TECHNICAL MEMORANDUM

Veranda Subdivision Wetland 1: Hydrogeologic Interpretation and Review of Geotechnical Investigation

To: Jim Wheeler, City of Gresham

From: Walter Burt, RG, Principal Hydrogeologist, GSI Water Solutions, Inc.

CC: File

Date: October 31, 2023

Introduction

I am a Registered Geologist in the State of Oregon and Principal Hydrogeologist GSI Water Solutions, Inc. (GSI) with over 34 years of experience in conducting hydrogeologic investigations in the Pacific Northwest. Much of the focus of my work has involved investigating groundwater flow regimes and groundwater/surface water connectivity of the sedimentary aquifer systems in East Multnomah County.

This document summarizes the hydrologic relationships between Wetland 1, located on the Veranda property (Site), and Kelley Creek, which flows along the northern boundary of the Site. This summary describes how the hydrology of Wetland 1 is directly connected to and is an important source of groundwater that eventually reaches Kelley Creek. Groundwater flowing into the creek lowers the water temperature, which is critical because the creek is a 303(d) listed stream for temperature. Due to the direct hydrologic connection, Wetland 1 provides a water quality improvement of the temperature in Kelley Creek, confirming the City's current designation of the wetland as locally significant under OAR 141-86-350.

This summary also includes observations and comments on information provided in the Preliminary Geotechnical Report and Geologic Hazard Evaluation, Veranda, 7928 SW 190th Drive, Gresham, Oregon (Hardman Geotechnical Services, Inc., August 3, 2023) and an accompanying cover letter by AKS Engineering & Forestry, LLC (AKS).

Hydrologic Relationship Between Wetland 1 and Kelley Creek

The key question in this matter is whether Wetland 1 provides a water quality benefit to Kelley Creek. The answer, provided using basic hydrologic principles, is "yes" because Wetland 1 is an important source of cool water that reaches Kelley Creek during the dry summer months when needed most:

1. Water in the wetland and shallow groundwater that it replenishes are in continuity in the wet season.
2. Wetland 1 provides a disproportionately large contribution of cool water to Kelley Creek in the dry season months than abutting non-wetland areas because it concentrates and holds water, which allows the water more time to infiltrate into the subsurface. The infiltrated water then flows downhill and emerges in the creek during the dry season. In contrast, precipitation falling on non-wetland areas is more susceptible to flowing overland, reaching the creek during the wet season.

3. This connection between Wetland 1 and Kelley Creek provides the water quality benefit when most needed because the flow of water in the subsurface is slow, so the cool water infiltrating from the wetland emerges in the creek during the dry season.

Why is Wetland 1 a Concentrated Source of Infiltration and Flow to the Creek?

More water infiltrates from the surface into the groundwater when it is retained and pooled rather than running downslope on the ground surface. The main portion of Wetland 1 is located within a swale that is situated below the foot of the steep northwest-facing slope of the butte. The swale collects seepage flows from upslope, as well as surface runoff during storm events, and slows and pools the water which allows it more time to infiltrate. The concentration of water in the swale is demonstrated by the presence of pooling and flow of water at the surface in the topographic low. Collection and pooling of water at this location enhances the seasonal infiltration of water to flow in the subsurface downhill and to the creek.

Why does Water from Wetland 1 Flow into Kelley Creek?

Kelley Creek occupies the lowest part of the Kelley Creek watershed and collects shallow groundwater that is flowing downhill from the surrounding slopes. Shallow groundwater from areas of enhanced infiltration such as Wetland 1 flows downhill and emerges in the creek year-round. Flow in the creek during the dry months is proof of capture of shallow groundwater that has infiltrated to the groundwater table during the rainy season.

Shallow groundwater from Wetland 1 is unlikely to flow in a northerly direction towards the creek (as implied by AKS) since the level of the creek upstream of SE 190th Drive is much higher than the downstream side and there is a low topographic divide on the north side of the swale between Wetland 1 and the creek.

