FOR CONTRACT NO.: 01-262004

INFORMATION HANDOUT - PART 7

OPTIONAL DISPOSAL

7-1. Re-vegetation and Erosion Control Plan Provisions/ Temporary Water Pollution Control Plan/ Drainage Plan / Re-vegetation Plan and Erosion Control Plan

7-2. Geotechnical Design Report (Oil Well Hill Borrow Site), December 23, 2009

7-3. Supplemental Site Assessment, Proposed borrow area, Willits Bypass, April 25, 2006

7-4. Seismic Investigation at Oil Well Hill (Willits Bypass), April 20, 2007

ROUTE: 01-MEN-101-R69.4/78.9

Background, General Cross Section and Layout Plans:

The Optional Borrow Site, known as Oil Well Hill, is located immediately adjacent to Highway 101 north of Outlet Creek and is within Caltrans right-of-way. It has been designated as a proposed borrow site due to its proximity to the project corridor, its location within the existing Caltrans right-of-way, and the presence of soil material suitable for use as fill for this project. It is located approximately 2.5-3.0 miles north of the project limits and as shown in the attached plans and as specified in "Supplemental Project Information, Oil Well Hill Optional Borrow Site". The intent is for the material at the optional borrow site to be used in conformance with the general earthwork operations and the Contractor's imported borrow activities. Attention is directed to FEIS/EIR regarding any requirements by the Regulatory Agencies for usage of the site.

The optional borrow site is composed of three variations in the amount of material that is proposed for excavation. Borrow Option One (BO-1) proposes to excavate 1.06 million cubic meters of material. BO-2 proposes to remove approximately 0.5 million cubic meters of material. BO-3 will remove approximately 0.1 million cubic meters of material (refer to Oil Well Hill Layouts). The three options are intended to provide flexibility to the contractor depending on Project embankment needs. It also provides a degree of guidance to evaluate both temporary and permanent impacts as they pertain to soils disturbance. This approach is intended to generate an estimate of both construction and permanent best management practices that will be required to minimize impacts to water quality.

General cross-section and layout plans are provided for informational purposes only. Final finished surface and grading will be performed in conformance with "Supplemental Project Information, Oil Well Hill Optional Borrow Site" plans and as directed by the Engineer

Borrow-site: Natural Setting of Existing Landscape:

The area surrounding Oil Well Hill is primarily a densely forested hillside consisting of both man-made and natural elements. Man-made features at the site include the existing highway and associated improvements (culverts, drainage inlets and dikes). There are also two houses adjacent to the borrow site. In addition, there are road cuts from the construction of Highway 101 with slopes up to ¾:1 (H:V).

Natural features at the site include a relatively steep hillside. Vegetation in the general area consists of moderate to dense trees and some moderate to dense brush.
The dominant vegetation types in the Oil Well Hill borrow area are the Douglas Fir/Madrone Association, Douglas Fir - Canyon Live Oak Forest Alliance, Black Oak – Douglas Fir Association and Douglas-Fir – Tanoak/Black Huckleberrry Association. More unusual vegetation types such as Douglas-Fir – Giant Chinquapin, Douglas-Fir - Bigleaf Maple / Hazel and Oregon White Oak - Douglas-fir/California Fescue also occur here.

The understory of the forests and woodlands throughout the study area is dominated mostly by native shrubs and herbs, though extensive Himalayan blackberry (*Rubus discolor*), Scotch broom (*Cytisus scoparius*) and Spanish broom (*Sparteum junceum*) thickets also occur in the study area, and herb cover is light beneath the denser riparian canopies.

Intended Final Landform Design:

The intended final appearance of the site will attempt to minimize existing natural vegetation disturbance. The primary means of achieving this is to maximize slope steepness to the extent possible. The geotechnical report conducted for this location authorizes cut slopes as steep as ¾:1 (H:V) with the intent to adhere to this maximum slope.

Excavation procedures will begin at the toe of the existing road cut and move toward the hillside. Embankment material will first be generated from these existing cut areas. Since the roadway will remain in its present alignment, flat areas will be created.

Once all material that can be generated from existing cut slopes is utilized, then excavation can proceed into vegetated slopes. All topsoil will be harvested and stored in the flat areas created adjacent to the roadway for future use. Additionally, these flat areas will then be designed to accept open drainage facilities as well as planting areas. New vegetation will be planted to screen cut slopes, prevent erosion, stabilize slopes, and enhance water quality. Plant palettes and species composition will be chosen based on the function they are intended to provide.

Specific Contour Grading and Re-Vegetation/Erosion Control Plan:

Re-vegetation/Erosion Control will include the implementation of several elements to minimize erosion and promote the re-establishment of native plant communities to areas impacted by operations associated with the optional borrow site. The following techniques will be implemented as part of the follow-up planting project:

- Minimizing the removal of trees and avoid, where feasible, established vegetation including trees.
- Removed vegetation six inches in diameter or smaller shall be reduced to chipped or shredded material and stockpiled for later use.
- Harvest and stockpile the top 150 mm topsoil layer that includes duff as first order of work as part of the excavation operations.
- All final excavated areas shall be contour graded.
- Apply stockpiled topsoil/duff to final contour graded slopes and drainage areas.

- Further amend soils and provide additional nutrients for plantings by applying organic fertilizers (slow release) and compost where deemed necessary.
- Revegetate all disturbed areas with grass and forb seed (as part of permanent erosion control); supplemental seeding and container plantings of native perennial grasses, shrubs and trees.
- As a passive erosion control measure, chipped or shredded material shall be applied to all exposed, disturbed and contoured slopes.
- Planting implementation shall reflect existing vegetation patterns to assure a natural appearance.
- All plant material used for both erosion control and re-vegetation plantings shall be derived from genetically adapted seed and plant material.
- Incorporate compost/duff to a depth of 12 inches on fill slopes and cut slopes 1:4 or flatter

BMP Measures-Proposed with Construction:

The following measures will be implemented during construction to minimize erosion:

Roadway Improvements

- Remove and reapply duff layer (topsoil and organic layer) to all disturbed and exposed bare areas including slopes as well as basin floors.
- Final excavated and embankment slopes will be roughened using a tracked vehicle or serrated devise to create an irregular surface. Where rocks are encountered during excavation, they will be left as a natural element to the highway design.
- All disturbed areas after all earthwork is complete will receive duff, compost, organic fertilizer, seed and chipped or shredded mulch as the last erosion control component.
- 100 mm of compost shall be thoroughly mixed into the final top 0.50 meters of cut slopes 1:4 or flatter.
- Any basins will be contour graded to better fit the natural landscape. As one site differs from the next, each basin will be contour graded to represent the unique characteristics found at each location.
- Address compaction and need to rip based on post construction conditions.

Aesthetics:

The visual impacts created by the excavation operations will be minimized by the erosion control measures and follow up planting effort. As part of construction (permanent erosion control), Caltrans is proposing to use a seed mix composed of native grasses, forbs and wildflowers that are known to provide positive results in the Willits Valley vicinity. The follow-up planting project proposes to use containerized plantings throughout impact areas, and to screen cut slopes. The follow-up planting will re-establish the natural appearance more quickly. Lastly, mulch, in the form of shredded or chipped material will be applied

throughout disturbed areas. Mulch provides an instant natural background and will last several years, providing cover until vegetation has matured.

Proposed cut slopes associated with the optional borrow-site operations are anticipated to be visible from the U.S. 101. To lessen the visibility of these slopes, soils in the newly generated flat areas of the borrow site will be improved to support vegetation in the attempt to screen views on the cuts.

Follow-up Planting Project – Oil Well Hill Optional Borrow Site:

A separate planting project will follow the excavation operations. The planting project will establish containerized native plant species. These plants will supplement the erosion control seeding and aid in the long-term restoration and soil stabilization of the disturbed areas. The plant species proposed for the project are those found in and near the project location.

Planting Plan

Implementation Schedule: Borrow-site excavation activities and temporary erosion control measures will be implemented through out much of the roadway contract time span. To ensure the best possible growing and plant establishment conditions, as well as to allow for the permanent erosion control to establish itself, the follow-up planting project will be implemented the second fall season following the completion of the road excavation operations at Oil Well Hill. Positive results have been documented with late summer or early fall plantings. Planting during this time ensures a higher degree of survival as well as establishment while minimizing plant establishment costs.

Species:

Seed and container species used for the project will be derived from genetic stock originating from the Tahoe Basin and similar elevation and vegetation characteristics as the project. The following is a list of those species proposed for both the erosion control and re-vegetation components:

Proposed Container Material (Re-vegetation)

Trees

Arbutus menziesii	Pacific madrone
Calocedrus decurrens	Incense cedar
Sequoia sempervirens	Coast redwood
Pinus ponderosa	Ponderosa pine
Pseudotsuga menziesii	Douglas fir

Shrubs

Arctostaphylos manzanita ssp. manzanita	shiny-leaf whiteleaf manzanita
Ceanothus integerrimus	deer brush
Ceanothus foliosus var. foliosus	wavyleaf ceanothus
Corylus cornuta var. californica	California hazelnut
Heteromeles salicifolia (formerly arbutifolia)	toyon

Achillea millefolium	common yarrow
Bromus carinatus var. carinatus	California brome
Clarkia purpurea ssp. quadrivulnera	Four-spot
Danthonia californica	California oatgrass
Elymus glaucus ssp. glaucus[1]	Blue wildrye
Eschscholzia californica	California poppy
Festuca californica	California fescue
Hemizonia congesta ssp. leucocephala,	hayfield tarweed
Hordeum brachyantherum ssp. californicum	California barley
Lotus purshianus var. purshianus	Spanish lotus
Lupinus bicolor	Miniature lupine
Nassella pulchra	Purple needlegrass

[1] Species to be included as plugs in revegetation component.

Plant container sizes: Caltrans will contract grow the material to be planted for this project. In most cases the materials will be one year old or less. Young plants in small containers are preferred because the plant is more likely to have healthy root:shoot ratios, and more likely to be able to quickly adapt to wildland soil, water and weather conditions.

The exception to this will be for incense cedar, Jeffery and Sugar Pine. Caltrans will obtain trees that are two years old, to more quickly provide larger plantings. This however, will not meet the 3-6 foot trees stated in the permit. Caltrans can plant this size material, but cannot ensure success. Caltrans has unsuccessfully tried to plant large size containers in wildland settings, as have others around the basin. Many of these examples have included watering, but have still not ended with good results. The main problem is likely in the unbalanced root:shoot ratio and the fact that these trees will be planted in disturbed soil conditions. Over the last 5 years, Caltrans has had much better success with smaller plant material. We have done so, at the recommendations of such agencies as the USFS and at the recommendations of native plant nurseries.

Mulch: Mulch shall be derived from pine needles collected in the vicinity of the project. No straw mulch shall be used for this project.

Planting Densities: Plant types will include trees, shrubs and ground covers as well as grass plugs. Ground cover species will be spaced at one-meter centers. Shrubs will be spaced to reflect the naturally occurring vegetation patterns found in and near the project location. The on-center spacing therefore will be between one and three meters (3 to 10 feet). Grass plugs will be spaced no more 0.3 meters (1 foot) apart and will be used extensively in the basin area as well as in areas deemed adequate for their placement. Re-vegetation will occur both within and outside the basin. Plantings within the basin will occur with the objective of absorbing pollutants found in the storm water before subsurface drainage occurs. Plantings around the outside of the basin will be done to help screen them from the public's view.

Estimated Quantities:

Quantities for earthwork (slope roughening), topsoil/duff, revegetation, erosion control (netting), fiber rolls and permanent erosion control items have been included in the contract. The approximate quantities for implementing permanent Erosion Control BMPs and revegetation work are as follows:

Item Description	Unit	Approximate Quantity
EARTHWORK – SLOPE ROUGHENING	M2	50,000
EROSION CONTROL (TYPE D)	M2	50,000
TOPSOIL/DUFF	M2	50,000
REVEGETATION	HA	2.0
EROSION CONTROL (NETTING)	M	9,000
FIBER ROLLS	M	2,500

INDEX OF SHEETS

STATE OF CALIFORNIA

DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON

STATE HIGHWAY

IN MENDOCINO COUNTY
ON ROUTE 101
4 MILES NORTH OF WILLITS

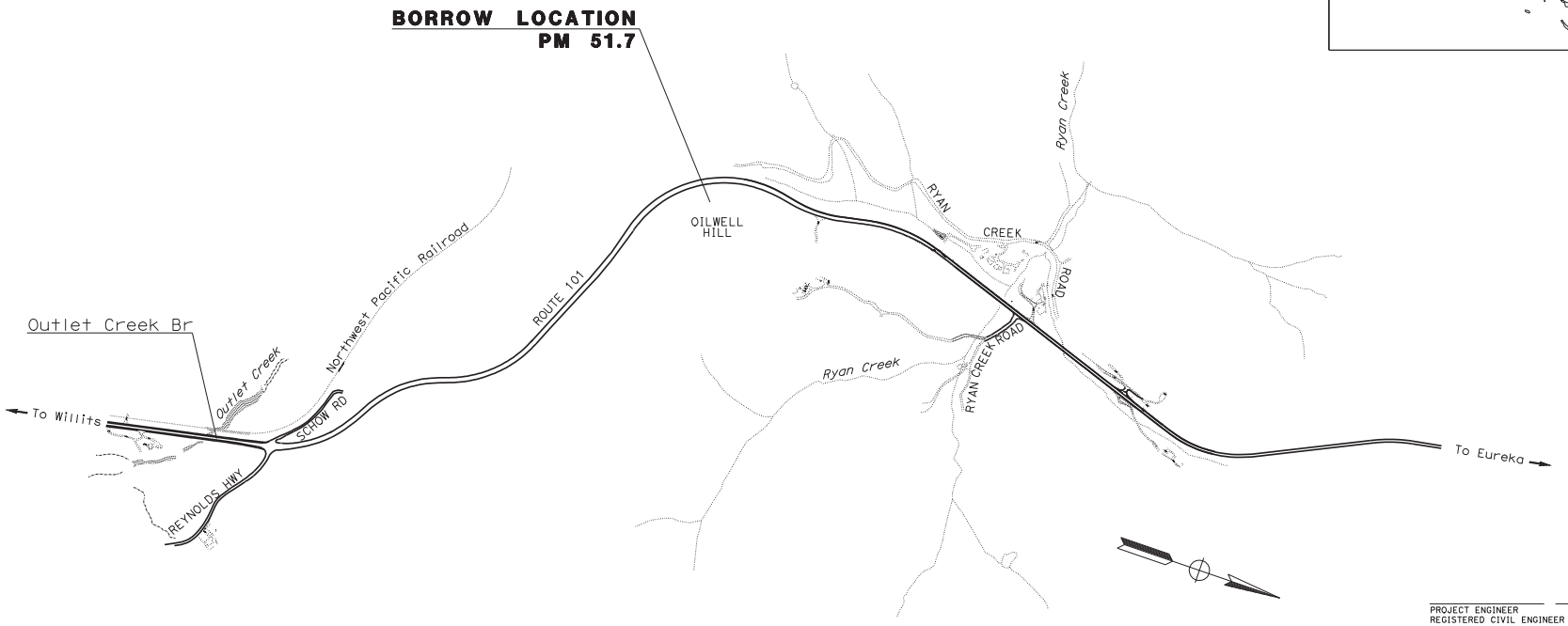
TO BE SUPPLEMENTED BY STANDARD PLANS DATED JULY 2004

Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	51.7		

LOCATION MAP

Caltrans

Caltrans Metric



NO SCALE

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO CONTRACTORS."

PROJECT ENGINEER DATE
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF ELECTRONIC COPIES OF THIS PLAN SHEET.

PROJECT MANAGER: David G. Kelley

DESIGN ENGINEER: Douglas S. Jones

LAST REVISION 01-20-12

DATE PLOTTED => 27-JAN-2012
TIME PLOTTED => 10:38

CONTRACT No. 0100000005

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01	MEN	101	83.0/83.5		

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REGISTERED PROFESSIONAL ENGINEER — No. — Exp. — CIVIL — STATE OF CALIFORNIA

NOTES:

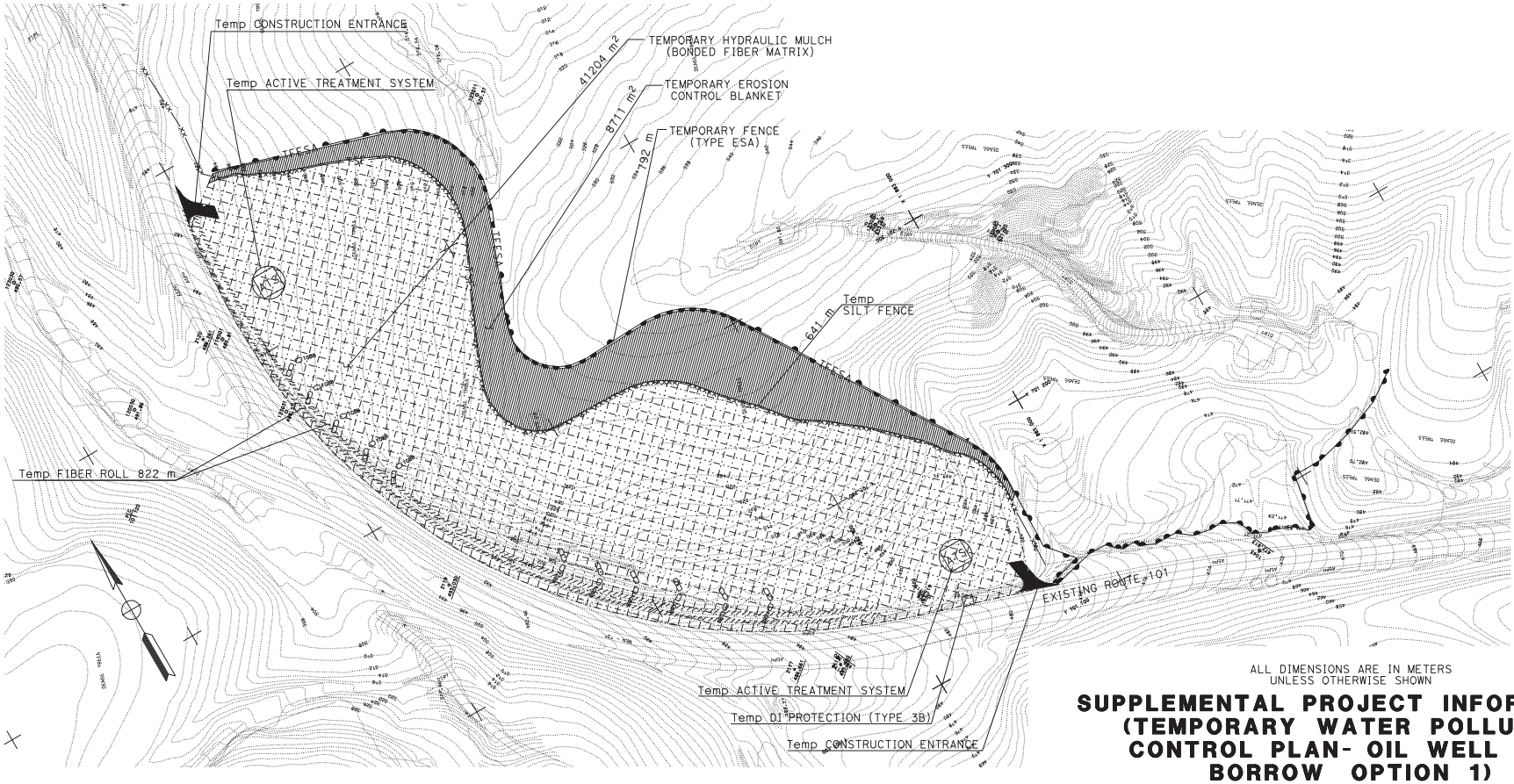
1. SUPPLEMENTAL PROJECT INFORMATION DOES NOT REPRESENT AN ORDER OF WORK AS INDICATED. THE INCLUSION OF CONTRACT ITEMS FOR BMPS, QUANTITY TABLES OR PLANS SHOWING LOCATION AND DEVELOPMENT OF BMPS DOES NOT RELIEVE THE CONTRACTOR OF PREPARING A STORM WATER POLLUTION PREVENTION PLAN.
2. THE PROPOSED LIMITS OF WORK SHOWN IN THESE PLANS ARE INCLUDED FOR ESTIMATING AND STUDY PURPOSES AND FOR THE CONVENIENCE OF BIDDERS.
3. CONTRACTOR SHALL PROVIDE TEMPORARY ACCESS TO DRIVEWAYS AND ROADWAY CONNECTIONS THROUGH THE WORK AT ALL TIMES AND AS DIRECTED BY THE ENGINEER.
4. FOR DRAINAGE SYSTEM DETAILS, SEE OIL WELL HILL DRAINAGE PLANS.
5. TEMPORARY EROSION CONTROL SHALL BE APPLIED TO ALL DISTURBED SOIL AREAS UPON COMPLETION OF WORK AS DIRECTED BY THE ENGINEER. IMPLEMENTATION SHALL BE COORDINATED WITH PERMANENT EROSION CONTROL WORK AS SHOWN IN OIL WELL HILL REVEGETATION AND EROSION CONTROL PLANS.

