November 22, 2024

Client: Ann C. Jones Family LP
807 Chuckanut Shore Road
Bellingham, WA 98229

Cc: Ali Taysi ; *AVT Consulting, LLC*
Pacific Surveying & Engineering, Inc.

Project: **Proposed 38-Lot Woods at Viewcrest Plat**
352 Viewcrest Road, Bellingham, WA

Subject: **Geohazard Review Addendum – Stormwater Outfall Plan**

Dear Ms. Jones & Project Team:

Element Solutions was retained by the client (property owner) to perform additional Geologic Hazard review for the project currently under review by the City of Bellingham (COB) for preliminary plat approval. This addendum specifically addresses the proposed stormwater outfall and dispersion systems depicted on preliminary plat civil drawings, Sheets 7 and 8 (attached), and related site conditions. These components of the project were not defined at the time of the *Geotechnical Investigation & Geohazard Report - Proposed 38-Lot Plat Development, Jones Edgemoor Estate* (GIR, Element Solutions; October 6, 2022), and as such they were not addressed fully in the original report.

Specific aspects of the additional work (in order of address below) have included:

1) Review of Preliminary Plat drawings pertaining to proposed stormwater system and outfall.
2) Consultation with the civil designer and biologist on the outfall and dispersion plan.
3) Field reconnaissance for geohazard observations along the:
    a. Outfall alignment as currently depicted, and
    b. Northeast area of site downhill of proposed upland dispersion area.
4) Observation of shoreline area conditions at the proposed outfall release location.
5) Offering our additional interpretations of site conditions related to drainage, and opinions on the feasibility of outfall construction, as generally concepted.
6) Providing additional recommendations for further planning, final system design, and construction.

This review relies substantially on data collected and reported previously in the GIR (2022), and our overall knowledge of the site and vicinity, for interpretation of conditions. This additional review and summary correspondence is intended to supplement the original report, and is provided for use in the plat review process.

Attached exhibits include collections of field photographs taken during the supplemental site visits (Exhibits A, B, and C). Exhibit D presents additional historical aerial photos from the Department of Ecology (DOE) Shorelines Collection. Also attached are GIS figures incorporating the most current proposed plat layout for illustration. Figure 1 shows a full site overview for orientation, with Figures 2 and 3 providing detailed views of the northeast and southern areas of the project site, respectively. Relevant Preliminary Plat drawings (Sheets 7 & 8; Pacific Surveying & Engineering, 12-01-2023; previously submitted) are appended for reference.

Background & Overview of Stormwater Plan

Our prior work (GIR, 2022) established that the site is largely infeasible for infiltration, except potentially locally for single lot development where noted, due to the common presence of shallow restrictive conditions (glacial drift, bedrock). Upland dispersion has also been largely avoided as a primary means of plat stormwater management because of topographic limitations and potential risk to steep slope areas. Localized, small-scale dispersion / release may be pursued in final design where deemed appropriate for relatively small outflows. However, we generally interpret that site conditions are not conducive to either large-scale infiltration or dispersion of development stormwater in the upland area from a geotechnical and geohazard perspective.

Preliminary Plat civil plans by Pacific Surveying & Engineering (PSE; Sheets 7 & 8) illustrate the project will employ two off-site conveyances. Northern portions of the plat that drain towards Viewcrest Road will be routed through a modular wetland treatment system and flow control detention vault, then out to the existing municipal storm drain network. Central and southern portions of the plat that slope southeastward will have stormwater collected and routed through a separate modular wetland treatment system, then down the south slope through a main tightline to a dispersion point next to the shoreline. One on-site release is shown, consisting of a split-flow to a dissipation trench above a wetland area intended to help maintain post-development wetland hydrology.

Below we review details of conditions along the alignment as proposed at this time, and provide guidance and recommendations for outfall final design and construction to optimize protection of the conveyance and slopes.

Reconnaissance of Proposed Conveyance Alignment

An Element Solutions Licensed Engineering Geologist performed a visual reconnaissance of the proposed outfall alignment on June 24, 2024. A photo array (Exhibit A) showing conditions observed is attached in the Appendix.

Weather conditions at the time of the visit were sunny and dry. Vegetation allowed for adequate access along the area of interest. A draft version of the attached Southern Region map (Figure 3) was produced overlaying outfall drawings on GIS slope-shade data to easily identify features in the field. The GIS map was loaded into a GPS-based application (Avenza) for continuous location tracking. As we traversed along the alignment, we observed surrounding slope stability conditions. We also assessed for potential concerns for outfall construction and protection such as local outcrops, rock fall evidence/risk, and signs of ground instability along the proposed alignment.

Upland Traverse

The upland extent of the tightline begins with an approximately 250’ long segment that extends directly down-gradient from near the East Road Cul-de-Sac (between Lot 31 & 32) to a 90-degree right turn. This is followed by a laterally contouring segment that is about 550’ long extending to a catch basin near the top of the lower shoreline bluff.

The uphill segment travels over generally gentle to moderate, rolling upland topography. Grades of over 40% on slope faces are interspersed with areas around or under 30%. The topographic variations are likely a reflection of underlying bedrock patterns, although outcrops are minimal in the uphill zone. This area is well vegetated with mature undergrowth and tree canopy (Photos 1 & 2).

Upon reaching the area of the 90-degree turn in the outfall alignment, conditions change locally and persist for over 100 feet to the southwest. Sandstone outcrops locally, exposed on the order of 5 to 10 feet in height, along “ridges” oriented roughly east-west that cut across the southeast-facing slope (Photos 3 & 4). The outcrops are interspersed with small benches, creating an uneven ground surface that rises and falls in small areas. Overall ground conditions appear to be stable in this area, based on the common presence of large mature trees, although locally loose soils and rock may be found in troughs and directly above/below outcrops.

Past the zone of small outcrops, the main southeast slope face is a broadly planar feature with minor local variation. Conditions are typically mature tree cover with varying degrees of underbrush and forest litter (Photos 5 & 6). Trees are generally growing with straight trunks indicating soil creep is not significant, but there is some evidence of leaning or fallen trees that suggests shallow rooting (likely in thin soils over bedrock). No evidence of slope erosion, sloughing, or failures was seen along the proposed alignment or on the slope face above/below. The slope becomes progressively more moderate to the southwest. At the location of the proposed top-of-bluff catch basin, topography is gentle and mature forest vegetation covers the zone between the upland slope face and lower bluff (Photos 7 & 8).

Lower Bluff Slope

The lower slope extent of the tightline path includes a short top segment about 40’ – 50’ long from the top-of-bluff catch basin that is oriented downhill. This transitions into a main section around 500’ long that traverses across the slope near the base of an exposed sandstone bedrock cliff. The last segment of about 50 feet length travels downhill to the location sited for dispersion on a large vegetated sandstone pad just above the Ordinary High Water Mark (OHWM) and High Tide Line (HTL). Refer to Figure 3 for illustration.

The location of the pipe entry onto the bluff slope is a planar section with little brush, grassy ground-cover, and several mature trees (Photo 9). The proposed alignment avoids a steeper erosion-prone area to the west, and wraps around the end of a large sandstone outcrop that appears broadly intact. Near to the east, the outcrop exposure becomes larger and exhibits common fracturing with some loose rock and recent rock fall remains on the ground below (Photos 10 & 11). The slope below the more fractured zone of outcrop has uneven terrain as a function of rock debris of varying sizes, but otherwise appears stabilized based on mature tree cover. The amount and size of rock debris generally dissipates downhill, further away from the outcrop face, with most surface rock observed within approximately 25 to 30 feet of the outcrop base. The outcrop remains exposed and becomes more competent to the east. Large boulders are present on the slope face just below the outcrop, but these appear to have been in place for a long time. The area with most recent rock debris evidence and outcrop fracturing is on the order of 100 feet wide, as estimated in the field, with the adjacent zone of older rock fall evidence and lesser fracturing an additional 100 feet wide (totaling about 200 feet width).

The proposed outfall path continues to follow the base of the sandstone cliff. The exposure grows to the east but becomes notably more competent with little to no evidence of recent rock fall (Photos 13 – 16). The lower slope below the outcrop is well vegetated with undergrowth, patches of grass, and mature pines. The final segment of the outfall travels a short distance down the slope to the proposed dispersion point atop a sandstone plateau at the shoreline (Photo 17). The level of activity in this area is generally low based on the outcrop competency and underlying slope conditions.

