FACET

04/01/2024

Memo/Report
TO: Kevin Cricchio, Senior Planner
Skagit County Planning and Development Services

FROM: Alan Wald, Hydrogeologist
Facet, Inc.

RE: Lake Erie Pit Groundwater Evaluation.

As per your request of 03/01/2024, following is our review of the accuracy and completeness of Lake Erie Pit Groundwater Evaluation by Northwest Groundwater Consultants LLC (NWGC report) dated 02/29/24. The report was submitted by order of the Board of County Commissioners/Hearing Examiner (BOCC/HE) remand of 10/6/23. The NWGC report is supplemental to the Geologic Hazard Site Assessment (Wood, 2022) and Hydrologic Site Assessment Report (MFA, 2016).

Unless otherwise noted, all reference below to figures and tables are from the NWGC Report (2024).

Aquifer Properties, including groundwater levels, gradients, and direction of flow. The NWGC report describes surface soils, local geology, subsurface lithology and water bearing strata in the existing Lake Erie Pit site and proposed expansion area based on available technical reports. These include USDA soil descriptions, published geologic maps, surveyed elevations, mapped topographic data, published well logs, and drilling logs for two observation wells (MW01, MW02). Although there are some minor discrepancies in areal extent of specific soil types and some details in the geologic material descriptions, i.e. comparing well logs to published geologic maps, they are not significant and do not affect the overall evaluation. Groundwater levels were measured following accepted protocols (Table 3) and groundwater flow characterized by standard methods (Figures 4, 5, and 6). 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. Given the high specific yield of sand and gravel aquifers and the low pumpage required for filling the pressure tank for a residential water supply, we believe this is a reasonable assumption. The observation well drilling logs and findings were in accordance with professional standards. We found no significant issues with using this information in the groundwater evaluation.

Water Quality Sampling, including lab analysis and water quality data. Water quality sampling from wells and springs followed accepted procedures and sample analysis was

according to agency guidelines and accredited laboratory methods (Table 3). We flagged some results from the East Well (S07) for concentrations outside the comparative range of other samples. Anomalous results for this well appear in Figure 2 (STIFF diagram) and Figure 3. There may be several reasons for these departures and the results do not have major bearing on other results. We found no significant issues with use of the water quality data in the groundwater evaluation.

Summary and Conclusions of the NWGC report.

The subject report provides a detailed characterization of the groundwater system in the mine area, based on distributed observation well logs, water level data, water quality sampling results, and cross-sections depicting relative groundwater levels and water bearing materials. The report makes the following conclusions:

1. Water quality sampling identified distinct differences in water types between the observation wells and the two identified springs in the coastal bluffs. These differences indicate groundwater in the mine area may not be hydrologically connected to the springs.

   Review and Comment: We note that Figure 5 (B to B' cross-section) shows groundwater levels in the mine area are significantly lower in elevation and unlikely to contribute seepage to Dodson Canyon Spring. Figure 4 (A to A' cross-section) shows groundwater generally flows away from North Spring, on a gradient of .0023 or 12 feet/mile. Low gradients are characteristic of water bearing strata with high rates of hydraulic conductivity. The direction and rate of groundwater flow and difference in water types support the conclusion that groundwater in the mine area is unlikely to contribute seepage to North Spring.

2. Groundwater in the central and east portions of the mine area generally flows to the northeast and smaller components flow to the north and northwest.

   Review and Comment: We note that groundwater flow from the mine would be expected to follow topographical and geologic controls (shown in Figure 1, Site Vicinity) draining north to northeast, downslope to Lake Erie, to Lake Campbell, then discharging into Skagit Bay.

3. The premise that the proposed mine may increase groundwater flow to the west, is not substantiated due to the absence of glacial till in the west portion of the site, and the lack of shallow groundwater in intervening strata.

Review and Comment: It is our conclusion that the NWGC report provides the additional physical investigation and analysis necessary to assess the general direction of groundwater flow, which is north/northeast, with no obvious hydrologic continuity with seepage from the springs.

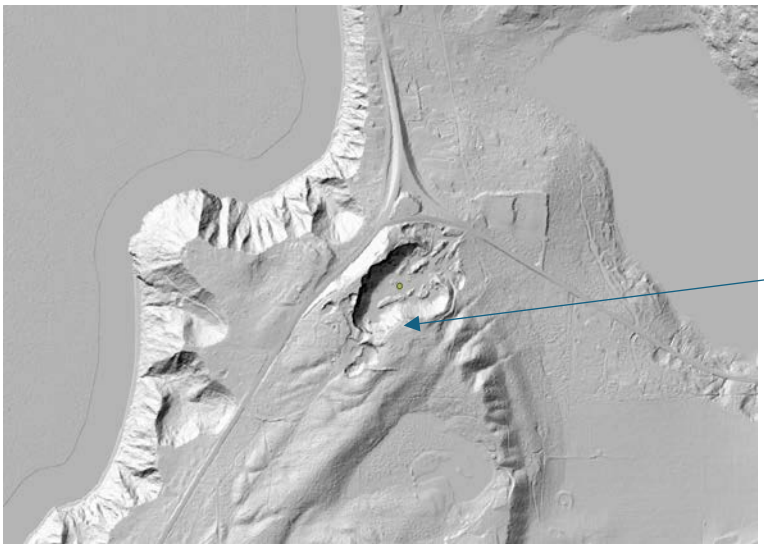
Skagit County Code14.24.400-.420, including requirements of the BOCC remand and supplemental review. The BOCC Resolution #R20230197 and order of the Hearing Examiner require additional analysis for the Geologic Hazard Site Assessment (GHSA) pertaining to potential mining impacts and requirements of SCC 14.24.420, particularly SCC 14.24.420 (e) estimating coastal bluff retreat rates and (f) assessment of coastal bluff stability.

