Appendix F
Geotechnical Investigation Report

Nortech 2022

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Geotechnical Investigation Updated
Proposed New Biomass Facility
908 Northstar Drive
Placer County, California

Introduction

This report presents the results of our updated geotechnical investigation for the proposed new Biomass Facility to be located at 908 Northstar Drive, in Placer County, California. Our scope of work was to conduct a subsurface investigation with testing and analysis to determine the engineering properties of the underlying soils and provide conclusions and recommendations concerning design criteria for foundations and retaining walls, including estimates of settlement.

Our scope of work was to conduct a subsurface investigation with testing and analysis to determine site conditions and the engineering properties of the underlying soils and any rock. We are to provide conclusions and recommendations concerning any geologic hazards, seismic design criteria, site preparation and grading, design criteria for foundations and retaining walls, including estimates of settlement, and support of interior and exterior flatwork. Recommendations for structural fill and drainage will also be presented.

This report has been updated from the previous iteration as the California Building Code (CBC) seismic design criteria has changed from the 2019 CBC previously given to the present code, 2022 CBC. There are no changes needed in our previous recommendations, only code changes to reflect current status.

Site, Soil and Rock Conditions

The structure will be located at 908 Northstar Drive in Placer County, California. The property is located on the northwest side of Northstar Drive. It is located to the north of the Northstar Fire Station. The property surface slopes towards Northstar Drive the vegetation on the property is mostly clear. During the time of investigation, multiple feet of snow was present on the property.

We explored the subsurface conditions by sampling and logging three test pits that were excavated with a backhoe to attempted depths of around 6 to 7 feet. All three test pits were located in close proximity of, or within the proposed building area. The soils encountered in the test pits were fairly uniform and consisted of a brown, poorly graded, medium dense sand, with silt and light brown, medium dense silty sand which has a higher fines content. Cobbles up to 7 inches in size were encountered in all three test pits. At the time of our field exploration (November 2022), no free ground water was encountered in any test pit.

The materials encountered in the test pits were logged and representative samples were obtained for laboratory classification and direct shear testing. The site plan with the approximate location of the test pit is shown on Plate 1 and a logs of the materials encountered is presented on Plates 2 and 3. The soils are classified in accordance with the Unified Soil Classification System, which is described on Plate 4. Laboratory classification and direct shear results are shown on Plates (Figures) 5 through 8.

Geologic, Seismic and Flooding Considerations

The site is located along the eastern slopes of the Sierra Nevada Mountain Range in the Northstar area in California. The present topography of the site results from the geologic rock formation mapped as Quaternary glacial deposits (CAQg). (Jennings, C.W., Strand, R.G., Rogers, T.H., Boylan, R.T., Moar, R.R., and Switzer, R.A., 1977, Geologic Map of California: California Division of Mines and Geology, Geologic Data Map 2, scale 1:750,000.).

No mapped active or potentially active faults transect the proposed site. The nearest faults are about 1 mile to the west of the property (see Plate 9)

Based on the regional potential for moderate to large magnitude earthquakes, the site characterization criteria can be found in the newly adopted 2022 California Building Code (CBC) for seismic design. The CBC is based on the 2022 International Building Code (IBC). The CBC requires that the Site Class be determined by the soil and rock parameters described per the ASCE 7-22, Chapter 11. Section 11.4.2 states "The Site class shall be classified as Site Class A, B, BC, C, CD, D, DE, E, or F in accordance with Chapter 20." The Site Class is to be based on average shear wave velocity parameters Vs, which are derived from a field determined shear wave velocity profile measured from the ground surface to a depth of 100 feet. A shear wave velocity analysis was performed, and based on this study, we assigned the Site Class as "CD" stiff soil. Using the site latitude and longitude as input, the ASCE 7 Hazard Tool website provides site specific acceleration values along with the respective site coefficients and design spectral response acceleration parameters in their Hazard Summary Report. Based on this research, see attached Table 2 below for Site Class determination.

