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DESIGN REPORT
VOLUME I
INTERIM DAM SAFETY IMPROVEMENTS
WHITE TANKS FRS #3 (07.28)

Prepared for:
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Prepared by
URS/Dames & Moore

D&M Job No. 15448-007-058
August 3, 2001

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ARIZONA, U.S.A.

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APPENDIX A

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DISPOSITION OF COMMENTS ON 10 PERCENT LEVEL SUBMITTAL

ADWR Comments – Reference ADWR letter dated December 16, 1999 (10% submittal). This letter is included in this appendix.

1. Section 3.0 (Filter Investigation)...
   This comment will be addressed when more data are acquired from additional field investigation. Additional exploration is planned related to crack investigation that will include trenches to explore the dam's filter zone.
2. Section 4.0 (Design)...
   In disposition similar to comment 1, above, we will address this comment after further field exploration.
3. Section 4.0 (Design)...
   The report text addresses the interim operational plan. This plan will be prepared by the District.
4. Section 4.1 (Diaphragm Filters and Outlet Pipe Extensions)...
   The report text now includes a sub-section on pipe addressing the information called for.
5. Section 4.1 (Diaphragm Filters and Outlet Pipe Extensions)...
   The alternative discussed in Section 4.1.1.1 is one that complies with NRCS design criteria. The second alternative proposes use of a geo-synthetic (fabric) filter.
6. Section 4.2 (Trash Racks)...
   The revised report text gives the MAG designation requested.
7. Section 4.3 (Riprap at the Right Dam Abutment)...
   Riprap design is in-progress engineering work. At the appropriate level we will select and report the design basis. We will consult the references indicated.
8. Appendix A (Boring Logs)
   Boring logs are now included in the appendix.
9. Drawing C1...
   This drawing has been revised. The flow from the low flow channel, or notch, is relatively low and does not wet the dam's toe. The riprap on the toe is not for armor protection against flow from the spillway notch. Rather, it is necessary for the design inflow event, when spillway discharge is at a maximum.
   The alignment of the notch is based upon topography and property lines. It was selected in order to provide the required channel dimensions (determined by freeboard requirements), to discharge to a wash close by and down-slope, and to avoid a property line close to the downstream toe of the dam. Alignment that routes flow in another direction would require extensive earthwork that does not appear justified.
   Section A has been modified. We now show two cross sections, at the District's request, to show typical channel dimensions, and non-typical dimensions for a roadway crossing. To comply with ADWR's comment we now show the armor in the section.
10. Drawing C2...
    This drawing has been revised. Its intention should now be clear.
11. Drawing D1...
    This drawing has been revised. The sections have been re-worked extensively to show detail. The space on the trash-rack has been dimensioned.

DISPOSITION OF COMMENTS ON 30 PERCENT LEVEL SUBMITTAL

ADWR Comments – Reference ADWR letter dated January 19, 2000 (30% submittal). This letter is included in this appendix.

1. Section 3.0 (Filter Investigation)...
   Filter investigation is still underway.
2. Section 4.1.1.1 (Conventional Graded Sand Filter)...
   Design calculations mentioned are included in Appendix B.
3. Section 4.2 (Trash Racks)...
   Trash racks have been redesigned, see Section 4.2.
4. Section 4.3 (Riprap at the Right Dam Abutment)...
   Riprap has been designed, see Section 4.3.
5. Section 4.4 (Emergency Spill Modifications)...
   A copy of the December 8 and 9, 1999 survey will be included in 90 percent report. The spillway notch elevation has been re-calculated to account for 10 years of future subsidence.
6. Section 4.6 (Interim Operational Plan)...
   No action required by Dames & Moore. The District will supply the Interim Operational Plan.
7. Appendix A ...
   Dam filter sieve analyses have been modified accordingly.
8. Appendix E...
   Specifications for the filter material including compaction requirements have been provided in the Special Provisions. Calculations supporting the D_{50} sizing of the riprap have also been provided, see Appendix B.
9. Drawing G3...
   Additional labeling has been added.
10. Drawing C1...
    Comments have been integrated into revised drawing.
11. Drawing C2...
    Additional cross-section requested has been provided.
12. Drawing D1...
    Cross-sections for each outlet have been provided. Other comments have been added.
13. Drawing D2...
    Stilling basins have been removed. Trash racks have been redesigned.

NRCS Comments – Reference NRCS letter dated January 24, 2000 (30% submittal). This letter is included in this appendix.

1. Section 2.1.2, Past Observed Problems, Cracks and Subsidence…
   The attached report has been reviewed.
2. Section 3.0, Filter Investigation…
   Gradations of the base material have been obtained and are included in Appendix C.
3. Section 4.1.1.2, Geotextile Filter…
   The geotextile filter alternative was not the preferred alternative. No further work was done on this subject.
4. Section 4.1.2, Outlet Pipe Extension, 2nd paragraph, 2nd sentence…
   The text has been changed.
5. Section 4.2, Trash Racks…
   The trash rack now meets NRCS TR-60 requirements. See the Central Trash Rack Sizing calculation presented in Appendix B.
6. Section 4.4, Emergency Spillway Modifications…
   Fence lines have been added to all plan sheets.
7. Drawing Sheet 1…
   North arrow has been added.

DISPOSITION OF COMMENTS ON 60 PERCENT LEVEL SUBMITTAL

ADWR Hydrology & Hydraulics Comments – Reference ADWR letter dated April 21, 2000 (60% submittal). This letter is included in this appendix.

1. This report references previous reports...
   No action necessary.
2. The spreadsheet being used to calculate normal depths needs to be checked...
   The spreadsheet was corrected and a calculation package review and check was performed. See revised RipRap Sizing calculation in Appendix D.
3. The final report should include a hydraulics section...
   Rating curves have been developed and are shown on drawing G3.
4. The final report should include a hydrology section...
   Hydrology for this project will be provided under separate cover.

ADWR Comments – Reference ADWR letter dated February 25, 2000. This letter is included in this appendix.

1. Section 4.1.1 (Conventional Graded Sand Filter)...
   The change was made to the latest TR-60.
2. Section 4.1.1 (Conventional Graded Sand Filter)...
   Minimum thickness has been changed to a true minimum thickness normal to the slope.
3. Section 4.1.1 (Conventional Graded Sand Filter)...
   The text has been changed.
4. Section 4.1.2 (Outlet Pipe Extensions)...
   The CMP is now being encased in concrete to the springline. The text has been changed.
5. Section 4.1.2 (Outlet Pipe Extensions)...
   The coupling of the existing pipe and extension pipe will now include universal band and full concrete encasement collar. The text has been changed.
6. Drawing G3...
   Boring locations have been included on Figure 1.
7. Drawing C2...
   Minimum cover requirements for soil buttress have been met. Recalculations for minimum cover and review and check procedures have been performed. Dimensions have been shown on plan and section views on the drawings for each respective outlet.
8. Drawing D1...
   Berms have been deleted from design. A toe drain has been incorporated into the design at all areas receiving riprap. See Drawing D1.
9. Drawing D2...
   Pipe joints are called out. Geotextile line and callout has been added to section.
10. Drawing D2...
    Detail drawing has been revised to show dimensions.
11. Drawing D5...
    The CMP coupling is being fully encased in concrete to insure a water-tight seal. The CMP extension is being encased in concrete to the springline.
12. Appendix B (Calculation Packages)...

    Diaphragm Filter & Fill Cover Sizing
    This calculation package has been completely redone and is included in Appendix D. Calculation packages for the capacity of diaphragm filter material at each outlet has also been provided in Appendix D. A drain material has been added to the design and a match has been performed, see Appendix D Diaphragm Filter – Drain Gradation Match.
13. Appendix B (Calculation Packages)...
    Diaphragm Filter Gradation
    a. Boring logs have been provided
    b. Sheet references have been corrected
    c. C33 Fine Aggregate gradation has been corrected.
14. Appendix B (Calculation Packages)...

    A match between the filter and the soil buttress has not been performed. The concern here is that material from the soil buttress will migrate into the filter. We don't believe that there will be enough seepage through the soil buttress that material will be able to migrate into the filter.
15. Appendix B (Calculation Packages)...
    No action necessary.
16. Appendix E (Special Provisons or Specifications)...

The approach to the Special Provision (specification) package has been revised to develop a "stand-alone" set of construction specifications that follow the MAG format and style. The text is detailed and includes project-specific requirements. References to the MAG standard document have been deleted.

a. Agree. The special provisions (specifications) text has been revised.
b. The approach to the special provisions (construction specifications) has been changed and references to the MAG standard document have been deleted.
c. The specification text has been revised to include requirement for field compaction and deletion of allowance of concrete backfill.
d. The term fill line has been deleted from the text. The specification text has been revised to restrict the contractor from cutting into existing embankment.
e. The specification text has been revised to read a PI requirement of less than 10 at both locations of the text to eliminate conflicts within the document.
f. The specification text has been revised to include a field compaction requirement for the sand.
g. The text has been revised to reference the Design Report, which includes soils data, in which excerpts can be made available for Contractor's review upon request.
h. A specification has been included in the text for soil buttress material. Specific reference to C33 Fine Aggregate material has been included in the text.
i. An initial review of the comparison of references to types and terms of materials between those named in the special provisions (specifications) and those called out on the drawings has been performed. However, A more thorough review by Dames & Moore is required by the 95 percent submittal to complete the quality control task.
j. The text has been revised to reference only one size of riprap.

17. Appendix F (Construction Quality Assurance and Quality Control Plan)...
    a. Text has been revised to delete liner system terms.
    b. The text has been revised to reference table as Table 1.
    c. Agree. The reference to this standard test has been moved.
    d. Agree. The text in Table 1 has been revised.
    e. The fill material designation have generally been revised on Table 1 to be consistent with the drawings, however, further quality control review for complete cross checking is required by the 95 percent submittal.
18. Table 1 the testing frequencies need to be adjusted.

    The frequency of conformance testing for this project has been revised based on discussions in the 60 percent design review meeting.

NRCS Comments – Reference NRCS letter dated February 29, 2000 (60% submittal). This letter is included in this appendix.

1. Our 30% submittal review comments were not mentioned or addressed.
   Comments have been addressed.
2. Page 1-1, change "National Resources Conservation Services" to read "Natural ...
   The text has been changed.
3. Page 4-1 and throughout document, Technical Release (TR) Notice 60C...
   The change was made to the latest TR-60.
4. Appendix B, Diaphragm Filter Gradation...
   The calculation has been revised so that the base soil was regraded. The revised calculation is presented in Appendix D.
5. Appendix B, Diaphragm Filter Gradation
   The calculation has been revised so that the d_{15} of the base soil was not used. The revised calculation is presented in Appendix D.
6. Appendix B, Diaphragm Filter Gradation...
   The calculation has been revised resulting in a change of the design band. The revised calculation is presented in Appendix D.
7. Section 4.1, Diaphragm Filters and Pipe Outlet Extensions...
   A minimum capacity calculation has been performed on the diaphragm outlets and is presented in Appendix C.
8. Sp page 8 of 39...
   Specification text has been revised to include conformance testing that will be performed prior to and during placement of fill and out-of-spec material will be rejected and rework will be necessary.
   Reference in the special provisions (specifications) to the compaction of drain fill includes requirements for maximum lift thickness, construction to the dimensions and elevations on the drawings, and compaction by walk-behind equipment.
   The text has been revised to include conformance testing for field compaction of drain fill.
9. Sp page 12 of 39...
   The moisture range for soil cover has been revised in the text.
10. Sp page 19 of 39...
    The specification section for geotextile has been enhanced.
11. Drawing sheet 8 of 12, Section A-8, Channel Section...
    The berms have been removed.

DISPOSITION OF COMMENTS ON 90 PERCENT LEVEL SUBMITTAL

ADWR Comments – Reference ADWR letter dated June 22, 2000 (90% submittal). This letter is included in this appendix.

1. Section 2.1.2.1 (Cracks)
   Text has been added to this section regarding the finger drain construction.
2. Section 3.0 (Existing Filter Investigation)
   Filter analysis has been conducted and this section has been expanded.
3. Section 5.1.1 (Diaphragm Filter)
   A calculation has been performed demonstrating a match between the filter and the soil buttress. This calculation is included in Appendix E.
4. Section 5.1.1 (Diaphragm Filter)
   Calculation packages have been prepared which consider each of the interfaces mentioned in this comment. These packages are presented in Appendix E.
5. Section 5.1.1 (Diaphragm Filter)
   The Filter to Drain Match calculation package has been revised and clarified. The revised calculation package is included in Appendix E.
6. Section 5.1.1 (Diaphragm Filter)
   The geotextile has been removed from the design except for at the riprap at the right dam abutment and beneath the riprap at the pipe outlets.
7. Section 5.4 (Emergency Spillway Modifications)
   The text has been changed so that the correct terms are used.
8. Section 5.4 (Emergency Spillway Modifications)
   The text has been changed to match the drawings. The correct bottom width for the channel is 75 feet. The change was made to ensure enough material will be excavated from the channel to build the soil buttresses without importing material.
9. Section 5.4 (Emergency Spillway Modifications)
   The rating curve for the spillway will be presented in the Interim Operational Plan being prepared by the District.
10. Section 5.4 (Emergency Spillway Modifications)
    The hydrology section will be prepared and submitted by the District.
11. Drawing C2
    The cross section sheet locations have been corrected.
12. Drawing C5
    The extra cross section designator has been removed.
13. Drawing D1
    The design has been changed to maintain the minimum thickness of the riprap.
14. Drawings D2, D3, and D4

Geotextile has been removed at that location so will not be shown on the elevation. A note has been added indicating that the filter completely encases the concrete at the pipe coupling. Titles for the control points have been adjusted accordingly.

15. Special Provisions (Specifications)
    Concrete specifications have been included. See Section 725 of the Specifications.
16. Special Provisions (Specifications)
    This sentence has been clarified.
17. Specification
    Content has been added to Section 515.1.2 and Subsection 515.3.
18. Specification
    Bid item references are not necessary on all sections.
19. Construction Quality Assurance Program
    Text has been added to section 6.1.2 of the CQA regarding to this issue.
20. Construction Quality Assurance Program
    comments address Table 1
    a. Testing frequencies have been adjusted. Estimated quantities are presented in Table 2.
    b. This additional requirement has been added.
    c. Frequencies have been changed back to 1/10.
    d. A frequency has been specified and the additional requirement has been added.

NRCS Comments – Reference NRCS letter dated June 12, 2000 (90% submittal). This letter is included in this appendix.

1. Drawing Sheet D6, 16 of 16
   Riprap has been added to the channel bottoms on the South and Central outlets.
2. Page 206-1, Section 206.2, last paragraph
   Required in-place densities will be added.
3. Page 206-2, Section 206.4, 4th paragraph
   ASTM testing method for relative density has been added.
4. Page 211-1, Section 211.1, 6th paragraph
   This paragraph has been revised accordingly.
5. Page 211-3, Section 211.3, 3rd paragraph from top, 1st sentence
   Sentence has been clarified.
6. General comment
   This comment will be addressed in the final submittal.
   100% Final Response - Moisture contents were revised in the special provisions to be consistent with one another.
7. General Comment
   We will consider your recommendation for the final submittal.

   100% Final Response - General Comment – Certification by Registered Professional EngineerWhere applicable to these design drawings, special provisions (specifications), have been prepared in general accordance with NRCS methodologies and standards. However, one example of why we can not certify complete conformance to NRCS, ADWR, and BOR standards is the use of corrugated metal pipe (CMP) for this interim dam safety project, which is not consistent with NRCS standards for longterm earth dam projects.

District Comments – Reference District memo dated July 18, 2000 regarding Special Provisions (90% submittal). This memo is included in this appendix.

Title Page…

Title page was changed as indicated.

Table of Contents…

Page and footer was revised.

First Page of SPs…

Page was revised as indicated.

Text Font…

Font was checked throughout the document.

Bid Item…

Bid items were revised so the special provisions, plans and cost estimate all matched.

Phrase "No Bid Item" was deleted throughout special provisions.

Section 201.4…

Changed wording accordingly.

Section 201.5…

Deleted first paragraph.

Section 202…

Added section as provided.

Section 206.5…

Deleted first paragraph.

Section 225.2…

Deleted contact name and added telephone number.

Section 350.2…

Deleted appropriate sentence.

Subsection 515.2…

Text has been added.

Subsection 515.3…

Subsection was renumbered correctly and spelling was corrected.

525.5…

Spelling was corrected.

530.8.2(C)…

"I" was changed to "1".

621.3…

"I" was changed to "1".

621.3.4…

Sentence was completed.

Page 701-1…

7013.1 was changed to 701.3.1.

701.4.3(B)(1)…

Text was changed as indicated.

760.1…

Text was changed as indicated.

760.3…

Text was changed as indicated.

Page 790-2…

"I" was changed to "1".

District Comments – Reference District memo dated July 20, 2000 regarding Supplementary General Conditions (90% submittal). This memo is included in this appendix.

Title Page

Title Page was changed to match the Special Provisions

Table of Contents

Table of Contents was changed to match the Special Provisions

First Page

The first page was changed to match the Special Provisions

Text Font

Text font was checked throughout the document.

Page 4/52

Subsection was deleted

Pages 10-15

Definitions were revised as indicted.

102.4

Text was added as indicated.

102.5

Section title was revised.

102.5

Underlined text was deleted and replace with text provided.

102.6

Underlined text was deleted and replaced with text provided.

102.7

Item J was replaced with text provided.

102.9

Project name, PCN, and FCD contract numbers were added.

103.3

Underlined text was deleted.

103.6

First sentence was revised as indicated.

103.6.2

The sentence was added as indicated.

104.1.1

The provided text was added.

105.2

Section 105.2.1 was added.

105.1.1

First sentence was revised to include reference to 105.2.1.

106.1

Last sentence was revised as indicated.

106.5

The text was added as indicated.

107.2

Section was deleted and replace with text provided.

Subsection 107.2.1

Section was added as indicated.

Subsection 107.2.2

Section was added as indicated.

107.4

Text was added as indicated.

107.5

Sentence was added as indicated.

107.5.1

Paragraph was revised to describe asbestos situation.

1075.2

Section number was corrected to 107.5.2.

107.5.3 & 107.5.4

Sections were added as indicated.

107.6.3

Section was added as indicated.

107.8

Text was deleted and replaced with text provided.

107.9

Text was added as indicated.

107.10

Text was added as indicated.

108.1

Paragraphs (A) and (B) were deleted and replaced with provided text.

108.4

First paragraph was deleted and replaced with text provided.

109.5.4

Subsection numbers were corrected.

109.7

Text was added as indicated.

109.7 (B)

Text was added as indicated.

DISPOSITION OF COMMENTS ON 95 PERCENT LEVEL SUBMITTAL

ADWR Comments – Reference ADWR letter dated August 14, 2000 (95% submittal). This letter is included in this appendix.

1. Application
   A complete application is included in this report. A separate submittal (letter) related to A.A.C. R12-15-1216 will be provided by the District at the same time as the application is submitted.
2. Section 3.3.2 (Design Information)
   The location of embankment drain fill and coarse aggregate drain appears to have been described correctly.
3. Section 5.4 (Emergency Spillway Modifications)
   The rating curve for the spillway will be presented in the Interim Operational Plan being prepared by the District.
4. Section 5.4 (Emergency Spillway Modifications)
   The hydrology section will be prepared and submitted by the District.
5. Sheets 6, 7 and 8 of 17
   The Sheets 6, 7 and 8 have been revised so the configurations of the concrete aprons on the slopes are consistent with the cross section details.
6. Sheets 6, and 9 of 17
   The Note 2 has been revised to specify a new shotcrete-lined channel.
7. Sheet 9 of 17
   The drawings have been revised so the referenced section corresponds with the design presented.
8. Sheets 9 and 11 of 17
   The drawings have been revised so the section designators for each section are consistent with the referenced section.
9. Sheet 12 of 17
   The Section C has been revised to show the riprap transition between Sections A and B.
10. Sheet 13 of 17
    The Note 2 has been revised to require the pipe to be extended into a new shotcrete.
11. Sheet 17 of 17
    The additional sections have been added to show a riprap section for each outlet on sheet 18.
12. Appendix D (Filter and Crack Investigation)
    The color photographs will be included in the final submittal (separate document) for Filter and Crack Investigation, the version in the appendix will remain black and white.
13. Appendix E (Calculation Packages)
    The Calculation for diaphragm filter and thickness of soil buttress fill was inadvertently omitted from the 95% submittal and has been included in the Appendix E.
14. Section 206.4 of the Special Provisions (Specifications) (Structural Backfill)

Extraneous text referring to bedding has been deleted.

15. Section 210.2 of the Special Provisions (Specifications) (Structural Borrow)
    The text has been revised to clearly state the maximum particle size is 3 inches. The gradation requirement has been revised to provide more detail on the allowable range of particle size for soil buttress fill that is within the calculated filter match design band (see Table 311.2).
16. Section 211.3 of the Special Provisions (Specifications) (Compacting)
    The specifications for compaction remain in Section 211. However, Section 211 has been substantially re-organized and edited to enhance understanding of the various fill materials. Reference to soil buttress fill has been deleted from Section 210.
17. Construction Quality Assurance Plan – Table 1 – filter sand
    Text allowing testing per material and change in material has been inserted into the table.
18. Construction Quality Assurance Plan – Table 1 - subgrade
    The frequency of testing has been increased per comment. The same frequency has been added to laboratory test D 4643.
19. Construction Quality Assurance Plan – Table 1 – soil buttress fill
    Text allowing testing per material and change in material has been inserted into the table. The frequency of testing for D 422 and D 4318 have been increased to one test per 250 cubic yards.

NRCS Comments – Reference ADWR letter dated September 21, 2000 (95% submittal). This letter is included in this appendix.

1. Appendix I, CQAP, page 9 of 29, Section 2.1.1
   The onsite Quality Assurance Engineer will prepare a Construction Completion Report providing certification regarding the completed project in general accordance with ADWR approved project documents and ADWR dam safety requirements. The report will provide such certification with approved design and field changes noted.
2. General Comment – Certification by Registered Professional Engineer
   Where applicable to these design drawings, special provisions (specifications), have been prepared in general accordance with NRCS methodologies and standards. However, one example of why we can not certify complete conformance to NRCS, ADWR, and BOR standards is the use of corrugated metal pipe (CMP) for this interim dam safety project, which is not consistent with NRCS standards for longterm earth dam projects.

Disposition of Comments on 100 Percent Design Report Submittal
Dated February 7, 2001
Based On
ADWR Administrative Review Comments Memorandum
Dated March 1, 2001

Responses to ADWR Comments are as follows:

General Items:

1. Instructions to Checklist – The checklist has been revised to include "Y" or "N/A" responses for all items to indicate applicability. Explanations have been provided for all "N/A" responses. The checklist was submitted to ADWR on May 8, 2001.

2. Fee – The Engineer's Cost Estimate was submitted on May 8, 2001, although the District does not generally reveal the Engineer's Cost Estimate prior to public bid.

3. Two Sets (minimum) of Construction Drawings - The District was initially waiting for possible technical comments that may affect the drawings. However, the District submitted two sets of full size drawing to ADWR on May 8, 2001. In response to other administrative review comments (including technical) the drawings have been revised, denoted by a 04 / 01 date in the revision block.

4. Two Sets (minimum) of the Emergency Action Plan, Operation and Maintenance Plan, and Instrumentation Plan - The District submitted two copies of this plan on May 8, 2001 as prepared by the FCDMC and dated March 19, 2001.

   A copy of the NRCS document entitled State of Arizona, Operation and Maintenance Handbook, dated March 1988 was submitted by the District for ADWR files.

5. Drawings, Specifications, CQA Plan and Design Report Sealed by P.E. - The full size drawings were sealed but not yet submitted to the ADWR. The Design Report cover and table of contents was sealed, however its individual components (appendices) were inadvertently not. However, all the Specifications, CQA Plan,

   Alexander W. Gourlay, P.E. of URS Corp. will stamp the cover and table of contents of the Special Provisions (SPs)(specs), Supplementary General Conditions (SGCs), and Construction Quality Assurance (CQA) Plan contained in Appendices G, H, and I per ADWR comments. Given the drawings have been revised, the new drawing package has been sealed again on April 13, 2001 and two sets will be submitted to ADWR.

Construction Drawings:

6. Spillway and Outlet Works Rating Curves and Tables – This curve was inadvertently omitted and been added to the revised Drawing C1. Reference to Drawing G3 has been deleted.

7. Geologic Information – Appendix C has been modified to include missing geotechnical information that is relevant to the Interim Dam Safety project. Specific section references to the Draft Design Issues Report have been made on the checklist where appropriate. Reference to a new document entitled Geotechnical Data Report has been made where appropriate. Reference to ADWR historical files has been deleted throughout.

8. Foundation Profile – Reference to ADWR historical files has been deleted throughout. The District's response to the applicability was changed from "Y" to "N/A", with an explanation that the profile of the existing dam is not relevant to the Interim Dam Safety project.

9. Drainage Area – A figure showing the drainage area and flood routing was prepared by the District and is enclosed as a stand-alone figure, in addition to being contained within the Emergency and Operation and Maintenance Plan.

Construction Specifications:

10. Control of Stream During Construction – The response to applicability was changed from "Y" to "N/A" and an explanation provided that a plan was not prepared because the scope of work for the Interim Dam Safety project is such that possibility for impact by storm water is minimal.

Design Report:

11. Geotechnical Investigation – Specific section reference was made for the Draft Design Issues Report. Reference to historical ADWR files has been deleted. A new document that has been prepared entitled Geotechnical Data Report was referenced, and will be submitted to ADWR.

12. Dewatering Plan – An explanation for a "N/A" response on the checklist was provided that indicated a plan was not needed for the scope of the Interim Dam Safety project.

13. Materials Information – Appendix C was revised to include complete and pertinent information to the Interim Dam Safety project. A summary table was added to present laboratory test results for samples applicable to the project and this application.

14. Foundation Conditions – Specific sections to the Draft Design Issues Report have been added to the checklist.

Disposition of Comments on 100 Percent Design Report Submittal
Dated February 7, 2001
Based On
ADWR Supplemental Administrative Review Comments Letter
Dated March 15, 2001

FCDMC

White Tanks FRS#3 – Interim Dam Safety Project

Responses to ADWR Comments are as follows:

1. A.A.C. R12-15-1220(C) Requirements – The District will submit a letter requesting a waiver of compliance to the cited requirements that is supported by justification.

2. Design Report (Section 3.3.2) – The description of central filter/drain materials was accurately provided by both Sections 3.3.1 and 3.3.2 of the design report as discussed and clarified during our recent meeting. Therefore, no changes to the text were made.

3. Drawing C2 – The concrete apron was incorrectly drawn, Drawing C2 and C5 has been revised to show the concrete with the correct dimensions.

4. Drawing C3 –

   a. The concrete apron was incorrectly drawn, Drawing C3 and C6 has been revised to show the concrete with the correct dimensions.

   b. Drawing C3 has been revised to show dimensions in plan for the riprap. Drawing D3 has also been revised to show the riprap on Section B-14.

5. Drawing C4 – The concrete apron was incorrectly drawn, Drawing C4 and C7 has been revised to show the concrete with the correct dimensions.

6. Drawing D2 – Drawing D2 showing the section of the diaphragm filter has been revised to include filter sand completely surrounding the concrete collar of the pipe joint. One foot of sand was added overtop the concrete collar to render the filter continuous past the pipe joint. The Revised Diaphragm Filter and Thickness of Soil Buttress calculations are presented in Appendix E Calculation Package No. 14 (which applicable portions supercede Calculation Package No. 3) to verify the minimum soil buttress dimensions are met with the current configuration. The revised calculation shows the current configuration of the soil buttress is okay without changes.

7. Drawing D3 –

   a. Drawing D3 showing the section of the diaphragm filter has been revised to include filter sand completely surrounding the concrete collar of the pipe joint. One foot of sand was added overtop the concrete collar to render the filter continuous past the pipe joint. The Revised Diaphragm Filter and Thickness of Soil Buttress calculations are presented in Appendix E Calculation Package No. 14 (which applicable portions supercede Calculation Package No. 3) to verify the minimum soil buttress dimensions are met with the current configuration. The revised calculation shows the current configuration of the soil buttress is okay without changes.

   b. The section B-14 indicator bar was relocated to the correct location on the revised Drawing D3.

8. Drawing D4 – Drawing D4 showing the section of the diaphragm filter has been revised to include filter sand completely surrounding the concrete collar of the pipe joint. One foot of sand was added overtop the concrete collar to render the filter continuous past the pipe joint. The Revised Diaphragm Filter and Thickness of Soil Buttress calculations are presented in Appendix E Calculation Package No. 14 (which applicable portions supercede Calculation Package No. 3) to verify the minimum soil buttress dimensions are met with the current configuration. The revised calculation shows the current configuration of the soil buttress is okay without changes.

9. Appendix D – Two copies of color photos for the Filter and Crack Investigation report are enclosed.

10. Appendix E – See below for specific comments and responses.

11. Appendix F – The December 1999 Survey was a compilation of raw survey data collected for multiple District purposes. Only a fraction of the survey data was relevant to the Interim Dam Safety project. Other survey work was conducted by the District for the original Dam Modifications project no longer being pursued, and the Basins Alternatives project ongoing concurrent to the Interim Dam Safety project. To remedy the confusion of relevant survey data, the District has omitted the December 1999 Survey information from the application and suggest that the drawings for construction of the Interim Dam Safety project and figure showing location of borings that are contained in the Design Report depict relevant survey data and stand alone. Relevant survey data associated with the lowest point on the dam crest was added to Drawing G3. This survey point was used in the spillway notch calculation.

a. The December 1999 survey consisted of specific scopes of work and is considered only partial.
b. Not relevant to the Interim Dam Safety project.
c. Not relevant to the Interim Dam Safety project.
d. Not relevant to the Interim Dam Safety project.
e. Not relevant to the Interim Dam Safety project.
f. Not relevant to the Interim Dam Safety project.
g. Not relevant to the Interim Dam Safety project.
h. Not relevant to the Interim Dam Safety project.

NOTE: For ADWR's information, separate from the Interim Dam Safety project and this application submittal, the District has recently conducted a survey of the monuments for the FRS#3 dam and is currently performing data compilation and comparisons. The District will provide ADWR with this data when it is available.

12. Specification Subsection Section 206.2 (Foundation Material Treatment) – Sections 206 and 211 of the Special Provision (specs) have been revised to include language that allows for sampling of foundation material and pre-approval of the foundation (before fill placement) as it relates to the gradation requirements of the filter match calculations contained in Appendix E (Calculation Package No. 7). Sections 206 provide for a possible change in scope to over-excavate and replace with pre-approved soil buttress fill. Drawing Nos. D2, D3, and D4 have been revised to add a note indicating sampling and pre-approval requirements.

The response and corresponding action for the comment regarding filter match between the foundation and the drain materials is the same as the filter match comment presented in 13.a for the filter match between the soil buttress fill and drain materials, As such, a geotextile filter fabric has been re-introduced into the design as a continuous wrap around the drain sand. Over-excavation of foundation material beneath the drain sand will not be required because the geotextile is being used.

13. Specification Subsection 211.1.2 (Soil Buttress Fill) –

a. In response to concerns regarding a filter match between the soil buttress fill and the drain sand, a geotextile filter fabric has been re-introduced into the design as a continuous wrap around the drain sand. Calculation Package No. 15 entitled Geotextile Around Drain Sand Material has been performed to demonstrate a filter match with the Soil Buttress material, which is enclosed as part. The gradation requirements for the soil buttress fill remain unchanged.

b. Section 210 of the Special Provisions already indicated blending may be required, Section 211 was also modified to re-iterate the requirement of pre-approval and the need for blending to achieve the gradation. These sections indicate that the Contractor is responsible for meeting the gradation requirements for soil buttress fill and screening and/or blending is referenced as one possible way to achieve such requirements.

c. The reference in Section 211.1.2 to a plasticity index (PI) value was revised to read less than or equal to 10.

14. CQA Plan (Table 1) – The column for drain sand was revised on Table 1 to indicate equivalent laboratory and field testing requirements as that of diaphragm filter sand.

VERBAL COMMENTS DURING REVIEW MEETING
DATED March 27, 2001

Responses to ADWR Comments are as follows:

1. Concrete Encasement – The drawings currently show diaphragm filter sand fill being placed around the haunches of the existing CMP pipe upstream of the concrete collar (pipe joint). Based on the rationale being used for the concrete encasement downstream of the collar, ADWR would like concrete encasement / backfill under the existing pipe also. Therefore, Note 4 has been added to Drawings D2, D3, and D4 requiring the Contractor to limit excavation to expose the existing pipe and concrete backfill be placed against the soil face up to the pipe springline. In addition, Section 206 of the Special Provisions have been revised to include requirements for the Contractor to conduct minimal, methodical neat excavation cuts to expose the pipe.

2. Filter Drain – The design for the drain sand for capacity is no longer allowed to be based on "nominal" capacity, but must meet the capacity requirements of TR-60, Soil Mechanics No. 1 (replaced by Part 650, Chapter 6), and associated referenced contained theirin as supported by calculations. Based on these calculations a drain pipe was added as an intergral component to the filter drain to supplement the flow capacity through the drain sand in lieu of changing the drain material gradation or dramatically changing the cross sectional area. A total of three (3) calculation packages were conducted to satisfy this requirement. Therefore, Calculation Package Nos. 160, 17, and 18 are enclosed as part of this response to comments and are to be considered supplemental to the design report and application.

Disposition of Comments on 100 Percent Design Report Submittal Dated February 7, 2001 and April 13, 2001 Revised Drawing Set Based On ADWR Approval of Application for Alteration Dated June 21, 2001

Response to comments / conditions of approval of the application are as follows:

Condition 1 – District is currently receiving bids and intends to comply by completing the work within one year.

Condition 2 – District will notify ADWR of sequence and schedule of field activities.

Condition 3 – Agree.

Condition 4 – The submission of this updated Design Report incorporating comments since the February 7, 2001 submittal satisfies this condition.

Condition 5 – Appendix E contains a new calculation package titled "Structural Assessment of Trash Racks". The calculation shows that the trash racks as currently designed are adequate for the purpose of Interim Dam Safety, satisfying this condition.

VERBAL COMMENTS DURING REVIEW MEETING
June 2001

1. Assess the capacity of the diaphragm filter and drain material and add a pipe if necessary.

   A calculation for capacity has been added to Appendix E showing drain pipes were necessary. Therefore, two additional calculations were also added to Appendix E for structural assessment of the pipe under soil load, and geotextile fabric filter match calculation.

2. Renumber the construction notes on Drawing Nos. 13, 14, and 15.

   Completed. Renumbered to be 1 through 8.

3. Revise the soil buttress fill gradation requirements.

   The gradation for the soil buttress fill material was revised that meets the filter match for the appropriate adjacent materials and achievable from the spillway notch borrow excavation after blending, mixing, or screening.

Summary of Drawing Revisions in April 13, 2001 Drawing Set
(From the 100% Submittal February 7, 2001)

Note: Two sets of full-sized, revised drawings were submitted to ADWR on May 8, 2001. Each of the 18 drawings discussed below have been updated to show a revision number dated 04/01.

Drawing No.	Sheet No.	Response
G1	1 of 18	- Revise chairpersons name.
G2	2 of 18	- Revised to added the word invert on the elevation of three control points.
G3	3 o f 18	- Revised to show the relevant survey data corresponding to the lowest point on the dam crest used in the spillway notch calculations.
Q1	4 of 18	- Revised to reflect the minor increases in quantities associated with filter sand, concrete, and geotextile. - Line items for 8-inch and 4-inch corrugated perforated drain pipe with geotextile sock has also been added.
C1	5 of 18	- Revised to add an emergency spillway discharge rating curve.
C2	6 of 18	- Revised with correct depiction of concrete apron.
		C3 7 of 18 - Revised with correct depiction of concrete apron and dimensions added to riprap at outlet of pipe.
C4	8 of 18	- Revised with correct depiction of concrete apron and dimensions added to riprap at outlet of pipe.
C5	9 of 18	- Revised to show extended breakpoint of filter sand. New critical control point "D" of filter sand added. - Plan layout of drain pipes added. - Detail 2-18 callout added.

Summary of Drawing Revisions in April 13, 2001 Drawing Set

(Page 2)

Drawing No.	Sheet No.	Response
C6	10 of 18	- Revised to show extended breakpoint of filter sand. - New critical control point "D" of filter sand added. - Plan layout of drain pipes added. - Detail 2-18 callout added.
C7	11 of 18	- Revised to show extended breakpoint of filter sand. - New critical control point "D" of filter sand added. - Plan layout of drain pipes added. - Detail 2-18 callout added.
D1	12 of 18	- Revised section B-13 depicting sand over top of the concrete collar encasement at the pipe joint. - Critical control point "D" added to the filter sand. - Note No. 3 added for foundation acceptance procedure. - Note No. 4 added to request Contractor to minimize excavation to expose existing outlet pipe in preparation of joining new pipe extension. - Note No. 4 added to describe drain pipe with geotextile sock.
D2	13 of 18	- Section B-13 revised to show filter sand over top and on sides of concrete collar encasement. - Elevation view of North Outlet revised to show location dimensions of drain pipe.

Summary of Drawing Revisions in April 13, 2001 Drawing Set

(Page 3)

Drawing No.	Sheet No.	Response
D3	14 of 18	- Revised section B-13 depicting sand over top of the concrete collar encasement at the pipe joint. - Critical control point "D" added to the filter sand. Note No. 3 added for foundation acceptance procedure. - Note No. 4 added to request Contractor to minimize excavation to expose existing outlet pipe in preparation of joining new pipe extension. - Note No. 4 added to describe drain pipe with geotextile sock. - Section B-13 revised to show filter sand over top and on sides of concrete collar encasement. - elevation view of North Outlet revised to show location dimensions of drain pipe.
D4	15 of 18	- Revised section B-13 depicting sand over top of the concrete collar encasement at the pipe joint. - Critical control point "D" added to the filter sand. - Note No. 3 added for foundation acceptance procedure. - Note No. 4 added to request Contractor to minimize excavation to expose existing outlet pipe in preparation of joining new pipe extension. - Note No. 4 added to describe drain pipe with geotextile sock. - Section B-13 revised to show filter sand over top and on sides of concrete collar encasement. - Elevation view of North Outlet revised to show location dimensions of drain pipe.
D5	16 of 18	- No technical changes.

Summary of Drawing Revisions in April 13, 2001 Drawing Set

(Page 4)

Drawing No.	Sheet No.	Response
D6	17 of 18	- No technical changes.
D7	18 of 18	- Revised Drawing No. from D6 to D7 - Revised Section B-18 to add riprap and dimension. - Added Detail 1-18 showing drain pipe with rodent screen (side view and front view) - Added Detail 2-18 showing drain pipe end cap (side view)

USDA

United States
Department of
Agriculture

Natural
Resources
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3003 N. Central Ave.
Suite 800
Phoenix, AZ
85012-2945

January 24, 2000

FLOOD CONTROL DISTRICT
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REMARKS

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

Subject: White Tanks FRS #3 Dam
Interim Dam Safety Measures (30% Submittal)

Dear Mr. Renckly:

The USDA, Natural Resources Conservation Service (NRCS) has reviewed the 30% submittal package prepared by Dames and Moore entitled, "Report Interim Dam Safety White Tanks FRS #3", dated January 10, 2000, for the proposed interim dam safety measures and has the following comments:

1. Section 2.1.2, Past Observed Problems, Cracks and Subsidence: This section mentioned a work plan currently under review to investigate the cracks. It is recommend that the findings and recommendations addressed in NRCS Geologist Bob Rasely's report entitled "Engineering Geologic Observations on White Tanks #3 Flood Control Structure, Maricopa County, Arizona", dated December 9, 1999, be reviewed by Dames and Moore. The recommendations should be used in the investigation and the determination of interim measures to resolve the cracking occurrences on the upstream toes of the embankments. I have attached a copy of this report for your reference.

2. Section 3.0, Filter Investigation: It is reported that a sieve analysis was performed on samples taken from each of the three borings. The gradation analysis is given in Appendix A. No gradation of the base-material or the embankment material was taken and analyzed. It is recommended that soil testing be performed on the base material to provide a gradation curve, which will be compared to the filter material gradation and evaluated to determine if the filter material is adequate to hold back fines of the base soils.

3. Section 4.1.1.2, Geotextile Filter: It is recommended that criteria or standards used for the design of this alternative be referenced. This alternative is neither mentioned nor covered in the NRCS TR-60.

4. Section 4.1.2, Outlet Pipe Extension, 2nd paragraph, 2nd sentence needs to be reworded. CMP shall be installed according to project specifications. The filter around the pipes is a safety measure against internal erosion and not to replace poor construction.

5. Section 4.2, Trash Racks: It is recommended that the trash rack being proposed meet NRCS TR-60 requirements. A copy of requirements is attached for your reference.

6. Section 4.4 (Emergency Spillway Modifications): How does the proposed channel alignment affect the existing fence-line and access gate? This can be shown by providing the existing and proposed fence-lines on plan sheets and the typical fence (chainlink) details on drawings. The proposed extended fence work around the outlet pipes should also be indicated.

7. Drawing Sheet 1: Missing north arrow.

Thank you for providing us the opportunity to review and comment on this project. If you have any questions, please contact Mr. Peter Bautista at (602) 280-8838 or myself at (602) 280-8839.

Sincerely,

Noller Herbert, P.E.
State Conservation Engineer

Enclosure

cc: w/ enclosure
Peter Bautista, SDE, NRCS, Phoenix, AZ

USDA, NATURAL RESOURCES CONSERVATION SERVICE
PHOENIX, ARIZONA

TO: Noller Herbert
State Conservation Engineer
NRCS, Phoenix, AZ

December 9, 1999

Subject: Engineering Geologic Observations on White Tanks #3 Flood Control Structure, Maricopa County, Arizona

BACKGROUND: In December 6-10, 1999, I participated in instructing a SITES training class in NRCS, Phoenix, AZ. White Tanks #3 earth embankment was used as a training example. Field trips to the site were conducted on December 6 and 7 with AZ-NRCS personnel and AZ State personnel. I reviewed several planning and engineering reports. The following observations and recommendations were discussed with the training participants,

FIELD OBSERVATIONS IN THE AREA OF THE SPILLWAY: The undisturbed natural surface materials at the site are a mix of fine grained material and coarse material up to 9" in diameter. The auxiliary spillway is located in an area that is covered by a less than 1 foot thick mantel of coarse material that covers more that 60% of the surface.

There are 8-10 foot deep trenches to the southwest of the spillway that expose the character of the material beneath the spillway. There are also materials exposed in the south wall of the spillway. It appears that there are alternating layers of 3-4 feet thick fine material and coarse unsorted material. The coarse material is abundant and scattered throughout the 3-4 foot thick layers. Most large fragments are angular to subangular and "floated" (surrounded) by sands and fines. The control section of the spillway is capped by a lag deposit of these gravels and cobbles. They form an armored layer that protects the spillway from erosion. These type of deposits are indicative of DEBRIS FLOW DEPOSITS.

The armor layer is generally less that 1 foot thick. Therefore, the control section of the spillway is sensitive to disturbance by vehicles and grazing animals. Any pathway slightly oriented to the flow path of the spillway will allow erosion to occur during storm flows. There are at least three separate debris flows piled on top of each other in the area. They range from geologically ancient to recent. An estimate of the ages is given in the Dames and Moore Draft Report (1998). The degree of rounding and disintegration of the cobbles and gravels in an indication of age. Also one of the flows has the inclusion of schist rock in it which indicates that the flows could come from differing portions of the upper watershed.

A general estimate of the timing of these flows in a granitic watershed is between 10,000 and 20,000 years. This is the amount of time it takes to rot more granite and pile sediment in the upper watershed in order to generate another debris flow from the same area. Evidence shows that debris flows can come from different areas of the

upper watershed so the "RETURN INTERVAL" debris flow events could be considerably shorter.

Down stream of the control section of the spillway are the deposits that represent the end of the debris flows. These are finger-like extensions of gravel deposits that protect the underlying layers from erosion. These fingers of gravel, shed precipitation on to the adjacent fine grained material and cause it to erode. This area is slightly dissected on a scale of less than 5 vertical feet of differential erosion. Gullies and head cuts are possible in this area if the spillway flows.

It should be noted that since 1954 the spillway has not flowed. The debris flow deposits are essentially undisturbed by erosion. After a major debris flow occurred, the upper watershed would be hydrologically altered to yield cleaner, high velocity flows for a few years. Considering the age of these deposits, it is very possible these conditions were present at various times. This indicates that high energy storm flows (comparable to PMP etc.) have probably impacted the area in the recent geologic past. The relatively undisturbed nature of the flows indicates that they are stable and erosion resistant in high energy hydrological events.

RECOMMENDATIONS: The natural stability of the spillway should be further investigated. There is a need for gradation analysis of the top foot of material in the control section. All of the previous sampling and investigation have been for the purposes of embankment construction and characterization of borrow areas. These samples and data are not adequate for spillway evaluation. Sampling needs to be done for stability analysis using SITES and other procedures.

Additional investigations should be conducted to obtain engineering characterization of the surface and shallow subsurface conditions in the auxiliary spillway area. The following additional investigations are recommended:

1 – Sampling of the upper foot materials of the control section should be accomplished with gradation, hydrometer and atterberg analysis.

2 – Sampling of the upper few feet of materials in the down stream outlet areas. This should include coarse materials and fine grained deposits.

3 – It is recommended that trenching be done in the entire spillway area. This should include a trench perpendicular to flow in the control section to characterize the depth of the coarse surface materials and the sediments to a depth of about 6-7 feet. Some trenches should be taken in the down stream outlet section to characterize the surface and shallow materials.

4 – The trenches should be logged, geologic material cross sections should be made and complete photographic documentation should be made of the trenches and the surface of the control area.

5 - Timely survey data will be needed for location of trenches and construction of topographic cross sections of the trench site (elevation and establishing stationing for logging purposes). An embankment crest line survey (accuracy to 0.1 foot) is recommended to see is there is any deflection of the crest line related to the upstream depressions.

This investigation could take about 3 weeks on site counting literature-map work, travel, and field time and a week for report time = ~ 3 weeks (1.5 weeks on site and 1.5 weeks in Utah). There will be an estimated 3 days of backhoe time at about $80/hour (?) = ~$750. This work will also entail SML analyses. Weather is not a factor for this investigation unless it rains for all the field days.

FIELD OBSERVATIONS IN THE POOL AREA: Two major depression areas were observed in the pool area in the immediate upstream toe area of the embankment. The northern one is located between stations 20+00 and 31+00 with the deepest portion between stations 27+00 and 30+00 and the southern one is located between stations 47+00 and 64+00 and has its deepest portion between stations 53+00 and 62+00.

These depressions were identified as former borrow areas used to construct the embankment. The depressions are characterized by being topographic low area and by ring-like zones of vegetation with the greenest and tallest plants in the lowest area. These areas hold water for a considerable time during the year. The depressions are around 6-7 feet deep.

The depressions have no outlet that could drain them. The constructed outlets of the embankment are above the grade of the depressions and located in areas between the depressions. The southern depression appears to have a channel leading to it from the upper watershed area. This means that at least one of the depressions receives watershed storm flows. The northern depression at least receives local drainage and may receive watershed drainage.

LITERATURE DATA ON DEPRESSIONS: These depressions are mentioned in various engineering and geologic reports. They note that water is being retained in these area. The Waddell, Arizona, USGS 7.5" topographic map has blue color in the bottom of the northern depression. This is significant because the USGS does intense editing of map revisions to insure accuracy. This means that there is more or less a nearly annual presence of water in the northern depression.

Dames and Moore Draft Report (1998) cites that the depressions should be considered collapse features (pg. 2-6). Serious cracks were noted on pages 2-5 and 3-3. Pages 2-5 to 2-11 are pertinent to understanding the depressions and cracks. This report does not directly associate the intense cracking locations with the depressions but it gives detailed data that enables an interpretation that the intense cracking areas do directly relate to the location of the depressions.

The following locations of intense cracking were found in various report from 1979 to present and the depression locations were measured from a Fugro map (1979):

Intense cracking locations	Depression locations (Deepest area)
25+36 to 29+00	27+00 to 30+00
55+47 to 59+55	53+00 to 62+00

This relationship supports the interpretation that the depression locations are directly related to the location of the most intense cracking.

Field observation and map analysis (see attached map for debris flow outlined locations) lead to the conclusion that the embankment is constructed on the lower portion of an ancient debris flow complex. The character of the debris flow material is visible in the south wall of the auxiliary spillway and was viewed by the field trip participants. Debris flows consist of all sizes of material ranging from silts and clays to cobbles. The coarse materials are deposited in a density flow and are surrounded by fine grade material. This deposit occurs rapidly and in a short period of time. The materials are not sorted and are deposited in a water poor environment. This results in the material having significant voids with the coarse materials "floated" in a matrix of fines. Debris flow deposits are often low in density and prone to collapse when wetted. The voids conduct water into the deposit and this process moves fine grained materials throughout the deposit. Debris flow deposits can undergo collapse when wetted. This process is called HYDROCOMPACTION.

It is hereby interpreted that the depressions be considered sinkholes. It should be noted that the sinkholes are former borrow areas, therefore, not all of the total depth of the depression can be considered related to hydrocompaction. There are many documented cases of dams in Utah experiencing hydrocompaction sinkholes and undergoing repairs to account for the problem. The association of intense cracking with the depressions should be considered a sinkhole hazard at the site.

It was noted in Dames and Moore Draft Report (pg. 4-11, 1998), that NRCS has allowed flood basin water to be dissipated by infiltration in lieu of direct outlet drainage of that water. The incidental and intentional storage of water at the upstream toe of the embankment is contributing to the intense character of cracking experienced at this site. WNTC-SCS trip reports note that the cracking at this site is of special significance due to the number, great depth and length of the cracking. It is proposed that the special nature of the cracking at this site is due to the combination of the regional surface collapse induced by extreme aquifer draw down and soil collapse associated with the ponding of water in the old borrow area depressions near the upstream toe of the structure.

SINKHOLE HAZARD RECOMMENDATIONS: Nothing can be done to stop the regional aquifer induced collapse at this site. Measures can be taken to maintain the

level surface of the embankment. The sinkhole hazard can be mitigated by the following measures:
1 - filling the former borrow areas to allow for positive drainage,
2 - maintaining positive drainage through the pool area near the embankment and do not allow long term storage of water near the embankment,
3 – if water storage and dissipation by evaporation is desired at the site, then it is recommended that storage occur outside at least 500 feet from the upstream toe of the embankment (500 is an arbitrary but safe distance),
4 – debris flow collapse rates have been measured in Utah from 1% to 5%, considering the age and depth of the deposits at the site, a value of 3% collapse potential is appropriate. This could result in about 3-6 feet minimal collapse potential for this site.

It is not recommended that the collapse potential be investigated. The collapse hazard can be avoided by not ponding water near the embankment, therefore characterization of the hazard is not necessary.

SEDIMENT CONSIDERATIONS: The need for sediment delivery volume calculations should be considered. This data would help determine if new debris flows are possible in the future and allow for basin volume vs sedimentation volume comparisons. This sedimentation evaluation should include the following:
1 - an annual rate of delivery,
2 - total delivery volume over the remaining life of the structure,
3 – debris flow potential for an event during the remaining life of the structure (mountain watershed reconnaissance for the degree of filling of valleys and estimation of the volume of sediment available for debris flow transport + photo documentation),
4 – Estimate of the volume of the potential debris flow in the future by evaluation of upper watershed sediment volumes and the historic flow volumes – purely an estimation process.

This evaluation could take about 2 weeks counting literature-map work, travel, field time and report time (1 week on site and 1 week in Utah). Snow cover is not allowed for the purposes of this evaluation.

If there are any questions regarding this report or clarifications are needed, please call me (801-524-4563). I appreciate the enthusiasm and support your people gave me during the training and evaluation.

ROBERT C. RASELY
Geologist, NRCS-UT

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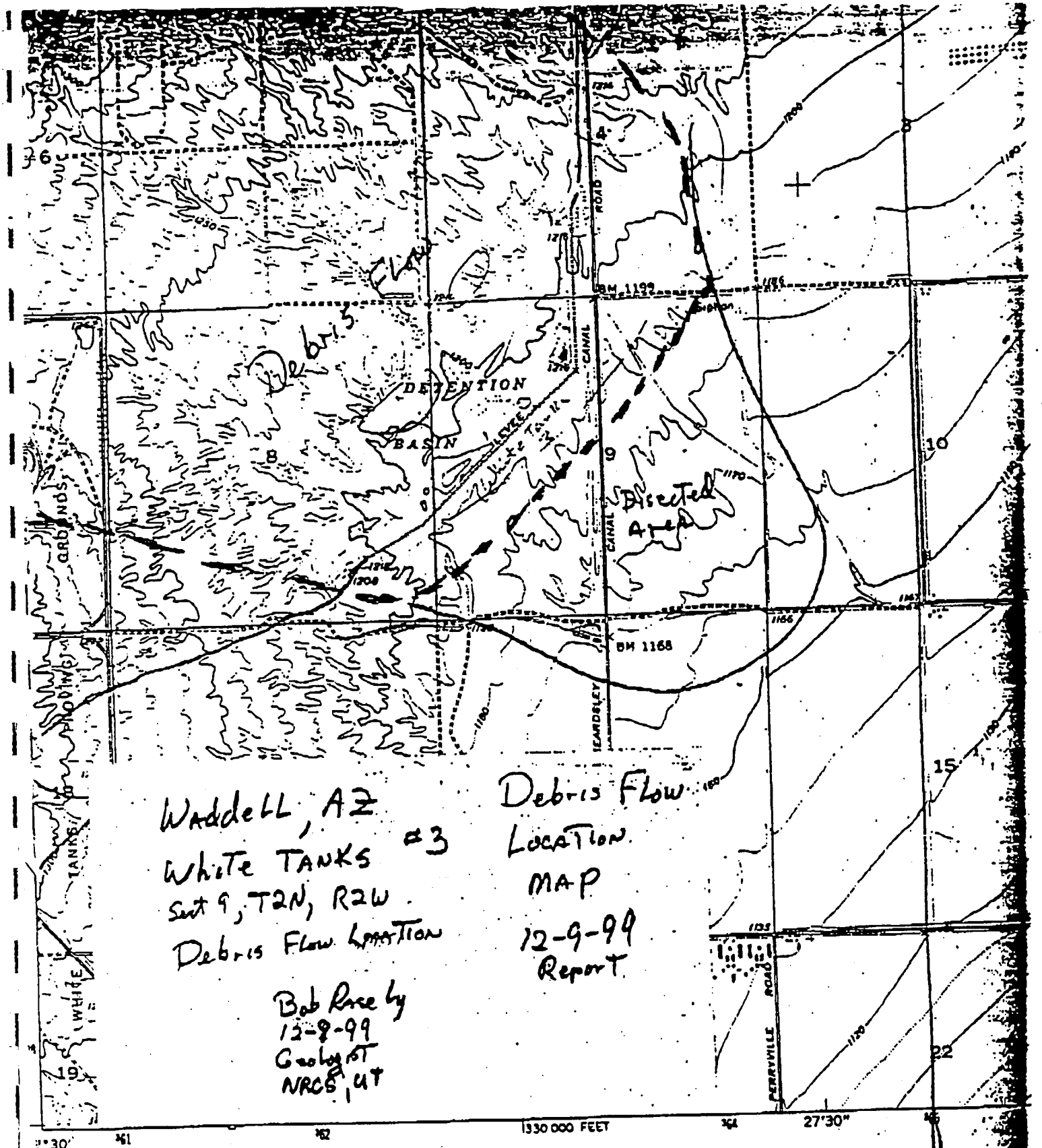

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Topography from aerial photographs by photogrammetric methods and by planetable surveys 1957. Aerial photographs taken 1954

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usually require the use of footings, keywalls and counterforts and drainage is properly located immediately downstream of these features. This drainage when properly designed can control piping and provide significant economics due to the effect on soil loads, uplift pressures, overturning forces and sliding stability.

Outlets

The choice of outlet is to be based on a careful consideration of all site and flow conditions that may affect operation and energy dissipation.

1. Cantilever outlet and plunge pools may be installed where their use:

   a. Does not create a piping hazard in the foundation of the structure.

   b. Is compatible with other conditions at the site.

   Plunge pools are to be designed to dissipate the energy and be stable. Unless the pool is to be in bedrock or very erosion resistant materials, riprap will be necessary to insure stability. Design Note 6, entitled, "Armored Scour Hole for Cantilever Outlet", is to be used for design.

   Cantilever outlets are to be supported on bents or piers and are to extend a minimum of 8 feet beyond the bents or piers. The bents are to be located downstream from the intersection of the downstream slope of the earth embankment with the grade line of the channel below the dam. They are to extend below the lowest elevation anticipated in the plunge pool. The invert of the cantilever outlet is to be at least 1 foot about the tailwater elevation at maximum discharge.

2. SAF basins may be used when there is adequate control of tailwater. Use TR-54 for structural design and NEH-14 for hydraulic design.

3. Impact basins may be used when positive measures are taken to prevent large debris from entering the conduit. TR-49 is to be used for hydraulic design.

Trash Racks

Trash racks are to be designed to provide positive protection against clogging of the spillway under any operating level. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

If a reservoir outlet with a trash rack or a ported concrete riser is used to keep the sediment pool drained the trash rack or riser is to extend above the anticipated sediment elevation at the riser to provide

for full design flow through the outlet during the design life of the dam. The velocity through the net area of the trash rack above the maximum sediment elevation must not exceed 2 feet per second when the water surface in the reservoir is 5 feet above the top of the trash rack or riser inlet.

Antivortex Device

All closed conduit spillways designed for pressure flow are to have adequate antivortex devices.

High Sulfate Areas

Under certain conditions concrete is susceptible to deterioration from sulfate ions, especially those derived from sodium and magnesium sulfates. In areas where experience or soil tests indicate the potential for problems, the following table will be used for design purposes:

Sulfate Concentration [1/] (parts per million)	Hazard	Corrective Measures
0 - 150	Low	None
150 - 1,000	Moderate	Use Type II Cement. (ASTM C-150). Adjust mix to protect against sulfate action.
1,000 - 2,000	High	Use Type V Cement (ASTM C-150). Adjust mix to protect against sulfate action. Use soils in contact with concrete surfaces that are low in sulfates.
2,000 - up		Do not use concrete materials unless measures are taken to protect concrete surfaces from sulfates. Product manufacturers should be consulted.

[1/] Sulfate concentration is for soil water at the concrete surface.

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

3003 N. Central Ave.
Suite 800
Phoenix, AZ 85012

February 29, 2000

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

Subject: White Tanks FRS #3 Dam
Interim Dam Safety Measures (60% Submittal)

Dear Mr. Renckly:

The USDA, Natural Resources Conservation Service (NRCS) has reviewed the 60% submittal package, prepared by Dames and Moore, entitled "Report Interim Dam Safety, White Tanks FRS #3", dated February 10, 2000, for the proposed interim dam safety measures and has the following comments:

1. Our 30 % submittal review comments were not mentioned or addressed. Recommend that the review comments be addressed in the 90% submittal.

2. Page 1-1, change "National Resources Conservation Services" to read "Natural Resources Conservation Service (NRCS)."

3. Page 4-1 and throughout the document, Technical Release (TR) Notice 60C, dated April 6, 1984 was replaced with TR-60, dated October 1985. Enclosed is the latest copy for your reference.

4. Appendix B, Diaphragm Filter Gradation: Particle size analysis shows at least 1-2 percent gravel present. Why was the base soil material not regraded as required in step 2 of Section 633.2603?

5. Appendix B, Diaphragm Filter Gradation: Permeability criteria are based on $4xd_{15}$ of the base soil before regrading, but not less than 0.1mm. The 0.75-mm size used to calculate the minimum D_{15} represents d_{50} of the base soil. There is insufficient data in the particle size analysis to obtain d_{15} of the base soil.

6. Appendix B, Diaphragm Filter Gradation: Width of the allowable filter design band should be reexamined because of comment 5 above.

7. Section 4.1, Diaphragm Filters and Pipe Outlet Extensions: The drawing (sheet 9 of 12) details the diaphragm filters and a blanket drain (bedding sand), 2 feet thick, extending from the trench to the toe of the embankment. Computations in Appendix B, regarding the diaphragm filters, show that only dimensions and fill requirements were performed. The diaphragm drain analysis was not performed for the drain outlet given.

8. Sp page 8 of 39: Need to specify how moisture content will be controled during placement, how the drainfill will be compacted, how the drainfill will be

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To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

placed to avoid segregation of particle size and if the drainfill will be tested in-place. Attached are NRCS construction and material specifications that might be helpful.

9. Sp page 12 of 39: Moisture range from optimum to plus 3 percent of optimum appears to be too wet. How do we know if the compaction curves are still to the left of the zero air voids line?

10. Sp page 19 of 39: The specification for the geotextile filter fabric needs elaboration. Attached are NRCS construction and material specifications that might be helpful.

11. Drawing sheet 8 of 12, Section A-8, Channel Section: Why are the two berms on the sides of the low flow channel? It seems that these berms would obstruct the spillway flow.

Thank you for providing us the opportunity to review and comment on this project. If you have any questions, please contact Mr. Peter Bautista at (602) 280-8838 or myself at (602) 280-8839.

Sincerely,

Noller Herbert, P.E.
State Conservation Engineer

Enclosure

cc: w/o enclosure
Peter Bautista, State Design Engineer, NRCS, Phoenix, Arizona

USDA

June 12, 2000

nited States
epartment of
Agriculture

atural
esources
Conservation
Service

)03 N. Central Ave.
Suite 800
Phoenix, AZ 85012

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

Subject: White Tanks FRS #3 Dam
Interim Dam Safety Measures (90% Submittal)

Dear Mr. Renckly:

The USDA, Natural Resources Conservation Service (NRCS) has reviewed the 90% submittal package prepared by URS, Dames and Moore entitled, "Draft Report Interim Dam Safety, White Tanks FRS #3", dated May 26, 2000, for the proposed interim dam safety measures and has the following comments:

D-6 16/16 ?

1. Drawing Sheet D1. Section C-16, Typical Riprap End Section. Why was the rock riprap not considered on the existing channel bottom? The velocities exiting the pipes will be erosive and could headcut or undermine the riprap and the pipe.

2. Page 206-1. Section 206.2, last paragraph. Required in-place densities are not given or stated for the foundation material to be obtained. If the moisture content of existing soils (subgrade) is maintained between optimum and optimum plus 3 percent moisture, there will be some pumping. With what density are we dealing?

3. Page 206-2. Section 206.4, 4th paragraph. The ASTM testing method for relative density needs to be mentioned.

4. Page 211-1, Section 211.1, 6th paragraph. Where do we need the grading of the diaphragm filter to be tested? At the plant, site, or in-place?

5. Page 211-3. Section 211.3. 3rd paragraph from top. 1st sentence. Clarify the intent.

6. General comment: The moisture contents and in-place density requirements are different for the foundation material, structure backfill, and fill construction. Why were these recommendations made? The designer should provide an explanation in the report.

7. General comment: There were different criteria (NRCS, ADWR and BOR) used for the Interim Dam Repair. I would like to recommend to you that the final submittal be stamped by the lead engineer and that engineer "certify to the best of his/her professional knowledge, judgement and belief, these plans meet applicable NRCS, ADWR and BOR standards".

Thank you for providing us the opportunity to review and comment on this project. If you have any questions, please contact Mr. Peter Bautista at (602) 280-8838 or myself at (602) 280-8839.

Sincerely,

NOLLER HERBERT, P.E.
State Conservation Engineer

cc:
Peter Bautista, State Design Engineer, NRCS, Phoenix, AZ

USDA NRCS

Natural Resources Conservation Service

Arizona State Headquarters
3003 N. Central Ave.
Suite 800
Phoenix, AZ
85012-2945
Phone: (602)280-8801
Fax: (602)280-8795

Fax

To: Kevin Somesville

From: Water Resources Staff

Fax: 602.861.7431

Pages: 2

Phone: 602.371.1110

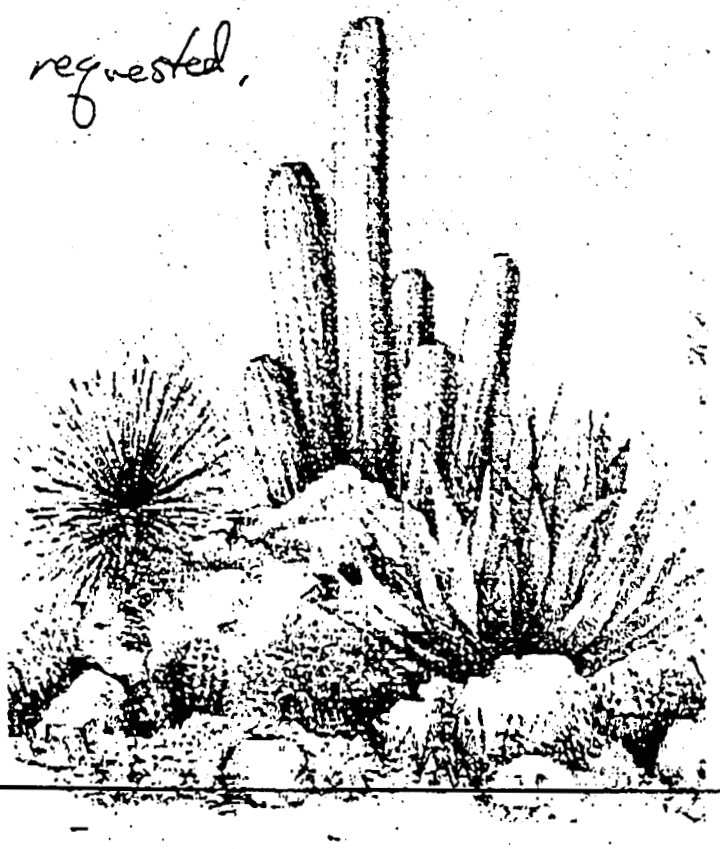
Date: 10-17-00

Re:

CC:

☐ Urgent ☒ For Review ☐ Please Comment ☐ Please Reply ☐ Please Recycle

As requested,



USDA

United States
Department of
Agriculture

Natural
Resources
Conservation
Service

3003 N. Central Ave.
Suite 800
Phoenix, AZ
85012

September 21, 2000

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

Subject: White Tanks FRS #3 Dam
Interim Dam Safety Measures (95% Submittal)

Dear Mr. Renckly:

The USDA-Natural Resources Conservation Service (NRCS) has reviewed the 95% submittal package prepared by URS/Dames and Moore entitled, "Draft Report Interim Dam Safety, White Tanks FRS #3", dated July 28, 2000, for the proposed interim dam safety measures and has the following comments:

1. Appendix I, CQAP, page 9 of 29, Section 2.1.1: Add to the CQA Director's list of responsibilities "shall certify to the Owner that all work installed or performed meets plans and specifications".

2. General comment: Criteria from NRCS, ADWR and BOR were used for the design of the Interim Dam Repair. It is highly recommended that a registered, professional engineer licensed in Arizona stamps the final submittals (design report, drawings, design calculations, test results and specifications). The engineer would "certify to the best of his/her professional knowledge, judgement, and belief, these plans and specifications meet applicable NRCS, ADWR and BOR standards".

Thank you for providing us the opportunity to review and comment on this project. If you have any questions, please contact Mr. Peter Bautista at (602) 280-8838 or myself at (602) 280-8839.

Sincerely,

NOLLER HERBERT, P.E.
State Conservation Engineer

CC:
Peter Bautista, State Design Engineer, NRCS, Phoenix, AZ

The Natural Resources Conservation Service works hand-in-hand with the American people to conserve natural resources on private lands.

AN EQUAL OPPORTUNITY PROVIDER AND EMPLOYER

ARIZONA DEPARTMENT OF WATER RESOURCES
Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004
Telephone (602) 417-2445
Fax (602) 417-2423

December 16, 1999

JANE DEE HULL
Governor

RITA P. PEARSON
Director

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

Subject: **White Tanks FRS #3 Dam (07.28)**
Interim Dam Safety Measures (10% Submittal)

Dear Mr. Renckly:

The Arizona Department of Water Resources (Department) has evaluated and provides comments regarding the Flood Control District of Maricopa County's (FCDMC) proposed interim dam safety measures as detailed in the Dames & Moore report titled "Report, Interim Dam Safety, 10% Submittal, White Tanks FRS #3" dated November 22, 1999.

1. Section 3.0 (Filter Investigation) – This section only states that filter material was found in all three borings drilled at Stations 57+30, 58+00, and 59+00. The report should document the gradation of the filter material found, confirm if the material found is consistent with the as-built drawings, and provide an engineering assessment as to the suitability of the in-place filter. During an inspection on November 4, 1999 the Department was informed that 2-inch drain rock was found in these three borings and that a suitable filter material was not in-place. The presence of 2-inch drain rock would appear to provide for an inadequate filter unless multiple zones of material were utilized.
2. Section 4.0 (Design) – This section should include a discussion about the partial central filter/drain installed and an assessment about the adequacy of the filter/drain in protecting the dam from the historic cracking. The Department has identified historic cracking and the presence of an inadequate filter/drain as a safety deficiency. Justification for not requiring interim safety measures for this safety deficiency needs to be documented in this report.
3. Section 4.0 (Design) – This section should include a discussion about an interim operation plan previously requested by the Department. If the operation plan is not within the scope of this report, the report should clarify who is responsible for the operation plan development.
4. Section 4.1 (Diaphragm Filters and Outlet Pipe Extensions) – Although the title of this section references the outlet pipe extensions, the report does not include a discussion about the outlet pipe extensions (i.e., type of pipe, coating, presence of asbestos in the coating of the existing pipe, connections, headwalls, etc).

5. Section 4.1 (Diaphragm Filters and Outlet Pipe Extensions) – This section states that NCRS criteria will be the basis of design of the diaphragm filters. It appears that only one of the three alternatives presented could meet NCRS design criteria. Deviation from the NCRS design criteria will need to be justified.
6. Section 4.2 (Trash Racks) – This section indicates that the design was taken from MAG details. Please include the specific MAG detail reference.
7. Section 4.3 (Riprap at the Right Dam Abutment – This section indicates that "several accepted" design methods, including the NCRS method, will be utilized in the design of the riprap. The Department recommends the Bureau of Reclamation's "Design Standards No. 13: Embankment Dams. Chapter 7 Riprap Slope Protection" dated July 1992, and the Corp of Engineer's "Earth and Rock-Fill Dams – General Design and Construction Considerations" (EM 1110-2-2300) dated July 31, 1994.
8. Appendix A (Boring Logs) – The one page provided states that the boring logs are to be completed in the 60% design report. Boring logs and laboratory test results typically provide basic design information, and should have been included with this 10% report. Consequently, without this information the Department may have comments on the 60% design report that may have been more appropriate at the 10% design level.
9. Drawing C1 – This drawing indicates that the proposed low flow channel alignment will direct flows to the toe of the dam. Consequently, approximately 1,500 feet of the toe is proposed to be armored with riprap. Directing flows to the downstream toe of the dam will promote wetting of the foundation of the dam and may result in adverse settlements. Directing flows away from the dam would appear to be more appropriate and significantly reduce the amount of riprap needed. Also, Section A on this drawing should show the right abutment of the dam and the proposed riprap protection.
10. Drawing C2 – It is unclear what this drawing is trying to show. The section references are confusing.
11. Drawing D1 – In the two Section A's, identify the various materials. On Section C, does the open space between the trashrack and slope exceed the trash rack bar spacing?

If you have any question concerning this letter please contact Michael Greenslade of the Dam Safety Section at (602) 417-2400 extension 7188.

Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:mdg

ARIZONA DEPARTMENT OF WATER RESOURCES
Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004
Telephone (602) 417-2445
Fax (602) 417-2423

January 19, 2000

JANE DEE HULL
Governor

RITA P. PEARSON
Director

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

Subject: **White Tanks FRS #3 Dam (07.28)**
Interim Dam Safety Measures (30% Submittal)

Dear Mr. Renckly:

The Arizona Department of Water Resources (Department) has evaluated and provides comments regarding the Flood Control District of Maricopa County's (FCDMC) proposed interim dam safety measures as detailed in the Dames & Moore report titled "Report, Interim Dam Safety, 30% Submittal, White Tanks FRS #3" dated January 10, 2000.

1. Section 3.0 (Filter Investigation) – In addition to documenting the gradation of the filter material found, the report should evaluate the material for conformance with the design, and provide an engineering assessment as to the suitability of the in-place filter. Plotting the gradations of the material found in the borings on the SCS Soil Mechanics Note #1 design gradations contained in the SCS design report (attached) indicates an inadequate filter.
2. Section 4.1.1.1 (Conventional Graded Sand Filter) – Design calculations need to be provided supporting the diaphragm design dimensions and filter material gradations. It is recommended that the SCS design calculations be reviewed for conformance with current standards. In addition, calculations should demonstrate that buttress fill placed adjacent to the filter material is also filter matched. Due to the temporary nature of the structure, a filter fabric may be considered to protect against loss of filter material due to piping.
3. Section 4.2 (Trash Racks) – The design should provide sufficient spacing away from the slide gate to ensure that debris, wedged in the trashrack, does not interfere with the operation of the slide gate. It is recommended thattrash rack designs conform to the requirements in Section 10.9 of the Bureau of Reclamation's "Design of Small Dams" (1987) which reads as follows:

   "Trash bars usually consist of thin, flat steel bars that are placed on edge from 3 to 6 inches apart and assembled in a grid pattern. The area of the trashrack required is fixed by the limiting velocity through the rack which, in turn, depends on the nature of the trash to be excluded. Where the trashracks are inaccessible

for cleaning, the velocity through the racks ordinarily should not exceed 2 ft/s. A velocity of up to approximately 5 ft/s may be tolerated for trashracks that are accessible for cleaning."

4. Section 4.3 (Riprap at the Right Dam Abutment) – For design of the riprap, the Department recommends the Bureau of Reclamation's "Design Standards No. 13: Embankment Dams. Chapter 7 Riprap Slope Protection" dated July 1992, and the Corp of Engineer's "Earth and Rock-Fill Dams – General Design and Construction Considerations" (EM 1110-2-2300) dated July 31, 1994.
5. Section 4.4 (Emergency Spillway Modifications) – This section references a December 8 & 9 settlement survey, and indicates that based on this survey the emergency spillway will be lowered to elevation 1207.5 feet. Please provide the Department a copy of this survey. Also, does this proposed elevation account for potential future settlement?
6. Section 4.6 (Interim Operation Plan) – Comments on the interim operation plan will be provided seperately.
7. Appendix A – Additional detail should be provided for the Dam Filter Investigation Sieve Analysis.- Standard sieve sizes should be included. Are the results percent passing or percent retained? According to the original project specifications, two types of filter material (Drain Fill and Course Aggregate) were used to construct the embankment drain. It is recommended that two additional columns be added to this table showing the gradation limits for these two drain materials (example attached). It appears that the samples obtained from Sta. 59+00 and 58+00 meet or are close to the Course aggregate specification while the samples from Sta. 57+30 do not meet either specification.
8. Appendix E – The specification for the filter material needs to be included. The specifications should also include compaction requirements for the filter material. It is anticipated that relative density determinations utilizing ASTM methods 4253 and 4254 will be required. Calculations need to be provided supporting the specification for the D_{50} sizing of the riprap.
9. Drawing G3 – It is recommended that stationing be added to the outlet identifiers, and Beardsley Canal and the emergency spillway be labeled. It is also recommended that the 100-year and maximum pool contours be identified.
10. Drawing C1 – It is recommend that the note "Primary Borrow Source for Soil Berms" in the plan view be relabeled to read "Borrow Source for Buttress Fill" for consistency with the detail notes on Drawing D1. A bedding layer for the riprap is needed. For an interim repair, a geotextile should be sufficient. The top of riprap elevations shown (1195 feet) on the sections are incorrect considering that the top of the low flow channel is set at elevation 1206.68 feet. The height of riprap, 2.5 feet, shown would appear to vary if the top elevation of the riprap is set. It is recommended that the channel profile include riprap elevations. Embankment slopes should be revised to show existing slopes. The width of the access road should be specified. The one-foot of soil cover specified on the access road should be changed to an aggregate material to ensure all weather access.
11. Drawing C2 – On this drawing, it is recommended that an additional cross section be cut perpendicular to the outlet pipe through the berm.
12. Drawing D1 – Dimension "B" in the table should be in terms of feet. The diaphragm filter dimensions are not consistent with SCS Technical Note W-21. For flexible conduits, the diaphragm limits should be 2 times the pipe diameter in all directions, or 5

feet beyond the excavation. Cross sections for each outlet should be provided. The location of the cross section in the upper right hand corner should be shown on the outlet sections, and the bedding sand design should be clarified as discussed during our January 13, 2000 meeting. Filter material may not be required full depth downstream of the diaphragm.

13. Drawing D2 - As discussed during the January 13, 2000 meeting, stilling basins may not be required. Since the only means of drawdown will be the 48-inch outlet located at Sta. 46+00, an additional extension of the pipe may be adequate. The vertical bar spacing of the trash rack, 12-inches, is marginal for the 48-inch inlets, and excessive for the 24-inch inlet. Horizontal bars need to be included to reduce the spacing in the horizontal direction.

If you have any question concerning this letter please contact Michael Greenslade of the Dam Safety Section at (602) 417-2400 extension 7188.

Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:mdg

White Tanks FRS #3
15448-007-058
Dam Filter Investigation
Sieve Analysis

Sieve Size 3.5"

% Passing ??

Particle Size (mm)		59+00, 15-20 ft	58+00, 5-10 ft	57+30, 20-25 ft	57+30, 5-10 ft
2.5"	63	100	93	100	100
2"	50	87	69	100	98
1 1/2"	37.5	36	13	86	90
1"	25	7	2	48	68
3/4"	19	2	1	24	49
1/2"	12.5	1	1	5	31
3/8	9.5	1	1	2	22
1/4	6.3	1	1	1	13
#4	4.75	1	1	1	13
#8	2.36	1	1	1	8
#10	2	1	1	1	8
#16	1.18	1	1	1	8
#30	0.6	1	1	1	8
#40	0.425	1	1	1	8
#50	0.3	1	1	1	8
#100	0.15	1	1	1	8
#200	0.075	0.3	0.3	0.8	4.2

Not Coarse

Not Fine

Not Fine

Not Fine

% Passing

Specs for Coarse Drain Rock	Specs for Fine Drain Rock
90-100	
35-70	100
0-15	80-100
	70-95
0-5	
	49-65
	35-50
	25-40
	10-25
	2-8

SCS—ENG—251A
Rev. 11-71

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

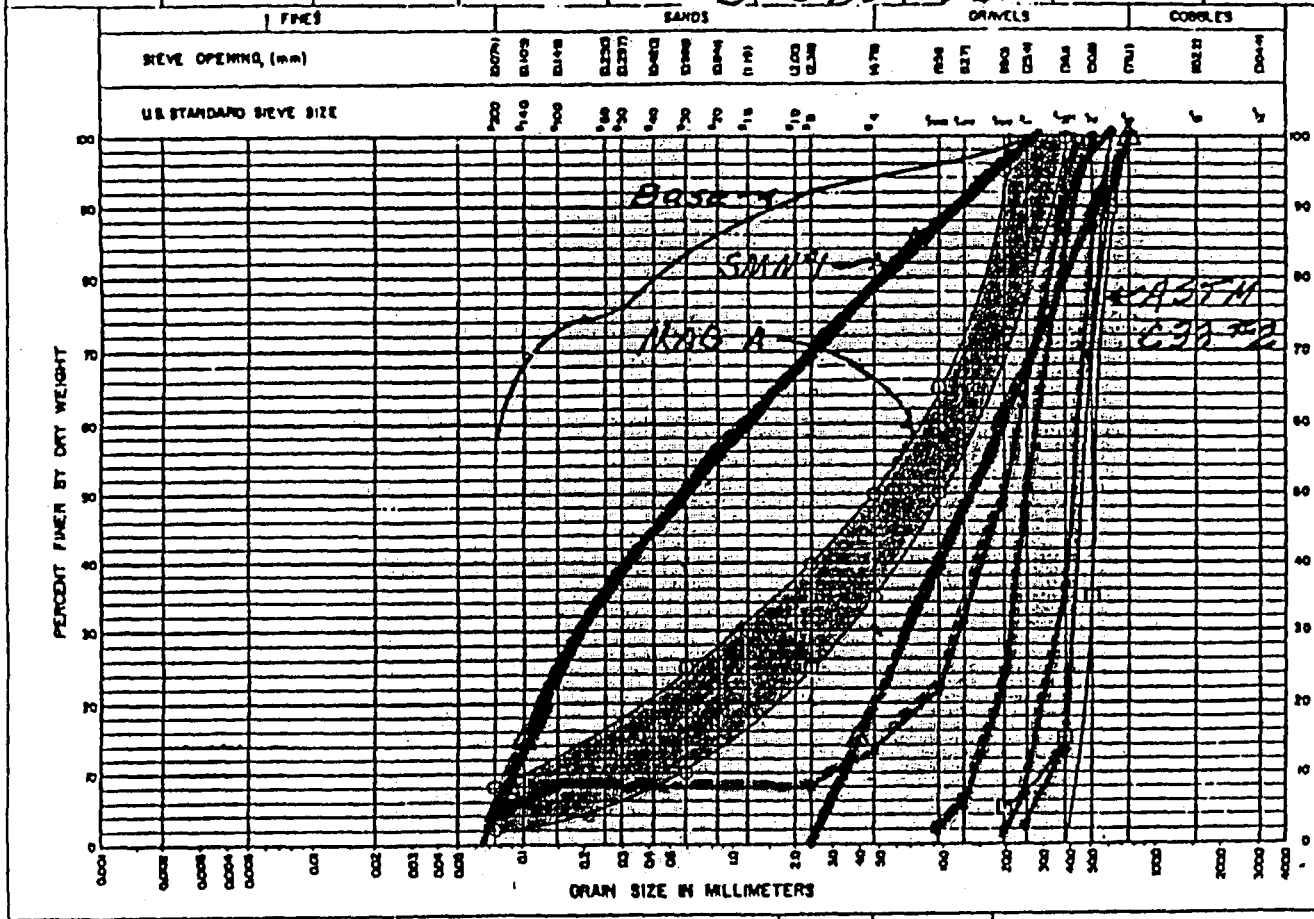
SOIL CLASSIFICATION

LABORATORY NO. 3164

PROJECT OR STATE	White Tanks #3 Arizona
FIELD SAMPLE NO.	21
DEPTH	5.5
SAMPLE LOCATION	Sta. 40+00 A. Dam
TYPE OF SAMPLE	Disturbed
TESTED AT	ATL
GEOLOGIC ORIGIN	
APPROVED BY	
DATE	3-10-81
SYMBOL	CL
DESCRIPTION	

GRAIN SIZE DISTRIBUTION

D_{10}	D_{16}	D_{30}	D_{50}	D_{60} 0.08	D_{85} 0.80	D_{MAX} 25.4	C_u	C_c



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI				g/cc
2.667						28	8	%	%	%	pcf

REMARKS:

CPO: 1971 O - 430-349

SCS-ENG-553A
Rev. 11-71

MATERIALS TESTING REPORT

U.S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

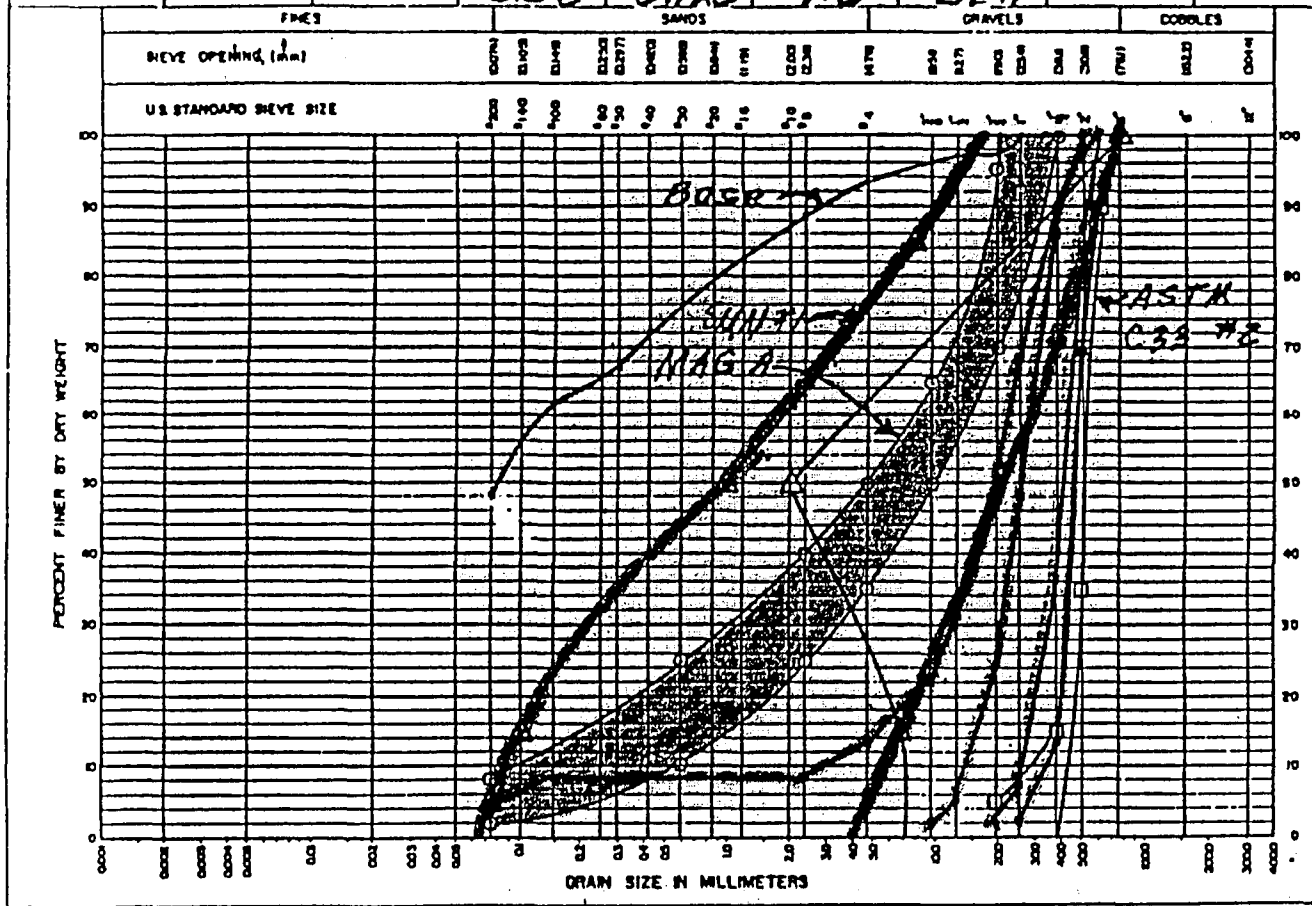
SOIL CLASSIFICATION

LABORATORY NO. 3179

PROJECT AND STATE: White Tanks #3 Arizona
FIELD SAMPLE NO. 11
TYPE OF SAMPLE: Disturbed
DEPTH: 5'0"
GEOLOGIC ORIGIN:
SAMPLE LOCATION: Sta. 70+00 & Dam
TESTED BY: ATL
APPROVED BY:
DATE: 3-10-81
SYMBOL: SM
DESCRIPTION:

GRAIN SIZE DISTRIBUTION

D_{10}	D_{16}	D_{30}	D_{50}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
			0.08	0.125	1.6	57.1		



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI				g/cc
2.674						21	3	%	%	4.6 %	pcf

REMARKS:

MATERIALS TESTING REPORT

U. S. DEPARTMENT of AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL CLASSIFICATION

LABORATORY NO. 7160

PROJECT AND STATE: White Tanks #3 Arizona

FIELD SAMPLE NO: 3.1

DEPTH: 8.0'

GEOLOGIC ORIGIN:

SAMPLE LOCATION: Sta. 3+00 d. Dam

TYPE OF SAMPLE: Disturbed

TESTED AT: ATL

APPROVED BY:

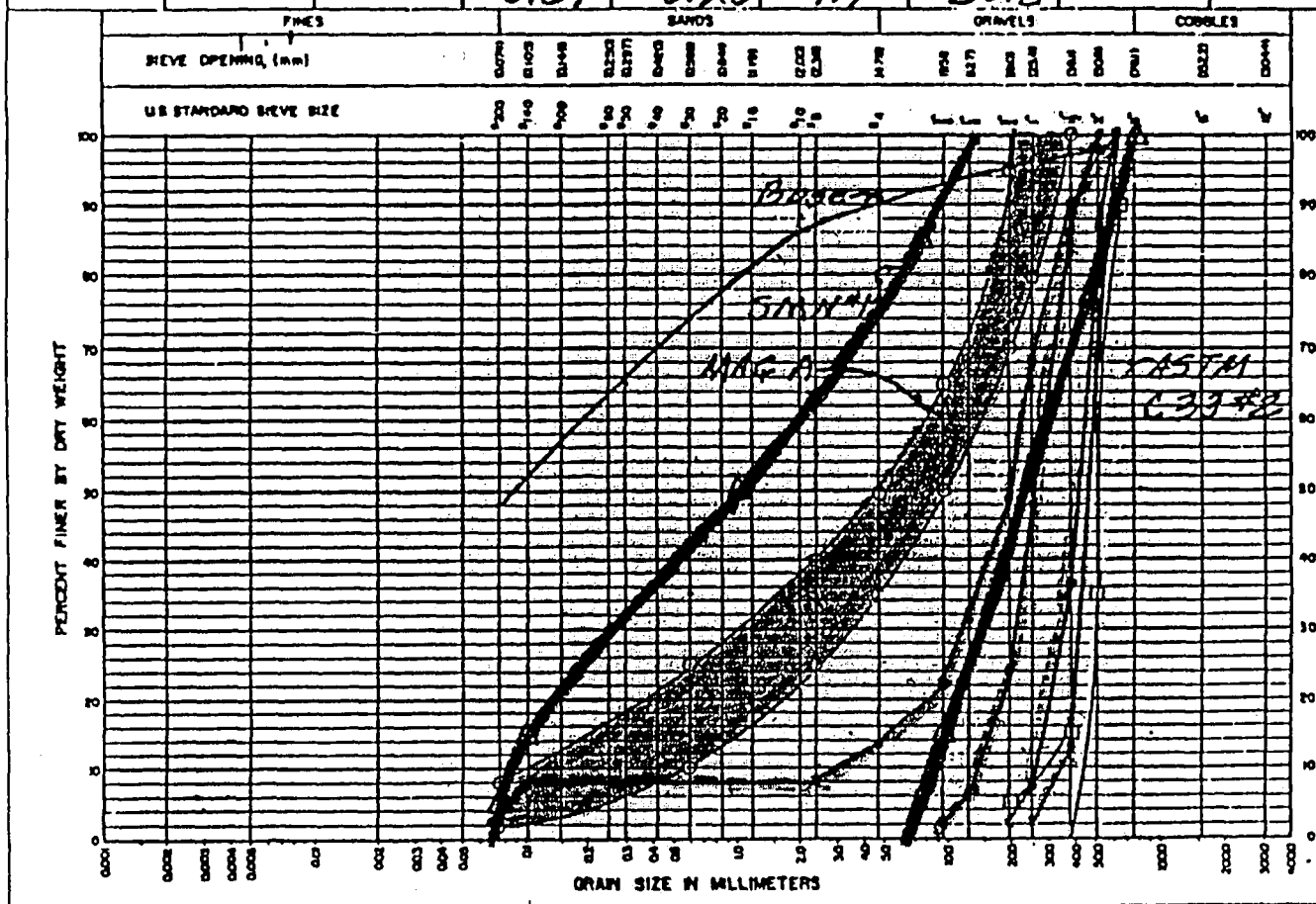
DATE: 3-10-81

SYMBOL: SC

DESCRIPTION:

GRAIN SIZE DISTRIBUTION

D_{10}	D_{15}	D_{20}	D_{30}	D_{60}	D_{85}	D_{MAX}	C_u	C_c
			0.09	0.20	1.9	50.8		



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI				g/cc
2.681						30	8	%	%	4.3 %	pcf

REMARKS:

ARIZONA DEPARTMENT OF WATER RESOURCES
Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004
Telephone (602) 417-2445
Fax (602) 417-2423

February 25, 2000

JANE DEE HULL
Governor

RITA P. PEARSON
Director

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

Subject: **White Tanks FRS #3 Dam (07.28)**
Interim Dam Safety Measures (60% Submittal)

Dear Mr. Renckly:

The Arizona Department of Water Resources (Department) has evaluated and provides these comments regarding the Flood Control District of Maricopa County's (FCDMC) proposed interim dam safety measures as detailed in the Dames & Moore report titled "Report, Interim Dam Safety, 60% Submittal, White Tanks FRS #3" dated February 10, 2000.

1. Section 4.1.1 (Conventional Graded Sand Filter) – This section as well as the calculations in Appendix B reference TR-60C 210-V as the basis for diaphragm filter design. The copy of TR-60C contained in the appendix is dated April 6, 1984, which is older than other versions available. It appears that the latest version is TR-60 210-VI revised October 1985 with Amendment 1 dated October 1990. While there appears to be very little variation between the two versions, other than the Amendment 1 revisions, it is recommended the latest version be used and referenced.
2. Section 4.1.1 (Conventional Graded Sand Filter) – The minimum thickness reported in this section is not the true minimum thickness as measured perpendicular to the slope. Please review the design, determine the true minimum thickness, and adjust the design accordingly.
3. Section 4.1.1 (Conventional Graded Sand Filter) – In the last paragraph reference is made to a "berm" and an "embankment". We assume that the two terms apply to the same feature. It is recommended that this paragraph be rewritten using a single term. We suggest the term used on the drawings which is "soil buttress".
4. Section 4.1.2 (Outlet Pipe Extensions) – The first paragraph states several reasons why the use of CMP as a pipe extension is appropriate. It is the Department's position that a CMP is only appropriate in a dam when fully encased in concrete and used as a form. It is acceptable for this application because of the temporary nature of the project and the fact that an existing CMP is being extended. Under any other circumstance, this design would not be allowed.
5. Section 4.1.2 (Outlet Pipe Extensions) – The second paragraph states that there should not be a concern regarding the potential negative aspects associated with the use of CMP

because it is being installed downstream of the new filter. The negative impacts identified are poor compaction around the pipe and deformation allowing erosion or piping of embankment fills. The design must also take into consideration piping along the new pipe regardless of the location of the diaphragm. Piping and stability of the filter material is a design issue. Construction of the extension must consider the use of concrete collars at joints and concrete cradles, full concrete encasement, and/or alternative pipe type such as reinforced concrete bell and spigot.

6. Drawing G3 (Sheet 3 of 12) – This drawing should include the location of the borings utilized in the diaphragm filter design.
7. Drawing C2 (Sheet 5 of 12) – The plan view should show the location of the diaphragm and pipe joints with a section cut perpendicular to and through the 3:1 slope showing that the minimum cover requirements have been met for the filter diaphragm. Also, for the final design please include dimensions on plans and sections.
8. Drawing D1 (Sheet 8 of 12) – The Access Road Riprap Section, Section C, appears to show the access road as a cut and depression through the abutment. A cut at this location is not recommended, as it would facilitate ponding of water at the toe of the abutment and promote excessive erosion due to adverse hydraulic conditions. If an access road is desired at this location, it should ramp over the riprap. What is the purpose of the berms on either side of the cut channel? Also, the toe of the riprap should be extended below the natural ground surface to a minimum depth for scour and undercut protection. At a minimum, the thickness of the riprap should remain constant throughout and not thin or taper in areas where erosion is expected.
9. Drawing D2 (Sheet 9 of 12) – In the North Outlet Section, Section 1, please show the location of all pipe joints and collars. It is recommended that new pipe joints be located downstream of the filter diaphragm. Also, in this section a geotextile should be provided below the riprap.
10. Drawing D2 (Sheet 9 of 12) – For final design, dimensions should be shown on the North Outlet Elevation detail.
11. Drawing D5 (Sheet 12 of 12) – The Department does not believe that the neoprene gasket proposed for the CMP pipe coupling would insure an adequate watertight seal and is requesting that a cast in-place reinforced concrete collar be utilized. In addition, concrete encasement to at least the springline is requested. If the use of CMP does not allow for partial encasement, full encasement or a bell and spigot RCP may be required. A reinforced concrete collar would be required at the old CMP to new RCP connection.
12. Appendix B (Calculation Packages) – The following comments address the "Diaphragm Filter & Fill Cover Sizing" calculations contained in Appendix B:
    a. See the above comment regarding the TR-60 referenced used.
    b. Please provide support for the utilization of the 0.7 settlement ratio.
    c. The maximum potential reservoir elevation utilized should coincide with the ½ PMF elevation or 1210.3 feet. This is an increase of 0.34 feet.
    d. On sheet 4 of 10, the measurement "H" is from the top of the filter to the maximum reservoir elevation (see Sheet 6 of 10). Therefore, H/2 appears to be drawn incorrect. The calculations utilize two "H" measurements.
    e. Sheets 5, 7 and 9 of 10 reference Page 4 of 6 for drawings. The referenced drawings cannot be found.

f. Sheets 6, 8 and 10 of 10 should use the maximum potential reservoir elevation of 1210.3 feet.

g. Calculations for the minimum capacity of diaphragm outlets need to be included (see TR-60). If drain material other than filter material is utilized, a filter match between the diaphragm material and drain material will need to be demonstrated. C-33 Course Aggregate may be evaluated as a drain material if one is required.

13. Appendix B (Calculation Packages) – The following comments address the "Diaphragm Filter Gradation" calculations contained in Appendix B:

a. Boring logs for the base samples used need to be provided.

b. The sheet references throughout are incorrect.

c. On Sheet 5 of 15, the D_5 for the course side of the ASTM C33 Fine Aggregate plot should be 5% instead of 10%.

14. Appendix B (Calculation Packages) – A filter match between the diaphragm and soil buttress materials needs to be provided. Piping of filter material must be considered.

15. Appendix B (Calculation Packages) – Comments on these calculations may be provided once the hydrology and hydraulic review has been completed.

16. Appendix E (Specifications) – A review of the specifications indicates numerous inaccurate and misleading entries, primarily due to the format modifying and cross-referencing MAG specifications. Therefore, the Department is requesting stand-alone specifications that do not cross-reference the MAG specifications. If MAG specifications are to be utilized, clarity requires that the deletions and additions made within the stand-alone document. Due to the number of comments on the submitted specifications, the Department is providing a copy of the specifications to Dames & Moore with hand written comments. The following comments address specific issues.

a. As written, Subsection 201.3, which incorporates Table 201-1 of the MAG specifications, allows for stumps to be left in-place. This section of the specifications is unacceptable.

b. Subsection 206.2 of the MAG specifications appears to apply to concrete and masonry footings. The last part of this subsection indicates that references to concrete and/or piles is not applicable, but is not specific as to what is to be deleted. When deleting parts of the MAG specifications, the reference should be specific. This comment applies to wherever a reference to deletion is given.

c. Subsection 206.4 includes a heading titled "Field Compaction" without any follow up text. It would appear that text is missing. Also, as written this subsection would appear to allow for concrete backfill.

d. Subsection 211.1 references a "fill line" on the plans. The plans do not cross-reference this term. In addition, this section allows the contractor to construct access ramps on the slopes. This section should be clarified to ensure that the contractor does not cut into the slopes to construct the ramps.

e. Subsection 211.1 indicates that soils removed from the excavation with a PI>25 cannot be used for fill. This appears to be in conflict with Subsection 211.3 which limits backfill cover material to a PI<10.

f. Subsection 211.3 needs a compaction specification for the ASTM C33 Fine Aggregate. ASTM methods D4253 and D4254 should be used to determine the density relationship for free draining cohesionless sands. Typical minimum compaction requirements range from 65% to 80%.

g. Subsection 211.3 references a "soils report". The Department requests a copy.
h. Subsection 211.3 needs a material specification for the soil buttress cover material that is filter matched to the diaphragm filter material. Also, the ASTM C33 specification should reference the "Fine Aggregate" component of ASTM C33.
i. In Subsection 211.3, the material types need to match the materials specified on the drawings. All materials shown on the drawings need to be included.
j. Subsection 220.2 references two riprap materials while the drawings show one.

17. Appendix F (Construction Quality Assurance and Quality Control Plan) – The following comments address the CQA Plan contained in Appendix F.
    a. Section 2.1 and 6.0 include references to "lining system" and "liner system". This project does not include a lining system.
    b. Section 6.2.3 includes a reference to Table 2. Should this be Table 1?
    c. In Section 6.2.4, the reference to relative density determination should be moved to Section 6.2.3.
    h. In Table 1 the ASTM D1557 row should be eliminated and a row for ASTM D4253/D4254 testing should be added.
    i. In Table 1 testing frequencies need be included in the ASTM D698 row for subgrade and structural fill, the ASTM D422 row for structural fill, and the ASTM D4318 row for subgrade and structural fill.
    j. Fill materials designations referenced in Table 1 should be cross-referenced and consistent with the materials referenced in the specifications and drawings.
18. In Table 1 the testing frequencies need to be adjusted to take into account the method of construction and quantity of material placed. As an example, the cost estimate table indicates that 250 cy of filter sand will be imported while the frequency of testing is 1 per 500 cy for field moisture content and 1 per 100 linear foot for in-place density. For the diaphragm and soil buttress fill materials sufficient testing needs to be conducted to ensure lift compaction is achieved. A linear foot designation may be adequate for a pipeline but not a small confined area.

If you have any question concerning this letter please contact Michael Greenslade of the Dam Safety Section at (602) 417-2400 extension 7188.

Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:mdg

Cc: Scott Newhouse, P.E. – Dames & Moore (with marked up specifications)
Noller Herbert, P.E. – NRCS

ARIZONA DEPARTMENT OF WATER RESOURCES
Dam Safety Section
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April 21, 2000

JANE DEE HULL
Governor

RITA P. PEARSON
Director

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

Subject: **White Tanks FRS #3 Dam (07.28)**
Interim Dam Safety Measures (60% Submittal)
Hydrology & Hydraulics

Dear Mr. Renckly:

Please find attached additional review comments regarding the Flood Control District of Maricopa County's proposed interim dam safety measures as detailed in the Dames & Moore report titled "Report, Interim Dam Safety, 60% Submittal, White Tanks FRS #3" dated February 10, 2000.

The attached comments address the hydrology and hydraulic components of the project and the Arizona Department of Water Resources expectations regarding an application. The comments are in the form of a two page memo by John Linkswiler dated March 14, 2000.

If you have any question concerning the memo, please contact John Linkswiler of the Dam Safety Section at (602) 417-2400 extension 7186.

Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:mdg

Attachment

Cc: Tod Ringsmith, P.E. – Dames & Moore
Noller Herbert, P.E. – NRCS

ARIZONA DEPARTMENT OF WATER RESOURCES
Dam Safety Section

File: 07.28
White Tanks FRS #3

PROJECT MEMORANDUM

TO: Mike Greenslade
FROM: John Linkswiler
DATE: March 14, 2000

SUBJECT: Report Review: Interim Dam Safety
60 Percent Submittal
White Tanks FRS #3
Prepared For: Flood Control District of Maricopa County
By: Dames and Moore, February 10, 2000

I have reviewed the referenced document for hydrologic and hydraulic items. My comments are as follows:

1. The report references previous reports for the determination of the Inflow Design Flood. Our files do contain the hydrology report as a separate report dating back to 1990. No review of the IDF hydrology is necessary for this report. Flood routing through the reservoir is involved.

2. The spreadsheet being used to calculate normal depth needs to be checked. The attached sheet shows the correct calculation for the velocity associated with the indicated normal depth of 1.72 feet. As may be noted the associated velocity is 0.427 fps, which results in an estimated discharge of 588 cfs. Because the desired flow rate is 525 cfs, an error exists.

3. The final report should include a hydraulics section which clearly shows the development of the rating curve for the several outlet works and the spillway. These rating curves are to be included on a sheet of the project drawings.

4. The final report should include a hydrology section, which reflects the parameters developed for the outlet works and spillway. This section may be included under a separate cover and should include the following items for this project.

A. Watershed map with all subwatershed boundaries and other pertinent points indicated.
B. Watershed diagram.
C. Computations supporting hydraulic conditions at split flow points.
D. Complete printout for at least one subwatershed area. (Check precipitation abstraction)
E. Worksheets for 6-hr Local Storm, HMR-49 PMP estimate.
F. Printout for input file for each option.

Sheet:

White Tanks FRS #3 Spillway

X-Section 1 at Slpillway

1.72	=normal depth	1.0	side slope left side
800.00	= bottom width	1.0	side slope right side
0.05	= Manning's n		
0.0001	= channel slope (S)		

Velocity = 1.49/n(R^0.6667)(S^0.5) R = A/P

1378.96 = A = 1.72*800+0.5*1*1.72*1.72+0.5*1.72*1.72

804.865 = P = 800+1.72*2*(1+1^2)^0.5

1.713 = A/P =R

1.432 = R^0.6667

0.010 = S^0.5

29.80 =1.49/n = 1.49/0.05

0.427 = Velocity = 1.49/n(R^0.6667)(S^0.5)

588.4 = A*V =Q

The computed 588.4 cfs is not equal to the report value of 525.0 cfs

Some body better check their spreadsheet.

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Dam Safety Section
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June 22, 2000

JANE DEE HULL
Governor

RITA PEARSON MAGUIRE
Director

JUN 2000
Received

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

Subject: **White Tanks FRS #3 Dam (07.28)**
Interim Dam Safety Measures (90% Submittal)

Dear Mr. Renckly:

The Arizona Department of Water Resources (Department) has evaluated and provides these comments regarding the Flood Control District of Maricopa County's (FCDMC) proposed interim dam safety measures as detailed in the Dames & Moore report titled "Draft Report, 90% Submittal, Interim Dam Safety, White Tanks FRS #3" dated May 26, 2000:

1. Section 2.1.2.1 (Cracks) – The criteria for finger drain construction is listed on the 1981 SCS repair drawings (Sheet 3). According to the as-built drawings, auxiliary outlets (finger drains) were provided to intercept cracks in the downstream face of the drain trench that extended below the trench excavation limit. Auxiliary outlets were also provided at locations with an open crack greater than 3/8-inch.
2. Section 3.0 (Existing Filter Investigation) – Reference is made to the Department's previous comments on the 10% and 30% submittals, which have not been addressed. Specifically, in addition to documenting the gradation of the materials in the existing central filter/drain, the report should provide an engineering assessment as to the suitability of the in-place filter/drain. A filter analysis must be conducted as part of the investigation. We would appreciate a response to this comment as soon as possible.
3. Section 5.1.1 (Diaphragm Filter) – The first paragraph on Page 5-2 states that a calculation to demonstrate a filter match between the soil buttress and the diaphragm was not performed. The response to the Department's Comment # 14 on the 60% drawings states that the concern is that the material from the soil buttress will migrate into the filter, which is incorrect. The Department's comment was "Piping of filter material must be considered". Apparently, the Department's comment was misunderstood. The concern is that the diaphragm filter material must not pipe into the buttress material. If the buttress material is finer than the filter material than piping is not a concern. If the buttress material is coarser than the filter material, than a filter match must be demonstrated. In addition, buttress material must be adequately specified to ensure the analysis remains valid for the constructed diaphragm.

4. Section 5.1.1 (Diaphragm Filter) – The second paragraph states that the dam foundation and diaphragm filter materials do not match. A review of the analysis conducted titled "Gradation Match Dam Foundation – Filter" indicates that the foundation material was used as the base soil and that the NRCS design method filter band for the base soil is coarser than the specified filter material (ASTM C33 Fine Aggregate). Therefore, it does not appear that piping of foundation material into the filter is an issue. A filter analysis assuming the filter material as the base soil also needs to be conducted. The design of the diaphragm needs to ensure that piping of adjacent materials will not occur. All possible seepage flow directions need to be carefully considered. The purpose of the filter diaphragm is to intercept fines that may be piped due to seepage along the outlet pipes. The interfaces that would appear to require consideration are (1) Dam⇒Diaphragm, (2) Diaphragm⇒Buttress, (3) Diaphragm⇒Drain, (4) Foundation⇒Diaphragm, (5) Diaphragm⇒Foundation, (6) Buttress⇒Drain, and (7) Foundation⇒Drain. A filter analysis may not be required for all cases. A review of the gradations may be sufficient (i.e., course material will not pipe into fine material).
5. Section 5.1.1 (Diaphragm Filter) – The analysis titled "Diaphragm Filter – Drain Match" is confusing. As the title and attached figure suggest, it appears that the analysis is intended to show a filter match between the filter material and drain material. The conclusion on Page 5 of 8 discusses the migration of filter material into the buttress material. Pages 6, and 7 of 8 appear to support the conclusion but not the analysis. Have two different analyses been combined? The use of figures is highly recommended as they show the intent of the analysis. Please clarify this analysis.
6. Section 5.1.1 (Diaphragm Filter) – The use of a geotextile has been proposed around portions of the diaphragm and drain. It does not appear that the analyses conducted supports the need for a geotextile at all locations shown on the drawings (i.e., at the filter/drain and filter/foundation interfaces. Also, as stated above it does not appear that the analyses are complete. Please reevaluate the use of geotextile after the analyses are complete.
7. Section 5.4 (Emergency Spillway Modifications) – The terms "dry freeboard" and "freeboard" should be replaced with the terms "total freeboard" and "residual freeboard".
8. Section 5.4 (Emergency Spillway Modifications) – This section of the report states that the bottom of the notch channel will have a minimum width of 10-feet. Drawing D1 indicates a minimum width of 75-feet. Which dimension is correct? If the 75-foot dimension is correct, please include a discussion as to the change from the 60% drawings.
9. Section 5.4 (Emergency Spillway Modifications) – In a review memo attached to the Department's April 21, 2000 letter, Comment #3 requested a hydraulics section in the report showing the development of rating curves for the outlets and emergency spillway. The response to this comment stated that the rating curves have been developed and are shown on Drawing G3. Calculations for the outlet rating curves were found in Appendix D. Drawing G3 does not include a rating curve for the emergency spillway. Please provide the previously requested rating curve on the drawing and the supporting calculations in the report.
10. Section 5.4 (Emergency Spillway Modifications) – In a review memo attached to the Department's April 21, 2000 letter, Comment #4 requested a hydrology section in the report reflecting the parameters developed for the outlet works and emergency spillway. The response to this comment stated that hydrology for this project will be provided

under separate cover. The submittal currently being reviewed is labeled as 90% complete. The hydrology, specifically routing the IDF through the emergency spillway, has not yet been provided for review. Therefore, the FCDMC needs to be aware of potential major design changes resulting from the Department's review of the hydrology and emergency spillway hydraulics.

11. Drawing C2 – The cross section sheet locations are incorrect.
12. Drawing C5 – This drawing appears to include an extra cross section designator.
13. Drawing D1 – The toe of the riprap does not appear constructable as shown. Riprap is shown tapering out and therefore, the minimum 2-foot thickness is not maintained. Please refer to the attached details (Figure 15 from TR 69). This comment also applies to the 1-foot thick layer of aggregate road base material over the riprap. The access road detail does not show riprap beyond the access road. Also, please refer to the Department's Comment # 8 on the 60% drawings for additional comments regarding this detail.
14. Drawings D2, D3 & D4 – On the diaphragm filter elevation please show the location of the geotextile. Also, does the diaphragm completely encase the concrete encasement at the pipe coupling? The titles for the control points are all labeled "North Outlet".
15. Specifications – Concrete specifications have not been included.
16. Specifications – The second sentence of the second paragraph of Section 210.2 Imported Borrow reads "*The maximum size of this material shall not be greater then 2/3 the compacted thickness of the course placed in the subgrade*" is confusing. Is this foundation replacement material? Will it be consistent with the materials used in the filter analysis?
17. Specifications – Section 515.1.2 and Subsection 515.3 are void of content.
18. Specifications – As a non-technical note, several of the sections (Sections 525, 701, 760, & 790) do not include a bid item reference. Also, the bid item reference for Section 530 appears in the middle of the section.
19. Construction Quality Assurance Program – The primary purpose of the CQA Plan is to confirm, verify, and validate the design. Testing of the foundation subgrade and buttress materials in the vicinity of the diaphragm will be required to ensure that a filter match between the various materials exists. Some of this testing must be conducted prior to material placement. Should testing invalidate the design, a field change will need to be considered. Please include a discussion in the CQA Plan that address this approach and details required actions by field and/or office personnel.
20. Construction Quality Assurance Program – The following comments address Table 1 of the CQA Plan:
    a. For ASTM Test Method D422, a frequency of testing needs to be specified for the foundation subgrade. Also, the frequency of testing for the other materials, 1/500cy, appears insufficient. While quantity estimates were not provided with this submittal, the estimate that was provided with the 60% submittal indicated 250cy of filter sand. Please provide quantity estimates so that the Department can evaluate the proposed testing frequency. Estimates will also be required as part of the fee calculation.
    b. For ASTM Test Methods D698, D4253 and D4254, please include an additional requirement that, at a minimum, tests be conducted for each material type or change in material.

c. For ASTM Test Methods D1556 and D4643 the frequencies were changed from 1/10 nuclear density tests in the 60% submittal to 1/20 in this submittal. The Department's standard is 1 sand cone test for every 10 nuclear density tests. Please revise this frequency back to the frequency previously specified, reviewed and accepted by the Department. The Department must be notified of any similar changes.

d. For ASTM Test Method D4318, a frequency of testing needs to be specified for the subgrade. Also, please include an additional requirement that, at a minimum, tests be conducted for each material type or change in material.

If you have any question concerning this letter please contact Michael Greenslade of the Dam Safety Section at (602) 417-2400 extension 7188.

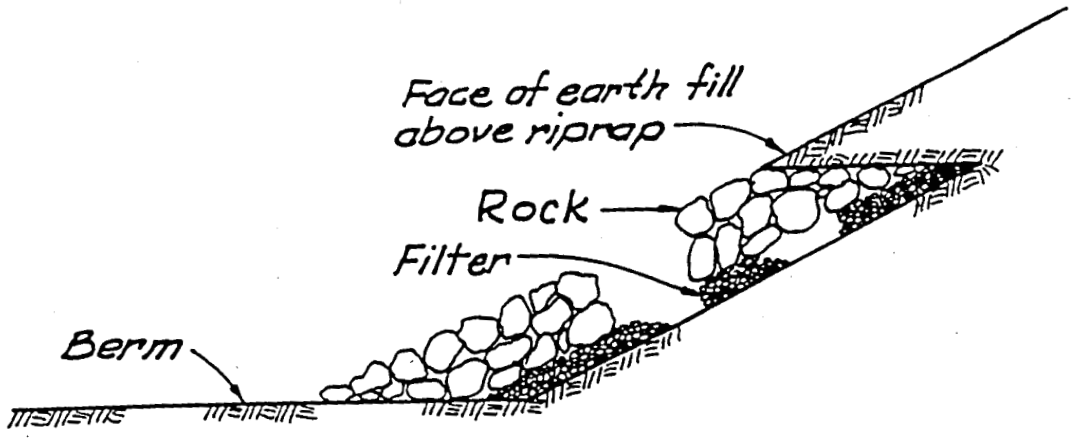
Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

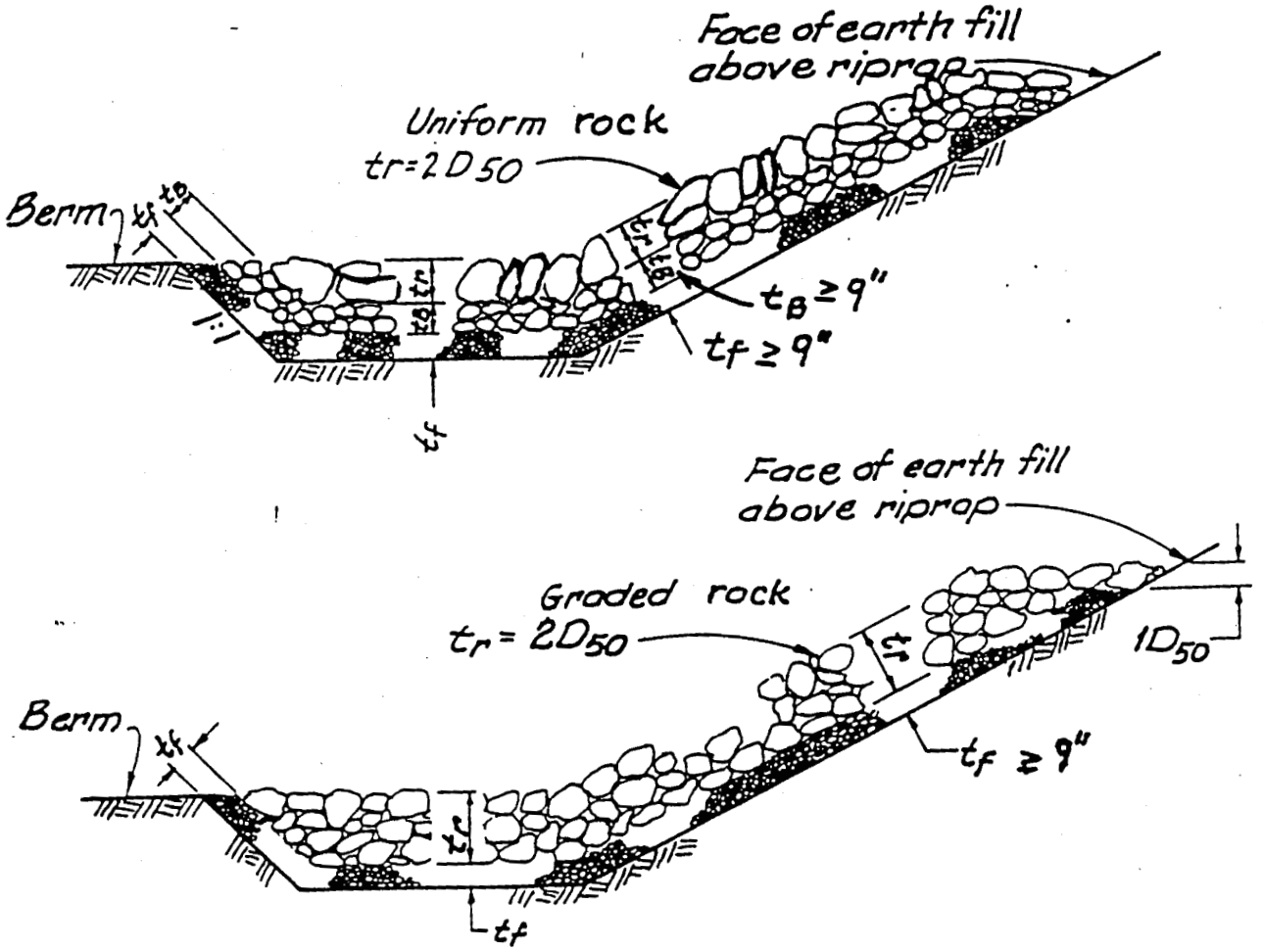
JMB:mdg

Attachment

Cc: Todd Ringsmuth, P.E. – Dames & Moore
Noller Herbert, P.E. – NRCS



UNACCEPTABLE DETAIL



ACCEPTABLE DETAIL

FIGURE 15

DUMPED ROCK
PLACEMENT DETA

WNTC ENG. STAFF

ARIZONA DEPARTMENT OF WATER RESOURCES
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August 14, 2000

JANE DEE HULL
Governor

RITA PEARSON
MAGUIRE
Director

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

Subject: **White Tanks FRS #3 Dam (07.28)**
Interim Dam Safety Measures (95 Percent Submittal)

Dear Mr. Renckly:

The Arizona Department of Water Resources (Department) has evaluated and provides the following comments regarding the Flood Control District of Maricopa County's (FCDMC) proposed interim dam safety measures. The proposed interim dam safety measures are detailed in the Dames & Moore report titled "Draft Report, 95 Percent Submittal, Interim Dam Safety, White Tanks FRS #3" dated July 28, 2000. The Department has previously provided comments on the 10, 30, 60 and 90% submittals.

1. Application – A partially completed application is included with the 95% submittal. Be advised that pursuant to A.A.C. R12-15-1208(A)(1), a complete application filed in duplicate will be required. Also, note that all requirements specified in A.A.C. R12-15-1208 must be complied with when submitting an application. Furthermore, A.A.C. R12-15-1220(C) requires that the owner of a dam that has been determined to be "Unsafe" must comply with the requirements of A.A.C. R12-15-1216 unless the requirement is determined to be unduly burdensome or expensive and is not necessary to protect human life or property. The Director must state in writing the reason or reasons why the owner is not required to comply with a requirement. Therefore, an application must include sufficient justification for the Director's waiver of requirements specified in A.A.C. R12-15-1216.
2. Section 3.3.2 of the Design Report (Design Information) – In the second paragraph reference is made to "drain fill on the upstream side" of the existing chimney drain and "coarse aggregate on the downstream side". Should the location of these two components of the chimney drain be reversed?
3. Section 5.4 of the Design Report (Emergency Spillway Modifications) – In a review memo attached to the Department's April 21, 2000 letter, Comment #3 requested a hydraulics section detailing the development of a rating curve for the emergency spillway. Please provide the previously requested rating curve on the drawings with supporting calculations in the report.

4. Section 5.4 of the Design Report (Emergency Spillway Modifications) – In a review memo attached to the Department's April 21, 2000 letter, Comment #4 requested a hydrology section in the report detailing parameters developed for the emergency spillway. The hydrology, specifically routing the IDF through the emergency spillway, has not yet been provided for review.
5. Sheets 6, 7 and 8 of 17 – The configuration of the concrete aprons on the slopes are not consistent with the cross section details. As an example, scaling Sheet 6 shows 19-feet of pipe exposed while Sheet 13, Section A shows 9-feet of pipe exposed.
6. Sheets 8 and 9 of 17 – Note 2 indicates that the existing shotcrete-lined channel will be excavated and widened at the toe of the soil buttress. While it appears that the quantity estimates on Drawing Q1 indicate that the shotcrete lining will be replaced, the drawing does not specify a new shotcrete lining. It is recommended that Note 2 be revised to specify a new shotcrete-lined channel where the existing channel is excavated.
7. Sheet 9 of 17 – The referenced Section C on Sheet 17 does not correspond with the design presented. Section C on Sheet 17 includes a riprap channel bottom while Sheet 9 should include a shotcrete-lined channel bottom.
8. Sheets 9 and 11 of 17 – The section designators for Section A on Sheet 17 should be moved upstream as on Sheet 10 to be consistent with the referenced section.
9. Sheet 12 of 17 – Section C should be revised to show the riprap transition between Sections A and B.
10. Sheet 13 of 17 – A note in Section A specifies that the pipe will be extended into the existing shotcrete-lined channel. According to Note 2 on Sheets 7 and 8, the existing channel is to be excavated and widened. For clarity, it is recommended that the note be revised to require the pipe to be extended into a new shotcrete-lined channel.
11. Sheet 17 of 17 – The typical riprap section, Section C, appears to only apply to the Central Outlet. The North Outlet has a shotcrete-lined channel and the South Outlet has a 24-inch pipe. Additional sections appear to be needed.
12. Appendix D (Filter and Crack Investigation) – When submitting the application, please include color photographs with the final submittal.
13. Appendix E (Calculation Packages) – The 95% submittal did not include calculations for sizing of the diaphragms or soil buttress fills. Please revise these calculations as necessary and incorporate them into the final submittal for review.
14. Section 206.4 of the Specifications (Structural Backfill) – The second paragraph in this section references ASTM C33 sand for outlet pipe culvert bedding. This specification does not correspond to the design that provides for a concrete cradle on the outlet pipes founded on natural material. Also, while the lift thickness is specified for the buttress fill material it is not specified for the diaphragm filter material.
15. Section 210.2 of the Specifications (Structural Borrow) – The maximum particle size (2/3 compacted lift thickness) specified for imported buttress fill material does not meet the maximum particle size specified (3-inches) for the buttress fill material in Section 211.3. Does the material specified in Section 211.3 meet the filter match design requirements? The specification appears to be extremely broad. Such a broad specification would suggest that materials not meeting the design requirements could fall within the limits of the specification. Please provide a discussion in the design report regarding the acceptable specification range that ensures a filter match with adjacent materials.

16. Section 211.3 of the Specifications (Compacting) – While the buttress fill material is specified within this section, it would appear more appropriate to specify it in Section 206.4 or 211.1.
17. Construction Quality Assurance Plan – For ASTM Test Methods D4253 and D4254, in the diaphragm filter sand column, please include an additional requirement that, at a minimum, tests be conducted for each material type or change in material source.
18. Construction Quality Assurance Plan – For ASTM Test Methods D1556 and D4643 the Department's standard is 1 sand cone test for every 10 nuclear density tests. Please include this testing requirement in the subgrade column.
19. Construction Quality Assurance Plan – For ASTM Test Methods D422 and D4318, in the soil buttress fill column, please include an additional requirement that, at a minimum, tests be conducted for each material type or change in material. Also, because limited testing on proposed buttress fill borrow fill material was conducted the frequency of testing for ASTM Test Methods D422 and D4318 needs to be increased significantly. Be advised, that should testing of borrow material show a deviation from the design and specifications the material will be considered unacceptable.

If you have any question concerning this letter please contact Michael Greenslade of the Dam Safety Section at (602) 417-2400 extension 7188.

