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MILLER PACIFIC
ENGINEERING GROUP

April 19, 2019
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WRA
2169 G East Francisco Blvd.
San Rafael, California 94901

Attn: Mr. George Salvaggio

Re: Geotechnical Engineering Review
35% Plan Review
Corte Madera 4-acre Marsh Restoration
Corte Madera, California

Introduction

At your request, we have conducted a geotechnical engineering review of the 35% plans for the proposed 4-acre wetland restoration at Corte Madera Ecologic Reserve located in Corte Madera, California. Miller Pacific Engineering Group prepared a geotechnical report dated June 20, 2016 for the 72-acre parcel owned by Golden Gate Bridge, Highway and Transportation District. The new plans have focused the improvement area to the northwest portion of the property and reduced the extent of site grading. The purpose of our review of the 35% plans is to confirm recommendations from our geotechnical report are still valid and pertain to the new design.

Review of Plans/Details

In our opinion, the new design has similar slope inclinations and fill placement quantities as the previous restoration alternatives analyzed in our report. Therefore, the conclusions and recommendations of our geotechnical report dated June 20, 2016 are appropriate for the new design.

In review of the 35% plans and as discussed in our report, the project site is underlain by soft, compressible bay mud that will consolidate with new surface loads (planned berms) resulting in settlement of the ground surface. In consideration of future settlement; (1) the planned berms could be built higher and allowed to settle to the desired long-term final grades, (2) allowed to settle to a lower elevation over time, or (3) occasional minor new fill placed over time to maintain elevations. More detailed discussion of settlement over time in present in the 2016 report.

As also discussed in our report, estimated seismic lateral displacement values of roughly 30 to 40 inches could occur if there is a strong seismic event during or shortly after construction. The total displacement would likely be a series of cracks that develop mostly in the higher elevation portion of the berm and bulging of ground within the lower elevation of the marsh. These estimated seismic displacements will decrease over time as the underlying bay mud consolidates and becomes stronger. Following a strong earthquake, the site should be inspected for damage and any significant ground cracks filled with soil-cement slurry. Minor surface grading may also be required based on the extent of ground deformation.

If there are any questions or comments, please call us at your convenience.

Very truly yours,
MILLER PACIFIC ENGINEERING GROUP

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MILLER PACIFIC
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GEOTECHNICAL INVESTIGATION
WETLAND RESTORATION DESIGN AND PERMITING SUPPORT SERVICES AT CORTE MADERA ECOLOGICAL RESERVE, PSA 2014-FT-13
CORTE MADERA, CALIFORNIA

August 2016

Project 1039.051

Prepared with:
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Prepared for:
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CERTIFICATION

This document is an instrument of service, prepared by or under the direction of the undersigned professionals, in accordance with the current ordinary standard of care. The service specifically excludes the investigation of radon, asbestos, toxic mold and other biological pollutants, and other hazardous materials. The document is for the sole use of the client and consultants on this project. Use by third parties or others is expressly prohibited without written permission. If the project changes, or more than two years have passed since issuance of this report, the findings and recommendations must be reviewed by the undersigned.

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APPENDIX A – SUBSURFACE EXPLORATION

1.0 INTRODUCTION

This report summarizes the results of the Geotechnical Investigation for the planned Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, Professional Service Agreement PSA No. 2014-FT-13, in Corte Madera, California. The project site is located on the eastern side of Corte Madera, adjacent to San Francisco Bay, as shown on Figure 1. The purpose of this investigation is to evaluate existing geologic and geotechnical site conditions, including stability of existing levees and slope stability of proposed breached levee end-points, and prepare preliminary geotechnical recommendations for use in project planning and design.

The scope of Miller Pacific Engineering Group's (MPEG) services includes review of readily available geotechnical and geologic reference material, subsurface exploration consisting of cone penetrometer tests and soil borings, and laboratory testing, engineering analysis, and preparation of this report. Issuance of this report completes the Phase 1 scope of services. Future phases are expected to include plan review, consultation, and construction observation and testing.

2.0 PROJECT DESCRIPTION

The project will involve wetland restoration of portions of a 72-acre parcel owned by the Golden Gate Bridge, Highway and Transportation District (District) located adjacent to the Corte Madera Ecological Reserve. The project site is located in Corte Madera, adjacent to San Francisco Bay. This report includes the geotechnical evaluation of three general alternatives. Alternative 1A includes 4.9 acres of new tidal marsh, while Alternative 1B includes 4.9 acres of new tidal marsh and a raised public access easement to protect from rising sea level. Alternative 2A would include 30.7 acres of new tidal marsh and a raised public access easement. Alternative 2B would include 32.9 acres of new tidal marsh and relocation of the public access easement to disposal area. Alternative 3A includes 20.5 acres of new tidal marsh and, 7.5 acres of seasonal wetland. Alternative 3B includes 22.5 acres of new tidal marsh, 7.5 acres of seasonal wetland, and the relocation of the public access easement to the centralized 5.5-acre park. An overall site plan with bay mud contour lines is shown on Figure 2. These bay mud contour lines are used to predict amounts of settlement across the site based on the thickness of the underlying bay mud. Site plans indicating the approximate proposed improvements for each alternative are shown on Figures 3 through 7.

3.0 SITE CONDITIONS

3.1 Regional Geology

The site is located within the Coast Ranges Geomorphic Province of California. The regional bedrock geology consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Jurassic-Cretaceous age (65-190 million years ago) Franciscan Complex.

Northwest-southeast trending mountain ridges formed by previous tectonic activity characterize the regional topography. Extensive faulting during the Pliocene Age (1.8-7 million years ago) formed the uneven depression that is now the San Francisco Bay. More recent tectonic activity is concentrated along the San Andreas Fault zone, a complex group of generally parallel faults.

Regional geologic mapping indicates that the project site is underlain by Bay Mud. The review of MPEG's subsurface exploration in the project area generally confirms the geologic mapping. A regional geologic map is presented on Figure 8.

3.2 Subsurface Exploration

Subsurface exploration was performed to determine the geologic contact between the fill soils and the bay mud. In addition, MPEG's exploration determined the approximate thickness of the Bay Mud deposits when encountered in the borings and cone penetrometer tests (CPTs). The 5 CPTs were performed atop the levee.

The subsurface exploration was performed on September 3, 2014 and consisted of 5 CPTs, which extended to maximum depths of 50-feet. Additional subsurface exploration was performed on September 14, 2014 and consisted of drilling 3 soil borings utilizing a manually-operated hand auger to a maximum explored depth of 6.0-feet. The locations of both the CPTs and borings are shown on Figures 2 through 7.

The soils encountered in the borings were logged by MPEG's Field Geologist and select samples were obtained for laboratory testing. A Soil Classification Chart is shown on Figure A-1. The boring logs are presented on Figures A-2 through A-4 of Appendix A.

The CPT is an exploration technique that provides a continuous profile of data throughout the depth of exploration. It is particularly useful in defining stratigraphy, relative soil strength and in assessing liquefaction potential. The device is illustrated on Figure A-5. The recorded data is transferred to an in-office computer for reduction and analysis. The cone tip bearing and sleeve friction (i.e. friction ratio) indicates the soil type, soil density, or strength. Variations in the data profile indicate changes in stratigraphy. This test method has been standardized and is described in detail by the ASTM Standard Test Method D3441 "Deep, Quasi-Static Cone and Friction Cone Penetration Tests of Soil." A CPT Soil Interpretation Chart is shown on Figure A-6 and CPT plots of interpreted subsurface conditions are shown on Figures A-7 through A-11.

Laboratory testing of relatively "undisturbed" samples from the exploratory borings included moisture content, dry density, and unconfined compressive strength. The results of the laboratory testing are presented on the boring logs.

3.3 Subsurface Conditions

Subsurface conditions across the site generally confirm the regionally-mapped geology. Approximately 5 to 10-feet of sandy silty clay fill material exists above approximately 20 to 40-feet of bay mud, followed by medium stiff to stiff alluvial clays that extend in excess of 50-feet below the ground surface. Exploration did not extend beyond 50-feet. The interpreted thickness of the bay mud layer varies across the site as shown on Figure 2. The existing perimeter levee is composed of medium stiff, clayey soils that transition to soft bay mud at a depth of about 10 feet. CPT and boring logs are attached in Appendix A.

4.0 GEOLOGIC HAZARDS EVALUATION

4.1 General

The MPEG has evaluated commonly-considered geologic hazards for the proposed project. Based on MPEG's review, the primary hazards that may affect the proposed improvements are:

- Strong seismic ground shaking,
- Liquefaction,
- Expansive soils,
- Site settlement, and
- Slope instability of the existing levee and proposed grading.

Other hazards, that are not considered significant geologic hazards at the site are::

- Erosion,
- Tsunami inundation, and
- Flooding.

Our evaluations and conceptual mitigation measures for geologic hazards that are significant or less than significant with mitigation are summarized below. There are no known active faults under the site and a deep soil layer overlies the bedrock, thus the potential for fault rupture is insignificant. There are several other geologic hazards (i.e. volcanic eruption and radon gas) that are also not included because they are also insignificant as geologic hazards.

4.2 Seismic Ground Shaking

The site will likely experience seismic ground shaking similar to other areas in Marin County with underlying bay mud in the seismically active San Francisco Bay Area. Earthquakes along several active faults in the region, as shown on the Fault Map Figure 9, could cause moderate to strong ground shaking at the site. Estimates of peak ground accelerations are based on either deterministic or probabilistic methods.

Deterministic Method

Deterministic methods use empirical relations developed from data collected during previous earthquakes to provide estimates of median peak ground accelerations. A summary of the active faults that could most significantly affect the site, their maximum credible magnitude, closest distance to the project area, and probable peak ground accelerations (PGAs) is provided in Table A.

TABLE A
ESTIMATED DETERMINISTIC PEAK GROUND ACCELERATION
Corte Madera Marsh Restoration
Corte Madera, California

Fault	Moment Magnitude for Characteristic Earthquake(1)	Closest Estimated Distance(1)	Median Peak Ground Acceleration(2)
San Andreas	8.0	14 km	0.27 g
Hayward	7.3	14 km	0.24 g
San Gregorio	7.4	15 km	0.23 g
Rodgers Creek	7.3	27 km	0.16 g
Maacama	7.4	68 km	0.09 g

1) California Department of Transportation (Caltrans) (2015), “Caltrans ARS Online”, http://dap3.dot.ca.gov/ARS_Online/, accessed August 21, 2015.
2) Values calculated using Vs^{30} = 180 m/s for Site Class “E” per 2013 California Building Code. Vs^{30} is the average shear velocity down to 30 meters.

Probabilistic Method

The PGA was calculated for two separate probabilistic conditions, the 2% chance of exceedance in 50 years (2,475-year statistical return period) and the 10% chance of exceedance in 50 years (475-year statistical return period), utilizing the 2008 Interactive Deaggregation (USGS, 2008). The PGA arising from a probabilistic analysis for a 10% chance of exceedance in 50 years is commonly utilized for residential, commercial, and industrial developments, while the PGA arising from a probabilistic analysis for a 2% chance of exceedance in 50 years is typically used for “critical” facilities such as schools and hospitals. The results of the probabilistic analyses are presented below in Table B.

TABLE B
PROBABILISTIC SEISMIC HAZARD ANALYSES
Corte Madera Marsh Restoration
Corte Madera, California

	Statistical Return Period	Mean Moment Magnitude(1)	Peak Ground Acceleration (g)(1,2)
2% in 50 years	2,475 years	7.1	0.66 g
10% in 50 years	475 years	7.0	0.43 g

(1) USGS 2008 Interactive Deaggregation, https://geohazards.usgs.gov/deaggint/2008/, accessed August 21, 2015.
(2) Values determined using Vs^{30} = 180 m/s for Site Class "E" in accordance with the 2013 California Building Code. Vs^{30} is the average shear velocity down to 30 meters.

Deterministic methods are commonly used for the majority of residential, commercial, and industrial developments. Probabilistic methods are used for "critical" facilities such as hospitals and schools or where "superior" seismic performance is desired.

The potential for strong seismic shaking at the project site is high. The San Andreas Fault is the closest and most likely source for a future earthquake. The most significant adverse impact associated with strong seismic shaking is potential damage to structures and improvements.

Evaluation: *Less than significant with mitigation.*

Mitigation: *New foundations should be designed in accordance with the latest edition of the California Building Code (2013 CBC), and if the final plans include any retaining structures they should be designed with a seismic surcharge load. Seismic criteria above were used in slope stability analyses. Seismic design criteria for any possible new foundations and retaining walls as well as any public access walkways and proposed levees are presented in the Conclusions and Recommendations section of this report.*

4.3 Liquefaction Potential and Lateral Spreading

Liquefaction refers to the sudden, temporary loss of soil shear strength during strong ground shaking. Liquefaction-related phenomena include liquefaction-induced settlement, flow failure, and lateral spreading. These phenomena can occur where there are saturated, loose, granular deposits. As shown on Figure 10, in regards to liquefiable material, the site is mapped as a water body with all of the surrounding areas mapped as having moderate liquefaction susceptibility. Loose saturated sand layers were not encountered in the subsurface exploration. Therefore, the risk of damage to future improvements due to liquefaction is low.

The potential for liquefaction of the levees is low because of the thick layer of bay mud beneath the fill soils. Lateral spreading occurs when continuous liquefiable soil layers lose strength and slopes flow toward a free face along the liquefied soil layer, resulting in large scale slope instability. It does not appear that potentially liquefiable deposits are continuous across the site. Therefore, the risk of lateral spreading is expected to be low.

Evaluation: *Less than significant.*
Mitigation: *No mitigation measures are required.*

4.4 Erosion

Sandy soils on moderate slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated surface water flow. The potential for erosion is increased when established vegetation is disturbed or removed.

