

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT		1. CONTRACT ID CODE	PAGE OF PAGES 1 2
2. AMENDMENT/MODIFICATION NO. 000003	3. EFFECTIVE DATE 01/21/2016	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. (If applicable)
6. ISSUED BY BIA NAVAJO 00009 301 WEST HILL ROOM 346 Contracting Office Gallup NM 87301	CODE A09	7. ADMINISTERED BY (If other than Item 6)	CODE
8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)		(x) 9A. AMENDMENT OF SOLICITATION NO. A16PS00021	
		x 9B. DATED (SEE ITEM 11) 11/02/2015	
		10A. MODIFICATION OF CONTRACT/ORDER NO.	
		10B. DATED (SEE ITEM 13)	
CODE	FACILITY CODE		

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers is extended. is not extended. Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning 4 copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
	D. OTHER (Specify type of modification and authority)

E. IMPORTANT: Contractor is not. is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

AMENDMENT NO. THREE (3) is issued as follows:

- The Geotechnical Report is incorporated into the solicitation. Seven (7) Attachments.
- The sign-in sheet for the Pre-bid meeting held on January 7, 2016 is incorporated into the solicitation.
- The Government's responses to the questions will be forthcoming.

Continued ...

Except as provided herein, all terms and conditions of the document referenced in Item 9 A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) Lynelle Benallie	
15B. CONTRACTOR/OFFEROR (Signature of person authorized to sign)	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA (Signature of Contracting Officer)	16C. DATE SIGNED

CONTINUATION SHEET

REFERENCE NO. OF DOCUMENT BEING CONTINUED
A16PS00021/000003

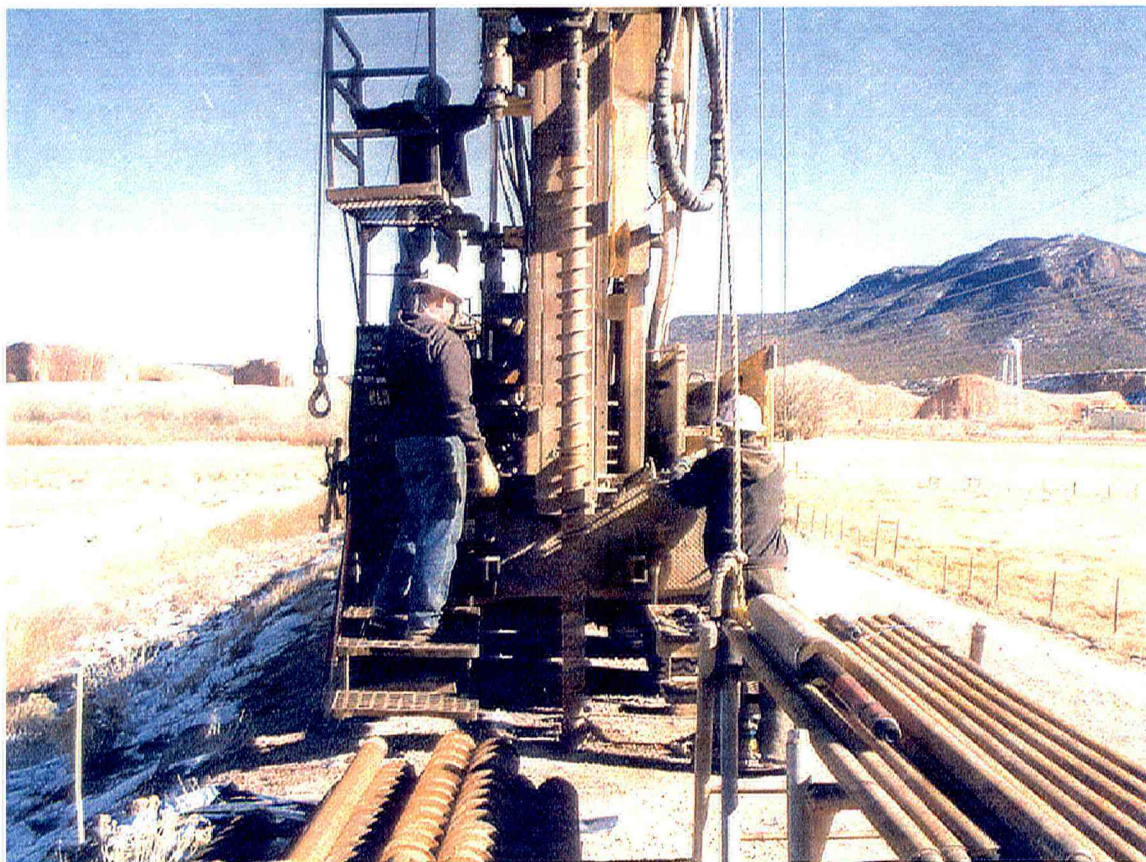
PAGE OF
2 2

NAME OF OFFEROR OR CONTRACTOR

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	<p>Performance Time is tentative until a Notice to Proceed is issued.</p> <p>Submit all questions by email to: lynelle.benallie@bia.gov</p>				

Red Lake Dam and Reservoir

Navajo Indian Reservation, New Mexico



Geologic Report



Prepared by:
U.S. Department of the Interior
Bureau of Reclamation
Phoenix Area Office
Phoenix, Arizona

RECLAMATION
Managing Water in the West

March 2007

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APPENDICES

DRAWINGS APPENDIX

Drawing No.	Drawing Contents
344-330-18924	Standard Descriptors and Descriptive Criteria for Rock
1748-331-1	Red Lake Dam - General Geologic Legend and Explanation
1748-331-2	Red Lake Dam - Location of Exploration and Surface Geology
1748-331-3	Red Lake Dam - Geologic Cross-Section A-A'
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DRILL LOGS APPENDIX

Drill Log BH-1

 Photographs of the SPT Intervals

Drill Log BH-2

 Photographs of the SPT Intervals

Summary of Physical Properties Test Results for the SPT Samples

Pinhole Test Classifications and Summaries of the Gradation and Atterberg Limits

Graphs of the Cone Penetrometer Test Soundings

PHOTOGRAPHS APPENDIX

Photographs from Mapping

PURPOSE

The purpose of this report is to present geologic data collected at Red Lake Dam as part of a Deficiency Verification Analysis (DVA) conducted by the Technical Services Center (TSC). Red Lake Dam is an embankment dam located at the Arizona/ New Mexico border, about 20 miles northeast of Window Rock, Arizona. The DVA (Technical Memorandum No XV-8311) was performed in October of 2006, and contained a Field Exploration Request (FER) to address possible dam failure modes. The geologic explorations contained in this report are part of that exploration request.

INVESTIGATIONS

The current investigation was performed to collect geotechnical data to evaluate the liquefaction potential of the dam and foundation material underlying Red Lake Dam. The data will also aid in evaluating some of the seepage and internal erosion issues associated with the embankment.

Cone penetrometer testing (CPT) was performed in November 2006, by Tony Shanahan of the Technical Service Center. A total of 12 CPT soundings were completed and the results were presented in a separate memorandum prepared by Jeff Farrar of the TSC and titled "Results of Cone Penetrometer Tests – Red Lake Dam and Reservoir - Navajo Nation Dam Safety - Bureau of Indian Affairs - New Mexico/Arizona". Graphs of the cone penetrometer test soundings are included in the Drill Logs Appendix.

Six drill holes located on the crest of the dam were required in the FER. Standard penetration tests (SPT) were to be conducted in all six holes and three would be cored into bedrock. However, only 2 holes were completed due to budget constraints. Drill holes BH-1 and BH 2 were located within ten feet of a CPT hole in order to compare the two test procedures. Samples were collected continuously in such a manner that; where a 1.5-foot SPT test was performed, a flight auger dry core clean out sample was extended one foot below the SPT interval resulting in two SPT samples per 5-foot interval. Piezometers were installed in both holes after drilling was completed. Geologic logs of the drill holes and the summary of physical properties test results for the SPT samples are contained in the Drill Logs Appendix along with photographs of the SPT intervals.

Six samples of the dam embankment were taken for dispersive pin hole testing. Results of the pinhole tests are as follows:

Drill Hole	Depth (ft.)	Sample Number	% Fines	% Sand	% Gravel	LL	PI	Pinhole Rating	Crumb Rating
BH-1	5.0-6.0	71H-1	74.8	22.8	3.0	36	19	ND3	1
BH-2	5.0-6.0	71H-2	36.6	52.4	11.0	27	11	ND3	1
BH-2	7.5-8.5	71H-3	59.1	35.9	5.0	35	19	ND3	1
BH-2	12.5-13.5	71H-4	72.4	25.0	2.6	36	18	D1	2
BH-2	20.5-21.0	71H-5	77.1	21.8	1.1	40	21	ND4	2
BH-2	22.5-23.5	71-H6	68.2	31.2	6.0	36	20	D1	3

The last three specimens demonstrated some degree of dispersion potential; particularly samples 71H-4 and 71H-6. The classifications and test summaries of the gradation and Atterberg Limits are reported in the Drill Logs Appendix.

Geologic mapping at a scale of 1:100 was performed 1,000 feet upstream and downstream of the dam and extending about 200 feet beyond the abutments and spillway. Geologic mapping, along with the locations of the cone penetrometer test holes and drill holes is shown on the surface geology plan map (Drawing Number 1743-331-2) contained in the Drawings Appendix. A geologic cross-section was drawn along the dam crest and through the drill holes and CPT holes. Two cross-sections were drawn perpendicular to the dam crest at drill holes BH-1 and BH-2, respectively. Cross-sections can be found in the Drawings Appendix (Drawing Numbers 1743-331-3 and -4). Photographs taken during the mapping are contained in the Photographs Appendix.

REGIONAL GEOLOGY

Red Lake Dam is located on the Black Creek in a north-south trending valley that lies between the Chuska Mountains to the east and the Defiance Plateau to the west. The Chuska Mountains and the Defiance Plateau form one of the prominent uplifted highs of the Colorado Plateau. Relative uplift, basin subsidence, and monocline formation began in the early stages of the Laramide Orogeny about 75 to 80 million years ago. Although the Chuska Mountains can be considered part of the Defiance Uplift, they stand relatively higher and are capped by an erosional remnant of Chuska Sandstone, a unit locally more than 500 meters thick. The flat-lying Chuska Sandstone rests unconformably on Mesozoic rocks deformed in the Defiance monocline.

The Navajo volcanic field is located within this portion of the Colorado Plateau. These volcanoes erupted from about 30 to 25 million years ago and consist of dozens of intrusions, diatremes, tuff pipes, and dikes. Most of the rocks of this volcanic field are minette and kimberlite based on their composition. Erosion has lowered the ground surface hundreds of meters, exposing the deeper levels of these extinct volcanoes. Outlet Neck and Frog Rock, located downstream of Red Lake are examples of a volcanic neck or plug. This is the feeding conduit of a volcano that has been filled with magma or volcanic breccia. The abundance of fragmented volcanic rock (breccia) indicates an explosive eruption of highly gas-charged magma. The minette within the Navajo Volcanic Field intruded and was extruded through the Chuska Sandstone.

Green Knobs, located northeast of Red Lake, is a large diatreme neck that has intruded through the Triassic Chinle Formation. This rock is mostly kimberlite and its green color comes from the mineral olivine. Green Knobs is a source of green sand for Navajo sand paintings.

SITE GEOLOGY

General

Red Lake Dam is located on Black Creek, approximately ¼ mile upstream of the confluence of Black Creek and Tohdildonih Wash. United States Geological Survey (USGS) maps and cross-sections show that the Chinle Formation forms the bedrock at the damsite. The Chinle Formation consists of interbedded siltstone, sandstone and limestone that has been further

subdivided into members and units. The Owl Rock Member of the Chinle Formation and Units 4 and 3 of the Petrified Forest Member of the Chinle Formation underlie roughly the eastern half of the dam, while Unit 2 of the Petrified Forest Member underlies roughly the western half of the dam and is exposed in the spillway cut. Alluvium up to 100 feet thick overlies the bedrock and forms the foundation for Red Lake Dam.

Stratigraphy (youngest to oldest)

Dam Embankment - Material for use as dam embankment was taken from the surrounding alluvium and consists primarily of sandy to clayey silts, lean clays with varying amounts of sand and silty sands. At the surface, lean clay with varying amounts of sand forms the western half of the dam embankment (west of CPT06-7). The eastern half consists mostly of silty sand with minor amounts of clay. The upstream slope is sparsely covered with a veneer of rip rap up to 2 feet in diameter.

Drill hole BH-1, drilled from the crest of the dam about 870 feet east of the left abutment, encountered mostly sandy silt in the upper 20 feet of the drill hole. A 3.5-foot-thick layer of sandy clay was present near the top of the hole. The contact between dam embankment and alluvium was not identified in the core, but the CPT data interpreted the base of the dam at around 20 feet deep.

Drill hole BH-2, drilled from the crest of the dam about 570 feet east of the right abutment and approximately 300 feet west of BH-1, encountered mostly lean clay with varying amounts of sand. Again, the contact between dam embankment and alluvium was not identified in the core, but the CPT data placed the base of the dam at around 19 feet deep.

Talus - Rockfall breccia consisting of unsorted, unconsolidated fragments of minette and minette breccia forms the slopes of Outlet Neck, a small butte located 1,000 feet downstream of the right abutment of Red Lake Dam. The talus ranges in size from sand and gravel to boulders up to 15 feet in diameter. The talus forming the northern face of Outlet Neck was reworked to build a road during dam construction. The road was used in order to quarry the minette for rip rap.

Alluvium - Alluvium consists of silty sand and sandy lean clay with varying percentages of sand, silt and clay. Sandy components such as poorly graded sand (SP) and silty sand (SM) are generally brown in color and are found upstream and downstream of the eastern half of the dam (east of CPT06-7). Clayey materials such as clayey sand (SC) and sandy lean clay (CL) are generally dark gray to black in color and are found in close proximity to the shore of Red Lake with the lake at elevation 7072. Sandy clay is also present in the marshy area that extends about 160 feet downstream of the right one-third of the dam west of CPT06-7. Interbedded lean clay and sandy lean clay with varying amounts of silt and sand forms the right abutment and the slopes upstream of the dam. The clays have medium to high plasticity and are sticky when wet. Gravel and cobble-size sandstone fragments litter the surface.

The alluvium overlies the bedrock to an estimated maximum thickness of 80 feet below the foundation of the dam based on the results of the CPT soundings, which showed a sharp change at the bottom of the soundings indicating harder material. Drill holes BH-1 and BH-2, drilled

from the crest of the dam to a depth of 80.1 and 91.0 feet, respectively, did not encounter bedrock.

Minette - Outlet Neck is a small butte located approximately 1,000 feet downstream of the right abutment of Red Lake Dam. The butte is the eroded remains of a volcanic neck and is composed of minette and minette breccia. The rock is dark gray to medium dark gray and dark olive gray in color and consists primarily of biotite phenocrysts in a groundmass of feldspar and biotite. Large fragments of wall rock (mostly sandstone) are incorporated in the breccia. Outlet Neck was the source of the rip rap used to protect the upstream slope the dam.

Chinle Formation Owl Rock Member

The Owl Rock Member of the Chinle Formation consists of cherty limestone interbedded with calcareous siltstone. The rock is thought to underlie the left abutment of the dam, but is not seen in outcrop at the dam site. The Owl Rock Member is exposed east of the left abutment, across Tribal Route 12. Bedding strikes N10°W and dips 10 to 20° east.

Petrified Forest Member

The Petrified Forest Member of the Chinle Formation is subdivided into Units 4, 3 and 2. Units 4 and 3 are not exposed at the dam site, but are thought to underlie the left abutment of the dam. USGS reports describe Unit 4 as consisting of laminated, slightly clayey siltstone. Unit 3 is dominantly a medium-grained sandstone.

Unit 2 of the Petrified Forest Member of the Chinle Formation underlies the right abutment and outcrops in the spillway excavation and along the west and south sides of the hill that forms the right abutment. The siltstone is described in USGS reports as being slightly sandy near the top of the unit and, near the dam and in the spillway, the siltstone is interbedded with very fine- to fine-grained sandstone beds up to 2 feet thick. The sandstone varies in color from pale red purple to pale grayish orange. The siltstone is generally light gray to light brownish gray.

The siltstone is mostly laminated to very thinly bedded (1/4 to 1/2 inch apart). Bedding in the sandstone ranges from moderately to thickly bedded (spaced from 2 to 18 inches apart), but is generally moderately bedded (spaced 5 inches apart.). Some cross-bedding is apparent in thicker beds. Weathering is dependent upon the thickness of the bedding. Beds generally greater than 3/4 inch thick are moderately weathered and moderately hard, whereas beds less than 3/4 inch thick are intensely weathered and soft. Bedding tends to be closer spaced as you approach the top of the exposure. Iron oxide staining follows some bedding joints, especially where the sandstone is cross-bedded. In general, the siltstone weathers to form gentle chip covered slopes with resistant ledges of sandstone.

The orientation of bedding varies greatly from exposure to exposure and within outcrop. This is probably a factor of the low dip angle and the presence of cross bedding. Within the spillway excavation, the strike of the bedding varies from N80°W to N30° W and dips 11-18° NE. Bedding exposed approximately 400 feet west of the right abutment is oriented N40-50° E, 10-20° NW.

Fractures are generally moderately to widely spaced (0.5 to 1.5 feet apart), excluding bedding joints. Joints are oriented N30°W, 30° NE; N85°W, 90°; and N60°E, 50°NW.

Spillway

The spillway is located approximately 200 feet upstream of the right abutment and consists of an unlined, trapezoidal-shaped channel with a concrete control weir structure. The cutslopes which form the first 220 feet of the spillway consist of light brown to moderate reddish brown, sandy lean clay with a very hard consistency. The clay is laminated and breaks into 1 inch chunks when dug with a geologic pick and has a strong reaction with HCl. As you precede upslope, the sandy lean clay grades into lean clay containing a lesser amount of sand. The top of the hill is capped with a veneer of polished, rounded to subangular gravel and platy sandstone fragments.

Downstream of the clay, siltstone with interbedded sandstone forms the cutslopes of the spillway (see Photo Collage Figure 1). The siltstone is laminated to very thinly bedded and contains sandstone beds up to 18 inches thick. The siltstone is intensely weathered and soft and the sandstone is moderately weathered and moderately hard, and forms resistant ledges in the cutslope.

The floor of the spillway is covered with an unknown thickness of clayey slopewash.

GROUNDWATER AND SEEPAGE

Red Lake Dam has a history of seepage in the area downstream of the right toe of the dam. No seepage was noted during geologic investigations with the reservoir at about elevation 7071. Drill holes BH-1 and BH-2, located on the crest of the dam, encountered groundwater at 25.7 feet (El. 7063.9) and 22.7 feet (El. 7067.1), respectively. Measurements were taken in the morning prior to drilling. The water surface of the lake was at about 7071 feet elevation. Both holes were completed as piezometers. The zone of influence in BH-1 is from 48.0 to 24.7 feet; the zone of influence in BH- 2 is from 51.0 to 29.7 feet.



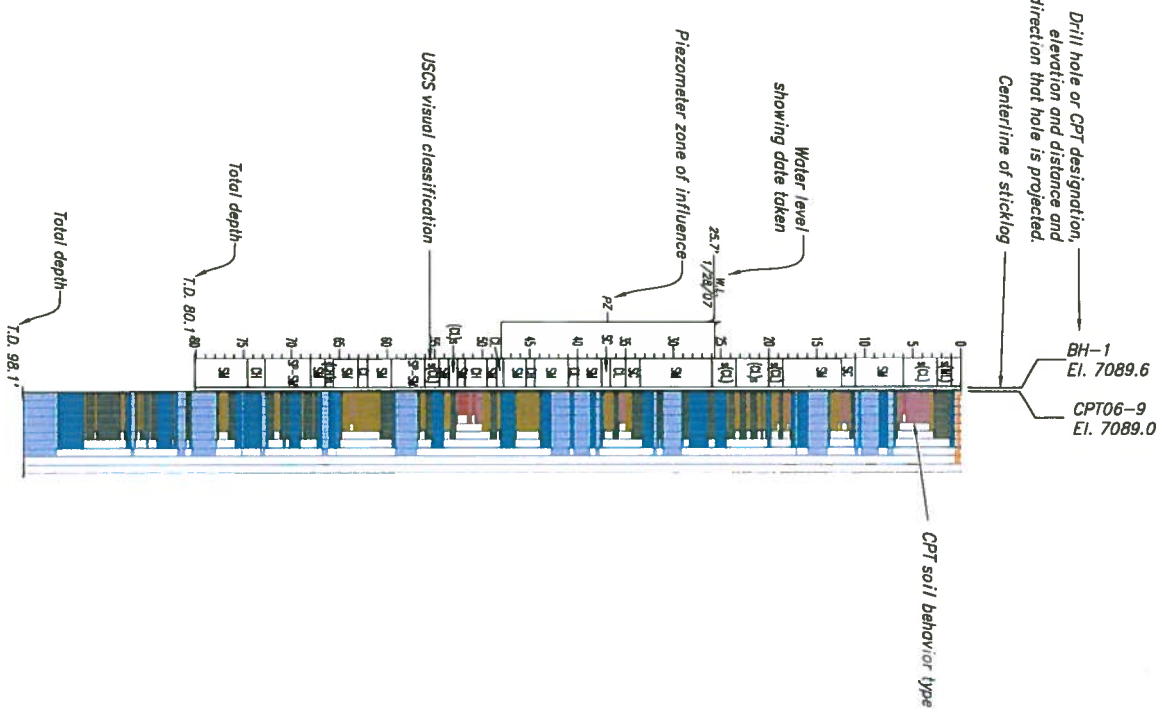
GENERAL GEOLOGIC LEGEND

- Dam Embankment** – Embankment consisting of materials ranging from silty sand to lean clay with varying amounts of sand placed during construction of the dam.
- Stock Pile (SM/SC)gc** – Material stock piled as part of the dam construction. Material consists of gravelly silty sand, sandy gravel and silty clayey sand with gravel and cobbles. Stock piles are located approximately 600 feet downstream of the right abutment.
- Talus** – Rockfall breccia consisting of unsorted, unconsolidated fragments of minette and minette breccia ranging in size from sand to boulders 15 feet in diameter. Talus forms the slopes of Outlet Neck, a small butte located 1000 feet downstream of the right abutment of Red Lake Dam. The talus forming the northern face of Outlet Neck was reworked to form a road during dam construction. The road was used in order to quarry the minette for rip rap.
- Qal** – Alluvium consisting of silty sand and sandy lean clay with varying percentages of sand, silt and clay. The alluvium that would be visually classified as sandy, i.e. poorly graded sand (SP) and silty sand (SM), was mapped as SM/SP. The sandy materials are generally brown in color and are found upstream and downstream of the eastern half of the dam (east of CPT06-7). The alluvium that would be visually classified as clayey, i.e. clayey sand (SC) and sandy lean clay s(CL), was mapped as SC/s(CL). Clayey materials are generally dark gray to black in color and are found in close proximity to the shore of Red Lake with the lake at elevation 7072. Reddish brown clay mantles the slopes of the right abutment and upstream of the right abutment. Gravel and cobble-size sandstone fragments litter the surface and cap the hillsides.
- Trcp4 Siltstone** – The siltstone (Unit 4) of the Petrified Forest Member of the Chinle Formation. Unit 4 is not exposed at the dam site, but is thought to underlie the left abutment of the dam. USGS reports describe Unit 4 as consisting of laminated, slightly clayey siltstone.
- Trcp3 Sandstone** – The sandstone (Unit 3) of the Petrified Forest Member of the Chinle Formation. Unit 3 is not exposed at the dam site, but is thought to underlie the left abutment of the dam. USGS reports describe Unit 3 as consisting of medium-grained sandstone.
- Trcp2 Siltstone** – The siltstone (Unit 2) of the Petrified Forest Member of the Chinle Formation is interbedded with very fine- to fine-grained sandstone beds up to 2 feet thick. The siltstone is generally light gray to light brownish gray. The sandstone varies in color from pale red purple to pale grayish orange. The siltstone is mostly laminated to very thinly bedded (1/4 to 2 inch apart). Bedding in the sandstone ranges from moderately to thickly bedded (spaced from 2 to 18 inches apart), but is generally moderately bedded (spaced 5 inches apart). Some cross-bedding is apparent in thicker beds. Weathering is dependent upon the thickness of the bedding and beds generally greater than 2 inch thick are moderately weathered and moderately hard, whereas beds less than 2 inch thick are intensely weathered and soft. Bedding tends to be closer spaced as you approach the top of the exposure. Iron oxide staining follows some bedding joints, especially where the sandstone is cross-bedded. In general, the siltstone weathers to form gentle chip covered slopes with resistant ledges of sandstone.

GENERAL GEOLOGIC EXPLANATION

- BH-1 Drill Hole, performed standard penetration tests (SPTs)
- CPT06-7 Cone Penetrometer Test (CPT) sounding; performed in 2006
- 15° Strike and Dip of Bedding
- 50° Strike and Dip of Joint
- Geologic contact – approximate
- Location of geologic cross-section.
- Waterline
- Restricted water surface El. 7073.0
- Buildings and Residences
- Roads, paved (solid line), dirt (dashed)

DRILL HOLE AND CPT SOUNDING



LEGEND – Soil Behavior Type for CPT Sticklogs

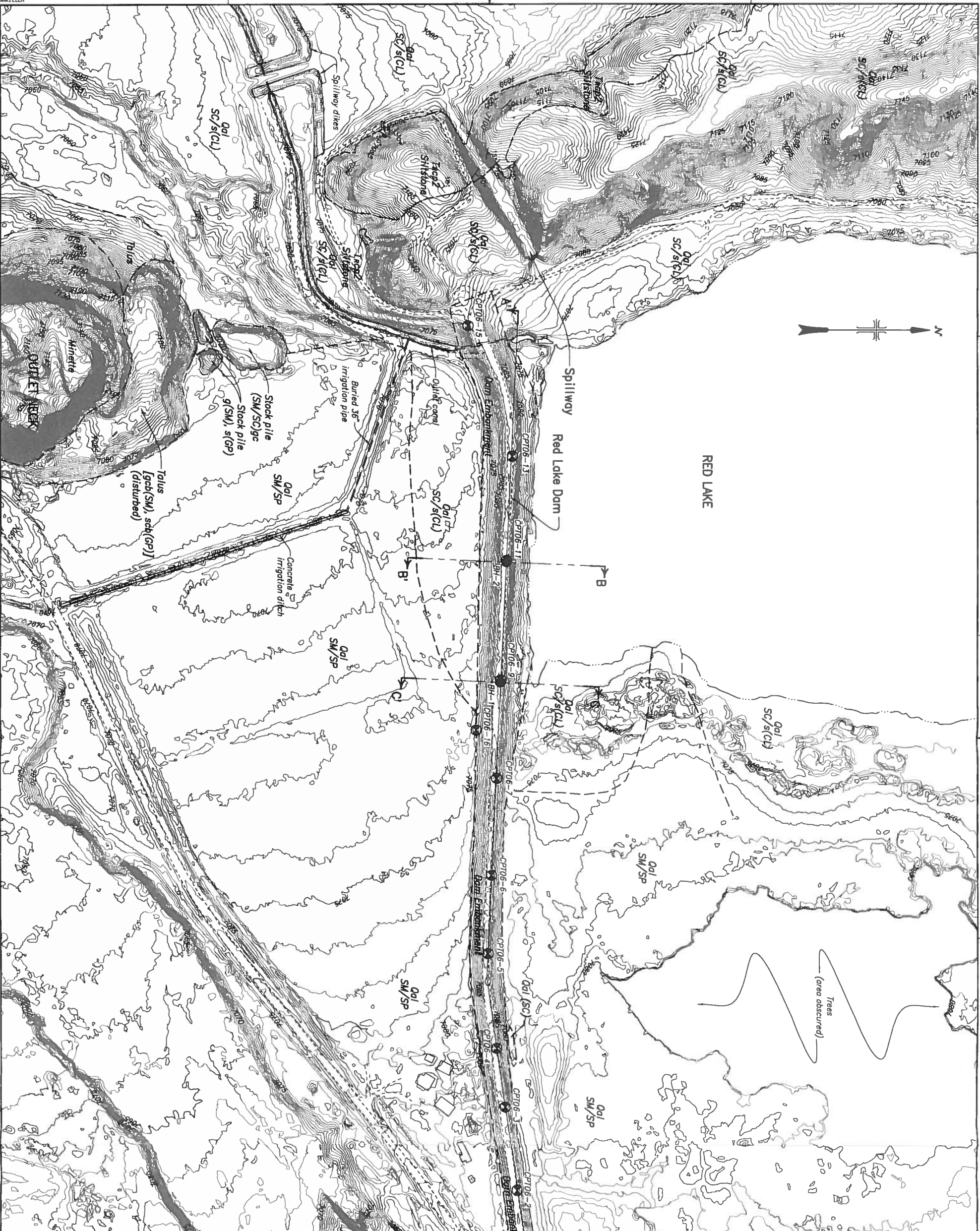
- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

ALWAYS THINK SAFETY

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NANKAI NATION INDIAN RESERVATION
NANKAI TRIBE OF ARIZONA AND NEW MEXICO
RED LAKE DAM
GENERAL GEOLOGIC LEGEND
AND EXPLANATION

DESIGNED BY: M. J. ...
CHECKED BY: ...
APPROVED: ...
DATE: 2007-04-17
SHEET 1 OF 1
1743-331-1

DATE AND TIME PLOTTED
APRIL 18, 2007 16:31
PLOTTED BY
MMILLER

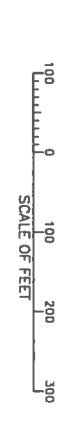


LEGEND

- Buildings and Residences
- Roads: paved (solid line), dirt (dashed)
- Geologic Contact
- Strike and Dip of Bedding
- Strike and Dip of Joint
- Drill Hole: performed standard penetration tests (SPTs)
- Cone Penetrometer Test (CPT) sounding: performed in 2006

Mapping compiled using Intergraph Photogrammetry and Mapping System from 1:3600 scale aerial photography flown November 2006.

Coordinates are in 1983 State Plane, New Mexico West Zone. The vertical datum is MVD 1988.



