Luhdorff & Scalmanini
Consulting Engineers

electronic submittal

Technical Memorandum

DATE: January 11, 2022 PROJECT: 10-1-074

TO: Mr. Jason Smith, Teichert Aggregates (JSmith@teichert.com)

FROM: Till Angermann, PG, CHG, Principal Hydrogeologist

SUBJECT: MINING PIT DEWATERING, EVAPORATION, AND POTENTIAL CONTAMINATION SHIFLER PROPERTY AT TEICHERT'S WOODLAND FACILITY, YOLO COUNTY

History of Comprehensive Data Collection and Evaluation

In the context of Teichert's off-channel mining activities at the Woodland facility there is a robust record of comprehensive data collection, evaluation, and predictive groundwater modeling. The cumulative data record documenting over 20 years of mining activities plus pre-mining conditions shows no evidence or indication that mining/reclamation activities have caused adverse effects on groundwater levels or quality to date. This is congruent with predictive analyses that were carried out as early as 1995 (LSCE 1995), subsequent in-depth analyses concerning potential contamination risks (LSCE and Todd Engineers 1996), and consistently thereafter as mining activities progressed across the site from one property to the next, as documented in annual monitoring reports through 2021 (LSCE 2021).

Luhdorff & Scalmanini Consulting Engineers (LSCE) has been providing professional services regarding groundwater resources in the context of off-channel aggregate mining operations to the Teichert corporation and other aggregate mining operations along Cache Creek since the mid-1980s. The early work was instrumental in comprehensively characterizing pre-mining groundwater conditions and provided insight into potential impacts on groundwater resources with the development of a numerical groundwater flow model (MODFLOW platform, developed by the U.S. Geological Survey). These efforts also helped inform the development of Yolo County's Off-Channel Surface Mining Ordinance (Ordinance), which sets forth robust groundwater and mining pit monitoring requirements for the duration of all mining phases (i.e., pre-mining, active mining, active reclamation, and post-reclamation). This includes sampling for a large suite of total (i.e., not filtered) metals concentrations (i.e., Title 22 inorganics).

Mining activities have been occurring continuously for well over 20 years including the Coors, Storz, Haller, Muller, and Schwarzgruber properties. Most recently, potential impacts to groundwater resources due to wetpit mining and reclamation activities at the Shifler property were comprehensively evaluated including the use of a calibrated numerical flow model

including particle tracking for the analysis of multiple different mining and reclamation scenarios (LSCE 2016, 2019, and 2020). These analyses concluded that no adverse effects to groundwater resources are expected.

Importantly, similar predictions have been made in the past for other mining properties at the Woodland plant, most recently for the Schwarzgruber property (LSCE 2011), and have been demonstrated to be realistic by the ongoing monitoring program for the entirety of Teichert's activities. For example, previously voiced concerns regarding adverse effects caused by diminished groundwater recharge, restricted groundwater movement, land subsidence, and groundwater contamination have been consistently shown to be unfounded both by predictive analysis and by the extensive data collection efforts.

Per your request, three technical items are revisited below.

Effects of Dewatering the Mining Pit on Groundwater Levels

The Ordinance codifies stringent limits on dewatering activities and their effects on groundwater resources. Probably most critically, the Ordinance stipulates that "Water generated from dewatering activities must be beneficially used and discharges onsite" (Section 10-4.412. Dewatering). In practice, this means that groundwater for the processing of aggregate, which otherwise would be extracted from an onsite water well, is extracted from the mining pit. Therefore, the activity of dewatering does not constitute an increase of groundwater extraction over what would otherwise be extracted from a water well. Furthermore, the stipulation to discharge water generated from dewatering activities onsite ensures the resource stays locally and is not exported.

In addition to the above, the Ordinance requires a demonstration, through technical analysis, that the proposed dewatering activity will not adversely impact active off-site wells or other water resources within 1,000 feet of the proposed dewatering pit boundary. The Ordinance states that "an effect shall be considered adverse if the reduction in simulated groundwater levels exceeds two (2) feet at any well located within 1,000 feet of the pit boundary or results in well failure)."

Using analyses that included a calibrated numerical flow model and particle tracking under consideration of multiple different mining and reclamation scenarios, LSCE (2019 and 2020) demonstrated that Teichert's proposed activities, including dewatering, will not cause adverse effects to groundwater resources. Going above and beyond Teichert's responsibilities under the Ordinance, the analysis was expanded to include a community water supply well at the Wild Wings community (LSCE 2020). This study concluded that Teichert's activities do not cause adverse effects at Wild Wings community water supply wells.

Evaporative Losses from the Pond Surface

For the consideration of long-term evaporative losses from a pond surface under reclaimed conditions, a comparison to an alternative land use, namely irrigated agriculture, is useful.

