CORNERSTONE EARTH GROUP

Type of Services	**Geotechnical and Geologic Evaluation**
Project Name	**Stonegate Water Well and Pipeline Initial Study**
Location	**Tres Pinos, California**
Client	**David J. Powers and Associates**
Client Address	**1871 The Alameda, Suite 200** **San Jose, California 95126**
Project Number	**118-18-1**
Date	**September 16, 2009**

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CORNERSTONE EARTH GROUP

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Type of Services	**Geotechnical and Geologic Evaluation**
Project Name	**Stonegate Water Well and Pipeline Initial Study**
Location	**Tres Pinos, California**

SECTION 1: INTRODUCTION

This report has been prepared for the proposed Stonegate Water Well and Pipeline Initial Study project referenced above. The location of the site is shown on the Vicinity Map, Figure 1.

For our use, we were provided with the following document:

- Stonegate Water Supply Project Description, Technical Memorandum by Schaaf & Wheeler, Consulting Civil Engineers, dated June 29, 2009, prepared for the San Benito County Public Works Department (PWD), JOB #: SBPW.02.09.006.

- A letter titled, "Summary of Findings Regarding Geological and Geophysical Survey For Water Well Location, Graniterock Property, Tres Pinos, San Benito County, California," prepared by Geoconsultants, Inc., dated January 15, 2009.

1.1 PROJECT DESCRIPTION

Based on our understanding, the project will include construction of a new water supply well and conveyance pipeline in the Town of Tres Pinos, San Benito County, California. The ground water well is planned to be drilled on Graniterock property, south of Tres Pinos, near the intersection of Bolado and Quien Sabe Roads, and connected to Stonegate's existing system via approximately 3,500 linear feet of pipeline, crossing Graniterock property south of Bolado Road and the Highway 25 right-of-way at Quien Sabe Road. The new pipeline will connect to the existing water distribution system that provides water to the Stonegate residential development. The well would be sized, if adequate ground water is available, to meet all of Stonegate's potable and non-potable water needs. The layout of the proposed well and pipeline alignment are shown on Figure 2, Site Plan.

1.2 SCOPE OF SERVICES

Our scope of services was presented in our agreement dated August 10, 2009, a study including geotechnical and geologic research and consolidation of data, site reconnaissance, identification of potential geologic, seismic and geotechnical impacts, mitigation measures, drafting and report preparation.

SECTION 2: REGIONAL SETTING

2.1 GEOLOGIC SETTING

2.1.1 General

As shown on the Vicinity Map, Figure 1, and Site Plan, Figure 2, the proposed Stonegate Well and Pipeline will be situated in an agricultural and residential area of the town of Tres Pinos, San Benito County, California. The proposed well and preferred pipeline alignment are shown on the Project Site Plan, Figure 2.

The Vicinity Geologic Map, Figure 3, shows the site is located at the northeastern side of Tres Pinos Creek. It is underlain by alluvial basin deposits of Holocene age (last 11,000 years) age (Dibblee, 2006). These deposits are generally composed of unconsolidated gravel, sand and clay. Older alluvial deposits of Pleistocene age occur throughout the hilly area to the south and west forming a system of alluvial terraces. These terrace deposits unconformably overlie outcrops of still older sediments of the Santa Clara Gravel (locally called the San Benito Gravel) to the west and south. Tertiary and Cretaceous sedimentary and volcanic rocks crop out in the hills bounding the Tres Pinos Creek valley to the northeast and southeast.

The well site and pipeline alignments are located in a generally flat area away from steep slopes or deep drainages and, therefore, the project is not subject to landsliding or similar types of ground failure.

2.1.2 Active Faults

Active faulting associated with the Calaveras and San Andreas Fault system affects the project area. The active Calaveras Fault, a major geologic structure in California, occurs at a distance of approximately 1.3 miles southwest of the project. The fault has been zoned by the State of California as a Special Study Zone in conformance with the Alquist Priolo Special Studies Zone Act (Figure 4). The Paicines Fault branches out from the Calaveras fault approximately 3 miles northwest of the site and has also been zoned.

Two short segments of the Tres Pinos Fault have been zoned under the Special Studies Zone concept based on weak geomorphic evidence and seismic activity apparently associated with the fault (Bryant, 1985). The southern segment of the zoned Tres Pinos fault extends for approximately 850 feet in a southeasterly direction from its northern end at a point on Bolado Road approximately 700 feet north of the proposed well location. The northern segment of the Tres Pinos fault extends in a northwesterly direction approximately 2½ miles to the northwest of the project well location.

The southern segment of the fault is mapped to cross the proposed project pipeline alignment at Quien Sabe Road, approximately 600 feet southwest of Highway 25.

The Tres Pinos fault has been characterized as a nearly vertical, right-lateral strike-slip fault not showing clear evidence for Holocene displacement, although it presents a broad linear trough, closed depressions, and right-laterally deflected drainages (Bryant, 1984).

In addition, the Quien Sabe fault, essentially parallel to the Calaveras fault, and located approximately 3.8 miles northeast of the project, has been zoned as a Special Studies Zone. Finally, a short unnamed fault approximately 6½ miles north of the project area has been zoned as well.

The San Andreas Fault lies approximately 4.1 miles southwest of the project area.

