LORING ADVISING

By Email

April 19, 2024

Skagit County Hearing Examiner
Skagit County Planning and Development Services
1800 Continental Place
Mount Vernon, WA 98273
hearings@co.skagit.wa.us

Re: File No. PL16-0056 – Applicant's Review on Second Remand & Third-party review

Dear Mr. Hearing Examiner,

I am submitting this letter and the attached opinion letter from Dan McShane on behalf of Evergreen Islands ("Evergreen") to address the February 29, 2024 report that Northwest Groundwater Consultants ("NGC Report") provided in response to the second remand for the Lake Erie Pit application. This letter also addresses the third-party review by Alan Wald ("Wald Review") that purports to evaluate the NGC Report.

Distressingly, and notwithstanding that this is the third chance the applicant has had to legitimately evaluate the landslide risk likely to be caused by clearing and mining 35 acres near unstable coastal bluffs, the NGC Report fails to analyze the risk that groundwater infiltration from the new mining will significantly increase groundwater discharging from springs in those bluffs that are located 22 feet lower/downgradient. Instead, the report speculates that non-existent bedrock deflects groundwater flow and that rain does not infiltrate into the ground at the site, and overlooks similarities in water quality between wells near the site and the spring. We note that the author of the NGC Report is the same person who authored the hydrogeologic site assessment and well reports between 2016 and 2019 and who relied on incomplete information to assume that groundwater flows to the north and northeast of the site. This may explain the NGC Report's inability to recognize the compelling data indicating a robust hydrological connection between the groundwater at the mine and at the spring to the northwest.

Regardless of the reason, the applicant has repeatedly demonstrated an unwillingness to evaluate the landslide risks associated with the proposed mine, and Evergreen Islands therefore requests that Skagit County deny the application. Evergreen Islands does not make this request lightly, but nearly eight years have passed since submission of the initial application and the community has yet to receive a valid investigation into the mine's potential impacts on the nearby unstable bluffs. Indeed, more than 2 ½ years have passed since the applicant obtained, and subsequently discarded, a proposal designed to elicit this essential information. Denial is the reasonable, warranted response at this point. The applicant can then decide whether it would be worthwhile to conduct a valid geologic hazard site assessment and, if so, reapply for the mining project with that information.

The sections below summarize the factual background and the standards for the preparation of an Assessment, and then identify the flaws in NGC's work and the Wald review, as explained in greater detail in the attached opinion letter by Dan McShane. The letter concludes by comparing insufficient review with the study that would have occurred if the applicant had allowed the consultants they hired in 2021 to conduct their assessment.

Mr. McShane has spent considerable time investigating the geology of the neighborhoods surrounding the site and emphatically disagrees with NGC's assertion that groundwater at the site flows primarily to the northeast and that stormwater does not infiltrate into groundwater within the 35 acres proposed for mining. He also expresses severe concerns about Mr. Wald's misrepresentation of local science about the coastal geology west of the site. Mr. McShane concludes that "[t]he water elevations at MW01 and North Spring clearly show a steep gradient in the groundwater towards the shoreline bluffs. Expansion of the mine will increase groundwater recharge to the mine and result in an increase of water flowing to the bluffs. It is my opinion that this will result in an increase of the frequency of saturated soils and increased high pore water pressures leading to an increase in the frequency of slope failures."

A. BACKGROUND

This matter involves a proposal by Lake Erie Pit 1 ("Applicant") to clear more than 35

acres of trees, shrubs, soil, and a layer of glacial till, and to mine approximately 60,000 tons of underlying gravel. On February 23, 2021, the Skagit County Board of Commissioners ("Board") reversed a Hearing Examiner approval for Special Use Permit PL16-0556 on the grounds that the Applicant had not conducted a Geologically Hazardous Area Site Assessment ("Assessment") and that Appellant Evergreen Islands had furnished evidence of springs discharging from unstable shoreline bluffs at an elevation downgradient of the inferred groundwater level at the mine. The Board consequently remanded the matter to determine whether the shoreline bluffs required the preparation of an Assessment, and if so, to have one conducted and conditions imposed as necessary to mitigate identified risks. In August 2022, the Applicant provided a report by Wood Environment & Infrastructure Solutions, Inc. that omitted a review of potential hydrogeological impacts on the unstable bluffs to the northwest. After a third-party report for Skagit County ("County") likewise overlooked these potential mine impacts and the Hearing Examiner again granted the permit, Evergreen Islands appealed the lack of analysis of landslide risk to the Board.

On October 6, 2023, for the second time, the Board granted the appeal and remanded this matter for the preparation of an Assessment.[1] The Board ruled that the Assessment must be consistent with the requirements of SCC 14.24.400-.420, including but not limited to SCC 14.24.420€ and (f). The Board directed the Hearing Examiner to consider any necessary evidence and to impose any additional conditions warranted by the foregoing analysis. The Board expressly directed that "additional physical investigation and analysis will be performed to assess the north/northwest groundwater flow and potential impacts under different mine development scenarios, rather than mere validation of the inferences and methodologies used in the original Maul Foster report."[2]

The Applicant subsequently obtained a report from NGC that involved the drilling of two new monitoring wells (denoted MW-1 and MW-2) and a snapshot of groundwater elevations

[1] Resolution # R20230197, at 4.
[2] Resolution # R20230197, at 4.

and water quality samples from those wells, a few private wells, and nearby springs.[3] The NGC Report states that the two monitoring wells were drilled in locations to investigate groundwater conditions in the north and west portions of the site, but an attached map shows that neither of them were drilled in the mine expansion area.[4]

Based on a limited sample of a single groundwater elevation measurement, the NGC Report shows that the groundwater elevation at North Spring, in the coastal bluff northwest of most of the mining area, is much lower than groundwater elevations measured in the other observed wells.[5] The North Spring discharges at an elevation of 169.3 feet, whereas groundwater flows through the East well at an elevation of 191.5 feet and in the two new wells at 194.9 feet (MW-2) and 191.4 feet (MW-1).[6] Wells to the north and northeast of these three wells reflected groundwater elevations of 184.5-190.6 feet. Figure 4 of the NGC Report shows that the 22-foot drop from MW-1 to North Spring occurs over a distance of approximately 850 feet, whereas the difference between MW-1 and the Reisner well to the east is 3.4 feet over a distance of about 1500 feet.[7]

The NGC Report does not analyze the effect of this steep gradient between groundwater at the mine site and that discharging from springs in the bluff. Instead, it concludes that "groundwater elevations measured in Site and private wells show that most groundwater in the central and east portions of the Site generally flows to the northeast and smaller components flow to the north and northwest."[8] The NGC Report also declares that bedrock "likely creates a no flow boundary" that redirects water to the central portion of the site.[9] This statement appears to rely on an online geology portal from the Washington State

[3] Northwest Groundwater Consultants, LLC, Lake Erie Pit Groundwater Evaluation (Feb. 29, 2024) (hereafter "NGC Report").
[4] NGC Report, Figure 7 (showing MW-1 at the northern boundary of the site, in an area that has been mined, and MW-2 southwest of the mine expansion).
[5] NGC Report, at 10 (Table 3).
[6] NGC Report, at 10 (Table 3).
[7] NGC Report, at Figure 4. A-A' Cross Section.
[8] NGC Report, at 12.
[9] NGC Report, at 11.

Department of Natural Resources.[10] As noted by Dan McShane, the NGC Report does not indicate whether an effort was made to verify the portal's accuracy by groundtruthing it with site observations.[11] Mr. McShane, who has conducted numerous site visits in the vicinity of the proposed mine, notes that bedrock does not exist in the location surmised by the map and offers site-specific maps showing that the nearest bedrock occurs a few hundred feet west of the site, near the shoreline.[12]

The NGC Report also concludes that springs in the coastal bluffs may not be hydrologically connected to groundwater at the site based on "differences in the water types."[13] A review of the results provided by the NGC Report indicates that the water quality parameters it measured are similar for most of the wells and springs and that the East Well and Wooding well are outliers for a few parameters.[14] As discussed below, errors in the implemented sampling protocol may explain these small differences.

Last, the NGC Report asserts that groundwater flow at the site likely will not increase after removal of the glacial till that currently impedes infiltration.[15] NGC does not offer a plausible scientific theory to explain why stormwater would not soak into the ground. Nor does NGC acknowledge that their opinion conflicts with local best available science that calculates significant groundwater recharge rates for similar geological settings in Island County and San Juan County.[16] Instead, the NGC Report asserts that groundwater levels in the new wells did not change significantly during an "atmospheric river," that glacial outwash was dry, and that groundwater flows to the northeast.[17] The report does not explain how the author could determine that groundwater levels did not change based on a single measurement.

[10] NGC Report, at 11, and at Figure 4 (referring at Notes to DNR); McShane Report, at 3.
[11] NGC Report, at 3; McShane Report, at 3.
[12] McShane Report, at 3-5.
[13] NGC Report, at 12.
[14] NGC Report, at Figures 1-3; McShane Report, at 5.
[15] NGC Report, at 13.
[16] *Id.*; McShane Report, at 11-12.
[17] NGC Report, at 12.

