URS

CONSTRUCTION REPORT
INTERIM DAM SAFETY IMPROVEMENTS
WHITE TANKS FRS NO. 3
MARICOPA COUNTY, ARIZONA

URS Job No. 23441928.00900
September 26, 2002

URS

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Registered Professional Engineer (Civil)
CERTIFICATE NO.
30016
RAVI
MURTHY
Date Signed 9/26/02
ARIZONA, U.S.A.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22867
ALEXANDER W.
GOURLAY
Date Signed 9-26-02
ARIZONA, U. S. A.

URS

September 26, 2002

Mr. Tom Renckly, P.E.
Flood Control District of Maricopa County
2801 West Durango Avenue
Phoenix, Arizona 85009

Re: Construction Report
Interim Dam Safety Improvements
White Tanks FRS No. 3
Maricopa County, Arizona.
URS Project No. E1-00001852.00

Dear Mr. Renckly:

URS Corporation (URS) is pleased to submit our final construction report for the referenced project. One copy each of the as-built drawings prepared by the Contractor and the Construction Materials Testing Report prepared by Alpha Geotechnical & Materials Inc. (Alpha) are attached.

Mr. Duke Yager of the Flood Control District of Maricopa County (District) served as the full-time Construction Manager for the project. The District retained Alpha to provide material testing services during construction. As the engineer-of-record during the design phase of the project, URS remained involved during construction by participating in partnering sessions, reviewing submittals from the contractor, visiting the site periodically to inspect key elements and stages of construction, reviewing test results submitted by Alpha, and serving as a technical liaison between the District, the Contractor, and the Arizona Department of Water Resources (ADWR).

Based on our involvement during the construction phase of the project as noted above, it is our opinion that the project was constructed in accordance with design intent and the construction documents prepared by URS. Should you have questions or require additional information please contact Ravi Murthy, P.E. of URS at (602) 648 2441.

Sincerely

URS Corporation

Ravi Murthy, P.E.
Project Manager

Registered Professional Engineer (Civil) CERTIFICATE NO. 30016 RAVI MURTHY Date Signed 9/26/02 ARIZONA, U.S.A.

Alexander W. Gourlay, P.E.
Principal, Engineer-of-Record

Registered Professional Engineer (Civil) CERTIFICATE NO. 22367 ALEXANDER W. GOURLAY Date Signed 9-26-02 ARIZONA, U.S.A.

URS Corporation
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1.0 INTRODUCTION

URS Corporation (URS) has prepared this Construction Report (Report) for the White Tanks FRS No. 3 Interim Dam Safety project (Project). The purpose of this report is to document activities during the construction phase of the project, including modifications made to the original design, summary of the materials testing results during construction, and photographic documentation of selected phases of the construction. This report and the accompanying certification is required as part of the approval process with the Arizona Department of Water Resources (ADWR).

The following individuals/entities played key roles during the construction phase of the project:

- ***Flood Control District of Maricopa County (District):*** The District owns and operates the White Tanks FRS No. 3. Mr. Duke Yager was the District's Construction Manager. Mr. Tom Renckly, P.E. is the Manager for the District's Dam Safety Program.

- ***URS Corporation:*** The District retained URS to design the interim safety modifications for the dam. Mr. Alexander W. Gourlay, P.E. is the Engineer of Record. Mr. Ravi Murthy, P.E. was URS' Project Manager, and Mr. Kevin Somerville served as the site representative and visited the site periodically during construction.

- ***Buesing Inc.:*** Buesing was selected by the District to perform the construction of the dam modifications. Mr. Richard Candelaria was Buesing's Project Manager and Mr. Jim Richards served as the Construction Superintendent.

- ***Arizona Department of Water Resources:*** ADWR oversees and regulates the safety and construction of non-federal dams in Arizona. Mr. Brett Howey was ADWR's primary representative during the construction phase. Messrs. Michael Greenslade, P.E. and Jon Benoist, P.E. provided regulatory oversight and support.

- ***Natural Resource Conservation Service (NRCS):*** The NRCS (then Soil Conservation Service – SCS) constructed the dam in the mid-1950s. Although the NRCS played no official part in the Project, Mr. Noller Herbert, P.E., the State Conservation Engineer participated in review and provided comments and input during the project.

- ***Alpha Geotechnical & Materials, Inc.*** (Alpha): The District retained Alpha to provide construction materials testing services for the project.

2.0 PROJECT DESCRIPTION

White Tanks FRS No. 3 is a homogenous earth dam located in west Maricopa County, Arizona. The dam was constructed by the SCS in the mid 1950s. The dam is currently owned, operated, and maintained by the District. The embankment is approximately 7,700 feet long and was constructed using material borrowed from the reservoir. The maximum height of the embankment is about 30 feet. The crest width varies between 10 and 11 feet. The upstream and downstream faces are sloped at approximately 2.5:1 and 2:1 (horizontal to vertical), respectively. Three gated, corrugated metal pipes (CMPs) through the embankment serve as the principal outlets from the reservoir. Two of the outlets are 48 inches in diameter while the third outlet is 24 inches in diameter. The emergency spillway for the facility is cut into natural ground at the right abutment of the dam. The design spillway crest elevation is approximately 1,210 feet.

Safety deficiencies identified by ADWR include:

- Inadequate freeboard
- Outlets require trash racks
- Outlets require diaphragm filters
- Develop operational plan
- Ensure safety of the embankment against erosion through transverse cracks
- Verify adequate filter protection between Sta 57+00 and Sta 59+00

As a result of these deficiencies, ADWR has classified White Tanks FRS No. 3 as "unsafe, non-emergency".

2.1 PURPOSE

The District retained URS (then Dames & Moore) to design and implement selected dam safety modifications at White Tanks FRS No. 3. The overall objective of the project was to increase the confidence of ADWR and the District in the integrity of the embankment and viable operation of the outlet works during an impoundment event, and to implement freeboard and erosion-related improvements in the vicinity of the emergency spillway.

2.2 KEY PROJECT ELEMENTS

The Project included the following key elements:

- ***Diaphragm Filters:*** Conventional, graded sand diaphragm filters were designed and installed around the three CMPs through the embankment. These diaphragm filters were

designed in accordance with Chapter 26 of the National Engineering Handbook published by the NRCS. The filter extends three times the pipe diameter on both sides and above the pipe, and extends one and a half times the diameter below the pipe. The filter is protected with a soil buttress that also provides resistance to blowout of the filter under hydraulic head. A granular drain was installed to convey water from the filter to the downstream toe of the buttress. The capacity of this granular drain is augmented with geotextile-encased slotted HDPE pipes.

- ***Outlet Pipe Extension:*** The existing CMPs were extended in order to accommodate the new sand filter and soil buttress. The existing concrete headwalls were demolished prior to extending the CMPs. The CMP extensions are galvanized, polymer-coated CMP connected to the original pipe with galvanized band couplings and neoprene gaskets. New headwalls have been constructed at the downstream toe of each buttress.

- ***Trash Racks***: The original design by the NCRS included trash racks to protect the inlets to the CMPs. However, it appears that these trash racks were never installed. New trash racks were designed and installed as part of the current Project.

- ***Right Abutment Erosion Protection***: The right abutment of the dam was armored with riprap to provide erosion protection in the event of discharge from the emergency spillway. The riprap was designed for a maximum particle size of 12 inches, D50 of 6 inches, and a minimum particle size of 2 inches.

- ***Emergency Spillway Modifications***: A 75-foot wide channel or "notch" was excavated long the centerline of the existing emergency spillway. The channel has 5:1 (horizontal to vertical) slopes and a bed slope of 0.5 percent. The channel invert elevation was set at 1207.0 feet. The design intent of the notch is to increase the dry free board under the IDF (1/2-PMF) as required by ADWR.

2.3 CONSTRUCTION DOCUMENTS

URS prepared the following construction documents for this project:

- ***Design Drawings***: A total of 18 drawings were prepared for this project. These drawings reflected the completion of engineering and each for each element of the project.

- ***Construction Specifications***: The construction specifications for this project included the Special Provisions and the Supplementary General Conditions. The Special Provisions provided technical instructions and guidance for the contractor. To a large extent, the

Supplementary General Conditions form a standalone document that is relatively project-independent but does contain some references to the Special Provisions.

- **Construction Quality Assurance (CQA) Plan**: The CQA Plan was a standalone document that served as a guide for materials testing, construction inspection, and construction oversight by the District.

3.0 CONSTRUCTION PHASE

3.1 URS RESPONSIBILITIES

As the Engineer-of-Record for the project, URS continued to remain very involved during the construction phase of the project. URS' key responsibilities during the construction phase included:

- Participate in pre-bid meetings to provide information and clarification during the bidding process.
- Respond to the Requests for Information from the Contractor and the District.
- Review contractor submittals prior to installation of materials.
- Review materials testing results by Alpha
- Visit the site periodically to inspect and document construction/installation of key components of the project.
- Participate in project progress and partnering sessions.
- Serve as the technical liaison between the District and ADWR.

3.2 COMMUNICATION AND DOCUMENTATION

As the Engineer-of-Record, URS provided input during construction through close communication with the project team. All major discussions and issues such as submittal reviews, design modifications, and design clarifications were documented in a series of Design Memoranda. Copies of all Design Memoranda for the construction phase of the project are included in Appendix A and summarized in Table 1. Selected photographs taken during construction are included in Appendix B.

3.3 DESIGN MODIFICATIONS DURING CONSTRUCTION

Several modifications were made to the original design configuration and specification during the construction phase of the project. These modifications were made to accommodate specific conditions encountered during construction, or in response to requests from the contractor and/or the District. In each case, the technical merit of the proposed modification was reviewed in light of the original design intent and potential impact to the dam. If no adverse impacts were identified in either to the (above) two cases, then URS presented the proposed modification to the District and ADWR for review, comment, and (if acceptable) for approval. Each proposed design modification was documented in a Design Memorandum. Copies of As-Built drawings are included in Appendix C.

Key design modifications implemented during the construction phase as briefly discussed below. The Design Memorandum Number and submittal date are also included.

- ***2Spillway Notch Location (Design Memo No. 3, December 7, 2001):*** During the initial stages of the project, the contractor's surveyor identified a discrepancy in the survey data used to develop the original design configurations, and the survey data generated during the current project. As a result of this discrepancy, the spillway notch was shifted by approximately 0.3 feet towards the dam embankment. The proposed modification was relatively insignificant and did not adversely impact the design intent of the project, and was therefore approved.

- ***4Second Coupling at South CMP (Design Memo No. 6, January 03, 2002):*** Excavation for the diaphragm filter at the southern CMP outlet exposed an older coupling along the CMP. Due to the condition of the coupling (rusting and lack of gasket), URS recommended replacement of the old coupling with a new neoprene gasket and coupling band. The upgraded coupling was then encased in concrete. The treatment proposed for this coupling was the same used for CMP couplings included in the current design. Therefore, the proposed treatment of the coupling was approved.

- ***8Length of Slotted HDPE Pipe at Central Outlet (Design Memo No. 20, July 25, 2002):*** After construction of the diaphragm filter and soil buttress at the central outlet was completed, it was brought to URS' attention that the slotted HDPE pipes within the drain did not extend the 8 feet into the filter sand as originally designed. Subsequent field measurements by the District and the contractor indicated that the HDPE pipes were 40 feet in length. Based on this measured length, it is estimated that the pipes extend 6 feet into the filter sand. Using relatively conservative simplifying assumptions, URS

estimated a drain capacity of approximately 3.2 cfs, and a maximum inflow of approximately 2.76 cfs. Since the available capacity was larger than the estimated inflow, the as-built condition of the HDPE pipes at the central outlet was accepted without modification.

- ***5Compaction Moisture Content for Subgrade and Buttress Fill (Design Memo No. 8, January 7, 2002):*** In response to a request from the Contractor, the compaction moisture content for the subgrade at each outlet was changed from "optimum to 3% above optimum", to "1% below to 2% above optimum". URS evaluated this change and found that the revised specification did not adversely affect the design intent of the project, and was not expected to have an adverse impact on the long-term performance of the diaphragm filter and buttress. Therefore, the proposed modification was adopted.

- ***1Test Method for Filter Sand Density (Design Memo No. 2, December 5, 2001):*** Alpha expressed concern about the time required to perform the in-situ density test per ASTM D4914 (test pit method) as was originally specified in the construction documents, and requested that this test method be replaced with ASTM D1556 (sand cone method). On January 18, 2002, the contractor performed comparative tests (test pit method versus sand cone) at three locations. The test results using the sand cone and test pit methods varied by less than 1 %. Therefore, the requested change in test method was approved.

- ***6Drain Sand Gradation Specification (Design Memo No. 15, January 24, 2002):*** The Contractor was unable to procure drain sand that met the project gradation specification, and instead submitted gradation data for an alternate sand. URS compared this proposed gradation with the design band developed for a match with the filter sand. The gradation curve for this proposed drain sand was within or finer than the design band. Furthermore, the proposed drain sand also met the filter match (retention) criteria when compared to the geotextile. Therefore, the alternate sand was approved for construction of the drains.

- ***7Gradation Specification for Buttress Fill (Design Memo No. 16, January 25, 2002):*** The gradation limits specified in the construction documents for the buttress fill was based on three soil samples collected from the emergency spillway during the design phase of the project. During excavation of the notch, it was apparent that the original three samples were not sufficiently representative and that the soils being excavated were finer grained than anticipated. Once these soils were stockpiled, the Contractor/District collected ten composite samples for sieve analyses. URS reviewed the results of these tests and confirmed that the stockpiled soils met the filter match requirements for the

filter sand as well as the geotextile, and that the design intent was not compromised. Therefore, the specified gradation band for the buttress fill soils was modified to include the stockpiled soils.

- *3Conflict with Existing Outlet Drains (Design Memo No. 5, December 31, 2001):* During construction, it was apparent that the excavation of the embankment required to accommodate the diaphragm filters would intersect four existing finger or outlet drains associated with the center filter system. URS reviewed this condition and concluded that the drains in conflict could be abandoned in place because there was significant redundancy in outlet capacity provided by adjacent outlet drains. Furthermore, the transverse crack mitigation provided by the outlets would not be compromised. Therefore, URS recommended that the outlet drains intersected by the excavation be covered with a geotextile (separation fabric) and be abandoned in place.

3.4 CONSTRUCTION MATERIALS TESTING

The District retained Alpha to perform materials testing during the course of the construction project. Technician(s) from Alpha were present on site for a significant portion of the construction. Results from the field and laboratory tests by Alpha are included in a separate report, and are not repeated herein. In addition, selected construction materials (geotextile, for example) were not specifically tested for this project. Instead, the manufacturer's product specification was reviewed for compliance with the project specifications.

In general, the following points are noted with respect to the construction materials testing task of the project:

- The testing frequency for the project was provided in the Construction Quality Assurance Plan prepared as part of the construction documents. Mr. Yager of the District was responsible for scheduling the testing required, and was also had primary responsibility for review of test results to assure compliance with the project specifications.

- The results from the gradation tests from the subgrades at each diaphragm filter location were provided directly to URS for verification of satisfactory filter match criteria. Placement of the filter sand commenced only after the results were reviewed and approved by URS.

- Index properties (gradation and plasticity index) of the buttress fill, filter sand, and drain sand were provided by Alpha, and pre-approved by URS prior to placement of the

materials. In addition, these materials were also sampled and tested for compliance during actual placement.

- The filter sand and drain sand easily met the minimum project relative density requirements. In fact, the field crews were advised on occasion to avoid overcompaction of these granular materials.

- The subgrade soils at all three locations met the project requirements for filter match, plasticity, moisture content, and compaction. In one instance, the subgrade soils had to be reworked in order to bring the moisture content to within project specifications.

- The buttress fill soils typically met project requirements for gradation, plasticity, moisture content, and compaction. In one instance, about three lifts of buttress fill were placed with inadequate compaction. Based on a review of the data and field procedures, it was concluded that the under-compaction was due to an incorrect moisture density relationship. The under-compacted fill was removed and re-placed at the required relative compaction.

4.0 CLOSURE

As discussed in Section 2.1 of this report, the overall objective of this project was to design and construct mitigation measures that would improve the safety of the dam relative to operation of the outlet works. Specifically, the District's goal was to decrease the likelihood of failure due to erosion and piping along the perimeter of the existing CMP outlets, to improve the erosion resistance of the right abutment of the dam, and to increase dry freeboard. The following comments are offered relative to these specific issues:

1. The diaphragm filters have been designed and installed in accordance with current dam engineering and ADWR regulatory practice and requirements. Therefore, it is our opinion that if needed, these modifications can be incorporated into a future dam rehabilitation alternative for the facility.

2. The placement of riprap at the right abutment of the dam has improved the erosion resistance of the abutment. In principle, this modification can (if needed) be incorporated into a future dam rehabilitation alternative for the facility. However, if spillway discharges were to change significantly as a result of the dam rehabilitation, then the design of the riprap should be reviewed for continued validity.

3. Installation of trash racks at the upstream ends of the CMP outlets reduces the likelihood that the outlets will be blocked by debris resulting in reduced flows.

4. Construction of the notch or secondary spillway has increased the dry freeboard for the dam in its existing configuration. The applicability of this modification to a dam rehabilitation alternative will have to be assessed in the future.

Based on the above items, it is believed that the interim dam safety measures that have been implemented during this project have improved the overall safety of the dam. However, there are other items of concern identified by ADWR and others that need to be addressed in the future.

TABLES

TABLE 1
SUMMARY OF DESIGN MEMORANDA AND EMAILS

Document Date	Document Name	Key Issues Discussed	Design Modification	Comments
27-Nov-01	Design Memo No. 1	Clarified that construction Benchmark to be used is SM-A7at Sta 70+07 with an elevation of 1214.786 ft.	None	
5-Dec-01	Design Memo No. 2	Responds to Contractor's request for digital files of drawings.	None	
		Provides clarification on the survey discrepancy identified by the Contractor.	None	
		Responds to Contractor's request for information on alignment of riprap. Suggests that centerline and extents of the riprap be identified be "field fitted".	None	
		Responds to Alpha's request for change in testing procedure from ASTM D4564 to ASTM D4914. URS requested additional information for the substitution.	None	
7-Dec-01	Design Memo No. 3	Responds to a discrepancy in the centerline survey information at the emergency spillway. The change resulted in the notch moving approximately 0.3 feet closer to the right abutment of the dam.	Yes	The modification to the original design was insignificant and does not adversely impact the design intent of the project or the performance of the existing dam embankment.
21-Dec-01	Design Memo No. 4	Review of submittals for filter sand, drain sand, riprap, #57 rock and geotextile fabric. Filter sand approved. Drain sand and #57 rock rejected. Inadequate information on riprap and geotextile.	None	
31-Dec-01	Design Memo No. 5	Addresses a field condition where four finger drains associated with the center filter system were in conflict with the diaphragm filters. Recommends that the outlet drains be covered with a non-woven geotextile for separation from the buttress fill, and abandoning the outlet drains in place.	Yes	The proposed modification does not have a significant impact on the performance of the embankment because the existing center filter system has sufficient redundancy. Furthermore, abandoning the drains as proposed does not adversely impact the transverse crack mitigation provided by the center filter system.
3-Jan-02	Design Memo No. 6	Addresses a second coupling along the southern CMP outlet. Recommends that the second coupling be replaced with the metal band and gasket as used with the new couplings included in this project. Also recommends concrete encasement for the new joint.	Yes	The proposed treatment is consistent with the treatment for new CMP couplings included in this project. Therefore, the proposed modification does not violate the design intent.
5-Jan-02	Design Memo No. 7	Review Contractor's submittal for filter sand gradation, retention criterion for geotextile and subgrade, filter match between filter sand and subgrade.	None	
7-Jan-02	Design Memo No. 8	In response to Contractor's request, URS evaluated compacted moisture content for subgrade and buttress fill. URS recommended compaction moisture content range to one percent below OMC to three percent above OMC for subgrade soils, and two percent below to one percent above OMC for buttress fill.	Yes	The proposed modification does not have a significant impact on the performance of the embankment.
9-Jan-02	Design Memo No. 9	Review Contractor's submittal for slotted HDPE pipe. HDPE pipe rejected due to inadequate opening size. Geotextile sock data not included.	None	
9-Jan-02	Design Memo No. 10	Review Contractor's submittal for concrete mix design.	None	
12-Jan-02	Design Memo No. 11	Review Contractor's submittal for subgrade soils at the North outlet. Verified filter match between subgrade soils and filter sand, and subgrade soils and geotextile.	None	
16-Jan-02	Design Memo No. 12 Revised	Reviewed results of subgrade compaction at the south outlet. Dry density met specifications but the moisture content did not meet specifications. Requested clarifications for moisture-density curves.	None	
17-Jan-02	Design Memo No. 13	Reviewed and approved results of minimum-maximum density test results for filter sand.	None	
20-Jan-02	Design Memo No. 14	Reviewed and approved results of compaction tests of subgrade at the north and south outlets, and the relative density of two lifts of filter sand at the south outlet. Also reviewed Contractor's request to replace test method ASTM D4914 with ASTM D1556. The change in test methods was recommended.	Yes	Contractor performed a field test to compare results on the same lift of filter sand using both test methods. The comparison was favorable and the change in project specifications was approved.

TABLE 1 (Continued)

Document Date	Document Name	Key Issues Discussed	Design Modification	Comments
24-Jan-02	Design Memo No. 15	Reviewed and approved Contractor's submittal for gradation of drain sand.	Yes	Contractor was unable to obtain the drain sand that met the project specifications. URS evaluated the gradations of commercially available drain sand provided by the contractor. The available drain sand was within the design band or finer, and was compatible (filter match) with the geotextile. Therefore, the drain sand was approved for use.
25-Jan-02	Design Memo No. 16	Addresses prequalification test results on the buttress fill stockpile. Stockpiled buttress fill approved. Modification of the project specification for gradation of the buttress fill is recommended.	Yes	The proposed gradation specification for the buttress fill meet the filter match requirements with the filter sand and the geotextile. Therefore, revision of the gradation specification was consistent with the design intent.
11-Feb-02	Email	Provides guidance on treatment of abandoned finger drains. See Design Memo No. 5 for additional Details.	Yes	See Design Memo. No. 5
26-Feb-02	Design Memo No. 17	Discusses approach/protocol to address an existing joint in the CMP at the central outlet that might be exposed during excavation for the diaphragm filter.	None	Not relevant because the joint was not exposed during excavation.
4-Mar-02	Email	Reviewed and approved second stockpile of buttress fill soils.	None	
10-Mar-02	Design Memo No. 18	Reviewed and approved relevant filter matches for the subgrade at the central outlet.	None	
20-Mar-02	Design Memo No. 19	Expansion of the Spillway Notch in order to generate additional buttress fill soils.	Yes	Additional buttress fill was needed. The proposed expansion of the spillway notch did not conflict with the design intent. Therefore the proposed change to the notch dimensions was implemented.
25-Jul-02	Design Memo No. 20	Reviewed and approved as-built condition for slotted HDPE pipes at central outlet.	Yes	Contractor installed shorter pipe that shown on design drawings. URS reviewed the as-built condition, estimated the capacity of the drain with the existing HDPE pipes in place, and concluded that the drain had adequate capacity.

APPENDIX A

DESIGN MEMORANDA AND EMAILS

URS

Memo

To: Tom Renckly, PE
FCDMC

From: Todd Ringsmuth, PE / Kevin Somerville E.I.T.

CC:

Date: 11/27/01

Re: Survey Clarifications

The Construction Project Benchmark to be used for the Interim Dam Safety Project is SM-A7 (station 70+07) at elevation 1214.786 feet.

The drawings submitted to ADWR and approved for construction included a note on sheet 2 of 18 indicating that FCDMC would provide a construction project benchmark for the contractor to use for construction layout and staking. Based on recent conversations, URS concurs with FCDMC with the use of subsidence reference monument A7 located on the crest at the southern end (station 70+07) of the dam embankment as the project benchmark. The details for this benchmark are as follows:

Reference Only	ID:	SM-A7
	Description:	Subsidence Monument (SM)
	Type:	USDOA Brass Cap in Concrete Stamped A-7 8-90
	Northing:	919484.657
	Easting:	528113.264
	Elevation:	1217.042 (feet)
	Date Last Surveyed:	August 2001
	Surveyed By:	MCDOT / FCDMC
	Vertical Datum:	NAVD 88
	Horizontal Datum:	NAD 83
For Construction	ID:	SM-A7 (A-Team Point # 1194)
	Description:	Subsidence Monument (SM)
	Type:	USDOA Brass Cap in Concrete Stamped A-7 8-90
	Northing:	919484.657
	Easting:	528113.264
	Elevation:	1214.786 (feet)
	Date Last Surveyed:	December 1999
	Surveyed By:	A-Team / URS
	Vertical Datum:	NAVD 29
	Horizontal Datum:	NAD 83

The vertical difference between elevation readings (29 datum vs. 88 datum) is 2.256 feet.

The design drawings also reference benchmark SCS BM 8-90, which was used as the vertical control at the site. This benchmark had an elevation recorded by A-Team of 1284.361(VD29), and an elevation recorded by MDOT of 1286.445 (VD88). The difference between these two survey readings is 2.084 feet.

Given the design drawings are based on the survey information obtained in 1999 by A-Team (using the 1929 vertical datum) and the baseline topographic mapping (Cooper Aerial, 1989) provided by the FCDMC, the corresponding elevation that is to be used for the proposed project benchmark A-7 is 1214.786 feet.

Unfortunately, none of the previous work conducted by URS/A-Team or three firms (Z&H Engineering, Gilbertson Associates, and Cooper Aerial) hired by FCD, referenced the vertical datum. However, a 1929 vertical datum has been assumed.

It is our understanding of the situation that the design (including drawings) has not been adversely affected by the more recent survey conducted by MCDOT using the 1988 vertical datum. It is for this reason we believe that the project benchmark be assigned the 1214.786 (feet) elevation to provide a consistent connection to the approved drawings. However, we recommend that the project control points be established, and layout and staking be conducted by the Contractor for observation and review by the FCDMC and URS prior to earthwork.

If you have any questions regarding the content of this memo please call either Kevin Somerville or myself at your convenience.

URS

Design Memo No. 2

Technical Support During Construction

To: Duke Yager
FCDMC

CC: Tom Renckly
FCDMC

From: Kevin Somerville, E.I.T.

CC:

Date: 12/05/01

Re: Survey Layout Clarifications and Test Methods

This memo is in response to several e-mail and voicemail messages in the past few days. A formal RFI has not been received to date.

1. Provide digital files for design drawings to WRG Design (survey subcontractor).

   At this time, it does not seem beneficial to provide digital files as a manner of clarifying outstanding issues. Particularly on this project, the official drawings are those that carry the ADWR stamp of approval. Having other copies of the drawings without ADWR approval could lead to confusion during the project.

2. Provide any survey information that may clarify a discrepancy discovered in the survey by WRG Design of the outlet extension structure horizontal alignments. The alignments vary from design drawings ranging from 0.2 feet to 1.0 feet (according to verbal descriptions).

   A fax was sent on December 3, 2001 to WRG Design showing the latitude and longitude (and northing and eastings) for the horizontal benchmark that A-Team used. URS subcontracted A-Team in 1999 to provide limited land survey of the outlets (cross section) for use in the design.

   A table, Initial GPS Survey – Final Coordinate List, prepared by FCD/MDOT on October 3, 2001 providing a list of the subsidence monuments across the crest and toe of the dam is attached.

   A table, Summary of Specific Survey Data Points, prepared by URS showing common survey points between the URS/A-Team survey and the FCD/MCDOT survey is attached. Specifically, subsidence monuments A1, A6, and A7 should be of interest.

   URS recommends WRG Design attempt to resolve the discrepancy by reviewing the available data in checking for error or incompatible benchmarks. If the reference information above does not sufficiently resolve the discrepancies of the outlet alignments after review and check with surveys recently conducted by WRG Design, then URS would review the

possibility of revising the horizontal position of the design control points, as needed. However, changing the coordinates of these control points on one or more outlets should be considered a last resort option.

3. Provide clarification for the alignment of the riprap placement along the southern end of the dam embankment for staking purposes.

   As discussed with WRG Design during a recent phone call, picking coordinate points off of the site plan digital file in AutoCad would be inappropriate for the design intent. The cross section A12 indicates dimensions from the "toe of slope" of the dam embankment. Identifying the toe of slope is largely a field fit assessment. Therefore, URS recommends that the staking of the centerline and corresponding extents of riprap be coordinated with both Duke Yager of FCDMC and Kevin Somerville of URS to assist and/or verify the appropriate toe of slope in the field.

4. Substitute ASTM D4564 (Field Density by Sleeve Method) with ASTM D4914 (Field Density with Sand Filled Test Pit) as requested by Alpha Testing (QC subcontractor).

   As part of this design, careful selection of the appropriate QA/QC test procedures was performed by URS and approved by the ADWR. The ASTM D4564 was selected because the standard clearly states its purpose includes and applicability includes granular soils and filters. Furthermore, ASTM D4914 does not state that this method is suitable for filters. In fact, the standard indicates that D4914 is applicable to soils with sufficient cohesion and /or particle interlocking. Therefore, URS requests that ASTM D4564 be used on this project as indicated in the Special Provisions (specs) and CQA Plan. Should concern for the use of this method still be evident, please provide URS with detail and basis for desiring the substitution.

If you have any questions regarding the content of this memo please call me at your convenience.

URS

Design Memo No. 3

Technical Support During Construction

To: Duke Yager
FCDMC

CC: Tom Renckly
FCDMC

From: Kevin Somerville, E.I.T.

CC:

Date: 12/07/01

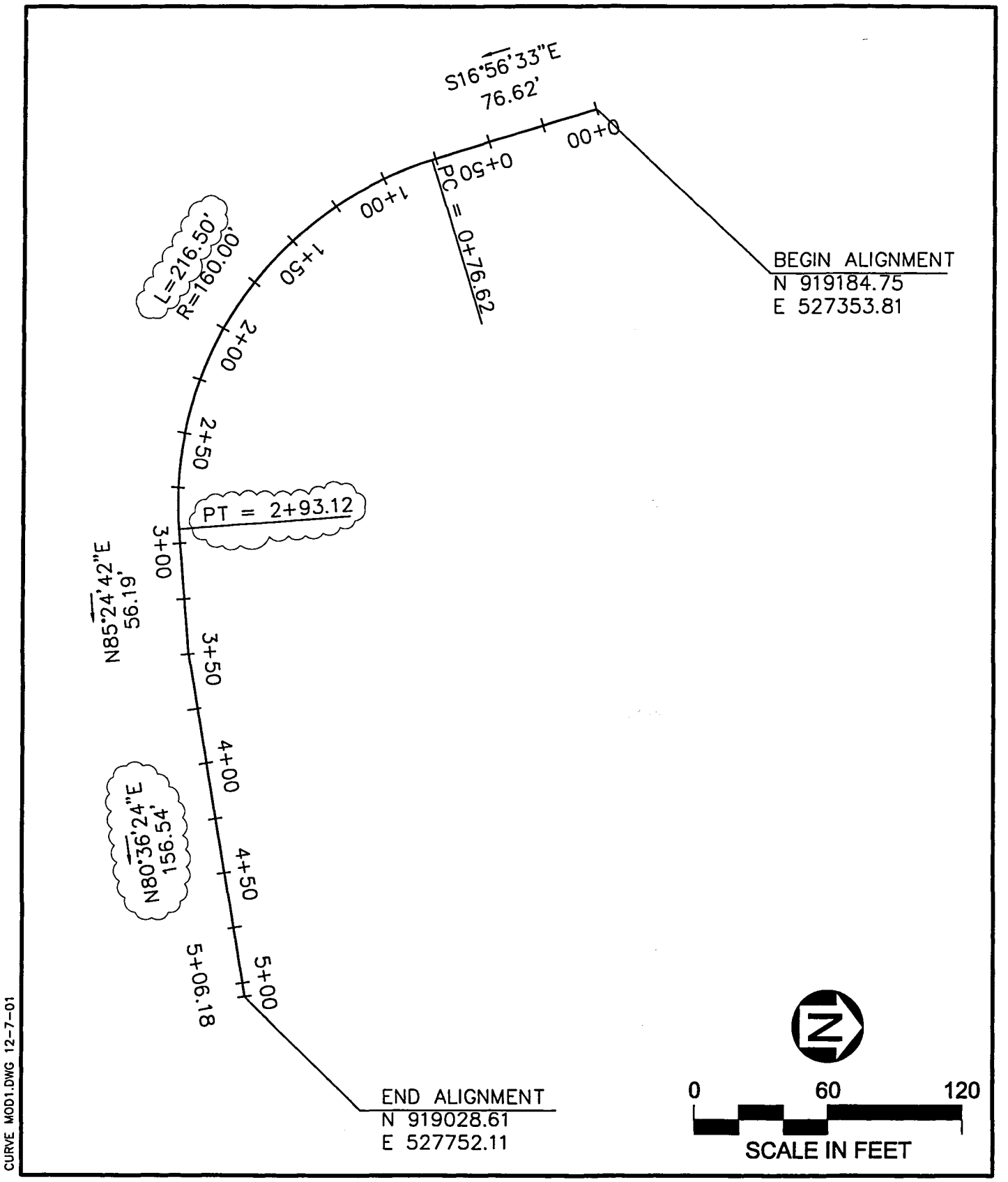
Re: Survey Layout Clarifications

This memo is in response to a recent voicemail message from WRG Design. A formal RFI has not been received to date.

1. Provide WRG Design with clarification of survey coordinates and centerline alignment for the spillway notch. The field survey curve data does not compute for that shown on the design drawings.

   After review of the survey centerline information shown on the drawings, there is a geometric bust in the curve alignment values. URS has recomputed these values and prepared a 8.5 x 11 figure (see attached) showing the changed values highlighted by clouding. The change in centerline curve alignment results in the notch being approximately 0.3 of a foot closer to the dam embankment. URS believes this change in the spillway notch alignment is relatively insignificant and does not adversely effect the design intent or the existing dam embankment.

If you have any questions regarding the content of this memo please call me at your convenience.



Revisions to Spillway Notch Alignment

White Tanks FRS#3
Design Memo No.3
December 7, 2001

URS

E1-15448007.00

URS

Design Memo No. 4

Technical Support During Construction

To: Duke Yager
FCDMC

CC: Tom Renckly
FCDMC

From: Kevin Somerville, E.I.T.

CC:

Date: 9/26/2002

Re: Submittal Review

This memo is prepared to provide URS's review comments on the project submittals from Buesing Corp. in support of the FCDMC formal approval process. In future submittals, we request that the individual data sheets typically should state the project material name and description for which they are proposed (i.e. drain sand). This information would greatly help us in the identification of the intended use of the material and to eliminate confusion.

1. Submittal for Filter Sand dated 12/19/01

   Approved. URS assumes the Concrete Sand shown on the Sunstate testing report is intended for use as the diaphragm filter on the project. This material appears **acceptable** for use as diaphragm filter sand.

   Acceptance of this material should be upon the condition that materials delivered to the site are subject to further testing and approval in accordance with the Technical Provisions (specifications) and CQA Plan.

   As requested in bid addenda, the Buesing is required to supply FCDMC with the opportunity to collect bulk samples from material delivered to the site for additional laboratory analysis.

2. Submittal for Drain Sand dated 12/19/01

   Rejected – Material Does Not Meet Specification. URS assumes the C-33 #8 Concrete Aggregate shown on the Sunstate testing report is intended for use as the drain sand on the project. The specification was written and approved by ADWR with C33 #9 in mind and the #8 does not meet this criteria. In addition, according to the data table provided sieve size No. 50 was not performed. Therefore, this material appears **unacceptable** for use as drain sand on the project. As requested in bid addenda, Buesing is required to supply FCDMC with the opportunity to collect bulk samples from material delivered to the site for additional laboratory analysis.

3. Submittal for Rip-Rap dated 12/19/01

No Decision – No Information To Review. Although the cover sheet indicates a submittal was being transmitted for riprap, the D_{50} = 6 inch riprap material is not included. A separate submittal is requested.

4. Submittal for #57 Rock dated 12/19/01

Rejected – Material Does Not Meet Specification. URS assumes the C-33 #57 rock shown on the Sunstate testing report and the 1-inch rock shown on the Western Technologies Inc. testing report is intended for the upper layer (driving surface) of the road crossing over the riprap zone at the southern abutment. If is our assumption is correct, then this material does not meet the gradation requirements for the 1-inch rock as per specification. Please advise URS if this assumption is incorrect. The re-submittal of data on a different material is requested.

Acknowledging that this material is more of an operational issue than it is dam safety, however, Buesing may choose to resubmit specifically requesting the C-33 #57 aggregate as a substitution to the material specification. Substitution may require approval from ADWR.

If the #57 aggregate is intended for concrete on the project, this submittal should accompany the separate concrete mix design submittal.

5. Submittals for Geotextile Fabric dated 12/19/01

No Decision – Request Additional Information. URS assumes the geotextile fabric data shown on the Amoco letter is intended for the wrap around drain sand **and** the riprap underlayment for the project. The Amoco Style 4553 appears to meet most of the specification criteria, with the exception that the unit weight (oz / sy) and permeability (cm/sec) material data are not included in the table submitted and therefore have not been confirmed. Upon brief review of URS's in-house Amoco Manufacturer catalogues, this information is not readily available.

The geotextile fabric discussed above is **unacceptable** for the drain pipe sock. Therefore, the geotextile sock around the HDPE perforated drain pipes should be a separate submittal that meets that specification.

If you have any questions regarding the content of this memo please call me at your convenience.

URS

Design Memo No. 5

Technical Support During Construction

To: Jon M. Benoist, P.E. – ADWR 417-2423
Brett Howey - ADWR

CC: Tom Renckly, P.E. – FCDMC (602) 506 8561
Duke Yager - FCDMC (602) 506 8561
George H. Beckwith, P.E. – FCDMC (602) 506 8561
Noller P. Herbert, P.E. – NRCS (602) 280 8795

From: Ravi Murthy, P.E.

CC: Kevin R. Somerville – URS, PHX
Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX

Registered Professional Engineer (Civil) CERTIFICATE NO. 30016 RAVI MURTHY Date Signed 12/31/01 ARIZONA, U.S.A.

Date: December 31, 2001

Re: White Tanks FRS #3, Outlet Drains

BACKGROUND

White Tanks FRS #3 is a homogenous earthen embankment dam, constructed by the NRCS (then SCS) in 1954. The embankment is about 7,700 feet in length, and 27 feet in height at its deepest section. Three corrugated metal pipes (CMPs) serve as the principal outlets. Two outlets are 48 inches in diameter while the third CMP is 24 inches in diameter. Historically, the embankment has exhibited moderate to severe transverse cracking.

In 1982, the NRCS implemented a remedial action program to address the transverse cracking. A section of the embankment between Sta 56+10 and 59+90 was breached and re-constructed. In addition, a central chimney drain was installed along the length of the embankment. Finger or outlet drains which daylight just beyond the downstream toe of the embankment were also installed to serve as outlets for the chimney drain.

The depth of the central drain and the location of the finger drains were established (by the NRCS) using the following criteria:

1. The depth of the trench along the embankment centerline would be equal to the depth of the crack plus 3 feet.

2. A finger drain would be installed at each location where an open crack wider than 3/8-inch was noted.

In accordance with ADWR's recommendation, diaphragm filters were designed (by URS) for all three CMP outlets. At the north outlet, two of the previously-constructed finger drains daylight within the footprint of the proposed buttress (not filter or drain). The north outlet is located at Sta 29+00. Based on records from the NRCS, the two finger drains that are impacted by construction of the diaphragm filter at the north outlet are located at Sta 28+82 and 29+16. Additionally, one outlet drain will be impacted at each of the central and south outlets.

PROPOSED SOLUTION

Our preferred solution would be to abandon the four finger drains in place, and construct the buttress currently planned. A non-woven geotextile fabric (approximately 8 feet by 8 feet) should be provided at the drain-buttress fill interface to minimize the risk of migration of the fines from the buttress fill into the coarser drain material. We believe that this approach provides a technically sound and practical approach to the problem at hand, for the following reasons:

1. There appears to be significant redundancy in the number of finger drains provided (68). Assuming a maximum pool elevation of 1210.5 feet, the capacity of the outlet drains (68) is estimated to be approximately 286,960 cubic feet per day. For a driving head of one foot, the outlet capacity (68 drains) is estimated to be approximately 19,000 cubic feet. If four of the sixty-eight drains are abandoned, the reduction in capacity would be approximately 6 percent.

2. Based on a simple seepage assessment through the dam, it is estimated that for the maximum pool elevation of 1210.5 feet (conservative, because does not account for spillway notch), the seepage through the dam (and therefore the seepage reporting to the central drain) would range from 31 to 190 cubic feet per day (Seepage estimate is based on a flow rate of 0.0041 to 0.0247 cubic feet per day per foot of dam). This volume is nearly two orders of magnitude less than the outlet capacity (see Item 1 above) even for a driving hydraulic head of 1-foot acting on the outlet drains. Since the outlet capacity far exceeds the estimated inflow even at a head of 1.0 feet, it is unlikely that the incremental hydraulic head developed within the embankment due to elimination of the four drain outlets would exceed 1 foot.

3. Since the central drain is relatively permeable (k estimated at 300 ft/day), blockage of the four outlets will cause water to flow lateral through the central drain and exit through the adjacent drains that remain operational. In order to confirm this

hypothesis, we performed a simple assessment of seepage and flows in the vicinity of the three CMP outlets. We estimate (conservatively) that the incremental head in the central drain due to blocking of the four drain outlets would range from less than 1.0 feet to 1.5 feet.

4. Since the outlet drains are hydraulically connected to the central drain, the hydrostatic head acting at the downstream end of the outlet drains (block by the buttress construction) would be less than 1.5 feet. Therefore, the thickness of buttress fill required to prevent "blow out" would be approximately 0.75 feet. As per the design configuration, the thickness of the buttress fill at each of the four drain outlets ranges from 8 to 12 feet.

Generally speaking, the *incremental* risk associated with elimination of the four finger drains is quite small for the following reasons:

1. The District anticipates that the dam will be replaced with a basin and/or channel system, or the dam will be rehabilitated to meet current ADWR requirements within the next five years. Considering this design life for the Interim Dam Safety measures, the probability of significant impoundment within the reservoir is quite small.

2. There appears to be considerable redundancy in the existing finger drain system both in terms of number and capacity.

3. The head built up within the embankment due to elimination of the four outlet drains is small (less than 1.5 feet).

ALTERNATE APPROACH

An alternate approach would be to extend the finger drains through the new buttress, and allow the drains to daylight beyond the downstream toe of the buttress. A geotextile filter fabric could be used as separation between the new drain material and the overlying buttress fill. We estimate that the cost to implement this option would be approximately $13,000. At this time, we do not believe that this approach is warranted.

IMPACT TO SCHEDULE

We understand that the contractor proposes to resume construction activities on Wednesday, January 02, 2002. If the District, ADWR, and URS concur that the Proposed Solution is preferred and acceptable over the Alternate Approach, then the impact to the construction schedule is expected to be negligible to none. On the other hand, if detailed calculations and/or drawings are to be prepared in support of the

Alternate Approach (or the Proposed Solution, for that matter), then there might be some delay in the construction schedule.

Please review and call to discuss at your convenience.

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS#3

PROJECT NO. 15448-007-058

SHEET 1 OF 20

Impact on Finger Drain Outlets
TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME)
SIGNATURE — DATE 12/31/01

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY FOR JIM C. SCOTT (PRINT NAME)
(for Jim C. Scott) (SIGNATURE) — DATE 12/31/01

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME)
Kevin R. Somerville (SIGNATURE) — DATE 12-31-01

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME)
SIGNATURE — DATE 12/31/01

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
PAGE NO. 2 OF ___ BY RM

* FLOW THROUGH OUTLET DRAIN

- According to Design Report and drawings by SCS, drain size = 4'x4' with 2'x2' coarse drain and outer layer of Drainfill

- Total area = 4'x4' = 16 sq ft
- Area of Coarse drain material = 2'x2' = 4'
- Area of Drainfill = 12 ft²

- Use weighted average for K

$$K = \frac{4 \times 2400 + 12 \times 300}{4+12} = 825 \text{ ft/day}$$

~~K = 800 ft/day~~

- $Q = KiA = K\frac{H}{L} \times A$

- H = difference in elevation from max. reservoir to exit elevation of outlet drain

- For a head equal to the maximum reservoir elevation (1210.5'), the combined capacity of all 68 drains would be approximately 286,960 cubic feet per day.

- The capacity lost due to abandoning four drains is estimated at approximately 18,000 cubic feet per day.

- The four abandoned drains correspond to a reduction of approximately 6% of the outlet capacity.

- See Spread Sheet #1

* SEEPAGE THROUGH DAM (Assume homogenous embankment)

Reference: Groundwater & Seepage - Milton E. Harr 1990

- from Pg 50, Eq^n 2,

$$q = k\left(\frac{h_1^2 - h_2^2}{2L}\right)$$

q = Seepage per unit width
k = permeability = 7.2×10^{-3} ft/day (estimated, see this calc)
h_1 = driving head. Conservatively assume h_1 = difference between maximum pool elevation (1210.5) and downstream toe (assumed to be elevation of downstream end of each outlet).
h_2 = depth of (tail)water = 0
L = distance from edge of pool to downstream toe. ~~Assume L = Length of outlet drain~~.
L = [Crest Elev - d/s drain elev] x 2.0 + 10 (Crest width)

- Discharge per foot of dam per day varies from 0.0041 cubic feet to 0.0247 cubic feet (See Spreadsheet 2)

- Discharge per day for the entire dam ranges from 31 cubic feet to 190 cubic feet.

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
PAGE NO. ~~B~~ 4 OF ____ BY RN

* HEAD BUILD UP DUE TO REMOVAL OF 4 OUTLETS

* Consider the dam as a complete unit

- If the embankment is considered to be a homogenous section, the total seepage through the dam is estimated to be 190 cubic feet per day (maximum).

- From spreadsheet 3, for a driving head of 1 foot, the total available capacity from the operational outlet drains (i.e. accounting for 4 that would be abandoned) is approx. 17,916.8 cubic feet per day.

- Since the available outlet capacity is nearly two orders of magnitude higher than the anticipated seepage volume, the head buildup within the central drain, ~~and~~ and downstream from the central drain is expected ~~be~~ to be less than one-foot.

* Consider the North Outlet @ 29+00.

- The two outlets that are to be blocked are at 28+82 and 29+16. The two nearest operational outlets will be at 27+64 and 30+20.

- Consider the length of embankment between 27+64 and 30+20, a total length of 256 feet.

- Seepage per day: $0.0247 \times 256 = 6.3\ ft^3/day$

- Conservatively, assume that all seepage within this section reports at the midpoint of the section, and splits equally along the central drain

- The total length of travel for the water before it exits the dam is equal to the length of drain plus half the section length.

- Conservatively, drain length = 55'

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
PAGE NO. 5 OF ___ BY RM

- Length of travel $= \frac{256}{2} + 55 = 183'$

- Assume the width of ~~travel~~ center drain is 3' and depth of flow $= 1'$.

- $Q = kiA$

- Conservatively, assume entire travel path has $k = 300$ ft/day

$$Q = k \cdot \frac{h}{L} A$$

$$h = \frac{QL}{kA}$$

$$= \frac{3.2 \times 183}{300 \times (3 \times 1)} = \underline{0.65'}$$

- Conservatively, the ~~increase~~ head caused by blocking outlets at 28+82 and 29+16 is <u>less than 1 foot</u>.

- Since the head required after the two outlets are blocked is < 1.0 foot, ⇒ Incremental head due to blocking outlets @ 28+82 & 29+16 & also < 1.0 ft.

- See Sheets 16 thru 19 for similar assessment of central & South CMPs.