TABLE 2 - ASCE 7-22 SEISMIC DESIGN CRITERIA	
Spectral Response at Short Periods, S_S (ASCE Hazard Tool)	1.820
Spectral Response at 1-Second Period, S_1 (ASCE Hazard Tool()	0.510
Site Class	CD
Short Periods MCE Spectral Response Parameter S_{MS} (ASCE Hazard Tool)	2.010
1-Second Period MCE Spectral Response parameter S_{M1} (ASCE Hazard Tool)	1.030
Design Spectral Response Acceleration, Short Periods, $SD_S = 2/3 \times S_{MS}$ (ASCE Hazard Tool)	1.340
Design Spectral Response Acceleration,1-Second Period, $SD_1 = 2/3 \times S_{M1}$ (ASCE Hazard Tool)	0.680
Peak Ground Acceleration (PGA)	0.790

The Federal Emergency Management Agency (FEMA) Study Flood Boundary and Floodway Map (Map Number 06061C0150H, November 2, 2018) indicates that the subject property is located in Zone X. The Zone X designation describes those areas outside the 500-year floodplain.

Conclusions

Based upon the results of our investigation we conclude that, from a geotechnical engineering standpoint, the site can be developed essentially as planned. We believe that in general, conventional site grading techniques, building foundations and floor slab construction can be used for the development, though deeper excavation difficulty may be encountered due to the expectation of encountering boulders and/or a hard bedrock mantle. If volcanic rock is within the footing trench depth or other deeper excavations, site grading techniques may involve special grading techniques. The structure and flatwork can be supported on firm compacted native soil, structural fill or on boulders and/or bedrock.

The exterior foundation excavations will be at least 24 inches deep and minor fill may be needed for pad leveling. This native silty sand excavation material can be used as fill if needed, but screening will be required to remove any oversize rock. Material can also be imported. All fill should be approved by the geotechnical engineer and be placed and compacted as recommended in subsequent sections of this report.

For any planned cuts or excavations of depths greater than about the 7 feet explored, very hard bedrock may be encountered in some, if not all, of the excavations. Boulders can be encountered at any depth. Deeper excavation for foundations and any utilities may be very difficult and blasting or other rock splitting technique will most likely be needed.

We anticipate that for the shallow foundations designed and constructed in accordance with our recommendations, the post construction differential settlement will be on the order of ½ to 3/4 inch. Any post construction differential settlement for footings bearing entirely on bedrock would be negligible.

Our exploration trenches (pits) were backfilled without mechanical compaction; therefore, where these pits lie in building or exterior flatwork areas, the backfill in the trenches should be mitigated by removal and replacement. This is needed where ever the test pits are deeper than the planned cuts or over-excavation depths. **Removal and replacement mitigation of these pits will be considered mandatory by Nortech to ensure there are no loose backfill zones left existing in building and flatwork areas that would result in isolated settlements.** The pits have also been approximately located using GPS equipment and the data is presented on the logs. **Since there is some error associated with the GPS readings, the removal and replacement operations should be performed prior to any stripping and the beginning of new site grading. This provides the best opportunity to field locate the pits by using the same GPS reference points and by evidence of surface disturbance, if possible.** Nortech personnel can assist the earthwork contractor in pit location and provide follow up testing of the new backfill operations. The same material excavated, if granular can be used for replacement backfill. Replacement material should be spread in thin, moisture conditioned lifts and be compacted as recommended later in his report for structural and trench backfill.

Recommendations

Initially, upon completion of any test pit mitigation needed, areas to be developed, should be cleared of any surface vegetation, trees to be removed and debris, then stripped about 2 to 4 inches to remove organic laden soils. These materials should be removed from the site. All stripped and any excavated soil surfaces should be moisture conditioned and compacted to at least 90 percent relative compaction (per ASTM D1557) prior to any fill placement or installation of structural components.

Only select structural materials should be used for fill and backfill. Structural materials imported to the site should be free of organic and other deleterious matter, have low to negligible expansion potential and conform in general to the following requirements:

Sieve Size	Percent Passing (by dry weight)
6 inch	100
3/4 Inch	70 - 100
No. 4	50 - 100
No. 200	10 - 35

Liquid Limit = 35 maximum
Plasticity Index = 15 maximum

All fill materials should be approved by the Geotechnical Engineer prior to use. The existing soils, if excavated and used for structural fill need not meet the above specification except for maximum rock size. Structural fill and backfill should be spread in eight to ten inch, moisture conditioned, loose lifts and compacted to at least 90 percent relative compaction.