B. APPLICABLE CODE CRITERIA FOR MINING SPECIAL USE PERMITS AND FOR GEOLOGIC HAZARD SITE ASSESSMENT

While the specific issue before the Hearing Examiner is whether the applicant provided valid information responsive to the order on remand, it is useful to keep in mind the overarching criteria that must be satisfied to approve a Mining Special Use Permit. An applicant for a mine permit bears the burden of proving that the impacts of the mine comply with Skagit County's Mineral Resource Overlay regulations and incorporated Special Use Permit criteria, and that conditions will mitigate detrimental impacts to the environment and will protect the general welfare, health and safety. SCC 14.16.440(9)(a). If the impacts are mitigable, then the permit shall be granted. *Id.* Mitigating conditions must be performance-based, objective standards. *Id.* In addition, the County's mining rules are "minimum standards based on unique site-specific factors or conditions as appropriate to protect public health, safety, and the environment." SCC 14.16.440(9)(b). Ultimately, appropriate conditions "shall be required to mitigate existing and potential incompatibilities between the mineral extraction operation and adjacent parcels." SCC 14.16.440(9)(c). In addition, site-specific conditions are required to mitigate a mine's stormwater runoff and erosion impact. SCC 14.16.440(9)(d).

In applying for a special use permit, the applicant bears the burden of demonstrating that the proposed activity will not adversely affect or prevent those uses normally allowed within the respective district and of proving compliance with the Special Use Permit criteria.[18] The applicant must demonstrate that the application satisfies criteria that include the following:

- The proposed use will not cause potential adverse effects on the general public health, safety, and welfare; and
- The proposed use is not in conflict with the health and safety of the community.[19]

More directly applicable to the remand order, the Code establishes criteria for a valid

[18] SCC 14.16.900(1)(a), (1)(b)(v).
[19] SCC 14.16.900(1)(b)(v)(E), (v)(G).

geologic hazard site assessment. A site assessment must be prepared by a qualified professional for the type of critical area involved and must contain information specified for that critical area. SCC 14.24.080(4)(a). The site assessment must use scientifically valid methods and studies in the analysis of critical areas data and field reconnaissance. SCC 14.24.080(4)(b). Critical areas site assessments generally must include: (1) an identification and characterization of all critical areas and buffers adjacent to the proposed project area; (2) an assessment of the probable cumulative impacts to critical areas resulting from development of the site and the proposed development; (3) a description of the proposed stormwater management plan for the development and consideration of impacts to drainage alterations; (4) a description of the efforts made to apply mitigation sequencing; and (5) a proposed mitigation plan. SCC 14.24.080(4)(c). Geologic hazard site assessments must also include: (1) an assessment of the geologic characteristics and engineering properties of the soils, sediments, and/or rock of the subject property and potentially affected adjacent properties; (2) a description of load intensity, and surface and groundwater conditions; (3) an estimate of bluff retreat rate for potential coastal bluff geologic hazards; (4) an estimate of slope stability for potential landslide hazards; and (5) additional site assessment elements as required by the Administrative Official. SCC 14.24.420(2).

The NGC Report does not satisfy the SUP or the site assessment criteria. It does not meet the Applicant's burden of demonstrating that the proposed use: (1) will not cause potential adverse effects on the general public health, safety, and welfare; and (2) is not in conflict with the health and safety of the community. SCC 14.19.900(1)(b). As explained below, the report speculates that the groundwater at the site is not hydrologically connected to springs in unstable bluffs in the face of substantial evidence to the contrary. Further, the report does not fully identify and characterize the unstable slope and buffers, does not assess the probable cumulative impacts to those slopes, does not consider impacts to drainage alterations, and does not apply the mitigation sequence. SCC 14.24.080(4)(c). Last, and most crucially, the report does not assess the geologic characteristics of the soils in the unstable bluffs where springs northwest of the site discharge groundwater on affected adjacent

properties, does not describe the load intensity and surface and groundwater conditions between the site and the springs to the northwest, and does not estimate the slope stability for potential landslides caused or exacerbated by the mine's intensification of groundwater flow to the springs. SCC 14.24.420(2). Instead, the NGC Report evades these analyses on the unsupported grounds that bedrock redirects groundwater, that groundwater characteristics differ between the site and the bluffs, and that stormwater does not soak into the ground at the site.

C. DISCUSSION

This section examines NGC's claims that: (1) a bedrock outcrop redirects groundwater from the site away from the spring to the northwest; (2) measurements show different water quality in the springs than in the wells; and (3) that rainwater in the newly mined area would not infiltrate into the groundwater at the site. Because these groundless claims prevented NGC from conducting an Assessment for site impacts on the unstable bluffs, the NGC Report does not demonstrate that the proposal satisfies the Mining Special Use Permit and Geologic Hazard Site Assessment criteria set forth at Section B above.

1. Groundwater at the Mine Site is Very Likely Hydrologically Connected to Groundwater Discharging from the Nearby Downgradient Springs.

Although well elevation data indicate a robust connection between groundwater at the mine site and groundwater discharging from the coastal bluffs, the NGC Report concludes that there likely is not a strong hydrological connection based on illusory support. First, NGC relies on an online mapping portal rather than site-specific maps and field verification to suggest that unverified bedrock may prevent groundwater from flowing in that direction.[20] Second, NGC asserts that water quality differences exist between water at the springs and water at the wells, yet the samples reveal similar water chemistry with the exception of one to two wells.[21] Further, the water samples would be anticipated to reflect variation in their constituents

[20] NGC Report, at 11.
[21] *Compare* NGC Report, at 9 (classification scheme) *with* NGC Report, at Figure 1 (Piper Diagrams showing similar constituents).

because they were drawn from different portions of the aquifer and under different sampling conditions.[22]

a. Strong evidence of hydrological connection between the mine and spring in unstable bluffs.

The magnitude of the difference between the higher groundwater elevations at the mine site (191.5-194.9 feet) and the lower elevations observed in the North Spring (169.3 feet) demonstrates that a substantial amount of the groundwater discharging from the bluffs likely flows through the mine site.[23] While the gradient in the applicant's assumed direction of groundwater flow to the east is 0.0023, or 12 vertical feet per mile, the gradient between MW-1 and the North Spring is 0.0246, or approximately 130 feet/mile, ten times steeper.[24] According to Mr. McShane, "the highest groundwater flow velocities will follow the steepest groundwater slope or gradient."[25] Consequently, the data provided by the NGC Report indicates that groundwater flows from the mine site to the North Spring.[26]

b. Nonexistent bedrock.

NGC asserts that

> [a]s previously discussed in the Geology section above, bedrock (Fidalgo ophiolite) is mapped in the northwest portion of Parcel P19158. Its presence at or near surface likely creates a no flow boundary in the northwest portion of Parcel P19158. Groundwater flow from the southwest portion of the Site likely is redirected to the central portion of the Site due to the presence of this bedrock.[27]

NGC does not indicate that it conducted a site investigation to verify the existence of the bedrock.

However, Dan McShane has conducted numerous visits in the vicinity of the site and has

[22] McShane Report, at 5.
[23] McShane Report, at 2, 6.
[24] McShane Report, at 6.
[25] McShane Report, at 6.
[26] McShane Report, at 6.
[27] NGC Report, at 11.

not detected bedrock in the northwest portion of Parcel P19158.[28] Mr. McShane has walked along Rosario Road and observed the western parts of the proposed mine expansion property from the road, including Parcel P19158, and declares that:

> there are no bedrock outcrops on the western parcel of the mine property and no indications of bedrock outcrops are observed in lidar bare earth imagery. There are no bedrock exposures along Rosario Road west of the mine. I have also traversed the steep slopes above and below and to the north and southwest of North Spring; there is no bedrock at these locations.[29]

Mr. McShane further explains that NGC's failure to visually investigate the site contravenes standard geologic practice, particularly when NGC relies on the alleged existence of this bedrock to support its claim that a bedrock ridge likely deflects groundwater flow.[30] Instead, the NGC Report relies on an on-line map from the Washington Department of Natural Resources Geology Portal that contains errors that should have been recognized through direct investigation.[31] NGC did not discover these errors because they do not appear to have conducted visual observations.[32] Nor did NGC appear to review a map by Miller and Pessel that they referenced, as this map does not show bedrock at the site.[33] NGC also would have learned that site-specific mapping shows the absence of bedrock if they had reviewed mapping by Pessel and others.[34] But NGC did not conduct this baseline review, and instead asserts that bedrock redirects groundwater flow at the site notwithstanding the absence of bedrock at the site.[35] This omission, and the failure to map and study other springs and landslides located to the northwest of the proposed mine, qualify as a failure to conduct the Assessment required by the Board on remand.

[28] McShane Report, at 3.
[29] McShane Report, at 3.
[30] McShane Report, at 3.
[31] McShane Report, at 3.
[32] McShane Report, at 3.
[33] McShane Report, at 3-4 (referencing NGC Report, at 3).
[34] McShane Report, at 4.
[35] McShane Report, at 4.

c. The water sources reflect similar water chemistry.