2.2 REGIONAL SEISMICITY

The San Francisco Bay area is one of the most seismically active areas in the country. While seismologists cannot predict earthquake events, the U.S. Geological Survey's Working Group on California Earthquake Probabilities (2008) estimates there is a 63 percent chance of one or more magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area region between 2007 and 2036. Their estimates of the probability of a magnitude 6.7 or greater earthquake on the San Francisco Peninsula segment of the San Andreas Fault has been updated to 21 percent for that same time period. During such a major earthquake, ground rupture at the site is not anticipated, but very strong ground shaking would likely occur.

Faults considered capable of generating significant earthquakes are generally associated with the well-defined areas of crustal movement, which trend northwesterly. Table 1 presents the State-considered active faults within 50 kilometers (31 miles) radius of the Stonegate Water Well and Pipeline project.

Local faults and the location of historical earthquake activity in the area are indicated on Figures 4 and 5, illustrating the distances of the site to significant fault zones.

Table 1: Approximate Fault Distances within 50-Kilometers

Fault Name	Distance (miles)	Distance (kilometers)
Calaveras (south)	1.4	2.3
Quien Sabe	3.6	5.8
San Andreas (Creeping)	4.5	7.2
Sargent	9.2	14.8
Zayante-Vergeles	9.3	15.0
San Andreas (Pajaro)	10.5	17.0
Ortigalita	18.7	30.1
Rinconada	21.9	35.4
Monterey Bay-Tularcitos	29.9	48.2

The area between the San Andreas Fault and the Quien Sabe fault, which encompasses the project area, is seismically active, as demonstrated by the northwest-trending alignment of recent earthquake epicenters (Figure 5). Broadly warped surfaces and scattered closed

depressions suggest that distributive tectonic deformation has occurred in late Quaternary time (Bryant, 1985).

SECTION 3: SITE CONDITIONS

3.1 GEOMORPHOLOGY

The project well is located on almost flat land sloping very gently northward at a gradient of about 0.003. Generally, the ground surface at the well site is at approximately Elevation 455 feet above mean sea level. The channel of Tres Pinos Creek drains northwestward. The flat alluvial terrain at the well site is bound to the north, approximately along Bolado Road, by a gentle bluff that rises to the slightly sloping terrace level upon which the Town of Tres Pinos is located. The terrace ranges from approximately Elevation 500 to 540 feet at the town.

A 2009 image from Google Earth shows the site vicinity as rural residential and agricultural. The well site appears to be in fallow land, immediately adjacent to an orchard. The fallow was previously an orchard (Soil Conservation Service, 1969).

3.2 SITE GEOLOGY

Geology of the Stonegate Well and Pipeline project and vicinity is shown in Figure 3, Vicinity Geologic Map. This figure is from preliminary quadrangle mapping by Thomas Dibble performed in 1979 and published in 2006. Based on our review, the project site is underlain by Holocene (Qa) and late Pleistocene (Qoa2) alluvial deposits. The younger alluvial deposits (Qa) underlying the well site are described as consisting of gravel, sand and clay of valley areas, whereas the older alluvial deposits (Qoa2) are described as dissected older alluvial terrace deposits consisting of gravel and sand.

3.3 SOILS

The project area is underlain by soils of the Rincon-Antioch-Cropley association consisting of nearly level to strongly sloping, well-drained and moderately well drained, medium to fine textured soils on terraces and alluvial fans (Soil Conservation Service, 1969). At the well site, and extending northward to approximately Bolado Road, the soil type is described as Sorrento silt loam, with 0 to 2% slope. To the east, the project area is underlain by silt and sandy loams with similar slopes, and by gravelly loams with 5 to 9% slopes.

The soils in the project area are described as having moderate shrink/swell potential, and moderate to moderately slow permeability. Closer to the Tres Pinos Creek are sandy loams with rapid permeability due to a sandy substratum.

3.4 GROUND WATER

No site-specific data about ground water conditions were made available for this study. Ground water was estimated to be at an elevation of approximately 380 feet (approximately 120 feet below the ground surface) in the Hollister ground water sub-basin, in the Tres Pinos Creek valley approximately 1½ mile west of the project area, in 1968 (Ferriz, 2001). No current ground water data for the project area are available.

Changes in ground water levels occur due to many factors, including seasonal fluctuations, underground drainage patterns, regional fluctuations, and other factors.

SECTION 4: GEOLOGIC HAZARDS

This section presents our review and comments concerning potential geologic hazards affecting the proposed project.

4.1 FAULT RUPTURE

As discussed above, several significant active faults are located within 100 kilometers of the site. The Tres Pinos fault crosses the project area and has been zoned as a Special Studies Zone by the State of California. The fault has weak evidence that it has moved during the Holocene (last 11,000 years). Therefore, fault rupture hazard is a significant geologic hazard at the site. Since the project pipeline alignment crosses the mapped trace of the fault, a portion of the alternate pipeline alignment appears to coincide with the northern end of the zoned fault trace, and the well will be located in near proximity to the fault, it is possible that future movement of the fault may affect the pipeline and well.

4.1.1 Potential Fault Rupture Hazard Mitigation

Potential mitigation for the fault rupture hazard and its impact on the pipeline includes performing a detailed subsurface investigation at the locations where the fault either crosses, is in close proximity, or coincides with the pipeline alignment to evaluate the fault characteristics at those locations and its degree of activity. If the fault is identified, the pipeline could be designed to withstand some potential displacement associated with renewed activity of the fault. Engineering controls, such as valves that could be installed on the pipeline at either side of the identified fault trace, would permit isolating and repairing the affected pipeline segment in the event of fault rupture. Other alternatives, such as placing the pipeline in a bed of granular material, and flexible connections on either side of the identified fault trace to allow for pipeline deformation without rupture, may also be considered.

