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25 January 2005

Tony Coe, City Engineer
City of Lafayette
P.O. Box 1968
3675 Mount Diablo Boulevard, Suite 210
Lafayette, California 94549-1968

RE: Addendum 2 to Geotechnical Investigation and Report
Proposed City Library
Mt. Diablo Boulevard at First Street
Lafayette, California

Dear Mr. Coe:

We recently met with the Michael Gimmel of Nabih Youssef & Associates , the project structural engineer, to discuss the design of the foundation system at the proposed new library facility. Mr. Gimmel indicated that final selection of the foundation system for the site was proving to be difficult due to the varying soil conditions across the site and the differing floor elevations throughout the facility. Based on our discussions with Mr. Gimmel, we have prepared this addendum to our geotechnical reports for the project dated 21 May 2003 and 15 September 2003. The purpose of this addendum is to provide updated recommendations for design and construction of the foundation system based on the current configuration for the facility. The recommendations of the 21 May 2003 and 15 September 2003 reports remain applicable unless superceded herein.

BACKGROUND

In early 2003, we completed a geotechnical investigation and prepared a Foundation Exploration Report for the new library to be constructed on the property located at the southeast corner of Mt. Diablo Boulevard and First Street. The report included geologic information and geotechnical recommendations and design parameters for shoring, foundations, retaining walls, slabs-on-grade, and paving. Recommendations provided in the report were developed based on the conceptual design plans available at the time. In September 2003, we prepared an Addendum Foundation Exploration Report that addressed the adjacent property to the southeast. The library design is now close to being finalized and it is sufficiently different to warrant reevaluation of our original foundation recommendations.

SCOPE OF WORK

Our scope of work for this addendum report has included review of some of the sheets from the 18 October 2004 plans provided to us by Mr. Gimmel, review of our previous 21 May 2003 and 15 September 2003 reports, and preparation of this report.

REVIEW OF CURRENT DESIGN

We reviewed the project plans prepared by Killefer and Flammang, Architects, dated 18 October 2004. The plans we reviewed show that the main library building will be constructed over a basement parking area. A one-story community hall will extend from the northwest corner of the main library building and a one-story staff building extends from the northeast corner. An outdoor reading court and amphitheater will be located to the west and southwest of the main library. A parking area is proposed to the east of the southeast corner of the library.

REVIEW OF SUBSURFACE SOIL CONDITIONS

The subsurface soil conditions at the site were previously explored by drilling and sampling 11 test borings. Additional borings were not excavated for this report. The results of our geologic research, exploratory borings, laboratory testing, and engineering analyses are presented in our previous reports.

To better understand the subsurface conditions in the context of the proposed construction, we reviewed the boring logs for the site and developed a bedrock contour map. The bedrock contours were then overlaid on a current plan for the site (see Figure 1). The bedrock contours shown on Figure 1 represent our interpretation of the surface of the bedrock that we consider to be suitable for foundation support. The bedrock contours neglect the 2 to 5 foot thick layer of weathered bedrock section which is considered unsuitable for foundation support.

FINDINGS AND RECOMMENDATIONS

General

The primary geotechnical concern for each of the proposed buildings is the variability of the subsurface conditions across the footprint of the structure. The subsurface conditions beneath each building differ enough to warrant specific foundation recommendations for each structure. Our recommendations for design and construction of the foundation system for each of the buildings are presented below.

Main Library Building

Below the main library dissimilar earth materials will be encountered at the elevation of the proposed basement (elevation 275) and an unacceptable amount of differential movement will result if conventional shallow footings are utilized. This adverse condition can be mitigated by supporting the entire library on the competent bedrock material. Because of the variation in the depth to competent bedrock, different types of foundation elements will need to be used within the building footprint.