Sincerely,

William C. Jenkins, P.E.
Manager
Dam Safety Section

WCJ:mdg

Attachment

Cc: Todd Ringsmuth, P.E. – Dames & Moore
Noller Herbert, P.E. – NRCS

ARIZONA DEPARTMENT OF WATER RESOURCES
SURFACE WATER MANAGEMENT DIVISION
Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004-3921
Telephone (602) 417-2445
Fax (602) 417-2423

JANE DEE HULL
Governor

RITA PEARSON MAGUIRE
Director

March 1, 2001

CERTIFIED MAIL (7000-0600-0023-9778-5037)
RETURN RECEIPT REQUESTED

Mr. Thomas D. Johnson, P.E., R.L.S.
Deputy Chief Engineer
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Subject: **White Tanks FRS #3 Dam (07.28)**
Receipt of Application

Dear Mr. Johnson:

Thank you for your application to alter White Tanks FRS #3 Dam. The Arizona Department of Water Resources (Department) received your application on February 9, 2001. Accompanying your application were the following additional documents:

1. Half-Size Construction Drawings included as attachments to the Design Report titled "Plans for the White Tanks FRS #3 Interim Dam Safety Improvements", dated January 2001, by Dames & Moore.
2. Specifications included as Appendix G (Special Provisions) and Appendix H (Supplementary General Conditions) of the Design Report titled "White Tanks FRS #3 Interim Dam Safety Improvements", undated, by Flood Control District of Maricopa County.
3. Construction Quality Assurance Plan included as Appendix I of the Design Report titled "Construction Quality Assurance Plan", undated, by Flood Control District of Maricopa County.
4. Design Report titled "Design Report Interim Dam Safety Improvements White Tanks FRS #3 (07.28)", dated February 7, 2001, by URS.
5. Engineer's Cost Estimate.
6. Fee, in the amount of $ 7,374.74 and Fee Calculation Sheet.
7. Curriculum Vitae for Alexander W. Gourlay, P.E.
8. Checklist of Items Required for an Application.
9. Draft Report titled "Maximum Water Surface Elevation for Inflow Design Flood (IDF) at White Tank Flood Retarding Structure No. 3 under Current Conditions", dated September 1, 1998, by Flood Control District of Maricopa County.
10. Report titled " Interim Operational Plan for White Tanks Flood Retarding Structure No. 3 Outlet Pipes", dated February 6, 2001, by Flood Control District of Maricopa County.

The Department has reviewed your submittal for conformance with the requirements of A.A.C. R12-15-1208 in accordance with the administrative review requirements of A.A.C. R12-15-1207(E)(2), and has determined that the application is administratively incomplete as detailed in the Department's Checklist of Items Required for a Complete Application. The attached comments identify additional information that is required to complete the application.

In accordance with A.A.C. R12-15-401(1), the administrative completeness review time-frame is 120 days from the day the Department received the application. The time-frame is suspended once a notification requesting additional information is mailed and until a response with the additional information requested is received. Although administratively incomplete according to the Department's checklist, we will continue to review the submittals for administrative completeness and will provide additional comments once our review has been completed. Upon receipt of all the additional items required we would begin our substantive review of the design. A.A.C. R12-15-401(2), requires that the additional information requested must be supplied within 60 days of the date of this notice, or within another time-frame agreed upon by the Department. Failure to complete the application within the specified time-frame, may deem the application withdrawn and the Department would close the file.

Your application to alter White Tanks #3 FRS Dam involves in no way the right to appropriate water. To secure the right to appropriate water, application must be made to the Arizona Department of Water Resources, Surface Water Rights Unit on forms, which will be furnished upon request.

Also as stated in the application instructions referred to above, construction of a dam may require additional permits from this and/or other governmental jurisdictions. We are advising, by separate letter, those jurisdictions we normally work with that we have received your application. We will send you a copy of each advisory letter. We recommend that you directly contact these jurisdictions as well as any others which may have jurisdiction on your project.

Michael Greenslade of the Dam safety Section will have primary responsibility for review of your project. You may contact him at (602) 417-2400 (Ex. 7188), if you have any questions.

Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:mdg

Enclosures

CC: Tom Renckly, P.E. - FCDMC (w/ Enclosures)

ARIZONA DEPARTMENT OF WATER RESOURCES
DAM SAFETY SECTION

MEMORANDUM

TO: Jon Benoist, P.E., Supervisor
Dam Safety Section

FROM: Michael Greenslade, P.E. MD6
Dam Safety Section

DATE: February 28, 2001

SUBJECT: White Tanks FRS #3 Dam (07.28) Administrative Completeness Review
Interim Dam Safety Measures Alteration Application

I have completed an administrative completeness review of the above referenced application. The following comments identify the additional information required for a complete the application in accordance with the Checklist of Items Required for a Complete Application. Additional comments may be generated as a result of my ongoing administrative completeness review as I have only reviewed the application for conformance with the checklist.

I. General Items

1. Instructions – The instructions for the Department's "Checklist of Items Required for a Complete Application" require that if a checklist item does not apply, indicate **N/A** and provide a supporting discussion. Where **N/A** was indicated, a supporting discussion was not provided. In addition, many of the checklist items were left blank. The checklist needs to be completed and revised in accordance with the instructions.
2. Fee – The engineer's cost estimate submitted to support the application fee is incomplete. The Unit Price and Total Cost columns are empty.
3. Two Sets (minimum) of Construction Drawings – The comment section of this item in the checklist references copies of drawings in the design report and full size sets (stamped by registered PE). The two full size sets were not included.
4. Two Sets (minimum) of the Emergency Action Plan, Operation and Maintenance Plan, and Instrumentation Plan – The comment section of this item in the checklist references an "Interim Operation Plan During Construction" that will be submitted by FCDMC in a separate document prior to contract award. This plan is required prior to approval of the application by the Department. The comment section also references an NRCS document titled "State of Arizona, Operation and Maintenance Handbook" dated March 1988. This document was not included with the application and is not on file at the Department.
5. Drawings, Specifications, CQA Plan and Design Report Sealed by a P.E. – The drawings, specifications and CQA Plan were not sealed.

II. Construction Drawings

6. Spillway and Outlet Works Rating Curves and Tables – The comment section references Drawings G3 and C1. A rating curve for the emergency spillway cannot be found.
7. Geologic Information – The comment section references Appendix C of the Design Report for boring and test pit logs and Figure 1 for their locations. Appendix C only contains 3 boring logs while Figure 1 shows 7 borings along with 3 test pits. Also, the comment references "ADWR historic files for FRS#3". The Department is not in a position to determine what data in its files the designer utilized. Specific references need to be provided.
8. Foundation Profile – ADWR historic files are referenced without specific references being provided. In addition, original dam design and as-builts are referenced. The Department does not have original as-built drawings on file for White Tanks FRS #3 Dam. The Department does have as-built drawings for construction of the central filter drain.
9. Drainage Area – A drawing showing the hydrologic data, drainage area (including sub-basins) and flood routing criteria was not included.

III. Construction Specifications

10. Control of Stream During Construction – While various sections of the specifications are referenced for this item, this information cannot be found.

IV. Design Report

11. Geotechnical Investigation – The comment section of this checklist item references a report titled "Draft Design Issues Report" and "ADWR historical files". Please refer to previous comments regarding the reference to ADWR historical files. Also, while the Department has a copy of the referenced report it is unclear what section(s) of this report are being referenced. A geotechnical investigation cannot be found. A Geotechnical Work Plan is included in Appendix A. Specific references need to be provided.
12. Dewatering Plan – The comment section states that a dewatering plan is not anticipated but will be required in the event water is encountered. This requirement should be included as a provision of the specifications.
13. Materials Information – The comment section for this checklist item references Figure 1 and Appendix C for materials information. Figure 1 is a boring and test pit location map and does not contain any tests results, and as previously stated Appendix C is incomplete. A table summarizing all test results is requested.
14. Foundation Conditions – The comment section of this checklist item references a report titled "Draft Design Issues Report". As previously stated, while the Department has a copy of the referenced report it is unclear what section(s) of this report are being referenced. Specific references need to be provided.

ARIZONA DEPARTMENT OF WATER RESOURCES
SURFACE WATER MANAGEMENT DIVISION
Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004-3921
Telephone (602) 417-2445
Fax (602) 417-2423

JANE DEE HULL
Governor

RITA PEARSON
MAGUIRE
Director

March 15, 2001

CERTIFIED MAIL (7000-0600-0023-9778-5020)
RETURN RECEIPT REQUESTED

Mr. Thomas D. Johnson, P.E., R.L.S.
Deputy Chief Engineer
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Subject: **White Tanks FRS #3 Dam (07.28) Alteration Application**
Supplemental Administrative Review Comments

Dear Mr. Johnson:

The Arizona Department of Water Resources (Department) has completed its administrative review of your alteration application for conformance with the requirements of A.A.C. R12-15-1208 and A.A.C. R12-15-1207(E)(2). As previously stated, in our letter of March 1, 2001, the Department has determined that the above referenced application is administratively incomplete The attached comments combined with the administrative review comments included with the Department's March 1, 2001 letter constitute the additional information that is required to complete the application.

In accordance with A.A.C. R12-15-401(1), the administrative completeness review time-frame is 120 days from the day the Department received the application. The time-frame is suspended once a notification requesting additional information is mailed and until a response with the additional information requested is received. Upon receipt of all the additional items required we would begin our substantive review of the design. A.A.C. R12 15-401(2), requires that the additional information requested must be supplied within 60 days of the date of this notice, or within another time-frame agreed upon by the Department. Failure to complete the application within the specified time-frame, may deem the application withdrawn and the Department would close the file.

Michael Greenslade of the Dam safety Section will have primary responsibility for review of your project. You may contact him at (602) 417-2400 (Ex. 7188), if you have any questions.

Sincerely,

For

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:mdg

Enclosure

CC: Tom Renckly, P.E. - FCDMC (w/ Enclosure)

ARIZONA DEPARTMENT OF WATER RESOURCES
DAM SAFETY SECTION

MEMORANDUM

TO: Jon Benoist, P.E., Supervisor JB
Dam Safety Section

FROM: Michael Greenslade, P.E. MG
Dam Safety Section

DATE: March 13, 2001

SUBJECT: White Tanks FRS #3 Dam (07.28) Administrative Completeness Review Interim Dam Safety Measures Alteration Application

I have completed an administrative completeness review of the above referenced application. Previous comments contained in my memo dated February 28, 2001 identified the additional information required for a complete the application as compared with the Department's "Checklist of Items Required for a Complete Application". The following additional comments were generated as a result of my administrative completeness review of the documents included with the application. The application remains administratively incomplete. Submittal of revised application documents that address comments in this memo as well as my February 28, 2001 memo are required for an administratively complete application.

1. A.A.C. R12-15-1220(C) Requirements – In the Department's review of the 95% pre-application submittal the Flood Control District of Maricopa County (FCDMC) was informed, review comment No. 1, that according to A.A.C. R12-15-1220(C) the owner of a dam that has been determined to be "Unsafe" must comply with the requirements of A.A.C. R12-15-1216 unless the requirements are determined to be unduly burdensome or expensive and are not necessary to protect human life or property. The Director must state in writing the reason or reasons why the owner is not required to comply with a requirement. Therefore, it was requested that the application include sufficient information for the Director to determine whether a waiver of requirements specified in A.A.C. R12-15-1216 is justified. While an unsigned discussion of the project description was attached to the application a request to waive the requirements of A.A.C. R12-15-1216 and supporting justification was not included. Without the requested waiver and supporting justification, I cannot recommend any waivers by the Director.
2. Design Report (Section 3.3.2) – The second paragraph of this section discusses the central filter/drain design and references drain fill on the upstream side and course aggregate on the downstream side. While the terminology used is consistent with the central filter/drain as-built drawings they do not adequately describe the materials and even mislead the reader. Figure 2 of the application provides a more accurate description of the central filter/drain materials. Figure 2 references gravel/cobble drain material on the downstream side and sandy gravel filter/transition material on the upstream side of the central filter/drain. Section 3.3.2 of the design report should be revised to provide a more accurate description of the chimney drain materials. While this comment may appear to be "nit-picking", in my opinion

it is critical that the design report discussion regarding the central filter/drain be clear and concise for the record.

3. Drawing C2 – The concrete apron on the slope of the buttress over the outlet pipe extension (also shown on Drawing C5) is not consistent with the apron shown in cross-section "A" on Drawing D2. Please revise the drawings for consistency.
4. Drawing C3
   a. See comment No. 3 above regarding the concrete apron on the slope of the buttress over the outlet pipe extension (also shown on Drawing C6) as not being consistent with the apron shown in cross-section "A" on Drawing D3.
   b. What appears to be a riprap pad is shown at the outlet of the pipe. This riprap, also shown on Drawing C6, is not shown in cross-section "A" of Drawing D3 and details of construction are not provided. Please provide details of construction for this riprap pad.
5. Drawing C4 – See comment No. 3 above regarding the concrete apron on the slope of the buttress over the outlet pipe extension (also shown on Drawing C7) as not being consistent with the apron shown in cross-section "A" on Drawing D4.
6. Drawing D2 - Section "B" does not show the diaphragm filter completely surrounding the concrete encasement as described in the second paragraph of Section 5.1.2 of the Design Report. Also, Section "A" appears to only show the diaphragm filter butting up against the upstream side of the concrete encasement. Please revise the details and sections to show diaphragm filter material completely surrounding the concrete collar. When doing so please ensure that the minimum soil buttress cover requirements are maintained over the diaphragm. This may require moving the pipe joint coupling further upstream into the embankment.
7. Drawing D3
   a. See comment No. 6 above regarding the diaphragm filter not completely surrounding the concrete encasement.
   b. The section designator for Section "B" of this drawing is not properly located.
8. Drawing D4 - See comment No. 6 above regarding the diaphragm filter not completely surrounding the concrete encasement.
9. Appendix D – In response to the Department's request for copies of color photographs for the "Filter and Crack Investigation" (comment No. 12 on the 95% pre-application submittal), color photographs were to be supplied with the final submittal. Color photographs have not been provided.
10. Appendix E – Comments on the calculations are addressed as they apply to the specified materials.
11. Appendix F – The appendix titled "December 1999 Survey" consists of full size drawings prepared by A Team Professional Associates Inc. and submitted separately. These drawings are confusing, and as a reviewer I cannot figure out their purpose or exactly where the specific survey points are in relation to known features of the dam. A detailed explanation of the drawings, results and interpretations are needed. Following are just a few questions that come to mind when viewing the drawings.
    a. Was the entire dam surveyed? It appears to only be a partial survey with seismic lines.
    b. Where are the results of the seismic line surveys?
    c. What was the purpose of the seismic surveys?
    d. How do these survey results compare with previous surveys (i.e., settlement

monument surveys contained in the FCDMC settlement monitoring report dated June 1, 1995)?

e. Have the results been charted and graphed?

f. Is there a survey profile?

g. Are the survey locations associated with stationing on the dam?

h. Were the settlement monuments surveyed?

12. Specification Subsection Section 206.2 (Foundation Material Treatment) – This subsection specifies no special treatment of the foundation beneath the structural fill unless the in-situ soil is disturbed or loosened, at a depth of 3-inches or more. To be valid for the design, the foundation materials must meet the filter design requirements and may require over excavation and replacement with suitable materials that meet the design requirements. Considering that the filter match design is based on only one sample (see Calculation Package #7 – "Foundation to Filter Match" and Calculation Package #10 – "Foundation to Drain Match") unacceptable foundation materials should be anticipated. This subsection needs to be revised to allow for the excavation and replacement of unsuitable foundation materials. This subsection should also identify what constitutes acceptable foundation materials and the depth of excavation required for replacement of unacceptable materials. When specifying acceptable foundation and replacement materials, filter matching between adjacent materials need to be considered. Section 6.4 of the CQA Plan does not adequately address the rejection and acceptance of foundation materials.

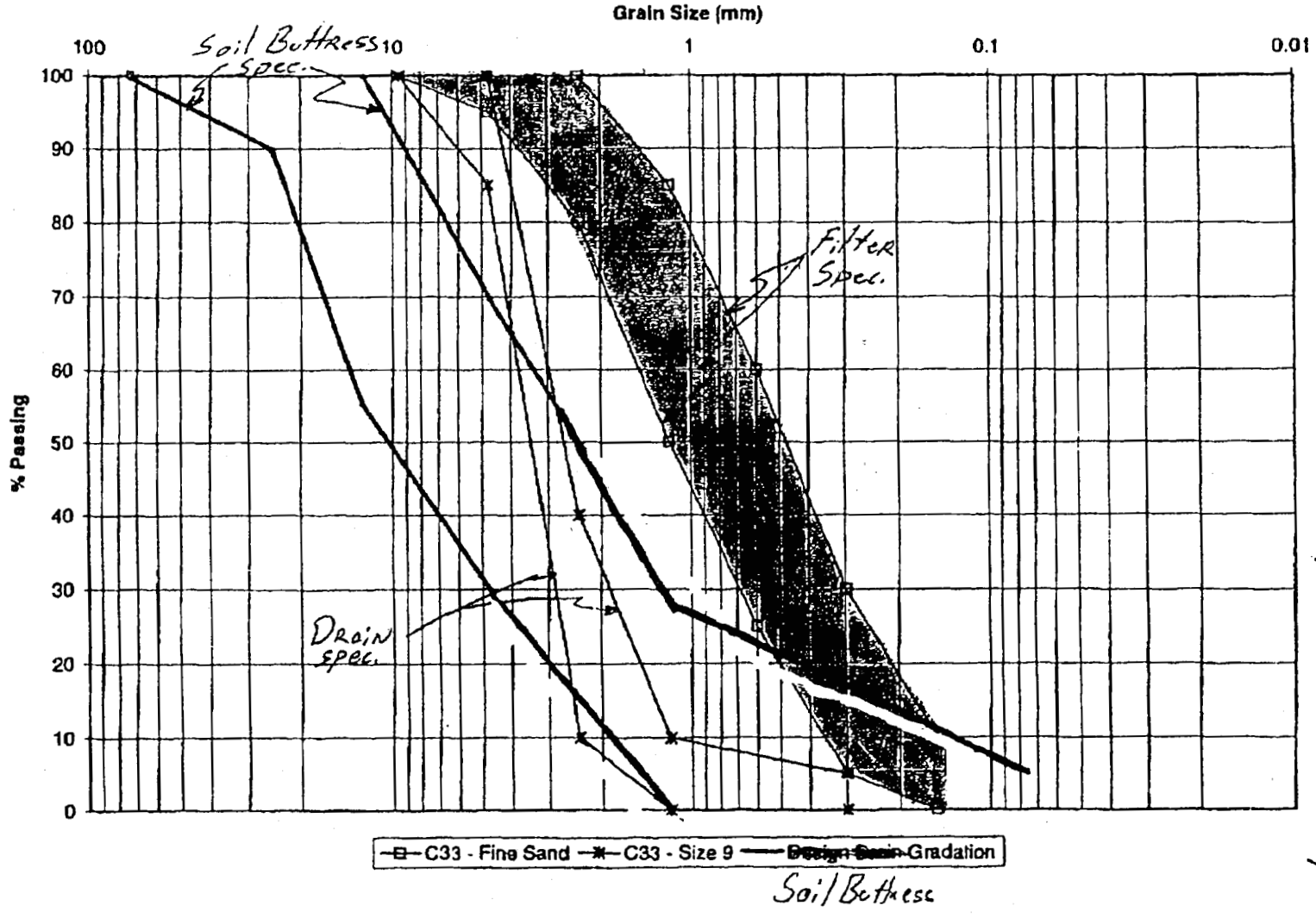
13. Specification Subsection 211.1.2 (Soil Buttress Fill)

a. This subsection specifies the soil buttress fill material. A review of the specifications indicates a possible filter mismatch with the drain sand specified in Subsection 211.1.3. The attached figure, witch is a slightly modified Page 3 of 10 of Calculation Package #10 indicates that as specified, the fine components of the drain sand can be courser than the fine components of the specified soil buttress material resulting in a possible filter mismatch. Corrective options are (1) modify the soil buttress material specification, (2) separate the soil buttress material and drain sand with the filter material, and (3) separate the soil buttress material and drain sand with a geotextile. If the second option is chosen, the thickness of the filter material will need to be evaluated. If the third option is chosen, the requirements of A.A.C. R12-15-1216(B)(3)(c) need to be considered (i.e., the geotextile cannot be the sole defense against dam failure).

b. The material specification for the soil buttress material does not appear to be achievable. The attached figure, Page 4 of 5 of Calculation Package #5, indicates that 2 of the 3 samples of potential borrow material obtained are significantly finer than the specified material. Does the contract for this project anticipate the blending of imported material?

c. This subsection specifies acceptable materials as having a PI less than 10 while Subsection 211.2.2 specifies unacceptable material as having a PI greater than 10. Is material with a PI equal to 10 acceptable or unacceptable?

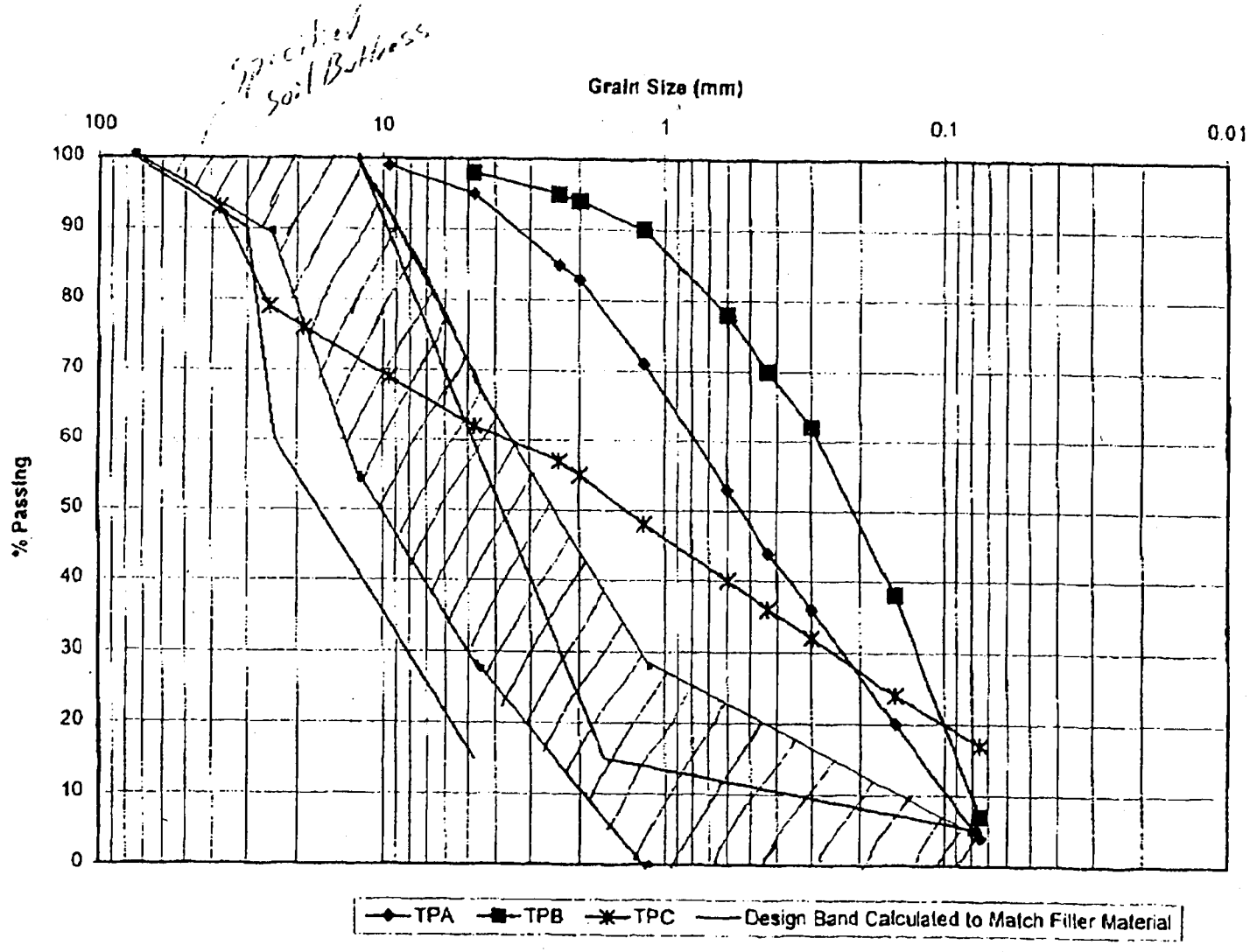
14. CQA Plan (Table 1) – Laboratory and field density testing is not specified for the course drain sand. The specifications, Subsection 211.3.3, require that the drain sand be compacted to a minimum relative density of 70%. How is the degree of compaction and compliance with the specifications to be determined if testing is not conducted?


Grain Size (mm)
100
10
1
0.1
0.01
% Passing
100
90
80
70
60
50
40
30
20
10
0
Soil Buttress Spec.
Filter Spec.
Drain Spec.
C33 - Fine Sand
C33 - Size 9
Design Basin Gradation
Soil Buttress

3/10

5/4

White Tanks FRS #3
Interim Dam Safety
15448-007-058



P:\15448\007\03DamSafety\Calcs\Filter Calcs.xls,Filter-Buttress Chart

RC 6/25/01

ARIZONA DEPARTMENT OF WATER RESOURCES
SURFACE WATER MANAGEMENT
Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004
Telephone 602-417-2445
Fax 602 417-2423

JANE DEE HULL
Governor

JOSEPH C. SMITH
Director

June 21, 2001

Mr. Thomas D. Johnson, P.E., R.L.S.
Deputy Chief Engineer
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Subject: White Tanks FRS #3 Dam (07.28)
Approval of Application for Alteration

Dear Mr. Johnson:

The Arizona Department of Water Resources (Department) has completed its review of your application and the supporting documentation submitted for the alteration of White Tanks FRS #3 Dam. The alteration includes the construction of diaphragm filter for the outlets, the installation of trash racks for the inlets and the construction of a low flow channel through the emergency spillway. In accordance with A.A.C. R12-15-401 and A.A.C. R12-15-1207 your application to alter the dam has been approved.

Enclosed are 5 copies each of the approved application and construction documents: Drawings, Specifications, and Construction Quality Assurance (CQA) Plan. Please ensure that a set of the construction documents is maintained at the construction site at all times.

Also enclosed for your information is the document titled "Requirements During and Following Dam Construction" which list items required of all applicants in accordance with A.A.C. R12-15-1212 and A.A.C. R12-15-1213. Please read the document carefully because the items described in them must be fulfilled before the Department can issue the owner a new License of Approval to operate the dam or allow use of the reservoir.

This approval is subject to specific terms and limitations (conditions) listed as follows:

Condition 1 – Construction work shall be started within one (1) year from date.
Condition 2 – No foundations or abutments shall be covered by the material of the dam until the Department has been given an opportunity to inspect and approve the same.
Condition 3 – The drawings and specifications approved incorporate Addendum No.1 (dated May 15, 2001) and Addendum No.2 (dated 12, 2001),

Condition 4 – The "Interim Dam Safety Design Report" must be updated to incorporate all revisions and resubmitted for approval to the Department prior to commencement of construction.

Condition 5 – Calculations demonstrating the structural adequacy of the trash racks if fully plugged with debris must be provided prior to installation of the trash racks.

As indicated in condition two, we intend to inspect the work periodically. In that regard please advise us at least 48 hours in advance of all critical construction activities. Advance notification will facilitate timely inspection and approval by the Department.

Please note that any changes proposed to the approved design during construction must have the Department's approval prior to implementation.

Please also note that this approval is limited to the Department's responsibilities and authority as described in the Arizona Revised Statutes, Title 45-Waters, Chapter 6, Article I, Supervision of Dams, Reservoirs and Projects. This approval in no way relieves the owner of responsibility for securing other required permits, approvals or permissions from other jurisdictional agencies before commencement of construction.

If you or anyone connected with the construction of this project have any questions regarding this approval, please contact Michael Greenslade of the Dam Safety Section at (602) 417-2400 (Ex. 7188). Thank you for your cooperation during our review of the application.

Sincerely,

Jon M. Benoist, P.E.
Supervisor
Dam Safety Section

JMB:MDG:mdg

Enclosures (1) Approved Application (2) Five copies each of the Drawings, Specifications, and CQA Plan (3) Requirements During and Following Dam Construction

CC: Tom Renckly, P.E. - FCDMC (w/o Enclosures)
Nollar Herbert, P.E. – NRCS (w/o Enclosures)

ARIZONA DEPARTMENT OF WATER RESOURCES
Safety of Dams & Flood Engineering Unit

Application No. 07.28-3 Filed Feb. 9, 2001
(Applicant shall not fill in above blanks)

APPLICATION for APPROVAL of the PLANS and SPECIFICATIONS for the CONSTRUCTION, ENLARGEMENT, REPAIR, ALTERATION or REMOVAL of a DAM and RESERVOIR

JANE DEE HULL
Governor

RITA PEARSON MAGUIRE
Director

This application is for the Modification (Construction, Enlargement, Repair, etc.) of the White Tanks FRS #3 (07.28) (Name of Dam) Dam.

LOCATION OF DAM

This dam is in Maricopa County, in the N/A 1/4, Sec. 4, 8, and 9, Twp. 2N, Rge. 2W, G&SR B&M,

at North Latitude 33°, 31', 40" and West Longitude 112°, 28', 0", on USGS Quad Waddell,

and is located on the White Tanks Flood Retarding Structure #3 (Wash, Creek, River or Watershed), tributary to N/A (Wash, Creek or River).

OWNER

Name: Flood Control District of Maricopa County Telephone: 602-506-1501

Mailing Address: 2801 W Durango St, Phoenix, AZ 85009

If this application is for construction of a new dam complete all items (1 through 21) except item 12. For enlargement, repair, alteration or removal complete items 12 through 21 and those other items where a change is being made.

DESCRIPTION OF DAM AND RESERVOIR

1. Type of dam _____ (Earth, Rock, Concrete Gravity, etc.). Purpose of dam _____.

2. Dam crest elevation _____ feet. Spillway crest elev. 1207.0 feet. Outlet invert elev. _____ feet.

3. Dam height is _____ feet (Measured from the lowest elevation of the outside limit of the dam at its intersection with the natural ground surface to the crest of the spillway - ARS 45-1201.2).

4. Dam crest length _____ feet. Dam crest width _____ feet. Dam Crest Camber (if any) _____ feet.

5. Dam slope: Upstream _____: 1 (horizontal:vertical); Downstream _____: 1 (horizontal:vertical).

6. Spillway (type, dimensions, control(s), design capacity, flow depth, etc.): A notch will be excavated in the spillway to lower the spillway crest elevation to 1207 feet.

7. Outlet (type, internal diameter, dimensions, control(s), capacity, trashrack, energy dissipator): Trash racks will be installed on all three existing outlets that have slide gates (north 48-inch dia., central 48-inch dia., south 24-inch dia.).

8. Reservoir at spillway crest elevation: Storage capacity _____ acre-feet; Surface area _____ acres.
Reservoir at dam crest elevation: Storage capacity _____ acre-feet; Surface area _____ acres.

HYDROLOGIC DATA

9. Drainage area _____ square miles. Names of upstream dams _____

10. Downstream Hazard: _____
(Nearest downstream town, population, distance, other inhabitants or development, Downstream Hazard Potential Classification)

11. Inflow design flood: _____. Duration _____ hours. Precipitation _____ inches.
(100-year, 0.5 PMF, PMF)

Peak inflow rate _____ cfs. Water surface elevation is _____ feet at the time of the maximum spillway discharge of _____ cfs during routing of the Inflow Design Flood.

GENERAL INFORMATION

12. Description of Work (enlargement, repair, alteration, etc.): Modification (Interim Dam Safety Modifications)

13. Use of stored water: Flood Control

14. Other federal, state or local permits (to be) applied for; Give details, include date(s): 404 Permit obtained on August 17, 2000, Temporary Construction Easement obtained from Maricopa Water District on January 16, 2001.

15. Describe provisions to divert flood flows during construction; include frequency (years) and flow rate (cfs): None.

16. Construction is expected to begin May 2001 (Month and Year). Estimated completion October 2001 (Month and Year).

17. Estimated cost of dam, reservoir and appurtenances (ARS 45-1204.A): $458,316.00

18. Fees accompanying this application (fees based on cost; R12-15-151): $7,374.74

19. Investigations, design, drawings and specifications prepared by (identify firm and Engineer of Record; attach resume highlighting dam design experience): Alexander W. Gourlay P.E., URS/Dames & Moore (see attached resume)

20. Construction Quality Assurance & Quality Control to be performed by (identify firm, Site Engineer, and Engineer of Record; attach resumes) highlighting dam construction experience): To be determined. (FCDMC on-call soil testing consultant)

21. Emergency Action Plan prepared by: Flood Control District of Maricopa County

Application submitted by (signature): _____ Date: 2-9-01

Name: Thomas D. Johnson, P.E., R.L.S., Deputy Chief Engineer, FCDMC Mailing Address: 2801 West Durango, Phoenix, AZ 85009

Legal capacity if other than owner: N/A

APPROVAL OF APPLICATION No. 07.28-3

This is to certify that Application No. 07.28-3, including the drawings and specifications for White Tanks FRS #3 Dam and Reservoir has been examined and the same is hereby approved, subject to the following terms and limitations:

1. Construction work shall be started within one (1) year from date.

2. No foundations or abutments shall be covered by the material of the dam until the Department has been given an opportunity to inspect and approve the same.

Dated this 19th day of June, 2001

J. Darrell Jordan
Assistant Director, Surface Water Division

95/04

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399
(602) 506-1501
FAX: (602) 506-4601
TT: (602) 506-5859

July 18, 2000

MEMO TO: Sandy Gourlay, Dames & Moore

FROM: Tom Renckly

SUBJECT: White Tanks FRS#3, Interim Dam Safety, 90% Submittal Dated May 26, 2000 – Comments on Special Provisions

SPECIAL PROVISIONS

Title Page - Label as "Special Provisions" instead of "Construction Specifications". See attached title page (electronic file to be provided).

Table of Contents- See attached revised Table of Contents page (electronic file to be provided). Use same footer through document, note table of contents is page 2.

First Page of SPs – See attached for heading and footer (electronic file to be provided).

Text Font - Use Font: Times New Roman, Font Style: Regular , Size 10

BID ITEM – Indicate bid item number (in bold caps) after all payment paragraphs:
Example: "**ITEM 215 – EARTHWORK FOR OPEN CHANNEL**"
NOTE: 1. Bid item number and description in SPs, Plans and Bid Item Sheet Must Match
2. Where there is no bid item, DO NOT include the words "NO BID ITEM"

Section 201.4 – Change "bestoraged" to "be stored".

Section 201.5 – Delete first paragraph.

Section 202 – Add mobilization section, see attached (electronic file to be provided). Typically, mobilization is not allowed to exceed 3% as indicated, however for this contract a larger percentage may be justified. Please evaluate.

Section 206.5 – Delete first paragraph. Delete words "BID ITEM"

Section 225.2, last paragraph – Delete name of contact and add MWD phone number 623-546-8266.

Section 350.2, Second paragraph – Delete second sentence. The county no longer handles landfill use permits.

515.2 Materials – Text missing.

Subsection 515.3 – Installation – Text missing.

Subsection 515.3 Workmanship – Should this be Subsection 515.4?
Correct the spelling of the word "corners" in two locations
525.5, First line - change "arc" to "are".

530.8.2 (C) – Change to read: "on at least **1**"

621.3 Fourth sentenee– Change to read "... shall be no more the **1** inch in 10 feet..."

621.3.4, Third sentence – Complete the sentence.

Page 701-1, 701.3 Sand – Change from "7013.1" to "701.3.1"

701.4.3 (B) (1), Second par., last sentence – Change to read: "...after test shall be weighed...

760.1 First paragraph, last sentence – Change to read: "The size, type..."

760.3 Second paragraph first sentence – Change to read:
"...accepted brands of metal, sheet manufacturer's certified..."

Page 790-2, Last sentence on page – Change to read: "When Paint No. **1** is ..."

Comments on Supplementary General Conditions will be provided by separate memorandum.

SPECIAL PROVISIONS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY

PCN 470-04-30

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2000C028
WHITE TANKS FRS#3
INTERIM DAM SAFETY

SPECIAL PROVISIONS

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY

PCN 470-04-30

SPECIAL PROVISIONS

SECTION 202 MOBILIZATION

202.1 Description:
The work under this section shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment , supplies and incidentals to the project site; the establishment of all offices, buildings and other facilities necessary for work on the project, and for all other work and operations that must be performed and costs incurred prior to beginning work on various items on the project site.

202.2 Payment:
Payment shall be made on the basis of the lump sum price bid and shall be full compensation for supplying and furnishing all materials, facilities, and services and performing all work involved as specified herein. The lump sum price bid shall not exceed three percent (3%) of the total project bid amount exclusive of mobilization. No additional payment will be made for occupancy and services during periods of contract time extension due to engineering changes.
ITEM 202 - MOBILIZATION

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399
(602) 506-1501
FAX: (602) 506-4601
TT: (602) 506-5859

July 20, 2000

MEMO TO: Sandy Gourlay, Dames & Moore

FROM: Tom Renckly

SUBJECT: White Tanks FRS#3, Interim Dam Safety, 90% Submittal Dated May 26, 2000 – Comments on Supplementary General Conditions

SUPPLEMENTARY GENERAL CONDITIONS

Title Page – Format title page the same as Special Provisions (reference memorandum dated July 18, 2000)

Table of Contents- Format Table of Contents page the same as Special Provisions (reference memorandum dated July 18, 2000).

First Page of SGCs – Format first page the same as first page of SPs. (reference memorandum dated July 18, 2000).

Text Font - Use Font: Times New Roman, Font Style: Regular, Size 10

Page 4/52, Subsection 101.2 – Delete this subsection on this page only.

Pages 10–15, 101.2 Definitions and Terms – Revise/add definitions of terms as follows:

1. Change definition to: "**Board of Supervisors**: The Board of Directors acting under the authority of the laws of the State of Arizona and in their capacity of the Board of Directors of the Flood Control District of Maricopa County."

2. Change definition to: "**Budget Project**: A project financed by funds set aside in the annual budget or otherwise approved by the Flood Control District of Maricopa County Board of Directors."

3. Add to the definition of **Contract Documents**: "Supplementary General Conditions."

4. Change definition to "**Engineer:** The person appointed by the Flood Control District of Maricopa County Board of Directors to the office of Chief Engineer and General Manager of the Flood Control District of Maricopa County acting directly or through its authorized representative, the Chief of the Flood Control District of Maricopa County Planning and Project Management Division."

5. Change definition to: "**Notice of Award:** A letter from the Flood Control District of Maricopa County advising Contractor that it is the successful bidder and the Flood Control District of Maricopa County has accepted its proposal."

6. Change definition to: "**Owner:** The Flood Control District of Maricopa County, acting through it's legally constituted officials, officers, or employees."

7. Add definition: "**Maricopa County Minority Business Office (MBO):** The office responsible for administering the Maricopa County Minority and Women Owned Business Enterprise Program."

8. Add definition: "**Maricopa County Minority and Women Owned Business Enterprise Program**: The Program adopted by the Board of Supervisors effective January 1, 1992."

102.4 – Add the following:

"Subsection 102.4 - Examination of Plans, Special Provisions, and Site OF Work: The following is available for review at the District, and Contractors are encouraged to do so:" ***Add here a list of reports/documents recommended for review by prospective Contractors***

"Existing moisture conditions shall be no basis for claim for additional money or time extensions. The Contractor shall manipulate the existing soil as required to achieve stable soil conditions and the required densities, as well as safe and stable side slopes during construction activities."

102.5 – Revise section title to: "Preparation of Bid:"

102.5 - Delete the underlined text and replace with the following:

"Bids, including the Bidding Schedule, must be legibly written in ink or typed, with all prices given in numerals. In case of a conflict between the unit bid price and the extension, the unit bid price shall govern.

It shall be the responsibility of prospective bidders to determine, prior to submission of a bid, if any

addenda have been issued by the Flood Control District. This may be accomplished by calling 602-506-1501. Any addendum issued, if not already bound into the Special Provisions, **shall be attached and included as part of the Specifications** and any quantities on the Bidding Schedule requiring change shall be adjusted to the new figure by pen and ink. **Bids which do not have appropriate addenda attached, show appropriate changes to the Bidding Schedule, and acknowledge receipt of addenda in the Proposal may be invalid.**

The bidder's Arizona State Contractor's License number and the classification under which it proposes to perform the work shall be shown on the proposal. An **"A" General Engineering** License is required for this contract. The two lowest bidders may be required to provide certification of prior satisfactory completion for similar construction and to furnish a copy of their license and the renewal certificate."

102.6 – Delete underlined text and replace with the following:

"A list of subcontractors and suppliers (including any M/WBE participation) intended to be used on the project shall be submitted with the bid, on the form provided in the Proposal. Although this list will not be considered as final commitment on the part of the successful proposer, any subcontractor changes from those listed must have Owners written approval prior to work performed on site by a subcontractor."

102.7 – Item J – Replace with the following:

"(J) If the statement from bidder's insurance carrier as required by Subsection 103.6 is not included."

102.9 - Revise for project name, PCN and FCD contract number:

103.3 – Delete underlined text.

103.6 – Revise the first sentence to read as follows:

"A statement from bidder's insurance carrier shall be included in the proposal certifying that it will furnish the specified kind and amounts of insurance to the bidder if it is awarded the contract."

103.6.2 – Add the following:

"Additionally, Contractor shall execute the Indemnification found in the Contract Documents."

104.1.1 – Add the following:

"The proposed work is located in unicorporated Maricopa County. The site is approximately __ miles _____ of Phoenix and can be reached by proceeding (***add driving directions to north entry***). The proposed work consists primarily of _____.

The average elevation of the project is _____feet.

All water for construction purposes, drinking water, lighting, temporary electric power, heat and

telephone service shall be arranged and provided for as per requirements of the work by Contractor at his expense."

105.2 – Add the following section:

"**105.2.1 – Plans and Shop Drawings:**

Shop drawings means drawings, submitted to the Engineer by the Contractor pursuant to the contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor to explain in detail specific portions of the work required by the contract.

Product Data is information on manufactured items, either stock or modified, and includes descriptive literature, operating data, performance curves, certified dimensional drawings, wiring or schematic control diagrams, piping, instrumentation, parts lists, and operating, maintenance and lubrication manuals."

105.1.1 – Revised first sentence to include reference to added section 105.2.1.

105.5.2 – Delete the last sentence of the first paragraph and add the following:

"The Contractor shall submit to the Engineer during the pre-construction meeting the following documents:

Mix design composition
Manufacturer's certification for all materials
Material data safety sheets
Preliminary work schedule
Preliminary traffic control plan
Shop drawings
Emergency telephone numbers
Signing authority letter
Name and telephone number of the certified safety professional

The pre-construction meeting will cover topics such as critical elements of the work schedule, payment application and processing of invoices. Additionally, a scheduled start date for the work will be determined."

106.1, Last paragraph, last sentence - Revise as follows: "...with the Special Provisions and these Supplementary General conditions."

106.5 – Add the following:

"The Contractor shall obtain approval of the Engineer when using vacant property to park and service

equipment and store materials for use. The Contractor will obtain prior written approval of the property owner for such use and submit a copy of the approval to the Engineer prior to use of the property.

The Contractor shall grade all construction yards, easements and limits of construction which are disturbed by construction or construction related activities to the lines and grades shown on the plans; or as a minimum, where no line or grade is shown, to a condition similar to or better than the pre-existing condition."

107.2 - Delete the complete section and replace with the following:

"Contractor shall obtain all permits and licenses, including those required by local utility companies and shall pay all charges, fees, taxes, and provide all notices necessary and incidental to the due and lawful prosecution of the work. Permits for earth moving may be obtained from Air Pollution Control, Maricopa County Department of Environmental Management, 2406 South 24th Street, Suite E-214, Phoenix, Arizona 85034, telephone number (602) 506-6700. The cost for the earth moving dust control permit is $80 plus $8 per acre. The above permit costs are subject to change. It is the responsibility of the Contractor to verify these costs."

FCD Comment: Add the following section:

" **Subsection 107.2.1 - NPDES Permit Requirements:**

A. This project is subject to the National Pollutant Discharge Elimination System (NPDES) Storm water requirements for construction sites under the Environmental Protection Agency (EPA) General Permit for Arizona. Under provisions of that permit, the Contractor shall be designated as permittee, and shall take all necessary measures to assure compliance with the NPDES General Permit for Arizona as well as all other applicable Federal, State and local laws, ordinances, statutes, rules and regulations pertaining to Storm water discharge. As the permittee, the Contractor is responsible for preparing, in a manner acceptable to the EPA, all documents required by this regulation, including but not necessarily limited to:

1. Storm water Pollution Prevention Plan (SWPPP) for the project, including certification of compliance form. Contractor shall be required to develop, implement, update and revise the SWPPP, as necessary, in order to assure compliance with the EPA permit requirements. The SWPPP shall be retained on the project site at all times during construction.

2. Notice of Intent (NOI) to assure compliance with the NPDES General Permit for Arizona, including certification of signatures.

3. Notice of Termination (NOT) of coverage under NPDES General Permit for Arizona.

B. Preliminary copies of the NOI and the SWPPP shall be submitted to Owner during the pre-construction meeting and shall be subject to review by Owner prior to implementation.

C. Contractor shall submit the completed and duly signed NOI forms no later than forty-eight (48) hours prior to the initial start of construction on the project to the following agencies:

EPA Storm water Notice of Intent
P.O. Box 1215
Newington, VA 22122

A copy of the completed NOI form shall be submitted to the following:

Storm water Coordinator
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600

Maricopa County, Current Planning
Planning and Development Division
411 N. Central Ave., Suite 300
Phoenix, AZ 85004
(602) 506-3301

Failure by the Contractor (or Subcontractors of any tier) to submit NOI's within the mandated time frame shall result in delay of the construction start date, and no claim for extension of time will be granted for such delay. A copy of the completed NOI shall be posted at the construction site.

D. Inspections of all Storm water pollution control devices on the project shall be performed by Contractor on a monthly basis and following each rainfall of 0.50 inches or more in a 24-hour period at the project site as required under provisions of the NPDES General Permit for Arizona. Contractor shall prepare reports on such inspections and retain the reports for a period of three years following the completion of the project. Inspection reports shall be submitted monthly to Owner along with progress payment requests. Additionally, Contractor shall maintain all Storm water pollution control devices on the project in proper working order, which shall include cleaning and/or repair during the duration of the project.

E. Contractor warrants that its employees and Subcontractors of any tier and their employees shall at all times comply with all applicable laws, ordinances, statutes, rules and regulations set forth by all federal, state and local governments and the Environmental Protection Agency in connection with NPDES Permitting requirements and laws and regulations pertaining to air, groundwater and surface water quality.

Fines and penalties imposed by the EPA against Owner or the Contractor for Contractor's failure to comply with any of the requirements of NPDES General Permit of Arizona shall be borne by the Contractor.

F. Upon project completion, acceptance and demobilization, Contractor shall submit its completed, duly executed NOT form to the EPA, with a copy to the Arizona Department of Environmental Quality (and the appropriate municipality), at the address listed in Section (B) above, thereby terminating all NPDES permit coverage for the project. Contractor shall then surrender to Owner copies of the SWPPP, inspection information and all other documents prepared and maintained by the Contractor in compliance of the NPDES General Permit. Contractor shall retain the originals of such documents for a period of three (3) years following the completion of the project.

G. The Lump Sum price for the SWPPP shall include all material, labor, and all other costs relating to the preparation, installation and maintenance of the SWPPP during project construction, including assuring proper operation of the pollution control devices installed, and all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events, runoff or releases on the project. The Lump Sum price for the SWPPP shall be inclusive of all costs, and no additional claims shall be made by Contractor under any other specification provision of these documents, including Changed Conditions. Payment for this bid item shall be upon completion and acceptance of the project, as per Section 109.1.

H. Copies of all required forms and guidance for preparing the SWPPP are available in the "Drainage Design Manual for Maricopa County, Volume III Erosion Control." The manual is available at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009.

Payment for NPDES/SWPPP permit requirements shall be made on the basis of lump sum for all work described in Subsection 107.2 .1 for:
ITEM 107-1 NPDES/SWPPP PERMITS "

FCD Comment: A determination of need for a 401 and 404 for this project is pending review by the USACOE. At this time it is assumed a permit will be needed therefore, Add the following section:

"Subsection 107.2.2 - OTHER PERMITS:

The following permits have been obtained by the Owner for the construction of the dam. The Contractor shall follow all terms and conditions of each permit as they apply to his operations.

State 401 Water Quality Certification:
The Corps of Engineers and the Arizona Department of Environmental Quality have determined that this project requires a Section 401 permit. The following are general requirements of the permit:

THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY - POLICY FOR PROTECTING WATER QUALITY DURING FACILITY CONSTRUCTION

Appropriate items as listed below should be included in specifications for construction and related activities in or near watercourses. Adherence to the cited procedures should assure compliance with Water Quality Standards for Navigable Waters, A.A.C. R18-11-1. Specifications should require the person responsible for the activity to submit a program for effective control of water pollution to the person in charge of the project which includes procedures for protecting water from pollution with fuels, oils, bitumens, calcium chloride, silt, cement, asphalt, tires, batteries and other harmful materials, and for conducting and scheduling operations so as to avoid or minimize silting of the water.

SPECIFIC PROCEDURES FOR PREVENTING WATER POLLUTION MAY INCLUDE:

1. *Provision for temporary pollution control measures such as: dikes, basins, ditches, diversions, silt fences and the application of straw and seed, to be functional prior to land disturbing activities.*

2. *Erosion control measures including minimizing clearing and grubbing and limiting exposure of erodible surface to 750,000 square feet for each construction phase or location.*

3. *Construction of footings in water by sheet pile cofferdam method and pumping water from within the dam to*

settling ponds before returning it to the watercourse.

4. *Isolation of the construction area by dikes and/or berms.*

5. *Erection of barriers, covers, shields and other protective devices as necessary to prevent any construction materials, equipment or contaminants/pollutants from falling or being thrown into a watercourse.*

6. *Construction of drainage facilities with armoring when necessary to control erosion and sedimentation.*

7. *Provision of an adequate means, such as a bypass channel, to carry a stream free from mud and silt around operations which remove material from beneath a flowing stream.*

8. *A requirement for the transportation of materials across live streams to be conducted without muddying the stream. Mechanized equipment should not be operated in stream channels of live streams except as may be necessary to construct crossings or barriers and fill for channel modifications.*

9. *A requirement for wash water from aggregate washing or other operations containing mud or silt to be treated by filtration or retention in a setting pond, or ponds adequate to prevent water from transporting sediment into streams or watercourses.*

10. *A requirement for oily or greasy or substances originating form the contractor's operations not be placed where they will later enter a stream or watercourse.*

11. *Provisions for Portland cement or fresh Portland cement concrete not be allowed to enter flowing water of streams.*

12. *A requirement to return the flow of streams as nearly as possible to a meandering thread without creating a possible future bank erosion problem when operations are completed.*

13. *A requirement that material derived from roadway work should not be deposited in a stream or watercourse where it could be washed away by stream flows.*

Contractor shall follow all the requirements in the 401 Water Quality Certification permit. The permit will be attached to the bid documents.

US Army Corps of Engineers, 404 Permit:
The Corps of Engineers has determined that this project requires a permit under Section 404 of the Clean Water Act. An excerpt from the permit is presented below:

Permit Number: _____

The Corps of Engineers has determined, under Section 404 of the Clean Water Act (33 U.S.C. 1344), that your proposed activity complies with the terms of Nationwide Permit No_____. You must comply with all terms and applicable conditions (regional, general, 404 only, and 401 conditions) described in Enclosure 1 and complete the compliance statement (Enclosure 2).

*Furthermore, you must comply with the following Special Condition(s):*_____

Contractor shall follow all the requirements in the permit. The permit will be attached to the bid documents."

107.4 - Add the following:

"Any cultural and/or paleontological resource (historic or prehistoric site or object) discovered by the Contractor, or any person working on his behalf, shall be immediately reported to the Engineer. The Contractor shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Engineer. An evaluation of the discovery will be made by authorized personnel and the Engineer to determine appropriate actions to prevent the loss of significant cultural or scientific resources."

107.5 – Add the following:

"The entire construction site shall be considered a "Hard Hat Area" and all personnel in the area will be required to wear a hard hat."

107.5.1 - Revise this paragraph as needed to describe asbestos coating in outlet pipes and associated Contractor requirements.

1075.2 - This should be 107.5.2

FCD Comment: Add the following sections:

" **107.5.3 - Compliance with the Arizona Communication Standard:**

Owner will provide Contractor with Material Safety Data Sheets (MSDS) for any products known to exist on the site that are deemed health hazards. Contractor will provide a copy of Owner-provided MSDS to all Subcontractors.

Contractor will provide Owner and all Subcontractors with MSDS for any products that have or are deemed health hazards that will be brought onto the site or created on the site by either Contractor or by any Subcontractors.

Contractor will provide Owner with a statement certifying that all personnel (Contractor and Subcontractor) employed by Contractor or by a Subcontractor on the job site have received the required Hazard Communication Standard training.

107.5.4 Contractor's Status During any Hazard Remediation:

If remediation of any discovered Regulated Substance, contamination or asbestos not identified in this contract is necessary, the Owner will address the problem, and if this interferes with the project's critical path, then the CPM and project schedule will be reviewed and revised as mutually acceptable by the Engineer and Contractor to minimize the impact to the **total project schedule.** An extension in contract time for any delay to Contractor then resulting may be granted by Owner in accordance with Subsection 108.7.

If any Regulated Substance, asbestos, or other type of contamination is encountered that results in a changed condition, then a change order may be issued in accordance with the contract.

If the delay impacts the CPM in such a manner that Contractor is prevented from continuing work on any portion of the project, and Owner issues a suspension of work order, then Contractor shall be entitled to compensation in the form of a **one-time payment** of Demobilization and Remobilization costs, which shall be no more than 6 percent of the original bid item for mobilization. "

FCD Comment - Add the following section:

"107.6.3 Public Information and Notification:

The Contractor shall employ a specialty public information service as a subcontractor to provide the community relations program for the project as described herein. The name and address of the public information subcontractor shall be submitted with the bid as specified in subsection 102.6 of the Supplementary General Conditions. Contractor shall work closely with his subcontractor in developing and carrying out the community relations program, but shall not expect to actually perform the work of providing the public information services. Contractor shall submit a history of the subcontractor's qualifications and experience in public information services at the pre-construction conference for acceptance by the Engineer. The community relations program shall be designed to run the full length of calendar days in the contract for this project. The program will include but not be limited to:

Printing and distributing a pre-construction information letters, public notices and news letters to all residents, business, schools, farm operations, etc. within _____ mile of the project area.

The Contractor will use these or other means to inform the local citizens of necessary operations which create high noise levels, street closures, limited access, detour locations, haul route and material delivery routes, hours of construction and disruption of bus, trash, school bus and other delivery/pick-up routes.

The Contractor will be required to furnish a private line telephone to be used solely for receiving incoming calls from local citizens with questions or complaints concerning construction operations or procedures. The Contractor shall publish this telephone number and maintain a 24-hour answering service. The answering service shall be operated by Contractor personnel during all hours that work is being performed on the job site. The Contractor shall maintain a log of incoming calls, responses, and action taken which shall be submitted to the Engineer weekly and/or upon request.

Prior to the start of work, the Contractor shall notify, by letter, all affected businesses and residents of construction plans and schedules within the geographic area identified above. In addition, all schools and emergency services which serve the geographic area will also be notified even though they may be located outside the geographic area described above. The letter shall contain, as a minimum, the following information:

1. Name of Contractor
2. 24-hour telephone complaint number
3. Brief description of the project

4. Name of Contractor project Superintendent
5. Name of Engineer
6 Name of area supervisor
7. Construction schedule including anticipated work hours
8. Traffic regulations including lane restrictions

The Contractor shall submit a Public Information and Notification Plan to the Engineer at the pre-construction meeting. No payments shall be made for this item until the Engineer approves the plan.

The plan and work which is eligible for reimbursement shall include: meetings with impacted businesses, schools, emergency services, residents, etc.; scheduling; preparation and distribution of newsletter at least BI-weekly; and maintaining a 24-hour telephone hot line for complaints.

The Contractor shall submit a final report/evaluation of the Public Information and Notification process performed for this project. This report shall be submitted before the Contractor receives final payment.

Any items not listed here and listed in Section 401, Subsection 104.4 or any other Section or Subsection of this Special Provision that requires the Contractor to inform the public will be responsibility of the General Contractor.

It will be up to the General Contractor to delegate that authority to the Public information SubConsultant. The cost of such item will not be paid from this allowance. However, this cost will be incidental to the bid item cost for constructing such item.

Payment will be based on invoices, and will be for a total amount not to exceed the amount shown in the bid schedule for the item, "PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE", for work performed in notifying and coordinating with the local population impacted by this project. To cover the cost for administration and supervision, the General Contractor may add an amount equal to not more than 5 percent of the accumulated total invoiced billing for actual public information services provided by a Subcontractor. This cost for administration and supervision will be considered included in the "PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE".
ITEM 107-2 - PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE"

107.8 – Delete the complete text and replace with the following:

"The use of explosives will NOT be permitted."

107.9 – Add the following:

"The Contractor shall limit all construction activities to the areas shown in the plans and shall not disturb any areas other than as required for construction as shown on the plans.

Under no circumstances shall the disposal of debris from construction operations create a blemish on the landscape. Material which is to be stockpiled or disposed of off-site shall not encroach on running or intermittent streams, or other waters of the U.S. unless the Contractor has obtained the appropriate permits in accordance with applicable state and federal regulations."

107.10 – Add the following:

"F) The Contractor shall not remove any vegetation, plants and/or trees outside the rights-of-way.
G) The Contractor shall take all necessary action to protect the public from the construction work area.
H) The Contractor shall take all necessary action to ensure that all construction materials are stored in such a manner that storm runoff from the storage area does not divert the flows or block the historical runoff patterns."

108.1 – Delete paragraphs (A) and (B) and replace with the following:

" (A) Contractor shall commence work within seven (7) calendar days after the date of the Notice to Proceed and complete all work within **one hundred and fifty (150)** calendar days beginning the day following the effective date specified in the Notice to Proceed. "

FCD Comment: ***At the 95% review meeting discuss Construction Contract completion time.***

108.4 – Delete first paragraph and replace with the following:

"Contractor shall submit a proposed work schedule to Engineer at the pre-construction meeting for review before starting work using the Primavera or other similar software program that is acceptable to the Engineer. Weekly updates shall be submitted to Engineer at the weekly coordination meeting.

Contractor shall be solely responsible for the planning, scheduling and execution of the work to assure timely completion of the project."

109.5.4 – Correct all subsection numbers.

109.7, Third paragraph – Add the following to the third paragraph"

"Payment or release of retained funds shall be made to the Contractor within thirty (30) days following final payment to the Contractor [reference (B) following], and Contractor furnishing to Engineer satisfactory receipts for all labor and material billed and waivers of liens from any and all persons and Subcontractors holding claims against the work. Additionally, Contractor shall furnish a completed Certificate of Performance to Engineer evidencing it has satisfactorily discharged all its duties in connection with the work to be performed under this Contract. The form of Certificate of Performance shall be provided to Contractor by the Engineer."

109.7 (B) - Add the following:

"The final payment will be made to Contractor by Owner within thirty (30) days following receipt of Engineer's final estimate and receipt by Owner of Consent of Contractor's Surety to said final payment. If payment will be longer than thirty (30) days as aforesaid, Owner will provide Contractor specific written findings for reasons justifying the delay in payment.

The Contractor's monthly pay estimates will be initially processed by the Engineer during the last week of the month covered."

APPENDIX B

OUTLET INSPECTION

- Speedie and Associates Report, November 4, 1998
- Results of Asbestos Testing on Outlet Pipes, October 23, 1998

SPEEDIE AND ASSOCIATES
GEOTECHNICAL / ENVIRONMENTAL / MATERIALS ENGINEERS
11029 N. 24th AVE., SUITE 805 • PHOENIX, ARIZONA 85029 • (602) 997-6391 • FAX (602) 943-5508

HENRIETTA SPEEDIE, C.E.O.
JAMES A. SPEEDIE, P.E.
GREGG A. CREASER, P.E.
BRETT P. CREASER, P.E.
DONALD L. CORNELISON, P.E.
STEVEN A. GRIESS, P.E.
PRABHAKAR (PETER) RUPAL, P.E.

November 4, 1998

Mr. Warren Rosebraugh
Flood Control District of Maricopa County
2801 W. Durango St.
Phoenix, Arizona 85009

RE: Speedie Project No. 981011SA
Assignment No. 3
White Tank #3 Outlet Inspection
Northern Ave. W/o Perryville Rd..
Maricopa County, Arizona

Dear Warren:

It is understood that the existing dam is to be heightened and lengthened. The two 48" diameter and one 24" diameter CMPs will be lengthened accordingly. The pipes are currently about 125' in length. Our mandate was to provide a visual and/or camera inspection of the culverts to document existing conditions and look for any signs of distress. This letter presents the findings of our visual evaluation of the two 48" pipes. Also included is the video of all three pipes.

On October 29, 1998, we arrived on site along with our sub-contractors, Critter Control (to check and clear the two 48" diameter CMPs), and Hoffman Southwest (for video investigation of all three pipes). The video revealed several potential problems areas. These included areas of possible buckling and joint separation. The video should be reviewed for more detail. Upon completion of the video investigation, we proceeded with the visual inspection of the two large pipes.

Starting with the CMP at station 46+00 we entered the pipe at the outflow opening working our way through to the inflow opening. Deformation was checked every 10 feet or at any noticeable area. We found the pipe to be in relatively good shape. Vertical heights ranged between 46½ to 48 inches. The 46½ measurement was taken at 80 feet from the outflow opening. Joints were also inspected showing only minor displacement of ½ to 1½ inches of separation and minor inward bending. Using a hammer, we worked our way through the pipe lightly tapping to check for the presence of voids. This revealed hollow sounds, indicating voids or weak compaction from construction, along the pipe from 5 to 7 o'clock. Also around the inflow opening a hollow sound was noticed on all sides. The asphalt asbestos lining was well intact and corrosion was not noticed.

In the CMP at station 29+00, we started at the inflow opening and worked our way to the outflow opening. Deformation was checked every 10 feet or at any noticeable area. Starting at the first joint 7 feet from the inflow opening, the vertical was measured at 45 inches and tapered to 48 inches by the joint at 47 feet from the inflow opening. From this point on, no deformation was apparent. Inspection of the joint

at 7 feet from the inflow opening had bending of ½ inch at 12 and 6 o'clock. The joint at 27 feet had a 1 to 2 inch bend inward at 12 o'clock. Small rocks and dirt were noticed inside this cavity. We could not determine the source of the debris. The other joints appeared to be in good condition with only minor displacement of ½ to 1½ inches of separation and minor inward bending, possibly caused during construction. Hammer tapping indicated hollow sounds consistently from 5 to 8 o'clock along the pipe, with the joint at 27 feet having additional hollow sounds at 3 and 9 o'clock. The asphalt asbestos lining was well intact and corrosion was not noticed.

Respectfully submitted,

SPEEDIE AND ASSOCIATES

Keith R. Gravel, E.I.T.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
30524
PRABHAKAR
RUPAL
Date Signed 11-4-98
ARIZONA, U.S.A.

Peter Rupal, P.E.

CMP at Station 29+00

Distance from Inflow (feet)	Roundness	Sounding	Notes
0	Round	Hollow all sides	
7 (Joint)	46" vert., 48" horiz.	Solid	½" inward separation at 12 & 6 o'clock
10	45" vert., 51" horiz.	Solid	
16	46" vert., 49" horiz.	Hollow 5-7 o'clock	
20	46½" vert., 49" horiz.	Solid	
27 (Joint)	Round	Hollow 3-9 o'clock	1"-2" inward separation at 12 o'clock, rocks present inside gap.
30	47½" vert., 48" horiz.	Hollow 3-9 o'clock	
40	47" vert., 48" horiz.	Hollow 5-8 o'clock	
47 (Joint)	Round	Hollow 5-8 o'clock	½"-1" separation
50	Round	Hollow 5-8 o'clock	
60	Round	Hollow 5-8 o'clock	
67 (Joint)	Round	Hollow 5-8 o'clock	½"-1" separation, small dents
70	Round	Hollow 5-8 o'clock	
80	Round	Hollow 5-8 o'clock	
88 (Joint)	Round	Hollow 4-8 o'clock	½"-1" separation
90	Round	Hollow 5-8 o'clock	
100	Round	Hollow 5-8 o'clock	

CMP at station 46+00

Distance from Outflow (feet)	Roundness	Sounding	Notes
8½ (Joint)	Round	Hollow 7 o'clock	Minor construction bending and separation
11	Round	Hollow 5 o'clock	
15	Round	Hollow 5 o'clock	
20	Round	Solid	
26 (Joint)	Round	Solid	Minor construction bending and separation
30	Round	Solid	
34	Round	Hollow 7 o'clock	
40	Round	Solid	
47 (Joint)	Round	Hollow 7 o'clock	½" bending at 7 o'clock, 1" of separation
50	Round	Solid	
59	Round	Hollow 7 o'clock	
67	Round	Hollow 7 o'clock	½" bending at 7 o'clock, 1½ " of separation
70	Round	Solid	
75	Round	Hollow 5 o'clock	
80	46½" vert., 48" horiz.	Hollow 7 o'clock	
83	Round	Hollow 5 o'clock	
88 (Joint)	Round	Hollow 4-8 o'clock	½"-1" separation
90	Round	Hollow 4-8 o'clock	
93	Round	Solid	
100	47½" vert., 48" horiz.	Hollow 4-8 o'clock	½"-1" separation bending 6 o'clock
109 (Joint)	Round	Hollow 12, 8-6 o'clock	

Hoffman Southwest

Pipe Cleaning and Video Inspection

Customer FCDMC

Location/1/4 Section Station 46+00

Contractor

Page # 2 of 3

Date 10.29.98 V.T. # 1 of

Inspector

Pipe Size 48" Pipe Type Corrugated

Overall Segment Length 117

Joint Length M/H Depth

Plan #/Permit #

Operator Name T. Jennings

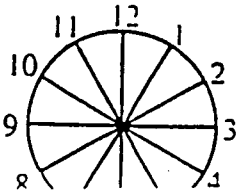
Outlet M/H # ← Flow Direction — Inlet M/H #

T.V. Direction →

Distance Reading	Clock	Remarks	VT	Distance Reading	Clock	Remarks	VT
		Outlet to inlet	1415				
68	12	buckle					
108	12	buckle					
117		inlet	0525				

Comments:

9608 N 21st Drive
Phoenix, Arizona 85021
Phone (602) 861-3944
Fax (602) 861-1423



Hoffman Southwest

Pipe Cleaning and Video Inspection

Customer FCDMC

Location/1/4 Section Station 63+80

Contractor

Page # 3 of 3

Date 10.29.98 V.T. # 1 of

Inspector

Pipe Size 24" Pipe Type Corrogated

Overall Segment Length 117

Joint Length M/H Depth

Plan #/Permit #

Operator Name T. Jennings

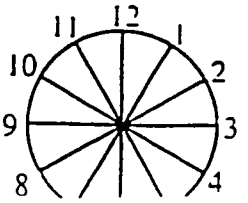
Outlet M/H # ← Flow Direction — inlet M/H #

T.V. Direction →

Distance Reading	Clock	Remarks	VT	Distance Reading	Clock	Remarks	VT
		outlet to inlet	2525				
38	1	buckle					
109	12	gap in joint?					
117		inlet	3930				

Comments:

9608 N 21st Drive
Phoenix, Arizona 85021
Phone (602) 861-3944
Fax (602) 861-1423



Hoffman Southwest

Pipe Cleaning and Video Inspection

Customer FCDMC

Location/1/4 Section Station 29+00

Contractor

Page # 1 of 3

Date 10.29.98 V.T. # 1 of

Inspector

Pipe Size 48" Pipe Type Corrugated

Overall Segment Length 101

Joint Length M/H Depth

Plan #/Permit #

Operator Name T. Jennings

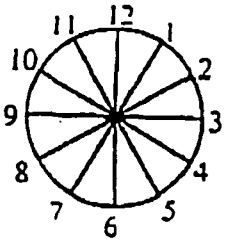
inlet M/H # — Flow Direction → — outlet M/H #

T.V. Direction →

Distance Reading	Clock	Remarks	VT	Distance Reading	Clock	Remarks	VT
		inlet to Outlet	0000				
22	12	buckling?					
77	11	buckling	1415				
101		outlet					

Comments:

9608 N 21st Drive
Phoenix, Arizona 85021
Phone (602) 861-3944
Fax (602) 861-1423



Bolin Laboratories Inc.

17631 N. 25th Avenue • Phoenix, Arizona 85023
(602) 942 8220 • FAX (602) 942 1050

Maricopa County Flood Control
Environmental Branch
2801 West Durango
Phoenix, AZ 85009
Attn: Dave Gardner

Received: 10/23/98
Reported: 0/00/00
Invoice No: 000000

Project Name: White Tanks #3

PARAMETER	METHOD	RESULTS	UNITS	PQL	DATE ANALYZED
Matrix: Solid Sample No: 9810-07581-001 Sample ID: WT-3 29+00			Time Sampled: 12:50 Date Sampled: 10/23/1998		
Asbestos	PLM	10	% Chrysotile		10/26/98
Matrix: Solid Sample No: 9810-07581-002 Sample ID: WT-3 46+00			Time Sampled: 12:50 Date Sampled: 10/23/1998		
Asbestos	PLM	10	% Chrysotile		10/26/98
Matrix: Solid Sample No: 9810-07581-003 Sample ID: WT-3 63+80			Time Sampled: 12:50 Date Sampled: 10/23/1998		
Asbestos	PLM	10	% Chrysotile		10/26/98

Asbestos performed by Legend Technical Services, St.Paul MN, #AZ0557.
Other Material: <1% cell, 88% non, <1% glass

Authorized Signatory
ADHS License No.: AZ0004

APPENDIX C

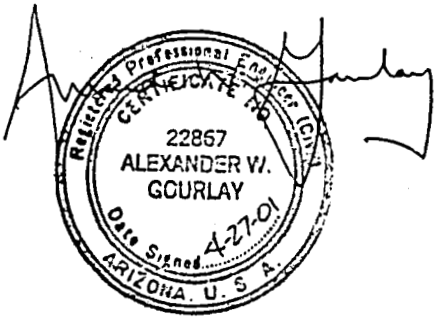
BORING LOGS AND LABORATORY DATA

APPENDIX C

(Revised April 27, 2001)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2000C028
WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

PCN 470-04-30



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

PCN 470-04-30

APPENIX C (REVISED APRIL 2001

Note: This document amends the previous Appendix C submittal presented in the Design Report for the Interim Dam Safety Improvements White Tanks FRS#3 dated February 7, 2001.

AMENDED

APPENDIX C

BORING LOGS AND LABORATORY DATA

Appendix C Contents

Boring Logs

- 57+30
- 58+00
- 59+00
- DMB-4
- DMB-6
- DMB-7
- DMB-9
- NOTE: Logs of Test Pits A, B and C not available.

Summary Table C-1 – Summary of Relevant Laboratory Test Results

Grain-Size Distributions

- Boring 57+30, 2 samples
- Boring 58+00, 1 sample
- Boring 59+00, 1 sample
- Crack and Filter Investigation Test Pits, 3 samples (plot only)
- Existing Filter Investigation Test Pit, 2 samples (plot only)
- Test Pits A, B, and C (spillway)

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT	LOCATION
STA. 57+30 WHITE TANKS DAM	15448-007-058	FCDMC	BUCKEYE, AZ

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
CME 75 WITH 3 3/4-INCH HOLLOW STEM AUGER	0'-31.5'	ATL	57+30
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON (SPT)	5-FOOT INTERVALS

				DRILLING START	DRILLING FINISH
LOGGED BY: BKW	WATER LEVEL	NA		TIME	TIME
CHECKED BY: SGN	TIME				
	DATE			DATE 11/1/99	DATE 11/1/99
DATUM: APPROX. ELEVATION: feet	CASING DEPTH				

SURFACE CONDITIONS:

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	LABORATORY TESTS: % PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	GRAPHIC LOG	USCS	DESCRIPTION
											GP	SANDY GRAVEL:
5	SPT	1	5.0						9			2 bag sample from 5 to 10 feet
10	SPT	2	10.0						7			1 bag sample from 10 to 15 feet
15	SPT	3	15.0						9			Less sand, more cobbles and rock at depth (from bag samples)
												1 bag sample from 15 to 20 feet
20	SPT	4	20.0						13			
												1 bag sample from 20 to 25 feet
25	SPT	5	25.0						15			1 bag sample from 25 to 30 feet
30	SPT	6	30.0						18		ML	Through dam fill into native ground silt, brown, dry
												Boring terminated at 31.5' below ground surface.
35												

BLGV022 5/2/00

DAMES & MOORE

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT FCDMC	LOCATION BUCKEYE, AZ
STA. 58+00 WHITE TANKS DAM	15448-007-058		

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
CME 75 WITH 3 3/4-INCH HOLLOW STEM AUGER	0'-31.5'	ATL	58+00
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATIN TEST WITH SPLIT SPOON (SPT)	5-FOOT INTERVALS

DRILLING	START	FINISH
TIME		
DATE	11/1/99	11/1/99

LOGGED BY: BKW	WATER LEVEL	NA	
CHECKED BY: SGN	TIME		
	DATE		
	CASING DEPTH		

DATUM: APPROX. ELEVATION: feet

SURFACE CONDITIONS:

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	% PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	GRAPHIC LOG	USCS	DESCRIPTION
											GP	SANDY GRAVEL: 4" max round 1 bag sample 0-5 feet
5	SPT	1	5.0						6			No recovery 1 bag sample 5-10 feet
10	SPT	2	10.0						10			No recovery
15	SPT	3	15.0						17			No recovery
20	SPT	4	20.0						12			No recovery
25	SPT	5	25.0						19			No recovery
30	SPT	6	30.0						50/6"			No recovery
												Boring terminated at 31.5' below ground surface.
35												

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DAMES & MOORE

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT FCDMC	LOCATION BUCKEYE, AZ
STA. 59+00 WHITE TANKS DAM	15448-007-058		

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
CME 75 WITH 3 3/4-INCH HOLLOW STEM AUGER	0'-31.5'	ATL	59+00
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATIN TEST WITH SPLIT SPOON (SPT)	5-FOOT INTERVALS

DRILLING	START	FINISH
TIME		
DATE	11/1/99	11/1/99

LOGGED BY: BKW	WATER LEVEL	NA	
CHECKED BY: SGN	TIME		
	DATE		
DATUM: APPROX. ELEVATION: feet	CASING DEPTH		

SURFACE CONDITIONS:

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	LABORATORY TESTS: % PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	GRAPHIC LOG	USCS	DESCRIPTION
											GP	SANDY GRAVEL: 3" max rounded 1 bag sample 0-5 feet
5	SPT	1	5.0						5			No recovery
10	SPT	2	10.0						5			No recovery
15	SPT	3	15.0						11			No recovery
20	SPT	4	20.0						15			No recovery 1 bag sample 20-25 feet
25	SPT	5	25.0						12			No recovery
30	SPT	6	30.0						50/6"			No recovery
												Boring terminated at 31.5' below ground surface.
35												

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DAMES & MOORE

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT MARICOPA COUNTY FLOOD CONTROL DISTRICT	LOCATION WHITE TANKS
WHITE TANKS DAM	15448-005-022		

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
MOBILE B-57 WITH 6-INCH HOLLOW STEM AUGER	0'-36'	ATL, INC.	DMB-4
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON (SPT) AND DAMES & MOORE TYPE (U) WITH BRASS SLEEVES AND RINGS	5-FOOT INTERVALS

			DRILLING START	DRILLING FINISH
LOGGED BY: PLG	WATER LEVEL	NA	TIME 0929	TIME 1145
CHECKED BY: PLG	TIME			
	DATE		DATE 11/3/98	DATE 11/3/98
DATUM: ELEVATION: feet	CASING DEPTH			

SURFACE CONDITIONS: GRADED ROADWAY SURFACE ON TOP OF DAM

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	% PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	USCS	DESCRIPTION
										CL ML	SANDY SILTY CLAY WITH GRAVEL: Sand is predominantly fine to medium graine, gravel is fine to coarse grained, dry, brown, hard
5	U	1.0	5.0	58	27	7	4.6	102.0	29 26		Same as above
10	SPT	2.0	10.0				4.0		48 50/4"		Same as above
15	U	3.0	15.0						40 43		Same as above, decreased in gravel content
20	SPT	4.0	20.0	55	23	8	3.1		50/4"	CL	SANDY LEAN CLAY: Sand is fine to coarse grained, dry, brown, hard
25											No recovery
30	U	5.0	30.0						45 48		Same as above, some signs of light cementaion
35	SPT	6.0	35.0				1.5		40 50/5"	SM	SILTY SAND WITH GRAVEL: Sand is fine to coarse, gravel is fine to coarse, dry, light brown, very dense, some signs of light cementation

Boring terminated at 36' below ground surface.

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BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT MARICOPA COUNTY FLOOD CONTROL DISTRICT	LOCATION WHITE TANKS
WHITE TANKS DAM	15448-005-022		

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
MOBILE B-57 WITH 6-INCH HOLLOW STEM AUGER	0'-36.5'	ATL, INC.	DMB-6
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON (SPT) AND DAMES & MOORE TYPE (U) WITH BRASS SLEEVES AND RINGS	5-FOOT INTERVALS

			DRILLING START	DRILLING FINISH
LOGGED BY: PLG	WATER LEVEL	NA	TIME 1103	TIME 1725
CHECKED BY: PLG	TIME			
	DATE		DATE 11/5/98	DATE 11/5/98
DATUM: ELEVATION: feet	CASING DEPTH			

SURFACE CONDITIONS: GRADED ROADWAY SURFACE ON TOP OF DAM

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	% PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	GRAPHIC LOG	USCS	DESCRIPTION
											CL	SANDY LEAN CLAY WITH GRAVEL: Sand is primarily fine to medium grained though a coarse fraction is present, gravel is fine to coarse, dry to slightly moist, brown, hard
5	U	1.0	5.0	39	32	9	3.0	121.7	20 28		SC	CLAYEY SAND WITH GRAVEL: Sand is fine to coarse grained, gravel is fine to coarse, dry to slightly moist, brown, very dense Small increase in gravel
10	U	2.0	10.0						45 48			Same as above
15	SPT	3.0	15.0				4.5		48 50/3"			Same as above
20	U	4.0	20.0				6.2	100.9	46 50/4"			Same as above, cemented light to moderate in layers and modules
25	SPT	5.0	25.0						8 9 8			Same as above, becomes medium dense, decreased cementaion
30	U	6.0	30.0	70	38	13	4.5	83.6	45 50/5"		CL	SANDY LEAN CLAY: Sand is predominantly fine grained, dry, light brown, hard, moderately well cemented
35	SPT	7.0	35.0						25 37 42		SM	SILTY SAND WITH GRAVEL: Sand is fine to coarse, gravel is fine to coarse and sub-angular, dry, light brown, very dense Boring terminated at 36.5' below ground surface.

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DAMES & MOORE

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT	LOCATION
WHITE TANKS DAM	15448-005-022	MARICOPA COUNTY FLOOD CONTROL DISTRICT	WHITE TANKS

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
MOBILE B-57 WITH 6-INCH HOLLOW STEM AUGER	0'-14.5'	ATL, INC.	DMB-7
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON (SPT) AND DAMES & MOORE TYPE (U) WITH BRASS SLEEVES AND RINGS	5-FOOT INTERVALS

			DRILLING START	DRILLING FINISH
LOGGED BY: PLG	WATER LEVEL	NA	TIME 1240	TIME 1305
CHECKED BY: PLG	TIME			
	DATE		DATE 11/5/98	DATE 11/5/98
	CASING DEPTH			

DATUM: ELEVATION: feet

SURFACE CONDITIONS: GRADED ROADWAY SURFACE ON TOP OF DAM

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	LABORATORY TESTS: % PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	GRAPHIC LOG	USCS	DESCRIPTION
											CL	SANDY LEAN CLAY WITH GRAVEL: Sand is predominatly fine to medium with some coarse, gravel is fine to coarse grained, dry to slightly moist, brown, hard
5	SPT	1.0	5.0	56	37	17	6.9		18 28 49			Same as above, moderately cemented
10	U		10.0				9.3	121.4	34 40			Becomes slightly moist
15												Boring terminated at 14.5' below ground surface.
20												
25												
30												
35												

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DAMES & MOORE

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT	LOCATION
WHITE TANKS DAM	15448-005-022	MARICOPA COUNTY FLOOD CONTROL DISTRICT	WHITE TANKS

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
MOBILE B-57 WITH 6-INCH HOLLOW STEM AUGER	0'-35.83'	ATL, INC.	DMB-9
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON AND DAMES & MOORE TYPE U WITH BRASS SLEEVES AND RINGS	5-FOOT INTERVALS

				DRILLING START	DRILLING FINISH
LOGGED BY: PLG	WATER LEVEL	NA		TIME 0722	TIME 0956
CHECKED BY: PLG	TIME				
	DATE			DATE 11/4/98	DATE 11/4/98
DATUM: ELEVATION: feet	CASING DEPTH				

SURFACE CONDITIONS: GRADED ROADWAY SURFACE ON TOP OF DAM

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	% PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	USCS	DESCRIPTION
										CL	SANDY LEAN CLAY WITH GRAVEL: Sand is fine to coarse, gravel is fine to coarse, sub-rounded to sub-angular, dry to slightly moist, brown, hard, gravel up to 2" in diameter
5	U	1.0	5.0						26 50/4"		SANDY LEAN CLAY: Sand is fine to coarse, sub-rounded to sub-angular, slightly moist, brown, hard
10	SPT	2.0	10.0	56	28	9	6.0		33 50/4"		Same as above, some light to moderate cementation
15	U	3.0	15.0	44	24	6	2.2	111.3	22 23	SC SM	SILTY CLAYEY SAND: Sand is primarily fine to medium grained with some coarse sand and few fine gravels, dry, brown, very dense
20	SPT	4.0	20.0				5.8		40 50/4"		Same as above, decreased gravel content (less than 2%), sand is primarily fine grained, becomes dry to slightly moist
										SP SM	Base of Dam
											Gravel/cobbles
25											No recovery
											Gravel/cobbles
30	SPT	5.0	30.0	12		NP	0.9		17 38 41		POORLY GRADED SAND WITH SILT AND GRAVEL: Sand is fine to coarse predominantly fine grained, all components are sub-angular, dry, light brown, very dense, some possible signs of cementation though not evident from sample cohesion
											Gravel/cobbles
35	SPT	6.0	35.0				2.3		33 50/4"		Same as above
											Boring terminated at 35.83' below ground surface.

BLGV022 1/22/99

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APPENDIX C
Table C-1
Summary of Relevant Laboratory Test Results

Boring / Test Pit	Location	Sample #	Depth (feet)	Type of Sample	Soil Classification (USCS)	Atterberg Limits			Sieve Analysis - Percent Finer														
						PL (%)	LL (%)	PI (%)	2.5"	2"	1.5"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#40	#50	#100	#200
DMB-4	31+00	1	5 - 6.5	Small Bag	CL-ML	20	27	7							100	99	97	94	88	83	79	68	57.8
DMB-4	31+00	4	20 - 21.5	Small Bag	CL	15	23	8							100	98	97	93	86	81	76	65	55.4
DMB-6	50+50	1	5 - 6.5	Sleeve	CL	21	32	9			100	87	87	83	82	79	74	67	60	55	51	44	38.6
DMB-6	50+50	6	30 - 31.5	Sleeve	CL	25	38	13								100	98	95	91	88	85	77	69.9
DMB-7	58+00	1	5 - 6.5	Small Bag	CL	20	37	17						100	98	97	94	88	81	76	72	64	56
DMB-9	73+50	2	10 - 11.5	Small Bag	CL	19	28	9						100	98	95	92	87	81	77	73	65	55.5
DMB-9	73+50	3	15 - 16.5	Sleeve	CL-ML	18	24	6					100	99	98	94	91	85	78	73	68	55	44.2
DMB-9	73+50	5	30 - 31.5	Small Bag	SM	NV	NV	NP				100	97	92	89	83	68	52	39	32	26	17	11.9
57+30	57+30	1	5 - 10	Bag	GP	NV	NV	NP	100	98	90	68	49	31	22	13	8	8	8	8	8	8	4.2
57+30	57+30	4	20 - 25	Bag	GP	NV	NV	NP	100	100	86	48	24	5	2	1	1	1	1	1	1	1	0.8
58+00	58+00	1	5 - 10	Bag	GP	NV	NV	NP	93	69	13	2	1	1	1	1	1	1	1	1	1	1	0.3
59+00	59+00	4	15 - 20	Bag	GP	NV	NV	NP	100	87	36	7	2	1	1	1	1	1	1	1	1	1	0.3
Test Pit A	Spillway	--	--	Bag	--	--	--	--							99	95	85	71	53	44	36	20	4
Test Pit B	Spillway	--	--	Bag	--	--	--	--								98	95	90	78	70	62	38	7
Test Pit C	Spillway	--	--	Bag	--	--	--	--			93	79	76		69	62	57	48	40	36	32	24	17

Note:

Results of the grain-size analyses on samples collected during the crack and filter investigation (5 samples) provided in graphical format only.

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

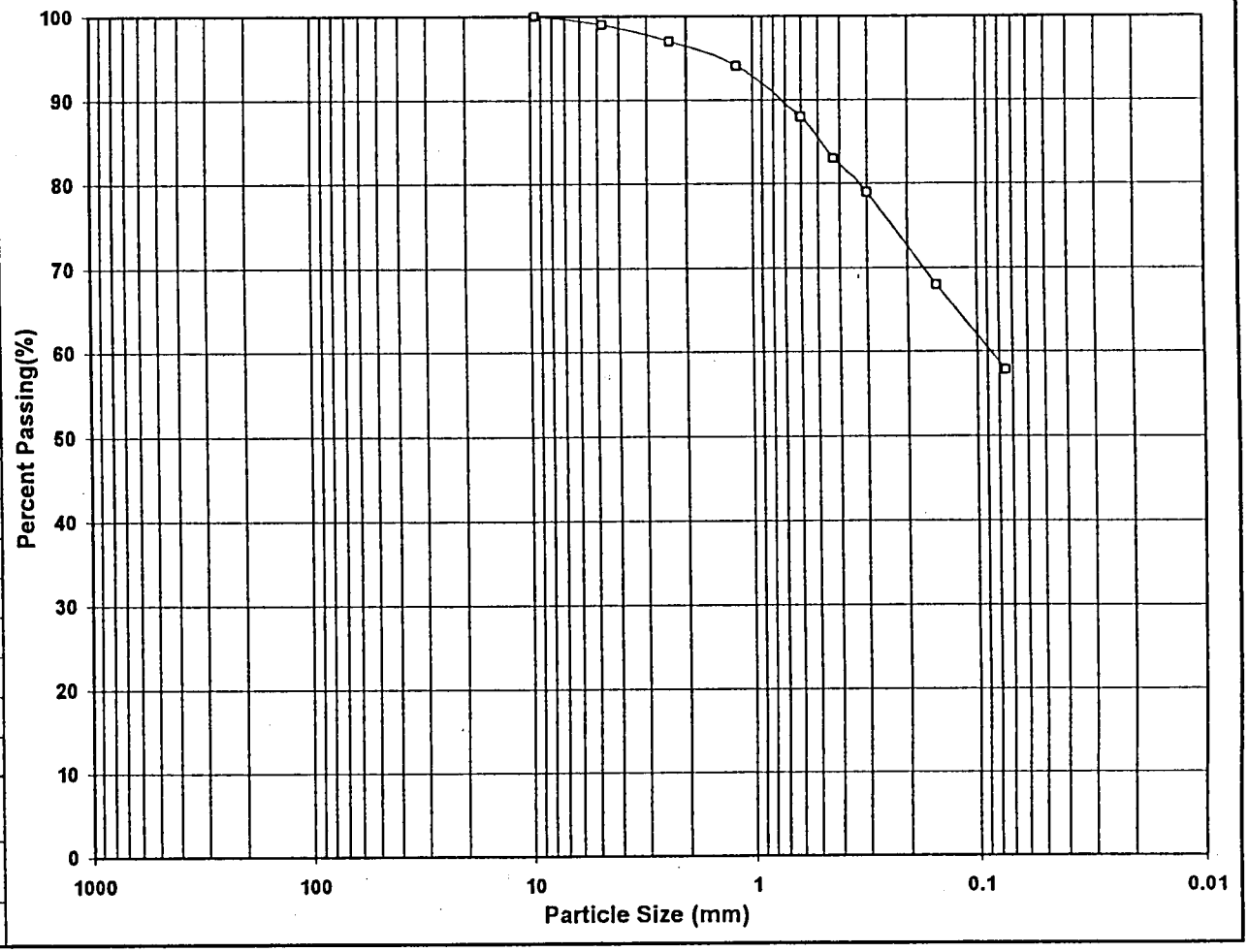
Drilled Sample:

Boring DMB-4 Sample # 1 Depth 5'-5.5'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5	100	
#4	4.75	99	
#8	2.36	97	
#10	2.0		
#16	1.18	94	
#30	0.6	88	
#40	0.43	83	
#50	0.3	79	
#100	0.15	68	
#200	0.075	57.8	

Plasticity Index 7

USCS Classification: CL-ML



PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

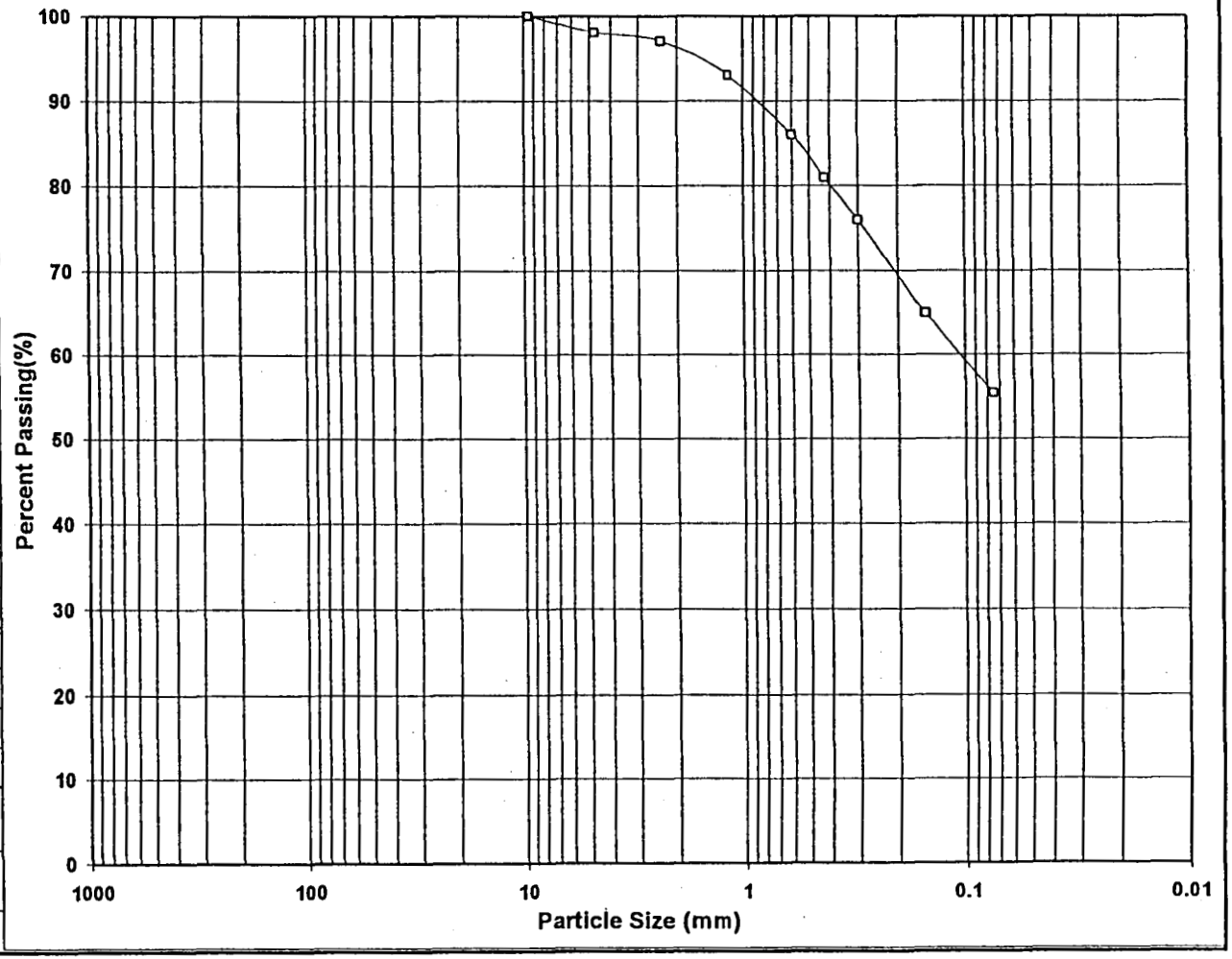
Drilled Sample:

Boring DMB-4 Sample # 4 Depth 20'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5	100	
#4	4.75	98	
#8	2.36	97	
#10	2.0		
#16	1.18	93	
#30	0.6	86	
#40	0.43	81	
#50	0.3	76	
#100	0.15	65	
#200	0.075	55.4	

Plasticity Index 8

USCS Classification: CL



PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

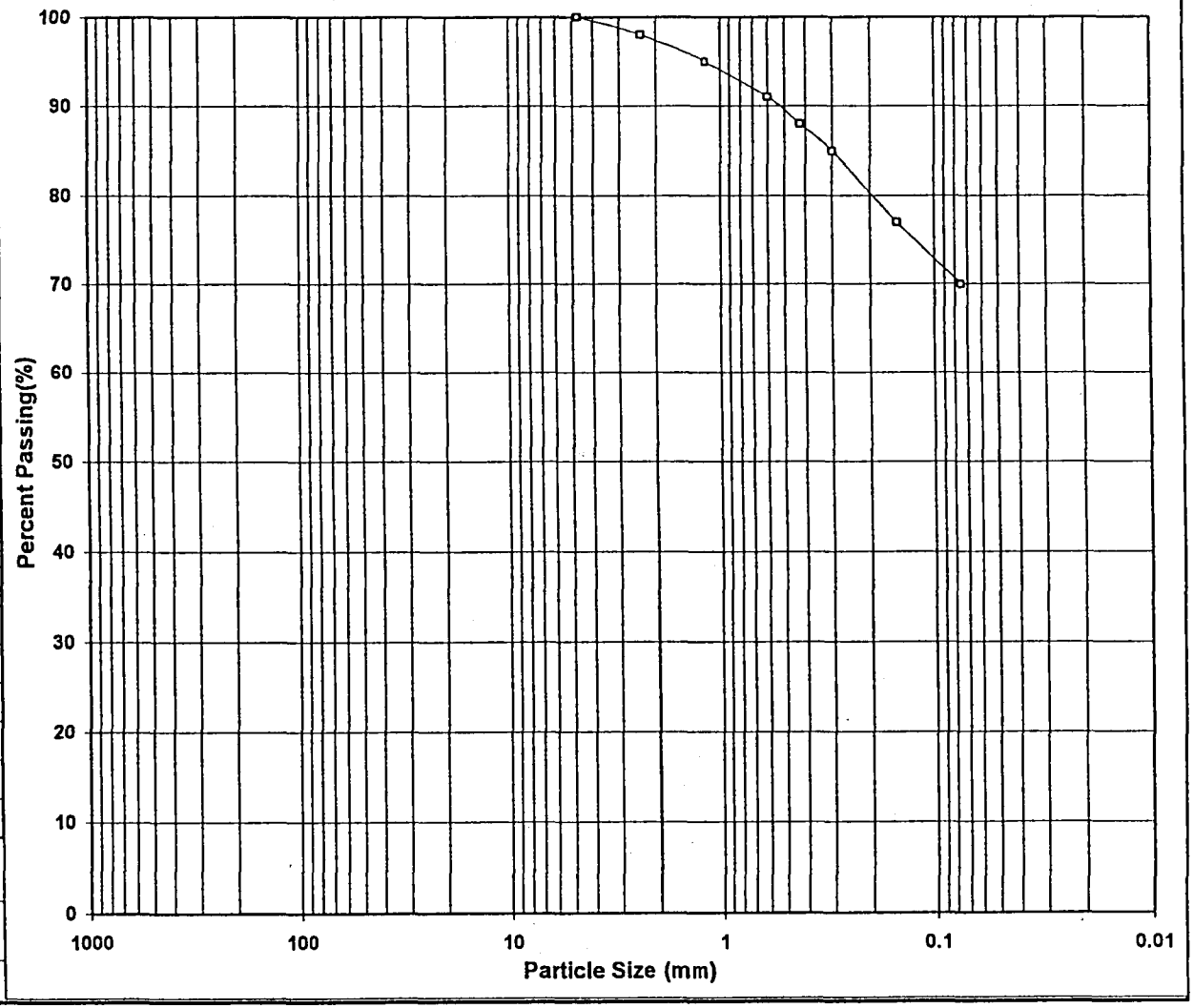
Drilled Sample:

Boring DMB-6 Sample # 6 Depth 30'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75	100	
#8	2.36	98	
#10	2.0		
#16	1.18	95	
#30	0.6	91	
#40	0.43	88	
#50	0.3	85	
#100	0.15	77	
#200	0.075	69.9	

Plasticity Index 13

USCS Classification: CL



PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

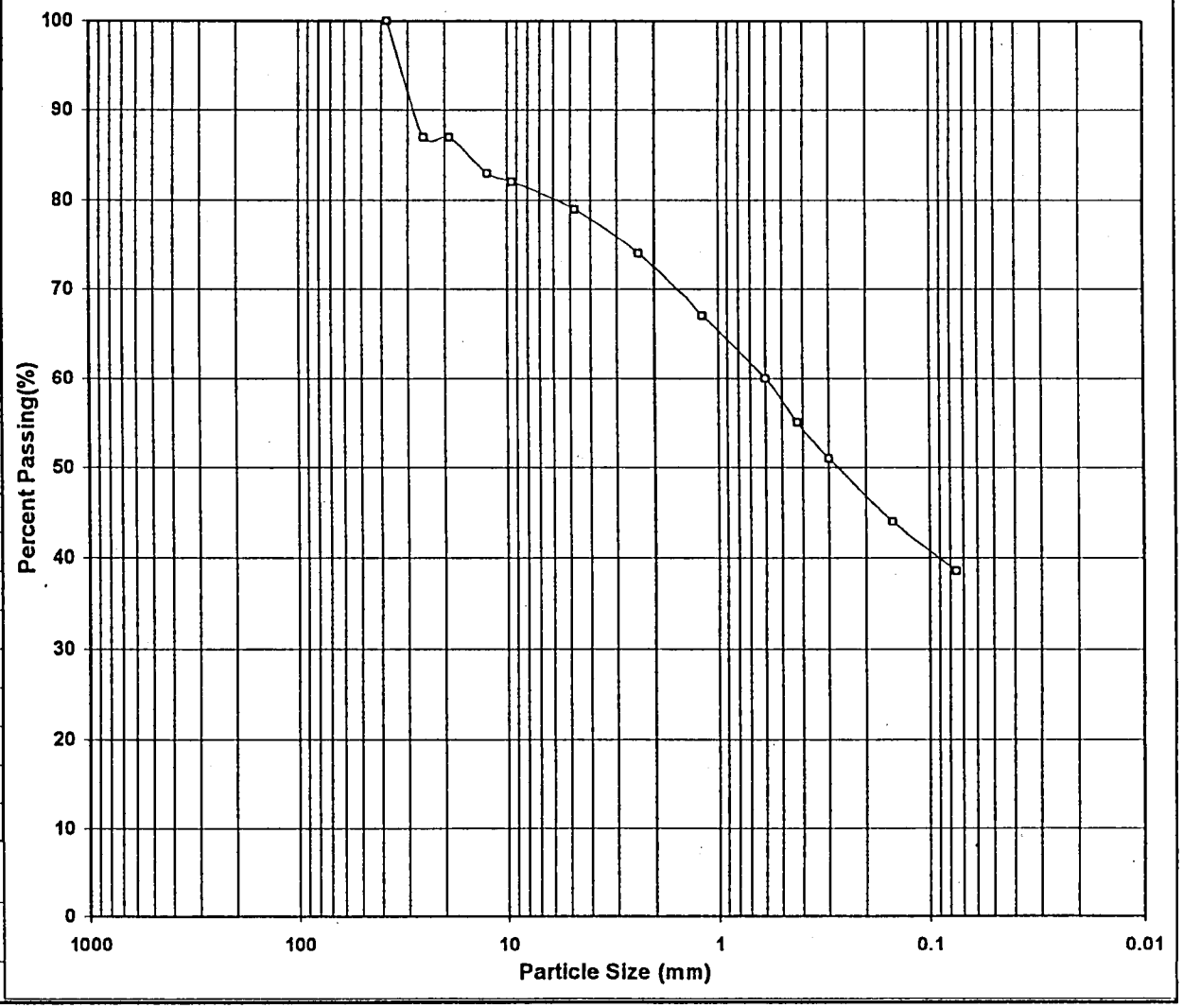
Drilled Sample:

Boring DMB-6 Sample # 1 Depth 5'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5	100	
1.25"	31.3		
1"	25.0	87	
3/4"	19.0	87	
1/2"	12.5	83	
3/8"	9.5	82	
#4	4.75	79	
#8	2.36	74	
#10	2.0		
#16	1.18	67	
#30	0.6	60	
#40	0.43	55	
#50	0.3	51	
#100	0.15	44	
#200	0.075	38.6	

Plasticity Index 9

USCS Classification: SC



PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

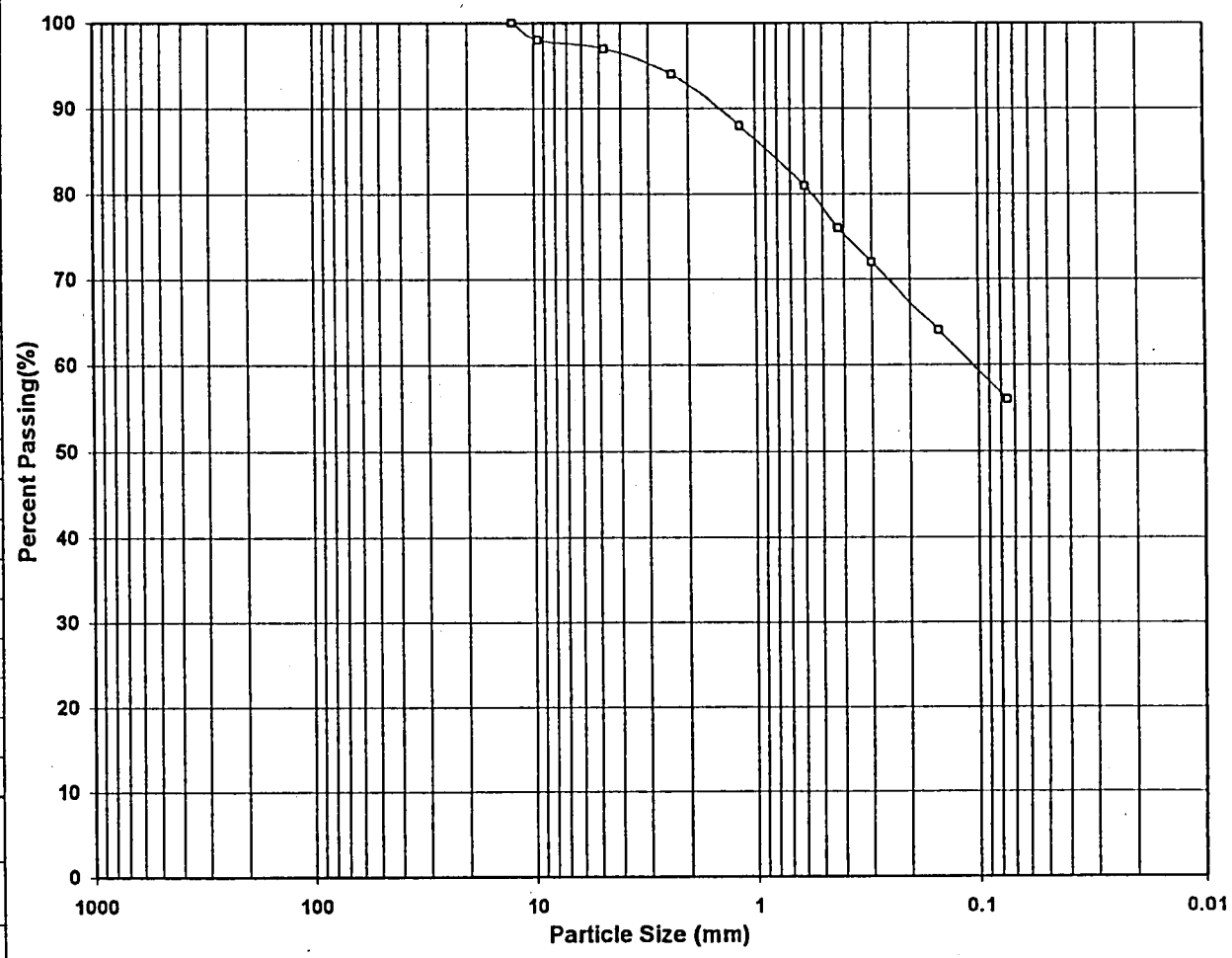
Drilled Sample:

Boring DMB-7 Sample # 1 Depth 5'-6'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5	100	
3/8"	9.5	98	
#4	4.75	97	
#8	2.36	94	
#10	2.0		
#16	1.18	88	
#30	0.6	81	
#40	0.43	76	
#50	0.3	72	
#100	0.15	64	
#200	0.075	56	

Plasticity Index 17

USCS Classification: CL



PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

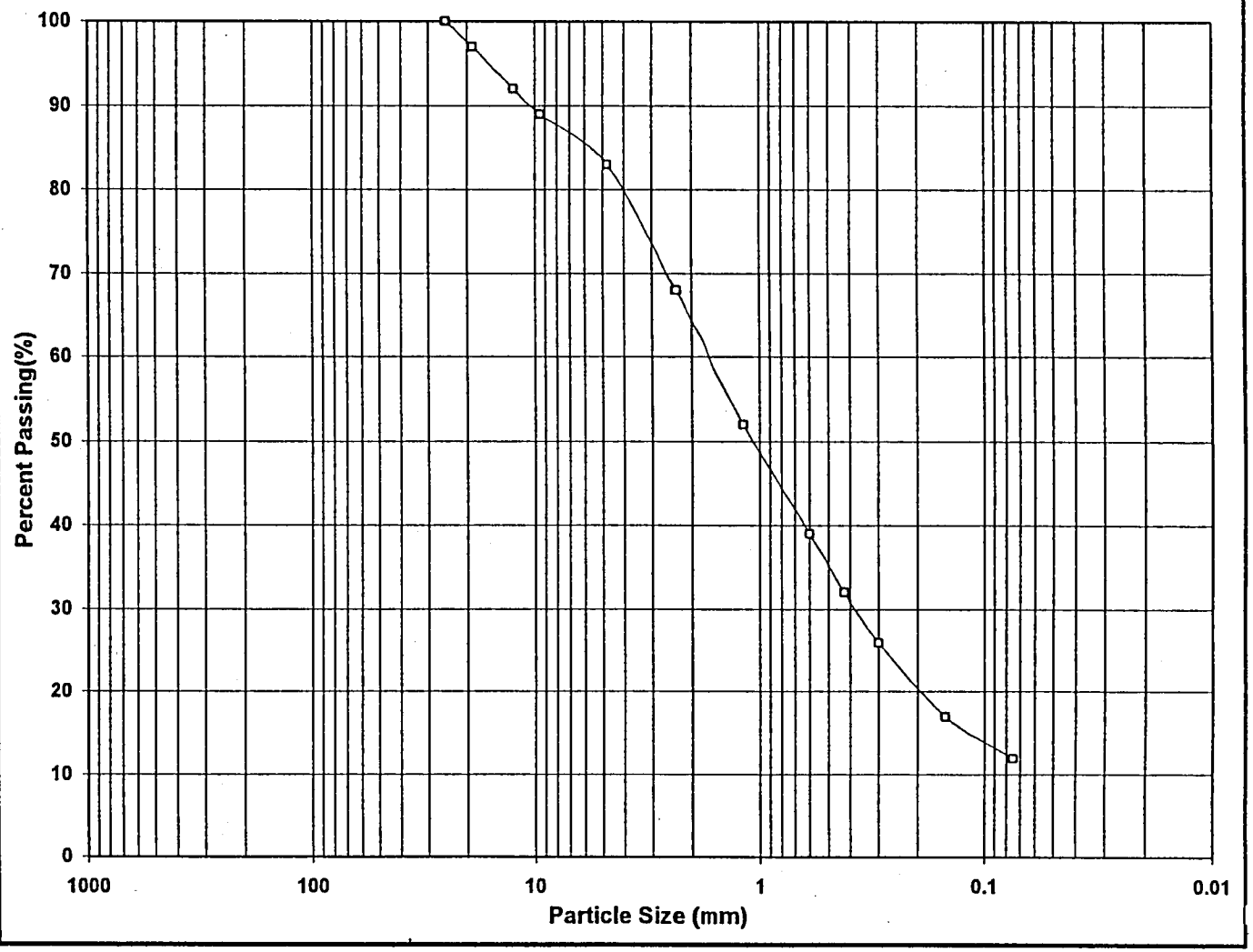
Drilled Sample:

Boring DMB-9 Sample # 5 Depth 30'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0	100	
3/4"	19.0	97	
1/2"	12.5	92	
3/8"	9.5	89	
#4	4.75	83	
#8	2.36	68	
#10	2.0		
#16	1.18	52	
#30	0.6	39	
#40	0.43	32	
#50	0.3	26	
#100	0.15	17	
#200	0.075	11.9	

Plasticity Index NONPLASTIC

USCS Classification: SP-SM



PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

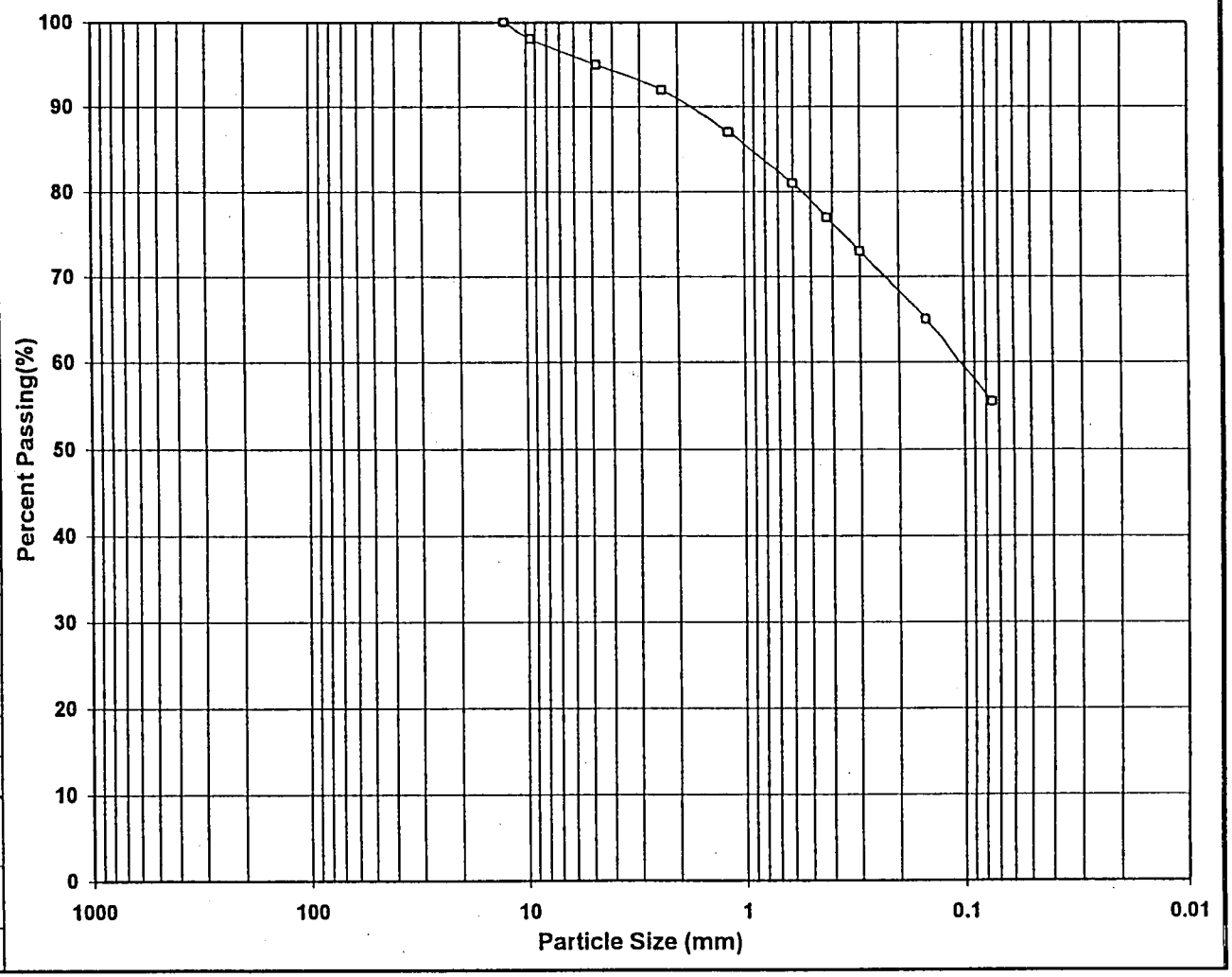
Drilled Sample:

Boring DMB-9 Sample 2 Depth 10'-11'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5	100	
3/8"	9.5	98	
#4	4.75	95	
#8	2.36	92	
#10	2.0		
#16	1.18	87	
#30	0.6	81	
#40	0.43	77	
#50	0.3	73	
#100	0.15	65	
#200	0.075	55.5	

Plasticity Index 9

USCS Classification: CL



PARTICLE SIZE ANALYSIS

DAMES MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

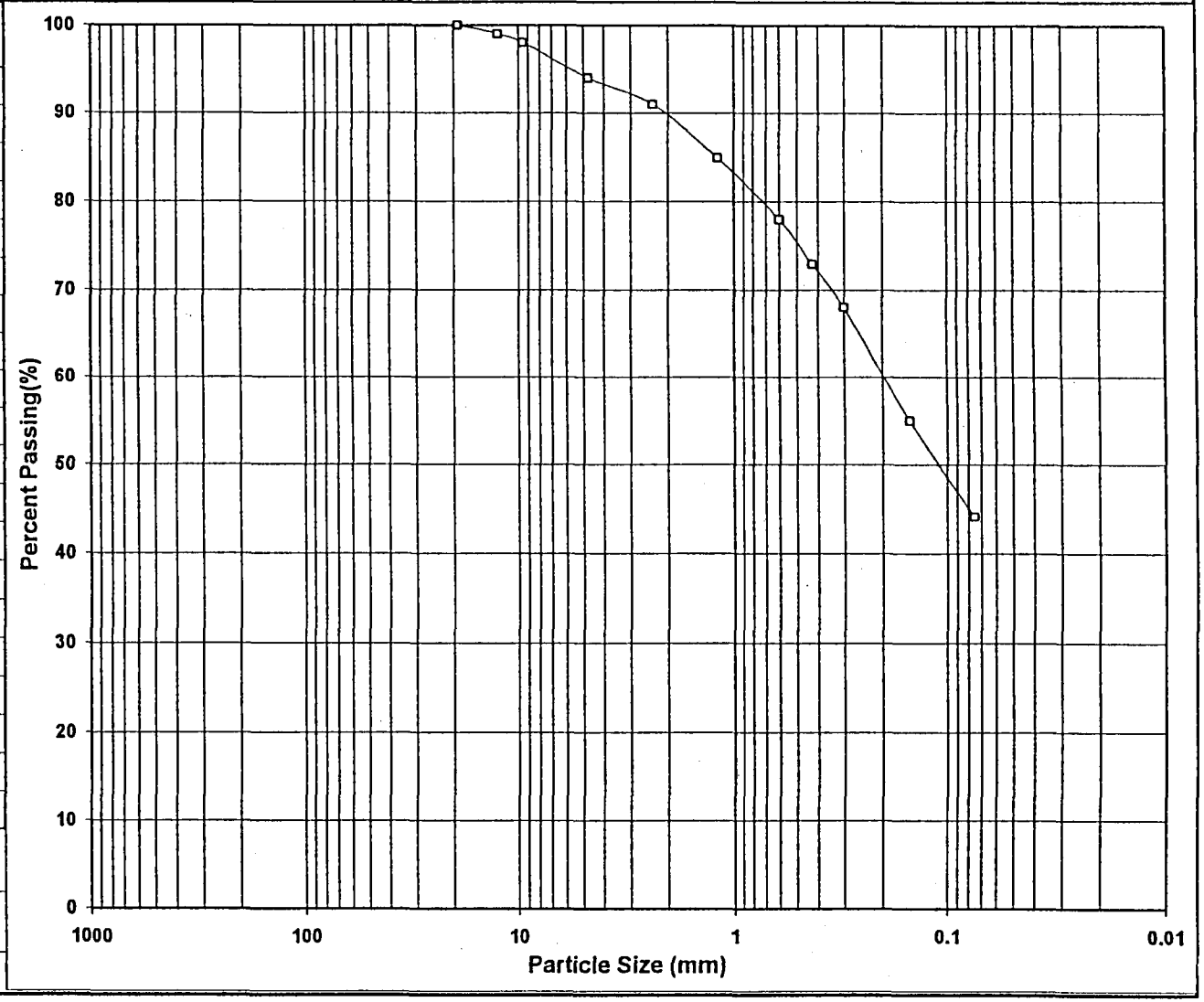
Drilled Sample:

Boring DMB-9 Sample # 3 Depth 15'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0	100	
1/2"	12.5	99	
3/8"	9.5	98	
#4	4.75	94	
#8	2.36	91	
#10	2.0		
#16	1.18	85	
#30	0.6	78	
#40	0.43	73	
#50	0.3	68	
#100	0.15	55	
#200	0.075	44.2	

Plasticity Index 6

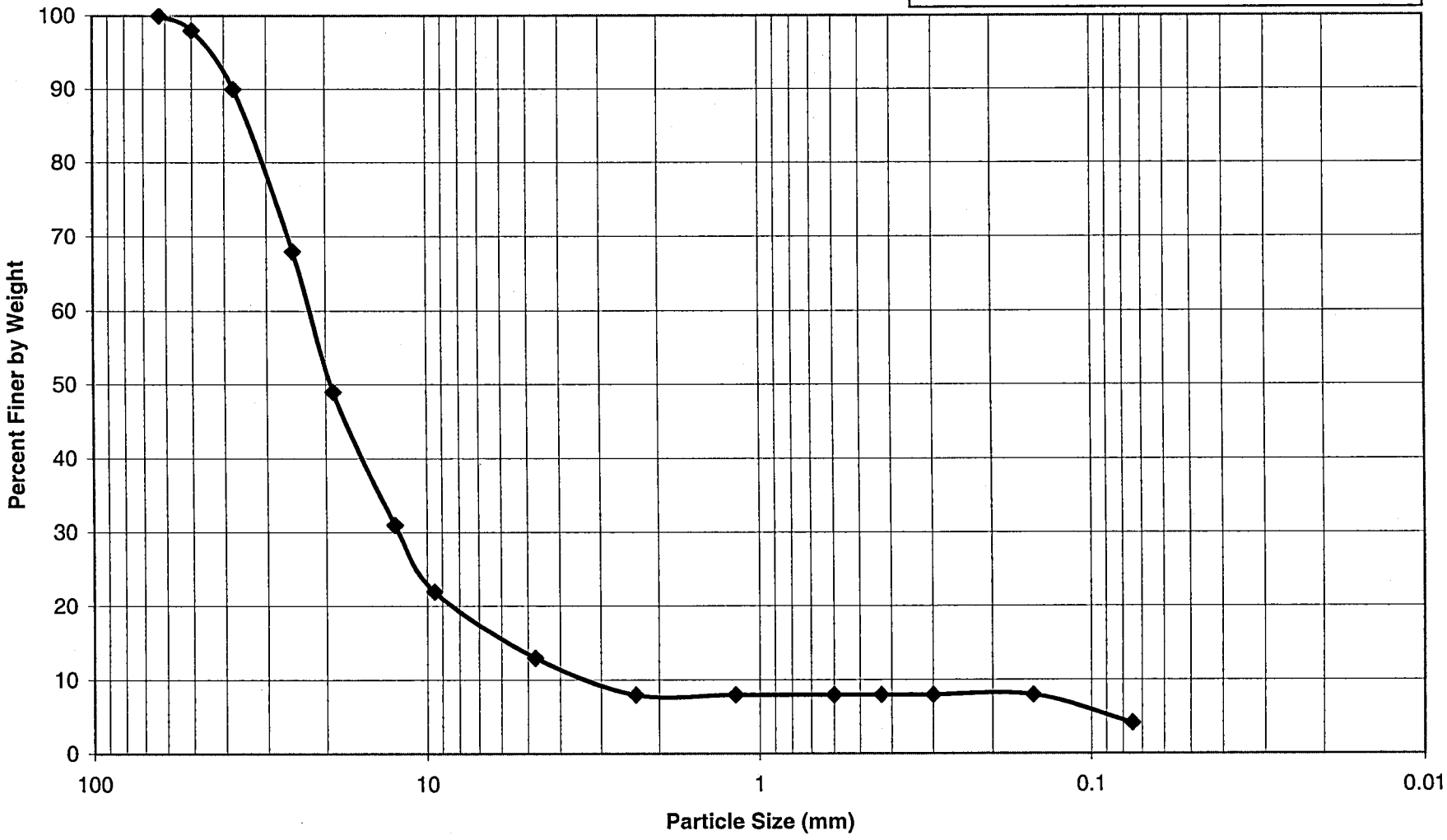
USCS Classification: SC-SM



Grain Size Distribution Curve

Boring 57+30 @ 5 - 10 Feet

Laboratory test performed by ATL Inc.

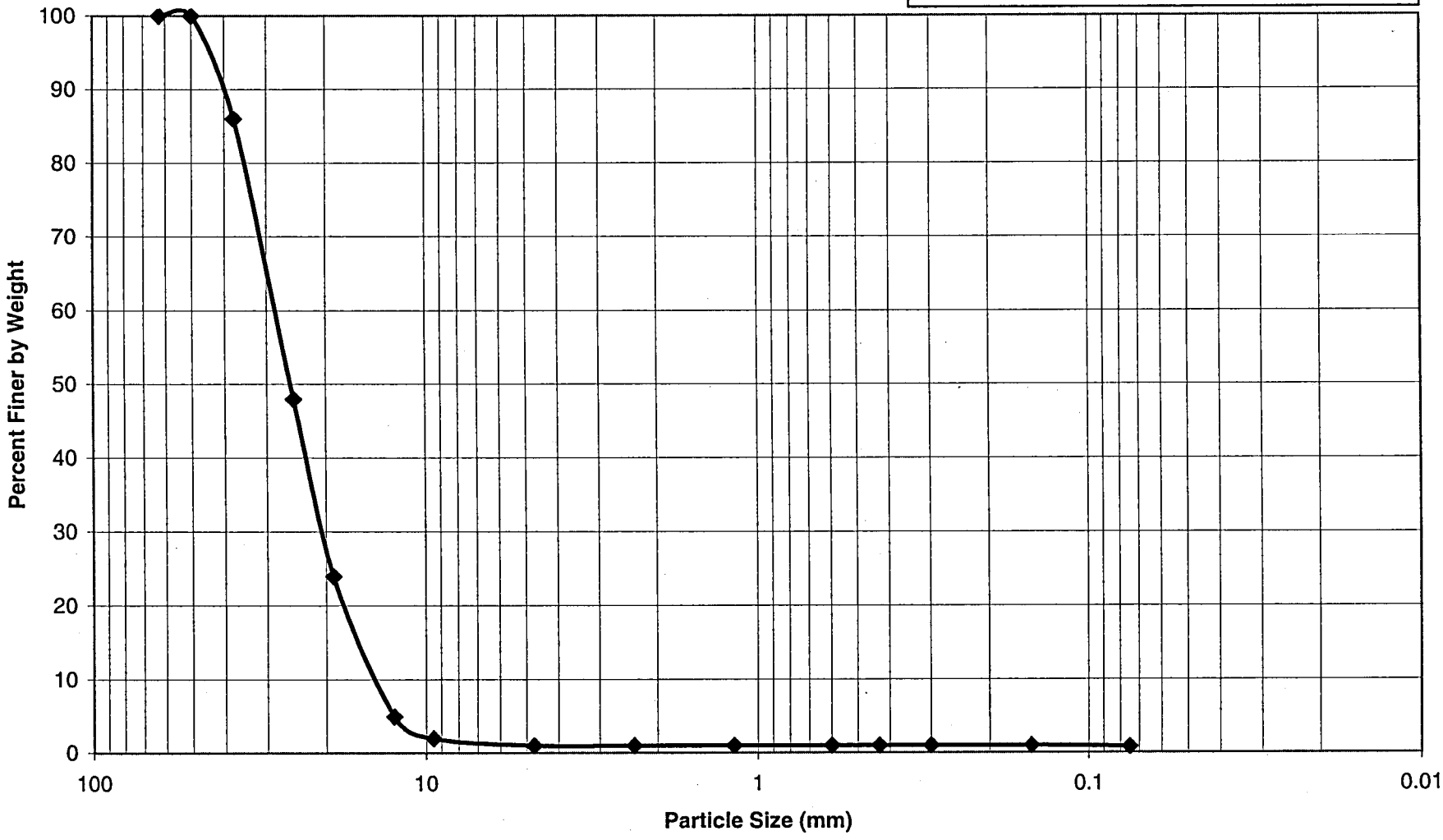


WHITE TANKS FRS #3

15448-007-022

Grain Size Distribution Curve
Boring 57+30 @ 20 - 25 Feet

Laboratory test performed by ATL Inc.

