Otay Hills Construction Aggregate and Inert Debris Engineered Fill Operation Project

Appendix C

Geotechnical Report

for the

Public Review Draft Environmental Impact Report

PDS2004-3300-04-004 (MUP);
PDS2004-3310-04-001 (RP);
PDS2010-3813-10-002 (SPA);
Log No. 04-190-04

June 2020

Prepared for:

County of San Diego
Planning & Development Services
5510 Overland Avenue, Suite 310
San Diego, California 92123

CHRISTIAN WHEELER
ENGINEERING

December 4, 2014

Superior Ready Mix Concrete, L.P. CWE 2110171.02R
1508 West Mission Road
Escondido, California 92029

Subject: Revised Report of Supplemental Slope Stability Analyses and Reclamation Fill Settlement, Proposed Otay Hills Quarry, Alta Road and Otay Mesa Road, San Diego County, California.

Dear Ladies and Gentlemen,

In accordance with your request and our Proposal dated March 17, 2011, Christian Wheeler Engineering has prepared this revised report to provide the results of our supplemental slope stability analyses for the subject project. Our supplemental analyses addressed the proposed Phase 2A, 2B, and 2C cut (extraction) slopes, the proposed Phases 3A, 3B, 3C, and 3D cut (extraction) slopes, the proposed Phases 4B, 4C, and 4D fill (reclamation) slopes, and the final (post reclamation) project cut and fill slopes. Full descriptions of the site's physical and geologic conditions as well as the scope of the proposed quarry project have been provided in our referenced Report of Geologic Reconnaissance (CWE, 2011).

SUPPLEMETNAL STABILITY ANALYSES: As described in our referenced report (CWE, 2011), "Global stability of steep rock slopes, such as those proposed for the quarry operation, depends on several factors such as type of rock, rock strength, orientation of fractures or other planes of weakness, and slope angles. In quarry operations with steep, high slopes, factors of safety typically range from approximately 1.2 to greater than 1.5. The previous slope stability analysis of the site performed by Testing Engineers in 2005 indicated that the proposed cut slopes should be adequately stable to the proposed heights for slopes as steep as 1:1 (horizontal to vertical), and possibly as steep as 0.5:1. Based on our review of those calculations, as well as our review of other available data pertaining to the stability of rock slopes in quarry operations, it is our opinion that the previous slope stability analysis by Testing Engineers adequately addresses the stability of the proposed cut slopes."

Our initial supplemental analyses performed in the preparation of this report included rock slope stability analyses (modelling planar and wedge failures) of the steepest of the proposed extraction (cut) slopes during Phases 2A, 2B, 2C, 3A, 3B, 3C, and 3D of the project utilizing the referenced Rockpack III © software prepared by C.F. Watts & Associates. Analyses of the extraction slopes that will remain as part of the project after the completion of the Phase 4E reclamation phase were also conducted. The findings presented herein are based on the assumption that the geologic conditions at the site, including rock type, rock strength, and degree and pattern of fracturing, are similar to those described in the Geotechnical Evaluation Report, Proposed Otay Hills Quarry prepared by Testing Engineers in September 2005.

The following Table I presents the results (factors-of-safety against failure) of our static and pseudo-static rock slope analyses for the extraction slopes proposed for this project as well as the final cut slopes to remain upon completion of Phase 4E (completion of reclamation). It should be noted that within Phase 2 of the project the interim and side quarry slopes will be approximately 1:1 (H:V) and during Phase 3 the interim extraction slopes will be approximately 1:1 (H:V) while the side quarry slopes will be cut at inclinations of 0.5:1 (H:V). Our analyses of the Phase 3 slopes focused on the steeper, side quarry slopes.

TABLE I – EXTRACTION & FINAL CUT SLOPES

Phase	Description of Extraction Slope	Static F.O.S.	Pseudo-Static F.O.S.
2A	175' high @ 1:1 (H:V) inclination	4.1	3.2
2B	175' high @ 1:1 (H:V) inclination	4.1	3.2
2C	165' high @ 1:1 (H:V) inclination	4.3	3.4
3A	260' high @ 0.5:1 (H:V) inclination with 1:1 cut above	2.4	2.1
3B	525' high @ 0.5:1 (H:V) inclination with 1:1 cut above	1.4	1.2
3C	525' high @ 0.5:1 (H:V) inclination with 1:1 cut above	1.4	1.2
3D	500' high @ 0.5:1 (H:V) inclination with 1:1 cut above	1.5	1.2
Final Cut Slopes	200' high @ 1:1 (H:V) inclination	4.7	3.7

The results of our rock slope stability analyses indicate that the steepest of the proposed extraction slopes will demonstrate minimum factors-of-safety against static and pseudo-static failure in excess of the minimum County requirements for temporary slopes of 1.3 and 1.1, respectively. Based on these results along with the nature of the material at the site, it is our opinion that the risk of significant, deep-seated slope instability in the native materials at the site can be considered to be low. It should be noted localized areas of potentially unstable slopes might be present where intersecting fractures or other planes of weakness are exposed in steep cut slopes. The potential for such unforeseen areas of potentially unstable conditions could be mitigated during site extraction with recommendations presented by a qualified engineer that would be based on site observations by a qualified geologist.

Furthermore, the final cut slopes will demonstrate minimum factors-of-safety against static and pseudo-static failure in excess of the minimum County requirements for final or permanent slopes of 1.5 and 1.1, respectively. The final cut slopes are anticipated to be stable and should not endanger public or private property or result in the deposition of debris on any public way or interfere with any existing drainage courses. The need for rock fall or debris barriers or fences along final cut slopes should be addressed by a qualified engineer at the completion of site reclamation.

We have also performed supplemental slope stability analyses of the proposed fill slopes associated with the Phase 4 reclamation operations at the site. As described in our previous report, the site will be used as an Inert Debris Engineered Fill (landfill). The material placed in the Inert Debris Engineered Fill will be imported to the site over a space of approximately 90 to 95 years and will consist of a variety of materials (CWE, 2011). The results of the reclamation slope stability analyses herein are based on the assumption that the fill materials will have strength parameters similar to those described in our previous report (CWE, 2011). The following Table II presents the results of our analyses for the proposed fill slopes (reclamation and final) proposed for this project. As necessary, the inclinations of the temporary reclamation slopes were adjusted in our analyses in order to allow the proposed fill slopes to demonstrate minimum factors-of-safety against failure under static and pseudo-static conditions of 1.3 and 1.1, respectively, which are the minimums required by the County.

TABLE II –FILL SLOPES (RECLAMATION & FINAL)

Phase	Slope Description	Static F.O.S.	Pseudo-Static F.O.S.	Required Slope Inclination (max)
4A	285' high @ 2.1:1 (H:V)	1.3	1.0 (inadequate)	**2.25:1**
4A	285' high @ 2.25:1 (H:V)	-	1.1	
4B & 4C	550' high @ 2.5:1 (H:V)	1.4	1.0 (inadequate)	**2.6:1**
4B & 4c	550' high @ 2.6:1 (H:V)	-	1.1	
4D	450' high @ 2.2:1 (H:V)	1.3	1.0 (inadequate)	**2.5:1**
4D	450' high @ 2.5:1 (H:V)	-	1.1	
Final 4D/E	70' high @ 2.0:1	1.5	1.1	**As steep as 2:1**

As demonstrated by the results of our reclamation slope stability analyses (included in Appendix A at the rear of this report), in order to demonstrate minimum factors-of-safety of 1.1 against pseudo-static, temporary slope failure, the temporary Phase 4A reclamation slope will need to be flattened to an inclination of 2.25:1 (H:V), the Phase 4B and 4C slopes will need to be flattened to inclinations of 2.6:1 (H:V), and the Phase 4D reclamation slope will need to be constructed at a 2.5:1 (H:V) inclination.

