

**TECHNICAL MEMORANDUM
FIELD OBSERVATIONS AND RECOMMENDATIONS
PROPOSED FLOOD PROTECTION AND STREAM STABILIZATION IMPROVEMENTS
VINCENT WELL, SAN BERNARDINO COUNTY, CALIFORNIA**

TO: Mr. Michael J. Gentile, P.E., QSD
CASC Engineering and Consulting, Inc.

FROM: Joseph J. Kulikowski, P.E., G.E. and Soma Balachandran, PhD., P.E., G.E.
GENTERRA Consultants, Inc.

SUBJECT: Field Observations and Recommendations
Proposed Flood Protection and Stream Stabilization Improvements
Vincent Well
San Bernardino County, California
GENTERRA Project No. 420-CASC-SBC

DATE: June 21, 2018

GENTERRA Consultants, Inc. (GENTERRA) is pleased to submit this brief technical memorandum presenting a summary of documents reviewed, the results of a visual assessment of site conditions, and recommendations for design of protection and grading work for the Flood Protection Design that is being carried out by CASC Engineering and Consulting, Inc., under the contract with the City of San Bernardino Municipal Water Department (SBMWD). This brief technical memorandum is part of the scope of work authorized in GENTERRA's agreement with CASC to provide geotechnical engineering support services associated with the proposed flood protection and stream stabilization improvements to the existing Vincent Well in San Bernardino County, California. The location of the existing Vincent Well is shown on Figure 1 – Vincent Well Location Map.

1. Introduction

The SBMWD wants to provide flood protection and stream stabilization improvements for SBMWD's Vincent Well and other wells in the areas having potential soil erosion problems as identified by this Project. Protection is also required for the Vincent Well water main and power poles.

SBMWD's Vincent Well is located in the Cajon Wash between Kenwood Avenue and Mathews Ranch Road in San Bernardino County, California. During a 2017 unusually heavy rainfall, the Vincent Well building's foundation was undermined by a flash flood, threatening the structural integrity of the well. Temporary stabilization consisted of placing grouted riprap in the eroded area. In order to prevent the Vincent Well's foundation from being undermined again, SBMWD is considering long-term protection measures for the well, the water main, and power poles.

This technical memorandum summarizes documents reviewed, the results of a visual assessment of site conditions, and provides recommendations for protection and gives considerations for construction.

2. Results of Document Review

The following documents and information were reviewed:

- URS Corporation (2013). *Final Hydraulics Report for Cajon Creek in Devore, CA, I-15/I-215 Interchange Improvement (Devore) Design-Build Project*;
- Gonzales, Portia (2010). *Cajon Creek, Devore Heights, CA: Hydrology and Hydraulics Study Using Geographical Information System, A Case Study*; and,
- Site photographs and maps

Information obtained in the review of these documents and the visual site assessment are being used to develop recommendations for protecting the well.

The location of the I-15/I-215 improvement project, described in the 2013 URS Corporation Report, is approximately two miles downstream of the Vincent Well. The geotechnical and hydraulics information in that report are considered applicable to the Vincent Well site due to the relative proximity and the fact that the similar soil types and close distance from the project site.

Grain size distribution analyses performed on seven near-surface samples at the I-15/I-215 site identified the soils as poorly graded sand (SP) and poorly graded sand with gravel (SP). The site photographs also show cobbles and boulders on the surface. The scour analyses at this site assume that the soil profile consists of predominantly of SP soils to the depth of scour potential and also assume that the grain size distribution of the soils is similar to that determined for the near-surface soils.

The hydraulics study in the URS Corporation Report identifies the peak flow rates for the 100-year and 100-year bulked flow as 20,500 cubic feet per second (cfs) and 30,750 cfs, respectively. Both flows were used to evaluate scour potential using guidelines in the Federal Highway Administration *Hydraulic Engineering Circular No. 20 (HEC-20), Stream Stability of Highway Structures (April 2012)*.

For highway bridge analyses, scour is the sum of the following three components:

- Long-term aggradation and degradation of the channel bed;
- General scour due to contraction scour and other general scour; and,
- Local scour at the piers (at the Vincent Well in this case) and abutments.

Long-term scour at the I-15/I-215 site was 8.2 feet in 37 years for an average of 0.2 feet per year. This time period ended in 2013. A flash flood occurred in 2017, and scour was as much as 8 feet deep in the vicinity of the Vincent Well. The estimated long-term scour, including the 2017 event, is 16.2 feet in 41 years for an average of 0.4 feet per year. For the Vincent Well, the projected time period for well protection is 50 years. Based on an average of 0.4 feet per year, the estimated long-term scour is 20 feet.

General scour primarily results from increased velocity at the channel cross section due to contraction. At the I-15/I-215 site the contraction was determined to be negligible because it is minimal in comparison to the width of the cross section. Since less contraction would occur at the

well than at the bridge, general scour is also considered to be minimal at the well. Any increase in velocity resulting from this contraction, particularly during the 100-year event, would be negligible.

Local scour is the result of flow around the piers or, in this case, the Vincent Well. At the I-15/I-215 site, using Equation 7.1 in HEC-18, this was calculated to range between 12 feet and 14.1 feet. A more complex analysis was conducted for one of the bents resulting in an estimated scour depth of as much as 24.4 feet based on the bulked 100-year flow rate. The complex analysis does not appear applicable to the Vincent Well site based on geometry and existing conditions. Therefore, local scour at the well is not expected to exceed 15 feet.

For conservatism, a cutoff depth extending below the lowest projected scour depth should be considered. For the well site, an estimated 5-foot-deep cutoff is recommended to provide a factor of safety. Based on the above estimates, scour protection at the Vincent Well should extend to a depth of 40 feet (20 feet + 15 feet + 5 feet) below the slab level of the building that contains the Vincent Well. The depth of the well screen is unknown. It is assumed that the well screen is considerably deeper than the projected scour depth.

Grouted riprap was placed in the eroded area at the well after the 2017 rain event. In considering alternatives for permanent protection, the grouted riprap was taken into account. Using this existing protection is considered feasible; however, the depth is not sufficient to provide the protection required. The portion of grouted riprap shown on Figure 3-3 can be kept in place. However, more materials may be needed. The option shown on Figure 3-2 needs less rock gabion and a portion of riprap will be kept in place, but geogrid reinforcement is required for construction. Both options will provide good performance. Cost estimates from the construction contractor would enable comparison to see which one is more cost-effective.

3. Field Observations

The field observations of the Vincent Well site and its immediate surrounding that are of interest to GENTERRA and CASC for the subject project were performed by Soma Balachandran, Ph.D., P.E., G.E. of GENTERRA, and Mike Gentile, P.E., Christopher Sidor, E.I.T, and Kimberly Boydston of CASC on May 23, 2018.

