Comments on the Permit Application (GRDE18-0048)
Phase III Queen City Farms Gravel Pit Refill Project

COMMENTS

General

These comments are based on a review of the Technical Information Report (TIR, 2019 revision) issued by Landau Associates (LAI) to support the Queen City Farms (QCF) King County permit application for the Phase III gravel pit refill project. The review is limited by lack of access to either the Phase I or Phase II refill permit application documents, as well as LAI's 2007 TIR for the Queen City Farms Refill Project. On the other hand, the comments herein are informed by principal researcher and author, Marcia Knadle, who possesses 29 years of experience with the Environmental Protection Agency (EPA) providing hydrogeology technical support to a succession of Remedial Project Managers for the Queen City Farms Superfund site (including the current one). In addition, Ms. Knadle is a native and resident of Maple Valley and, as a result, always has had a strong interest in the site.

These comments are also limited to issues related to groundwater and surface water flow at the site. It's tempting to think that it should be possible to predict accurately the effects that the various changes associated with the refill project will have on water flow on and through the site. However, there are so many different changes, that it's probably not possible. As a result, King County should ensure that QCF is committed and prepared to manage the site adaptively, so that if impacts are different (particularly if they're worse) than projected, they can respond quickly and effectively to protect local residents and infrastructure.

The comments herein also are limited to the refill of the more easterly portion of the gravel pit, in particular, the filling of the Main Gravel Pit Lake (MGPL), which has long been the primary recharge area for the main *trichloroethylene (TCE)* plume at QCF. This refill has already been permitted as part of the Phase II project, but there probably will be additional impacts from the Phase III project.

It's important to recognize QCF is required to reclaim the gravel pits. This means they're required to place fill in a way that roughly mimics the pre-mining topography and then revegetate it. That doesn't necessarily mean that the fill is required to mimic the pre-mining hydrologic functions as regards drainage, rainfall infiltration, and groundwater recharge, but it should aim to do so to the extent feasible.

Another thing that's important to recognize is that the refilling process will be slow. QCF can only bring in fill materials as they become available, since that is largely dependent on construction of commercial buildings – ones large enough to require a sub-basement. The rate of filling is likely to be be much slower than was anticipated when this permit application was submitted because of the economic impacts of COVID-19.

Attached are a set of the figures from EPA's most recent *Five-Year Review (5YR) of the QCF Superfund* site. Four of them specifically are referred to herein. The others are included for the Department of Local Services, Permitting Division's review and information.

Following these comments please find a GLOSSARY of terms/acronyms employed herein.

Historical Changes in Surface Water and Groundwater Flows Over Time

Whatever surface water doesn't run off infiltrates, and most of what the infiltrated water that plants don't take up becomes groundwater. Shallow groundwater also discharges to surface water, so hydrogeologists must understand hydrology to be able to evaluate how surface water and groundwater interact at a given site. At QCF, and probably most gravel mines, the relationship between surface water flow and groundwater flow is unusually direct.

Comments on the Permit Application (GRDE18-0048)
Phase III Queen City Farms Gravel Pit Refill Project

The Main Gravel Pit mined out a large hillside of gravel that originally extended from Queen City Lake (QCL) nearly to the north side of Cedar Grove Road. While it may have had a thin layer of finer-grained soil on top of it, it must have had greater infiltration capacity than the area north of QCL, which has a thick layer of glacial till at the surface. The gravel had some lower permeability silty layers, which resulted in the surficial aquifer (Aquifer 1) being perched. Before mining, that aquifer discharged year round to a spring along the north side of Cedar Grove Road just north of tax parcel 3323069027. After mining started to remove Aquifer 1, that spring became seasonal, and Aquifer 1 began discharging from various springs along the pit face to the bottom of the pit, the area that eventually became the MGPL. According to nearby residents at the time, the original spring fed a stream that flowed down the Cedar Grove Channel to Cedar River, and had enough flow during late summer and early fall to allow salmon to spawn nearly all the way up to the spring. When the spring became seasonal, so did the stream, and that tributary no longer supported salmon spawning. There are probably a number of letters from local residents buried in King County's files from the mid-1980s complaining about this loss of spawning habitat as a direct result of the mining. The TIR (page 1-1) states that *"The proposed Phase III Refill will establish new grades in this area of the site to restore the surface water drainage patterns to more closely resemble historical conditions, and support future use of the site as wildlife habitat."* As such, it would be entirely appropriate for this project to address this significant historical mining impact as part of the refill project.