It should be noted that although the results of our pseudo-static analyses demonstrate that the proposed 450-foot-high 4D reclamation slope will need to constructed at a maximum inclination of 2.5:1 (H:V) in order to demonstrate adequate temporary stability, upon completion of Phase 4E, the proposed 70-foot-high fill slope that will remain could be steepened to 2.0:1 (H:V) and still demonstrate adequate stability.

Included in Appendix B of this report are the results of our surficial stability analysis of the final fill slope (following Phase 4E) that could be constructed as steeply as 2:1 (H:V). This analysis demonstrates that the proposed final fill slope will demonstrate a factor-of-safety against surficial failures of 1.5, which is the minimum that is generally considered to be stable.

From a geotechnical standpoint, the inclusion of drainage terraces on the final cut and fill slopes is not considered necessary as such terraces will not adversely affect or significantly improve the stabilities of the proposed slopes.

RECLAMATION FILL SETTLEMENT: As described on page 6 of our referenced report, "some settlement of the fill will occur. The amount of settlement is expected to range from approximately two percent to approximately five percent. The amount of settlement will depend on a variety of factors such as the type of material used in the fill, the degree of compaction of the fill, and the thickness of the fill. The deeper portions of the fill will probably experience greater settlement than the upper portions of the fill, due in part to the increased weight of the overlying fill. It is recommended that settlement monuments be installed and the potential fill settlement be evaluated by qualified personnel as the backfilling operations approach proposed finish grade elevations" (CWE, 2011). Although difficult to quantitatively predict given the potential variability in the factors described above, for planning purposes we expect that primary settlement of the deeper fill areas will occur from the beginning of reclamation and likely continue over several years. Secondary settlement of the fills may likely continue for a few decades after the completion of reclamation. As such, the placement and periodic monitoring of settlement monuments will be necessary to assist in future development of the site.

If you have any questions after reviewing this report, please do not hesitate to contact this office. This opportunity to be of professional service is sincerely appreciated.

Respectfully submitted,
CHRISTIAN WHEELER ENGINEERING

REGISTERED GEOLOGIST
DAVID R. RUSSELL
No. 2215
CERTIFIED
ENGINEERING
GEOLOGIST
Exp. 09-15
STATE OF CALIFORNIA

David R. Russell, CEG 2215

Daniel B. Adler, RCE 36037

cc: (2) Submitted
(4) EnviroMine Inc., 3511 Camino del Rio South, Suite 403, San Diego, CA 92108
(1) via email: travisj@enviromineinc.com

REGISTERED PROFESSIONAL ENGINEER
DANIEL B. ADLER
No. 36037
Exp. 06-30-16
CIVIL
STATE OF CALIFORNIA

REFERENCES

California Division of Mines and Geology, 1997, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117.

C.F. Watts & Associates, 2003, Rockpack III © for Windows.

Christian Wheeler Engineering, 2011, Report of Geologic Reconnaissance and Slope Stability Analysis, Proposed Otay Hills Quarry, Alta Road and Otay Mesa Road, San Diego County, California, CWE Report No. 2110171.01, dated October 6, 2011.

Eberhardt, Erik, 2003, Rock Slope Stability Analysis, Utilization of Advanced Numerical Techniques.

EnviroMine, Inc., 2010, Project Description for the Otay Hills Project, dated October 2010.

Geotechnics Incorporated, 2010, Feasibility of Restoration Backfill, Proposed Otay Hills Quarry, San Diego County, California Project No. 0695-006-00, Document No. 10-0387R, dated July 2, 2010.

Hoek, E. and Bray, J.W., 1974, Rock Slope Engineering.

Jennings, C.W., 1975, Fault Map of California, California Division of Mines and Geology, Map No. 1; Scale 1:750,000.

Testing Engineers, 2005, Geotechnical Evaluation Report, Proposed Otay Hills Quarry, Contract No. 85012, dated September 28, 2005.

United States Geological Survey 2004, Geologic Map of the El Cajon 30’ X 60’ Quadrangle, California, Open-File Report 2004-1361; compiled by Victoria R. Todd.

PLANS AND TOPOGRAPHIC MAPS

Chang Consultants, 2011, Plot Plan for Otay Hills, 2 Sheets; Scale: 1 inch = 200 feet, print date May 5, 2013.

Chang Consultants, 2011, Reclamation Plan for Otay Hills, 3 Sheets; Scale: 1 inch = 200 feet, print date May 5, 2013.

County of San Diego, 1963, Topographic Map Sheet 242-1791; Scale: 1 inch = 200 feet

County of San Diego, 1963, Topographic Map Sheet 242-1797; Scale: 1 inch = 200 feet

County of San Diego, 1963, Topographic Map Sheet 246-1791; Scale: 1 inch = 200 feet

County of San Diego, 1963, Topographic Map Sheet 246-1797; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 242-1791; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 242-1797; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 246-1791; Scale: 1 inch = 200 feet

County of San Diego, 1983, Ortho-Topographic Map Sheet 246-1797; Scale: 1 inch = 200 feet

United States Geological Survey, 1975, Otay Mesa Quadrangle; Scale 1 inch = 2000 feet

PHOTOGRAPHS

San Diego County, 1928, Flight 78A and 78B; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1953, Flight 3M, Photographs 23, 24, and 25, Scale: 1 inch = 1700 feet (approximate)

San Diego County, 1953, Flight 3M, Photographs 23, 24, and 25, Scale: 1 inch = 1700 feet (approximate)

San Diego County, 1960, Flight 14, Photographs 24 and 25; Scale: 1 inch = 1000 feet (approximate)

San Diego County, 1968, Flight 3JJ, Photographs 41 and 42; Scale: 1 inch= 1000 feet (approximate)

San Diego County, 1970, Flight 13, Photographs 1, 2, and 3; Scale: 1 inch= 2000 feet (approximate)

San Diego County, 1973, Flight 14, Photographs 1, 2, and 3; Scale: 1 inch= 1000 feet (approximate)

San Diego County, 1978, Flight 34D, Photographs 32, 33, and 34; Scale: 1 inch= 1000 feet (approximate)

San Diego County, 1983, Photographs 133 and 134; Scale: 1 inch= 2000 feet (approximate)

San Diego County, 1989, Photograph 18-45; Scale: 1 inch= 2640 feet (approximate)

Appendix A

Plots of Global Fill Slope (Reclamation and Final)

Stability Analyses

Otay Hills Quarry - RECLAMATION Phase 4A - 285 High (2.1:1)