Based on the visual assessment of the site conditions at the time of the site visit, the surface of the project area is covered with alluvial materials consisting of poorly graded sand, poorly graded sand with gravel, poorly graded gravel, well-graded sand, well-graded sand with gravel, poorly graded gravel, well-graded gravel, cobbles, and boulders. Also, very thin layers of silt were observed on the surface of the river channel. A portion of the east side slope of the west channel near the Vincent Well was covered with grouted riprap, but it was partially undermined due to recent flow in the channel.

No standing water was observed on the ground surface during the time of the site visit on May 23, 2018. It is our opinion that groundwater may have an impact on the construction of the remedial measures that are needed to provide adequate erosion protection since the project site was identified to have high liquefaction susceptibility by the County of San Bernardino.

No soil samples were collected for laboratory testing since site-specific geotechnical investigation work is beyond the authorized scope of work for this project.

4. Recommendations

4.1 General

Based on the results of our evaluations of existing conditions around the existing Vincent Well, some remedial work is necessary to provide needed erosion protection during the 100-year flood event. Upon completion of the remedial work that is recommended in this technical memorandum, the existing Vincent Well will have adequate erosion protection during a 100-year flood event.

Based on our visual evaluation of site conditions, very difficult excavation conditions should be anticipated during the construction of the remedial work proposed in this technical memorandum. Based on our experience, the construction contractor should anticipate cobbles and large boulders within the required excavation for the project as well as during the site preparation. Groundwater may be present within the limits of excavation or a few feet within the bottom of the proposed excavation, and therefore an appropriate dewatering plan should be submitted for GENTERRA's review and approval. Since the project site is located within a creek, the moisture content of the subsurface materials can vary substantially (very dry to very wet) during the construction period and therefore significant delay should be anticipated in processing the subsurface materials to make it as a suitable fill material. Also, the exposed temporary excavation slope should be properly protected to prevent surficial shallow failure of the loose and/or soft subsurface materials.

Since no site-specific geotechnical exploration was performed to develop recommendations, potential construction contractors are advised to visit the project site and its surrounding area to evaluate the level of difficulties during site preparation, grading, excavation and construction of the project. Significant variations in subsurface materials and groundwater conditions should be anticipated because segments of the San Andreas Fault are running very close to the project site. Also, GENTERRA encourages potential construction contractors to explore the project site using test pits and other exploratory methods with appropriate permissions and permits to develop appropriate means and methods to accomplish the remedial work construction in a timely and efficient manner.

4.2 Recommendations for Design of Armoring

Several alternatives were considered for protecting the Vincent Well against future scour. These alternatives included:

- A reinforced concrete slab on an excavated slope; the excavation would be backfilled;
- Rock protection placed on an excavated slope; the rock would be underlain by bedding material and filter fabric; the rock would not be grouted; the excavation would be backfilled. (See Figure 3-1);
- Grouted rock protection placed on an excavated slope which is similar to ungrouted rock protection except that the rock is grouted; the grouting would allow for a lesser rock layer thickness and for the use of smaller rock;

- Gabion baskets stacked in a retaining wall shape and placed in an excavated area around the well; Geogrid would be installed in the excavated area between the gabion baskets and the bottom of the excavated slope; the remainder of the excavation would be backfilled. (See Figure 3-2);
- Gabion blanket placed on an excavated slope similar to rock protection (See Figure 3-3); the gabion blanket thickness would be about half the thickness of ungrouted rock protection; and,
- A steel sheet pile enclosure around the well.

The steel sheet pile enclosure was not given further consideration because the presence of cobbles and boulders would make installation problematic. The reinforced concrete slab is a rigid option that would be susceptible to cracking and joint separation due to settlement or loading during a major flood event and seismic event. Since a non-rigid option is preferred, the reinforced concrete slab is not being given further consideration. Grouted rock protection is also a more rigid alternative than the ungrouted option and so was not given further consideration.

The three non-rigid alternatives are one loose rock protection (riprap) option and the two gabion options. Regarding the three alternatives, the preferred alternative is the gabion blanket on the excavated slope as shown on Figure 3-3. The gabion blanket should extend to a depth of 40 feet below existing grade around the Vincent Well Building. This scour protection is considered adequate for a 50-year period that would include a 100-year flood event.

Based on historical scour at the well site, protection should completely encircle the well site as shown on Figure 2, including the existing power pole. Flow can occur around the well on both the east and west sides. The increase in loading on the wall of the vertical well will be less with the sloping gabion blanket than with the rock fill or gabion retaining wall option.

The water line that crosses the east channel will be impacted during the design scour event. If the existing water line is located above the anticipated scour level, damage to the water line that is beyond the protected area should be anticipated. Any additional power poles beyond the protected area may be impacted by the 100-year flood event.

4.3 Grading

It is anticipated that the existing grouted riprap will remain in place. The slope for the gabion blanket will be excavated to a 2:1 (Horizontal:Vertical) slope. At the interface of the existing grouted riprap and gabion blanket, at the top of the slope, the grouted riprap may require shaping to form a smooth transition between the gabions and riprap. Anchors should be installed to tie the gabion baskets to the riprap and the interface should be grouted. The opposite slope can be excavated to a 1½:1 (Horizontal:Vertical) slope. Please see the section, “Excavation and Temporary Slopes” for further details and requirements.

The gabion blanket should be installed on a filter bedding layer or geotextile to prevent the migration of fines through the gabion stone fill. After the gabion blanket is installed, the excavated area should be backfilled with excavated materials. Cobbles larger than four inches in size should not be used in the immediate fill (fill within five feet of the completed surface of the gabion

baskets) to be placed against the gabion baskets to prevent damages to gabion baskets. Compaction requirements should be determined based on the results of compaction tests. Please see the section, “Compaction” for further details and requirements.

Regular maintenance after each major flood event will enhance the performance of the proposed design. Therefore, any permit to be obtained for this project should include the maintenance activities during the design life of the project.

All required fill should be uniformly well compacted, and it should be observed and tested during placement. The existing soils, except any expansive soils, are suitable for use as compacted fill, but some modification/blending may be required to have enough binding materials.

Good drainage of surface water around the well structure should be provided by providing adequate slopes to all graded surfaces around the Vincent Well. Proper drainage will enhance the performance of the proposed remedial repair.

Please note that heavy construction equipment should not be operated so as to encroach within 15 feet of existing structures and utilities to prevent damage to existing features.