Reconnaissance of Northeast Wetland Areas

Our reconnaissance on June 24, 2024 included traversing portions of the northeast upland area of the property to observe existing conditions downhill of the proposed stormwater dispersion location. We returned for additional observation and supplemental coverage of the northeast area on October 7, 2024. Exhibit B contains photos from the northeast upland area reconnaissance.

Weather conditions during both visits were sunny and dry. The October visit was completed after the onset of fall weather and several rain events in the preceding weeks. On both visits, vegetation in parts of the northeast area was commonly thick to locally impassable, hindering access to some areas (where noted) and generally limiting the lateral extent of visibility. Site-specific GIS maps and hand-held GPS (Avenza) were used for detailed orienteering and location confirmations among the areas of thick vegetation.

Dispersion and Upper Wetland Areas

The June reconnaissance focused on upland Wetland "B" and proximal areas down to the margins of downhill slopes to the east and southeast. The proposed dispersion area runs along a historical road grade that is covered in grass (Photo 1). The design intent is to have the final location and alignment of the spreader system coincide optimally with topography while minimizing or avoiding clearing for its construction in this area (per communication with PSE).

Directly downhill from the historical grade is a short and moderately sloped bank that is blanketed with trees and thick underbrush. After that, overall grades fall to around 15% and continue downhill to the east for roughly 200 feet, through the Wetland "B" area (Photo 2). This area is marginally bound to the south by a small rise in topography, which contributes to a slight elongate bowl shape surrounding the wetland zone. This area is well vegetated with trees and underbrush, but is largely passable aside from pockets of brambles. Ground within the mapped wetland extent was often moist and locally wet in small areas, but no standing water was encountered. The sloping grades throughout this area are expected to preclude major surface water collection. To the east and south of Wetland "B" (Photos 3 & 4), we observed typical upland forest conditions with no sign of stormwater runoff effects (active erosion, channelization, etc.) approaching the steeply sloping areas downhill of this area.

This area was traversed again in October, finding no obvious change in conditions among Wetland "B" and surrounding extents. Ground was locally moist to wet after some early fall rain events but free water was not encountered. The small Wetland "C" was also located and observed to be a pocket of limited brush with some wet-zone vegetation and locally moist ground, appearing to coincide with swale-like topography between two ridge forms (Photos 5 & 6). This feature is isolated among otherwise typical forest areas, and no free water or evidence of significant flow was observed.

Landslide Hazard Area – Slopes & Basin

We attempted to traverse the head-slopes of the Landslide Hazard Area (LHA) in the northeast corner, which is suspected to be a historical zone of instability as discussed in the Element GIR (2022). Only limited access was viable on foot without clearing efforts, due to the combination of thick brush and old deadfall. We accessed the southern third of the slope face with some success, and attempted to view conditions to the north where possible. Then, we accessed the interior of the convergent basin area below the slopes to view general conditions from below.

Upland areas leading down to the crest of the slope within the site and among nearby off-site areas were generally well forested and did not show signs of erosion, settling, or wasting activity (Photos 7 & 8). The crest zone was either rolling or abrupt, varying locally. Abrupt changes were often associated with large and mature "anchor" trees and vegetation clumps (Photo 9). The upper slope face was typically steep and covered in heavy brush with common trees of various size and age, including pines and cedars at least 50 years old. Tree trunks ranged from straight and vertical to somewhat leaning and/or curved (Photo 10). No patterns of lean or back-rotation of trees were observed. We found no runoff channels, large erosion surfaces, recent slumps/translations, or active failure scarps. The main mechanism of slope activity in the present day is interpreted to be shallow soil creep and minor surface raveling or sloughing on the steep grades, which are common factors for steep forested slopes in this region. We were unable to travel directly down the slope into the basin due to impassable brush. Direct observation of the lower part of the slope was not possible. Viewing from the south margin of the basin, we did not see any obvious failures, bare areas, or accumulations on the lower slope or below the slope.

The convergent basin below the LHA slopes consists of lower surface grades leading into the low-lying Wetland "A" area. The transitional lower slope zone was covered in heavy brush and not accessed, but was viewed from within the basin bottom (Photos 11 & 12). We observed ground conditions becoming progressively moist to wet northeastward. Vegetation also changes to wet zone grasses and plants approaching the east site boundary (Photo 14) which is paralleled by a driveway embankment (Photo

15) that effectively confines the basin on that side. At the low-point east margin of the basin, we found the mapped public Storm Drain inlet that leads into the Sea Pines Road system (Photo 16). City of Bellingham maps indicate an outfall for a public storm drain system from Viewcrest Drive located just uphill from the site's northeast corner (shown on Figure 2). We could not access this area from within the site (Photo 13). The presence of the mapped wetland extending well up the slope toward this outfall suggests the conditions are related. It is plausible, if not likely, that the SD outfall is a primary contributor to Wetland "A", and that the accumulation of water in this basin is controlled by the downhill inlet. We did not find or directly observe other seeps in the area.

Lot 37 and Downhill Wetland "D"

The anticipated Lot 37 building area is located directly south of Wetland "A" by approximately 60 feet. The building zone is separated from the wetland basin by a topographic ridge-form that flanks the south side of the basin. The moderate, forested slope face to the south of the ridge form is characteristic of general upland forest areas within the project site (Photos 17 & 18). We saw stable grades and vegetation there, and no sign of wetness or runoff associated with nearby Wetland "A".

Wetland "D" begins at the southwest margin of proposed Lot 37, and extends as a narrow strip in the downhill direction until near the top of the shoreline bluff. Directly uphill of its origin is a steep bedrock outcrop zone. To the northeast and west are typical upland forest areas with moderate to locally steep grades. These conditions continue to flank the wetland strip on either side along its descent, while the wet zone is confined within a narrow natural swale on the order of 10 to 15 feet wide.

We located the top of the mapped wetland, finding wet ground exposed where a large tree had fallen in the past (Photo 19). Nearby rock exposures suggest bedrock is shallow in this area, limiting root depth and contributing to perched water conditions. We followed the upper half of the feature downhill until heavy brush became impassable. The feature was slightly lower compared to flanking slope areas, confining its extent. The feature typically had dark, moist to wet organic soils amid wet zone plants (Photo 20). Minor free water was present, although there was no consistent flow or channelization seen at the time of our visit. The lower end of Wetland "D" was found from below. At its terminus, the wet zone flora ends abruptly into typical brushy undergrowth approaching the lower slope (Photo 21). Along the nearby bluff slope crest, bedrock is exposed and patchy cover soils did not have signs of erosion from excess water flow (Photo 22). We interpret that any excess wet conditions emanating from the Wetland "D" feature are reabsorbed into the ground along the gentle upland grades before reaching the rocky bluff crest.

The Wetland "D" feature is interpreted to be a low energy migration path for runoff and perched water seepage. The origin of wetness is not apparent. Based on the nearby outcrops and fallen tree exposure, we suspect it is due to a combination of shallow restrictive rock and locally convergent topography which tends to concentrate downhill water migration.

Observations of Shoreline Area

During the June 24, 2024 visit, the tide was low and allowed full access to the tidal area below the site. Element performed reconnaissance in the area of the proposed outfall dispersion point, and of other shoreline areas to the southwest for comparison. A photo array (Exhibit C) showing conditions observed along the shoreline is attached in the Appendix.

Proposed Dispersion Location

Dispersion of the primary outfall is proposed to be located atop an existing vegetated rock outcrop, approximately 2 feet above the High Tide Line (HTL). The outcrop is a large sandstone table with grass and small brush vegetation growing on top of and around it. The outcrop is relatively obscured from view by the presence of numerous other outcrops and large boulders along the shoreline in the vicinity (Photo 1). The flat top of the outcrop is roughly 3 to 4 feet above the adjacent soil level of the upper tideland. The adjacent area is interspersed with both old translated large sandstone remnants and local exposures of underlying/partially buried bedrock (either float or in-place; Photo 2).

Upper tidal sediments around and below the dispersion outcrop are composed of sand and gravel with low fines content, based on surface observation and shallow potholing (Photos 3 & 4). The coarse upper tidal sediments extend for several tens of feet out from the rocky shoreline (varying locally) as grade falls gradually at around a 3% to 5% common decline. Past the upper tidal zone is a relatively thin transitional margin (10 to 15 feet wide) composed of mixed coarse and fine sediment, then the lower tidal flat is reached (Photos 5 & 6). Lower tidal sediment is predominantly fine-grained material with rare cobbles and small boulders.