The project improvements are located on relatively flat ground. Therefore, the potential for damage due to erosion is low. However, as with all new construction projects, areas disturbed by grading and/or construction traffic should be restored. The proposed breach in the northern levee will be susceptible to erosion from the incoming and outgoing water flow. The hydraulic engineer will need to account for the velocity of the water going in and out and design the opening to withstand that possible erosion. The lowered levees in Alternatives 2B and 3B also have a potential for erosion caused by wave-run during storms and sea level rise.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Erosion control measures during and after construction should conform to the most recent version of the California Stormwater Quality Association's Best Management Practice Handbook (2009). After construction, vegetation should be re-established and erosion-control measures implemented in disturbed areas.*

4.5 Seiche and Tsunami

Seiches and tsunamis are short duration earthquake-generated water waves in large enclosed bodies of water and the open ocean, respectively. The extent and severity of a tsunami would be dependent upon ground motions and fault offset from active faults. The site is located within a mapped tsunami inundation area as shown on Figure 12.

According to data from the National Oceanic and Atmospheric Administration (NOAA), approximately 77 credible seiches or tsunamis have been recorded or observed within the San Francisco Bay area since 1700. Of these, the only tsunamis to cause damage near San Rafael resulted from the 1960 Chile earthquake (Magnitude 9.5) and the 1964 Alaska earthquake (Magnitude 9.2). The 1964 tsunami was the most damaging historic event, with a maximum wave height of 4.00-feet recorded at San Rafael (NOAA 2013b).

There have been eight credible local seiche events observed in San Francisco Bay between 1854 and 1906, six of which are attributed to earthquake activity and two to landslides. The Mare Island earthquake caused the largest seiche with 1.97-feet amplitude waves near Benicia, and is attributed to slip on the Rodgers Creek fault. No confirmed seiches have been recorded in San Francisco Bay since 1906. In light of the recorded history of seiches in the San Francisco Bay, the risk of a seiche or tsunami in excess of the height observed in 1964 is expected to be low. In addition, the project site is partially protected by the existing perimeter levee. Although the existing levee will be breached in all project alternatives, the risk of damage from seiche is expected to be low and would not require any mitigation measures.

Evaluation: *Less than significant.*
Mitigation: *No mitigation measures are required.*

4.6 Flooding

The adverse impact from flooding is water damage to structures. The project site is located within a FEMA 100-year flood zone as shown on Figure 11. Therefore, the risk of damage to improvements due to large scale flooding is moderate. Potential for flooding is significant; however, since no improvements would be damaged by flood waters, potential for significant damage to improvements appears low.

Evaluation: *Less than significant.*
Mitigation: *While risk of damage to new improvements due to global flooding is moderate, the project includes new wetlands designed to accommodate flooding. If any hardscape improvements are planned, they should be designed to limit damages during flooding.*

4.7 Expansive Soils

Expansive soil occurs when clay particles interact with water causing volume changes in the clay soil. Clayey soil may swell when saturated and shrink when dried. Based on MPEG's site visit and subsurface exploration, MPEG observed the presence of highly plastic or expansive soils near-surface and some shrinkage cracks. The risk of damage due to expansive soils is generally low to moderate.

Evaluation: *Less than significant with mitigation.*
Mitigation: *For most of the planned project, no mitigation measures are required. Any possible new structures should be designed with a foundation system that can accommodate seasonal expansive soil movement.*

4.8 Site Settlement

The project site is located on about 5-feet of fill underlain by about 50-feet of soft compressible bay mud. Additional loads due to placement of new fill will result in additional settlement across the site. The potential for consolidation of the underlying bay mud and settlement of the ground surface for the proposed project is high.

Evaluation: *Significant.*
Mitigation: *Engineer will need to design the levees higher than the desired elevation to account for future site settlements. If the settlement values are acceptable then no mitigation measures are required. Further discussion of settlement mechanisms and potential future settlement is discussed in the Conclusions and Recommendations section of this report.*

4.9 Slope Instability/Landsliding

Weak soils and bedrock on moderate to steep slopes can move downslope due to gravity. Slope instability is often initiated or accelerated from soil saturation and groundwater pressure, though may also be aggravated by grading activity, such as removal of toe support by excavation or addition of new loads, such as fill placement. The primary adverse effect of slope instability is damage to structures and improvements.

The project site is located on approximately 5 to 10-feet of fill underlain by soft, weak bay mud. Under static conditions, existing grades at the site should perform adequately and future instability is not anticipated. However, the potential for future instability during a significant seismic event is moderate to high. Given the relatively flat grades at the site, future instability would likely result more in lateral displacements and ground cracking rather than vertical displacements. Provided permanent cuts are made per the recommendations in the site grading section of this report, seismic instability at the ends of the levee should not be a significant issue. If a deepened channel will be created, then stability should be checked. Erosion of the slopes will be a concern and bank protection should be provided.

Evaluation: *Less than significant with mitigation.*
Mitigation: *Given the scale of the proposed improvements significant mitigation to prevent future instability due to seismic events is impractical. Slope displacements will likely be primarily lateral and no threat to life safety is anticipated.*

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on the results of MPEG's geotechnical investigation, the MPEG concludes that the proposed project is feasible from a geotechnical perspective. The primary geotechnical considerations for the project are the anticipated site settlements and potential for seismic slope instability of the levees, including the breached levees. Recommendations and design criteria to address these and other geotechnical items are presented in the following sections.

5.2 Seismic Design

Minimum mitigation of seismic ground shaking includes design of any proposed new structures in conformance to the provisions of the most recent edition (2013) of the California Building Code. The magnitude and character of these ground motions will depend on the particular earthquake and the site response characteristics. Based on the interpreted subsurface conditions and close proximity of the San Andreas Fault, the MPEG recommends the CBC coefficients and site values shown in Table C below to calculate the design base shear of the new construction. To determine site seismic coefficients, the MPEG used latitude and longitude coordinates shown on Figure 9.

TABLE C
2013 CBC SEISMIC DESIGN FACTORS
Corte Madera Marsh Restoration
Corte Madera, California

Factor Name	Coefficient	Site Specific Value(1)
Site Class(2)	$S_{A,B,C,D,E,\text{ or }F}$	S_E
Spectral Acc. (short)	S_s	1.500 g
Spectral Acc. (1-sec)	S_1	0.600 g
Site Coefficient	F_a	0.9
Site Coefficient	F_v	2.4

1) Values determined in accordance with the 2010 ASCE-7 standard.

2) Soil Profile Type S_E Description: Soft Clay Soil, Shear Wave Velocity less than 600 feet per second, standard penetration blow counts below 15, undrained shear strength less than 1,000 psf, and having 10 feet or more of soil with PI greater than 20, moisture content greater than 40% and an undrained shear strength of less than 500 psf.

The effects of earthquake shaking (i.e. protection of life safety) can be mitigated by close adherence to the seismic provisions of the current edition of the CBC. However, some structural damage of possible proposed structures may still occur during strong ground shaking.

5.3 Site Preparation and Grading

Site grading will consist primarily of cuts and fills to restore the marsh. Site preparation, excavation, and backfill should be performed in accordance with the following recommendations and criteria.

5.3.1 Surface Preparation

Within cuts and fills to be developed, clear all trees, over-size debris, and organic matter from the site. Any “organic” soil or soil contaminated with debris will not be suitable for use as structural fill and should be removed from the site or stockpiled for use in landscape areas. Any areas of loose soil observed during the site preparation need to be over-excavated down to firm soil and replaced with compacted fill.

The project area should be scarified and moisture conditioned to within 2% optimum moisture content. Once the subgrade has been moisture conditioned, the subgrade should be compacted to 90% relative compaction[1] (R.C.) and to achieve a firm and unyielding surface.

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[1] Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density, as determined by laboratory test procedure (ASTM 1557).

If any new pavement areas are proposed, the upper 8-inches of subgrade soil should be moisture conditioned as described above and further compacted to at least 95% R.C. Subgrades should be maintained in a moist condition up until final pavement, flatwork, or structures are constructed.

5.3.2 Excavations

The majority of the excavations will likely be accomplished with "conventional" equipment, such as excavators or backhoes. Excavations at the site are generally likely to yield clayey to gravelly mixtures from the fill zone that could be suitable for re-use as fill in other areas of the project provided they can be processed to meet the criteria presented below in Part 3 of this section. The high plasticity bay mud is not suitable for re-use as structural fill, see Part 3 below.

Excavations having a depth of 5 feet or more must be sloped and/or benched in accordance with OSHA regulations. Pursuant to OSHA classifications, the onsite fill and native soils are Type "C". For Type "C" soils, excavations up to 20-feet deep must be sloped no steeper than 1-1/2:1 (horizontal:vertical). If vertical slopes are required, they must be shored or braced to a minimum of 18-inches above the top of the vertical slope. The Contractor should be responsible for site safety and should select and maintain and appropriate shoring system for the site conditions and in accordance with OSHA requirements.

5.3.3 Fill Compaction

Fill soils, if used, should be conditioned to a moisture content within 2 percent of the optimum moisture content. Properly moisture-conditioned soils should be placed in loose horizontal lifts of 8 inches thick or less and uniformly compacted to at least 90 percent relative compaction. In landscape areas including restoration wetland areas and/or upland areas, compaction in upper two feet can be reduced to 85 percent relative compaction to aid in planting and vegetation growth. Temporary access roads that include fill placement or cuts made for construction equipment to access the areas of proposed site grading should be compacted to 85% relative compaction. Temporary access roads would be removed at completion of site grading to restore conditions.

The new side slopes at the proposed breach in the northern levee will need to be reinforced to prevent erosion. Rip rap or erosion mats are two alternatives to preventing erosion.

5.3.4 Permanent and Temporary Cut and Fill Slopes

Temporary (steeper) cut slopes may be required during construction of new fill slopes. For planning purposes, these cut slopes in onsite soils should be inclined no steeper than 1-1/2:1 (horizontal:vertical), based on an OSHA Type "C" soil profile.

Performance of temporary cut slopes will be heavily dependent on the amount of time the cut is unsupported, seepage and surface runoff over the face, bedding and fracture planes of soil materials, and other factors. The steeper (temporary) cut slopes may exhibit some sloughing, especially during wet weather conditions, and cleanup of soil debris at the base of slopes may be required. The project grading contractor should be responsible for the performance of temporary cut slopes and implementation of temporary shoring if needed.

Permanent cut and fill slopes if utilized, should be inclined no steeper than 2:1. This would apply to primarily to new levee construction. Flatter slopes are recommended, if possible, for improved stability and flatter slopes will be necessary for the levee breach and new channels in the marsh. If steeper slopes are planned, MPEG should be consulted to provide specific design recommendations. The current preliminary internal and breach channel designs should follow these recommendations as well.

5.4 Slope Stability

Slope stability analyses were performed in order to evaluate the potential for the planned grading and improvements to induce instability. Using the computer program Slide, Version 6.008 (Rocscience, 2011), MPEG modeled existing conditions using geologic cross-sections that represent the planned site grading and engineering properties of the soil layers. The results of the slope stability analyses are presented on Figures 3 through 7. These results include the factors of safety for both static and seismic conditions as well as the estimated seismic lateral displacement of the proposed grading. The estimated seismic lateral displacement values are for immediately after construction, which is the worst-case scenario. These values will decrease over time as the site becomes more stable. These displacements can be extrapolated to other areas of the site. The new excavated slough channels in the restored marsh are susceptible to displacement and were included in MPEG's calculations. It is possible that they will be displaced into the channel during a strong seismic event.

5.4.1 Alternative 1A and 1B

Alternative 1A includes 4.9 acres of new tidal marsh while Alternative 1B includes 4.9 acres of new tidal marsh and a raised public access easement to protect from rising sea level. The results of the slope stability analyses for Options 1A and 1B are presented on Figure 3.

For static conditions, factors of safety above 1.5 are maintained. For pseudo-static (seismic) conditions, analyses were performed using the deterministic median PGA of 0.27 g and the results are shown on Figure 3. During the strong seismic shaking immediately after construction, the factor of safety is 0.34 and therefore some seismic induced displacement is expected to occur. Calculated lateral displacements are expected to be on the order of 31 inches in some areas as shown on Figure 3. The stability will slowly increase as the underlying bay mud consolidates and becomes stronger. After long term consolidation, seismic displacements are expected to be minor.

5.4.2 Alternative 2A and 2B

Alternative 2A would include 30.7 acres of new tidal marsh and a raised public access easement. Alternative 2B would include 32.9 acres of new tidal marsh and relocation of the public access easement to disposal area. Stability analyses at Section A-A' for both Alternative 2A and 2B indicate that adequate factors of safety can be achieved under both static and pseudo-static conditions for long term conditions. The results of the stability analyses for this option are presented on Figures 4 and 5. During the strong seismic shaking immediately after construction, the factor of safety is below 1.0 and therefore some seismic induced displacement is expected to occur. Calculated lateral displacements are expected to be up to 40 inches.

5.4.3 Alternative 3A and 3B

Alternative 3A includes 20.5 acres of new tidal marsh and 7.5 acres of seasonal wetland. Alternative 3B includes 22.5 acres of new tidal marsh and 7.5 acres of seasonal wetland and relocation of the public access easement to the centralized upland area. Stability analyses at Section A-A' for both Alternative 3A and 3B indicate that adequate factors of safety can be achieved under both static and long term pseudo-static conditions. The results of the stability analyses for this option are presented on Figures 6 and 7. Calculated seismic lateral displacements immediately after construction could be up to 40 inches as shown on Figures 6 and 7.

5.5 Site Settlements

The project site is underlain by soft, compressible bay mud that will consolidate with applications of surface loads resulting in settlement of the ground surface. The rate at which the settlement occurs depends on the thickness of the bay mud deposit, the distance to a drainage layer, and the vertical permeability of the bay mud. There are two modes of settlement in the bay mud: primary consolidation and secondary compression. Consolidation settlement often takes decades to complete. Secondary compression is generally a fraction of the total settlement, but occurs over a much longer time. The channel prism adjacent to the northern levee is not expected to settle. Portions of the project that will be loaded with new fill are expected to settle but areas that are not receiving fill, such as the marsh plain area, are not expected to settle.