The remainder of this section provides recommendations for the following grading items:

- Site preparation
- Excavations and Temporary Slopes
- Compaction
- Backfill
- Material for fill

4.3.1 Site Preparation

After the site is cleared and any existing loose fill soils are excavated as recommended, the exposed soils should carefully be observed for the removal of all unsuitable deposits such as disturbed soils, soft soils, and any debris. Next, the exposed soils should be scarified to a minimum depth of six inches, brought to within two percent below or two percent above the optimum moisture content for both sandy and clayey soils and compacted with heavy compaction equipment. At least the upper six inches of the exposed soils should be compacted to at least 90 percent of the maximum dry density obtainable by ASTM Designation D1557 for clayey soils and 95 percent of the maximum dry density obtainable by ASTM Designation D1557 for sandy soils. This compaction requirement may not be achievable if the exposed subgrade is too wet due to ponding of water or due to high groundwater table. In this case, we recommend proper dewatering to prevent standing water and placing a layer of gravel material (typically 6-inch- to 12-inch-thick) to stabilize the exposed subgrade before placing any fill materials or geotextile layer or geogrid that is needed to construct the gabions.

4.3.2 Excavations and Temporary Slopes

Where excavations deeper than about five feet are required, the sides of the excavations should be sloped back at a slope of 1½:1 (Horizontal:Vertical) or shored for safety. If shoring is needed, the

construction contractor must confirm that it is safe and stable. Please see Section 4.4 below in this Memorandum.

If the temporary construction embankments are to be maintained during the rainy season, we suggest that berms be constructed along the tops of the slopes where necessary as diversion structures to prevent runoff water from entering the excavation and eroding the slope faces.

The actual depth of excavation should be based on recommendations and observations made during grading. Therefore, some variations in the depth and lateral extent of over-excavation recommended in this technical memorandum should be anticipated.

The excavations should be observed by personnel of GENTERRA so that any necessary modifications based on variations in the soil conditions encountered may be made. All applicable safety requirements and regulations, including OSHA regulations, should be met.

Where sloped embankments are used, the tops of the slopes should be barricaded to prevent vehicles and storage loads within five feet of the tops of the slopes. A greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes; GENTERRA should be advised of such heavy vehicle loadings so that specific setback requirements may be established

Heavy-duty earth moving should be able to excavate the earth materials at the site.

4.3.3 Compaction

Any required fill should be placed in loose horizontal lifts not more than eight-inches-thick and compacted. The fill should be compacted to at least 95 percent for sandy soils and 90 percent for clayey soils of the maximum density obtainable per ASTM D1557. The moisture content of the on-site sandy soils and clayey soils at the time of compaction should vary no more than two percent below or two percent above optimum moisture content.

4.3.4 Backfill

All required backfill should be placed in loose horizontal lifts not more than eight-inches-thick and compacted mechanically in layers; flooding should not be permitted. Proper compaction of backfill will be necessary to minimize settlement of the backfill and to reduce settlement of overlying slabs and paving. Backfill should be compacted to at least 95 percent for sandy soils and 90 percent for clayey soils of the maximum dry density obtainable per ASTM D1557. The on-site soils, except expansive soils, may be used in compacted backfill.

Some settlement of the backfill should be expected, and any utilities supported therein should be designed to accept differential settlement.

4.3.5 Material for Fill

The on-site soils, other than any expansive soils, free of any debris or organic matter, may be used in required fills. Cobbles larger than four inches in diameter should not be used in the fill. Any

required import material should consist of relatively non-expansive soils with an Expansion Index of less than 20. The imported materials should contain sufficient fines (binder material; at least 12 percent passing No. 200 sieve) so as to be relatively impermeable (but, fines content cannot be more than 35 percent passing No. 200 sieve) and result in a stable subgrade when compacted. All proposed import materials should be approved by GENTERRA prior to placing at the site.

4.4 Geotechnical Observation and Testing

The reworking of the upper soils in the excavated slope and the compaction of all required fill should be observed and tested during placement by a representative of GENTERRA. This representative should be authorized to perform at least the following duties:

- Observe the clearing and grubbing operations for proper removal of all unsuitable materials;
- Observe the exposed subgrade in areas to receive fill and in areas where excavation has resulted in the desired finished subgrade;
- Evaluate the suitability of on-site and import soils for fill placement; collect and submit soil samples for required or recommended laboratory testing where necessary;
- Observe the fill and backfill for uniformity during placement;
- Test backfill for field density and compaction to determine the percentage of compaction achieved during backfill placement;
- Observe the placement of geotextile or geogrid layer under the gabions basket; and,
- Observe the construction of gabion blanket where needed.

The local and/or federal review agencies having jurisdiction over the project should be notified prior to commencement of grading so that the necessary permits can be obtained and arrangements can be made for required inspection(s). The Contractor should be familiar with the inspection requirements of the reviewing agencies.

Earthwork should be performed in accordance with Project Specifications to be prepared by the project Civil Engineers in accordance with SBMWD's guidelines for Project Specifications. This specification should include geotechnical recommendations given in this technical memorandum. Appropriate measures should be taken to prevent damage to Vincent Well, adjacent structures and utilities. Any design and construction of temporary sloping, sheeting, or shoring should be made the Contractor's responsibility. It should be noted that it is the responsibility of the Contractor to oversee the safety of the workers in the field during construction. The Contractor shall conform to all applicable occupational and health standards, rules, regulations, and orders established by the State of California. In addition, other State, County, or City regulations may supersede the recommendations presented in this section. If a trench shoring design and safety plan is required, GENTERRA should be given the opportunity to review the plan to confirm that recommendations presented by GENTERRA have been applied to the design.

4.5 Limitations and Basis for Recommendations

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or

similar localities. No other warranty, express or implied, is made as to the professional advice included in this technical memorandum. This technical memorandum has been prepared for CASC and is to be used solely for design of armoring for the existing Vincent Well in Devore in San Bernardino County, California, and may not contain sufficient information for use by other parties.

The recommendations provided in this technical memorandum are based upon our understanding of the described project information and our interpretation of available published information and field observations done by GENTERRA. We have made our recommendations based upon experience with similar site conditions under similar loading conditions. The recommendations apply to the specific project discussed in this technical memorandum; therefore, any change in the configuration of the existing Vincent Well or the site grades should be provided to us so that we can review our conclusions and recommendations and make any necessary modifications.