4.2 STRONG GROUND SHAKING

Moderate to severe (design-level) earthquakes can cause strong ground shaking, which is the case for most sites within the Bay Area. While a seismic hazard analysis was not prepared for this initial study, strong ground shaking should be expected at the site during the life of the improvement.

4.2.1 Strong Ground Shaking Mitigation

Potential mitigation of strong ground shaking would likely include designing new pipelines to industry standards, such as those provided by the American Water Works Association (AWWA).

4.3 LIQUEFACTION POTENTIAL

4.3.1 Background

The State of California is in the process of mapping seismic hazards statewide. These maps will assist cities and counties in fulfilling their responsibilities for protecting the public safety from the effects of earthquake-triggered ground failure as required by the Seismic Hazards Mapping Act. No seismic hazards maps are available for the project site.

During strong seismic shaking, cyclically induced stresses can cause increased pore pressures within the soil matrix that can result in liquefaction triggering, soil softening due to shear stress loss, potentially significant ground deformation due to settlement within sandy liquefiable layers as pore pressures dissipate, and/or flow failures in sloping ground or where open faces are present (lateral spreading) (NCEER 1998). Limited field and laboratory data is available regarding ground deformation due to settlement; however, in clean sand layers settlement on the order of 2 to 3 percent of the liquefied layer thickness can occur. Soils most susceptible to liquefaction are loose, non-cohesive soils that are saturated and are bedded with poor draining materials, such as sand and silt layers bedded with a cohesive cap.

Based on guidelines set forth in CGS Special Publication 117 (CGS, 1997), “screening investigations” could be used to determine whether a particular site has “obvious indicators” for potential failure as a result of liquefaction. Three of these indicators include soil type, soil density, and depth to ground water. As discussed above, ground water appears to be at considerable depth in the project area. The alluvial soils described above may vary in density, but since the depth to ground water appears to be in excess of 100 feet, the potential for liquefaction impacting the planned project is considered low during seismic shaking.

4.4 LATERAL SPREADING

Lateral spreading or lurching typically occurs as a form of horizontal displacement of relatively flat-lying material toward an open face such as an excavation, channel, or body of water. Generally, in soils, this movement is due to failure along a weak plane and may often be associated with liquefaction.

As described above, the potential for liquefaction occurring at the site is considered low. In addition, there are no steep open faces within 200 feet of the site where lateral spreading could occur. Therefore, in our opinion, the potential for lateral spreading to affect the site is low.

4.5 GROUND RUPTURE

The methods used to estimate liquefaction settlements assume that there is a sufficient cap of non-liquefiable material to prevent ground rupture or sand boils. For ground rupture to occur, the pore water pressure within liquefiable soil layers will need to be great enough to break through the overlying non-liquefiable layer, which could cause ground rupture. However, because the potential for liquefaction at the site appears low, the potential for ground rupture at the site appears low.

4.6 DIFFERENTIAL COMPACTION

If near-surface materials vary in composition either vertically or laterally, major earthquake shaking can cause non-uniform compaction, resulting in movement of the materials and overlying facilities. This can also occur gradually over a long period of time. Surficial materials underlying the proposed project area generally consist of alluvial deposits. Therefore, in our judgment, the potential for significant differential compaction affecting proposed improvements is low provided undocumented fill is removed or replaced as engineered fill.

4.7 LANDSLIDING

Landsliding is evident in the hills to the south and north of the project area (Majmundar, 1994). However, the nearly flat to gently sloping ground surface surrounding the project area precludes landsliding.

4.8 SEISMICALLY INDUCED WAVES

The site is situated inland, many miles from the nearest water body, at an elevation greater than 450 feet above mean sea level (USGS datum). This location is more than 25 miles east of Monterey Bay and is not located next to any major uncontrolled drainage area that would be affected by a seismically induced wave. Therefore, seismically induced waves, such as seiches, are not an anticipated hazard at the site.

4.9 SOIL EROSION AND DEBRIS FLOWS

The surficial soils in the project area are moderately to well drained and are not likely to be significantly eroded by surface runoff or by wind action. Since the project area is not located in hilly terrain underlain by weak bedrock or soils, debris flows are unlikely to affect the proposed facilities.

4.10 EXPANSIVE SOILS

The soils in the area have been noted as having a moderate expansion potential. Expansive soils can undergo significant volume change with changes in moisture content. Expansive soils shrink and harden when dried, and expand and soften when wetted. During our visit, surface soils appeared to be of a low expansion potential along the alignment; however, some moderately expansive soils could be present. However, the new pipeline will likely be embedded several feet below grade and below the zone of significant moisture fluctuation. Therefore, in our opinion, the potential for impact to the proposed pipeline due to expansive soils is low.

4.11 EXISTING FILLS

It is feasible that some existing fills could be present along the proposed pipeline alignment due to previous development, agriculture, or grading improvements for local roads and utilities. Should old fills be encountered, they should be characterized at that time, and potentially be mitigated. Likely mitigation would be removal and/or replacement with engineered fill.

4.12 LOOSE, COMPRESSIBLE SURFACE SOILS

Much of the proposed alignment for the new pipeline is within paved public roads. Approximately 600 feet of the pipeline will traverse an open field. It appears that the field may have once been used as an orchard, although now the field appears mowed. It is unknown if the field was previously tilled for agricultural purposes. Tilling of agricultural fields is typically deep, on the order of 30 inches or deeper. We anticipate that the bottom of trench excavations would remove most, if not all, of the loose soils should the area have been previously tilled. Therefore, the potential for loose, compressible surface soils affecting pipeline should be low.

