APPENDIX D3

Geotechnical Peer Review

CORNERSTONE EARTH GROUP

Date:	August 23, 2019
Project No.:	118-103-1
Prepared For:	Ms. Tali Ashurov **DAVID J. POWERS & ASSOCIATES** 1111 Broadway, Suite 1510 Oakland, California
Re:	Geotechnical Peer Review TopGolf Burlingame 1001 Airport Boulevard Burlingame, California

Dear Ms. Ashurov:

As requested, this letter presents the results of our geotechnical peer review for the above referenced project. Our services were performed in accordance with our previously prepared agreement dated August 20, 2018.

Information Provided

- A preliminary geotechnical investigation summary titled "Preliminary Summary of Geotechnical Investigation Findings - Topgolf Burlingame, Golf Center Redevelopment Project" prepared by Geo-Logic Associates, dated, June 25, 2018.
- An updated geotechnical investigation report titled "DRAFT Geotechnical Investigation Report – Proposed Topgolf Redevelopment Project, Burlingame, CA" prepared by Geo - Logic Associates, dated, March 13, 2019.
- A set of preliminary plans titled, "Topgolf Burlingame, 250 Anza Boulevard, Burlingame, CA," prepared by BKF dated February 5, 2019.

Project Description

The proposed TopGolf project will be constructed over the closed Burlingame landfill, which is currently occupied by an existing golf driving range. The new entertainment facility will consist of a two-story, at-grade building with a 12-inch thick concrete slab. Several golf targets will be constructed in the fairway area that are approximately 6 feet deep. The fairway area will be surrounded by netting supported on 50- to 75-foot high poles. Appurtenant parking lots, driveways and underground utilities are also planned.

The preliminary dead loads for the interior structure footings will reportedly range from about 50 to 150 kips, dead load for walls is ranging from about 3 to 4½ kips per lineal foot, and dead load for the concrete slab is about 150 pounds per square foot (psf).

Site Background

The Burlingame Landfill reportedly operated between 1957 and 1987 and accepted construction debris, concrete rubble, roofing shingles, gardening debris, wood, metal, cloth, plastic, and anaerobic digester sludge. Hazardous wastes and commercially collected household wastes were reportedly not accepted at the site. Early fill methods were not documented, but refuse was reportedly bulldozed into the tidal flats bordering San Francisco Bay. The approximate quantity of debris within the landfill footprint is estimated to be about 2.5 million tons that consists of about 50 percent soil, 20 to 30 percent inert material (concrete rubble, construction debris, metal, and plastic), and 20 to 30 percent non-inert debris.

A landfill gas (LFG) collection system was reportedly installed at the site in 1995 and a permanent flare was installed in 1996. The approximate limits of waste in the landfill are shown in the City of Burlingame/URS Record Drawings for the closed landfill. The landfill was closed in three phases with a final cover that incorporated either a 1-foot-thick compacted clay or geosynthetic clay liner (GCL) low hydraulic conductivity barrier layer. Various fill, drainage, and protective soil layers overlie the compacted clay and GCL. Most of the drainage system, LFG components, and a portion of the utility lines were installed during closure construction.

Post-closure development of the landfill was performed in four phases and included installation of fencing, paving, structures, irrigation systems, a dog park, and landscaping. The drainage and utility systems were completed during this phase of work. The different cover sections and their respective locations at the site are shown in the 2005 Landfill Closure Record Drawings that were prepared by the City of Burlingame and URS Consultants. These drawings were included in Appendix A of the GLA report, and also show the locations of utilities and site improvements and represent a compilation of record drawings and information from the three closure projects and four post-closure development projects implemented at the site.

Previous Geotechnical Scope of Work

The following presents a brief description of the previous geotechnical exploration performed by others at the site to support the TopGolf project.

- An electrical resistivity (ER) geophysical survey was performed to estimate the approximate thickness of the existing landfill material overlying Young Bay Mud. This task was conducted prior to soil borings to determine the depths of the soil borings to extend below the bottom of the Young Bay Mud.