ABBREVIATIONS

WPC - WATER POLLUTION CONTROL

LEGEND

- Temp EROSION CONTROL (BONDED FIBER MATRIX)
- TSF — Temp SILT FENCE
- Temp CHECK DAM (TYPE 2)
- TFESA — Temp FENCE (TYPE ESA)
- Temp DI PROTECTION (TYPE 3B)
- TFR — Temp FIBER ROLL
- Temp CONSTRUCTION ENTRANCE
- Temp EROSION CONTROL BLANKET
- ATS — Temp ACTIVE TREATMENT SYSTEM



ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

SUPPLEMENTAL PROJECT INFORMATION (TEMPORARY WATER POLLUTION CONTROL PLAN- OIL WELL HILL BORROW OPTION 1)

SCALE 1:1000

WPC-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans 03-DESIGN EAST

FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY	DATE REVISED
DOUGLAS S. JONES	KARA BRIMHALL		
	CHECKED BY	MITCH ANDRUS	

LAST REVISION 01/20/12 DATE PLOTTED =>
TIME PLOTTED =>

BORDER LAST REVISED 3/1/2007

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USERNAME => s115121
DGN FILE => OWH_gb001.dgn

CU 03221

EA 262001

Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	R69.4/78.9		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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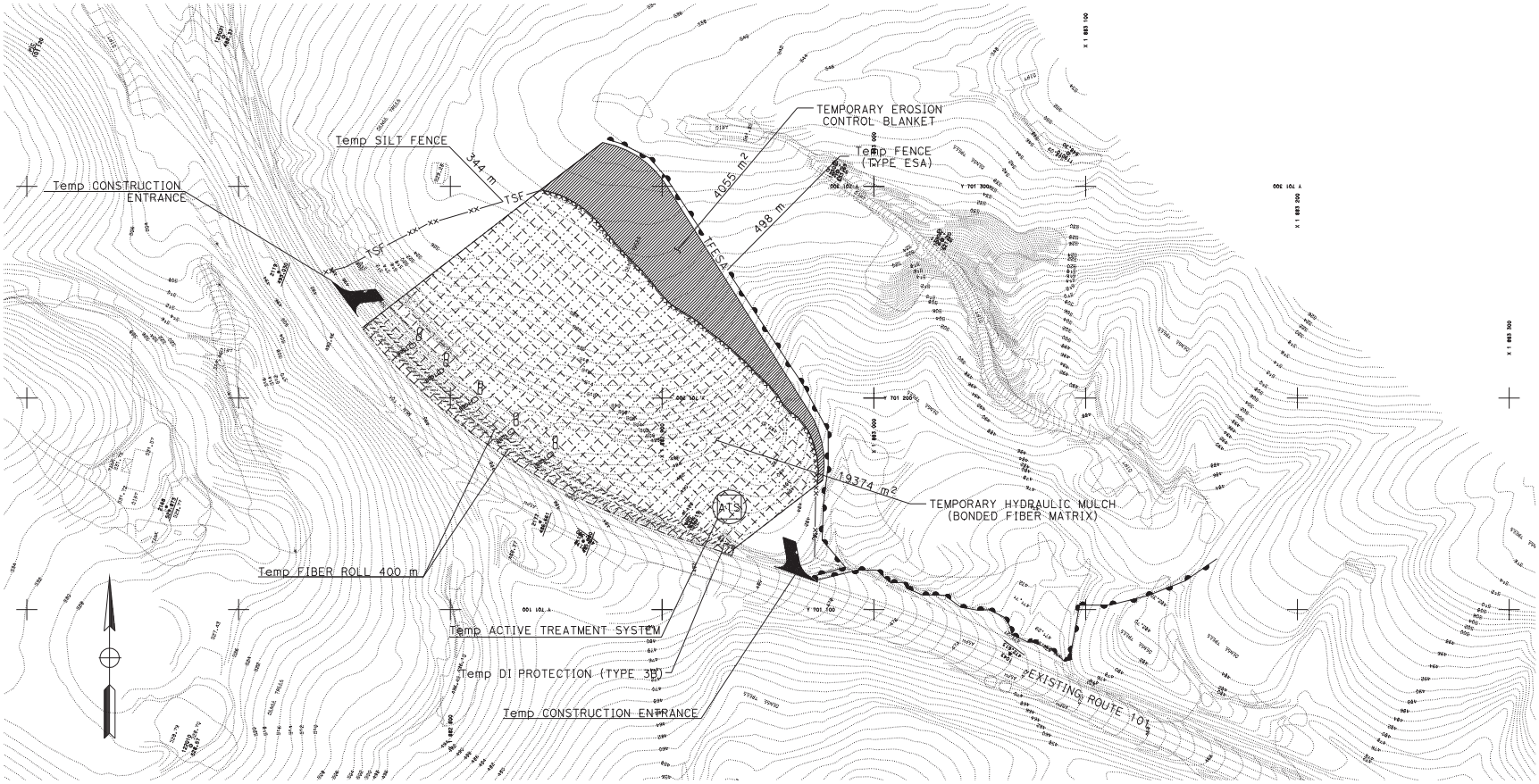

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SUPPLEMENTAL PROJECT INFORMATION (TEMPORARY WATER POLLUTION CONTROL PLAN- OIL WELL HILL BORROW OPTION 2)

SCALE 1:1000

WPC-2

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans 03-DESIGN EAST

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES
CALCULATED-DESIGNED BY: KARA BRIMHALL
CHECKED BY: MITCH ANDRUS
REVISED BY
DATE REVISED

LAST REVISION 1/23/12
DATE PLOTTED => 27-JAN-2012
TIME PLOTTED => 10:38

BORDER LAST REVISED 3/1/2007

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DGN FILE => OWH_gb002.dgn

CU 03221

EA 262001

Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	R69.4/78.9		

REGISTERED CIVIL ENGINEER DATE

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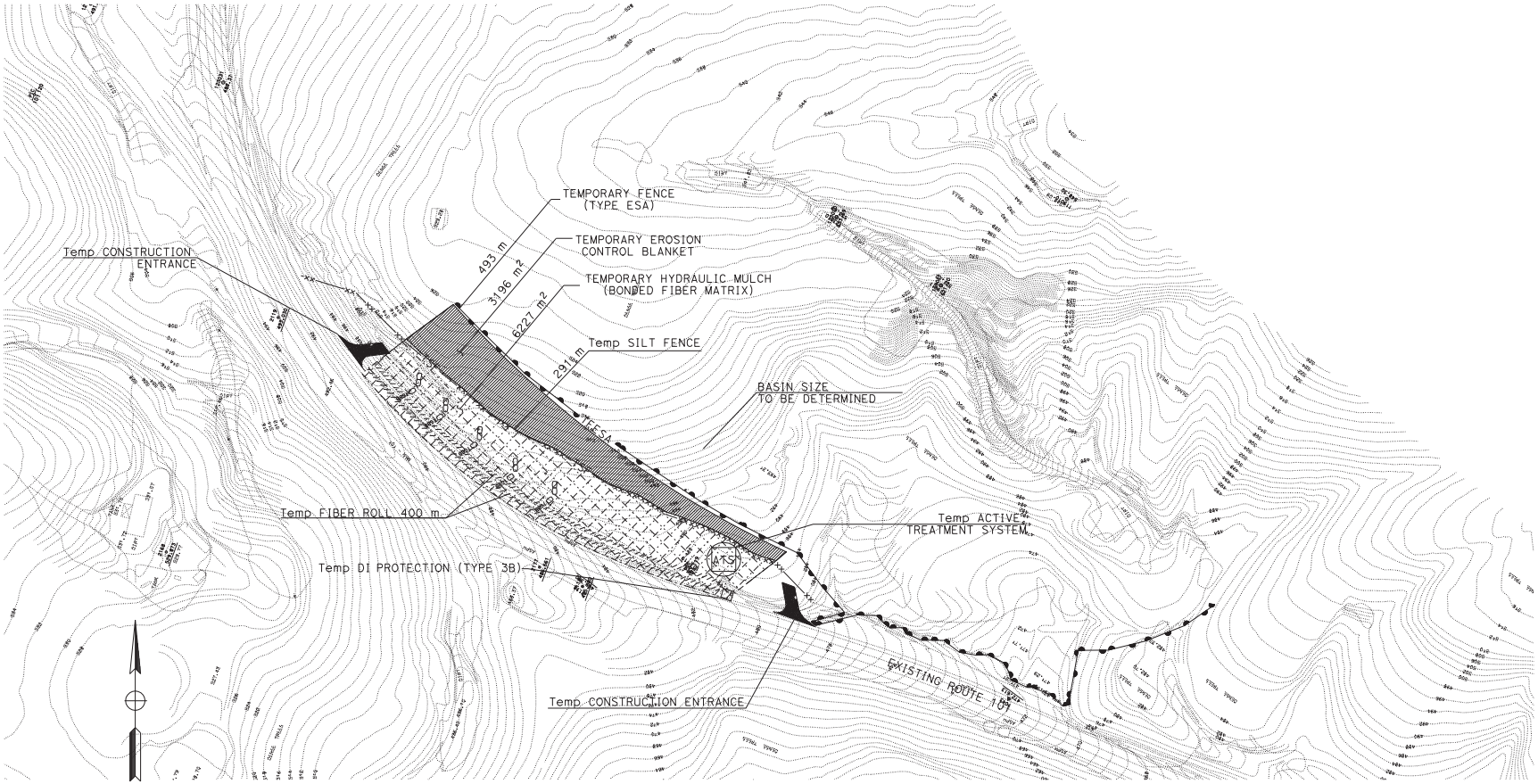

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SUPPLEMENTAL PROJECT INFORMATION (TEMPORARY WATER POLLUTION CONTROL PLAN- OIL WELL HILL BORROW OPTION 3)

SCALE 1:1000

WPC-3

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans 03-DESIGN EAST

FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	KARA BRIMHALL	REVISED BY
DOUGLAS S. JONES	CHECKED BY	MITCH ANDRUS	DATE REVISED

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01	MEN	101	R69.4/78.9		

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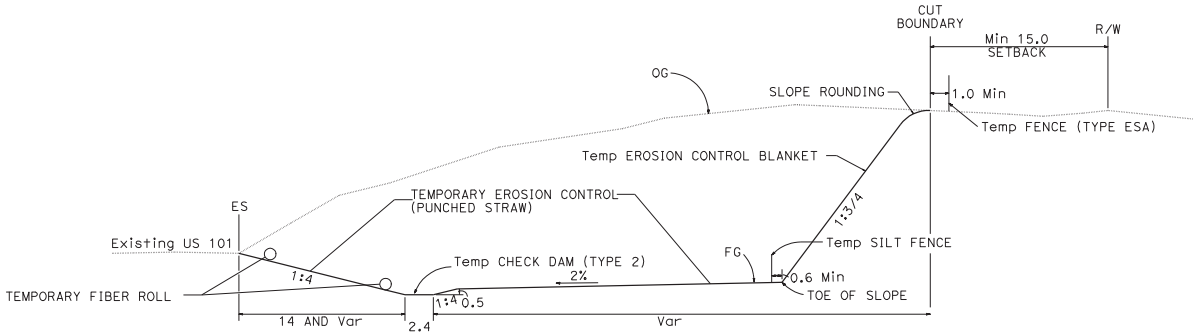
4. FOR DRAINAGE SYSTEM DETAILS, SEE OIL WELL HILL DRAINAGE PLANS.
5. TEMPORARY EROSION CONTROL SHALL BE APPLIED TO ALL DISTURBED SOIL AREAS UPON COMPLETION OF WORK AS DIRECTED BY THE ENGINEER. IMPLEMENTATION SHALL BE COORDINATED WITH PERMANENT EROSION CONTROL WORK AS SHOWN IN OIL WELL HILL REVEGETATION AND EROSION CONTROL PLANS.



BORROW SITE TYPICAL CROSS SECTIONS

ALL DIMENSIONS ARE IN METERS
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SUPPLEMENTAL PROJECT INFORMATION (TEMPORARY WATER POLLUTION CONTROL PLAN- OIL WELL HILL DETAILS)

NO SCALE

WPC-4

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans 03-DESIGN EAST

REVISED BY	DATE REVISED

CALCULATED-DESIGNED BY	CHECKED BY
KARA BRIMHALL	MITCH ANDRUS

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

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2. THE PROPOSED LIMITS OF WORK SHOWN IN THESE PLANS ARE INCLUDED FOR ESTIMATING AND STUDY PURPOSES AND FOR THE CONVENIENCE OF BIDDERS.

3. ASSSUME THREE SEASONS TO CONSTRUCT BORROW OPTION 1, TWO SEASONS FOR BORROW OPTION 2 AND TWO SEASONS FOR BORROW OPTION 3.

4. EXTRA AREA IS USED TO ACCOUNT FOR A FINISHED SLOPE ADJUSTMENT FACTOR.

TEMPORARY WATER POLLUTION CONTROL QUANTITIES (BORROW OPTION 1)

ITEM	EA (N)	m (N)	m^2 (N)	EXTRA AREA	SEASONS (N)	TOTAL (N)
Temp DRAINAGE INLET PROTECTION	1				3	3 EA
Temp CHECK DAM		55			3	165 m
Temp SILT FENCE		641			3	1923 m
MOVE IN/ MOVE OUT (Temp EROSION CONTROL)	1				3	3 EA
Temp FENCE (TYPE ESA)		792			3	2376 m
Temp CONSTRUCTION ENTRANCE	2				3	6 EA
Temp HYDRAULIC MULCH (BONDED FIBER MATRIX)			36021	10%	3	118869 m^2
Temp EROSION CONTROL BLANKET			8711	67%	3	43642 m^2
Temp FIBER ROLL		822			3	2466 m

TEMPORARY WATER POLLUTION CONTROL QUANTITIES (BORROW OPTION 2)

ITEM	EA (N)	m (N)	m^2 (N)	EXTRA AREA	SEASONS (N)	TOTAL (N)
Temp DRAINAGE INLET PROTECTION	1				2	2 EA
Temp CHECK DAM		25			2	50 m
Temp SILT FENCE		344			2	688 m
MOVE IN/ MOVE OUT (Temp EROSION CONTROL)	1				2	2 EA
Temp FENCE (TYPE ESA)		498			2	996 m
Temp CONSTRUCTION ENTRANCE	2				2	4 EA
Temp HYDRAULIC MULCH (BONDED FIBER MATRIX)			19374	10%	2	42623 m^2
Temp EROSION CONTROL BLANKET			4055	67%	2	13544 m^2
Temp FIBER ROLL		400			2	800 m

TEMPORARY WATER POLLUTION CONTROL QUANTITIES (BORROW OPTION 3)

ITEM	EA (N)	m (N)	m^2 (N)	EXTRA AREA	SEASONS (N)	TOTAL (N)
Temp DRAINAGE INLET PROTECTION	1				2	2 EA
Temp CHECK DAM		25			2	50 m
Temp SILT FENCE		291			2	582 m
MOVE IN/ MOVE OUT (Temp EROSION CONTROL)	1				2	2 EA
Temp FENCE (TYPE ESA)		493			2	986 m
Temp CONSTRUCTION ENTRANCE	2				2	4 EA
Temp HYDRAULIC MULCH (BONDED FIBER MATRIX)			6227	10%	2	13699 m^2
Temp EROSION CONTROL BLANKET			3196	67%	2	10675 m^2
Temp FIBER ROLL	400				2	800 m

(N) NOT A SEPERATE PAY ITEM, FOR INFORMATION ONLY

Caltrans Metric

Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	R69.4/78.9		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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SUPPLEMENTAL PROJECT INFORMATION (TEMPORARY WATER POLLUTION CONTROL PLAN- OIL WELL HILL QUANTITIES)

SCALE 1:500

WPCQ-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION | Caltrans | 03-DESIGN EAST

FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

CALCULATED-DESIGNED BY: KARA BRIMHALL

CHECKED BY: MITCH ANDRUS

REVISED BY | DATE REVISED

LAST REVISION | DATE PLOTTED => 27-JAN-2012 | TIME PLOTTED => 10:38

01-23-12

BORDER LAST REVISED 3/1/2007

RELATIVE BORDER SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => s115121

DGN FILE => OWH_gd005.dgn

CU 03221

EA 262001

NOTES:
1. THIS PLAN ACCURATE FOR DRAINAGE ONLY.

Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	R69.4/78.9		

REGISTERED CIVIL ENGINEER DATE

PLANS APPROVAL DATE

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DB-1	1	-	-	2
DB-2	2	-	-	2

All dimensions are in meters unless otherwise shown

OIL WELL HILL DRAINAGE PLAN

Scale: 1:1000

D-1

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	FUNCTIONAL SUPERVISOR	DATE	REVISED BY	
Caltrans 03-DESIGN EAST	David G. Kelley		DATE REVISED	
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	CHECKED BY			

LAST REVISION 10-19-09

DATE PLOTTED => 27-JAN-2012
PLOT TIME => 10:38

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USERNAME => s115121
DGN FILE => OWHia01.dgn

CU 03226

EA 262001

NOTES:
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01	MEN	101	R69.4/78.9		

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OIL WELL HILL DRAINAGE PLAN

Scale: 1:1000

D-2

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FUNCTIONAL SUPERVISOR: DOUGLAS S. JONES

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USERNAME => s115121
DGN FILE => OWHia02.dgn

CU 03226

EA 262001

LAST REVISION 10-19-09

DATE PLOTTED => 27-JAN-2012
PLOT TIME => 10:39

NOTES:
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Dist	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
01	MEN	101	R69.4/78.9		

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Caltrans Metric

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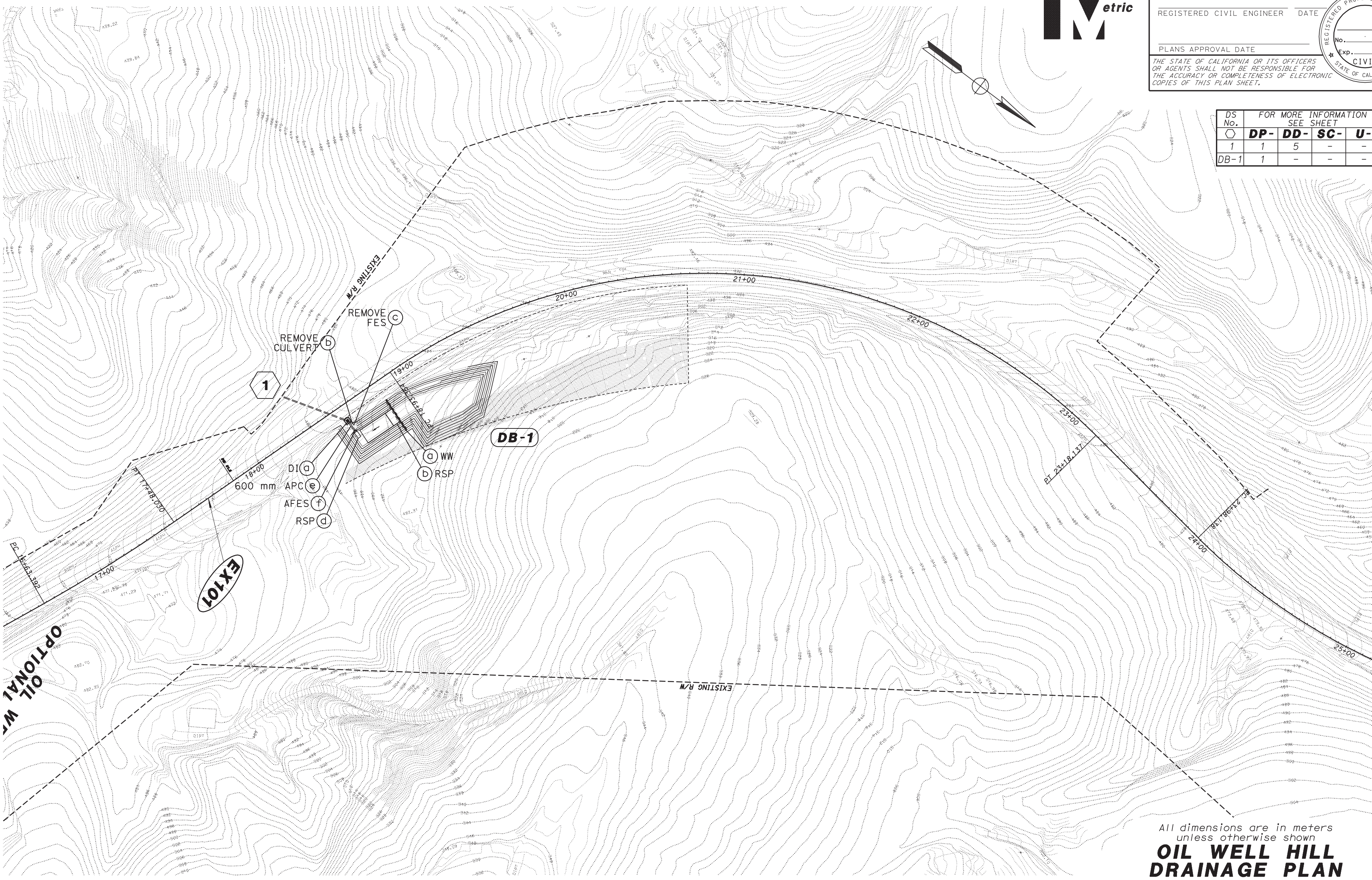

All dimensions are in meters unless otherwise shown

OIL WELL HILL DRAINAGE PLAN

Scale: 1:1000

D-3

CALCULATED/ DESIGNED BY	CHECKED BY	DATE	REVISED BY	DATE REVISED

FUNCTIONAL SUPERVISOR DOUGLAS S. JONES

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans 03-DESIGN EAST

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DGN FILE => OWHia03.dgn

CU 03226 EA 262001

DATE PLOTTED => 27-JAN-2012
PLOT TIME => 10:39

LAST REVISION 10-19-09

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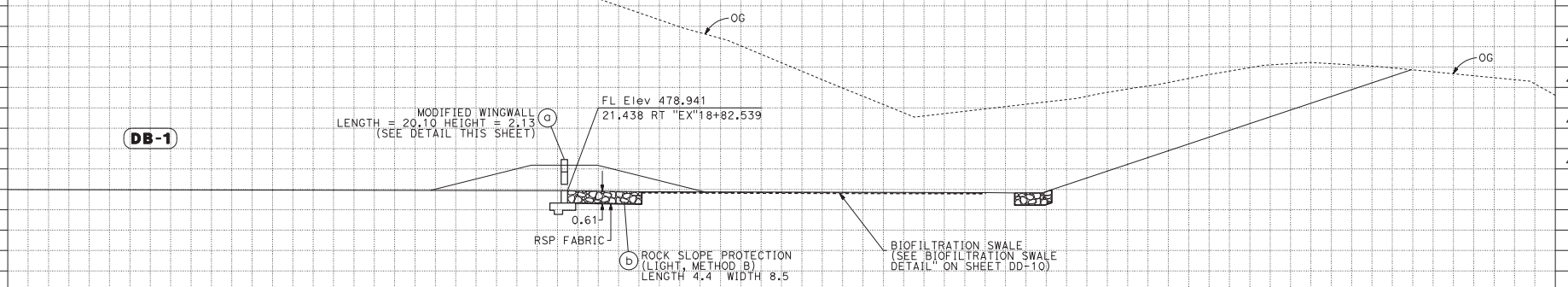

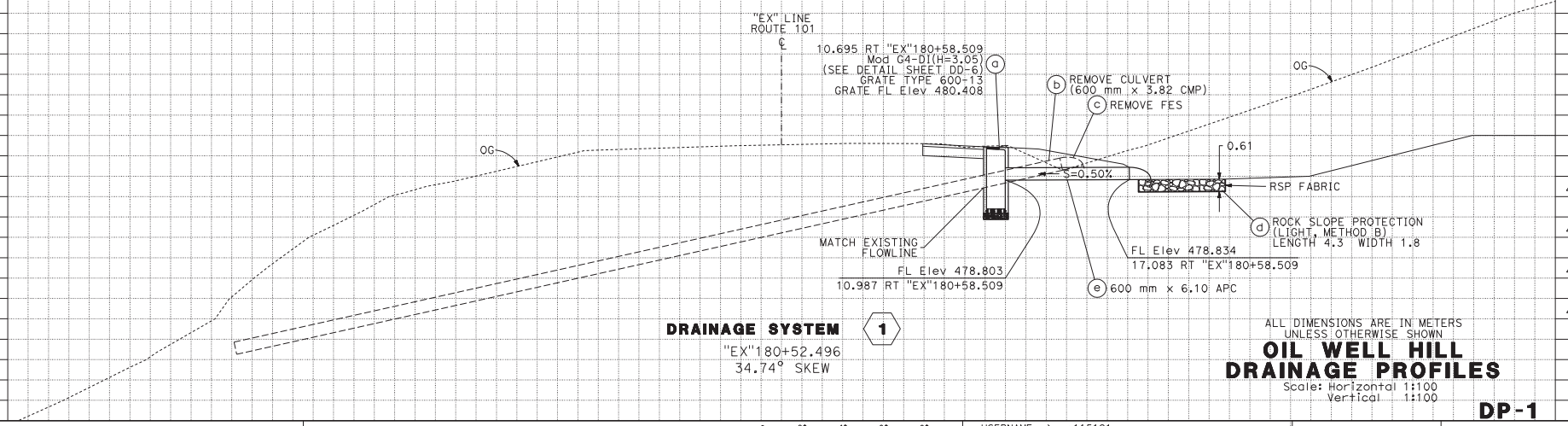

DRAINAGE SYSTEM (1)

"EX"180+52.496

34.74° SKEW

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

OIL WELL HILL DRAINAGE PROFILES

Scale: Horizontal 1:100
Vertical 1:100

DP-1

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OIL WELL HILL
DRAINAGE PROFILES

Scale: Horizontal 1:100
Vertical 1:100

DP-2

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USERNAME => s115121
DGN FILE => OWHib02.dgn

CU 03226

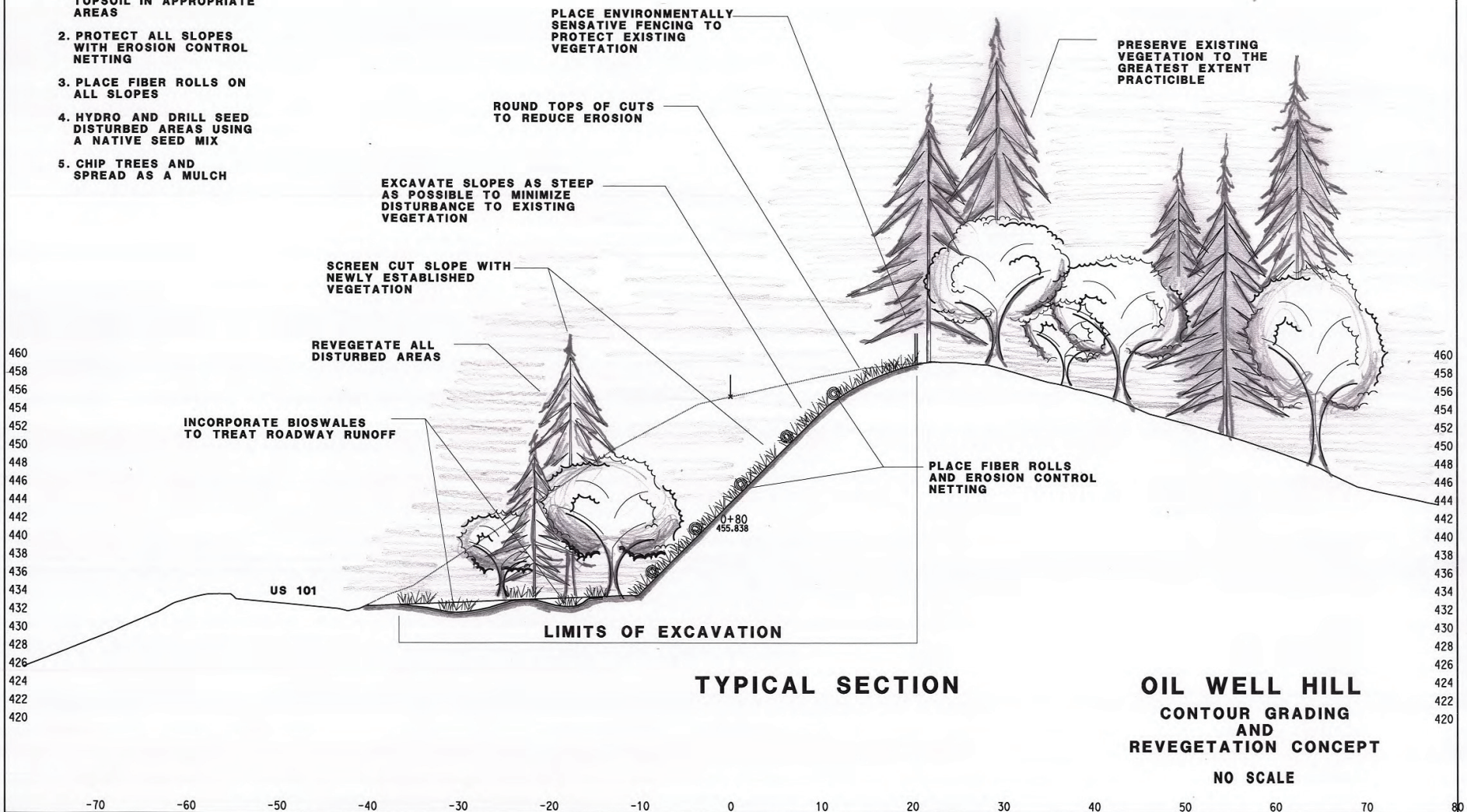
EA 262001

LAST REVISION 10-19-09

DATE PLOTTED => 27-JAN-2012
PLOT TIME => 10:39

POST CONSTRUCTION BMP'S

1. HARVEST AND SPREAD TOPSOIL IN APPROPRIATE AREAS
2. PROTECT ALL SLOPES WITH EROSION CONTROL NETTING
3. PLACE FIBER ROLLS ON ALL SLOPES
4. HYDRO AND DRILL SEED DISTURBED AREAS USING A NATIVE SEED MIX
5. CHIP TREES AND SPREAD AS A MULCH