Using a coefficient of vertical consolidation of the bay mud of 10 ft^2/year and drainage conditions between single and double, the number of years it would take for 95 percent primary consolidation of the underlying bay mud to occur was calculated for the proposed grading for each alternative. The thickness of bay mud for each section was determined by the CPT data collected and the bay mud contour lines shown on Figure 2. The results of the settlement analysis for each alternative are shown on Figures 3 through 7.

The 30-year measurement is the amount of settlement of expected 30 years from now. The 50 year measurement is the amount of settlement expected 50 years from now. The total settlement is the amount of settlement expected over the lifetime of the site if no new fill or load is applied to the site.

To account for site settlements, either the levee will need to be built higher in order for it to settle to the desired elevation or the levee can be built to the desired elevation with the knowledge that the levee will be lower over time.

5.6 Trench Backfill

If any utilities may be necessary, MPEG recommends minimum of 6-inches of non-corrosive sand (or other approved pipe bedding material) be placed in the bottom of trench excavations. The bedding material should be continuous around the pipe and extend at least 6-inches above the top of pipe. The bedding material over the pipe should be compacted prior to placement of intermediate backfill.

Intermediate trench backfill above the bedding material and up to the subgrade elevation may be select fill material or aggregate base, unless otherwise specified. The native bay mud and alluvial soil materials derived from excavations at the site are not likely suitable for re-use as select fill. The existing fills may be suitable for re-use provided they are properly processed to conform to the fill criteria discussed in the Site Preparation and Grading/Fill Compaction section above.

Intermediate backfill should be moisture-conditioned to near the optimum-moisture content and compacted to at least 90 percent relative compaction. Within pavement or other structural areas, the uppermost 12-inches should be compacted to at least 95 percent relative compaction, in general accordance with ASTM D-1557. The compacted surface must also be non-yielding when proof-rolled with heavy construction equipment.

6.0 SUPPLEMENTAL SERVICES

Project plans should be reviewed by MPEG as they near completion to ensure that the intent of the aforesaid recommendations have been sufficiently incorporated. Additionally, MPEG should be present during construction to verify that actual conditions encountered are consistent with the recommendations and design criteria included in this report.

7.0 LIST OF REFERENCES

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Idriss, I.M. & Boulanger, R.W. “SPT-Based Liquefaction Triggering Procedures” Department of Civil and Environmental Engineering, College of Engineering, University of California at Davis, UCD/GCM-10/02, December 2010.

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United States Geological Survey (2003), “Earthquake Probabilities in the San Francisco Bay Region, 2002 to 2031 – A Summary of Finding,” The Working Group on California Earthquake Probabilities, Open File Report 99-517, 2003.

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United States Geological Survey (2008), “The Uniform California Earthquake Rupture Forecast, Version 2,” The 2007 Working Group on California Earthquake Probabilities, Open File Report 2007-1437, 2008.

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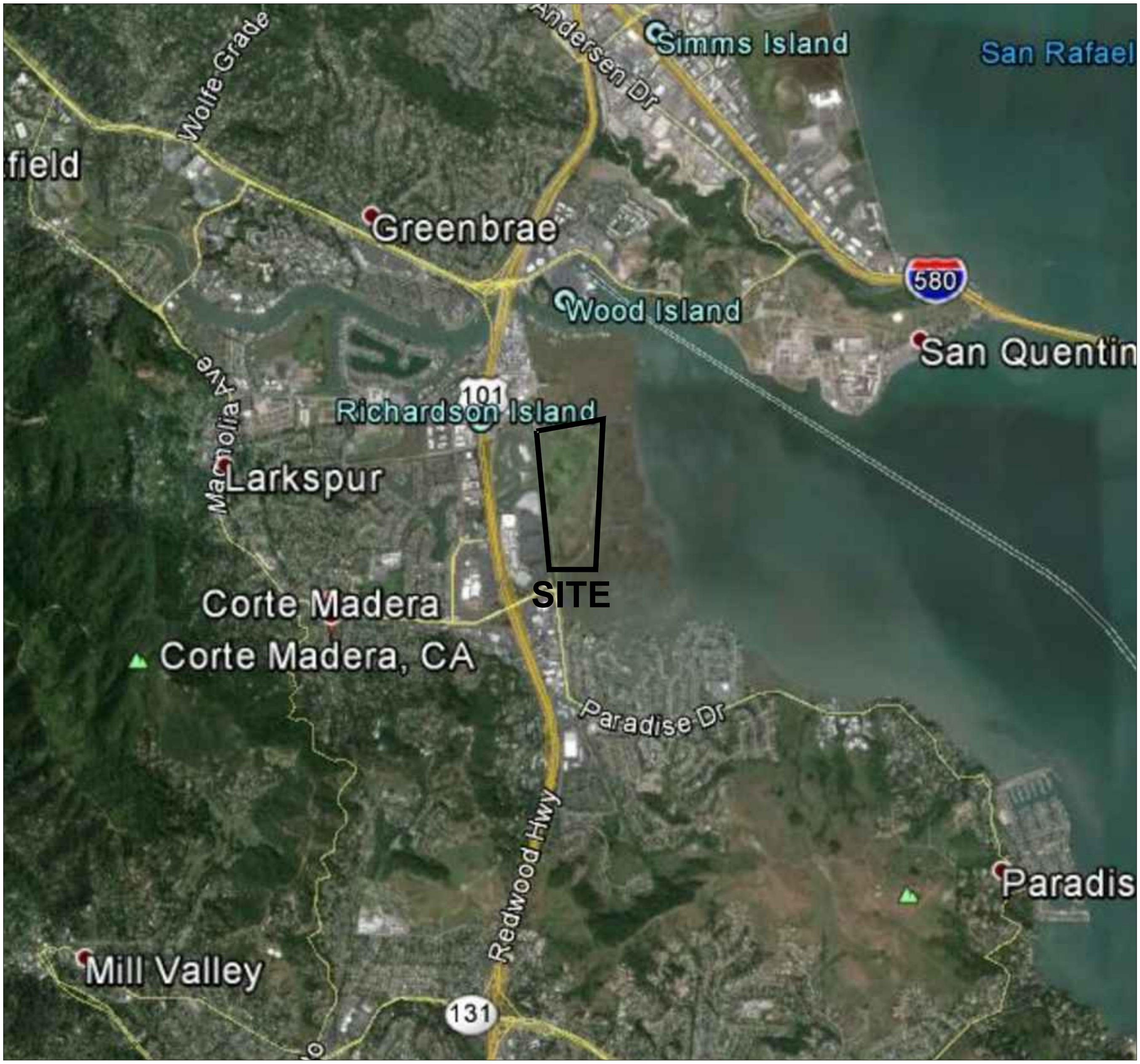

SITE LOCATION MAP

(Not to Scale)

LATITUDE 37.9338°
LONGITUDE -122.5096°

NORTH

REFERENCE: Google Earth, 2015.

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FILE: 1039.051 SLM.dwg

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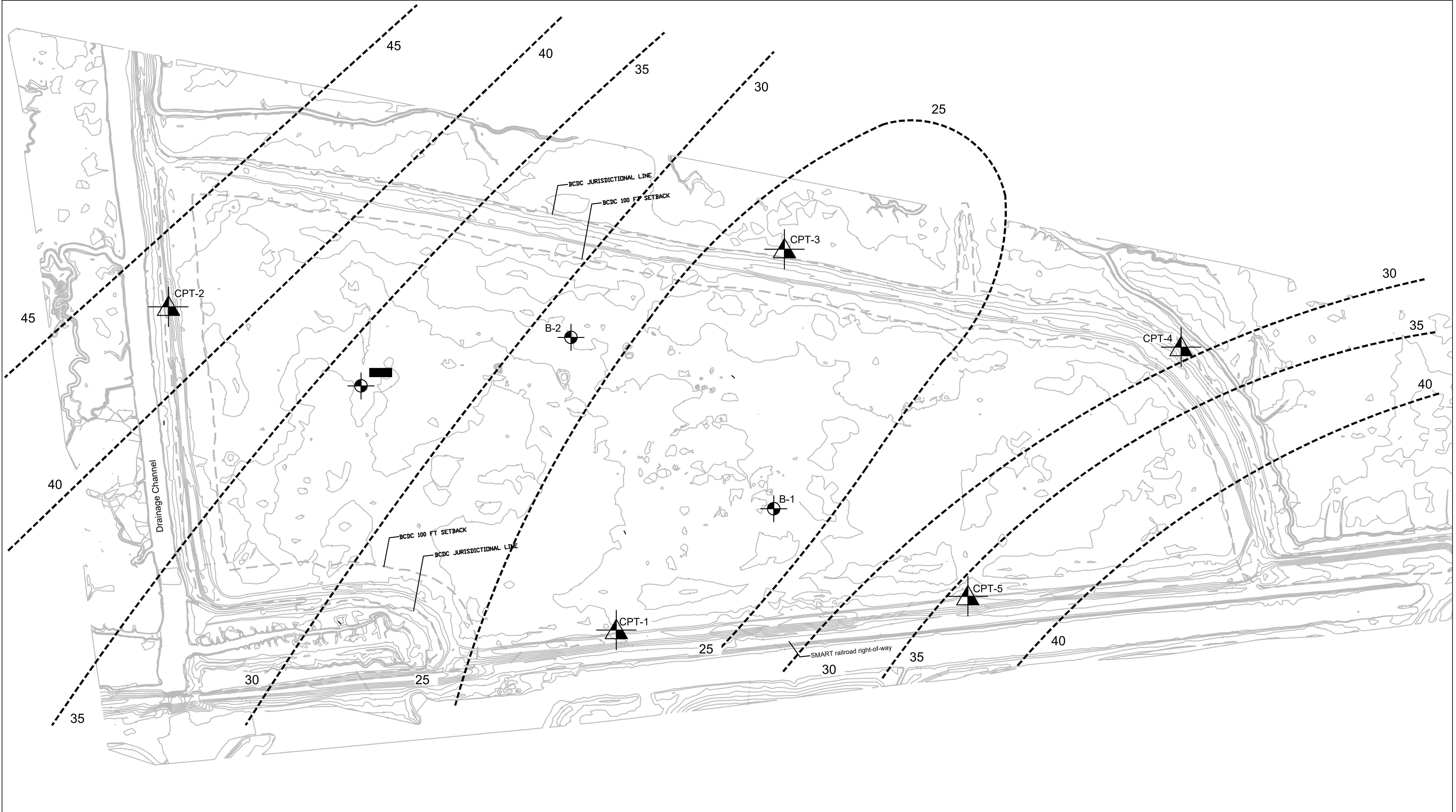
SITE LOCATION MAP

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 8-21-15

Drawn MMT
Checked

1
FIGURE



- ⊕ Approximate location of boring completed by MPEG.
- ▲ Approximate location of CPT completed by MPEG.
- Approximate thickness of bay mud contours in feet below the fill material.

SCALE
0 125 250 500 FEET

NORTH

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FILE: 1039.051 Alternative 1.dwg

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SITE PLAN WITH BAY MUD CONTOURS

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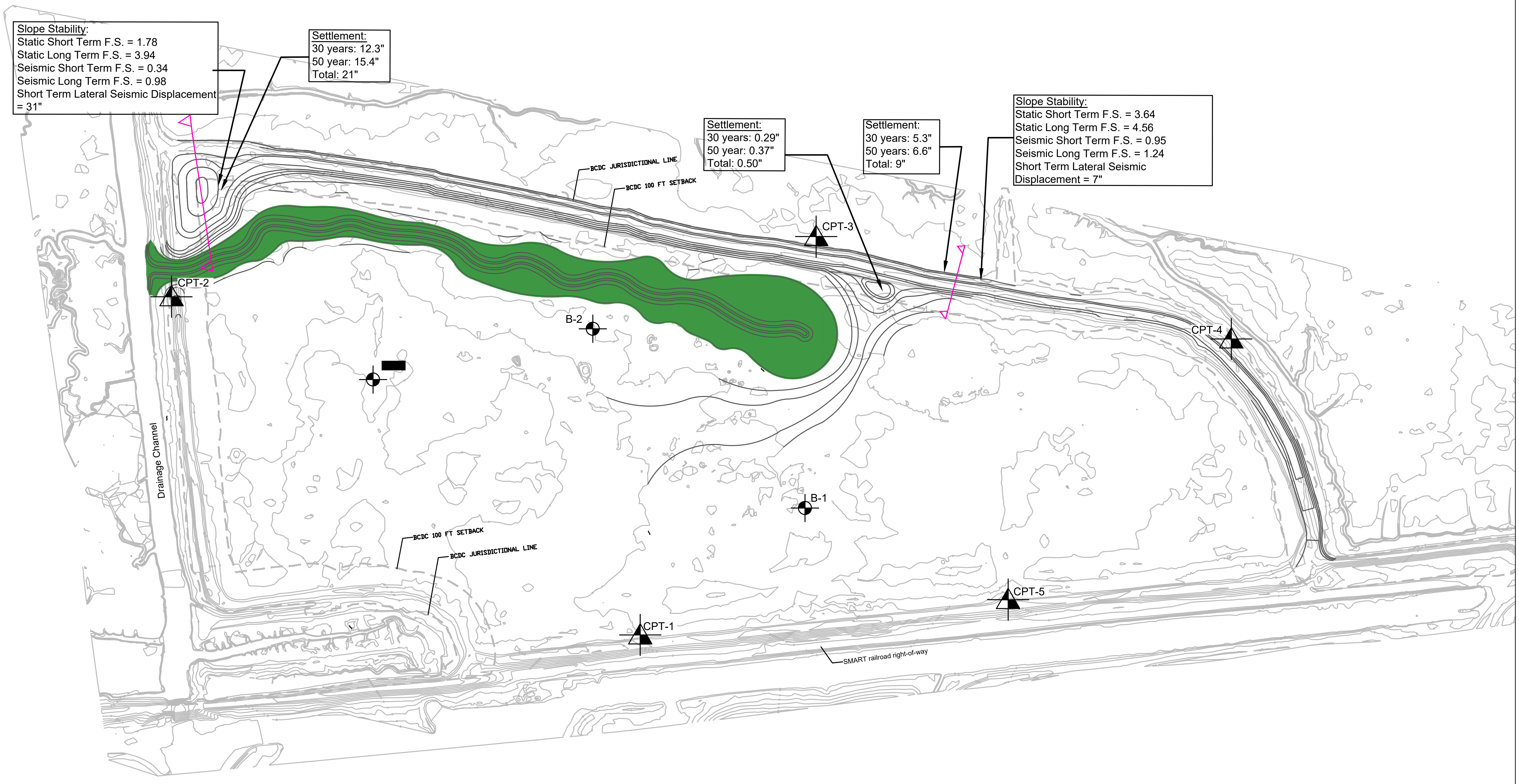
Project No. 1039.051 Date: 10-8-15

Drawn MMT
Checked

2
FIGURE



Slope Stability:
Static Short Term F.S. = 1.78
Static Long Term F.S. = 3.94
Seismic Short Term F.S. = 0.34
Seismic Long Term F.S. = 0.98
Short Term Lateral Seismic Displacement = 31"

Settlement:
30 years: 12.3"
50 year: 15.4"
Total: 21"

Settlement:
30 years: 0.29"
50 year: 0.37"
Total: 0.50"

Settlement:
30 years: 5.3"
50 years: 6.6"
Total: 9"

Slope Stability:
Static Short Term F.S. = 3.64
Static Long Term F.S. = 4.56
Seismic Short Term F.S. = 0.95
Seismic Long Term F.S. = 1.24
Short Term Lateral Seismic Displacement = 7"

⊕ Approximate location of boring completed by MPEG.