* DRAIN FILL MATERIAL

- According to a letter from Dan Lawerence of ADWR dated November 25, 1981, allowable gradation of drain fill:

	%
3 in	100
3/4 in	52-100
#4	31-57
#8	23-46
#60	0-18
#200	0-6.5

- From Fig #1, $D_{10} = 0.15$ mm to 0.4 mm
- From EM1110-2-1901 (30 Sept 1986) "Seepage Analysis & Control for Dams, Dept of Army, Corps of Engineers, Pg 2-20

$$K = 100 D_{10}^2 \text{ (cms/sec)}$$

$$K = 100 \times \frac{0.15}{10}^2 \text{ to } 100 \times \frac{0.4}{10}^2$$

~~K = 2.25 to 16 cms/sec~~

$$K = 0.0225 \text{ to } 0.16 \text{ cms/sec}$$

$$K = 64.8 \text{ ft/day to } 460.8 \text{ ft/day}$$

$$\underline{K = 300 \text{ ft/day}}$$

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
PAGE NO. 87 OF ____ BY RM

* COARSE DRAIN MATERIAL

- According to SCS Design Report dated 5/11/1981, Coarse Aggregate for outlet is C-33 No 2.
- From Fig 1, D_{10} = 30mm to 40mm
- From EM1110-2-1901 (30 Sept 1986) "Seepage Analysis & Control for Dams, Dept of Army, Corps of Engineers, Pg 2-21

$$K = 100 D_{10}^2 \text{ (cms/sec)}$$

$$K = 100 \times \left(\frac{30}{10}\right)^2 \text{ to } 100 \times \left(\frac{40}{100}\right)^2$$

$$K = 900 \text{ to } 1600 \text{ cms/sec} \Rightarrow \underline{1200 \text{ cms/sec}}$$

$$\Rightarrow \underline{2400 \text{ ft/day}}$$

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
PAGE NO. 8 OF ____ BY RM

* BUTTRESS FILL PERMEABILITY

- Buttress fill will be obtained from the spillway notch excavation
- Three samples from spillway yielded fines contents ranging from 5% to 17%. Conservatively, assume 8% fines
- From NAVFAC DM 7.01, assuming fines are a silt,

$$K = 5 \times 10^{-6}\ ft/min \Rightarrow \underline{7.2 \times 10^{-3}\ ft/day}$$

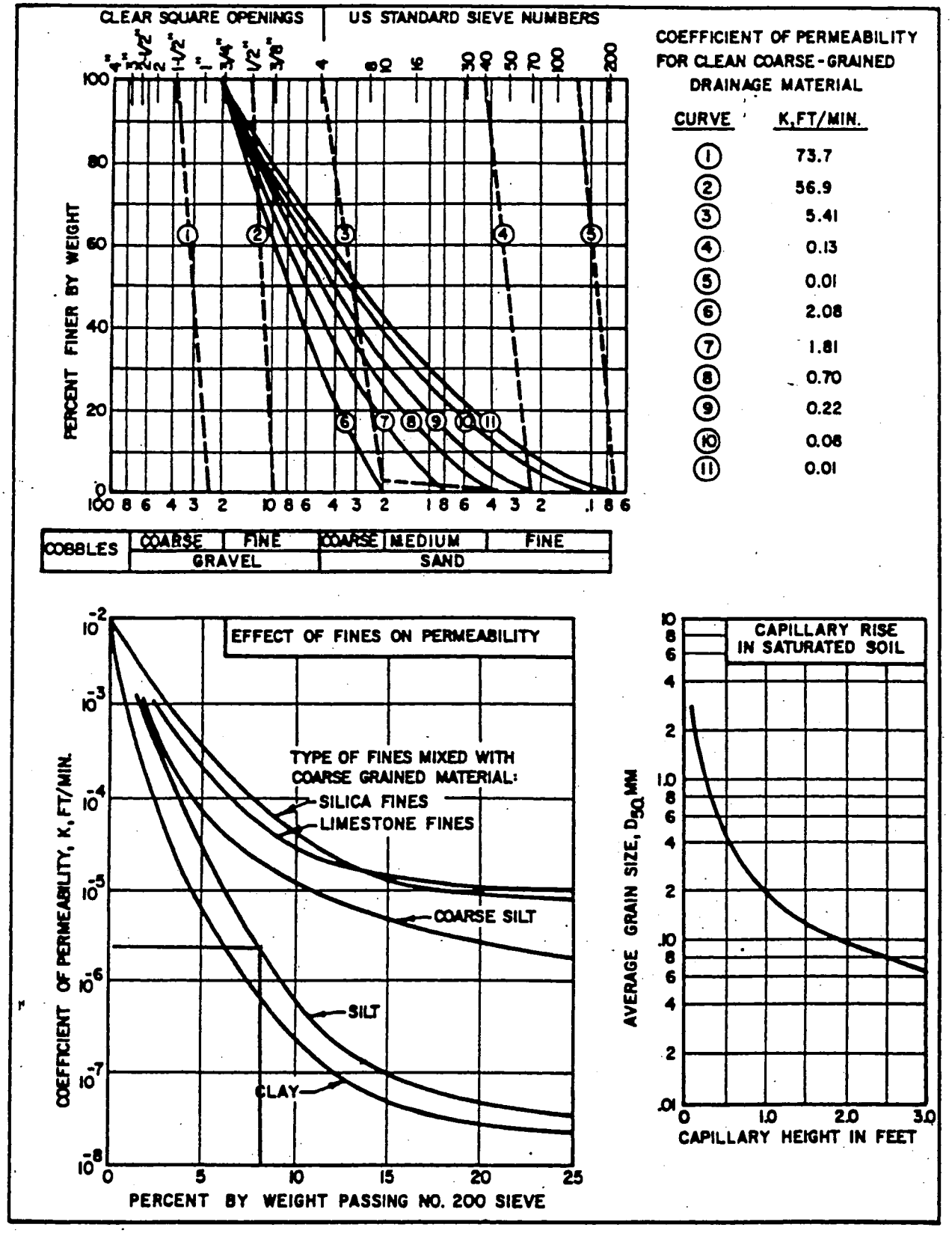


FIGURE 6
Permeability and Capillarity of Drainage Materials

NAVFAC DM 7-01

(10)

SPREADSHEET #1
CAPACITY OF OUTLETS
WITH HEAD = 1210.5'
(MAX POOL ELEVATION)

Max. Pool elevation	1210.5	(feet)
Drain Cross Sectional Area	16	(sq. feet)
Drain Permeability	825	(feet per day)

STATION	DRAIN UPSTREAM	DRAIN DOWNSTREAM	DAM CREST	BOTTOM CENTRAL	LENGTH	GRADIENT	CAPACITY (cu. Ft per day)	
7+90	1204.5	1204.7	1213.4	1206.2	29	0.20	2,640.00	
8+44	1204	1204.3	1213.1	1205.8	29.5	0.21	2,774.24	
12+03	1203.5	1201.8	1213.8	1203.8	36	0.24	3,190.00	
12+51	1201.4	1201.4	1213.8	1203.8	31.5	0.29	3,813.33	
13+07	1200.5	1200.5	1213.7	1204.3	36.5	0.27	3,616.44	
13+47	1200.5	1200.6	1213.8	1204.7	35	0.28	3,733.71	
14+28	1207	1199.6	1213.7	1204	39	0.28	3,689.23	
14+43	1198.5	1198.8	1213.6	1204	39	0.30	3,960.00	
14+63	1197.5	1197.9	1213.6	1204.1	44	0.29	3,780.00	
15+27	1190	1196.3	1213	1204.4	46	0.31	4,074.78	
16+10	1203.2	1195.8	1213.7	1204.4	46	0.32	4,218.26	
16+75	1195	1196.2	1213.7	1204.2	46.5	0.31	4,059.35	
17+22	1195	1195.4	1213.7	1204.2	46	0.33	4,333.04	
17+77	1194.5	1195	1213	1204.2	49.5	0.31	4,133.33	
18+39	1202.8	1194.9	1213	1204.3	48	0.32	4,290.00	
18+95	1194.5	1194.9	1213	1204.1	49	0.32	4,202.45	
19+71	1201.3	1194.8	1213.8	1204	48	0.33	4,317.50	
20+51	1203.6	1194.3	1213.6	1204	49	0.33	4,364.08	
21+60	1193.7	1194.2	1213.8	1201.1	49	0.33	4,391.02	
21+92	1194.5	1194.8	1213.8	1201	49	0.32	4,229.39	
22+60	1194.5	1194.7	1213.8	1200.8	46.5	0.34	4,485.16	
24+03	1193.5	1193.6	1213.6	1200.3	46.5	0.36	4,797.42	
24+27	1193.2	1193.4	1213.7	1200.2	48.5	0.35	4,654.02	
24+60	1192.5	1193	1213.7	1200.2	49.5	0.35	4,666.67	
24+31	1192.5	1192.9	1213.7	1200.2	49.5	0.36	4,693.33	
25+34	1192	1192.2	1214.2	1200.6	52	0.35	4,645.38	
26+24	1192	1192.1	1214.4	1201.2	52.5	0.35	4,626.29	
27+48	1191	1191.2	1214	1201.3	53.5	0.36	4,761.87	
27+64	1191	1191.5	1214	1201.2	53.5	0.36	4,687.85	
28+82	1191	1191.6	1213.9	1201.2	53	0.36	4,707.17	Impacted by North
29+16	1191.5	1191.8	1213.8	1201.3	53	0.35	4,657.36	Outlet
30+20	1192.5	1192.8	1213.6	1201.3	51.5	0.34	4,536.70	
30+72	1193.1	1193.7	1213.9	1201.1	50	0.34	4,435.20	
31+56	1196.2	1192.9	1214.2	1198.4	49	0.36	4,741.22	
32+28	1197.5	1192.5	1214.3	1198.5	50	0.36	4,752.00	
32+50	1196	1192.6	1214.3	1198.6	50	0.36	4,725.60	
32+76	1192.5	1192.8	1214.2	1198.5	50	0.35	4,672.80	
33+04	1196	1192.9	1214.2	1198.5	50	0.35	4,646.40	
34+16	1196.5	1194.4	1214.2	1198.5	48.5	0.33	4,381.86	
34+70	1196.5	1194.6	1214.1	1198.5	48.5	0.33	4,327.42	
35+09	1195.6	1194.1	1214.1	1198.6	50	0.33	4,329.60	
35+51	1197.8	1193.7	1214.2	1198.8	50	0.34	4,435.20	
35+85	1196	1193.5	1214.3	1199	50	0.34	4,488.00	
36+55	1193	1193.5	1214.4	1199	52	0.33	4,315.38	
36+89	1193	1193.3	1214.4	1198.9	52	0.33	4,366.15	
37+50	1195.5	1193.8	1214.5	1195.6	50.5	0.33	4,365.15	
38.04	1194	1194.4	1214.4	1195.5	49	0.33	4,337.14	
39+08	1194	1195.6	1214.5	1196.1	47	0.32	4,184.68	
45+62	1195.6	1194.3	1215.1	1197.1	49	0.33	4,364.08	Impacted by Central Outlet
46+94	1191	1191.4	1215	1200.2	53	0.36	4,756.98	
47+16	1199	1191.3	1215	1200.5	53	0.36	4,781.89	
49+15	1195.1	1195.6	1215.7	1200.5	51.5	0.29	3,819.03	
50+40	1193	1193.3	1215.6	1200.9	52.5	0.33	4,324.57	
52+55	1199	1193.2	1215.4	1199.3	53.5	0.32	4,268.41	
53+90	1191.2	1191.9	1216	1199.6	55.5	0.34	4,423.78	
54+71	1189.3	1189.8	1216	1199.7	58	0.36	4,711.03	
55+61	1190.1	1190.6	1216.6	1200.5	61	0.33	4,306.23	
60+82	1190.7	1191.2	1216.3	1199.9	60.5	0.32	4,210.91	
63+53	1192.4	1192.9	1216.2	1200.1	54	0.33	4,302.22	Impacted by South Outlet
65+79	1193.5	1194	1216.2	1200.7	65.5	0.25	3,325.19	
66+50	1190.5	1191	1216.4	1200.4	57	0.34	4,515.79	
68+04	1193.1	1193.6	1216.4	1196.9	54	0.31	4,131.11	
68+62	1195.3	1195.8	1216.5	1197.1	49.5	0.30	3,920.00	
68+82	1196	1196.4	1216.4	1196.9	49	0.29	3,798.37	
69+14	1196.4	1196.9	1216.4	1196.9	49	0.28	3,663.67	
69+92	1196.7	1197.1	1216.4	1196.7	46	0.29	3,845.22	
70+44	1196.7	1197.2	1216.4	1196.8	46.5	0.29	3,775.48	
73+86	1203.7	1204.2	1216.6	1203.7	33.5	0.19	2,482.39	

Combined Capacity of All Drains	286,959.6	cubic feet per day
Capacity of Impacted Drains	18,030.8	cubic feet per day
Reduced Capacity of Drains	268,928.7	
Capacity lost at Impacted Drains	6%	percent

(11)

SPREADSHEET #2

Seepage through homogenous Embankment at max Pool Elevation (1210.5')

Max. Pool elevation	1210.5	(feet)
Embankment Permeability	0.0072	(feet per day)

STATION	DRAIN DOWNSTREAM	LENGTH	DISCHARGE PER FOOT	
7+90	1204.7	27.4	0.0044	
8+44	1204.3	27.6	0.0050	
12+03	1201.8	34	0.0080	
12+51	1201.4	34.8	0.0086	
13+07	1200.5	36.4	0.0099	
13+47	1200.6	36.4	0.0097	
14+28	1199.6	38.2	0.0112	
14+43	1198.8	39.6	0.0124	
14+63	1197.9	41.4	0.0138	
15+27	1196.3	43.4	0.0167	
16+10	1195.8	45.8	0.0170	
16+75	1196.2	45	0.0164	
17+22	1195.4	46.6	0.0176	
17+77	1195	46	0.0188	
18+39	1194.9	46.2	0.0190	
18+95	1194.9	46.2	0.0190	
19+71	1194.8	48	0.0185	
20+51	1194.3	48.6	0.0194	
21+60	1194.2	49.2	0.0194	
21+92	1194.8	48	0.0185	
22+60	1194.7	48.2	0.0186	
24+03	1193.6	50	0.0206	
24+27	1193.4	50.6	0.0208	
24+60	1193	51.4	0.0214	
24+31	1192.9	51.6	0.0216	
25+34	1192.2	54	0.0223	
26+24	1192.1	54.6	0.0223	
27+48	1191.2	55.6	0.0241	
27+64	1191.5	55	0.0236	
28+82	1191.6	54.6	0.0236	Impacted by North Outlet
29+16	1191.8	54	0.0233	
30+20	1192.8	51.6	0.0219	
30+72	1193.7	50.4	0.0202	
31+56	1192.9	52.6	0.0212	
32+28	1192.5	53.6	0.0218	
32+50	1192.6	53.4	0.0216	
32+76	1192.8	52.8	0.0214	
33+04	1192.9	52.6	0.0212	
34+16	1194.4	49.6	0.0188	
34+70	1194.6	49	0.0186	
35+09	1194.1	50	0.0194	
35+51	1193.7	51	0.0199	
35+85	1193.5	51.6	0.0202	
36+55	1193.5	51.8	0.0201	
36+89	1193.3	52.2	0.0204	
37+50	1193.8	51.4	0.0195	
38.04	1194.4	50	0.0187	
39+08	1195.6	47.8	0.0167	
45+62	1194.3	51.6	0.0183	Impacted by Central Outlet
46+94	1191.4	57.2	0.0230	
47+16	1191.3	57.4	0.0231	
49+15	1195.6	50.2	0.0159	
50+40	1193.3	54.6	0.0195	
52+55	1193.2	54.4	0.0198	
53+90	1191.9	58.2	0.0214	
54+71	1189.8	62.4	0.0247	
55+61	1190.6	62	0.0230	
60+82	1191.2	60.2	0.0223	
63+53	1192.9	56.6	0.0197	Impacted by South Outlet
65+79	1194	54.4	0.0180	
66+50	1191	60.8	0.0225	
68+04	1193.6	55.6	0.0185	
68+62	1195.8	51.4	0.0151	
68+82	1196.4	50	0.0143	
69+14	1196.9	49	0.0136	
69+92	1197.1	48.6	0.0133	
70+44	1197.2	48.4	0.0132	
73+86	1204.2	34.8	0.0041	

Maximum Discharge per foot per day	0.0247	cu. Ft per foot
Minimum Discharge per foot per day	0.0041	cu. Ft per foot
Average Discharge per foot per day	0.0181	cu. Ft per foot

Maximum Discharge thru 7700 foot Embankment	190.35	cubic feet/day
Minimum Discharge thru 7700 foot Embankment	31.62	cubic feet/day
Average Discharge thru 7700 foot Embankment	139.32	cubic feet/day

(12)

SPREADSHEET #3
Flow through Outlets Under a Driving Head of 1.0 feet.

Head	1	(feet)
Max. Pool elevation	1210.5	(feet)
Drain Cross Sectional Area	16	(sq. feet)
Drain Permeability	825	(feet per day)

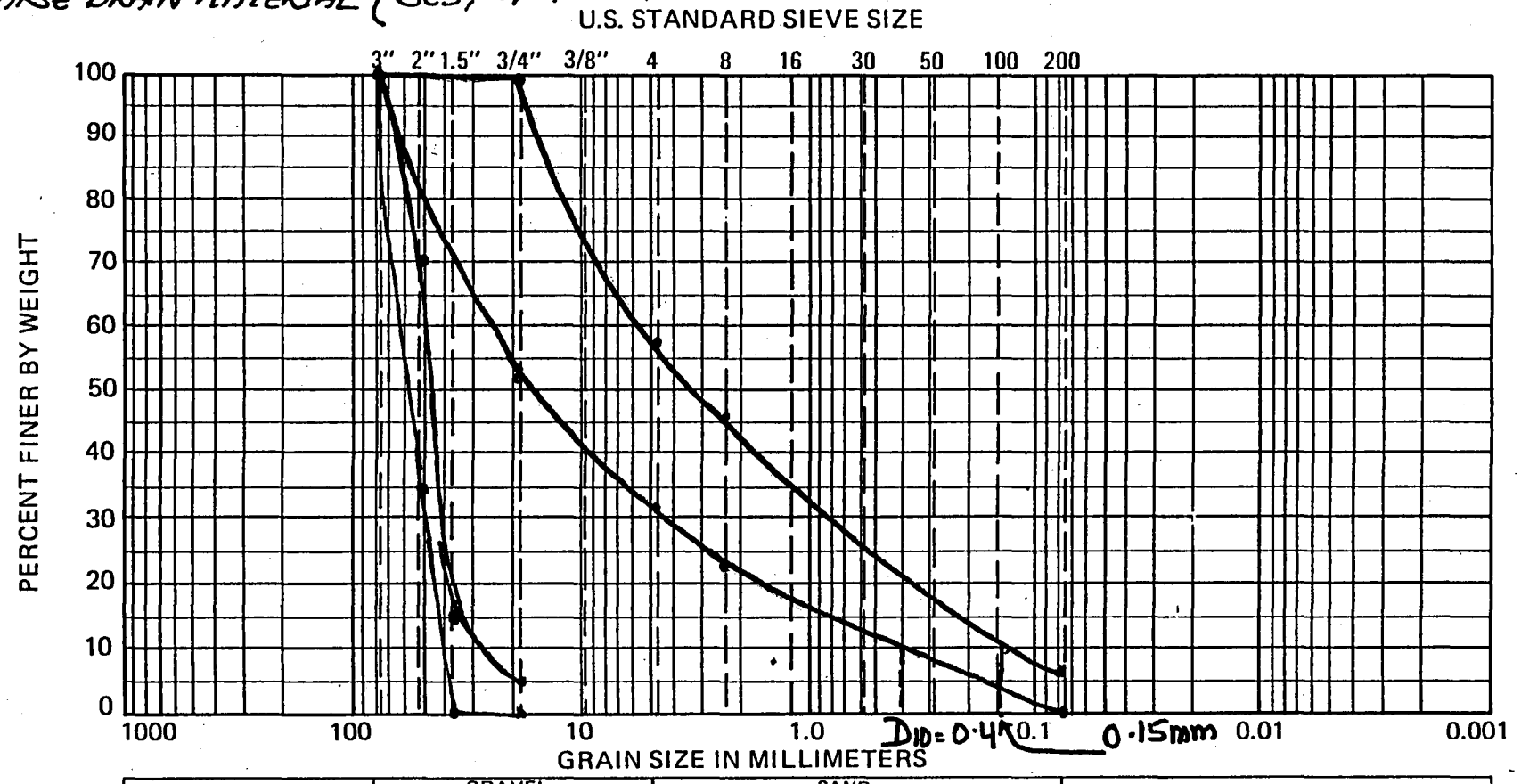
STATION	DRAIN UPSTREAM	DRAIN DOWNSTREAM	DAM CREST	BOTTOM CENTRAL	LENGTH	GRADIENT	CAPACITY (cu. Ft per day)	
7+90	1204.5	1204.7	1213.4	1206.2	29	0.034483	455.17	
8+44	1204	1204.3	1213.1	1205.8	29.5	0.033898	447.46	
12+03	1203.5	1201.8	1213.8	1203.8	36	0.027778	366.67	
12+51	1201.4	1201.4	1213.8	1203.8	31.5	0.031746	419.05	
13+07	1200.5	1200.5	1213.7	1204.3	36.5	0.027397	361.64	
13+47	1200.5	1200.6	1213.8	1204.7	35	0.028571	377.14	
14+28	1207	1199.6	1213.7	1204	39	0.025641	338.46	
14+43	1198.5	1198.8	1213.6	1204	39	0.025641	338.46	
14+63	1197.5	1197.9	1213.6	1204.1	44	0.022727	300.00	
15+27	1190	1196.3	1213	1204.4	46	0.021739	286.96	
16+10	1203.2	1195.8	1213.7	1204.4	46	0.021739	286.96	
16+75	1195	1196.2	1213.7	1204.2	46.5	0.021505	283.87	
17+22	1195	1195.4	1213.7	1204.2	46	0.021739	286.96	
17+77	1194.5	1195	1213	1204.2	49.5	0.020202	266.67	
18+39	1202.8	1194.9	1213	1204.3	48	0.020833	275.00	
18+95	1194.5	1194.9	1213	1204.1	49	0.020408	269.39	
19+71	1201.3	1194.8	1213.8	1204	48	0.020833	275.00	
20+51	1203.6	1194.3	1213.6	1204	49	0.020408	269.39	
21+60	1193.7	1194.2	1213.8	1201.1	49	0.020408	269.39	
21+92	1194.5	1194.8	1213.8	1201	49	0.020408	269.39	
22+60	1194.5	1194.7	1213.8	1200.8	46.5	0.021505	283.87	
24+03	1193.5	1193.6	1213.6	1200.3	46.5	0.021505	283.87	
24+27	1193.2	1193.4	1213.7	1200.2	48.5	0.020619	272.16	
24+60	1192.5	1193	1213.7	1200.2	49.5	0.020202	266.67	
24+31	1192.5	1192.9	1213.7	1200.2	49.5	0.020202	266.67	
25+34	1192	1192.2	1214.2	1200.6	52	0.019231	253.85	
26+24	1192	1192.1	1214.4	1201.2	52.5	0.019048	251.43	
27+48	1191	1191.2	1214	1201.3	53.5	0.018692	246.73	
27+64	1191	1191.5	1214	1201.2	53.5	0.018692	246.73	
28+82	1191	1191.6	1213.9	1201.2	53	0.018868	249.06	Impacted by North
29+16	1191.5	1191.8	1213.8	1201.3	53	0.018868	249.06	Outlet
30+20	1192.5	1192.8	1213.6	1201.3	51.5	0.019417	256.31	
30+72	1193.1	1193.7	1213.9	1201.1	50	0.020000	264.00	
31+56	1196.2	1192.9	1214.2	1198.4	49	0.020408	269.39	
32+28	1197.5	1192.5	1214.3	1198.5	50	0.020000	264.00	
32+50	1196	1192.6	1214.3	1198.6	50	0.020000	264.00	
32+76	1192.5	1192.8	1214.2	1198.5	50	0.020000	264.00	
33+04	1196	1192.9	1214.2	1198.5	50	0.020000	264.00	
34+16	1196.5	1194.4	1214.2	1198.5	48.5	0.020619	272.16	
34+70	1196.5	1194.6	1214.1	1198.5	48.5	0.020619	272.16	
35+09	1195.6	1194.1	1214.1	1198.6	50	0.020000	264.00	
35+51	1197.8	1193.7	1214.2	1198.8	50	0.020000	264.00	
35+85	1196	1193.5	1214.3	1199	50	0.020000	264.00	
36+55	1193	1193.5	1214.4	1199	52	0.019231	253.85	
36+89	1193	1193.3	1214.4	1198.9	52	0.019231	253.85	
37+50	1195.5	1193.8	1214.5	1195.6	50.5	0.019802	261.39	
38.04	1194	1194.4	1214.4	1195.5	49	0.020408	269.39	
39+08	1194	1195.6	1214.5	1196.1	47	0.021277	280.85	
45+62	1195.6	1194.3	1215.1	1197.1	49	0.020408	269.39	Impacted by Central Outlet
46+94	1191	1191.4	1215	1200.2	53	0.018868	249.06	
47+16	1199	1191.3	1215	1200.5	53	0.018868	249.06	
49+15	1195.1	1195.6	1215.7	1200.5	51.5	0.019417	256.31	
50+40	1193	1193.3	1215.6	1200.9	52.5	0.019048	251.43	
52+55	1199	1193.2	1215.4	1199.3	53.5	0.018692	246.73	
53+90	1191.2	1191.9	1216	1199.6	55.5	0.018018	237.84	
54+71	1189.3	1189.8	1216	1199.7	58	0.017241	227.59	
55+61	1190.1	1190.6	1216.6	1200.5	61	0.016393	216.39	
60+82	1190.7	1191.2	1216.3	1199.9	60.5	0.016529	218.18	
63+53	1192.4	1192.9	1216.2	1200.1	54	0.018519	244.44	Impacted by South Outlet
65+79	1193.5	1194	1216.2	1200.7	65.5	0.015267	201.53	
66+50	1190.5	1191	1216.4	1200.4	57	0.017544	231.58	
68+04	1193.1	1193.6	1216.4	1196.9	54	0.018519	244.44	
68+62	1195.3	1195.8	1216.5	1197.1	49.5	0.020202	266.67	
68+82	1196	1196.4	1216.4	1196.9	49	0.020408	269.39	
69+14	1196.4	1196.9	1216.4	1196.9	49	0.020408	269.39	
69+92	1196.7	1197.1	1216.4	1196.7	46	0.021739	286.96	
70+44	1196.7	1197.2	1216.4	1196.8	46.5	0.021505	283.87	
73+86	1203.7	1204.2	1216.6	1203.7	33.5	0.029851	394.03	

Combined Capacity of All Drains	18,928.7	cubic feet per day
Capacity of Impacted Drains	1,011.9	cubic feet per day
Reduced Capacity of Drains	17,916.8	cubic feet per day
Capacity lost at Impacted Drains	5%	percent

FILE _____ VISIONS _____
BY _____ DATE _____ BY _____ DATE _____
CHECKED BY _____ DATE _____ BY _____ DATE _____
PLATE _____ OF _____

— DRAIN FILL MATERIAL (ADWR, 11/25/1981)
___ COARSE DRAIN MATERIAL (SCS, 5/11/1981) C-33 #2

FIG #1



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	

D10 = 30mm to 40mm

(13)

GRADATION CURVE

Dames & Moore

we see that the form of the solution for this case is

$$\frac{iL}{h_0} = \psi(\eta_2) - \psi(\eta_1) \tag{3}$$

Equation (2) is plotted in Fig. 2-12. The method of problem solving is

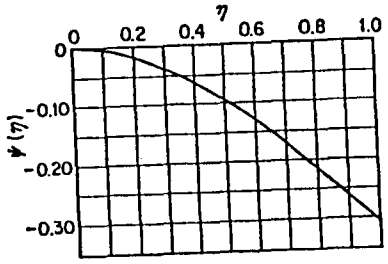


FIG. 2-12

entirely similar to that demonstrated in Example 2-1, except that the free surface lies below the normal depth ($h_0 > h$).

2-7. Seepage through an Earth Dam on an Impervious Base

In this section we shall consider several solutions for the determination of the discharge and the free surface through homogeneous earth dams on impervious bases. Each of these procedures makes use of Dupuit's assumptions and hence is subject to the limitations outlined in Sec. 2-1. A more rigorous treatment of this problem will be given in a later chapter.

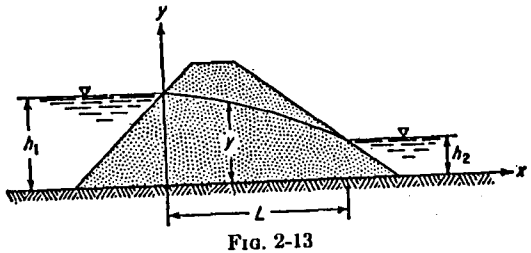


FIG. 2-13

1. Dupuit's Solution. With Dupuit's assumptions, the discharge (per unit width) through any vertical section of the dam in Fig. 2-13 is [Eq. (4), Sec. 2-2]

$$q = -ky\frac{dy}{dx} \tag{1}$$

Integrating and substituting the boundary conditions $x = 0$, $y = h_1$ and $x = L$, $y = h_2$, we obtain Dupuit's formula [Eq. (5), Sec. 2-2]

$$q = \frac{k(h_1^2 - h_2^2)}{2L} \tag{2}$$

Equation (2) specifies a parabolic free surface, commonly referred to as *Dupuit's parabola*. In the derivation above no cognizance has been taken of the entrance or exit conditions (cf. Fig. 1-13) of the line of seepage or of the development of a surface of seepage. Indeed, in the absence of tail water ($h_2 = 0$), the line of seepage is seen to intersect the impervious base. Also, it should be noted that both the discharge quantity and the locus of the free surface are independent of the slopes of the dam.

2. Solution of Schaffernak and Van Iterson. The first approximate method that accounts for the development of the surface of seepage was proposed independently in 1916 by Schaffernak [125] and van Iterson [62].

Considering an earth dam on an impervious base (Fig. 2-14*a*) with no tail water and applying Eq. (1) to triangle CAB, we obtain for the dis-

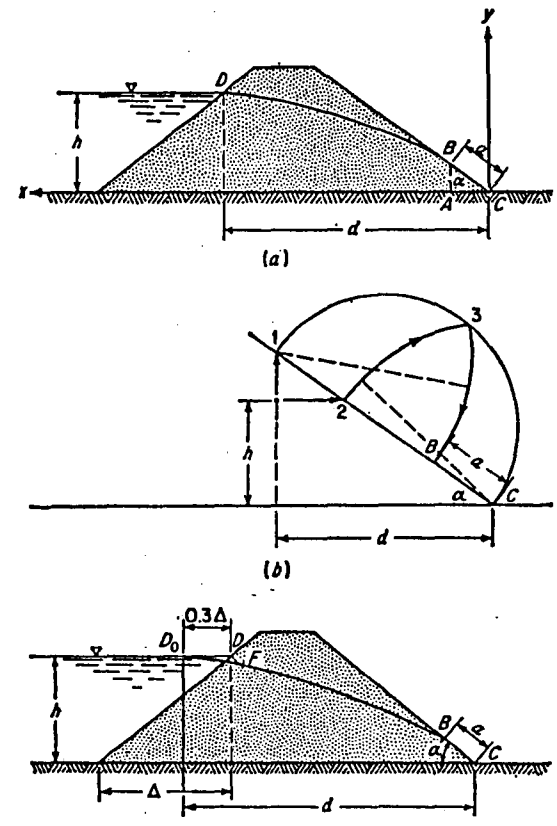


FIG. 2-14

14

GROUNDWATER & SEEPAGE
MILTON E. HARR

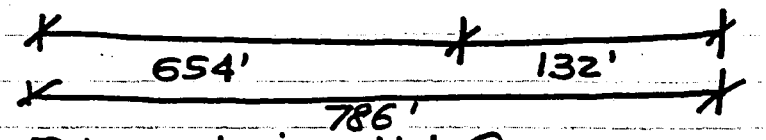
ENGINEER'S COST ESTIMATE
Interim Dam Safety
Extending Existing Outlet Drains
White Tanks FRS#3
Maricopa County Flood Control District

SECTION	DESCRIPTION	Unit	Quantity	Unit Price	Total Cost
206-2	Trench Excavation	CY	135.00	$16.00	$2,160.00
215-1	Fine Grade Excavation	CY	6.00	$100.00	$600.00
220-2	2-inch Aggregate Drain Rock (rounded)	CY	150.00	$45.00	$6,750.00
230-1	Geotextile	SF	2,500.00	$1.30	$3,250.00
220-1	Riprap	CY	9.00	$50.00	$450.00

TOTAL COST	$13,210.00

* INCREMENTAL HEAD @ CENTRAL CMP – PRIOR TO FILTER CONSTRUCTION

OUTLET @ 39+08 OUTLET @ 45+62 ** 46+94 (OUTLET) ← (BUTTRESS)



** This ~~on~~ drain outlet @ 45+62 will be blocked.

- Consider segment of dam between 45+62 and 39+08' (654')
- Seepage reporting to this section = 0.0247 x 654 = 16.2 c.ft/day
- ½ the above seepage to drain @ 39+08 and ½ to 45+62 = 8.1 cu.ft/day
- Length of travel = $\frac{654}{2}$ + 55 (assumed drain length) = 382'

$$Q = KiA = K\frac{h}{L}A$$

$$\therefore h = \frac{QL}{KA} = \frac{8.1 \times 382}{300 \times (3 \times 1)} = 3.4'$$

⇒ WITHOUT CONSTRUCTION OF THE FILTER, THE HEAD REQUIRED TO DRIVE FLOWS TO DRAINS @ 39+08 and 45+62 IS APPROXIMATELY 3.4'

URS

DATE 12/31/01
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* INCREMENTAL HEAD @ CENTRAL CMP - POST FILTER CONSTRUCTION (BUTTRESS)

- Length of dam section = 786'
- Seepage reporting to section = 0.0247 × 786 = 19.4 cu.ft/day
- ½ Seepage reports to Outlet @ 39+08 and the other half to 46+94 = 9.7 cu.ft/day
- Length of travel = $\frac{786}{2} + 55 = 448'$
- $h = \frac{QL}{kA}$

$$= \frac{9.7 \times 448}{300 \times (3 \times 1)} = 4.8'$$

⇒ AFTER CONSTRUCTION, HEAD REQUIRED TO DRIVE FLOWS TO DRAINS @ 39+08 AND 46+94 (OUTLET @ 45+62 BLOCKED) IS APPROXIMATELY 4.8'

⇒ INCREMENTAL HEAD (POST & PRE-CONSTRUCTION) = 1.4'

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
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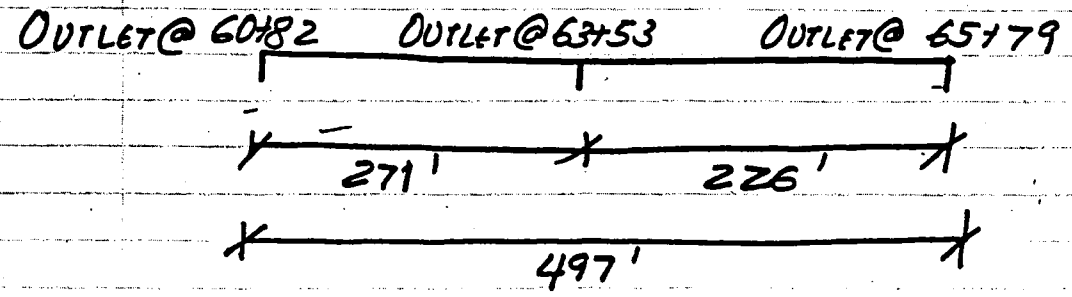
* INCREMENTAL HEAD @ SOUTH CMP



PRE-DIAPHRAGM FILTER CONSTRUCTION

- Consider section of dam between drain outlets @ 60+82 and 63+53 (271')

- $Q = 0.0247 \times 271 = 6.7$ cubic ft/day

- ½ Reports to 60+82 & 65+79 = 3.3 cu. ft/day

- Length of travel $= \frac{271}{2} + 55 = 190.5'$

- $h = \frac{QL}{kA} = \frac{3.3 \times 190.5}{300 \times (3 \times 1)} = 0.7'$

⇒ PRIOR TO CONSTRUCTION OF DIAPHRAGM FILTER, HEAD REQUIRED TO DRIVE FLOWS TO OUTLET DRAINS @ 60+82 & 63+53 = 0.7'

URS

DATE 12/31/01
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POST DIAPHRAGM FILTER CONSTRUCTION (Outlet @ 63+53 Blocked)

- Consider section of dam between outlets @ 60+82 and 65+79
= 497'

- $Q = 0.0247 \times 497 = 12.2$ cubic ft/day

$\frac{1}{2}Q = 6.1$ cubic ft/day

- Length of travel $= \frac{497}{2} + 55 = 303.5'$

$$h = \frac{QL}{KA} = \frac{6.1 \times 303.5}{300 \times (3 \times 1)} = 2.1'$$

⇒ POST CONSTRUCTION (OUTLET @ 63+53 blocked), HEAD REQUIRED = 2.1'.

⇒ INCREMENTAL HEAD = 1.4'

URS

DATE 12/31/01
PROJECT NO. 15448-007-058
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CMP OUTLET	HEAD IN CENTRAL DRAIN			THICKNESS OF DESING BUTTRESS FILL @ OUTLET
	PRIOR TO CONSTRUCT.	POST CONSTRUCTION	INCREMENTAL HEAD	
NORTH	<1.0'	<1.0'	<1.0'	14'-16'
CENTRAL	3.4'	4.8'	1.4'	10'-12'
SOUTH	0.7'	2.1'	1.4'	8'-10'

Note: Thickness of buttress fill estimated from design Drawings

URS

Design Memo No. 6

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)
Richard Candelaria – Buesing (Fax 602-233-3377)
Noller Herbert – NRCS (Fax 602-280-8795)

From: Kevin Somerville E.I.T.
Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX

Date: January 3, 2002

Re: White Tanks FRS #3, Concrete Collars at Existing CMP Outlet Pipe Joint Coupling (s)

South Outlet

During observations made by URS on Friday, December 28, 2001 and observations and conversations during Progress Meeting No.1 today, January 2, 2002, an existing pipe joint and coupling band was discovered at the Southern Outlet pipe, exposed by recent excavations for the diaphragm filter. The joint is located 5 feet 3 inches from the cut end (one foot was cut off per specifications). Pipe inspection records indicate the joint was 8 feet from the original pipe end. The existing coupling bolts also appear to be severely corroded.

It is URS' understanding from the design process for this project executed with FCDMC and ADWR that review comments from ADWR requiring concrete encapsulation of standard coupling band that joins the new pipe extension to the existing pipe. URS incorporated the concrete collar to encapsulate the entire coupling band into the design. Furthermore, the diaphragm filter sand was to also be present 3 feet upstream of the concrete collar. Given this logic in the previous design phase, URS recommends the following:

- Replace the coupling band that exhibits severe corrosion. Using the same 5 feet 3 inch segment of existing pipe is acceptable, but should remain in its current location.
- Perform additional hand excavation (assumed to be minor) into the dam face, local to the outlet pipe as shown on the attached figure to allow for the additional concrete

collar and diaphragm filter sand. Excavation may be phased; initial excavation for forming concrete collar ; excavation to allow 3 feet of sand. Slope the new face cut for safety, as necessary. Given the dam embankment is constructed with engineered fill and compacted to stringent requirements, and from a general geotechnical standpoint, a slope of 3/4:1 (H:V) may be sufficient for short term excavations. However, Buesing should field verify site conditions and rely on its own judgement and experience to meet the regulatory requirements for slope safety.

- Install a concrete collar similar to that proposed for new joint around the newly exposed pipe joint. Due to the proximity of the currently proposed concrete collar, we recommend that Buesing prepare form work and place concrete to produce one continuous collar that spans both joints, as indicated by the attached figure.

- Place diaphragm filter sand behind the concrete collar to a thickness of 3 feet as per the design drawings, while maintaining filter sand contiguous throughout the diaphragm envelope.

A decision to install a concrete collar around the existing pipe joint as described above is needed as soon as practicable. Buesing has expressed a desire to begin form work and attempt to place concrete as early as Monday. However, additional excavations will be more difficult if form work has already began.

Discussions between URS, FCDMC, and Buesing also included the elimination of the 5 feet 3 inch segment of existing pipe and ordering a longer pipe to make up the difference. According to Buesing, the 37 feet long pipe (one piece) has already been ordered for the South Outlet, which was special ordered, unfortunately without opportunity of refunds. Therefore, URS recommends using the existing pipe stub given the entire length will be encapsulated in concrete anyway.

Central Outlet

A joint has been observed at 7 feet 3 inches from the cut end of the CMP pipe. Discussion and recommendations for this outlet will be under separate correspondence.

North Outlet

According to pipe inspection records, a joint is documented at about 11 feet (12 feet from original end) from the cut end of the CMP pipe. Visual observation and measurement to confirm this distance is pending over the next day or two. Discussion and recommendations for this outlet will be under separate correspondence.

Please review and call to discuss at your convenience.

Attachments: Figure 1 – Collar Detail – Existing Pipe Joint

URS

Job WHITE DANKS PRS #3 – IDS

Description FIGURE 1

Project No. EI-0000 1852

Computed by KRS

Checked by TER

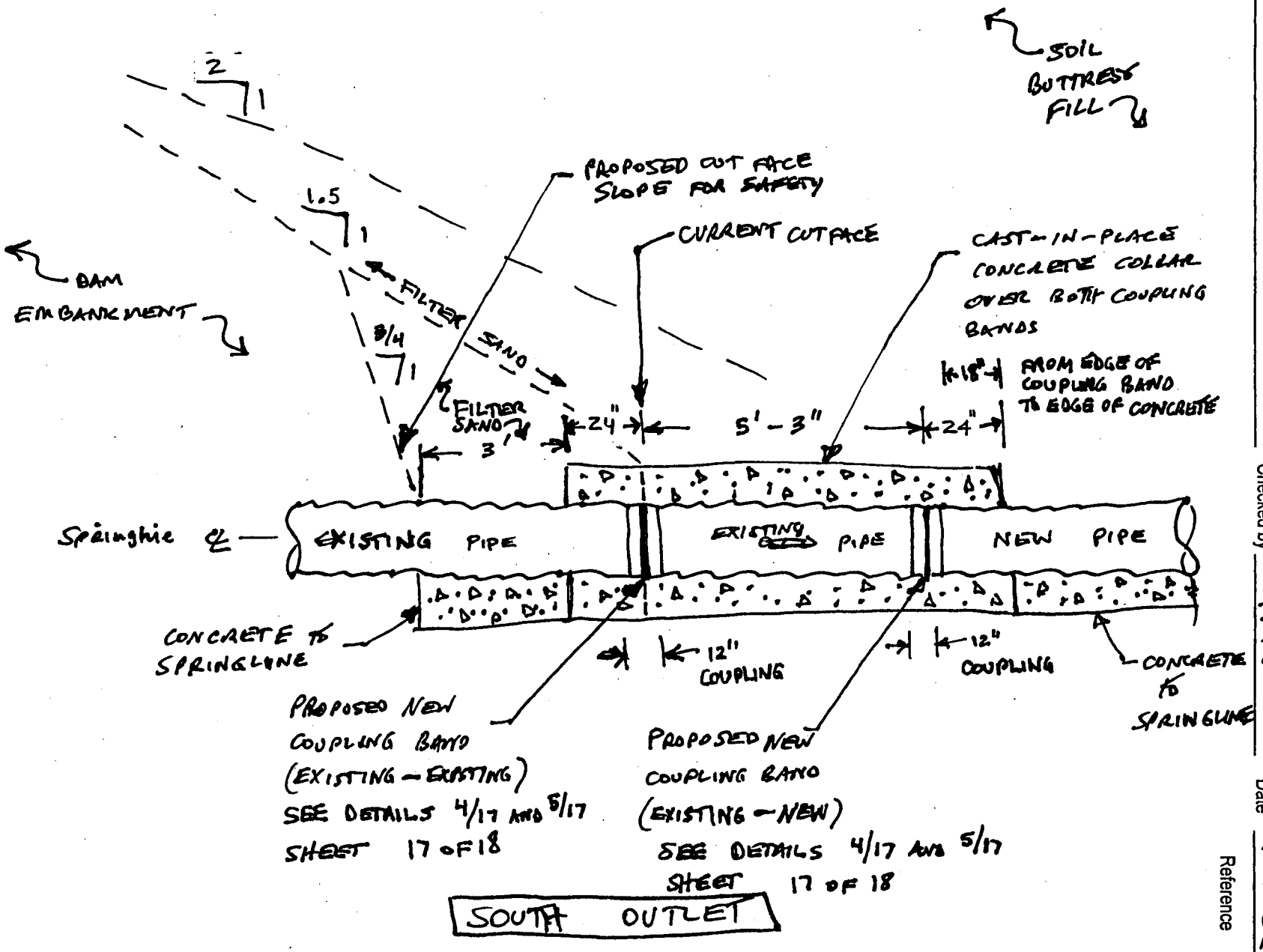
Page 4 of 4

Sheet ___ of ___

Date 1-2-02

Date 1-3-02

Reference



TRANSMISSION RESULT REPORT (JAN 03 '02 11:34AM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 03	11:32AM	6024172423	01'24"	OK	ES	03		001

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (JAN 03 '02 11:36AM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 03	11:34AM	602 506 8561	01'22"	OK	ES	03		003

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (JAN 03 '02 11:38AM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 03	11:36AM	2333377	01'27"	OK	ES	03		005

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (JAN 03 '02 11:40AM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 03	11:38AM	602 280 8795	01'24"	OK	ES	03		007

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

URS

Design Memo No. 7

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

Date: January 5, 2002

Re: White Tanks FRS #3 – **South Outlet** Filter Matches

URS has received and reviewed the laboratory test results of samples collected and tested by Alpha Geotechnical & Materials Inc. We understand that three samples were collected from the subgrade in the vicinity of the **south outlet**, while the fourth sample was collected from the filter sand delivered to the project site. The four attached Calculation Packages document the results of our review and assessment. These results are also summarized in the Table below:

Calc. Pkg. No.	Subject	Comments
CONS #1	Gradation of filter sand	Gradation is within project specifications
CONS #2	Retention Criterion – Geotextile versus Subgrade	Geotextile is compatible with the subgrade soils
CONS #3	Filter Match – Filter Sand (as base soil) versus Subgrade soils	Meets filter match criteria
CONS #4	Filter Match – Subgrade (as base soil) versus Filter Sand	Meets filter match criteria

Results of the compaction tests (moisture and density) of the subgrade at the south outlet have not yet been provided to URS for review. Should you have questions or require additional information, please contact us at (602) 371 1100.

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS#3 CONSTRUCTION

PROJECT NO. E1-00001R52:00

SHEET 1 OF 3

CONS #1

Gradation of Filter Sand ~~Are~~ Delivered to Site

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME) — Kevin R. Somerville (SIGNATURE) — 1/6/02 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

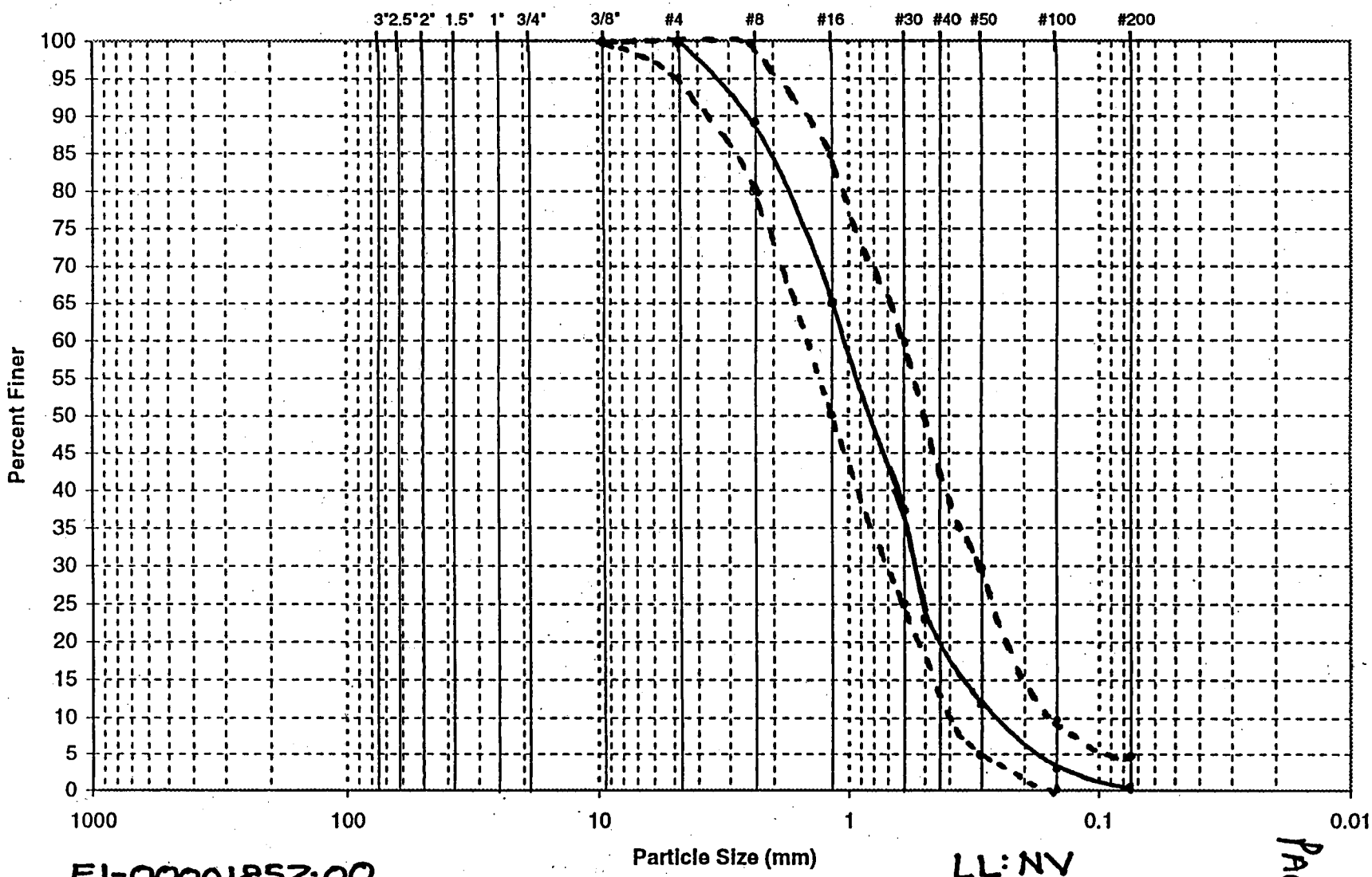
INITIALS

—— - Gradation results provided by Alpha.

- - - - - Gradation Per Project Specs South Outlet (CMP)

WHITE TANKS FRS 3 – 25
01/04/02
FILTER SAND GRADATION
(Sample collected and tested by Alpha Geotechnical & Materials Inc)

GRADATION SHEET



EI-00001852.00

LL: NV
PI: NP

PAGE 2

OKAY

Alpha Geotechnical & Materials, Inc.

PAGE 3

PROJECT:	WHITE TANK	JOB NO:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	1
MATERIAL:	FILTER SAND ~~(COURSE)~~ KRA	LAB NO:	1
SAMPLE SOURCE:	STOCKPILE KRA	DATE SAMPLED:	01-02-02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	100
1/4 IN	100
#4	100
#8	89
#10	85
#16	65
#30	37
#40	23
#50	12
#100	3
#200	1.1

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS #3 CONSTRUCTION

PROJECT NO. EI-00001852.00

SHEET 1 OF 5

CONS # 2

SOUTH OUTLET - GEOTEXTILE VS.

TITLE OF CALCULATIONS/DOCUMENT

SUBGRADE SOILS

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME) — Kevin R. Somerville (SIGNATURE) — 1/6/02 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
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INITIALS

URS

Page 2 of ____

Job WHITE TANKS FRS#3 - CONSTRUCTION Project No. E1-00001852.00 Sheet ____ of ____

Description FILTER MATCH – SUBGRADE SOIL & GEOTEXTILE – SOUTH CHIP Computed by RAVI MURTHY Date ____

Checked by ____ Date ____

Reference

OBJECTIVE: Check compatibility of subgrade soils and geotextile. (Subgrade exposed during construction)

DATA : (1) Gradation results for 3 subgrade samples. Sampling & testing completed by Alpha

(2) Spec sheet for AMOCO Style 4553, provided by contractor

REFERENCE: "Designing with Geosynthetics" – R.M. Koerner, 3rd Ed, Pg 101, Carroll (1983).

* From gradation curves, for subgrade soils

$$d_{85} = 1.8\text{mm to } 8\text{mm} \checkmark$$

* From AMOCO cutsheet, $AOS = O_{95} = 0.15\text{mm}$

* $$O_{95}/d_{85} = \frac{0.15}{8} \text{ to } \frac{0.15}{1.8} \checkmark$$

$$= 0.02 \text{ to } 0.08 \checkmark$$

* From Reference, $O_{95}/d_{85} < 2 \text{ to } 3$ ✓

∴ Geotextile & subgrade soils are compatible.

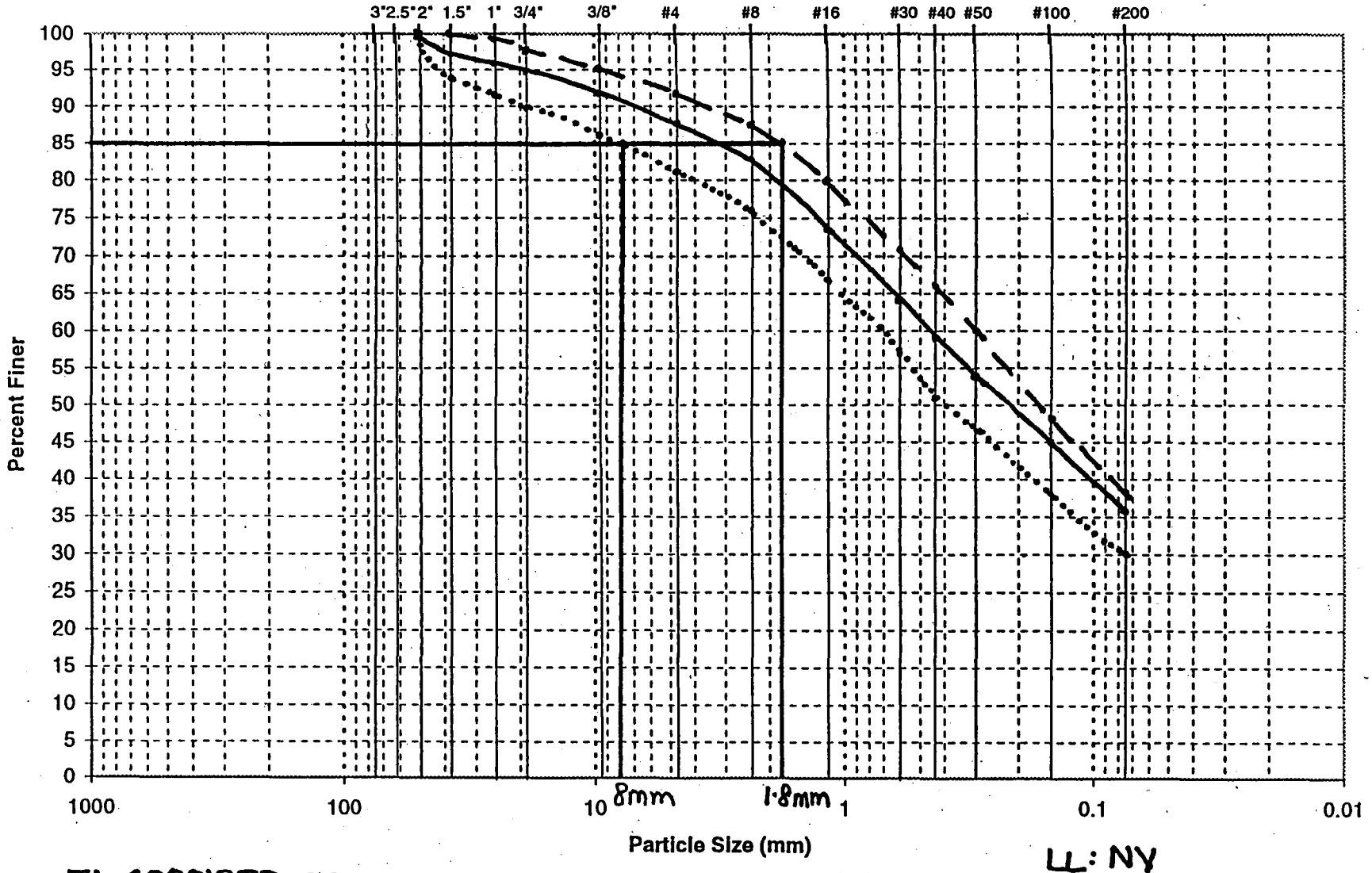
OKAY

——— [illegible]
— — — EAST END
..... MIDDLE

01/04/02
SOUTH OUTLET
SUBGRADE SAMPLES
Sampling & Testing by Alpha Geotechnical & Materials Inc.

PAGE 3

GRADATION SHEET



EI-00001852.00

LL: NV
PI: NP

OKAY
KRA

AMOCO FABRICS AND FIBERS COMPANY
900 Circle 75 Parkway, Suite 300
Atlanta, GA 30339
PH: (770) 984-4444
FX: (770) 956-2430

STYLE 4553

Amoco Style 4553 is a polypropylene nonwoven needlepunched fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a ph range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that Amoco Style 4553 meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Grab Tensile	ASTM-D-4632	203 lbs	0.900 kN
Grab Elongation	ASTM-D-4632	50 %	50 %
Mullen Burst	ASTM-D-3786	400 psi	2750 kPa
Puncture	ASTM-D-4833	130 lb	0.575 kN
Trapezoidal Tear	ASTM-D-4533	80 lb	0.355 kN
UV Resistance	ASTM-D-4355	70 % at 500 hrs	70 % at 500 hrs
AOS	ASTM-D-4751	100 sieve	0.15 mm
Permittivity	ASTM-D-4491	1.5 sec^{-1}	1.5 sec^{-1}
Flow Rate	ASTM-D-4491	110 $gal/min/ft^2$	4470 $L/min/m^2$

Amoco Fabrics and Fibers Company manufactures the nonwoven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories. A letter certifying the minimum average roll values will be issued from the manufacturing plant by the Quality Control Manager at the time shipment is made.

DATE ISSUED: 01/01/98

The information presented herein, while not guaranteed, is to the best of our knowledge true and accurate. Except when agreed to in writing for specific conditions of use, no warranty or guarantee expressed or implied is made regarding the performance of any product, since the manner of use and handling are beyond our control. Nothing contained herein is to be construed as permission or as a recommendation to infringe any patent.

d_{85}, d_{50}, or d_{15}; see Table 2.3). The numeric value of the ratio depends on the geotextile type, the soil type, the flow regime, etc. For example, Carroll [5] recommends the following:

$$O_{95} < (2 \text{ or } 3)\ d_{85} \tag{2.9}$$

where d_{85} is the soil particle size in mm for which 85% of the total soil is finer.

Table 2.3 Existing geotextile retention criteria, after Christopher and Fischer [3]

Source	*Criterion*	*Remarks*
Task Force #25 (1986)	50% ≤ 0.074 mm, O_{95} < 0.59 mm 50% > 0.074 mm, O_{95} < 0.30 mm	No limitations on geotextile type or soil type
Calhoun (1972)	$O_{95}/d_{85} \leq 1$	Wovens, soils with ≤50% passing No. 200 sieve
	$O_{95} \leq 0.2$ mm	Wovens, cohesive soils
Zitscher (1975)	$O_{50}/d_{50} \leq 1.7$–2.7	Wovens, soils with CU ≤ 2, d_{50} = 0.1 to 0.2 mm
	$O_{50}/d_{50} \leq 2.5$ to 3.7	Nonwovens, cohesive soil
Ogink (1975)	$O_{90}/d_{90} \leq 1$	Wovens
	$O_{90}/d_{90} \leq 1.8$	Nonwovens
Sweetland (1977)	$O_{15}/d_{85} \leq 1$	Nonwovens, soils with CU = 1.5
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with CU = 4.0
Rankilor (1981)	$O_{50}/d_{85} \leq 1$	Nonwovens, soils with 0.2 ≤ d_{85} ≤ 0.25 mm
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with d_{85} > 0.25 mm
Schober & Teindl (1979)	$O_{90}/d_{50} \leq 2.5$–4.5	Woven and thin nonwovens, dependent on CU
	$O_{90}/d_{50} \leq 4.5$–7.5	Thick nonwovens, dependent on CU, silt and sand soils
Giroud (1982)	$O_{95}/d_{50} \leq (9$–$18)/CU$	Dependent on soil CU and density Assumes fines in soil migrate for large CU values
Carroll (1983)	$O_{95}/d_{85} \leq 2$–3	Wovens and nonwovens
Christopher and Holtz (1985)	$O_{95}/d_{85} \leq 1$–2 $O_{95}/d_{15} \leq 1$ or $O_{50}/d_{85} \leq 0.5$	Dependent on soil type and CU Dynamic, pulsating, and cyclic flow, if soil can move beneath geotextile
French Committee on Geotextiles and Geomembranes (1986)	$O_f/d_{85} \leq 0.38$–1.25	Dependent on soil type, compaction, hydraulic and application conditions
Fischer et al. (1990)	$O_{50}/d_{85} \leq 0.8$ $O_{50}/d_{15} \leq 1.8$–7.0 $O_{50}/d_{50} \leq 0.8$–2.0	Based on geotextile pore size distribution, dependent on CU of soil

O_x = geotextile opening size corresponding to x particle size based on dry glass bead sieving.
O_f = filtration opening size based on hydrodynamic sieving.
d_y = soil particle size corresponding to y percent passing.
CU = coefficient of uniformity = d_{60}/d_{10}.