After another approximately 50 feet into the tideland, about 100 feet in total from the shoreline, is a low zone that appears to be a natural preferred tidal flow path. This zone divides the shoreline of the site from the large tidal expanse further out to the southeast. This area was submerged in shallow water at very low tide during our visit. Under present-day existing conditions, there are no other obvious flow paths along the shoreline in this area. Water transmission from upland runoff and tidal fluctuations is presumed to occur in generally distributed flows, over and through the beach sediment.

Existing Stormwater Release (Arbutus Place)

We traversed to the southwest along the shoreline below the project site and continued off-site through similarly undeveloped shoreline area flanked by forested slopes. After a large protruding outcrop is a small, isolated shoreline pocket next to the railroad embankment. This area below Arbutus Place is mapped to contain the shoreline discharge of a large upland public stormwater conveyance system that services the uphill neighborhood and has been in place since 1981 (COB CityIQ GIS). The area around the mapped location of the existing discharge was observed in its current condition with respect to the surrounding shoreline and adjacent lower tidal area.

The point of discharge is obscured by brush and large boulders, and was not observed directly. Per COB CityIQ GIS, the Arbutus Place outfall consists of a direct release from an 18-inch concrete pipe which terminates around the base of the slope near the shoreline. The surrounding upper tidal conditions, consisting of coarse-grained sediments and local bedrock, are similar to that of the project location (Photo 7). A localized drainage “apron” around 10 feet wide emerges from the shoreline at the OHWM. The apron narrows quickly away from the shoreline; after approximately 20 feet it transitions to a discrete flow channel (Photo 8). The channel is a shallow and broad feature with gradual sides that progressively becomes smaller with distance from the shoreline (Photo 9). After about 100 feet, the channel becomes very shallow with little to no confining profile as it traverses the lower tidal zone and turns broadly left to head toward the main outer tidal area (Photo 10). After another approximately 50 feet, the channel feature is indistinguishable and remaining flows distribute over a broad area resembling general tidal conditions.

Historical aerial photos (Exhibit D) were reviewed for context on past conditions at the existing Arbutus Place shoreline outfall. The outfall has been active for approximately 43 years, installed in 1981 (COB CityIQ data). A 1977 photo shows pre-development conditions without visible channelization, although lesser natural flows may have been occurring from a small drainage at this location historically. After approximately 9 years post-establishment, photos from 1990 show a discrete flow channel extending out from the shoreline below Arbutus Place. Higher resolution photos from 2000 and 2006 continue to show the flow channel feature which appears to be maintaining a similar morphology through that timeframe (approximately 20 to 25 years post-establishment). Photos from 2016 and 2024 show no notable change from that of a discrete flow path which dissipates into the nearby lower tidal area.

<u>Commentary on Potential Impacts</u>

The conditions at the shoreline around the proposed dispersion location are interpreted to have a relatively low and localized susceptibility to erosion associated with overland water flow within the upper tidal area. Surface sediments in the upper tidal zone are also subjected to the effects of tidal fluctuations and wave action daily, which is likely to have a dampening effect on progressive changes to the landscape. The dispersion of stormwater from a spreader pipe over bedrock will further help to mitigate channelization at the discharge point. However, it is reasonable to anticipate some cumulative effect will result from stormwater release at one location over a long timeframe. In our opinion, the most likely effect is localized flow channeling from the release area leading outward through the upper tidal and transitional zones. Flows are likely to be directed generally down-gradient towards the closest preferential flow zone of the bay interior, which is roughly 100 feet out from the shoreline at this location. This natural tidal flow area is interpreted to provide a backstop for any localized channeling resulting from long-term stormwater-related flows.

The existing outfall below Arbutus Place provides a comparison opportunity for potential impacts to tidal area conditions. Based on review of COB CityIQ GIS mapping of stormwater conveyance in the area, the Arbutus Place outfall appears to serve a cumulative extent larger than that of the project site. We have observed during shorefront reconnaissance, and by review of historical aerial photos, that associated effects to the upper tidal area from the Arbutus Place outfall are localized and relatively minor in nature after 43 years in service. No discernable impacts were seen to the main tidal extent past the local flow channel which dissipates progressively from the shoreline. This comparison location does not appear to have experienced impacts resulting in a loss of shoreline and tidal area function.

We interpret, from a geotechnical perspective, that the proposed outfall for the project is not likely to result in significant impacts to the shoreline and tidal area beyond those seen at the comparative location. Nor do we anticipate impacts resulting in a loss of function to the shoreline environment adjacent to the site.

Recommendations for Stormwater Outfall Design & Construction

Based on this review of the proposed stormwater outfall concept, which has included targeted field reconnaissance along with review of maps and current plans, it is our opinion that the stormwater conveyance pipe as generally intended in the preliminary plat plans is feasible for construction. Among most areas along the alignment as currently concepted, slope conditions are clearly amenable for outfall construction and pose no obvious risk from instability, construction difficulties, or potential risks to an exposed surface pipe system from surrounding factors. This determination of feasibility is based on our substantial experience with stormwater tightline construction in steep slope environments, and industry standards of practice. For select areas presenting localized risk potential and construction challenges, additional consideration and input for final design is provided below.

Discussion of Key Areas

Two areas of greater-than-typical challenge for tightline installation have been identified which pose unique difficulties that must be addressed in final design and construction. The approximate locations and extents of these areas are noted on Figure 3. For the purposes of this review, we have assumed that the general routing concept as shown on the Preliminary Plat drawings will be pursued for final design.

Upland Slope Small Outcrop Zone: This zone may present difficulties for conveyance pipe construction and long-term outfall security due to the variability in topography as a function of the local rock outcrops. With careful planning and preparation of a suitable corridor the depicted route is expected to be viable, although pipe installation could incur greater-than-typical efforts and costs to do so.

- We encourage additional detailed reconnaissance and collaboration during final design to assess for routes for optimal avoidance of specific outcrop obstructions. For instance, an angled segment through Lots 30 and 31 may be considered as an alternative to the right-angle junction shown.

Bluff Slope Rock Fall Zone: After descending onto the lower bluff slope, the conveyance piping is proposed near the base of the tall rock exposure. While the eastern majority of this rock face appears intact with a low rock fall risk, the western portion appears prone to occasional rock fall from fractured outcrops. In particular, the first approximately 100 feet along the cliff face displays an elevated risk of incidental rock fall. This is evidenced by common rock talus on the underlying slope which generally dissipates out from the outcrop. The next roughly 100 feet of slope also has common older rock debris but little evidence of recent activity.

- One method to mitigate rock fall hazard from the cliff band is to adjust the alignment to traverse across the slope further away from the cliff exposure below elevated hazard areas. The hazard of rock fall directly impacting a downhill pipe generally lessens with distance from the source.

  - A downslope shift on the order of 50 feet is interpreted to be sufficient to minimize rock fall impact risk, based on conditions observed during the recent reconnaissance. We recommend an alignment shift below the elevated hazard areas be considered for final design. Site conditions should be re-observed during final design to optimize the outfall path for rock fall protection.
  - Constraints on pipe elevations appear to allow for such a downhill alignment adjustment while retaining suitable fall to reach the proposed terminus location. Our observation and map review of the conveyance zone also indicate there is adequate room along moderate slope areas to allow for an adjusted pipe alignment.

- Alternatively, or in tandem with a shift, the conveyance pipe should be constructed with additional shielding from rock fall impacts as needed for the final design location. Possible options include natural barriers (use of existing rock talus and large boulders for upslope shielding), or sleeving / covering the HDPE pipe with another material for impact protection where necessary (like concrete or steel casing).
- In addition to the above protective mitigations, shallow burial or inset of the pipe into natural topography will help minimize the potential for dislodged rolling or sliding rock debris to “catch” on the pipe as it travels downslope. We recommend the pipe placement be optimized to minimize a surface debris “catch” hazard by use of shallow embedment.
- The recommendations above are provided to offer guidance from conceptual to final design. We recommend detailed field review during final design to evaluate conveyance pipe placement, and to determine the extent and methods of additional protections, where deemed necessary by detailed review. Additional or revised recommendations may be issued at that time.
- For the purpose of this review, we have not discussed complete alternate alignments to reach the proposed dispersion location, nor use of other outfall points at the shoreline. We recognize other potential options were previously evaluated by PSE, with the most current version representing the preferred concept in consideration of a number of factors. If the conveyance concept is substantially revised, we recommend additional review be completed to assess its viability from a geotechnical and geologic hazard perspective.