- A total of 12 soil borings were performed in April 2018, on top of the existing landfill to depths ranging from approximately 68½ to 91 feet below the existing surface grades to determine the approximate thickness of the existing landfill and underlying soil layers and evaluate the existing subsurface conditions.

- Geotechnical laboratory testing was performed that included moisture content, dry densities, Plasticity Indexes, particle size analysis, percent passing No. 200 sieve, consolidated-undrained triaxial tests, unconsolidated-undrained triaxial tests, and consolidation tests.

- Supplemental Cone Penetration Test (CPT) soundings were performed in January 2019, which include two seismic CPTs completed to maximum depths of about 16 and 36 feet, where refusal was encountered due to buried landfill debris.

Generalized Subsurface Conditions

The subsurface exploration at the site included soil borings performed by Geo-Logic Associates (GLA) on top of the existing landfill area. Prior borings performed by Harding Lawson Associates during previous landfill evaluations were also reviewed by Geo-Logic. As presented in Table 1 of the GLA report, the thickness of the existing landfill cover material ranged from about 5 to 15 feet, and the refuse thickness was determined to range from about 28½ to 53 feet. The landfill refuse is underlain by approximately 0 to 10 feet of weak, moderately to highly compressible estuarine deposits, known locally as Young Bay Mud. Bay Mud was reportedly not encountered in Soil Borings TG-04 and TG-06. The Bay Mud is reportedly underlain by Older Bay Alluvium soils consisting of interbedded stiff to very stiff clays with occasional interbedded layers of medium dense to dense sands. The maximum depth of exploration into the underlying older alluvial soils was reported at 45½ feet (total exploration depth of approximately 91 feet below current site grades).

Summary of Geotechnical Concerns

The updated geotechnical report prepared by GLA identified the following primary geotechnical concerns at the site.

- Potential instability of existing landfill slopes
- Long-term settlement of landfill debris and underlying Bay Mud deposits
- Strong ground shaking due to seismicity in the region
- Design and construction considerations associated with the existing landfill

A brief discussion of these concerns and how they were addressed in the GLA report are presented below.

Slope Instability

GLA Conclusions

Section 4.1 - "The Topgolf project will be located on the flat top deck of the closed landfill and will be set back sufficiently from the approximately 3:1 side slopes of the landfill that the potential for adverse slope stability impacts associated with the building, net poles, and targets is low. There are no natural slopes adjacent to the project and the potential for natural slope instability affecting the site is negligible. As noted in Section 2, the August 2018 concept drawings included in Appendix C show an access road may be constructed up the northern side slope of the landfill. Assessing potential impacts associated with this roadway on stability and the integrity of final cover of the landfill at this location was outside the scope of this study."

Comments

TopGolf Building, Target Areas and Net Pole Areas: GLA concludes that the potential for slope instability is low with respect to proposed buildings and target area improvements because the improvements are set back sufficiently from the tops of existing landfill slopes. However, slope stability analysis was not performed for the project to confirm. The preliminary plans included in

Appendix C of the report show the proposed TopGolf building will be setback approximately 65 to 100 feet from the southern landfill slopes. Parking lots and access roads will be constructed to within about 6 to 20 feet from the southern and western slopes. We recommend that slope stability analysis be performed to estimate the factor safety with respect to potential slope instability. The analysis should attempt to model the strength characteristics of the landfill cap and refuse material. The analysis should include both static and seismic loading conditions. If factors of safety during seismic loading conditions are at or below 1.0, the potential for slope deformation should be evaluated in accordance with current standards of practice. If seismic slope deformation exceeds reasonably tolerable levels, GLA should present recommendations to mitigate potential impacts to the pile-supported building and its surrounding improvements.

Access Road: In Section 2.3.2, GLA indicates that the proposed access roadway planned along the western side of the landfill will require additional evaluation and analysis to determine if the roadway grading will impact the stability of the landfill cover. We concur and recommend that this analysis also be performed prior to finalizing the grading and improvement plans.

