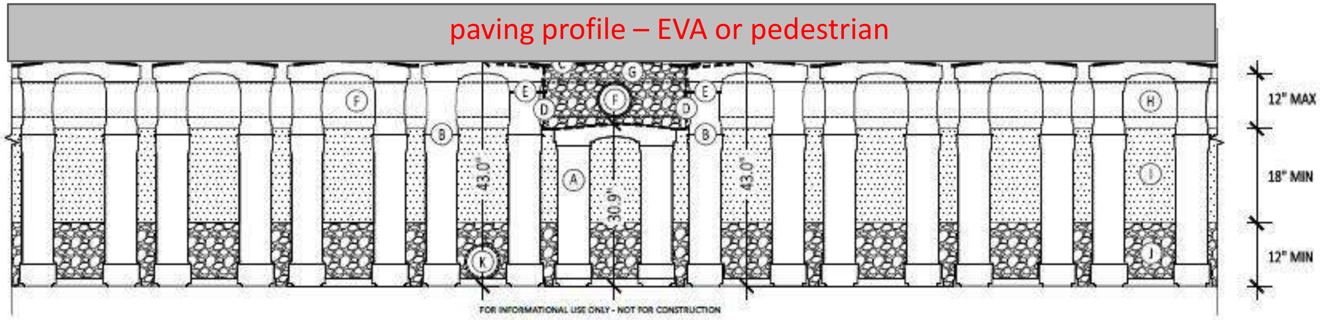
LID Report

```
LID Technique                  Used for    Total Volume   Volume     Infiltration  Cumulative
Percent     Water Quality  Percent        Comment
                               Treatment?  Needs          Through    Volume        Volume
Volume                     Water Quality
                                           Treatment      Facility   (ac-ft.)       Infiltration
Infiltrated                Treated
                                          (ac-ft)        (ac-ft)                   Credit
Silva Cell POC                     N      17.04                                          N      0.00
Total Volume Infiltrated                  17.04          0.00       0.00                        0.00
0.00        0%               No Treat. Credit
Compliance with LID Standard 8
Duration Analysis Result = Passed
```

Perlnd and Implnd Changes
No changes have been made.

deeproot

Typical Details:



2
CB2
BIORETENTION APPLICATION | STORM.xCB | TYPICAL DISTRIBUTION PIPE DETAIL
NOT TO SCALE

KEY PLAN

Ⓐ 2x SILVA CELL SYSTEM (DECK, BASE, AND POSTS) 30.9"
Ⓑ 3x SILVA CELL SYSTEM (DECK, BASE, AND POSTS) 43.0"
Ⓒ GEOTEXTILE FABRIC
Ⓓ GEOGRID. ATTACH TO CELL FRAMES WITH CABLE TIES.
Ⓔ CABLE TIE, ATTACHING GEOGRID TO SILVA CELL LEG
Ⓕ DISTRIBUTION PIPE ASSEMBLY PER ENGINEER
Ⓖ CLEAR STONE AGGREGATE PER ENGINEER
Ⓗ AVAILABLE PONDING DEPTH
Ⓘ 18" BIORETENTION MEDIA
Ⓙ 12" MINIMUM GRAVEL
Ⓚ UNDERDRAIN; SIZING AND ELEVATION PER ENGINEER

NOTES

1. DETAIL TO BE USED IN CONJUNCTION WITH SILVA CELL STANDARD DETAILS, IN ACCORDANCE WITH ALL MANUFACTURER'S SPECIFICATIONS
2. DEEPROOT ACCEPTS NO LIABILITY FOR PROJECT APPLICATION OF DETAILS SHOWN

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47600 • Olympia, WA 98504-7600 • 360-407-6000
711 for Washington Relay Service • Persons with a speech disability can call 877-833-6341

May 14, 2013

Brenda Guglielmina
DeepRoot Partners
530 Washington Street
San Francisco, CA 94111

RE: Silva Cells for Stormwater Runoff Filtration

Dear Ms. Guglielmina:

The Washington State Department of Ecology (Ecology) finds the Silva Cells functionally equivalent to a bioretention facility. The media specifications for Silva Cells must adhere to the guidelines for Bioretention areas, found in Appendix C, Volume III, in the 2005 Stormwater Management Manual for Western Washington (SWMMWW); or BMP T7.30 in the 2012 SWMMWW. The sizing procedure must also adhere to the procedure outlined in the Bioretention area of the manuals mentioned above or the procedure DeepRoot submitted to Ecology for design of the Silva Cells using WWHM dated March 2013.

Contractors may use the Silva Cells BMP at project sites without seeking additional Ecology approval though Ecology cannot endorse this product or its manufacturer. Manufacturer installation recommendations must be followed.

For more information, contact Doug Howie at douglas.howie@ecy.wa.gov, or (360) 407-6444.

Sincerely

Douglas C. Howie, P.E.
Stormwater Engineer
Program Development Services
Water Quality Program

cc: Kathleen Emmett, Ecology
Ed O'Brien, Ecology

E-6

Project SPRUCE ES PHASE I
Subject CAVFS
With/To
Address
Date 9/6/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. MCDONALD

☐ Page ____ of ____
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AHBL

Civil Engineers

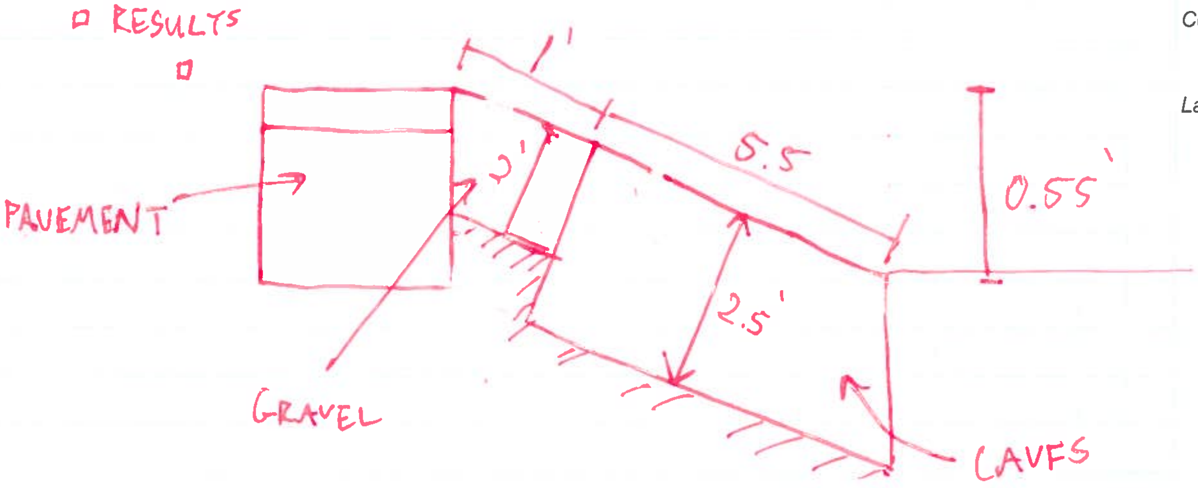
Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

☐ CAVFS
- ☐ GIVEN
  - ☐ RUN WWHM
  - ☐ NEED WQ TO PASS @ 91%
- ☐ RESULTS
  - ☐



WWHM2012
PROJECT REPORT

Project Name: 20170906-Spruce ES - CAVFS
Site Name: Spruce ES
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 9/6/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA C - Predeveloped- CAVFS
Bypass: No

GroundWater: No

Pervious Land Use	acre
C, Forest, Mod	.43
Pervious Total	0.43

Impervious Land Use	acre
Impervious Total	0
Basin Total	0.43

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : TDA C - Developed-CAVFS
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
DRIVEWAYS FLAT	0.43
Impervious Total	0.43
Basin Total	0.43

Element Flows To:

Surface	Interflow	Groundwater
SPRUCE ES SurfaceS	SPRUCE ES SurfaceS	

Name : SPRUCE ES - CAVFS
CAVFS Length: 315.00 ft.
CAVFS Width: 5.50 ft.
Gravel thickness: 2
Material thickness of CAVFS layer: 2.5
Slope of CAVFS layer: 0.1
Outlet Control
Overflow Height: 0.5 ft.
Overflow width: 157.5 in.

Element Flows To:

Outlet 1	Outlet 2

SPRUCE ES - CAVFS Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0181	0.0000	0.0000	0.0000
0.0890	0.0181	0.0007	0.0000	0.0000
0.1780	0.0181	0.0013	0.0000	0.0000
0.2670	0.0181	0.0020	0.0000	0.0000
0.3560	0.0181	0.0027	0.0000	0.0000
0.4451	0.0181	0.0033	0.0000	0.0000
0.5341	0.0181	0.0040	0.0000	0.0000
0.6231	0.0181	0.0047	0.0000	0.0000
0.7121	0.0181	0.0053	0.0000	0.0000
0.8011	0.0181	0.0060	0.0000	0.0000
0.8901	0.0181	0.0067	0.0000	0.0000
0.9791	0.0181	0.0073	0.0000	0.0000
1.0681	0.0181	0.0080	0.0000	0.0000
1.1571	0.0181	0.0087	0.0001	0.0000
1.2462	0.0181	0.0093	0.0001	0.0000
1.3352	0.0181	0.0100	0.0001	0.0000
1.4242	0.0181	0.0107	0.0001	0.0000
1.5132	0.0181	0.0114	0.0002	0.0000

1.6022	0.0181	0.0120	0.0002	0.0000
1.6912	0.0181	0.0127	0.0002	0.0000
1.7802	0.0181	0.0134	0.0003	0.0000
1.8692	0.0181	0.0140	0.0004	0.0000
1.9582	0.0181	0.0147	0.0004	0.0000
2.0473	0.0181	0.0153	0.0005	0.0000
2.1363	0.0181	0.0160	0.0005	0.0000
2.2253	0.0181	0.0166	0.0006	0.0000
2.3143	0.0181	0.0172	0.0007	0.0000
2.4033	0.0181	0.0179	0.0008	0.0000
2.4923	0.0181	0.0185	0.0009	0.0000
2.5813	0.0181	0.0191	0.0010	0.0000
2.6703	0.0181	0.0198	0.0011	0.0000
2.7593	0.0181	0.0204	0.0012	0.0000
2.8484	0.0181	0.0210	0.0014	0.0000
2.9374	0.0181	0.0217	0.0015	0.0000
3.0264	0.0181	0.0223	0.0016	0.0000
3.1154	0.0181	0.0230	0.0018	0.0000
3.2044	0.0181	0.0236	0.0019	0.0000
3.2934	0.0181	0.0242	0.0021	0.0000
3.3824	0.0181	0.0249	0.0023	0.0000
3.4714	0.0181	0.0255	0.0024	0.0000
3.5604	0.0181	0.0261	0.0026	0.0000
3.6495	0.0181	0.0268	0.0028	0.0000
3.7385	0.0181	0.0274	0.0030	0.0000
3.8275	0.0181	0.0280	0.0032	0.0000
3.9165	0.0181	0.0287	0.0035	0.0000
4.0055	0.0181	0.0293	0.0037	0.0000
4.0945	0.0181	0.0299	0.0039	0.0000
4.1835	0.0181	0.0306	0.0042	0.0000
4.2725	0.0181	0.0312	0.0044	0.0000
4.3615	0.0181	0.0319	0.0047	0.0000
4.4505	0.0181	0.0325	0.0050	0.0000
4.5396	0.0181	0.0331	0.0052	0.0000
4.6286	0.0181	0.0338	0.0055	0.0000
4.7176	0.0181	0.0344	0.0058	0.0000
4.8066	0.0181	0.0350	0.0062	0.0000
4.8956	0.0181	0.0357	0.0065	0.0000
4.9846	0.0181	0.0363	0.0068	0.0000
5.0736	0.0181	0.0369	0.0072	0.0000
5.1626	0.0181	0.0376	0.0075	0.0000
5.2516	0.0181	0.0382	0.0079	0.0000
5.3407	0.0181	0.0388	0.0082	0.0000
5.4297	0.0181	0.0395	0.0086	0.0000
5.5187	0.0181	0.0401	0.0090	0.0000
5.6077	0.0181	0.0408	0.0094	0.0000
5.6967	0.0181	0.0414	0.0098	0.0000
5.7857	0.0181	0.0420	0.0103	0.0000
5.8747	0.0181	0.0427	0.0107	0.0000
5.9637	0.0181	0.0433	0.0111	0.0000
6.0527	0.0181	0.0439	0.0361	0.0000
6.1418	0.0181	0.0446	0.0361	0.0000
6.2308	0.0181	0.0452	0.0361	0.0000
6.3198	0.0181	0.0458	0.0361	0.0000
6.4088	0.0181	0.0465	0.0361	0.0000
6.4978	0.0181	0.0471	0.0361	0.0000
6.5868	0.0181	0.0477	0.0361	0.0000

6.6758	0.0181	0.0484	0.0361	0.0000
6.7648	0.0181	0.0490	0.0361	0.0000
6.8538	0.0181	0.0497	0.0361	0.0000
6.9429	0.0181	0.0503	0.0361	0.0000
7.0319	0.0181	0.0509	0.0361	0.0000
7.1209	0.0181	0.0516	0.0361	0.0000
7.2099	0.0181	0.0522	0.0361	0.0000
7.2989	0.0181	0.0528	0.0361	0.0000
7.3879	0.0181	0.0535	0.0361	0.0000
7.4769	0.0181	0.0541	0.0361	0.0000
7.5000	0.0181	0.0543	0.0361	0.0000

SPRUCE ES SurfaceS Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	To Amended(cfs)	Wetted Surface
7.5000	0.0181	0.0543	0.0000	0.0361	0.0000
7.5890	0.0181	0.0559	0.0000	0.0361	0.0000
7.6780	0.0181	0.0575	0.0000	0.0361	0.0000
7.7670	0.0181	0.0591	0.0000	0.0361	0.0000
7.8560	0.0181	0.0607	0.0000	0.0361	0.0000
7.9451	0.0181	0.0623	0.0000	0.0361	0.0000
8.0341	0.0181	0.0639	0.0000	0.0361	0.0000
8.1000	0.0181	0.0651	0.0000	0.0361	0.0000

Name : SPRUCE ES SurfaceS

Element Flows To:

Outlet 1	**Outlet 2**
SPRUCE ES - CAVFS	

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0.43
Total Impervious Area:0

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.43

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.00958
5 year	0.014664
10 year	0.01832
25 year	0.023227
50 year	0.027076

100 year	0.03108

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.159391
5 year	0.225782
10 year	0.276079
25 year	0.347256
50 year	0.406089
100 year	0.470138

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.005	0.161
1950	0.010	0.195
1951	0.009	0.191
1952	0.007	0.146
1953	0.005	0.201
1954	0.027	0.261
1955	0.014	0.189
1956	0.012	0.091
1957	0.014	0.171
1958	0.010	0.400
1959	0.010	0.143
1960	0.009	0.137
1961	0.009	0.523
1962	0.008	0.181
1963	0.012	0.211
1964	0.008	0.099
1965	0.009	0.121
1966	0.005	0.123
1967	0.011	0.347
1968	0.013	0.174
1969	0.013	0.353
1970	0.007	0.122
1971	0.012	0.179
1972	0.009	0.241
1973	0.007	0.190
1974	0.016	0.244
1975	0.007	0.182
1976	0.007	0.152
1977	0.006	0.120
1978	0.007	0.093
1979	0.016	0.227
1980	0.008	0.106
1981	0.007	0.118
1982	0.009	0.124
1983	0.015	0.169
1984	0.009	0.154
1985	0.013	0.233
1986	0.031	0.216
1987	0.013	0.198
1988	0.007	0.136
1989	0.007	0.152
1990	0.010	0.110

```
1991            0.010           0.144
1992            0.008           0.142
1993            0.005           0.107
1994            0.005           0.106
1995            0.010           0.109
1996            0.018           0.164
1997            0.034           0.216
1998            0.006           0.213
1999            0.009           0.085
2000            0.005           0.357
2001            0.002           0.105
2002            0.009           0.094
2003            0.007           0.140
2004            0.011           0.310
2005            0.008           0.123
2006            0.023           0.158
2007            0.018           0.168
2008            0.025           0.149
2009            0.008           0.129
```

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

```
Rank      Predeveloped        Mitigated
1           0.0344              0.5233
2           0.0306              0.3997
3           0.0273              0.3573
4           0.0247              0.3532
5           0.0232              0.3466
6           0.0182              0.3102
7           0.0181              0.2607
8           0.0160              0.2435
9           0.0160              0.2410
10          0.0149              0.2333
11          0.0140              0.2267
12          0.0140              0.2159
13          0.0132              0.2155
14          0.0131              0.2128
15          0.0130              0.2109
16          0.0129              0.2008
17          0.0122              0.1979
18          0.0116              0.1945
19          0.0115              0.1907
20          0.0112              0.1902
21          0.0107              0.1887
22          0.0104              0.1824
23          0.0102              0.1812
24          0.0101              0.1788
25          0.0099              0.1745
26          0.0097              0.1707
27          0.0095              0.1694
28          0.0093              0.1676
29          0.0092              0.1638
30          0.0092              0.1609
31          0.0091              0.1578
32          0.0091              0.1542
33          0.0090              0.1518
```

```
34          0.0089                  0.1516
35          0.0088                  0.1492
36          0.0087                  0.1462
37          0.0084                  0.1444
38          0.0081                  0.1431
39          0.0080                  0.1425
40          0.0078                  0.1401
41          0.0077                  0.1372
42          0.0077                  0.1357
43          0.0073                  0.1290
44          0.0073                  0.1244
45          0.0072                  0.1231
46          0.0072                  0.1229
47          0.0072                  0.1216
48          0.0072                  0.1211
49          0.0070                  0.1201
50          0.0069                  0.1184
51          0.0068                  0.1101
52          0.0068                  0.1092
53          0.0061                  0.1071
54          0.0058                  0.1065
55          0.0054                  0.1059
56          0.0053                  0.1053
57          0.0052                  0.0987
58          0.0050                  0.0939
59          0.0050                  0.0926
60          0.0047                  0.0914
61          0.0016                  0.0848
```

```
Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs) Predev  Mit Percentage Pass/Fail
0.0048    20668   18587  89      Pass
0.0050    18360   11308  61      Pass
0.0052    16294   8066   49      Pass
0.0055    14429   6278   43      Pass
0.0057    12876   5204   40      Pass
0.0059    11486   4483   39      Pass
0.0061    10243   3998   39      Pass
0.0064    9133    3670   40      Pass
0.0066    8185    3339   40      Pass
0.0068    7270    3093   42      Pass
0.0070    6498    2851   43      Pass
0.0073    5831    2684   46      Pass
0.0075    5251    2509   47      Pass
0.0077    4753    2374   49      Pass
0.0079    4295    2160   50      Pass
0.0082    3863    2060   53      Pass
0.0084    3459    1950   56      Pass
0.0086    3069    1868   60      Pass
0.0088    2714    1775   65      Pass
0.0091    2449    1689   68      Pass
```

0.0093	2209	1622	73	Pass
0.0095	2008	1552	77	Pass
0.0097	1844	1486	80	Pass
0.0100	1707	1419	83	Pass
0.0102	1569	1360	86	Pass
0.0104	1456	1308	89	Pass
0.0106	1362	1241	91	Pass
0.0109	1291	1178	91	Pass
0.0111	1212	1134	93	Pass
0.0113	1145	1088	95	Pass
0.0115	1074	1050	97	Pass
0.0118	996	996	100	Pass
0.0120	934	952	101	Pass
0.0122	893	913	102	Pass
0.0124	849	882	103	Pass
0.0127	809	842	104	Pass
0.0129	761	792	104	Pass
0.0131	720	756	104	Pass
0.0133	689	724	105	Pass
0.0136	664	697	104	Pass
0.0138	641	672	104	Pass
0.0140	623	648	104	Pass
0.0142	603	620	102	Pass
0.0145	586	597	101	Pass
0.0147	570	579	101	Pass
0.0149	554	561	101	Pass
0.0151	540	545	100	Pass
0.0154	524	524	100	Pass
0.0156	510	506	99	Pass
0.0158	484	490	101	Pass
0.0160	466	476	102	Pass
0.0163	450	449	99	Pass
0.0165	439	429	97	Pass
0.0167	424	408	96	Pass
0.0169	412	385	93	Pass
0.0172	403	359	89	Pass
0.0174	390	345	88	Pass
0.0176	376	330	87	Pass
0.0178	365	318	87	Pass
0.0181	357	307	85	Pass
0.0183	343	298	86	Pass
0.0185	335	287	85	Pass
0.0187	323	281	86	Pass
0.0190	311	271	87	Pass
0.0192	304	264	86	Pass
0.0194	300	258	86	Pass
0.0196	293	253	86	Pass
0.0199	285	245	85	Pass
0.0201	277	237	85	Pass
0.0203	268	233	86	Pass
0.0205	259	225	86	Pass
0.0208	251	217	86	Pass
0.0210	243	207	85	Pass
0.0212	236	203	86	Pass
0.0214	229	196	85	Pass
0.0217	213	190	89	Pass
0.0219	206	181	87	Pass

```
0.0221    198      176     88       Pass
0.0223    191      174     91       Pass
0.0226    185      170     91       Pass
0.0228    178      168     94       Pass
0.0230    168      164     97       Pass
0.0232    163      161     98       Pass
0.0235    155      158     101      Pass
0.0237    148      151     102      Pass
0.0239    141      144     102      Pass
0.0241    132      137     103      Pass
0.0244    126      133     105      Pass
0.0246    120      130     108      Pass
0.0248    115      125     108      Pass
0.0251    110      119     108      Pass
0.0253    108      112     103      Pass
0.0255    104      107     102      Pass
0.0257    101      105     103      Pass
0.0260    98       96      97       Pass
0.0262    92       93      101      Pass
0.0264    86       89      103      Pass
0.0266    77       83      107      Pass
0.0269    70       75      107      Pass
0.0271    67       70      104      Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 acre-feet
On-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.
Off-line facility target flow: 0 cfs.
Adjusted for 15 min: 0 cfs.

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

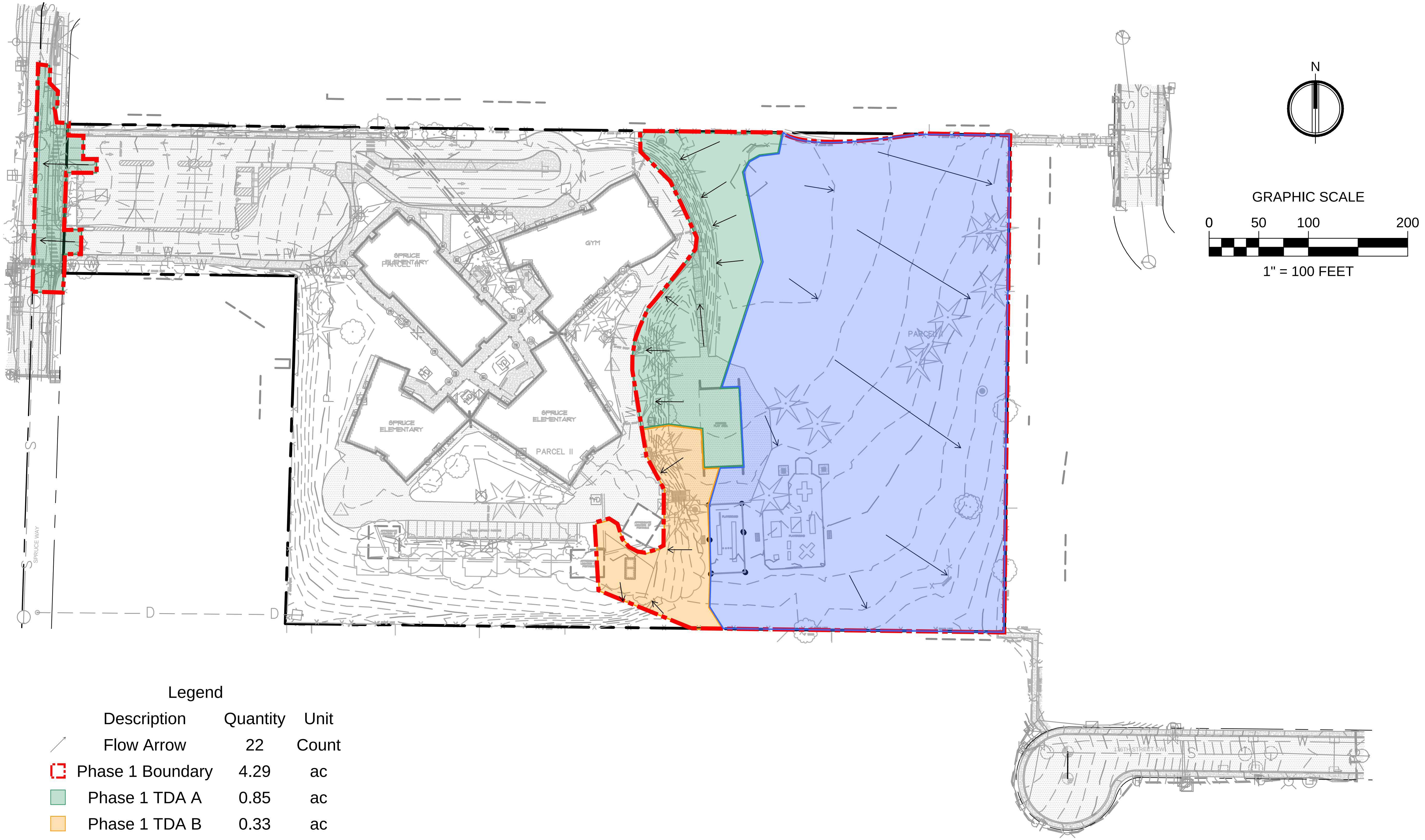
Appendix F

Conveyance Calculations and Exhibit

To be provided with final report submission.

Appendix G

TESC Exhibits and Calculations



Legend

	Description	Quantity	Unit
↗	Flow Arrow	22	Count
⬚	Phase 1 Boundary	4.29	ac
🟩	Phase 1 TDA A	0.85	ac
🟧	Phase 1 TDA B	0.33	ac
🟦	Phase 1 TDA C	3.11	ac

AHBL

1200 6th Avenue, #1620
Seattle, WA 98101
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206.267.2429 FAX
www.ahbl.com

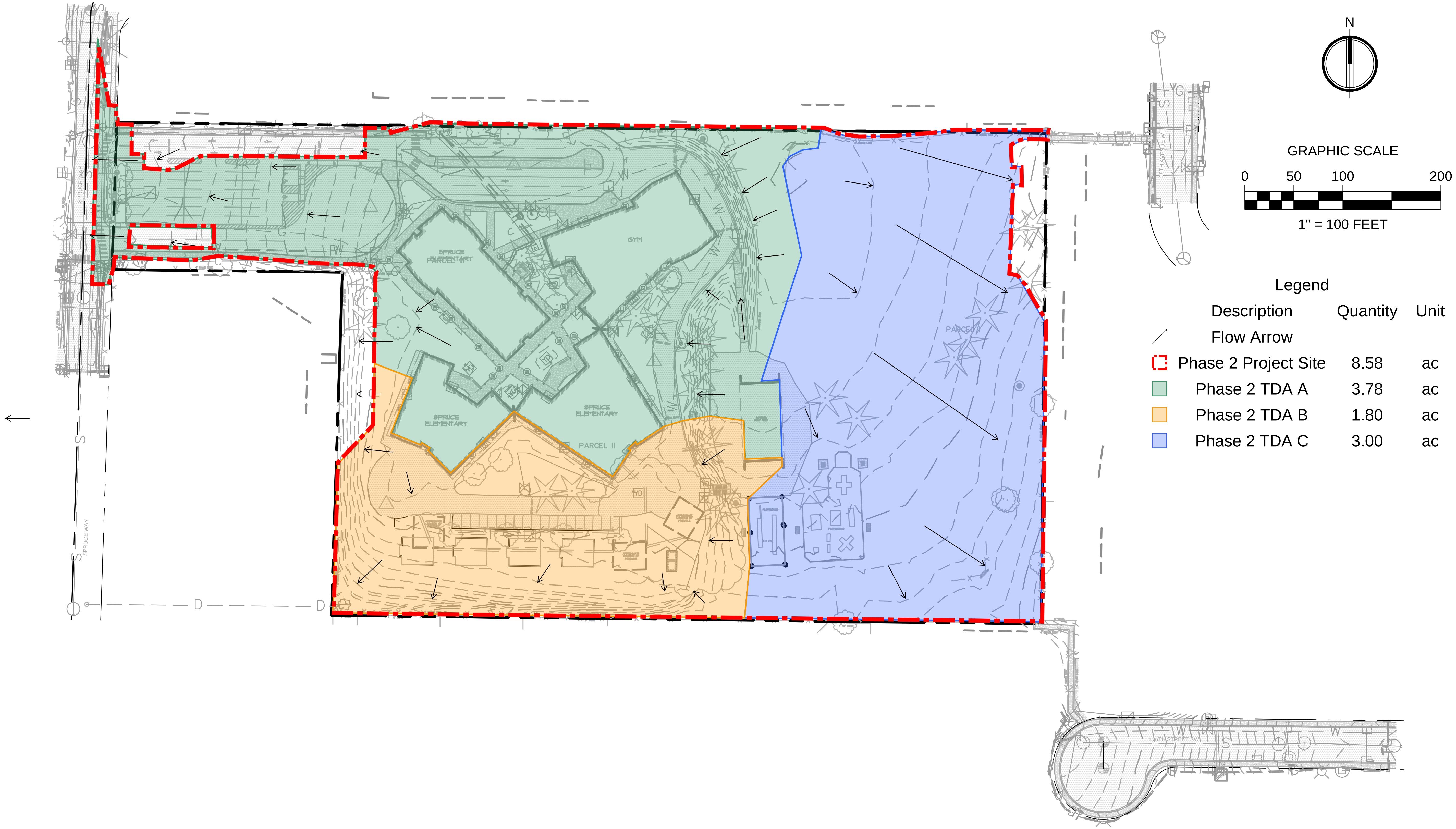
Spruce Elementary School

TESC BMP MAP - Phase 1

JOB NO.
2140275

DATE:
July 2017

G-1a



Legend

Description	Quantity	Unit
⟋ Flow Arrow		
🟥 Phase 2 Project Site	8.58	ac
🟩 Phase 2 TDA A	3.78	ac
🟧 Phase 2 TDA B	1.80	ac
🟦 Phase 2 TDA C	3.00	ac

AHBL

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Spruce Elementary School

TESC BMP MAP - Phase 2

JOB NO.
2140275

DATE:
July 2017

G-2b

G-2

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

Project SPRUCE ES
Subject TEMP STORM
With/To PHASE I - TDA A
Address
Date 8/3/17

Project No. 2140275
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PHASE I - TDA A

☐ SEDIMENT POND

$SA = 2 \times Q_2 / 0.00096$ ← FROM COS STORMWATER

$Q_2 = 0.361$ CFS
↑ FROM EXHIBIT G-3a (WWHM)

$\boxed{SA = 752 \text{ SF}}$

☐ PORTABLE TANK

☐ $CF = Q_2 (gpm) \times 16 = \text{STORAGE} (FT^3)$ ← COS STORMWATER

$* Q_2 = 0.361 \cdot 448.83 \text{ gpm/cfs} = 162.0 \text{ gpm}$

$= 162 \times 16 = 2592 \text{ FT}^3$

☐ BAKER TANKS REQUIRED

☐ CAPACITY OF BAKER = 17,640 GAL ⇒ 2352 FT^3

☐ # OF TANKS REQUIRED

$2592 \text{ FT}^3 / 2352 \Rightarrow 1.1$ BAKER TANKS

$= \boxed{2 \text{ BAKER TANKS}}$

AHBL
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors

Project SPRUCE ES
Subject TEMP STORM PHASE - TDA B
With/To
Address
Date 8/3/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. McDONALD

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PHASE I - TDA B

☐ SEDIMENT POND

$SA = 2 \times Q_2 / 0.00096$

$\boxed{SA = 292\ SF}$

$Q_2 = 0.140$ CFS
↑ Ex. G-4a
(WWHM)

☐ PORTABLE TANK

☐ $CF = Q_2 \times 16$

$= 1005.4\ FT^3$

$Q_2 = 0.140$ CFS → 62.8 gpm

☐ BAKER TANKS REQUIRED

☐ # OF TANKS

1005.4/2352 = 0.43 BAKER TANKS

$\boxed{1\ \text{BAKER TANK}}$

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

Project SPRUCE ES
Subject TEMP STORM
With/To PHASE 1 - TDA A
Address
Date 9/7/17

Project No. 2140275
Phone
Fax #
Faxed Pages
By J. McDONALD

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☐ Calculations
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☐ Memorandum
☐ Meeting Minutes
☐ Telephone Memo

PHASE I - TDA C

☐ SEDMENT POND

$SA = 2 \times Q_2 / 0.00096$

$Q_2 = 1.321$ CFS → 592.9 gpm
↑ Ex G-5a
(WWHM)

$\boxed{SA = 2{,}752 \text{ SF}}$

☐ PORTABLE TANK

☐ $CF = Q_2 \times 16$

$= 9487 \text{ FT}^3$

☐ BAKER TANKS REQUIRED
☐ # OF TANKS

$9487 \text{ FT}^3 / 2352 = 4.03$ BAKER TANKS

$\boxed{5 \text{ BAKER TANKS}}$

AHBL
Civil Engineers
Structural Engineers
Landscape Architects
Community Planners
Land Surveyors

Project SPRUCE ES
Subject TEMP STORM
With/To PHASE II - TDA A
Address
Date 8/3/17

Project No. 2140275
Phone
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PHASE II - TDA A

☐ **SEDIMENT POND**

$SA = 2 \times Q_2 / 0.00096$

$$\boxed{SA = 3344 \text{ SF}}$$

$Q_2 = 1.605$ CFS → 720.4 gpm
↑ Ex. G-3b
(WWHM)

☐ **PORTABLE TANK**

☐ $CF = Q_2 \times 16$

$= 11526 \text{ FT}^3$

☐ BAKER TANKS REQUIRED
☐ # OF TANKS

$11526 / 2352 = 4.9$ BAKER TANKS

$$\boxed{5 \text{ BAKER TANKS}}$$

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

Project SPRUCE ES
Subject TEMP STORM PHASE II - TDA B
With/To
Address
Date 8/3/17

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PHASE II - TDA B

- SEDIMENT POND

$$SA = 2 \times Q_2 / 0.00096$$

$$\boxed{SA = 1592\ SF}$$

$Q_2 = 0.764$ cfs → 342.9 gpm
↑ Ex G-4b
(WWHM)

- PORTABLE TANK

  - $CF = Q_2 \times 16$

    $= 5486.4\ FT^3$

  - BAKER TANKS REQUIRED

    5486/2352 = 2.3 BAKER TANKS

    $\boxed{3 \quad \text{BAKER TANKS}}$

Project SPRUCE ES

Subject TEMP STORM

With/To PHASE II ~ TDA C

Address

Date 8/3/17

Project No. 2140275

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Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

PHASE II - TDA C

☐ SEDIMENT POND

$SA = 2 \times Q_2 / 0.00096$

$Q_2 = 1.274$ CFS → 571.8 gpm
↑ Ex G-5b
(WWHM

$\boxed{SA = 2654 \text{ SF}}$

☐ PORTABLE TANK

☐ $CF = Q_2 \times 16$

$= 9149$ FT^3

☐ BAKER TANK REQUIRED

9149/2352 = 3.9 BAKER TANKS

$\boxed{4 \quad \text{BAKER TANKS}}$

WWHM2012
PROJECT REPORT

Project Name: TDA A - TESC
Site Name: Phase I - TDA A - TESC
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA A - Phase I - TESC
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
DRIVEWAYS FLAT	0.85
Impervious Total	0.85
Basin Total	0.85

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : TDA A - Phase I - TESC
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	0

Impervious Land Use	**acre**
DRIVEWAYS FLAT	0.85
Impervious Total	0.85
Basin Total	0.85

Element Flows To:

Surface	**Interflow**	**Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.85

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.85

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.360914
5 year	0.488303
10 year	0.581457
25 year	0.709577
50 year	0.812848
100 year	0.923056

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.360914
5 year	0.488303
10 year	0.581457
25 year	0.709577
50 year	0.812848
100 year	0.923056

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.370	0.370
1950	0.431	0.431
1951	0.422	0.422
1952	0.339	0.339
1953	0.444	0.444
1954	0.552	0.552
1955	0.421	0.421
1956	0.191	0.191
1957	0.324	0.324
1958	0.816	0.816
1959	0.337	0.337
1960	0.318	0.318
1961	1.063	1.063
1962	0.412	0.412
1963	0.464	0.464
1964	0.253	0.253
1965	0.295	0.295
1966	0.298	0.298
1967	0.723	0.723
1968	0.385	0.385
1969	0.723	0.723
1970	0.286	0.286
1971	0.404	0.404
1972	0.514	0.514
1973	0.423	0.423
1974	0.522	0.522
1975	0.403	0.403
1976	0.281	0.281
1977	0.285	0.285
1978	0.216	0.216
1979	0.475	0.475
1980	0.277	0.277
1981	0.285	0.285
1982	0.288	0.288
1983	0.381	0.381
1984	0.356	0.356
1985	0.512	0.512
1986	0.468	0.468
1987	0.419	0.419
1988	0.337	0.337
1989	0.349	0.349
1990	0.265	0.265
1991	0.346	0.346
1992	0.332	0.332
1993	0.260	0.260
1994	0.284	0.284
1995	0.267	0.267
1996	0.382	0.382
1997	0.408	0.408
1998	0.461	0.461
1999	0.213	0.213
2000	0.722	0.722
2001	0.260	0.260
2002	0.249	0.249

2003	0.336	0.336
2004	0.639	0.639
2005	0.300	0.300
2006	0.361	0.361
2007	0.358	0.358
2008	0.282	0.282
2009	0.304	0.304

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.0628	1.0628
2	0.8158	0.8158
3	0.7235	0.7235
4	0.7233	0.7233
5	0.7218	0.7218
6	0.6387	0.6387
7	0.5521	0.5521
8	0.5216	0.5216
9	0.5137	0.5137
10	0.5124	0.5124
11	0.4747	0.4747
12	0.4681	0.4681
13	0.4643	0.4643
14	0.4609	0.4609
15	0.4444	0.4444
16	0.4305	0.4305
17	0.4232	0.4232
18	0.4221	0.4221
19	0.4213	0.4213
20	0.4194	0.4194
21	0.4117	0.4117
22	0.4080	0.4080
23	0.4036	0.4036
24	0.4031	0.4031
25	0.3849	0.3849
26	0.3824	0.3824
27	0.3810	0.3810
28	0.3696	0.3696
29	0.3610	0.3610
30	0.3576	0.3576
31	0.3556	0.3556
32	0.3488	0.3488
33	0.3463	0.3463
34	0.3387	0.3387
35	0.3369	0.3369
36	0.3366	0.3366
37	0.3355	0.3355
38	0.3316	0.3316
39	0.3244	0.3244
40	0.3182	0.3182
41	0.3044	0.3044
42	0.2995	0.2995
43	0.2976	0.2976
44	0.2949	0.2949
45	0.2884	0.2884

46	0.2865	0.2865
47	0.2855	0.2855
48	0.2850	0.2850
49	0.2838	0.2838
50	0.2822	0.2822
51	0.2813	0.2813
52	0.2769	0.2769
53	0.2666	0.2666
54	0.2650	0.2650
55	0.2602	0.2602
56	0.2601	0.2601
57	0.2528	0.2528
58	0.2494	0.2494
59	0.2162	0.2162
60	0.2127	0.2127
61	0.1907	0.1907

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1805	1185	1185	100	Pass
0.1868	1053	1053	100	Pass
0.1932	919	919	100	Pass
0.1996	813	813	100	Pass
0.2060	726	726	100	Pass
0.2124	650	650	100	Pass
0.2188	581	581	100	Pass
0.2252	506	506	100	Pass
0.2316	465	465	100	Pass
0.2379	413	413	100	Pass
0.2443	365	365	100	Pass
0.2507	333	333	100	Pass
0.2571	300	300	100	Pass
0.2635	277	277	100	Pass
0.2699	264	264	100	Pass
0.2763	243	243	100	Pass
0.2827	219	219	100	Pass
0.2890	195	195	100	Pass
0.2954	177	177	100	Pass
0.3018	165	165	100	Pass
0.3082	145	145	100	Pass
0.3146	134	134	100	Pass
0.3210	126	126	100	Pass
0.3274	116	116	100	Pass
0.3338	107	107	100	Pass
0.3402	97	97	100	Pass
0.3465	92	92	100	Pass
0.3529	84	84	100	Pass
0.3593	82	82	100	Pass
0.3657	76	76	100	Pass
0.3721	74	74	100	Pass
0.3785	70	70	100	Pass

```
0.3849    64      64     100    Pass
0.3913    62      62     100    Pass
0.3976    58      58     100    Pass
0.4040    55      55     100    Pass
0.4104    50      50     100    Pass
0.4168    47      47     100    Pass
0.4232    43      43     100    Pass
0.4296    41      41     100    Pass
0.4360    38      38     100    Pass
0.4424    37      37     100    Pass
0.4487    32      32     100    Pass
0.4551    28      28     100    Pass
0.4615    25      25     100    Pass
0.4679    23      23     100    Pass
0.4743    22      22     100    Pass
0.4807    20      20     100    Pass
0.4871    20      20     100    Pass
0.4935    20      20     100    Pass
0.4998    20      20     100    Pass
0.5062    16      16     100    Pass
0.5126    14      14     100    Pass
0.5190    12      12     100    Pass
0.5254    11      11     100    Pass
0.5318    11      11     100    Pass
0.5382    11      11     100    Pass
0.5446    11      11     100    Pass
0.5509    11      11     100    Pass
0.5573    10      10     100    Pass
0.5637    10      10     100    Pass
0.5701    10      10     100    Pass
0.5765    10      10     100    Pass
0.5829    9       9      100    Pass
0.5893    9       9      100    Pass
0.5957    9       9      100    Pass
0.6021    9       9      100    Pass
0.6084    9       9      100    Pass
0.6148    8       8      100    Pass
0.6212    8       8      100    Pass
0.6276    8       8      100    Pass
0.6340    8       8      100    Pass
0.6404    7       7      100    Pass
0.6468    7       7      100    Pass
0.6532    6       6      100    Pass
0.6595    6       6      100    Pass
0.6659    6       6      100    Pass
0.6723    6       6      100    Pass
0.6787    6       6      100    Pass
0.6851    6       6      100    Pass
0.6915    6       6      100    Pass
0.6979    6       6      100    Pass
0.7043    6       6      100    Pass
0.7106    6       6      100    Pass
0.7170    6       6      100    Pass
0.7234    5       5      100    Pass
0.7298    3       3      100    Pass
0.7362    3       3      100    Pass
0.7426    3       3      100    Pass
```

```
0.7490    3      3      100    Pass
0.7554    3      3      100    Pass
0.7617    3      3      100    Pass
0.7681    3      3      100    Pass
0.7745    3      3      100    Pass
0.7809    3      3      100    Pass
0.7873    3      3      100    Pass
0.7937    3      3      100    Pass
0.8001    3      3      100    Pass
0.8065    3      3      100    Pass
0.8128    3      3      100    Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: TDA A - TESC
Site Name: Phase II - TDA A - TESC
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA A - Phase II - TESC
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	**0**

Impervious Land Use	acre
DRIVEWAYS FLAT	**3.78**
Impervious Total	**3.78**
Basin Total	**3.78**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : TDA A - Phase II - TESC
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
DRIVEWAYS FLAT	3.78
Impervious Total	3.78
Basin Total	3.78

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:3.78

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:3.78

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	1.605005
5 year	2.171515
10 year	2.585776
25 year	3.155534
50 year	3.614786
100 year	4.104885

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	1.605005
5 year	2.171515
10 year	2.585776
25 year	3.155534
50 year	3.614786
100 year	4.104885

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	1.644	1.644
1950	1.915	1.915
1951	1.877	1.877
1952	1.506	1.506
1953	1.976	1.976
1954	2.455	2.455
1955	1.874	1.874
1956	0.848	0.848
1957	1.443	1.443
1958	3.628	3.628
1959	1.497	1.497
1960	1.415	1.415
1961	4.726	4.726
1962	1.831	1.831
1963	2.065	2.065
1964	1.124	1.124
1965	1.311	1.311
1966	1.323	1.323
1967	3.217	3.217
1968	1.712	1.712
1969	3.217	3.217
1970	1.274	1.274
1971	1.795	1.795
1972	2.284	2.284
1973	1.882	1.882
1974	2.320	2.320
1975	1.792	1.792
1976	1.251	1.251
1977	1.269	1.269
1978	0.962	0.962
1979	2.111	2.111
1980	1.232	1.232
1981	1.268	1.268
1982	1.283	1.283
1983	1.694	1.694
1984	1.581	1.581
1985	2.279	2.279
1986	2.082	2.082
1987	1.865	1.865
1988	1.498	1.498
1989	1.551	1.551
1990	1.179	1.179
1991	1.540	1.540
1992	1.474	1.474
1993	1.157	1.157
1994	1.262	1.262
1995	1.185	1.185
1996	1.700	1.700
1997	1.814	1.814
1998	2.049	2.049
1999	0.946	0.946
2000	3.210	3.210
2001	1.157	1.157
2002	1.109	1.109

2003	1.492	1.492
2004	2.840	2.840
2005	1.332	1.332
2006	1.605	1.605
2007	1.590	1.590
2008	1.255	1.255
2009	1.354	1.354

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	4.7264	4.7264
2	3.6279	3.6279
3	3.2173	3.2173
4	3.2168	3.2168
5	3.2097	3.2097
6	2.8404	2.8404
7	2.4553	2.4553
8	2.3196	2.3196
9	2.2843	2.2843
10	2.2787	2.2787
11	2.1109	2.1109
12	2.0816	2.0816
13	2.0649	2.0649
14	2.0494	2.0494
15	1.9761	1.9761
16	1.9145	1.9145
17	1.8821	1.8821
18	1.8773	1.8773
19	1.8736	1.8736
20	1.8651	1.8651
21	1.8308	1.8308
22	1.8143	1.8143
23	1.7947	1.7947
24	1.7924	1.7924
25	1.7117	1.7117
26	1.7005	1.7005
27	1.6945	1.6945
28	1.6436	1.6436
29	1.6054	1.6054
30	1.5902	1.5902
31	1.5814	1.5814
32	1.5513	1.5513
33	1.5399	1.5399
34	1.5061	1.5061
35	1.4981	1.4981
36	1.4969	1.4969
37	1.4920	1.4920
38	1.4745	1.4745
39	1.4428	1.4428
40	1.4152	1.4152
41	1.3537	1.3537
42	1.3320	1.3320
43	1.3232	1.3232
44	1.3112	1.3112
45	1.2827	1.2827

46	1.2740	1.2740
47	1.2695	1.2695
48	1.2675	1.2675
49	1.2620	1.2620
50	1.2552	1.2552
51	1.2508	1.2508
52	1.2315	1.2315
53	1.1854	1.1854
54	1.1786	1.1786
55	1.1570	1.1570
56	1.1567	1.1567
57	1.1244	1.1244
58	1.1090	1.1090
59	0.9616	0.9616
60	0.9459	0.9459
61	0.8481	0.8481

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8025	1181	1181	100	Pass
0.8309	1044	1044	100	Pass
0.8593	916	916	100	Pass
0.8877	807	807	100	Pass
0.9161	726	726	100	Pass
0.9445	648	648	100	Pass
0.9729	576	576	100	Pass
1.0014	506	506	100	Pass
1.0298	458	458	100	Pass
1.0582	408	408	100	Pass
1.0866	365	365	100	Pass
1.1150	328	328	100	Pass
1.1434	300	300	100	Pass
1.1718	276	276	100	Pass
1.2002	262	262	100	Pass
1.2286	243	243	100	Pass
1.2570	214	214	100	Pass
1.2854	195	195	100	Pass
1.3138	177	177	100	Pass
1.3422	164	164	100	Pass
1.3706	145	145	100	Pass
1.3990	132	132	100	Pass
1.4275	126	126	100	Pass
1.4559	116	116	100	Pass
1.4843	104	104	100	Pass
1.5127	97	97	100	Pass
1.5411	91	91	100	Pass
1.5695	84	84	100	Pass
1.5979	81	81	100	Pass
1.6263	76	76	100	Pass
1.6547	74	74	100	Pass
1.6831	70	70	100	Pass

1.7115	64	64	100	Pass
1.7399	62	62	100	Pass
1.7683	58	58	100	Pass
1.7967	55	55	100	Pass
1.8252	50	50	100	Pass
1.8536	47	47	100	Pass
1.8820	43	43	100	Pass
1.9104	41	41	100	Pass
1.9388	38	38	100	Pass
1.9672	36	36	100	Pass
1.9956	32	32	100	Pass
2.0240	28	28	100	Pass
2.0524	25	25	100	Pass
2.0808	23	23	100	Pass
2.1092	22	22	100	Pass
2.1376	20	20	100	Pass
2.1660	20	20	100	Pass
2.1944	20	20	100	Pass
2.2228	19	19	100	Pass
2.2513	16	16	100	Pass
2.2797	13	13	100	Pass
2.3081	12	12	100	Pass
2.3365	11	11	100	Pass
2.3649	11	11	100	Pass
2.3933	11	11	100	Pass
2.4217	11	11	100	Pass
2.4501	11	11	100	Pass
2.4785	10	10	100	Pass
2.5069	10	10	100	Pass
2.5353	10	10	100	Pass
2.5637	10	10	100	Pass
2.5921	9	9	100	Pass
2.6205	9	9	100	Pass
2.6490	9	9	100	Pass
2.6774	9	9	100	Pass
2.7058	9	9	100	Pass
2.7342	8	8	100	Pass
2.7626	8	8	100	Pass
2.7910	8	8	100	Pass
2.8194	8	8	100	Pass
2.8478	7	7	100	Pass
2.8762	7	7	100	Pass
2.9046	6	6	100	Pass
2.9330	6	6	100	Pass
2.9614	6	6	100	Pass
2.9898	6	6	100	Pass
3.0182	6	6	100	Pass
3.0466	6	6	100	Pass
3.0751	6	6	100	Pass
3.1035	6	6	100	Pass
3.1319	6	6	100	Pass
3.1603	6	6	100	Pass
3.1887	6	6	100	Pass
3.2171	4	4	100	Pass
3.2455	3	3	100	Pass
3.2739	3	3	100	Pass
3.3023	3	3	100	Pass

```
3.3307    3       3      100    Pass
3.3591    3       3      100    Pass
3.3875    3       3      100    Pass
3.4159    3       3      100    Pass
3.4443    3       3      100    Pass
3.4728    3       3      100    Pass
3.5012    3       3      100    Pass
3.5296    3       3      100    Pass
3.5580    3       3      100    Pass
3.5864    3       3      100    Pass
3.6148    3       3      100    Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: TDA B - TESC
Site Name: Phase I - TDA B - TESC
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA B - Phase I - TESC
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	**0**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**0.33**
Impervious Total	**0.33**
Basin Total	**0.33**

Element Flows To:

Surface	**Interflow**	**Groundwater**

MITIGATED LAND USE

Name : TDA B - Phase I - TESC
Bypass: No

GroundWater: No

```
Pervious Land Use           acre

Pervious Total                0

Impervious Land Use         acre
 DRIVEWAYS FLAT               0.33

Impervious Total              0.33

Basin Total                   0.33


Element Flows To:
Surface              Interflow               Groundwater




                     ANALYSIS RESULTS

                 Stream Protection Duration


Predeveloped Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.33

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:0.33

Flow Frequency Return Periods for Predeveloped.  POC #1
Return Period        Flow(cfs)
2 year                 0.140119
5 year                 0.189577
10 year                0.225742
25 year                0.275483
50 year                0.315577
100 year               0.358363

Flow Frequency Return Periods for Mitigated.  POC #1
Return Period        Flow(cfs)
2 year                 0.140119
5 year                 0.189577
10 year                0.225742
25 year                0.275483
50 year                0.315577
100 year               0.358363
```

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.143	0.143
1950	0.167	0.167
1951	0.164	0.164
1952	0.131	0.131
1953	0.173	0.173
1954	0.214	0.214
1955	0.164	0.164
1956	0.074	0.074
1957	0.126	0.126
1958	0.317	0.317
1959	0.131	0.131
1960	0.124	0.124
1961	0.413	0.413
1962	0.160	0.160
1963	0.180	0.180
1964	0.098	0.098
1965	0.114	0.114
1966	0.116	0.116
1967	0.281	0.281
1968	0.149	0.149
1969	0.281	0.281
1970	0.111	0.111
1971	0.157	0.157
1972	0.199	0.199
1973	0.164	0.164
1974	0.203	0.203
1975	0.156	0.156
1976	0.109	0.109
1977	0.111	0.111
1978	0.084	0.084
1979	0.184	0.184
1980	0.108	0.108
1981	0.111	0.111
1982	0.112	0.112
1983	0.148	0.148
1984	0.138	0.138
1985	0.199	0.199
1986	0.182	0.182
1987	0.163	0.163
1988	0.131	0.131
1989	0.135	0.135
1990	0.103	0.103
1991	0.134	0.134
1992	0.129	0.129
1993	0.101	0.101
1994	0.110	0.110
1995	0.103	0.103
1996	0.148	0.148
1997	0.158	0.158
1998	0.179	0.179
1999	0.083	0.083
2000	0.280	0.280
2001	0.101	0.101
2002	0.097	0.097

2003	0.130	0.130
2004	0.248	0.248
2005	0.116	0.116
2006	0.140	0.140
2007	0.139	0.139
2008	0.110	0.110
2009	0.118	0.118

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.4126	0.4126
2	0.3167	0.3167
3	0.2809	0.2809
4	0.2808	0.2808
5	0.2802	0.2802
6	0.2480	0.2480
7	0.2144	0.2144
8	0.2025	0.2025
9	0.1994	0.1994
10	0.1989	0.1989
11	0.1843	0.1843
12	0.1817	0.1817
13	0.1803	0.1803
14	0.1789	0.1789
15	0.1725	0.1725
16	0.1671	0.1671
17	0.1643	0.1643
18	0.1639	0.1639
19	0.1636	0.1636
20	0.1628	0.1628
21	0.1598	0.1598
22	0.1584	0.1584
23	0.1567	0.1567
24	0.1565	0.1565
25	0.1494	0.1494
26	0.1485	0.1485
27	0.1479	0.1479
28	0.1435	0.1435
29	0.1402	0.1402
30	0.1388	0.1388
31	0.1381	0.1381
32	0.1354	0.1354
33	0.1344	0.1344
34	0.1315	0.1315
35	0.1308	0.1308
36	0.1307	0.1307
37	0.1303	0.1303
38	0.1287	0.1287
39	0.1260	0.1260
40	0.1235	0.1235
41	0.1182	0.1182
42	0.1163	0.1163
43	0.1155	0.1155
44	0.1145	0.1145
45	0.1120	0.1120

46	0.1112	0.1112
47	0.1108	0.1108
48	0.1107	0.1107
49	0.1102	0.1102
50	0.1096	0.1096
51	0.1092	0.1092
52	0.1075	0.1075
53	0.1035	0.1035
54	0.1029	0.1029
55	0.1010	0.1010
56	0.1010	0.1010
57	0.0982	0.0982
58	0.0968	0.0968
59	0.0839	0.0839
60	0.0826	0.0826
61	0.0740	0.0740

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0701	1179	1179	100	Pass
0.0725	1042	1042	100	Pass
0.0750	916	916	100	Pass
0.0775	806	806	100	Pass
0.0800	726	726	100	Pass
0.0825	646	646	100	Pass
0.0849	574	574	100	Pass
0.0874	506	506	100	Pass
0.0899	457	457	100	Pass
0.0924	408	408	100	Pass
0.0949	365	365	100	Pass
0.0973	328	328	100	Pass
0.0998	299	299	100	Pass
0.1023	277	277	100	Pass
0.1048	262	262	100	Pass
0.1073	243	243	100	Pass
0.1097	214	214	100	Pass
0.1122	195	195	100	Pass
0.1147	177	177	100	Pass
0.1172	164	164	100	Pass
0.1197	145	145	100	Pass
0.1221	132	132	100	Pass
0.1246	126	126	100	Pass
0.1271	116	116	100	Pass
0.1296	105	105	100	Pass
0.1321	97	97	100	Pass
0.1345	91	91	100	Pass
0.1370	84	84	100	Pass
0.1395	81	81	100	Pass
0.1420	76	76	100	Pass
0.1445	74	74	100	Pass
0.1469	70	70	100	Pass

0.1494	64	64	100	Pass
0.1519	62	62	100	Pass
0.1544	58	58	100	Pass
0.1569	55	55	100	Pass
0.1593	50	50	100	Pass
0.1618	47	47	100	Pass
0.1643	43	43	100	Pass
0.1668	41	41	100	Pass
0.1693	38	38	100	Pass
0.1717	36	36	100	Pass
0.1742	32	32	100	Pass
0.1767	28	28	100	Pass
0.1792	25	25	100	Pass
0.1817	23	23	100	Pass
0.1841	22	22	100	Pass
0.1866	20	20	100	Pass
0.1891	20	20	100	Pass
0.1916	20	20	100	Pass
0.1941	19	19	100	Pass
0.1965	16	16	100	Pass
0.1990	13	13	100	Pass
0.2015	12	12	100	Pass
0.2040	11	11	100	Pass
0.2065	11	11	100	Pass
0.2089	11	11	100	Pass
0.2114	11	11	100	Pass
0.2139	11	11	100	Pass
0.2164	10	10	100	Pass
0.2189	10	10	100	Pass
0.2213	10	10	100	Pass
0.2238	10	10	100	Pass
0.2263	9	9	100	Pass
0.2288	9	9	100	Pass
0.2313	9	9	100	Pass
0.2337	9	9	100	Pass
0.2362	9	9	100	Pass
0.2387	8	8	100	Pass
0.2412	8	8	100	Pass
0.2437	8	8	100	Pass
0.2461	8	8	100	Pass
0.2486	7	7	100	Pass
0.2511	7	7	100	Pass
0.2536	6	6	100	Pass
0.2561	6	6	100	Pass
0.2585	6	6	100	Pass
0.2610	6	6	100	Pass
0.2635	6	6	100	Pass
0.2660	6	6	100	Pass
0.2685	6	6	100	Pass
0.2709	6	6	100	Pass
0.2734	6	6	100	Pass
0.2759	6	6	100	Pass
0.2784	6	6	100	Pass
0.2809	5	5	100	Pass
0.2833	3	3	100	Pass
0.2858	3	3	100	Pass
0.2883	3	3	100	Pass

```
0.2908    3       3       100    Pass
0.2933    3       3       100    Pass
0.2957    3       3       100    Pass
0.2982    3       3       100    Pass
0.3007    3       3       100    Pass
0.3032    3       3       100    Pass
0.3057    3       3       100    Pass
0.3081    3       3       100    Pass
0.3106    3       3       100    Pass
0.3131    3       3       100    Pass
0.3156    3       3       100    Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: TDA B - TESC
Site Name: Phase II - TDA B - TESC
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA B - Phase II - TESC
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	**0**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**1.8**
Impervious Total	**1.8**
Basin Total	**1.8**

Element Flows To:

Surface	**Interflow**	**Groundwater**

MITIGATED LAND USE

Name : TDA B - Phase II - TESC
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	0

Impervious Land Use	acre
DRIVEWAYS FLAT	1.8
Impervious Total	1.8
Basin Total	1.8

Element Flows To:

Surface	Interflow	Groundwater

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:1.8

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:1.8

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.764288
5 year	1.034054
10 year	1.231321
25 year	1.502634
50 year	1.721325
100 year	1.954705

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.764288
5 year	1.034054
10 year	1.231321
25 year	1.502634
50 year	1.721325
100 year	1.954705

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	0.783	0.783
1950	0.912	0.912
1951	0.894	0.894
1952	0.717	0.717
1953	0.941	0.941
1954	1.169	1.169
1955	0.892	0.892
1956	0.404	0.404
1957	0.687	0.687
1958	1.728	1.728
1959	0.713	0.713
1960	0.674	0.674
1961	2.251	2.251
1962	0.872	0.872
1963	0.983	0.983
1964	0.535	0.535
1965	0.624	0.624
1966	0.630	0.630
1967	1.532	1.532
1968	0.815	0.815
1969	1.532	1.532
1970	0.607	0.607
1971	0.855	0.855
1972	1.088	1.088
1973	0.896	0.896
1974	1.105	1.105
1975	0.854	0.854
1976	0.596	0.596
1977	0.605	0.605
1978	0.458	0.458
1979	1.005	1.005
1980	0.586	0.586
1981	0.604	0.604
1982	0.611	0.611
1983	0.807	0.807
1984	0.753	0.753
1985	1.085	1.085
1986	0.991	0.991
1987	0.888	0.888
1988	0.713	0.713
1989	0.739	0.739
1990	0.561	0.561
1991	0.733	0.733
1992	0.702	0.702
1993	0.551	0.551
1994	0.601	0.601
1995	0.564	0.564
1996	0.810	0.810
1997	0.864	0.864
1998	0.976	0.976
1999	0.450	0.450
2000	1.528	1.528
2001	0.551	0.551
2002	0.528	0.528

2003	0.710	0.710
2004	1.353	1.353
2005	0.634	0.634
2006	0.764	0.764
2007	0.757	0.757
2008	0.598	0.598
2009	0.645	0.645

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	2.2507	2.2507
2	1.7276	1.7276
3	1.5320	1.5320
4	1.5318	1.5318
5	1.5284	1.5284
6	1.3526	1.3526
7	1.1692	1.1692
8	1.1046	1.1046
9	1.0878	1.0878
10	1.0851	1.0851
11	1.0052	1.0052
12	0.9912	0.9912
13	0.9833	0.9833
14	0.9759	0.9759
15	0.9410	0.9410
16	0.9117	0.9117
17	0.8962	0.8962
18	0.8939	0.8939
19	0.8922	0.8922
20	0.8881	0.8881
21	0.8718	0.8718
22	0.8639	0.8639
23	0.8546	0.8546
24	0.8535	0.8535
25	0.8151	0.8151
26	0.8097	0.8097
27	0.8069	0.8069
28	0.7827	0.7827
29	0.7645	0.7645
30	0.7572	0.7572
31	0.7530	0.7530
32	0.7387	0.7387
33	0.7333	0.7333
34	0.7172	0.7172
35	0.7134	0.7134
36	0.7128	0.7128
37	0.7105	0.7105
38	0.7021	0.7021
39	0.6871	0.6871
40	0.6739	0.6739
41	0.6446	0.6446
42	0.6343	0.6343
43	0.6301	0.6301
44	0.6244	0.6244
45	0.6108	0.6108

46	0.6067	0.6067
47	0.6045	0.6045
48	0.6036	0.6036
49	0.6009	0.6009
50	0.5977	0.5977
51	0.5956	0.5956
52	0.5865	0.5865
53	0.5645	0.5645
54	0.5612	0.5612
55	0.5509	0.5509
56	0.5508	0.5508
57	0.5354	0.5354
58	0.5281	0.5281
59	0.4579	0.4579
60	0.4504	0.4504
61	0.4039	0.4039

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.3821	1180	1180	100	Pass
0.3957	1045	1045	100	Pass
0.4092	916	916	100	Pass
0.4227	812	812	100	Pass
0.4363	726	726	100	Pass
0.4498	650	650	100	Pass
0.4633	575	575	100	Pass
0.4768	509	509	100	Pass
0.4904	458	458	100	Pass
0.5039	411	411	100	Pass
0.5174	365	365	100	Pass
0.5309	332	332	100	Pass
0.5445	302	302	100	Pass
0.5580	277	277	100	Pass
0.5715	262	262	100	Pass
0.5851	243	243	100	Pass
0.5986	215	215	100	Pass
0.6121	195	195	100	Pass
0.6256	177	177	100	Pass
0.6392	164	164	100	Pass
0.6527	146	146	100	Pass
0.6662	132	132	100	Pass
0.6797	126	126	100	Pass
0.6933	116	116	100	Pass
0.7068	106	106	100	Pass
0.7203	97	97	100	Pass
0.7338	92	92	100	Pass
0.7474	84	84	100	Pass
0.7609	82	82	100	Pass
0.7744	76	76	100	Pass
0.7880	74	74	100	Pass
0.8015	70	70	100	Pass

0.8150	64	64	100	Pass
0.8285	62	62	100	Pass
0.8421	58	58	100	Pass
0.8556	55	55	100	Pass
0.8691	50	50	100	Pass
0.8826	47	47	100	Pass
0.8962	43	43	100	Pass
0.9097	41	41	100	Pass
0.9232	38	38	100	Pass
0.9368	37	37	100	Pass
0.9503	32	32	100	Pass
0.9638	28	28	100	Pass
0.9773	25	25	100	Pass
0.9909	23	23	100	Pass
1.0044	22	22	100	Pass
1.0179	20	20	100	Pass
1.0314	20	20	100	Pass
1.0450	20	20	100	Pass
1.0585	19	19	100	Pass
1.0720	16	16	100	Pass
1.0856	14	14	100	Pass
1.0991	12	12	100	Pass
1.1126	11	11	100	Pass
1.1261	11	11	100	Pass
1.1397	11	11	100	Pass
1.1532	11	11	100	Pass
1.1667	11	11	100	Pass
1.1802	10	10	100	Pass
1.1938	10	10	100	Pass
1.2073	10	10	100	Pass
1.2208	10	10	100	Pass
1.2344	9	9	100	Pass
1.2479	9	9	100	Pass
1.2614	9	9	100	Pass
1.2749	9	9	100	Pass
1.2885	9	9	100	Pass
1.3020	8	8	100	Pass
1.3155	8	8	100	Pass
1.3290	8	8	100	Pass
1.3426	8	8	100	Pass
1.3561	7	7	100	Pass
1.3696	7	7	100	Pass
1.3831	6	6	100	Pass
1.3967	6	6	100	Pass
1.4102	6	6	100	Pass
1.4237	6	6	100	Pass
1.4373	6	6	100	Pass
1.4508	6	6	100	Pass
1.4643	6	6	100	Pass
1.4778	6	6	100	Pass
1.4914	6	6	100	Pass
1.5049	6	6	100	Pass
1.5184	6	6	100	Pass
1.5319	5	5	100	Pass
1.5455	3	3	100	Pass
1.5590	3	3	100	Pass
1.5725	3	3	100	Pass

```
1.5861    3       3      100    Pass
1.5996    3       3      100    Pass
1.6131    3       3      100    Pass
1.6266    3       3      100    Pass
1.6402    3       3      100    Pass
1.6537    3       3      100    Pass
1.6672    3       3      100    Pass
1.6807    3       3      100    Pass
1.6943    3       3      100    Pass
1.7078    3       3      100    Pass
1.7213    3       3      100    Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: TDA C - TESC
Site Name: Phase I - TDA C - TESC
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 9/7/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA C - Phase I - TESC
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	**0**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**3.11**
Impervious Total	**3.11**
Basin Total	**3.11**

Element Flows To:

Surface	**Interflow**	**Groundwater**

MITIGATED LAND USE

Name : TDA C - Phase I - TESC
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	**0**

Impervious Land Use	**acre**
DRIVEWAYS FLAT	**3.11**
Impervious Total	**3.11**
Basin Total	**3.11**

Element Flows To:

Surface	**Interflow**	**Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:3.11

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:3.11

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.320519
5 year	1.786615
10 year	2.127448
25 year	2.596217
50 year	2.974066
100 year	3.377295

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.320519
5 year	1.786615
10 year	2.127448
25 year	2.596217
50 year	2.974066
100 year	3.377295

Stream Protection Duration

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	1.352	1.352
1950	1.575	1.575
1951	1.545	1.545
1952	1.239	1.239
1953	1.626	1.626
1954	2.020	2.020
1955	1.542	1.542
1956	0.698	0.698
1957	1.187	1.187
1958	2.985	2.985
1959	1.232	1.232
1960	1.164	1.164
1961	3.889	3.889
1962	1.506	1.506
1963	1.699	1.699
1964	0.925	0.925
1965	1.079	1.079
1966	1.089	1.089
1967	2.647	2.647
1968	1.408	1.408
1969	2.647	2.647
1970	1.048	1.048
1971	1.477	1.477
1972	1.879	1.879
1973	1.548	1.548
1974	1.908	1.908
1975	1.475	1.475
1976	1.029	1.029
1977	1.044	1.044
1978	0.791	0.791
1979	1.737	1.737
1980	1.013	1.013
1981	1.043	1.043
1982	1.055	1.055
1983	1.394	1.394
1984	1.301	1.301
1985	1.875	1.875
1986	1.713	1.713
1987	1.534	1.534
1988	1.233	1.233
1989	1.276	1.276
1990	0.970	0.970
1991	1.267	1.267
1992	1.213	1.213
1993	0.952	0.952
1994	1.038	1.038
1995	0.975	0.975
1996	1.399	1.399
1997	1.493	1.493
1998	1.686	1.686
1999	0.778	0.778
2000	2.641	2.641
2001	0.952	0.952
2002	0.912	0.912

2003	1.228	1.228
2004	2.337	2.337
2005	1.096	1.096
2006	1.321	1.321
2007	1.308	1.308
2008	1.033	1.033
2009	1.114	1.114

Stream Protection Duration

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	3.8887	3.8887
2	2.9848	2.9848
3	2.6470	2.6470
4	2.6466	2.6466
5	2.6408	2.6408
6	2.3370	2.3370
7	2.0201	2.0201
8	1.9084	1.9084
9	1.8794	1.8794
10	1.8748	1.8748
11	1.7367	1.7367
12	1.7126	1.7126
13	1.6989	1.6989
14	1.6862	1.6862
15	1.6258	1.6258
16	1.5752	1.5752
17	1.5485	1.5485
18	1.5445	1.5445
19	1.5415	1.5415
20	1.5345	1.5345
21	1.5063	1.5063
22	1.4927	1.4927
23	1.4766	1.4766
24	1.4747	1.4747
25	1.4083	1.4083
26	1.3991	1.3991
27	1.3941	1.3941
28	1.3523	1.3523
29	1.3208	1.3208
30	1.3083	1.3083
31	1.3011	1.3011
32	1.2763	1.2763
33	1.2670	1.2670
34	1.2391	1.2391
35	1.2325	1.2325
36	1.2316	1.2316
37	1.2276	1.2276
38	1.2131	1.2131
39	1.1871	1.1871
40	1.1643	1.1643
41	1.1138	1.1138
42	1.0959	1.0959
43	1.0887	1.0887
44	1.0788	1.0788
45	1.0553	1.0553

46	1.0482	1.0482
47	1.0445	1.0445
48	1.0429	1.0429
49	1.0383	1.0383
50	1.0327	1.0327
51	1.0291	1.0291
52	1.0133	1.0133
53	0.9753	0.9753
54	0.9697	0.9697
55	0.9519	0.9519
56	0.9517	0.9517
57	0.9251	0.9251
58	0.9125	0.9125
59	0.7911	0.7911
60	0.7783	0.7783
61	0.6978	0.6978

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.6603	1179	1179	100	Pass
0.6836	1045	1045	100	Pass
0.7070	921	921	100	Pass
0.7304	811	811	100	Pass
0.7537	726	726	100	Pass
0.7771	649	649	100	Pass
0.8005	576	576	100	Pass
0.8239	506	506	100	Pass
0.8472	458	458	100	Pass
0.8706	410	410	100	Pass
0.8940	365	365	100	Pass
0.9173	328	328	100	Pass
0.9407	300	300	100	Pass
0.9641	276	276	100	Pass
0.9875	262	262	100	Pass
1.0108	243	243	100	Pass
1.0342	214	214	100	Pass
1.0576	195	195	100	Pass
1.0810	177	177	100	Pass
1.1043	164	164	100	Pass
1.1277	146	146	100	Pass
1.1511	133	133	100	Pass
1.1744	126	126	100	Pass
1.1978	116	116	100	Pass
1.2212	105	105	100	Pass
1.2446	97	97	100	Pass
1.2679	91	91	100	Pass
1.2913	84	84	100	Pass
1.3147	81	81	100	Pass
1.3380	76	76	100	Pass
1.3614	74	74	100	Pass
1.3848	70	70	100	Pass

1.4082	64	64	100	Pass
1.4315	62	62	100	Pass
1.4549	58	58	100	Pass
1.4783	55	55	100	Pass
1.5016	50	50	100	Pass
1.5250	47	47	100	Pass
1.5484	43	43	100	Pass
1.5718	41	41	100	Pass
1.5951	38	38	100	Pass
1.6185	36	36	100	Pass
1.6419	32	32	100	Pass
1.6652	28	28	100	Pass
1.6886	25	25	100	Pass
1.7120	23	23	100	Pass
1.7354	22	22	100	Pass
1.7587	20	20	100	Pass
1.7821	20	20	100	Pass
1.8055	20	20	100	Pass
1.8288	19	19	100	Pass
1.8522	16	16	100	Pass
1.8756	14	14	100	Pass
1.8990	12	12	100	Pass
1.9223	11	11	100	Pass
1.9457	11	11	100	Pass
1.9691	11	11	100	Pass
1.9925	11	11	100	Pass
2.0158	11	11	100	Pass
2.0392	10	10	100	Pass
2.0626	10	10	100	Pass
2.0859	10	10	100	Pass
2.1093	10	10	100	Pass
2.1327	9	9	100	Pass
2.1561	9	9	100	Pass
2.1794	9	9	100	Pass
2.2028	9	9	100	Pass
2.2262	9	9	100	Pass
2.2495	8	8	100	Pass
2.2729	8	8	100	Pass
2.2963	8	8	100	Pass
2.3197	8	8	100	Pass
2.3430	7	7	100	Pass
2.3664	7	7	100	Pass
2.3898	6	6	100	Pass
2.4131	6	6	100	Pass
2.4365	6	6	100	Pass
2.4599	6	6	100	Pass
2.4833	6	6	100	Pass
2.5066	6	6	100	Pass
2.5300	6	6	100	Pass
2.5534	6	6	100	Pass
2.5767	6	6	100	Pass
2.6001	6	6	100	Pass
2.6235	6	6	100	Pass
2.6469	5	5	100	Pass
2.6702	3	3	100	Pass
2.6936	3	3	100	Pass
2.7170	3	3	100	Pass

```
2.7403    3       3       100    Pass
2.7637    3       3       100    Pass
2.7871    3       3       100    Pass
2.8105    3       3       100    Pass
2.8338    3       3       100    Pass
2.8572    3       3       100    Pass
2.8806    3       3       100    Pass
2.9040    3       3       100    Pass
2.9273    3       3       100    Pass
2.9507    3       3       100    Pass
2.9741    3       3       100    Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

WWHM2012
PROJECT REPORT

Project Name: TDA C - TESC
Site Name: Phase II - TDA C - TESC
Site Address: 17405 Spruce Way
City : Lynnwood
Report Date: 8/3/2017
Gage : Everett
Data Start : 1948/10/01
Data End : 2009/09/30
Precip Scale: 1.00
Version Date: 2017/07/05
Version : 4.2.13

Low Flow Threshold for POC 1 : 50 Percent of the 2 Year

High Flow Threshold for POC 1: 50 year

PREDEVELOPED LAND USE

Name : TDA C - Phase II - TESC
Bypass: No

GroundWater: No

Pervious Land Use	acre
Pervious Total	**0**

Impervious Land Use	acre
DRIVEWAYS FLAT	**3**
Impervious Total	**3**
Basin Total	**3**

Element Flows To:

Surface	Interflow	Groundwater

MITIGATED LAND USE

Name : TDA C - Phase II - TESC
Bypass: No

GroundWater: No

Pervious Land Use	**acre**
Pervious Total	0

Impervious Land Use	**acre**
DRIVEWAYS FLAT	3
Impervious Total	3
Basin Total	3

Element Flows To:

Surface	**Interflow**	**Groundwater**

ANALYSIS RESULTS

Stream Protection Duration

Predeveloped Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:3

Mitigated Landuse Totals for POC #1
Total Pervious Area:0
Total Impervious Area:3

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.273813
5 year	1.723424
10 year	2.052202
25 year	2.504391
50 year	2.868876
100 year	3.257843

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.273813
5 year	1.723424
10 year	2.052202
25 year	2.504391
50 year	2.868876
100 year	3.257843

Stream Protection Duration
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1949	1.304	1.304
1950	1.519	1.519
1951	1.490	1.490
1952	1.195	1.195
1953	1.568	1.568
1954	1.949	1.949
1955	1.487	1.487
1956	0.673	0.673
1957	1.145	1.145
1958	2.879	2.879
1959	1.188	1.188
1960	1.123	1.123
1961	3.751	3.751
1962	1.453	1.453
1963	1.639	1.639
1964	0.892	0.892
1965	1.041	1.041
1966	1.050	1.050
1967	2.553	2.553
1968	1.358	1.358
1969	2.553	2.553
1970	1.011	1.011
1971	1.424	1.424
1972	1.813	1.813
1973	1.494	1.494
1974	1.841	1.841
1975	1.423	1.423
1976	0.993	0.993
1977	1.008	1.008
1978	0.763	0.763
1979	1.675	1.675
1980	0.977	0.977
1981	1.006	1.006
1982	1.018	1.018
1983	1.345	1.345
1984	1.255	1.255
1985	1.809	1.809
1986	1.652	1.652
1987	1.480	1.480
1988	1.189	1.189
1989	1.231	1.231
1990	0.935	0.935
1991	1.222	1.222
1992	1.170	1.170
1993	0.918	0.918
1994	1.002	1.002
1995	0.941	0.941
1996	1.350	1.350
1997	1.440	1.440
1998	1.627	1.627
1999	0.751	0.751
2000	2.547	2.547
2001	0.918	0.918
2002	0.880	0.880

2003	1.184	1.184
2004	2.254	2.254
2005	1.057	1.057
2006	1.274	1.274
2007	1.262	1.262
2008	0.996	0.996
2009	1.074	1.074

Stream Protection Duration
Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	3.7511	3.7511
2	2.8793	2.8793
3	2.5534	2.5534
4	2.5530	2.5530
5	2.5474	2.5474
6	2.2543	2.2543
7	1.9487	1.9487
8	1.8409	1.8409
9	1.8129	1.8129
10	1.8085	1.8085
11	1.6753	1.6753
12	1.6521	1.6521
13	1.6388	1.6388
14	1.6265	1.6265
15	1.5683	1.5683
16	1.5195	1.5195
17	1.4937	1.4937
18	1.4899	1.4899
19	1.4870	1.4870
20	1.4802	1.4802
21	1.4530	1.4530
22	1.4399	1.4399
23	1.4243	1.4243
24	1.4226	1.4226
25	1.3585	1.3585
26	1.3496	1.3496
27	1.3448	1.3448
28	1.3044	1.3044
29	1.2741	1.2741
30	1.2620	1.2620
31	1.2551	1.2551
32	1.2312	1.2312
33	1.2222	1.2222
34	1.1953	1.1953
35	1.1889	1.1889
36	1.1880	1.1880
37	1.1841	1.1841
38	1.1702	1.1702
39	1.1451	1.1451
40	1.1232	1.1232
41	1.0744	1.0744
42	1.0572	1.0572
43	1.0502	1.0502
44	1.0407	1.0407
45	1.0180	1.0180

46	1.0111	1.0111
47	1.0075	1.0075
48	1.0060	1.0060
49	1.0016	1.0016
50	0.9962	0.9962
51	0.9927	0.9927
52	0.9774	0.9774
53	0.9408	0.9408
54	0.9354	0.9354
55	0.9182	0.9182
56	0.9180	0.9180
57	0.8923	0.8923
58	0.8802	0.8802
59	0.7632	0.7632
60	0.7507	0.7507
61	0.6731	0.6731

Stream Protection Duration
POC #1
The Facility PASSED

The Facility PASSED.