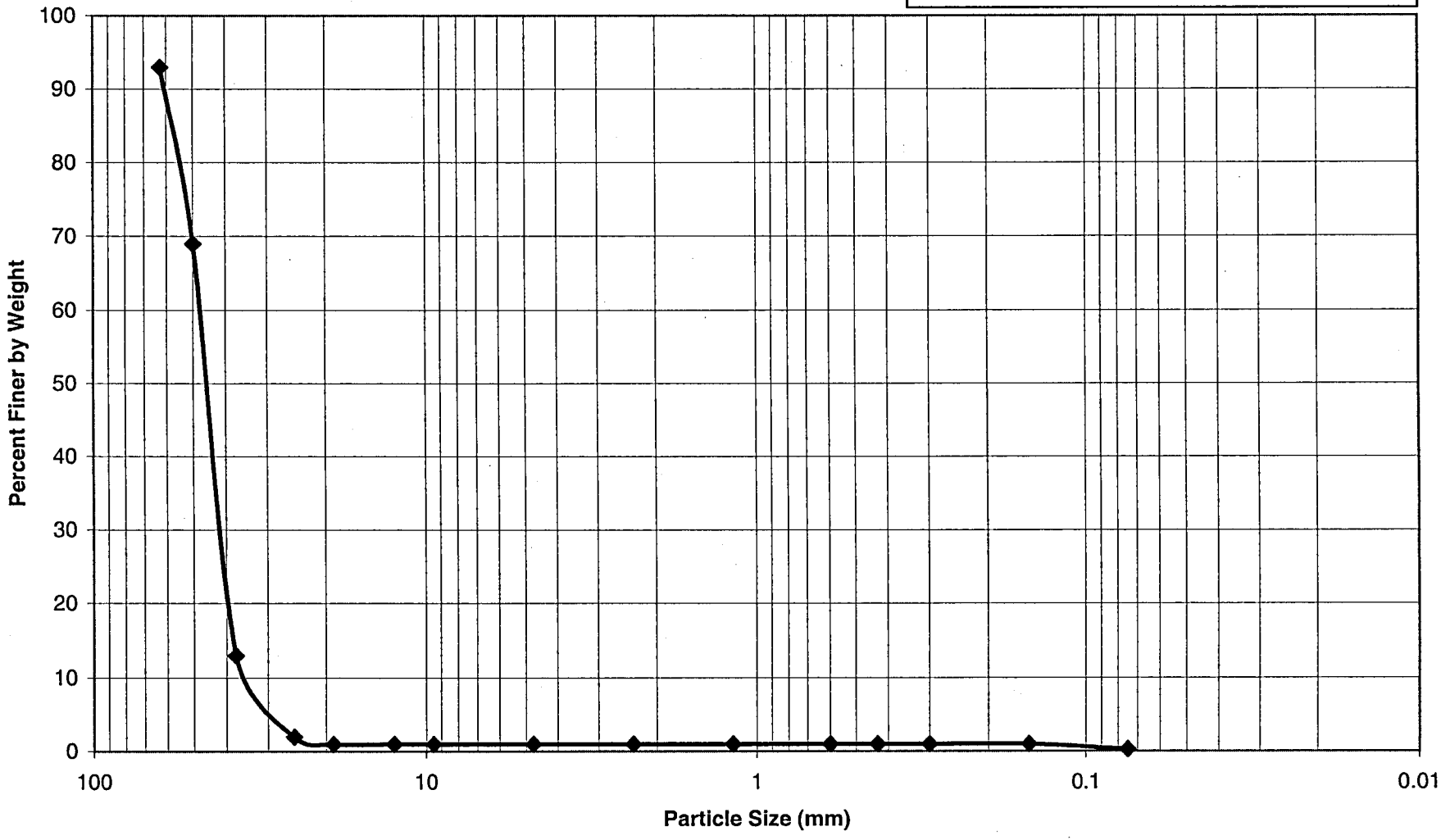


WHITE TANKS FRS #3

15448-007-022

Grain Size Distribution Curve
Boring 58+00 @ 5 - 10 Feet

Laboratory test performed by ATL Inc.

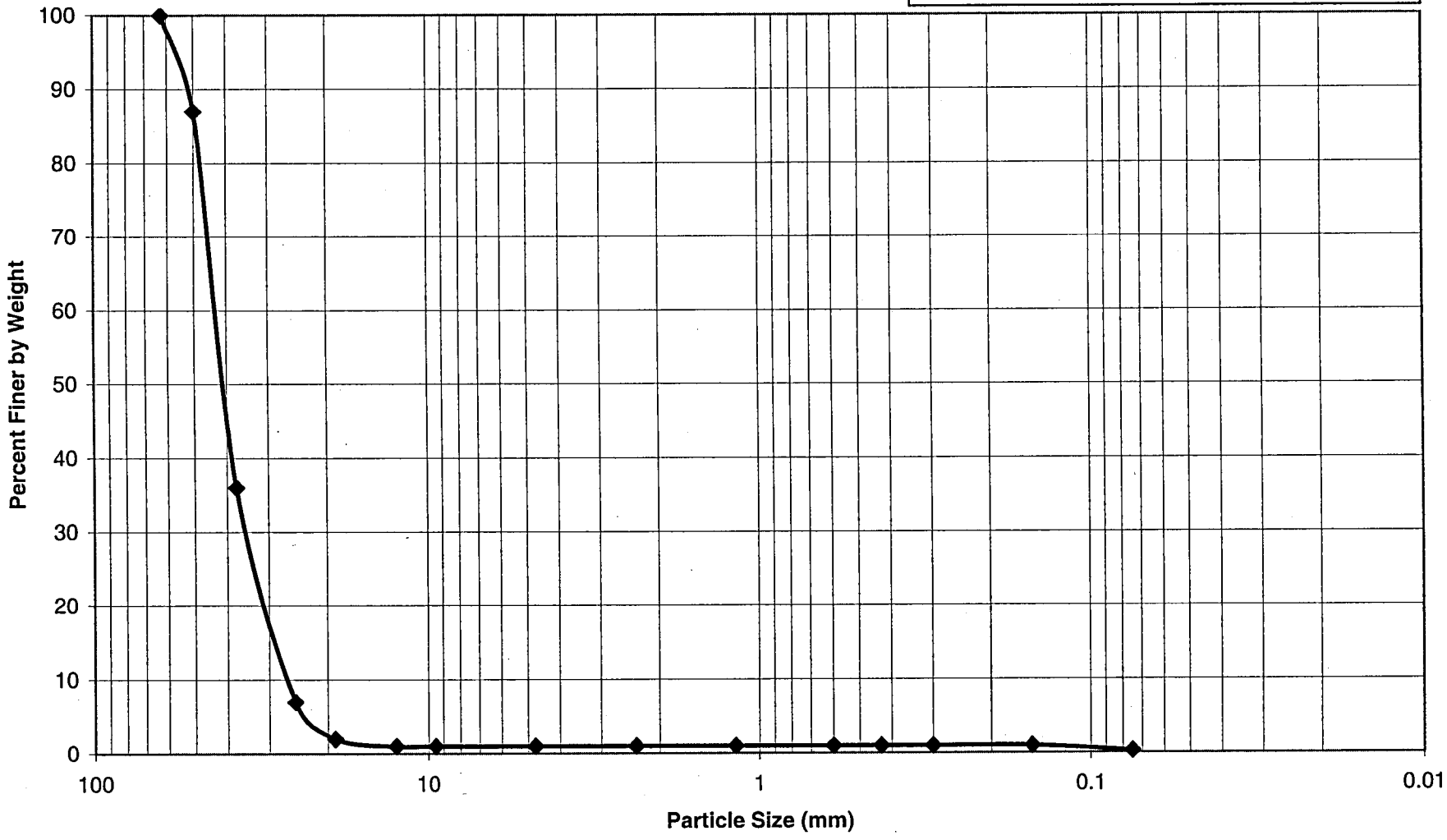


WHITE TANKS FRS #3

15448-007-022

Grain Size Distribution Curve
Boring 59+00 @ 15 - 20 Feet

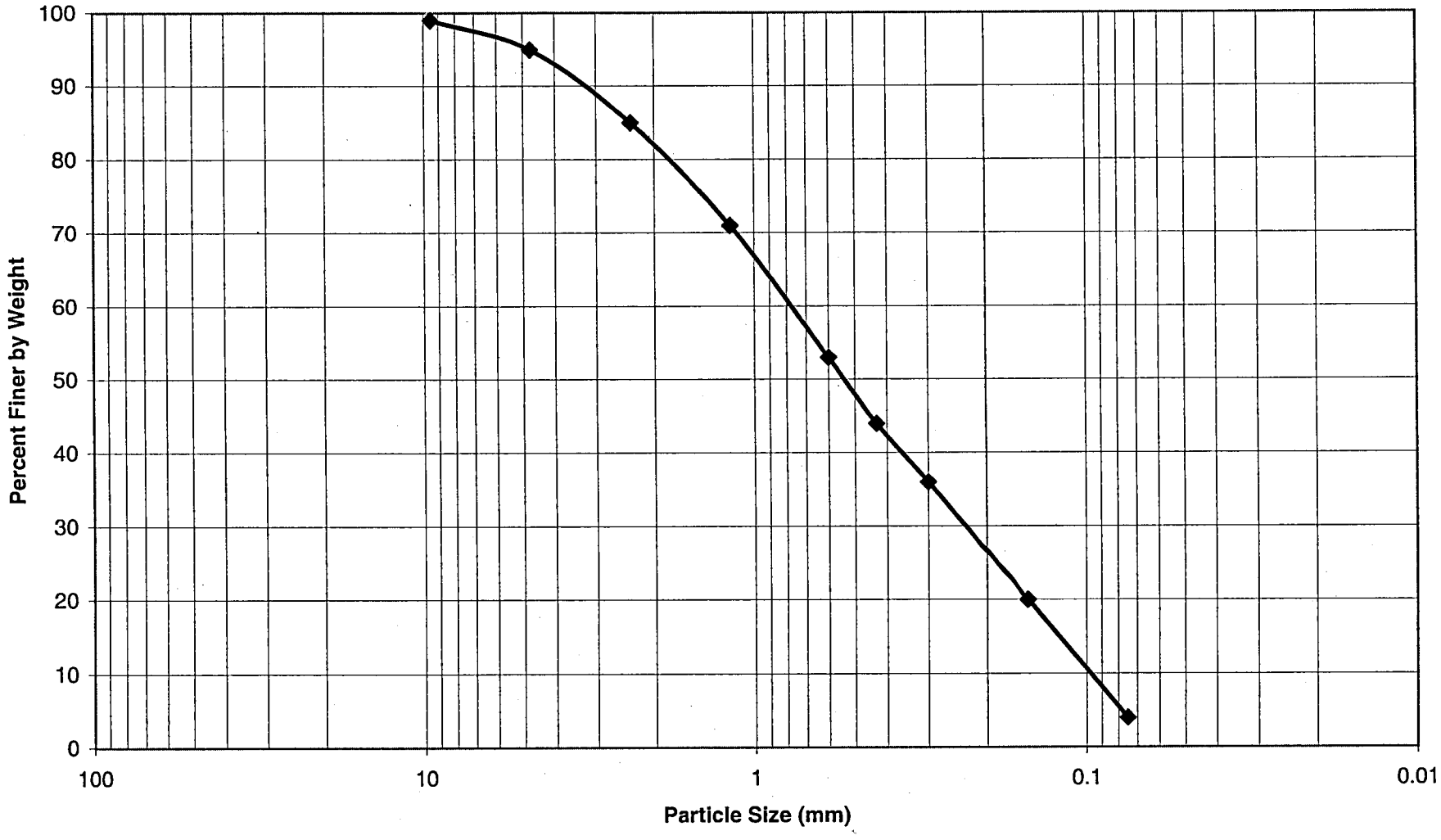
Laboratory test performed by ATL Inc.



WHITE TANKS FRS #3

15448-007-022

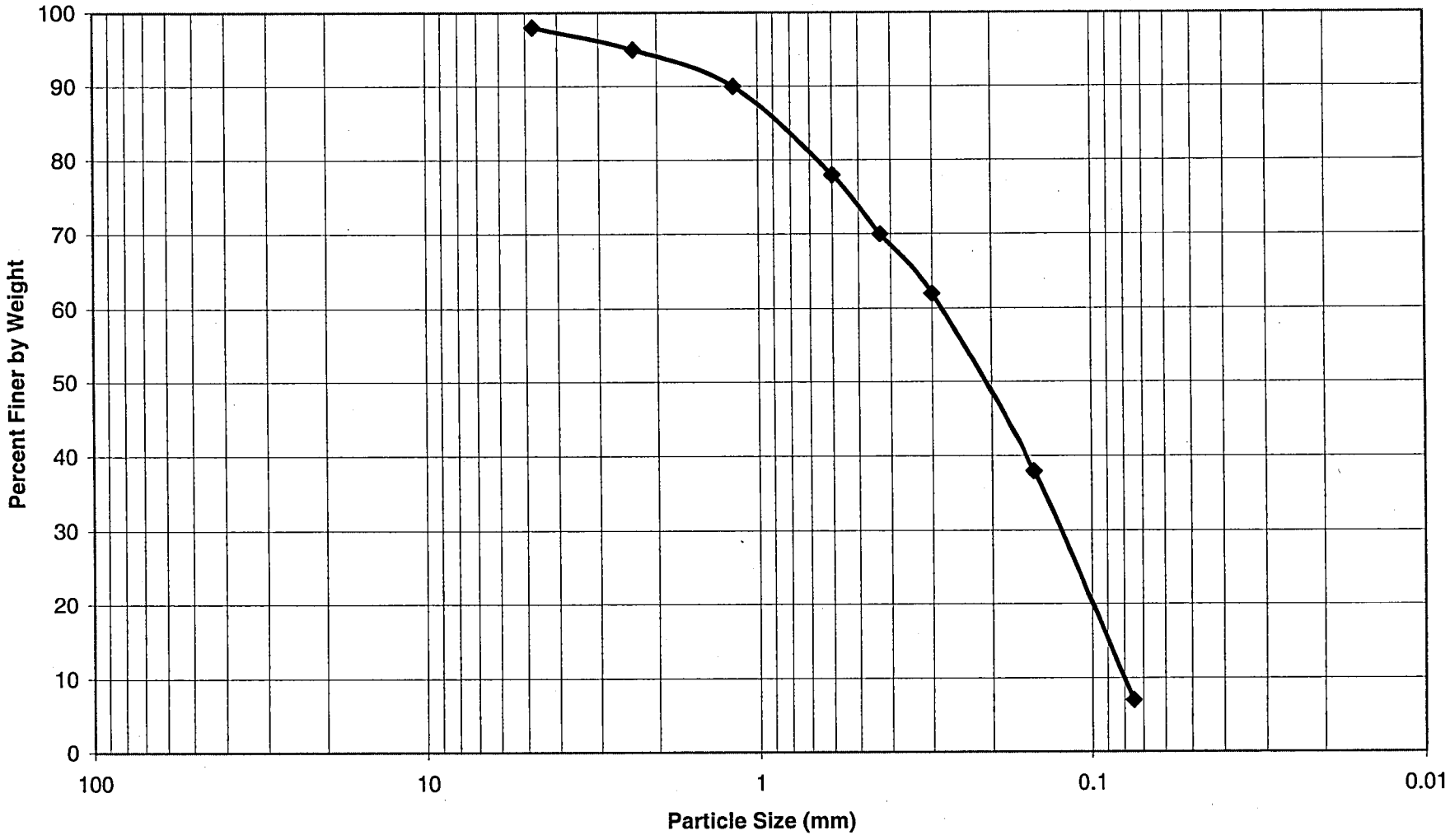
Grain Size Distribution Curve
Test Pit A



WHITE TANKS FRS #3

15448-007-022

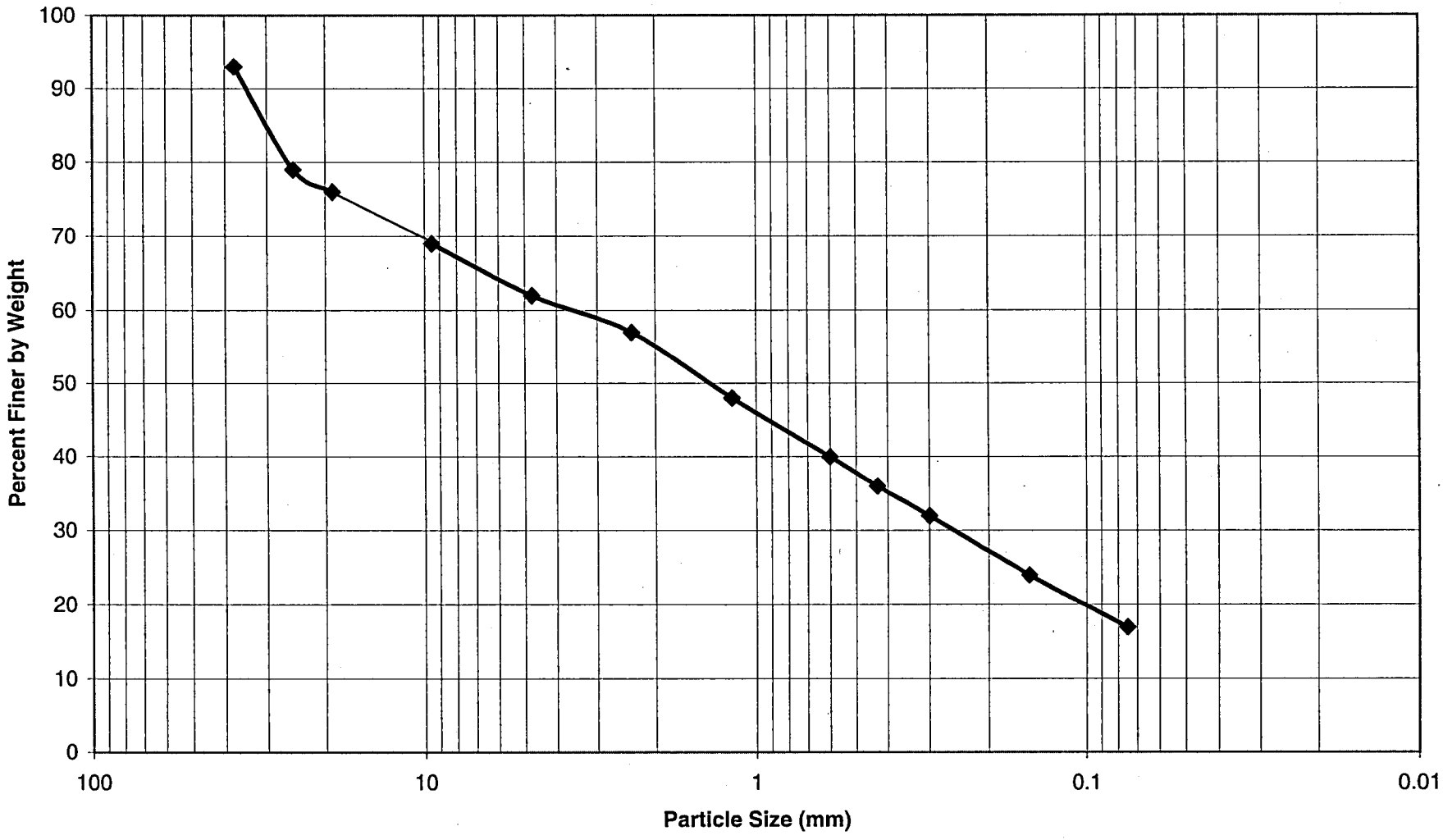
Grain Size Distribution Curve
Test Pit B



WHITE TANKS FRS #3

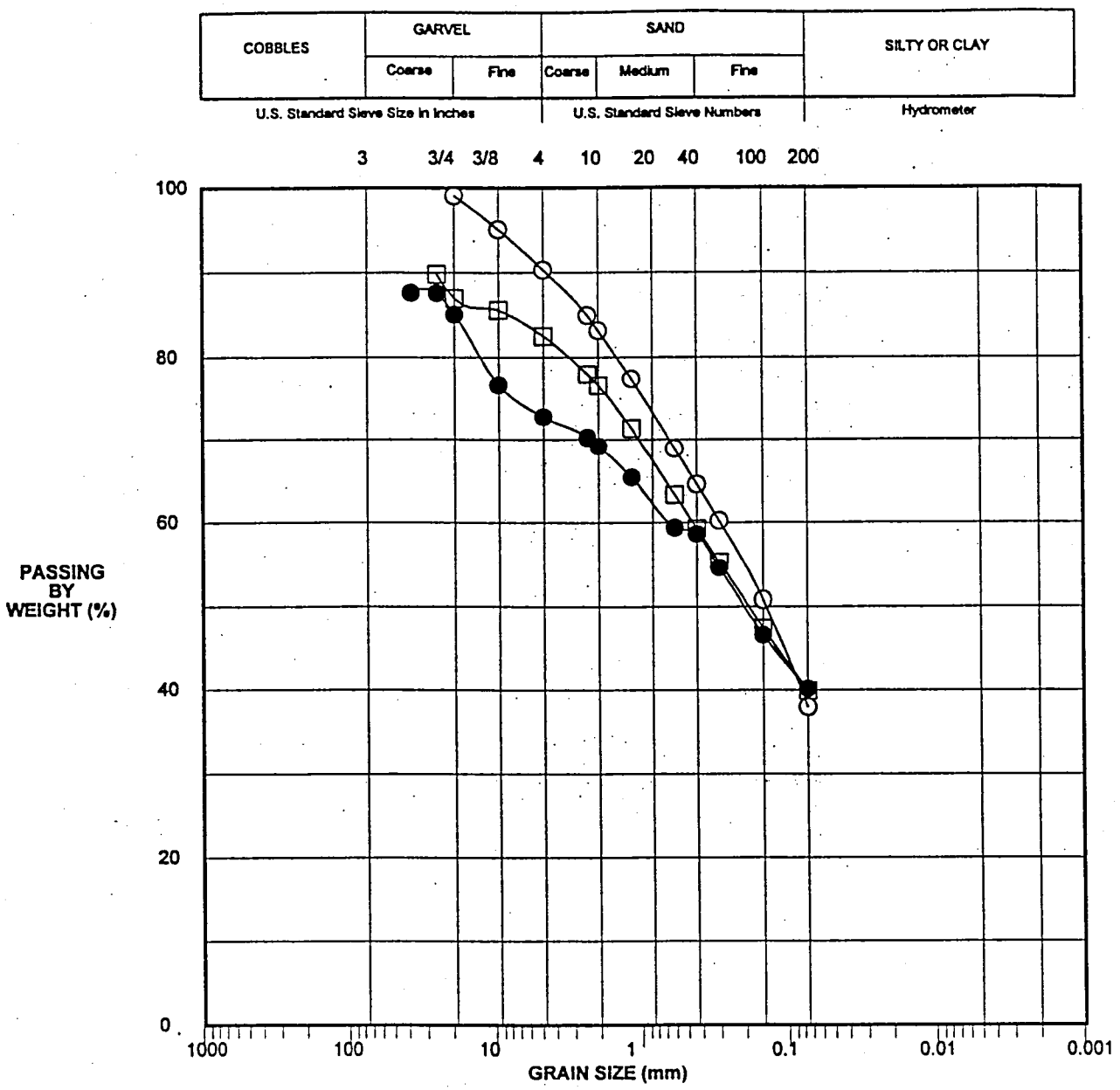
15448-007-022

Grain Size Distribution Curve
Test Pit C



WHITE TANKS FRS #3

15448-007-022



GRAIN SIZE DISTRIBUTION

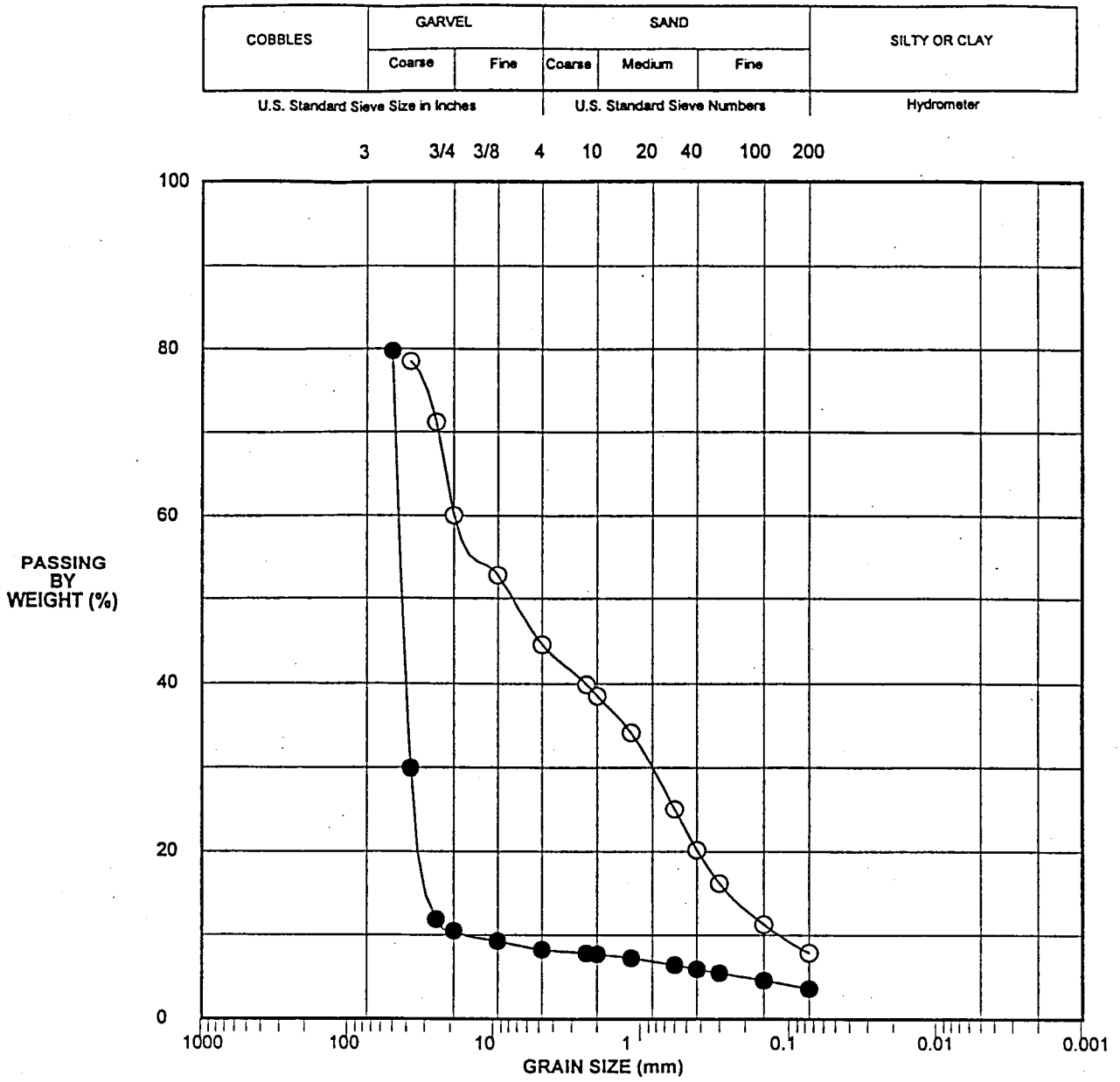
SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	% GRAVEL	% SAND	% FINES
○	E	5	Crack Investigation Test Pit	9.6	52.2	38.2
●	D	5	Filter Investigation Test Pit - South Sidewall	27.2	32.5	40.3
□	D	8	Filter Investigation Test Pit - North Sidewall	17.4	42.5	40.1

Note: Samples obtained during Crack & Filter Investigation, March 2000.

REMARKS:

ATL, INC.
CONSTRUCTION QUALITY ASSURANCE
GEOTECHNICAL/ENVIRONMENTAL CONSULTANTS

WHITE TANKS DAM



GRAIN SIZE DISTRIBUTION

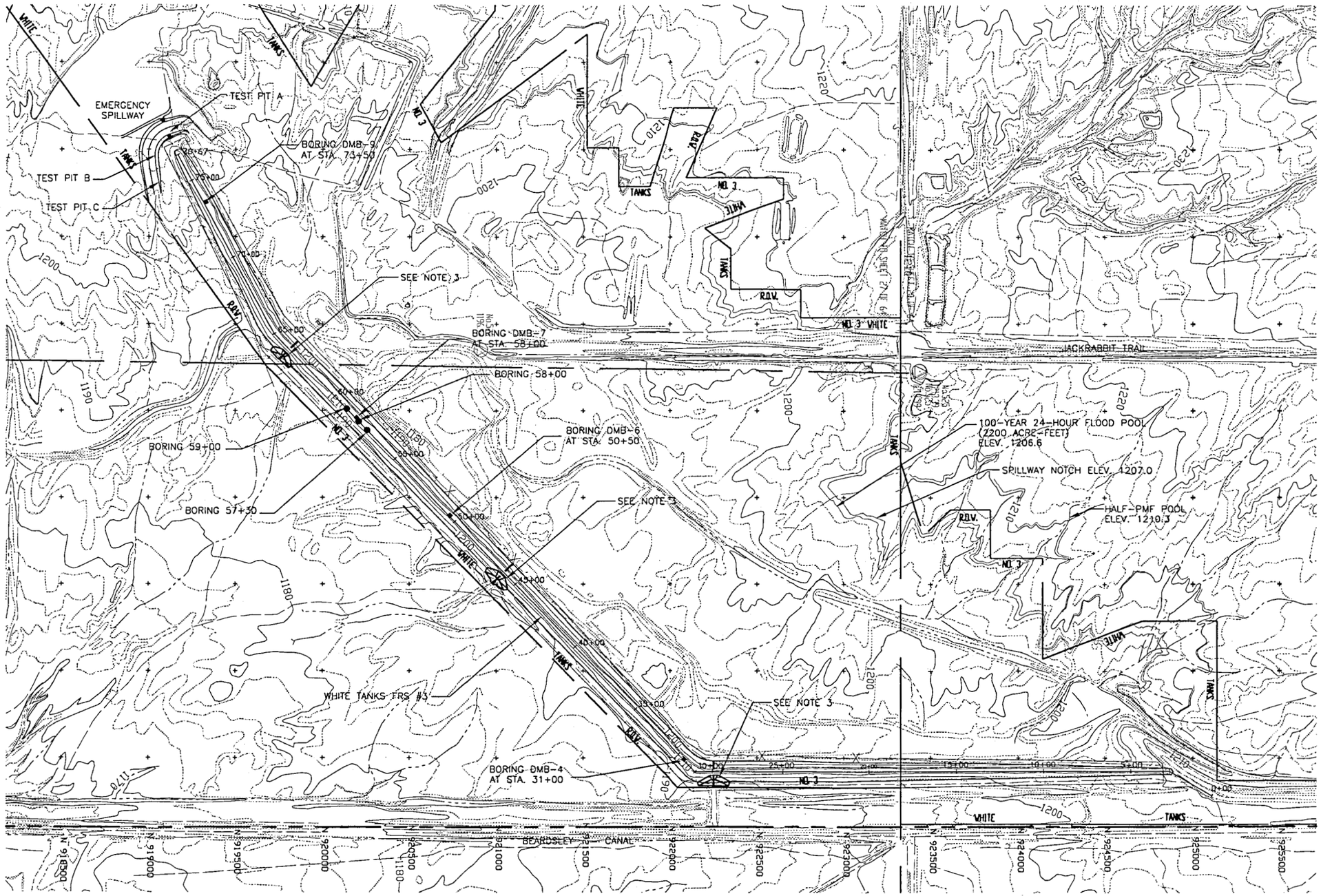
SYMBOL	BORING NO.	DEPTH (ft)	DESCRIPTION	% GRAVEL	% SAND	% FINES
○	D	5	Filter Material	55.3	0.0	44.7
●	D	5	Drain Material	91.7	4.6	3.6

Note: Samples obtained during Crack & Filter Investigation, March 2000.

REMARKS:

ATL, INC.
CONSTRUCTION QUALITY ASSURANCE
GEOTECHNICAL/ENVIRONMENTAL CONSULTANTS

White Tanks Dam



NOTES:

1. Borings 57+30, 58+00, and 59+00 are part of the filter investigation.
2. Samples from borings DMB-4, DMB-6, DMB-7 and DMB-9 were used in calculating the diaphragm filter gradation.
3. Proposed Interim Dam Safety (IDS) modifications.

NORTH

0 300 600 900 1200
Scale in Feet

WHITE TANKS FRS #3

Flood Control District of Maricopa County

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

SOURCE:
BASE 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.

A14018.DWG 9-20-00 XREF:TOPO1289

Dames & Moore Job No. 15448-007-058

Location of Borings and Testpits

Figure 1

APPENDIX D

FILTER AND CRACK INVESTIGATION

Contents of Appendix D

- Contract Modification Package dated November 25, 1981
- Photographs of Filter and Crack Investigation, March 31, 2000
- White Tanks FRS #3 Repair Design Report Prepared for ADWR, May 1981
- Filter Gradation Match Calculation Package
- Drain Gradation Match Calculation Package

7-28
15448-005-022
4-8

November 25, 1981

Mr. Verne M. Bathurst, State Conservationist
Soil Conservation Service
Federal Building, Room 3008
Phoenix, Arizona 85025

Attention: Mr. Ralph Arrington

Subject: White Tanks No. 3 (7-28) and
White Tanks No. 4 (7-29) Repairs
Contract Modification No. 1

Dear Mr. Bathurst:

The Department of Water Resources approves the change of the drainfill gradation outlined in Contract Modification No. 1 for the repair of White Tanks 3 and 4 Dams as attached to your letter of November 18, 1981. The approved gradation is as follows:

Sieve Size	Percent passing by wt.
3"	100
3/4"	52-100
#4	31-57
#8	23-46
#60	0-18
#200	0-6.5

We have reviewed this new gradation and have determined it to be satisfactory for the intended purpose.

Sincerely,

DAN ROGER LAWRENCE, P.E.
Acting Chief
Division of Safety of Dams

DRL:MLA:kaf
cc: Mr. William D. Mathews
Maricopa County Flood Control District

United States Department of Agriculture

Soil Conservation Service

Room 3008 Federal Bldg., Phoenix, AZ 85025

NOV 1981 DEPARTMENT OF WATER RESOURCES

November 18, 1981

DRL ✓ DEC
KMH
GDC Karen
MLA File 7-28
WES 7-29

Mr. Dan Lawrence
Arizona Department of Water Resources
99 East Virginia, Suite 150
Phoenix, Arizona 85004

RE: ENG 210-13 Modification of White Tanks No. 3 and 4 Drain Repair - Drain Fill Material

Dear Mr. Lawrence:

Attached is the Modification No. 1 for the drain fill material for the above structures. The included material is as follows:

1. Modification No. 1
2. Justification
3. Drain Fill materials limits
4. Letter from contractor
5. Letter from material supplier

If you have any questions please call Paul Monville of my staff.

Sincerely,

Verne M. Bathurst
State Conservationist

Attachments

cc: Ralph Arrington, SCE
Joe Knisley, Tucson Area Office

DAN -
① THE FILTER IS COMPATIBLE WIT THE EMBANKMENT
② THE NEW SPEC ALLOWS 100% PASSING 3/4" SIEVE. NEXT CONTROL IS 31-57%, PASSING #4. MY FIRST THOUGHT WAS THAT THIS COULD ALLOW THE LARGEST PARTICLES TO BE JUST OVER 1/4" DIAMETER - LESS THAN THE DESIGN CRACK WIDTH OF 3/8". THIS SHOULD NOT BE A PROBLEM, HOWEVER, SINCE THE SPECS CALL FOR AN AUXILLARY DRAIN AT ANY CRACK WHICH EXCEEDS 3/8" IN WIDTH AT A DEPTH OF 3 FEET OR GREATER. THE AUXILLARY DRAIN WOULD REPLACE THE CRACK AND PREVENT THE LONGITUDINAL DRAIN MATERIAL FROM WASHING INTO A VOID.
MLA

The Soil Conservation Service is an agency of the Department of Agriculture

SCS-AS-50
Rev. 3-70
File Code AS-14-13

Soil Conservation Service

Phoenix, Arizona

CONTRACT MODIFICATION NO. 1

White Tanks Nos. 3&4 Drain Repair (Name of Watershed or other Project) — 50-8A02-1-00223 (Contract No.)

To: GRL Construction Company, Inc. (Name of Contractor) — 203 5th St., Safford, AZ 85546 (Address)

You are hereby requested to comply with the following.

Item No.	Applicable General Provision	CHANGE	Increase in Contract Cost	Decrease in Contract Cost
Tanks No. 3 6 Tanks No. 4 5	3	Change section 9. a. (3) of construction Specification 24. Drain Fill as follows: Sieve Size — Percent passing by wt. 3" — 100 — 100 - 1½" 3/4" — 52 - 100 — 60-100 1" / 70-90 3/4" #4 — 31 - 57 — 50-60 3/8" / 35-50 #4 #8 — 23 - 46 — 25-40 #8 #60 — 0 - 18 — 10-25 #30 #200 — 0 - 6.5 — 0-6.5 #200	0.00	
		Delete section 9. a. (8) of construction Specification 24. Drain Fill	0.00	
		TOTAL	$ 0.00	$

Net (Increase) (Decrease) in Contract Cost $ 0.00

The Completion Date of the contract is (not changed) (extended) (reduced) by _____ calendar days.

Revised Completion Date _____ 19 ____

List of Attachments: (If none, so state) None

Original Contract Price $ 303,524.39 Revised Contract Price $ 303,524.39

THIS MODIFICATION IS HEREBY MADE A PART OF THE CONTRACT.

ACCEPTED:

(CONTRACTING OFFICER OR AUTHORIZED REPRESENTATIVE) (CONTRACTOR)

(DATE) (DATE)

JUSTIFICATION

Contract No. 50-8A02-1-00223

Modification No. 1

Date: October 5, 1981

By:
Government Representative

10/8/81 [illegible]

The original specified Drain Fill gradation requirements were so ~~stringent~~ tight that the contractor was unable to find a supplier to furnish the material. The unavailability of the material was checked and verified, therefore the gradation was changed so that available material can be used.

MATERIALS TESTING REPORT | U.S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE

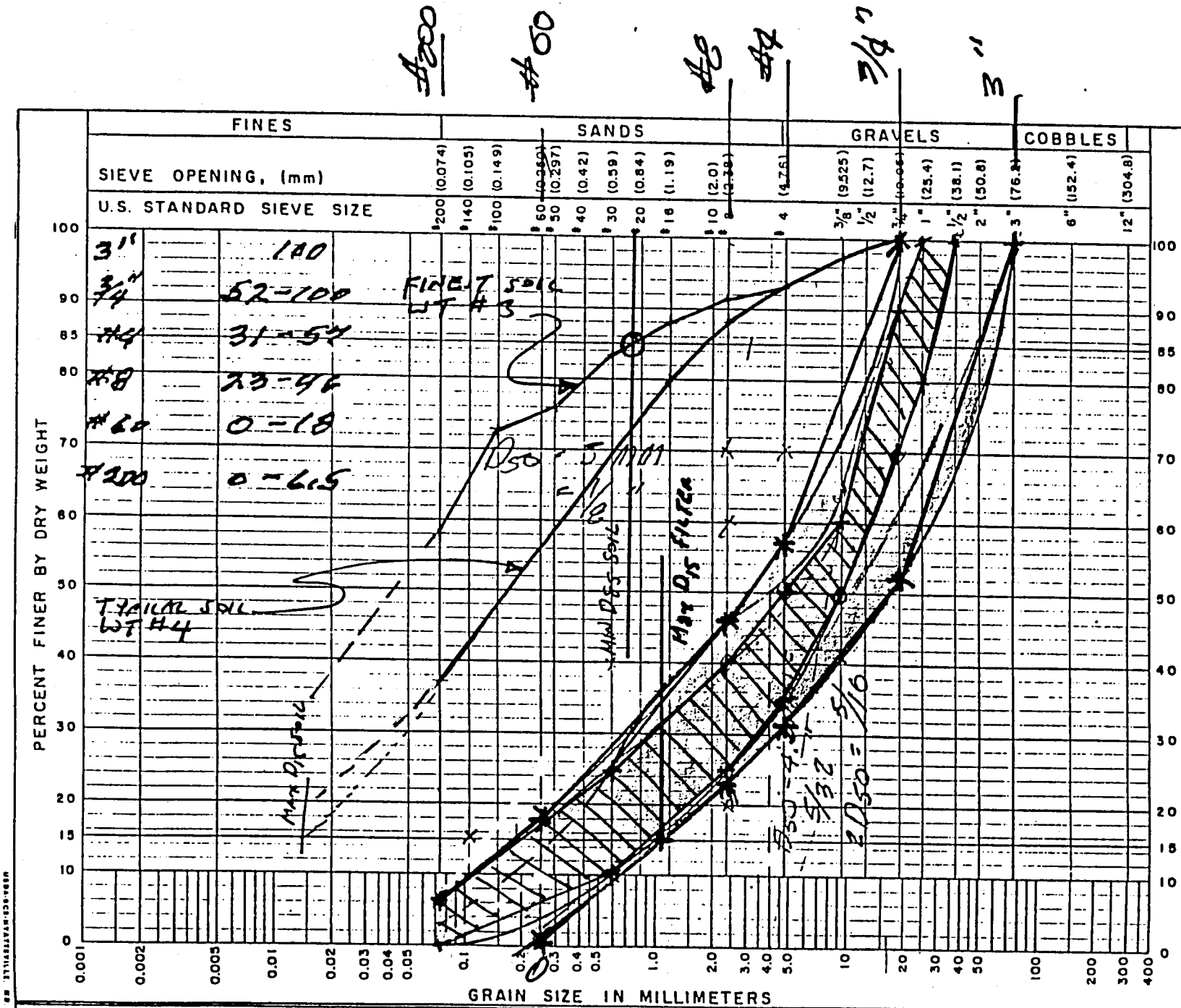
DRAIN MATERIALS

PROJECT and STATE: Hi Tanks FRS 3 & 4

DESIGNED AT: Phoenix AZ

BY: RM

DATE: 10-20-81



REMARKS

PIPING POTENTIAL: $\frac{D_{15}\ \text{FILTER}}{D_{85}\ \text{SOIL}} = \frac{1.2\text{mm}}{0.8\text{mm}} = 1.5 < 5$ OK

PERMEABILITY $\frac{D_{15}\ \text{FILTER}}{D_{15}\ \text{SOIL}} = \frac{0.2\text{mm}}{0.0145} = 13 > 5$ OK

NEW SPEC ORIGINAL SPEC

GRL Construction Co., Inc.
203 FIFTH STREET — (602) 428-6940
SAFFORD, ARIZONA 85546

Oct. 16, 1981

Soil Conservation Service
Room 3008 - Federal Building
230 North First Ave.
Phoenix, Arizona 85025

To Whom it May Concern:

In the process of bidding the White Tanks job we ask for quotes on the materials from several of the sand and gravel companies. During the process of certification of their bids they one by one withdrew their bids. Included among these are Tanner Co., McKinnley Trucking, Ashton, and the one on which we based our bid: Allied Concrete Inc.

Allied produced a sample of rock which was turned down. Allied's final analysis was the same as all the rest of the suppliers. They tried to correct their mix but found that their machinery was unable to produce it. Consequently, at this point in time we are without a material supplier.

We have asked Allied to present a letter stating their situation, which Steve Kopp agreed to do. In this letter it is our intention to notify you of our situation and inquire as to whether you have any suggestions.

Sincerely,

Stanley John

Stanley John
GRL Construction, Co. Inc.

D CONCRETE, INC.

NE 247-0730 P.O. BOX 14737 PHOENIX, ARIZONA 85063

John

October 16, 1981

GRL Construction Co., Inc.
203 5th Street
Safford, Arizona 85546

Attn: Stanley John

Dear Mr. John,

After extensive testing of all the material in our plant we find that our material will not meet the stringent gradation set forth by the Soil Conservation Service.

The Department of Transportation also has grading for material which they enforce. However, they have found that the midrange size material cannot realistically be confined to a range of ± 5% of a given means value. They have a range of ± 12.5% of a given means value for most all the material in the midrange sieve sizes.

We therefore feel it would be best for your interest to contact another supplier for this project. Should the Soil Conservation Service reconsider the gradation specification we would be most willing to evaluate this change with regards to the material on hand.

Respectfully,

Steven Kopp

Steven Kopp
Quality Control

SK/ml

Craig Reed

COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69 SOIL CONSERVATION SERVICE

STATE Arizona	PROJECT White Tanks WP		
BY W.E. Payne / DATE 4-16-81	CHECKED BY	DATE	JOB NO. 3
SUBJECT Crack Repair			SHEET ___ OF ___

The method of repair of this structure is a combination of the methods used on Buckeye Site I Drain and Graveyard Wash Repair as recommended in Jack Stevenson's Trip Report dated November 10, 1980.

The structure will be breached at station 58+00. The embankment will be removed to an elevation of 1186 which is approximately 3 feet below original ground and 8 feet below the bottom of the maximum depth of crack observed (21.9 feet). The fill will be replaced and compacted to 95% density according to ASTM D 698. An embankment drain with an outlet will be installed during the backfill stage.

The three crack areas at stations 18+00, 29+00 and 48+00 will be repaired by trenching and backfilled with a graded filter. The trenches will extend 100 feet on either side of the observed crack. The trenches and

SCS-ENG-523 Rev. 8-69

SOIL CONSERVATION SERVICE

STATE Arizona	PROJECT White Tanks W.P.		
BY W.E. Payne DATE 4-16-81	CHECKED BY	DATE	JOB NO. 8
SUBJECT Crack Repair			SHEET ___ OF ___

filter will be extended to include any cracked area observed during the construction.

The drain filter has been designed in accordance with SMN #1 from sample taken in locations as shown on the drawings. The D_{75} size is slightly larger than ½ inch. Twice the D_{50} size is 3/8 to 3/4 inch. Therefor the design crack is 3/8 inch in accordance with the criteria set for Buckeye Site I Drain.

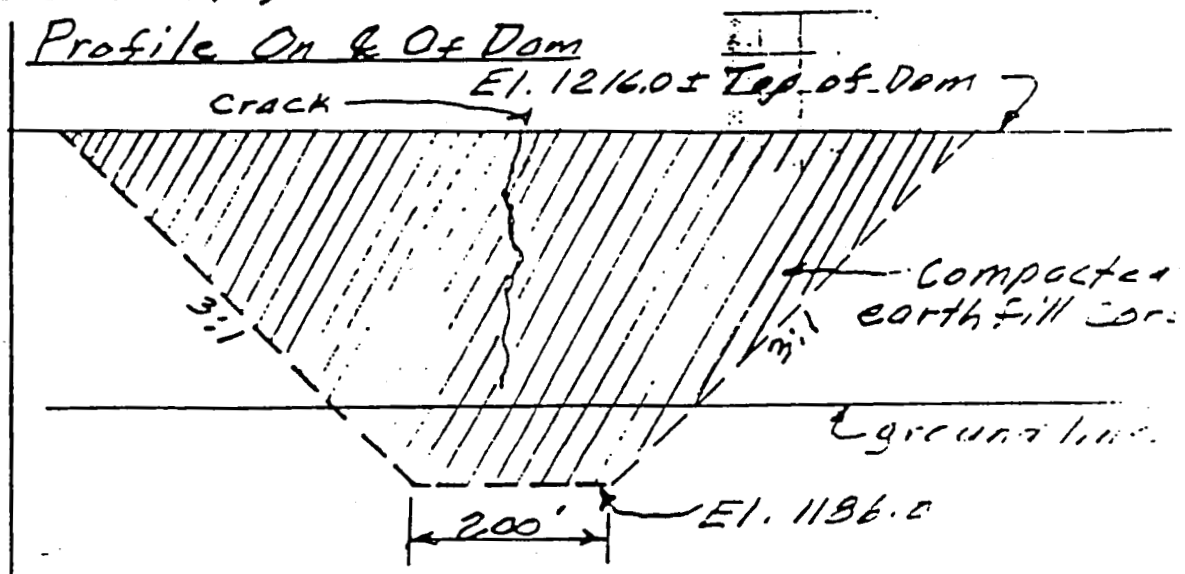
COMPUTATION SHEET

SCS-ENG-523 Rev. 8-69

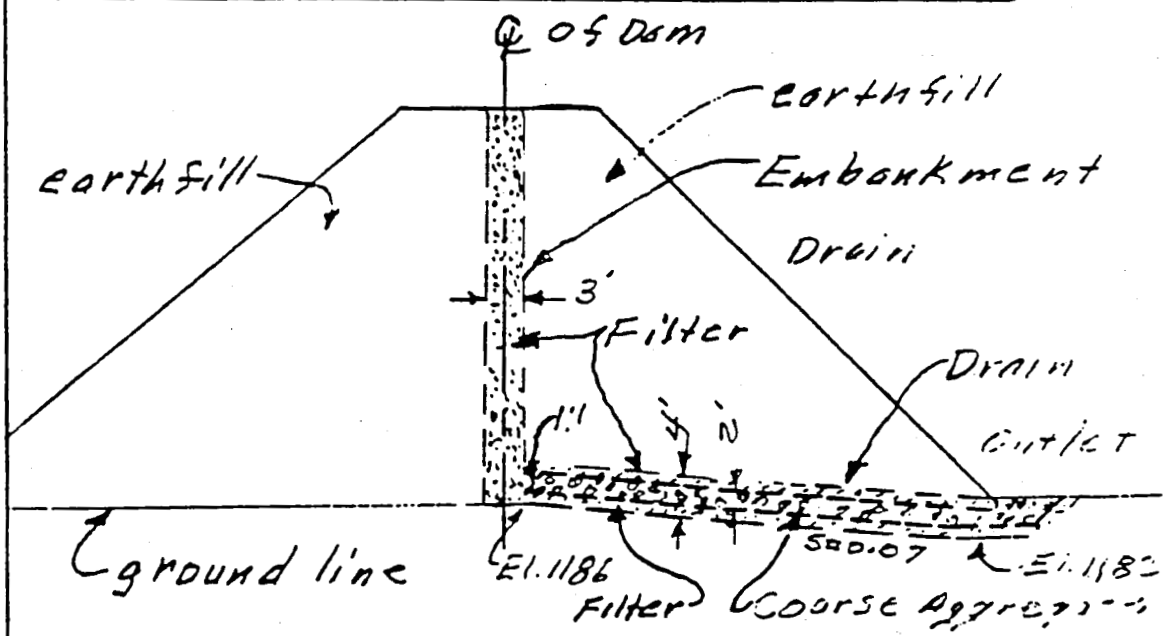
SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT White Tanks WP	
BY W.F. Payne	DATE 4-16-81	CHECKED BY	DATE	JOB NO. 3
SUBJECT Crack Repair			SHEET ___ OF ___

Profile On ℄ Of Dam



Cross-section of Dam Sta. 58+00

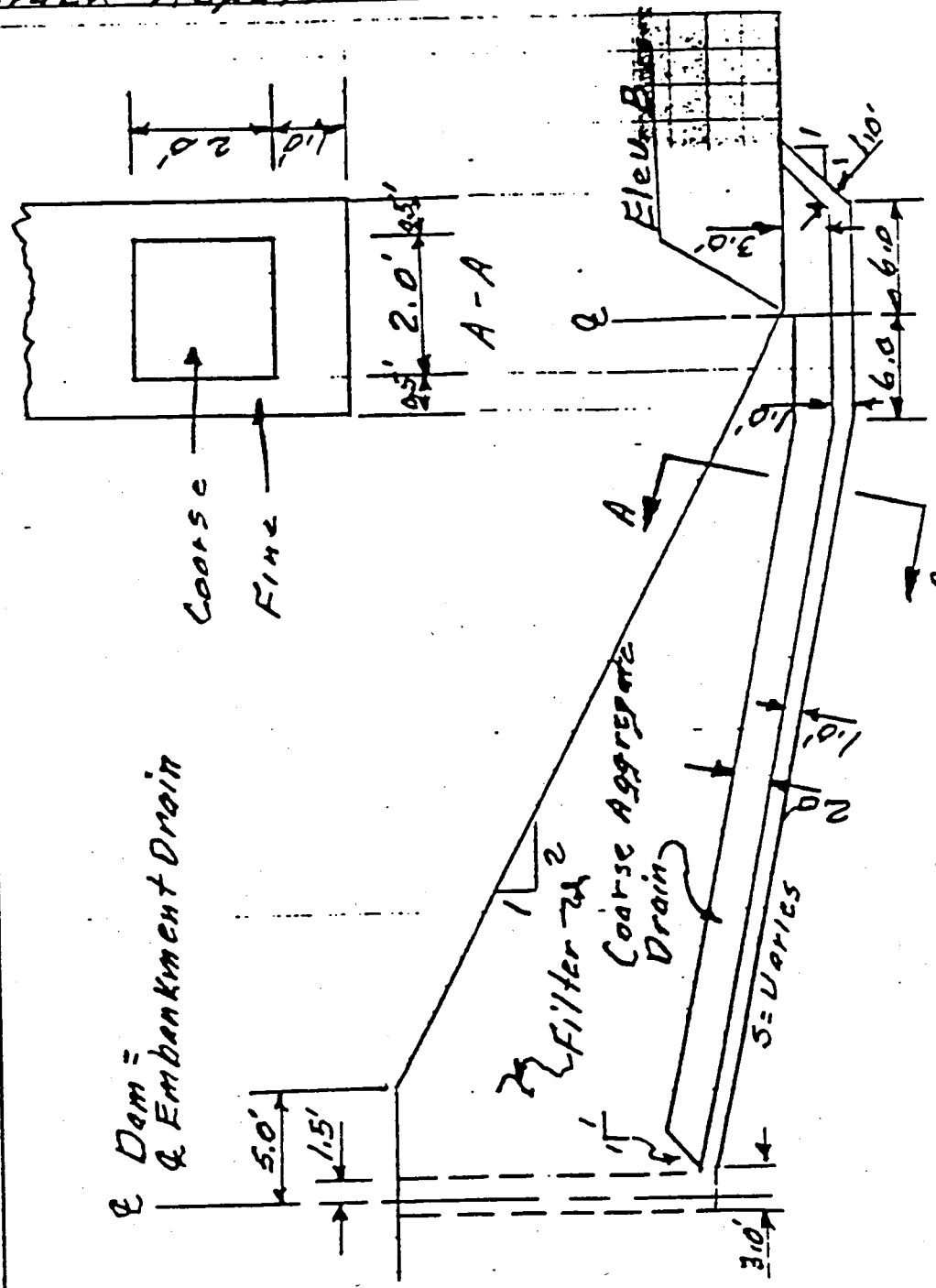


The drain outlet will be a two part filter designed in accordance with SMN #1. Design crack is $2 D_{50} = 3/8$ inc

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

SOIL CONSERVATION SERVICE

STATE Arizona		PROJECT White Tanks WP	
BY W.E. Payne	DATE 4-16-81	CHECKED BY	DATE	JOB NO. 3
SUBJECT Crack Repair			SHEET ___ OF ___



PROFILE ON ℄ OF EMBANKMENT DRAIN OUTLET

Cracks on dam at approximately Station 59+00.

Cracks on dam at approximately Station 59+00.

Side of crack investigation test pit.

Side of crack investigation test pit.

Side of crack investigation test pit.

Side of crack investigation test pit.

Side of crack investigation test pit.

Side of filter investigation test pit showing drain material.

Filter investigation test pit showing the drain on the left and the filter/transition zone on the right.

Filter investigation test pit showing the drain on the left and the filter/transition zone on the right.

Filter investigation test pit showing the drain on the left and the filter/transition zone on the right.

Filter investigation test pit showing the drain on the left and the filter/transition zone on the right.

KRS
JL
15448-007-058

ARIZONA DEPARTMENT OF WATER RESOURCES

Dam Safety Section
500 North Third Street, Phoenix, Arizona 85004
Telephone (602) 417-2445
Fax (602) 417-2423

JANE DEE HULL
Governor

RITA PEARSON
MAGUIRE
Director

LETTER OF TRANSMITTAL

To: URS Dames & Moore
7500 North Dreamy Draw Drive, Suite 145
Phoenix, Arizona 85020

Date: June 13, 2000
File Name: White Tanks #3
File No.: 07.28

Attention: Sandy Gourlay, P.E.

Sent Via: ☒ U.S. Mail ☐ Express Mail ☐ Messenger

☐ Fax: Phone #_____ No. Pages (Attached):_____

We Are Sending The Following:

DESCRIPTION	DATED	COPIES
White Tanks #3 Repair Design Report (3 pages)	May 11, 1981	1
Sheet 3 of 3 from the design report	April 1981	1
Sheet 3 of 5 from the as-built drawings	December 1981	1

These Are Transmitted:

☐ For Your Use
☐ As Requested
☐ For Review & Comment
☒ For Your Information
☐ _____

Remarks:

cc: Noller Herbert, P.E.
NRCS
3003 N. Central, Suite 800
Phoenix, Arizona 85012

Tom Renckly, P.E.
FCDMC
2801 West Durango Street
Phoenix, Arizona 85009

Fax: _____

Signed: _____

fax.frm.. 5/4/95

DESIGN REPORT

Job: White Tanks No. 3 Repair
Project: White Tanks Watershed Protection Project
Location: Maricopa County, Arizona
Authority: PL 566
Phase: Final Design

Summary:

The final design is in accordance with the "Cracking of Dams in Arizona," April 27, 1978, a report by the Crack Study Team and "Crack Location Investigation," April 16,1979 by Fugro, Inc., Consulting Engineers and Geologists.

Description of the Job:

The project consists of the removal of 200 feet of embankment at Station 58+00 and replacement to its original exterior dimensions. An embankment drain shall be excavated along the centerline at Stations 18+00, 29+00, and 42+00, for 200 feet each to depths of 7.5, 12.0, and 10.0 feet respectively. Each trench shall be excavated approximately three (3) feet below the maximum depth of crack observed as recommended. Each trench shall be graded to its individual outlet. The trenches and outlets shall be filled with well-graded drain fill material of maximum size passing the 1 1/2-inch sieve.

Design Objective:

To treat and repair the damaged areas of the structure, perform a comprehensive inspection of the cracks during construction, and collect more data for the study of cracking.

Basis for Design:

1. Cracking of Dams in Arizona, April 27, 1978, Report of the Crack Study Team.

2. Crack Location Investigation, White Tanks No. 3 Flood Retarding Structure, Maricopa County, Arizona, April 16, 1979, Fugro, Inc., Consulting Engineers and Geologists, Goodyear, Arizona, 85338.

3. Soil Mechanics Note 1. - Tentative Guide for Determining the Gradation of Filter Materials, U.S. Department of Agriculture, SCS Engineering Division, Soil Mechanics Unit, May 1968.

4. Vertical Drains and Embankment Zones, Clarence E. Dennis, Lincoln E&WP Unit, April 1971.

5. Uniform Standard Specifications for Public Works Construction, Maricopa Association of Governments (MAG), July 1, 1974, Arizona.

Design of Repair Method:

1. The method of repair of this structure is a combination of the methods used on Buckeye Site I Drain and Graveyard Wash repair as recommended in Jack Stevenson's trip report dated November 10, 1980.

The structure will be breached at Station 58+00. The embankment will be removed to an elevation of 1186, which is approximately three (3) feet below original ground and eight (8) feet below the bottom of the maximum depth of crack observed (21.9 feet). The embankment will be replaced and compacted to 95% of Standard Proctor according to ASTM D 698. An embankment drain with an outlet will be installed during the backfill stage.

The three crack areas at Stations 18+00, 29+00, and 42+00 will be repaired by trenching and backfilled with a graded filter. These areas were chosen from Reference No. 2 Degree of Cracking Map, which shows the locations to be in the moderate to severe cracking areas. The trenches extend 100 feet on either side of the observed crack and each trench will have its own outlet. The trenches and filter will be extended to include any cracked area observed during the construction.

2. The depth of each trench was based on the maximum depth of the crack observed in each location, as noted in Reference No. 2, plus three (3) feet as recommended in Reference No. 1. Alternate designs were considered in the preliminary design phase and the trench drain method of repair was selected because it was the most economical of the alternatives studied.

3. The drain fill gradation was taken from the requirements of the MAG specifications for aggregate base, crushed, Section 702, Type A. The drain fill materials were checked for piping and permeability requirements using Reference No. 3 on representative embankment samples as a base.

4. Auxiliary drain outlets shall be installed where directed by the Engineer when the crack depth exceeds the designed trench depth. An auxiliary drain outlet shall be provided at the immediate location where there is located an open crack greater than 3/8 inch wide at depths below three (3) feet from the top of the dam.

5. The drain outlets are designed with a two-foot square of coarse aggregate in accordance with the requirements of ASTM C-33 size No. 2. The coarse aggregate was checked for piping and permeability requirements of Reference No. 3.

6. The D_{50} size of the drain fill is 3/16 to 3/8 inch and the D_{75} size is 5/8 to one (1) inch. The design crack is taken conservatively as 3/8 inch. This meets the requirements of Stan Hobson's letter of February 6, 1980 on Buckeye Site 1 Drain.

7. The requirements of Reference No. 4 are not totally met for the D_{15} and D_{85} size for the drain fill and the D_{85} size for the coarse aggregate, but the drain fill and coarse aggregate are in accordance with Reference Nos. 1 and 3. Since Reference No. 1 was written by people that have on-site experience, it was assumed their recommendations would take precedence over the requirements in Reference No. 4.

8. The Design Review Report for Buckeye Site 1 Drain is part of the documentation and its requirements have been met for the design of the drain filter and the specifications.

9. Reference No. 2 recommended the use of perforated pipe in the drain fill. A crack width and head were assumed and the quantity of flow by the orifice and short tube procedures were calculated. The amount of flow was minimal and it was determined a pipe was not needed, particularly with the coarse aggregate outlets.

Environmental Considerations

Fragile vegetation other than native annuals have not developed. Native annuals will automatically reseed and sprout in the area of disturbance after the first rain. Visual impact will last until after the first rain and growth begins. Wasting trench excavation material adjacent to the trenches will cause the least detrimental effects to the environment. Hauling the waste material to other areas for disposal will cause more disturbance in the construction area due to the need for haul roads and handling the waste materials several times. The structure is relatively isolated with no easy access on the east side of the White Tank Mountains.

Bid Schedule

The only lump sum item considered is mobilization which is taken as a percentage of the total construction cost for estimating purposes.

Operation and Maintenance

Normal operation and maintenance will be performed by the local sponsor upon completion of the work. Annual inspections are recommended.

Construction Review

Any condition not covered in the drawings and specifications that is encountered during construction shall be reported to the appropriate specialist for possible field review to insure that conditions anticipated during design are verified and consistent with the design assumptions.

AUTHORITY

Submitted by	Date 5-11-81
Recommended by	Date 5-11-81
Approved by	Date 5-11-81

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SHEET 1 OF 14

SUBJECT:

Filter Investigation: Filter Gradation Match

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 5/4/00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 6-20-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

(SIGNATURE) 5-11-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 6-20-00 (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

White Tanks FRS #3
Filter Investigation
Embankment to Filter Match

Problem

Determine if existing filter material matches the embankment in the re-built section of the dam.

References

National Engineering Handbook, Part 633, Chapter 26 Gradation Design of Sand and Gravel Filters, October 1994

ADWR letter dated November 25, 1981 stating gradation of existing filter

Conclusion

As shown on sheet 9 of 14, the existing filter material is coarser than the design band. Therefore, material would migrate from the embankment into the filter and a match does not exist.

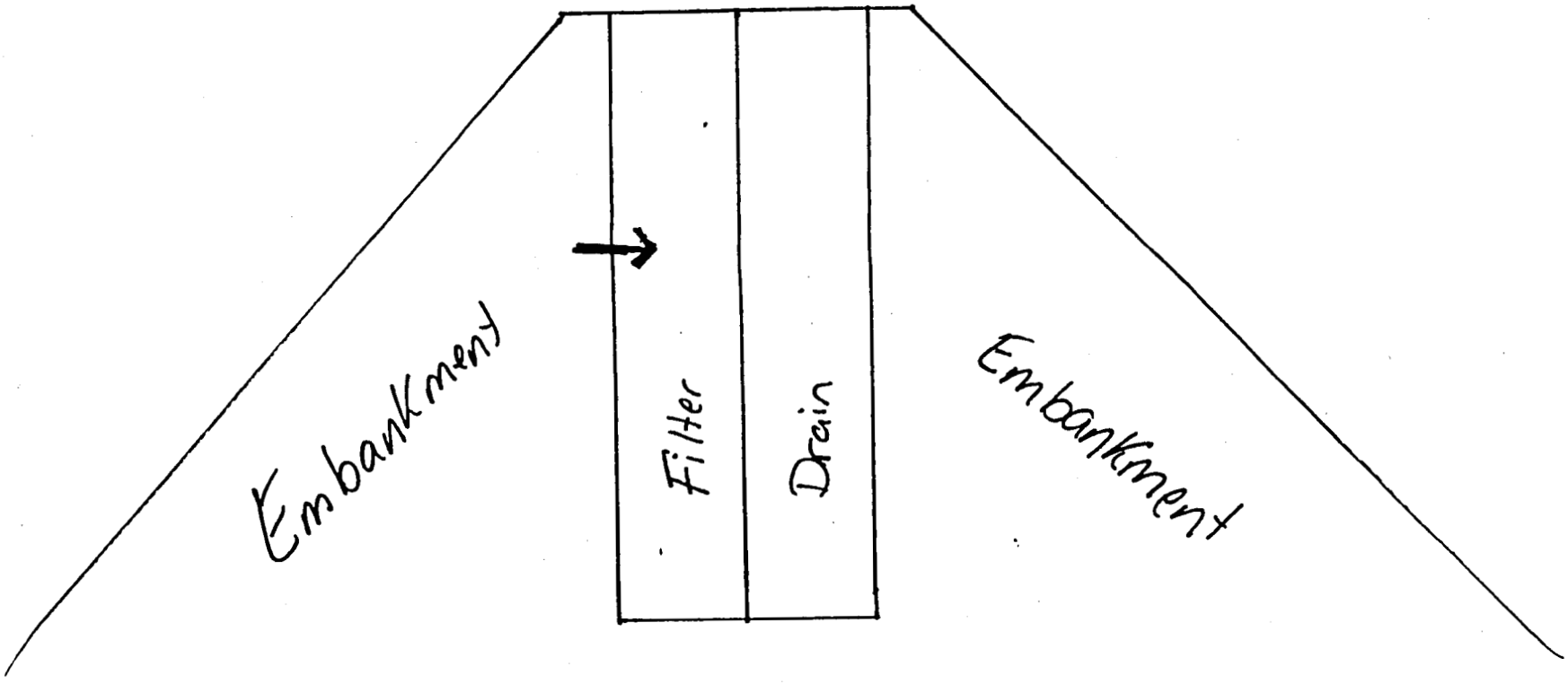
DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Job No. Job
Client Subject

Sheet No.
Calc. No.
Rev. No.
By Date
Chk'd. Date

White Tanks FRS #3

This calc checks for a match between the embankment fill and the existing filter.



F-1321/7 9.11

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 2\14
Calc. No.
Rev. No.
By BKW Date 5/4/a
Chk'd. TWL Date

Job No. Job
Client Subject

Determine if the existing filter in the re-built area of the dam is appropriately matched with the embankment material.

- Samples used for base soil were taken during the filter/crack investigation from the test pits excavated on the dam crest + side at approximately Station 59+00
- Calculated according to National Engineering Handbook, Chapter 26 Gradation Design of Sand + Gravel Filters (NRCS, 199

F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 3/14
Calc. No.
Rev. No.
By BKW Date 5/4/00
Chk'd. JWL Date 5-11-00

Job No. Job
Client Subject

- Regrade base soil

Correction Factors

North Slope = $\frac{100}{90}$ = 1.11

South Sidewall = $\frac{100}{74}$ = 1.35

North Sidewall = $\frac{100}{82}$ = 1.22

see attached spreadsheets

- Base Soil Category = 2 according to Table 26-1
- Max $D_{15} \leq 0.7$ according to Table 26-2
- Min $D_{15} \geq 4 \times d_{15}$ of base soil but not less than 0.1mm

Base soil has no meaningful d_{15} therefore Min D_{15} = 0.1mm @ Control Point 2

- $\frac{\text{Max } D_{15}}{\text{Min } D_{15}} = \frac{0.7}{0.1} = 7$ ratio must be less than 5

locate bars at Min D_{15} side since filtering is the most important function

$\frac{\text{Max } D_{15}}{0.1} = 5$ Max D_{15} = 0.5mm @ Control Point 1

F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 4|14
Calc. No.
Rev. No.
By BKW Date 5/4/
Chk'd. TWL Date

Job No. Job
Client Subject

$$\text{Max } D_{10} = \frac{\text{Max } D_{15}}{1.2} = \frac{0.5\text{mm}}{1.2}$$
$$= 0.42 \text{ mm}$$

$$\text{Max } D_{60} = 6 \text{ Max } D_{10}$$

$$\text{Max } D_{60} = 6(0.42\text{mm})$$

$$\text{Max } D_{60} = 2.52 \text{ mm}$$ * Control Point 3

$$\text{Min } D_{60} = \frac{\text{Max } D_{60}}{5}$$

$$\text{Min } D_{60} = \frac{2.52 \text{ mm}}{5}$$

$$\text{Min } D_{60} = 0.50 \text{ mm}$$ * Control Point 4

- $$\text{Min } D_{10} = \frac{\text{Min } D_{15}}{1.2}$$

$$\text{Min } D_{10} = \frac{0.1 \text{ mm}}{1.2}$$

$$\text{Min } D_{10} = 0.08 \text{ mm}$$

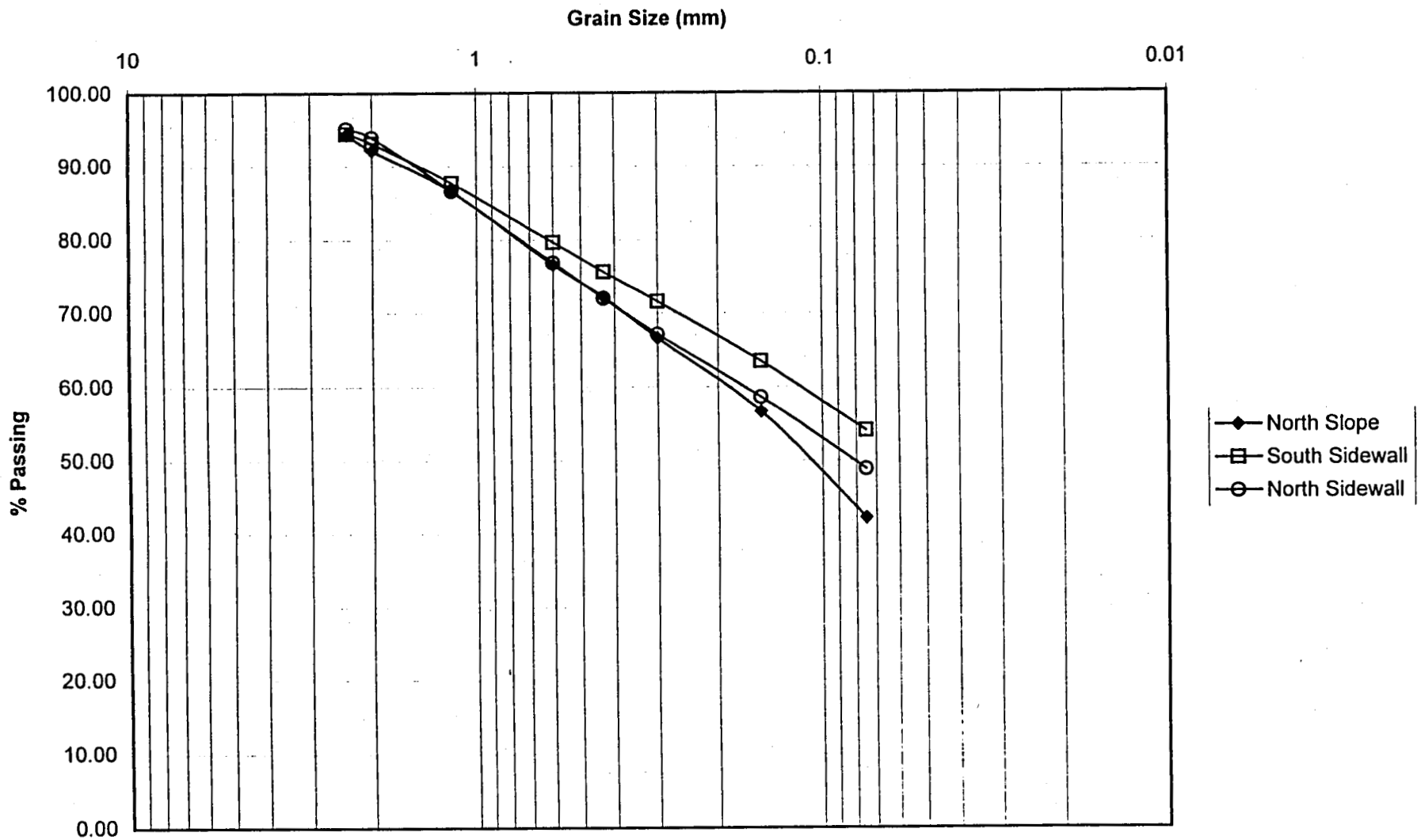
Max D_{90} = 20mm according to Table 26-6
* Control Point 7

- Min D_5 = 0.075mm * Control Point 5

Max D_{60} ≤ 75mm * Control Point 6
according to Table 26-5

F-132(7/91)

Corrected Dam Gradations



P:\15448\007\03DamSafety\Filter investigation.xls,Corrected Dam Gradations chart

Base Soil Corrected Gradations

North Slope

Sieve Size	Sieve	% Passing	Corrected % Passing
2.36	#8	85	94.35
2	#10	83	92.13
1.18	#16	78	86.58
0.6	#30	69	76.59
0.43	#40	65	72.15
0.3	#50	60	66.60
0.15	#100	51	56.61
0.075	#200	38	42.18

Correction Factor = 1.11

South Sidewall

Sieve	% Passing	Corrected % Passing
#8	70	94.50
#10	69	93.15
#16	65	87.75
#30	59	79.65
#40	56	75.60
#50	53	71.55
#100	47	63.45
#200	40	54.00

Correction Factor = 1.35

North Sidewall

Sieve	% Passing	Corrected % Passing
#8	78	95.16
#10	77	93.94
#16	71	86.62
#30	63	76.86
#40	59	71.98
#50	55	67.10
#100	48	58.56
#200	40	48.80

Correction Factor = 1.22

Base Soil Corrected

North Slope

Sieve Size (mm)	Sieve	% Passing	Corrected % Passing
2.36	#8	85	=C5*1.11
2	#10	83	=C6*1.11
1.18	#16	78	=C7*1.11
0.6	#30	69	=C8*1.11
0.43	#40	65	=C9*1.11
0.3	#50	60	=C10*1.11
0.15	#100	51	=C11*1.11
0.075	#200	38	=C12*1.11

Correction Factor
= 1.11

South Sidewall

Sieve	% Passing	Corrected % Passing
#8	70	=G5*1.35
#10	69	=G6*1.35
#16	65	=G7*1.35
#30	59	=G8*1.35
#40	56	=G9*1.35
#50	53	=G10*1.35
#100	47	=G11*1.35
#200	40	=G12*1.35

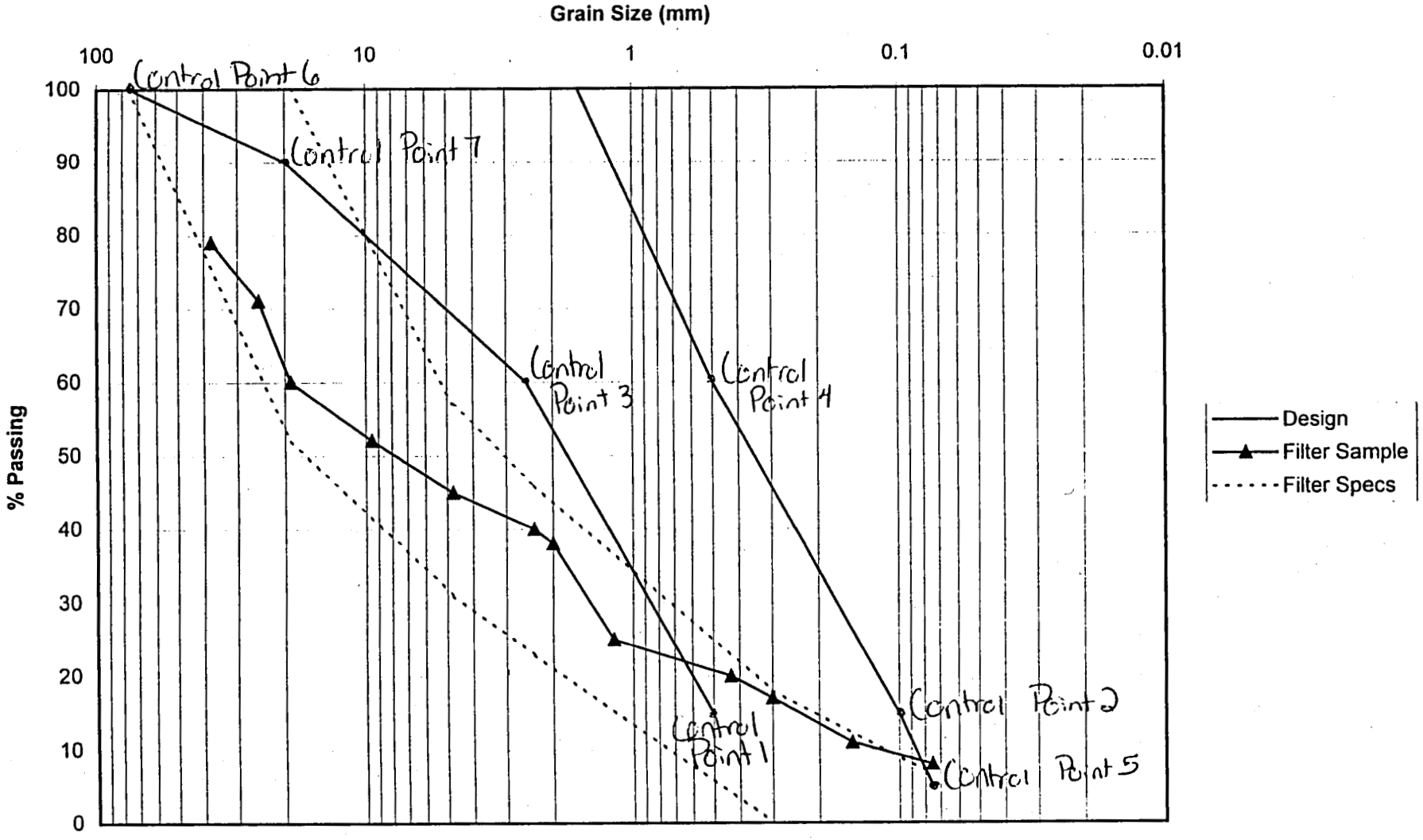
Correction Factor =
1.35

North Sidewall

Sieve	% Passing	Corrected % Passing
#8	78	=C18*1.22
#10	77	=C19*1.22
#16	71	=C20*1.22
#30	63	=C21*1.22
#40	59	=C22*1.22
#50	55	=C23*1.22
#100	48	=C24*1.22
#200	40	=C25*1.22

Correction Factor
= 1.22

Filter Match Between Dam and Existing Filter



P:\15448\007\03DamSafety\Filter investigation.xls,Dam-Filter chart

Filter Design from Calculation				Filter Sample		Filter Specs from SCS Plans		
Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine	Grain Size (mm)	% Passing	Grain Size (mm)	Coarse Side of Existing Filter	Fine Side of Existing Filter
75	100	1.6	100	37.5	79	76	100	100
20	90	0.5	60	25	71	19	100	52
2.52	60	0.1	15	19	60	4.75	57	31
0.5	15	0.075	5	9.5	52	2.36	46	23
				4.75	45	0.3	18	0
				2.36	40	0.075	6.5	0
				2	38			
				1.18	25			
				0.43	20			
				0.3	17			
				0.15	11			
				0.075	8			

633.2602 Permeability and capacity

he laboratory filter study clearly demonstrated that graded filters designed in accordance with these criteria will seal a crack. The sealing begins when water flows through a crack or opening and carries soil particles eroded from the sides of the openings. Eroding soil particles collect on the face of the filter and seal the crack at the interface. Any subsequent is through the pores of the soil. If filters are designed to intercept cracks, the permeability required in the filter zone should be based on the steady state seepage flow through the pores of the base soil alone. The hydraulic capacity of any cracks need not be considered in designing the filter because the cracks have been shown to seal.

Where saturated steady-state seepage flow will not develop, for instance in dry dams for flood control having a normal drawdown time of 10 days or less, filter capacity need only be nominal. Filters designed either to protect against steady state seepage or internal erosion through cracks are to be thick enough to compensate for potential segregation and contamination of the filter zones during construction. They must also be thick enough that cracks cannot extend ugh the filter zone during any possible differential movements.

A zone of coarser materials immediately downstream or below the filter, or both, provides additional capacity to collect and convey seepage to a controlled outlet. In some cases a strip drain is used, and in others a perforated collector pipe is employed to outlet the collected seepage. To prevent movement of the filter materials into the coarse drain materials, the coarse drain materials must be designed for the proper gradation using procedures in this subchapter. Perforations in collector pipes must also be sized properly to prevent movement of the coarse drain materials into the perforations.

633.2603 Determining filter gradation limits

Determine filter gradation limits using the following steps:

Step 1: Plot the gradation curve (grain-size distribution) of the base soil material. Use enough samples to define the range of grain sizes for the base soil or soils. Design the filter using the base soil that requires the smallest D_{15} size for filtering purposes. Base the design for drainage purposes on the base soil that has the largest D_{15} size.

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than No. 4 sieve).

Step 3: Prepare adjusted gradation curves for base soils that have particles larger than the No. 4 (4.75 mm) sieve.

- Obtain a correction factor by dividing 100 by the percent passing the No. 4 (4.75 mm) sieve.
- Multiply the percentage passing each sieve size of the base soil smaller than No. 4 (4.75 mm) sieve by the correction factor determined above.
- Plot these adjusted percentages to obtain a new gradation curve.
- Use the adjusted curve to determine the percentage passing the No. 200 (0.075 mm) sieve in step 4.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26–1.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter in accordance with the table 26–2.

If desired, the maximum D_{15} may be adjusted for certain noncritical uses of filters where significant hydraulic gradients are not predicted, such as bedding beneath riprap and concrete slabs. For fine clay base soil that has d_{85} sizes between 0.03 and 0.1 mm, a maximum D_{15} of $\leq$ 0.5 mm is still conservative. For fine-grained silt that has low sand content, plotting below the "A" line, a maximum D_{15} of 0.3 mm may be used.

Step 6: If permeability is a requirement (see section 633.2602), **determine the minimum allowable D_{15} in accordance with table 26–3.** Note: The permeability requirement is determined from the d_{15} size of the base soil gradation before regrading.

Step 7: The width of the allowable filter design band must be kept relatively narrow to prevent the use of possibly gap-graded filters. Adjust the maximum and minimum D_{15} sizes for the filter band determined in steps 5 and 6 so that the ratio is 5 or less at any given percentage passing of 60 or less. Criteria are summarized in table 26–4.

Table 26–1 Regraded gradation curve data

Base soil category	% finer than No. 200 sieve (0.075 mm) (after regrading, where applicable)	Base soil description
1	> 85	Fine silt and clays
2	40 – 85	Sands, silts, clays, and silty & clayey sands
3	15 – 39	Silty & clayey sands and gravel
4	< 15	Sands and gravel

Table 26–2 Filtering criteria — Maximum D_{15}

Base soil category	Filtering criteria
1	$\leq 9 \times d_{85}$ but not less than 0.2 mm
2	≤ 0.7 mm
3	$\leq \left(\frac{40-A}{40-15}\right)\left[(4\times d_{85})-0.7\text{mm}\right]+0.7\text{mm}$ A = % passing #200 sieve after regrading (If $4 \times d_{85}$ is less than 0.7 mm, use 0.7 mm)
4	$\leq 4 \times d_{85}$ of base soil after regrading

This step is required to avoid the use of gap-graded filters. The use of a broad range of particle sizes to specify a filter gradation could result in allowing the use of gap-graded (skip-graded) materials. These materials have a grain size distribution curve with sharp breaks or other undesirable characteristics. Materials that have a broad range of particle sizes may also be susceptible to segregation during placement. The requirements of step 9 should prevent segregation, but other steps are needed to eliminate the use of any gap-graded filters.

Gap-graded materials generally can be recognized by simply looking at their grain size distribution curve. However, for specification purposes, more precise controls are needed. In designing an acceptable filter band using the preliminary control points obtained in steps 1 through 6, the following additional requirements should be followed to decrease the probability of using a gap-graded filter.

Table 26–3 Permeability criteria

Base soil category	Minimum D_{15}
All categories	**$\geq 4 \times d_{15}$ of the base soil before regrading, but not less than 0.1 mm**

Table 26–4 Other filter design criteria

Design element	Criteria
To prevent gap-graded filters	The width of the designed filter band should be such that the ratio of the maximum diameter to the minimum diameter at any given percent passing value ≤ 60% is ≤ 5.
Filter band limits	Coarse and fine limits of a filter band should each have a coefficient of uniformity of 6 or less.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26–5. Label as Control points 5 and 6, respectively.

Table 26–5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

Step 10: To minimize segregation during construction, the relationship between the maximum D_{90} and the minimum D_{10} of the filter is important. Calculate a preliminary minimum D_{10} size by dividing the minimum D_{15} size by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Determine the maximum D_{90} using table 26–6. Label this as Control point 7.

Sand filters that have a D_{90} less than about 20 mm generally do not require special adjustments for the broadness of the filter band. For coarser filters and gravel zones that serve both as filters and drains, the ratio of D_{90}/D_{10} should decrease rapidly with increasing D_{10} sizes.

Step 11: Connect Control points 4, 2, and 5 to form a partial design for the fine side of the filter band. Connect Control points 6, 7, 3, and 1 to form a design for the coarse side of the filter band. This results in a preliminary design for a filter band. Complete the design by extrapolating the coarse and fine curves to the 100 percent finer value. For purposes of writing specifications, select appropriate sieves and corresponding percent finer values that best reconstruct the design band and tabulate the values.

Step 12: Design filters adjacent to perforated pipe to have a D_{85} size no smaller than shown in table 26–7. For critical structure drains where rapid gradient reversal (surging) is probable, it is recommended that the D_{15} size of the material surrounding the pipe be no smaller than the perforation size.

Additional design considerations: Note that these steps provide a filter band design that is as well graded as possible and still meets criteria. This generally provides the most desirable filter characteristics. However, in some cases a more poorly graded filter band may be preferable; for example, if more readily available standard gradations are needed or where onsite filters are used for economy.

The design filter band obtained in steps 1 through 12 may be adjusted to a steeper configuration in such cases. The width of the filter band should be maintained so that the ratio of the maximum diameters to the minimum diameters at a given percent finer is no greater than 5 below the 60 percent finer value.

Only the portion of the design filter band above the previously established minimum and maximum D_{15} sizes should be adjusted. The design band may be adjusted so that the coefficients of uniformity of both the coarse and fine sides of the design band are less than 6, but not less than 2, to prevent use of very poorly graded filters.

Table 26–6 Segregation criteria

Base soil category	If D_{10} is :	Then maximum D_{90} is:
	(mm)	(mm)
All categories	< 0.5	20
	0.5 – 1.0	25
	1.0 – 2.0	30
	2.0 – 5.0	40
	5.0 – 10	50
	> 10	60

Table 26–7 Criteria for filters used adjacent to perforated collector pipe

Noncritical drains where surging or gradient reversal is not anticipated	The filter D_{85} must be greater than or equal to the perforation size
Critical drains where surging or gradient reversal is anticipated	The filter D_{15} must be greater than or equal to the perforation size.

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CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-C58

SUBJECT:

SHEET 1 OF 15

Filter Investigation: Drain Gradation Match

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 5/4/00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 6-20-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

(SIGNATURE) 5-11-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 6-20-00 (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	

White Tanks FRS #3
Filter Investigation
Filter to Drain Match

Problem

Determine if existing drain material matches the existing filter material in the re-built section of the dam.

References

National Engineering Handbook, Part 633, Chapter 26 Gradation Design of Sand and Gravel Filters, October 1994

ADWR letter dated November 25, 1981 stating gradation of existing filter

ASTM C33 Standard Specification for Coarse Aggregate Size 2 (existing drain material)

Conclusion

As shown on sheet 6 of 15, the existing drain material is coarser than the design band. Therefore, material would migrate from the filter into the drain and a match does not exist.

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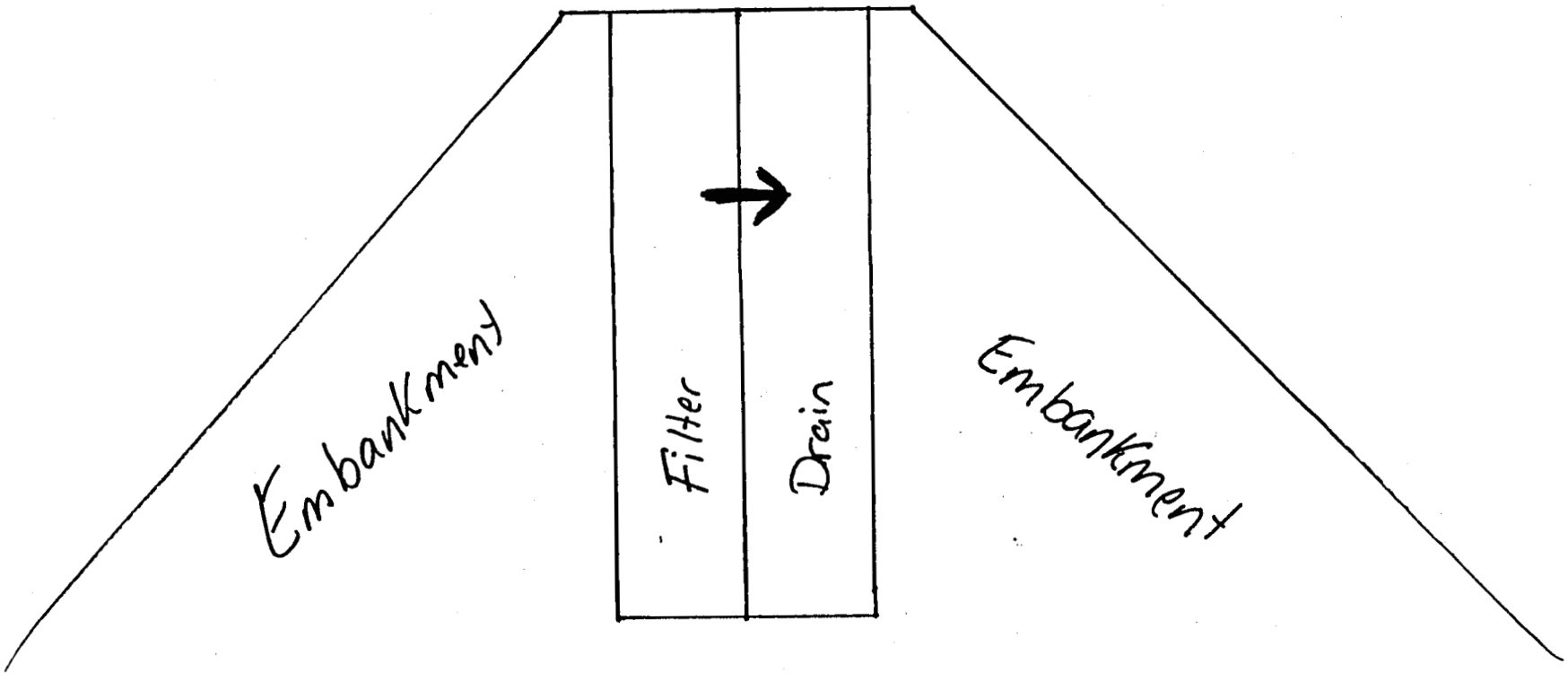
Job No. Job
Client Subject

Sheet No.
Calc. No.
Rev. No.
By Date
Chk'd. Date

White Tanks FRS #3

This calc checks for a match between the existing filter and the existing drain.



5/8

F-132(7/91)

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Sheet No. ~~212~~ 315
Calc. No.
Rev. No.
By BKW Date 5/4/00
Chk'd. JWL Date 5-11-00

Job No. 15448-007-058 Job
Client Subject

Determine if existing drain is an appropriate match to the existing filter in the rebuilt section of the dam.

- Using filter band from SCS Contract Modification No. 1. (The filter samples fits this band.)

Base soil (filter specs) need to be regraded

see attached spreadsheet for corrected gradation

Regrades curves correspond to Base Soil Category 4 according to Table 26-1 (0 + 1% Passing No 200 sieve)

Max $D_{15} \leq 4 \times d_{85}$ of base soil after regrading according to Table 26-2

Max $D_{15} \leq 4 \times (2.7\ mm)$

Max $D_{15} \leq 10.8\ mm$ * Control Point 1

Min $D_{15} \geq 4 \times d_{15}$ of base soil before regrading according to Table 26-3

Min $D_{15} \geq 4 \times (0.2\ mm)$

Min $D_{15} \geq 0.8\ mm$

F-132(7/91)

DAMES & MOORE
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Sheet No. ~~3/12~~ 4/15
Calc. No.
Rev. No.
By BKW Date 5/4/00
Chk'd. JVL Date 5-11-00

Job No. 15448-007-058 Job
Client Subject

$$\frac{\text{Max } D_{15}}{\text{Min } D_{15}} \leq 5$$

$$\frac{10.8\text{mm}}{0.8\text{mm}} = 13.5$$

locate band @ ~~#1~~ Max D_{15} side since draining is most important function

$$\frac{10.8\text{mm}}{\text{Min } D_{15}} = 5$$

Min D_{15} = 2.2 mm ☆ Control Point 2

$$\text{Max } D_{10} = \frac{\text{Max } D_{15}}{1.2}$$

$$\text{Max } D_{10} = \frac{10.8\text{mm}}{1.2} = 9\text{mm}$$

$$\text{Max } D_{60} = 6 \times \text{Max } D_{10}$$

$$\text{Max } D_{60} = 6\,(9\text{mm}) = 54\text{ mm}$$

☆ Control Point 3

$$\text{Min } D_{60} = \frac{\text{Max } D_{60}}{5}$$

$$\text{Min } D_{60} = \frac{54\text{mm}}{5} = 10.8\text{mm}$$

☆ Control Point 4

F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. ~~412~~ 515
Calc. No.
Rev. No.
By BKW Date 5/14/00
Chk'd. TWL Date 5-11-00

Job No. 15448-007-058 Job
Client Subject

Min D_5 = 0.075 mm ☆ Control Point 5

Max D_{100} = 75 mm ☆ Control Point 6

$$\text{Min } D_{10} = \frac{\text{Min } D_{15}}{1.2}$$

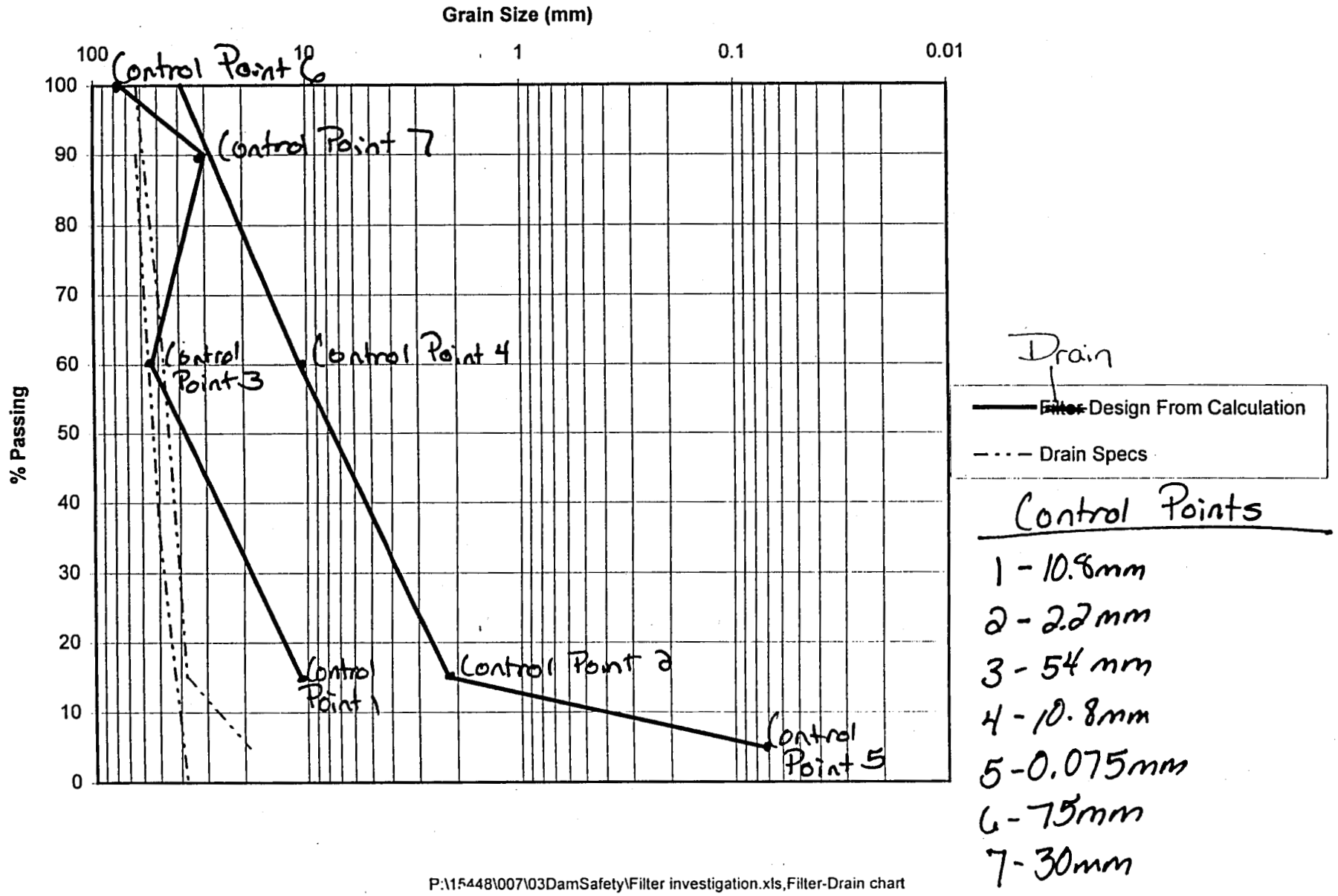
$$\text{Min } D_{10} = \frac{22\text{ mm}}{1.2\text{ mm}} = 1.8\text{ mm}$$

Therefore Max D_{90} = 30 mm according to Table 26-6
☆ Control Point 7

F-132(7/91)

5119

Gradation Match Between Existing Filter and Existing Drain



Control Points

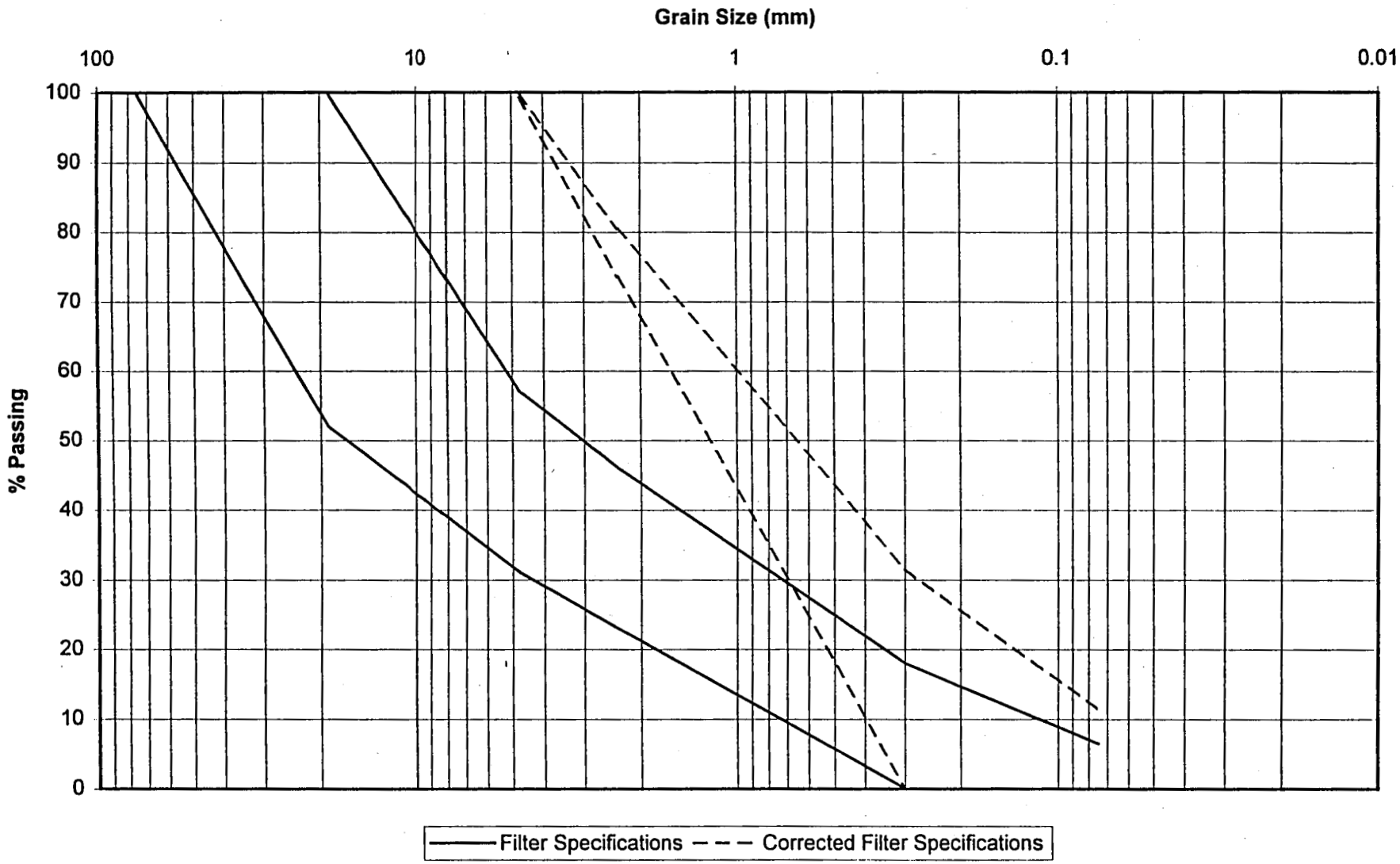
1 - 10.8mm
2 - 2.2mm
3 - 54 mm
4 - 10.8mm
5 - 0.075mm
6 - 75mm
7 - 30mm

P:\15448\007\03DamSafety\Filter investigation.xls,Filter-Drain chart

Design Filter From Calculation				Drain Specs			
Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine	Grain Size (mm)	% Passing	Grain Size (mm)	% Passing
75	100	38.90451	100	75	100	63	90
30	90	10.8	60	63	100	50	35
54	60	2.2	15	50	70	37.5	0
10.8	15	0.075	5	37.5	15	19	0
				19	5		

C18

Corrected Filter Gradation



P:\15448\007\03 Dam Safety\calcs\Filter investigation.xls,Corrected Filter

Filter Specifications			Corrected Filter Specifications		
Grain Size (mm)	% Passing	% Passing	Grain Size (mm)	% Passing	% Passing
76	100	100	4.75	99.75	99.2
19	100	52	2.36	80.5	73.6
4.75	57	31	0.3	31.5	0
2.36	46	23	0.075	11.375	0
0.3	18	0			
0.075	6.5	0			

633.2602 Permeability and capacity

The laboratory filter study clearly demonstrated that graded filters designed in accordance with these criteria will seal a crack. The sealing begins when water flows through a crack or opening and carries soil particles eroded from the sides of the openings. Eroding soil particles collect on the face of the filter and seal the crack at the interface. Any subsequent flow is through the pores of the soil. If filters are designed to intercept cracks, the permeability required in the filter zone should be based on the steady state seepage flow through the pores of the base soil alone. The hydraulic capacity of any cracks need not be considered in designing the filter because the cracks have been shown to seal.

Where saturated steady-state seepage flow will not develop, for instance in dry dams for flood control having a normal drawdown time of 10 days or less, filter capacity need only be nominal. Filters designed either to protect against steady state seepage or internal erosion through cracks are to be thick enough to compensate for potential segregation and contamination of the filter zones during construction. They must also be thick enough that cracks cannot extend through the filter zone during any possible differential movements.

A zone of coarser materials immediately downstream or below the filter, or both, provides additional capacity to collect and convey seepage to a controlled outlet. In some cases a strip drain is used, and in others a perforated collector pipe is employed to outlet the collected seepage. To prevent movement of the filter materials into the coarse drain materials, the coarse drain materials must be designed for the proper gradation using procedures in this subchapter. Perforations in collector pipes must also be sized properly to prevent movement of the coarse drain materials into the perforations.

633.2603 Determining filter gradation limits

Determine filter gradation limits using the following steps:

Step 1: Plot the gradation curve (grain-size distribution) of the base soil material. Use enough samples to define the range of grain sizes for the base soil or soils. Design the filter using the base soil that requires the smallest D_{15} size for filtering purposes. Base the design for drainage purposes on the base soil that has the largest D_{15} size.

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than No. 4 sieve).

Step 3: Prepare adjusted gradation curves for base soils that have particles larger than the No. 4 (4.75 mm) sieve.

- Obtain a correction factor by dividing 100 by the percent passing the No. 4 (4.75 mm) sieve.
- Multiply the percentage passing each sieve size of the base soil smaller than No. 4 (4.75 mm) sieve by the correction factor determined above.
- Plot these adjusted percentages to obtain a new gradation curve.
- Use the adjusted curve to determine the percentage passing the No. 200 (0.075 mm) sieve in step 4.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26–1.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter in accordance with the table 26–2.

If desired, the maximum D_{15} may be adjusted for certain noncritical uses of filters where significant hydraulic gradients are not predicted, such as bedding beneath riprap and concrete slabs. For fine clay base soil that has d_{85} sizes between 0.03 and 0.1 mm, a maximum D_{15} of ≤ 0.5 mm is still conservative. For fine-grained silt that has low sand content, plotting below the "A" line, a maximum D_{15} of 0.3 mm may be used.

Step 6: If permeability is a requirement (see section 633.2602), **determine the minimum allowable D_{15} in accordance with table 26–3.** Note: The permeability requirement is determined from the d_{15} size of the base soil gradation before regrading.

Step 7: The width of the allowable filter design band must be kept relatively narrow to prevent the use of possibly gap-graded filters. Adjust the maximum and minimum D_{15} sizes for the filter band determined in steps 5 and 6 so that the ratio is 5 or less at any given percentage passing of 60 or less. Criteria are summarized in table 26–4.

Table 26–1 Regraded gradation curve data

Base soil category	% finer than No. 200 sieve (0.075 mm) (after regrading, where applicable)	Base soil description
1	> 85	Fine silt and clays
2	40 – 85	Sands, silts, clays, and silty & clayey sands
3	15 – 39	Silty & clayey sands and gravel
4	< 15	Sands and gravel

Table 26–2 Filtering criteria — Maximum D_{15}

Base soil category	Filtering criteria
1	$\leq 9 \times d_{85}$ but not less than 0.2 mm
2	≤ 0.7 mm
3	$\leq \left(\frac{40-A}{40-15}\right)\left[(4 \times d_{85}) - 0.7\text{mm}\right] + 0.7\text{mm}$ A = % passing #200 sieve after regrading (If $4 \times d_{85}$ is less than 0.7 mm, use 0.7 mm)
4	$\leq 4 \times d_{85}$ of base soil after regrading

This step is required to avoid the use of gap-graded filters. The use of a broad range of particle sizes to specify a filter gradation could result in allowing the use of gap-graded (skip-graded) materials. These materials have a grain size distribution curve with sharp breaks or other undesirable characteristics. Materials that have a broad range of particle sizes may also be susceptible to segregation during placement. The requirements of step 9 should prevent segregation, but other steps are needed to eliminate the use of any gap-graded filters.

Gap-graded materials generally can be recognized by simply looking at their grain size distribution curve. However, for specification purposes, more precise controls are needed. In designing an acceptable filter band using the preliminary control points obtained in steps 1 through 6, the following additional requirements should be followed to decrease the probability of using a gap-graded filter.

Table 26–3 Permeability criteria

Base soil category	Minimum D_{15}
All categories	$\geq 4 \times d_{15}$ of the base soil before regrading, but not less than 0.1 mm

Table 26–4 Other filter design criteria

Design element	Criteria
To prevent gap-graded filters	The width of the designed filter band should be such that the ratio of the maximum diameter to the minimum diameter at any given percent passing value ≤ 60% is ≤ 5.
Filter band limits	Coarse and fine limits of a filter band should each have a coefficient of uniformity of 6 or less.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26-5. Label as Control points 5 and 6, respectively.

Table 26-5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

Step 10: To minimize segregation during construction, the relationship between the maximum D_{90} and the minimum D_{10} of the filter is important. Calculate a preliminary minimum D_{10} size by dividing the minimum D_{15} size by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Determine the maximum D_{90} using table 26-6. Label this as Control point 7.

Sand filters that have a D_{90} less than about 20 mm generally do not require special adjustments for the broadness of the filter band. For coarser filters and gravel zones that serve both as filters and drains, the ratio of D_{90}/D_{10} should decrease rapidly with increasing D_{10} sizes.

Step 11: Connect Control points 4, 2, and 5 to form a partial design for the fine side of the filter band. Connect Control points 6, 7, 3, and 1 to form a design for the coarse side of the filter band. This results in a preliminary design for a filter band. Complete the design by extrapolating the coarse and fine curves to the 100 percent finer value. For purposes of writing specifications, select appropriate sieves and corresponding percent finer values that best reconstruct the design band and tabulate the values.

Step 12: Design filters adjacent to perforated pipe to have a D_{85} size no smaller than shown in table 26-7. For critical structure drains where rapid gradient reversal (surging) is probable, it is recommended that the D_{15} size of the material surrounding the pipe be no smaller than the perforation size.

Additional design considerations: Note that these steps provide a filter band design that is as well graded as possible and still meets criteria. This generally provides the most desirable filter characteristics. However, in some cases a more poorly graded filter band may be preferable; for example, if more readily available standard gradations are needed or where onsite filters are used for economy.

The design filter band obtained in steps 1 through 12 may be adjusted to a steeper configuration in such cases. The width of the filter band should be maintained so that the ratio of the maximum diameters to the minimum diameters at a given percent finer is no greater than 5 below the 60 percent finer value.

Only the portion of the design filter band above the previously established minimum and maximum D_{15} sizes should be adjusted. The design band may be adjusted so that the coefficients of uniformity of both the coarse and fine sides of the design band are less than 6, but not less than 2, to prevent use of very poorly graded filters.

Table 26-6 Segregation criteria

Base soil category	If D_{10} is :	Then maximum D_{90} is:
	(mm)	(mm)
All categories	< 0.5	20
	0.5 - 1.0	25
	1.0 - 2.0	30
	2.0 - 5.0	40
	5.0 - 10	50
	> 10	60

Table 26-7 Criteria for filters used adjacent to perforated collector pipe

Noncritical drains where surging or gradient reversal is not anticipated	The filter D_{85} must be greater than or equal to the perforation size
Critical drains where surging or gradient reversal is anticipated	The filter D_{15} must be greater than or equal to the perforation size.

Example 26–5 Design of a coarse filter to be compatible with a previously designed fine filter and used around a perforated pipe

The base soil for this example is the filter band obtained in the design for example 26–1. The base soil in this case is actually a band of soil gradations specifying a suitable sand filter. The sand filter was designed to protect a silty clay base soil.

Example 26–5 illustrates how to design a gravel filter band to be compatible with the finer sand filter previously designed. In the first part of this example it is understood that the gravel filter will not be used around perforated collector pipe, but some other type of outlet of seepage is employed. The second part of this example illustrates how the design of a coarse filter is changed if perforated pipe is used.

Step 1: Plot the gradation curve of the base soil material. In example 26–5, the base soil is actually a band of possible filter gradations. The filter band that was obtained in example 26–1 is used. Refer to the plotted grain size distribution curve for this example, labeled Fine filter in figure 26–5. The plotted band is from the following data:

Sieve size	% passing
1 inch	100
3/4 inch	90–100
No. 4	70–100
No. 10	52–100
No. 20	30–75
No. 60	0–40
No. 140	0–15
No. 200	0–5

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than the No. 4 sieve).

Only the fine side of the specified filter band need be considered for this step because the finest base soil controls the filter criteria. Because the fine side of the filter band has no particles larger than the No. 4 sieve, step 3 is skipped. Proceed to step 4.

Step 3: Not applicable because the base soil contains no particles larger than the No. 4 Sieve.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26–1.

Example 26–5 base filter band has from 0 to 5 percent finer than the No. 200 sieve, determined from examination of the plotted grain size distribution curve in figure 26–5. From table 26–1, the soil is in category 4.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter according to table 26–2.

This table states the filtering criteria for base soil category 4 as: The maximum D_{15} of the filter will be less than or equal 4 times the d_{85} of the base soil.

The finest gradation from the range of gradations given by the base filter band will be controlling under this criterion. The d_{85} of the fine side of the base filter band from the plotted grain size distribution curve in figure 26–5 is 1.2 mm. Then, 4 x 1.2 mm = 4.8 mm. This is labeled as Maximum D_{15} in figure 26–5.

Step 6: If permeability is a requirement (section 633.2602), determine the minimum allowable D_{15} according to table 26–3. Note: The permeability requirement is determined from the d_{15} size of the base soil gradation before regrading.

The permeability criterion for all categories of base soils is that the filter have a minimum D_{15} of no less than 4 times the d_{15} of the base soil (before any regrading of the base soil), but not be less than 0.1 mm in any case.

The coarse limit of the base filter band will control under this criterion. Determine that the coarse limit line for the base filter band has a maximum d_{15} size of 0.45 mm. Using the criterion, the minimum D_{15} of the filter would be 4 x 0.45 = 1.8 mm. Label this value as Minimum D_{15} in figure 26–5.

7-28 1515

15448-005-022
4-8

November 25, 1981

Mr. Verne M. Bathurst, State Conservationist
Soil Conservation Service
Federal Building, Room 3008
Phoenix, Arizona 85025

Attention: Mr. Ralph Arrington

Subject: White Tanks No. 3 (7-28) and
White Tanks No. 4 (7-29) Repairs
Contract Modification No. 1

Dear Mr. Bathurst:

The Department of Water Resources approves the change of the drainfill gradation outlined in Contract Modification No. 1 for the repair of White Tanks 3 and 4 Dams as attached to your letter of November 18, 1981. The approved gradation is as follows:

Sieve Size	Percent passing by wt.
3"	100
3/4"	52-100
#4	31-57
#8	23-46
#60	0-18
#200	0-6.5

We have reviewed this new gradation and have determined it to be satisfactory for the intended purpose.

Sincerely,

DAN ROGER LAWRENCE, P.E.
Acting Chief
Division of Safety of Dams

DRL:MLA:kaf
cc: Mr. William D. Mathews
Maricopa County Flood Control District

APPENDIX E

CALCULATION PACKAGES

Appendix E
Calculation Packages
Table of Contents
(Revised August 3, 2001)

1. Spillway Notch Elevation
2. Central Trash Rack Sizing
3. Diaphragm Filter and Thickness of Soil Buttress
4. Diaphragm Filter Gradation
5. Filter to Soil Buttress Match
6. Filter to Drain Match
7. Foundation to Filter Match
8. Filter to Foundation Match
9. Soil Buttress to Drain Match
10. Foundation to Drain Match
11. Drain Gradation Design and Drain Material Selection
12. Riprap Sizing at the Southern Side of White Tanks FRS #3 and at the Northern Outlet
13. Development of Rating Curves
14. Revised Diaphragm Filter and Thickness of Soil Buttress (added April 2001)
15. Geotextile Around Drain Sand Material (added April 2001)
16. Sizing of Drain Pipes (added April 2001)(revised June 2001)
17. Performance of Drain Pipes Under Soil Buttress Loads (added April 2001)
18. Geotextile Sock Around Drain Pipes (added April 2001)
19. Buttress Soil Specification – Revised Gradation (added June 2001)
20. Structural Assessment of Trash Racks (added August 2001)

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SHEET 1 OF 3

SUBJECT:

White Tanks Spillway Notch Elevation
TITLE OF CALCULATIONS/DOCUMENT

Calc Package #1

CALCULATIONS/DOCUMENT BY: Bonnie Whitley
PRINT NAME

Bonnie Whitley
SIGNATURE

1-25-00
DATE

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth
PRINT NAME

SIGNATURE

1-28-00
DATE

CALCULATIONS/DOCUMENT CHECKED BY: CHRIS WIGGINTON
PRINT NAME

SIGNATURE

1-28-00
DATE

APPROVED BY:
(PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM)

Todd Ringsmuth
PRINT NAME

SIGNATURE

1-28-00
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

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
4. Is the calculation complete in format with all sections included?

   - Problem Statement & Calculation Objectives
   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

5. Does the calculation conform with:

   - Codes
   - Project Design Criteria
   - Project Procedures?

6. Are the mathematics of the calculation accurate?
7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 2 OF 3
Calc. No.
Rev. No.
By BKW Date 1-25-00
Chk'd. CWD Date 1-28-00

Job No. 15488-007-058 Job
Client Subject

White Tanks Spillway Notch Elev

Notch Elev = Lowest Point On Dam − Subsidence Allowance − 4 ft Freeboard

Lowest Point On Dam = 1211.385 ft (Sta 8+70, survey 12/99)

Subsidence Allowance account for 10 yrs
subsidence @ A-1 (Sta 10+00) = 0.0266 ft/yr
(subsidence surveys, 7/90 + 7/97)

Subsidence Allowance = (0.0266 ft/yr)(10 yrs)
= 0.266 ft

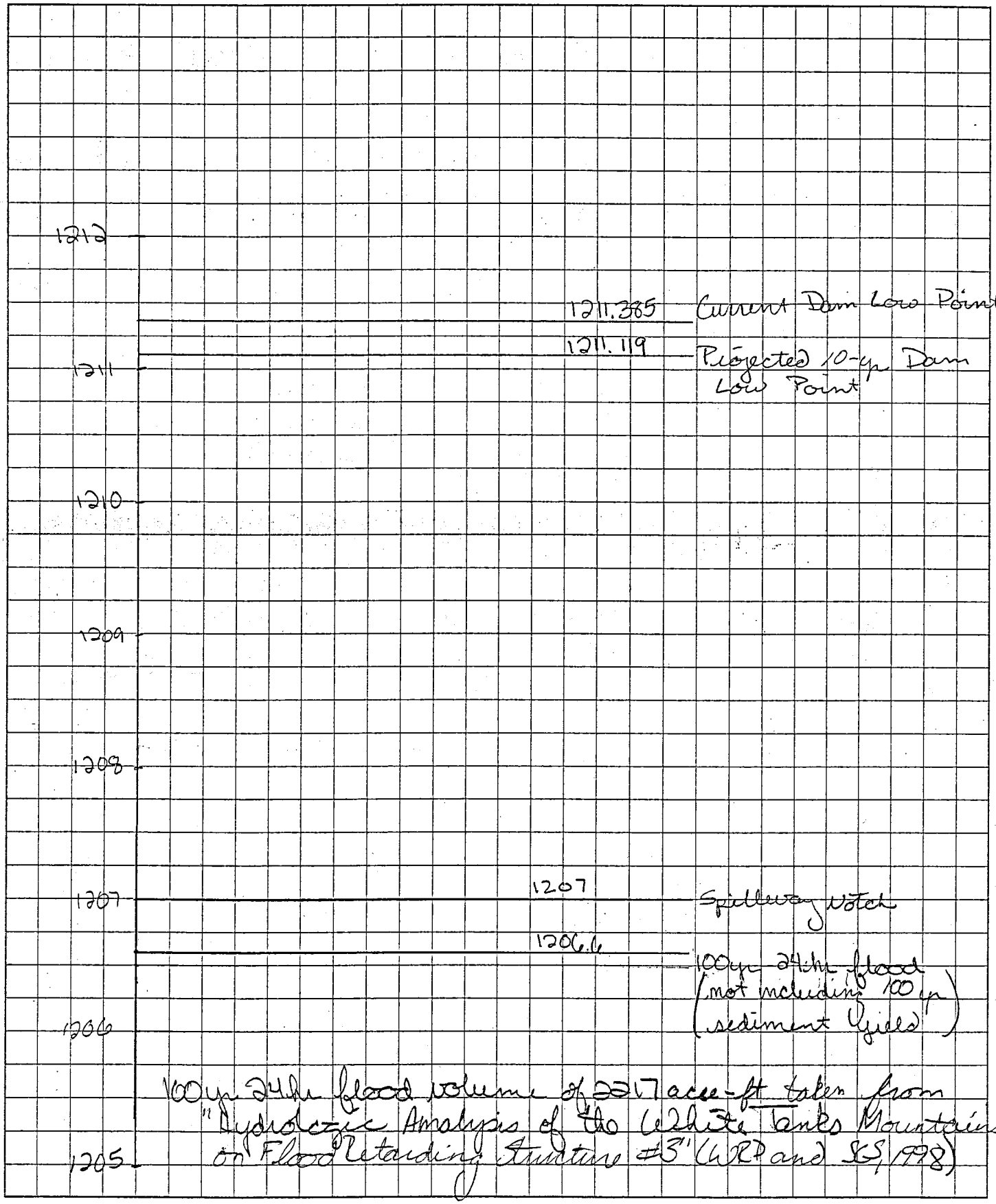
Notch Elev = 1211.385 ft − 0.266 ft − 4 ft =
= 1207.119 ft use 1207 ft

F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 3 of 3
Calc. No.
Rev. No.
By BKW Date 1-25-00
Chk'd. CDW Date 1-28-00

Job No. 15468-007-058 Job
Client Subject



100yr 24hr flood volume of 2217 acre-ft taken from "Hydrologic Analysis of the White Tanks Mountains on Flood Retarding Structure #3" (WRP and SS, 1998)

F-132(7/91)

GILBERTSON ASSOCIATES inc.

WHITE TANKS F.R.S. NO. 3
SUBSIDENCE SURVEYS

Sta.	Monument	7-97 Elev.
10+00	Brass Cap A-1	1211.464
	Brass Cap B-1	1201.417
19+95	Brass Cap A-2	1211.764
	Brass Cap B-2	1192.919
30+00	Brass Cap A-3	1212.019
	Brass Cap B-3	1190.514
40+00	Brass Cap A-4	1212.736
	Brass Cap B-4	1192.624
49+88	Brass Cap A-5	1214.206
	Brass Cap B-5	1191.187
60+08	Brass Cap A-6	1214.524
	Brass Cap B-6	1190.149
70+07	Brass Cap A-7	1215.106
	Brass Cap B-7	1195.949

Prime Benchmark USGS Domed Brass Cap – Stamped N-475, located 1,320' South of the northeast corner of Section 1, along the East line of Section 1, T2N, R3W of the Gila and Salt River Base and Meridian. Elevation = 1474.154

Certification

This Survey was done under my direction during the Month of July, 1997.