The NGC Report suggests that "distinct differences in water chemistry between the North Spring and that of the groundwater beneath the site" indicate that a hydrologic connection may not exist. The Wald Report repeats this claim without analyzing whether distinct differences exist or whether the sampling methods would explain the differences.[36] Instead, the Wald Report discusses groundwater elevations and ignores the steep downward gradient to the northwest, focusing instead on the slight gradient to the east.[37]

As explained by Mr. McShane and as can be seen by reviewing the diagrams in the NGC Report, the water quality data do not support the claim that water chemistry in the North Spring differs significantly from that in wells at the site.[38] The three Piper Diagrams that the report offers to visually compare the water sources based on a variety of constituents show tight clustering of all of the water sources other than the East well and the Wooding well, revealing that they share similar levels of those constituents.[39] Thus, to the extent that an outlier exists, it is the East well, followed by the Wooding well, which do not show similar characteristics with each other. Regardless, the small differences in water parameters do not support NGC's speculation that a hydrologic connection may not exist between groundwater at the site and the North Spring.[40]

Instead, to the extent that sampling shows different levels of constituents, it likely can be explained by the consultant's use of samples from different zones in the aquifer, which would be anticipated to contain different constituents.[41] For example, water from the East Well comes from the bottom of the aquifer or below because that well is an open-ended pipe that draws from the bottom where silt and wood fragments exist.[42] Water in the other wells would

[36] Wald Report, at 2.
[37] Wald Report, at 2.
[38] McShane Report, at 6.
[39] NGC Report, at Figure 1.
[40] McShane Report, at 6.
[41] McShane Report, at 5-7.
[42] McShane Report, at 5; NGC Report, at 2.

not be expected to represent the character of water in the water column or the aquifer overall because that water is drawn through a small screen that draws water from a limited vertical portion of the aquifer.[43] Last, the water discharging from the springs would be expected to differ from well water drawn from the earth because that water passes through organic matter on the steep landslide slope immediately above the spring and because the spring water flows through weathered soil and would be exposed to atmospheric air.[44] Thus, the NGC Report relied on sampling of different types of water, which likely explains the small differences in the water parameters measured.

d. The water level measurements in the residential wells may have underestimated static water elevations.

The water level measurements taken for the residential wells suffer from two infirmities: (1) they were not surveyed; and (2) they may not have ensured that pumping ceased with sufficient time for the wells to recover to their static levels prior to the measurement.[45]

First, the very similar heights of the water levels measured across all wells warranted a survey for accuracy.[46] With the exception of the De Vries well, the difference in measured elevation between the East well and the residential wells was 3.5 feet.[47] Nonetheless, water levels were measured with a Trimble R1 GNSS Receiver that has an accuracy only to 1 meter, or 3.2 feet.[48] Thus, if the receiver overestimated the elevation of the East well by 2 feet, meaning that its elevation is actually 189.5 feet, and underestimated the water height in any of the residential wells by 2 feet, meaning that they actually range from 186.5 feet 192.6 feet, it would indicate a different groundwater flow altogether. Although the Trimble device's error range would not affect the significant downgradient elevations from the site to North Spring, a survey

[43] McShane Report, at 5.
[44] McShane Report, at 5.
[45] McShane Report, at 6-8.
[46] McShane Report, at 7-8.
[47] NGC Report, at Table 3.
[48] McShane Report, at 7.

is essential given that inaccuracies within the accepted range for the Trimble could directly undermine NGC's assertion that groundwater flows to the northeast, and would qualify as a standard practice.[49]

Second, the well pumping may not have ceased far enough in advance to allow water levels to return to their static elevation in the residential wells.[50] The NGC Report states that the pumps were not operating at the time that measurements were taken, but does not identify when they stopped pumping, or the amount of time that elapsed between that action and the measurements.[51] It is not possible without this information to confirm that water levels had risen back to their static level, and the measurements therefore may have underrepresented the actual water level.[52] With such a small difference between the water heights observed in the residential wells and the monitoring wells, this is a material omission. It is even more important given the fine material in which those residential wells are situated, which causes a longer recharge period than if they were installed in sand and gravel.[53] As set forth by Mr. McShane, "[t]his uncertainty regarding water level recovery is significant enough to affect the interpretation of water flow direction between the wells."[54]

While the data unquestionably show a large differential between the wells at the site and the North Spring, the lack of demonstrated accuracy in the measurements for the wells at the site and the residential wells directly undermines NGC's narrative that groundwater flows to the north/northeast from the site.

On a final point, the Wald Report does not support the water level measurements because it relies on inarticulated and incorrect assumptions. First, Wald fails to recognize that the margin of error inherent in the tool used for the measurement actually exceeds the

[49] McShane Report, at 7-8.
[50] McShane Report, at 6-7.
[51] NGC Report, at 10.
[52] McShane Report, at 6-7.
[53] McShane Report, at 7.
[54] McShane Report, at 7.

measured difference.[55] Second, Wald blandly asserts that groundwater levels were measured following accepted protocols, but does not identify those protocols and does not explain why it would be acceptable to use a measurement technique with a margin of error broad enough to misrepresent the direction of groundwater flow when more precise techniques are available.[56] Third, although Wald notes the potential recharge issue, he appears to assume that the residential wells have recovered to their static wells based on an incorrect assumption that they are located in sand and gravel strata that recharge quickly.[57] As discussed in Mr. McShane's report, the well logs show that the Calvert, De Vries, and Reisner wells are screened in areas of fine sand or silt with clay layers bounding those areas.[58] These materials significantly delay well recovery after the pumping has ceased.[59] Consequently, these wells may not have been allowed to fully recover from standard residential well pumping and the report may underestimate their static groundwater heights.

2. Local aquifer recharge science rebuts the NGC claim that water will not infiltrate into the ground at the site.

NGC infers that mining at the site will not increase groundwater infiltration based on alleged observations that soils were dry when drilling wells MW-1 and MW-2 and the claim that groundwater levels measured in those wells did not significantly change during drilling.[60] NGC does not justify these assertions in the lone paragraph it dedicates to this bold proposition that stormwater will not infiltrate into groundwater at the site once the till layer that currently serves as a barrier is removed.[61] Nor does NGC offer an alternative explanation for the path traveled by the stormwater that falls at the site.

The McShane Report identifies several flaws with NGC's assertions, namely:[62]

[55] Wald Report, at 1.
[56] Wald Report, at 1.
[57] Wald Report, at 1.
[58] McShane Report, at 7.
[59] *Id.*
[60] NGC Report, at 12.
[61] *Id.*
[62] McShane Report, at 11-12.

- NGC does not explain why groundwater recharge does not occur at the site given the local measurements that have been applied to Island County and San Juan County. United States Geological Survey studies have found that groundwater recharge typically amounts to 10-20 inches per year in glacial outwash sediments like those underlying the mine site;

- NGC does not explore the possibility that a fundamental principle of groundwater recharge could explain the observations, if accurate. When water infiltrates through unsaturated soils including sand and gravel between the ground surface and the water table, it very often develops preferential flow paths that single borings likely will not encounter;

- NGC's characterization of the soils encountered during drilling as dry may not be accurate. The well log for MW-1 indicates that the drillers added water when they encountered sand flowing into the bore hole, to prevent that flow, which usually happens when the drill encounters saturated sands. This indicates a likely wet zone; and

- No soils were measured for moisture. The well log for MW-1 used the term "dry" but did not quantify it and a logical explanation for that term was that the sediment that was being blown out of the boring with pressurized air was not wet. This could be explained by the heat generated by the substantial friction that the drilling bit generates, as well as the soil being air-dried when it is blown up through the drill casing.

As explained by Mr. McShane, consistent with generally accepted principles of groundwater recharge, removal of the till layer at the site will substantially increase groundwater recharge to the deep aquifer on the mine property.[63] By expanding the mine and removing the till that forms a vertical barrier for water infiltration, the project would change the hydrology and increase the flow of water toward the unstable bluff slopes to the

[63] McShane Report, at 12.

northwest.[64] By declaring that groundwater recharge does not occur at the site, NGC avoided evaluating the volume of this increased flow.[65] As calculated by Dan McShane, the recharge at the site likely would fall in the range of 271,333 gallons to 542,666 gallons per acre.[66]

3. The Wald Report offered erroneous information about the unstable shoreline bluffs west of the proposed mine.

As explained in detail by the McShane report,[67] the Wald Report relied on a misinterpretation of a study of the coastal geology west of the site to dangerously suggest that "[t]he small slides are typically non-hazardous slope readjustments due to local slumps, soil creep, and surface erosion."[68] Wald did not indicate that he visited the site or observed slope conditions in the bluffs near the site. Conversely, Mr. McShane has visited those slopes on numerous occasions, and has described in previous comments a relatively recent sand blowout feature just north of the North Spring amphitheater feature.[69] Landslide blowouts that form cave-like areas below unconsolidated sediments are very hazardous, and Mr. McShane opines that Wald's statement to the contrary was highly irresponsible and dangerously misleading and that it is an unacceptable practice to make a statement about landslide safety without directly observing the site in question.[70] Mr. McShane consequently recommends that the County reconsider using the third-party reviewer in the future, emphasizing that "Skagit County should reconsider ever using this geologist for third party reviews."[71]

4. The landsliding in the coastal bluffs is caused by groundwater conditions that will be exacerbated by the proposed mine.