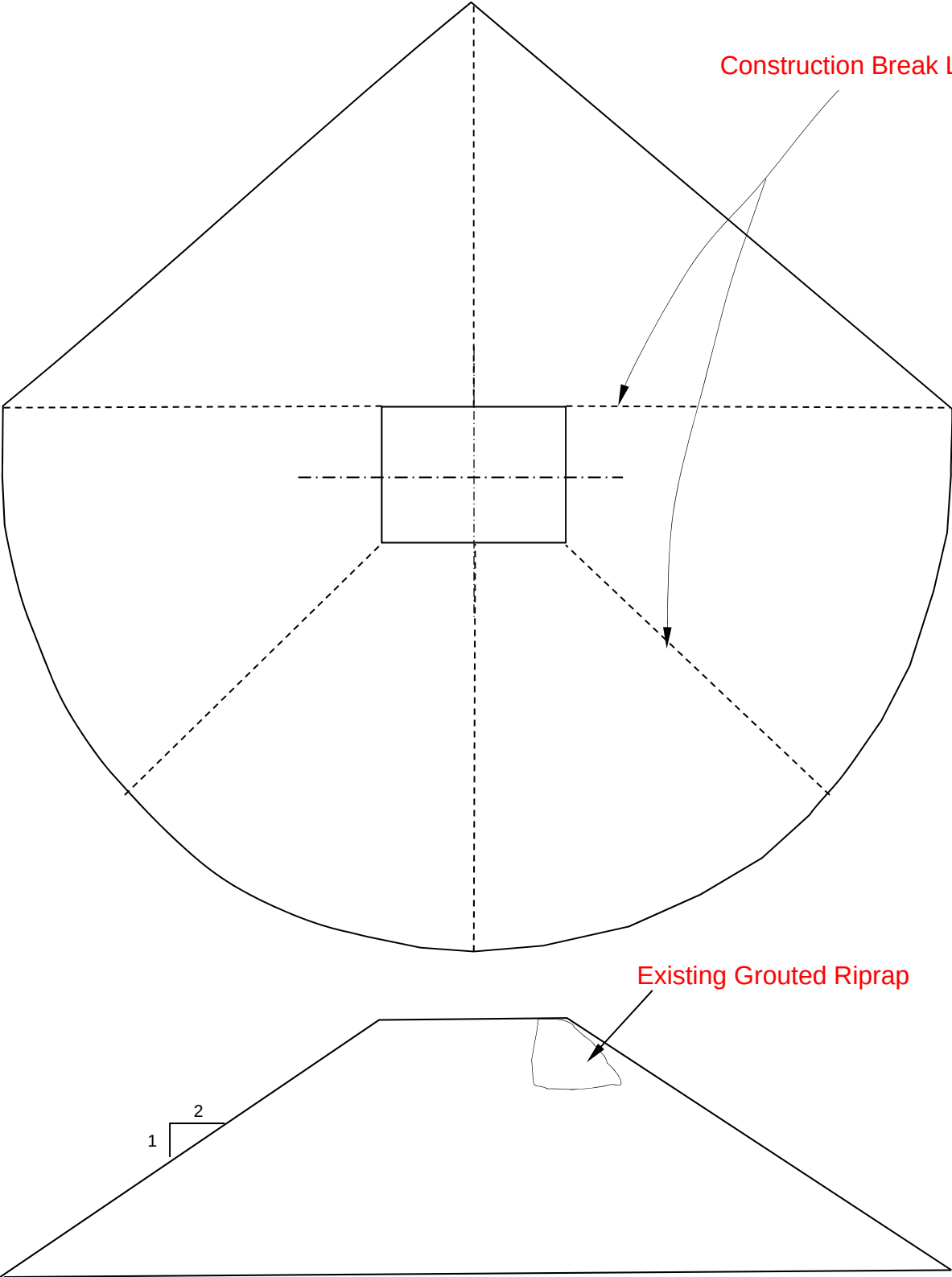
The recommendations provided in this technical memorandum are based upon the assumption that the necessary geotechnical observations and testing during construction of remedial measures will be performed by GENTERRA. The field observation services are considered a continuation of the geotechnical evaluation and essential to verify that the actual soil conditions are as expected. This also provides for the procedure whereby the SBMWD may be advised of unexpected or changed conditions that would require modifications of our original recommendations. In addition, the presence of our firm at the site provides the SBMWD with an independent professional opinion regarding the geotechnical construction procedures. If another firm is retained for the geotechnical observation services, our professional responsibility and liability would be limited to the extent that we would not be the geotechnical engineer of record.