ALWAYS THINK SAFETY

DEPARTMENT OF GEOSCIENCES
MILWAUKEE INDIAN RESERVATION
NAAVAO TRIBE OF ARIZONA AND NEW MEXICO

RED LAKE DAM

LOCATION OF EXPLORATION AND SURFACE GEOLOGY

PROJECT NUMBER	1743-331-2
DATE	APRIL 18, 2007
DRAWN BY	MMILLER
CHECKED BY	TECH APPR
APPROVED BY	
ADJUSTMENTS	
DATE	1743-331-2
SHEET	1 OF 1

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APRIL 18, 2007 11:00
PLOTTED BY
MILLER

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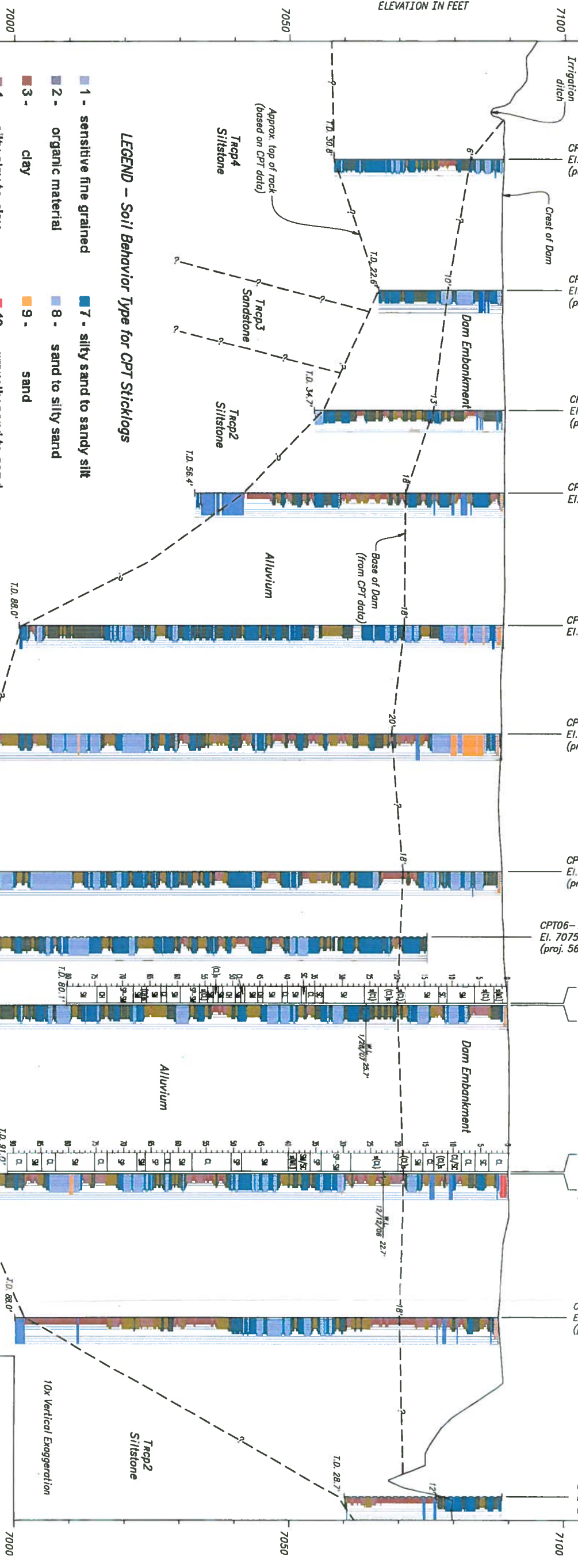
Bearing S87°W

Turn

Bearing N82°W

A'

ELEVATION IN FEET



LEGEND - Soil Behavior Type for CPT Sticklogs

- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

Cone penetrometer test (CPT) results are presented in a memorandum titled "Results of Cone Penetrometer Tests - Red Lake Dam and Reservoir - Navajo Nation Dam Safety - Bureau of Indian Affairs - New Mexico/Arizona".

INTERSECTION SECTION C-C'

INTERSECTION SECTION B-B'

LOOKING DOWNSTREAM

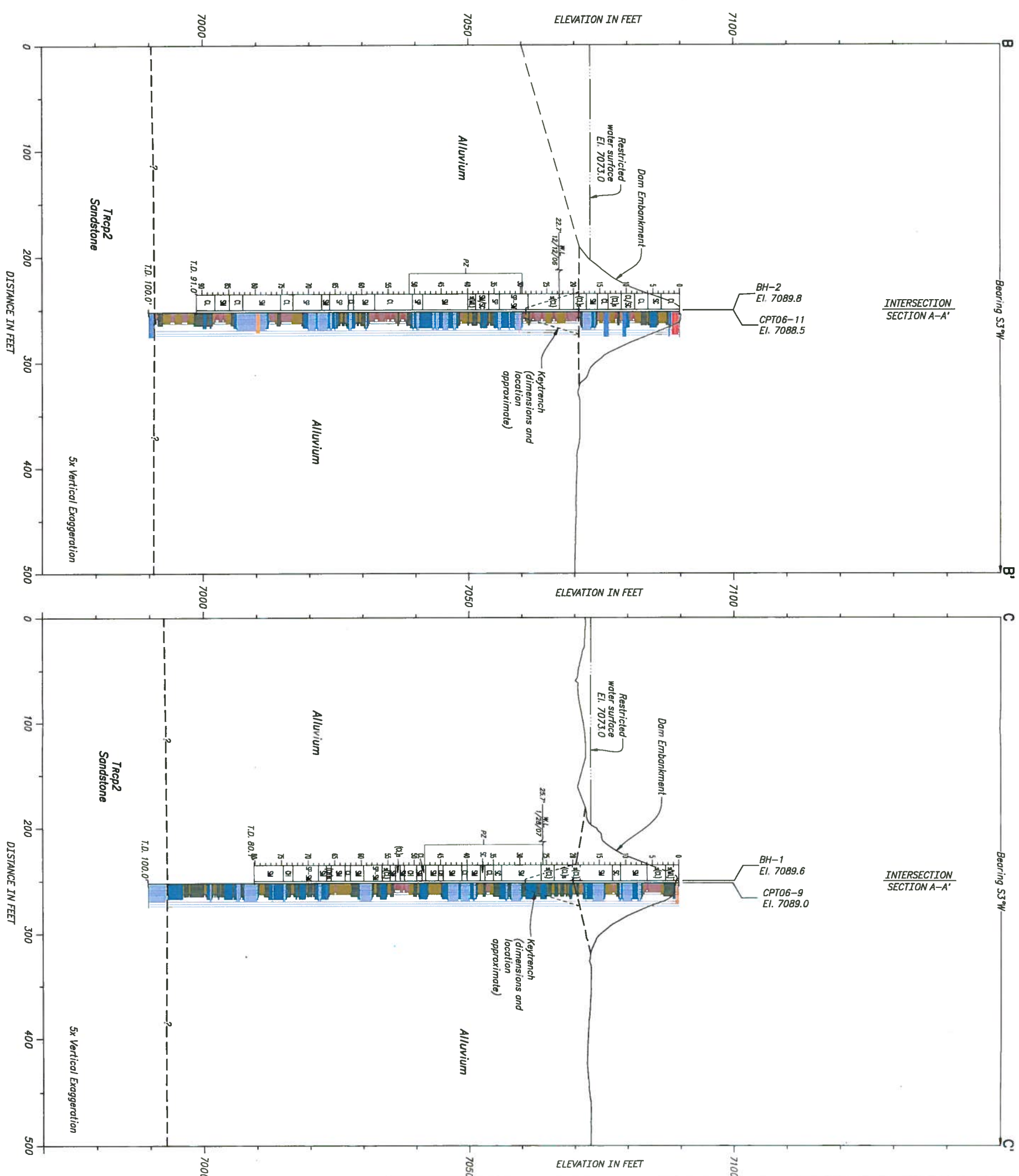
SCALE OF FEET

ALWAYS THINK SAFETY

RED LAKE DAM
NAVAJO TRIBE OF ARIZONA AND NEW MEXICO

DESIGNED BY	APPROVED
CHECKED	TECH. APPR.
DRAWN	
GEOLOGIC CROSS-SECTION A-A'	
OPERATION OF RED LAKE DAM	
MEMPHIS INDIAN RESERVATION	
NAVAJO TRIBE OF ARIZONA AND NEW MEXICO	
RED LAKE DAM	
DATE	2007-01-18
PROJECT	1743-331-3

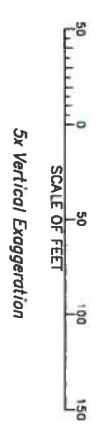
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APRIL 18, 2007 11:01
PLOTTED BY
MILLER



LEGEND
Soil Behavior Type for CPT Sticklogs

- 1 - sensitive fine grained
- 2 - organic material
- 3 - clay
- 4 - silty clay to clay
- 5 - clayey silt to silty clay
- 6 - sandy silt to clayey silt
- 7 - silty sand to sandy silt
- 8 - sand to silty sand
- 9 - sand
- 10 - gravelly sand to sand
- 11 - very stiff fine grained (*)
- 12 - sand to clayey sand (*)

NOTES
Drillhole sticklogs have been simplified. Refer to drillhole log for detailed descriptions. For cone penetrometer test (CPT) results, see memorandum titled "Results of Cone Penetrometer Tests - Red Lake Dam and Reservoir - Navajo Nation Dam Safety - Bureau of Indian Affairs - New Mexico/Arizona."

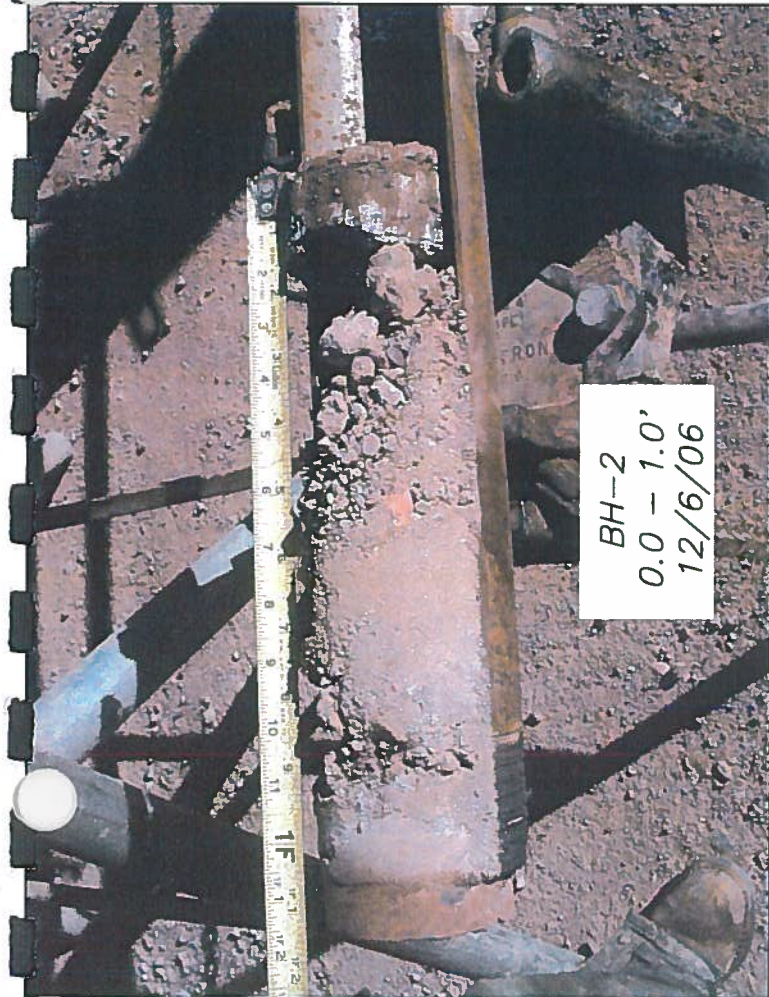


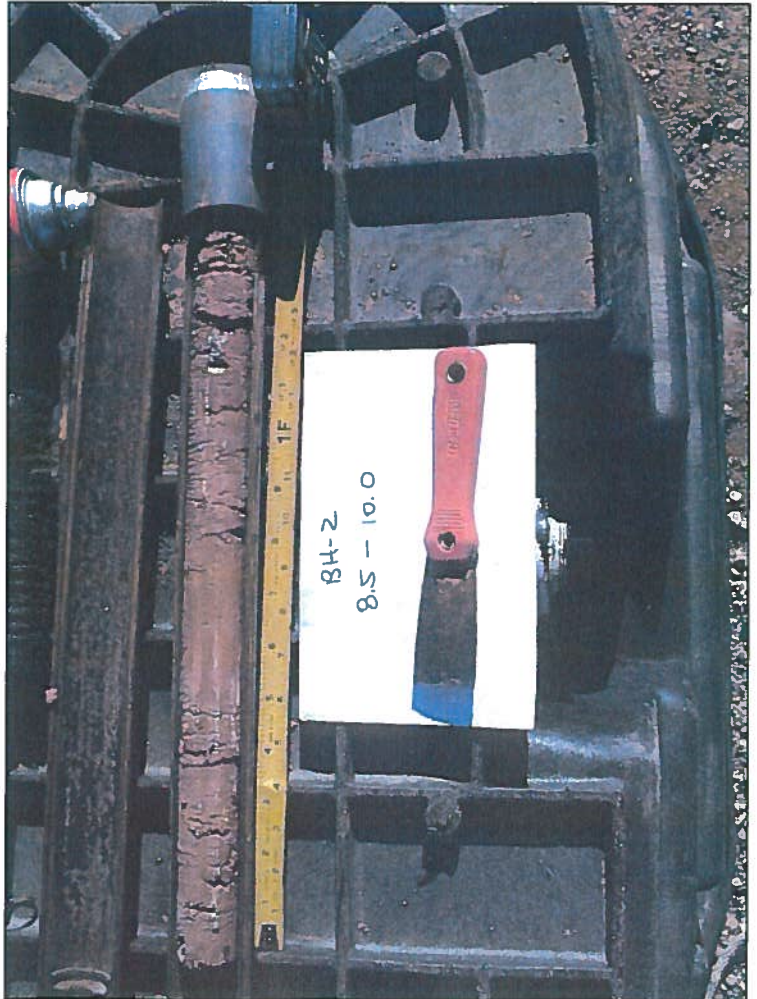
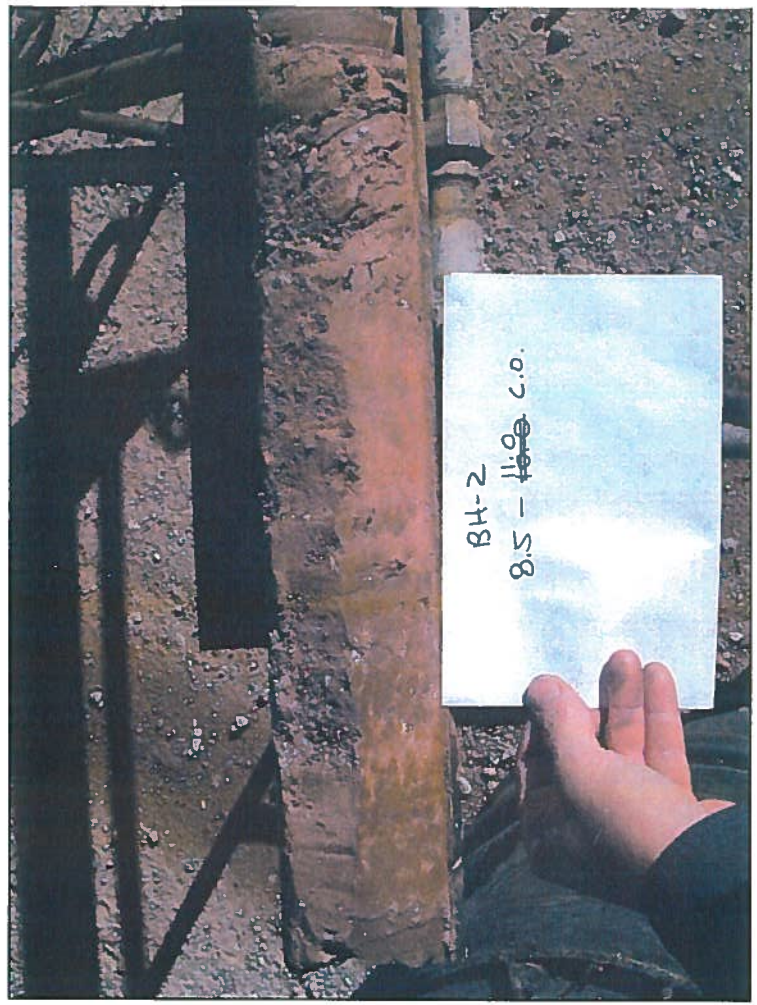
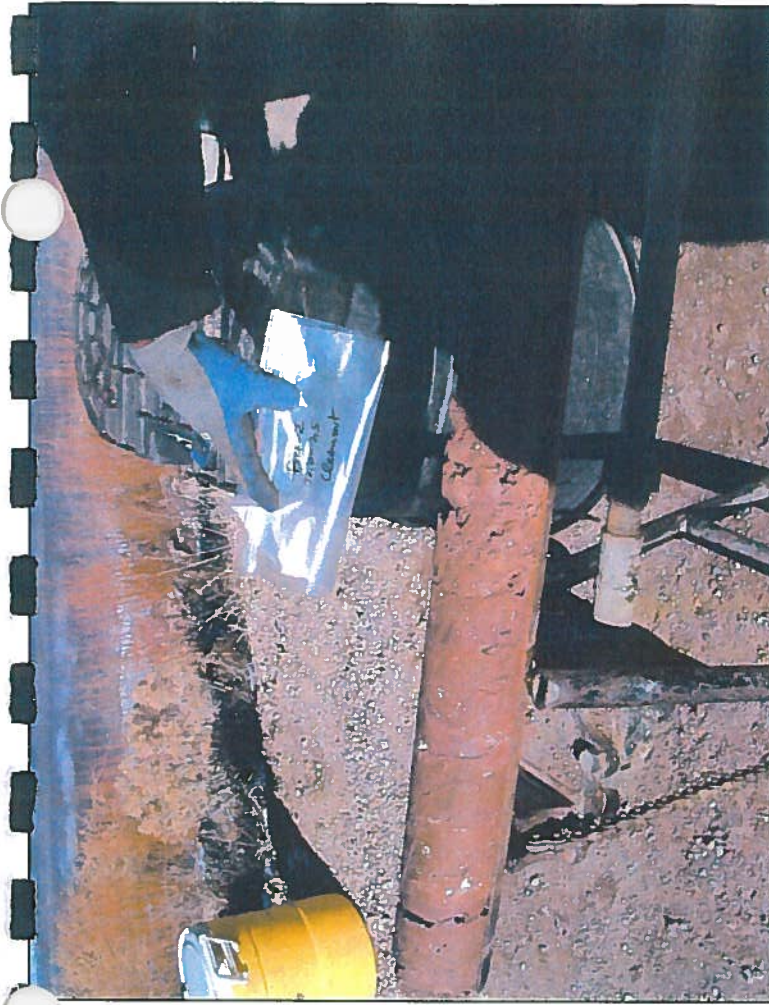
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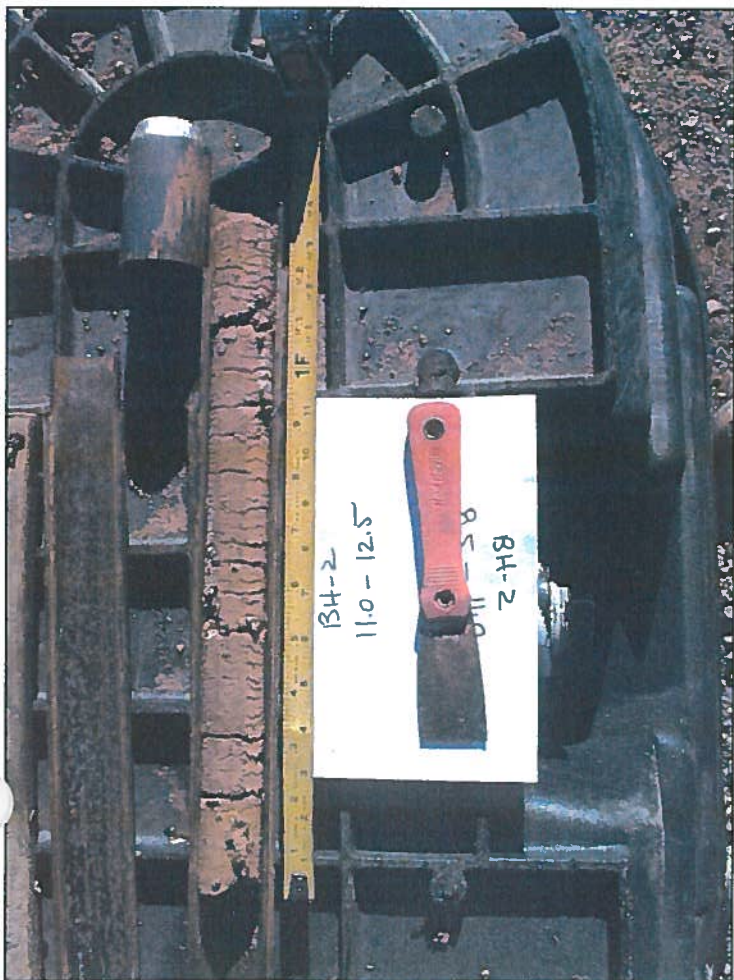
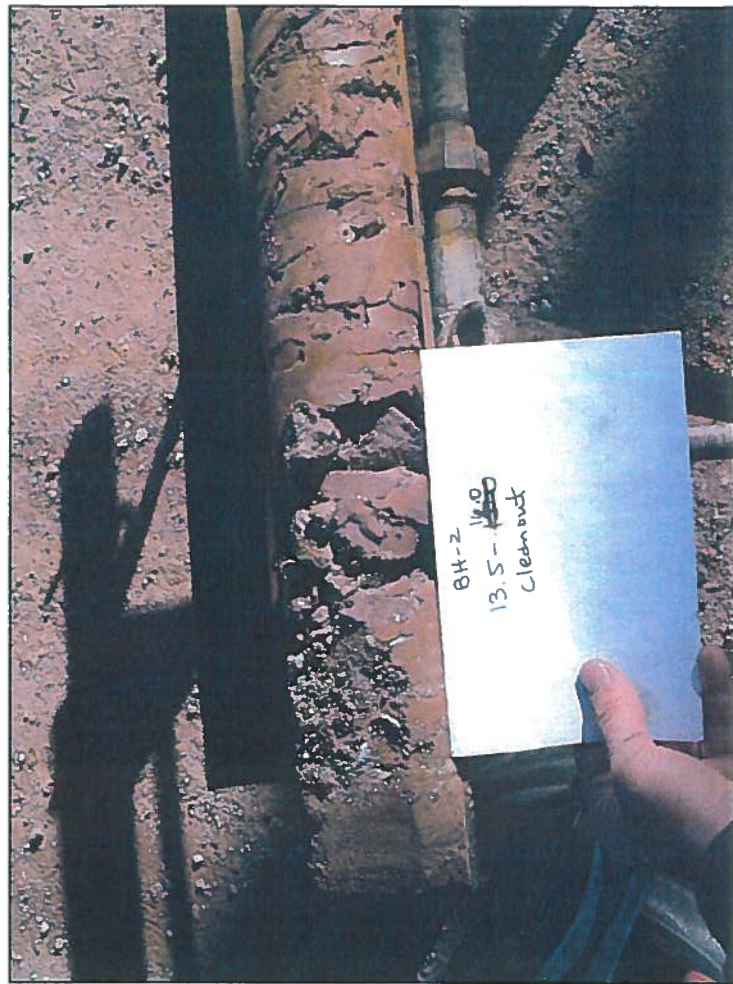
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
NAVAJO NATION INDIAN RESERVATION
NAVAJO TRIBE OF ARIZONA AND NEW MEXICO
RED LAKE DAM

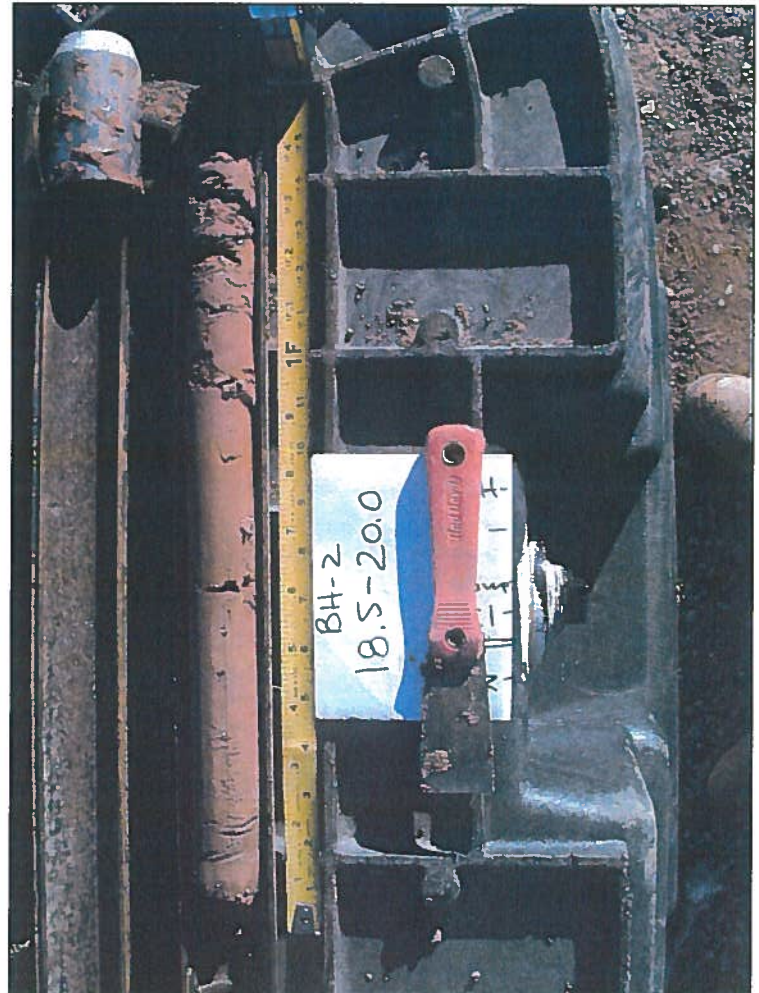
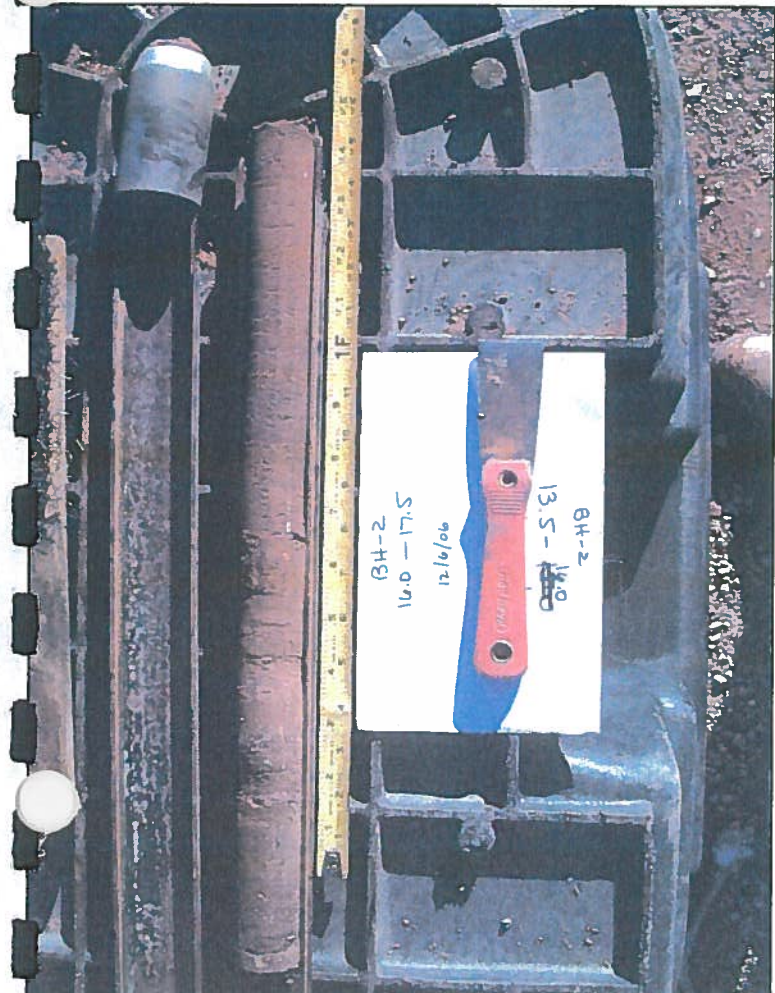
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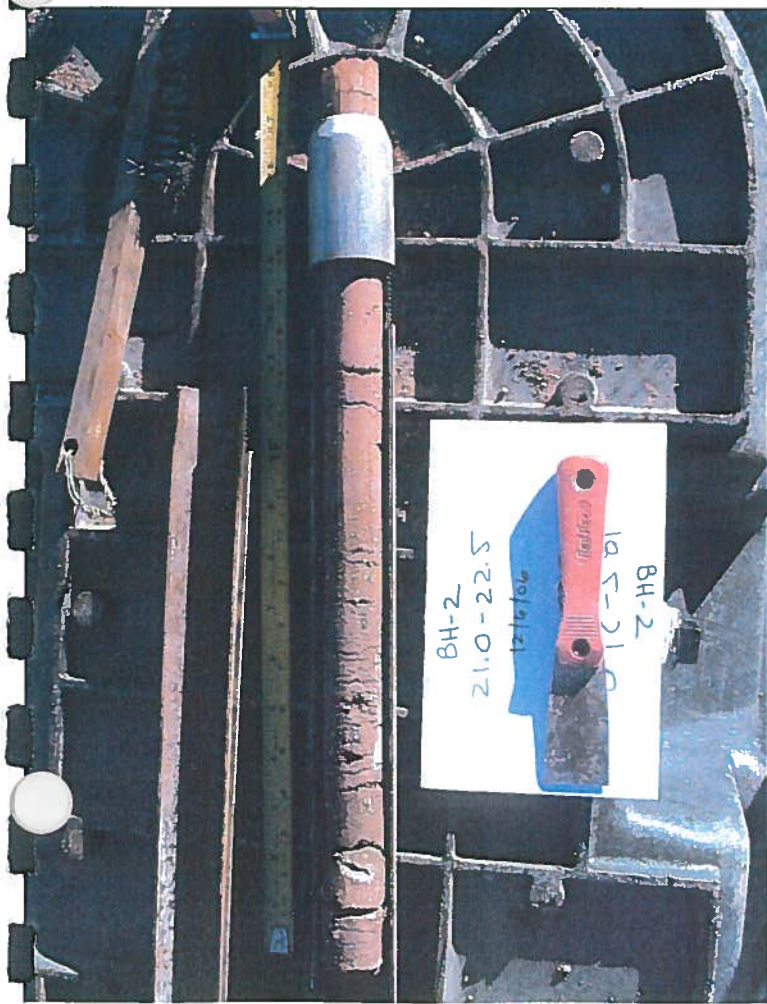
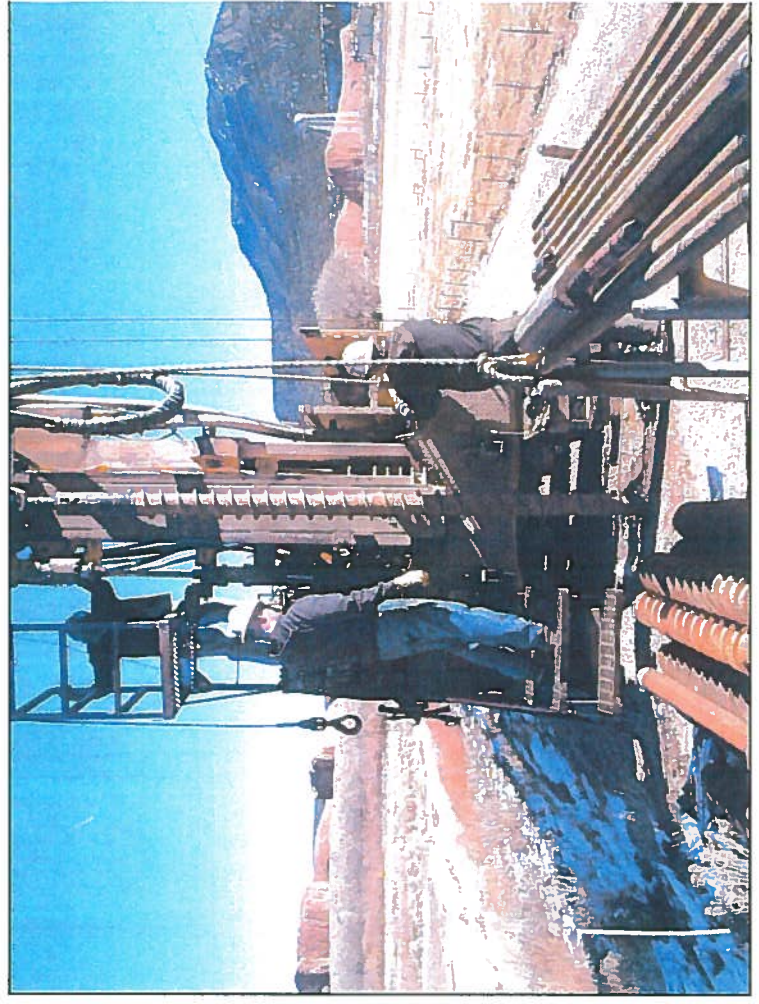
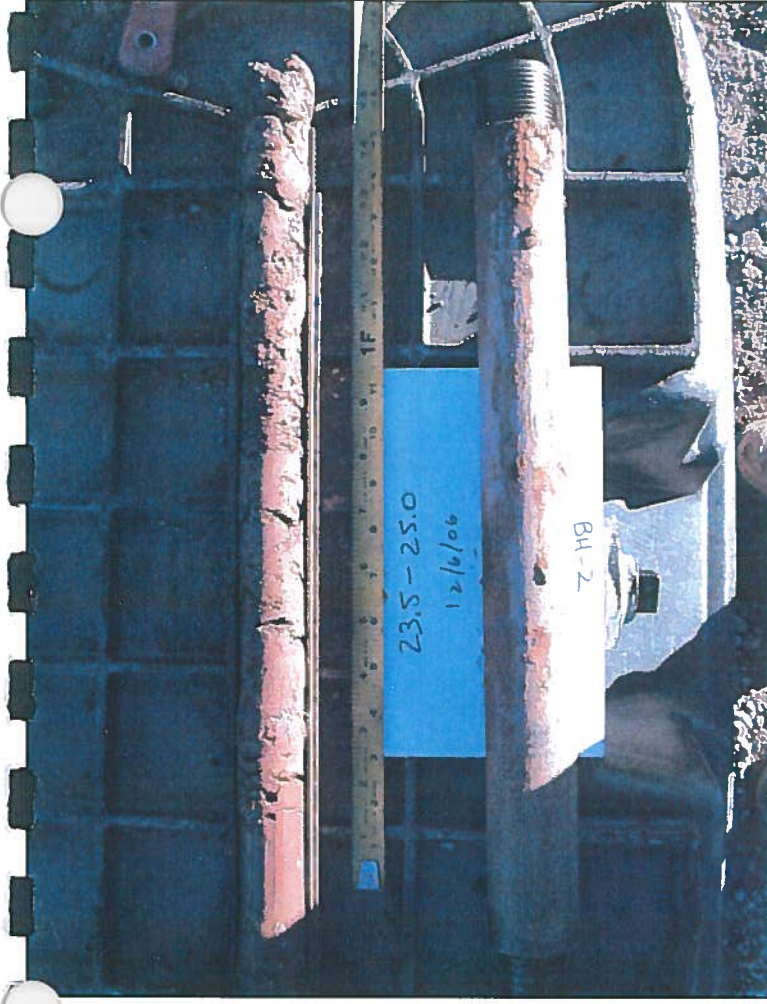
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PROJECT: NA
SHEET 1 OF 1
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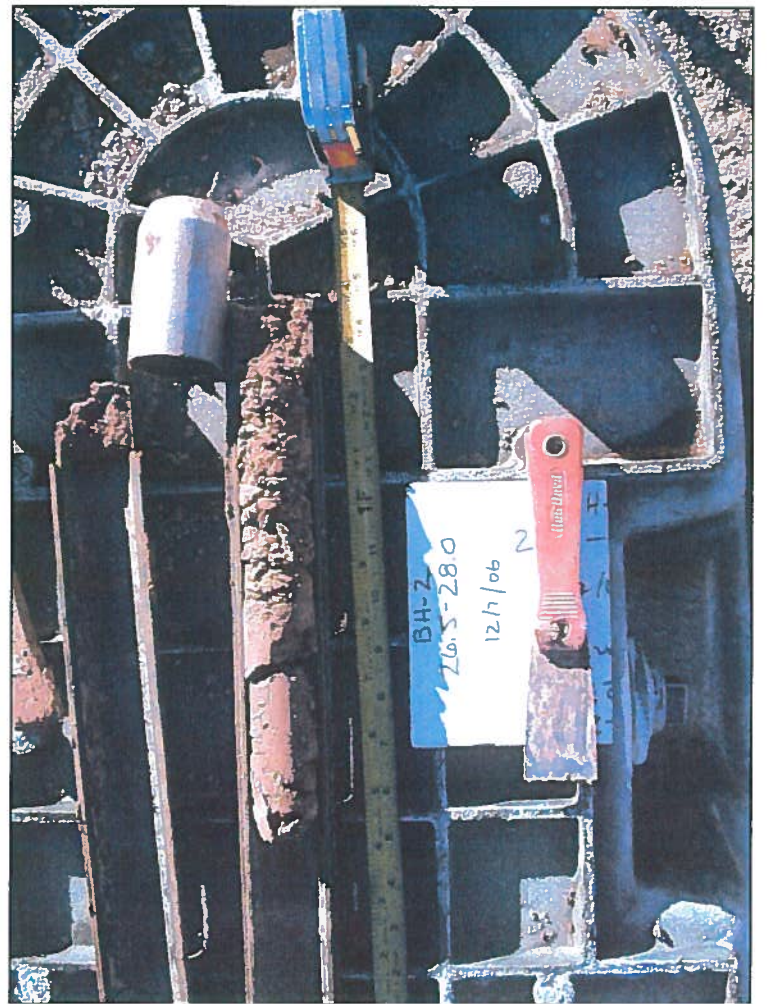
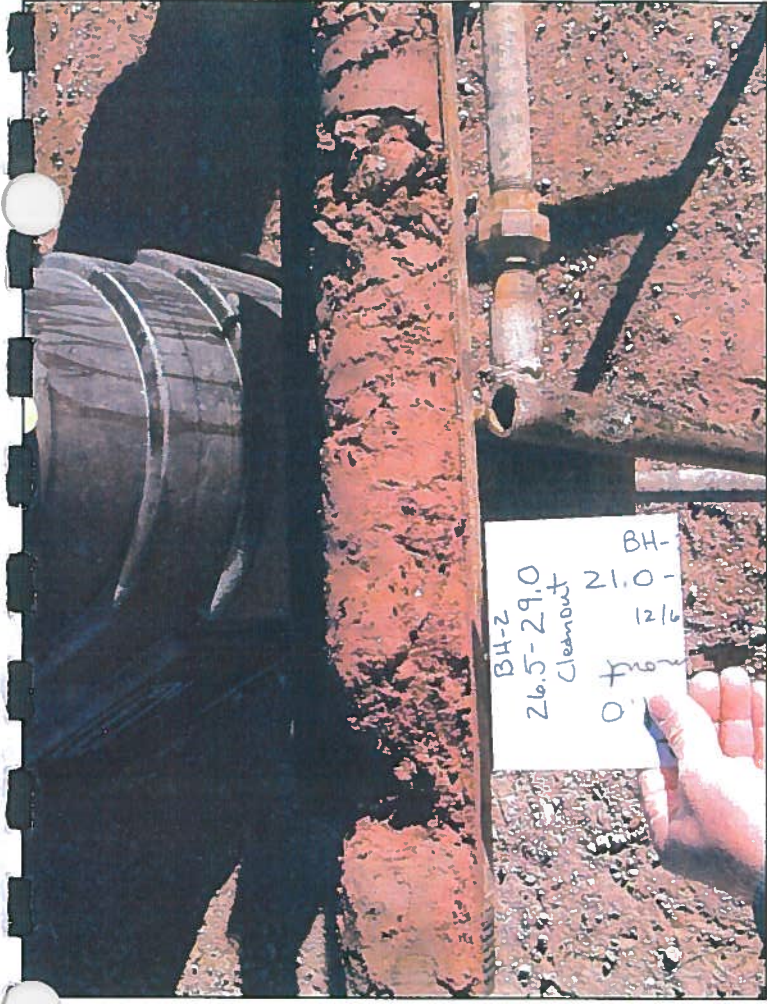