The NGC Report does not attempt to ascertain bluff retreat or erosion rates, and the Wald Report misrepresents the long-term bluff retreat rate west of the mine site.[72] Wald

[64] McShane Report, at 12.
[65] McShane Report, at 12.
[66] McShane Report, at 12.
[67] McShane Report, at 8-11.
[68] Wald Report, at 3.
[69] McShane Report, at 10.
[70] McShane Report, at 10.
[71] McShane Report, at 10 (emphasis in original).
[72] McShane Report, at 10-11.

purports to rely on a 1988 Keuler study to estimate long-term bluff retreat rates of 2-4 cm/yr.[73] However, Keuler did not find that the landslides in the area northwest of the mine stemmed from wave erosion. Instead, he indicated that the bluffs were in an area "'of substantial sediment loss caused by large sporadic landslides (little or no direct wave erosion),'" which was consistent with his earlier finding that "'[t]he failures almost certainly are controlled only by the stratigraphic and groundwater conditions, and are not influenced by marine erosion.'"[74]

Due to this hydrogeologic reality, Mr. McShane states that, "[i]ncreased groundwater from removing the impermeable glacial till to mine the sand and gravel will result in an increase in groundwater flow to these unstable slopes leading to an increase in slope failures within the amphitheater-like landforms."[75]

5. The Applicant Discarded a Proposal to Conduct a Valid Geologically Hazardous Area Study.

It bears repeating that the Applicant discarded a 2021 proposal by Canyon Environmental Group to conduct a geohazard study.[76] The Applicant relied heavily on that proposal to defeat the County's denial of its application for failure to timely submit information about its groundwater impacts in 2021. But at some point between 2021 and 2023, the Applicant decided not to pursue that proposal. It contained elements designed to accurately characterize groundwater flow at the site, including:

- installation of 3-4 permanent groundwater monitoring wells in time to gather as much data during the rainy season as possible;

- monitoring of the wells digitally and manually throughout the wet season, collecting measurements every 1-3 hours;

[73] Wald Report, at 3.
[74] McShane Report, at 11 (quoting Keuler (1988) and Keuler (1979)).
[75] McShane Report, at 11 (emphasis added).
[76] See Canyon Environmental Group, Proposed Hydrogeology and Groundwater Characterization Timelines (Sept. 7, 2021) (attached hereto as Attachment B).

- drilling of two temporary bore holes along the western boundary during the height of the wet season to assess whether perched water tables are potentially present and contributing to seeps known to exist west of the mine;

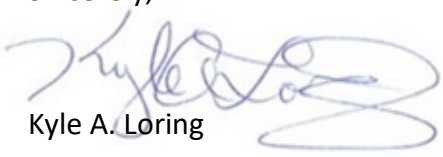
- conducting modeling to evaluate groundwater flow direction and potential groundwater impacts and implications of the proposed gravel mine expansion.

In contrast, the NGC report involved the installation of two monitoring wells[77] and the reporting of a single water elevation measurement,[78] taken on two different days four weeks apart in January—January 4, 2024 for the springs and January 31, 2024 for the wells. The immense gap between the quality of the proposed investigation and the level of review conducted may explain the failure to examine the mine's likely impacts on the unstable bluffs to the northwest.

D. CONCLUSION

The NGC Report relies on unfounded speculation to continue to assert that groundwater does not flow between the mine site and the unstable bluffs to the northwest notwithstanding patent evidence to the contrary – the significant vertical gradient between the two. This does not meet the Applicant's burden to show that the project avoids public harm or that landslide risks have been properly identified and addressed. The report should be disregarded and the permit denied until the Applicant obtains an Assessment consistent with the requirements for a Mining Special Use Permit.

Sincerely,



Kyle A. Loring

Cc: Kevin Cricchio, Senior Planner
Jason D'Avignon, Deputy Prosecuting Attorney
Marlene Finley, Evergreen Islands

[77] NGC Report, at 5.
[78] NGC Report, at 10.

Attachments: Stratum Group Comments Regarding: Lake Erie Groundwater Evaluation and third-party review

Canyon Environmental Group, Skagit County Hearing Examiner Request for Additional Information (PL16-0556): Proposed Hydrogeology and Groundwater Characterization Timeline (Sept. 7, 2021)

ATTACHMENT A

STRATUM GROUP
PO Box 2546, Bellingham, Washington 98227

April 18, 2024

Jan Heald Robinson
Board Member, Evergreen Islands

Re: **Comments regarding:**
Lake Erie Groundwater Evaluation and third-party review

Dear Jan,

You asked me to review the Northwest Groundwater Consultants, LLC (NGC) letter titled Lake Erie Pit Groundwater Evaluation and Skagit County's 3rd-party review letter from Facet. Based on my professional review, and as explained in detail below, these documents continue to avoid evaluating the geologic risk that the proposed Lake Erie gravel pit expansion poses to the unstable bluffs to the northwest of the mine. In fact, the data from MW01 indicates there is a strong groundwater flow gradient from the mine area toward the unstable bluffs to the northwest of the mine. The 3rd-party review overlooks this information and adds to the flaws in the NGC review by providing inaccurate and highly misleading information about the bluff slopes to the west of the mine.

Together, the NGC and Facet documents display the following errors:

- The NGC report opines that groundwater flows away from the shoreline bluffs, but produces data of a steep vertical gradient between groundwater elevation at the site (191.4 feet) and groundwater elevation in the bluff (169.3 feet) that indicates that groundwater flows primarily toward the bluffs.

- The NGC report opines that bedrock blocks groundwater flowing from the mine to the shoreline bluffs based on erroneous statements about the presence of bedrock on the site and along Rosario Drive.

- The NGC report relies on the results of water quality testing that do not provide meaningful information about the direction of groundwater flow.

- The method NGC used for measuring groundwater elevations contains inaccuracies that are significant enough to affect the interpretation of water flow direction between the wells, though it nonetheless indicated a flow toward the bluffs.

- The 3rd-Party report provides erroneous information about the bluff area west of the

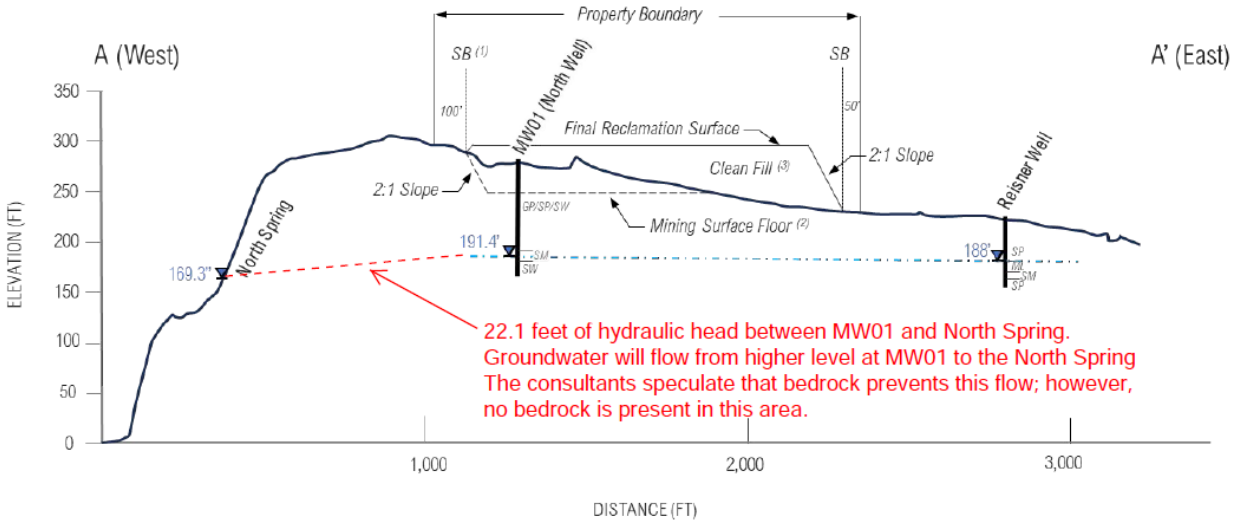
mine.

- The NGC report that groundwater recharge will not take place is contrary to best available science studies by the United States Geologic Services.

The sections below detail the flaws and erroneous assumptions and speculations in the reports, and identify the information needed to address them.

A. The Report Does Not Demonstrate that Groundwater at the Site Moves Away from the Shoreline Bluffs.

Groundwater elevations between the mine and the North Spring indicate that groundwater will flow predominantly towards the northwest from the mine site towards the shoreline bluff. As seen in the diagram below, the new groundwater elevation data provided by the installation of MW01, at the north end of the pit, confirms that there is a steep groundwater gradient from the mine area to the groundwater spring within that landslide area to the northwest of the mine. The groundwater elevation measured at MW01 was 191.4 feet while the groundwater elevation at North Spring was 169.3 feet, a full 22.1 feet lower at a distance of approximately 850 feet.