The NWGC report identifies the coastal bluffs west of Rosario Road. It compares water quality test results, groundwater level data, and geologic materials in the area for potential groundwater continuity from the mine to North Spring and Dobson Spring. The report concludes that hydrologic connection between the mine and springs, based on differences in groundwater chemistry and the prevailing direction of groundwater flow, may not exist.

The report does not specifically address bluff retreat rates and slope stability. It does conclude that mining would not contribute to increased seepage from the springs, which implies there would be no cause and effect change in bluff retreat rates or bluff stability.

We note that residents on the coastal bluffs west of the proposed mine certainly are concerned about potential increases in bluff retreat rates and changes in bluff stability. Coastal bluffs from Biz Point to beyond Edith Point are mapped as geologically hazardous areas for good reason. 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). As shown in the LiDAR image (below), the coastal bluff landform includes steep slopes (some greater than 30%), high bluffs (greater than 300 ft), and numerous landslides resulting from coastal erosion and slope failures.

Most of the large slides visible in this image are more than 1,000 years old (Keuler, 1979). The small slides are typically non-hazardous slope readjustments due to local slumps, soil creep, and surface erosion. 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). The area between Biz Point and Edith Point had 3 to 7 major slope failures in 20 years prior to 1988 (ibid).



WDNR. LiDAR Hillshade. bare earth. Washington Geologic Information Portal. https://geologyportal.dnr.wa.gov/2d-view#wigm

We note that coastal bluffs west of the mine are naturally unstable due to steep slopes, unconsolidated glacial material, permeable strata over silt and clay layers, and added groundwater recharge from housing development. These natural hazards are mitigated to some extent by methods that observe necessary setbacks, protect native vegetation, reduce impervious surfaces, and reduce onsite water use.

We note that the additional groundwater investigation and analyses presented in the NWGC report supports the conclusion that the risk of increased groundwater flow towards the springs is very small. Based on detailed information available in the studies to date, less than 10% of the mine area could contribute any additional flow towards the bluffs. It appears that any increase in groundwater flow towards the bluffs would originate in the western portions of parcels P19108, P19162, P19155, and P19158, shown in the Skagit County iMAP (below) and NWGC report, Figure 7.

https://skagitcounty.net/Maps/iMap/?mapid=a6cf480ed7fa449bac7dc6086ecfdf49

A possible mitigation measure to reduce the small risk even further would be to increase the buffer width from the current 50 feet to 100 feet along the western boundary of these parcels. The remaining mining area clearly drains away from the bluffs and towards Lake Erie.

It is our professional opinion that the proposed Lake Erie Pit project, with increased buffer widths in these parcels, and as approved with conditions by the Hearings Examiner, would not increase groundwater flow to Dodson and North Springs or increase bluff retreat rates and instability of the coastal bluffs. We believe the NWGC report meets the requirement for assessment of potential impacts on bluff retreat rates and slope stability required under SCC14.24.420 and the BOCC/HE remand. The suggested mitigation measure is for consideration.

References.

Keuler, R.F. Coastal zone processes and geomorphology of Skagit County, Washington. Master's thesis, Western Washington University, Bellingham, WA. 123 p. 1979

Keuler, R. F., Map showing coastal erosion, sediment supply, and longshore transport in the Port Townsend 30- by 60-minute quadrangle, Puget Sound Region, Washington, Miscellaneous Investigations Map 1198-E, United States Geological Survey. 1988

Maul Foster & Alongi, Inc. (Maul Foster). 2016. Hydrogeologic Site Assessment Report, Lake Erie Pit Expansion. 2016

Shipman, H. A Geomorphic Classification of Puget Sound Nearshore Landforms. Puget Sound Nearshore Partnership Report No. 2008-01. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington. 2008. www.pugetsoundnearshore.org.

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Shipman, H. Coastal Bluffs and Sea Cliffs on Puget Sound, Washington. In: M.A. Hampton and G.B. Griggs (eds.), Formation, Evolution, and Stability of Coastal Cliffs–Status and Trends, Professional Paper 1693. U.S. Geological Survey: 81-94. ND. https://apps.ecology.wa.gov/publications/UIPages/documents/0406029.pdf

Wood Environment & Infrastructure Solutions, Inc. Geologic Hazard Site Assessment Lake Erie Pit 1 Expansion Southeast corner of Rosario Road & Marine Drive. Kirkland, Washington. August 11, 2022