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.6369	1184	1184	100	Pass
0.6595	1044	1044	100	Pass
0.6820	921	921	100	Pass
0.7045	807	807	100	Pass
0.7271	726	726	100	Pass
0.7496	648	648	100	Pass
0.7722	574	574	100	Pass
0.7947	508	508	100	Pass
0.8173	457	457	100	Pass
0.8398	411	411	100	Pass
0.8624	365	365	100	Pass
0.8849	328	328	100	Pass
0.9074	300	300	100	Pass
0.9300	277	277	100	Pass
0.9525	262	262	100	Pass
0.9751	243	243	100	Pass
0.9976	214	214	100	Pass
1.0202	195	195	100	Pass
1.0427	177	177	100	Pass
1.0653	164	164	100	Pass
1.0878	145	145	100	Pass
1.1104	132	132	100	Pass
1.1329	126	126	100	Pass
1.1554	116	116	100	Pass
1.1780	105	105	100	Pass
1.2005	97	97	100	Pass
1.2231	91	91	100	Pass
1.2456	84	84	100	Pass
1.2682	81	81	100	Pass
1.2907	76	76	100	Pass
1.3133	74	74	100	Pass
1.3358	70	70	100	Pass

1.3584	64	64	100	Pass
1.3809	62	62	100	Pass
1.4034	58	58	100	Pass
1.4260	55	55	100	Pass
1.4485	50	50	100	Pass
1.4711	47	47	100	Pass
1.4936	43	43	100	Pass
1.5162	41	41	100	Pass
1.5387	38	38	100	Pass
1.5613	36	36	100	Pass
1.5838	32	32	100	Pass
1.6063	28	28	100	Pass
1.6289	25	25	100	Pass
1.6514	23	23	100	Pass
1.6740	22	22	100	Pass
1.6965	20	20	100	Pass
1.7191	20	20	100	Pass
1.7416	20	20	100	Pass
1.7642	19	19	100	Pass
1.7867	16	16	100	Pass
1.8093	13	13	100	Pass
1.8318	12	12	100	Pass
1.8543	11	11	100	Pass
1.8769	11	11	100	Pass
1.8994	11	11	100	Pass
1.9220	11	11	100	Pass
1.9445	11	11	100	Pass
1.9671	10	10	100	Pass
1.9896	10	10	100	Pass
2.0122	10	10	100	Pass
2.0347	10	10	100	Pass
2.0573	9	9	100	Pass
2.0798	9	9	100	Pass
2.1023	9	9	100	Pass
2.1249	9	9	100	Pass
2.1474	9	9	100	Pass
2.1700	8	8	100	Pass
2.1925	8	8	100	Pass
2.2151	8	8	100	Pass
2.2376	8	8	100	Pass
2.2602	7	7	100	Pass
2.2827	7	7	100	Pass
2.3052	6	6	100	Pass
2.3278	6	6	100	Pass
2.3503	6	6	100	Pass
2.3729	6	6	100	Pass
2.3954	6	6	100	Pass
2.4180	6	6	100	Pass
2.4405	6	6	100	Pass
2.4631	6	6	100	Pass
2.4856	6	6	100	Pass
2.5082	6	6	100	Pass
2.5307	6	6	100	Pass
2.5532	4	4	100	Pass
2.5758	3	3	100	Pass
2.5983	3	3	100	Pass
2.6209	3	3	100	Pass

```
2.6434    3       3      100    Pass
2.6660    3       3      100    Pass
2.6885    3       3      100    Pass
2.7111    3       3      100    Pass
2.7336    3       3      100    Pass
2.7562    3       3      100    Pass
2.7787    3       3      100    Pass
2.8012    3       3      100    Pass
2.8238    3       3      100    Pass
2.8463    3       3      100    Pass
2.8689    3       3      100    Pass
```

Water Quality BMP Flow and Volume for POC #1
On-line facility volume: 0 **acre-feet**
On-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**
Off-line facility target flow: 0 **cfs.**
Adjusted for 15 min: 0 **cfs.**

LID Report

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

Perlnd and Implnd Changes

No changes have been made.

Appendix H

Operation and Maintenance Manual

Source Controls

No. 3 – Closed Detention Systems (Tanks/Vaults)

Maintenance Component	**Defect**	**Conditions When Maintenance is Needed**	**Results Expected When Maintenance is Performed**
Storage Area	Plugged Air Vents	One-half of the cross section of a vent is blocked at any point or the vent is damaged.	Vents open and functioning.
	Debris and Sediment	Accumulated sediment depth exceeds 10% of the diameter of the storage area for 1/2 length of storage vault or any point depth exceeds 15% of diameter. (Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than 1/2 length of tank.)	All sediment and debris removed from storage area.
	Joints Between Tank/Pipe Section	Any openings or voids allowing material to be transported into facility. (Will require engineering analysis to determine structural stability).	All joint between tank/pipe sections are sealed.
	Tank Pipe Bent Out of Shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape. (Review required by engineer to determine structural stability).	Tank/pipe repaired or replaced to design.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch and any evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determines that the vault is not structurally sound.	Vault replaced or repaired to design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or any evidence of soil particles entering the vault through the walls.	No cracks more than 1/4-inch wide at the joint of the inlet/outlet pipe.
Manhole	Cover Not in Place	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed.
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread (may not apply to self-locking lids).	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. Intent is to keep cover from sealing off access to maintenance.	Cover can be removed and reinstalled by one maintenance person.
	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, misalignment, not securely attached to structure wall, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Catch Basins	See “Catch Basins” (No. 5)	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).

No. 4 – Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.

No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

No. 7 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a “sheet flow” of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of “Distributor” Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See “Catch Basins” (No. 5).	See “Catch Basins” (No. 5).

No. 15 – Manufactured Media Filters)

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Below Ground Vault	Sediment Accumulation on Media.	Sediment depth exceeds 0.25-inches.	No sediment deposits which would impede permeability of the compost media.
	Sediment Accumulation in Vault	Sediment depth exceeds 6-inches in first chamber.	No sediment deposits in vault bottom of first chamber.
	Trash/Debris Accumulation	Trash and debris accumulated on compost filter bed.	Trash and debris removed from the compost filter bed.
	Sediment in Drain Pipes/Clean-Outs	When drain pipes, clean-outs, become full with sediment and/or debris.	Sediment and debris removed.
	Damaged Pipes	Any part of the pipes that are crushed or damaged due to corrosion and/or settlement.	Pipe repaired and/or replaced.
	Access Cover Damaged/Not Working	Cover cannot be opened; one person cannot open the cover using normal lifting pressure, corrosion/deformation of cover.	Cover repaired to proper working specifications or replaced.
	Vault Structure Includes Cracks in Wall, Bottom, Damage to Frame and/or Top Slab	Cracks wider than 1/2-inch or evidence of soil particles entering the structure through the cracks, or maintenance/inspection personnel determine that the vault is not structurally sound.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound.
		Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking warping, and/or showing signs of failure as determined by maintenance/inspection person.	Baffles repaired or replaced to specifications.
	Access Ladder Damaged	Ladder is corroded or deteriorated, not functioning properly, not securely attached to structure wall, missing rungs, cracks, and misaligned.	Ladder replaced or repaired and meets specifications, and is safe to use as determined by inspection personnel.
Below Ground Cartridge Type	Media	Drawdown of water through the media takes longer than 1 hour, and/or overflow occurs frequently.	Media cartridges replaced.
	Short Circuiting	Flows do not properly enter filter cartridges.	Filter cartridges replaced.

No. 21 - Maintenance Standards and Procedures for Bioretention Facilities.

Note that the inspection and routine maintenance frequencies listed below are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for “stormwater treatment and flow control BMPs/facilities.”

Maintenance Component	**Recommended Frequency** [a]		**Condition when Maintenance is Needed (Standards)**	**Action Needed (Procedures)**
	Inspection	**Routine Maintenance**		
Facility Footprint				
Earthen side slopes and berms	B, S		Erosion (gullies/ rills) greater than 2 inches deep around inlets, outlet, and alongside slopes	• Eliminate cause of erosion and stabilize damaged area (regrade, rock, vegetation, erosion control matting) • For deep channels or cuts (over 3 inches in ponding depth), temporary erosion control measures should be put in place until permanent repairs can be made. • Properly designed, constructed and established facilities with appropriate flow velocities should not have erosion problems except perhaps in extreme events. If erosion problems persist, the following should be reassessed: (1) flow volumes from contributing areas and bioretention facility sizing; (2) flow velocities and gradients within the facility; and (3) flow dissipation and erosion protection strategies at the facility inlet.
	A		Erosion of sides causes slope to become a hazard	Take actions to eliminate the hazard and stabilize slopes
	A, S		Settlement greater than 3 inches (relative to undisturbed sections of berm)	Restore to design height
	A, S		Downstream face of berm wet, seeps or leaks evident	Plug any holes and compact berm (may require consultation with engineer, particularly for larger berms)
	A		Any evidence of rodent holes or water piping in berm	• Eradicate rodents (see "Pest control") • Fill holes and compact (may require consultation with engineer, particularly for larger berms)
Concrete sidewalls	A		Cracks or failure of concrete sidewalls	• Repair/ seal cracks • Replace if repair is insufficient
Rockery sidewalls	A		Rockery side walls are insecure	Stabilize rockery sidewalls (may require consultation with engineer, particularly for walls 4 feet or greater in height)
Facility area		All maintenance visits (at least biannually)	Trash and debris present	Clean out trash and debris
Facility bottom area	A, S		Accumulated sediment to extent that infiltration rate is reduced (see “Ponded water”) or surface storage capacity significantly impacted	• Remove excess sediment • Replace any vegetation damaged or destroyed by sediment accumulation and removal • Mulch newly planted vegetation • Identify and control the sediment source (if feasible) • If accumulated sediment is recurrent, consider adding presettlement or installing berms to create a forebay at the inlet
		During/after fall leaf drop	Accumulated leaves in facility	Remove leaves if there is a risk to clogging outlet structure or water flow is impeded
Low permeability check dams and weirs	A, S		Sediment, vegetation, or debris accumulated at or blocking (or having the potential to block) check dam, flow control weir or orifice	Clear the blockage
	A, S		Erosion and/or undercutting present	Repair and take preventative measures to prevent future erosion and/or undercutting
	A		Grade board or top of weir damaged or not level	Restore to level position

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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No. 21 (continued) - Maintenance Standards and Procedures for Bioretention Facilities.

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	**Routine Maintenance**		
Facility Footprint (cont'd)				
Ponded water	B, S		Excessive ponding water: Water overflows during storms smaller than the design event or ponded water remains in the basin 48 hours or longer after the end of a storm.	Determine cause and resolve in the following order: 1) Confirm leaf or debris buildup in the bottom of the facility is not impeding infiltration. If necessary, remove leaf litter/debris. 2) Ensure that underdrain (if present) is not clogged. If necessary, clear underdrain. 3) Check for other water inputs (e.g., groundwater, illicit connections). 4) Verify that the facility is sized appropriately for the contributing area. Confirm that the contributing area has not increased. If steps #1-4 do not solve the problem, the bioretention soil is likely clogged by sediment accumulation at the surface or has become overly compacted. Dig a small hole to observe soil profile and identify compaction depth or clogging front to help determine the soil depth to be removed or otherwise rehabilitated (e.g., tilled). Consultation with an engineer is recommended.
Bioretention soil media	As needed		Bioretention soil media protection is needed when performing maintenance requiring entrance into the facility footprint	• Minimize all loading in the facility footprint (foot traffic and other loads) to the degree feasible in order to prevent compaction of bioretention soils. • Never drive equipment or apply heavy loads in facility footprint. • Because the risk of compaction is higher during saturated soil conditions, any type of loading in the cell (including foot traffic) should be minimized during wet conditions. • Consider measures to distribute loading if heavy foot traffic is required or equipment must be placed in facility. As an example, boards may be placed across soil to distribute loads and minimize compaction. • If compaction occurs, soil must be loosened or otherwise rehabilitated to original design state.
Inlets/Outlets/Pipes				
Splash block inlet	A		Water is not being directed properly to the facility and away from the inlet structure	Reconfigure/ repair blocks to direct water to facility and away from structure
Curb cut inlet/outlet	M during the wet season and before severe storm is forecasted	Weekly during fall leaf drop	Accumulated leaves at curb cuts	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
Pipe inlet/outlet	A		Pipe is damaged	Repair/ replace
	W		Pipe is clogged	Remove roots or debris
	A, S		Sediment, debris, trash, or mulch reducing capacity of inlet/outlet	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages
		Weekly during fall leaf drop	Accumulated leaves at inlets/outlets	Clear leaves (particularly important for key inlets and low points along long, linear facilities)
		A	Maintain access for inspections	• Clear vegetation (transplant vegetation when possible) within 1 foot of inlets and outlets, maintain access pathways • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Erosion control at inlet	A		Concentrated flows are causing erosion	Maintain a cover of rock or cobbles or other erosion protection measure (e.g., matting) to protect the ground where concentrated water enters the facility (e.g., a pipe, curb cut or swale)

No. 21 (continued) - Maintenance Standards and Procedures for Bioretention Facilities.

Maintenance Component	**Recommended Frequency** [a]		**Condition when Maintenance is Needed (Standards)**	**Action Needed (Procedures)**
	Inspection	**Routine Maintenance**		
Inlets/Outlets/Pipes (cont'd)				
Trash rack	S		Trash or other debris present on trash rack	Remove/dispose
	A		Bar screen damaged or missing	Repair/replace
Overflow	A, S		Capacity reduced by sediment or debris	Remove sediment or debris/dispose
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	• Plant roots, sediment or debris reducing capacity of underdrain • Prolonged surface ponding (see "Ponded water")	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly.
Vegetation				
Facility bottom area and upland slope vegetation	Fall and Spring		Vegetation survival rate falls below 75% within first two years of establishment (unless project O&M manual or record drawing stipulates more or less than 75% survival rate).	• Determine cause of poor vegetation growth and correct condition • Replant as necessary to obtain 75% survival rate or greater. Refer to original planting plan, or approved jurisdictional species list for appropriate plant replacements (See Appendix 3 - Bioretention Plant List, in the LID Technical Guidance Manual for Puget Sound). • Confirm that plant selection is appropriate for site growing conditions • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Vegetation (general)	As needed		Presence of diseased plants and plant material	• Remove any diseased plants or plant parts and dispose of in an approved location (e.g., commercial landfill) to avoid risk of spreading the disease to other plants • Disinfect gardening tools after pruning to prevent the spread of disease • See Pacific Northwest Plant Disease Management Handbook for information on disease recognition and for additional resources • Replant as necessary according to recommendations provided for "facility bottom area and upland slope vegetation".
Trees and shrubs		All pruning seasons (timing varies by species)	Pruning as needed	• Prune trees and shrubs in a manner appropriate for each species. Pruning should be performed by landscape professionals familiar with proper pruning techniques • All pruning of mature trees should be performed by or under the direct guidance of an ISA certified arborist
	A		Large trees and shrubs interfere with operation of the facility or access for maintenance	• Prune trees and shrubs using most current ANSI A300 standards and ISA BMPs. • Remove trees and shrubs, if necessary.
	Fall and Spring		Standing dead vegetation is present	• Remove standing dead vegetation • Replace dead vegetation within 30 days of reported dead and dying plants (as practical depending on weather/planting season) • If vegetation replacement is not feasible within 30 days, and absence of vegetation may result in erosion problems, temporary erosion control measures should be put in place immediately. • Determine cause of dead vegetation and address issue, if possible • If specific plants have a high mortality rate, assess the cause and replace with appropriate species. Consultation with a landscape architect is recommended.
	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.

No. 21 (continued) - Maintenance Standards and Procedures for Bioretention Facilities.

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Trees and shrubs (cont'd)	Fall and Spring		Planting beneath mature trees	• When working around and below mature trees, follow the most current ANSI A300 standards and ISA BMPs to the extent practicable (e.g., take care to minimize any damage to tree roots and avoid compaction of soil). • Planting of small shrubs or groundcovers beneath mature trees may be desirable in some cases; such plantings should use mainly plants that come as bulbs, bare root or in 4-inch pots; plants should be in no larger than 1-gallon containers.
	Fall and Spring		Presence of or need for stakes and guys (tree growth, maturation, and support needs)	• Verify location of facility liners and underdrain (if any) prior to stake installation in order to prevent liner puncture or pipe damage • Monitor tree support systems: Repair and adjust as needed to provide support and prevent damage to tree. • Remove tree supports (stakes, guys, etc.) after one growing season or maximum of 1 year. • Backfill stake holes after removal.
Trees and shrubs adjacent to vehicle travel areas (or areas where visibility needs to be maintained)	A		Vegetation causes some visibility (line of sight) or driver safety issues	• Maintain appropriate height for sight clearance • When continued, regular pruning (more than one time/ growing season) is required to maintain visual sight lines for safety or clearance along a walk or drive, consider relocating the plant to a more appropriate location. • Remove or transplant if continual safety hazard • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
Flowering plants		A	Dead or spent flowers present	Remove spent flowers (deadhead)
Perennials		Fall	Spent plants	Cut back dying or dead and fallen foliage and stems
Emergent vegetation		Spring	Vegetation compromises conveyance	• Hand rake sedges and rushes with a small rake or fingers to remove dead foliage before new growth emerges in spring or earlier only if the foliage is blocking water flow (sedges and rushes do not respond well to pruning)
Ornamental grasses (perennial)		Winter and Spring	Dead material from previous year's growing cycle or dead collapsed foliage	• Leave dry foliage for winter interest • Hand rake with a small rake or fingers to remove dead foliage back to within several inches from the soil before new growth emerges in spring or earlier if the foliage collapses and is blocking water flow
Ornamental grasses (evergreen)		Fall and Spring	Dead growth present in spring	• Hand rake with a small rake or fingers to remove dead growth before new growth emerges in spring • Clean, rake, and comb grasses when they become too tall • Cut back to ground or thin every 2-3 years as needed
Noxious weeds		M (March – October, preceding seed dispersal)	Listed noxious vegetation is present (refer to current county noxious weed list)	• By law, class A & B noxious weeds must be removed, bagged and disposed as garbage immediately • Reasonable attempts must be made to remove and dispose of class C noxious weeds • It is strongly encouraged that herbicides and pesticides not be used in order to protect water quality; use of herbicides and pesticides may be prohibited in some jurisdictions • Apply mulch after weed removal (see "Mulch")

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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No. 21 (continued) - Maintenance Standards and Procedures for Bioretention Facilities.

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Vegetation (cont'd)				
Weeds		M (March – October, preceding seed dispersal)	Weeds are present	• Remove weeds with their roots manually with pincer-type weeding tools, flame weeders, or hot water weeders as appropriate • Follow IPM protocols for weed management (see "Additional Maintenance Resources" section for more information on IPM protocols)
Excessive vegetation		Once in early to mid-May and once in early- to mid-September	Low-lying vegetation growing beyond facility edge onto sidewalks, paths, or street edge poses pedestrian safety hazard or may clog adjacent permeable pavement surfaces due to associated leaf litter, mulch, and soil	• Edge or trim groundcovers and shrubs at facility edge • Avoid mechanical blade-type edger and do not use edger or trimmer within 2 feet of tree trunks • While some clippings can be left in the facility to replenish organic material in the soil, excessive leaf litter can cause surface soil clogging
	As needed		Excessive vegetation density inhibits stormwater flow beyond design ponding or becomes a hazard for pedestrian and vehicular circulation and safety	• Determine whether pruning or other routine maintenance is adequate to maintain proper plant density and aesthetics • Determine if planting type should be replaced to avoid ongoing maintenance issues (an aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow) • Remove plants that are weak, broken or not true to form; replace in-kind • Thin grass or plants impacting facility function without leaving visual holes or bare soil areas • Consultation with a landscape architect is recommended for removal, transplant, or substitution of plants
	As needed		Vegetation blocking curb cuts, causing excessive sediment buildup and flow bypass	• Remove vegetation and sediment buildup
Mulch				
Mulch		Following weeding	Bare spots (without mulch cover) are present or mulch depth less than 2 inches	• Supplement mulch with hand tools to a depth of 2 to 3 inches • Replenish mulch per O&M manual. Often coarse compost is used in the bottom of the facility and arborist wood chips are used on side slopes and rim (above typical water levels) • Keep all mulch away from woody stems
Watering				
Irrigation system (if any)		Based on manufacturer's instructions	Irrigation system present	• Follow manufacturer's instructions for O&M
	A		Sprinklers or drip irrigation not directed/located to properly water plants	• Redirect sprinklers or move drip irrigation to desired areas
Summer watering (first year)		Once every 1-2 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in first year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present o Pulse water to enhance soil absorption, when feasible o Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff • Add a tree bag or slow-release watering device (e.g., bucket with a perforated bottom) for watering newly installed trees when irrigation system is not present

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

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No. 21 (continued) - Maintenance Standards and Procedures for Bioretention Facilities.

Maintenance Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Watering (cont'd)				
Summer watering (second and third years)		Once every 2-4 weeks or as needed during prolonged dry periods	Trees, shrubs and groundcovers in second or third year of establishment period	• 10 to 15 gallons per tree • 3 to 5 gallons per shrub • 2 gallons water per square foot for groundcover areas • Water deeply, but infrequently, so that the top 6 to 12 inches of the root zone is moist • Use soaker hoses or spot water with a shower type wand when irrigation system is not present o Pulse water to enhance soil absorption, when feasible o Pre-moisten soil to break surface tension of dry or hydrophobic soils/mulch, followed by several more passes. With this method , each pass increases soil absorption and allows more water to infiltrate prior to runoff
Summer watering (after establishment)		As needed	Established vegetation (after 3 years)	• Plants are typically selected to be drought tolerant and not require regular watering after establishment; however, trees may take up to 5 years of watering to become fully established • Identify trigger mechanisms for drought-stress (e.g., leaf wilt, leaf senescence, etc.) of different species and water immediately after initial signs of stress appear • Water during drought conditions or more often if necessary to maintain plant cover
Pest Control				
Mosquitoes	B, S		Standing water remains for more than 3 days after the end of a storm	• Identify the cause of the standing water and take appropriate actions to address the problem (see "Ponded water") • To facilitate maintenance, manually remove standing water and direct to the storm drainage system (if runoff is from non pollution-generating surfaces) or sanitary sewer system (if runoff is from pollution-generating surfaces) after getting approval from sanitary sewer authority. • Use of pesticides or *Bacillus thuringiensis israelensis* (Bti)may be considered only as a temporary measure while addressing the standing water cause. If overflow to a surface water will occur within 2 weeks after pesticide use, apply for coverage under the Aquatic Mosquito Control NPDES General Permit.
Nuisance animals	As needed		Nuisance animals causing erosion, damaging plants, or depositing large volumes of feces	• Reduce site conditions that attract nuisance species where possible (e.g., plant shrubs and tall grasses to reduce open areas for geese, etc.) • Place predator decoys • Follow IPM protocols for specific nuisance animal issues (see "Additional Maintenance Resources" section for more information on IPM protocols) • Remove pet waste regularly • For public and right-of-way sites consider adding garbage cans with dog bags for picking up pet waste.
Insect pests	Every site visit associated with vegetation management		Signs of pests, such as wilting leaves, chewed leaves and bark, spotting or other indicators	• Reduce hiding places for pests by removing diseased and dead plants • For infestations, follow IPM protocols (see "Additional Maintenance Resources" section for more information on IPM protocols)

[a] Frequency: A = Annually; B = Biannually (twice per year); M = Monthly; W = At least one visit should occur during the wet season (for debris/clog related maintenance, this inspection/maintenance visit should occur in the early fall, after deciduous trees have lost their leaves); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

IPM – Integrated Pest Management

ISA – International Society of Arboriculture

No. 22 - Maintenance Standards and Procedures for Permeable Pavement.

Note that the inspection and routine maintenance frequencies listed below are recommended by Ecology. They do not supersede or replace the municipal stormwater permit requirements for inspection frequency required of municipal stormwater permittees for “stormwater treatment and flow control BMPs/facilities.”

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course				
Permeable Pavements, all	A, S		Runoff from adjacent pervious areas deposits soil, mulch or sediment on paving	• Clean deposited soil or other materials from permeable pavement or other adjacent surfacing • Check if surface elevation of planted area is too high, or slopes towards pavement, and can be regraded (prior to regrading, protect permeable pavement by covering with temporary plastic and secure covering in place) • Mulch and/or plant all exposed soils that may erode to pavement surface
Porous asphalt or pervious concrete		A or B	None (routine maintenance)	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: o Walk-behind vacuum (sidewalks) o High efficiency regenerative air or vacuum sweeper (roadways, parking lots) o ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.
	A[b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. To clean clogged pavement surfaces, use one or combination of the following methods: • Combined pressure wash and vacuum system calibrated to not dislodge wearing course aggregate. • Hand held pressure washer or power washer with rotating brushes • Pure vacuum sweepers Note: If the annual/biannual routine maintenance standard to clean the pavement surface is conducted using equipment from the list above, corrective maintenance may not be needed.
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Pressure wash, vacuum sweep, or use a combination of the two for cleaning moss from pavement surface. May require stiff broom or power brush in areas of heavy moss.
	A		Major cracks or trip hazards and concrete spalling and raveling	• Fill potholes or small cracks with patching mixes • Large cracks and settlement may require cutting and replacing the pavement section. Replace in-kind where feasible. Replacing porous asphalt with conventional asphalt is acceptable if it is a small percentage of the total facility area and does not impact the overall facility function. • Take appropriate precautions during pavement repair and replacement efforts to prevent clogging of adjacent porous materials

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during storm event.

No. 22 (continued) - Maintenance Standards and Procedures for Permeable Pavement.

Component	**Recommended Frequency** [a]		**Condition when Maintenance is Needed (Standards)**	**Action Needed (Procedures)**
	Inspection	**Routine Maintenance**		
Surface/Wearing Course (cont'd)				
Interlocking concrete paver blocks and aggregate pavers		A or B	None (routine maintenance)	Clean pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: o Walk-behind vacuum (sidewalks) o High efficiency regenerative air or vacuum sweeper (roadways, parking lots) o ShopVac or brush brooms (small areas) • Note: Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints. Vacuum surface openings in dry weather to remove dry, encrusted sediment.
	A [b]		Surface is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)]	• Review the overall performance of the facility (note that small clogged areas may not reduce overall performance of facility) • Test the surface infiltration rate using ASTM C1701 as a corrective maintenance indicator. Perform one test per installation, up to 2,500 square feet. Perform an additional test for each additional 2,500 square feet up to 15,000 square feet total. Above 15,000 square feet, add one test for every 10,000 square feet. • If the results indicate an infiltration rate of 10 inches per hour or less, then perform corrective maintenance to restore permeability. • Clogging is usually an issue in the upper 2 to 3 centimeters of aggregate. Remove the upper layer of encrusted sediment, and fines, and/or vegetation from openings and joints between the pavers by mechanical means and/or suction equipment (e.g., pure vacuum sweeper). • Replace aggregate in paver cells, joints, or openings per manufacturer's recommendations
	A		Sediment present at the surface of the pavement	• Assess the overall performance of the pavement system during a rain event. If water runs off the pavement and/or there is ponding, then see above. • Determine source of sediment loading and evaluate whether or not the source can be reduced/eliminated. If the source cannot be addressed, consider increasing frequency of routine cleaning (e.g., twice per year instead of once per year).
	Summer		Moss growth inhibits infiltration or poses slip safety hazard	• Sidewalks: Use a stiff broom to remove moss in the summer when it is dry • Parking lots and roadways: Vacuum sweep or stiff broom/power brush for cleaning moss from pavement surface
	A		Paver block missing or damaged	Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations
	A		Loss of aggregate material between paver blocks	Refill per manufacturer's recommendations for interlocking paver sections
	A		Settlement of surface	May require resetting
Open-celled paving grid with gravel		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A [b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)]	• Use vacuum truck to remove and replace top course aggregate • Replace aggregate in paving grid per manufacturer's recommendations
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace gravel • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	May require resetting
	A		Loss of aggregate material in paving grid	Replenish aggregate material by spreading gravel with a rake (gravel level should be maintained at the same level as the plastic rings or no more than 1/4 inch above the top of rings). See manufacturer's recommendations.
		A	Weeds present	• Manually remove weeds • Presence of weeds may indicate that too many fines are present (refer to Actions Needed under "Aggregate is clogged" to address this issue)

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during storm event.

No. 22 (continued) - Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Surface/Wearing Course (cont'd)				
Open-celled paving grid with grass		A or B	None (routine maintenance)	• Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Follow equipment manufacturer guidelines for cleaning surface.
	A [b]		Aggregate is clogged: Ponding on surface or water flows off the permeable pavement surface during a rain event (does not infiltrate)]	• Rehabilitate per manufacturer's recommendations.
	A		Paving grid missing or damaged	• Remove pins, pry up grid segments, and replace grass • Replace grid segments where three or more adjacent rings are broken or damaged • Follow manufacturer guidelines for repairing surface.
	A		Settlement of surface	• May require resetting
	A		Poor grass coverage in paving grid	• Restore growing medium, reseed or plant, aerate, and/or amend vegetated area as needed • Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible
		As needed	None (routine maintenance)	• Use a mulch mower to mow grass
		A	None (routine maintenance)	• Sprinkle a thin layer of compost on top of grass surface (1/2" top dressing) and sweep it in • Do not use fertilizer
		A	Weeds present	• Manually remove weeds • Mow, torch, or inoculate and replace with preferred vegetation
Inlets/Outlets/Pipes				
Inlet/outlet pipe	A		Pipe is damaged	Repair/replace
	A		Pipe is clogged	Remove roots or debris
Underdrain pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain (may cause prolonged drawdown period)	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Raised subsurface overflow pipe	Clean pipe as needed	Clean orifice at least biannually (may need more frequent cleaning during wet season)	Plant roots, sediment or debris reducing capacity of underdrain	• Jet clean or rotary cut debris/roots from underdrain(s) • If underdrains are equipped with a flow restrictor (e.g., orifice) to attenuate flows, the orifice must be cleaned regularly
Outlet structure	A, S		Sediment, vegetation, or debris reducing capacity of outlet structure	• Clear the blockage • Identify the source of the blockage and take actions to prevent future blockages

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during storm event.

No. 22 (continued) - Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlets/Outlets/Pipes (cont'd)				
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.
Vegetation				
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).

[b] Inspection should occur during storm event.

VIII. Inspection and Maintenance

The BayFilter system requires periodic maintenance to continue operating at the design efficiency. The maintenance process comprises the removal and replacement of each BayFilter cartridge and the cleaning of the vault or manhole with a vacuum truck.

The maintenance cycle of the BayFilter system will be driven mostly by the actual solids load on the filter. The system should be periodically monitored to be certain it is operating correctly. Since stormwater solids loads can be variable, it is possible that the maintenance cycle could be more or less than the projected duration.

BayFilter systems in volume-based applications are designed to treat the WQv in 24 hours initially. Late in the operational cycle of the BayFilter, the flow rate will diminish as a result of occlusion. When the drain down exceeds the regulated standard, maintenance should be performed.

When a BayFilter system is first installed, it is recommended that it be inspected every six (6) months. When the filter system exhibits flows below design levels the system should be maintained. Filter cartridge replacement should also be considered when sediment levels are at or above the level of the manifold system. Please contact the BaySaver Technologies Engineering Department for maintenance cycle estimations or assistance at **1.800.229.7283.**

Maintenance Procedures

1. Remove the manhole covers and open all access hatches.

2. Before entering the system make sure the air is safe per OSHA Standards or use a breathing apparatus. Use low O2, high CO, or other applicable warning devices per regulatory requirements.

3. Using a vacuum truck remove any liquid and sediments that can be removed prior to entry.

4. Using a small lift or the boom of the vacuum truck, remove the used cartridges by lifting them out.

5. Any BayFilters that cannot be readily lifted directly out of the vault should be removed from their location and carried to the lifting point using the Trolley system installed in the Vault (if applicable).

6. When all BayFilters are removed, remove the balance of the solids and water; then loosen the stainless clamps on the Fernco couplings in the pipe manifold; remove the drain pipes as well. Carefully cap the manifold and the Ferncos and rinse the floor removing the balance of the collected solids.

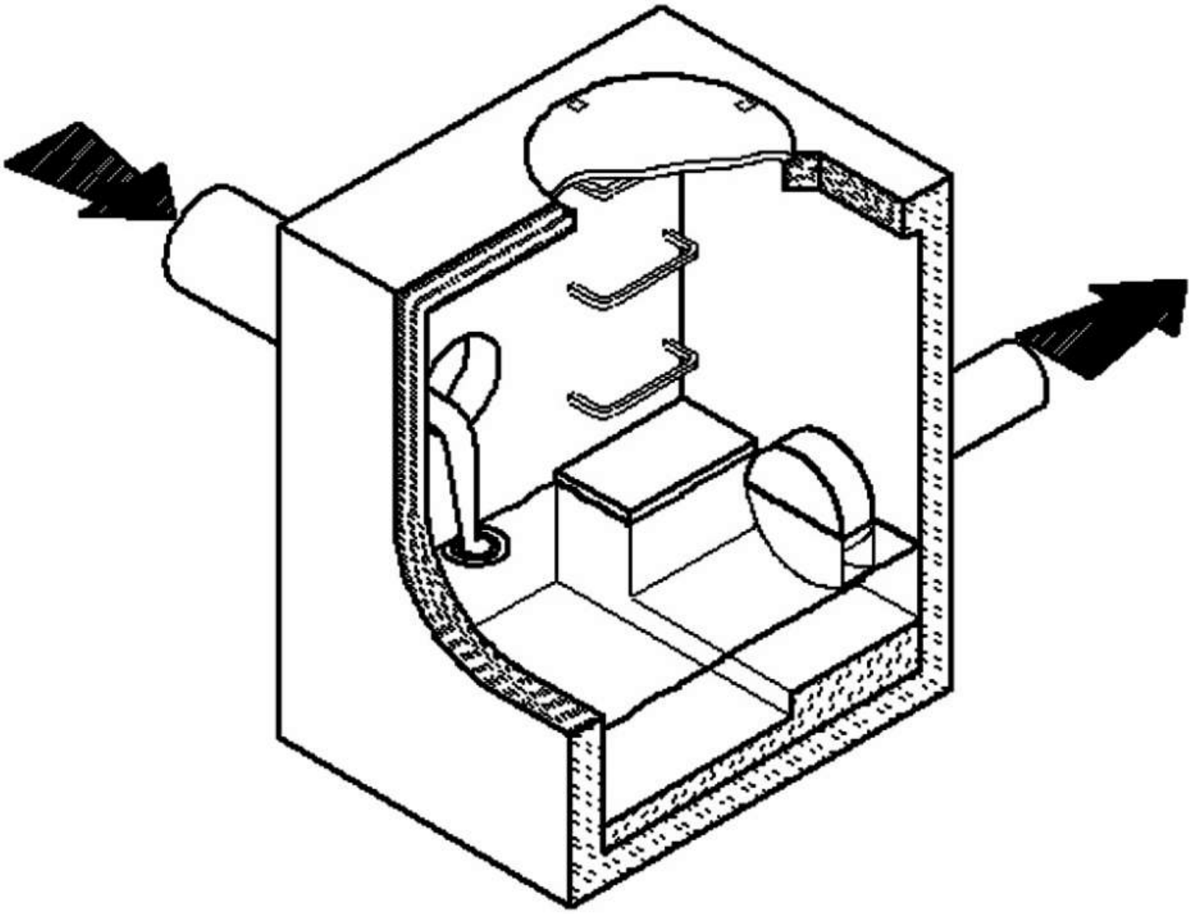
7. Clean the manifold pipes, inspect, and reinstall.

8. Install the exchange BayFilters and close all covers.

9. The used BayFilters must be sent back to BaySaver Technologies for exchange/recycling and credit on undamaged units.

10. Contact BaySaver Technologies for Exchange Filter pricing and availability at **1.800.229.7283**.

VHV/SVHV VORTEX FLOW REGULATOR
INSTALLATION, OPERATION
AND MAINTENANCE MANUAL



HYDROVEX®

VORTEX FLOW REGULATOR
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

PROJECT :

EQUIPMENT LOCATION :

DESCRIPTION : **VORTEX FLOW REGULATOR**

TYPE : **HYDROVEX®**

REFERENCE N° OF THE SUPPLIER :

MODEL N° :

SERIAL N° :

UNIT WEIGHT :

DATE OF FABRICATION :

DATE OF DELIVERY :

SUPPLIER : **Veolia Water Technologies Canada Inc.**
4105 Sartelon
Montreal, Quebec
H4S 2B3
Tel.: (514) 334-7230
Fax: (514) 334-5070
E-Mail: cso@veolia.com
ISO 9001:2000

WARRANTY

CLIENT NAME	:
OUR REFERENCE N°	:
PROJECT NAME	:
PROJECT LOCATION	:
REGULATOR MODEL	:
SERIAL NUMBER	:
DELIVERY DATE	:

The manufacturer, **Veolia Water Technologies Canada Inc.** warrants for a period of 5 years, starting from the delivery date, its “Vortex Flow Regulators” against workmanship defects and failure to perform, once installed and used in conditions for which it had been originally designed and sold.

Veolia Water Technologies Canada Inc. warrants that the actual flow as measured under the original installation conditions will not exceed plus or minus 5% of the flow shown on the certified curve provided with the regulating valve.

HYDROVEX® Vortex Flow Regulators shall be installed in accordance with **Veolia Water Technologies Canada Inc.** recommendations.

This warranty shall be void if repairs and/or alterations are made without **Veolia Water Technologies Canada Inc.** authorization.

VORTEX FLOW REGULATOR
INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

TABLE OF CONTENTS

Section 1.0 GENERAL INFORMATION

The **HYDROVEX®** vortex flow regulator is a static device, which controls discharge without the aid of moving parts. The control is accomplished as a result of the unit's geometric shape and depends solely on the upstream water level.

THE **HYDROVEX®** VORTEX FLOW REGULATOR CAN ONLY WORK EFFECTIVELY IF THE INSTALLATION IS PROPERLY CARRIED OUT.

Prior to installation, it is recommended that the installation procedure be followed carefully and that:

- The contractor or subcontractor is familiar with the installation procedures of the **HYDROVEX®** regulator.
- The various elevations, as shown on the approval drawings, have been verified and respected.
- The access hatch to the regulator chamber has a sufficiently large opening for allowing the passage of the **HYDROVEX**.
- That you acquire all the necessary components of the **HYDROVEX®** valve required for installation.

If you have any problems or questions concerning the installation procedure, **DO NOT HESITATE** to contact the **HYDROVEX®** division at:

Veolia Water Technologies Canada Inc.
4105 Sartelon
Montreal, Quebec
H4S 2B3
Tel.: (514) 334-7230
Fax: (514) 334-5070
E-Mail: cso@veolia.com

Section 2.0 APPROVED SHOP DRAWINGS AND DISCHARGE CURVES

The approved drawings and discharge curves included hereafter have been approved by the consultant. This information was used for fabrication and to evaluate the performances of the equipment.

Section 3.0 INSTALLATION PROCEDURES

3.1 UNIT DESCRIPTION

The model number provides important details required for installation of the **HYDROVEX®** regulator, for example: **100 SVHV-2.**

Number **100** indicates the inlet width of the **HYDROVEX®** flow regulator in millimeters. To obtain the exact inlet width of the flow regulator, you divide by 25.4 (100mm = 3 15/16 inches).

Letter **S** indicates the presence of a spoiler the regulator inlet.

Number **1** indicates the calculation ratio of the unit.

3.2 PREPARATION FOR INSTALLATION

The regulator outlet pipe should be cleared and properly cleaned prior to installation. It should be noted for easier installation and reduce the weight of the regulator that it's possible to remove the stainless steel part by sliding it upward with the handle. In order to carry out the installation, it may be necessary to have lifting equipment available.

The **HYDROVEX®** regulator is delivered complete with its cover. It is lowered into position either by hand (using ropes or cables attached to the main orifice).

3.3 INSTALLING THE HYDROVEX® REGULATOR

Alignment of the **HYDROVEX®** regulator is made by placing the back plate orifice in the center of the outlet chamber pipe and making sure that the back plate is leveled and that the track can be pull upward.

The back plate bolts are installed and hand tightened, but not locked in place. Install the rubber-packing rings to seal the joint between the concrete and the back plate.

NOTE: Proper operation of the **HYDROVEX®** vortex flow regulator is ensured only if the correct mounting leveling of the device is respected

ANCHOR INSTALLATION PROCEDURE

1. Using a proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.
2. Blow the hole clean of dust and other material.
3. Position the washer on the anchor and thread on the nut.
4. Drive the anchor through the fixture into the anchor hole until the nut and washer are firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.
5. Tighten the anchor by turning the nut 3 to 4 turns.

Size	Drill Bit Diam.	Minimum Embedment	Thread Length
3/8" x 5"	3/8"	1 5/8"	3 3/4"

Section 4.0 OPERATION

The basic operating principle governing the **HYDROVEX®** regulator is the use of vortex flow to regulate the discharge through the outlet orifice of the regulator while maximizing the flow area. The flow area for the **HYDROVEX®** regulator may be up to 6 times larger than the flow area of an orifice plate operating under the same design conditions.

The **HYDROVEX®** flow regulator controls the discharge without moving parts. It does not require any external signals or electricity. The discharge curve for a given **HYDROVEX®** regulator depends entirely on the geometry of the valve itself, the water level and the installation parameters.

The **HYDROVEX®** regulator does not allow for flow modulation; however certain parameters may be changed, such as the outlet orifice diameter, to obtain a new discharge curve.

The hole located on the top part of the **HYDROVEX®** flow regulator is only used to equalize the internal pressure of the unit and does not serve to control the discharge.

Section 5 MAINTENANCE

5.1 INSPECTION

The **HYDROVEX**® regulator switches automatically between orifice and vortex flow mode depending on the water level in the chamber, therefore manual operation is not required. It is recommended that a regular visual inspection be carried out, particularly during start-up period or after construction works are completed upstream from the chamber. The attached "Maintenance Schedule" provides information on the recommended maintenance intervals. Please refer to the Table below.

MAINTENANCE INTERVAL	MAINTENANCE PROCEDURE
Three (3) months after start of operation and after first heavy rainfall	- Visual check - Inspect valve inlet and outlet; open housing, remove coarse debris (if any)
Then every six (6) months	As above

The **HYDROVEX**® regulator is not a waste grinder unit. Debris bigger than outlet orifice may enter in the valve body and not exit due to their length. Such debris must be manually removed when detected. This debris may also cause unit to malfunction.

Once every year, a full inspection of the unit is recommended, including removal of the sliding gate regulator, cleaning of the area, visual inspection for abnormalities like leaks and cracks in the unit.

5.2 EQUIPMENT TESTING

Trial runs of a newly installed valve are recommended. The testing is the responsibility of the owner; however **Veolia Water Technologies Canada Inc.** will be pleased to give any advice concerning the tests. The recommended procedure is to allow the water level to rise in the chamber to its maximum level by blocking the outlet pipe with a blocking balloon, then quickly deflating the balloon. At that point, the **HYDROVEX®** vortex valve should turn into full vortex flow. In some cases, the unit does not operate in vortex mode even at the maximum head in the chamber. In this case, check the water flow coming out of the unit. If the blockage is removed, the flow should be important and fast. If you still feel that the unit is blocked, check the inlet and the valve housing for any obstructions. If any obstruction is found, remove it and repeat the procedure.

BMPs for Landscaping and Lawn/ Vegetation Management

Description of Pollutant Sources: Landscaping can include grading, soil transfer, vegetation removal, pesticide and fertilizer applications, and watering. Stormwater contaminants include toxic organic compounds, heavy metals, oils, total suspended solids, coliform bacteria, fertilizers, and pesticides.

Lawn and vegetation management can include control of objectionable weeds, insects, mold, bacteria and other pests with chemical pesticides and is conducted commercially at commercial, industrial, and residential sites. Examples include weed control on golf course lawns, access roads, and utility corridors and during landscaping; sap stain and insect control on lumber and logs; rooftop moss removal; killing nuisance rodents; fungicide application to patio decks, and residential lawn/plant care. Toxic pesticides such as pentachlorophenol, carbamates, and organometallics can be released to the environment by leaching and dripping from treated parts, container leaks, product misuse, and outside storage of pesticide contaminated materials and equipment. Poor management of the vegetation and poor application of pesticides or fertilizers can cause appreciable stormwater contamination.

Pollutant Control Approach: Control of fertilizer and pesticide applications, soil erosion, and site debris to prevent contamination of stormwater.

Develop and implement an Integrated Pest Management Plan (IPM) and use pesticides only as a last resort. If pesticides/herbicides are used they must be carefully applied in accordance with label instructions on U.S. Environmental Protection Agency (EPA) registered materials. Maintain appropriate vegetation, with proper fertilizer application where practicable, to control erosion and the discharge of stormwater pollutants. Where practicable grow plant species appropriate for the site, or adjust the soil properties of the subject site to grow desired plant species.

Applicable Operational BMPs for Landscaping:

- Install engineered soil/landscape systems to improve the infiltration and regulation of stormwater in landscaped areas.
- Do not dispose of collected vegetation into waterways or storm drainage systems.

Recommended Additional Operational BMPs for Landscaping:

- Conduct mulch-mowing whenever practicable
- Dispose of grass clippings, leaves, sticks, or other collected vegetation, by composting, if feasible.

- Use mulch or other erosion control measures when soils are exposed for more than one week during the dry season or two days during the rainy season.
- If oil or other chemicals are handled, store and maintain appropriate oil and chemical spill cleanup materials in readily accessible locations. Ensure that employees are familiar with proper spill cleanup procedures.
- Till fertilizers into the soil rather than dumping or broadcasting onto the surface. Determine the proper fertilizer application for the types of soil and vegetation encountered.
- Till a topsoil mix or composted organic material into the soil to create a well-mixed transition layer that encourages deeper root systems and drought-resistant plants.
- Use manual and/or mechanical methods of vegetation removal rather than applying herbicides, where practical.

Applicable Operational BMPs for the Use of Pesticides:

- Develop and implement an IPM (See section on IPM at end of BMP) and use pesticides only as a last resort.
- Implement a pesticide-use plan and include at a minimum: a list of selected pesticides and their specific uses; brands, formulations, application methods and quantities to be used; equipment use and maintenance procedures; safety, storage, and disposal methods; and monitoring, record keeping, and public notice procedures. All procedures shall conform to the requirements of Chapter 17.21 RCW and Chapter 16-228 WAC (Appendix IV-D R.7).
- Choose the least toxic pesticide available that is capable of reducing the infestation to acceptable levels. The pesticide should readily degrade in the environment and/or have properties that strongly bind it to the soil. Any pest control used should be conducted at the life stage when the pest is most vulnerable. For example, if it is necessary to use a Bacillus thuringiens is application to control tent caterpillars, it must be applied before the caterpillars cocoon or it will be ineffective. Any method used should be site-specific and not used wholesale over a wide area.
- Apply the pesticide according to label directions. Under no conditions shall pesticides be applied in quantities that exceed manufacturer’s instructions.
- Mix the pesticides and clean the application equipment in an area where accidental spills will not enter surface or ground waters, and will not contaminate the soil.

- Store pesticides in enclosed areas or in covered impervious containment. Ensure that pesticide contaminated stormwater or spills/leaks of pesticides are not discharged to storm drains. Do not hose down the paved areas to a storm drain or conveyance ditch. Store and maintain appropriate spill cleanup materials in a location known to all near the storage area.
- Clean up any spilled pesticides and ensure that the pesticide contaminated waste materials are kept in designated covered and contained areas.
- The pesticide application equipment must be capable of immediate shutoff in the event of an emergency.
- Do not spray pesticides within 100 feet of open waters including wetlands, ponds, and streams, sloughs and any drainage ditch or channel that leads to open water except when approved by Ecology or the local jurisdiction. All sensitive areas including wells, creeks and wetlands must be flagged prior to spraying.
- As required by the local government or by Ecology, complete public posting of the area to be sprayed prior to the application.
- Spray applications should only be conducted during weather conditions as specified in the label direction and applicable local and state regulations. Do not apply during rain or immediately before expected rain.

Recommended Additional Operational BMPs for the use of pesticides:

- Consider alternatives to the use of pesticides such as covering or harvesting weeds, substitute vegetative growth, and manual weed control/moss removal.
- Consider the use of soil amendments, such as compost, that are known to control some common diseases in plants, such as Pythium root rot, ashy stem blight, and parasitic nematodes. The following are three possible mechanisms for disease control by compost addition (USEPA Publication 530-F-9-044):
    1. Successful competition for nutrients by antibiotic production;
    2. Successful predation against pathogens by beneficial microorganism; and
    3. Activation of disease-resistant genes in plants by composts.

Installing an amended soil/landscape system can preserve both the plant system and the soil system more effectively. This type of approach provides a soil/landscape system with adequate depth, permeability, and organic matter to sustain itself and continue working as an effective stormwater infiltration system and a sustainable nutrient cycle.

- Once a pesticide is applied, its effectiveness should be evaluated for possible improvement. Records should be kept showing the applicability and inapplicability of the pesticides considered.
- An annual evaluation procedure should be developed including a review of the effectiveness of pesticide applications, impact on buffers and sensitive areas (including potable wells), public concerns, and recent toxicological information on pesticides used/proposed for use. If individual or public potable wells are located in the proximity of commercial pesticide applications contact the regional Ecology hydrogeologist to determine if additional pesticide application control measures are necessary.
- Rinseate from equipment cleaning and/or triple-rinsing of pesticide containers should be used as product or recycled into product.
- The application equipment used should be capable of immediate shutoff in the event of an emergency.

For more information, contact the WSU Extension Home-Assist Program, (253) 445-4556, or Bio-Integral Resource Center (BIRC), P.O. Box 7414, Berkeley, CA.94707, or the Washington Department of Ecology to obtain "Hazardous Waste Pesticides" (Publication #89-41); and/or EPA to obtain a publication entitled "Suspended, Canceled and Restricted Pesticides" which lists all restricted pesticides and the specific uses that are allowed. Valuable information from these sources may also be available on the internet.

Applicable Operational BMPs for Vegetation Management:

- Use at least an eight-inch "topsoil" layer with at least 8 percent organic matter to provide a sufficient vegetation-growing medium. Amending existing landscapes and turf systems by increasing the percent organic matter and depth of topsoil can substantially improve the permeability of the soil, the disease and drought resistance of the vegetation, and reduce fertilizer demand. This reduces the demand for fertilizers, herbicides, and pesticides. Organic matter is the least water-soluble form of nutrients that can be added to the soil. Composted organic matter generally releases only between 2 and 10 percent of its total nitrogen annually, and this release corresponds closely to the plant growth cycle. If natural plant debris and mulch are returned to the soil, this system can continue recycling nutrients indefinitely.
- Select the appropriate turfgrass mixture for your climate and soil type. Certain tall fescues and rye grasses resist insect attack because the symbiotic endophytic fungi found naturally in their tissues repel or kill common leaf and stem-eating lawn insects. They do not, however, repel root-feeding lawn pests such as Crane Fly larvae, and are toxic to ruminants such as cattle and sheep. The fungus causes no known

adverse effects to the host plant or to humans. Endophytic grasses are commercially available and can be used in areas such as parks or golf courses where grazing does not occur. The local Cooperative Extension office can offer advice on which types of grass are best suited to the area and soil type.

- Use the following seeding and planting BMPs, or equivalent BMPs to obtain information on grass mixtures, temporary and permanent seeding procedures, maintenance of a recently planted area, and fertilizer application rates: Temporary Seeding, Mulching and Matting, Clear Plastic Covering, Permanent Seeding and Planting, and Sodding as described in Volume II).
- Selection of desired plant species can be made by adjusting the soil properties of the subject site. For example, a constructed wetland can be designed to resist the invasion of reed canary grass by layering specific strata of organic matters (e.g., compost forest product residuals) and creating a mildly acidic pH and carbon-rich soil medium. Consult a soil restoration specialist for site-specific conditions.
- Aerate lawns regularly in areas of heavy use where the soil tends to become compacted. Aeration should be conducted while the grasses in the lawn are growing most vigorously. Remove layers of thatch greater than ¾-inch deep.
- Mowing is a stress-creating activity for turfgrass. When grass is mowed too short its productivity is decreased and there is less growth of roots and rhizomes. The turf becomes less tolerant of environmental stresses, more disease prone and more reliant on outside means such as pesticides, fertilizers and irrigation to remain healthy. Set the mowing height at the highest acceptable level and mow at times and intervals designed to minimize stress on the turf. Generally mowing only 1/3 of the grass blade height will prevent stressing the turf.

Irrigation:

- The depth from which a plant normally extracts water depends on the rooting depth of the plant. Appropriately irrigated lawn grasses normally root in the top 6 to 12 inches of soil; lawns irrigated on a daily basis often root only in the top 1 inch of soil. Improper irrigation can encourage pest problems, leach nutrients, and make a lawn completely dependent on artificial watering. The amount of water applied depends on the normal rooting depth of the turfgrass species used, the available water holding capacity of the soil, and the efficiency of the irrigation system. Consult with the local water utility, Conservation District, or Cooperative Extension office to help determine optimum irrigation practices.

Fertilizer Management:

- Turfgrass is most responsive to nitrogen fertilization, followed by potassium and phosphorus. Fertilization needs vary by site depending on plant, soil and climatic conditions. Evaluation of soil nutrient levels through regular testing ensures the best possible efficiency and economy of fertilization. For details on soils testing, contact the local Conservation District or Cooperative Extension Service.
- Fertilizers should be applied in amounts appropriate for the target vegetation and at the time of year that minimizes losses to surface and ground waters. Do not fertilize during a drought or when the soil is dry. Alternatively, do not apply fertilizers within three days prior to predicted rainfall. The longer the period between fertilizer application and either rainfall or irrigation, the less fertilizer runoff occurs.
- Use slow release fertilizers such as methylene urea, IDBU, or resin coated fertilizers when appropriate, generally in the spring. Use of slow release fertilizers is especially important in areas with sandy or gravelly soils.
- Time the fertilizer application to periods of maximum plant uptake. Generally fall and spring applications are recommended, although WSU turf specialists recommend four fertilizer applications per year.
- Properly trained persons should apply all fertilizers. At commercial and industrial facilities fertilizers should not be applied to grass swales, filter strips, or buffer areas that drain to sensitive water bodies unless approved by the local jurisdiction.

Integrated Pest Management

An IPM program might consist of the following steps:

Step 1: Correctly identify problem pests and understand their life cycle

Step 2: Establish tolerance thresholds for pests.

Step 3: Monitor to detect and prevent pest problems.

Step 4: Modify the maintenance program to promote healthy plants and discourage pests.

Step 5: Use cultural, physical, mechanical, or biological controls first if pests exceed the tolerance thresholds.

Step 6: Evaluate and record the effectiveness of the control and modify maintenance practices to support lawn or landscape recovery and prevent recurrence.

For an elaboration of these steps refer to Appendix IV-F.

BMPs for Maintenance of Stormwater Drainage and Treatment Systems

Description of Pollutant Sources: Facilities include roadside catch basins on arterials and within residential areas, conveyance systems, detention facilities such as ponds and vaults, oil and water separators, biofilters, settling basins, infiltration systems, and all other types of stormwater treatment systems presented in Volume V. Roadside catch basins can remove from 5 to 15 percent of the pollutants present in stormwater. When catch basins are about 60 percent full of sediment, they cease removing sediments. Oil and grease, hydrocarbons, debris, heavy metals, sediments and contaminated water are found in catch basins, oil and water separators, settling basins, etc.

Pollutant Control Approach: Provide maintenance and cleaning of debris, sediments, and oil from stormwater collection, conveyance, and treatment systems to obtain proper operation.

Applicable Operational BMPs:

Maintain stormwater treatment facilities according to the O & M procedures presented in Section 4.6 of Volume V in addition to the following BMPs:

- Inspect and clean treatment BMPs, conveyance systems, and catch basins as needed, and determine whether improvements in O & M are needed.
- Promptly repair any deterioration threatening the structural integrity of the facilities. These include replacement of clean-out gates, catch basin lids, and rock in emergency spillways.
- Ensure that storm sewer capacities are not exceeded and that heavy sediment discharges to the sewer system are prevented.
- Regularly remove debris and sludge from BMPs used for peak-rate control, treatment, etc. and discharge to a sanitary sewer if approved by the sewer authority, or truck to a local or state government approved disposal site.
- Clean catch basins when the depth of deposits reaches 60 percent of the sump depth as measured from the bottom of basin to the invert of the lowest pipe into or out of the basin. However, in no case should there be less than six inches clearance from the debris surface to the invert of the lowest pipe. Some catch basins (for example, WSDOT Type 1L basins) may have as little as 12 inches sediment storage below the invert. These catch basins will need more frequent inspection and cleaning to prevent scouring. Where these catch basins are part of a stormwater collection and treatment system, the system owner/operator may choose to concentrate maintenance efforts on downstream control devices as part of a systems approach.

- Clean woody debris in a catch basin as frequently as needed to ensure proper operation of the catchbasin.
- Post warning signs; “Dump No Waste - Drains to Ground Water,” “Streams,” “Lakes,” or emboss on or adjacent to all storm drain inlets *where practical*.
- Disposal of sediments and liquids from the catch basins must comply with “Recommendations for Management of Street Wastes” described in Appendix IV-G of this volume.

Additional Applicable BMPs: Select additional applicable BMPs from this chapter depending on the pollutant sources and activities conducted at the facility. Those BMPs include:

- BMPs for Soil Erosion and Sediment Control at Industrial Sites
- BMPs for Storage of Liquid, Food Waste, or Dangerous Waste Containers
- BMPs for Spills of Oil and Hazardous Substances
- BMPs for Illicit Connections to Storm Drains
- BMPs for Urban Streets.

BMPs for Parking and Storage of Vehicles and Equipment

Description of Pollutant Sources: Public and commercial parking lots such as retail store, fleet vehicle (including rent-a-car lots and car dealerships), equipment sale and rental parking lots, and parking lot driveways, can be sources of toxic hydrocarbons and other organic compounds, oils and greases, metals, and suspended solids caused by the parked vehicles.

Pollutant Control Approach: If the parking lot is a **high-use site** as defined below, provide appropriate oil removal equipment for the contaminated stormwater runoff.

Applicable Operational BMPs:

- If washing of a parking lot is conducted, discharge the washwater to a sanitary sewer, if allowed by the local sewer authority, or other approved wastewater treatment system, or collect it for off-site disposal.
- Do not hose down the area to a storm drain or to a receiving water. Sweep parking lots, storage areas, and driveways, regularly to collect dirt, waste, and debris.

Applicable Treatment BMPs: An oil removal system such as an API or CP oil and water separator, catch basin filter, or equivalent BMP, approved by the local jurisdiction, is applicable for parking lots meeting the threshold vehicle traffic intensity level of a *high-use site.*

Vehicle High-Use Sites

Establishments subject to a vehicle high-use intensity have been determined to be significant sources of oil contamination of stormwater. Examples of potential high use areas include customer parking lots at fast food stores, grocery stores, taverns, restaurants, large shopping malls, discount warehouse stores, quick-lube shops, and banks. If the PGIS for a high-use site exceeds 5,000 square feet in a threshold discharge area, and oil control BMP from the Oil Control Menu is necessary. A high-use site at a commercial or industrial establishment has one of the following characteristics: (Gaus/King County, 1994)

- Is subject to an expected average daily vehicle traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area: or
- Is subject to storage of a fleet of 25 or more diesel vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.).

BMPs for Roof/ Building Drains at Manufacturing and Commercial Buildings

Description of Pollutant Sources: Stormwater runoff from roofs and sides of manufacturing and commercial buildings can be sources of pollutants caused by leaching of roofing materials, building vents, and other air emission sources. Vapors and entrained liquid and solid droplets/particles have been identified as potential pollutants in roof/building runoff. Metals, solvents, acidic/alkaline pH, BOD, and organics, are some of the pollutant constituents identified.

Pollutant Control Approach: Evaluate the potential sources of stormwater pollutants and apply source control BMPs where feasible.

Applicable Operational Source Control BMPs:

- If leachates and/or emissions from buildings are suspected sources of stormwater pollutants, then sample and analyze the stormwater draining from the building.
- If a roof/building stormwater pollutant source is identified, implement appropriate source control measures such as air pollution control equipment, selection of materials, operational changes, material recycle, process changes, etc.

Stormwater Site Plan Report

PREPARED FOR:

Bassetti Architects
71 Columbia Street, Suite 500
Seattle, WA 98104

PROJECT:

Spruce Elementary School Phase 2
17405 Spruce Way
Lynnwood, WA 98037
2140275.10

PREPARED BY:

Yi Yang, PE
Project Engineer

REVIEWED BY:

Douglas G. Tapp, PE
Principal

Bethany P. Steadman, PE
Senior Engineer

DATE:

February 2020 – Phase 2

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Senior Engineer

DATE:

February 2020 – Phase 2

DOUGLAS G. TAPP
STATE OF WASHINGTON
35702
REGISTERED
PROFESSIONAL ENGINEER

02/03/2020

I hereby state that this Stormwater Site Plan Report for Spruce Elementary School Phase 2 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 City of Lynnwood does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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Permanent Stormwater Control Calculations

1.0 Project Overview

1.1 General Description of Project

This report supplements the Stormwater Site Plan Report dated April 2018 for the Spruce Elementary School project located on the existing Spruce Elementary School site (17405 Spruce Way, Lynnwood, Washington), and encompasses three tax parcels (00372700301502, 00372700301501, and 00372700301504). This report documents a revision to the hydrologic model for Phase 2, providing a final design of stormwater facilities for Threshold Discharge Area (TDA) A and TDA B, and providing an update to the hydrologic model for TDA C stormwater facilities that were constructed during Phase 1.

Phase 1 was constructed with substantial completion in August 2019. Phase 2 is expected to start construction in July 2020.

1.2 Existing Conditions

See Section 1.2 of the Stormwater Site Plan Report dated April 2018 for a description of the existing conditions prior to construction of Phase 1.

1.3 Developed Conditions

See Section 1.3 of the Stormwater Site Plan Report dated April 2018 for a description of the Phase 1 and Phase 2 projects. Edmonds School District acquired the neighboring property in December 2019. During Phase 2, the total project area is 5.99 acres.

An open stormwater pond combined with a stormwater wetland and underground detention pipe will be constructed to provide flow control and water quality treatment for TDA A. The constructed wetland comprises an open pond, flow control structure, and an emergency overflow structure. The constructed wetland will encourage infiltration and evapotranspiration. A bioretention cell combined with underground detention pipe will be constructed to provide flow control and water quality treatment for TDA B.

1.4 Project Classification

Project classification is unchanged. Per LMC Section 13.40.050, the project is classified as a Large Project because it disturbs more than 1 acre of land and is required to provide a Detailed Drainage Plan. Per the Drainage Manual, the project is classified as a Redevelopment Project and all Minimum Requirements apply to the new and replaced hard surfaces and converted vegetation areas.

2.0 Minimum Requirements

See Section 2.0 of the Stormwater Site Plan Report dated April 2018 for a Minimum Requirements analysis and conclusion. How the project is addressing the Minimum Requirements is unchanged, with the following exception.

Per the *2012 Washington State Department of Ecology Stormwater Management Manual for Western Washington amended in 2014 (Drainage Manual)*, under the definition for a Threshold Discharge Area (TDA) on page G-43 in Volume 1, TDAs do not include “offsite” areas. As such, the right-of-way improvements have been removed from TDA A flow control and water quality threshold review. See updated Appendix A-3b. The right-of-way improvements within TDA A include 4,500 square feet of new or replaced impervious area and are subject to Minimum Requirements (MRs) 1 through 5, thus not triggering flow control or water quality treatment.

It is not feasible to provide any onsite stormwater management for the road improvements because the road improvements are lower than stormwater facilities located onsite, and there is insufficient area available within the right-of-way.

3.0 Offsite Analysis

See Section 3.0 of the Stormwater Site Plan Report dated April 2018 for offsite analysis and conclusion.

4.0 Permanent Stormwater Control Plan

The project will meet MRs 5 through 7 by providing a permanent stormwater control plan, including Onsite Stormwater Management Best Management Practices (BMPs), flow control facilities, and water quality facilities.

During Phase 1, flow control in TDA C was constructed by using a pond that is interconnected with a 6-foot diameter pipe, and a Silva Cell has been constructed serving the service yard. In Phase 2, a pond combined with detention pipe will be constructed for flow control in TDA A, with wetland underneath the pond providing both onsite stormwater management and water quality treatment. In TDA B, a detention pipe will be constructed for flow control, followed by a bioretention cell, for both onsite stormwater management and water quality treatment.