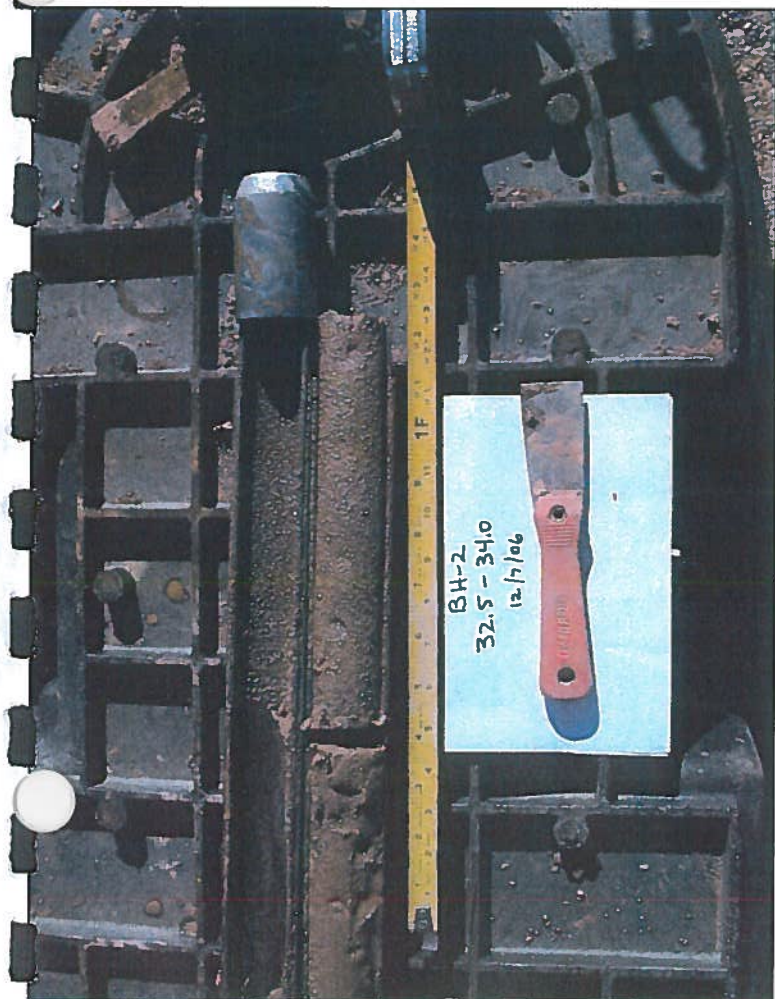
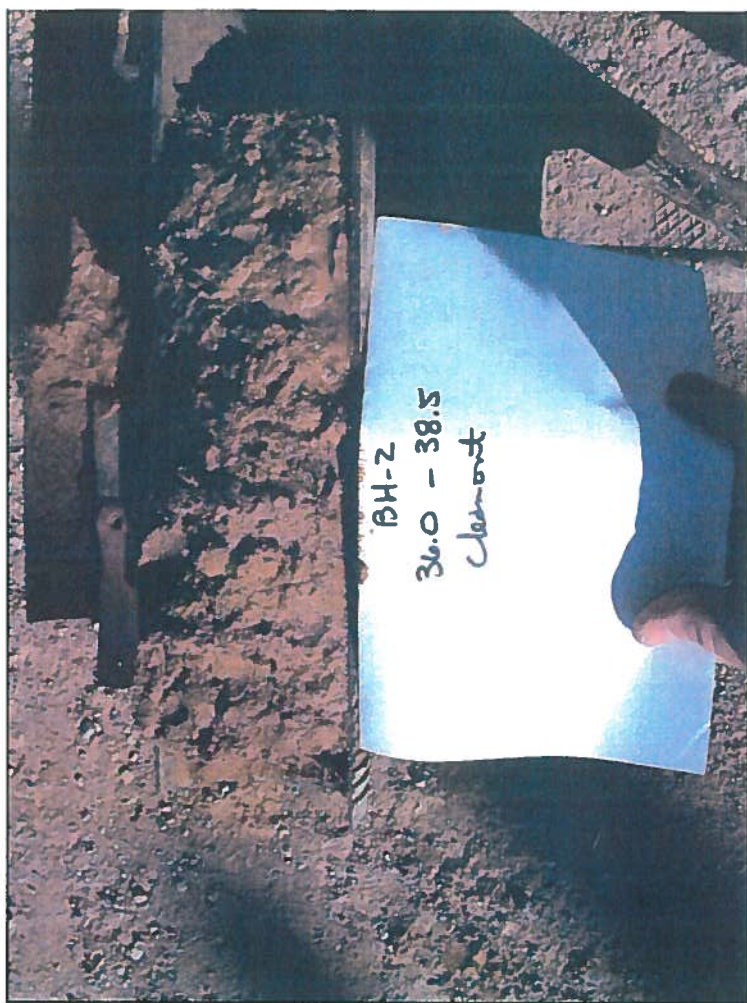
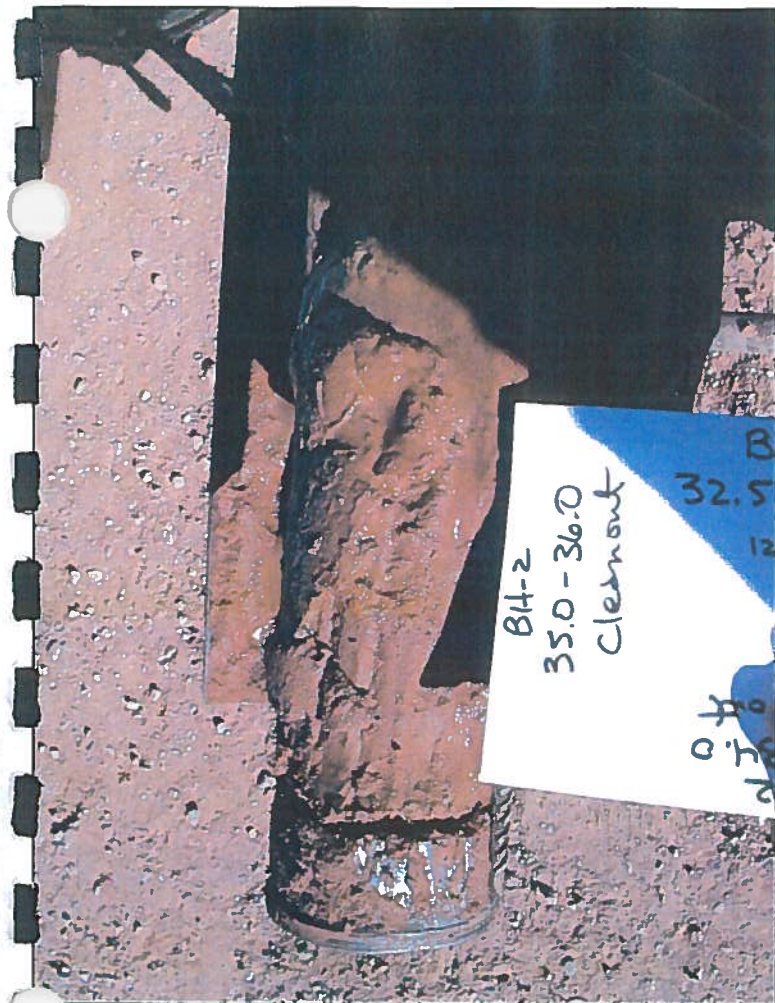


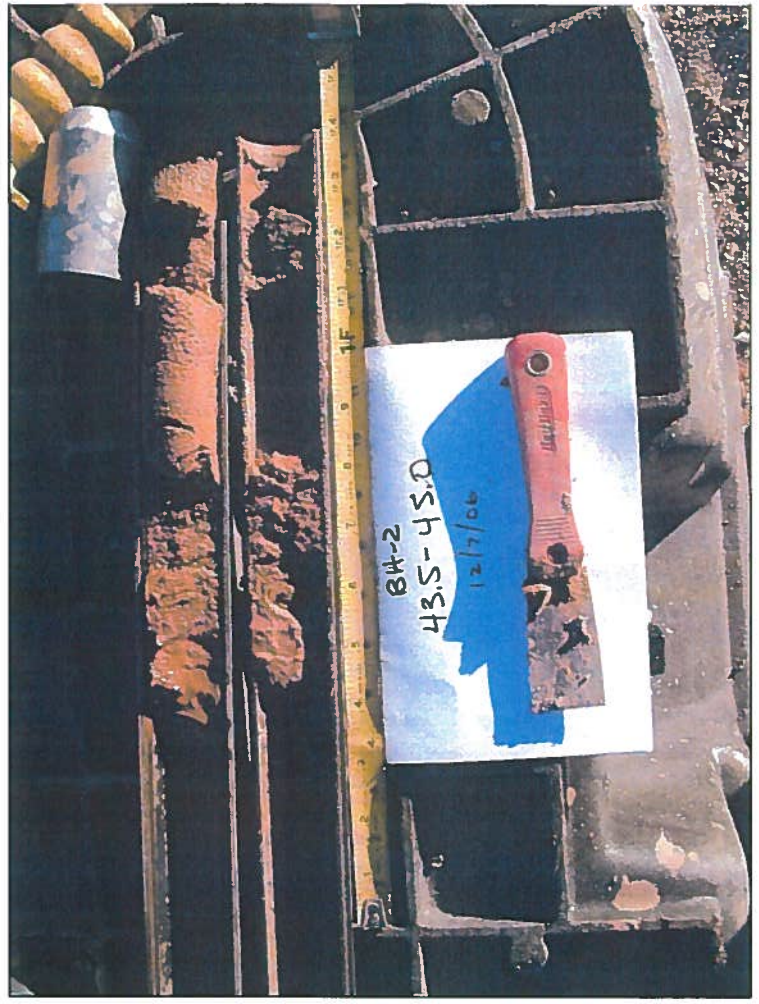


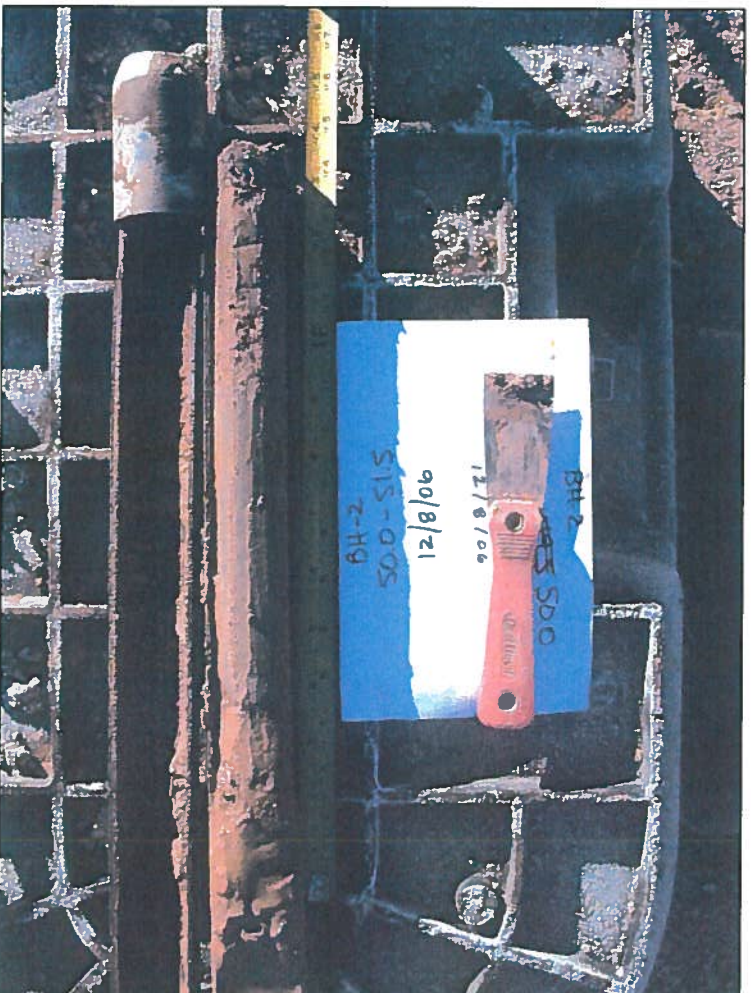
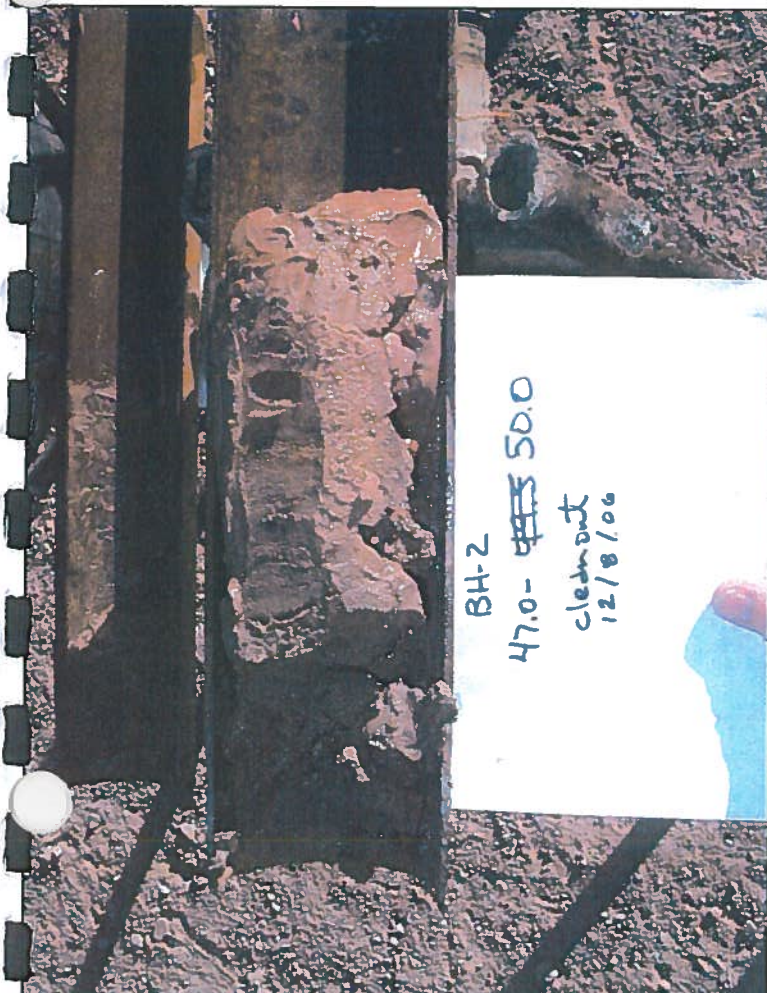
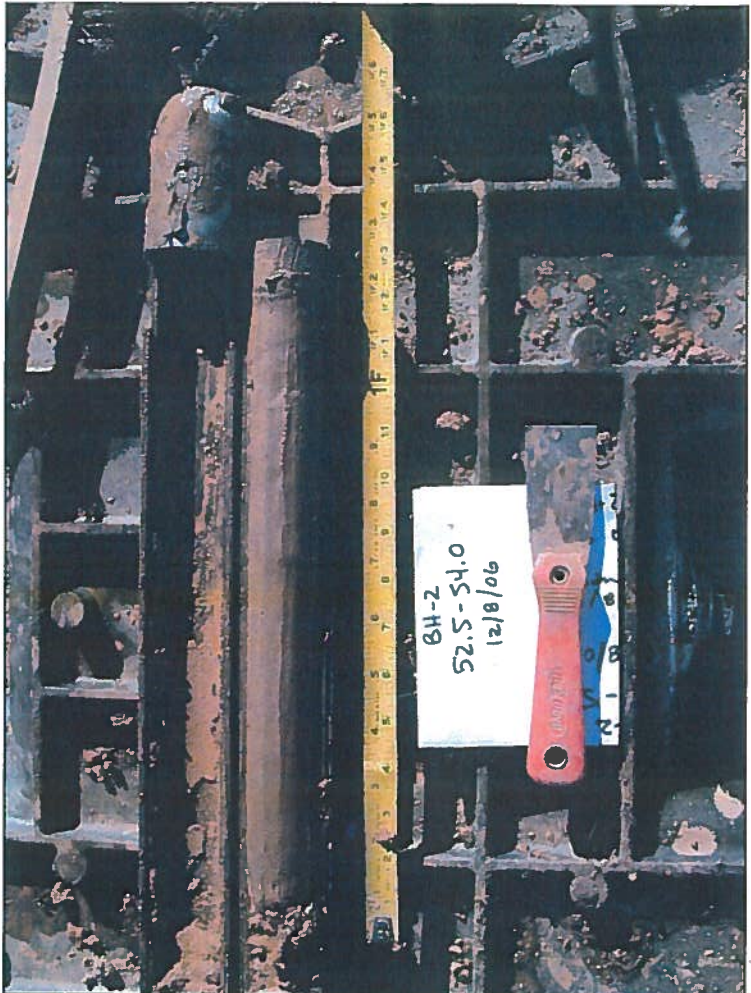


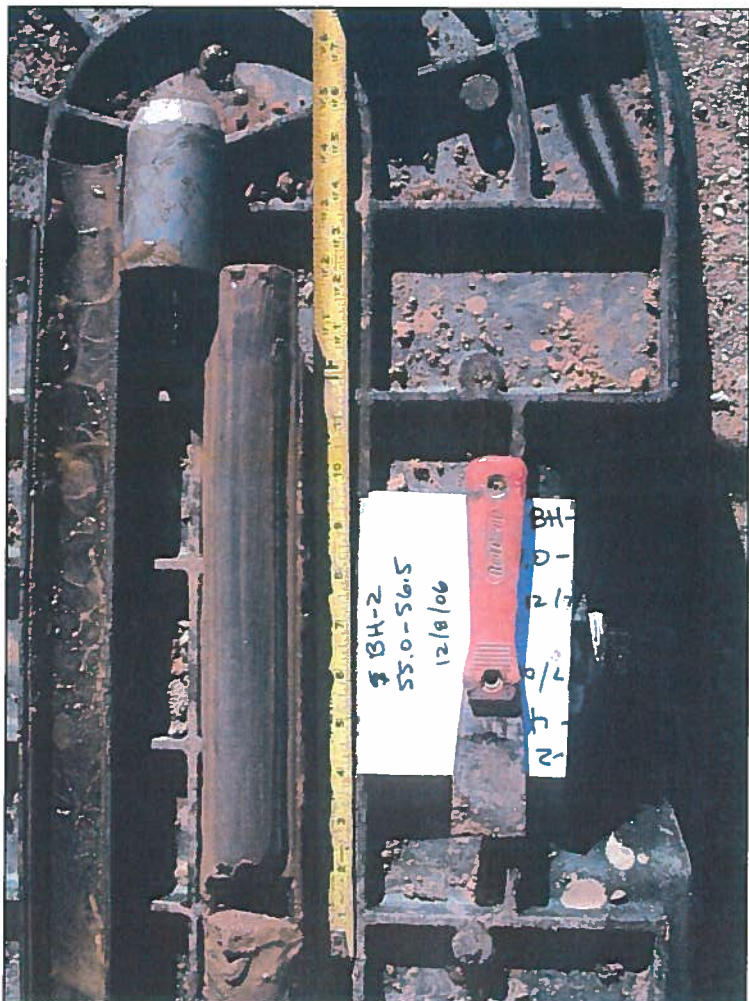
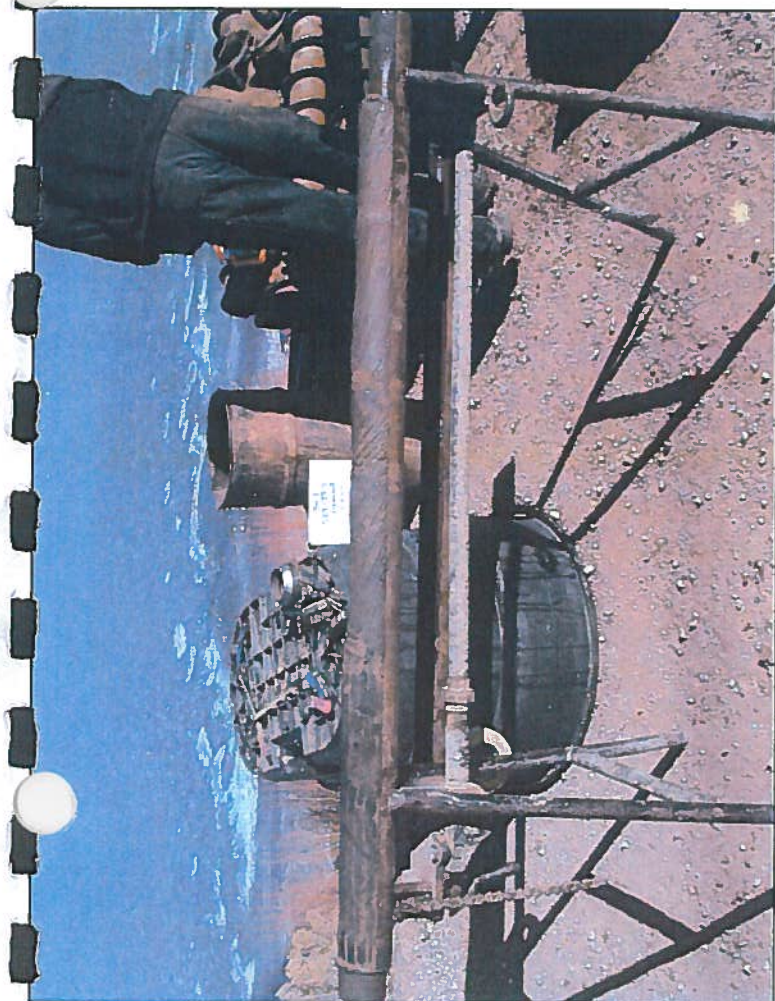
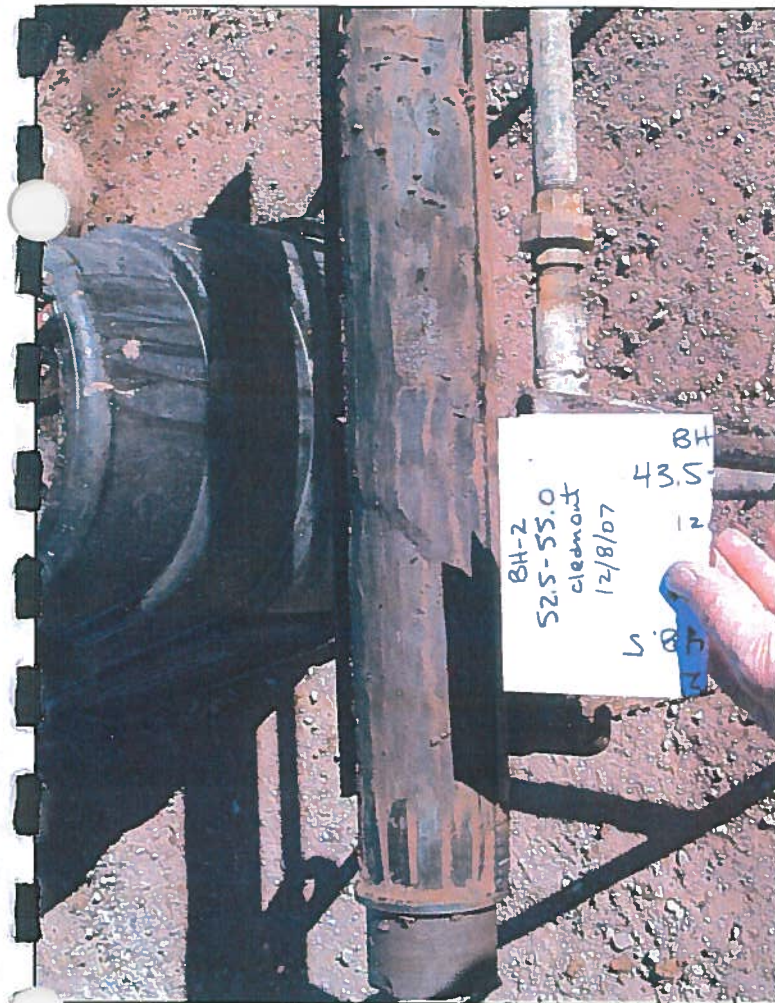