Additional Outfall Construction Guidance

Based on our past experience with similar projects and conditions, we offer the following additional general guidance typical for outfall construction. Contact Element Solutions for additional outfall design, construction, and anchoring guidance as needed.

- Avoid or minimize vegetation clearing and ground disturbance on slopes during outfall installation. Avoid removal of or impacts to mature, healthy trees.
- Stabilize locally disturbed areas resulting from outfall installation once complete using a combination of planting and erosion control surfacing suitable for the location.

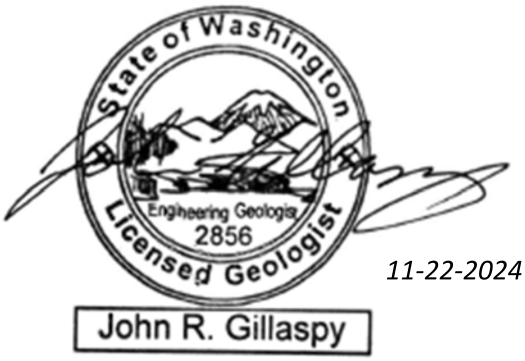
- Employ welded HDPE pipe materials for above-grade tightlines. Route the pipe suitably to avoid unnecessary stress or risks of damage to the pipe due to surface variations.
- Recommended minimum criteria for pipe anchoring of the HDPE tightline:
  - Install anchors within 10 feet of the daylight point and downhill terminus. Employ additional anchors at deflection points in the alignment, around significant changes in topography, and near pipe connections with catch basins to minimize the risk of pipe movement impacting these installations.
  - Install anchors spaced generally every 50 feet. For areas of steeper slopes or more variable topography, a lesser spacing of 25 feet is advised.
  - Use a slip collar system with ground anchors that allows for expansion/contraction of the HDPE pipe while limiting lateral and vertical movement.
  - Embed anchors (such as driven pipe stakes, helical screws, pull-back tension rods) sufficiently into firm soil to provide effective pull-out strength.
  - Use appropriate anchors for the subsurface conditions present. Driven stakes are commonly utilized, and may be preferable under a larger range of conditions to a flip-out-style tension anchor rod. Helical screw-style stakes can be substituted in construction if necessary due to driving difficulties or poor anchor seating amid local soil conditions at anchor locations.
  - Where suitably intact, in-place rock is present at the surface, anchoring can be attached to rock by use of epoxied threaded dowels.
  - The project geologist should be consulted on anchor placement and installation methods during construction.
- Design the shoreline Dispersion Tee so that it is sufficiently secured and resistant to damage from storm surge wave events.
  - Anchor the Dispersion Tee directly to the rock shelf by use of epoxied dowels and collars to the extent that it is not at risk of loss or dislodgement from a maximum potential storm wave magnitude.
  - Select a Dispersion Tee material that is suitably resistant to potential impacts from wave-generated debris anticipated for the location. High wave activity is not expected in this area due to the BNSF causeway which acts as a breakwater during storm events.

Closing

We recommend that Element Solutions be given the opportunity to review final design plans and details for the stormwater outfall and related stormwater management system components. We encourage the design team to consult with Element prior to or during design to address specific challenges noted for outfall conveyance pipe routing and construction. Element will be pleased to provide additional geotechnical support as needed for final stormwater outfall planning and design for the project.

Thank you for the opportunity to contribute our expertise to your project. Please feel free to contact us at (360) 671-9172 if you have any questions or comments regarding this report.

Sincerely,



11-22-2024

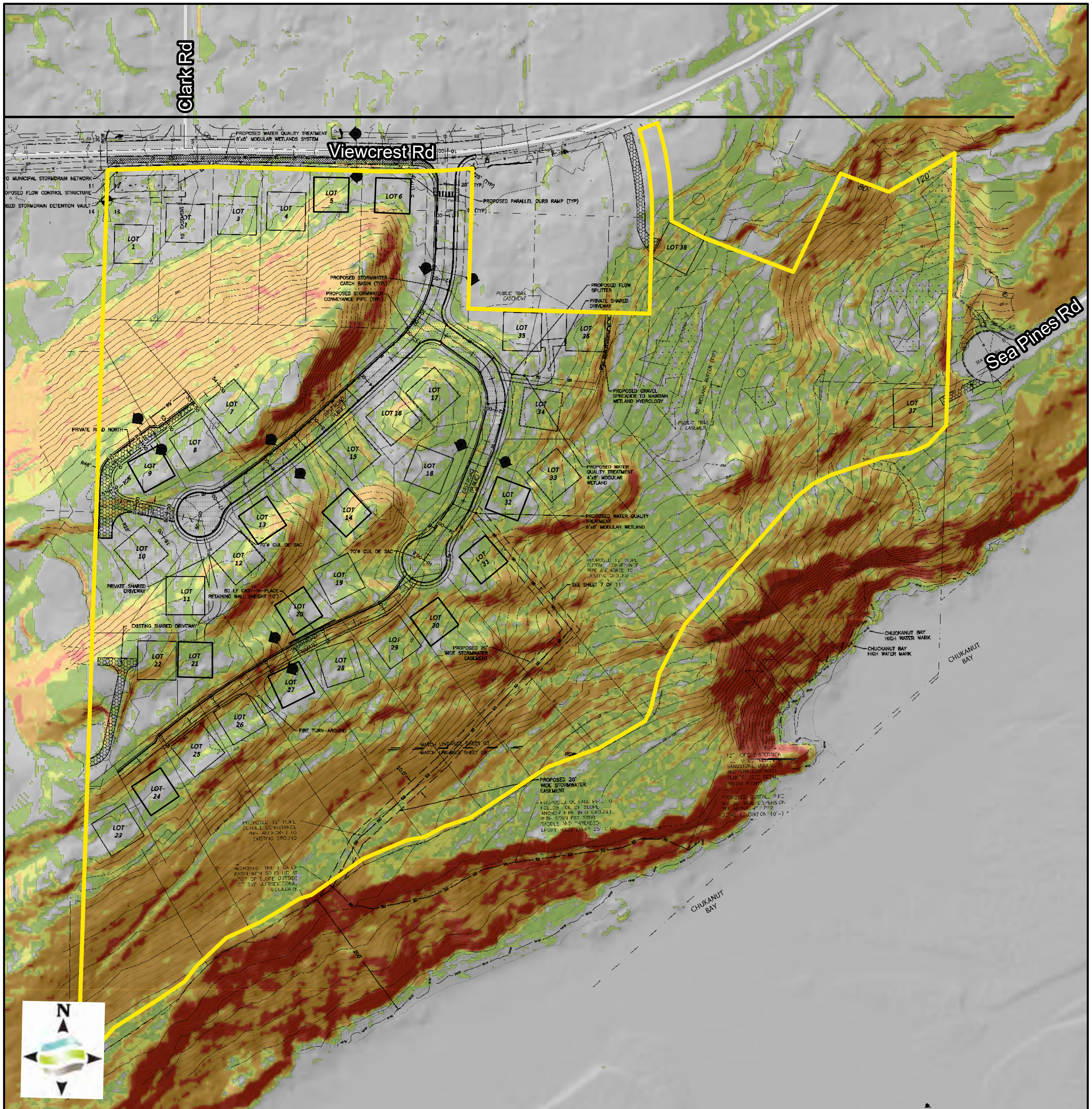
John Gillaspy, LEG
Environmental Services Manager

Attached: Figures 1 to 3 – GIS Maps with Proposed Stormwater System Plan Overlay
Exhibits A to C –Photos of Site Conditions (Element; 6-24-2024 & 10-7-2024)
Exhibit D – Historical Shoreline Aerial Photos (WA DOE Collection)
*The Woods at Viewcrest Preliminary Plat (*Pacific Surveying & Engineering, 12-1-2023*)*:
Road & Stormdrain Plan (Sheet 7), Stormwater Outfall Plan (Sheet 8)

Statement of Limitations

This document has been prepared by Element Solutions for exclusive use and benefit of the client. No other party is entitled to rely on any of the conclusions, data, opinions, or other information contained herein. This document represents Element Solution's best professional judgment based on the information available at the time of its completion and as appropriate for the project scope of work. Services performed in developing the content of this document have been conducted in a manner consistent with that level and skill ordinarily exercised by members of the geologic engineering profession currently practicing under similar conditions. No warranty, expressed or implied, is made.