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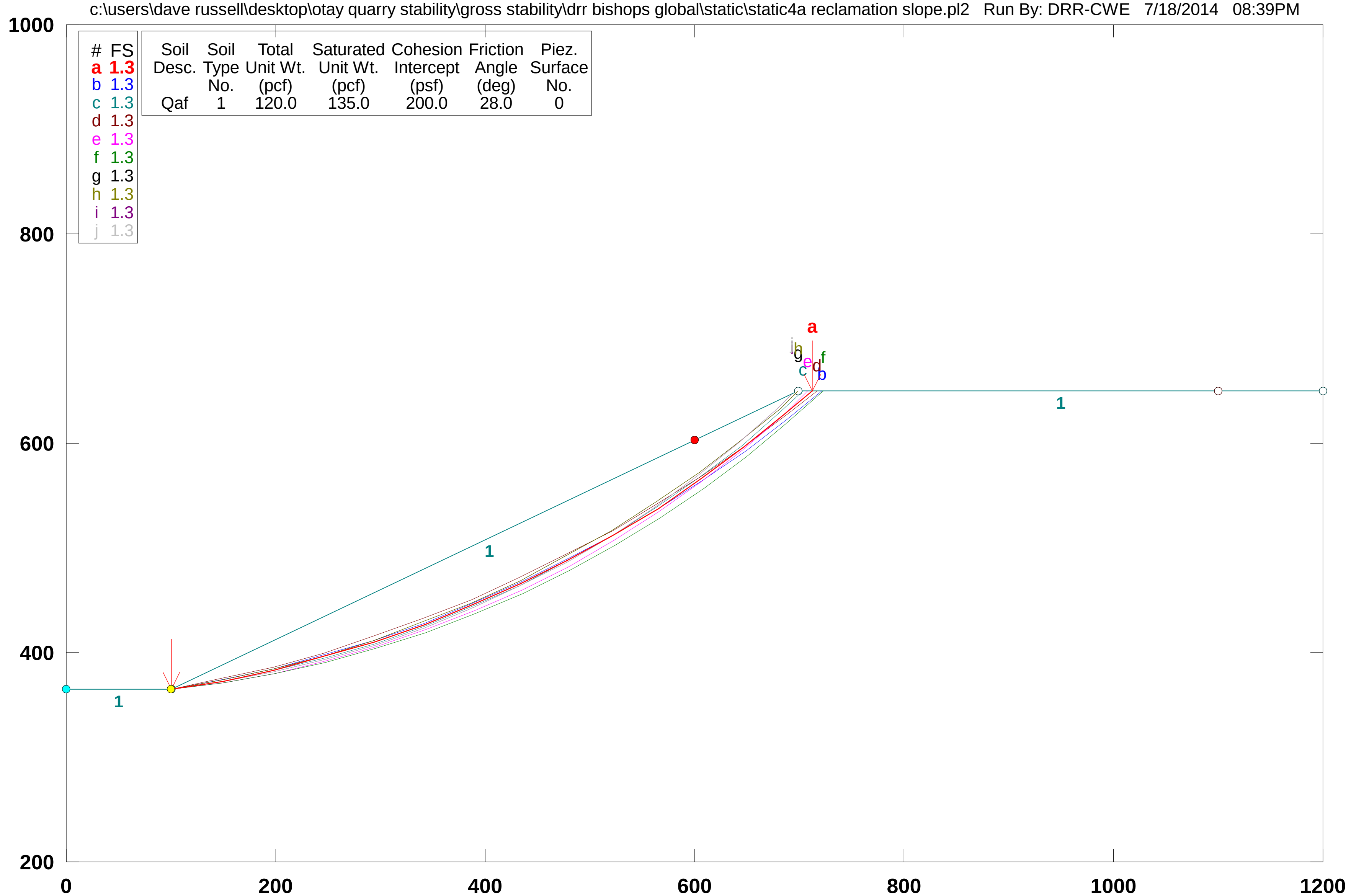

GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

CHRISTIAN WHEELER ENGINEERING

Otay Hills Quarry - RECLAMATION Phases 4B & 4C - 550' High (2.5:1)

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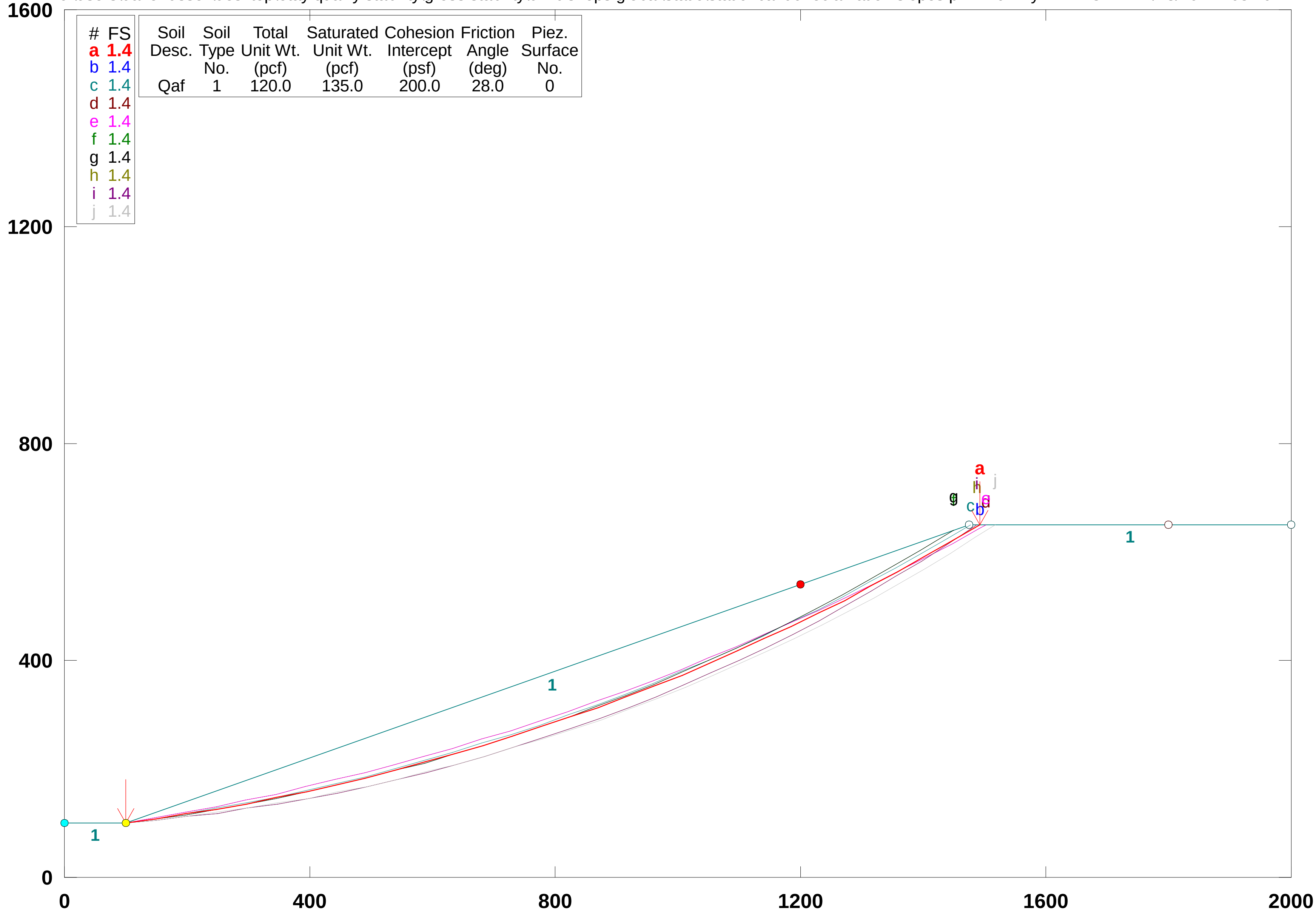

GSTABL7 v.2 FSmin=1.4

Safety Factors Are Calculated By The Modified Bishop Method

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ENGINEERING

Otay Hills Quarry - RECLAMATION Phase 4D - 450' High (2.2:1 UNIFORM)