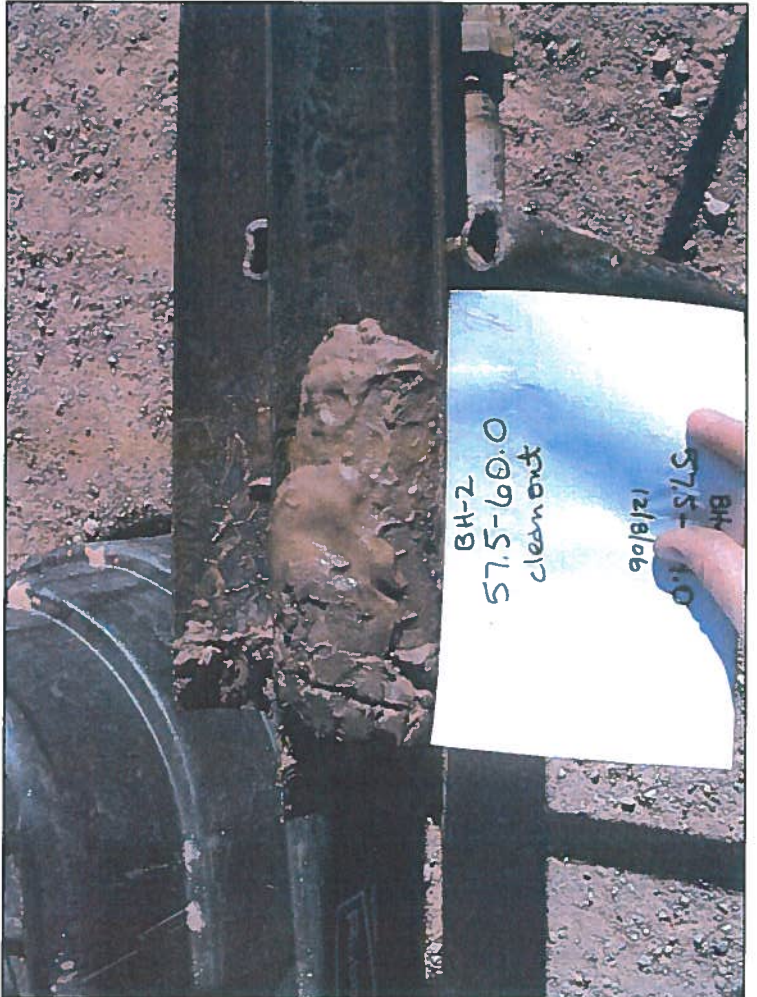


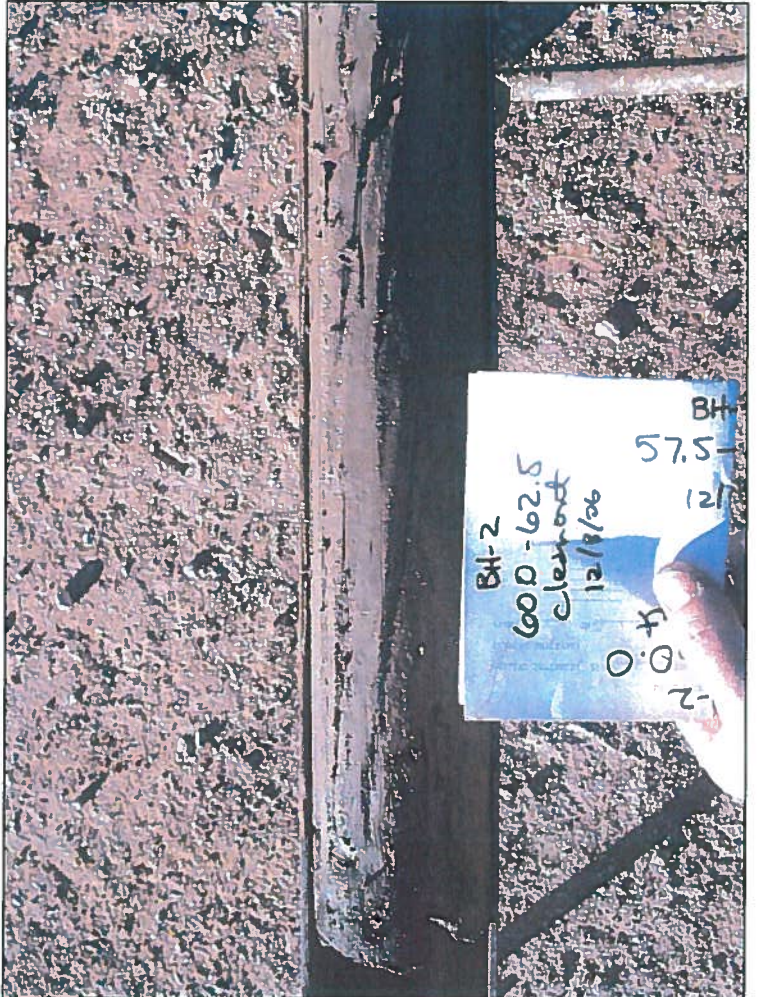
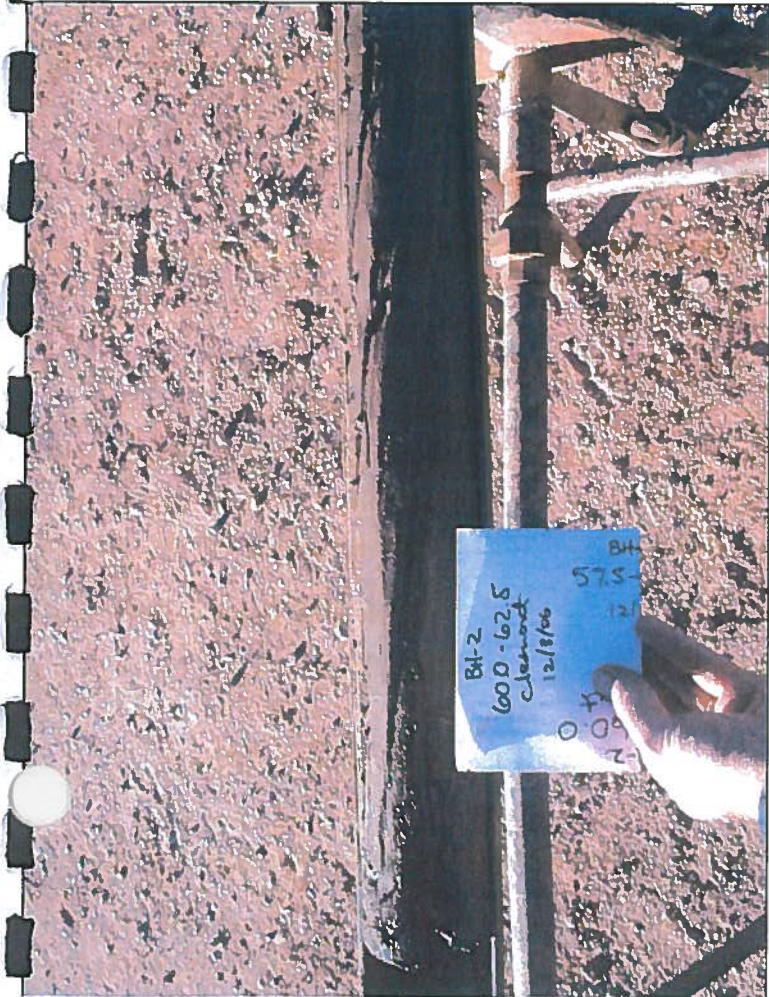
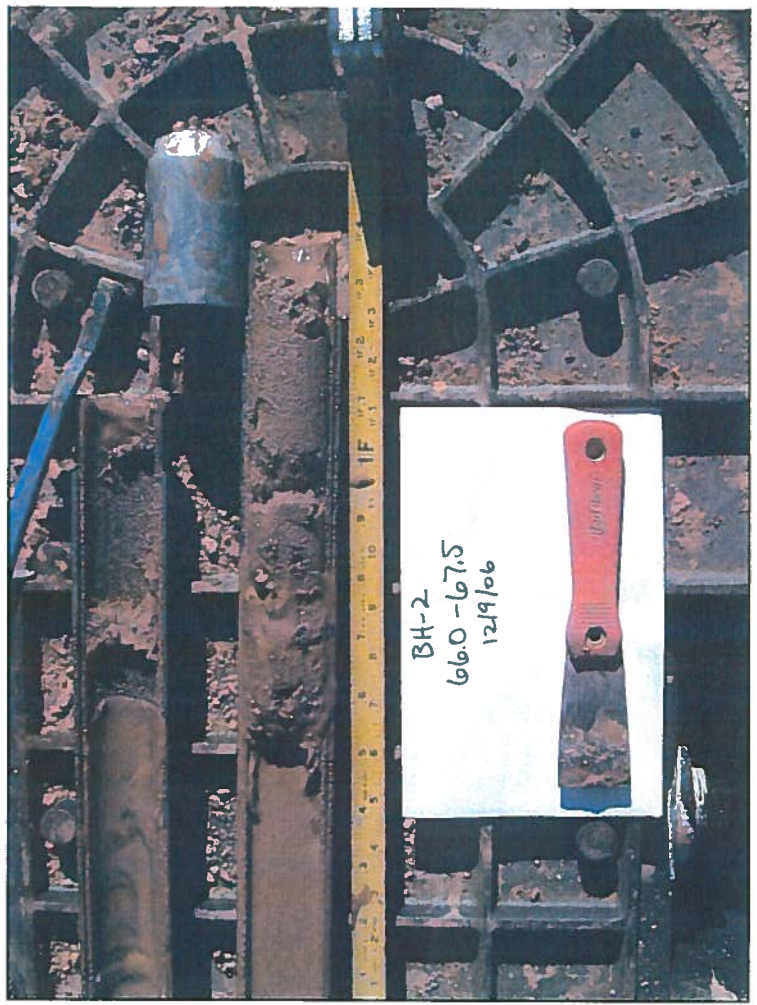


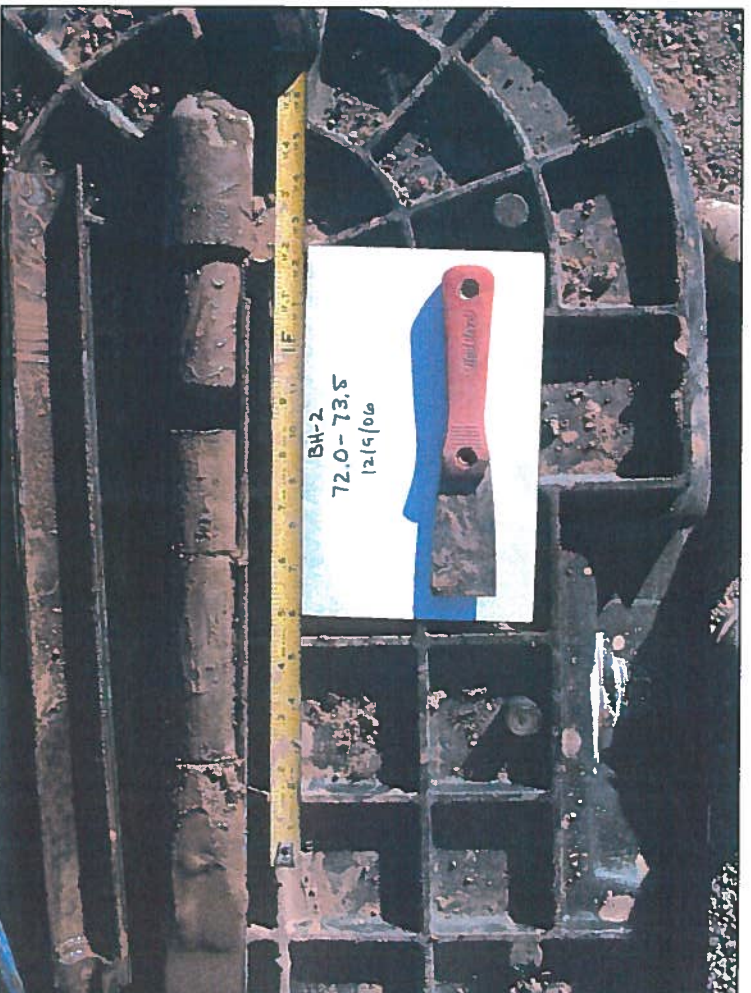
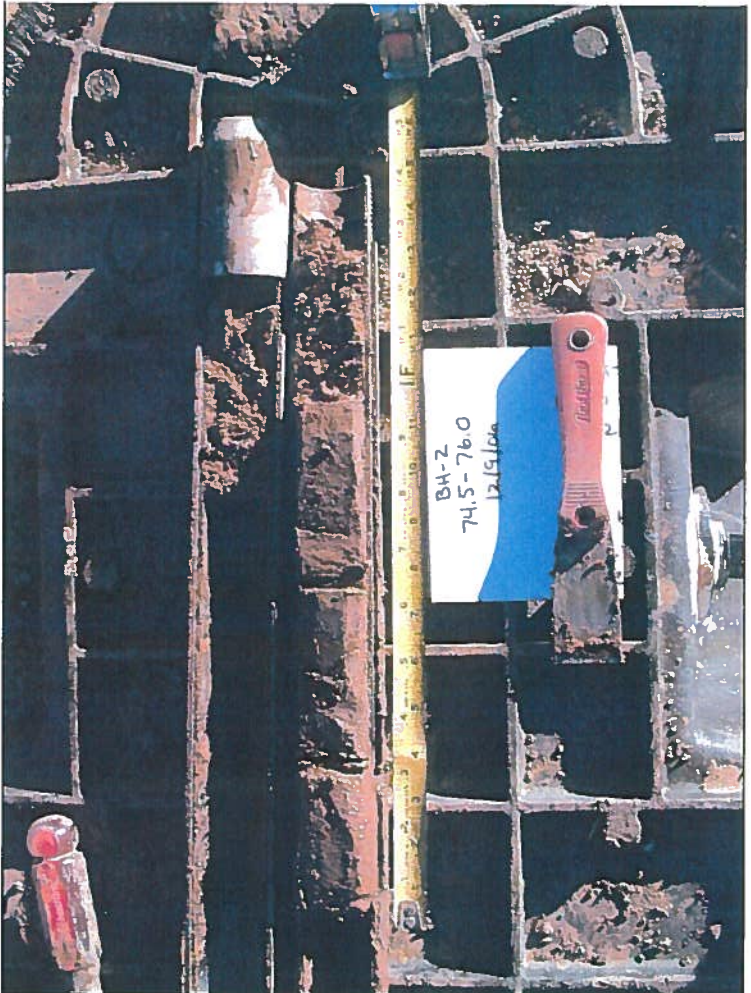


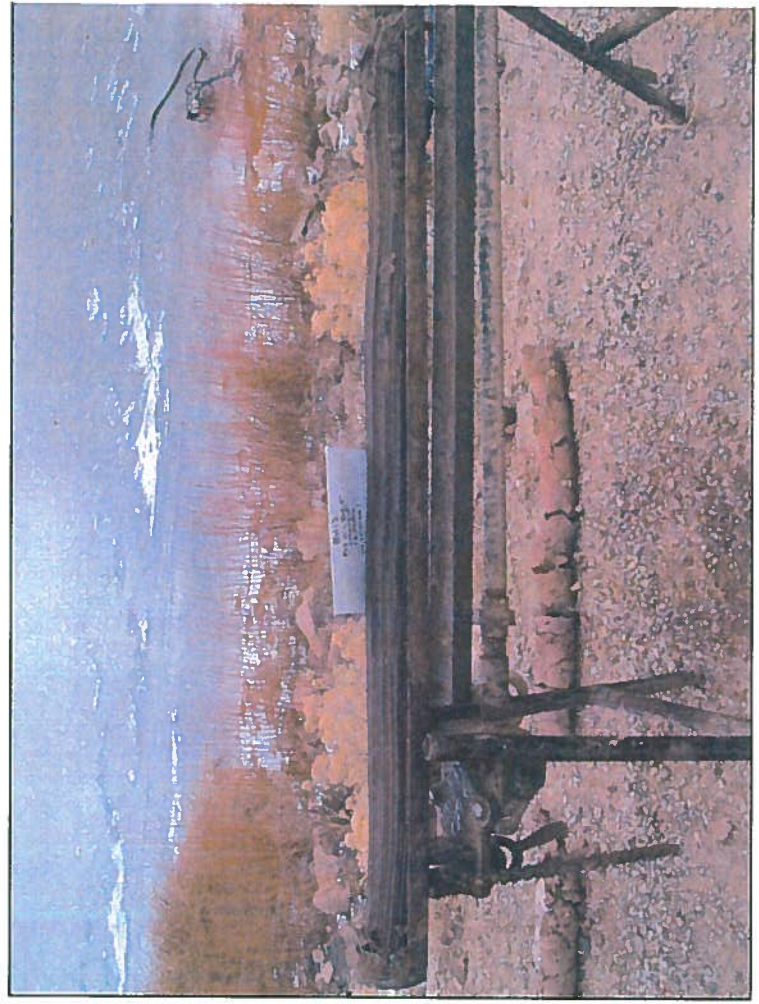


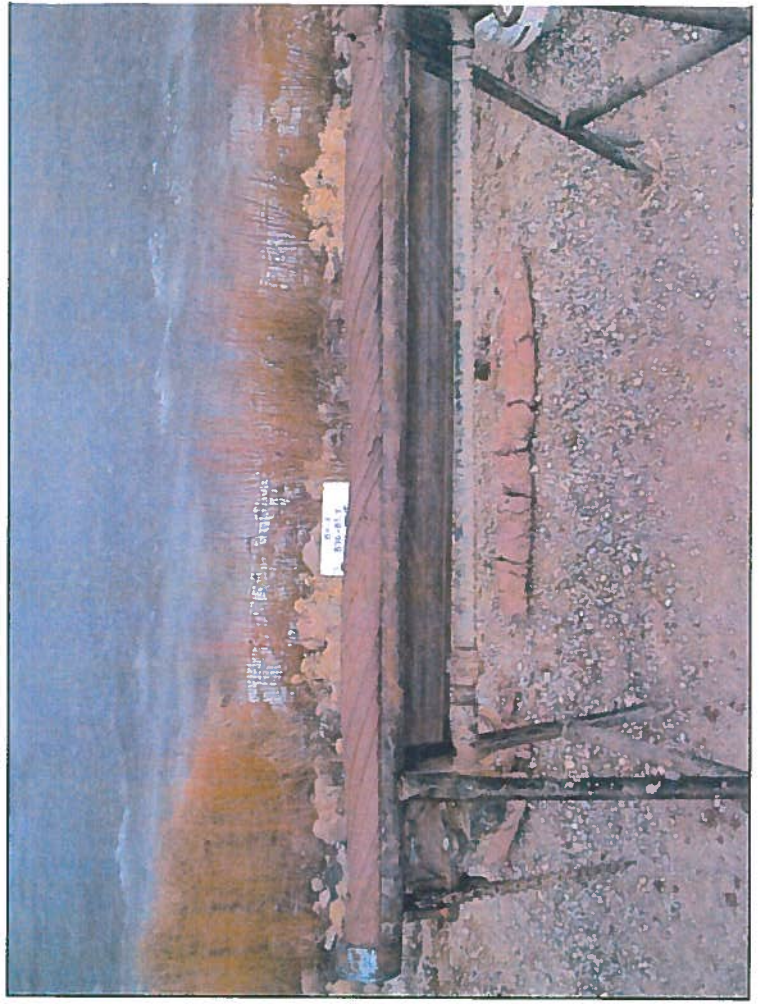


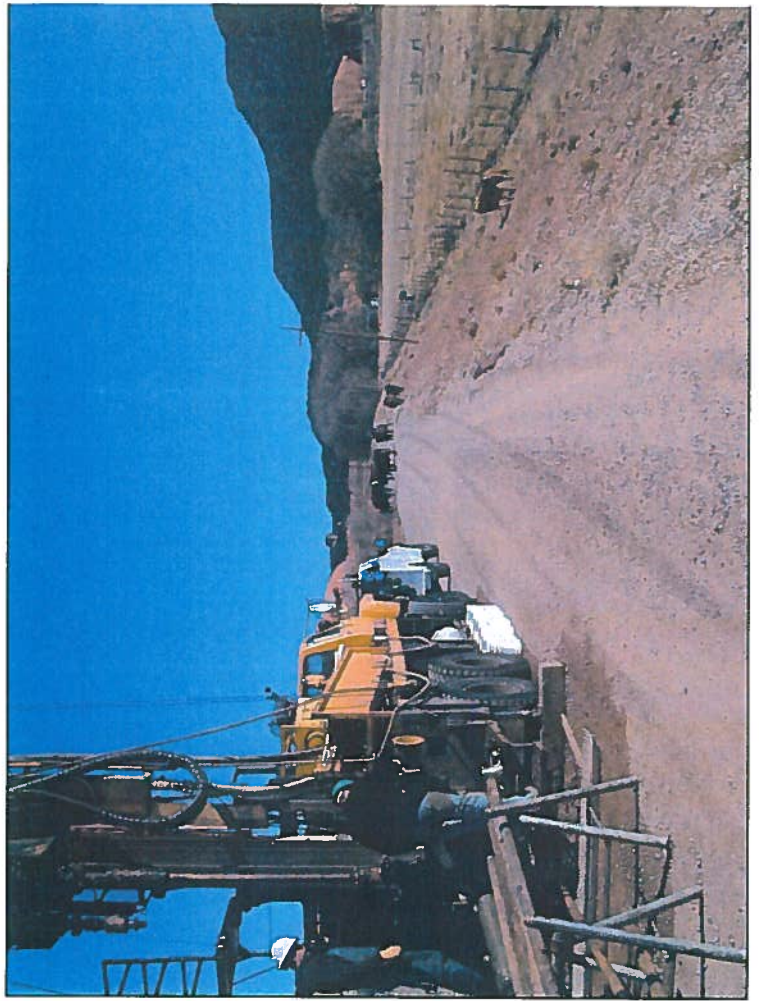
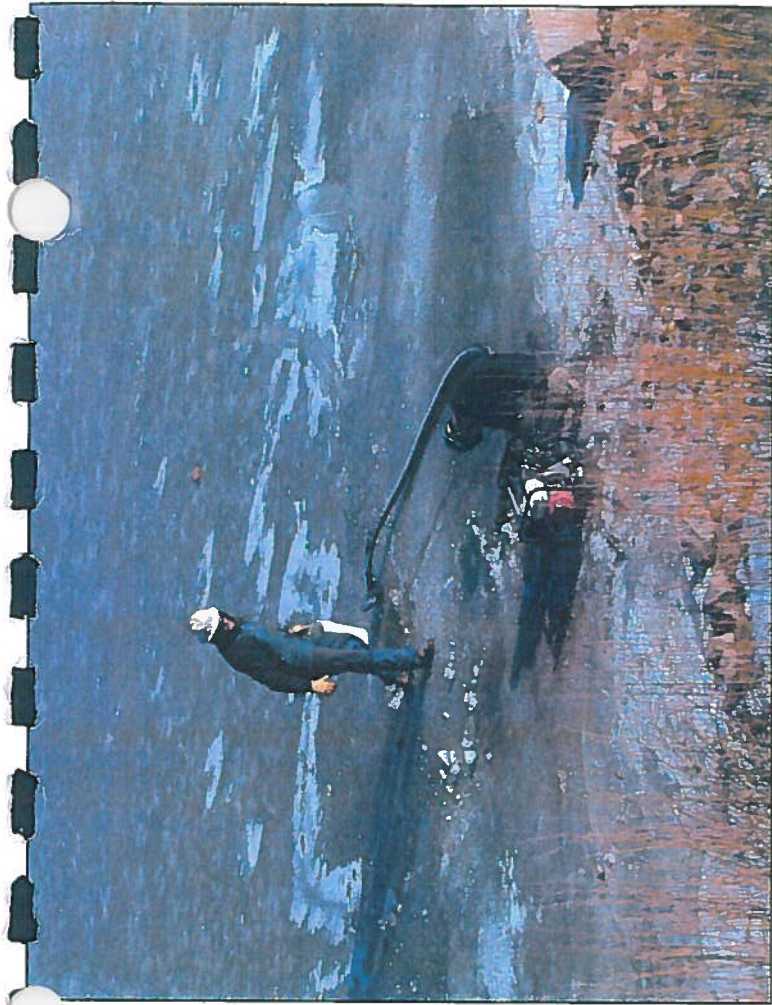












GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 1 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06 FINISHED: 12/14/06

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV. OF WATER LEVEL

TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

START DATE MEASURED: 22.7 (7067.1) 12/12/06

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

NOTES	DEPTH	% CORE RECOVERY	STANDARD PENETRATION TEST				DEPTH	VISUAL CLASSIFICATION	ELEVATION	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION		
			# OF BLOWS	% MOISTURE*	BLOWS PER FOOT								
					140 LB. HAMMER - 30 IN. DROP								
			10	20	30	40							
<p>PURPOSE OF HOLE: Perform continuous sampling and standard penetration tests (SPTs) in the dam embankment and foundation to determine gradations and physical properties and to evaluate those materials for susceptibility to liquefaction and seepage. Install a slotted pipe piezometer to measure water levels.</p> <p>DRILL SITE & SET-UP: Drilled on the dam crest roadway, approx. 570 ft. east of the right abutment, approx. 3 ft. from the upstream edge of the dam, and about 4.6 ft. left of cone penetrometer test hole CPT06-11.</p> <p>DRILL EQUIPMENT: Gus Pech Brat 22R truck-mounted rotary drill rig; 7-1/4 in. O.D. hollow stem augers with 4-1/4 in. I.D.; 5-ft.-long, 2-1/4 in. O.D. drill rods; 4 in. O.D. Laskey Continuous Soil Sampler; 1.8-ft.-long, 2-1/4 in. O.D. SPT Sampler.</p> <p>DRILLER: Zolman (driller), Chip Todhunter and Patrick Root (helpers) from Provo Area Office, Upper Colorado Region, U.S. Bureau of Reclamation.</p> <p>DRILL FLUID: Drilling fluid not used. When the hole was at 36.0 ft., water from the lake was added to the hole before performing SPTs.</p> <p>DRILLING METHODS: Drilled from 0.0 to 91.0 ft. using 7-1/4 in. O.D. hollow stem augers.</p> <p>DRILLING CONDITIONS & DRILLER'S COMMENTS: Core slipped out of barrel after cleanout interval 29.0 to 31.5 and 32.5 to 35.0 ft. Added a basket modified with duct tape to the barrel to retain cored material. At SPT interval 36.0 to 37.5 ft., began adding water to stabilize the bore hole. During the cleanout of interval 48.5 to 49.5 ft., the augers drilled too fast and went 0.5 ft. beyond the intended depth. While pulling up from cleanout interval 60.0 to 62.5 ft., the core barrel stuck in the rods and the augers and rods had to be pulled together and the core barrel extracted manually; the combination of fine sand and the strapping tape used to hold the split-tube barrel together had locked the barrel in the rods. Drilled to 63.5 ft. with pilot bit to clean out hole.</p>	100						CL			<p>Material descriptions are based on visual classification of SPT split-tube samples taken at 1.5-foot intervals and 1-foot cored (cleanout) intervals unless noted as Lab Test Data.</p> <p>0.0 to 1.0 ft. CORED INTERVAL 0.0 to 0.2 ft. Poorly Graded Gravel with Sand (GP)s; Road base 0.2 to 1.0 ft. Lean Clay: Similar to interval 1.0 to 2.5 ft. (below).</p> <p>1.0 to 2.5 ft. SPT SAMPLE Lean Clay (CL): Approx. 90 % fines with medium plasticity, medium to high toughness, high dry strength; Approx. 10 % fine, rounded sand. Moist, brown, hard consistency, strong cementation, homogenous. Strong reaction with HCl.</p> <p>2.5 to 3.5 ft. CORED INTERVAL Lean Clay (CL): Similar to interval 1.0 to 2.5 ft.</p> <p>3.5 to 5.0 ft. SPT SAMPLE Clayey Sand (SC): Approx. 55 % fine, subangular sand; Approx. 45 % fines with low plasticity, medium toughness, high dry strength; Trace of fine gravel. Dry to moist, brown, soft consistency, weak cementation, homogenous. Strong reaction with HCl. Sampler sank 0.1 ft. under weight of hammer and rods in the seating interval.</p> <p>4.0 to 5.0 ft. Lab Test Data: 56.0 % sand, 39.0% plastic fines, 5.0 % gravel: PI = 12.8%, LL = 26.3%, MC = 6.0%. Lab Classification: Clayey Sand (SC).</p> <p>5.0 to 6.0 ft. CORED INTERVAL Clayey Sand (SC): Similar to interval 3.5 to 5.0 ft.</p> <p>5.0 to 6.0 ft. Pinhole Test Results: Sample No. 71H-2; 52.4 % sand, 36.6% fines, 11.0% gravel. LL = 27, PI = 11, Pinhole Rating = ND3, Crumb Rating = 1.</p> <p>6.0 to 7.5 ft. SPT SAMPLE Lean Clay (CL): Approx. 90 % fines with medium plasticity, medium toughness, high dry strength; Approx. 10 % fine sand. Moist, brown, firm consistency, strong cementation, contains thin (less than 1/4 inch thick), discontinuous pockets and streaks of calcium carbonate. Strong reaction with HCl.</p> <p>7.5 to 8.5 ft. CORED INTERVAL Sandy Lean Clay s(CL): Approx. 60 % fines with medium plasticity, medium toughness, high dry strength; Approx. 30 % fine sand, Trace of fin gravel. Moist, brown, firm consistency, strong cementation. Strong reaction with HCl.</p> <p>7.5 to 8.5 ft. Pinhole Test Results: Sample No. 71H-3; 59.1 % fines, 35.9% sand, 5.0% gravel. LL = 35, PI = 19, Pinhole Rating = ND3, Crumb Rating = 1.</p> <p>8.5 to 10.0 ft. SPT SAMPLE Lean Clay/ Clayey Sand (CL/SC): Approx. 50 % fines with low to medium plasticity, medium toughness, high dry strength; Approx. 50 % fine to medium, subangular to subrounded sand. Dry, brown, hard consistency, moderate cementation, homogenous. Strong reaction with HCl.</p> <p>10.0 to 11.0 ft. CORED INTERVAL Lean Clay (CL): Similar to interval 6.0 to 7.5 ft.</p>			
	40	25	8.9										
	100												
	5	67	30	5.5				SC					
	100												
	100							CL					
	100												
	100							CL/SC					
	10	100	41	8.3				CL					
	100												
	100							(CL)s					
	100												
	15	100	25	16.4				CL					
	100												
	100							SM					
	100												
	100							(CL)s					
	20	100	21	18.1									
	100												
	100												
100							s(CL)						
25	100	24	16.3										
100													
100													
100													
25	100	13	21.2										
100													
100													
100													
30	73	14	21.6				SM						
100													
100													
30	100	27	20.3				SP-SM*						
100													
100													
35	67	9	23.7										
100													
100													
100													
35	80	14	20.0				SM/SC						
100													
100							SM						
100							s(ML)						
40	80	17	20.8 22.9				CL						
100													
100													
40	73	13	23.5										
100													
100													
45	67	18	23.7				SM*						
100													
100													
45	67	19	23.8										
100													
50	47						SM						

REMARKS:
Measurements are from ground surface unless otherwise noted.
% MOISTURE* - Moisture content was measured in material taken from the sampler shoe and may differ slightly from samples sent for gradation analysis.
SP*, SM* or SP-SM* - Includes small zones of no recovery.