Richard D. Tabor, R.L.S. #19857

REGISTERED LAND SURVEYOR CERTIFICATE NO. 19857 RICHARD D. TABOR

consulting civil engineers & land surveyors

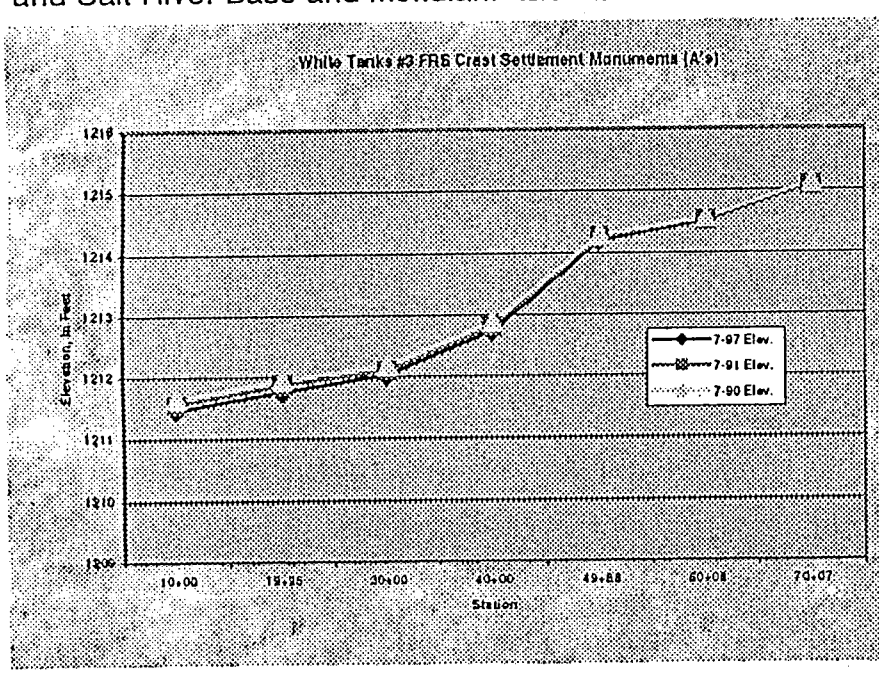
15974 North 77th Street. Scottsdale, Arizona 85260-1761
Telephone:\602\607\2244 Facsimile:\602\607\2299

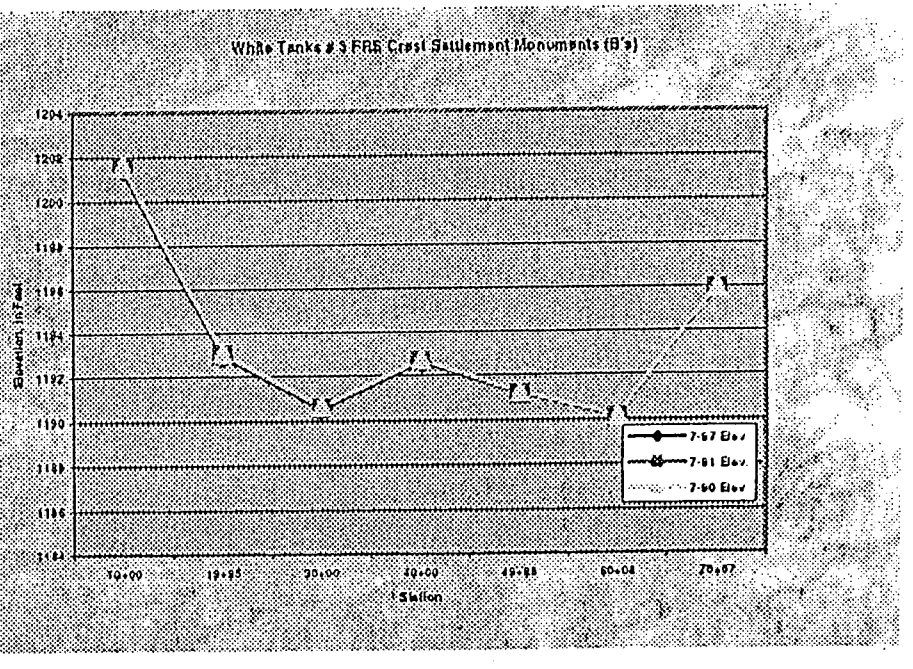
August 26, 1997

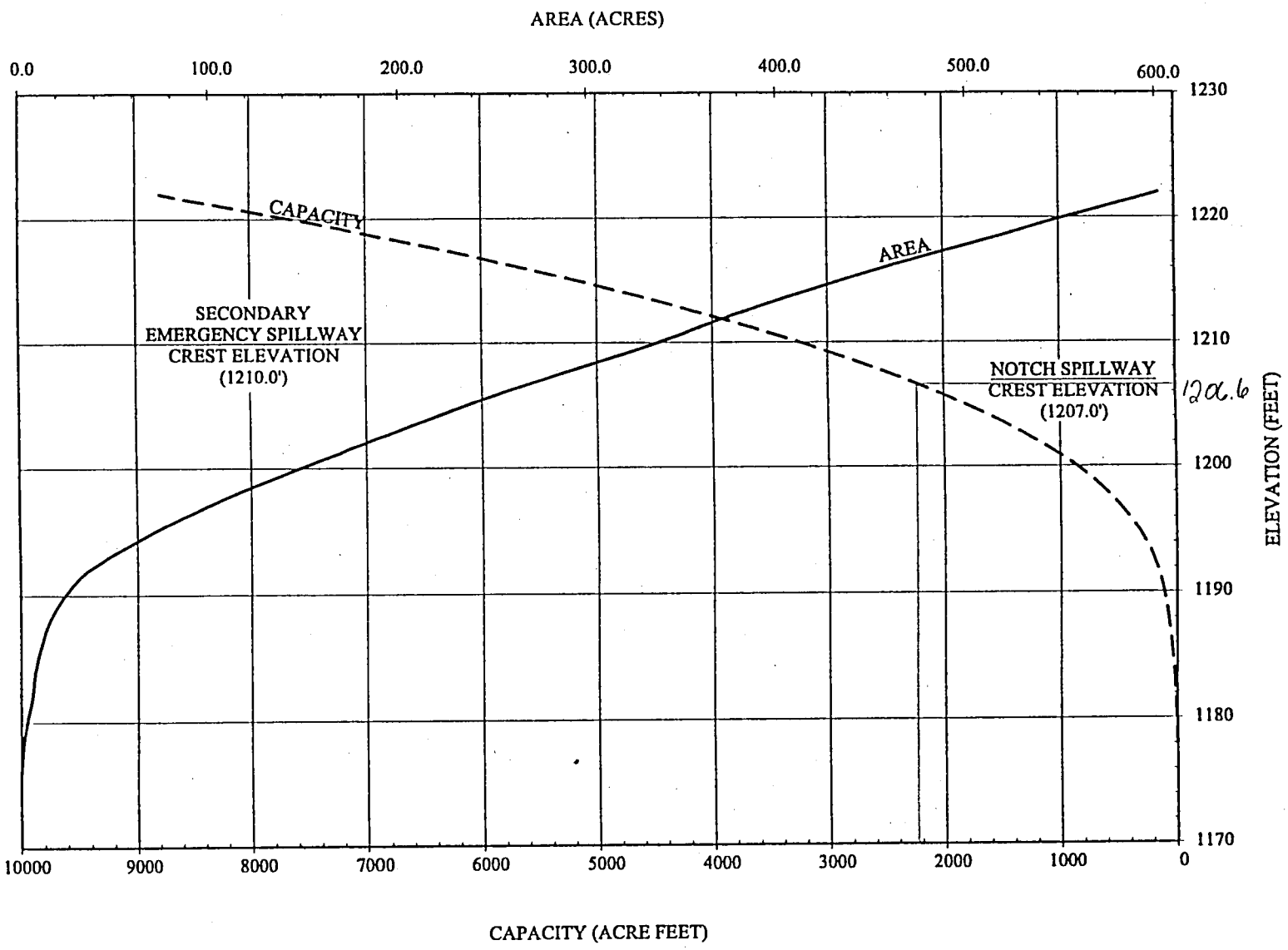
Recd from John Hughes 12/23/97

Sta.	Monument	7-97 Elev.	1 Elev.	7-90 Elev.
10+00	A-1	1211.464	1211.561	1211.65
	B-1	1201.417	1201.491	1201.586
19+95	A-2	1211.764	1211.866	1211.946
	B-2	1192.919	1192.979	1193.071
30+00	A-3	1212.019	1212.099	1212.183
	B-3	1190.514	1190.562	1190.65
40+00	A-4	1212.736	1212.812	1212.883
	B-4	1192.624	1192.664	1192.728
49+88	A-5	1214.206	1214.255	1214.297
	B-5	1191.187	1191.19	1191.242
60+08	A-6	1214.524	1214.531	1214.559
	B-6	1190.149	1190.129	1190.175
70+07	A-7	1215.106	1215.091	1215.124
	B-7	1195.949	1195.931	1195.973

Prime benchmark USGS Domed Brass Cap - Stamped N-475, Located 1,320' South of the northeast corner of Section 1, along the East line of Section 1, T2N, R3W of the Gila and Salt River Base and Meridian. Elevation = 1474.154







A12048 11-18-98

— — CAPACITY

—— AREA

Area Capacity Curves

White Tanks Dam - FRS #3

Figure 4-1

DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

15449 005-022

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SHEET 1 OF 9

SUBJECT:

Central TRANSHREICK SIZING

TITLE OF CALCULATIONS/DOCUMENT

WHITE TANKS FRS #3

Calc Package #2

CALCULATIONS/DOCUMENT BY: CHRIS WIGGINTON (PRINT NAME) — SIGNATURE — 1-28-00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: SCOTT NEWHOUSE (PRINT NAME) — SIGNATURE — 2-01-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Bonnie Whitley (PRINT NAME) — SIGNATURE — 1-31-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME) — SIGNATURE — 2-1-00 (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
				OK for 90% AMG 5-26-00
1	5-16-00	CDW	BKW	TFR 9-29-00
2				
3				
4				

INITIALS

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
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   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

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   - Project Design Criteria
   - Project Procedures?

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7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 2 OF 9
Calc. No.
Rev. No.
By CDW Date 1-28-00
Chk'd. BKW Date 1-31-00

Job No. Job
Client Subject

Central TRASHRACK SIZING CALC.

FROM THE DESIGN CRITERIA TAKEN FROM "DESIGN OF SMALL DAMS", SECTION 10.9, PGS. 451 & 452, THE TRASHRACK SHALL "CONSIST OF THIN, FLAT STEEL BARS THAT ARE PLACED ON EDGE FROM 3 TO 6 INCHES APART AND ASSEMBLED IN A GRID PATTERN." ALSO, "WHERE AN OUTLET INVOLVES A LARGE CONDUIT WITH LARGE SLIDE GATE CONTROLS, THE RACKS CAN BE MORE WIDELY SPACED."

FROM THESE STATEMENTS IT WAS ASSUMED THAT THIS TRASH RACK WOULD BE CONSTRUCTED USING THIN, FLAT STEEL BARS PLACED ON EDGE, 6" APART IN A GRID PATTERN.

FROM THE SAME DOCUMENT IT READS "WHERE THE TRASHRACKS ARE INACCESSIBLE FOR CLEANING, THE VELOCITY THROUGH THE RACKS ORDINARILY SHOULD NOT EXCEED 2 FT/SEC. A VELOCITY OF UP TO APPROXIMATELY 5 FT/SEC MAY BE TOLERATED FOR RACK THAT ARE ACCESSIBLE FOR CLEANING.

FROM THIS TEXT, AND FROM THE ASSUMPTION THAT INACCESSIBILITY IS SYNONOMOUS WITH SUBMERGED, THE DESIGN FLOW RATE THAT APPLIES TO OUR CONDITION IS 5 FT/SEC.

HOWEVER, FROM THE SOIL CONSERVATION SERVICE TECHNICAL RELEASE NOTICE 60, 210VI IT STATES, "THE AVERAGE VELOCITY OF FLOW THROUGH A CLEAN TRASH RACK

IS NOT TO EXCEED 2.5 FEET PER SECOND UNDER THE FULL RANGE OF STAGE AND DISCHARGE."

FROM THIS DOCUMENT WE DECIDED TO USE A MAXIMUM DESIGN FLOW RATE OF 2.5 FEET/SEC. FOR THIS CALC.

WE ASSUMED THAT THE TRASHRACK MUST EXTEND BEYOND THE LIMITS OF THE SLIDE GATE FRAME IN ORDER TO PREVENT DEBRIS FROM INTERUPTING THE OPERATION OF THE SLIDE GATE.

DISCHARGE OF 207 cfs WAS TAKEN FROM THE, "DRAFT - PROPOSED NEW OPERATIONAL PLAN for WHITE TANK FLOOD RETARDING STRUCTURE NO. 3 OUTLET PIPES" DATED JAN. 12, 2000, PUBLISHED BY FCMCD.

BY: CDW, 1-28-00
CKD - BKW 1-31-00

TRASHRACK SIZING SPREADSHEET
WHITE TANKS FRS #3

Bar Diameter or Bar Edge Width (in)	0.25
Edge Angle Width (in)	3
Bar Spacing (in)	6
Discharge (cfs)	207

Target Flow Velocity < 2.5 ft/sec

Height (ft)	Length (ft)	Width (ft)	Adjusted Height (ft)	Adjusted Length (ft)	Adjusted Width (ft)	Gross Area (sf)	Net Area (sf)	Flow Velocity (ft/sec)
1.5	9.5	6	0.98	8.65	5.29	103.5	73.05	2.83
2	9.5	6	1.46	8.65	5.29	119	86.40	2.40
2.5	9.5	6	1.94	8.65	5.29	134.5	99.76	2.08

This spreadsheet calculates the flow velocity through a cage trashrack. The variables used to calculate this flow velocity are as follows:

Bar Diameter:	This spreadsheet calculation assumes the use of round bars. If thin, flat bars are desired, the width of the bar can be inserted into this cell.
Edge Angle Width:	This spreadsheet calculation assumes that the trashrack cage will have angle iron supports on all of the edges of each of the 5 sides.
Bar Spacing:	The bar spacing is a center to center dimension that is consistent for horizontal and vertical spacing
Discharge:	This number is the calculated maximum discharge through the outlet pipe in question. This maximum discharge is used to calculate the flow velocity through the trashrack.
Target Flow Velocity:	This requirment was taken from the SCS Technical Release Notice 60C, 210-V. It states, "The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack."
Height:	Actual height of the trash rack (see attached drawing)
Length:	Actual length of the trash rack (see attached drawing)
Width:	Actual width of the trash rack (see attached drawing)
Adj. Height:	Actual height of the trash rack minus the area of the edge angles and bar thicknesses.
Adj. Length:	Actual length of the trash rack minus the area of the edge angles and bar thicknesses.
Adj. Width:	Actual width of the trash rack minus the area of the edge angles and bar thicknesses.
Gross Area:	Height x Length x Width
Net Area:	Adj. Height x Adj. Length x Adj. Width
Flow Velocity:	Discharge / Net Area, from the equation Q=VA

	A	B	C	D	E
2	Bar Diameter or Bar Edge Width (in)		0.25	Target Flow Velocity <	
3	Edge A		3		
4	Bar Sp:		6		
5					
6	Discharge		207		
7					
8					
9	Height (ft)	Length (ft)	Width (ft)	Adjusted Height (ft) No. of bars	Adjusted Length (ft)
10	1.5	9.5	6	=((A11*12)-(((ROUND((A11/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12	=((B11*12)-(((ROUND((B11/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12
11	2	9.5	6	=((A12*12)-(((ROUND((A12/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12	=((B12*12)-(((ROUND((B12/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12
12	2.5	9.5	6	=((A13*12)-(((ROUND((A13/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12	=((B13*12)-(((ROUND((B13/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12

FORMULAS

5 of 9

BY: CMD, 1-28-00
CKD: BMW, 1-31-00

	F	G	H	I
1				
2		2.5 ft/sec		
3				
4				
5				
6				
7				
8				
9	Adjusted Width (ft)	Gross Area (sf)	Net Area (sf)	Flow Velocity (ft/sec)
10	=((C11*12)-(((ROUND((C11/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12	=(B11*C11)+(2*B11*A11)+(2*C11*A11)	=(E11*F11)+(2*E11*D11)+(2*F11*D11)	=$C$6/H11
11	=((C12*12)-(((ROUND((C12/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12	=(B12*C12)+(2*B12*A12)+(2*C12*A12)	=(E12*F12)+(2*E12*D12)+(2*F12*D12)	=$C$6/H12
12	=((C13*12)-(((ROUND((C13/($C$4/12)),0))-2)*$C$2)-($C$3*2))/12	=(B13*C13)+(2*B13*A13)+(2*C13*A13)	=(E13*F13)+(2*E13*D13)+(2*F13*D13)	=$C$6/H13

$Q = vA$

$v = \frac{Q}{A}$

6 of 9
by: CDM, 1-28-00
CKD: BKW, 1-31-00

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 7 OF 9
Calc. No.
Rev. No.
By CDW Date 1-28-00
Chk'd. BKW Date 1-31-00

Job No. Job
Client Subject

CONCLUSION

BASED ON THESE CALCULATIONS, WE INTEND TO USE A TRASH RACK THAT IS

9.5' LONG × 6' WIDE × 2' HIGH

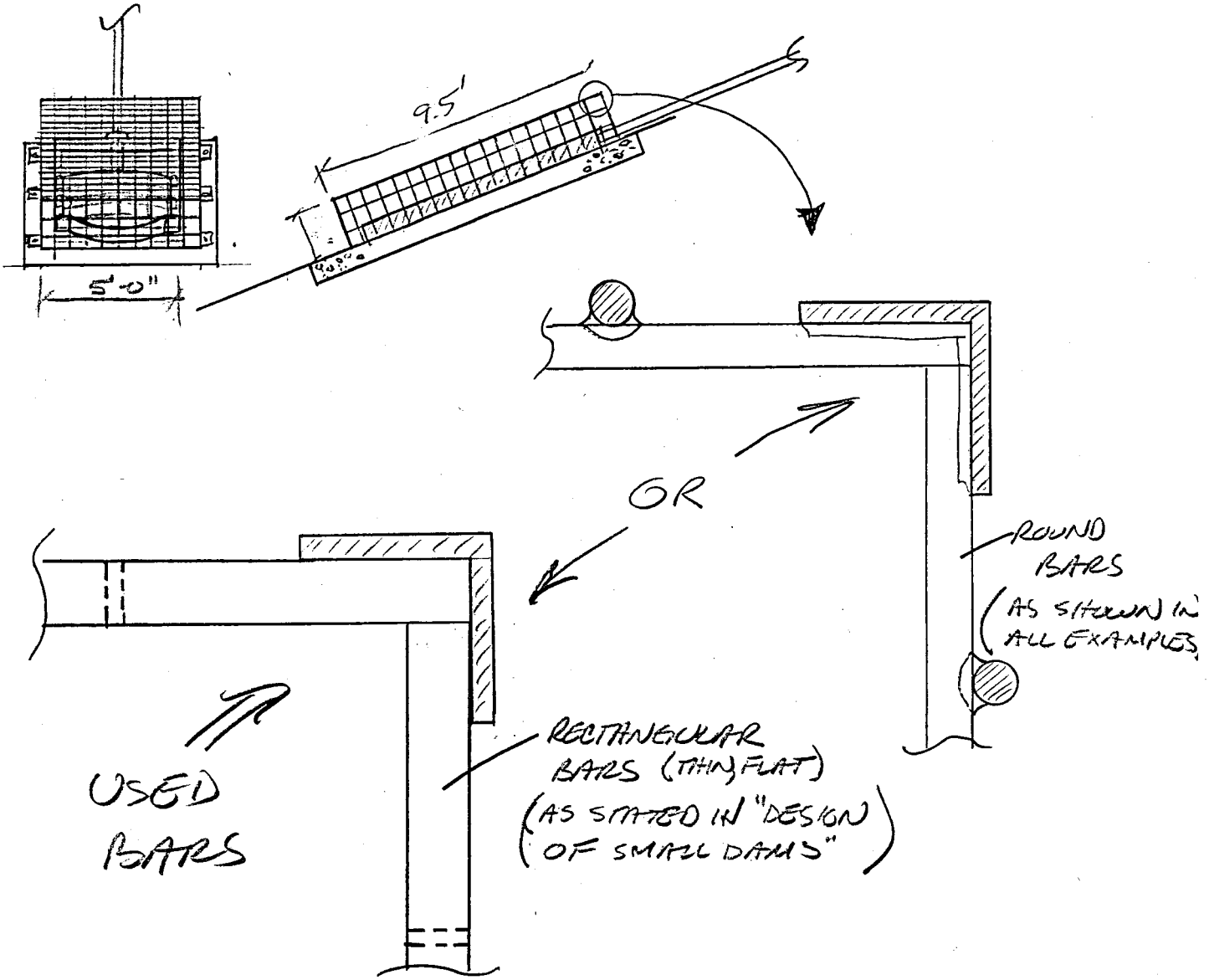
IT WILL BE CONSTRUCTED USING 3"×3"×1/4" ANGLE ~~ON~~ ALONG ALL EDGES, WITH 2"×1/4" BAR STOCK USED FOR THE GRATE. ALSO IT WILL BE FASTENED USING 6 - 1/2" ϕ ANCHOR BOLTS, 3 ON EACH SIDE.

F-132(7/91)

FILE
SUBJECT

BY: CDW, 1-28-00
CKD: BKW 1-31-00

VISIONS
BY ____ DATE ____ TO EO ____
BY ____ DATE ____ TO EO ____



BY ____ DATE ____
CHECKED BY ____
COPY TO EO ____

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structed through the dam embankment. The structural design must consider the possibility of settlement and of lateral displacement caused by the movement of the embankment. Where a wet-well shaft is used, care must be taken in the design to prevent cracking and the opening of joints, which would permit leakage from the interior of the shaft into the surrounding embankment. The walls of the wet-well shaft must be designed to resist the internal hydrostatic pressure from full reservoir head and the external embankment loading. If a shaft extends through the embankment and projects into the reservoir, external hydrostatic loads and, where applicable, earthquake loads must also be considered. The protruding portion of the shaft is a tower, which is subject to the ice loads discussed in section 10.9.

(d) *Control Houses.*—A housing is sometimes provided around the outlet controls where operating equipment would otherwise be exposed or where adverse weather conditions will prevail during operating periods. A house is sometimes provided to enclose the top of an access shaft, although the controls may be located elsewhere. Such houses are usually made large enough to accommodate auxiliary equipment, such as ventilating fans, heaters, flow-measuring and recording meters, air pumps, small power-generator sets, and equipment needed for maintenance.

10.9. ***Intake Structures.***—In addition to forming the entrance to the outlet works, an intake structure may accommodate control devices. It also supports necessary auxiliary appurtenances (such as trashracks, fishscreens, and bypass devices), and it may include temporary diversion openings and provisions for installation of bulkhead or stoplog closure devices.

Intake structures may appear in many forms. The type of intake structure selected should be based on several factors: the functions it must serve, the range in reservoir head under which it must operate, the discharge it must handle, the frequency of reservoir drawdown, the trash conditions in the reservoir (which will determine the need for or the frequency of cleaning of the trashracks), reservoir ice conditions or wave action that could affect the stability, and other similar considerations. Depending on its function, an intake structure may be either submerged or extended in the form of a tower above the maximum reservoir water surface. A tower must be provided if the controls are placed at the intake, or if an operating platform is needed for trash removal, maintaining and cleaning fishscreens, or installing stoplogs. Where the structure serves only as an entrance to the outlet conduit and where trash cleaning is ordinarily not required, a submerged structure may be adopted.

The conduit entrance may be placed vertically, inclined, or horizontally, depending on intake requirements. Where a sill level higher than the conduit level is desired, the intake can be a drop inlet similar to the entrance of a drop inlet spillway. A vertical entrance is usually provided for inlets at the conduit level. In certain instances, an inclined intake structure may be placed along the upstream slope of the dam or along the reservoir bank upstream of the dam. Such an arrangement is typified by the Ortega Reservoir outlet shown on figure 10-7. In most cases, conduit entrances should be rounded or bellmouthed to reduce hydraulic entrance losses.

The necessity for trashracks on an outlet works depends on the size of the sluice or conduit, the type of control device used, the nature of the trash burden in the reservoir, the use of the water, the need for excluding small trash from the outflow, and other factors. These factors determine the type of trashracks and the size of the openings. Where an outlet consists of a small conduit with valve controls, closely spaced trash bars are needed to exclude small trash. Where an outlet involves a large conduit with large slide-gate controls, the racks can be more widely spaced. If there is no danger of clogging or damage from small trash, a trashrack may consist simply of struts and beams placed to exclude only larger trees and similarly sized floating debris. The rack arrangement should also be based on the accessibility for removing accumulated trash. Thus, a submerged rack that seldom will be unwatered must be more substantial than one at or near the surface. Similarly, an outlet with controls at the entrance, where the gates can be jammed by trash protruding through the rack bars, must have a more substantial rack arrangement than one whose controls are not at the entrance.

Trash bars usually consist of thin, flat steel bars that are placed on edge from 3 to 6 inches apart and assembled in a grid pattern. The area of the trashrack required is fixed by a limiting velocity through the rack which, in turn, depends on the nature of the trash to be excluded. Where the trashracks are inaccessible for cleaning, the velocity

through the racks ordinarily should not exceed 2 ft/s. A velocity of up to approximately 5 ft/s may be tolerated for racks that are accessible for cleaning.

Trashrack structures may have varied shapes, depending on how they are mounted or arranged on the intake structure. Trashracks for a drop inlet intake are generally formed as a cage atop the entrance. They may be arranged as an open box placed in front of a vertical entrance, or they may be positioned along the front side of a tower structure. Figures 10-1 through 10-7 show various arrangements of trashracks at entrances to outlet works.

At some reservoir sites, it may be desirable or required to screen the inlet entrance to prevent fish from being carried through the outlet works. Two such installations are illustrated on figure 10-2. Because small openings must be used to exclude fish, the screens can easily become clogged with debris. Provisions must therefore be made for periodically removing the fish screens and cleaning them by brooming or water jetting.

Where the control is placed at an intermediate point along a conduit, some means of unwatering the upstream pressure section of the conduit and the intake is desirable to make inspections and needed repairs. Stoplog or bulkhead slots are generally provided for this purpose in the intake or immediately downstream from the intake. In intake towers containing control devices, the stoplog slots are placed upstream from the controls. A circular, flat bulkhead that can drop down over the entrance is generally provided for a drop inlet structure. This type of bulkhead is normally lowered into place from a barge and positioned on a seat embedded in the intake sill concrete by divers. It can, however, be put in place in the dry condition and used for initial filling or refilling of the outlet works pipe.

For an intake structure with an inlet sill above the invert of the conduit, it may be desirable for various reasons to draw the reservoir down below the level of the sill. In such an instance, a bypass may be provided near the base of the structure to connect the reservoir to the conduit downstream. In other instances where flow must be maintained while installing or maintaining the control gates and outlet pipes or while repairing or maintaining the free flow conduit concrete, it may be desirable to carry a separate pipe under or alongside the conduit to bypass it entirely. In either case, the bypass inlet may be placed in the intake structure where it usually can be controlled by a gate or butterfly valve mounted on or in the structure and operated from some higher level.

Where winter reservoir storage is maintained and the surface ices over, the effect of such conditions on the intake structure must be considered. When the reservoir surface freezes around an intake structure, there is danger to the structure not only from the ice pressures acting laterally, but also from the uplift forces if a filling reservoir lifts the ice mass vertically. These effects must be considered when the advantages or disadvantages of a tower are compared with those of a submerged intake.

If a tower is constructed where icing conditions present a hazard, ice may be prevented from forming around the structure by the subsurface release of compressed air. The released air causes the slightly warmer water at lower depths to rise and mix with the cooler surface water, thus preventing freezing. However, if not enough warm water is available, as when the approach channel to the tower is shallow or the reservoir storage is small, the release of air may actually enhance freezing around the structure.

10.10. ***Terminal Structures and Dissipating Devices.***—The discharge from an outlet, whether it be a gate valve, or free flow conduit, will emerge at a high velocity, usually in a nearly horizontal direction. If erosion-resistant bedrock exists at shallow depths, the flow may be discharged directly into the river. Otherwise, it should be directed away from the toe of the dam by a deflector. Where erosion is to be minimized, a plunge basin may be excavated and lined with riprap or concrete. The design of such a basin is discussed in section 9.24.

When more energy dissipation is required for free flow conduits, the terminal structures described for spillways (part E, ch. 9) may be used. The hydraulic-jump basin is most often used for energy dissipation of outlet works discharges. However, flow that emerges from the outlet in the form of a free jet, as is the case for valve-controlled outlets of pressure conduits, must be directed onto the transition floor approaching the basin so it will become uniformly distributed before entering the basin. Otherwise, proper energy dissipation will not be obtained.

Two types of dissipating devices used more commonly with outlet works than with spillways are the impact-type stilling basin and the stilling well. An impact-type stilling basin dissipates energy by impeding the flow with a stationary concrete baffle.

usually require the use of footings, keywalls and counterforts and drainage is properly located immediately downstream of these features. This drainage when properly designed can control piping and provide significant economies due to the effect on soil loads, uplift pressures, overturning forces and sliding stability.

Outlets

The choice of outlet is to be based on a careful consideration of all site and flow conditions that may affect operation and energy dissipation.

1. Cantilever outlet and plunge pools may be installed where their use:

   a. Does not create a piping hazard in the foundation of the structure.

   b. Is compatible with other conditions at the site.

   Plunge pools are to be designed to dissipate the energy and be stable. Unless the pool is to be in bedrock or very erosion resistant materials, riprap will be necessary to insure stability. Design Note 6, entitled, "Armored Scour Hole for Cantilever Outlet", is to be used for design.

   Cantilever outlets are to be supported on bents or piers and are to extend a minimum of 8 feet beyond the bents or piers. The bents are to be located downstream from the intersection of the downstream slope of the earth embankment with the grade line of the channel below the dam. They are to extend below the lowest elevation anticipated in the plunge pool. The invert of the cantilever outlet is to be at least 1 foot about the tailwater elevation at maximum discharge.

2. SAF basins may be used when there is adequate control of tailwater. Use TR-54 for structural design and NEH-14 for hydraulic design.

3. Impact basins may be used when positive measures are taken to prevent large debris from entering the conduit. TR-49 is to be used for hydraulic design.

Trash Racks

Trash racks are to be designed to provide positive protection against clogging of the spillway under any operating level. The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

If a reservoir outlet with a trash rack or a ported concrete riser is used to keep the sediment pool drained the trash rack or riser is to extend above the anticipated sediment elevation at the riser to provide

* additional criteria for trash racks from SCS Tech. Release.

for full design flow through the outlet during the design life of the dam. The velocity through the net area of the trash rack above the maximum sediment elevation must not exceed 2 feet per second when the water surface in the reservoir is 5 feet above the top of the trash rack or riser inlet.

Antivortex Device

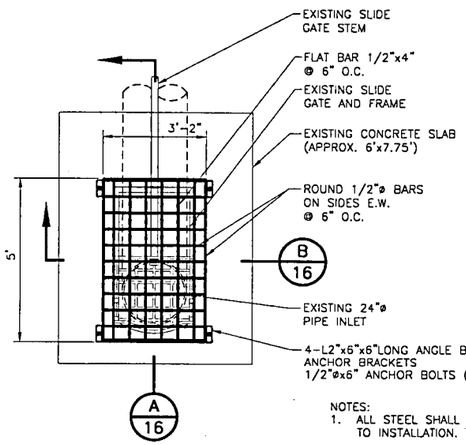
All closed conduit spillways designed for pressure flow are to have adequate antivortex devices.

High Sulfate Areas

Under certain conditions concrete is susceptible to deterioration from sulfate ions, especially those derived from sodium and magnesium sulfates. In areas where experience or soil tests indicate the potential for problems, the following table will be used for design purposes:

Sulfate Concentration [1/] (parts per million)	Hazard	Corrective Measures
0 - 150	Low	None
150 - 1,000	Moderate	Use Type II Cement. (ASTM C-150). Adjust mix to protect against sulfate action.
1,000 - 2,000	High	Use Type V Cement (ASTM C-150). Adjust mix to protect against sulfate action. Use soils in contact with concrete surfaces that are low in sulfates.
2,000 - up		Do not use concrete materials unless measures are taken to protect concrete surfaces from sulfates. Product manufacturers should be consulted.

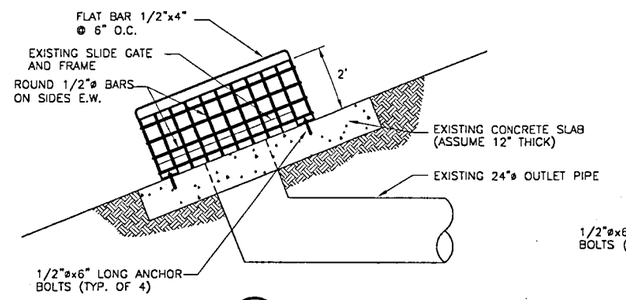
[1/] Sulfate concentration is for soil water at the concrete surface.



1/16 SOUTH TRASH RACK PLAN

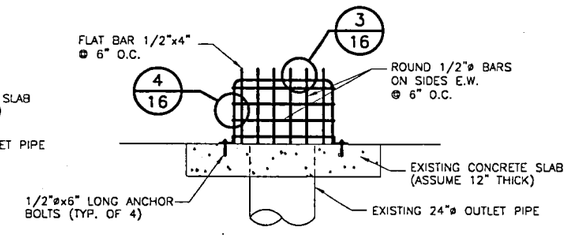
0 2 4
SCALE IN FEET

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.



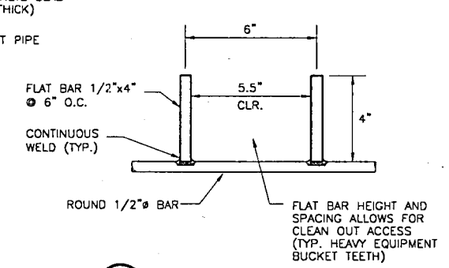
A/16 SOUTH TRASH RACK SECTION

0 2 4
SCALE IN FEET

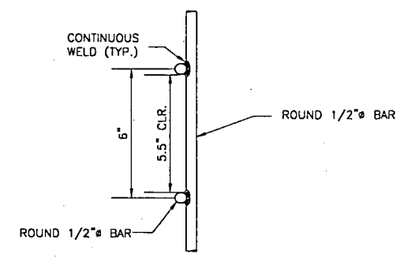


B/16 SOUTH TRASH RACK SECTION

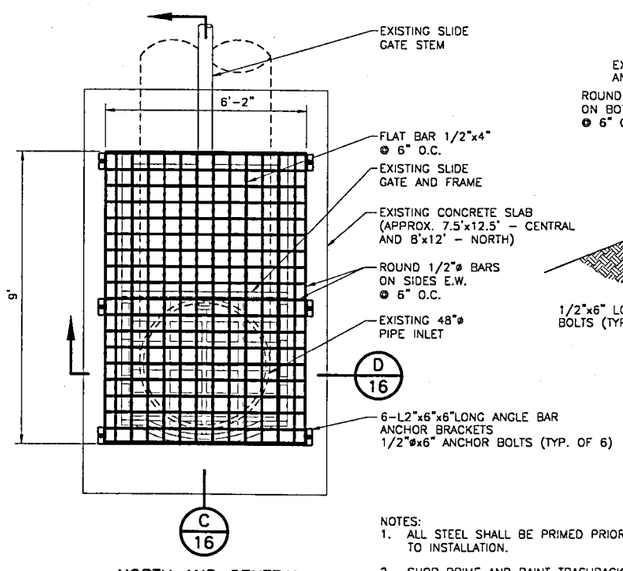
0 2 4
SCALE IN FEET



3/16 TOP OF TRASH RACK DETAIL
NTS



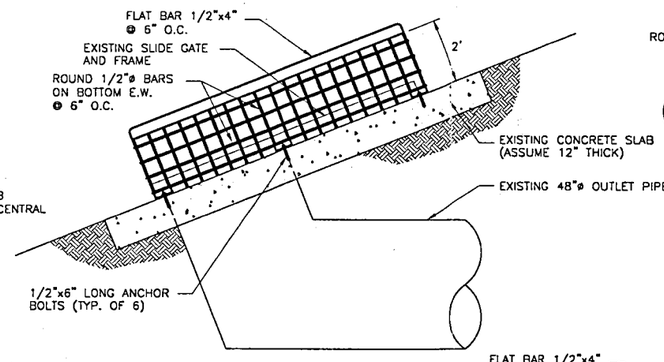
4/16 SIDE OF TRASH RACK DETAIL
NTS



2/16 NORTH AND CENTRAL TRASH RACK PLAN

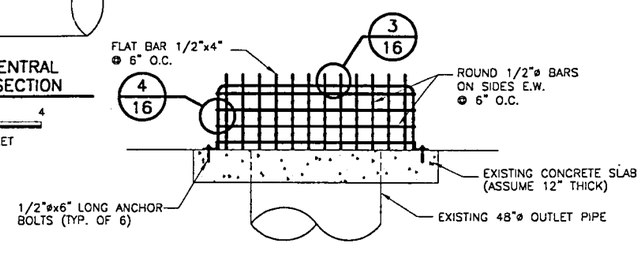
0 2 4
SCALE IN FEET

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.



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

CALL FOR THE BLUE STAKES
283-1100
1-800-STAKE-IT
OUTSIDE MARICOPA COUNTY

ADWR APPROVAL

NO.	REVISION	BY	DATE
G	100% SUBMITTAL, ISSUED FOR ADWR PERMIT	TER	09/00
F	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	9/00
DRAWN	K. PALMISANO	9/00
CHECKED	T. RINGSMUTH	9/00

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

DRAWING NO. D5

TRASH RACK PLANS, SECTIONS AND DETAILS

SHEET 16 OF 18

\Z2\JOBS\15448\007\REV-D\A13403RD.DWG 9-18-00

REVSION ONE

CENTRAL OUTLET TRASHRACK SIZING CALCULATION

WHITE TANKS FRS #3

MCFCD JOB #15448-007-058

REVISION

The general rectangular shape of the trashrack remained the same as in the original calculation. In this calculation, we did away with the angle iron along all of the edges of the trashrack. We also incorporated thin flat bars across the top of the trashrack to better facilitate the cleaning of the trashrack using a backhoe, trackhoe or gradeall. For this revision we referenced the Amendment 1 to the SCS TR-60, design criteria for trashracks.

See the attached spreadsheet for the dimensions of the individual components of the trashrack and for the revised calculation.

CONCLUSION

The revised spreadsheet shows that the Target Flow Velocity of 2.5 ft/sec could be achieved using a trashrack that is 1.5 ft in height x 9 ft in length x 6 ft in width. We opted to increase the height of the trashrack to 2 ft in order to add a factor of safety.

TRASHRACK SIZING SPREADSHEET
WHITE TANKS FRS #3

Bar Diameter or Bar Edge Width (in)	0.5
Edge Angle Width (in)	0
Bar Spacing (in)	6
Discharge (cfs)	207

Target Flow Velocity < 2.5 ft/sec

Height (ft)	Length (ft)	Width (ft)	Adjusted Height (ft)	Adjusted Length (ft)	Adjusted Width (ft)	Gross Area (sf)	Net Area (sf)	Flow Velocity (ft/sec)
1	9	6	0.92	8.21	5.50	84	70.28	2.95
1.5	9	6	1.38	8.21	5.50	99	82.84	2.50
2	9	6	1.83	8.21	5.50	114	95.41	2.17

This spreadsheet calculates the flow velocity through a cage trashrack. The variables used to calculate this flow velocity are as follows:

Bar Diameter: This spreadsheet calculation assumes the use of round bars and flat thin bars.

Edge Angle Width: This spreadsheet calculation assumes that the trashrack cage will **not** have angle iron supports on all of the edges of each of the 5 sides.

Bar Spacing: The bar spacing is a center to center dimension that is consistent for horizontal and vertical spacing

Discharge: This number is the calculated maximum discharge through the outlet pipe in question. This maximum discharge is used to calculate the flow velocity through the trashrack.

Target Flow Velocity: This requirment was taken from the SCS Technical Release Notice 60C, 210-VI, Amendment 1. It states, "The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack."

Height: Actual height of the trash rack (see attached drawing)

Length: Actual length of the trash rack (see attached drawing)

Width: Actual width of the trash rack (see attached drawing)

Adj. Height: Actual height of the trash rack minus the area of the bar thicknesses.

Adj. Length: Actual length of the trash rack minus the area of the bar thicknesses.

Adj. Width: Actual width of the trash rack minus the area of the bar thicknesses.

Gross Area: Height x Length x Width

Net Area: Adj. Height x Adj. Length x Adj. Width

Flow Velocity: Discharge / Net Area, from the equation Q=VA

TRASHRACK SIZING SPREADSHEET
WHITE TANKS FRS #3

	A	B	C	D
1				
2	**Bar Diameter or Bar Edge Width**		**0.5**	
3	**Edge An**		**0**	
4	**Bar Spa**		**6**	
5				
6	**Discharge (cfs)**		**207**	
7				
8				
9	**Height (ft)**	**Length (ft)**	**Width (ft)**	**Adjusted Height (ft)**
10	1	9	6	=((A10*12)-(((ROUND((A10/($C$4/12)),0)))*$C$2))/12
11	1.5	9	6	=((A11*12)-(((ROUND((A11/($C$4/12)),0)))*$C$2))/12
12	2	9	6	=((A12*12)-(((ROUND((A12/($C$4/12)),0)))*$C$2))/12
13				
14				
15	This spre			
16	are as fol			
17				
18	Bar Diam	This spr		
19				
20	Edge An	This spr		
21	Width:	on all of		
22	Bar Spac	The bar		
23	Discharg	This nu		
24		dischar		
25	Target Fl	This req		
26	Velocity:	"The av		
27		range of		
28		the rack		
29	Height:	Actual h		
30	Length:	Actual l		
31	Width:	Actual		
32	Adj. Heig	Actual h		
33	Adj. Leng	Actual l		
34	Adj. Widt	Actual		
35	Gross Ar	Height x		
36	Net Area:	Adj. Hei		
37	Flow Vel	Dischar		

Height IN INCHES

Bar spacing IN FT

OF BARS/HT.

Bar Height IN INCHES

convert to FT.

same for width & length

Adjusted Height = Height − Bar Height

TRASHRACK SIZING SPREADSHEET
WHITE TANKS FRS #3

	E
1	
2	**Target Flow Velocity <**
3	
4	
5	
6	
7	
8	
9	**Adjusted Length (ft)**
10	=((B10*12)-(((ROUND((B10/($C$4/12)),0))+1)*$C$2))/12
11	=((B11*12)-(((ROUND((B11/($C$4/12)),0))+1)*$C$2))/12
12	=((B12*12)-(((ROUND((B12/($C$4/12)),0))+1)*$C$2))/12
13	
14	
15	
16	
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19	
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27	
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37	

TRASHRACK SIZING SPREADSHEET
WHITE TANKS FRS #3

	F	G
1		
2		**2.5 ft/sec**
3		
4		
5		
6		
7		
8		
9	**Adjusted Width (ft)**	**Gross Area (sf)**
10	=((C10*12)-(((ROUND((C10/($C$4/12)),0)))*$C$2))/12	=(B10*C10)+(2*B10*A10)+(2*C10*A10)
11	=((C11*12)-(((ROUND((C11/($C$4/12)),0)))*$C$2))/12	=(B11*C11)+(2*B11*A11)+(2*C11*A11)
12	=((C12*12)-(((ROUND((C12/($C$4/12)),0)))*$C$2))/12	=(B12*C12)+(2*B12*A12)+(2*C12*A12)
13		
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TRASHRACK SIZING SPREADSHEET
WHITE TANKS FRS #3

	H	I
1		
2		
3		
4		
5		
6		
7		
8		
9	**Net Area (sf)**	**Flow Velocity (ft/sec)**
10	=(E10*F10)+(2*E10*D10)+(2*F10*D10)	=$C$6/H10
11	=(E11*F11)+(2*E11*D11)+(2*F11*D11)	=$C$6/H11
12	=(E12*F12)+(2*E12*D12)+(2*F12*D12)	=$C$6/H12
13		
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FILE 15448-007-058
SUBJECT
SHEET 9 OF 9

REVISIONS
BY ____ DATE ____ TO EO ____
BY ____ DATE ____ TO EO ____

BY CDM DATE 2/1/
CHECKED BY BKW 2/1/00
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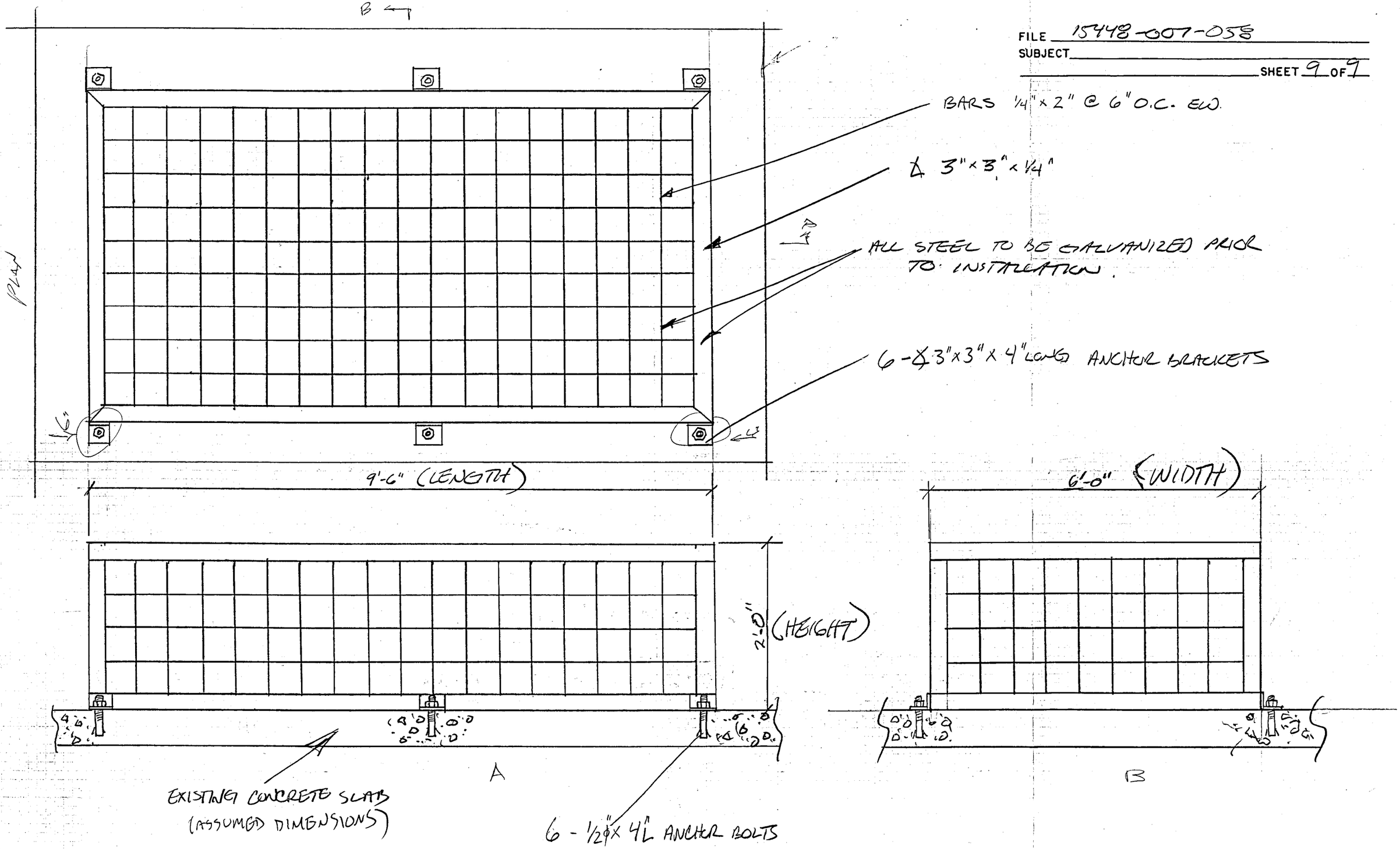

SCALE = 3/4" = 1'

CENTRAL OUTLET TRASH RACK

DAMES & MOORE

946 8 (10-67)

usually require the use of footings, keywalls and counterforts and drainage is properly located immediately downstream of these features. This drainage when properly designed can control piping and provide significant economies due to the effect on soil loads, uplift pressures, overturning forces and sliding stability.

Outlets

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   b. Is compatible with other conditions at the site.

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If a reservoir outlet with a trash rack or a ported concrete riser is used to keep the sediment pool drained the trash rack or riser is to extend above the anticipated sediment elevation at the riser to provide

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SHEET 1 OF 13

SUBJECT:

Diaphragm Filter and Thickness of Soil Buttress Fill at White Tank FRS #3.
Calc. Pkg. #3

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: Jian W Liu (PRINT NAME)

Jian Liu (SIGNATURE) 5-8-00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 9-29-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 5/16/00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) AW. GOURLAY (PRINT NAME)

AW. Gourlay (SIGNATURE) 9-29-00 (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.

OK for 90% submittal AWG 5-26-00

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

Objective: Determine the thickness of Soil Buttress Fill for each of the three outlet Pipes at White Tank FRS #3.

Procedure:
1. Determine the Elevation of the top of the diaphragm (H_{TOP});
2. Determine the Elevation of the maximum potential reservoir water level (H_{max});
3. Thickness of Soil Buttress Fill $= \frac{1}{2}(H_{max} - H_{TOP})$.

Assumptions:
1. Maximum Potential Reservoir Water Level is 1210.34 feet, Using 1210.5 feet for This Calculation.
2. The Diaphragm Filter will extend 3 pipe diameters above and on each side of pipe for the filter.
3. Using 3 feet diaphragm thickness.
4. The Diaphragm Filter will extend 1.5

Summary Table 1: Minimum Thickness of Soil Buttress Fill

Location of Outlet Pipe		North	Central	South
Minimum Thickness of Soil Buttress Fill (ft)	Point A	3.9	4.3	6.7
	Point B	9.4	9.8	9.2
	Point C	10.9	11.3	10.2

Summary Table 2: Construction Thickness of Soil Buttress Fill

Location of Outlet Pipe		North	Central	South
Construction Thickness of Soil Buttress Fill (ft)	Point A	4.5	5.0	7.5
	Point B	10.0	10.5	10.0
	Point C	11.5	12.0	11.0

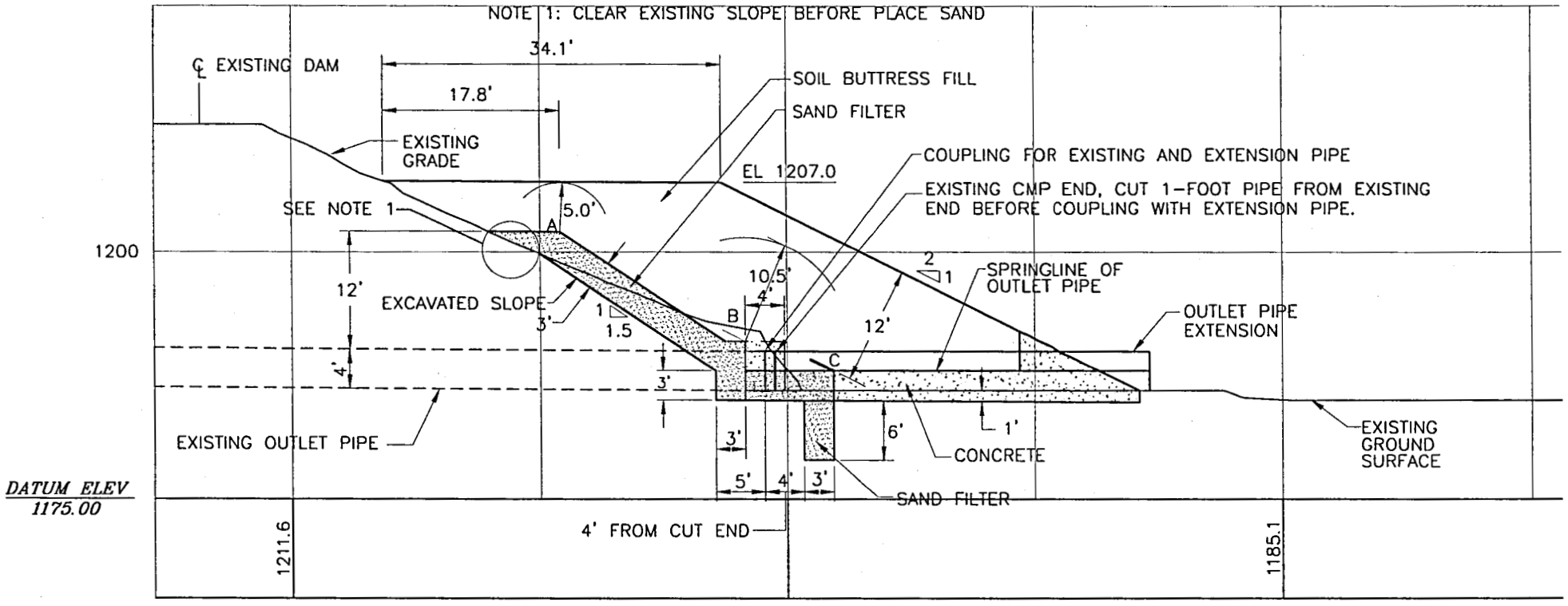


FIGURE 2. CENTRAL OUTLET CROSS-SECTION OF DIAPHRAGM FILTER

CENTRAL PIPE CROSS-SECTION FROM TOPO 1-28-00
SDSK: A13405.DWG

6/13

(-) North Outlet Pipe

Elevation of Invert of Pipe : 1186.891'

Diameter of Pipe : 4'

3 times of Pipe Diameter : 12'

Therefore, elevation of Top of Filter:

$$1186.891 + 4 + 12 = 1202.891' \checkmark$$

Known maximum potential reservoir water level:

1210.5 feet (Assumption #1);

The thickness of Soil Buttress Fill @ Elevation 1202.891'

$$= \frac{1}{2}(1210.5 - 1202.891) = 3.805 \text{ feet} \checkmark$$

Use minimum $\boxed{3.9\text{-ft}}$ of Soil Buttress Fill in All Direction at Filter Elevation 1202.891 feet.

(See Point A of Figure 1, Sheet 5 of 13).

Point B of Figure 1:

$$\text{Elevation} = 1186.891 + 5.0 = 1191.891 \text{ feet} \checkmark$$

The thickness of Soil Buttress Fill @ Point B:

$$\frac{1}{2}(1210.5 - 1191.891) = 9.305 \text{ feet} \checkmark$$

Use Minimum 4.3' of Soil Buttress Fill in All Direction at Point A of Figure 2 (sheet 6 of 13).

Elevation at Point B = 1185.918 + 5 = 1190.918 feet ✓

$$\frac{1}{2}(H_{max} - H_{TOP}) = \frac{1}{2}(1210.5 - 1190.918)$$

$$= 9.79 \text{ feet}$$ ✓

Use Minimum 9.8 feet of Soil Buttress Fill in All Direction at Point B of Figure 2.

Elevation at Point C = 1185.918 + 2 = 1187.918' ✓

$$\frac{1}{2}(H_{max} - H_{TOP}) = \frac{1}{2}(1210.5 - 1187.918)$$

$$= 11.29 \text{ feet}$$ ✓

Use Minimum 11.3 feet of Soil Buttress Fill in All Direction at Point C of Figure 2.

(三) South Outlet Pipe

Elevation of Invert of Pipe: 1189.261 feet

Diameter of Pipe: 2 feet

3 times the Pipe Diameter: 6 feet

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 12 of 13
Calc. No.
Rev. No.
By JWL Date 5/8/00
Chk'd. BKW Date 5/16/00

Job No. 15448-007 Job White Tanks FRS #3
Client Subject

Use minimum 10.2 feet of Soil Buttress Fill in All Direction at Point C of Figure 3 (Sheet No. 7 of 13).

F-132(7/91)

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT:

SHEET 1 OF 15

Diaphragm Filter Gradation
TITLE OF CALCULATIONS/DOCUMENT

Calc Package #4

CALCULATIONS/DOCUMENT BY: Bonnie Whitley
PRINT NAME

Bonnie Whitley
SIGNATURE

2-1-00
DATE

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: SCOTT NEWHOUSE
PRINT NAME

SIGNATURE

2-2-00
DATE

CALCULATIONS/DOCUMENT CHECKED BY: CHRIS WIGGINTON
PRINT NAME

SIGNATURE

2-2-00
DATE

APPROVED BY:
(PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM)

TODD Ringsmuth
PRINT NAME

SIGNATURE

2-2-00
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.

~~OK for 90% submittal~~ ~~AWG 5-26-00~~ AWG 7-27-00

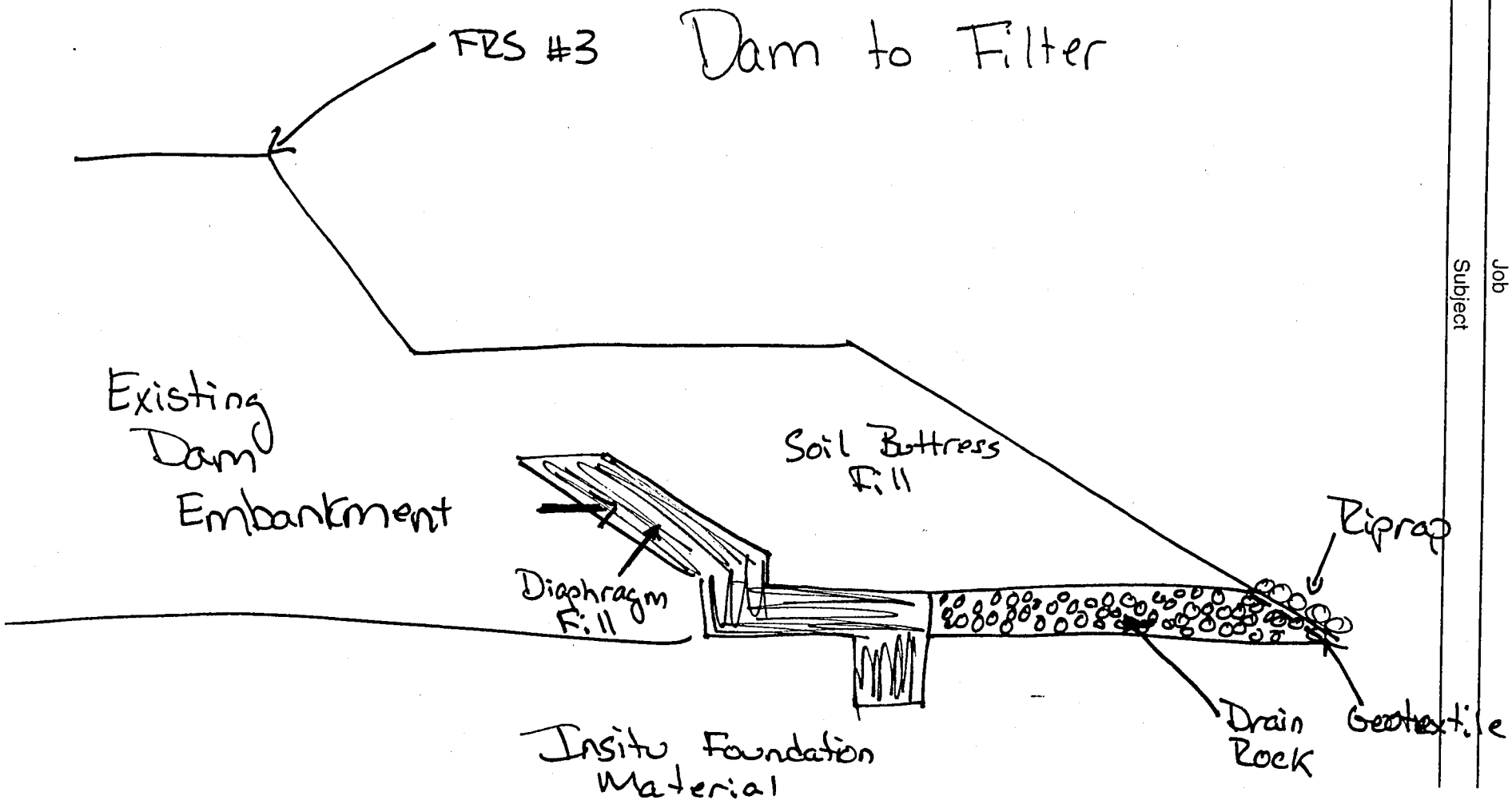
Revision Number	Date	By	Checked By	Approval
1	5/3/00	BKW	JWL	AWG
2				
3				
4				

INITIALS

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Job No. Job
Client Subject

FRS #3 Dam to Filter



Sheet No. 2/5
Calc. No.
Rev. No.
By Date
Chk'd. Date

F-132(7/91)

Adjust limits of design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less.

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

$$\text{Max } D_{10} = \frac{\text{Max } D_5}{1.2} = \frac{0.7\text{mm}}{1.2} = 0.583\text{mm}$$

$$\text{Max } D_{60} = 6 \times D_{10} = 6 \times 0.583\text{mm} = 3.5$$

Label Max D_{60} Control Point 3

$$\text{Min } D_{60} = \frac{\text{Max } D_{60}}{5} = \frac{3.5\text{mm}}{5} = 0.7\text{mm}$$

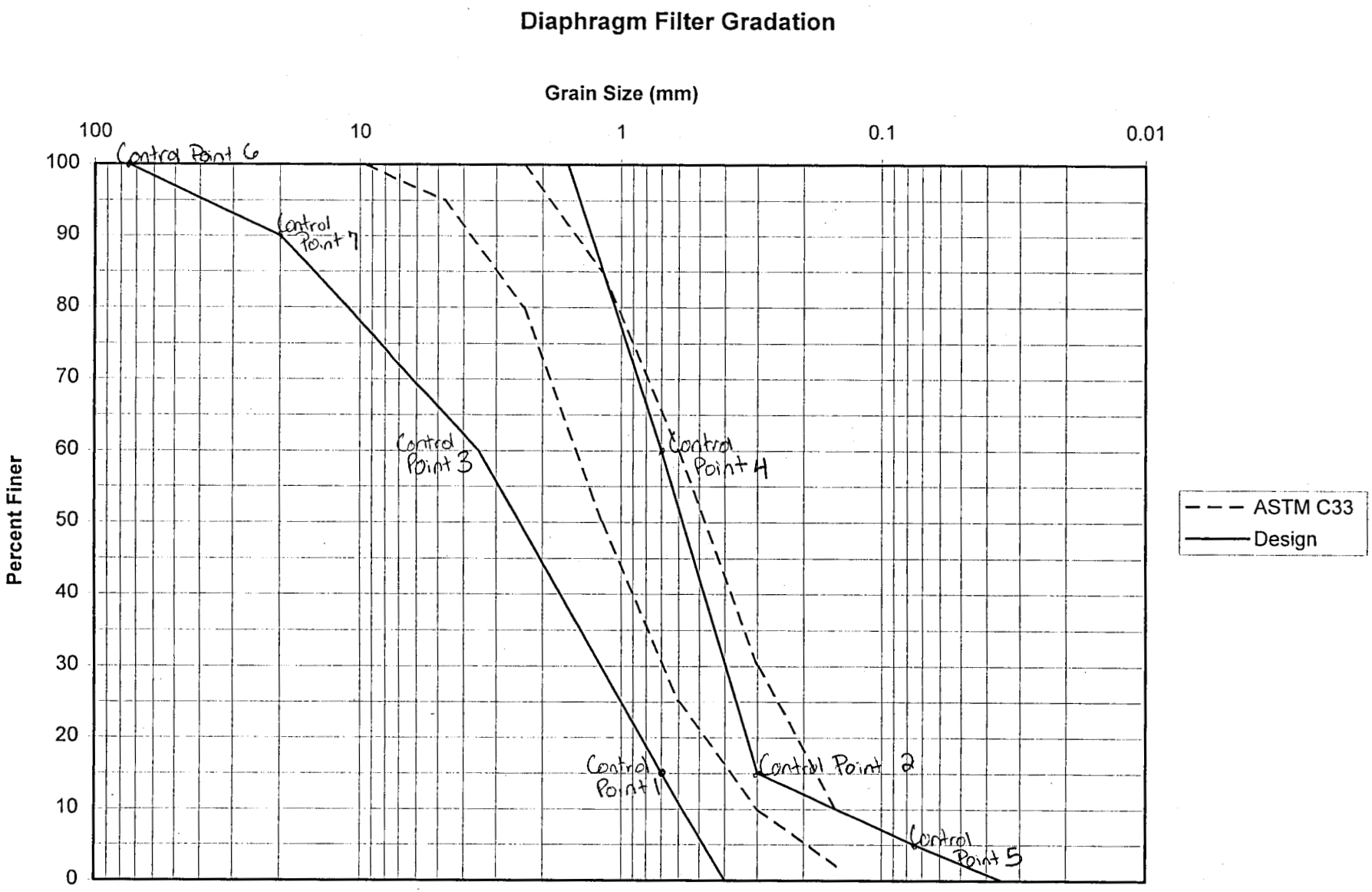
(ratio is 5 or less at any percentage passing of 60 or less)

Label Min D_{60} Control Point 4

Determine minimum D_5 and maximum D_{100} according to Table 26-5 (see sheet 9)

Min D_5 = 0.075 mm

Label as Control Point 5


Diaphragm Filter Gradation
Grain Size (mm)
100
10
1
0.1
0.01
Percent Finer
100
90
80
70
60
50
40
30
20
10
0
Control Point 6
Control Point 7
Control Point 3
Control Point 4
Control Point 1
Control Point 2
Control Point 5
ASTM C33
Design

633.2602 Permeability and capacity

The laboratory filter study clearly demonstrated that graded filters designed in accordance with these criteria will seal a crack. The sealing begins when water flows through a crack or opening and carries soil particles eroded from the sides of the openings. Eroding soil particles collect on the face of the filter to seal the crack at the interface. Any subsequent flow is through the pores of the soil. If filters are designed to intercept cracks, the permeability required in the filter zone should be based on the steady state seepage flow through the pores of the base soil alone. The hydraulic capacity of any cracks need not be considered in designing the filter because the cracks have been shown to seal.

Where saturated steady-state seepage flow will not develop, for instance in dry dams for flood control having a normal drawdown time of 10 days or less, filter capacity need only be nominal. Filters designed either to protect against steady state seepage or internal erosion through cracks are to be thick enough to compensate for potential segregation and contamination of the filter zones during construction. They must also be thick enough that cracks cannot extend through the filter zone during any possible differential movements.

A zone of coarser materials immediately downstream or below the filter, or both, provides additional capacity to collect and convey seepage to a controlled outlet. In some cases a strip drain is used, and in others a perforated collector pipe is employed to outlet the collected seepage. To prevent movement of the filter materials into the coarse drain materials, the coarse drain materials must be designed for the proper gradation using procedures in this subchapter. Perforations in collector pipes must also be sized properly to prevent movement of the coarse drain materials into the perforations.

633.2603 Determining filter gradation limits

Determine filter gradation limits using the following steps:

Step 1: Plot the gradation curve (grain-size distribution) of the base soil material. Use enough samples to define the range of grain sizes for the base soil or soils. Design the filter using the base soil that requires the smallest D_{15} size for filtering purposes. Base the design for drainage purposes on the base soil that has the largest D_{15} size.

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than No. 4 sieve).

Step 3: Prepare adjusted gradation curves for base soils that have particles larger than the No. 4 (4.75 mm) sieve.

- Obtain a correction factor by dividing 100 by the percent passing the No. 4 (4.75 mm) sieve.
- Multiply the percentage passing each sieve size of the base soil smaller than No. 4 (4.75 mm) sieve by the correction factor determined above.
- Plot these adjusted percentages to obtain a new gradation curve.
- Use the adjusted curve to determine the percentage passing the No. 200 (0.075 mm) sieve in step 4.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26–1.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter in accordance with the table 26–2.

If desired, the maximum D_{15} may be adjusted for certain noncritical uses of filters where significant hydraulic gradients are not predicted, such as bedding beneath riprap and concrete slabs. For fine clay base soil that has d_{85} sizes between 0.03 and 0.1 mm, a maximum D_{15} of ≤ 0.5 mm is still conservative. For fine-grained silt that has low sand content, plotting below the "A" line, a maximum D_{15} of 0.3 mm may be used.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26–5. Label as Control points 5 and 6, respectively.

Table 26–5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

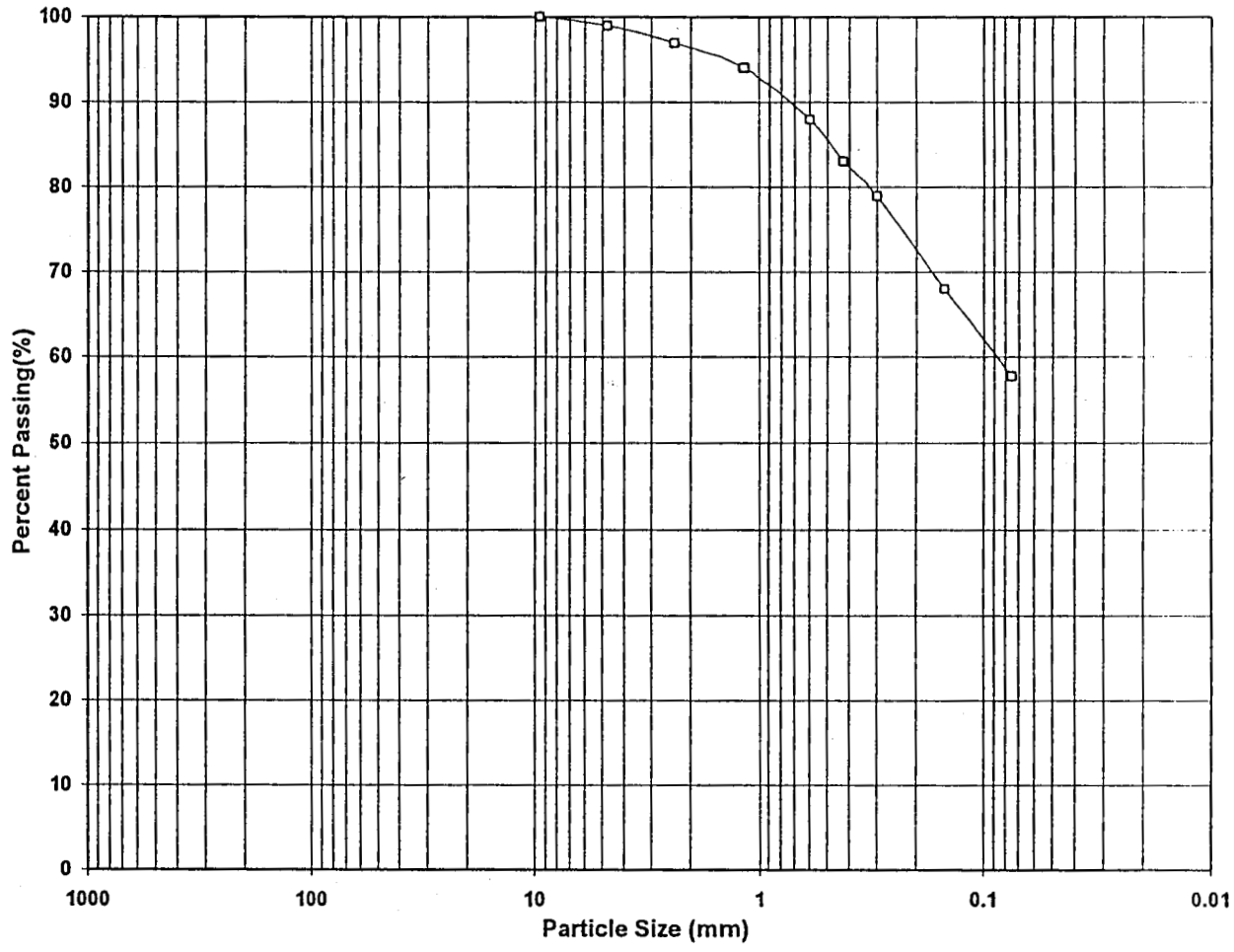
Drilled Sample:

Boring DMB-4 Sample # 1 Depth 5'-5.5'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5	100	
#4	4.75	99	
#8	2.36	97	
#10	2.0		
#16	1.18	94	
#30	0.6	88	
#40	0.43	83	
#50	0.3	79	
#100	0.15	68	
#200	0.075	57.8	

Plasticity Index 7

USCS Classification: CL-ML



Sheet 11 of 15

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

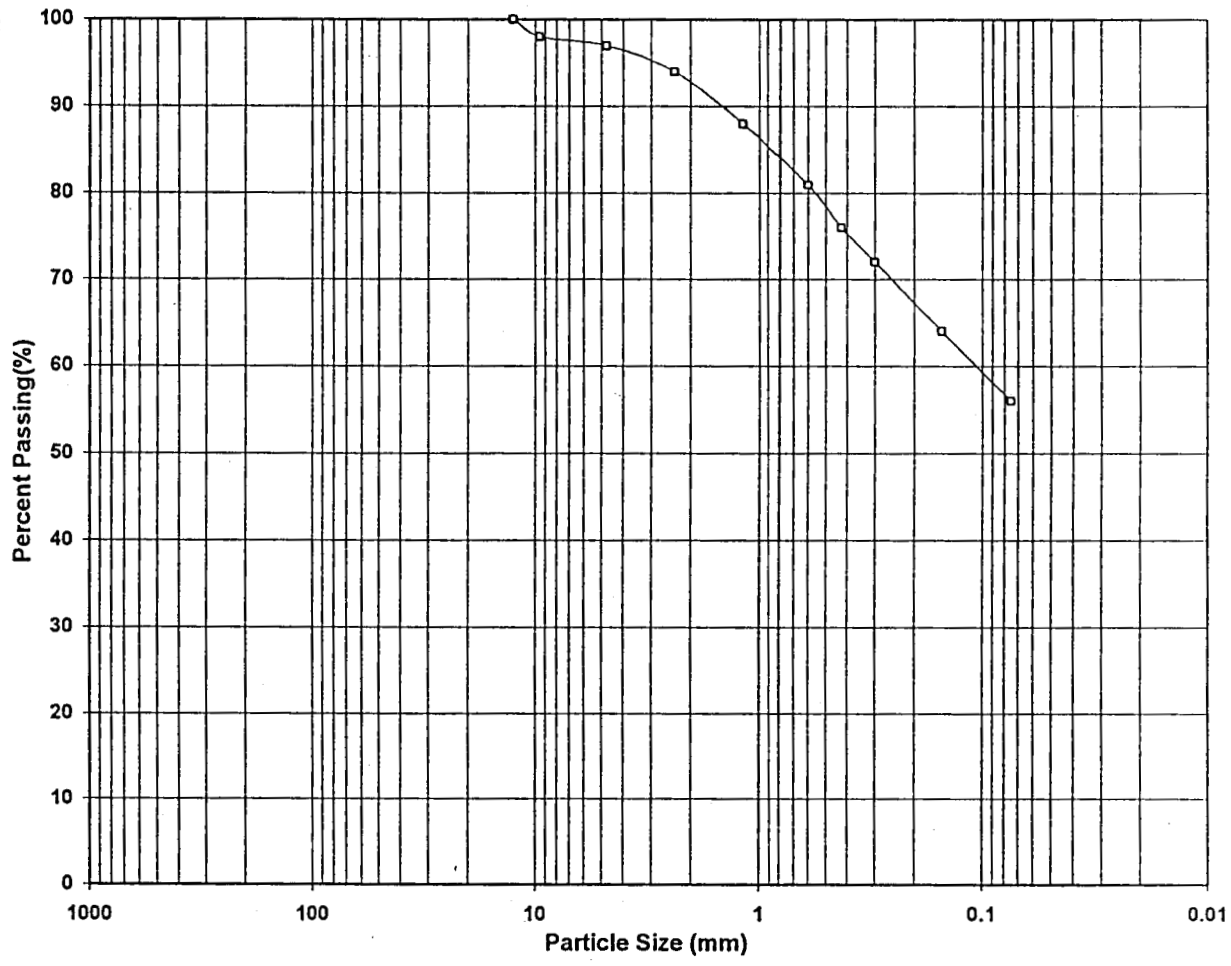
Drilled Sample:

Boring DMB-7 Sample # 1 Depth 5'-6'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5	100	
3/8"	9.5	98	
#4	4.75	97	
#8	2.36	94	
#10	2.0		
#16	1.18	88	
#30	0.6	81	
#40	0.43	76	
#50	0.3	72	
#100	0.15	64	
#200	0.075	56	

Plasticity Index 17

USCS Classification: CL



Sheet 13 of 15

PARTICLE SIZE ANALYSIS

DAMES DCM MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

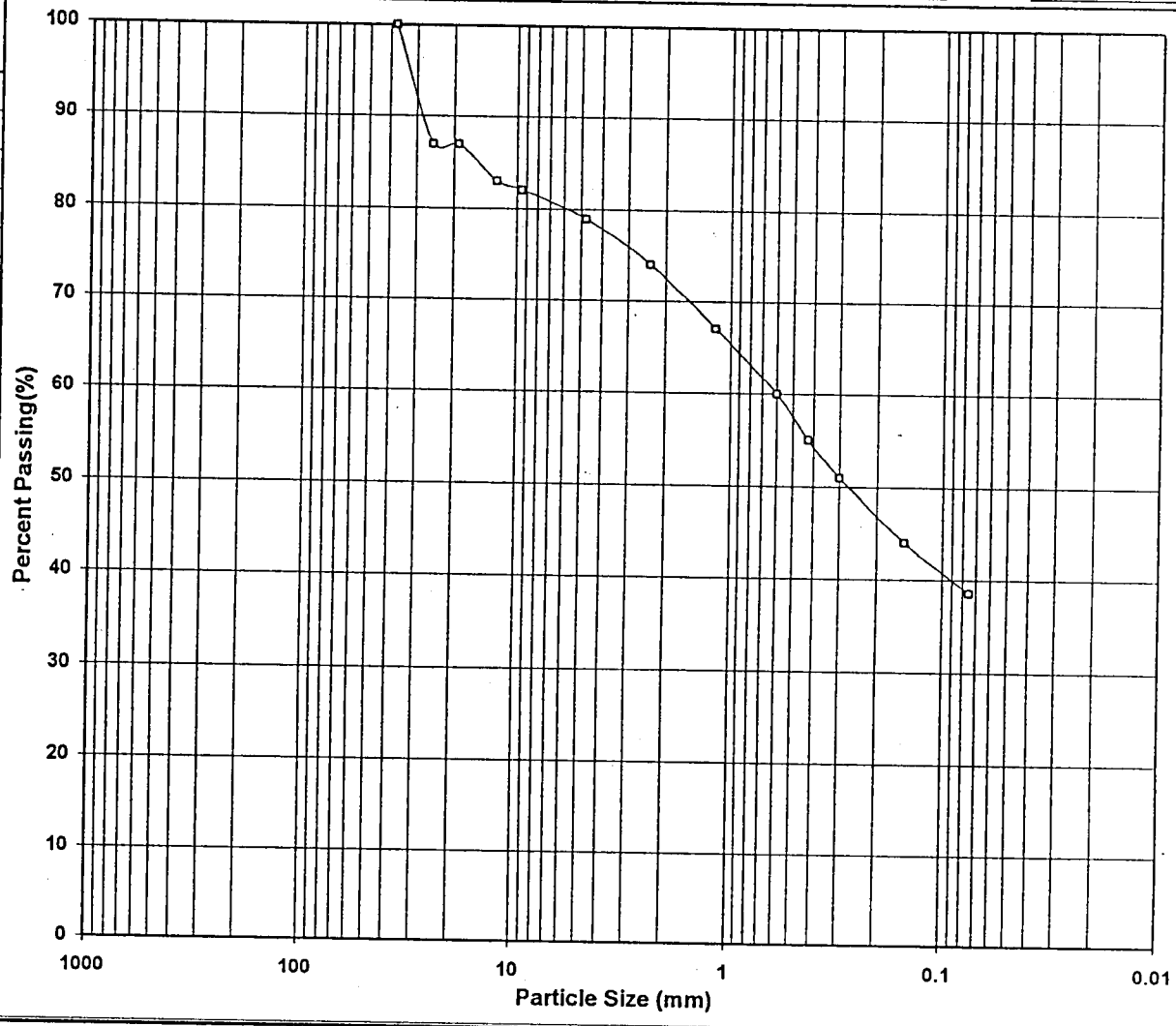
Drilled Sample:

Boring DMB-6 Sample # 1 Depth 5'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5	100	
1.25"	31.3		
1"	25.0	87	
3/4"	19.0	87	
1/2"	12.5	83	
3/8"	9.5	82	
#4	4.75	79	
#8	2.36	74	
#10	2.0		
#16	1.18	67	
#30	0.6	60	
#40	0.43	55	
#50	0.3	51	
#100	0.15	44	
#200	0.075	38.6	

Plasticity Index 9

USCS Classification: SC



Sheet 15 of 15

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 1/15
Calc. No.
Rev. No.
By BKW Date 5/3/00
Chk'd. JWL Date 6-29-00

Job No. 15448-007-056 Job
Client Subject

Filter Gradation Revision

Revising calculation using regraded base soil gradations and determining Min D_{15} without using d_{15} of base soil samples. Also included boring logs for base soil samples.

Regraded base soil samples

$$\text{Correction Factor} = \frac{100}{\%\ \text{Passing \#4 sieve}}$$

See attached spreadsheets (Sheets 3 + 4)

F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 3\15
Calc. No.
Rev. No.
By BKW Date 5/3/00
Chk'd. JWL Date 6-29-00

Job No. Job
Client Subject

$$\text{Min } D_{60} = \frac{\text{Max } D_{60}}{5} = \frac{2.52\text{mm}}{5}$$

Min D_{60} = 0.50mm ✱ Control Point 4

$$\text{Min } D_{10} = \frac{\text{Min } D_5}{1.2} = \frac{0.1\text{mm}}{1.2} = 0.083\text{mm}$$

Max D_{90} = 20mm according to Table 26-4

Conclusion: ASTM C33. Fine Aggregate is an acceptable material for the diaphragms filter

Note: All available samples from the embankment (13 in all) were reviewed after completion of this calculation. All 13 samples returned the same results as shown in this calculation.

F-132(7/91)

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT	LOCATION
WHITE TANKS DAM	15448-005-022	MARICOPA COUNTY FLOOD CONTROL DISTRICT	WHITE TANKS

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
MOBILE B-57 WITH 6-INCH HOLLOW STEM AUGER	0'-14.5'	ATL, INC.	DMB-7
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON (SPT) AND DAMES & MOORE TYPE (U) WITH BRASS SLEEVES AND RINGS	5-FOOT INTERVALS

			DRILLING START	DRILLING FINISH
LOGGED BY: PLG	WATER LEVEL	NA	TIME 1240	TIME 1305
CHECKED BY: PLG	TIME			
	DATE		DATE 11/5/98	DATE 11/5/98
DATUM: ELEVATION: feet	CASING DEPTH			

SURFACE CONDITIONS: GRADED ROADWAY SURFACE ON TOP OF DAM

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	LABORATORY TESTS: % PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	GRAPHIC LOG	USCS	DESCRIPTION
											CL	SANDY LEAN CLAY WITH GRAVEL: Sand is predominatly fine to medium with some coarse, gravel is fine to coarse grained, dry to slightly moist, brown, hard
5	SPT	1.0	5.0	56	37	17	6.9		18 28 49			Same as above, moderately cemented
10	U		10.0				9.3	121.4	34 40			Becomes slightly moist
15												Boring terminated at 14.5' below ground surface.
20												
25												
30												
35												

BLGV022 1/22/99

DAMES & MOORE

BORING LOG

LOCATION OF BORING:	JOB NO.	CLIENT	LOCATION
WHITE TANKS DAM	15448-005-022	MARICOPA COUNTY FLOOD CONTROL DISTRICT	WHITE TANKS

DRILLING METHOD:	INTERVAL:	DRILLER:	BORING NO.
MOBILE B-57 WITH 6-INCH HOLLOW STEM AUGER	0'-36'	ATL, INC.	DMB-4
			SHEET 1 OF 1

SAMPLING METHOD:	INTERVAL:
STANDARD PENETRATION TEST WITH SPLIT SPOON (SPT) AND DAMES & MOORE TYPE (U) WITH BRASS SLEEVES AND RINGS	5-FOOT INTERVALS

				DRILLING START	DRILLING FINISH
LOGGED BY: PLG	WATER LEVEL	NA		TIME 0929	TIME 1145
CHECKED BY: PLG	TIME				
	DATE			DATE 11/3/98	DATE 11/3/98
DATUM: ELEVATION: feet	CASING DEPTH				

SURFACE CONDITIONS: GRADED ROADWAY SURFACE ON TOP OF DAM

DEPTH IN FEET	SAMPLER TYPE	SAMPLE NO.	SAMPLE DEPTH (ft)	LABORATORY TESTS: % PASSING #200 SIEVE	LIQUID LIMIT %	PLASTICITY INDEX %	WATER CONTENT %	DRY DENS. (pcf)	BLOWS/ft	USCS	DESCRIPTION
										CL ML	SANDY SILTY CLAY WITH GRAVEL: Sand is predominantly fine to medium graine, gravel is fine to coarse grained, dry, brown, hard
5	U	1.0	5.0	58	27	7	4.6	102.0	29 26		Same as above
10	SPT	2.0	10.0				4.0		48 50/4"		Same as above
15	U	3.0	15.0						40 43		Same as above, decreased in gravel content
20	SPT	4.0	20.0	55	23	8	3.1		50/4"	CL	SANDY LEAN CLAY: Sand is fine to coarse grained, dry, brown, hard
25											No recovery
30	U	5.0	30.0						45 48		Same as above, some signs of light cementaion
35	SPT	6.0	35.0				1.5		40 50/5"	SM	SILTY SAND WITH GRAVEL: Sand is fine to coarse, gravel is fine to coarse, dry, light brown, very dense, some signs of light cementation
											Boring terminated at 36' below ground surface.

BLGVO22 1/22/99

DAMES & MOORE

Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine	Grain Size (mm)	C33 - Coarse	Grain Size (mm)	C33 - Fine
75	100	1.6	100	9.5	100	2.36	100
20	90	0.5	60	4.75	95	1.18	85
2.52	60	0.1	15	2.36	80	0.6	60
0.5	15	0.075	5	1.18	50	0.3	30
				0.6	25	0.15	10
				0.3	5		
				0.15	0		

10/15

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

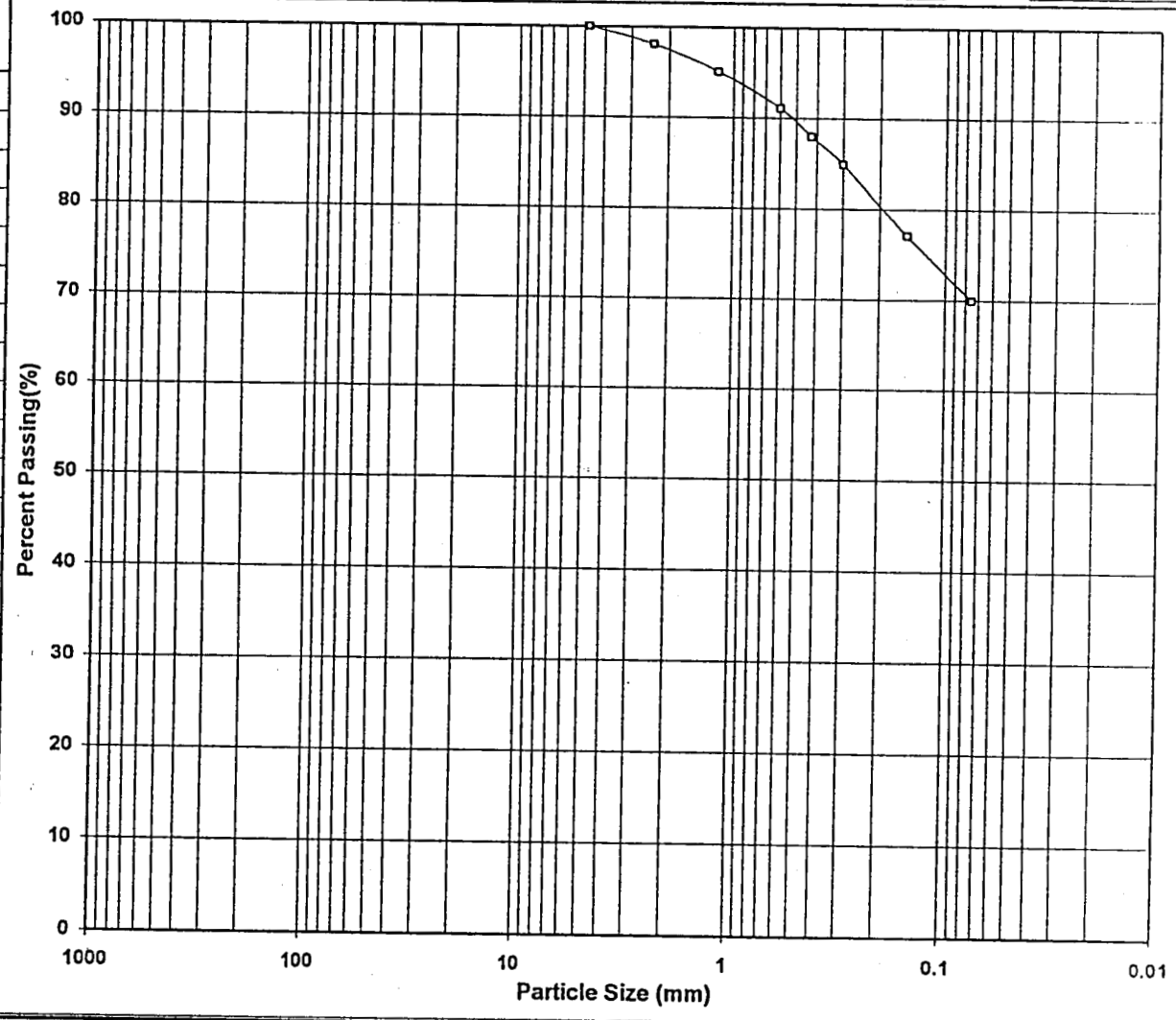
Drilled Sample:

Boring DMB-6 Sample # 6 Depth 30'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75	100	
#8	2.36	98	
#10	2.0		
#16	1.18	95	
#30	0.6	91	
#40	0.43	88	
#50	0.3	85	
#100	0.15	77	
#200	0.075	69.9	

Plasticity Index 13

USCS Classification: CL



no correction needed – nothing bigger than 1 1/4 sieve

8/15

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

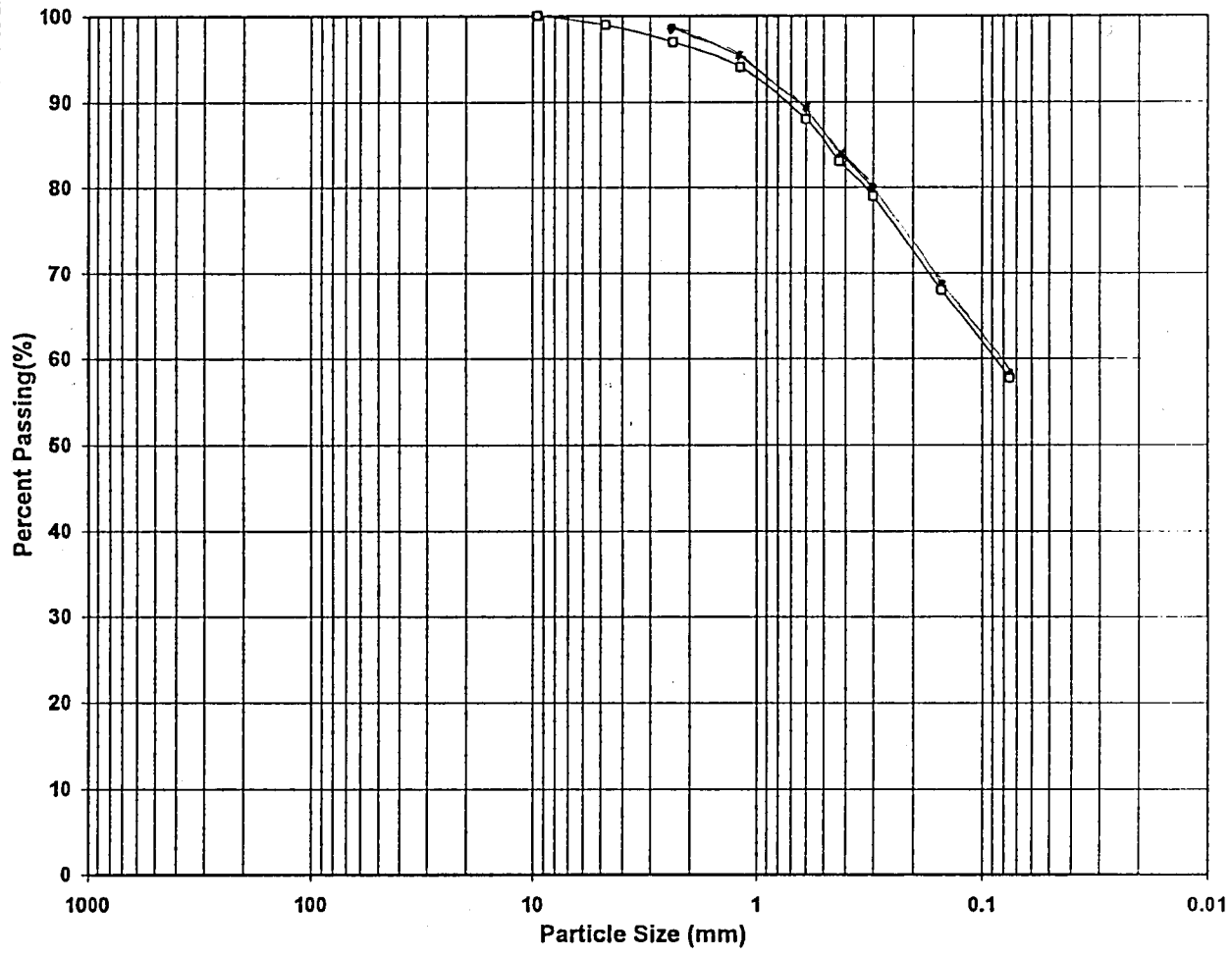
Drilled Sample:

Boring DMB-4 Sample # 1 Depth 5'-5.5'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5	100	
#4	4.75	99	
#8	2.36	97	
#10	2.0		
#16	1.18	94	
#30	0.6	88	
#40	0.43	83	
#50	0.3	79	
#100	0.15	68	
#200	0.075	57.8	

Plasticity Index 7

USCS Classification: CL-ML



6/15

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

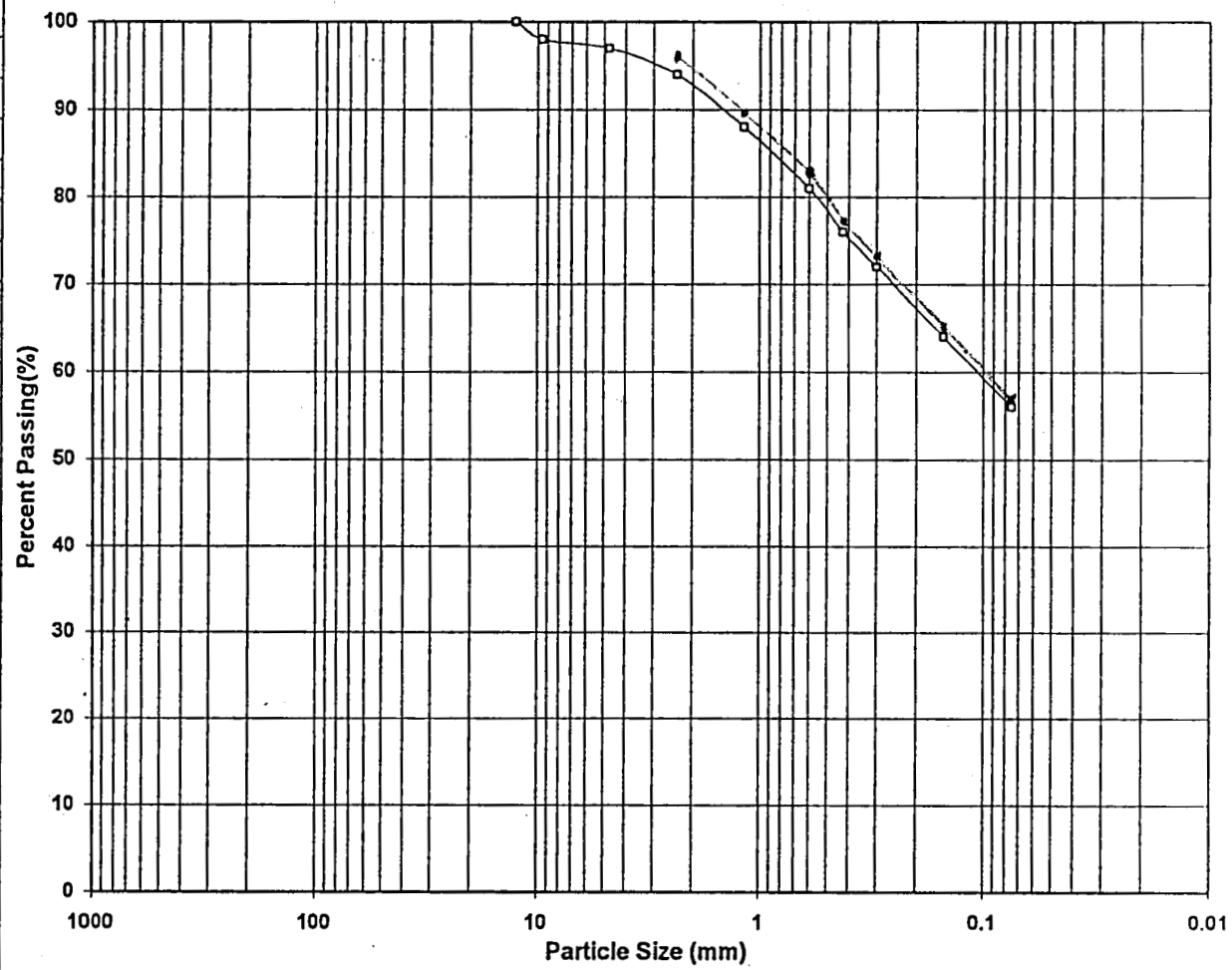
Drilled Sample:

Boring DMB-7 Sample # 1 Depth 5'-6'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0		
3/4"	19.0		
1/2"	12.5	100	
3/8"	9.5	98	
#4	4.75	97	
#8	2.36	94	
#10	2.0		
#16	1.18	88	
#30	0.6	81	
#40	0.43	76	
#50	0.3	72	
#100	0.15	64	
#200	0.075	56	

Plasticity Index 17

USCS Classification: CL



DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT: _____

SHEET 1 OF 5

Filter to Soil Buttress Match

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #5

CALCULATIONS/DOCUMENT BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 6/7/00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

Jian Liu (SIGNATURE) 6-19-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (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.

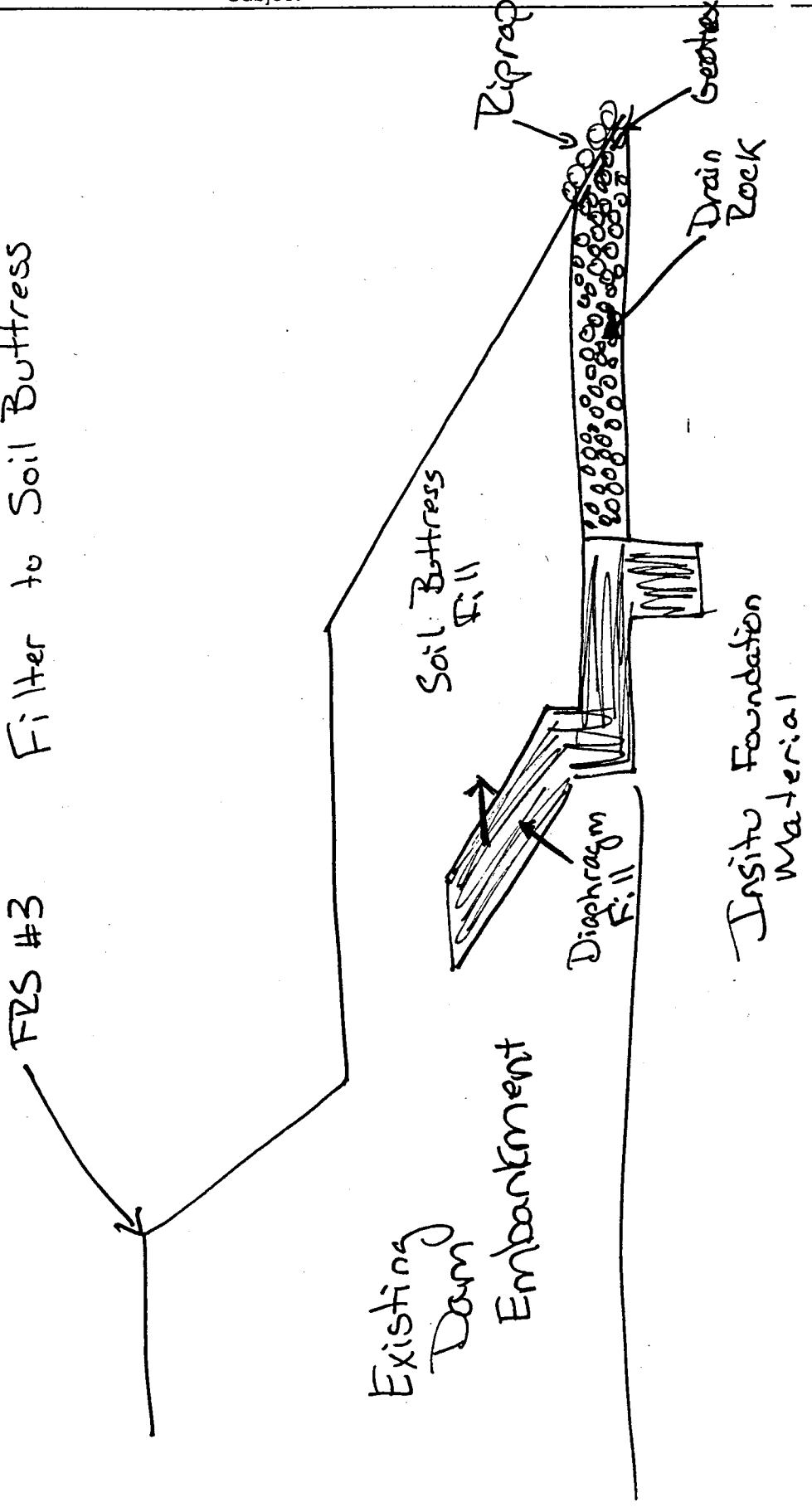
Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 2/5
Calc. No.
Rev. No.
By BKW Date 6/7/00
Chk'd. Date

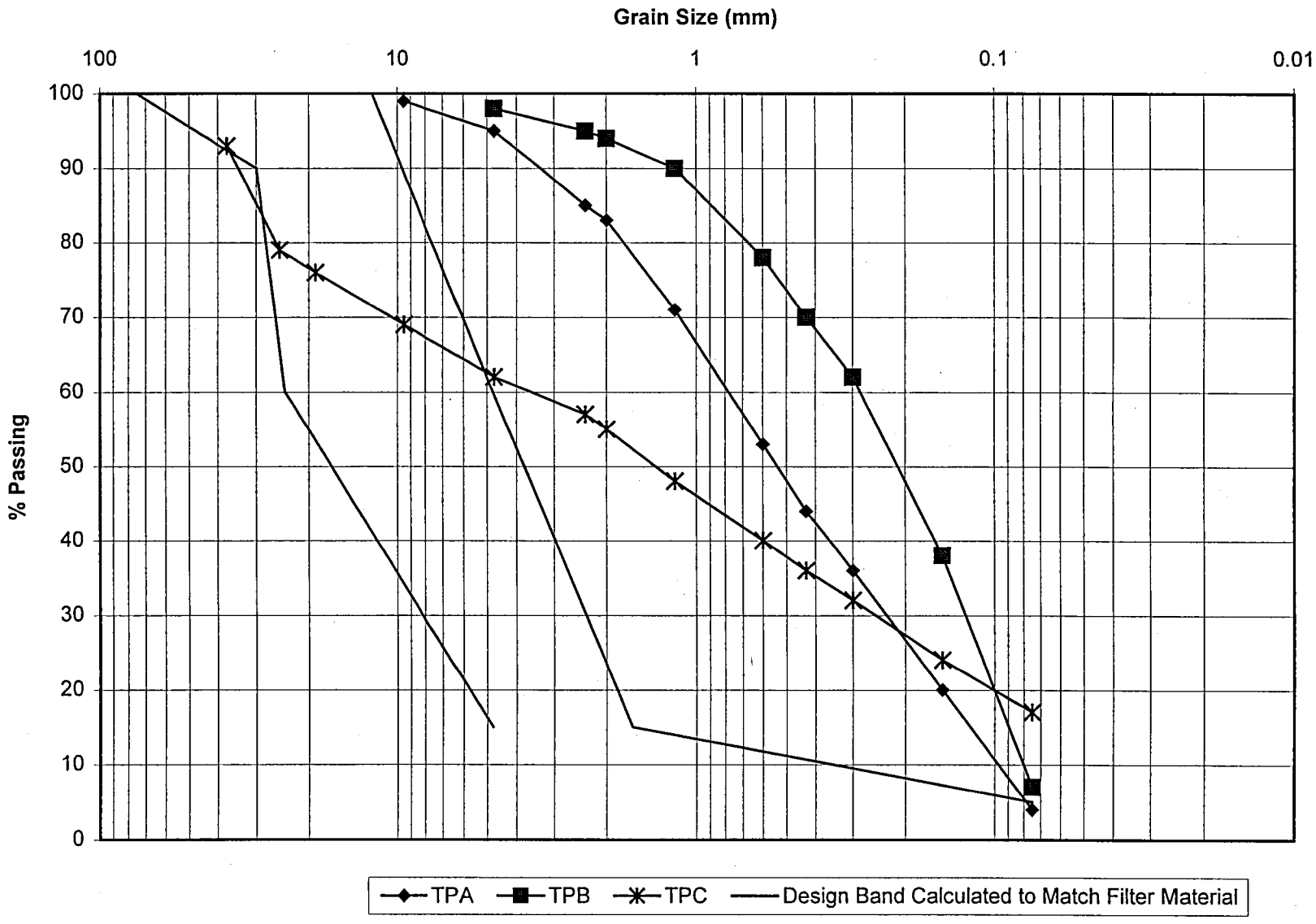
Job No. Job
Client Subject



F-132(7/91)

4/5

White Tanks FRS #3
Interim Dam Safety
15448-007-058



P:\15448\007\03DamSafety\Calcs\Filter Calcs.xls,Filter-Buttress Chart

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT: _____

SHEET 1 OF 10

Filter to Drain Match

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #6

CALCULATIONS/DOCUMENT BY: Bonnie Whitley

PRINT NAME

Bonnie Whitley — 6/12/00

SIGNATURE — DATE

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: A.W. GOURLAY

PRINT NAME

A.W. Gourlay — 7-27-00

SIGNATURE — DATE

CALCULATIONS/DOCUMENT CHECKED BY: Jian Liu

PRINT NAME

Jian Liu — 6/19/00

SIGNATURE — DATE

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY

PRINT NAME

A.W. Gourlay — 7-27-00

SIGNATURE — 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

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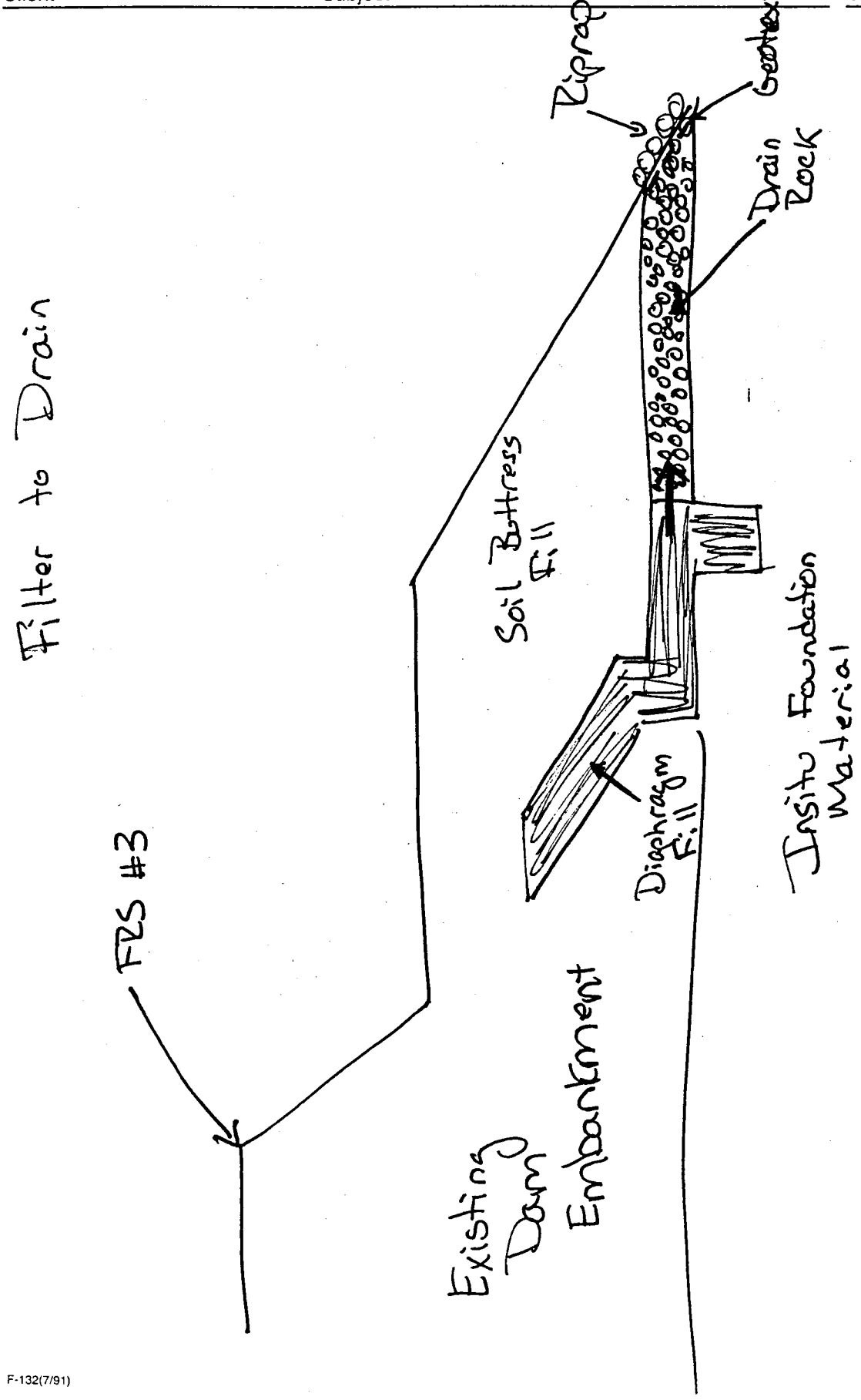
Sheet No. 2/10
Calc. No.
Rev. No.
By BKW Date 6/12/00
Chk'd. Date

Job No. Job
Client Subject



F-132(7/91)

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Sheet No. 4\10
Calc. No.
Rev. No.

Job No. 15448-007-058 Job White Tanks Dam Safety
By BKW Date 6/12/00
Client Subject Filter → Drain Match
Chk'd. JWL Date 6-19-00

Step 1: Plot gradation curve of base soil.

See Sheet 9

Step 2: Does base soil need to be regraded? (Particles larger than No. 4 sieve?)

Yes → go to step 3

Step 3: Regrade Base Soil

Correction Factor = $\frac{100}{95}$

Only coarse side of C33 fine aggregate gradation band requires regrading. See Sheet 9 for plot.

Step 4: Determine Base Soil Category according to Table 26-1

% Passing No 200 sieve is <15

therefore category 4

Step 5: Determine Max D.5 according to Table 26-2

Max D.5 ≤ 4 x d85 of soil after regrading

Max D.5 ≤ 4(1.2mm)

Max D.5 ≤ 4.8mm

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Sheet No. 6/10
Calc. No.
Rev. No.
Job No. 15448-007-058 Job White Tanks Dam Safety By BKW Date 6/12/00
Client Subject Filter & Drain Match Chk'd. JWL Date 6-19-00

Min D_{60} = $\frac{24mm}{5}$ = 4.8mm

Step 9: Determine Min D_5 and Max D_{100} according to Table 26-5

Min D_5 = 0.075mm

Max D_{100} = 75 mm

Step 10: Determine Max D_{10} according to Table 26-6

Min D_{10} = $\frac{\text{Min } D_5}{1.2}$

Min D_{10} = $\frac{1.64mm}{1.2}$

Min D_{10} = 1.4mm

Therefore Max D_{10} = 30mm

Step 11: Connect control points to form partial band. (See sheet 7) Complete design by extrapolating both sides to 100% passing.

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White Tanks FRS #3
Interim Dam Safety
Filter - Drain Calc

Design Drain Gradation			
Grain Size (mm)	% Passing - Coarse	Grain Size (mm)	% Passing - Fine
75	100	12.10598134	99.8
30	90	4.8	60
24	60	1.64	15
4.8	15	0.075	5

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C33 Fine Aggregate				C33 Fine Aggregate - Regraded			
Grain Size (mm)	% Passing Coarse	Grain Size (mm)	% Passing Fine	Grain Size (mm)	% Passing Coarse	Grain Size (mm)	% Passing Fine
9.5	100	2.36	100	4.75	100	2.36	100
4.75	95	1.18	85	2.36	84	1.18	85
2.36	80	0.6	60	1.18	53	0.6	60
1.18	50	0.3	30	0.6	26	0.3	30
0.6	25	0.15	10	0.3	5	0.15	10
0.3	5			0.15	0		
0.15	0						

Step 6: If permeability is a requirement (see section 633.2602), **determine the minimum allowable D_{15} in accordance with table 26-3.** Note: The permeability requirement is determined from the d_{15} size of the base soil gradation before regrading.

Step 7: The width of the allowable filter design band must be kept relatively narrow to prevent the use of possibly gap-graded filters. Adjust the maximum and minimum D_{15} sizes for the filter band determined in steps 5 and 6 so that the ratio is 5 or less at any given percentage passing of 60 or less. Criteria are summarized in table 26-4.

Table 26-1 Regraded gradation curve data

Base soil category	% finer than No. 200 sieve (0.075 mm) (after regrading, where applicable)	Base soil description
1	> 85	Fine silt and clays
2	40 – 85	Sands, silts, clays, and silty & clayey sands
3	15 – 39	Silty & clayey sands and gravel
4	< 15	Sands and gravel

Table 26-2 Filtering criteria — Maximum D_{15}

Base soil category	Filtering criteria
1	$\leq 9 \times d_{85}$ but not less than 0.2 mm
2	≤ 0.7 mm
3	$\leq \left(\frac{40-A}{40-15}\right)\left[\left(4\times d_{85}\right)-0.7\text{mm}\right]+0.7\text{mm}$ A = % passing #200 sieve after regrading (If $4 \times d_{85}$ is less than 0.7 mm, use 0.7 mm)
4	$\leq 4 \times d_{85}$ of base soil after regrading

This step is required to avoid the use of gap-graded filters. The use of a broad range of particle sizes to specify a filter gradation could result in allowing the use of gap-graded (skip-graded) materials. These materials have a grain size distribution curve with sharp breaks or other undesirable characteristics. Materials that have a broad range of particle sizes may also be susceptible to segregation during placement. The requirements of step 9 should prevent segregation, but other steps are needed to eliminate the use of any gap-graded filters.

Gap-graded materials generally can be recognized by simply looking at their grain size distribution curve. However, for specification purposes, more precise controls are needed. In designing an acceptable filter band using the preliminary control points obtained in steps 1 through 6, the following additional requirements should be followed to decrease the probability of using a gap-graded filter.

Table 26-3 Permeability criteria

Base soil category	Minimum D_{15}
All categories	$\geq 4 \times d_{15}$ of the base soil before regrading, but not less than 0.1 mm

Table 26-4 Other filter design criteria

Design element	Criteria
To prevent gap-graded filters	The width of the designed filter band should be such that the ratio of the maximum diameter to the minimum diameter at any given percent passing value ≤ 60% is ≤ 5.
Filter band limits	Coarse and fine limits of a filter band should each have a coefficient of uniformity of 6 or less.

Step 10: To minimize segregation during construction, the relationship between the maximum D_{90} and the minimum D_{10} of the filter is important. Calculate a preliminary minimum D_{10} size by dividing the minimum D_{15} size by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Determine the maximum D_{90} using table 26-6. Label this as Control point 7.

Sand filters that have a D_{90} less than about 20 mm generally do not require special adjustments for the broadness of the filter band. For coarser filters and gravel zones that serve both as filters and drains, the ratio of D_{90}/D_{10} should decrease rapidly with increasing D_{10} sizes.

Step 11: Connect Control points 4, 2, and 5 to form a partial design for the fine side of the filter band. Connect Control points 6, 7, 3, and 1 to form a design for the coarse side of the filter band. This results in a preliminary design for a filter band. Complete the design by extrapolating the coarse and fine curves to the 100 percent finer value. For purposes of writing specifications, select appropriate sieves and corresponding percent finer values that best reconstruct the design band and tabulate the values.

Step 12: Design filters adjacent to perforated pipe to have a D_{85} size no smaller than shown in table 26-7. For critical structure drains where rapid gradient reversal (surging) is probable, it is recommended that the D_{15} size of the material surrounding the pipe be no smaller than the perforation size.

Additional design considerations: Note that these steps provide a filter band design that is as well graded as possible and still meets criteria. This generally provides the most desirable filter characteristics. However, in some cases a more poorly graded filter band may be preferable; for example, if more readily available standard gradations are needed or where onsite filters are used for economy.

The design filter band obtained in steps 1 through 12 may be adjusted to a steeper configuration in such cases. The width of the filter band should be maintained so that the ratio of the maximum diameters to the minimum diameters at a given percent finer is no greater than 5 below the 60 percent finer value.

Only the portion of the design filter band above the previously established minimum and maximum D_{15} sizes should be adjusted. The design band may be adjusted so that the coefficients of uniformity of both the coarse and fine sides of the design band are less than 6, but not less than 2, to prevent use of very poorly graded filters.

Table 26-6 Segregation criteria

Base soil category	If D_{10} is :	Then maximum D_{90} is:
	(mm)	(mm)
All categories	< 0.5	20
	0.5 – 1.0	25
	1.0 – 2.0	30
	2.0 – 5.0	40
	5.0 – 10	50
	> 10	60

Table 26-7 Criteria for filters used adjacent to perforated collector pipe

Noncritical drains where surging or gradient reversal is *not* anticipated	The filter D_{85} must be greater than or equal to the perforation size
Critical drains where surging or gradient reversal is anticipated	The filter D_{15} must be greater than or equal to the perforation size.

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CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT: _____

SHEET 1 OF 9

Foundation to Filter Match

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #7

CALCULATIONS/DOCUMENT BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 6/7/00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

Jian Liu (SIGNATURE) 6-29-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (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.

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INITIALS

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Job No. | Job
Client | Subject

Sheet No. 2/9
Calc. No.
Rev. No.
By | Date
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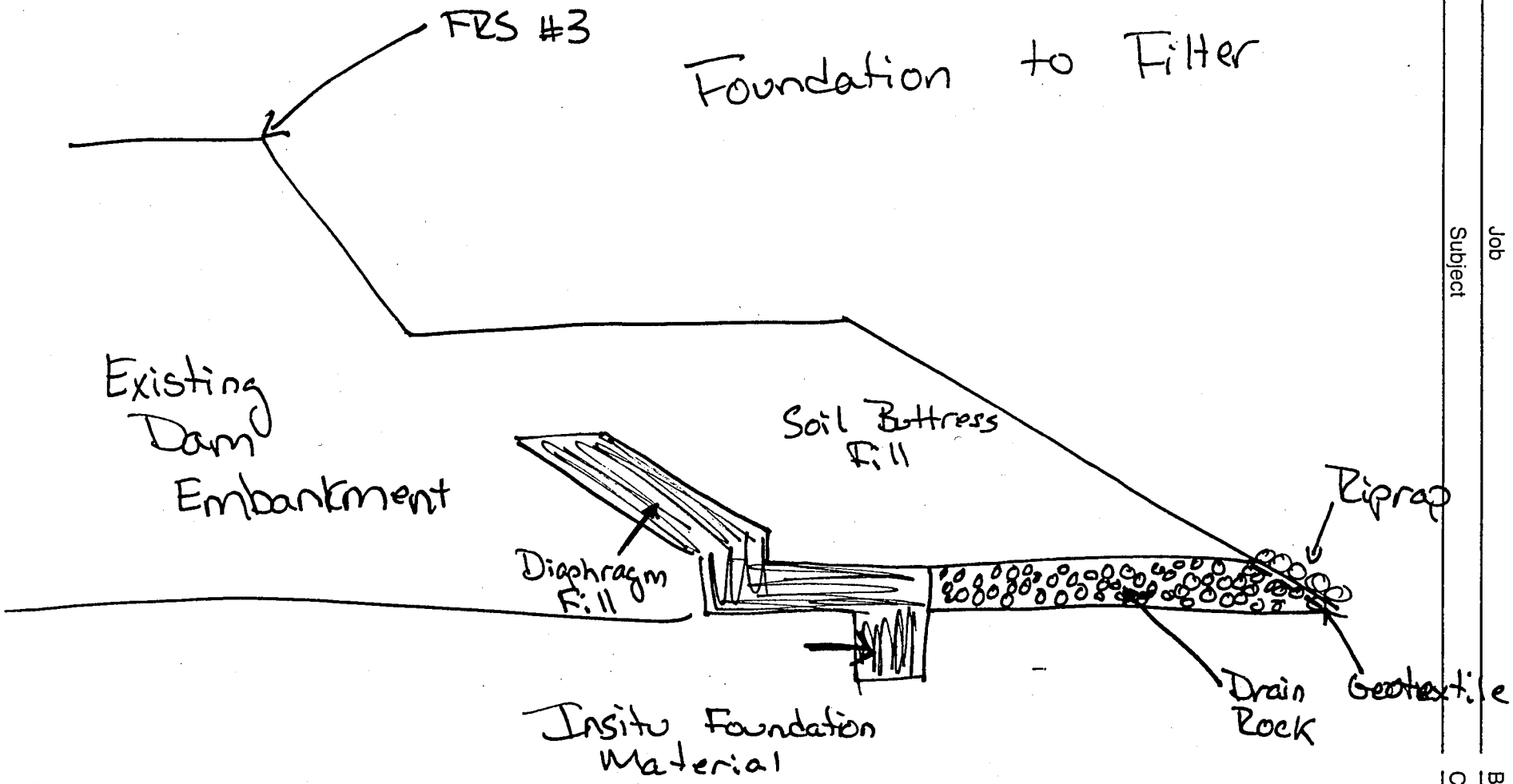

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Base Soil Category = 4
since % Passing No 200 = 14.3

Step 5: Determine Max D_{15} according to Table 26-2

Max $D_{15} \leq 4 \times d_{85}$ of base soil after regradin

Max $D_{15} \leq 4(2.7\ mm)$

Max $D_{15} \leq 10.8\ mm$

Step 6: Determine Min D_{15} according to Table 26-3

Min $D_{15} \geq 4 \times d_{15}$ of base soil before regrading

Min $D_{15} \geq 4(0.11\ mm)$

Min $D_{15} \geq 0.44\ mm$

Step 7: Adjust Max D_{15} + Min D_{15} so that ratio is ≤ 5

$$\frac{\text{Max } D_{15}}{\text{Min } D_{15}} = \frac{10.8}{0.44} = 24.5$$

Locate design band at Min D_{15} side since filtering is most important function.

$$\frac{\text{Max } D_{15}}{0.44\ mm} = 5$$

$$\text{Min } D_{10} = \frac{\text{Min } D_{15}}{1.2}$$

$$\text{Min } D_{10} = \frac{0.44\text{mm}}{1.2} = 0.37\text{mm}$$

Therefore Max D_{90} = 20mm

Step 11: Connect control points to form partial band (See Sheet 7) Complete design by ~~cop~~ extrapolating both sides to 100% passing.

Conclusion: The filter material (C33 fine sand) is finer than the design band. Therefore, foundation material will not migrate ~~from~~ into the filter.

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Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine	Grain Size (mm)	C33 - Coarse	Grain Size (mm)	C33 - Fine
75	100	10.13911386	100	9.5	100	2.36	100
20	90	2.2	60	4.75	95	1.18	85
10.8	60	0.44	15	2.36	80	0.6	60
2.2	15	0.075	5	1.18	50	0.3	30
				0.6	25	0.15	10
				0.3	5		
				0.15	0		

633.2602 Permeability and capacity

The laboratory filter study clearly demonstrated that graded filters designed in accordance with these criteria will seal a crack. The sealing begins when water flows through a crack or opening and carries soil particles eroded from the sides of the openings. Eroding soil particles collect on the face of the filter and seal the crack at the interface. Any subsequent flow is through the pores of the soil. If filters are designed to intercept cracks, the permeability required of the filter zone should be based on the steady state seepage flow through the pores of the base soil alone. The hydraulic capacity of any cracks need not be considered in designing the filter because the cracks have been shown to seal.

Where saturated steady-state seepage flow will not develop, for instance in dry dams for flood control having a normal drawdown time of 10 days or less, filter capacity need only be nominal. Filters designed either to protect against steady state seepage or internal erosion through cracks are to be thick enough to compensate for potential segregation and contamination of the filter zones during construction. They must also be thick enough that cracks cannot extend through the filter zone during any possible differential movements.

A zone of coarser materials immediately downstream or below the filter, or both, provides additional capacity to collect and convey seepage to a controlled outlet. In some cases a strip drain is used, and in others a perforated collector pipe is employed to outlet the collected seepage. To prevent movement of the filter materials into the coarse drain materials, the coarse drain materials must be designed for the proper gradation using procedures in this subchapter. Perforations in collector pipes must also be sized properly to prevent movement of the coarse drain materials into the perforations.

633.2603 Determining filter gradation limits

Determine filter gradation limits using the following steps:

Step 1: Plot the gradation curve (grain-size distribution) of the base soil material. Use enough samples to define the range of grain sizes for the base soil or soils. Design the filter using the base soil that requires the smallest D_{15} size for filtering purposes. Base the design for drainage purposes on the base soil that has the largest D_{15} size.

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than No. 4 sieve).

Step 3: Prepare adjusted gradation curves for base soils that have particles larger than the No. 4 (4.75 mm) sieve.

- Obtain a correction factor by dividing 100 by the percent passing the No. 4 (4.75 mm) sieve.
- Multiply the percentage passing each sieve size of the base soil smaller than No. 4 (4.75 mm) sieve by the correction factor determined above.
- Plot these adjusted percentages to obtain a new gradation curve.
- Use the adjusted curve to determine the percentage passing the No. 200 (0.075 mm) sieve in step 4.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26–1.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter in accordance with the table 26–2.

If desired, the maximum D_{15} may be adjusted for certain noncritical uses of filters where significant hydraulic gradients are not predicted, such as bedding beneath riprap and concrete slabs. For fine clay base soil that has d_{85} sizes between 0.03 and 0.1 mm, a maximum D_{15} of ≤ 0.5 mm is still conservative. For fine-grained silt that has low sand content, plotting below the "A" line, a maximum D_{15} of 0.3 mm may be used.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26–5. Label as Control points 5 and 6, respectively.

Table 26–5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

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CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT: _____

SHEET 1 OF 5

Filter to Foundation Match

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #8

CALCULATIONS/DOCUMENT BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 6/7/00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

Jian Liu (SIGNATURE) 6-19-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (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.