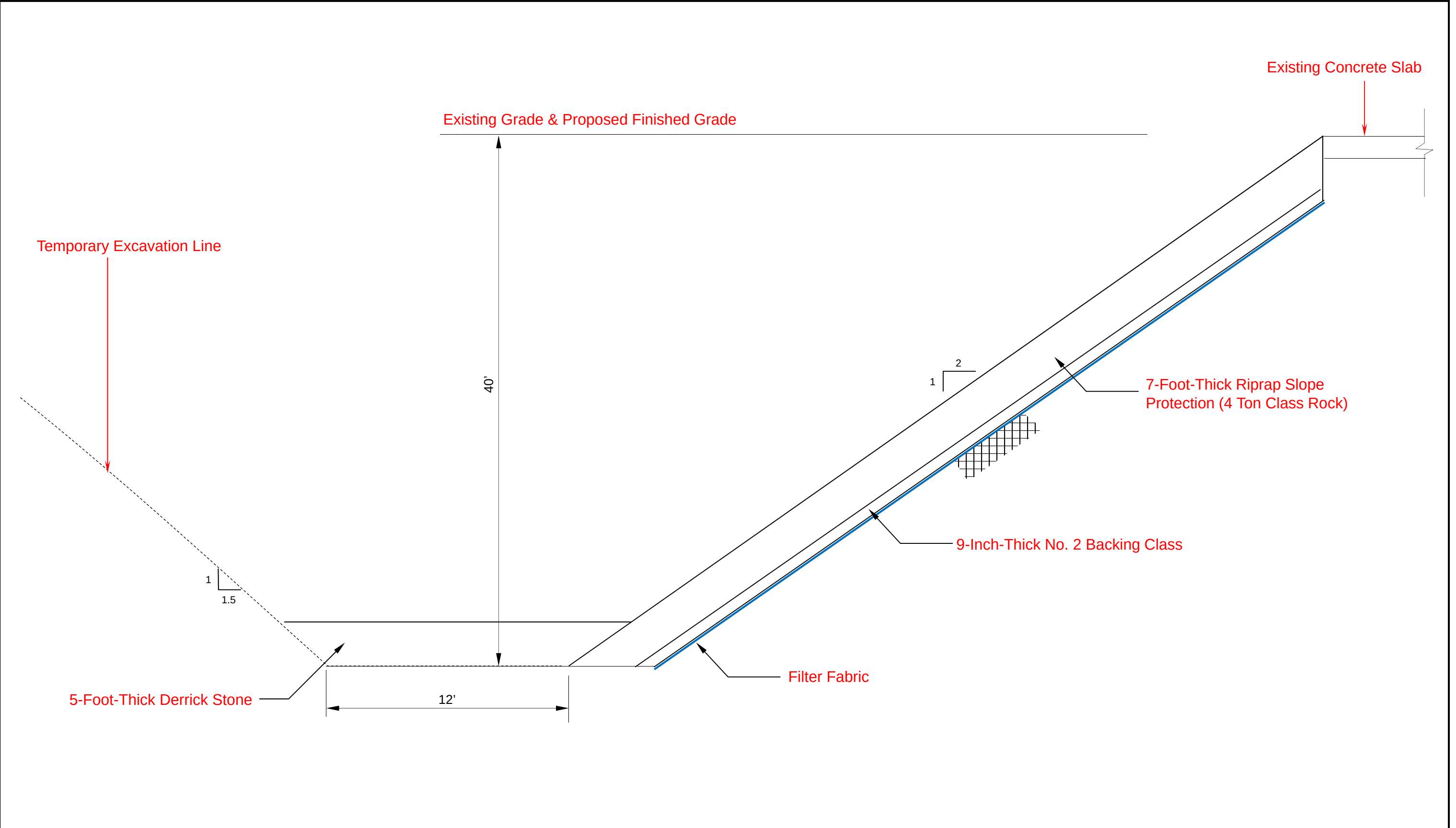
REFERENCE: Google Earth
2018 Website

	THE CITY OF SAN BERNARDINO MUNICIPAL WATER DEPARTMENT 444 RIALTO AVENUE, SUITE D SAN BERNARDINO, CALIFORNIA 92401	VINCENT WELL FLOOD PROTECTION & STREAM STABILIZATION IMPROVEMENT SAN BERNARDINO COUNTY, CALIFORNIA	PROJECT NO.	DATE	FIGURE 1
			420-CASC-SBC	JUNE 21, 2018	VINCENT WELL LOCATION MAP