ABBREVIATIONS	
LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 2 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06 FINISHED: 12/14/06

US STATE PLANE, NAD_83 (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

AND DATE MEASURED: 22.7' (7067.1') 12/12/06

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

NOTES	DEPTH	% CORE RECOVERY	STANDARD PENETRATION TEST				DEPTH	VISUAL CLASSIFICATION	ELEVATION	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION																									
			# OF BLOWS	% MOISTURE	BLOWS PER FOOT																															
					140 LB. HAMMER - 30 IN. DROP																															
				10	20	30	40																													
<p>DEPTH TO WATER DURING DRILLING:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>Date (2006)</th> <th>Depth to Water (ft.)</th> <th>Hole Depth (ft.)</th> </tr> <tr> <td>12/7</td> <td>23.1</td> <td>30.5</td> </tr> <tr> <td>12/8</td> <td>15.7</td> <td>48.5</td> </tr> <tr> <td>12/9</td> <td>21.0</td> <td>62.5</td> </tr> <tr> <td>12/10</td> <td>19.0</td> <td>77.0</td> </tr> <tr> <td>12/12</td> <td>22.7</td> <td>91.0</td> </tr> </table> <p>SAMPLE DATA: Samples collected at 1.5 ft. intervals with a 1 ft. minimum cleanout interval between samples. Samples were transported to the Farmington Field Office for storage and selected samples were sent to the lab for testing.</p> <p>HOLE COMPLETION: Backfilled hole from 91.0 to 51.0 ft. with 3/8 in. dia. coated bentonite pellets. Placed a transitional layer of sand from 51.0 to 50.0 ft. Installed 3-1/4 in. O.D. pre-formed 20-40 sand packed screen from 50.0 to 28.7 ft., and backfilled around screen with 8-12 silica sand to 29.7 ft. Zone of influence 51.0 to 29.7 ft. Backfilled from 29.7 to 3.0 ft. with bentonite chips and placed cement from 3.0 ft. to the top of the dam. Embedded a protective cover in concrete over the 1-1/4 in. PVC (PVC has a 0.4 ft. stickup). Mounded gravel around the cover and placed large rocks to protect from dam crest road traffic.</p> <p>REASON FOR HOLE TERMINATION: Drilled 1.0 ft. beyond predetermined depth.</p> <p>ESTIMATED DRILLING TIME:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th></th> <th>No. of Hours</th> </tr> <tr> <td>Set-Up</td> <td>2</td> </tr> <tr> <td>Drilling</td> <td>30</td> </tr> <tr> <td>Hole Completion</td> <td>16</td> </tr> </table>	Date (2006)	Depth to Water (ft.)	Hole Depth (ft.)	12/7	23.1	30.5	12/8	15.7	48.5	12/9	21.0	62.5	12/10	19.0	77.0	12/12	22.7	91.0		No. of Hours	Set-Up	2	Drilling	30	Hole Completion	16	55	100	18	34.3						11.0 to 12.5 ft. SPT SAMPLE Lean Clay with Sand (CL)s: Approx. 80% fines with low to medium plasticity, medium toughness, high dry strength; Approx. 20% fine sand. Dry, brown, firm to hard consistency, strong cementation, contains thin (less than 1/4 inch thick) discontinuous pockets and streaks of calcium carbonate. Strong reaction with HCl. Lab Test Data: 77.8% plastic fines, 22.2% sand; PI = 16.7%, LL = 32.5%, MC = 11.6%. Lab Classification: Lean Clay with Sand (CL)s.
	Date (2006)	Depth to Water (ft.)	Hole Depth (ft.)																																	
	12/7	23.1	30.5																																	
	12/8	15.7	48.5																																	
	12/9	21.0	62.5																																	
	12/10	19.0	77.0																																	
	12/12	22.7	91.0																																	
		No. of Hours																																		
	Set-Up	2																																		
	Drilling	30																																		
	Hole Completion	16																																		
		60	100	0	22.1						12.5 to 13.5 ft. CORED INTERVAL Lean Clay with Sand (CL)s: Similar to interval 11.0 to 12.5 ft. with a trace of gravel (max. size 1 inch). 12.5 to 13.5 ft. Pinhole Test Results: Sample No. 71H-4; 72.4% fines, 25.0% sand, 2.6% gravel. LL = 36, PI = 18, Pinhole Rating = D1, Crumb Rating = 2.																									
		65	10	28	28.7						13.5 to 15.0 ft. SPT SAMPLE Lean Clay (CL): Approx. 95% fines with medium plasticity, no to medium toughness, high dry strength; Approx. 5% fine sand. Moist, brown, firm to hard consistency, weak to moderate cementation, contains thin (less than 1/4 inch thick), discontinuous pockets and streaks of calcium carbonate. Strong reaction with HCl.																									
		70	100	9	23.6						15.0 to 16.0 ft. CORED INTERVAL 15.0 to 15.5 ft. Lean Clay (CL): Similar to interval 13.5 to 15.0 ft. 15.5 to 16.0 ft. Silty Sand (SM): Similar to interval 16.0 to 17.5 ft. (below)																									
		75	100	31	24.7						16.0 to 17.5 ft. SPT SAMPLE Silty Sand (SM): Approx. 70% fine, subangular to subrounded sand; 30% nonplastic fines with slow to rapid dilatancy, no toughness and high dry strength. Dry, brown, soft to firm consistency, weak cementation. Strong reaction with HCl. Lab Test Data: 71.9% sand, 28.1% nonplastic fines; PI = NP, LL = NP, MC = 10.0%. Lab Classification: Silty Sand (SM).																									
		80	100	49	21.4						17.5 to 18.5 ft. CORED INTERVAL 17.5 to 17.6 ft. Silty Sand (SM): Similar to interval 16.0 to 17.5 ft. 17.6 to 18.5 ft. Lean Clay with Sand (CL)s: Similar to interval 18.5 to 20.0 ft. (below)																									
		85	100	11	26.6						18.5 to 20.0 ft. SPT SAMPLE Lean Clay with Sand (CL)s: Approx. 80% fines with medium plasticity, medium toughness, high to very high dry strength; Approx. 20% fine sand. Dry, brown, firm consistency, weak cementation, contains thin (less than 1/4 inch thick), discontinuous pockets and streaks of calcium carbonate. Strong reaction with HCl. Sampler driven 0.2 ft. (18.5 to 18.7 ft.) with 1st blow.																									
		90	100	18	33.8						20.0 to 21.0 ft. CORED INTERVAL Lean Clay with Sand (CL)s: Similar to interval 18.0 to 20.0 ft. (below). 20.5-21.0 ft. Pinhole Test Results: Sample No. 71H-5; 77.1% fines, 21.8% sand, 1.1% gravel. LL = 40, PI = 21, Pinhole Rating = ND4, Crumb Rating = 2.																									
		91	100	30	28.3																															

BOTTOM OF HOLE

COMMENTS:

All measurements are from ground surface unless otherwise noted.
% MOISTURE* - Moisture content was measured in material taken from the sampler shoe and may differ slightly from samples sent for gradation analysis.
SP*, SM* or SP-SM* - Includes small zones of no recovery.

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 3 OF 6

FEATURE: RED LAKE DAM
 LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT
 BEGUN: 12/6/06 FINISHED: 12/14/06
 DEPTH AND ELEV OF WATER LEVEL
 DATE MEASURED: 22.7 (7067.1') 12/12/06

PROJECT: DVA FIELD INVESTIGATION
 COORDINATES: N. 1791102.1 E. 2365929.4
 US STATE PLANE, NM_W (WGS 84)
 TOTAL DEPTH: 91.0'
 DEPTH TO BEDROCK: NOT ENCOUNTERED

STATE: ARIZONA
 GROUND ELEVATION: 7089.8'
 ANGLE FROM HORIZONTAL: 90°
 LOGGED BY : M. MILLER
 BUREAU OF RECLAMATION

CLASSIFICATION AND PHYSICAL CONDITION (continued)

CLASSIFICATION AND PHYSICAL CONDITION (continued)

21.0 to 22.5 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 60% fines with medium plasticity, medium toughness, high dry strength; Approx. 40% fine sand; Trace of fine, subangular, hard gravel. Moist, brown, firm to hard consistency, strong cementation, contains thin (less than 1/4 inch thick), discontinuous pockets of calcium carbonate and fine sand and silt; thin dark gray striations are inclined parallel to the core barrel. Strong reaction with HCl. Sample slipped 0.15 ft. beyond the shoe during extraction.

Lab Test Data: 56.0% plastic fines, 42.1% sand; PI = 17.1%, LL = 31.1%, MC = 15.1%. Lab Classification: Sandy Lean Clay s(CL).

22.5 to 23.5 ft. CORED INTERVAL

Sandy Lean Clay s(CL): Similar to interval 21.0 to 22.5 ft.

22.5-23.5 ft. Pinhole Test Results: Sample No. 71H-6; 68.2% fines, 31.2% sand, 0.6% gravel. LL = 36, PI = 20, Pinhole Rating = D1, Crumb Rating = 3.

23.5 to 25.0 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 60% fines with medium plasticity, no toughness, high dry strength; Approx. 40% fine to coarse sand; Trace of fine, subangular, hard gravel. Moist, brown, soft to firm consistency, weak to moderate cementation, contains small (less than 1/4 inch diameter) white dots of calcium carbonate. Strong reaction with HCl. Sampler sank 0.3 ft. under weight of hammer and rods in the seating interval.

25.0 to 26.5 ft. CORED INTERVAL

25.0 to 26.5 ft. Sandy Lean Clay s(CL): Approx. 70% fines with medium plasticity, no toughness, high dry strength; Approx. 30% fine to coarse sand; Trace of fine, subangular, hard gravel. Moist, brown, soft consistency, weak cementation, contains small (less than 1/4 inch diameter) white dots of calcium carbonate. Strong reaction with HCl. A 1-inch-long rootlet was present at 25.9 ft.

26.5 to 28.0 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 70% fines with medium plasticity, no to medium toughness, high to very high dry strength; Approx. 30% predominantly fine to coarse, rounded to subrounded sand. Moist, brown, soft to firm consistency, weak cementation. Strong reaction with HCl. Sampler sank 0.1 ft. under weight of hammer and rods in the seating interval. Material sticks to split-tube sampler.

Lab Test Data: 59.5% plastic fines, 35.4% sand; PI = 15.8%, LL = 31.8%, MC = 18.4%. Lab Classification: Sandy Lean Clay s(CL).

28.0 to 29.0 ft. CORED INTERVAL

28.0 to 28.6 ft. Sandy Lean Clay s(CL): Similar to interval 26.5 to 28.0 ft.
 28.6 to 29.0 ft. Silty Sand (SM): Approx. 70% fine sand; 30% nonplastic fines.

29.0 to 30.5 ft. SPT SAMPLE

Poorly Graded Sand with Silt (SP-SM): Approx. 90% fine to medium, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, medium dry strength. Moist, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data: 86.8% sand, 13.2% nonplastic fines; PI = NP, LL = NP, MC = 20.6%. Lab Classification: Silty Sand (SM).

30.5 to 31.5 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand with Silt (SM-SP).

31.5 to 32.5 ft. CORED INTERVAL

Poorly Graded Sand with Silt (SP-SM): Similar to interval 29.0 to 30.5 ft.

32.5 to 34.0 ft. SPT SAMPLE

Poorly Graded Sand with Silt (SP-SM): Approx. 90% fine, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, medium dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.3 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 88.8% sand, 11.2% nonplastic fines; PI = NP, LL = NP, MC = 21.0%. Lab Classification: Poorly Graded Sand with Silt (SP-SM).

34.0 to 35.0 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand (SP).

35.0 to 36.0 ft. CORED INTERVAL

Poorly Graded Sand (SP): Approx. 95% fine sand; Approx 5% nonplastic fines.

36.0 to 37.5 ft. SPT SAMPLE

Silty Clayey Sand (SM/SC): Approx. 60% predominantly fine to medium, subangular to subrounded sand; 40% fines with no to low plasticity, slow dilatancy, no toughness and medium dry strength. Wet, brown, soft consistency, no to weak cementation. Weak to strong reaction with HCl when dry. Sampler sank 0.05 ft. under weight of hammer and rods in the seating interval.

37.5 to 38.5 ft. CORED INTERVAL

Silty Sand (SM): Approx. 70% fine sand; 30% nonplastic fines.

38.5 to 40.0 ft. SPT SAMPLE

38.5 to 39.5 ft. Sandy Silt s(ML): Approx. 45% fine, subangular to subrounded sand; 55% nonplastic fines with slow dilatancy, no toughness and medium dry strength. Moist to wet, brown, soft consistency, weak cementation. Strong reaction with HCl when dry.

Lab Test Data: 53.2% nonplastic fines, 46.8% sand; PI = NP, LL = NP, MC = 21.5%. Lab Classification: Sandy Silt s(ML).

39.5 to 40.0 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high dry strength; Approx. 5% fine sand. Moist, brown, firm to hard consistency, strong cementation. Weak reaction with HCl. Sampler sank 0.1 ft. under weight of hammer and rods in the seating interval.

40.0 to 41.0 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM).

41.0 to 42.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% predominantly fine to medium, subangular to subrounded sand; 20% nonplastic fines with rapid dilatancy, no toughness and low to medium dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.08 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 80.6% sand, 19.4% nonplastic fines; PI = NP, LL = NP, MC = 21.8%. Lab Classification: Silty Sand (SM).

42.5 to 43.5 ft. CORED INTERVAL

Silty Sand (SM): Similar to interval 41.0 to 42.5 ft.

43.5 to 45.0 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, low to medium dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data: 78.0% sand, 22.0% nonplastic fines; PI = NP, LL = NP, MC = 21.7%. Lab Classification: Silty Sand (SM).

REMARKS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 4 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06 FINISHED: 12/14/06

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

AND DATE MEASURED: 22.7' (7067.1') 12/12/06

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

45.0 to 47.0 ft. CORED INTERVAL
No Recovery; assumed to be Silty Sand (SM).

47.0 to 48.5 ft. SPT SAMPLE
Silty Sand (SM): Approx. 90% fine, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data: 78.0% sand, 22.0% nonplastic fines: PI = NP, LL = NP, MC = 21.3%.
Lab Classification: Silty Sand (SM).

48.5 to 50.0 ft. CORED INTERVAL
48.5 to 49.9 ft. Poorly Graded Sand (SP): Approx. 95% fine sand; Approx 5% nonplastic fines.
49.9 to 50.0 ft. Silty Sand (SM): Approx. 80% fine sand; 20% nonplastic fines.

50.0 to 51.5 ft. SPT SAMPLE
50.0 to 50.4 ft. Poorly Graded Sand (SP): Approx. 95% fine sand; Approx 5% nonplastic fines.
50.4 to 51.5 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high to very high dry strength; Approx. 5% fine sand. Moist, dark grayish brown, firm to hard consistency, strong cementation. No reaction with HCl. Sampler sank 0.2 ft. under weight of hammer and rods in the seating interval.

51.5 to 52.5 ft. CORED INTERVAL
Lean Clay (CL): Similar to interval 50.4 to 51.5 ft. Clay swelled to 2 times the cored length in the core barrel.

52.5 to 54.0 ft. SPT SAMPLE
Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high to very high dry strength; Approx. 5% fine sand. Moist, dark grayish brown, slight organic odor, firm consistency, strong cementation. No reaction with HCl. A piece of shiny charcoal 1/2 in. diameter in size was found at 53.8 ft. Sampler sank 0.46 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: No gradation tests ran. PI = 46.7%, LL = 83.0%, SL = 9.1%, MC = 47.0%. Lab Classification: Fat Clay (CH).

54.0 to 55.0 ft. CORED INTERVAL
Lean Clay (CL): Similar to interval 52.5 to 54.0 ft.

55.0 to 56.5 ft. SPT SAMPLE
Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength; Trace of fine sand. Moist, dark gray, slight organic odor, firm consistency, strong cementation. No reaction with HCl. Sampler sank 0.33 ft. under weight of hammer and rods in the seating interval.

56.5 to 57.5 ft. CORED INTERVAL
56.5 to 57.2 ft. Lean Clay (CL): Similar to interval 55.0 to 56.5 ft.
57.2 to 57.5 ft. Poorly Graded Sand (SP): Similar to interval 57.5 to 59.0 ft. (below).

57.5 to 59.0 ft. SPT SAMPLE
Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Weak to strong reaction with HCl when dry.

Lab Test Data: 69.2% sand, 30.8% nonplastic fines: PI = NP, LL = NP, MC = 22.6%.
Lab Classification: Silty Sand (SM).

59.0 to 60.0 ft. CORED INTERVAL
59.0 to 59.2 ft. No Recovery; assumed to be Silty Sand (SM).
59.2 to 59.6 ft. Silty Sand (SM): Similar to interval 57.5 to 59.0 ft.
59.6 to 59.8 ft. Lean Clay (CL): Similar to interval 55.0 to 56.5 ft.
59.8 to 60.0 ft. No Recovery; assumed to be Silty Sand (SM).

60.0 to 61.5 ft. SPT SAMPLE
Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 1.7 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 81.5% sand, 18.5% nonplastic fines: PI = NP, LL = NP, MC = 22.3%.
Lab Classification: Silty Sand (SM).

61.5 to 62.5 ft. CORED INTERVAL
Lean Clay (CL): Similar to interval 55.0 to 56.5 ft.

62.5 to 63.5 ft. DRILLED
Drilled with pilot bit; no ability to sample.

63.5 to 65.0 ft. SPT SAMPLE
Poorly Graded Sand (SP): Approx. 95% fine, subangular to subrounded sand; Approx 5% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.45 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 93.3% sand, 6.7% nonplastic fines: PI = NP, LL = NP, MC = 19.9%.
Lab Classification: Poorly Graded Sand with Silt (SP-SM).

65.0 to 66.0 ft. CORED INTERVAL
Recovered 0.1 ft. of loose, Silty Sand with Gravel (SM)g:

66.0 to 67.5 ft. SPT SAMPLE
Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft to soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data (66.5 to 67.5 ft.): 77.1% sand, 22.9% nonplastic fines: PI = NP, LL = NP, MC = 21.1%. Lab Classification: Silty Sand (SM).

67.5 to 68.5 ft. CORED INTERVAL
Recovered 0.2 ft. of Poorly Graded Sand (SP): Similar to interval 63.5 to 65.0 ft.

68.5 to 69.5 ft. CORED INTERVAL
No Recovery; assumed to be Poorly Graded Sand (SP).

69.5 to 71.0 ft. SPT SAMPLE
69.5 to 70.2 ft. Poorly Graded Sand (SP): Approx. 95% fine, subangular to subrounded sand; Approx 5% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data 69.5 to 70.2 ft.): 87.4% sand, 12.6% nonplastic fines: PI = NP, LL = NP, MC = 22.8%. Lab Classification: Silty Sand (SM).

70.2 to 70.6 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, very high dry strength; Approx. 5% fine sand. Moist, dark gray, firm consistency, strong cementation. Strong reaction with HCl when dry.

70.6 to 70.7 ft. Silty Sand (SM): Approx. 90% fine sand; Approx. 10% nonplastic fines. Other characteristics similar to interval 69.5 to 70.2 ft.

COMMENTS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 5 OF 6

FEATURE: RED LAKE DAM
 LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT
 BEGUN: 12/6/06 FINISHED: 12/14/06
 DEPTH AND ELEV OF WATER LEVEL
 DATE MEASURED: 22.7' (7067.1') 12/12/06

PROJECT: DVA FIELD INVESTIGATION
 COORDINATES: N. 1791102.1 E. 2365929.4
 US STATE PLANE, NM_W (WGS 84)
 TOTAL DEPTH: 91.0'
 DEPTH TO BEDROCK: NOT ENCOUNTERED

STATE: ARIZONA
 GROUND ELEVATION: 7089.8'
 ANGLE FROM HORIZONTAL: 90°
 LOGGED BY: M. MILLER
 BUREAU OF RECLAMATION

**CLASSIFICATION AND
 PHYSICAL CONDITION
 (continued)**

**CLASSIFICATION AND
 PHYSICAL CONDITION
 (continued)**

70.7 to 71.0 ft. Lean Clay (CL): Similar to interval 70.2 to 70.6 ft.
 Sampler sank 0.5 ft. under weight of hammer and rods in the seating interval.

81.0 to 82.0 ft. CORED INTERVAL
 No Recovery; assumed to be Silty Sand (SM).

71.0 to 72.0 ft. CORED INTERVAL
 No Recovery; assumed to be Poorly Graded Sand (SP).

82.0 to 83.5 ft. SPT SAMPLE
 82.0 to 82.3 ft. Silty Sand (SM): Similar to interval 79.5 to 81.0 ft.
 82.3 to 83.5 ft. Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength. Moist, dark gray with black streaks, firm to hard consistency, strong cementation. No to weak reaction with HCl.

72.0 to 73.5 ft. SPT SAMPLE
 72.0 to 72.3 ft. Poorly Graded Sand (SP): Similar to interval 69.5 to 70.2 ft.
 73.2 to 72.4 ft. Silty Sand (SM): Similar to interval 72.5 to 72.9 ft. (below).
 72.4 to 72.5 ft. Lean Clay (CL): Similar to interval 72.9 to 73.5 ft. (below).
 72.5 to 72.9 ft. Silty Sand (SM): Approx 70% nonplastic fines with no dilatancy, no toughness, high dry strength; Approx. 30% fine, subangular to subrounded sand. Moist, brown, soft to firm consistency, weak cementation. Strong reaction with HCl when dry.

Lab Test Data: No gradation tests ran: PI = 48.8%, LL = 82.3%, SL = 10.7%, MC = 41.6%. Lab Classification: Fat Clay (CH).

Lab Test Data: 63.3% nonplastic fines, 36.7% sand: PI = NP, LL = NP, MC = 22.9%.
 Lab Classification: Silty Silt s(ML).

83.5 to 84.5 ft. CORED INTERVAL
 Lean Clay (CL): Similar to interval 82.3 to 83.5 ft.

72.9 to 73.5 ft. Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, high to very high dry strength; Trace of fine sand. Moist, brown, firm consistency, strong cementation. No reaction with HCl.

84.5 to 86.0 ft. SPT SAMPLE
 84.5 to 84.8 ft. Lean Clay (CL): Similar to interval 82.3 to 83.5 ft.
 84.8 to 86.0 ft. Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 1.15 ft. under weight of hammer and rods in the seating interval.

Sampler sank 0.5 ft. under weight of hammer and rods in the seating interval.

Lab Test Data (84.8 to 86.0 ft.): 74.2% sand, 25.8% nonplastic fines: PI = NP, LL = NP, MC = 23.1%. Lab Classification: Silty Sand (SM).

73.5 to 74.5 ft. CORED INTERVAL
 Lean Clay (CL): Similar to interval 72.9 to 73.5 ft. except material is dark brown from 73.5 to 74.1 ft. and dark gray from 74.1 to 74.5 ft.

86.0 to 87.0 ft. CORED INTERVAL
 No Recovery; assumed to be Silty Sand (SM).

74.5 to 76.0 ft. SPT SAMPLE
 74.5 to 74.9 ft. Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, firm consistency, no cementation. Strong reaction with HCl when dry.
 74.9 to 75.2 ft. Lean Clay (CL): Similar to interval 70.2 to 70.6 ft.
 75.2 to 76.0 ft. Silty Sand (SM): Similar to interval 74.5 to 74.9 ft.

87.0 to 88.5 ft. SPT SAMPLE
 87.0 to 87.5 ft. Silty Sand (SM): Similar to interval 84.8 to 86.0 ft. except material is dark gray from 87.0 to 87.5 ft. and brown from 87.3 to 87.5 ft.
 87.5 to 87.7 ft. Silty Sand (SM): Approx. 70% plastic fines and 30% fine sand.
 87.7 to 88.5 ft. Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength. Moist, brown, firm consistency, strong cementation. Weak reaction with HCl. Sampler sank 0.05 ft. under weight of hammer and rods in the seating interval.

Lab Test Data (75.2 to 76.0 ft.): 74.7% sand, 25.3% nonplastic fines: PI = NP, LL = NP, MC = 20.4%. Lab Classification: Silty Sand (SM).

76.0 to 77.0 ft. CORED INTERVAL
 Recovered 0.4 ft. of Silty Sand (SM): Similar to interval 72.5 to 72.9 ft.

88.5 to 89.5 ft. CORED INTERVAL
 Lean Clay (CL): Similar to interval 87.7 to 88.5 ft.

77.0 to 78.5 ft. SPT SAMPLE
 Silty Sand (SM): Approx. 85% fine, subangular to subrounded sand; Approx 15% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.05 ft. under weight of hammer and rods in the seating interval.

89.5 to 91.0 ft. SPT SAMPLE
 Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength. Moist, reddish brown, firm to hard consistency, strong cementation. Weak to strong reaction with HCl. Sampler sank 0.6 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 85.4% sand, 14.6% nonplastic fines: PI = NP, LL = NP, MC = 21.0%.
 Lab Classification: Silty Sand (SM).

78.5 to 79.5 ft. CORED INTERVAL
 No Recovery.

79.5 to 81.0 ft. SPT SAMPLE
 Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler was driven 0.9 ft. (80.0 to 80.9 ft.) with 1 blow.

Lab Test Data: 73.1% sand, 26.9% nonplastic fines: PI = NP, LL = NP, MC = 20.8%.
 Lab Classification: Silty Sand (SM).

COMMENTS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 6 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06 FINISHED: 12/14/06

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

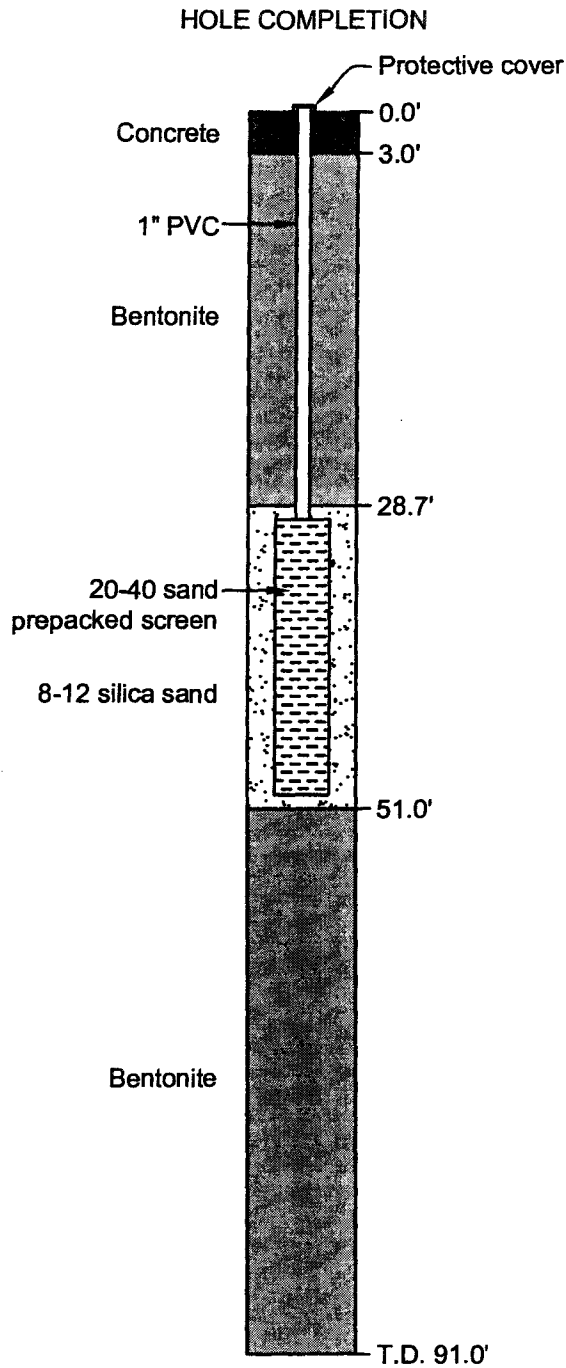
TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