Long-Term Settlement

GLA Conclusions

GLA identified potential long-term term, post-construction settlement as a potential impact to the development. Deep foundations were recommended to support the building and net poles to mitigate potential settlement. Targets will not impose any additional loads; therefore, GLA assumed that targets would be supported on shallow foundations. To mitigate potential settlement impacts to the development, in addition to supporting buildings on deep foundations, GLA recommended consideration of using ground improvement, lightweight fill, or surcharging target areas. GLA also recommended using flexible utility connections for all target areas and where utilities cross into pile supported building areas.

Comments

In general, we concur that long-term settlement can be mitigated through the use of a deep foundation system that derives support from the underlying older alluvial soils. Long-term settlement estimates were provided in Section 4.3 of the GLA report, which concluded that settlement on the order of ½ to 2 feet could occur in the future due to the weight of 2 to 8 feet of new fill. We concur that total and differential settlement will likely impact proposed target areas, even if ground improvement or surcharging alternatives are considered. Final target designs should be capable of tolerating or resisting long-term settlement. Site improvements surrounding the building will need to be pile supported or designed to tolerate anticipated settlement (such as stairways, entry walkways, etc).

Regarding proposed deep foundation systems, GLA should comment on whether long-term settlement will impact perimeter grade beams such that grade beams or underslab areas would be exposed by continued ground surface settlement. GLA should also comment on how the proposed landfill penetration will impact foundation and grade beam design with respect to landfill gases. Additional comments are present in the following sections.

Regional Ground Shaking

GLA Conclusions

Due to the underlying landfill materials ranging from about 25 to 55 feet thick and weak Bay Mud up to 10 feet thick, GLA characterized the site as Site Class F in accordance with the 1026 California Building Code (CBC). Therefore, as required, a site-specific response analysis (SRA) was performed for the site and attached in Appendix I.

Comments

In general, we concur with the Site Class F characterization and the required SRA. However, the analysis relied on published shear wave velocity data from the SF Bay Bridge approximately 16 miles to the north. We recommend that site-specific shear wave velocity data be collected from the site. In-situ information from seismic cone penetration testing could be collected from the around the perimeter of the landfill such that penetration through existing landfill obstructions would be avoided. The SRA analysis should be updated to reflect the revised data. Further discussion is presented below.

Landfill Construction Considerations

GLA Conclusions

The GLA report indicates that deep foundations will be used to support the building and net poles. Grading will include cuts and fills to construct the building pad, parking lots, an access road and the outfield target areas. GLA has provided detailed recommendations and design criteria for a deep foundation system that will penetrate the landfill cap.

Comments

In general, we concur with this approach; however, additional information should be provided in the report to address the following items.

1. Although vertical pile capacity through the landfill and Bay Mud layers were considered to be negligible, vertical downdrag on piles was neglected. We recommend that GLA re-evaluate the potential for downdrag acting on the pile foundation system since long-term settlement is predicted from the weight of new fill and due to continued settlement of the landfill waste. Updated pile capacity charts should be developed, as needed.

2. Piles that penetrate the landfill will need to be constructed to minimize landfill gases from migrating upward and daylighting under the building or surrounding net pole areas. Grout or bentonite plugs may be required at each pile location.

3. Perimeter and interior grade beams should be designed to account for future settlement such that bottoms of grade beams are not exposed in the future.

4. If utilities will extend beneath the building slab, considerations should be made to hanging utilities from beneath the structural slab and/or providing adequate flexible connections to account for future settlement.

5. We assume that cuts in the existing landfill cover and cap materials are to be avoided if possible. For the western access road, which is currently shown to have cuts on the uphill side and fills on the downhill side of the road, the roadway should be designed to reduce slope instability. Retaining walls should be designed to retain the 3:1 slope above. GLA should provide recommendations for keying and benching the fill on the downhill side of the roadway. Retaining wall recommendations will need to be included in the GLA report.

After reviewing the provided preliminary and DRAFT geotechnical reports, it is our opinion that the proposed site is suitable for this development provided the planned improvements can be designed to mitigate the identified geotechnical concerns listed above. Recommendations regarding the current draft geotechnical report are presented below.