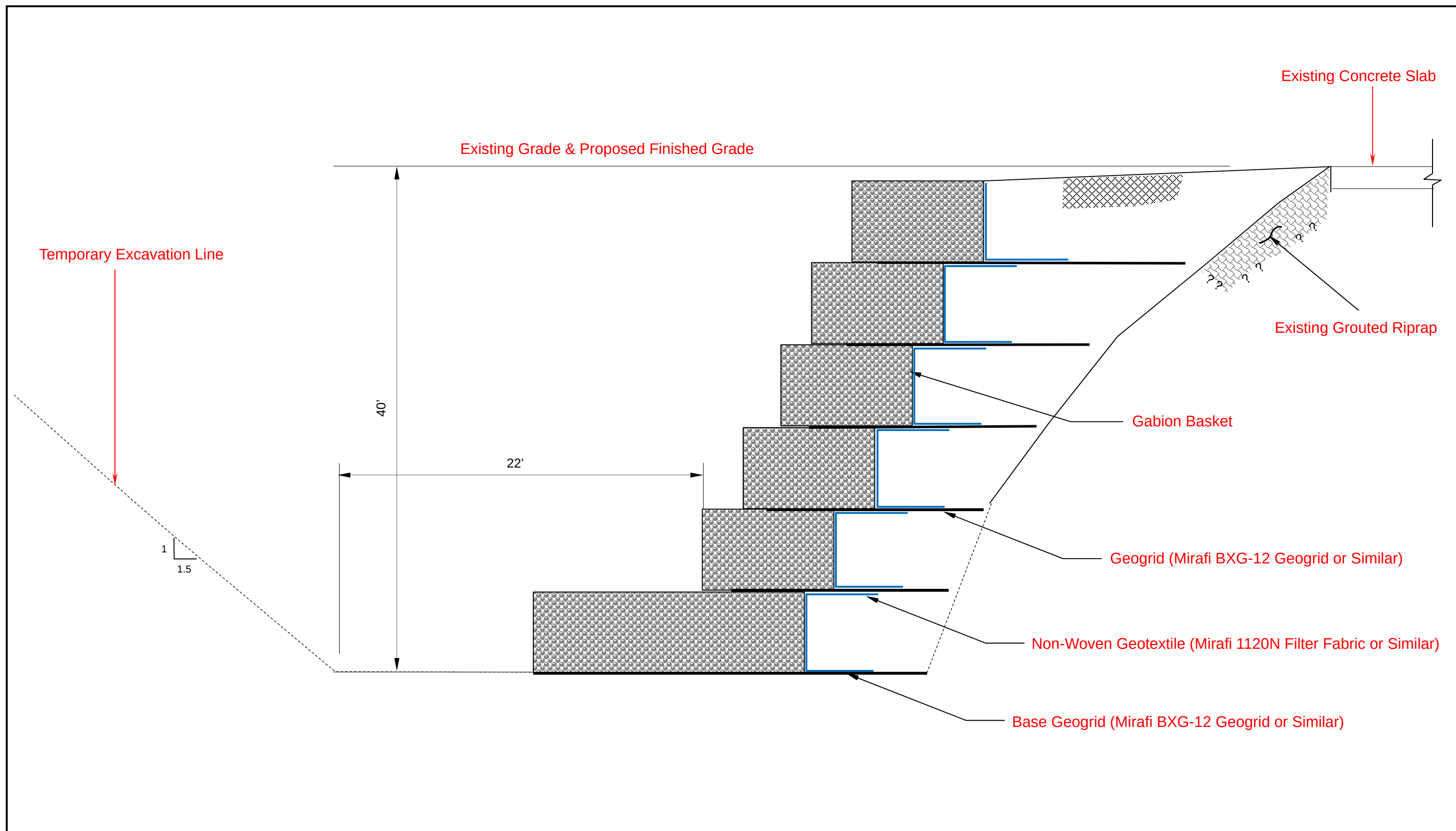
Proposed Finished Grade



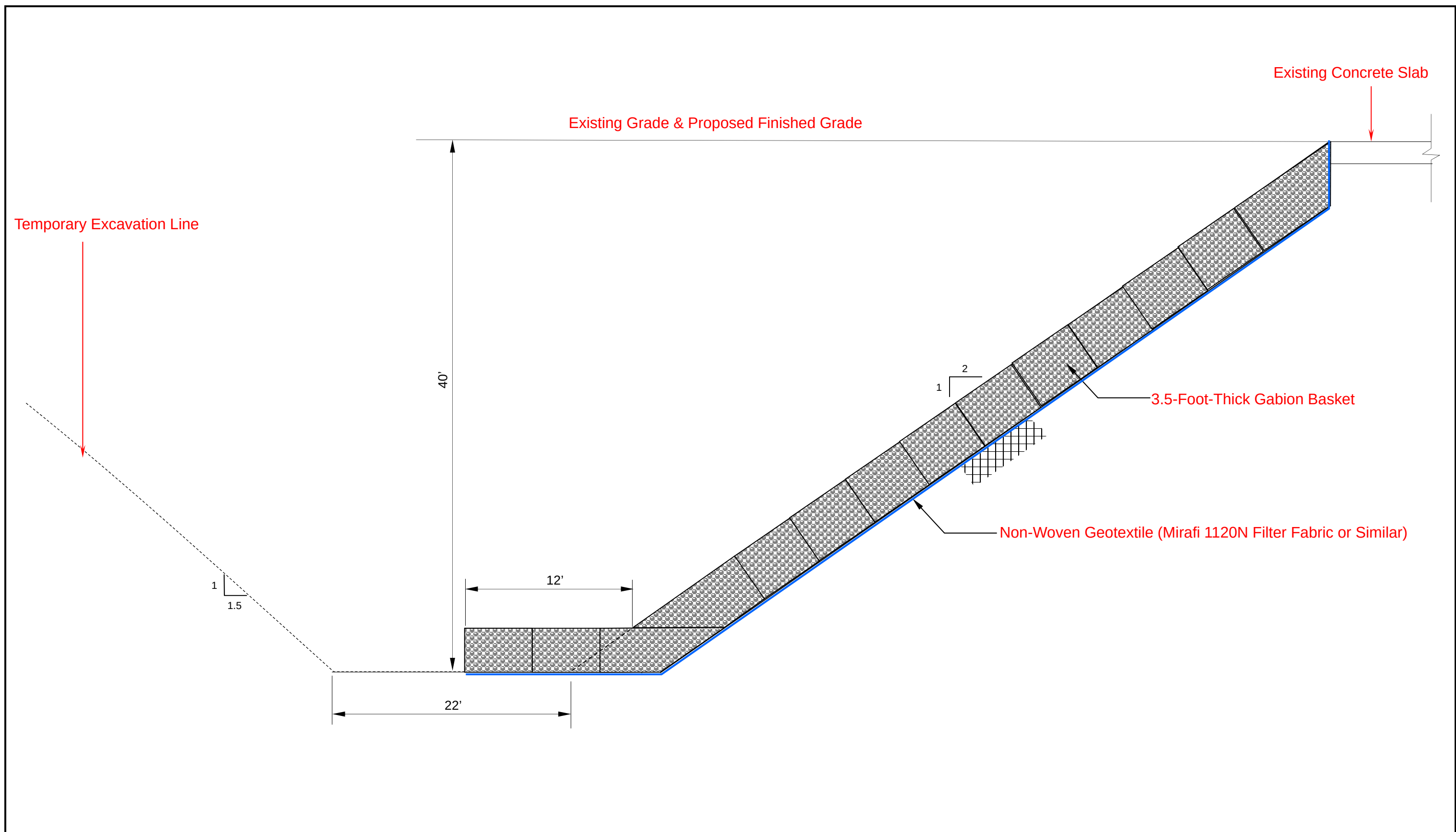
	THE CITY OF SAN BERNARDINO MUNICIPAL WATER DEPARTMENT 444 RIALTO AVENUE, SUITE D SAN BERNARDINO, CALIFORNIA 92401	VINCENT WELL FLOOD PROTECTION & STREAM STABILIZATION IMPROVEMENT SAN BERNARDINO COUNTY, CALIFORNIA	PROJECT NO.	DATE	FIGURE 2
			420-CASC-SBC	JUNE 21, 2018	CONCEPTUAL DESIGN-OPTION 1 PLAN VIEW



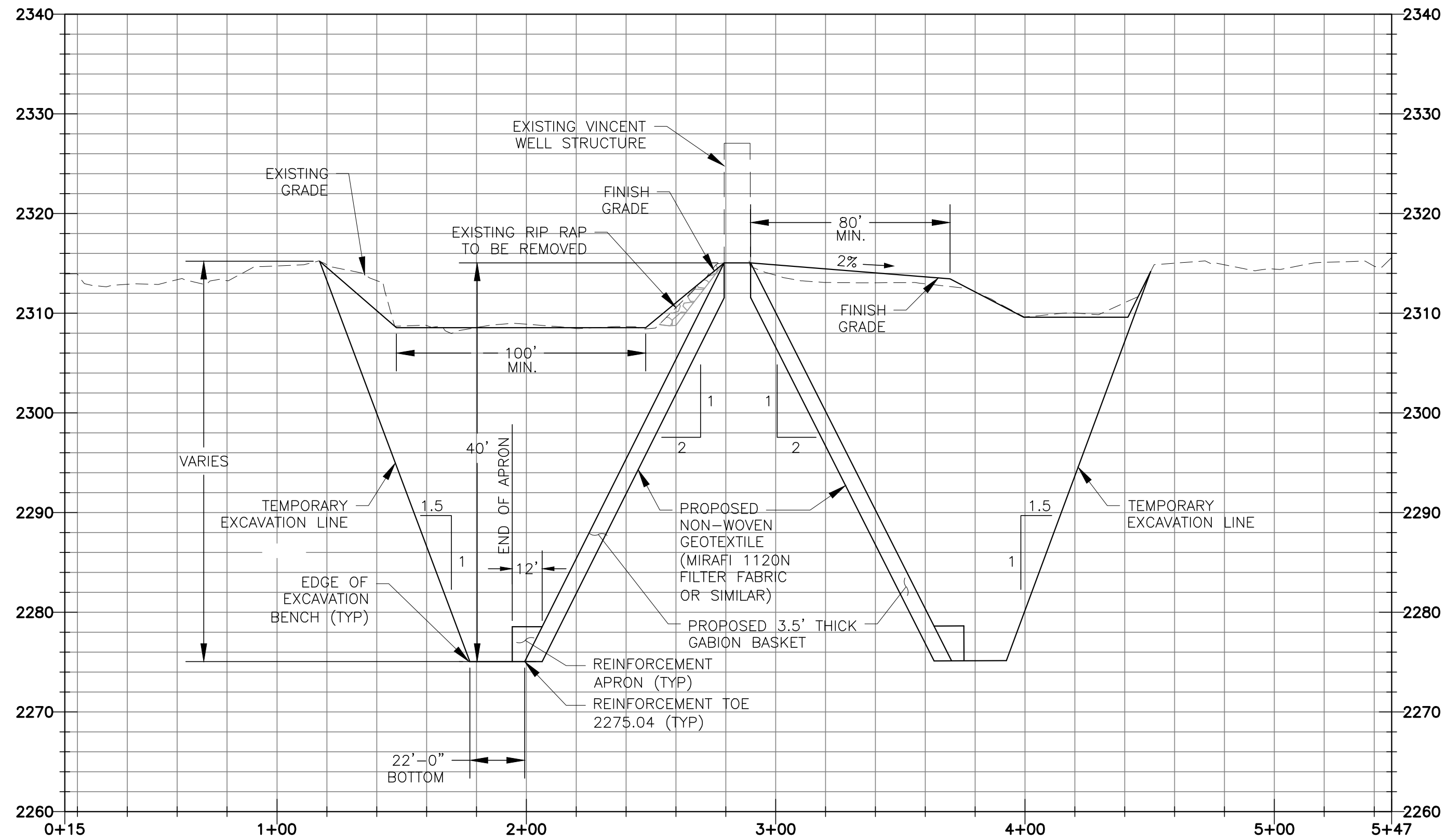
	THE CITY OF SAN BERNARDINO MUNICIPAL WATER DEPARTMENT 444 RIALTO AVENUE, SUITE D SAN BERNARDINO, CALIFORNIA 92401	VINCENT WELL FLOOD PROTECTION & STREAM STABILIZATION IMPROVEMENT SAN BERNARDINO COUNTY, CALIFORNIA	PROJECT NO.	DATE	FIGURE 3-1
			420-CASC-SBC	JUNE 21, 2018	CONCEPTUAL DESIGN-OPTION 1 TYPICAL CROSS-SECTION