TYPICAL SECTION

OIL WELL HILL

CONTOUR GRADING AND REVEGETATION CONCEPT

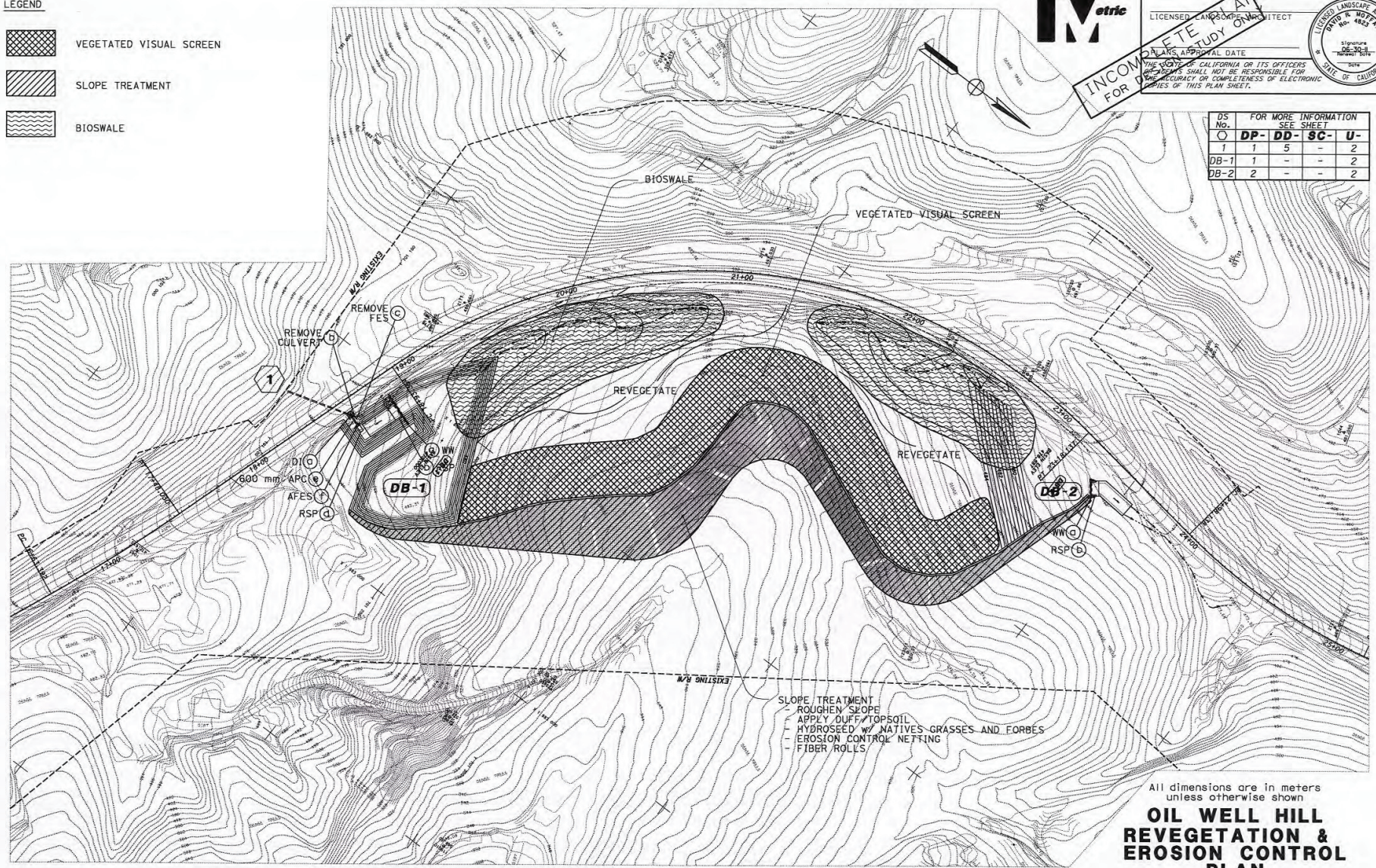
NO SCALE

DATE: 2/5/2007 ALL DIMENSIONS ARE METRIC

Project: 0059 File: P:\proj\01\26200\design\pse\designs\dtm\0059\OWH\owhnewfin.ear

Scale Ratio: 1:200 Horiz. 1:200 Vert.

OWH1
CROSS SECTIONS
SHEET 12 OF XXX



DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
01	MEN	101	R69.4/78.9		

LICENSED LANDSCAPE ARCHITECT

PLANS APPROVAL DATE

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INCOMPLETE PLANS FOR STUDY ONLY

LICENSED LANDSCAPE ARCHITECT DAVID R. MOFFATT No. 4823 Signature 06-30-11 Renewal Date Date STATE OF CALIFORNIA

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1	1	5	-	2
DB-1	1	-	-	2
DB-2	2	-	-	2

All dimensions are in meters unless otherwise shown

OIL WELL HILL REVEGETATION & EROSION CONTROL PLAN

Scale: 1:1000

EC-1

DATE	REVISED BY
	DATE REVISED

CALCULATED/ DESIGNED BY

CHECKED BY

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION

Caltrans

North Region
Division of Project Development

FUNCTIONAL SUPERVISOR

Kenneth Murray

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CU 03340

EA 262001

LAST REVISION DATE PLOTTED => 28-OCT-2009
08-31-09 TIME PLOTTED => 11:58

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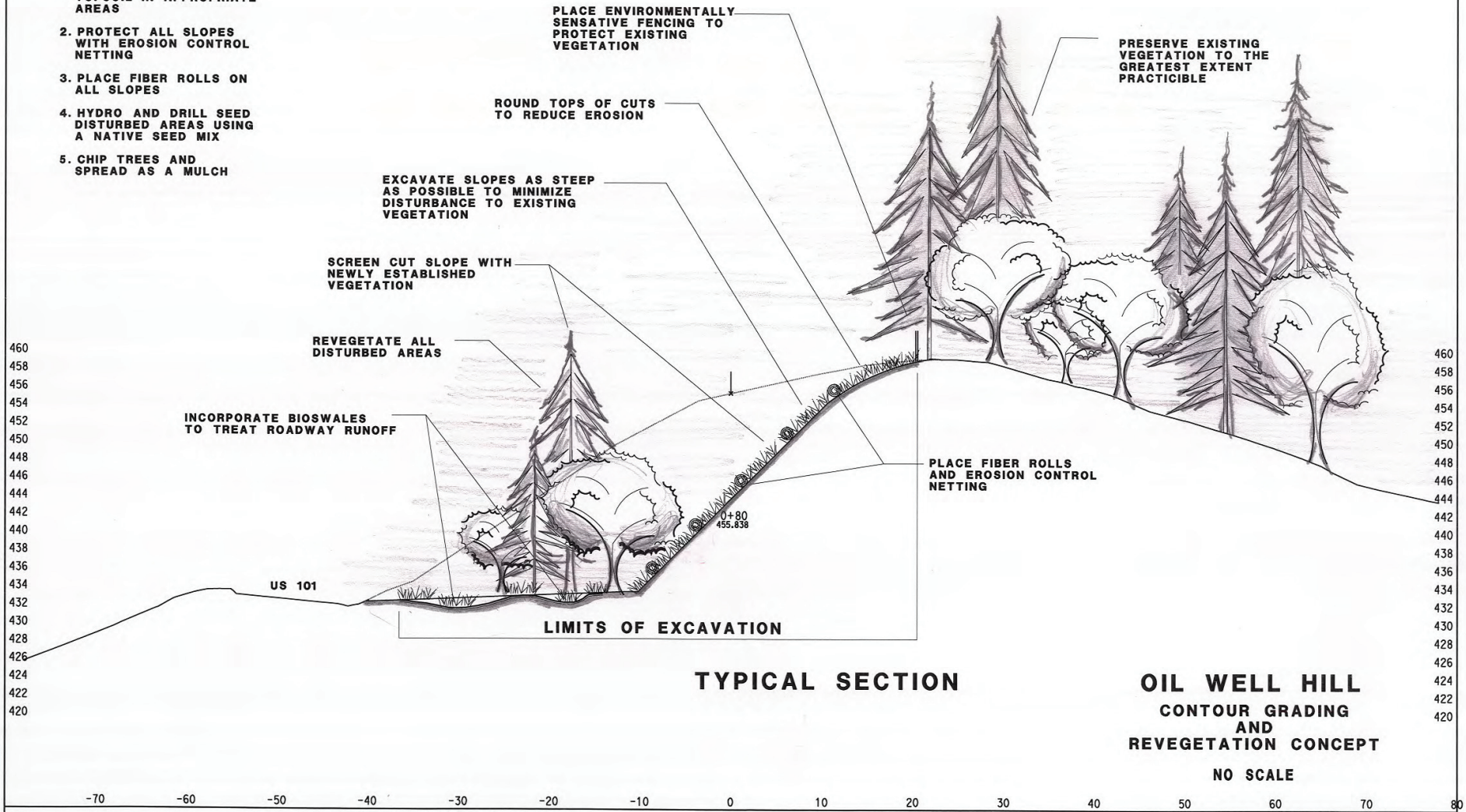
POST CONSTRUCTION BMP'S

1. HARVEST AND SPREAD TOPSOIL IN APPROPRIATE AREAS
2. PROTECT ALL SLOPES WITH EROSION CONTROL NETTING
3. PLACE FIBER ROLLS ON ALL SLOPES
4. HYDRO AND DRILL SEED DISTURBED AREAS USING A NATIVE SEED MIX
5. CHIP TREES AND SPREAD AS A MULCH



TYPICAL SECTION

OIL WELL HILL

CONTOUR GRADING AND REVEGETATION CONCEPT

NO SCALE

DATE: 2/5/2007 ALL DIMENSIONS ARE METRIC

Project: 0059 File: P:\proj\01\26200\design\pse\designs\dtm\0059\OWH\owhnewfin.ear

Scale Ratio: 1:200 Horiz. 1:200 Vert.

OWH1
CROSS SECTIONS
SHEET 12 OF XXX

State of California
Department of Transportation

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. DAVID KELLEY
Branch Chief
North Region
Division of Design and Engineering Services

Date: December 23, 2009

File: 01-MEN-101- KP 82.1 –83.4
(PM 51.0-51.8)
EA: 01-262001
Willits Bypass
(Oil Well Hill Borrow Site)

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES – MS 5

Subject: Geotechnical Design Report

1. Introduction

Per your request, we are providing a Geotechnical Design Report (GDR) for the borrow site for the Willits Bypass in Mendocino County, California. To facilitate the bypass, borrow material may be used from a site located adjacent to Highway 101 KP 82.1-83.4 (PM 51.0-51.8). This area is known as Oil Well Hill. A project location map along with borehole locations are presented in Figure 1. This report addresses our assessment of the borrow material site only.

This report includes a review of published data such as California Geologic Survey (CGS) publications, National Resource Conservation Service (NRCS) soil surveys, nearby water well, a site reconnaissance, subsurface exploration, geophysical refraction survey, laboratory testing and analysis.

The purpose of this report is to assist planners, project studies personnel, and environmental personnel. Information from this report may be included in the project report.

2. Existing Facilities

The proposed borrow location is composed of three sites in the Oil Well Hill area. The

three sites are referred to in this report as Sites #1, #2, and #3. These sites are generally bordered by the Reynolds Highway to the south, Highway 101 to the west, Ryan Creek Road to the north and approximately 152 meters (m) (500 feet) to the east from Highway 101. There is a house and surrounding buildings north of borrow Site #3 (refer to Figure 1.) There is also a house and surrounding buildings between Site # 2 and Site #3. Refer to Figure 1 and 2 to view a site map and location of the boreholes.

3. Pertinent Reports and Investigations

The following documents were used in preparing this report.

a) Western Regional Climate Data Center http://www.wrcc.dri.edu/, November 2009.
b) United States Geological Survey (USGS) 7.5 minute Topographic Map "Willits Quadrangle," dated 1991.
c) California Geologic Survey (CGS) "Geologic Map of California, Ukiah Sheet," 1960.
d) California Geologic Survey (CGS), Open File Report 2000-19 "A General Guide for Ultramafic Rocks in California - Areas More Likely to Contain Naturally Occurring Asbestos," 2000.
e) Caltrans DOT, "Asbestos Locations Map District 1," 2001.
f) Caltrans DOT, "California Seismic Hazards Map," 1996.
g) Caltrans DOT, "Seismic Investigation at Oil Well Hill (Willits Bypass)," April 20, 2007.

4. Physical Setting

The physical setting of the project site and the surrounding area was reviewed to provide climate, topography and drainage, man-made and natural features, geology and seismicity, and soil survey characteristics to aid in project design and construction. The site itself is located approximately 7.2 kilometers (4.5 miles) north of the junction of Highway 20 and Highway 101 in the town of Willits, California. The following is a discussion of the above review:

4.1 Climate

According to the National Weather Service, California Climate Normals for 1902-2009, the average total annual precipitation in the Willits area, is about 1311.91 mm (51.65 inches). The average annual maximum air temperature is approximately 20.66 °C (69.2°F) with average monthly extremes of 0.22 °C (32.4°F) in December and 29.72 °C (85.5°F) in July. Heavy rain occurs in the area typically between the months of October to May.

4.2 Topography and Drainage

According to the USGS 7.5 minute Topographic Map "Willits Quadrangle," dated 1991 and observations in the field, the site is located in the steep hills of the Coast Ranges. Drainage in the area flows to the southwest to Outlet Creek, which flows to the north. The elevation in the Oil Well Hill area ranges from 432 m (1417.3 feet) and 560 m (1837.3 ft).

4.3 Man-made and Natural Features of Engineering and Construction Significance

Man-made features at the site include the existing highway and associated improvements (ie: culverts, drain-inlets, curbs and gutters). There are also two houses adjacent to the borrow sites. In addition, there are road cuts from the construction of Highway 101 with slopes up to ¾:1 (H:V).

Natural features at the site mostly include a relatively steep hillside. Vegetation in the general area consists of moderate to dense trees and some moderate to dense brush.

4.4 Regional Geology and Seismicity

According to the California Geological Survey (CGS) "Geologic Map of California, Ukiah Sheet, 1960," the project is in an area of Undivided Cretaceous marine sedimentary rocks consisting of sandstone, shale, and conglomerate (K). A portion of the geologic map depicting the project area is attached as Figure 2.

We have reviewed the Caltrans DOT "Asbestos Location Map, District 1", 2001. According to this map and the geologic map reviewed, the site is not in an area known to contain naturally occurring asbestos. In addition, during our site reconnaissance the presence of serpentine or ultra-mafic rock was not observed in the project limits.

We reviewed the Caltrans California Seismic Hazard Map dated 1996. The map indicated that the Maacama-Brush Mountain Fault is located approximately 3.2 km (2 mi) to the west. The fault could produce a maximum credible earthquake M_w= 7.25. The style orientation of the Maacama-Brush Mountain Fault is strike-slip. The map indicated that the maximum credible earthquake from this fault would result in a peak horizontal bedrock acceleration of approximately 0.6g at the site.

5. Exploration

5.1 Drilling and Sampling

The field exploration portion of the project was performed in September and October, 2006, and consisted of drilling ten mud rotary borings. Two borings (B-4 and B-5) were drilled in site #1, three borings (B-6, B-7, and B-8) were drilled in site #2, and five borings (B-1, B-2, B-3, B-9, and B-10) were drilled in site #3.

5.2 Geophysical Investigation

The Office of Geotechnical Support, Geophysics and Geology Branch conducted a series of seismic refraction lines throughout the proposed borrow site. A copy of their report is attached.

6. Geotechnical Testing

6.1 Field Testing

The only testing performed was the driving of the Standard Penetration Test (SPT) sampler during drilling and pocket penetrometer testing of the samples recovered during drilling.

6.2 Laboratory Testing

The following laboratory tests were performed on selected samples obtained from the borings.

Sieve Analysis – CTM 203
Moisture Content – CTM 226
Relative Compaction – CTM 216
Plasticity Index – CTM 204
Remolded Direct Shear
Sand Equivalent
Corrosion
R-Value CTM 301

The tests above were used in classifying the soils encountered. The results of the tests are summarized in the tables below. The original lab data will be made available upon request.

The test results are summarized in the tables below.

Table I – Sieve Analysis Results

Boring No.	Sample No.	Depth (m)	-#4 (% Passing)	-#200 (% Passing)	Moisture Content (%)
B-1	11-19	8.5-15.2	81	71	n/a
B-2	7	4.6-6.1	86	62	n/a
B-2	24-36	18.3-29	99	39	n/a
B-3	1-6	0-4.6	100	52	n/a
B-3	17-27	12.2-22.9	100	30	n/a
B-3	28-31	22.9-29.3	100	33	11.1

Table II – Relative Compaction Test Results

Boring No.	Sample No.	Soil Type	Depth (m)	Dry Unit Weight (lbs/ft^3)	Optimum Moisture Content (%)
B-1	1-7	clay	0-6.1	112.4	13.1
B-3	7-16	silty sand	4.6-12.2	108.0	18.3
B-3	28-31	silty sand	22.9-29.3	122.0	11.9

Table III – Remolded Direct Shear at 90% Recompaction

Boring No.	Sample No.	Depth (m)	c (lbs/ft^2)	Φ	tan Φ
B-1	1-7	0-6.1	304	36.8	0.75
B-3	7-16	4.6-12.2	598	36.2	0.73

Table IV – Sand Equivalent

Boring No.	Sample No.	Depth (m)	Sand Equivalent
B-2	24-36	18.3-29	14
B-3	1-6	0-4.6	13
B-3	17-27	12.2-22.9	22
B-3	28-31	22.9-29.3	23

Table V - Corrosion

Boring No.	Sample #	Depth (m)	Minimum Resistivity (Ohm-Cm)	pH	Chloride Content (ppm)	Sulfate Content (ppm)
B-1	11-19	8.5-15.2	3400	6.34	N/A	N/A
B-2	7	4.6-6.1	40000	4.64	N/A	N/A
B-3	1-6	0-4.6	29000	4.22	N/A	N/A

Table VI – R-Value

Boring No.	Sample No.	Depth (m)	R- Value
B-1	11-19	8.5-15.2	24
B-2	1-6	0-4.6	45
B-3	17-27	12.2-22.9	72

7. Site Conditions

7.1 Surface

The proposed borrow pit is located on fairly steep slopes. Existing site vegetation consists of moderate to dense trees and some moderate to dense brush. Both sandstone and a clayey soil are exposed at the surface. Where there is dense vegetation a layer of duff is found on the surface.

7.2 Subsurface

In general, at Site #3 the near-surface soils indicated in the borings for this investigation consisted of stiff to very stiff lean clay, and sandy lean clay with gravel to an approximate depth of 15.0 m near Borings B-1 and B-2. The underlying bedrock was also exposed at the surface in some areas. The bedrock consisted of intensely weathered, soft to moderately soft sandstone. According to the "Seismic Investigation at Oil Well Hill" dated April 20, 2007 by Caltrans' Geophysics and Geology Branch, at site #3 "all material above the present elevation of Highway 101 should be rippable."

According to the borings, Site #1 soils consist of moderately cemented silty sand up to 1.5 m (5 feet) thick. The underlying bedrock is intensely weathered to slightly weathered and soft to moderately hard sandstone. The "Seismic Investigation at Oil

Well Hill" states, "Data indicates unrippable material was imaged approximately 3.0 meters below the surface."

Borings in Site #2 show the subsurface soils to be loose to very dense silty sand and sandy silt up to a depth of 1.5 m (5 feet). The underlying bedrock ranges from a decomposed to slightly weathered, soft to hard sandstone. The "Seismic Investigation at Oil Well Hill" states, "Data indicate unrippable material was detected 10 to 15 meters below the surface."

For a more complete description of the soil conditions encountered, please refer to the attached boring logs.

7.3 Groundwater

Groundwater was measured in a peizometer at a depth of 15.4 m at B-2, and in open holes 25.7 m at B-4, and 12.7 m at B-9 on October 12, 2006. The depth of the groundwater measured at B-2 is a best guess estimate due to contamination of mud in the peizometer. Communication with the landowner of the property north of the proposed borrow pit indicated that the water well drilled on their property in the late 1980's or early 1990's encountered groundwater at 22.86 to 24.1 meters (75 to 79 feet) deep. It is possible that the water table may be encountered at shallower depths of the excavation.

8. Geotechnical Recommendations

8.1 Cut Slopes

It is recommended that the cuts in the borrow pit be no steeper than ¾ : 1 (H:V). The steepest existing cut slopes in the area are approximately ¾ : 1 (H:V) and appear to have no major problems.

9. Proposed Future Investigations

No other fieldwork is proposed at this time. If the project scope changes, such as borrow pit location, changes in the borrow pit dimensions, etc., areas of the project may need to be revisited.

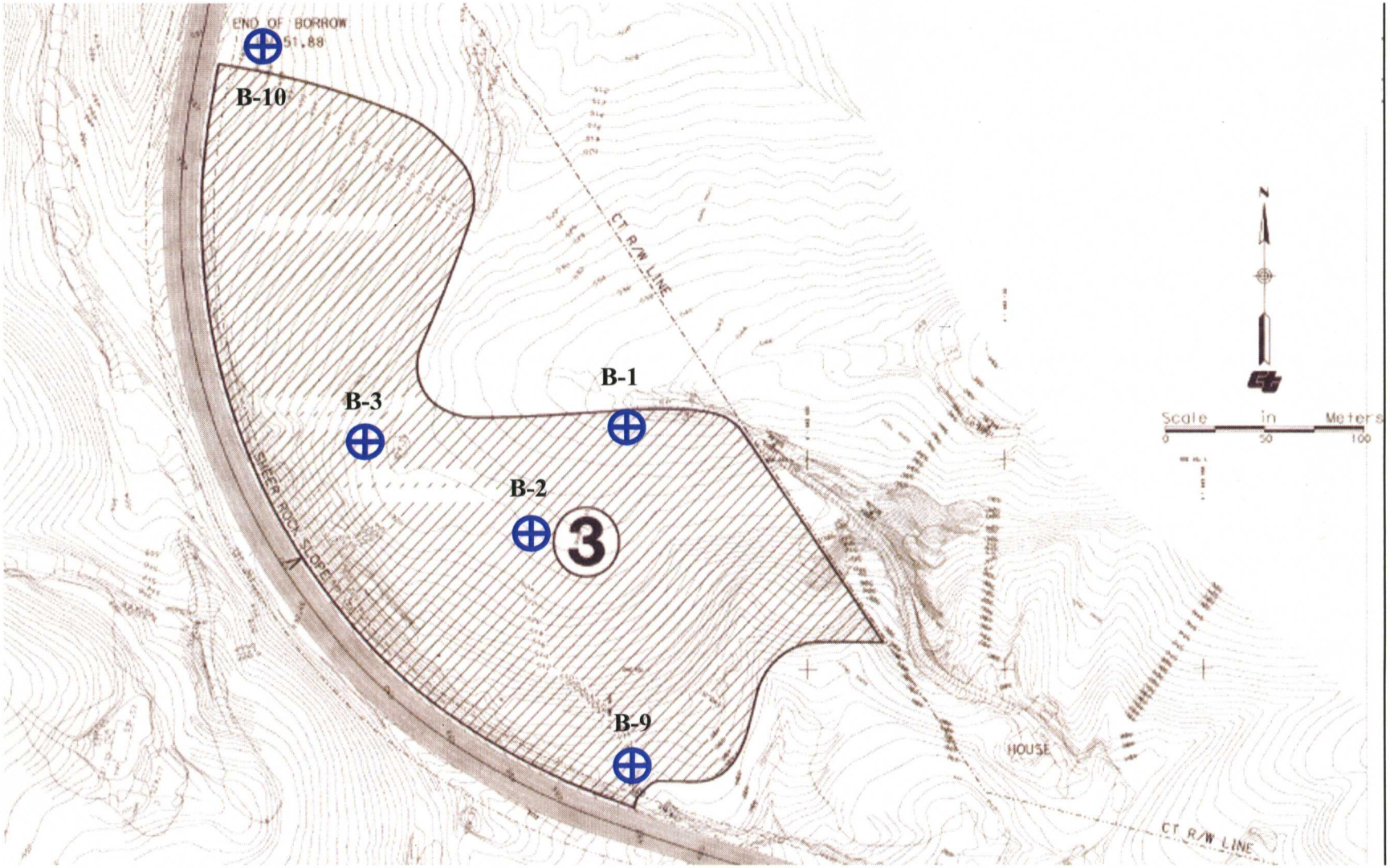
If you have any questions or comments, please call me at (916) 227-1044.