If the client elects to retain another consultant to continue work on the project in a similar capacity, that firm or individual must be responsible for fully reviewing this report and any associated documents. They shall either accept responsibility for the findings and implementing the recommendations presented in this report, or shall offer their own conclusions and recommendations superseding those of Element Solutions as they see fit. In no way will Element Solutions be held responsible for misapplication or disregard of our recommendations by the client, contractors, or other consultants. Element Solutions is not responsible for misuse or misunderstanding of our recommendations, and recommends that we be contacted in the event that clarification or guidance is needed. Non-compliance of these stipulations or to the recommendations in this report will release Element Solutions from any associated liability.



Data Credits:
[Parcels] Whatcom County 2018
[Roads] COB 2018
[Lidar] COB 2013

Development Area
Roads

percent_slope

0 - 15
15 - 30
30 - 40
40 - 80
80 +

*Contours Shown are From Survey by PSE

Feet
0 55 110 220 330 440 550

1:2,700

909 Squalicum Wa Ste 111
Bellingham, WA 98225
info@elementsolutions.org
Phone: 360. 671. 9172

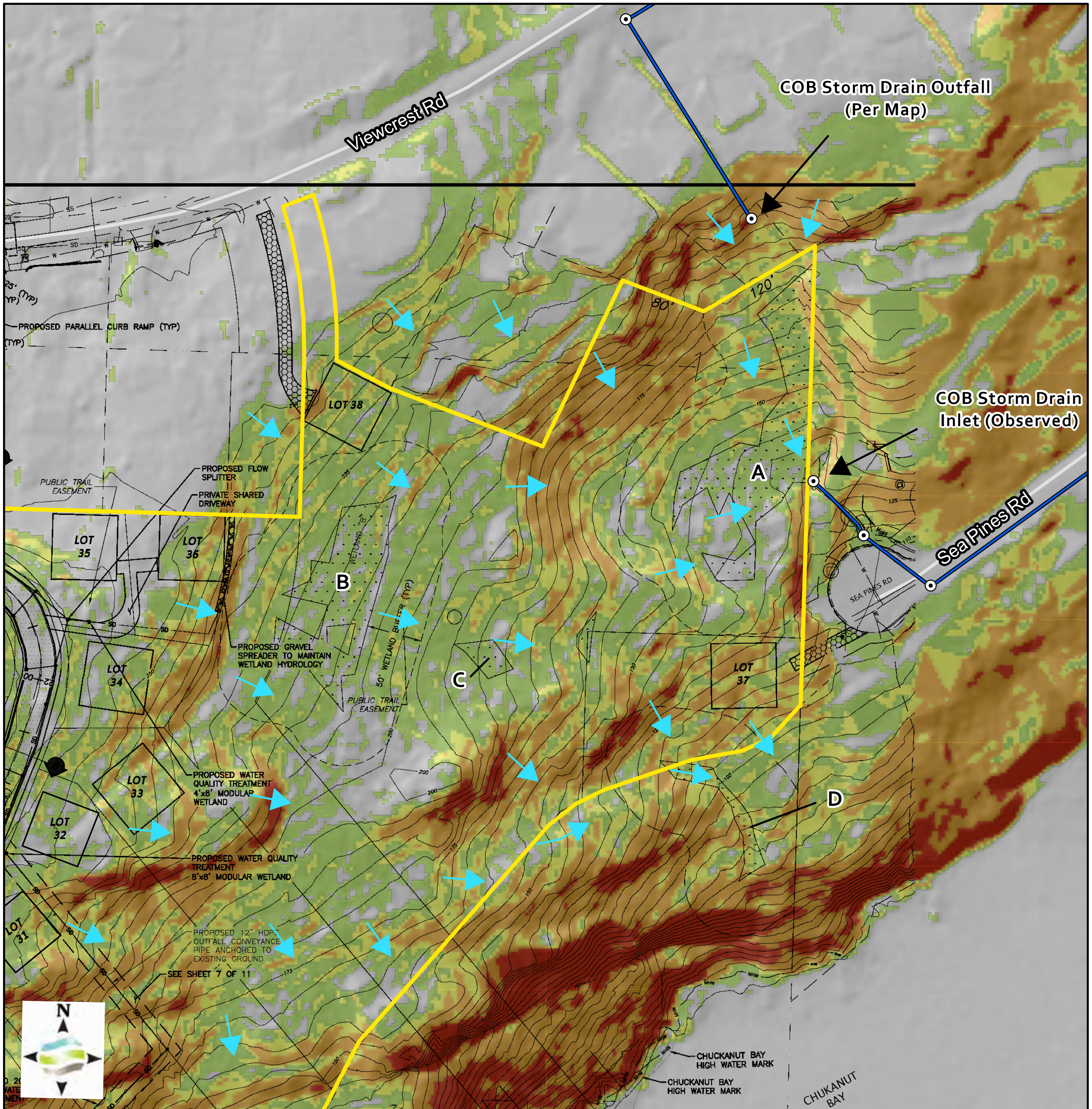
ELEMENT solutions

Figure 1

Viewcrest Plat
Jones Edgemoor GHA Review
Percent Slope Map - Entire Study Area

Date: 10/18/2024

P:\Pse Project\2020094\ENVRMNT\GIS\2024 GIS\2024 Master Map.aprx



Data Credits:
[Parcels] Whatcom County 2018
[Roads] COB 2018
[Lidar] COB 2013

Development Area
Roads

percent_slope
- 0 - 15
- 15 - 30
- 30 - 40
- 40 - 80
- 80 +

Interpreted Surface Water Flow Path

*Contours Shown are From Survey by PSE

Feet
0 30 60 120 180 240 300

1:1,600

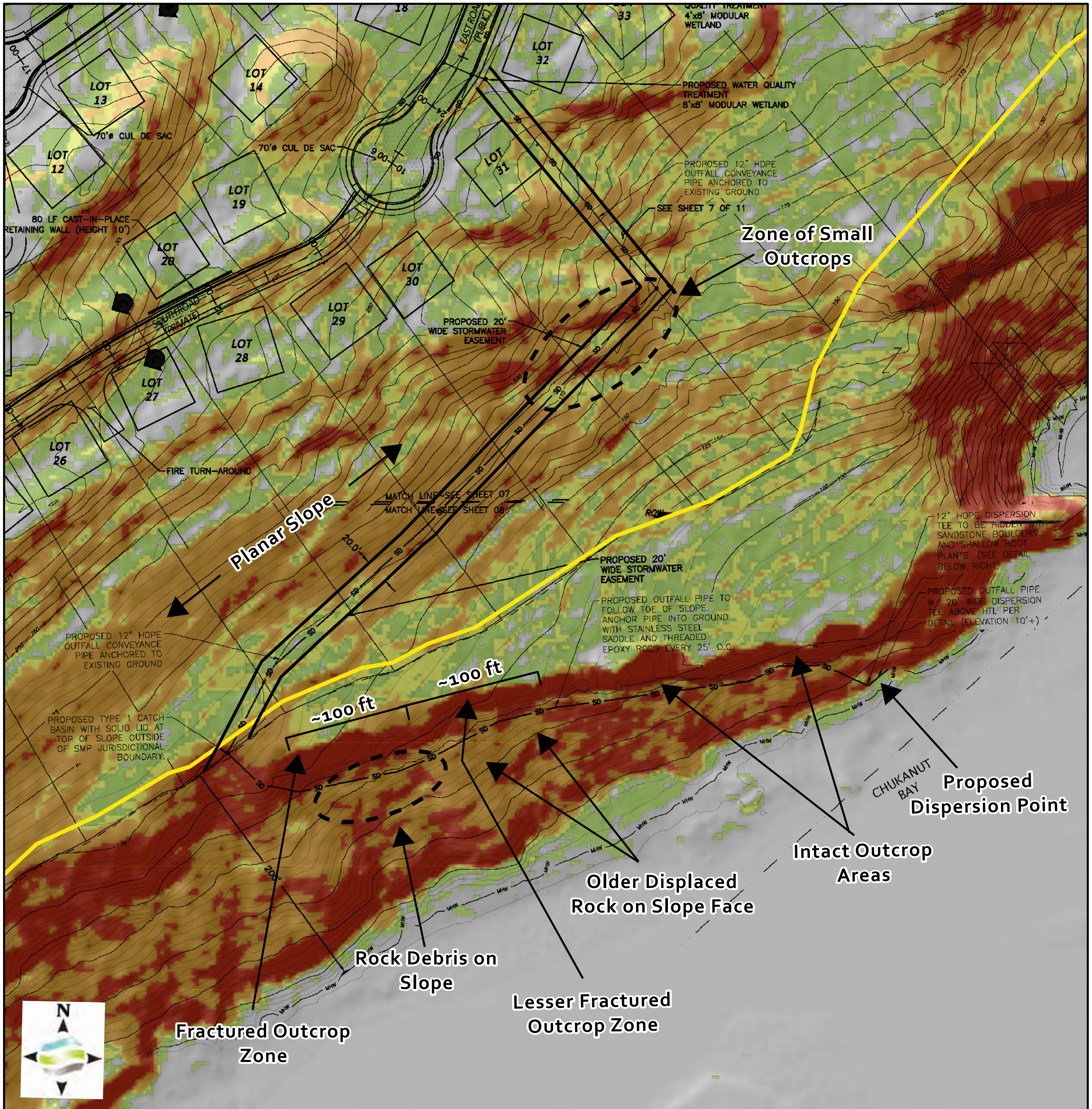
909 Squalicum Wa Ste 111
Bellingham, WA 98225
info@elementsolutions.org
Phone: 360. 671. 9172