Conventional Footings

We recommend that conventional spread footings supported on competent bedrock be utilized in the area where bedrock is encountered at or above the basement floor elevation of 275. Figure 1 can be used to determine what portions of the building footprint will likely encounter bedrock at 275 or higher. Design parameters for conventional spread footings can be found in our 21 May 2003 report.
In the area where the bedrock is encountered between elevation 270 and 275, it is our opinion that conventional footings that bear on competent bedrock can also be used but will require localized excavation of 5 to 8 feet deep. We recommend that continuous footings should not exceed a total depth of 5 feet, including the required bedrock embedment. Pad footings should not exceed a total depth of 8 feet, including the required bedrock embedment. Temporary shoring may be locally required for deepened continuous footings.

Deep Foundations

For the area where the bedrock is anticipated to be encountered below elevation 270, we recommend that a deep foundation be utilized. The depth to bedrock in this area will vary from about 5 to 15 feet below the basement subgrade. It is anticipated that alluvium and ground water will be encountered along the west side of the structure that adjoins First Street and along the extreme western portion of the south side of the structure.

In our opinion, one of the following deep foundation systems should be utilized:

Friction Piers

Cast-in-drilled-hole (CIDH) friction piers (piles) that extend into bedrock may be used for support of the library. As noted in our 21 May 2003 report, the recommended minimum diameter for CIDH friction piers is 24 inches with a minimum embedment of 10 feet into bedrock. Friction values to be used in the design of CIDH frictionpiers are included in our May 2003 report.

Based on the recommended allowable friction values, a 24-inch diameter CIDH friction pier with the minimum embedment of 10 feet into bedrock would support an allowable load of 37 kips and a pile 20 feet into bedrock 75 kips. Lateral resistance may be provided by passive earth pressure in the alluvium/weathered bedrock and bedrock. The thickness of the alluvium/weathered bedrock may be assumed to be the depth from the basement subgrade to the bedrock contour as shown on Figure 1. The passive earth pressure of the alluvium/weathered bedrock may be computed as an equivalent fluid having a density of 200 pounds per cubic foot with a maximum earth pressure of 2,000 pounds per square foot. The passive earth pressure of the bedrock may be computed as an equivalent fluid having a density of 400 pounds per cubic foot with a maximum earth pressure of 4,000 pounds per square foot. For design of isolated piers, the allowable passive earth pressure may be increased by 100 percent. Piers that are spaced more than three pile diameters on center may be considered isolated.

The advantages of the small diameter friction piers is that they can be constructed by a wide range of contractors, can be quickly drilled and placed, do not require casing unless there is caving ground, and can be placed through water with proper construction techniques. The disadvantage is that only side friction can be utilized for vertical loading resistance because it can not be assured that the base of the pier is sufficiently clean of debris (cuttings) to allow for end-bearing. Water displaced from the pier excavations will have to be contained on site or pumped to a truck for disposal to an approved location.

Large Diameter Piers that Utilize Friction and End Bearing

In our opinion, CIDH piers at least 30 inches in diameter and that extend at least 10 feet into bedrock can be designed to utilize both friction and end bearing. The larger diameter is necessary to allow qualified personnel to downhole access the pier to clean the base of cuttings and/or to verify the cleanliness of the base of the pier for end-bearing. Skin friction values provided in our previous report for friction piers can also be used for these large diameter CIDH piers. In addition, an end-bearing value of 25 kips per square foot can be used for piers constructed on adequately cleaned bedrock exposed at bottom of the pier hole.

Based on these recommended values, a 30-inch pier with a 10-foot of embedment into bedrock and a nominal total depth of 15 feet can support an allowable load of 47 kips in friction and 122 kips in end-bearing for a total of 169 kips. A 48-inch pier with a 10-foot of embedment into bedrock and a nominal total depth of 15 feet can support an allowable load of 75 kips in friction and 313 kips in end-bearing for a total of 388 kips. Lateral resistance may be provided by passive earth pressure in the alluvium/weathered bedrock and bedrock utilizing the parameters noted above.