JOSEPH KAUMP, PG 7837
Engineering Geologist
Geotechnical Design - North

Attachments: Site Map and Boring Locations
Geology Map
Log of Borings
Seismic Investigation at Oil Well Hill (Willits Bypass)

C:
Reid Buell
Mike Stapleton DME (E-copy)
GDN File

CALTRANS Division of Engineering Services Geotechnical Services Office of Geotechnical Design -North	EA: 01-262001 Date: December 2009	**Site Map and Boring Locations**
	01-MEN-101; KP 82.0/83.4 (PM 51.0/51.8) GEOTECHNICAL DESIGN REPORT	Figure No. 1



CALTRANS
Division of Engineering Services
Geotechnical Services
Office of Geotechnical Design -North

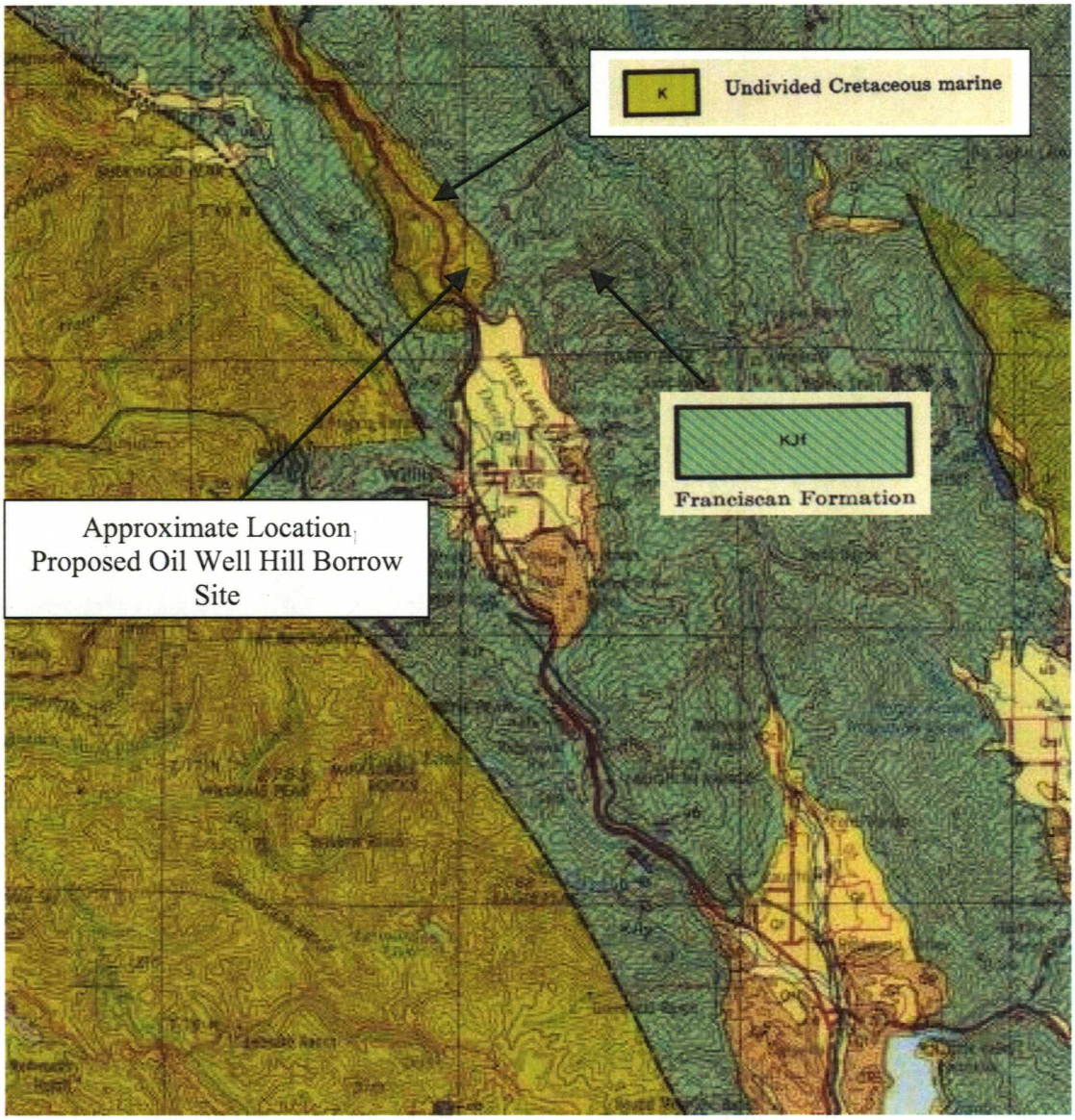
EA: 01-262001

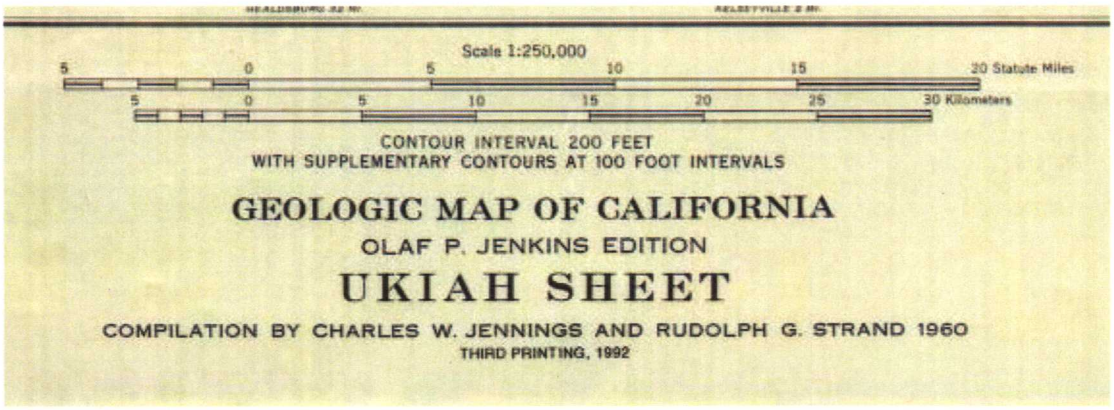
Date: December 2009

Site Map and Boring Locations

01-MEN-101; KP 82.0/83.4 (PM 51.0/51.8)
GEOTECHNICAL DESIGN REPORT

Figure No. 2





Division of Engineering Services Geotechnical Services Geotechnical Design – North	EA: 01-262001 December 23, 2009	Geologic Map
	01-MEN-101 KP 82.0/83.4 (PM 51.0/51.8) **Oil Well Hill Borrow Site**	Figure 3

GRAPHIC SYMBOLS


Bulk Sample


Rock Core


Modified California Sampler


Standard Penetration Sampler


Shelby Tube


Vane Shear


Auger


Diamond Core


Rotary


California Sampler


Water Level - 1st Reading

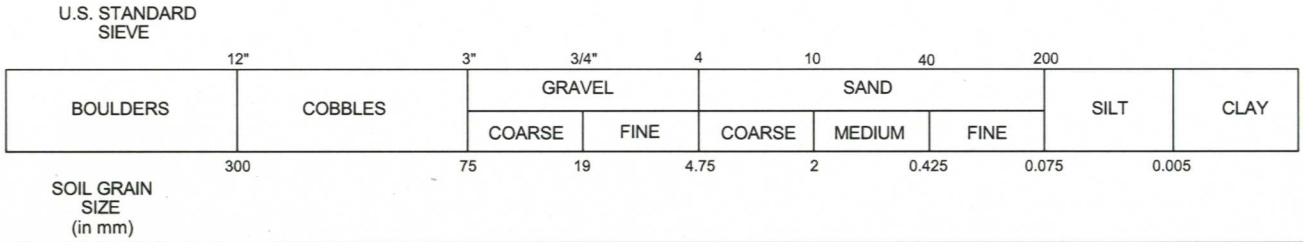

Water Level - 2nd Reading


Water Level - 3rd Reading

TESTING

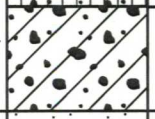
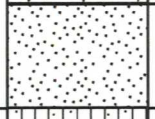
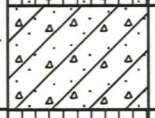
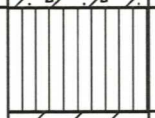
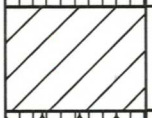
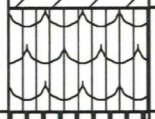
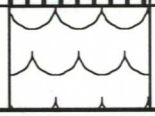
CONS	Consolidation (Cal Test 219)	RQD	Rock Quality Designation (ASTM D6032)
UU	Unconsolidated Undrained Triaxial (Cal Test 230)	CP	Compaction Test (Cal Test 216)
CU	Consolidated Undrained Triaxial (Cal Test 230)	PERM	Permeability (Cal Test 220)
DS	Direct Shear (ASTM D3080)	COR	Corrosivity Testing (Cal Test 532/643)
UC	Unconfined Compression (Cal Test 221)	GRAD	Gradation Analysis (Cal Tests 202/203)
LL	Liquid Limit-% (Cal Test 204)	EP	Expansion Pressure (Cal Test 354)
PI	Plasticity Index-% (Cal Test 204)	OC	Organic Content-% (ASTM D2974)
PP	Pocket Penetrometer	SE	Sand Equivalent (Cal Test 217)
TV	Pocket Torvane		

SOIL GRAIN SIZE



GENERAL NOTES

1. Logs represent general subsurface conditions observed at the point of exploration on the date indicated.
2. In general, USCS designations presented on logs were established by visual methods only; therefore, actual designations (based on laboratory tests) may vary.
3. No warranty is provided as to the continuity of soil conditions between individual sample locations.
4. Lines separating strata on the logs represent approximate boundaries only; actual transitions may be different or gradual.
5. Pocket penetrometer values reported on the logs under shear strength are actual values as recorded in the field. (To be used in analysis, the pocket penetrometer value should be divided by two)

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 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, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

SYMBOLS

 SEDIMENTARY  METAMORPHIC  IGNEOUS

DEGREE OF WEATHERING

Descriptor	Criteria
Fresh	Crystals are bright. Discontinuities may show some minor surface staining. No discoloration in rock fabric
Slightly weathered	Rock mass is generally fresh. Discontinuities are stained and may contain clay. Some discoloration in rock fabric. Decomposition extends up to 25.4 mm into rock.
Moderately Weathered	Rock mass is decomposed 50% or less. Significant portions of rock show discoloration and weathering effects. Crystals are dull and show visible chemical alteration. Discontinuities are stained and may contain secondary mineral deposits.
Intensely weathered	Rock mass is more than 50% decomposed. Rock can be excavated with geologist's pick. All discontinuities exhibit secondary mineralization. Complete discoloration of rock fabric. Surface of core is friable and usually pitted due to washing out of highly altered minerals by drilling water.
Decomposed	Rock mass is completely decomposed. Original rock "fabric" may be evident. May be reduced to soil with hand pressure.

FRACTURING & FOLIATION (BEDDING)

Fracturing Descriptor*	Foliation (Bedding) Descriptor	Thickness/Spacing Criteria
Unfractured	Massive	None observed
Very slightly fractured	Massive	Greater than 3 m
	Very thickly foliated	Between 1 m and 3 m
Slightly fractured	Thickly foliated	Between 300 mm and 1 m
Moderately fractured	Moderately foliated	Between 100 mm and 300 mm
Intensely fractured	Thinly foliated	Between 30 mm and 100 mm
Very intensely fractured	Very thinly foliated	Between 10 mm and 30 mm
	Laminated (or intensely foliated)	Less than 10 mm (3/8")

*Note: Spacing criteria for fracturing can refer to general or average recovery length of core measured along core axis; for other exposures, the criteria is distance measured between fracture (size of blocks).

RELATIVE HARDNESS

Descriptor	Criteria
Extremely hard	Core, fragment, or exposure cannot be scratched with knife or sharp pick; can only be chipped with repeated hammer blows.
Very hard	Cannot be scratched with knife or sharp pick. Core or fragment breaks with repeated heavy hammer blows.
Hard	Can be scratched with knife or sharp pick with difficulty (heavy pressure). Heavy hammer blow required to break specimen.
Moderately hard	Can be scratched with knife or sharp pick with light or moderate pressure. Core or fragment breaks with moderate hammer blow.
Moderately soft	Can be grooved 2 mm (1/16") deep by knife or sharp pick with moderate or heavy pressure. Core or fragment breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily by knife or sharp pick with light pressure, can be scratched with fingernail. Breaks with light to moderate manual pressure.
Very soft	Can be readily indented, grooved or gouged with fingernail, or carved with a knife. Breaks with light manual pressure.

Equipment: CME 750	Station/KP:	Boring ID.: B-1
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 9-6-06
Drilling Method: Rotary wash, open-ended punch core bit	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~536.9m	Total Depth: 30.6m
Notes:	~Depth to GW/date measured: Not Measured on 9-6-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
536.63	0.30	1		Lean CLAY (CL): firm, reddish yellow, dry to moist, rootlets.		1									
536.33	0.61	2													
536.02	0.91	3													
535.72	1.22	4													
535.41	1.52	5			X	2	2 5 3	8							
535.11	1.83	6													
534.80	2.13	7		Lean CLAY (CL): hard, reddish yellow, moist, with angular rock fragments and rootlets.		3									
534.50	2.44	8													
534.19	2.74	9													
533.89	3.05	10													
533.58	3.35	11		COLLUVIUM (Sandy Lean CLAY) (CL): stiff, pale yellow, moist, with rock fragments.	X	4	8 15 19	34							
533.28	3.66	12				5									
532.97	3.96	13		Lean CLAY (CL): stiff, brown, moist to wet, with rock fragments, mottled.											
532.67	4.27	14													
532.36	4.57	15			X	6	3 3 5	8							
532.06	4.88	16													
531.75	5.18	17				7									
531.45	5.49	18													
531.14	5.79	19													
530.84	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				SANDY lean CLAY (CL): stiff, reddish yellow, moist to wet, mottled.		8	4 6 6	12							
530.53	6.40	21													
						9									
530.23	6.71	22													
529.93	7.01	23													
529.62	7.32	24													
529.32	7.62	25													
						10	4 6 7	13							
529.01	7.92	26													
528.71	8.23	27				11									
528.40	8.53	28		Lean CLAY (CL): very stiff, light olive brown, moist, mottled.											
528.10	8.84	29													
527.79	9.14	30				12	5 4 6	10							
527.49	9.45	31													
527.18	9.75	32				13									
526.88	10.06	33													
526.57	10.36	34													
526.27	10.67	35													
						14	2 3 6	9							
525.96	10.97	36													
525.66	11.28	37				15									
525.35	11.58	38													
525.05	11.89	39													
524.74	12.19	40		Lean CLAY with GRAVEL (CL): very stiff, olive, moist, mottled.											
						16	5 7 15	22							
524.44	12.50	41													
524.13	12.80	42				17									
523.83	13.11	43													
523.52	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
523.22	13.72	45		Lean CLAY with GRAVEL (CL): very stiff, olive, moist, mottled. *(continued)*											
						18	6 8 12	20							
522.91	14.02	46													
522.61	14.33	47				19									
				SANDY lean CLAY (CL): very stiff, yellowish brown, moist, with rock fragments, mottled.											
522.31	14.63	48													
522.00	14.94	49													
521.70	15.24	50													
				SANDSTONE: dark yellowish orange, intensely weathered, soft.		20	13 11 14	25							
521.39	15.54	51													
521.09	15.85	52				21									
520.78	16.15	53													
520.48	16.46	54													
520.17	16.76	55													
						22	16 26 36	62							
519.87	17.07	56													
519.56	17.37	57				23									
519.26	17.68	58													
518.95	17.98	59													
518.65	18.29	60													
						24	8 17 17	34							
518.34	18.59	61													
518.04	18.90	62				25									
517.73	19.20	63													
517.43	19.51	64													
517.12	19.81	65													
						26	13 14 21	35							
516.82	20.12	66													
516.51	20.42	67				27									
516.21	20.73	68													
515.90	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				SANDSTONE: dark yellowish orange, intensely weathered, soft. *(continued)*											
515.60	21.34	70													
						28	10 19 28	47							
515.29	21.64	71													
514.99	21.95	72				29									
514.69	22.25	73													
514.38	22.56	74													
514.08	22.86	75													
						30	10 15 20	35							
513.77	23.16	76													
513.47	23.47	77				31									
513.16	23.77	78													
512.86	24.08	79													
512.55	24.38	80													
						32	19 45 50/3								
512.25	24.69	81													
						33									
511.94	24.99	82													
511.64	25.30	83													
511.33	25.60	84													
511.03	25.91	85													
						34	14 23 30	53							
510.72	26.21	86													
510.42	26.52	87				35									
510.11	26.82	88													
509.81	27.13	89													
509.50	27.43	90													
						36	50/6								
509.20	27.74	91				37									
508.89	28.04	92													
508.59	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
508.28	28.65	94		SANDSTONE: dark yellowish orange, intensely weathered, soft. *(continued)*											
507.98	28.96	95				38									
507.67	29.26	96													
507.37	29.57	97													
507.07	29.87	98													
506.76	30.18	99													
506.46	30.48	100			X	39	50/4								
506.15	30.78	101		Bottom of Hole at 30.57 m (100.3 ft) on 9-6-06											
505.85	31.09	102													
505.54	31.39	103													
505.24	31.70	104													
504.93	32.00	105													
504.63	32.31	106													
504.32	32.61	107													
504.02	32.92	108													
503.71	33.22	109													
503.41	33.53	110													
503.10	33.83	111													
502.80	34.14	112													
502.49	34.44	113													
502.19	34.75	114													
501.88	35.05	115													
501.58	35.36	116													
501.27	35.66	117													
500.97	35.97	118													

Equipment:	Station/KP:	Boring ID.:
CME 750		B-2
Hammer:	Offset Distance/Line:	Date Completed:
CME automatic		9-7-06
Drilling Method:	North/East:	Hole Diameter:
Rotary wash, open-ended punch core bit		94mm
Sampling Method:	Ground Surface Elevation:	Total Depth:
	~527.5m	30.9m
Notes:	~Depth to GW/date measured:	Logged By:
	15.4m on 10-12-06	J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
527.18	0.30	1		Lean CLAY (CL): stiff, yellowish red, moist.		1									
526.88	0.61	2													
526.57	0.91	3													
526.27	1.22	4													
525.96	1.52	5													
525.66	1.83	6				2	10 14 15	29							
525.35	2.13	7		Lean CLAY with GRAVEL (CL): stiff, reddish brown, moist, angular to subangular.		3									
525.05	2.44	8													
524.74	2.74	9													
524.44	3.05	10													
524.13	3.35	11				4	4 5 7	12							
523.83	3.66	12				5									
523.52	3.96	13													
523.22	4.27	14													
522.91	4.57	15		Lean CLAY (CL): stiff, yellowish red, moist.		6	2 3 3	6							
522.61	4.88	16													
522.31	5.18	17				7									
522.00	5.49	18													
521.70	5.79	19													
521.39	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
521.09	6.40	21		SANDY lean CLAY with GRAVEL (CL): medium stiff to stiff, yellowish red, moist, angular to subangular.		8	2 5 9	14							
520.78	6.71	22				9									
520.48	7.01	23													
520.17	7.32	24													
519.87	7.62	25													
519.56	7.92	26				10	3 5 9	14							
519.26	8.23	27				11									
518.95	8.53	28													
518.65	8.84	29													
518.34	9.14	30				12	5 8 11	19							
518.04	9.45	31				13									
517.73	9.75	32													
517.43	10.06	33													
517.12	10.36	34													
516.82	10.67	35				14	4 6 11	17							
516.51	10.97	36				15									
516.21	11.28	37													
515.90	11.58	38													
515.60	11.89	39													
515.29	12.19	40				16	9 8 10	18							
514.99	12.50	41				17									
514.69	12.80	42													
514.38	13.11	43													
514.08	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
513.77	13.72	45		SANDY lean CLAY with GRAVEL (CL): medium stiff to stiff, yellowish red, moist, angular to subangular. *(continued)*											
						18	4 7 8	15							
513.47	14.02	46													
513.16	14.33	47		SANDSTONE: brownish yellow, intensely weathered, moderately soft to soft.		19									
512.86	14.63	48													
512.55	14.94	49													
512.25	15.24	50													
						20	4 8 12	20							
511.94	15.54	51													
511.64	15.85	52				21									
511.33	16.15	53													
511.03	16.46	54													
510.72	16.76	55													
						22	5 9 13	22							
510.42	17.07	56													
510.11	17.37	57				23									
509.81	17.68	58													
509.50	17.98	59													
509.20	18.29	60													
						24	10 11 17	28							
508.89	18.59	61													
508.59	18.90	62				25									
508.28	19.20	63													
507.98	19.51	64													
507.67	19.81	65													
						26	10 12 16	28							
507.37	20.12	66													
507.07	20.42	67				27									
506.76	20.73	68													
506.46	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				SANDSTONE: brownish yellow, intensely weathered, moderately soft to soft. *(continued)*											
506.15	21.34	70													
						28	8 15 25	40							
505.85	21.64	71													
505.54	21.95	72				29									
505.24	22.25	73													
504.93	22.56	74													
504.63	22.86	75													
						30	18 28 50/4.5								
504.32	23.16	76													
504.02	23.47	77				31									
503.71	23.77	78													
503.41	24.08	79													
503.10	24.38	80													
						32	15 40 50/5.5								
502.80	24.69	81													
502.49	24.99	82				33									
502.19	25.30	83													
501.88	25.60	84													
501.58	25.91	85													
						34	18 37 50/4								
501.27	26.21	86													
500.97	26.52	87				35									
500.66	26.82	88													
500.36	27.13	89													
500.05	27.43	90													
499.75	27.74	91				36									
499.45	28.04	92													
499.14	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
498.84	28.65	94		SANDSTONE: brownish yellow, intensely weathered, moderately soft to soft. *(continued)*											
498.53	28.96	95				37									
498.23	29.26	96													
497.92	29.57	97													
497.62	29.87	98													
497.31	30.18	99													
497.01	30.48	100													
496.70	30.78	101				38	32 46 45	91							
496.40	31.09	102		Bottom of Hole at 30.94 m (101.5 ft) on 9-7-06											
496.09	31.39	103													
495.79	31.70	104													
495.48	32.00	105													
495.18	32.31	106													
494.87	32.61	107													
494.57	32.92	108													
494.26	33.22	109													
493.96	33.53	110													
493.65	33.83	111													
493.35	34.14	112													
493.04	34.44	113													
492.74	34.75	114													
492.43	35.05	115													
492.13	35.36	116													
491.83	35.66	117													
491.52	35.97	118													