Conventional spread foundations can be supported on surface compacted native granular soils or structural fill as previously discussed. To provide adequate confinement and frost protection, exterior footings should bottom at least 24 inches below lowest adjacent exterior grade. Footings can be designed to impose dead plus long-term live load bearing pressures of no greater than 3,500 pounds per square foot. These pressures can be increased by one-third for consideration of all live loads including wind or seismic. The footing grades disturbed by excavations should be moisture conditioned and compacted to at least 90 percent relative compaction prior to reinforcing steel placement. An exterior drain system should be installed next to foundations to completely discharge any seepage that may collect along footing lines.

Resistance to lateral loads can be obtained from passive earth pressures and soil friction. We recommend the following design criteria:

Passive Earth Resistance - 350 pounds per cubic foot, (pcf) equivalent fluid

Soil Friction Factor - 0.40

We are unaware if retaining walls will be needed. If planned, we recommend that unrestrained (cantilever) retaining walls be designed to resist the active pressure imposed by soils with an equivalent fluid unit weight of 35 pcf. Any restrained retaining walls should be designed to resist an "at rest" pressure imposed by soils with an equivalent fluid unit weight of 55 pcf. Wall back-drains, with a four inch diameter collector pipe (at the base of the wall), should be installed along the retaining walls to collect any seepage that may accumulate and discharge it to planned discharge points or drainage areas. The gravel (drain rock) should extend to within 12 inches of the final grade and should be covered with a fabric inter-layer. Native soils should be placed on the top of the drain rock and fabric. All walls should be backfilled with structural material, or retain native undisturbed soils as design pressure calculations are based on retaining on-site native soils or imported granular soils.

For seismic design pressures on retaining walls greater than 4 feet in height, use:

$$\text{Resultant Seismic Force} = 0.375 * K_h * Y * H^2$$

$$\text{Seismic design Coefficient } (K_h) = Sd_s/2.5$$

$$\text{Total Soil Unit Weight } (Y) = 110 \text{ pcf}$$

The pressure distribution is inverted semi-triangular (with the maximum pressure at the top of the wall) and the resultant acts at 0.6 X H above the wall base. The 0.6 reference is from the Retain-Pro manual. For restrained walls, RetainPro suggests that $K_h = 0.30$ maximum. We concur with this value.

Any interior floor slabs and exterior concrete flatwork such as driveways, curbs, sidewalks and patios can be supported on surface approved compacted structural fill. To provide uniform slab section and other flatwork support, all subgrade surfaces (upper six inches) should be scarified, moisture conditioned, and compacted to at least 90 percent relative compaction. The resulting surfaces should be smooth, firm and non-yielding.

Floor slabs should be underlain by at least six inches of free draining crushed rock base or aggregate base. Exterior concrete should be underlain by at least 6 inches of aggregate base (see requirements for paving areas later in this report). Aggregate base material used in these interior and exterior areas should be compacted to at least 95 percent relative compaction.

Concrete mix proportions and construction techniques, including the addition of water and improper curing, can adversely affect the finished quality of the concrete and result in cracking and spalling of the slabs and other flatwork. We recommend that all placement and curing be performed in accordance with procedures outlined by the American Concrete Institute (ACI). Special consideration should be given to concrete placed and cured during hot or cold weather conditions. Proper control joints and reinforcing should be provided where applicable to minimize any cracking resulting from shrinkage.

Asphaltic concrete (AC) pavement is to be used for driveway or parking areas. An appropriate design section is based on an estimated subgrade Resistance "R" Value of the replacement fill materials and native, granular soils. Typically, reused on-site fill and any import materials meeting the requirements for select fill will have an R-Value of at least 30. Our pavement design for most projects is based on the Asphalt Institute Thickness Design Manual, MS-1. However, for private developments such as this project, the traffic volume is very low.