▲ Approximate location of CPT completed by MPEG.

SCALE
0 125 250 500 FEET

NORTH

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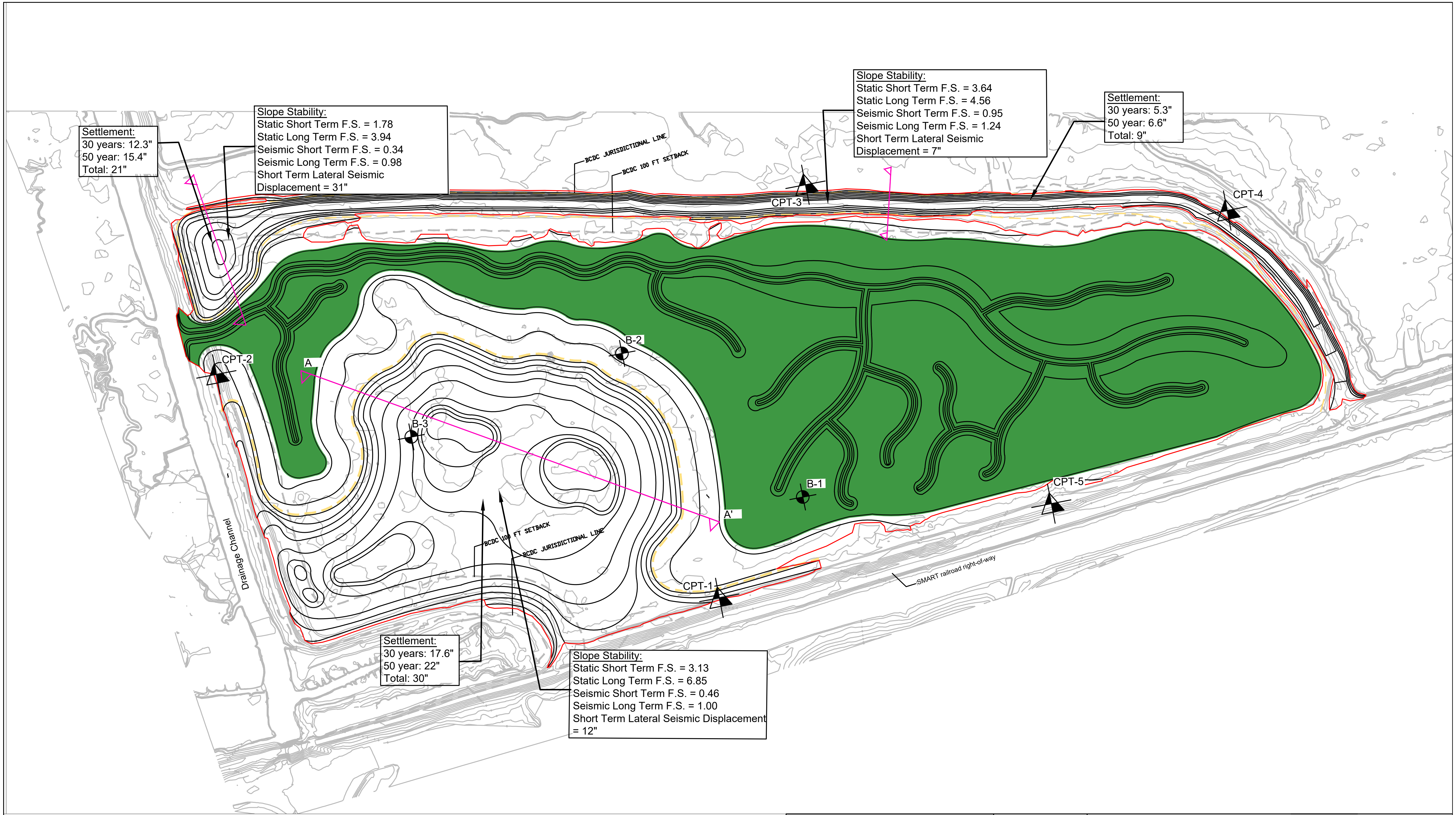
ALTERNATIVE 1B SITE PLAN

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 10-8-15

Drawn MMT
Checked

3
FIGURE



⌖ Approximate location of boring completed by MPEG.

▲ Approximate location of CPT completed by MPEG.

SCALE
0 125 250 500 FEET

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AutoCAD file number: Alternative 2A.dwg

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ALTERNATIVE 2A SITE PLAN

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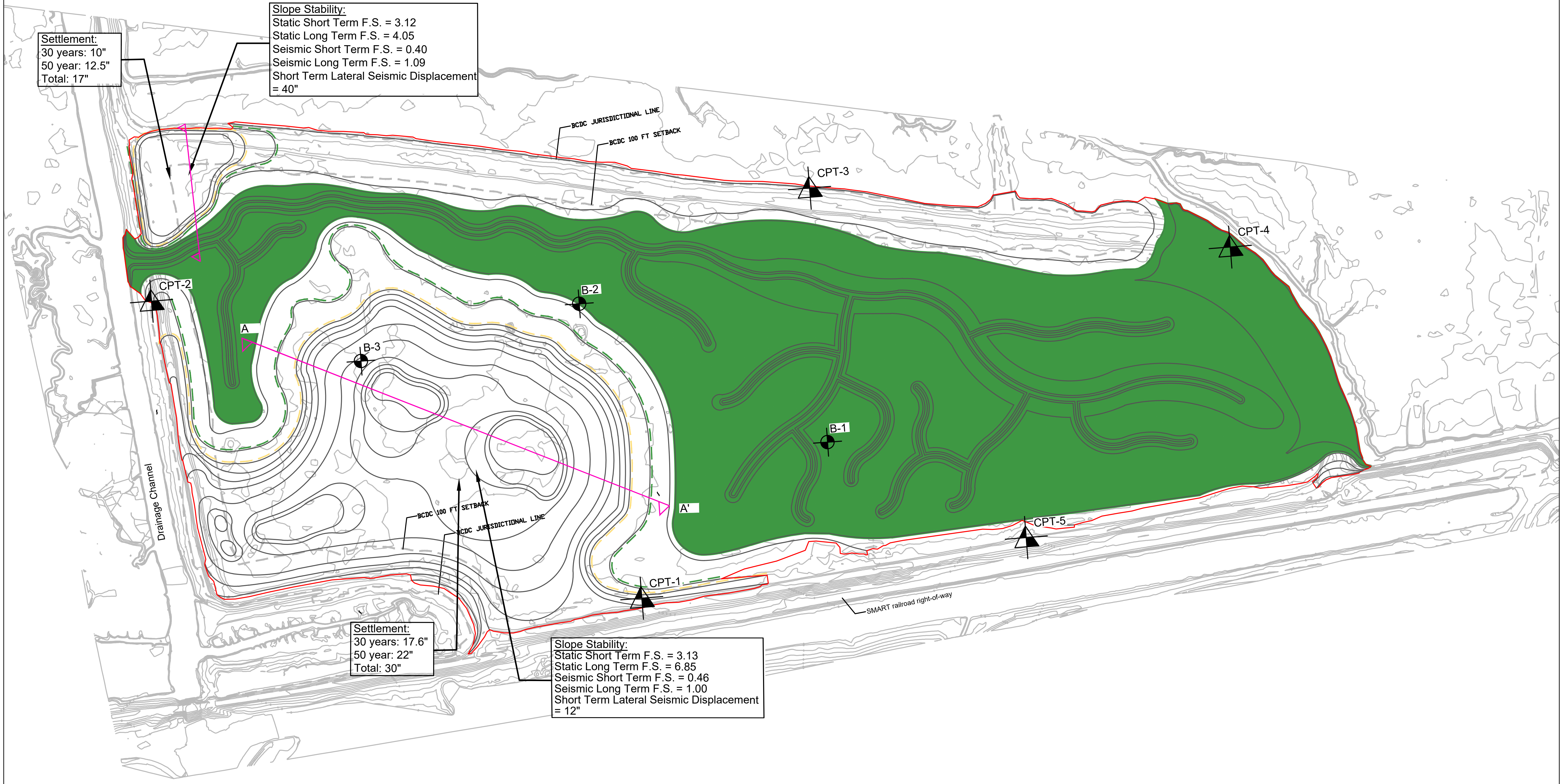
Reserve, PSA 2014-FT-13
Project No. 1039.051 Date: 8-28-15

Designed SAS
Drawn MMT
Checked

4
FIGURE



Settlement:
30 years: 10"
50 year: 12.5"
Total: 17"

Slope Stability:
Static Short Term F.S. = 3.12
Static Long Term F.S. = 4.05
Seismic Short Term F.S. = 0.40
Seismic Long Term F.S. = 1.09
Short Term Lateral Seismic Displacement = 40"

Settlement:
30 years: 17.6"
50 year: 22"
Total: 30"

Slope Stability:
Static Short Term F.S. = 3.13
Static Long Term F.S. = 6.85
Seismic Short Term F.S. = 0.46
Seismic Long Term F.S. = 1.00
Short Term Lateral Seismic Displacement = 12"

⊕ Approximate location of boring completed by MPEG.

▲ Approximate location of CPT completed by MPEG.

SCALE
0 125 250 500 FEET

NORTH

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FILE: 1039.051 Alternative 2B.dwg

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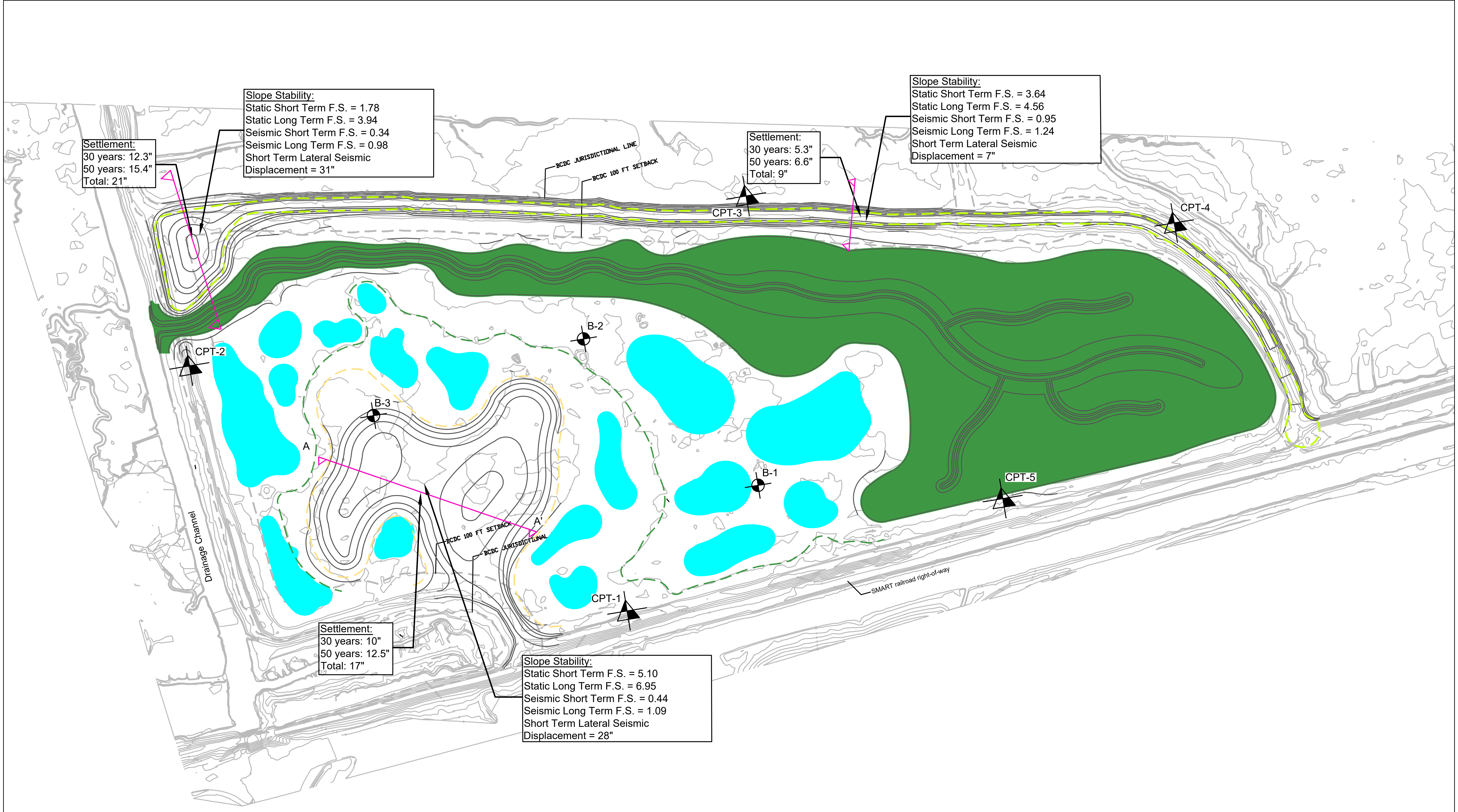
ALTERNATIVE 2B

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2104-FT-13
Project No. 1039.051 Date: 10-8-15

Drawn MMT
Checked

5
FIGURE



⌖ Approximate location of boring completed by MPEG.