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INITIALS

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Job No. Job
Client Subject

Sheet No. 215
Calc. No.
Rev. No.
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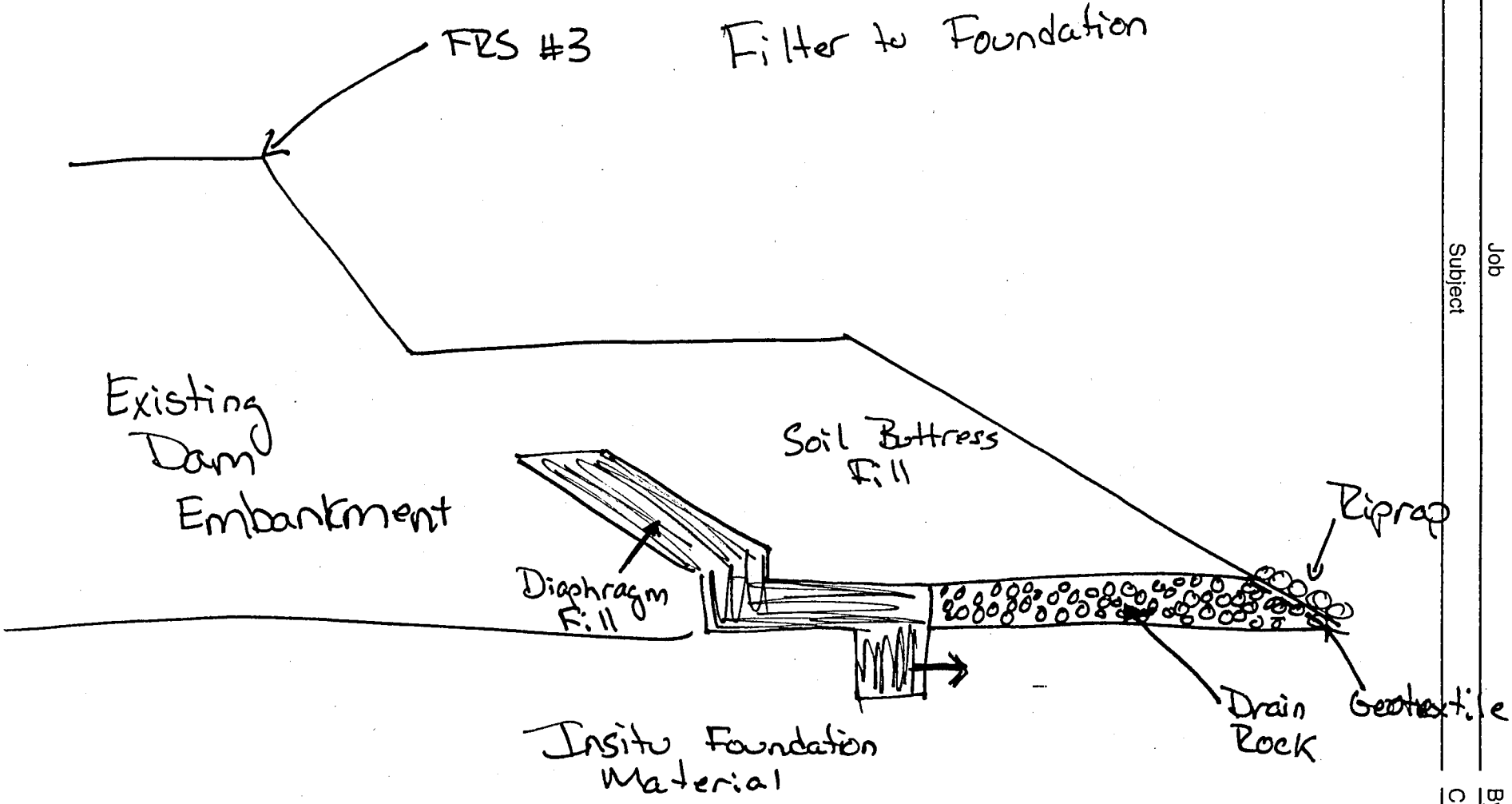
Chk'd. Date



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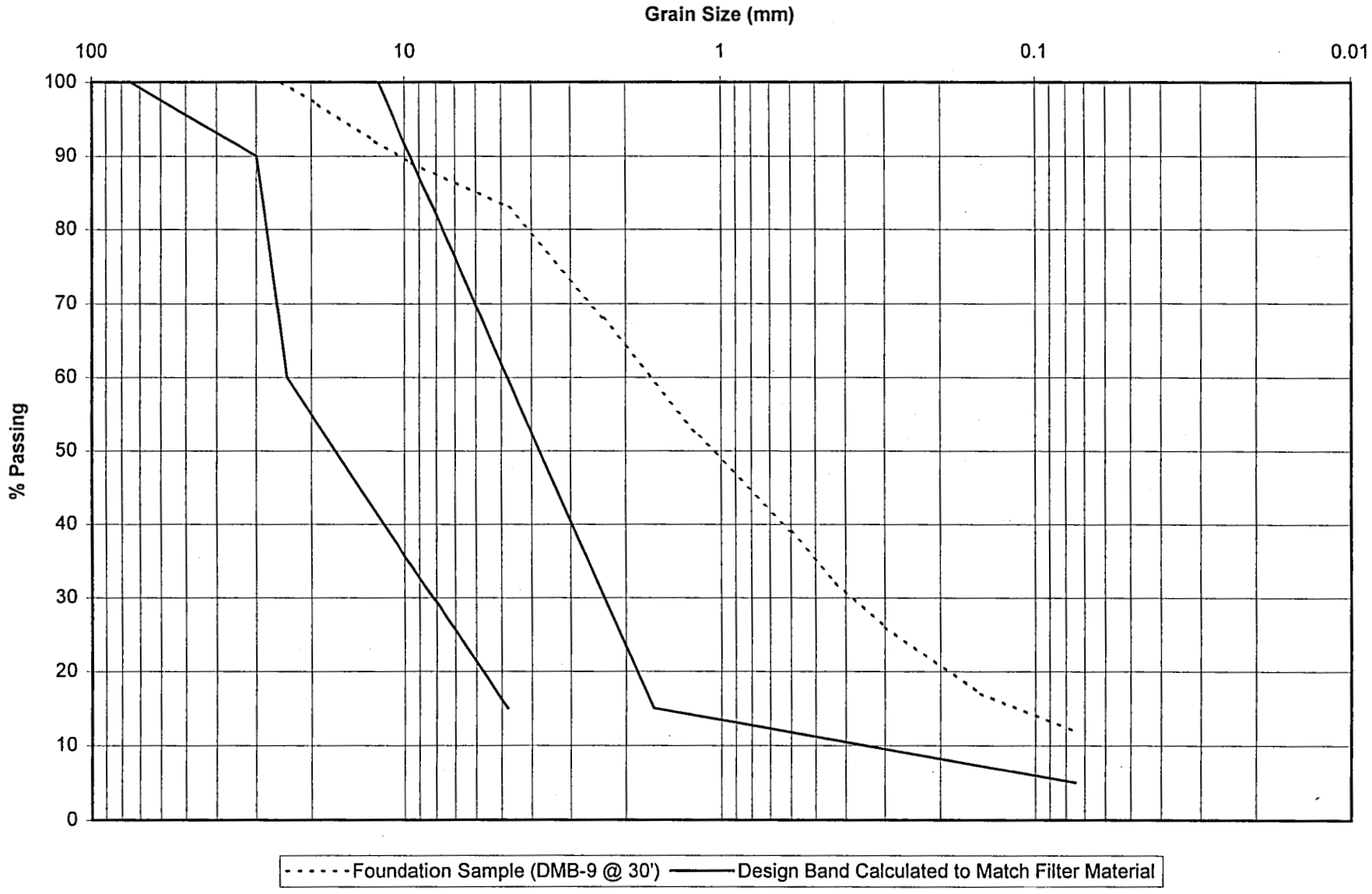
White Tanks FRS #3
Interim Dam Safety
15448-007-058
Filter to Foundation Match



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DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15418-007-058

SUBJECT:

SHEET 1 OF 152

Soil Buttress to Drain Match

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #9

CALCULATIONS/DOCUMENT BY:

Bonnie Whitley

PRINT NAME

Bonnie Whitley

SIGNATURE

6/12/00

DATE

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL:

A.W. GOURLAY

PRINT NAME

A.W. Gourlay

SIGNATURE

7-27-00

DATE

CALCULATIONS/DOCUMENT CHECKED BY:

Jian W. Liu

PRINT NAME

Jian Liu

SIGNATURE

7-7-00

DATE

APPROVED BY:
(PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM)

A.W. GOURLAY

PRINT NAME

A.W. Gourlay

SIGNATURE

7-27-00

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
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INITIALS

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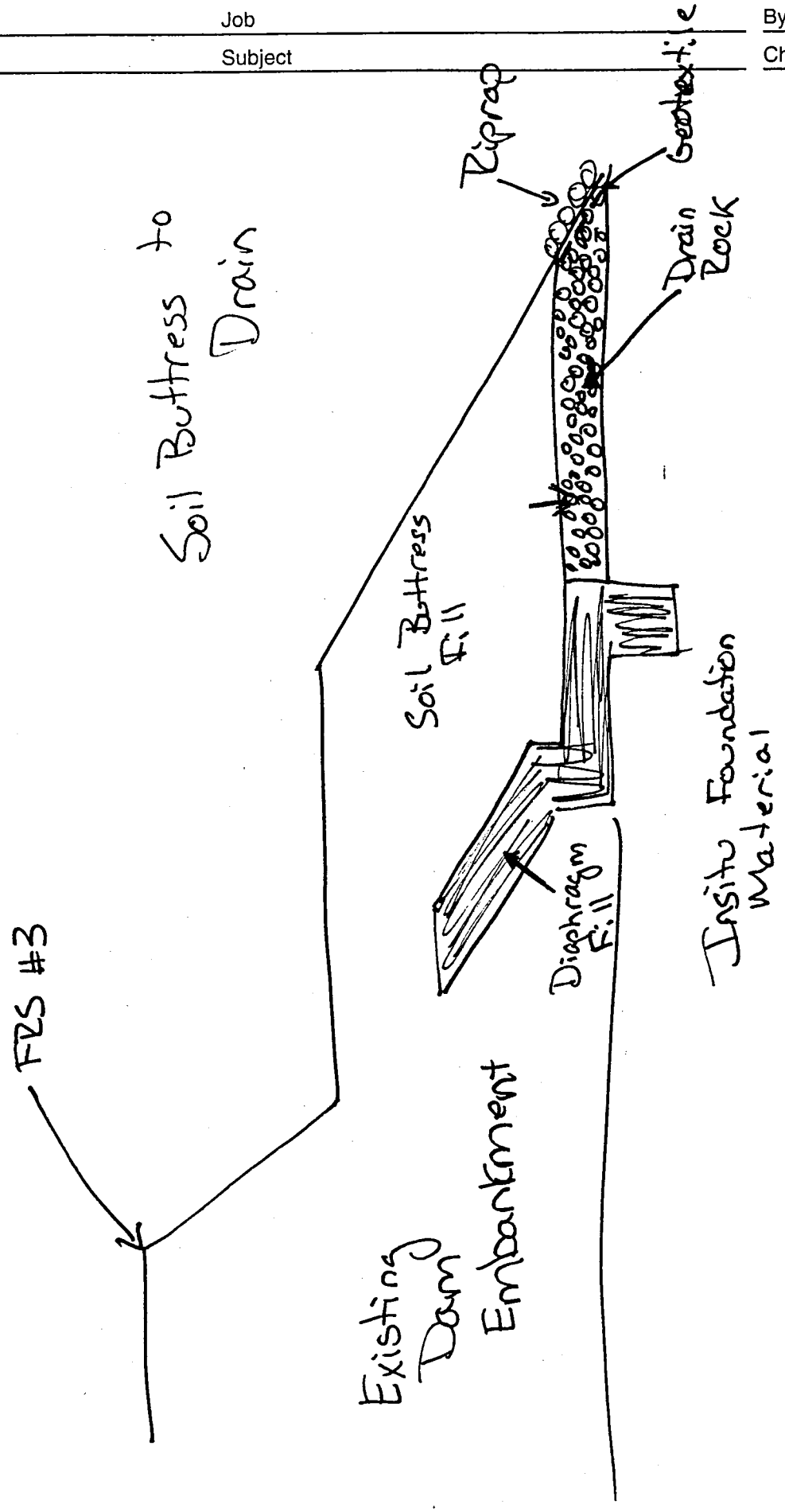
Sheet No. 2215
Calc. No.
Rev. No.

Job No.	Job	By	Date
Client	Subject	Chk'd.	Date



F-132(7/91)

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Sheet No. 4|15
Calc. No.
Rev. No.

Job No. 15448-007-058 Job White Tanks Dam Safety By BKW Date 6/12/00
Client Subject Soil Buttress → Drain Chk'd JWL Date 7-7-00

Step 1: Plot base soil (soil buttress) gradations.

See Sheet 13

Step 2: Do samples need to be regraded? (Particles larger than No. 4 sieve)

Yes → go to Step 3

Step 3: Regrade soil samples

$$\text{Correction Factor} = \frac{100}{\%\ \text{Passing No. 4 sieve}}$$

Sample	Correction Factor
TPA	$\frac{100}{95}$
TPB	$\frac{100}{98}$
TBC	$\frac{100}{62}$

See Sheet 10 for plot

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$$\frac{3.2mm}{\text{Min } D_{15}} = 5$$

Min D_{15} = 0.64 mm

Step 8: Adjust band so that the sides have a coefficient of uniformity of 6 or less

$$\text{Max } D_{10} = \frac{\text{Max } D_{15}}{1.2}$$

$$\text{Max } D_{10} = \frac{3.2mm}{1.2} = 2.7mm$$

Max D_{60} = 6 x Max D_{10}

Max D_{60} = 6(2.7mm) = 16.2 mm

$$\text{Min } D_{60} = \frac{\text{Max } D_{60}}{5}$$

$$\text{Min } D_{60} = \frac{16.2mm}{5} = 3.2mm$$

Step 9: Determine Min D_5 and Max D_{100} according to Table 26-5

Min D_5 = 0.075 mm

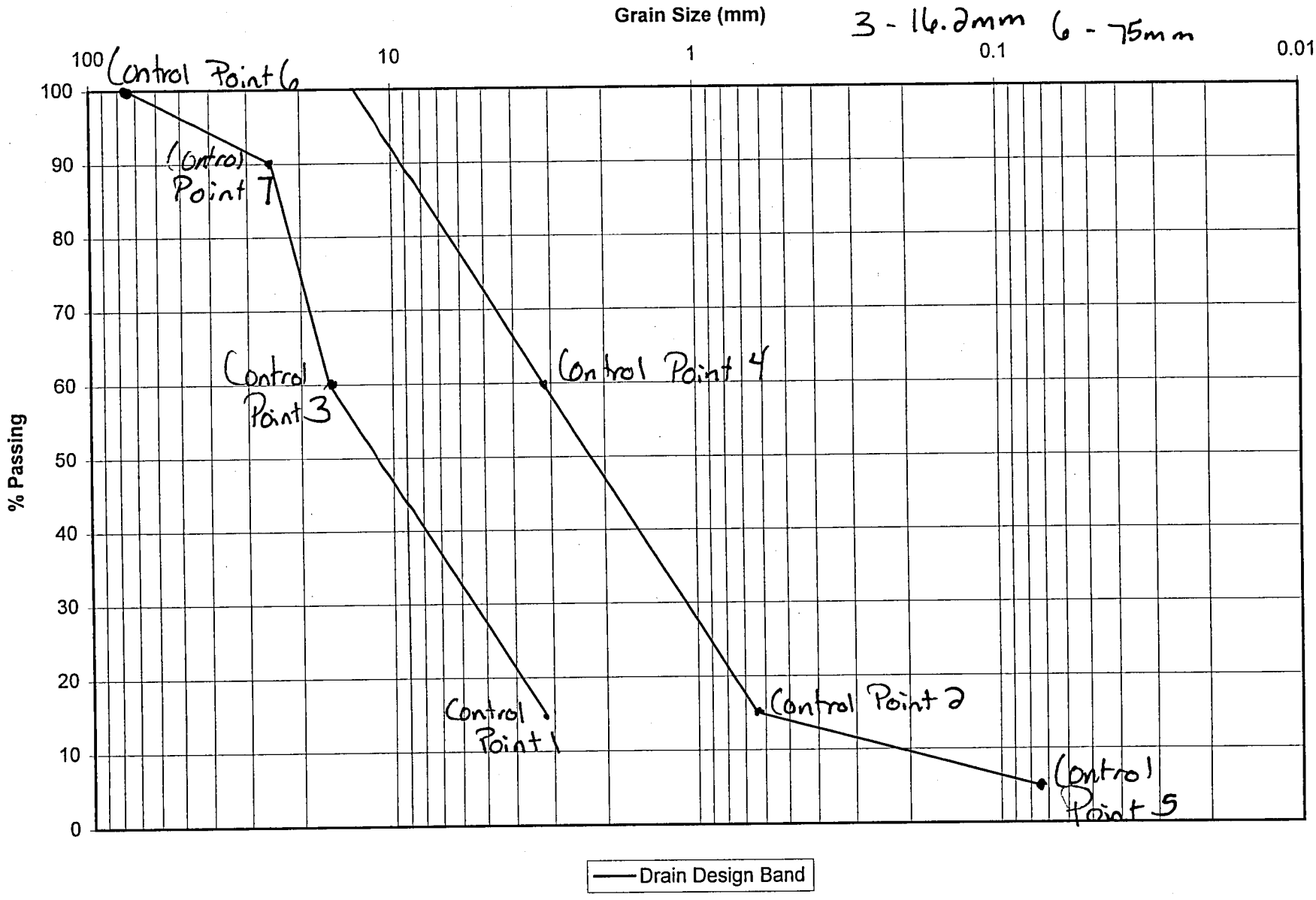
Max D_{100} = 75 mm

8/15

White Tanks FRS #3
Interim Dam Safety
15448-007-058

Control Points

1 - 3.2mm 4 - 3.2mm 7 - 25mm
2 - 0.64mm 5 - 0.075mm
3 - 16.2mm 6 - 75mm



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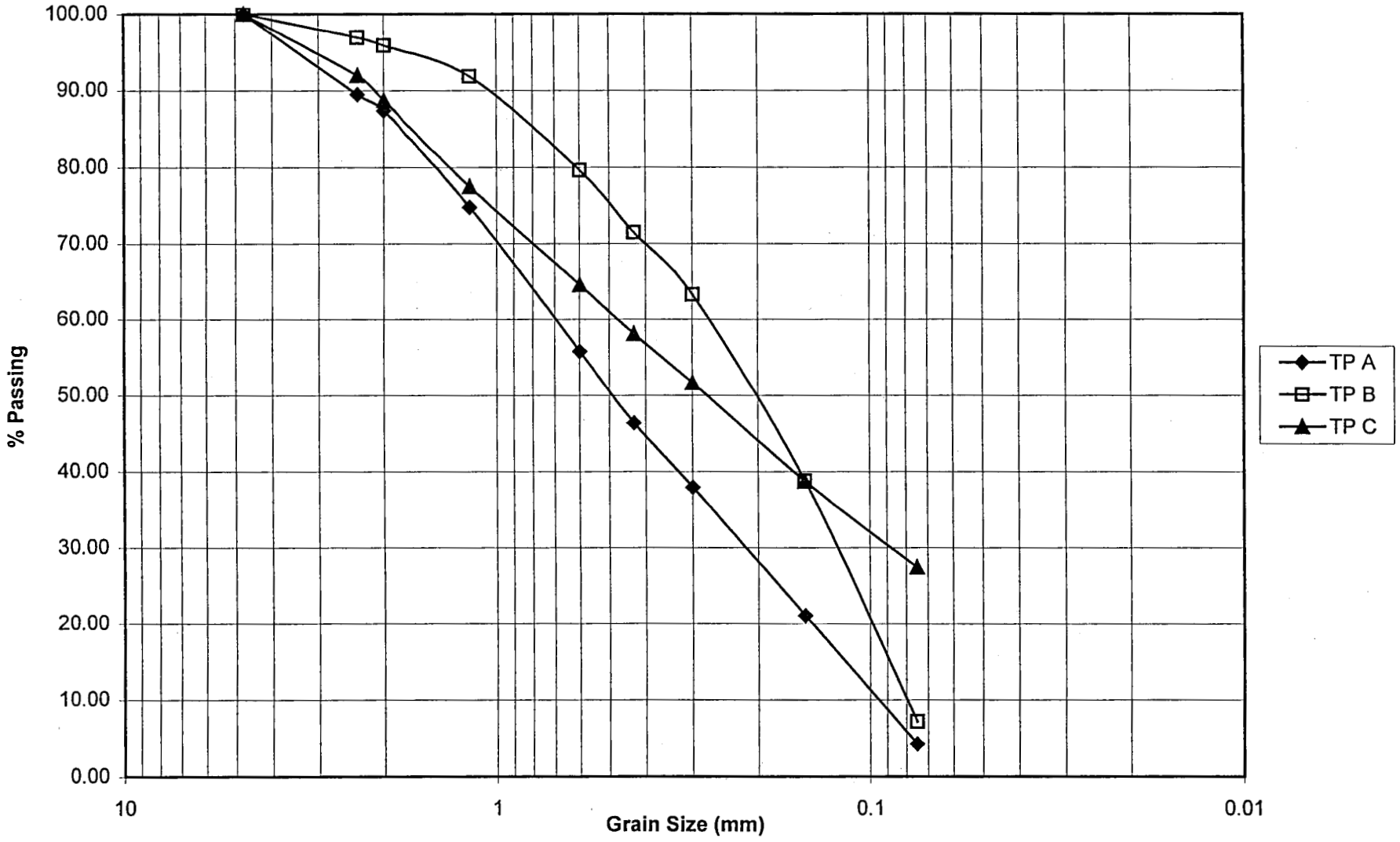
10/15

Spillway Corrected Gradations



P:\15448\007\03DamSafety\Filter Calcs.xls,Spillway Gradation Chart

5/16

Base Soil Corrected Gradati

TP A

	Sieve	% Passing	Corrected % Passing
4.75	#4	95	=C5*(100/95)
2.36	#8	85	=C6*(100/95)
2	#10	83	=C7*(100/95)
1.18	#16	71	=C8*(100/95)
0.6	#30	53	=C9*(100/95)
0.43	#40	44	=C10*(100/95)
0.3	#50	36	=C11*(100/95)
0.15	#100	20	=C12*(100/95)
0.075	#200	4	=C13*(100/95)

Correction F

TP B

Sieve	% Passing	Corrected % Passing
#4	98	=G5*(100/98)
#8	95	=G6*(100/98)
#10	94	=G7*(100/98)
#16	90	=G8*(100/98)
#30	78	=G9*(100/98)
#40	70	=G10*(100/98)
#50	62	=G11*(100/98)
#100	38	=G12*(100/98)
#200	7	=G13*(100/98)

Correction

TP C

Sieve	% Passing	Corrected % Passing
#4	62	=C19*(100/62)
#8	57	=C20*(100/62)
#10	55	=C21*(100/62)
#16	48	=C22*(100/62)
#30	40	=C23*(100/62)
#40	36	=C24*(100/62)
#50	32	=C25*(100/62)
#100	24	=C26*(100/62)
#200	17	=C27*(100/62)

Correction F

14/15

White Tanks FRS #3
Interim Dam Safety
15448-007-058
Soil Buttress - Drain Calc

Drain Design Band			
Grain Size (mm)	% Passing - Coarse	Grain Size (mm)	% Passing - Fine
75	100	13.24342	100
25	90	3.2	60
16.2	60	0.64	15
3.2	15	0.075	5

Proposed Soil Buttress Gradation			Sieve
75	100		3 in
25	90	100	1 in
12.5	55	100	1/2 in
4.75	28	70	#4
1.18	0	28	#16
0.6		13	#30
0.3		10	#50
0.15		7	#100
0.075		5	#200

633.2602 Permeability and capacity

The laboratory filter study clearly demonstrated that graded filters designed in accordance with these criteria will seal a crack. The sealing begins when water flows through a crack or opening and carries soil particles eroded from the sides of the openings. Eroding soil particles collect on the face of the filter and seal the crack at the interface. Any subsequent flow is through the pores of the soil. If filters are designed to intercept cracks, the permeability required in the filter zone should be based on the steady state seepage flow through the pores of the base soil alone. The hydraulic capacity of any cracks need not be considered in designing the filter because the cracks have been shown to seal.

Where saturated steady-state seepage flow will not develop, for instance in dry dams for flood control having a normal drawdown time of 10 days or less, filter capacity need only be nominal. Filters designed either to protect against steady state seepage or internal erosion through cracks are to be thick enough to compensate for potential segregation and contamination of the filter zones during construction. They must also be thick enough that cracks cannot extend through the filter zone during any possible differential movements.

A zone of coarser materials immediately downstream or below the filter, or both, provides additional capacity to collect and convey seepage to a controlled outlet. In some cases a strip drain is used, and in others a perforated collector pipe is employed to outlet the collected seepage. To prevent movement of the filter materials into the coarse drain materials, the coarse drain materials must be designed for the proper gradation using procedures in this subchapter. Perforations in collector pipes must also be sized properly to prevent movement of the coarse drain materials into the perforations.

633.2603 Determining filter gradation limits

Determine filter gradation limits using the following steps:

Step 1: Plot the gradation curve (grain-size distribution) of the base soil material. Use enough samples to define the range of grain sizes for the base soil or soils. Design the filter using the base soil that requires the smallest D_{15} size for filtering purposes. Base the design for drainage purposes on the base soil that has the largest D_{15} size.

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than No. 4 sieve).

Step 3: Prepare adjusted gradation curves for base soils that have particles larger than the No. 4 (4.75 mm) sieve.

- Obtain a correction factor by dividing 100 by the percent passing the No. 4 (4.75 mm) sieve.
- Multiply the percentage passing each sieve size of the base soil smaller than No. 4 (4.75 mm) sieve by the correction factor determined above.
- Plot these adjusted percentages to obtain a new gradation curve.
- Use the adjusted curve to determine the percentage passing the No. 200 (0.075 mm) sieve in step 4.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26-1.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter in accordance with the table 26-2.

If desired, the maximum D_{15} may be adjusted for certain noncritical uses of filters where significant hydraulic gradients are not predicted, such as bedding beneath riprap and concrete slabs. For fine clay base soil that has d_{85} sizes between 0.03 and 0.1 mm, a maximum D_{15} of ≤ 0.5 mm is still conservative. For fine-grained silt that has low sand content, plotting below the "A" line, a maximum D_{15} of 0.3 mm may be used.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26-5. Label as Control points 5 and 6, respectively.

Table 26-5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26–5. Label as Control points 5 and 6, respectively.

Table 26–5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT: _____

SHEET 1 OF 9

Foundation to Drain Match

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #10

CALCULATIONS/DOCUMENT BY: Bonnie Whitley (PRINT NAME)

Bonnie Whitley (SIGNATURE) 7/3/00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

Jian Liu (SIGNATURE) 7-7-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY (PRINT NAME)

A.W. Gourlay (SIGNATURE) 7-27-00 (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.

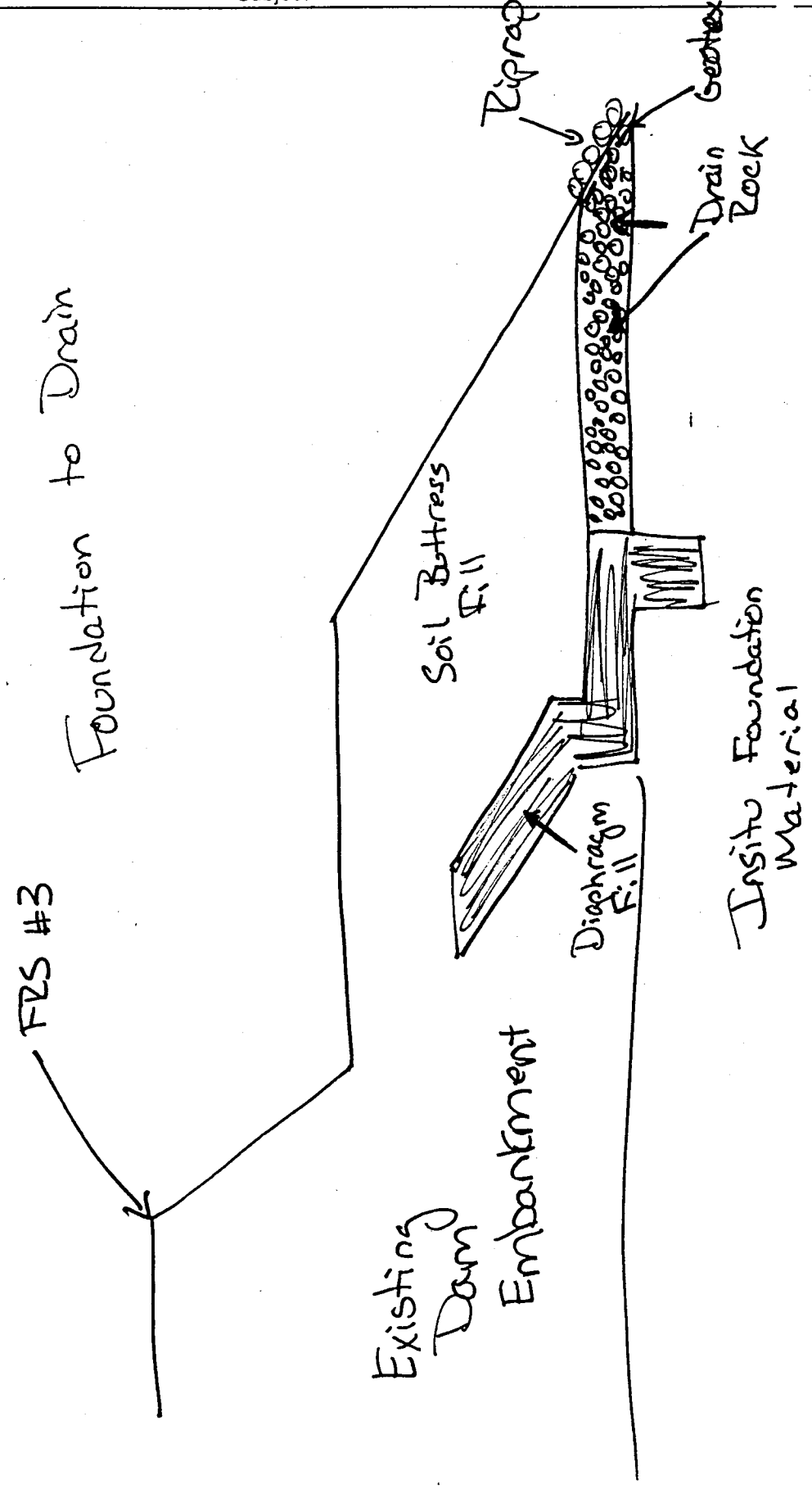
Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4				

INITIALS

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 21 of 9
Calc. No.
Rev. No.
By BKW Date 6/28/00
Chk'd. Date

Job No. Job
Client Subject



F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 4|9
Calc. No.
Rev. No.
Job No. 15448-007-058 Job White Tanks Dam Safety
By BKW Date 7/8/00
Client Subject Foundation → Drain
Chk'd. JWL Date 7-7-00

Step 1: Plot gradation curve of base soil.

See 9 sheet

Step 2: Does base soil contain gravel (larger than No. 4 sieve)?

Yes → go to Step 3

Step 3: Prepare adjusted gradation curves.

$$\text{Correction Factor} = \frac{100}{\%\ \text{Passing No. 4 sieve}} = \frac{100}{83}$$

see sheet 9 for adjusted curve

Step 4: Determine base soil category based on Table 26-1

Base Soil Category = 4
since % Passing No. 200 = 14.3

Step 5: Determine Max D_{15} according to Table 26-2

Max $D_{15} \leq 4 \times d_{85}$ of base soil after regrading

Max $D_{15} \leq 4(2.7\text{mm})$

Max $D_{15} \leq 10.8\text{mm}$

F-132(7/91)

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Sheet No. 6/9
Calc. No.
Rev. No.
Job No. 15448-007-058 Job White Tanks Dam Safety
Client Subject Foundation & Drain
By BKW Date 7/7/00
Chk'd JWL Date 7-7-00

Max D_{60} = 6 x Max D_{10}

Max D_{60} = 6 (9mm) = 54mm

Min D_{60} = $\frac{\text{Max } D_{60}}{5}$

Min D_{60} = $\frac{54mm}{5}$ = 10.8mm

Step 9: Determine Min D_{15} and Max D_{100} according to Table 26-5

Min D_5 = 0.075mm

Max D_{100} = 75mm

Step 10: Determine Max D_{50} according to Table 26-6

Min D_{10} = $\frac{\text{Min } D_{15}}{1.2}$

Min D_{10} = $\frac{2.2mm}{1.2}$ = 1.8mm

Therefore Max D_{50} = 30mm

Step 11: Connect the control points to form partial band (see sheet 7) Complete design by extrapolating both sides to 100% passing.

F-132(7/91)

White Tanks FRS #3
Interim Dam Safety
Foundation - Drain Calc

Drain Design				Sample of 5/16 minus	
Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine	Grain Size	% Passing
75	100	35.48134	100	9.5	100
30	90	10.8	60	6.25	88.7
54	60	2.1	15	4.75	55
10.8	15	0.075	5	2.36	6.7
				0.075	0.2

633.2602 Permeability and capacity

The laboratory filter study clearly demonstrated that graded filters designed in accordance with these criteria will seal a crack. The sealing begins when water flows through a crack or opening and carries soil particles eroded from the sides of the openings. Eroding soil particles collect on the face of the filter and seal the crack at the interface. Any subsequent flow is through the pores of the soil. If filters are designed to intercept cracks, the permeability required in the filter zone should be based on the steady state seepage flow through the pores of the base soil alone. The hydraulic capacity of any cracks need not be considered in designing the filter because the cracks have been shown to seal.

Where saturated steady-state seepage flow will not develop, for instance in dry dams for flood control having a normal drawdown time of 10 days or less, filter capacity need only be nominal. Filters designed either to protect against steady state seepage or internal erosion through cracks are to be thick enough to compensate for potential segregation and contamination of the filter zones during construction. They must also be thick enough that cracks cannot extend through the filter zone during any possible differential movements.

A zone of coarser materials immediately downstream or below the filter, or both, provides additional capacity to collect and convey seepage to a controlled outlet. In some cases a strip drain is used, and in others a perforated collector pipe is employed to outlet the collected seepage. To prevent movement of the filter materials into the coarse drain materials, the coarse drain materials must be designed for the proper gradation using procedures in this subchapter. Perforations in collector pipes must also be sized properly to prevent movement of the coarse drain materials into the perforations.

633.2603 Determining filter gradation limits

Determine filter gradation limits using the following steps:

Step 1: Plot the gradation curve (grain-size distribution) of the base soil material. Use enough samples to define the range of grain sizes for the base soil or soils. Design the filter using the base soil that requires the smallest D_{15} size for filtering purposes. Base the design for drainage purposes on the base soil that has the largest D_{15} size.

Step 2: Proceed to step 4 if the base soil contains no gravel (material larger than No. 4 sieve).

Step 3: Prepare adjusted gradation curves for base soils that have particles larger than the No. 4 (4.75 mm) sieve.

- Obtain a correction factor by dividing 100 by the percent passing the No. 4 (4.75 mm) sieve.
- Multiply the percentage passing each sieve size of the base soil smaller than No. 4 (4.75 mm) sieve by the correction factor determined above.
- Plot these adjusted percentages to obtain a new gradation curve.
- Use the adjusted curve to determine the percentage passing the No. 200 (0.075 mm) sieve in step 4.

Step 4: Place the base soil in a category determined by the percent passing the No. 200 (0.075 mm) sieve from the regraded gradation curve data according to table 26–1.

Step 5: To satisfy filtration requirements, determine the maximum allowable D_{15} size for the filter in accordance with the table 26–2.

If desired, the maximum D_{15} may be adjusted for certain noncritical uses of filters where significant hydraulic gradients are not predicted, such as bedding beneath riprap and concrete slabs. For fine clay base soil that has d_{85} sizes between 0.03 and 0.1 mm, a maximum D_{15} of ≤ 0.5 mm is still conservative. For fine-grained silt that has low sand content, plotting below the "A" line, a maximum D_{15} of 0.3 mm may be used.

First, calculate the ratio of the maximum D_{15} to the minimum D_{15} sizes determined in steps 5 and 6. If this ratio is greater than 5, adjust the values of these control points so that the ratio of the maximum D_{15} to the minimum D_{15} is no greater than 5. If the ratio is 5 or less, no adjustments are necessary. Label the maximum D_{15} size as Control point 1 and the minimum D_{15} size as Control point 2. Proceed to step 8.

The decision on where to locate the final D_{15} sizes within the range established with previous criteria should be based on one of the following considerations:

1. Locate the design filter band at the maximum D_{15} side of the range if the filter will be required to transmit large quantities of water (serve as a drain as well as a filter). With the maximum D_{15} size as the control point, establish a new minimum D_{15} size by dividing the maximum D_{15} size by 5, and locate a new minimum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

2. Locate the band at the minimum D_{15} side of the range if it is probable there are finer base materials than those sampled and filtering is the most important function of the zone. With the minimum D_{15} size as the control point, establish a new maximum D_{15} size by multiplying the minimum D_{15} size by 5, and locate a new maximum D_{15} size. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

3. The most important consideration may be to locate the maximum and minimum D_{15} sizes, within the acceptable range of sizes determined in steps 5 and 6, so that a standard gradation available from a commercial source or other gradations from a natural source near the site would fall within the limits. Locate a new maximum D_{15} and minimum D_{15} within the permissible range to coincide with the readily available material. Ensure that the ratio of these sizes is 5 or less. Label the maximum D_{15} size Control point 1 and the minimum D_{15} size Control point 2.

Step 8: The designed filter band must not have an extremely broad range of particle sizes to prevent the use of possibly gap-graded filters. Adjust the limits of the design filter band so that the coarse and fine sides have a coefficient of uniformity of 6 or less. The width of the filter band should be such that the ratio of maximum to minimum diameters is less than or equal to 5 for all percent passing values of 60 or less.

Other filter design criteria in step 8

To prevent gap-graded filters—Both sides of the design filter band will have a coefficient of uniformity, defined as:

$$CU = \frac{D_{60}}{D_{10}} \leq 6$$

Initial design filter bands by this step will have CU values of 6. For final design, filter bands may be adjusted to a steeper configuration, with CU values less than 6, if needed. This is acceptable so long as other filter and permeability criteria are satisfied.

Calculate a maximum D_{10} value equal to the maximum D_{15} size divided by 1.2. (This factor of 1.2 is based on the assumption that the slope of the line connecting D_{15} and D_{10} should be on a coefficient of uniformity of about 6.) Calculate the maximum permissible D_{60} size by multiplying the maximum D_{10} value by 6. Label this Control point 3.

Determine the minimum allowable D_{60} size for the fine side of the band by dividing the determined maximum D_{60} size by 5. Label this Control point 4.

Step 9: Determine the minimum D_5 and maximum D_{100} sizes of the filter according to table 26–5. Label as Control points 5 and 6, respectively.

Table 26–5 Maximum and minimum particle size criteria*

Base soil category	Maximum D_{100}	Minimum D_5, mm
All categories	≤ 3 inches (75 mm)	0.075 mm (No. 200 sieve)

* The minus No. 40 (.425 mm) material for all filters must be nonplastic as determined in accordance with ASTM D4318.

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. 15448-007-058

SUBJECT: _____

SHEET 1 OF 10

Drain Gradation Design and Drain Material Selection calc. pkg. #11

TITLE OF CALCULATIONS/DOCUMENT

CALCULATIONS/DOCUMENT BY: Jian W. Liu (PRINT NAME)

Jian Liu (SIGNATURE) 9-25-00 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: KEVIN R. SOMERVILLE (PRINT NAME)

Kevin R. Somerville (SIGNATURE) 9-28-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME)

Kevin R. Somerville (SIGNATURE) 9-28-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 9-28-00 (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

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
4. Is the calculation complete in format with all sections included?

   - Problem Statement & Calculation Objectives
   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

5. Does the calculation conform with:

   - Codes
   - Project Design Criteria
   - Project Procedures?

6. Are the mathematics of the calculation accurate?
7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

White Tanks FRS #3
Interim Dam Safety
15448-007-058

Drain Gradation Design and Drain Material Selection

Objective

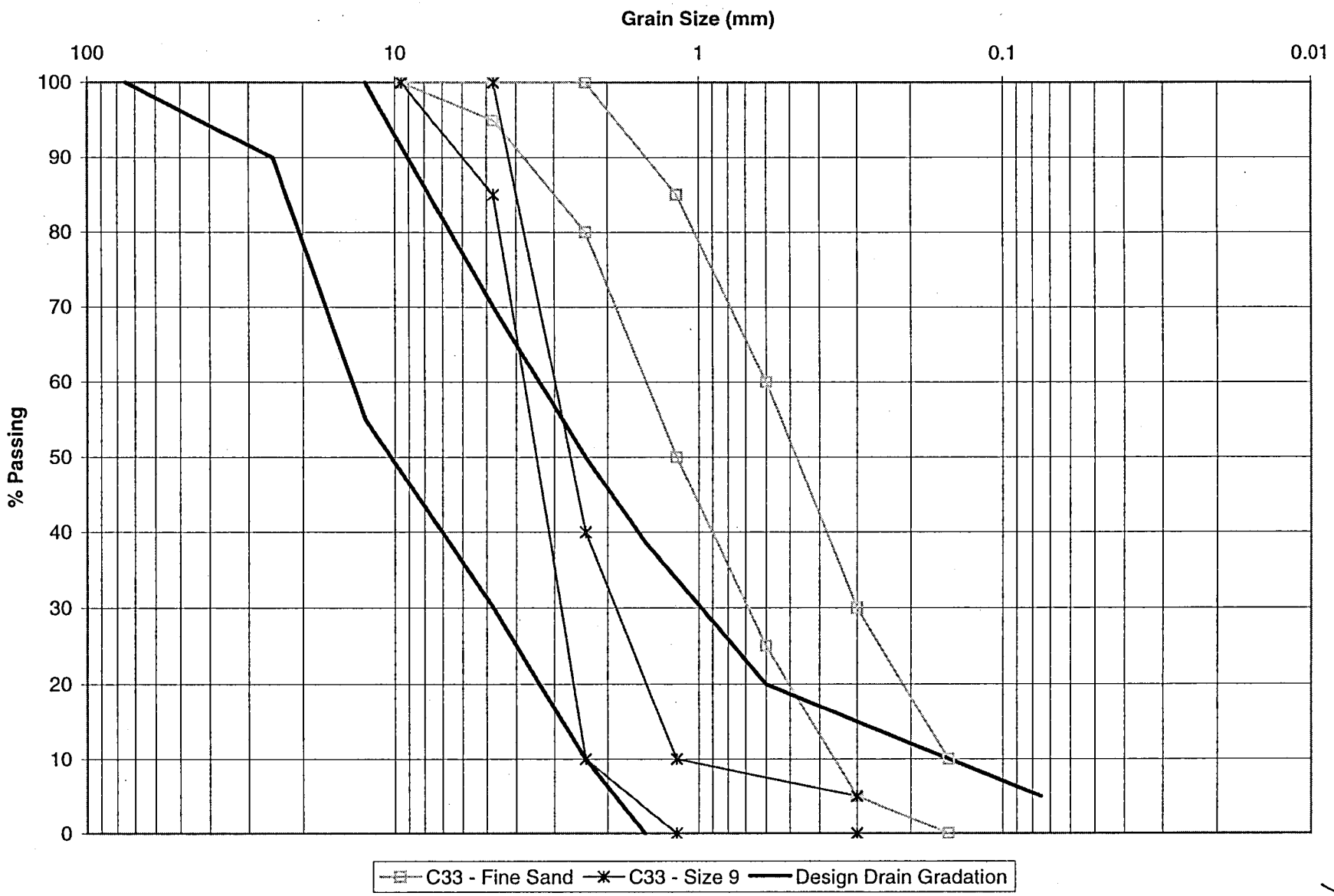
Design a drain gradation that matches with the filter, soil buttress, and foundation materials. Select a drain material from standard specification of C33 materials.

Method

Preliminary drain gradations from the Filter to Drain calculation, the Soil Buttress to Drain calculation, and the Foundation to Drain calculation were plotted separately on sheets 7, 8, and 9. On each graph the percent passing for nine standard sieve sizes were noted. From this, a drain gradation was developed. The drain gradation was then plotted against the gradations from the three calculation packages (shown on sheet 6). The gradation range common to the three preliminary drain gradations is shaded on this graph. Since this is such a narrow range it is unlikely that a material can be produced that will fall within the range. Therefore, the final drain gradation was designed to meet or be finer than the common range. Finer drain materials is acceptable since White Tanks FRS #3 is a dry dam for flood control having a normal drawdown time of 10 days or less, drainage capacity need only be nominal. (Natural Resource Conservation Service, Gradation Design of Sand & Gravel Filters, October 1994).

Conclusion

The final drain gradation is shown on sheet 3. C33_Size 9 is selected for the drain material because it is within the design band or finer. C33_Size 9 material is coarser than the C33 fine sand, and commercially available at local materials supplier.


Grain Size (mm)
100
10
1
0.1
0.01
% Passing
100
90
80
70
60
50
40
30
20
10
0
C33 - Fine Sand
C33 - Size 9
Design Drain Gradation

3/10

White Tanks FRS #3
Interim Dam Safety
15448-007-058
Drain Gradation Design Band

4/10

Grain Size (mm)	Final Drain Gradation	
75		100
25		90
12.5	100	55
4.75	70	30
2.36	50	10
1.5	38.7	0
0.6	20	
0.075	5	

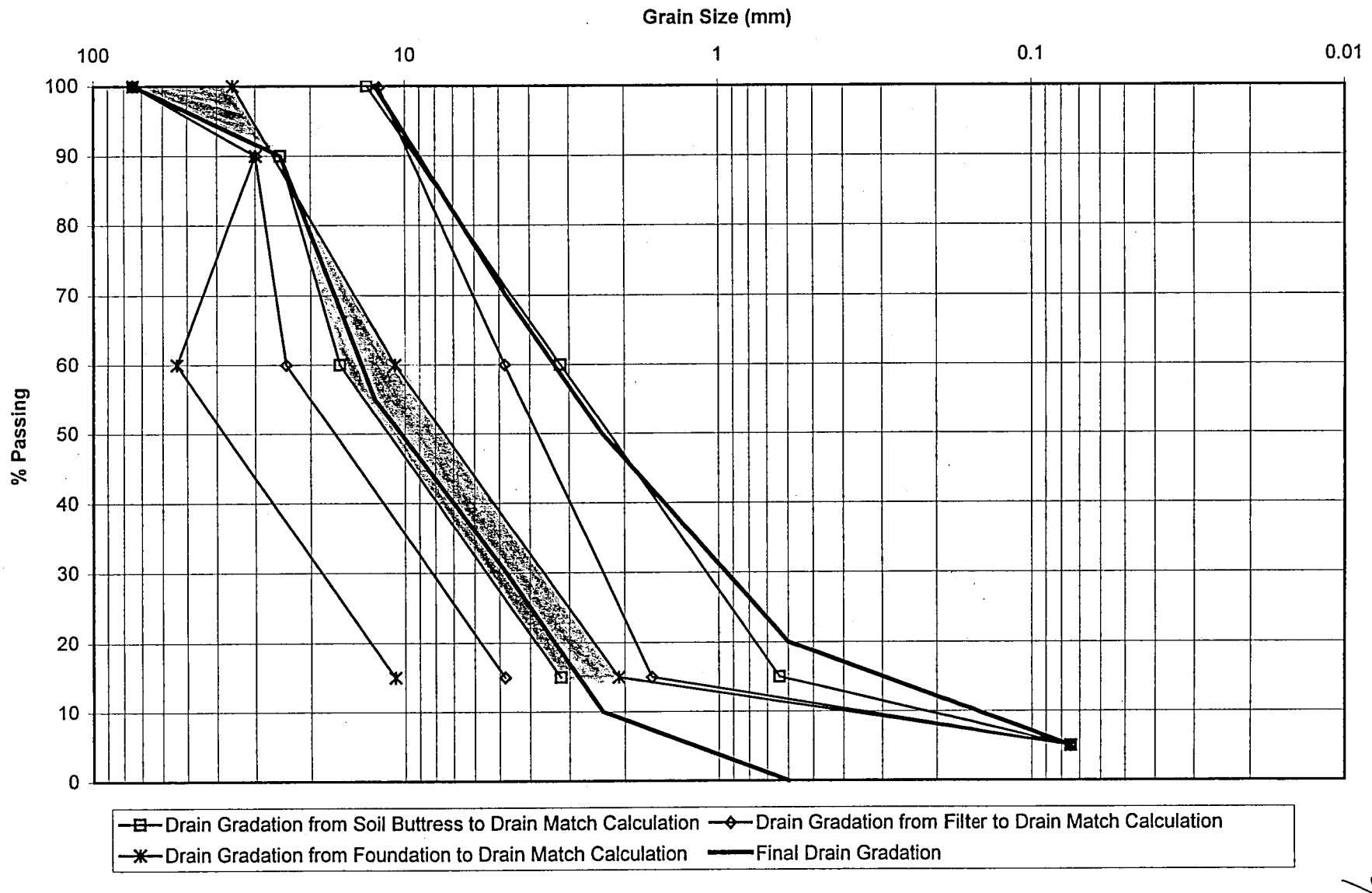
White Tanks FRS #3
Interim Dam Safety
15448-007-058
Drain Material Selection

5/10

C33-Fine Sand			
Grain Size (mm)	% Passing - Coarse	Grain Size (mm)	% Passing - Fine
9.5	100	9.5	100
4.75	95	4.75	100
2.36	80	2.36	100
1.18	50	1.18	85
0.6	25	0.6	60
0.3	5	0.3	30
0.15	0	0.15	10

C33-Size 9			
Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine
9.5	100	9.5	100
4.75	85	4.75	100
2.36	10	2.36	40
1.18	0	1.18	10
0.3	0	0.3	5

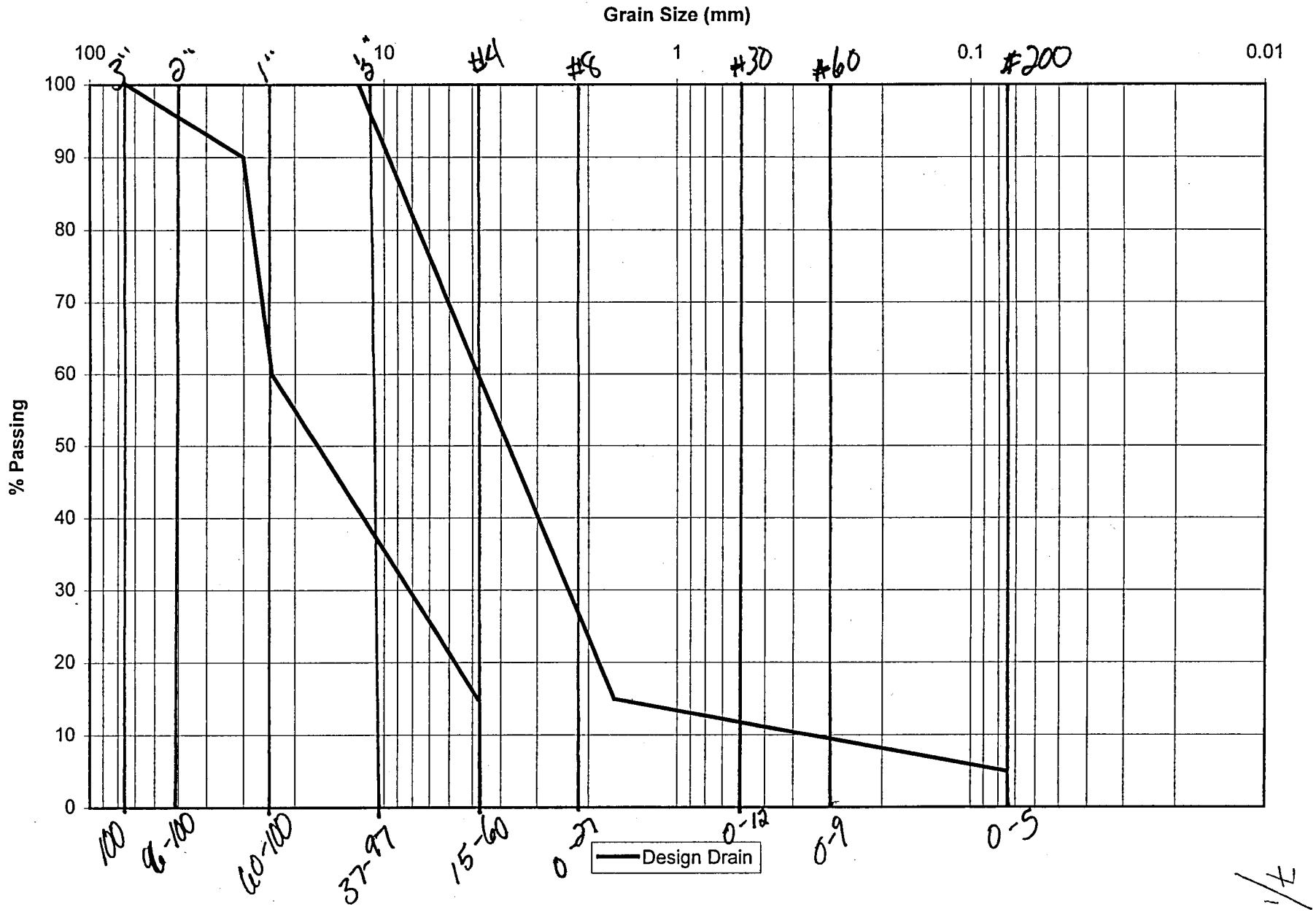
White Tanks FRS #3
Interim Dam Safety
15448-007-058
Drain Gradation Design



6/10

P:\15448/007\03DamSafety\calcs\drain gradation.xls,Drain Design Chart

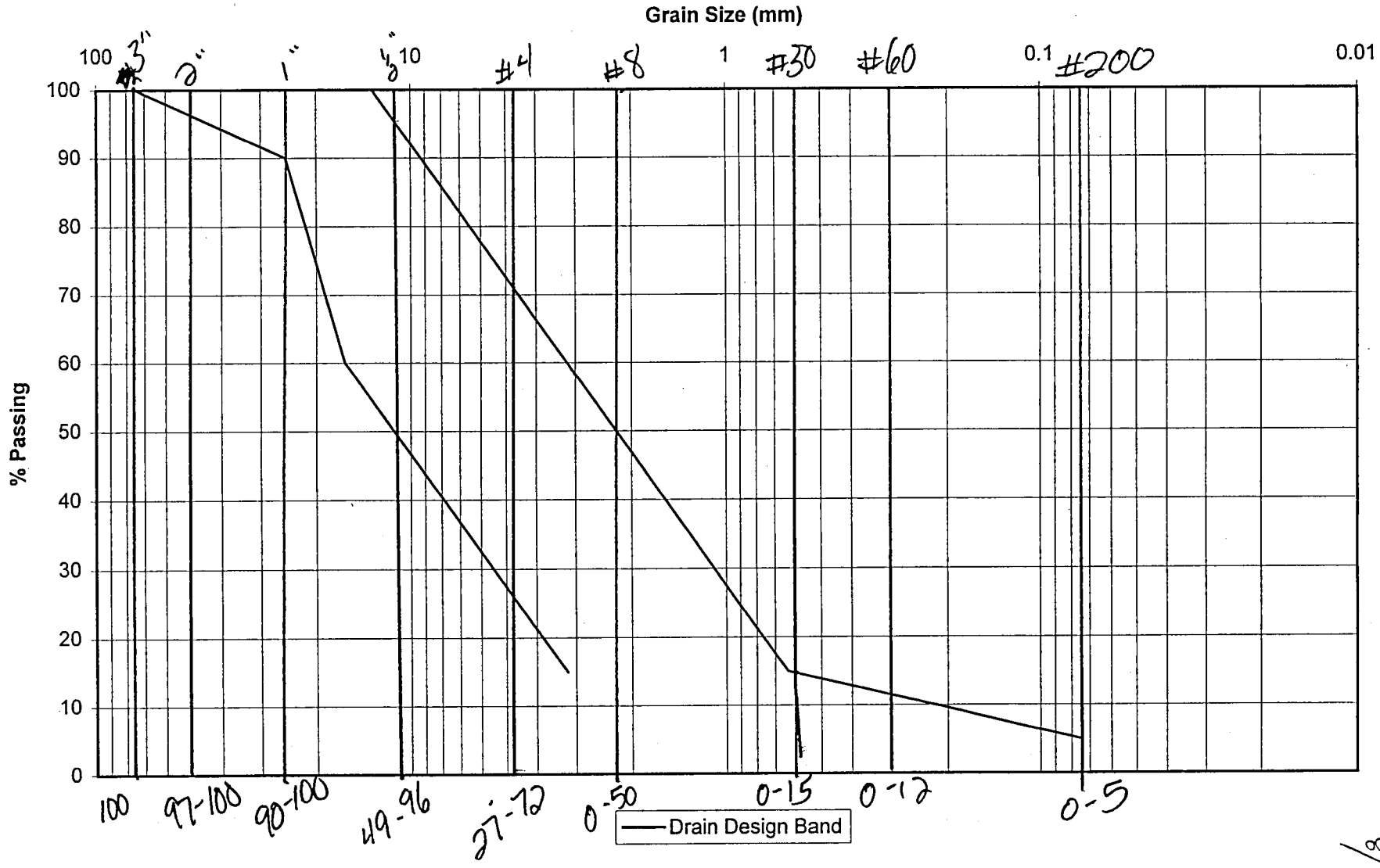
White Tanks FRS #3
Interim Dam Safety
Filter - Drain Calc



P:\15448\007\03DamSafety\Filter Calcs.xls,Filter-Drain Chart

White Tanks FRS #3
Interim Dam Safety
15448-007-058

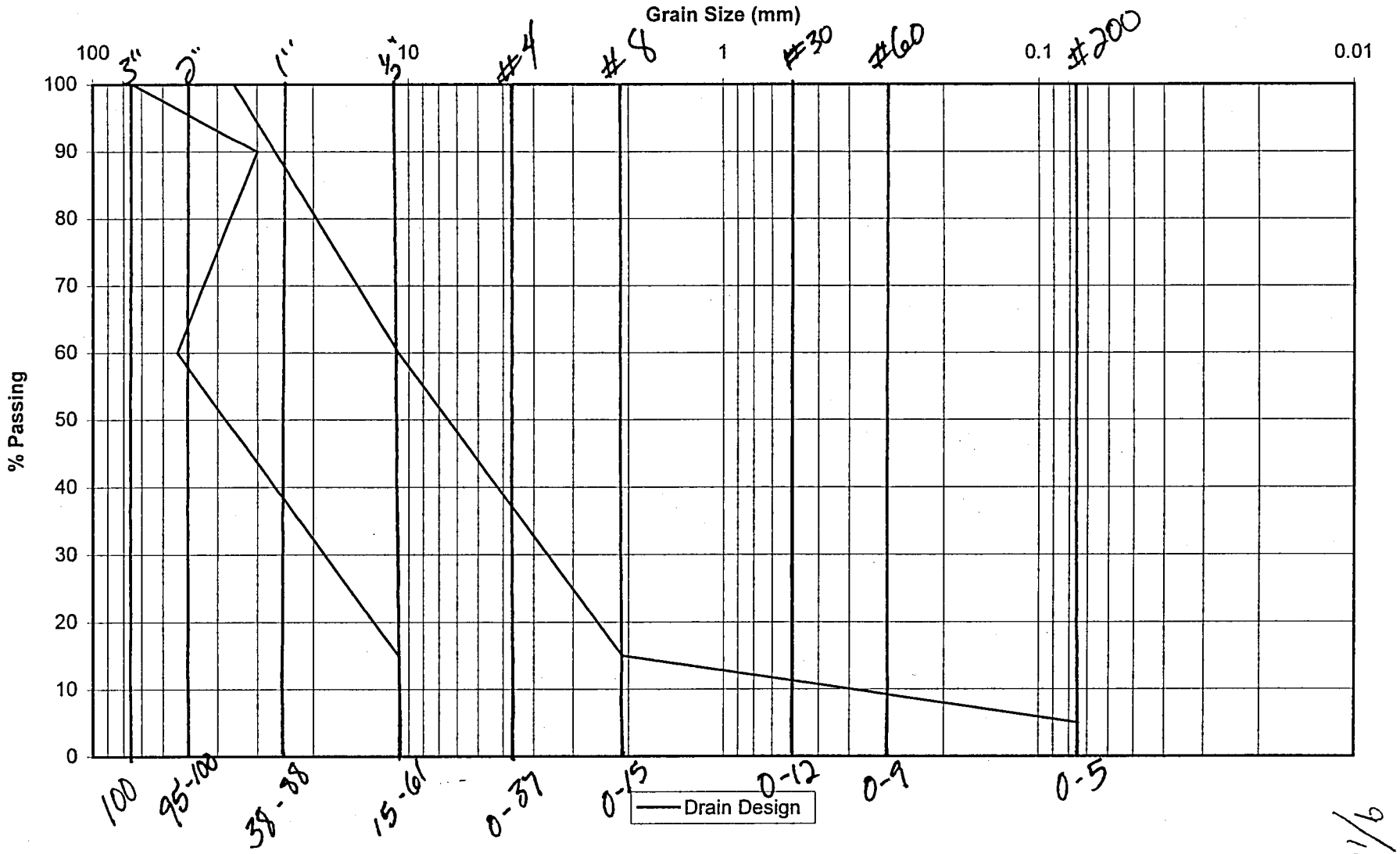
Drain Design Band Using Soil Buttress as Base Soil



P:\15448\007\03DamSafety\Calcs\Filter Calcs.xls,Buttress-Drain Chart

White Tanks FRS #3
Interim Dam Safety
Foundation - Drain Calc

Drain Design Band using Foundation as Base Soil



P:\15448\007\03DamSafety\calcs\Filter Calcs.xls,Foundation-Drain Chart

White Tanks FRS #3
Interim Dam Safety
15448-007-058
Drain Gradation Design

10/10

Drain Gradation from Soil Buttress to Drain Match Calculatio			
Grain Size (	% Passing - Co	Grain Size (	% Passing - Fine
75	100	13.24342	100
25	90	3.2	60
16.2	60	0.64	15
3.2	15	0.075	5

Drain Gradation from Filter to Drain Match Calculation			
Grain Size (mm)	% Passing - Coarse	Grain Size (mm)	% Passing - Fine
75	100	12.1059813	99.8
30	90	4.8	60
24	60	1.64	15
4.8	15	0.075	5

Drain Gradation from Foundation to Drain Match Calculation			
Grain Size (mm)	Design Coarse	Grain Size (mm)	Design Fine
75	100	35.4813389	100
30	90	10.8	60
54	60	2.1	15
10.8	15	0.075	5

Designation: C 33 – 99a$^{\epsilon 1}$

Standard Specification for Concrete Aggregates[1]

This standard is issued under the fixed designation C 33; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

ϵ^1 NOTE—The title of Specification E 11 was editorially corrected December 1999.

1. Scope

1.1 This specification defines the requirements for grading and quality of fine and coarse aggregate (other than lightweight or heavyweight aggregate) for use in concrete.[2]

1.2 This specification is for use by a contractor, concrete supplier, or other purchaser as part of the purchase document describing the material to be furnished.

NOTE 1—This specification is regarded as adequate to ensure satisfactory materials for most concrete. It is recognized that, for certain work or in certain regions, it may be either more or less restrictive than needed. For example, where aesthetics are important, more restrictive limits may be considered regarding impurities that would stain the concrete surface. The specifier should ascertain that aggregates specified are or can be made available in the area of the work, with regard to grading, physical, or chemical properties, or combination thereof.

1.3 This specification is also for use in project specifications to define the quality of aggregate, the nominal maximum size of the aggregate, and other specific grading requirements. Those responsible for selecting the proportions for the concrete mixture shall have the responsibility of determining the proportions of fine and coarse aggregate and the addition of blending aggregate sizes if required or approved.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this standard.

2. Referenced Documents

2.1 *ASTM Standards:*

C 29/C 29M Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate[3]

C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete[3]

C 87 Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar[3]

C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate[3]

C 117 Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing[3]

C 123 Test Method for Lightweight Particles in Aggregate[3]

C 125 Terminology Relating to Concrete and Concrete Aggregates[3]

C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine[3]

C 136 Test Method for Sieve Analysis of Fine and Coarse Aggregates[3]

C 142 Test Method for Clay Lumps and Friable Particles in Aggregates[3]

C 227 Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)[3]

C 289 Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)[3]

C 295 Guide for Petrographic Examination of Aggregates for Concrete[3]

C 330 Specification for Lightweight Aggregates for Structural Concrete[3]

C 331 Specification for Lightweight Aggregates for Concrete Masonry Units[3]

C 332 Specification for Lightweight Aggregates for Insulating Concrete[3]

C 342 Test Method for Potential Volume Change of Cement-Aggregate Combinations[3]

C 535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine[3]

C 586 Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method)[3]

C 637 Specification for Aggregates for Radiation-Shielding Concrete[3]

C 638 Descriptive Nomenclature of Constituents of Aggregates for Radiation-Shielding Concrete[3]

[1] This specification is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.20 on Normal Weight Aggregates.

Current edition approved July 10, 1999. Published September 1999. Originally published as C 33 – 21 T. Last previous edition C 33 – 99.

[2] For lightweight aggregates, see Specifications C 331, C 332, and C 330; for heavyweight aggregates see Specification C 637 and Descriptive Nomenclature C 638.

[3] *Annual Book of ASTM Standards*, Vol 04.02.

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TABLE 2 Grading Requirements for Coarse Aggregates

Size Number	Nominal Size (Sieves with Square Openings)	Amounts Finer than Each Laboratory Sieve (Square-Openings), Mass Percent													
		100 mm (4 in.)	90 mm (3½ in.)	75 mm (3 in.)	63 mm (2½ in.)	50 mm (2 in.)	37.5 mm (1½ in.)	25.0 mm (1 in.)	19.0 mm (¾ in.)	12.5 mm (½ in.)	9.5 mm (⅜ in.)	4.75 mm (No. 4)	2.36 mm (No. 8)	1.18 mm (No. 16)	300 µm (No 50)
1	90 to 37.5 mm (3½ to 1½ in.)	100	90 to 100	...	25 to 60	...	0 to 15	...	0 to 5	...	...	...	...	...	...
2	63 to 37.5 mm (2½ to 1½ in.)	...	...	100	90 to 100	35 to 70	0 to 15	...	0 to 5	...	...	...	...	...	
3	50 to 25.0 mm (2 to 1 in.)	...	...	...	100	90 to 100	35 to 70	0 to 15	...	0 to 5	...	...	...	...	
357	50 to 4.75 mm (2 in. to No. 4)	...	...	...	100	95 to 100	...	35 to 70	...	10 to 30	...	0 to 5	...		
4	37.5 to 19.0 mm (1½ to ¾ in.)	...	...	...	...	100	90 to 100	20 to 55	0 to 15	...	0 to 5	...	...		
467	37.5 to 4.75 mm (1½ in. to No. 4)	...	...	...	...	100	95 to 100	...	35 to 70	...	10 to 30	0 to 5	...		
5	25.0 to 12.5 mm (1 to ½in.)	...	...	...	...	...	100	90 to 100	20 to 55	0 to 10	0 to 5	...	...	...	
56	25.0 to 9.5 mm (1 to ⅜ in.)	...	...	...	...	...	100	90 to 100	40 to 85	10 to 40	0 to 15	0 to 5	...	...	
57	25.0 to 4.75 mm (1 in. to No. 4)	...	...	...	...	...	100	95 to 100	...	25 to 60	...	0 to 10	0 to 5		
6	19.0 to 9.5 mm (¾ to ⅜ in.)	...	...	...	...	...	...	100	90 to 100	20 to 55	0 to 15	0 to 5			
67	19.0 to 4.75 mm (¾ in. to No. 4)	...	...	...	...	...	...	100	90 to 100	...	20 to 55	0 to 10	0 to 5		
7	12.5 to 4.75 mm (½ in. to No. 4)	...	...	...	...	...	...	...	100	90 to 100	40 to 70	0 to 15	0 to 5		
8	9.5 to 2.36 mm (⅜ in. to No. 8)	...	...	...	...	...	...	...	...	100	85 to 100	10 to 30	0 to 10	0 to 5	
89	9.5 to 1.18 mm (⅜in to No. 16)	...	...	...	...	...	...	...	...	100	90 to 100	20 to 55	5 to 30	0 to 10	0 to 5
9[A]	4.75 to 1.18 mm (No. 4 to No. 16)	...	...	...	...	...	...	...	...	...	100	85 to 100	10 to 40	0 to 10	0 to 5

[A] Although size 9 aggregate is defined in Terminology C 125 as a fine aggregate, it is included as a coarse aggregate when it is combined with a size 8 material to create a size 89, which is a coarse aggregate as defined by Terminology C 125.

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CALCULATIONS COVER SHEET

SUBJECT: WT FRS #3 Interim Dam Safety

PROJECT NO. 15448-007-058

SHEET 1 OF 40

Riprap sizing at the Southern side of White Tanks FRS #3 and the Northern Outlet

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #12

CALCULATIONS/DOCUMENT BY: Muawieh Radaideh (PRINT NAME)

Muawieh Radaideh (SIGNATURE) 9-14-2000 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 9-29-00 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Jian W. Liu (PRINT NAME)

Jian Liu (SIGNATURE) 9-27-00 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. Gourley (PRINT NAME)

(SIGNATURE) 9-29-00 (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

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
4. Is the calculation complete in format with all sections included?

   - Problem Statement & Calculation Objectives
   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

5. Does the calculation conform with:

   - Codes
   - Project Design Criteria
   - Project Procedures?

6. Are the mathematics of the calculation accurate?
7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

Objective:

-To assess the extent of contact between water flowing over the White Tanks FRS #3 and the downstream side of the dam.
-Size of riprap needed to provide the necessary protection for the dam from flows over the spillway.
- Size of riprap needed to provide the necessary protection at the exit of the North Outlet.

Flow:

-The flow rate of 525 cfs used in this design is the maximum expected flow over the spillway as specified in the FCDMC "Maximum Water Surface Elevation for Inflow Design Flood (IDF) at White Tank Flood Retarding Structure No.3 under Current Conditions" report dated September 1, 1998.
-Flow rate of 208 cfs used for riprap sizing at the northern outlet was from the FCDMC report titled "Proposed New Operational Plan for White Tank Flood Retarding Structure No. 3 Outlet Pipes, January 12, 2000".

Calculation details and assumptions:

The following calculation and design methods were used:
-Hydraulic calculations were conducted using Manning's equation. A spreadsheet was developed and used to carry out these calculations. A spreadsheet showing the calculations equations is included.
-Similar Manning's coefficients (n) were used as those calculated in the JE Fuller/ Hydrology and Geomorphology White Tanks FRS #3 Reconnaissance Report, January 1999.
-Riprap design was conducted using a computer software known as "Riprap Design System, Version 2.0", developed by West Consultants, Inc. The following riprap design methods were used:

-USCOE Method (recommended by the ADWR)
-ASCE Method
-USBR Method (recommended by the ADWR)
-USGS Method
-Isbash Method
-Cal B&SP Method

The parameters used in these calculations were:
-Velocity type (local or average): average velocity was used.
-Channel type (natural or trapezoidal): natural channel type was used because it relates more to this case and would be more conservative.
-Average channel velocity (calculated by Manning's equation)

-Unit weight of Stone: natural stone generally varies from 150 to 175 lb/ft^3 according to the Riprap Design System, Version 2.0 (User Guide). A value of 165 lb/ft^3 was used in these calculations.
-Local flow depth: is 80% of the total flow depth (also in the User Guide).
-A factor of safety of 1.5 was used.

Results:

Resulting riprap sizes at the dam were very small due to the low velocity used in the design. The calculated D_{50}, minimum D_{30} and minimum D_{90} are shown for each of the cases in the Program Output sheets attached. We recommend the use of a D_{50} of 6 inches with a minimum stone size of 2 inches and a maximum stone size of 12 inches. Riprap will be needed up to the location of cross section #2 but extended to a distance similar to that of the spillway channel as an added element of safety (see Figure 2). Riprap is not as critical on the upstream side of the dam and would only cover a distance of about 50 feet to an elevation higher than the water level as shown on Figure 2.

The high velocity at the North Outlet resulted in a stone size greater than the largest USCOE stone gradation in most cases. In this case, a better surface protection is recommended; like shotcrete or a combination of shotcrete and riprap. However, the outlet pipe may be extended through the disturbed portions of the channel into existing portions. No shotcrete or riprap in the channel would be required for this scenario.

FILE
SUBJECT
SHEET ___ OF ___

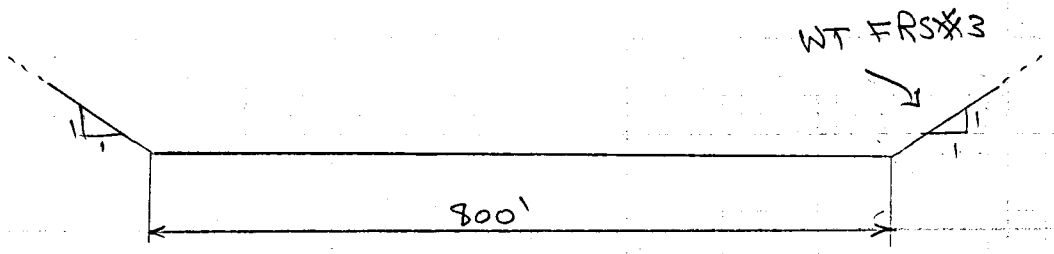
(I) Cross Sections at and downstream of spillway

(a) Cross Section 1 at top of spillway (see attached Figure)

$Q = 525$ cfs

$n = 0.05$ (JE Fuller Field Reconnaissance

$S = 0.01$ Report, Jan 1999)



Using Excell Spreadsheet Attached:

$Y_n = 1.72'$ ✓

$Y_c = 0.24'$ ✓ ⇒ Flow is subcritical

Flow Velocity = 0.38 ft/sec. ✓ (to be used for riprap design)

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BY ___ DATE ___ TO EO ___
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White Tanks FRS#3 Spillway
X-Section 1 at Spillway

Normal Depth

Cross Section #	Normal depth	Bottom width	Ditch left side slope	Ditch right side slope	Manning's n	Flow area	Wetted Perimeter	Hydraulic Radius	Slope	Flow velocity	Flow, Q*	peak flow
	(ft)	(ft)	(z:1)	(z:1)		(ft^2)	(ft)	(ft)	(percent)	(ft/s)	(cfs)	(cfs)
1	1.61	800.00	1.00	1.00	0.05	1289.70	804.55	1.60	0.01	0.41	525.00	525

Critical Depth

Cross Section #	critical depth	Bottom width	Left side slope	Right side slope	Channel top width, T	Flow Area	Flow, Q	Q^2/g	A^3/T*
	(ft)	(ft)	(z:1)	(z:1)	(ft)	(sq ft)	(cfs)		
1	0.24	800.00	1.00	1.00	800.47	189.93	525.00	8559.78	8559.78

*Goal Seek in Microsoft Excel's Tools was used to fix "Flow, Q" and "A3/T" values to values of or related to the expected 100-year 24-hour flow values. These values were fixed by changing the normal depth and critical depth values.

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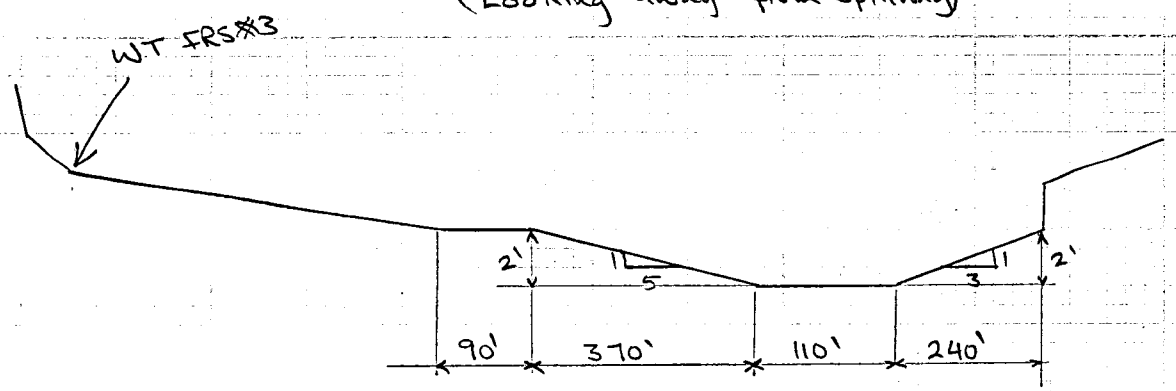
(b) at Cross Section #2 (shown on Figure 1 attached)
(Looking away from spillway)



$n = 0.05$ (from JE Fuller's Field Reconnaissance Report, Jan. 1999)

$Q = 525$ cfs

slope $= 0.039$

Using Excell spreadsheet attached

$Y_n = 0.98' < 2'$ ✓ ⇒ Water would stay within the steep portion of the cross section away from the dam

$Y_c = 0.88'$ (subcritical flow) ✓

∴ Stop riprap here (as a measure of assurance, riprap can be extended as shown on drawing)

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White Tanks FRS#3 Spillway
X-Section 2

Normal Depth

Cross Section #	Normal depth	Bottom width	Ditch left side slope	Ditch right side slope	Manning's n	Flow area	Wetted Perimeter	Hydraulic Radius	Slope	Flow velocity	Flow, Q*	peak flow
	(ft)	(ft)	(z:1)	(z:1)		(ft^2)	(ft)	(ft)	(percent)	(ft/s)	(cfs)	(cfs)
2	0.98	110.00	5.00	3.00	0.06	111.52	118.09	0.94	3.90	4.71	525.00	525

Critical Depth

Cross Section #	critical depth	Bottom width	Left side slope	Right side slope	Channel top width, T	Flow Area	Flow, Q	Q^2/g	A^3/T*
	(ft)	(ft)	(z:1)	(z:1)	(ft)	(sq ft)	(cfs)		
2	0.88	110.00	5.00	3.00	117.05	100.06	525.00	8559.78	8559.78

*Goal Seek in Microsoft Excel's Tools was used to fix "Flow, Q" and "A3/T" values to values related to the 525 cfs flow. These values were fixed by changing the normal depth and critical depth values.

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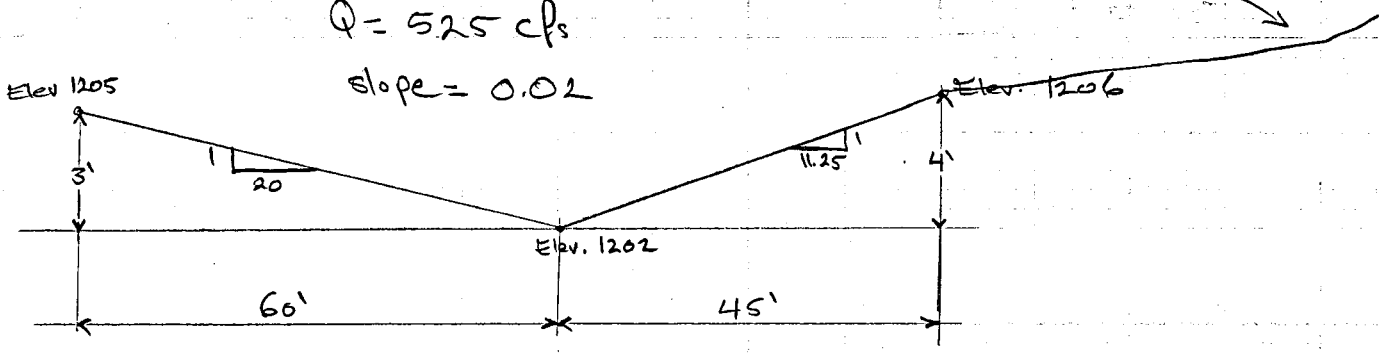
* Flow in cross sections when notch is at spillway (Looking towards spillway)

(c) Cross Section \# 3 (immediately downstream of end of notch)

n = 0.06 (JE Fuller Report, Jan 1999)

Q = 525 cfs

slope = 0.02



$Y_n = 2.78' < 3'$ ⇒ Flow will be contained within Y-cross section away from FRS #3

$Y_c = 2.34'$ (subcritical) ✓

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White Tanks FRS#3 Spillway
X-Section 3

Normal Depth

Cross Section #	Normal depth	Bottom width	Ditch left side slope	Ditch right side slope	Manning's n	Flow area	Wetted Perimeter	Hydraulic Radius	Slope	Flow velocity	Flow, Q*	peak flow
	(ft)	(ft)	(z:1)	(z:1)		(ft^2)	(ft)	(ft)	(percent)	(ft/s)	(cfs)	(cfs)
3	2.78	0.00	20.00	11.25	0.06	120.58	87.01	1.39	2.00	4.35	525.00	525

Critical Depth

Cross Section #	critical depth	Bottom width	Left side slope	Right side slope	Channel top width, T	Flow Area	Flow, Q	Q^2/g	A^3/T*
	(ft)	(ft)	(z:1)	(z:1)	(ft)	(sq ft)	(cfs)		
3	2.34	0.00	20.00	11.25	73.12	85.54	525.00	8559.78	8559.78

*Goal Seek in Microsoft Excel's Tools was used to fix "Flow, Q" and "A3/T" values to values related to the 525 cfs flow. These values were fixed by changing the normal depth and critical depth values.

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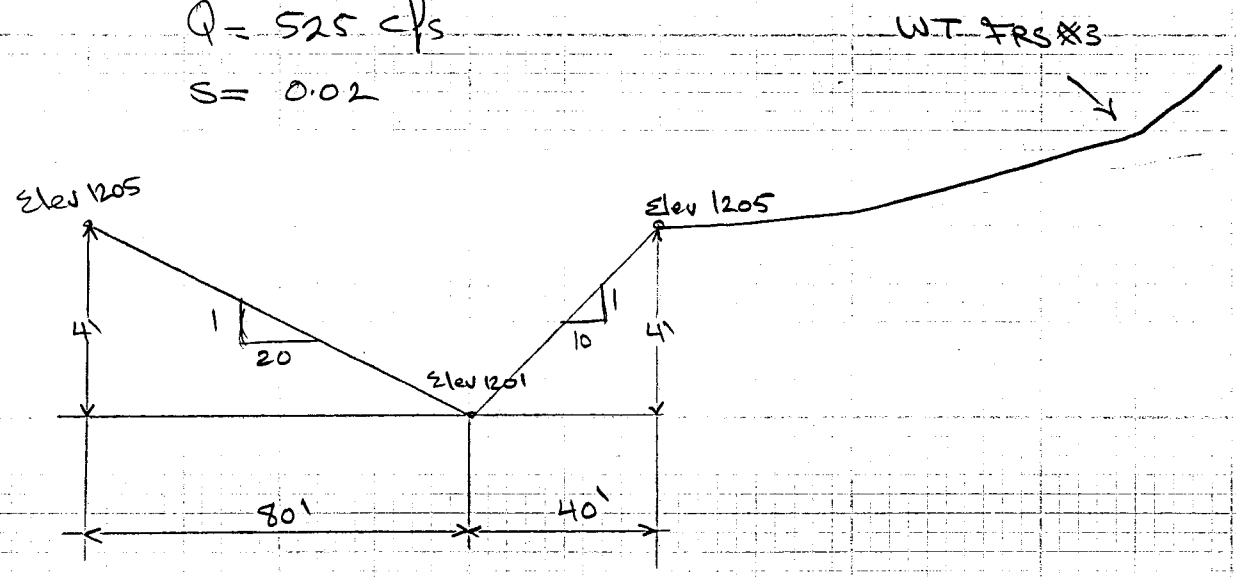
(d) Cross Section #4 (Looking towards the spillway)

n = 0.06 (JE Fuller Report, Jan 1999)

Q = 525 cfs

S = 0.02



$Y_n = 2.82' < 4'$ ✓ ⇒ Flow will be contained within V-shaped cross section

$Y_c = 2.38'$ (subcritical flow) ✓

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White Tanks FRS#3 Spillway
X-Section 4

Normal Depth

Cross Section #	Normal depth	Bottom width	Ditch left side slope	Ditch right side slope	Manning's n	Flow area	Wetted Perimeter	Hydraulic Radius	Slope	Flow velocity	Flow, Q*	peak flow
	(ft)	(ft)	(z:1)	(z:1)		(ft^2)	(ft)	(ft)	(percent)	(ft/s)	(cfs)	(cfs)
4	2.82	0.00	20.00	10.00	0.06	119.37	84.84	1.41	2.00	4.40	525.00	525

Critical Depth

Cross Section #	critical depth	Bottom width	Left side slope	Right side slope	Channel top width, T	Flow Area	Flow, Q	Q^2/g	A^3/T*
	(ft)	(ft)	(z:1)	(z:1)	(ft)	(sq ft)	(cfs)		
4	2.38	0.00	20.00	10.00	71.35	84.84	525.00	8559.78	8559.78

*Goal Seek in Microsoft Excel's Tools was used to fix "Flow, Q" and "A3/T" values to values related to the 525 cfs flow.
These values were fixed by changing the normal depth and critical depth values.

p:/15448/007/dam safety/spillwayx-section 6502/3/00x-sec #4

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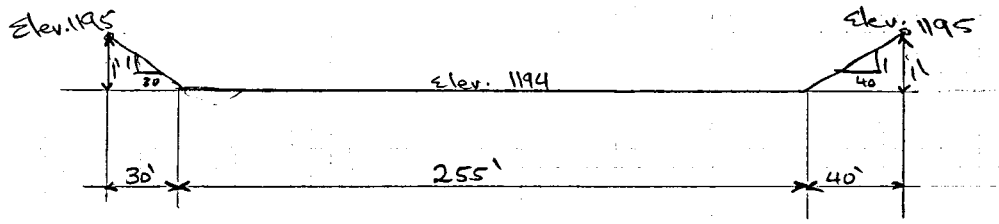
e) Cross section #5 (Looking toward spillway)

$n = 0.06$ (JE Fuller Report, Jan 1999)
$Q = 525$ cfs
$S = 0.02$



$Y_n = 0.71' < 1'$ ✓ ⇒ flow is still contained within cross section

$Y_c = 0.50$ (subcritical flow) ✓

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White Tanks FRS#3 Spillway
X-Section 5

Normal Depth

Cross Section #	Normal depth	Bottom width	Ditch left side slope	Ditch right side slope	Manning's n	Flow area	Wetted Perimeter	Hydraulic Radius	Slope	Flow velocity	Flow, Q*	peak flow
	(ft)	(ft)	(z:1)	(z:1)		(ft^2)	(ft)	(ft)	(percent)	(ft/s)	(cfs)	(cfs)
5	0.71	255.00	30.00	40.00	0.06	199.10	304.82	0.65	2.00	2.64	525.00	525

Critical Depth

Cross Section #	critical depth	Bottom width	Left side slope	Right side slope	Channel top width, T	Flow Area	Flow, Q	Q^2/g	A^3/T*
	(ft)	(ft)	(z:1)	(z:1)	(ft)	(sq ft)	(cfs)		
5	0.50	255.00	30.00	40.00	289.79	135.37	525.00	8559.78	8559.78

*Goal Seek in Microsoft Excel's Tools was used to fix "Flow, Q" and "A3/T" values to values related to the 525 cfs flow.
These values were fixed by changing the normal depth and critical depth values.

CKD BKW 2-7-00

White Tanks FRS#3 Spillway
X-Section 1 at Spillway

Normal Depth

Cross Section #	Normal depth	Bottom width	Ditch left side slope	Ditch right side slope	Manning's n	Flow area	Wetted Perimeter	Hydraulic Radius	Slope	Flow velocity	Flow, Q*	peak flow
	(ft)	(ft)	(z:1)	(z:1)		(ft^2)	(ft)	(ft)	(percent)	(ft/s)	(cfs)	(cfs)
1	1.608886	800	1	1	0.05	=C8*B8+0.5*B8*B8*D8+0.5*B8*B8*E8	=(C8+((B8^2)+((D8*B8)^2))^0.5)+(((B8^2)+((E8*B8)^2))^0.5)	=G8/H8	0.01	=L8/G8	=(1.486/F8)*(G8)*(I8^(2/3))*(J8/100)^0.5	525

From JE Fuller Field Reconnaissance Report, Jan. 1999

From the District hydrology report

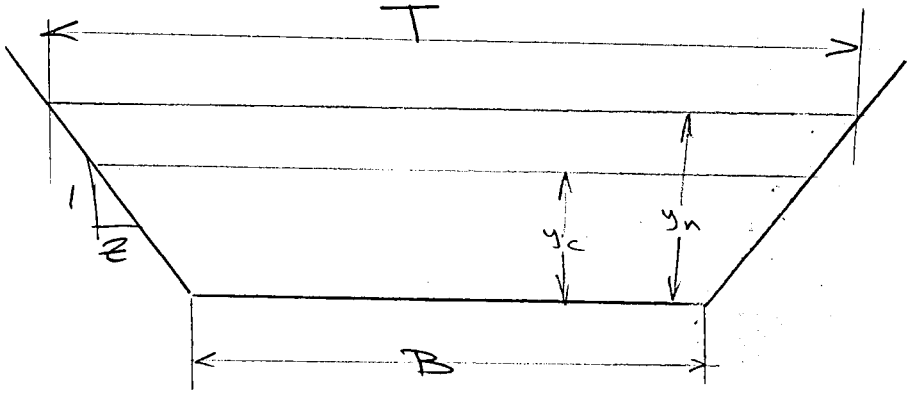
Critical Depth

	critical depth	Bottom width	Left side slope	Right side slope	Channel top width, T	Flow Area	Flow, Q	Q^2/g	A^3/T*
Cross Section #	(ft)	(ft)	(z:1)	(z:1)	(ft)	(sq ft)	(cfs)		
=A8	0.237347	800	1	1	=C14+B14*D14+B14*E14	=C14*B14+0.5*B14*B14*D14+0.5*B14*B14*E14	525	=(H14^2)/32.2	=(G14^3)/F14

used to solve for critical depth

$$\frac{Q^2}{g} = \frac{A^3}{T}$$

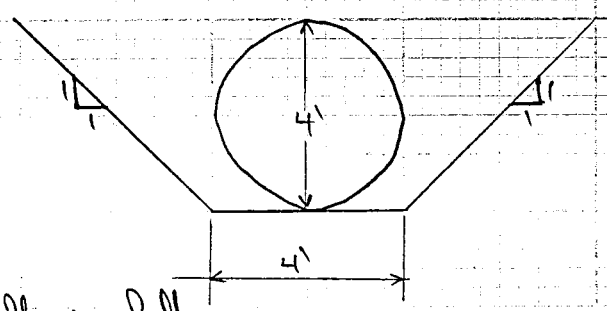
(from Water Resources Engineering, Linsley et.al, 1992)



FILE
SUBJECT
SHEET ___ OF ___

* Northern Outlet

$Q = 208$ cfs



4' pipe flowing full

$Q = VA$

$208 \text{ cfs} = V * (\pi * 4)$

$V = 16.6$ fps ✓

Riprap design for outlet channel will be based on the 16.6 fps velocity.

REVISIONS
BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

BY ___ DATE ___
CHECKED BY BKW 2-7-00
COPY TO EO ___

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FILE
SUBJECT
SHEET ___ OF ___

REVISIONS
BY ___ DATE ___ TO EO ___
BY ___ DATE ___ TO EO ___

(II) Riprap Design

— Two designs were conducted

a) Riprap size and gradation based on velocity from X-section 1

b) Riprap size and gradation at North Outlet structure

The following methods are used:

* a) USCOE Method (recommended by DWR)
b) ASCE Method
* c) USBR Method (recommended by DWR)
d) USGS Method
e) Isbash Method
f) Cal B&SP Method

Riprap at the dam min D_{30} = 0.37', min D_{90} = 0.53 (All method

Use D_{50} = 0.5' min of 2" & max of 12"

Riprap at northern outlet is greater than the largest USCOE stone gradation.

BY ___ DATE ___
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WHITE TANKS FRS #3 MODIFICATION DESIGN
Contract FCD 98-11
Dames & Moore Job No. 15448-0005-022

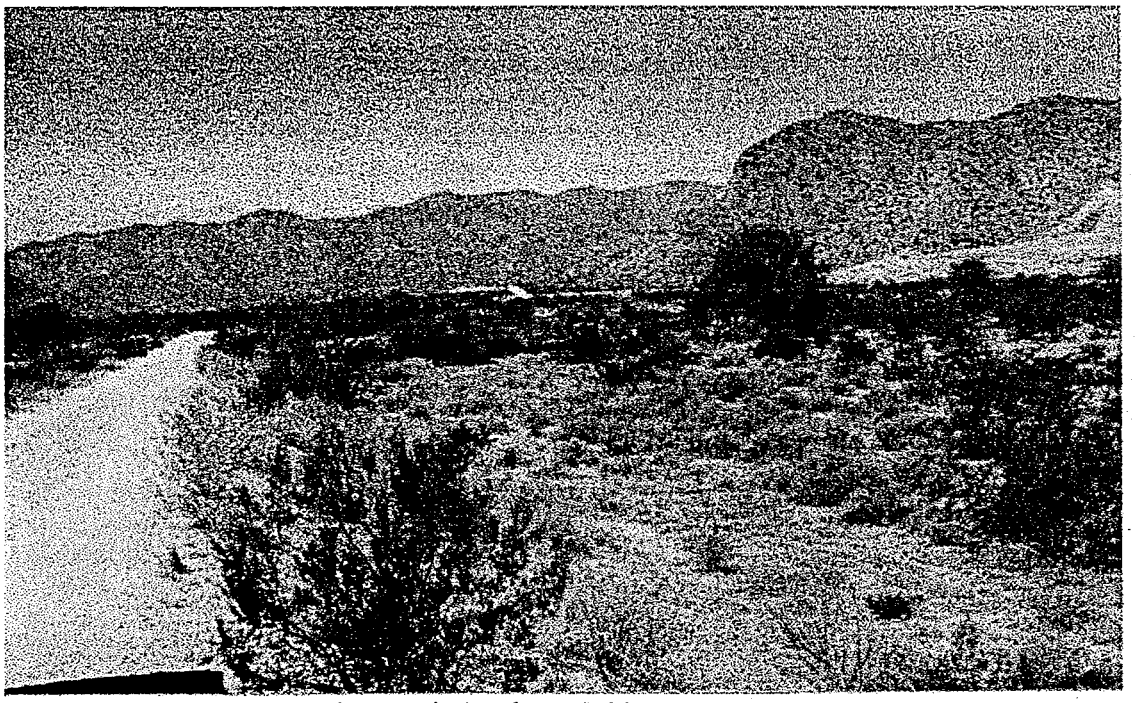
TASK 3.24.3 FIELD RECONNAISSANCE REPORT
DRAFT
January 1999

JE Fuller Hydrology and Geomorphology, Inc., (JEF) conducted its original field reconnaissance of the project area on September 14, 1998. Subsequent field reconnaissance was undertaken on November 18 and 27 and December 28, 1998. The purpose of the field reconnaissance was to document channel and overbank Manning's "n" values, floodplain conditions affecting the floodplain delineation, and major hydraulic structures. The project area, channel alignments (where applicable) ground photo locations, and Manning's "n" values are shown on Figure 1.

Manning's "n" Values

Manning's "n" values were determined using the methodology in the USGS report, "Estimating Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona". On the following pages, photographs showing typical conditions at various locations are followed by the worksheet used to determine the Manning's "n" values for the location depicted in the photographs.

The project area consists of a broad shallow inundation area composed primarily of active and former agricultural fields. As such, in most locations the inundation area is not a typical riverine configuration composed of a channel and associated overbanks. Roughness coefficients were developed and assigned based on distinctions in land use, vegetation, effects of infrastructure such as roads and canals and, where applicable, channel characteristics. Manning's roughness coefficients for the agricultural areas were developed assuming worst case conditions (i.e., mature crops present). These agricultural areas (for which typical photos are shown on the following page) represent overbank conditions for all channels except where noted. Where defined channels or flow paths exist, names for these conveyances have been taken from the White Tanks ADMS (where applicable) for the sake of familiarity and consistency.



Bethany Home Road Wash, Reach A, Photo 2.08:
Looking upstream toward existing White Tanks FRS #3 spillway.

5) Manning's Roughness $n = 0.024$ (Modern Sewer Design) for an unpaved CMP

6) Calculate Hazen-Williams Coefficient C_H by setting the headloss from Chézy-Manning's equal to the headloss from Hazen-Williams

$$\frac{V^2 n^2 \cancel{L}}{2.21 R^{4/3}} = 3.02 \cancel{L} D^{-1.167} \frac{V^{1.85}}{C_H^{1.85}}$$

$$C_H = \left(\frac{6.67 R^{4/3}}{V^{0.15} n^2 D^{1.167}} \right)^{1/1.85}$$

7) Spreadsheet is used to calculate headloss in the pipe using Hazen-Williams eqn along with minor losses due to entrance & exit

8) The values in (7) above are set equal to the physical losses due to difference in elev. using Goal Seek to calculate velocity values

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Sheet No. 2
Calc. No.
Rev. No.
By mkl Date 5-19
Chk'd. BW Date 5-26

Job No. Job
Client Subject

Objective

To develop rating curves for the Northern, Central, and Southern outlet CMP outlets.

Calculation Details and Assumptions

1) Use previously designed and calculated values such as pipe diameter, length, inlet invert elev. & outlet invert elev.

2) Calculate Hydraulic Radius $R = D/4$

3) Water elevation at inlet ranges from the (inlet invert elev + pipe dia) value to the max water elevation of 1210.34 (1/2 PMF)

4) Headwater depth = water elev. at inlet - inlet invert elev. - pipe dia.

F-132(7/91)

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
4. Is the calculation complete in format with all sections included?

   - Problem Statement & Calculation Objectives
   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

5. Does the calculation conform with:

   - Codes
   - Project Design Criteria
   - Project Procedures?

6. Are the mathematics of the calculation accurate?
7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

DAMES & MOORE

CALCULATIONS COVER SHEET

SUBJECT: Interim Dam Safety

PROJECT NO. 15448-007-058

SHEET 1 OF 16

Outlet Pipes Rating Curves

TITLE OF CALCULATIONS/DOCUMENT

Calc Package #13

CALCULATIONS/DOCUMENT BY: Muawieh Radaideh

PRINT NAME

MK Radaideh

SIGNATURE

5-19-00

DATE

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth

PRINT NAME

SIGNATURE

7-27-00

DATE

CALCULATIONS/DOCUMENT CHECKED BY: Bonnie Whitley

PRINT NAME

Bonnie Whitley

SIGNATURE

5-26-00

DATE

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) A.W. GOURLAY

PRINT NAME

A.W. Gourlay

SIGNATURE

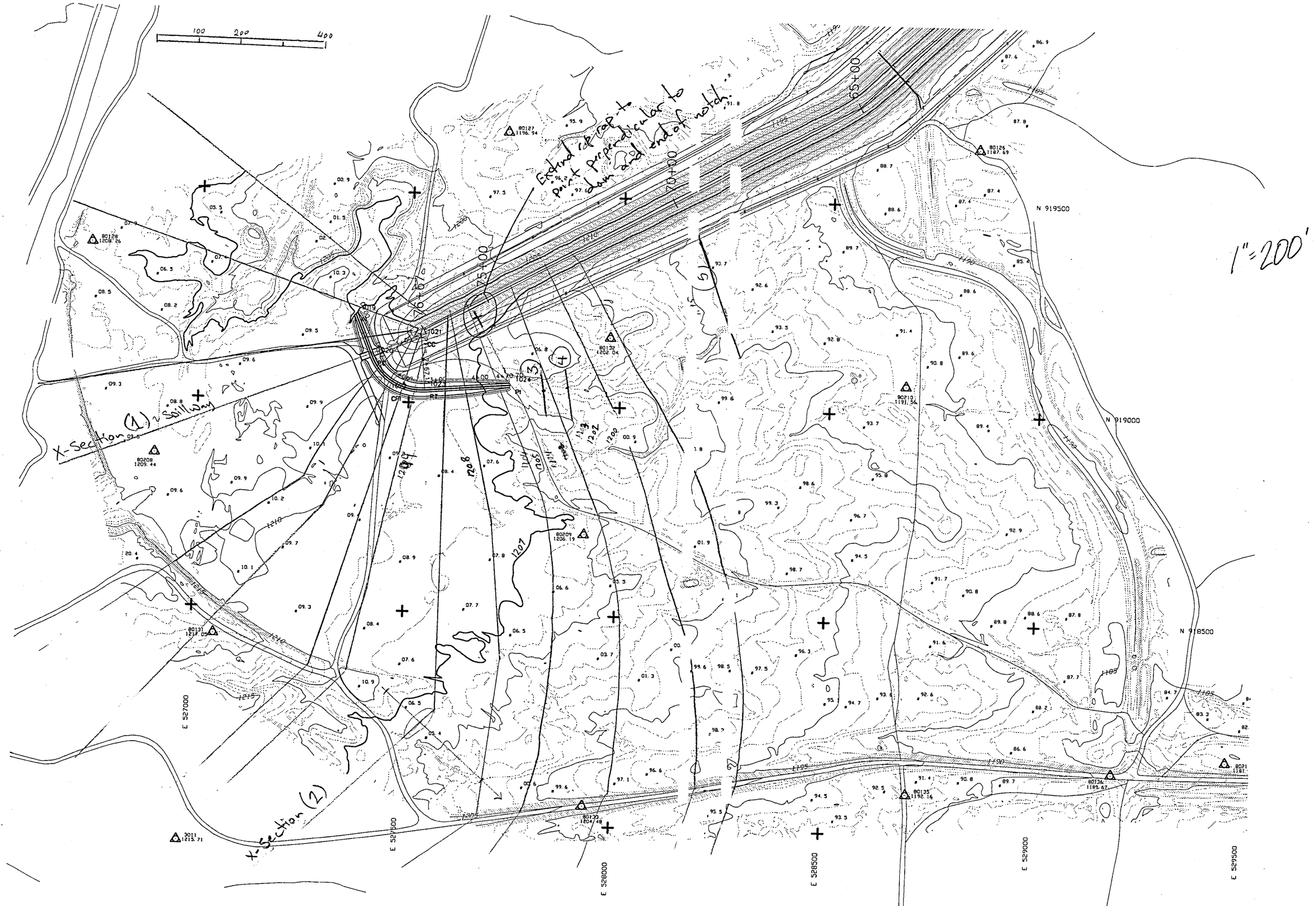
7-27-00

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.

~~OK for 90% submittal AWG 5-26-00~~ AWG 7-27-00

Revision Number	Date	By	Checked By	Approval
1				
2				
3				
4			INITIALS	


100 200 400
1"=200'
Extend ck top to point perpendicular to dam and end of notch.
X-Section (1) ~ Spillway
X-Section (2)
65+00
70+00
75+00
80+00
N 919500
N 919000
N 918500
E 527000
E 527500
E 528000
E 528500
E 529000
E 529500

2.3.7 HEC-11 Method

The HEC-11 Riprap design method (FHWA, 1989) was developed for use in rivers or streams with typical non-uniform flow conditions and discharges normally greater than fifty cubic feet per second. The application of the HEC-11 equation is limited to uniform or gradually varying flow conditions in straight or mildly curving channel reaches with relatively uniform cross sections. Modifications to the method have been developed to allow its use in non-uniform rapidly varying flow conditions as well as allowances for steep slopes, large channel bends, bridge piers and abutments (FHWA, 1989). The stable median rock size is calculated by;

$$D_{50} = D_{50}' \, C_f C_s$$

Where:

$$D_{50}' = \frac{0.001 V_a^3}{\sqrt{d}\, K_1^{1.5}}$$

$$K_1 = \left(1 - \frac{\sin^2\theta}{\sin^2\phi}\right)^{0.5}$$

$$\theta = \arctan\left(\frac{1}{\text{cot angent of sideslope}}\right)$$

$$C_f = \left(\frac{safety\ factor}{1.2}\right)^{1.5}$$

$$C_s = \frac{2.12}{(G_s - 1)^{1.5}}$$

D_{50} = stone size, feet
V_a = average channel velocity, ft/s
ϕ = material angle of repose, degrees
G_s = specific gravity of stone, (γ_s / γ_w)
d = average flow depth, feet

The following describes the required input parameters shown in Figure 2.11.

Average Channel Velocity: The average channel velocity is defined as the total discharge (ft^3/s or m^3/s) divided by the flow area (ft^2 or m^2). Valid values are greater than zero in either ft/s or m/s.

Average Flow Depth: This is found by measuring the distance from the channel bottom to the free surface at various points along a given channel section and averaging the results. The average flow depth is reported in feet or meters.

Unit Weight of Stone: This is the weight of one solid cubic foot or meter of the stone that will be used and varies by the type of rock. Valid values are $130 lbs/ft^3$ to $200 lbs/ft^3$ in English units and $2085 kg/m^3$ to $3206 kg/m^3$ in

2.3.6 *Cal B & SP Method*

The California Department of Transportation developed the California Bank and Shore Protection riprap design method to protect highway embankments (CDPW, 1970). The method accounts for large impinging flow forces by modifying the average channel velocity. The multiplication factor for impinging flows is 4/3 and for tangential flows is 2/3. This modification converts the average channel velocity into the local depth averaged velocity. The following equation is used to size rock:

$$W_{33} = \left(\frac{0.00002\, V^6 G_s}{(G_s - 1)^3 \sin^3(\rho - \theta)} \right)$$

Where:

W_{33} = minimum weight of outside stone for no damage, lbs
V = stream velocity to which bank is exposed, ft/s
= $4/3 V_a$ for impinging flow

= $2/3 V_a$ for tangential flow
V_a = average channel velocity, ft/s
ρ = 70° for randomly placed rubble
θ = bank angle, degrees
G_s = specific gravity of stone, (γ_s / γ_w)

The following describes the required input parameters shown in Figure 2.10.

Local Depth Averaged Velocity: The local depth averaged velocity is the average water velocity located at a certain point in a channel cross-section, irrespective of the shape of the channel. This velocity is often determined beforehand by physical or numerical models or from field measurements.

> **Note:** For this method the local depth averaged velocity may be the average channel velocity multiplied by 4/3 for impinging flows, or by 2/3 for tangential flows.

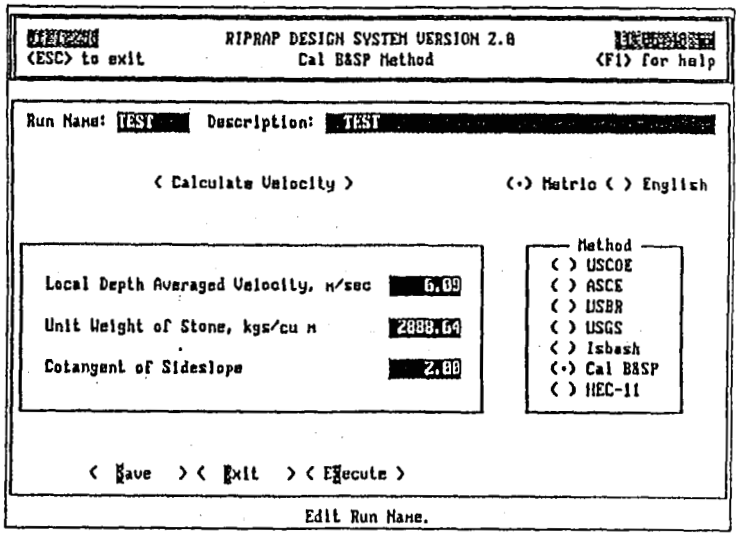


Figure 2.10 Cal B & SP Method Input Screen

Unit Weight of Stone: This is the weight of one solid cubic foot or meter of the stone that will be used and varies by the type of rock. Valid values are

2.3.5 *Isbash Method*

The Isbash formula (Isbash, 1936) as used by the U.S. Army Corps of Engineers (USCOE, 1971), was developed for the construction of dams by depositing rock into running water. The median stone size of stable rock is computed by;

$$D_{50} = \frac{V_a^2}{2gC^2(G_s - 1)}$$

Where:

D_{50} = stone size, feet
V_a = average Channel Velocity, ft/s
G_s = specific gravity of stone (γ_s / γ_w)
g = gravitational constant, feet/sec^2
C = 0.86 for high turbulence zones
= 1.20 for low turbulence zones

The following describes the required input parameters shown in Figure 2.9.

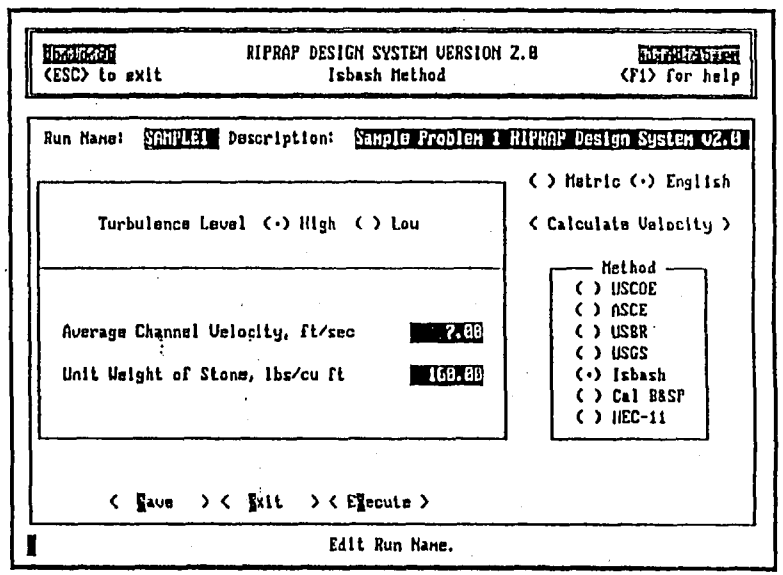


Figure 2.9 ISBASH Method Input Screen

Turbulence Level: The value of the variable "C" in the Isbash equation varies for high turbulence (C=0.86) or low turbulence (C=1.20) flows. The Isbash coefficients are from tests with essentially no boundary layer development and average flow velocities representative of the velocity against stone. When the stone movement resulted by sliding, a coefficient

2.3.3 USBR Method

The U.S. Bureau of Reclamation method (USBR EM-25, Peterka, 1958) was developed for estimating the riprap size to be used downstream of a stilling basin. The procedure was developed using eleven prototype installations with velocities varying from about one foot per second to about eighteen feet per second. This method calculates the median size of stable rock with the following equation.

$$D_{50} = 0.0122\, V_a^{2.06}$$

Where:

D_{50} = stone size, feet
V_a = average channel velocity, ft/s

The following describes the required input parameters shown in Figure 2.7.

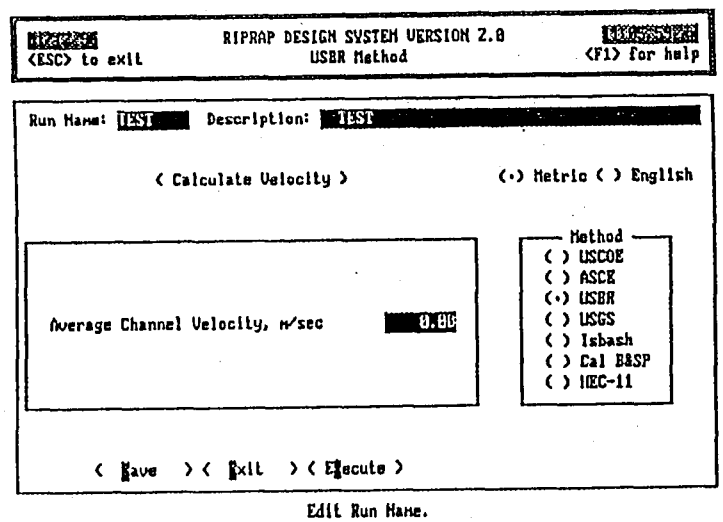


Figure 2.7 USBR Method Input Screen

Average Channel Velocity: The average channel velocity is defined as the total discharge (ft^3/s or m^3/s) divided by the flow area (ft^2 or m^2). Valid values are greater than zero in either ft/s or m/s.

> Note: When using USCOE gradations (See Sec. 2.5), a default value of 165 lb/ft^3 (2,645 kg/m^3) for unit weight of stone is assumed. This can be changed by entering the desired value in the Unit Weight of Stone input field of the USCOE Method.

2.3.4 USGS Method

The U.S. Geological Survey riprap design equation resulted from the analysis of field data taken from Washington, Oregon, California, Nevada, and Arizona (Blodgett, 1981). A survey was taken that related the site hydraulic conditions to the performance of the riprap protection. The surveys included 39 events of which 22 resulted in no riprap damage. The remaining 17 events were analyzed and 14 failures were found to be caused by particle erosion. The field data from the 39 events, as well as the velocity/D_{50} relationship from HEC-11 (FHWA, 1989), were then plotted. Using the plot with recognition of those sites with riprap failure, the USGS riprap design equation was developed.

$$D_{50} = 0.01 V_a^{2.44}$$

Where:

D_{50} = stone size, feet
V_a = average velocity in cross section, ft/s

The following describes the required input parameters shown in Figure 2.8.

Average Channel Velocity: The average channel velocity is defined as the total discharge (ft^3/s or m^3/s) divided by the flow area (ft^2 or m^2). Valid values are greater than zero in either ft/s or m/s.

turbulence). A minimum safety factor of 1.5 should be used when cobbles (rounded stone) are used. A minimum safety factor of 1.25 should be used at abrupt changes in roughness (e.g., riprap to natural channel or concrete).

2.3.2 ASCE Method

The American Society of Civil Engineers (Vanoni, 1977) design method uses the Isbash equation (Isbash, 1936) with a modification to account for channel bank slope. The median rock size (D_{50}) is based upon the channel flow velocity, unit weight of stone and the channel sideslope.

$$D_{50} = \left(\frac{6\,W}{\pi\,\gamma_s} \right)^{1/3}$$

Where:

$$W = \frac{0.000041\,G_s\,V^6}{(G_s - 1)^3\,\cos^3(\theta)} \qquad \theta = \arctan\left(\frac{1}{\text{cotangent of sideslope}} \right)$$

D_{50} = stone size, feet
W = weight of stone, lbs.
V = local depth averaged velocity, ft/s
γ_s = unit weight of stone, lb/ft^3
γ_w = unit weight of water, lb/ft^3
G_s = specific gravity of stone, (γ_s/γ_w)

Note: RIPRAP layer thickness for ASCE method is $1 \cdot D_{100}$.

The following describes the required input parameters shown in Figure 2.6.

Local Depth Averaged Velocity: The local depth averaged velocity is the average water velocity above a certain point in a channel cross-section,

2.3.1 USCOE Method

The U.S. Army Corps of Engineers method (USCOE, 1994) of riprap placement was developed for flow in man-made or natural channels having low turbulence and slopes less than two percent. The channel section to be protected should not be immediately downstream of stilling basins or other highly turbulent areas. The following equation is used with the USCOE method.

$$D_{30} = S_f C_s C_v C_t d \left(\left(\frac{\gamma_w}{\gamma_s - \gamma_w} \right)^{0.5} \frac{V}{\sqrt{K_1 g d}} \right)^{2.5}$$

Where:

D_{30} = stone size, feet

S_f = safety Factor (see description later in this section)
= 1.25, downstream of concrete channels, end of dikes, flow impingement

C_s = stability coefficient for incipient failure
= 0.30 for angular rock
(for rounded rock, increase safety factor)

C_v = vertical velocity distribution coefficient
= 1.0 for straight channels, inside of bends
= 1.283-0.2log(R/W), outside of bends (1 for R/W >26)
(see Figure 2.5 for a description of R/W)

C_t = thickness coefficient
= 1.0 for thickness = $1*D_{100}$(max) or $1.5*D_{50}$(max) whichever is greater

d = local depth of flow at same location as V, feet

γ_s = unit weight of stone, lbs/ft^3

γ_w = unit weight of water, lbs/ft^3

V = local depth averaged velocity, V_{ss} for side slope riprap, ft/s

g = gravitational constant, ft/sec^2

K_1 = side slope correction factor
= 1 for bottom riprap

$$= \left(1 - \frac{\sin^2 \theta}{\sin^2 \phi}\right)^{0.5}$$

$$\theta = \arctan\left(\frac{1}{\text{cotangent of sideslope}}\right)$$

ϕ = riprap angle of repose = 40 degrees

RIPRAP DESIGN SYSTEM

Version 2.0

USER'S GUIDE

WEST Consultants, Inc.

Water • Environmental • Sedimentation • Technology

San Diego, California *(619) 487-9378*

Bellevue, Washington *(425) 646-8806*

WEST Consultants, Inc.
2111 Palomar Airport Rd.
Suite 180
Carlsbad, CA 92009-1419

Dames & Moore/Phoenix
Riprap Design

PROGRAM OUTPUT

Cal B&SP Method

Input Parameters:

Run Name: WT~FRS#3 Description: North Outlet

Local Depth Averaged Velocity, ft/sec	4.20
Unit Weight of Stone, lbs/cu ft	165.00
Cotangent of Sideslope	1.50

Output Results:

Computed W33, lb 0.31

*** Using CalTrans Gradation - Placement Method B ***

Gradation Class	Facing
Layer Thickness, ft	1.41

Percent Larger Than	Rock Size
0-5	200 Lb.
50-100	75 Lb.
90-100	25 Lb.