From Figure 4 of Northwest Groundwater Consultants. Northwest Groundwater Consultants assert that there is no groundwater water flow MW01 to the North Spring. The red line and red text notation has been added by me to show the steep groundwater gradient between MW01 and the North Spring.

The NGC report claims that groundwater at North Spring located northwest of the proposed mine expansion is not hydrologically connected to the groundwater under the proposed mine or the existing mined area based on speculation that an intervening bedrock ridge redirects water flow and based on differences in water chemistry. As explained below, there is no evidence of a bedrock ridge and no difference in water chemistry that supports that claim.

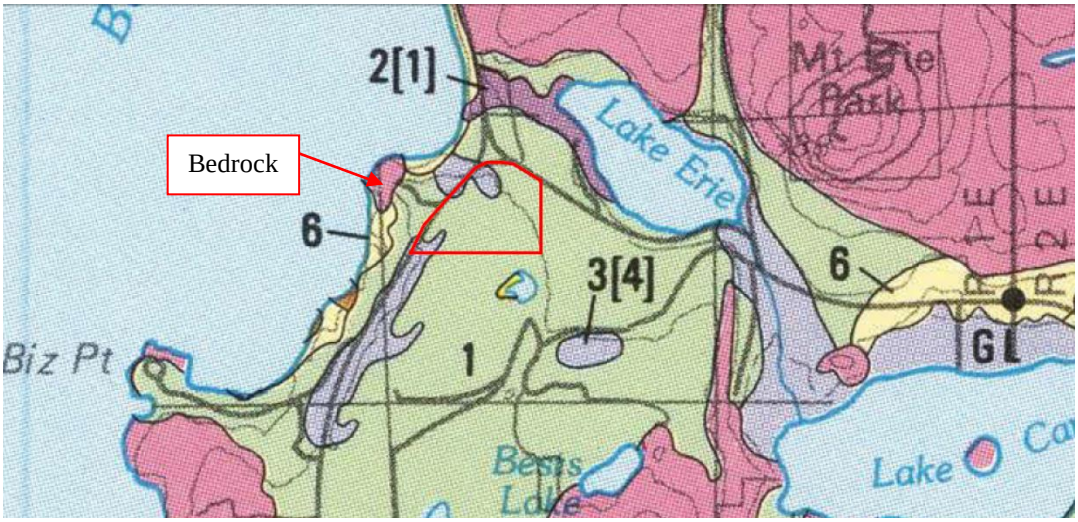
B. The NGC Report Erroneously Assumes That Bedrock Blocks Groundwater From Flowing From the Mine to the North Spring.

> NGC states that *"As previously discussed in the Geology section above, bedrock (Fidalgo ophiolite) is mapped in the northwest portion of Parcel P19158. Its presence at or near surface likely creates a no flow boundary in the northwest portion of Parcel P19158. Groundwater flow from the southwest portion of the Site likely is redirected to the central portion of the Site due to the presence of this bedrock. Because of the uncertainty to the extent of the bedrock in the subsurface, groundwater contours in this area may not reflect groundwater flow being redirected."* Page 11, last full paragraph before Discussion section.

But there is no bedrock in the northwest portion of Parcel P19158. I have walked along Rosario Road and observed the western parts of the proposed mine expansion property from the road including Parcel P19158; there are no bedrock outcrops on the western parcel of the mine property and no indications of bedrock outcrops are observed in lidar bare earth imagery. There are no bedrock exposures along Rosario Road west of the mine. I have also traversed the steep slopes above and below and to the north and southwest of North Spring; there is no bedrock at these locations.

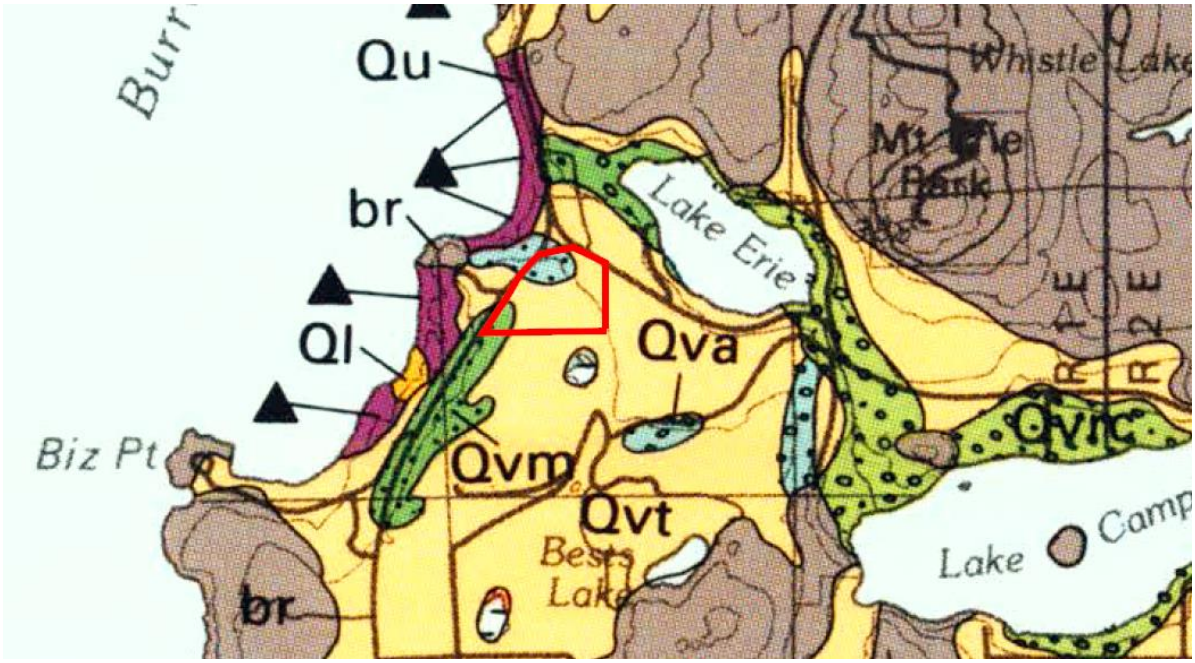
The report geology section appears to rely entirely on an on-line map from the Washington State Department of Natural Resources Geology Portal that is reproduced in the report as Figure 4. That map shows bedrock extending to the property. Unfortunately that map is incorrect in regards to the extent of bedrock. This map error should have been recognized by NGC. Direct observations should be standard geologic practice particularly given the assertion that there is a bedrock ridge deflecting groundwater flow. But NGC does not document any observations of bedrock or provide any evidence of bedrock deflecting groundwater flow to support the narrative that groundwater flows in a different direction than the one shown by the data.

At the beginning of the geology section on Page 3, NGC does state that "Detailed descriptions of the surficial and subsurface geology of the Site and vicinity are presented in a map completed by the U.S. Geological Survey (Miller and Pessel, 1986)." It should be noted that Miller and Pessel (1986) do not show bedrock at the site (see portion of map below).



Map showing unconsolidated deposits grouped on the basis of texture, Port Townsend 30' x 60' Quadrangle, Puget Sound region, Washington Miller and Pessel (1986), Pink = bedrock. Proposed mine is outlined in red.

Contrary to NGC's claim about the referenced map, the Miller and Pessel (1986) map does not provide detailed descriptions of the geology units. Pessel and others (1989) do provide detailed descriptions, but it appears NGC did not review the Pessel and others (1989) map. Pessel and others (1989) also do not show bedrock on the property; that map depicts the geology of the site and vicinity, as presented below.



Portion of the Port Townsend 30- by 60-minute Quadrangle, Puget Sound Region, Washington (Pessel and others, 1989). Qvt = Vashon glacial till, Qvm = melt water deposits, Qva = Vashon glacial advance deposits, Qvrc = Vashon recessional deposits, Ql = landslide, Qu = undifferentiated glacial and non glacial deposits, Vashon glacial marine sediments, br = bedrock.

The erroneous assumption of the existence of this bedrock resulted in NGC not completing a geological hazard assessment of the bluff northwest of the mine. It should be further noted that no attempt was made to identify and map the other springs at other locations associated with landslides northwest of the mine or for that matter any other springs in the area. I pointed out three spring locations in my previous comments.

C. The Results of the Water Quality Testing Do Not Provide Meaningful Information About the Direction of Groundwater Flow.

Despite the large elevation difference between the water under the mine area and the North Spring, NGC speculates that groundwater does not flow toward the North Spring based on "distinct differences in water chemistry," stating:

> "*Although these differences in elevation suggest that the hydraulic gradient is towards the spring, analytical data discussed above indicates that there are distinct differences in water chemistry between the North Spring and that of the groundwater beneath the Site. As such, a hydrologic connection between groundwater beneath the Site and the North Spring may not exist."* Northwest Groundwater Consultants, Page 11, first full paragraph. Facet simply repeats this same speculation by ignoring the steep groundwater gradient from MW01 to the North Spring and then referencing "difference in water types." Facet, page 2, paragraph 3.