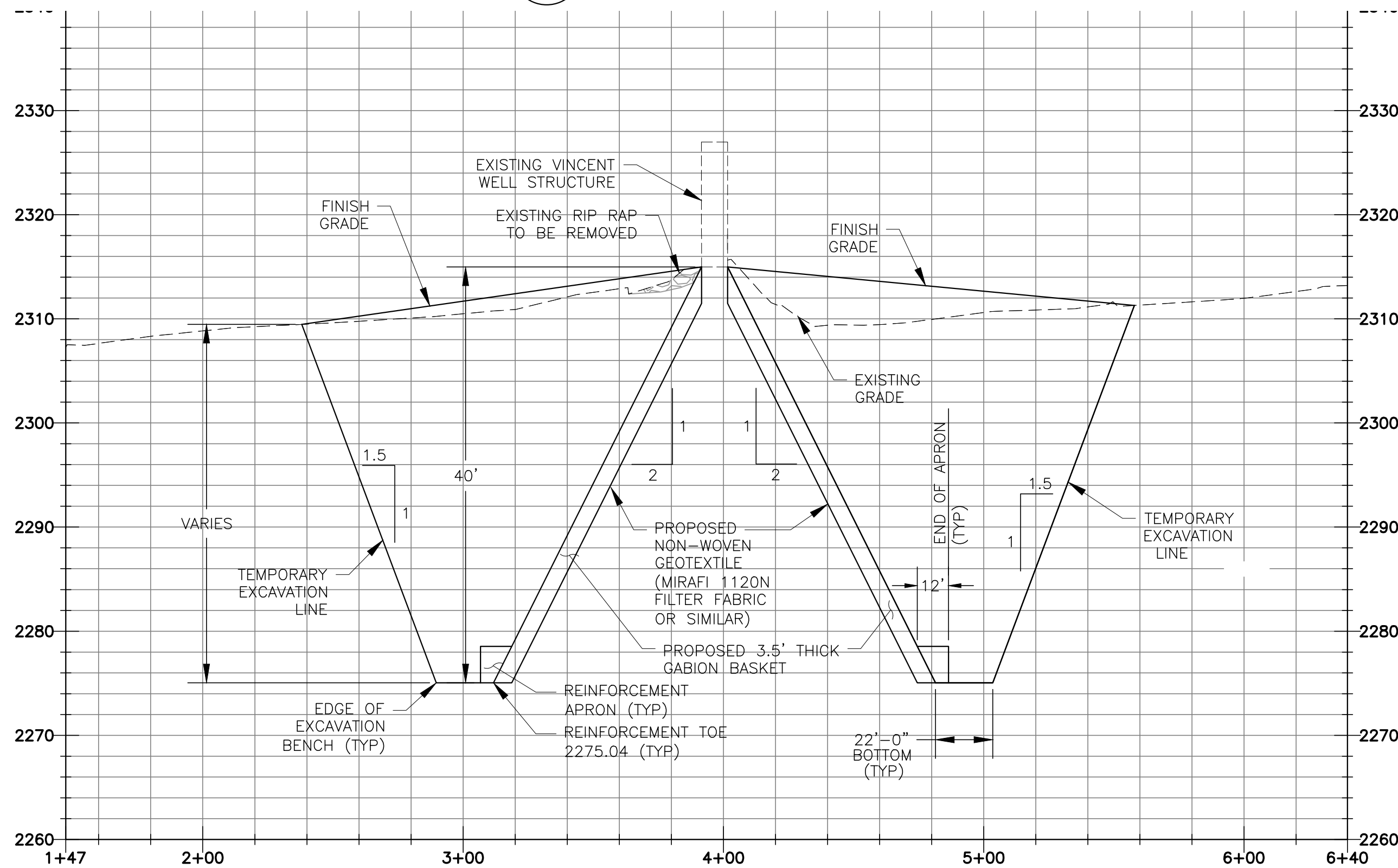
	THE CITY OF SAN BERNARDINO MUNICIPAL WATER DEPARTMENT 444 RIALTO AVENUE, SUITE D SAN BERNARDINO, CALIFORNIA 92401	VINCENT WELL FLOOD PROTECTION & STREAM STABILIZATION IMPROVEMENT SAN BERNARDINO COUNTY, CALIFORNIA	PROJECT NO.	DATE	FIGURE 3-2
			420-CASC-SBC	JUNE 21, 2018	CONCEPTUAL DESIGN-OPTION 2 TYPICAL CROSS-SECTION