4.1 Site Hydrology

The site hydrology is determined by the type of land coverage, soil type, and slope. Onsite soils are Vashon Lodgement till, which is categorized as a Class C soil for modeling purposes. Landscape areas will meet BMP T5.13 post-construction soil quality and depth. Per the *Drainage Manual*, page 5-10 from Volume V, these areas shall be modeled as pasture. See Appendix A-3b for the revised Phase 2 Developed Conditions Map.

TDAs A, B, and C require flow control and water quality in Phase 2 of the project. The stormwater modeling software MGSFlood was utilized to size facilities and confirm compliance with the *Drainage Manual for* TDA A and TDA B. The Western Washington Hydrology Model (WWHM) was used to confirm compliance with the *Drainage Manual for* TDA C to maintain consistency with previous calculations during Phase 1.

4.1.1 TDA A

The areas shown below were used in MGSFlood for sizing of stormwater flow control facilities for TDA A. The mitigated areas are areas tributary to the pond and detention pipe system, whereas the bypass area does not drain to the flow control system. An area of existing pavement is being directed to onsite stormwater management facilities as a flow-through area to help offset the bypass areas. The combined volume of the pond and detention tank system is calculated using a stage storage table in MGSFlood. An Excel table provided by MGSFlood is used to create the stage storage table in MGSFlood.

Refer to the table below for a summary of areas that were entered into the MGSFlood model, which is consistent with Appendix A-3b, Developed Conditions Map.

Table 1 – Land Cover Summary for Target Areas in TDA A Phase 2 for Flow Control

Subbasin	C, Forest (ac)	C, Pasture* (ac)	Bioretention area* (ac)	Impervious (ac)	Total (ac)
Total Pre-Developed	3.730	-	-	0.090**	3.820
Bioretention 1 (B1)	-	0.278	0.052	0.850	1.180
Pond/Detention Tank	-	0.540	-	1.820	2.360
Bypass	-	0.170	-	0.020	0.190
Non-target Pond	-	-	-	0.090	0.090
Total Developed	-	0.988	0.052	2.780	3.820

* Bioretention cell area is subtracted from Pasture. Bioretention is represented by "Area at Riser Crest" in the model and precipitation/evaporation is applied to the bioretention node.

** Non-target area that flows through stormwater facilities.

4.1.2 TDA B

TDA B will be provided with flow control and water quality to meet the minimum requirements. The mitigated areas are areas tributary to the detention pipe that are followed by a bioretention cell, whereas the bypass area does not drain to the flow control system.

Table 2 – Land Cover Summary for Target Areas in TDA B Phase 2 for Flow Control

Subbasin	C, Forest (ac)	C, Pasture (ac)	C, Pasture* (Silva Cell) (ac)	Impervious (ac)	Total (ac)
Total Pre-Developed	2.260	-	-	-	**2.260**
Bioretention 2 (B2)	-	0.310	0.100	0.040	0.450
Detention Tank	-	0.460	-	1.060	1.520
Bypass	-	0.250	-	0.040	0.290
Total Developed	-	1.020	0.100	1.140	**2.260**

* Bioretention cell area is subtracted from Pasture. Bioretention is represented by "Area at Riser Crest" in the model and precipitation/evaporation is applied to the bioretention node.

** Basin includes pollution generating surfaces.

4.1.3 TDA C

Developed conditions for TDA C have been modeled to evaluate the flow control facilities designed in Phase 1. The same rain gage was selected in WWHM to match the precipitation modeled in MGSFlood.

The areas shown below were measured on construction plans and used in the model. The mitigated areas are areas tributary to the flow control system, whereas the bypass area does not drain to the flow control system. TDA C flow control volume was constructed in Phase 1. The control structure will be revised in Phase 2 per updated calculation results.

Table 3 – Land Cover Summary for Target Areas in TDA C Phase 2 for Flow Control

Subbasin	C, Forest (ac)	C, Pasture (ac)	Impervious (ac)	Total (ac)
Total Pre-Developed	3.000 ac	-	-	**3.000**
Basin 3 (Silva Cell)*	-	-	0.140	0.140
Mitigated (Pond+Tank)	-	0.660	1.840	2.500
Bypass	-	0.330	0.030	0.360
Total Developed	-	0.990	2.010	**3.000**

* Basin includes pollution generating surfaces.

4.2 Onsite Stormwater Management

All TDAs are required to fulfill List 2 in Section 2.5.5, Volume 1, of the *Drainage Manual*. During Phase 2 of the project, BMPs are implemented to the maximum extent. Based on the requirements from List 2, Table 4 summarizes the BMP consideration for each surface in TDA A and the feasibility determination for the work in this subbasin.

Table 4 – Onsite Stormwater Management BMP Feasibility (TDA A)

Surface Type	List #2 Feasibility Review (**Bold Determined Feasible and Provided**)	Justification
Landscaping	**1. Post Construction Soil (BMP T5.13)**	**1. BMP T5.13 is proposed for all proposed landscaped areas.**
Roof Basins: B1	~~1. Full Dispersion or Downspout Full Infiltration Systems~~ **2. Bioretention** 3. Downspout Dispersion 4. Perforated Stub-out Connections	1. Full Dispersion is not feasible be, as a 65% native growth area is not being set aside downstream of impervious areas. 2. **A bioretention cell has been provided.**
Drive Lanes, Fire Lane, Parking Lot, and Walks Basins: B1	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ **3. Bioretention** 4. Sheet Flow Dispersion	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils (including existing fill soils) and permeable pavement is infeasible. **3. A bioretention cell has been provided.**
Other Hard Surfaces: Pond maintenance access; Bike path around pond; Existing Driveway and Sidewalk Basin: Pond Bypass	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ ~~3. Bioretention~~ ~~4. Sheet Flow Dispersion~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils (including existing fill soils) and permeable pavement is infeasible. 3. Bioretention cells are not feasible, as there is no area available within the ROW that can accept drainage via gravity. 4. Sheet Flow Dispersion is not feasible, as there is not a 50-foot vegetated path available.

Table 5 summarizes the BMP consideration for each surface in TDA B and the feasibility determination for the work in this subbasin.

Table 5 – Onsite Stormwater Management BMP Feasibility (TDA B)

Surface Type	List #2 Feasibility Review (**Bold Determined Feasible and Provided**)	Justification
Landscaping	**1. Post Construction Soil (BMP T5.13)**	**1. BMP T5.13 is proposed for all proposed landscaped areas.**
Playfield Basins: Field	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ ~~3. Bioretention~~ ~~4. Sheet Flow Dispersion~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. The surface is not a pavement area, thus permeable pavement is not feasible. 3. Bioretention cells are not feasible, as the surface area is being collected with an underdrain system that would be too deep to gravity discharge into a bioretention cell. 4. Sheet Flow Dispersion is not feasible, as the vegetated flow path is not available.
Drive Lanes, Parking Lot, and Concrete Walks; Pathway around playfield Basins: B2	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ **3. Bioretention** 4, Sheet Flow Dispersion	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils, and thus permeable pavement is infeasible. **3. A bioretention cell has been provided.**
Other Hard Surfaces: Driveway and Sidewalk Basins: Bypass	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ ~~3. Bioretention~~ ~~4. Sheet Flow Dispersion~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils, and thus permeable pavement is infeasible. 3. Bioretention cells are not feasible, as there is no area available within the ROW that can accept drainage via gravity. 4. Sheet Flow Dispersion is not feasible, as the vegetated flow path is not available.

Table 6 summarizes the BMP consideration for each surface in TDA C and the feasibility determination for the work in this subbasin.

Table 6 – Onsite Stormwater Management BMP Feasibility (TDA C)

Surface Type	List #2 Feasibility Review (**Bold Determined Feasible and Provided**)	Justification
Landscaping	**1. Post Construction Soil (BMP T5.13)**	**1. BMP T5.13 is proposed for all proposed landscaped areas.**
Roof Basins: Det	~~1. Full Dispersion or Downspout Full Infiltration Systems~~ ~~2. Bioretention~~ ~~3. Downspout Dispersion~~ ~~4. Perforated Stub-Out Connections~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Bioretention is not feasible, as there is no area available that can accept drainage. 3. Downspout dispersion is not feasible, as the vegetated flow path is not available. 4. Perforated Stub-Out Connection is not feasible, as the Geotechnical engineer has deemed the site to have non-infiltrating soils.
Service Yard Basins: Basin 3	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ **3. Bioretention** 4. Sheet Flow Dispersion	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils (including existing fill soils) and permeable pavement is infeasible. **3. A bioretention cell (Silva Cell) has been provided. (Sized and constructed in Phase 1)**
Other Hard Surfaces: Classroom Courtyard, Loop Path, Play Areas Basin: Det, Bypass	~~1. Full Dispersion~~ ~~2. Permeable Pavement~~ ~~3. Bioretention~~ ~~4. Sheet Flow Dispersion~~	1. Full Dispersion is not feasible, as a 65% native growth area is not being set aside downstream of impervious areas. 2. Geotechnical engineer has deemed the site to have non-infiltrating soils (including existing fill soils) and permeable pavement is infeasible. 3. Bioretention cells are not feasible, as there is no area available within the ROW that can accept drainage via gravity. 4. Sheet Flow Dispersion is not feasible, as there is not a 50-foot vegetated path available.

Bioretention areas are sized per BMP T5.14B. The design guidelines recommended in the *Drainage Manual* are 5 percent of the total impervious surface area and 2 percent of the total pervious surface area draining to it. See Table 7 for areas draining to each bioretention cell, as well as the required and provided ponding surface areas. TDA C has not changed from Phase 1 and is not repeated below.

Table 7 – Bioretention Cell Sizing for OSM

Bioretention Cell	**Contributing Area Type**	**Contributing Surface Area (ac)**	**Required Ponding Surface Area (sf)**	**Provided Ponding Surface Area (sf)**	**Area Mitigated by OSM?**
Bioretention 1 (TDA A)	Impervious	0.85	2,148	3,017	☒
	Pervious	0.34			
Bioretention 2 (TDA B)	Impervious	1.17	2,844	7,410	☒
	Pervious	0.34			

4.3 Flow Control

Flow control in TDA A will be implemented by constructing a pond system combined with a 6-foot diameter detention tank under the northwesterly parking area. The flow control restrictor tee within the control manhole has been sized to mitigate peak flows modeled in MGSFlood. See Table 8 for the MGSFlood inputs and Appendix E-1 for the modeling report.

Table 8 – TDA A - Flow Control Facility Summary

Facility Type	Pond connected to 6-foot Diameter Pipe
Required Total Volume	57,111 cf
Live Storage Depth	6 ft
Total Linear Feet Provided	325 ft
Provided Total Volume in Pipe	**8,510 cf**
Facility Type	Pond
Live Storage Depth	6 ft
Available Total Volume in Pond	**58,195 cf**
Provided Total Volume in Pipe + Pond	**66,705 cf**

Flow control in TDA B will be implemented by a detention pond in the southwest corner of the site with a flow control structure. Below is a summary of the required and provided flow control system. See Table 9 for the MGSFlood inputs and Appendix E-2 for the modeling report.

Table 9 – TDA B - Flow Control Facility Summary

Facility Type	6-foot Diameter Pipe
Required Total Volume	27,413 cf
Live Storage Depth	5 ft
Total Linear Feet Provided	1,100 ft
Provided Total Volume in Pipe	**27,560 cf**

Flow control for TDA C will be provided using a detention pond interconnected with a 6-foot diameter detention tank that was constructed during Phase 1. The post-developed condition has been modeled in MGSFlood to confirm the design from Phase 1 meets the Phase 2 developed conditions. The flow control riser will be replaced based on the updated modeling results in Phase 2. See Table 10 for the MGSFlood input and Appendix E-3 for the modeling report.

Table 10 – TDA C - Flow Control Facility Summary

Facility Type	Pond connected to 6-foot Diameter Pipe
Required Total Volume	35,364 cf
Live Storage Depth	5 ft
Provided Total Volume in Pipe + Pond	**40,380 cf**

4.4 Water Quality Treatment

A. Phase 1

TDA A: Pollution-generating surfaces in TDA A include the school bus drop-off area, the north half of the parking lot, and the fire lane to the east. The runoff generated by these areas will be treated by the wetland located downstream of the detention system, which will also provide treatment for the non-target and bypass pollution generating surfaces. The non-target areas are treated to help offset areas that bypass the system. The wetland is designed per BMP T-10.30. See Appendix E-5 for wetland sizing.

TDA B: Pollution-generating surfaces in TDA B include the south half of the parking lot. A bioretention system located near the south entrance will provide treatment for these surfaces. The playfield will be covered by natural grass. Water quality treatment is not required for the playfield.

TDA C: The temporary parking constructed in Phase 1 has been replaced with non-pollution generation surfaces. The remaining pollution-generating surface in TDA C includes the service yard on the south side of the school. A Silva Cell bioretention system has been constructed in Phase 1 to provide water quality treatment. The design of the system has been confirmed in WWHM.

See Appendices E-1 through E-3 for MGSFlood/WWHM modeling reports. A letter from DeepRoot Partners was provided in the previous report confirming that the Silva Cell is acceptable as BMP T7.30. See the table below for a summary of the water quality facility sizes.

Table 11 – Water Quality Facilities Summary

TDA A – Wetland	See Appendix E-5	
TDA A – Bioretention 2	Facility Type	Bioretention
	Required Infiltration %	91%
	Provided Infiltration %	96.01%
	Required Bottom Area	5,242 SF
	Provided Bottom Area	5,521 SF

5.0 Stormwater Pollution Prevention

The project will provide temporary and permanent BMPs per the Construction Stormwater Pollution Prevention Plan (CSWPPP) outlined in Section 5.0 of the Stormwater Site Plan Report dated April 2018 to meet MR 2. A CSWPPP plan has been provided as a separate report. An additional calculation for TDA C was necessary because the entire basin is not being disturbed in Phase 2. All TESC modeling is included in Appendix E.

6.0 Special Reports and Studies

See Section 6.0 of the Stormwater Site Plan Report dated April 2018.

7.0 Other Permits

See Section 7.0 of the Stormwater Site Plan Report dated April 2018.

8.0 Operation and Maintenance Manual

See Section 8.0 of the Stormwater Site Plan Report dated April 2018.

9.0 Declaration of Covenant for Privately Maintained Stormwater Facilities

A declaration of covenant can be provided, if required.

10.0 Bond Quantities Worksheet

A Bond Quantities Worksheet for this project has not been included. Per the Revised Code of Washington (RCW), schools cannot use capital funds to post bonds. The necessary bonds for construction will be posted by the contractor, if required.

11.0 Conclusion

After completion of Phase 2, the project will meet the requirements of the 2012 Washington State Department of Ecology *Stormwater Management Manual for Western Washington amended in 2014 (Drainage Manual)*, City of Lynnwood Standard Plans, and Lynnwood Municipal Code (LMC) Chapter 13.40, Stormwater Management. This report, in conjunction with the report dated April 2018, documents how the project will meet Minimum Requirements (MRs) 1 through 9

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.

Yi Yang, PE
Project Engineer

YY/lsk

February 2020 – Phase 2

Q:\2014\2140275\WORDPROC\Reports\Phase 2\20200203 Rpt (SSP Ph 2) 2140275.10.docx

Appendix A

Maps

A-3b ....Developed Conditions Map – Phase 2

TDA A - ROW

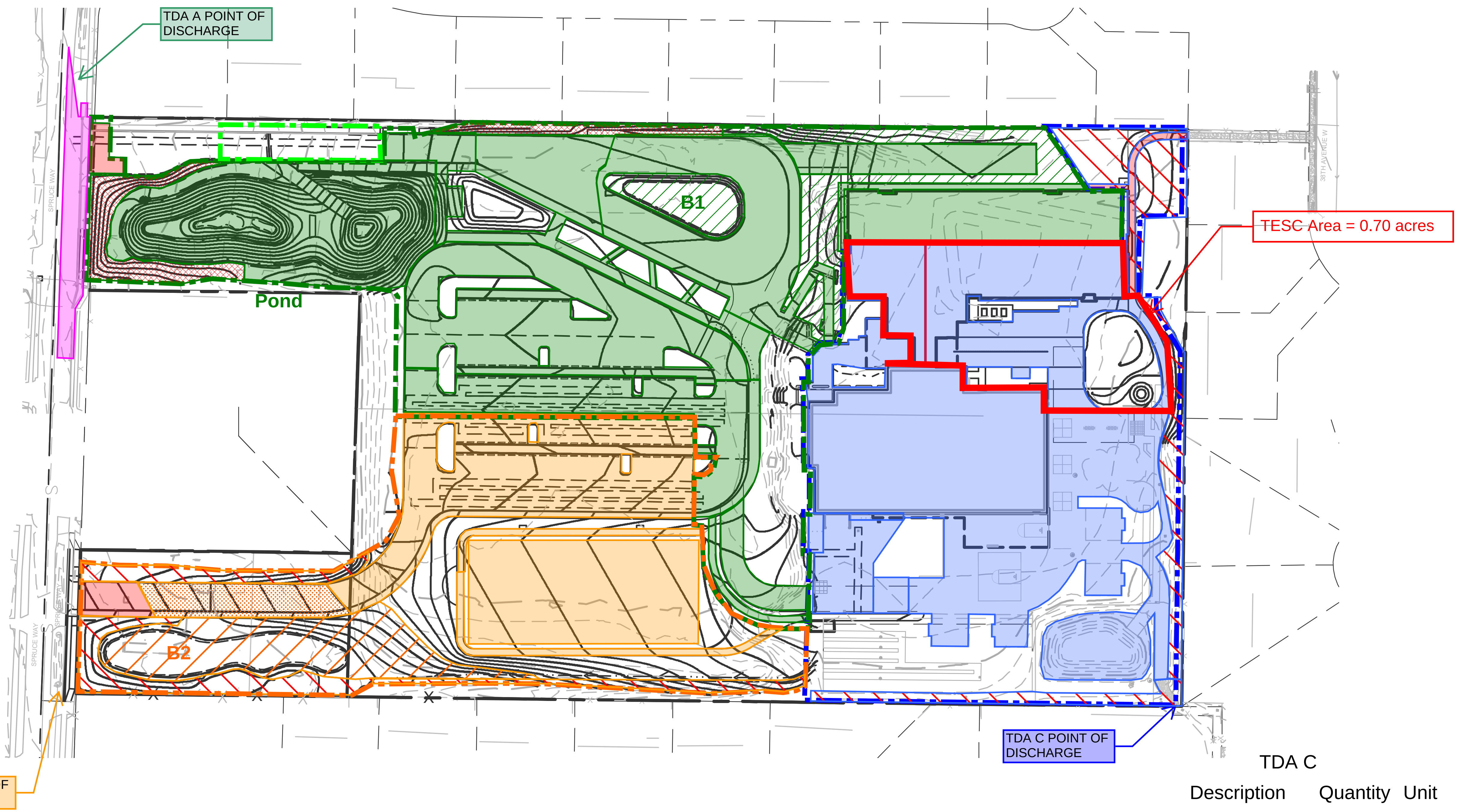
	Description	Quantity	Unit
🟪	ROW Imp	0.10	ac

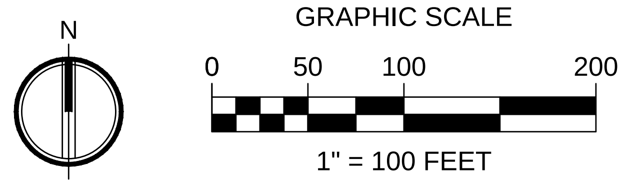
TDA A

	Description	Quantity	Unit
🟩	B1 Imp	0.85	ac
▨	B1 Perv	0.34	ac
🟥	Bypass Imp	0.02	ac
▩	Bypass Perv	0.17	ac
⬚	Non-Target Area	0.09	ac
🟩	Pond Imp	1.82	ac
⬚	Total TDA A	3.73	ac

TDA B

	Description	Quantity	Unit
▩	B2 Imp	0.11	ac
▨	B2 Perv	0.34	ac
🟥	Bypass Imp	0.04	ac
▨	Bypass Perv	0.25	ac
🟧	Dentention Imp	1.06	ac
⬚	Total TDA B	2.26	ac





TDA C

	Description	Quantity	Unit
🟥	Bypass Imp	0.03	ac
▨	Bypass Total	0.36	ac
🟦	Det Imp	1.84	ac
🟦	SC Imp	0.14	ac
⬚	TDA C - TOTAL	3.00	ac

AHBL

1200 6th Avenue
Suite 1620
Seattle, WA 98101
206.267.2425 TEL
206.267.2429 FAX

Spruce Elementary School

Developed Conditions Map - Phase 2

EXHIBIT A-3b

Appendix E

Permanent Stormwater Control Calculations

E-1

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201710010
Project Simulation Performed on: 01/29/2020 2:08 PM
Report Generation Date: 01/30/2020 11:46 AM

Input File Name:	TDA.fld
Project Name:	Spruce ES
Analysis Title:	TDA A
Comments:	

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Precipitation Station Data Selected
Climatic Region Number: 5

Full Period of Record Available used for Routing
Precipitation Station : 452675 Everett 10/01/1948-10/01/2011
Evaporation Station : 456803 Puyallup
At Site 25-Year, 24-Hour Precipitation (inches): 2.99
Gage 25-Year, 24-Hour Precipitation (inches) : 2.69
Precipitation Scale Factor : 1.112
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) ***************

********************** WATERSHED DEFINITION ***********************

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	3.820	3.768
Area of Links that Include Precip/Evap (acres)	0.000	0.052
Total (acres)	3.820	3.820

---------------------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : TDA A - Predev ----------

	-------Area (Acres) --------
Till Forest	3.730

```
Impervious                  0.090
---------------------------------------------
Subbasin Total              3.820

----------------------SCENARIO: POSTDEVELOPED
Number of Subbasins:   4


  ---------- Subbasin : Area to B1 ----------
                           -------Area (Acres) --------
Till Pasture                0.278
Impervious                  0.850
---------------------------------------------
Subbasin Total              1.128


  ---------- Subbasin : Area to Pond ----------
                           -------Area (Acres) --------
Till Pasture                0.540
Impervious                  1.820
---------------------------------------------
Subbasin Total              2.360


  ---------- Subbasin : Bypass   ----------
                           -------Area (Acres) --------
Till Pasture                0.170
Impervious                  0.020
---------------------------------------------
Subbasin Total              0.190


  ---------- Subbasin : Non Target Pond ----------
                           -------Area (Acres) --------
Impervious                  0.090
---------------------------------------------
Subbasin Total              0.090



************************** LINK DATA *******************************

----------------------SCENARIO: PREDEVELOPED
Number of Links:   0


************************** LINK DATA *******************************

----------------------SCENARIO: POSTDEVELOPED
Number of Links:   3


------------------------------------------
Link Name: B1
Link Type:   Bioretention Facility
Downstream Link Name: Pond
```

Base Elevation (ft) : 544.54
Riser Crest Elevation (ft) : 544.79
Storage Depth (ft) : 0.25
Bottom Length (ft) : 100.0
Bottom Width (ft) : 22.7
Side Slopes (ft/ft) : L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft) : 2268.
Area at Riser Crest El (sq-ft) : 2,454.
(acres) : 0.056
Volume at Riser Crest (cu-ft) : 1,951.
(ac-ft) : 0.045

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft) : 1.50
Biosoil Saturated Hydraulic Conductivity (in/hr) : 3.00
Biosoil Porosity (Percent) : 40.00
Maximum Elevation of Bioretention Soil : 545.29
Native Soil Hydraulic Conductivity (in/hr) : 0.00

Underdrain Present
Orifice Present in Under Drain
Orifice Control Elevation (ft) : 541.29
Orifice Diameter (in) : 0.500

Riser Geometry
Riser Structure Type : Rectangular
Riser Length (ft) : 2.00
Riser Width (ft) : 2.00
Common Length (ft) : 0.000
Riser Crest Elevation : 544.79 ft

Hydraulic Structure Geometry

Number of Devices: 0

--
Link Name: Pond
Link Type: Structure
Downstream Link Name: POC

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
531.50	0.
531.75	532.
532.00	1938.
532.25	3556.
532.50	5225.
532.75	7004.
533.00	8885.
533.25	10865.
533.50	12941.
533.75	15224.

534.00	17485.
534.25	19829.
534.50	22260.
534.75	24773.
535.00	27364.
535.25	30148.
535.50	32891.
535.75	35707.
536.00	38591.
536.25	41543.
536.50	44558.
536.75	47708.
537.00	50819.
537.25	53966.
537.50	57111.
537.75	60230.
538.00	63443.
538.25	66751.
538.50	69654.

Minimum total detention volume required

Required total detention volume = 57,111 cf

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.000
Riser Crest Elevation : 537.50 ft

Hydraulic Structure Geometry

Number of Devices: 4

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 531.50
Diameter (in) : 1.00
Orientation : Horizontal
Elbow : No

---Device Number 2 ---
Device Type : Circular Orifice
Control Elevation (ft) : 534.85
Diameter (in) : 1.25
Orientation : Horizontal
Elbow : Yes

---Device Number 3 ---
Device Type : Circular Orifice
Control Elevation (ft) : 535.60
Diameter (in) : 1.88
Orientation : Horizontal

Elbow : Yes

---Device Number 4 ---
Device Type : Circular Orifice
Control Elevation (ft) : 536.40
Diameter (in) : 1.37
Orientation : Horizontal
Elbow : Yes

--
Link Name: POC
Link Type: Copy
Downstream Link: None

***********************FLOOD FREQUENCY AND DURATION STATISTICS*********************

---------------------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

---------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 4
Number of Links: 3

*************Groundwater Recharge Summary ***************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: TDA A - Predev	236.032
Total:	236.032

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Area to B1	16.851
Subbasin: Area to Pond	32.732
Subbasin: Bypass	10.305
Subbasin: Non Target Pond	0.000
Link: B1	Not Computed
Link: Pond	Not Computed
Link: POC	0.000
Total:	59.888

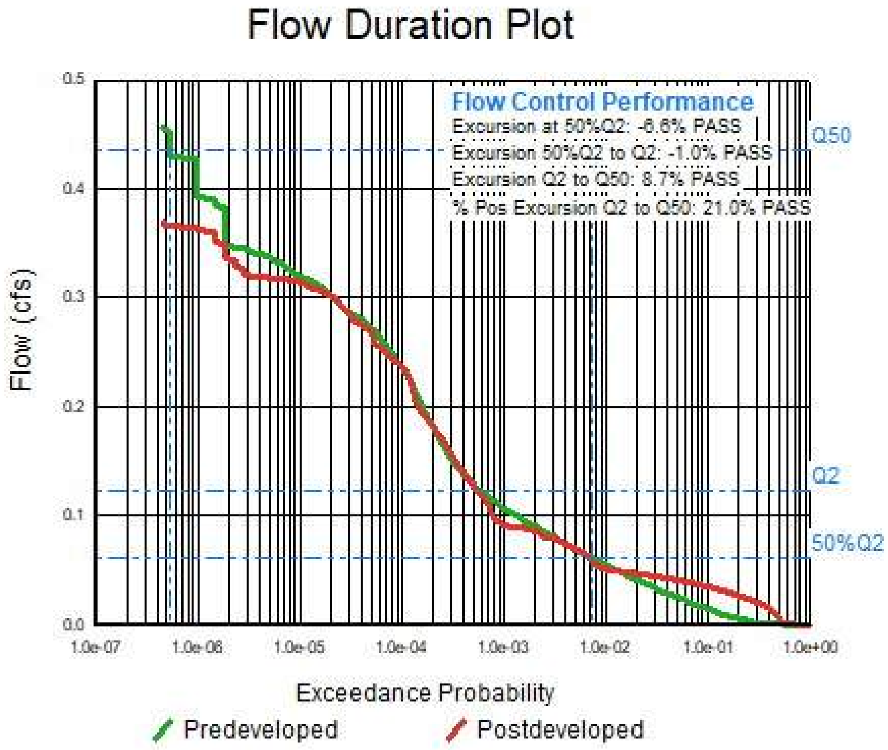
Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 63)
Predeveloped: 3.747 ac-ft/year, Post Developed: 0.951 ac-ft/year

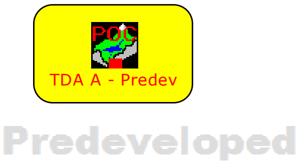
*************Water Quality Facility Data ***************

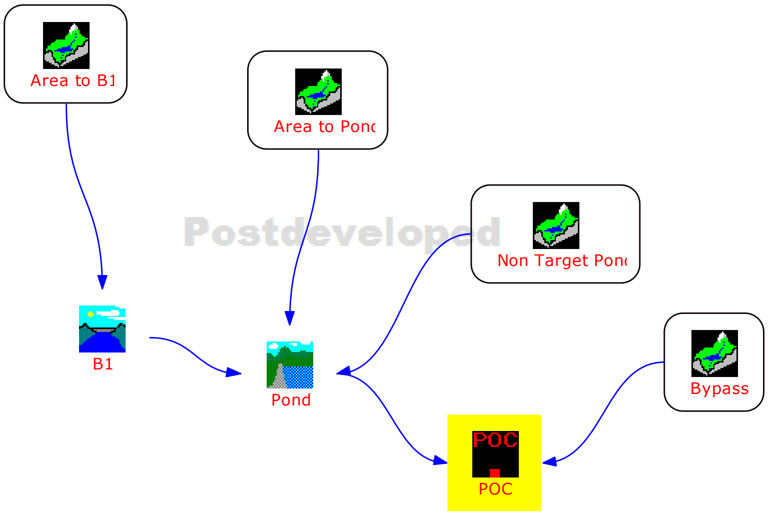
```
---------------------SCENARIO: PREDEVELOPED

Number of Links:   0


---------------------SCENARIO: POSTDEVELOPED

Number of Links:   3


********** Link: Pond                                                        **********

 Basic Wet Pond Volume (91% Exceedance):   13973. cu-ft    Volume for sizing wetland
 Computed Large Wet Pond Volume, 1.5*Basic Volume:   20959. cu-ft


********** Link: POC                                                         **********

 Infiltration/Filtration Statistics--------------------
 Inflow Volume (ac-ft):   599.30
 Inflow Volume Including PPT-Evap (ac-ft):   599.30
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Primary Outflow To Downstream System (ac-ft):   599.30
 Secondary Outflow To Downstream System (ac-ft):   0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%


 ************Compliance Point Results **************

Scenario Predeveloped Compliance Subbasin: TDA A - Predev

Scenario Postdeveloped Compliance Link: POC

       *** Point of Compliance Flow Frequency Data ***
      Recurrence Interval Computed Using Gringorten Plotting Position

        Predevelopment Runoff                    Postdevelopment Runoff
Tr (Years)        Discharge (cfs)             Tr (Years)       Discharge (cfs)
------------------------------------------------------------------------------------------------------
   2-Year                     0.124                2-Year           7.849E-02
   5-Year                     0.209                5-Year               0.127
   10-Year                    0.292                10-Year              0.155
   25-Year                    0.393                25-Year              0.254
   50-Year                    0.434                50-Year              0.279
   100-Year                   0.452                100-Year             0.356
   200-Year                     **                         200-Year               **
   500-Year                     **                         500-Year               **
 ** Record too Short to Compute Peak Discharge for These Recurrence Intervals


**** Flow Duration Performance ****
Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):              -6.6%    PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):           -1.0%    PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):                         8.7%    PASS
```

Percent Excursion from Q2 to Q50 (Must be less than 50%): 21.0% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS




POC
TDA A - Predev
Predeveloped


Area to B1
Area to Ponc
Postdeveloped
Non Target Ponc
B1
Pond
Bypass
POC
POC

E-2

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201710010
Project Simulation Performed on: 02/04/2020 12:13 PM
Report Generation Date: 02/04/2020 12:14 PM

Input File Name:	TDA B-BPS.fld
Project Name:	Spruce Phase 2 - TDA B
Analysis Title:	
Comments:	

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Precipitation Station Data Selected
Climatic Region Number: 5

Full Period of Record Available used for Routing
Precipitation Station : 452675 Everett 10/01/1948-10/01/2011
Evaporation Station : 456803 Puyallup
At Site 25-Year, 24-Hour Precipitation (inches): 2.99
Gage 25-Year, 24-Hour Precipitation (inches) : 2.69
Precipitation Scale Factor : 1.112
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) ***************

********************** WATERSHED DEFINITION ***********************

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	2.260	2.160
Area of Links that Include Precip/Evap (acres)	0.000	0.100
Total (acres)	2.260	2.260

---------------------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : TDA B ----------

	-------Area (Acres) --------
Till Forest	2.260

```
---------------------------------------------
Subbasin Total              2.260

---------------------SCENARIO: POSTDEVELOPED
Number of Subbasins:   3


  ---------- Subbasin : Det Pipe ----------
                        -------Area (Acres) --------
Till Pasture                0.460
Impervious                  1.060
---------------------------------------------
Subbasin Total              1.520


  ---------- Subbasin : Bypass   ----------
                        -------Area (Acres) --------
Till Pasture                0.250
Impervious                  0.040
---------------------------------------------
Subbasin Total              0.290


  ---------- Subbasin : Bioretention ----------
                        -------Area (Acres) --------
Till Pasture                0.240
Impervious                  0.110
---------------------------------------------
Subbasin Total              0.350


************************* LINK DATA *******************************

---------------------SCENARIO: PREDEVELOPED
Number of Links:   1


-----------------------------------------
Link Name: POC
Link Type:   Copy
Downstream Link: None


************************* LINK DATA *******************************

---------------------SCENARIO: POSTDEVELOPED
Number of Links:   3


-----------------------------------------
Link Name: POC
Link Type:   Copy
Downstream Link: None
```

Link Name: Det Pipe
Link Type: Structure
Downstream Link Name: Bioretention

User Specified Elevation Volume Table Used

Elevation (ft)	Pond Volume (cu-ft)
533.80	0.
534.00	249.
534.20	872.
534.40	1474.
534.60	2161.
534.80	3188.
535.00	4027.
535.20	4917.
535.40	6162.
535.60	7138.
535.80	8140.
536.00	9515.
536.20	10567.
536.40	11629.
536.60	13062.
536.80	14143.
537.00	15223.
537.20	16656.
537.40	17718.
537.60	18770.
537.80	20146.
538.00	21147.
538.20	22123.
538.40	23369.
538.60	24258.
538.80	25097.
539.00	26124.
539.20	26812.
539.40	27413.
539.60	28036.
539.80	28285.

Total detention volume required = 27413 cu-ft

Massmann Infiltration Option Used
Hydraulic Conductivity (in/hr) : 0.00
Massmann Regression Used to Estimate Hydralic Gradient
Depth to Water Table (ft) : 100.00
Bio-Fouling Potential : Low
Maintenance : Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 18.00
Common Length (ft) : 0.000
Riser Crest Elevation : 539.30 ft

Hydraulic Structure Geometry

Number of Devices: 4

```
         ---Device Number     1 ---
Device Type                    :   Circular Orifice
Control Elevation (ft)         :   534.30
Diameter (in)                  :   0.62
Orientation                    : Horizontal
Elbow                          : No

         ---Device Number     2 ---
Device Type                    :   Circular Orifice
Control Elevation (ft)         :   536.50
Diameter (in)                  :   0.50
Orientation                    : Horizontal
Elbow                          : Yes

         ---Device Number     3 ---
Device Type                    :   Circular Orifice
Control Elevation (ft)         :   537.10
Diameter (in)                  :   0.75
Orientation                    : Horizontal
Elbow                          : Yes

         ---Device Number     4 ---
Device Type                    :   Circular Orifice
Control Elevation (ft)         :   538.00
Diameter (in)                  :   1.37
Orientation                    : Horizontal
Elbow                          : Yes


------------------------------------------
Link Name: Bioretention
Link Type:   Bioretention Facility
Downstream Link Name: POC

Base Elevation (ft)                  :      533.76
Riser Crest Elevation (ft)                  :      534.16
Storage Depth (ft)                   :    0.40
Bottom Length (ft)                   :      208.0
Bottom Width (ft)                    :      21.0
Side Slopes (ft/ft)                  : L1= 3.00     L2= 3.00    W1= 3.00    W2= 3.00
Bottom Area (sq-ft)                  :      4368.
Area at Riser Crest El (sq-ft)       :      4,923.
                           (acres)   :       0.113
Volume at Riser Crest (cu-ft)        :      4,479.
                           (ac-ft)   :      0.103

Infiltration on Bottom and Sideslopes Selected

Soil Properties
Biosoil Thickness (ft)                               :        1.50
Biosoil Saturated Hydraulic Conductivity (in/hr)    :        3.00
Biosoil Porosity (Percent)                           :        40.00
Maximum Elevation of Bioretention Soil  : 534.51
Native Soil Hydraulic Conductivity (in/hr)           :        0.00

Underdrain Present
```

Minimum bottom area required for
Bioretention 2 = 4,368*1.2 = 5,242 sq-ft

```
Orifice Present in Under Drain
Orifice Control Elevation (ft)     :      530.51
Orifice Diameter (in)              :      0.625

Riser Geometry
Riser Structure Type               : Rectangular
Riser Length (ft)           : 2.00
Riser Width   (ft)                 : 2.00
Common Length (ft)                 : 0.000
Riser Crest Elevation              : 534.16 ft

 Hydraulic Structure Geometry

Number of Devices:     1

      ---Device Number    1 ---
Device Type                 :   Circular Orifice
Control Elevation (ft)      :   534.01
Diameter (in)               :   4.00
Orientation                 : Horizontal
Elbow                       : Yes


**********************FLOOD FREQUENCY AND DURATION STATISTICS*******************

---------------------SCENARIO: PREDEVELOPED
Number of Subbasins:   1
Number of Links:   1

********** Subbasin: TDA B **********

 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
=====================================
   2-Year         6.416E-02
   5-Year         9.840E-02
   10-Year        0.165
   25-Year        0.196
   50-Year        0.233
   100-Year       0.237
   200-Year       **
   500-Year       **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: POC                                                   **********      Link Inflow
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
=====================================
   2-Year         6.416E-02
   5-Year         9.840E-02
   10-Year        0.165
```

```
    25-Year       0.196
    50-Year       0.233
    100-Year      0.237
    200-Year      **
    500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

----------------------SCENARIO: POSTDEVELOPED

```
Number of Subbasins:   3
Number of Links:   3
```

************ Subbasin: Det Pipe ************

```
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)            Flood Peak (cfs)
========================================
    2-Year        0.495
    5-Year        0.689
    10-Year       0.861
    25-Year       1.147
    50-Year       1.342
    100-Year      1.667
    200-Year      **
    500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

************ Subbasin: Bypass   ************

```
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)            Flood Peak (cfs)
========================================
    2-Year        3.015E-02
    5-Year        5.065E-02
    10-Year       6.169E-02
    25-Year       0.131
    50-Year       0.150
    100-Year      0.200
    200-Year      **
    500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

************ Subbasin: Bioretention ************

```
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)            Flood Peak (cfs)
========================================
    2-Year        5.996E-02
    5-Year        8.996E-02
    10-Year       0.109
```

```
   25-Year      0.195
   50-Year      0.219
   100-Year     0.286
   200-Year     **
   500-Year     **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals


********** Link: POC                                          **********     Link Inflow
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
========================================
   2-Year       7.785E-02
   5-Year       0.110
   10-Year      0.137
   25-Year      0.158
   50-Year      0.210
   100-Year     0.225
   200-Year     **
   500-Year     **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals


********** Link: Det Pipe                                     **********     Link Inflow
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
========================================
   2-Year       0.495
   5-Year       0.689
   10-Year      0.861
   25-Year      1.147
   50-Year      1.342
   100-Year     1.667
   200-Year     **
   500-Year     **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals


********** Link: Det Pipe                                     **********     Link Outflow 1
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
========================================
   2-Year       2.142E-02
   5-Year       3.432E-02
   10-Year      3.917E-02
   25-Year      6.649E-02
   50-Year      8.809E-02
```

```
   100-Year      0.136
   200-Year      **
   500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: Det Pipe                                                  **********     Link WSEL
Stats
 WSEL Frequency Data(ft)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)           WSEL Peak (ft)
========================================
   1.05-Year     535.986
   1.11-Year     536.148
   1.25-Year     536.386
   2.00-Year     536.975
   3.33-Year     537.286
      5-Year     537.519
     10-Year     537.838
     25-Year     538.222
     50-Year     538.543
   100-Year      539.201



********** Link: Bioretention                                               **********     Link Inflow
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)           Flood Peak (cfs)
========================================
   2-Year        7.262E-02
   5-Year        0.104
   10-Year       0.126
   25-Year       0.206
   50-Year       0.227
   100-Year      0.293
   200-Year      **
   500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: Bioretention                                               **********     Link Outflow 1
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)           Flood Peak (cfs)
========================================
   2-Year        6.000E-02
   5-Year        7.912E-02
   10-Year       9.046E-02
   25-Year       0.105
   50-Year       0.132
   100-Year      0.160
```

```
   200-Year      **
   500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: Bioretention                                   **********      Link WSEL Stats
 WSEL Frequency Data(ft)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          WSEL Peak (ft)
===================================
   1.05-Year    533.921
   1.11-Year    533.944
   1.25-Year    534.011
   2.00-Year    534.022
   3.33-Year    534.028
      5-Year    534.032
     10-Year    534.041
     25-Year    534.055
     50-Year    534.088
   100-Year     534.131
```

*************Groundwater Recharge Summary ***************

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

```
                Total Predeveloped Recharge During Simulation
Model Element                             Recharge Amount (ac-ft)
-----------------------------------------------------------------------------------------------
Subbasin: TDA B                  143.011
Link:       POC                  0.000
_________________________________________________
Total:                                    143.011

              Total Post Developed Recharge During Simulation
Model Element                             Recharge Amount (ac-ft)
-----------------------------------------------------------------------------------------------
Subbasin: Det Pipe               27.883
Subbasin: Bypass                 15.154
Subbasin: Bioretention           14.548
Link:       POC                  0.000
Link:       Det Pipe             0.000
Link:       Bioretention         0.000
_________________________________________________
Total:                                            57.584
```

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 63)
Predeveloped: 2.270 ac-ft/year,   Post Developed: 0.914 ac-ft/year

*************Water Quality Facility Data ***************

---------------------SCENARIO: PREDEVELOPED

Number of Links: 1

```
********** Link: POC                                                          **********

  Infiltration/Filtration Statistics--------------------
  Inflow Volume (ac-ft):   117.49
  Inflow Volume Including PPT-Evap (ac-ft):   117.49
  Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
  Total Runoff Filtered (ac-ft):   0.00,   0.00%
  Primary Outflow To Downstream System (ac-ft):   117.49
  Secondary Outflow To Downstream System (ac-ft):   0.00
  Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

---------------------SCENARIO: POSTDEVELOPED

Number of Links:   3


********** Link: POC                                                          **********

  Infiltration/Filtration Statistics--------------------
  Inflow Volume (ac-ft):   313.46
  Inflow Volume Including PPT-Evap (ac-ft):   313.46
  Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
  Total Runoff Filtered (ac-ft):   0.00,   0.00%
  Primary Outflow To Downstream System (ac-ft):   313.46
  Secondary Outflow To Downstream System (ac-ft):   0.00
  Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Det Pipe                                                    **********

  Basic Wet Pond Volume (91% Exceedance):   5543. cu-ft
  Computed Large Wet Pond Volume, 1.5*Basic Volume:   8314. cu-ft


  Infiltration/Filtration Statistics--------------------
  Inflow Volume (ac-ft):   231.33
  Inflow Volume Including PPT-Evap (ac-ft):   231.33
  Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
  Total Runoff Filtered (ac-ft):   0.00,   0.00%
  Primary Outflow To Downstream System (ac-ft):   231.30
  Secondary Outflow To Downstream System (ac-ft):   0.00
  Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: Bioretention                                               **********

  Infiltration/Filtration Statistics--------------------
  Inflow Volume (ac-ft):   270.33
  Inflow Volume Including PPT-Evap (ac-ft):   286.57
  Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
  Total Runoff Filtered (ac-ft):   278.00,   97.01%
  Primary Outflow To Downstream System (ac-ft):   286.57
  Secondary Outflow To Downstream System (ac-ft):   0.00
  Percent Treated (Infiltrated+Filtered)/Total Volume: 97.01%
```

*************Compliance Point Results ***************

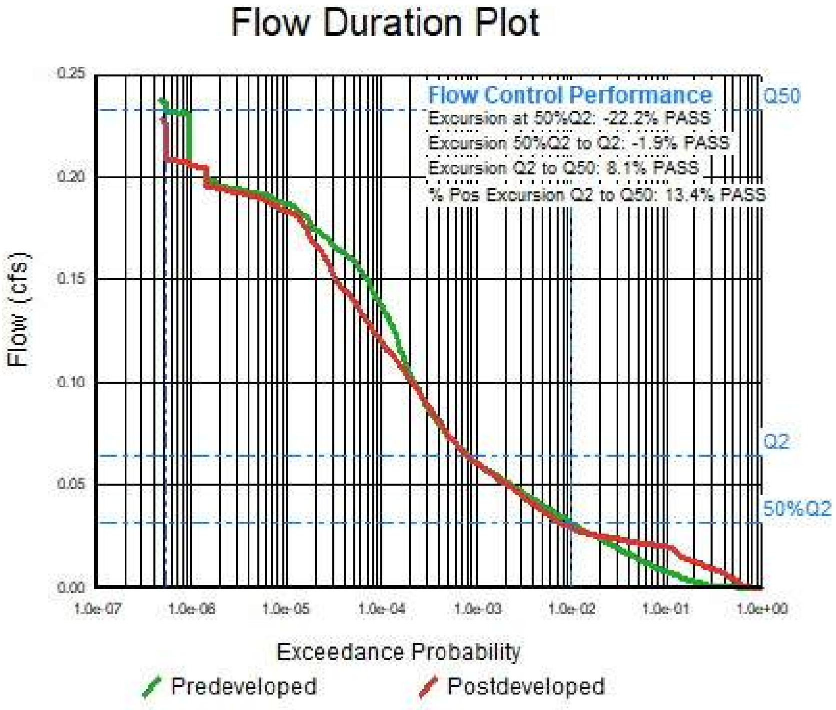
Scenario Predeveloped Compliance Link: POC
Scenario Postdeveloped Compliance Link: POC

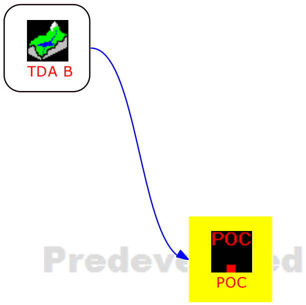
***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

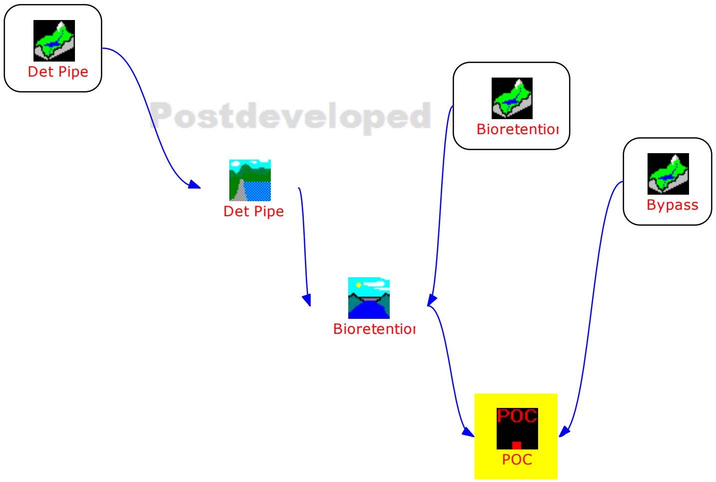
```
        Predevelopment Runoff                    Postdevelopment Runoff
Tr (Years)        Discharge (cfs)            Tr (Years)        Discharge (cfs)
---------------------------------------------------------------------------------------
    2-Year                  6.416E-02              2-Year           7.785E-02
    5-Year                  9.840E-02              5-Year                0.110
    10-Year                     0.165              10-Year               0.137
    25-Year                     0.196              25-Year               0.158
    50-Year                     0.233              50-Year               0.210
    100-Year                    0.237              100-Year              0.225
    200-Year                       **                    200-Year                **
    500-Year                       **                    500-Year                **
 ** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

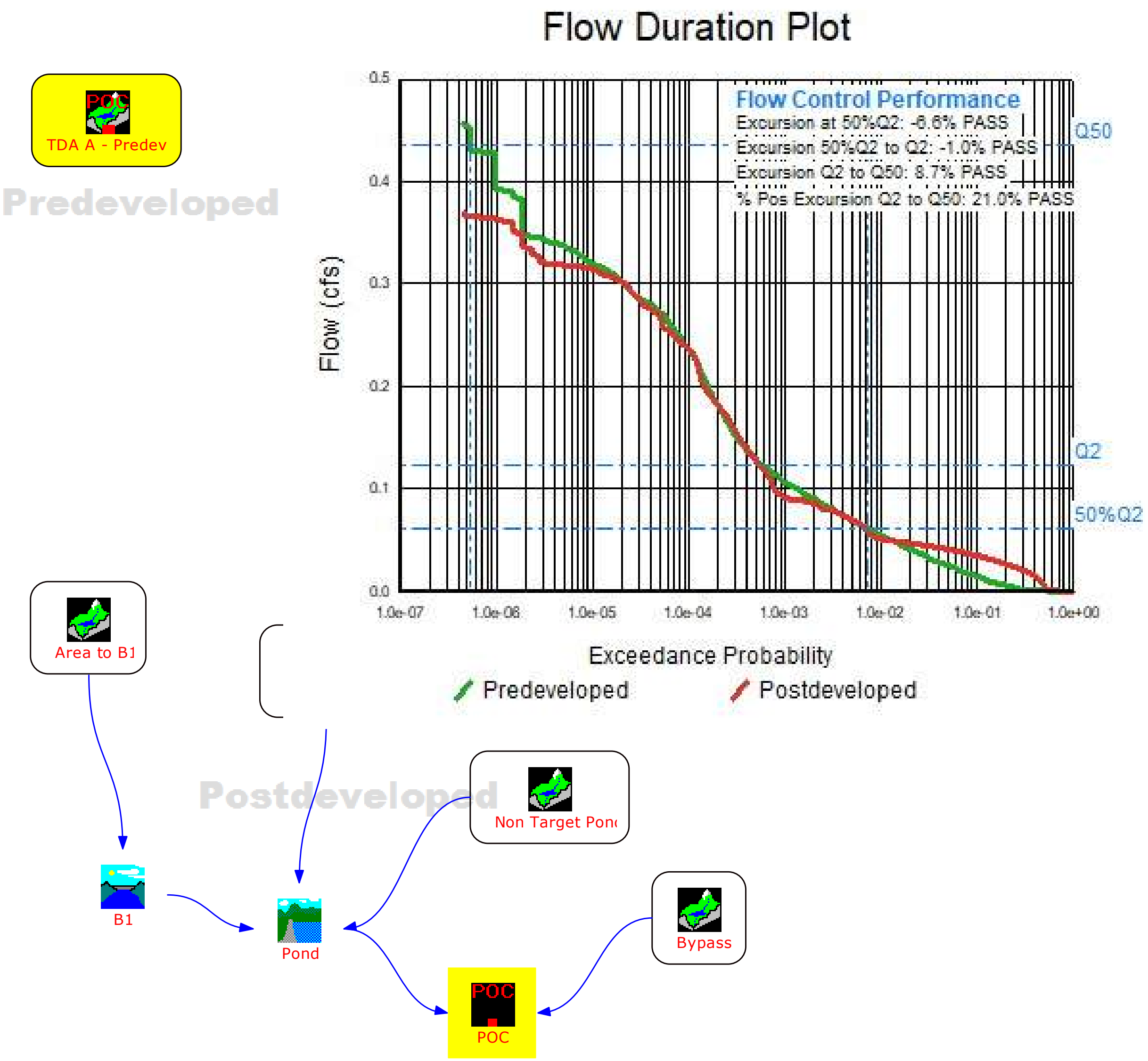
****** Flow Duration Performance ******

```
Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):          -22.2%    PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):        -1.9%    PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):                      8.1%    PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):                     13.4%    PASS

-------------------------------------------------------------------------------
MEETS ALL FLOW DURATION DESIGN CRITERIA:     PASS
-------------------------------------------------------------------------------
```




TDA B
Predeve
ed
POC
POC


Det Pipe
Postdeveloped
Bioretentio
Bypass
Det Pipe
Bioretentio
POC
POC


Flow Duration Plot
Flow Control Performance
Excursion at 50%Q2: -6.6% PASS
Excursion 50%Q2 to Q2: -1.0% PASS
Excursion Q2 to Q50: 8.7% PASS
% Pos Excursion Q2 to Q50: 21.0% PASS
Q50
Q2
50%Q2
0.5
0.4
0.3
0.2
0.1
0.0
Flow (cfs)
1.0e-07
1.0e-06
1.0e-05
1.0e-04
1.0e-03
1.0e-02
1.0e-01
1.0e+00
Exceedance Probability
Predeveloped
Postdeveloped
POC
TDA A - Predev
Predeveloped
Area to B1
B1
Pond
Postdeveloped
Non Target Pond
Bypass
POC
POC

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	TDA C
Site Name:	
Site Address:	
City:	
Report Date:	10/15/2019
Gage:	Everett
Data Start:	1948/10/01
Data End:	2009/09/30
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2017/04/14
Version:	4.2.13

POC Thresholds

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

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	3
Pervious Total	3
Impervious Land Use	acre
Impervious Total	0
Basin Total	3

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Mitigated

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.66
Pervious Total	0.66
Impervious Land Use	acre
SIDEWALKS FLAT	1.84
Impervious Total	1.84
Basin Total	2.5

Element Flows To:

Surface	Interflow	Groundwater
Detention	Detention	

Bypass

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	0.33
Pervious Total	0.33
Impervious Land Use	acre
PARKING FLAT	0.03
Impervious Total	0.03
Basin Total	0.36

Element Flows To:

Surface	Interflow	Groundwater

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
PARKING FLAT	0.14
Impervious Total	0.14
Basin Total	0.14

Element Flows To:

Surface	Interflow	Groundwater
Surface Silva Cell	Surface Silva Cell	

Routing Elements

Predeveloped Routing

Mitigated Routing

Detention

Bottom Length:	60.00 ft.
Bottom Width:	65.00 ft.
Depth:	6 ft.
Volume at riser head:	0.8057 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:	5.5 ft.
Riser Diameter:	18 in.
Notch Type:	Rectangular
Notch Width:	0.010 ft.
Notch Height:	0.750 ft.
Orifice 1 Diameter:	0.75 in. Elevation:0.5 ft.
Orifice 2 Diameter:	0.625 in. Elevation:4.3 ft.
Orifice 3 Diameter:	0.625 in. Elevation:4.8 ft.

Element Flows To:
Outlet 1 Outlet 2

Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.089	0.000	0.000	0.000
0.0667	0.090	0.006	0.000	0.000
0.1333	0.091	0.012	0.000	0.000
0.2000	0.093	0.018	0.000	0.000
0.2667	0.094	0.024	0.000	0.000
0.3333	0.095	0.030	0.000	0.000
0.4000	0.096	0.037	0.000	0.000
0.4667	0.097	0.043	0.000	0.000
0.5333	0.098	0.050	0.002	0.000
0.6000	0.100	0.056	0.004	0.000
0.6667	0.101	0.063	0.006	0.000
0.7333	0.102	0.070	0.007	0.000
0.8000	0.103	0.077	0.008	0.000
0.8667	0.105	0.084	0.009	0.000
0.9333	0.106	0.091	0.010	0.000
1.0000	0.107	0.098	0.010	0.000
1.0667	0.108	0.105	0.011	0.000
1.1333	0.110	0.112	0.012	0.000
1.2000	0.111	0.120	0.012	0.000
1.2667	0.112	0.127	0.013	0.000
1.3333	0.114	0.135	0.013	0.000
1.4000	0.115	0.143	0.014	0.000
1.4667	0.116	0.150	0.015	0.000
1.5333	0.117	0.158	0.015	0.000
1.6000	0.119	0.166	0.016	0.000
1.6667	0.120	0.174	0.016	0.000
1.7333	0.121	0.182	0.017	0.000
1.8000	0.123	0.190	0.017	0.000
1.8667	0.124	0.198	0.017	0.000
1.9333	0.125	0.207	0.018	0.000

2.0000	0.127	0.215	0.018	0.000
2.0667	0.128	0.224	0.019	0.000
2.1333	0.130	0.232	0.019	0.000
2.2000	0.131	0.241	0.019	0.000
2.2667	0.132	0.250	0.020	0.000
2.3333	0.134	0.259	0.020	0.000
2.4000	0.135	0.268	0.021	0.000
2.4667	0.137	0.277	0.021	0.000
2.5333	0.138	0.286	0.021	0.000
2.6000	0.139	0.295	0.022	0.000
2.6667	0.141	0.305	0.022	0.000
2.7333	0.142	0.314	0.022	0.000
2.8000	0.144	0.324	0.023	0.000
2.8667	0.145	0.333	0.023	0.000
2.9333	0.147	0.343	0.023	0.000
3.0000	0.148	0.353	0.024	0.000
3.0667	0.150	0.363	0.024	0.000
3.1333	0.151	0.373	0.024	0.000
3.2000	0.153	0.383	0.025	0.000
3.2667	0.154	0.393	0.025	0.000
3.3333	0.156	0.404	0.025	0.000
3.4000	0.157	0.414	0.026	0.000
3.4667	0.159	0.425	0.026	0.000
3.5333	0.160	0.436	0.026	0.000
3.6000	0.162	0.446	0.026	0.000
3.6667	0.163	0.457	0.027	0.000
3.7333	0.165	0.468	0.027	0.000
3.8000	0.166	0.479	0.027	0.000
3.8667	0.168	0.490	0.028	0.000
3.9333	0.170	0.502	0.028	0.000
4.0000	0.171	0.513	0.028	0.000
4.0667	0.173	0.525	0.028	0.000
4.1333	0.174	0.536	0.029	0.000
4.2000	0.176	0.548	0.029	0.000
4.2667	0.178	0.560	0.029	0.000
4.3333	0.179	0.572	0.031	0.000
4.4000	0.181	0.584	0.033	0.000
4.4667	0.182	0.596	0.034	0.000
4.5333	0.184	0.608	0.035	0.000
4.6000	0.186	0.620	0.036	0.000
4.6667	0.187	0.633	0.037	0.000
4.7333	0.189	0.645	0.038	0.000
4.8000	0.191	0.658	0.039	0.000
4.8667	0.192	0.671	0.043	0.000
4.9333	0.194	0.684	0.047	0.000
5.0000	0.196	0.697	0.049	0.000
5.0667	0.198	0.710	0.052	0.000
5.1333	0.199	0.723	0.056	0.000
5.2000	0.201	0.737	0.059	0.000
5.2667	0.203	0.750	0.062	0.000
5.3333	0.204	0.764	0.065	0.000
5.4000	0.206	0.777	0.068	0.000
5.4667	0.208	0.791	0.071	0.000
5.5333	0.210	0.805	0.170	0.000
5.6000	0.211	0.819	0.576	0.000
5.6667	0.213	0.833	1.149	0.000
5.7333	0.215	0.848	1.832	0.000
5.8000	0.217	0.862	2.578	0.000

5.8667	0.219	0.877	3.339	0.000
5.9333	0.220	0.891	4.067	0.000
6.0000	0.222	0.906	4.718	0.000
6.0667	0.224	0.921	5.259	0.000

Silva Cell

Bottom Length: 11.00 ft.
Bottom Width: 11.00 ft.
Material thickness of first layer: 1.5
Material type for first layer: SMMWW 12 in/hr
Material thickness of second layer: 2
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.): 6
Flow Through Underdrain (ac-ft.): 20.881
Total Outflow (ac-ft.): 21.772
Percent Through Underdrain: 95.91 >91% thus Water Quality Treatment provided
Discharge Structure
Riser Height: 0.5 ft.
Riser Diameter: 24 in.
Element Flows To:
Outlet 1 Outlet 2
Detention

Bioretention Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.0028	0.0000	0.0000	0.0000
0.0495	0.0028	0.0001	0.0000	0.0000
0.0989	0.0028	0.0001	0.0000	0.0000
0.1484	0.0028	0.0002	0.0000	0.0000
0.1978	0.0028	0.0003	0.0000	0.0000
0.2473	0.0028	0.0003	0.0000	0.0000
0.2967	0.0028	0.0004	0.0000	0.0000
0.3462	0.0028	0.0004	0.0000	0.0000
0.3956	0.0028	0.0005	0.0000	0.0000
0.4451	0.0028	0.0006	0.0000	0.0000
0.4945	0.0028	0.0006	0.0000	0.0000
0.5440	0.0028	0.0007	0.0000	0.0000
0.5934	0.0028	0.0008	0.0000	0.0000
0.6429	0.0028	0.0008	0.0000	0.0000
0.6923	0.0028	0.0009	0.0000	0.0000
0.7418	0.0028	0.0009	0.0000	0.0000
0.7912	0.0028	0.0010	0.0000	0.0000
0.8407	0.0028	0.0011	0.0000	0.0000
0.8901	0.0028	0.0011	0.0000	0.0000
0.9396	0.0028	0.0012	0.0000	0.0000
0.9890	0.0028	0.0013	0.0000	0.0000
1.0385	0.0028	0.0013	0.0000	0.0000
1.0879	0.0028	0.0014	0.0000	0.0000
1.1374	0.0028	0.0014	0.0000	0.0000
1.1868	0.0028	0.0015	0.0000	0.0000
1.2363	0.0028	0.0016	0.0000	0.0000
1.2857	0.0028	0.0016	0.0000	0.0000
1.3352	0.0028	0.0017	0.0000	0.0000
1.3846	0.0028	0.0018	0.0000	0.0000
1.4341	0.0028	0.0018	0.0000	0.0000
1.4835	0.0028	0.0019	0.0000	0.0000

1.5330	0.0028	0.0019	0.0000	0.0000
1.5824	0.0028	0.0020	0.0000	0.0000
1.6319	0.0028	0.0021	0.0000	0.0000
1.6813	0.0028	0.0021	0.0000	0.0000
1.7308	0.0028	0.0022	0.0000	0.0000
1.7802	0.0028	0.0022	0.0000	0.0000
1.8297	0.0028	0.0023	0.0000	0.0000
1.8791	0.0028	0.0023	0.0000	0.0000
1.9286	0.0028	0.0024	0.0000	0.0000
1.9780	0.0028	0.0025	0.0000	0.0000
2.0275	0.0028	0.0025	0.0000	0.0000
2.0769	0.0028	0.0026	0.0000	0.0000
2.1264	0.0028	0.0026	0.0000	0.0000
2.1758	0.0028	0.0027	0.0000	0.0000
2.2253	0.0028	0.0027	0.0000	0.0000
2.2747	0.0028	0.0028	0.0000	0.0000
2.3242	0.0028	0.0029	0.0000	0.0000
2.3736	0.0028	0.0029	0.0000	0.0000
2.4231	0.0028	0.0030	0.0000	0.0000
2.4725	0.0028	0.0030	0.0000	0.0000
2.5220	0.0028	0.0031	0.0000	0.0000
2.5714	0.0028	0.0031	0.0000	0.0000
2.6209	0.0028	0.0032	0.0000	0.0000
2.6703	0.0028	0.0033	0.0000	0.0000
2.7198	0.0028	0.0033	0.0000	0.0000
2.7692	0.0028	0.0034	0.0000	0.0000
2.8187	0.0028	0.0034	0.0000	0.0000
2.8681	0.0028	0.0035	0.0000	0.0000
2.9176	0.0028	0.0035	0.0000	0.0000
2.9670	0.0028	0.0036	0.0000	0.0000
3.0165	0.0028	0.0037	0.0000	0.0000
3.0659	0.0028	0.0037	0.0000	0.0000
3.1154	0.0028	0.0038	0.0000	0.0000
3.1648	0.0028	0.0038	0.0000	0.0000
3.2143	0.0028	0.0039	0.0000	0.0000
3.2637	0.0028	0.0039	0.0000	0.0000
3.3132	0.0028	0.0040	0.0000	0.0000
3.3626	0.0028	0.0041	0.0000	0.0000
3.4121	0.0028	0.0041	0.0000	0.0000
3.4615	0.0028	0.0042	0.0000	0.0000
3.5000	0.0028	0.0042	0.0000	0.0000

Bioretention Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**To Amended(cfs)**	**Infilt(cfs)**
3.5000	0.0028	0.0042	0.0000	0.0347	0.0000
3.5495	0.0028	0.0043	0.0000	0.0347	0.0000
3.5989	0.0028	0.0045	0.0000	0.0358	0.0000
3.6484	0.0028	0.0046	0.0000	0.0369	0.0000
3.6978	0.0028	0.0048	0.0000	0.0380	0.0000
3.7473	0.0028	0.0049	0.0000	0.0392	0.0000
3.7967	0.0028	0.0050	0.0000	0.0403	0.0000
3.8462	0.0028	0.0052	0.0000	0.0414	0.0000
3.8956	0.0028	0.0053	0.0000	0.0425	0.0000
3.9451	0.0028	0.0054	0.0000	0.0436	0.0000
3.9945	0.0028	0.0056	0.0000	0.0447	0.0000
4.0440	0.0028	0.0057	0.0000	0.0458	0.0000
4.0934	0.0028	0.0059	0.0000	0.0469	0.0000
4.1429	0.0028	0.0060	0.0000	0.0480	0.0000

4.1923	0.0028	0.0061	0.0000	0.0491	0.0000
4.2418	0.0028	0.0063	0.0000	0.0502	0.0000
4.2912	0.0028	0.0064	0.0000	0.0513	0.0000
4.3407	0.0028	0.0065	0.0000	0.0524	0.0000
4.3901	0.0028	0.0067	0.0000	0.0536	0.0000
4.4396	0.0028	0.0068	0.0000	0.0547	0.0000
4.4890	0.0028	0.0070	0.0000	0.0558	0.0000
4.5000	0.0028	0.0070	0.0000	0.0560	0.0000

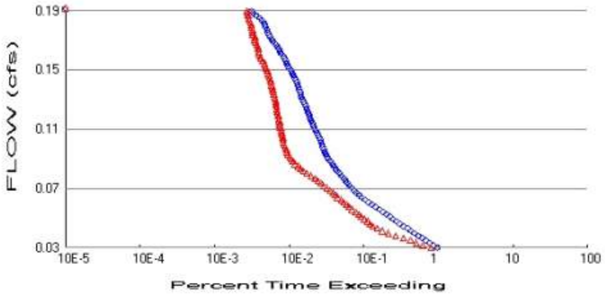
Surface Silva Cell

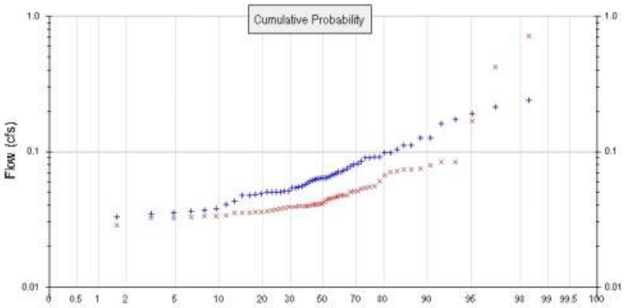
Element Flows To:

Outlet 1	Outlet 2
Detention	Silva Cell

Analysis Results

POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 3
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.99
Total Impervious Area: 2.01

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.066835
5 year	0.10231
10 year	0.127814
25 year	0.162052
50 year	0.188903
100 year	0.216837

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.046074
5 year	0.076225
10 year	0.103644
25 year	0.148939
50 year	0.191988
100 year	0.244514

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1949	0.036	0.035
1950	0.071	0.045
1951	0.064	0.036
1952	0.049	0.039
1953	0.038	0.033
1954	0.191	0.071
1955	0.098	0.066
1956	0.085	0.074
1957	0.098	0.051
1958	0.069	0.051

1959	0.073	0.040
1960	0.061	0.041
1961	0.064	0.074
1962	0.055	0.037
1963	0.080	0.046
1964	0.057	0.034
1965	0.064	0.038
1966	0.035	0.035
1967	0.078	0.041
1968	0.092	0.043
1969	0.090	0.083
1970	0.050	0.036
1971	0.081	0.079
1972	0.063	0.047
1973	0.051	0.041
1974	0.112	0.055
1975	0.050	0.035
1976	0.048	0.036
1977	0.040	0.033
1978	0.051	0.038
1979	0.111	0.054
1980	0.058	0.039
1981	0.047	0.032
1982	0.061	0.045
1983	0.104	0.047
1984	0.063	0.075
1985	0.090	0.060
1986	0.213	0.423
1987	0.091	0.084
1988	0.051	0.041
1989	0.050	0.037
1990	0.067	0.042
1991	0.071	0.040
1992	0.054	0.039
1993	0.035	0.029
1994	0.033	0.040
1995	0.068	0.048
1996	0.126	0.051
1997	0.240	0.712
1998	0.043	0.033
1999	0.062	0.039
2000	0.037	0.045
2001	0.011	0.025
2002	0.065	0.053
2003	0.047	0.032
2004	0.074	0.048
2005	0.055	0.040
2006	0.162	0.072
2007	0.127	0.055
2008	0.172	0.168
2009	0.054	0.039

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	0.2402	0.7119
2	0.2134	0.4229
3	0.1906	0.1684

4	0.1720	0.0836
5	0.1617	0.0834
6	0.1272	0.0791
7	0.1264	0.0746
8	0.1120	0.0740
9	0.1113	0.0736
10	0.1040	0.0721
11	0.0980	0.0708
12	0.0976	0.0664
13	0.0918	0.0605
14	0.0914	0.0552
15	0.0905	0.0546
16	0.0899	0.0542
17	0.0852	0.0529
18	0.0811	0.0509
19	0.0804	0.0508
20	0.0784	0.0506
21	0.0744	0.0478
22	0.0727	0.0475
23	0.0711	0.0472
24	0.0708	0.0467
25	0.0689	0.0463
26	0.0678	0.0454
27	0.0665	0.0447
28	0.0649	0.0446
29	0.0641	0.0433
30	0.0639	0.0425
31	0.0636	0.0415
32	0.0632	0.0410
33	0.0626	0.0408
34	0.0618	0.0407
35	0.0612	0.0404
36	0.0608	0.0401
37	0.0584	0.0396
38	0.0567	0.0396
39	0.0555	0.0395
40	0.0547	0.0395
41	0.0540	0.0391
42	0.0539	0.0388
43	0.0512	0.0388
44	0.0507	0.0383
45	0.0506	0.0381
46	0.0505	0.0373
47	0.0502	0.0369
48	0.0501	0.0362
49	0.0489	0.0358
50	0.0483	0.0358
51	0.0473	0.0353
52	0.0472	0.0352
53	0.0428	0.0350
54	0.0404	0.0337
55	0.0376	0.0334
56	0.0368	0.0331
57	0.0363	0.0330
58	0.0352	0.0325
59	0.0348	0.0324
60	0.0329	0.0287
61	0.0112	0.0251

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0334	20679	16948	81	Pass
0.0350	18362	13161	71	Pass
0.0366	16309	10889	66	Pass
0.0381	14429	8994	62	Pass
0.0397	12882	7264	56	Pass
0.0413	11477	5722	49	Pass
0.0428	10243	4594	44	Pass
0.0444	9133	3820	41	Pass
0.0460	8181	3243	39	Pass
0.0476	7270	2813	38	Pass
0.0491	6494	2584	39	Pass
0.0507	5831	2387	40	Pass
0.0523	5251	2165	41	Pass
0.0538	4753	1960	41	Pass
0.0554	4295	1815	42	Pass
0.0570	3861	1664	43	Pass
0.0585	3461	1501	43	Pass
0.0601	3069	1352	44	Pass
0.0617	2714	1253	46	Pass
0.0633	2449	1152	47	Pass
0.0648	2209	1070	48	Pass
0.0664	2008	954	47	Pass
0.0680	1844	892	48	Pass
0.0695	1707	820	48	Pass
0.0711	1569	763	48	Pass
0.0727	1455	684	47	Pass
0.0743	1362	614	45	Pass
0.0758	1289	571	44	Pass
0.0774	1212	522	43	Pass
0.0790	1144	473	41	Pass
0.0805	1074	422	39	Pass
0.0821	996	367	36	Pass
0.0837	934	330	35	Pass
0.0852	893	303	33	Pass
0.0868	849	281	33	Pass
0.0884	809	258	31	Pass
0.0900	761	240	31	Pass
0.0915	720	226	31	Pass
0.0931	689	218	31	Pass
0.0947	664	210	31	Pass
0.0962	641	197	30	Pass
0.0978	623	195	31	Pass
0.0994	603	190	31	Pass
0.1010	586	184	31	Pass
0.1025	571	178	31	Pass
0.1041	555	178	32	Pass
0.1057	541	175	32	Pass
0.1072	523	172	32	Pass
0.1088	506	169	33	Pass
0.1104	484	167	34	Pass
0.1119	465	164	35	Pass
0.1135	448	158	35	Pass
0.1151	440	158	35	Pass

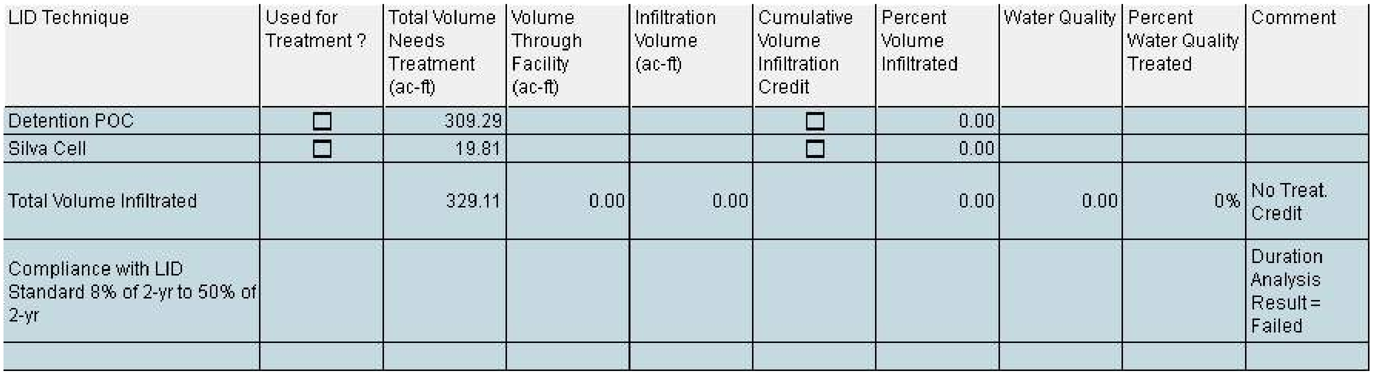
0.1167	424	158	37	Pass
0.1182	412	155	37	Pass
0.1198	403	153	37	Pass
0.1214	390	150	38	Pass
0.1229	376	147	39	Pass
0.1245	365	145	39	Pass
0.1261	357	145	40	Pass
0.1277	343	142	41	Pass
0.1292	335	141	42	Pass
0.1308	323	140	43	Pass
0.1324	312	136	43	Pass
0.1339	304	134	44	Pass
0.1355	300	131	43	Pass
0.1371	293	129	44	Pass
0.1386	285	127	44	Pass
0.1402	275	125	45	Pass
0.1418	269	122	45	Pass
0.1434	259	120	46	Pass
0.1449	251	117	46	Pass
0.1465	244	115	47	Pass
0.1481	235	110	46	Pass
0.1496	228	108	47	Pass
0.1512	213	104	48	Pass
0.1528	206	102	49	Pass
0.1544	198	100	50	Pass
0.1559	191	93	48	Pass
0.1575	185	89	48	Pass
0.1591	178	87	48	Pass
0.1606	168	84	50	Pass
0.1622	163	83	50	Pass
0.1638	155	82	52	Pass
0.1653	148	81	54	Pass
0.1669	141	79	56	Pass
0.1685	132	75	56	Pass
0.1701	126	74	58	Pass
0.1716	119	74	62	Pass
0.1732	115	69	60	Pass
0.1748	111	69	62	Pass
0.1763	108	69	63	Pass
0.1779	104	66	63	Pass
0.1795	101	66	65	Pass
0.1811	98	65	66	Pass
0.1826	91	63	69	Pass
0.1842	87	61	70	Pass
0.1858	77	60	77	Pass
0.1873	70	59	84	Pass
0.1889	67	58	86	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0 acre-feet
On-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.
Off-line facility target flow:	0 cfs.
Adjusted for 15 min:	0 cfs.