In addition, surface water flows from the southern part of the Cedar Hills Regional Landfill (CHRL) also drain to Aquifer 1 via QCL, mainly infiltrating through the sides of the lake when the water level is high. With development of the landfill, and especially capping, the peak runoff flows to QCL increased. CHRL has greatly improved their stormwater detention facilities over the past few decades, but the peak runoff is likely still a bit greater than existed originally. In short, with mining, the volume of Aquifer 1 shrank, but the inputs have probably not declined as much.

Below Aquifer 1, is Aquifer 2. Besides the discharge to the spring near Cedar Grove Road, Aquifer 1 also discharged vertically to Aquifer 2, even before mining. The evidence for this is that the Aquifer 2 *TCE* plume [from the (now contained) source area to Aquifer 1 to the east of QCL] has clearly long had a radial flow pattern, indicating that a water level mound existed in Aquifer 2 in an area between Queen City Lake and the MGPL. The plume has been mostly driven to the bottom of the aquifer by all this focused recharge. With the gravel mining, the groundwater mound mostly moved south to below the MGPL (see *Figure 4-3* in the EPA *5YR* for the water level map). The result of the enhanced recharge at that location has been the apparent splitting of the Aquifer 2 plume into 2 separate plumes – a northern plume under the remnants of Aquifer 1 and a southern plume south of the MGPL, currently being mostly captured by Boeing's Ground Water Extraction System (*Figure 4-10* in the EPA *5YR*). The water is treated before being returned to the MGPL, but with that lake gradually being filled, it's unclear where that treated water will be discharged in future.

Below the eastern edge of the Aquifer 2 plume, is a *TCE* plume in the upper part of Aquifer 3, which is not even mentioned in LAI's TIR. This plume flows south from a point apparently under the eastern portion of the MGPL. Its extent is smaller, but the maximum contaminant concentration is now nearly double the maximum concentration currently found in Aquifer 2. This plume extends beneath Cedar Grove Road NE and appears to end beneath a wetland in the Cedar Grove Channel (*Figure 4-12* in the EPA *5YR*).

Figure 5-7 (*"Conceptual Site Model"*) from the EPA *5YR* shows a schematic cross section of the hydrogeology and how contamination is thought to have migrated through the various aquifers. This

is a figure recycled from earlier reports and is now a bit out of date, so we've added some red and green arrows to indicate the current understanding of contaminant migration in upper Aquifer 3. None of these plumes are in aquifers that are currently tapped for drinking water in the vicinity, and all the plumes are now either being actively remediated, are stable in extent, or are shrinking. Nevertheless, Boeing has periodically tested existing water supply wells in the general area, as an extra measure to ensure that no one is being exposed to contaminants from the site.

Surface Water Flows Could Be Greater Than Anticipated

LAI's analysis of surface water flow volumes are based on modeling (and its associated assumptions) plus some additional assumptions. The Western Washington Hydrologic Model (WWHM, which is based on an EPA model and incorporates its limitations) is approved by the Washington State Department of Ecology for use at new developments, but the predictive reliability of any model is only as good as its major assumptions, so it's worthwhile to consider whether the assumptions behind it are adequately conservative. Those assumptions are listed here: https://fortress.wa.gov/ecy/madcap/wq/2014SWMMWWinteractive/Content/Topics/VolumeIII2014/VolIII%20Ch2%202014/VolIII%20Ch2-2%202014.htm

Most of the listed assumptions are valid in this situation or are not likely to have a major impact on the results, but using the 100-yr frequency 24-hr storm (as statistically determined over the past 20-50 yrs) as the maximum rainfall event may not be all that realistic. As anyone who's spent a few winters in western Washington knows, we can get heavy rainfall events that last significantly longer than 24 hours (an atmospheric river event) as well as a rapid succession of heavy rainstorms, where the breaks between storms are too short to allow either natural ponds or engineered stormwater detention facilities to drain much in the interim. As a result, a major storm may either last so long that it overwhelms the detention facilities or storms may occur so close together that there isn't enough detention pond capacity after the earlier ones to accommodate runoff from the later ones. This doesn't account for the possibility that climate change may make large storms of any past frequency happen more often in the future. If so, storms that used to happen on average every 100 yrs may start happening every 10 or 20 yrs, and what used to be 500-yr frequency storms may happen every 50-100 yrs.