SECTION 5: CLOSURE AND LIMITATIONS

We hope this report provides the information needed at this time. This report, an instrument of professional service, has been prepared for the sole use of David J. Powers & Associates and their representatives specifically to support the Initial Study of the Stonegate Well and Pipeline Project in Tres Pinos, California. The opinions and conclusions presented in this report have been formulated in accordance with accepted geotechnical engineering and engineering geology practices that exist in Northern California at the time this report was prepared. No warranty, expressed or implied, is made or should be inferred.

Recommendations in this report are based upon literature review and professional experience. No subsurface exploration of the project area was performed for this study. If variations or unsuitable conditions are encountered during construction, Cornerstone should be contacted to provide supplemental recommendations, as needed.

David J. Powers & Associates may have provided Cornerstone with plans, reports and other documents prepared by others. David J. Powers & Associates understands that Cornerstone reviewed and relied on the information presented in these documents and cannot be responsible for their accuracy.

Cornerstone prepared this report with the understanding that it is the responsibility of the owner or his representatives to see that the recommendations contained in this report are presented to other members of the design team and incorporated into the project plans and specifications, and that appropriate actions are taken to implement the geotechnical recommendations during construction.

Conclusions and recommendations presented in this report are valid as of the present time for the development as currently planned. Changes in the condition of the property or adjacent properties may occur with the passage of time, whether by natural processes or the acts of other persons. In addition, changes in applicable or appropriate standards may occur through legislation or the broadening of knowledge. Therefore, the conclusions and recommendations presented in this report may be invalidated, wholly or in part, by changes beyond Cornerstone's control. This report should be reviewed by Cornerstone after a period of three (3) years has elapsed from the date of this report. In addition, if the current project design is changed, then Cornerstone must review the proposed changes and provide supplemental recommendations, as needed.

An electronic transmission of this report may also have been issued. While Cornerstone has taken precautions to produce a complete and secure electronic transmission, please check the electronic transmission against the hard copy version for conformity.

Recommendations provided in this report are based on the assumption that Cornerstone will be retained to provide observation and testing services during construction to confirm that conditions are similar to that assumed for design, and to form an opinion as to whether the work has been performed in accordance with the project plans and specifications. If we are not retained for these services, Cornerstone cannot assume any responsibility for any potential claims that may arise during or after construction as a result of misuse or misinterpretation of Cornerstone's report by others. Furthermore, Cornerstone will cease to be the Geotechnical-Engineer-of-Record if we are not retained for these services.

SECTION 6: REFERENCES

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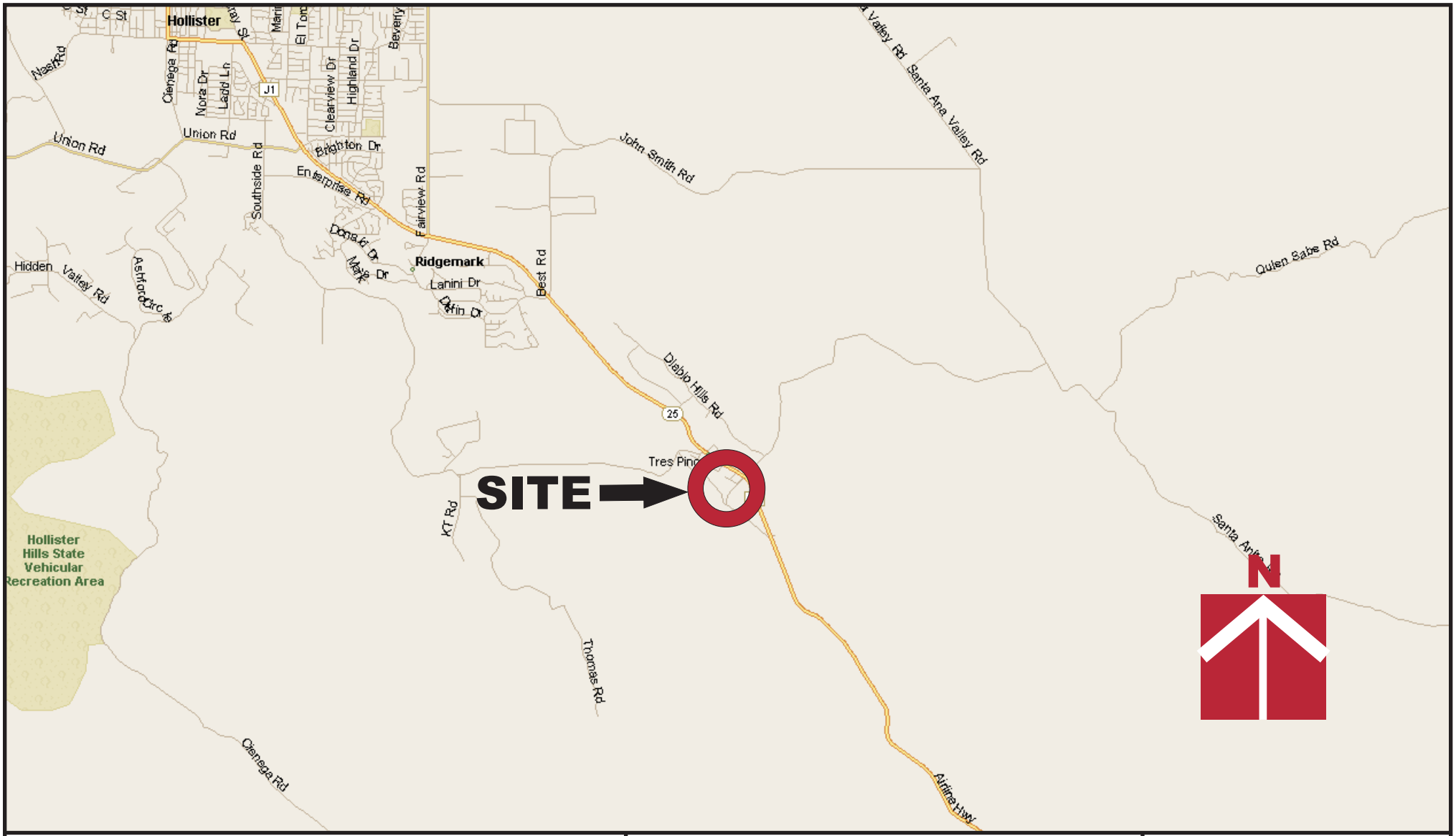