AND DATE MEASURED: 22.7' (7067.1') 12/12/06

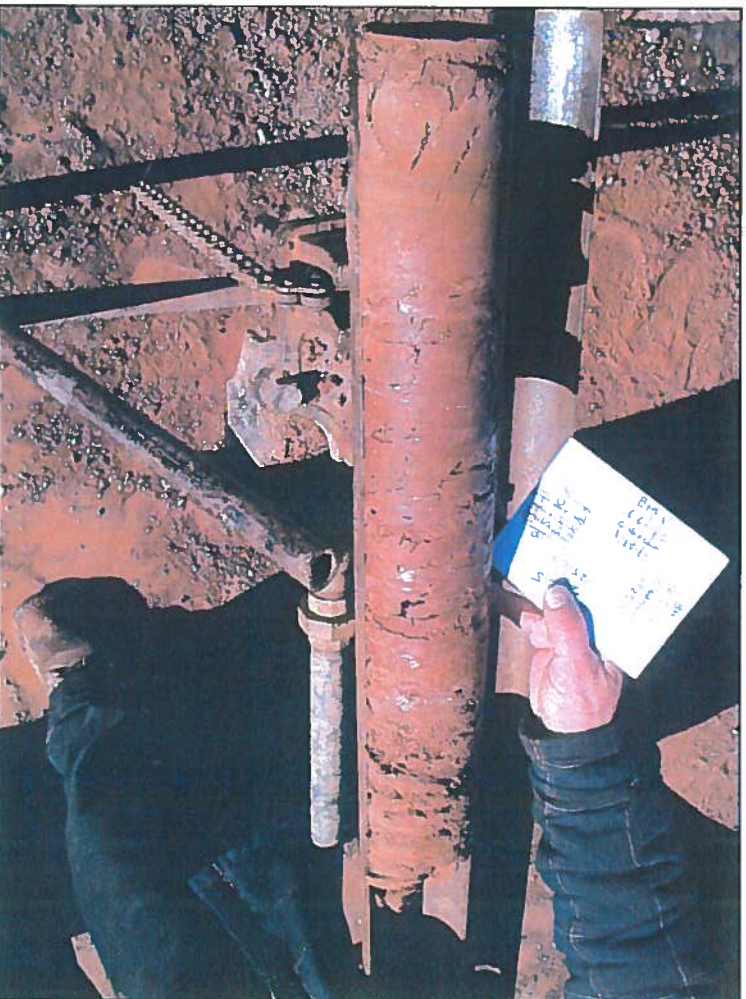
DEPTH TO BEDROCK: NOT ENCOUNTERED

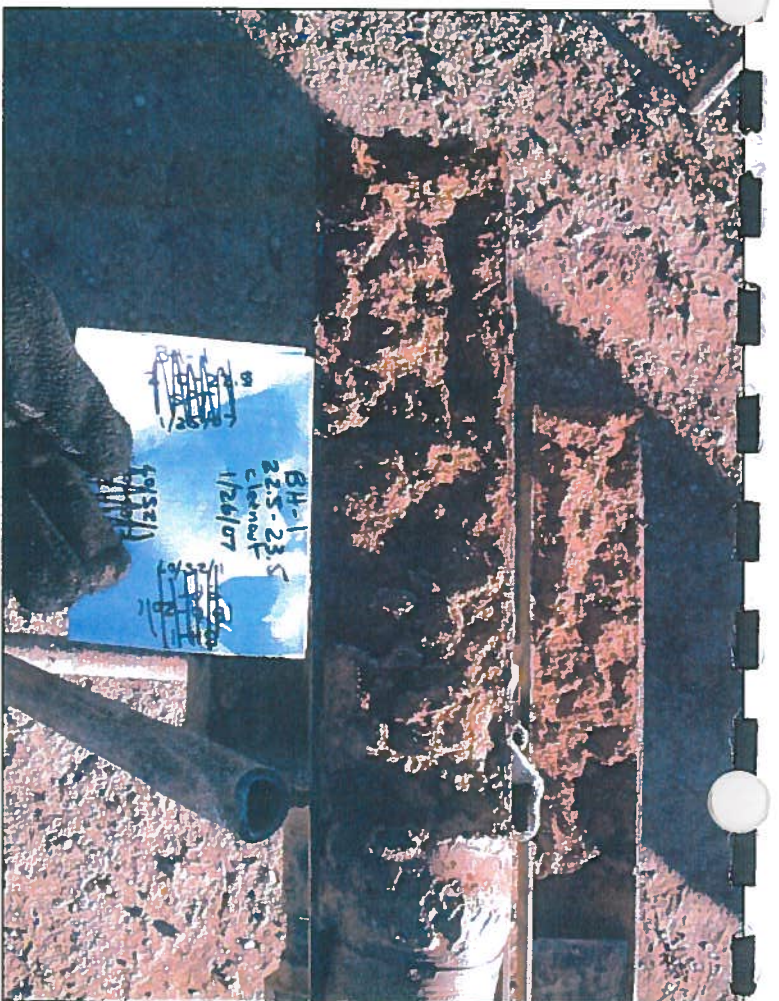
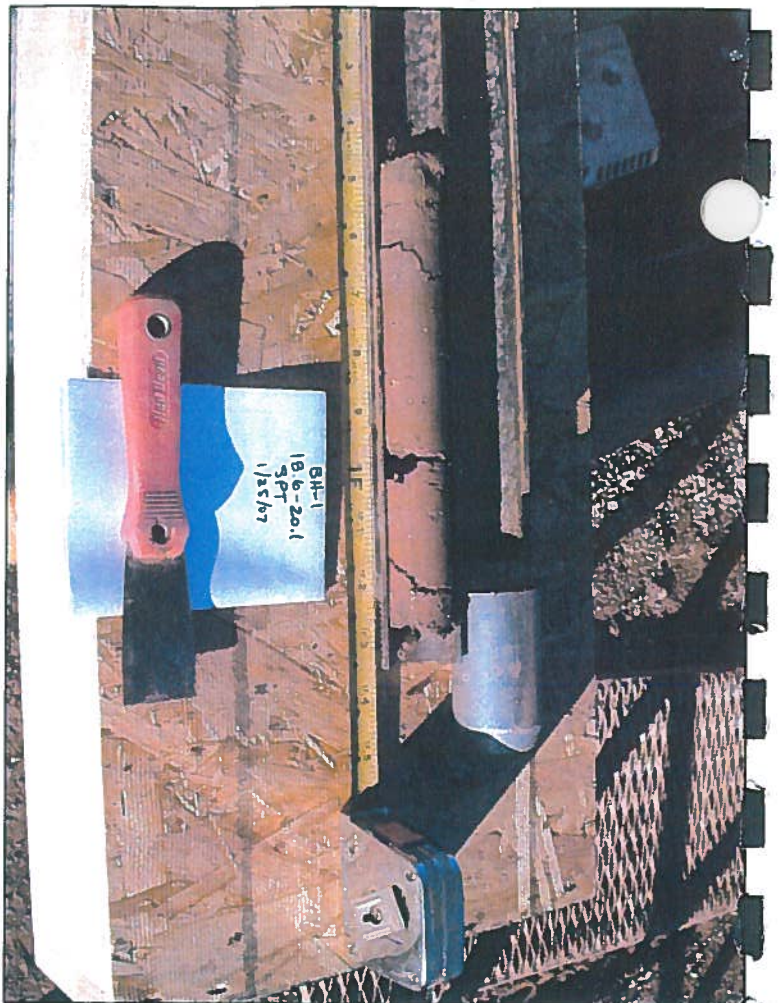
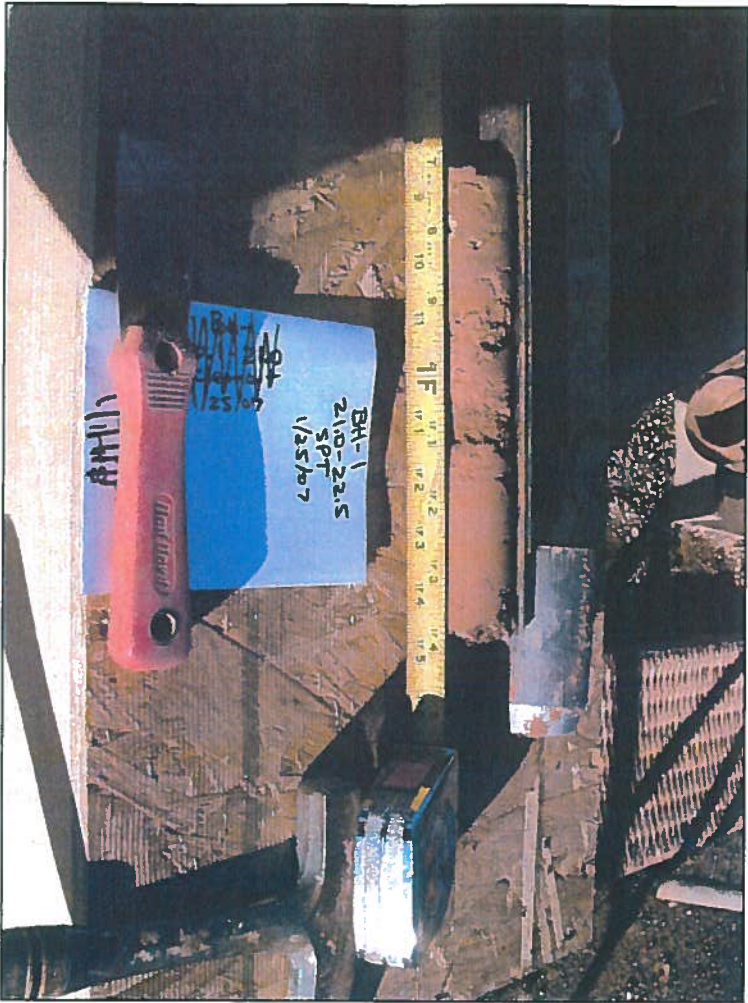
BUREAU OF RECLAMATION

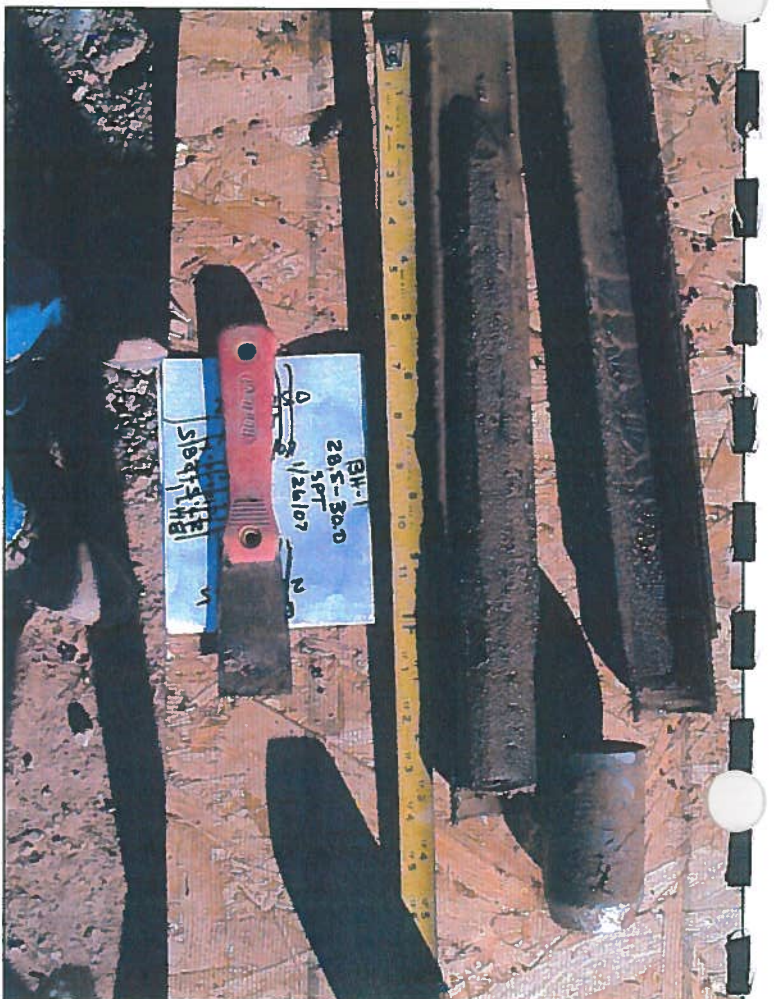
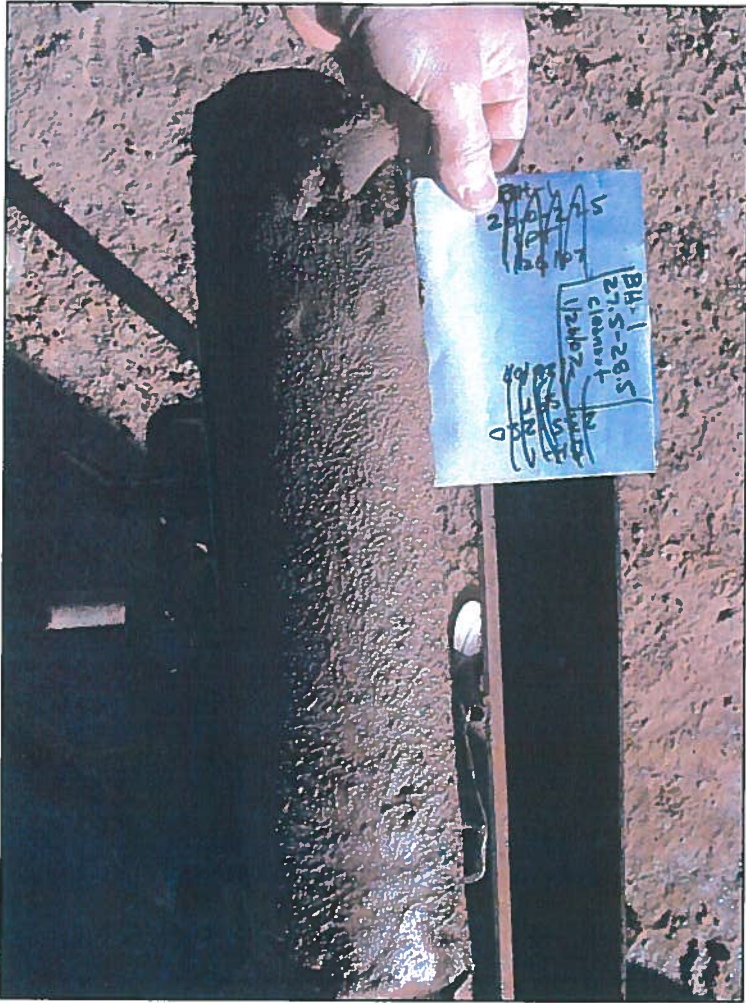


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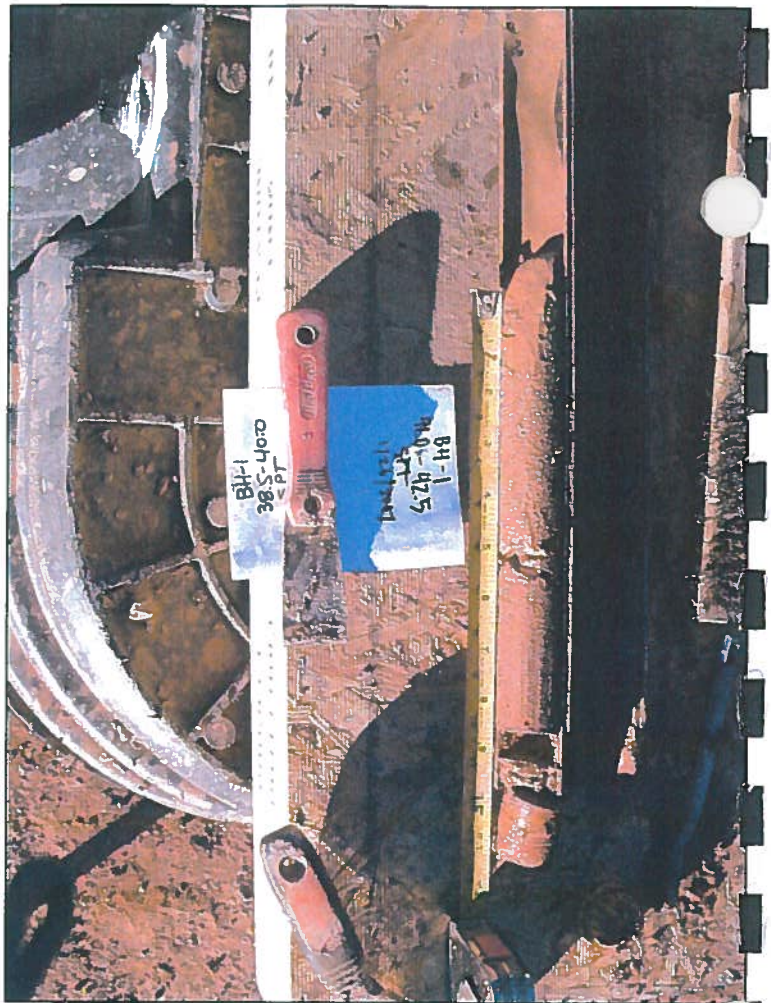


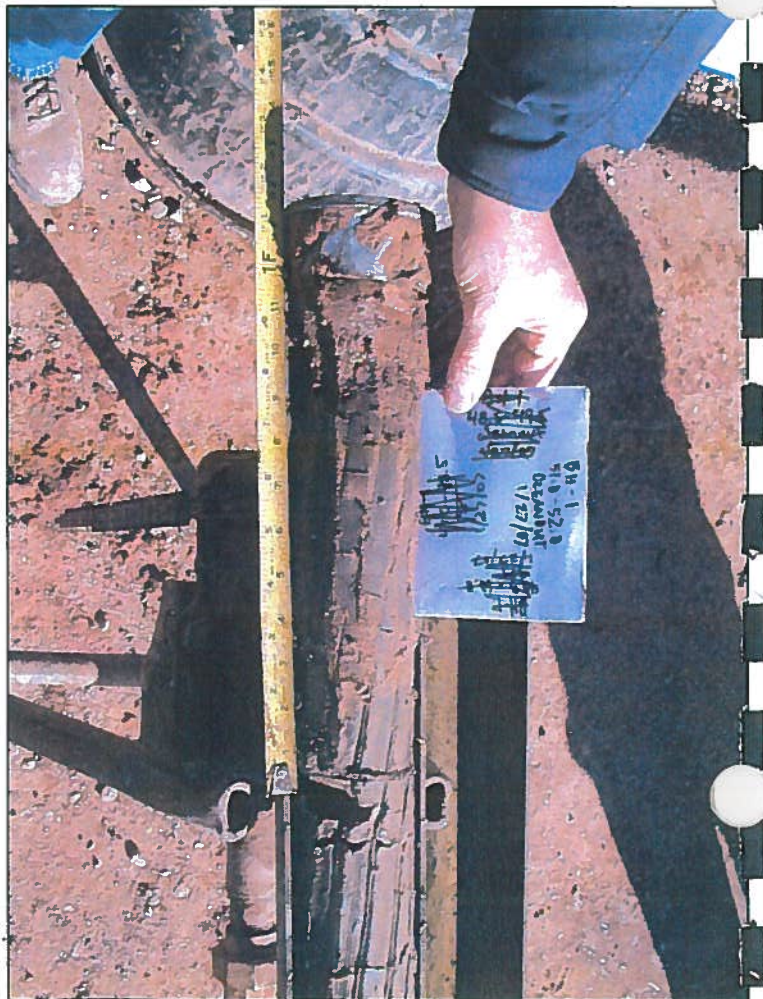
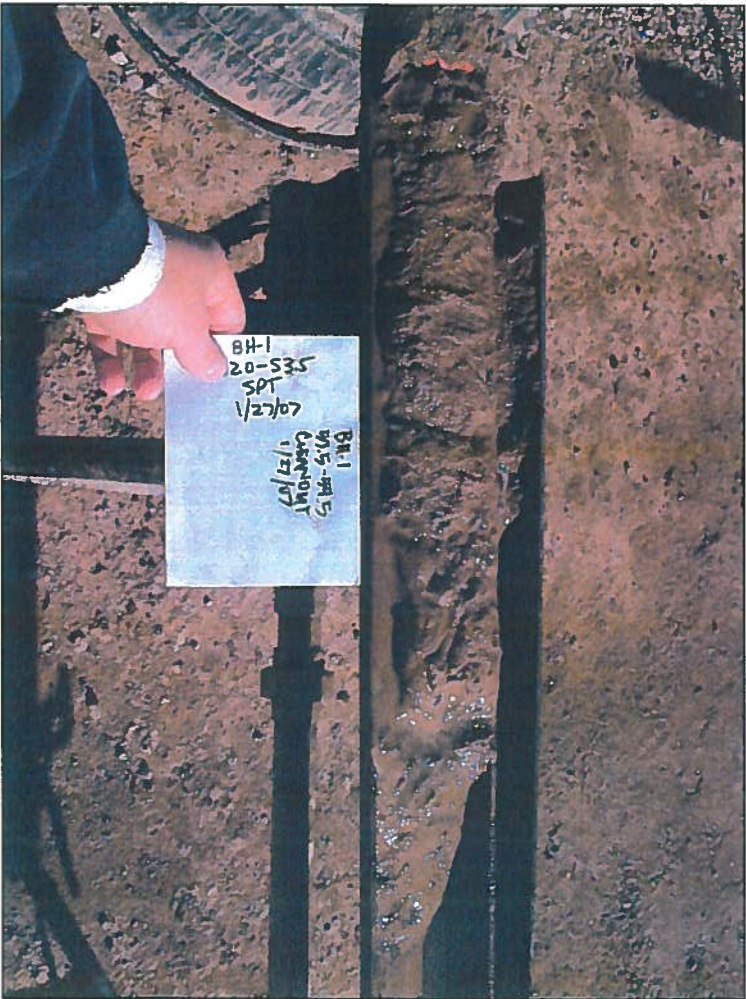
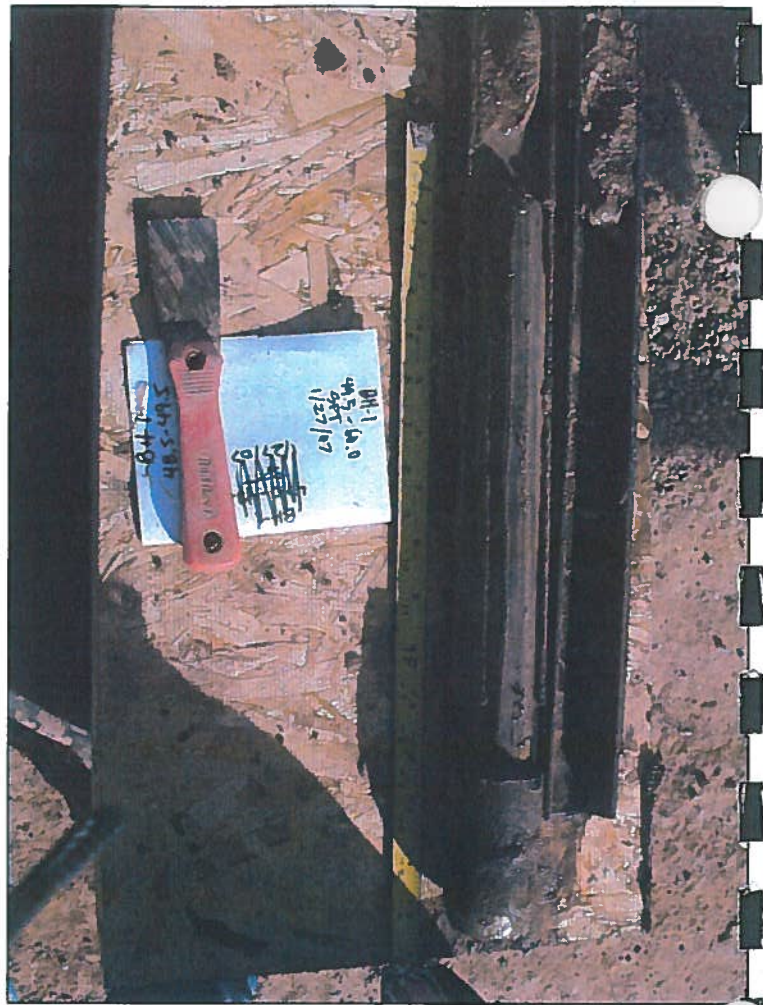


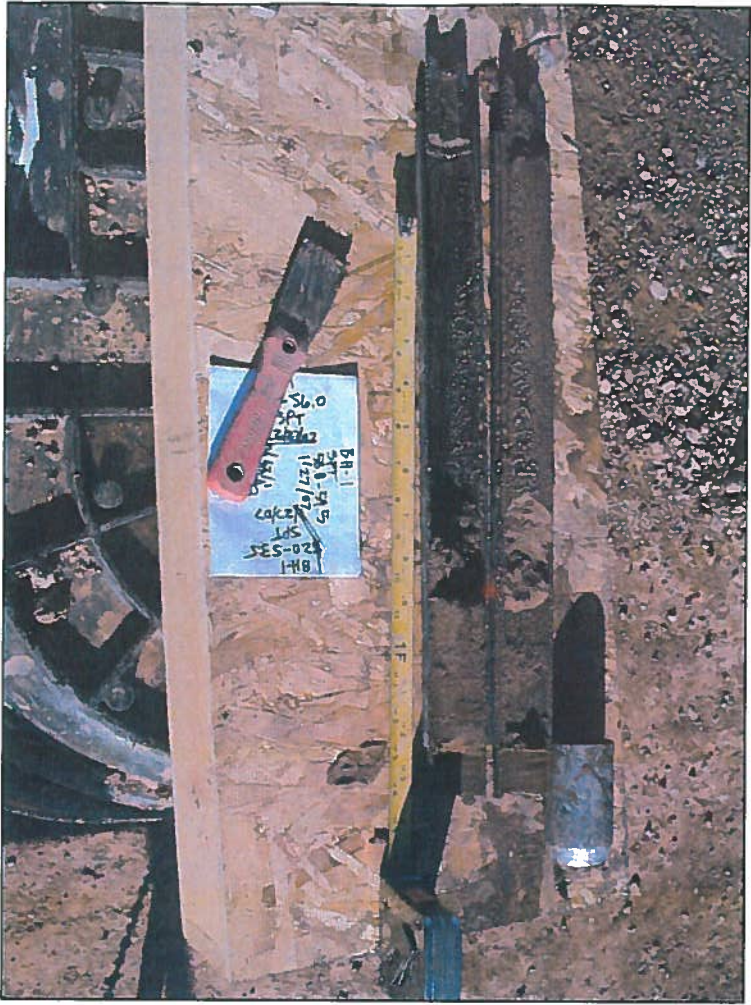




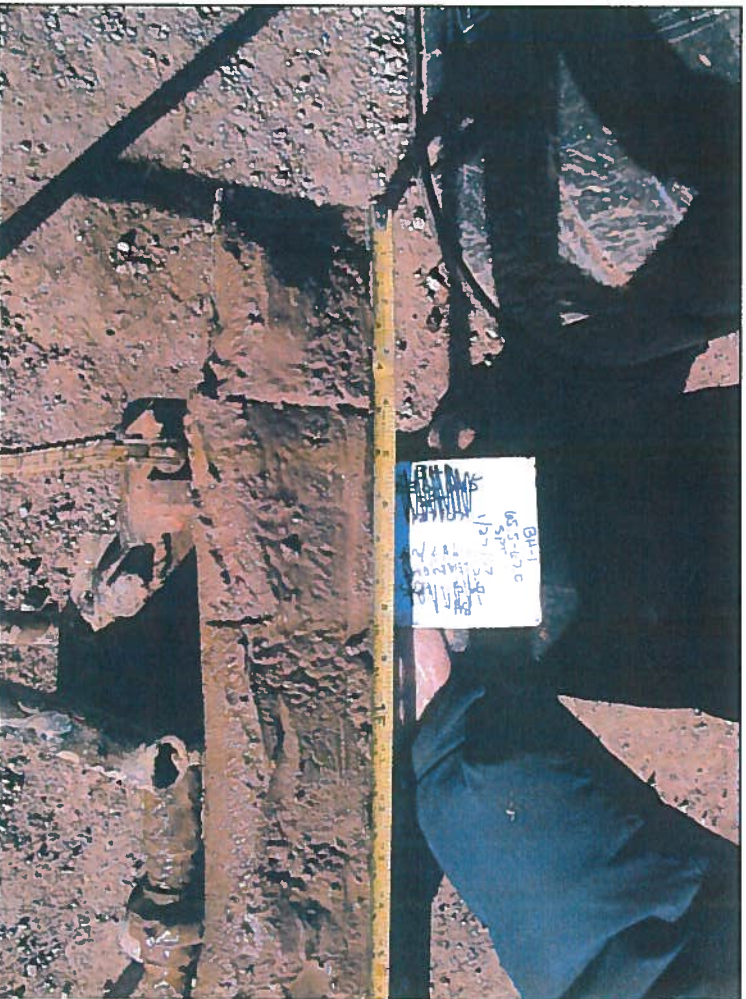












GEOLOGIC LOG OF DRILL HOLE NO. BH-1

SHEET 1 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 870' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791086.3 E. 2366235.3

GROUND ELEVATION: 7089.6'

BEGUN: 1/25/07

FINISHED: 1/28/07

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 80.1'

LOGGED BY : M. MILLER

DATE MEASURED: 25.7' (7063.9') 1/28/07

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

NOTES

PURPOSE OF HOLE:

Perform continuous sampling and standard penetration tests (SPTs) in the dam embankment and foundation to determine gradations and physical properties and to evaluate those materials for susceptibility to liquefaction and seepage. Install a slotted pipe piezometer to measure water levels.

DRILL SITE & SET-UP:

Drilled on the dam crest roadway, approx. 870 ft. east of right abutment, 3 ft. from the upstream edge of the dam, and about 4 ft. left of cone penetrometer test hole CPT06-9.

DRILL EQUIPMENT:

Gus Pech Brat 22R truck-mounted rotary drill rig; 7-1/4 in. O.D. hollow stem augers with 4-1/4 in. I.D.; 5-ft.-long, 2-1/4 in. O.D. drill rods; 4 in. O.D. Laskey Continuous Soil Sampler; 1.8-ft.-long, 2-1/4 in. O.D. SPT Sampler.

DRILLER:

Edward Washburn (driller). Larry Goldman and Patrick Root (helpers) from Provo Area Office, Upper Colorado Region, U.S. Bureau of Reclamation.

DRILL FLUID:

Drilling fluid not used. When the hole was at 31.0 ft., water from the lake was added to the hole before performing SPTs.

DRILLING METHODS:

Drilled from 0.0 to 80.1 ft. using 7-1/4 in. O.D. hollow stem augers.

DRILLING CONDITIONS/COMMENTS:

Encountered water table around 26.0 ft. Set up water pump on top of lake ice to fill hole with water prior to performing SPTs. Sample fell out of core barrel during cleanout of interval 38.5 to 41.0 ft.; went back in with core barrel to 42.0 ft. From 42.0 to 76.1 ft., sand flowing into augers, had to redo some cleanout intervals. From 76.1 to 80.1 ft. sand flowing into augers, could not keep hole cleaned out and perform SPT. Geologist called hole at 80.1 ft.

DEPTH TO WATER DURING DRILLING:

Date	Depth to Water (ft.)	Hole Depth (ft.)
(2007)		
1/27	27.5	42.0
1/28	27.4	65.5
1/29	25.7	80.1

REMARKS:

Measurements are from ground surface unless otherwise noted.
 SP*, SM* or SP-SM* - Includes small zones of no recovery.
 NR (SM) = No Recovery, assumed to be SM.

STANDARD PENETRATION TEST

DEPTH	% CORE RECOVERY	# OF BLOWS	% MOISTURE*	BLOWS PER FOOT			
				140 LB. HAMMER - 30 IN. DROP			
				10	20	30	40
	NA						
70		50/0.6	10.7				
100							
50		35	14.0				
60							
100		42	7.4				
100							
100		42	6.3				
73		29	12.6				
100							
100		21	9.1				
87		11	19.5				
100							
73		23	16.1				
100							
60		15	20.2				
100							
93		8	21.5				
100							
53		12	20.8				
100							
93		13	20.8				
0							
100		8	24.0				
0							
93		6	27.0				
100							
100		4	24.9				
80							
80		19	22.4				
30							
100							
67		9	26.7				
0							
80		13	47.9				
100							
100		10	39.4				
0							

CLASSIFICATION AND PHYSICAL CONDITION

DEPTH	VISUAL CLASSIFICATION	ELEVATION	SAMPLES FOR TESTING
	NS		
	s(ML)		
0.0 to 1.0 ft. DRILLED			
Drilled with pilot bit; no ability to sample.			
1.0 to 2.5 ft. SPT SAMPLE			
Sandy Silt s(ML): Approx. 70 % nonplastic fines, slow dilatancy, low toughness, very high dry strength; Approx. 30 % predominantly fine to medium sand; Trace of fine, subangular to subrounded, hard gravel. Dry, brown, very hard consistency, strong cementation. Strong reaction with HCl. SPT exceeded 50 blows in first 0.6 ft.			
1.0 to 1.4 ft. Lab Test Data: 70.1 % nonplastic fines, 29.9 % sand; PI = NP, LL = NP. Lab Classification: Silt with Sand (ML)s.			
2.5 to 3.5 ft. CORED INTERVAL			
Sandy Lean Clay s(CL): Approx. 70 % plastic fines and 30 % fine to medium sand. Trace of fine, subangular to subrounded, hard gravel. Dry, brown, very hard consistency, strong cementation. Strong reaction with HCl.			
3.5 to 5.0 ft. SPT SAMPLE			
Lean Clay with Sand (CL)s: Approx. 80 % fines with low to medium plasticity, medium toughness, very high dry strength, Approx. 20 % predominately fine to medium sand. Dry, brown with white specks of CaCO ₃ , very hard consistency, strong cementation. Strong reaction with HCl.			
3.5 to 3.7 ft. Lab Test Data: 79.2 % plastic fines, 20.8 % sand; PI = 19.9%, LL = 38.1%. Lab Classification: Lean Clay with Sand (CL)s.			
5.0 to 6.0 ft. CORED INTERVAL			
Lean Clay with Sand (CL)s: Similar to interval 3.5 to 5.0 ft.			
5.0 to 6.0 ft. Pinhole Test Results: Sample No. 71H-1; 74.8 % fines, 22.8 % sand, 3.0 % gravel. LL = 36, PI = 19, Pinhole Rating = NDS, Crumb Rating = 1.			
6.0 to 7.5 ft. SPT SAMPLE			
Silty Sand (SM): Approx. 75 % predominantly fine to medium sand, Approx. 25% nonplastic fines with rapid dilatancy, no toughness, very high dry strength. Dry, brown, firm to hard consistency, moderate to strong cementation. Strong reaction with HCl.			
6.0 to 7.2 ft. Lab Test Data: 75.2 % sand, 24.8 % nonplastic fines; PI = NP, LL = NP. Lab Classification: Silty Sand (SM).			
7.5 to 8.5 ft. CORED INTERVAL			
Silty Sand (SM): Similar to interval 6.0 to 7.5 ft.			
8.5 to 10.0 ft. SPT SAMPLE			
Silty Sand (SM): Approx. 75 % predominantly fine to medium sand, Approx. 25% nonplastic fines with rapid dilatancy, no toughness, very high dry strength. Dry, brown, firm to hard consistency, moderate to strong cementation. Strong reaction with HCl.			
8.5 to 9.7 ft. Lab Test Data: 72.9 % sand, 27.1 % nonplastic fines; PI = NP, LL = NP. Lab Classification: Silty Sand (SM).			
10.0 to 11.0 ft. CORED INTERVAL			
Silty Sand (SM): Similar to interval 8.5 to 10.0 ft.			