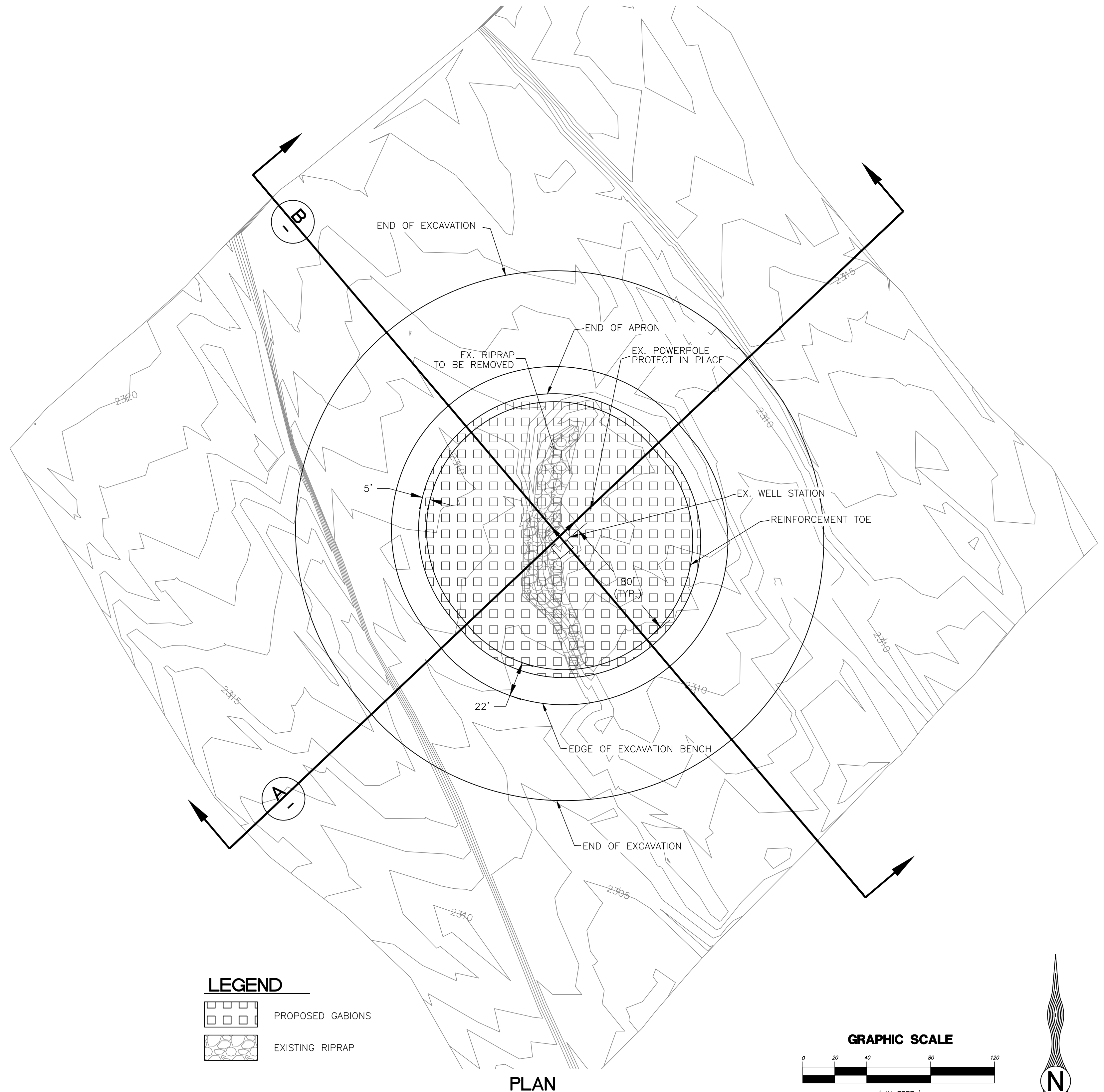
	THE CITY OF SAN BERNARDINO MUNICIPAL WATER DEPARTMENT 444 RIALTO AVENUE, SUITE D SAN BERNARDINO, CALIFORNIA 92401	VINCENT WELL FLOOD PROTECTION & STREAM STABILIZATION IMPROVEMENT SAN BERNARDINO COUNTY, CALIFORNIA	PROJECT NO.	DATE	FIGURE 3-3
			420-CASC-SBC	JUNE 21, 2018	CONCEPTUAL DESIGN-OPTION 3 TYPICAL CROSS-SECTION



A SECTION
SCALE: 1"=40' HORIZONTAL, 1"=10' VERTICAL

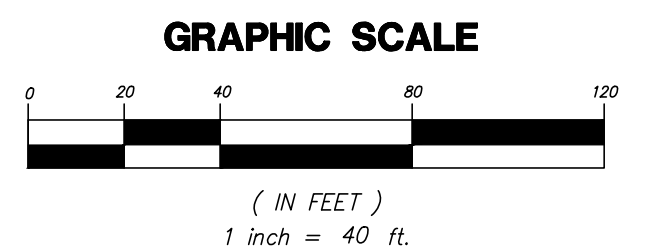


B SECTION
SCALE: 1"=40' HORIZONTAL, 1"=10' VERTICAL



LEGEND

	PROPOSED GABIONS
	EXISTING RIPRAP



UNDERGROUND SERVICE ALERT
CALL: TOLL FREE
811
TWO WORKING DAYS
BEFORE YOU DIG

DECLARATION OF RESPONSIBLE CHARGE: ENGINEER OF WORK:
I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER DESIGN OF THIS PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE, AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS.
I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE SAN BERNARDINO MUNICIPAL WATER DEPARTMENT IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.
SIGNATURE _____ DATE _____

INSERT ENGINEER'S
STAMP HERE
ENGINEER'S SEAL

CASC
Engineering and Consulting
1475 EAST COOLEY DRIVE, SUITE 100, CA 92424
(951) 783-0101
APPROVED BY: _____ DATE: _____
REGISTERED CIVIL ENGINEER No. XXXXX

MARK	REVISIONS	APPROVED	DATE	APPROVED	DATE
DESIGNED BY: XX	DRAWN BY: XX	CHECKED BY: XX	DESIGN ENGINEER	SEWARD ENGINEER	

BENCHMARK:

ELEV.= XXXX.XX FT.

CITY OF SAN BERNARDINO
MUNICIPAL WATER DEPARTMENT
VINCENT WELL STABILIZATION PROJECT
CONCEPTUAL PLAN EXHIBIT
DRAWING SCALES:
HORIZ: 1"=40' VERT: N/A
C.O. NO.:
1682
DWG G1
SHEET **1** OF **1**

C-1682-1-G-G1.DWG

Estimate of Probable Cost - Conceptual Plan Stage
 Vincent Well Stabilization Project
 Preferred Alternative (Figure 3-3)

6/22/2018

Bid Item	Bid Item Description	Quantity	Unit	Unit Cost	Item Cost
1	Excavation	75,275	CY	\$ 5.00	\$ 376,375.00
2	Non-Woven Geotextile (Mirafi 1120N Filter Fabric or Approved Equal)	3,845	SY	\$ 5.00	\$ 19,225.00
3	Gabion Slope Protection (3.5' Thick)	4,485	CY	\$ 250.00	\$ 1,121,250.00
4	Backfill	70,000	CY	\$ 5.00	\$ 350,000.00
5	Export	5,275	CY	\$ 10.00	\$ 52,750.00
	Subtotal				\$ 1,919,600.00
	Dewatering				\$ 125,000.00
	Contingency (Permits, Mobilization, Temporary Construction)			35%	\$ 671,860.00
	Total Estimate of Probable Cost				\$ 2,716,460.00