Instead, water infiltrating from Wetland 1 flows downhill towards the lowest level of Kelley Creek near the Site. The lowest level of Kelley Creek in the vicinity of the Site is downstream (west) of SE 190th Drive where the level of the creek is approximately 15 feet lower than east of SE 190th Drive[1] (Figure 1). Thus, water from Wetland 1 flows in the subsurface in a northwest direction, under SE 190th Drive and to Kelley Creek. Groundwater contours on a map by Lee and Snyder (USGS, 2009) map clearly show that groundwater flow converges on Kelley Creek, and flows in a northwesterly in the vicinity of the site.

[1] A culvert beneath SE 190th Drive maintains the creek at a higher level upstream (east) of the road.

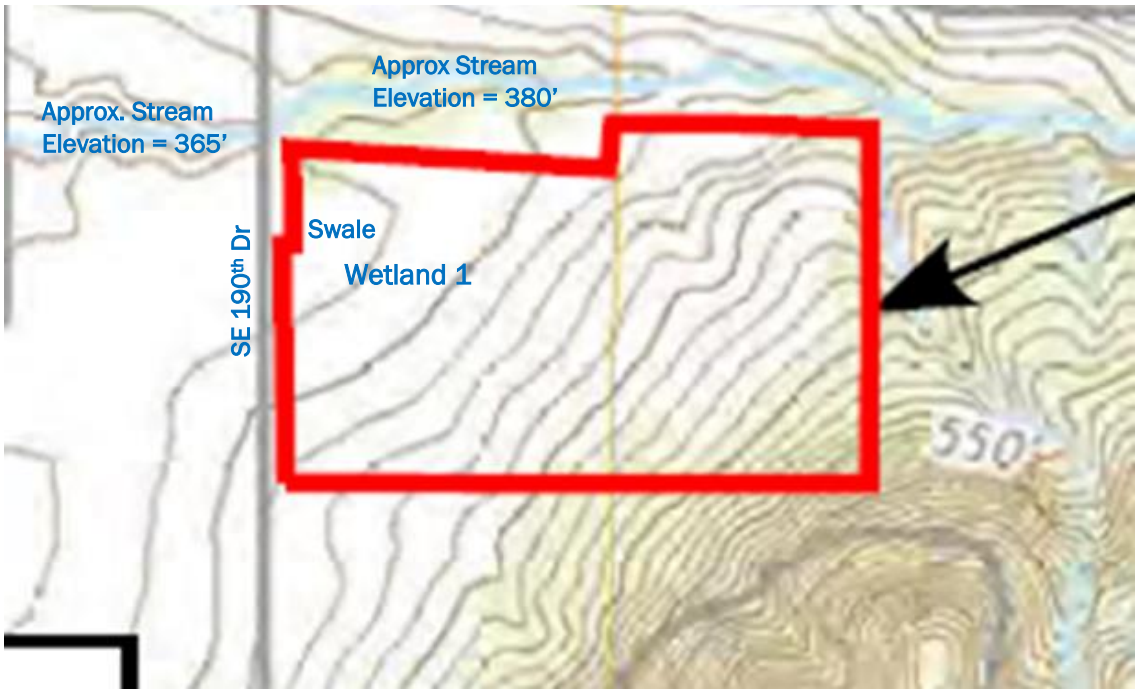

Figure 1. Groundwater flow between Wetland 1 and Kelley Creek (Basemap source: Figure 1, Hardman Geotechnical Services, 2023)

How does Shallow Groundwater Provide a Water Quality Benefit to Kelley Creek?

The average temperature of groundwater in the Pacific Northwest ranges between 52 and 57 degrees F.[2] Cool water that has infiltrated to the groundwater table and flows to Kelley Creek helps cool stream temperatures. In addition to providing an overall temperature benefit to the stream, areas of groundwater inflows are important cool water refuges (called "cold water refugia") where juvenile salmon and other cold-water fish species congregate when ambient water temperatures are high.[3]

Review of Hardman Geotechnical Services, Inc. Preliminary Geotechnical Report and October 6, 2023 AKS Engineering & Forestry Cover Letter.