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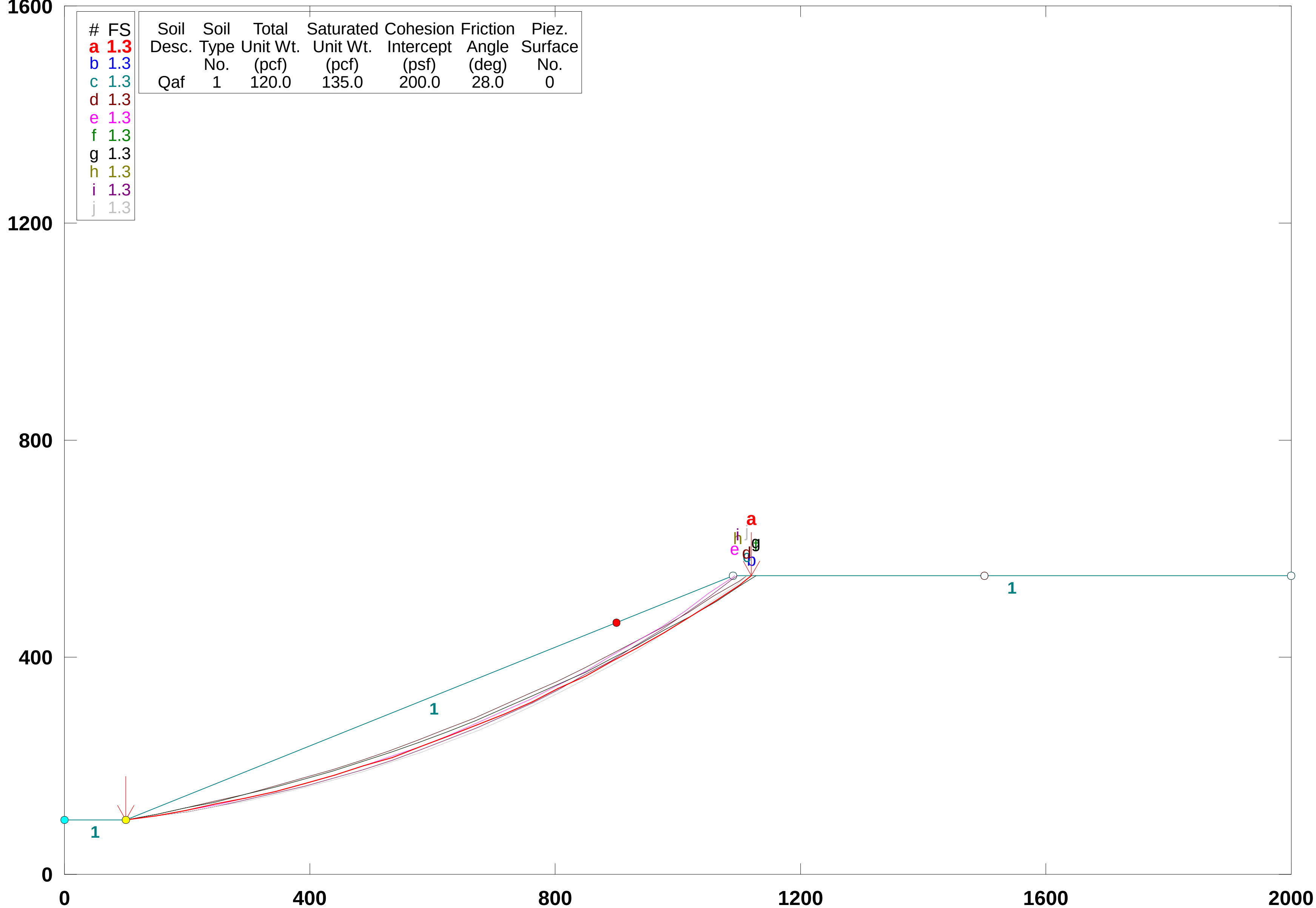

GSTABL7 v.2 FSmin=1.3

Safety Factors Are Calculated By The Modified Bishop Method

CHRISTIAN WHEELER
ENGINEERING

Otay Hills Quarry - RECLAMATION Phase 4A - 285 High (2.1:1)

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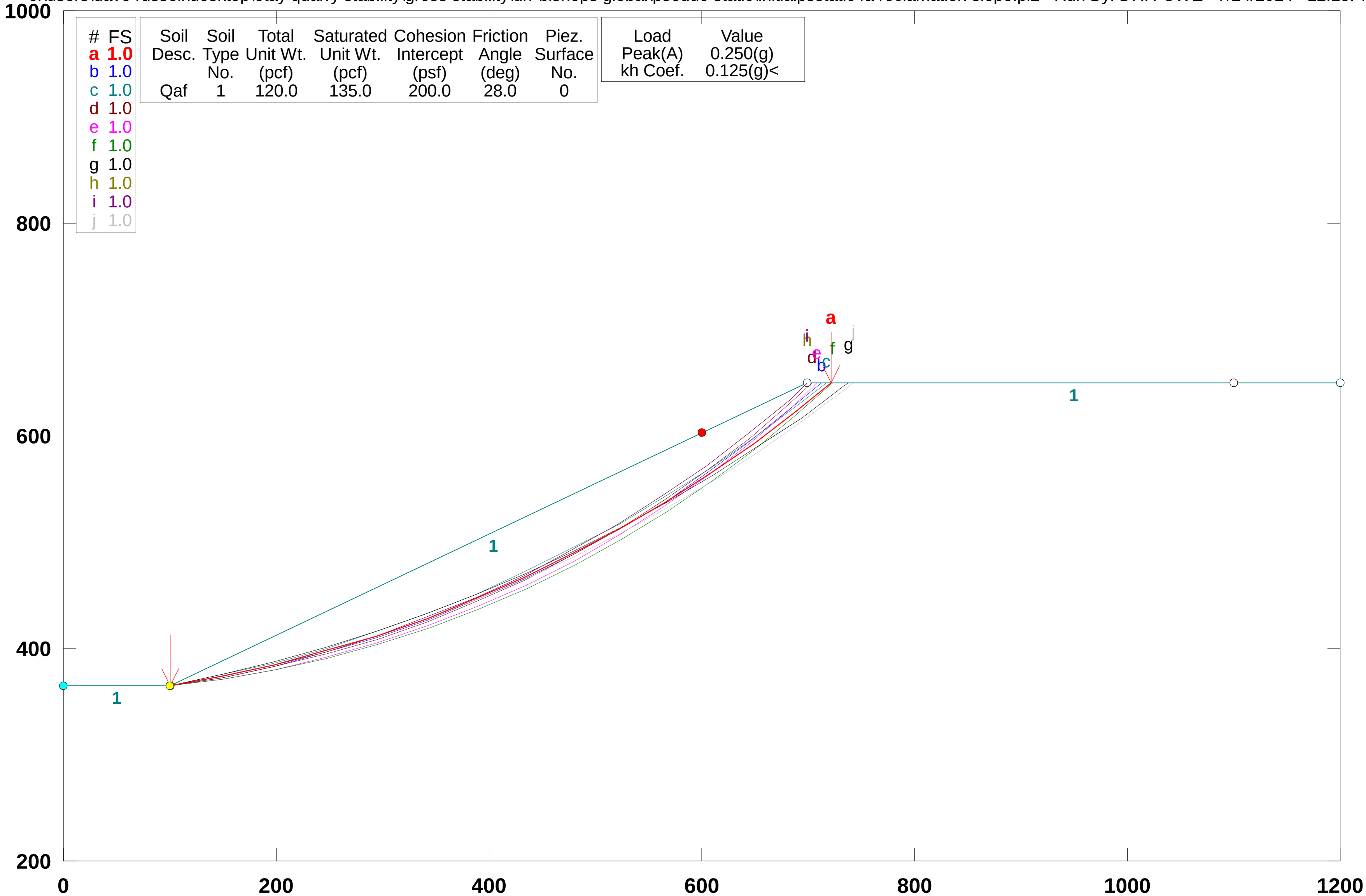

GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Otay Hills Quarry - RECLAMATION Phase 4A - 285 High (2.25:1) PS

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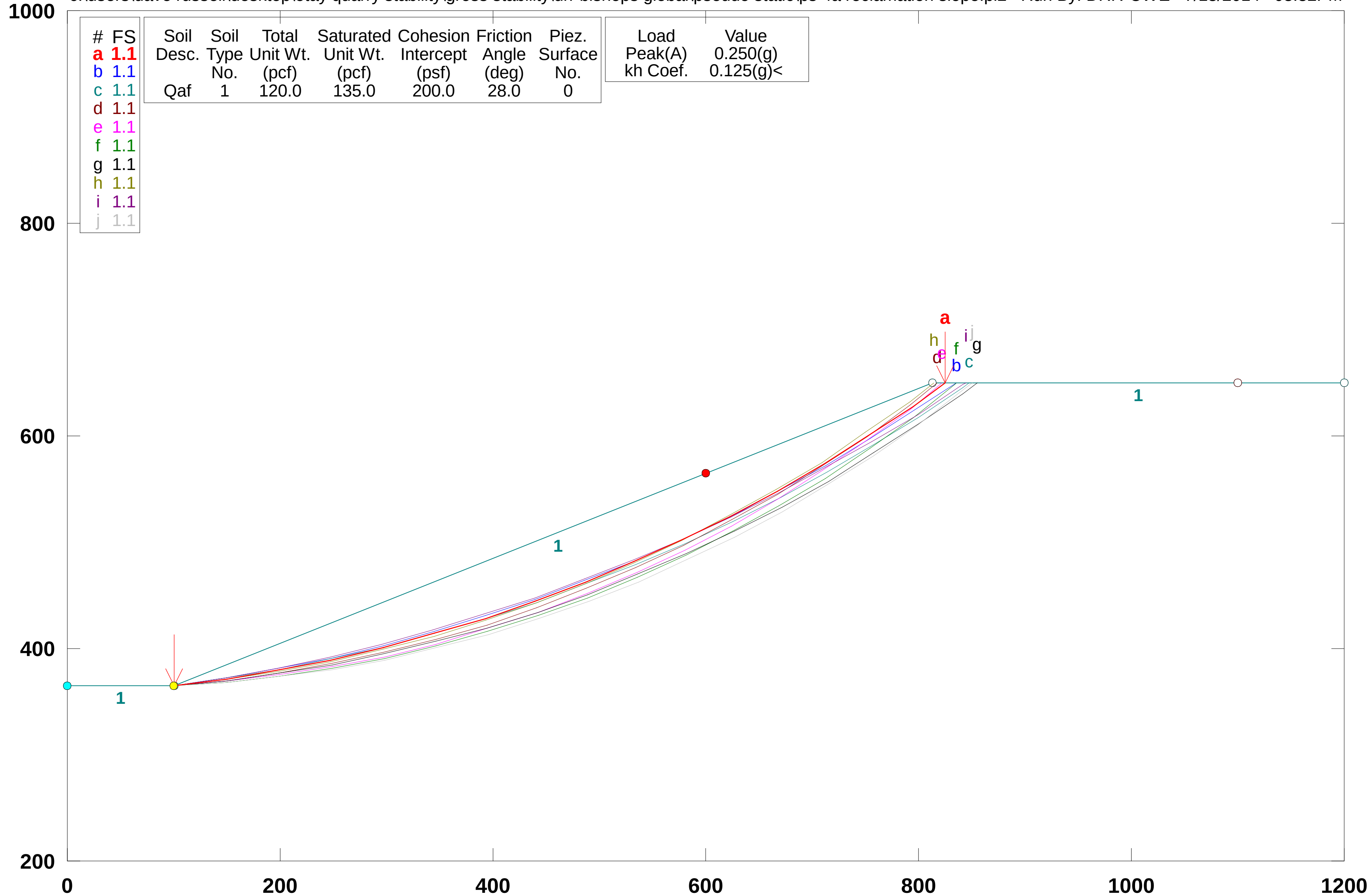

#	FS
a	1.1
b	1.1
c	1.1
d	1.1
e	1.1
f	1.1
g	1.1
h	1.1
i	1.1
j	1.1

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Qaf	1	120.0	135.0	200.0	28.0	0

Load	Value
Peak(A)	0.250(g)
kh Coef.	0.125(g)<

GSTABL7 v.2 FSmin=1.1

Safety Factors Are Calculated By The Modified Bishop Method

CHRISTIAN WHEELER ENGINEERING

Otay Hills Quarry - RECLAMATION Phases 4B & 4C - 550' High (2.5:1)

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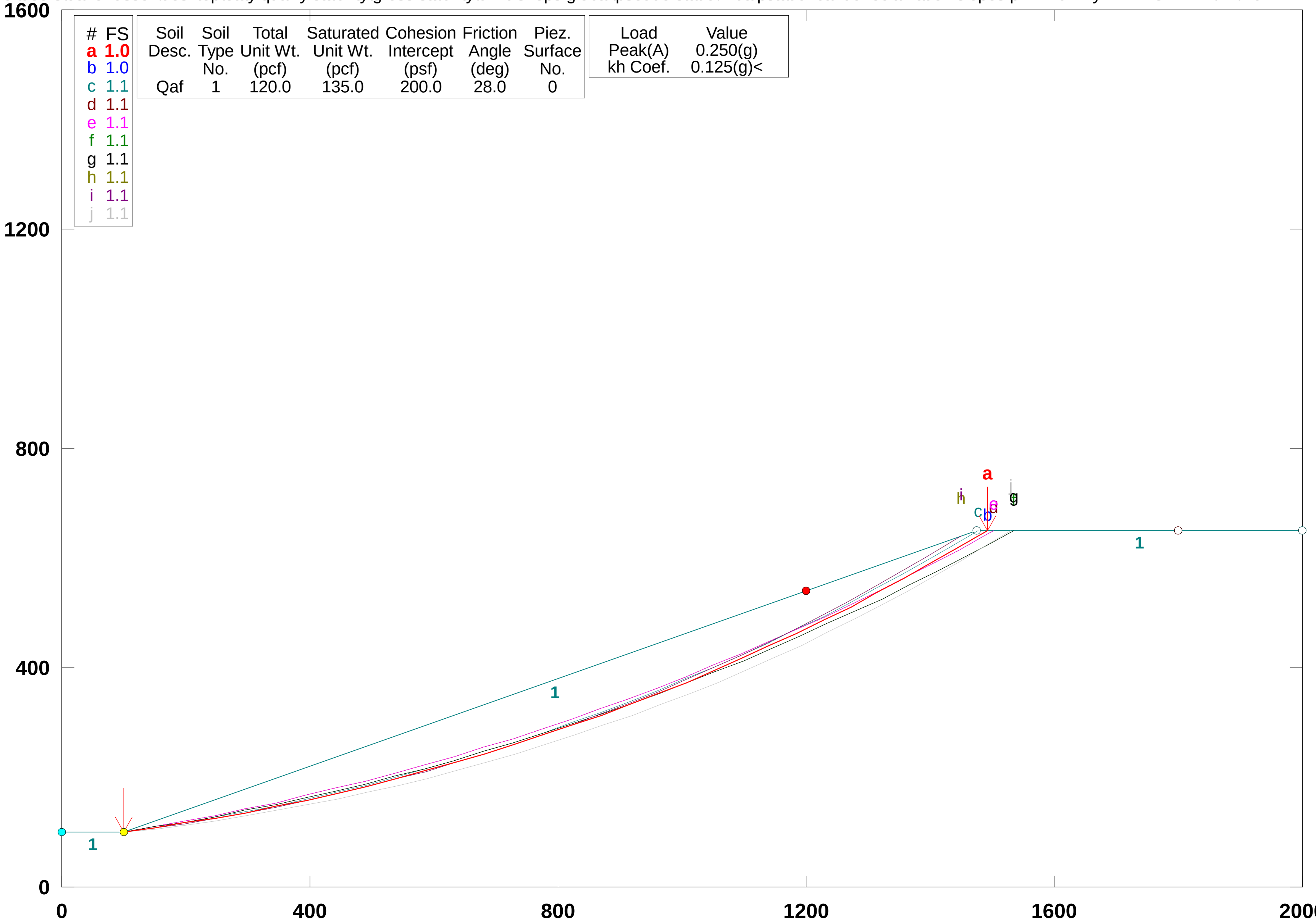

GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Otay Hills Quarry - RECLAMATION Phases 4B & 4C - 550' High (2.6:1)

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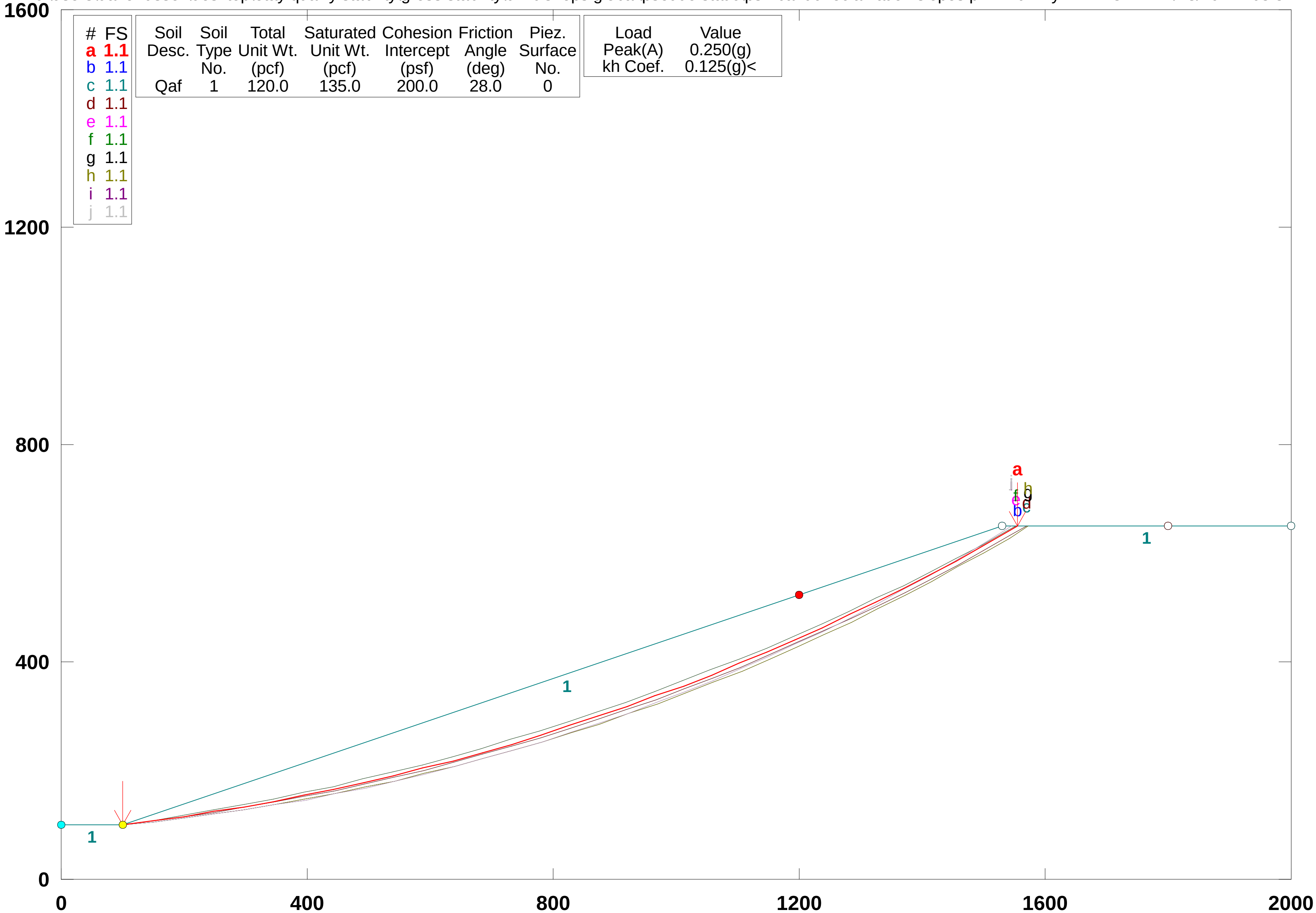

#	FS
a	1.1
b	1.1
c	1.1
d	1.1
e	1.1
f	1.1
g	1.1
h	1.1
i	1.1
j	1.1

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Piez. Surface No.
Qaf	1	120.0	135.0	200.0	28.0	0

Load	Value
Peak(A)	0.250(g)
kh Coef.	0.125(g)<

GSTABL7 v.2 FSmin=1.1

Safety Factors Are Calculated By The Modified Bishop Method

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Otay Hills Quarry - RECLAMATION Phase 4D - 450' High (2.2:1 UNIFORM)