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SL = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-1

SHEET 2 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 870' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791086.3 E. 2366235.3

GROUND ELEVATION: 7089.6'

BEGUN: 1/25/07 FINISHED: 1/28/07

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 80.1'

LOGGED BY: M. MILLER

AND DATE MEASURED: 25.7' (7063.9') 1/28/07

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

NOTES	DEPTH	STANDARD PENETRATION TEST			DEPTH	VISUAL CLASSIFICATION ELEVATION	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION							
		% CORE RECOVERY	# OF BLOWS	% MOISTURE					BLOWS PER FOOT						
									140 LB. HAMMER - 30 IN. DROP						
				10	20	30	40								
<p>SAMPLE DATA: Samples collected at 1.5 ft. intervals with a 1 ft. minimum cleanout interval between samples. Samples were transported to the Farmington Field Office for storage and selected samples were sent to the lab for testing.</p> <p>HOLE COMPLETION: Backfilled hole from 80.1 to 48.0 ft. with 3/8 in. dia. coated bentonite pellets. Placed a transitional layer of sand from 48.0 to 46.0 ft. Installed 3-1/4 in. O.D. pre-formed 20-40 sand packed screen from 46.0 to 25.7 ft., and backfilled around screen with 8-12 silica sand to 24.7 ft. Zone of influence is 48.0 to 24.7 ft. Backfilled from 24.7 to 3.0 ft. with bentonite chips and placed cement from 3.0 ft. to the top of the dam. Embedded a protective cover in concrete over the 1-1/4 in. PVC (PVC has a 0.4 ft. stickup). Mounded gravel around the cover and placed large rocks to protect from dam crest road traffic.</p> <p>REASON FOR HOLE TERMINATION: From 76.1 to 80.1 ft. sand flowing into augers, could not keep hole cleaned out and perform SPT. Terminated hole 10 ft. above predetermined depth.</p> <p>ESTIMATED DRILLING TIME:</p> <table border="1"> <tr> <th>No. of Hours</th> </tr> <tr> <td>Set-Up</td> <td>2</td> </tr> <tr> <td>Drilling</td> <td>35</td> </tr> <tr> <td>Hole Completion</td> <td>9</td> </tr> </table>	No. of Hours	Set-Up	2	Drilling	35	Hole Completion	9	93	14	45.2					<p>11.0 to 12.5 ft. SPT SAMPLE Clayey Sand (SC): Approx. 70% fine sand; Approx. 30% fines with low plasticity, low toughness, high dry strength;. Dry, brown, firm to hard consistency, moderate to strong cementation. Strong reaction with HCl.</p> <p>11.4 to 12.2 ft. Lab Test Data: 52.2% sand, 47.8% plastic fines: PI = 12.4%, LL = 26.2%. Lab Classification: Clayey Sand (SC).</p> <p>12.5 to 13.5 ft. CORED INTERVAL Silty Sand (SM): Similar to interval 13.5 to 15.0 ft.</p> <p>13.5 to 15.0 ft. SPT SAMPLE Silty Sand (SM): Approx. 75% fine sand, Approx. 25% nonplastic fines with rapid dilatancy, no toughness, very high dry strength. Dry to moist, brown, firm consistency, moderate. Strong reaction with HCl.</p> <p>13.5 to 14.7 ft. Lab Test Data: 77.1% sand, 22.9% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).</p> <p>15.0 to 16.0 ft. CORED INTERVAL Silty Sand (SM): Similar to interval 13.5 to 15.0 ft.</p> <p>16.0 to 17.5 ft. SPT SAMPLE 16.0 to 17.1 ft. Silty Sand (SM): Approx. 85% fine, subangular to subrounded sand; 15% nonplastic fines with rapid dilatancy, no toughness, very high dry strength. Dry, brown, soft to firm consistency, moderate cementation. Strong reaction with HCl.</p> <p>16.2 to 17.1 ft. Lab Test Data: 72.4% sand, 27.6% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).</p> <p>17.1 to 17.5 ft. Lean Clay (CL): Approx. 90% fines with medium plasticity, medium toughness, high to very high dry strength; Approx. 10% fine sand. Dry to moist, brown, firm to hard consistency, strong cementation, contact is perpendicular to core axis. Strong reaction with HCl.</p> <p>17.5 to 18.6 ft. CORED INTERVAL 17.5 to 18.2 ft. Silty Sand (SM): Similar to interval 16.0 to 17.1 ft.</p> <p>18.2 to 18.6 ft. Lean Clay (CL): Similar to interval 17.1 to 17.5 ft. except moist and clay increases in length after coring.</p> <p>18.6 to 20.1 ft. SPT SAMPLE Sandy Lean Clay s(CL): Approx. 55% fines with medium to high plasticity, medium toughness, very high dry strength; Approx. 45% predominantly fine to coarse sand; Trace of fine gravel. Moist, brown with white specks of CaCO₃, hard consistency, strong cementation. Strong reaction with HCl. Sampler sank 0.035 ft. under weight of hammer and rods in the seating interval.</p> <p>20.1 to 21.0 ft. CORED INTERVAL Lean Clay with Sand (CL)s: Similar to interval 21.0 to 22.5 ft. (below)</p>
	No. of Hours														
	Set-Up	2													
	Drilling	35													
	Hole Completion	9													
		100													
		100	3	51.5											
		0													
		100	6	36.4											
		0													
		100													
		100	6	55.4											
		50													
		100	12	25.5											
		100													
		80	8	24.6											
		0													
		100	13	34.1											
		0													
		80	5	24.0											
	0														
	80														
	70														
	100	10	30.4												
	50														
	87	11	26.0												
	0														
	0														
	0														
	0														
	60														

BOTTOM OF HOLE

COMMENTS:

All measurements are from ground surface unless otherwise noted.
 SP*, SM* or SP-SM* - Includes small zones of no recovery.
 NR {SM} = No Recovery, assumed to be SM.

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SL = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-1

SHEET 3 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 870' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791086.3 E. 2366235.3

GROUND ELEVATION: 7089.6'

REGUN: 1/25/07 FINISHED: 1/28/07

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 80.1'

LOGGED BY : M. MILLER

AND DATE MEASURED: 25.7' (7063.9') 1/28/07

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

21.0 to 22.5 ft. SPT SAMPLE

Lean Clay with Sand (CL)s: Approx. 75% fines with medium to high plasticity, medium toughness, very high dry strength; Approx. 25% fine sand. Moist, brown, hard to very hard consistency, strong cementation. Strong reaction with HCl. Sampler sank 0.035 ft. under weight of hammer and rods in the seating interval.

21.6 to 22.2 ft. Lab Test Data: 71.4% plastic fines, 28.6% sand: PI = 20.8%, LL = 36.3%. Lab Classification: Lean Clay with Sand (CL)s.

22.5 to 23.5 ft. CORED INTERVAL

Lean Clay with Sand (CL)s: Similar to interval 21.0 to 22.5 ft.

23.5 to 25.0 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 55% fines with low plasticity, medium toughness, high dry strength; Approx. 45% predominantly fine to medium sand. Moist, brown, soft consistency, weak cementation. Strong reaction with HCl. Sampler sank 0.3 ft. under weight of hammer and rods in the seating interval.

23.6 to 24.7 ft. Lab Test Data: 53.5% plastic fines, 46.5% sand: PI = 8.3%, LL = 7.7%. Lab Classification: Sandy Lean Clay s(CL).

25.0 to 26.0 ft. CORED INTERVAL

25.0 to 26.0 ft. Sandy Lean Clay s(CL): Similar to interval 23.5 to 25.0 ft.

26.0 to 27.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 85% predominantly fine to medium, subangular to subrounded sand; 15% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.6 ft. under weight of hammer and rods in the seating interval. Encountered water table at approx. 26.0 ft.

26.5 to 27.0 ft. Lab Test Data: 86.5% sand, 13.5% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

27.5 to 28.5 ft. CORED INTERVAL

Silty Sand (SM): Similar to interval 26.0 to 27.5 ft.

28.5 to 30.0 ft. SPT SAMPLE

Silty Sand (SM): Approx. 85% predominantly fine to medium, subangular to subrounded sand; 15% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.035 ft. under weight of hammer and rods in the seating interval.

26.5 to 27.0 ft. Lab Test Data: 85.0% sand, 15.0% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

30.0 to 31.0 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM).

31.0 to 32.5 ft. SPT SAMPLE

31.0 to 32.3 ft. Silty Sand (SM): Approx. 85% predominantly fine to medium, subangular to subrounded sand; 15% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry.

31.0 to 32.2 ft. Lab Test Data: 85.9% sand, 14.1% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

32.3 to 32.4 ft. Lean Clay (CL): Approx. 90% plastic fines, 10% fine sand.

32.4 to 32.5 ft. Silty Sand (SM): Similar to interval 31.0 to 32.3 ft.

32.5 to 33.5 ft. CORED INTERVAL

Recovered 0.3 ft. of Silty Sand (SM) similar to interval 31.0 to 32.3 ft.

COMMENTS:

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

33.5 to 35.0 ft. SPT SAMPLE

Clayey Sand (SC): Approx. 60% predominantly fine to medium, subangular to subrounded sand; 40% fines with no to low plasticity, slow dilatancy, no to medium toughness, medium dry strength. Wet, brown, soft consistency, weak cementation. Weak to strong reaction with HCl when dry. Sampler sank 0.035 ft. under weight of hammer and rods in the seating interval.

33.6 to 34.7 ft. Lab Test Data: 57.3% sand, 42.7% nonplastic fines: PI = 11.6%, LL = 27.5%. Lab Classification: Clayey Sand (SC).

35.0 to 36.0 ft. CORED INTERVAL

Lean Clay (CL): Approx. 90% plastic fines, 10% fine sand. Brown from 35.0 to 35.7 ft., dark gray 35.7 to 36.0 ft.

36.0 to 37.5 ft. SPT SAMPLE

36.0 to 36.6 ft. Silty Sand (SM): Approx. 85% predominantly fine to medium, subangular to subrounded sand; 15% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry.

36.0 to 36.6 ft. Lab Test Data: 58.8% sand, 41.2% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

36.6 to 37.3 ft. Clayey Sand (SC): Approx. 70% fine, subangular to subrounded sand; 30% fines with low plasticity, slow dilatancy, no to medium toughness, medium dry strength. Moist, brown, firm consistency, moderate cementation. Strong reaction with HCl when dry.

37.3 to 37.5 ft. Silty Sand (SM): Similar to interval 36.0 to 36.6 ft.

37.5 to 38.5 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM) similar to interval 36.0 to 36.6 ft.

38.5 to 40.0 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; 20% nonplastic fines with rapid dilatancy, no toughness, very high dry strength. Wet, brown, firm consistency, no cementation. Weak to strong reaction with HCl when dry.

38.8 to 39.7 ft. Lab Test Data: 82.2% sand, 17.8% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

40.0 to 41.0 ft. CORED INTERVAL

Recovered 0.3 ft. of Lean Clay (CL) and Silty Sand (SM).

41.0 to 42.0 ft. CORED INTERVAL

Silty Sand (SM): Similar to interval 38.5 to 40.0 ft.

42.0 to 43.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, very high dry strength. Wet, brown, very soft consistency, weak cementation. Strong reaction with HCl when dry.

42.5 to 43.2 ft. Lab Test Data: 62.8% sand, 37.2% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

43.5 to 44.5 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM) similar to interval 42.0 to 43.5 ft.

44.5 to 46.0 ft. SPT SAMPLE

44.5 to 45.4 ft. Fat Clay (CH): Approx. 90% fines with high plasticity, medium toughness, very high dry strength; Approx. 10% fine sand. Moist, dark gray, hard consistency, strong cementation. No to weak reaction with HCl. Sampler sank 0.38 ft. under weight of hammer and rods in the seating interval.

ABBREVIATIONS

LL = Liquid Limit
MC = Moisture Content
NP = Nonplastic
NR = No Recovery

NS = Not sampled
PI = Plasticity Index
SL = Shrinkage Limit

GEOLOGIC LOG OF DRILL HOLE NO. BH-1

SHEET 4 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 870' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791086.3 E. 2366235.3

GROUND ELEVATION: 7089.6'

BEGUN: 1/25/07 FINISHED: 1/28/07

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 80.1'

LOGGED BY: M. MILLER

AND DATE MEASURED: 25.7' (7063.9') 1/28/07

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

44.8 to 45.4 ft. Lab Test Data: 91.6% plastic fines, 8.4% sand: PI = 38.1%, LL = 59.8 %, SL = 9.4%. Lab Classification: Fat Clay (CH).

45.4 to 46.0 ft. Silty Sand (SM): Approx. 70% fine, subangular to subrounded sand; Approx 30% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, very soft to soft consistency, weak cementation. Strong reaction with HCl when dry.

45.4 to 45.7 ft. Lab Test Data: 74.9% sand, 25.1% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

46.0 to 47.0 ft. CORED INTERVAL

Silty Sand (SM): Similar to interval 45.4 to 46.0 ft.

47.0 to 48.5 ft. SPT SAMPLE

47.0 to 47.8 ft. Silty Sand (SM): Approx. 70% fine, subangular to subrounded sand; Approx 30% nonplastic fines with rapid dilatancy, no toughness, low to medium dry strength. Wet, brown, very soft consistency, weak cementation. Strong reaction with HCl when dry. Sampler was driven 0.7 ft. with first blow.

47.0 to 47.8 ft. Lab Test Data: 56.7% sand, 43.3% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

47.8 to 48.5 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high to very high dry strength; Approx. 5% fine sand. Moist, dark gray, firm to hard consistency, strong cementation. No reaction with HCl.

47.8 to 48.2 ft. Lab Test Data: 92.5% plastic fines, 7.5% sand: PI = 12.8%, LL = 33.3 %. Lab Classification: Lean Clay (CL).

48.5 to 49.5 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM) similar to interval 47.0 to 47.8 ft.

49.5 to 51.0 ft. SPT SAMPLE

Fat Clay (CH): Approx. 90% fines with high plasticity, medium toughness, high to very high dry strength; Approx. 10% fine sand. Moist, brown, firm consistency, moderate cementation. Weak reaction with HCl. Sampler sank 0.25 ft. under weight of hammer and rods in the seating interval.

49.6 to 50.4 ft. Lab Test Data: 95.3% plastic fines, 4.7% sand: PI = 53.9%, LL = 88.8 %, SL = 11.2%. Lab Classification: Fat Clay (CH).

51.0 to 52.0 ft. CORED INTERVAL

51.0 to 51.8 ft. Fat Clay (CH): Similar to interval 49.5 to 51.0 ft.
51.8 to 52.0 ft. Silty Sand (SM): Similar to interval 52.0 to 52.5 ft. (below).

52.0 to 53.5 ft. SPT SAMPLE

52.0 to 52.6 ft. Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, soft consistency, no to weak cementation. Weak to strong reaction with HCl when dry. Sampler sank 1.35 ft. under weight of hammer and rods in the seating and test interval.

52.0 to 52.6 ft. Lab Test Data: 58.7% sand, 41.3% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

52.6 to 53.5 ft. Lean Clay with Sand (CL)s: Approx. 75% fines with medium plasticity, medium toughness, high to very high dry strength; Approx. 25% fine sand. Moist, dark gray, firm to hard consistency, strong cementation. No reaction with HCl.

52.9 to 53.5 ft. Lab Test Data: 74.9% plastic fines, 25.1% sand: PI = 27.3%, LL = 46.2 %. Lab Classification: Lean Clay with Sand (CL)s.

53.5 to 54.5 ft. CORED INTERVAL
No Recovery; assumed to be Silty Sand (SM) similar to interval 54.5 to 55.3 ft. (below).

54.5 to 56.0 ft. SPT SAMPLE

54.5 to 55.3 ft. Sandy Lean Clay s(CL): Approx. 55% fines with low plasticity, medium toughness, low dry strength; Approx. 45% fine sand. Wet, brown, very soft consistency, weak cementation. Weak to strong reaction with HCl. Sampler sank 1.05 ft. under weight of hammer and rods in the seating and test interval.

54.5 to 55.3 ft. Lab Test Data: 56.2% plastic fines, 43.8% sand: PI = 8.1%, LL = 26.2 %. Lab Classification: Sandy Lean Clay s(CL).

55.3 to 56.0 ft. Fat Clay (CH): Approx. 95% fines with high plasticity, medium toughness, very high dry strength; Approx. 5% fine sand. Moist, dark gray, hard consistency, strong cementation. No reaction with HCl.

55.3 to 55.7 ft. Lab Test Data: 98.3% plastic fines, 1.7% sand: PI = 31.7%, LL = 58.9 %, SL = 13.9%. Lab Classification: Fat Clay (CH).

56.0 to 57.0 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand with Silt (SP-SM) similar to interval 58.0 to 58.9 ft.

57.0 to 58.0 ft. CORED INTERVAL

Poorly Graded Sand with Silt (SP-SM) similar to interval 58.0 to 58.9 ft.

58.0 to 59.5 ft. SPT SAMPLE

58.0 to 58.9 ft. Poorly Graded Sand with Silt (SP-SM): Approx. 95% fine to medium, subangular to subrounded sand; Approx 5% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.7 ft. under weight of hammer and rods in the seating and test interval.

58.0 to 58.9 ft. Lab Test Data: 93.6% sand, 6.4% nonplastic fines: PI = NP, LL = NP. Lab Classification: Poorly Graded Sand with Silt (SP-SM).

58.9 to 59.3 ft. Sandy Silt s(ML): Approx 60% nonplastic fines with no dilatancy, no toughness, low dry strength; Approx. 40% fine to medium, subangular to subrounded sand. Moist, brown, soft to firm consistency, weak cementation. Strong reaction with HCl when dry.

58.9 to 59.2 ft. Lab Test Data: 63.1% nonplastic fines, 36.9% sand: PI = NP, LL = NP. Lab Classification: Sandy Silt s(ML).

59.3 to 59.5 ft. Lean Clay with Sand (CL)s: Approx. 75% fines with medium plasticity, medium toughness, high to very high dry strength; Approx. 25% fine sand. Moist, brown, firm to hard consistency, strong cementation. No reaction with HCl.

59.5 to 60.5 ft. CORED INTERVAL

Silty Sand (SM): Similar to interval 60.5 to 62.0 ft.

60.5 to 62.0 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, no dry strength. Wet, brown, firm consistency, no cementation. Weak to strong reaction with HCl when dry. Sampler sank 0.35 ft. under weight of hammer and rods in the seating interval.

60.5 to 61.7 ft. Lab Test Data: 81.3% sand, 18.7% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

COMMENTS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SL = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-1

SHEET 5 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 870' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791086.3 E. 2366235.3

GROUND ELEVATION: 7069.6'

BEGIN: 1/25/07 FINISHED: 1/28/07

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 80.1'

LOGGED BY: M. MILLER

DEPTH AND DATE MEASURED: 25.7' (7063.9') 1/28/07

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

CLASSIFICATION AND PHYSICAL CONDITION (continued)

CLASSIFICATION AND PHYSICAL CONDITION (continued)

62.0 to 63.0 ft. CORED INTERVAL

Lean Clay (CL): Approx. 90% fines with medium plasticity, medium toughness, very high dry strength; Approx. 10% fine sand. Moist, brown, firm consistency, strong cementation. Strong reaction with HCl when dry.

63.0 to 64.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, very soft to soft consistency, weak cementation. Strong reaction with HCl when dry. Sampler sank 0.5 ft. under weight of hammer and rods in the seating interval.

63.0 to 63.9 ft. Lab Test Data: 86.7% sand, 13.3% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

64.5 to 65.5 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM) similar to interval 63.0 to 64.5 ft.

65.5 to 67.0 ft. SPT SAMPLE

65.5 to 65.6 ft. Silty Sand (SM) similar to interval 66.5 to 67.0 ft. Sampler sank 0.8 ft. under weight of hammer and rods in the seating and test interval.

65.6 to 66.5 ft. Fat Clay with Sand (CH)s: Approx. 75% fines with medium to high plasticity, medium toughness, very high dry strength; Approx. 25% fine sand. Moist, brown, firm consistency, strong cementation. Strong reaction with HCl when dry.

65.6 to 66.3 ft. Lab Test Data: 76.0% plastic fines, 42.0% sand: PI = 30.9%, LL = 51.7%, SL = 10.4%. Lab Classification: Fat Clay with Sand (CH)s.

66.5 to 67.0 ft. Silty Sand (SM): Approx. 70% fine, subangular to subrounded sand; Approx 30% nonplastic fines with rapid dilatancy, no toughness, medium dry strength. Wet, brown, very soft to soft consistency, weak cementation. Strong reaction with HCl when dry.

66.5 to 67.0 ft. Lab Test Data: 71.5% sand, 28.5% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

67.0 to 68.0 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM) similar to interval 66.5 to 67.0 ft.

68.0 to 69.5 ft. SPT SAMPLE

Poorly Graded Sand with Silt (SP-SM): Approx. 90% fine, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, very soft to soft consistency, no to weak cementation. Strong reaction with HCl when dry. Sampler sank 1.0 ft. under weight of hammer and rods in the seating and test interval.

68.0 to 68.9 ft. Lab Test Data: 90.7% sand, 9.3% nonplastic fines: PI = NP, LL = NP. Lab Classification: Poorly Graded Sand with Silt (SP-SM).

69.5 to 70.5 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand with Silt (SP-SM) similar to interval 68.0 to 69.5 ft.

70.5 to 71.3 ft. CORED INTERVAL

Poorly Graded Sand with Silt (SP-SM) similar to interval 68.0 to 69.5 ft.

71.3 to 72.1 ft. CORED INTERVAL

Poorly Graded Sand with Silt (SP-SM) similar to interval 68.0 to 69.5 ft.

72.1 to 73.6 ft. SPT SAMPLE

72.1 to 72.8 ft. Silty Sand (SM): Approx. 70% fine, subangular to subrounded sand; Approx 30% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.75 ft. under weight of hammer and rods in the seating and test interval.

72.1 to 72.8 ft. Lab Test Data: 66.5% sand, 33.5% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

72.8 to 73.6 ft. Fat Clay (CH): Approx. 90% fines with high plasticity, medium toughness, very high dry strength; Approx. 10% fine sand. Moist, dark gray, hard consistency, strong cementation. No reaction with HCl.

72.8 to 73.3 ft. Lab Test Data: 87.1% plastic fines, 12.9% sand: PI = 43.8%, LL = 72.4%, SL = 12.1%. Lab Classification: Fat Clay (CH).

73.6 to 74.6 ft. CORED INTERVAL

Recovered 0.5 ft. of Fat Clay (CH) and Silty Sand (SM).

74.6 to 76.1 ft. SPT SAMPLE

Silty Sand (SM): Approx. 85% fine, subangular to subrounded sand; Approx 15% nonplastic fines with rapid dilatancy, no toughness, medium dry strength. Wet, brown, very soft to soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.65 ft. under weight of hammer and rods in the seating and test interval.

74.6 to 75.6 ft. Lab Test Data: 87.5% sand, 12.5% nonplastic fines: PI = NP, LL = NP. Lab Classification: Silty Sand (SM).

76.1 to 77.1 ft. CORED INTERVAL

No Recovery. Fine sand slough coming into hole. Could not get to bottom to perform SPT.

77.1 to 78.1 ft. CORED INTERVAL

No Recovery. Fine sand slough coming into hole. Could not get to bottom to perform SPT.

78.1 to 79.1 ft. CORED INTERVAL

No Recovery. Fine sand slough coming into hole. Could not get to bottom to perform SPT.

79.1 to 80.1 ft. CORED INTERVAL

No Recovery. Fine sand slough coming into hole. Could not get to bottom to perform SPT.

COMMENTS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SL = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-1

SHEET 6 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 870' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791086.3 E. 2366235.3

GROUND ELEVATION: 7089.6'

BEGUN: 1/25/07 FINISHED: 1/28/07

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

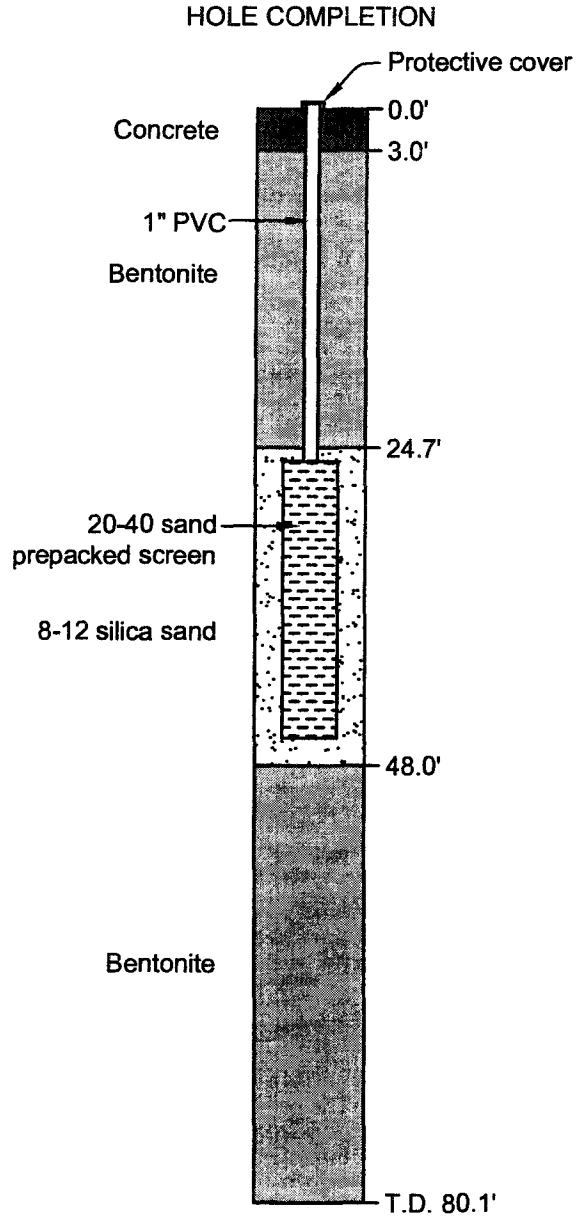
TOTAL DEPTH: 80.1'

LOGGED BY: M. MILLER

AND DATE MEASURED: 25.7' (7063.9') 1/28/07

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION



COMMENTS:

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 1 OF 6

FEATURE: RED LAKE DAM
 LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT
 BEGUN: 12/6/06 FINISHED: 12/14/06
 DEPTH AND ELEV OF WATER LEVEL
 END DATE MEASURED: 22.7' (7067.1) 12/12/06

PROJECT: DVA FIELD INVESTIGATION
 COORDINATES: N. 1791102.1 E. 2365929.4
 US STATE PLANE, NM_W (WGS 84)
 TOTAL DEPTH: 91.0'
 DEPTH TO BEDROCK: NOT ENCOUNTERED

STATE: ARIZONA
 GROUND ELEVATION: 7089.8'
 ANGLE FROM HORIZONTAL: 90'
 LOGGED BY: M. MILLER
 BUREAU OF RECLAMATION

NOTES	DEPTH	% CORE RECOVERY	STANDARD PENETRATION TEST				DEPTH	VISUAL CLASSIFICATION	ELEVATION	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION		
			# OF BLOWS	% MOISTURE*	BLOWS PER FOOT								
					140 LB. HAMMER - 30 IN. DROP								
				10	20	30	40						
<p>PURPOSE OF HOLE: Perform continuous sampling and standard penetration tests (SPTs) in the dam embankment and foundation to determine gradations and physical properties and to evaluate those materials for susceptibility to liquefaction and seepage. Install a slotted pipe piezometer to measure water levels.</p> <p>DRILL SITE & SET-UP: Drilled on the dam crest roadway, approx. 570 ft. east of the right abutment, approx. 3 ft. from the upstream edge of the dam, and about 4.6 ft. left of cone penetrometer test hole CPT06-11.</p> <p>DRILL EQUIPMENT: Gus Pech Brat 22R truck-mounted rotary drill rig; 7-1/4 in. O.D. hollow stem augers with 4-1/4 in. I.D.; 5-ft.-long, 2-1/4 in. O.D. drill rods; 4 in. O.D. Laskey Continuous Soil Sampler; 1.8-ft.-long, 2-1/4 in. O.D. SPT Sampler.</p> <p>DRILLER: Zolman (driller), Chip Todhunter and Patrick Root (helpers) from Provo Area Office, Upper Colorado Region, U.S. Bureau of Reclamation.</p> <p>DRILL FLUID: Drilling fluid not used. When the hole was at 36.0 ft., water from the lake was added to the hole before performing SPTs.</p> <p>DRILLING METHODS: Drilled from 0.0 to 91.0 ft. using 7-1/4 in. O.D. hollow stem augers.</p> <p>DRILLING CONDITIONS & DRILLER'S COMMENTS: Core slipped out of barrel after cleanout interval 29.0 to 31.5 and 32.5 to 35.0 ft. Added a basket modified with duct tape to the barrel to retain cored material. At SPT interval 36.0 to 37.5 ft., began adding water to stabilize the bore hole. During the cleanout of interval 48.5 to 49.5 ft., the augers drilled too fast and went 0.5 ft. beyond the intended depth. While pulling up from cleanout interval 60.0 to 62.5 ft., the core barrel stuck in the rods and the augers and rods had to be pulled together and the core barrel extracted manually; the combination of fine sand and the strapping tape used to hold the split-tube barrel together had locked the barrel in the rods. Drilled to 63.5 ft. with pilot bit to clean out hole.</p>	0	100								<p>Material descriptions are based on visual classification of SPT split-tube samples taken at 1.5-foot intervals and 1-foot cored (cleanout) intervals unless noted as Lab Test Data.</p> <p>0.0 to 1.0 ft. CORED INTERVAL 0.0 to 0.2 ft. Poorly Graded Gravel with Sand (GP)s; Road base 0.2 to 1.0 ft. Lean Clay: Similar to interval 1.0 to 2.5 ft. (below).</p> <p>1.0 to 2.5 ft. SPT SAMPLE Lean Clay (CL): Approx. 90 % fines with medium plasticity, medium to high toughness, high dry strength; Approx. 10 % fine, rounded sand. Moist, brown, hard consistency, strong cementation, homogenous. Strong reaction with HCl.</p> <p>2.5 to 3.5 ft. CORED INTERVAL Lean Clay (CL): Similar to interval 1.0 to 2.5 ft.</p> <p>3.5 to 5.0 ft. SPT SAMPLE Clayey Sand (SC): Approx. 55 % fine, eubangular sand; Approx. 45 % fines with low plasticity, medium toughness, high dry strength; Trace of fine gravel. Dry to moist, brown, soft consistency, weak cementation, homogenous. Strong reaction with HCl. Sampler sank 0.1 ft. under weight of hammer and rods in the seating interval.</p> <p>4.0 to 5.0 ft. Lab Test Data: 56.0 % sand, 39.0 % plastic fines, 5.0 % gravel; PI = 12.8%, LL = 26.3%, MC = 6.0%. Lab Classification: Clayey Sand (SC).</p> <p>5.0 to 6.0 ft. CORED INTERVAL Clayey Sand (SC): Similar to interval 3.5 to 5.0 ft.</p> <p>5.0 to 6.0 ft. Pinhole Test Results: Sample No. 71H-2; 52.4 % sand, 36.6% fines, 11.0% gravel. LL = 27, PI = 11, Pinhole Rating = ND3, Crumb Rating = 1.</p> <p>6.0 to 7.5 ft. SPT SAMPLE Lean Clay (CL): Approx. 90 % fine with medium plasticity, medium toughness, high dry strength; Approx. 10 % fine sand. Moist, brown, firm consistency, strong cementation, contains thin (less than 1/4 inch thick), discontinuous pockets and streaks of calcium carbonate. Strong reaction with HCl.</p> <p>7.5 to 8.5 ft. CORED INTERVAL Sandy Lean Clay s(CL): Approx. 60 % fines with medium plasticity, medium toughness, high dry strength; Approx. 30 % fine sand, Trace of fin gravel. Moist, brown, firm consistency, strong cementation. Strong reaction with HCl.</p> <p>7.5 to 8.5 ft. Pinhole Test Results: Sample No. 71H-3; 69.1 % fines, 35.9% sand, 5.0% gravel. LL = 35, PI = 19, Pinhole Rating = ND3, Crumb Rating = 1.</p> <p>8.5 to 10.0 ft. SPT SAMPLE Lean Clay/ Clayey Sand (CL/SC): Approx. 50 % fines with low to medium plasticity, medium toughness, high dry strength; Approx. 50 % fine to medium, subangular to subrounded sand. Dry, brown, hard consistency, moderate cementation, homogenous. Strong reaction with HCl.</p> <p>10.0 to 11.0 ft. CORED INTERVAL Lean Clay (CL): Similar to interval 6.0 to 7.5 ft.</p>			
	5	100	25	8.9				CL					
	5	67	30	5.5				SC					
	5	100						CL					
	5	100	34	12.7				CL					
	5	100						CL/SC					
	5	100	41	8.3				CL					
	5	100						(CL)s					
	5	100	32	12.1				CL					
	5	100						(CL)s					
	5	100	25	16.4				CL					
	5	100						SM					
	5	100	25	10.9				(CL)s					
	5	100						(CL)s					
	5	100	21	18.1				s(CL)					
	5	100						s(CL)					
	5	100	24	16.3				SM					
	5	100						SP-SM*					
	5	100	13	21.2				SP*					
	5	100						SM/WSC					
	5	73	14	21.6				SM					
	5	100						s(ML)					
	5	100	27	20.3				CL					
	5	0						SM*					
	5	30						SM*					
5	30						SM*						
5	67	9	23.7				SM*						
5	0						SM*						
5	70						SM*						
5	80	14	20.0				SM*						
5	90						SM*						
5	80	17	20.8				SM*						
5	0						SM*						
5	73	13	23.5				SM*						
5	70						SM*						
5	67	18	23.7				SM*						
5	0						SM*						
5	67	19	23.8				SM*						
5	47						SM*						

REMARKS:
 All measurements are from ground surface unless otherwise noted.
 % MOISTURE - Moisture content was measured in material taken from the sampler shoe and may differ slightly from samples sent for gradation analysis.
 SP*, SM* or SP-SM* - Includes small zones of no recovery.