In addition, the modeling has assumed certain conditions affecting future peak flows from the CHRL that may not be borne out. The first is the assumption of forested conditions in the portion of the landfill that makes up about 80% of the QCL drainage basin (p. 4-1 of the *TIR*), and the second is that King County is planing to improve the stormwater detention facilities at the portion of CHRL in the QCL Sub-basin (p. 3-9 of the *TIR*). Since this report was developed last year, CHRL has announced plans to extend landfill operations much longer, including expanding landfilling into some of the currently forested buffer zones. The extent to which the proposed continued operations would impact the portion of the landfill in the QCL drainage is not clear, but it may not be wise to make any non-conservative assumptions about future peak flows from CHRL. Moreover, even if CHRL does start reforesting the area by 2030, it will be decades before there's any significant reduction in peak flows to QCL. Surface water flows should decrease over time as forests get established, both at CHRL and on the completed refill at QCF, at which point some detention facilities could be closed. However, in the meantime detention facilities need to be designed to accommodate near-term flows from large minimally vegetated areas.

Finally, it's not credible that soils in the refilled areas will have rainfall infiltration properties similar to either the current gravel surface or the pre-mining gravelly surface and underlying gravel deposits,

even after reforestation, as suggested on p. 3-9 of the *TIR*. The fill materials will be much finer-grained and more heterogeneous than the Aquifer 1 coarse gravels and sands that were originally in place. Moreover, the refill materials will be compacted to help make the new slopes stable, so there will likely be even less infiltration and more runoff or rear-surface seepage at the base of the slopes. The project description on the Notice of Application for the permit says QCF will *"refill and restore a portion of a formally permitted mined gravel pit to its approximate historical grade and hydrology"* While it's possible to refill and regrade the land surface to the approximate historical grade, it's really not possible to restore the hydrology or hydrogeology, especially with the proposed fill materials. It's difficult to say whether this difference will cause significant contributions to overall runoff, but it's yet another non-conservative assumption.

Regarding LAI's assessments of both the hydrogeology and surface water, p. 1-9 of the *TIR* states that *"The assessment was only qualitative, therefore a hydrological analysis will be completed using either hydrologic modeling or data collection, or a combination of both. LAI expects that DPER will issue the Phase III permit with the condition that an updated wetland memorandum and hydrological analysis will be completed prior to beginning Phase III Operation."* This additional analysis may help refine some of the modeling inputs. Even so, the potential cumulative impact of multiple non-conservative assumptions is troubling. If the capacity of the planned stormwater detention and infiltration features turns out to be seriously insufficient, it should be apparent within a few years of refill completion, perhaps even before refilling is complete. QCF should be prepared to rectify promptly any shortfall that may occur. It may be wise for King County to require a contingency plan.

How Groundwater Flows May Change with the Refill Project's Changes to Surface Water Flows

The refill project will make several changes in where and how surface water flows through the site, as well as change where rainfall infiltrates. Currently, rainfall in the QCL Sub-basin, including water coming from the southern part of CHRL, infiltrates into Aquifer 1, which mostly discharges from a spring in the pit face and down a pipe into MGPL, thereby directly recharging Aquifer 2. As part of the refill project, the discharge from this spring will be routed through an infiltration gallery along the pit face. *[we couldn't find a map showing the location of the infiltration gallery (perhaps it's shown on figures from the Phase II permit application), but presumably it's in an area to the north of the MGPL.]* Overflow from QCL, which currently enters Aquifer 1, will be piped directly to the East Retention Pond (located to the west of the current groundwater extraction well line, as shown on Sheets 2 of 13 and 3 of 13 of the *GRDE18-0048 Plan Set*) and directly north of Cedar Grove Road. This will effectively move some portion of the Aquifer 2 recharge south. The fill and regrading project in itself will also likely move some of the Aquifer 2 recharge in the MGPL area south by decreasing rainfall infiltration over the filled area. This is because the fill material will almost certainly be finer-grained and have a lower permeability than the soils currently exposed and likely lower than the original gravel soil deposit. This water will runoff to the bioswale and various ponds existing and to be constructed along the north side of Cedar Grove Road (the East Retention Pond, South Pond, and Main Infiltration Area), also having the effect of moving some of the recharge to Aquifer 2 south. The MGPL accommodates a lot of infiltration through its sides during the wet season, and it's not entirely clear if the planned infiltration features will have enough infiltration capacity to replace it, especially before the new fill is reforested.