Equipment: CME 750	Station/KP:	Boring ID.: B-3
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 9-14-06
Drilling Method: Rotary wash, open-ended punch core bit	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~516.3m	Total Depth: 30.5m
Notes:	~Depth to GW/date measured: Not Measured on 9-14-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
515.97	0.30	1		SANDSTONE: browish yellow, very intensely weathered, soft.		1									
515.66	0.61	2													
515.36	0.91	3													
515.05	1.22	4													
514.75	1.52	5			X	2	2 4 6	10							
514.44	1.83	6													
514.14	2.13	7				3									
513.83	2.44	8													
513.53	2.74	9													
513.22	3.05	10			X	4	2 3 5	8							
512.92	3.35	11													
512.61	3.66	12				5									
512.31	3.96	13													
512.00	4.27	14													
511.70	4.57	15		intensely weathered, moderately soft to soft.	X	6	3 3 7	10							
511.39	4.88	16													
511.09	5.18	17				7									
510.78	5.49	18													
510.48	5.79	19													
510.17	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				intensely weathered, moderately soft to soft. *(continued)*	X	8	3 4 8	12							
509.87	6.40	21				9									
509.56	6.71	22													
509.26	7.01	23													
508.96	7.32	24													
508.65	7.62	25			X	10	9 15 21	36							
508.35	7.92	26				11									
508.04	8.23	27													
507.74	8.53	28													
507.43	8.84	29													
507.13	9.14	30			X	12	7 11 15	26							
506.82	9.45	31				13									
506.52	9.75	32													
506.21	10.06	33													
505.91	10.36	34													
505.60	10.67	35			X	14	8 13 25	38							
505.30	10.97	36				15									
504.99	11.28	37													
504.69	11.58	38													
504.38	11.89	39													
504.08	12.19	40			X	16	14 23 46	69							
503.77	12.50	41				17									
503.47	12.80	42													
503.16	13.11	43													
502.86	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
502.55	13.72	45		intensely weathered, moderately soft to soft. *(continued)*											
						18	15 26 40	66							
502.25	14.02	46													
501.94	14.33	47				19			100	100					
501.64	14.63	48													
501.34	14.94	49													
501.03	15.24	50													
						20	15 24 36	60							
500.73	15.54	51													
500.42	15.85	52				21			14	0					
500.12	16.15	53													
499.81	16.46	54													
499.51	16.76	55				22			100	50					
499.20	17.07	56													
498.90	17.37	57													
498.59	17.68	58													
498.29	17.98	59													
497.98	18.29	60		intensely to moderately weathered, moderately soft.		23	36 50/5								
497.68	18.59	61				24			43	0					
497.37	18.90	62													
497.07	19.20	63													
496.76	19.51	64													
496.46	19.81	65				25			70	54					
496.15	20.12	66													
495.85	20.42	67													
495.54	20.73	68													
495.24	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				intensely to moderately weathered, moderately soft. *(continued)*											
494.93	21.34	70			X	26	52/6								
494.63	21.64	71				27			89	78					
494.32	21.95	72													
494.02	22.25	73													
493.72	22.56	74													
493.41	22.86	75				28			114	110					
493.11	23.16	76													
492.80	23.47	77													
492.50	23.77	78													
492.19	24.08	79													
491.89	24.38	80				29			100	85					
491.58	24.69	81													
491.28	24.99	82													
490.97	25.30	83													
490.67	25.60	84													
490.36	25.91	85				30			100	0					
490.06	26.21	86													
489.75	26.52	87													
489.45	26.82	88													
489.14	27.13	89													
488.84	27.43	90													
					X	31	47								
488.53	27.74	91				32	50/3		100	89					
488.23	28.04	92													
487.92	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
487.62	28.65	94		intensely to moderately weathered, moderately soft. *(continued)*											
487.31	28.96	95													
						33			100	0					
487.01	29.26	96													
486.70	29.57	97													
486.40	29.87	98													
486.10	30.18	99													
485.79	30.48	100													
				Bottom of Hole at 30.48 m (100.0 ft) on 9-14-06											
485.49	30.78	101													
485.18	31.09	102													
484.88	31.39	103													
484.57	31.70	104													
484.27	32.00	105													
483.96	32.31	106													
483.66	32.61	107													
483.35	32.92	108													
483.05	33.22	109													
482.74	33.53	110													
482.44	33.83	111													
482.13	34.14	112													
481.83	34.44	113													
481.52	34.75	114													
481.22	35.05	115													
480.91	35.36	116													
480.61	35.66	117													
480.30	35.97	118													

Equipment:	Station/KP:	Boring ID.:
CME 750		B-4
Hammer:	Offset Distance/Line:	Date Completed:
CME automatic		9-20-06
Drilling Method:	North/East:	Hole Diameter:
Rotary wash, open-ended punch core bit		94mm
Sampling Method:	Ground Surface Elevation: ~454.0m	Total Depth: 30.5m
Notes:	~Depth to GW/date measured: 25.7m on 10-12-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
453.69	0.30	1		SANDSTONE: dark yellowish orange, moist, intensely weathered, soft, intensely fractured.		1			100	0					
453.39	0.61	2													
453.09	0.91	3													
452.78	1.22	4													
452.48	1.52	5		soft to moderately soft.		2	16 27 22	49							
452.17	1.83	6													
451.87	2.13	7				3			100	0					
451.56	2.44	8													
451.26	2.74	9													
450.95	3.05	10				4	40 50/3.5								
450.65	3.35	11				5			75	0					
450.34	3.66	12													
450.04	3.96	13													
449.73	4.27	14													
449.43	4.57	15				6			100	0					
449.12	4.88	16													
448.82	5.18	17													
448.51	5.49	18													
448.21	5.79	19													
447.90	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				intensely to moderately weathered, moderately soft, intensely to moderately fractured.		7	50/3.5								
447.60	6.40	21				8			100	15					
447.29	6.71	22													
446.99	7.01	23													
446.68	7.32	24													
446.38	7.62	25		moderately soft to moderately hard.		9			80	0					
446.07	7.92	26													
445.77	8.23	27													
445.47	8.53	28													
445.16	8.84	29													
444.86	9.14	30				10			100	22					
444.55	9.45	31													
444.25	9.75	32													
443.94	10.06	33													
443.64	10.36	34													
443.33	10.67	35		soft to moderately soft, intensely fractured.		11	50/2		100	6					
443.03	10.97	36				12									
442.72	11.28	37													
442.42	11.58	38													
442.11	11.89	39													
441.81	12.19	40		dusky yellow, intensely to moderately weathered, moderately soft to moderately hard, intensely to moderately fractured.		13			100	28					
441.50	12.50	41													
441.20	12.80	42													
440.89	13.11	43													
440.59	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
440.28	13.72	45		dusky yellow, intensely to moderately weathered, moderately soft to moderately hard, intensely to moderately fractured. *(continued)*		14			100	42					
439.98	14.02	46													
439.67	14.33	47													
439.37	14.63	48													
439.06	14.94	49													
438.76	15.24	50		very intensely to intensely fractured.		15			100	10					
438.45	15.54	51													
438.15	15.85	52													
437.85	16.15	53													
437.54	16.46	54													
437.24	16.76	55		moderate yellowish brown, very intensely weathered, soft to very soft.		16			100	0					
436.93	17.07	56													
436.63	17.37	57													
436.32	17.68	58													
436.02	17.98	59													
435.71	18.29	60		moderately weathered, moderately soft to moderately hard.		17			100	36					
435.41	18.59	61													
435.10	18.90	62													
434.80	19.20	63													
434.49	19.51	64													
434.19	19.81	65		intensely to moderately fractured.		18			100	10					
433.88	20.12	66													
433.58	20.42	67													
433.27	20.73	68													
432.97	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				intensely to moderately fractured. *(continued)*											
432.66	21.34	70		moderately to slightly weathered.		19			96	42					
432.36	21.64	71													
432.05	21.95	72													
431.75	22.25	73													
431.44	22.56	74													
431.14	22.86	75				20			100	190					
430.83	23.16	76													
430.53	23.47	77													
430.23	23.77	78													
429.92	24.08	79													
429.62	24.38	80		moderately hard, moderately fractured.		21			100	66					
429.31	24.69	81													
429.01	24.99	82													
428.70	25.30	83													
428.40	25.60	84													
428.09	25.91	85				22			92	46					
427.79	26.21	86													
427.48	26.52	87													
427.18	26.82	88													
426.87	27.13	89													
426.57	27.43	90		moderately to slightly weathered.		23			98	77					
426.26	27.74	91													
425.96	28.04	92													
425.65	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
425.35	28.65	94		moderately to slightly weathered. *(continued)*											
425.04	28.96	95													
						24			98	40					
424.74	29.26	96													
424.43	29.57	97													
424.13	29.87	98													
423.82	30.18	99													
423.52	30.48	100		Bottom of Hole at 30.48 m (100.0 ft) on 9-20-06											
423.21	30.78	101													
422.91	31.09	102													
422.61	31.39	103													
422.30	31.70	104													
422.00	32.00	105													
421.69	32.31	106													
421.39	32.61	107													
421.08	32.92	108													
420.78	33.22	109													
420.47	33.53	110													
420.17	33.83	111													
419.86	34.14	112													
419.56	34.44	113													
419.25	34.75	114													
418.95	35.05	115													
418.64	35.36	116													
418.34	35.66	117													
418.03	35.97	118													

Equipment: CME 750	Station/KP:	Boring ID.: B-5
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 9-27-06
Drilling Method: Rotary wash	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~459.0m	Total Depth: 30.5m
Notes:	~Depth to GW/date measured: Not Measured on 9-27-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
458.69	0.30	1		SILTY SAND (SM): very dense, brownish yellow, moist, weak and moderate cementation.		1									
458.39	0.61	2													
458.08	0.91	3													
457.78	1.22	4													
457.47	1.52	5													
457.17	1.83	6		SANDSTONE: dark yellowish orange, moderately to slightly weathered, moderately hard, intensely to moderately fractured.		2	50/5.25								
456.86	2.13	7				3			92	24					
456.56	2.44	8													
456.26	2.74	9													
455.95	3.05	10													
455.65	3.35	11				4			90	32					
455.34	3.66	12													
455.04	3.96	13													
454.73	4.27	14													
454.43	4.57	15				5			82	28					
454.12	4.88	16													
453.82	5.18	17													
453.51	5.49	18													
453.21	5.79	19													
452.90	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
452.60	6.40	21		SANDSTONE: dark yellowish orange, moderately to slightly weathered, moderately hard, intensely to moderately fractured. *(continued)*		6			98	70					
452.29	6.71	22													
451.99	7.01	23													
451.68	7.32	24													
451.38	7.62	25				7			100	33					
451.07	7.92	26													
450.77	8.23	27													
450.46	8.53	28													
450.16	8.84	29													
449.85	9.14	30		dusky yellow.		8			100	24					
449.55	9.45	31													
449.24	9.75	32													
448.94	10.06	33													
448.64	10.36	34													
448.33	10.67	35				9			74	10					
448.03	10.97	36													
447.72	11.28	37													
447.42	11.58	38													
447.11	11.89	39													
446.81	12.19	40				10			70	15					
446.50	12.50	41													
446.20	12.80	42													
445.89	13.11	43													
445.59	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
445.28	13.72	45		dusky yellow. *(continued)*											
444.98	14.02	46				11			96	7					
444.67	14.33	47													
444.37	14.63	48													
444.06	14.94	49													
443.76	15.24	50													
443.45	15.54	51				12			82	0					
443.15	15.85	52													
442.84	16.15	53													
442.54	16.46	54													
442.23	16.76	55		intensely fractured.		13			90	7					
441.93	17.07	56													
441.62	17.37	57													
441.32	17.68	58													
441.02	17.98	59													
440.71	18.29	60				14			100	8					
440.41	18.59	61													
440.10	18.90	62													
439.80	19.20	63													
439.49	19.51	64													
439.19	19.81	65		dark yellowish orange, very intensely weathered, moderately hard and soft.		15			100	8					
438.88	20.12	66													
438.58	20.42	67													
438.27	20.73	68													
437.97	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				dark yellowish orange, very intensely weathered, moderately hard and soft. *(continued)*											
437.66	21.34	70				16			100	24					
437.36	21.64	71		dusky yellow, intensely to moderately weathered, moderately hard to moderately soft, intensely to moderately fractured.											
437.05	21.95	72													
436.75	22.25	73													
436.44	22.56	74													
436.14	22.86	75				17			100	13					
435.83	23.16	76													
435.53	23.47	77													
435.22	23.77	78													
434.92	24.08	79													
434.61	24.38	80				18			100	0					
				moderately to slightly weathered, moderately hard, very intensely to intensely fractured.											
434.31	24.69	81													
434.00	24.99	82													
433.70	25.30	83													
433.40	25.60	84													
433.09	25.91	85				19			100	28					
				moderate yellowish brown, slightly weathered, moderately hard to hard, intensely to moderately fractured.											
432.79	26.21	86													
432.48	26.52	87													
432.18	26.82	88													
431.87	27.13	89													
431.57	27.43	90				20			100	7					
431.26	27.74	91													
430.96	28.04	92													
430.65	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
430.35	28.65	94		moderate yellowish brown, slightly weathered, moderately hard to hard, intensely to moderately fractured. *(continued)*											
430.04	28.96	95		intensely weathered, moderately soft, very intensely to intensely fractured.		21			100	0					
429.74	29.26	96													
429.43	29.57	97													
429.13	29.87	98													
428.82	30.18	99													
428.52	30.48	100		Bottom of Hole at 30.48 m (100.0 ft) on 9-27-06											
428.21	30.78	101													
427.91	31.09	102													
427.60	31.39	103													
427.30	31.70	104													
426.99	32.00	105													
426.69	32.31	106													
426.38	32.61	107													
426.08	32.92	108													
425.78	33.22	109													
425.47	33.53	110													
425.17	33.83	111													
424.86	34.14	112													
424.56	34.44	113													
424.25	34.75	114													
423.95	35.05	115													
423.64	35.36	116													
423.34	35.66	117													
423.03	35.97	118													

Equipment: CME 750	Station/KP:	Boring ID.: B-6
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 9-29-06
Drilling Method: Rotary wash	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~500.1m	Total Depth: 30.5m
Notes:	~Depth to GW/date measured: Not Measured on 6-29-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
499.81	0.30	1		SANDSTONE: dark yellowish orange, very intensely weathered, soft.		1									
499.51	0.61	2													
499.20	0.91	3													
498.90	1.22	4													
498.59	1.52	5		decomposed, very soft.	X	2	8 12 16	28							
498.29	1.83	6													
497.98	2.13	7				3									
497.68	2.44	8													
497.37	2.74	9													
497.07	3.05	10		very intensely weathered, soft.	X	4	35 51/6								
496.76	3.35	11				5									
496.46	3.66	12													
496.15	3.96	13													
495.85	4.27	14													
495.54	4.57	15													
495.24	4.88	16			X	6	30 50/4.5								
494.93	5.18	17				7			85	85					
494.63	5.49	18													
494.32	5.79	19													
494.02	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				soft to moderately soft.		8			100	80					
493.72	6.40	21													
493.41	6.71	22													
493.11	7.01	23													
492.80	7.32	24													
492.50	7.62	25		intensely weathered.		9			100	54					
492.19	7.92	26													
491.89	8.23	27													
491.58	8.53	28													
491.28	8.84	29													
490.97	9.14	30		dusky yellow, intensely to moderately weathered, moderately soft, intensely fractured.		10			92	0					
490.67	9.45	31													
490.36	9.75	32													
490.06	10.06	33													
489.75	10.36	34													
489.45	10.67	35				11			96	72					
489.14	10.97	36													
488.84	11.28	37		dark yellowish orange, moderately to slightly weathered, moderately hard, intensely to moderately fractured.											
488.53	11.58	38													
488.23	11.89	39													
487.92	12.19	40				12			96	19					
487.62	12.50	41													
487.31	12.80	42													
487.01	13.11	43													
486.70	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
486.40	13.72	45		moderate yellowish brown, moderately to slightly weathered, moderately hard to hard, intensely to moderately fractured.		13			92	33					
486.10	14.02	46													
485.79	14.33	47													
485.49	14.63	48													
485.18	14.94	49													
484.88	15.24	50		intensely fractured.		14			84	0					
484.57	15.54	51													
484.27	15.85	52													
483.96	16.15	53													
483.66	16.46	54													
483.35	16.76	55		dark yellowish orange, intensely to moderately weathered, moderately soft to moderately hard, very slightly fractured.		15			56	0					
483.05	17.07	56													
482.74	17.37	57													
482.44	17.68	58													
482.13	17.98	59													
481.83	18.29	60		moderately soft, very intensely to intensely fractured.		16			76	0					
481.52	18.59	61													
481.22	18.90	62													
480.91	19.20	63													
480.61	19.51	64													
480.30	19.81	65				17			74	0					
480.00	20.12	66													
479.69	20.42	67													
479.39	20.73	68													
479.08	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				moderately soft, very intensely to intensely fractured. *(continued)*											
478.78	21.34	70													
				dark yellowish orange, intensely weathered, soft to moderately soft.		18			100	18					
478.48	21.64	71													
478.17	21.95	72													
477.87	22.25	73													
477.56	22.56	74													
477.26	22.86	75				19			100	0					
476.95	23.16	76													
476.65	23.47	77													
476.34	23.77	78													
476.04	24.08	79													
475.73	24.38	80													
				moderate yellowish brown, moderately to slightly weathered, moderately hard to hard, intensely to moderately fractured.		20			98	19					
475.43	24.69	81													
475.12	24.99	82													
474.82	25.30	83													
474.51	25.60	84													
474.21	25.91	85													
				intensely to moderately weathered, moderately soft to moderately hard.		21			96	38					
473.90	26.21	86													
473.60	26.52	87													
473.29	26.82	88													
472.99	27.13	89													
472.68	27.43	90													
						22			100	0					
472.38	27.74	91													
472.07	28.04	92													
471.77	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
471.46	28.65	94		intensely to moderately weathered, moderately soft to moderately hard. *(continued)*											
471.16	28.96	95		moderately to slightly weathered, moderately hard, intensely to moderately fractured.		23			100	0					
470.86	29.26	96													
470.55	29.57	97													
470.25	29.87	98													
469.94	30.18	99													
469.64	30.48	100		Bottom of Hole at 30.48 m (100.0 ft) on 9-29-06											
469.33	30.78	101													
469.03	31.09	102													
468.72	31.39	103													
468.42	31.70	104													
468.11	32.00	105													
467.81	32.31	106													
467.50	32.61	107													
467.20	32.92	108													
466.89	33.22	109													
466.59	33.53	110													
466.28	33.83	111													
465.98	34.14	112													
465.67	34.44	113													
465.37	34.75	114													
465.06	35.05	115													
464.76	35.36	116													
464.45	35.66	117													
464.15	35.97	118													

Equipment: CME 750	Station/KP:	Boring ID.: B-7
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 10-2-06
Drilling Method: Rotary wash	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~496.8m	Total Depth: 25.9m
Notes:	~Depth to GW/date measured: Not Measured on 10-2-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
496.52	0.30	1		SANDY SILT (SM): loose, dark yellowish brown, dry.		1									
496.21	0.61	2													
495.91	0.91	3													
495.60	1.22	4													
495.30	1.52	5		SANDSTONE: dark yellowish orange, very intensely weathered, very soft, rootlets.		2	1 2 6	8							
495.00	1.83	6													
494.69	2.13	7				3									
494.39	2.44	8													
494.08	2.74	9													
493.78	3.05	10		moderate yellowish brown, moderately to slightly weathered, moderately soft to moderately hard, intensely to moderately fractured.		4	50/5								
493.47	3.35	11				5			91	16					
493.17	3.66	12													
492.86	3.96	13													
492.56	4.27	14													
492.25	4.57	15		slightly weathered, moderately hard to hard.		6			100	18					
491.95	4.88	16													
491.64	5.18	17													
491.34	5.49	18													
491.03	5.79	19													
490.73	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				slightly weathered, moderately hard to hard. *(continued)*		7			100	8					
490.42	6.40	21													
490.12	6.71	22													
489.81	7.01	23													
489.51	7.32	24													
489.20	7.62	25		intensely fractured.		8			100	0					
488.90	7.92	26													
488.59	8.23	27													
488.29	8.53	28													
487.98	8.84	29													
487.68	9.14	30		hard.		9			100	8					
487.38	9.45	31													
487.07	9.75	32													
486.77	10.06	33													
486.46	10.36	34													
486.16	10.67	35				10			100	15					
485.85	10.97	36													
485.55	11.28	37													
485.24	11.58	38													
484.94	11.89	39													
484.63	12.19	40				11			100	7					
484.33	12.50	41													
484.02	12.80	42													
483.72	13.11	43													
483.41	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
483.11	13.72	45		hard. *(continued)*											
				moderately fractured.		12			98	67					
482.80	14.02	46													
482.50	14.33	47													
482.19	14.63	48		SANDSTONE: light olive gray, slightly weathered, hard, moderately to slightly fractured.											
481.89	14.94	49													
481.58	15.24	50				13			100	82					
481.28	15.54	51													
480.97	15.85	52													
480.67	16.15	53													
480.36	16.46	54													
480.06	16.76	55		moderately fractured.		14			100	38					
479.76	17.07	56													
479.45	17.37	57													
479.15	17.68	58													
478.84	17.98	59													
478.54	18.29	60		intensely to moderately fractured.		15			100	26					
478.23	18.59	61													
477.93	18.90	62													
477.62	19.20	63													
477.32	19.51	64													
477.01	19.81	65				16			89	16					
476.71	20.12	66													
476.40	20.42	67													
476.10	20.73	68													
475.79	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				intensely to moderately fractured. *(continued)*											
475.49	21.34	70		greenish gray.		17			100	14					
475.18	21.64	71													
474.88	21.95	72													
474.57	22.25	73													
474.27	22.56	74													
473.96	22.86	75				18			100	59					
473.66	23.16	76													
473.35	23.47	77													
473.05	23.77	78													
472.74	24.08	79													
472.44	24.38	80		very intensely to intensely fractured.		19			100	80					
472.14	24.69	81													
471.83	24.99	82													
471.53	25.30	83													
471.22	25.60	84													
470.92	25.91	85		Bottom of Hole at 25.91 m (85.0 ft) on 10-2-06											
470.61	26.21	86													
470.31	26.52	87													
470.00	26.82	88													
469.70	27.13	89													
469.39	27.43	90													
469.09	27.74	91													
468.78	28.04	92													
468.48	28.35	93													

Equipment: CME 750	Station/KP:	Boring ID.: B-8
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 10-4-06
Drilling Method: Rotary wash	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~497.9m	Total Depth: 22.1m
Notes:	~Depth to GW/date measured: Not Measured on 10-4-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
497.62	0.30	1		SILTY SAND (SM): very dense, dark yellowish brown, moist, weak and moderate cementation, and rootlets.		1									
497.31	0.61	2													
497.01	0.91	3													
496.70	1.22	4													
496.40	1.52	5		SANDSTONE: dark yellowish orange, very intensely weathered, soft.		2	12 45 50/3								
496.09	1.83	6													
495.79	2.13	7				3			80	0					
495.48	2.44	8													
495.18	2.74	9													
494.87	3.05	10		light olive gray, intensely to moderately weathered, moderately soft to moderately hard, intensely fractured.		4	21 36 50/3								
494.57	3.35	11													
494.26	3.66	12				5			100	0					
493.96	3.96	13													
493.65	4.27	14													
493.35	4.57	15		moderately to slightly weathered, intensely to moderately fractured.		6			94	25					
493.04	4.88	16													
492.74	5.18	17													
492.43	5.49	18													
492.13	5.79	19													
491.83	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				hard, intensely fractured.		7			97	0					
491.52	6.40	21													
491.22	6.71	22													
490.91	7.01	23													
490.61	7.32	24													
490.30	7.62	25				8			103	10					
490.00	7.92	26													
489.69	8.23	27													
489.39	8.53	28													
489.08	8.84	29													
488.78	9.14	30				9			100	8					
488.47	9.45	31													
488.17	9.75	32													
487.86	10.06	33													
487.56	10.36	34													
487.25	10.67	35				10			92	8					
486.95	10.97	36													
486.64	11.28	37													
486.34	11.58	38													
486.03	11.89	39													
485.73	12.19	40				11			94	7					
485.42	12.50	41													
485.12	12.80	42													
484.81	13.11	43													
484.51	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
484.21	13.72	45		hard, intensely fractured. *(continued)*											
				dark olive gray, slightly weathered, intensely to moderately fractured.		12			103	39					
483.90	14.02	46													
483.60	14.33	47													
483.29	14.63	48													
482.99	14.94	49													
482.68	15.24	50		very intensely to intensely fractured.		13			100	9					
482.38	15.54	51													
482.07	15.85	52													
481.77	16.15	53													
481.46	16.46	54													
481.16	16.76	55				14			110	0					
480.85	17.07	56													
480.55	17.37	57													
480.24	17.68	58													
479.94	17.98	59													
479.63	18.29	60		very intensely fractured.		15			90	0					
479.33	18.59	61													
479.02	18.90	62													
478.72	19.20	63													
478.41	19.51	64													
478.11	19.81	65				16			110	11					
477.80	20.12	66													
477.50	20.42	67													
477.19	20.73	68													
476.89	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				very intensely fractured. *(continued)*											
476.59	21.34	70		very intensely to intensely fractured.		17			100	0					
476.28	21.64	71													
475.98	21.95	72													
475.67	22.25	73		Bottom of Hole at 22.10 m (72.5 ft) on 10-4-06											
475.37	22.56	74													
475.06	22.86	75													
474.76	23.16	76													
474.45	23.47	77													
474.15	23.77	78													
473.84	24.08	79													
473.54	24.38	80													
473.23	24.69	81													
472.93	24.99	82													
472.62	25.30	83													
472.32	25.60	84													
472.01	25.91	85													
471.71	26.21	86													
471.40	26.52	87													
471.10	26.82	88													
470.79	27.13	89													
470.49	27.43	90													
470.18	27.74	91													
469.88	28.04	92													
469.57	28.35	93													