LID Report



LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Detention POC	☐	309.29			☐	0.00			
Silva Cell	☐	19.81			☐	0.00			
Total Volume Infiltrated		329.11	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

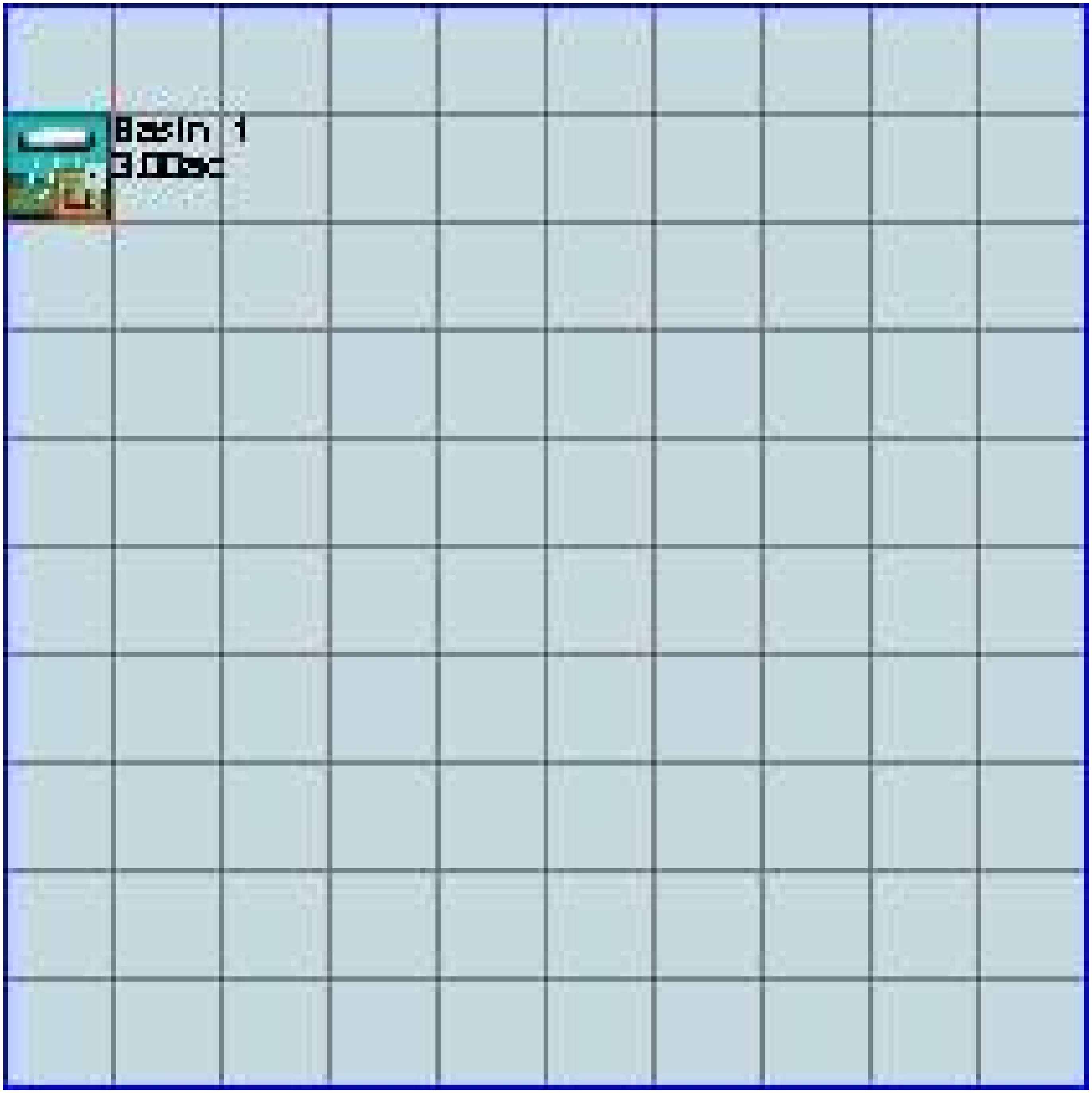
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix

Predeveloped Schematic



Mitigated Schematic

Predeveloped UCI File

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1948 10 01        END    2009 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   TDA C.wdm
MESSU      25   MitTDA C.MES
           27   MitTDA C.L61
           28   MitTDA C.L62
           30   POCTDA C1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      13
      IMPLND       8
      IMPLND      11
      GENER        2
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      COPY       601
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Detention                   MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  601         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
    2        24
  END OPCODE
  PARM
    #    #         K ***
    2             0.
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   13      C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
```

```
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   13              0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GVWS
   13              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    8      SIDEWALKS/FLAT         1    1    1   27    0
   11      PARKING/FLAT           1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    8         0    0    1    0    0    0
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    8         0    0    4    0    0    0    1    9
   11         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
```

```
    8         0    0    0    0    0
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    8            400      0.01       0.1       0.1
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    8             0         0
   11             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    8             0         0
   11             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Mitigated***
PERLND  13                        0.66     RCHRES   3      2
PERLND  13                        0.66     RCHRES   3      3
IMPLND   8                        1.84     RCHRES   3      5
Basin  3***
IMPLND  11                        0.14     RCHRES   1      5
Bypass***
PERLND  13                        0.33     COPY   501     12
PERLND  13                        0.33     COPY   601     12
PERLND  13                        0.33     COPY   501     13
PERLND  13                        0.33     COPY   601     13
IMPLND  11                        0.03     COPY   501     15
IMPLND  11                        0.03     COPY   601     15

******Routing******
PERLND  13                        0.66     COPY     1     12
IMPLND   8                        1.84     COPY     1     15
PERLND  13                        0.66     COPY     1     13
RCHRES   2                           1     RCHRES   3      6
RCHRES   2                                 COPY     1     16
RCHRES   1                           1     RCHRES   3      7
RCHRES   1                                 COPY     1     17
RCHRES   1                           1     RCHRES   2      8
RCHRES   3                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1
GENER    2 OUTPUT TIMSER      .0011111     RCHRES   1     EXTNL  OUTDGT 1



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

RCHRES
  GEN-INFO
```

```
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                          in  out                            ***
    1     Surface Silva Ce-015    3    1    1    1   28    0    1
    2     Silva Cell              1    1    1    1   28    0    1
    3     Detention               1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *        ***
    1        0  1  0  0    4  5  6  0  0       0  1  0  0  0       2  1  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.01       0.0       0.0       0.5       0.0
    2             2      0.01       0.0       0.0       0.5       0.0
    3             3      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0         4.0  5.0  6.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3           0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
*** User-Defined Variable Quantity Lines
***                          addr
***                        <------>
*** kwd  varnam optyp  opn  vari  s1 s2 s3 tp multiply  lc ls ac as agfn ***
  <****> <----> <----> <-> <----><-><-><-><-><--------> <><-> <><-> <--> ***
  UVQUAN vol2   RCHRES   2 VOL              4
  UVQUAN v2m2   GLOBAL     WORKSP  1        3
  UVQUAN vpo2   GLOBAL     WORKSP  2        3
  UVQUAN v2d2   GENER    2 K       1        3
*** User-Defined Target Variable Names
***                    addr or                         addr or
***                   <------>                       <------>
*** kwd   varnam ct  vari  s1 s2 s3  frac oper     vari  s1 s2 s3  frac oper
  <****>  <----><-> <----><-><-><-> <---> <-->    <----><-><-><-> <---> <-->
  UVNAME  v2m2    1 WORKSP  1         1.0 QUAN
  UVNAME  vpo2    1 WORKSP  2         1.0 QUAN
```

```
  UVNAME  v2d2    1 K       1         1.0 QUAN
*** opt foplop dcdts  yr mo dy hr mn d t   vnam  s1 s2 s3 ac quantity  tc  ts rp
  <****><-><--><><-><--> <> <> <> <><><>  <----><-><-><-><-><--------> <> <-><->
  GENER   2                               v2m2            =  172.
*** Compute remaining available pore space
  GENER   2                               vpo2            =  v2m2
  GENER   2                               vpo2           -=  vol2
*** Check to see if VPORA goes negative; if so set VPORA = 0.0
IF (vpo2 < 0.0) THEN
  GENER   2                               vpo2            =  0.0
END IF
*** Infiltration volume
  GENER   2                               v2d2            =  vpo2
END SPEC-ACTIONS
FTABLES
  FTABLE      3
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.089532  0.000000  0.000000
  0.066667  0.090683  0.006007  0.000000
  0.133333  0.091842  0.012091  0.000000
  0.200000  0.093008  0.018253  0.000000
  0.266667  0.094182  0.024493  0.000000
  0.333333  0.095363  0.030811  0.000000
  0.400000  0.096551  0.037208  0.000000
  0.466667  0.097747  0.043685  0.000000
  0.533333  0.098949  0.050241  0.002787
  0.600000  0.100160  0.056878  0.004827
  0.666667  0.101377  0.063596  0.006232
  0.733333  0.102602  0.070395  0.007373
  0.800000  0.103835  0.077277  0.008361
  0.866667  0.105074  0.084240  0.009243
  0.933333  0.106321  0.091287  0.010048
  1.000000  0.107576  0.098417  0.010794
  1.066667  0.108837  0.105630  0.011491
  1.133333  0.110107  0.112928  0.012148
  1.200000  0.111383  0.120311  0.012771
  1.266667  0.112667  0.127780  0.013365
  1.333333  0.113958  0.135334  0.013934
  1.400000  0.115256  0.142974  0.014481
  1.466667  0.116562  0.150702  0.015008
  1.533333  0.117875  0.158516  0.015517
  1.600000  0.119196  0.166419  0.016009
  1.666667  0.120523  0.174409  0.016487
  1.733333  0.121859  0.182489  0.016952
  1.800000  0.123201  0.190657  0.017404
  1.866667  0.124551  0.198916  0.017845
  1.933333  0.125908  0.207264  0.018275
  2.000000  0.127273  0.215704  0.018695
  2.066667  0.128645  0.224234  0.019106
  2.133333  0.130024  0.232857  0.019508
  2.200000  0.131410  0.241571  0.019902
  2.266667  0.132804  0.250378  0.020289
  2.333333  0.134206  0.259279  0.020668
  2.400000  0.135614  0.268273  0.021041
  2.466667  0.137030  0.277361  0.021407
  2.533333  0.138454  0.286543  0.021766
  2.600000  0.139884  0.295821  0.022120
  2.666667  0.141322  0.305195  0.022469
  2.733333  0.142768  0.314665  0.022812
  2.800000  0.144220  0.324231  0.023150
  2.866667  0.145680  0.333894  0.023483
  2.933333  0.147148  0.343655  0.023811
  3.000000  0.148623  0.353514  0.024135
  3.066667  0.150105  0.363472  0.024455
  3.133333  0.151594  0.373528  0.024770
  3.200000  0.153091  0.383685  0.025082
  3.266667  0.154595  0.393941  0.025390
  3.333333  0.156107  0.404298  0.025694
```

```
3.400000  0.157625  0.414755  0.025994
3.466667  0.159152  0.425314  0.026292
3.533333  0.160685  0.435976  0.026585
3.600000  0.162226  0.446739  0.026876
3.666667  0.163774  0.457606  0.027163
3.733333  0.165330  0.468576  0.027448
3.800000  0.166893  0.479650  0.027729
3.866667  0.168463  0.490829  0.028008
3.933333  0.170040  0.502112  0.028284
4.000000  0.171625  0.513501  0.028557
4.066667  0.173218  0.524996  0.028828
4.133333  0.174817  0.536597  0.029096
4.200000  0.176424  0.548305  0.029362
4.266667  0.178039  0.560120  0.029625
4.333333  0.179660  0.572044  0.031821
4.400000  0.181289  0.584075  0.033497
4.466667  0.182926  0.596216  0.034729
4.533333  0.184569  0.608466  0.035776
4.600000  0.186220  0.620825  0.036714
4.666667  0.187879  0.633295  0.037577
4.733333  0.189545  0.645876  0.038385
4.800000  0.191218  0.658568  0.039517
4.866667  0.192898  0.671372  0.043910
4.933333  0.194586  0.684288  0.046965
5.000000  0.196281  0.697317  0.049945
5.066667  0.197983  0.710459  0.052934
5.133333  0.199693  0.723715  0.055951
5.200000  0.201410  0.737085  0.059001
5.266667  0.203135  0.750570  0.062079
5.333333  0.204867  0.764170  0.065181
5.400000  0.206606  0.777886  0.068300
5.466667  0.208353  0.791718  0.071431
5.533333  0.210107  0.805667  0.170333
5.600000  0.211868  0.819732  0.576602
5.666667  0.213636  0.833916  1.149611
5.733333  0.215412  0.848217  1.832486
5.800000  0.217196  0.862638  2.578371
5.866667  0.218986  0.877177  3.339467
5.933333  0.220784  0.891836  4.067624
6.000000  0.222590  0.906615  4.718708
END FTABLE  3
FTABLE      2
 72    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  0.002778  0.000000  0.000000
0.049451  0.002778  0.000063  0.000000
0.098901  0.002778  0.000126  0.000000
0.148352  0.002778  0.000188  0.000000
0.197802  0.002778  0.000251  0.000000
0.247253  0.002778  0.000314  0.000000
0.296703  0.002778  0.000377  0.000000
0.346154  0.002778  0.000440  0.000000
0.395604  0.002778  0.000503  0.000000
0.445055  0.002778  0.000565  0.000000
0.494505  0.002778  0.000628  0.000000
0.543956  0.002778  0.000691  0.000000
0.593407  0.002778  0.000754  0.000000
0.642857  0.002778  0.000817  0.000000
0.692308  0.002778  0.000879  0.000000
0.741758  0.002778  0.000942  0.000000
0.791209  0.002778  0.001005  0.000000
0.840659  0.002778  0.001068  0.000000
0.890110  0.002778  0.001131  0.000000
0.939560  0.002778  0.001194  0.000000
0.989011  0.002778  0.001256  0.000000
1.038462  0.002778  0.001319  0.000000
1.087912  0.002778  0.001382  0.000676
1.137363  0.002778  0.001445  0.000754
1.186813  0.002778  0.001508  0.000927
```

```
  1.236264  0.002778  0.001570  0.001122
  1.285714  0.002778  0.001633  0.001340
  1.335165  0.002778  0.001696  0.001582
  1.384615  0.002778  0.001759  0.001848
  1.434066  0.002778  0.001822  0.002139
  1.483516  0.002778  0.001884  0.002456
  1.532967  0.002778  0.001941  0.002799
  1.582418  0.002778  0.001998  0.003170
  1.631868  0.002778  0.002055  0.003569
  1.681319  0.002778  0.002113  0.003997
  1.730769  0.002778  0.002170  0.004454
  1.780220  0.002778  0.002227  0.004942
  1.829670  0.002778  0.002284  0.005459
  1.879121  0.002778  0.002341  0.006008
  1.928571  0.002778  0.002398  0.006589
  1.978022  0.002778  0.002455  0.007202
  2.027473  0.002778  0.002512  0.007846
  2.076923  0.002778  0.002569  0.008403
  2.126374  0.002778  0.002626  0.008403
  2.175824  0.002778  0.002683  0.008403
  2.225275  0.002778  0.002740  0.008403
  2.274725  0.002778  0.002797  0.008403
  2.324176  0.002778  0.002854  0.008403
  2.373626  0.002778  0.002911  0.008403
  2.423077  0.002778  0.002968  0.008403
  2.472527  0.002778  0.003025  0.008403
  2.521978  0.002778  0.003082  0.008403
  2.571429  0.002778  0.003139  0.008403
  2.620879  0.002778  0.003196  0.008403
  2.670330  0.002778  0.003253  0.008403
  2.719780  0.002778  0.003310  0.008403
  2.769231  0.002778  0.003367  0.008403
  2.818681  0.002778  0.003424  0.008403
  2.868132  0.002778  0.003481  0.008403
  2.917582  0.002778  0.003538  0.008403
  2.967033  0.002778  0.003595  0.008403
  3.016484  0.002778  0.003652  0.008403
  3.065934  0.002778  0.003709  0.008403
  3.115385  0.002778  0.003766  0.008403
  3.164835  0.002778  0.003823  0.008403
  3.214286  0.002778  0.003880  0.008403
  3.263736  0.002778  0.003937  0.008403
  3.313187  0.002778  0.003994  0.008403
  3.362637  0.002778  0.004051  0.008403
  3.412088  0.002778  0.004108  0.008403
  3.461538  0.002778  0.004165  0.008403
  3.500000  0.002778  0.008839  0.008403
  END FTABLE  2
  FTABLE      1
   22    6
     Depth      Area    Volume  Outflow1  Outflow2  outflow 3 Velocity  Travel
Time***
      (ft)   (acres) (acre-ft)    (cfs)      (cfs)     (cfs)   (ft/sec)
(Minutes)***
  0.000000  0.002778  0.000000  0.000000  0.000000  0.000000
  0.049451  0.002778  0.000137  0.000000  0.034719  0.000000
  0.098901  0.002778  0.000275  0.000000  0.035827  0.000000
  0.148352  0.002778  0.000412  0.000000  0.036935  0.000000
  0.197802  0.002778  0.000549  0.000000  0.038043  0.000000
  0.247253  0.002778  0.000687  0.000000  0.039151  0.000000
  0.296703  0.002778  0.000824  0.000000  0.040259  0.000000
  0.346154  0.002778  0.000962  0.000000  0.041368  0.000000
  0.395604  0.002778  0.001099  0.000000  0.042476  0.000000
  0.445055  0.002778  0.001236  0.000000  0.043584  0.000000
  0.494505  0.002778  0.001374  0.000000  0.044692  0.000000
  0.543956  0.002778  0.001511  0.195553  0.045800  0.000000
  0.593407  0.002778  0.001648  0.605153  0.046908  0.000000
  0.642857  0.002778  0.001786  1.142846  0.048016  0.000000
  0.692308  0.002778  0.001923  1.779946  0.049124  0.000000
  0.741758  0.002778  0.002060  2.496989  0.050232  0.000000
```

```
  0.791209  0.002778  0.002198  3.277130  0.051340  0.000000
  0.840659  0.002778  0.002335  4.104021  0.052448  0.000000
  0.890110  0.002778  0.002473  4.961058  0.053556  0.000000
  0.939560  0.002778  0.002610  5.831235  0.054664  0.000000
  0.989011  0.002778  0.002747  6.697340  0.055772  0.000000
  1.000000  0.002778  0.002778  7.542349  0.056019  0.000000
  END FTABLE  1
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   1     EXTNL  PREC
WDM      1 EVAP     ENGL    0.5            RCHRES   1     EXTNL  POTEV
WDM      1 EVAP     ENGL    0.76           RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
RCHRES   3 HYDR   RO     1 1        1      WDM   1002 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1003 STAG     ENGL      REPL
END EXT TARGETS

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

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

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

  MASS-LINK        6
RCHRES     ROFLOW                          RCHRES         INFLOW
  END MASS-LINK    6

  MASS-LINK        7
RCHRES     OFLOW  OVOL   1                 RCHRES         INFLOW IVOL
  END MASS-LINK    7

  MASS-LINK        8
RCHRES     OFLOW  OVOL   2                 RCHRES         INFLOW IVOL
  END MASS-LINK    8

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

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

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

```
  MASS-LINK        16
RCHRES     ROFLOW                            COPY           INPUT  MEAN
  END MASS-LINK    16

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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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E-4

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.50
Program License Number: 201710010
Project Simulation Performed on: 07/16/2019 3:07 PM
Report Generation Date: 07/16/2019 3:10 PM

Input File Name:	TDA C TESC.fld
Project Name:	Spruce ES - Phase 2
Analysis Title:	TDA C TESC
Comments:	Calculations for TDA C TESC Basin

———————— PRECIPITATION INPUT ————————

Computational Time Step (Minutes): 15

Precipitation Station Data Selected
Climatic Region Number: 5

Full Period of Record Available used for Routing
Precipitation Station : 452675 Everett 10/01/1948-10/01/2011
Evaporation Station : 456803 Puyallup
At Site 25-Year, 24-Hour Precipitation (inches): 2.99
Gage 25-Year, 24-Hour Precipitation (inches) : 2.69
Precipitation Scale Factor : 1.112
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) ***************

********************** WATERSHED DEFINITION ***********************

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.700	0.700
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.700	0.700

----------------------SCENARIO: PREDEVELOPED

Number of Subbasins: 1

---------- Subbasin : TDA C ----------

	-------Area (Acres) --------
Till Forest	0.700
--	
Subbasin Total	0.700

----------------------SCENARIO: POSTDEVELOPED

Number of Subbasins: 1

---------- Subbasin : TESC Area ----------

	-------Area (Acres) --------
Impervious	0.700
--	
Subbasin Total	0.700

************************* LINK DATA *******************************

```
----------------------SCENARIO: PREDEVELOPED
Number of Links:  0


************************* LINK DATA *******************************

----------------------SCENARIO: POSTDEVELOPED
Number of Links:  1


------------------------------------------
Link Name: TESC
Link Type:  Copy
Downstream Link: None


**********************FLOOD FREQUENCY AND DURATION STATISTICS*******************

----------------------SCENARIO: PREDEVELOPED
Number of Subbasins:  1
Number of Links:  0


----------------------SCENARIO: POSTDEVELOPED
Number of Subbasins:  1
Number of Links:  1

********** Subbasin: TESC Area **********

 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)       Flood Peak (cfs)
====================================
   2-Year          0.313
   5-Year          0.420
   10-Year         0.501
   25-Year         0.651
   50-Year         0.761
   100-Year        0.923
   200-Year        **
   500-Year        **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: TESC                                        **********    Link Outflow 1 Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)       Flood Peak (cfs)
====================================
   2-Year          0.313
   5-Year          0.420
   10-Year         0.501    TESC Q
   25-Year         0.651
   50-Year         0.761
   100-Year        0.923
   200-Year        **
   500-Year        **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



 ***********Groundwater Recharge Summary *************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

              Total Predeveloped Recharge During Simulation
Model Element                        Recharge Amount (ac-ft)
-----------------------------------------------------------------------------------------
Subbasin: TDA C                       44.295
```

```
____________________________________
Total:                                 44.295

          Total Post Developed Recharge During Simulation
Model Element                         Recharge Amount (ac-ft)
-----------------------------------------------------------------------------------------
Subbasin: TESC Area                    0.000
Link:     TESC                         0.000
____________________________________
Total:                                 0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 63)
Predeveloped:   0.703 ac-ft/year,  Post Developed:   0.000 ac-ft/year

 ***********Water Quality Facility Data *************

---------------------SCENARIO: PREDEVELOPED

Number of Links:  0


---------------------SCENARIO: POSTDEVELOPED

Number of Links:  1


********** Link: TESC                                          **********

 Infiltration/Filtration Statistics--------------------
 Inflow Volume (ac-ft):  129.04
 Inflow Volume Including PPT-Evap (ac-ft):  129.04
 Total Runoff Infiltrated (ac-ft):  0.00,  0.00%
 Total Runoff Filtered (ac-ft):  0.00,  0.00%
 Primary Outflow To Downstream System (ac-ft):  129.04
 Secondary Outflow To Downstream System (ac-ft):  0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%


 ***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: TDA C

Scenario Postdeveloped Compliance Link: TESC

     *** Point of Compliance Flow Frequency Data ***
     Recurrence Interval Computed Using Gringorten Plotting Position

          Predevelopment Runoff                      Postdevelopment Runoff
Tr (Years)         Discharge (cfs)             Tr (Years)         Discharge (cfs)
------------------------------------------------------------------------------------------------------------
   2-Year          1.987E-02                  2-Year                0.313
   5-Year          3.048E-02                  5-Year                0.420
   10-Year         5.107E-02                  10-Year               0.501
   25-Year         6.072E-02                  25-Year               0.651
   50-Year         7.204E-02                  50-Year               0.761
   100-Year        7.344E-02                  100-Year              0.923
   200-Year            **                     200-Year                **
   500-Year            **                     500-Year                **
 ** Record too Short to Compute Peak Discharge for These Recurrence Intervals


**** Flow Duration Performance ****
Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):             607.1%   FAIL
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):         4850.8%   FAIL
Maximum Excursion from Q2 to Q50 (Must be less than 10%):                      99999.0%   FAIL
Percent Excursion from Q2 to Q50 (Must be less than 50%):                       100.0%   FAIL