Recommendations

As discussed, we concur with most of the GLA report findings; however, additional exploration and analysis should be considered before finalizing the report. We recommend that the draft geotechnical report be updated to address the following comments:

1. The geotechnical engineer of record should sign and stamp the geotechnical report. The current draft report dated March 13, 2019, does not list the report authors.

2. Perform slope stability analysis of the existing landfill slopes for both static and seismic loading conditions. A slope deformation analysis should be performed if factors of safety are at or below acceptable lower bound limits. Slope mitigation recommendations should be included if slope deformation is determined to above acceptable levels for the planned development.

3. GLA should perform supplemental exploration to develop in-situ shear wave velocity data to support the Site Response Analysis and ground shaking models. This can likely be completed by performing seismic CPTs adjacent to the landfill to avoid encountering landfill materials. Once completed, the SRA model should be updated, as needed. If the project will be designed in accordance with the update 2019 CBC, then GLA should update the analysis based on the latest code requirements.

4. GLA presented recommendations for both driven concrete piles and cast-in-place concrete piles. Pile capacity charts were provided to a depth of approximately 90 feet. GLA should update and revise the pile foundation criteria to deeper depths, if required by foundation designers and depending on the pile type and diameter selected. This may need to include supplemental exploration to support the analysis to deeper depths. GLA should comment on the suitability of driven concrete piles considering the potential for obstructions within the landfill debris. If pre-drilling through the landfill is already being considered, then driven piles may be suitable. If driven concrete piles are determined to be a feasible alternative, then lateral load capacities should be included for 14-inch square piles discussed in Section 5.2.1.

5. GLA should comment on why vertical downdrag (negative skin friction) was neglected for their pile analysis. It has been our experience and it is current standard of practice to include vertical downdrag on piles where either long-term settlement or seismically induced settlement will occur.

6. GLA should comment on pre-drilling through the existing landfill cap, liner and refuse and the need for an additional slurry cap or seal at each pile location to reduce the potential for landfill gas seepage.

7. Section 5.2.3 of the report discusses the need for a vapor "retarder" beneath the structural slab of the building, which is typical for a conventional slab-on-grade. GLA should consider updating this discussion based on whether a permanent vapor barrier and venting system is required for the building to mitigate potential landfill gas migration beneath the building. GLA should provide comments about the potential impact long-term settlement would have on a vapor barrier system.

8. GLA should comment on whether a settlement monitoring program would be beneficial or required during and after construction. The results of a settlement monitoring program could be used to track future settlement in target and parking lot areas.

9. GLA should comment on whether soil corrosion testing is required to determine the corrosion potential to buried metal pipes or concrete in contact with soil, such as the landfill cap soil or underlying Bay Mud or alluvial soils. If sulfate is encountered in the on-site soils, the concrete mix design for piles, pile caps or buried utilities may need to be modified to resist sulfate attack on concrete.

10. GLA should provide retaining wall recommendations for the proposed access road or other site walls, as needed, including lateral earth pressures and recommended foundation types.

11. Settlement of target areas should be further evaluated to account for future landfill settlement or settlement due to new fill, which could cause long-term differential settlement across a single target area. Since TopGolf target areas are typically constructed of a corrugated steel perimeter wall and a thin, cast-in-place concrete floor, GLA should comment on whether the target system should be supported on a more rigid mat foundation capable of tolerating increased differential settlement.

12. Consider a long-term maintenance plan for releveling targets, as needed, due to potential differential settlement of landfill materials.

13. GLA should provide updated earthwork recommendations (Section 5.1) for keying and benching the fill on the downhill side of the proposed access roadway. Cross sections should be provided, as needed. Guidelines should be provided for cut areas that encounter landfill materials, and any cap repair recommendations that will be required.

Closure

We hope this provides the information you need at this time. Recommendations presented in this letter have been prepared for the sole use of David J. Powers & Associates specifically for the property at 1001 Airport Boulevard in Burlingame, California. Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices at this time and location. No warranties are either expressed or implied.

If you have any questions or need any additional information from us, please call and we will be glad to discuss them with you.

Sincerely,

Cornerstone Earth Group, Inc.

John R. Dye, P.E., G.E.
Principal Engineer

Copies: Addressee (PDF by email)