The advantages of the large diameter friction/end-bearing pier is the potential for significant end-bearing resistance gained with a shorter embedment. The disadvantage is that the base of the piers must be sufficiently clean for end-bearing. While mechanical devices for cleaning piers are available, their effectiveness can vary with soil type and the experience of the drill rig operator and the ground water condition. It may be possible to suction cuttings out of piers that are not of great length. Verification of the cleanliness of a short pier may be possible from the ground surface. Casing may be required for downhole entry of those piers that can not be mechanically cleaned and inspected. Casing will also be required to prevent heavy water flow into the pier. Some minor water is allowable if it does not effect the cleaning of the pier. If this option is used, we recommend that extremely stringent specifications be used and enforced during construction. In addition, we recommend that the foundation contractor be required by specification to submit a detailed plan and method for cleaning and maintaining the pier holes.

Driven Piles

It is our opinion that as an option to CIDH piers, driven piles could be effectively used as a deep foundation system for the main library building. We recommend that 12-inch square pre-cast concrete piles be used. The piles should be driven a minimum depth of 10 feet into bedrock or until practical refusal is attained. A pile-driving hammer that is capable of providing a minimum effective energy of 400 times the designed bearing capacity of the pile should be specified. Pre-drilling may be performed through the alluvium if desired. The pre-drilled holes should be less than the least pile dimension. We estimate that 12-inch square piles driven between 10 feet into bedrock will support an allowable vertical load of 100 kips. Actual allowable loads of selected piles should be confirmed by a pile driving analyzer (PDA).

Lateral resistance may be provided by friction at the base of the pile cap and by passive earth pressure in the alluvium/weathered bedrock and bedrock. A coefficient of friction of 0.3 may be utilized for the alluvium or weathered bedrock at the base of the pile cap. Passive earth pressures may be determined utilizing the parameters noted above. For the purposes of the preliminary driven pile design, we recommend that the lateral load resistance capacity of driven pile groups use the passive earth pressures assuming the piles are not isolated.

The advantages of using driven piles includes the elimination of the transport and disposal of cuttings, no requirements to address caving or adverse groundwater conditions, and the ability to install many piles in a relatively short amount of time. The main disadvantages of using driven piles are the potentially high mobilization costs for manufacturing and driving a limited number of piles and the noise and vibration that arises from the pile-driving operations. While we do not believe that vibrations from the pile-driving operations will cause damage to surrounding structures, pile-driving operations frequently receive complaints. If driven piles are used a the site, we recommend that a photographic and/or video survey of nearby properties be performed prior to commencing pile-driving operations to document existing distress. It may also prudent to perform some vibration monitoring during the pile driving operations.

Community Hall Building

It is our understanding that the south edge of the community hall is common with the north wall of the library basement. The footprint of the one-story community hall that will extend off the northwest corner of the main library building is underlain by undocumented fill, alluvium, and weathered bedrock over bedrock. The fill and alluvium are on the order of 2 to 15 feet thick, increasing in depth to the west toward the axis of the storm drain pipe that is to be removed. The planned finished floor elevation of 300 is about 2 to 10 feet higher than the existing ground surface meaning that additional fill will need to be placed in this area. After the additional fill has been placed the fill below the building footprint would range from 2 feet thick at the northeast corner of the building to about 25 feet at the southwest corner of the building.

Due to the unavoidable variable subsurface conditions beneath the community hall building, we do not recommend that shallow conventional footings be used to support the building. In our opinion use of a conventional shallow foundation will result in an unacceptable level of long-term differential performance between the south edge of the structure founded in bedrock and the remaining portion of the structure which is supported on thick fill.

We recommend that the community hall building (including the floor slab) be supported entirely on a deepened foundation that extends into bedrock. The floor slab should be constructed as a structural slab or raised floor system supported by the deepened foundation. In our opinion, it is not necessary to remove the existing fill from below the building foot print or to place additional compacted fill to the proposed floor subgrade from a geotechnical standpoint. The deepened foundation types presented above for the main library building may be utilized. The vertical load carrying capacity assigned to the deepened foundation types are considered conservative so that any negative skin friction created by settlement/consolidation of the existing deeper fill and/or alluvium can be ignored. Lateral loading could be taken up by passive resistance in the alluvium/weathered bedrock and bedrock. The top of the alluvium/weathered bedrock surface may be assumed at elevation 296 at the northeast corner of the community hall and at elevation 275 at the southwest corner. The alluvium/weathered bedrock thickness at the northeast corner of the building is 2 feet thick. The alluvium/weathered bedrock thickness at the southwest corner of the building is 10 feet thick. Thickness of the alluvium/weathered bedrock at any point below the community hall can be interpolated between the thickness of the alluvium/weathered bedrock at the endpoints. The depth of the top of the alluvium/weathered bedrock can be determined by adding the interpolated thickness to the top of the bedrock surface.