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Riprap Design

PROGRAM OUTPUT

Isbash Method

:n ut Parameters:

Run Name: WT~FRS#3 Description: North Outlet

ıv rage Channel Velocity, ft/sec	16.60
Jn_t Weight of Stone, lbs/cu ft	165.00
:urbulence Level	Low

)' ɔut Results:

:omputed D50, ft	1.81

*** Using Gradation from COE ETL 1110-2-120 ***

:c puted D30, ft	1.48
;pecific Weight, pcf	165.00
ıa''er Thickness, ft	3.50
;e ected Minimum D30, ft	1.70
;e_ected Minimum D90, ft	2.47

?e cent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
]100	1,482	3,704
]5	741	1,096
]1	232	548

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Riprap Design

PROGRAM OUTPUT

USGS Method

Input Parameters:

Run Name: WT~FRS#3 Description: North Outlet

Average Channel Velocity, ft/sec 16.60

Output Results:

Computed D50, ft 9.49

Computed D30, ft 7.77

*** * * * * * * WARNING * * * * * * ***

THE REQUIRED STONE SIZE IS GREATER THAN THE LARGEST USCOE STONE GRADATION

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Dames & Moore/Phoenix
Riprap Design

PROGRAM OUTPUT

USBR Method

Input Parameters:

Run Name: WT~FRS#3 Description: North Outlet

Average Channel Velocity, ft/sec 16.60

Output Results:

Computed D50, ft 3.98

Computed D30, ft 3.26

*** * * * * * * WARNING * * * * * * ***

THE REQUIRED STONE SIZE IS GREATER THAN THE LARGEST USCOE STONE GRADATION

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Suite 180
Carlsbad, CA 92009-1419

Dames & Moore/Phoenix
Riprap Design

PROGRAM OUTPUT

ASCE Method

Input Parameters:

Run Name: WT~FRS#3 Description: North Outlet

Local Depth Averaged Velocity, ft/sec	4.20
Unit Weight of Stone, lbs/cu ft	165.00
Cotangent of Sideslope	1.50

Output Results:

Computed D50, ft	0.14

*** Using Gradation from COE ETL 1110-2-120 ***

Computed D30, ft	0.11
Specific Weight, pcf	165.00
Layer Thickness, ft	0.75
Selected Minimum D30, ft	0.37
Selected Minimum D90, ft	0.53

Percent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
W100	15	36
W[illegible]	7	11
W[illegible]	2	5

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Carlsbad, CA 92009-1419

Dames & Moore/Phoenix
Riprap Design

PROGRAM OUTPUT

USCOE Method

nput Parameters:

un Name: WT~FRS#3 Description: North Outlet

elocity	Average
hannel Type	Trapezoidal
traight Channel	Yes
end Angle, °	N/A
verage Channel Velocity, ft/sec	16.60
ottom Width, ft	N/A
inimum Centerline Bend Radius, ft	N/A
ater Surface Width, ft	N/A
n : Weight of Stone, lbs/cu ft	165.00
iprap Layer Thickness	1.00
ocal Flow Depth, ft	4.00
otangent of Sideslope	1.50
afety Factor	1.50

utput Results:

omputed Local Depth Average Velocity, ft/sec	16.60
ocal Velocity / Avg. Channel Velocity	1.00
orrection for Layer Thickness	1.00
ide Slope Correction Factor	1.52
orrection for Secondary Currents	1.00

omputed D30, ft 3.82

*** * * * * * * WARNING * * * * * * ***

THE REQUIRED STONE SIZE IS GREATER THAN THE LARGEST USCOE STONE GRADATION

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Suite 180
Carlsbad, CA 92009-1419

Dames & Moore/Phoenix
Riprap Design

PROGRAM OUTPUT

Cal B&SP Method

Input Parameters:

Run Name: FRS #3 Description: X-Section 1 at Spillway

Local Depth Averaged Velocity, ft/sec	4.20
Unit Weight of Stone, lbs/cu ft	165.00
Cotangent of Sideslope	1.50

C put Results:

Computed W33, lb 0.31

*** Using CalTrans Gradation - Placement Method A ***

Gradation Class	1/2 ton
Layer Thickness, ft	3.34

Percent Larger Than	Rock Size
0-5	1 Ton
50-100	1/2 Ton
95-100	1/4 Ton

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Riprap Design
PROGRAM OUTPUT

Isbash Method

nput Parameters:

u Name: FRS #3 Description: X-Section 1 at Spillway

verage Channel Velocity, ft/sec	0.41
n: Weight of Stone, lbs/cu ft	165.00
u: bulence Level	Low

utput Results:

omputed D50, ft	0.00

*** Using Gradation from COE ETL 1110-2-120 ***

omputed D30, ft	0.00
pecific Weight, pcf	165.00
ayer Thickness, ft	0.75
elected Minimum D30, ft	0.37
elected Minimum D90, ft	0.53

ercent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
100	15	36
50	7	11
1	2	5

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PROGRAM OUTPUT

USGS Method

Input Parameters:

Run Name: FRS #3 Description: X-Section 1 at Spillway

Average Channel Velocity, ft/sec 0.41

Output Results:

Computed D50, ft 0.00

*** Using Gradation from COE ETL 1110-2-120 ***

Computed D30, ft	0.00
Specific Weight, pcf	165.00
Layer Thickness, ft	0.75
Selected Minimum D30, ft	0.37
Selected Minimum D90, ft	0.53

Percent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
W100	15	36
W50	7	11
W15	2	5

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PROGRAM OUTPUT

USBR Method

n: ıt Parameters:

.un Name: FRS #3 Description: X-Section 1 at Spillway

.v: :age Channel Velocity, ft/sec 0.41

ıutput Results:

: ɔuted D50, ft 0.00

*** Using Gradation from COE ETL 1110-2-120 ***

:omputed D30, ft 0.00
:p: :ific Weight, pcf 165.00
ıa: :er Thickness, ft 0.75
:elected Minimum D30, ft 0.37
:el ected Minimum D90, ft 0.53

'ercent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
/1)	15	36
/5ʊ	7	11
/15	2	5

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Riprap Design

PROGRAM OUTPUT

ASCE Method

Input Parameters:

Run Name: FRS #3 Description: X-Section 1 at Spillway

Local Depth Averaged Velocity, ft/sec	4.20
Unit Weight of Stone, lbs/cu ft	165.00
Cotangent of Sideslope	1.50

Output Results:

Computed D50, ft	0.14

*** Using Gradation from COE ETL 1110-2-120 ***

Computed D30, ft	0.11
Specific Weight, pcf	165.00
Layer Thickness, ft	0.75
Selected Minimum D30, ft	0.37
Selected Minimum D90, ft	0.53

Percent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
W100	15	36
W5[illegible]	7	11
W1[illegible]	2	5

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Dames & Moore/Phoenix
Riprap Design

PROGRAM OUTPUT

USCOE Method

Input Parameters:

Run Name: FRS #3 Description: X-Section 1 at Spillway

Velocity	Average
Channel Type	Natural
Straight Channel	Yes
Bend Angle, °	N/A
Average Channel Velocity, ft/sec	0.41
Bottom Width, ft	N/A
Minimum Centerline Bend Radius, ft	N/A
Water Surface Width, ft	N/A
Unit Weight of Stone, lbs/cu ft	165.00
Riprap Layer Thickness	1.00
Local Flow Depth, ft	1.40
Cotangent of Sideslope	1.50
Safety Factor	1.50

Output Results:

Computed Local Depth Average Velocity, ft/sec	0.41
Local Velocity / Avg. Channel Velocity	1.00
Correction for Layer Thickness	1.00
Side Slope Correction Factor	1.52
Correction for Secondary Currents	1.00

*** Using Gradation from COE ETL 1110-2-120 ***

Computed D30, ft	0.00
Specific Weight, pcf	165.00
Layer Thickness, ft	0.75
Selected Minimum D30, ft	0.37
Selected Minimum D90, ft	0.53

Percent Lighter by Weight	Stone Weight, lbs Minimum	Maximum
W100	15	36
W50	7	11
W1	2	5

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: White Tanks FRS #3 Modification Design, FCD98-11
Stream: Bethany Home Road Wash
Location: Reach A
Photo No: 2.08

Channel Conditions		Manning's n Adjustment		Left Overbank (Undisturbed Desert)	Channel (Firm Soil)	Right Overbank (Undisturbed Desert)
Channel Material	Concrete	n_b	.012 - .018			
	Firm Soil		.025 -.032	.030	.030	.030
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0	0	0	0
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004	0		0
	Minor		.005 - .015		.005	
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010			
	Medium		.010 - .025		.015	
	Large		.025 - .050	.030		.030
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0	0	0	0
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
				0.060	0.050	0.060
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Severe		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.060	0.050	0.060

C:\PROJECTS\Dames & Moore\White Tanks FRS#3\draft field recon report\Mannings Tables\Bethany Home Road Wash - Reach A.WPD

9) Flow is calculated for inlet & outlet control conditions

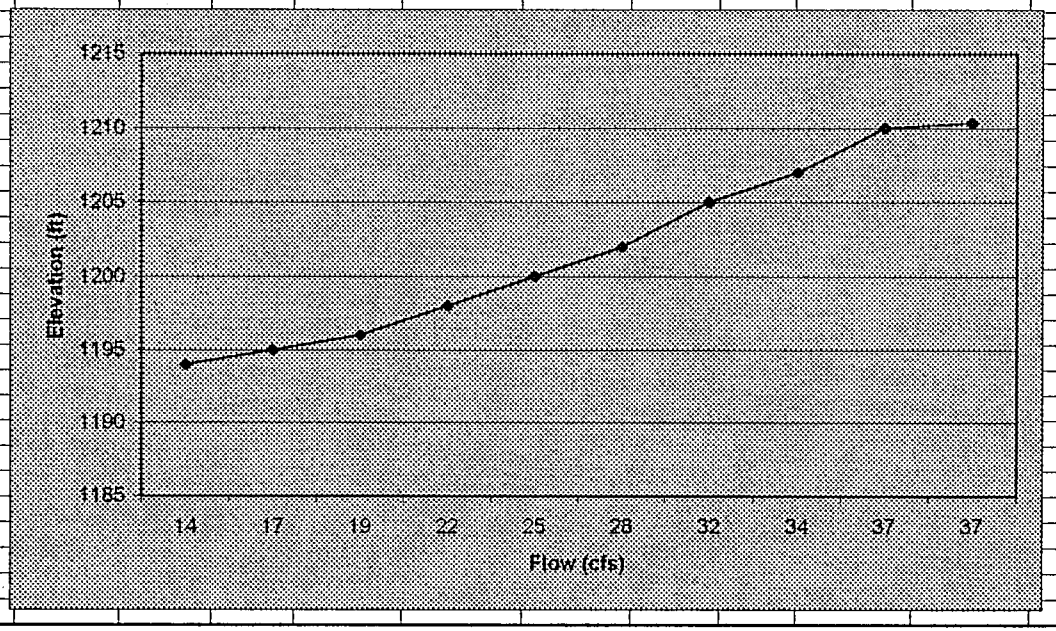
10) If outlet control Q < Inlet control Q
⇒ Use outlet control Q otherwise
flow = Inlet control Q

Results

The relationship between stage and flow is plotted for each of the outlet pipes as shown in attached figures

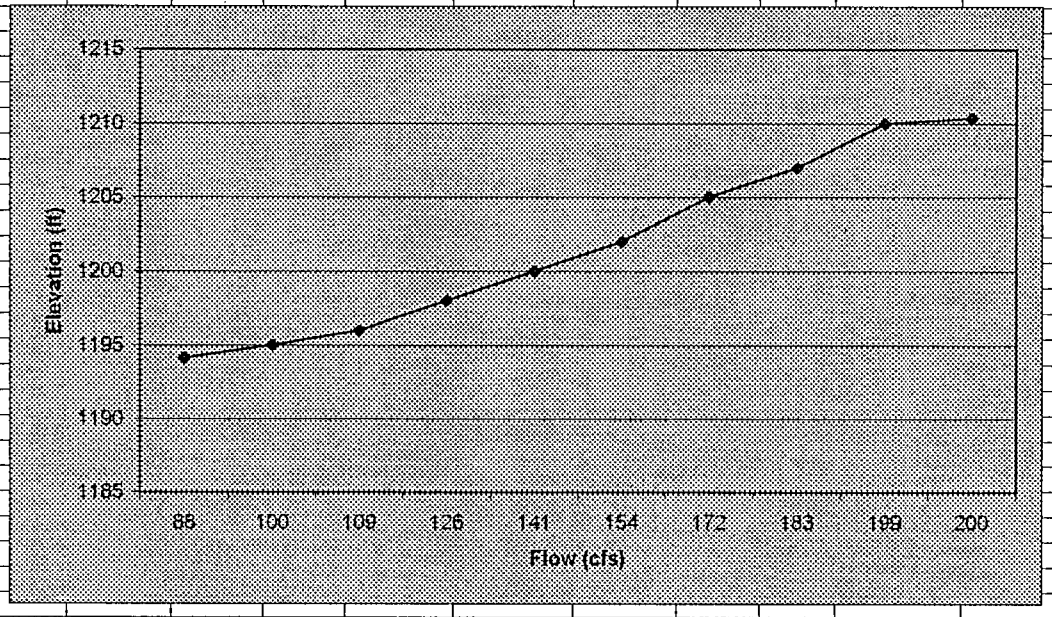
White Tanks
Outlet Flow Capacity - Extended Pipes

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	South Pipe												
2	diameter (ft)	2											
3	length (ft)	145.87											
4	inlet invert elevation (ft)	1192.004											
5	outlet invert elevation (ft)	1189.261											
6	hydraulic radius (ft)	0.5											
7													
8	water elevation at inlet	headwater depth, h1	tailwater depth, h2	velocity	Manning's roughness	Hazen-Williams Coeff., Ch	Entrance loss coeff.	Exit loss coeff.	(z1-z2)	Physical (h1+d1+z1)-(h2+d2+z2)	Outlet Control, Q	Linsley/ Franzini Inlet Control, Q	pipe flow
9	(ft)	(ft)	(ft)	(fps)					(feet)	(feet)	(cfs)	(cfs)	(cfs)
10	1194.004	0.0	0	4.5	0.024	54.5	0.50	1.0	2.74	2.74	14	16	14
11	1195	1.0	0	5.3	0.024	53.9	0.50	1.0	3.74	3.74	17	22	17
12	1196	2.0	0	5.9	0.024	53.3	0.50	1.0	4.74	4.74	19	27	19
13	1198	4.0	0	7.1	0.024	52.6	0.50	1.0	6.74	6.74	22	35	22
14	1200	6.0	0	8.1	0.024	52.0	0.50	1.0	8.74	8.74	25	41	25
15	1202	8.0	0	8.9	0.024	51.6	0.50	1.0	10.74	10.74	28	47	28
16	1205	11.0	0	10.1	0.024	51.1	0.50	1.0	13.74	13.74	32	54	32
17	1207	13.0	0	10.8	0.024	50.8	0.50	1.0	15.74	15.74	34	58	34
18	1210	16.0	0.	11.8	0.024	50.4	0.50	1.0	18.74	18.74	37	64	37
19	1210.34	16.3	0	11.9	0.024	50.4	0.50	1.0	19.08	19.08	37	65	37



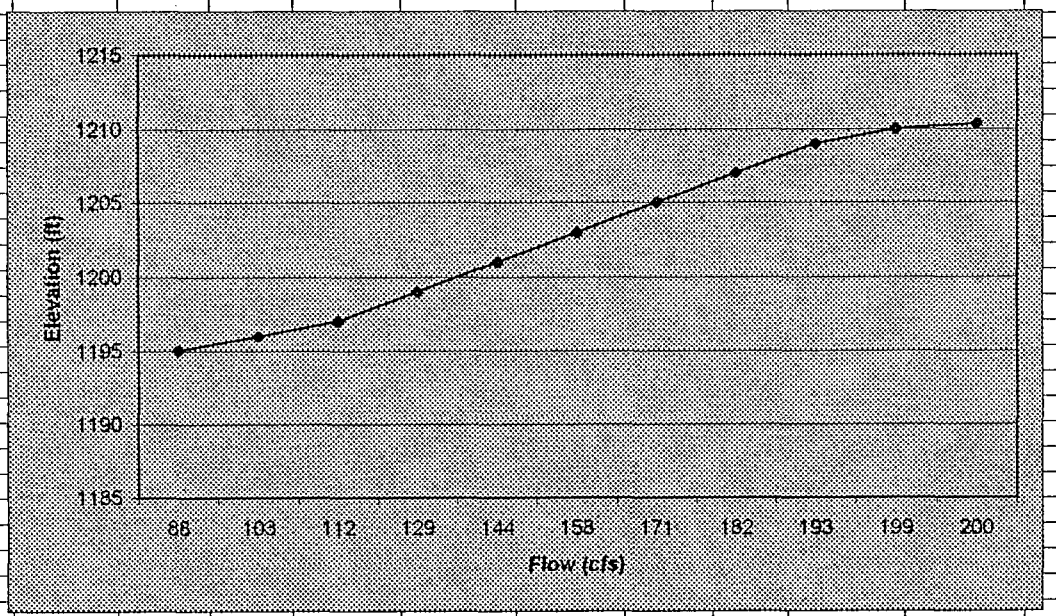
White Tanks
Outlet Flow Capacity - Extended Pipes

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Central Pipe												
2	diameter (ft)	4											
3	length (ft)	159.16											
4	inlet invert elevation (ft)	1190.107											
5	outlet invert elevation (ft)	1185.918											
6	hydraulic radius (ft)	1											
7													
8	water elevation at inlet	headwater depth, h1	tailwater depth, h2	velocity	Manning's roughness	Hazen-Williams Coeff., Ch	Entrance loss coeff.	Exit loss coeff.	(z1-z2)	Physical (h1+d1+z1)-(h2+d2+z2)	Outlet Control, Q	Linsley/ Franzini Inlet Control, Q	pipe flow
9	(ft)	(ft)	(ft)	(fps)					(feet)	(feet)	(cfs)	(cfs)	(cfs)
10	1194.107	0.0	0	7.2	0.024	55.9	0.50	1.0	4.19	4.19	91	88	88
11	1195	0.9	0	8.0	0.024	55.4	0.50	1.0	5.08	5.08	100	106	100
12	1196	1.9	0	8.7	0.024	55.0	0.50	1.0	6.08	6.08	109	123	109
13	1198	3.9	0	10.0	0.024	54.4	0.50	1.0	8.08	8.08	126	152	126
14	1200	5.9	0	11.2	0.024	53.9	0.50	1.0	10.08	10.08	141	176	141
15	1202	7.9	0	12.3	0.024	53.5	0.50	1.0	12.08	12.08	154	197	154
16	1205	10.9	0	13.7	0.024	53.0	0.50	1.0	15.08	15.08	172	225	172
17	1207	12.9	0	14.6	0.024	52.8	0.50	1.0	17.08	17.08	183	241	183
18	1210	15.9	0	15.8	0.024	52.4	0.50	1.0	20.08	20.08	199	264	199
19	1210.34	16.2	0	15.9	0.024	52.4	0.50	1.0	20.42	20.42	200	267	200



White Tanks
Outlet Flow Capacity - Extended Pipes

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	North Pipe												
2	diameter (ft)	4											
3	length (ft)	144.35											
4	inlet invert elevation (ft)	1191.034											
5	outlet invert elevation (ft)	1186.891											
6	hydraulic radius (ft)	1											
7													
8	water elevation at inlet	headwater depth, h1	tailwater depth, h2	velocity	Manning's roughness	Hazen-Williams Coeff., Ch	Entrance loss coeff.	Exit loss coeff.	(z1-z2)	Physical (h1+d1+z1)-(h2+d2+z2)	Outlet Control, Q	Linsley/ Franzini Inlet Control, Q	pipe flow
9	(ft)	(ft)	(ft)	(fps)					(feet)	(feet)	(cfs)	(cfs)	(cfs)
10	1195.034	0.0	0	7.4	0.024	55.8	0.50	1.0	4.14	4.14	92	88	88
11	1196	1.0	0	8.2	0.024	55.3	0.50	1.0	5.11	5.11	103	108	103
12	1197	2.0	0	8.9	0.024	54.9	0.50	1.0	6.11	6.11	112	125	112
13	1199	4.0	0	10.3	0.024	54.3	0.50	1.0	8.11	8.11	129	153	129
14	1201	6.0	0	11.5	0.024	53.8	0.50	1.0	10.11	10.11	144	176	144
15	1203	8.0	0	12.6	0.024	53.4	0.50	1.0	12.11	12.11	158	197	158
16	1205	10.0	0	13.6	0.024	53.1	0.50	1.0	14.11	14.11	171	216	171
17	1207	12.0	0	14.5	0.024	52.8	0.50	1.0	16.11	16.11	182	234	182
18	1209	14.0	0	15.4	0.024	52.5	0.50	1.0	18.11	18.11	193	250	193
19	1210	15.0	0	15.8	0.024	52.4	0.50	1.0	19.11	19.11	199	258	199
20	1210.34	15.3	0	15.9	0.024	52.4	0.50	1.0	19.45	19.45	200	260	200



BKW 5-26 7

White Tanks
Existing Outlet Flow Capacity

	A	B	C	D	E	F
1	**South Pipe**					
2	diameter (ft)	2				
3	length (ft)	145.87				
4	inlet invert elevation (ft)	1192.004				
5	outlet invert elevation (ft)	1189.261				
6	hydraulic radius (ft)	=B2/4 → R = D/4				
7						
8	water elevation at inlet	headwater depth, h1	tailwater depth, h2	velocity	Manning's roughness	Hazen-Williams Coeff., Ch
9	(ft)	(ft)	(ft)	(fps)		
10	1194.004	=A10-$B$4-$B$2	0	**4.51043**	0.024	=(6.67*($B$6^(4/3))/((E10^2)*(D10^0.15)*($B$2^1.167)))^(1/1.85)
11	1195	=A11-$B$4-$B$2	0	**5.26961**	0.024	=(6.67*($B$6^(4/3))/((E11^2)*(D11^0.15)*($B$2^1.167)))^(1/1.85)
12	1196	=A12-$B$4-$B$2	0	**5.93242**	0.024	=(6.67*($B$6^(4/3))/((E12^2)*(D12^0.15)*($B$2^1.167)))^(1/1.85)
13	1198	=A13-$B$4-$B$2	0	**7.07418**	0.024	=(6.67*($B$6^(4/3))/((E13^2)*(D13^0.15)*($B$2^1.167)))^(1/1.85)
14	1200	=A14-$B$4-$B$2	0	**8.05552**	0.024	=(6.67*($B$6^(4/3))/((E14^2)*(D14^0.15)*($B$2^1.167)))^(1/1.85)
15	1202	=A15-$B$4-$B$2	0	**8.92994**	0.024	=(6.67*($B$6^(4/3))/((E15^2)*(D15^0.15)*($B$2^1.167)))^(1/1.85)
16	1205	=A16-$B$4-$B$2	0	**10.1004**	0.024	=(6.67*($B$6^(4/3))/((E16^2)*(D16^0.15)*($B$2^1.167)))^(1/1.85)
17	1207	=A17-$B$4-$B$2	0	**10.8104**	0.024	=(6.67*($B$6^(4/3))/((E17^2)*(D17^0.15)*($B$2^1.167)))^(1/1.85)
18	1210	=A18-$B$4-$B$2	0	**11.7959**	0.024	=(6.67*($B$6^(4/3))/((E18^2)*(D18^0.15)*($B$2^1.167)))^(1/1.85)
19	1210.34	=A19-$B$4-$B$2	0	**11.9024**	0.024	=(6.67*($B$6^(4/3))/((E19^2)*(D19^0.15)*($B$2^1.167)))^(1/1.85)
20						

= water elev. @ inlet
- inlet invert elev
- pipe dia

Found using Goal Seek by equating $z_1 - z_2$ (column I) to the Physical $(h_1 + d_1 + z_1) - (h_2 + d_2 + z_2)$ (column J)

set Chézy - Mannings head loss = Hazen-Williams and solve for C_H

$$\frac{V^2 n^2 L}{2.21 R^{4/3}} = 3.02 L D^{-1.167} \frac{V^{1.85}}{C_H^{1.85}}$$

$$C_H = \frac{(6.67 R^{4/3})}{(n^2 V^{0.15} D^{1.167})^{1/1.85}}$$

(see solution for C_H in previous pages)

White Tanks
Existing Outlet Flow Capacity

	C	G	H	I	J
1					
2					
3					
4					
5					
6					
7					
8	tailwater depth, h2	Entrance loss coeff.	Exit loss coeff.	(z1-z2)	Physical (h1+d1+z1)-(h2+d2+z2)
9	(ft)			(feet)	(feet)
10	0	0.5	1	=((D10^2)/(2*32.2))*(1+G10+H10)+3.02*$B$3*($B$2^-1.167)*((D10/F10)^1.85)	=($B$4+$B$2+B10)-($B$5+$B$2+C10)
11	0	0.5	1	=((D11^2)/(2*32.2))*(1+G11+H11)+3.02*$B$3*($B$2^-1.167)*((D11/F11)^1.85)	=($B$4+$B$2+B11)-($B$5+$B$2+C11)
12	0	0.5	1	=((D12^2)/(2*32.2))*(1+G12+H12)+3.02*$B$3*($B$2^-1.167)*((D12/F12)^1.85)	=($B$4+$B$2+B12)-($B$5+$B$2+C12)
13	0	0.5	1	=((D13^2)/(2*32.2))*(1+G13+H13)+3.02*$B$3*($B$2^-1.167)*((D13/F13)^1.85)	=($B$4+$B$2+B13)-($B$5+$B$2+C13)
14	0	0.5	1	=((D14^2)/(2*32.2))*(1+G14+H14)+3.02*$B$3*($B$2^-1.167)*((D14/F14)^1.85)	=($B$4+$B$2+B14)-($B$5+$B$2+C14)
15	0	0.5	1	=((D15^2)/(2*32.2))*(1+G15+H15)+3.02*$B$3*($B$2^-1.167)*((D15/F15)^1.85)	=($B$4+$B$2+B15)-($B$5+$B$2+C15)
16	0	0.5	1	=((D16^2)/(2*32.2))*(1+G16+H16)+3.02*$B$3*($B$2^-1.167)*((D16/F16)^1.85)	=($B$4+$B$2+B16)-($B$5+$B$2+C16)
17	0	0.5	1	=((D17^2)/(2*32.2))*(1+G17+H17)+3.02*$B$3*($B$2^-1.167)*((D17/F17)^1.85)	=($B$4+$B$2+B17)-($B$5+$B$2+C17)
18	0	0.5	1	=((D18^2)/(2*32.2))*(1+G18+H18)+3.02*$B$3*($B$2^-1.167)*((D18/F18)^1.85)	=($B$4+$B$2+B18)-($B$5+$B$2+C18)
19	0	0.5	1	=((D19^2)/(2*32.2))*(1+G19+H19)+3.02*$B$3*($B$2^-1.167)*((D19/F19)^1.85)	=($B$4+$B$2+B19)-($B$5+$B$2+C19)
20					

$$= \left(\frac{V^2}{2g}\right) * \left(\overbrace{1 + \text{Entrance Loss} + \text{Exit Loss}}^{\text{minor losses}}\right) + 3.02 * L * \left(D^{-1.167}\right) * \left(\frac{V}{C_H}\right)^{1.85}$$

= (inlet invert elev + Dia + headwater depth) - (Outlet Invert Elev. + Dia + Tailwater Depth)

BCW 5-26

White Tanks
Existing Outlet Flow Capacity

	C	K	L	M
1				
2				
3				
4				
5				
6				
7				
8	tailwater depth, h2	Outlet Control, Q	Linsley/ Franzini Inlet Control, Q	pipe flow
9	(ft)	(cfs)	(cfs)	(cfs)
10	0	=D10*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B10+($B$2/2)))^0.5	=IF(K10<L10,K10,L10)
11	0	=D11*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B11+($B$2/2)))^0.5	=IF(K11<L11,K11,L11)
12	0	=D12*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B12+($B$2/2)))^0.5	=IF(K12<L12,K12,L12)
13	0	=D13*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B13+($B$2/2)))^0.5	=IF(K13<L13,K13,L13)
14	0	=D14*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B14+($B$2/2)))^0.5	=IF(K14<L14,K14,L14)
15	0	=D15*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B15+($B$2/2)))^0.5	=IF(K15<L15,K15,L15)
16	0	=D16*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B16+($B$2/2)))^0.5	=IF(K16<L16,K16,L16)
17	0	=D17*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B17+($B$2/2)))^0.5	=IF(K17<L17,K17,L17)
18	0	=D18*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B18+($B$2/2)))^0.5	=IF(K18<L18,K18,L18)
19	0	=D19*(3.1416/4)*($B$2^2)	=0.62*((3.1416/4)*($B$2^2))*(2*32.2*(B19+($B$2/2)))^0.5	=IF(K19<L19,K19,L19)
20				

$= V * \pi * \frac{D^2}{4}$

$= 0.62 * \left(\frac{\pi}{4} * \frac{D^2}{4}\right) * \left(2g * (h_{1/2})\right)^{0.5}$

If outlet Control Q < Inlet Control Q, then use outlet Control Q, otherwise use Inlet Control Q

BJW 5-26

10

Modern Sewer Design

Published by

AMERICAN IRON AND STEEL INSTITUTE

First Edition 1980

Second Edition 1990

TABLE 4.9 Values of Coefficient of Roughness (n) for Standard Corrugated Steel Pipe [4, 5, 6] (Manning's Formula)*

Corrugations	Annular $2^2/_3 \times {}^1/_2$ in. All Diameters	Helical $1^1/_2 \times {}^1/_4$ in 8 in.	10 in.	12 in.	18 in.	$2^2/_3 \times {}^1/_2$ in 24 in.	36 in.	48 in.	60 in. and Larger
Unpaved	0.024	0.012	0.014	0.011	0.013	0.015	0.018	0.020	0.021
25% Paved	0.021					0.014	0.017	0.020	0.019

Corrugations	Annular 3 x 1 in.	Helical — 3 x 1 in. 48 in.	54 in.	60 in.	66 in.	72 in.	78 in./Larger
Unpaved	0.027	0.023	0.023	0.024	0.025	0.026	0.027
25% Paved	0.023	0.020	0.020	0.021	0.022	0.022	0.023

Corrugations	Annular 5 x 1 in.	Helical — 5 x 1 in. 54 in.	60 in.	66 in.		78 in./Larger
Unpaved	0.025	0.022	0.023	0.024		0.025
25% Paved	0.022	0.019	0.020	0.021		0.022

All pipe with smooth interior**	All Diameters n = 0.012

*AISI
**Includes fully paved, concrete lined, spiral rib & doublewall pipe.

TABLE 4.10 Values of n for Structural Plate Pipe for 6 in. x 2 in. Corrugations (Manning's Formula)

Corrugations 6 x 2 in.	Diameters 5 ft.	7 ft.	10 ft.	15 ft.
Plain—unpaved	0.033	0.032	0.030	0.028
25% Paved	0.028	0.027	0.026	0.024

Figure 4.8 provides nomographs for estimating steady uniform flows for pipes flowing full, using the Manning equation. In cases where conduits are flowing only partly full, the corresponding hydraulic ratios may be determined from Figures 4.9 and 4.10.

Kutter Equation

The Kutter Equation is used for open channel calculations in certain areas of the United States. It is an empirically derived relation between the Chezy coefficient 'C' and the Manning roughness coefficient 'n.' As stated the equation is intended for use with U.S. Customary (Imperial) units.

$$Q = A \cdot C \cdot R^{1/2} \cdot S_f^{1/2}$$

where $$C = \frac{41.65 + \dfrac{.00281}{n} + \dfrac{1.811}{n}}{1 + (41.65 + \dfrac{0.00281}{S_f})\dfrac{n}{\sqrt{R}}}$$

13

Hydraulic Engineering

John A. Roberson
John J. Cassidy
M. Hanif Chaudhry

Houghton Mifflin Company Boston
Dallas / Geneva, Illinois
Palo Alto / Princeton, New Jersey

Head Loss Using the Hazen-Williams Formula

The head loss formulas we have presented up to now are general because they are applicable for any fluid and any system of units. Other more restrictive empirical equations are also useful for their limited range of application. The most notable one, used for decades by waterworks engineers in the United States, is the Hazen-Williams formula. In English units, the formula is given in Eq. (5-12):

$$V = 1.318 C_h R^{0.63} S^{0.54} \tag{5-12}$$

where V = mean velocity in ft/s
C_h = Hazen-Williams friction coefficient (depends on pipe roughness)
R = hydraulic radius in ft
$S = h_f/L$ (slope of energy grade line)

To solve for head loss using the Hazen-Williams equation, a little algebraic manipulation of Eq. (5-12) yields

$$h_f = 3.02 L D^{-1.167} \left(\frac{V}{C_h}\right)^{1.85} \tag{5-13}$$

The resistance coefficient C_h depends on the surface characteristics of the pipe

Table 5-2 Hazen-Williams C_h Values for Different Kinds of Pipe (5)

Character of Pipe	C_h
New or in excellent condition cast-iron and steel pipe with cement or bituminous linings centrifugally applied, concrete pipe centrifugally spun, cement-asbestos pipe, copper tubing, brass pipe, plastic pipe, and glass pipe	140
Older pipe listed above in good condition, and cement mortar-lined pipes in place with good workmanship, larger than 24 in. in diameter	130
Cement mortar-lined pipe in place, small diameter with good workmanship or large diameter with ordinary workmanship; wood stave; tar dipped cast-iron pipe new or old in inactive water	120
Old unlined or tar-dipped cast-iron pipe in good condition	100
Old cast-iron pipe severely tuberculated, or any pipe with heavy deposits	10–80

15

WATER-RESOURCES ENGINEERING

Fourth Edition

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Stanford University
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TABLE 11.1
Values of Hazen-Williams coefficient C_H

Pipe material	C_H
Brick sewers	100
Cast iron	
New	130
5 yr old	120
20 yr old	100
Concrete (regardless of age)	130
Plastic (PVC)	140
Riveted steel, new	110
Vitrified clay	110
Welded steel, new	120
Wood stave (regardless of age)	120

Example 11.1 Find the head loss in 1000 ft of 6-ft-diameter smooth concrete pipe carrying 80 cfs of water at 50°F.

Solution. By the Darcy-Weisbach formula,

$$V = \frac{Q}{A} = \frac{80 \times 4}{\pi \times 6^2} = 2.83 \text{ ft/sec}$$

$$N_R = \frac{DV}{\nu} = \frac{6 \times 2.83}{1.41 \times 10^{-5}} = 1.20 \times 10^6$$

Assume $e = 0.001$ ft; then $e/D = 0.001/6 = 0.00017$ and $f = 0.014$ from Fig. 11.2.

$$h_L = f\frac{L}{D}\frac{V^2}{2g} = 0.014\,\frac{1000 \times 2.83^2}{6 \times 64.4} = 0.29 \text{ ft}$$

By the Chézy-Manning formula, using $n = 0.013$,

$$h_L = SL = \frac{V^2 n^2 L}{2.21 R^{4/3}} = \frac{2.83^2 \times 0.013^2 \times 1000}{2.22 \times 1.5^{4/3}} = 0.36 \text{ ft}$$

$R = \frac{A}{wp} = \frac{\pi r^2}{2\pi r} = r/2$

By the Hazen-Williams formula, using $C_H = 130$,

$$h_L = SL = \frac{V^{1.85} L}{(1.318 C_H)^{1.85} R^{1.17}} = \frac{2.83^{1.85} \times 1000}{(1.318 \times 130)^{1.85} \times 1.5^{1.17}} = 0.31 \text{ ft}$$

The main element of uncertainty in all methods is the selection of the roughness coefficient. Tests indicate that the absolute roughness of most metal pipes increases more or less linearly with the time of use. The carrying capacity of ordinary tar-dipped cast-iron pipe will decrease about 30 percent in 20 yr. The

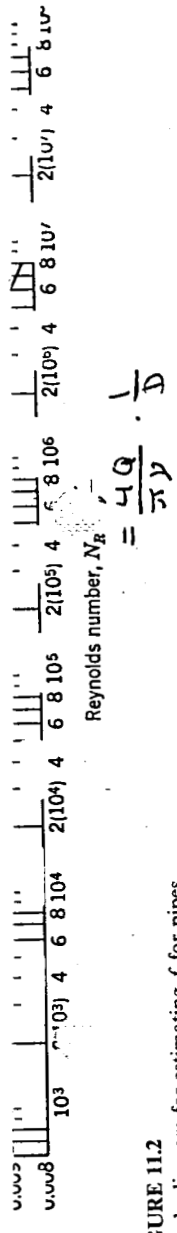

FIGURE 11.2
Moody diagram for estimating f for pipes.

DAMES & MOORE

CALCULATIONS COVER SHEET

SUBJECT: INTERIM DAM SAFETY – FRS #3

PROJECT NO. _____

SHEET _____ OF _____

* REVISED *

DIAPHRAGM FILTER AND THICKNESS OF SOIL BUTTRESS

TITLE OF CALCULATIONS/DOCUMENT

#14

CALCULATIONS/DOCUMENT BY: KEVIN R. SOMERVILLE (PRINT NAME)

Kevin R. Somerville (SIGNATURE) 3-30-01 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Ravi MURTHY (PRINT NAME)

Ravi (SIGNATURE) 04/10/01 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Ravi MURTHY (PRINT NAME)

Ravi (SIGNATURE) 04/10/01 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 4-13-01 (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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4				

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2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
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   - Project Design Criteria
   - Project Procedures?

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7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

TABLE 1 REVISED
SUMMARY OF MINIMUM THICKNESS OF SOIL BUTTRESS FILL
INTERIM DAM SAFETY
FCDMC WHITE TANKS FRS #3

SCENARIO: ONE (1) FOOT OF SAND ADDED OVER TOP OF CONCRETE COLLAR ENCASEMENT

LOCATION	THICKNESS OF SOIL BUTTRESS			EVALUATION RESULTS
	DESIGN THICKNESS FOR CONSTRUCTION (feet)		MINIMUM THICKNESS REQUIRED (feet)	
NORTH OUTLET PIPE				
POINT A	4.5	>	3.9	okay
POINT B	**13.5**	>	**8.75**	okay
POINT C	11.5	>	10.9	okay
POINT D	**9.7**	>	**8.75**	okay
CENTRAL OUTLET PIPE				
POINT A	5.0	>	4.3	okay
POINT B	**14.0**	>	**8.75**	okay
POINT C	12.0	>	11.3	okay
POINT D	**10.2**	>	**8.75**	okay
SOUTH OUTLET PIPE				
POINT A	7.5	>	6.7	okay
POINT B	**11.5**	>	**8.63**	okay
POINT C	11.0	>	10.2	okay
POINT D	**10.0**	>	**8.63**	okay

Notes:

1. All "Design for Construction" thickness values rounded up to equal or greater than one-half foot.
2. Small print values are same as shown in calculation package dated 5-8-00.
3. Large print and bold values are revised for this calculation package to check with added sand over concrete collar.

URS

Job _____ Project No. 15448007 Page ____ of ____

Description _____ Computed by KRS Sheet ____ of ____

Checked by _____ Date 3/30/01

Date _____

Reference

CENTRAL OUTLET

CALC: $\frac{1}{2}(1210.5 - 1193.0) = 17.50$

$\frac{17.50}{2} = 8.75$ ✓

SEE RADIUS MEASUREMENT BY CAD = 14.0' ON DWG

THEREFORE @ POINT B: 14.0' > 8.75' OKAY

@ POINT D: 10.20' > 8.75' OKAY

@ POINT A: - SAME AS 5-8-00 CALC

@ POINT C: - SAME AS 5-8-00 CALC

Calc. No.

Rev. No.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

By JWL Date 5/8/00

Job No. 15448-007 Job White Tanks FRS #3

Chk'd. BW Date 5/16/00

Client Subject

Summary Table 1: Minimum Thickness of Soil Buttress Fill

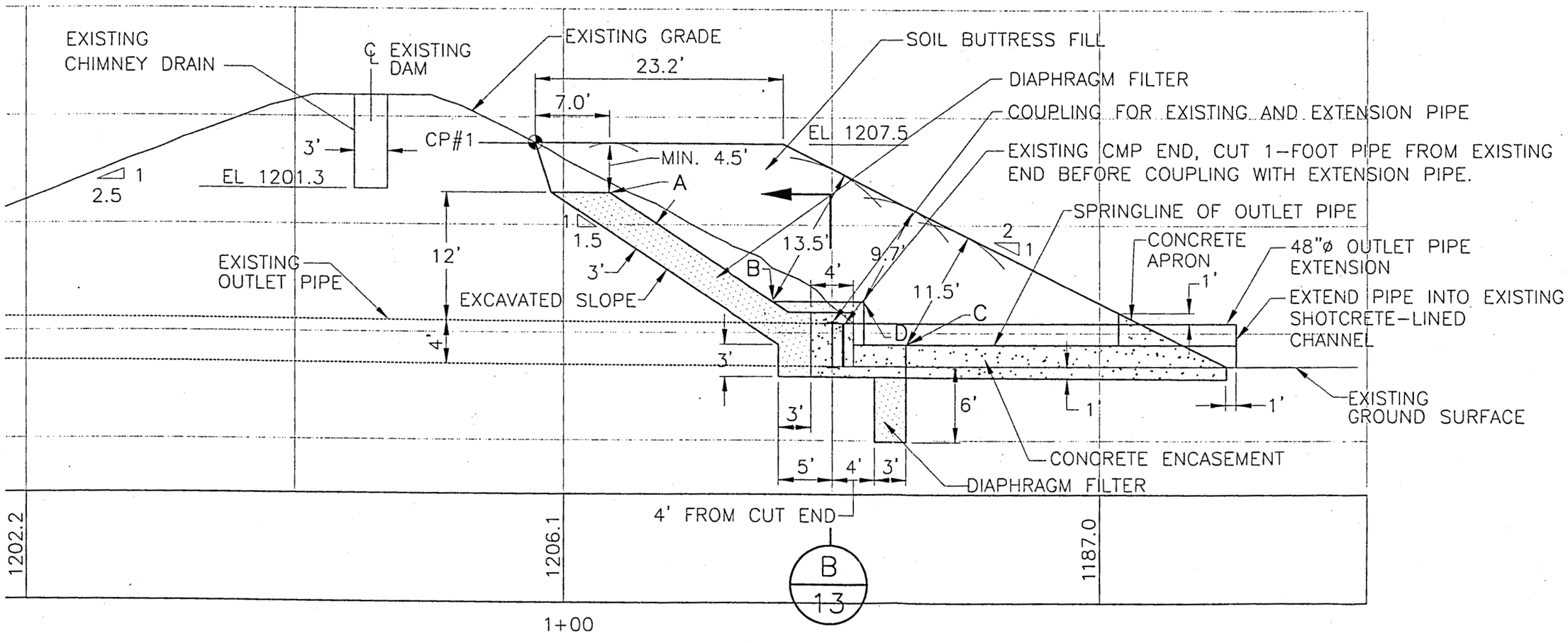
Location of Outlet Pipe		North	Central	South
Minimum Thickness of Soil Buttress Fill (ft)	Point A	3.9	4.3	6.7
	Point B	9.4	9.8	9.2
	Point C	10.9	11.3	10.2

Summary Table 2: Construction Thickness of Soil Buttress Fill

Location of Outlet Pipe		North	Central	South
Construction Thickness of Soil Buttress Fill (ft)	Point A	4.5	5.0	7.5
	Point B	10.0	10.5	10.0
	Point C	11.5	12.0	11.0

→ From 5-8-00 Calculation

POINT I.D.	ELEVATION (FT.)
A	1203.0
B	1193.0
C	1189.0
D	1193.0



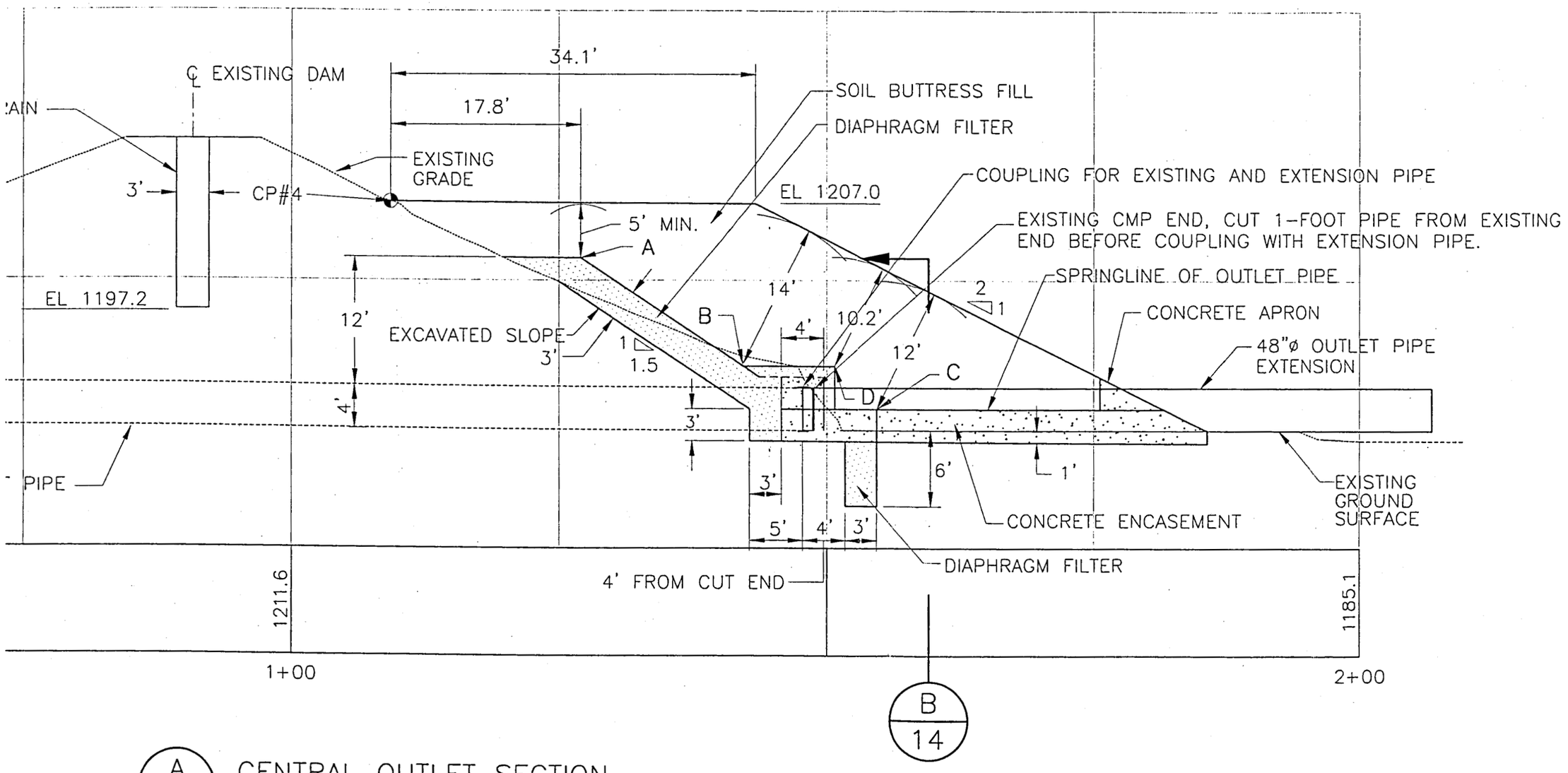
A
13
NORTH OUTLET SECTION

0 10 20
SCALE IN FEET

NOTE 1: FILTER EXTENDS TO POINT C.

NOTE 2: SPECIAL PRECAUTIONS MUST BE TAKEN WHEN CUTTING EXISTING CMP DUE TO PRESENCE OF

POINT I.D.	ELEVATION (FT.)
A	1202.0
B	1193.0
C	1189.0
D	1193.0



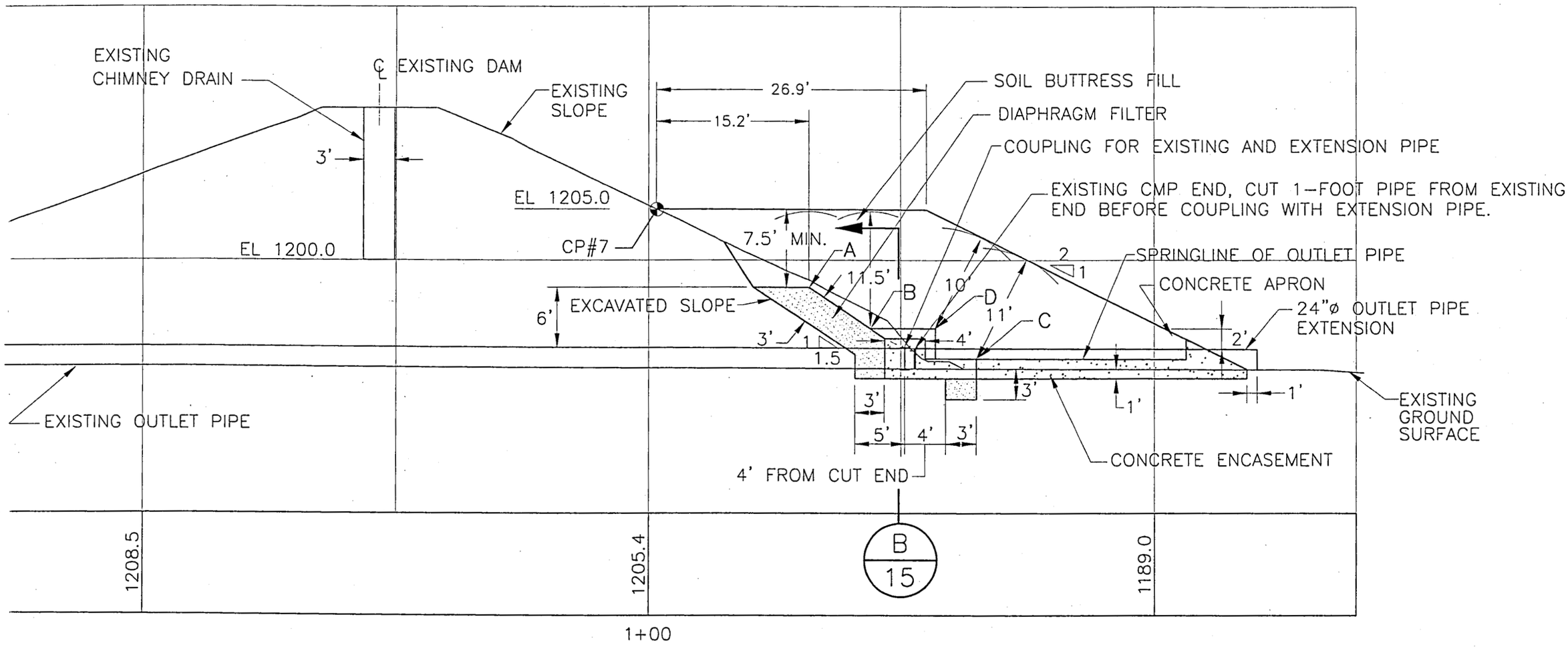
A / 14 CENTRAL OUTLET SECTION

0 10 20
SCALE IN FEET

NOTE 1: FILTER EXTENDS TO POINT C.

NOTE 2: SPECIAL PRECAUTIONS MUST BE TAKEN WHEN CUTTING EXISTING CMP DUE TO PRESENCE OF ASBESTOS CONTAINING MATERIALS.

POINT I.D.	ELEVATION (FT.)
A	1197.5
B	1193.5
C	1190.5
D	1193.5



A
15

SOUTH OUTLET SECTION

0 10 20
SCALE IN FEET

NOTE 1: FILTER EXTENDS TO POINT C.

NOTE 2: SPECIAL PRECAUTIONS MUST BE TAKEN WHEN CUTTING EXISTING CMP DUE TO PRESENCE OF ASBESTOS CONTAINING MATERIALS

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. _____

SUBJECT: _____

SHEET _____ OF _____

GEOTEXTILE AROUND DRAIN MATERIAL

TITLE OF CALCULATIONS/DOCUMENT

FILTER MATCH BETWEEN FABRIC AND BUTTRESS, AND FOUNDATION

#15

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME)

Ravi (SIGNATURE) 04/12/01 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: KEVIN R. SOMERVILLE (PRINT NAME)

Kevin R. Somerville (SIGNATURE) 4-12-01 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME)

Kevin R. Somerville (SIGNATURE) 4-12-01 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 4-13-01 (DATE)

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    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

URS

Page 2 of ____

Job WHITE TANKS FRS#3 | Project No. ____ | Sheet ____ of ____

Description BUTTRESS FILL & BASE SOIL VS. FILTER FABRIC | Computed by ____ | Date ____

Checked by ____ | Date ____

Reference

OBJECTIVE: To check the compatability of the buttress fill versus geotextile wrap around drain. & BASE SOIL Vs. Geotextile

BUTTRESS FILL

* From Fig 1, D_{85} = 7.5mm to 22mm

* Specs allow for 6oz to 12oz/sq yd geotextile from SI Industries Product specs, typical AOS (O_{95}) = 0.106mm to 0.150mm

NOTE: SYNTHETIC INDUSTRIES USED AS TYPICAL

* From "Designing with Geosynthetics" - RM Koerner 3rd Ed, Pg 101 & Carroll (1983)

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

$$O_{95}/D_{85} = 0.0048 \text{ to } 0.02 \leq 2 \therefore \text{OK} \checkmark$$

BASE SOIL (FOUNDATION)

* From Fig 2, D_{85} = 6mm

* From above, AOS (O_{95}) = 0.106mm to 0.150mm

* $O_{95}/D_{85} = 0.106/6\text{mm} = 0.018 \ll 2 \Rightarrow \text{OK} \checkmark$

D_{15} = 0.2 mm to [illegible]
D_{50} = 2.7mm to 11mm
D_{85} = 7.5mm to 22mm
D_{90} = 8.8mm to 26mm

White Tanks FRS #3 Interim Dam Safety
Soil Buttress Fill

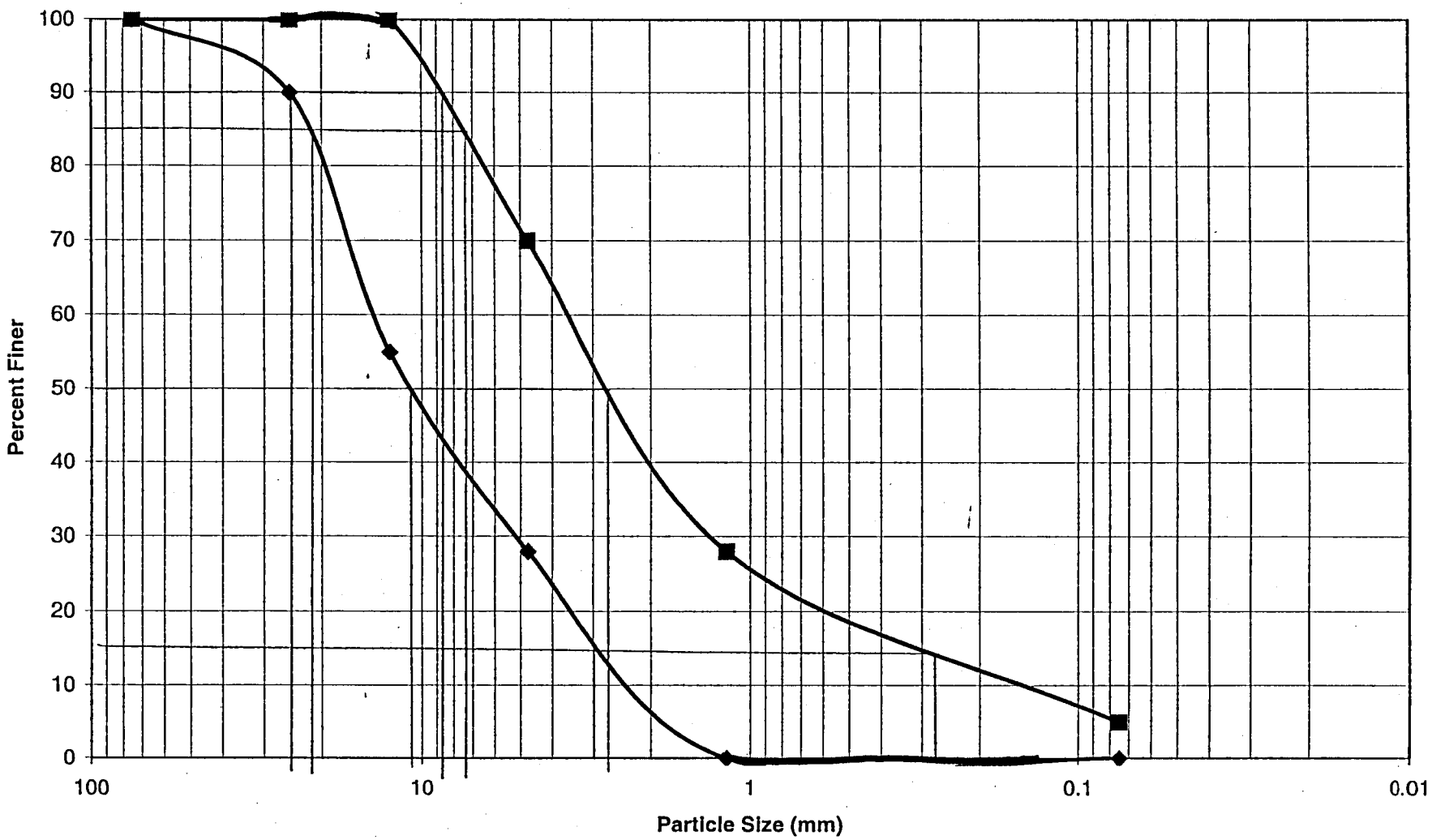


Fig 1

PARTICLE SIZE ANALYSIS

DAMES & MOORE GROUP

Project: White Tanks FRS #3 Project No.: 15448-005-022 Date: December 21, 1998

Client: Maricopa County Flood Control District

Stockpile/Windrow Sample

Location:

Drilled Sample:

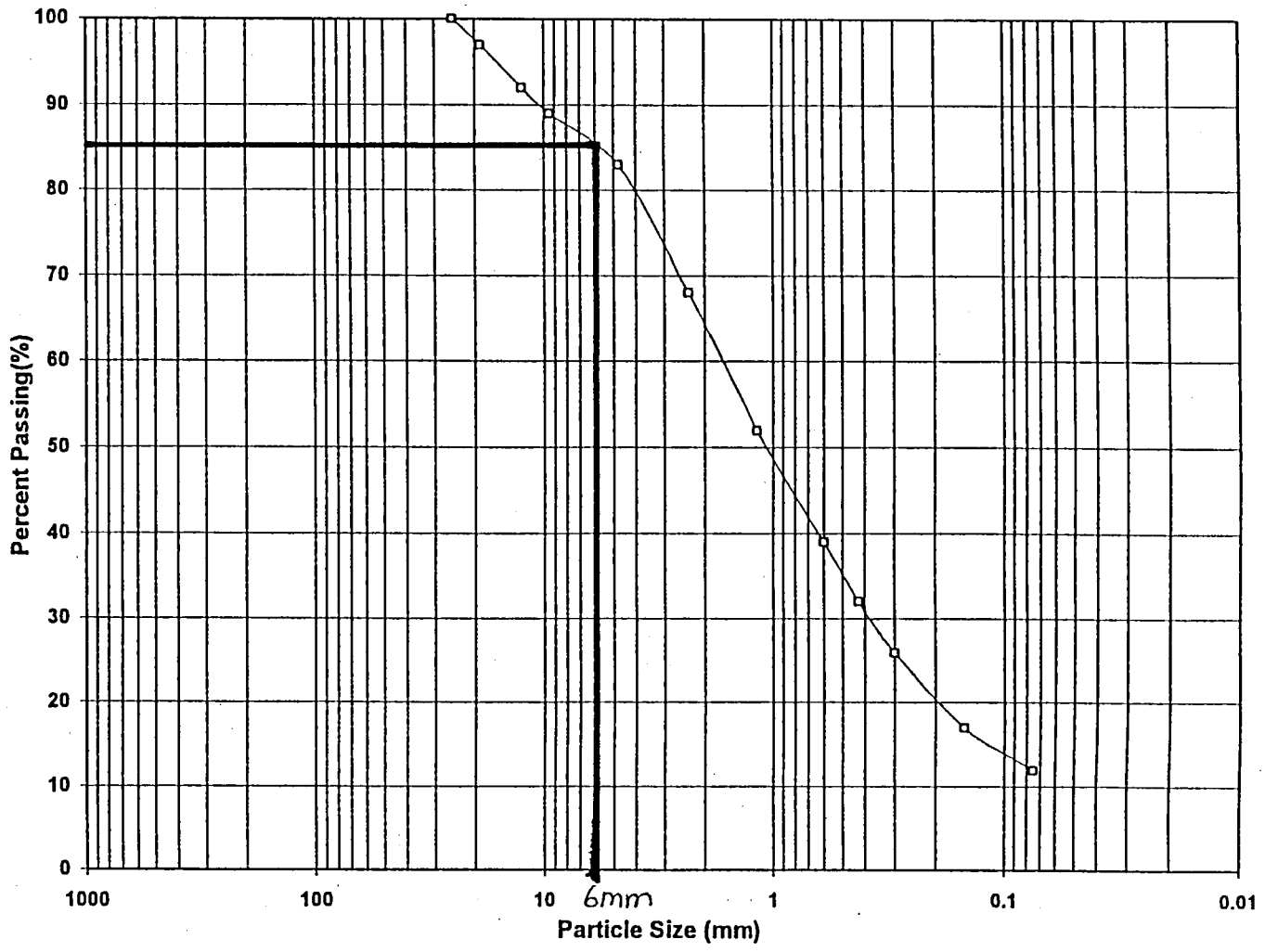
Boring DMB-9 Sample # 5 Depth 30'

Sieve US Std	Sieve Metric(mm)	Percent Passing	Specification
3"	75.0		
2.5"	62.5		
2"	50.0		
1.5"	37.5		
1.25"	31.3		
1"	25.0	100	
3/4"	19.0	97	
1/2"	12.5	92	
3/8"	9.5	89	
#4	4.75	83	
#8	2.36	68	
#10	2.0		
#16	1.18	52	
#30	0.6	39	
#40	0.43	32	
#50	0.3	26	
#100	0.15	17	
#200	0.075	11.9	

Plasticity Index NONPLASTIC

USCS Classification: SP-SM

(FOUNDATION) BASE SOIL GRADATION FIG 2



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 $O_{50}/d_{85} \leq 0.5$	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)	$O_{50}/d_{85} \leq 0.8$	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}.

MES & MOORE

CALCULATIONS COVER SHEET

WHITE TANKS FRS# 3

PROJECT NO. _____

SHEET _____ OF _____

SIZING OF DRAIN PIPES

TITLE OF CALCULATIONS/DOCUMENT

#16

CALCULATIONS/DOCUMENT BY: RAVI MURTHY, P.E. (PRINT NAME) — SIGNATURE — DATE 04/11/01

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: KEVIN R. SOMERVILLE (PRINT NAME) — SIGNATURE — DATE 4-11-01

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME) — SIGNATURE — DATE 4-11-01

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME) — SIGNATURE — DATE 4-13-01

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    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

URS

Page 2 of ____

Job WHITE TANKS FRS #3 | Project No. ____ | Sheet ____ of ____

Description SIZING OF DRAIN PIPES | Computed by RAVI MURTHY | Date 09/10/01

Checked by ____ | Date ____

Reference

OBJECTIVE : To estimate slotted pipe diameters required as part of the drain system to convey ~~the~~ seepage water from the diaphragm filter to the d/s toe.

NORTH OUTLET:

Darcy's Eq^n $Q = KiA$

K : permeability of the filter

i : Hydraulic Conductivity = $\frac{\text{Head Loss}}{\text{Distance}}$

A = Cross Sectional area ~~of~~ (face) of filter

FILTER

Permeability : See Fig 1 For gradation specification based on Subsection 211.1.1, Sp Page 10 of 64, "Design Report Interim Dam Safety Improvements" Dated Feb 7, 2001.

From EM 1110-2-1901 / 30 Sept 1986 "Seepage Analysis & Control for Dams", Dept of the Army, Corps OF Engineers, Page 2-20 Using Gradation provided in specs

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

From Fig 1, D_{10} ranges from 0.038 cms to 0.175 cms (From specs)

$K_F = 100 \times 0.038^2$ to 100×0.017^2 cms/sec

$K_F = 0.14$ to 0.0289 cms/sec

Conservatively $\boxed{0.14 \text{ cm/sec}} = \boxed{4.6 \times 10^{-3} \text{ ft/s}}$

AREA: From Sheet 13 of 18, Feb 7, 2001 Design Report

$Area_F = 28 \times 22 = \boxed{616 \text{ sq ft}}$

HYDRAULIC GRADIENT : $\frac{h_F}{l_F} = \frac{17}{12} = 1.42$ ✓

$Q_F = 4.6 \times 10^{-3} \times 616 \times 1.42 = 4.02 \Rightarrow \boxed{4.0\ ft^3/sec}$ ✓

CAPACITY OF PROPOSED DRAIN

Permeability $K = 100 \times 0.11^2 = 1.21$ cms/sec $= 0.04$ ft/sec

$i_D = \frac{3}{29.7} = 0.10$

$Area_D = 2 \times \frac{8+5}{2} \times 3 = 39$ sq ft ✓

$Q_{DRAIN} = 0.04 \times 0.1 \times 39 = 0.156\ ft^3/sec$ ✓

$Q_{DRAIN} \ll Q_{FILTER}$

∴ Drain pipes required.

DRAIN PIPE DESIGN

Ref: Soil Mechanics Note #3 - Soil Mechanics Considerations for Embankment Drains - USDA, SCS May 1971
(Pipe data below typical (ADS) from Manufacture Info (ADS))
Assume drains are slotted pipe, minimum opening = 2.5 sq in/ft. ✓
Assume head = 3.0 ft ✓
From Fig A-5, for h = 3.0', and Area of openings = 2.5 sq in, discharge ✓
per foot of length = 0.096 cfs. ✓
Length of pipe = Length of drain = 29.7' ✓
∴ Discharge per pipe = 0.096 × 29.7 = 2.85 cfs ✓
Provide one pipe on each side of CMP ✓
Capacity: 2×2.85 = 5.7 cfs > 4 cfs ⇒ OK

URS

Page 4 of ____

Job WHITE TANKS FRS#3 | Project No. ____ | Sheet ____ of ____

Description SIZING OF DRAIN PIPES | Computed by RAVI MURTHY | Date ____

Checked by ____ | Date ____

Reference

FLOW THROUGH PIPE:

From "Elementary Fluid Mechanics - Street, Watters & Vennard" page 356, Eqn 9.45

$$f = \frac{185 n^2}{d^{1/3}} \checkmark$$

Assume 6" pipe, $n = 0.016$ ✓ (Assuming corrugated interior)

$$f = \frac{185 \times 0.016^2}{0.5^{1/3}} = 0.06 \checkmark$$

$$H = f \cdot \frac{L}{D} \frac{V^2}{2g} + \frac{V^2}{2g} \checkmark$$

$$= \frac{V^2}{2g}\left(f \cdot \frac{L}{D} + 1\right) = \frac{V^2}{64.8}\left(0.06 \times \frac{30}{0.5} + 1\right) \checkmark$$

$$3 = \frac{V^2}{64.8} \times 4.6 \checkmark$$

$$V^2 = 42.3 \quad V = 6.5 \cancel{48} \text{ fps} \checkmark$$

$$Q = \frac{\pi}{4}\left(\frac{6}{12}\right)^2 \times 6.5 = 1.27 \text{ cfs} \checkmark$$

URS

Page 5 of ____

Job WHITE TANKS FRS # 3 | Project No. ____ | Sheet ____ of ____

Description SIZING OF DRAIN PIPES | Computed by RAVI MURTHY | Date ____

Checked by ____ | Date ____

Reference

Note: for smooth interior pipe, assume Mannings $n = 0.012$ (Eqs: ADS Manual)

Assume $d = 8'' = 0.67'$

$$f = \frac{185 n^2}{d^{1/3}} = \frac{185 \times 0.012^2}{\sqrt[3]{(8/12)}} = 0.030$$

$$H = f \cdot \frac{L}{D} \frac{V^2}{2g} + \frac{V^2}{2g}$$

$$= \frac{V^2}{2g}\left[f \cdot \frac{L}{D} + 1\right] = \frac{V^2}{64.8} \times \left[0.03 \times \frac{30}{0.67} + 1\right]$$

$$3 = \frac{V^2}{64.8} \times 2.34$$

$V = 9.1$ fps

$$Q = \frac{\pi}{4} \times \left(\frac{8}{12}\right)^2 \times 9.1 = 3.2 \text{ cfs}$$

∴ Provide 2 pipes

$Q_{TOT} = 6.4$ cfs > 4.0 cfs (Filter) ⇒ OK

CENTRAL OUTLET.

* Approach used same as that for North Outlet

FILTER

$K = 100 D_{10}^2 = 4.6 \times 10^{-3}$ ft/sec

$i = \frac{17}{12} = 1.42$

$A = 28 \times 22 = 616$ sq ft

$Q = KiA = 4.6 \times 10^{-3} \times 1.42 \times 616 = \boxed{4.0 \text{ cfs}}$

DRAIN:

From Fig A-5, USDA, 1971, dicharge per foot of pipe = 0.096 cfs/ft

Length of pipe = Length of drain = 31'

∴ Total discharge = 0.096 x 31 = 2.98 ≈ $\boxed{3.0 \text{ cfs}}$

∴ Provide 1 pipe on each side of CMP outlet.

PIPE DIAMETER

$f = \frac{185 n^2}{d^{1/3}}$ (n = 0.012 for smooth pipe)

For 8" pipe, $f = \frac{185 \times 0.012^2}{\sqrt[3]{8/12}} = 0.030$

$H = f \times \frac{L}{D} \frac{V^2}{2g} + \frac{V^2}{2g} = \frac{V^2}{2g}\left(f \cdot \frac{L}{D} + 1\right)$

$3 = \frac{V^2}{64.8} \times 2.4 \quad V = 9$ fps

$Q = \frac{\pi}{4}\left(\frac{8}{12}\right)^2 \times 9 = 3.14$ cfs ⇒ 6.28 for 2 pipes.

SOUTH OUTLET (Same Approach as for North Outlet)

FILTER

$K = 100 D_{10}^2 = 4.6 \times 10^{-3}$ ft/sec

$i = \frac{9}{12} = 0.75$

$A = 11 \times 14 = 154$ sq ft

$Q = KiA = 4.6 \times 10^{-3} \times 0.75 \times 154 = 0.53$ cfs

DRAIN PIPE

From Fig A-5, USDA 1971, discharge per foot of pipe = 0.078 cfs/ft

Length = 26.8'

$\therefore Q = 0.078 \times 26.8 = 2.1$ cfs

PIPE DIAMETER

Assume $n = 0.012$ for smooth pipe, $d = 6''$, Head = 2'

$$f = \frac{185 n^2}{d^{1/3}} = \frac{185 \times 0.012^2}{\sqrt[3]{6/12}} = 0.034$$

$$H = f \times \frac{L}{D} \frac{V^2}{2g} + \frac{V^2}{2g} = \frac{V^2}{2g}\left(f \cdot \frac{L}{D} + 1\right)$$

$$2 = \frac{V^2}{2 \times 32.4}\left(0.034 \times \frac{26.8}{0.5} + 1\right)$$

$$2 = \frac{V^2}{64.8} \times 2.82 \qquad \therefore V = 6.8 \text{ fps}$$

$$Q = \frac{\pi}{4} \times \left(\frac{6}{12}\right)^2 \times 6.8 = 1.3 \text{ cfs}$$

URS

Job WHITE TANKS FRS#3 | Project No. ____ | Sheet ____ of ____

Description SIZING OF DRAINPIPES | Computed by RAVI MURTHY | Date ____

Checked by ____ | Date ____

Reference

Assume 4" dia pipe

$$f = \frac{185 \times 0.012^2}{\sqrt[3]{(4/12)}} = \frac{185 \times 0.012^2}{\sqrt[3]{4/12}} = 0.038$$

$$H = \frac{V^2}{2g}\left(f \cdot \frac{L}{D} + 1\right)$$

$$2 = \frac{V^2}{2 \times 32.4}\left(0.038 \times \frac{26.8}{(4/12)} + 1\right) = \frac{V^2}{64.8} \times 4.06$$

$$V = 5.65 \text{ fps}$$

$$Q = \frac{\pi}{4}\left(\frac{4}{12}\right)^2 \times 5.65 = 0.49 \text{ cfs}$$

Provide 2, 4"Ø slotted pipes

White Tanks FRS #3 - Interim Dam Safety
Particle Size Distribution for Diaphragm Filter

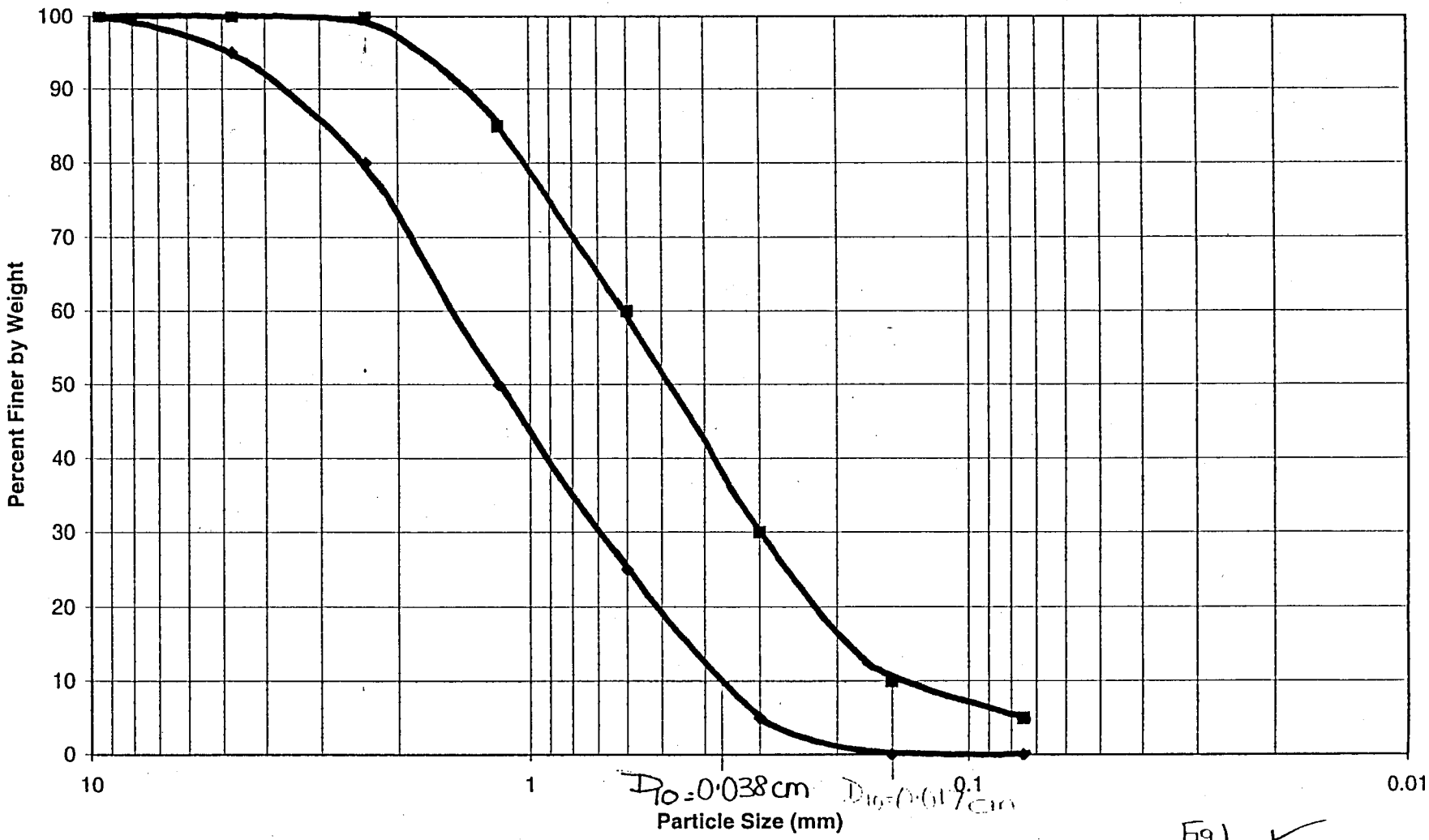
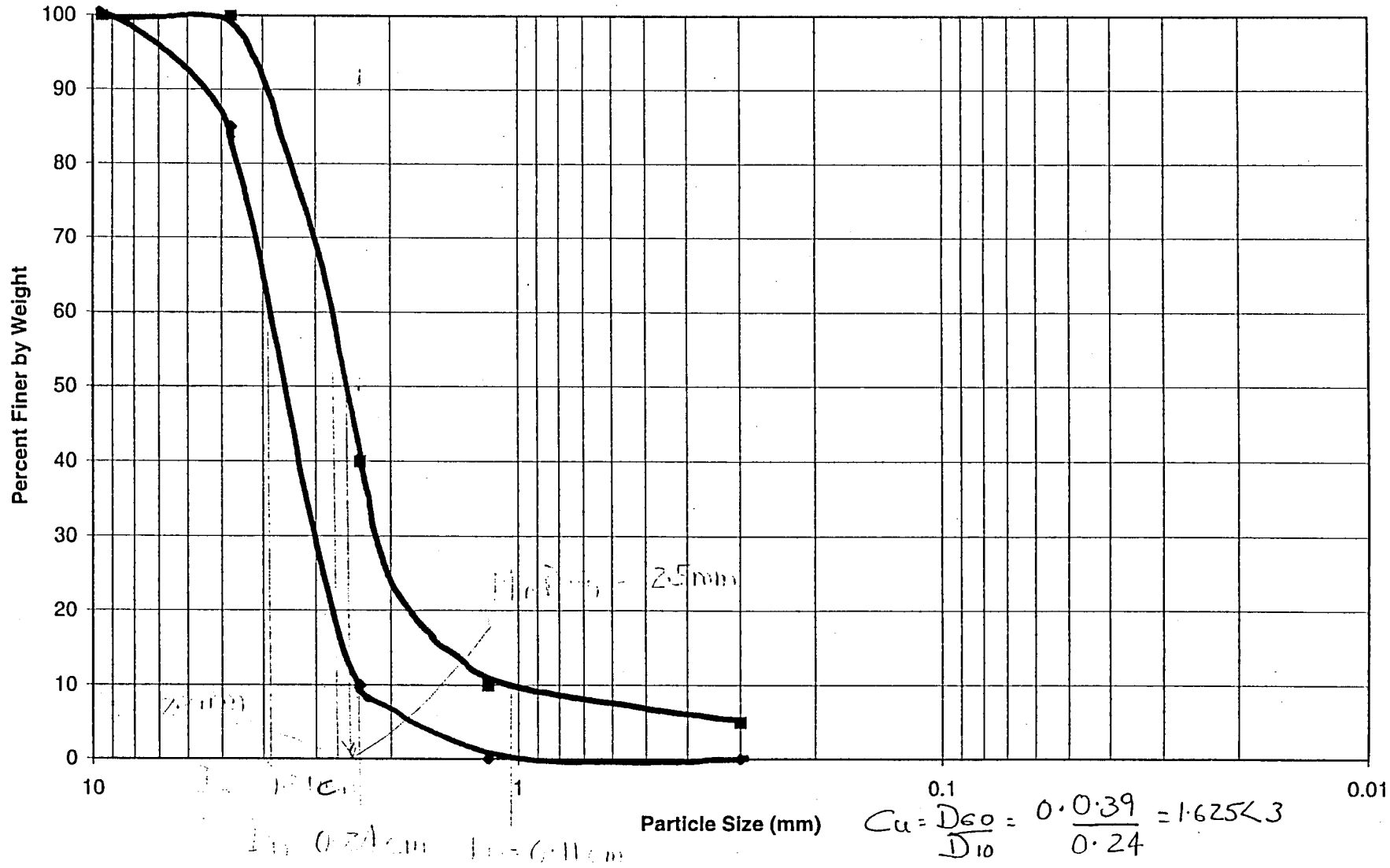


Fig 1

White Tanks FRS #3 - Interim Dam Safety

PARTICLE SIZE - DRAIN



$$C_u = \frac{D_{60}}{D_{10}} = \frac{0.0.39}{0.24} = 1.625 < 3$$

$$C_u = \frac{0.28}{0.11} = 2.54 < 3$$

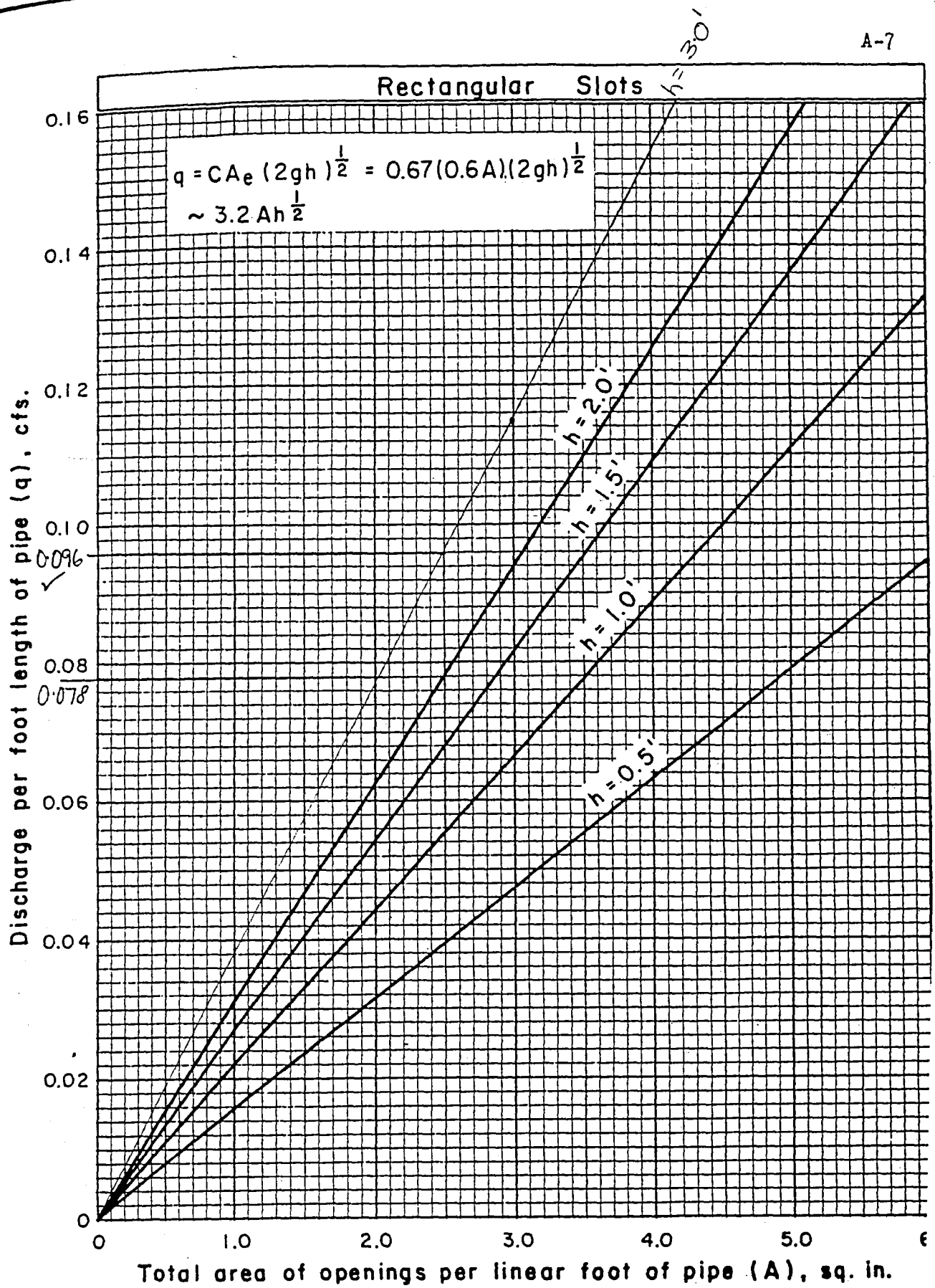
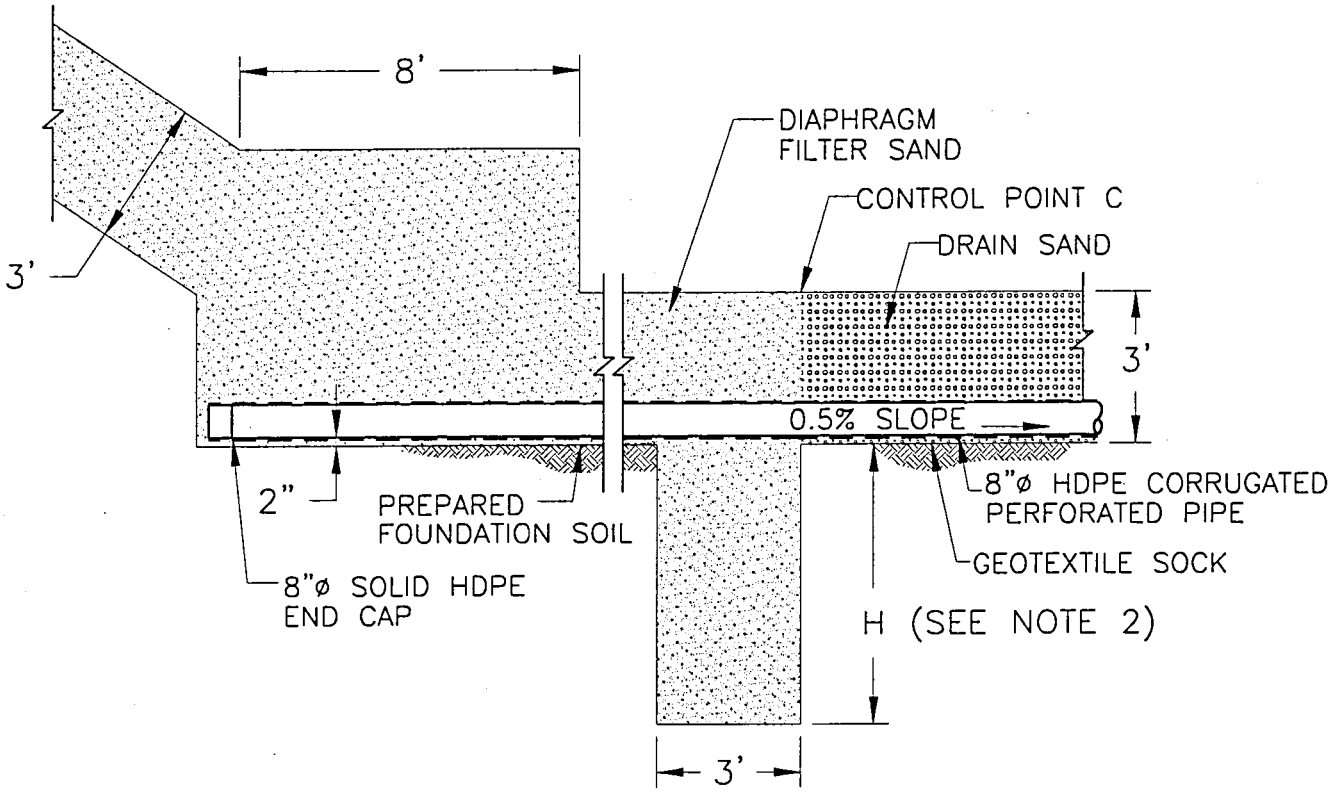


Figure A-5: Flow into pipe with rectangular slots.



2/18 DRAIN PIPE END CAP

0 4 8

SCALE IN FEET

NOTE 1: CONSTRUCT 4"ø HDPE DRAIN PIPE FOR THE SOUTHERN OUTLET SIMILAR TO DETAIL FOR 8"ø DRAIN PIPE.

NOTE 2: H IS 6 FT FOR NORTH AND CENTRAL OUTLETS. H IS 3 FT FOR SOUTH OUTLET.

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Drain Pipe End Cap

URS

E1-15448007.75

Figure 1

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. _____

SUBJECT: _____

SHEET _____ OF _____

PERFORMANCE OF DRAIN PIPES UNDER SOIL

TITLE OF CALCULATIONS/DOCUMENT

BUTTRESS LOADS

#17

CALCULATIONS/DOCUMENT BY: Ravi Murthy (PRINT NAME) — SIGNATURE — 04/13/01 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Kevin R. Somerville (PRINT NAME) — SIGNATURE — 4-13-01 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: Kevin R. Somerville (PRINT NAME) — SIGNATURE — 4-13-01 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME) — SIGNATURE — 4-13-01 (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	

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
4. Is the calculation complete in format with all sections included?

   - Problem Statement & Calculation Objectives
   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

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   - Project Design Criteria
   - Project Procedures?

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8. Is the computer input correct?
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10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

URS

Job INHITE TANKS FRS#3 | Project No. 15448-007 | Sheet ____ of ____

Description PERFORMANCE OF DRAIN PIPES UNDER SOIL BUTTRESS LOAD | Computed by RAVI MURTHY | Date ____

Checked by ____ | Date ____

Reference

* From "Designing with Geosynthetics" by RM Koerner, 3rd Edition 1994 (Ref ①) Pg 685
  - For 8"Ø Corrugated HDPE pipe and Good Quality Soil allowable height = 21.9' Long term (50yrs)
  - For 4"Ø Corrugated HDPE pipe and Good Quality Soil, allowable fill height = 25.2 ft Long term (50 years)

* From pg 684 of Ref ①, above values are conservative.

Table 7.7 Design table for allowable fill height, after Katona [15]

Pipe Properties		*Allowable Fill Heights*			
		Good-Quality Soil		*Fair-Quality Soil*	
Inside Pipe Diameter (in.)	*Corrugated Area (in.²/in.)*	*S** *(ft.)*	*L*** *(ft.)*	*S** *(ft.)*	*L*** *(ft.)*
4	0.04	45.0	25.2	31.5	12.0
	0.09	87.3	41.4	63.4	23.7
	0.14	125.2	56.6	76.9	35.2
6	0.05	39.0	23.0	26.3	10.3
	0.10	68.6	34.3	51.3	18.2
	0.15	95.5	44.9	65.7	26.0
8	0.06	35.6	21.9	23.6	9.6
	0.11	58.1	30.6	42.3	15.2
	0.16	79.1	38.6	58.8	21.3
10	0.08	37.3	22.8	25.0	10.1
	0.13	55.3	29.7	40.0	14.8
	0.18	72.4	36.2	54.8	19.5
12	0.10	38.4	23.4	26.0	10.4
	0.15	53.4	29.2	38.4	14.4
	0.20	67.8	34.6	50.7	18.3
15	0.15	44.0	25.8	30.7	12.0
	0.20	55.9	30.3	40.6	15.1
	0.25	67.5	34.6	50.5	18.2
18	0.20	48.1	27.6	34.0	12.8
	0.25	57.9	31.4	42.3	15.8
	0.30	67.5	34.9	50.5	18.3
24	0.25	47.9	28.4	33.4	13.1
	0.30	55.9	31.5	40.0	15.2
	0.35	63.7	34.4	46.6	17.2
30	0.30	43.7	26.7	30.2	12.2
	0.35	49.7	29.0	35.2	13.8
	0.40	55.6	31.3	40.2	15.3

**S* = Short-term design life (0.05 years).

***L* = Long-term design life (50 years).

7.10b for circumferential shortening. All values are within reason, and the performance seems to indicate proper functioning of the pipe under this very heavy static overburden stress, which is approximately twice the value predicted in Table 7.7. This information seems to suggest that predicted values of overburden stress on polymer pipes (when properly placed and backfilled) may be quite conservative.

Regarding the *internal* stress mobilization from pressurized fluids or gases, there is a tremendous body of knowledge available. Pressurized water and natural gas transmission lines form the bulk of this information. As mentioned in the introduction to this chapter, however, this topic is not treated and instead we focus on gravity flow situations.

DAMES & MOORE

CALCULATIONS COVER SHEET

PROJECT NO. _____

SUBJECT: _____

SHEET _____ OF _____

GEOTEXTILE SOCK AROUND DRAIN PIPES

TITLE OF CALCULATIONS/DOCUMENT

#18

CALCULATIONS/DOCUMENT BY: RAVI MURTHY (PRINT NAME) — SIGNATURE — DATE 04/11/01

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: KEVIN R. SOMERVILLE (PRINT NAME) — SIGNATURE — DATE 4-12-01

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMERVILLE (PRINT NAME) — SIGNATURE — DATE 4-12-01

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME) — SIGNATURE — DATE 4-13-01

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

CALCULATION CHECKING CRITERIA

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    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

URS

Page 2 of ____

Job WHITE TANKS FRS #3 | Project No. ____ | Sheet ____ of ____

Description HYDRAULIC & SOIL RETENTION PROPERTIES OF GEOTEXTILE SOCK | Computed by RAVI MURTHY | Date 04/12/01

Checked by ____ | Date ____

Reference

OBJECTIVE: To check that the geotextile sock around the drain pipes has adequate hydraulic conductivity & soil retention properties

SOIL RETENTION: ALL OUTLETS

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

$O_{95} / D_{85} < 2 - 3$

* From Proj Specs, allowable drain gradation (Fig 1)

$D_{85} = 7.5\,mm$ to $22\,mm$

* From product specs, AOS (O_{95}) = Sieve # 30 to 50
= 0.6 mm to 0.3 mm

* $O_{95}/D_{85} = \frac{0.6}{7.5}$ to $\frac{0.3}{22}$

$= 0.08$ to $0.01 \ll 2\text{-}3 \Rightarrow$ OK

REF ① Carrift Corp Drain-Sleeve Specs

② Designing with Geosynthetics - RM Koerner, 3rd Ed, 1994

NORTH & CENTRAL OUTLETS

Data from previous calculations
- Flow entering pipe/ft length = 0.096 cfs
- Diameter of drain pipe = 8"

∴ Area of sock per length of pipe $= \pi d L$

$= \pi \times \frac{8}{12} \times 1$

$= 2.1$ sqft.

* From Page 131 of Ref ②

$$q = K_{req}\, i\, A$$

q = dicharge /ft
K_{req} = required hydraulic conductivity for discharge q
i = hydraulic gradient
A = Area of sock/geotextile /ft
t = thickness

$$q = K_{req} \cdot \frac{\Delta h}{t} A$$

$$\therefore \frac{K_{req}}{t} = \Psi_{req} \text{(required permittivity)} = \frac{q}{A\,\Delta H}$$

H = 3'

$$\Psi_{req} = \frac{0.096}{2.1 \times 3} = 0.015 \text{ ft/sec/ft}$$

* From Ref ①

Permeability = 12 in/sec = 30 cms/sec

Thickness = 1.0 mm = 0.1 cms

∴ Ultimate Permittivity $(\psi_{ult}) = \frac{30}{0.1} = 300$ cms/sec/cm

* From Ref ② Page 160 Table 2.13

Conservatively, the following partial safety factors (mid range) were selected

- Soil Clogging & Blinding = 8.0
- Creep Reduction of Voids = 1.3
- Intrusion into voids = 1.1
- Chemical Clogging = 1.3
- Biological Clogging = 3.0

∴ Composite Safety factor = 8.0 x 1.3 x 1.1 x 1.3 x 3.0 = 44.6 ≈ 45

$\psi_{allowable}$ = ψ_{ult} / Comp. Safety Factor

= 300/45

= 6.7 cms/sec/cm

$\psi_{req} << \psi_{allowable} \Rightarrow$ OK

D_{15} = 0·21mm to [illegible]
D_{50} = 2·7mm to 11mm
D_{85} = 7·5mm to 22mm
D_{90} = 8·8mm to 26mm

White Tanks FRS #3 Interim Dam Safety
Soil Buttress Fill

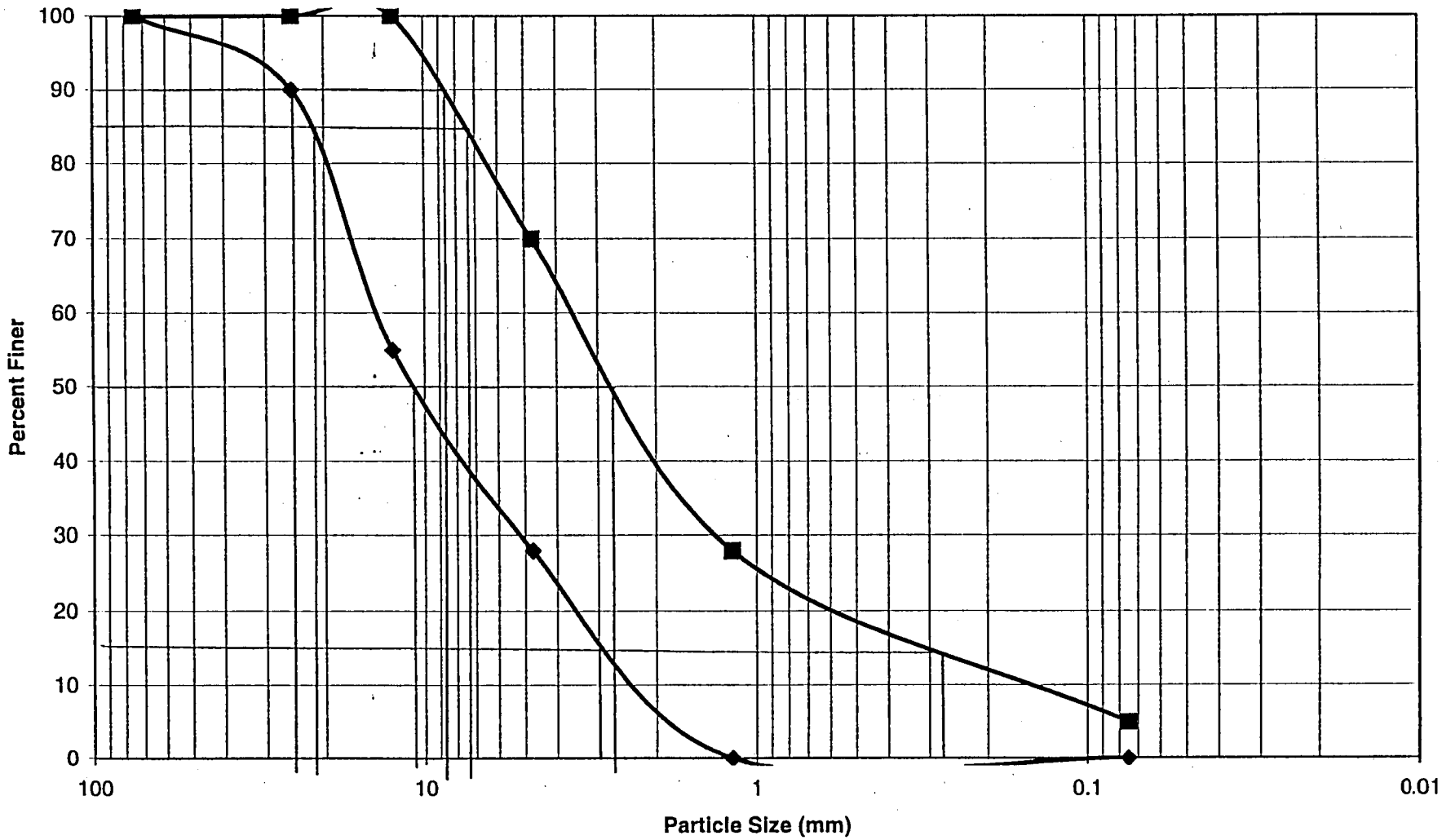

Fig 1

Carriff Corporation's Drain-Sleeve Specifications

February/95

Description	2" Regular	3" Regular &Highway	4" Regular	4" Highway	5" Regular	5" Highway	6" Regular	6" Highway	8" Regular	10" Regular	12" Regular	15" Regular	18" Regular	24" Regular
Yarn Denier	100	150	135	150	150	150	150	150	150	150	150	150	150	150
Color	white	white	white	blue	orange	yellow	white	red	white	black	blue	orange	white	red
Oz/yd² relaxed	3.20	5.40	3.80	5.40	4.30	5.40	3.30	4.10	3.50	3.50	3.50	3.50	3.50	3.50
Oz/yd² Applied	2.10	3.50	2.50	3.50	2.80	3.50	2.80	3.50	3.00	3.00	3.00	3.00	3.00	3.00
Layflat Width														
Inches	5.25	5.60	6.75	6.00	7.00	7.00	10.00	9.75	14.00	14.00	16.00	25.00	27.50	30.00
mm	133	140	170	152	178	178	255	248	355	355	406	635	699	762
Cross Stretch														
inches	7.5	10	16	14.5	17.5	16.75	20.5	19	25	30	35	40	42	52
mm	190	254	406	368	445	425	520	483	635	762	890	1020	1065	1320
Applied Weight* per 1000'														
lbs	11.0	23.0	25.0	30.0	30.0	36.0	35.0	44.0	52.0	65.0	81.0	103.0	115.0	150.0
kgs	5.0	10.5	12.0	13.5	13.5	16.3	16.0	20.0	23.6	30.0	37.0	42.0	52.0	68.0
ft/#	90.0	43.0	40.0	33.0	33.0	27.0	28.0	22.0	19.0	15.0	12.0	9.0	8.0	6.0

** These weights may vary by application procedure and O.D. of pipe*

SPECIFICATION	Test Method	Regular Sleeve	Highway Sleeve
Fiber		Polyester	Polyester
Weight (Oz/yd²) Applied	ASTM D-3776	2.5-3.5	3.5
Thickness, in (mm)		.040 (1)	.040 (1)
Mullen Burst, p.s.i. (kpa)	ASTM D-3786	100	135
PunctureStrength	ASTM D-4833	N/A	35
Air Permeability ft³/ft²/min(cm³/cm²/sec)	ASTM D-737	700 (335)	700 (335)
Water flow rate (US) gal/ft²/min-3" Head		700	700
Water Permeability (K) 3GPM.in/s-1 (m/s x 10⁻⁵)		.12 (3)	.12 (3)
AOS, US sieve	ASTM D-4751	30	40-50
AOS, (UM)	ASTM D-4751	600	425-300
UV Degradation	ASTM D-4355	70%	70%

Specifications are based on independent laboratory studies and are considered to be true and accurate

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Date 4/11 # of pages ▶ 1

To RAVI MURTHY From CINDY

Co./Dept. Co. ADS

Phone # Phone #

Fax # 6023711615 Fax #

ECONOMICAL

VERSATILE

EFFECTIVE

CARRIFF CORPORATION INC.

2890 Highway 49 North
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1-800-845-5184
704-786-3917
Fax 704-788-8514

DESIGNING WITH GEOSYNTHETICS
RM KOERNER, 3rd ED
1994.

Table 2.13 Recommended partial factors of safety values for use in Equation 2.25

	Various Partial Factors of Safety				
Application	*Soil Clogging and Blinding*	*Creep Reduction of Voids*	*Intrusion into Voids*	*Chemical Clogging*	*Biological Clogging*
Retaining wall filters	2.0 to 4.0	1.5 to 2.0	1.0 to 1.2	1.0 to 1.2	1.0 to 1.3
* → Underdrain filters	5.0 to 10	1.0 to 1.5	1.0 to 1.2	1.2 to 1.5	2.0 to 4.0
Erosion control filters	2.0 to 10	1.0 to 1.5	1.0 to 1.2	1.0 to 1.2	2.0 to 4.0
Landfill filters	5.0 to 10	1.5 to 2.0	1.0 to 1.2	1.2 to 1.5	2.0 to 50
Gravity drainage	2.0 to 4.0	2.0 to 3.0	1.0 to 1.2	1.2 to 1.5	1.2 to 1.5
Pressure drainage	2.0 to 3.0	2.0 to 3.0	1.0 to 1.2	1.1 to 1.3	1.1 to 1.3

do not serve this function, the other, sometimes primary, function will not be served properly. This should not give the impression that geotextiles as separators always play a secondary role. Many situations call for separation only, and in such cases the geotextiles do serve a significant and worthwhile function.

2.5.1 Overview of Applications

Perhaps the target application that can best illustrate the use of geotextiles as separators is their placement between an underlying reasonably firm soil subgrade and a stone base course, aggregate, or ballast placed above the geotextile. We say "reasonably firm" because it is assumed that the subgrade deformation is not sufficiently large to mobilize uniformly high tensile stress in the geotextile. (The application of geotextiles in unpaved roads on soft soils wherein membrane-type reinforcement is developed is treated later in Section 2.6.) Thus for such a separation function to occur, the geotextile must be placed on the soil subgrade and then have stone placed, spread, and compacted on top of it. A number of scenarios can be developed showing what geotextile properties are required for a given situation.

2.5.2 Burst Resistance

Consider a geotextile on a soil subgrade with stone of average particle diameter (d_a) placed above it. If the stone is uniformly sized, there will be voids within it that will be available for the geotextile to enter into. This entry is caused by the simultaneous action of the traffic loads being transmitted to the stone, through the geotextile, and into the underlying soil. The stressed soil then tries to push the geotextile up into the voids within the stone. The situation is shown schematically in Figure 2.26. Giroud [59] provides a formulation for the required geotextile strength which can be adopted for this application.

$$T_{reqd} = \frac{1}{2} p' d_v [f(\epsilon)] \qquad (2.$$

where T_{reqd} = the required geotextile strength,
p' = the stress at the geotextile's surface, which is less than, or equal

URS

CALCULATIONS COVER SHEET

SUBJECT: WHITE TANKS FRS#3, IDS

PROJECT NO. EI-15448007

SHEET 1 OF

BUTTRESS SOIL SPECIFICATION – REVISED GRADATION

TITLE OF CALCULATIONS/DOCUMENT

(REVISES GRADATION TABLE SHOWN ON SPECIAL PROVISIONS

#19

CALCULATIONS/DOCUMENT BY: ~~RAVI~~ RAVI MURTHY (PRINT NAME)

SIGNATURE — DATE: 06/01/01

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: Todd Ringsmuth (PRINT NAME)

SIGNATURE — DATE: 6-7-01

CALCULATIONS/DOCUMENT CHECKED BY: KEVIN R. SOMMERVILLE (PRINT NAME)

SIGNATURE — DATE: 6/5/01

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

SIGNATURE — DATE: 6-7-01

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

Page 2 of ____

Job WHITE TANKS FRS#3 IDS | Project No. ____ | Sheet ____ of ____

Description BUTTRESS FILL SPEC | Computed by RAM MURTHY | Date 06/01/01

Checked by ____ | Date ____

Reference

OBJECTIVE: To develop a gradation specification for buttress fill material that allows for use of soil from the spillway area, and is satisfactory in terms of gradation (avoid gap gradation) and segregation (avoid).

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

APPROACH:
* Matching between filter & buttress was completed previously.
* Establish coarse limit for buttress fill that meets gradation requirements
* Then check the fine limit to ensure it meets gradation requirements

COARSE LIMIT

* Based on gradation of the spillway soil samples, select $(D_{15})_{max} = 0.24\,mm = \underline{CP1}$

* From Pg 26-4, $(D_{10})_{max} = (D_{15})_{max}/1.2 = 0.24/1.2 = 0.20$ ✓

* From Pg 26-4; $Cu = \frac{(D_{60})_{max}}{(D_{10})_{max}} \leq 6$

$$(D_{60})_{max} = 6(D_{10})_{max} = 6 \times .20 = 1.2\,mm \text{ say } 1.1\,mm = \underline{CP2}$$

* From 26-4, $(D_{100})_{max} = 3'' = 75\,mm = \underline{CP3}$

* Based on spillway soil sample gradations, it is likely that $(D_{10})_{min} < 0.5\,mm$

∴ From Table 26-6 on Page 26-5, $(D_{90})_{max} = 20\,mm = \underline{CP4}$

* $Cu = \frac{(D_{60})_{max}}{(D_{10})_{max}} = \frac{1.1}{0.19} = 5.7$ ∴ OK ✓

FINE UNIT

The proposed buttress specification (fine) is shown on Fig 1

* $CU = \frac{(D_{60})_{min}}{(D_{10})_{min}} = \frac{0.25}{0.075} = 3.33 < 6.0 \Rightarrow OK$ ✓

* $(D_{60})_{max}/(D_{60})_{min} = 1.1/0.25 = 4.4 < 5 \Rightarrow OK$ ✓
  $(D_{50})_{max}/(D_{50})_{min} = 0.7/0.18 = 3.9 < 5 \Rightarrow OK$ ✓
  $(D_{40})_{max}/(D_{40})_{min} = 0.5/0.15 = 3.3 < 5 \Rightarrow OK$ ✓
  $(D_{30})_{max}/(D_{30})_{min} = 0.4/0.11 = 3.6 < 5 \Rightarrow OK$ ✓
  $(D_{20})_{max}/(D_{20})_{min} = 0.3/0.09 = 3.3 < 5 \Rightarrow OK$ ✓
  $(D_{10})_{max}/(D_{10})_{min} = 0.19/0.085 = 2.2 < 5 \Rightarrow OK$ ✓

Per Step 8, Page 26-4, Ratio of max to min diameters for all % passing of 60 and less, must not exceed 5. ∴ OK

* REF #1 calls for $(D_5)_{min} \geq 0.075$ mm. While this criterion is suitable for a filter, the buttress does not function as a filter i.e. permeability of the buttress is not a concern. Therefore, a maximum fines content (minus #200 fraction) of 20% is allowed for the buttress fill.

URS

Page 4 of ____

Job WHITE TANKS FRS #3 IDS | Project No. ____ | Sheet ____ of ____

Description BUTTRESS FILL SPEC | Computed by ____ | Date 06/06/01

Checked by ____ | Date ____

Reference

FILTER MATCH: FILTER SAND (Base Soil) Versus Specified Buttress Fill

* The buttress fill will be in direct contact with the filter sand, and direction of flow of water will be from the filter to the buttress. Therefore, a "filter match" is required between the buttress fill and the filter sand, with the filter sand as the "base soil".

* CALCULACTION # 6 In the design report dated Feb 7, 2001, documents the definition of a design band that is compatible (filter match) with the filter sand as the "base soil". Theoretically therefore, this design band represents the "design" buttress gradation. The control points for this "design" buttress gradation are:

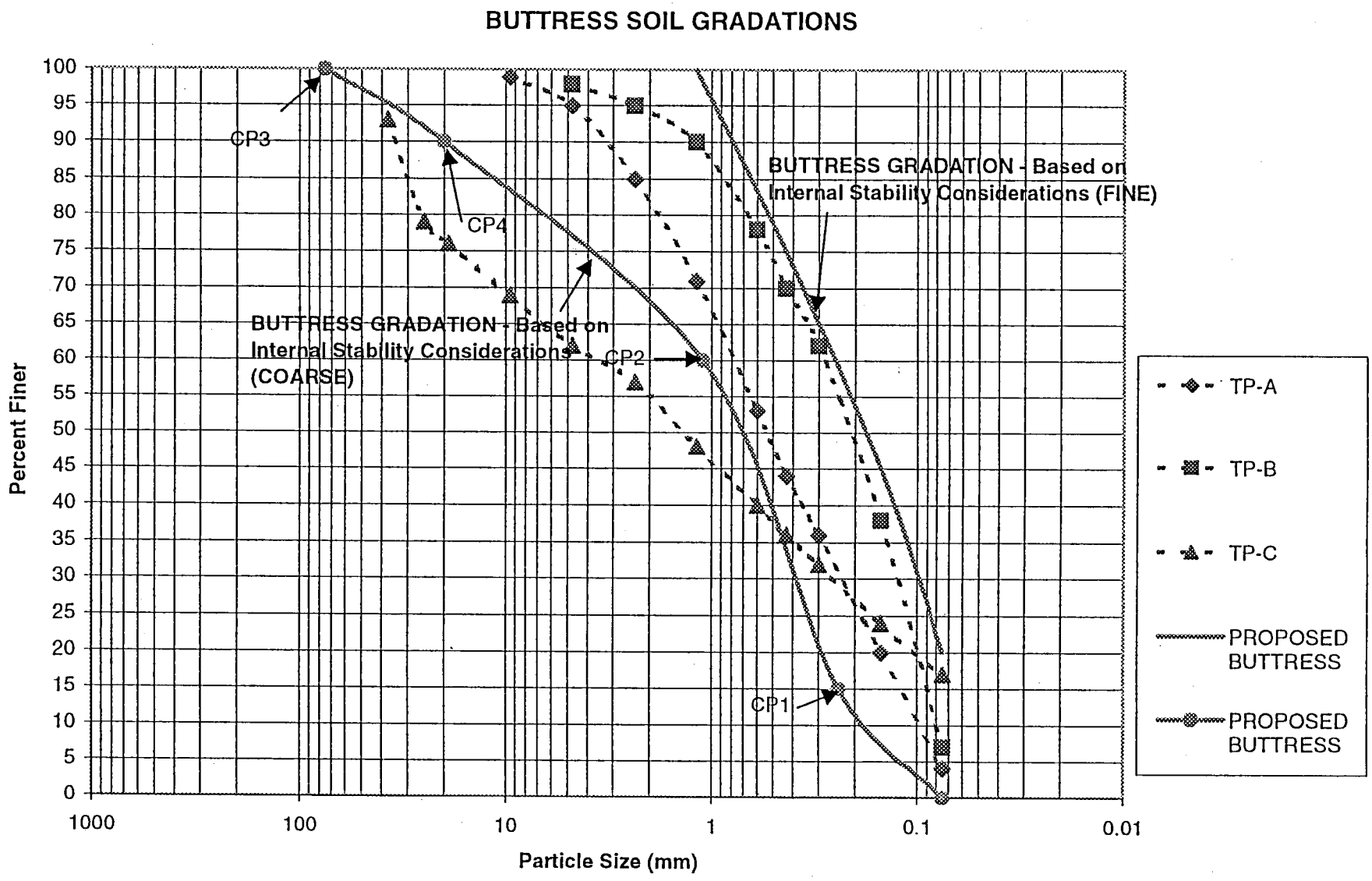
4.75 mm	15 %	0.075	5%
24 mm	60 %	1.64 mm	15%
30 mm	90%	4.75 mm	60 %
75 mm	100 %		

* The above control points and the buttress gradation as specified in the construction specifications are shown on Figure 3. As seen in Figure # 3, the buttress gradation provided in the project specifications is finer than the the "Design" Band. Therefore, additional matching is not required for the filter sand (base soil) and the buttress spec as provided in the project specifications.

NOTE: This revised spec for buttress fill was provided as an addendum

Buttress Fill as Provided in the Construction Specs			
Designation	**Size (mm)**	**Coarse Limit % Finer**	**Fine Limit % Finer**
3"	75	100	100
2"	50	95	100
#4	4.75	80	100
#16	1.18	60	100
#30	0.6	45	85
#50	0.3	20	65
#200	0.075	0	20

FIGURE 1


BUTTRESS SOIL GRADATIONS
Percent Finer
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1000
100
10
1
0.1
0.01
Particle Size (mm)
CP3
CP4
CP2
CP1
BUTTRESS GRADATION - Based on Internal Stability Considerations (FINE)
BUTTRESS GRADATION - Based on Internal Stability Considerations (COARSE)
TP-A
TP-B
TP-C
PROPOSED BUTTRESS
PROPOSED BUTTRESS

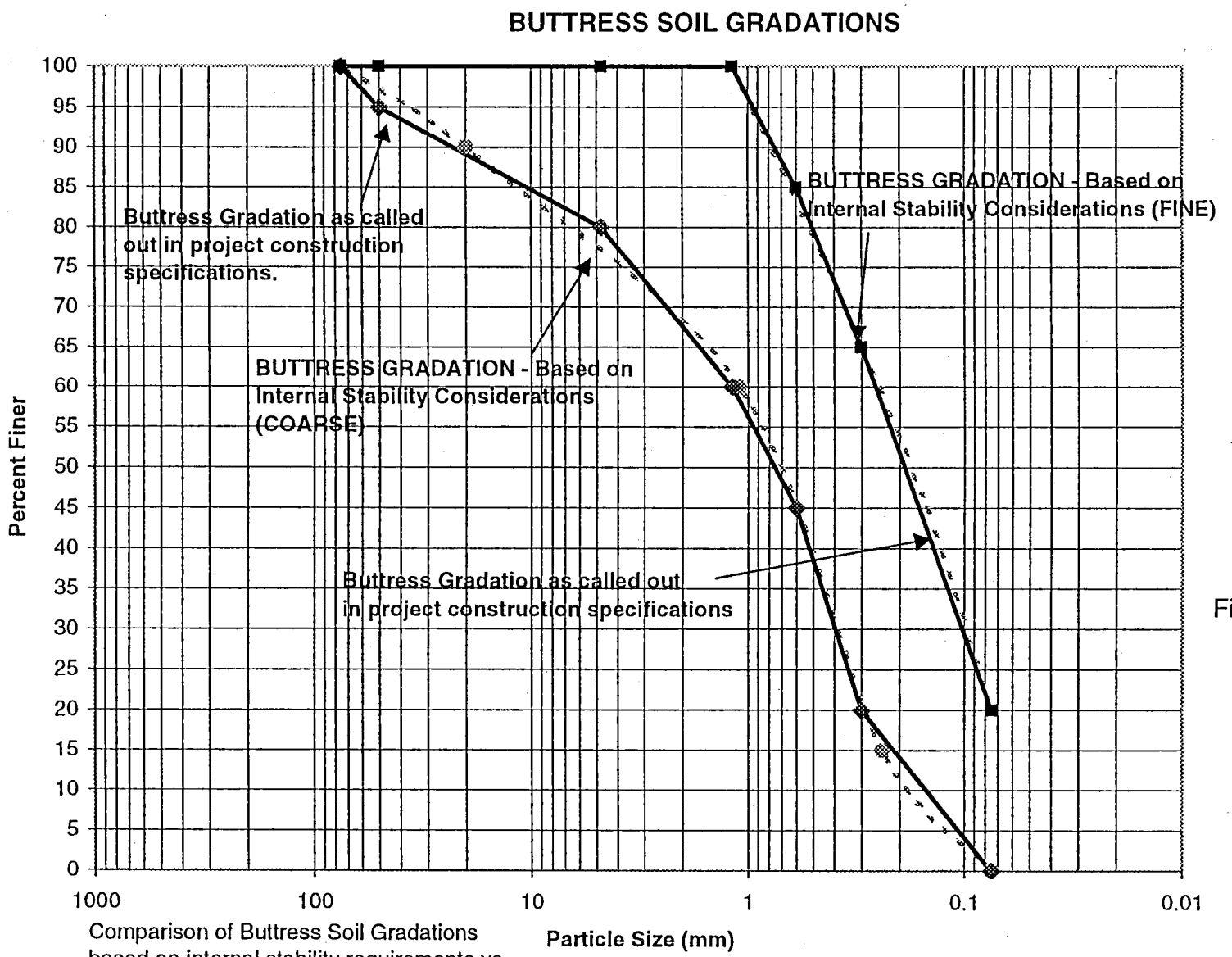
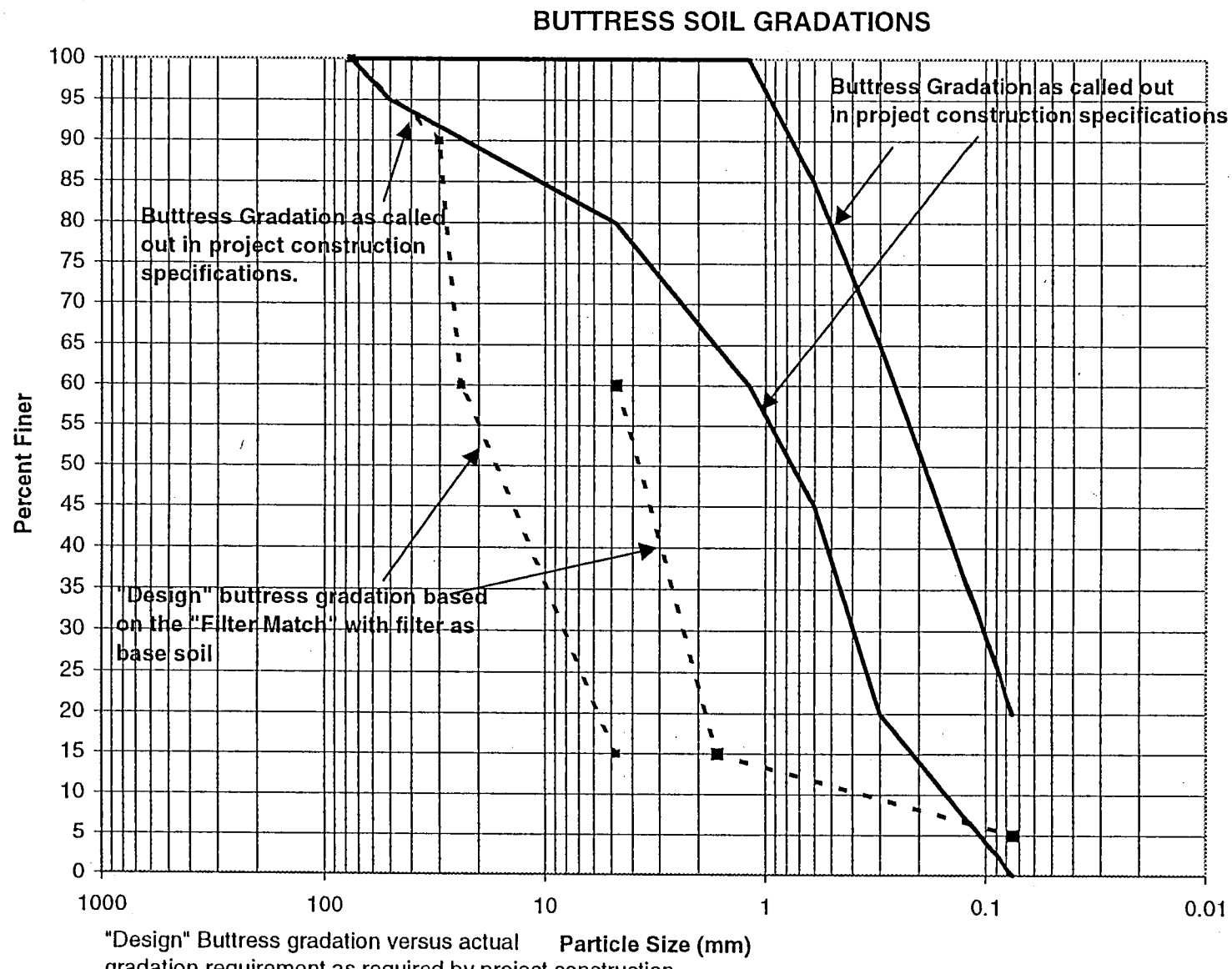


Figure 2

Comparison of Buttress Soil Gradations based on internal stability requirements vs. gradation actually provided in project construction specifications.



"Design" Buttress gradation versus actual gradation requirement as required by project construction specifications

Figure 3

URS

CALCULATIONS COVER SHEET

PROJECT NO. EL-15448007.00

SUBJECT: _____

SHEET _____ OF _____

STRUCTURAL ASSESSMENT OF TRASH RACKS

TITLE OF CALCULATIONS/DOCUMENT

CALC #20

CALCULATIONS/DOCUMENT BY: KEN RUFFENNACH (PRINT NAME)

Ken Ruffennach (SIGNATURE) 08/02/01 (DATE)

ASSUMPTIONS CHECKED BY CONSULTANT/SENIOR PERSONNEL: OSCAR OLIDEN (PRINT NAME)

Oscar Olidens (SIGNATURE) 08/02/01 (DATE)

CALCULATIONS/DOCUMENT CHECKED BY: OSCAR OLIDEN (PRINT NAME)

Oscar Olidens (SIGNATURE) 08/02/01 (DATE)

APPROVED BY: (PRINCIPAL INVESTIGATOR, CONSULTANT, OR PM) Todd Ringsmuth (PRINT NAME)

(SIGNATURE) 8-2-01 (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

CALCULATION CHECKING CRITERIA

1. Is the calculation method appropriate?
2. Are the results and conclusions reasonable when compared with the design input and the project objectives?
3. Are the results and conclusions reasonably within the project construction budget?
4. Is the calculation complete in format with all sections included?

   - Problem Statement & Calculation Objectives
   - Data Available
   - Design Criteria
   - Assumptions
   - Analysis and Conclusions
   - Attachments

5. Does the calculation conform with:

   - Codes
   - Project Design Criteria
   - Project Procedures?

6. Are the mathematics of the calculation accurate?
7. Are computer programs used in the calculation appropriate for use in this application?
8. Is the computer input correct?
9. Is the computer output correct and reasonable?
10. Are all sheets completely filled out?

    - Project number?
    - File number?
    - Sheet ? of ?
    - By ? Date ?
    - Checked By ?

11. Are the calculations neat and legible?

EXHIBIT D

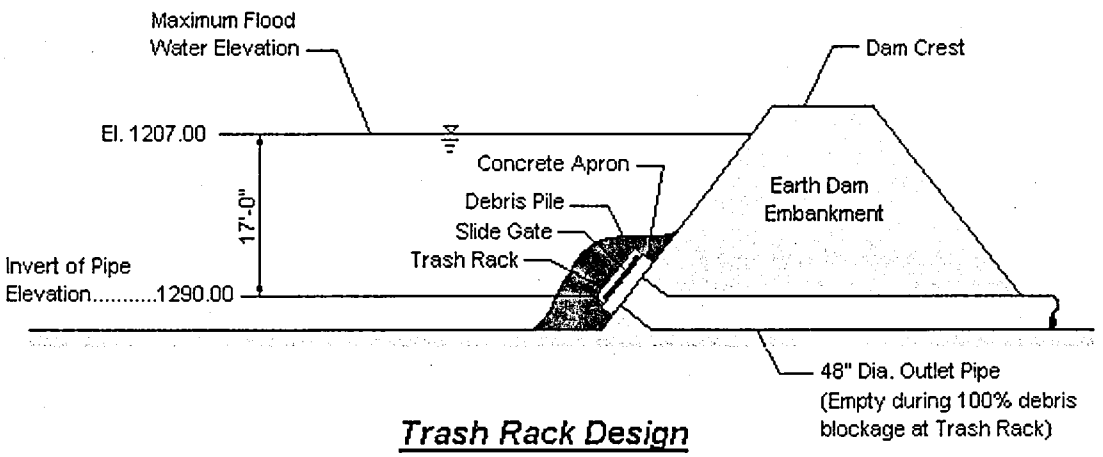
UNITS: $kip \equiv 1000 \cdot lbf$ $TOL \equiv 0.01$ $ft \equiv 12.0 \cdot in$

$plf \equiv \frac{lbf}{ft}$ $psf \equiv \frac{lbf}{ft^2}$ $pcf \equiv \frac{lbf}{ft^3}$ $psi \equiv \frac{lbf}{in^2}$ $pci \equiv \frac{lbf}{in^3}$ $pft \equiv lbf \cdot ft$

$kft \equiv kip \cdot ft$

$klf \equiv \frac{kip}{ft}$ $ksf \equiv \frac{kip}{ft^2}$ $kcf \equiv \frac{kip}{ft^3}$ $ksi \equiv \frac{kip}{in^2}$ $kci \equiv \frac{kip}{in^3}$ $CY \equiv 27 \cdot ft^3$

Trash Rack Design Check



Trash Rack Design

Check the design of a trash rack that must be capable of withstanding 17 feet of hydrostatic pressure. There are two bars that must be checked for flexural stresses. The first bar is the 1/2" diameter bar that spans 6-ft with intermediate welded connections to larger rectangular bars spaced at 6 inches. For this bar we'll assume a 6-in span with a simple span moment. The larger 1/2" x 4" bar spans 8 feet with an intermediate semi-support at the mid-point of the span. This bar will be analyzed with a full 8-ft span (ignoring the intermediate semi-support), but the moment will be reduced from $wL^2/8$ to $wL^2/12$. The shear in the welded connections were checked at the round/rectangular bar connection and at the angle/round bar connection. In addition, the 1/2" diameter bolt will be checked for shear.

Load and Resistance Factor Design (LRFD) method will be used for checking bar stresses and bolt shear, and Allowable Stress Design (ASD) method will be used for all welded connections.

Analysis of the 1/2" Diameter Bar:

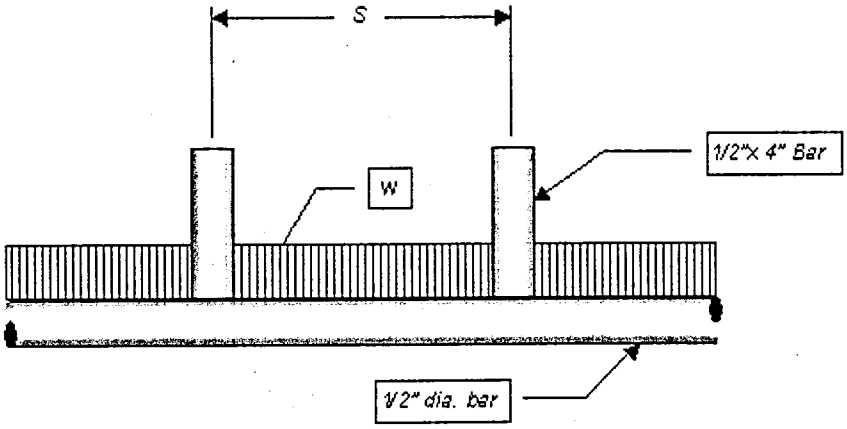
Data.....

Unit Weight of Water: $\gamma_w := 62.4$ pcf

Maximum Height of Water: $H := 17$ ft

Spacing of 1/2" Dia. Bars: $S_1 := 6$ in

Spacing of 1/2" x 4" Bars: $S_2 := 6$ in



1/2" Diameter Bar Analysis

Analysis.....

Uniform Load on 1/2" Dia. Bar:

$w := \gamma_w \cdot H \cdot S_1$ $\quad w = 530.4 \cdot plf$

Ultimate Moment[1]:

$M_u := 1.4 \cdot \frac{w \cdot S_2^2}{8}$ $\quad M_u = 278.46 \cdot lbf \cdot in$

Section Modulus:

$S_{bar1} := \frac{\pi \cdot (0.25\ in)^3}{4}$ $\quad S_{bar1} = 0.0123 \cdot in^3$

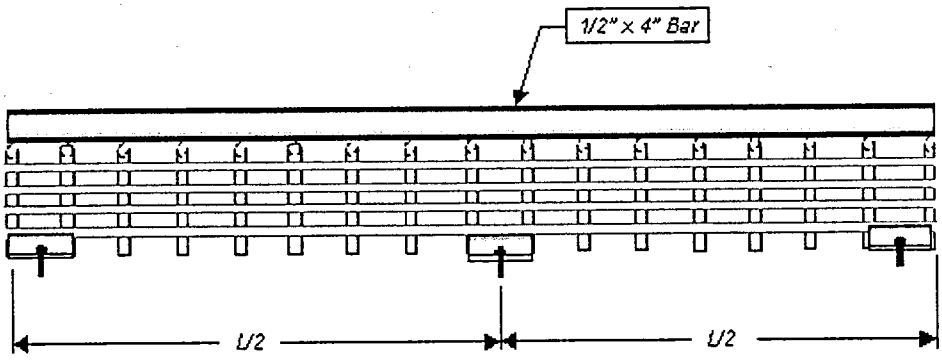
Flexural Stress:

$f_b := \frac{M_u}{S_{bar1}}$ $\quad f_b = 22691 \cdot psi$ < 36,000 psi, OK

Analysis of the 1/2" x 4" Bar:

Added Data.....

Span Length: $L := 8$ ft



1/2" x 4" Bar Analysis

Analysis.....

Uniform Load on 1/2" x 4" Bar:

$w := \gamma_w \cdot H \cdot S_2$ $\quad w = 530.4 \cdot plf$

Ultimate Moment[1]:

$M_u := 1.4 \cdot \frac{w \cdot L^2}{12}$ $\quad M_u = 47524 \cdot lbf \cdot in$

Section Modulus: $S_{bar2} := \frac{0.5\ in \cdot (4\ in)^2}{6}$

$S_{bar2} = 1.333 \cdot in^3$

Flexural Stress:

$f_b := \frac{M_u}{S_{bar2}}$ $\quad f_b = 35643 \cdot psi$ < 36,000 psi, OK

Check Welds.....

Total Load on bar/bar welded connection:

$P := \gamma_w \cdot H \cdot S_1 \cdot S_2$ $\quad P = 265.2 \cdot lbf$

Assumed length of weld:

$L_w := 0.5\ in \cdot 4$ $\quad L_w = 2 \cdot in$

Assume 1/8" fillet weld (smallest weld) and the lowest tensile strength of weld (60 ksi):

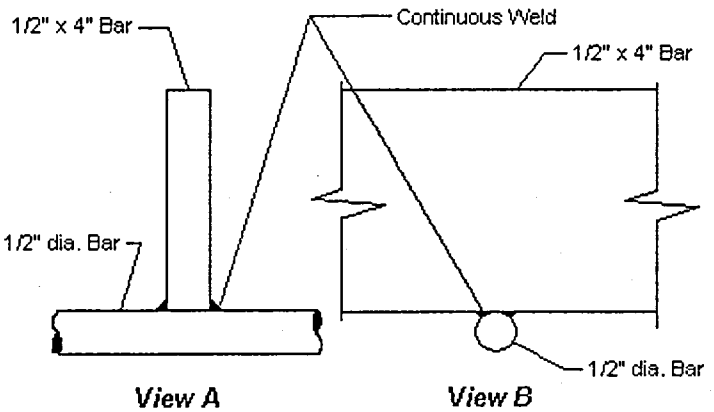
Allowable shear strength per inch:

$R_w := 1.59 \frac{kip}{in}$

Total strength of weld:

$R_{tot} := L_w \cdot R_w$ $\quad R_{tot} = 3180 \cdot lbf$

$R_{tot} > P$, OK



Bar Connection Weld

Area of Trash Rack in direction of Shear:

$L = 8 \cdot ft$ $\quad h := 2.33\ ft$ $\quad A := L \cdot h$ $\quad A = 18.64 \cdot ft^2$

Total Load on angle/bar welded connection:

$P := \gamma_w \cdot H \cdot A$ $\quad P = 19.77 \cdot kip$

Assumed length of weld:

$L_w := 2\ in \cdot 2$ $\quad L_w = 4 \cdot in$

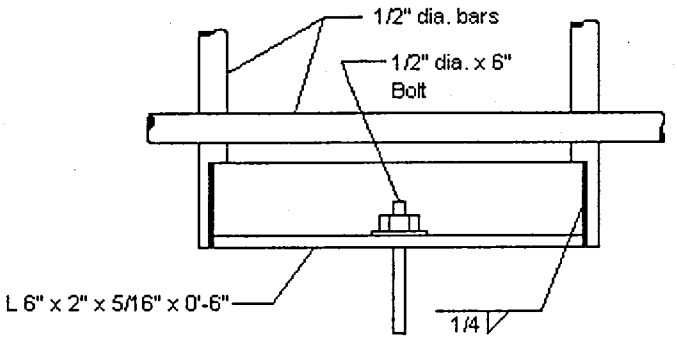
Allowable shear strength per inch for a 1/4" fillet weld:

$R_w := 3.18 \frac{kip}{in}$

Total allowable strength of weld per angle:

$R_a := L_w \cdot R_w$ $\quad R_a = 12.72 \cdot kip$

Number of Angles: $\quad N_a := 6$



Angle/Bar Welded Connection

Total allowable strength for all angles: $\quad R_{tot} := R_a \cdot N_a$ $\quad R_{tot} = 76.32 \cdot kip$ $\quad R_{tot} > P$, OK

Check Shear on Bolts.....