A review of the Piper Diagrams that NGC includes as Figure 1 reveals that the majority of the wells and the North Spring and Dodson Canyon share similar parameter concentrations, as demonstrated by the tight clustering of those water sources. The exceptions, to the extent that they exist, are the East Well and the Wooding Well, both of which plot well away from the cluster that the other water wells and springs plot at on the Piper diagrams. Using the NGC 'distinct differences' would suggest the Wooding Well and the East Well are in a different aquifer.

Regardless, it should be expected that some water parameters will differ between the various wells and springs because water samples come from different levels in the aquifer, from relatively narrow water bearing zones where water enters the wells through the well screens. For example, the East Well is an open-ended pipe that draws water from the opening at the end of the well pipe. That opening is within a silt zone that includes wood fragments per the well log. Water entering the well is from an area likely below or at the base of the aquifer; hence this water should be expected to have different parameter concentrations. The parameter concentrations in other wells will be influenced by the specific narrow interval where water enters the well. The North Spring water parameters will also be influenced by nearby water flowing through organic matter and weathered soil and exposure to atmospheric air, all of which can alter the parameter concentrations in the water.

These small differences in water parameters do not support the speculative comment by NGC that "a hydrologic connection between groundwater beneath the Site and the North Spring may not exist."

Facet refers to NGC's water quality sampling but does not examine the credibility of NGC's water quality claims. Instead, Facet chooses to discuss water elevations, stating that *"Figure 4 (A to A' cross-section) shows groundwater generally flows away from North Spring, on a gradient of .0023 or 12 feet/mile."* Facet, page 2, under Number 1.

But the gradient between MW01 and the North Spring is 0.0246, or approximately 130 feet/mile, ten times steeper. The highest groundwater flow velocities will follow the steepest groundwater slope or gradient.

Facet simply ignores the much steeper groundwater gradient between MW01 and the North Spring.

The water at MW01 will flow more rapidly towards the North Spring than toward the east/northeast. Further, figure 6 in the NGC report shows a slope gradient to the north from MW01 to the Devries Well of 0.0153, which is 5 times greater than the gradient towards the east.

Of the three data points down gradient of MW01, the North Spring is by far the steepest gradient indicating a much higher flow velocity in that direction; twice as high as that towards the north and 10 times higher than the flow to the east. Much more water flow will be to the northwest than to the northeast. Using the groundwater elevations at these three wells shows groundwater flow is predominantly to the northwest, not to the east.

D. The Accuracy of the Groundwater Levels Is In Question.

NGC did not identify the amount of time that elapsed between the shutting down of pumps in the wells and the time that measurements were taken—NGC states that *"Pumps installed in the private wells were not operating at the time the measurements were taken."* page 10, middle of first paragraph. The time between pumping and measuring can affect the accuracy of the water level readings. For example, if the wells have not been given sufficient time for the water levels to rise from the level reached during pumping to their static levels at rest, the results will show incorrectly that water levels are lower than the local groundwater surface. The absence of this information is critical for the accuracy of the reported water levels.

Facet recognized the importance of the lack of information about the amount of time that elapsed between shutting down the pumps and measuring the water levels, stating that, "*We note that pumps installed in the four private wells were not operating at the time water level measurements were taken. The measurements assume that water levels in the well have recovered from any recent pumping."* Facet, Page 1, third paragraph.

If the assumption that water levels were fully recovered is not correct, the reported elevations will be artificially lower than the actual groundwater elevations and distort the groundwater flow direction results.

Facet dismisses this concern based on a misunderstanding that the residential wells are located in an aquifer with *"high specific yield of sand and gravel."* Facet, Page 1, third paragraph. But the well logs in the NGC report show that the residential wells are located in finer-material that will take longer to recharge than sand and gravel:

- The Calvert Well is only screened across 92 to 96 foot depth in fine sand. Water flow is restricted to this narrow width inlet to the well through the screen length of 4 feet. Units above this narrow band are mostly clay per the well log and the unit below is clay and fine sand which will also slow the water flow and recovery time for the well.

- The Devries well is screened in a 10-foot layer of fine sand with clay layers above and below this narrow water bearing zone. Recovery of water levels is restricted to the fine sand layer.

- The Reisner well water zone is within silt and sand with silt sand and clay above this zone and silt sand below.

All of these wells had static water levels well above the water bearing zone indicated in the well log. The groundwater at the residential wells is within sediment that contains significant silt and clay contrary to the statement that the aquifer at these wells is sand and gravel. Hence, the premise put forth by Facet is not accurate and water levels in these wells may not recover rapidly and therefore the water elevations recorded may be lower than full recovery to static stable water elevations. This can result in water elevations in the wells being lower than the aquifer level and will impact the interpretation of groundwater flow direction. This uncertainty regarding water level recovery is significant enough to affect the interpretation of water flow direction between the wells.

In addition, NGC's groundwater elevation determinations are not as precise as implied in the report due to the methods used to obtain elevations.

The well elevations were not surveyed. NGC stated that "Ground surface elevations were measured with the Trimble R1 (sub-meter precision) and corrected using 3DEP LiDAR digital elevation model from the USGS." The Trimble R1 system can locate the sites with an accuracy within a meter (hence, the tern sub meter). The USGS indicates the newer elevation data used in the 3DEP model has an accuracy of 0.53 meters (about 1.75 feet) (https://www.usgs.gov/faqs/what-vertical-accuracy-3d-elevation-program-3dep-dems).

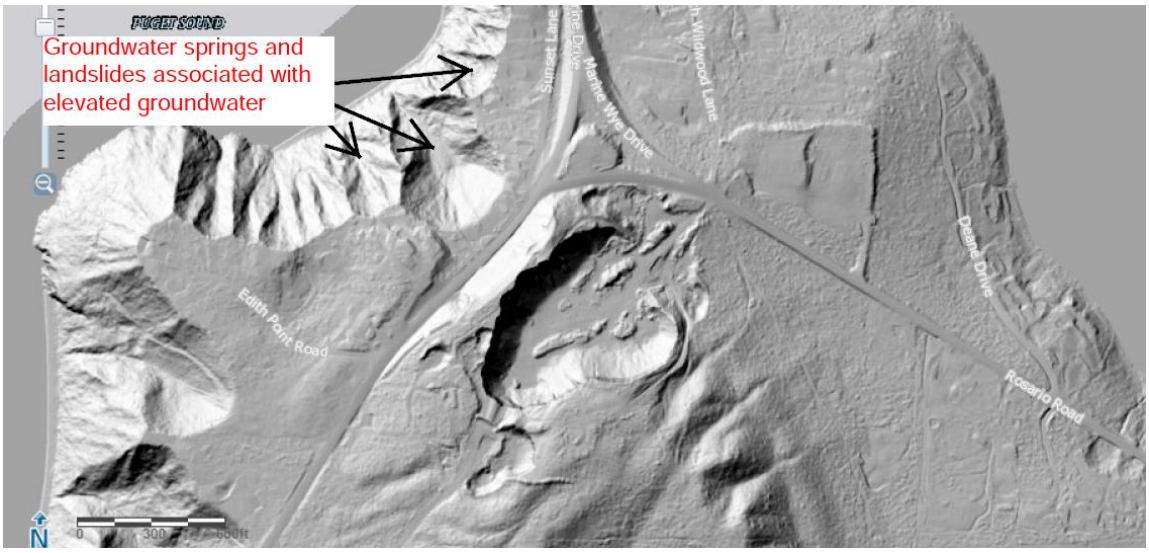
The elevation data in Table 3 is not as precise as implied and should include a +/- range to reflect the uncertainty or the uncertainty should have been discussed in the NGC report and should have been raised by Facet in their review. The +/- range is on the order of 2 to 4 feet. Given the low

difference in water levels between some of the wells this uncertainty is significant enough to affect the interpretation of water flow direction between some of the wells. That said the large difference between MW01 and the North Spring clearly shows that there is a steep groundwater gradient from MW01 to the North Spring.

In its review, Facet states *"Groundwater levels were measured following accepted protocols (Table 3)."* Facet, Page 1, middle of third paragraph. Facet does not identify the protocols it references; it has been my experience in developing accurate groundwater maps that groundwater elevation determinations utilize surveyed wells. This is particularly true when the difference in groundwater elevations is as small as seen in several of the wells at this site.

E. The 3rd-Party Report Provides Erroneous Information About the Bluff Area West of the Mine.

The figure below shows the geological context for the shoreline bluffs near the proposed mine expansion. I have visited each of these spring sites identified and evaluated the steep amphitheater-like slopes as well as the shoreline bluff area and shoreline below these slopes as well as slope areas to the north, west and southwest. Slopes above the spring areas have had recent slides and recent slides have taken place on the lower slopes below the springs. The northernmost spring area indicated on the figure below has never been identified in the previous NGC reports or in this latest NGC report. The northern spring site had a sand blowout failure at the base of the nearly vertical amphitheater wall approximately 5 years ago. The sand blowout failure was the result of high groundwater pore pressure within the dense outwash sand causing the sand to blowout forming a cave-like feature at the base of the slope.