In this case we recommend a minimum AC section. Based on this criteria, our recommended pavement section is as follows:

Flexible Pavement Section
Driveway and Parking Areas

Type 2 Asphaltic Concrete Surfacing	3"
Class 2, Aggregate Base (Minimum R-Value = 78)	6"

In all AC paved flatwork improvement areas, the upper 6 inches of fill at subgrade elevation should be moisture conditioned (by scarification, if needed) and compacted to at least 90 percent relative compaction. Subsequently, aggregate base material should be spread in thin, moisture conditioned layers and compacted to at least 95 percent. All subgrades and final grades should be rolled to provide smooth, firm non-yielding surfaces.

An asphaltic concrete mix design should be submitted for approval prior to paving. During paving, asphaltic concrete should be sampled and tested by the Geotechnical Engineer to ensure material quality and compaction.

The ground surface around the structure should be permanently sloped to drain away from the building so that water is not allowed to pond against perimeter walls. The finish grading should be in accordance with current local and California Building Code requirements. Finish grading should be verified by the Civil Engineer.

Backfilling around building walls needed to attain final grade in non-structural areas should be moisture conditioned, placed in 12 inch maximum thickness lifts, and be compacted to at least 85 percent minimum relative compaction. Field density testing of the backfill operations should be performed to ensure compaction is being achieved. In addition to adequate surface drainage, a system of roof gutters and down spouts is recommended to collect roof drainage and direct it away from the walls and foundations.

Upon sale of the property, the Builder, the design and project managing Architect, Civil Engineer and Nortech will have no control over any alteration of the respective lot grades and drainage conveyance. Therefore, it is the responsibility of the current, and any future property owners, to maintain proper surface and subsurface drainage on their property.

Site drainage should also be designed to restrict infiltration from entering any flatwork and pavement sections. Periodic crack sealing and surface sealing should be implemented to increase service lift of the concrete slabs and pavements.

There has been an increase in ground water rising to, and seeping out of concrete floor slab and/or collecting in crawl spaces in many alpine communities. Many project design plans show that the drain pipe and rock (or Mira-drain type systems) around the exterior foundation is to be located on the top of the footing. We strongly recommended that the drains be installed along the side of the footing and be placed at the foundation grade.

These drains along foundations should be graded to drain to a collection point, with a pipe provided to daylight to an exterior discharge area. Details for the various foundation and wall systems are presented on the attached Plate 11.

Additional Geotechnical Engineering and Inspection Services

The conclusions and recommendations presented in this report are based on the results of previous vicinity and current on-site evaluation and our understanding of the proposed development construction. This report has been prepared in accordance with current, generally accepted, geotechnical engineering standards of practice. It is believed that the soil information compiled presents an accurate representation of the soil conditions and variations to be expected within the areas studied. However, there is a possibility that conditions other than those observed in this evaluation exist on-site. In the event that unanticipated conditions are encountered during construction, we should be contacted immediately for consultation. We should be given budget allowances to evaluate the condition(s) and make timely new recommendations or modify our existing report to satisfy the project needs.

We should provide on-site observations, together with field and laboratory testing during site preparation and grading, excavation, over-excavation, fill placement, and foundation and slab installation. These observations and tests would allow us to verify that the soil conditions are as anticipated and that the Contractor's work is in conformance with this report and the approved plans and specifications.

In addition, Nortech can provide any and all IBC/CBC Special Inspection services such as masonry, concrete, steel (welding, bolting, dry pack, etc.), fireproofing and any other construction or installations requiring such services. We have ICC certified inspectors on staff and would be pleased to submit a proposal for any inspection services prior to construction.

We trust this provides the information needed; however, if you have any questions regarding this report, please contact our office.

Yours very truly,

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Enclosures:
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- Plate 2: Logs of Test Pits 1 and 2
- Plate 3: Log of Test Pit 3
- Plate 4: Unified Soil Classification Chart
- Figure 5: Particle Size Distribution Report
- Figure 6: Particle Size Distribution Report
- Figure 7: Particle Size Distribution Report
- Figure 8: Direct Shear Test Report
- Figure 9: USGS Fault Map
- Plate 10: Vs30 Shear Wave Analysis
- Plate 11: Foundation Drain Details