The effect of these changes in recharge location is more difficult to predict. The relocation of Aquifer 1 recharge back to the north of MGPL, as well as the relocation of some water that currently enters Aquifer 2 via the MGPL to the East Retention Pond will cause at least some of the rainfall

infiltration around the MGPL to recharge both further north and further south and southeast. This may weaken the existing Aquifer 2 groundwater mound. At this point in time (based on Google Earth images), the Phase II filling of MGPL is about half done with the western half now filled, so the groundwater mound may already be starting to shift eastward. Shifting or weakening that groundwater mound may actually help the groundwater extraction system capture the Aquifer 2 plume more effectively. If the groundwater mound were to go away entirely from the MGPL area, it could allow some the Aquifer 2 plume that currently sits north of the MGPL to flow south again (as it did before mining), possibly extending the timeframe for groundwater extraction and treatment. However, since Aquifer 1 will still discharge in the vicinity of the current pit face, this seems unlikely. Of greater concern is the location of the proposed East Retention Pond directly above the Aquifer 3 plume. Not enough is known about how and where the contamination enters Aquifer 3, and it's not clear whether a change in groundwater levels in Aquifer 2 above the Aquifer 3 plume will affect contaminant migration in Aquifer 3. Boeing and EPA may need to increase the groundwater monitoring throughout both plumes until the effects of these changes in recharge amount and location on groundwater flow is understood. This will probably require additional monitoring wells. However, one upside of filling the MGPL is that Boeing will be able to drill monitoring wells in areas they previously couldn't because of standing water much of the year.

It's also not clear from the maps whether some if these features will interfere with the operation and maintenance of Boeing's groundwater extraction and treatment system. The fill appears to come very close to the line of extraction wells, and we can't tell whether the bioswale will be on their north side or on the south side (hopefully the north side). We contacted the EPA Remedial Project Manager and were assured that Boeing is reviewing these plans carefully and will make their own concerns known, to QCF if not to the County.

Conclusions and Recommendations

While QCF can reclaim (refill) the mined areas, they can't restore the pre-mining hydrology or, especially, the hydrogeology.

The *TCE* groundwater plumes at the Superfund site will probably be impacted to some extent, and additional groundwater monitoring wells will likely be needed. However, there is an ongoing monitoring program, and the plumes migrate slowly enough that Boeing and EPA should be able to identify and address any issues in a timely manner. The refill of the MGPL will even enable Boeing and EPA to place monitoring wells where they couldn't previously, allowing them to improve their understanding of the how contamination flows through the site, as well as to identify any changes caused by the reclamation project.

The stormwater control measures may not be adequate to manage future peak flows, especially in the decades before the various areas become meaningfully revegetated. The permit should require a contingency plan to enable QCF to upgrade the stormwater detention capacity quickly if needed. This could be developed as part of the additional analysis QCF and LAI has promised to perform after the permit is approved.

To enable restoration of salmon spawning habitat in the Cedar Grove Channel that was disrupted when Aquifer 1 was largely mined out, the permit should include as a Condition the re-establishment of year-round flows in the stream that originates from the spring at the south property boundary. If QCF could truly restore the hydrogeology of the site, this would happen automatically. While that's not possible, it would be entirely feasible for them to restore this hydrologic function by pumping groundwater into that drainage (ideally at the spring location at the source of the stream) during the

late summer and early fall. Perhaps they could use the treated water discharging from Boeing's groundwater treatment plant, which currently discharges to MGPL and will need to be moved eventually anyway.

REFERENCES

EPA, 2018, *Fifth Five-Year Review Report for Queen City Farms Superfund Site, Maple Valley, WA*. Link to report text without figures: https://semspub.epa.gov/work/10/100120622.pdf. The cited figures are appended to these comments.

LAI, Aug. 30 2019 Revision, *Technical Information Report, Queen City Farms Phase III Refill Project, Maple Valley, King County, WA.*

GRDE18-0048 Plan_Set_2018_04_06

GLOSSARY

5YR—EPA's Five-Year Review

CHRL—Cedar Hills Regional Landfill

EPA—Environmental Protection Agency

GMVUAC—Greater Maple Valley Unincorporated Area Council

LAI—Landau Associates

MGPL—Main Gravel Pit Lake

QCF—Queen City Farms
QCL—Queen City Lake

TCE—Trichloroethylene

WWHM—Western Washington Hydrologic Model

Prepared by: Marcia Knadle, Principal Researcher, GMVUAC Environment Committee
[Hydrogeologist (licensed in Washington State) and retired EPA hydrogeologist formerly assigned to the Queen City Farms Superfund site]

Approved by: LarKen Buchanan, Chair, GMVUAC Environment Committee

Approved by: Steve Hiester, Chair, GMVUAC