Equipment: CME 750	Station/KP:	Boring ID.: B-9
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 10-10-06
Drilling Method: Rotary wash	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~480.5m	Total Depth: 30.5m
Notes:	~Depth to GW/date measured: 12.7m on 10-10-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
480.21	0.30	1		SANDSTONE: dark yellowish orange, intensely weathered, soft to moderately soft.		1									
479.91	0.61	2													
479.60	0.91	3													
479.30	1.22	4													
478.99	1.52	5													
						2	36 50/3								
478.69	1.83	6				3			102	0					
478.38	2.13	7													
478.08	2.44	8													
477.77	2.74	9													
477.47	3.05	10		very intensely weathered, soft to moderately hard.		4			104	0					
477.16	3.35	11													
476.86	3.66	12													
476.55	3.96	13													
476.25	4.27	14													
475.95	4.57	15				5			102	0					
475.64	4.88	16													
475.34	5.18	17													
475.03	5.49	18													
474.73	5.79	19													
474.42	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				very intensely weathered, soft to moderately hard. *(continued)*		6			100	53					
474.12	6.40	21													
473.81	6.71	22													
473.51	7.01	23													
473.20	7.32	24													
472.90	7.62	25		moderate yellowish brown, intensely to moderately weathered, moderately soft to moderately hard.		7			93	43					
472.59	7.92	26													
472.29	8.23	27													
471.98	8.53	28													
471.68	8.84	29													
471.37	9.14	30				8			100	25					
471.07	9.45	31													
470.76	9.75	32													
470.46	10.06	33													
470.15	10.36	34													
469.85	10.67	35		moderately to slightly weathered, moderately hard to hard, intensely to moderately fractured.		9			105	50					
469.54	10.97	36													
469.24	11.28	37													
468.93	11.58	38													
468.63	11.89	39													
468.33	12.19	40				10			100	46					
468.02	12.50	41													
467.72	12.80	42													
467.41	13.11	43													
467.11	13.41	44													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
466.80	13.72	45		light olive brown, slightly weathered, hard, moderately fractured.		11			102	54					
466.50	14.02	46													
466.19	14.33	47													
465.89	14.63	48													
465.58	14.94	49													
465.28	15.24	50				12			100	58					
464.97	15.54	51													
464.67	15.85	52													
464.36	16.15	53													
464.06	16.46	54													
463.75	16.76	55		dusky yellow.		13			100	68					
463.45	17.07	56													
463.14	17.37	57													
462.84	17.68	58													
462.53	17.98	59													
462.23	18.29	60				14			100	60					
461.92	18.59	61													
461.62	18.90	62													
461.31	19.20	63													
461.01	19.51	64													
460.71	19.81	65				15			100	23					
460.40	20.12	66													
460.10	20.42	67													
459.79	20.73	68													
459.49	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				dusky yellow. *(continued)*											
459.18	21.34	70		moderate yellowish brown, intensely to moderately fractured.		16			100	39					
458.88	21.64	71													
458.57	21.95	72													
458.27	22.25	73													
457.96	22.56	74													
457.66	22.86	75		intensely fractured.		17			100	9					
457.35	23.16	76													
457.05	23.47	77													
456.74	23.77	78													
456.44	24.08	79													
456.13	24.38	80		intensely to moderately fractured.		18			100	40					
455.83	24.69	81													
455.52	24.99	82													
455.22	25.30	83													
454.91	25.60	84													
454.61	25.91	85				19			100	65					
454.30	26.21	86													
454.00	26.52	87													
453.69	26.82	88		moderately to slightly weathered, soft to moderately hard.											
453.39	27.13	89													
453.09	27.43	90				20			98	55					
452.78	27.74	91													
452.48	28.04	92													
452.17	28.35	93													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
451.87	28.65	94		moderately to slightly weathered, soft to moderately hard. *(continued)*											
451.56	28.96	95													
						21			100	20					
451.26	29.26	96													
450.95	29.57	97													
450.65	29.87	98		light olive gray, slightly weathered, hard.											
450.34	30.18	99													
450.04	30.48	100													
				Bottom of Hole at 30.48 m (100.0 ft) on 10-10-06											
449.73	30.78	101													
449.43	31.09	102													
449.12	31.39	103													
448.82	31.70	104													
448.51	32.00	105													
448.21	32.31	106													
447.90	32.61	107													
447.60	32.92	108													
447.29	33.22	109													
446.99	33.53	110													
446.68	33.83	111													
446.38	34.14	112													
446.07	34.44	113													
445.77	34.75	114													
445.47	35.05	115													
445.16	35.36	116													
444.86	35.66	117													
444.55	35.97	118													

Equipment: CME 750	Station/KP:	Boring ID.: B-10
Hammer: CME automatic	Offset Distance/Line:	Date Completed: 10-12-06
Drilling Method: Rotary wash	North/East:	Hole Diameter: 94mm
Sampling Method:	Ground Surface Elevation: ~484.4m	Total Depth: 25.1m
Notes:	~Depth to GW/date measured: Not Measured on 10-12-06	Logged By: J. Kaump

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
484.05	0.30	1		Lean CLAY (CL): firm, strong brown, moist, rootlets.		1									
483.75	0.61	2													
483.44	0.91	3													
483.14	1.22	4													
482.83	1.52	5		hard.		2	7 11 8	19							
482.53	1.83	6													
482.22	2.13	7				3									
481.92	2.44	8													
481.61	2.74	9													
481.31	3.05	10		CLAYSTONE: yellowish gray, very intensely weathered, very soft to soft, very intensely fractured.		4	13 22 43	65							
481.00	3.35	11													
480.70	3.66	12				5									
480.40	3.96	13													
480.09	4.27	14													
479.79	4.57	15		light olive gray.		6	19 31 33	64							
479.48	4.88	16													
479.18	5.18	17				7									
478.87	5.49	18													
478.57	5.79	19													
478.26	6.10	20													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				SILTSTONE: dusky yellow, intensely weathered, soft, very intensely fractured.		8	23 38 44	82							
477.96	6.40	21													
477.65	6.71	22				9									
477.35	7.01	23													
477.04	7.32	24													
476.74	7.62	25													
						10	36 35 46	81							
476.43	7.92	26													
476.13	8.23	27				11									
475.82	8.53	28													
475.52	8.84	29													
475.21	9.14	30		light olive gray, intensely to moderately weathered, moderately soft to moderately hard, very intensely fractured.											
						12	29 50/4								
474.91	9.45	31				13			98	72					
474.60	9.75	32													
474.30	10.06	33													
473.99	10.36	34													
473.69	10.67	35													
						14			85	0					
473.38	10.97	36													
473.08	11.28	37		SANDSTONE: dark greenish gray, slightly weathered, hard, very intensely fractured.											
472.78	11.58	38													
472.47	11.89	39													
472.17	12.19	40		medium bluish gray, slightly weathered to fresh, hard, very intensely to intensely fractured.		15			93	0					
471.86	12.50	41													
471.56	12.80	42													
471.25	13.11	43													
470.95	13.41	44				16			81	0					

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m^3)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
470.64	13.72	45		very intensely fractured.											
470.34	14.02	46													
470.03	14.33	47													
						17			69	0					
469.73	14.63	48													
469.42	14.94	49													
469.12	15.24	50		intensely to moderately fractured.		18			81	19					
468.81	15.54	51													
468.51	15.85	52													
468.20	16.15	53													
467.90	16.46	54		very intensely fractured.		19			22	0					
467.59	16.76	55													
467.29	17.07	56													
466.98	17.37	57				20			76	0					
466.68	17.68	58													
466.37	17.98	59													
466.07	18.29	60				21			65	0					
465.76	18.59	61													
465.46	18.90	62													
465.16	19.20	63													
464.85	19.51	64													
464.55	19.81	65				22			42	0					
464.24	20.12	66													
463.94	20.42	67				23			78	0					
463.63	20.73	68													
463.33	21.03	69													

(continued)

ELEVATION (m)	DEPTH (m)	DEPTH (ft)	Graphic Log	Description	Sample Type	Sample Number	Sample Blows	Blows per Foot	Recovery (%)	RQD (%)	w/c (%)	Dry Density (kN/m³)	Shear Strength (kPa)	Drilling Method/ Casing	Remarks
				very intensely fractured. *(continued)*											
463.02	21.34	70				24			102	0					
462.72	21.64	71													
462.41	21.95	72													
462.11	22.25	73													
461.80	22.56	74				25			67	0					
461.50	22.86	75													
461.19	23.16	76													
460.89	23.47	77													
460.58	23.77	78		intensely fractured.		26			88	0					
460.28	24.08	79													
459.97	24.38	80				27			83	15					
459.67	24.69	81													
459.36	24.99	82													
459.06	25.30	83		Bottom of Hole at 25.15 m (82.5 ft) on 10-12-06											
458.75	25.60	84													
458.45	25.91	85													
458.14	26.21	86													
457.84	26.52	87													
457.54	26.82	88													
457.23	27.13	89													
456.93	27.43	90													
456.62	27.74	91													
456.32	28.04	92													
456.01	28.35	93													

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: **REID BUELL**
Senior, Engineering Geologist, Branch D
Geotechnical Design North
Division of Engineering Services

Attn: Joseph Kaump

Date: April 20, 2007

File: 01-MEN-101-51PM
01-262001

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES-MS#5

Subject: Seismic Investigation at Oil Well Hill (Willits Bypass)

Introduction

This report documents the results of a seismic refraction investigation to determine rippability values and earthwork factors of three sites being evaluated for potential borrow sites. Plans indicate site three has been identified as a good borrow area.

Results and Conclusions

Seismic data from Site 3 did not image unrippable material in any of the six profiles surveyed except Line 3, near Boring B-10, (elevation 484.36). Figure 1 shows the approximate locations of the six seismic profiles. Unrippable material was detected 6.30 meters below the surface at Line 3. The elevation of that velocity layer is below the existing road grade of Highway 101. Plans indicate the borrow site will not be excavated to this elevation. Therefore, all material above the present elevation of Highway 101 should be rippable.

Our other findings are as follows. One seismic line was acquired between borings B-6 and B-7 at Site 2. Data indicate unrippable material was detected 10 to 15 meters below the surface. One seismic line was acquired at Site 1. Data indicates unrippable material was imaged approximately 3.0 meters below the surface.

Earthwork Factor

The earthwork factor for a highway-grading project is the ratio of embankment to excavation volume. A factor of 1.0 indicates no volumetric change from excavation to emplacement. This is an empirical correlation between the seismic velocity of rock and their earthwork factors. Earthwork factors were derived from the seismic velocity data and are summarized along with

rippability values in table 1. below. Earthwork factors are based on published Caltrans studies (Stephens, 1978) and are extrapolated if necessary.

Line Number	Layer	Average Thickness (m)	Average Velocity (m/s)	Inferred Material	Earthwork Factor	Rippability
1	1	8.0	400	Soil/Saprolite	0.92	ER
1	2	NA	1073	Weathered Sandstone	1.05	ER
2	1	4.5	369	Soil/Saprolite	0.92	ER
2	2	NA	1208	Weathered Sandstone	1.05	MD
3	1	1.5	350	Soil/Saprolite	0.92	ER
3	2	4.8	770	Weathered Sandstone	1.00	ER
3	3	NA	2684	Sandstone	1.18	NR
4	1	1.5	335	Soil	0.92	ER
4	2	6.3	704	Weathered Sandstone	1.00	ER
4	3	NA	1845	Sandstone	1.13	DR
5	1	2.3	234	Fill	NA	ER
5	2	NA	475	Weathered Sandstone	0.93	ER
6	1	3.3	436	Soil	0.93	ER
6	2	NA	1342	Weathered Sandstone	1.08	MD
7	1	3.6	400	Soil	0.93	ER
7	2	NA	2248	Sandstone	1.15	NR
8	1	2.4	436	Soil	0.93	NA
8	2	5.0	973	Weathered Sandstone	1.02	ER
8	3	NA	2013	Sandstone	1.14	NR

[1] ER = Easily Ripped, MD = Moderately Difficult, DR = Difficult Ripping, NR = Not Rippable, NA = Not Applicable.

Table 1: Summary of refraction interpretation results for Oil Well Hill including earthwork factors.

Ripping ability is based on unpublished Caltrans data for a Caterpillar D9G series bulldozer with a single-tooth ripper. These values are as follows:

Velocity (m/s)	Rippability
<1050	Easily Ripped
1050-1500	Moderately Difficult
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Different excavation equipment may experience different results. Penetrating efficacy of the ripping tooth is often more important in predicting ripping success than seismic velocity alone. Undetected blocks or lenses of high-velocity material may also be present within rippable zones, requiring blasting or other means of mechanical breakage for excavation.

Data Acquisition and Processing

Seismic refraction data were recorded using an EG&G Smartseis 24channel seismograph with 14 MHz geophones. The profiles were 36 or 48 meters long.

A striker plate was used as the energy source for the survey. The striker plate is placed on the ground surface and is struck with a sledgehammer until sufficient energy is recorded. During data acquisition, the profile geometry (shot and geophone locations) was recorded and stored in seismograph memory. Refraction data from each shot were also stored in the seismograph's
Five shots were recorded for each profile. Both profile geometry and refraction data were backed-up to paper and floppy disk upon completion of the survey. The attached aerial photos show the general locations and orientations of the seismic refraction profiles.

Interpretation of the survey results used the Generalized Reciprocal Method of refraction interpretation where possible (GRM; Palmer, 1980). The method can accommodate variation in refractor velocity and depth along the seismic line, is relatively insensitive to refractor dip (up to 20 degrees), and can accommodate hidden layer conditions (where supporting borehole data exist).

The Viewseis computer program was used to analyze and interpret the refraction data. This is a commercially developed program that uses the GRM method for interpretation and presentation of refraction data. This method calculates refractor depths for each geophone location, using overlapping refraction arrival times from both forward and reverse shots. Accuracy of the GRM method relies on data from both forward and reverse shots, and on the selection of an optimum XY value. XY is defined as the distance of separation, measured at the surface, where forward and reverse seismic waves originate from the same point on the refractor. Where incomplete refractor coverage exists, the refractor can be modeled using the standard intercept-time method of interpretation (ITM), but with comparatively reduced accuracy. ITM models typically are less robust and tend to overestimate seismic velocity.

In addition to the intercept-time method of interpretation, two methods of GRM interpretation can be used: the approximate velocity (AP) and the average velocity (AV) method. The approximate velocity method is relatively insensitive to selection of the optimum XY. However, this method requires that every refractor above the target be defined. The average velocity method is very sensitive to optimum XY selection and is, therefore, normally used only where supporting borehole information exists. However, the average velocity method does not require that every refractor above the target be known. The type of line drawn for the refractor represents the method used for interpretation. ITM interpretations are shown as a solid line, GRM interpretations are drawn as a series of arcs—the envelope formed by the locus of interconnecting points at the base of these arcs represents the "best fit" model for the refractor.

The refraction data were transferred from the seismograph to the Viewseis program via floppy disks. Utilizing the Viewseis program, initial P-wave arrivals were picked for the seismic line and refractor layers assigned. GRM analyses were then performed. Layer velocities, thicknesses, and rippabilities are summarized in Table 1. Average velocities and thicknesses are approximate and were estimated from velocity models and depth sections.

Profiles in this report are presented in terms of velocity units. A velocity unit is a three-dimensional unit, which due to its elastic properties and density, propagates seismic waves at a characteristic velocity or within a characteristic velocity range. Velocities denoted in this report and in the seismic refraction sections are expressed in meters per second. At least one velocity is present within a geological rock unit. In addition, each zone of weathering, or fracturing within that geological unit can constitute its own velocity unit. Conversely, when two rock units such as water saturated gravel and moderately weathered rock propagate seismic waves at the same velocity and are adjacent to each other, both units would be part of the same velocity unit. Lastly, discontinuous velocities might result from variation in the degree of alteration in the form of physical and chemical weathering and should be considered in the interpretation of the data. Thank you for the opportunity to work on this project. If you have any questions or need additional assistance, please contact me at (916) 227-1307 or Bill Owen at (916) 227-0227.

Report by:

Dennison Leeds
Engineering Geologist
Geophysics and Geology Branch

Reviewed By:

William Owen, CEG 1735
Chief, Geophysics and Geology Branch

PROFESSIONAL GEOLOGIST
W.P. OWEN
NO. 1735
Exp. 3/08
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

References

Stephens, E., 1978, Calculating earthwork factors using seismic velocities, California Department of Transportation, Report No. FHWA-CA-TL-78-23

c: Project File.
dl/WO/01_MEN_101_51.0_2007_SEI.

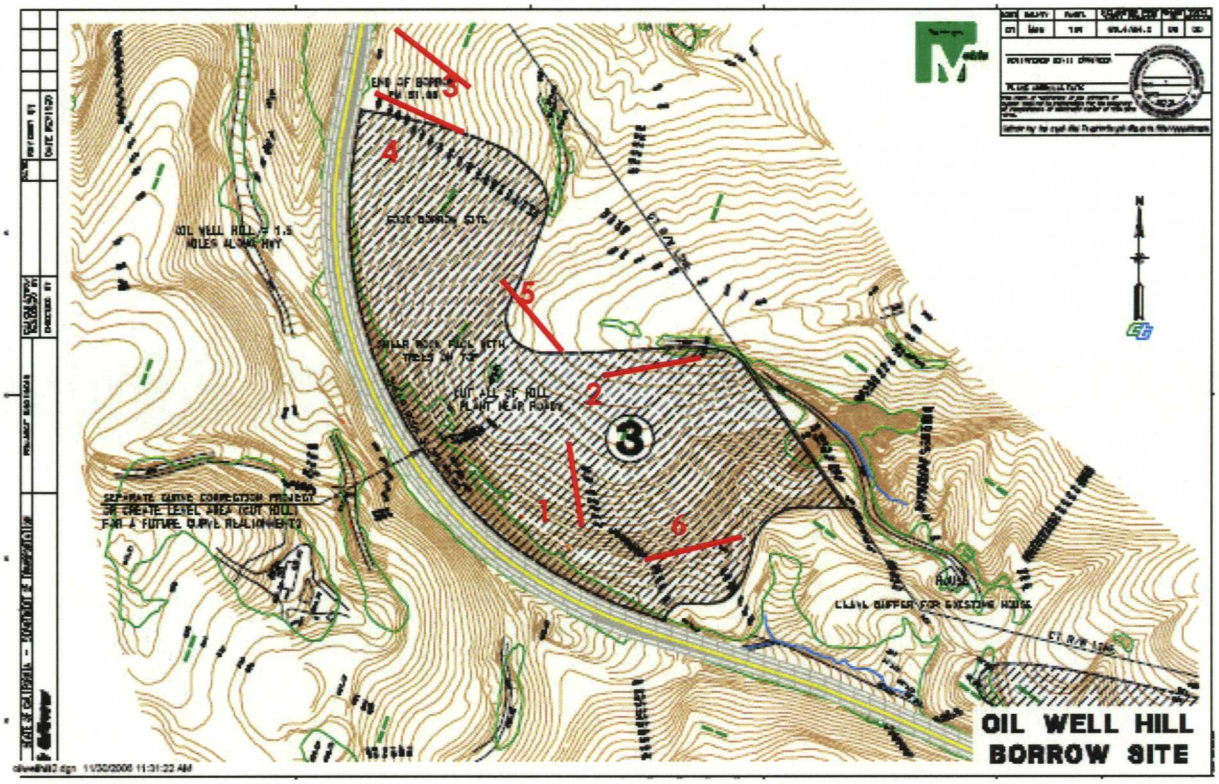

Figure 1. Approximate locations of the seismic lines surveyed in Site 3.

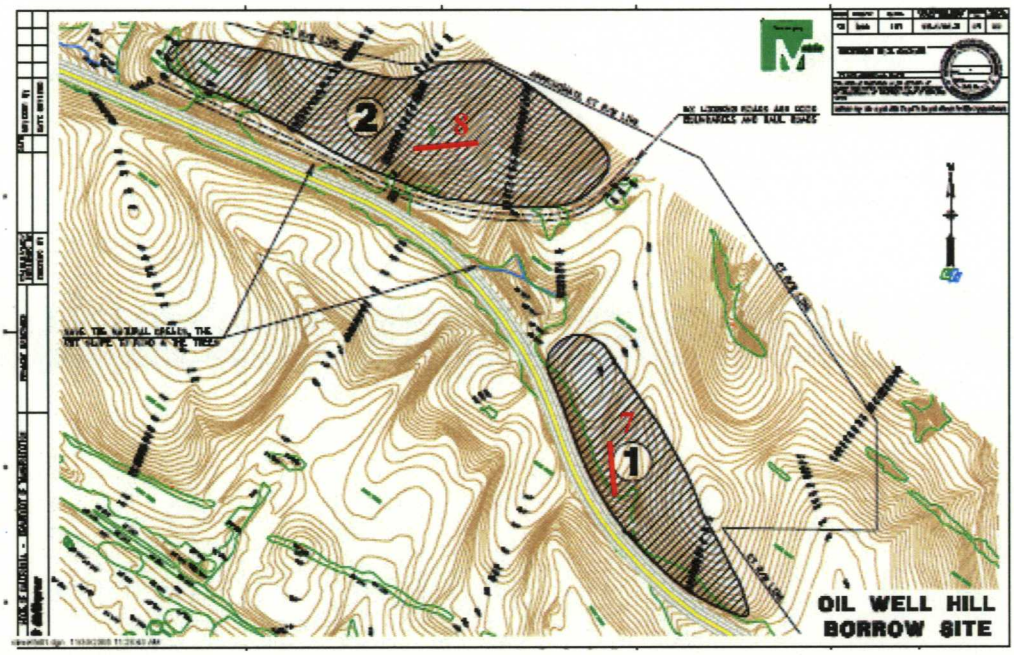

Figure 2. Approximate locations of the seismic lines surveyed at Sites 1 and 2.

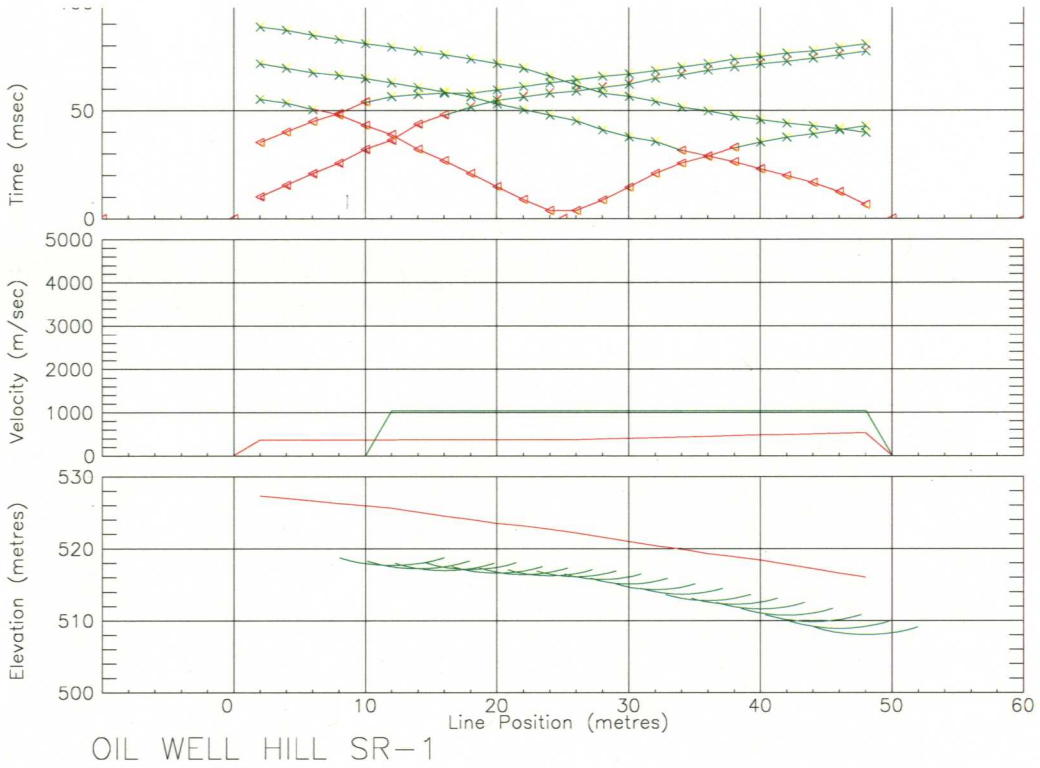

Figure 3 Travel-time curve, velocity model and depth section for Seismic Line 1.