ELEMENT solutions

Figure 2

Viewcrest Plat
Jones Edgemoor GHA Review
NorthEast Region

Date: 10/18/2024



Data Credits:
[Parcels] Whatcom County 2018
[Roads] COB 2018
[Lidar] COB 2013

Development Area
Roads
percent_slope
0 - 15
15 - 30
30 - 40
40 - 80
80 +
*Contours Shown are From Survey by PSE

Feet
0 30 60 120 180 240 300

1:1,500

909 Squalicum Wa Ste 111
Bellingham, WA 98225
info@elementsolutions.org
Phone: 360. 671. 9172

ELEMENT solutions

Figure 3

Viewcrest Plat
Jones Edgemoor GHA Review
Southern Region

Date: 10/18/2024

P:\Pse Project\2020094\ENVRMNT\GIS\2024 GIS\2024 Master Map.aprx

Exhibit A – Field Photos of Slope Conditions (June 24, 2024)

Photo 1: Upper slope conditions near top of SW outfall path, looking uphill.

Photo 2: Upper slope conditions near top of SW outfall path, looking downhill.

Photo 3: View to southwest from turn in alignment along proposed path with rock outcrop to right.

Photo 4: Looking uphill toward area of outfall path passing from right to left through extent of outcrop.

Photo 5: View along main outfall path across planar slope. Looking SW. Taken near end of outcrop zone.

Photo 6: View to SW along outfall path across slope face. Location further to west of #5.

Photo 7: Looking at location of catch basin proposed near top of bluff (out of photo to right).

Photo 8: View uphill from location of catch basin. No evidence of slope activity and mature vegetation.

Photo 9: Looking up at slope face at entry of outfall onto lower bluff.

Photo 10: Fractured area of sandstone outcrop with loose rock exposed.

Photo 11: Slope face below fractured outcrop. Note rock fall debris in foreground.

Photo 12: Sandstone outcrop becomes more competent / less fractured to east.

Photo 13: View across lower slope below large sandstone outcrop. Looking east.

Photo 14: View of large intact bedrock face with forested slope below. Looking west.

Photo 15: Large intact sandstone bedrock face near east end of conveyance alignment. Looking east.

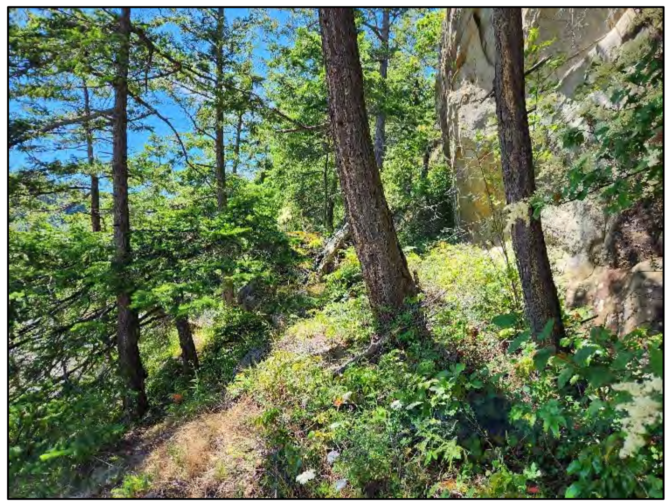


Photo 16: View of slope face below large sandstone cliff (near #15).

Photo 17: Looking down slope at proposed outfall release location above tidal beach.

Exhibit B – Field Photos of Northeast Upland Area (June 24 & October 7, 2024)

Photo 1: View along area of proposed dispersion spreader at west edge of Lot 38. (6-24-24)

Photo 2: View to North across Wetland "B" area downhill to east of planned dispersion area. (6-24-24)

Photo 3: View to East downhill from Wetland "B" toward small Wetland "C" and forest area. (6-24-24)

Photo 4: Gentle forested upland area to south of Wetland "B". (6-24-24)

Photo 5: Small Wetland "C" area, looking to northwest. (10-7-24)

Photo 6: Small Wetland "C" area, looking downhill to east along minor convergence in grades. (10-7-24)

Photo 7: Upper slope leading into LHA area from off-site lots. Looking North from site boundary. (10-7-24)

Photo 8: Typical upland forest conditions approaching LHA slope crest within site, looking East. (10-7-24)

Photo 9: LHA slope crest along south area of slope, looking South downhill of proposed Lot 38. (10-7-24)

Photo 10: LHA slope face. Looking North toward middle of slope. (10-7-24)

Photo 11: View Northwest through LHA basin / Wetland "A" area from South end. (10-7-24)

Photo 12: Conditions in middle of LHA basin / Wetland "A" area. (10-7-24)

Photo 13: Within middle of LHA basin, looking North up brushy slope toward mapped SD outfall. (10-7-24)

Photo 14: Wet ground and plants concentrated along East margin of LHA basin. (10-7-24)

Photo 15: Within east side of LHA basin, looking east toward SFR driveway embankment. (10-7-24)

Photo 16: Found SD inlet at East edge of LHA basin and site, leads to Sea Pines Road utility. (10-7-24)

Photo 17: Moderate forested slope conditions at Lot 37 building zone, looking West. (10-7-24)

Photo 18: Moderate forested slope conditions at Lot 37 building zone, looking Southeast. (10-7-24)

Photo 19: Uphill end of Wetland "D" with fallen tree remains and wet ground below. (10-7-24)

Photo 20: View down-gradient along strip of Wetland "D". (10-7-24)

Photo 21: Downhill terminus of Wetland "D" above bluff slope. (10-7-24)

Photo 22: Rocky bluff slope crest near end of Wetland "D". (10-7-24)

Exhibit C – Field Photos of Shoreline Conditions (June 24, 2024)

Photo 1: View of site shoreline from tidal zone at proposed dispersion area.

Photo 2: Dispersion is proposed atop the flat "table" outcrop situated among a rocky area.

Photo 3: Profile view of dispersion outcrop and upper tidal conditions below.

Photo 4: Upper tidal sediments consist of coarse-grained sand and gravel.

Photo 5: View to east from near dispersion area showing lower tidal conditions

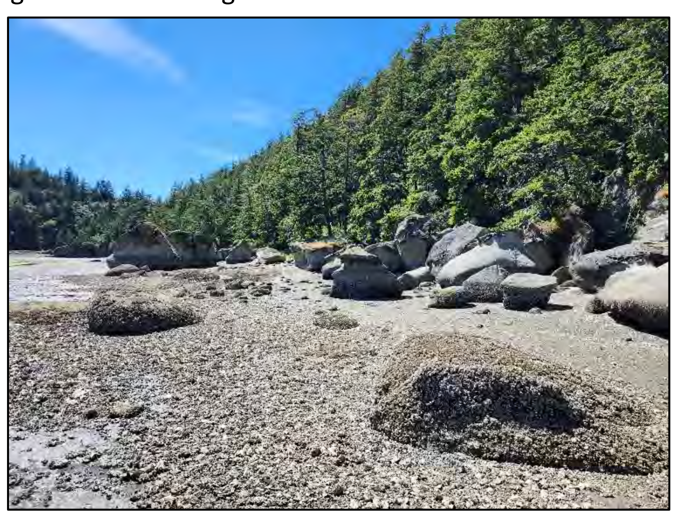


Photo 6: View to southwest from near dispersion area showing transition zone between upper and lower tidal areas.