Assume A325 bolts, 1/2" dia. Ultimate shear Capacity per bolt (LRFD - AISC Manual, 1st Ed.): $\phi F_v := \pi \cdot \left(\frac{1}{4}\ \text{in}\right)^2 \cdot 35.1\ \text{ksi}$ from LRFD $\quad \phi F_v = 6.89 \cdot \text{kip}$

Number of Bolts: $N_b := 6$

Total Ultimate Shear Capacity of all bolts: $F_{vtot} := N_b \cdot \phi F_v \quad F_{vtot} = 41.35 \cdot \text{kip}$

$A = 18.64 \cdot \text{ft}^2$

Total Factored load of water causing shear[1]: $F_{water} := 1.4 \cdot \gamma_w \cdot H \cdot A \quad F_{water} = 27.68 \cdot \text{kip}$

$F_{vtot} > F_{water}$, OK

---

1. (AISC - LRFD Does not have a specific load factor for fluid pressure, therefore a load factor of 1.4 was used - REF.: ACI 318-95, Code Section 9.2.5).

APPENDIX F

DECEMBER 1999 SURVEY

DECEMBER 1999 SURVEY FULL SIZE DRAWINGS

SUBMITTED UNDER SEPARATE COVER

APPENDIX G

SPECIAL PROVISIONS

SPECIAL PROVISIONS

(Revised August 3, 2001)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

PCN 470-04-30

22867
ALEXANDER W.
GOURLAY
Date Signed 8-3-01
ARIZONA, U. S. A.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22867
ALEXANDER W.
GOURLAY
Date Signed 8-3-01
ARIZONA, U.S.A.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2000C028
WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

SPECIAL PROVISIONS

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SECTION 201 CLEARING AND GRUBBING

SUBSECTION 201.1 DESCRIPTION:

This work shall consist of removing objectionable material from the boundaries of work and such other areas as may be specified in the special provisions. Clearing and grubbing shall be performed in advance of grading operations.

Clearing and grubbing shall be performed within the limits of work only, including borrow areas, excavation limits, foundation footprint, and fill zone. Do not clear excessive areas. Large trees should not be encountered, and should not be affected by the Contractor's activities.

SUBSECTION 201.2 PRESERVATION OF PROPERTY:

Existing improvements, adjacent property, utilities and other facilities, and trees and plants not to be removed, shall be protected from injury or damage resulting from the Contractor's operations.

SUBSECTION 201.3 CONSTRUCTION METHODS:

The construction site and areas to the toe of an embankment, the top of a cut slope, the slope rounding limit or to a line 10 feet outside the edge of the surfaced area, whichever is greater, but not beyond the boundaries of work, shall be cleared of all trees, stumps, brush, roots, rubbish, debris and other objectionable matter, except as follows.

All trees and shrubs found suitable for improvement and beautification, which will not interfere with excavation or embankment or cause disintegration of the improvements shall not be disturbed. In any event, the Contractor shall avoid, as far as practicable, injury to shrubbery, vines, plants, grasses and other vegetation growing outside of the clearing limits. The dragging and the piling of materials of various kinds and the performing of other work which may be injurious to vegetation shall, insofar as practicable, be confined to areas which have no vegetation or which will be covered by embankment or disturbed by excavation during grading operations.

Vegetative and deleterious material shall be carefully removed and discarded from fill material. Hand removal of small roots may be required. Dispose of material generated from clearing and grubbing activities shall be disposed of at an approved landfill or greenwaste recycling facility. Cavities left below subgrade elevation by removal of stumps or roots shall be carefully backfilled and compacted. All tree trunks, stumps, brush, limbs, roots, vegetation and other debris removed in clearing and grubbing shall be removed and disposed of so as to leave the construction site and adjacent areas in a neat and finished condition, free from unsightly debris.

SUBSECTION 201.4 REMOVAL AND DISPOSAL OF SALVAGEABLE ITEMS:

Items and materials of salvage value as determined by the Engineer, unless incorporated in the new work, shall remain the property of the Contracting Agency and shall be stored in adjacent areas as directed by the Engineer. Such items and materials shall be carefully removed and in such a manner as to permit reuse.

SUBSECTION 201.5 MEASUREMENT:

Measurement will be made on a square yard basis.

SUBSECTION 201.5 PAYMENT:

Payment will be made on a square yard basis.

BID ITEM 201-1 CLEARING AND GRUBBING

END OF SECTION

SECTION 202 MOBILIZATION

SUBSECTION 202.1 DESCRIPTION:

The work under this section shall consist of preparatory work and operations, including but not limited to, the movement of personnel, equipment, supplies and incidentals to the project site; the establishment of all offices, buildings and other facilities necessary for work on the project, and for all other work and operations that must be performed and costs incurred prior to beginning work on various items on the project site. A field office is not specifically required for this project. The Contractor may mobilize a job trailer as appropriate.

SUBSECTION 202.2 TEMPORARY CONSTRUCTION FACILITIES:

Site Plan:

The Contractor shall prepare a site plan indicating the location and dimensions of all areas proposed to be used by the Contractor. The site plan shall indicate the following: staging areas, material stockpile areas, access and haul road locations, temporary fencing locations and location of contractor's trailer(s). The site plan shall be submitted to the Engineer for review and approval prior to mobilization.

Payment for Utility Services:

Unless otherwise specified in the contract, the Contractor shall arrange for all connections to required utilities and shall pay for all charges for connection and service.

Sanitation:

The Contractor shall provide and maintain within the construction area minimum field-type sanitary facilities approved by the Engineer. District toilet facilities will not be available to Contractor's personnel.

Bulletin Board:

Immediately upon beginning of work, the Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Engineer. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees, as approved by the Engineer. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of the Contractor.

Haul Roads:

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. The Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads within the project site shall be subject to approval by the Engineer. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads designated by the Engineer shall be removed and the area restored to its previous condition.

Storage Area:

The Contractor shall construct a temporary 6 foot high chain link fence around trailers and materials. The fence shall include plastic strip inserts, colored green or brown, so that visibility through the fence is obstructed. Trailers, materials, or equipment shall not be placed or stored outside the fenced area unless such trailers, materials, or

equipment are assigned a separate and distinct storage area by the Engineer away from the vicinity of the construction site. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

Appearance of Trailers:

Trailers utilized by the Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair. Trailers which, in the opinion of the Engineer, require exterior painting or maintenance will not be allowed.

Security Provisions:

Adequate outside security lighting shall be provided at the Contractor's temporary facilities. The Contractor shall be responsible for the security of its own equipment; in addition, the Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

Cleanup:

Construction debris, waste materials, packaging material and the like shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

Restoration Of Storage Area:

Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition.

SUBSECTION 202.3 MEASUREMENT:

Evaluation of measurement for payment will be based on equipment and materials delivered to the site and the level of work being accomplised commensorate with the scope of work.

SUBSECTION 202.4 PAYMENT:

Payment shall be made on the basis of the lump sum price bid and shall be full compensation for supplying and furnishing all materials, facilities, and services and performing all work involved as specified herein. The lump sum price bid shall not exceed three percent (3%) of the total project bid amount exclusive of mobilization. No additional payment will be made for occupancy and services during periods of contract time extension due to engineering changes.

BID ITEM 202-1 MOBILIZATION

END OF SECTION

SECTION 206 STRUCTURE EXCAVATION AND BACKFILL

SUBSECTION 206.1 DESCRIPTION:

Structure excavation shall consist of the excavation of material from the dam face and toe of the FRS#3 for the construction of each of the three soil buttress structures, and other excavation designated on the plans or in these special provisions as structure excavation. Specifically, excavation to around the pipe to expose sufficient length of existing CMP to cut off the end and install the coupling band to join the new pipe extension shall be conducted methodically with neat cut lines. This excavation shall also be limited to remove only that which is needed to implement work, minimizing the amount of existing pipe exposed. Neat cut lines is required to pour concrete backfill to the springliine of all existing pipe exposed upstream of the coupling and concrete collar.

Structure backfill shall consist of incidental fill at the borrow, road re-alignments, or outlet structures, including placing and compacting backfill material to the lines designated on the plans or specified or as directed by the Engineer. Areas of incidental fill shall be further identified and approved as needed to complete Work as designed.

Structure excavation and backfill shall include the furnishing of all materials and equipment and the providing of other facilities which may be necessary to perform the excavations and place and compact the backfill as they are required or generally called out by the plans, special provisions or Engineer.

SUBSECTION 206.2 FOUNDATION MATERIAL TREATMENT:

Treatment of the foundation (subgrade) beneath the diaphragm filter, drain material, concrete, and soil buttress structural fill is required. The Contractor is required to scarify, moisture condition the loose soil layer, and recompact.

Foundations/subgrades shall be exposed, inspected, sampled, and approved by the Engineer prior to treatment, preparation, or fill placement. The Engineer shall have opportunity to collect soil samples of foundation material after being exposed (embankment material removed). The Engineer will test the soil from approximately two locations to verify the gradation of existing foundation materials provide a filter match for the diaphragm filter sand. The gradation testing will be performed as expeditiously as possible. The Engineer will perform the filter match calculations and consult with the District and ADWR for acceptance or rejection of the material as foundation interface material. The following actions by the Contractor are likely based on this evaluation:

1) Should the foundation material be found compatible with the filter design, the Contractor shall perform the preparatory work as outlined in this Section as the based bid scope of work. Prep work shall consist of scarification, moisture conditioning, and re-compaction prior to fill placement.

2) Should the foundation material be rejected due to a mismatch of materials based on gradation, the Contract shall submit a Change Order Request for overexcavation of the foundation within the footprint of the diaphragm filter to a depth of 2 feet and dispose onsite as spoils at a location agreed upon by the District. The Contractor shall moisture condition, backfill, and compact in uniform lifts with Soil Buttress Fill material in general accordance with Section 211.

The Contractor should allow for scheduling and sequencing work at one or more of the outlet structures to allow time for sampling and evaluation of the foundation materials without claims for delay or impedence of production. It is expected that two days per outlet is needed to complete the evaluation.

All foundation excavations shall be inspected and approved by the Engineer prior to placing the filter sand and/or culvert pipe and all trench excavations shall be inspected prior to placing engineered material. Any loose or disturbed zones should be removed and replaced with compacted fill as directed by the Engineer.

Below outlet pipe extensions, the moisture content of existing site soils (subgrade) shall be maintained between optimum and optimum plus 3 percent moisture, as determined by Standard Proctor ASTM D 698, during and

subsequent to compaction and final grading. Compaction field densities of the prepared foundation shall be at least 95 percent of Standard Proctor as determined by ASTM D2922.

At these moist conditions, some pumping may be experienced under dynamic loading if the compaction is done by very heavy equipment (i.e., loaded scrapers, water-pulls, etc.) Some pumping is not considered detrimental in areas below the culvert/pipeline bottom (i.e., static loading conditions) provided specified field densities are obtained. Lighter compaction equipment and/or drying of wet soils may be used to reduce pumping if this condition becomes severe.

SUBSECTION 206.3 INSPECTION:

When any structure excavation is completed and the foundation/subgrade is exposed, the Contractor shall notify the Engineer who will make an inspection of the excavation, foundation, or subgrade. No fill shall be placed until the excavation, foundation, or subgrade has been approved by the Engineer.

Inspection of the excavation limits is required to verify lines and grades and subgrade compaction. Materials testing for density of in-place subgrade is required prior to backfill operations.

206.4 INCIDENTAL STRUCTURE BACKFILL:

Incidental backfilling operations shall conform to the following requirements: Structure backfill shall not be placed until the subgrade has been inspected by the Engineer and approved for backfilling.

All soil materials to be incidental fill and subgrade preparation shall be placed in approximately 8 inch loose lifts to produce a compacted lift thickness of approximately 6 inches. The incidental fill shall be compacted to a minimum of 95 percent of maximum dry density in accordance with ASTM D 698. Compaction of fill shall be accomplished to a uniform moisture content within range of minus 2 percent of its optimum to optimum.

SUBSECTION 206.5 MEASUREMENT:

Measurement for payment of foundation preparation shall be conducted on a square yard basis.

Measurement for payment of excavation of the dam face and toe and general backfill shall be conducted on an in-place cubic yard basis.

SUBSECTION 206.6 PAYMENT:

Payment of foundation preparation shall be made on a square yard basis.

Payment of excavation of the dam face and toe and general backfill shall be made on an in-place cubic yard basis.

BID ITEM 206-1 FOUNDATION PREPARATION

BID ITEM 206-2 EXCAVATION OF DAM FACE AND TOE

END OF SECTION

SECTION 210 BORROW EXCAVATION

SUBSECTION 210.1 LOCAL BORROW:

Local borrow from the spillway notch excavation shall consist of material excavated and used in the construction of fills or for use as selected material or for other construction purposes. Local borrow shall be obtained by widening cuts or by excavating from other sources outside the planned or authorized cross section within the right-of-way and within the limits of the project. Local borrow shall be excavated to the lines and grades established by the Engineer.

Borrow material for cover over each of the three outlet pipe extensions shall be excavated from the notch channel to be constructed at the spillway location. Should additional borrow be needed for access ramps or to replace unsuitable material, then the notch can be uniformly widened in the field with prior approval and direction from the Engineer. Limited geotechnical data showing the borrow material is "generally" consistent with project requirements can be made available for the Contractor's understanding and use, however, it remains the Contractor's responsibility to satisfy the gradation and compaction requirements for fill.

The Contractor is required to excavate borrow material from the notch excavation and stockpile the material at a pre-approved location. Stockpiling is necessary to sample and perform laboratory testing to prequalify the material before it is placed. It may be necessary to blend and/or screen the material to meet the gradation requirements of the fill. The additional handling and processing of the material to meet the gradation specification shall be the responsibility of the Contractor.

SUBSECTION 210.2 IMPORTED BORROW:

Although not anticipated, the contractor may be required to locate and conduct operations at a secondary borrow site, importing fill to the site.

Imported borrow shall consist of material required for construction and unless otherwise designated in the special provisions, the Contractor shall make his own arrangements for obtaining imported borrow and he shall pay all costs involved. Imported borrow shall be obtained from sources indicated on the plans, designated in the special provisions, or approved by the Engineer.

The material shall be free from wood, vegetation, or other deleterious matter. The maximum size of this material shall not be greater than 3 inches.

The Contractor shall notify the Engineer sufficiently in advance of opening any material sites so that cross section elevations and measurements of the ground surface after stripping may be taken and sufficient time for pre-qualification material testing and acceptance.

Borrow pits shall be excavated to regular lines to permit accurate measurement; depth of excavation throughout the area of borrow pits shall be as uniform as practicable and the side slope shall be dressed to such slope as may be directed, leaving the borrow pit area in a clean and safe condition. Borrow sites other than the one identified for the construction of the spillway notch channel require prior approval by the Engineer and are subject to materials testing.

SUBSECTION 210.3 PLACING AND COMPACTING:

Local borrow and imported borrow shall be placed and compacted as specified in Section 211. The Contractor shall verify there is sufficient space available in fill locations for placing any excavated material, before placing borrow. Any excess excavation which develops as a result of placing borrow in advance of completing excavations shall be disposed of by the Contractor at no additional cost to the Contracting Agency and a corresponding reduction in the quantity of borrow to be paid for will be made, for which the Contractor will have no claim for compensation.

SUBSECTION 210.4 MEASUREMENT:

Measurement and quantity verification only apply to the determination of soil buttress fill required to meet the configuration of soil buttress fill cover over each of the three outlet pipes. No measurement will be made for purposes of payment.

SUBSECTION 210.5 PAYMENT:

No payment compensation shall be made for this scope of work. Compensation shall be included in the fill construction of the soil buttress fill (cover).

END OF SECTION

SECTION 211 FILL CONSTRUCTION

SUBSECTION 211.1 DESCRIPTION:

Fill construction shall consist of constructing diaphragm filter, drain, and soil buttress over the outlet pipe extensions; the placing and compacting of approved fill material to the lines and grades in accordance with the drawings.

The Contractor's approach will require methodical planning and sequencing and may include, but is not required to, constructing access ramps on one or both sides. The Contractor is not allowed to cut or excavate into the existing dam embankment to provide ramps or staging areas. The barbed wire fence may have to be temporarily removed and replaced upon fill completion.

The Contractor's approach may include, but is not required to, temporarily filling the shotcrete-lined north outlet channel for a segment downstream of the work zone to maintain access to both sides.

SUBSECTION 211.1.1 Diaphragm Filter:

Fill placement for the installation of the seepage diaphragm filter material to the lines, grades, and densities is critical to the success of this project and the Contractor is obligated to utilize construction methods accordingly.

Work specified in this item includes excavation and sand backfill required to construct the diaphragm filter structure at each of the three outlet pipes as shown on the plans. The earthwork described in this section shall be coordinated with the requirements specific to the culvert pipe, fill construction, and associated subsections.

The backfill material for the diaphragm shall be engineered sand. The sand for the filter diaphragm shall be imported, commercially manufactured sand (typically used in concrete mix), uniformly washed and conform to the following requirements:

(A) Fine Aggregate (Sand) complying with ASTM C 33 Fine Aggregate. In addition the filter sand for this project shall have a maximum of 5% particles passing the No. 200 sieve.

(B) Certificates of compliance or recent test results signed and stamped by a representative of the commercial supplier that ensures the sand delivered to the site meets the requirements of ASTM C 33.

(C) Pre-qualified filter sand shall be subject to further laboratory testing to ensure uniformity in material delivered to the site in accordance with the CQA plan.

(D) The Contractor shall submit one 5-gallon bucket of diaphragm filter sand material obtained from the commercial supplier to the District for laboratory analysis to assess the permeability of the material, in addition to gradation. The bucket sample must be submitted at least 2 weeks prior to the placement of the diaphragm filter sand material.

Diaphragm filter sand shall be ASTM C33 fine aggregate and manufactured by a certified commercial material supplier, and graded within the following limits:

TABLE 211-1	
DIAPHRAGM FILTER SAND	
Sieve	Percent Passing
9.5-mm (3/8-in.)	100
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600-µm (No. 30)	25 to 60
300-µm (No. 50)	5 to 30
150-µm (No. 100)	0 to 10
75-µm (No. 200)	0 to 5
ASTM C33 Fine Aggregate	

SUBSECTION 211.1.2 Soil Buttress Fill:

The work under this section shall consist of fill to provide soil cover over the top of the diaphragm filter, drain, and culvert pipe extensions at each of the three locations. The minimum limits of fill are delineated on the plans.

Construction of the soil buttresses shall be in accordance to the drawing lines, grades, and elevations without deviation unless specific express written approval from the Engineer. The Contractor is responsible for quality control to achieve completed dimensions and elevations as designed. The Contractor also has an obligation to notify the Engineer upon discovery of discrepancies within the dimensions or elevations prior to work for clarification or approved field design changes.

Soil buttress fill cover material shall consist of on-site native soils, free of vegetation, debris, organic contaminants, obtained from the approved borrow notch excavation at the spillway. The fill shall also meet the following requirements:

TABLE 211-2	
SOIL BUTTRESS FILL	
Sieve	Percent Passing
3 inches (75 mm)	100
2 inches (50 mm)	95 to 100
No. 4 (4.75 mm)	80 to 100
No. 16 (1.18 mm)	60 to 100
No. 30 (0.6 mm)	45 to 85
No. 50 (0.3 mm)	20 to 65
No. 200 (0.075 mm)	0 to 20

In addition, the soil buttress fill shall meet the following soil engineering properties:

Maximum Particle Size:	3 inches
Plasticity Index:	≤10
Soil Type:	CL, ML, or SM (per Unified Soil Classification System)

As required by Section 210 for borrow excavation, the Contractor shall stockpile excavated material and provide opportunity for the Engineer to sample and perform tests to prequalify the material for use as Soil Buttress Material. The Contractor is responsible for meeting the requirements listed above, therefore blending may be required to achieve the desired gradation. In the event blending is required, additional samples and test results must be evaluated and approved prior to soil buttress fill placement.

Investigative soils data indicates gradation and plasticity index and classification of existing soil from the spillway notch excavation would be appropriate borrow for fill at each of the culvert extensions. An excerpt copy of the Design Report that contains soils data (including sieve analysis) from limited investigations will be made available for review upon request in accordance with Subsection 102.4 of the Supplementary General Conditions.

SUBSECTION 211.1.3 Drain Sand:

The backfill material for the drain shall be engineered coarse sand. The coarse sand shall be imported, commercially manufactured sand, uniformly washed and conform to the following requirements:

(A) No. 9 coarse sand aggregate complying with ASTM C 33.

(B) Certificates of compliance or recent test results signed and stamped by a representative of the commercial supplier that ensures the sand delivered to the site meets the requirements of ASTM C 33.

(C) Pre-qualified drain sand shall be subject to further laboratory testing to ensure uniformity in material delivered to the site in accordance with the CQA plan.

(D) The Contractor shall submit one 5-gallon bucket of drain sand material obtained from the commercial supplier to the District for laboratory analysis to assess the permeability of the material, in addition to gradation. The bucket sample must be submitted at least 2 weeks prior to the placement of the drain sand material.

Drain sand shall be material manufactured from a certified commercial material supplier, and graded within the following limits:

TABLE 211-3	
COARSE DRAIN SAND	
Sieve	Percent Passing
9.5-mm (3/8 in.)	100
4.75-mm (No. 4)	85 to 100
2.36-mm (No. 8)	10 to 40
1.18-mm (No. 16)	0 to 10
300-μm (No. 50)	0 to 5
ASTM C33 No. 9	

SUBSECTION 211.2 PLACING:

SUBSECTION 211.2.1 Diaphragm Filter Sand:

Specific approval of diaphragm filter sand upon review of pre-qualification and subsequent laboratory conformance testing results shall be obtained from the Engineer prior to placement.

Specific approval of the foundation / subgrade is required prior to placement of diaphragm filter sand. The Contractor shall allow the Engineer sufficient time to inspect, sample, and evaluate the foundation soils. Allow approximately two days per outlet structure.

Placement of filter sand requires a well-planned method and approach from the Contractor. Placement shall be conducted using the appropriate combination of heavy equipment, small equipment, and labor. Placement of filter sand to accurate lines, grades, and thickness is essential. The drawings indicate a series of control points and measurements that define the limits of the filter sand. Deviations from dimensions shall not be permitted without the Engineer's approval. The filter sand shall be placed to configuration shown on the various drawing plan views, sections, and elevations. The filter sand shall be continuous down the cut face of the embankment and to the key trench. Filter sand also should envelope the entire concrete collar.

Filter sand shall be placed in uniform lifts thickness not to exceed 12 inches as measured in its loose state, prior to compaction. Each lift shall be placed near horizontal and continuous along its length to ensure optimal compaction conditions.

The Contractor is responsible for protecting the sand filter from being commingled with dam embankment material or soil buttress fill. In the event sloughing from either adjacent soil zones occurs, the Contractor shall remove and replace any commingled filter sand and soil.

SUBSECTION 211.2.2 Soil Buttress Fill:

Specific approval of soil fill upon review of pre-qualification and subsequent laboratory conformance testing results shall be obtained from the Engineer prior to placement and buttress construction.

Placement of soil buttress fill requires a well-planned method and approach from the Contractor. Placement shall be conducted using the appropriate combination of heavy equipment, small equipment, and labor. Placement of soil buttress fill to accurate lines, grades, and thickness is essential. The drawings indicate a series of control points and

measurements that define the limits of the soil buttress fill. Deviations from dimensions shall not be permitted without the Engineer's approval.

Fill shall be moisture conditioned prior to spreading at its final destination and placed in uniform lifts and compacted to the minimum requirements.

Cutting, benching, or excavation into the existing embankment is prohibited.

The maximum particle size is 3-inches in its greatest dimension. Material containing oversize rock will be rejected by the Engineer. However, should occasional random oversize material be encountered and the material otherwise meets the gradation requirements, the Contractor may employ hand labor and equipment to hand pick the oversize rock out of the loose lifts, only upon specific approval of the Engineer. Clods or hard lumps of earth of 6-inches in greatest dimension shall be broken up and moisture conditioned before compacting the material in embankment.

The loose thickness of each layer of soil buttress fill material before compacting shall not exceed 8 inches.

On-site undisturbed soils or compacted soils subsequently disturbed or removed by construction operations should be replaced by materials compacted as specified above.

Fill material placed beyond the minimum soil cover configuration over top of the pipes and diaphragm filter sand shall meet the same material, moisture conditioning, placement, and compaction requirements as the fill, incorporating the ramp into the soil cover. For purposes of consistency verifying that field compaction requirements for the soil cover are being met, all soil used for overbuilding and ramp construction as incorporated during construction, shall meet the same compaction requirements for density and moisture.

Fill temporarily placed in the outlet channel for access purposes shall be removed upon completion of work on the outlet structures. Shotcrete debris shall be disposed of offsite at an approved construction debris landfill. Excess soil may be stockpiled or spread out at a location onsite approved by the Engineer. Replacement shotcrete shall be installed in accordance with Section 525.

Highly plastic soils, PI > 10, removed from the excavation shall not be used in any required fills or structural backfills.

Nesting of coarse particles will not be permitted.

The minimum compressive strength required before backfill against and over the top of the concrete encasement of the culvert pipe extension shall apply as described in Section 725. Damage caused by premature fill placement shall be replaced or repaired as recommended by Owner at no cost to Owner. Do not operate heavy equipment over pipes and buried concrete structures until at least 1.5 feet of fill materials have been placed and compacted over the top in conformance with the requirements specified herein. Select and operate compaction equipment so that concrete structures are not damaged nor overstressed during compaction operations. Use hand-operated mechanical tampers for compaction of fill adjacent to structures where rolling equipment is impracticable for use in compaction.

Soil buttresses shall be constructed so that each layer shall have a cross fall of at least 1 percent (1%) but no more than 5 percent (5%) to prevent water ponding during construction.

SUBSECTION 211.2.3 Drain Sand:

Specific approval of drain sand upon review of pre-qualification and subsequent laboratory conformance testing results shall be obtained from the Engineer prior to placement.

Placement of drain sand requires a well-planned method and approach from the Contractor. Placement shall be conducted using the appropriate combination of heavy equipment, small equipment, and labor. Placement of drain sand to accurate lines, grades, and thickness is essential. The drawings indicate a series of control points and measurements that define the limits of the drain sand. Deviations from dimensions shall not be permitted without the Engineer's approval.

The drain sand shall be placed in uniform lifts not to exceed 12 inches as measured in its loose state, prior to compaction. Each lift shall be placed near horizontal and continuous along its length to ensure optimal compaction conditions.

The Contractor is responsible from protecting the drain sand from being commingled with soil buttress fill. In the event sloughing occurs, the Contractor shall remove and replace any commingled drain sand and soil.

The minimum compressive strength required before backfill against the concrete encasement of the culvert pipe extension shall apply as described in Section 725. Damage caused by premature fill placement shall be replaced or repaired as recommended by Owner at no cost to Owner. Do not operate heavy equipment over pipes and buried concrete structures until at least 1.5 feet of fill materials have been placed and compacted over the top in conformance with the requirements specified herein. Select and operate compaction equipment so that concrete structures are not damaged nor overstressed during compaction operations. Use hand-operated mechanical tampers for compaction of fill adjacent to structures where rolling equipment is impracticable for use in compaction.

SUBSECTION 211.3 COMPACTING:

SUBSECTION 211.3.1 Diaphragm Filter Sand:

The diaphragm filter sand shall be compacted to a minimum relative density of 70% as tested according to ASTM D4253 and D4254. At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill is firm and unyielding. Fill material which contains excessive moisture shall not be compacted until the material is dry enough to obtain the required relative compaction. Full compensation for any additional work involved in drying fill material to the required moisture content shall be considered as included in the contract price paid and no additional compensation will be allowed therefore.

Compaction of filter sand shall be achieved using vibratory equipment. The Contractor is responsible for selecting the compaction equipment to achieve required relative densities. Different equipment or thinner lift thickness' will be at the Contractor's expense.

SUBSECTION 211.3.2 Soil Buttress Fill:

Fill shall be constructed in compacted layers of uniform thickness and each layer shall be compacted in accordance with the requirements herein specified. Soil buttress fill construction shall consist of material compacted to a uniform density of not less than 95 percent of the maximum dry density and within a moisture range of 2 percent minus optimum to optimum. The maximum dry density will be determined by ASTM D698.

Areas over which fills are to be placed over one (1) hour previously shall be scarified to a depth of 3 inches and re-conditioned to the appropriate moisture content to provide a bond between the existing ground and the material to be deposited thereon.

Compaction operations shall be accomplished by mechanical and vibratory methods, including padded foot rollers. Water settling or jetting shall not be permitted. Compaction of soil adjacent to culverts or concrete collar within 3 feet shall be accomplished using manual or walk-behind compaction equipment only.

SUBSECTION 211.3.3 Drain Sand:

The drain sand shall be compacted to a minimum relative density of 70% as tested according to ASTM and D4253 and D4254. At the time of compaction, the moisture content of fill material shall be such that the specified relative compaction will be obtained and the fill is firm and unyielding.

Compaction of drain sand shall be achieved using vibratory equipment. The Contractor is responsible for selecting the compaction equipment to achieve required relative densities. Different equipment or thinner lift thickness' will be at the Contractor's expense.

SUBSECTION 211.4 TESTS:

Pre-qualification testing and conformance testing prior to placement will be conducted on the filter sand, drain sand, and soil buttress fill in accordance with the CQA plan.

The soil buttress fill shall be thoroughly compacted to not less than the stated densities when tested and determined by ASTM D-2922 (nuclear gauge) and D-3017 (sand cone) with the percent of density adjusted in accordance with the rock correction procedure for maximum density determination, to compensate for the rock content larger than that which will pass a No. 4 sieve.

Failing results is the responsibility of the Contractor. Rework, fill replacement, and retesting shall be at the Contractor's expense.

SUBSECTION 211.5 MEASUREMENT:

The quantities of fill construction used to construct embankments will be in-place cubic yard volumes, within the limits of dimensions shown on the plans. The Engineer will compute the quantities of fill by a method, which is best suited to obtain an accurate determination.

SUBSECTION 211.6 PAYMENT:

Quantities of fill construction for filter, drain, and soil buttress will be paid for at the contract unit price per cubic yard of fill (in place) as stipulated in the proposal. Such price shall include placing and compaction and all related work as specified above.

No payment will be made for fill construction to replace unsuitable material or for rework due to failing tests or overbuilding for construction convenience and then cut back to the required lines and grades. The cost thereof shall be included in the price bid for the construction of the items to which such fill is incidental or appurtenant.

BID ITEM 211-1 FILTER SAND

BID ITEM 211-2 SOIL BUTTRESS FILL CONSTRUCTION

BID ITEM 211-3 DRAIN SAND

END OF SECTION

SECTION 215 NOTCH EXCAVATION

SUBSECTION 215.1 DESCRIPTION:

The work in this section consists of excavation, over-excavation, fill, grading, and disposal of excavated and removed material for the modification of the spillway by constructing a notch at the desired elevations and dimensions. The cut material resulting from the notch or channel excavation at the spillway may be used as soil buttress fill at each of the three outlet pipe locations. Based on limited geotechnical data, the soil from the channel, or notch, being excavated through the spillway is generally suitable for soil cover fill. However, it remains the Contractors obligation to meet the gradation requirements for fill.

Coordinate channel construction with placement of Riprap as described in Section 220.

SUBSECTION 215.2 STRIPPING:

When stripping is indicated on the plans or specified in the special provisions, the Contractor shall strip the soil from the designated areas to the depths shown or specified or as directed by the Engineer. The material obtained from stripping operations shall be disposed of away from the site unless otherwise specified, shown on the plans or authorized by the Engineer.

If field observations during construction identify the soil proposed for fill construction is unsuitable due to the presence of vegetative matter or does not meet the gradation requirements, then the Contractor is responsible for minor stripping of the upper 12 inches to remove and discard. Stripping would be required to gain access to more suitable borrow material for the fill construction portion of the project.

SUBSECTION 215.3 EXCAVATION:

Excavation in open cut for lined channels may be made so as to place concrete directly against the excavated surfaces providing the faces of the excavation are firm and unyielding, are such as will stand or can be made to stand without sloughing and are, at all points outside the concrete lines shown on the plans.

Excavation to provide a subgrade for lined channels, or subdrainage material, shall be to the lines indicated on the plans; and, excavation made below subgrade shall be backfilled and compacted to a uniform density of not less than 90 percent or, if approved by the Engineer, with concrete or other materials being placed. However, no payment will be made for such over-excavation or material used for such backfill.

Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, the voids remaining after the removal of such boulders or interfering objects shall be backfilled as specified below, or as otherwise approved by the Engineer.

When the void is in the side of the excavation, it shall be filled with suitable material as approved by the Engineer, placed in the manner and to the same uniform density as the backfill in the vicinity of the void. With the approval of the Engineer, concrete of the same mix as used in the concrete channel may be used. If concrete is placed prior to lining, a lower grade concrete may be used only if approved by the Engineer.

It shall be understood that the removal of boulders or other interfering objects and the backfilling of voids caused by such removals shall be done by the Contractor at no additional cost to the Contracting Agency. The cost of such work shall be included in the prices bid for the various items of work.

If during the progress of excavation, material is encountered, which, in the opinion of the Engineer, is unsuitable for subgrade for the channel to be constructed on, the Engineer may direct the Contractor to excavate beyond the pay lines shown on the plans. However, the suitability of subgrade shall be determined by the Engineer on the basis of its ability to withstand the load of the proposed channel and not upon the capacity to withstand the loads which may be placed upon it by the Contractor's equipment. Should the Contractor be directed to excavate beyond the pay lines

shown on the plans, said pay lines will be extended to include such ordered excavation; and the pay lines for subdrainage material, if used, will be adjusted accordingly.

Excavation to the lines and grades shown on the plans is required and deviations to the plans for purpose of borrow ease or quantities shall be prior approved by the Engineer. Consideration shall be given to the access road, which will cross the channel at the location perpendicular to the road along the crest of the dam.

Materials used or work performed by the Contractor, to stabilize the subgrade so it will withstand loads, which may be placed upon it by his equipment, shall be accomplished by the Contractor at no additional cost to the Contracting Agency.

SUBSECTION 215.4 FILL AND BACKFILL:

Unless otherwise specified in the special provisions, material obtained from the project excavations may be presumed to be suitable for use as fill or backfill and is free of all organic material, rubbish, debris, and other objectionable material.

SUBSECTION 215.5 GRADING:

Grading of unlined channels, shall conform to the following tolerances:

A vertical tolerance of none above and 3 inches below the specified grade will be allowed on:

(1) Channel bottom
(2) Channel side slopes in both cut and fill

Regardless of the construction tolerances specified, excavation and grading shall be performed so that finished surfaces are in uniform planes with no abrupt breaks in the surface. Construction tolerances specified above for grading are solely for purposes of field control.

The contractor will maintain a 0.5 % grade along the length of the channel as shown on the drawings. The grade is of the utmost importance. Abrupt crowns or depression shall be eliminated to the practical extent possible by fine grading.

SUBSECTION 215.6 TESTS:

The channel bottom shall be proof rolled using rubber tire equipment with a gross vehicle weight of no less than 30,000 pounds. Proof rolling shall be conducted with no less than two passes with overlapping tire path and shall be witnessed by the Engineer.

SUBSECTION 215.7 MEASUREMENT:

Measurement for excavation will be made according to the quantity of material excavated from natural ground to the finished sub-grades shown on the plans. The Engineer will verify the quantities of excavation by a method, which in his opinion is best suited to obtain an accurate determination.

SUBSECTION 215.8 PAYMENT:

Earthwork for open channels will be paid for at the contract unit price per cubic yard of excavation as stipulated in the proposal. Such unit price shall include clearing, stripping, excavation, stockpiling, fill, backfill, compaction, grading, hauling, removal and disposal of excess excavated material and debris

BID ITEM 215-1 – NOTCH EXCAVATION

END OF SECTION

SECTION 220 RIPRAP CONSTRUCTION

SUBSECTION 220.1 DESCRIPTION:

The construction of plain riprap shall consist of furnishing and placing stone to the depth and limits at the right abutment as shown on the plans.

The construction of plain riprap at the outlet pipes of the FRS#3 Dam shall consist of furnishing and placing stone to the depth and limits as shown on the plans.

Riprap construction shall be coordinated with the placement of geotextile filter fabric per drawing sections and details.

SUBSECTION 220.2 MATERIALS:

In order to maintain slope stability where plain riprap is constructed, stones shall be angular in shape and conform to the gradation requirements set forth in the table below.

Description	Size
D_{50}	6 inches
Minimum Stone Size	2 inches
Maximum Stone Size	12 inches

Aggregate stone for the road crossing that is placed over top riprap shall be angular in shape and conform to the gradation requirements below:

Sieve	Percent Passing
2-inch	100%
1-inch	90%
½-inch	30%
#4	15%
#200	5%

A geotextile fabric underlay shall be furnished in accordance with Section 230.

SUBSECTION 220.3 PREPARATION OF GROUND SURFACES:

The bed for the riprap shall be shaped and trimmed to provide even surfaces. A footing (toe) trench shall be excavated along the toe of the slope as shown on the plans.

The bed (or subgrade) shall be proof rolled along the slope and bottom to establish a firm surface.

Place the geotextile filter fabric to the same dimensions that are to receive riprap in accordance with Section 230.

Protect the position and integrity of the geotextile during placement of the riprap.

SUBSECTION 220.4 PLAIN RIPRAP:

Riprap shall be placed by heavy equipment and hand labor as required. Stone shall be placed to provide a minimum of voids. Stones shall be placed with their longitudinal axis normal to the face of the embankment and so arranged that each stone above the foundation course have at least a 3 point bearing on the underlying stones. Bearing on smaller stones used to chink voids will not be acceptable. Interstices between stones shall be chinked with small stones and spalls. The finished surface shall be even and tight and shall not vary from the planned surface by more than 3 inches per foot of depth.

Riprap may initially be placed by dumping from loader-type equipment in a careful, methodical manner. However, hand placement to the outer dimensions and hand repositioning shall be conducted to the Engineer's satisfaction in the field.

Place the riprap along one side of the spillway notch channel to the limits, elevation, and thickness shown on the plans. Elevation measurements shall be staked prior to placement of riprap and to be inspected and verified in the field by the Engineer.

A trench shall be excavated a minimum of 12 inches below grade and replaced with geotextile and riprap to provide scour protection at the toe of slope. The trench shall be excavated as shown on the drawings for riprap placement. The trench shall be continuous along the toe of slope.

SUBSECTION 220.5 MEASUREMENT:

The quantities of riprap construction shall be those of the completed bid item, in place, within the limits of dimensions shown on the plans. The Engineer will compute the quantities of riprap by a method, which, in his opinion, is best suited to obtain an accurate determination.

The quantities of 1-inch aggregate construction shall be those of the completed bid item, in place, within the limits of dimensions shown on the plans. The Engineer will compute the quantities of aggregate by a method, which, in his opinion, is best suited to obtain an accurate determination.

SUBSECTION 220.6 PAYMENT:

Payment for riprap and 1-inch aggregate construction shall be made at the price bid per cubic yard to the neat lines shown on the plans, and shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in constructing the riprap and aggregate structures complete in place as specified on the plans, and in the special provisions. This includes, but is not limited to, preparation of ground surfaces, excavation and backfill, geotextile fabric, riprap, aggregate, and cleanup.

BID ITEM 220-1 RIPRAP

BID ITEM 220-2 1-INCH AGGREGATE

END OF SECTION

SECTION 225 WATERING

SUBSECTION 225.1 DESCRIPTION:

Water for compacting embankments, constructing subgrade, placement of screened gravel and crushed materials , and for laying dust caused from grading operations, shall be applied in the amounts and places as directed by the Engineer.

The moisture content of soil shall be kept at a content sufficient to insure that dust will be kept at a minimum for the excavation, hauling, and disposal or placement of soil.

All fill materials shall be moisture conditioned with uniform water application prior to spreading or placement to desired location. Blend soil with water to ensure uniform moisture content. Moisture content shall be adjusted to within the required range as specified in Section 206 and Section 211.

SUBSECTION 225.2 WATER SUPPLY:

Water shall consist of providing a water supply sufficient for the needs of the project for construction purposes such as moisture conditioning, excavation, dust control and the Contractor's means of hauling and applying the water required.

The Contractor shall make arrangements for and provide all necessary water for his construction operation and domestic use at his own expense.

If the Contractor purchases water from a water utility at a fire hydrant on or near the project, all arrangements shall be made by him at his own expense and payment made direct to the water utility as agreed upon. The Contractor shall use only those hydrants designated by the water utility in charge of water distribution and in strict accordance with its requirements for hydrant use. The Contractor shall furnish all connections, wrenches, valves and small tools that may be necessary to meet the requirements of the water utility pertaining to hydrant use. Coordination and use of a local fire hydrant is the responsibility of the Contractor. There are no fire hydrants on District property.

Water may be available from the Beardsley Irrigation Canal depending on the season and volume needed. Permits must be obtained from Maricopa Water District for the use of this water. The permit paperwork may be obtained at the Maricopa Water District offices located at 19420 North Grand Avenue, Surprise, AZ.

SUBSECTION 225.3 CONSTRUCTION EQUIPMENT:

The tank truck and/or trailer shall meet all safety and licensing regulations and the water shall be applied by sprinkling with tank trucks equipped with spray bars and suitable apparatus.

SUBSECTION 225.4 MEASUREMENT:

No measurement will be made of water by the Engineer. The contractor is responsible for measurement and recording of progress and total water used as agreement is made with the utility or water district.

SUBSECTION 225.5 PAYMENT:

The cost of watering shall be included in the contractor's bid price for the construction operation to which such watering is incidental or appurtenant, unless otherwise provided .

END OF SECTION

SECTION 230 GEOTEXTILE

SUBSECTION 230.1 DESCRIPTION:

Geotextile filter fabric shall be placed to the same limits and dimensions as the riprap construction, as indicated on the plans.

Geotextile shall also be installed at the drain for each of the three outlet structures. The geotextile envelopes the drain sand.

In the event that the foundation material, as evaluated by the Engineer, is not compatible with the diaphragm filter sand, a strip of geotextile would need to be draped down the downstream face of the filter key trench in conjunction with the overexcavation activities as described in Section 206. In this case where the foundation would require the geotextile to be added, the Contractor will be asked to submit Change Order Request. Otherwise, the base bid scope does not include geotextile in the filter key trench.

SUBSECTION 230.2 MATERIALS:

Geotextile filter fabric shall be a non-woven needle punched polypropylene material manufactured for erosion control that meet or exceed the following requirements:

GEOTEXTILE	
Property	Value
Unit Weight	Range: 6 oz/sy to 12 oz/sy
Apparent Opening Size (AOS)	70 (minimum)
Burst Strength	400 psi (minimum)
Permeability	0.16 cm/sec (minimum)
Puncture Strength	120 lbs (minimum)
Trapezoid Tear Strength	60 lbs (minimum)

Manufactured roll length and width shall be standard for the industry. Used or scrap pieces will not be accepted.

SUBSECTION 230.3 INSTALLATION:

The subgrade shall be verified it is ready to receive geotextile filter fabric by the Engineer prior to deployment. The subgrade shall be trimmed and firm density.

The fabric shall be placed evenly without significant wrinkles or excessive stretching. Securing the fabric on the slope using sandbags, stakes, or pins may be required until all of the riprap is placed to prevent the wind from displacing the fabric and the riprap from dragging the fabric down the slope.

A minimum of 12 inches of overlap shall be placed when splicing two pieces of fabric either side by side or end to end. No sewing, stitching, or heat bonding is required at the seam.

Torn or otherwise damaged areas of the fabric shall be repaired with a patch of like material that is 24 inches larger than the damaged area in all directions.

Coordination of fabric installation and riprap construction is required to maintain the integrity of the fabric from possible damage that may emanate from riprap placement. The method of riprap construction may need to consider the use of particular equipment, sequence of activities, and employment of hand labor to protect the fabric.

For construction of the drain, coordination of geotextile fabric installation, placement of drain sand, and soil buttress fill construction is required to maintain the integrity of the fabric from possible damage that may emanate from drain sand or soil buttress fill placement. The method of construction may need to consider the use of particular equipment, sequence of activities, and employment of hand labor to protect the fabric.

SUBSECTION 230.4 MEASUREMENT:

Measurement for pay quantities will be performed on a square foot basis of area applied, excluding overlap and waste of fabric. The Contractor is required to procure and install the required quantity of fabric as per dimensions for riprap and drain as shown on plans.

SUBSECTION 230.5 PAYMENT:

Payment for geotextile shall be made at the price bid per square feet per the neat lines shown on the plans, and shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all the work involved in installing geotextile complete in place as specified on the plans, and in the special provisions.

BID ITEM 230-1 GEOTEXTILE

END OF SECTION

SECTION 350 REMOVAL OF EXISTING STRUCTURES

SUBSECTION 350.1 DESCRIPTION:

The work includes the demolition, removal, and disposal of existing outlet headwall structures. The work also includes the temporary removal and reconstruction of the existing barbed wire fence along the District right-of-way as shown on the plans. The fence shall be removed for extension of the outlet pipes. The fencing shall be reinstalled at the same location after construction of these pipe extensions. The disposal of all construction debris waste material removed under this item shall be the responsibility of the Contractor. The disposal site shall be approved by the Engineer.

SUBSECTION 350.2 METHODS:

The removal of existing improvements shall be conducted in such a manner as not to injure utilities or any portion of the improvement that is to remain in place.

All construction debris and waste materials shall be disposed of at an approved landfill. If a Maricopa County landfill is selected for disposition of waste materials and/or debris, a Maricopa County Landfill Use Permit will be required. Application for permit can be made at the Maricopa County Landfill Office, located at 2801 West Durango Street, Phoenix, Arizona 85009 (telephone (602) 269-2661).

The project construction limits shall be cleared of all trash and construction debris. Such material as collected shall be disposed of at an approved landfill site and shall be subject to landfill fees so assessed, which will be included in the unit price bid for this item.

Weigh tickets from all landfill disposal must be furnished to the Engineer.

Work associated with asbestos containing materials shall be performed by qualified and certified personnel that can carry out the applicable regulations governing the removal and disposal of such material.

SUBSECTION 350.3 MISCELLANEOUS REMOVAL:

This work shall include, but not be limited to the following, where called for on the plans.

(A) Demolition and removing existing headwall from each outlet prior to excavation.
(B) Cutting and Removal of one-foot of existing pipe.
(C) Demolition and relocate existing barbed wire fence at each outlet with the TCE to allow practical access to work areas. Barbed wire fence shall be re-erected or replaced upon completion of project.
(D) Remove existing shotcrete lining from the downstream channel at the North Outlet.

Cutting and removal of a one-foot section of the existing outlet pipe requires a specialty contractor to handle and dispose of the pipe and coating that consists of asbestos-containing materials (ACM). The Contractor is responsible for coordinating this work and retaining subcontractors as necessary. This work is also described in Section 621 as it relates to connecting new corrugated metal pipe to the existing pipe.

The Contractor may have to temporarily remove part of an existing barbed wire fence along the property line to maintain access to the work zone. It is the Contractor's responsibility to minimize the amount of impacted fence and to restore the fence to at least its original condition. As observed at the time of a pre-bid site walk, the barbed wire fence is a standard 4-strand with diagonal reinforcing posts at intersections to alignment or grade. New replacement barbed wire and/or tee posts will be the responsibility of the Contractor and no additional compensation will be made for materials or labor.

SUBSECTION 350.4 MEASUREMENT:

Measurement of miscellaneous demolition, removal, and disposal of headwall, outlet pipe, and shotcrete will be completion of each outlet as verified by Engineer.

No measurement of perimeter fencing will be required, payment is on a lump sum basis.

SUBSECTION 350.5 PAYMENT:

Payment for all miscellaneous demolition, removals (construction debris) required for construction of the project shall be made on the basis of each completed outlet structure as bid, and including but not limited to, removal and disposal of headwalls, shotcrete, vegetative matter, unsuitable riprap, and pipe remnants abandoned within the area of construction, and other items as required.

Payment for perimeter fencing that must be temporarily removed and replaced shall be made on a lump sum basis.

BID ITEM 350-1	**DEMOLITION OF EXISTING CONCRETE HEADWALL & REMOVAL OF PIPE AND SHOTCRETE**
BID ITEM 350-2	**REMOVE AND REPLACE PERIMETER FENCE**

END OF SECTION

SECTION 401 TRAFFIC CONTROL

SUBSECTION 401.1 DESCRIPTION:

Traffic control necessary for delivery of bulk stone materials or oversize pipe materials shall conform to Section 701 of the Arizona Department of Transportation (ADOT) Specifications. References made to approval authority shall be understood to be Flood Control District of Maricopa County acting on behalf of ADOT.

All traffic control shall conform to the Special Provisions for this project, including Part VI of the "Manual On Uniform Traffic Control Devices For Streets And Highways" (U.S. Department of Transportation, Federal Highway Division) and the associated ADOT supplement.

It shall be Contractor's responsibility to provide, erect and maintain and remove after completion of the work all necessary signs, barricades, barriers, berms, lights, high level warning devices, delineators, and any other required devices, uniformed officers, and flagman, necessary to properly mark and control the construction area for the safe and efficient movement of traffic. Temporary traffic control devices shall be installed prior to the start of work necessitating traffic safety. It shall be Contractor's responsibility to construct the required detour lanes in order to make the road available to traffic.

Approval of the Contractor's traffic control method by The District, or Federal guidelines shall not relieve Contractor of its responsibility to protect the work, the Contractor's personnel, or the general public.

SUBSECTION 401.2 TRAFFIC CONTROL DEVICES AND EQUIPMENT:

Devices and equipment may include flashing barricades, signage, and high-visibility cones.

SUBSECTION 401.3 FLAGMEN OR PILOT CARS:

Flagmen or pilot cars shall consist of providing sufficient flagmen, uniformed off-duty law enforcement officers or pilot cars to expedite the safe passage of traffic for mobilization of heavy equipment or delivery of materials on narrow rural roads.

SUBSECTION 401.4 TRAFFIC CONTROL MEASURES:

The application of all traffic control measures shall be based primarily upon the conditions existing at the time that such measures are deemed necessary. Prior to the start of any work that would interrupt the normal flow of traffic, sufficient and adequate devices and measures shall be provided and erected as directed by the Engineer. These devices shall be immediately removed when no longer needed.

SUBSECTION 401.5 GENERAL TRAFFIC REGULATIONS:

A traffic lane shall be a minimum of 10 feet of clear street width with a safe motor vehicle operating speed of at least 25 miles per hour.

An intersection shall be all of the area within the right of way intersection streets plus 300 feet beyond the edge of the intersected right of way on all legs of the intersection.

Local access shall be maintained to all properties on the project at all possible times. When local access cannot be maintained, the Contractor must notify the affected property owner at least 24 hours in advance and restore access as soon as possible.

All temporary traffic control devices and equipment shall be ballasted with sandbags or other approved ballast.
The "SPEED LIMIT 25" sign shall be used on temporary detour roads or on traffic lanes that are severely restricted.
The contractor shall conform to applicable regulations governing oversize loads for equipment mobilization and pipe delivery and truck traffic safety for the delivery of commercial sand and coarse rock.

Access to all adjacent properties shall be maintained at all times. When access cannot be maintained, Contractor shall notify the adjacent residents at least 48 hours in advance of the access closure.

Contractor shall maintain or relocate all existing signal indications, warning signs, STOP, YIELD, and street name signs erect, clean and in full view of the intended traffic at all times. Portable signs should be used to supplement blocked or removed signs. Contractor shall reset all disturbed signs to permanent locations when construction is completed. The Contractor shall cover all existing signs that are in conflict with the traffic control signing. Contractor is responsible for the cost of replacing lost or damaged traffic signs.

Subject to the approval of the Engineer, the Contractor shall furnish and install the 25-MPH Construction Zone Speed Limit Signs. The Contractor shall maintain the signs erect, clean and in full view of the intended traffic at all times.

SUBSECTION 401.5.1 Special Traffic Regulations:

The public shall be adequately notified of construction operations using methods including distribution of construction alert publications.

Prior to construction activities, the Engineer shall be notified regarding any road closures or temporary impedance of traffic.

Construction shall not commence or proceed without an approved Traffic Control Plan. The Traffic Control Plans shall address all construction staging and special provisions requirements.

At the time of the Pre-Construction conference, the Contractor shall designate an employee, other than the Project Superintendent, who is well qualified and experienced in construction traffic control and safety, to be available on the project site during all periods of construction to set up, maintain and coordinate safe barricading whenever construction restricts traffic. This individual shall be authorized to receive and fulfill instructions from the Engineer and shall supervise and direct the work. Instructions and information given by the Engineer to this individual shall be considered as having been given to the Contractor.

SUBSECTION 401.6 MEASUREMENT:

No measurement for a lump sum payment will be made for traffic control implemented by the Contractor for construction or delivery of equipment or materials.

SUBSECTION 401.7 PAYMENT:

Payment for traffic control shall be made on the basis of the lump sum price bid and shall be full compensation for all work, including mobilization, placing, storing, removal and maintenance of all traffic control devices, signing and striping, flag persons, and other activities incidental to the implementation of the approved traffic control plan.

BID ITEM 401-1 TRAFFIC CONTROL

END OF SECTION

SECTION 405 MONUMENTS

SUBSECTION 405.1 DESCRIPTION:

The primary scope of work is the utilization and protection of existing survey monuments. Construction of new survey monuments is only required in the event an existing monument was inadvertently damaged or altered.

The Contractor is required to utilize at least two of the four benchmarks shown on the plans to tie-in construction layout for work and as-built survey data. In addition, construction activity involving heavy earthmoving equipment shall be conducted using delineated work zones and planned haul routes that avoid existing subsidence monuments (including project survey control stakes). The Contractor has the responsibility of protecting the survey monuments from damage and inadvertent altering from its own earthmoving equipment and construction activity, including its subcontractors.

SUBSECTION 405.2 MATERIALS:

Construction materials for a new monument will only be required if the Contractor inadvertently damaged an existing monument and therefore is responsible for its replacement.

Materials required for the protection of existing monuments includes, but is not limited to, painted lath or staking, flagging, barricades, orange safety fence, etc.

SUBSECTION 405.3 CONSTRUCTION:

In the event damage and reconstruction is required, the Contractor is responsible for work at its expense. In constructing precast monuments, the forms shall not be removed until after the concrete has hardened. The exposed surface of the finished monuments shall be uniform, of even texture, and shall be free from holes, cracks and chipped edges. The precast monuments shall not be transported to the work site until the concrete has cured.

Cast-in-place monuments shall be cast in drilled holes without the use of forms.

Brass caps shall be placed in survey monuments before the concrete block has reached initial set and shall be firmly bedded in the concrete. The concrete block shall be so located that, the reference point will fall within a 1-inch circle in the center of the brass cap.

SUBSECTION 405.4 INSTALLATION:

Survey monuments shall be reset in position to equal the recorded location of the altered or damaged monument with tolerances allowed in the industry and agreed upon by the District.

SUBSECTION 405.5 MEASUREMENT:

No measurement will be made for this scope of work.

SUBSECTION 405.6 PAYMENT:

No payment shall be made for protection or possible replacement of a subsidence survey monument. Should the replacement of a survey monument be necessary, the Contractor would bear the associated costs for construction and independent detailed survey and seal by a registered land surveyor.The Contractor will be paid an allowance (with no unit of measure) to utilize the monument for survey reference and materials and methods required to adequately protect monuments in the work or haul areas.

BID ITEM 405-1 MONUMENTS

END OF SECTION

SECTION 505 CONCRETE STRUCTURES

SUBSECTION 505.1 DESCRIPTION:

Concrete structures consisting of pipe encasement and aprons shall be constructed in conformity with the plans and these specifications. Concrete for use in work constructed under this specification and testing thereof shall conform to the requirements of Section 725. Reinforcing shall conform to the requirements of Section 727. Pipe encasement shall consist of concrete backfill under the haunches of the pipe placed level to the springline on the existing CMP upstream of the coupling / collar and along the new CMP downstream of the coupling / collar. The concrete collar shall be placed completely around the coupling. The concrete encasement (to springline) upstream of the collar shall be placed directly against insitu dam embankment soil, no use of forms will be allowed.

SUBSECTION 505.2 SUBGRADE FOR CONCRETE STRUCTURES:

Each subgrade upon which concrete is placed shall be firm and free from water. Ground water shall be kept several inches below subgrade until the concrete has set. When the subgrade is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

When the design details for the project provide for the construction of filter or drain material consisting of gravel or combination of gravel and sand, which material becomes subgrade for concrete, the placing of steel reinforcement and pouring of concrete shall follow the placing of the filter or drain material as closely as practical. The filter or drain material shall be kept dewatered to the extent necessary to prevent any portion of concrete materials being carried away before the concrete has attained its final set. No payment will be made for the work required to keep such materials dewatered, other than such costs as may be included in the prices bid for various items of work or amount bid for dewatering when the schedule provides an item for same.

When concrete is to rest on rock, the rock shall be fully uncovered. The surface of the rock shall be removed to a depth sufficient to expose sound rock. Bedrock shall be roughly leveled off or cut to approximately horizontal and vertical steps. Seams in the rock shall be grouted as directed by the Engineer and the base for structures shall be slush grouted or otherwise treated as the Engineer may direct.

SUBSECTION 505.3 FORMS:

Forms shall be of suitable material and of type, size, shape, quality, and strength to enable construction as designed. The forms shall be true to line and grade, mortar tight, and sufficiently rigid to resist any appreciable amount of springing out of shape during placing of the concrete. The responsibility for their adequacy shall rest with the Contractor. All dirt, chips, sawdust, nails, and other foreign matter shall be completely removed from forms before any concrete is deposited. The surfaces of forms shall be smooth and free from irregularities, dents, sags and holes that would appreciably deface the finished surface. Forms previously used shall be thoroughly cleaned of all dirt, mortar and foreign matter before being reused, and the reuse of forms shall be subject to the approval of the Engineer. Before concrete is placed in forms, all inside surfaces of the forms shall be thoroughly treated with an approved releasing agent that will leave no objectionable film on the surface of the forms that can be absorbed by the concrete. Care shall be exercised that no releasing agent is deposited on previously placed concrete.

Forms for all surfaces that will not be completely enclosed or hidden below the permanent surface of the ground shall be made of surfaced lumber, or material which will provide a surface at least equally satisfactory. Any lumber or material which becomes badly checked or warped prior to placing concrete may be rejected.

Wood forms for copings and curbs shall have a thickness of not less than 1-1/2 inches and a width of not less than the full depth of coping or curb.

Unless otherwise shown on the plans, all sharp edges shall be chamfered with 3/4-inch triangular fillets. Forms for curved surfaces shall be so constructed and placed that the finished surface will not deviate appreciably from the arc of the curve.

Forms shall be so constructed that portions, where finishing is required, may be removed without disturbing portion of forms to remain.

Forms shall, as far as practicable, be so constructed that the form marks will conform to the general lines of the structure.

Form clamps or bolts, approved by the Engineer, shall be used to fasten forms. The use of twisted wire loop ties to hold forms in position will not be permitted, nor shall wooden spreaders be used unless authorized by the Engineer. Clamps or bolts shall be of sufficient strength and number to prevent spreading of the forms. They shall be of such type that they can be entirely removed or cut back 1 inch below the finished surface of the concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to the studs and all form clamps shall extend through and fasten such wales, all based on the rate of concrete pour.

The Contractor may at his own option, pour such portions of the concrete for the structure directly against the side of the excavation or sheathing without the use of outside forms, provided that the following conditions are met.

(A) If concrete is poured directly against the sides of the excavation, the faces of the excavation must be firm and compact, and be able to stand without sloughing off and be at all points outside the concrete lines shown on the plans.

(B) If concrete is poured against sheathing, such sheathing shall be closely fitted and shall be outside of the concrete lines shown on the plans. Those surfaces against which the concrete is to be poured shall be faced with building paper. Except as otherwise specified all sheathing shall be removed, but not until either at least 7 days after placing concrete or until the concrete has attained a strength in compression of not less than 2,000 psi. Care should be used in pulling sheathing so as to avoid damaging the concrete. Voids left by the removal of sheathing, piles and/or similar sheathing supports shall be backfilled with material having a sand equivalent of not less than 30 and consolidated by jetting as directed by the Engineer. When, in the opinion of the Engineer, field conditions or the type of sheathing or methods of construction used by the Contractor are such as to make the removal of sheathing impracticable, that portion of the sheathing against which concrete has been poured may be left in place.

Regardless of the method used in pouring concrete without outside forms the following stipulations shall hold:

(A) The reinforcing steel shall be accurately set and held firmly in place, to the satisfaction of the Engineer.

(B) No direct payment will be made for building paper, sheeting, gunite or concrete placed outside of concrete lines shown on the plans. The cost thereof shall be absorbed in the prices bid for the various items of work.

(C) The Contractor shall assume all risks of damage to the work or to existing improvements due to any reason whatsoever that may be attributable to the method of construction outlined above.

SUBSECTION 505.3.1 Removal of Forms:

Forms shall be removed from the initial placement of concrete components before placement of subsequent concrete components so that the quality of the concrete may be inspected. Such forms shall be so constructed such that they may be removed without disturbing other forms.

Forms may be removed after 24 hours. The period of time at which the Contractor may remove forms, as set forth above, are permissive only and subject to the Contractor's assuming all risks that may be involved in such removals. At his option, except for surfaces to be finished, the Contractor may leave the forms in place for such longer periods as are, in his opinion, required.

SUBSECTION 505.4 PLACING CONCRETE:

Where a schedule for placing concrete is shown on the plans, no deviation will be permitted therefrom unless approved in writing by the Engineer.

The placing of concrete for a given pour shall start at the low point and shall proceed upgrade, unless otherwise permitted by the Engineer.

With the exception of concrete placed in slope paving and aprons, and concrete placed under water, all concrete shall be compacted by means of high frequency internal vibrators of a type, size and number approved by the Engineer. The number of vibrators employed shall be ample to consolidate the incoming concrete to a proper degree within 15 minutes after it is deposited in the forms. In all cases, at least 2 vibrators shall be available at the site of the structure in which more than 25 cubic yards of concrete is to be placed. The vibrators shall not be attached to or held against the forms or the reinforcing steel. The locations, manner and duration of the application of the vibrators shall be such as to secure maximum consolidation of the concrete without causing segregation of the mortar and coarse aggregate, and without causing water or cement paste to flush to the surface. Fresh concrete shall be spread in horizontal layers insofar as practicable and the thickness of the layers shall not be greater than can be satisfactorily consolidated with the vibrators. If additional concrete is to be placed, care shall be taken to remove all laitance and to roughen the surfaces of the concrete to insure that fresh concrete is deposited upon sound concrete surfaces. Layers of concrete shall not be tapered off in wedge-shaped slopes, but shall be built with square ends and level tops.

Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface. The concrete shall be placed as nearly as possible in its final position and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted.

Fresh concrete shall not be permitted to fall from a height greater than 6 feet without the use of adjustable length pipes or elephant trunks.

The use of approved external vibrators for compacting concrete will be permitted when the concrete is inaccessible for adequate compaction provided the forms are constructed sufficiently rigid to resist displacement or damage from external vibration.

During the placing of concrete, care shall be taken that methods of compaction used will result in a surface of even texture free from voids, water or air pockets, and that the coarse aggregate is forced away from the forms in order to leave a mortar surface. Spades or broad-tined forks shall be provided and used to produce the desired results if required by the Engineer.

The use of chutes in conveying or depositing concrete will be allowed only at the discretion of the Engineer, and wherever they are used they shall be laid at such inclination as will permit the flow of concrete of such consistency as is required. The use of additional water in mixing the concrete to promote free flow in chutes of low inclination will not be allowed. Where necessary in order to prevent segregation, chutes shall be provided with baffle boards or a reversed section at the outlet.

SUBSECTION 505.4.1 Joints:

The work shall be so prosecuted that construction joints will occur at designated places shown on plans unless specifically permitted otherwise by the Engineer. The Contractor shall complete, by continuous depositing of concrete, section for the work comprised between such joints. The joints shall be kept moist until adjacent concrete is placed.

All construction joints at the bottom of walls or arches, at the top of walls, and all longitudinal construction joints having a keyed, stepped or roughened surface shall be cleaned by sandblasting prior to pouring the adjacent concrete. Any quality of sand may be used which will accomplish the desired results.

The sandblasting operations shall be continued until all unsatisfactory concrete, and all laitance, coatings, stains, debris, and other foreign materials are removed. The surface of the concrete shall be washed thoroughly to remove all loose material. The method used in disposing of wastewater employed in washing the concrete surfaces shall be such that the wastewater will not stain, discolor, or affect exposed surfaces of the structures. The method of disposal will be subject to the approval of the Engineer.

All horizontal construction joints or those on slight slopes, shall be covered with Class D mortar as specified in Section 776.

Expansion and contraction joints in the concrete structures shall be formed where shown on the plans and as directed. In general, such joints shall have smooth abutting surfaces, painted or separated and sealed as detailed on the plans. No reinforcement shall be extended through the joints, except where specifically noted or detailed on the plans. Concrete or mortar shall not be permitted to lap these joints in such a manner as to effect a tie or bond that would later promote spalling.

Asphalt paint or premolded asphalt filler used in joints shall be as specified in Section 729.

No direct payment will be made for furnishing and placing asphaltic paint, premolded asphaltic filler or other types of joint separators; their costs shall be included in the price bid for the item of work of which they are a part.

SUBSECTION 505.4.2 Adverse Weather Concreting:

(A) Hot Weather Concreting: Hot weather is defined as any combination of high ambient temperature, low relative humidity, and wind velocity which would tend to impair the quality of fresh concrete. These effects become more pronounced as wind velocity increases. Since last minute improvisations are rarely successful, preplanning and coordination of all phases of the work are required to minimize these adverse effects.

As an absolute minimum, the Contractor shall insure that the following measures are taken:

1. An ample supply of water, hoses, and fog nozzles are available at the site.

2. Spare vibrators are on hand in the ratio of one spare vibrator for each three in use.

3. Preplanning has been accomplished to insure prompt placement, consolidation, finishing, and curing of the concrete.

4. Concrete temperature on arrival should be approximately 45°F. and in any event shall not exceed 80°F. The use of cold water and ice is recommended.

5. The subgrade is moist, but free of standing water.

6. Fog spray is utilized to cool the forms and steel.

Under extreme conditions of high ambient temperature, exposure to the direct rays of the sun, low relative humidity, and wind, even strict adherence to these measures may not produce the quality desired and it may be necessary to restrict concrete placement to early morning only. If this decision is made, then particular attention must be directed to the curing process since the concrete will be exposed to severe thermal stresses due to temperature variation; heat of hydration plus midday sun radiation versus nighttime cooling.

(B) Cold Weather Concreting: Concrete shall not be placed on frozen ground. nor shall it be placed when the ambient temperature is below 40°F. unless adequate means are used to heat the aggregate and/or water and satisfactory means have been taken for protecting and heating the concrete during the curing period.

(C) Wet Weather Concreting: Placing of concrete shall be discontinued when the quantity of rainfall is such as to cause a flow or wash to the surface. Any concrete already placed and partially cured shall be covered to prevent dimpling. A construction joint will be installed prior to shut down.

(D) Replacement of Damaged or Defective Concrete: Upon written notice from the Engineer, all concrete which has been damaged or is defective, shall be replaced by the Contractor at no cost to the Contracting Agency.

(E) Recommended Reference:

1. ACI-305 Hot Weather Concreting
2. ACI-306 Cold Weather Concreting
3. ACI-308 Recommended Practices for Curing Concrete

SUBSECTION 505.5 CURING:

As soon after the completion of the specified finishing operations as the condition of the concrete will permit without danger of subsequent damage thereto, all exposed surface shall either be sprinkled with water, covered with earth, sand or burlap; sprayed with a curing compound or sealed with a material conforming with Section 726.

Concrete that is water cured must be kept continuously wet for at least 10 days after being placed; preferably being covered, if possible, with at least 2 layers of not lighter than 7 ounce burlap, except that handrail, baserail, railing posts, tops of walls, and similar parts of the structure, if water cured, must be covered with burlap as above prescribed, immediately following the finishing treatment specified therefor, and such covering shall not be removed in less than 4 days. Roadway areas, floors, slabs, curbs, walks, and the like. that are water cured may be covered with sand to a depth of at least 2 inches, in lieu of the burlap as specified above, as soon as the condition of the concrete will properly permit, and such covering must remain wet and in place until the concrete so covered is at least 10 days old unless otherwise directed by the Engineer or provided by special provisions.

When a sprayed impervious membrane is used, it shall be applied under pressure through a spray nozzle in such manner and quantity as to entirely cover and seal all exposed surfaces of the concrete with a uniform film. To insure complete coverage, membrane shall be applied in two applications for a total coverage of 150 square feet per gallon. The membrane, however, shall not be applied to any surface until all of the finishing operations have been completed; such surfaces being kept damp, until the membrane is applied. All surfaces on which a bond is required, such as construction joints, shear planes, reinforcing steel, and the like, shall be adequately covered and protected before starting the application of the sealing medium in order to prevent any of the membrane from being deposited thereon; and any such surface with which the seal may have come in contact shall immediately thereafter be cleaned. Care shall be exercised to avoid and prevent any damage to the membrane seal during the curing period. Should the seal be broken or damaged before the expiration of 10 days after the placing of the concrete, the break shall be immediately repaired by the application of additional impervious membrane over the damaged area.

Should any forms be removed sooner than 10 days after the placing of the concrete, the surface so exposed shall either be immediately sprayed with a coating of the membrane seal, or kept continuously wet by the use of burlap or other suitable means until such concrete has cured for at least 10 days.

When tops of walls are cured by the membrane sealing method the side forms, except metal forms, must be kept continuously wet for the 10 days following the placing of the concrete.

If due to weather conditions, materials used, or for any other reason, there is any likelihood of the fresh concrete checking or cracking prior to the commencement of the curing operations, it shall be kept damp, but not wet, by means of an indirect fine spray of water until all danger of such checking or cracking is past, or until the curing operations are started in the particular area affected.

Since hot weather leads to more rapid drying of concrete, protection and curing are far more critical than in cool weather. Water curing should be used wherever it is practical and should be continuous to avoid volume changes due to alternation of wetting and drying. The need for adequate continuous curing is greatest during the first few hours after placement of concrete in hot weather.

SUBSECTION 505.6 FINISHING CONCRETE:

Immediately after the removal of forms as provided above, all concrete surfaces shall be finished in accordance with the requirements specified below.

All surfaces scheduled to be covered with backfill shall be finished so as to be free of open and rough spaces.

All surfaces that will remain exposed in the completed work shall be finished so as to be free of open and rough spaces, depressions or projections. All angles and fillets shall be sharp and true and the finished surface shall present a pleasing appearance of uniform color.

All top surfaces of walls, abutments, piers, etc., shall be finished to a smooth surface and shall be cured by an approved method.

If rock pockets or honeycomb are of such an extent and character as to affect materially the strength of the structure and to endanger the steel reinforcement the Engineer may declare the concrete defective and require the removal and replacement of that portion of the structure affected by the Contractor at no additional cost to the Contracting Agency.

If finishing operations are not carried out as set forth below, all placing of concrete shall stop until satisfactory arrangements are made by the Contractor to promptly correct defective finishing work and to carry out finishing operations as specified.

One of the classes of finish as specified shall be applied to the various surfaces as set forth under applicability of finishes.

No finishing or patching shall be permitted until the surface has been inspected by the Engineer.

SUBSECTION 505.6.1 Finishing Green Concrete:

Class I Finish - All bolts, wires and rods shall be clipped and recessed. All holes, honeycomb, rock pockets and other surface imperfections shall be cleaned out, thoroughly moistened and carefully patched with mortar. Mortar shall be composed of 1 part of cement and 2 parts of fine sand. A portion of the required cement for mortar shall be white as required to match the color of the surrounding concrete.

Class II Finish - The surface shall be patched and pointed as specified above for Class I Finish and then promptly covered with polyethylene film, wet burlap or wet cotton mats. If polyethylene film is used, the film shall be held securely to the surface by means of weights, adhesive or other suitable means. Only white polyethylene film for covering will be acceptable.

When the mortar used in patching and pointing has set sufficiently, the surface shall be uncovered and thoroughly rubbed with either a float or a carborundum stone until the surface is covered with a lather. Cork, wood or rubber floats shall be used only on surfaces sufficiently green to work up such lather, otherwise a carborundum stone shall be used. During the rubbing process, a thin grout composed of 1 part cement and 1 part of fine sand may be used to facilitate producing a satisfactory lather; however, this grout shall not be used in quantities sufficient to cause a plaster coating to be left on the finished surface. A portion of the required cement for grout shall be white as required to match the color of the surrounding concrete. Rubbing shall continue until irregularities are removed and there is no excess material. At the time a light dust appears, the surface shall be brushed or sacked. Brushing or sacking shall be carried in one direction so as to produce a uniform texture.

Class III Finish - The surface shall be treated as specified above under Class II Finish except that after brushing, the surface shall again be securely covered with polyethylene film, wet burlap or wet cotton mats. In not less than 1 day nor more than 4 days, the surface shall be uncovered and rubbed with a carborundum stone. This rubbing shall continue until the entire surface is of a smooth texture and uniform color. During the process, the use of a thin mixture of equal parts of sand and cement with water will be permitted. At the time a light dust appears, the surface shall be brushed or sacked, care being taken to carry this brushing in one direction so as to produce a uniform texture.

SUBSECTION 505.6.2 Finish Hardened Concrete:

If for reasons either beyond the control of the Contractor or with the approval of the Engineer, more than 6 days have elapsed between the time of placing concrete and the time of the removal of forms, the concrete shall be considered as hardened. Prior to finishing hardened concrete, the surface shall be covered with burlap or cotton mats and kept thoroughly wet for a period of at least 1 hour. Finishing shall be identical to the respective requirements for Class I, Class II and Class III Finish for green concrete, except that the use of a mechanically operated carborundum stone will be required for Class II and Class III Finishes.

SUBSECTION 505.6.3 Applicability of Finishes:

Surfaces requiring Class I Finish - All formed structures that are to be covered by backfill and those surfaces that are normally not in view of either vehicular or pedestrian traffic such as the buried surfaces on the pipe encasement.

Surfaces requiring Class II Finish - All exposed surfaces of pipe headwalls and/or aprons.

When surfaces of uniform texture and pleasing appearance are obtained through the use of first class metal forms, paper tubing or the use of special form coatings and the use of special care, such surfaces may, upon approval of the Engineer, be excluded from the surfaces requiring Class II Finish.

SUBSECTION 505.7 MEASUREMENT:

Concrete shall be measured for payment on the basis of cubic yards. The calculation of the quantity of concrete for payment will be made only to the neat lines of the structures as shown on the plans and on the basis of the concrete having the specified lengths, breadths, and thicknesses. However, all concrete shall be placed to line and grade within such tolerances as, in the opinion of the Engineer, are reasonable and acceptable for the type of work involved. The quantity of such concrete will be calculated considering the mortar used to cover construction joints as being concrete and no deductions will be made for rounded or beveled edges, space occupied by reinforcing steel, metal inserts, or openings 5 square feet or less in area. The cost of cement used in mortar for covering construction joints, patching, or other uses in the structure being constructed, in excess of that required for the design mix of the adjacent concrete, is incidental and shall be absorbed in the item of work of which said mortar is a part.

SUBSECTION 505.8 PAYMENT:

Payment for Portland cement concrete structures will be made in conformity with the terms of the contract and will be based on unit prices as set forth in the proposal. Such payment shall include full compensation for furnishing all labor, materials, tools and equipment, curing, placing of concrete and doing all work required to construct the structures in conformity with the plans and specifications.

BID ITEM 505-1 CONCRETE STRUCTURES

END OF SECTION

SECTION 515 TRASH RACKS

SUBSECTION 515.1 DESCRIPTION:

A shop-fabricated trash rack shall be provided and installed for each of the three outlet structures. Each trash rack shall be installed on the upstream side of the outlet pipe structure and anchored to the existing concrete pad. A trash rack shall be installed at the following locations:

(A)	North Outlet Structure	48-inch pipe
(B)	Central Outlet Structure	48-inch pipe
(C)	South Outlet Structure	24-inch pipe

The trash racks shall be shop-fabricated to the dimensions and specified materials shown on the plans. All surfaces shall be shop primed.

SUBSECTION 515.1.1 Shop Drawings:

The Contractor shall prepare and submit to the Engineer for approval, complete shop drawings which shall show details, dimensions, sizes of materials, and all information and data necessary for the metal work, including full details of the match markings. Any materials fabricated by the Contractor prior to the approval of the drawings will be at his risk. The Contractor shall be responsible for the correctness of the drawings and for shop fits and field corrections, even though the drawings may have been approved by the Engineer.

SUBSECTION 515.1.2 Materials:

Rolled steel shapes, plates and bars shall conform to ASTM A36 and A572.

High strength bolts should conform to ASTM A325.

Anchor bolts should conform to ASTM A307. Provide two hexagonal nuts and two plain washers per bolt.

SUBSECTION 515.1.3 As-Built Plans:

When required by the special provisions, the Contractor shall furnish to the Engineer, before formal acceptance of the work, detailed plans of the structure as built. Inasmuch as the plans will be retained by the Contracting Agency as permanent records, they must be in the form of printable transparencies of quality satisfactory to the Engineer.

SUBSECTION 515.1.4 Methods and Equipment:

When requested by the Engineer, before starting erection of any structural members, the Contractor shall inform the Engineer fully as to the methods he proposes to follow and the amount and character of equipment he proposes to use. The use of such methods and equipment shall be subject to the approval of the Engineer. Approval by the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his methods or equipment or for carrying out the work in full accordance with the plans and specifications.

SUBSECTION 515.1.5 Epoxy Anchors:

Anchoring adhesive shall be a two-component solid epoxy based system supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer. Epoxy shall meet the minimum requirements of ASTM C881 specification for Type I, II, IV, and V, Grade 3, Class B, C, and D and must develop a minimum 12,650 psi compressive yield strength after 7 days. Epoxy must have a heat deflection temperature of a minimum 136° F (58°). Adhesive shall be installed per manufacturer's instructions.

SUBSECTION 515.2 FABRICATION:

An inspector or other authorized representative of the Engineer may examine the metals and metal items to be fabricated before they are worked in the shop and may exercise constant surveillance over the work during its progress, with full power to reject materials or workmanship not conforming to the plans and specifications.

The Contractor shall give the Engineer sufficient advance notice to permit ample time for the inspection of materials before commencement of the fabricating operations.

No fabricating. machining. cutting, welding. assembling, or painting shall be done except with the knowledge of the Engineer. Any work done otherwise will be subject to rejection.

The acceptance of any material or finished member by the Engineer shall not be a bar to subsequent rejection if it is later found to be defective. Rejected material and workmanship shall be promptly replaced.

SUBSECTION 515.3 INSTALLATION:

Drill 3 holes (2 holes for South trash rack) on each side of existing concrete slab as shown on the plans. Drill bit diameter shall be 1/8" larger than bolt diameter. Anchors shall be installed perpendicular to the surface. Surfaces to receive epoxy must be clean and sound. Epoxy should not be installed in or through standing water. The existing concrete slab temperature must be 40° F or above at the time of installation. For best results, the concrete should be 70° - 80° F at the time of application, therefore not during the heat of the day. Mixed material in the nozzle can harden in 5-7 minutes at a temperature of 40° F or above.

SUBSECTION 515.4 WORKMANSHIP:

Workmanship and finish shall be equal to the best general practice in the industry.

Rolled material before being laid off or worked shall be straight. If straightening is necessary, it shall be done by methods approved by the Engineer. Kinks and bends may be cause for rejection of the material. Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture.

Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting and chipping shall be done carefully and accurately. Undercut gusset plates will not be accepted. All sharp comers and edges, and edges that are marred, cut or roughened in handling or erection, shall be slightly rounded by grinding or other suitable means.

The completion of trash racks metal items shall not be less in quality and workmanship than that standard considered to be the commercial standard for the kind of member being furnished. Punched and drilled holes shall be burred and, unless otherwise specified, sheared and machined edges shall be finished by grinding to an appropriate radius. Riser, sprue, or vent marks on castings shall be ground flush with the adjacent surface. Blow holes in castings shall not be repaired by any method except as authorized in advance by the Engineer. Exposed edges of sheet metal shall be dressed with a stone or file to remove the sharp edges or comers. Drilled or punched holes, which are improperly, located or misaligned shall be cause for rejection and may not be corrected without the prior approval of the Engineer. All parts of assemblies shall be fabricated so that they may be assembled without forcing or drifting.

Welders proposed to be used on miscellaneous metal fabrication will be subject to qualifications.

SUBSECTION 515.5 PAINTING:

Trash racks shall have a shop prime coat of approved rust-inhibitive paint. Application shall be as specified in Section 530. The thickness of the prime coat shall be not less than one (1) mil.

After installation, surfaces where the shop coat has been abraded or otherwise damaged shall be touched up. Match marks and identification marks shall be properly cleaned off and painted over. The paint shall be identical to that used for the shop prime coat.

Paint shall be applied to the trash racks at the fabrication shop and touched up in the field both by spray methods as described in Section 530.

SUBSECTION 515.6 MEASUREMENT:

Steel trash racks will be measured by each completed structure installed.

SUBSECTION 515.7 PAYMENT:

Compensation for furnishing and installing trash racks including all labor, materials, tools, equipment, and incidentals, mounting, and for doing all the work involved in furnishing the complete in-place, trash rack as shown on the plans, and as specified in the specifications, and as directed by the Engineer will be paid on a lump sum per trash rack basis.

BID ITEM 515-1 TRASH RACK (48-INCH DIAMETER OUTLET)

BID ITEM 515-2 TRASH RACK (48-INCH DIAMETER OUTLET)

BID ITEM 515-3 TRASH RACK (24-INCH DIAMETER OUTLET)

END OF SECTION

SECTION 525 PNEUMATICALLY PLACED MORTAR

SUBSECTION 525.1 DESCRIPTION:

Pneumatically placed mortar shall be applied to the sides and bottom of the north outlet channel to the extent existing concrete lining is damaged as a result of construction. It is anticipated shotcrete will be severely damaged due to fill temporarily placed in the shotcrete-lined channel to gain access on both sides of the buttress.

SUBSECTION 525.2 WET PROCESS:

The wet process shall consist of premixing by mechanical methods a proportional combination of Portland cement, aggregate and water required to produce mortar or concrete and conveying this mortar or concrete through the delivery hose to the special nozzle where additional compressed air is added prior to discharge. The air ports in the nozzle shall be cleaned daily.

The Portland cement concrete used for the Wet Mix Process shall conform to Section 725 and shall be Class A (3000 psi) unless otherwise specified. In no event shall a slump greater than 4 inches be used. As the work approaches the vertical, the maximum slump shall not exceed 1 inch.

The fine and coarse aggregate shall conform to ASTM C-33 using the following gradation graduations shown in Table 525-1 below.

TABLE 525-1	
PNEUMATICALLY PLACED MORTAR GRADATION (A.C.I. TABLE 2.2.1)	
Percent by weight passing individual sieves	
Sieve size	**Gradation No. 1**
3/4 in.	---
1/2 in.	---
3/8 in.	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

The minimum thickness of placed mortar limits shall be 2 inches.

SUBSECTION 525.3 REINFORCING STEEL:

Reinforcing steel welded-wire fabric shall be 6 x 6 - W 1.4 x 1.4. Reinforcement shall be placed as closely as possible to the center of the mortar. Welded wire fabric shall be placed to the same dimensions receiving mortar as shown on the drawings. Overlap of 12 inches shall be maintained for splicing fabric pieces, wired together.

SUBSECTION 525.4 EQUIPMENT:

Prior to the start of construction, the Contractor shall demonstrate that his equipment, materials and operators arc capable of providing a finished structure in accordance with the specifications. For this demonstration, the Contractor shall provide test panels, 30 inches by 30 inches, with a depth the same as the structure, but not less than 4 inches. A separate panel shall be provided for each shooting position to be used (overhead, slope and/or slab) and one half of each panel shall contain reinforcement as used in the structure. Cores will be taken for visual inspection and compressive strength tests. The Engineer has the authority to accept or reject equipment, materials and/or operators based on his evaluation and his decision will be final.

If the Contractor can present valid, factual documentation to the satisfaction of the Engineer that his equipment, materials and operators have produced satisfactory results on similar work within the past six months, the Engineer may eliminate the test panel procedure.

The Contractor or Subcontractor shall provide sufficient documentation of previous projects similar in nature that are directly relevant to the company and the foreman proposed to oversee the work in the field. If documentation is sufficient and approved by the Engineer, then a procedure for field demonstration and testing is not required.

SUBSECTION 525.5 SURFACE PREPARATION:

The existing shotcrete, which will be adjoining new shotcrete, shall be sawcut around the removal area to provide neat lines at the butt joint.

The surface on which the mortar is to be placed shall be compacted and true to line and grade as required by the plans and specifications. The surface shall be uniformly moistened so that water will not be drawn from the freshly placed mortar. Placement of the mix shall not start until the temperature is 35°F and rising and shall stop when the temperature is 40°F and falling.

SUBSECTION 525.6 FORMS AND GROUND WIRES:

Forms shall be plywood or some other suitable material, true to line and grade, sufficiently rigid to resist deflection during mortar placement.

Ground or gauging wires shall be installed where necessary to establish the thickness and finish lines of the structure.

SUBSECTION 525.7 JOINTS:

Construction joints shall be tapered to a shallow edge from not more than one inch thick over a width of approximately one foot except where the joint will be subjected to compressive stress. In this case, square joints shall be constructed. Joints shall be thoroughly cleaned and wetted prior to any additional application.

Install control joints in accordance with the plans. Reinforcement shall not extend across control joints.

SUBSECTION 525.8 FINISHING:

Unless otherwise specified, the natural gun finish shall be provided.

SUBSECTION 525.9 CURING:

Curing shall be accomplished using approved compound materials as described in Section 726 and methods of application as described in Section 505.

SUBSECTION 525.10 TESTING:

Tests to determine the quality of the mortar will be performed periodically during the course of work. Test panels shall be prepared by the Contractor.

Test panels shall be at least 12 inches square and as deep as the structure, but not less than 4 inches. Cores shall be taken from the panel for visual and compressive strength tests. The minimum compressive strength at the end of 28 days shall be 3000 psi.

The Engineer may allow the use of 6 inch by 12-inch hardware cloth cylinders for testing in lieu of the test panels. These cylinders shall be furnished by the Contractor.

All rebound pockets and any mortar, defective in the compressive strength test, shall be cut out and replaced.

SUBSECTION 525.11 MEASUREMENT:

Pneumatically placed mortar will be measured by square feet units per field measurements of completed work.

SUBSECTION 525.12 PAYMENT:

Payment for pneumatically placed mortar will be made at the unit price per square foot. Such payment shall be full compensation for furnishing all labor, tools, equipment and accomplishing work in conformity with the plans and specifications.

BID ITEM 525-1 PNEUMATICALLY PLACED MORTAR (SHOTCRETE)

END OF SECTION

SECTION 530 PAINTING

SUBSECTION 530.1 DESCRIPTION:

Painting shall be applied to the metal trash racks installed as part of this project at each of the three outlet structures.

SUBSECTION 530.2 MATERIALS:

Paint materials shall consist of weather-resistant, UV resistant, acrylic paint manufactured for outdoor metal surfaces. The paint shall be compatible with shop primers used in the fabrication of the trash racks.

Paint material shall meet or exceed the following requirements:

Finish Color	beige (earthtone)
Type	acrylic
System	two coat
Solids Content	0.5 %
Thickness per coat	3 mils

SUBSECTION 530.3 WEATHER CONDITIONS:

Paint shall be applied only on thoroughly dry surfaces and during periods of favorable weather. Except as provided below, painting will not be permitted when weather conditions during application are such that the atmospheric temperature will drop below 35°F. during the drying period. If fresh paint is damaged by the elements, it shall be replaced by the Contractor at no additional cost to the Contracting Agency.

Subject to the approval of the Engineer, the Contractor may provide suitable enclosures to permit painting during inclement weather. Provisions must be made to control atmospheric conditions artificially inside the enclosures within limits suitable for painting throughout the painting operation. The cost of providing and maintaining such enclosures shall be considered as included in the prices paid for the various contract items of work and no additional payment will be made therefore.

Do not paint during inclement weather and protect a freshly painted trash rack from rain for at least 24 hours.

SUBSECTION 530.4 APPLICATION:

Painting shall be done in a neat and workmanlike manner. Unless otherwise specified paint shall be applied either by brush, roller, or spray methods.

The trash racks will be shop fabricated and primed to the dimensions and details shown on the plans. Upon completion of installation of each trash rack and approval by the Engineer, the trash racks shall be painted. The trash rack may also be painted prior to installation and touched up after upon the Engineer's approval of timing and sequence.

Treat the shop primer as necessary to prepare for paint. Clean the surface of any residue, dirt, grease, and lightly brush with steel wool to remove oxidized contact surface. Touch up primer where scratches or marring has occurred during shipment or installation of the trash rack.

Paint the trash rack completely on all exposed surfaces with two coats, allowing time for drying per the manufacturer's recommendations. The paint may either be applied by spray or brush methods.

If brushes are used, they shall have sufficient body and length of bristle to spread the paint in a uniform coat. In general, the primary movement of the brush shall be such as to fill thoroughly all irregularities in the surface, after which the coating shall be smoothed by a series of parallel strokes. Paint shall be evenly spread and thoroughly brushed out. If a considerable amount of brush marks appear, it will be considered that the paint has been improperly applied. If rollers are used, they shall be of a type that does not]cave a stippled texture in the paint file.

On all surfaces, which are inaccessible for brushing, the paint shall be applied by spray or by sheepskin daubers especially constructed for the purpose, or by other means approved by the Engineer.

If spray methods are used, the operator shall be thoroughly experienced. Runs, sags, thin areas in the paint coat, or skips and holidays shall be considered as evidence the work is unsatisfactory and the Contractor may be required to apply the remainder of the paint by brush.

Mechanical mixers shall be used to mix the paint. The paint shall be mixed a sufficient length of time, prior to use, to thoroughly mix the pigment and vehicle together. Paint shall be kept thoroughly mixed while being applied.

SUBSECTION 530.5 PROTECTION OF WORK:

The Contractor shall protect all parts of the structure against disfigurement by spatters, splashes, and smirches of paint or of paint materials. The Contractor shall be responsible for any damage caused by his operations to vehicles, persons, or property, and shall provide protective means to guard against such damage at his expense.

SUBSECTION 530.6 SAFETY PRECAUTIONS:

The following safety precautions shall be observed in addition to those prescribed by law.

The applicable sections of NACE, A Manual for Painter Safety.

SUBSECTION 530.7 SURFACE PREPARATION FOR PAINTING:

SUBSECTION 530.7.1 Steel:

Surface preparation for painting of the steel shall conform to the surface preparation specifications of the Steel Structures Painting Council.

Unless otherwise specified, the commercial blast method shall be used.

After erection and riveting or welding, all surfaces of structural steel which will be exposed to air in the completed structure and the repainting of existing steel structures where partial painting is required, the method of cleaning will be as directed by the Engineer or as specified in the special provisions.

SUBSECTION 530.7.2 Galvanized Surfaces:

(A) Hand Cleaning: Concrete spatter, heavy grease, and other foreign matter shall be removed from galvanized surfaces by hand scraping or wire brushing.

(B) Solvent Cleaning: After hand cleaning, all galvanized surfaces shall be cleaned by the solvent cleaning procedures prescribed under steel above to remove oil, grease and other detrimental foreign matter.

(C) Pretreatment: After hand and solvent cleaning, the cleaned areas shall then be painted by brushing on at least I full coat of paint No. 1. Unless otherwise directed by the Engineer, the second coat shall be applied within 24 hours after the primer is applied.

SUBSECTION 530.8 PAINTING:

SUBSECTION 530.8.1 Structural Steel:

(A) **Paint:** Unless otherwise required on the plans or in the special provisions, the paints to be applied to structural steel surfaces shall consist of a shop prime coat, as specified in Section 515, a second coat, and a finish coat. The total dry film thickness of the prime and second coat shall be not less than 3 mills. The dry thickness of the paint will be measured in place with a calibrated magnetic film thickness gauge.

Excessively thick coats of paint will not be permitted. The thickness of each coat shall be limited to that which will result in uniform drying throughout the paint film.

Unless specified otherwise on the plans or in the special provisions, the paint coats shall be as specified for general use on structural steel in Section 790. Succeeding coats of paint, not otherwise materially different in color, shall have carbon black mixed into the paint in accordance with Section 790 to produce a perceptible color difference between the paint coat being applied and the preceding coat.

Any damage to sound paint on areas not designated for treatment, resulting from the Contractor's operations, shall be repaired as directed by the Engineer.

(B) **Application of Paint:** Painting of structural steel, except for shop applied prime coats and sections which will be inaccessible after erection as described below, shall be done after erection unless otherwise specified in the special provisions. Requests to do any additional painting prior to erection shall be submitted by the Contractor and approved by the Engineer in writing before such work is started. Painting prior to erection will be limited to a prime coat of paint, except that surfaces exposed to the atmosphere which would be inaccessible for painting after erection shall be painted the full number of coats prior to erection. Any deficiencies in the prime coat of paint, or any second coat shall be corrected to the satisfaction of the Engineer prior to the application of the finish coat of paint.

The surface of the paint coat being covered shall be free from moisture, dust, grease, or any other deleterious material, which would prevent the bond of the succeeding coat. In spot painting, any old paint, which lifts after application of the touch-up coat, shall be removed by scraping and the area repainted before application of the next coat.

The finish coat shall not be applied until the required total film thickness of the undercoats of paint, as described above is obtained.

Open seams at contact surfaces of built-up members, which would retain moisture, shall be caulked with red lead paste before applying the second coat of paint.

Except for anchor bolt assemblies, steel embedded in concrete need not be painted. Anchor bolt assemblies shall be painted or dipped with 1 coat of paint prior to installation.

With the exception of abutting chord and column splices and column and truss shoe bases, machine finished surfaces shall be coated with a rust inhibitor which can be easily removed. Surfaces of iron and steel castings which have been machine finished shall be painted with a coat of shop paint.

SUBSECTION 530.9 MEASUREMENT:

Measurement for priming and painting for each completed trash rack in-place, as verified by the Engineer.

SUBSECTION 530.10 PAYMENT:

Payment for the preparation of surfaces, shop prime coat, second paint coat, finish coats, and field touch-up coats on steel and miscellaneous metal items shall be considered as included in the bid pricing for each trash rack.

BID ITEM 530-1 PAINTING TRASH RACK (NORTH OUTLET)

BID ITEM 530-2 PAINTING TRASH RACK (CENTRAL OUTLET)

BID ITEM 530-3 PAINTING TRASH RACK (SOUTH OUTLET)

END OF SECTION

SECTION 605 HDPE CORRUGATED PERFORATED DRAIN PIPE

SUBSECTION 605.1 DESCRIPTION:

The high density polyethylene (HDPE) corrugated perforated drain pipe shall be furnished and installed in accordance with this section and the plan views, sections, and details shown on the drawings. The drain pipes are intergral to the drain of the diaphragm filter. A drain pipe is laid one on each side of the outlet CMP pipe prior to fill placement of drain sand.

SUBSECTION 605.2 MATERIALS:

All drain pipe materials shall conform to the requirements in this section and in accord accordance to Section 738 of these Special Provisions. Submittals of drain pipe and geotextile sock material data sheets and approval by the Engineer is required prior to procurement.

SUBSECTION 605.3 INSTALLATION:

The Contractor shall coordinate the installation of the drain pipes with work associated with concrete encasement, soil buttress fill, geotextile deployment, and drain sand placement. The Contractor shall verify that the grade of the foundation is adequate to achieve the slopes within the allowed tolerances prior to geotextile placement and drain pipe installation. No pipe shall be laid except in the presence of a representative of the Engineer. Pipelines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from, or return to established grade or alignment shall be no more than 1 inch in 10 feet, unless otherwise approved by the Engineer.

Rotate and align the perforation configuration in accordance with the manufacturers' instructions. The pipe shall be laid directly on top of the geotextile wrap for the drain sand and held secure while drain sand is placed. The drain pipe shall be maintained in a straight line and not allowed to shift or float due to the placement of additional drain sand. The drain pipe may be joined by either manufactured gasketed bell and spigot fittings, or manufactured corrugated coupling bands for plain end corrugated pipe.

As determined by the Engineer, pipe that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

SUBSECTION 605.3.1 End Cap:

The drain pipe shall be capped by a HDPE solid end cap manufactured by the same company as the drain pipe and secure so as not to come off during installation of pipe or drain sand. The end cap shall be gasketed so as not to allow fines to enter through the end cap. The end cap need not be perforated. The geotextile sock is to be slid over the solid end cap joint after installation.

SUBSECTION 621.3.3 Geotextile Sock:

The geotextile sock, manufactured (and sewn) for this type of installation and to fit snugly around the pipe, shall be continuous throughout the drain pipe length. Continuous sock is defined as no gaps will be allowed at pipe joints. The geotextile sock is to be slid over the solid end cap joint after installation. The sock is to cut to fit at the interfacing slope of the soil buttress and riprap armor so no geotextile is exposed (just below the visible riprap surface.

The geotextile sock shall be protected from UV degradation by covering with opaque sheeting prior to installation. The geotextile fabric shall not be exposed to the elements longer than two days in total without cover.

The geotextile sock may not be used if damaged. Drain pipe and/or geotextile sock will be rejected if delivered to the site damaged, damaged while being stored, or damaged during drain sand placement and compaction. The Contractor shall employ the methods and controls to ensure the sock is not damaged or compromised. At the Engineer's descretion, geotextile patches may be allowed over joints or damaged areas upon prior approval. As

determined by the Engineer, geotextile sock that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

SUBSECTION 621.3.4 Rodent Screens:

The stainless steel rodent screen (cloth) shall be installed over the exposed end of the drain pipe immediately upon completion of the drain pipe installation to prevent animal or rodent activity. However, the rodent screen is not to be damaged or marred during completion of the outlet structure, including concrete aprons, and riprap. The rodent screen shall be carefully field cut to provide a standard level of quality installation, the screen cloth shall be amply secured and free of frayed edges and excessive wrinkles or deformations.

SUBSECTION 621.5 MEASUREMENT:

All drain pipe installation shall be measured on a per lineal foot basis.

SUBSECTION 621.6 PAYMENT:

Payment for the installation of drain pipe with geotextile sock shall be made on the basis of the price bid per lineal foot, and shall be full compensation for furnishing and installing the pipe and couplings, and all incidental work (i.e. end cap and rodent screens) not specifically covered in other pay items.

BID ITEM 605-1 8-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE

BID ITEM 605-2 4-INCH HDPE CORRUGATED PERFORATED DRAIN PIPE

END OF SECTION

SECTION 621 CORRUGATED METAL PIPE

SUBSECTION 621.1 DESCRIPTION:

These specifications are for polycoated, galvanized corrugated metal pipe (CMP). The pipe shall be of the types, constructed as specified, and shall be manufactured in accordance with the requirements of the stated specifications. Except as otherwise required, corrugated metal pipe shall conform to AASHTO M-36.

The outlet pipe extension shall consist of cylindrical, polymer coated, corrugated metal pipe as specified in Section 760 for the three locations as shown on the plans.

SUBSECTION 621.2 MATERIALS:

All helically wound corrugated metal pipe shall have a marking system which shall provide a quick external visual check of diameter variations during and after the manufacturing process.

Corrugated metal pipe, couplings, and coating shall be according to Section 760.

SUBSECTION 621.3 INSTALLATION:

No pipe shall be laid except in the presence of a representative of the Engineer. Each pipe shall be carefully inspected immediately before it is laid and defective pipe will be rejected. Pipelines shall be laid to the grades and alignment indicated on the drawings. Variation from prescribed grade and alignment shall not exceed 0.10 foot, and the rate of departure from, or return to established grade or alignment shall be no more than I inch in 10 feet, unless otherwise approved by the Engineer. Proper facilities shall be provided for lowering sections of pipe into trenches. All pipes, elliptical or round, as well as pipe arches requiring external coating or internal lining shall be equipped with lifting lugs as required and shall have connecting bands designed to provide positive connection without damaging the coating on the pipe or pipe arch.

Corrugated metal pipe and/or pipe arches shall be laid with separate section joined together in such a manner that the joint space shall not exceed ½ inch, with the outside laps of circumferential joints pointing upstream and with longitudinal laps on the side. Elliptical pipe shall be installed so that the major or minor axis, whichever the case may be, and which should be indicated by suitable markings on the top of each end of the pipe sections, coincides with the survey alignment of the trench excavation. Any metal in the joints, which is not thoroughly protected, shall be coated with bituminous mastic. During the installation, the pipe shall be handled with care so as not to damage the external coating or internal lining. Coupling band bolts and damaged areas of the coupling bands and pipe shall be given a coating of bituminous mastic as specified above prior to placing the backfill. As determined by the Engineer, pipe that is damaged to such an extent that satisfactory field repairs cannot be made shall be removed and replaced at no additional cost to the Contracting Agency.

A universal band coupling with neoprene gasket shall be used to join the existing pipe and new pipe. The universal coupling is required because the existing pipe has standard corrugations and the new pipe required is helical wound corrugated pipe. A typical detail is shown on the plans for both the 24-inch diameter and 48-inch diameter pipe.

Marring or damage to the polymer coated pipe shall be repaired in the field using like polymer system as recommended by manufacturer of primary coating system. Any damage or marring shall be brought to the attention of the Engineer and repairs shall be witnessed by the Engineer.

SUBSECTION 621.3.1 Joints:

Before the connecting band is placed around the pipe, the ends of the pipe that will be beneath the band, shall be coated with bituminous mastic or, if of suitable design, fitted with circular rubber gaskets to provide a watertight joint. The band shall be tightened evenly, keeping equal tension on the bolts. If mastic is used, tension shall be maintained over an interval of time until the flow of mastic terminates. The joint shall remain uncovered over a period designated by the Engineer, and before covering the joint the nuts shall be tested for tightness. If the nut has a

tendency to loosen its grip on the bolt, it shall be tightened again and remain uncovered until a tight, permanent joint can be obtained. Prior to concrete encasement around the joint, the bolts, lugs, and nuts shall be given a coating of bituminous mastic. The annular space between abutting pipe sections shall be filled with bituminous mastic after jointing.

In the event CMP is not ordered at the lengths required for this project, the Contractor shall inform the Owner and Engineer and obtain express written approval to install an additional pipe joint. The Contractor would also be required to provide total concrete encasement as detailed on the drawings for the primary joint between the old and new pipes.

SUBSECTION 621.3.2 Pipe Elongation:

Except as otherwise specified, the standard details shall control as to conditions under which pipe must be elongated. Pipe shall be elongated 5 ±1/2 percent of the nominal diameter to take advantage of the buildup of side support as it settles back toward a full round shape under the backfill load. The method or technique for obtaining and releasing the elongation shall be optional to the Contractor. Under no circumstances shall the vertical diameter of the pipe at any point along the pipe section, after backfill and compaction is completed, be less than the nominal diameter of the pipe, or more than 5 percent greater than the nominal diameter of the pipe as shown on the plans or specified elsewhere in this specification. Any damage done as a result of strutting shall be repaired as directed by the Engineer at no additional cost to the Contracting Agency. Strutting of pipe shall be approved by the Engineer.

SUBSECTION 621.3.3 Cutting:

The Contractor will be prohibited from using conventional welding torches in cutting full lined CMP due to fire hazard. Pipe will either be sawcut or cut with special cutting tools, which will not expose the pipe to the fire hazard of a normal acetylene torch. Whenever possible, connections shall be shop fabricated to prevent any exposure to fire hazard.

Special precautions shall be employed for cutting one-foot off of the existing pipe prior to connecting new pipe. The coating of the existing pipe is found to have asbestos containing materials (ACM). A special contractor may be required that is qualified and certified to work with and dispose of ACM.

SUBSECTION 621.3.4 Repair of Damage to Coatings:

Corrugated metal pipe shall be carefully handled at all times to prevent damage to the external coating, spelter coating, or internal lining. Each length of pipe shall be carefully inspected immediately prior to placing in the trench to ascertain that no damage has been done to the exterior coating that will be concealed when the pipe is placed. Any damage to the spelter coating, shall be repaired to the satisfaction of the. Any damage to the external coating or internal lining shall be repaired to the satisfaction of the Engineer with bituminous mastic as specified above.

SUBSECTION 621.4 TEST SPECIMENS:

Manufacturer certification and/or test data indicating the polymer coating has been properly applied to the pipe and at the required thickness.

SUBSECTION 621.5 MEASUREMENT:

All pipe installation shall be measured on a per lineal foot basis.

SUBSECTION 621.6 PAYMENT:

Payment for the installation of outlet pipe extensions shall be made on the basis of the price bid per lineal foot, and shall be full compensation for furnishing and installing the pipe, coatings, and couplings, and all incidental work (i.e. cable tie-downs) not specifically covered in other pay items. The cutting and removal of existing pipe shall be compensated for in Section 350.

BID ITEM 621-1 CORRUGATED METAL PIPE (48-INCH NORTH OUTLET)

BID ITEM 621-2 CORRUGATED METAL PIPE (48-INCH CENTRAL OUTLET)

BID ITEM 621-3 CORRUGATED METAL PIPE (24-INCH SOUTH OUTLET)

END OF SECTION

SECTION 701 ROCK, GRAVEL, AND SAND MATERIALS

SUBSECTION 701.1 GENERAL:

The following specifications set forth the requirements for crushed rock, gravel, sand, and quarry stone. Samplings and sieve analysis shall be performed in accordance with ASTM D-75 and ASTM C-136. Sand equivalents shall be determined in accordance with AASHTO T-176. The liquid limit and plasticity index shall be determined in accordance with AASHTO T-89 and T-90.

SUBSECTION 701.2 CRUSHED ROCK AND GRAVEL:

Rock and gravel shall be clean, hard, sound, durable, uniform in quality, and free of any detrimental quantity of soft, friable, thin elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.

The loss by abrasion in the Los Angeles abrasion machine, determined as prescribed in ASTM C-131, Grading A, shall not exceed 10 percent, by weight, after 100 revolutions nor 40 percent after 500 revolutions.

SUBSECTION 701.2.1 Crushed Rock: Crushed rock shall consist of the product obtained by crushing rock, stone, or gravel so that at least 50 percent by weight of aggregate retained on the No. 4 sieve for 3/4 inch or larger maximum sizes, and 50 percent retained on the No. 8 sieve for maximum sizes less than 3/4 inch shall consist of particles which have at least one rough, angular surface produced by crushing. All material that will pass a grizzly with bars spaced 15 inches apart, clear opening, shall be crushed when producing from the Contracting Agency's source,

The gradation of crushed rock shall comply with ASTM D-448.

SUBSECTION 701.2.2 Gravel: Material designated herein as gravel shall be composed entirely of particles that are either fully or partially rounded and water-worn. Crushed rock obtained by crushing rock which exceeds ASTM D-448 maximum gradation sizes may be combined provided it is uniformly distributed throughout and blended with the gravel. The quality and gradation requirements shall be as stated in this specification.

SUBSECTION 701.3 SAND:

Sand shall be fine granular material produced by the crushing of rock or gravel or naturally produced by disintegration of rock and shall be sufficiently free of organic material, mica, loam, clay, and other deleterious substances to be thoroughly suitable for the purpose for which it is intended.

SUBSECTION 701.3.1 Sand for Asphalt Concrete Pavement: Sand for asphalt concrete pavement shall comply with AASHTO M-29 except that grading requirements shall be deleted and have a minimum sand equivalent of not less than 50 and shall be non-plastic when tested in accordance with AASHTO T-89 and T-90.

SUBSECTION 701.3.2 Sand for Portland Cement Concrete, Mortar and Plaster: It shall be thoroughly and uniformly washed and shall be entirely free from oil and deleterious substances.

The average value of sand equivalent determined on 3 successive samples shall not be less than 70. No individual sample shall have a sand equivalent less than 65.

The size and grading of sand to be used in cement concrete, mortar, and plaster shall be such as to conform to the requirements specified as follows:

Concrete:	ASTM C-33
Mortar:	ASTM C- 144
Plaster:	ASTM C-35

SUBSECTION 701.3.3 Coarse Aggregate for Portland Cement Concrete: Coarse aggregate shall conform to ASTM C-33 grading size No. 467, 57, 67, and 7.

SUBSECTION 701.3.4 Aggregate for Masonry Grout: The size and grading of the fine or coarse aggregate to be used in masonry grout shall conform to ASTM C-404.

SUBSECTION 701.3.5 Aggregate for Controlled Low Strength Material: Coarse aggregate shall conform to ASTM C-33 grading size No. 57. The size and gradation of fine aggregates (sand) shall conform to ASTM C-33.

SUBSECTION 701.4 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 701.5 PAYMENT:

No payment will be made separately for rock, gravel, and sand materials. The Contractor shall receive payment in accordance with Section 211. Costs associated with procuring commerical materials are considered incidental to the work in Section 211.

END OF SECTION

SECTION 703 RIPRAP MATERIALS

SUBSECTION 703.1 STONE:

Stone riprap shall be sound and durable, free from seams and coatings, and of such characteristics that it will not disintegrate when subjected to the action of water. Loss by abrasion shall not exceed the limits specified in Section 701.

Stone shall be of shapes, which will form a stable protection structure of the required depth.. Angular shapes obtained through crushing or fracturing shall be used. Flat or needle shapes will not be acceptable unless the thickness of the piece is more than 1/3 the length.

Rounded boulders or cobbles or waste concrete shall **not** be used

SUBSECTION 703.2 SIZE OF STONE:

Riprap stone shall be as large as can be conveniently placed in a layer of the required depth. The stones, excepting small stones and spalls used to chink interstices shall weigh be D_{50} = 6 inches.

The specific gravity of the stone shall be at least 2.64 (or specific weight 165 pcf).

SUBSECTION 703.3 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 703.4 PAYMENT:

No payment will be made separately for riprap materials. The Contractor shall receive payment in accordance with Section 220. Costs associated with procuring commerical materials are considered incidental to the work in Section 220.

END OF SECTION

SECTION 725 PORTLAND CEMENT CONCRETE MATERIALS

SUBSECTION 725.1 GENERAL:

Portland cement concrete shall be composed of Portland cement or Portland Pozzolan cement, Pozzolonic Materials, fine and coarse aggregates, water, and, if provided for or allowed, certain admixtures.

All of the materials used for concrete shall be in accordance with these specifications and requirements for the particular material as provided herein.

Weighing and metering devices used for the purpose of proportioning materials shall fulfill requirements as to accuracy and tolerance prescribed by the Weights and Measures Division of the State of Arizona and shall be sealed and certified in accordance with the procedures established by this agency. This certification shall not be over 12 months old and shall be renewed whenever required by the Engineer. When portable plants are set up at a new or temporary location, the scales and scale assembly shall be inspected and certificate issued regardless of the date when the scales were last tested. The Engineer may require the Contractor to run a quick scale check at any time with certified weights furnished by the Contractor and order the scale recertified if necessary.

TABLE 725-1
CONCRETE CLASSES MINIMUM REQUIREMENTS

Class of Concrete	Min. Cement Content	Minimum Compressive Strength (1)	
	Lbs. Per Cu Yard	At 14 Days psi	At 28 Days psi
AA	600	3200	4000
A	520	2400	3000
B	470	2000	2500
C	420	1600	2000

Note: (1) As tested in accordance with ASTM C-39. Maximum slump 5 inches when tested in accordance with ASTM C-143.

Class AA concrete shall be used as specified.

Class A concrete shall be used for concrete structures, either reinforced or non-reinforced, and for concrete pavements.

Class B concrete may be used for curbs, gutters and sidewalks.

Class C concrete may be used for thrust blocks, encasements, fill or over-excavation, etc.

SUBSECTION 725.2 PORTLAND CEMENT:

Cement to be used or furnished under this specification shall be Portland cement, conforming with the requirements of ASTM C-150, Type II, low alkali, or Portland Pozzolan Cement, conforming with the requirements of ASTM C-595, Type IP (MS), low alkali, except when another type including high early strength is specified in the special provisions or shown on the plans. Type V cement (ASTM C-150) shall be specified in the special provisions for use in concrete which will be exposed to contact with soils or waters containing water soluble sulfates (as S04) in concentration greater than 0.20% by weight of soil or 1500 PPM in solutions. Pozzolonic materials shall not be used as a directly added ingredient in concrete in combination with Portland Pozzolan Cement.

Cement shall be sampled and tested as prescribed in applicable ASTM specifications. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the cement manufacturer, identifying the cement and stating that the cement delivered to the batching site complies with those specifications. When requested by the Engineer, the Contractor shall furnish him with 3 copies of said certification. The cost of furnishing tested cement shall be considered as included in the contract bid price and no additional allowance will be made therefore.

When suitable facilities, as recommended by the Concrete Plant Manufacturer's Bureau, and approved by the Engineer, are available for handling and weighing bulk cement, such facilities shall be used. Otherwise the cement shall be delivered in original unopened sacks that have been filled at the mill and bear the name or brand of the manufacturer. The type of cement, and the weight of cement contained in each sack shall be plainly marked thereon.

Cement shall be stored in such manner as to permit ready access for the purpose of inspection and identification, and so as to be suitably protected against damage by contamination or moisture. Should any lot of bulk cement be delivered to the site show evidence of contamination, the Engineer may require that such lot be removed from the site.

A cement shall not be mixed with any other brand or type unless written permission has first been obtained from the Engineer. All cement used in the manufacture of concrete for any individual structure shall be of the same brand unless otherwise approved by the Engineer.

SUBSECTION 725.2.1 Pozzolonic Materials:

Pozzolonic materials to be used in concrete or furnished under this specification shall conform to the requirements of ASTM C-618.

If an approved pozzolonic material is used, 15 percent by weight of the Table 725-1 minimum Portland cement requirements shall be replaced. The replacement ratio shall be 1.2 pounds of Pozzolan per pound of replaced Portland cement. If the class of concrete is not from Table 725-1, the amount of Pozzolanic material used will be 17.5 percent of the combined weight of Pozzolanic material and Portland cement.

Pozzolans shall be sampled and tested as prescribed in ASTM C-618 and ASTM C-311. The Contractor shall obtain and deliver to the Engineer a certification of compliance signed by the Pozzolan supplier identifying the Pozzolan and stating the Pozzolan delivered to the batching site complies with applicable specifications. The cost of furnishing tested Pozzolan shall be considered as included in the contract bid price and no additional allowance will be made therefore.

Pozzolan material shall be handled and stored in the same manner as Portland cement. When facilities for handling bulk Pozzolan are not available, the Pozzolan shall be delivered in original unopened sacks bearing **the name and brand** of the supplier, the type and source of the Pozzolan. and the weight contained in each sack plainly marked thereon.

A Pozzolan shall not be mixed with any other brand or type unless written permission has first been obtained from the Engineer. All Pozzolan used in the manufacture of concrete for any individual structure shall be of the same type, and from the same source unless otherwise approved by the Engineer.

SUBSECTION 725.3 AGGREGATES:

Aggregates shall be crushed rock or gravel or a combination thereof and sand conforming to the requirements prescribed in Section 701. Prior to the delivery of the aggregates, the Contractor will be required to furnish samples for testing, and shall notify the Engineer as to when and where they will be available. Thereafter, additional required samples shall be furnished at the expense of the Contractor, but the cost of testing and making the grading analysis will be borne by the Contracting Agency. Samples shall be taken by the Engineer or in the presence of the Engineer.

No method which may cause the segregation, degradation or the combining of materials of different grading shall be used.

SUBSECTION 725.4 AGGREGATE GRADING:

Aggregates for each batch of concrete to be prepared shall be combined from materials separately stored in the various sizes and gradations as prescribed in Section 701. The relative proportions of each aggregate used will be as required to meet the provisions of this specification and will be the responsibility of the Contractor.

Except where the amount of concrete for any one job is 10 cubic yards or less, various sizes of both coarse and fine aggregate shall be proportioned by weight unless permission to do otherwise has first been obtained from the Engineer. Aggregates that are proportioned by volume shall be measured in containers of known capacity. Regardless of the method employed, either by weight or volume, each individually stored size of aggregate shall be proportioned separately, but not necessarily weighed individually.

The maximum size of the aggregate shall not be larger than one-fifth of the narrowest dimension between forms of the members for which the concrete is to be used, or larger than 3/4 of the minimum clear spacing between reinforcing bars.

SUBSECTION 725.5 WATER:

The amount of water shall be varied in accordance with the percentage of free moisture in the material and the requirements of the workability of the aggregate.

The equipment for measuring and supplying the water in the mixer shall be so constructed and arranged that the amount of water to be added to the mixture can be measured, in gallons or by weight, positively and that the predetermined quantity of water required can be discharged rapidly in one operation into the mixing drum without dribbling. Tanks or other equipment for measuring and discharging water into the mixer shall be sufficiently accurate that the amount of water delivered to the mixer for any batch shall not vary more than 1 percent from the required quantity. Adequate means for determining and checking the accuracy of the equipment shall be provided and made available to the Engineer at all times.

The water used for mixing with concrete shall be potable and free from oil, vegetable matter and other deleterious substances, and shall conform to the following requirements:

Water for prestressed concrete shall not contain chlorides calculated as sodium chloride in excess of 1,000 parts per million nor sulphates calculated as sodium sulphate in excess of 1,000 parts per million nor any sulphates calculated as sulphate in excess of 1,000 parts per million. Water shall not contain an amount of impurities that will cause a change in the time of setting of portland cement of more than 25 percent nor a reduction in the compressive strength of portland cement mortar of more than 5 percent compared to results obtained with distilled water.

SUBSECTION 725.6 ADMIXTURES:

Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer.

If an air-entraining agent is authorized, the amount used will be limited to the extent that the amount of entrained air by volume shall not be more than 6 percent. Air-entraining agents complying with or ASTM C-260 will be permitted as long as strength requirements are met. Any admixture shall be measured accurately by mechanical means into each batch by equipment and in a method approved by the Engineer. Any admixtures used shall be included in the bid price for that item.

SUBSECTION 725.7 PROPORTIONING:

All proportioning equipment shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association. The proportioning shall consist of combining the specified sizes of aggregates, each stored in a separate bin with cement, Pozzolanic Materials, and water as herein provided. Weigh hoppers shall be charged from bins located directly over the weigh hoppers or from conveyor belts. When conveyor belts are used, there shall be a separate belt for each size of aggregate.

Bulk cement shall be weighed in an individual hopper and shall be kept separate from the aggregates until the batch ingredients are released for discharge. The cement hopper shall be attached to a separate scale for individual weighing.

All Pozzolan that is to be incorporated into the concrete as a separate ingredient shall be weighed. When the cement scales are used for weighing both cement and Pozzolan, the cement shall be weighed first. If separate scales are provided, they shall be accurate to ± 0.3 percent of the scale capacity.

Scales utilized in the proportioning device may be of the springless dial-type or of the multiple-beam type.

If the dial-type, the dial shall be of such size and so arranged that it may be read easily from the operating platform.

If the multiple beam-type, the scales shall be provided with an indicator operated by the main beam, which will give positive visible evidence of over or under weight. The indicator shall be so designed that it will operate during the addition of the last 400 pounds of any weighing. The over travel of the indicator hand shall be at least 1/3 of the loading travel. Indicators shall be enclosed against moisture and dust.

Weighing equipment shall be as recommended by the Concrete Plant Manufacturer's Bureau and be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cutoff shall not vary from the weight designated by the Engineer more than 1 percent for cement, Pozzolan or Cement Pozzolan, 1 1/2 percent for any size of aggregate, nor 1 percent for the total aggregate in any batch. When proportioned at a central mixing plant there shall be an approved moisture meter, accurate within 1/2 percent, installed to indicate the moisture in the fine aggregate.

A concrete mix design carrying the producer's designated mix number of the concrete being furnished under these specifications shall be submitted to the Contracting Agency at least once each year. In the event there is any change in the source of material, another mix design shall be submitted.

SUBSECTION 725.8 MIXING:

Machine mixing will be required in all cases other than those in which it would obviously prove to be impractical; in which latter event hand mixing will be permitted, only to the extent necessary. Regardless of the method employed, mixing shall be commenced as soon as possible after the cement is placed in contact with the aggregates.

The temperature of materials as charged in the mixer shall be such that the temperature of the mixed concrete at the time it is placed in final position does not exceed 90°F. When the atmospheric temperature at the time of placing concrete is less than 40°F., the temperature of the concrete, as placed, shall not be less than 60°F.

All concrete mixers shall be of such design and construction, and so operated, as to provide a thoroughly and properly mixed concrete in which the ingredients are uniformly distributed.

SUBSECTION 725.8.1 Paving and Stationary Mixers:

Paving and stationary mixers shall comply with the standards of the Concrete Plant Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association. They shall be equipped with an accurate automatic timing device so designed and constructed as to lock the discharge lever before aggregate, cement and Pozzolan enter the drum, and release such lever only after the specified mixing time has elapsed. The regulation of the setting of said device shall be under the supervision of the Engineer. Water control equipment as described in this specification shall also be provided with each concrete mixer.

Mixers shall be maintained in proper and serviceable working condition, and any part or portion thereof that is out of order, or becomes worn to such extent as to detrimentally affect the quality of mixing, shall be promptly repaired or replaced.

The proper proportions of aggregate, cement, Pozzolan and water for each batch of concrete shall be placed in the mixer, and shall be mixed for a period of not less than 50 seconds after all such materials are in the drum. The rotating speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

SUBSECTION 725.8.2 Transit Mixers:

Transit mixers shall be high quality equipment and meet the requirements of the Truck Mixer Manufacturer's Bureau and the certification requirements of the Arizona Rock Products Association. Ready mix concrete shall comply with ASTM C-94 except as herein specified.

The total elapsed time between the addition of water at the batch plant and depositing the complete mix shall not exceed 90 minutes. Each mixer and agitator shall have attached thereto in a prominent place a metal plate or plates, installed by the manufacturer, on which is plainly marked the capacity of the drum in terms of the volume of mixed concrete and the speed of rotation for the agitating and mixing speeds of the mixing drum or blades.

Each mixer shall have an identification number painted on the truck in such a location that it can be easily read from the batching platform.

The total volume of materials introduced into the mixer for mixing purposes shall not exceed the manufacturer's guaranteed mixing capacity. If the concrete so mixed does not meet the uniformity requirements of this section, the amount of materials charged into the mixer shall be reduced.

The rotation speed at which the mixer shall be operated shall conform to that recommended by the manufacturer.

The total volume of materials mixed in any one batch shall neither exceed the water level capacity of the mixer nor the manufacturer's catalog rated capacity of the mixer.

Each batch of concrete placed in the mixer shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades, at the speed designated by the manufacturer of the equipment as mixing speed. Additional mixing shall be at the agitating speed designated by the manufacturer of the equipment. The revolving of the drum shall be continuous until the concrete is completely emptied from the drum. Before any portion of the materials for any batch of concrete is placed therein, the drum of the mixer shall be completely emptied of the previously mixed batch.

At the time of delivery to the job site, the Engineer shall be provided with a legible weighmaster's certificate (delivery ticket) which shall contain the following information;

- Date and Truck Number.
- Name of the Supplier.
- Name of the Contractor.
- Specific designation of job (name and location).
- Number of cubic yards in the batch.
- Type of cement.
- Type of Pozzolan, if any.
- Time the transit mixer is loaded.
- Amount of water added at the job site at request of receiver, and his signature or initials.
- Suppliers' mix design code number.
- Type and amount of admixture, if any.
- Serial number of the ticket.

The type, capacity and manner of operation of the mixing and transporting equipment for ready-mix concrete shall conform to the current Standards for Operation of Truck Mixers and Agitators of the National Ready-Mixed Concrete Association and the Truck Mixer and Agitators Standards of the Truck Mixer Manufacturers Bureau. Water shall not be added to the batch during transit. Additional water may be added at the point of discharge to adjust slump providing the slump after such water addition does not exceed the maximum allowed by these specifications and that water so added is mixed into the batch for a minimum of 30 additional revolutions at mixing speed. Loss of cement mortar during discharge which in the opinion of the Engineer would be of sufficient amount to affect the homogeneity of the concrete will be cause for rejection of the load. The Contractor shall be responsible for all concrete to which water is added at the job site.

SUBSECTION 725.8.3 Hand Mixed Concrete:

Hand mixed concrete shall be prepared on a watertight level platform in batches of not to exceed 1/3 cubic yard each. Hand mix concrete requires prior approval from the Engineer. The required amount of coarse aggregate shall first be spread on the platform in an even and uniform layer, over which the proper proportion of fine aggregate shall then be likewise spread. The combined depth of both such layers shall not be greater than one foot. The required quantity of cement shall then be evenly distributed over the fine aggregate; following which the entire batch shall be turned with shovels at least twice before the water is added. The proper amount of water shall then be uniformly sprinkled or sprayed over the batch, which shall thereafter be returned with shovels not less than 3 times before being removed from the platform.