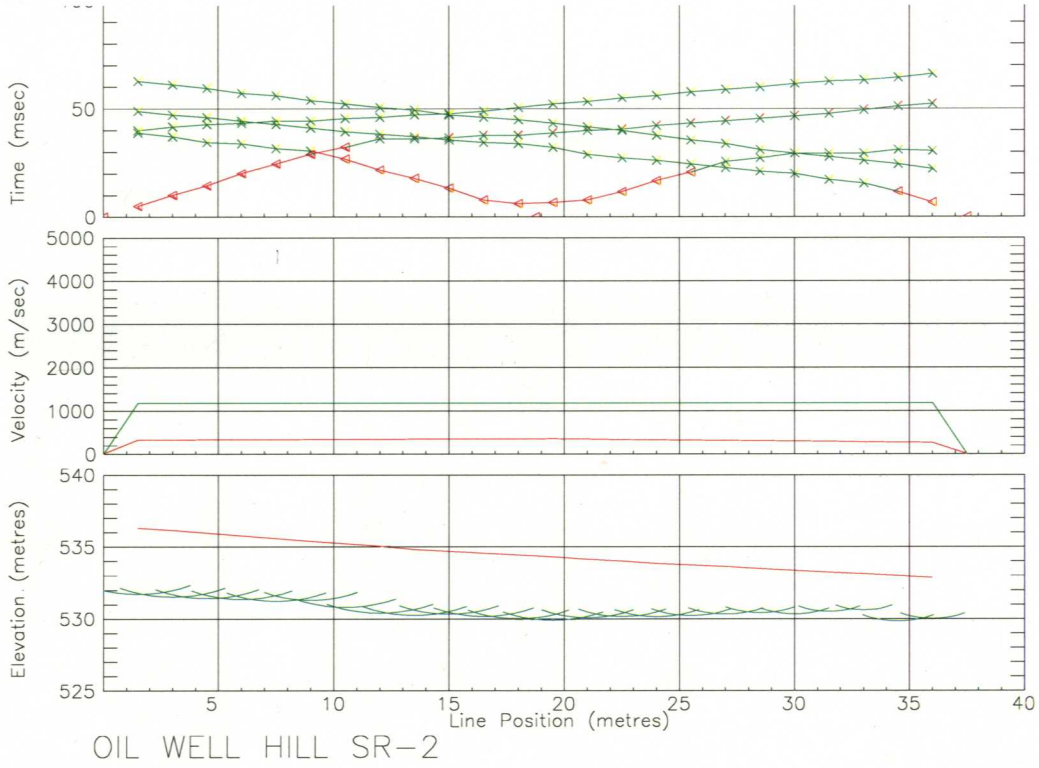

Figure 4. Travel-time curve, velocity model and depth section for Seismic Line 2

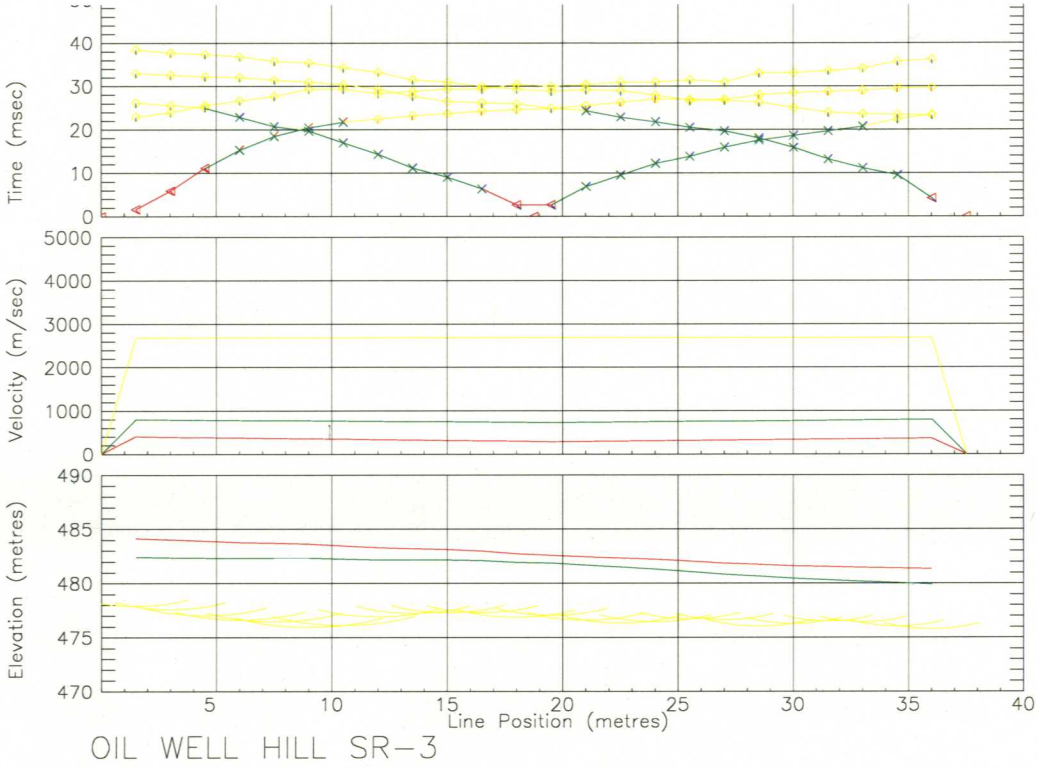

Figure 5. Travel-time curve, velocity model and depth section for Seismic Line 3.

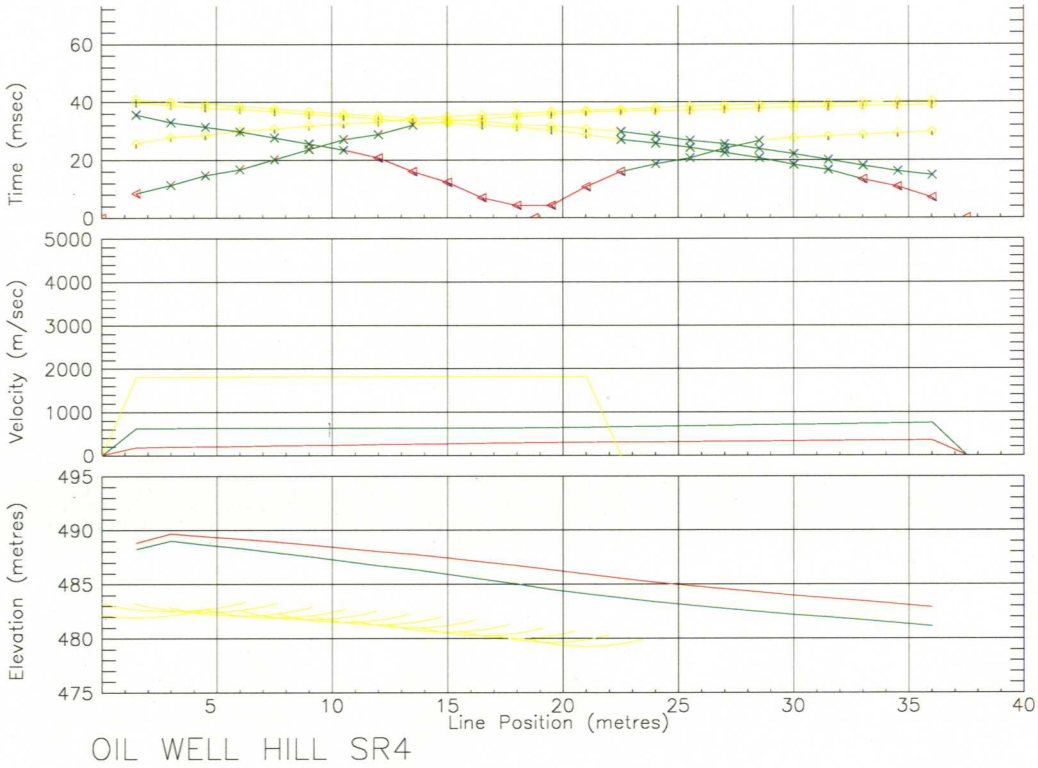

Figure 6. Travel-time curve, velocity model and depth section for Seismic Line 4.

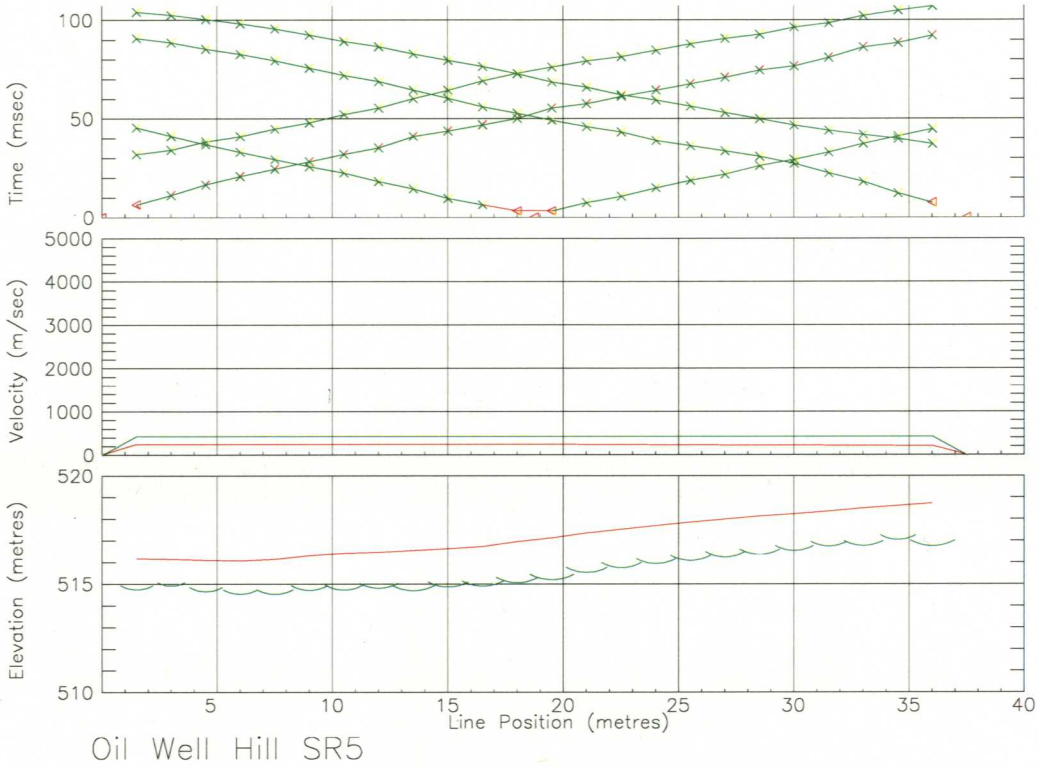

Figure 7. Travel-time curve, velocity model and depth section for Seismic Line 5.

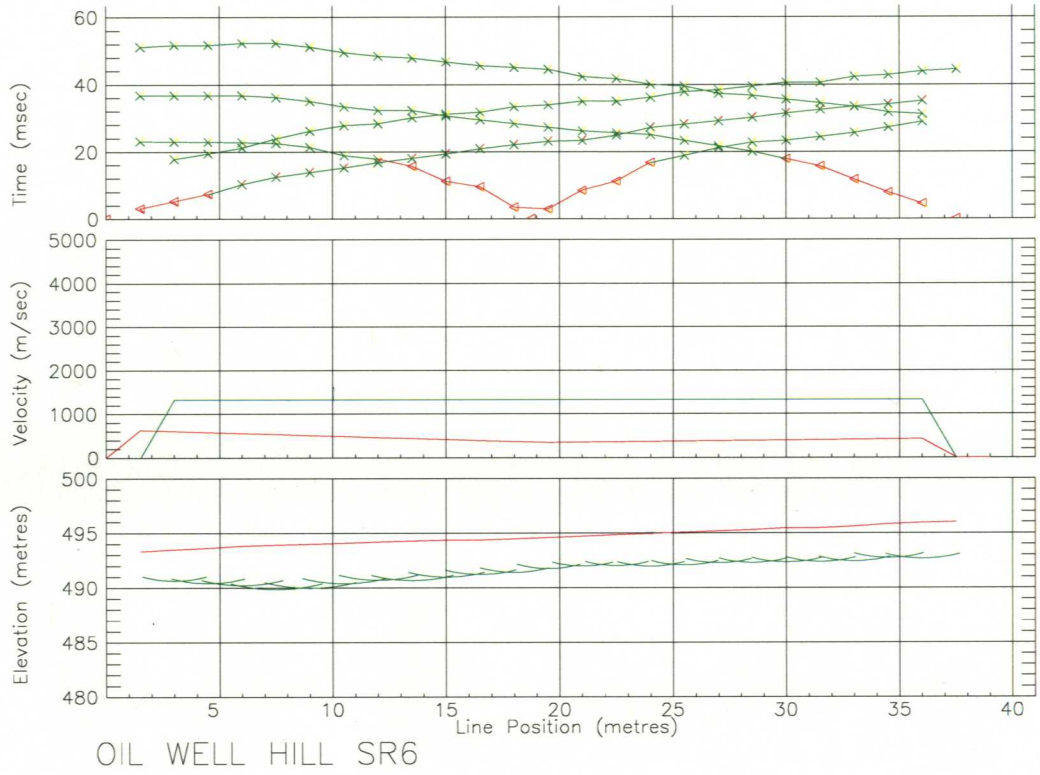

Figure 8. Travel-time curve, velocity model and depth section for Seismic Line 6.

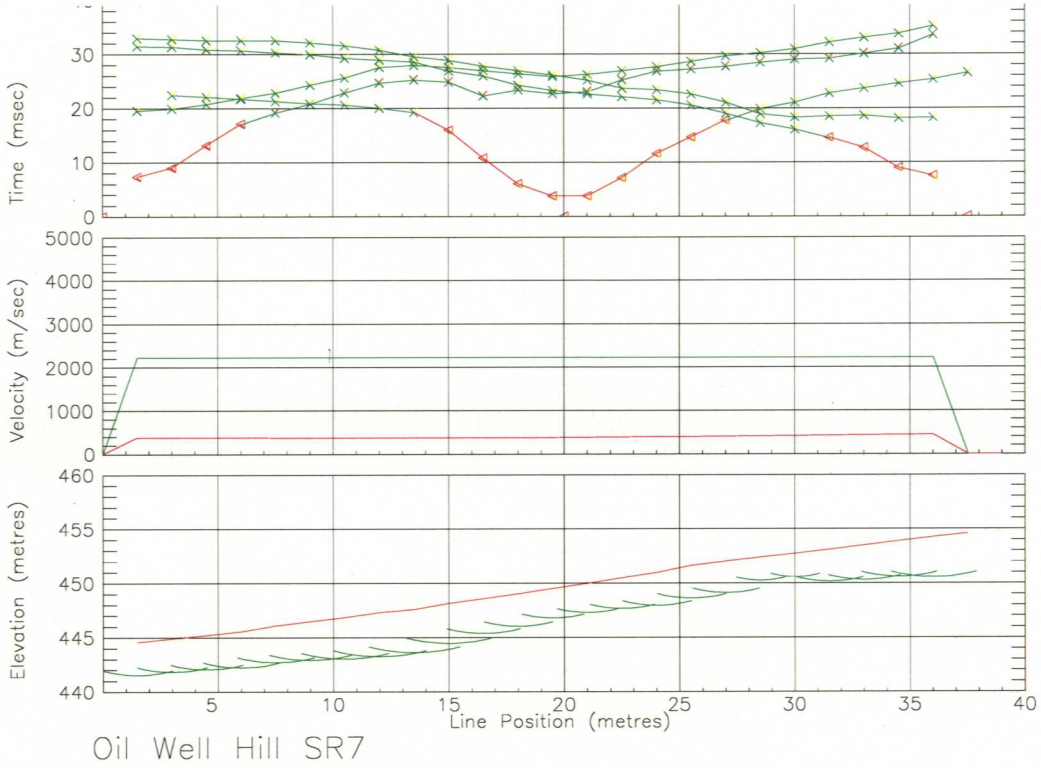

Figure 9. Travel-time curve, velocity model and depth section for Seismic Line 7.

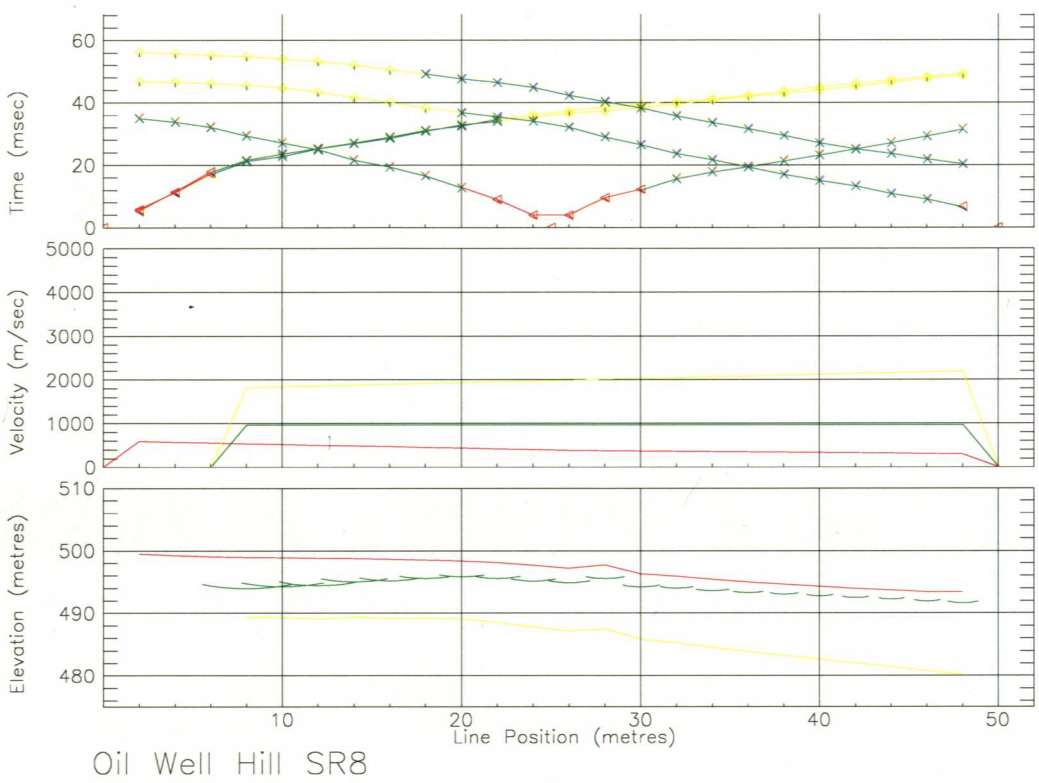

Figure 10. Travel-time curve, velocity model and depth section for Seismic Line 8.

State of California
Memorandum

Business, Transportation and Housing Agency

To: Sarah Allred
Associate Environmental Coordinator
2389 Gateway Oaks
Sacramento CA 95833

Date: April 25, 2006

File No: 01-Men-101
PM 50.7/52.1
Proposed Borrow Area -
Willits Bypass Project

EA: 01-262000

From: DEPARTMENT OF TRANSPORTATION
Office of Environmental Engineering – South (OEES)

Subject: Supplemental Site Assessment (SSA)

This SSA has been prepared by OEES to assess the significance, if any, of the addition of a soil borrow area to the Willits Bypass project. The proposed borrow area is located in Oil Well Hill, in Mendocino County, near the northern limits of the proposed Willits Bypass project. The entire area proposed for borrow is within existing Caltrans r/w. There were no hazardous waste/material issues identified in a search of local, State, or Federal databases. Naturally occurring asbestos is not located in the vicinity of the proposed borrow area. Review of aerial photos did not reveal any obvious hazardous waste/material issues.

Based on this review, no significant hazardous waste/material issues were identified for the proposed borrow area. Therefore, the borrow area may be utilized without NSSP's, SSP's, or other restrictions from OEES.

If there are any significant changes to the project scope, or if new information is identified, please contact the OEES, as soon as reasonably possible so the significance of the new information can be assessed. If you have any questions or comments, please call me at (530) 741-4556.

Mark Melani,
Office of Environmental Engineering – South

cc: File
Don Rushford, Project Engineer
(Electronic copy only)
Dave Kelley, Project Manager
(Electronic copy only)

Memorandum

Flex your power!
Be energy efficient!

To: **REID BUELL**
Senior, Engineering Geologist, Branch D
Geotechnical Design North
Division of Engineering Services

Attn: Joseph Kaump

Date: April 20, 2007

File: 01-MEN-101-51PM
01-262001

From: **DEPARTMENT OF TRANSPORTATION**
DIVISION OF ENGINEERING SERVICES
GEOTECHNICAL SERVICES-MS#5

Subject: Seismic Investigation at Oil Well Hill (Willits Bypass)

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4	1	1.5	335	Soil	0.92	ER
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4	3	NA	1845	Sandstone	1.13	DR
5	1	2.3	234	Fill	NA	ER
5	2	NA	475	Weathered Sandstone	0.93	ER
6	1	3.3	436	Soil	0.93	ER
6	2	NA	1342	Weathered Sandstone	1.08	MD
7	1	3.6	400	Soil	0.93	ER
7	2	NA	2248	Sandstone	1.15	NR
8	1	2.4	436	Soil	0.93	NA
8	2	5.0	973	Weathered Sandstone	1.02	ER
8	3	NA	2013	Sandstone	1.14	NR

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Table 1: Summary of refraction interpretation results for Oil Well Hill including earthwork factors.

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A striker plate was used as the energy source for the survey. The striker plate is placed on the ground surface and is struck with a sledgehammer until sufficient energy is recorded. During data acquisition, the profile geometry (shot and geophone locations) was recorded and stored in seismograph memory. Refraction data from each shot were also stored in the seismograph's Five shots were recorded for each profile. Both profile geometry and refraction data were backed-up to paper and floppy disk upon completion of the survey. The attached aerial photos show the general locations and orientations of the seismic refraction profiles.

Interpretation of the survey results used the Generalized Reciprocal Method of refraction interpretation where possible (GRM; Palmer, 1980). The method can accommodate variation in refractor velocity and depth along the seismic line, is relatively insensitive to refractor dip (up to 20 degrees), and can accommodate hidden layer conditions (where supporting borehole data exist).

The Viewseis computer program was used to analyze and interpret the refraction data. This is a commercially developed program that uses the GRM method for interpretation and presentation of refraction data. This method calculates refractor depths for each geophone location, using overlapping refraction arrival times from both forward and reverse shots. Accuracy of the GRM method relies on data from both forward and reverse shots, and on the selection of an optimum XY value. XY is defined as the distance of separation, measured at the surface, where forward and reverse seismic waves originate from the same point on the refractor. Where incomplete refractor coverage exists, the refractor can be modeled using the standard intercept-time method of interpretation (ITM), but with comparatively reduced accuracy. ITM models typically are less robust and tend to overestimate seismic velocity.

In addition to the intercept-time method of interpretation, two methods of GRM interpretation can be used: the approximate velocity (AP) and the average velocity (AV) method. The approximate velocity method is relatively insensitive to selection of the optimum XY. However, this method requires that every refractor above the target be defined. The average velocity method is very sensitive to optimum XY selection and is, therefore, normally used only where supporting borehole information exists. However, the average velocity method does not require that every refractor above the target be known. The type of line drawn for the refractor represents the method used for interpretation. ITM interpretations are shown as a solid line, GRM interpretations are drawn as a series of arcs—the envelope formed by the locus of interconnecting points at the base of these arcs represents the "best fit" model for the refractor.

The refraction data were transferred from the seismograph to the Viewseis program via floppy disks. Utilizing the Viewseis program, initial P-wave arrivals were picked for the seismic line and refractor layers assigned. GRM analyses were then performed. Layer velocities, thicknesses, and rippabilities are summarized in Table 1. Average velocities and thicknesses are approximate and were estimated from velocity models and depth sections.

Profiles in this report are presented in terms of velocity units. A velocity unit is a three-dimensional unit, which due to its elastic properties and density, propagates seismic waves at a characteristic velocity or within a characteristic velocity range. Velocities denoted in this report and in the seismic refraction sections are expressed in meters per second. At least one velocity is present within a geological rock unit. In addition, each zone of weathering, or fracturing within that geological unit can constitute its own velocity unit. Conversely, when two rock units such as water saturated gravel and moderately weathered rock propagate seismic waves at the same velocity and are adjacent to each other, both units would be part of the same velocity unit. Lastly, discontinuous velocities might result from variation in the degree of alteration in the form of physical and chemical weathering and should be considered in the interpretation of the data. Thank you for the opportunity to work on this project. If you have any questions or need additional assistance, please contact me at (916) 227-1307 or Bill Owen at (916) 227-0227.

Report by:

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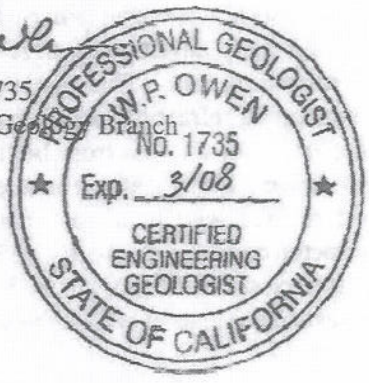

References

Stephens, E., 1978, Calculating earthwork factors using seismic velocities, California Department of Transportation, Report No. FHWA-CA-TL-78-23

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dl/WO/01_MEN_101_51.0_2007_SEI.

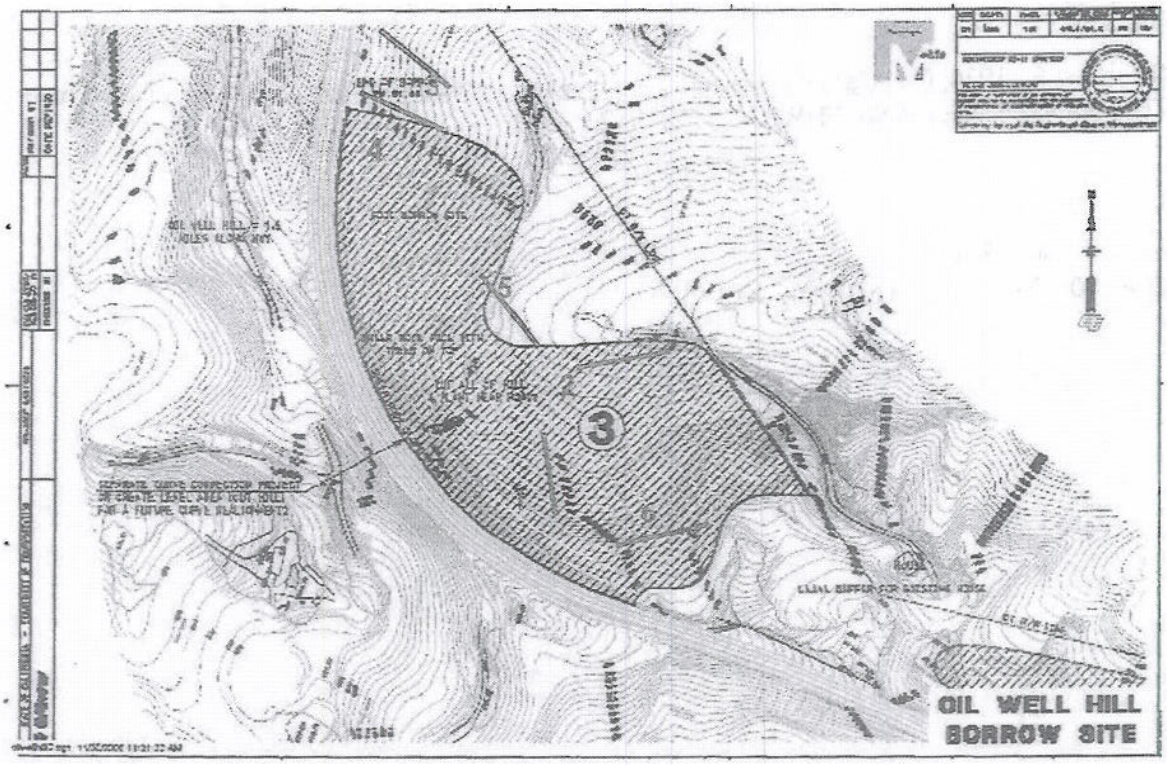

Figure 1. Approximate locations of the seismic lines surveyed in Site 3.

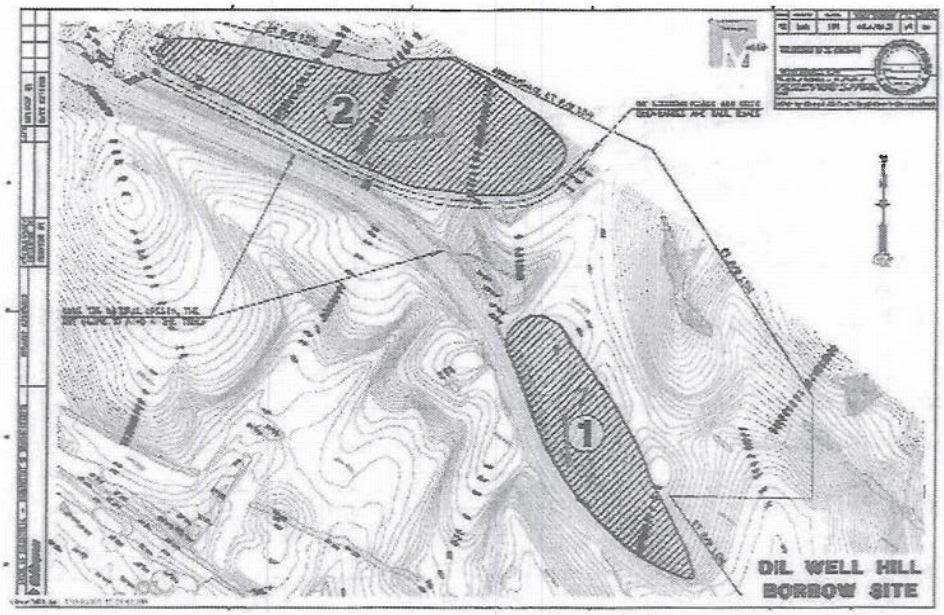

Figure 2. Approximate locations of the seismic lines surveyed at Sites 1 and 2.

A_2 27,00

A_1 = 15,00

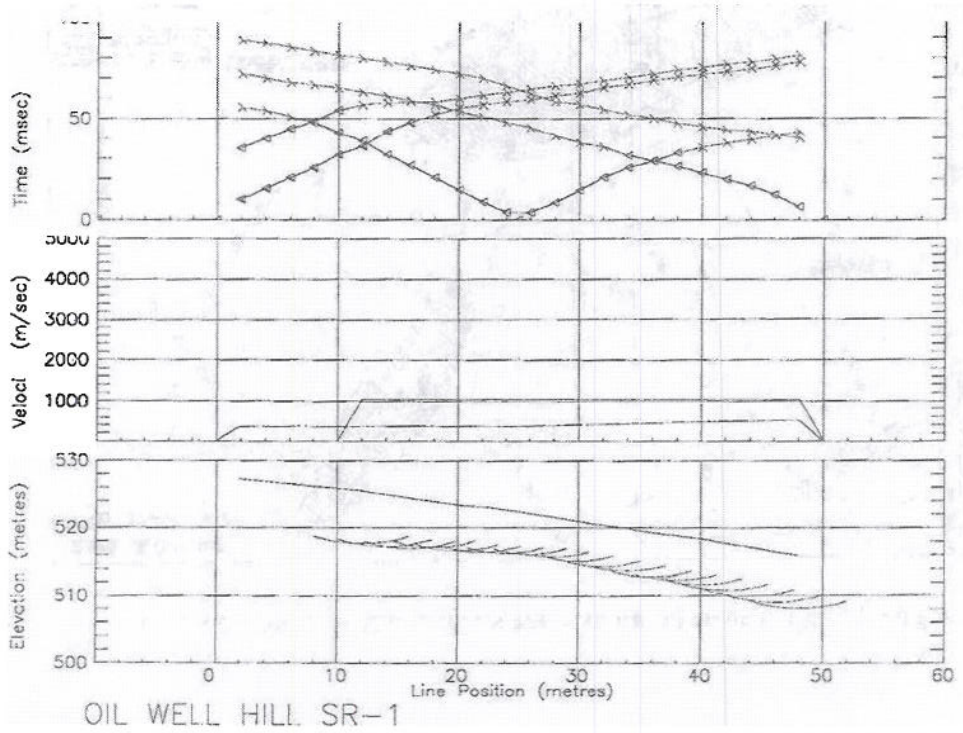

Figure 3 Travel-time curve, velocity model and depth section for Seismic Line 1.

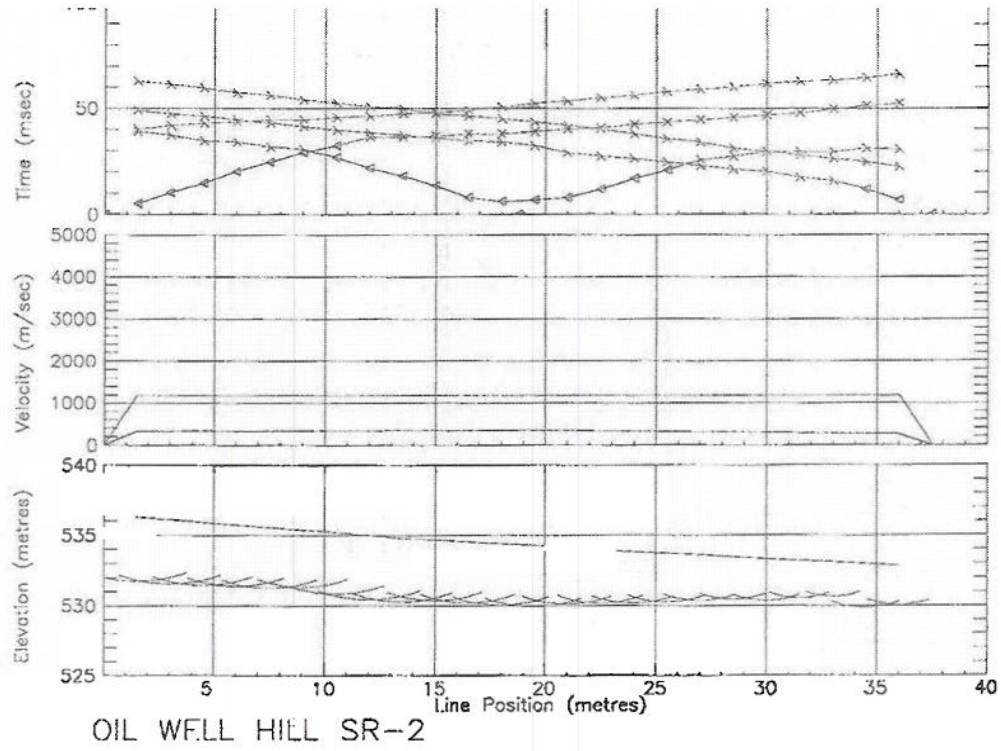

Figure 4. Travel-time curve, velocity model and depth section for Seismic Line 2

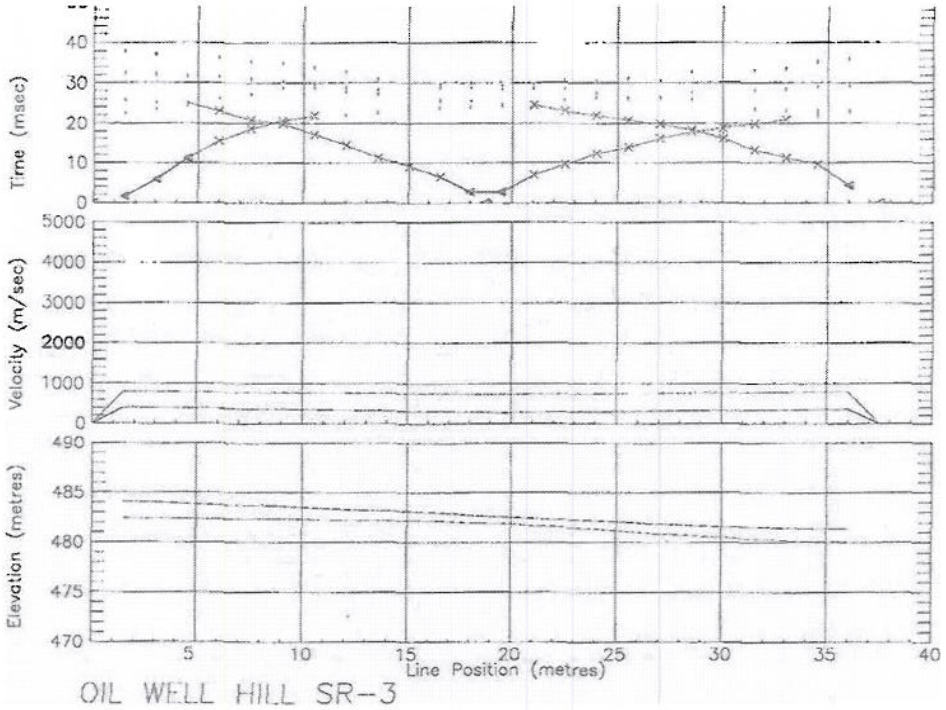

Figure 5. Travel-time curve, velocity model and depth section for Seismic Line 3.

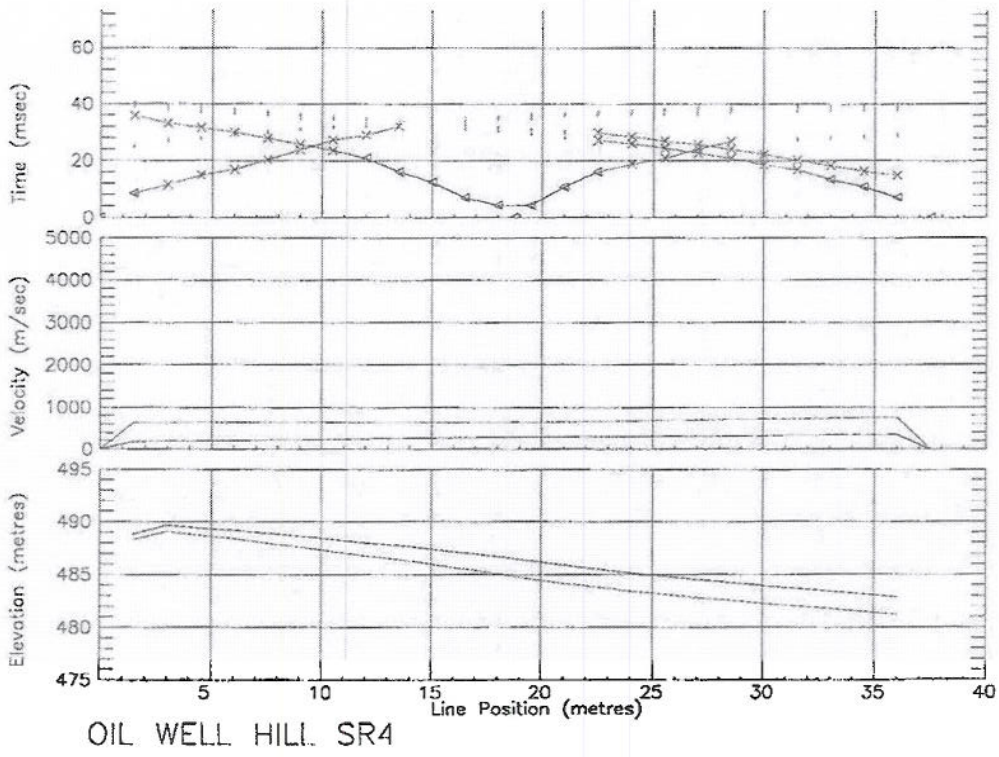

Figure 6. Travel-time curve, velocity model and depth section for Seismic Line 4.

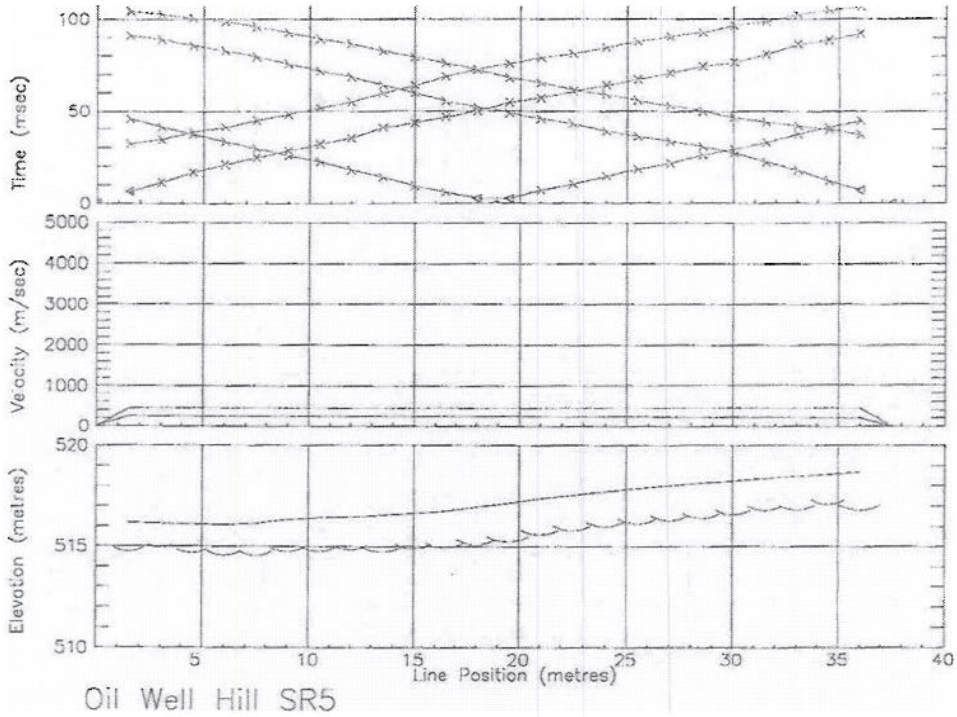

Figure 7. Travel-time curve, velocity model and depth section for Seismic Line 5.

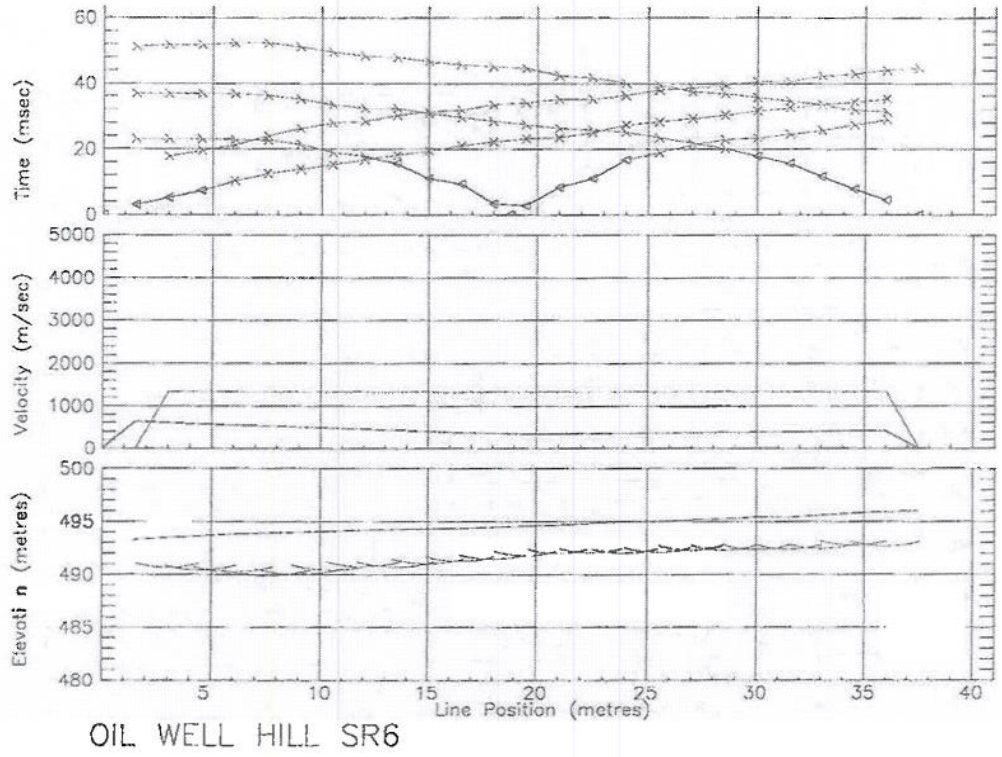

Figure 8. Travel-time curve, velocity model and depth section for Seismic Line 6.

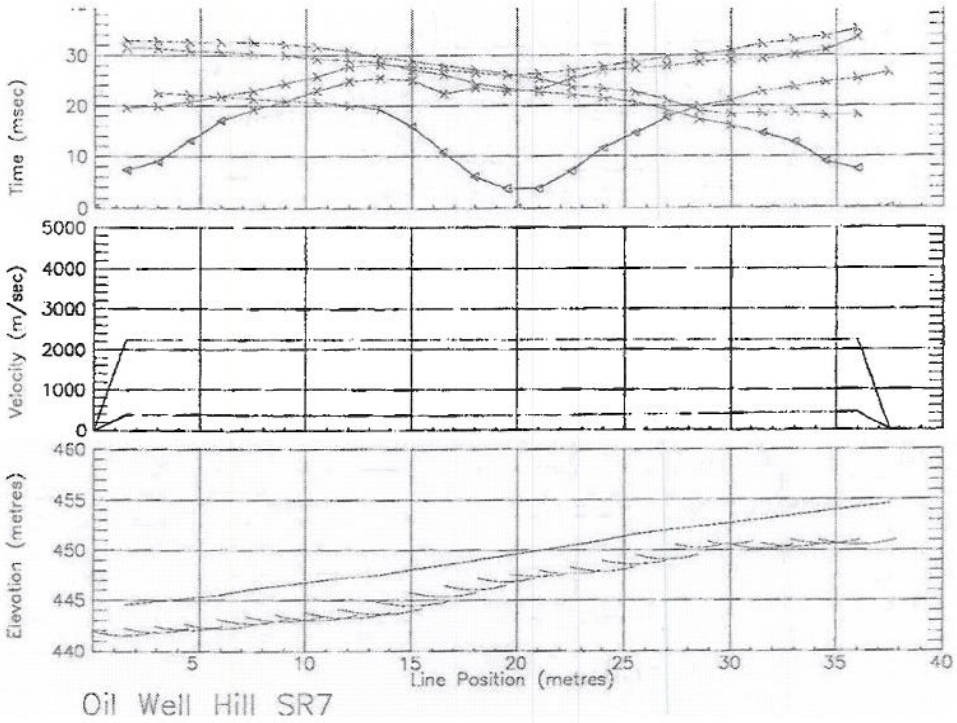

Figure 9. Travel-time curve, velocity model and depth section for Seismic Line 7.

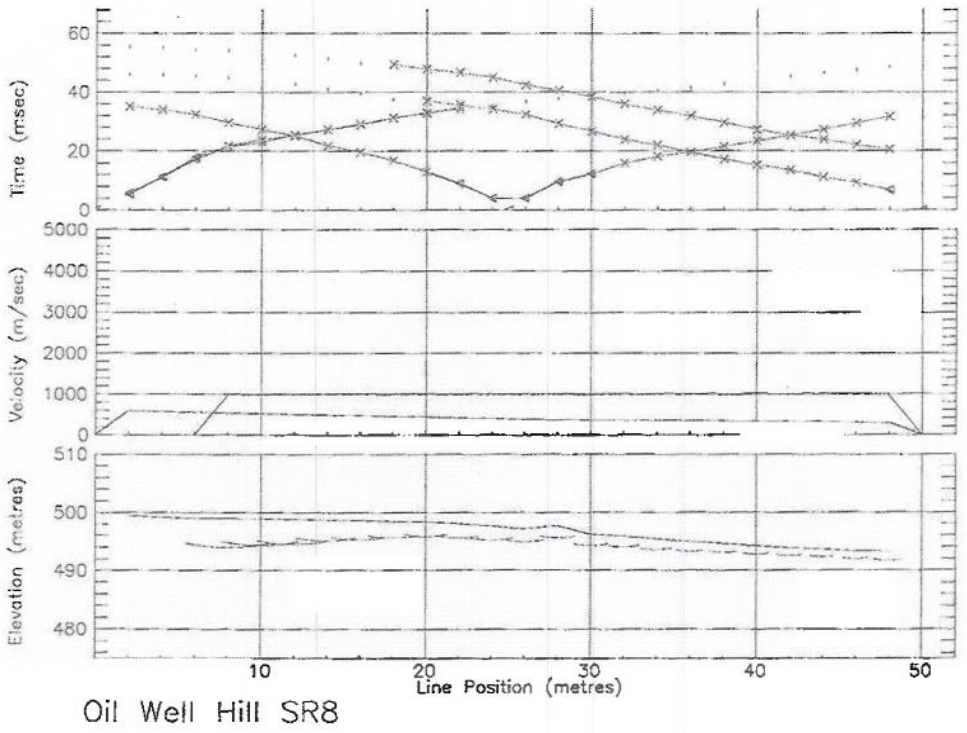

Figure 10. Travel-time curve, velocity model and depth section for Seismic Line 8.