We reviewed the Hardman Geotechnical Services, Inc. (HGS) geotechnical report and cover letter by AKS to assess the data in the report and conclusions by AKS regarding the connectivity between Wetland 1 and Kelley Creek. HGS conducted a soil foundation geotechnical investigation at the Site by excavating test pits to depths of up to 19 feet below ground level at the Site in August 2023. One test pit (TP-5) was excavated to a depth of 17 feet within the footprint of Wetland 1 and observations from the test pit were used by AKS to draw inferences on the hydrologic relationship between Wetland 1 and Kelley Creek. Key assertions by AKS included:

1. Groundwater was not observed in any of the test pits, including TP-5
2. The bottom of TP-5 coincides with the level of the "toe slope" adjacent to Kelley Creek on the northern edge of the site, the groundwater level at Wetland 1 is lower than the creek level and groundwater cannot be flowing to the creek in the dry season.

[2] Average Shallow GroundWater Temperatures | Ecosystems Research | US EPA
[3] Primer for Identifying Cold-Water Refuges to Protect and Restore Thermal Diversity in Riverine Landscapes Document Display | NEPIS | US EPA

3. Therefore, Wetland 1 does not have a subsurface connection to provide a temperature cooling effect to Kelley Creek during the summer months.

We have the following comments to these assertions:

1. The test pits were excavated in August, at the height of the dry season under severe drought conditions [4], and therefore it would be anticipated that groundwater levels would be low. The lack of groundwater in TP-5 at a depth of 17 feet only demonstrates that groundwater table in the dry season is below the bottom of the test pit and the test pit was not excavated deep enough to encounter groundwater. Groundwater is still present and is flowing towards the creek regardless of whether it is observed in a test pit.
2. We noted in the descriptions of the test pit logs that residual moisture from water percolation and high groundwater levels during the wet season is present below a few feet, and the moisture content of the soils increases with greater depth as the test pits approach the depth of the receding water table. This moisture profile is what we would expect in the dry season after water from the wetland has percolated into the soil column and replenished groundwater, which is present below the bottom of the test pits.
3. The lack of groundwater at a depth of 17 feet in TP-5 does not in any way prove a lack of connection with Kelley Creek, particularly given that Wetland 1 is in a swale where groundwater likely flows in a northwesterly direction towards the lowest level of Kelley Creek, and not northerly (and under the creek) as implied by AKS.
4. Lastly, groundwater from Wetland 1 and other upland areas takes at least several months to reach Kelley Creek in the subsurface. The water contributing to Kelley Creek from Wetland 1 was "sent" several months before the dry season. The time lag for water from Wetland 1 to reach the creek is precisely why Wetland 1 benefits water quality in Kelley Creek. Looking at this another way, taking away the source of groundwater replenishment at Wetland 1 during the rainy months would affect streamflow and temperature months later, not immediately.
5. If Wetland 1 and its swale (and other wetlands) were removed, less cool water will reach Kelley Creek during the summer season. This will be further exacerbated by the proposed installation of a drain pipe on the upslope side of the Veranda development because it will significantly alter the hydrology of the site by capturing and piping water from the butte that sustains Wetland 1 and groundwater during the wet season. The effect of the piping will be greatly reduced subsurface flow to the creek in the summer months.

Test pits, even if excavated to the groundwater table, are not suitable for assessing the groundwater flow direction and the hydrologic dynamics between Wetland 1 and Kelley Creek. A hydrologic investigation to evaluate relationships between Wetland 1 and Kelley Creek should involve drilling several observation wells in the vicinity of the wetland (including west of SE 190th Dr), and monitoring groundwater levels at a minimum over a water year (October 1 – September 30) to evaluate the contribution of the wetland to groundwater and the seasonal groundwater flow direction from the wetland. AKS indicated in the cover letter to the HGS report that the City recommended excavating the test pits completed by HGS. For clarification purposes, GSI outlined a general approach and starting point for an investigation involving observation wells, not test pits. The approach and scope were sent in an email to the City on July 14, 2023 and subsequently forwarded to Mr. Jim Leeper by the City on July 21, 2023.

[4] Oregon Water Resources Conditions Report dated August 28th, 2023. 2023_08_28_Water_Conditions_Report.pdf (govdelivery.com)