For example, the California Department of Water Resources (DWR ---) estimated the annual evapotranspiration (ET) from an almond orchard at 52.61 inches in Zone 14, which includes Woodland. Some ET is offset by rainfall-recharge. The annual average rainfall at the Davis experimental farm station is 17.55 inches. Of that, only a relatively small proportion (i.e., 10-20%) would ultimately recharge the groundwater under the orchard. The remainder would leave the site as surface water runoff. Using the above high recharge estimate yields an annual recharge amount of 3.51 inches and a net ET of 49.1 inches/year.

In comparison, using the industry standard of Class A pan evaporation data (Davis station, annual long-term average of 81.68 inches) and a coefficient range of 0.70 to 0.80 (Western Regional Climate Center, https://wrcc.dri.edu/) yields an evaporative loss estimate for a shallow lake in the project area ranging from 57.18 to 65.34 inches. All precipitation that falls onto the pond surface constitutes groundwater recharge. Therefore, the net ET for a shallow lake at the Woodland plant is estimated to range from 39.63 to 47.79 inches/year.

In summary, net ET from an almond orchard is expected to be greater than from the surface of a shallow lake left behind as part of reclamation.

Ponds as a Potential Pathway for Contamination

LSCE & Todd Engineers (1996) comprehensively evaluated potential risks to groundwater via the potential introduction of contaminants to the land surface and the mining pits. The report considered chemical and biological sources, and physical mechanisms and migration processes in the subsurface. The report concluded that the risk posed by mining activities and ponds is very small. It also evaluated risks associated with alternative land use, namely irrigated agriculture. The report concluded (Section 7, p.98):

> "Due to the wide distribution and recurrent nature of agricultural applications, this land use is expected to cause, and is currently posing a larger, more consistent risk to the beneficial use of ground water than those potentially associated with the alternative use of land for gravel mining."

Given the unequivocal documentation of widespread groundwater nitrate contamination caused by agricultural activities in the Central Valley (Harter et al. 2017), agriculture's role in the salinization of soils and groundwater as documented by the Central Valley Salinity Alternatives for Long-Term Sustainability initiative (https://www.cvsalinity.org/), the recent formation of Nitrate Management Zones across the Central Valley, and the California Department of Water Resources' focus on agricultural water demands in the context of the implementation of the Sustainable Groundwater Management Act[1], it is clear that the authors' assessment was correct. Again, over 20 years of mining activities show no evidence or indication that mining/reclamation activities have caused adverse effects on groundwater quality to date.

References

California Department of Water Resources. ---. Irrigation Scheduling using ET.

[1] https://water.ca.gov/programs/groundwater-management/sgma-groundwater-management

Harter, T., K. Dzurella, G. Kourakos, A. Hollander, A. Bell, N. Santos, Q. Hart, A. King, J. Quinn, G. Lampinen, D. Liptzin, T. Rosenstock, M. Zhang, G. S. Pettygrove, T. Tomich. 2017. Nitrogen Fertilizer Loading to Groundwater in the Central Valley. Final Report to the Fertilizer Research and Education Program, Projects 11-0301 and 15-0454. California Department of Food and Agriculture and University of California, Davis

Luhdorff and Scalmanini Consulting Engineers. 1995. Groundwater Conditions in the Vicinity of Planned Wet-Pit Mining Operations, Teichert Aggregates' Woodland Properties. Report. November 1995. LSCE file 95-1-119.

Luhdorff and Scalmanini Consulting Engineers. 2011. Groundwater Conditions in the Vicinity of Planned Wet-Pit Mining Operations, Schwarzgruber Property. Report. April 25, 2011. LSCE file 10-1-074.

Luhdorff and Scalmanini Consulting Engineers. 2016. Groundwater Conditions in the Vicinity of Planned Wetpit Mining Operations, Shifler Property. Report. February 8, 2016. LSCE file 10-1-074.

Luhdorff and Scalmanini Consulting Engineers. 2019. Groundwater Conditions in the Vicinity of Planned Wet Pit Mining Operations, Shifler Property, Woodland. Technical Memorandum. December 9, 2019. LSCE file 10-1-074.

Luhdorff and Scalmanini Consulting Engineers. 2020. Supplemental Analysis of Groundwater Conditions, Planned Mining and Reclamation Activities, Shifler Property, Woodland, Yolo County. Technical Memorandum. February 5, 2020. LSCE file 10-1-074

Luhdorff and Scalmanini Consulting Engineers. 2021. 2021 Annual Report, Groundwater Conditions in the Vicinity of the Woodland Plant Site. Teichert Aggregates, Yolo County, CA. October 19, 2021. LSCE file 07-1-004.

Luhdorff and Scalmanini Consulting Engineers & Todd Engineers. 1996. Ground-Water Quality Protection Near Planned Wet-Pit Mining Operations. March 1996.