As an alternative to a deepened foundation system for the community hall, the library basement level could be extended below the community hall. We anticipate that the eastern half to two-thirds of a basement below the community hall with a finished floor of 276 would encounter bedrock at the basement subgrade elevation.

Staff Building

A one-story staff building is proposed to extend off the northeast corner of the main library building. The northern portion of the staff building is underlain by a thin (3-foot thick where encountered in Boring B-1) fill cap over bedrock. The south portion of the footprint is underlain by fill over soil and alluvium which in turn overlie weathered bedrock and bedrock. An additional 3 to 6 feet of fill is necessary to achieve the proposed floor elevation of 300. It is our understanding that the south edge of the staff building will adjoin the main library which is supported on foundations that extend into bedrock.

To obtain an acceptable performance across the building we recommend that deepened foundations that extend into bedrock be used. It is our opinion that compacted fill can be utilized for support of the staff building floor slab. This recommendation is made to minimize the potential for differential settlement between the staff building, in that area of increasing fill and alluvium depth, and the library building. Deepened foundations may be constructed using the design parameters noted previously.

Where the floor slab are to be supported on grade, we recommend that the existing fill and upper 2 feet of the existing alluvium should be removed to firm alluvium and/or bedrock and recompacted to a minimum of 90 percent of the maximum dry density according to ASTM D 1557. Conventional on-grade floor slabs should be a minimum of 5 inches thick and reinforced with #3 steel bars at 18 inches on center. The reader is referred to the 21 May 2003 report for other recommendations regarding floor slab design.

Decking Adjacent to Buildings

The existing fill and upper 2 feet of alluvium is to be removed to firm alluvium and or bedrock below areas of exterior decking. Some decking in the reading court area will be a structural deck that extends over the basement below the main library. We recommend that a joint be provided between the on-grade and structurally supported deck sections to allow for differential movement of the decking.

LIMITATIONS

The conclusions and recommendations of this addendum report are based upon information provided to us regarding the proposed improvements, subsurface conditions encountered at the boring locations, our geologic reconnaissance, the results of the laboratory testing program, and professional judgement. We have employed accepted geotechnical engineering and engineering geologic procedures, and our professional opinions and conclusions are made in accordance with generally accepted geotechnical engineering and engineering geologic principles and practices. This standard is in lieu of all other warranties, either expressed or implied.

This report reflects information included on plan sheets dated 18 October 2004. Please note that the report was completed based on the current design information available to us. Should the actual configuration of the project change from that indicated in the report, we should be consulted to determine if additional subsurface exploration, testing, and/or analyses are warranted based on the changes.

Cal Engineering & Geology, Inc. should be accorded the opportunity to review the final plans and specifications to determine if the recommendations of this report have been implemented in those documents. The review would be acknowledged in writing.

Field observation and testing services are essential parts of the proposed project. It is important that Cal Engineering & Geology, Inc. be retained to observe the earthwork, footing excavations, and other relevant construction operations. The recommendations of this report are contingent upon this stipulation.

Evaluation of the site with regard to hazardous or toxic materials was not within the scope of this investigation.

We trust this report provides you with the information required to proceed. If you have any questions, please call us.

Yours truly,

CAL ENGINEERING & GEOLOGY, INC.