Lidar image of groundwater induced slide areas and mine area

In discussing shoreline bluffs northwest of the proposed mine expansion, Facet does not appear to have done any ground assessment of the bluff slopes and misinterprets Keuler (1979) and Keuler (1988), the sources cited for their opinions on the bluff geology.

The following statement offers a serious misinterpretation *"The bluffs have been receding continuously for 6,000 years, retreating landward more than 740 feet since the increase in sea level following continental glaciation (Keuler, 1979)."* Facet, Page 3, last 2 paragraphs.

This statement is not consistent with Keuler (1979) or Keuler (1988). Keuler (1979) identified a bluff area to the south of Edith Point (the bluff area northwest of the mine where the North Spring is located is north of Edith Point), that he estimated had retreated approximately 325 feet over the past 5,000 years. This equates to a long-term average of 2 cm per year. Facet doubles the retreat rate that Keuler (1979) estimated. Keuler (1979 and 1988) provides no estimate of bluff retreat in the area north of Edith Point.

I am very familiar with Keuler's work as Keuler (1988) is a shoreline erosion mapping effort that covers all of the shorelines of the Port Townsend 1:100,000 Quadrangle, an area where I have conducted well over 1,000 geologic hazard assessments. I am also familiar with Keuler (1979) which is a detailed thesis on the shoreline and shoreline bluffs of Skagit County including Fidalgo Island where I have also done extensive work. Keuler (1979) and Keuler (1988) provide no long-term bluff retreat for the bluff area northwest of the mine. The reason he does not is that erosion rates along the base of the bluff at this location is very slow. He notes, I believe correctly, that top edge of the bluff retreat is driven not by wave erosion and shoreline retreat, but instead by unstable slopes impacted by groundwater.

Facet also states that,

> *"Most of the large slides visible in this image are more than 1,000 years old (Keuler, 1979)."* Fact, page 3, last paragraph.

However, Keuler did not reach such a conclusion. Keuler (1979) provided detailed observations and assessment of the amphitheater-like landforms on the bluff slopes to the northwest and west of the mine and surmised that "[t]he *amphitheaters* are old features." Keuler (1979), page 101 (emphasis added). Importantly, he does not describe the landslides in this area as old, but rather the amphitheatre-like features as old. With regard to landslides, he declares that "*Active landsliding into these amphitheaters is continuing*" and "*The amphitheaters are currently active and will continue to be active into the foreseeable future*." *Id.*

Consistent with these prognostications, I have personally observed evidence of several landslides within the amphitheater-like features north of Edith point during the 45 years since Keuler (1979) described this bluff area.

Facet also makes the following statement,

> *"The small slides are typically non-hazardous slope readjustments due to local slumps, soil creep, and surface erosion."* Facet, page 3, last paragraph.

Neither Facet nor NGC indicate that they visited the site or observed slope conditions along the bluff northwest of the mine. As noted in my previous comments, a relatively recent sand blowout feature undermined the bluff area of an amphitheater-like feature located just north of North Spring amphitheater (see picture below). This slope failure feature disproves Facet's statement. Landslide blowouts forming cave-like areas below unconsolidated sediments are very hazardous conditions, and Facet's unsupported claim that the *"The small slides are typically non-hazardous slope readjustments due to local slumps, soil creep, and surface erosion"* is highly irresponsible and dangerously misleading. It is an unacceptable practice for a geologist to make statements regarding landslides with associated safety concerns without any direct observations. Skagit County should reconsider ever using this geologist for third party reviews.

Site of recent sand blowout within sand and gravel from the groundwater aquifer springs above the silt clay layer at the bluff northwest of the mine. The springs associated with this blowout were not identified by Northwest Groundwater Consultants and the failure is not consistent with the Facet review stating *"The small slides are typically non-hazardous slope readjustments due to local slumps, soil creep, and surface erosion."*

On a final point, Facet offers the following unsupported statement,

> *"The estimated long-term bluff retreat rate is on the order of 2 to 4 cm/yr for 40 years prior to 1988 (Keuler, 1988)"* Facet, page 3, last paragraph.

Keuler (1988) does not indicate any bluff retreat rate or erosion rate at the shore area northwest

of the mine. Facet appears to be misinterpreting or is confused. Keuler (1988) does indicate the area is subject to relatively slow wave erosion and relatively small frequent landslides. He also indicates that the bluff is an area of "substantial sediment loss caused by large sporadic landslides (little or no direct wave erosion)". This is consistent with Keuler (1979), where he states "The failures almost certainly are controlled only by the stratigraphic and groundwater conditions, and are not influenced by marine erosion. The 225 m average distance of the headscarps from the beach indicates the continued activity is unrelated to marine processes." Keuler (1979) recognized that the large indentations along this bluff are not the result of shoreline erosion, but are the result of groundwater within outwash sands causing ongoing slope failures. Increased groundwater from removing the impermeable glacial till to mine the sand and gravel will result in an increase in groundwater flow to these unstable slopes leading to an increase in slope failures within the amphitheater-like landforms.

F. The NGC Report Does Not Adequately Explain Its Claim That the Mining Will Not Increase Groundwater Flow.

Although the remand order directed the applicant to assess the potential impacts of increased groundwater flow to the area northwest of the proposed mine, NGC declines to conduct such an analysis in part based on their conclusion that the mining will not increase groundwater recharge.

However, NGC asserts that the mine will not increase groundwater recharge on the grounds that "during the drilling of MW-1 and MW-2, it was observed that much of the subsurface sands and gravels were dry until drilling reached the water table." Facet does not examine this claim; that document simply states summarily that NGC assessed the general direction of groundwater flow to show no obvious hydrologic continuity with seepage from the springs. Facet, page 3, first paragraph, Review and Comment on Number 3.

There are numerous problems with NGC's assertion that there is no groundwater recharge based on the drilling observations:

1) NGC ignores or is unaware of the groundwater recharge measurements utilized and verified by the USGS in Island County, Washington (Sumioka and Bauer, 2003) and San Juan County, Washington (Or and others, 2002). For glacial outwash sediments such as those underlying the mine site, the USGS studies found groundwater recharge of 10 to 20 inches per year.

2) NGC ignores or is unaware of groundwater recharge principles regarding movement of infiltrating water through layered sand and gravel vadose zones (unsaturated soil between the ground surface and the water table). Water infiltrating through layered sand and gravel deposits can and very often does develop preferential flow paths that single borings are unlikely to encounter.

3) The MW01 well log indicated that the drillers added water at a depth of 12 feet due to

heaving sand. Heaving sands refer to sand flowing into the bore hole. Typically, this happens when saturated sands are encountered. The water pore pressure causes the sands to flow. Drillers will add water to the boring to counter the pore pressure in the sand in order to stop the saturated sand from heaving into the boring. The encountering of heaving sands in the boring for MW01 at 12 feet indicates that a wet zone was likely encountered.

4) No moisture measurements or direct samples where moisture could be measured were collected. The term dry was used in MW01 throughout until the groundwater was encountered, but this term is not quantified and may simply have been the well logger noting the sediment that was being blown out of the boring with pressurized air was not wet. Note there is a fair bit of heat generated by the heavy friction of the drilling bit as well as the friction of the sediment being blown by air up through the drill casing. This will be particularly true when drilling through gravel and rocks that the drill bit is breaking apart. There is an inconsistency between MW01 and MW02 logs in that MW01 used the term dry throughout and MW02 never used the term.

Removal of the glacial till that underlies the southern and eastern parts of the proposed mine will lead to a substantial increase in groundwater recharge to the deep aquifer under the mine site. At present, downward migration of water to the deep aquifer is mostly precluded by the dense very low permeability glacial till in the area of the proposed mine expansion. By acting as a vertical barrier, this dense till forces water to flow above it and to follow generally the surface topography that slopes to the east over much, but not all, of the proposed expansion mine area. Expansion of the mine will change the hydrology of the area around the mine by allowing infiltrated water to move vertically down to the deep aquifer and thus increasing the flow of water towards the unstable bluff slopes to the northwest.

Because NGC dismisses groundwater recharge without any explanation as to where the water goes, NGC did not evaluate changes in groundwater recharge and groundwater flow under different mine configurations. To do that, one can rely on a method developed by the United States Geologic Survey (USGS) to estimate groundwater recharge that was utilized and verified in Island County, Washington (Sumioka and Bauer, 2003) and San Juan County, Washington (Or and others, 2002). For glacial outwash sediments such as those underlying the mine site the USGS studies found groundwater recharge of 10 to 20 inches per year. This equates to 271,333 gallons to 542,666 gallons per acre.

G. Closure.

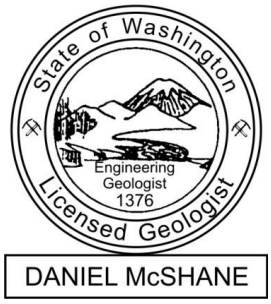
The water elevations in MW01 and North Spring clearly show a steep gradient in the groundwater towards the shoreline bluffs. Expansion of the mine will increase groundwater recharge to the mine and result in an increase of water flowing to the bluffs. It is my opinion that this will result in an increase of the frequency of saturated soils and increased high pore water pressures leading to an increase in the frequency of slope failures.