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS #3 CONSTRUCTION

PROJECT NO. EI-00001852.00

SHEET 1 OF 3

CONS # 3

SOUTH OUTLET : FILTER MATCH

TITLE OF CALCULATIONS/DOCUMENT

Filter Sand (Base) versus Subgrade

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME) — SIGNATURE — 1/6/02 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/04/02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

URS

Job WHITE TANKS FRS#3 - CONSTRUCTION | Project No. EI-00001852.00 | Sheet ___ of ___

Description SOUTH OUTLET - Filter Sand versus Subgrade soil | Computed by RAVI MURTHY | Date 01/04/02

Checked by ___ | Date ___

Reference

OBJECTIVE: To check compatibility of the filter sand (base) and subgrade soil @ South Outlet.

DATA: (1) Subgrade gradation results provided by Alpha

(2) Calculation Package #6, Design Report Volume 2, August 3, 2001, Appendix E

REFERENCE: Chapter 26: Gradation Design of Sand & Gravel Filters Part 633, National Engineering Handbook, NRCS

* Calculation Package #6 documents a filter match between the filter sand (base) and drain.

* From Calc Package #6, following Control Points are used to define the design band

COARSE SIZE (mm)	COARSE % Passing	FINE SIZE (mm)	FINE % Pass
75	100	12.1	99.8
30	90	4.8	60
24	60	1.64	15
4.8	15	0.075	5

* Above Control Points are plotted on Pg 3

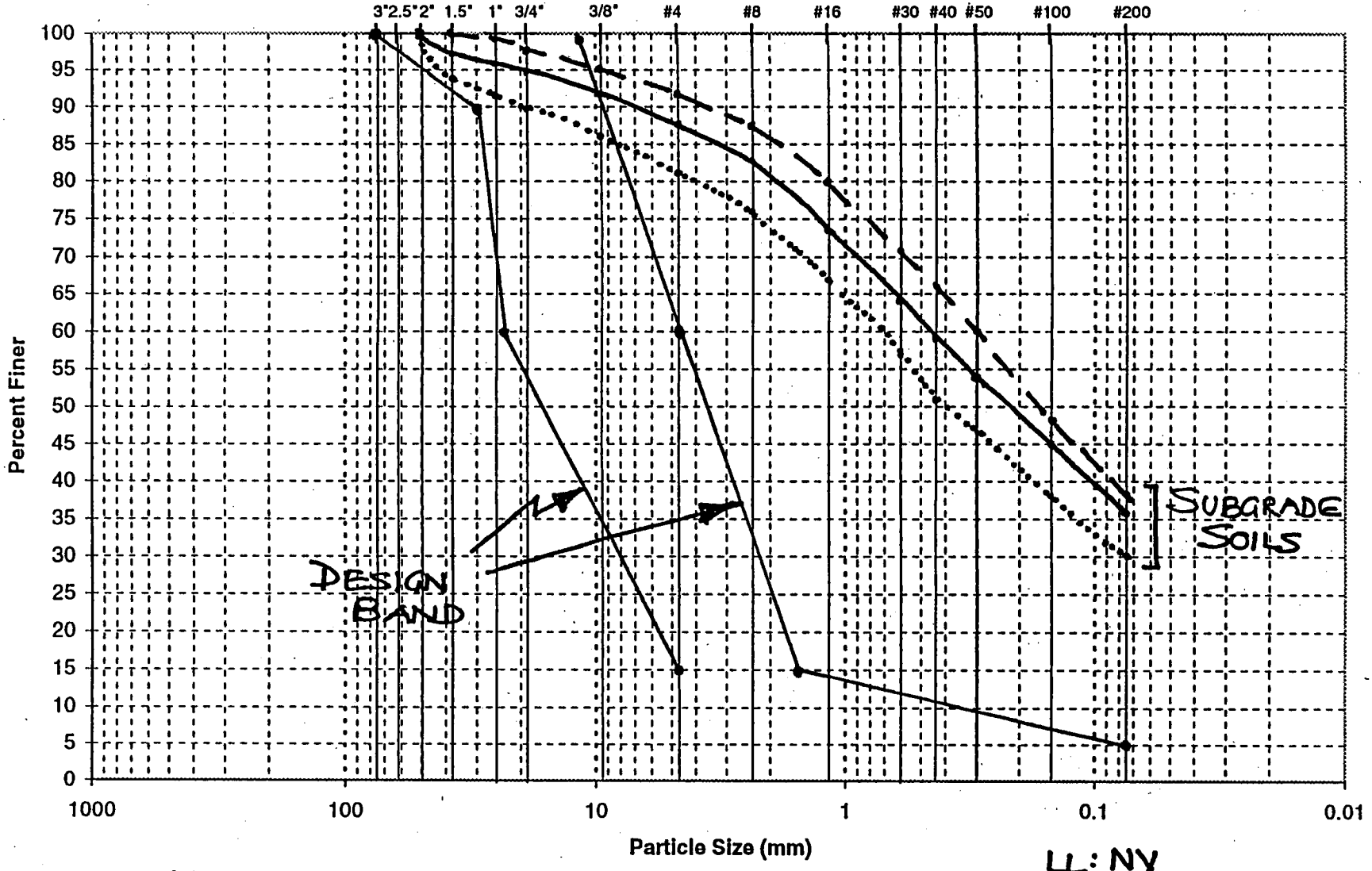
* As seen on Pg 3, subgrade soil is finer than design band

⇒ OK

EAST END
MIDDLE
SUBGRADE SAMPLES

WHITE TANK [illegible]
01/04/02
SOUTH OUTLET
SUBGRADE SAMPLES
Sampling & Testing by Alpha Geotechnical & Materials Inc.

GRADATION SHEET



LL: NV
PI: NP

EI-00001852.00

OKAY

PAGE 3

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS#3 CONSTRUCTION

PROJECT NO. EI-00001852.00

SHEET 1 OF 7

CONST #4

SOUTH OUTLET - FILTER MATCH

TITLE OF CALCULATIONS/DOCUMENT

SUBGRADE (BASE) VERSUS FILTER SAND

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — (SIGNATURE) — 01/04/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY (PRINT NAME) — (SIGNATURE) — 01/04/02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: (PRINT NAME) — (SIGNATURE) — (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME) — (SIGNATURE) — 05/04/02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

URS

Job WHITE TANKS FRS#3 - CONSTRUCTION | Project No. EI-00001852.00 | Sheet ___ of ___

Description SOUTH OUTLET - FILTER MATCH - SUBGRADE (BASE) TO FILTER SAND | Computed by RAVI NURTHY | Date 01/04/02

Checked by _____ | Date _____

Reference

OBJECTIVE: To check filter match between subgrade (South Outlet) and filter sand.

REFERENCE: Chapter 26: Gradation Design of Sand & Gravel Filters Part 633 National Engineering Handbook / NRCS

DATA: (1) Gradation data for subgrade samples by Alpha
(2) Gradation data for filter sand by Alpha / Specs

* Gradation data provided by Alpha is plotted on Fig 1 and summarized on Table 1.

* Since subgrade contains a gravel fraction, correction factor = $\frac{100}{92}$ = ~~1.23~~ 1.09

* Corrected gradation data is provided on Table 1.
  Corrected = Original × Correction Factor. Corrected gradations are plotted on Fig 2

* With fines content of ~~36.9%~~ 41.4%, Base Soil Category = 2
  (Table 26-1 of Reference)

* FILTERING CRITERIA - MAX D_{15}

$$D_{15} \leq \left[\frac{40-A}{40-15}\right]\left[(4 \times d_{85}) - 0.7mm\right] + 0.7mm$$

A = Minus 200 = 36.9%
d_{85} = 1.2mm (Fig 2)

$D_{15} \leq$ 0.7mm

* PERMEABILITY - MIN D_{15}

From Table 26-3 of Reference,

$(D_{15})_{min} \geq 4\, d_{15}$

$d_{15} \Rightarrow$ Base soil before regrading; $\geq 0.1mm$

From Fig 1, $d_{15} < 0.1mm$

Assume $(D_{15})_{min} = 0.1mm \Rightarrow \underline{0.1 \leq D_{15} \leq 0.7mm}$

$\Rightarrow$ Fig 3 shows Filter Sand spec from Special Provisions. Based on Specs,

$(D_{15})_{min} = 0.2mm$

$(D_{15})_{max} = 0.5mm$

Meets above requirement for $(D_{15})_{max}$ and $(D_{15})_{min}$ $\Rightarrow$ OK

$\Rightarrow$ The remainder of the filter match procedure relates to the width of the acceptable filter band, and the shape of the filter band (C_u). The proposed filter sand (C33 fine) was shown to meet these ~~ctr~~ criteria during design (See Calc #7 in Design Report).

$\Rightarrow$ Filter match between Subgrade Soils and Filter Sand is OK.

ALPHA Geotechnical & Materials, Inc.

4

PROJECT:	WHITE TANK	JOB NUMBER:	01-A-00075
LOCATION:	WHITE TANK DAM – SOUTH OUTLET KBA	WORK ORDER NO:	1
MATERIAL:	SUB-GRADE	LAB NO:	5
SAMPLE SOURCE:	EAST END	DATE SAMPLED:	01/02/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING	ATTERBERG LIMITS
6 IN	100	
4 IN	100	LL: NV
3 IN	100	PI: NP
2 IN	100	
1 1/2 IN	100	
1 IN	99	
3/4 IN	98	
1/2 IN	96	
3/8 IN	95	
1/4 IN	93	
#4	92 100	
#8	88 96	
#10	87 95	
#16	80 87	
#30	71 77	
#40	66 72	
#50	60 65	
#100	48 52	
#200	38 41.4	

OKAY KBA

CORRECTION FACTOR: 100 / 92 = 1.09

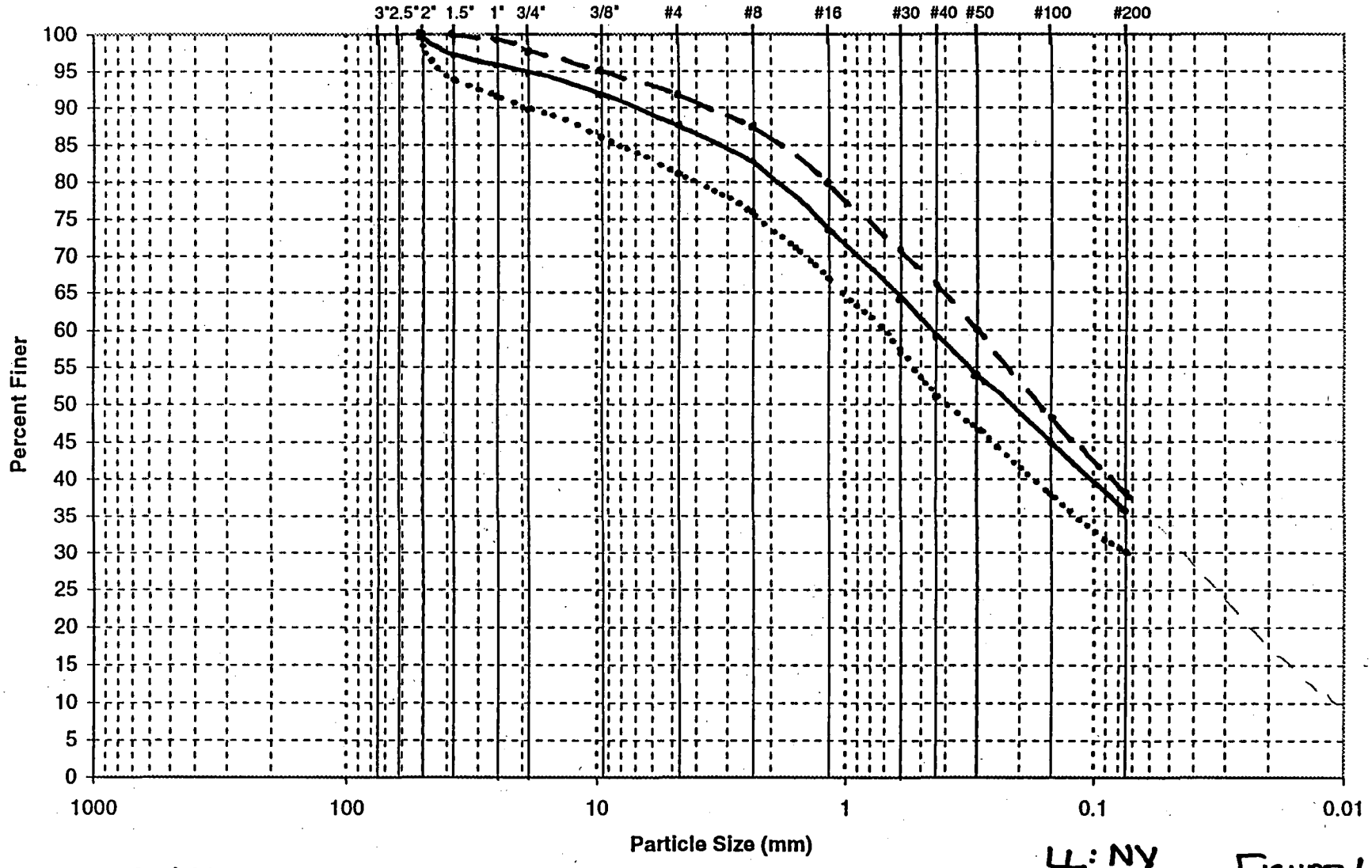
TABLE 1

ALPHA
Engineering • Testing • Solutions

——— [illegible]
— — — EAST END (Used in Filter Match)
..... MIDDLE (FINEST SAMPLE CORRECTED)

[illegible]
01/04/02
SOUTH OUTLET
SUBGRADE SAMPLES
Sampling & Testing by Alpha Geotechnical & Materials Inc.

GRADATION SHEET



EI-00001852.00

LL: NV
PI: NP

FIGURE 1

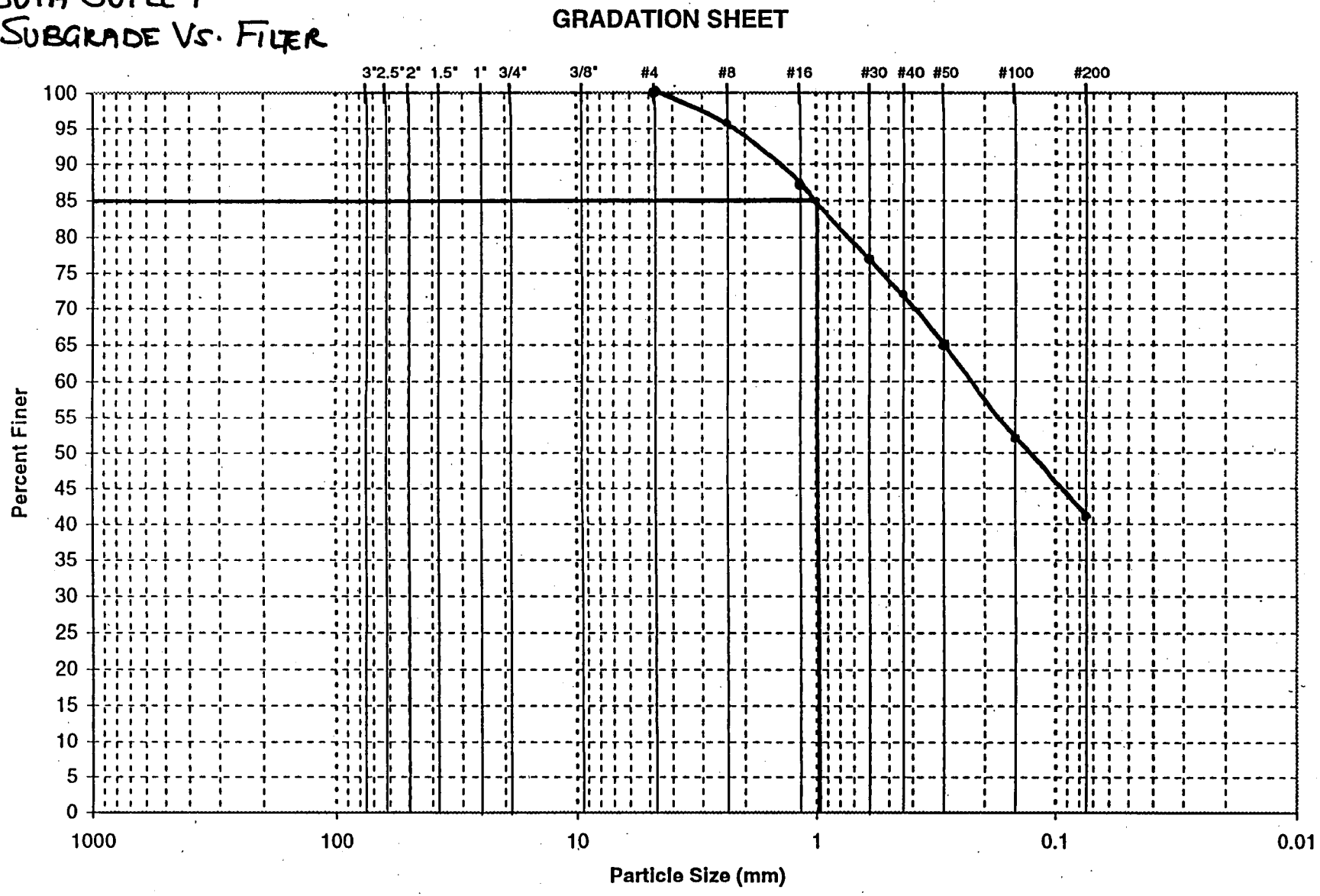
5

OKAY

WHITE TANKS FRS #3
01/04/02
SOUTH OUTLET
B2 SUBGRADE VS. FILTER

—— REGRADED SUBGRADE

FIGURE 2



OKAY

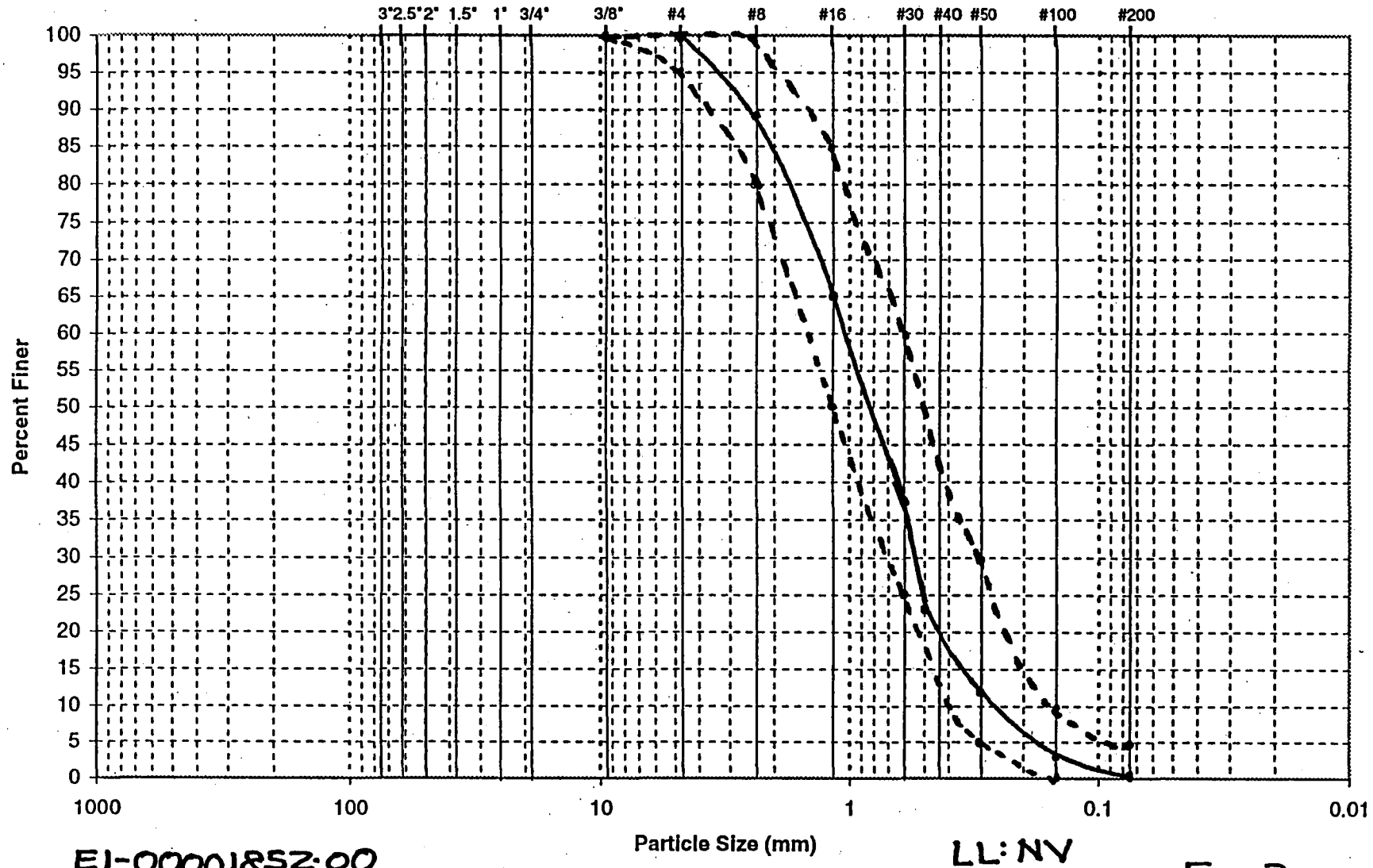
—— - Gradation results provided by Alpha.

- - - - - Gradation Per Project Specs

SOUTH OUTLET (CMP)

WHITE TANKS FRS#3 - DS
01/04/02
FILTER SAND GRADATION
(Sample collected and tested by Alpha Geotechnical & Materials Inc)

GRADATION SHEET



OKAY

EI-00001852.00

LL: NV
PI: NP

FIG 3

URS

Design Memo No. 8 (Revised)

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Kevin Somerville, E.I.T. / Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX

Date: February 25, 2002 **(Revised to Clarify Which Materials Are Affected by Change in Spec)**

Re: White Tanks FRS #3 – **Compaction Moisture Content Specification**

The following compaction moisture content specifications for the White Tanks FRS #3 IDS project should be modified as discussed below:

- ***Page 6 of 67 of the Special Provisions, Subsection 206.2 Foundation Material Treatment:*** The moisture content specification for the foundation (prepared subgrade) should be changed to one (1) percent below optimum moisture content (OMC) to three (3) percent above optimum. All other discussions and recommendations (including discussion relating to pumping of the subgrade) continue to remain valid. **(range = -1% to +3%)**

- ***Page 7 to 67, Subsection 206.4 & Page 13 of 67, Subsection 211.2.2 Soil Buttress Fill:*** The moisture content specification for the soil buttress fill material should be changed to two (2) percent below OMC to one (1) percent above OMC. **(range = -2% to +1%)**

The above text changes serve to clarify and do not affect the technical nature of the original change or intent presented in Design Memo No. 8 dated January 7, 2002.

Should you have questions or require additional information, please contact us at (602) 371-1100.

URS

Design Memo No. 9

Technical Support During Construction

To: Duke Yager
FCDMC

CC: Tom Renckly
FCDMC

From: Kevin Somerville, E.I.T.

CC:

Date: 01/09/02

Re: Submittal Review

This memo is prepared to provide URS's review comments on the project submittals from Buesing Corp. in support of the FCDMC formal approval process.

1. Submittal for 48" and 24" 14 Gage 2-2/3 x ½" Galvanized Polycoated CSP dated 12/20/01 (faxed 12/27)

   No Decision – No Information To Review. Although the cover sheet indicates a submittal was being transmitted for corrugated metal pipe (CMP), manufacturer data is not included. A separate submittal is requested.

2. Submittal for 4" and 8" HDPE Triple Wall Perforated Pipe dated 12/20/01(faxed 12/27)

   Rejected – Material Does Not Meet Specification. The minimum open area per lineal foot of pipe is insufficient to meet spec. Also, no data was submitted on the manufactured geotextile sock to go over the HDPE drain pipes. The triple wall pipe appears okay, however only double wall is required.

If you have any questions regarding the content of this memo please call me at your convenience.

URS

Design Memo No. 10

Technical Support During Construction

To: Duke Yager
FCDMC

CC: Tom Renckly
FCDMC

From: Kevin Somerville, E.I.T.

CC:

Date: 01/09/02

Re: Submittal Review

This memo is prepared to provide URS's review comments on the project submittals from Buesing Corp. in support of the FCDMC formal approval process.

1. Submittal for Concrete Materials (Mix Design) dated January 4, 2002 (faxed 1 / 4 / 02).

   Approved. The MAG A, Type II cement, 3,000 PSI @ 28 days, 1" coarse aggregate (#57), slump range 3 to 5 inches, 1% air, and water reducing agent mix design appears meet specification.

If you have any questions regarding the content of this memo please call me at your convenience.

URS

Design Memo No. 11

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

Date: January 12, 2002

Re: White Tanks FRS #3 – **North Outlet** Filter Matches

Registered Professional Engineer
CERTIFICATE NO. 30016
RAVI MURTHY
Date Signed 01/12/02
ARIZONA, U.S.A.

URS has received and reviewed the laboratory test results of samples collected and tested by Alpha Geotechnical & Materials Inc. We understand that three samples were collected from the subgrade in the vicinity of the **north outlet**. The attached Calculation Package (CONS #5) documents the results of our review and assessment. These results are also summarized in the Table below:

Subject	Comments
Retention Criterion – Geotextile versus Subgrade	Geotextile is compatible with the subgrade soils
Filter Match – Filter Sand (as base soil) versus Subgrade soils	Meets filter match criteria
Filter Match – Subgrade (as base soil) versus Filter Sand	Meets filter match criteria

Results of the compaction tests (moisture and density) of the subgrade at the north outlet have not yet been provided to URS for review. Should you have questions or require additional information, please contact us at (602) 371 1100.

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS#3 IDS CONSTRUCTION

PROJECT NO. EI-0000185200

SHEET 1 OF 15

CONS # 5

NORTH OUTLET: Filter Matches

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/11/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/11/02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Todd Ringsmuth (PRINT NAME) — SIGNATURE — 1/14/02 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME) — SIGNATURE — 01/11/02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

URS

DATE 01/11/02

PROJECT NO. E1-00001852.00

PAGE NO. 2 OF 15 BY RAVI MURTHY

NORTH OUTLET

OBJECTIVE: Check compatibility of subgrade soils and geotextile. Subgrade soils exposed during construction

DATA: (1) Gradation results for 3 subgrade samples. Sampling and testing by Alpha
(2) Spec sheet for AMOCO Style 4553 provided by contractor

REFERENCE: "Designing with Geosynthetics" - R.M. Koerner, 3rd Ed, Pg 101, Carroll (1983)

* from gradation curves for subgrade soils

$d_{85} = 0.9mm$ to $1.3mm$

* from AMOCO spec sheet, $AOS = O_{95} = 0.15mm$

* $O_{95}/d_{85} = \frac{0.15}{1.3}$ to $\frac{0.15}{0.9}$

$= 0.12$ to 0.17

* from Reference (2), $O_{95}/d_{85} < 2$ to 3

∴ Geotextile and subgrade soils are compatible

—— SOUTH END LL: 28 PI: 6
..... MIDDLE LL: 38 PI: 11
- - - - NORTH END LL: 41 PI: 20

WHITE TANKS FRS#3 IDS CONSTRUCTION
01/10/02
NORTH OUTLET
SUBGRADE SAMPLES - Sampling & Testing by Alpha

GRADATION SHEET

EI-0000185200.00

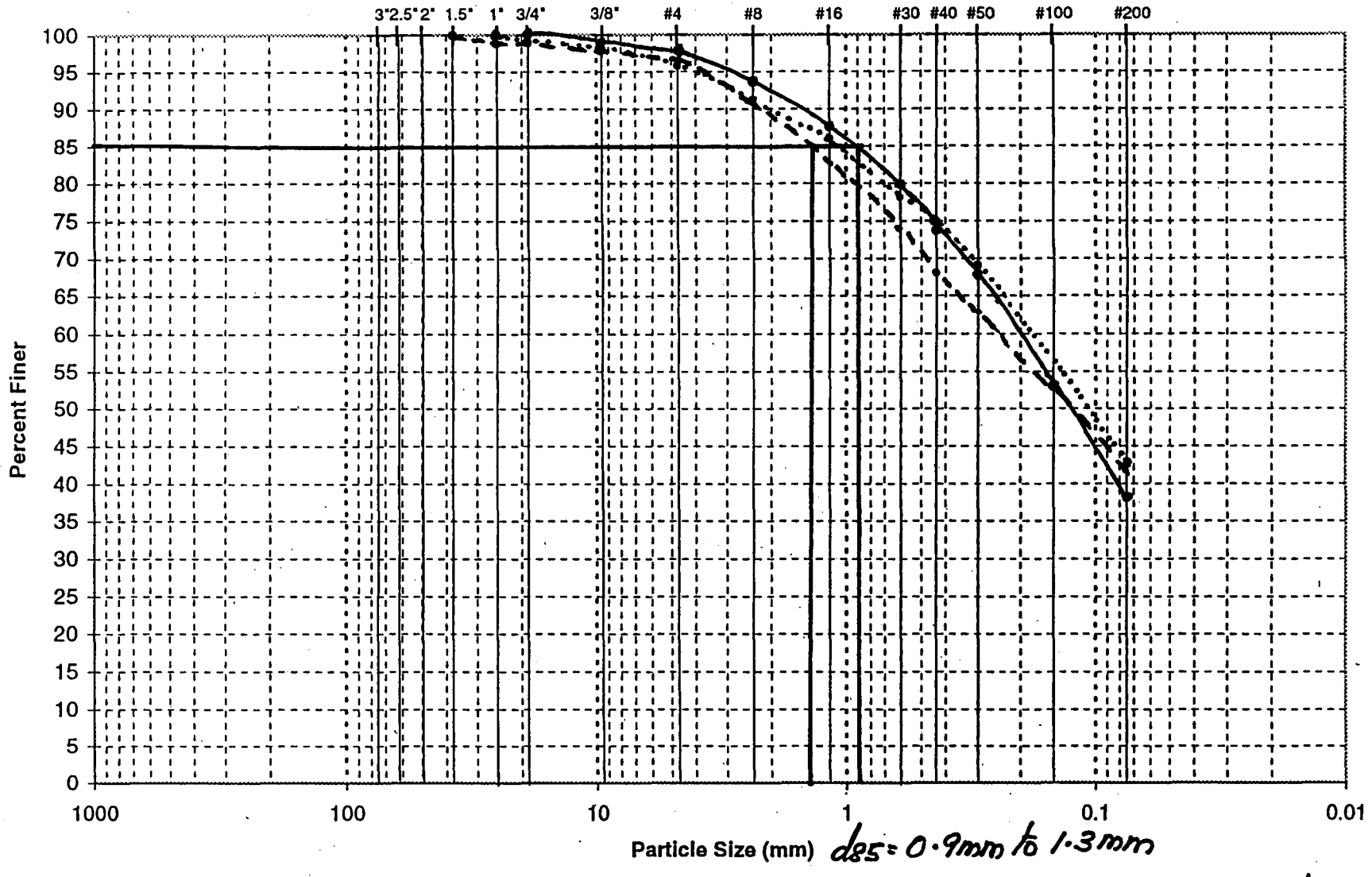


FIGURE 1

AMOCO FABRICS AND FIBERS COMPANY
900 Circle 75 Parkway, Suite 300
Atlanta, GA 30339
PH: (770) 984-4444
FX: (770) 956-2430

STYLE 4553

Amoco Style 4553 is a polypropylene nonwoven needlepunched fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a ph range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that Amoco Style 4553 meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Grab Tensile	ASTM-D-4632	203 lbs	0.900 kN
Grab Elongation	ASTM-D-4632	50 %	50 %
Mullen Burst	ASTM-D-3786	400 psi	2750 kPa
Puncture	ASTM-D-4833	130 lb	0.575 kN
Trapezoidal Tear	ASTM-D-4533	80 lb	0.355 kN
UV Resistance	ASTM-D-4355	70 % at 500 hrs	70 % at 500 hrs
AOS	ASTM-D-4751	100 sieve	0.15 mm
Permittivity	ASTM-D-4491	1.5 sec^{-1}	1.5 sec^{-1}
Flow Rate	ASTM-D-4491	110 $gal/min/ft^2$	4470 $L/min/m^2$

Amoco Fabrics and Fibers Company manufactures the nonwoven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories. A letter certifying the minimum average roll values will be issued from the manufacturing plant by the Quality Control Manager at the time shipment is made.

DATE ISSUED: 01/01/98

The information presented herein, while not guaranteed, is to the best of our knowledge true and accurate. Except when agreed to in writing for specific conditions of use, no warranty or guarantee expressed or implied is made regarding the performance of any product, since the manner of use and handling are beyond our control. Nothing contained herein is to be construed as permission or as a recommendation to infringe any patent.

d_{85}, d_{50}, or d_{15}; see Table 2.3). The numeric value of the ratio depends on the geotextile type, the soil type, the flow regime, etc. For example, Carroll [5] recommends the following:

$$O_{95} < (2 \text{ or } 3)\ d_{85} \tag{2.9}$$

where d_{85} is the soil particle size in mm for which 85% of the total soil is finer.

Table 2.3 Existing geotextile retention criteria, after Christopher and Fischer [3]

Source	*Criterion*	*Remarks*
Task Force #25 (1986)	50% ≤ 0.074 mm, O_{95} < 0.59 mm 50% > 0.074 mm, O_{95} < 0.30 mm	No limitations on geotextile type or soil type
Calhoun (1972)	$O_{95}/d_{85} \leq 1$	Wovens, soils with ≤50% passing No. 200 sieve
	$O_{95} \leq 0.2$ mm	Wovens, cohesive soils
Zitscher (1975)	$O_{50}/d_{50} \leq 1.7$–2.7	Wovens, soils with CU ≤ 2, d_{50} = 0.1 to 0.2 mm
	$O_{50}/d_{50} \leq 2.5$ to 3.7	Nonwovens, cohesive soil
Ogink (1975)	$O_{90}/d_{90} \leq 1$	Wovens
	$O_{90}/d_{90} \leq 1.8$	Nonwovens
Sweetland (1977)	$O_{15}/d_{85} \leq 1$	Nonwovens, soils with CU = 1.5
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with CU = 4.0
Rankilor (1981)	$O_{50}/d_{85} \leq 1$	Nonwovens, soils with 0.2 ≤ d_{85} ≤ 0.25 mm
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with d_{85} > 0.25 mm
Schober & Teindl (1979)	$O_{90}/d_{50} \leq 2.5$–4.5	Woven and thin nonwovens, dependent on CU
	$O_{90}/d_{50} \leq 4.5$–7.5	Thick nonwovens, dependent on CU, silt and sand soils
Giroud (1982)	$O_{95}/d_{50} \leq (9$–$18)/\text{CU}$	Dependent on soil CU and density
		Assumes fines in soil migrate for large CU values
Carroll (1983)	$O_{95}/d_{85} \leq 2$–3	Wovens and nonwovens
Christopher and Holtz (1985)	$O_{95}/d_{85} \leq 1$–2	Dependent on soil type and CU
	$O_{95}/d_{15} \leq 1$ or $O_{50}/d_{85} \leq 0.5$	Dynamic, pulsating, and cyclic flow, if soil can move beneath geotextile
French Committee on Geotextiles and Geomembranes (1986)	$O_f/d_{85} \leq 0.38$–1.25	Dependent on soil type, compaction, hydraulic and application conditions
Fischer et al. (1990)	$O_{50}/d_{85} \leq 0.8$ $O_{50}/d_{15} \leq 1.8$–7.0 $O_{50}/d_{50} \leq 0.8$–2.0	Based on geotextile pore size distribution, dependent on CU of soil

O_x = geotextile opening size corresponding to x particle size based on dry glass bead sieving.
O_f = filtration opening size based on hydrodynamic sieving.
d_y = soil particle size corresponding to y percent passing.
CU = coefficient of uniformity = d_{60}/d_{10}.

URS

DATE 01/11/02
PROJECT NO. EI-00001852.00
PAGE NO. 6 OF 15 BY RAVI MURTHY

NORTH OUTLET

OBJECTIVE: To check compatibility of the filter sand (base) and subgrade soil @ North Outlet

DATA: (1) Subgrade gradation results provided by Alpha
(2) Design gradation for filter sand
(3) Calculation Package #6, Design Report Vol 2, August 3, 2001, Appendix E

REFERENCE: Chapter 26; Gradation, Design of Sand & Gravel Filters Part 633, National Engineering Handbook, NRCS

* Calculation Package #6 Documents a filter match between filter sand (base) and drain

* From Calculation Package #6, following Control Points were used to define the design band

COARSE		FINE	
Size (mm)	% Passing	Size (mm)	% Passing
75	100	12.1	99.8
30	90	4.8	60
24	60	1.64	15
48	15	0.075	5

* Above Control Points are plotted on Page 7.

* As seen on Page 7, subgrade soils are finer than design band

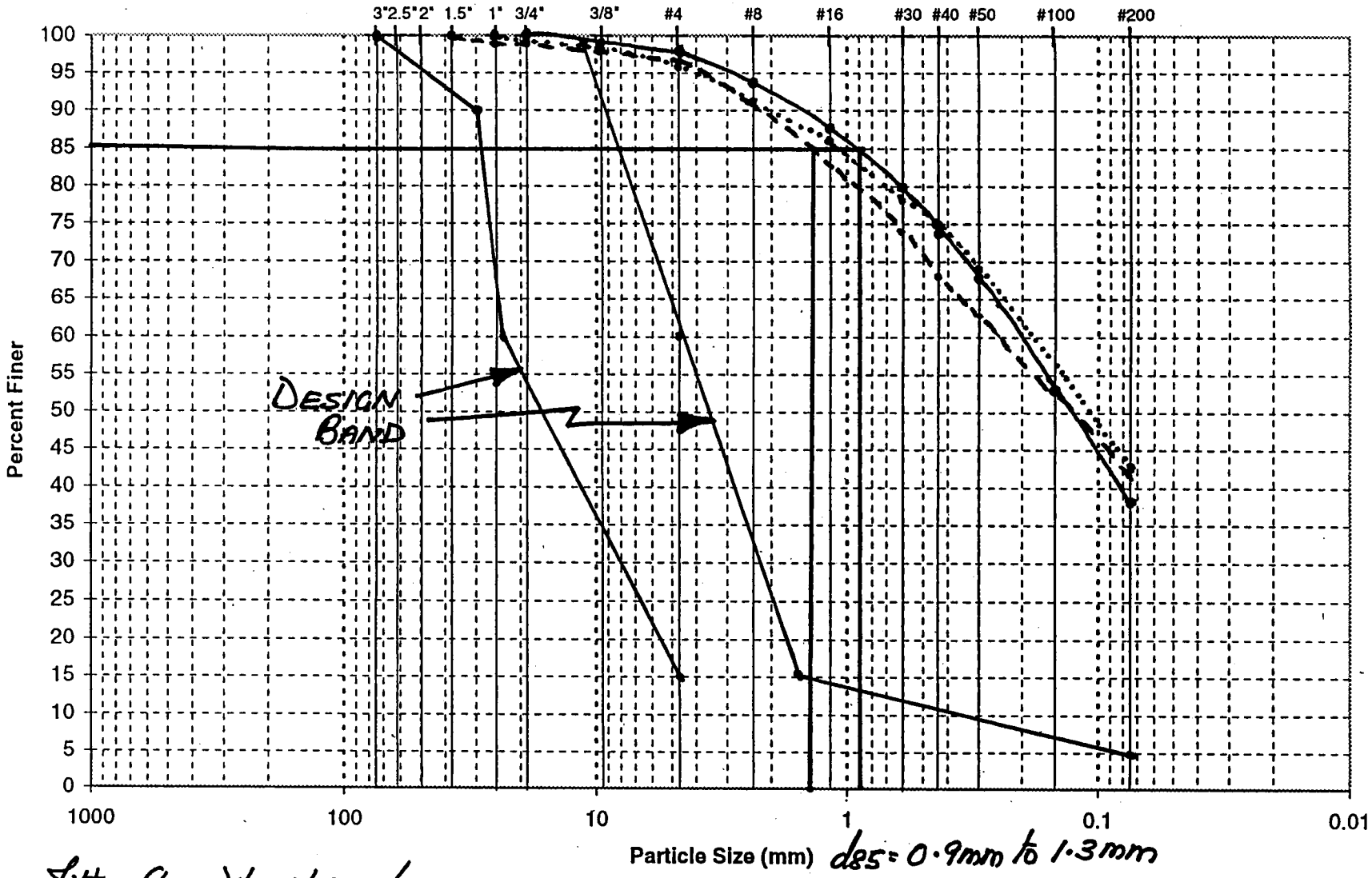
⇒ OK

—— SOUTH END LL: 38 PI: [illegible]
..... MIDDLE LL: 38 PI: 11
- - - - NORTH END LL: 41 PI: 20

[illegible]
01/10/02
NORTH OUTLET
SUBGRADE SAMPLES - Sampling & Testing by Alpha

GRADATION SHEET

EI-0000185200.00



filter (base) to subgrade

NORTH OUTLET

OBJECTIVE: To check filter match between subgrade at North Outlet and filter sand.

DATA: (1) Gradation data for subgrade provided by Alpha
(2) Gradation data for filter sand from project specifications
(3) Gradation data for filter sand from Alpha

REFERENCES: Chapter 26: Gradation Design of Sand & Gravel Filters Part 633, National Engineering Handbook, NRCS

* The gradation data provided by Alpha is plotted on Page 10 and summarized on Tables 1,2,3. Of the 3 subgrade samples, the one with the highest fines content is used in the filter match.

* Since subgrade contains a gravel fraction,

$$\text{Correction Factor} = \frac{100}{96} = 1.04$$

* Corrected gradation = Original Gradation x Correction Factor. Corrected data is summarized on Table 1, and plotted on Page 11

* Table 26-1 of Reference, with fines content of 45%, Base Soil Category = 2

* FILTERING CRITERIA – MAX D_{15}

$$D_{15\,max} \leq 0.7mm$$

* PERMEABILITY CRITERIA – MIN D_{15}
From Table 26-3 of Reference,
$(D_{15})_{min} \geq 4 \times d_{15}$ (before regrading)

* Based on gradation, $(D_{15})_{min} = 0.1mm$ (Limiting value from Table 26-3)

$\Rightarrow \quad 0.1mm \leq D_{15} \leq 0.7mm$

* As seen on Page 12, for filter sand

$(D_{15})_{min} = 0.2mm$
$(D_{15})_{max} = 0.5mm$

Meets the above requirements $\Rightarrow$ OK

* The remainder of the filter match relates to the width of the acceptable filter band, ~~the~~ and the shape of the filter band. The proposed filter sand was shown to meet these requirements during design. (See Calc # 7 in Design Report)

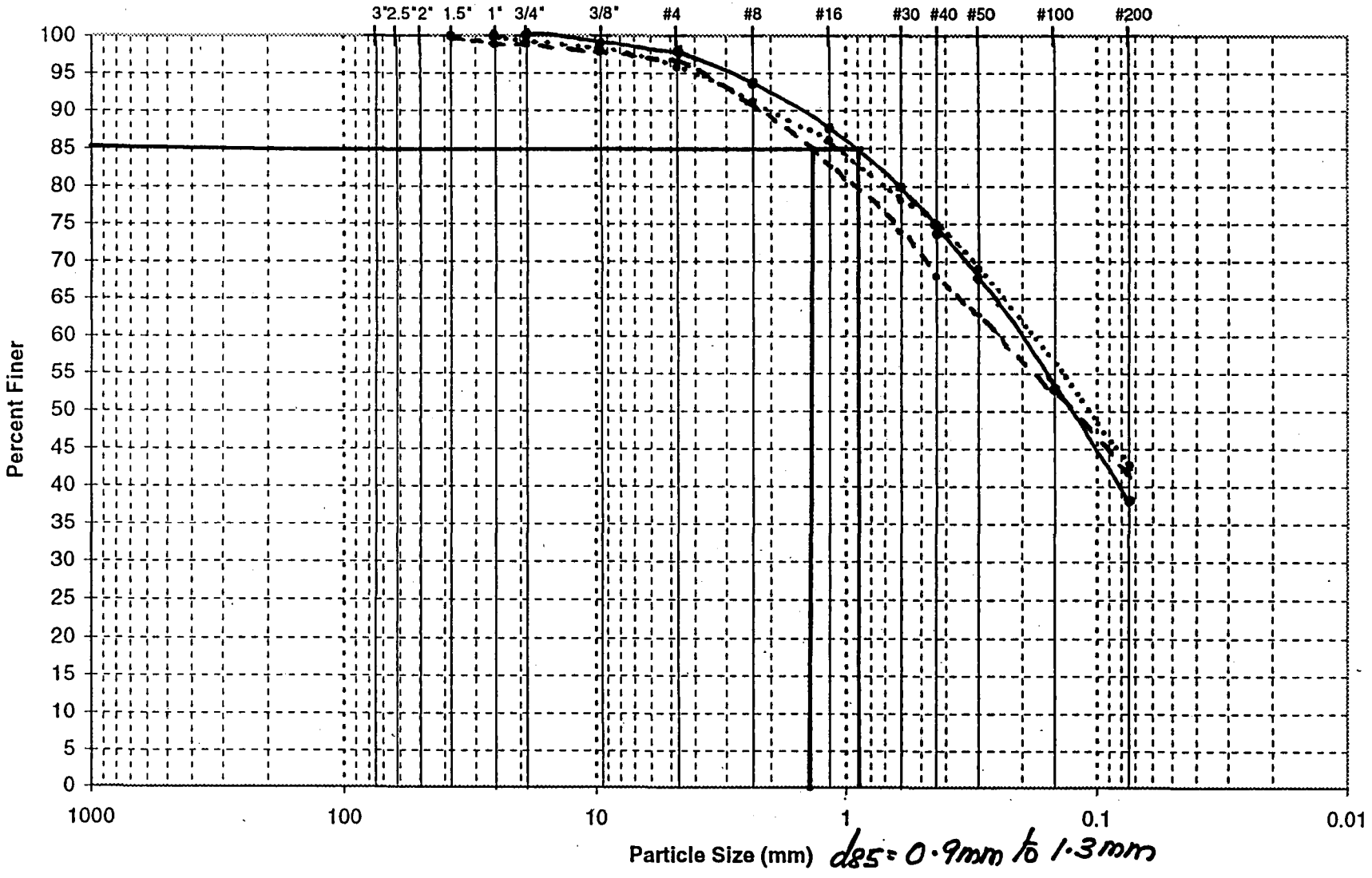
$\Rightarrow$ Filter match between Subgrade Soils & Filter Sand is OK

— SOUTH END LL: 38 PI: [illegible]
..... MIDDLE LL: 38 PI: 11
- - - - NORTH END LL: 41 PI: 20

[illegible] 01/10/02
NORTH OUTLET
SUBGRADE SAMPLES - Sampling & Testing by Alpha

GRADATION SHEET

EI-0000185200.00

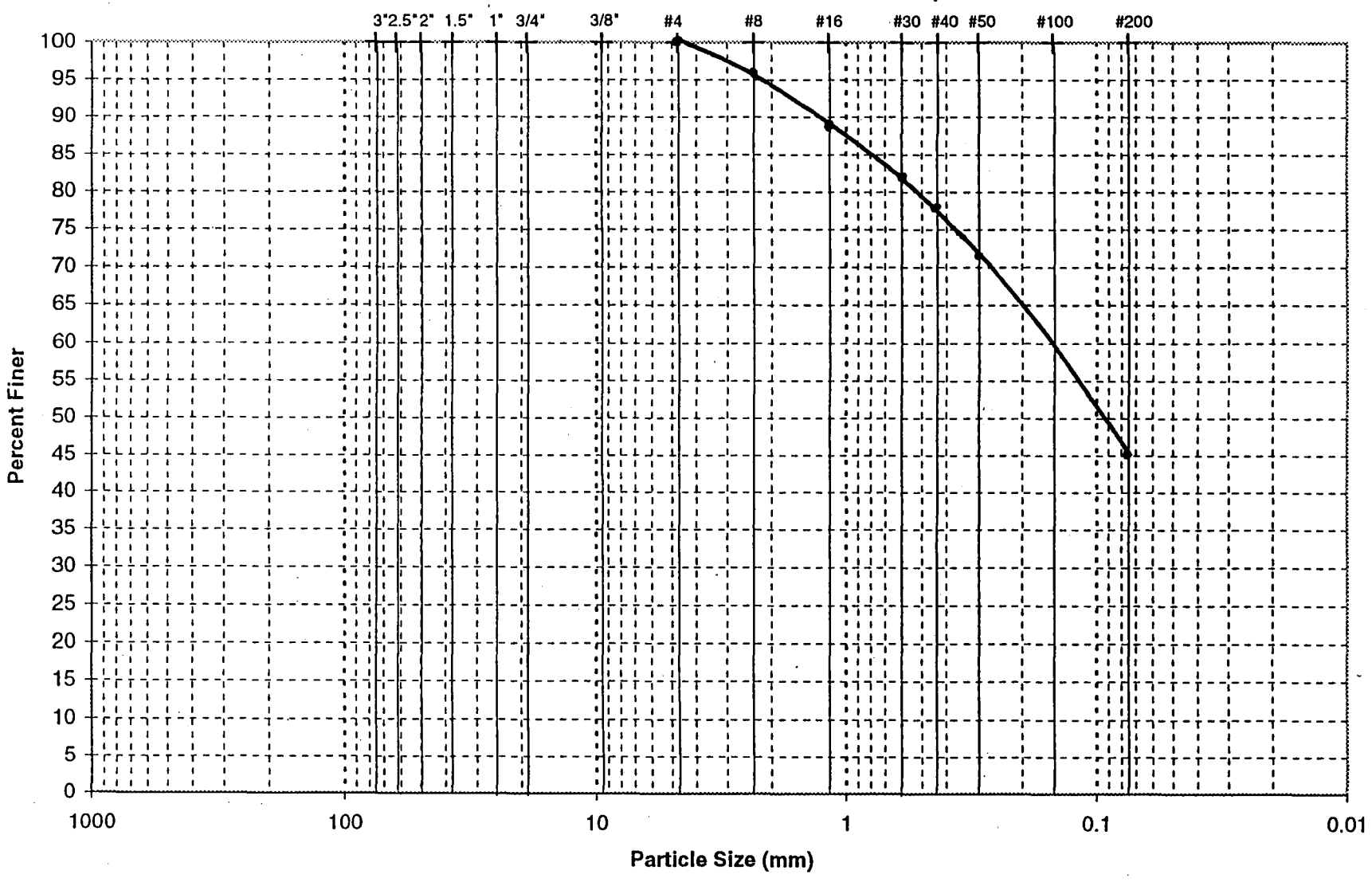


E1-00001852.00

WHITE TANKS FRS #3 IDS CONSTRUCTION
01/11/02
NORTH OUTLET

Corrected gradation for subgrade sample.

GRADATION SHEET



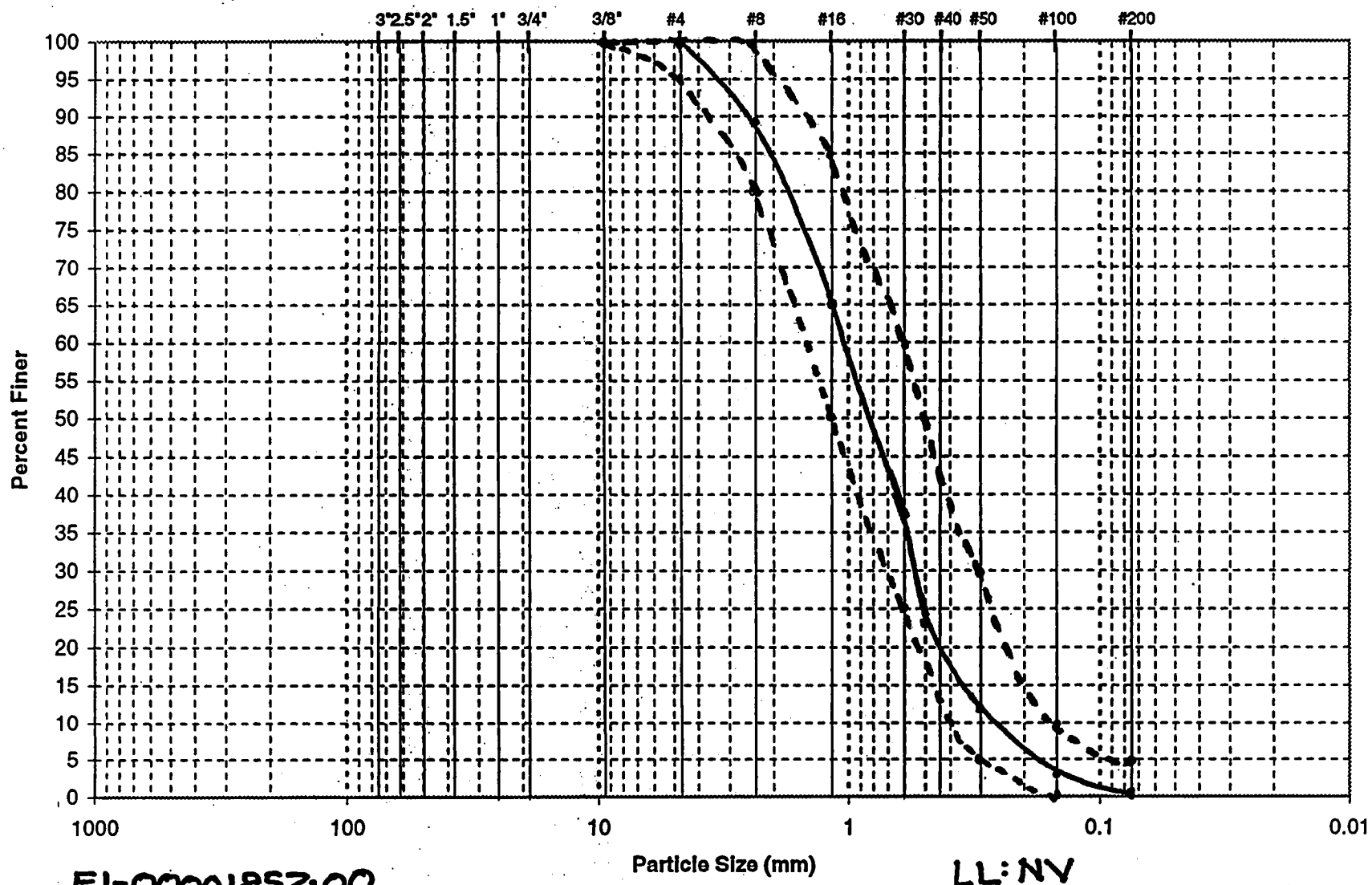
— Gradation Results provided by Alpha.

- - - - - Gradation Per Project Specs

WHITE TANKS FRS #3 IL
01/11/02

FILTER SAND GRADATION
(Sample collected and tested by Alpha Geotechnical & Materials Inc)

GRADATION SHEET



EI-00001852.00

LL: NV
PI: NP

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	**JOB NUMBER:**	01-A-00075
LOCATION:	WHITE TANK DAM	**WORK ORDER NO:**	3
MATERIAL:	NATIVE	**LAB NO:**	11
SAMPLE SOURCE:	MIDDLE (N. EXCAVATION)	**DATE SAMPLED:**	01/08/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING	ATTERBERG LIMITS
6 IN	100	
4 IN	100	LL: 38
3 IN	100	PI: 11
2 IN	100	
1 1/2 IN	100	
1 IN	100	
3/4 IN	99	
1/2 IN	98	
3/8 IN	98	
1/4 IN	97	
#4	96 100	
#8	92 96	
#10	91 95	
#16	86 89	
#30	79 82	
#40	75 78	
#50	69 72	
?? → #100	92 ??	
#200	43 45	

HAND WRITTEN VALUES = CORRECTED FOR + #4 fraction

Correction Factor = $\frac{100}{96}$ = 1.04

TABLE 1

ALPHA
Engineering • Testing • Solutions

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	**JOB NUMBER:**	01-A-00075
LOCATION:	WHITE TANK DAM	**WORK ORDER NO:**	3
MATERIAL:	NATIVE	**LAB NO:**	10
SAMPLE SOURCE:	SOUTH END (N. EXCAVATION)	**DATE SAMPLED:**	01/08/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING	ATTERBERG LIMITS
6 IN	100	
4 IN	100	LL: 28
3 IN	100	PI: 6
2 IN	100	
1 1/2 IN	100	
1 IN	100	
3/4 IN	100	
1/2 IN	99	
3/8 IN	99	
1/4 IN	98	
#4	98	
#8	94	
#10	93	
#16	88	
#30	80	
#40	74	
#50	68	
#100	53	
#200	38	

TABLE 2
Page 14 Of 15

ALPHA
Engineering • Testing • Solutions

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	**JOB NUMBER:**	01-A-00075
LOCATION:	WHITE TANK DAM	**WORK ORDER NO:**	3
MATERIAL:	NATIVE	**LAB NO:**	12
SAMPLE SOURCE:	NORTH END (N. EXCAVATION)	**DATE SAMPLED:**	01/08/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	99
3/4 IN	99
1/2 IN	99
3/8 IN	98
1/4 IN	97
#4	97
#8	91
#10	90
#16	83
#30	74
#40	68
#50	63
#100	53
#200	42

ATTERBERG LIMITS

LL: 41
PI: 20

TABLE 3
PAGE 15 OF 15

ALPHA
Engineering • Testing • Solutions

TRANSMISSION RESULT REPORT (JAN 14 '02 12:26PM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 14	12:20PM	602 506 8561	06'09"	OK	ES	16		014

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (JAN 14 '02 11:55AM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 14	11:49AM	6024172423	06'07"	OK	ES	16		010

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (JAN 14 '02 12:09PM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
JAN 14	12:02PM	602 506 8561	06'06"	OK	ES	16		012

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

URS

Design Memo No. 12

REVISED

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

Date: January 16, 2002

Re: White Tanks FRS #3 – **South Outlet** Subgrade Compaction - ***Revised***

Registered Professional Engineer (Civil) CERTIFICATE NO. 30016 RAVI MURTHY Date Signed 01/16/02 ARIZONA, U.S.A.

URS has received by fax (January 15, 2002) and reviewed the field compaction test results, and the moisture-density relationship (ASTM D698) for the subgrade (prepared foundation) at the south outlet. The field and laboratory testing was performed by Alpha Engineering. ***The compacted dry density meets project specifications; however, the moisture content at the time of compaction for two of the field tests is below the specified range based on the Proctor results depicted on Figure 2.*** The results of the field and laboratory tests are attached, and are also summarized below:

Sheet 1: Results of compaction tests performed by Alpha on January 7, 2002. The subgrade did not meet specifications for dry density and moisture content. Buesing conducted rework of the subgrade.

Sheet 2: Results of compaction retests performed by Alpha on January 8, 2002. The subgrade met specifications for dry density and moisture content based on a maximum dry density (MDD) (D698) of 127.6 pcf and an optimum moisture content (OMC) of 9.7%.

Figure 1 Results of Std. Proctor (D698) sampled on 01/02/02 used on Sheets 1 and 2. However, there was some doubt as to the origin of the sample tested (stockpile versus actual subgrade). Therefore, the subgrade was re-sampled and re-tested.

MDD = 127.6 pcf OMC = 9.7% Curve A

Figure 2 Results of Std. Proctor (D698) following re-sampling of subgrade on 01/14/02 and re-test. MDD = 125.0 pcf OMC = 11.4% Curve G

Alpha should prepare final field and laboratory reports (on letterhead) for incorporation into the construction report.

Should you have questions or require additional information, please contact us at (602) 371 1100.

ALPHA Geotechnical & Materials, Inc. Report # _____

FIELD DENSITY TEST DATA
CAMPBELL PACIFIC
NUCLEAR GAUGE
SOIL/ASPHALT

Project Name: White Tanks FRS #3 - IDS Job No: _____ Date: 1-7-02

Material (Circle One):

ABC IMPORT RIVER-RUN (NATIVE) EXISTING FILL

Gauge No: 4 Technician: E. Hall

Test No.	1	2	3		
Location of Test South Excavation (General Location)	4' Downstream of Pipe outlet ℄ of Pipe (Exact location)	16' Downstream of Pipe outlet 4' left of Pipe ℄ (Exact location)	34' Downstream of Pipe outlet ℄ of Pipe (Exact location)	(Exact location)	(Exact location)
Depth of Test (100=Finish grade)	95	97	98		
Wet Density	127.5	116.8	128.4		
pcf Moisture	8.4	6.9	7.9		
Dry Density	119.0	109.9	120.4		
% Moisture	7.1	6.3	6.6		
% Compaction	93.3	86.2	94.39		
% Compaction Req'd. (Spec.)	95%	95%	95%		
Curve Used	A	→	→		
Maximum Density/ Corrected Density	127.6	→	→		
Optimum Moisture/ Corrected Moisture	9.7	→	→		
Depth of Rod	8"	→	→		
% Rock (÷#4)	<10%	→	→		
Pass or Fail	F	F	F		

TECHNICIAN: E. Hall

SHEET 1

ALPHA Geotechnical & Materials, Inc. Report # _____

FIELD DENSITY TEST DATA
CAMPBELL PACIFIC
NUCLEAR GAUGE
SOIL/ASPHALT

Project Name: White Tanks FRS #3 105 Job No: 01-075 Date: 1-8-02

Material (Circle One):

ABC IMPORT RIVER-RUN (NATIVE) EXISTING FILL

Gauge No: 4 Technician: E. Hall

Re Test from 1-7-02

Test No.	1	2	3		
Location of Test South Excavation Re Test from 1-7-02 (General Location)	4' Downstream of Existing 24" Pipe at ℄ of Pipe (Exact location)	16' Downstream of Existing 24" Pipe 4' left of ℄ of Pipe (Exact location)	34' Downstream of Existing 24" Pipe ℄ of Pipe (Exact location)	(Exact location)	(Exact location)
Depth of Test (100 = Finish grade)	95	97	98		
Wet Density	137.0	135.8	134.6		
pcf Moisture	11.2	11.5	10.7		
Dry Density	123.9	123.3	122.6		
% Moisture	10.6	10.1	9.8		
% Compaction	97.0	96.7	96.1		
% Compaction Req'd. (Spec.)	95%	95%	95%		
Curve Used	A	A	A		
Maximum Density/ Corrected Density	127.6	127.6	127.6		
Optimum Moisture/ Corrected Moisture	9.7	9.7	9.7		
Depth of Rod	8"	8"	8"		
% Rock (+#4)	<10%	<10%	<10%		
Pass or Fail	P	P	P		

TECHNICIAN: _____

SHEET 2

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NO:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	1
MATERIAL:	NATIVE	LAB NO:	2
SAMPLE SOURCE:	STOCKPILE	DATE SAMPLED:	01-02-02

ASTM D698

MAXIMUM DRY DENSITY	127.6 PCF	METHOD	A
OPTIMUM MOISTURE CONTENT	9.7%	CURVE	A

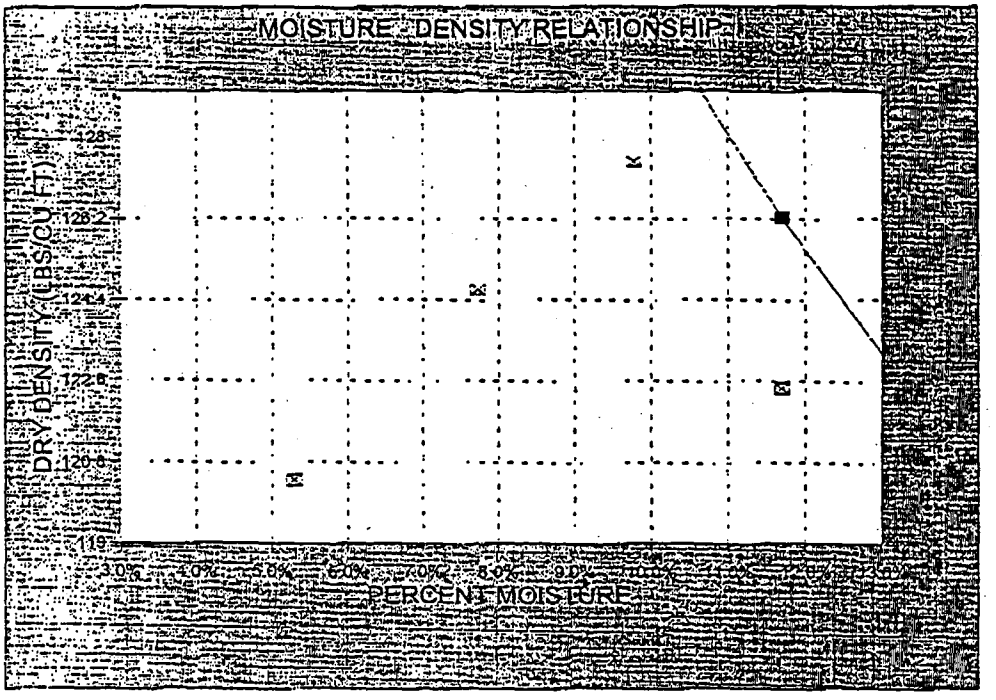


Fig 1

ALPHA
Engineering • Testing • Solutions

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NO:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	4
MATERIAL:	NATIVE (SANDY SOIL)	LAB NO:	13
SAMPLE SOURCE:	S. EXCAVATION, 27' DOWNSTREAM OF E. PIPE	DATE SAMPLED:	01-14-02

ASTM D698

MAXIMUM DRY DENSITY	125.0 PCF	METHOD	A
OPTIMUM MOISTURE CONTENT	11.4%	CURVE	G

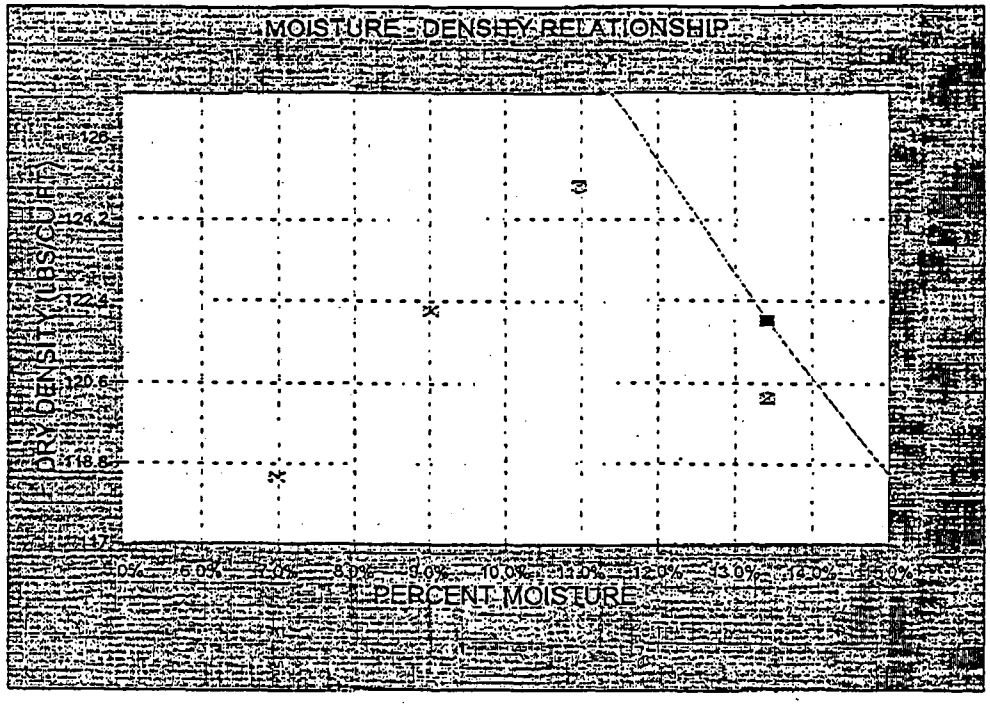


FIG 2

ALPHA
Engineering • Testing • Solutions

Ravi Murthy

01/16/2002 06:36 AM

To: trr@mail.maricopa.gov, lly@mail.maricopa.gov
cc:
Subject: Design Memo 12 Revision

Duke and Tom:

I issued Design Memo 12 on the subgrade compaction at the south outlet yesterday and then found that I had made an error. The subgrade meets spec for the dry density but NOT for the moisture content. The revised Memo 12 is being faxed to you this morning. I spoke with Richard Candelaria and Jim Richards last evening, and they had not placed any fill yet. In fact, they had not yet received Memo 12. However, they are aware of the error now.

Sorry about the error.

REgards
Ravi

To:

TOM RENCKLY : 506 8561
DUKE YAGER : 506 8561

URS

Design Memo No. 13

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

Date: January 17, 2002

Re: White Tanks FRS #3 – **Minimum & Maximum Density of Filter Sand**

URS has received by fax (January 16, 2002) and reviewed the test results of the minimum and maximum density tests on a sample of the filter sand. The tests were performed by Western Technologies on behalf of Alpha. The results appear reasonable and may be used for density control of the filter sand during construction. URS has two requests relative to these results:

1. Please check and confirm the ASTM designations for the two test methods
2. Please provide URS with a hard copy of the test results for inclusion in the final construction report.

Should you have questions or require additional information, please contact us at (602) 371 1100.

Western Technologies Inc.
The Quality People
Since 1955

8305 Washington Place, N.E.
Albuquerque, New Mexico 87113
(505) 823-4488 • fax 821-2963

RELATIVE DENSITY

Project: Alpha Geotechnical & Materials, Inc. No. 01-A-00075 **Date:** January 18, 2002

Sample No: Alpha Bucket #2 **Job No:** 3242092

Soil Classification: Filter Sand

Mold No: 1 **Mold Diameter, in.** 5.99 **Weight of Mold, Wm, lbs.** 11.055

Volume of Mold, Vm, cu ft: 0.0988 **End Area of Mold, Am, sq ft:** 28.18

MINIMUM DENSITY (ASTM D4253)

Trial No			1	2	3	4
weight, lbs	Mold(or tare) and soil, dry	W	20.581	20.548	20.567	
	Mold(or tare)	Wm	11.055	11.055	11.055	
	Soil, dry	Ws	9.526	9.493	9.512	
Minimum Dry Density, lb/cu ft = Ws/Vm		Yd	96.4	96.1	96.3	

Minimum Dry Density, Average: 96.3

MAXIMUM DENSITY (ASTM D4254)

Trial No			1	2	3	4
Height, in.	Left Dial Reading	Hl	0.880	0.880	0.910	
	Right Dial Reading	Hr	0.835	0.854	0.846	
	Average Dial Reading	Havg	0.858	0.867	0.878	
	Initail Dial Reading	Ho	1.931	1.927	1.966	
	Height Change = Ho-Havg	Delta, h	1.07	1.06	1.088	
Vol,cuft	Volume Change	Delta v	0.0175	0.0173	0.0177	
	Volume of Soil	V	0.0813	0.0815	0.0811	
weight, lbs	Mold(or tare) and soil, dry	W	20.581	20.548	20.567	
	Mold(or tare)	Wm	11.055	11.055	11.055	
	Soil, dry	Ws	9.526	9.493	9.512	
Maximum Dry Density, lb/cu ft = Ws/Vm		Yd	117.2	116.5	117.3	

Maximum Dry Density, Average: 117.0

Reviewed by: Cuadores, Andrew L.

WESTERN TECHNOLOGIES INC.

URS

Design Memo No. 14

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX
Richard Candelaria - Buesing (Fax 602-233-3377)

Date: January 20, 2002

Re: White Tanks FRS #3 – **Various**

---

1. ***South Outlet Subgrade:*** The subgrade at the south outlet was reworked and re-tested on January 18, 2002. Results were provided to Mr. Kevin Somerville of URS during his site visit on the same day. These results are attached as Sheet No. 1. Based on these results, it appears that two of the three test results meet project specifications for both relative compaction (min. 95% of MDD) and moisture content (1% below OMC to 3% above OMC; 10.4% to 14.4%). The third test meets specification for relative compaction, but is marginally (0.5 %) above the specified range for moisture content. We recommend that this area of the subgrade be inspected closely for adverse impacts due to higher moisture content, and be re-tested prior to placement of sand or concrete. If the subgrade appears soft or the moisture content is still higher than the specified range, re-working of the subgrade soils in this area may be required.

2. ***North Outlet Subgrade:*** The subgrade at the North outlet was tested on January 18, 2002. Results were faxed to URS on January 18, 2002. These results are attached as Sheet No. 2. Based on these results, it appears that tthe three test results meet project specifications for both relative compaction (min. 95% of MDD) and moisture content (1% below OMC to 3% above OMC).

3. ***Density by Test Pit (ASTM D4914) versus Density by Sand Cone (ASTM D1556):*** Due to the time required to complete the D4914 test, the contractor and District have asked if the sand cone method (D1556) can be substituted for the test pit method (D4914) to measure in-situ density. The two methods were used side-by-side for three tests on the filter sand at the south outlet. The results of these tests (Sheet No. 3) show good correlation. Based on these results, URS agrees with the Contractor's/District's request that the sand cone test be used in lieu of the test pit method, provided the field technician exercises caution in maintaining stability of the excavation walls during the sand cone method. We recommend that the District's representative on site (Mr. Duke Yager) pay close attention to this issue during the sand cone testing.

4. ***South Outlet – First Two Lifts of Filter Sand:*** In-situ density tests were performed on two lifts of filter sand placed within the 3-foot wide trench at the south outlet. These results are shown on

Sheet No. 4. The tests yielded results of 110.7 pcf and 112.5 pcf, corresponding to relative densities of 73.5% and 81.4%, respectively. These values meet the project specification of 70% (minimum). For future tests, URS requests that the test results be reported in terms of dry density *and* relative density.

Should you have questions or require additional information, please contact us at (602) 371 1100.

ALPHA Geotechnical & Materials, Inc. Report #_____

FIELD DENSITY TEST DATA
CAMPBELL PACIFIC
NUCLEAR GAUGE
SOIL/ASPHALT

SHEET #1

Project Name: White Tanks FRS #3 IDS Job No: 01-075 Date: 1-18-02

Material (Circle One):

ABC IMPORT RIVER-RUN (NATIVE) EXISTING FILL

Gauge No: 4 Technician: E. Hall

Test No.	1	2	3		
Location of Test South Excavation (General Location)	10' upstream @ 1' left of ℄ of Pipe (Exact location)	23' upstream @ ℄ of Pipe (Exact location)	38' upstream 1' left of ℄ of Pipe (Exact location)	(Exact location)	(Exact location)
Depth of Test (100 = Finish grade)	1187.95	1187.95	1187.95		
Wet Density	135.6	135.9	134.9		
pcf Moisture	15.1	17.1	14.6		
Dry Density	119.7	118.0	120.0		
% Moisture	13.2 ✓	14.9 ✓	12.4 ✓		
% Compaction	95.9 ✓	95.0 ✓	96.1 ✓		
% Compaction Req'd. (Spec.)	95%	95	95		
Curve Used	G	G	G		
Maximum Density/ Corrected Density	124.9	124.9	124.9		
Optimum Moisture/ Corrected Moisture	11.4	11.4	11.4		
Depth of Rod	8"	8"	8"		
% Rock (+#4)	<10%	<10%	<10%		
Pass or Fail	P	P	P		

TECHNICIAN: E. Hall

ALPHA Geotechnical & Materials, Inc. Report #_____

FIELD DENSITY TEST DATA
CAMPBELL PACIFIC
NUCLEAR GAUGE
SOIL/ASPHALT

SHEET # 2

Project Name: White Tanks FRS #3 IDS Job No: 01-075 Date: 1-18-02

Material (Circle One):

ABC IMPORT RIVER-RUN NATIVE EXISTING FILL

Gauge No: 4 Technician: E. Hall

Test No.	1	2	3		
Location of Test North Excavation (General Location)	3' upstream @ 1' Right of ℄ of Pipe (Exact location)	21' upstream @ 3' Left of ℄ of Pipe (Exact location)	37' upstream @ 3' Right of ℄ of Pipe (Exact location)	(Exact location)	(Exact location)
Depth of Test (100 = Finish grade)	1185.66	1185.66	1185.66		
Wet Density	127.9	131.2	128.7		
pcf Moisture	19.9	18.7	13.1		
Dry Density	107.7	111.3	115.0		
% Moisture	18.8 ✓	17.9 ✓	11.9 ✓		
% Compaction	95.0 ✓	98.2 ✓	95.8 ✓		
% Compaction Req'd. (Spec.)	95	95	95		
Curve Used					
Maximum Density/ Corrected Density	113.3	113.3	120.0		
Optimum Moisture/ Corrected Moisture	15.8	15.8	12.2		
Depth of Rod	8"	8"	8"		
% Rock (+#4)	<10%	<10%	<10%		
Pass or Fail	P	P	P		

TECHNICIAN: E. Hall

Correlation Data Sheet

'Uhite Tanks FRS #3 - IDS

1/18/02

SHEET #3

Testing Performed By:
Frank Hathaway
Ed Hall

Fax To: Kevin or Ravi w/ URS @ 371-1615

Test Procedure	Trial #1 (Test Pit) (Dry Density)	Trial #2 (S. Excav., 1st Lift) (Dry Density)	Trial #3 (S. Excav., 2nd lift) (Dry Density)
Nuclear Gauge	Kevin w/ URS Documented Results	8" Direct 101.9 pcf Back Scatter 97.9 pcf	8" Direct 100.2 pcf Backscatter 95.4 pcf
Sandcone Method ASTM D1556	108.7 pcf	110.7 pcf	112.5 pcf
Density By Test Pit Method ASTM D4914	108.3 pcf	110.6 pcf	111.6 pcf

Results from these methods indicate a good correlation between the Sandcone Method and the Density By Test Pit Method.

Due to the high potential of the Nuclear Gauge hole collapsing, Results show no consistent correlation between the Nuclear Gauge Readings and the other 2 Tests performed.

Also attached, are the data sheets for each test performed with all calculations listed.

I will create a final (More Professional) Report on Monday and fax it to you.

If you have any Questions, or If I may be of further Assistance please Contact me @ 602-448-8180.

Respectively Submitted,

F Hathaway Alpha Geotechnical & Materials, Inc.

SHEET #4

ALPHA Geotechnical & Materials, Inc.

FIELD DENSITY TEST DATA - SAND CONE METHOD (ASTM D1556, AASHTO T217 & T224)

Project White Tanks FRS #3-IDS Date 1-18-02 Job No. 01-A-00075

Material: Native On-Site Borrow Existing Fill Import ABC Select River-Run Pit Run Other Diaphragm Filter Sand

Test No.	1	2	3		
Location of Test	Test Pit	S. Excav. 1st Lift	S. Excav. 2nd Lift		
Depth/Elevation of ~~Reference Point~~ Test	Test	1st Lift	2nd Lift		
Depth/Elevation of Test	Area	—	—		
(A) Initial weight of Apparatus + Sand (lbs)	13.30	13.92	13.43		
(B) Final weight of Apparatus + Sand (lbs)	6.50	7.09	6.83		
(C) Sand Used (lbs) A-B	6.80	6.83	6.60		
(D) Sand in Funnel & Plate (lbs)	3.38	3.38	3.38		
(E) Sand to Fill Hole (lbs) C-D	3.42	3.45	3.22		
(F) Density of Sand (pcf)	80.8	80.8	80.8		
(G) Volume of Hole (cu. ft) E ÷ F	.0423267	.042698	.0398514		
Wet Soil + Tare (lbs) / (H) Wet Soil (lbs)	5.25 / 4.68	5.59 / 5.02	5.31 / 4.74		
(I) Wet Density (pcf) H ÷ G	110.6	117.6	118.9		
Speedie Moisture / (J) Moisture (%)	— / 1.7%	— / 6.2	— / 5.7		
(K) * Corrected Moisture Content (%) $\frac{(J \times M) + L}{100}$	—	—	—		
(N) Dry Density (pcf) $\frac{I}{1 + ((J \text{ or } K) \div 100)}$	108.7	110.7 ✓	112.5 ✓		
(O) Percent Compaction (%) N ÷ P or N ÷ P'	—	—	—		
Percent Compaction Required (%)	—	—	—		
Curve Used	—	—	—		
(P) Maximum Density (pcf)	—	—	—		
(P') *Corrected Maximum Density (pcf) $\frac{(P \times M) + (62.4 \times .9 \times Sp.Gr. \times L)}{100}$	—	—	—		
Optimum Moisture (%) / * Corrected Optimum	— / —	— / —	— / —		
Rock + Tare (lbs) / (Q) Rock (lbs)	— / —	— / —	— / —		
(R) % of Rock (Q ÷ H) x 100	—	—	—		
(M) % of Sand & Fines 100-L	—	—	—		

Alpha Technician _____

* Correct Moisture and Maximum Density only if "L" is greater than 10%

URS

Design Memo No. 15

Technical Support During Construction

		Fax Numbers	Action
To:	Brett Howey – ADWR	(Fax 602-417-2423)	Review and respond with concurrence
CC:	Tom Renckly, P.E. – FCDMC	(Fax 602-506-8561)	For your information
	Duke Yager - FCDMC	(Fax 602-506-8561)	Review and comment, and coordinate ADWR approval and commencement of Buesing's work on memo subject
From:	Ravi Murthy, P.E.		
CC:	Todd E. Ringsmuth, P.E. – URS, PHX		For your information
	Sandy Gourlay, P.E. – URS, PHX		For your information
	Kevin R. Somerville, URS, PHX		For your information
	Richard Candelaria - Buesing	(Fax 602-233-3377)	Wait for Approval from Duke (ADWR)
Date:	January 24, 2002		
Re:	White Tanks FRS #3 – **Drain Sand Submittal**		

---

1. ***Drain Sand Submittal – SunState Fax Received 1/22/02, Alpha Fax Received 1/23/02***

Approved - URS has received and reviewed the results of four gradation tests (two from SunState and two from Alpha attached) on the proposed drain sand. All four test results are marginally outside the project specifications (ASTM C-33 #9). Upon further review of the results, the following points are noted:

1. The four test results indicate that the proposed drain sand is generally finer than, or within the drain design band (see Figure 1) based on the filter (base soil) to drain match (see Calculation Package #6 in the Design Report). The above statement is also true when the proposed drain sand gradation is compared to the Design Drain Band (See Calculation No. 11 in the Design Report). Based on this information we conclude that the diaphragm filter sand and the proposed drain sand are compatible.

2. A calculation package documenting the compatibility of the proposed drain sand and geotextile is attached (pages 1 thru 5). As seen therein, the proposed drain sand and geotextile are compatible.

Based on the above two points, it is our opinion that although the gradation of the proposed drain sand is marginally outside the project specifications, the proposed drain sand still meets the design intent of the project, and is therefore approved.

Approval of this material is given upon the condition that the material is sampled and tested again upon delivery and as work progresses in accordance with QC procedures implemented by the Contractor and the CQA Plan being implemented by Alpha. Results of CQC / CQA testing must show a consistent material gradation for all sand delivered. This condition thus requires the drain sand to be collected by certified field technicians and sieve analysis performed by a certified soils

laboratory. The min/max laboratory test for relative density on the drain sand should be performed on a sample collected by Alpha.

The permeability test results URS received on January 14, 2002 for the approved filter sand material also included test results for a drain sand that had not been approved based on gradation, therefore the results associated with this drain sand material should be ignored (or preferably deleted from Alpha's final reporting). A new permeability test is required on the "approved" drain sand per the specifications and CQA Plan.

Should you have questions or require additional information, please contact us at (602) 371 1100.

URS

Design Memo No. 16

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX
Richard Candelaria - Buesing (Fax 602-233-3377)

Date: January 25, 2002

Re: White Tanks FRS #3 – **Soil Buttress Fill Stockpile Prequalification**

---

1. ***Soil Buttress Fill Stockpile Gradation Results and PI Limit for Prequalification – Fax From Alpha Received 1/21/02***

Approved - URS has received and reviewed the results of 10 gradation tests (Alpha results attached pages 1 thru 11) on the soils from the spillway notch excavation (borrow) that are currently stockpiled and blended. It is our understanding that this soil is to be for use as soil buttress fill. Ten samples were collected from 10 test pits excavated into the stockpile (see Figure 1 showing test pit/sample locations and depths attached). The samples were collected from soil that represents the bottom of the test pit. All 10 test results are outside the project specifications, exceeding the allowable percent passing on the finer sieve sizes. The Plasticity Index (PI) on the 10 samples are all reported as non-plastic (NP), thereby meeting the specification of ≤10. Upon further review of the results, the following points are noted:

1. Figure 2 (attached) depicts a design band that meets the filter criteria with the filter sand as the base soil. The stockpiled soil buttress fill material is finer than this design band. Therefore, the risk that the filter sand will pipe into the proposed buttress soil is minimal. Based on this information we conclude that the diaphragm filter sand and the soil buttress fill currently stockpiled at the site are compatible.

2. A calculation package documenting the compatibility of the soil buttress fill stockpile material and geotextile. (attached pages 1 thru 5). As seen therein, the soil buttress fill material currently stockpiled and the geotextile (wrapped around the drain) are compatible.

Based on the above two points, it is our opinion that the native soil stockpiled for use as soil buttress fill does not meet project specifications, However, the current stockpile still meets the design intent of the project, and is therefore approved and prequalified. Additional borrow excavation of the notch will

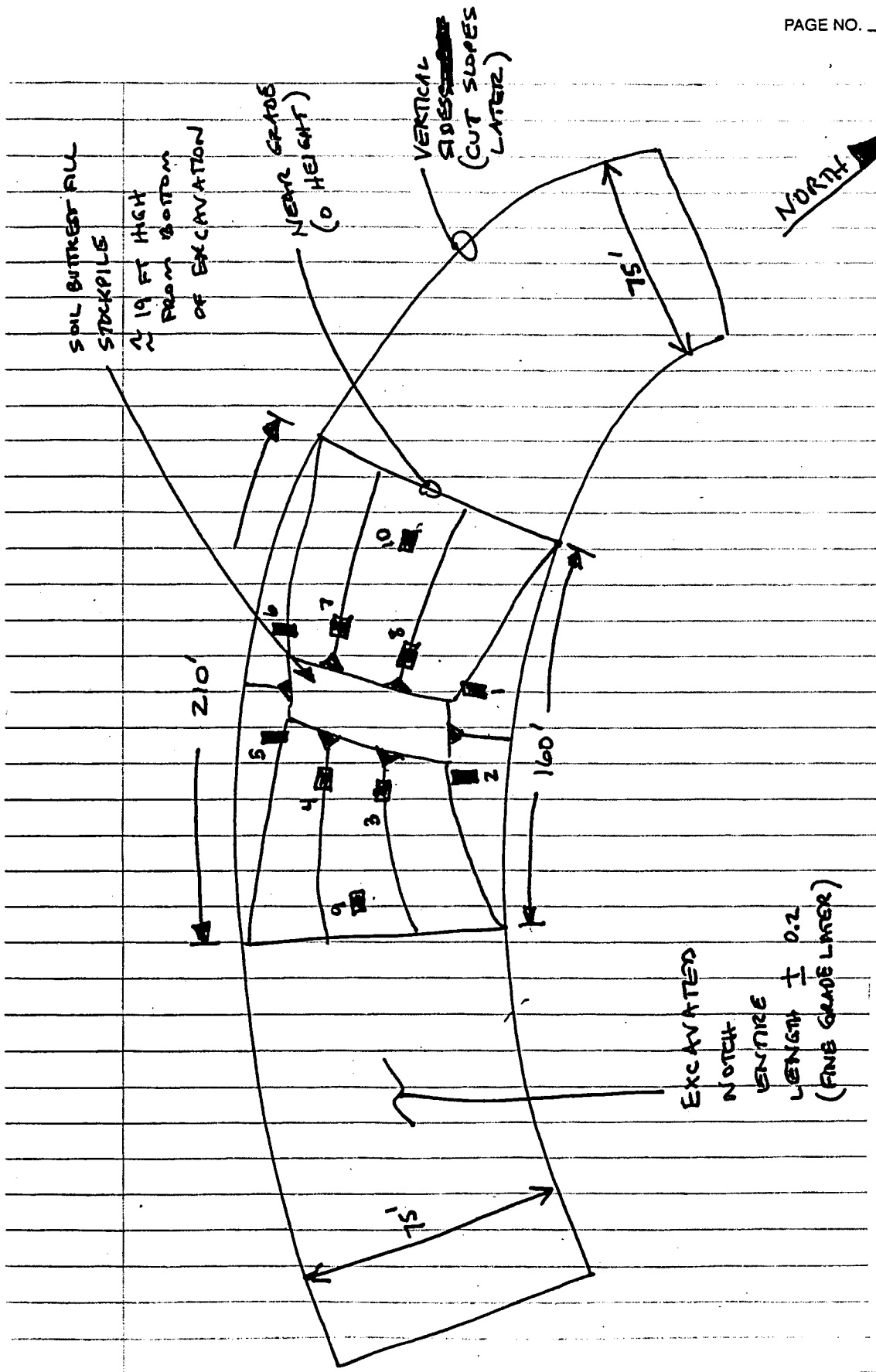
URS

DATE 1-17-02

PROJECT NO. WHITE TANKS PRS#3

PAGE NO. ____ OF ____ BY KRS

FIGURE 1



NOTE: OBSERVED MOISTURE CONDITIONING SPORATIC / INCONSISTENT

Test Pit #	Approx. Depth
1	2' to 3'
2	2' to 3'
3	7' to 8'
4	4' to 5'
5	2' to 3'
6	2' to 3'
7	4' to 5'
8	4' to 5'
9	1' to 1.5'
10	1' to 1.5'

GRADATION RESULTS

Soil Buttress Fill Stockpile

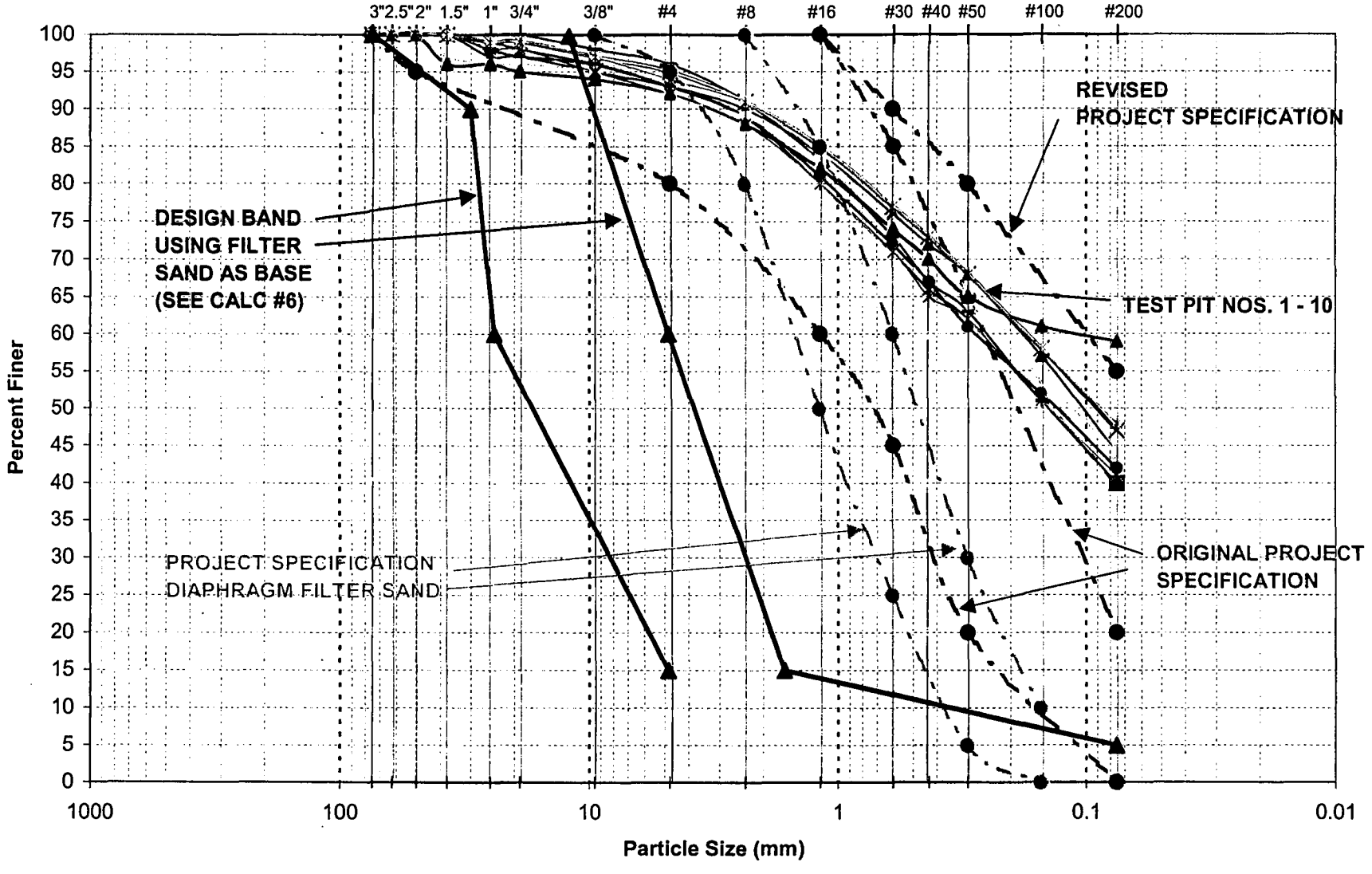


FIGURE 2

require separate stockpiling and a separate prequalification process. Furthermore, we recommend the project specification be revised as follows:

Sieve Size (Square Openings)	Percent Passing
3 inch	100
2 inch	95 – 100
#4	80 – 100
#16	60 – 100
#30	45 – 90
#50	20 – 80
#200	0 - 55

A standard proctor test can be performed on any of the 10 samples for use during fill compaction testing.

All other requirements and specifications continue to remain valid.

Should you have questions or require additional information, please contact us at (602) 371 1100.

ALPHA Geotechnical & Materials, Inc.
5002 S. 40th Street, Suite E
Phoenix, Arizona 85040
Phone No: (602) 453-3265
Fax No: (602) 453-3267

FACSIMILE TRANSMITTAL

TO: Mr. Kevin Somerville
Mr. Ravi Murthy
FROM: Mr. Frank Hathaway
COMPANY: URS
RE: Laboratory test results
DATE: 1-21-02
FAX #: 602-371-1615
NUMBER OF PAGES: (including cover sheet)

This transmission is intended only for the Addressee. It may contain privileged or confidential information. Any unauthorized disclosure is strictly prohibited. If you have received this transmission in error, please notify us immediately so that we may correct our transmisaion. Thank you.

Transmitted here within are the laboratory test results from the "stockpile".

If you need anything else, please do not hesitate to contact me at 60-453-3265.

Respectfully submitted,

Frank Hathaway

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	15
SAMPLE SOURCE:	STOCKPILE- #1	DATE SAMPLED:	01/17/02

Soil Buttress Fill

TP

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	97
3/4 IN	97
1/2 IN	96
3/8 IN	95
1/4 IN	94
#4	93
#8	90
#10	89
#16	84
#30	76
#40	72
#50	68
#100	57
#200	44

ATTERBERG LIMITS

LL: NV
PI: NP

ALPHA
Engineering • Testing • Solutions

ALPHA Geotechnical & Materials, Inc.

PROJECT: WHITE TANK FRS #3 - I.D.S
LOCATION: WHITE TANK DAM
MATERIAL: NATIVE
SAMPLE SOURCE: STOCKPILE- #2

SOIL BUTTRESS
Fill

TP

JOB NUMBER: 01-A 00075
WORK ORDER NO: 6
LAB NO: 16
DATE SAMPLED: 01/17/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	99
3/4 IN	99
1/2 IN	97
3/8 IN	97
1/4 IN	96
#4	95
#8	91
#10	90
#16	85
#30	77
#40	73
#50	68
#100	58
#200	47

ATTERBERG LIMITS

LL: NV
PI: NP

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ALPHA Geotechnical & Materials, Inc.

PROJECT: WHITE TANK FRS #3 - I.D.S.
LOCATION: WHITE TANK DAM
MATERIAL: NATIVE
SAMPLE SOURCE: STOCKPILE #3

SOIL BUTTRESS FILL

TP

JOB NUMBER: 01-A-00075
WORK ORDER NO: 6
LAB NO: 17
DATE SAMPLED: 01/17/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
5 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	99
3/4 IN	98
1/2 IN	97
3/8 IN	96
1/4 IN	95
#4	93
#8	89
#10	88
#16	80
#30	71
#40	65
#50	62
#100	51
#200	40

ATTERBERG LIMITS

LL: NV
PI: NP

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ALPHA Geotechnical & Materials, Inc.

PROJECT: WHITE TANK FRS #3 - I.D.S.
LOCATION: WHITE TANK DAM
MATERIAL: NATIVE
SAMPLE SOURCE: STOCKPILE- E4

SOIL ~~BUTTRESS~~ Fill

TP

JOB NUMBER: 01-A-00075
WORK ORDER NO: 6
LAB NO: 18
DATE SAMPLED: 01/17/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	98
3/4 IN	97
1/2 IN	97
3/8 IN	96
1/4 IN	94
#4	93
#8	89
#10	88
#16	81
#30	72
#40	67
#50	61
#100	52
#200	42

ATTERBERG LIMITS

LL: NV
PI: NP

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PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	19
SAMPLE SOURCE:	STOCKPILE- #5	DATE SAMPLED:	01/17/02

SOIL BUTTRESS FILL

TP

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	99
3/8 IN	98
1/4 IN	97
#4	96
#8	91
#10	90
#16	83
#30	73
#40	67
#50	63
#100	51
#200	40

ATTERBERG LIMITS

LL: NV
PI: NP

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PROJECT: WHITE TANK FRS #3 - I.D.S
LOCATION: WHITE TANK DAM
MATERIAL: NATIVE
SAMPLE SOURCE: STOCKPILE- #6

Soil ~~Buttress~~ Fill

TP

JOB NUMBER: 01-A-00075
WORK ORDER NO: 6
LAB NO: 20
DATE SAMPLED: 01/17/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	99
3/4 IN	99
1/2 IN	98
3/8 IN	97
1/4 IN	96
#4	95
#8	91
#10	90
#16	84
#30	75
#40	70
#50	64
#100	54
#200	44

ATTERBERG LIMITS

LL: NV
PI: NP

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PROJECT: WHITE TANK FRS #3 I D S
LOCATION: WHITE TANK DAM
MATERIAL: NATIVE
SAMPLE SOURCE: STOCKPILE- #7

SOIL BUTTRESS Fill

TP

JOB NUMBER: 01-A-00075
WORK ORDER NO: 6
LAB NO: 21
DATE SAMPLED: 01/17/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	97
1 IN	96
3/4 IN	96
1/2 IN	95
3/8 IN	95
1/4 IN	93
#4	92
#8	89
#10	88
#16	83
#30	74
#40	70
#50	68
#100	55
#200	44

ATTERBERG LIMITS

LL: NV
PI: NP

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PROJECT:	WHITE TANK FRS #3 - I.D.S	JOB NUMBER:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	22
SAMPLE SOURCE:	STOCKPILE- #6	DATE SAMPLED:	01/17/02

Soil Buttress Fill

TP

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	98
1 IN	96
3/4 IN	95
1/2 IN	94
3/8 IN	94
1/4 IN	92
#4	92
#8	88
#10	87
#16	82
#30	74
#40	70
#50	65
#100	61
#200	59

ATTERBERG LIMITS

LL: NV
PI: NP

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PROJECT: WHITE TANK FRS #3 - L.D.S
LOCATION: WHITE TANK DAM
MATERIAL: NATIVE
SAMPLE SOURCE: STOCKPILE- #9

Soil Buttress Fill

TP

JOB NUMBER: 01-A-00075
WORK ORDER NO: 6
LAB NO: 23
DATE SAMPLED: 01/17/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318).

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	98
3/4 IN	98
1/2 IN	96
3/8 IN	95
1/4 IN	94
#4	92
#8	88
#10	86
#16	80
#30	71
#40	66
#50	62
#100	51
#200	41

ATTERBERG LIMITS

LL: NV
PI: NP

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ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	WHITE TANK DAM	WORK ORDER NO:	6
MATERIAL:	NATIVE	LAB NO:	24
SAMPLE SOURCE:	STOCKPILE- #10	DATE SAMPLED:	01/17/02

Soil Buttress Fill

TP

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	99
3/4 IN	99
1/2 IN	98
3/8 IN	97
1/4 IN	95
#4	94
#8	91
#10	90
#16	85
#30	77
#40	73
#50	68
#100	58
#200	48

ATTERBERG LIMITS

LL: NV
PI: NP

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EXHIBIT 4.7-2

CALCULATION COVER SHEET

Client: FLOOD CONTROL DIST. M.C. Project Name: WHITE TANKS FRS #3

Project/Calculation Number: EI-00001852.00

Title: FILTER MATCH BETWEEN FABRIC AND BUTTRESS

Total Number of Pages (including cover sheet): 5

Total Number of Computer Runs:

Prepared by: Jeff Heyman Date: 01/22/02

Checked by: [signature] Date: 01/23/02

Description and Purpose: SEE PAGE 2

Design Basis/References/Assumptions

FABRIC SPEC Pg. 4

"Designing with Geosynthetics". R.M. Koerner, 3rd Ed., Pg. 101, Carroll (1983) — Attached as Pg. 5

Remarks/Conclusions/Results: Geotextile and Buttress are Compatible.

Calculation Approved by: [signature] 01/23/02
Project Manager/Date

Revision No.:	Description of Revision:	Approved by:

Project Manager/Date

URS

Job WHITE TANKS FRS#3 Project No. _____ Sheet ___ of ___

Description BUTTRESS FILL VS. FILTER FABRIC Computed by Jeff Heyman Date 01/22/02

Checked by [illegible] Date 01/23/02

Reference

OBJECTIVE: To Check the Compatability of the buttress fill (specified) Versus the geotextile drain wrap.

BUTTRESS FILL

* From Fig. 1 D_{85} = 0.43 mm to 9.5 mm

* From Amoco Specification Sheet for "Style 4553" polypropylene nonwoven needlepunched fabric (geotextile drain wrap).

AOS (O_{95}) = 0.15 mm

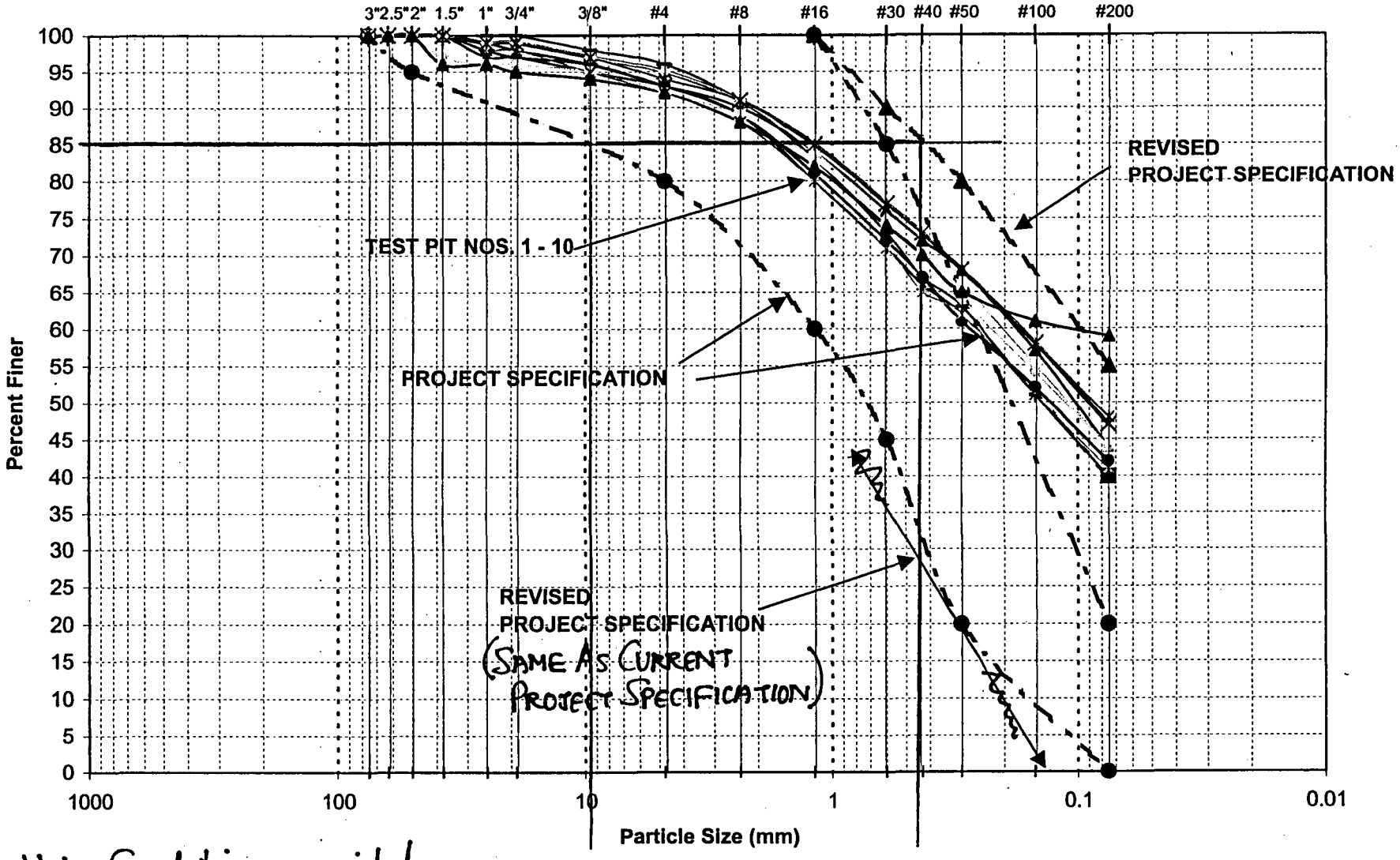
* From "Designing with Geosynthetics" - R. M. Koerner 3rd Ed., Pg. 101, Carroll (1983)

$$O_{95}/D_{85} \leq 2-3$$

$$O_{95}/D_{85} = 0.15\,mm / 0.43\,mm \text{ to } 9.5\,mm$$

$$O_{95}/D_{85} = 0.016 \text{ to } 0.36 \leq 2 \therefore OK$$

GRADATION SHEET



Note: Gradations provided by Alpha

AMOCO FABRICS AND FIBERS COMPANY
900 Circle 75 Parkway, Suite 300
Atlanta, GA 30339
PH: (770) 984-4444
FX: (770) 956-2430

STYLE 4553

Amoco Style 4553 is a polypropylene nonwoven needlepunched fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a ph range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that **Amoco Style 4553** meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Grab Tensile	ASTM-D-4632	203 lbs	0.900 kN
Grab Elongation	ASTM-D-4632	50 %	50 %
Mullen Burst	ASTM-D-3786	400 psi	2750 kPa
Puncture	ASTM-D-4833	130 lb	0.575 kN
Trapezoidal Tear	ASTM-D-4533	80 lb	0.355 kN
UV Resistance	ASTM-D-4355	70 % at 500 hrs	70 % at 500 hrs
AOS	ASTM-D-4751	100 sieve	0.15 mm
Permittivity	ASTM-D-4491	1.5 sec^{-1}	1.5 sec^{-1}
Flow Rate	ASTM-D-4491	110 $gal/min/ft^2$	4470 $L/min/m^2$

Amoco Fabrics and Fibers Company manufactures the nonwoven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories. A letter certifying the minimum average roll values will be issued from the manufacturing plant by the Quality Control Manager at the time shipment is made.

DATE ISSUED: 01/01/98

The information presented herein, while not guaranteed, is to the best of our knowledge true and accurate. Except when agreed to in writing for specific conditions of use, no warranty or guarantee expressed or implied is made regarding the performance of any product, since the manner of use and handling are beyond our control. Nothing contained herein is to be construed as permission or as a recommendation to infringe any patent.

PAGE 5 OF 5

d_{85}, d_{50}, or d_{15}; see Table 2.3). The numeric value of the ratio depends on the geotextile type, the soil type, the flow regime, etc. For example, Carroll [5] recommends the following:

$$O_{95} < (2 \text{ or } 3)\ d_{85} \tag{2.9}$$

where d_{85} is the soil particle size in mm for which 85% of the total soil is finer.

Table 2.3 Existing geotextile retention criteria, after Christopher and Fischer [3]

Source	*Criterion*	*Remarks*
Task Force #25 (1986)	50% ≤ 0.074 mm, $O_{95} < 0.59$ mm 50% > 0.074 mm, $O_{95} < 0.30$ mm	No limitations on geotextile type or soil type
Calhoun (1972)	$O_{95}/d_{85} \leq 1$	Wovens, soils with ≤50% passing No. 200 sieve
	$O_{95} \leq 0.2$ mm	Wovens, cohesive soils
Zitscher (1975)	$O_{50}/d_{50} \leq 1.7$–2.7	Wovens, soils with CU ≤ 2, d_{50} = 0.1 to 0.2 mm
	$O_{50}/d_{50} \leq 2.5$ to 3.7	Nonwovens, cohesive soil
Ogink (1975)	$O_{90}/d_{90} \leq 1$	Wovens
	$O_{90}/d_{90} \leq 1.8$	Nonwovens
Sweetland (1977)	$O_{15}/d_{85} \leq 1$	Nonwovens, soils with CU = 1.5
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with CU = 4.0
Rankilor (1981)	$O_{50}/d_{85} \leq 1$	Nonwovens, soils with $0.2 \leq d_{85} \leq 0.25$ mm
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with $d_{85} >$ 0.25 mm
Schober & Teindl (1979)	$O_{90}/d_{50} \leq 2.5$–4.5	Woven and thin nonwovens, dependent on CU
	$O_{90}/d_{50} \leq 4.5$–7.5	Thick nonwovens, dependent on CU, silt and sand soils
Giroud (1982)	$O_{95}/d_{50} \leq (9$–$18)/\text{CU}$	Dependent on soil CU and density Assumes fines in soil migrate for large CU values
Carroll (1983)	$O_{95}/d_{85} \leq 2$–3	Wovens and nonwovens
Christopher and Holtz (1985)	$O_{95}/d_{85} \leq 1$–2	Dependent on soil type and CU
	$O_{95}/d_{15} \leq 1$ or $O_{50}/d_{85} \leq 0.5$	Dynamic, pulsating, and cyclic flow, if soil can move beneath geotextile
French Committee on Geotextiles and Geomembranes (1986)	$O_f/d_{85} \leq 0.38$–1.25	Dependent on soil type, compaction, hydraulic and application conditions
Fischer et al. (1990)	$O_{50}/d_{85} \leq 0.8$ $O_{50}/d_{15} \leq 1.8$–7.0 $O_{50}/d_{50} \leq 0.8$–2.0	Based on geotextile pore size distribution, dependent on CU of soil

O_x = geotextile opening size corresponding to x particle size based on dry glass bead sieving.
O_f = filtration opening size based on hydrodynamic sieving.
d_y = soil particle size corresponding to y percent passing.
CU = coefficient of uniformity = d_{60}/d_{10}.

Memo substitute

Kevin Somerville

02/11/2002 04:09 PM

To: Duke Yager - FCDX <lly@mail.maricopa.gov>, Tom Renckly - FCDX <trr@mail.maricopa.gov>, "Richard Candelaria" <richardc@buesingcorp.com>, "Brett Howey" <bahowey@ADWR.STATE.AZ.US>
cc: Ravi Murthy/Phoenix/URSCorp@URSCorp, Alexander Gourlay/Phoenix/URSCorp@URSCORP
Subject: White Tanks FRS#3 - Abandoning 4 Finger Drains - Figures Showing Geotextile

Gentlemen:

Please find attached a 8.5 x 11 figure (pdf) for each outlet showing URS's recommended approach for placing a geotextile filter fabric over the finger drain trench and outlet drain prior to placement of diaphragm filter sand and buttress soil fills. These figures are in response to requests made during our partnering meeting / progress meeting held on January 9, 2002.

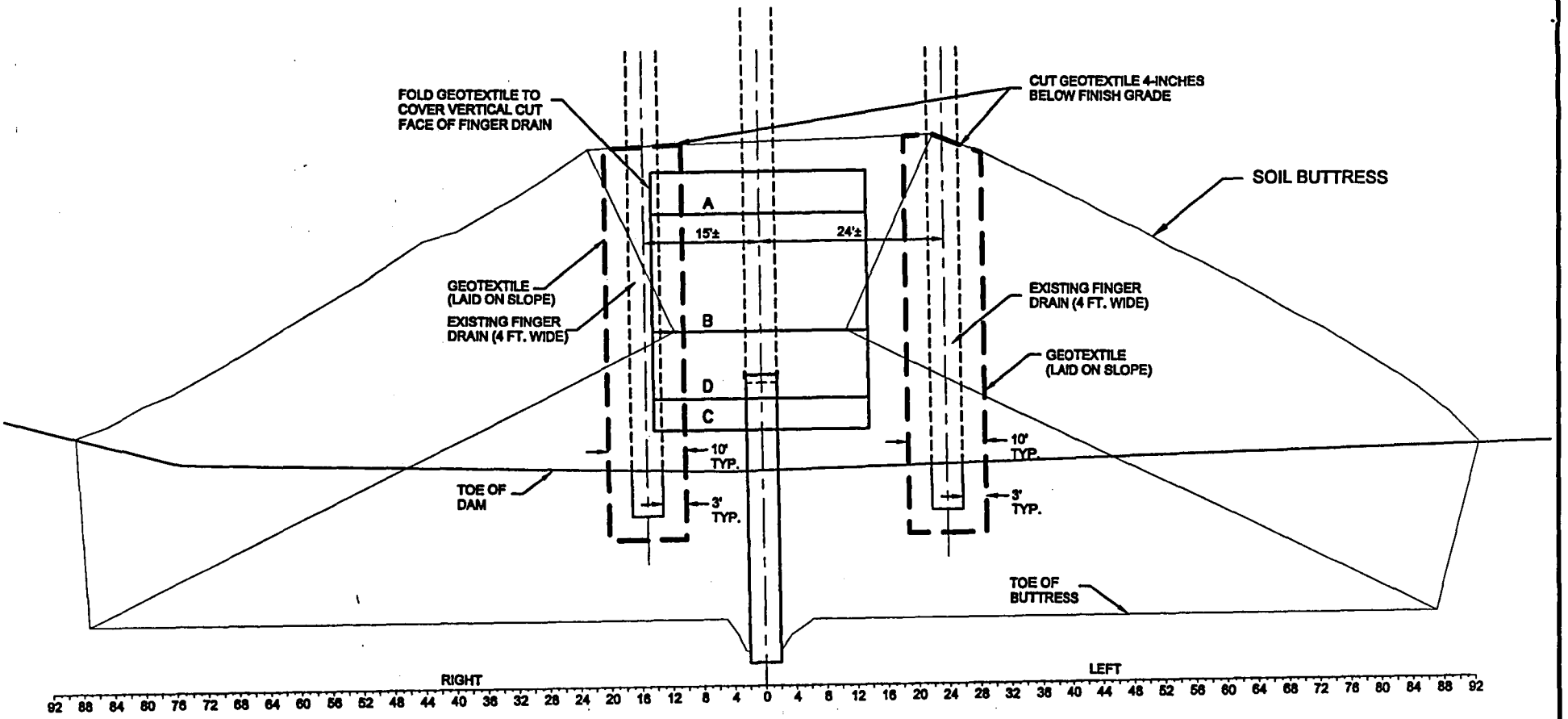
URS recommends the following:

1. Using the same geotextile fabric material for covering the fingers as is used for the drains (material that has been approved).
2. Grading the cobbles that consist of the outlet drain at the toe of the dam to be flat, matching surrounding ground level.
3. Using pin or nail anchors to hold the geotextile in place at approximately 2 feet centers around the perimeter.
4. Special installation of the geotextile over the finger drain on the right side (looking downstream) of the North Outlet is required, folding the fabric to transition to the vertical cut face created by the diaphragm filter excavation.

A15237 - geotextile figure.p(A15238 - geotextile figure.p(A15239 - geotextile figure.p(

Please call if you have questions or need clarification.

- Kevin



NOTES:

1. EXISTING FINGER DRAIN TO BE ABANDONED AS PROPOSED IN URS DESIGN MEMO No.5 AND APPROVED IN ADWR LETTER DATED JANUARY 14, 2002.
2. GEOTEXTILE FABRIC IS THE SAME MATERIAL USED FOR THE DRAIN.
3. THE REFERENCE A, B, C, AND D ON THE FILTER REFER TO FILTER ZONES SHOWN ON CONSTRUCTION DRAWINGS.
4. DIMENSIONS FROM CENTERLINE OF PIPE TO THE CENTERLINE OF FINGER DRAINS ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD.

0 20 40

SCALE IN FEET

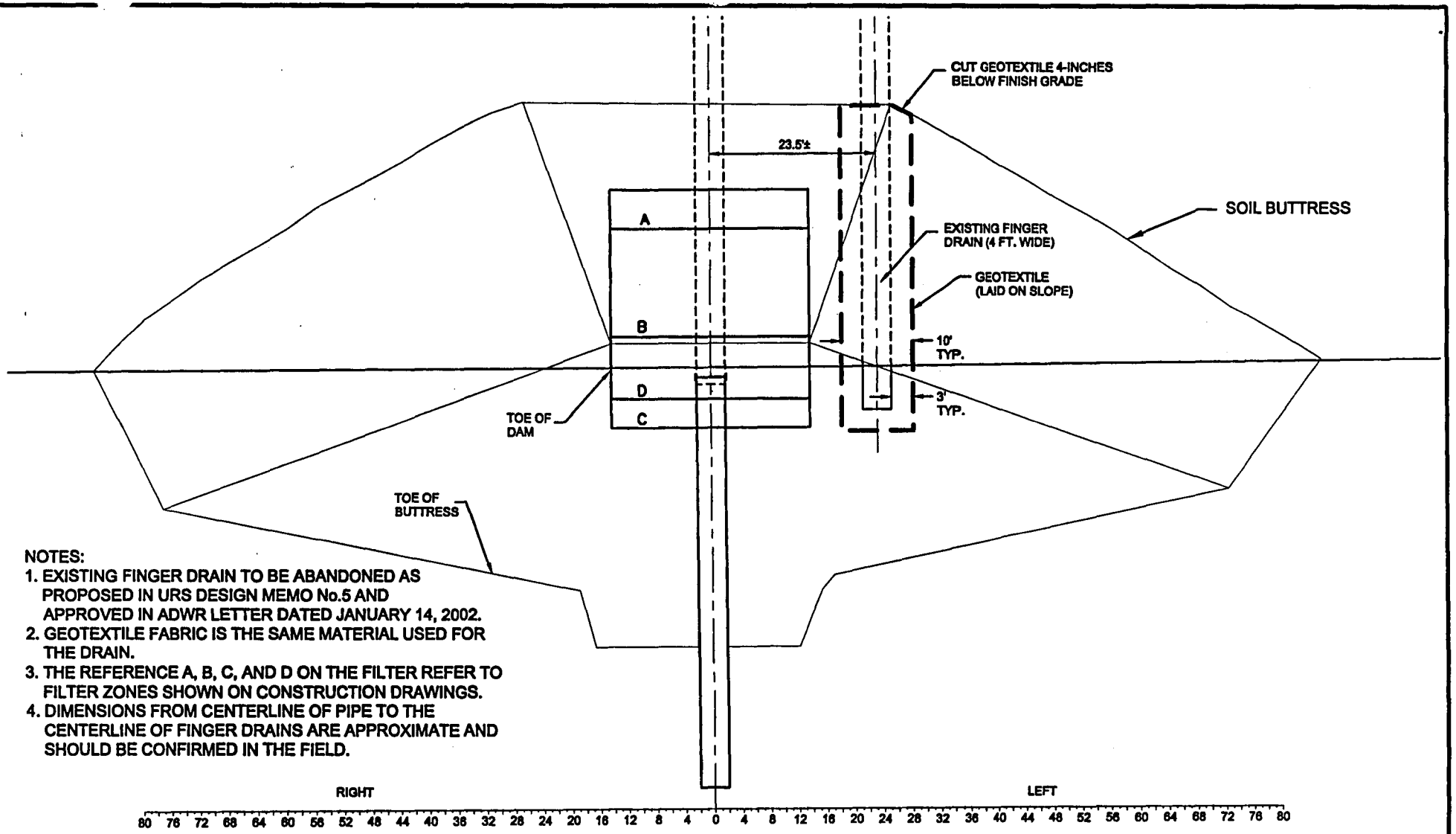
North Outlet - Existing Finger Drain Abandonment

White Tanks FRS #3 Interim Dam Safety Project

Figure 1

E1-15448007.00 A15237.DWG 2-11-02

URS



NOTES:
1. EXISTING FINGER DRAIN TO BE ABANDONED AS PROPOSED IN URS DESIGN MEMO No.5 AND APPROVED IN ADWR LETTER DATED JANUARY 14, 2002.
2. GEOTEXTILE FABRIC IS THE SAME MATERIAL USED FOR THE DRAIN.
3. THE REFERENCE A, B, C, AND D ON THE FILTER REFER TO FILTER ZONES SHOWN ON CONSTRUCTION DRAWINGS.
4. DIMENSIONS FROM CENTERLINE OF PIPE TO THE CENTERLINE OF FINGER DRAINS ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD.

0 20 40
SCALE IN FEET

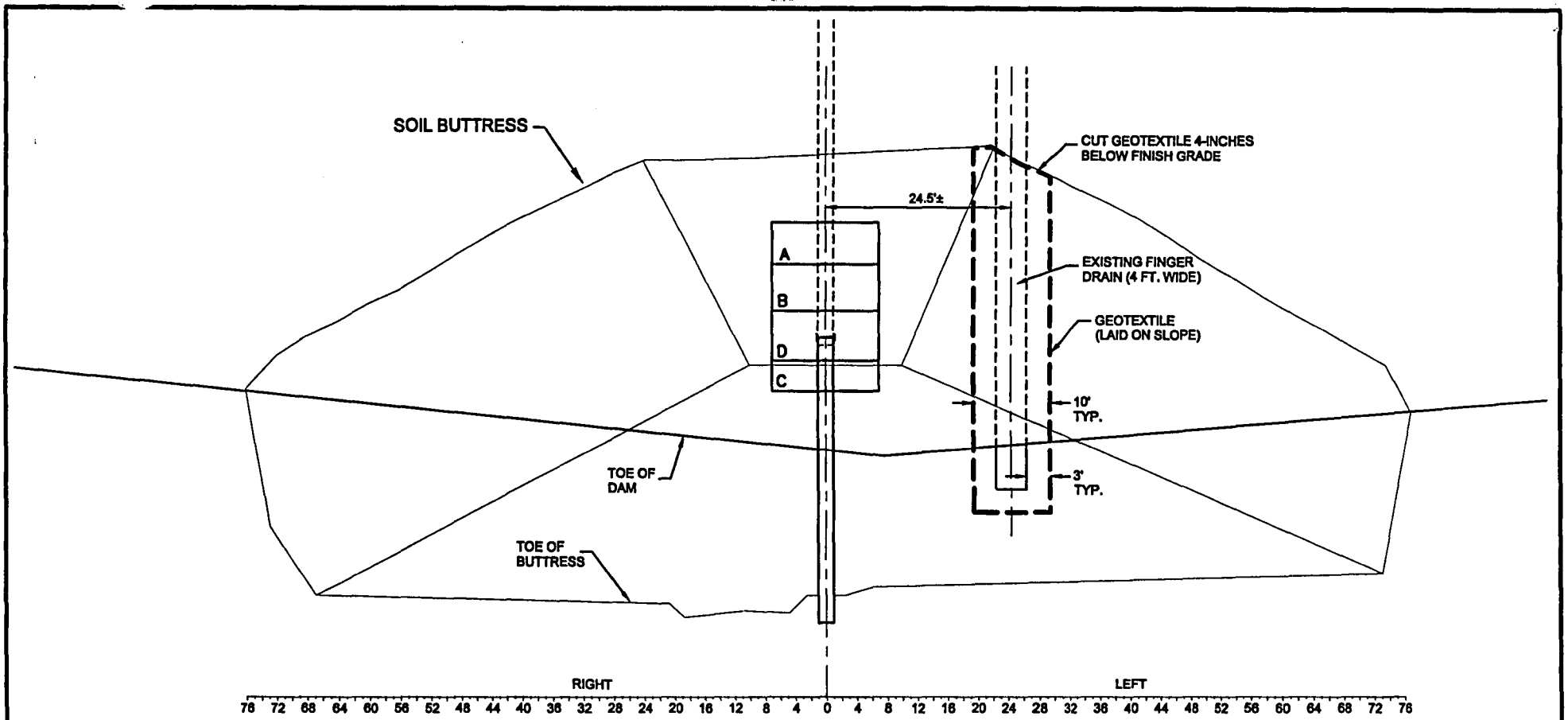
Central Outlet - Existing Finger Drain Abandonment

White Tanks FRS #3 Interim Dam Safety Project

Figure 2

E1-15448007.00 A15238.DWG 2-11-02

URS



NOTES:

1. EXISTING FINGER DRAIN TO BE ABANDONED AS PROPOSED IN URS DESIGN MEMO No.5 AND APPROVED IN ADWR LETTER DATED JANUARY 14, 2002.
2. GEOTEXTILE FABRIC IS THE SAME MATERIAL USED FOR THE DRAIN.
3. THE REFERENCE A, B, C, AND D ON THE FILTER REFER TO FILTER ZONES SHOWN ON CONSTRUCTION DRAWINGS.
4. DIMENSIONS FROM CENTERLINE OF PIPE TO THE CENTERLINE OF FINGER DRAINS ARE APPROXIMATE AND SHOULD BE CONFIRMED IN THE FIELD.

0 20 40

SCALE IN FEET

South Outlet - Existing Finger Drain Abandonment

White Tanks FRS #3 Interim Dam Safety Project

Figure 3

E1-15448007.00 A15239.DWG 2-11-02

URS

URS

Design Memo No. 19

Technical Support During Construction

To: Duke Yager - FCDMC (Fax 602-506-8561)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Brett Howey – ADWR (Fax 602-417-2423)
Michael D. Greenslade – ADWR (Fax 602-417-2423)

From: Kevin Somerville E.I.T.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

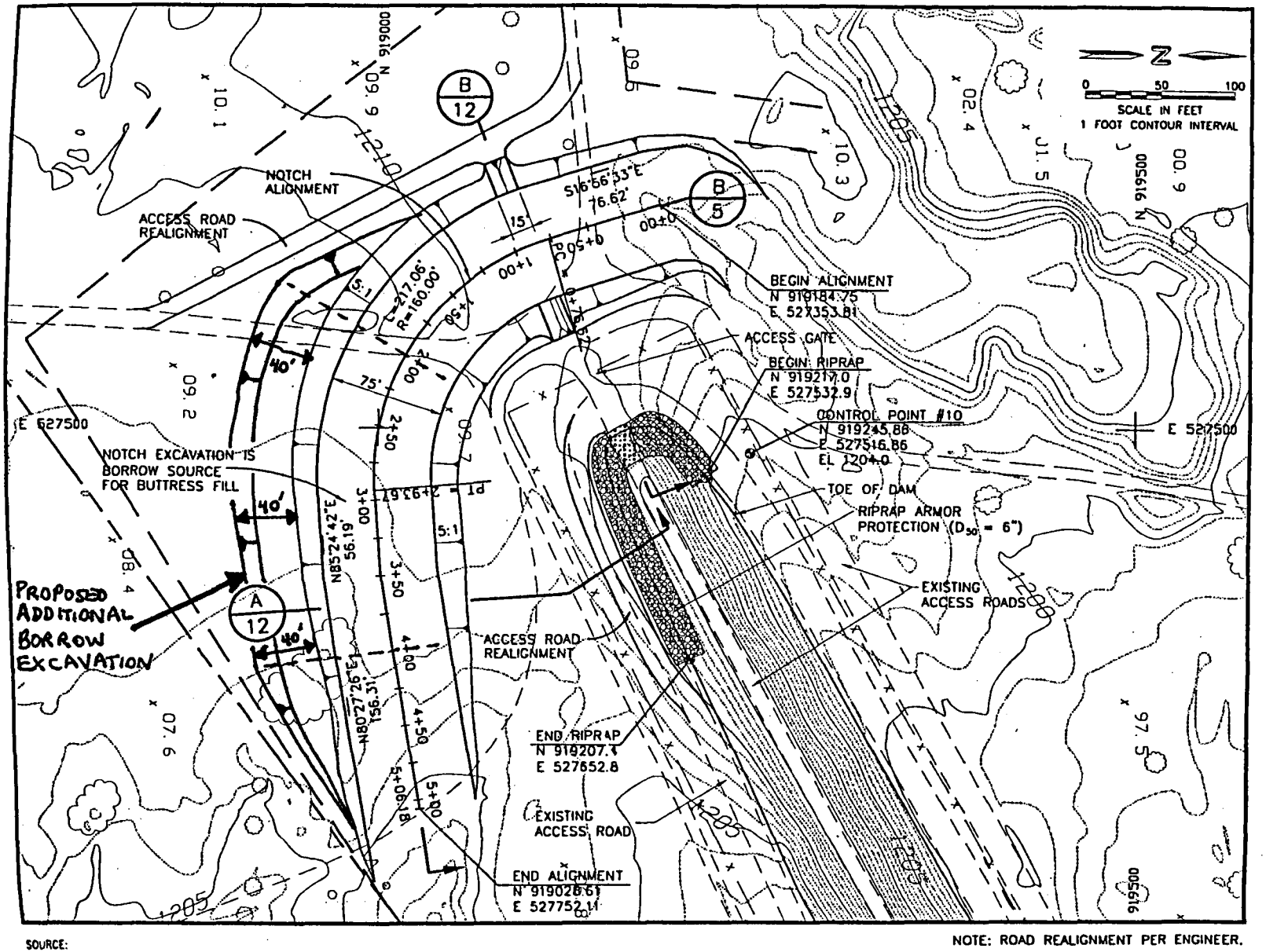
Date: March 20, 2002

Re: White Tanks FRS #3 – **Expansion of Spillway Notch Borrow for Soil Buttress Fill**

URS has reviewed the discussion points identified during Progress Meeting No. 10 on Wednesday, March 13, 2002 (see separate minutes). On Thursday, URS transmitted a "draft" sketch showing a proposed modification to the spillway notch to allow additional borrow excavation for development of needed Soil Buttress Fill. Buesing estimates that 600 in-place cubic yards is still needed, after the notch has been excavated per plan. During the meeting is was discussed increasing this volume for shrinkage (~30%) due to compaction and contingency to approximately 1,000 cubic yards bank measure. Comments have been received by the project team and incorporated into this memo transmitting our final proposed Borrow Excavation Plan (see attached sketch).

- Access road re-alignment is constructed per approved design plan.
- Additional mass excavation is performed between station 2+00 and 4+00 at a width of 40 feet from original top of slope to proposed top of slope (or 40 feet from toe of original and proposed).
- The depth of additional excavation should match the elevation and grade of adjacent stationing for the centerline of the original notch configuration (absolutely no deeper than).
- The additional excavation is conducted with same 5:1 (H:V) side slopes as the original notch.
- Additional excavation of triangular areas is performed with transitions from original width and side slopes.
- Excavation should not be beyond the property line shown on the plan drawings.
- The additional excavation is considered primarily an operation and maintenance issue and not a dam safety issue, therefore FCDMC should be aware that a non-uniform width of spillway notch may result in increased erosion of the bank and / or sediment buildup.
- The final excavation configuration should be surveyed and the drawings red-lined for as-builts.
- ADWR has approved (see copy of e-mail message) of the proposed additional notch excavation based on the condition that FCDMC modify its Operation and Maintenance plan to specifically indicate observation and inspection of the spillway notch after a flow condition through the spillway has occurred. The inspection procedure should allow for maintenance to remove sediment buildup, if present.

Should you have questions or require additional information, please contact us at (602) 371 1100.



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS, PROVIDED BY FCDMC 12/98.
BASIS OF BEARING: ARIZONA ZONE 12 CENTRAL NAD 83

NOTE: ROAD REALIGNMENT PER ENGINEER.

A/5 SPILLWAY PLAN

BORROW EXCAVATION PLAN

KEVIN S. - URS
3-20-02
EXCERPT FROM
SHEET 5 OF 18

"Brett Howey"
<bahowey@ADWR.STATE.AZ.US>

03/18/02 08:06 AM

To: <lly@mail.maricopa.gov>, <Ravi_Murthy@urscorp.com>
cc: <mdgreenslade@ADWR.STATE.AZ.US>, <lkl@mail.maricopa.gov>, <trr@mail.maricopa.gov>, <kevin_somerville@urscorp.com>
Subject: Re: White Tanks FRS #3 (07.28) Widening of Spillway Notch

The proposal to widen the spillway notch as outlined in the URS "draft", dated 3/14/02, appears acceptable. A final may be prepared and submitted to the contractor when appropriate.

Since there may be O&M implications the FCDMC should update their Operations and Maintenance Plan to reflect the need to assess the condition of the spillway notch after any discharge events.

Please contact me with any questions.

Regards

Brett A. Howey, E.I.T.
Engineer Specialist
Arizona Department of Water Resources
Dam Safety Section
602-417-2400 ext 7190
bahowey@adwr.state.az.us

URS

Design Memo No. 17

Technical Support During Construction

To: Brett Howey – ADWR (Fax 602-417-2423)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Duke Yager - FCDMC (Fax 602-506-8561)
Richard Candelaria – Buesing (Fax 602-233-3377)
Noller Herbert – NRCS (Fax 602-280-8795)

From: Kevin Somerville E.I.T.
Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX

Date: February 26, 2002

Re: White Tanks FRS #3, Concrete Collars at Existing Central CMP Outlet Pipe Joint Coupling

---

Background

URS Corporation (URS) has prepared this technical memo to address the issue of existing couplings along the central outlet.

The November 1998 CMP inspection report by Speedie and Associates identified a joint at approximately 8.5 feet from the outflow (downstream) end of the outlet pipe. Overall, the CMP was found to be in relatively good condition and no corrosion was noted. The joint components (strap and bolts) could not be inspected in 1998 due to obvious practical difficulties. It is anticipated that this joint may be partially exposed during installation of the diaphragm filter around the central outlet.

During excavation of the downstream face of the dam at the South Outlet, (for installation of the diaphragm filter), the contractor exposed an existing joint along the south outlet pipe. Field inspections revealed that although the pipe itself was relatively sound, the bolts holding the strap together were severely corroded, and there was no gasket between the strap and the pipes.

Rationale

In light of the location of the joint along the central outlet, and the condition of the joint exposed along the south outlet, URS reviewed practical options to apply to the central

outlet. Specifically, this memo presents our technical opinion on two issues relative to the central outlet:

1. If the excavation of the downstream embankment face as currently proposed does not expose an existing coupling, then how far should the District extend the excavation in order to intercept the next joint?

2. Once an older coupling is exposed during the excavation process, how should the exposed joint be treated?

It is our opinion that if the older coupling is not exposed during excavation of the downstream face as currently proposed then the District/Contractor need not extend the excavation solely for the purpose of exposing and treating the joint. We believe that the added expense associated with extending the excavation and corresponding joint treatment is not commensurate with the anticipated reduction in risk of failure. This is because there are four other joints within the embankment that remain untreated. Furthermore, the risk of the embankment soils intruding into the pipe through a poor joint is relatively small compared to corresponding risk when dealing with a free-flowing filter sand.

If on the other hand, an old coupling is exposed during the course of excavation of the downstream face of the embankment, and there is risk of the diaphragm filter sand piping into the pipe through a poor joint, then we believe that the joint should be treated in a manner similar to the exposed joint along the south outlet. This would involve replacing the old coupling band and providing a full-width neoprene gasket, and encapsulating the joint in concrete.

Design Recommendations

The original design required encapsulation of the new pipe couplings in concrete and installation of the diaphragm filter sand 3 feet upstream of the concrete collar. Given this logic in the previous design phase, URS recommends the following:

- Replace the coupling band that may exhibit severe corrosion. Using the same 7'-6" (as recently field measured) segment of existing pipe is acceptable, but should remain in its current location. A universal dimpled or 5-C type coupling band with full-width neoprene gasket should also be provided.

- Perform additional excavation (assumed to be minor) into the dam face, local to the outlet pipe as shown on the attached figure to allow for the additional concrete collar

and diaphragm filter sand. A "pocket" excavation is all that is required, excavation the full width of the diaphragm need not be performed.

- Excavation may be phased if desired with an initial excavation for forming the concrete collar; followed by additional excavation to allow 3 feet of sand behind and 3 feet on either side of the collar.

- Slope the new face cut for safety, as necessary. Given the dam embankment is originally constructed with engineered fill and has cemented over time, a slope of 3/4:1 (H:V) may be sufficient for short term excavations. However, Buesing should field verify site conditions and rely on its own judgement and experience to meet the regulatory requirements for slope safety.

- Install a concrete collar similar to that proposed for new joint around the existing, exposed pipe joint. Due to the proximity of the currently proposed concrete collar, we recommend that Buesing prepare form work and place concrete to produce one continuous collar that spans both joints, as indicated by the attached Figure 1.

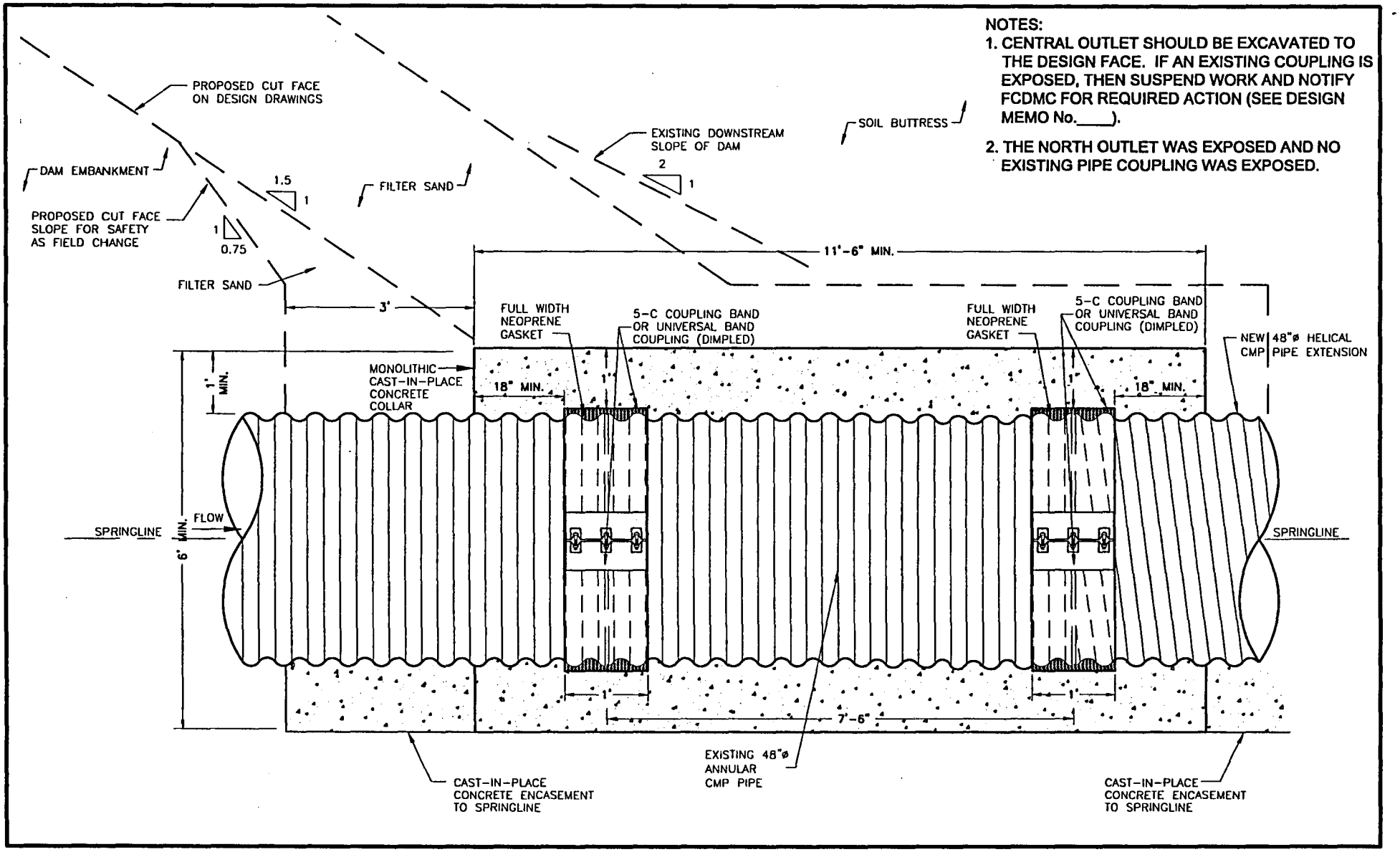
- Place diaphragm filter sand behind the concrete collar to a thickness of 3 feet as per the design drawings, while maintaining filter sand contiguous throughout the diaphragm envelope.

Please feel free to call either us at your convenience should questions or the need for clarification arise.

Attachments: Figure 1 – Central Collar Detail – Existing Pipe Joint

NOTES:

1. CENTRAL OUTLET SHOULD BE EXCAVATED TO THE DESIGN FACE. IF AN EXISTING COUPLING IS EXPOSED, THEN SUSPEND WORK AND NOTIFY FCDMC FOR REQUIRED ACTION (SEE DESIGN MEMO No.____).
2. THE NORTH OUTLET WAS EXPOSED AND NO EXISTING PIPE COUPLING WAS EXPOSED.



G:\22\JOBS\15448\007\A15236.DWG 2-18-02

Central Outlet Double Pipe Coupling

White Tanks FRS#3 Interim Dam Safety Project

URS

Figure 1

E1-15448007.75

TRANSMISSION RESULT REPORT (FEB 26 '02 04:26PM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
FEB 26	04:24PM	6024172423	01'59"	OK	ES	05		005

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (FEB 26 '02 04:18PM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
FEB 26	04:16PM	602 506 8561	01'53"	OK	ES	05		003

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

TRANSMISSION RESULT REPORT (FEB 26 '02 04:57PM)

DAMES & MOORE

(AUTO)

DATE	START TIME	REMOTE TERMINAL IDENTIFICATION	TIME	RE-SULTS	MODE	TOTAL PAGES	PERSONAL LABEL	FILE NO.
FEB 26	04:55PM	2333377	01'59"	OK	ES	05		008

E)ECM >)REDUCTION S)STANDARD D)DETAIL F)FINE M)MEMORY C)CONFIDENTIAL $)TRANSFER P)POLLING #)BATCH

MEMO SUBSTITUTE

Ravi Murthy

03/04/2002 08:03 AM

To: lly@mail.maricopa.gov
cc: Kevin Somerville/Phoenix/URSCorp@URSCORP, trr@mail.maricopa.gov, Alexander Gourlay/Phoenix/URSCorp@URSCORP, bahowey@adwr.state.az.us
Subject: Soil Sample Gradations

Dear Duke

I am following up on a message that I sent you over the weekend RE: 10 gradation test results that were faxed to us late Friday afternoon. I have not heard back from you and I suspect that the contractor will be ready to go first thing this (Monday) morning. I am therefore assuming that the 10 gradations pertain to the buttress fill stockpile from the spillway excavation, and that the soil from this excavation will be used to construct the buttresses at the three outlets. If this assumption is incorrect, please advise ASAP.

1. The gradation of the 10 samples meet the (revised) project specifications (gradation) for buttress fill.
2. The project specifications also call for a maximum PI of 10. The results that were faxed to me do not include the results of the Atterberg Limits tests. What is the PI of these soils and how does it compare with the project specifications??
3. The results of the gradation tests on the 10 samples collected on Feb 27 show a bit more variation when compared to the gradation of the first 10 samples collected. Furthermore, the gravel content in the second lot of samples appears to be slightly higher than than in the first set of stockpile samples. In light of this variability, I have the following suggestions that you might consider during construction:
    - You may want to run more than one Proctor (D698) to make sure that you catch the "range" of soils. If you do this, I suggest that you run full sieve analysis and PIs on the Proctor samples.
    - You may want to have the field tech perform more one-point Proctors to catch material changes
    - At least one sample has a gravel content greater than 10 percent. The testing lab and you may want to review the ASTM standard and see if a rock correction is warranted.
    - The testing lab and you may need to monitor the buttress soil placement closely so that you catch any changes in soil type, and use the appropriate Proctor curve.
    - During our meeting with you on Feb 21, George Beckwith of your office pointed out that the nuclear gage could overestimate densities as the gravel content increased. You may want to be on the lookout for this as the soil is being placed.
    - In addition to the CQA Plan requirements, you may want to have the tech run a sand cone density if you believe that the nuclear gage results are unrepresentative.

Please do not hesitate to call or email if I can be of further assistance. Thanks.

Regards
Ravi

Ravi Murthy

03/02/2002 08:51 AM

To: Duke Yager - FCDX <lly@mail.maricopa.gov>
cc: trr@mail.maricopa.gov, Kevin Somerville/Phoenix/URSCorp@URSCORP
Subject: Re: Daily

Duke

Late Friday afternoon, I received a fax from Alpha that contained 10 sieve analysis results. The material is listed as "Native". I am assuming that I need to review these need to be reviewed against the project specifications. However, the results do not indicate what this material is going to be used for, and therefore I am unable to determine what project specs I need to be looking at. Please advise urgently via email or voice mail at (602) 648 2441. Please advise Alpha to re-submit the results so that the material source can be identified. Thanks.

Regards
Ravi

Ravi Murthy

03/03/2002 08:47 AM

To: Duke Yager - FCDX <lly@mail.maricopa.gov>
cc: Kevin Somerville/Phoenix/URSCorp, trr@mail.maricopa.gov
Subject: Alpha Daily

Dear Duke

Thanks for faxing me Daily Density Reports from Alpha. I received the fax on Friday. There appear to be some discrepancies in the moisture-density relationships (Proctor Curves) used to estimate the relative compaction of the buttress fill.

1) Early results by Jim Ashcraft quote a maximum dry density of 124.1 pcf and an Optimum Moisture content of 11.1 percent. There is no curve number or designation assigned to these values.

2) Some results by Frank Hathaway quote a maximum dry density of 124.1 pcf and an optimum dry density of 10.6 percent. These results apparently pertain to Curve "K".

3) Most of the results reported by Frank Hathaway quote a maximum dry density of 123.8 pcf and an optimum moisture content of 10.8 percent. These results apparently ALSO pertain to Curve "K".

Why are there these discrepancies in the values of maximum dry density and optimum moisture content? What is the correct value to be used? What is our basis for selecting a particular set of values over the others? If there is indeed a discrepancy, please have Alpha select the proper values and recalculate the relative compactions.

I realize that the differences in the sets of values is relatively small, and that this is more an issue of bookeeping than a technical flaw. However, we should try and resolve these issues early so that we dont have unanswered questions when preparing the construction report. Also, the procedures and protocol (including data assessment, application, and documentation) may become more critical if the new buttress fill stockpile is not as consistent and homogenous as the first stockpile was.

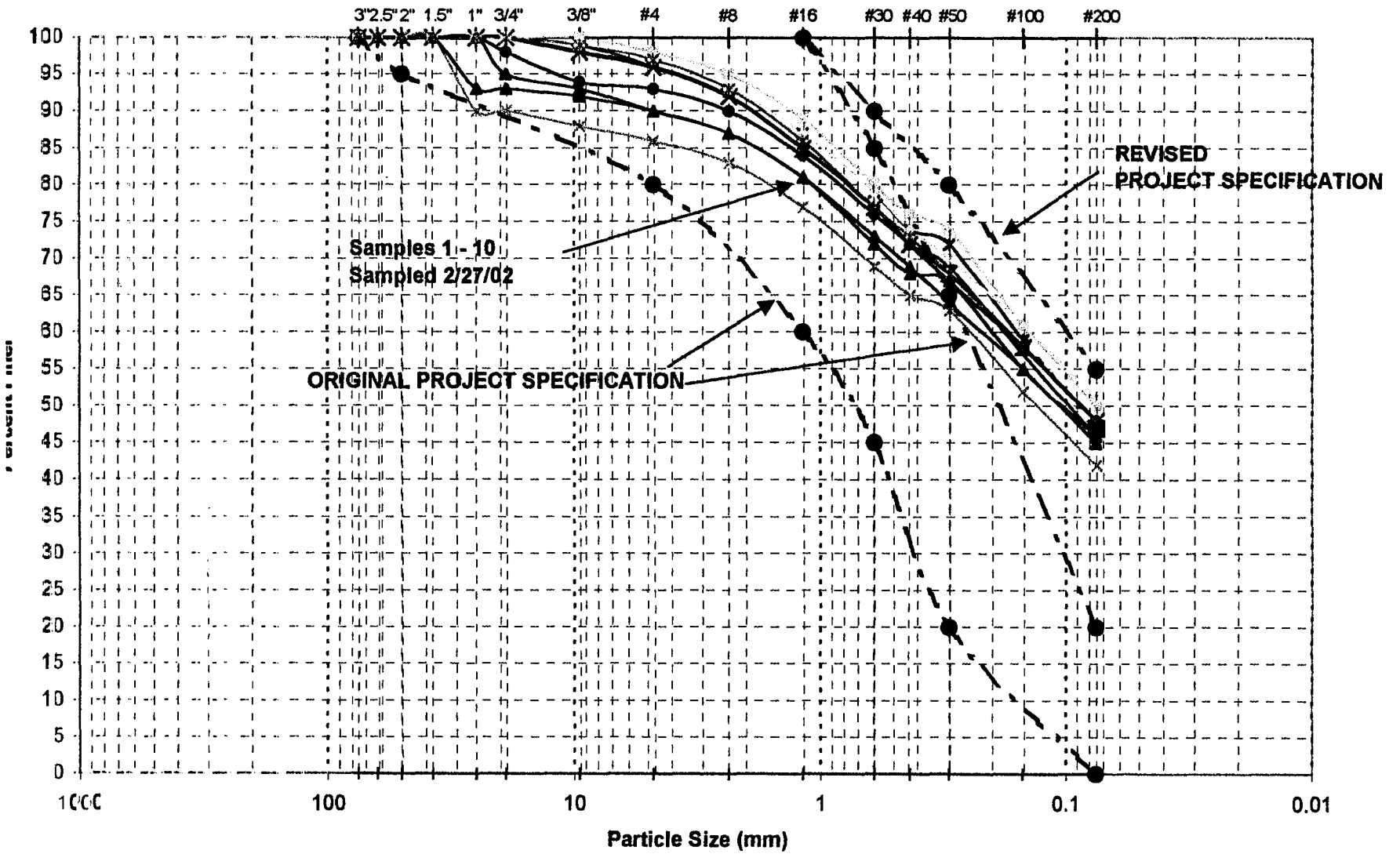
Please call or email if I can be of further assistance. Thanks.

Regards
Ravi

GRADATION RESULTS

2nd Stockpile

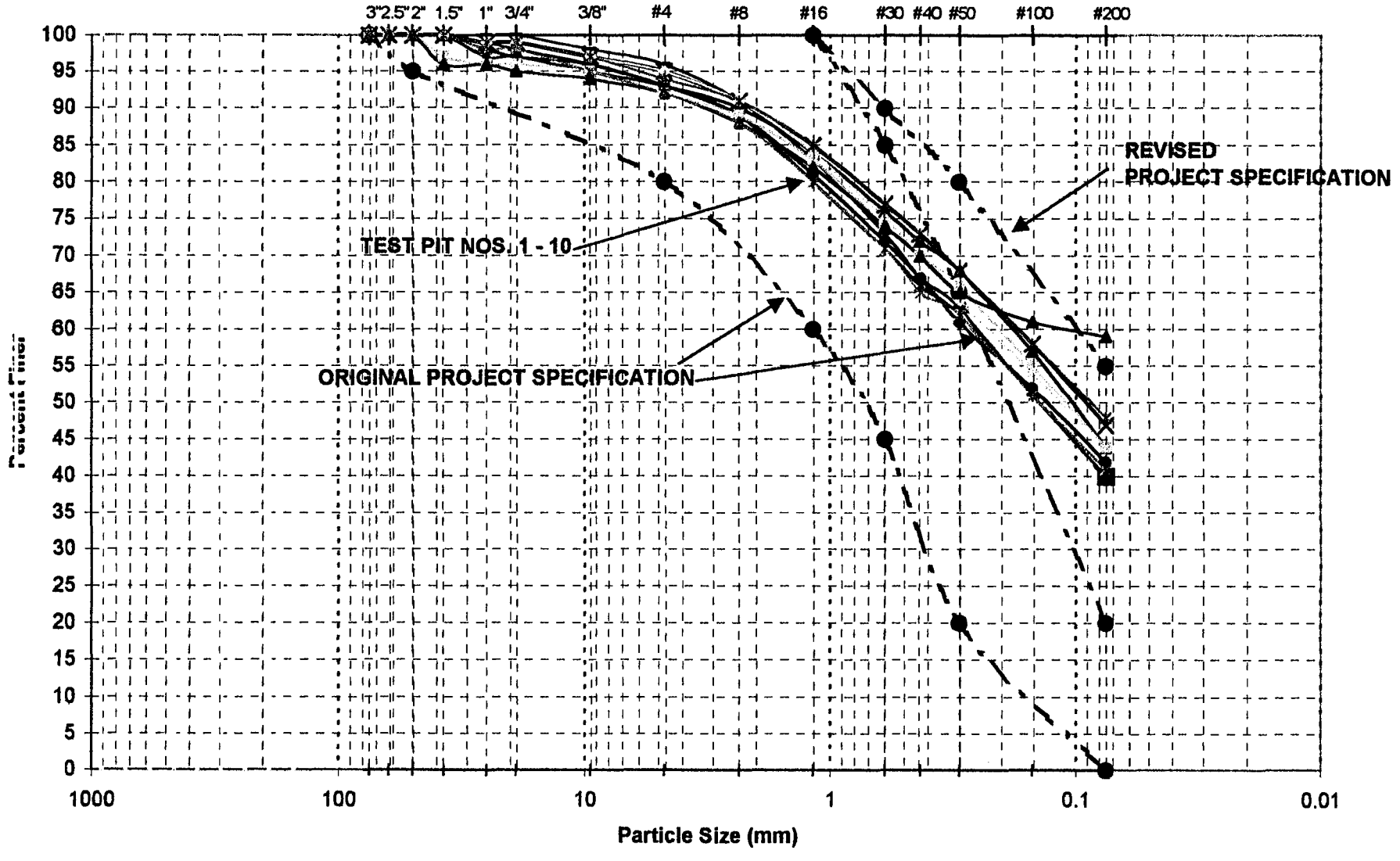
Soil Buttress Fill Stockpile



GRADATION RESULTS

First Stockpile

Soil Buttress Fill Stockpile



ALPHA Geotechnical & Materials, Inc.
5002 S. 40th Street, Suite E
Phoenix, Arizona 85040
Phone No: (602) 453-3265
Fax No: (602) 453-3267

FACSIMILE TRANSMITTAL

TO: Mr. Kevin Somerville
Mr. Ravi Murthy
FROM: Kylene Williams
COMPANY: URS
RE: Laboratory test results
DATE: March 1, 2002
FAX #: 602-371-1615
NUMBER OF PAGES: (including cover sheet) 11

This transmission is intended only for the Addressee. It may contain privileged or confidential information. Any unauthorized disclosure is strictly prohibited. If you have received this transmission in error, please notify us immediately so that we may correct our transmission. Thank you.

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	JOB NO:	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	WORK ORDER NO:	20
MATERIAL:	NATIVE	LAB NO:	44
SAMPLE SOURCE:	#1	DATE SAMPLED:	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	93
3/4 IN	93
1/2 IN	93
3/8 IN	92
1/4 IN	91
#4	90
#8	87
#10	86
#16	81
#30	72
#40	68
#50	67
#100	55
#200	46

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	JOB NO:	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	WORK ORDER NO:	20
MATERIAL:	NATIVE	LAB NO:	45
SAMPLE SOURCE:	#2	DATE SAMPLED:	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	99
3/8 IN	98
1/4 IN	97
#4	96
#8	92
#10	91
#16	85
#30	77
#40	72
#50	68
#100	58
#200	48

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	46
SAMPLE SOURCE:	#3	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	99
1/4 IN	98
#4	97
#8	93
#10	92
#16	87
#30	79
#40	74
#50	72
#100	59
#200	47

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	47
SAMPLE SOURCE:	#4	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	98
1/2 IN	95
3/8 IN	94
1/4 IN	94
#4	93
#8	90
#10	89
#16	84
#30	76
#40	72
#50	67
#100	58
#200	48

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	48
SAMPLE SOURCE:	#5	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	99
3/8 IN	99
1/4 IN	97
#4	96
#8	92
#10	91
#16	85
#30	77
#40	72
#50	69
#100	57
#200	46

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	49
SAMPLE SOURCE:	#6	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	99
1/4 IN	98
#4	97
#8	93
#10	92
#16	87
#30	79
#40	74
#50	70
#100	61
#200	51

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	50
SAMPLE SOURCE:	#7	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	100
1/4 IN	99
#4	98
#8	95
#10	93
#16	89
#30	80
#40	76
#50	74
#100	61
#200	50

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	51
SAMPLE SOURCE:	#8	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	95
1/2 IN	94
3/8 IN	93
1/4 IN	91
#4	90
#8	87
#10	86
#16	81
#30	73
#40	69
#50	64
#100	55
#200	45

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	JOB NO:	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	WORK ORDER NO:	20
MATERIAL:	NATIVE	LAB NO:	52
SAMPLE SOURCE:	#9	DATE SAMPLED:	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	90
3/4 IN	90
1/2 IN	89
3/8 IN	88
1/4 IN	87
#4	86
#8	83
#10	82
#16	77
#30	69
#40	65
#50	63
#100	52
#200	42

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANKS- FRS #3- IDS	**JOB NO:**	01-A-00075
LOCATION:	WHITE TANKS DAM- WEST END OF NORTHERN AVE.	**WORK ORDER NO:**	20
MATERIAL:	NATIVE	**LAB NO:**	53
SAMPLE SOURCE:	#10	**DATE SAMPLED:**	02/27/02

SIEVE ANALYSIS OF FINE AND COARSE AGGREGATES (ASTM C136/C117)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	100
3/4 IN	100
1/2 IN	100
3/8 IN	99
1/4 IN	98
#4	97
#8	93
#10	91
#16	86
#30	77
#40	73
#50	68
#100	58
#200	48

URS

Design Memo No. 18

Technical Support During Construction

To: Duke Yager - FCDMC (Fax 602-506-8561)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Brett Howey – ADWR (Fax 602-417-2423)
Michael D. Greenslade – ADWR (Fax 602-417-2423)

From: Ravi Murthy, P.E.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

Date: March 10, 2002

Re: White Tanks FRS #3 – **Central Outlet** Filter Matches

URS has received and reviewed the laboratory test results of samples collected and tested by Alpha Geotechnical & Materials Inc (Fax dated March 8, 2002). We understand that the three samples were collected from the subgrade in the vicinity of the **Central Outlet.** The attached Calculation Package documents the results of our review and assessment.

The following filter matches were considered:

- Retention Criterion – Geotextile versus Subgrade
- Filter Match – Filter Sand (as base soil) versus Subgrade soils
- Filter Match – Subgrade (as base soil) versus Filter Sand

It is our opinion that the Calculation Package demonstrates that the design intent is met for the subgrade at the central outlet.

Should you have questions or require additional information, please contact us at (602) 371 1100.

URS

CALCULATIONS COVER SHEET

SUBJECT: WT#3-IDS CONSTRUCTION

PROJECT NO. EI-0000852.00

SHEET 1 OF 10

CENTRAL OUTLET SUBGRADE ACCEPTANCE

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — SIGNATURE — 03/09/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: RAVI MURTHY (PRINT NAME) — SIGNATURE — 03/09/02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME) — SIGNATURE — 3/11/02 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) RAVI MURTHY (PRINT NAME) — SIGNATURE — 03/09/02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

URS

Job WT#3-JDS CONSTRUCTION Project No. EI-0000185200 Sheet ___ of ___

Description CENTRAL OUTLET - SUBGRADE VS GEOTEXTILE MATCH Computed by RAVI MURTHY Date 03/09/02

Checked by Kevin R. Donnelly Date 3/11/02

Reference

OBJECTIVE: Check compatibility of subgrade soils and geotextile. Subgrade exposed during construction

DATA : Gradation results for 3 subgrade samples provided by Alpha (FAX DATED 3/08/02

: Spec sheet for AMOCO Style 4553 provided by contractor

REF : Designing with Geosynthetics - RM Koerner, 3rd Ed Pg 101, Carroll 1983

* from gradation curves for subgrade soils

$d_{85} = 1.6\,mm$ to $3.5\,mm$

* from AMOCO cutsheet $AOS = O_{95} = 0.15\,mm$

$$O_{95}/d_{85} = \frac{0.15}{3.5} \text{ to } \frac{0.15}{1.6}$$

$$= 0.04 \text{ to } 0.09$$

* from Reference, $O_{95}/d_{85} \approx < 2$ to 3

∴ Geotextile + subgrade soils are compatible

URS

Job WT#3 IDS CONSTRUCTION Project No. EI-0000185200 Sheet ___ of ___

Description CENTRAL OUTLET - SUBGRADE VERSUS FILTER SAND (base) Computed by RAVI MURTHY Date 03/09/02

Checked by Kari R. Lomeli Date 3/11/02

Reference

OBJECTIVE: To check compatibility of the filter sand (base) and subgrade soil @ Central Outlet

DATA: (1) Subgrade gradation results provided by Alpha FAXED 3/8/02

(2) Calculation Package #6 Design Report Vol 2 Aug 3, 2001, Appendix E

REF: Chapter 26: Gradation Design of Sand & Gravel Filters Part 633, NEH, NRCS

* Calculation Package #6 documents a filter match between filter sand (base) and drain

* from Calc #6, following points are used to define the design band

COARSE		FINE	
SIZE	% PASS	SIZE	% PASS
75	100	12.1	99.8
30	90	4.8	60
24	60	1.64	15
4.8	15	0.075	5

* Above Control Points are plotted on Fig 1

* Subgrade soil is finer than design band

⇒ OK

URS

Job WT#3 - IDS CONSTRUCTION | Project No. EI-0000852.00 | Sheet ___ of ___

Description CENTER OUTLET - SUBGRADE (BASE) TO FILTER SAND | Computed by RAVI MURTHY | Date 03/09/02

Checked by Kevin R. Armilli | Date 3/11/02

OBJECTIVE: To check filter match between subgrade (BASE) and filter sand at the Central Outlet

REF : Chapter 26: Gradation Design of Sand & Gravel Filters Part 633 NEH, NRCS

DATA (1) Gradation data for subgrade samples from Alpha FAXED 3/8/02
(2) Gradation data for filter sand

* For Lab No 56 provided by Alpha, correction factor $= \frac{100}{93} = 1.08$

* Corrected fines : $39 \times 1.08 = 41.9\%$

* From Table 26-1 of Reference, Base Soil Category = 2

* Filtering Criteria : $D_{15} \leq 0.7mm$

* Permeability Criteria : From Table 26-3 of Reference

$(D_{15})_{min} \geq 4 d_{15}$

From Fig 1, $d_{15} < 0.1mm$

$\therefore D_{15} = 0.1mm \Rightarrow 0.1 \leq D_{15} \leq 0.7mm$ (A)

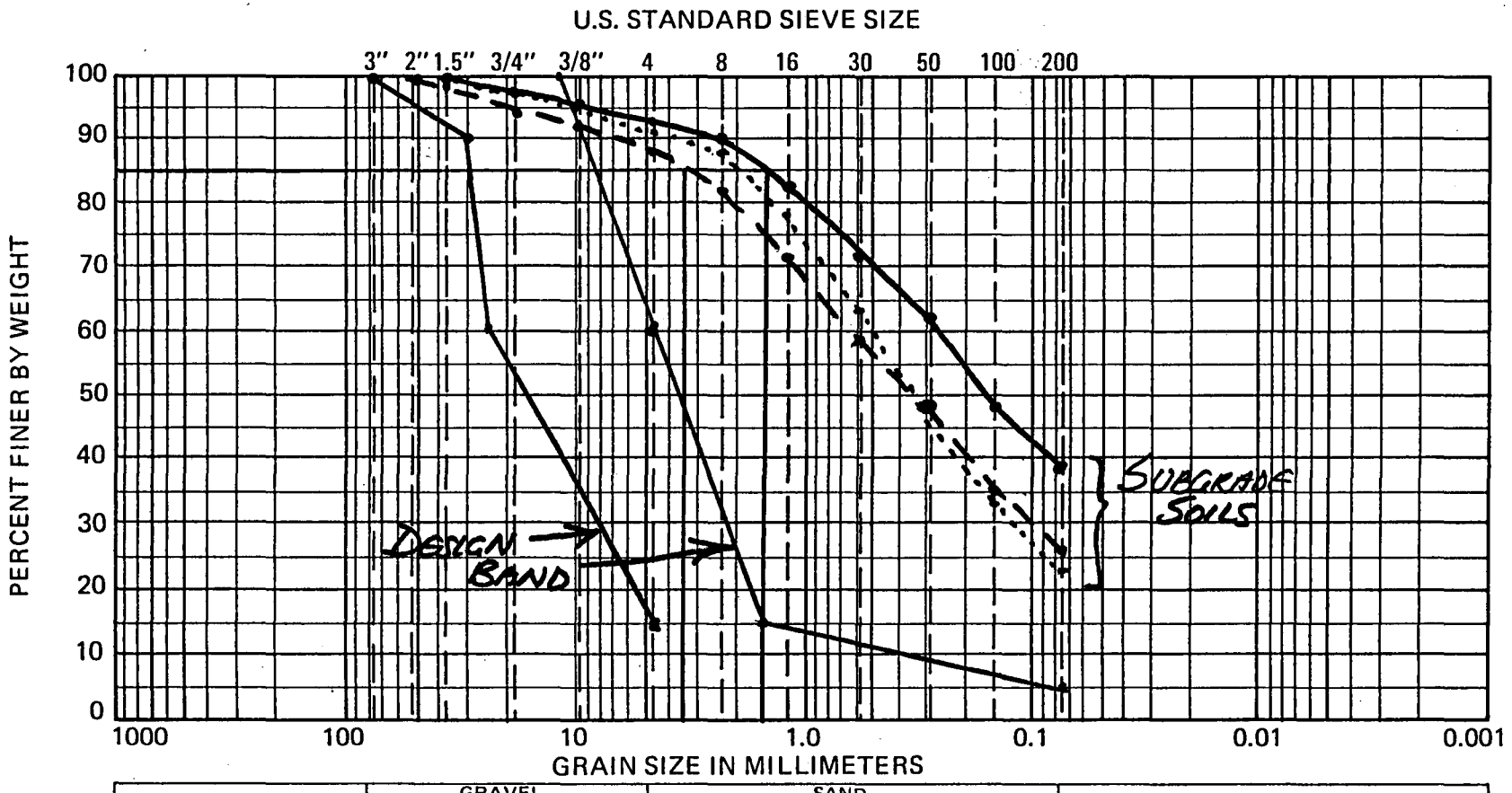
* From Project Specs, $(D_{15})_{min} = 0.2mm$, $(D_{15})_{max} = 0.5mm$ } Meets (A) above

* Remainder of Filter Match procedure relates to acceptable width and shape of filter band. Project specs meet these requirements (See Calc # 7 in Design Report)

$\Rightarrow$ Filter Match between Subgrade Soils & Filter Sand is OK

NT 3 5 200 25
CENTRAL SUBGRADE
BY RAVI MURTHY DATE 03/09/02
CHECKED BY DATE

REV S
BY DATE
BY DATE
PLATE OF



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION		NAT. W C	LL	PL	PI	

d_{85} = 1.6mm to 3.5mm

GRADATION CURVE

FIGURE 1

3-11-02

Page 5 of 10

Dames & Moore

3-11-02

Figure 1

ALPHA Geotechnical & Materials, Inc.

PROJECT:	TE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	ST END OF NORTHERN AVENUE	WORK ORDER NO:	21
MATERIAL:	GRADE	LAB NO:	56
MATERIAL SOURCE:	3/8 21" U.S. @ THE CENTER LINE	DATE SAMPLED:	03/08/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

GRADATION CURVE

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	98
3/4 IN	98
1/2 IN	97
3/8 IN	96
1/4 IN	95
#4	93
#8	90
#10	89
#16	82
#30	71
#40	65
#50	62
#100	49
#200	39

ATTERBERG LIMITS

LL: NV
PI: NP

Dames & Moore

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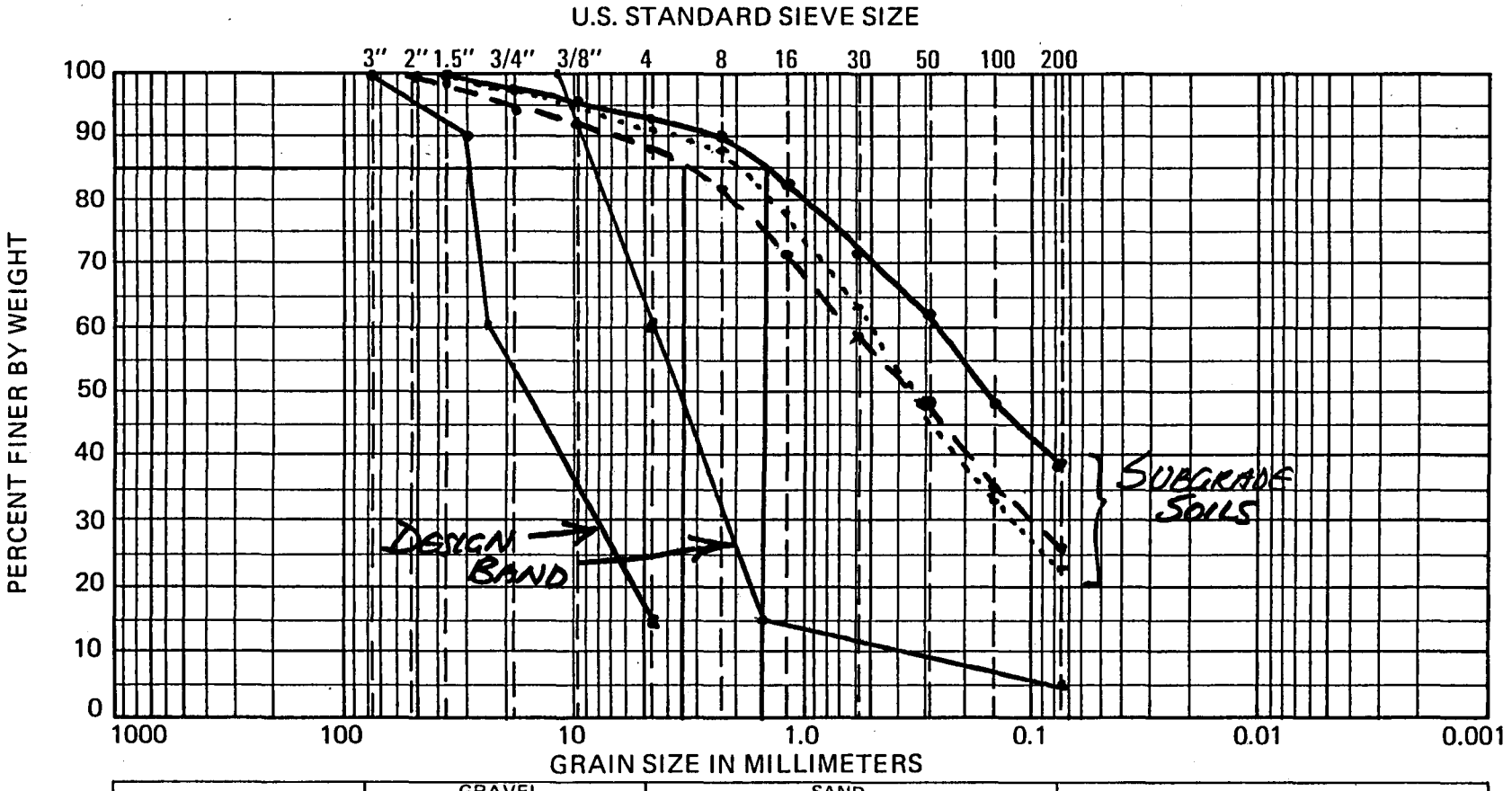
WT 3 [illegible]
CENTRAL SUBGRADE
BY RAVI MURTHY DATE 03/09/02
CHECKED BY _____ DATE _____

REV IS _____
BY _____ DATE _____
BY _____ DATE _____
PLATE _____ OF _____

3 SAMPLES TESTED BY ALPHA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

	DEPTH	CLASSIFICATION	NAT. W C	LL	PL	PI	

d_{85} = 1.6mm to 3.5mm

GRADATION CURVE

FIGURE 1

3-11-02

Page 5 of 10

Dames & Moore

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	WEST END OF NORTHERN AVENUE	WORK ORDER NO:	21
MATERIAL:	SUBGRADE	LAB NO:	56
SAMPLE SOURCE:	#3, 3/8 21' U.S. @ THE CENTER LINE	DATE SAMPLED:	03/08/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	98
3/4 IN	98
1/2 IN	97
3/8 IN	96
1/4 IN	95
#4	93
#8	90
#10	89
#16	82
#30	71
#40	65
#50	62
#100	49
#200	39

ATTERBERG LIMITS

LL: NV
PI: NP

7 of 10

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	WEST END OF NORTHERN AVENUE	WORK ORDER NO:	21
MATERIAL:	SUBGRADE	LAB NO:	54
SAMPLE SOURCE:	#1, 3/8 57' U.S., 3' RIGHT	DATE SAMPLED:	03/08/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	100
1 IN	98
3/4 IN	97
1/2 IN	96
3/8 IN	95
1/4 IN	93
#4	92
#8	88
#10	87
#16	78
#30	63
#40	55
#50	48
#100	32
#200	23

ATTERBERG LIMITS

LL: NV
PI: NP

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8 of 10

ALPHA Geotechnical & Materials, Inc.

PROJECT:	WHITE TANK FRS #3 - I.D.S.	JOB NUMBER:	01-A-00075
LOCATION:	WEST END OF NORTHERN AVENUE	WORK ORDER NO:	21
MATERIAL:	SUBGRADE	LAB NO:	55
SAMPLE SOURCE:	#2, 3/8 46' U.S. @ THE CENTER LINE	DATE SAMPLED:	03/05/02

MECHANICAL SIEVE ANALYSIS (ASTM C136 & C117)
ATTERBERG LIMITS (ASTM D4318)

MECHANICAL ANALYSIS

SIEVE SIZE	% PASSING
6 IN	100
4 IN	100
3 IN	100
2 IN	100
1 1/2 IN	98
1 IN	97
3/4 IN	95
1/2 IN	93
3/8 IN	92
1/4 IN	89
#4	88
#8	82
#10	80
#16	71
#30	59
#40	53
#50	49
#100	35
#200	26

ATTERBERG LIMITS

LL: NV
PI: NP

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AMOCO FABRICS AND FIBERS COMPANY
900 Circle 75 Parkway, Suite 300
Atlanta, GA 30339
PH: (770) 984-4444
FX: (770) 956-2430

STYLE 4553

Amoco Style 4553 is a polypropylene nonwoven needlepunched fabric. This engineered geotextile is stabilized to resist degradation due to ultraviolet exposure. It is resistant to commonly encountered soil chemicals, mildew and insects, and is non-biodegradable. Polypropylene is stable within a ph range of 2 to 13, making it one of the most stable polymers available for geotextiles today. We wish to advise that **Amoco Style 4553** meets the following minimum average roll values:

Property	Test Method	Minimum Average Roll Value (English)	Minimum Average Roll Value (Metric)
Grab Tensile	ASTM-D-4632	203 lbs	0.900 kN
Grab Elongation	ASTM-D-4632	50 %	50 %
Mullen Burst	ASTM-D-3786	400 psi	2750 kPa
Puncture	ASTM-D-4833	130 lb	0.575 kN
Trapezoidal Tear	ASTM-D-4533	80 lb	0.355 kN
UV Resistance	ASTM-D-4355	70 % at 500 hrs	70 % at 500 hrs
AOS	ASTM-D-4751	100 sieve	0.15 mm
Permittivity	ASTM-D-4491	1.5 sec^{-1}	1.5 sec^{-1}
Flow Rate	ASTM-D-4491	110 $gal/min/ft^2$	4470 $L/min/m^2$

Amoco Fabrics and Fibers Company manufactures the nonwoven fabric indicated above. The values listed are a result of testing conducted in on-site laboratories. A letter certifying the minimum average roll values will be issued from the manufacturing plant by the Quality Control Manager at the time shipment is made.

DATE ISSUED: 01/01/98

The information presented herein, while not guaranteed, is to the best of our knowledge true and accurate. Except when agreed to in writing for specific conditions of use, no warranty or guarantee expressed or implied is made regarding the performance of any product, since the manner of use and handling are beyond our control. Nothing contained herein is to be construed as permission or as a recommendation to infringe any patent.

d_{85}, d_{50}, or d_{15}; see Table 2.3). The numeric value of the ratio depends on the geotextile type, the soil type, the flow regime, etc. For example, Carroll [5] recommends the following:

$$O_{95} < (2 \text{ or } 3)\ d_{85} \tag{2.9}$$

where d_{85} is the soil particle size in mm for which 85% of the total soil is finer.

Table 2.3 Existing geotextile retention criteria, after Christopher and Fischer [3]

Source	*Criterion*	*Remarks*
Task Force #25 (1986)	50% ≤ 0.074 mm, $O_{95} < 0.59$ mm	No limitations on geotextile type or soil type
	50% > 0.074 mm, $O_{95} < 0.30$ mm	
Calhoun (1972)	$O_{95}/d_{85} \leq 1$	Wovens, soils with ≤50% passing No. 200 sieve
	$O_{95} \leq 0.2$ mm	Wovens, cohesive soils
Zitscher (1975)	$O_{50}/d_{50} \leq 1.7$–2.7	Wovens, soils with CU ≤ 2, d_{50} = 0.1 to 0.2 mm
	$O_{50}/d_{50} \leq 2.5$ to 3.7	Nonwovens, cohesive soil
Ogink (1975)	$O_{90}/d_{90} \leq 1$	Wovens
	$O_{90}/d_{90} \leq 1.8$	Nonwovens
Sweetland (1977)	$O_{15}/d_{85} \leq 1$	Nonwovens, soils with CU = 1.5
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with CU = 4.0
Rankilor (1981)	$O_{50}/d_{85} \leq 1$	Nonwovens, soils with $0.2 \leq d_{85} \leq 0.25$ mm
	$O_{15}/d_{15} \leq 1$	Nonwovens, soils with $d_{85} >$ 0.25 mm
Schober & Teindl (1979)	$O_{90}/d_{50} \leq 2.5$–4.5	Woven and thin nonwovens, dependent on CU
	$O_{90}/d_{50} \leq 4.5$–7.5	Thick nonwovens, dependent on CU, silt and sand soils
Giroud (1982)	$O_{95}/d_{50} \leq (9$–$18)/\text{CU}$	Dependent on soil CU and density
		Assumes fines in soil migrate for large CU values
Carroll (1983)	$O_{95}/d_{85} \leq 2$–3	Wovens and nonwovens
Christopher and Holtz (1985)	$O_{95}/d_{85} \leq 1$–2	Dependent on soil type and CU
	$O_{95}/d_{15} \leq 1$ or	Dynamic, pulsating, and cyclic flow, if soil can move beneath geotextile
	$O_{50}/d_{85} \leq 0.5$	
French Committee on Geotextiles and Geomembranes (1986)	$O_f/d_{85} \leq 0.38$–1.25	Dependent on soil type, compaction, hydraulic and application conditions
Fischer et al. (1990)	$O_{50}/d_{85} \leq 0.8$	Based on geotextile pore size distribution, dependent on CU of soil
	$O_{50}/d_{15} \leq 1.8$–7.0	
	$O_{50}/d_{50} \leq 0.8$–2.0	

O_x = geotextile opening size corresponding to x particle size based on dry glass bead sieving.
O_f = filtration opening size based on hydrodynamic sieving.
d_y = soil particle size corresponding to y percent passing.
CU = coefficient of uniformity = d_{60}/d_{10}.

URS

Design Memo No. 19

Technical Support During Construction

To: Duke Yager - FCDMC (Fax 602-506-8561)

CC: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)
Brett Howey – ADWR (Fax 602-417-2423)
Michael D. Greenslade – ADWR (Fax 602-417-2423)

From: Kevin Somerville E.I.T.

CC: Todd E. Ringsmuth, P.E. – URS, PHX
Sandy Gourlay, P.E. – URS, PHX
Kevin R. Somerville, URS, PHX

Date: March 20, 2002

Re: White Tanks FRS #3 – **Expansion of Spillway Notch Borrow for Soil Buttress Fill**

URS has reviewed the discussion points identified during Progress Meeting No. 10 on Wednesday, March 13, 2002 (see separate minutes). On Thursday, URS transmitted a "draft" sketch showing a proposed modification to the spillway notch to allow additional borrow excavation for development of needed Soil Buttress Fill. Buesing estimates that 600 in-place cubic yards is still needed, after the notch has been excavated per plan. During the meeting is was discussed increasing this volume for shrinkage (~30%) due to compaction and contingency to approximately 1,000 cubic yards bank measure. Comments have been received by the project team and incorporated into this memo transmitting our final proposed Borrow Excavation Plan (see attached sketch).

- Access road re-alignment is constructed per approved design plan.
- Additional mass excavation is performed between station 2+00 and 4+00 at a width of 40 feet from original top of slope to proposed top of slope (or 40 feet from toe of original and proposed).
- The depth of additional excavation should match the elevation and grade of adjacent stationing for the centerline of the original notch configuration (absolutely no deeper than).
- The additional excavation is conducted with same 5:1 (H:V) side slopes as the original notch.
- Additional excavation of triangular areas is performed with transitions from original width and side slopes.
- Excavation should not be beyond the property line shown on the plan drawings.
- The additional excavation is considered primarily an operation and maintenance issue and not a dam safety issue, therefore FCDMC should be aware that a non-uniform width of spillway notch may result in increased erosion of the bank and / or sediment buildup.
- The final excavation configuration should be surveyed and the drawings red-lined for as-builts.
- ADWR has approved (see copy of e-mail message) of the proposed additional notch excavation based on the condition that FCDMC modify its Operation and Maintenance plan to specifically indicate observation and inspection of the spillway notch after a flow condition through the spillway has occurred. The inspection procedure should allow for maintenance to remove sediment buildup, if present.

Should you have questions or require additional information, please contact us at (602) 371 1100.

URS

Design Memo No. 20

Rev. No. 1

Technical Support During Construction

To: Tom Renckly, P.E. – FCDMC (Fax 602-506-8561)

CC: Duke Yager - FCDMC (Fax 602-506-8561)
Brett Howey – ADWR (Fax 602-417-2423)

From: Ravi Murthy, P.E.

CC: Sandy Gourlay, P.E. – URS, PHX

Date: July 25, 2002

Re: White Tanks FRS #3 – **Slotted HDPE Pipe at Central Outlet – Revision No. 1**

URS has reviewed the as-constructed condition of the slotted HDPE drain pipes at the Central Outlet. The original design by URS required that the HDPE pipes extend 8 feet into the filter. It is our understanding that the contractor inadvertently terminated the drain pipes short of the design length. Initial indications from the contractor were that the pipes extended a foot beyond the filter trench. However, subsequent measurement by Duke Yager of the District and Richard Candelaria of Buessing showed that the HDPE pipes were about 40 feet in length, corresponding to approximately 6 feet into the filter.

In light of this construction modification, URS reviewed the flow capacity of the diaphragm and the flow capacity across the transition zone from the filter to the drain. During this process, the assumptions made during the initial design effort was reviewed. The revised estimate of filter flow is attached, and the results are summarized below:

- Based on the project specification for gradation of the filter sand, the hydraulic conductivity of the filter sand could vary between 9.5E-04 ft/sec and 4.6E-03 ft/sec. Using these values of hydraulic conductivity, the maximum flow from the filter is estimated to be 2.76 cfs.

- Based on a six-foot penetration (into the filter) for each HDPE pipe, the total capacity of the HDPE pipes is approximately 3.2 cfs.

The following conservative assumptions were used during this analysis:

1. There is no loss of head along the CMP
2. The head at Point Z is 0 (zero).
3. The capacity (albeit small) of the granular drain is neglected.

Based on the above results and the conservatism inherent in the analysis because of the above assumptions, it is our opinion that diaphragm filter and drain in their existing constructed condition meet the design intent, and will perform satisfactorily. Should you have questions or require additional information, please contact us at (602) 371 1100.

URS

CALCULATIONS COVER SHEET

SUBJECT: WT#3 IDS

PROJECT NO. E1-0000185 2.00

SHEET 1 OF

ASSESSMENT OF "AS BUILT" HDPE PIPES
TITLE OF CALCULATIONS/DOCUMENT

@ CENTER OUTLET

CALCULATIONS/DOCUMENT BY: RAJI MURTHY (PRINT NAME) — SIGNATURE — 7/15/02 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: A.W. GOURLAY (PRINT NAME) — SIGNATURE — 7-19-02 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: A.W. GOURLAY (PRINT NAME) — SIGNATURE — 7-19-02 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY (PRINT NAME) — SIGNATURE — 7-19-02 (DATE)

Approval Notice: If Calculations/Document are only spot checked, do not require checking, or are assumed to be correct by experience of engineering judgement, it should be noted here.

Revision Number	Date	By	Checked By	Approval
→ 1	7/25/02	RAJI MURTHY		7-25-02
2				
3				
4				

INITIALS

See Pg. 4 (Added)

OBJECTIVE: To assess the assess the capacity/adequacy of the drain in its as-built condition.

A. REFER TO FIGURE ①
- Maximum reservoir elevation = 1210.5' ✓
- Assume a void around the CMP and no head loss. ✓
- If the filter and drain have adequate capacity, the seepage along the CMP flows through the drain and exits the dam at the down-stream toe. ⇒ OK ✓
- If the filter/drain do not have adequate capacity, the water builds up in the filter. In the "worst case" scenario, the filter is completely saturated. ✓

• Consider the flow between Point A & Point C

$\Delta H = 12 + \frac{4}{2} = 14'$ ✓

• $L = \sqrt{12^2 + 18^2} + (3+4+1) = 29.6' \Rightarrow i = 0.47$

B. REFER FIGURE ②
- The area above B (shown hatched) serves as a "reservoir" for water, but is a "dead zone" from a flow standpoint
- Similarly, the cut off trench is a "dead zone".
- ∴ The area of flow = (1+1+2+2+1) x 28 = 196 sq ft

C. From project specifications, D_{10} = 0.017 cms to 0.038 cms

$K = 100 D_{10}^2 = 100 \times (0.038)^2$ to $100 \times (0.017)^2$

$K = 0.029$ cms/sec to 0.14 cms/sec $= 9.5 \times 10^{-4}$ ft/sec to 4.7×10^{-3} ft/sec ✓

D. From Ⓐ, Ⓑ, Ⓒ, $Q = KiA$

$Q = 9.5 \times 10^{-4} \times 0.47 \times 196$ to $4.7 \times 10^{-3} \times 0.47 \times 196$

$Q = 0.088$ cfs to 0.43 cfs

Checker's Note: With maximum head loss of 24'

$i = \frac{24}{29.6} = 0.81$

Q = 0.15 to 0.74 cfs

Still significantly less than pipe capacity (3.24 cfs) from next page ⇒ OK.

E. - From "Soil Mechanics Note #3 - Soil Mechanics Considerations for Embankment Drains" USDA, SCS May 1971

q (flow into slotted pipe) $= 3.2Ah^{1/2}$ ✓

A = Area of slots
h = head.

- From project specs, $A = 2.5\ in^2/ft = 0.0174\ ft^2/ft$ ✓

- Assuming a void around the CMP and no head loss, head acting on slotted pipe = 24' (See Figure 2)

- $q = 3.2 \times 0.0174 \times 24^{1/2}$

$q = 0.27\ cfs/ft$

- There are two pipes ⇒ $= 0.54\ cfs/ft$ ✓

F. Refer Figure ③ & Attached Email

- According to FCD measurement, HDPE pipe is 40' long.
- ∴ HDPE pipe extends approx. 10' upstream of the downstream edge of the cutoff trench
- As seen in Figure ①, the above measurements indicate that the HDPE pipes extend 6' upstream of Point Ⓐ

- ∴ Pipe capacity for 2 pipes $= 0.54 \times 6 = 3.24\ cfs$ ✓

Conclusion: Flow capacity into HDPE pipes ≫ estimated flow from filter. ∴ Ok.

URS

DATE JULY 25, 2002
PROJECT NO. EI-00001852.00
PAGE NO. 4 OF ____ BY RM

Rev. No 1: This sheet added in response to telephone discussions with ADWR on July 24, 2002.

A. Conservatively, assume full reservoir head @ Point Y (See Figure 1). Conservatively, assume flow path Y-Z and zero pressure @ Point Z

$\Delta H = 24'$

$L = 1+4+3 = 8'$ ✓

$i = \frac{24}{8} = 3.0$ ✓

B. Same as previous $A = 196$ sq ft ✓

C. Same as previous
$K = 9.5 \times 10^{-4}$ ft/sec to 4.7×10^{-3} ft/sec ✓

D. $Q = 9.5 \times 10^{-4} \times 3 \times 196$ to $4.7 \times 10^{-3} \times 3 \times 196$
$Q = 0.56$ cfs to 2.76 cfs ✓ correct my scaling i values

E & F Same as previous:
Capacity of 2 pipes = 3.24 cfs.

CONCLUSION: Max Flow (2.76 cfs) < Pipe Capacity (3.24 cfs) ⇒ OK ✓

CONSERVATIVE ASSUMPTIONS USED IN ASSESSMENT
* No head loss along CMP ✓
* Zero head @ Point Z ✓
* Neglected Capacity of Granular drain fill ✓

Page 4 checked AWG 7-25-02

FIGURE 1

FLOW PATH = X-Y-Z

FLOW PATH BASED ON DISCUSSION WITH ADWR ON 7/25/02 = Y-Z

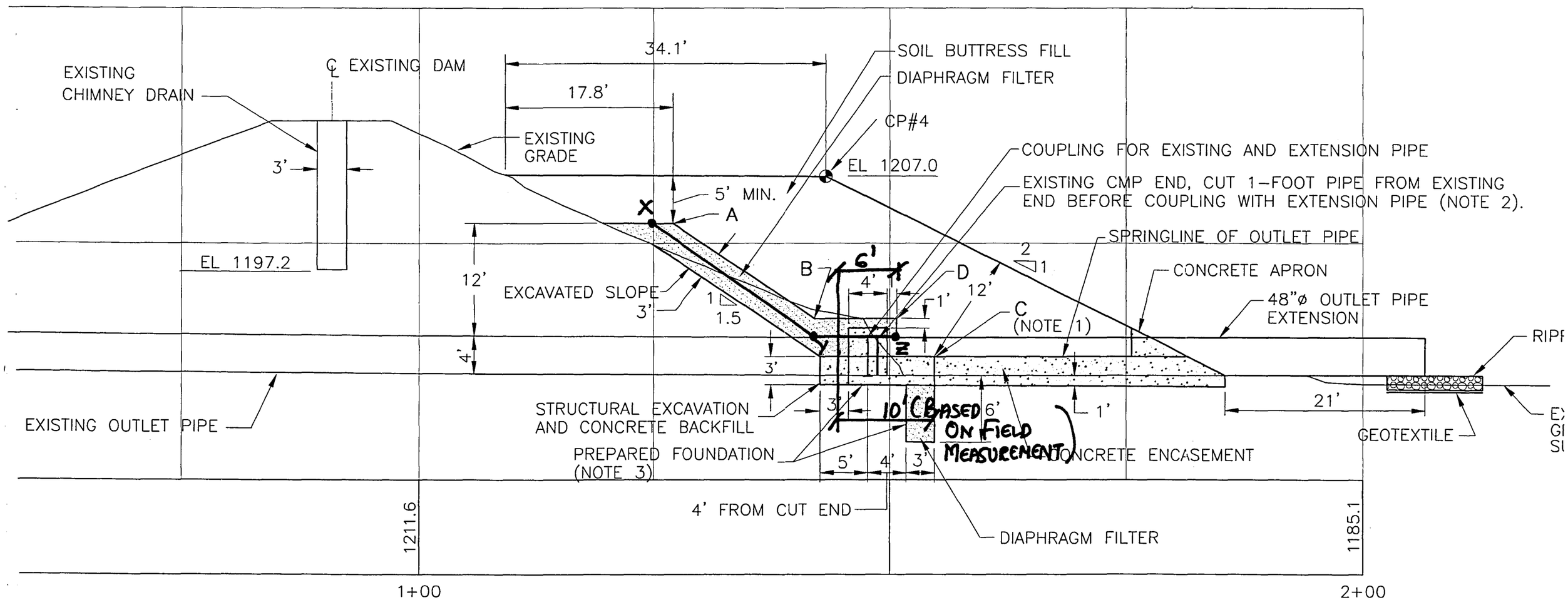
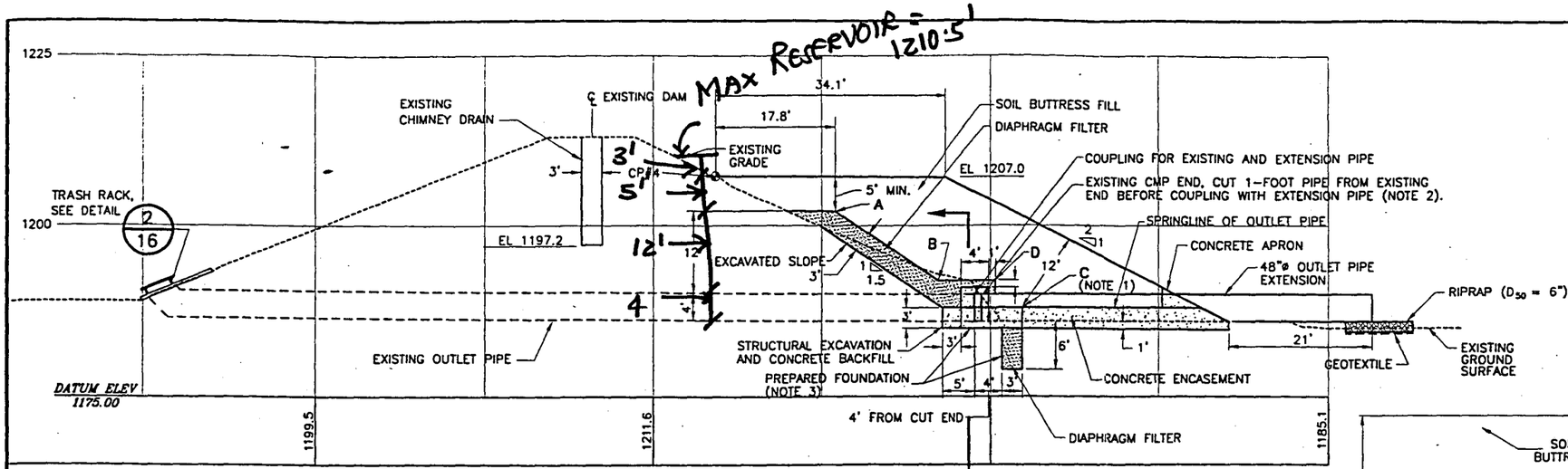


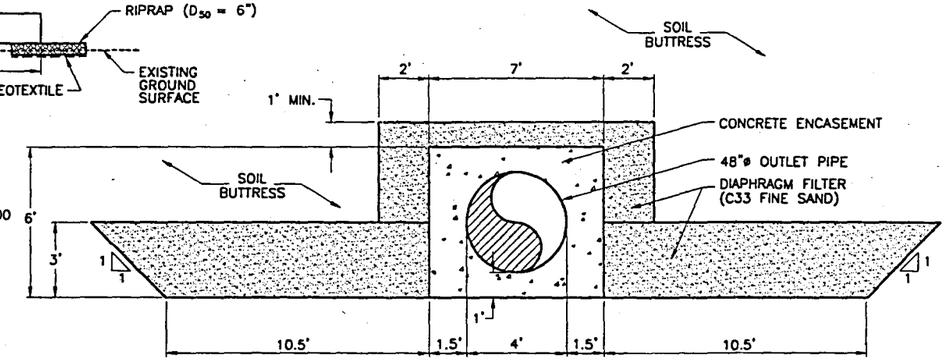
FIGURE 2



HEAD ON HDPE
PIPE = 3+5+12+4 = 24'

A/14 CENTRAL OUTLET SECTION

0 10 20
SCALE IN FEET



B/14 SECTION

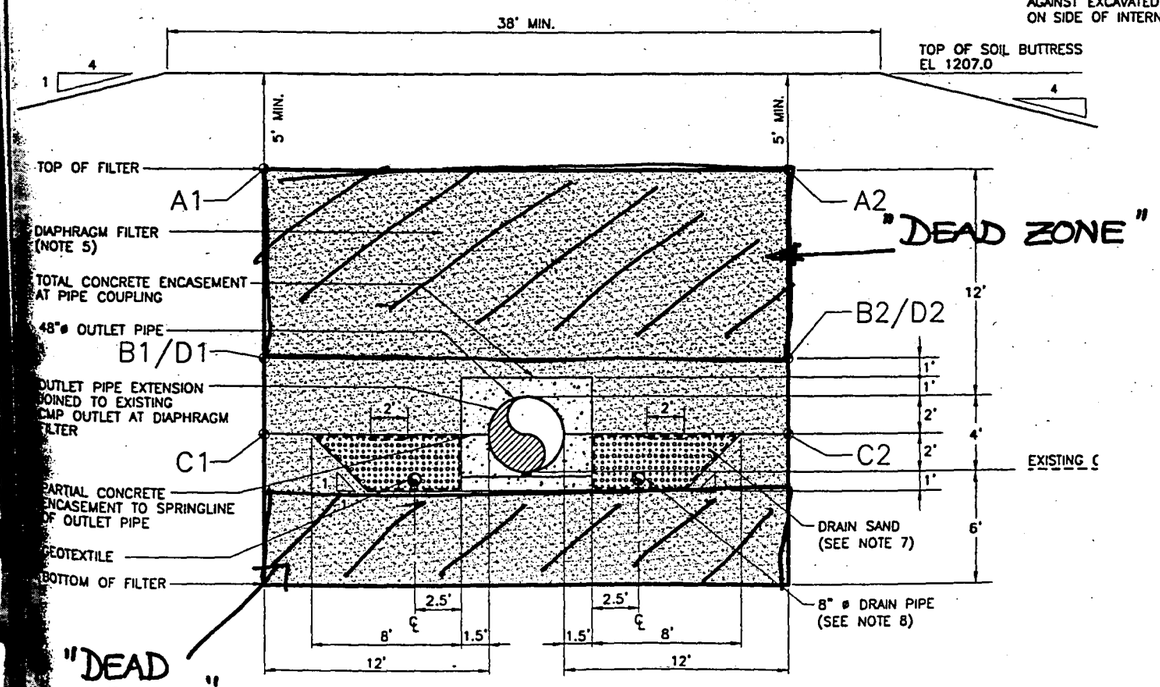
0 3 6
SCALE IN FEET

NOTES:

1. FILTER EXTENDS TO POINT C, AROUND CONCRETE.
2. SPECIAL PRECAUTIONS MUST BE TAKEN WHEN CUTTING EXISTING CMP DUE TO PRESENCE OF ASBESTOS CONTAINING MATERIAL.
3. THE FOUNDATION MATERIAL REQUIRES SAMPLING AND LABORATORY ANALYSIS PRIOR TO PREP WORK OR FILL PLACEMENT.
4. CONTRACTOR SHALL MINIMIZE EXCAVATION TO EXPOSE EXISTING CMP AND BACKFILL TO SPRINGLINE WITH CAST-IN-PLACE CONCRETE AGAINST EXCAVATED SOIL FACE (NO FORMS ON SIDE OF INTERNAL DAM).
5. WASHED SAND CONFORMING TO ASTM C33 FINE AGGREGATE GRADATION (AS SPECIFIED).
6. SEE DRAWING NO. D6 SHEET 17 OF 17 FOR TIEDOWN SECTION AND DRAWING NO. D7 SHEET 18 OF 18 RIPRAP END SECTION DETAILS.
7. SEE SPECIFICATIONS FOR DRAIN SAND GRADATION, CONFORMING TO ASTM C-33 SIZE NO.9.
8. DRAIN PIPE SHALL BE INSTALLED WITH MANUFACTURED GEOTEXTILE SOCK.

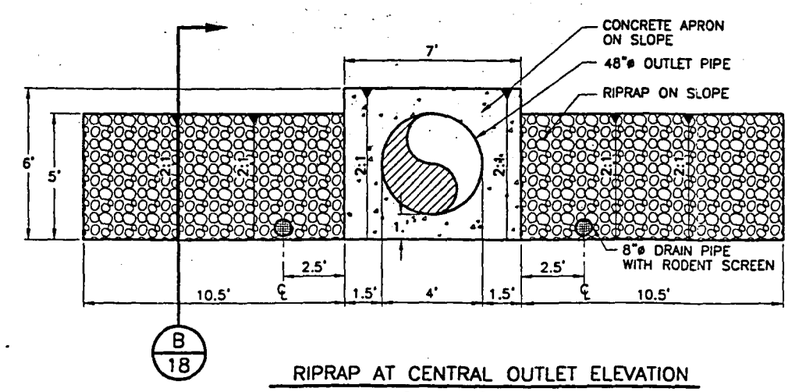
KEY CONTROL POINTS OF DIAPHRAGM FILTER AT CENTRAL OUTLET

CP			CP			ELEVATION
A1	N	921008.36	A2	N	921027.69	1202.00
	E	529944.37		E	529964.63	
B1	N	920998.89	B2	N	921018.35	1192.00
	E	529953.40		E	529973.61	
C1	N	920988.83	C2	N	921008.20	1188.00
	E	529963.13		E	529983.34	
D1	N	920991.71	D2	N	921011.08	1192.00
	E	529960.36		E	529980.57	



DIAPHRAGM FILTER ELEVATION AT CENTRAL OUTLET

0 4 8
SCALE IN FEET



B/18 RIPRAP AT CENTRAL OUTLET ELEVATION

0 3 6
SCALE IN FEET

263-1100
1-800-STAKE-IT

ADWR APPROVAL

NO.	REVISION	BY	DATE
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	NEW SHEET 60% SUBMITTAL	TER	02/00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

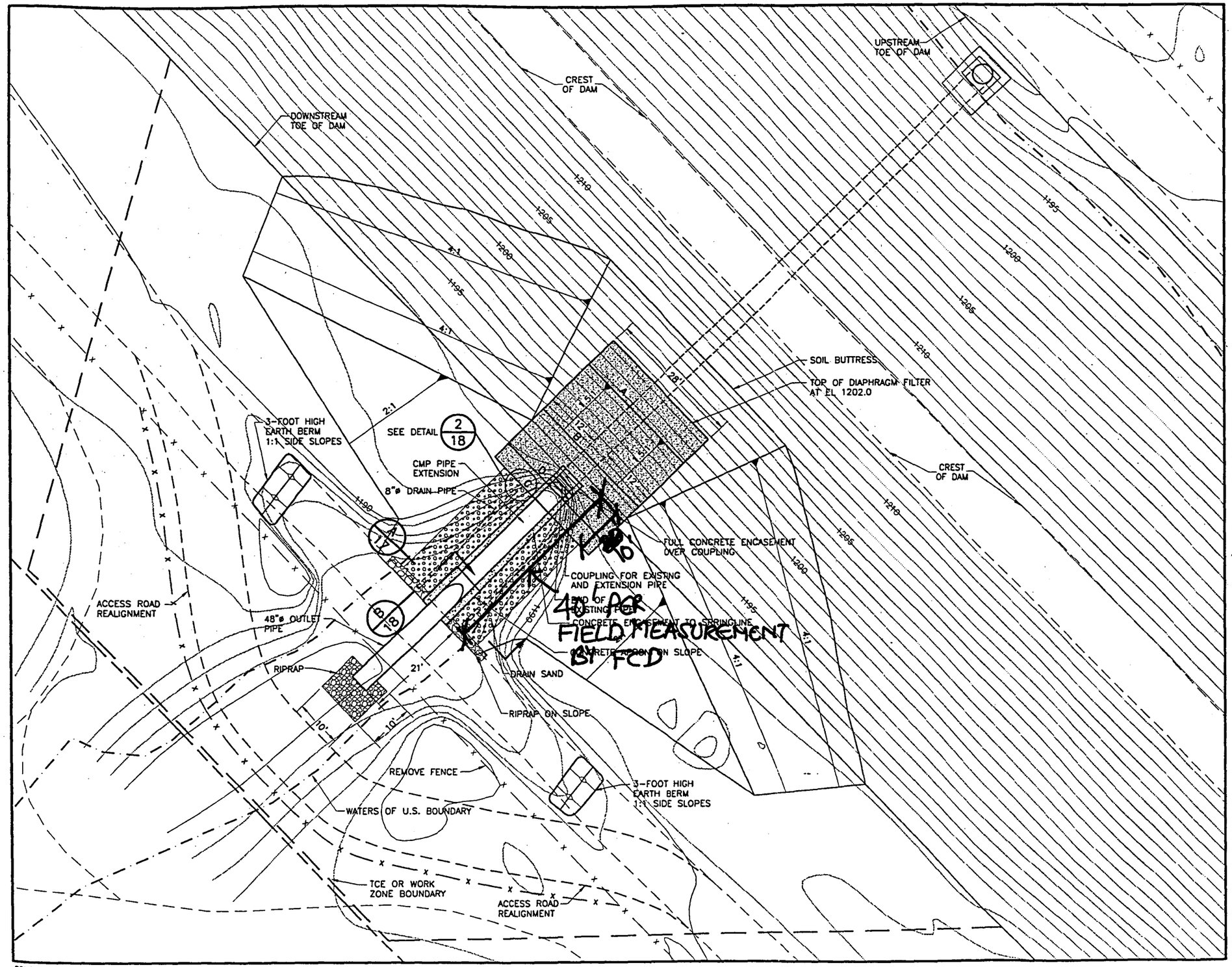
WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

Registered Professional Engineer (Civil) CERTIFICATE NO. 23867 ALEXANDER W. COURLAY ARIZONA, U.S.A.

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO. D3 | CENTRAL OUTLET SECTION AND ELEVATIONS | SHEET 14 OF 18



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS, PROVIDED BY FCDMC 12/98.
BASIS OF BEARING: ARIZONA ZONE 12 CENTRAL NAD 83

N

0 10 20
SCALE IN FEET
1 FOOT CONTOUR INTERVAL

CENTRAL OUTLET PLAN – FILTER

ITEM NO.	ITEM DESCRIPTION	QUANTITY
211-1	FILTER SAND	134 CY
211-3	DRAIN SAND	50 CY
621-2	CORRUGATED METAL PIPE (48-INCH DIA. CENTRAL OUTLET)	57 L.F.
505-1	CONCRETE STRUCTURE	27 CY
230-1	GEOTEXTILE	3100 SF
605-1	8-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE	60 L.F.

LEGEND:

- 1200 — EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- — x — x — EXISTING BARBED WIRE FENCE
- WATERS OF U.S.

NOTE:
1. LIMITS OF CONSTRUCTION 30 FT OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.

263-1100
1-800-STAKE-IT

ADWR APPROVAL

FIGURE 3

NO.	REVISION	BY	DATE
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	90% SUBMITTAL	TER	07/00
D	NEW SHEET 90% SUBMITTAL	TER	05/00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

Registered Professional Engineer (Civil) CERTIFICATE NO. 22857 ALEXANDER W. GOURLAY ARIZONA, U.S.A.

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO. C6

CENTRAL OUTLET PLAN – FILTER

SHEET 10 OF 18

Tom Renckly - FCDX <trr@mail.maricopa.gov>

06/18/2002 05:28 PM

To: "'Ravi_Murthy@URSCorp.com'" <Ravi_Murthy@URSCorp.com>
cc:
Subject: FW: White Tanks FRS#3 - Important

FYI

Let's discuss.

-----Original Message-----

From: **Duke Yager - FCDX**

Sent: Tuesday, June 18, 2002 1:20 PM

To: Tom Renckly - FCDX

Subject: RE: White Tanks FRS#3 - Important

Tom,

Richard Candelaria and I measured the drain pipe today and it does measure 40 feet. So you can now infowm Ravi and decide what you want to do. The red lines are with the surveyor and should be returned by the end of the week. Buesing did not get all of the Mylars from URS so FCD will have to give Buesing theirs when the red lines are completed.

Thank You,

Duke

-----Original Message-----

From: Tom Renckly - FCDX

Sent: Friday, June 14, 2002 12:01 PM

To: Duke Yager - FCDX

Subject: White Tanks FRS#3 - Important

Duke,

I just got a Voice Mail Message from ADWR. They want to know about the status of verifying the length of the drain pipe.

They are getting ready to write a letter on it. I think you can head the letter off if you call Brett Howey and let him know the plan and timeframe for investigating/addressing.

Thanks

Tom

APPENDIX B

SELECTED CONSTRUCTION PHOTOGRAPHS

PHOTOGRAPH 1 – South Outlet – Initial excavation.

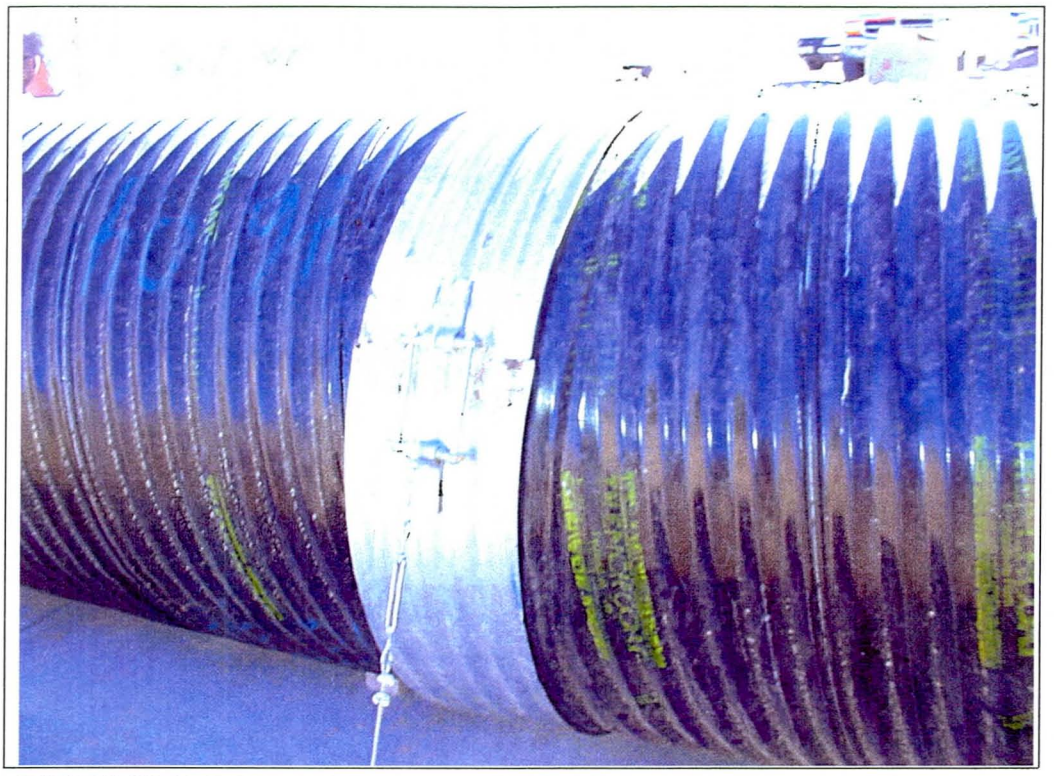
PHOTOGRAPH 2 – South outlet – compacting subgrade.

PHOTOGRAPH 3 – North outlet – soil cavities at bottom of corrugated metal pipe.

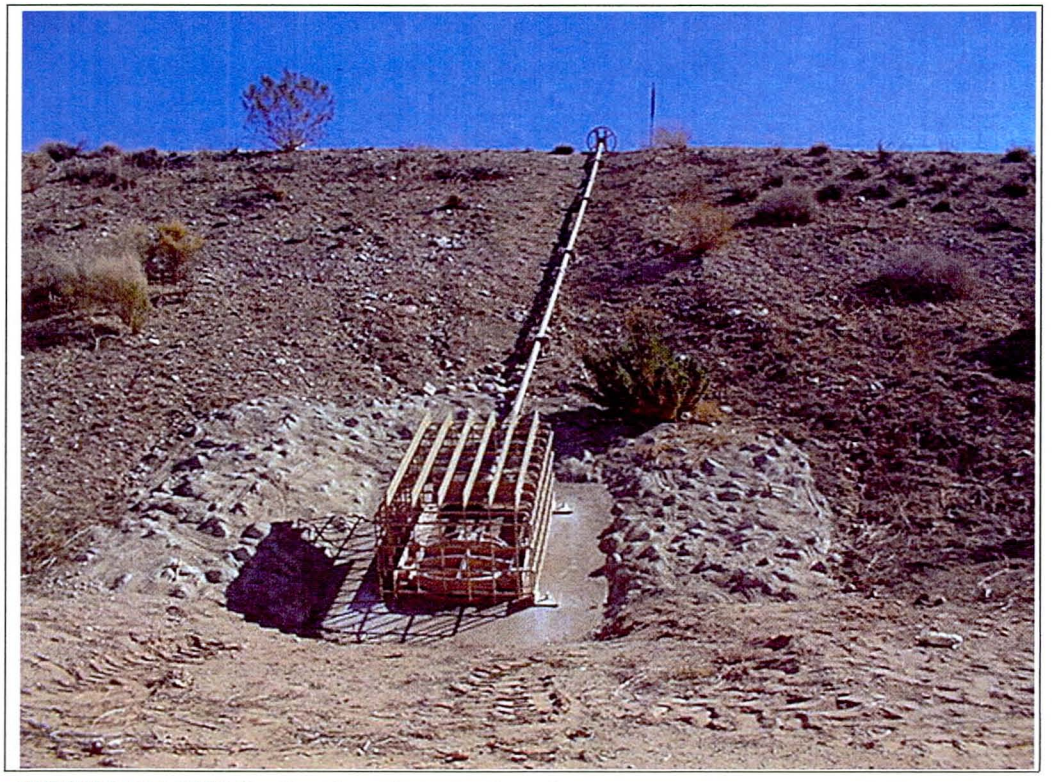
PHOTOGRAPH 4 – North outlet – finger drain (right side looking downstream) intersected by diaphragm filter excavation.

PHOTOGRAPH 5 – North outlet – finger drain (right side looking downstream) intersected by diaphragm filter excavation.

PHOTOGRAPH 6 – North Outlet – Soil buttress with 2:1 slope and riprap complete.



PHOTOGRAPH 7 – North outlet – coupling band (5-c corrugated) located downstream.

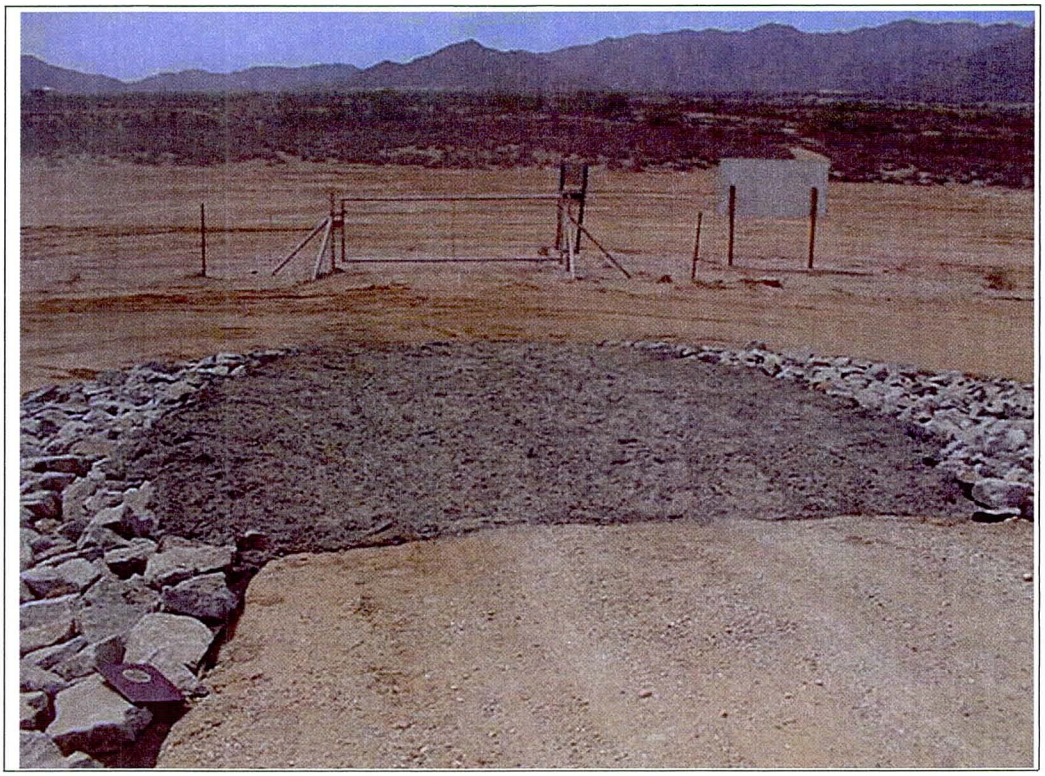


PHOTOGRAPH 8 – South outlet – trash rack.

PHOTOGRAPH 9 – Central Outlet – Excavation complete – no apparent voids in backfill of haunch.

PHOTOGRAPH 10 – Central Outlet – forming slab-on-grade pipe foundation. Inspection of subgrade and review of results.

PHOTOGRAPH 11 – Riprap at Southern Abutment.



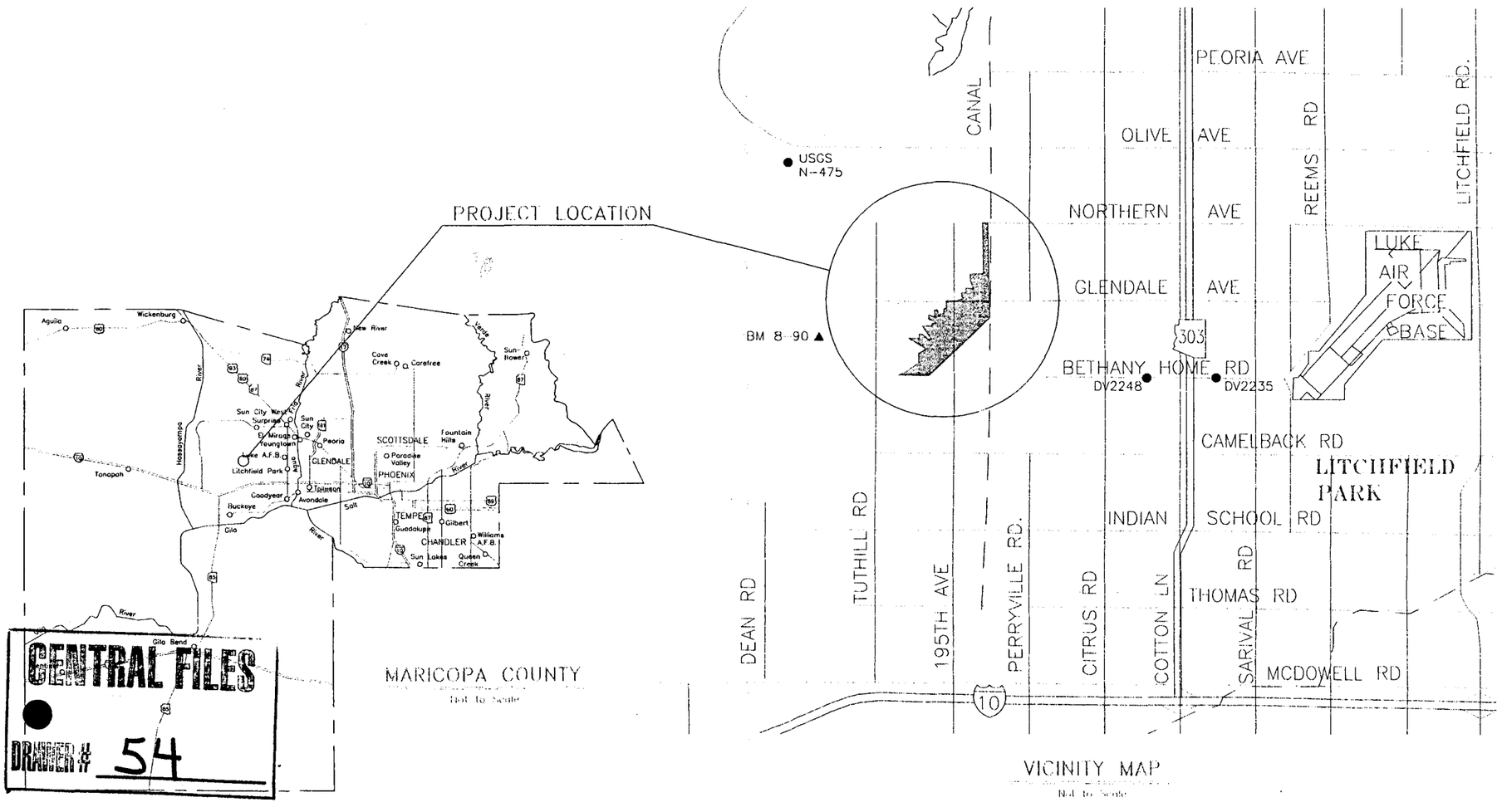
PHOTOGRAPH 12 – Right abutment – grouted riprap section for access road crossing.

APPENDIX C

AS-BUILT DRAWINGS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PLANS FOR THE WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS
PCN. 4700430
FCD CONTRACT NO. FCD2000C028



CALL FOR THE BLUE STAKES
263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

ISSUED FOR PUBLIC BIDDING BY:
04/23/01

CHIEF ENGINEER AND GENERAL MANAGER

BOARD OF DIRECTORS OF THE FLOOD CONTROL DISTRICT

JAN BREWER - CHAIRMAN

DISTRICT 1	FULTON BROCK
DISTRICT 2	DON STAPLEY
DISTRICT 3	ANDY KUNASEK
DISTRICT 4	JAN BREWER
DISTRICT 5	MARY ROSE WILCOX

CENTRAL FILES
DRAWER # 54

LEGEND

- USGS PIN
- BENCHMARK
- EXISTING SURVEY MONUMENT (BRASS CAP FLUSH)
- EXISTING SURVEY MONUMENT (BRASS CAP IN HAND HOLE)
- EXISTING DITCH
- EXISTING IRRIGATION LINE (NOTE AS TO – PRIVATE, SALT RIVER OR R.I.D.)
- EXISTING IRRIGATION STRUCTURE
- EXISTING IRRIGATION STANDPIPE
- EXISTING WATER LINE / SIZE
- EXISTING FIRE HYDRANT
- EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- APPROXIMATE PROJECT BOUNDARY
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE
- GATE WITH POST
- WATERS OF U.S.

STRUCTURAL NOTES

1. ALL CONSTRUCTION SHALL CONFORM TO PROJECT SPECIAL PROVISIONS AND SUPPLEMENTARY GENERAL CONDITIONS.
2. REINFORCING STEEL SHALL CONFORM TO ASTM SPECIFICATION A615, GRADE 60.
3. STRESSES – FS = 60,000 PSI – GRADE 60 REINFORCING STEEL.
4. ALL REINFORCING STEEL PLACEMENT DIMENSIONS SHALL BE TO CENTER OF BARS UNLESS OTHERWISE NOTED.
5. ALL REINFORCING STEEL SHALL HAVE 2" CLEAR COVER UNLESS OTHERWISE NOTED.
6. ALL WELDING SHALL CONFORM TO THE REQUIREMENTS OF THE AMERICAN WELDING SOCIETY, STRUCTURAL WELDING CODE, REVISED 1996.
7. DIMENSIONS SHALL NOT BE SCALED FROM DRAWINGS.
8. CHAMFER ALL EXPOSED CONCRETE CORNERS 3/4" UNLESS OTHERWISE NOTED.
9. CONCRETE COMPRESSIVE STRENGTH SHALL BE 3,000 PSI AT 28 DAYS, UNLESS NOTED OTHERWISE.

GENERAL NOTES

1. ALL CONSTRUCTION TO BE PERFORMED ACCORDING TO THESE PROJECT DRAWINGS, SPECIAL PROVISIONS, AND SUPPLEMENTARY GENERAL CONDITIONS.
2. FACILITIES WHICH ARE NOT SPECIFICALLY LOCATED WITH ACTUAL HORIZONTAL AND VERTICAL CONTROLS ARE APPROXIMATE AND TO THE BEST AVAILABLE INFORMATION.
3. EXISTING UTILITIES AND OTHER FACILITIES HAVE BEEN PLACED ON THE PLANS FROM FIELD SURVEYS, EXISTING MAPS AND OTHER CURRENT PLANS WITHIN THE AREA OF THIS PROJECT. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION AND/OR ELEVATION OF EXISTING UTILITIES WHICH PERTAIN TO AND AFFECT THE CONSTRUCTION OF THIS PROJECT.
4. TWO (2) WORKING DAYS PRIOR TO EXCAVATING, THE CONTRACTOR SHALL CALL FOR BLUE STAKE UTILITY LOCATING SERVICE AT THE BLUE STAKE CENTER (PHONE: 602-263-1100).
5. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS PRIOR TO CONSTRUCTION.
6. THE FLOOD CONTROL DISTRICT IS NOT RESPONSIBLE FOR LIABILITY ACCRUED DUE TO DELAYS AND/OR DAMAGE TO UTILITIES IN CONJUNCTION WITH THIS CONSTRUCTION.
7. ANY WORK PERFORMED WITHOUT THE APPROVAL OF THE FLOOD CONTROL DISTRICT AND/OR THE ENGINEER AND ALL WORK AND MATERIALS NOT IN CONFORMANCE WITH THE SPECIFICATIONS IS SUBJECT TO REMOVAL AND REPLACEMENT AT THE CONTRACTOR'S EXPENSE.
8. THE ENGINEER WILL DETERMINE THE NUMBER AND LOCATION OF THE REQUIRED CONFORMANCE COMPACTION TESTS FOR STRUCTURE BACKFILL IN GENERAL ACCORDANCE WITH THE APPROVED CQA PLAN.
9. TRAFFIC CONTROL SHALL BE MAINTAINED IN ACCORDANCE WITH M.A.G. SPECIFICATION 40.1, PART VI OF THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (1988 EDITION) INCLUDING REVISION 3 DATED SEPTEMBER 3, 1993).
10. PRIOR TO FINAL APPROVAL AND ACCEPTANCE OF THE WORK, THE CONTRACTOR WILL BE REQUIRED TO CLEAN ADJACENT (OFF-PROJECT) ROADWAYS USED DURING THE COURSE OF CONSTRUCTION.

UTILITY NOTIFICATION

PHONE NO.	COMPANY	CONTACT
(602) 250-1000	ARIZONA PUBLIC SERVICE COMPANY (APS)	MS. ISABEL CABRERA
(909) 898-4776	AT&T FIBER OPTIC TELEPHONE	MR. FRANCO JAUREGUI
(602) 659-7214	COX COMMUNICATIONS (CABLE TV)	MR. CARL McKAY
(602) 438-4224	EL PASO NATURAL GAS (EPNG)	MR. BILL WARD
(623) 975-1125	MARICOPA WATER DISTRICT (CANAL)	MR. GLENN VORTHERMS
(602) 236-4609	SALT RIVER PROJECT IRRIGATION (SRP)	MR. GERRY BASTIAN
(602) 236-8643	SALT RIVER PROJECT POWER DISTRIBUTION (SRPPD)	MR. GREG WILSON
(602) 236-8603	SALT RIVER PROJECT POWER TRANSMISSION (SRPPT)	MR. DAN HAWKINS
(602) 484-5302	SOUTHWEST GAS (SWG)	MR. GENE FLOREZ
(602) 630-0496	U.S. WEST COMMUNICATIONS (USW)	MR. JOHN AKER

NOTE: OTHER UTILITIES MAY BE PRESENT.

PROJECT BENCHMARKS AND CONTROL POINTS

NAME	NORTHING	EASTING	ELEVATION	GENERAL DESCRIPTION	STATUS
DV2235	918038.84	546702.59	NOT VERIFIED	DISK IN CONCRETE	EXISTING
DV2248	918094.59	541630.47	NOT VERIFIED	DISK IN CONCRETE	EXISTING
SCS BM 8-90	* 921112.4	* 522153.7	1284.36	DISK IN ROCK	EXISTING
USGS N-475	* 928029.7	* 518015.5	1474.15	BRASS CAP IN CONCRETE	EXISTING
* *				PROJECT BENCH MARK	
CP#1	922254.14	531126.16	1207.5	NORTH OUTLET CONTROL POINT FOR BUTTRESS	DESIGNED
CP#2	922254.81	531168.76	1186.66 (INVERT)	NORTH OUTLET CONTROL POINT FOR PIPE	DESIGNED
CP#3	922371.4	531142.7	1190.5	REBAR IN CONCRETE AT NORTH OUTLET	DESIGNED
CP#4	921007.38	529965.89	1207.00	CENTRAL OUTLET CONTROL POINT FOR BUTTRESS	DESIGNED
CP#5	920962.82	520008.55	1185.60 (INVERT)	CENTRAL OUTLET CONTROL POINT FOR PIPE	DESIGNED
CP#6	921012.0	530047.3	1189.9	REBAR IN CONCRETE AT CENTRAL OUTLET	DESIGNED
CP#7	919772.42	528683.59	1205.0	SOUTH OUTLET CONTROL POINT FOR BUTTRESS	DESIGNED
CP#8	919748.15	528706.55	1188.95 (INVERT)	SOUTH OUTLET CONTROL POINT FOR PIPE	DESIGNED
CP#9	919691.9	528611.6	1191.5	REBAR IN CONCRETE AT SOUTH OUTLET	DESIGNED
CP#10	919184.75	527353.81	1204.0	REBAR IN CONCRETE AT SPILLWAY	DESIGNED

COORDINATE INFORMATION WAS OBTAINED FROM THE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS, FLOWN 12/22/89 BY COOPER AERIAL OF PHOENIX, INC. FOR THE WLB GROUP INC., AREA DRAINAGE MASTER STUDY.
BASIS OF BEARING: COVERTED FROM NAD 27 TO ARIZONA ZONE 12 CENTRAL NAD 83

* COORDINATES ARE APPROXIMATE. THESE POINTS ARE FOR VERTICAL CONTROL ONLY.

* * PROJECT BENCH MARK TO BE PROVIDED BY FCDMC.

SECTION LETTER OR DETAIL NUMBER

SHEET NUMBER TO LOCATE

ABBREVIATIONS

CSTR	CONSTRUCTION
DESC	DESCRIPTION
EQ	EQUAL
OHE	OVERHEAD ELECTRIC
P/L	PROPERTY LINE
C/L	CENTERLINE
PRV	PRIVATE
ROW	RIGHT-OF-WAY
TCE	TEMPORARY CONSTRUCTION EASEMENT
O.C.	ON CENTER
E.W.	EACH WAY
N	NORTHING
E	EASTING
EL	ELEVATION
BM	BENCHMARK
CP	CONTROL POINT
CLR	CLEARANCE
TYP	TYPICAL
NTS	NOT TO SCALE

INDEX OF SHEETS

DRAWING NO.	TITLE	SHEET NO.
G1	COVER SHEET AND VICINITY MAP	1
G2	DRAWING INDEX, LEGEND AND GENERAL NOTES	2
G3	SITE MAP	3
Q1	QUANTITY SUMMARY	4
C1	PLAN AND ALIGNMENT OF EMERGENCY SPILLWAY MODIFICATIONS AND ARMOR	5
C2	NORTH OUTLET PLAN – BUTTRESS	6
C3	CENTRAL OUTLET PLAN – BUTTRESS	7
C4	SOUTH OUTLET PLAN – BUTTRESS	8
C5	NORTH OUTLET PLAN – FILTER	9
C6	CENTRAL OUTLET PLAN – FILTER	10
C7	SOUTH OUTLET PLAN – FILTER	11
D1	EMERGENCY SPILLWAY SECTIONS	12
D2	NORTH OUTLET SECTION AND ELEVATIONS	13
D3	CENTRAL OUTLET SECTION AND ELEVATIONS	14
D4	SOUTH OUTLET SECTION AND ELEVATIONS	15
D5	TRASH RACK SECTION AND DETAILS	16
D6	OUTLET PIPES SECTIONS AND DETAILS	17
D7	OUTLET RIPRAP END SECTIONS AND DETAILS	18

"AS-BUILT DRAWING"
I HEREBY CERTIFY THAT THE "AS-BUILT DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

9-4-02

CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

NO.	REVISION	BY	DATE
4	REVISED BUTTRESS CONTROL POINTS PER SURVEY	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

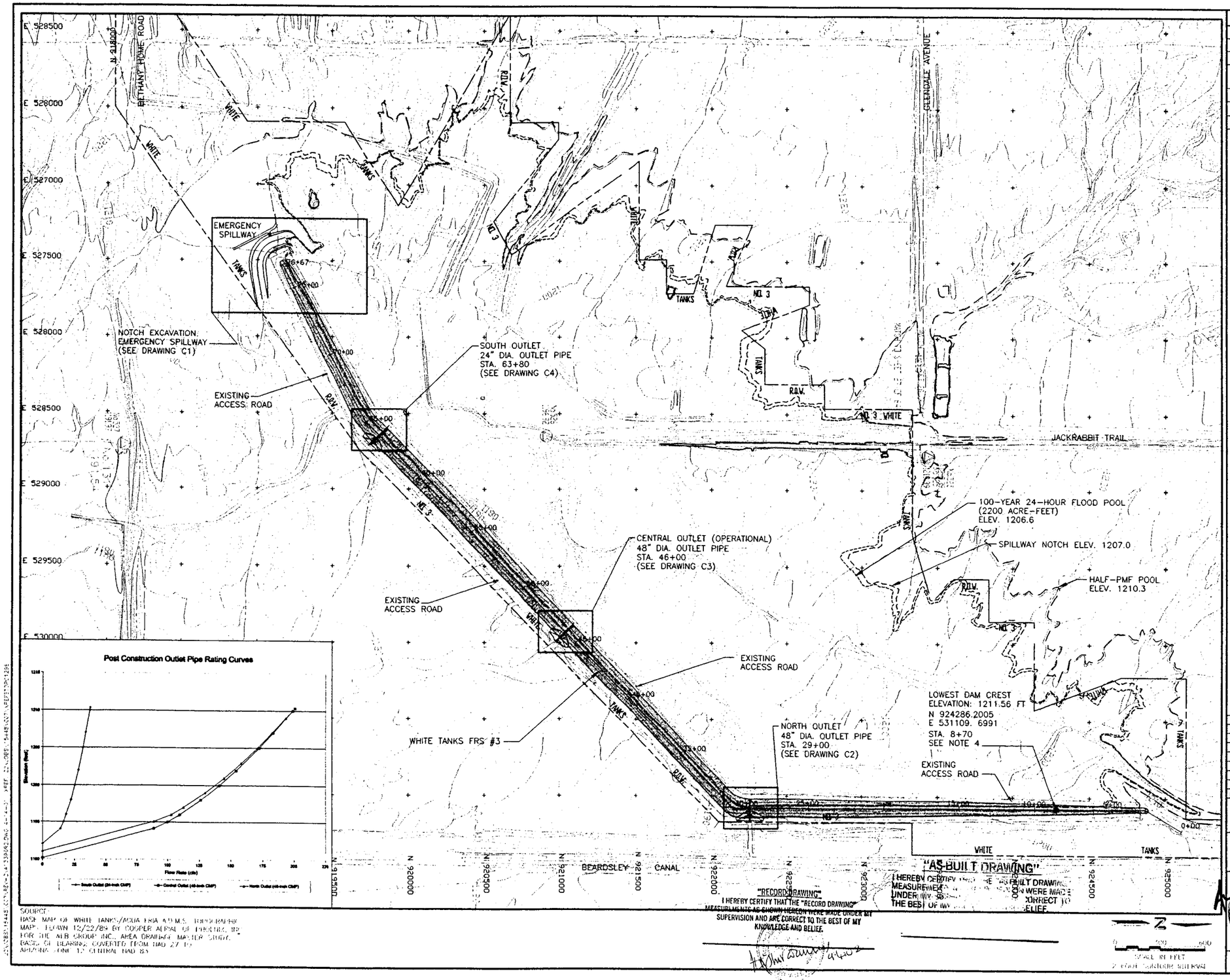
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	M. HANCHETT	01/01
CHECKED	T. RINGSMUTH	01/01

URS
7720 N. 16th Street Suite 100
Phoenix, Arizona 85020
(602) 371-1100

DRAWING NO.	DRAWING INDEX, LEGEND AND GENERAL NOTES	SHEET OF
G2		2 18



SOURCE:
BASE MAP OF WHITE TANKS/MOJA FRIA A.D.M.S. TOPOGRAPHIC MAPS, FLOWN 12/22/84 BY COOPER AERIAL OF PHOENIX, INC. FOR THE A.E.B. GROUP INC., AREA DRAINAGE MASTER STUDY. BASED ON BEARING COVERTED FROM NAD 27 TO ARIZONA ZONE 12 CENTRAL NAD 83

ITEM NO.	ITEM DESCRIPTION	QUANTITY
105-1	PARTNERING (ALLOWANCE)	1 LS
107-1	CONSTRUCTION SWPPP	1 LS
107-2	PROJECT SIGN ALLOWANCE	1 LS
107-3	PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE	1 LS
202-1	MOBILIZATION	1 LS
401-1	TRAFFIC CONTROL	1 LS
405-2	MONUMENTS	1 LS

LEGEND:

- 1200 — EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE

NOTES:

1. BENCHMARK LOCATIONS IDENTIFIED FOR THIS PROJECT ARE BEYOND THE LIMITS OF THIS DRAWING. SEE PROJECT BENCHMARK AND CONTROL POINT APPROXIMATE GEOGRAPHIC LOCATION SHOWN ON DRAWING G1 AND COORDINATE TABLE ON DRAWING G2.
2. CENTRAL OUTLET IS IDENTIFIED AS BEING THE PRIMARY OPERATIONAL STRUCTURE.
3. CONTRACTOR SHALL STAY ON EXISTING ROADS AND WORK WITHIN SPECIFIED ZONES ALLOWED FOR PROJECT.
4. LOWEST DAM CREST ELEVATION IDENTIFIED FROM A-TEAM SURVEY DATED 01/31/00.

263-1100 1-800-STAKE-IT

ADWR APPROVAL

NO.	REVISION	BY	DATE
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE

DRAWING NO. G3

SITE MAP

SHEET 3 OF 18

QUANTITY SUMMARY

ITEM NO.	ITEM DESCRIPTION	UNIT	SHEET NUMBERS 3	5	6	7	8	9	10	11	12	13	14	15	16	17	18	TOTAL QUANTITY
105-1	PARTNERING (ALLOWANCE)	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
107-1	CONSTRUCTION SWPPP	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
107-2	PROJECT SIGN ALLOWANCE	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
107-3	PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
201-1	CLEARING/GRUBBING	S.Y.		6060	845	990	620	0	0	0	0	0	0	0	0	0	0	9,182 ~~8,562~~
202-1	MOBILIZATION	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
206-1	FOUNDATION PREPARATION	S.Y.	0	0	475	475	475	0	0	0	0	0	0	0	0	0	0	1,430 ~~1,425~~
206-2	EXCAVATION OF DAM FACE AND TOE	C.Y.	0	0	200	140	60	0	0	0	0	0	0	0	0	0	0	412 ~~400~~
	BORROW EXCAVATION																	INCIDENTAL
211-1	FILTER SAND	C.Y.	0	0	0	0	0	134	134	62	0	0	0	0	0	0	0	335 ~~330~~
211-2	SOIL BUTTRESS FILL CONSTRUCTION	C.Y.	0	0	1800	1900	1360	0	0	0	0	0	0	0	0	0	0	5060
211-3	DRAIN SAND	C.Y.	0	0	0	0	0	50	50	15	0	0	0	0	0	0	0	115
215-1	NOTCH EXCAVATION	C.Y.	0	5000	0	0	0	0	0	0	0	0	0	0	0	0	0	5000
220-1	RIPRAP	C.Y.	0	330	0	5	3	3	0	0	0	0	0	0	0	0	0	341
220-2	1-INCH AGGREGATE	C.Y.	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	Ø ~~30~~
	WATERING																	INCIDENTAL
230-1	GEOTEXTILE	S.F.	0	0	0	0	0	3000	3100	1584	7650	0	0	0	0	0	0	16,200 ~~15,334~~
350-1	DEMOLITION OF EXISTING CONCRETE HEADWALL & REMOVAL OF PIPE & SHOTCRETE	EACH	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	3
350-2	REMOVE AND REPLACE PERIMETER FENCING	EACH	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	3
401-1	TRAFFIC CONTROL	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
405-1	MONUMENTS	L.S.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
505-1	CONCRETE STRUCTURES	C.Y.	0	0	0	0	0	27	27	17	0	0	0	0	0	0	0	78 ~~71~~
515-1	TRASH RACK (48-INCH DIAMETER OUTLET)	EACH	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
515-2	TRASH RACK (48-INCH DIAMETER OUTLET)	EACH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
515-3	TRASH RACK (24-INCH DIAMETER OUTLET)	EACH	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
525-1	PNEUMATICALLY PLACED MORTAR (SHOTCRETE)	S.F.	0	0	810	0	0	0	0	0	0	0	0	0	0	0	0	1,430 ~~1,420~~
530-1	PAINTING TRASH RACK (NORTH OUTLET)	EACH	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
530-2	PAINTING TRASH RACK (CENTRAL OUTLET)	EACH	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
530-3	PAINTING TRASH RACK (SOUTH OUTLET)	EACH	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
605-1	8-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE	L.F	0	0	0	0	0	60	60	0	0	0	0	0	0	0	0	168 ~~120~~
605-2	4-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE	L.F	0	0	0	0	0	0	0	52	0	0	0	0	0	0	0	76 ~~52~~
621-1	CORRUGATED METAL PIPE (48-INCH NORTH OUTLET)	L.F.	0	0	0	0	0	37	0	0	0	0	0	0	0	0	0	40 ~~37~~
621-2	CORRUGATED METAL PIPE (48-INCH CENTRAL OUTLET)	L.F.	0	0	0	0	0	0	57	0	0	0	0	0	0	0	0	57
621-3	CORRUGATED METAL PIPE (24-INCH SOUTH OUTLET)	L.F.	0	0	0	0	0	0	0	37	0	0	0	0	0	0	0	43 ~~37~~

NOTE: SPECIAL PROVISION SECTION NUMBERS 210, 225, 701, 725, 726, 727, 738, 760, 790, ARE INCIDENTAL TO THE PROJECT AND ARE NOT CONSIDERED BID ITEMS.

"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

8-4-02

"AS-BUILT DRAWING"
I HEREBY CERTIFY THAT THE "AS-BUILT DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO.	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	NEW SHEET 95% SUBMITTAL	TER	07/00

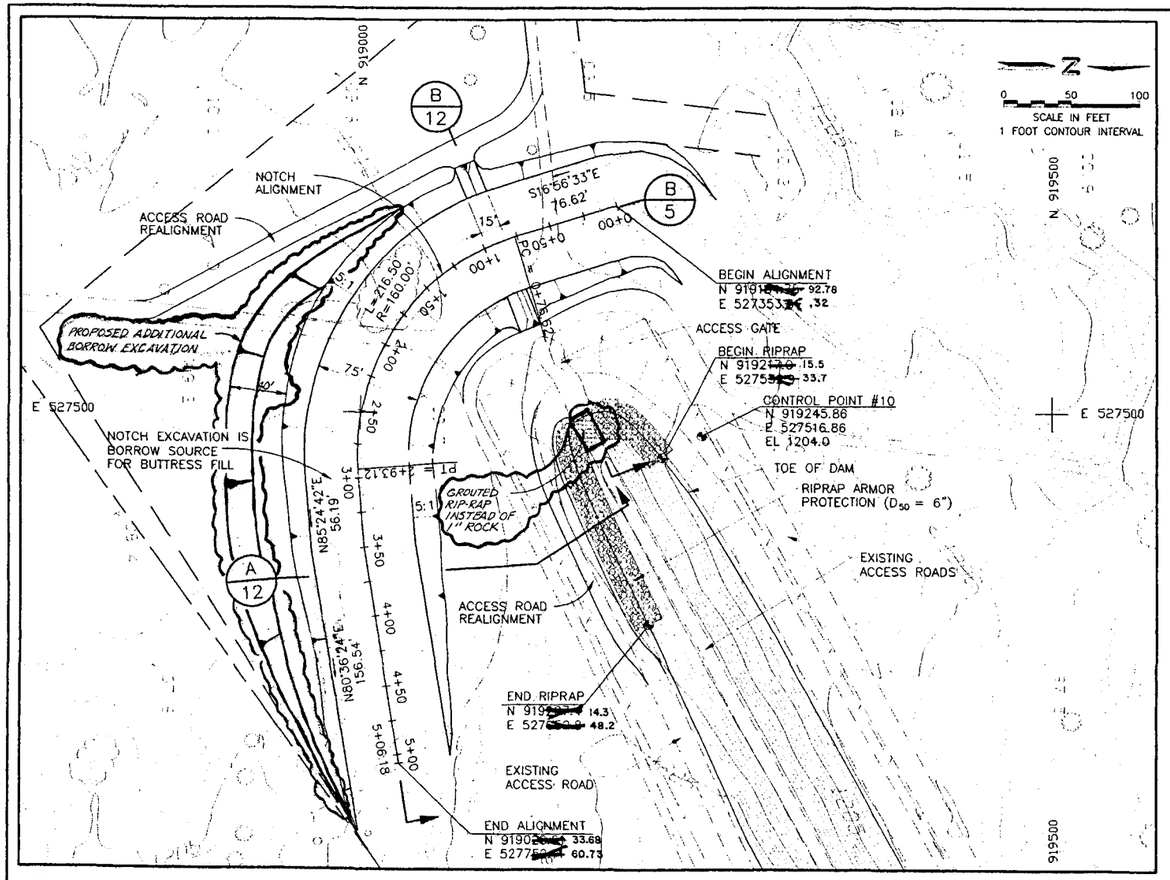
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE

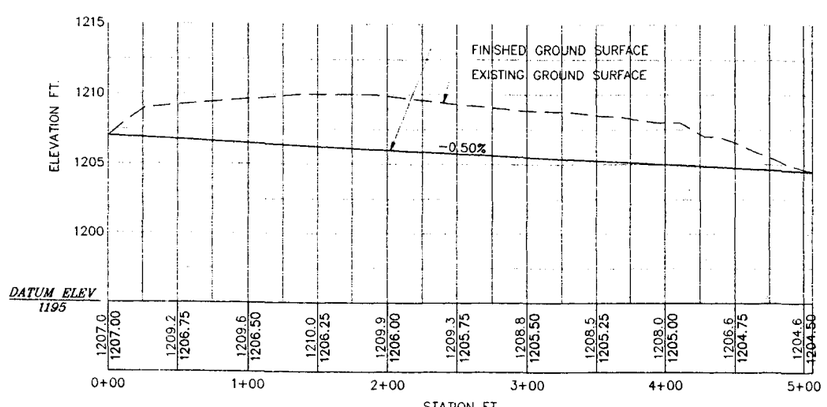
DRAWING NO. Q1 | QUANTITY SUMMARY | SHEET 4 OF 18



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA AREAS, TOPO-MAPPER MAPS, PROVIDED BY FCDMC, 11/98
BASIS OF BEARING: ARIZONA STATE PLANE CENTRAL ZONE

NOTE: ROAD REALIGNMENT PER ENGINEER.

A/5 SPILLWAY PLAN



LEGEND:

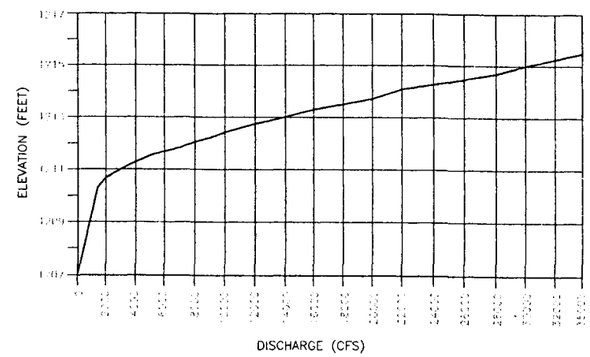
1209.2 EXISTING GROUND SURFACE ELEVATION
1206.75 FINISHED GROUND SURFACE ELEVATION

B/5 NOTCH PROFILE

HORIZONTAL SCALE: 0 50 100 SCALE IN FEET
VERTICAL SCALE: 0 5 10 SCALE IN FEET

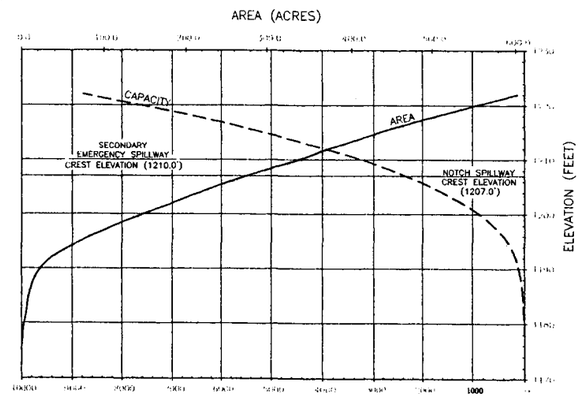
"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF

8-4-02



EMERGENCY SPILLWAY DISCHARGE RATING CURVE

REFERENCE: INTERIM OPERATIONAL PLAN FOR WHITE TANKS FRS#3 DAMSITE, FEB. 6, 2001



CAPACITY
AREA

AREA-CAPACITY CURVES

ITEM NO.	ITEM DESCRIPTION	QUANTITY
201-1	CLEARING/GRUBBING	6060 SY
215-1	NOTCH EXCAVATION	5000 CY
220-1	RIPRAP	330 CY

LEGEND:

- EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE
- WORK ZONE BOUNDARY

SURVEYOR'S AS-BUILT CERTIFICATION

REGISTERED LAND SURVEYOR CERTIFICATE NO. 16825 RICHARD A. STOCKMAN ARIZONA, U.S.A.

8-4-02

The earlier you call the better you dig
CALL FOR THE BLUE STAKES
263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO.	REVISION	BY	DATE
5	AS-BUILT CHANGES	RC	08/02
4	REVISED SPILLWAY NOTCH ALIGNMENT	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

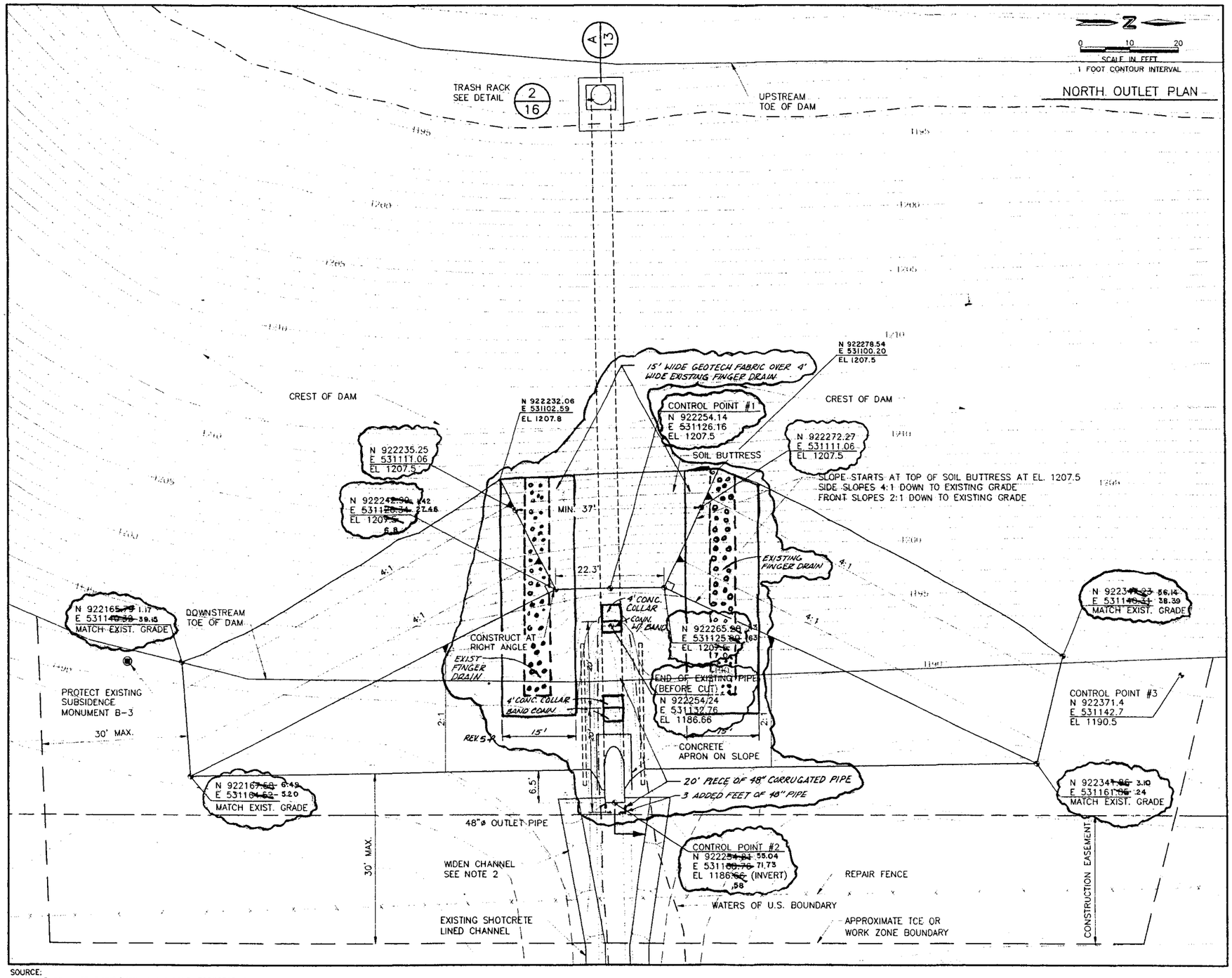
WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

22767 ALEXANDER COURLAY 8-7-02

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO. | PLAN AND ALIGNMENT OF EMERGENCY SPILLWAY | SHEET OF



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS, PROVIDED BY FCDMC 12/98.
BASIS OF BEARING: ARIZONA ZONE 12 CENTRAL NAD 83

ITEM NO.	ITEM DESCRIPTION	QUANTITY
201-1	CLEARING/GRUBBING	845 SY
206-1	FOUNDATION PREPARATION	475 SY
206-2	EXCAVATION AT DAM FACE AND TOE	200 CY
515-1	TRASH RACK (48-INCH DIA. OUTLET)	1 EA
211-2	SOIL BUTTRESS FILL CONSTRUCTION	1800 CY
525-1	PNEUMATICALLY PLACED MORTAR (SHOTCRETE)	810 SF
530-1	PAINTING TRASH RACK (NORTH OUTLET)	1 EA
350-2	PERIMETER FENCING REMOVE AND REPLACE	1 EA
350-1	DEMOLITION OF EXISTING CONCRETE HEADWALL & REMOVAL OF PIPE & SHOTCRETE	1 EA
206-1	FOUNDATION PREPARATION	475 SY

LEGEND:

- 1200 — EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE
- WATERS OF U.S.
- TCE OR WORK ZONE BOUNDARY

NOTES:

1. LIMITS OF CONSTRUCTION 30 FT OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.
2. EXCAVATE CHANNEL TO WIDEN BOTTOM FROM TOE OF SOIL BUTTRESS TAPERING TO EXISTING WIDTH AT TCE LINE, AND REPLACE SHOTCRETE AS NEEDED.

SURVEYOR'S AS-BUILT CERTIFICATION

REGISTERED LAND SURVEYOR CERTIFICATE NO. 36326 RICHARD A. STOCKMAN ARIZONA U.S.A.

THE MEASUREMENTS SHOWN ON THIS DRAWING WERE MADE UNDER MY SUPERVISION TO THE BEST OF MY KNOWLEDGE AND BELIEF.

9-4-02

CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

NO.	REVISION	BY	DATE
5	AS-BUILT CHANGES	RC	08/02
4	REVISED BUTTRESS CONTROL POINTS PER SURVEY	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

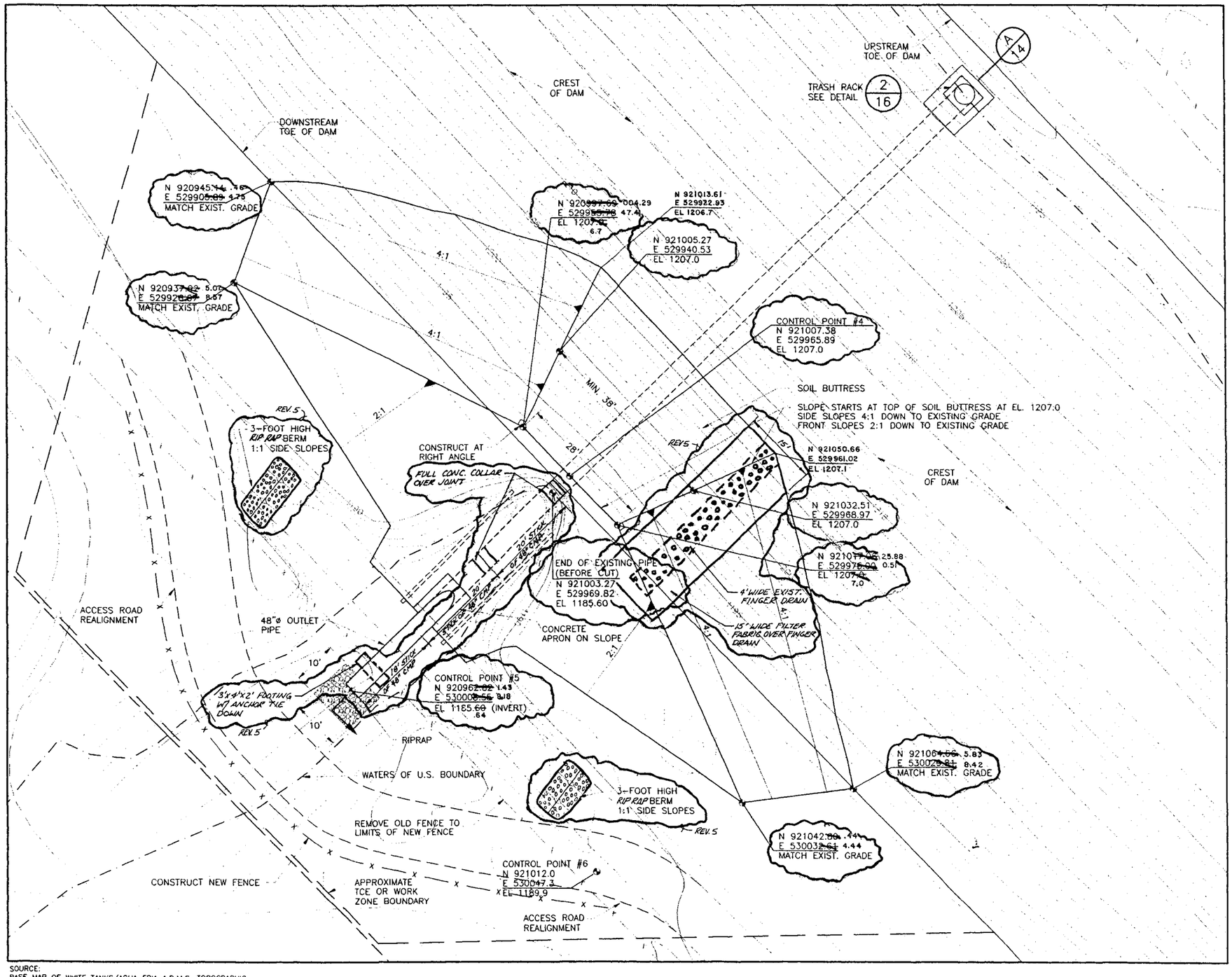
22367 ALEXANDER M. COUGLAY

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO. C2

NORTH OUTLET PLAN-BUTTRESS

SHEET 6 OF 18



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS, PROVIDED BY FCDMC 12/98.
BASIS OF BEARING: ARIZONA ZONE 12 CENTRAL NAD 83

N

0 10 20
SCALE IN FEET
1 FOOT CONTOUR INTERVAL

CENTRAL OUTLET PLAN

ITEM NO.	ITEM DESCRIPTION	QUANTITY
201-1	CLEARING/GRUBBING	990 SY
206-2	EXCAVATION AT DAM FACE AND TOE	140 CY
515-2	TRASH RACK (48-INCH DIA. OUTLET)	1 EA
211-2	SOIL BUTTRESS FILL CONSTRUCTION	1900 CY
220-1	RIPRAP	5 CY
206-1	FOUNDATION PREPARATION	475 SY
350-1	DEMOLITION OF EXISTING CONCRETE HEADWALL & REMOVAL OF PIPE & SHOTCRETE	1 EA
350-2	REMOVE AND REPLACE PERIMETER FENCING	1 EA
530-2	PAINTING TRASH RACK (CENTRAL OUTLET)	1 EA

LEGEND:
- 1206 EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE
- WATERS OF U.S.
- WORK ZONE BOUNDARY

NOTES:
1. LIMITS OF CONSTRUCTION 30 FT OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.
2. CENTRAL OUTLET IS IDENTIFIED AS BEING THE PRIMARY OPERATIONAL STRUCTURE.

SURVEYOR'S AS-BUILT CERTIFICATION

REGISTERED LAND SURVEYOR CERTIFICATE NO. 36328 RICHARD A. STOCKMAN ARIZONA, U.S.A.

I HEREBY CE... "DRAWING" MEASUREMENTS A... UNDER MY SUPERVISION A... OF MAY

Two working days before you dig CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

NO.	REVISION	BY	DATE
5	AS-BUILT CHANGES	RC	08/02
4	REVISED BUTTRESS CONTROL POINTS PER SURVEY	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

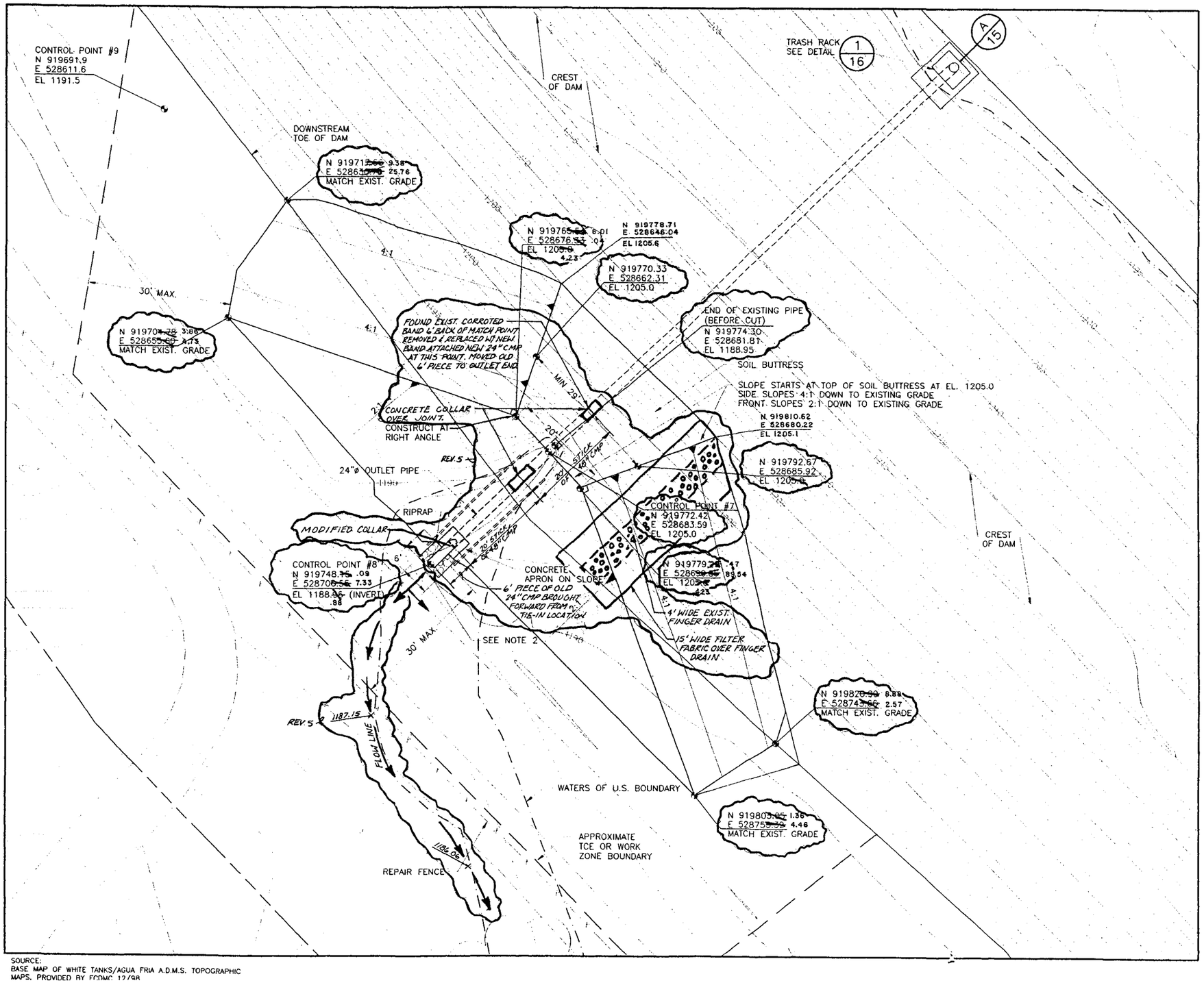
REGISTERED ALLAN R. SOURLAY 8-17-02

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO. C3

CENTRAL OUTLET PLAN-BUTTRESS

SHEET 7 OF 18



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS. PROVIDED BY FCDMC 12/98

N

0 10 20
SCALE IN FEET
1 FOOT CONTOUR INTERVAL

SOUTH OUTLET PLAN

ITEM NO.	ITEM DESCRIPTION	QUANTITY
201-1	CLEARING/GRUBBING	620 SY
206-2	EXCAVATION AT DAM FACE AND TOE	60 CY
515-3	TRASH RACK (24-INCH DIA. OUTLET)	1 EA
211-2	SOIL BUTTRESS FILL CONSTRUCTION	1360 CY
220-1	RIPRAP	3 CY
206-1	FOUNDATION PREPARATION	475 SY
350-1	DEMOLITION OF EXISTING CONCRETE HEADWALL & REMOVAL OF PIPE & SHOTCRETE	1 EA
350-2	PERIMETER FENCING REMOVE AND REPLACE	1 EA
530-3	PAINTING TRASH RACK (SOUTH OUTLET)	1 EA

LEGEND:
- 1200 EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE
- WATERS OF U.S.
- WORK ZONE BOUNDARY

NOTE:
1. LIMITS OF CONSTRUCTION 30 FT OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.
2. MINOR EXCAVATION NEEDED TO DAYLIGHT.

SURVEYOR'S AS-BUILT CERTIFICATION

REGISTERED LAND SURVEYOR CERTIFICATE NO. 36326 RICHARD A. STUCKMAN ARIZONA U.S.A.

"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF

9-4-02

Two working days before you dig, CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

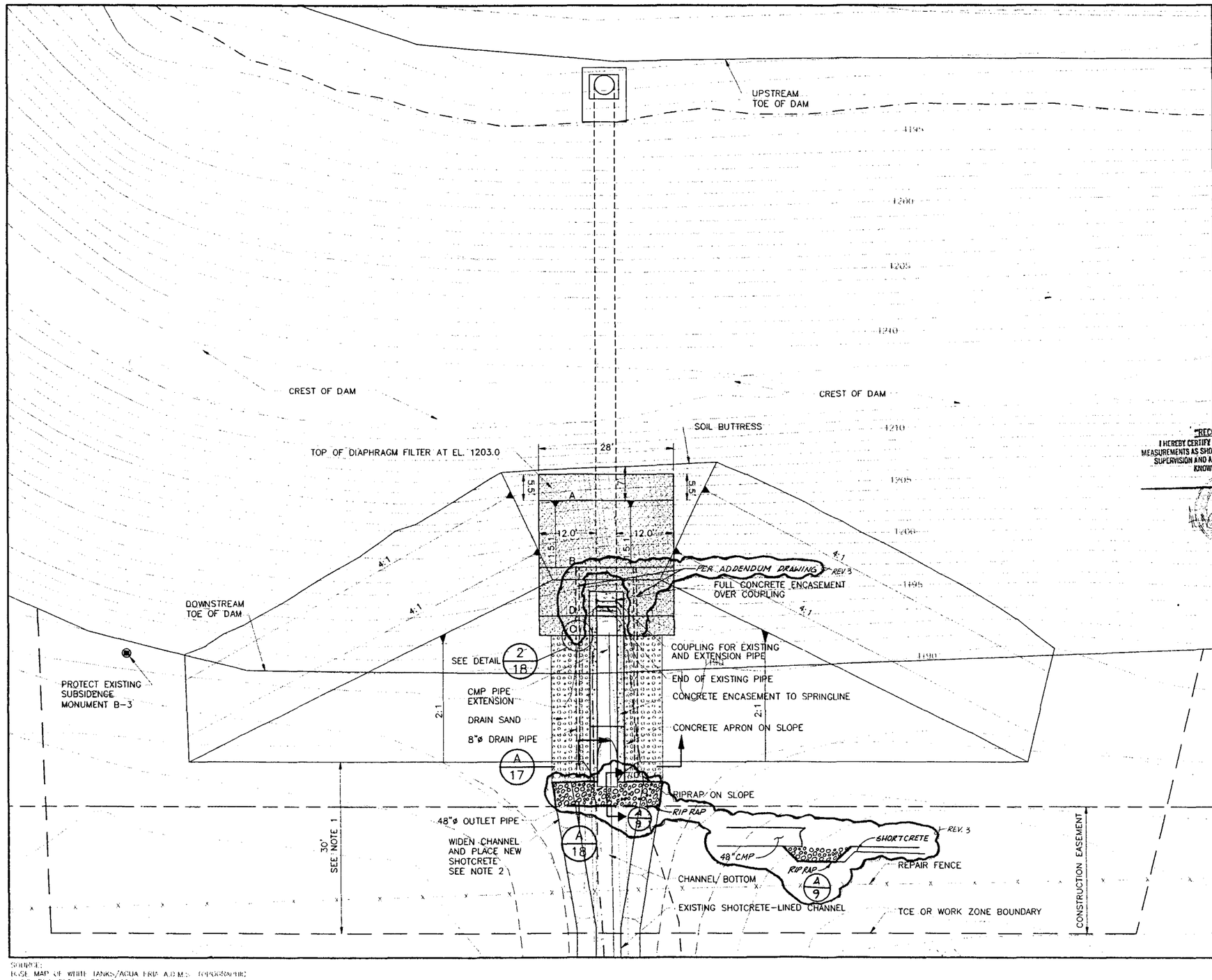
NO.	REVISION	BY	DATE
5	AS-BUILT CHANGES	RC	08/02
4	REVISED BUTTRESS CONTROL POINTS PER SURVEY	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

URS
7720 N. 16th Street Suite 100
Phoenix, Arizona 85020
(602) 371-1100



SOURCE:
BASE MAP OF WHITE TANKS/AGUA FRIA A.D.M.S. TOPOGRAPHIC MAPS, PROVIDED BY FCDMC 12/98
DATUM OF BEARING ARIZONA ZONE 12 CENTRAL NAD 83

0 10 20
SCALE IN FEET
1 FOOT CONTOUR INTERVAL

NORTH OUTLET PLAN – FILTER

ITEM NO.	ITEM DESCRIPTION	QUANTITY
211-1	FILTER SAND	134 CY
211-3	DRAIN SAND	50 CY
621-1	CORRUGATED METAL PIPE (48-INCH DIA. NORTH OUTLET)	37 L.F.
505-1	CONCRETE STRUCTURE	27 CY
220-1	RIPRAP	3 CY
230-1	GEOTEXTILE	3000 SF
605-1	8-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE	60 L.F.