Phillip Gregory, P.E., G.E.
Principal Engineer

copy: Michael Gimmel, Nabih Youssef & Associates

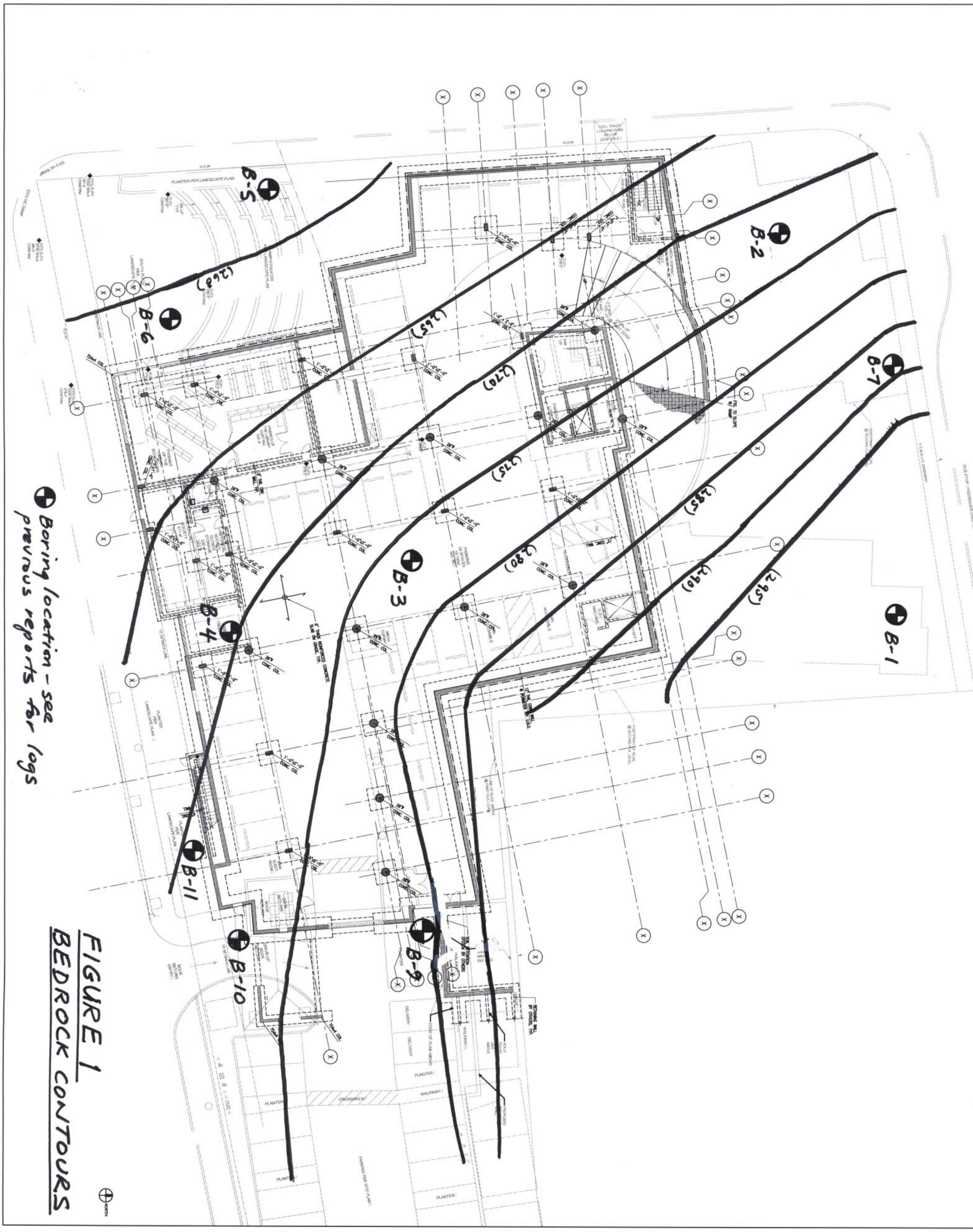

FIGURE 1
BEDROCK CONTOURS

LAFAYETTE LIBRARY AND LEARNING CENTER

3491 MOUNT DIABLO BLVD.
LAFAYETTE, CALIFORNIA 94549

100% DESIGN DEVELOPMENT
OCTOBER 18, 2004

REVISIONS

JOB NO. 23007 NYA JOB NO. 03587

DATE 06.19.04

SCALE AS NOTED

SHEET TITLE
FOUNDATION & LOW LEVEL FRAMING PLAN

SHEET NUMBER
S101