I fully concur with Keuler (1979) "The failures almost certainly are controlled only by the stratigraphic and groundwater conditions, and are not influenced by marine erosion. The 225 m average distance of the headscarps from the beach indicates the continued activity is unrelated to marine processes." Adding addition groundwater to these bluffs poses a hazard and increases the risk to properties above the slope failures areas.

Thank you for considerations of these comments.

Sincerely yours,
Stratum Group

Dan McShane, L.E.G., M.Sc.
Licensed Engineering Geologist



References:

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Sumioka, S.S. and Bauer, H.H. 2004, Estimating Ground-Water Recharge from Precipitation on Whidbey and Camano Islands, Island County, Washington, Water Years 1998 and 1999. Prepared in cooperation with the Island County Heath Department, United States Geological Survey, Water-Resources Investigations Report 03-4101, Version Number 1.20, August 2004.

ATTACHMENT B

Canyon Environmental Group LLC
112 Ohio Street, Suite 115
Bellingham, WA 98225

September 7, 2021

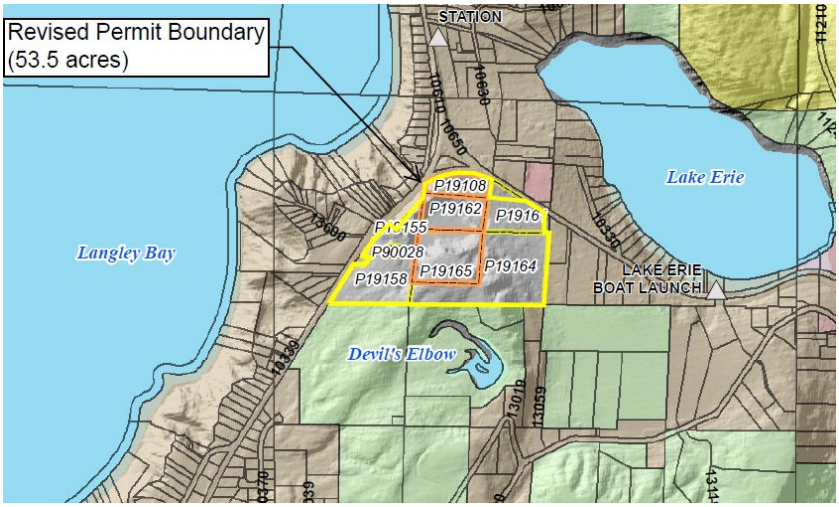
Prepared For:	McLucas & Associates Inc. c/o Steve Taylor P.O. Box 5352 Lacey, Wash509 s.l.taylor7117@gmail.com
Subject:	Skagit County Hearing Examiner Request for Additional Information (PL16-0556): Proposed Hydrogeology and Groundwater Characterization Timeline
Project Locations:	Skagit County Tax Parcels P19108, P19162, P19161, P19155, P90028, P19158, P19165, and P19164.

Dear Steve Taylor,

This scope of work and time estimate have been prepared by Canyon Environmental Group LLC (Canyon) at the request of Steve Taylor and McLucas & Associates Inc. This document covers the proposed hydrogeological and groundwater characterization services the Lake Erie Gravel Mine and is meant to help inform the permit and regulatory review associated with the proposed mine expansion. Specifically, this scope is meant to help refine the understanding of groundwater and perched groundwater flow within the subject parcels and help address if changes to groundwater flow will affect the geohazard conditions in the close vicinity. This scope does not include a geohazard study, but the report generated by this scope of work will help inform the geologist that works on the geohazard study.

Study Area

The "Study Area" is defined as the subject parcel(s), shown below in yellow.



Outline of Scope of Work

Overview

The scope of services for this task are to perform hydrogeological services per the best available science and Skagit County Code to help characterize groundwater and groundwater flow directions related to existing conditions and the proposed mine expansion.

This study will include but not be limited to field visits to document existing surface conditions, extensive desktop review of existing geologic mapping and pre-existing studies and documents, topographical analysis, supervision of well installations, grainsize analysis, wet season groundwater monitoring, precipitation monitoring, wet season borehole and perched water evaluation, groundwater modeling/analysis, and report compilation. A report meeting professional standards will be provided with the study's findings and recommendations.

TASK 1: Desktop and Existing Study Evaluation

The currently available public information and previous studies conducted on and near the study area related to geologic conditions, mining operations and planning documents, groundwater movement and/well installations will be reviewed for relevant information. Information gleaned from the databases and studies will be written up in a summary memo.

Estimated:

- Desktop Review (2-3 weeks)

TASK 2: Field Investigations, Well Installations, Limited Soil Characterization, and Grain Size Analysis

This scope of work will be performed by qualified Canyon personnel, who will conduct site visits to document, describe, and characterize the conditions on-site with the intent to gather information that can be used to inform this hydrogeology study, groundwater well placement locations, and eventual geohazard study. During this task, three to four permanent groundwater monitoring wells will be installed. Canyon employees will evaluate the well boring for subsurface geology and groundwater conditions to determine groundwater and subsurface hydrological properties, including grain-size and redoximorphic features, evaluate depth to groundwater, and identify any potentially restrictive layers. Well installation should occur at the earliest possible time to gather as much of the rainy season as possible, preferably before the end of October.

Soil infiltration characteristics and site uniformity will be assessed using the Grain Size Analysis method (D422/D1140 sieve analysis to determine grain size distribution of the sample and C136/C117 method sieve analysis to correlate soil types).

Information gained from Task 2 will be used in the final Hydrogeological Report.

Estimated:

- Field investigation (3-days)

- Well installation
    - Possibly access clearing for wells (2-3 weeks)
    - Coordination with well drillers (8-weeks)
        - Clients will have to hire well drillers independently of Canyon
    - Supervision of well installation (3-4 days)
    - Survey of well location (1 day)
        - Client will have to hire professional surveyors independently of Canyon
- Grainsize Analysis (7-10 days)

TASK 3: Wet Season Water Table Monitoring

Once the monitoring wells have been installed, the depth to groundwater will be monitored both digitally and manually throughout the wet season (October to May/June). The digital monitoring will be conducted using direct read Solisnt™ pressure transducers which will collect measurements every 1-3 hours. Additionally onsite rain gauges will be installed and monitored to aid in the groundwater characterization and modeling. The digital DTW and precipitation data will be collected monthly along with manual depth to water (DTW) measurements.

Estimated:

- Wet season DTW measurements (8-9 months)

TASK 4: Wet Season Field Observation and Borehole Evalaution

During the height of the wet season (March or April), two additional temporary bore holes will be drilled along the western boundary of the Study Area. In addition to manual observation of the drilling operation, downhole geophysics well profiling probes will be used to analyze for the presence and quantity of groundwater. This data collection will be used to evaluate if perched water tables are potentially present onsite and if they are potentially a source for the seeps known to exist west of the Study Area.

Wet season field assessments and characterization will be conducted within the Study Area. Additionally field assessment will be conducted on the slopes west of the Study Area but will be limited to areas where access is granted to Canyon field staff.

Estimated:

- Borehole drilling
    - Coordination with well drillers (8-weeks)
        - Will occur in March or April
        - Clients will have to hire well drillers independent of Canyon
    - Supervision of well installation (1-2 days)
- Survey of well location (1 day)
    - Client will have to hire professional surveyors independently of Canyon
- Borehole Geophysics Well Profiling (1-2 days)
    - Client will have to hire the well profiling company independently of Canyon

TASK 5: Groundwater Modeling and Report

Once the field data has been gathered, groundwater modeling of the Study Area will be conducted to evaluate the groundwater flow direction and potential groundwater impacts and implications of the proposed gravel mine expansion. The results of the field data and groundwater evaluation will be written in a Hydrogeologic Assessment Report which will discuss our findings, results, and recommendations. This report and field data will be given to the geologist conducting the geohazard assessment to inform their study.

Estimated:

- Groundwater Modeling (2-3 months)
- Hydrogeologic Assessment Report (2 months)

Summary of Estimated Schedule and Timeline

In summary if the above proposed scope of work were started on October 1st it is estimated that the whole project would take approximately 1 year. The table below shows the timeline and schedule for each of the tasks and subtasks discussed above.

	2021			2022									
TASK	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Task 1: Desktop Evaluation													
Task 2: Field Studies													
Site Visit													
Well Drilling													
Surveying													
Grainsize Analysis													
Task 3: Water Table Monitoring													
Task 4: Wet Season Evaluation													
Site Visits													
Borehole Evaluation													
Task 5: Modeling and Reports													
Groundwater Modeling													
Report Compliation													

For questions, scheduling arrangements, or inquiries about additional services we may be able to provide for your or your project, please contact us at (360) 389-1693. Thank you in advance for the opportunity to work with you.

Sincerely,

Jeff Ninnemann

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