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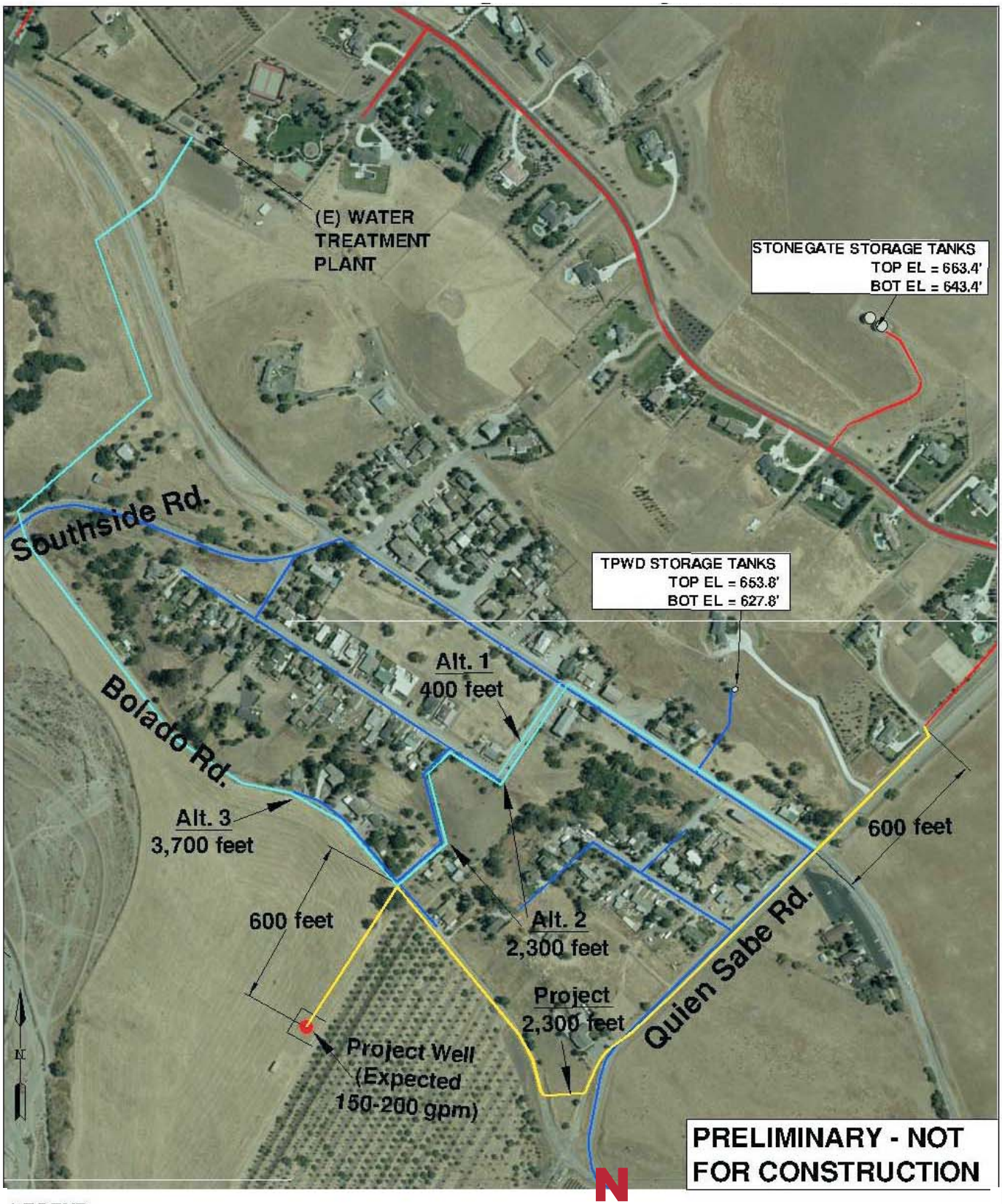
Vicinity Map

Stonegate Water Supply
San Benito County, CA

Project Number	118-18-1
Figure Number	Figure 1
Date	September 2009
Drawn By	FLL



LEGEND

- PROJECT PIPELINE
- ALTERNATIVE PIPELINE
- (E) TRES PINOS PIPELINE
- (E) STONEGATE PIPELINE

N

0 500 1000

APPROXIMATE SCALE (FEET)

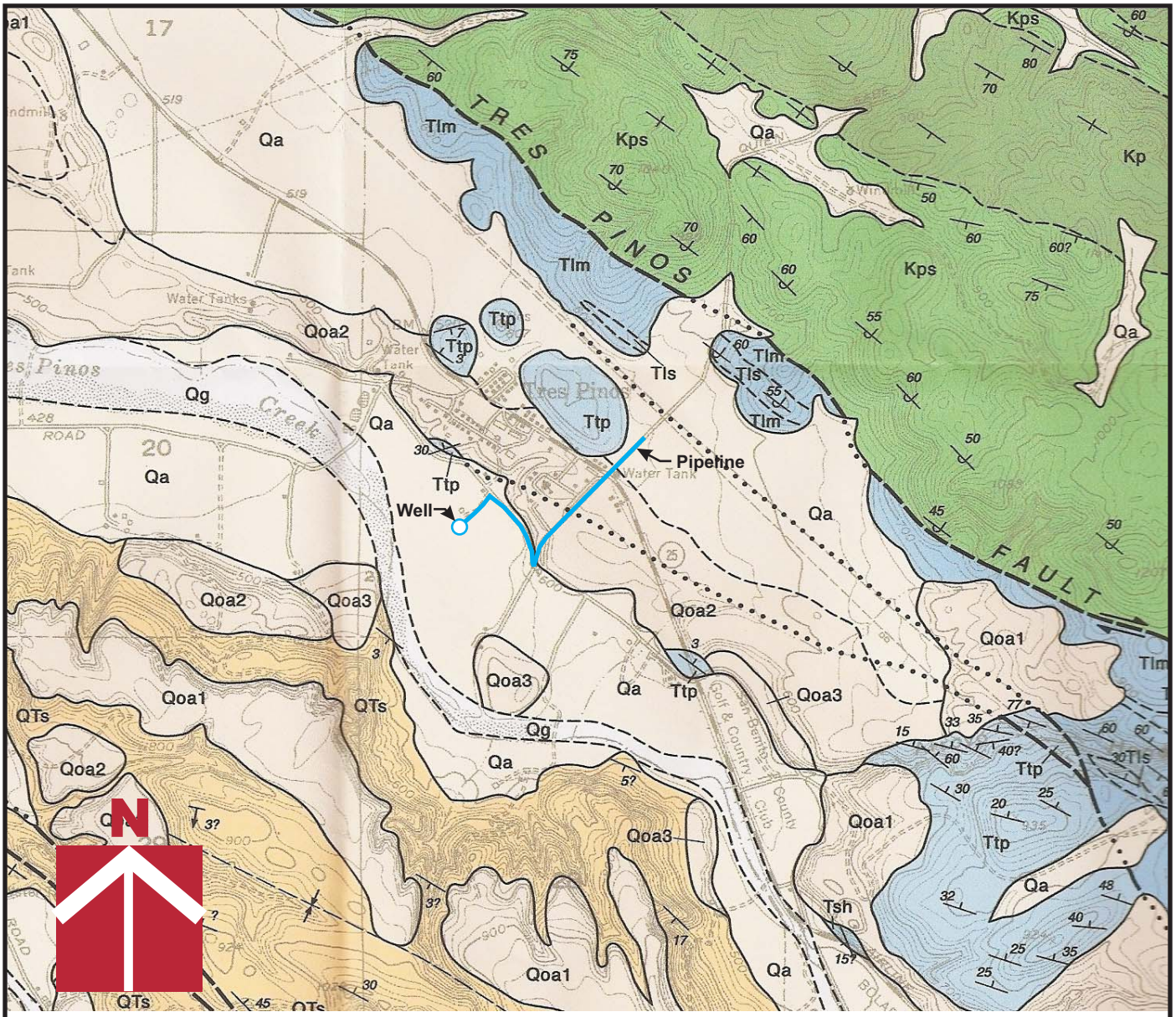
Base by Schaaf & Wheeler, dated June 29, 2009

CORNERSTONE EARTH GROUP

Site Plan

Stonegate Water Supply
San Benito County, CA

Project Number	118-18-1
Figure Number	Figure 2
Date	September 2009
Drawn By	FLL



GEOLOGIC SYMBOLS

not all symbols shown on each map

FORMATION CONTACT *dashed where inferred or indefinite dotted where concealed*

MEMBER CONTACT *between units of a formation* ..... **Prominent bed**

CONTACT BETWEEN SURFICIAL SEDIMENTS *located only approximately in places*

FAULT: *Dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful. Parallel arrows indicate inferred relative lateral movement. Relative vertical movement is shown by U/D (U=upthrown side, D=downthrown side). Short arrow indicates dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.*

FOLDS: overturned **ANTICLINE** **SYNCLINE**

arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments

Strike and dip of sedimentary rocks — 18 *inclined*; 20 *inclined (approximate)*; 80 *overturned*; *horizontal*; *vertical*

Strike and dip of metamorphic or igneous rock foliation or flow banding or compositional layers — 75 *inclined*; *inclined (approximate)*; *vertical*; 80 *overturned*

OTHER SYMBOLS: *Direction of landslide movement*; *outline of water bodies shown on map*; *water well*; *oil well*; *springs*

Geologic Units

Qa	Quaternary, surficial sediments, alluvial gravel, sand, and clay of valley area
Qoa2	Quaternary, older surficial sediments, intermediate alluvial terrace
Tlm	Tertiary, Los Muertos shale, marine clay shale
Ttp	Tertiary, Tres Pinos sandstone, sandstone, light gray to tan, in thick beds (1-2mm thick), separated by thin partings of clay shale, base not exposed.
Kps	Cretaceous, Panoche formation sandstone, light gray to light brown, fine to medium grained, bedded, arkosic, includes interbedded clay shale

0 2000 4000

APPROXIMATE SCALE (FEET)

Base by Thomas W. Dibblee, Jr, 2006. Titled "Geologic Map of the Tres Pinos Quadrangle"

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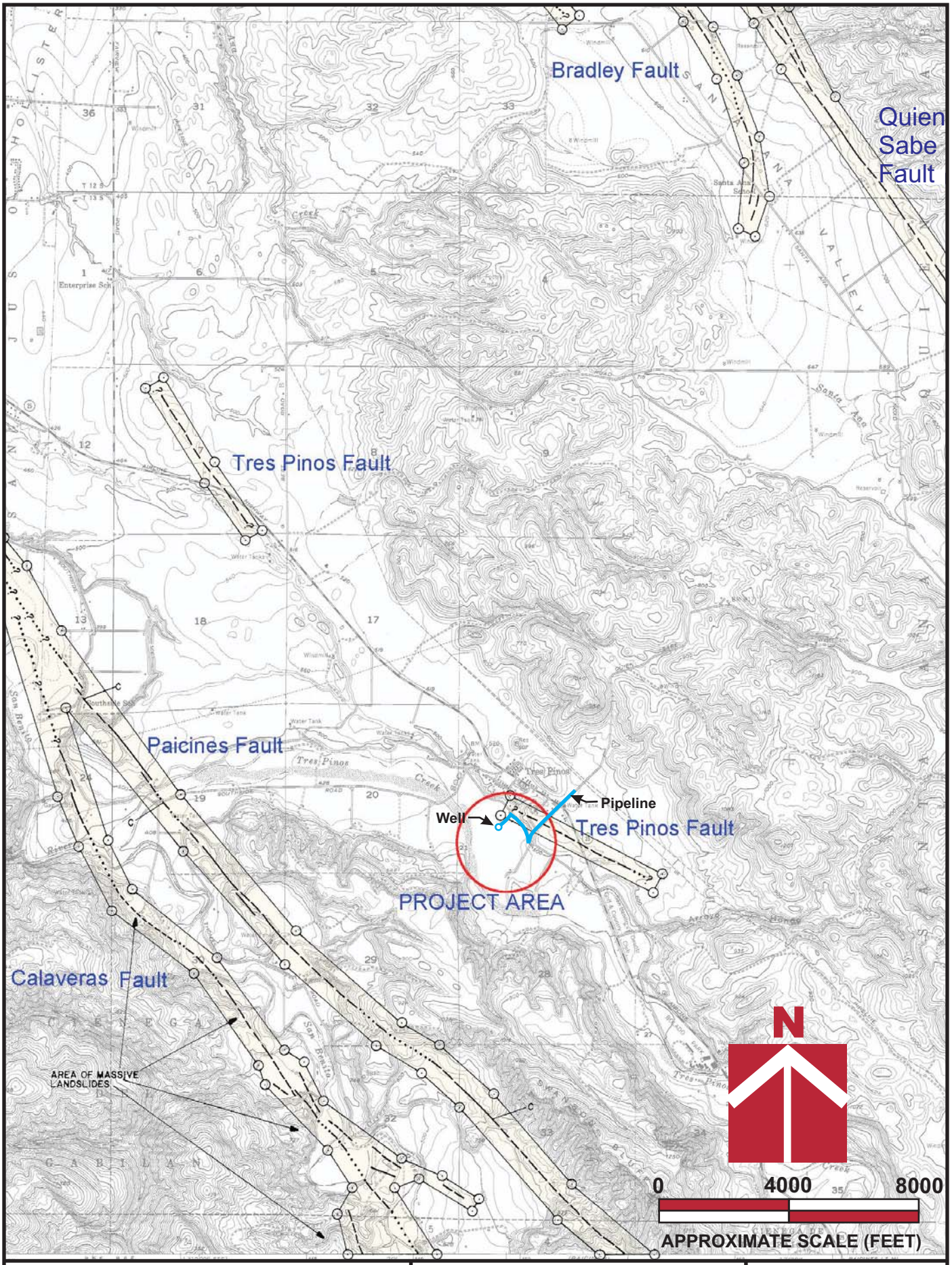
Vicinity Geologic Map

Stonegate Water Supply
San Benito County, CA

Project Number	118-18-1
Figure Number	Figure 3
Date	September 2009
Drawn By	FLL



CORNERSTONE EARTH GROUP

Special Study Zone Fault Map

Stonegate Water Supply
San Benito County, CA

Project Number	118-18-1
Figure Number	Figure 4
Date	September 2009
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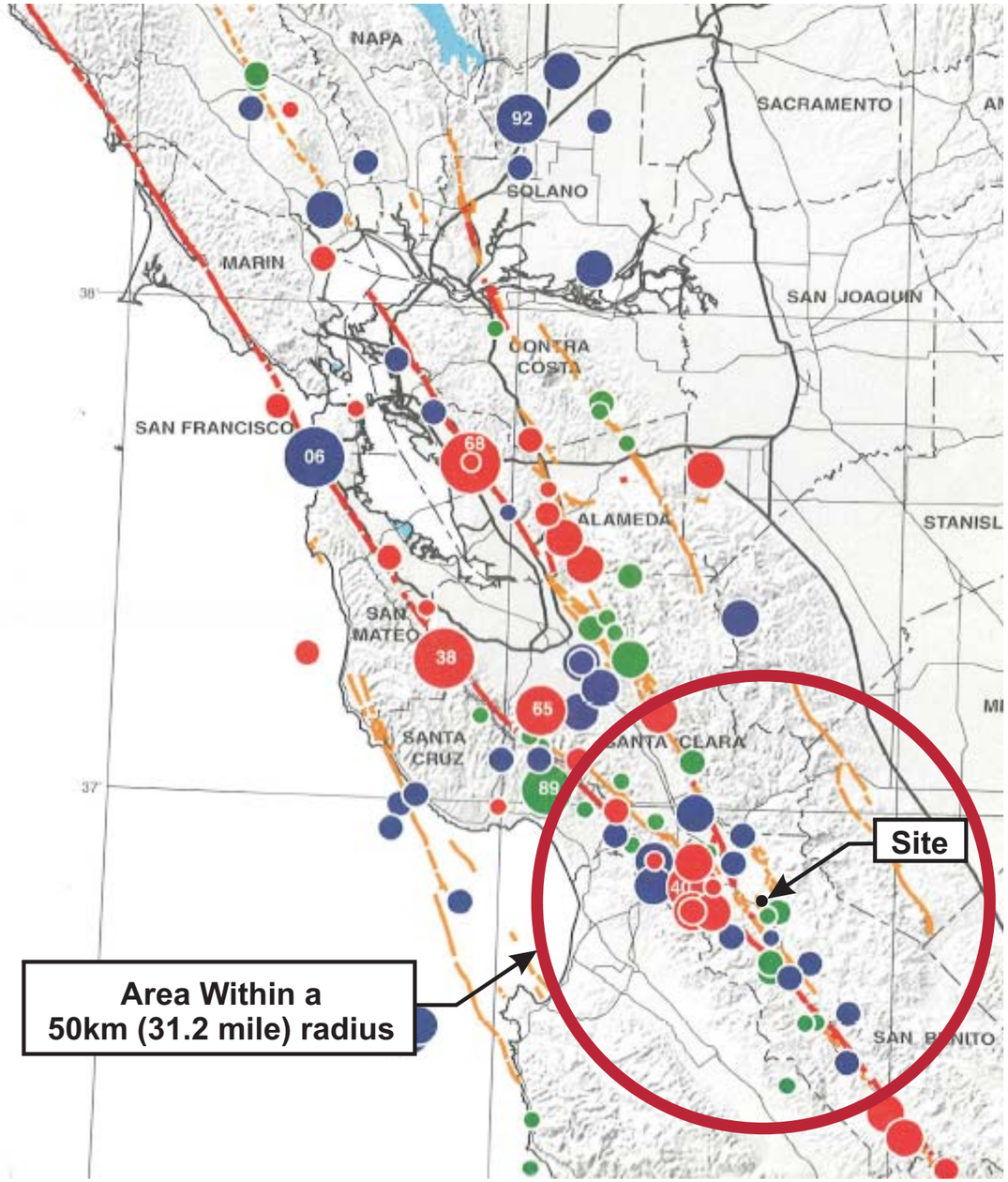

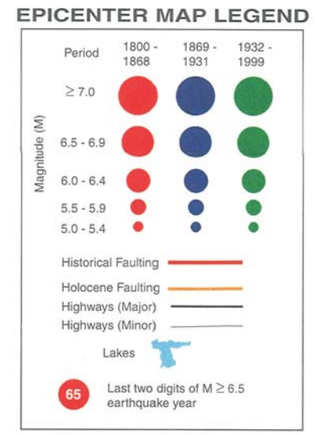

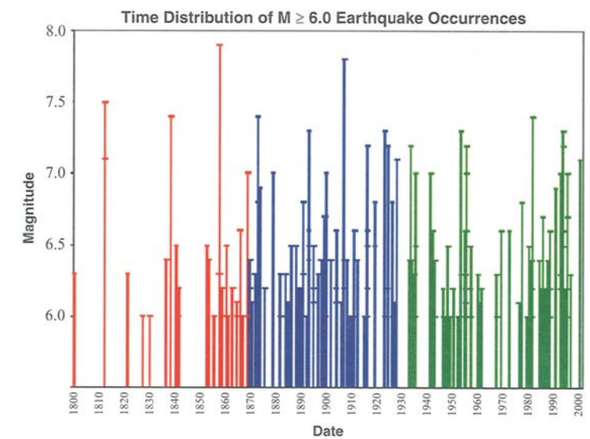

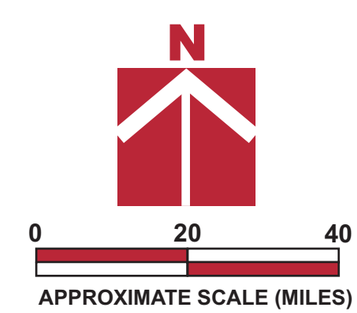

From: T. Toppozada & Others (2000)

Project Number	118-18-1
Figure Number	Figure 5
Date	September 2009
Drawn By	FLL

Historical Earthquakes Map

Stonegate Water Supply
San Benito County, CA

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