Photo 7: View of shoreline at location of existing stormwater release below Arbutus Place.

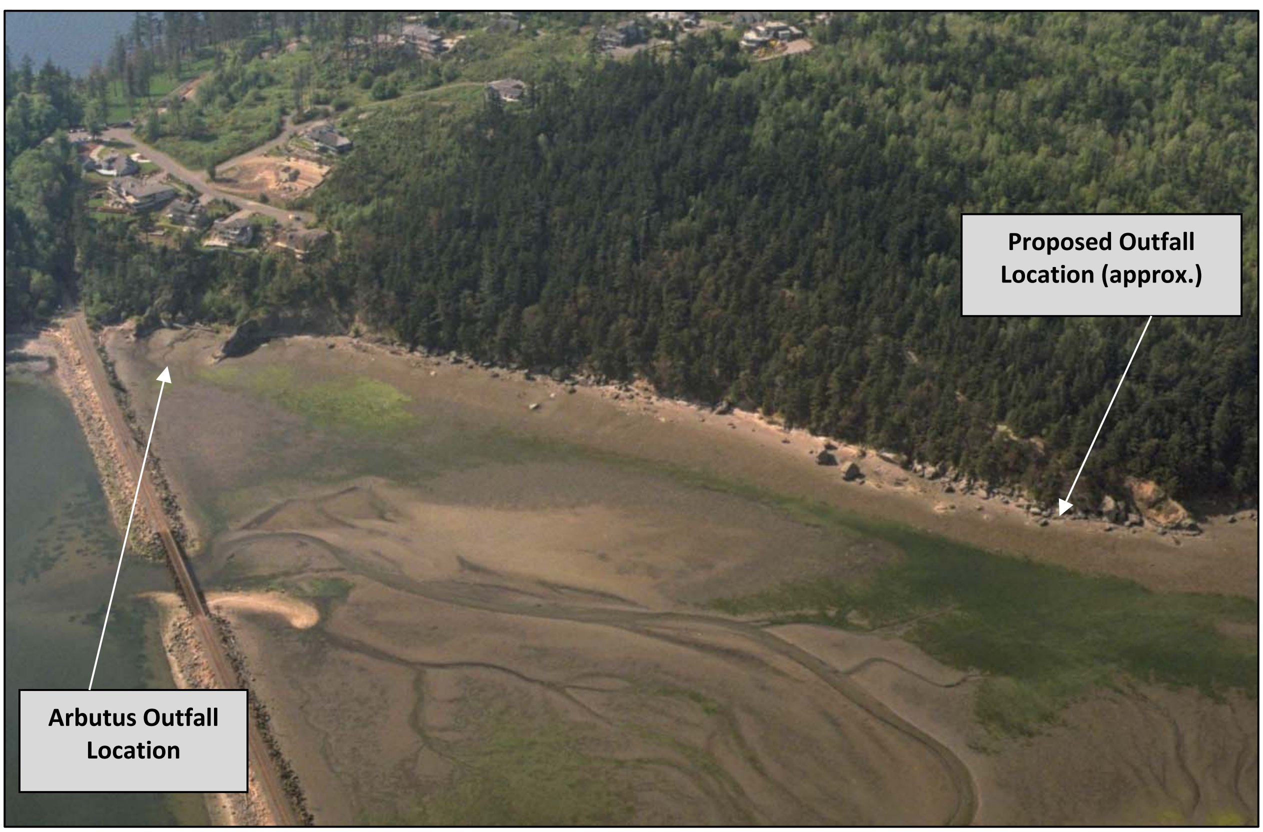
Photo 8: View out from shoreline next to emergence point of existing release.

Photo 9: Closer view of flow channel conditions through upper tidal area.

Photo 10: View of channel through transitional zone heading into lower tidal area where it becomes indistinguishable.

Exhibit D – Historical Aerial Photos (DoE Shorelines Collection)

1977



1990


Arbutus Outfall
Location

2000


6/28/2006 3:15 PM
Arbutus Outfall
Location

2006

2016

2024 (Google Earth Imagery)

CALL BEFORE YOU DIG 1-800-424-5555

REVISION	DATE	DESCRIPTION	ISSUE	DATE	DESCRIPTION
			1	9/13/2021	PRELIMINARY SITE PLAN
			2	10/18/2022	COB RFI REVISIONS
			3	6/09/2023	COB RFI 2 REVISIONS
			4	12/01/2023	COB RFI 3 REVISIONS