-------------------------------------------------------------------------------------------
```

FLOW DURATION DESIGN CRITERIA: FAIL

E-5

Project Spruce Elementary School
Subject TDA Wetland Sizing
With/To
Address
Date 1/30/2020

Project No. 214075.10
Phone 206.267.2425
FAX #
Faxed Pages
By Yi Yang

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

See Appendix E-1 for MGSFlood which provide the basic wetpond design volume (highlighted).

Basic wetpond volume (91% exceedance): 13,973 cu-ft

Determine the surface area of the total wetland:
Basic wetland volume dividing by the average water depth (use 3 feet) = 13,973/3 = 4,658 sq-ft

Determine the surface area of the first cell (the presettling cell):

First cell should contain approximately 33% of the wetpond volume = (13,973 *33%)/4 = 1,153 cu-ft;
Depth of the wetland = 4 feet
First Cell Area = = 1,153/4 = 288 sq-ft

Determine the surface area of the second cell (the wetland cell):
Total area - first cell = 4,658 - 288 = 4,370 sq-ft

Distribution of depths in wetland cell:

Depth range (feet)	Percent	Required Area (sq-ft)	Provided Area (sq-ft)
Total		4,658	5,370
0.1 to 1	25	1092.5	1,191
1 to 2	55	2403.5	2,969
2 to 2.5	20	874	1,210

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

AHBL

Civil Engineers

Structural Engineers

Landscape Architects

Community Planners

Land Surveyors

Neighbors

SEATTLE

1200 6th Avenue
Suite 1620
Seattle, WA 98101-3117
206.267.2425 TEL

www.ahbl.com

Appendix D
Traffic Impact Analysis and Updated Traffic Analysis

Gibson Traffic Consultants, Inc.
2813 Rockefeller Avenue
Suite B
Everett, WA 98201
425.339.8266

Spruce Elementary School
Traffic Impact Analysis

Prepared for: Edmonds School District
Jurisdiction: City of Lynnwood

April 2017

MATTHEW JOHN PALMER
42322
Matthew Palmer
4/12/17

TABLE OF CONTENTS

LIST OF FIGURES

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ATTACHMENTS

1. INTRODUCTION

Gibson Traffic Consultants, Inc. (GTC) has been retained to complete a traffic impact analysis (TIA) for the Spruce Elementary School reconstruction. Edmonds School District (ESD) is proposing to reconstruct Spruce Elementary School, which is located on the east side of Spruce Way between 176th Street SW and 172nd Street SW in the City of Lynnwood. A site vicinity map is included in Figure 1. The school will continue to be an elementary school serving grades kindergarten through 6th grade with school hours from 9:20 AM and to 3:50 PM. For this analysis, the school is anticipated to have a capacity of 650 students. A similar ratio of volunteers and staff currently serving the school was assumed for future conditions as well. The school's current district boundary extends from SR-99 to 25th Avenue W and from 176th Street SW to 148th Street SW.

2. PROPOSED SITE DEVELOPMENT & ACCESS

Spruce Elementary School is being reconstructed with a capacity of 650 students. Bus traffic will be separated from staff and parent drop-off/pick-up traffic. The number of buses servicing the school is not anticipated to change. Neither of the school's access points are planning on moving, however, the north access will be repurposed to service the bus loop while the south access will serve for parent drop-off/pick-up and parking. Additionally, the parent drop-off/pick-up area will expand to allow for additional drop-off/pick-up of simultaneous vehicles while allowing other vehicles to bypass the stopped vehicles. The number of available parking spaces on-site will also increase to 90 parking stalls. The proposed school is scheduled for full facility build-out and occupancy by the 2018-2019 school year. However, the project may get delayed; therefore, the year 2020 has been used as the opening year in the analysis.

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(650 STUDENTS)

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▨	DEVELOPMENT SITE
○ #X	STUDY INTERSECTIONS

FIGURE 1
SITE VICINITY MAP

3. METHODOLOGY & ANALYSIS SCOPING

Peak-hour level of service (LOS) is determined using the methodology described in the 2010 *Highway Capacity Manual* (HCM) and *Synchro 9.1* software developed by Trafficware. There are currently 558 students enrolled at Spruce Elementary School according to the Office of Superintendent of Public Instruction in May of 2016. The turning movement counts were performed during the next school year in November 2016. In order to analyze “worst case” traffic conditions at the school site, GTC has utilized existing driveway count data to estimate future peak-hour traffic volumes and peak-hour LOS conditions.

Traffic congestion on roadways is generally measured in terms of LOS at critical intersections. In accordance with the 2010 *Highway Capacity Manual*, roadway facilities and intersections are rated between LOS A and F, with LOS A being free flow and LOS F being forced flow or over-capacity conditions. The LOS at signalized intersections and all-way stop-controlled intersections are based on the average stopped delay for all entering vehicles. The LOS at two-way stop-controlled intersections is based on stopped delay times for the critical approach or movement(s). Geometric characteristics and conflicting traffic movements are taken into consideration when determining LOS values. A summary of the level of service criteria has been included in Table 1.

GTC utilized a 2.0-percent annual compounding growth rate to account for background traffic growth in the site vicinity based on projects located near the site. The street network surrounding the school is primarily comprised of stop-controlled intersections (all-way and two-way) and primarily serves single family-residential homes.

Matthew Palmer, responsible for the traffic analysis and report, is a licensed professional engineer (Civil) in the State of Washington and a current member of the Washington State section of ITE.

Table 1: Level of Service Criteria for Intersections

Level of Service[1]	Expected Delay	Intersection Control Delay (Seconds per Vehicle)	
		Unsignalized Intersections	**Signalized** Intersections
A	Little/No Delay	≤10	≤10
B	Short Delays	>10 and ≤15	>10 and ≤20
C	Average Delays	>15 and ≤25	>20 and ≤35
D	Long Delays	>25 and ≤35	>35 and ≤55
E	Very Long Delays	>35 and ≤50	>55 and ≤80
F	Extreme Delays[2]	>50	>80

The acceptable level of service at arterial intersections within the City of Lynnwood is LOS C for local streets at all times and LOS D for non-City Center arterials during the PM peak-hour.

GTC analyzed AM and School PM peak-hour level of service. Listed below are the intersections analyzed:

- Spruce Way at 172nd Street SW
- Spruce Way at North School Driveway
- Spruce Way at South School Driveway

---

[1] **Source:** *Highway Capacity Manual* 2010.

LOS A: Free-flow traffic conditions, with minimal delay to stopped vehicles (no vehicle is delayed longer than one cycle at signalized intersection).
LOS B: Generally stable traffic flow conditions.
LOS C: Occasional back-ups may develop, but delay to vehicles is short term and still tolerable.
LOS D: During short periods of the peak hour, delays to approaching vehicles may be substantial but are tolerable during times of less demand (i.e. vehicles delayed one cycle or less at signal).
LOS E: Intersections operate at or near capacity, with long queues developing on all approaches and long delays.
LOS F: Jammed conditions on all approaches with excessively long delays and vehicles unable to move at times.

[2] When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection.

4. EXISTING CONDITIONS

4.1 Walking Conditions

Spruce Way is a two-lane road, one in each direction. Each lane is approximately 10 feet wide. There are paved sidewalks traveling north from the school and a walking path to the south. Per the City of Lynnwood's *Transportation Business Plan* draft dated May 2009, there are project to improve pedestrian and bicycle conditions along Spruce Way. Project B50/B51 will widen the street to allow for 5' bike lanes on both sides of the road and P50/P51 will build concrete sidewalks on both sides of the road.

There are two paved trails within proximity to Spruce Elementary, one across from the school on Spruce way connecting to 175th Street SW and one on the northeast corner of the school connecting to 174th Place SW. These connections allow easy access to 44th Avenue W and 36th Avenue W, both of which are primary north/south streets with three lanes, one in each direction with a two-way left-turn lane. 36th Avenue W has a paved shoulder on the east side and at-grade sidewalk separated with a c-curb on the west. 44th Avenue W has separated raised sidewalk on both sides of the street.

4.2 Collision Data

Collision data was provided by WSDOT for 5-years from January 1, 2012 through the available 2016 data at the study intersections. The collision data is summarized in **Table 2** and **Table 3**.

Table 2: Collision Summary

Intersection	Collision Type							Total Collisions	Collisions Per Year
	Rear-end	Entering at Angle	Opp. Dir.	Sideswipe	Same Dir. Other	Ped./Cyclist Involved	Fixed Object		
172nd St SW at Spruce Way	0	2	0	0	0	0	0	2	0.4

Table 3: 6-Year Collision Rate Calculation

Intersection	PM Peak-Hour Intersection Vol.	K-Factor	Total Collisions	Collision Rate[3]
172nd St SW at Spruce Way	542	10	2	0.20

The intersection of 172nd Street SW at Spruce Way was the only location to have collisions. The intersection of 172nd Street SW at Spruce Way has a collision rate per million entering below 1.0, which corresponds to a relatively normal to low rate of accidents, and is below the average rate for the area.

---

[3] The collision rate is based on Million Entering Vehicles.

4.3 Existing Parking Utilization

A parking survey was completed by the independent count firm, Traffic Data Gathering (TDG) staff after the morning peak period at 9:45 AM and prior to school dismissal at PM on November 16, 2016. Currently on site there are a total of 58 spaces. In the morning, there were a total of 46 vehicles parked for the site, 2 of which were utilizing the ADA stalls. Prior to the school dismissal/arrival of parent pick-up traffic, there were a total of 43 parked vehicles for the school, 1 of which utilized the ADA stalls. The parking generation per student based on 558 existing students is 0.08 vehicles per student for the AM and 0.08 vehicles per student at School PM peak-hours, this includes all vehicles parked on-site (staff and visitor).

4.4 Existing Volumes and Level of Service

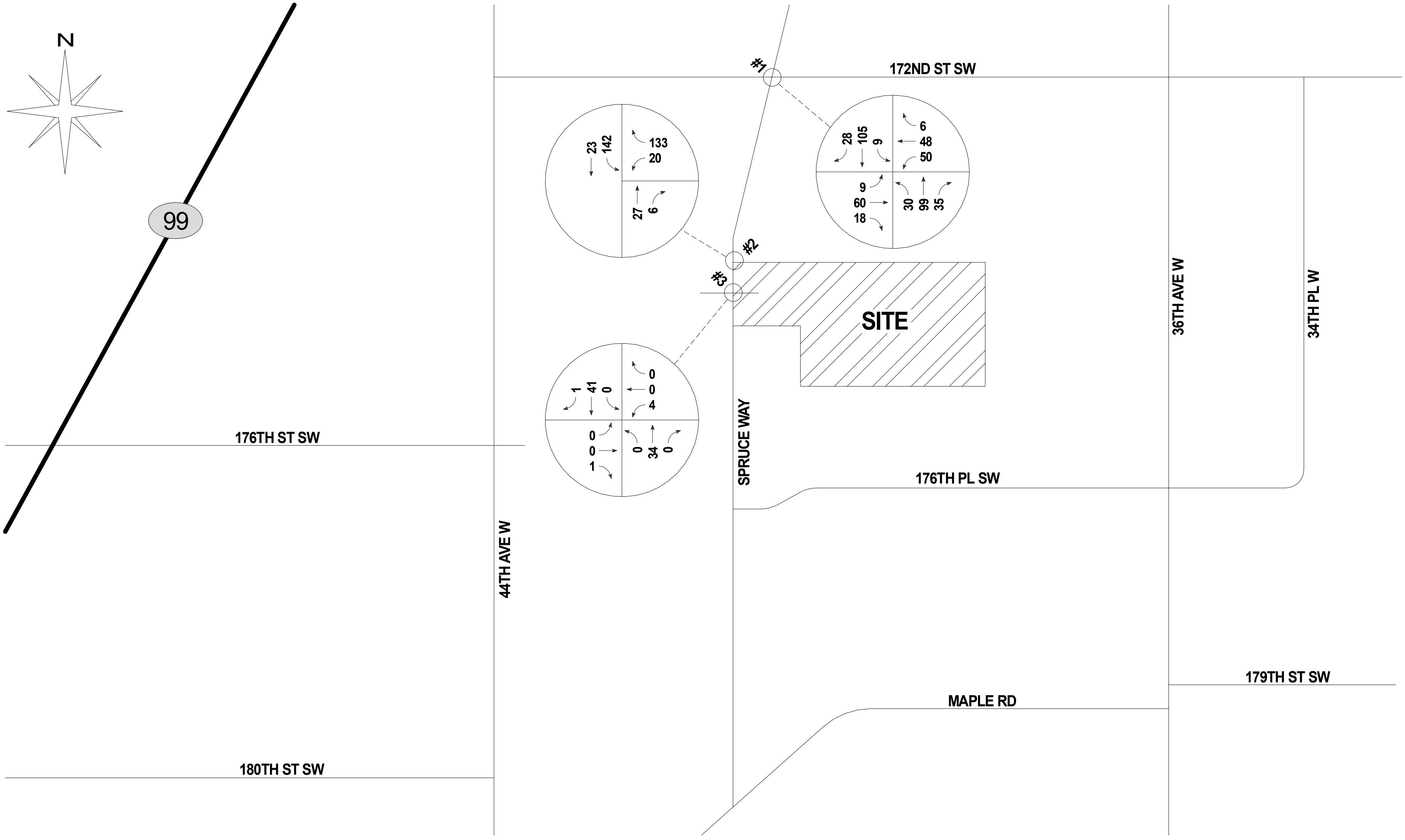
Existing turning movement counts at all the study intersections were obtained by the independent count firm, Traffic Data Gathering (TDG) on Wednesday, November 16, 2016. The existing peak-hour turning movement volumes are shown at the study intersections during the AM peak-hour (8:45-9:45 AM) and School PM peak-hour (3:00-5:00 PM) in Figure 2 and Figure 3 respectively. Based on the existing counts, channelization and intersection control; all of the study intersections will operate at LOS B or better during AM peak-hour and School PM peak-hour. The existing level of service for the AM peak-hour and School PM peak-hour is summarized in Table 4 and Table 5 respectively. The existing level of service calculations are included in the attachments.

Table 4: Existing Level of Service Summary – AM Peak-Hour

Intersections	Existing Conditions		
	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	B	10.2 sec	---
2. Spruce Way at North Driveway	B	11.8 sec	Westbound
3. Spruce Way at South Driveway	B	10.5 sec	Westbound

Table 5: Existing Level of Service Summary – School PM Peak-Hour

Intersections	Existing Conditions		
	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	A	9.4 sec	---
2. Spruce Way at North Driveway	B	10.7 sec	Westbound
3. Spruce Way at South Driveway	A	9.8 sec	Westbound



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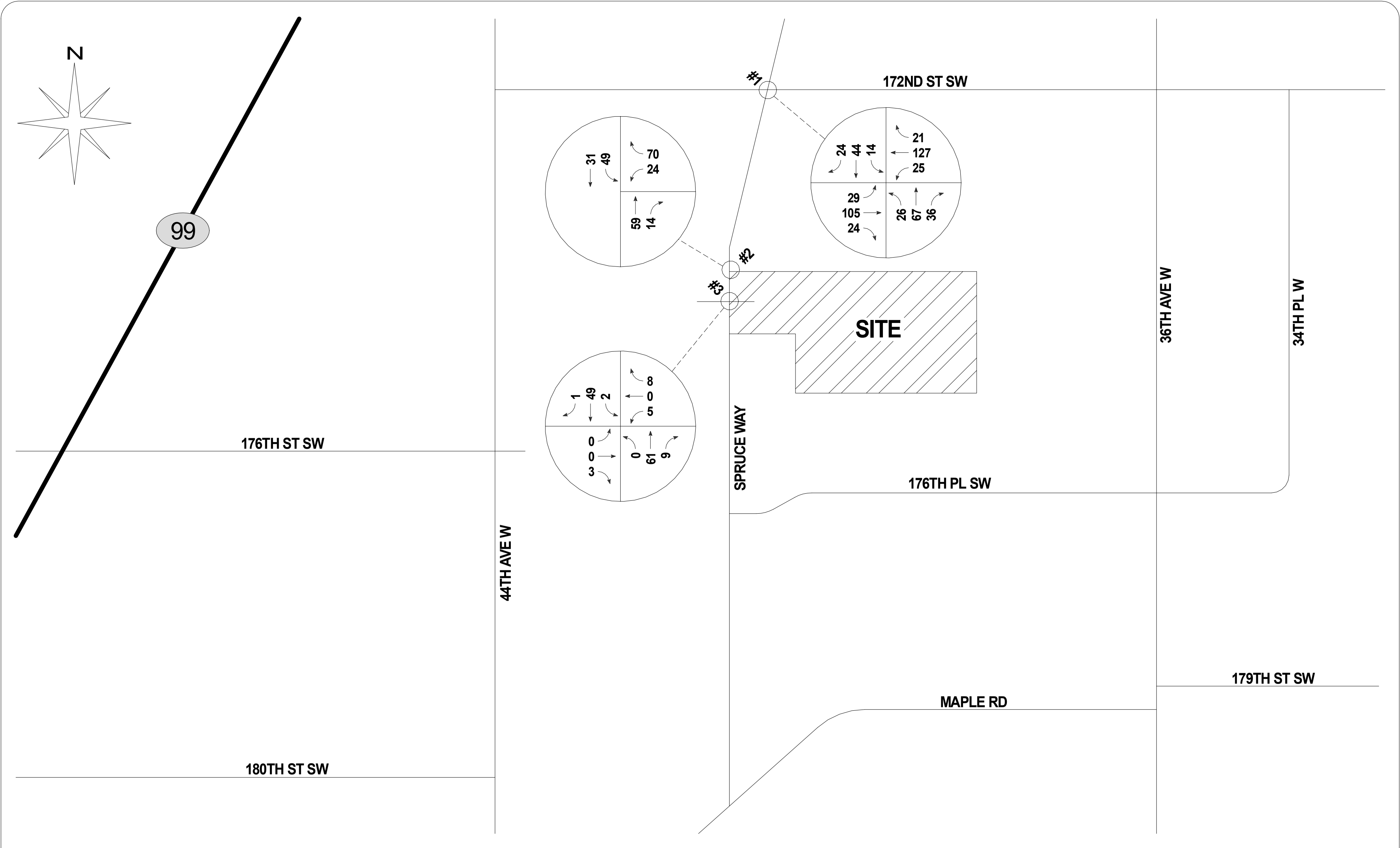
XXX → AM PEAK-HOUR TURNING MOVEMENTS

FIGURE 2
EXISTING AM PEAK-HOUR TURNING MOVEMENTS



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XXX → SCHOOL PM PEAK-HOUR TURNING MOVEMENTS

FIGURE 3
EXISTING
SCHOOL PM PEAK-HOUR
TURNING MOVEMENTS

5. FUTURE CONDITIONS

5.1 Trip Generation

According to the Office of Superintendent of Public Instruction, there were 558 students enrolled in May of the 2015-2016 school year. Per ITE *Trip Generation* (9th Edition, 2012) Land Use Code: 520, Elementary School, the trip generation rate per student is 1.29 for daily, 0.45 for AM peak-hour and 0.28 for PM peak-hour and the existing 558-student school would have an ITE trip generation of 720 daily, 251 AM and 156 School PM peak trips on an average weekday or school day.

AM peak traffic counts at the school entrances and exits taken on Wednesday November 16, 2016 indicate school trip volumes are higher than the ITE trip estimates, with 307 peak-hour trips (150 inbound and 157 outbound) during the AM peak hour for existing conditions, approximately 22% higher than ITE estimates. School PM peak traffic counts taken on Wednesday November 16, 2016 indicate school traffic volumes are also higher than ITE trip estimates with 179 peak trips (73 inbound and 106 outbound) during the school PM peak hour, approximately 15% higher than ITE estimates. In order to analyze "worst case" traffic conditions at the school site, GTC has utilized existing driveway count data to estimate future peak-hour traffic volumes and peak-hour LOS conditions.

For future school traffic with the proposed school reconstruction, GTC assumed the same traffic generation characteristics as counted at the existing school driveways with new school traffic proportional to the expected growth in the student enrollment. The expected enrollment increase at Spruce Elementary School is to 650 students, or an increase of 92 students. For the critical AM peak period, school traffic would increase by an estimated 50.3 trips (24.4 inbound/25.9 outbound) and by 29.8 trips (12.2 inbound/17.6 outbound) for the School PM peak. During the street peak-hour it is anticipated that there would be an increase of 13.8 PM peak-hour trips (6.8 inbound/7.0 outbound). The trip generation is summarized in Table 6.

Table 6: Elementary School Trip Generation Summary

Students	Average Daily Trips	AM Peak-Hour			School PM Peak-Hour			PM Peak-Hour[4]		
		Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
92	140.8[5]	24.4	25.9	50.3	12.2	17.6	29.8	6.8	7.0	13.8

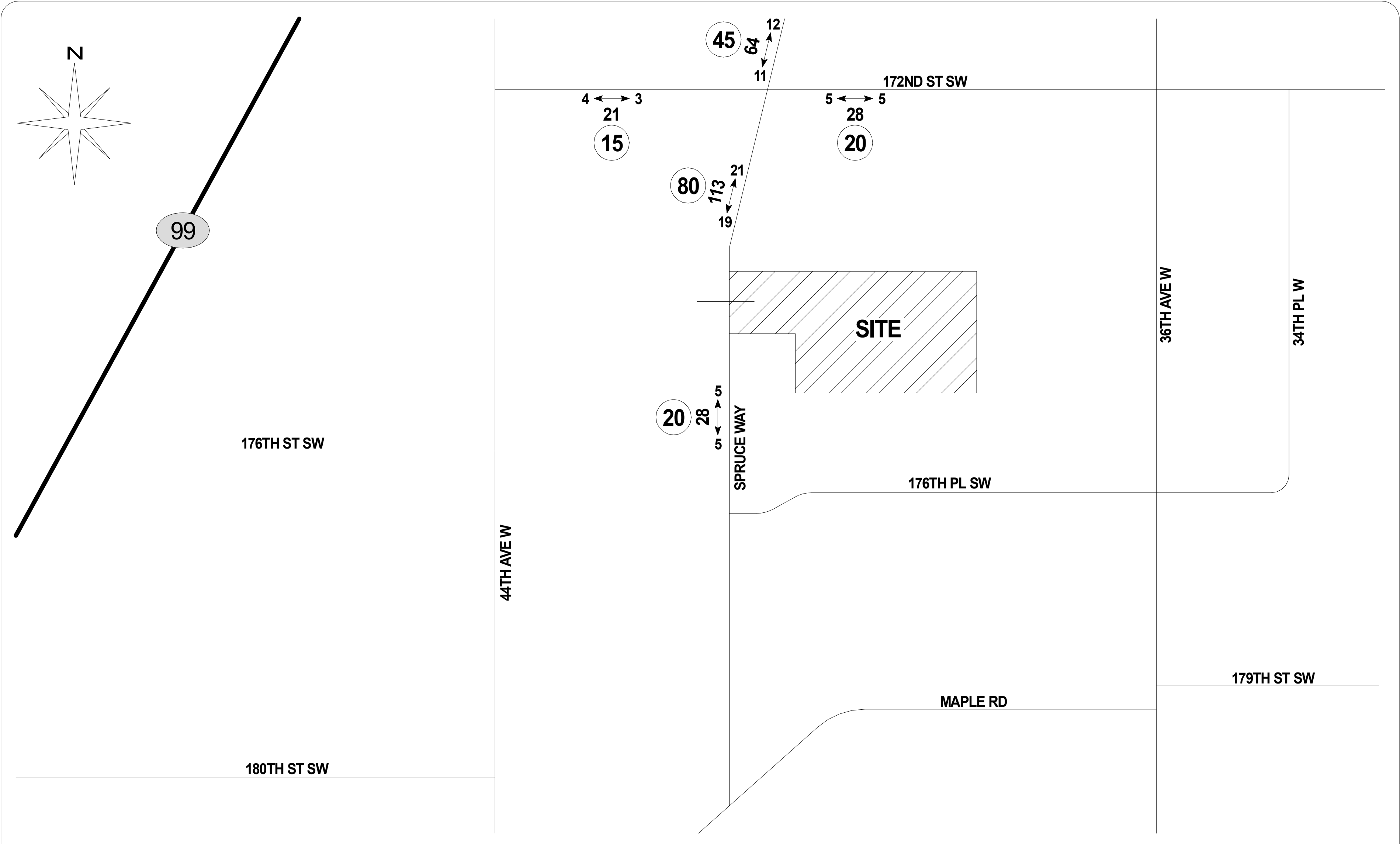
---

[4] Based on ITE rates

[5] Uses a ratio of ITE and on site trip generation rates.

5.2 Trip Distribution

Trip distribution is based on the existing traffic counts in the site vicinity and potential school draw areas. It is estimated that 20% of the site traffic will travel to and from the south along Spruce Way. An estimated 15% will travel to and from the west on 172nd Street SW. An estimated 20% will travel to and from the east on 172nd Street SW. The remaining 45% is expected to travel to and from the north on Spruce Way. Detailed trip distributions are shown in Figure 4 and Figure 5 for the AM peak-hour and School PM peak-hour respectively.



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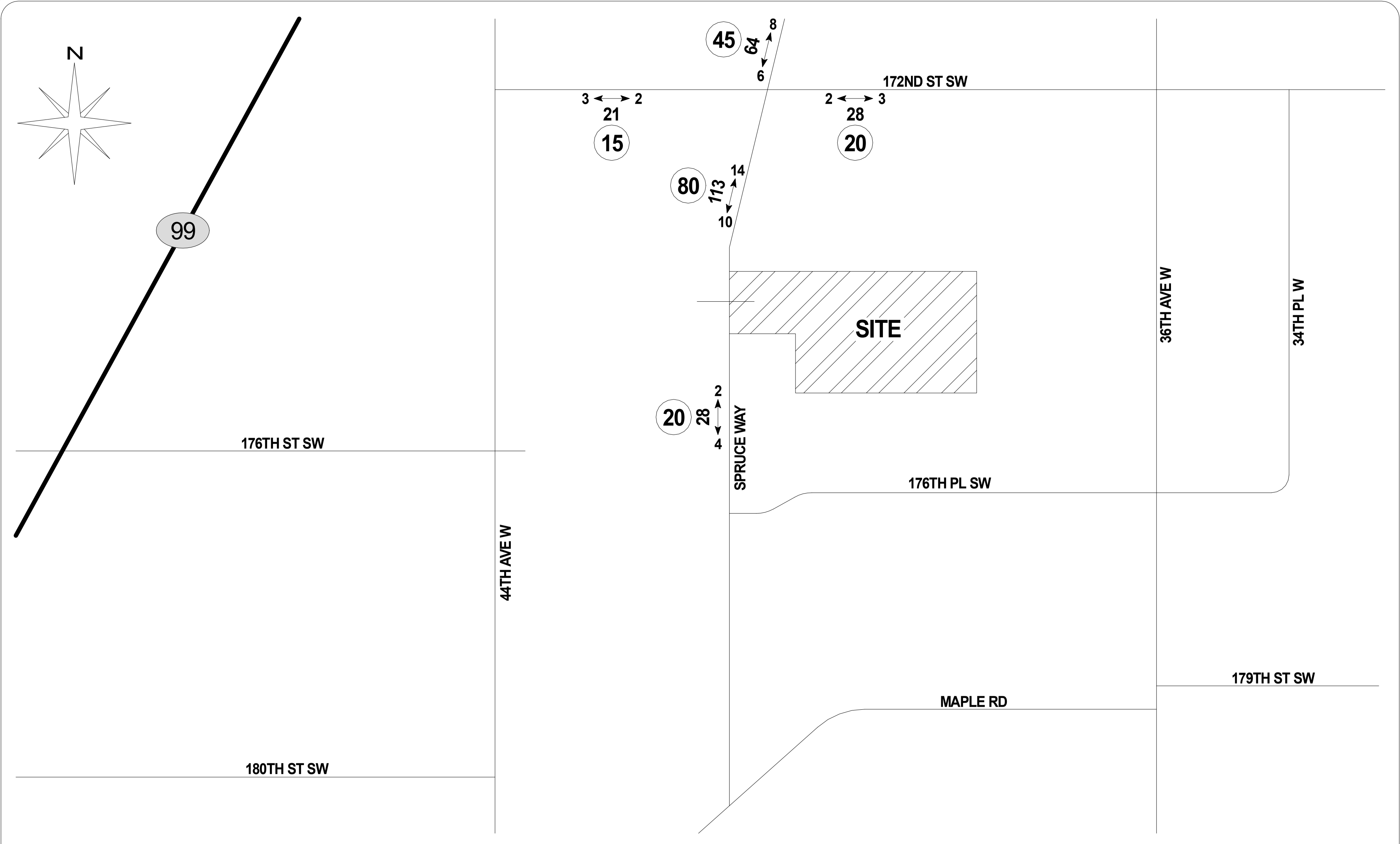
AM ← AWDT → PEAK NEW SITE TRAFFIC (DAILY/PEAK HOUR)

(XX) TRIP DISTRIBUTION %

FIGURE 4
DEVELOPMENT TRIP DISTRIBUTION AM PEAK-HOUR



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PM ← AWDT → PEAK	NEW SITE TRAFFIC (DAILY/PEAK HOUR)
XX	TRIP DISTRIBUTION %

FIGURE 5
DEVELOPMENT TRIP DISTRIBUTION SCHOOL PM PEAK-HOUR

5.3 2020 Baseline Volumes and Level of Service

The 2020 baseline (future without project) turning movement volumes are estimated by applying a 2.0% annual compounding growth rate to the existing turning movement volumes. The 2020 baseline turning movement volumes for the AM peak-hour and School PM peak-hour are shown in Figure 6 and Figure 7.

With the addition of baseline growth, all of the study intersections will continue to operate at LOS B or better during the AM and School PM peak-hours. The 2020 baseline level of service results for the AM peak-hour and School PM peak-hour are summarized in Table 7 and Table 8. The baseline level of service calculations are included in the attachments.

Table 7: 2020 Baseline Level of Service Summary – AM Peak-Hour

Intersection	Existing Conditions			2020 Baseline Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	B	10.2 sec	---	B	10.8 sec	---
2. Spruce Way at North Driveway	B	11.8 sec	Westbound	B	12.5 sec	Westbound
3. Spruce Way at South Driveway	B	10.5 sec	Westbound	B	10.6 sec	Westbound

Table 8: 2020 Baseline Level of Service Summary – School PM Peak-Hour

Intersection	Existing Conditions			2020 Baseline Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	A	9.4 sec	---	A	9.8 sec	---
2. Spruce Way at North Driveway	B	10.7 sec	Westbound	B	11.0 sec	Westbound
3. Spruce Way at South Driveway	A	9.8 sec	Westbound	A	9.9 sec	Westbound

5.4 2020 Future with Project Volumes and Level of Service

The 2020 future with project turning movement volumes are calculated by adding all of the school traffic based on the trip distribution to the 2020 baseline turning movement volumes. It was assumed that the number of buses did not change with the reconstruction based on the low increase in student population. Additionally, all of the traffic was rerouted so that all of the bus traffic was utilizing the north driveway while all of the parent traffic was utilizing the south driveway. The peak-hour factor and heavy vehicle percentage was also switched in conjunction with the driveway uses. The 2020 future with project turning movement volumes for the AM peak-hour and School PM peak-hour in Figure 8 and Figure 9.

With the addition of school traffic, all the study intersections will continue to operate at LOS C or better during the AM peak-hour and LOS B or better during the School PM peak-hour. All of the off-site study intersections will operate at acceptable City of Lynnwood Intersection Standards used for SEPA impact evaluation. The 2020 future with project level of service results for the AM peak-hour and School PM peak-hour are summarized in Table 9 and Table 10. The 2020 future with project level of service calculations are included in the attachments.

Table 9: 2020 Future Level of Service Summary – AM Peak-Hour

Intersection	2020 Baseline Conditions			2020 Future Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	B	10.8 sec	---	B	11.5 sec	---
2. Spruce Way at North Driveway	B	12.5 sec	Westbound	C	17.9 sec	Westbound
3. Spruce Way at North Driveway	B	12.5 sec	Westbound	B	12.7 sec	Westbound

Table 10: 2020 Future Level of Service Summary – School PM Peak-Hour

Intersection	2020 Baseline Conditions			2020 Future Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	A	9.8 sec	---	A	10.0 sec	---
2. Spruce Way at North Driveway	B	11.0 sec	Westbound	B	10.6 sec	Westbound
3. Spruce Way at North Driveway	A	9.9 sec	Westbound	B	11.2 sec	Westbound

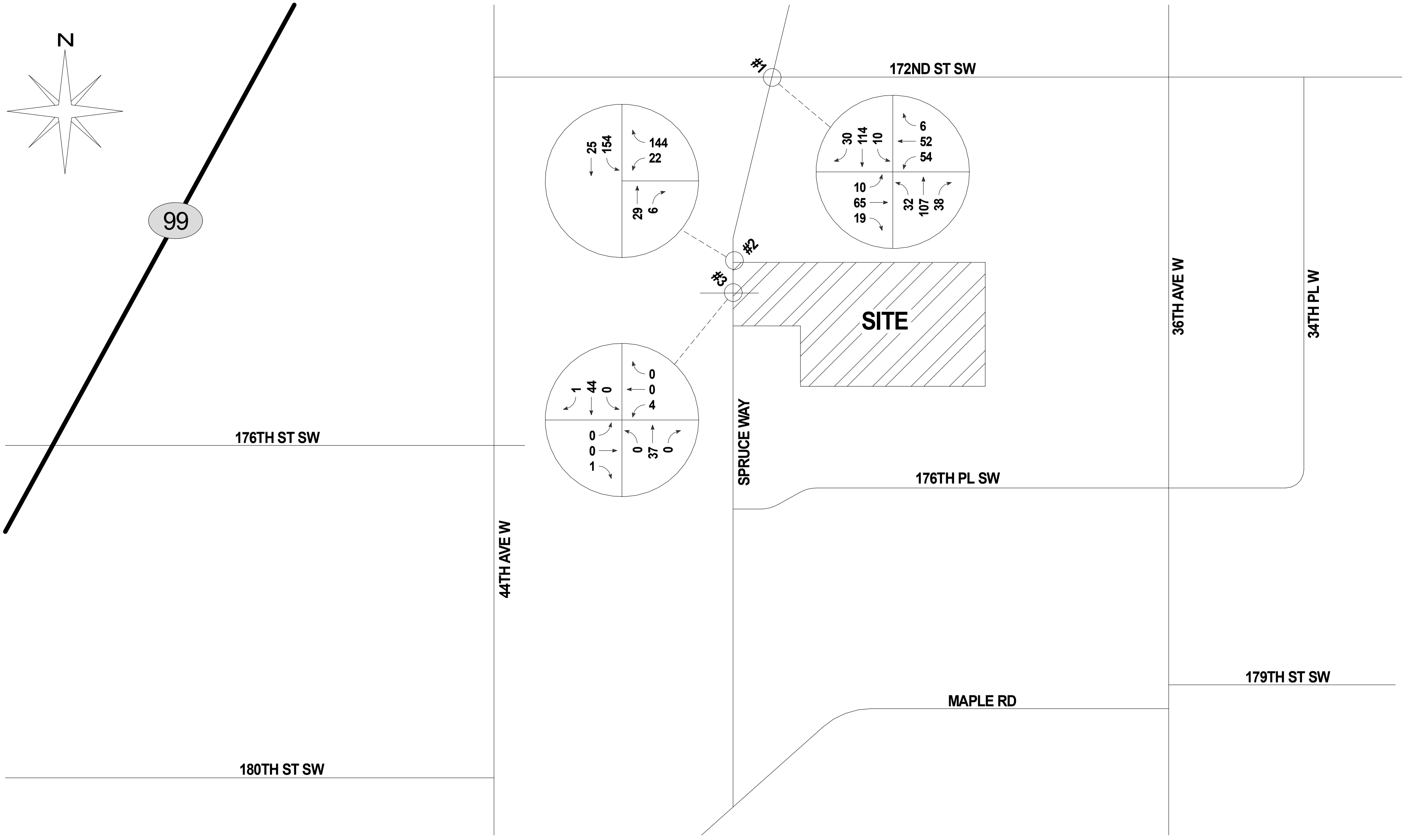
5.5 2020 Opening Year Queuing

Table 11 below shows a comparison of vehicle queue lengths depending on the number of vehicles picking-up/dropping-off at one time. The proposed loop will provide about 830 feet of service and queueing space before impacting Spruce Way. This provides space for about 38 vehicles (between 20-22 feet per vehicle) which would satisfy the requirement if only 4 vehicles could be serviced simultaneously. With increased drop-off/pick-up efficiency due to increased service area and additional parking on-site the proposed parent loop would provide adequate queuing space to limit impacts to the City street system.

Table 11: Expected Drop-off/pick-up Queuing

Vehicles Served Simultaneously	50% Queue [vehicles]	95% Queue [vehicles]	Queuing Required [feet]	Total Loop Length Required
4	**1**	**8**	**176**	**330**
5	**0**	**4**	**88**	**286**
6	**0**	**3**	**66**	**308**

This projected queuing is based on 172 vehicles (anticipated future parent traffic to the site) arriving in a 15-minute period and having a service rate of 15 seconds to drop-off a student. The 15 seconds is the measured time for a vehicle to stop, drop-off the student, start moving again based on video observations. The queue identified as the additional queue beyond the area required for the vehicles being served simultaneously. It was assumed that the length required to service X vehicles was 22 feet multiplied by (2*X-1). It was assumed that there will be enough width for vehicles to by-pass those dropping off. The width would allow for double stacking if queuing becomes a problem.



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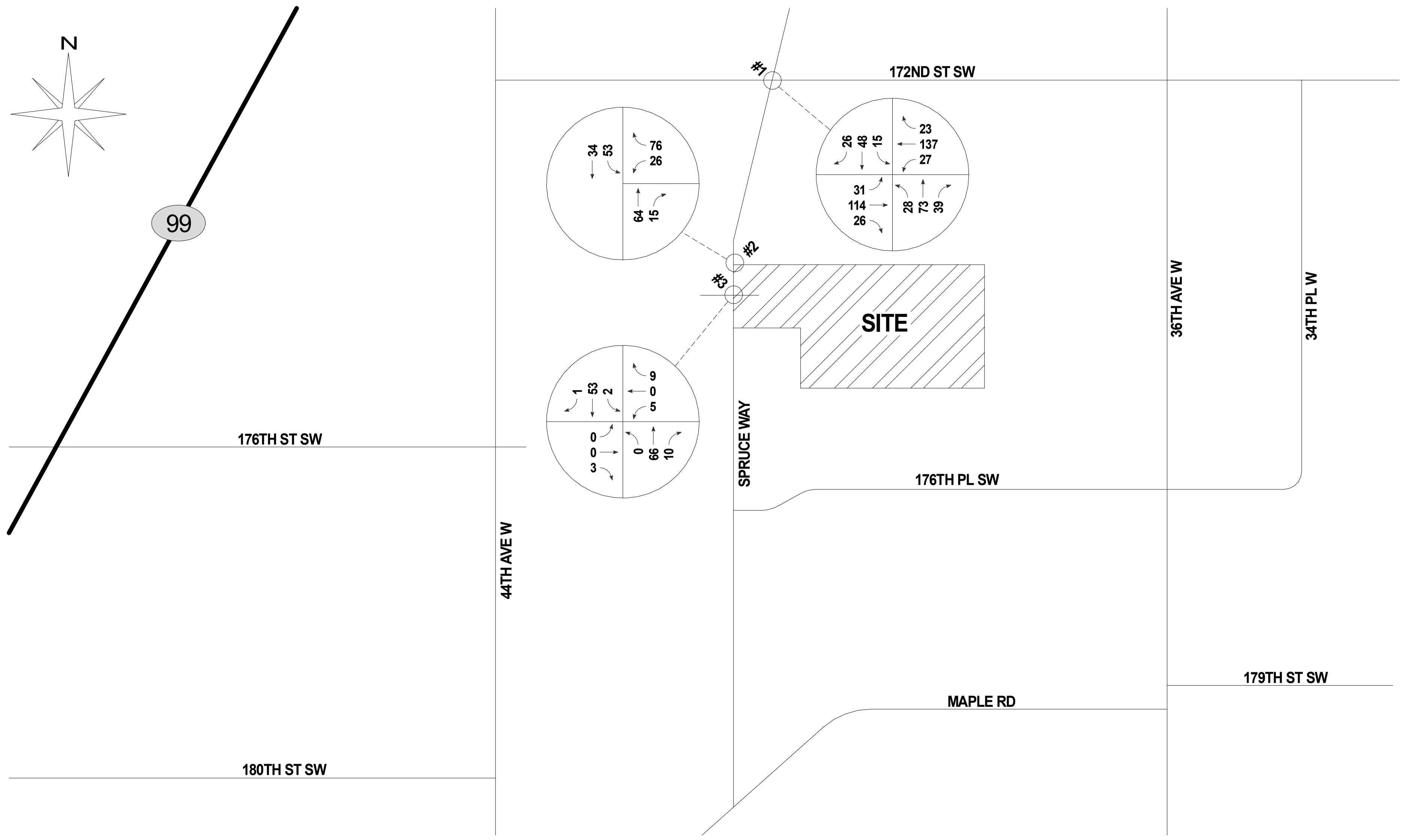
XXX →	AM PEAK-HOUR TURNING MOVEMENTS

FIGURE 6

2020 BASELINE
TRAFFIC VOLUMES
AM PEAK-HOUR



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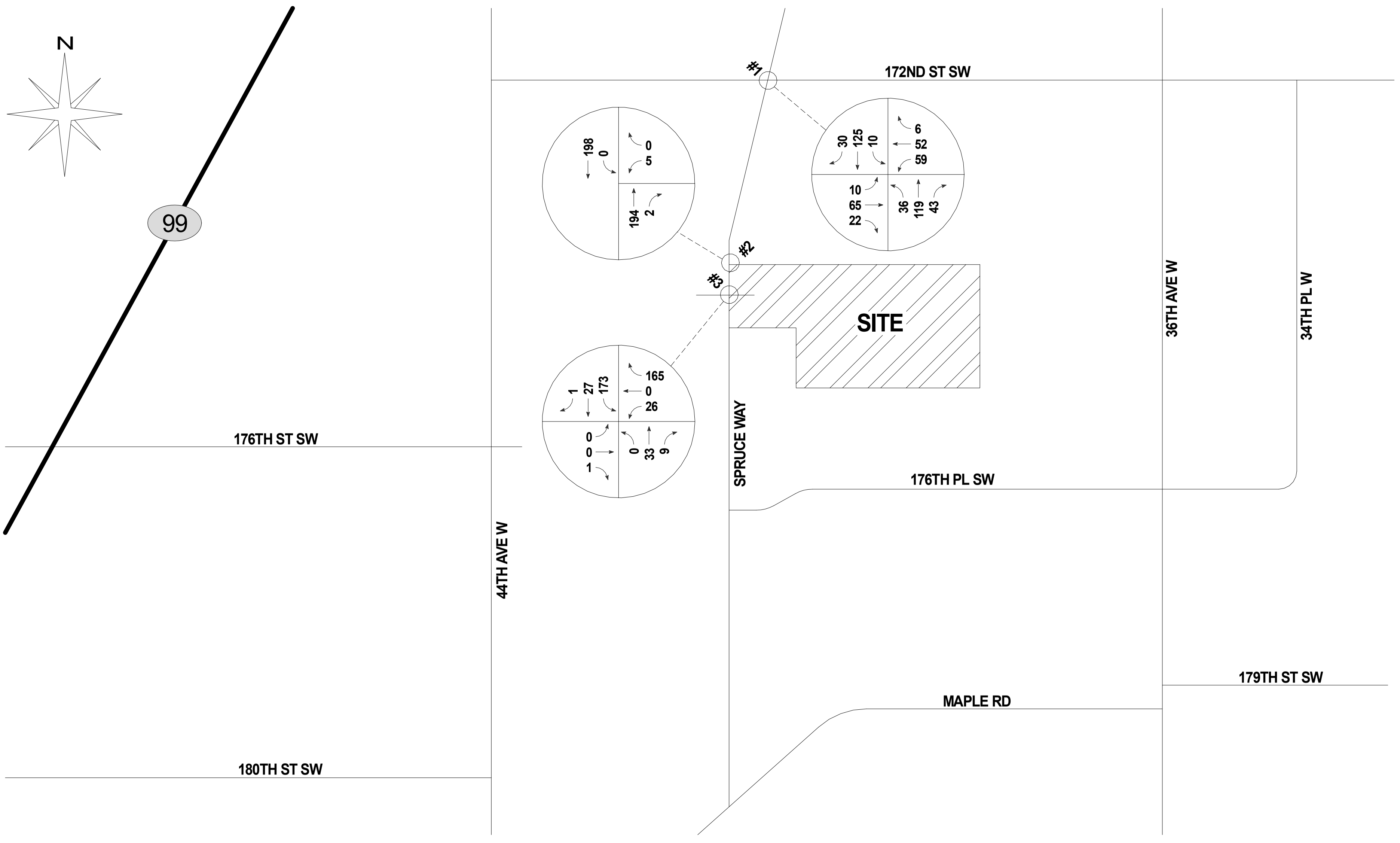
LEGEND

XXX → SCHOOL PM PEAK-HOUR TURNING MOVEMENTS

FIGURE 7

2020 BASELINE
TRAFFIC VOLUMES
SCHOOL PM PEAK-HOUR



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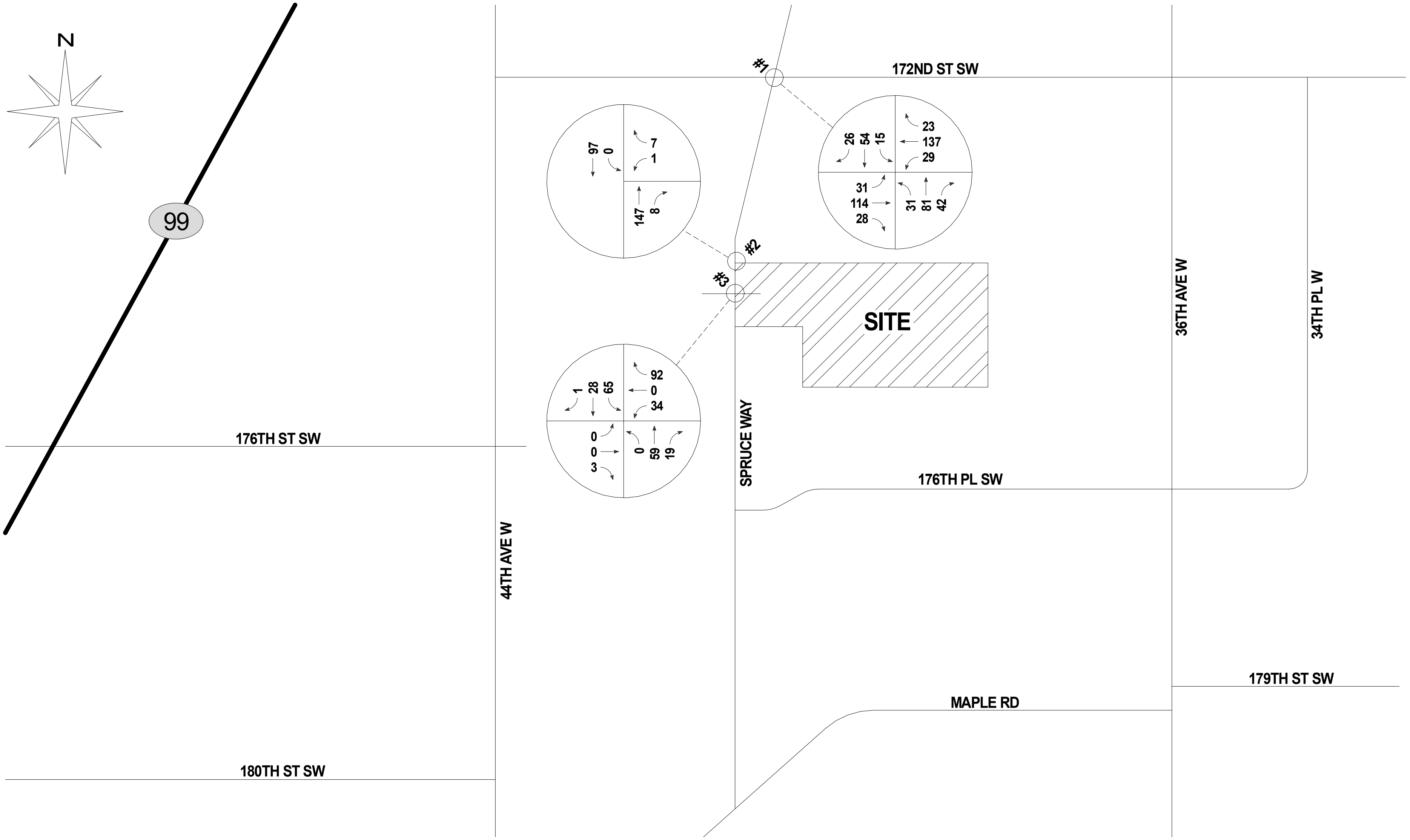
LEGEND

XXX → AM PEAK-HOUR TURNING MOVEMENTS

FIGURE 8
2020 FUTURE WITH PROJECT TRAFFIC VOLUMES AM PEAK-HOUR



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(650 STUDENTS)

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LEGEND

XXX → SCHOOL PM PEAK-HOUR TURNING MOVEMENTS

FIGURE 9

2020 FUTURE WITH PROJECT TRAFFIC VOLUMES SCHOOL PM PEAK-HOUR

5.6 2020 Opening Year Parking Demand

For the future parking assessment, GTC assumed that the student enrollment would increase from 558 existing students (latest student data on OSPI) to 650 students projected by the Edmonds School District. The City of Lynnwood requires one parking space per six students and sufficient off-street space for safe loading and unloading of buses. This would result in a parking demand of 108 parking spaces. A parking study performed by GTC in November of 2016 shows that Spruce Elementary School has a parking demand of 0.083 vehicles per student. Assuming 85% represents a parking lot reaching capacity, the school would have a total parking demand of 63 parking spaces. Spruce Elementary School is proposing to have a total of 90 parking spaces, this represents an 17% reduction in parking from the City Code requirement of 108 parking spaces, an administrative reduction of up to 20% would be allowed per City Code 21.18.820.

The parent and bus loops would have sufficient off-street space to load and unload students on-site. The 90 spaces plus parking provided in the loops on campus along with the additional on-street parking spaces in the surrounding neighborhoods would provide additional event parking.

6. CONCLUSIONS

Spruce Elementary School will continue to serve grades kindergarten through 6th grade with a capacity of 650 students by the future analysis year, 2020. The school hours are from 9:20 AM and to 3:50 PM.

The reconstruction of Spruce Elementary School is estimated to generate a total of 140.8 new average daily trips with 50.3 trips (24.4 inbound/25.9 outbound) during the AM peak-hour and 29.8 trips (12.2 inbound/17.6 outbound) during the School PM peak-hour. During the street peak-hour between 4 and 6 PM it is anticipated that there would be an increase of 13.8 PM peak-hour trips (6.8 inbound/7.0 outbound).

In the 2020 future with the reconstruction analysis all off-site study intersections will continue to operate at LOS C or better during the AM peak-hour and LOS B or better during the School PM peak-hour, thus meeting the City of Lynnwood Intersection Standards used for SEPA impact evaluation. The main parent access for the school, the south driveway, will operate at LOS B during the AM peak-hour and School PM peak-hour with the westbound leg (school driveway) operating as the critical approach. The bus loop, utilizing the north driveway, is anticipated to operate at acceptable LOS C during the AM peak-hour and LOS B in the school PM peak-hour.

The site is expected to have sufficient parking to satisfy the long-term parking needs. Additionally, the site will have sufficient queuing space to satisfy the drop-off and pick-up queuing needs without impacting Spruce Way.

Trip Generation Calculations

Spruce Elementary School

Count Data:

	AM (8:45 AM to 9:45 AM)				PM (3:00 PM - 5:00 PM)			
Location	In	% of Total	Out	% of Total	In	% of Total	Out	% of Total
N Driveway	148	100%	153	97%	63	85%	94	88%
S Driveway	0	0%	4	3%	11	15%	13	12%
Frontage	0	0%	0	0%	0	0%	0	0%
Total	148	49%	157	51%	74	41%	107	59%

Trip Generation per student:

558 students

	School Rates			ITE Comparison			+/- to Lynnwood
	Rate	% In	% Out	Rate	% In	% Out	Trips
AM	0.55	49%	51%	0.45	68%	32%	54
School PM	0.32	41%	59%	0.28	33%	55%	25

New Trips

92 students

	Total	In	Out
AM	50.3	24.4	25.9
School PM	29.8	12.2	17.6

Total Trips

650 students

	Total	In	Out
AM	355	172	183
School PM	211	86	125

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday**
(a.k.a.): **Average Weekday Daily Trips (AWDT)**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	stdy	1.53	50%	50%	140.8	0%	0.0	140.8	0%	0.0	0%	0.0	140.8	0.0	0.0	0.0	0.0	70.4	70.4
Total						140.8		0.0	140.8		0.0		0.0	140.8	0.0	0.0	0.0	0.0	70.4	70.4

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday, Peak Hour of Adjacent Street Traffic, One Hour between 7 and 9 AM**
(a.k.a.): **Weekday AM Peak Hour**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	stdy	0.55	49%	51%	50.3	0%	0.0	50.3	0%	0.0	0%	0.0	50.3	0.0	0.0	0.0	0.0	24.4	25.9
Total						50.3		0.0	50.3		0.0		0.0	50.3	0.0	0.0	0.0	0.0	24.4	25.9

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday, School PM Peak-Hour, One Hour between 1:30 and 3:30 PM**
(a.k.a.): **Weekday School PM Peak Hour**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	stdy	0.32	41%	59%	29.8	0%	0.0	29.8	0%	0.0	0%	0.0	29.8	0.0	0.0	0.0	0.0	12.2	17.6
Total						29.8		0.0	29.8		0.0		0.0	29.8	0.0	0.0	0.0	0.0	12.2	17.6

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday, PM Peak-Hour of Adjacent Street Traffic, One Hour between 4 and 6 PM**
(a.k.a.): **Weekday PM Peak Hour**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	520	0.15	49%	51%	13.8	0%	0.0	13.8	0%	0.0	0%	0.0	13.8	0.0	0.0	0.0	0.0	6.8	7.0
Total						13.8		0.0	13.8		0.0		0.0	13.8	0.0	0.0	0.0	0.0	6.8	7.0

Spruce Elementary School

GTC #16-281

AM Peak-Hour

%	New ADT	New AM Peak Hour Trips		
		In	Out	Total
100%	141	24	26	50
1%	1.41	0.24	0.26	0.50
2%	2.82	0.49	0.52	1.01
3%	4.22	0.73	0.78	1.51
4%	5.63	0.98	1.04	2.01
5%	**7.04**	**1.22**	**1.30**	**2.52**
6%	8.45	1.46	1.55	3.02
7%	9.86	1.71	1.81	3.52
8%	11.26	1.95	2.07	4.02
9%	12.67	2.20	2.33	4.53
10%	**14.08**	**2.44**	**2.59**	**5.03**
11%	15.49	2.68	2.85	5.53
12%	16.90	2.93	3.11	6.04
13%	18.30	3.17	3.37	6.54
14%	19.71	3.42	3.63	7.04
15%	**21.12**	**3.66**	**3.89**	**7.55**
16%	22.53	3.90	4.14	8.05
17%	23.94	4.15	4.40	8.55
18%	25.34	4.39	4.66	9.05
19%	26.75	4.64	4.92	9.56
20%	**28.16**	**4.88**	**5.18**	**10.06**
21%	29.57	5.12	5.44	10.56
22%	30.98	5.37	5.70	11.07
23%	32.38	5.61	5.96	11.57
24%	33.79	5.86	6.22	12.07
25%	**35.20**	**6.10**	**6.48**	**12.58**
26%	36.61	6.34	6.73	13.08
27%	38.02	6.59	6.99	13.58
28%	39.42	6.83	7.25	14.08
29%	40.83	7.08	7.51	14.59
30%	**42.24**	**7.32**	**7.77**	**15.09**
31%	43.65	7.56	8.03	15.59
32%	45.06	7.81	8.29	16.10
33%	46.46	8.05	8.55	16.60
34%	47.87	8.30	8.81	17.10
35%	**49.28**	**8.54**	**9.07**	**17.61**
36%	50.69	8.78	9.32	18.11
37%	52.10	9.03	9.58	18.61
38%	53.50	9.27	9.84	19.11
39%	54.91	9.52	10.10	19.62
40%	**56.32**	**9.76**	**10.36**	**20.12**
41%	57.73	10.00	10.62	20.62
42%	59.14	10.25	10.88	21.13
43%	60.54	10.49	11.14	21.63
44%	61.95	10.74	11.40	22.13
45%	**63.36**	**10.98**	**11.66**	**22.64**
46%	64.77	11.22	11.91	23.14
47%	66.18	11.47	12.17	23.64
48%	67.58	11.71	12.43	24.14
49%	68.99	11.96	12.69	24.65
50%	**70.40**	**12.20**	**12.95**	**25.15**

%	New ADT	New AM Peak Hour Trips		
		In	Out	Total
100%	141	24	26	50
51%	71.81	12.44	13.21	25.65
52%	73.22	12.69	13.47	26.16
53%	74.62	12.93	13.73	26.66
54%	76.03	13.18	13.99	27.16
55%	**77.44**	**13.42**	**14.25**	**27.67**
56%	78.85	13.66	14.50	28.17
57%	80.26	13.91	14.76	28.67
58%	81.66	14.15	15.02	29.17
59%	83.07	14.40	15.28	29.68
60%	**84.48**	**14.64**	**15.54**	**30.18**
61%	85.89	14.88	15.80	30.68
62%	87.30	15.13	16.06	31.19
63%	88.70	15.37	16.32	31.69
64%	90.11	15.62	16.58	32.19
65%	**91.52**	**15.86**	**16.84**	**32.70**
66%	92.93	16.10	17.09	33.20
67%	94.34	16.35	17.35	33.70
68%	95.74	16.59	17.61	34.20
69%	97.15	16.84	17.87	34.71
70%	**98.56**	**17.08**	**18.13**	**35.21**
71%	99.97	17.32	18.39	35.71
72%	101.38	17.57	18.65	36.22
73%	102.78	17.81	18.91	36.72
74%	104.19	18.06	19.17	37.22
75%	**105.60**	**18.30**	**19.43**	**37.73**
76%	107.01	18.54	19.68	38.23
77%	108.42	18.79	19.94	38.73
78%	109.82	19.03	20.20	39.23
79%	111.23	19.28	20.46	39.74
80%	**112.64**	**19.52**	**20.72**	**40.24**
81%	114.05	19.76	20.98	40.74
82%	115.46	20.01	21.24	41.25
83%	116.86	20.25	21.50	41.75
84%	118.27	20.50	21.76	42.25
85%	**119.68**	**20.74**	**22.02**	**42.76**
86%	121.09	20.98	22.27	43.26
87%	122.50	21.23	22.53	43.76
88%	123.90	21.47	22.79	44.26
89%	125.31	21.72	23.05	44.77
90%	**126.72**	**21.96**	**23.31**	**45.27**
91%	128.13	22.20	23.57	45.77
92%	129.54	22.45	23.83	46.28
93%	130.94	22.69	24.09	46.78
94%	132.35	22.94	24.35	47.28
95%	**133.76**	**23.18**	**24.61**	**47.79**
96%	135.17	23.42	24.86	48.29
97%	136.58	23.67	25.12	48.79
98%	137.98	23.91	25.38	49.29
99%	139.39	24.16	25.64	49.80
100%	**140.80**	**24.40**	**25.90**	**50.30**

Spruce Elementary School

GTC #16-281

School PM Peak-Hour

%	New	New PM Peak Hour Trips		
	ADT	In	Out	Total
100%	141	12	18	30
1%	1.41	0.12	0.18	0.30
2%	2.82	0.24	0.35	0.60
3%	4.22	0.37	0.53	0.89
4%	5.63	0.49	0.70	1.19
5%	**7.04**	**0.61**	**0.88**	**1.49**
6%	8.45	0.73	1.06	1.79
7%	9.86	0.85	1.23	2.09
8%	11.26	0.98	1.41	2.38
9%	12.67	1.10	1.58	2.68
10%	**14.08**	**1.22**	**1.76**	**2.98**
11%	15.49	1.34	1.94	3.28
12%	16.90	1.46	2.11	3.58
13%	18.30	1.59	2.29	3.87
14%	19.71	1.71	2.46	4.17
15%	**21.12**	**1.83**	**2.64**	**4.47**
16%	22.53	1.95	2.82	4.77
17%	23.94	2.07	2.99	5.07
18%	25.34	2.20	3.17	5.36
19%	26.75	2.32	3.34	5.66
20%	**28.16**	**2.44**	**3.52**	**5.96**
21%	29.57	2.56	3.70	6.26
22%	30.98	2.68	3.87	6.56
23%	32.38	2.81	4.05	6.85
24%	33.79	2.93	4.22	7.15
25%	**35.20**	**3.05**	**4.40**	**7.45**
26%	36.61	3.17	4.58	7.75
27%	38.02	3.29	4.75	8.05
28%	39.42	3.42	4.93	8.34
29%	40.83	3.54	5.10	8.64
30%	**42.24**	**3.66**	**5.28**	**8.94**
31%	43.65	3.78	5.46	9.24
32%	45.06	3.90	5.63	9.54
33%	46.46	4.03	5.81	9.83
34%	47.87	4.15	5.98	10.13
35%	**49.28**	**4.27**	**6.16**	**10.43**
36%	50.69	4.39	6.34	10.73
37%	52.10	4.51	6.51	11.03
38%	53.50	4.64	6.69	11.32
39%	54.91	4.76	6.86	11.62
40%	**56.32**	**4.88**	**7.04**	**11.92**
41%	57.73	5.00	7.22	12.22
42%	59.14	5.12	7.39	12.52
43%	60.54	5.25	7.57	12.81
44%	61.95	5.37	7.74	13.11
45%	**63.36**	**5.49**	**7.92**	**13.41**
46%	64.77	5.61	8.10	13.71
47%	66.18	5.73	8.27	14.01
48%	67.58	5.86	8.45	14.30
49%	68.99	5.98	8.62	14.60
50%	**70.40**	**6.10**	**8.80**	**14.90**

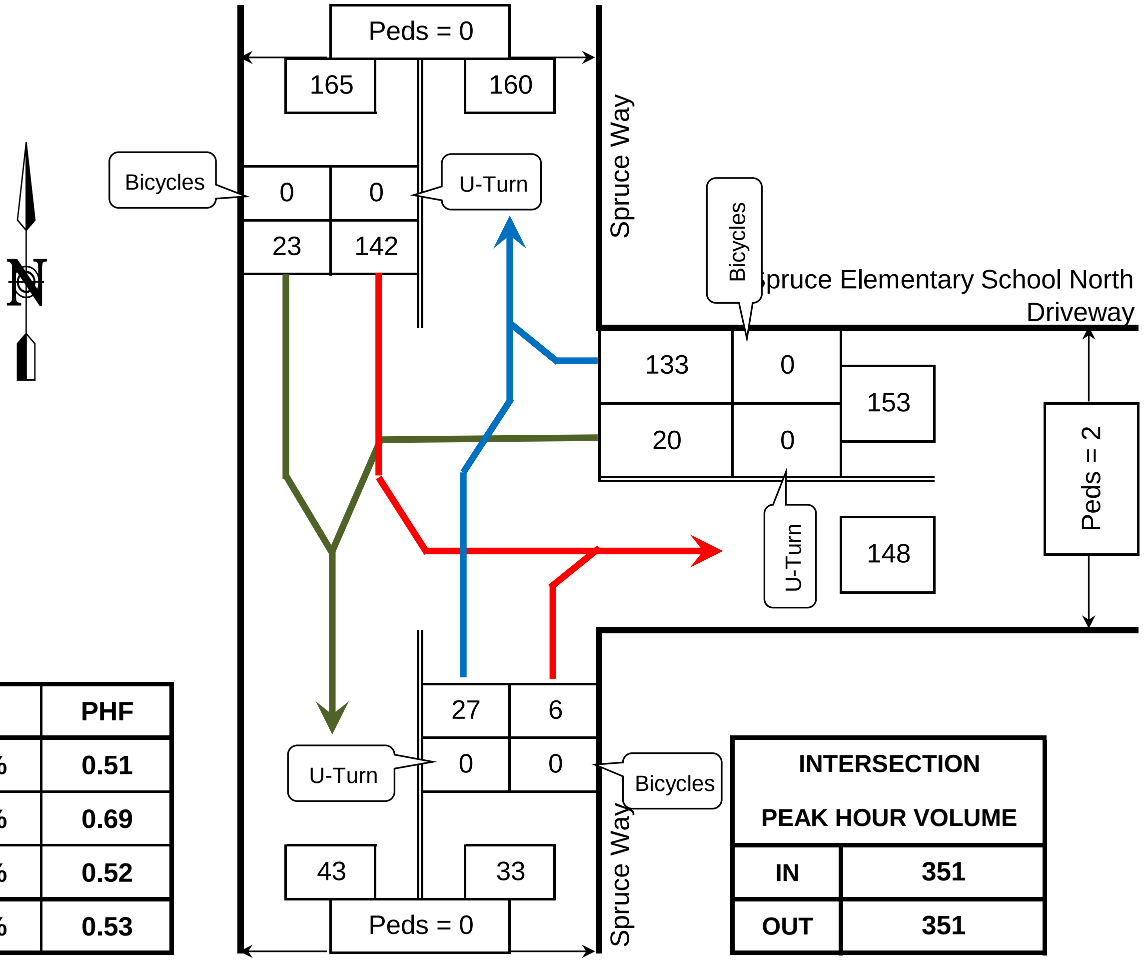
%	New	New PM Peak Hour Trips		
	ADT	In	Out	Total
100%	141	12	18	30
51%	71.81	6.22	8.98	15.20
52%	73.22	6.34	9.15	15.50
53%	74.62	6.47	9.33	15.79
54%	76.03	6.59	9.50	16.09
55%	**77.44**	**6.71**	**9.68**	**16.39**
56%	78.85	6.83	9.86	16.69
57%	80.26	6.95	10.03	16.99
58%	81.66	7.08	10.21	17.28
59%	83.07	7.20	10.38	17.58
60%	**84.48**	**7.32**	**10.56**	**17.88**
61%	85.89	7.44	10.74	18.18
62%	87.30	7.56	10.91	18.48
63%	88.70	7.69	11.09	18.77
64%	90.11	7.81	11.26	19.07
65%	**91.52**	**7.93**	**11.44**	**19.37**
66%	92.93	8.05	11.62	19.67
67%	94.34	8.17	11.79	19.97
68%	95.74	8.30	11.97	20.26
69%	97.15	8.42	12.14	20.56
70%	**98.56**	**8.54**	**12.32**	**20.86**
71%	99.97	8.66	12.50	21.16
72%	101.38	8.78	12.67	21.46
73%	102.78	8.91	12.85	21.75
74%	104.19	9.03	13.02	22.05
75%	**105.60**	**9.15**	**13.20**	**22.35**
76%	107.01	9.27	13.38	22.65
77%	108.42	9.39	13.55	22.95
78%	109.82	9.52	13.73	23.24
79%	111.23	9.64	13.90	23.54
80%	**112.64**	**9.76**	**14.08**	**23.84**
81%	114.05	9.88	14.26	24.14
82%	115.46	10.00	14.43	24.44
83%	116.86	10.13	14.61	24.73
84%	118.27	10.25	14.78	25.03
85%	**119.68**	**10.37**	**14.96**	**25.33**
86%	121.09	10.49	15.14	25.63
87%	122.50	10.61	15.31	25.93
88%	123.90	10.74	15.49	26.22
89%	125.31	10.86	15.66	26.52
90%	**126.72**	**10.98**	**15.84**	**26.82**
91%	128.13	11.10	16.02	27.12
92%	129.54	11.22	16.19	27.42
93%	130.94	11.35	16.37	27.71
94%	132.35	11.47	16.54	28.01
95%	**133.76**	**11.59**	**16.72**	**28.31**
96%	135.17	11.71	16.90	28.61
97%	136.58	11.83	17.07	28.91
98%	137.98	11.96	17.25	29.20
99%	139.39	12.08	17.42	29.50
100%	**140.80**	**12.20**	**17.60**	**29.80**

Count Data

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM



	HV	PHF
SB	**1.8%**	**0.51**
NB	**0.0%**	**0.69**
WB	**0.7%**	**0.52**
INTRS.	**1.1%**	**0.53**

INTERSECTION PEAK HOUR VOLUME	
IN	**351**
OUT	**351**

HV = Heavy Vehicles
PHF = Peak Hour Factor

Spruce Elementary School North Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY: VT
REDUCED BY: CN
REDUCTION DATE: Fri. 11/18/16

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM
WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School North Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 AM	0	0	0	0	45	8	0	0	0	0	0	0	10	1	0	0	0	0	6	0	33	0	0	0	0	0	0	0	103
09:15 AM	0	0	0	0	77	4	0	0	0	0	0	0	8	4	2	0	0	0	9	0	64	0	0	0	0	0	0	0	166
09:30 AM	0	0	3	0	18	5	0	0	0	0	0	0	4	0	0	0	0	0	4	0	31	0	0	0	0	0	0	0	62
09:45 AM	0	0	0	0	2	6	0	0	0	0	0	0	5	1	0	0	1	0	1	0	5	0	0	0	0	0	0	0	20
PEAK HOUR TOTALS	0	0	3	0	142	23	0	0	0	0	0	0	27	6	2	0	1	0	20	0	133	0	0	0	0	0	0	0	INTERSECTION
ALL MOVEMENTS				165							33							153							0				351
% HV			1.8%							0.0%							0.7%							#N/A					1.1%
PEAK HOUR FACTOR				0.51							0.69							0.52							#N/A				0.53

HV = Heavy Vehicle
PHF = Peak Hour Factor

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM

REDUCED BY: CN

DATE OF REDUCTION: 11/18/2016

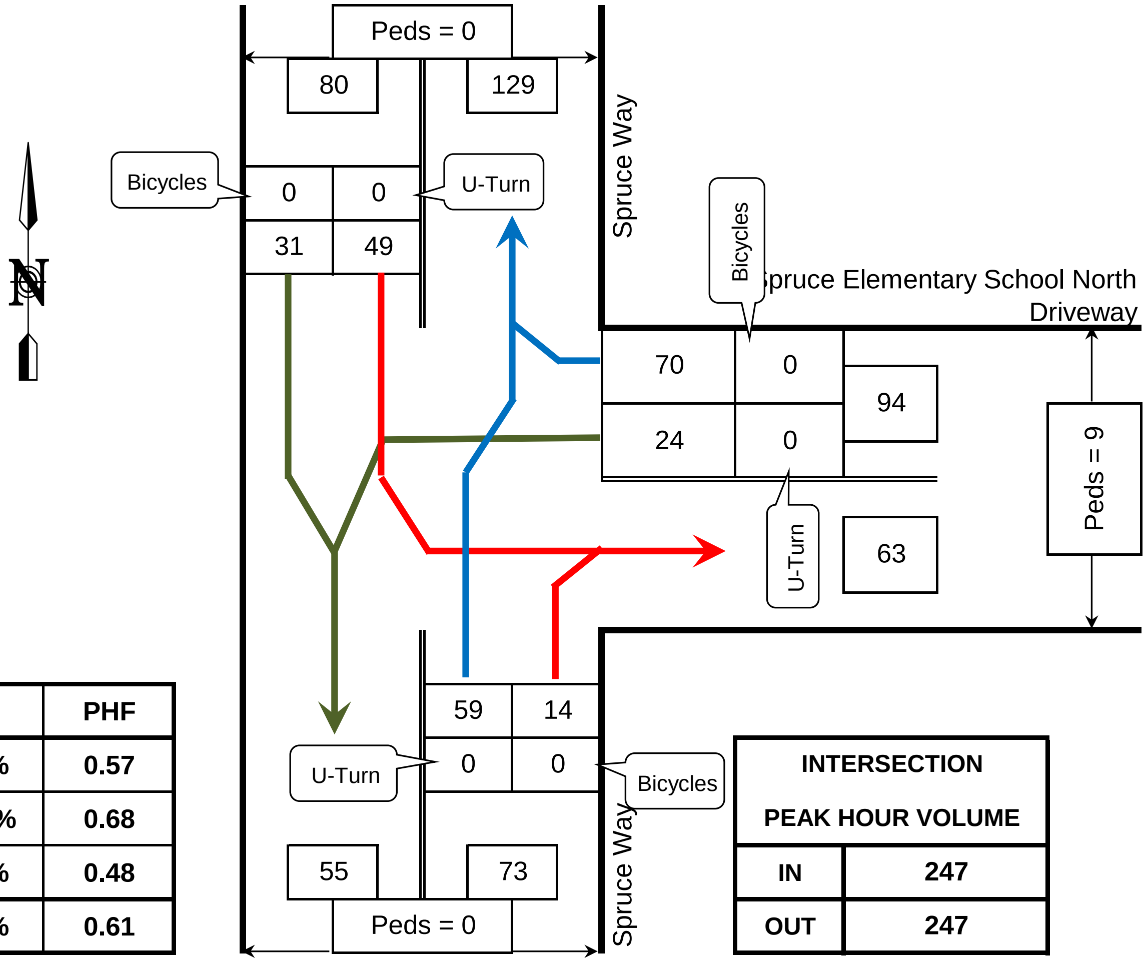
ROLLING HOUR COUNT

	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM - 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM - 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM - 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM - 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM - 9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM - 9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM - 9:45 AM	0	0	3	0	142	23	0	0	0	0	0	0	27	6	2	0	1	0	20	0	133	0	0	0	0	0	0	0	351

DTG *TRAFFIC DATA GATHERING*

TURNING MOVEMENTS DIAGRAM

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM



	HV	PHF
SB	**3.8%**	**0.57**
NB	**13.7%**	**0.68**
WB	**1.1%**	**0.48**
INTRS.	**5.7%**	**0.61**

INTERSECTION PEAK HOUR VOLUME	
IN	**247**
OUT	**247**

HV = Heavy Vehicles
PHF = Peak Hour Factor

Spruce Elementary School North Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY:	VT	DATE OF COUNT:	Wed. 11/16/16
REDUCED BY:	CN	TIME OF COUNT:	3:00 PM - 5:00 PM
REDUCTION DATE:	Fri. 11/18/16	WEATHER:	Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School North Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 3:00 PM - 5:00 PM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:15 PM	0	0	0	0	6	6	0	0	0	0	0	0	8	0	2	0	1	0	2	0	4	0	0	0	0	0	0	0	**26**
03:30 PM	0	0	2	0	6	7	0	0	0	0	0	0	3	1	2	0	0	0	1	0	3	0	0	0	0	0	0	0	**21**
03:45 PM	0	0	1	0	7	12	0	0	0	0	0	0	12	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	**34**
04:00 PM	0	0	2	0	27	8	0	0	0	4	0	0	11	6	5	0	0	0	6	0	43	0	0	0	0	0	0	0	**101**
04:15 PM	0	0	0	0	13	7	0	0	0	5	0	0	22	5	2	0	1	0	8	0	22	0	0	0	0	0	0	0	**77**
04:30 PM	0	0	0	0	2	4	0	0	0	1	0	0	14	1	1	0	0	0	9	0	5	0	0	0	0	0	0	0	**35**
04:45 PM	0	1	0	0	4	10	0	0	0	1	0	0	15	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	**32**
05:00 PM	0	0	0	0	2	5	0	0	0	2	0	0	14	1	0	0	0	0	3	0	10	0	0	0	0	0	0	0	**35**
PEAK HOUR TOTALS	**0**	**0**	**3**	**0**	**49**	**31**	**0**	**0**	**0**	**10**	**0**	**0**	**59**	**14**	**9**	**0**	**1**	**0**	**24**	**0**	**70**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**INTERSECTION**
ALL MOVEMENTS				80							73							94							0				247
% HV			3.8%							13.7%							1.1%							#N/A					5.7%
PEAK HOUR FACTOR				0.57							0.68							0.48							#N/A				0.61

HV = Heavy Vehicle
PHF = Peak Hour Factor

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM

REDUCED BY: CN

DATE OF REDUCTION: 11/18/2016

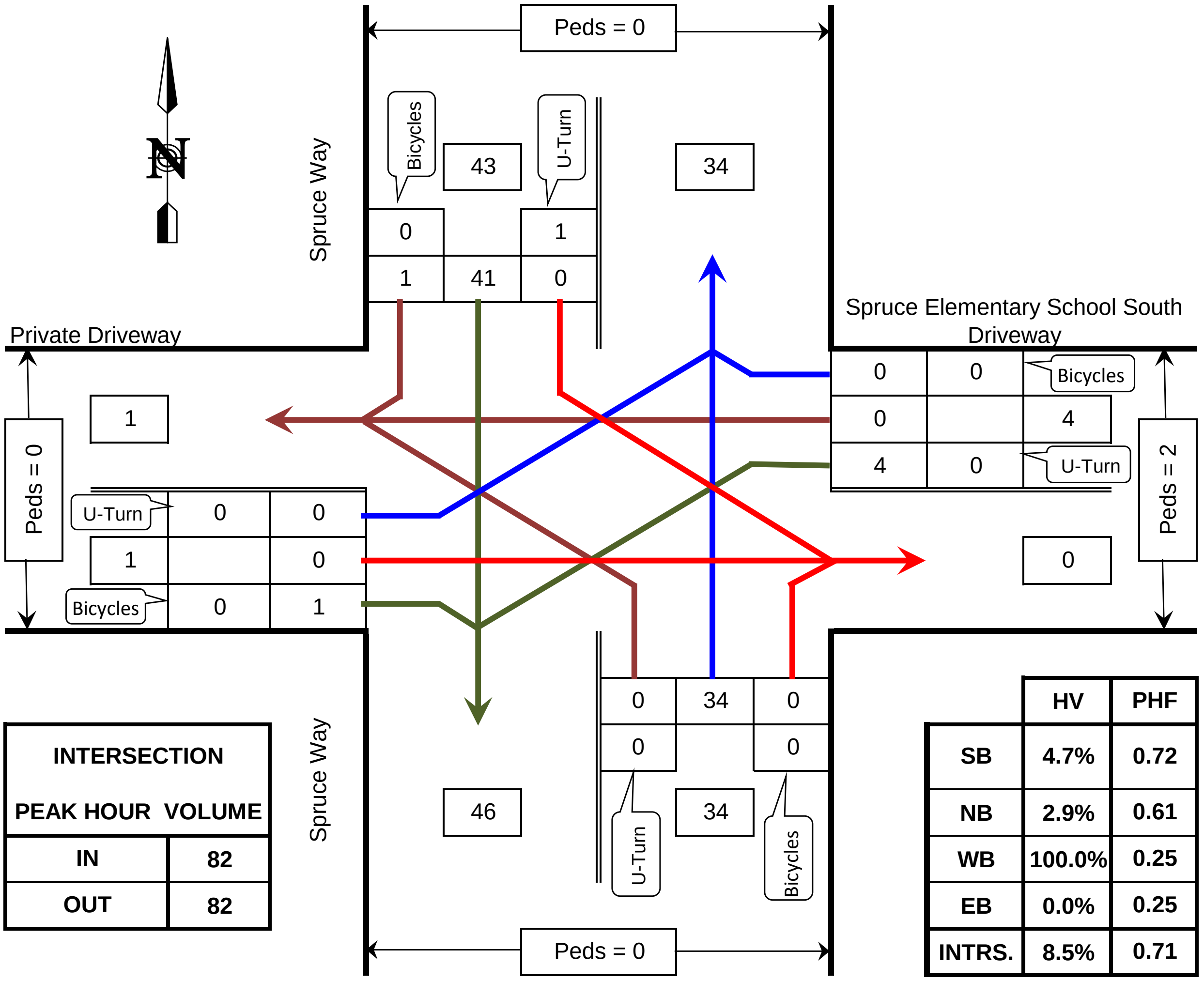
ROLLING HOUR COUNT

	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
1:00 PM - 2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM - 2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM - 2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM - 2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	5	0	46	33	0	0	0	4	0	0	34	9	10	0	1	0	10	0	50	0	0	0	0	0	0	0	182
3:15 PM - 4:15 PM	0	0	5	0	53	34	0	0	0	9	0	0	48	14	10	0	1	0	16	0	68	0	0	0	0	0	0	0	233
3:30 PM - 4:30 PM	0	0	3	0	49	31	0	0	0	10	0	0	59	14	9	0	1	0	24	0	70	0	0	0	0	0	0	0	247
3:45 PM - 4:45 PM	0	1	2	0	46	29	0	0	0	11	0	0	62	13	8	0	1	0	24	0	71	0	0	0	0	0	0	0	245
4:00 PM - 5:00 PM	0	1	0	0	21	26	0	0	0	9	0	0	65	8	3	0	1	0	21	0	38	0	0	0	0	0	0	0	179

DTG ***TRAFFIC DATA GATHERING***

TURNING MOVEMENTS DIAGRAM

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM



INTERSECTION PEAK HOUR VOLUME	
IN	82
OUT	82

	HV	PHF
SB	4.7%	0.72
NB	2.9%	0.61
WB	100.0%	0.25
EB	0.0%	0.25
INTRS.	8.5%	0.71

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Elementary School South Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY: VT
REDUCED BY: CN
REDUCTION DATE: Wed. 11/16/16
DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM
WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School South Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 AM	0	0	0	0	0	15	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
09:15 AM	0	0	0	0	0	12	0	0	0	0	0	0	10	0	2	0	4	0	4	0	0	0	0	0	0	0	0	0	26
09:30 AM	0	0	1	1	0	8	0	0	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
09:45 AM	0	0	1	0	0	6	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13
PEAK HOUR TOTALS	0	0	2	1	0	41	1	0	0	1	0	0	34	0	2	0	4	0	4	0	0	0	0	0	0	0	0	1	INTERSECTION
ALL MOVEMENTS				43							34							4							1				82
% HV			4.7%							2.9%							100.0%							0.0%					8.5%
PEAK HOUR FACTOR				0.72							0.61							0.25							0.25				0.71

HV = Heavy Vehicle
PHF = Peak Hour Factor

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM

REDUCED BY: CN

DATE OF REDUCTION: 11/16/2016

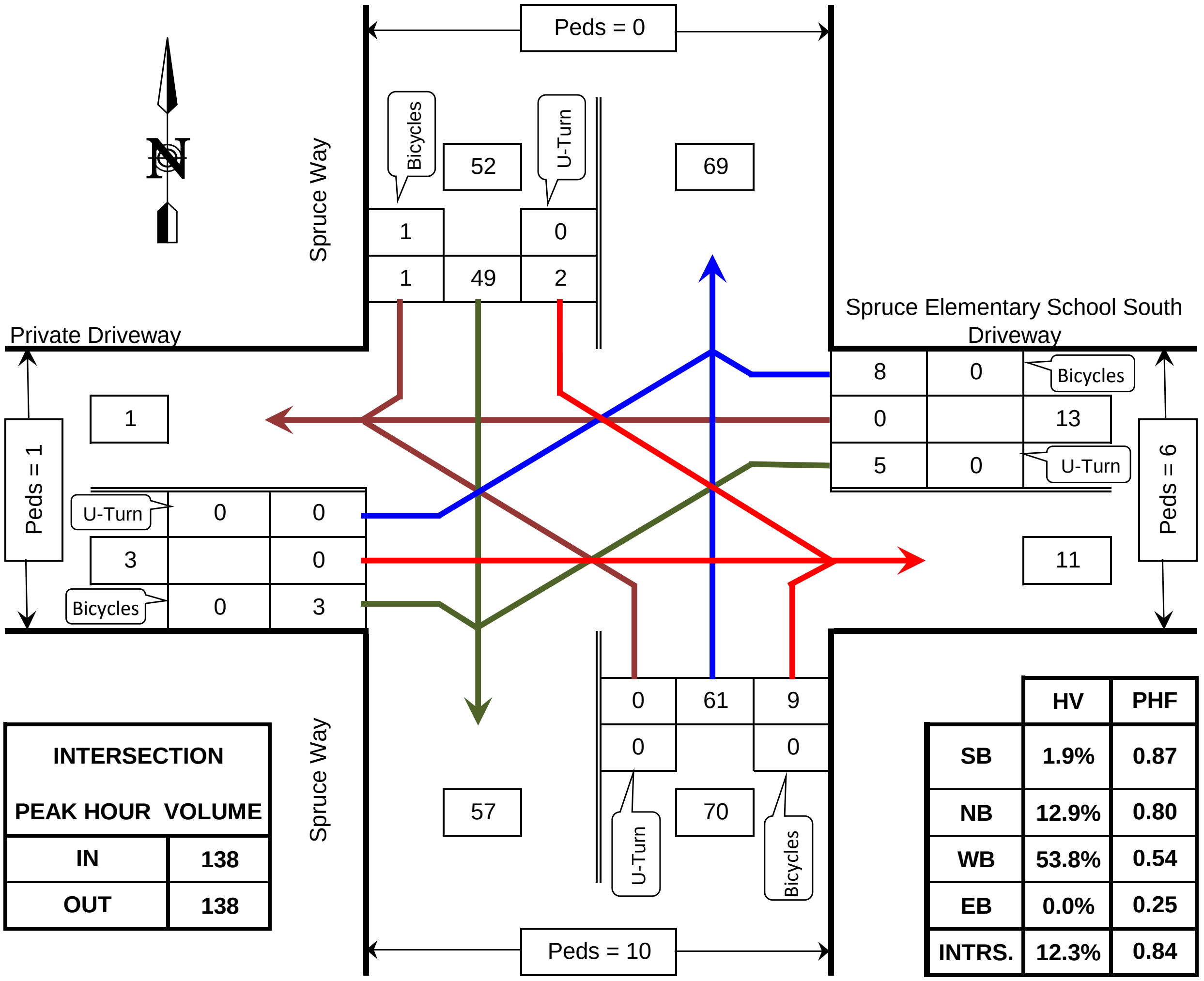
ROLLING HOUR COUNT

	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM - 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM - 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM - 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM - 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM - 9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM - 9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM - 9:45 AM	0	0	2	1	0	41	1	0	0	1	0	0	34	0	2	0	4	0	4	0	0	0	0	0	0	0	0	1	82

DTG TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

3:00 PM - 5:00 PM PEAK HOUR: 3:45 PM TO 4:45 PM



INTERSECTION PEAK HOUR VOLUME	
IN	138
OUT	138

	HV	PHF
SB	1.9%	0.87
NB	12.9%	0.80
WB	53.8%	0.54
EB	0.0%	0.25
INTRS.	12.3%	0.84

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Elementary School South Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY: VT
REDUCED BY: CN
REDUCTION DATE: Sat. 11/19/16
DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 3:00 PM - 5:00 PM
WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School South Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 3:00 PM - 5:00 PM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:15 PM	0	0	1	0	0	8	0	0	0	0	0	0	8	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**17**
03:30 PM	0	0	1	0	0	6	0	0	0	0	0	0	3	0	2	0	0	0	2	0	1	1	0	0	0	0	0	1	**13**
03:45 PM	0	0	1	0	3	9	0	1	0	0	0	0	16	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	**28**
04:00 PM	0	0	1	0	1	11	0	4	0	4	0	0	14	6	3	0	4	0	3	0	3	0	0	0	0	0	0	0	**38**
04:15 PM	0	0	0	0	1	14	0	6	0	2	0	0	21	1	2	0	3	0	0	0	4	0	0	0	0	0	0	0	**41**
04:30 PM	0	0	0	0	0	13	0	0	0	1	0	0	14	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	**30**
04:45 PM	0	1	0	0	0	11	1	0	0	2	0	0	12	1	0	0	0	0	0	0	1	1	0	0	0	0	0	3	**29**
05:00 PM	0	1	0	0	0	8	0	0	0	1	0	0	13	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	**23**
PEAK HOUR TOTALS	**0**	**1**	**1**	**0**	**2**	**49**	**1**	**10**	**0**	**9**	**0**	**0**	**61**	**9**	**6**	**0**	**7**	**0**	**5**	**0**	**8**	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**INTERSECTION**
ALL MOVEMENTS				**52**							**70**							**13**							**3**				**138**
% HV			**1.9%**							**12.9%**							**53.8%**							**0.0%**					**12.3%**
PEAK HOUR FACTOR				**0.87**							**0.80**							**0.54**							**0.25**				**0.84**

HV = Heavy Vehicle
PHF = Peak Hour Factor

3:00 PM - 5:00 PM PEAK HOUR: 3:45 PM TO 4:45 PM

REDUCED BY: CN

DATE OF REDUCTION: 11/19/2016

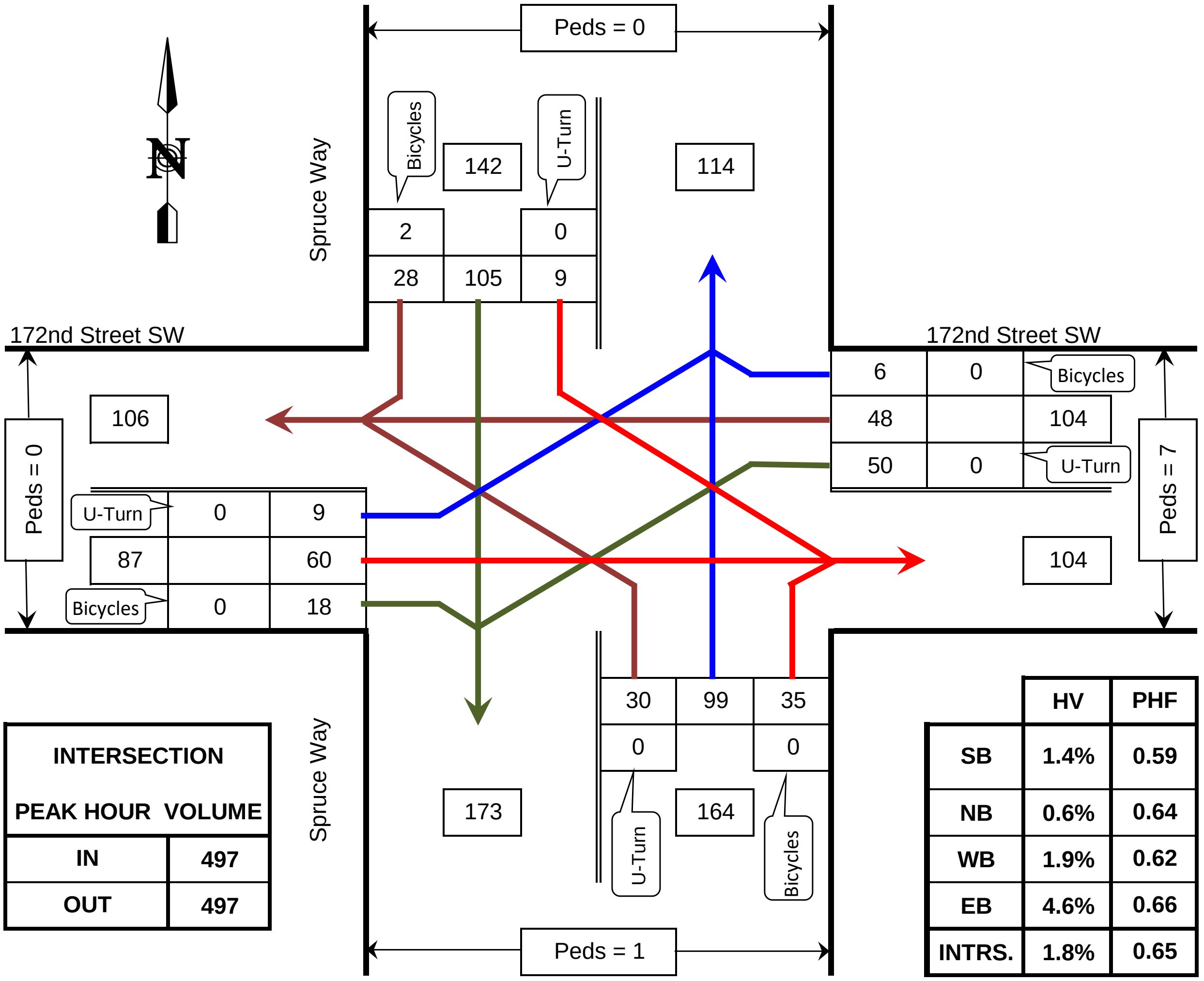
ROLLING HOUR COUNT

	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
1:00 PM - 2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM - 2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM - 2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM - 2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	4	0	4	34	0	5	0	4	0	0	41	7	9	0	4	0	5	0	4	2	0	0	0	0	0	1	96
3:15 PM - 4:15 PM	0	0	3	0	5	40	0	11	0	6	0	0	54	7	8	0	7	0	5	0	8	2	0	0	0	0	0	1	120
3:30 PM - 4:30 PM	0	0	2	0	5	47	0	11	0	7	0	0	65	8	7	0	7	0	5	0	7	1	0	0	0	0	0	0	137
3:45 PM - 4:45 PM	0	1	1	0	2	49	1	10	0	9	0	0	61	9	6	0	7	0	5	0	8	1	0	0	0	0	0	3	138
4:00 PM - 5:00 PM	0	2	0	0	1	46	1	6	0	6	0	0	60	3	3	0	4	0	2	0	6	1	0	0	0	1	0	3	123

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM



INTERSECTION PEAK HOUR VOLUME	
IN	497
OUT	497

	HV	PHF
SB	1.4%	0.59
NB	0.6%	0.64
WB	1.9%	0.62
EB	4.6%	0.66
INTRS.	1.8%	0.65

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Way @ 172nd Street SW

Lynnwood, WA

COUNTED BY: CN

REDUCED BY: CN

REDUCTION DATE: Wed. 11/16/16

DATE OF COUNT: Wed. 11/16/16

TIME OF COUNT: 8:45 AM - 9:45 AM

WEATHER: Sunny

TDG TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION:	Spruce Way @ 172nd Street SW	DATE OF COUNT:	Wed. 11/16/16
	Lynnwood, WA	TIME OF COUNT:	8:45 AM - 9:45 AM
COUNTED BY:	CN	WEATHER:	Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON 172nd Street SW							FROM WEST ON 172nd Street SW							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 AM	0	0	0	0	1	29	4	0	0	0	0	6	22	9	2	0	0	0	18	5	1	0	0	0	0	0	8	2	105
09:15 AM	0	0	1	0	2	49	9	0	0	0	0	14	36	14	5	0	0	0	28	12	2	0	0	1	0	2	14	8	190
09:30 AM	0	2	0	0	2	20	3	1	0	1	0	7	35	10	0	0	1	0	3	18	3	0	0	1	0	2	12	6	121
09:45 AM	0	0	1	0	4	7	12	0	0	0	0	3	6	2	0	0	1	0	1	13	0	0	0	2	0	5	26	2	81
PEAK HOUR TOTALS	0	2	2	0	9	105	28	1	0	1	0	30	99	35	7	0	2	0	50	48	6	0	0	4	0	9	60	18	INTERSECTION
ALL MOVEMENTS				142							164							104							87				497
% HV			1.4%							0.6%							1.9%							4.6%					1.8%
PEAK HOUR FACTOR				0.59							0.64							0.62							0.66				0.65

HV = Heavy Vehicle

PHF = Peak Hour Factor

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM

REDUCED BY: CN

DATE OF REDUCTION: 11/16/2016

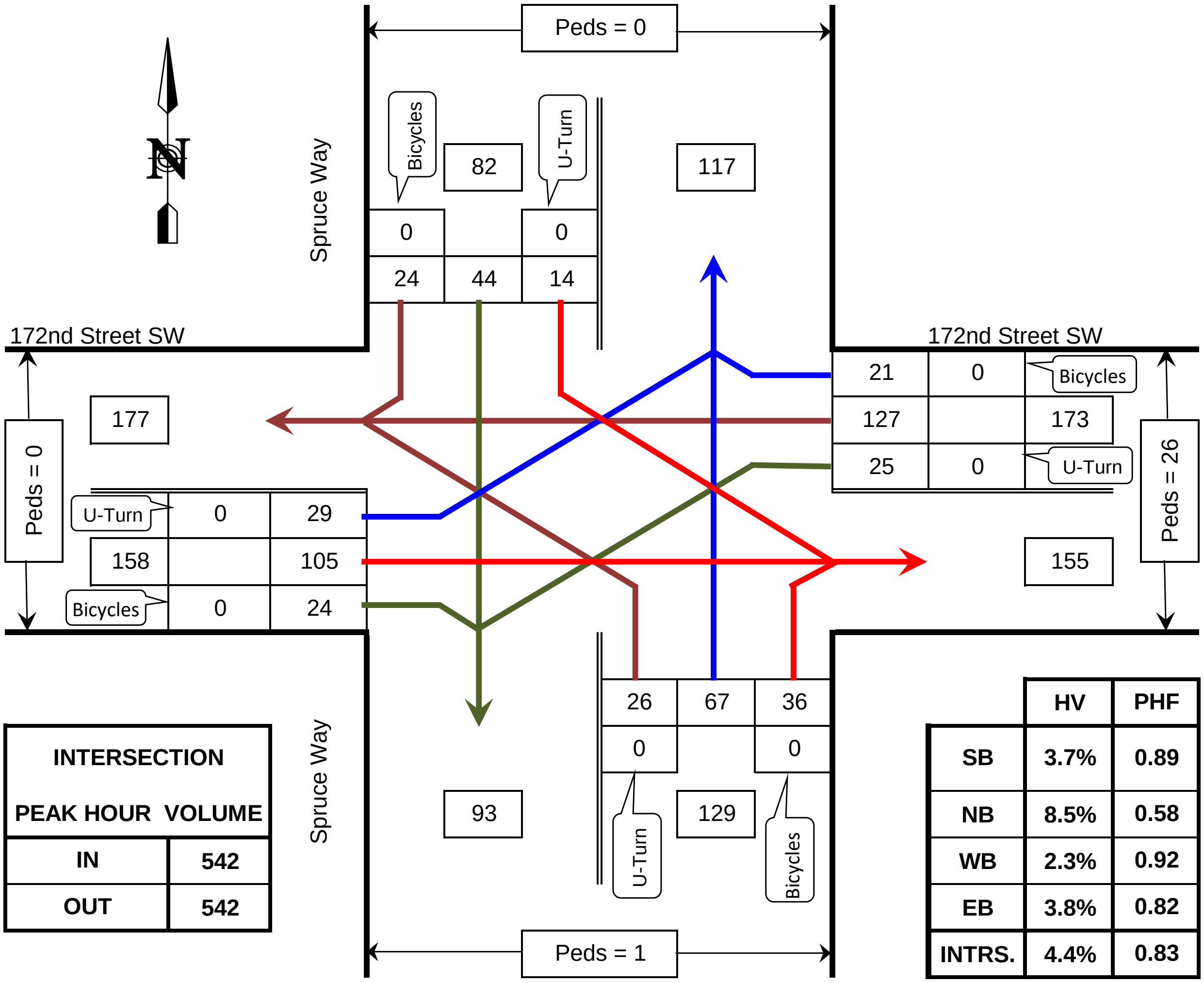
ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON 172nd Street SW							FROM WEST ON 172nd Street SW							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM - 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM - 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM - 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM - 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM - 9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM - 9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM - 9:45 AM	0	2	2	0	9	105	28	1	0	1	0	30	99	35	7	0	2	0	50	48	6	0	0	4	0	9	60	18	497

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM



INTERSECTION PEAK HOUR VOLUME	
IN	**542**
OUT	**542**

	HV	PHF
SB	**3.7%**	**0.89**
NB	**8.5%**	**0.58**
WB	**2.3%**	**0.92**
EB	**3.8%**	**0.82**
INTRS.	**4.4%**	**0.83**

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Way @ 172nd Street SW

Lynnwood, WA

COUNTED BY:	CN	DATE OF COUNT:	Wed. 11/16/16
REDUCED BY:	CN	TIME OF COUNT:	3:00 PM - 5:00 PM
REDUCTION DATE:	Wed. 11/16/16	WEATHER:	Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION:	Spruce Way @ 172nd Street SW	DATE OF COUNT:	Wed. 11/16/16	COUNTED BY:	CN
	Lynnwood, WA	TIME OF COUNT:	3:00 PM - 5:00 PM	WEATHER:	Sunny

TIME INTERVAL ENDING	FROM NORTH ON							FROM SOUTH ON							FROM EAST ON							FROM WEST ON							INTERVAL TOTALS
	Spruce Way							Spruce Way							172nd Street SW							172nd Street SW							
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:15 PM	0	0	1	0	2	7	4	0	0	0	0	4	1	0	3	0	0	0	2	24	3	0	0	0	0	4	24	2	**77**
03:30 PM	0	0	0	0	5	7	3	0	0	0	0	1	6	3	1	0	0	0	4	29	4	0	0	0	0	7	34	5	**108**
03:45 PM	0	0	1	0	5	14	4	0	0	0	0	6	6	1	3	0	1	0	9	30	5	0	0	1	0	5	25	5	**115**
04:00 PM	0	0	2	0	0	15	5	1	0	1	0	3	27	11	16	0	1	0	7	29	6	0	0	2	0	1	21	11	**136**
04:15 PM	0	0	0	0	3	11	5	0	0	9	0	15	26	15	7	0	2	0	6	29	5	0	0	2	0	13	30	5	**163**
04:30 PM	0	0	0	0	6	4	10	0	0	1	0	2	8	9	0	0	0	0	3	39	5	0	0	1	0	10	29	3	**128**
04:45 PM	0	0	0	0	4	9	4	0	0	0	0	4	7	3	0	0	2	0	1	31	2	0	0	0	0	16	31	3	**115**
05:00 PM	1	0	0	0	0	6	5	0	0	3	0	3	18	1	0	0	0	0	2	21	4	0	0	0	0	10	31	3	**104**
PEAK HOUR TOTALS	**0**	**0**	**3**	**0**	**14**	**44**	**24**	**1**	**0**	**11**	**0**	**26**	**67**	**36**	**26**	**0**	**4**	**0**	**25**	**127**	**21**	**0**	**0**	**6**	**0**	**29**	**105**	**24**	**INTERSECTION**
ALL MOVEMENTS				**82**							**129**							**173**							**158**				**542**
% HV			**3.7%**							**8.5%**							**2.3%**							**3.8%**					**4.4%**
PEAK HOUR FACTOR				**0.89**							**0.58**							**0.92**							**0.82**				**0.83**

HV = Heavy Vehicle

PHF = Peak Hour Factor

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM

REDUCED BY: CN

DATE OF REDUCTION: 11/16/2016

ROLLING HOUR COUNT

	FROM NORTH ON							FROM SOUTH ON							FROM EAST ON							FROM WEST ON							INTERVAL TOTALS
	Spruce Way							Spruce Way							172nd Street SW							172nd Street SW							
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
1:00 PM - 2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM - 2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM - 2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM - 2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	4	0	12	43	16	1	0	1	0	14	40	15	23	0	2	0	22	112	18	0	0	3	0	17	104	23	436
3:15 PM - 4:15 PM	0	0	3	0	13	47	17	1	0	10	0	25	65	30	27	0	4	0	26	117	20	0	0	5	0	26	110	26	522
3:30 PM - 4:30 PM	0	0	3	0	14	44	24	1	0	11	0	26	67	36	26	0	4	0	25	127	21	0	0	6	0	29	105	24	542
3:45 PM - 4:45 PM	0	0	2	0	13	39	24	1	0	11	0	24	68	38	23	0	5	0	17	128	18	0	0	5	0	40	111	22	542
4:00 PM - 5:00 PM	1	0	0	0	13	30	24	0	0	13	0	24	59	28	7	0	4	0	12	120	16	0	0	3	0	49	121	14	510

AM Turning Movement Calculations

Synchro ID: 1

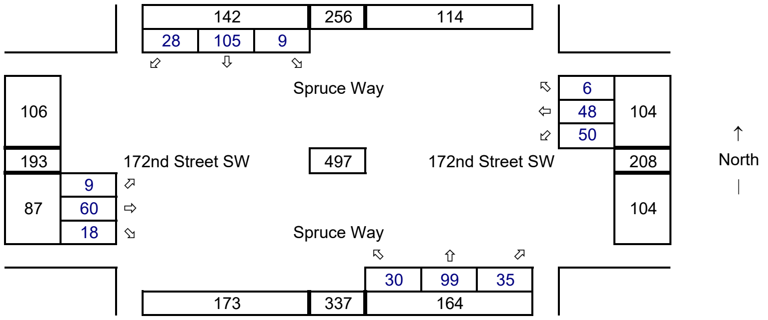
Existing

Average Weekday

AM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

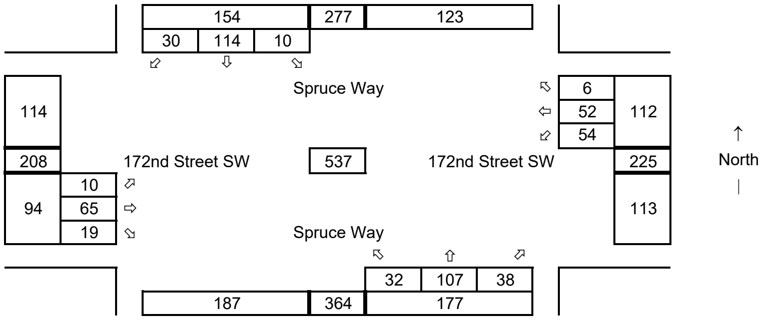
AM Peak Hour

Year: 2020

Growth Rate = 2.0%

Years of Growth = 4

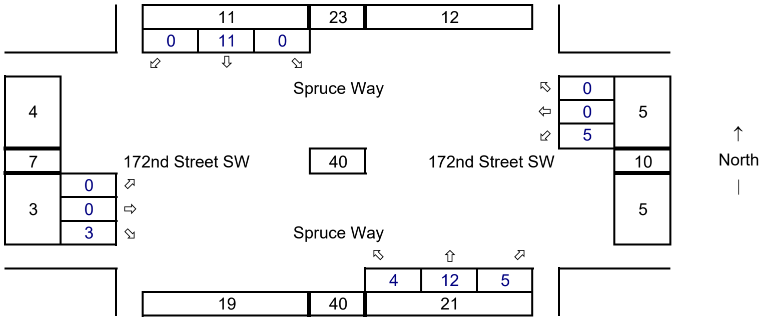
Total Growth = 1.0824



Total Project Trips

Average Weekday

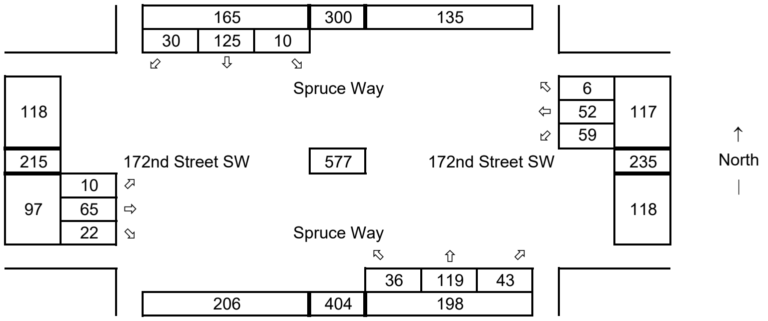
AM Peak Hour



Future with Project

Average Weekday

AM Peak Hour



2 Spruce Way @ N Driveway

Synchro ID: 2

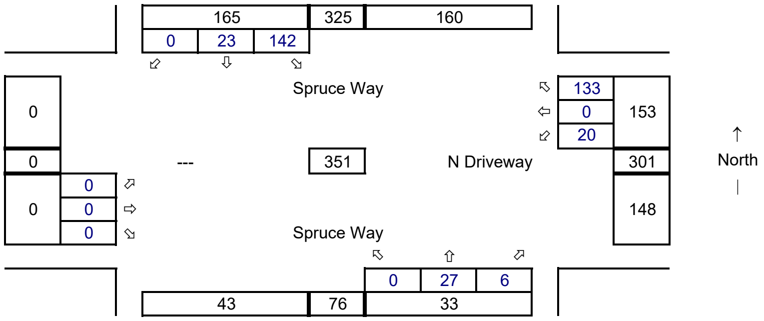
Existing

Average Weekday

AM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

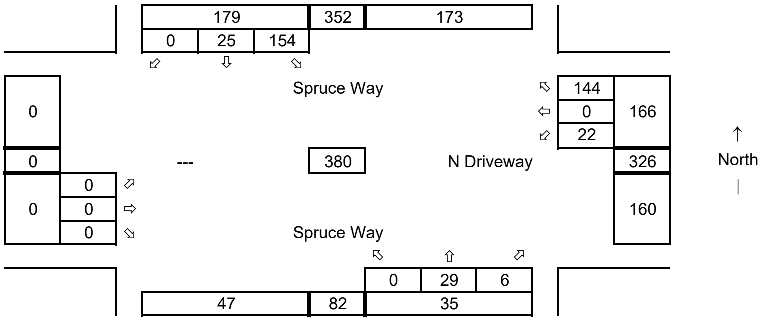
AM Peak Hour

Year: 2020

Growth Rate = 2.0%

Years of Growth = 4

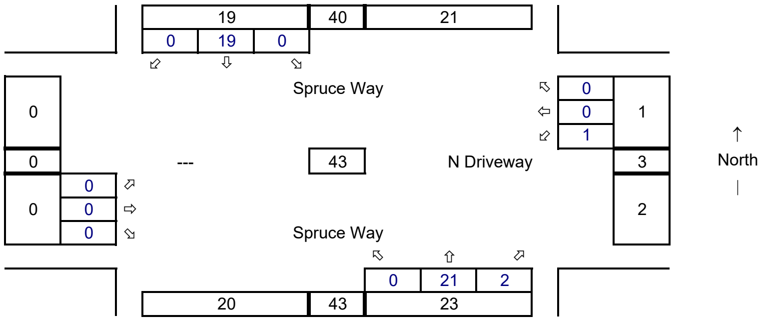
Total Growth = 1.0824



Total Project Trips

Average Weekday

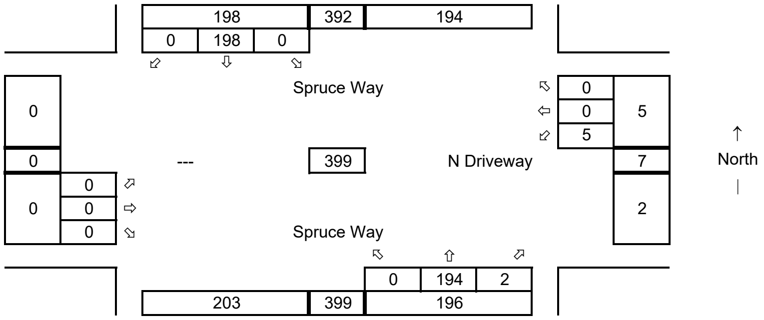
AM Peak Hour



Future with Project

Average Weekday

AM Peak Hour

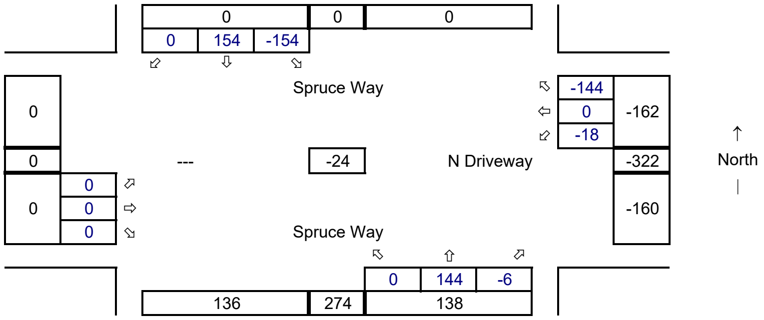


Diverted Trips

Average Weekday

AM Peak Hour

Conversion to Bus Loop



3 Spruce Way @ S Driveway

Synchro ID: 3

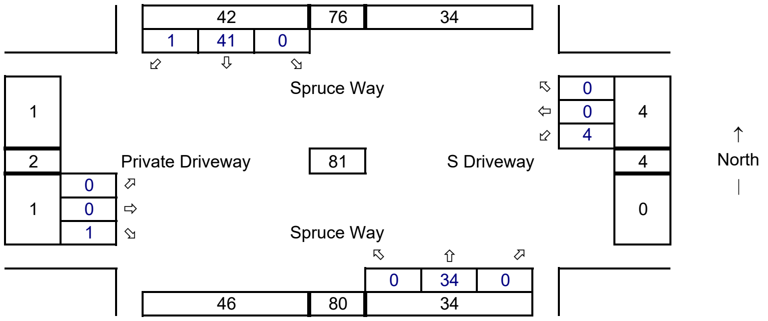
Existing

Average Weekday

AM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

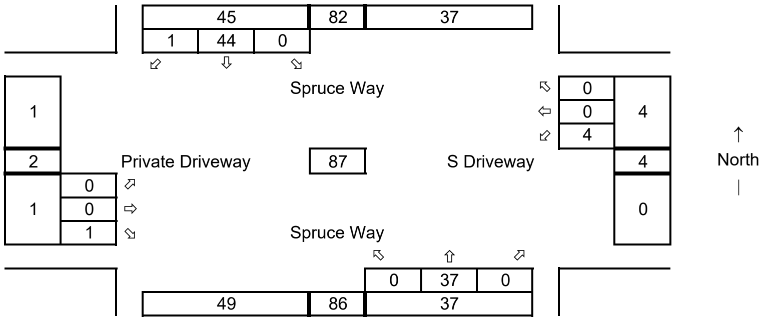
AM Peak Hour

Year: 2020

Growth Rate = 2.0%

Years of Growth = 4

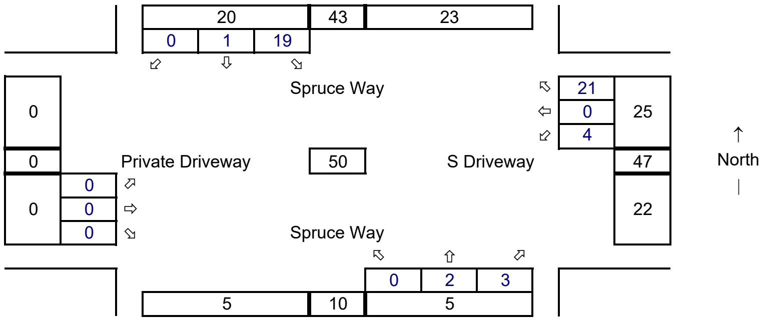
Total Growth = 1.0824



Total Project Trips

Average Weekday

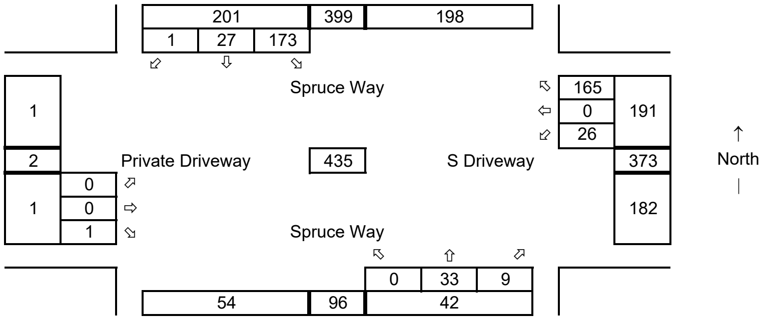
AM Peak Hour



Future with Project

Average Weekday

AM Peak Hour

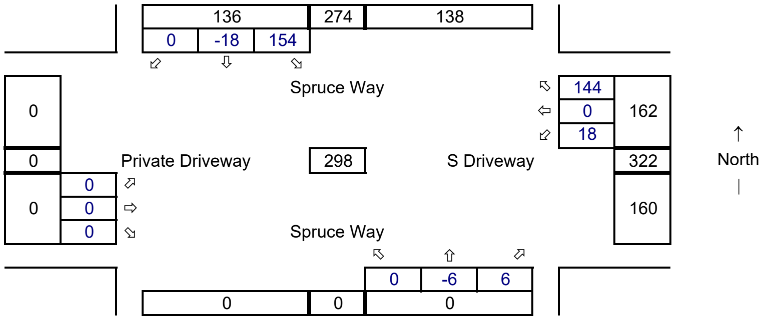


Diverted Trips

Average Weekday

AM Peak Hour

Conversion to Pick-Up/Drop-Off Loop and Parking Lot.



School PM Turning Movement Calculations

Synchro ID: 1

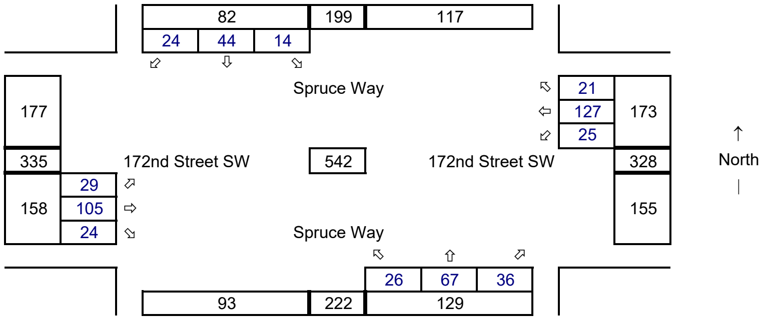
Existing

Average Weekday

PM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

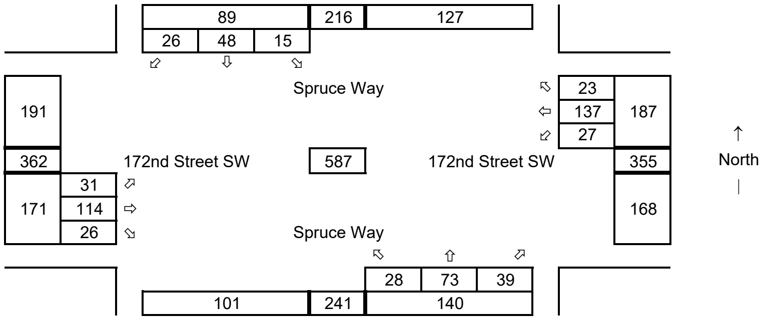
PM Peak Hour

Year: 2020

Growth Rate = 2.0%

Years of Growth = 4

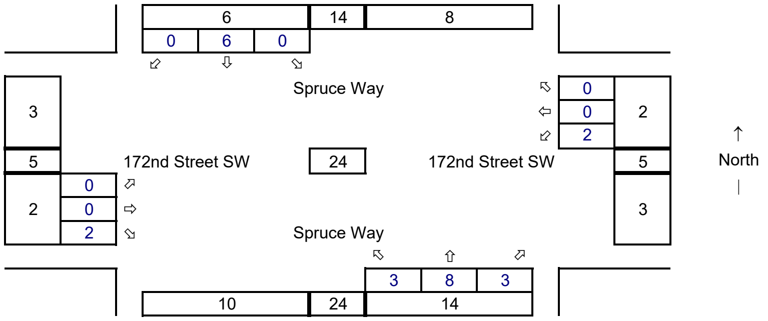
Total Growth = 1.0824



Total Project Trips

Average Weekday

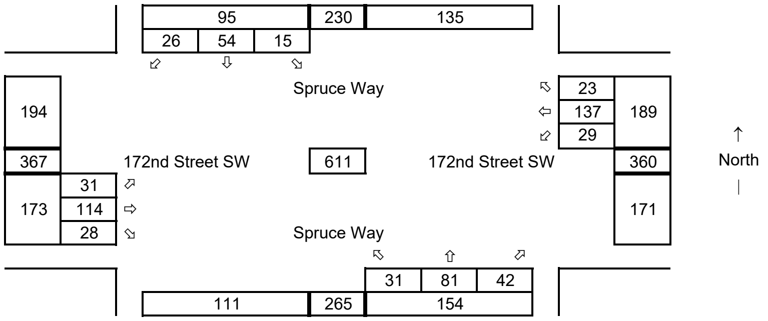
PM Peak Hour



Future with Project

Average Weekday

PM Peak Hour

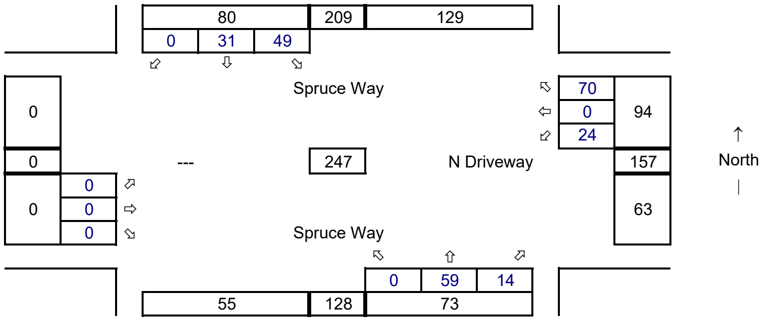


Synchro ID: 2

Existing
Average Weekday
PM Peak Hour

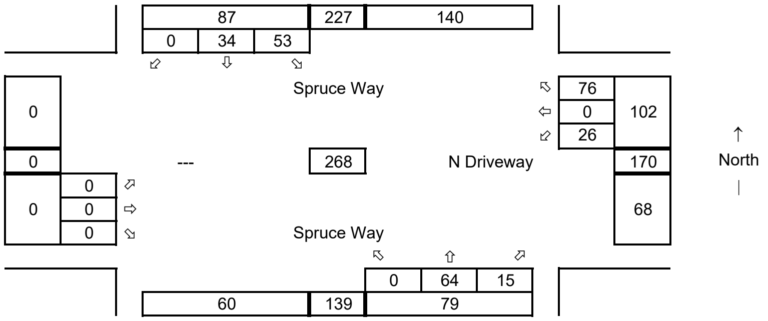
Year: **11/16/16**

Data Source: TDG

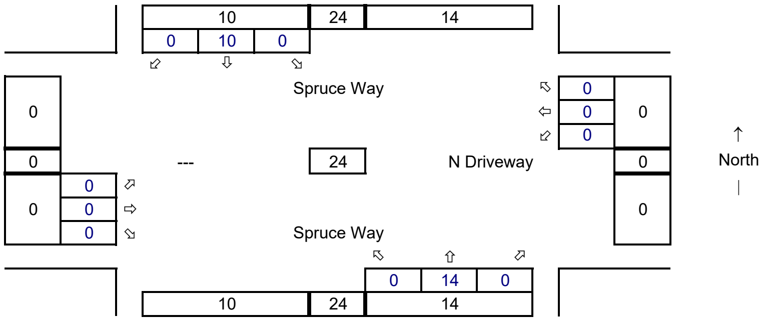


Future without Project
Average Weekday
PM Peak Hour

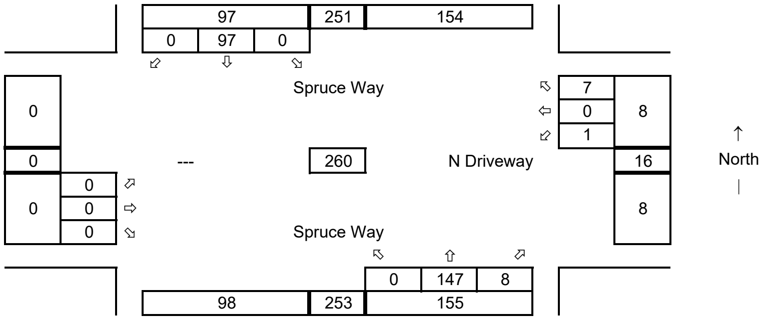
Year: 2020
Growth Rate = 2.0%
Years of Growth = 4
Total Growth = 1.0824



Total Project Trips
Average Weekday
PM Peak Hour

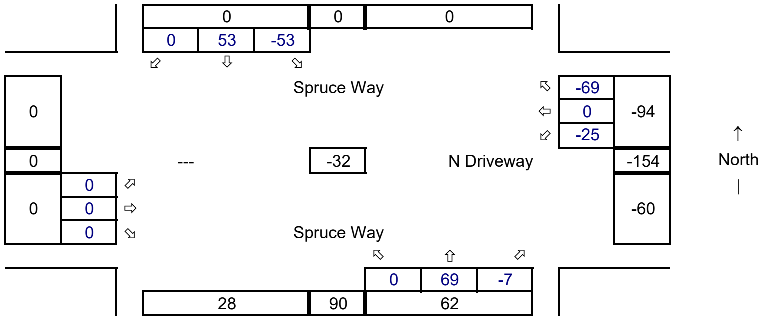


Future with Project
Average Weekday
PM Peak Hour



Diverted Trips
Average Weekday
PM Peak Hour

Conversion to Bus Loop.



3 Spruce Way @ S Driveway

Synchro ID: 3

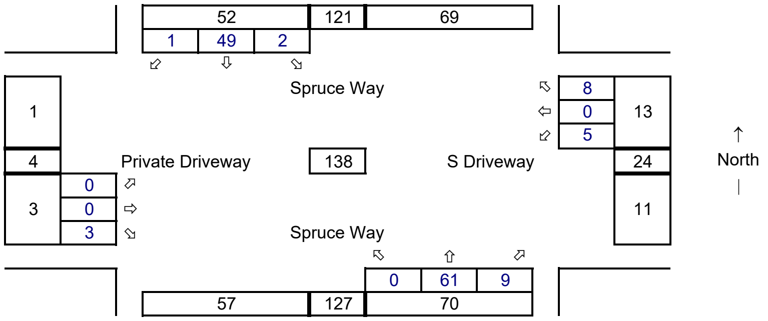
Existing

Average Weekday

PM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

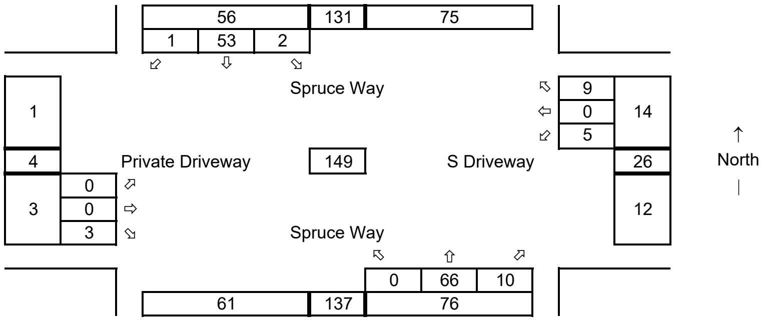
PM Peak Hour

Year = 2020

Growth Rate = 2.0%

Years of Growth = 4

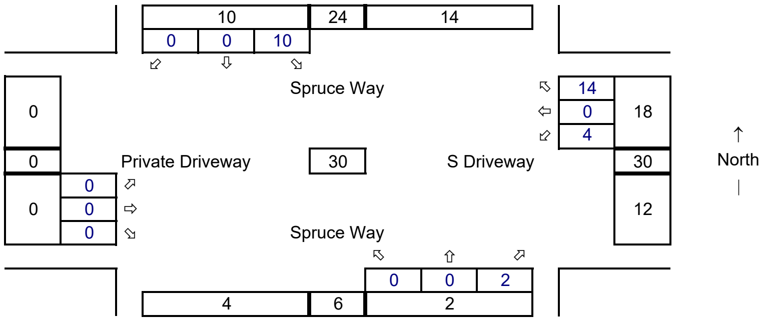
Total Growth = 1.0824



Total Project Trips

Average Weekday

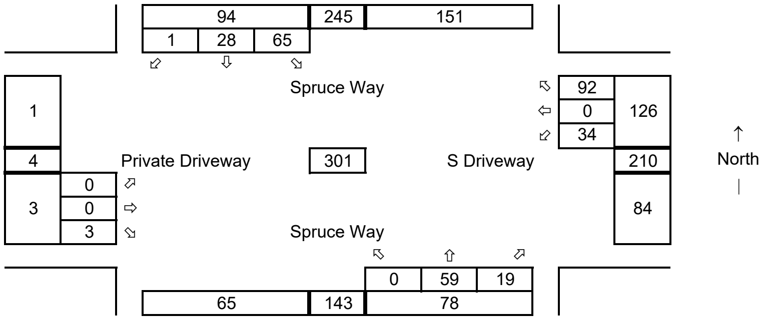
PM Peak Hour



Future with Project

Average Weekday

PM Peak Hour

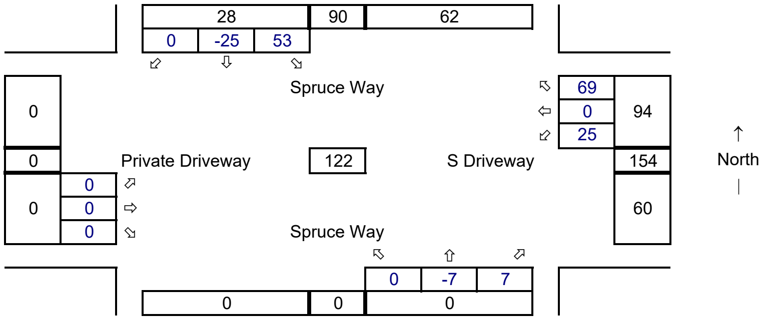


Diverted Trips

Average Weekday

PM Peak Hour

Conversion to Pick-Up/Drop-off loop and parking lot.



Existing AM Peak-Hour Level of Service Analysis

Intersection	
Intersection Delay, s/veh	10.2
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	9	60	18	0	50	48	6	0	30	99	35
Future Vol, veh/h	0	9	60	18	0	50	48	6	0	30	99	35
Peak Hour Factor	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	14	92	28	0	77	74	9	0	46	152	54
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.6	10.2	10.6
HCM LOS	A	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	10%	48%	6%
Vol Thru, %	60%	69%	46%	74%
Vol Right, %	21%	21%	6%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	164	87	104	142
LT Vol	30	9	50	9
Through Vol	99	60	48	105
RT Vol	35	18	6	28
Lane Flow Rate	252	134	160	218
Geometry Grp	1	1	1	1
Degree of Util (X)	0.349	0.197	0.241	0.305
Departure Headway (Hd)	4.986	5.299	5.414	5.019
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	724	677	664	719
Service Time	2.994	3.332	3.446	3.026
HCM Lane V/C Ratio	0.348	0.198	0.241	0.303
HCM Control Delay	10.6	9.6	10.2	10.2
HCM Lane LOS	B	A	B	B
HCM 95th-tile Q	1.6	0.7	0.9	1.3

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	9	105	28
Future Vol, veh/h	0	9	105	28
Peak Hour Factor	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	14	162	43
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	10.2
HCM LOS	B

Intersection	
Int Delay, s/veh	8.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	20	133	27	6	142	23
Future Vol, veh/h	20	133	27	6	142	23
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	52	52	69	69	51	51
Heavy Vehicles, %	1	1	0	0	2	2
Mvmt Flow	38	256	39	9	278	45

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	647	45	0	0	50	0
Stage 1	45	-	-	-	-	-
Stage 2	602	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.12	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.218	-
Pot Cap-1 Maneuver	437	1028	-	-	1557	-
Stage 1	980	-	-	-	-	-
Stage 2	549	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	356	1026	-	-	1557	-
Mov Cap-2 Maneuver	356	-	-	-	-	-
Stage 1	978	-	-	-	-	-
Stage 2	449	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.8	0	6.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	823	1557	-
HCM Lane V/C Ratio	-	-	0.358	0.179	-
HCM Control Delay (s)	-	-	11.8	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.6	0.7	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	0	0	1	4	0	0	0	34	0	0	41	1
Future Vol, veh/h	0	0	1	4	0	0	0	34	0	0	41	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	25	25	25	61	61	61	72	72	72
Heavy Vehicles, %	0	0	0	100	100	100	3	3	3	5	5	5
Mvmt Flow	0	0	4	16	0	0	0	56	0	0	57	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	114	116	58	118	116	58	58	0	0	58	0	0
Stage 1	58	58	-	58	58	-	-	-	-	-	-	-
Stage 2	56	58	-	60	58	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	8.1	7.5	7.2	4.13	-	-	4.15	-	-
Critical Hdwy Stg 1	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	4.4	4.9	4.2	2.227	-	-	2.245	-	-
Pot Cap-1 Maneuver	868	778	1014	674	624	789	1540	-	-	1527	-	-
Stage 1	959	851	-	756	688	-	-	-	-	-	-	-
Stage 2	961	851	-	754	688	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	868	777	1014	670	623	787	1540	-	-	1527	-	-
Mov Cap-2 Maneuver	868	777	-	670	623	-	-	-	-	-	-	-
Stage 1	959	851	-	755	687	-	-	-	-	-	-	-
Stage 2	961	849	-	751	688	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.6	10.5	0	0
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1540	-	-	1014	670	1527	-	-
HCM Lane V/C Ratio	-	-	-	0.004	0.024	-	-	-
HCM Control Delay (s)	0	-	-	8.6	10.5	0	-	-
HCM Lane LOS	A	-	-	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

Existing School PM Peak-Hour Level of Service Analysis

Existing Sch PM Conditions.syn
1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	9.4
Intersection LOS	A

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	29	105	24	0	25	127	21	0	26	67	36
Future Vol, veh/h	0	29	105	24	0	25	127	21	0	26	67	36
Peak Hour Factor	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4	2	4	4	4	2	4	4	4
Mvmt Flow	0	35	127	29	0	30	153	25	0	31	81	43
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.5	9.7	9.3
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	20%	18%	14%	17%
Vol Thru, %	52%	66%	73%	54%
Vol Right, %	28%	15%	12%	29%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	129	158	173	82
LT Vol	26	29	25	14
Through Vol	67	105	127	44
RT Vol	36	24	21	24
Lane Flow Rate	155	190	208	99
Geometry Grp	1	1	1	1
Degree of Util (X)	0.212	0.254	0.277	0.137
Departure Headway (Hd)	4.92	4.797	4.785	4.986
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	724	744	746	713
Service Time	2.987	2.858	2.845	3.058
HCM Lane V/C Ratio	0.214	0.255	0.279	0.139
HCM Control Delay	9.3	9.5	9.7	8.9
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.8	1	1.1	0.5

Existing Sch PM Conditions.syn
1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	14	44	24
Future Vol, veh/h	0	14	44	24
Peak Hour Factor	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4
Mvmt Flow	0	17	53	29
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	8.9
HCM LOS	A

Intersection	
Int Delay, s/veh	6.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	24	70	59	14	49	31
Future Vol, veh/h	24	70	59	14	49	31
Conflicting Peds, #/hr	0	0	0	9	9	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	48	48	68	68	57	57
Heavy Vehicles, %	1	1	14	14	4	4
Mvmt Flow	50	146	87	21	86	54

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	332	106	0	0	116	0
Stage 1	106	-	-	-	-	-
Stage 2	226	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.14	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.236	-
Pot Cap-1 Maneuver	665	951	-	-	1460	-
Stage 1	921	-	-	-	-	-
Stage 2	814	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	619	943	-	-	1460	-
Mov Cap-2 Maneuver	619	-	-	-	-	-
Stage 1	913	-	-	-	-	-
Stage 2	764	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.7	0	4.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	832	1460	-
HCM Lane V/C Ratio	-	-	0.235	0.059	-
HCM Control Delay (s)	-	-	10.7	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.9	0.2	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	0	0	3	5	0	8	0	61	9	2	49	1
Future Vol, veh/h	0	0	3	5	0	8	0	61	9	2	49	1
Conflicting Peds, #/hr	0	0	10	10	0	0	1	0	6	6	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	54	54	54	80	80	80	87	87	87
Heavy Vehicles, %	0	0	0	54	54	54	13	13	13	2	2	2
Mvmt Flow	0	0	12	9	0	15	0	76	11	2	56	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	151	156	68	165	151	88	58	0	0	94	0	0
Stage 1	62	62	-	88	88	-	-	-	-	-	-	-
Stage 2	89	94	-	77	63	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.64	7.04	6.74	4.23	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.986	4.486	3.786	2.317	-	-	2.218	-	-
Pot Cap-1 Maneuver	821	740	1001	696	655	844	1479	-	-	1500	-	-
Stage 1	954	847	-	806	731	-	-	-	-	-	-	-
Stage 2	923	821	-	817	751	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	805	734	991	677	650	839	1465	-	-	1500	-	-
Mov Cap-2 Maneuver	805	734	-	677	650	-	-	-	-	-	-	-
Stage 1	953	845	-	801	727	-	-	-	-	-	-	-
Stage 2	907	816	-	799	750	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.7	9.8	0	0.3
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1465	-	-	991	768	1500	-	-
HCM Lane V/C Ratio	-	-	-	0.012	0.031	0.002	-	-
HCM Control Delay (s)	0	-	-	8.7	9.8	7.4	0	-
HCM Lane LOS	A	-	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

2020 Baseline AM Peak-Hour Level of Service Analysis

Intersection	
Intersection Delay, s/veh	10.8
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	10	65	19	0	54	52	6	0	32	107	38
Future Vol, veh/h	0	10	65	19	0	54	52	6	0	32	107	38
Peak Hour Factor	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	15	100	29	0	83	80	9	0	49	165	58
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	10	10.6	11.3
HCM LOS	A	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	11%	48%	6%
Vol Thru, %	60%	69%	46%	74%
Vol Right, %	21%	20%	5%	19%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	177	94	112	154
LT Vol	32	10	54	10
Through Vol	107	65	52	114
RT Vol	38	19	6	30
Lane Flow Rate	272	145	172	237
Geometry Grp	1	1	1	1
Degree of Util (X)	0.385	0.219	0.267	0.338
Departure Headway (Hd)	5.092	5.461	5.569	5.132
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	705	657	644	701
Service Time	3.125	3.5	3.606	3.165
HCM Lane V/C Ratio	0.386	0.221	0.267	0.338
HCM Control Delay	11.3	10	10.6	10.8
HCM Lane LOS	B	A	B	B
HCM 95th-tile Q	1.8	0.8	1.1	1.5

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	10	114	30
Future Vol, veh/h	0	10	114	30
Peak Hour Factor	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	15	175	46
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	10.8
HCM LOS	B

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	8.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	22	144	29	6	154	25
Future Vol, veh/h	22	144	29	6	154	25
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	52	52	69	69	51	51
Heavy Vehicles, %	1	1	0	0	2	2
Mvmt Flow	42	277	42	9	302	49

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	701	48	0	0	53	0
Stage 1	48	-	-	-	-	-
Stage 2	653	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.12	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.218	-
Pot Cap-1 Maneuver	406	1024	-	-	1553	-
Stage 1	977	-	-	-	-	-
Stage 2	520	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	324	1022	-	-	1553	-
Mov Cap-2 Maneuver	324	-	-	-	-	-
Stage 1	975	-	-	-	-	-
Stage 2	416	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.5	0	6.8
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	795	1553	-
HCM Lane V/C Ratio	-	-	0.402	0.194	-
HCM Control Delay (s)	-	-	12.5	7.9	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.9	0.7	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	0	0	1	4	0	0	0	37	0	0	44	1
Future Vol, veh/h	0	0	1	4	0	0	0	37	0	0	44	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	25	25	25	61	61	61	72	72	72
Heavy Vehicles, %	0	0	0	100	100	100	3	3	3	5	5	5
Mvmt Flow	0	0	4	16	0	0	0	61	0	0	61	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	123	125	62	127	126	63	63	0	0	63	0	0
Stage 1	62	62	-	63	63	-	-	-	-	-	-	-
Stage 2	61	63	-	64	63	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	8.1	7.5	7.2	4.13	-	-	4.15	-	-
Critical Hdwy Stg 1	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	4.4	4.9	4.2	2.227	-	-	2.245	-	-
Pot Cap-1 Maneuver	856	769	1009	664	615	784	1533	-	-	1521	-	-
Stage 1	954	847	-	751	684	-	-	-	-	-	-	-
Stage 2	955	846	-	750	684	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	856	768	1009	660	614	783	1533	-	-	1521	-	-
Mov Cap-2 Maneuver	856	768	-	660	614	-	-	-	-	-	-	-
Stage 1	954	847	-	750	683	-	-	-	-	-	-	-
Stage 2	955	844	-	747	684	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.6	10.6	0	0
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1533	-	-	1009	660	1521	-	-
HCM Lane V/C Ratio	-	-	-	0.004	0.024	-	-	-
HCM Control Delay (s)	0	-	-	8.6	10.6	0	-	-
HCM Lane LOS	A	-	-	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

2020 Baseline School PM Peak-Hour Level of Service Analysis

Intersection	
Intersection Delay, s/veh	9.8
Intersection LOS	A

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	31	114	26	0	27	137	23	0	28	73	39
Future Vol, veh/h	0	31	114	26	0	27	137	23	0	28	73	39
Peak Hour Factor	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4	2	4	4	4	2	4	4	4
Mvmt Flow	0	37	137	31	0	33	165	28	0	34	88	47
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.9	10.1	9.7
HCM LOS	A	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	20%	18%	14%	17%
Vol Thru, %	52%	67%	73%	54%
Vol Right, %	28%	15%	12%	29%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	140	171	187	89
LT Vol	28	31	27	15
Through Vol	73	114	137	48
RT Vol	39	26	23	26
Lane Flow Rate	169	206	225	107
Geometry Grp	1	1	1	1
Degree of Util (X)	0.235	0.28	0.305	0.152
Departure Headway (Hd)	5.023	4.887	4.873	5.098
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	707	729	730	696
Service Time	3.106	2.963	2.947	3.188
HCM Lane V/C Ratio	0.239	0.283	0.308	0.154
HCM Control Delay	9.7	9.9	10.1	9.1
HCM Lane LOS	A	A	B	A
HCM 95th-tile Q	0.9	1.1	1.3	0.5

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	15	48	26
Future Vol, veh/h	0	15	48	26
Peak Hour Factor	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4
Mvmt Flow	0	18	58	31
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	9.1
HCM LOS	A

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	6.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	26	76	64	15	53	34
Future Vol, veh/h	26	76	64	15	53	34
Conflicting Peds, #/hr	0	0	0	9	9	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	48	48	68	68	57	57
Heavy Vehicles, %	1	1	14	14	4	4
Mvmt Flow	54	158	94	22	93	60

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	360	114	0	0	125	0
Stage 1	114	-	-	-	-	-
Stage 2	246	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.14	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.236	-
Pot Cap-1 Maneuver	641	941	-	-	1449	-
Stage 1	913	-	-	-	-	-
Stage 2	797	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	594	933	-	-	1449	-
Mov Cap-2 Maneuver	594	-	-	-	-	-
Stage 1	905	-	-	-	-	-
Stage 2	744	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11	0	4.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	815	1449	-
HCM Lane V/C Ratio	-	-	0.261	0.064	-
HCM Control Delay (s)	-	-	11	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1	0.2	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	1.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	0	0	3	5	0	9	0	66	10	2	53	1
Future Vol, veh/h	0	0	3	5	0	9	0	66	10	2	53	1
Conflicting Peds, #/hr	0	0	10	10	0	0	1	0	6	6	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	54	54	54	80	80	80	87	87	87
Heavy Vehicles, %	0	0	0	54	54	54	13	13	13	2	2	2
Mvmt Flow	0	0	12	9	0	17	0	83	13	2	61	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	164	168	72	177	163	95	63	0	0	101	0	0
Stage 1	67	67	-	95	95	-	-	-	-	-	-	-
Stage 2	97	101	-	82	68	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.64	7.04	6.74	4.23	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.986	4.486	3.786	2.317	-	-	2.218	-	-
Pot Cap-1 Maneuver	805	728	996	683	645	836	1472	-	-	1491	-	-
Stage 1	948	843	-	799	726	-	-	-	-	-	-	-
Stage 2	914	815	-	812	747	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	788	722	986	664	640	831	1458	-	-	1491	-	-
Mov Cap-2 Maneuver	788	722	-	664	640	-	-	-	-	-	-	-
Stage 1	947	841	-	794	722	-	-	-	-	-	-	-
Stage 2	896	810	-	794	746	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.7	9.9	0	0.3
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1458	-	-	986	763	1491	-	-
HCM Lane V/C Ratio	-	-	-	0.012	0.034	0.002	-	-
HCM Control Delay (s)	0	-	-	8.7	9.9	7.4	0	-
HCM Lane LOS	A	-	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

2020 Future With Project AM Peak-Hour Level of Service Analysis

2020 Future with Development AM Conditions.syn
1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	10	65	22	0	59	52	6	0	36	119	43
Future Vol, veh/h	0	10	65	22	0	59	52	6	0	36	119	43
Peak Hour Factor	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	15	100	34	0	91	80	9	0	55	183	66
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	10.4	11.1	12.3
HCM LOS	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	10%	50%	6%
Vol Thru, %	60%	67%	44%	76%
Vol Right, %	22%	23%	5%	18%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	198	97	117	165
LT Vol	36	10	59	10
Through Vol	119	65	52	125
RT Vol	43	22	6	30
Lane Flow Rate	305	149	180	254
Geometry Grp	1	1	1	1
Degree of Util (X)	0.439	0.233	0.287	0.371
Departure Headway (Hd)	5.188	5.627	5.745	5.259
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	695	636	625	683
Service Time	3.229	3.678	3.794	3.302
HCM Lane V/C Ratio	0.439	0.234	0.288	0.372
HCM Control Delay	12.3	10.4	11.1	11.4
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	2.2	0.9	1.2	1.7

2020 Future with Development AM Conditions.syn
1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	10	125	30
Future Vol, veh/h	0	10	125	30
Peak Hour Factor	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	15	192	46
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	11.4
HCM LOS	B

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	5	0	194	2	0	198
Future Vol, veh/h	5	0	194	2	0	198
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	25	25	69	69	51	51
Heavy Vehicles, %	100	100	0	0	2	2
Mvmt Flow	20	0	281	3	0	388

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	673	285	0	0	286	0
Stage 1	285	-	-	-	-	-
Stage 2	388	-	-	-	-	-
Critical Hdwy	7.4	7.2	-	-	4.12	-
Critical Hdwy Stg 1	6.4	-	-	-	-	-
Critical Hdwy Stg 2	6.4	-	-	-	-	-
Follow-up Hdwy	4.4	4.2	-	-	2.218	-
Pot Cap-1 Maneuver	301	570	-	-	1276	-
Stage 1	584	-	-	-	-	-
Stage 2	515	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	300	569	-	-	1276	-
Mov Cap-2 Maneuver	300	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	515	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17.9	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	300	1276	-
HCM Lane V/C Ratio	-	-	0.067	-	-
HCM Control Delay (s)	-	-	17.9	0	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	0.2	0	-

Intersection	
Int Delay, s/veh	9.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	⅄		↱			↰
Traffic Vol, veh/h	26	165	33	9	173	27
Future Vol, veh/h	26	165	33	9	173	27
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	52	52	61	61	72	72
Heavy Vehicles, %	1	1	3	3	5	5
Mvmt Flow	50	317	54	15	240	38

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	581	63	0	0	71	0
Stage 1	63	-	-	-	-	-
Stage 2	518	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.15	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.245	-
Pot Cap-1 Maneuver	478	1004	-	-	1510	-
Stage 1	962	-	-	-	-	-
Stage 2	600	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	400	1002	-	-	1510	-
Mov Cap-2 Maneuver	400	-	-	-	-	-
Stage 1	960	-	-	-	-	-
Stage 2	503	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	12.7	0	6.8
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	832	1510	-
HCM Lane V/C Ratio	-	-	0.441	0.159	-
HCM Control Delay (s)	-	-	12.7	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2.3	0.6	-

2020 Future With Project School PM Peak-Hour Level of Service Analysis

Intersection	
Intersection Delay, s/veh	10
Intersection LOS	A

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	31	114	28	0	29	137	23	0	31	81	42
Future Vol, veh/h	0	31	114	28	0	29	137	23	0	31	81	42
Peak Hour Factor	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4	2	4	4	4	2	4	4	4
Mvmt Flow	0	37	137	34	0	35	165	28	0	37	98	51
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	10.1	10.3	10
HCM LOS	B	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	20%	18%	15%	16%
Vol Thru, %	53%	66%	72%	57%
Vol Right, %	27%	16%	12%	27%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	154	173	189	95
LT Vol	31	31	29	15
Through Vol	81	114	137	54
RT Vol	42	28	23	26
Lane Flow Rate	186	208	228	114
Geometry Grp	1	1	1	1
Degree of Util (X)	0.261	0.287	0.313	0.167
Departure Headway (Hd)	5.06	4.953	4.946	5.257
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	701	717	717	687
Service Time	3.155	3.048	3.039	3.257
HCM Lane V/C Ratio	0.265	0.29	0.318	0.166
HCM Control Delay	10	10.1	10.3	9.3
HCM Lane LOS	A	B	B	A
HCM 95th-tile Q	1	1.2	1.3	0.6

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	15	54	26
Future Vol, veh/h	0	15	54	26
Peak Hour Factor	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4
Mvmt Flow	0	18	65	31
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	9.3
HCM LOS	A

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	0.4

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	1	7	147	8	0	97
Future Vol, veh/h	1	7	147	8	0	97
Conflicting Peds, #/hr	0	0	0	9	9	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	54	54	68	68	57	57
Heavy Vehicles, %	54	54	14	14	4	4
Mvmt Flow	2	13	216	12	0	170

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	401	231	0	0	237	0
Stage 1	231	-	-	-	-	-
Stage 2	170	-	-	-	-	-
Critical Hdwy	6.94	6.74	-	-	4.14	-
Critical Hdwy Stg 1	5.94	-	-	-	-	-
Critical Hdwy Stg 2	5.94	-	-	-	-	-
Follow-up Hdwy	3.986	3.786	-	-	2.236	-
Pot Cap-1 Maneuver	516	695	-	-	1318	-
Stage 1	699	-	-	-	-	-
Stage 2	748	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	512	689	-	-	1318	-
Mov Cap-2 Maneuver	512	-	-	-	-	-
Stage 1	693	-	-	-	-	-
Stage 2	748	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.6	0	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	660	1318	-
HCM Lane V/C Ratio	-	-	0.022	-	-
HCM Control Delay (s)	-	-	10.6	0	-
HCM Lane LOS	-	-	B	A	-
HCM 95th %tile Q(veh)	-	-	0.1	0	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	7.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	0	0	3	34	0	92	0	59	19	65	28	1
Future Vol, veh/h	0	0	3	34	0	92	0	59	19	65	28	1
Conflicting Peds, #/hr	0	0	10	10	0	0	1	0	6	6	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	48	48	48	80	80	80	87	87	87
Heavy Vehicles, %	0	0	0	1	1	1	13	13	13	2	2	2
Mvmt Flow	0	0	12	71	0	192	0	74	24	75	32	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	364	287	44	290	276	92	34	0	0	104	0	0
Stage 1	183	183	-	92	92	-	-	-	-	-	-	-
Stage 2	181	104	-	198	184	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.11	6.51	6.21	4.23	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.509	4.009	3.309	2.317	-	-	2.218	-	-
Pot Cap-1 Maneuver	596	626	1032	664	633	968	1509	-	-	1488	-	-
Stage 1	823	752	-	918	821	-	-	-	-	-	-	-
Stage 2	825	813	-	806	749	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	458	590	1021	621	597	962	1495	-	-	1488	-	-
Mov Cap-2 Maneuver	458	590	-	621	597	-	-	-	-	-	-	-
Stage 1	822	713	-	913	816	-	-	-	-	-	-	-
Stage 2	661	808	-	749	710	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.6	11.2	0	5.2
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1495	-	-	1021	838	1488	-	-
HCM Lane V/C Ratio	-	-	-	0.012	0.313	0.05	-	-
HCM Control Delay (s)	0	-	-	8.6	11.2	7.5	0	-
HCM Lane LOS	A	-	-	A	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	1.3	0.2	-	-

Parking Data

Matt

From: Carla Nasr <CarlaN@trafficdatagathering.com>
Sent: Sunday, November 20, 2016 10:30 PM
To: Matt
Subject: RE: Spruce ES, GTC 16-281
Attachments: Spruce ES N Drvwy @ Spruce Way AM.pdf; Spruce ES N Drvwy @ Spruce Way PM.pdf; Spruce ES S Drvwy @ Spruce Way AM.pdf; Spruce ES S Drvwy @ Spruce Way PM.pdf; Spruce Way @ 172 St SW AM.pdf; Spruce Way @ 172 St SW PM.pdf

Hi Matt,

Attached are the Spruce ES counts.

The number of vehicles parked at 9:45 AM in the school's parking lot is: 44 cars including 2 in the ADA stalls.
The number of vehicles parked at 3:00 PM in the school's parking lot is: 42 cars including 1 in the ADA stalls.

Number of Vehicles parked on Street at South Driveway:
At 8:45 AM 0
9:00 AM 1
9:15 AM (-1,1,-1) 0
9:30 AM 0
9:45 AM 0

at 3:00 PM 2
3:15 PM 4
3:30 PM 5
3:45 PM 3
4:00 PM (+1, -3) 1
4:15 PM 0
4:30 PM 0
4:45 PM 0
5:00 PM 0

I observed Queuing at the North driveway between 9:00-9:15AM of 2 cars coming from the South and turning Right into the driveway. As well as queuing of about 14 cars coming from the North and turning Left into the driveway. And a constant queuing coming out of the North Driveway during this 15 minutes period.

Regards,

Carla Nasr

Traffic Data Gathering
11410 13th Street SE
Lake Stevens, WA 98258
(425) 345-1148 C
(425) 334-3348 O
CarlaN@TrafficDataGathering.com

From: Matt [mailto:Mattp@gibsontraffic.com]
Sent: Tuesday, November 15, 2016 9:26 AM
To: Carla Nasr <CarlaN@trafficdatagathering.com>
Subject: RE: Spruce ES, GTC 16-281

Queuing Analysis

Arrivals	172 / 15 mins	λ
Service	240 / 15 mins	μ

Average number of cars in the system	$\lambda/(\mu-\lambda)$	2.529412		2.529412	vehicles
Average waiting time in the system	$1/(\mu-\lambda)$	0.014706	180	2.647059	minutes
Average number of cars in the queue	λ^$2/\mu(\mu-\lambda)$	1.812745		1.812745	vehicles
Average waiting time in the queue	$\lambda/\mu(\mu-\lambda)$	0.010539	180	1.897059	minutes
Average system utilization	λ/μ	0.716667		72%	
Probability of no cars in system	$1-\lambda/\mu$	0.283333		28%	
Probability of n cars in system	$(1-\lambda/\mu)(\lambda/\mu)$^n				
- max queue available					

		$(1-\lambda/\mu)$	(λ/μ)^n	P(n)	
P(0)	0	0.283333333	1	0.283333	
P(1)	1	0.283333333	0.716666667	0.203056	49%
P(2)	2	0.283333333	0.513611111	0.145523	
P(3)	3	0.283333333	0.368087963	0.104292	
P(4)	4	0.283333333	0.263796373	0.074742	
P(5)	5	0.283333333	0.189054068	0.053565	
P(6)	6	0.283333333	0.135488748	0.038388	
P(7)	7	0.283333333	0.09710027	0.027512	
P(8)	8	0.283333333	0.069588527	0.019717	95%

Probability of 8 or fewer Cars	95.01%
Probability of more than 8 Cars	4.99%

Arrivals	172 / 15 mins	λ
Service	300 / 15 mins	μ

Average number of cars in the system	$\lambda/(\mu-\lambda)$	1.34375		1.34375	vehicles
Average waiting time in the system	$1/(\mu-\lambda)$	0.007813	180	1.40625	minutes
Average number of cars in the queue	λ^$2/\mu(\mu-\lambda)$	0.770417		0.770417	vehicles
Average waiting time in the queue	$\lambda/\mu(\mu-\lambda)$	0.004479	180	0.80625	minutes
Average system utilization	λ/μ	0.573333		57%	
Probability of no cars in system	$1-\lambda/\mu$	0.426667		43%	
Probability of n cars in system	$(1-\lambda/\mu)(\lambda/\mu)$^n				
- max queue available					

		$(1-\lambda/\mu)$	(λ/μ)^n	P(n)	
P(0)	0	0.426666667	1	0.426667	43%
P(1)	1	0.426666667	0.573333333	0.244622	67%
P(2)	2	0.426666667	0.328711111	0.14025	
P(3)	3	0.426666667	0.188461037	0.08041	
P(4)	4	0.426666667	0.108050995	0.046102	94%

Probability of 4 or fewer Cars	93.81%
Probability of more than 4 Cars	6.19%

Arrivals	172 / 15 mins	λ
Service	360 / 15 mins	μ

Average number of cars in the system	$\lambda/(\mu-\lambda)$	0.914894		0.914894	vehicles
Average waiting time in the system	$1/(\mu-\lambda)$	0.005319	180	0.957447	minutes
Average number of cars in the queue	$\lambda\text{^}2/\mu(\mu-\lambda)$	0.437116		0.437116	vehicles
Average waiting time in the queue	$\lambda/\mu(\mu-\lambda)$	0.002541	180	0.457447	minutes
Average system utilization	λ/μ	0.477778		48%	
Probability of no cars in system	$1-\lambda/\mu$	0.522222		52%	
Probability of n cars in system	$(1-\lambda/\mu)(\lambda/\mu)$^n				
- max queue available					

		$(1-\lambda/\mu)$	(λ/μ)^n	P(n)	
P(0)	0	0.522222222	1	0.522222	52%
P(1)	1	0.522222222	0.477777778	0.249506	
P(2)	2	0.522222222	0.228271605	0.119209	
P(3)	3	0.522222222	0.1090631	0.056955	95%

Probability of 3 or fewer Cars	94.79%
Probability of more than 3 Cars	5.21%

Collision Data

OFFICER REPORTED CRASHES THAT OCCURRED ON ALL ROADS IN THE CITY OF LYNNWOOD

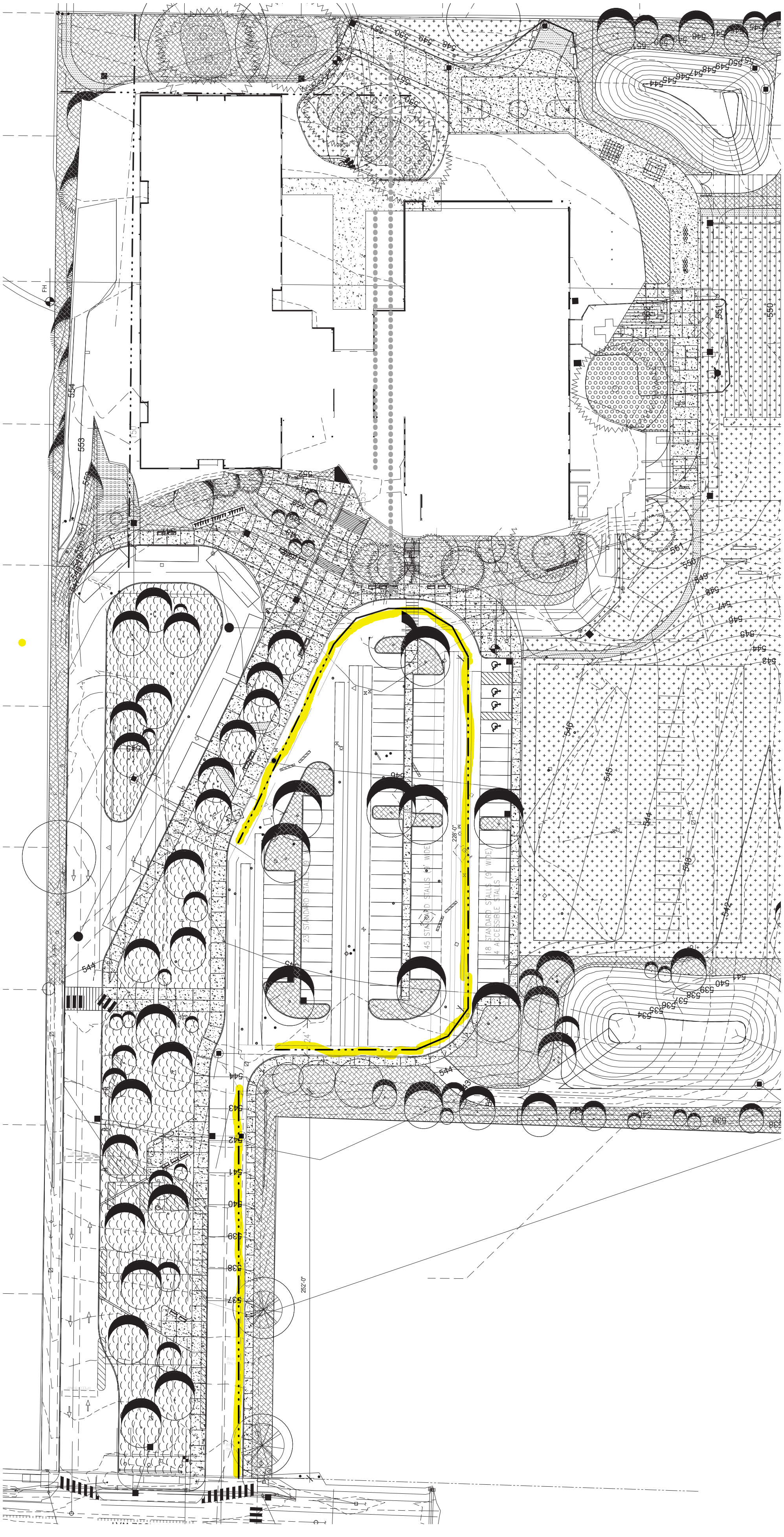
01/01/2012 - *available 2016*

Under 23 U.S. Code § 409 and 23 U.S. Code § 148, safety data, reports, surveys, schedules, lists compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential crash sites, hazardous roadway conditions, or railway-highway crossings are not subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.

JURISDICTION	PRIMARY TRAFFICWAY	BLOCK NUMBER	INTERSECTING TRAFFICWAY	A / B	REPORT NUMBER	DATE	TIME	MOST SEVERE INJURY TYPE	# INJ	# FAT	# VEH	# PEDS	# BIKES	FIRST COLLISION TYPE / OBJECT STRUCK
City Street	172ND ST SW	3900	SPRUCE WAY		E233883	03/20/2013	12:57	No Injury	0	0	2	0	0	Entering at angle
City Street	172ND ST SW	3900	SPRUCE WAY		E397346	02/02/2015	17:54	No Injury	0	0	2	0	0	Entering at angle

Site Layout

N


23 STANDARD STALLS (9' WIDE)
45 STANDARD STALLS (9' WIDE)
18 STANDARD STALLS (9' WIDE)
4 ACCESSIBLE STALLS
228'-0"
252'-0"
24'
FH
554
553
552
551
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541
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537
536
535
534

GTC
Gibson Traffic Consultants, Inc.
2813 Rockefeller Avenue
Suite B
Everett, WA 98201
425.339.8266

Spruce Elementary School
Updated Traffic Impact Analysis

Prepared for: Edmonds School District
Jurisdiction: City of Lynnwood

December 2019

MATTHEW JOHN PALMER
42322
12/12/19

GTC #16-281

TABLE OF CONTENTS

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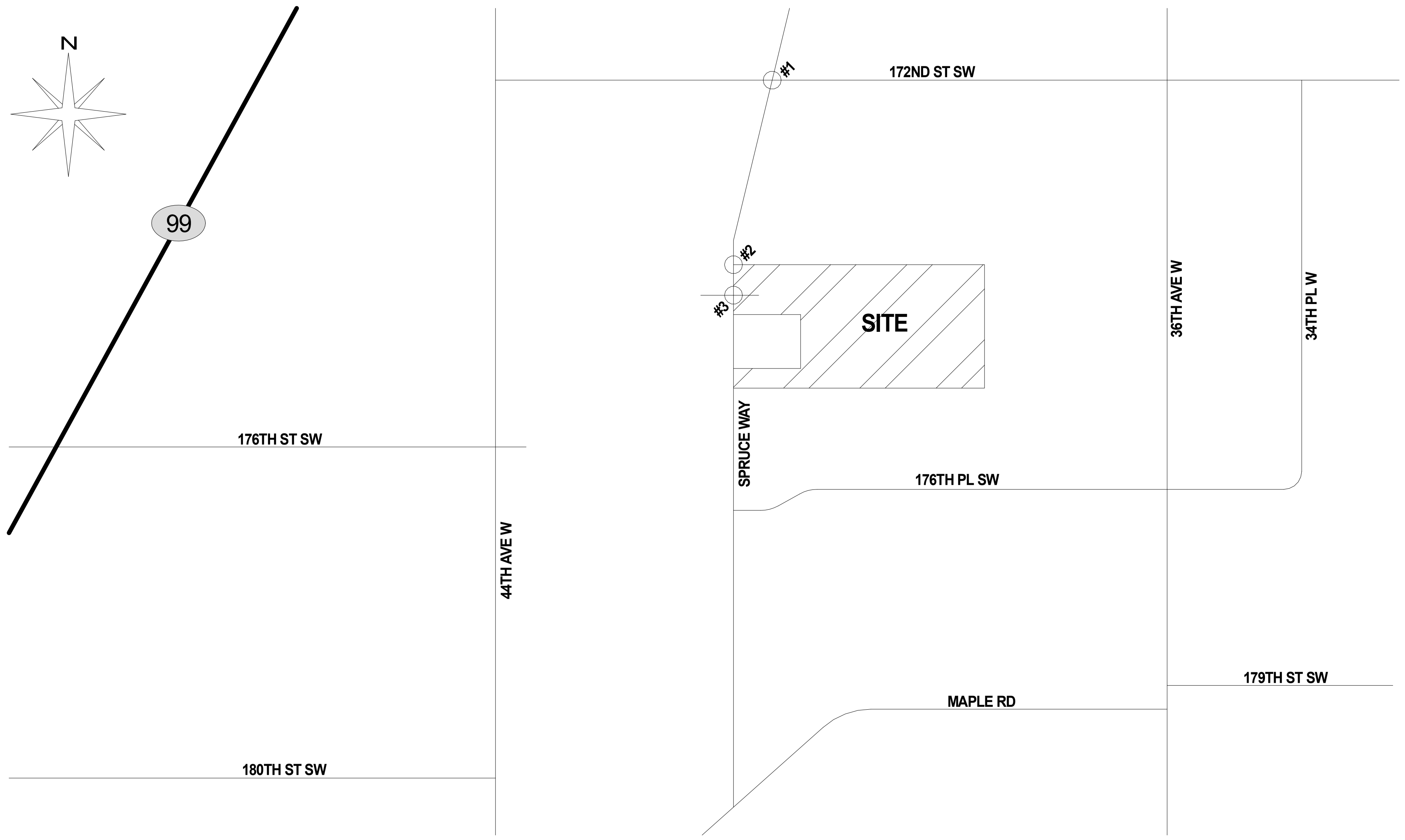
ATTACHMENTS

1. INTRODUCTION