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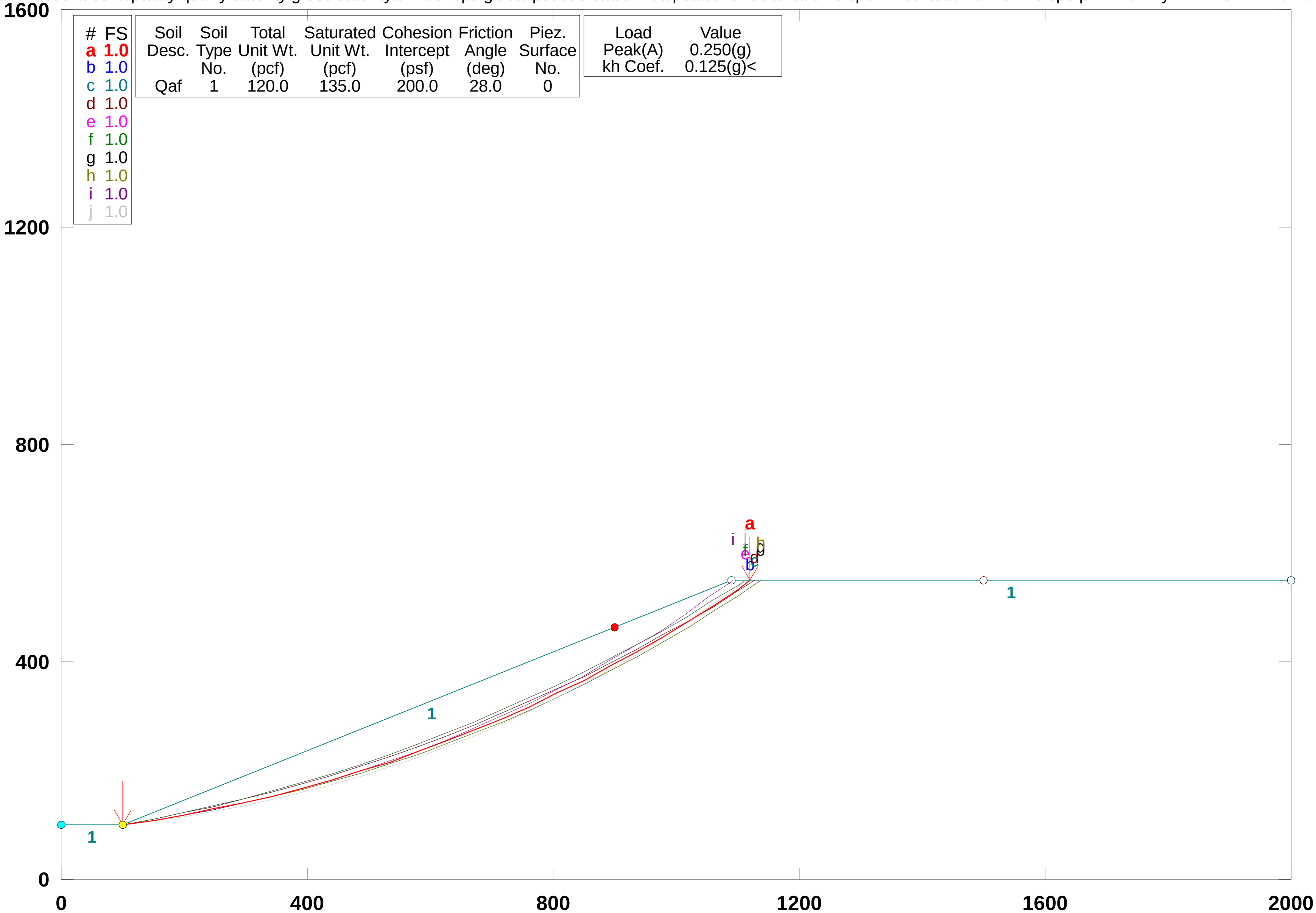
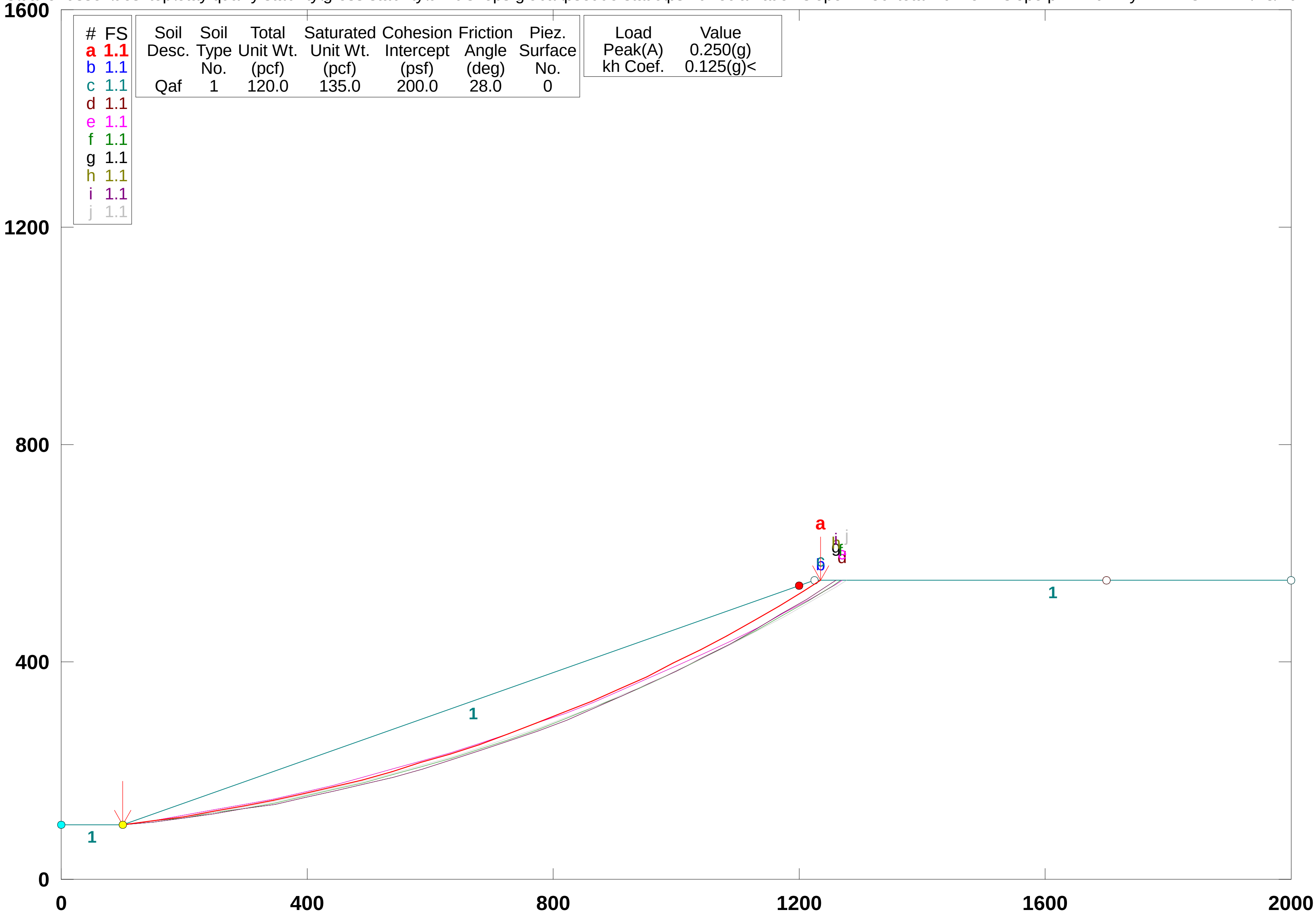


GSTABL7 v.2 FSmin=1.0

Safety Factors Are Calculated By The Modified Bishop Method

Otay Hills Quarry - RECLAMATION Phase 4D - 450' High (2.5:1) PS

c:\users\dave russell\desktop\otay quarry stability\gross stability\drr bishops global\pseudo static\ps 4d reclamation slope - 450' total - uniform slope.pl2 Run By: DRR-CWE 7/18/2014 08:34PM