LEGEND:

- 1200 EXISTING CONTOUR 5' INTERVAL
- EXISTING CONTOUR 1' INTERVAL
- FCDMC PROPERTY LINE
- EXISTING DIRT ROAD
- EXISTING BARBED WIRE FENCE
- WATERS OF U.S.
- TCE OR WORK ZONE BOUNDARY

NOTES:

1. LIMITS OF CONSTRUCTION 30 FT OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.
2. EXCAVATE CHANNEL TO WIDEN BOTTOM FROM TOE OF SOIL BUTTRESS TAPERING TO EXISTING WIDTH AT TCE LINE.

"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

4-9-02

CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO.	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	NEW SHEET 90% SUBMITTAL	TER	05/00

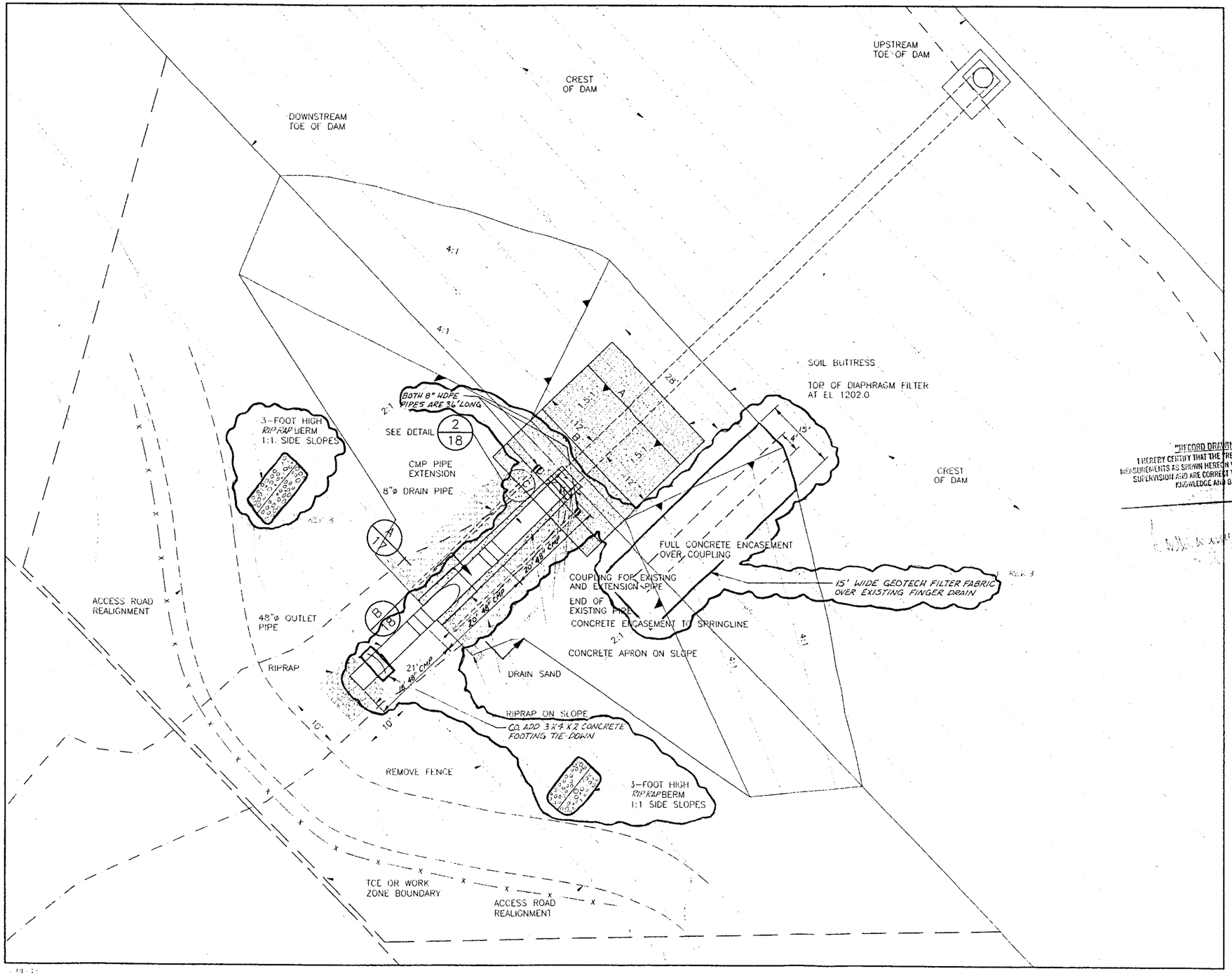
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

DRAWING NO. C5 | NORTH OUTLET PLAN – FILTER | SHEET 9 OF 18



"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

0 10 20
SCALE IN FEET
1 FOOT CONTOUR INTERVAL

CENTRAL OUTLET PLAN – FILTER

ITEM NO.	ITEM DESCRIPTION	QUANTITY
211-1	FILTER SAND	134 CY
211-3	DRAIN SAND	50 CY
621-2	CORRUGATED METAL PIPE (48-INCH DIA. CENTRAL OUTLET)	57 L.F.
505-1	CONCRETE STRUCTURE	27 CY
230-1	GEOTEXTILE	3100 SF
605-1	8-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE	60 L.F.

LEGEND:

EXISTING CONTOUR 5' INTERVAL
EXISTING CONTOUR 1' INTERVAL
FCDMC PROPERTY LINE
EXISTING DIRT ROAD
EXISTING BARBED WIRE FENCE
WATERS OF U.S.

NOTE:
1. LIMITS OF CONSTRUCTION 50 FT. OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.

CALL FOR THE BLUE STAKES
263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	90% SUBMITTAL	TER	07/00
D	NEW SHEET 90% SUBMITTAL	TER	05/00

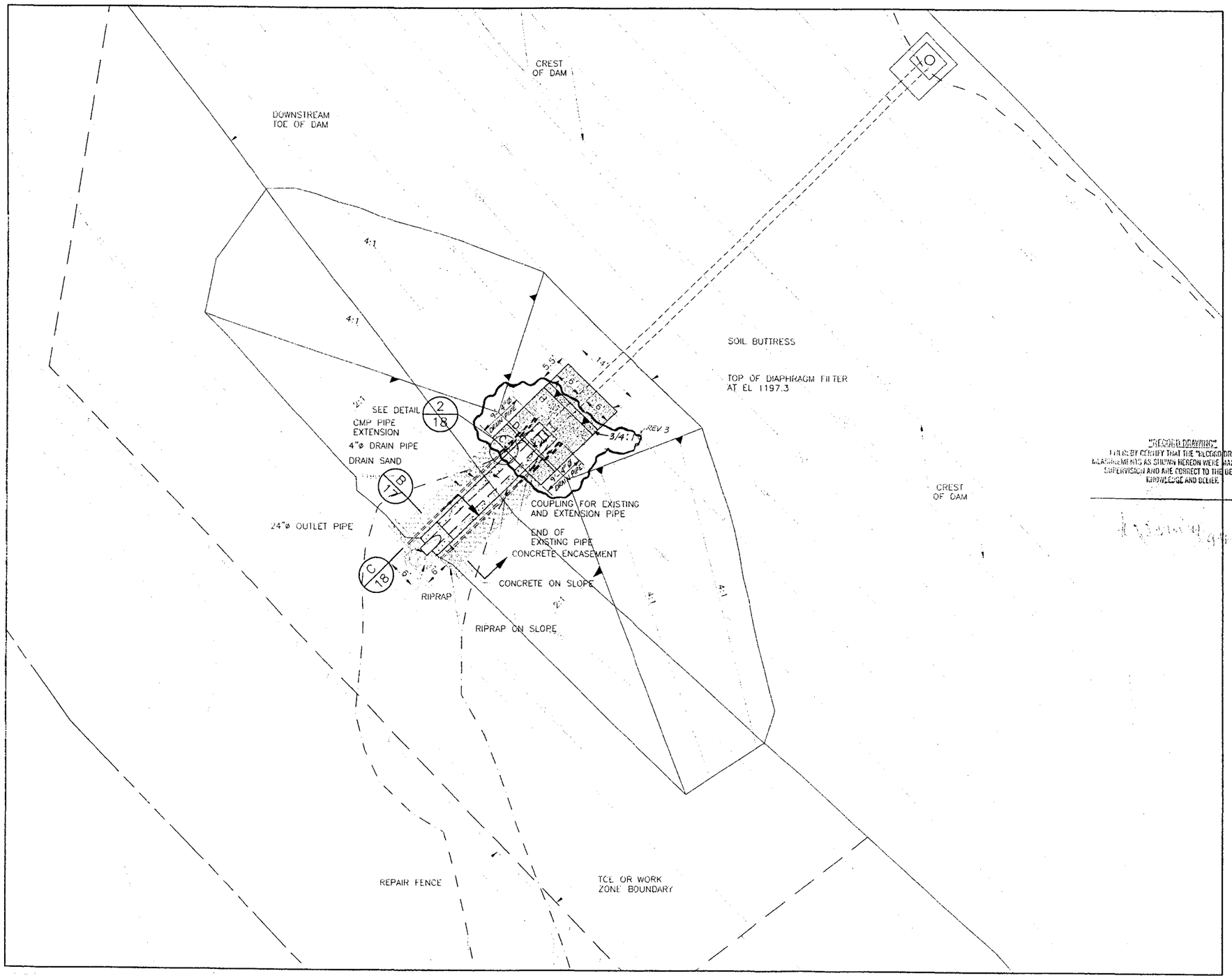
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

DRAWING NO		SHEET OF
C6	CENTRAL OUTLET PLAN – FILTER	10 18



"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

N

0 10 20
SCALE IN FEET
1 FOOT CONTOUR INTERVAL

SOUTH OUTLET PLAN – FILTER

ITEM NO.	ITEM DESCRIPTION	QUANTITY
211-1	FILTER SAND	62 CY
211-3	DRAIN SAND	15 CY
621-3	CORRUGATED METAL PIPE (24-INCH DIA. SOUTH OUTLET)	37 L.F.
505-1	CONCRETE STRUCTURE	17 CY
230-1	GEOTEXTILE	1584 SF
605-2	4-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE	52 L.F.

LEGEND:

EXISTING CONTOUR 5' INTERVAL
EXISTING CONTOUR 1' INTERVAL
FCDMC PROPERTY LINE
EXISTING DIRT ROAD
EXISTING BARBED WIRE FENCE
WATERS OF U.S.

NOTE:
1. LIMITS OF CONSTRUCTION 30 FT OUTSIDE WORK ZONE ON OUTLET SOIL BUTTRESS.

Two working days before you dig
CALL FOR THE BLUE STAKES
263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO.	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	NEW SHEET 90% SUBMITTAL	TER	05/00

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

22867 ALEXANDER M. GOURLAY 4-13-01

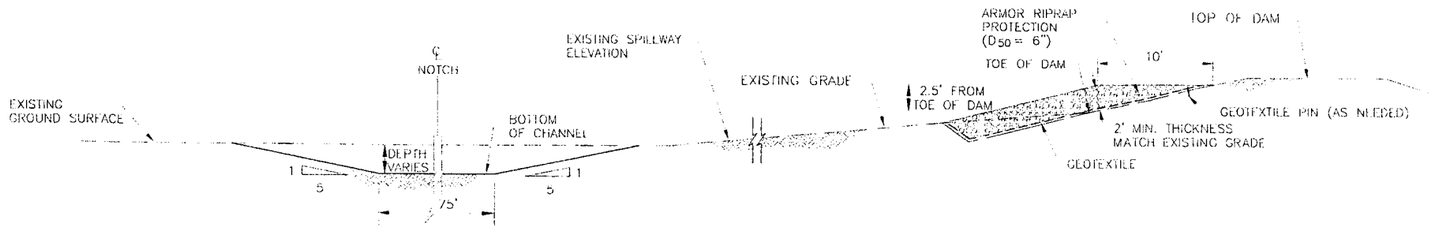
DAMES & MOORE GROUP
A DAMES & MOORE GROUP COMPANY

DRAWING NO. C7

SOUTH OUTLET PLAN - FILTER

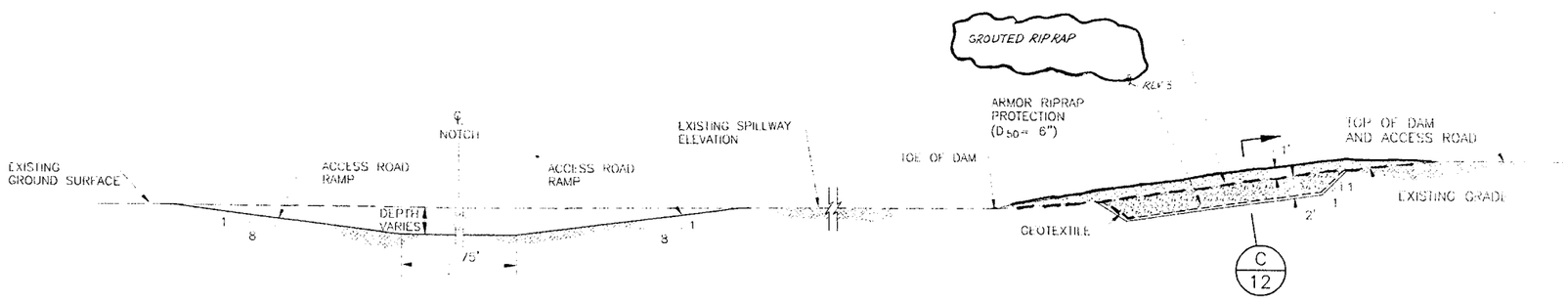
SHEET 11 OF 18

ITEM NO.	ITEM DESCRIPTION	QUANTITY
220-2	1-INCH AGGREGATE	30 CY
230-1	GEOTEXTILE	7650 SF



A 12 NOTCH SECTION

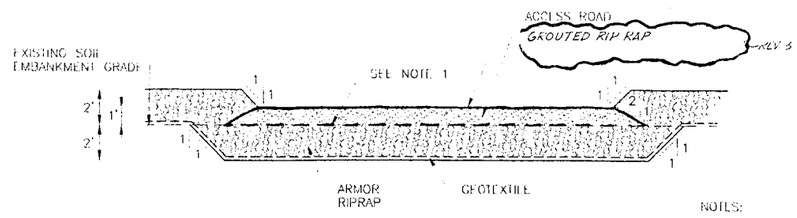
0 6 12
SCALE IN FEET



B 12 ACCESS ROAD SECTION

0 6 12
SCALE IN FEET

NOTE: ACCESS ROAD REALIGNMENT PER DIRECTION OF ENGINEER.



NOTES:

1. FILL VOIDS OF RIPRAP WITH SOIL PRIOR TO PLACEMENT OF GRAVEL, TO SATISFACTION OF FIELD ENGINEER.

C 12 ACCESS ROAD RIPRAP SECTION

0 4 8
SCALE IN FEET

ADWR APPROVAL

NO	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL PER ADWR COMMENTS	TER	04-01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
F	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	NEW SHEET 60% SUBMITTAL	TER	02/00

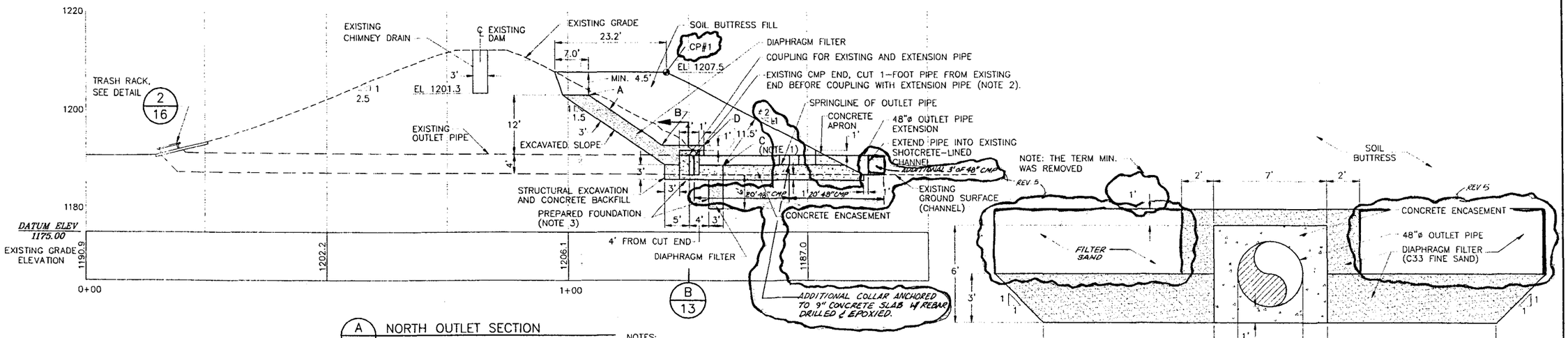
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	E. KINOSMUTH	01/01

DAMES & MOORE

DRAWING NO.		SHEET OF
D1	EMERGENCY SPILLWAY SECTIONS	12 18



A/13 NORTH OUTLET SECTION

SCALE IN FEET 0 10 20

B/13 SECTION

SCALE IN FEET 0 3 6

NOTES:

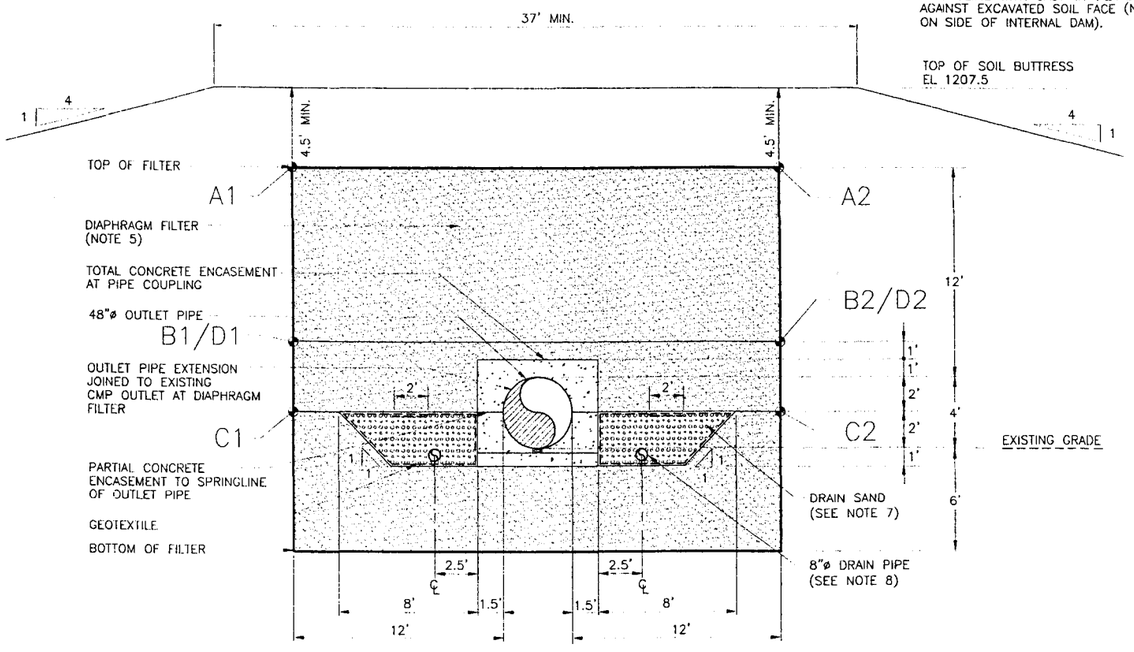
1. FILTER EXTENDS TO POINT C, AROUND CONCRETE.
2. SPECIAL PRECAUTIONS MUST BE TAKEN WHEN CUTTING EXISTING CMP DUE TO PRESENCE OF ASBESTOS CONTAINING MATERIAL.
3. THE FOUNDATION MATERIAL REQUIRES SAMPLING AND LABORATORY ANALYSIS PRIOR TO PREP WORK OR FILL PLACEMENT.
4. CONTRACTOR SHALL MINIMIZE EXCAVATION TO EXPOSE EXISTING CMP AND BACKFILL TO SPRINGLINE WITH CAST-IN-PLACE CONCRETE AGAINST EXCAVATED SOIL FACE (NO FORMS ON SIDE OF INTERNAL DAM).
5. WASHED SAND CONFORMING TO ASTM C33 FINE AGGREGATE GRADATION (AS SPECIFIED).
6. SEE DRAWING NO. D6 SHEET 17 OF 18 FOR TIEDOWN SECTION AND DRAWING NO. D7 SHEET 18 OF 18 RIPRAP END SECTION DETAILS.
7. SEE SPECIFICATIONS FOR DRAIN SAND GRADATION, CONFORMING TO ASTM C-33 SIZE NO.9.
8. DRAIN PIPE SHALL BE INSTALLED WITH MANUFACTURED GEOTEXTILE SOCK.

KEY CONTROL POINTS OF DIAPHRAGM FILTER AT NORTH OUTLET

CP			CP			ELEVATION
A1	N	922239.90	A2	N	922267.89	1203.00
	E	531111.27		E	531110.83	
B1	N	922240.14	B2	N	922268.13	1193.00
	E	531126.42		E	531125.98	
C1	N	922240.34	C2	N	922268.33	1189.00
	E	531138.98		E	531138.54	
D1	N	922240.27	D2	N	922268.27	1193.00
	E	531134.98		E	531134.54	

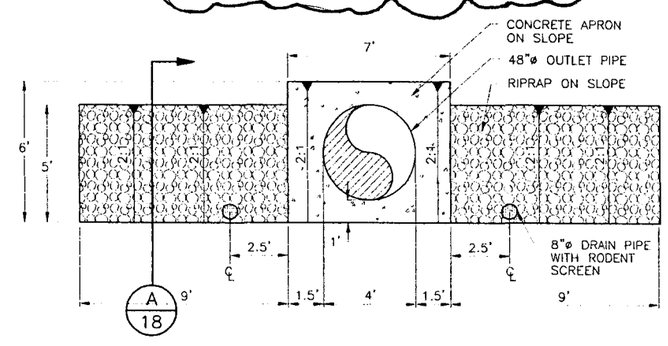
"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF

9-6-02



DIAPHRAGM FILTER ELEVATION AT NORTH OUTLET

SCALE IN FEET 0 4 8



A/18 RIPRAP AT NORTH OUTLET ELEVATION

SCALE IN FEET 0 3 6

CALL FOR THE BLUE STAKES 263-1100 1-800-STAKE-IT OUTSIDE MARICOPA COUNTY

NO.	REVISION	BY	DATE
5	AS-BUILT CHANGES	RC	08/02
4	REVISED BUTTRESS CONTROL POINTS PER SURVEY	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

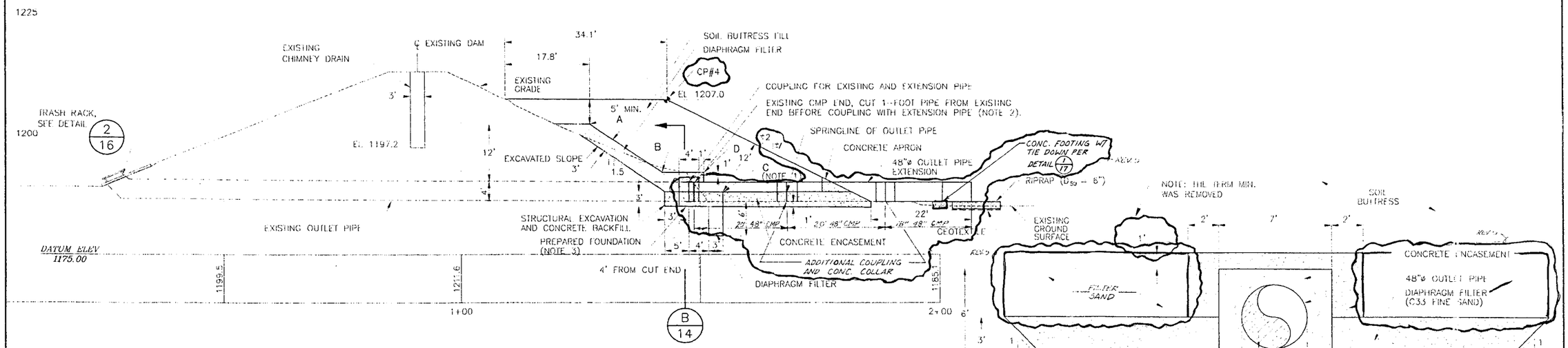
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO.		SHEET	OF
D2	NORTH OUTLET SECTION AND ELEVATIONS	13	18



A 14 CENTRAL OUTLET SECTION

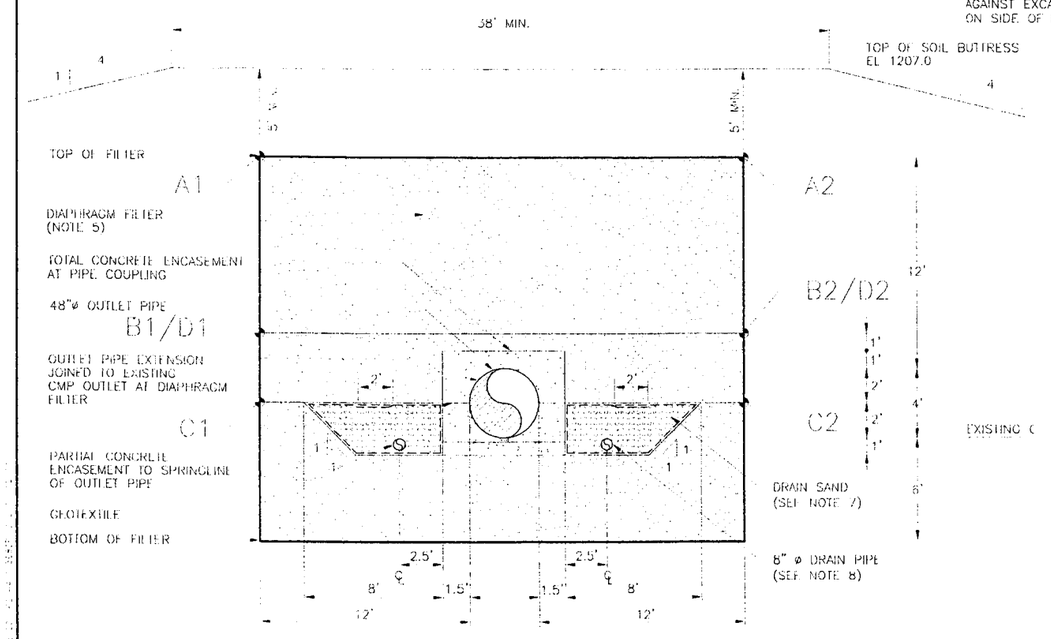
0 10 20
SCALE IN FEET

B 14 SECTION

0 3 6
SCALE IN FEET

NOTES:

1. FILTER EXTENDS TO POINT C, AROUND CONCRETE.
2. SPECIAL PRECAUTIONS MUST BE TAKEN WHEN CUTTING EXISTING CMP DUE TO PRESENCE OF ASBESTOS CONTAINING MATERIAL.
3. THE FOUNDATION MATERIAL REQUIRES SAMPLING AND LABORATORY ANALYSIS PRIOR TO PREP WORK OR FILL PLACEMENT.
4. CONTRACTOR SHALL MINIMIZE EXCAVATION TO EXPOSE EXISTING CMP AND BACKFILL TO SPRINGLINE WITH CAST-IN-PLACE CONCRETE AGAINST EXCAVATED SOIL FACE (NO FORMS ON SIDE OF INTERNAL DAM).
5. WASHED SAND CONFORMING TO ASTM C33 FINE AGGREGATE GRADATION (AS SPECIFIED).
6. SEE DRAWING NO. D6 SHEET 17 OF 18 FOR TIEDOWN SECTION AND DRAWING NO. D7 SHEET 18 OF 18 RIPRAP END SECTION DETAILS.
7. SEE SPECIFICATIONS FOR DRAIN SAND GRADATION, CONFORMING TO ASTM C-33 SIZE NO.9.
8. DRAIN PIPE SHALL BE INSTALLED WITH MANUFACTURED GEOTEXTILE SOCK.

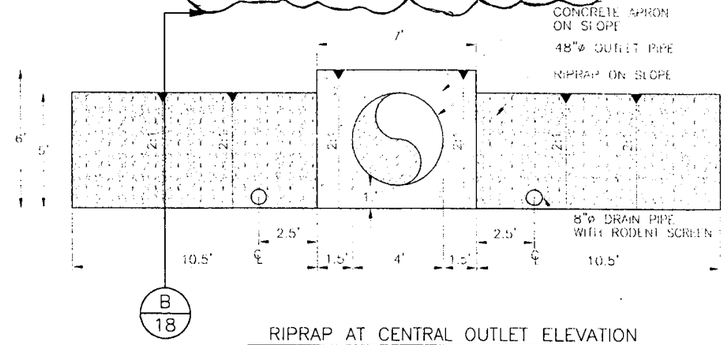


DIAPHRAGM FILTER ELEVATION AT CENTRAL OUTLET

0 4 8
SCALE IN FEET

KEY CONTROL POINTS OF DIAPHRAGM FILTER AT CENTRAL OUTLET

CP			CP			ELEVATION
A1	N	921009.26	A2	N	921028.63	1202.00
	E	529944.70		E	529964.92	
B1	N	920998.33	B2	N	921017.70	1192.00
	E	529955.16		E	529975.39	
C1	N	920989.25	C2	N	921008.62	1188.00
	E	529963.86		E	529984.08	
D1	N	920992.14	D2	N	921011.51	1192.00
	E	529961.09		E	529981.31	



B 18 RIPRAP AT CENTRAL OUTLET ELEVATION

0 3 6
SCALE IN FEET

"AS-BUILT RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

CALL FOR 48 HOURS STATES 263-1100 1-800-STAKE-IT (ELSEWHERE MARICOPA COUNTY)

NO.	REVISION	BY	DATE
5	AS-BUILT CHANGES	RC	08/02
4	REVISED BUTTRESS CONTROL POINTS PER SURVEY	TER	12/01
3	APPROVED FOR CONSTRUCTION	TER	08/01
2	100% FINAL PER ADWR COMMENTS	TER	04/01
1	100% FINAL ISSUED FOR ADWR PERMIT	TER	01/01
D	100% SUBMITTAL REVIEW FOR ADWR PERMIT	TER	10/00
F	95% SUBMITTAL	TER	07/00
B	90% SUBMITTAL	TER	05/00
C	NEW SHEET 60% SUBMITTAL	TER	02/00

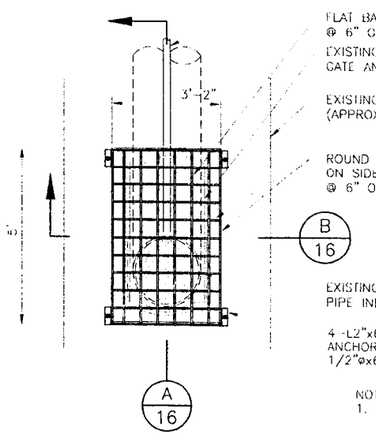
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PRIMISANO	01/01
CHECKED	T. RIDSMUTH	01/01

URS 7720 N. 16th Street Suite 100 Phoenix, Arizona 85020 (602) 371-1100

DRAWING NO.		SHEET	OF
D5	CENTRAL OUTLET SECTION AND ELEVATIONS	14	18



EXISTING SLIDE GATE STEM

FLAT BAR 1/2"x4" @ 6" O.C.

EXISTING SLIDE GATE AND FRAME

EXISTING CONCRETE SLAB (APPROX. 6'x7.75')

ROUND 1/2"ø BARS ON SIDES E.W. @ 6" O.C.

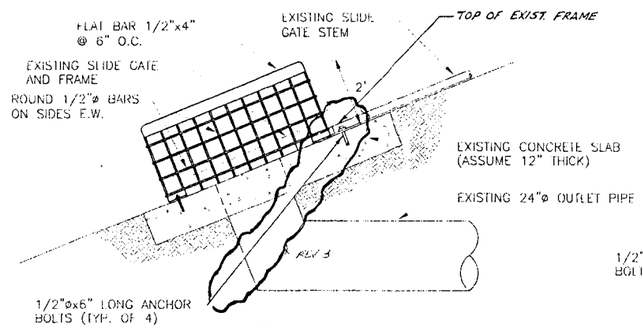
EXISTING 24"ø PIPE INLET

4 - L2"x6"x6" LONG ANGLE BAR ANCHOR BRACKETS 1/2"øx6" ANCHOR BOLTS (TYP. OF 4)

NOTES:
1. ALL STEEL SHALL BE PRIMED PRIOR TO INSTALLATION.
2. SHOP PRIME AND PAINT TRASHRACK AND FINAL TOUCH UP PAINT IN FIELD.
3. DRILL AND EPOXY ANCHOR BOLTS PER SPECIFICATIONS.

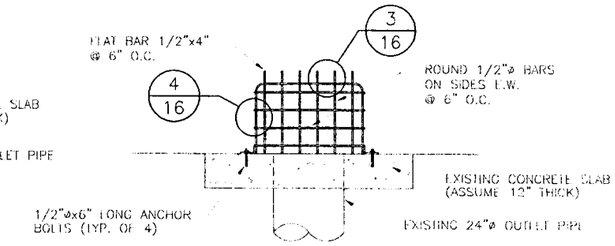
1/16 SOUTH TRASH RACK PLAN

0 2 4
SCALE IN FEET



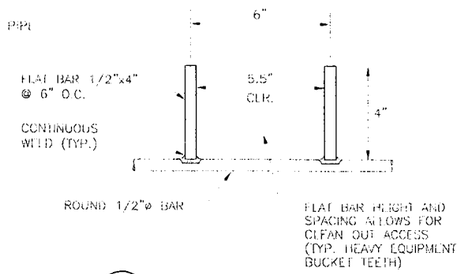
A/16 SOUTH TRASH RACK SECTION

0 2 4
SCALE IN FEET

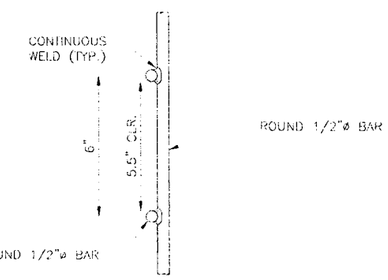


B/16 SOUTH TRASH RACK SECTION

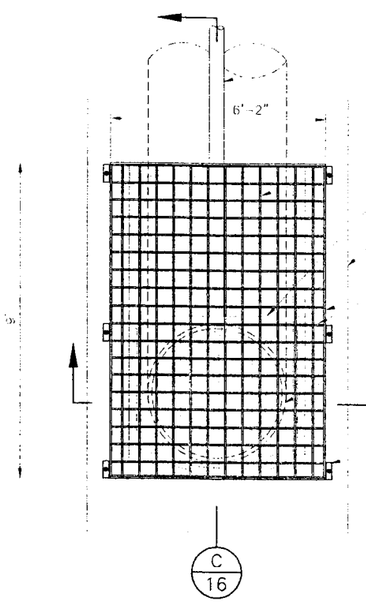
0 2 4
SCALE IN FEET



3/16 TOP OF TRASH RACK DETAIL
NTS



4/16 SIDE OF TRASH RACK DETAIL
NTS



EXISTING SLIDE GATE STEM

FLAT BAR 1/2"x4" @ 6" O.C.

EXISTING SLIDE GATE AND FRAME

EXISTING CONCRETE SLAB (APPROX. 7.5'x12.5' - CENTRAL AND 8'x12' - NORTH)

ROUND 1/2"ø BARS ON SIDES E.W. @ 6" O.C.

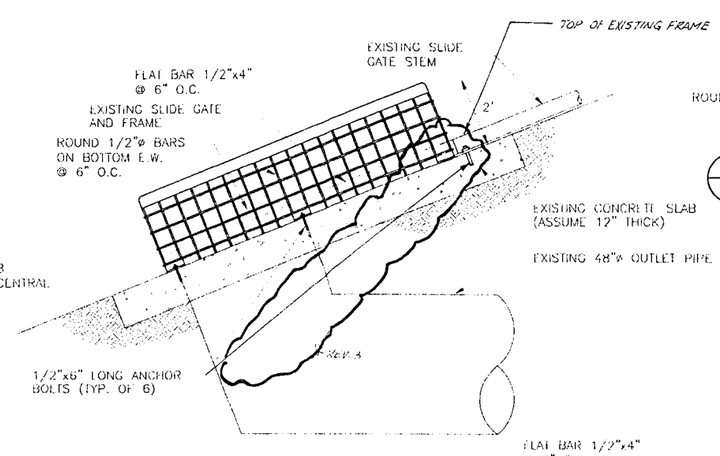
EXISTING 48"ø PIPE INLET

6 - L2"x6"x6" LONG ANGLE BAR ANCHOR BRACKETS 1/2"øx6" ANCHOR BOLTS (TYP. OF 6)

NOTES:
1. ALL STEEL SHALL BE PRIMED PRIOR TO INSTALLATION.
2. SHOP PRIME AND PAINT TRASHRACK AND FINAL TOUCH UP PAINT IN FIELD.
3. CENTRAL OUTLET IS IDENTIFIED AS BEING THE PRIMARY OPERATIONAL STRUCTURE.
4. DRILL AND EPOXY ANCHOR BOLTS PER SPECIFICATIONS.

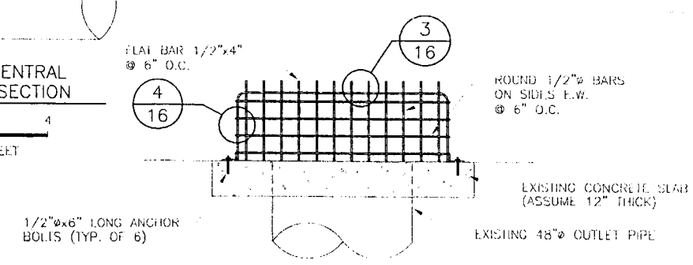
2/16 NORTH AND CENTRAL TRASH RACK PLAN

0 2 4
SCALE IN FEET



C/16 NORTH AND CENTRAL TRASH RACK SECTION

0 2 4
SCALE IN FEET



D/16 NORTH AND CENTRAL TRASH RACK SECTION

0 2 4
SCALE IN FEET

"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWINGS" WITH REVISIONS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

2 BLK STAKES BEFORE YOU DIG
CALL FOR THE BLUE STAKES
263-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO.	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL PER ADWR COMMENTS	TER	04/01
1	100% FINAL ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

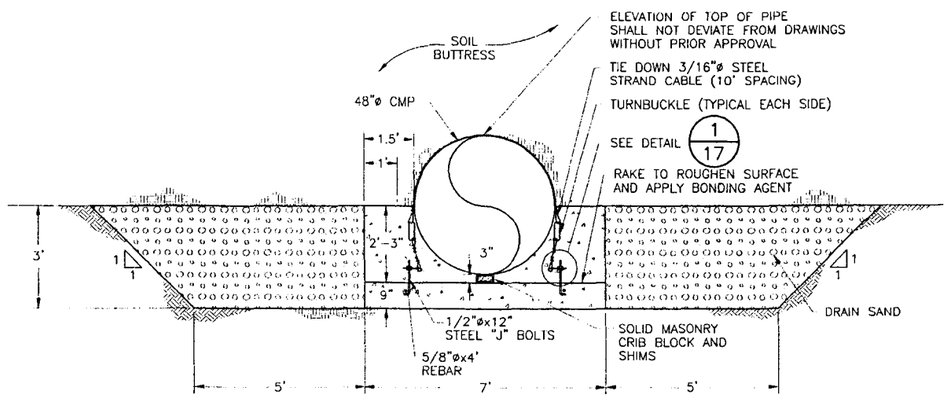
	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PARMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

DRAWING NO. D5

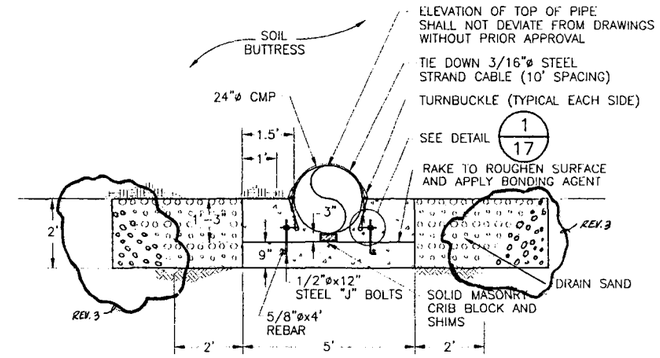
TRASH RACK PLANS, SECTIONS, AND DETAILS

SHEET 16 OF 18



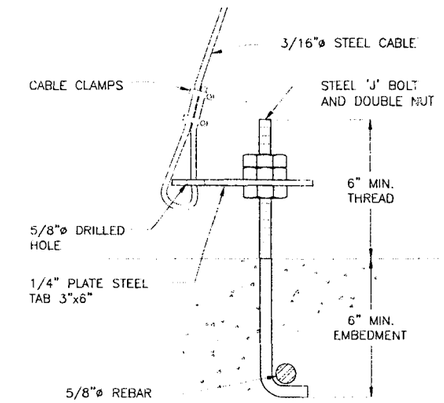
A/17 48"ø PIPE TIEDOWN SECTION

0 2 4
SCALE IN FEET

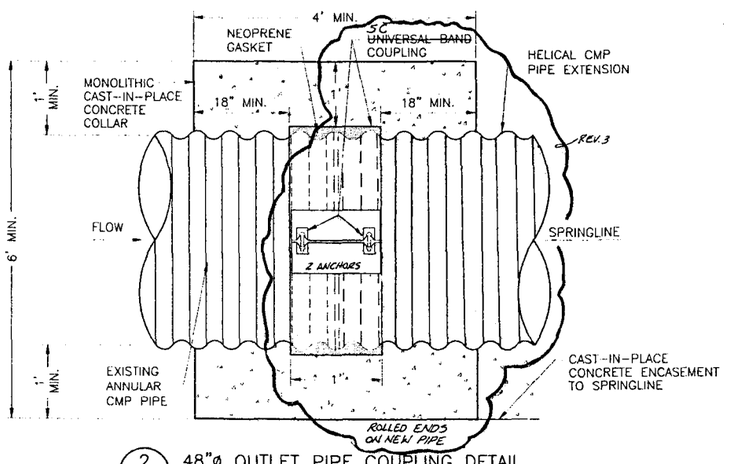


B/17 24"ø PIPE TIEDOWN SECTION

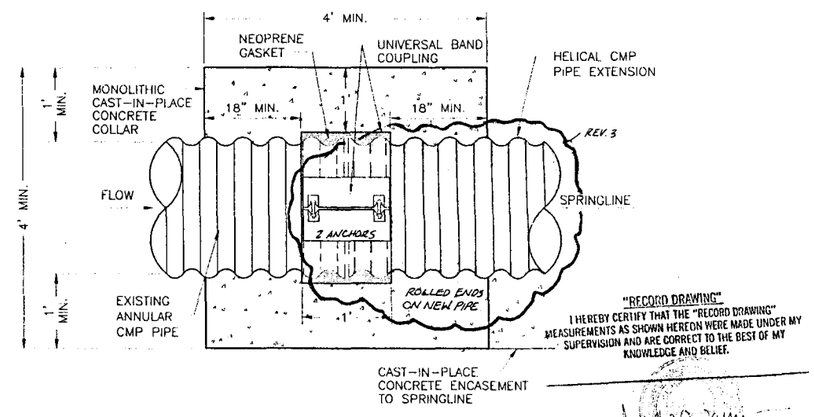
0 2 4
SCALE IN FEET



1/17 TIEDOWN DETAIL
NTS



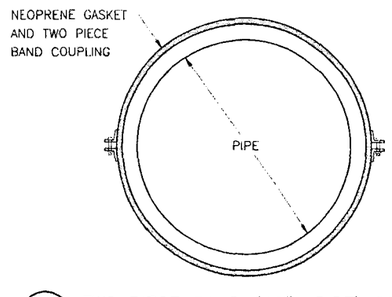
2/17 48"ø OUTLET PIPE COUPLING DETAIL
NTS



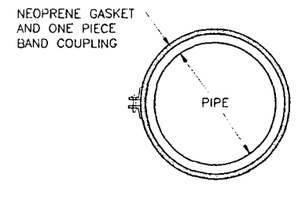
"RECORD DRAWING"
I HEREBY CERTIFY THAT THE "RECORD DRAWING" MEASUREMENTS AS SHOWN HEREON WERE MADE UNDER MY SUPERVISION AND ARE CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

9-4-02

4/17 24"ø OUTLET PIPE COUPLING DETAIL
NTS



3/17 TWO PIECE BAND (48"ø PIPE) DETAIL
NTS



5/17 ONE PIECE BAND (24"ø PIPE) DETAIL
NTS

263-1100
1-800-STAKE-IT

ADWR APPROVAL

NO.	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL, PER ADWR COMMENTS	TER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	TER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	TER	10/00
E	95% SUBMITTAL	TER	07/00
D	90% SUBMITTAL	TER	05/00
C	60% SUBMITTAL	TER	02/00
B	30% SUBMITTAL	TER	01/00
A	10% SUBMITTAL	TER	11/99

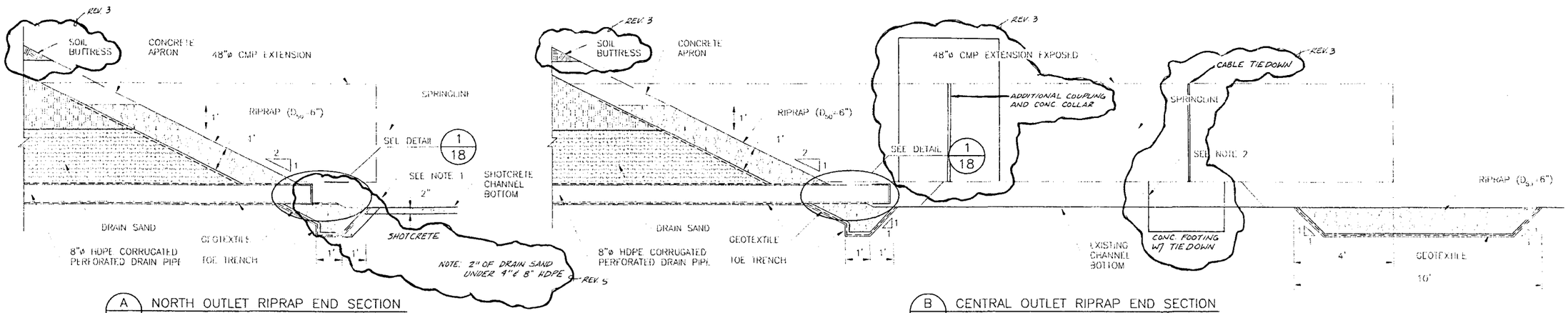
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2000C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

DRAWING NO.		SHEET	OF
D6	OUTLET PIPES SECTION AND DETAILS	17	18

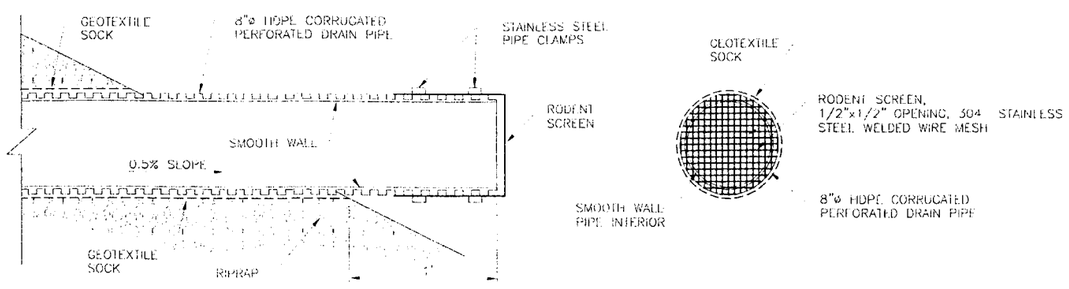


A/18 NORTH OUTLET RIPRAP END SECTION

SCALE IN FEET 0 2 4

B/18 CENTRAL OUTLET RIPRAP END SECTION

SCALE IN FEET 0 2 4



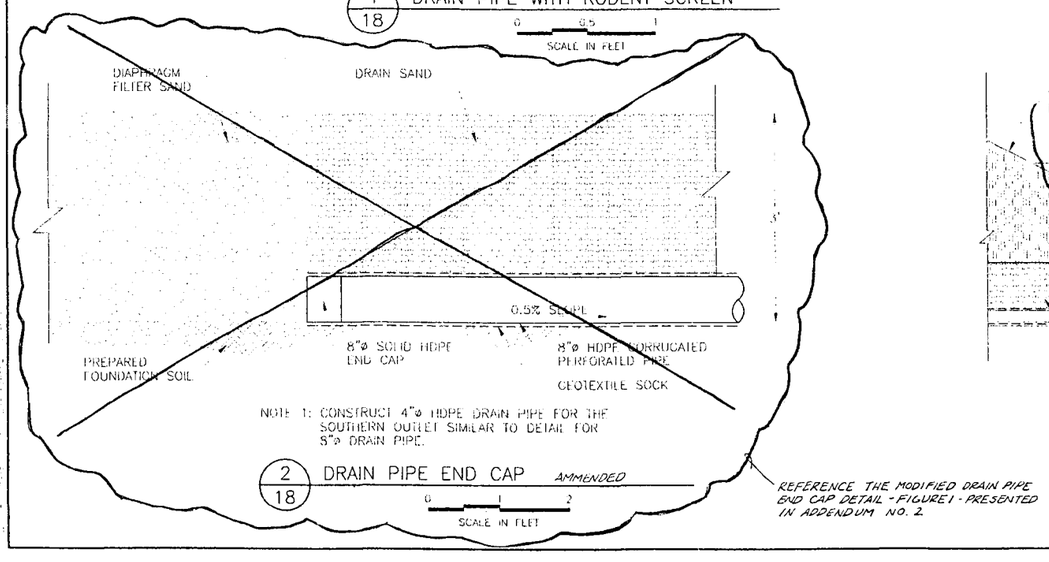
NOTE 1: CONSTRUCT 4"ø HDPE DRAIN PIPE FOR THE SOUTHERN OUTLET SIMILAR TO DETAIL FOR 8"ø DRAIN PIPE.

1/18 DRAIN PIPE WITH RODENT SCREEN

SCALE IN FEET 0 0.5 1

NOTE 1: DIFFERENCES IN ELEVATION BETWEEN INVERT OF PIPE AND EXISTING CHANNEL BOTTOM AND THE PIPE SLOPE IS NOMINAL. THESE ARE TO BE FIELD VERIFIED AND APPROVED BY THE ENGINEER.

NOTE 2: THE EXTENSION OF THE PIPE 21 FEET BEYOND THE SOIL BUTTRESS TOE WILL REQUIRE CONTINUOUS GROUND SUPPORT. THE CONTRACTOR SHALL PROVIDE CUT AND FILL ALONG THE CHANNEL BOTTOM TO SUPPORT THE PIPE. THE DIFFERENCE BETWEEN THE INVERT OF THE PIPE AND EXISTING CHANNEL BOTTOM IS NOMINAL. ALL STRUCTURAL FILL SHALL BE PLACED AND COMPACTED.

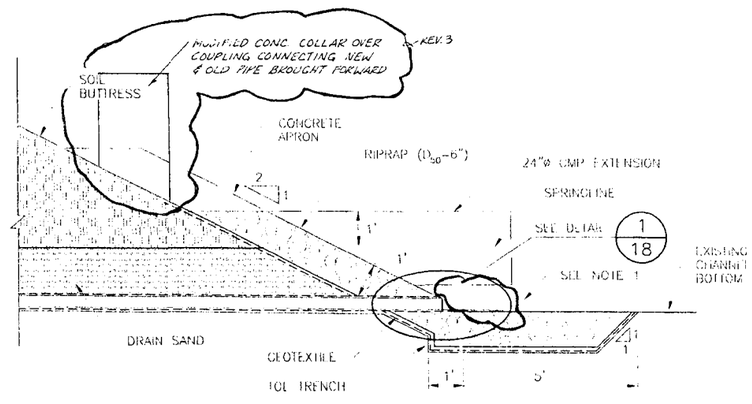


NOTE 1: CONSTRUCT 4"ø HDPE DRAIN PIPE FOR THE SOUTHERN OUTLET SIMILAR TO DETAIL FOR 8"ø DRAIN PIPE.

2/18 DRAIN PIPE END CAP *AMMENDED*

SCALE IN FEET 0 1 2

REFERENCE THE MODIFIED DRAIN PIPE END CAP DETAIL - FIGURE 1 - PRESENTED IN ADDENDUM NO. 2.



C/18 SOUTH OUTLET RIPRAP END SECTION

SCALE IN FEET 0 2 4

263-1100
1-800-STAKE-IT

ADWR APPROVAL

NO	REVISION	BY	DATE
3	AS-BUILT CHANGES	RC	08/02
2	100% FINAL, PER ADWR COMMENTS	ER	04/01
1	100% FINAL, ISSUED FOR ADWR PERMIT	ER	01/01
0	100% SUBMITTAL, REVIEW FOR ADWR PERMIT	RER	10/00
E	95% SUBMITTAL	RER	07/00
D	90% SUBMITTAL	RER	05/00
C	60% SUBMITTAL	RER	02/00
B	30% SUBMITTAL	RER	01/00
A	10% SUBMITTAL	RER	11/99

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION

WHITE TANKS FRS#3
INTERIM DAM SAFETY
F.C.D. CONTRACT NO. FCD2[illegible]0C028

	BY	DATE
DESIGNED	K. SOMERVILLE	01/01
DRAWN	K. PALMISANO	01/01
CHECKED	T. RINGSMUTH	01/01

DAMES & MOORE GROUP

DRAWING NO		SHEET	OF
D/	OUTLET RIPRAP END SECTIONS	18	18