▲ Approximate location of CPT completed by MPEG.

SCALE
0 125 250 500 FEET

NORTH

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FILE: 1039.051 Alternative 3A.dwg

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ALTERNATIVE 3A SITE PLAN

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13
Project No. 1039.051 Date: 10-6-15

Drawn MMT
Checked

6
FIGURE

Slope Stability:
Static Short Term F.S. = 3.12
Static Long Term F.S. = 4.05
Seismic Short Term F.S. = 0.40
Seismic Long Term F.S. = 1.09
Short Term Lateral Seismic
Displacement = 40"

Settlement:
30 years: 10"
50 years: 12.5"
Total: 17"

Settlement:
30 years: 10"
50 years: 12.5"
Total: 17"

Slope Stability:
Static Short Term F.S. = 5.10
Static Long Term F.S. = 6.95
Seismic Short Term F.S. = 0.44
Seismic Long Term F.S. = 1.09
Short Term Lateral Seismic Displacement
= 28"

⊕ Approximate location of boring completed by MPEG.

▲ Approximate location of CPT completed by MPEG.

SCALE
0 125 250 500 FEET

NORTH

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FILE: 1039.051 Alternative 3B.dwg

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ALTERNATIVE 3B SITE PLAN

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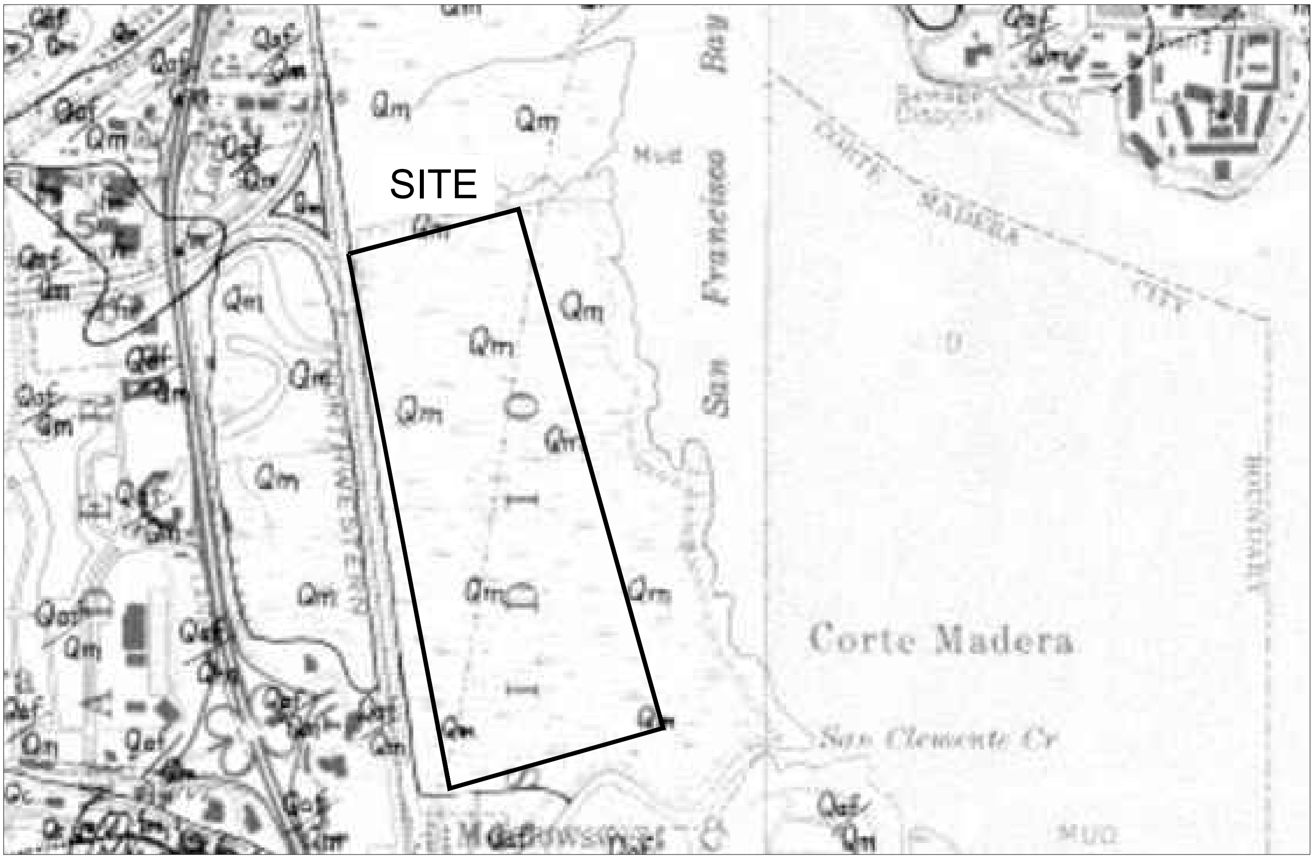
Drawn MMT
Checked

7
FIGURE



REGIONAL GEOLOGIC MAP

(NOT TO SCALE)

LEGEND:

△ Landslide deposits and debris avalanche scars that are too small to be delineated at this scale

Qm Bay Mud - Marshlands, former marshlands, and mudflats bordering San Francisco and San Pablo Bays. Mostly at or below mean sea level; these are thick deposits of unconsolidated, low-density, semi-fluid, highly compressible, highly impermeable silty clay.

Qc Colluvium - Unsorted sands, silts, clays and weathered rock fragments accumulated on or at the base of slopes by natural gravitational or slope wash processes

Headwall scarps of block slump and debris flow landslides, and scarps left at sources of soil and rock debris avalanches.

Slopes exhibiting evidence of continuous or intermittent downslope surface creep.

Debris Flow Landslides. Predominantly deposits of un-consolidated and unsorted soil and rock debris that have moved downslope en masse or in increments by flow or creep processes.

REFERENCE: Rice, S.J., and Smith, T.C., "Geology of the Tiburon Peninsula, Sausalito, and Adjacent Areas" *in* Geology for Planning in Central and Southeastern Marin County, California, California Department of Conservation, Division of Mines and Geology, Map Scale 1:12,000

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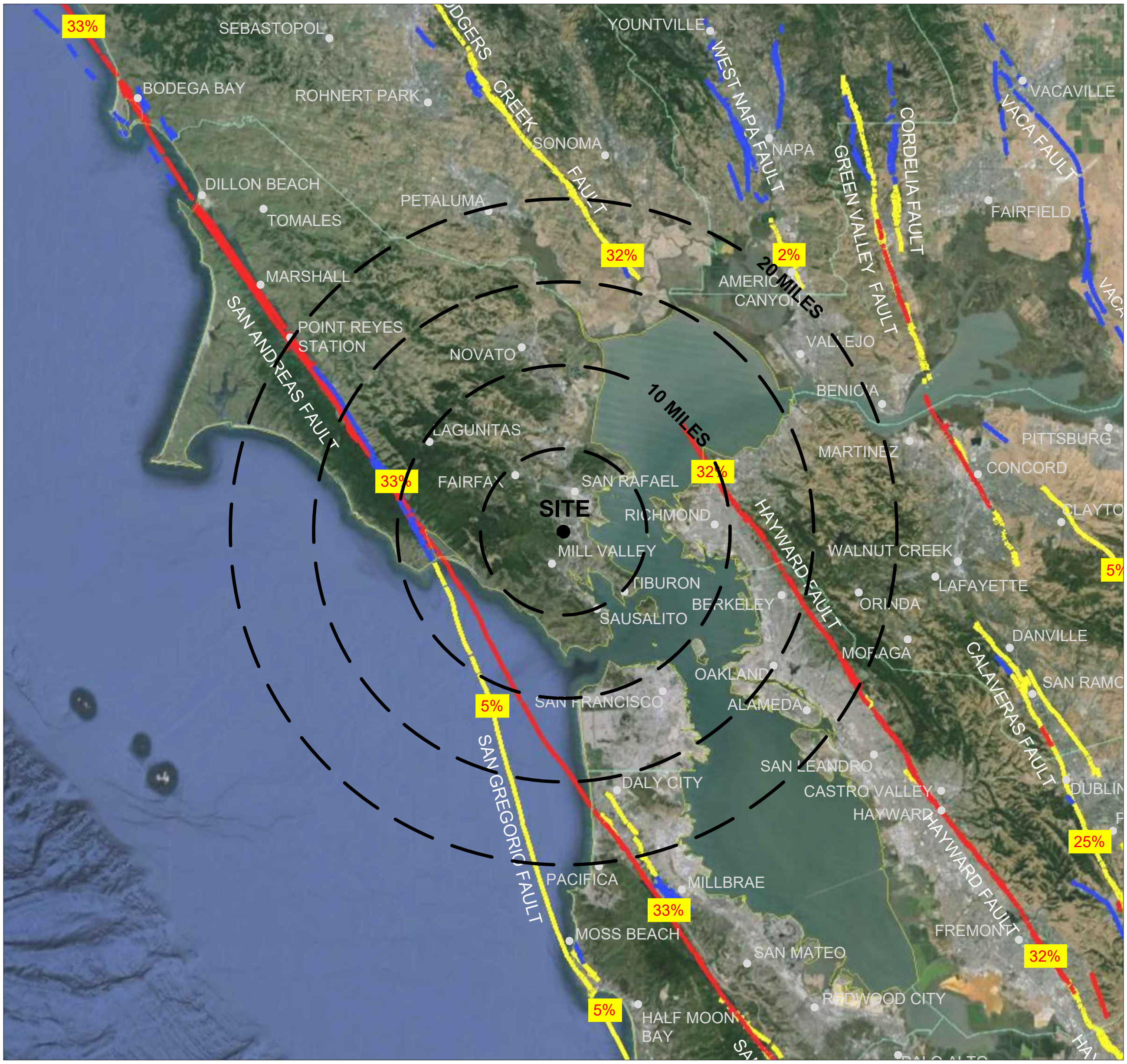
REGIONAL GEOLOGIC MAP

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

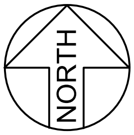
Project No. 1039.051 Date: 8-21-15

Drawn MMT
Checked

8
FIGURE



SITE COORDINATES: LAT. 37.9338, LON. -122.5096



LEGEND

(COLOR INDICATES AGE OF MOST RECENT KNOWN MOVEMENT)

🟥	HISTORIC (<150 YEARS)
🟨	HOLOCENE (<11,000 YEARS)
🟦	LATE QUATERNARY (<1.0M YEARS)
32%	PROBABILITY OF AT LEAST ONE M>6.7 EARTHQUAKE BETWEEN 2015 AND 2045 FOR FAULTS SHOWN

DATA SOURCE:
1) Working Group on California Earthquake Probabilities (WGCEP)(2014), "Long-Term Time-Dependent Probabilitites for the Third Uniform California Earthquake Rupture Forecast (UCERF3), Bulletin of the Seismological Society of America (BSSA), Volume 105, No. 2A, 33pp, April 2015.

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FILE: 1039.051 FM.dwg

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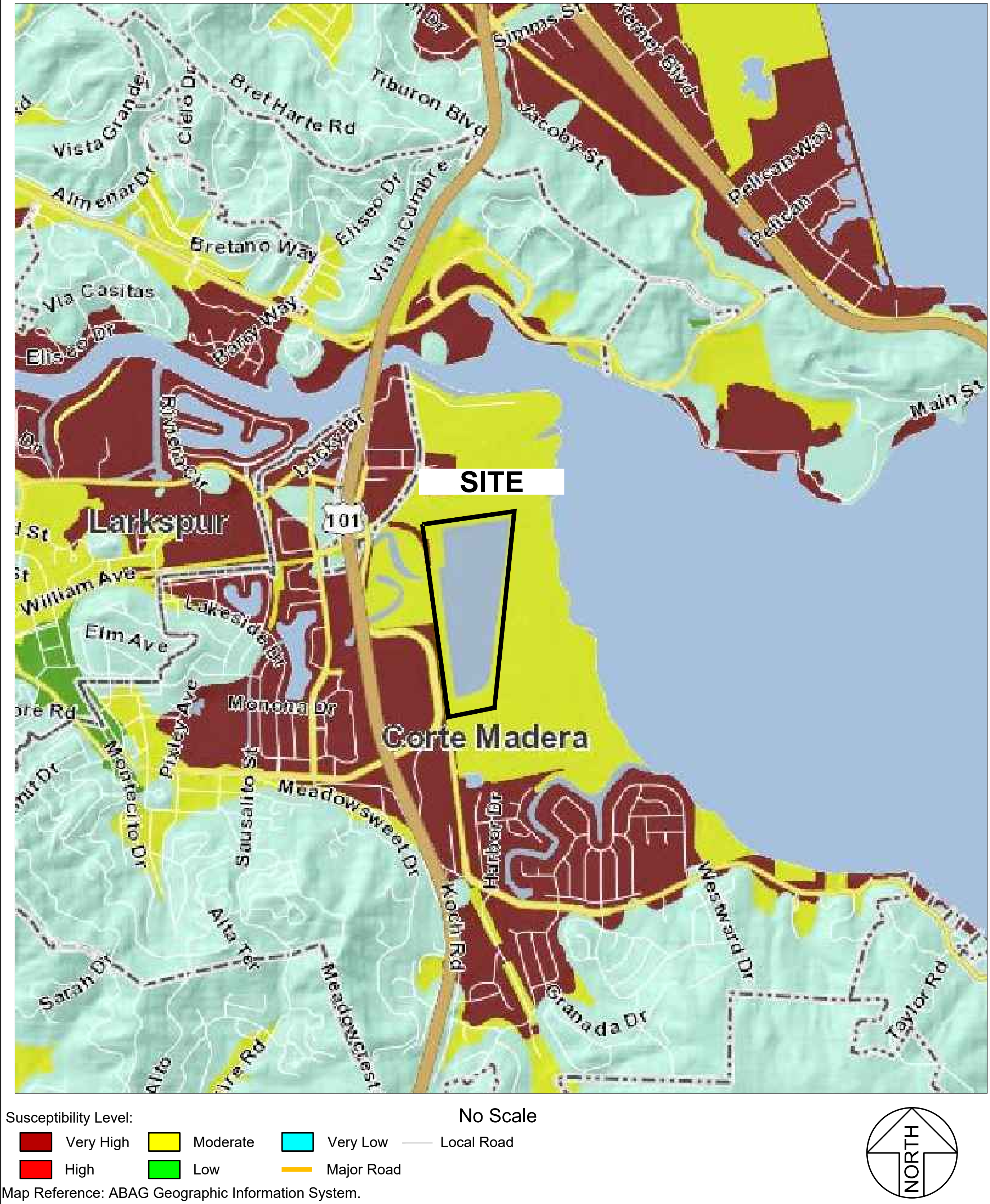
ACTIVE FAULT MAP

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 8-21-15

Drawn MMT
Checked

9
FIGURE



Map Reference: ABAG Geographic Information System.

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LIQUEFACTION SUSCEPTIBILITY MAP

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Project No. 1039.051 Date: 8-27-15

Drawn MMT
Checked

10
FIGURE

FILE: 1039.051 Liq.dwg

Flood Hazard Area:

▨	Zone V- 100yr.	🟦	Zone X - 500yr.
🟦	Zone A - 100yr.	🟧	Urbanized Area

Map Reference: ABAG Geographic Information System.

No Scale

Zone V: This code identifies an area inundated by 1% annual chance flooding with velocity hazard (wave action).

Zone A: This code identifies an area inundated by 1% annual chance flooding.

Zone X 500yr: This code identifies an area inundated by .02% annual chance flooding and area inundated by 1% annual chance of flooding with average depth of less than 1 foot with drainage areas less than 1 square mile or an area protected by levees form 1% annual chance flooding.

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FILE: 1039.051 Flood.dwg

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FEMA DIGITAL FLOOD INSURANCE RATE MAP (DFIRM)

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 8-27-15

Drawn MMT
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11
FIGURE

Tsunami Inundation:

No Scale

🟦 Tsunami Inundation Area

🟧 Urbanized Area

NORTH

Map Reference: ABAG Geographic Information System.

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FILE: 1039.051 Tsunami.dwg

TSUNAMI INUNDATION MAP

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 8-27-15

Drawn MMT
Checked

12
FIGURE

APPENDIX A

SUBSURFACE EXPLORATION

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MAJOR DIVISIONS		SYMBOL	DESCRIPTION
COARSE GRAINED SOILS over 50% sand and gravel	CLEAN GRAVEL	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
	GRAVEL with fines	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	CLEAN SAND	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
	SAND with fines	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS over 50% silt and clay	SILT AND CLAY liquid limit <50%	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	SILT AND CLAY liquid limit >50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT	Peat, muck, and other highly organic soils
ROCK		▨	Undifferentiated as to type or composition

KEY TO BORING AND TEST PIT SYMBOLS

CLASSIFICATION TESTS

PI	PLASTICITY INDEX
LL	LIQUID LIMIT
SA	SIEVE ANALYSIS
HYD	HYDROMETER ANALYSIS
P200	PERCENT PASSING NO. 200 SIEVE
P4	PERCENT PASSING NO. 4 SIEVE

SAMPLER TYPE

▮	MODIFIED CALIFORNIA
▯	STANDARD PENETRATION TEST
▨	THIN-WALLED / FIXED PISTON
⊠	HAND SAMPLER
⊠	ROCK CORE
X	DISTURBED OR BULK SAMPLE

NOTE: Test boring and test pit logs are an interpretation of conditions encountered at the excavation location during the time of exploration. Subsurface rock, soil or water conditions may vary in different locations within the project site and with the passage of time. Boundaries between differing soil or rock descriptions are approximate and may indicate a gradual transition.

STRENGTH TESTS

TV	FIELD TORVANE (UNDRAINED SHEAR)
UC	LABORATORY UNCONFINED COMPRESSION
TXCU	CONSOLIDATED UNDRAINED TRIAXIAL
TXUU	UNCONSOLIDATED UNDRAINED TRIAXIAL
	UC, CU, UU = 1/2 Deviator Stress

SAMPLER DRIVING RESISTANCE

Modified California and Standard Penetration Test samplers are driven 18 inches with a 140-pound hammer falling 30 inches per blow. Blows for the initial 6-inch drive seat the sampler. Blows for the final 12-inch drive are recorded onto the logs. Sampler refusal is defined as 50 blows during a 6-inch drive. Examples of blow records are as follows:

25	sampler driven 12 inches with 25 blows after initial 6-inch drive
85/7"	sampler driven 7 inches with 85 blows after initial 6-inch drive
50/3"	sampler driven 3 inches with 50 blows during initial 6-inch drive or beginning of final 12-inch drive

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SOIL CLASSIFICATION

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 2/2/15

Drawn MMT
Checked

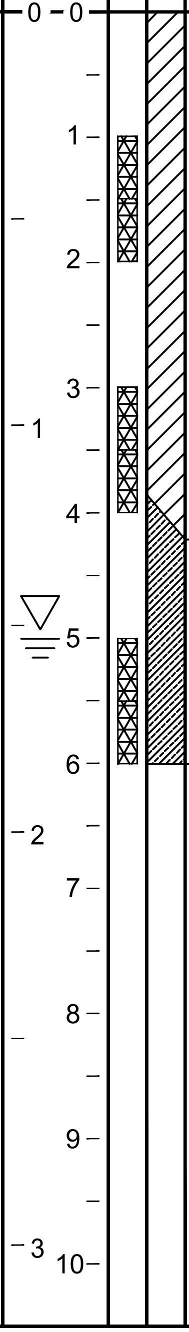
A-1
FIGURE

BORING 1

EQUIPMENT: 3.25 inch manual bucket auger

DATE: 9/14/14
ELEVATION: 9-Feet*
*REFERENCE: Google Earth used for Elevation

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	
						CLAY (CL-MH) Dark brown to gray, moist, soft, medium to high plasticity. [Alluvium/Fill?]
	LL:49 PI:21	550 UC		48.7	69	
						Grades to orange and gray mottling, wet, very soft, medium plasticity.
		440 UC		65.4	60	
						Organic CLAY (OH-MH) Dark gray, saturated, very soft, high organic content, high plasticity clay. [Bay Mud] Grades to black, saturated.
		470 UC		52.0	70	
						Boring terminated at 6.0 feet. Groundwater measured at 5.0 feet upon completion of drilling.



NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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FILE: 1039.051 BL.dwg

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BORING LOG

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13
Project No. 1039.051 Date: 2/2/15

Drawn MMT
Checked

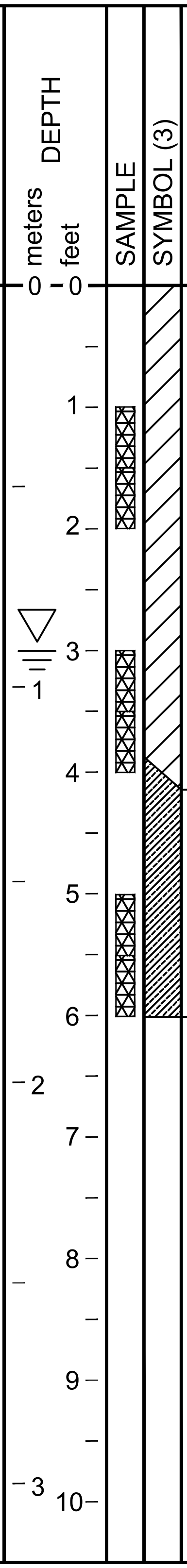
A-2
FIGURE

BORING 2

EQUIPMENT: 3.25 inch manual bucket auger

DATE: 9/14/14
ELEVATION: 7-Feet*
*REFERENCE: Google Earth used for Elevation

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)	
						CLAY (CH) Medium gray mottled orange, moist, very soft to soft, medium plasticity. [Alluvium/Fill?]
		550 UC		47.9	69	
						Grades to saturated.
	LL:79 PI:43	300 UC		44.9	73	
						Grades to dark gray.
						Organic CLAY (OH-MH) Black, saturated, very soft, ~30% organics, high plasticity clay. [Bay Mud]
		180 UC		43.6	62	
						Boring terminated at 6.0 feet. Groundwater measured at 3.0 feet upon completion of drilling.



NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING LOG

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 2/2/15

Drawn MMT
Checked

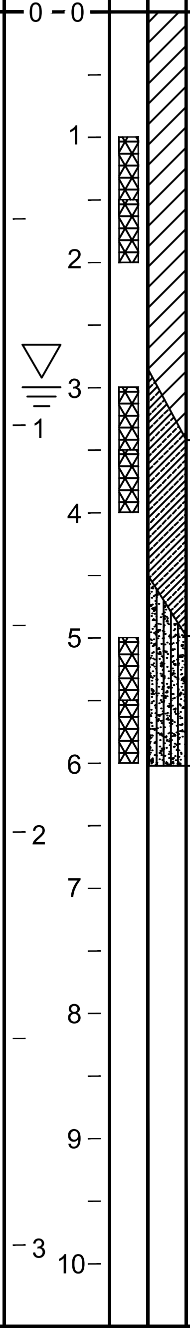
A-3
FIGURE

BORING 3

EQUIPMENT: 3.25 inch manual bucket auger

DATE: 9/14/14
ELEVATION: 7-Feet*
*REFERENCE: Google Earth used for Elevation

OTHER TEST DATA	OTHER TEST DATA	UNDRAINED SHEAR STRENGTH psf (1)	BLOWS PER FOOT	MOISTURE CONTENT (%)	DRY UNIT WEIGHT pcf (2)
		430 UC		17.4	77
		480 UC		37.7	80
	P200 34.7%			38.8	
				35.8	



Silty CLAY (CL)
Medium brown with gray, dry to moist, medium stiff, low to medium plasticity, many organics. [Alluvium/Fill?]

Grades to dark gray, moist to wet, soft, low to medium plasticity. [Alluvium]

Organic CLAY (OH-MH)
Dark gray, moist to wet, soft, low to medium plasticity clay. [Bay Mud Crust]

Silty SAND (SM)
Medium brown, saturated, loose, low to medium plasticity silt. [Alluvium]

Boring terminated at 6.0 feet. Groundwater measured at 3.0 feet upon completion of drilling.

NOTES: (1) METRIC EQUIVALENT STRENGTH (kPa) = 0.0479 x STRENGTH (psf)
(2) METRIC EQUIVALENT DRY UNIT WEIGHT kN/m^3 = 0.1571 x DRY UNIT WEIGHT (pcf)
(3) GRAPHIC SYMBOLS ARE ILLUSTRATIVE ONLY

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BORING LOG

Wetland Restoration Design and Permitting Support Services at Corte Madera Ecological Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 2/2/15

Drawn MMT
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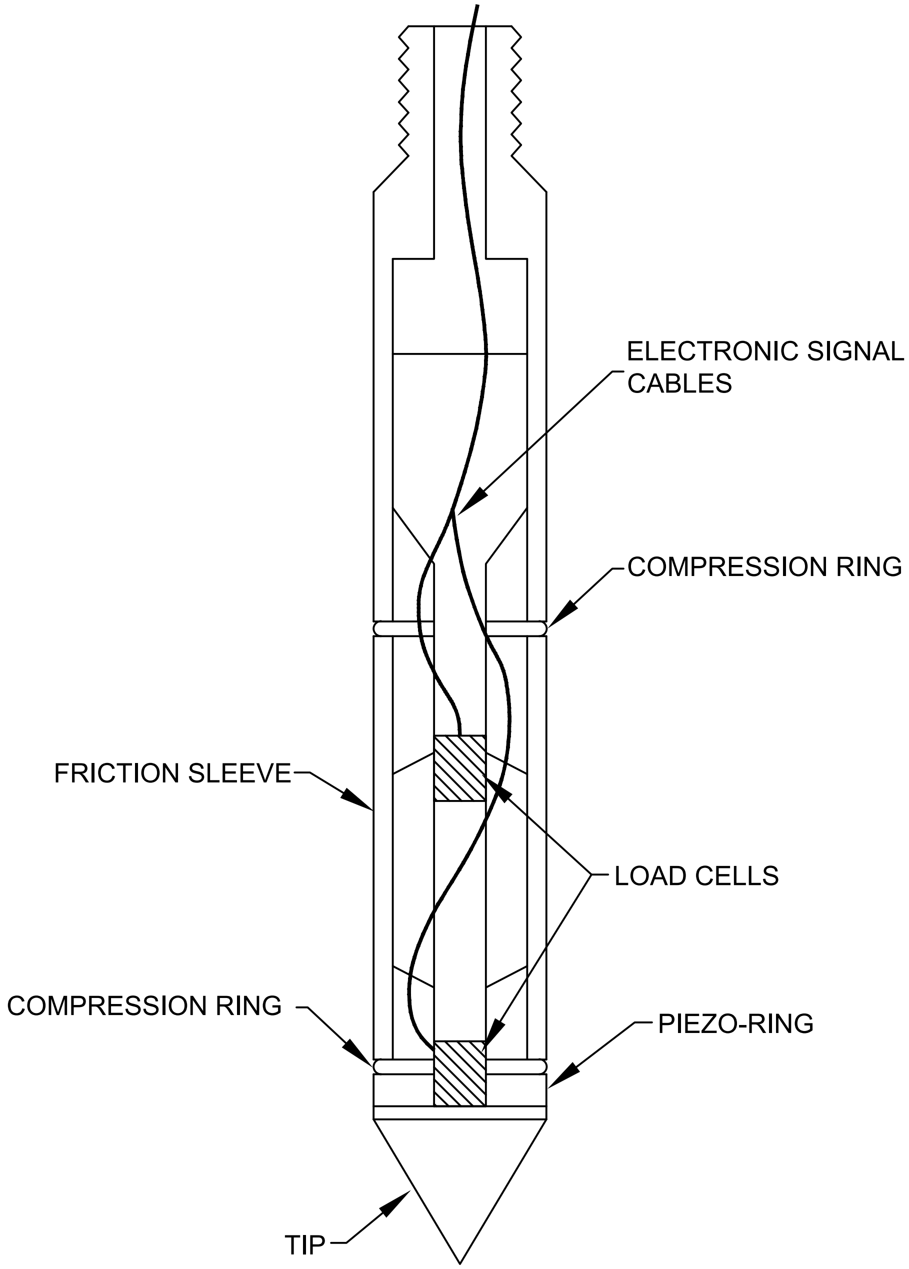
A-4
FIGURE



CONE PENETROMETER

(NO SCALE)

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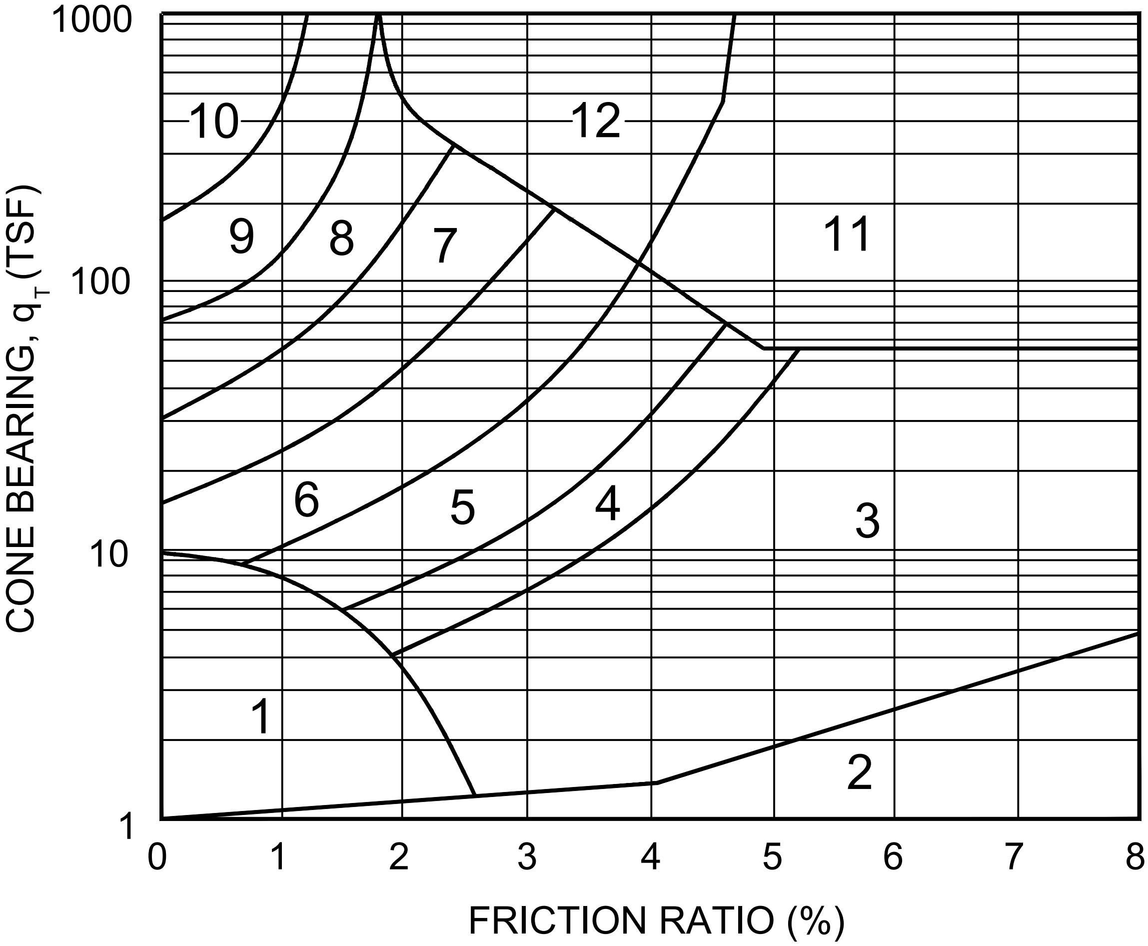
CONE PENETROMETER

Wetland Restoration Design and Permitting
Support Services at Corte Madera Ecological
Reserve, PSA 2014-FT-13

Project No. 1039.051 Date: 2/2/15

Drawn MMT
Checked

A-5
FIGURE



Zone:	Qc/N	Soil Behavior Type:
1)	2	Sensitive Fine Grained
2)	1	Organic Material
3)	1	Clay
4)	1.5	Silty Clay to Clay
5)	2	Clayey Silt to Silty Clay
6)	2.5	Sandy Silt to Clayey Silt
7)	3	Silty Sand to Sandy Silt
8)	4	Sand to Silty Sand
9)	5	Sand
10)	6	Gravelly Sand to Sand
11)	1	Very Stiff Fine Grained (*)
12)	2	Sand to Clayey Sand (*)

(*) Overconsolidated or Cemented

Reference: Robertson, P.K. (1986), "In-Situ Testing and Its Application to Geotechnical Engineering," Canadian Geotechnical Journal, Vol. 23; No. 23; No. 4, pp. 573-594

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CPT SOIL INTERPRETATION CHART

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Project No. 1039.051 Date: 2/2/15

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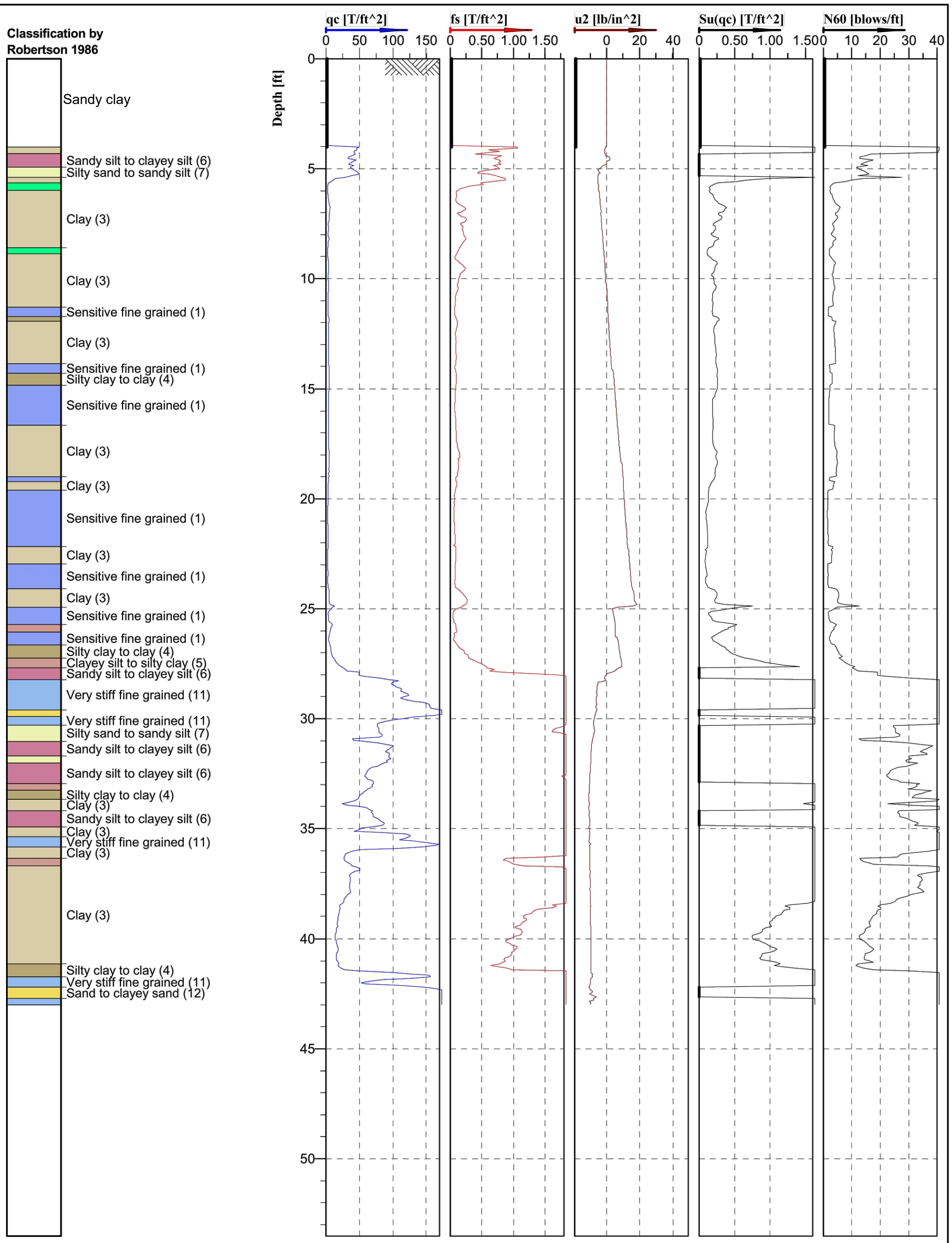
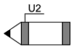
A-6
FIGURE





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Cone No: 4141
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Corte Madera, California	Position:	Ground level:	Test no: CPT-1
Project ID: 1039.051	Client: MPEG	Date: 9/3/2014	Scale: 1 : 75
Project: Corte Madera SF Bay Trail		Page: 1/1	Fig:
		File: CPT-1.cpd	

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CPT-1 DATA PLOT

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Project No. 1039.051 Date: 2/2/15

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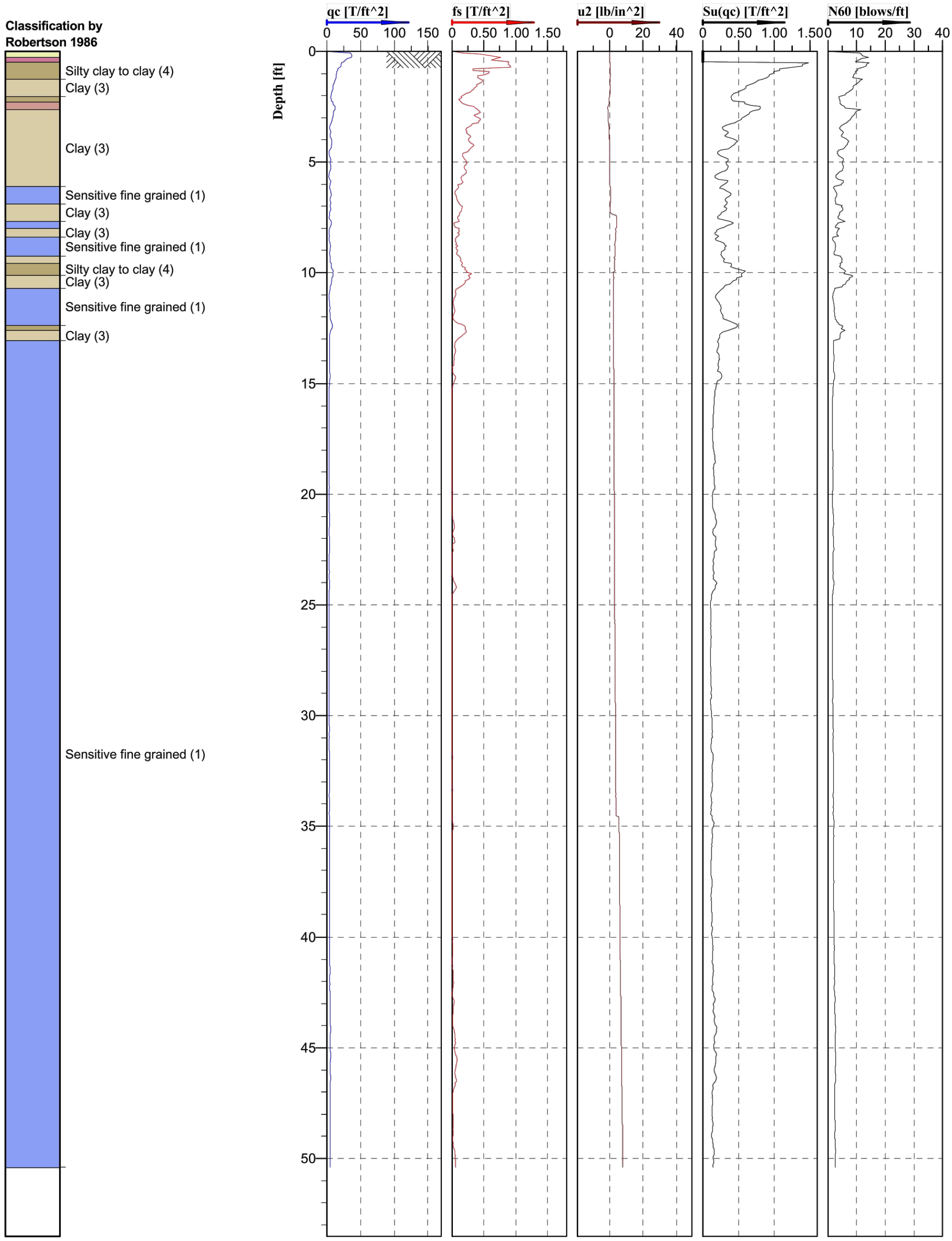
A-7
FIGURE

FILE: 1039.051 CPT.dwg



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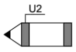

Cone No: 4141
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Corte Madera, California
Position:
Ground level:
Test no: CPT-2
Project ID: 1039.051
Client: MPEG
Date: 9/3/2014
Scale: 1 : 75
Project: Corte Madera SF Bay Trail
Page: 1/1
Fig:
File: CPT-2.cpd

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CPT-2 DATA PLOT

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Project No. 1039.051 Date: 2/2/15

Drawn MMT
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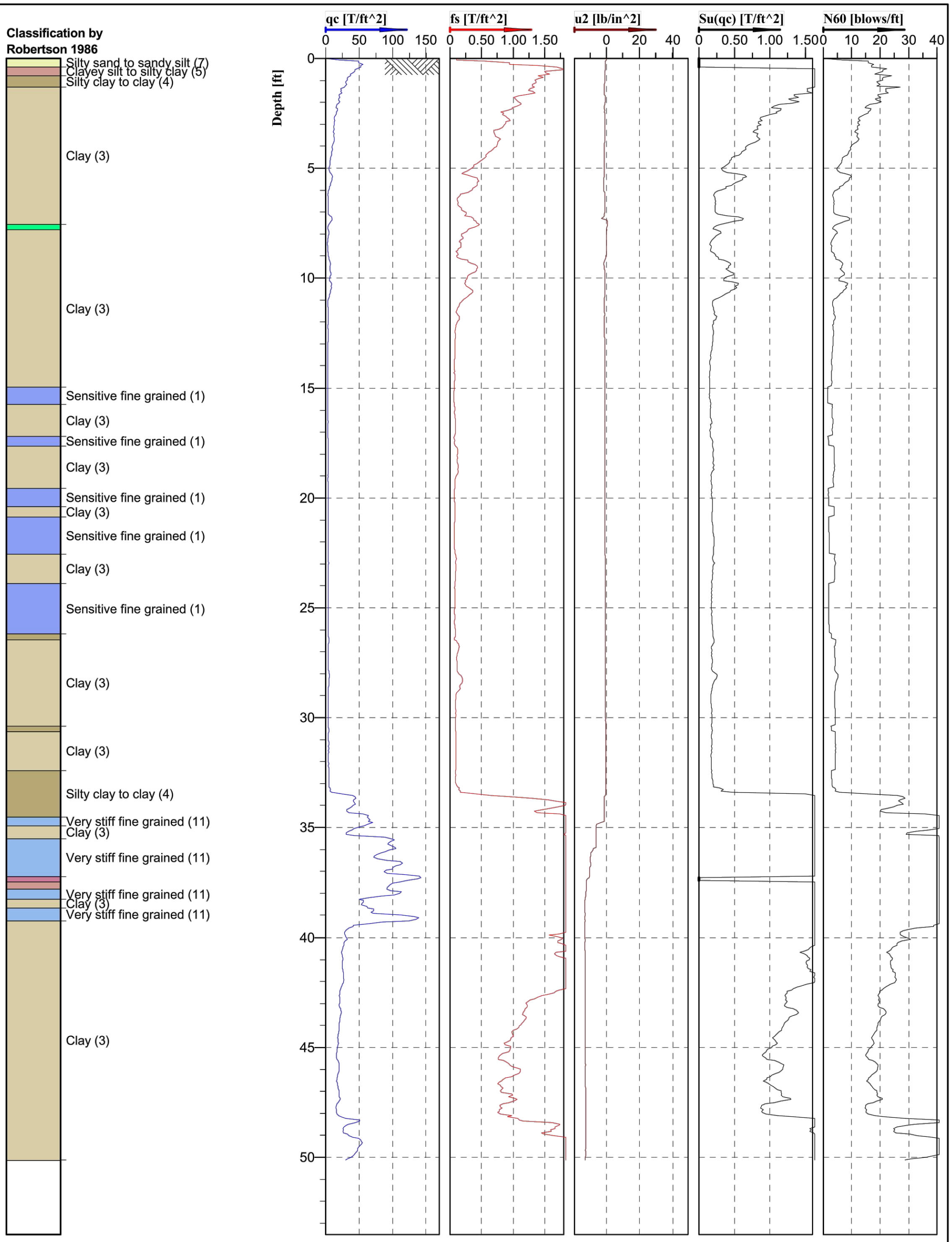
A-8
FIGURE

FILE: 1039.051 CPT.dwg



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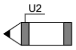

Cone No: 4141
Tip area [cm2]: 10
Sleeve area [cm2]: 150

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Project ID: 1039.051	Client: MPEG	Date: 9/3/2014	Scale: 1 : 75
Project: Corte Madera SF Bay Trail		Page: 1/1	Fig:
		File: CPT-3.cpd	

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CPT-3 DATA PLOT

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Project No. 1039.051 Date: 2/2/15

Drawn MMT
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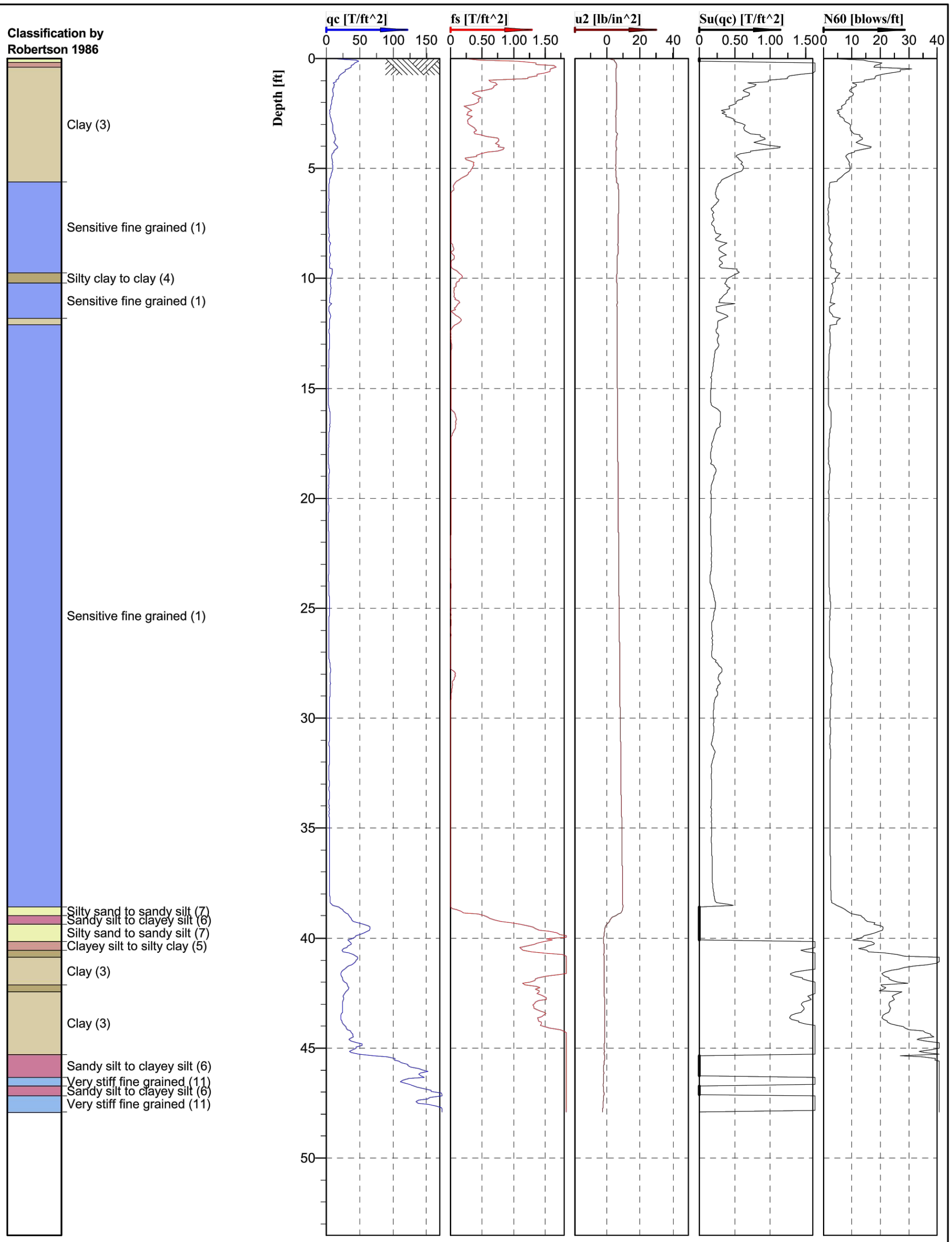
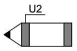
A-9
FIGURE





Cone No: 4141
Tip area [cm2]: 10
Sleeve area [cm2]: 150

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Project ID: 1039.051	Client: MPEG	Date: 9/3/2014	Scale: 1 : 75
Project: Corte Madera SF Bay Trail		Page: 1/1	Fig:
		File: CPT-4.cpd	

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CPT-4 DATA PLOT

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Project No. 1039.051 Date: 2/2/15

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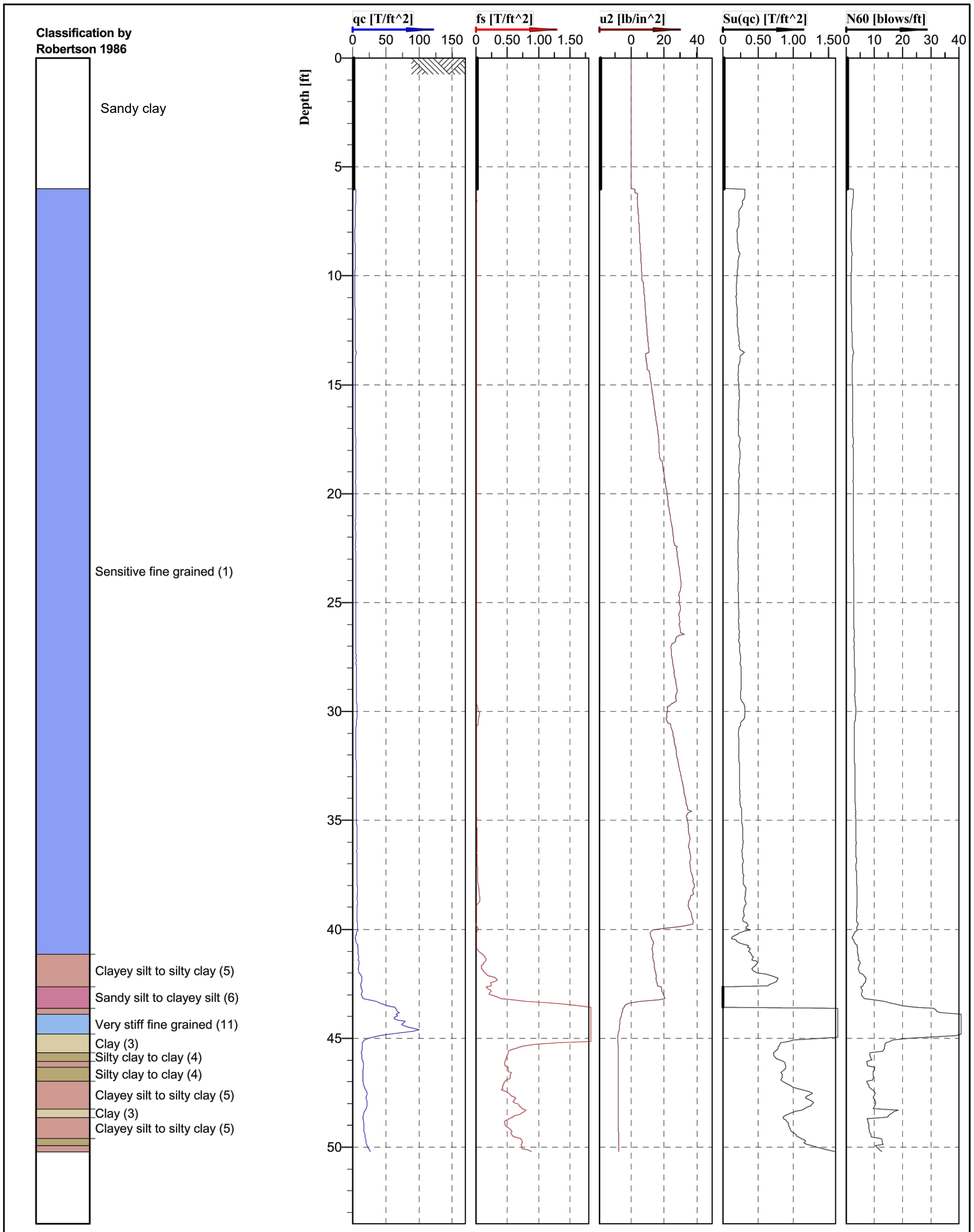
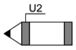
A-10
FIGURE





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Cone No: 4141
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Corte Madera, California	Position:	Ground level:	Test no: CPT-5
Project ID: 1039.051	Client: MPEG	Date: 9/3/2014	Scale: 1 : 75
Project: Corte Madera SF Bay Trail		Page: 1/1	Fig:
		File: CPT-5.cpd	

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CPT-5 DATA PLOT

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Project No. 1039.051 Date: 2/2/15

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A-11
FIGURE