GSTABL7 v.2 FSmin=1.1

Safety Factors Are Calculated By The Modified Bishop Method

CHRISTIAN WHEELER
ENGINEERING

Otay Hills Quarry - FINAL FILL SLOPE FINAL 4D/E Fill Slope 70' (2:1) PS

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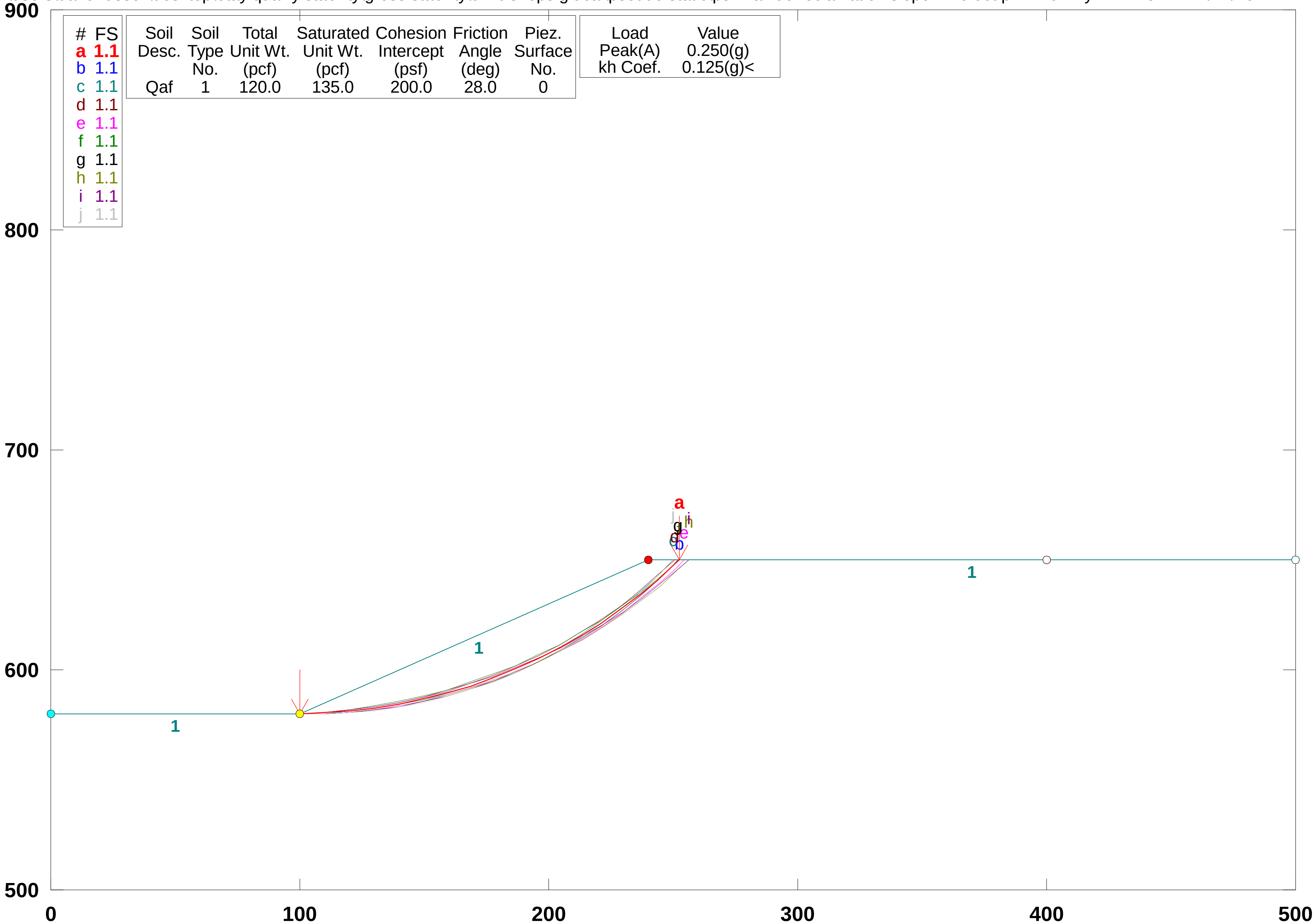

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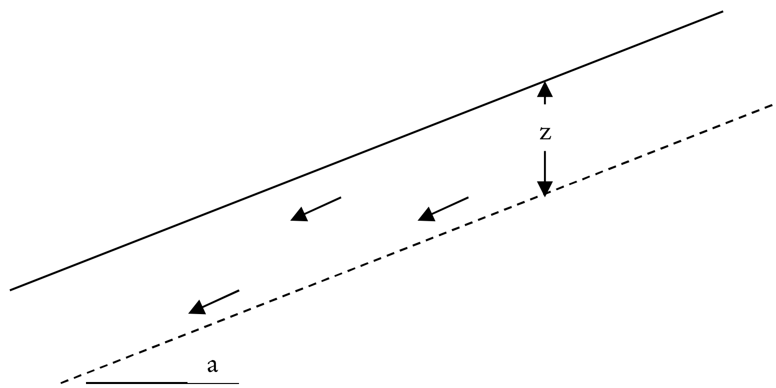
Safety Factors Are Calculated By The Modified Bishop Method

Appendix B

Plot of Surficial Stability Analysis

Final Phase 4D/E Fill Slope

SURFICIAL SLOPE STABILITY - 2:1 (H:V) FILL SLOPE



SEEPAGE PARALLEL TO SLOPE

ASSUMED PARAMETERS

z	Depth of Saturation (ft)	4
a	Slope Angle (H:1)	2
γ_W	Unit Weight of Water (pcf)	62.4
γ_T	Saturated Unit Weight of Soil (pcf)	125
ϕ	Angle of Internal Friction Along Plane of Failure (degrees)	28
c	Cohesion Along Plane of Failure (psf)	200

FACTOR OF SAFETY

$$FS = \frac{c + T(\tan\phi)}{T} \longrightarrow FS = \frac{c + (\gamma_T - \gamma_W)(z)(\cos^2 a)(\tan\phi)}{(\gamma_T)(z)(\sin a)(\cos a)}$$

$$\boxed{FS = 1.5}$$

CHRISTIAN WHEELER
ENGINEERING

OTAY HILLS QUARRY Final Fill Slope			
BY:	DRR	DATE:	Jul-14
JOB NO.:	2110171.02	Appendix B	

Appendix C

Landscape Architect Slope Certification

HELIX Environmental Planning, Inc.
7578 El Cajon Boulevard
Suite 200
La Mesa, CA 91942
619.462.1515 tel
619.462.0552 fax
www.**helixepi**.com

December 10, 2014

Mr. Travis Jokerst
EnviroMINE, Inc.
3511 Camino de Rio South, Suite 403
San Diego, CA

Subject: Otay Hills Quarry Steep Slope Certification

Dear Mr. Jokerst:

As per your request, I have reviewed the Landscape Concept Plan (prepared by HELIX) and the Revegetation Plan for Superior Ready Mix, LP, Otay Hills Quarry Project (prepared by others) and evaluated these documents as they relate to Section 87.401 (a) of the County of San Diego Grading Ordinance related to maximum cut-slopes.

As stated in the Revegetation Plan, slopes steeper than 2:1 are proposed as the final condition for much of the mineral extraction areas on site. These final cut slopes will be as steep as 1:1, graded to create a roughened surface with small benches carved into the cut slope. Revegetation operations will consist of spreading salvaged topsoil over these slopes and the small benches then hydroseeding these areas with a native seed mix. Hydroseeding is to be done between November 15 and January 15, when climatic conditions are expected to be most favorable. Rock outcrops and/or exposed bedrock areas that are not subject to excessive potential erosion and unlikely to support revegetation may be chemically stained to reduce visual contrast with surrounding areas.

I can certify that in my opinion, adherence to the approved Revegetation Plan for Superior Ready Mix, LP, Otay Hills Quarry Project, will support the proposed planting on slopes greater that 2:1 without significant or excessive erosion. If you have any questions or need any additional information please don't hesitate to contact me at (619) 462-1515.

Sincerely,

R. Brad Lewis, ASLA, LEED AP BD+C, CA QSD/QSP
Landscape Architecture Group Manager
CA Landscape Architect RLA #2657