Gibson Traffic Consultants, Inc. (GTC) has been retained to complete an updated traffic impact analysis (TIA) for the Spruce Elementary School reconstruction. This is an update to the April 2017 TIA to address the change in horizon year from 2020 to 2021, the movement of the parent access further south with the acquisition of an additional property, and changes to queuing length/parking on-site. All the following information has not changed from the April 2017 TIA. Edmonds School District (ESD) is proposing to reconstruct Spruce Elementary School, which is located on the east side of Spruce Way between 176th Street SW and 172nd Street SW in the City of Lynnwood. A site vicinity map is included in Figure 1. The school will continue to be an elementary school serving grades kindergarten through 6th grade with school hours from 9:20 AM and to 3:50 PM. For this analysis, the school is anticipated to have a capacity of 650 students. A similar ratio of volunteers and staff currently serving the school was assumed for future conditions as well. The school's current district boundary extends from SR-99 to 25th Avenue W and from 176th Street SW to 148th Street SW.

2. PROPOSED SITE DEVELOPMENT & ACCESS

Spruce Elementary School is being reconstructed with a capacity of 650 students. Bus traffic will be separated from staff and parent drop-off/pick-up traffic. The number of buses servicing the school is not anticipated to change. The school's existing bus access point will turn into the parent/staff access and move approximately 250 feet to the south while the north access will be repurposed to service the bus loop. Additionally, the parent drop-off/pick-up area will expand to allow for additional drop-off/pick-up of simultaneous vehicles while allowing other vehicles to bypass the stopped vehicles. The number of available parking spaces on-site will also increase to 96 parking stalls (90 parking stalls identified in the April 2017 TIA). The proposed school is scheduled for full facility build-out and occupancy by the 2021-2022 school year. Therefore, the year 2021 has been used as the opening year in the analysis.



GIBSON TRAFFIC CONSULTANTS

TRAFFIC IMPACT STUDY
GTC #16-281

SPRUCE
ELEMENTARY SCHOOL
(650 STUDENTS)

SNOHOMISH COUNTY

LEGEND

▨ DEVELOPMENT SITE

○ #X STUDY INTERSECTIONS

FIGURE 1
SITE VICINITY MAP

3. METHODOLOGY & ANALYSIS SCOPING

Peak-hour level of service (LOS) is determined using the methodology described in the 2010 *Highway Capacity Manual* (HCM) and *Synchro 10* software developed by Trafficware. The traffic analysis methodology has not been changed to stay consistent with the April 2017 TIA.

Traffic congestion on roadways is generally measured in terms of LOS at critical intersections. In accordance with the 2010 *Highway Capacity Manual*, roadway facilities and intersections are rated between LOS A and F, with LOS A being free flow and LOS F being forced flow or over-capacity conditions. The LOS at signalized intersections and all-way stop-controlled intersections are based on the average stopped delay for all entering vehicles. The LOS at two-way stop-controlled intersections is based on stopped delay times for the critical approach or movement(s). Geometric characteristics and conflicting traffic movements are taken into consideration when determining LOS values. A summary of the level of service criteria has been included in Table 1.

GTC utilized a 2.0-percent annual compounding growth rate to account for background traffic growth in the site vicinity based on projects located near the site. The street network surrounding the school is primarily comprised of stop-controlled intersections (all-way and two-way) and primarily serves single family-residential homes.

Matthew Palmer, responsible for the traffic analysis and report, is a licensed professional engineer (Civil) in the State of Washington and a current member of the Washington State section of ITE.

Table 1: Level of Service Criteria for Intersections

Level of Service[1]	Expected Delay	Intersection Control Delay (Seconds per Vehicle)	
		Unsignalized Intersections	**Signalized** Intersections
A	Little/No Delay	≤10	≤10
B	Short Delays	>10 and ≤15	>10 and ≤20
C	Average Delays	>15 and ≤25	>20 and ≤35
D	Long Delays	>25 and ≤35	>35 and ≤55
E	Very Long Delays	>35 and ≤50	>55 and ≤80
F	Extreme Delays[2]	>50	>80

The acceptable level of service at arterial intersections within the City of Lynnwood is LOS C for local streets at all times and LOS D for non-City Center arterials during the PM peak-hour.

GTC analyzed AM and School PM peak-hour level of service. Listed below are the intersections analyzed:

- Spruce Way at 172nd Street SW
- Spruce Way at North School Driveway
- Spruce Way at South School Driveway

---

[1] **Source:** *Highway Capacity Manual* 2010.

LOS A: Free-flow traffic conditions, with minimal delay to stopped vehicles (no vehicle is delayed longer than one cycle at signalized intersection).
LOS B: Generally stable traffic flow conditions.
LOS C: Occasional back-ups may develop, but delay to vehicles is short term and still tolerable.
LOS D: During short periods of the peak hour, delays to approaching vehicles may be substantial but are tolerable during times of less demand (i.e. vehicles delayed one cycle or less at signal).
LOS E: Intersections operate at or near capacity, with long queues developing on all approaches and long delays.
LOS F: Jammed conditions on all approaches with excessively long delays and vehicles unable to move at times.

[2] When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection.

4. EXISTING CONDITIONS

4.1 Walking Conditions

Spruce Way is a two-lane road, one in each direction. Each lane is approximately 10 feet wide. There are paved sidewalks traveling north from the school and a walking path to the south.

There are two paved trails within proximity to Spruce Elementary, one across from the school on Spruce way connecting to 175th Street SW and one on the northeast corner of the school connecting to 174th Place SW. These connections allow easy access to 44th Avenue W and 36th Avenue W, both of which are primary north/south streets with three lanes, one in each direction with a two-way left-turn lane. 36th Avenue W has a paved shoulder on the east side and at-grade sidewalk separated with a c-curb on the west. 44th Avenue W has separated raised sidewalk on both sides of the street.

4.2 Collision Data

Collision data was provided by WSDOT for 5-years from January 1, 2014 through December 31, 2018 data at the study intersections. The collision data is summarized in **Table 2** and **Table 3**.

Table 2: Collision Summary

Intersection	Collision Type							Total Collisions	Collisions Per Year
	Rear-end	Entering at Angle	Opp. Dir.	Sideswipe	Same Dir. Other	Ped./Cyclist Involved	Fixed Object		
172nd St SW at Spruce Way	0	2	0	0	0	0	0	2	0.4

Table 3: 5-Year Collision Rate Calculation

Intersection	PM Peak-Hour Intersection Vol.	K-Factor	Total Collisions	Collision Rate[3]
172nd St SW at Spruce Way	542	10	2	0.20

The intersection of 172nd Street SW at Spruce Way was the only location to have collisions. The intersection of 172nd Street SW at Spruce Way has a collision rate per million entering below 1.0, which corresponds to a relatively normal to low rate of accidents, and is below the average rate for the area.

---

[3] The collision rate is based on Million Entering Vehicles.

4.3 Existing Parking Utilization

A parking survey was completed by the independent count firm, Traffic Data Gathering (TDG) staff after the morning peak period at 9:45 AM and prior to school dismissal at PM on November 16, 2016. Currently on site there are a total of 58 spaces. In the morning, there were a total of 46 vehicles parked for the site, 2 of which were utilizing the ADA stalls. Prior to the school dismissal/arrival of parent pick-up traffic, there were a total of 43 parked vehicles for the school, 1 of which utilized the ADA stalls. The parking generation per student based on 558 existing students is 0.08 vehicles per student for the AM and 0.08 vehicles per student at School PM peak-hours, this includes all vehicles parked on-site (staff and visitor).

4.4 Existing Volumes and Level of Service

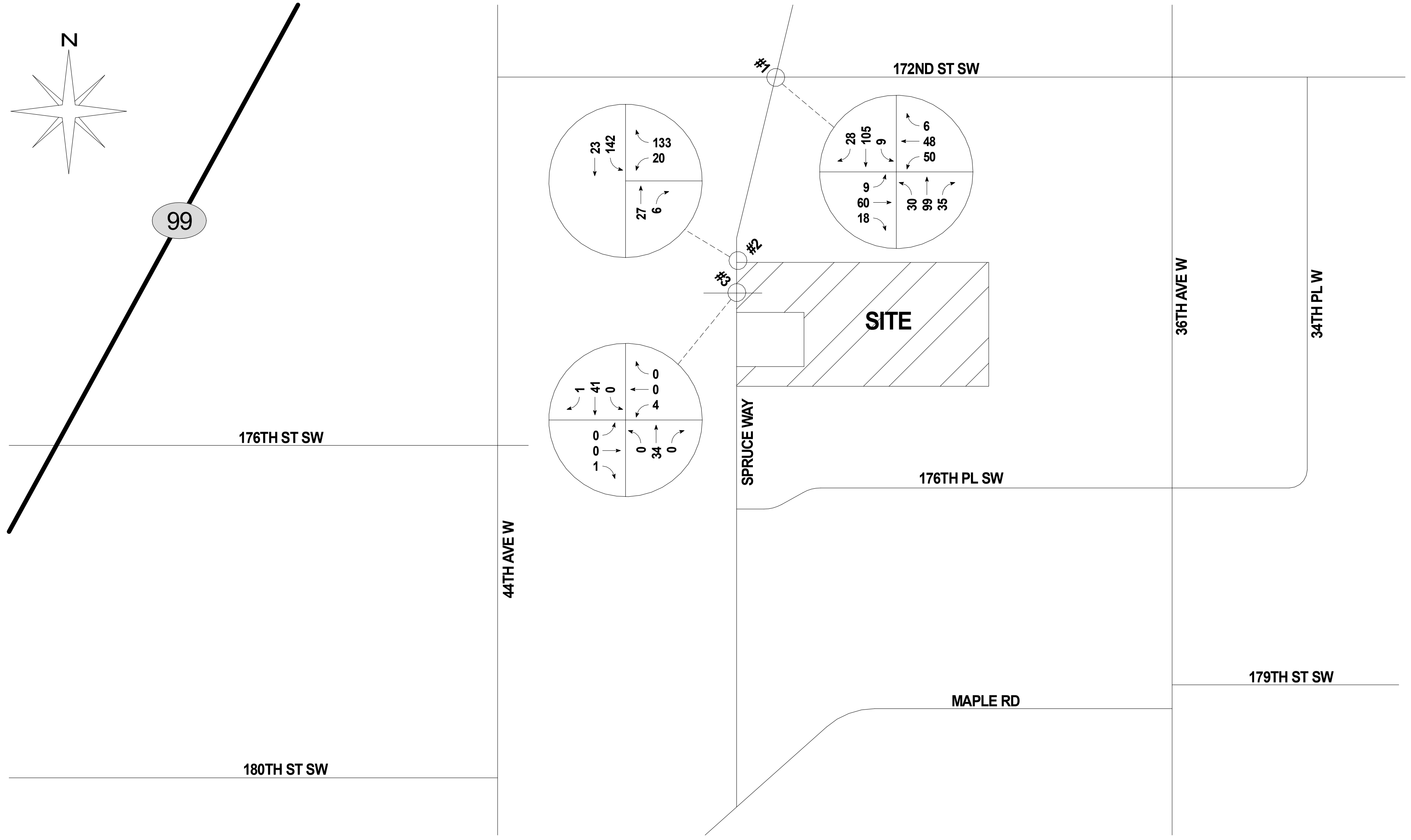
Existing turning movement counts at all the study intersections were obtained by the independent count firm, Traffic Data Gathering (TDG) on Wednesday, November 16, 2016. The existing peak-hour turning movement volumes are shown at the study intersections during the AM peak-hour (8:45-9:45 AM) and School PM peak-hour (3:00-5:00 PM) in Figure 2 and Figure 3 respectively. Based on the existing counts, channelization and intersection control; all the study intersections will operate at LOS B or better during AM peak-hour and School PM peak-hour. The existing level of service for the AM peak-hour and School PM peak-hour is summarized in Table 4 and Table 5 respectively. The existing level of service calculations are included in the attachments.

Table 4: Existing Level of Service Summary – AM Peak-Hour

Intersections	Existing Conditions		
	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	B	10.2 sec	---
2. Spruce Way at North Driveway	B	11.8 sec	Westbound
3. Spruce Way at South Driveway	B	10.5 sec	Westbound

Table 5: Existing Level of Service Summary – School PM Peak-Hour

Intersections	Existing Conditions		
	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	A	9.4 sec	---
2. Spruce Way at North Driveway	B	10.7 sec	Westbound
3. Spruce Way at South Driveway	A	9.8 sec	Westbound



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(650 STUDENTS)

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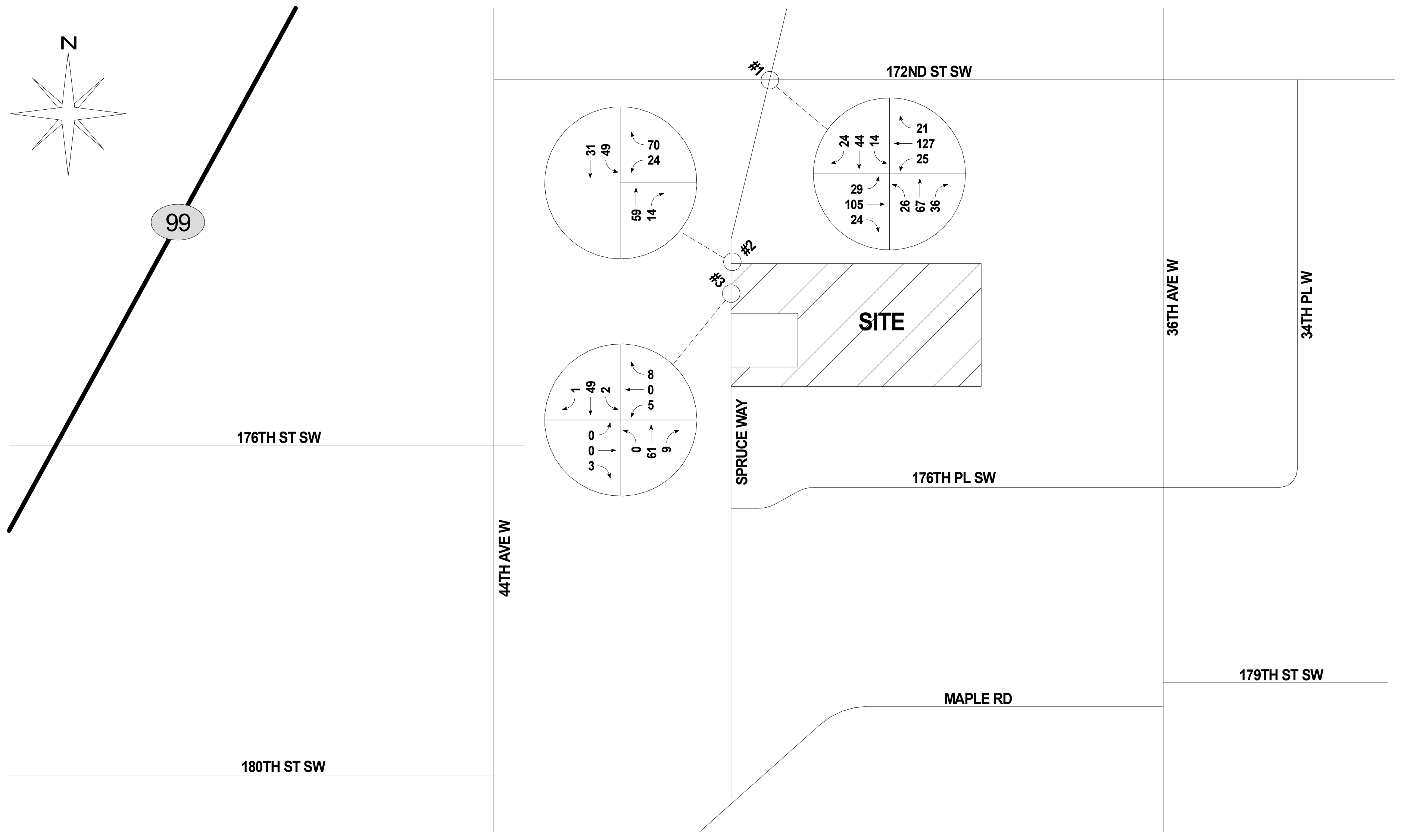
XXX → AM PEAK-HOUR TURNING MOVEMENTS

FIGURE 2

EXISTING AM PEAK-HOUR TURNING MOVEMENTS



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XXX →	SCHOOL PM PEAK-HOUR TURNING MOVEMENTS

FIGURE 3
EXISTING
SCHOOL PM PEAK-HOUR
TURNING MOVEMENTS

5. FUTURE CONDITIONS

5.1 Trip Generation

Consistent with the April 2017 TIA, the Office of Superintendent of Public Instruction, there were 558 students enrolled in May of the 2015-2016 school year. Per ITE *Trip Generation* (9th Edition, 2012) Land Use Code: 520, Elementary School, the trip generation rate per student is 1.29 for daily, 0.45 for AM peak-hour and 0.28 for PM peak-hour and the existing 558-student school would have an ITE trip generation of 720 daily, 251 AM and 156 School PM peak trips on an average weekday or school day.

AM peak traffic counts at the school entrances and exits taken on Wednesday November 16, 2016 indicate school trip volumes are higher than the ITE trip estimates, with 307 peak-hour trips (150 inbound and 157 outbound) during the AM peak hour for existing conditions, approximately 22% higher than ITE estimates. School PM peak traffic counts taken on Wednesday November 16, 2016 indicate school traffic volumes are also higher than ITE trip estimates with 179 peak trips (73 inbound and 106 outbound) during the school PM peak hour, approximately 15% higher than ITE estimates. In order to analyze "worst case" traffic conditions at the school site, GTC has utilized existing driveway count data to estimate future peak-hour traffic volumes and peak-hour LOS conditions.

For future school traffic with the proposed school reconstruction, GTC assumed the same traffic generation characteristics as counted at the existing school driveways with new school traffic proportional to the expected growth in the student enrollment. The expected enrollment increase at Spruce Elementary School is to 650 students, or an increase of 92 students. For the critical AM peak period, school traffic would increase by an estimated 50.3 trips (24.4 inbound/25.9 outbound) and by 29.8 trips (12.2 inbound/17.6 outbound) for the School PM peak. During the street peak-hour it is anticipated that there would be an increase of 13.8 PM peak-hour trips (6.8 inbound/7.0 outbound). The trip generation is summarized in Table 6.

Table 6: Elementary School Trip Generation Summary

Students	Average Daily Trips	AM Peak-Hour			School PM Peak-Hour			PM Peak-Hour[4]		
		Inbound	Outbound	Total	Inbound	Outbound	Total	Inbound	Outbound	Total
92	140.8[5]	24.4	25.9	50.3	12.2	17.6	29.8	6.8	7.0	13.8

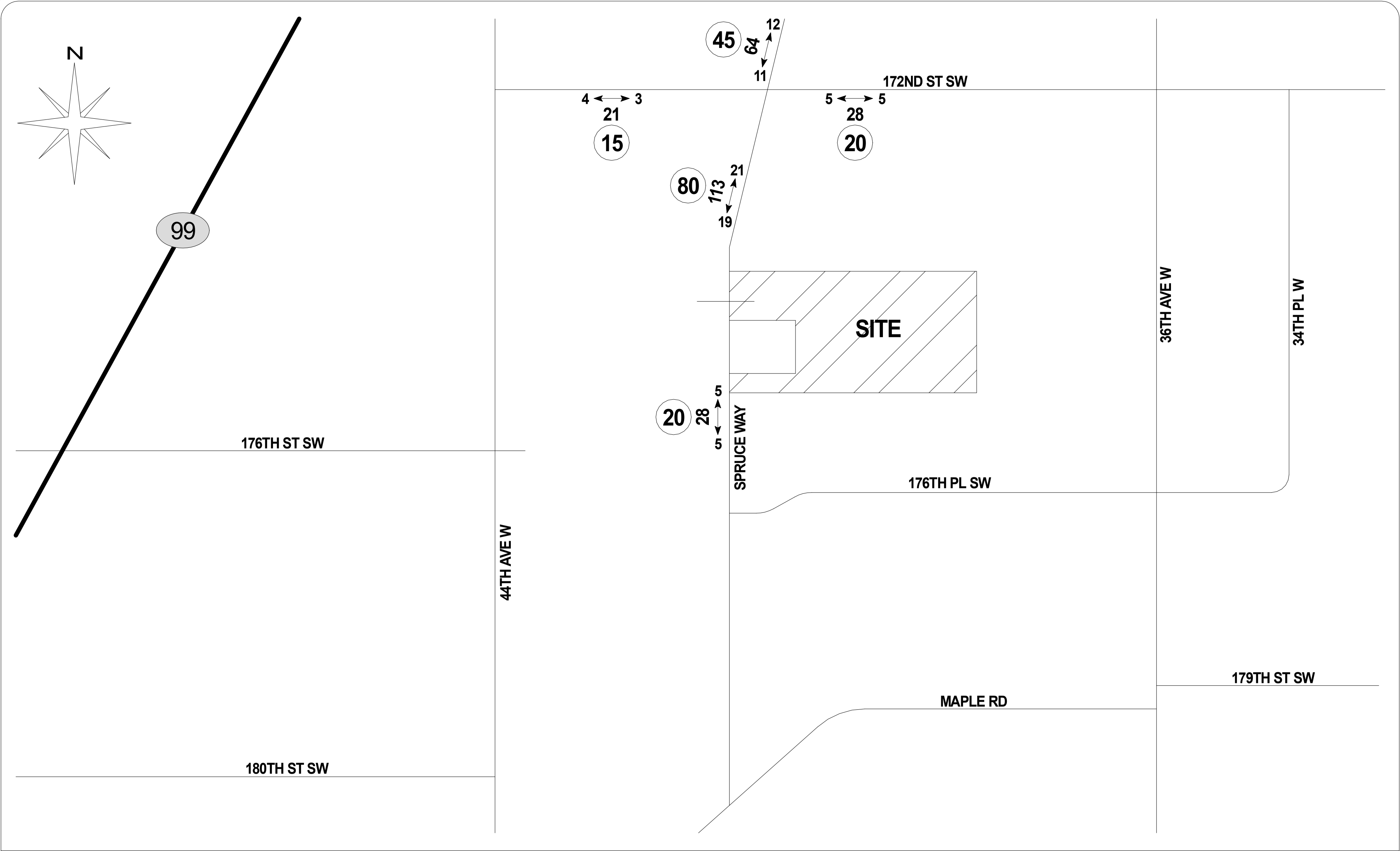
---

[4] Based on ITE rates

[5] Uses a ratio of ITE and on site trip generation rates.

5.2 Trip Distribution

Trip distribution is based on the existing traffic counts in the site vicinity and potential school draw areas. It is estimated that 20% of the site traffic will travel to and from the south along Spruce Way. An estimated 15% will travel to and from the west on 172nd Street SW. An estimated 20% will travel to and from the east on 172nd Street SW. The remaining 45% is expected to travel to and from the north on Spruce Way. Detailed trip distributions are shown in Figure 4 and Figure 5 for the AM peak-hour and School PM peak-hour respectively.



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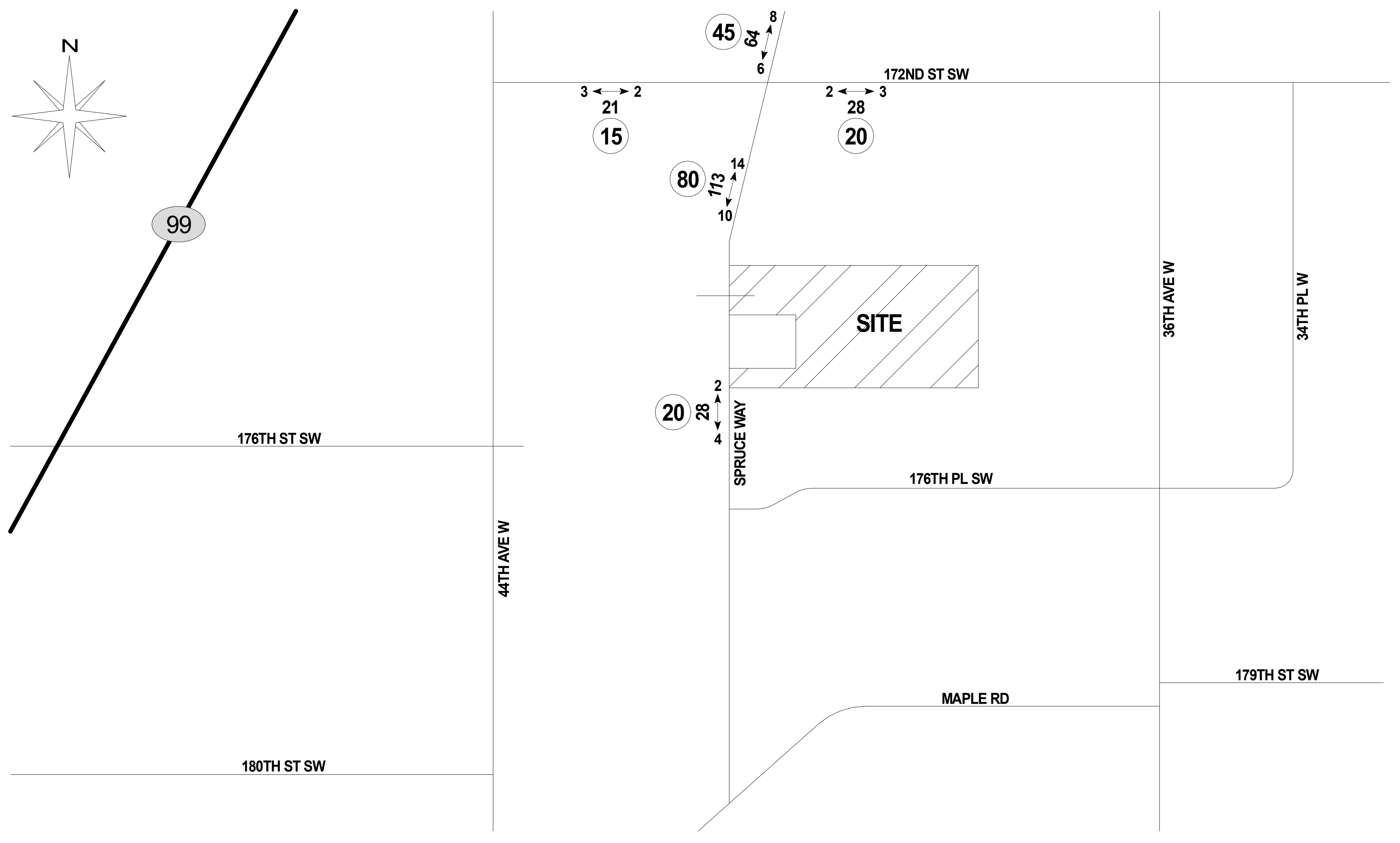
AM ← AWDT → PEAK — NEW SITE TRAFFIC (DAILY/PEAK HOUR)

(XX) — TRIP DISTRIBUTION %

FIGURE 4

DEVELOPMENT
TRIP DISTRIBUTION
AM PEAK-HOUR



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PM ← AWDT → PEAK NEW SITE TRAFFIC (DAILY/PEAK HOUR)

XX TRIP DISTRIBUTION %

FIGURE 5
DEVELOPMENT TRIP DISTRIBUTION SCHOOL PM PEAK-HOUR

5.3 2021 Baseline Volumes and Level of Service

The 2021 baseline (future without project) turning movement volumes are estimated by applying a 2.0% annual compounding growth rate to the existing turning movement volumes. The 2021 baseline turning movement volumes for the AM peak-hour and School PM peak-hour are shown in Figure 6 and Figure 7.

With the addition of baseline growth, all the study intersections will continue to operate at LOS B or better during the AM and School PM peak-hours. The 2021 baseline level of service results for the AM peak-hour and School PM peak-hour are summarized in Table 7 and Table 8. The baseline level of service calculations are included in the attachments.

Table 7: 2021 Baseline Level of Service Summary – AM Peak-Hour

Intersection	Existing Conditions			2021 Baseline Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	B	10.2 sec	---	B	11.0 sec	---
2. Spruce Way at North Driveway	B	11.8 sec	Westbound	B	12.7 sec	Westbound
3. Spruce Way at South Driveway	B	10.5 sec	Westbound	B	10.6 sec	Westbound

Table 8: 2021 Baseline Level of Service Summary – School PM Peak-Hour

Intersection	Existing Conditions			2021 Baseline Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	A	9.4 sec	---	A	9.9 sec	---
2. Spruce Way at North Driveway	B	10.7 sec	Westbound	B	11.0 sec	Westbound
3. Spruce Way at South Driveway	A	9.8 sec	Westbound	B	10.0 sec	Westbound

5.4 2021 Future with Project Volumes and Level of Service

The 2021 future with project turning movement volumes are calculated by adding all the school traffic based on the trip distribution to the 2021 baseline turning movement volumes. It was assumed that the number of buses did not change with the reconstruction based on the low increase in student population. Additionally, all the traffic was rerouted so that all the bus traffic was utilizing the north driveway while all the parent traffic was utilizing the south driveway. The peak-hour factor and heavy vehicle percentage was also switched in conjunction with the driveway uses. The 2021 future with project turning movement volumes for the AM peak-hour and School PM peak-hour in Figure 8 and Figure 9.

With the addition of school traffic, all the study intersections will continue to operate at LOS C or better during the AM peak-hour and LOS B or better during the School PM peak-hour. All the off-site study intersections will operate at acceptable City of Lynnwood Intersection Standards used for SEPA impact evaluation. The 2021 future with project level of service results for the AM peak-hour and School PM peak-hour are summarized in Table 9 and Table 10. The 2021 future with project level of service calculations are included in the attachments.

Table 9: 2021 Future Level of Service Summary – AM Peak-Hour

Intersection	2021 Baseline Conditions			2021 Future Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	B	11.0 sec	---	B	11.5 sec	---
2. Spruce Way at North Driveway	B	12.7 sec	Westbound	C	17.9 sec	Westbound
3. Spruce Way at South Driveway	B	10.6 sec	Westbound	B	12.7 sec	Westbound

Table 10: 2021 Future Level of Service Summary – School PM Peak-Hour

Intersection	2021 Baseline Conditions			2021 Future Conditions		
	LOS	Delay	Critical Approach	LOS	Delay	Critical Approach
1. Spruce Way at 172nd Street SW	A	9.9 sec	---	B	10.1 sec	---
2. Spruce Way at North Driveway	B	11.0 sec	Westbound	B	10.6 sec	Westbound
3. Spruce Way at South Driveway	B	10.0 sec	Westbound	B	11.3 sec	Westbound

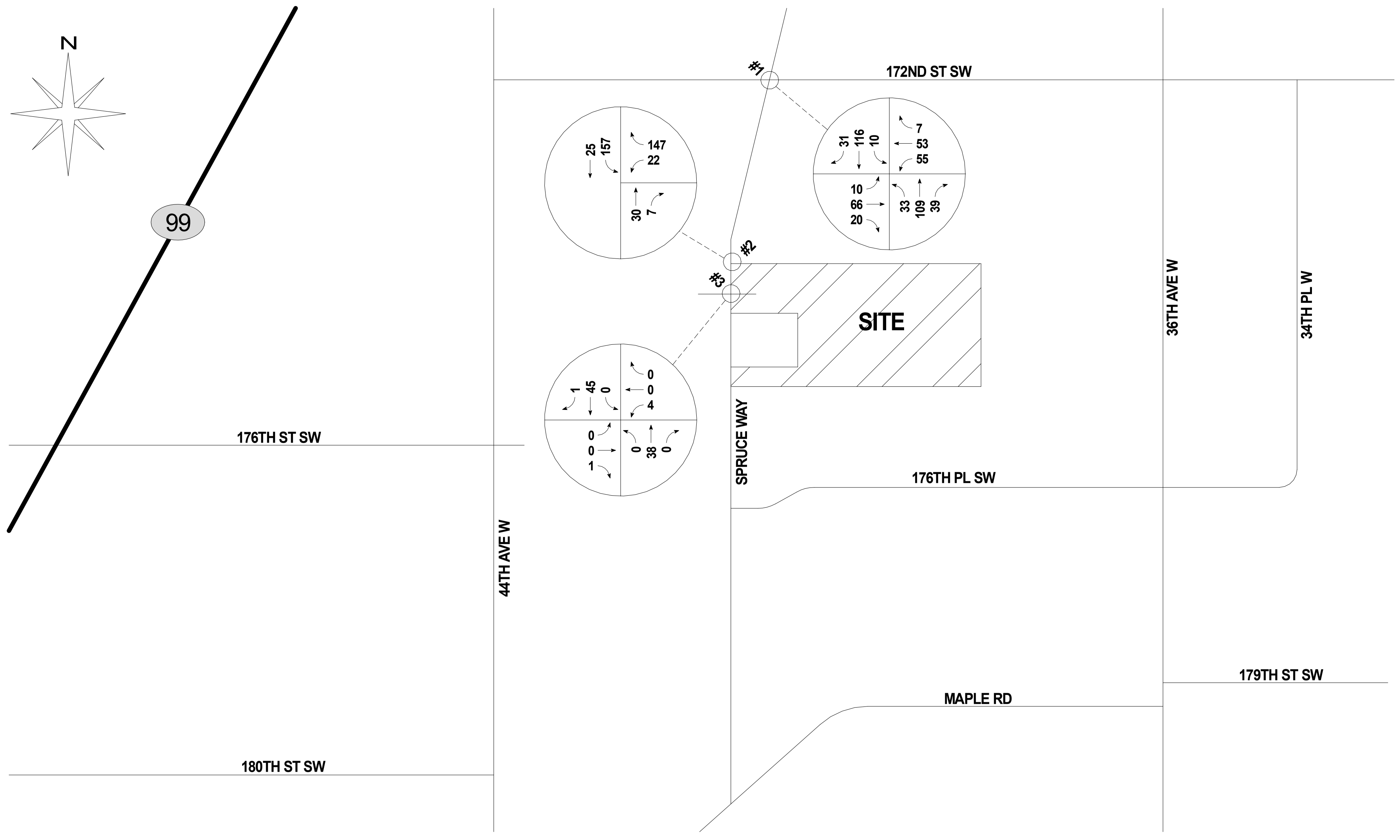
5.5 2021 Opening Year Queuing

Table 11 below shows a comparison of vehicle queue lengths depending on the number of vehicles picking-up/dropping-off at one time. In the April 2017 TIA the proposed loop was 830 feet long with room for approximately 38 vehicles. The proposed loop will provide about 900 feet of service and queueing space before impacting Spruce Way. This provides space for about 45 vehicles (between 20-22 feet per vehicle) which would satisfy the requirement if only 4 vehicles could be serviced simultaneously. With increased drop-off/pick-up efficiency due to increased service area and additional parking on-site the proposed parent loop would provide adequate queuing space to limit impacts to the City street system.

Table 11: Expected Drop-off/pick-up Queuing

Vehicles Served Simultaneously	50% Queue [vehicles]	95% Queue [vehicles]	Queuing Required [feet]	Total Loop Length Required
4	**1**	**8**	**176**	**330**
5	**0**	**4**	**88**	**286**
6	**0**	**3**	**66**	**308**

This projected queuing is based on 172 vehicles (anticipated future parent traffic to the site) arriving in a 15-minute period and having a service rate of 15 seconds to drop-off a student. The 15 seconds is the measured time for a vehicle to stop, drop-off the student, start moving again based on video observations. The queue identified as the additional queue beyond the area required for the vehicles being served simultaneously. It was assumed that the length required to service X vehicles was 22 feet multiplied by (2*X-1). It was assumed that there will be enough width for vehicles to by-pass those dropping off. The width would allow for double stacking if queuing becomes a problem.



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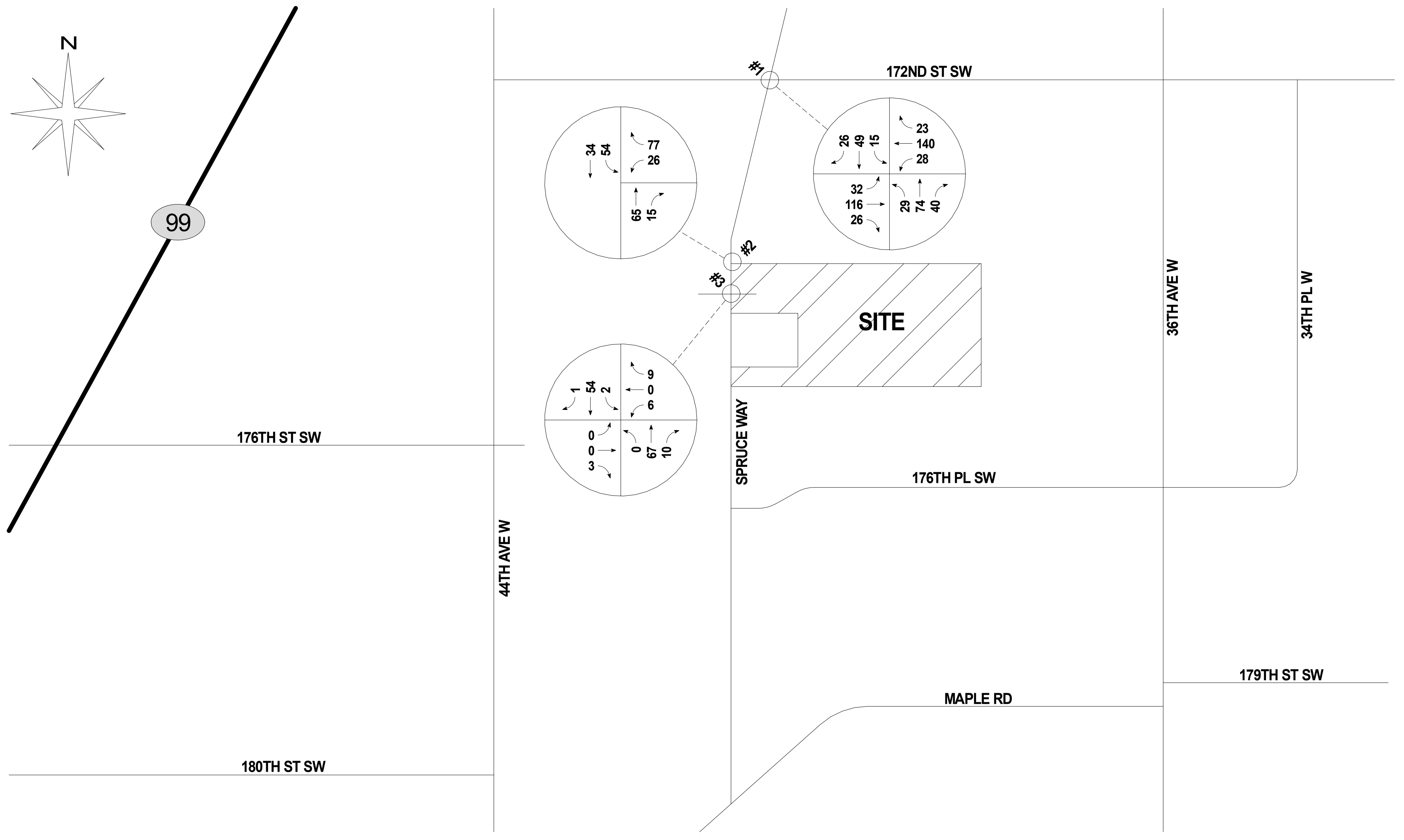
XXX → AM PEAK-HOUR TURNING MOVEMENTS

FIGURE 6
2021 BASELINE
TRAFFIC VOLUMES
AM PEAK-HOUR



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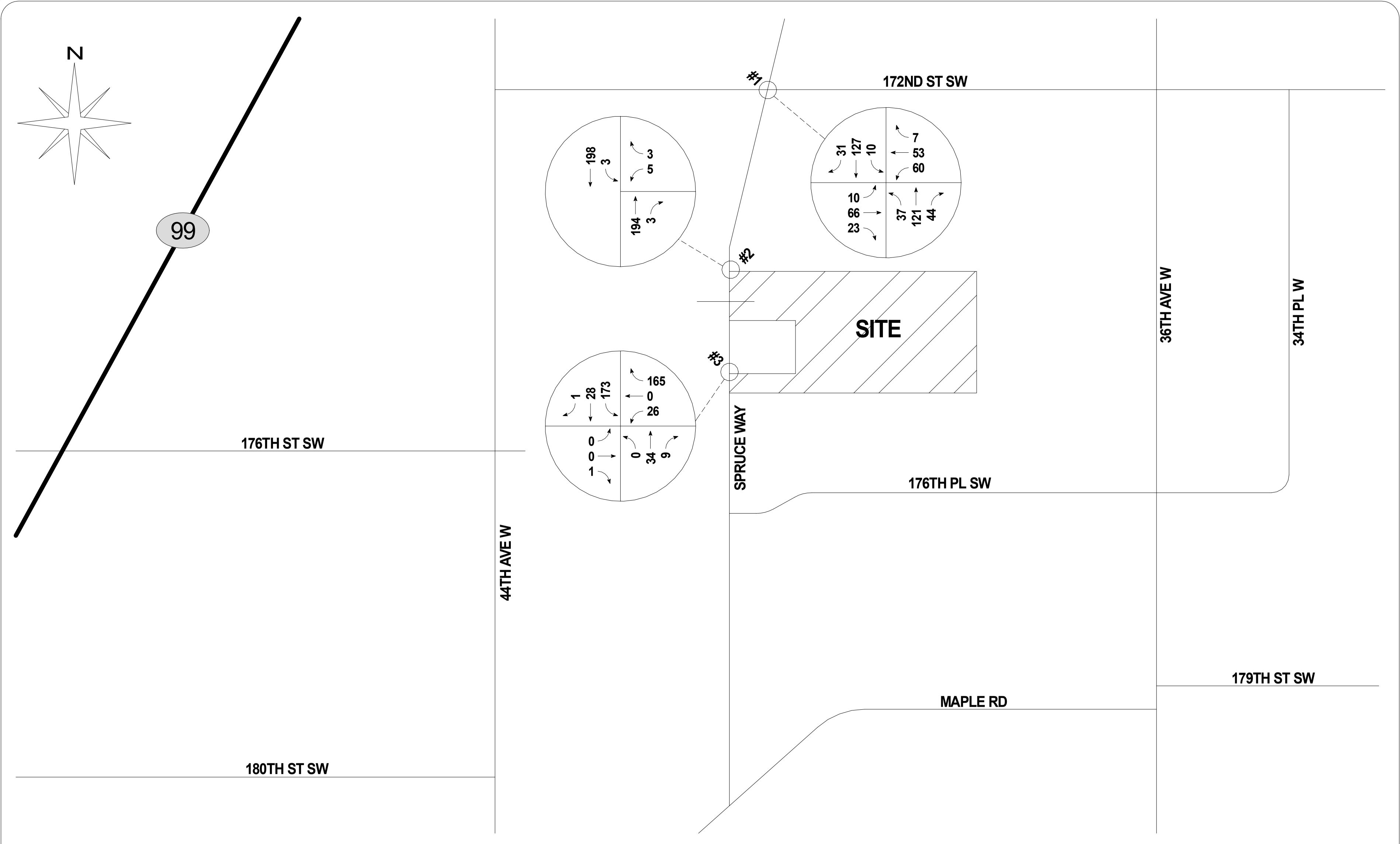
SNOHOMISH COUNTY

LEGEND

XXX → SCHOOL PM PEAK-HOUR TURNING MOVEMENTS

FIGURE 7
2021 BASELINE TRAFFIC VOLUMES SCHOOL PM PEAK-HOUR



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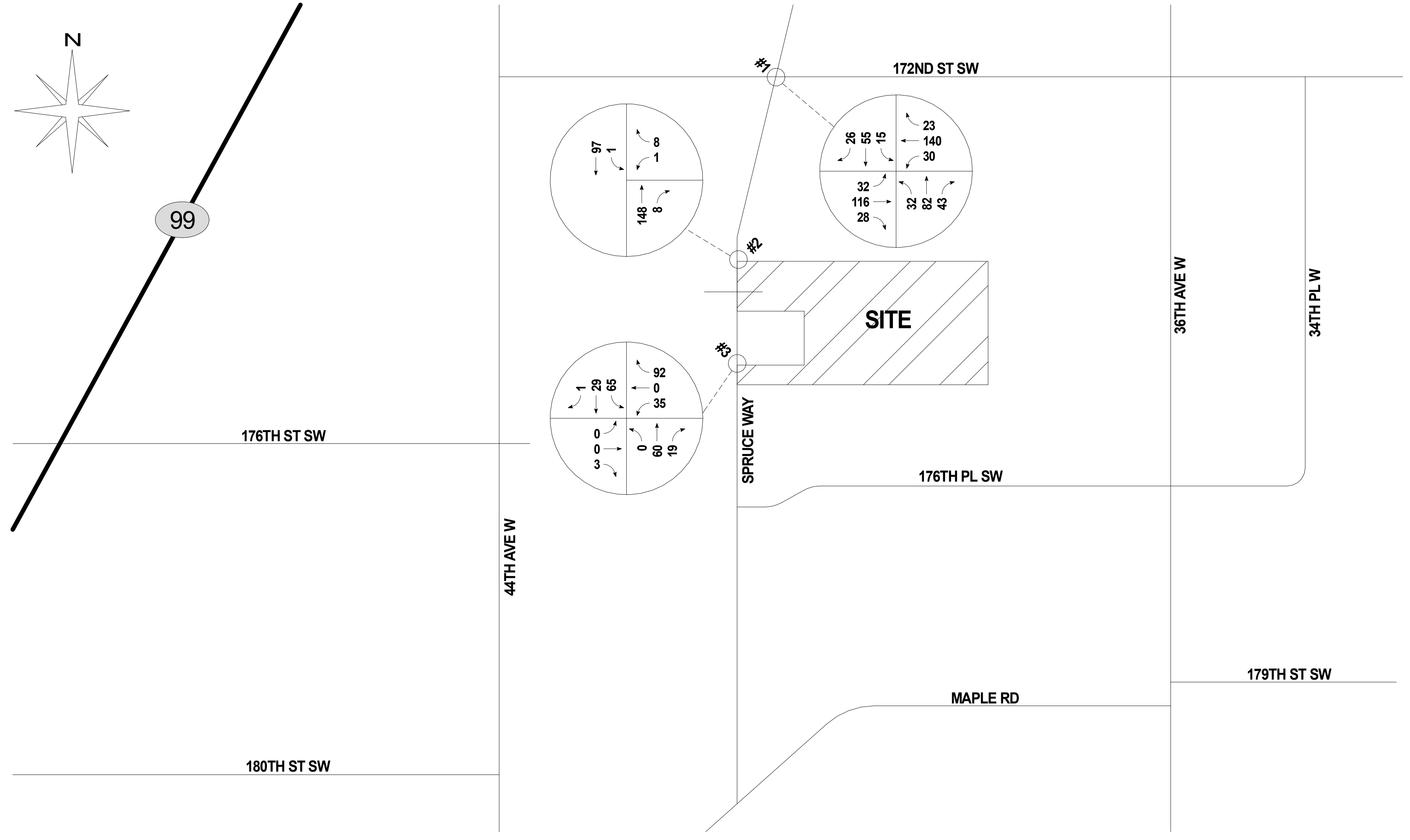
XXX → AM PEAK-HOUR TURNING MOVEMENTS

FIGURE 8
2021 FUTURE WITH PROJECT
TRAFFIC VOLUMES
AM PEAK-HOUR



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LEGEND

XXX → SCHOOL PM PEAK-HOUR TURNING MOVEMENTS

FIGURE 9
2021 FUTURE WITH PROJECT
TRAFFIC VOLUMES
SCHOOL PM PEAK-HOUR

5.6 2021 Opening Year Parking Demand

For the future parking assessment, GTC assumed that the student enrollment would increase from 558 existing students (latest student data on OSPI) to 650 students projected by the Edmonds School District. The City of Lynnwood requires one parking space per six students and sufficient off-street space for safe loading and unloading of buses. This would result in a parking demand of 108 parking spaces. A parking study performed by GTC in November of 2016 shows that Spruce Elementary School has a parking demand of 0.083 vehicles per student. Assuming 85% represents a parking lot reaching capacity, the school would have a total parking demand of 63 parking spaces. Spruce Elementary School is proposing to have a total of 96 parking spaces, this represents a 12% reduction in parking from the City Code requirement of 108 parking spaces, an administrative reduction of up to 20% would be allowed per City Code 21.18.820.

The parent and bus loops would have sufficient off-street space to load and unload students on-site. The 96 spaces plus parking provided in the loops on campus along with the additional on-street parking spaces in the surrounding neighborhoods would provide additional event parking.

6. CONCLUSIONS

Spruce Elementary School will continue to serve grades kindergarten through 6th grade with a capacity of 650 students by the future analysis year, 2021. The school hours are from 9:20 AM and to 3:50 PM.

The reconstruction of Spruce Elementary School is estimated to generate a total of 140.8 new average daily trips with 50.3 trips (24.4 inbound/25.9 outbound) during the AM peak-hour and 29.8 trips (12.2 inbound/17.6 outbound) during the School PM peak-hour. During the street peak-hour between 4 and 6 PM it is anticipated that there would be an increase of 13.8 PM peak-hour trips (6.8 inbound/7.0 outbound).

In the 2021 future with the reconstruction analysis all off-site study intersections will continue to operate at LOS C or better during the AM peak-hour and LOS B or better during the School PM peak-hour, thus meeting the City of Lynnwood Intersection Standards used for SEPA impact evaluation. The main parent access for the school, the south driveway, will operate at LOS B during the AM peak-hour and School PM peak-hour with the westbound leg (school driveway) operating as the critical approach. The bus loop, utilizing the north driveway, is anticipated to operate at acceptable LOS C during the AM peak-hour and LOS B in the school PM peak-hour.

The site is expected to have sufficient parking to satisfy the long-term parking needs. Additionally, the site will have sufficient queuing space to satisfy the drop-off and pick-up queuing needs without impacting Spruce Way.

Trip Generation Calculations

Spruce Elementary School

Count Data:

	AM (8:45 AM to 9:45 AM)				PM (3:00 PM - 5:00 PM)			
Location	In	% of Total	Out	% of Total	In	% of Total	Out	% of Total
N Driveway	148	100%	153	97%	63	85%	94	88%
S Driveway	0	0%	4	3%	11	15%	13	12%
Frontage	0	0%	0	0%	0	0%	0	0%
Total	148	49%	157	51%	74	41%	107	59%

Trip Generation per student:

558 students

	School Rates			ITE Comparison			+/- to Lynnwood
	Rate	% In	% Out	Rate	% In	% Out	Trips
AM	0.55	49%	51%	0.45	68%	32%	54
School PM	0.32	41%	59%	0.28	33%	55%	25

New Trips

92 students

	Total	In	Out
AM	50.3	24.4	25.9
School PM	29.8	12.2	17.6

Total Trips

650 students

	Total	In	Out
AM	355	172	183
School PM	211	86	125

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday**
(a.k.a.): **Average Weekday Daily Trips (AWDT)**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	stdy	1.53	50%	50%	140.8	0%	0.0	140.8	0%	0.0	0%	0.0	140.8	0.0	0.0	0.0	0.0	70.4	70.4
Total						140.8		0.0	140.8		0.0		0.0	140.8	0.0	0.0	0.0	0.0	70.4	70.4

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday, Peak Hour of Adjacent Street Traffic, One Hour between 7 and 9 AM**
(a.k.a.): **Weekday AM Peak Hour**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	stdy	0.55	49%	51%	50.3	0%	0.0	50.3	0%	0.0	0%	0.0	50.3	0.0	0.0	0.0	0.0	24.4	25.9
Total						50.3		0.0	50.3		0.0		0.0	50.3	0.0	0.0	0.0	0.0	24.4	25.9

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday, School PM Peak-Hour, One Hour between 1:30 and 3:30 PM**
(a.k.a.): **Weekday School PM Peak Hour**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	stdy	0.32	41%	59%	29.8	0%	0.0	29.8	0%	0.0	0%	0.0	29.8	0.0	0.0	0.0	0.0	12.2	17.6
Total						29.8		0.0	29.8		0.0		0.0	29.8	0.0	0.0	0.0	0.0	12.2	17.6

Spruce Elementary School
GTC #16-281

Trip Generation for: **Development Peak Weekday, PM Peak-Hour of Adjacent Street Traffic, One Hour between 4 and 6 PM**
(a.k.a.): **Weekday PM Peak Hour**

									NET EXTERNAL TRIPS BY TYPE											
									IN BOTH DIRECTIONS						DIRECTIONAL ASSIGNMENTS					
			Gross Trips				Internal Crossover		TOTAL	PASS-BY		DIVERTED LINK		NEW	PASS-BY		DIVERTED LINK		NEW	
LAND USES	VARIABLE	ITE LU code	Trip Rate	% IN	% OUT	In+Out (Total)	% of Gross Trips	Trips In+Out (Total)	In+Out (Total)	% of Ext. Trips	In+Out (Total)	% of Ext. Trips	In+Out (Total)	In+Out (Total)	In	Out	In	Out	In	Out
High School	92 students	520	0.15	49%	51%	13.8	0%	0.0	13.8	0%	0.0	0%	0.0	13.8	0.0	0.0	0.0	0.0	6.8	7.0
Total						13.8		0.0	13.8		0.0		0.0	13.8	0.0	0.0	0.0	0.0	6.8	7.0

Spruce Elementary School

GTC #16-281

AM Peak-Hour

%	New	New AM Peak Hour Trips		
	ADT	In	Out	Total
100%	141	24	26	50
1%	1.41	0.24	0.26	0.50
2%	2.82	0.49	0.52	1.01
3%	4.22	0.73	0.78	1.51
4%	5.63	0.98	1.04	2.01
5%	**7.04**	**1.22**	**1.30**	**2.52**
6%	8.45	1.46	1.55	3.02
7%	9.86	1.71	1.81	3.52
8%	11.26	1.95	2.07	4.02
9%	12.67	2.20	2.33	4.53
10%	**14.08**	**2.44**	**2.59**	**5.03**
11%	15.49	2.68	2.85	5.53
12%	16.90	2.93	3.11	6.04
13%	18.30	3.17	3.37	6.54
14%	19.71	3.42	3.63	7.04
15%	**21.12**	**3.66**	**3.89**	**7.55**
16%	22.53	3.90	4.14	8.05
17%	23.94	4.15	4.40	8.55
18%	25.34	4.39	4.66	9.05
19%	26.75	4.64	4.92	9.56
20%	**28.16**	**4.88**	**5.18**	**10.06**
21%	29.57	5.12	5.44	10.56
22%	30.98	5.37	5.70	11.07
23%	32.38	5.61	5.96	11.57
24%	33.79	5.86	6.22	12.07
25%	**35.20**	**6.10**	**6.48**	**12.58**
26%	36.61	6.34	6.73	13.08
27%	38.02	6.59	6.99	13.58
28%	39.42	6.83	7.25	14.08
29%	40.83	7.08	7.51	14.59
30%	**42.24**	**7.32**	**7.77**	**15.09**
31%	43.65	7.56	8.03	15.59
32%	45.06	7.81	8.29	16.10
33%	46.46	8.05	8.55	16.60
34%	47.87	8.30	8.81	17.10
35%	**49.28**	**8.54**	**9.07**	**17.61**
36%	50.69	8.78	9.32	18.11
37%	52.10	9.03	9.58	18.61
38%	53.50	9.27	9.84	19.11
39%	54.91	9.52	10.10	19.62
40%	**56.32**	**9.76**	**10.36**	**20.12**
41%	57.73	10.00	10.62	20.62
42%	59.14	10.25	10.88	21.13
43%	60.54	10.49	11.14	21.63
44%	61.95	10.74	11.40	22.13
45%	**63.36**	**10.98**	**11.66**	**22.64**
46%	64.77	11.22	11.91	23.14
47%	66.18	11.47	12.17	23.64
48%	67.58	11.71	12.43	24.14
49%	68.99	11.96	12.69	24.65
50%	**70.40**	**12.20**	**12.95**	**25.15**

%	New	New AM Peak Hour Trips		
	ADT	In	Out	Total
100%	141	24	26	50
51%	71.81	12.44	13.21	25.65
52%	73.22	12.69	13.47	26.16
53%	74.62	12.93	13.73	26.66
54%	76.03	13.18	13.99	27.16
55%	**77.44**	**13.42**	**14.25**	**27.67**
56%	78.85	13.66	14.50	28.17
57%	80.26	13.91	14.76	28.67
58%	81.66	14.15	15.02	29.17
59%	83.07	14.40	15.28	29.68
60%	**84.48**	**14.64**	**15.54**	**30.18**
61%	85.89	14.88	15.80	30.68
62%	87.30	15.13	16.06	31.19
63%	88.70	15.37	16.32	31.69
64%	90.11	15.62	16.58	32.19
65%	**91.52**	**15.86**	**16.84**	**32.70**
66%	92.93	16.10	17.09	33.20
67%	94.34	16.35	17.35	33.70
68%	95.74	16.59	17.61	34.20
69%	97.15	16.84	17.87	34.71
70%	**98.56**	**17.08**	**18.13**	**35.21**
71%	99.97	17.32	18.39	35.71
72%	101.38	17.57	18.65	36.22
73%	102.78	17.81	18.91	36.72
74%	104.19	18.06	19.17	37.22
75%	**105.60**	**18.30**	**19.43**	**37.73**
76%	107.01	18.54	19.68	38.23
77%	108.42	18.79	19.94	38.73
78%	109.82	19.03	20.20	39.23
79%	111.23	19.28	20.46	39.74
80%	**112.64**	**19.52**	**20.72**	**40.24**
81%	114.05	19.76	20.98	40.74
82%	115.46	20.01	21.24	41.25
83%	116.86	20.25	21.50	41.75
84%	118.27	20.50	21.76	42.25
85%	**119.68**	**20.74**	**22.02**	**42.76**
86%	121.09	20.98	22.27	43.26
87%	122.50	21.23	22.53	43.76
88%	123.90	21.47	22.79	44.26
89%	125.31	21.72	23.05	44.77
90%	**126.72**	**21.96**	**23.31**	**45.27**
91%	128.13	22.20	23.57	45.77
92%	129.54	22.45	23.83	46.28
93%	130.94	22.69	24.09	46.78
94%	132.35	22.94	24.35	47.28
95%	**133.76**	**23.18**	**24.61**	**47.79**
96%	135.17	23.42	24.86	48.29
97%	136.58	23.67	25.12	48.79
98%	137.98	23.91	25.38	49.29
99%	139.39	24.16	25.64	49.80
100%	**140.80**	**24.40**	**25.90**	**50.30**

Spruce Elementary School

GTC #16-281

School PM Peak-Hour

%	New	New PM Peak Hour Trips		
	ADT	In	Out	Total
100%	141	12	18	30
1%	1.41	0.12	0.18	0.30
2%	2.82	0.24	0.35	0.60
3%	4.22	0.37	0.53	0.89
4%	5.63	0.49	0.70	1.19
5%	**7.04**	**0.61**	**0.88**	**1.49**
6%	8.45	0.73	1.06	1.79
7%	9.86	0.85	1.23	2.09
8%	11.26	0.98	1.41	2.38
9%	12.67	1.10	1.58	2.68
10%	**14.08**	**1.22**	**1.76**	**2.98**
11%	15.49	1.34	1.94	3.28
12%	16.90	1.46	2.11	3.58
13%	18.30	1.59	2.29	3.87
14%	19.71	1.71	2.46	4.17
15%	**21.12**	**1.83**	**2.64**	**4.47**
16%	22.53	1.95	2.82	4.77
17%	23.94	2.07	2.99	5.07
18%	25.34	2.20	3.17	5.36
19%	26.75	2.32	3.34	5.66
20%	**28.16**	**2.44**	**3.52**	**5.96**
21%	29.57	2.56	3.70	6.26
22%	30.98	2.68	3.87	6.56
23%	32.38	2.81	4.05	6.85
24%	33.79	2.93	4.22	7.15
25%	**35.20**	**3.05**	**4.40**	**7.45**
26%	36.61	3.17	4.58	7.75
27%	38.02	3.29	4.75	8.05
28%	39.42	3.42	4.93	8.34
29%	40.83	3.54	5.10	8.64
30%	**42.24**	**3.66**	**5.28**	**8.94**
31%	43.65	3.78	5.46	9.24
32%	45.06	3.90	5.63	9.54
33%	46.46	4.03	5.81	9.83
34%	47.87	4.15	5.98	10.13
35%	**49.28**	**4.27**	**6.16**	**10.43**
36%	50.69	4.39	6.34	10.73
37%	52.10	4.51	6.51	11.03
38%	53.50	4.64	6.69	11.32
39%	54.91	4.76	6.86	11.62
40%	**56.32**	**4.88**	**7.04**	**11.92**
41%	57.73	5.00	7.22	12.22
42%	59.14	5.12	7.39	12.52
43%	60.54	5.25	7.57	12.81
44%	61.95	5.37	7.74	13.11
45%	**63.36**	**5.49**	**7.92**	**13.41**
46%	64.77	5.61	8.10	13.71
47%	66.18	5.73	8.27	14.01
48%	67.58	5.86	8.45	14.30
49%	68.99	5.98	8.62	14.60
50%	**70.40**	**6.10**	**8.80**	**14.90**

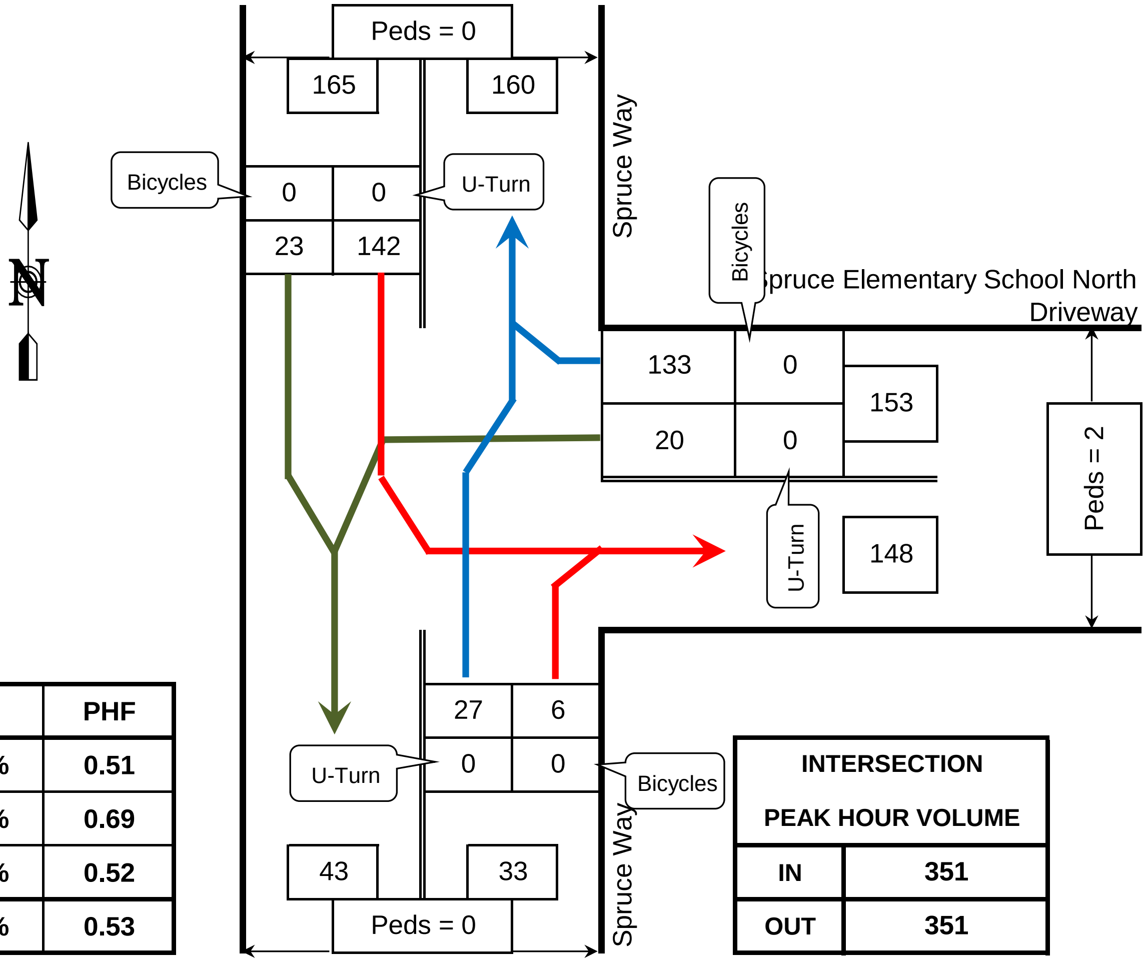
%	New	New PM Peak Hour Trips		
	ADT	In	Out	Total
100%	141	12	18	30
51%	71.81	6.22	8.98	15.20
52%	73.22	6.34	9.15	15.50
53%	74.62	6.47	9.33	15.79
54%	76.03	6.59	9.50	16.09
55%	**77.44**	**6.71**	**9.68**	**16.39**
56%	78.85	6.83	9.86	16.69
57%	80.26	6.95	10.03	16.99
58%	81.66	7.08	10.21	17.28
59%	83.07	7.20	10.38	17.58
60%	**84.48**	**7.32**	**10.56**	**17.88**
61%	85.89	7.44	10.74	18.18
62%	87.30	7.56	10.91	18.48
63%	88.70	7.69	11.09	18.77
64%	90.11	7.81	11.26	19.07
65%	**91.52**	**7.93**	**11.44**	**19.37**
66%	92.93	8.05	11.62	19.67
67%	94.34	8.17	11.79	19.97
68%	95.74	8.30	11.97	20.26
69%	97.15	8.42	12.14	20.56
70%	**98.56**	**8.54**	**12.32**	**20.86**
71%	99.97	8.66	12.50	21.16
72%	101.38	8.78	12.67	21.46
73%	102.78	8.91	12.85	21.75
74%	104.19	9.03	13.02	22.05
75%	**105.60**	**9.15**	**13.20**	**22.35**
76%	107.01	9.27	13.38	22.65
77%	108.42	9.39	13.55	22.95
78%	109.82	9.52	13.73	23.24
79%	111.23	9.64	13.90	23.54
80%	**112.64**	**9.76**	**14.08**	**23.84**
81%	114.05	9.88	14.26	24.14
82%	115.46	10.00	14.43	24.44
83%	116.86	10.13	14.61	24.73
84%	118.27	10.25	14.78	25.03
85%	**119.68**	**10.37**	**14.96**	**25.33**
86%	121.09	10.49	15.14	25.63
87%	122.50	10.61	15.31	25.93
88%	123.90	10.74	15.49	26.22
89%	125.31	10.86	15.66	26.52
90%	**126.72**	**10.98**	**15.84**	**26.82**
91%	128.13	11.10	16.02	27.12
92%	129.54	11.22	16.19	27.42
93%	130.94	11.35	16.37	27.71
94%	132.35	11.47	16.54	28.01
95%	**133.76**	**11.59**	**16.72**	**28.31**
96%	135.17	11.71	16.90	28.61
97%	136.58	11.83	17.07	28.91
98%	137.98	11.96	17.25	29.20
99%	139.39	12.08	17.42	29.50
100%	**140.80**	**12.20**	**17.60**	**29.80**

Count Data

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM



	HV	PHF
SB	1.8%	0.51
NB	0.0%	0.69
WB	0.7%	0.52
INTRS.	1.1%	0.53

INTERSECTION PEAK HOUR VOLUME	
IN	351
OUT	351

HV = Heavy Vehicles
PHF = Peak Hour Factor

Spruce Elementary School North Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY: VT
REDUCED BY: CN
REDUCTION DATE: Fri. 11/18/16

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM
WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School North Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING AT	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 AM	0	0	0	0	45	8	0	0	0	0	0	0	10	1	0	0	0	0	6	0	33	0	0	0	0	0	0	0	103
09:15 AM	0	0	0	0	77	4	0	0	0	0	0	0	8	4	2	0	0	0	9	0	64	0	0	0	0	0	0	0	166
09:30 AM	0	0	3	0	18	5	0	0	0	0	0	0	4	0	0	0	0	0	4	0	31	0	0	0	0	0	0	0	62
09:45 AM	0	0	0	0	2	6	0	0	0	0	0	0	5	1	0	0	1	0	1	0	5	0	0	0	0	0	0	0	20
PEAK HOUR TOTALS	0	0	3	0	142	23	0	0	0	0	0	0	27	6	2	0	1	0	20	0	133	0	0	0	0	0	0	0	INTERSECTION
ALL MOVEMENTS				165							33							153							0				351
% HV			1.8%							0.0%							0.7%							#N/A					1.1%
PEAK HOUR FACTOR				0.51							0.69							0.52							#N/A				0.53

HV = Heavy Vehicle
PHF = Peak Hour Factor

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM

REDUCED BY: CN

DATE OF REDUCTION: 11/18/2016

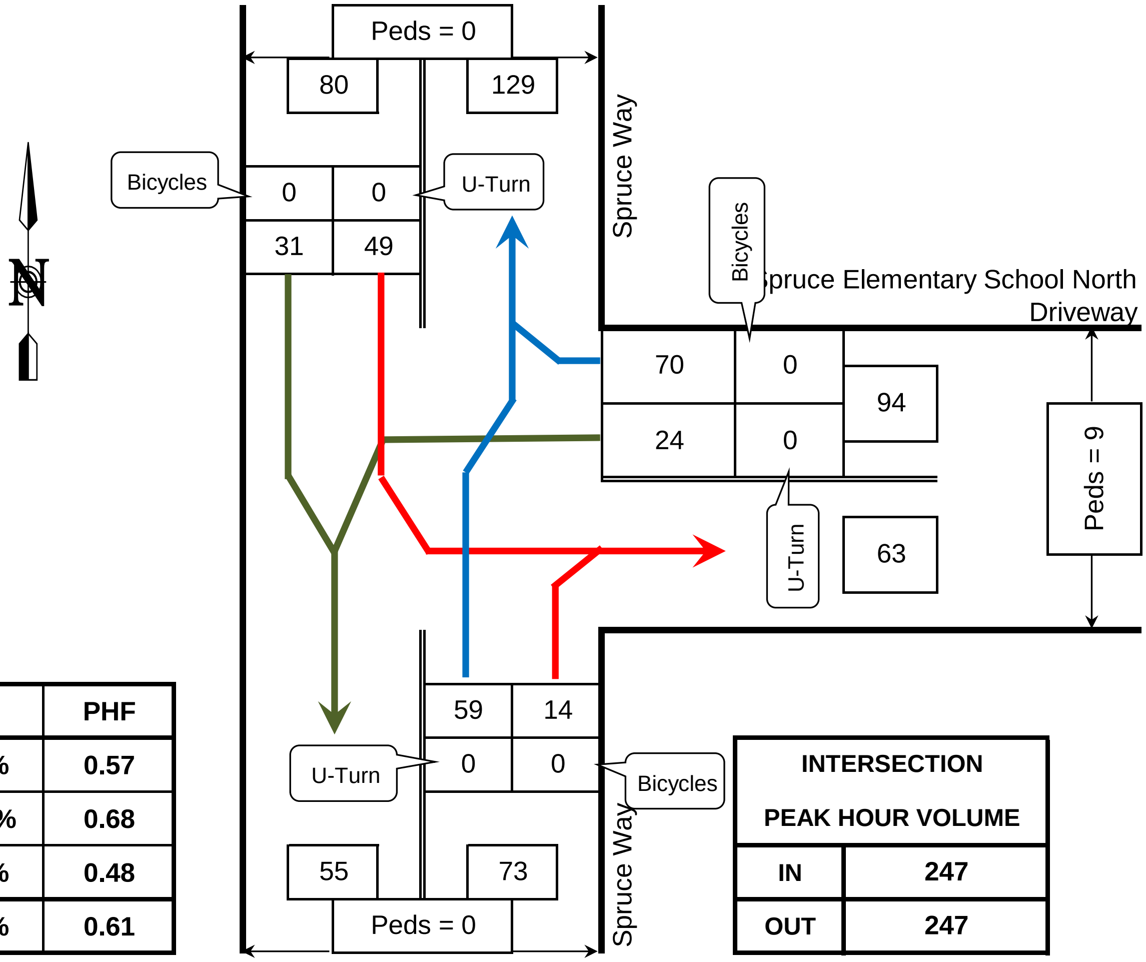
ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM - 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM - 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM - 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM - 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM - 9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM - 9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM - 9:45 AM	0	0	3	0	142	23	0	0	0	0	0	0	27	6	2	0	1	0	20	0	133	0	0	0	0	0	0	0	351

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM



	HV	PHF
SB	**3.8%**	**0.57**
NB	**13.7%**	**0.68**
WB	**1.1%**	**0.48**
INTRS.	**5.7%**	**0.61**

INTERSECTION PEAK HOUR VOLUME	
IN	**247**
OUT	**247**

HV = Heavy Vehicles
PHF = Peak Hour Factor

Spruce Elementary School North Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY: VT
DATE OF COUNT: Wed. 11/16/16
REDUCED BY: CN
TIME OF COUNT: 3:00 PM - 5:00 PM
REDUCTION DATE: Fri. 11/18/16
WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School North Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 3:00 PM - 5:00 PM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING AT	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:15 PM	0	0	0	0	6	6	0	0	0	0	0	0	8	0	2	0	1	0	2	0	4	0	0	0	0	0	0	0	**26**
03:30 PM	0	0	2	0	6	7	0	0	0	0	0	0	3	1	2	0	0	0	1	0	3	0	0	0	0	0	0	0	**21**
03:45 PM	0	0	1	0	7	12	0	0	0	0	0	0	12	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	**34**
04:00 PM	0	0	2	0	27	8	0	0	0	4	0	0	11	6	5	0	0	0	6	0	43	0	0	0	0	0	0	0	**101**
04:15 PM	0	0	0	0	13	7	0	0	0	5	0	0	22	5	2	0	1	0	8	0	22	0	0	0	0	0	0	0	**77**
04:30 PM	0	0	0	0	2	4	0	0	0	1	0	0	14	1	1	0	0	0	9	0	5	0	0	0	0	0	0	0	**35**
04:45 PM	0	1	0	0	4	10	0	0	0	1	0	0	15	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	**32**
05:00 PM	0	0	0	0	2	5	0	0	0	2	0	0	14	1	0	0	0	0	3	0	10	0	0	0	0	0	0	0	**35**
PEAK HOUR TOTALS	**0**	**0**	**3**	**0**	**49**	**31**	**0**	**0**	**0**	**10**	**0**	**0**	**59**	**14**	**9**	**0**	**1**	**0**	**24**	**0**	**70**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**INTERSECTION**
ALL MOVEMENTS				80							73							94							0				247
% HV			3.8%							13.7%							1.1%							#N/A					5.7%
PEAK HOUR FACTOR				0.57							0.68							0.48							#N/A				0.61

HV = Heavy Vehicle
PHF = Peak Hour Factor

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM

REDUCED BY: CN

DATE OF REDUCTION: 11/18/2016

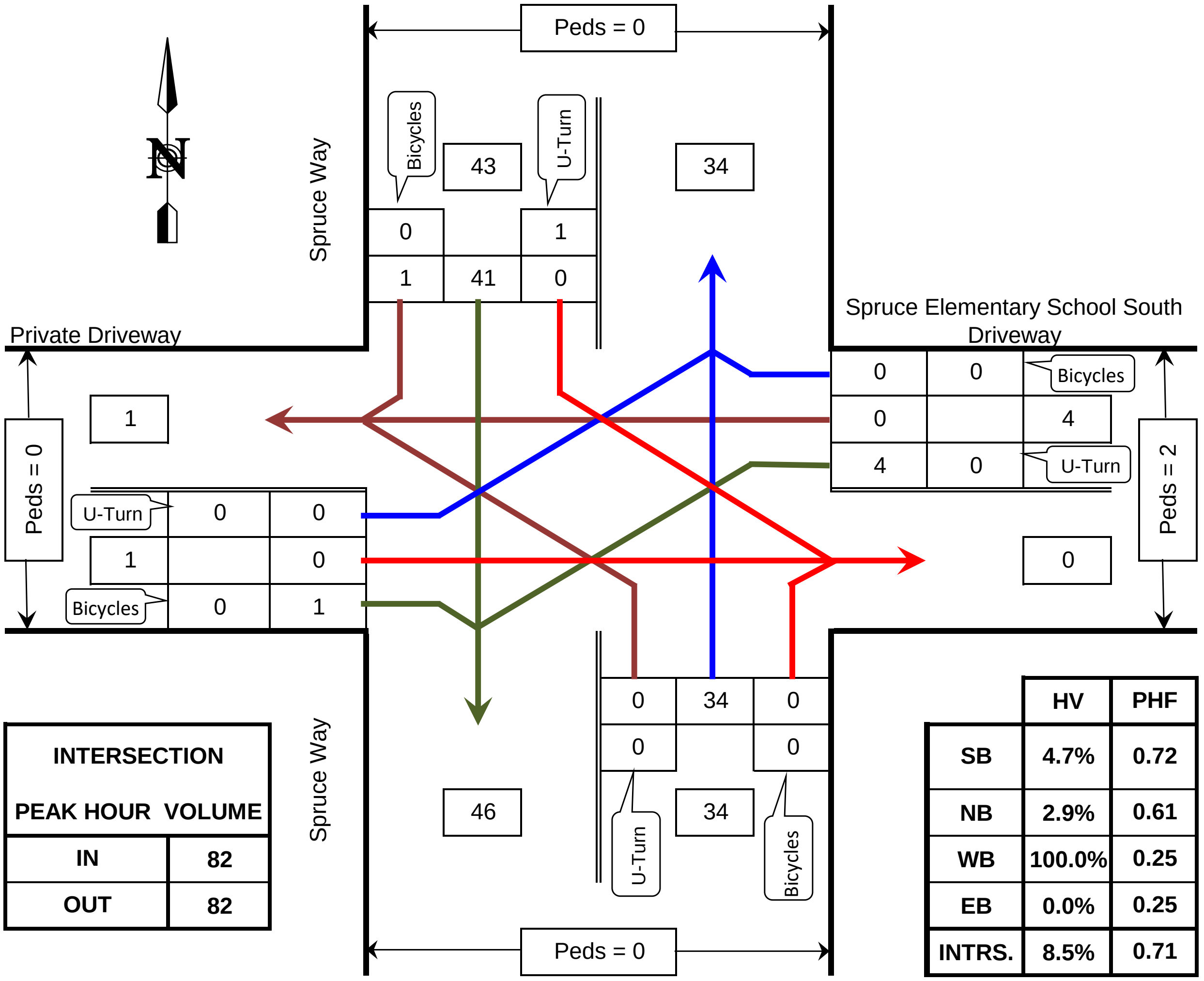
ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School North Driveway							FROM WEST ON							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
1:00 PM - 2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM - 2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM - 2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM - 2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	5	0	46	33	0	0	0	4	0	0	34	9	10	0	1	0	10	0	50	0	0	0	0	0	0	0	182
3:15 PM - 4:15 PM	0	0	5	0	53	34	0	0	0	9	0	0	48	14	10	0	1	0	16	0	68	0	0	0	0	0	0	0	233
3:30 PM - 4:30 PM	0	0	3	0	49	31	0	0	0	10	0	0	59	14	9	0	1	0	24	0	70	0	0	0	0	0	0	0	247
3:45 PM - 4:45 PM	0	1	2	0	46	29	0	0	0	11	0	0	62	13	8	0	1	0	24	0	71	0	0	0	0	0	0	0	245
4:00 PM - 5:00 PM	0	1	0	0	21	26	0	0	0	9	0	0	65	8	3	0	1	0	21	0	38	0	0	0	0	0	0	0	179

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM



INTERSECTION PEAK HOUR VOLUME	
IN	82
OUT	82

	HV	PHF
SB	4.7%	0.72
NB	2.9%	0.61
WB	100.0%	0.25
EB	0.0%	0.25
INTRS.	8.5%	0.71

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Elementary School South Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY: VT

REDUCED BY: CN

REDUCTION DATE: Wed. 11/16/16

DATE OF COUNT: Wed. 11/16/16

TIME OF COUNT: 8:45 AM - 9:45 AM

WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School South Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00 AM	0	0	0	0	0	15	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29
09:15 AM	0	0	0	0	0	12	0	0	0	0	0	0	10	0	2	0	4	0	4	0	0	0	0	0	0	0	0	0	26
09:30 AM	0	0	1	1	0	8	0	0	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
09:45 AM	0	0	1	0	0	6	1	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	13
PEAK HOUR TOTALS	0	0	2	1	0	41	1	0	0	1	0	0	34	0	2	0	4	0	4	0	0	0	0	0	0	0	0	1	INTERSECTION
ALL MOVEMENTS				43							34							4							1				82
% HV			4.7%							2.9%							100.0%							0.0%					8.5%
PEAK HOUR FACTOR				0.72							0.61							0.25							0.25				0.71

HV = Heavy Vehicle
PHF = Peak Hour Factor

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM

REDUCED BY: CN

DATE OF REDUCTION: 11/16/2016

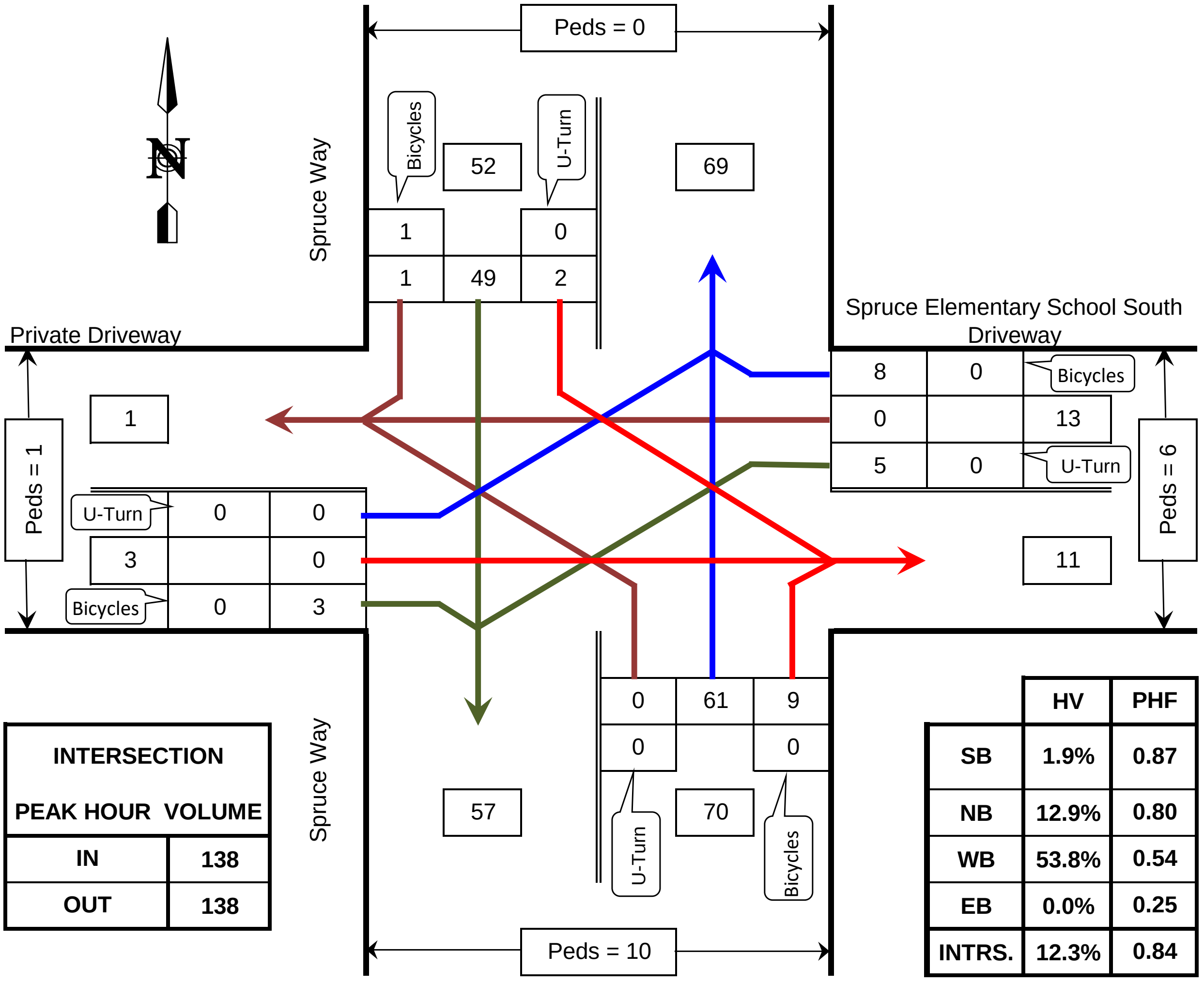
ROLLING HOUR COUNT

	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM - 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM - 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM - 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM - 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM - 9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM - 9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM - 9:45 AM	0	0	2	1	0	41	1	0	0	1	0	0	34	0	2	0	4	0	4	0	0	0	0	0	0	0	0	1	82

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

3:00 PM - 5:00 PM PEAK HOUR: 3:45 PM TO 4:45 PM



INTERSECTION PEAK HOUR VOLUME	
IN	138
OUT	138

	HV	PHF
SB	1.9%	0.87
NB	12.9%	0.80
WB	53.8%	0.54
EB	0.0%	0.25
INTRS.	12.3%	0.84

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Elementary School South Driveway @ Spruce Way

Lynnwood, WA

COUNTED BY:	VT	DATE OF COUNT:	Wed. 11/16/16
REDUCED BY:	CN	TIME OF COUNT:	3:00 PM - 5:00 PM
REDUCTION DATE:	Sat. 11/19/16	WEATHER:	Sunny

TDG TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Elementary School South Driveway @ Spruce Way
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 3:00 PM - 5:00 PM

COUNTED BY: VT
WEATHER: Sunny

TIME INTERVAL ENDING AT	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:15 PM	0	0	1	0	0	8	0	0	0	0	0	0	8	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	**17**
03:30 PM	0	0	1	0	0	6	0	0	0	0	0	0	3	0	2	0	0	0	2	0	1	1	0	0	0	0	0	1	**13**
03:45 PM	0	0	1	0	3	9	0	1	0	0	0	0	16	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	**28**
04:00 PM	0	0	1	0	1	11	0	4	0	4	0	0	14	6	3	0	4	0	3	0	3	0	0	0	0	0	0	0	**38**
04:15 PM	0	0	0	0	1	14	0	6	0	2	0	0	21	1	2	0	3	0	0	0	4	0	0	0	0	0	0	0	**41**
04:30 PM	0	0	0	0	0	13	0	0	0	1	0	0	14	1	1	0	0	0	2	0	0	0	0	0	0	0	0	0	**30**
04:45 PM	0	1	0	0	0	11	1	0	0	2	0	0	12	1	0	0	0	0	0	0	1	1	0	0	0	0	0	3	**29**
05:00 PM	0	1	0	0	0	8	0	0	0	1	0	0	13	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	**23**
PEAK HOUR TOTALS	**0**	**1**	**1**	**0**	**2**	**49**	**1**	**10**	**0**	**9**	**0**	**0**	**61**	**9**	**6**	**0**	**7**	**0**	**5**	**0**	**8**	**1**	**0**	**0**	**0**	**0**	**0**	**3**	**INTERSECTION**
ALL MOVEMENTS				**52**							**70**							**13**							**3**				**138**
% HV			**1.9%**							**12.9%**							**53.8%**							**0.0%**					**12.3%**
PEAK HOUR FACTOR				**0.87**							**0.80**							**0.54**							**0.25**				**0.84**

HV = Heavy Vehicle
PHF = Peak Hour Factor

3:00 PM - 5:00 PM PEAK HOUR: 3:45 PM TO 4:45 PM

REDUCED BY: CN

DATE OF REDUCTION: 11/19/2016

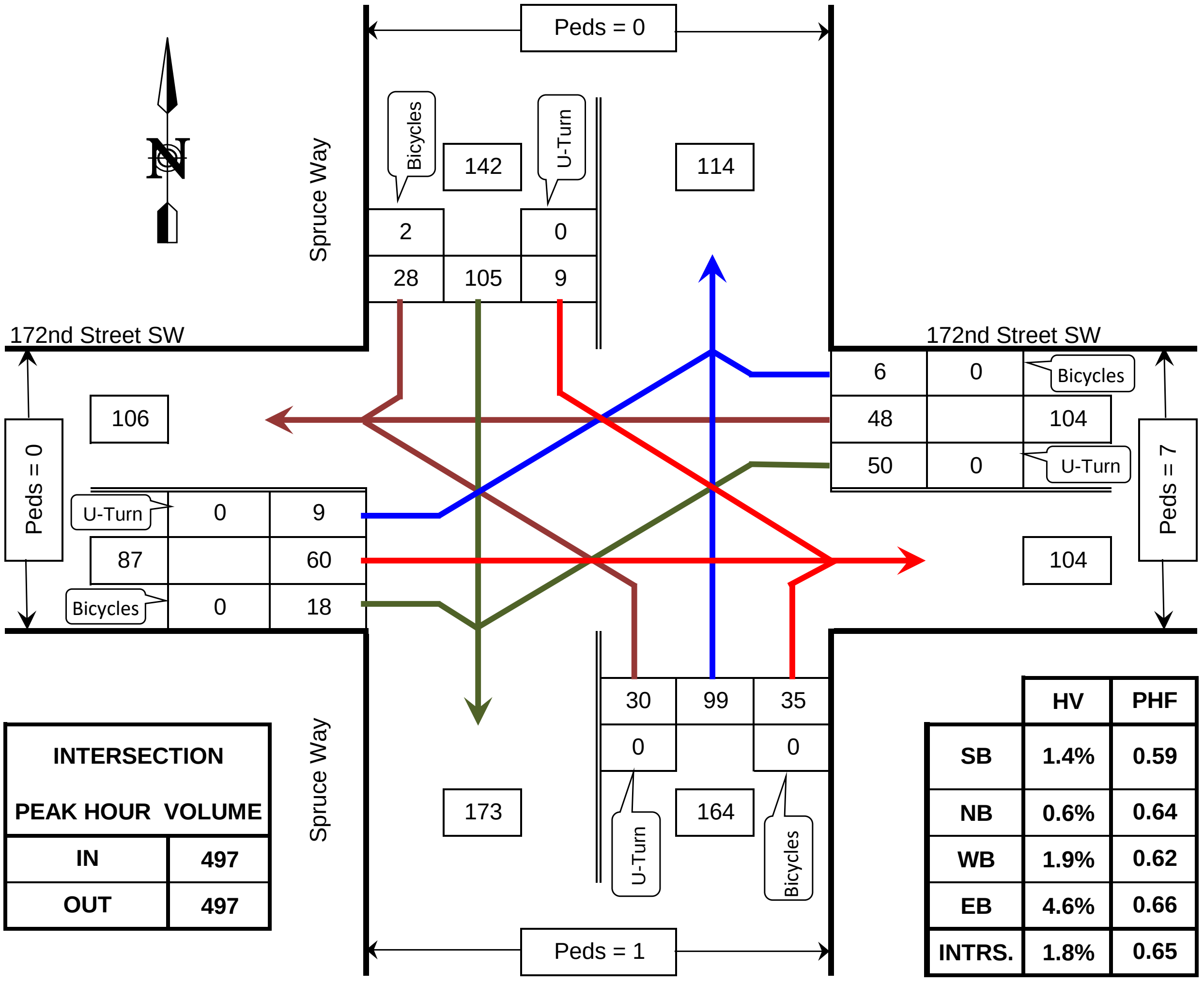
ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON Spruce Elementary School South Driveway							FROM WEST ON Private Driveway							INTERVAL TOTALS
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