ABBREVIATIONS	
LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 2 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 179°102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06

FINISHED: 12/14/06

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL:

TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

AND DATE MEASURED: 22.7' (7067.1) 12/12/06

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

NOTES	DEPTH	% CORE RECOVERY	STANDARD PENETRATION TEST				DEPTH	VISUAL CLASSIFICATION	ELEVATION	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION																									
			# OF BLOWS	% MOISTURE	BLOWS PER FOOT																															
					140 LB. HAMMER - 30 IN. DROP																															
				10	20	30	40																													
<p>DEPTH TO WATER DURING DRILLING:</p> <table border="1"> <tr> <th>Date</th> <th>Depth to Water (ft.)</th> <th>Hour</th> </tr> <tr> <td>12/7</td> <td>23.1</td> <td>30.5</td> </tr> <tr> <td>12/8</td> <td>15.7</td> <td>48.5</td> </tr> <tr> <td>12/9</td> <td>21.0</td> <td>62.5</td> </tr> <tr> <td>12/10</td> <td>19.0</td> <td>77.0</td> </tr> <tr> <td>12/12</td> <td>22.7</td> <td>91.0</td> </tr> </table> <p>SAMPLE DATA: Samples collected at 1.5 ft. intervals with a 1 ft. minimum cleanout interval between samples. Samples were transported to the Farmington Field Office for storage and selected samples were sent to the lab for testing.</p> <p>HOLE COMPLETION: Backfilled hole from 91.0 to 51.0 ft. with 3/8 in. dia. coated bentonite pellets. Placed a transitional layer of sand from 51.0 to 50.0 ft. installed 3-1/4 in. O.D. pre-formed 20-40 sand packed screen from 50.0 to 28.7 ft., and backfilled around screen with 8-12 silica sand to 29.7 ft. Zone of influence 51.0 to 29.7 ft. Backfilled from 29.7 to 3.0 ft. with bentonite chips and placed cement from 3.0 ft. to the top of the dam. Embedded a protective cover in concrete over the 1-1/4 in. PVC (PVC has a 0.4 ft. stickup). Mounded gravel around the cover and placed large rocks to protect from dam crest road traffic.</p> <p>REASON FOR HOLE TERMINATION: Drilled 1.0 ft. beyond predetermined depth.</p> <p>ESTIMATED DRILLING TIME:</p> <table border="1"> <tr> <th></th> <th>No. of Hours</th> </tr> <tr> <td>Set-Up</td> <td>2</td> </tr> <tr> <td>Drilling</td> <td>30</td> </tr> <tr> <td>Hole Completion</td> <td>16</td> </tr> </table>	Date	Depth to Water (ft.)	Hour	12/7	23.1	30.5	12/8	15.7	48.5	12/9	21.0	62.5	12/10	19.0	77.0	12/12	22.7	91.0		No. of Hours	Set-Up	2	Drilling	30	Hole Completion	16	100	18	34.3							11.0 to 12.5 ft. SPT SAMPLE Lean Clay with Sand (CL): Approx. 80% fines with low to medium plasticity, medium toughness, high dry strength; Approx. 20% fine sand. Dry, brown, firm to hard consistency, strong cementation, contains thin (less than 1/4 inch thick) discontinuous pockets and streaks of calcium carbonate. Strong reaction with HCl. Lab Test Data: 77.8% plastic fines, 22.2% sand; PI = 16.7%, LL = 32.5%, MC = 11.6%. Lab Classification: Lean Clay with Sand (CL)s.
	Date	Depth to Water (ft.)	Hour																																	
	12/7	23.1	30.5																																	
	12/8	15.7	48.5																																	
	12/9	21.0	62.5																																	
	12/10	19.0	77.0																																	
	12/12	22.7	91.0																																	
		No. of Hours																																		
	Set-Up	2																																		
	Drilling	30																																		
	Hole Completion	16																																		
		100																																		
		100	20	53.1																																
		100																																		
		55	87	22	44.7																															
		70																																		
		100	10	27.3																																
		60	60																																	
		100	0	22.1							12.5 to 13.5 ft. CORED INTERVAL Lean Clay with Sand (CL): Similar to interval 11.0 to 12.5 ft. with a trace of gravel (max. size 1 inch). 12.5 to 13.5 ft. Pinhole Test Results: Sample No. 71H-4; 72.4% fines, 25.0% sand, 2.6% gravel. LL = 36, PI = 18, Pinhole Rating = D1, Crumb Rating = 2.																									
		100																																		
	100	NS																																		
	100	28	26.7																																	
	65	10																																		
	87	28	21.4																																	
	20																																			
	0																																			
	70	100	9	23.6																																
	0			51.3																																
	0			33.2																																
	100	18	50.9																																	
	100			34.9																																
	75	100	31	24.7																																
	40																																			
	100	49	21.4																																	
	0																																			
	80	40	2	20.8																																
	0																																			
	100	29	43.2																																	
	80																																			
	85	100	11	26.6																																
	0																																			
	100	18	33.8																																	
	100																																			
	90	100	30	28.3																																
	91																																			

BOTTOM OF HOLE

COMMENTS:

All measurements are from ground surface unless otherwise noted.
% MOISTURE* - Moisture content was measured in material taken from the sampler shoe and may differ slightly from samples sent for gradation analysis.
SP*, SM* or SP-SM* - Includes small zones of no recovery.

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SL = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 3 OF 6

FEATURE: RED LAKE DAM
 LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT
 BEGUN: 12/6/06 FINISHED: 12/14/06
 DEPTH AND ELEV OF WATER LEVEL
 DATE MEASURED: 22.7' (7067.1') 12/12/06

PROJECT: DVA FIELD INVESTIGATION
 COORDINATES: N. 1791102.1 E. 2365929.4
 US STATE PLANE, NM_W (WGS 84)
 TOTAL DEPTH: 91.0'
 DEPTH TO BEDROCK: NOT ENCOUNTERED

STATE: ARIZONA
 GROUND ELEVATION: 7089.8'
 ANGLE FROM HORIZONTAL: 90°
 LOGGED BY: M. MILLER
 BUREAU OF RECLAMATION

**CLASSIFICATION AND
 PHYSICAL CONDITION
 (continued)**

**CLASSIFICATION AND
 PHYSICAL CONDITION
 (continued)**

21.0 to 22.5 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 60% fines with medium plasticity, medium toughness, high dry strength; Approx. 40% fine sand; Trace of fine, subangular, hard gravel. Moist, brown, firm to hard consistency, strong cementation, contains thin (less than 1/4 inch thick), discontinuous pockets of calcium carbonate and fine sand and silt; thin dark gray striations are inclined parallel to the core barrel. Strong reaction with HCl. Sample slipped 0.15 ft. beyond the shoe during extraction.

Lab Test Data: 56.0% plastic fines, 42.1% sand; PI = 17.1%, LL = 31.1%, MC = 15.1%. Lab Classification: Sandy Lean Clay s(CL).

22.5 to 23.5 ft. CORED INTERVAL

Sandy Lean Clay s(CL): Similar to interval 21.0 to 22.5 ft.

22.5-23.5 ft. Pinhole Test Results: Sample No. 71H-6; 68.2% fines, 31.2% sand, 0.6% gravel. LL = 36, PI = 20, Pinhole Rating = D1, Crumb Rating = 3.

23.5 to 25.0 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 60% fines with medium plasticity, no toughness, high dry strength; Approx. 40% fine to coarse sand; Trace of fine, subangular, hard gravel. Moist, brown, soft to firm consistency, weak to moderate cementation, contains small (less than 1/4 inch diameter) white dots of calcium carbonate. Strong reaction with HCl. Sampler sank 0.3 ft. under weight of hammer and rods in the seating interval.

25.0 to 26.5 ft. CORED INTERVAL

Sandy Lean Clay s(CL): Approx. 70% fines with medium plasticity, no toughness, high dry strength; Approx. 30% fine to coarse sand; Trace of fine, subangular, hard gravel. Moist, brown, soft consistency, weak cementation, contains small (less than 1/4 inch diameter) white dots of calcium carbonate. Strong reaction with HCl. A 1-inch-long rootlet was present at 25.9 ft.

26.5 to 28.0 ft. SPT SAMPLE

Sandy Lean Clay s(CL): Approx. 70% fines with medium plasticity, no to medium toughness, high to very high dry strength; Approx. 30% predominantly fine to coarse, rounded to subrounded sand. Moist, brown, soft to firm consistency, weak cementation. Strong reaction with HCl. Sampler sank 0.1 ft. under weight of hammer and rods in the seating interval. Material sticks to split-tube sampler.

Lab Test Data: 59.5% plastic fines, 35.4% sand; PI = 15.8%, LL = 31.8%, MC = 18.4%. Lab Classification: Sandy Lean Clay s(CL).

28.0 to 29.0 ft. CORED INTERVAL

28.0 to 28.6 ft. Sandy Lean Clay s(CL): Similar to interval 26.5 to 28.0 ft.
 28.6 to 29.0 ft. Silty Sand (SM): Approx. 70% fine sand; 30% nonplastic fines.

29.0 to 30.5 ft. SPT SAMPLE

Poorly Graded Sand with Silt (SP-SM): Approx. 90% fine to medium, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, medium dry strength. Moist, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data: 86.8% sand, 13.2% nonplastic fines; PI = NP, LL = NP, MC = 20.6%. Lab Classification: Silty Sand (SM).

30.5 to 31.5 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand with Silt (SM-SP).

31.5 to 32.5 ft. CORED INTERVAL

Poorly Graded Sand with Silt (SP-SM): Similar to interval 29.0 to 30.5 ft.

32.5 to 34.0 ft. SPT SAMPLE

Poorly Graded Sand with Silt (SP-SM): Approx. 90% fine, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, medium dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.3 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 88.8% sand, 11.2% nonplastic fines; PI = NP, LL = NP, MC = 21.0%. Lab Classification: Poorly Graded Sand with Silt (SP-SM).

34.0 to 35.0 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand (SP).

35.0 to 36.0 ft. CORED INTERVAL

Poorly Graded Sand (SP): Approx. 95% fine sand; Approx 5% nonplastic fines.

36.0 to 37.5 ft. SPT SAMPLE

Silty Clayey Sand (SM/SC): Approx. 60% predominantly fine to medium, subangular to subrounded sand; 40% fines with no to low plasticity, slow dilatancy, no toughness and medium dry strength. Wet, brown, soft consistency, no to weak cementation. Weak to strong reaction with HCl when dry. Sampler sank 0.05 ft. under weight of hammer and rods in the seating interval.

37.5 to 38.5 ft. CORED INTERVAL

Silty Sand (SM): Approx. 70% fine sand; 30% nonplastic fines.

38.5 to 40.0 ft. SPT SAMPLE

38.5 to 39.5 ft. Sandy Silt s(ML): Approx. 45% fine, subangular to subrounded sand; 55% nonplastic fines with slow dilatancy, no toughness and medium dry strength. Moist to wet, brown, soft consistency, weak cementation. Strong reaction with HCl when dry.

Lab Test Data: 53.2% nonplastic fines, 46.8% sand; PI = NP, LL = NP, MC = 21.5%. Lab Classification: Sandy Silt s(ML).

39.5 to 40.0 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high dry strength; Approx. 5% fine sand. Moist, brown, firm to hard consistency, strong cementation. Weak reaction with HCl. Sampler sank 0.1 ft. under weight of hammer and rods in the seating interval.

40.0 to 41.0 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM).

41.0 to 42.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% predominantly fine to medium, subangular to subrounded sand; 20% nonplastic fines with rapid dilatancy, no toughness and low to medium dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.08 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 80.6% sand, 19.4% nonplastic fines; PI = NP, LL = NP, MC = 21.8%. Lab Classification: Silty Sand (SM).

42.5 to 43.5 ft. CORED INTERVAL

Silty Sand (SM): Similar to interval 41.0 to 42.5 ft.

43.5 to 45.0 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, low to medium dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data: 78.0% sand, 22.0% nonplastic fines; PI = NP, LL = NP, MC = 21.7%. Lab Classification: Silty Sand (SM).

REMARKS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SL = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 4 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06 FINISHED: 12/14/06

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL

TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

AND DATE MEASURED: 22.7 (7067.1) 12/12/06

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

**CLASSIFICATION AND
PHYSICAL CONDITION
(continued)**

45.0 to 47.0 ft. CORED INTERVAL

No Recovery; assumed to be Silty Sand (SM).

47.0 to 48.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 90% fine, subangular to subrounded sand; Approx 10% nonplastic fines with rapid dilatancy, no toughness, low dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data: 78.0% sand, 22.0% nonplastic fines: PI = NP, LL = NP, MC = 21.3%.
Lab Classification: Silty Sand (SM).

48.5 to 50.0 ft. CORED INTERVAL

48.5 to 49.9 ft. Poorly Graded Sand (SP): Approx. 95% fine sand; Approx 5% nonplastic fines.

49.9 to 50.0 ft. Silty Sand (SM): Approx. 80% fine sand; 20% nonplastic fines.

50.0 to 51.5 ft. SPT SAMPLE

50.0 to 50.4 ft. Poorly Graded Sand (SP): Approx. 95% fine sand; Approx 5% nonplastic fines.

50.4 to 51.5 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high to very high dry strength; Approx. 5% fine sand. Moist, dark grayish brown, firm to hard consistency, strong cementation. No reaction with HCl. Sampler sank 0.2 ft. under weight of hammer and rods in the seating interval.

51.5 to 52.5 ft. CORED INTERVAL

Lean Clay (CL): Similar to interval 50.4 to 51.5 ft. Clay swelled to 2 times the cored length in the core barrel.

52.5 to 54.0 ft. SPT SAMPLE

Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, high to very high dry strength; Approx. 5% fine sand. Moist, dark grayish brown, slight organic odor, firm consistency, strong cementation. No reaction with HCl. A piece of shiny charcoal 1/2 in. diameter in size was found at 53.8 ft. Sampler sank 0.46 ft. under weight of hammer and rods in the seating interval.

Lab Test Date: No gradation tests ran. PI = 46.7%, LL = 83.0%, SL = 9.1%, MC = 47.0%. Lab Classification: Fat Clay (CH).

54.0 to 55.0 ft. CORED INTERVAL

Lean Clay (CL): Similar to interval 52.5 to 54.0 ft.

55.0 to 56.5 ft. SPT SAMPLE

Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength; Trace of fine sand. Moist, dark gray, slight organic odor, firm consistency, strong cementation. No reaction with HCl. Sampler sank 0.33 ft. under weight of hammer and rods in the seating interval.

56.5 to 57.5 ft. CORED INTERVAL

56.5 to 57.2 ft. Lean Clay (CL): Similar to interval 55.0 to 56.5 ft.
57.2 to 57.5 ft. Poorly Graded Sand (SP): Similar to interval 57.5 to 59.0 ft. (below).

57.5 to 59.0 ft. SPT SAMPLE

Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Weak to strong reaction with HCl when dry.

Lab Test Data: 69.2% sand, 30.8% nonplastic fines: PI = NP, LL = NP, MC = 22.6%.
Lab Classification: Silty Sand (SM).

COMMENTS:

59.0 to 60.0 ft. CORED INTERVAL

59.0 to 59.2 ft. No Recovery; assumed to be Silty Sand (SM).
59.2 to 59.6 ft. Silty Sand (SM): Similar to interval 57.5 to 59.0 ft.
59.6 to 59.8 ft. Lean Clay (CL): Similar to interval 55.0 to 56.5 ft.
59.8 to 60.0 ft. No Recovery; assumed to be Silty Sand (SM).

60.0 to 61.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 1.7 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 81.5% sand, 18.5% nonplastic fines: PI = NP, LL = NP, MC = 22.3%.
Lab Classification: Silty Sand (SM).

61.5 to 62.5 ft. CORED INTERVAL

Lean Clay (CL): Similar to interval 55.0 to 56.5 ft.

62.5 to 63.5 ft. DRILLED

Drilled with pilot bit; no ability to sample.

63.5 to 65.0 ft. SPT SAMPLE

Poorly Graded Sand (SP): Approx. 95% fine, subangular to subrounded sand; Approx 5% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.45 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 93.3% sand, 6.7% nonplastic fines: PI = NP, LL = NP, MC = 19.9%.
Lab Classification: Poorly Graded Sand with Silt (SP-SM).

65.0 to 66.0 ft. CORED INTERVAL

Recovered 0.1 ft. of loose, Silty Sand with Gravel (SM)g:

66.0 to 67.5 ft. SPT SAMPLE

Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, very soft to soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Date (66.5 to 67.5 ft.): 77.1% sand, 22.9% nonplastic fines: PI = NP, LL = NP, MC = 21.1%. Lab Classification: Silty Sand (SM).

67.5 to 68.5 ft. CORED INTERVAL

Recovered 0.2 ft. of Poorly Graded Sand (SP): Similar to interval 63.5 to 65.0 ft.

68.5 to 69.5 ft. CORED INTERVAL

No Recovery; assumed to be Poorly Graded Sand (SP).

69.5 to 71.0 ft. SPT SAMPLE

69.5 to 70.2 ft. Poorly Graded Sand (SP): Approx. 95% fine, subangular to subrounded sand; Approx 5% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry.

Lab Test Data 69.5 to 70.2 ft.): 87.4% sand, 12.6% nonplastic fines: PI = NP, LL = NP, MC = 22.8%. Lab Classification: Silty Sand (SM).

70.2 to 70.6 ft. Lean Clay (CL): Approx. 95% fines with medium to high plasticity, medium toughness, very high dry strength; Approx. 5% fine sand. Moist, dark gray, firm consistency, strong cementation. Strong reaction with HCl when dry.

70.6 to 70.7 ft. Silty Sand (SM): Approx. 90% fine sand; Approx. 10% nonplastic fines. Other characteristics similar to interval 69.5 to 70.2 ft.

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 5 OF 6

FEATURE: RED LAKE DAM
 LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT
 BEGUN: 12/6/06 FINISHED: 12/14/06
 DEPTH AND ELEV. OF WATER LEVEL
 DATE MEASURED: 22.7 (7067.1) 12/12/06

PROJECT: DVA FIELD INVESTIGATION
 COORDINATES: N. 1791102.1 E. 2365929.4
 US STATE PLANE, NM_W (WGS 84)
 TOTAL DEPTH: 91.0'
 DEPTH TO BEDROCK: NOT ENCOUNTERED

STATE: ARIZONA
 CORNER ELEVATION: 7089.8'
 ANGLE FROM HORIZONTAL: 90°
 LOGGED BY: M. MILLER
 BUREAU OF RECLAMATION

**CLASSIFICATION AND
 PHYSICAL CONDITION
 (continued)**

**CLASSIFICATION AND
 PHYSICAL CONDITION
 (continued)**

70.7 to 71.0 ft. Lean Clay (CL): Similar to interval 70.2 to 70.6 ft.
 Sampler sank 0.5 ft. under weight of hammer and rods in the seating interval.

81.0 to 82.0 ft. CORED INTERVAL
 No Recovery; assumed to be Silty Sand (SM).

71.0 to 72.0 ft. CORED INTERVAL
 No Recovery; assumed to be Poorly Graded Sand (SP).

82.0 to 83.5 ft. SPT SAMPLE
 82.0 to 82.3 ft. Silty Sand (SM): Similar to interval 79.5 to 81.0 ft.
 82.3 to 83.5 ft. Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength. Moist, dark gray with black streaks, firm to hard consistency, strong cementation. No to weak reaction with HCl.

72.0 to 73.5 ft. SPT SAMPLE
 72.0 to 72.3 ft. Poorly Graded Sand (SP): Similar to interval 69.5 to 70.2 ft.
 73.2 to 72.4 ft. Silty Sand (SM): Similar to interval 72.5 to 72.9 ft. (below).
 72.4 to 72.5 ft. Lean Clay (CL): Similar to interval 72.9 to 73.5 ft. (below).
 72.5 to 72.9 ft. Sandy Silt s(ML): Approx 70% nonplastic fines with no dilatancy, no toughness, high dry strength; Approx. 30% fine, subangular to subrounded sand. Moist, brown, soft to firm consistency, weak cementation. Strong reaction with HCl when dry.

Lab Test Data: No gradation tests ran: PI = 48.8%, LL = 82.3%, SL = 10.7%, MC = 41.6%. Lab Classification: Fat Clay (CH).

Lab Test Data: 63.3% nonplastic fines, 36.7% sand: PI = NP, LL = NP, MC = 22.9%. Lab Classification: Sandy Silt s(ML).

83.5 to 84.5 ft. CORED INTERVAL
 Lean Clay (CL): Similar to interval 82.3 to 83.5 ft.

72.9 to 73.5 ft. Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, high to very high dry strength; Trace of fine sand. Moist, brown, firm consistency, strong cementation. No reaction with HCl.

84.5 to 86.0 ft. SPT SAMPLE
 84.5 to 84.8 ft. Lean Clay (CL): Similar to interval 82.3 to 83.5 ft.
 84.8 to 86.0 ft. Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 1.15 ft. under weight of hammer and rods in the seating interval.

Sampler sank 0.5 ft. under weight of hammer and rods in the seating interval.

Lab Test Data (84.8 to 86.0 ft.): 74.2% sand, 25.8% nonplastic fines: PI = NP, LL = NP, MC = 23.1%. Lab Classification: Silty Sand (SM).

73.5 to 74.5 ft. CORED INTERVAL
 Lean Clay (CL): Similar to interval 72.9 to 73.5 ft. except material is dark brown from 73.5 to 74.1 ft. and dark gray from 74.1 to 74.5 ft.

86.0 to 87.0 ft. CORED INTERVAL
 No Recovery; assumed to be Silty Sand (SM).

74.5 to 76.0 ft. SPT SAMPLE
 74.5 to 74.9 ft. Silty Sand (SM): Approx. 80% fine, subangular to subrounded sand; Approx 20% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, firm consistency, no cementation. Strong reaction with HCl when dry.
 74.9 to 75.2 ft. Lean Clay (CL): Similar to interval 70.2 to 70.6 ft.
 75.2 to 76.0 ft. Silty Sand (SM): Similar to interval 74.5 to 74.9 ft.

87.0 to 88.5 ft. SPT SAMPLE
 87.0 to 87.5 ft. Silty Sand (SM): Similar to interval 84.8 to 86.0 ft. except material is dark gray from 87.0 to 87.5 ft. and brown from 87.3 to 87.5 ft.
 87.5 to 87.7 ft. Sandy Lean Clay s(CL): Approx. 70% plastic fines and 30% fine sand.
 87.7 to 88.5 ft. Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength. Moist, brown, firm consistency, strong cementation. Weak reaction with HCl. Sampler sank 0.05 ft. under weight of hammer and rods in the seating interval.

Lab Test Data (75.2 to 76.0 ft.): 74.7% sand, 25.3% nonplastic fines: PI = NP, LL = NP, MC = 20.4%. Lab Classification: Silty Sand (SM).

76.0 to 77.0 ft. CORED INTERVAL
 Recovered 0.4 ft. of Silty Sand (SM): Similar to interval 72.5 to 72.9 ft.

88.5 to 89.5 ft. CORED INTERVAL
 Lean Clay (CL): Similar to interval 87.7 to 88.5 ft.

77.0 to 78.5 ft. SPT SAMPLE
 Silty Sand (SM): Approx. 85% fine, subangular to subrounded sand; Approx 15% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler sank 0.05 ft. under weight of hammer and rods in the seating interval.

89.5 to 91.0 ft. SPT SAMPLE
 Lean Clay (CL): Approx. 100% fines with medium to high plasticity, medium toughness, very high dry strength. Moist, reddish brown, firm to hard consistency, strong cementation. Weak to strong reaction with HCl. Sampler sank 0.6 ft. under weight of hammer and rods in the seating interval.

Lab Test Data: 85.4% sand, 14.6% nonplastic fines: PI = NP, LL = NP, MC = 21.0%. Lab Classification: Silty Sand (SM).

78.5 to 79.5 ft. CORED INTERVAL
 No Recovery.

79.5 to 81.0 ft. SPT SAMPLE
 Silty Sand (SM): Approx. 75% fine, subangular to subrounded sand; Approx 25% nonplastic fines with rapid dilatancy, no toughness, high dry strength. Moist to wet, brown, soft consistency, no cementation. Strong reaction with HCl when dry. Sampler was driven 0.9 ft. (80.0 to 80.9 ft.) with 1 blow.

Lab Test Data: 73.1% sand, 26.9% nonplastic fines: PI = NP, LL = NP, MC = 20.8%. Lab Classification: Silty Sand (SM).

COMMENTS:

ABBREVIATIONS

LL = Liquid Limit	NS = Not sampled
MC = Moisture Content	PI = Plasticity Index
NP = Nonplastic	SI = Shrinkage Limit
NR = No Recovery	

GEOLOGIC LOG OF DRILL HOLE NO. BH-2

SHEET 6 OF 6

FEATURE: RED LAKE DAM

PROJECT: DVA FIELD INVESTIGATION

STATE: ARIZONA

LOCATION: CREST OF DAM, 570' EAST OF RIGHT ABUTMENT

COORDINATES: N. 1791102.1 E. 2365929.4

GROUND ELEVATION: 7089.8'

BEGUN: 12/6/06

FINISHED: 12/14/06

US STATE PLANE, NM_W (WGS 84)

ANGLE FROM HORIZONTAL: 90°

DEPTH AND ELEV OF WATER LEVEL:

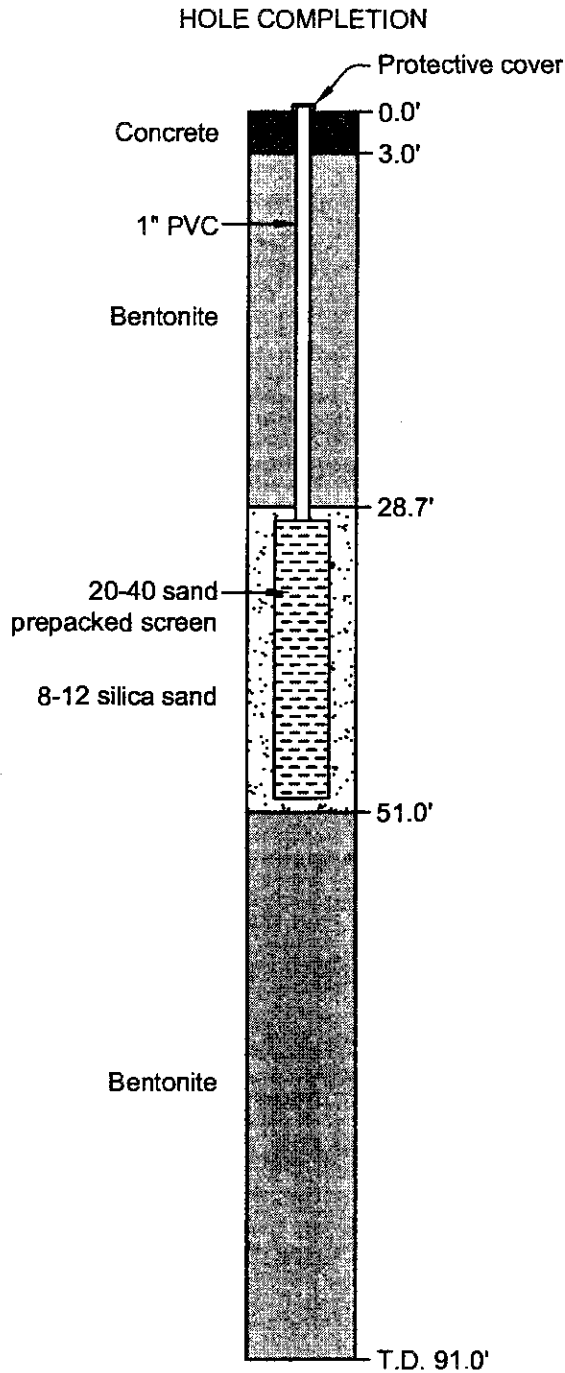
TOTAL DEPTH: 91.0'

LOGGED BY: M. MILLER

AND DATE MEASURED: 22.7' (7067.1') 12/12/06

DEPTH TO BEDROCK: NOT ENCOUNTERED

BUREAU OF RECLAMATION



COMMENTS: