GRCB

ENTERED

GIANT
REFINING COMPANY

CERTIFIED MAIL # 7099 3220 0010 2242 4849

January 17, 2005

Ms. Hope Monzeglio
State of New Mexico Environmental Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87505-6303

Re: Giant Bloomfield Refinery – NMED Conditional Approval of North Boundary Barrier Voluntary Corrective Measures Plan
RCRA Permit No. NMD 089416416
HWB-GRCB-04-005

Dear Ms. Monzeglio:

Giant Refining Company Bloomfield (GRCB) received the December 21, 2004 letter from the New Mexico Environmental Department (NMED) stating NMED's conditional approval of the November 17, 2004 *Corrective Action Plan* (CAP) submitted by GRCB. The CAP describes the voluntary corrective measures to be implemented by GRCB at the Bloomfield refinery. The purpose of this letter is to provide NMED with the anticipated starting date of the barrier construction and to respond to several of the conditions stated in NMED's letter.

Giant has entered into a contract with Remedial Construction Services, L.P. (RECON) to construct the north boundary barrier. RECON, based in Houston, Texas, is a contractor that specializes in the construction of barrier walls for environmental applications. RECON is tentatively scheduled to mobilize to the Bloomfield refinery the week of January 17, 2005, with barrier excavation activities expected to begin the following week. Construction is anticipated to be completed by the end of March 2005. Giant's environmental consultant (Malcolm Pirnie) will provide a senior geotechnical engineer and a full-time resident engineer to oversee and document the barrier construction activities. The barrier type will be a soil-bentonite slurry wall with permeability less than or equal to 1×10^{-7} cm/sec and a minimum thickness of 30 inches.

Response to NMED Conditions of Approval

The following responses correspond to the conditions in NMED's December 17, 2004 approval letter.

PHONE
505-632-8013
FAX
505-632-3911

50 ROAD 4990
P.O. BOX 159
BLOOMFIELD
NEW MEXICO
87413

1. Condition accepted by Giant.

2. Giant will plan to key the barrier wall 5 feet into the Nacimiento Formation. Any exception shall be approved by NMED and OCD.

   Hydraulic conductivity testing of samples taken from the Nacimiento Formation along the barrier alignment indicates the formation is essentially impervious to water migration in its upper one-foot interval (soil boring SB2-1004, permeability of 6×10^{-7} cm/sec at a depth of 12.0 to 12.5 feet below ground surface (bgs); soil boring SB5-1004, permeability of 1.2×10^{-9} cm/sec at 9.5 to 10.5 bgs). Refer to the November 11, 2004 investigation report by Precision Engineering (Appendix A of CAP) for the testing results. An annotated test results summary table is included with this letter (Attachment A).

   Groundwater levels measured in piezometers installed along the proposed barrier alignment show there is generally one foot of water or less on the top of the Nacimiento Formation. This is an inappreciable amount of hydrostatic head.

   The quantity of flow migrating from the facility to the river bluff in the Jackson Lake Terrace gravels (across the entire proposed slurry wall alignment - over 2,600 feet in length) has been estimated (using the Darcy equation) to be less than 20 gallons per minute. This estimate assumes a saturated thickness of 2 feet on top of the Nacimiento Formation (greater than measured), a uniform gradient, and a moderate Jackson Lake Terrace permeability. This relatively low quantity of flow is consistent with the observed "isolated seeps" at the river bluff. As such, the amount of water anticipated to accumulate against the barrier is low.

   Based on these conditions, Giant anticipates that seepage beneath the barrier will be insignificant. In lieu of conducting a flow net analysis, Giant will install monitoring wells behind the barrier wall at appropriate intervals (to be approved by NMED and OCD). The monitoring well design and spacing will be included as part of the monitoring plan (see Response #10).

3. The barrier type will be a soil-bentonite slurry wall with permeability less than or equal to 1×10^{-7} cm/sec and a minimum thickness of 30 inches. The construction specifications require the soil-bentonite backfill mix design to be approved by Malcolm Pirnie. The mix design will be submitted to NMED and OCD. The specifications also require industry-standard quality control testing by the contractor during construction and verification permeability testing by an independent third-party laboratory.

4. As-built drawings and photo documentation are included in the construction procedures and will be provided to NMED as requested.

5. Daily logs will be kept by the full-time on-site resident engineer.

6. Weekly progress reports and photos will be provided as requested.

7. Giant anticipates installing the fluid collection points in the second quarter of 2005 after construction of the barrier is complete. The contour of the Nacimiento Formation along the barrier alignment will be surveyed during construction to aid in locating collection points. A fluid collection system design will be submitted to NMED for approval prior to installation of the collection points.

8. A senior geotechnical engineer and a full-time resident engineer from Malcolm Pirnie will oversee and document the barrier construction activities. Due to the character of the Jackson Lake Terrace soils, a slurry trench excavation method will be used. As such, collection of representative soil samples from the trench at prospective collection system locations is not technically possible. If these soil samples are necessary, Giant proposes they be obtained separately after barrier construction.

9. RECON will prepare a detailed construction activity schedule and Giant will provide a copy to NMED prior to start of construction. The schedule will be reviewed weekly during construction progress meetings and revisions will be made as necessary. Schedule changes will be communicated to NMED on a weekly basis.

10. Giant anticipates developing a monitoring plan concurrent with the collection system design. Conceptually, the plan will be based on monitoring hydraulic conditions on both sides of the barrier at locations where fluid accumulation is anticipated. The monitoring plan will be submitted to NMED for approval.

11. A typical log for the piezometers installed in the soil borings along the north property boundary is contained in Attachment B. The depth to water (bgs) in each of the locations is stated in the upper left header of the logs contained in Appendix A of the CAP. It should be noted that many of the subject piezometers will be destroyed during construction of the barrier wall.

12. The description "black with hydrocarbon odor" refers to hydrocarbon staining.

13. Slug test data for the shallow-zone soils (Jackson Lake Terrace deposit) is contained in Attachment C.

14. Grain size analyses were performed only on samples obtained from the October 2004 soil borings SB2-1004, SB5-1004, and SB8-1004 and from the depth intervals indicated on the annotated test results summary table (Attachment A). These three locations are spatially distributed across the area of the October 2004 investigation and the results provided sufficient information for barrier wall bentonite slurry and soil-bentonite backfill mix designs. Hydraulic conductivity

tests were performed only on Nacimiento Formation samples taken from soil borings SB2-1004 and SB4-1004.

15. Quality control measures consistent with industry-standard practices will be applied during barrier construction. We have provided Technical Specification Section 02234 for the barrier wall (Attachment D), which contains the construction quality control and testing procedures, primarily in Paragraphs 1.2 and 3.6. Please note this is a construction contract document, and is being provided to NMED for information purposes only.

16. Based on the small amount of fluids expected to collect against the barrier (see Response #2), GRCB anticipates a vacuum truck will be the only method of fluid removal from collection points. Operational experience, as it is gained, will determine if a deviation from this approach is required.

17. The referenced soil samples were taken from potential borrow sources to aid in mix design for the slurry wall. PEI Lab Nos. 46464 and 46465 were taken from a sand pile at the Foutz and Bursum gravel yard. PEI Lab Nos. 46461, 46462 and 46463 were taken from the earthen embankment adjacent to the Hammond Ditch on the north side.

18. GRCB will work with NMED to determine an appropriate long-term sampling and monitoring plan.

If you have any questions in this matter, please contact me at 505-632-4171.

Sincerely,

GIANT REFINING COMPANY

James R. Schmaltz
Environmental Manager

Cc: Wayne Price - OCD
Denny Foust - OCD Aztec Office
Bob Wilkinson – EPA
Ed Riege
Chad King

ATTACHMENT A

Annotated Test Results Summary from Precision Engineering, Inc.

Precision Engineering, Inc.
P.O. Box 422
Las Cruces, NM 88004
505-523-7674

Project Bloomfield-Hammond Ditch File No. 03-122 Date November 2, 2004

	Boring No.	PEI Lab No.	Depth ft.	Sieve Analysis %Passing 3"	2"	1½"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#60	#140	#200	Atterberg Limits LL	PI	Moisture %M	Unit Wt. PCF	Classification USCS	AASHTO
SB2-1004		46450	5.0-5.4							100	100	99	97	74	31	10	8.7		N/P	3.8		SP-SM	A-3
		46451	11.0-11.5				100	90	86	85	82	81	73	48	21	6	4.7		N/P	15.6		SP	A-1-b
SB3-1004		46452	9.0-10.0							100	100	71	57	45	37	28	23.8		N/P	5.6		SM	A-1-b
SB8-1004		46458	10.0-11.0				100	89	73	68	64	62	55	25	9	3	2.5		N/P	19.2		SP	A-1-b
SAND PILE @ GRVL PIT		46464	Surface								100	100	100	96	92	80	65.2		N/P	8.6		ML	A-4
		46465	Sruface							100	100	100	99	96	92	79	71.3		N/P	14.8		ML	A-4
	A.	46461	Surface	95	95	93	88	86	83	81	79	78	75	64	52	29	23.7		N/P	2.5		SM	A-2-4
	B.	46462	Surface	96	80	76	64	57	49	44	40	38	31	22	16	8	7.0		N/P	0.9		GP-GM	A-1-a
	C.	46463	Surface	94	86	76	64	54	43	38	32	29	23	14	9	6	5.3		N/P	1.1		GP-GM	A-1-a
SB2-1004		46456	12-12.5	Hydraulic Conductivity: 6.0 X10^{-7} cm/sec																13.3	118.7		
SB4-1004		46454	9.5-10.5	Hydraulic Conductivity: 1.2 X10^{-9} cm/sec																13.8	117.1		

A. HILLSIDE - 70 FEET NORTH OF MW-47 (APPROX. STA 5+20)
B. HILLSIDE - 60 FEET SOUTH OF MW-47 (APPROX. STA 3+90)
C. UNCLEAR - NORTHSIDE BY SYPHON - NEAR EAST END OF ALIGNMENT?

Prepared By:

ATTACHMENT B

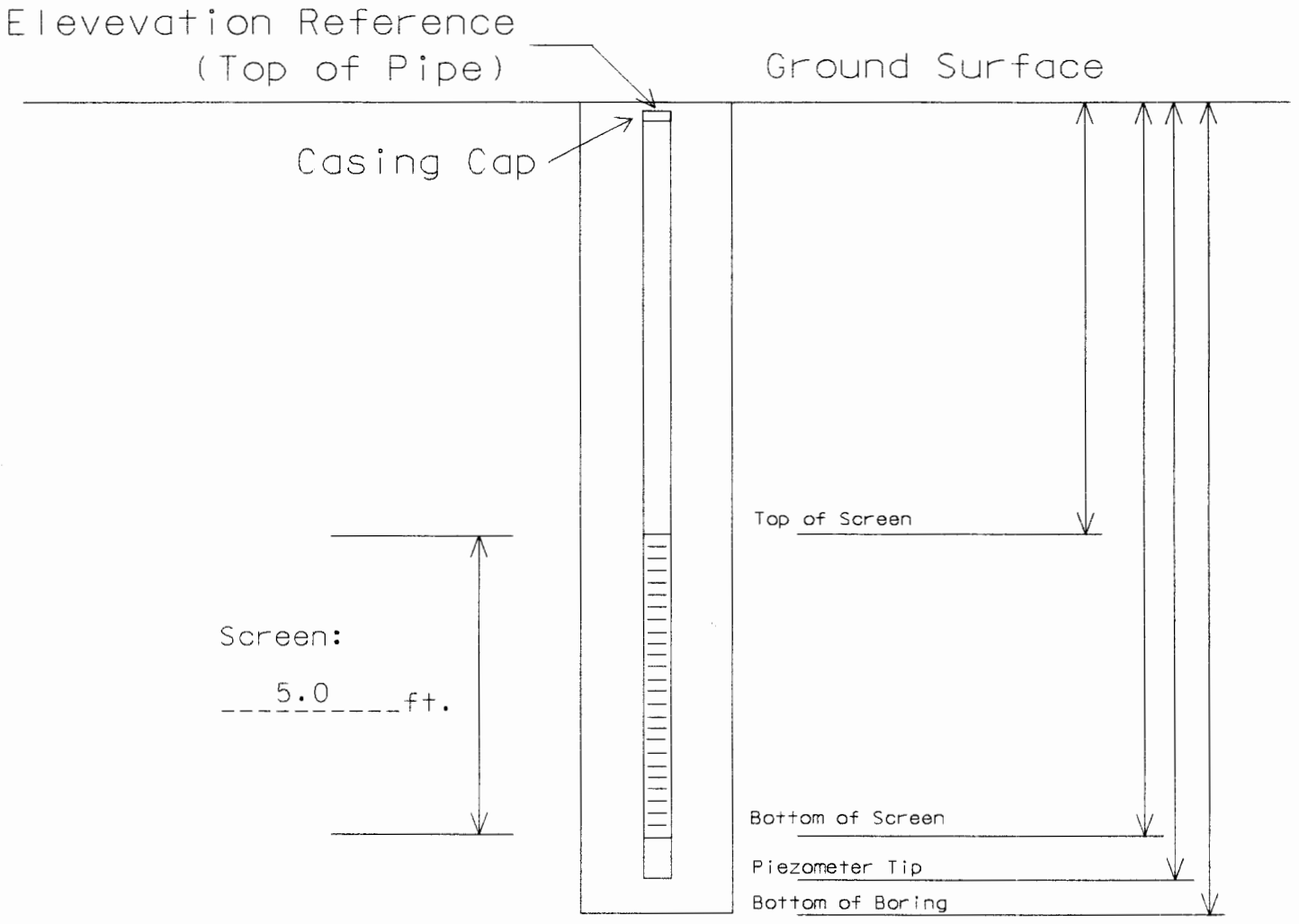
Typical Piezometer Log

PRECISION ENGINEERING, INC.

505-523-7674

Temporary Piezometer Installation - Typical

See Logs for Depth Details



Boring Diameter: 8 5/8"

Sand Type: Native Backfill

Bollards, Type/Size: None

Bentonite: None

Screen Type/Size: 2" PVC Sch. 40, 0.060" Hand Slotted @ 3" Intervals

Cement/Grout: None

Riser Type/Size: 2" PVC Sch. 40

Water: Potable

Locking Expandable Casing Plug? No (Slip Cap)

Site Northing:

Other: N/A

Bottom Cap Used? Yes

Site Easting:

Giant Refining Co.

Project #: 03-122

Project Name: Bloomfield Wells

Elevation:

ATTACHMENT C

MW-47 Slug Test Data

SLUG TEST RAW DATA FOR MW-47

	Depth Below Grade
Total Boring Depth:	14.28 ft
Static Water:	8.59 ft
Depth to PSH	7.54 ft
Depth to Nacimiento:	10.2 ft
Groundwater Depth Above Naci:	1.61 ft
PSH(1) Depth Above Groundwater:	1.05 ft
Total Fluids Above Naci:	2.66 ft

Time (seconds)	Depth to GW (ft)	Dh (ft)	h/h_o
0	11.22		
8	12.78	$1.56 = h_o$	1
15	12.12	0.9	0.58
45	11.64	0.42	0.27
60	11.52	0.3	0.19
90	11.42	0.2	0.13
120	11.34	0.12	0.08
150	11.29	0.07	0.04
180	11.27	0.05	0.03
210	11.27	0.05	0.03
240	11.26	0.04	0.03
270	11.26	0.04	0.03
300	11.26	0.04	0.03
330	11.26	0.04	0.03
360	11.26	0.04	0.03

(1) PSH = Phase-Separated Hydrocarbon

The time for the head to rise to 37% of initial change is 4.5 seconds (To).
The following parameters are obtained from the geometery of the piezometer:

r = 0.083 ft
R = 0.083 ft
L = 10 ft

Therefore:

$$K = \frac{r^2 \ln (L/R)}{2LT_o} \times 8.64 \times 10^4 \text{ sec/day}$$

K = 32 Ft/Day

ATTACHMENT D

Slurry Wall Construction Specification

SECTION 02234

SOIL/BENTONITE SLURRY WALL (Revised 11-28-04)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope:
   1. CONTRACTOR shall furnish all materials, labor and equipment required for the complete installation of a continuous slurry wall including but not limited to the following Work:
      a. Furnish, maintain and remove equipment and supplies as necessary for the preparation, mixing and circulation of bentonite slurry.
      b. Remove and dispose of bentonite-contaminated soils unsuitable for incorporation into the final subgrade.
      c. Excavate slurry-filled trench to the limits defined by the Specifications and the Drawings. Remove and legally dispose of all materials encountered during excavation operations unsuitable for re-use at no additional cost to the OWNER.
      d. Furnish, maintain and remove all equipment and supplies as necessary for the mixing and placement of soil-bentonite backfill in the slurry-filled trenches: Soil Bentonite (SB) backfill to provide a permeability (k) less than or equal to 1×10^{-7} cm/sec, to a minimum thickness of 30 inches and the limits defined by the Plans.
      e. Provide all equipment and materials to test quality of water, bentonite, soils, bentonite slurry, and bentonite-soil backfill and perform all specified tests.
      f. Grout, seal or reconstruct all points of leakage, and provide a continuous slurry cutoff wall system.
      g. Clean, cover and protect the top of the slurry wall.
      h. Where applicable, repair damage to roads.
   2. CONTRACTOR shall develop mix designs for the bentonite slurry and soil-bentonite backfill and manage those mixes during the Work to meet all the performance requirements specified in this Section.

B. Related Work Specified Elsewhere:
   1. Section 02223, Trench Excavation.
   2. Section 01452, Testing Laboratory Services Furnished by Contractor.

1.2 QUALITY ASSURANCE

A. Installer's Qualifications and Experience:
   1. CONTRACTOR shall have a minimum of ten years experience successfully installing soil bentonite slurry trenches to equal or greater depths and areas as

shown on the Plans and as specified. Key labor and supervisory personnel shall be experienced in this type of work. A slurry trench specialist approved by the ENGINEER shall supervise the construction, slurry preparation and quality control.

2. If OWNER is not satisfied with field personnel qualifications, CONTRACTOR must provide different qualified people as indicated.

B. Minimum Criteria:

1. Minimum criteria for the installation of the slurry wall are shown on the Drawings and described herein. CONTRACTOR shall be responsible for construction methods which account for the actual field conditions.

C. Testing and Inspection:

1. Testing and inspection of the slurry, backfill, stabilizing agent and finished slurry wall shall be performed by the contractor. At a minimum, the following tests shall be conducted:

Description	Test Designation	Frequency
Bentonite Slurry		
Viscosity (Marsh Funnel)	API RP 13B-1	1. At time of mixing 2. Twice daily
Filtrate Loss	API RP 13B-1	1. At time of mixing 2. Twice daily
Density	API RP 13B-1	1. At time of mixing 2. Twice daily
Sand Content	API RP 13B-1	1. At time of mixing 2. Twice daily
pH	API RP 13B-1	1. At time of mixing 2. Twice daily
Soil Bentonite Backfill		
Slump Cone	ASTM C143/C143M	Twice daily
Fines Content	ASTM D1140	Daily
Density	ASTM D698 & Para. C.2	Daily

2. The density of the SB backfill shall be calculated using a 101.6 mm (4-inch) cylindrical mold as described in Paragraph 6 of ASTM D 698. SB backfill shall be placed in the mold and rodded 10 times. Additional SB backfill shall then be added to fill the mold. The weight and volume of the molded SB backfill shall then be used to determine the density.
3. CONTRACTOR shall provide all necessary services to perform the specified tests at no additional cost to OWNER.
4. CONTRACTOR shall provide all assistance necessary to obtain representative samples of the slurry and backfill for quality assurance checks by ENGINEER.

5. CONTRACTOR shall use the services of an independent qualified geotechnical laboratory for the performance of slurry and soil-bentonite backfill conformance testing during construction. The CONTRACTOR shall collect representative samples of soil-bentonite backfill to the satisfaction of the ENGINEER. Samples shall be delivered to an independent testing laboratory, selected by the CONTRACTOR and approved by the ENGINEER, within 48 hours of sample collection. The independent testing laboratory shall initiate testing within 24 hours of receipt of samples. At a minimum, the following conformance tests shall be conducted on soil bentonite backfill:

Description	Test Designation	Frequency
Moisture Content	ASTM D 2216	per 250 cubic yards
Density	ASTM D698 & Para. C.2	per 250 cubic yards
Grain-Size Distribution	ASTM D422	per 250 cubic yards
Hydraulic Conductivity	ASTM D5084 & Para. C.6	per 250 cubic yards

6. The confining pressure used to perform permeability testing should be representative of site conditions. To simulate site conditions, the confining pressure specified should be representative of one-half of the wall depth at the location of sample collection.
7. OWNER will perform independent Quality Assurance Tests. The Quality Assurance tests performed by OWNER will be the basis of acceptance of the Work.

D. Reference Standards
   1. ASTM American Standard for Testing of Materials.
   2. API Standard 13 A "Drilling Fluid Materials"
   3. API Standard 13B-1 "Standard Procedures for Testing Drilling Fluids."

E. Test Reports

   A report summarizing the procedures and results of the all testing performed by the CONTRACTOR and independent laboratory shall be submitted to the ENGINEER following completion of all testing. The report shall reference all procedures and include all test results in tabular form.

F. Surveys
   1. Provide certified surveys by licensed land surveyor of the Slurry Wall as indicated in Section 01722, Field Engineering.

1.3 SUBMITTALS

A. Not less than 10 days prior to start of slurry wall construction, submit the following information for review:
   1. Drawings to include:
      a. Plan layout of slurry wall showing the proposed location, length, width and depth of wall. Also indicate work bench requirements, the planned sequence of installation, and protection and/or replacement of utilities and structures.
      b. Location of all Work areas including bentonite slurry mixing and storage area, and soil/bentonite mixing and storage area.
   2. Written reports, calculations or other data to include:
      a. Resumes of supervisory and key labor personnel including field and laboratory technicians with required experience in slurry wall construction and testing.
      b. Soil-bentonite backfill mix designs prepared and sealed by a Professional Engineer.
      c. Bentonite slurry mix proportions prepared and sealed by a Professional Engineer.
      d. Description of all processing equipment to be used, including space requirements for operations and storage of materials.
      e. Two examples of laboratory tests of production mixes including grain size analysis, slump cone test and hydraulic conductivity of soil-bentonite backfill mix.
      f. Qualifications of the geotechnical laboratory for quality assurance/quality control testing during construction.
      g. Qualifications of registered Professional Engineer who will prepare mix designs.

B. During slurry wall construction, submit the following to the ENGINEER:
   1. As-built field data:
      a. Slurry wall thickness as well as elevations at top and bottom of the trench at 20-foot or less intervals.
      b. Dates, time and depth of excavation and backfill placement.
      c. Description of soils encountered, obstructions, excavation problems and use of admixtures, if any.
      d. Any unusual conditions as noted.
      e. As-built field data shall be submitted daily to the OWNER.
   2. Results of construction quality assurance/quality control testing by the independent qualified geotechnical laboratory including tests on bentonite, water, bentonite slurry, bentonite-soil backfill, stabilizing agents, and all other specified tests.
      a. Test results shall be submitted within 1 day of test completion.

1.4 STORAGE AND HANDLING OF MATERIALS

A. Methods of handling and storage of materials and equipment are subject to the approval of the ENGINEER.
   1. Stockpiled materials and any mixing plant setup shall be allowed only in areas designated by OWNER.
   2. Excavated materials unsuitable for re-use and surplus materials, including bentonite slurry, shall be disposed of at no additional cost to the OWNER.
   3. Special care shall be taken to properly dispose of all used bentonite materials and slurries. Disposal of bentonite slurry in any sewer system will not be permitted.
   4. Public ways and areas shall be kept clear of all spillages from construction operations.

B. The OWNER identified existing former raw water ponds behind the refinery office building for slurry and SB spoils disposal during the Pre-Bid Conference on November 22, 2004. The CONTRACTOR shall haul and dispose of slurry and SB spoils to the location identified by the OWNER. Hauling and disposal shall be conducted in a manner that will not impede or disrupt operation of the refinery and associated activities. If the former raw water disposal ponds are not appropriate to CONTRACTOR, the CONTRACTOR shall construct suitable spoils disposal ponds in a location designated by the OWNER, at no additional cost to the OWNER.

1.5 JOB CONDITIONS

A. Subsurface Information: Refer to Project Information Summary for data on subsurface conditions. Data is not intended as a representation or warranty of continuity of conditions between soil borings nor of groundwater levels at dates and times other than date and time when measured. OWNER will not be responsible for interpretations or conclusions drawing therefrom by CONTRACTOR. Data is solely made available for the convenience of CONTRACTOR.
   1. Additional test borings and other exploratory operations may be made by CONTRACTOR, at no additional cost to the OWNER.

B. Existing Structures and Utilities: The Drawings show certain existing facilities and surface and underground utilities located on or adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of CONTRACTOR. CONTRACTOR shall explore ahead of the required excavation to determine the exact location of all piping and utilities. They shall be supported and protected from damage by CONTRACTOR. If they are broken or damaged, they shall be restored immediately by CONTRACTOR at his expense. All utilities shall remain in service during the Work.

   Should uncharted or incorrectly charted piping or utilities be encountered during excavation, consult ENGINEER immediately for directions as to procedure.

Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

C. Use of Explosives:
   1. The use of explosives will not be permitted.

PART 2 - PRODUCTS

2.1 BENTONITE

A. Bentonite shall be high swelling, pure, premium grade type, sodium cation-based bentonite consisting of montmorillonite.

B. Bentonite shall meet the requirements of API Standard 13A. A certificate of compliance (for each lot shipped to the site) from the bentonite manufacturer stating that the bentonite complies with applicable standards shall be provided to the ENGINEER. No bentonite from the bentonite manufacturer shall be used prior to acceptance of the compliance certification by the ENGINEER. Bentonite not meeting specifications shall be promptly removed from the site at the CONTRACTOR's expense. Bentonite shall be protected from moisture during transit and storage.

C. Chemical treatment of bentonite shall not be permitted without approval of ENGINEER.

2.2 WATER

A. Water used for mixing with bentonite shall satisfy the following requirements:
   1. Be clean, fresh and free from oil, acid, alkali, organic matter or other deleterious substances.
   2. Demonstrate the following minimum quality:
      a. Hardness < 50 ppm.
      b. TDS < 500 ppm.
      c. TOC < 50 ppm.
      d. 6<pH<8.

B. The CONTRACTOR shall be responsible for obtaining all water needed for the work at no additional cost to the OWNER. OWNER identified the refinery fire water reservoir as a construction water source during the November 23, 2004 Pre-Bid Conference. CONTRACTOR shall coordinate required construction water volumes with OWNER in advance to avoid impacts on OWNER's operational water needs.

2.3 BENTONITE SLURRY

A. Bentonite slurry shall consist of a stable colloidal suspension comprised of bentonite in water. Resulting bentonite slurry shall have the following minimum characteristics:
   1. Viscosity of stabilizing fluid shall be as required to provide stable trench conditions but shall be a minimum of 35 seconds (V>35 sec-Marsh @ 68 degrees F) using Marsh Funnel Viscometer prior to placement of backfill.
   2. Filtrate loss: 20 cc maximum in 30 minutes @ 100 psi using standard filter press.
   3. Bentonite slurry shall be allowed to hydrate a minimum of 8 hours after it is mixed with water and before it is used, except where specifically requested and approved.
   4. Sand content of 10 percent measured 5 feet above the trench bottom.
   5. pH shall be controlled between 7 and 12.

2.4 SOIL-BENTONITE BACKFILL

A. Soil-Bentonite backfill mix for use in the slurry wall shall be comprised of select soil and bentonite.

B. Soil-Bentonite backfill shall meet the following requirements at time of placement:

Hydraulic Conductivity: Less than or equal to 1×10^{-7} cm/sec (0.0000001 cm/sec)

C. The density of the soil-bentonite backfill shall be such that it completely and rapidly displaces the bentonite slurry upon placement.

D. Selected soils used in the soil-bentonite backfill shall meet the following requirements:
   1. Soils excavated from the slurry trench may be used if the requirements of this specification are met. If the trench soils do not meet the specification requirements, then the CONTRACTOR shall provide off-site soils that meet the requirements, or soil that when mixed with the trench soils meet the requirements of this specification.
   2. Shall be a mixture of clean gravel, sand, silt and clay with no physical organic matter or other deleterious substances.

2.5 BANK-RUN GRAVEL

A. Bank run gravel for trench cover shall consist of well graded hard, sound, tough, durable particles of uncrushed gravel free from soft, thin, elongated or laminated pieces, organic matter and other deleterious substance. The percentage by weight

passing a No. 100 square mesh sieve shall not exceed ten percent, and it shall not contain stones larger than 6-inches.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform preparatory work to discover, protect, maintain, and restore utilities, manholes, pipe, force-mains or other facilities in the vicinity of the slurry wall.

B. Employ construction methods and provide protective coverings which prevent the leakage and spillage of excavated materials, bentonite slurry or backfill into adjacent utilities or structures.

C. CONTRACTOR shall be responsible for the proper disposal of excess slurry.

D. At the completion of slurry wall work, all surfaces of adjacent areas and structures shall be restored to their original condition.

E. Take all necessary measures to prevent collapse of the excavated slurry trench prior to backfilling, provide covers and/or barricades at open trench areas as required for safety.

G. Construct work platform as necessary to achieve installation of the slurry wall and adequate support of all construction equipment.

3.2 TRENCH EXCAVATION

A. Excavation equipment shall be capable of removing all materials required for excavation of the slurry wall so that the required width trench can be carried to its final depth of cut continuously along the trench line. The width of the excavating tool shall be equal to or greater than the specified width of the slurry wall. Drilling, hydraulic excavating, scraping or other methods may be used, subject to approval of the ENGINEER.

B. The excavation equipment shall be able to reach at least 5 feet deeper than, for a horizontal length of 8 feet, the maximum depth shown on the drawings. The excavation equipment shall have a minimum gross power of 140 horsepower.

C. The excavation shall begin from the working surface and shall provide a vertical, within 2 percent, continuous 30-inch minimum width trench along the centerline of the excavation. If trench excavation overlaps into previously completed slurry trench, the excavation shall extend a minimum of 10 feet into the previously placed SB backfill at all depths. Any removed section of completed slurry trench shall be refilled with SB backfill at no additional expense to the OWNER.

D. The slurry wall shall be excavated in a continuous manner to the lines and grades shown on the Drawings and as specified herein.

E. The slurry wall shall be constructed with a minimum key-in depth of 3 feet into the lower Nacimiento Formation or until refusal is met; whichever is less in depth. Refusal shall be defined as 3 passes for a horizontal distance of 5 feet with less than 0.2 feet of total penetration. Passes shall be made utilizing 90 percent of the manufacturer's maximum-rated down pressure and breakout power of the excavator.

F. The trench bottom shall be cleaned at the start of each day and as the excavation proceeds. The trench bottom shall be cleaned by using an excavator bucket or other equipment approved by ENGINEER to ensure removal of sand, gravel, sediment, and other material left in the trench during excavation or which has settled out of the slurry. Cleaning equipment shall not remove material from the walls of the trench.

G. Each excavation shall be filled and maintained with a stable suspension of bentonite slurry. Excavation shall proceed through the slurry. Slurry shall be added to the excavated trench as necessary to maintain the slurry level within 2' of the top of the trench. Losses of bentonite slurry into utilities and underground structure may occur, CONTRACTOR shall take all measures necessary to contain such losses. The slurry shall be circulated and cleaned to control uniformity and remove coarse material greater than 4" in diameter throughout its depth.

E. The slurry shall consist of a stable suspension of powdered or granular bentonite thoroughly mixed with water. All slurry for use in trenching shall be mixed in a batch or continuous mixer. No slurry is to be made in the trench. It shall be adequate in all respects to support the sides of the excavation.

F. Losses of bentonite slurry into the surrounding soils may occur. The CONTRACTOR shall take all measures necessary to contain such losses and maintain the stability of the trench.

3.3 MIXING

A. Bentonite Slurry
   1. Mixing method shall be capable of producing a homogenous colloidal suspension of bentonite in water, in pumps, valves, hoses, supply lines, and all other equipment as required to adequately supply slurry to the trench.
   2. Mixing of water and bentonite shall continue until bentonite particles are fully hydrated and the resulting slurry appears homogeneous.
   3. No slurry is to be made in the trench.

B. Soil-Bentonite Backfill

1. Soil-Bentonite backfill shall be mixed in such a manner that results in a backfill mixture that is homogenous with uniform distribution of properties to be tested during construction.
2. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill.
3. The backfill shall be thoroughly mixed to produce a homogenous mass, free from large lumps or pockets of fine-grained soil, sand, or gravel. Occasional lumps of up to 3-inches in their largest dimension will be permitted. Occasional rocks greater than 3-inches in their largest dimension will be permitted, provided they are not nested (i.e., in contact with one another) in the backfill. All particles shall be coated with slurry. The SB backfill may be sluiced with slurry during the mixing operations. Sluicing with water is not permitted.
4. Backfill shall not be mixed in the trench.

3.4 BACKFILL PLACEMENT

A. The bottom of the slurry-filled trench, defined as the bottom of the key into the Nacimiento Formation, shall be cleaned of all loose material prior to the placement of backfill.

B. Initially, the backfill shall be placed into the trench at one location only by placement at the bottom of the trench through a tremie pipe until the backfill material emerges from the slurry with no less than a 1H:1V slope. Additional backfill may then be placed in such manner that the backfill enters the trench by sliding down the forward face of the backfill slope.

C. Backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of daily excavation.

D. Backfill shall be placed in such a manner that the backfill displaces the slurry progressively from the bottom, rising uniformly to the surface, and such that intermixing of the backfill and slurry will not occur.

E. Free dropping of backfill materials through the slurry is not permitted. The backfill shall not be dropped or deposited in any manner that will result in a segregated mixture.

F. The toe of the trench excavation slope shall precede the toe of the backfill slope so that the toe of the backfill shall not be less than 50 feet following the toe of the excavation, or as required to permit proper cleaning of the trench bottom and to permit inspection and measurement.

G. Placement of backfill shall result in a backfill surface below the slurry that shall follow a smooth grade and not trap pockets of slurry during subsequent backfill placement.

H. Soil-bentonite backfill shall not be placed if it contains ice particles or will freeze in the trench. If this occurs, all Work shall cease and an adjustment will be made to the schedule based on the number of days the Work is delayed.

I. CONTRACTOR shall be responsible for the proper disposal of excess slurry.

3.5 TREATMENT OF TOP OF SLURRY TRENCH

A. Prior to placement of the compacted trench cover, a temporary plastic sheeting cover shall be placed over the trench to prevent desiccation. The temporary cover material shall be placed within 2 days after SB backfill placement is completed over each 100 foot reach.

B. If any depression develops within the completed slurry trench area, it shall be repaired by placing soil bentonite mix.

C. After a minimum 3 weeks, the temporary trench cover shall be removed and replaced by a final compacted trench cover.

D. A final compacted trench cover over the entire width of the trench and 3-feet deep shall be placed. A woven geotextile of Mirafi Geolon HP465 or equivalent shall be placed over the top of the SB backfill and along trench walls prior to backfill placement. Backfill in the upper 3 feet of trench shall consist of bank-run gravel placed at 90 percent of maximum density at optimum moisture to plus 3 percent in accordance with ASTM D 698.

3.6 INSPECTION AND TESTING DURING CONSTRUCTION

A. CONTRACTOR shall perform the following quality control testing during construction of the slurry wall.
   1. Testing of bentonite slurry and soil-bentonite backfill shall be in accordance with PART 1 – General, 1.2 Quality Assurance.
   2. CONTRACTOR shall be responsible for verifying that base of excavation is clear of all loose soil or other foreign materials, as well as verifying the depth of the slurry trench. CONTRACTOR shall be responsible for verifying to the ENGINEER that the trench is continuous and keyed the minimum specified depth into the underlying lower clay unit. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that the excavating tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Verification of the key-in depth of the slurry trench,

depth of trench and vertical continuity shall be by sounding techniques with a drop line at 10-foot intervals along the centerline of the trench.

3.7 TOLERANCES

A. The overall out-of-plumb tolerances for the entire cutoff wall from top to bottom shall not exceed 2.0% of the height of the slurry wall at that point.

B. The alignment of the slurry wall shall be limited to a lateral displacement of 1-foot from the alignment identified by the CONTRACTOR prior to trench excavation. Alignment changes as necessary to bypass obstructions may be made with the approval of the ENGINEER.

3.8 CANAL SERVICE ROAD

Canal service road shall be restored to its original grade and condition by placing a minimum 6-inch layer of compacted General Fill material. Finished grade of the service road shall slope away from the canal a minimum of 1/8-inch per foot.

+ + END OF SECTION + +

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