ANN C. JONES FAMILY LP
807 CHUCKANUT SHORE ROAD
BELLINGHAM, WA 98229

THE WOODS AT VIEWCREST
ESTATE PLANNING
SITE IMPROVEMENTS

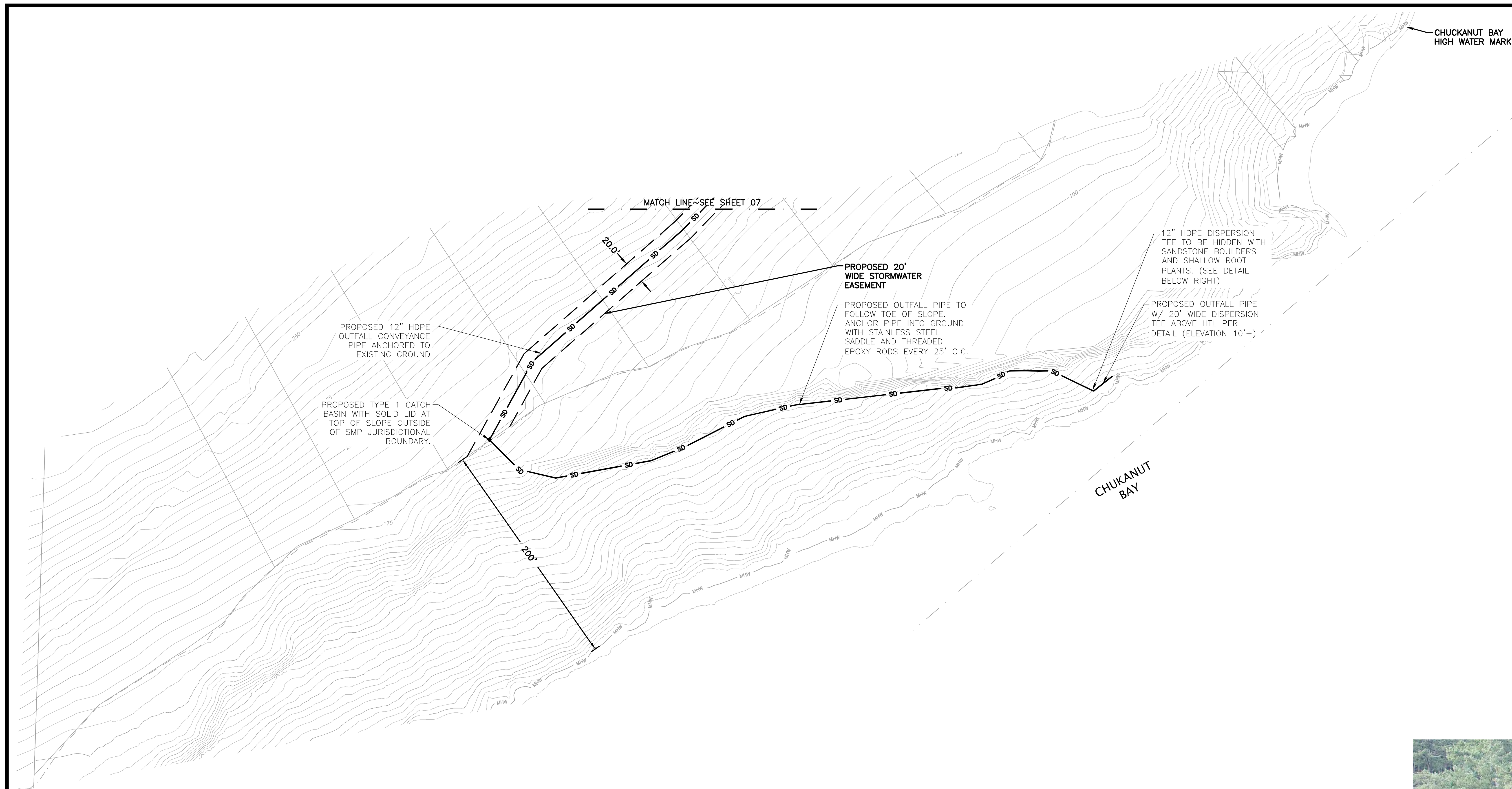
ROAD & STORMDRAIN PLAN

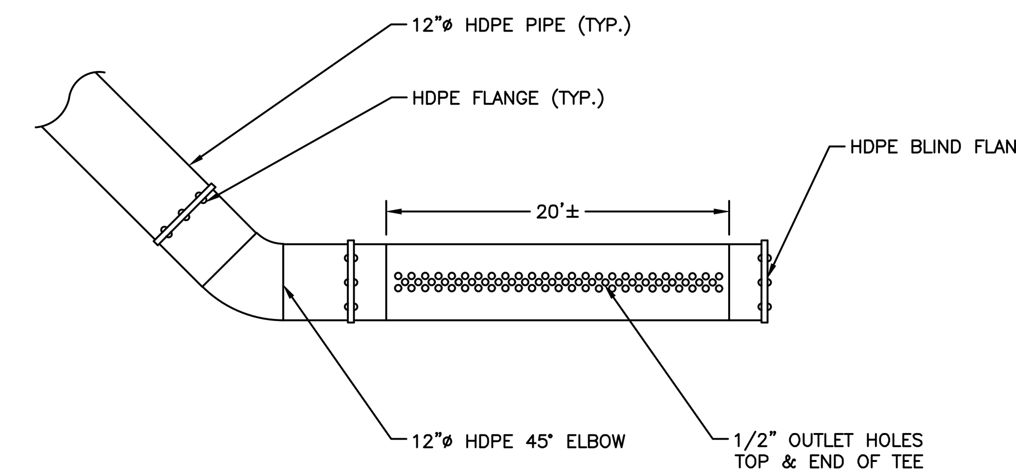
PSE
PACIFIC SURVEYING & ENGINEERING, INC.
909 Squalicum Way, Suite 111 | BELLINGHAM, WA 98225
T: 360.671.7387 | F: 360.671.4685
WWW.PSESURVEY.COM | INFO@PSESURVEY.COM

DATA	DRAWN BY	CHECKED BY	FIELD BOOKS	
BASE	–	–	DESIGN:	–
DESIGN	RIR	JVY	STAKING:	–
XREF:	–		ASBUILT:	–
JOB#: 2019196			DATUM	
HORIZ. SCALE: SEE GRAPHIC SCALE			HORIZ.:	NAD83
VERT. SCALE: AS NOTED			VERT.:	NAVD88
DWG: P:\Pse Project\2019196\DWGs_SHEET\2019196_ecP_SP.dwg				

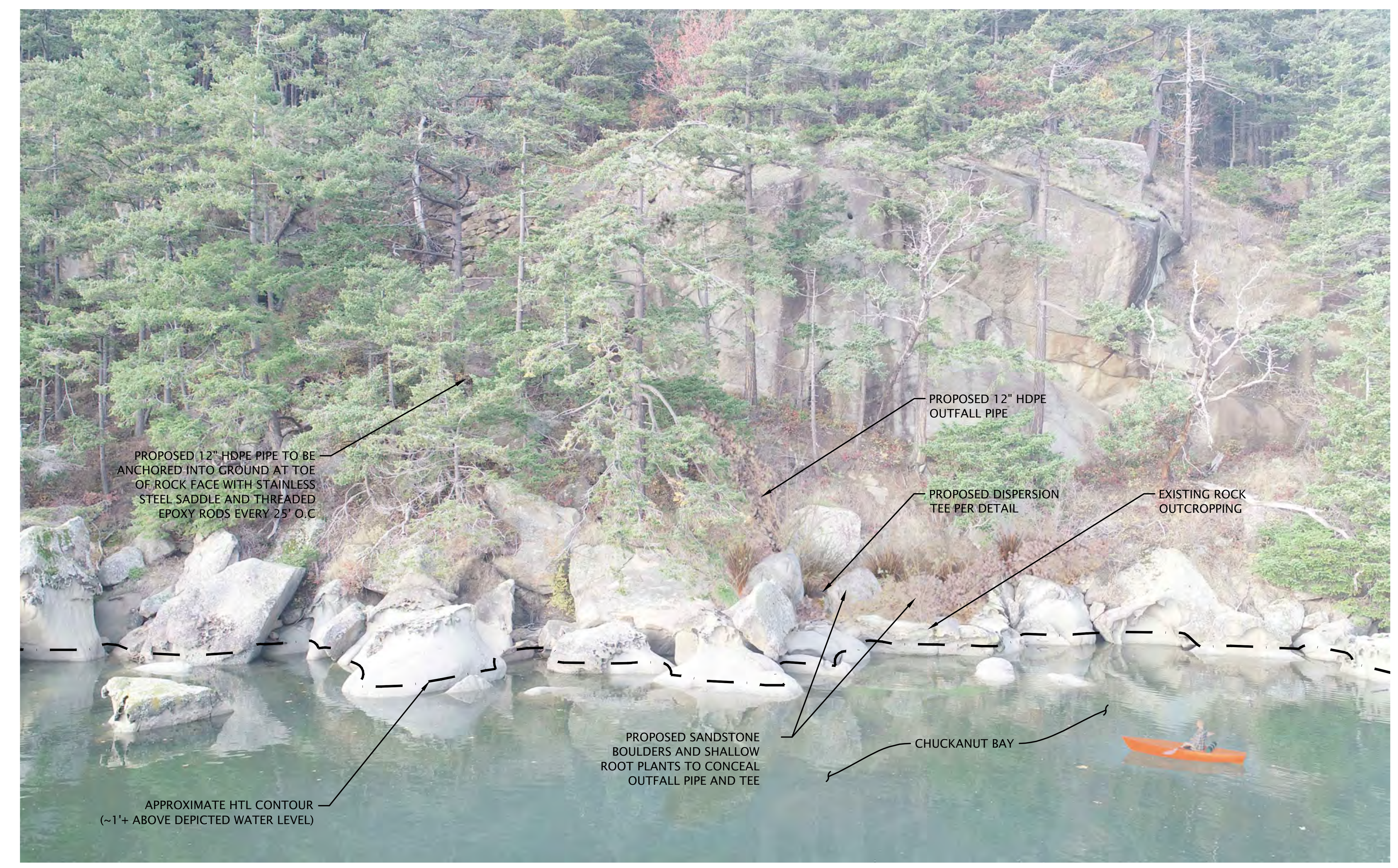
SHEET 7 OF 11

STATE OF WASHINGTON
37432
REGISTERED PROFESSIONAL ENGINEER
12-01-2023





FLOW DISPERSION TEE DETAIL



STORMWATER OUTFALL PIPE RENDERING

NTS

CALL BEFORE YOU DIG 1-800-424-5555

REVISION	DATE	DESCRIPTION	ISSUE	DATE	DESCRIPTION
			1	9/13/2021	PRELIMINARY SITE PLAN
			2	10/18/2022	COB RFI REVISIONS
			3	6/09/2023	COB RFI 2 REVISIONS
			4	12/01/2023	COB RFI 3 REVISIONS

ANN C. JONES FAMILY LP
807 CHUCKANUT SHORE ROAD
BELLINGHAM, WA 98229

THE WOODS AT VIEWCREST
ESTATE PLANNING
SITE IMPROVEMENTS

STORMWATER OUTFALL

PACIFIC SURVEYING & ENGINEERING, INC.
909 Squalicum Way, Suite 111 | BELLINGHAM, WA 98225
T: 360.671.7387 | F: 360.671.4685
WWW.PSESURVEY.COM | INFO@PSESURVEY.COM

DATA	DRAWN BY	CHECKED BY	FIELD BOOKS	
BASE	–	–	DESIGN:	–
DESIGN	RIR	JVY	STAKING:	–
XREF:	–		ASBUILT:	–
JOB#:	2019196		DATUM	
HORIZ. SCALE:	SEE GRAPHIC SCALE		HORIZ.:	NAD83
VERT. SCALE:	AS NOTED		VERT.:	NAVD88
DWG: P:\Pse Project\2019196\DWGs_SHEET\2019196_ecP_SP.dwg				
SHEET 8 OF 11				

JEFFREY A. VANDER YACHT
STATE OF WASHINGTON
37432
REGISTERED PROFESSIONAL ENGINEER
12-01-2023