1:00 PM - 2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM - 2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM - 2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM - 2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	4	0	4	34	0	5	0	4	0	0	41	7	9	0	4	0	5	0	4	2	0	0	0	0	0	1	96
3:15 PM - 4:15 PM	0	0	3	0	5	40	0	11	0	6	0	0	54	7	8	0	7	0	5	0	8	2	0	0	0	0	0	1	120
3:30 PM - 4:30 PM	0	0	2	0	5	47	0	11	0	7	0	0	65	8	7	0	7	0	5	0	7	1	0	0	0	0	0	0	137
3:45 PM - 4:45 PM	0	1	1	0	2	49	1	10	0	9	0	0	61	9	6	0	7	0	5	0	8	1	0	0	0	0	0	3	138
4:00 PM - 5:00 PM	0	2	0	0	1	46	1	6	0	6	0	0	60	3	3	0	4	0	2	0	6	1	0	0	0	1	0	3	123

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM



INTERSECTION PEAK HOUR VOLUME	
IN	497
OUT	497

	HV	PHF
SB	1.4%	0.59
NB	0.6%	0.64
WB	1.9%	0.62
EB	4.6%	0.66
INTRS.	1.8%	0.65

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Way @ 172nd Street SW

Lynnwood, WA

COUNTED BY: CN
REDUCED BY: CN
REDUCTION DATE: Wed. 11/16/16

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM
WEATHER: Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION: Spruce Way @ 172nd Street SW
Lynnwood, WA

DATE OF COUNT: Wed. 11/16/16
TIME OF COUNT: 8:45 AM - 9:45 AM

COUNTED BY: CN
WEATHER: Sunny

TIME INTERVAL ENDING	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON 172nd Street SW							FROM WEST ON 172nd Street SW							INTERVAL TOTALS
AT	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
06:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
06:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
06:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
06:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
07:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
07:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
07:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
07:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
08:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
08:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
08:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
08:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
09:00 AM	0	0	0	0	1	29	4	0	0	0	0	6	22	9	2	0	0	0	18	5	1	0	0	0	0	0	8	2	**105**
09:15 AM	0	0	1	0	2	49	9	0	0	0	0	14	36	14	5	0	0	0	28	12	2	0	0	1	0	2	14	8	**190**
09:30 AM	0	2	0	0	2	20	3	1	0	1	0	7	35	10	0	0	1	0	3	18	3	0	0	1	0	2	12	6	**121**
09:45 AM	0	0	1	0	4	7	12	0	0	0	0	3	6	2	0	0	1	0	1	13	0	0	0	2	0	5	26	2	**81**
PEAK HOUR TOTALS	**0**	**2**	**2**	**0**	**9**	**105**	**28**	**1**	**0**	**1**	**0**	**30**	**99**	**35**	**7**	**0**	**2**	**0**	**50**	**48**	**6**	**0**	**0**	**4**	**0**	**9**	**60**	**18**	**INTERSECTION**
ALL MOVEMENTS				**142**							**164**							**104**							**87**				**497**
% HV			**1.4%**							**0.6%**							**1.9%**							**4.6%**					**1.8%**
PEAK HOUR FACTOR				**0.59**							**0.64**							**0.62**							**0.66**				**0.65**

HV = Heavy Vehicle
PHF = Peak Hour Factor

8:45 AM - 9:45 AM PEAK HOUR: 8:45 AM TO 9:45 AM

REDUCED BY: CN

DATE OF REDUCTION: 11/16/2016

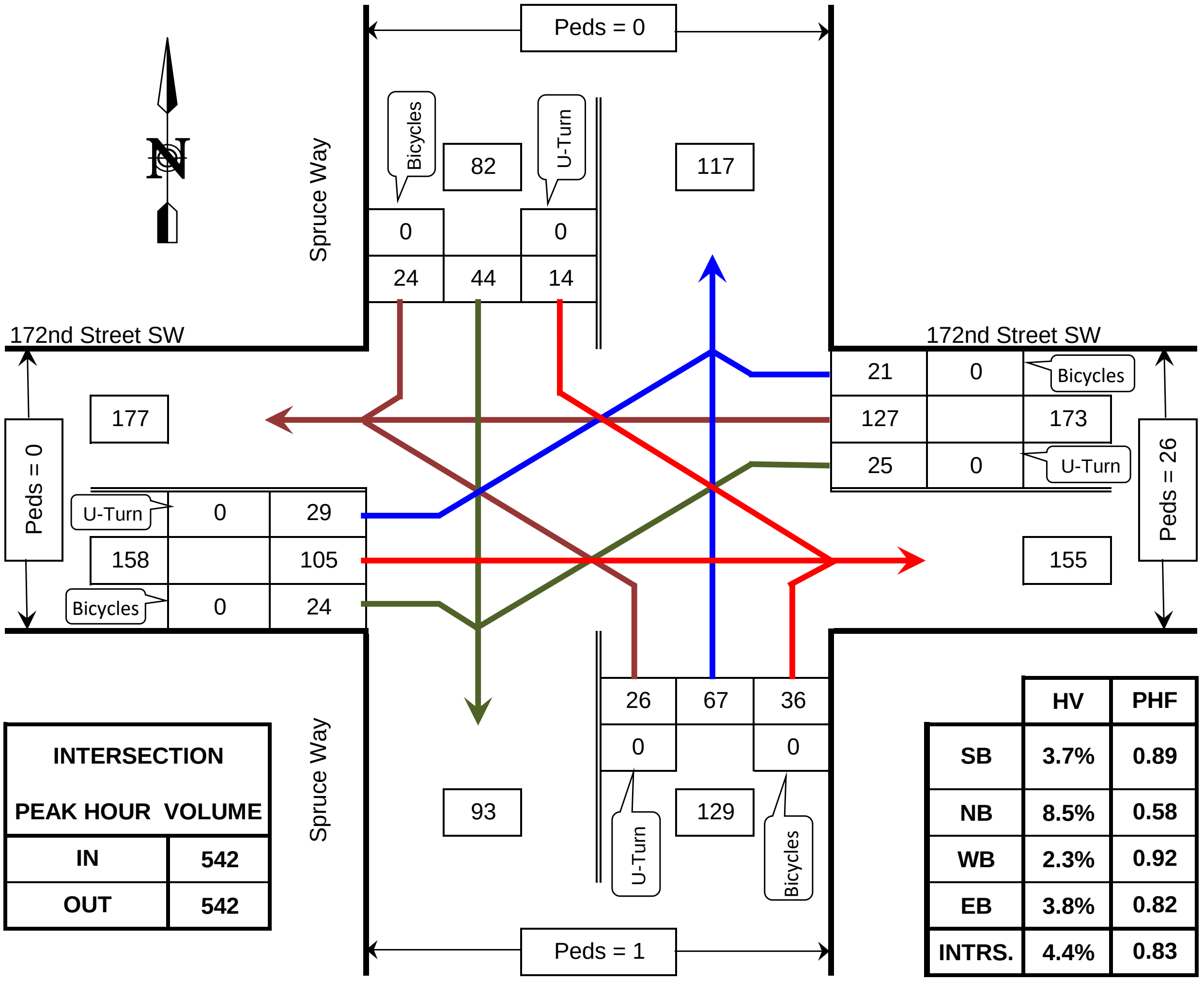
ROLLING HOUR COUNT

	FROM NORTH ON Spruce Way							FROM SOUTH ON Spruce Way							FROM EAST ON 172nd Street SW							FROM WEST ON 172nd Street SW							INTERVAL TOTALS
TIME INTERVAL	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
5:45 AM - 6:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:00 AM - 7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:15 AM - 7:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:30 AM - 7:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6:45 AM - 7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:00 AM - 8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM - 8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 AM - 8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 AM - 8:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM - 9:00 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM - 9:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM - 9:30 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM - 9:45 AM	0	2	2	0	9	105	28	1	0	1	0	30	99	35	7	0	2	0	50	48	6	0	0	4	0	9	60	18	497

TRAFFIC DATA GATHERING

TURNING MOVEMENTS DIAGRAM

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM



INTERSECTION PEAK HOUR VOLUME	
IN	542
OUT	542

	HV	PHF
SB	3.7%	0.89
NB	8.5%	0.58
WB	2.3%	0.92
EB	3.8%	0.82
INTRS.	4.4%	0.83

PHF = Peak Hour Factor
HV = Heavy Vehicle

Spruce Way @ 172nd Street SW

Lynnwood, WA

COUNTED BY:	CN	DATE OF COUNT:	Wed. 11/16/16
REDUCED BY:	CN	TIME OF COUNT:	3:00 PM - 5:00 PM
REDUCTION DATE:	Wed. 11/16/16	WEATHER:	Sunny

TRAFFIC DATA GATHERING

INTERSECTION TURNING MOVEMENTS REDUCTION SHEET

LOCATION:	Spruce Way @ 172nd Street SW	DATE OF COUNT:	Wed. 11/16/16	COUNTED BY:	CN
	Lynnwood, WA	TIME OF COUNT:	3:00 PM - 5:00 PM	WEATHER:	Sunny

TIME INTERVAL ENDING AT	FROM NORTH ON							FROM SOUTH ON							FROM EAST ON							FROM WEST ON							INTERVAL TOTALS
	Spruce Way							Spruce Way							172nd Street SW							172nd Street SW							
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
01:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
01:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
02:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
03:15 PM	0	0	1	0	2	7	4	0	0	0	0	4	1	0	3	0	0	0	2	24	3	0	0	0	0	4	24	2	**77**
03:30 PM	0	0	0	0	5	7	3	0	0	0	0	1	6	3	1	0	0	0	4	29	4	0	0	0	0	7	34	5	**108**
03:45 PM	0	0	1	0	5	14	4	0	0	0	0	6	6	1	3	0	1	0	9	30	5	0	0	1	0	5	25	5	**115**
04:00 PM	0	0	2	0	0	15	5	1	0	1	0	3	27	11	16	0	1	0	7	29	6	0	0	2	0	1	21	11	**136**
04:15 PM	0	0	0	0	3	11	5	0	0	9	0	15	26	15	7	0	2	0	6	29	5	0	0	2	0	13	30	5	**163**
04:30 PM	0	0	0	0	6	4	10	0	0	1	0	2	8	9	0	0	0	0	3	39	5	0	0	1	0	10	29	3	**128**
04:45 PM	0	0	0	0	4	9	4	0	0	0	0	4	7	3	0	0	2	0	1	31	2	0	0	0	0	16	31	3	**115**
05:00 PM	1	0	0	0	0	6	5	0	0	3	0	3	18	1	0	0	0	0	2	21	4	0	0	0	0	10	31	3	**104**
PEAK HOUR TOTALS	**0**	**0**	**3**	**0**	**14**	**44**	**24**	**1**	**0**	**11**	**0**	**26**	**67**	**36**	**26**	**0**	**4**	**0**	**25**	**127**	**21**	**0**	**0**	**6**	**0**	**29**	**105**	**24**	**INTERSECTION**
ALL MOVEMENTS				**82**							**129**							**173**							**158**				**542**
% HV			**3.7%**							**8.5%**							**2.3%**							**3.8%**					**4.4%**
PEAK HOUR FACTOR				**0.89**							**0.58**							**0.92**							**0.82**				**0.83**

HV = Heavy Vehicle

PHF = Peak Hour Factor

3:00 PM - 5:00 PM PEAK HOUR: 3:30 PM TO 4:30 PM

REDUCED BY: CN

DATE OF REDUCTION: 11/16/2016

ROLLING HOUR COUNT

TIME INTERVAL	FROM NORTH ON							FROM SOUTH ON							FROM EAST ON							FROM WEST ON							INTERVAL TOTALS
	Spruce Way							Spruce Way							172nd Street SW							172nd Street SW							
	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	Peds	Bicycle	HV	U-Turn	Left	Thru	Right	
1:00 PM - 2:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:15 PM - 2:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:30 PM - 2:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1:45 PM - 2:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:00 PM - 3:00 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:15 PM - 3:15 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:30 PM - 3:30 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2:45 PM - 3:45 PM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00 PM - 4:00 PM	0	0	4	0	12	43	16	1	0	1	0	14	40	15	23	0	2	0	22	112	18	0	0	3	0	17	104	23	436
3:15 PM - 4:15 PM	0	0	3	0	13	47	17	1	0	10	0	25	65	30	27	0	4	0	26	117	20	0	0	5	0	26	110	26	522
3:30 PM - 4:30 PM	0	0	3	0	14	44	24	1	0	11	0	26	67	36	26	0	4	0	25	127	21	0	0	6	0	29	105	24	542
3:45 PM - 4:45 PM	0	0	2	0	13	39	24	1	0	11	0	24	68	38	23	0	5	0	17	128	18	0	0	5	0	40	111	22	542
4:00 PM - 5:00 PM	1	0	0	0	13	30	24	0	0	13	0	24	59	28	7	0	4	0	12	120	16	0	0	3	0	49	121	14	510

AM Turning Movement Calculations

Synchro ID: 1

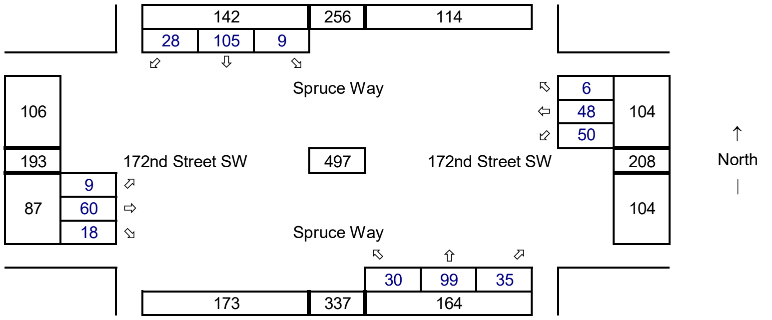
Existing

Average Weekday

AM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

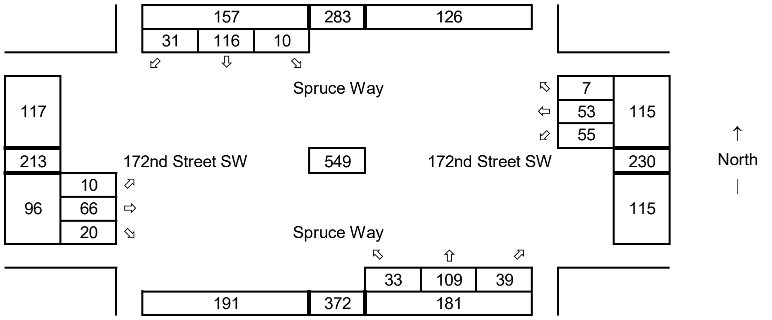
AM Peak Hour

Year: 2021

Growth Rate = 2.0%

Years of Growth = 5

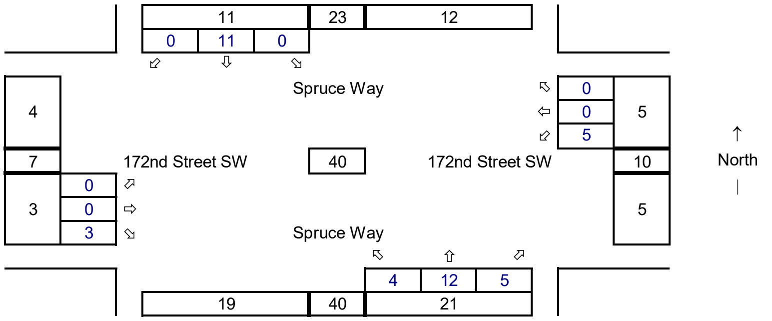
Total Growth = 1.1041



Total Project Trips

Average Weekday

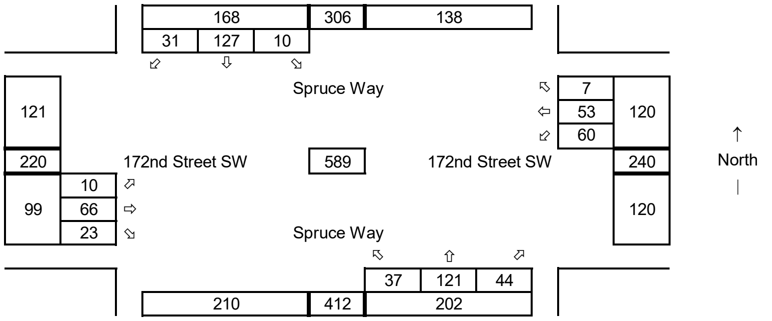
AM Peak Hour



Future with Project

Average Weekday

AM Peak Hour



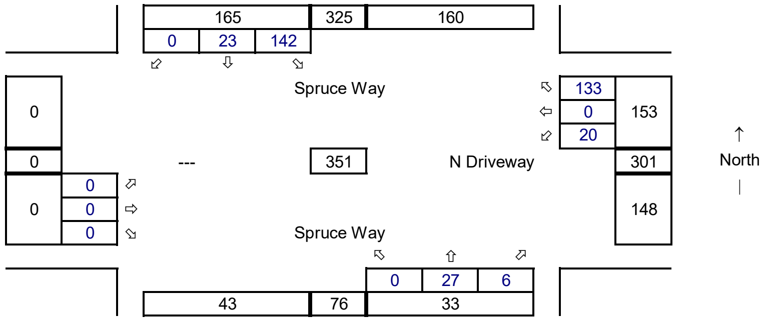
2 Spruce Way @ N Driveway

Synchro ID: 2

Existing
Average Weekday
AM Peak Hour

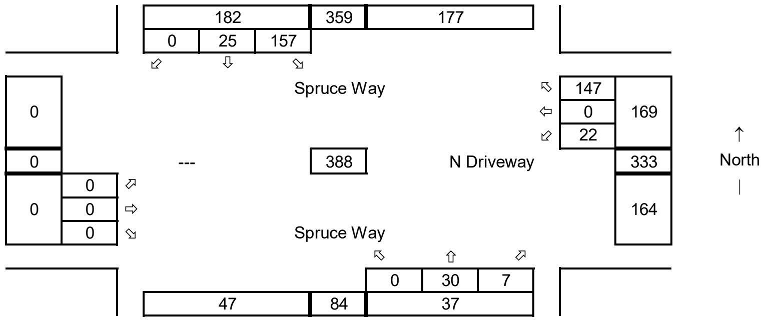
Year: **11/16/16**

Data Source: TDG

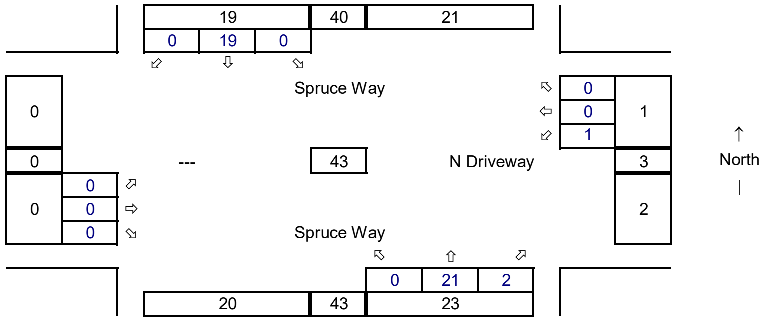


Future without Project
Average Weekday
AM Peak Hour

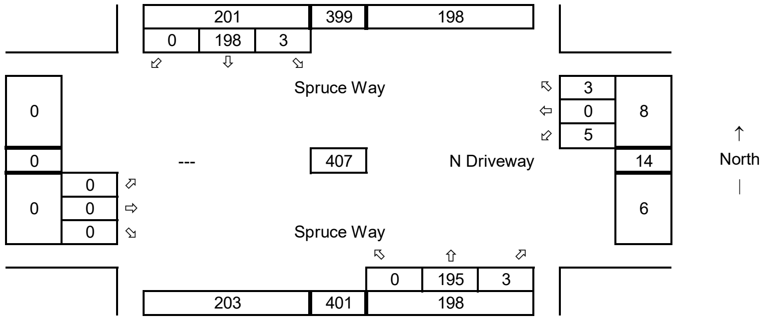
Year: 2021
Growth Rate = 2.0%
Years of Growth = 5
Total Growth = 1.1041



Total Project Trips
Average Weekday
AM Peak Hour

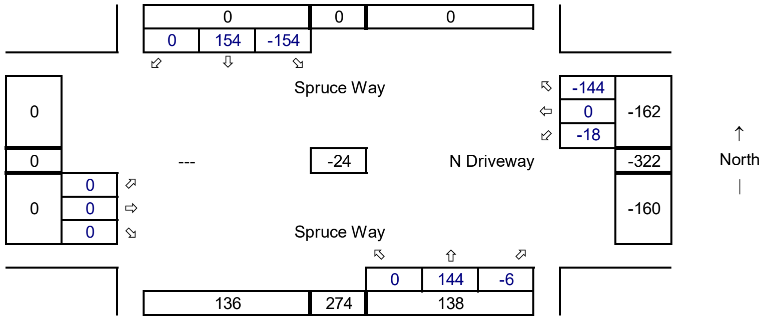


Future with Project
Average Weekday
AM Peak Hour



Diverted Trips
Average Weekday
AM Peak Hour

Conversion to Bus Loop



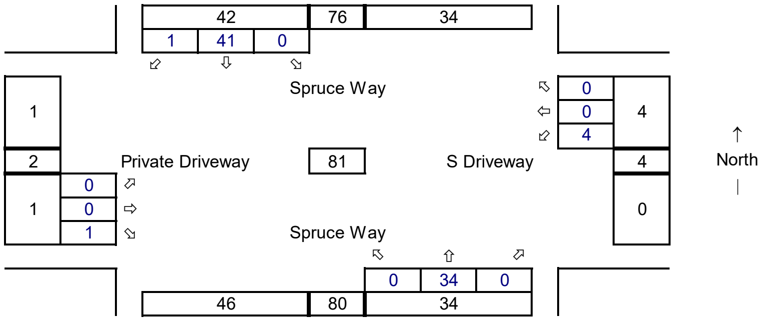
3 Spruce Way @ S Driveway

Synchro ID: 3

Existing
Average Weekday
AM Peak Hour

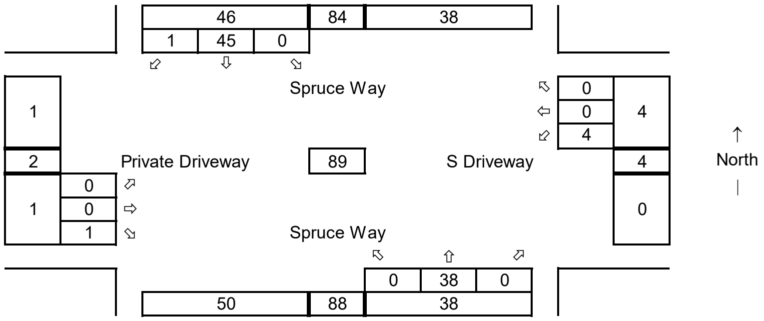
Year: **11/16/16**

Data Source: TDG

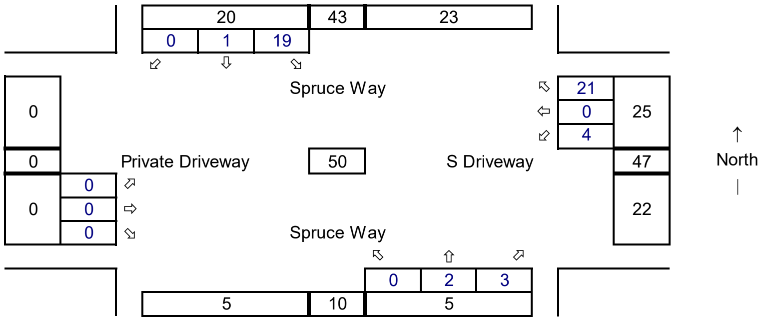


Future without Project
Average Weekday
AM Peak Hour

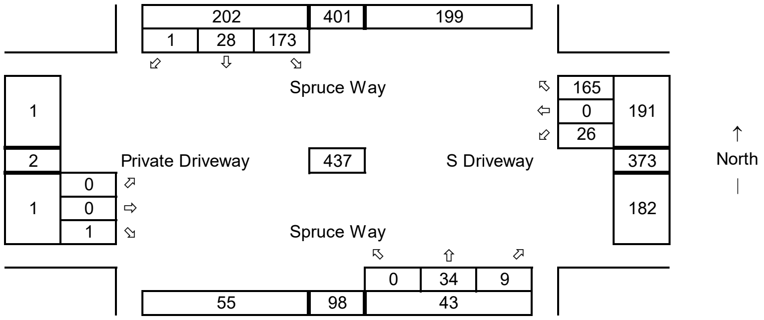
Year: 2021
Growth Rate = 2.0%
Years of Growth = 5
Total Growth = 1.1041



Total Project Trips
Average Weekday
AM Peak Hour

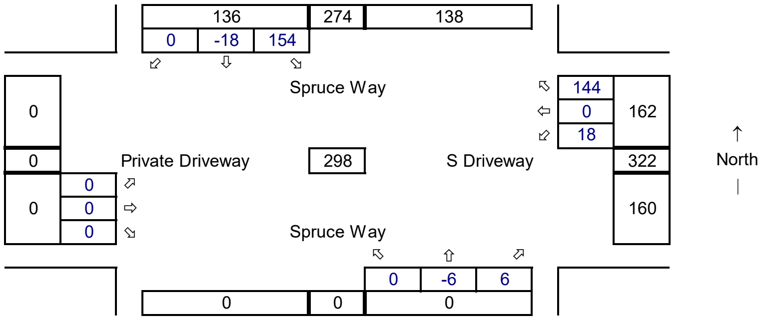


Future with Project
Average Weekday
AM Peak Hour



Diverted Trips
Average Weekday
AM Peak Hour

Conversion to Pick-Up/Drop-Off Loop and Parking Lot.



School PM Turning Movement Calculations

Synchro ID: 1

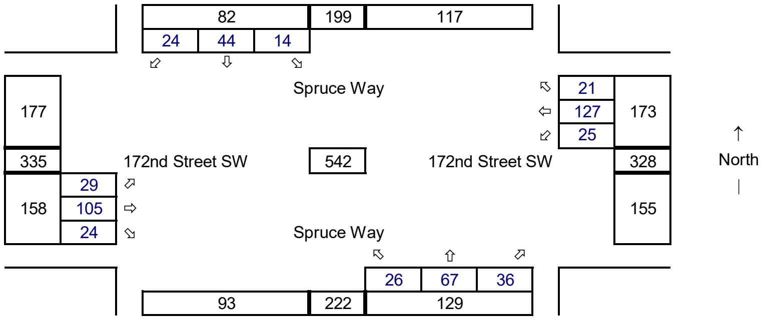
Existing

Average Weekday

PM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

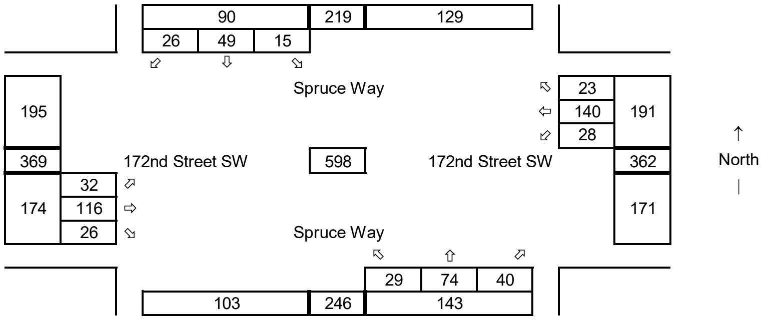
PM Peak Hour

Year: 2021

Growth Rate = 2.0%

Years of Growth = 5

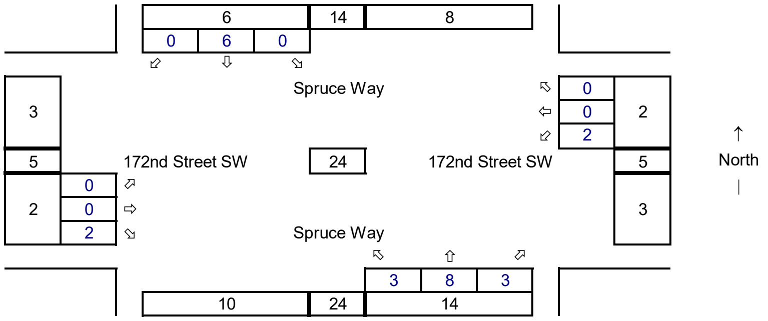
Total Growth = 1.1041



Total Project Trips

Average Weekday

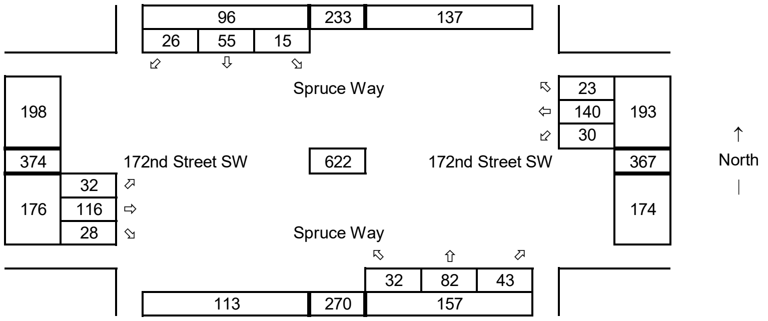
PM Peak Hour



Future with Project

Average Weekday

PM Peak Hour



2 Spruce Way @ N Driveway

Synchro ID: 2

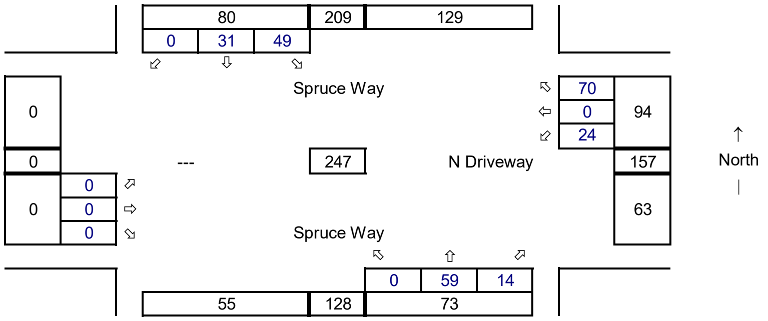
Existing

Average Weekday

PM Peak Hour

Year: **11/16/16**

Data Source: TDG



Future without Project

Average Weekday

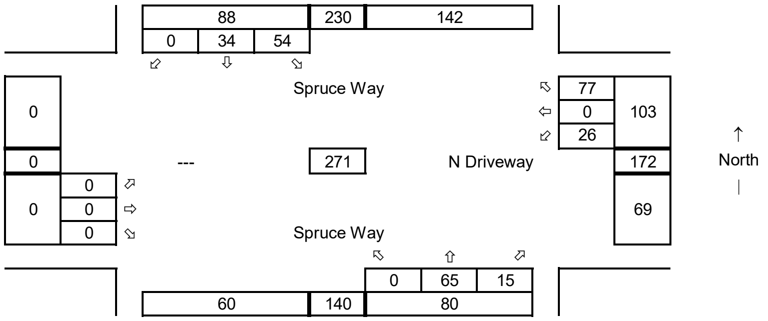
PM Peak Hour

Year: 2021

Growth Rate = 2.0%

Years of Growth = 5

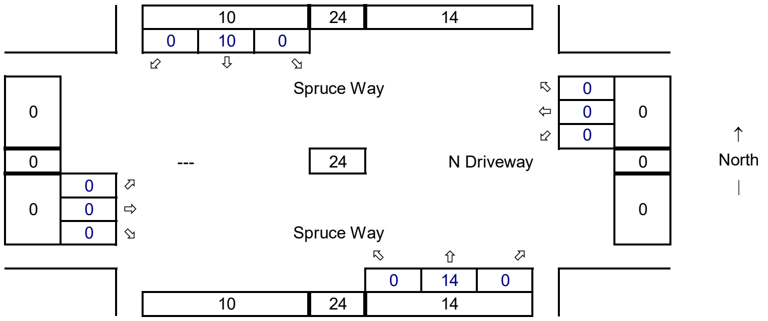
Total Growth = 1.1041



Total Project Trips

Average Weekday

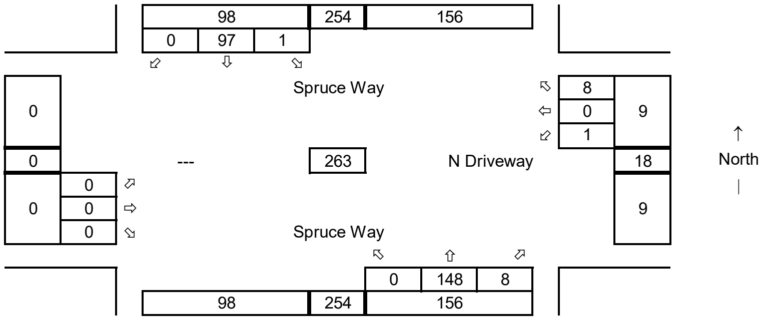
PM Peak Hour



Future with Project

Average Weekday

PM Peak Hour

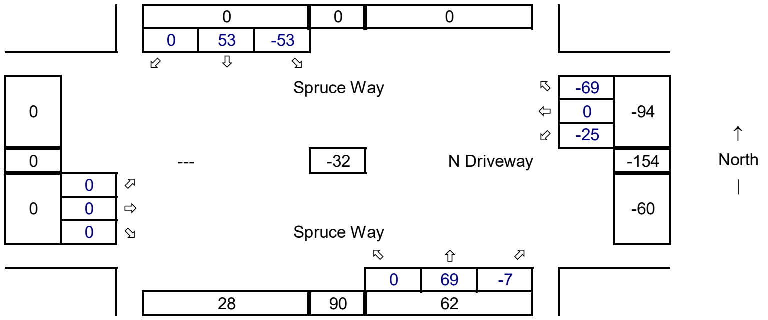


Diverted Trips

Average Weekday

PM Peak Hour

Conversion to Bus Loop.

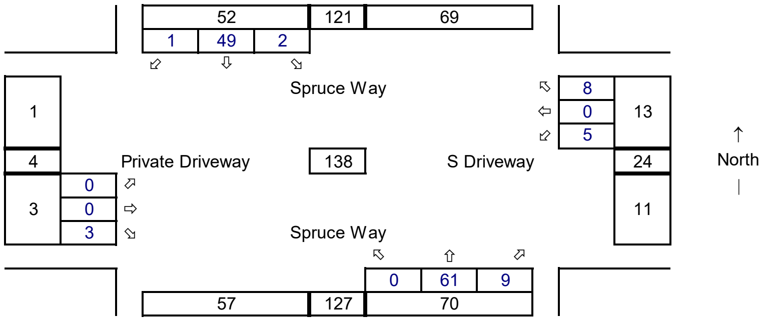


Synchro ID: 3

Existing
Average Weekday
PM Peak Hour

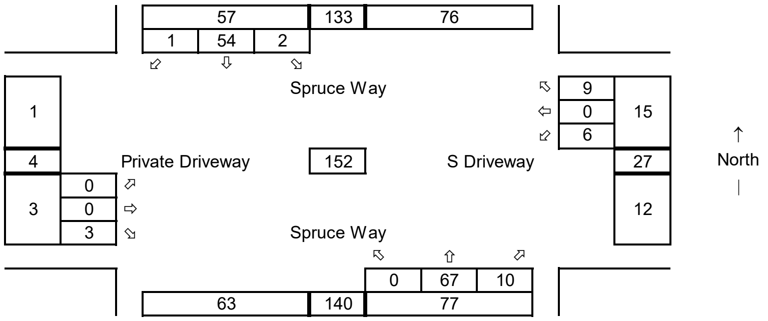
Year: **11/16/16**

Data Source: TDG

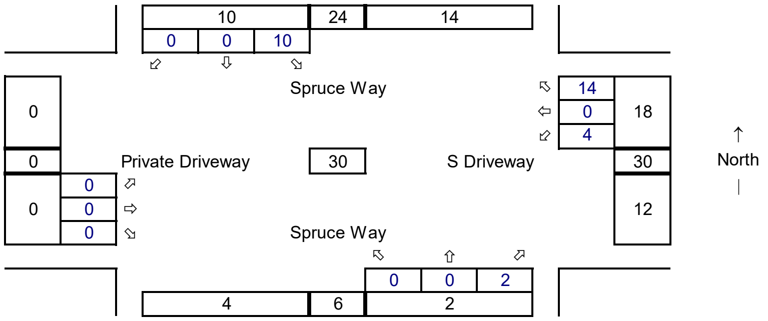


Future without Project
Average Weekday
PM Peak Hour

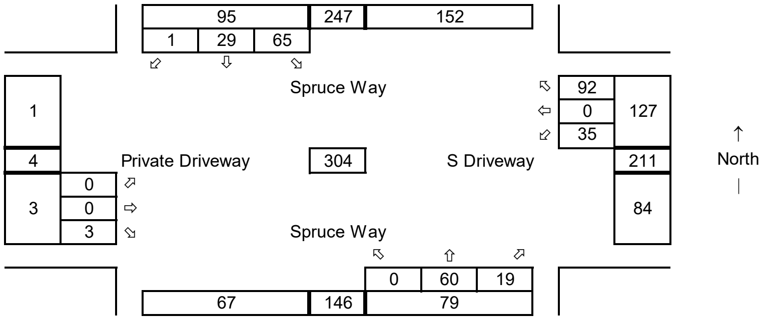
Year: 2021
Growth Rate = 2.0%
Years of Growth = 5
Total Growth = 1.1041



Total Project Trips
Average Weekday
PM Peak Hour

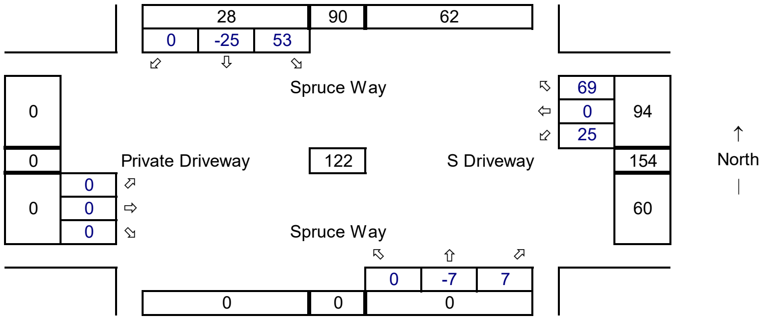


Future with Project
Average Weekday
PM Peak Hour



Diverted Trips
Average Weekday
PM Peak Hour

Conversion to Pick-Up/Drop-off loop and parking lot.



Existing AM Peak-Hour Level of Service Analysis

Intersection	
Intersection Delay, s/veh	10.2
Intersection LOS	B

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	9	60	18	0	50	48	6	0	30	99	35
Future Vol, veh/h	0	9	60	18	0	50	48	6	0	30	99	35
Peak Hour Factor	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	0	14	92	28	0	77	74	9	0	46	152	54
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.6	10.2	10.6
HCM LOS	A	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	10%	48%	6%
Vol Thru, %	60%	69%	46%	74%
Vol Right, %	21%	21%	6%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	164	87	104	142
LT Vol	30	9	50	9
Through Vol	99	60	48	105
RT Vol	35	18	6	28
Lane Flow Rate	252	134	160	218
Geometry Grp	1	1	1	1
Degree of Util (X)	0.349	0.197	0.241	0.305
Departure Headway (Hd)	4.986	5.299	5.414	5.019
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	724	677	664	719
Service Time	2.994	3.332	3.446	3.026
HCM Lane V/C Ratio	0.348	0.198	0.241	0.303
HCM Control Delay	10.6	9.6	10.2	10.2
HCM Lane LOS	B	A	B	B
HCM 95th-tile Q	1.6	0.7	0.9	1.3

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	9	105	28
Future Vol, veh/h	0	9	105	28
Peak Hour Factor	0.92	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2
Mvmt Flow	0	14	162	43
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	10.2
HCM LOS	B

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	8.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	20	133	27	6	142	23
Future Vol, veh/h	20	133	27	6	142	23
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	52	52	69	69	51	51
Heavy Vehicles, %	1	1	0	0	2	2
Mvmt Flow	38	256	39	9	278	45

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	647	45	0	0	50	0
Stage 1	45	-	-	-	-	-
Stage 2	602	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.12	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.218	-
Pot Cap-1 Maneuver	437	1028	-	-	1557	-
Stage 1	980	-	-	-	-	-
Stage 2	549	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	356	1026	-	-	1557	-
Mov Cap-2 Maneuver	356	-	-	-	-	-
Stage 1	978	-	-	-	-	-
Stage 2	449	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11.8	0	6.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	823	1557	-
HCM Lane V/C Ratio	-	-	0.358	0.179	-
HCM Control Delay (s)	-	-	11.8	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.6	0.7	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	1.5

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	0	0	1	4	0	0	0	34	0	0	41	1
Future Vol, veh/h	0	0	1	4	0	0	0	34	0	0	41	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	25	25	25	61	61	61	72	72	72
Heavy Vehicles, %	0	0	0	100	100	100	3	3	3	5	5	5
Mvmt Flow	0	0	4	16	0	0	0	56	0	0	57	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	114	116	58	118	116	58	58	0	0	58	0	0
Stage 1	58	58	-	58	58	-	-	-	-	-	-	-
Stage 2	56	58	-	60	58	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	8.1	7.5	7.2	4.13	-	-	4.15	-	-
Critical Hdwy Stg 1	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	4.4	4.9	4.2	2.227	-	-	2.245	-	-
Pot Cap-1 Maneuver	868	778	1014	674	624	789	1540	-	-	1527	-	-
Stage 1	959	851	-	756	688	-	-	-	-	-	-	-
Stage 2	961	851	-	754	688	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	868	777	1014	670	623	787	1540	-	-	1527	-	-
Mov Cap-2 Maneuver	868	777	-	670	623	-	-	-	-	-	-	-
Stage 1	959	851	-	755	687	-	-	-	-	-	-	-
Stage 2	961	849	-	751	688	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.6	10.5	0	0
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1540	-	-	1014	670	1527	-	-
HCM Lane V/C Ratio	-	-	-	0.004	0.024	-	-	-
HCM Control Delay (s)	0	-	-	8.6	10.5	0	-	-
HCM Lane LOS	A	-	-	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

Existing School PM Peak-Hour Level of Service Analysis

1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	9.4
Intersection LOS	A

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Lane Configurations			✥				✥				✥	
Traffic Vol, veh/h	0	29	105	24	0	25	127	21	0	26	67	36
Future Vol, veh/h	0	29	105	24	0	25	127	21	0	26	67	36
Peak Hour Factor	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4	2	4	4	4	2	4	4	4
Mvmt Flow	0	35	127	29	0	30	153	25	0	31	81	43
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	1
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	1	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	1	1
HCM Control Delay	9.5	9.7	9.3
HCM LOS	A	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	20%	18%	14%	17%
Vol Thru, %	52%	66%	73%	54%
Vol Right, %	28%	15%	12%	29%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	129	158	173	82
LT Vol	26	29	25	14
Through Vol	67	105	127	44
RT Vol	36	24	21	24
Lane Flow Rate	155	190	208	99
Geometry Grp	1	1	1	1
Degree of Util (X)	0.212	0.254	0.277	0.137
Departure Headway (Hd)	4.92	4.797	4.785	4.986
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	724	744	746	713
Service Time	2.987	2.858	2.845	3.058
HCM Lane V/C Ratio	0.214	0.255	0.279	0.139
HCM Control Delay	9.3	9.5	9.7	8.9
HCM Lane LOS	A	A	A	A
HCM 95th-tile Q	0.8	1	1.1	0.5

1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Lane Configurations			✥	
Traffic Vol, veh/h	0	14	44	24
Future Vol, veh/h	0	14	44	24
Peak Hour Factor	0.92	0.83	0.83	0.83
Heavy Vehicles, %	2	4	4	4
Mvmt Flow	0	17	53	29
Number of Lanes	0	0	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	8.9
HCM LOS	A

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	6.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↱		↑↱			↰↑
Traffic Vol, veh/h	24	70	59	14	49	31
Future Vol, veh/h	24	70	59	14	49	31
Conflicting Peds, #/hr	0	0	0	9	9	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	48	48	68	68	57	57
Heavy Vehicles, %	1	1	14	14	4	4
Mvmt Flow	50	146	87	21	86	54

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	332	106	0	0	116	0
Stage 1	106	-	-	-	-	-
Stage 2	226	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.14	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.236	-
Pot Cap-1 Maneuver	665	951	-	-	1460	-
Stage 1	921	-	-	-	-	-
Stage 2	814	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	619	943	-	-	1460	-
Mov Cap-2 Maneuver	619	-	-	-	-	-
Stage 1	913	-	-	-	-	-
Stage 2	764	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.7	0	4.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	832	1460	-
HCM Lane V/C Ratio	-	-	0.235	0.059	-
HCM Control Delay (s)	-	-	10.7	7.6	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.9	0.2	-

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	0	0	3	5	0	8	0	61	9	2	49	1
Future Vol, veh/h	0	0	3	5	0	8	0	61	9	2	49	1
Conflicting Peds, #/hr	0	0	10	10	0	0	1	0	6	6	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	54	54	54	80	80	80	87	87	87
Heavy Vehicles, %	0	0	0	54	54	54	13	13	13	2	2	2
Mvmt Flow	0	0	12	9	0	15	0	76	11	2	56	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	151	156	68	165	151	88	58	0	0	94	0	0
Stage 1	62	62	-	88	88	-	-	-	-	-	-	-
Stage 2	89	94	-	77	63	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.64	7.04	6.74	4.23	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.986	4.486	3.786	2.317	-	-	2.218	-	-
Pot Cap-1 Maneuver	821	740	1001	696	655	844	1479	-	-	1500	-	-
Stage 1	954	847	-	806	731	-	-	-	-	-	-	-
Stage 2	923	821	-	817	751	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	805	734	991	677	650	839	1465	-	-	1500	-	-
Mov Cap-2 Maneuver	805	734	-	677	650	-	-	-	-	-	-	-
Stage 1	953	845	-	801	727	-	-	-	-	-	-	-
Stage 2	907	816	-	799	750	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.7	9.8	0	0.3
HCM LOS	A	A		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1465	-	-	991	768	1500	-	-
HCM Lane V/C Ratio	-	-	-	0.012	0.031	0.002	-	-
HCM Control Delay (s)	0	-	-	8.7	9.8	7.4	0	-
HCM Lane LOS	A	-	-	A	A	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

2021 Baseline AM Peak-Hour Level of Service Analysis

1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	11
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	10	66	20	55	53	7	33	109	39	10	116	31
Future Vol, veh/h	10	66	20	55	53	7	33	109	39	10	116	31
Peak Hour Factor	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	102	31	85	82	11	51	168	60	15	178	48
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.2	10.8	11.5	11
HCM LOS	B	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	10%	48%	6%
Vol Thru, %	60%	69%	46%	74%
Vol Right, %	22%	21%	6%	20%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	181	96	115	157
LT Vol	33	10	55	10
Through Vol	109	66	53	116
RT Vol	39	20	7	31
Lane Flow Rate	278	148	177	242
Geometry Grp	1	1	1	1
Degree of Util (X)	0.397	0.226	0.276	0.347
Departure Headway (Hd)	5.132	5.506	5.609	5.173
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	702	651	640	696
Service Time	3.167	3.548	3.649	3.209
HCM Lane V/C Ratio	0.396	0.227	0.277	0.348
HCM Control Delay	11.5	10.2	10.8	11
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	1.9	0.9	1.1	1.6

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	8.9

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	22	147	30	7	157	25
Future Vol, veh/h	22	147	30	7	157	25
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	52	52	69	69	51	51
Heavy Vehicles, %	1	1	0	0	2	2
Mvmt Flow	42	283	43	10	308	49

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	715	50	0	0	55	0
Stage 1	50	-	-	-	-	-
Stage 2	665	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.12	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.218	-
Pot Cap-1 Maneuver	399	1021	-	-	1550	-
Stage 1	975	-	-	-	-	-
Stage 2	513	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	316	1019	-	-	1547	-
Mov Cap-2 Maneuver	316	-	-	-	-	-
Stage 1	773	-	-	-	-	-
Stage 2	513	-	-	-	-	-

Approach	WB		NB		SB
HCM Control Delay, s	12.7		0		6.8
HCM LOS	B				

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	790	1547	-
HCM Lane V/C Ratio	-	-	0.411	0.199	-
HCM Control Delay (s)	-	-	12.7	7.9	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2	0.7	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	0	0	1	4	0	0	0	38	0	0	45	1
Future Vol, veh/h	0	0	1	4	0	0	0	38	0	0	45	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	2	2	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	25	25	25	61	61	61	72	72	72
Heavy Vehicles, %	0	0	0	100	100	100	3	3	3	5	5	5
Mvmt Flow	0	0	4	16	0	0	0	62	0	0	63	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	126	128	64	130	128	64	64	0	0	64	0	0
Stage 1	64	64	-	64	64	-	-	-	-	-	-	-
Stage 2	62	64	-	66	64	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	8.1	7.5	7.2	4.13	-	-	4.15	-	-
Critical Hdwy Stg 1	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	7.1	6.5	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	4.4	4.9	4.2	2.227	-	-	2.245	-	-
Pot Cap-1 Maneuver	852	766	1006	660	613	783	1532	-	-	1519	-	-
Stage 1	952	846	-	750	683	-	-	-	-	-	-	-
Stage 2	954	846	-	748	683	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	852	764	1006	656	612	782	1532	-	-	1516	-	-
Mov Cap-2 Maneuver	852	764	-	656	612	-	-	-	-	-	-	-
Stage 1	952	846	-	749	682	-	-	-	-	-	-	-
Stage 2	954	844	-	745	683	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.6	10.6	0	0
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1532	-	-	1006	656	1516	-	-
HCM Lane V/C Ratio	-	-	-	0.004	0.024	-	-	-
HCM Control Delay (s)	0	-	-	8.6	10.6	0	-	-
HCM Lane LOS	A	-	-	A	B	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

2021 Baseline School PM Peak-Hour Level of Service Analysis

Intersection	
Intersection Delay, s/veh	9.9
Intersection LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	32	116	26	28	140	23	29	74	40	15	49	26
Future Vol, veh/h	32	116	26	28	140	23	29	74	40	15	49	26
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles, %	4	4	4	4	4	4	4	4	4	4	4	4
Mvmt Flow	39	140	31	34	169	28	35	89	48	18	59	31
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10	10.2	9.8	9.2
HCM LOS	A	B	A	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	20%	18%	15%	17%
Vol Thru, %	52%	67%	73%	54%
Vol Right, %	28%	15%	12%	29%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	143	174	191	90
LT Vol	29	32	28	15
Through Vol	74	116	140	49
RT Vol	40	26	23	26
Lane Flow Rate	172	210	230	108
Geometry Grp	1	1	1	1
Degree of Util (X)	0.242	0.286	0.313	0.154
Departure Headway (Hd)	5.047	4.91	4.894	5.129
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	703	723	727	691
Service Time	3.134	2.992	2.974	3.225
HCM Lane V/C Ratio	0.245	0.29	0.316	0.156
HCM Control Delay	9.8	10	10.2	9.2
HCM Lane LOS	A	A	B	A
HCM 95th-tile Q	0.9	1.2	1.3	0.5

Intersection	
Int Delay, s/veh	6.3

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↰↱		↑↱			↰↑
Traffic Vol, veh/h	26	77	65	15	54	34
Future Vol, veh/h	26	77	65	15	54	34
Conflicting Peds, #/hr	0	0	0	9	9	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	48	48	68	68	57	57
Heavy Vehicles, %	1	1	14	14	4	4
Mvmt Flow	54	160	96	22	95	60

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	366	116	0	0	127	0
Stage 1	116	-	-	-	-	-
Stage 2	250	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.14	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.236	-
Pot Cap-1 Maneuver	636	939	-	-	1447	-
Stage 1	911	-	-	-	-	-
Stage 2	794	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	588	931	-	-	1435	-
Mov Cap-2 Maneuver	588	-	-	-	-	-
Stage 1	842	-	-	-	-	-
Stage 2	794	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	11	0	4.7
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	812	1435	-
HCM Lane V/C Ratio	-	-	0.264	0.066	-
HCM Control Delay (s)	-	-	11	7.7	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	1.1	0.2	-

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	0	0	3	6	0	9	0	67	10	2	54	1
Future Vol, veh/h	0	0	3	6	0	9	0	67	10	2	54	1
Conflicting Peds, #/hr	0	0	10	10	0	0	1	0	6	6	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	54	54	54	80	80	80	87	87	87
Heavy Vehicles, %	0	0	0	54	54	54	13	13	13	2	2	2
Mvmt Flow	0	0	12	11	0	17	0	84	13	2	62	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	167	171	74	180	165	97	64	0	0	103	0	0
Stage 1	68	68	-	97	97	-	-	-	-	-	-	-
Stage 2	99	103	-	83	68	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.64	7.04	6.74	4.23	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.64	6.04	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.986	4.486	3.786	2.317	-	-	2.218	-	-
Pot Cap-1 Maneuver	802	726	993	680	643	834	1471	-	-	1489	-	-
Stage 1	947	842	-	796	724	-	-	-	-	-	-	-
Stage 2	912	814	-	811	747	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	784	720	983	661	638	829	1470	-	-	1480	-	-
Mov Cap-2 Maneuver	784	720	-	661	638	-	-	-	-	-	-	-
Stage 1	946	840	-	791	720	-	-	-	-	-	-	-
Stage 2	894	809	-	793	746	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.7	10	0	0.3
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1470	-	-	983	752	1480	-	-
HCM Lane V/C Ratio	-	-	-	0.012	0.037	0.002	-	-
HCM Control Delay (s)	0	-	-	8.7	10	7.4	0	-
HCM Lane LOS	A	-	-	A	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	0.1	0	-	-

2021 Future With Project AM Peak-Hour Level of Service Analysis

1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	11.5
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	10	65	22	59	52	6	36	119	43	10	125	30
Future Vol, veh/h	10	65	22	59	52	6	36	119	43	10	125	30
Peak Hour Factor	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	15	100	34	91	80	9	55	183	66	15	192	46
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.4	11.1	12.3	11.4
HCM LOS	B	B	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	18%	10%	50%	6%
Vol Thru, %	60%	67%	44%	76%
Vol Right, %	22%	23%	5%	18%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	198	97	117	165
LT Vol	36	10	59	10
Through Vol	119	65	52	125
RT Vol	43	22	6	30
Lane Flow Rate	305	149	180	254
Geometry Grp	1	1	1	1
Degree of Util (X)	0.439	0.233	0.287	0.371
Departure Headway (Hd)	5.188	5.627	5.745	5.259
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	695	636	625	683
Service Time	3.229	3.678	3.794	3.302
HCM Lane V/C Ratio	0.439	0.234	0.288	0.372
HCM Control Delay	12.3	10.4	11.1	11.4
HCM Lane LOS	B	B	B	B
HCM 95th-tile Q	2.2	0.9	1.2	1.7

2: Spruce Way & North School Dwy

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	5	0	194	2	0	198
Future Vol, veh/h	5	0	194	2	0	198
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	25	25	69	69	51	51
Heavy Vehicles, %	100	100	0	0	2	2
Mvmt Flow	20	0	281	3	0	388

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	673	285	0	0	286	0
Stage 1	285	-	-	-	-	-
Stage 2	388	-	-	-	-	-
Critical Hdwy	7.4	7.2	-	-	4.12	-
Critical Hdwy Stg 1	6.4	-	-	-	-	-
Critical Hdwy Stg 2	6.4	-	-	-	-	-
Follow-up Hdwy	4.4	4.2	-	-	2.218	-
Pot Cap-1 Maneuver	301	570	-	-	1276	-
Stage 1	584	-	-	-	-	-
Stage 2	515	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	300	569	-	-	1274	-
Mov Cap-2 Maneuver	300	-	-	-	-	-
Stage 1	583	-	-	-	-	-
Stage 2	515	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	17.9	0	0
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	300	1274	-
HCM Lane V/C Ratio	-	-	0.067	-	-
HCM Control Delay (s)	-	-	17.9	0	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	0.2	0	-

Intersection	
Int Delay, s/veh	9.2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	26	165	33	9	173	27
Future Vol, veh/h	26	165	33	9	173	27
Conflicting Peds, #/hr	0	0	0	2	2	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	52	52	61	61	72	72
Heavy Vehicles, %	1	1	3	3	5	5
Mvmt Flow	50	317	54	15	240	38

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	582	64	0	0	71	0
Stage 1	64	-	-	-	-	-
Stage 2	518	-	-	-	-	-
Critical Hdwy	6.41	6.21	-	-	4.15	-
Critical Hdwy Stg 1	5.41	-	-	-	-	-
Critical Hdwy Stg 2	5.41	-	-	-	-	-
Follow-up Hdwy	3.509	3.309	-	-	2.245	-
Pot Cap-1 Maneuver	477	1003	-	-	1510	-
Stage 1	961	-	-	-	-	-
Stage 2	600	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	398	1001	-	-	1507	-
Mov Cap-2 Maneuver	398	-	-	-	-	-
Stage 1	802	-	-	-	-	-
Stage 2	600	-	-	-	-	-

Approach	WB		NB		SB	
HCM Control Delay, s	12.7		0		6.8	
HCM LOS	B					

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	830	1507	-
HCM Lane V/C Ratio	-	-	0.443	0.159	-
HCM Control Delay (s)	-	-	12.7	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	2.3	0.6	-

2021 Future With Project School PM Peak-Hour Level of Service Analysis

1: Spruce Way & 172nd Street SW

Intersection	
Intersection Delay, s/veh	10.1
Intersection LOS	B

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✥			✥			✥			✥	
Traffic Vol, veh/h	32	116	28	30	140	23	32	82	43	15	55	26
Future Vol, veh/h	32	116	28	30	140	23	32	82	43	15	55	26
Peak Hour Factor	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.83
Heavy Vehicles, %	4	4	4	4	4	4	4	4	4	4	4	4
Mvmt Flow	39	140	34	36	169	28	39	99	52	18	66	31
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	10.2	10.4	10.1	9.4
HCM LOS	B	B	B	A

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	20%	18%	16%	16%
Vol Thru, %	52%	66%	73%	57%
Vol Right, %	27%	16%	12%	27%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	157	176	193	96
LT Vol	32	32	30	15
Through Vol	82	116	140	55
RT Vol	43	28	23	26
Lane Flow Rate	189	212	233	116
Geometry Grp	1	1	1	1
Degree of Util (X)	0.267	0.293	0.321	0.17
Departure Headway (Hd)	5.086	4.979	4.971	5.292
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	698	712	714	682
Service Time	3.185	3.077	3.066	3.292
HCM Lane V/C Ratio	0.271	0.298	0.326	0.17
HCM Control Delay	10.1	10.2	10.4	9.4
HCM Lane LOS	B	B	B	A
HCM 95th-tile Q	1.1	1.2	1.4	0.6

Intersection	
Int Delay, s/veh	0.5

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↱			↰
Traffic Vol, veh/h	1	8	148	8	1	97
Future Vol, veh/h	1	8	148	8	1	97
Conflicting Peds, #/hr	0	0	0	9	9	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	54	54	68	68	57	57
Heavy Vehicles, %	54	54	14	14	4	4
Mvmt Flow	2	15	218	12	2	170

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	407	233	0	0	239	0
Stage 1	233	-	-	-	-	-
Stage 2	174	-	-	-	-	-
Critical Hdwy	6.94	6.74	-	-	4.14	-
Critical Hdwy Stg 1	5.94	-	-	-	-	-
Critical Hdwy Stg 2	5.94	-	-	-	-	-
Follow-up Hdwy	3.986	3.786	-	-	2.236	-
Pot Cap-1 Maneuver	512	693	-	-	1316	-
Stage 1	698	-	-	-	-	-
Stage 2	745	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	506	687	-	-	1305	-
Mov Cap-2 Maneuver	506	-	-	-	-	-
Stage 1	690	-	-	-	-	-
Stage 2	745	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.6	0	0.1
HCM LOS	B		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	661	1305	-
HCM Lane V/C Ratio	-	-	0.025	0.001	-
HCM Control Delay (s)	-	-	10.6	7.8	0
HCM Lane LOS	-	-	B	A	A
HCM 95th %tile Q(veh)	-	-	0.1	0	-

3: Spruce Way & Private Drive/South School Dwy

Intersection	
Int Delay, s/veh	7.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Vol, veh/h	0	0	3	35	0	92	0	60	19	65	29	1
Future Vol, veh/h	0	0	3	35	0	92	0	60	19	65	29	1
Conflicting Peds, #/hr	0	0	10	10	0	0	1	0	6	6	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	25	25	25	48	48	48	80	80	80	87	87	87
Heavy Vehicles, %	0	0	0	1	1	1	13	13	13	2	2	2
Mvmt Flow	0	0	12	73	0	192	0	75	24	75	33	1

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	368	290	45	293	278	93	35	0	0	105	0	0
Stage 1	185	185	-	93	93	-	-	-	-	-	-	-
Stage 2	183	105	-	200	185	-	-	-	-	-	-	-
Critical Hdwy	7.1	6.5	6.2	7.11	6.51	6.21	4.23	-	-	4.12	-	-
Critical Hdwy Stg 1	6.1	5.5	-	6.11	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.1	5.5	-	6.11	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.5	4	3.3	3.509	4.009	3.309	2.317	-	-	2.218	-	-
Pot Cap-1 Maneuver	592	624	1031	661	632	967	1508	-	-	1486	-	-
Stage 1	821	751	-	916	820	-	-	-	-	-	-	-
Stage 2	823	812	-	804	749	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	455	587	1020	618	595	961	1507	-	-	1478	-	-
Mov Cap-2 Maneuver	455	587	-	618	595	-	-	-	-	-	-	-
Stage 1	820	711	-	911	815	-	-	-	-	-	-	-
Stage 2	659	807	-	746	709	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	8.6	11.3	0	5.2
HCM LOS	A	B		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1507	-	-	1020	834	1478	-	-
HCM Lane V/C Ratio	-	-	-	0.012	0.317	0.051	-	-
HCM Control Delay (s)	0	-	-	8.6	11.3	7.6	0	-
HCM Lane LOS	A	-	-	A	B	A	A	-
HCM 95th %tile Q(veh)	0	-	-	0	1.4	0.2	-	-

Parking Data

Matt

From: Carla Nasr <CarlaN@trafficdatagathering.com>
Sent: Sunday, November 20, 2016 10:30 PM
To: Matt
Subject: RE: Spruce ES, GTC 16-281
Attachments: Spruce ES N Drvwy @ Spruce Way AM.pdf; Spruce ES N Drvwy @ Spruce Way PM.pdf; Spruce ES S Drvwy @ Spruce Way AM.pdf; Spruce ES S Drvwy @ Spruce Way PM.pdf; Spruce Way @ 172 St SW AM.pdf; Spruce Way @ 172 St SW PM.pdf

Hi Matt,

Attached are the Spruce ES counts.

The number of vehicles parked at 9:45 AM in the school's parking lot is: 44 cars including 2 in the ADA stalls.
The number of vehicles parked at 3:00 PM in the school's parking lot is: 42 cars including 1 in the ADA stalls.

Number of Vehicles parked on Street at South Driveway:
At 8:45 AM 0 at 3:00 PM 2
9:00 AM 1 3:15 PM 4
9:15 AM (-1,1,-1) 0 3:30 PM 5
9:30 AM 0 3:45 PM 3
9:45 AM 0 4:00 PM (+1, -3) 1
4:15 PM 0
4:30 PM 0
4:45 PM 0
5:00 PM 0

I observed Queuing at the North driveway between 9:00-9:15AM of 2 cars coming from the South and turning Right into the driveway. As well as queuing of about 14 cars coming from the North and turning Left into the driveway. And a constant queuing coming out of the North Driveway during this 15 minutes period.

Regards,

Carla Nasr

Traffic Data Gathering
11410 13th Street SE
Lake Stevens, WA 98258
(425) 345-1148 C
(425) 334-3348 O
CarlaN@TrafficDataGathering.com

From: Matt [mailto:Mattp@gibsontraffic.com]
Sent: Tuesday, November 15, 2016 9:26 AM
To: Carla Nasr <CarlaN@trafficdatagathering.com>
Subject: RE: Spruce ES, GTC 16-281

Queuing Analysis

4-Vehicle

Spruce Elementary School
GTC #16-281

Single Channel Queuing Analysis

Arrivals	172 / 15 mins	λ
Service	240 / 15 mins	μ

Average number of cars in the system	$\lambda/(\mu-\lambda)$	2.529412		2.529412	vehicles
Average waiting time in the system	$1/(\mu-\lambda)$	0.014706	180	2.647059	minutes
Average number of cars in the queue	λ^$2/\mu(\mu-\lambda)$	1.812745		1.812745	vehicles
Average waiting time in the queue	$\lambda/\mu(\mu-\lambda)$	0.010539	180	1.897059	minutes
Average system utilization	λ/μ	0.716667		72%	
Probability of no cars in system	$1-\lambda/\mu$	0.283333		28%	
Probability of n cars in system	$(1-\lambda/\mu)(\lambda/\mu)$^n				
- max queue available					

		$(1-\lambda/\mu)$	(λ/μ)^n	P(n)	
P(0)	0	0.283333333	1	0.283333	
P(1)	1	0.283333333	0.716666667	0.203056	49%
P(2)	2	0.283333333	0.513611111	0.145523	
P(3)	3	0.283333333	0.368087963	0.104292	
P(4)	4	0.283333333	0.263796373	0.074742	
P(5)	5	0.283333333	0.189054068	0.053565	
P(6)	6	0.283333333	0.135488748	0.038388	
P(7)	7	0.283333333	0.09710027	0.027512	
P(8)	8	0.283333333	0.069588527	0.019717	95%

Probability of 8 or fewer Cars	95.01%
Probability of more than 8 Cars	4.99%

Arrivals	172 / 15 mins	λ
Service	300 / 15 mins	μ

Average number of cars in the system	$\lambda/(\mu-\lambda)$	1.34375		1.34375	vehicles
Average waiting time in the system	$1/(\mu-\lambda)$	0.007813	180	1.40625	minutes
Average number of cars in the queue	$\lambda^{\wedge}2/\mu(\mu-\lambda)$	0.770417		0.770417	vehicles
Average waiting time in the queue	$\lambda/\mu(\mu-\lambda)$	0.004479	180	0.80625	minutes
Average system utilization	λ/μ	0.573333		57%	
Probability of no cars in system	$1-\lambda/\mu$	0.426667		43%	
Probability of n cars in system	$(1-\lambda/\mu)(\lambda/\mu)^{\wedge}$n				
- max queue available					

		$(1-\lambda/\mu)$	$(\lambda/\mu)^{\wedge}$n	P(n)	
P(0)	0	0.426666667	1	0.426667	43%
P(1)	1	0.426666667	0.573333333	0.244622	67%
P(2)	2	0.426666667	0.328711111	0.14025	
P(3)	3	0.426666667	0.188461037	0.08041	
P(4)	4	0.426666667	0.108050995	0.046102	94%

Probability of 4 or fewer Cars 93.81%
Probability of more than 4 Cars 6.19%

Arrivals	172 / 15 mins	λ
Service	360 / 15 mins	μ

Average number of cars in the system	$\lambda/(\mu-\lambda)$	0.914894		0.914894	vehicles
Average waiting time in the system	$1/(\mu-\lambda)$	0.005319	180	0.957447	minutes
Average number of cars in the queue	λ^$2/\mu(\mu-\lambda)$	0.437116		0.437116	vehicles
Average waiting time in the queue	$\lambda/\mu(\mu-\lambda)$	0.002541	180	0.457447	minutes
Average system utilization	λ/μ	0.477778		48%	
Probability of no cars in system	$1-\lambda/\mu$	0.522222		52%	
Probability of n cars in system	$(1-\lambda/\mu)(\lambda/\mu)$^n				
- max queue available					

		$(1-\lambda/\mu)$	(λ/μ)^n	P(n)	
P(0)	0	0.522222222	1	0.522222	52%
P(1)	1	0.522222222	0.477777778	0.249506	
P(2)	2	0.522222222	0.228271605	0.119209	
P(3)	3	0.522222222	0.1090631	0.056955	95%

Probability of 3 or fewer Cars	94.79%
Probability of more than 3 Cars	5.21%

Collision Data

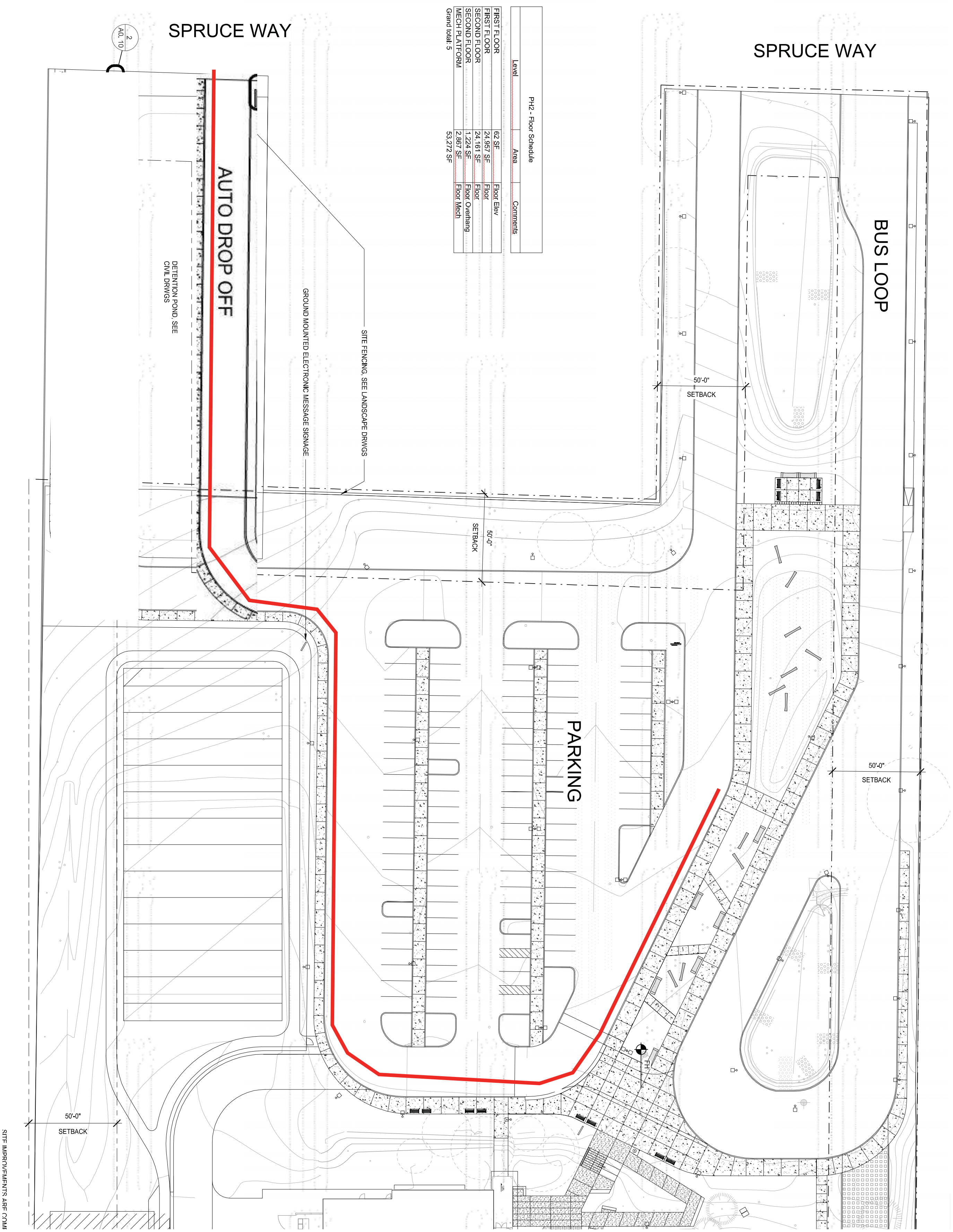
JURISDICTION	COUNTY	CITY	PRIMARY TRAFFICWAY	BLOCK NUMBER	INTERSECTING TRAFFICWAY/ REFERENCE POINT NAME	DIST FROM REF POINT	REPORT NUMBER	DATE	TIME	MOST SEVERE INJURY TYPE	# INJ	# FAT	# VEH	# PEDS	# BIKES	VEHICLE 1 TYPE	VEHICLE 2 TYPE	JUNCTION RELATIONSHIP
City Street	Snohomish	Lynnwood	172ND ST SW	3900	SPRUCE WAY	0	E397346	2015-02-02	17:54	No Apparent Injury	0	0	2	0	0	Pickup,Panel Truck or Vanette under 10,000 lb	Passenger Car	At Intersection and Related
City Street	Snohomish	Lynnwood	172ND ST SW	0	SPRUCE WAY	0	E688455	2017-07-05	11:23	No Apparent Injury	0	0	2	0	0	Passenger Car	Pickup,Panel Truck or Vanette under 10,000 lb	At Intersection and Related

WEATHER	ROADWAY SURFACE CONDITION	LIGHTING CONDITION	FIRST COLLISION TYPE / OBJECT STRUCK	VEHICLE 1 ACTION	VEHICLE 2 ACTION	VEHICLE 1 COMPASS DIRECTION FROM	VEHICLE 1 COMPASS DIRECTION TO	VEHICLE 2 COMPASS DIRECTION FROM
Overcast	Wet	Dark-Street Lights On	Entering at angle	Going Straight Ahead	Making Left Turn	East	West	South
Clear or Partly Cloudy	Dry	Daylight	Entering at angle	Going Straight Ahead	Starting in Traffic Lane	East	West	North

VEHICLE 2 COMPASS DIRECTION TO	MV DRIVER CONTRIBUTING CIRCUMSTANCE 1 (UNIT 1)	MV DRIVER CONTRIBUTING CIRCUMSTANCE 1 (UNIT 2)	FIRST IMPACT LOCATION (City, County & Misc Trafficways - 2010 forward)	WA STATE PLANE SOUTH - X 2010 - FORWARD	WA STATE PLANE SOUTH - Y 2010 - FORWARD
West	Other	Other	Lane of Primary Trafficway	1201251.68	920211.05
South	Disregard Stop Sign - Flashing Red	None	Lane of Primary Trafficway	1201251.69	920211.05

Site Layout

N



PH2 - Floor Schedule

Level	Area	Comments
FIRST FLOOR	62 SF	Floor Elev
FIRST FLOOR	24,957 SF	Floor
SECOND FLOOR	24,161 SF	Floor
SECOND FLOOR	1,224 SF	Floor Overhang
MECH PLATFORM	2,867 SF	Floor Mech
Grand total: 5	53,272 SF	