SUBSECTION 725.8.4 Drybatched Unmixed Concrete:

Should the Contractor elect to use drybatched unmixed concrete, an accurate automatic batch weight recorder shall be provided to record the quantities of cement, aggregate and water batched into the containers; the weight of cement shall be recorded on either a separate charge from the aggregate or on the same chart using a separate needle. The recorder shall produce an autographic readable record on a visible chart of the weights of each of the materials batched. After batching, the needle on the chart shall return to zero. The chart scale along the ordinate shall be such that the major portion of the chart is used to record the total weights of the aggregates and water, and the cement. The date of batching, the container number and the batching certificate number shall be recorded on the recorder chart at the time of batching. The recorder charts, or copies thereof, shall become the property of the Contracting Agency and shall be submitted upon request.

All drybatched unmixed concrete delivered to the job site shall be stored in containers so constructed that the cement cannot commingle with the water and aggregate within the container. Any admixture added in powder form shall be added to the cement; or if added in liquid form, it shall be added to the water.

The contents of the container shall be discharged into a mixer at the job site. Following discharge of the first container into the mixer, the mixer shall be operated at mixing speeds during the discharge of the remaining containers. After the contents of the last container have been discharged into the mixer, the concrete shall be mixed as specified in this specification for transit mixers, and drum or turbine type mixers.

Any spillage of cement, aggregate, water or admixture during the filling, transporting, or the discharging of the container, shall be cause for rejection of the container or the contents of the mixer if any portion of the rejected container is discharged into the mixer.

SUBSECTION 725.9 LOADING AND TRANSPORTATION OF MATERIALS AND MIXED CONCRETE:

The compartments of trucks or other equipment used for the purpose of transporting proportioned aggregates, bulk cement or mixed concrete, shall be sufficiently high and tight, and otherwise suitably constructed and adequately protected, to prevent loss or leakage of the contents thereof during transit or charging.

SUBSECTION 725.10 TESTS:

Concrete specimens for compression tests will be taken in the field by a representative of the Engineer in accordance with ASTM C-172 and C-31, except at noted hereinafter.

Concrete samples shall be taken from the approximate middle 50 percent of the batch in an uninterrupted stream from the chute directly into the wheelbarrow or similar equipment. Where excessive slump is suspected, a controlling slump test may be made from any portion of the batch, except for the approximate 5 percent on each end of the discharge. If excessive slump is verified, at any time, the remainder of the load shall be rejected and removed from the project and a set of cylinders for compressive strength shall be taken from the batch, if any concrete from the batch was placed. The rate of discharge of the batch shall be regulated by the rate of revolutions of the drum and not by the size of the gate opening. Specimens for compression tests shall be stored in the field in accordance with methods approved by the Contracting Agency and protected from vibration and other disturbances, for a minimum of

28 hours and maximum of 76 hours. A maximum storage period would be involved only where weekends or holidays are involved. Cylinders stored in the field for the maximum period shall have the same validity as cylinders that have been stored overnight and brought in the following day.

Not less than 4 cylinder specimens will be made for each 50 cubic yards of each class of concrete with a minimum of 4 specimens for each class placed or not less than 4 test specimens for each half-day's pour, whichever results in the greater number of tests. All test specimens shall be molded and cured in accordance with ASTM C-31. Specimens will be tested in a laboratory designated by the Engineer in accordance with ASTM C-39 at the expense of the Contracting Agency.

Two cylinders (test specimens) shall be laboratory tested at 7 days. Two cylinders shall be laboratory tested at 28-days.

Additional specimens may be collected at the Engineer's discretion for low strengths have been detected on previous pours, early breaks (less than 7 days), or to have an extra specimen after two are broken at 28-days (held for 60 days beyond).

SUBSECTION 725.11 ACCEPTANCE:

Compressive strength results for all specimens that meets or exceeds the minimum requirements at the 28-day break will be acceptable concrete by the Engineer. All compressive strength test results shall be reported immediately to the Engineer. Quality control charts shall kept by the Engineer for individual strength tests, moving average for strength, and moving average for range for each mixture. The charts shall be similar to those found in ACI 214.

If this strength does not meet the 7-day requirement, the Contractor shall schedule and pay for two cores to be taken, on the 29th day, from the area of concrete represented by the cylinders. The Engineer shall be present when the coring is accomplished or additional cores will be required.

If the 28-day cylinder test does not meet the minimum 28-day compressive strength requirement, the cores will be tested in accordance with ASTM C-42 in a laboratory designated by the Contracting Agency. If the cores meet or exceed the minimum 28-day strength, the concrete will be accepted by the Contracting Agency.

If the strength of the 28-day cylinders and the strength of the cores as calculated in accordance with ASTM C-42 are deficient, the Contractor shall remove all of the concrete represented by the failing test specimens with the exception that if the Contractor believes that the deficient concrete was confined to a single batch, he may immediately cut a minimum of 4 additional cores, two on either side of the affected batch. The cores would be compared with the minimum specified compressive strength, for the purpose of defining the confines of the deficient concrete. All coring done to establish this premise would be at the expense of the Contractor. Evaluation of the cores shall be by the Engineer, or by a substitute agent designated by the Contracting Agency, and his decision shall be final.
All concrete failing to meet this requirement as evidenced by tests of either standard cylinder or drilled core specimens shall be rejected, removed and replaced by the Contractor at the Contractor's expense.

Fills shall not be placed against structural concrete until the concrete has been in place for at least 7 days or until the concrete has attained a strength of not less than 2,500 psi, whichever occurs first. At the Contractor's option, additional cyclinders and strength tests may be performed to obtain early (3 to 5 days) breaks.

SUBSECTION 725.12 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 725.13 PAYMENT:

No payment will be made separately for concrete materials. The Contractor shall receive payment in accordance with Section 505. Costs associated with procuring commerical materials are considered incidental to the work in Section 505.

END OF SECTION

SECTION 726 CONCRETE CURING MATERIALS

SUBSECTION 726.1 GENERAL:

Curing materials shall consist of waterproof paper, polyethylene film or liquid membrane forming compounds which, when applied to fresh concrete, will inhibit moisture loss and reduce temperature rise during the curing period. All curing materials and methods shall be approved by the Engineer prior to use. Wet coverings such as burlap, cotton mats, or other moisture-retaining fabrics also may be used, or may be required by special provisions.

SUBSECTION 726.2 MATERIALS:

(A) Waterproof paper, or polyethylene film, shall conform to AASHTO M-171.

(B) Type 1 liquid membrane-forming compounds shall conform to AASHTO M-148.

(C) Burlap cloth made from jute or kenaf shall conform to AASHTO M-182.

SUBSECTION 726.3 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 726.4 PAYMENT:

No payment will be made separately for concrete curing materials. The Contractor shall receive payment in accordance with Section 550. Costs associated with procuring commerical materials are considered incidental to the work in Section 550.

END OF SECTION

SECTION 727 STEEL REINFORCEMENT MATERIALS

SUBSECTION 727.1 GENERAL:

The following specifications set forth the requirements for bar reinforcement, wire reinforcement, and wire mesh reinforcement. The reinforcement shall conform accurately to the dimensions and details indicated on the plans or otherwise prescribed and before being placed in any concrete work, shall be thoroughly cleaned of all loose rust, mill scale, mortar, oil, dirt, or coating of any character, which would be likely to destroy, reduce, or impair its proper binding with the concrete.

No reinforcing steel will be accepted under this specification until it has been approved by the Engineer. When required by the Engineer, the Contractor or supplier shall furnish a spot sample taken on the project and notify the Engineer as to when and where they will be available. Such samples shall be furnished at the expense of the Contractor or supplier, but the cost of any testing that may be required will be borne by the Contracting Agency. Samples shall only be taken in the presence of the Engineer. The Contractor shall furnish 3 certified mill test reports or certificates of compliance for each heat or size of steel, which can be clearly identified with the lot. When such information has been furnished, placing of the steel will not be held up until results of spot samples have been received. Unless otherwise specified, all reinforcing steel bars shall be deformed intermediate grade 40 billet steel conforming with ASTM A-615 and the shapes shall conform with ASTM B-670.

In testing bar reinforcement, only the theoretical cross-sectional area will be used in all computations.

Bending of steel shall conform to the requirements of ACI-318.

The various grades of steel shall not be used interchangeably in structures.

SUBSECTION 727.2 WIRE REINFORCEMENT:

Wire reinforcement shall in all respects fulfill requirements prescribed in ASTM A-82.

SUBSECTION 727.3 WIRE MESH REINFORCEMENT:

Mesh reinforcements shall conform to ASTM A-185. The gage of the wire and the dimension of the mesh will be specified in the special provisions or shown on the plans. The wire mesh reinforcement shall be so constructed as to retain its original shape and form during necessary handling. The effective cross-sectional area of the metal shall be equal to that specified or indicated on the plans.

SUBSECTION 727.4 WIRE TIES:

Wire for ties shall be black, annealed, not lighter than 16 gage.

SUBSECTION 727.5 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 727.6 PAYMENT:

No payment will be made separately steel reinforcement materials. The Contractor shall receive payment in accordance with Section 550. Costs associated with procuring commerical materials are considered incidental to the work in Section 550.

END OF SECTION

SECTION 738 HDPE CORRUGATED PERFORATED DRAIN PIPE MATERIALS

SUBSECTION 738.1GENERAL:

The high density polyethylene (HDPE) corrugated perforated drain pipe shall be furnished accordance with ASTM F-894 for gravity flow. Provide 8-inch and 4-inch diameter corrugated perforated drain pipe materials in the quantities sufficient to conform with the dimensions shown on the drawings and the Contractor's field verification. The drain pipe material shall also be double-walled to provide a smooth wall interior for improved hydraulic characteristics. Perforations in the drain pipe shall provide a minimum of 2.5 square inches of open area per lineal foot of pipe with no single perforation dimension greater than 1.25 inches.

SUBSECTION 738.2 HDPE PIPE MATERIALS:

All drain pipe materials shall have a base material composition of polyethylene, Type III, Class C in accordance with ASTM F-894 and ASTM D-1248.

SUBSECTION 738.2.1 Fittings:

Coupling band fittings and end cap fittings shall be of the same HDPE material composition and manufacturer. Rubber gaskets shall be of natural rubber or synthetic elastomer or a blend and conform to ASTM F-477.

SUBSECTION 738.3 GEOTEXTILE SOCK:

The geotextile sock shall be manufactured and factory sewn to provide a continuous snug fit over the corrugated drain pipe. The geotextile material shall be nonwoven polypropylene or polyester material conforming to the following:

GEOTEXTILE SOCK	
Property	Value
Unit Weight	3 oz/sy
Apparent Opening Size (AOS)	70 (minimum)
Burst Strength	100 psi (minimum)
Permeability	0.20 cm/sec (minimum)
Puncture Strength	50 lbs (minimum)
Trapezoid Tear Strength	35 lbs (minimum)

SUBSECTION 738.4 RODENT SCREENS:

The rodent screens shall be constructed of 304 standard grade woven stainless steel cloth with openings approximately ½ inch by ½ inch square (2 x 2 per square inch) and wire size of a minimum of 0.08 inches diameter. The open area for the cloth shall be at least 60 percent. The cloth shall be ordered in sufficient size to cover the entire end of the pipe and wrap around the pipe to allow two pipe clamps to be installed to secure the cloth. Provide two stainless steel pipe / band clamps at least two inches apart from one another spacing. The clamps shall be screw or bolt-type so as to allow periodic removal / replacement of the rodent screen.

SUBSECTION 738.5 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 738.6 PAYMENT:

No payment will be made separately for geotextile sock or rodent screen over the end of the drain pipe. The Contractor shall receive payment in accordance with Section 605. Costs associated with procuring commerical materials are considered incidental to the work in Section 605.

END OF SECTION

SECTION 760 COATING CORRUGATED METAL PIPE MATERIALS

SUBSECTION 760.1 GENERAL:

Corrugated metal pipe, pipe arches, and connectors to be used or furnished under this specification shall be manufactured and inspected in conformance with the requirements of AASHTO M-36, and as hereinafter specified. The size, type, and wall thickness of the pipe to be furnished shall be as specified on the project plans or specifications.

Corrugated metal pipe shall be used to extend the outlets at each of the three locations to the dimensions shown on the plans.

Polymer coating shall be shop-applied and touched up in the field.

Standard universal coupling shall be used to join the existing pipe with the new pipe.

SUBSECTION 760.2 MATERIALS:

Corrugated metal products covered by this specification shall be poly coated galvanized conforming to the requirements of AASHTO M-36 as modified herein. The diameters required for this project are:

(A) Corrugated metal pipe shall be 24-inches diameter for the South outlet extension.
(B) Corrugated metal pipe shall be 48-inches diameter for the Central outlet extension.
(C) Corrugated metal pipe shall be 48-inches diameter for the North outlet extension.

Wall thickness of pipe at all three locations shall be .079 inches (14 gauge).

Coupling shall be universal type, bolted with neoprene gasket.

Coating shall be polymer system applied at a minimum 10 mils thickness per ASTM A742.

Gasket material shall be a standard neoprene, manufactured fit for the respective pipe diameter and coupling type.

SUBSECTION 760.3 BASE METAL, SPELTER AND FABRICATION:

Helically Corrugated Metal Pipe:

The nominal pipe diameter shall meet the tolerances of this specification. The pipe shall be fabricated from flat sheets in coils. The base metal, spelter coating, method of sampling, accepted brands of metal. sheet manufacturers certified analysis and guarantee, workmanship, marking, inspection and rejection, shall meet the requirements of AASHTO M-36. Structures furnished shall be either full circle, or pipe-arch in accordance with Table 4 of AASHTO M-36, or other shape as shown on the plans. The pipe dimensions shall conform to AASHTO M-36 in all respects, except that the corrugations shall be helical instead of annular. The thickness of the galvanized metal shall be in accordance with project plans or specifications as otherwise specified. Pipe with helical corrugations shall have a continuous lock or weld sewn extending from end to end of each length of pipe. The scams shall be fabricated in such a manner that they will not affect the shape or nominal diameter of the pipe and so that they will not create an element of weakness in the pipe.

SUBSECTION 760.4 COUPLING BANDS:

Watertight joints shall be fabricated for corrugated metal pipe by the use of galvanized couplers or connecting bands, bituminous coated where required, with each band overlapping by at least 2 inches. Corrugated coupling bands shall be constructed and connected as specified in AASHTO M-36, except as otherwise required herein. The couplers or bands shall be manufactured of material 2 gages lighter than the gage specified for the pipe material, shall have corrugations or dimples to match the pipe corrugations or end treatment or may be flat, and shall be fastened with

bolts. Dimpled coupling bands shall be 10½ inches wide for diameters 12 through 60 inches, and 17 inches wide for diameters above 60 through 96 inches. The 10½ inch wide bands shall have 2 rows of dimples of not less than 7 dimples per row, and the 17 inch wide bands shall have 4 rows of dimples of not less than 7 dimples per row. The dimple arrangements shall be such that a maximum spread can be attained. The shape of the dimple shall be such that it shall, in general conform to the standard pipe corrugation. The connecting angles for dimpled coupling bands may be riveted as for standard corrugated coupling bands, or may have slotted angles. The bands shall be attached by means of ½ inch nominal diameter carriage bolts. Two bolts are required for pipe up to 36 inches in diameter, 3 bolts for 36 through 60-inch diameters and 5 bolts for pipes above 60 inches in diameter. Plain flat coupling bands and spiral rib flange bands shall have the same width and number of bolts as specified above. Flat coupling bands having a single circumferential corrugation rolled in each edge to match a similar corrugation in the end of each pipe may be 10 1/2 inches wide regardless of pipe diameter And shall be fastened with 2 bolts.

When flanges are provided on the pipe ends, the coupling shall be made by interlocking the flanges with a preformed channel band or other band incorporating a locking channel not less than 3/4 inches in width. The depth of the channel shall be not less than 1/2 inch. The channel band shall have a minimum nominal thickness of 0.079 inches.

SUBSECTION 760.5 PERMISSIBLE VARIATIONS IN DIMENSION:

The internal diameter of 12 through 24-inch pipe shall not vary more than ±1.5 percent from the design diameter. The internal diameter of 27 through 108 inch shall not vary more than ±1 percent or 3/8 inch, whichever is greater from the design diameter.

SUBSECTION 760.6 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 760.7 PAYMENT:

No payment will be made separately for coating materials for corrugated metal pipe. The Contractor shall receive payment in accordance with Section 621. Costs associated with procuring commerical materials are considered incidental to the work in Section 621.

END OF SECTION

SECTION 790 PAINT MATERIALS

SUBSECTION 790.1 GENERAL:

Paint shall be homogeneous, free of contaminants, and of a consistency suitable for the intended use. Finished paint shall be well-ground and the pigment shall be properly dispersed in the vehicle according to the requirements of the paint; and this dispersion shall be of such nature that the pigment does not settle appreciably, does not cake or thicken in the container, or become granular or curdled. Paint and paint materials shall be delivered to the job site in new, unopened air-tight containers appropriately identified with the manufacturer's name, date of manufacture, type of paint or paint material, specifications paint number, and lot or batch number. The container shall have a formula label.

No paint shall be used until at least 7 days have elapsed from the date of manufacture. Paint containing lead shall comply with Subsection 107.5.2.

SUBSECTION 790.2 PROPRIETARY BRANDS:

For the purpose of this specification, proprietary brands of paint and paint materials shall be construed to mean paint or paint materials conforming to the requirements of this specification and produced for distribution and consumption through regular wholesale and retail outlets. Whenever paint or paint materials are designated on the plans or special provision by a manufacturer's name or catalog reference, any proprietary brand of equal quality will be permitted, subject to the approval of the Engineer. Information required by the Engineer as proof of the comparative quality shall be furnished by the Contractor.

SUBSECTION 790.3 PAINT COATS:

The first coat of paint applied to an unpainted surface shall be called the prime coat. The paint applied to field connections, welds, rivets, and all damaged or defectively painted or rusty areas on a prime coated surface shall be called a touch-up coat. The paint applied over the prime coat and touch-up coat shall be called the second coat. The final coat of paint shall be called the finish coat.

SUBSECTION 790.4 MATERIALS:

Materials shall conform in all respects to the requirements of references specifications indicated for such material.

Upon request of the Engineer, the Contractor shall furnish a certification from the manufacturer that the material conforms with this specification.

	Vehicles:	**Specifications:**
(A)	Raw Linseed Oil	ASTM D-234
	Boiled Linseed Oil	ASTM D-260
	Water-Resistant Spar Varnish	Navy Department Specification 52V20
	Alkyd Resin	TT-R-266C
	Driers	ASTM D-600, Class A or Class B, as applicable
	Thinners:	
	Xylene	TT-X-916B, Grade A
	Turpentine (shall be used in paints used for timber)	ASTM D- 13, Gum Spirits
	Petroleum Spirits (Mineral Spirits)	ASTM D-235

	Pigments	**Specifications:**
(B)	Carbonblack	TT-P-343 Form 1, Class B
	Lampblack	ASTM D-209
	Red Lead	ASTM D-83
	Titanium Dioxide, Non-extended	ASTM D-476, Type 11, Class II
	Titanium Dioxide, Extended	ASTM D-476

(Titanium Calcium, Rutile)	
Titanium Dioxide	TT-P422B, Type III, Class A
White Lead Basic Carbonate	ASTM D-81
Zinc Yellow (Zinc Chromate)	ASTM D478, Type II
Zinc Oxide	ASTM D-79
Iron Blue	TT-P-385
Iron Oxide, Yellow	TT-P-458A
Iron Oxide, Orange	ASTM D-3721, D-3722, D-3724
Hansa Yellow G	MIL-H-10330
Organic Green Gold	Dupont YT 562-D or equal, specific gravity 161 ±0.05
Chromium Oxide, Green Graphite	TT-P-347

Graphite shall be natural amorphous material (American product) which shall contain not less than 35 percent nor more than 45 percent graphite carbon. The remainder shall be insoluble siliceous material containing a total of not more than 5 percent calcium and magnesium carbonate and sulfate. The pigment shall be ground to such a fineness that not less than 97 percent shall pass a No. 325 sieve. The graphite paste shall be made by grinding the pigment in pure raw linseed oil in the following proportions:

Amphorus Graphite	68.0 percent
Linseed Oil	32.0 percent

(C) **Inert Materials:**	**Specifications:**
Diatomaceous Silica	ASTM D-604, Type A
Magnesium Silicate	ASTM D-605

SUBSECTION 790.5 MIXED PAINTS:

All mixed paints shall, in general, be machine-mixed and shall consist of the pigment of the required fineness and composition, ground to the desired paste consistency in pure raw or boiled linseed oil, to which shall be added the remainder of the vehicle to make paint conforming to the required formula as herein specified.

Paint, which has hardened and thickened in the container such that it cannot be readily broken up to a smooth uniform paint of good brushing consistency, shall not be used.

All materials used in mixed paints shall conform to the requirements as herein specified. The paint shall be made to satisfactory workable consistency conforming to one of the following formulas for paint as required on the plans or in the special provisions. All percentages shown are by weight.

Any of the following paints, which are too thick to have a satisfactory workable consistency, shall be thinned with a suitable thinner from the group of thinners herein specified. In no case shall gasoline be used as a thinner.

Fineness of grind for enamel shall conform to Hegman 7 minimum.

SUBSECTION 790.6 MEASUREMENT:

No measurement for payment is required for this section.

SUBSECTION 790.7 PAYMENT:

No payment will be made separately for painting materials. The Contractor shall receive payment in accordance with Section 530. Costs associated with procuring commerical materials are considered incidental to the work in Section 530.

END OF SECTION

APPENDIX H

SUPPLEMENTARY GENERAL CONDITIONS

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Registered Professional Engineer (Civil)
CERTIFICATE NO. 22867
ALEXANDER W. GOURLAY
Date Signed 8-3-01
ARIZONA, U.S.A.

SUPPLEMENTARY GENERAL CONDITIONS

CONTRACT FCD 2000C028

WHITE TANKS FLOOD RETARDING STRUCTURE #3 - INTERIM DAM SAFETY

PCN 470.04.30

The Supplementary General Conditions, while normally keyed to another document, for this project are a stand-alone document. This document provides the Contractor with Owner-specific requirements, interpretations of certain specifications, general project and contract requirements, and instructions for administering the contract.

These Supplementary General Conditions, have been written using the Uniform Standard Specifications and Details for Public Works Construction document that is sponsored and distributed by the Maricopa Association of Governments (MAG) as a template.

SUPPLEMENTARY GENERAL CONDITIONS
CONTRACT FCD 2000C028
WHITE TANKS FLOOD RETARDING STRUCTURE #3 - INTERIM DAM SAFETY

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT 2000C028

WHITE TANKS FRS#3
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PRECEDENCE OF CONTRACT DOCUMENTS

This Contract and its designated documents, whether taken separately or together, are to be interpreted according to full intent, meaning, and spirit, and shall be deemed to mutually explain each other and to be descriptive of any materials to be furnished and the work to be performed under this Contract. In cases of any difference or discrepancy between the Contract documents, the order of precedence shall be:

A) Addendum to the Invitation for Bids
B) Contract form
C) Supplementary General Conditions
D) Special Provisions
E) Project Plans
F) Contracting Agency's Supplements to Special Provisions
G) Contracting Agency's Supplements to Standard Specifications and Details

SECTION 101 ABBREVIATIONS AND DEFINITIONS

SUBSECTION 101.1 ABBREVIATIONS:

Wherever the following abbreviations are used in these specifications, standard details or on the plans, they are to be construed the same as the respective expressions represented.

AASHTO	American Association of State Highway and Transportation Officials
AAN	American Association of Nurserymen
AB	Aggregate base
Aban	Abandon
ABC	Aggregate base course
AC	Asphalt cement or concrete
ACB	Asphalt concrete base
ACI	American Concrete Institute
ACP	Asbestos cement pipe
ACPA	American Concrete Pipe Association
ACWS	Asphalt concrete wearing surface
AFRB	Arizona Fire Rating Bureau
AGC	Associated General Contractors of America, Ins.
Agg	Aggregate
ADOT	Arizona Department of Transportation
Ahd	Ahead
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
Approx	Approximate
APWA	American Public Works Association
AR	Aged residue
ARS	Arizona Revised Statutes
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
Asph	Asphalt
ASTM	American Society for Testing Materials
Ave	Avenue
AWPA	American Wood Preservers Association
AWSC	American Welding Society Code
AWWA	American Water Works Association
Bbl	Barrel
BC	Beginning of curve
BCR	Beginning of curb return
Beg	Beginning
Bk	Book or Back
Blvd	Boulevard
BM	Bench Mark or Board Measure
Brg	Bearing
BST	Bituminous Surface Treatment
BTB	Bituminous Treated Base
BTU	British Thermal Units
BVC	Beginning of vertical curve
C	Centigrade or Curb
CB	Catch Basin
CBF&C	Catch basin frame & cover
CC or C/C	Center to Center
CE	City or County Engineer
Cem	Cement
CF	Curb face
cfs	Cubic Feet per second
CIP	Cast Iron pipe
CIPP	Cast-in-place concrete pipe
CL or C	Centerline
Cm	Centimeter
CMP	Corrugated metal pipe
CO	Clean out
Col	Column
Conc	Concrete
Const	Construct
CP	Concrete pipe (non-reinforced)
CTB	Cement Treated Base
Cu	Cubic
Deg	Degree
DF	Douglas Fir
DG	Decomposed granite
Dia	Diameter
Dim	Dimension
DIP	Ductile Iron Pipe
Div	Division
Dr	Drive
Drwg	Drawing
Dwy	Driveway
Ea	Each
Ease	Easement
E	East
EC	End of curve
ECR	End of curb return
El or Elv	Elevation

Equa or Eq	Equation
EVC	End of vertical curve
Ex or Exist	Existing
F	Fahrenheit
FB	Field book
F & C	Frame & cover
FH	Fire hydrant
FL or F	Floor line or flow line
Fl El	Floor Elevation
Fnd	Found
fps	Feet per second
FS	Finished surface
FSS	Federal Specifications and Standards
Ft	Foot or feet
G	Gutter
Ga	Gage
Galv	Galvanized
GL	Ground line
gpm	Gallons per minute
Gr	Grade
H	High or height
HC	House connection
Hdwl	Headwall
Horiz	Horizontal
Hwy	Highway
ICA	Industrial Commission of Arizona
ID	Improvement District or inside diameter
IE	Invert Elevation
IEEE	Institute of Electrical and Electronic Engineers
In	Inch
Inv	Invert
IP	Iron Pipe
IPS	Iron Pipe Size
Irrig	Irrigation
Jt	Joint
JC	Junction Chamber
Jct	Junction
JS	Junction Structure
L	Length
Lb	Pound
L&T	Lead and tack
LD	Local depression
LF	Linear Feet
LH	Lamp hole
Lin	Linear
Long	Longitudinal
Lt	Left
M	Map or maps
MAG	Maricopa Association of Governments
Max	Maximum
MCR	Maricopa County Records
Meas	Measured
MH	Manhole
MHF&C	Manhole frame and cover
Min	Minutes or minimum
Misc	Miscellaneous
ML or M	Monument line
mm	Millimeter
Mon	Monolithic or monument
MTD	Multiple tile duct
N	North
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NE	Northeast
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NP	Non-plastic
NPI	Non pay item
NSC	National Safety Council
NSF	National Sanitation Foundation
NW	Northwest
No	Number
OC	On center
OD	Outside diameter
Oz	Ounces
P.C	Point of curvature
PCC	Point of compound curve or Portland Cement Concrete
PI	Point of intersection or plastic index
PL	Property line
POC	Point of Curve
POS	Point of Spiral
PP	Power pole
ppm	Parts per million
PRC	Point of reverse curve
Prod	Produced
Prop	Proposed or property
psi	Pounds per square inch
psf	Pounds per square foot
PT or POT	Point of Tangent
P&TP	Power and telephone pole
Pvmt	Pavement
Q	Rate of flow

R	Radius
RC	Reinforced concrete
RCP	Reinforced concrete pipe
Rd	Road
Rdwy	Roadway
Reinf	Reinforced, Reinforcing
Ret Wall	Retaining Wall
RGRCP Pipe	Rubber Gasket Reinforced Concrete
rpm	Revolutions Per Minute
Rt	Right
R/W	Right-of-way
S	South or slope
SAE	Society of Automotive Engineers
San	Sanitary
SC	Spiral to Curve
SCCP	Steel cylinder concrete pipe
SD	Storm drain or Sewer District
Sdl	Saddle
Sec	Seconds
Sect	Section
SE	Southeast
Sht	Sheet
Spec	Specifications
SPR	Simplified Practice Recommendation
Sp MH	Special manhole
Sq Ft Yd	Square Foot, Yard
SS	Sanitary sewer
St	Street
Sta	Station
Std	Standard
Str gr	Structural grade
Struct	Structure or structural
SW	Southwest
SWPPP	Storm Water Pollution Prevention Plan
T	Tangent Distance
TCE	Temporary Construction Encasement
Tel	Telephone
Temp	Temporary
TH	Test hole
TP	Telephone pole
Tr	Tract
Trans	Transition
TS	Traffic signal or Tangent to spiral
TSC	Traffic signal conduit
Typ	Typical
UL	Underwriters' Laboratories Inc.
USC & GS	United States Coast and Geodetic Survey
USGS	United States Geological Survey
V	Velocity of flow
VC	Vertical curve
VCP	Vitrified clay pipe
Vert	Vertical
W	West or width
WI	Wrought iron
WS	Wearing surface
Wt	Weight
Yd	Yard
'	feet or minutes
"	inches or seconds
°	degrees
%	percent
#	number or pound
@	at
/	per
=	equals

SUBSECTION 101.2 DEFINITIONS AND TERMS:

Whenever in these specifications or in other contract documents the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:

Addendum: A supplement to any of the Contract Documents issued, in writing, after advertisement of but prior to the opening of bids for a contract.

Advertisement: The public announcement, as required by law, inviting bids for work to be performed or materials to be furnished.

Agency: The governmental agency for which the construction is being done, either by permit or contract.

Architect: The individual or firm who has accomplished the architectural services for the project, including his representatives.

Award: The formal action of the governing body is accepting a proposal.

Backfill: Material placed in an excavated space to fill such space. For trenches, this space will be the area from 1 foot above the top of the pipe or conduit to the existing or proposed finished grade of pavement.

Base Course: The upper course of the granular base of a pavement or the lower course of an asphalt concrete pavement structure.

Bedding: Is the material placed in the area from the bottom of the trench to 1 foot above the top of the pipe or conduit.

Bidder: Any qualified individual, firm, partnership, corporation or combination thereof, acting directly or through a duly authorized representative who legally submits a proposal for the advertised work.

Board of Supervisors: The Board of Directors acting under the authority of the laws of the State of Arizona and in their capacity of the Board of Directors of the Flood Control District of Maricopa County.

Bond Issue Project: A project financed from bonds issued by the City or County pledging credit or a revenue resource.

Bridge: A structure, including supports, erected over a depression or an obstruction, as water, highway, or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than 20 feet between undercopings of abutments or extreme ends of openings for multiple boxes.

(Length) The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

(Roadway Width) The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom or curbs or guard timbers or in the case of multiple height of curbs, between the bottom of the lower risers.

Budget Project: A project financed by funds from General Tax levies and shared revenue funds set aside in the annual budget adopted by the Council or Board of Supervisors.

Building: Any structure built for the support, shelter, or enclosure of persons, animals, chattel or movable property.

Building Code: A regulation adopted by the governing body establishing minimum standards of construction for the protection of the public health, safety, and welfare in terms of measured performance rather than in terms of rigid specification of materials and methods.

Calendar Day: Everyday shown on the calendar.

Call for Bids: The standard forms inviting proposals or bids.

Careful and prudent manner: conducting excavation in such a way that when it approaches within twenty-four inches of the underground facility located and marked by the owner or operator, by stakes, paint or in some customary manner, the exact location is manually determined, and the uncovered facility is supported and protected.

Change Order: A written order issued by the Engineer to the Contractor to make changes in the work or to perform extra work, and setting forth conditions for payment and/or adjustment in time of completion.

City: A municipal corporation, organized and existing under and by virtue of the laws of the State of Arizona.

City/County Clerk: The duly authorized person who performs the duties of clerk for the Contracting Agency.

Completion Time: The number of calendar days for completion of an act, including authorized time extensions. In case a calendar date of completion is shown in the proposal in lieu of the number of calendar days, the contract shall be completed by that date. The time within which an act is to be done shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.

Conflicting Utility: An existing utility, shown or not shown on the plans is conflicting when any part of the utility falls within the dimensions of the new installation, such that it would be in physical contact with the new installation.

Construction Project: The erection, installation, remodeling, alteration, of durable facilities upon, under, or over the ground. This shall include, but is not limited to buildings, roadways and utility pipes, lines, poles or other structures.

Contingent Bid Item: This is a minor bid item which is likely, but not certain, to occur during the course of work. If the Engineer determines that this work is required, the Contractor will accomplish the work and payment will be made based on the contingent unit bid price included in the proposal. Since the quantity listed in the proposal is primarily for bid comparison, the amount of work required by the Engineer may vary materially from this.

Contract: The written instrument executed by the Contractor and the Contracting Agency by which the Contractor is bound to furnish all labor, equipment, and materials and to perform the work specified, and by which the Contracting Agency is obligated to compensate the Contractor therefor at the prices set forth therein. The Contract Documents are herewith by reference made a part of the contract as if fully set forth therein.

Contract Documents: All the integral documents of the contract, including but not limited to, Call for Bids, Plans, Standard Specifications and Details, Supplementary General Conditions, Special Provisions, Proposal, Addenda, Performance Bond, Payment Bond, Certificates of Insurance, Ordinance, Contract, and Change Orders.

Contracting Agency: The Flood Control District of Maricopa County (District) entity that will contracted for the performance of the work and for whom the work is being performed.

Contractor: The individual, firm, partnership, corporation or combination thereof entering into a contract with the Contracting Agency to perform the advertised work.

Council: The City Council which by law constitutes the Legislative Department of the City.

County: Maricopa County, organized and existing under and by virtue of the laws of the State of Arizona.

Culvert: Any structure not classified as a bridge, which provides an opening under or adjacent to the roadway.

Days: Unless otherwise designated, days will be understood to mean calendar days.

District : The Flood Control District of Maricopa County, also referred to as Engineer.

Emergency: Unforeseen occurrences and combinations of circumstances involving the public welfare or the protection of work already done under the Contract Documents, or which endanger life or property and call for immediate action or remedy.

Engineer: The person appointed by the Flood Control District of Maricopa County Board of Directors to the office of Chief Engineer and General Manager of the Flood Control District of Maricopa County acting directly or through its authorized representative, the Chief of the Flood Control District of Maricopa County Planning and Project Management Division.

Engineer of Record: The independent engineering and design firm reponsible for the investigation, and preparation of contract drawings, special provisions, supplementary general conditions, and construction quality assurance plan under the direction of a Professional Engineer registered in the State of Arizona.

Equipment: (Construction) - All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) - All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.

Extra Work: An item of work not provided for in the contract as awarded but found essential to the satisfactory completion of the contract within its intended scope.

Flooding: Flooding will consist of the inundation of the entire lift with water, puddled with poles or bars to insure saturation of the entire lift.

Force Account Work: Work done by personnel of the Contracting Agency as in-house work.

Foundation: For buildings or structures, this will be the substructure. For pipe this will be the native material or prepared material on which the pipe rests; normally, this is the bottom grade line of the trench.

Full Depth Pavement: An asphalt concrete pavement structure in which the granular base and subbase are replaced by proportionate thickness of asphalt concrete.

General Conditions: This document which spells out the contract conditions by defining the duties and responsibilities of those who are signatory to the contract, namely the Owner and Contractor, as well as the duties and responsibilities of those affected by the Contract including subcontractors.

Improvement District Project: A project financed by assessments against the property included in a special assessment district authorized under, or implemented by an act of the legislature of the State and/or a procedural ordinance of the City or County.

Inspector: The Engineer's authorized representative assigned to make detailed inspections of contract performance.

Jetting: Jetting is the densification of material, using a continuous supply of water, under pressure, transmitted to the material through a rigid pipe of sufficient length to reach the bottom of the lift being densified. In all cases, the entire lift will be completely saturated working from the top to the bottom.

Laboratory: The established materials testing laboratory of the Contracting Agency's Engineering Department, or other laboratories acceptable to and/or authorized by the Engineer to test materials and work involved in the Contract.

Major Item: A major item shall be the total of any item of work and/or materials specified in the bid schedule that exceeds the amount established in Table 109-1.

Maricopa County Minority and Women-Owned Small Business Enterprise Program: The Program adopted by the Board of Supervisors effective January 1, 1992.

Materials: Any substance specified in the project, equipment and other material used or consumed in the performance of the work.

Median: The portion of a divided highway separating the roadways used by traffic going in opposite directions.

Non Pay Item: An item of work for which no separate payment will be made under the proposal, but which must be included as an incidental cost for payment on an associated item included in the proposal.

Notice of Award: A letter from the City or County Clerk advising the Contractor that he is the successful bidder and the Council or Board of Supervisors has accepted his proposal.

Notice of Award: A letter from the Flood Control District of Maricopa County advising Contractor that it is the successful bidder and the Flood Control District of Maricopa County has accepted its proposal.

Notice to Proceed: A directive issued by the Engineer, authorizing the Contractor to start the work or improvements required in the Contract.

Obligee: One to whom another is obligated.

Open Trench: The excavated area shall be considered as open trench until all the aggregate base course for pavement replacement has been placed and compacted or, if outside of a pavement area, until the excavated area is brought to finish grade or natural grade.

Owner: The Flood Control District of Maricopa County (District), acting through its legally constituted officials, officers or employees.

Pavement: Any surfacing of streets, alleys, sidewalks, courts, driveways, etc., consisting of mineral aggregate bound into a rigid or semi-rigid mass by a suitable binder such as, but not limited to, portland cement or asphalt cement.

Pavement Structure: The combination of subbase, base course, and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

Pay Item: A detail of work for which separate payments are to be made under the Contract, as specified in the proposal.

Payment Bond: The security provided by the Contractor solely for the protection of claimants, supplying labor and materials to the Contractor or his Subcontractors.

Performance Bond: The security provided by the Contractor solely for the protection of the Contracting Agency and conditioned upon the faithful performance of the contract in accordance with the plans, specifications and conditions thereof.

Permit: The license to do construction in public rights-of-way and/or easements; issued by an Agency to a Contractor working for another party.

Plans: All approved drawings or reproductions thereof pertaining to the work and details therefor, which are made a part of the Contract Documents.

Plant: The Contractor's and/or subcontractor's facilities, including but not limited to small tools and mobile equipment, located on and/or offsite, necessary for preparation of materials and prosecution of work for the project.

Principal: The individual, firm or corporation primarily liable on an obligation, as distinguished from a surety.

Profile Grade: The trace of a vertical plan intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

Project: A specific coordinated construction or similar undertaking identified by a single project number and bid and awarded as one contract. On occasion two or more projects may be bid and awarded as a single contract.

Proposal: The offer of a bidder on the prescribed form, to perform the work and to furnish the labor and materials at the prices quoted.

Proposal Form: The approved form on which the Contracting Agency requires bids to be prepared and submitted for the work.

Proposal Guarantee: The security furnished with a bid to guarantee that the bidder will enter into the contract if his bid is accepted.

Proposal Pamphlet: The book or pamphlet pertaining to a specific project, containing proposal forms, special provisions and other information necessary for and pertinent to the preparation of the proposal or bid.

Referred Documents: On all work authorized by the Contracting Agency, any referenced documents in the specification, i.e., Bulletins, Standards, Rules, Methods of Analysis or test. Codes and Specifications of other Agencies, Engineering Societies or Industrial Associations, refer to the Latest Edition thereof, including Amendments, which are in effect and published at the time of Advertising for Bids or the issuing of a permit for the work, unless otherwise stated.

Right-of-way: A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to a street, highway, or other public improvement.

Road: A general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way.

Roadside: A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

Roadside Development: Those items necessary to the complete roadway which provide for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the roadway.

Roadway: The portion of the right-of-way intended primarily for vehicular traffic, and including all appurtenant structures and other features necessary for proper drainage and protection. Where curbs exist, it is that portion of roadway between the faces of the curbs.

Sewers: Conduits and related appurtenances employed to collect and carry off water and waste matter to a suitable point of final discharge.

Shop Drawings: Drawings or reproduction of drawings, detailing; fabrication and erection of structural elements, falsework and forming for structures, fabrication of reinforcing steel, installed equipment and installation of systems, or any other supplementary plans or similar data, which the Contractor is required to submit for approval.

Shoulder: The portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

Sidewalk: That portion of the roadway primarily constructed for the use of pedestrians.

Special Provisions: The special conditions, requirements, additions, and/or revisions to the Standard Specifications, applicable to the work, to cover conditions or requirements peculiar to the project under consideration. However, for this project the special provisions are stand-alone and represent the specifications for construction.

Specifications: The descriptions, directions, provisions, and requirement for performing the work as contained in the Contract Documents.

Standard Details: Uniform detail drawings of structures or devices adopted as Standard Details by the Engineer.

Standard Specifications: Uniform general specifications adopted as Standard Specifications by the Engineer.

Storm Drain: Any conduit and appurtenance intended for the reception and transfer of storm water.

Street: Streets, avenues, alleys, highways, crossings, lanes, intersections, courts, places, and grounds now open or dedicated or hereafter opened or dedicated to public use and public ways.

Structures: Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, sewers, service pipes underdrains foundation drains, fences, swimming pools, and other features which may be encountered in the work and not otherwise classed herein.

Subbase: The lower course of the base of a roadway, immediately above the subgrade.

Subcontractors: Those having direct contracts with the Contractor and those who furnish material worked into a special design according to the Plans and Specifications for the work, but not those who merely furnish material not so worked.

Subgrade: The supporting structures on which the pavement and its special undercourses rest.

Substructure: All of that part of the structure or building below the bearings of simple and continuous spans, skewbacks of arches and tops of footings of rigid frames, together with the backwalls, wingwalls and wing protection railings.

Superintendent: The Contractor's authorized representative in responsible charge of the work.

Superintendent of Streets: The person duly appointed by the Council of the Contracting Agency, as provided by Sections 9-601 and 11-701 of the Arizona Revised Statutes.

Superstructure: The entire structure or building except the substructure.

Supplemental Specifications: Additions and revisions to the Standard Specifications that are adopted subsequent to issuance of the printed book.

Supplementary General Conditions: Requirements, or revisions, to the Standard General Conditions, applicable to the work, and to cover conditions or requirements peculiar to the project under consideration. However, for this project the supplementary General Conditions are stand-alone and represent the standard general conditions for the project.

Surety: The individual, firm or corporation, bound with and for the Contractor for the acceptable performance, execution, and completion of the work, and for the satisfaction of all obligations incurred.

Surface Course: The finished or wearing course of an asphalt concrete pavement structure.

Title or Headings: The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

Township, City, Town or District: A subdivision of the County used to designate or identify the location of the proposed work.

Traveled Way: The portion of the roadway for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

Underground Facility: any item which shall be buried or placed below ground for use in connection with the storage or conveyance of water, sewage, electronic, telephone or telegraphic communications, electric energy, oil, gas or other substances, and shall include, but not be limited to pipes, sewers, conduits, cables, valves, lines, wires, manholes, attachments and those portions of poles and their attachments below ground.

Utility: Pipe lines, conduits, ducts, transmission lines, overhead or underground wires, railroads, storm drains, sanitary sewers, irrigation facilities, street lighting, traffic signals, and fire alarm systems, and appurtenances of public utilities and those of private industry, businesses or individuals solely for their own use or use of their customers which are operated or maintained in, on, under, over or across public right-of-way or public or private easement.

Waterworks (Water Supply System): The reservoirs, pipe lines, wells, pumping equipment, purification works, mains, service pipes, and all related appliances and appurtenances utilized in the procurement, transportation and delivery of an adequate, safe, and palatable water supply for the Contracting Agency.

Work: Any or all of the improvements mentioned and authorized to be made, and the construction, demolition, reconstruction, and repair of all or any portion of such improvements, and all labor, services, incidental expenses, and material necessary or incidental thereto.

Working Day: A calendar day, exclusive of Saturdays, Sundays, and Contracting Agency recognized legal holidays, on which weather and other conditions not under the control of the Contractor will permit construction operations to proceed for the major part of the day with the normal working force engaged in performing the controlling item or items of work which would be in progress at that time.

SUBSECTION 101.3 EXPRESSIONS IN GENERAL CONDITIONS:

In order to avoid cumbersome and confusing repetition of expressions in these specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where contemplated required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected, or condemned, it shall be understood as if the expression were followed by the words by the Engineer or to the Engineer.

End of Section

SECTION 102 BIDDING REQUIREMENTS AND CONDITIONS

SUBSECTION 102.1 ELIGIBILITY AND PREFERENCE:

The employment of Contractors and Subcontractors shall be governed by the provisions of the District.

SUBSECTION 102.2 CONTENTS OF PROPOSAL PAMPHLET:

The prospective bidder may examine and/or purchase plans, special provisions, and proposal pamphlets at the Engineering Office of the Contracting Agency advertising for bids.

The proposal pamphlet will state the location of the contemplated construction; give the description of the various quantities of work to be performed or materials to be furnished, and have a bid schedule of pay items for which unit bid prices are invited. In addition, it will state the form and amount of the proposal guarantee, the time in which the work shall be completed and include additional instructions not included in these specifications.

The plans, the special provisions, the contracting agency's supplements and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work.

Each and every provision of law and clause required by law to be inserted in the contract shall be deemed to be inserted herein, and the contract shall be read and enforced as though it were included herein.

SUBSECTION 102.3 INTERPRETATION OF QUANTITIES IN PROPOSAL:

The quantities appearing in the proposal are approximate only and are to be used for the comparison of bids. Payment to the Contractor will be made only for the actual quantities of work performed and accepted or materials furnished in accordance with the contract at the unit bid price in the proposal.

After the contract is awarded the quantities of work listed by any pay item, or all pay items, may be increased or decreased a reasonable amount at the discretion of the Contracting Agency, without in any way invalidating the unit bid price.

SUBSECTION 102.4 EXAMINATION OF PLANS, SPECIAL PROVISIONS AND SITE OF WORK:

The following is available for review at the District, and Contractors are encouraged to do so:

A) Contract Form
B) Bid Schedule
C) Plans for the White Tanks FRS #3 Interim Dam Safety Improvements
D) Special Provisions
E) Supplementary General Conditions

F) Raw Survey Data Collected for Design
G) Results of Soil Materials Testing for Design
H) Logs of Soil Borings and Test Pits Conducted at the Site for Design

The Contracting Agency will prepare plans and special provisions in accordance with acceptable engineering standards, giving such direction as will enable any competent Contractor to carry them out.

The bidder shall examine the site of the proposed work and all documents pertaining to the work. It is mutually agreed that the submission of a proposal shall be considered prima facie evidence that the bidder has made such examination and is familiar with the character, quality and quantity of the work to be performed and material to be furnished.

Logs of the test holes, ground water levels, and any accompanying soil reports as furnished by the Contracting Agency are furnished for general information only. The field condition so set forth shall not constitute a representation or warranty, expressed or implied, that such conditions are actually existent. Bidders shall make their own investigations and form their own estimates of the site conditions.

Existing moisture conditions shall be no basis for claim for additional money or time extensions. The Contractor shall manipulate the existing soil as required to achieve stable soil conditions and the required densities, as well as safe and stable side slopes during construction activities.

After the submission of the proposal, no complaint or claim that there was any misunderstanding as to the quantities, conditions or nature of the work will be entertained.

SUBSECTION 102.5 PREPARATION OF BID:

Bids, including the Bidding Schedule, must be legibly written in ink or typed, with all prices given in numerals. In case of a conflict between the unit bid price and the extension, the unit bid price will govern.

It shall be the responsibility of prospective bidders to determine, prior to submission of a bid, if any addenda have been issued by the Flood Control District. This may be accomplished by calling 602-506-1501. Any addendum issued, if not already bound into the Special Provisions **shall be attached and included as part of the Specifications** and any quantities on the Bidding Schedule requiring change shall be adjusted to the new figure by pen and ink. **Bids which do not have appropriate addenda attached, show appropriate changes to the Bidding Schedule, and acknowledge receipt of addenda in the Proposal may be invalid.**

The bidder's Arizona State Contractor's License number and the classification under which it proposes to perform the work shall be shown on the proposal. An **"A" General Engineering** License is required for this contract. The two lowest bidders may be required to provide certification of prior satisfactory completion for similar construction and to furnish a copy of their license and the renewal certificate.

The bidder shall submit his proposal on the forms obtained from the Contracting Agency. The bidder shall specify a unit bid price and extension in words, figures or both, whichever is required, for each pay item where units and approximate quantities are given.

Allowances as shown on the Bid Schedule shall cover the cost to the Contractor, and if applicable, delivered to the site, unloaded and handled on the site, labor, and installation costs. The Contractor's taxes, bonds, insurance, overhead, profit, and other expenses contemplated for the original Allowance amount shall be included in the Base Bid, and not in the Allowance. Whenever the costs are more than or less than the Allowance, the Contract Sum shall be adjusted accordingly by Change Order, the amount of which will recognize proportionate changes, if any, in handling costs on the site, labor, installation costs, taxes, bonds, insurance, overhead, profit, and other expenses. Contractor's monthly Application for Payment shall include supporting documentation of Allowance funds.

The proposal total will be obtained by adding the extension amount or lump sum indicated for the individual pay items. If there is a conflict between words and figures, the words shall apply. If there is a conflict between the unit bid price and the extension for a particular pay item, the unit bid price shall govern. In either case, the Contracting Agency shall correct the discrepancy in accordance with the above procedure and the corrected proposal total will apply.

In addition, the following shall be completed by the bidder on the proposal:

(A) Acknowledge receipt of and agree that the proposal is based on the listed Addenda received with and/or after receipt of the proposal pamphlet.

(B) Note the bidders Arizona State Contractor's License number and classification.

(C) Signatures in ink and attested or witnessed as applicable.

SUBSECTION 102.6 SUBCONTRACTORS' LIST:

The List of Subcontractors' form will be attached to the proposal pamphlet. The bidder shall submit this form with his proposal, in a separate sealed envelope, listing the firm name and business address of each specialty subcontractor to whom he proposes to subcontract any portion of the work. Only one name shall be listed for each category. A list of subcontractors and suppliers (including any M/WBE participation) intended to be used on the project shall be submitted with the bid, on the form provided in the Proposal. Although this list will not be considered as final commitment on the part of the successful proposer, any subcontractor changes from those listed must have Owners written approval prior to work performed on site by a subcontractor.

The bidder may list himself to perform one or more of the listed categories of work for which he has any requisite State licenses when required.

SUBSECTION 102.7 IRREGULAR PROPOSALS:

Proposals will be considered irregular and may be rejected for the following reasons:

(A) If the proposal is on a form other than that furnished by the Contracting Agency; or if the form is altered or any part thereof is detached.

(B) If there are unauthorized additions, statements, conditional or alternate bids, or irregularities of any kind.

(C) If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.

(D) If the proposal does not contain a unit price for each pay item listed except in the case of authorized alternate pay items.

(E) If, when required, the bidder fails to accomplish and submit the List of Subcontractors' form

(F) If the Maricopa County Minority and Women-Owned Small Business Enterprises Assurances Affidavit is not completed and submitted.

(G) If any addenda are not acknowledged and attached.

(H) If the Owner's bond forms are not utilized.

(I) If the entire specifications document is not returned.

(J) If the statement from bidder's insurance carrier as required by Subsection 103.6 is not included.

SUBSECTION 102.8 PROPOSAL GUARANTEE:

No proposal will be read unless accompanied by a proposal guarantee in the proper amount and in the form provided in the proposal pamphlet. The guarantee shall be made payable and acceptable to the Contracting Agency as a guarantee that the bidder, if awarded the contract, will execute the contract documents and furnish the required bonds and certificates of insurance to be forfeited if the Contractor fails or refuses to enter into a contract as required by the bid documents. The proposal guarantee shall be in the form of a certified check, cashiers check, or surety bond for ten percent of the amount of the bid. The surety bond shall be executed solely by a surety company or companies holding a certificate of authority to transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The surety bond shall not be executed by an individual surety or sureties. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Guide, published by the A.M. Best Company, Inc.

SUBSECTION 102.9 SUBMISSION OF PROPOSAL:

The proposal and proposal guarantee shall be submitted in a sealed envelope. The outside, lower right-hand corner of which shall be marked as follows:

Bid of [NAME OF CONTRACTOR], Contractor **For INTERIM DAM SAFETY PROJECT PCN 470.04.30** **Construction Contract FCD 2000C028**

Envelopes shall be mailed or delivered to the office of the Contracting Agency, and must be received before the time and date specified in the Call for Bids or any Addenda.

Proposals received after the time and date specified will be returned, unopened, to the bidder.

SUBSECTION 102.10 WITHDRAWAL OR REVISION OF PROPOSAL:

Any bidder may withdraw or revise a proposal after it has been deposited with the Contracting Agency, provided his request is received by the Contracting Agency, in writing or by telegram, before the time specified for opening proposals or as stipulated herein.

SUBSECTION 102.11 PUBLIC OPENING OF PROPOSALS:

Proposals will be opened and read publicly at the time and place specified in the Call for Bids or any Addenda. Bidders, their authorized agents and other interested parties are invited to be present.

When proposals for more than one project are to be opened at the same time, any bidder may, after the time set for the opening proposals, request to withdraw his second or succeeding proposal prior to the opening of proposals for that project. Should this occur, there will be a brief delay in the opening of proposals to permit the bidder to submit his request. Upon receipt of the bidder's written request, by the Contracting Agency, his proposal will be returned unopened.

SUBSECTION 102.12 DISQUALIFICATION OF BIDDERS:

Either of the following reasons may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal:

(A) Receipt of more than one proposal for the same work from an individual, partnership or corporation under the same or different names.

(B) Evidence of collusion among bidders or assistance from any officer of the Contracting Agency, or of any Department thereof.

SUBSECTION 102.13 SUCCESSFUL BIDDERS:

Unless otherwise specified in the proposal pamphlet, the successful bidder may obtain 7 sets of plans and special provisions, for the project from the Contracting Agency, at no cost.

End of Section

SECTION 103 AWARD AND EXECUTION OF CONTRACT

SUBSECTION 103.1 CONSIDERATION OF PROPOSALS:

After the proposals, for the contemplated work, have been opened and read as provided in these specifications, the respective totals will be checked and compared by the Contracting Agency. The basis of comparison will be to verify the accuracy of the total proposal by checking the extensions and additions. In the event of a discrepancy, in the amount bid for a pay item, the unit bid price will govern unless obviously in error. The results of such comparison will be considered public information.

The right is reserved to award the contract to the lowest and/or best responsible bidder, or to reject all proposals and to readvertise for any reason the Contracting Agency determines.

In case all proposals are rejected, any subsequent changes, additions, addenda, or new sets of plans and special provisions will be provided to all purchasers of the first issue of the plans and special provisions at no additional charge, except that out-of-town bidders will pay shipping charges.

SUBSECTION 103.2 RETURN OF PROPOSAL GUARANTEE:

All proposal guarantees, except those of: the two lowest responsible bidders on Bond Issue and Budget Projects; the lowest responsible bidder or the lowest responsible bidders of alternative plans and specifications on Improvement District Projects, will be returned immediately following the opening and checking of proposals. The retained proposal guarantee or guarantees will be returned immediately after the contract documents have been executed by all parties.

SUBSECTION 103.3 AWARD OF CONTRACT:

The Contracting Agency, through its duly authorized body or agent will award the contract to the lowest and/or best responsible bidder, or all proposals will be rejected, as soon as practicable after the date of opening proposals.

No proposal shall be withdrawn for a period of 50 days after opening without consent of the Contracting Agency through the body or agent duly authorized to accept or reject the proposal except that in the case of Federally-assisted projects, or other projects award of which is conditioned on the approval of an agency not under the control of the Contracting Agency, withdrawal shall be made within a period of 50 days after opening without such consent.

If written notice of the acceptance of a proposal is delivered to the successful bidder within the times noted above, or at any time thereafter before such proposal has been withdrawn, the bidder shall execute and deliver a contract in the prescribed form, within 10 days after receipt of such notice or his proposal guarantee shall be forfeited as provided elsewhere herein. Concurrently with the contract, the Contractor shall submit all documentation required to enable the agency to execute the contract.

The successful bidder will be furnished a Notice of Award on:

(A) Bond Issue or Budget Projects by letter, to the address shown on the proposal.

(B) Improvement District Projects by publication in accordance with the requirements of ARS, Section 9-681.

SUBSECTION 103.4 CANCELLATION OF AWARD:

The Contracting Agency reserves the right to cancel the award of any contract at any time before the execution of said contract by all parties, without any liability against the Contracting Agency.

SUBSECTION 103.5 REQUIREMENT OF CONTRACT BONDS:

Concurrently with the submittal of the contract, the Contractor shall furnish the Contracting Agency the following bonds, which shall become binding upon the award of the contract to the Contractor.

(A) A Performance Bond in an amount equal to the full contract amount conditioned upon the faithful performance of the contract in accordance with plans, specifications and conditions thereof. Such bond shall be solely for the protection of the Contracting Agency awarding the contract.

(B) A Payment Bond in an amount equal to the full contract amount solely for the protection of claimants supplying labor or materials to the Contractor or his Subcontractors in the prosecution of the work provided for in such contract.

Each such bond shall include a provision allowing the prevailing party in a suit on such bond to recover as a part of his judgement such reasonable attorney's fees as may be fixed by a judge of the court.

Each such bond shall be executed by a surety company or companies holding a certificate of authority to transact surety business in the State of Arizona issued by the Director of the Department of Insurance. The bonds shall not be executed by an individual surety or sureties. The bonds shall be made payable and acceptable to the Contracting Agency. The bonds shall be written or countersigned by an authorized representative of the surety who is either a resident of the State of Arizona or whose principal office is maintained in this State, as by law required, and the bonds shall have attached thereto a certified copy of Power of Attorney of the signing official. In addition, said company or companies shall be rated "Best A-" or better as required by the Contracting Agency, as currently listed in the most recent Best Key Rating Guide, published by the A.M. Best Company.

SUBSECTION 103.6 CONTRACTOR'S INSURANCE:

A statement from the bidder's insurance carrier shall be included in the proposal certifying that it will furnish the specified kind and amounts of insurance to the bidder if it is awarded the contract. As required by law, the statement will be from an insurance carrier or carriers authorized to do business in the State of Arizona, or countersigned by an agent of the carrier authorized to do business in the State of Arizona. Concurrently with the execution of the contract, Contractor shall furnish a Certificate of Insurance, using the included Certificate, that names the additional insureds as set out in the Certificate. The Certificate shall also name the additional insureds as Certificate Holders. The types of insurance and the limits of liability shall be as indicated on the included form.

SUBSECTION 103.6.1 General: The Contractor shall agree to carry all insurance which may be required by Federal and State Laws, County and City Ordinances, Regulations and Codes. Neither the Contractor nor any subcontractor shall commence work under a contract until the Contracting Agency has approved the insurance. The entire project covered by the contract will be at the Contractor's risk until final acceptance by the Contracting Agency. The Contractor will include the additional insureds as indicated on the included Certificate of Insurance form.

SUBSECTION 103.6.2 INDEMNIFICATION OF THE CONTRACTING AGENCY AGAINST LIABILITY: The Contractor shall execute the indemnification found in the contract documents.

SUBSECTION 103.7 EXECUTION AND APPROVAL OF CONTRACT:

The Contractor shall execute the contract with the Contracting Agency as follows:

(A) Bond Issue or Budget Projects within 10 calendar days after the date of Notice of Award of contract from the Contracting Agency.

(B) Improvement District Projects, not less than 15 or more than 20 calendar days after the date of the first publication of Notice of Award, if no objections have been filed.

The Contracting Agency will approve and execute the contract within ten (10) calendar days following receipt of signed contract and acceptable bonds and certificates of insurance.

No contract shall be considered in effect until it has been fully executed by all parties concerned.

Information relative to the execution of contract documents may be obtained from the Engineering Office of the Contracting Agency advertising for bids.

SUBSECTION 103.8 FORFEITURE OF PROPOSAL GUARANTEES:

If the Contractor fails or refuses to enter into the contract, within the time stated, then the Contracting Agency may declare a forfeiture of his proposal guarantee as liquidated damages for failure to enter into the contract.

End of Section

SECTION 104 SCOPE OF WORK

SUBSECTION 104.1 WORK TO BE DONE:

SUBSECTION 104.1.1 GENERAL: The Contractor shall perform all work as may be necessary to complete the contract in a satisfactory and acceptable manner in full compliance with the plans, specifications and terms of the contract. Unless otherwise specified in the special provisions, the Contractor shall furnish all labor, materials, equipment, transportation, utilities, services and facilities required to perform all work for the construction of the project within the time specified.

The proposed work is located in unincorporated Maricopa County. The site is approximately 40 miles west of Phoenix and can be reached by proceeding west on Northern Avenue. The northern gate to the site is located on Northern Avenue west of Beardsley Canal. The proposed work consists primarily of constructing diaphragm filters on the three dam outlets and excavating a channel in the emergency spillway.

The average elevation of the project is 1200 feet.

All water for construction purposes, drinking water, temporary electric power, heat and telephone service shall be arranged and provided for as per requirements of the work by Contractor at his expense.

SUBSECTION 104.1.2 MAINTENANCE OF TRAFFIC: The Contractor's operations shall be in accordance with the traffic manual and/or policies of the appropriate public agency having jurisdiction over the project and Section 401. These operations shall cause no unnecessary inconvenience to the public and public access rights shall be considered at all times. Unless otherwise authorized in the specifications or on a temporary basis by the Engineer, traffic shall be permitted to pass through the work area. The Contractor shall coordinate with the various agencies both commercial and public, involved in the collection and removal of trash and garbage, so that adequate services are maintained.

Safe and adequate pedestrian and vehicular access shall be provided and maintained to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, motel, hospitals, fire stations, police stations, and establishments of a similar nature. Access to residential properties shall be in accordance with Section 107.

Grading operations, roadway excavation and fill construction shall be conducted and maintained in such a manner as to provide a reasonably satisfactory and safe surface for vehicular and pedestrian traffic. When rough grading is completed, the roadbed shall be brought to and maintained in a reasonably smooth condition, satisfactory and safe for vehicular traffic at the posted speed limit. Pedestrian walkways shall be provided and maintained in a like manner. The Contractor shall accomplish any additional grading operations and/or repairs, including barricade replacement or repairs during working and nonworking periods which, in the opinion of the Engineer, are required.

In the event of abnormal weather conditions, such as windstorms, rainstorms, etc., the Contractor shall immediately inspect his work area and take all necessary actions to insure that public access and safety are maintained.

The Contractor shall provide the Engineer with the emergency address of his representatives as required by Section 105.

SUBSECTION 104.1.3 CLEANUP AND DUST CONTROL: Throughout all phases of construction, including suspension of work, and until final acceptance of the project, the Contractor shall keep the work area clean and free from rubbish, excess materials and debris generated by Construction Activities.

At disposal sites and storage sites, other than agency landfills, the Contractor shall be responsible for all required dust control measures. This includes temporary yard or staging areas.

The Contractor shall take whatever steps, procedures or means required to prevent any dust nuisance due to his construction operations. The dust control measures shall be maintained at all times to the satisfaction of the Engineer and in accordance with the requirements of the Maricopa County Bureau of Air Pollution Control Rules and Regulations.

Failure of the Contractor to comply with the Engineer's cleanup orders may result in an order to suspend work until the condition is corrected. No additional compensation or time will be allowed as a result of such suspension and the Engineer has the authority to take such other measures as may be necessary to remedy the situation. Subsection 104.2.5 applies.

SUBSECTION 104.1.4 FINAL CLEANING UP: Before final acceptance, all private or public property and grounds occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures and equipment, and all parts of the work area shall be left in a condition acceptable by Owner.

SUBSECTION 104.2 ALTERATION OF WORK:

SUBSECTION 104.2.1 BY THE CONTRACTING AGENCY: The Contracting Agency reserves the right to make, at anytime during the progress of the work, such alterations in the details of construction and such increases or decreases in quantities as may be found necessary or desirable. Such alterations and changes shall not invalidate the contract nor release the surety and the Contractor agrees to perform the work as altered, the same as if it had been a part of the original contract. The District or Engineer will issue Change Orders to cover unforeseen circumstances which make it impossible to carry out the work in accordance with the original contract plans and specifications.

If the alterations or changes made by the Contracting Agency increases or decreases the total cost of the contract or the total cost of any major item by more than 20 percent, either party may request an adjustment in payment in accordance with Section 109.

SUBSECTION 104.2.2 DUE TO PHYSICAL CONDITIONS:

(A) Should the Contractor encounter or discover during the process of the work, subsurface or latent physical conditions at the site differing materially from those indicated in the contract, or unknown physical conditions at the site of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract, the Engineer shall be promptly notified in writing of such conditions before they are disturbed. The Engineer will thereupon promptly investigate the conditions and, if he finds they do so materially differ and cause an increase or decrease in the cost of or the time required for performance of the contract, an equitable adjustment will be made and the contract modified in writing accordingly.

(B) If at the time of opening up any portion of the work, material from which the subgrade, backfill or bedding is to be constructed contains an excess of moisture so that the required compaction cannot be obtained without additional manipulation, the Engineer will determine the cause of such condition. If the cause of such condition is determined to have been unforeseeable and beyond the control of and without fault or negligence of the Contractor, the Engineer will determine whether the material shall be aerated or removed and replaced. Such work shall be done as directed and will be paid for as provided in Section 109.

(C) Failure to notify the Engineer of the conditions described in A and B above prior to doing any work may be just cause to reject any claims for additional monies and/or time.

(D) Material in ditches and ditch banks that contains moisture in an amount considered excessive by the Engineer shall be removed and shall be aerated to the extent required by the Engineer before compaction is effected. No measurement or direct payment for the removal and aeration of such material will be made.

(E) After any portion of the work has been opened up, saturation of material caused by irrigation water, storm drainage, weather or such similar causes will be considered as within the responsibility of the Contractor.

SUBSECTION 104.2.3 DUE TO EXTRA WORK: The Contractor shall perform unforeseen work, for which there is no unit bid price in the proposal, whenever it is deemed necessary or desirable by the Engineer in order to fully complete the work as contemplated. Such work shall be governed by all applicable provisions of the contract documents and payment will be made in accordance with the provisions set forth in Section 109.

Should the Contractor claim that any instructions received involve extra work under the contract, he shall give the Engineer written notice within two work days after receipt of such instructions, and in any event before proceeding to execute the work, except in emergencies endangering life or property. No claim shall be valid unless written notice is given.

If this extra work is performed by others, the Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

The Owner may at any time, by written order, and without notice to the sureties, if any, make changes within the general scope of this contract in any one or more of the following:

(A) Drawings, designs, or specifications;

(B) Method or manner of performance of the work;

(C) Owner-furnished facilities, equipment, materials, services, or site;

(D) Directing acceleration in the performance of the work.

Any other written or oral order from the Owner that causes a change shall be treated as a change order under this section provided that the Contractor gives the Owner written notification within two work days after receipt of such direction stating:

(A) The date, nature, and circumstances of the conduct regarded as a change;

(B) The particular elements of the contract performance for which the Contractor is seeking an equitable adjustment under this section, including any price or schedule adjustments;

(C) The Contractor's estimate of the time by which the Owner must respond to the Contractor's notice to minimize cost, delay, or disruption of performance.

The Contractor shall diligently continue performance of this contract to the maximum extent possible in accordance with its provisions. Except as provided in this section, no order, statement, or conduct of the Owner shall be treated as a change or entitle the Contractor to an equitable adjustment. If any change under this section causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, the Owner shall make an equitable adjustment and modify the contract in writing. The equitable adjustment shall not include increased costs or time extensions for delay resulting from the Contractor's failure to provide notice or to diligently continue performance. No proposal for the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

SUBSECTION 104.2.4 At the CONTRACTOR'S REQUEST: Changes in the plans or specifications, which do not materially affect and are not detrimental to the work or to the interests of the Contracting Agency, may be granted to facilitate the work. Requests shall be in writing and submitted to the Engineer for approval. These changes, if approved and when resulting in a saving to the Contractor, will be made at an equitable reduction in cost or in no case at any additional cost to the Contracting Agency.

The Contractor and any lower-tier subcontractors shall submit itemized cost estimates or price proposals for any owner-directed change order or Contractor-initiated claim.

Cost estimates or pricing proposals shall be itemized to include direct labor by man-hours, individual craft, hourly wage rate and verifiable labor burden. Other direct costs shall include rental and operator rates for rented or owned equipment, material trucking expenses and other costs clearly identified and directly allocable to contract performance. Material costs shall be itemized by item description, quantity for each item, unit price per item, including applicable sales tax markup, and extended total price per item. The Contractor shall provide copies of material supplier quote sheets, invoices or purchase orders, as appropriate.

Lump sum cost estimates or price proposals shall be rejected and returned to the Contractor for itemization as described above. Failure of the Contractor to submit properly itemized cost estimates or price proposals shall not constitute an excusable delay and will result in a change order being unilaterally priced at the Owner's fair estimated price.

SUBSECTION 104.2.5 DUE TO THE FAILURE OF THE CONTRACTOR TO PROPERLY MAINTAIN THE PROJECT:

(A) If the Contractor fails to provide adequate Maintenance of Traffic or Cleanup and Dust Control or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to suspend the work wholly or in part until this condition has been corrected.

(B) If the Contractor fails to comply with the Engineer's written order to provide adequate maintenance of traffic, cleanup, dust control, or to correct deficiencies resulting from abnormal weather conditions, the Engineer has the authority to have this work accomplished by other sources.

(C) The Contractor agrees to cooperate fully with the other source accomplishing this work and agrees that this action shall not invalidate the Contract or release the surety.

SUBSECTION 104.2.6 VALUE ENGINEERING:

(A) *General.* The Contractor is encouraged to voluntarily develop, prepare, and submit value engineering change proposals (VECPs). The Contractor shall share in any instant contract savings realized from accepted VECPs, in accordance with paragraph F below. The Owner reserves the right to make alterations to the contract, in accordance with procedures elsewhere within this contract. Such alterations will not be eligible for inclusion in any VECP.

(B) *Definitions.*

Contractor's development and implementation costs means those costs the Contractor incurs on a VECP in developing, testing, preparing, and submitting the VECP as well as those costs incurred by the Contractor to make the changes required by the Owner's acceptance of the VECP.

Owner costs means those owner costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistical support. The term does not include the normal administrative costs of processing the VECP.

Instant contract savings means the estimated reduction in Contract cost of performance resulting from acceptance of the VECP, minus the allowable Contractor's development and implementation costs, minus subcontractor's development and implementation costs (see paragraph G below).

Value engineering change proposal (VECP) means a proposal that (1) requires a change to the contract; (2) results in reducing the contract price or estimated cost without impairing essential functions or characteristics; and (3) does not involve a change in deliverable end item quantities, schedule, or a change to the contract type.

(C) *VECP Preparation.* As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change affects contractually required schedule and

cost reporting, it shall be revised to incorporate proposed VECP modifications. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effects of the change on the end item's performance. All design changes must be submitted on 24"x 36" standard drawing sheets along with supporting calculations. Each drawing sheet and at least the content sheet of the calculations shall be sealed by an Engineer registered in the State of Arizona.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revision.

(3) A separate, detailed cost estimate for the affected portions of the existing contract requirements and the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph G below.

(4) A description and estimate of costs the Owner may incur implementing the VECP, such as test and evaluation and operating and support costs. This is an estimate based only on the Contractor's understanding of additional efforts to be expended by the Owner, should the VECP be accepted. The final cost will be determined by the Owner.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency, i.e., costs of operation or maintenance.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved and previous Owner actions, if known.

(D) ***Submission.*** The Contractor shall submit VECPs to the Owner's Engineer.

(E) ***Owner Action.***

(1) The Owner will notify the Contractor of the status of the VECP within 15 calendar days after receipt from the Contractor. If additional time is required, the Owner will notify the Contractor within the 15-day period and provide the reason for the delay and the expected date of the decision. The Owner will process VECPs expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Owner will notify the Contractor in writing, explaining the reasons for rejection.

(3) The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Owner.

(4) Any VECP may be accepted, in whole or in part, by the Owner's award of a change order to this contract, citing this subsection. The Owner may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a change order incorporates a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Owner's decision to accept or reject all or any part of any VECP shall be final and not subject to disputes or otherwise subject to litigation.

(F) *Cost Sharing.*

(1) **Rates**. The Owner's share of savings is determined by subtracting the Owner's costs from instant contract savings and multiplying the result by 50 percent. The Contractor's share shall be the remaining 50 percent.

(2) **Payment**. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a change order to this contract to accept the VECP, reduce the contract price or estimated cost by the amount of instant contract savings, and provide the Contractor□s share of savings by adding the amount calculated to the contract price.

(G) ***Subcontracts***. The Contractor may include an appropriate value engineering clause in any subcontract. In computing any adjustment in this contract's price under paragraph F above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Owner under this contract, but shall exclude any value engineering incentive payments; provided that these payments shall not reduce the Owner's share of the savings resulting from the VECP.

End of Section

SECTION 105 CONTROL OF WORK

SUBSECTION 105.1 AUTHORITY OF THE ENGINEER:

SUBSECTION 105.1.1 ENGINEER'S EVALUATION: Engineer will be allowed ten (10) working days within which to evaluate each proposal or submittal made pursuant to subsections 105.2.1, 105.3.1 and 106.4. Engineer will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized without Engineer's prior written acceptance which will be evidenced by either a Change Order or an approved Shop Drawing. Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any "or-equal" or substitute. Engineer will record time required by Engineer and Engineer's Consultants in evaluating substitutes proposed or submitted by Contractor pursuant to subparagraphs 105.3.1 and 106.4(B) and in making changes in the Contract Documents (or in the provisions of any other direct contract with Owner for work on the project) occasioned thereby. Whether or not Engineer accepts a substitute item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer and Engineer's Consultants for evaluating each such proposed substitute item.

The Engineer will decide all questions which may arise as to the quality and acceptability of materials furnished and work performed and as to the rate of progress of the work; all questions which may arise as to the interpretation of the plans and specifications; all questions as to the acceptable fulfillment of the contract on the part of the Contractor. The Engineer's estimates and decisions shall be final and conclusive. In case any question should arise, relative to the Contract Documents, the determination or decision of the Engineer shall be a condition precedent to the right of the Contractor to receive final approval of the work being questioned under the contract.

In giving instructions, the Engineer may make minor changes in the work, not involving extra work and not inconsistent with the purpose of the work, except in emergencies endangering life or property.

The Engineer will suspend the work wholly or in part due to the failure of the Contractor; to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out orders; for such periods as he may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

SUBSECTION 105.2 PLANS AND SHOP DRAWINGS:

The Contractor shall submit, for review, a proposed schedule of shop drawings and product data submittals. This schedule will include concrete and asphalt concrete mix designs unless they are previously approved supplier's mix design. The schedule will show the needed response date for each submittal and will indicate the relationship of the submittal to the project construction schedule.

The Contractor shall submit five (5) copies of each shop drawing, product data or mix design to the Engineer for review. Each submittal shall be numbered sequentially and shall be submitted in accordance with the schedule established in conjunction with the Contracting Agency so as to cause no delay in the work schedule. The Contractor shall certify, by stamp or letter, that he has reviewed and approved the submittal and that it conforms to the requirements of the contract documents. If this certification is not included, the submittal will be returned without action.

At the time of each submittal, the Contractor shall define and delineate in writing, separate from the certification, any deviations from the contract documents. If the Engineer accepts this deviation, he will authorize the deviation by issuing a change order or if the deviation is minor by endorsement to the letter.

The Engineer will review and return the submittals in accordance with the previously established response date. The review will be only for conformance with the design concept of the work and for compliance with the information contained in the contract documents. The review of a specified item, as such, will not indicate review of the assembly in which the item functions. Review by the Engineer will not relieve the Contractor from responsibility for any errors

or omissions in the submittals nor from his responsibility for complying with the contract documents. The only exception is deviations accepted in accordance with the preceding paragraph.

If the submittal is acceptable, one (1) copy with each page stamped "Furnish as Submitted" will be returned to the Contractor. The Contractor shall submit additional copies (as required) to the Engineer.

If the Engineer determines that the submittal requires corrections or is to be rejected, one (1) copy stamped "Furnish as Noted" or "Revise and Resubmit" will be returned to the Contractor. The Contractor shall submit five (5) corrected or new copies.

The copy stamped "Furnish as Submitted," returned to the Contractor, shall become a part of the contract documents and shall be kept at the job site. Any work done prior to the receipt of this review will be at the Contractor's risk and expense.

SUBSECTION 105.2.1 PLANS AND SHOP DRAWINGS: Shop drawings means drawings, submitted to the Engineer by the Contractor pursuant to the contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the Contractor the explain in detail specific portions of the work required by the contract.

Product Data is information on manufactured items, either stock or modified, and includes descriptive literature, operating data, performance curves, certified dimensional drawings, wiring or schematic control diagrams, piping, instrumentation, parts lists, and operating, maintenance and lubrication manuals.

SUBSECTION 105.3 CONFORMITY WITH PLANS AND SPECIFICATIONS:

All work performed and all materials furnished shall be in conformity with the lines, elevations, grades, cross sections, dimensions and material requirements, including tolerances, shown on the plans or indicated in the specifications.

In the event the Engineer finds the materials or the finished product in which the materials are used not in conformity with the plans and specifications, but that reasonably acceptable work has been produced, he shall then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as he deems necessary to conform to his determination based on engineering judgement.

In the event the Engineer finds the materials or the finished product in which the materials are used or the work performed are not in conformity with the plans and specifications and have resulted in an inferior or unsatisfactory product, the work or materials shall be removed and replaced or otherwise corrected by the Contractor at no additional cost to the Contracting Agency.

In all instances wherein the items and/or specifications require installation or construction in accordance with either manufacturers' or suppliers' recommendations and/or instructions, said recommendations and/or instructions shall be submitted with the applicable portion clearly marked for approval prior to the commencement of work on that item or portions of the contract.

SUBSECTION 105.3.1 SUBSTITUTE CONSTRUCTION METHODS OR PROCEDURES: If a specific means, method, technique, sequence or procedure of construction is shown or indicated and expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence or procedure of construction acceptable to Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by Engineer will be similar to that provided in subparagraph 106.4(B).

SUBSECTION 105.4 COORDINATION OF PLANS AND SPECIFICATIONS:

The Contractor shall take no advantage of any apparent error or omission in the plans or specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the plans and specifications.

SUBSECTION 105.5 COOPERATION OF CONTRACTOR:

The Contractor will be supplied with a minimum of seven sets of approved plans and construction specifications, one set of which the Contractor shall keep available on the work at all times.

The Contractor shall give the work the constant attention necessary to facilitate the progress thereof, and shall cooperate with the Engineer, his inspectors, and other Contractors in every way possible.

The Contractor shall at all times be present at the work in person or represented by a competent superintendent. The superintendent shall be authorized to receive and fulfill instructions from the Engineer and who shall supervise and direct the work. No less than fourteen days prior to the scheduled/planned Notice to Proceed, the Contractor shall submit to the Engineer for review and approval, the name and qualifications of the proposed superintendent. When the superintendent is approved, he shall not be changed by the Contractor without written approval of the Engineer. Instructions and information given by the Engineer to the Contractor's superintendent shall be considered as having been given to the Contractor.

(A) All phases of the project such as concrete work, pipe work, etc., shall be under the direct supervision of a foreman or his designated representative on the site who shall have authority to accept instructions, with respect to that particular phase of the project, and take action required to properly carry out the work.

(B) In the event of noncompliance with the above, the Engineer may require the Contractor to stop work on that part of the project until the required supervision is present.

The Contractor shall file with the Engineer, the names, addresses, and telephone numbers of representatives who can be contacted, at any time, in case of emergency. These representatives must be fully authorized and equipped to correct unsafe or excessively inconvenient conditions on short notice.

Emergencies may arise during the progress of the work which may require special effort or require extra shifts of men to continue the work beyond normal working hours. The Contractor shall be prepared in case of such emergencies from whatever cause, to do all necessary work promptly.

SUBSECTION 105.5.1 PARTNERING: The Owner intends to encourage the foundation of a partnering relationship with the Contractor and its subcontractors. This partnering relationship will be structured to draw on the strength of each organization to identify and achieve reciprocal goals. The objectives are effective and efficient contract performance, intended to achieve completion within budget, on schedule, and in accordance with plans and specifications.

This partnering relationship will be bilateral in makeup. Any cost associated with effectuating partnering will be covered by the Bid Item. The initial partnering workshop shall be scheduled after award of the contract, and prior to the Notice to Proceed, and shall be facilitated by a third party competent in the fundamentals of partnering, and mutually acceptable to Contractor and Owner. The Contractor shall be responsible for scheduling, coordinating, and hiring the third party facilitator, and planning all of the partnering meetings in consultation with the Engineer. The Owner will be responsible to notify and coordinate attendance at the partnering meetings by other agencies. To achieve the desired partnering relationships, the Contractor will need to encourage attendance by its major subcontractors on the project. Follow-up workshops will be held periodically throughout the duration of the contract as agreed to by the Contractor and Owner.

An integral aspect of partnering is the resolution of disputes in a timely, professional, and non-adversarial manner. Alternative dispute resolution (ADR) methodologies will be encouraged in place of the more formal dispute resolution procedures. ADR will assist in promoting and maintaining an amicable working relationship to preserve the partnering relationship. ADR in this context is intended to be a voluntary, non-binding procedure available for use by the parties to this contract to resolve any dispute that may arise during performance.

Payment for Partnering will be made on the basis of invoices of actual costs, and will be for a total amount not to exceed the amount shown in the bid schedule for **ITEM 105-1 – PARTNERING.**

SUBSECTION 105.5.2 PRE-CONSTRUCTION MEETING: After award of the contract, a pre-construction meeting shall be scheduled at a location and time (prior to mobilization and start of construction) to be agreed upon between the Owner and the Contractor. The Contractor shall make all necessary arrangements to have key personnel of his company and of his principal subcontractors present at the meeting. Each representative shall have authority to make commitments and act for his firm. The purpose of the pre-construction meeting is to discuss any specific concerns or potential problems that the Contractor is aware of, to provide general information appropriate to the contract, to identify responsible individuals for various functions within each organization, and to develop tentative dates for the start of construction. The Contractor shall submit to the Engineer during the pre-construction meeting the following documents:

Material data safety sheets
Preliminary work schedule
Preliminary traffic control plan
Emergency telephone numbers
Signing authority letter
Name and telephone number of the certified safety professional

The pre-constuction meeting will cover topics such as critical elements of the work schedule, payment application and processing of invoices. Additionally, a scheduled start date for the work will be determined.

The Contractor shall be responsible to take minutes of the pre-construction meeting and distribute copies to all meeting participants. The meeting minutes shall be distributed within 48 hours of the meeting. At the subsequent construction progress meeting, the minutes will be attested or revised, as appropriate. The cost for attendance at the pre-construction meeting, and preparation and distribution of meeting minutes shall be incidental to the project and no extra payment will be made.

SUBSECTION 105.5.3 CONSTRUCTION PROGRESS MEETINGS: Construction progress meetings shall be scheduled weekly, or as considered necessary by the Owner. The Contractor shall make all arrangements to have key personnel of his company and of his principal subcontractors present at all progress meetings; representatives shall have authority to make commitments and act for their firms. The Contractor shall assume full responsibility to act for and commit any subcontractor employed by the Contractor, whether or not such subcontractor is represented at the meeting.

During the construction progress meeting the Owner's representative will act as chairman and will advise the Contractor of any administrative matters connected with the contract. The Contractor shall submit for review his two-week rolling schedule. The Contractor's representative at these meetings shall be prepared to discuss and resolve construction problems and concerns, material delivery and vendor data submittals status, construction progress as measured against the Contractor's approved construction schedule and the Contractor's short range construction activities as provided on his two-week rolling schedule. The Contractor shall not be relieved of his responsibility to fulfill all of the terms of the contract as a result of any inferences drawn or suggestions made available at these meetings.

The Contractor shall be responsible to take minutes of the construction progress meetings and distribute copies to all meeting participants. The meeting minutes shall be distributed within 48 hours of the meeting. At the subsequent construction progress meeting, the minutes will be attested or revised, as appropriate. The cost for attendance at meetings, and preparation and distribution of meeting minutes shall be incidental to the project and no extra payment will be made.

SUBSECTION 105.6 COOPERATION WITH UTILITIES:

SUBSECTION 105.6.1 GENERAL: The Contracting Agency will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of the public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

The Contractor shall comply with the requirements of ARS-40-360.21 through 40-360.29 (one call system, Blue Stake) in notification to the interested utility owners prior to start of construction. The Contractor shall resolve all problems with the utility owners concerned.

Where water users association facilities obstruct construction of the work, the Contractor shall contact officials of the association relative to the shutdown of irrigation water and shall acquaint himself with and conform to the requirements of the association.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals and all other utility appurtenances within the limits of the proposed construction which are to be relocated or adjusted are to be moved by the owners at their expense except as otherwise provided for in the special provisions or as noted on the plans. In the event an existing service is found to be in a materially different location than shown on the plans and requires additional or more costly work on the part of the Contractor, the procedures in Section 104, will apply.

It is understood and agreed that the Contractor has considered in his proposal all of the permanent and temporary utility appurtenances in their present or relocated positions as shown on the plans and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference from the said utility appurtenance or the operation of moving them. If delays are encountered because utility owners have not relocated or adjusted their facilities, the contract time will be adjusted in accordance with Section 108.

It shall be the responsibility of the Contractor to ascertain the need for bracing or shoring of utility poles during the construction of the project and no additional compensation will be allowed for such bracing or shoring.

In general, the contract will indicate various utility items, certain of which are to be relocated or adjusted by the utility owner and others by the Contractor. Any work performed by the Contractor for any utility company, separate from the contract shall be paid for by the utility company and will not be a part of the agency contract.

An attempt has been made to determine the location of all underground utilities, drainage pipes, and structures; however, it shall be the Contractor's responsibility to cooperate with the pertinent utility companies so that any obstructing utility installation(s) may be adjusted. The location of the underground and overhead utilities as shown on the plans is based on the best available information. The Contractor shall not assume that this represents an exact location of the line. No guarantee is made to the accuracy of the location shown on the plans. The Contractor shall determine for himself the exact location of all utilities. Should Contractor's operations result in damage to any utility the location of which has been brought to its attention, he shall assume full responsibility for such damage. There also exists the strong likelihood that other abandoned older and undocumented underground utility and irrigation lines exist within the project area. **Contractor shall contact Arizona Blue Stake (telephone number 602-263-1100) a minimum of two (2) working days before beginning any underground work.** In addition, Blue Stake notification(s) shall be maintained on a current basis.

Overhead and underground facilities may have been relocated in advance of construction to avoid conflicts. However, it shall be the responsibility of the Contractor to verify the location of all utilities prior to commencing any construction activities in a particular area. All existing overhead and underground utilities shall be Protected-in-Place (P.I.P.) unless noted otherwise on the plans, in these Supplementary General Conditions, and in the Special Provisions.

SUBSECTION 105.6.2 NOTIFICATIONS REQUIREMENT IN THE EVENT OF ANY DAMAGE TO OR DISLOCATION OF UNDERGROUND FACILITIES: In the event of any damage to or dislocation of any

underground facility, the Contractor responsible for the excavation operation shall immediately notify the owner of such facility and shall not attempt to repair any facility, except those intended for the conveyance or storage of water and sewage. The excavation shall be left open until the arrival of representatives of the owner. The owner will dispatch its representative promptly to examine the underground facility and, if necessary, make repairs.

SUBSECTION 105.6.3 UTILITY PHONE LIST:

The following phone numbers should put the Contractor in contact with the proper personnel:

Arizona Public Service Company (APS) 230kV OHE	
Mr. Steve Goodman, Project Design Leader	(602) 371-6965
AT&T Fiber Optic Telephone	
Mr. Franco Jauregui	(909) 898-4776
Cox Communications (COX) Cable TV	
Mr. Carl McKay, Utility Liaison	(623) 322-7214
El Paso Natural Gas (EPNG) High pressure gas mains	
Mr. Bill Ward, Phoenix District Superintendent	(602) 438-4224
Mr. John McNeely, Principal Engineer	(915) 496-5562
Maricopa Water District (Beardsley canal)	(623) 975-1125
Salt River Project Irrigation (SRP)	
Mr. Gerry Bastian, Project Leader	(602) 236-4609
Salt River Project Power Distribution (SRPPD) 12kV lines, etc.	
Mr. Greg Wilson, Project Leader	(602) 236-8643
Salt River Project Power Transmission (SRPPT) 69kV Trans.	
Mr. Dan Hawkins, Senior Engineer	(602) 236-8603
Southwest Gas Corporation (SWG) Natural gas lines	
Mr. Gene Florez	(602) 484-5302
Union Pacific Railroad Company (UPRR)	
Mr. Gary Houk, Manager of Track Maintenance	(602) 257-2505
Mr. Sam Kephart, Manager of Train Operations	(602) 257-2531
U.S. West Communications (USW) Telephone Lines	
Mr. John Aker, Public Works Project Manager	(602) 630-0496

SUBSECTION 105.6.4 APS and SRPPT: Both APS and SRP maintain high voltage (69 kV, 230kV and 500kV) overhead electric transmission lines in the vicinity of the project. The project does not directly impact the APS and SRP overhead lines.

At all times during construction, the Contractor shall comply with all laws, ordinances, rules, regulations, and safety requirements, including but not limited to the National Electric Safety Code, and the Occupational Safety and Health Standards for General Industry when working in the vicinity of these high voltage lines.

SUBSECTION 105.6.5 EL PASO NATURAL GAS (EPNG): The Contractor shall verify the location of these lines and shall protect in place all gas lines. Specifically:

(A) Maintain a minimum of five (5) feet of cover over the gas pipelines at any location the line is crossed.

(B) The Contractor will contact EPNG a minimum of 14 calendar days in advance of any construction activities near these lines. EPNG will have a representative on site as they deem necessary.

SUBSECTION 105.6.6 SALT RIVER PROJECT POWER DISTRIBUTION (SRPPD): The contractor should contact SRP safety department at (602) 236-8120 prior to the start of construction to discuss safety issues related to working near energized overhead lines. One group meeting will be conducted prior to construction. The contractor will pay for individual contractor or subcontractor meetings.

Please address any questions regarding the above conditions to Mr. Dan Hawkins at P. O. Box 52025, Phoenix, AZ 85072-2025, Mail Station XCT 315.

At all times during construction, the Contractor shall comply with all laws, ordinances, rules, regulations, and safety requirements, including but not limited to the National Electric Safety Code, and the Occupational Safety and Health Standards for General Industry when working in the vicinity of electrical lines.

The cost for the repair of any damage to these facilities, and any loss of revenue by SRP due to the loss of service of the overhead or underground electric cables that is in any way caused by the Contractor's actions shall be the sole responsibility of the Contractor at no cost to the project.

SUBSECTION 105.7 COOPERATION BETWEEN CONTRACTORS:

The Contracting Agency reserves the right at any time to contract for and perform other or additional work on or near the work covered by the contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct his work so as not to interfere with or hinder the progress or completion of the work being performed by other Contractors. Contractors working on the same project shall cooperate with each other as directed.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his contract and shall protect and save harmless the Contracting Agency from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced by him because of the presence and operations of other Contractors working within the limits of the same project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other Contractors within the limits of the same project. He shall join his work with that of others in an acceptable manner and shall perform it in proper sequence to that of the others.

The Contracting Agency will not honor any claim for extra compensation due to delays, extra work, or extension of time caused by any other Contractors working within the limits of the same project.

SUBSECTION 105.8 CONSTRUCTION STAKES, LINES AND GRADES:

The Engineer will set construction stakes establishing lines and grades for road work, curbs, gutters, sidewalks, structures and centerlines for utilities and necessary appurtenances as he may deem necessary, he will furnish the Contractor with all necessary information relating to the lines and grades. These stakes and marks shall constitute the field control by and in accordance with which the Contractor shall establish other necessary controls and perform the work. The following stakes, lines, and grades construction:

(A) The Engineer will furnish a Benchmark which the Contractor will use to set line and grade for all construction. All other surveying required for the project shall be the Contractor's responsibility. The Engineer will not set any construction stakes.

(B) Before any construction work is started, the Contractor shall perform all base surveys and cross sections of existing conditions that may be required as a basis for quantity determination.

(C) The Contractor shall submit original construction surveyor's notes duly signed by a Registered Land Surveyor to the Engineer at the end of the project. Copies of the survey notes shall be submitted to the Engineer during construction as and when requested.

(D) As-built drawings shall be prepared by updating original mylar drawings as provided by the Owner. Any changes required are to be made in red ink having waterproof, opaque, and reproducible characteristics. Deleted items shall be crossed out or lined out, no erasures will be allowed. Paper as-built progress drawings shall be maintained in a current condition at all times until completion of the work and shall be available for review by the Engineer at all times. The final as-built mylar drawings shall be sealed by an Engineer registered in the State of Arizona

and shall be provided by the Contractor to the Engineer prior to project close out and prior to the final contract payment. And, as-builts will also be provided in electronic format using files on disk or CD as provided by the Owner.

The Contractor shall perform the work in accordance with the Engineer's stakes and marks, and shall be charged with full responsibility for conformity and agreement of the work with such stakes and marks.

The Contractor shall be held responsible for the preservation of all stakes and marks, and if the construction stakes or marks have been carelessly or willfully destroyed or disturbed by the Contractor, the cost for replacing them will be charged against him and will be deducted from the payment for the work.

The Contractor shall give notice to the Engineer not less than 2 working days in advance of when he will require survey services in connection with any portion of the work.

The Contractor shall set the construction stakes for buildings establishing lines, grades, and elevations to include necessary utilities and appurtenances and shall be responsible for their conformance with plans and specifications. The Engineer will establish or designate a control line or bench mark of known location and elevation for use as a reference.

SUBSECTION 105.9 DUTIES OF INSPECTOR:

The Engineer may provide the Inspector, assistants, and other field staff to assist the Engineer in observing performance of the work of the Contractor. Through onsite observations of the work in progress and field checks of materials and equipment, the Inspector shall endeavor to provide further protection for the Contracting Agency against defects and deficiencies in the work of the Contractor, but, the furnishing of such services will not make the Inspector responsible for or give the Inspector control over construction means, methods, techniques, sequences, or procedures or for safety precautions or programs, or responsibility for the Contractor's failure to perform the work in accordance with the contract documents.

Inspectors employed by the Contracting Agency will be authorized to inspect all work done and materials furnished. Such inspection may extend to all or any part of the work and to the preparation, fabrication or manufacture of the materials to be used. The inspector will not be authorized to alter or waive the provisions of the contract. The inspector will not be authorized to issue instructions contrary to the plans and specifications or to act as foreman for the Contractor.

The inspector will, however, have the authority to reject work or materials until any questions at issue can be referred to and decided by the Engineer.

SUBSECTION 105.10 INSPECTION OF WORK:

Inspection of the work by the Engineer or his authorized representative shall not be considered as direct control of the individual workman and his work. The direct control shall be solely the responsibility of the Contractor's foreman and superintendent.

The Engineer shall be permitted to inspect all materials, and each part or detail of the work at any time for the purpose of expediting and facilitating the progress of the work. He shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. Any work done or materials used without supervision and inspection by an authorized Contracting Agency representative may be ordered removed and replaced at no additional cost to the Contracting Agency. Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered nor obligate the Engineer to final acceptance.

When any unit of government or political subdivision is to pay a portion of the cost of the work covered by the contract, its representatives shall have the right to inspect the work. Such inspection shall in no sense make any unit

of government or political subdivision a party to the contract, and shall in no way interfere with the rights of either party to the contract.

SUBSECTION 105.11 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK:

Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness or any other cause, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner.

No work shall be done without lines and grades having been given by the Engineer. Work done contrary to the instructions of the Engineer, work done beyond the lines shown on the plans, or as given, or any extra work done without authority, will be considered as unauthorized and will not be paid for under the provisions of the contract. Work so done may be ordered removed or replaced at no additional cost to the Contracting Agency.

SUBSECTION 105.12 MAINTENANCE DURING CONSTRUCTION:

The Contractor shall maintain the work during construction and until the project is accepted. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end so that the roadway or structures are kept in satisfactory conditions at all times.

In the case of a contract for the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations. All cost of maintenance work during construction and before the project is accepted shall be included in the unit bid price on the various pay items.

SUBSECTION 105.13 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE:

If the Contractor, at any time, fails to perform maintenance during construction, the Engineer will immediately notify the Contractor of such noncompliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project. The entire cost of this maintenance will be deducted from monies due or to become due the Contractor on his contract.

SUBSECTION 105.14 PARTIAL USE OR OCCUPANCY:

Should an urgent or unforeseen need occur, the Contractor agrees to let the Contracting Agency use or occupy a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, prior to final acceptance.

Prior to such use or occupancy the Contracting Agency will prepare a written agreement with the Contractor and accomplish a partial acceptance inspection. The written agreement will include a revised construction schedule, responsibilities for maintenance of the partial acceptance and continued construction of the original project to final acceptance, payments, insurance and bond requirements.

SUBSECTION 105.15 ACCEPTANCE:

(A) **PARTIAL ACCEPTANCE:** If at any time during the prosecution of the project the Contractor substantially completes a unit or portion of the project, such as a structure, utility service, or a section of road or pavement, he may request the Engineer to make final inspection of that work. If the Engineer finds, upon inspection, that the work has been satisfactorily completed in compliance with the contract he may accept the work as being completed and the Contractor may be relieved of further responsibility for that work. Such partial acceptance shall in no way void or alter any terms of the contract.

(B) **FINAL ACCEPTANCE:** Upon due notice from the Contractor of presumptive completion of the entire project, the Engineer will make an inspection. If all construction provided for and contemplated by the contract is found completed to his satisfaction, that inspection shall constitute the final inspection and the Engineer will make the final acceptance. The Contractor will be notified in writing of this acceptance as of the date of the final inspection.

If, however, the inspection discloses any work, in whole or in part, as being unsatisfactory, the Engineer will give the Contractor the necessary instructions for correction of same, and the Contractor shall immediately comply with and execute such instructions. Upon correction of the work, another inspection will be made which shall constitute the final inspection provided the work has been satisfactorily completed. In such event, the Engineer will make the final acceptance and notify the Contractor in writing of this acceptance as of the date of the final inspection.

End of Section

SECTION 106 CONTROL OF MATERIALS

SUBSECTION 106.1 SOURCE OF MATERIALS AND QUALITY:

All construction materials to be used on the work or incorporated into the work, equipment, plant, tools, appliances or methods to be used on the work shall be subject to the inspection and approval or rejection of the Engineer.

The materials used on the work shall meet all quality requirements of the contract. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of his proposed source of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If it is found after trial that sources of supply for previously approved materials do not produce specified products the Contractor shall furnish materials from other sources.

Unless otherwise noted, all materials used in the project shall be new and unused. Additionally, any new materials used in this project that are damaged during the construction of the project and prior to final acceptance, as determined by the Engineer, shall be replaced by the Contractor with new material at no additional cost to the Contracting Agency.

Select Material, Aggregate Base, Mineral Aggregate, concrete, steel products and pipe shall be obtained from commercial sources. Contractor shall pay all royalties, or any other charges or expenses, incurred in connection with the securing and hauling of the material. Contractor will be required to furnish Engineer with a list of its proposed commercial sources prior to use, and shall present certificates stating that the material produced from any commercial sources is in accordance with the Special Provisions and these Supplementary General conditions.

SUBSECTION 106.2 SAMPLES AND TESTS OF MATERIALS:

All materials to be incorporated in the work may be subject to sampling, testing and approval, and samples furnished shall be representative of the materials to be used. The Engineer may select samples, or may require that samples be delivered by the Contractor to a laboratory designated by the Engineer.

The Contracting Agency will pay for the initial or normal test required by the Engineer to guard against unsuitable materials or defective workmanship. Additional tests, required due to failure of the initial or normal test(s), shall be paid for by the Contractor. The Engineer will designate the laboratory which will accomplish the additional test(s).

The procedures and methods used to sample and text materials will be determined by the Engineer. Unless otherwise specified, samples and tests will be made in accordance with either the Materials Testing Manual of the Contracting Agency or the standard methods of AASHTO or ASTM, which were in effect and published at the time of advertising for bids.

The laboratory responsible for the test shall furnish at least one copy of the test results to the Contracting Agency or his designated representative, to the Contractor, and to the appropriate material supplier.

With respect to certain manufactured materials, the Engineer may permit the use of some materials prior to sampling and testing provided they are delivered with either a certificate of compliance or analysis or both, stating that the materials comply in all respects with the requirements of the specifications. These certificates shall be furnished in triplicate and clearly identify each delivery of materials to the work area. The certificates shall be signed by a person having legal authority to bind the supplier or manufacturer.

SUBSECTION 106.3 PLANT INSPECTION:

The Engineer may undertake the inspection of materials at the source. In this event, the following conditions shall be met:

(A) The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom he has contracted for materials.

(B) The Engineer shall have full entry at all times to such parts of the plant as may concern the manufacture or production of the materials being furnished.

It is understood that the Contracting Agency reserves the right to retest all materials, prior to their use in the work, upon delivery.

SUBSECTION 106.4 TRADE NAMES AND SUBSTITUTIONS:

Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function and quantity required. Unless the specification or description contains or is followed by words reading that no like, equivalent or "or-equal" item or no substitution is permitted, other items of material or equipment of other Suppliers may be accepted by Engineer under the following circumstances:

(A) "Or-Equal": If in the Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for acceptance of proposed substitute items.

(B) Substitute Items: If in the Engineer's sole discretion an item does not qualify as an "or-equal" item under subparagraph 106.4 (A), it will be considered a proposed substitute item. Contractor shall submit sufficient information as provided below to allow Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. The procedure for review by Engineer will include the following and may be supplemented in the Construction Specifications and as Engineer may decide is appropriate under the circumstances. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor. If Contractor wishes to furnish or use a substitute item of material or equipment, Contractor shall first make written application to Engineer for acceptance thereof, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified and be suited to the same use as that specified. The application will state the extent, if any, to which the evaluation and acceptance of the proposed substitute will prejudice Contractor's achievement of completion on time, whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for work on the project) to adapt the design to the proposed substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified will be identified in the application and available maintenance, repair and replacement service will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other Contractors affected by the resulting change, all of which will be considered by Engineer in evaluating the proposed substitute. Engineer may require Contractor to furnish additional data about the proposed substitute.

(C) Contractor's Expense: All data to be provided by Contractor in support of any proposed "or-equal" or substitute item will be at Contractor's expense.

(D) If the final placement of a product will remain the property of the municipality or utility and/or owned by the municipality or utility, that entity is responsible for issuing written approval for any equivalent or "or-equal" products. The Contractor or Supplier will submit to that entity the request and documentation for written approval of a product substitution. The Contractor will provide the entity's written approval to the Engineer at the Pre-Construction Meeting.

Plans and specifications may contain references to equipment, materials or patented processes by manufacturer, trade name, make or catalog number. Unless the name is followed by words indicating that no substitution is permitted, such references shall be regarded as establishing a standard of quality, finish, appearance, performance or, as indicated, a selection based upon compatibility with existing equipment or materials.

The use of an alternate or substitute item or source may be permitted, subject to the following:

(A) No consideration will be given to a substitution prior to the award of the contract.

(B) Only substitutions submitted by the Contractor will be accepted for review. The substitution shall be submitted in writing to the Engineer.

(C) The submittal shall certify that the substitution will perform the functions and achieve the results called for by the general design, be similar and of equal substance, and be suited to the same use as that specified.

(D) The submittal shall state any required changes in the contract documents to adapt the design to the proposed substitution. This will include all changes required of other contractors/subcontractors affected by the resulting changes.

(E) The submittal shall contain an itemized estimate of all costs and credits that will result directly or indirectly from the acceptance of such substitution, including costs of design, license fees, royalties, testing, Engineer's evaluation, claims of other contractors/subcontractors, etc. Also, the submittal shall include any adjustment in the contract time created by the substitution.

(F) The Contractor, on request of the Engineer, shall submit samples or any additional information the Engineer may deem necessary to evaluate the acceptability of the substitution. The Engineer will evaluate the information provided, perform tests when necessary and make comparisons. The Engineer will then make the final decision as to the acceptability of the proposed substitution. The Contractor will be notified in writing by the Engineer as to whether his substitution has been accepted or rejected.

(G) The submittal, for purposes of review, number of copies, etc., shall follow the procedures as outlined in Section 105.2, except in the case of response time. If the Engineer does not respond in a timely manner, which in turn, impacts the substitution, the Contractor shall continue to perform the work in accordance with the contract and the substitution will be considered rejected. Also, no adjustment in the contract time will be granted for nonacceptance of the substitution.

(H) There will be no additional costs to the Contracting Agency for the substitution. If the substitution yields a net savings in the contract price, the amount of savings shall be divided between the Contracting Agency and the Contractor in a percentage established by the Contracting Agency.

(I) If the substitution is accepted and an adjustment in the contract cost and/or contract time is in order, a change order will be issued to the Contractor for the changes.

SUBSECTION 106.5 STORAGE OF MATERIALS:

The Contractor shall provide storage facilities and exercise such measures as will insure the preservation of the quality and fitness of all materials and/or equipment to be used in the work. Stored materials and/or equipment, even though approved before storage, may again be inspected prior to their use in the work. Stored items shall be located so as to facilitate their prompt inspection. That portion of the right-of-way and easements not required for public

travel may be used for storage purposes, when approved by the Engineer. Any additional storage area as required must be provided by the Contractor. Private property shall not be used for storage purposes without written permission of the owner or lessee. If requested, by the Engineer, copies of such written permission shall be made available.

The Contractor shall obtain approval of the Engineer when using vacant property to park and service equipment and store materials for use. The Contractor will obtain prior written approval of the property owner for such use and submit a copy of the approval to the Engineer prior to use of the property.

The Contractor shall grade all construction yards, easements and limits of construction which are disturbed by construction or construction related activities to the lines and grades shown on the plans; or as a minimum, where no line or grade is shown, to a condition similar to or better than the pre-existing condition.

SUBSECTION 106.6 HANDLING MATERIALS:

All materials and/or equipment shall be handled in such a manner as to preserve their quality and fitness for the work.

SUBSECTION 106.7 UNACCEPTABLE MATERIALS:

All materials and/or equipment not conforming to the requirements of the specifications, whether in place or not, may be rejected. Rejected materials and/or equipment shall be removed immediately from the site of work unless otherwise permitted by the Engineer. No rejected material and/or equipment, the defects of which have been subsequently corrected, shall be used until approved in writing by the Engineer.

SUBSECTION 106.8 FURNISHED MATERIALS:

Materials and/or equipment, furnished by the Contracting Agency, will be delivered or made available to the Contractor as indicated in the special provisions. The cost of handling and placing shall be considered as included in the contract price for the pay item with which they are used.

The Contractor will be held responsible for all materials and/or equipment accepted by him and will make good any shortages, deficiencies and damages which may occur after such acceptance.

End of Section

SECTION 107 LEGAL REGULATIONS AND RESPONSIBILTY TO PUBLIC

SUBSECTION 107.1 LAWS TO BE OBSERVED:

The Contractor shall keep fully informed of all Federal and State laws, County and City ordinances, regulations, codes and all orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any way affect the conduct of the work. He shall at all times observe and comply with all such laws, ordinances, regulations, codes, orders and decrees; and shall protect and indemnify the Contracting Agency and its representatives against any claim or liability arising from or based on the violation of such, whether by himself or his employees.

The attention of the Contractors is directed to the provisions of the following sections, Arizona Revised Statutes.

(A) ARS 23-373. Contracts negotiated between public Contractors and public employers shall contain the following contractual provisions:

In connection with the performance of work under this contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of race, religion, color or national origin. The aforesaid provision shall include, but not be limited to, the following: Employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Contractor agrees to post hereafter in conspicuous places, available for employees and applicants for employment, notices to be provided by the contracting officer setting forth the provision of the nondiscrimination clause.

The Contractor further agrees to insert the foregoing provision in all subcontracts, except subcontracts for standard commercial supplies or raw materials.

(B) When Federal-aid funds are used on a project, the prevailing basic hourly wage rates and fringe benefit payments, as determined by the Secretary of Labor pursuant to the provisions of the Davis-Bacon Act, shall be the minimum wages paid to the described classes of laborers and mechanics employed to perform the contract.

(C) ARS 40-360.22 Excavations:. determining location of underground facilities; providing information. This statute requires that no person shall begin excavating before the location and marking are complete or the excavator is notified that marking is unnecessary and requires that upon notification, the owner of the facility shall respond as promptly as practical, but in no event later than two working days. The "Blue Stake Center" (263-1100) was formed to provide a more efficient method of compliance with this statute.

This section is not applicable to an excavation made during an emergency which involves danger to life, health or property if reasonable precautions are taken to protect underground facilities.

(D) ARS-40-360.23. Making excavations in careful, prudent manner: liability for negligence. This statute states that obtaining information as required does not excuse any person making any excavation from doing so in a careful and prudent manner nor shall it excuse such persons from liability for any damage or injury resulting from his negligence.

(E) ARS-40-360.28 Civil penalty; liability. If the owner or operator fails to locate, or incorrectly locates the underground facility, pursuant to this article, the owner or operator becomes liable for resulting damages, costs and expenses to the injured party.

(F) ARS 32-2313. Business license; business name; branch office registration; renewal. No person, partnership, corporation or association shall engage in the business of general pest or weed control without being duly licensed/certified by the Structural Pest Control Board.

SUBSECTION 107.2 PERMITS:

Contractor shall obtain all permits and licenses, including those required by local utility companies and shall pay all charges, fees, taxes, and provide all notices necessary and incidental to the due and lawful prosecution of the work. Permits for earth moving may be obtained from Air Pollution Control, Maricopa County Department of Environmental Management, 2406 South 24th Street, Suite E-214, Phoenix, Arizona 85034, telephone number (602) 506-6700. The cost for earth moving dust control permit is $80 plus $8 per acre. The above permit costs are subject to change. It is the responsibility of the Contractor to verify these costs.

SUBSECTION 107.2.1 – NPDES PERMIT REQUIREMENTS:

(A) This project is subject to the National Pollutant Discharge Elimination System (NPDES) Storm water requirements for constuction sites under the Environmental Protection Agency (EPA) General Permit for Arizona. Under provisions of that permit, the Contractor shall be designated as permittee, and shall take all necessary measures to assure compliance with the NPDES General Permit for Arizona as well as all other applicable Federal, State and local laws, ordinances, statutes, rules and regulations pertaining to Storm wter discharge. As the permittee, the Contractor is responsible for preparing, in a manner acceptable to the EPA, all documents required by this regulation, including but not necessarily limited to:

1. Storm water Pollution Prevention Plan (SWPPP) for the project, including certification of compliance form. Contractorshall be required to develop, implement, update and revise the SWPPP, as necessary, in order to assure compliance with the EPA permit requirements. The SWPPP shall be retained on the project site at all times during construction.

2. Notice of Intent (NOI) to assure compliance with the NPDES General Permit for Arizona, including certification of signatures.

3. Notice of Termination (NOT) of coverage under NPDES General Permit for Arizona.

(B) Preliminary copies of the NOI and the SWPPP shall be submitted to Owner duing the pre-construction meeting and shall be subject to review by Owner prior to implementation.

(C) Contractor shall submit the completed and duly signed NOI forms no later than forty-eight (48) hours prior to the initial start of construction on the project to the following agencies:

Storm water Notice of Intent (4203)
USEPA
401 M Street, SW
Washington, D.C. 20460

A copy of the completed NOI form shall be submitted to the following:

Storm water Coordinator
Arizona Department of Environmental Quality
P.O. Box 600
Phoenix, AZ 85001-0600

Maricopa County, Current Planning
Planning and Development Division
411 N. Central Ave., Suite 300
Phoenix, AZ 85004
(602) 506-3301

Failure by the Contractor (or Subcontractors of any tier) to submit NOI's within the mandated time frame shall result in delay of the construction start date, and no claim for extension of time will be granted for such delay. A copy of the completed NOI shall be posted at the construction site.

(D) Inspections of all Storm water pollution control devices on the project shall be performed by Cntractor on a monthly basis and following each rainfall of 0.50 inches or more in a 24-hour period at the project site as required under provisions of the NPDES General Permit for Arizona. Contractor shall prepare reports on such inspections and retain the reports for a period of three years following the completion of the project. Inspection reports shall be submitted monthly to Owner along with progress payment requests. Additionally, Contractor shall maintain all Storm water pollution control devices on the project in proper working order, which shall include cleaning and/or repair during the duration of the project.

(E) Contractor warrants that its employees and Subcontractors of any tier and their employees shall at all times comply with all applicable laws, ordinances, statutes, rules and regulations set forth by all federal, state and local governments and the Environment Protection Agency in connection with NPDES Permitting requirements and laws and regulations pertaining to air, groundwater and surface water quality.

Fines and penalties imposed by the EPA against Owner or the Contractor for Contractor's failure to comply with any of the requirements of NPDES General Permit of Arizona shall be borne by the Contractor.

(F) Upon project completion, acceptance and demobilization, Contractor shall submit its completed, duly executed NOT form to the EPA, with a copy to the Arizona Deparment of Environmental Quality (and the appropriate municipality), at the address listed in Section (B) above, thereby terminating all NPDES permit coverage for the project. Contractor shall then surrender to Owner copies of the SWPPP, inspection information and all other documents prepared and maintained by the Contractor in compliance of the NPDES permit coverage for the project. Contractor shall retain the originals of such documents for a period of three (3) years following the completion of the project.

(G) The Lump Sum price for the SWPPP shall include all material, labor, and all other costs relating to the preparation, installation and maintenance of the SWPPP during project construction, including assuring proper operation of the pollution control devices installed, and all maintenance, cleaning, and disposal costs associated with clean-up and repair following storm events, runoff or releases on the project. The Lump Sum price for the SWPPP shall be inclusive of all costs, and no additional claims shall be made by Contractor under any other specification provision of these doucments, including Changed Conditions. Payment for this bid itme shall be upon completion and acceptance of the project, as per Section 109.1.

(H) Copies of all required forms and guidance for preparing the SWPPP are available in the "Drainage Design Manual for Maricopa County, Volume III Erosion Control." The manual is available at the Flood Control District, 2801 West Durango Street, Phoenix, Arizona 85009.

Payment for Construction SWPPP and permit requirements shall be made on the basis of lump sum for all work described in Subsection 107.2.1 for:
ITEM 107-1 Construction SWPPP

SUBSECTION 107.2.2 – OTHER PERMITS: The following permits have been obtained by the Owner for the construction of the dam. The Contractor shall follow all terms and conditions of each permit as they apply to his operations.

State 401 Water Quality Certification:

The Corps of Engineers and the Arizona Department of Environmental Quality have determined that this activity is precertified for a Section 401 permit under nationwide permit no. 3. The following are general requirements of the certification:

THE ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY - POLICY FOR PROTECTING WATER QUALITY DIRNG FACILITY CONSTRUCTION

Appropriate items as listed below should be included in specifications for construction and related activitites in or near watercourses. Adherence to the cited procedures should assure compliance with Water Quality Standards for Navigable Waters, A.A.C. R18-11-1. Specifications should require the person responsible for the activity to submit a program for effective control of water pollution to the person in charge of the project which includes procedures for protecting water from pollution with fuels, oils, bitumens, calcium chloride, silt, cement, asphalt, tires, batteries and other harmful materials, and for conducting and scheduling operatuions so as to avoid or minimize silting of the water.

SPECIFIC PR0CEDURES FOR PREVENTING WATER POLLUTION MAY INCLUDE:

1. *Provision for temporary pollution control measures such as : dikes, basins, ditches, diversions, silt fences and the application of straw and seed, to be functional prior to land disturbing activities.*

2. *Erosion control measures including minimizing clearing and grubbing and limiting exposure of erodible surface to 750,000 square feet for each construction phase or location.*

3. *Construction of footings in water by sheet pile cofferdam method and pumping water from within the dam to settling ponds before returning it to the watercourse.*

4. *Isolation of the construction area by dikes and/or berms.*

5. *Erection of barriers, covers, shields and other protective devices as necessary to prevent any construction materials, equipment or contaminants/pollutants from falling or being thrown into a watercourse.*

6. *Construction of drainage facilities with armoring when necessary to control erosion and sedimentation.*

7. *Provision of an adequate means, such as a bypass channel, to carry a stream free from mud and silt around operations which remove material from beneath a flowing stream.*

8. *A requirment for the transportation of materials across live streams to be conducted without muddyin the stream. Mechanized equipment should not be operated in stream channels of live streams except as may be necessary to construct crossings or barriers and fill for channel modifications.*

9. *A requirement for wash water from aggregate washing or other operations containing mud or silt to be treated by filtration or retention in a settng pond, or ponds adequate to prevent water from tranporting sediment into streams or watercourses.*

10. *A requirement for oily or greasy or substances originating from the contractor's operations not be placed where they will later enter a stream or watercourse.*

11. *Provisions for Portland cement or fresh Portland cement concrete not be allowed to enter flowing water of streams.*

12. *A requirement to return the flow of streams as nearly as possible to a meandering thread without creating a possible future bank erosion problem when operations are completed.*

13. *A requirement that material derived from roadway work should not be desposited in a stream or watercourse where it could be washed away by stream flows.*

Contractor shall follow all the requirements in the 401 Water Quality Certification permit.

US Army Corps of Engineers, 404 Permit (Attachment No.1 to SGCs):

The Corps of Engineers has determined, under Section 404 of the Clean Water Act (33 U.S.C. 1344), that the contract work complies with the terms of Nationwide Permit No 3. The 404 Permit Number is: 984-0495-LSF (Reference Attachment No.1 to SGCs).

The Contractor must comply with the following Special Condition(s) of the 404 permit:

1. *Should previously unknown historic or archeological remains be discovered while accomplishing activities authorized by this permit, the Contractor shall immediately cease work in the area of the discovery and shall immediately notify the Engineer who will notify the U.S.Army Corps of Engineers (ACOE) to insure compliance with paragraph 12. (Historic Properties) of the Nationwide Permit General Conditions. The Contractor is restricted from entering any archeological sites on or adjacent to the project area.*
2. *It the Contractor encounters an individual tortoise or its burrow prior to or during any activities authorized by this permit the Contractor shall utilize the Arizona Game and Fish Department's "Guidelines for Handling Sonoran Desert Tortoises Encountered on Development Projects".*
3. *The work shall be restored after construction to an environmentally acceptable condition. Watercourse morphology shall be re-established to match pre-construction configurations.*
4. *Construction material placed within the ACOE's jurisdictional area shall be free of substances which can cause or contribute to the pollution of waters of the United States.*

5. *If utilized, riprap shall be washed prior to placement to remove fines which may cause a violation of the turbidity water quality standard.*
6. *All work shall be conducted in a manner that minimizes the potential for the discharge of pollutants from action-related machinery or materials inside the ACOE's jurisdiction.*
7. *Pollution from the operation, repair, and maintenance, and storage of equipment in the construction area shall be immediately removed from and property disposed outside the ACOE's jurisdictional area.*
8. *No disposal of construction or demolition wastes, contaminated water or any other pollutant is authorized within or adjacent to the watercourse*
9. *No excavation, fill, or leveling is permitted in the watercourse, outside the boundaries of the permitted work areas. Work shall be contained within the boundaries of these work areas. These areas shall be clearly marked prior to start of any construction activities, and the contractor (s) shall be thoroughly familiarized with this boundary.*
10. *No fill shall be taken from the watercourses, outside the boundaries of the permitted work areas. Fill shall come from an area outside the Ordinary High Water Mark that does not impact the watercourses. Fill shall be free of any contaminants or pollutants.*
11. *During construction the work sites shall be maintained such that no construction debris or material spillover is allowed in the watercourses. Upon completion of the work all construction debris, excess material, residues, construction equipment, and other non-native material shall be removed from the job site, and outside of the ACOE's jurisdiction area.*
12. *A copy of the Section 404 authorization is included as Attachment No.1 to the Supplementary General Conditions. This is intended to confirm that the Contractor has read, understood and agrees to comply with the terms and conditions of the Section 404 authorization.*
13. *The Contractor shall allow representatives from the ACOE to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished within the terms and conditions of the permit.*

Contractor shall follow all the requirements in the 404 permit (Attachment No. 1).

ADWR Contruction Approval:

The Arizona Department of Water Resources (ADWR) has determined that this project is under the jurisdiction of the Division of Safety of Dams. The District (Owner) has applied for approval by ADWR to construct the modifications to White Tanks FRS#3 (Dam). It is anticipated that ADWR construction approval will be obtained prior to opening the bids.

All plans, specifications, addendums, plan and specification changes, shop drawings, Value Engineering proposals and other documents pertinent to the modification of the Dam will be reviewed by ADWR. Construction means, methods, materials, products and quality control will be reviewed and inspected and will be subject to approval by ADWR. Acceptance of the constructed facilities by the Owner will be contingent on approval by ADWR. As such, it is imperative that the Contractor shall follow all the

requirements specified on the plans and specifications and maintain strict quality control for all construction work .

SUBSECTION 107.3 PATENTED DEVICES, MATERIALS AND PROCESSES:

If the Contractor employees any design, device, material, or process covered by letters of patent or copyright, he shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the surety shall indemnify and save harmless the Contracting Agency, any affected third party or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material or process, or any trademark or copyright, and shall indemnify the Contracting Agency for any costs, expenses, and damages which it may be obligated to pay by reason of any infringement, at any time during the prosecution or after the completion of the work.

SUBSECTION 107.4 ARCHAEOLOGICAL REPORTS:

Attention is directed to Sections 41-844 and 41-846 Arizona Revised Statues. In view of the above, it shall be a provision of every contract that when archaeological features are encountered or unearthed in the excavation of material pits or of the roadway prism, or other excavation, the Contractor shall report promptly to the Director of the Arizona State Museum and the Contracting Agency. The Contractor will be allowed extra time as appropriate in accordance with the provisions of Section 108.

Any cultural and/or paleontological resource (historic or prehistoric site or object) discovered by the Contractor, or any person working on his behalf, shall be immediately reported to the Engineer. The Contractor shall suspend all operations in the immediate area of such discovery until written authorization to proceed is issued by the Engineer. An evaluation of the discovery will be made by authorized personnel and the Engineer to determine appropriate actions to prevent the loss of significant cultural or scientific resources.

SUBSECTION 107.5 SAFETY, HEALTH AND SANITATION PROVISIONS:

The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements and regulations of the Arizona State Department of Health or as specified by the Maricopa County Health Department, Sanitary Code.

The Contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions, on his own responsibility or as the Engineer may determine, reasonably necessary to protect the life and the health of employees on the job, the safety of the public and to protect property in connection with the performance of the work covered by the contract.

Precaution shall be exercised by the Contractor at all times for the protection of persons (including employees) and property. The Contractor shall comply with the provisions of all applicable laws, pertaining to such protection including all Federal and State occupational safety and health acts, and standards and regulations promulgated thereunder.

The entire construction site shall be considered a "Hard Hat Area" and all personnel in the area will be required to wear a hard hat.

SUBSECTION 107.5.1 ASBESTOS MATERIALS: The general contractor shall retain the services of a certified subcontractor specializing in asbestos abatement to cut, demolish, and properly dispose of the one-foot end section of each of the three CMP outlet pipes. The Contractor is required to employ these specialized services due to the expected disturbance asbestos-containing materials (ACM), specifically the rust-proofing coating, that will likely become airborne during the abrasive sawcutting procedure. Appropriate cutting and asbestos abatement procedures shall be employed by the subcontractor to contain the ACM and maintain work crew health and safety. Prewetting, particulate respirators, and plastic encapsulation shall be implemented as appropriate Analytical results for asbestos

content from samples taken from the interior coating of the three existing CMP outlet pipes are included as Attachment No.2 to the Supplementary General Conditions.

SUBSECTION 107.5.2 LEAD-CONTAINING PAINT: Paint and similar surface coating materials that contain lead compounds and in which the lead content exceeds 0.06 percent of the total weight of the non-volatile content of the paint or the weight of the dried paint film is declared a banned hazardous product and will not be used (Consumer Product Safety Act Part 1303 dated 9-1-77).

SUBSECTION 107.5.3 COMPLIANCE WITH THE ARIZONA COMMUNICATION STANDARD: Owner will provide Contractor with Material Safety Data Sheets (MSDS) for any products known to exist on the site that are deemed health hazards. Contractor will provide a copy of Owner-provided MSDS to all Subcontractors.

Contractor will provide Owner and all Subcontractors with MSDS for any products that have or are deemed health hazards that will be brought onto the site or created on the site by either Contractor or by any Subcontractors.

Contractor will provide Owner with a statement certifying that all personnel (Contractor and Subcontractor) employed by Contractor or by a Subcontractor on the job site have received the required Hazard Communication Standard training.

SUBSECTION 107.5.4 CONTRACTOR'S STATUS DURING ANY HAZARD REMEDIATION: If remediation of any discovered Regulated waste such as petroleum products (i.e. oil, grease), asbestos or hazardous waste not identified in this contract is necessary, the Owner will address the problem, and if this interferes with the project's critical path, then the CPM and project schedule will be reviewed and revised as mutually acceptable by the Engineer and Contractor to minimize the impact to the **total project schedule.** An extension in contract time for any delay to Contractor then resulting may be granted by Owner in accordance with Subsection 108.7.

If any Regulated substance, asbestos, or hazardous substance is encountered that results in a changed condition, then a change order may be issued in accordance with the contract.

If the delay impacts the CPM in such a manner that Contractor is prevented from continuing work on any portion of the project, and Owner issues a suspension of work order, then Contractor shall be entitled to compensation in the form of a **one-time payment** of Demobilization and Rebmobilization costs, which shall be no more than 6 percent of the original bid item for mobilization.

SUBSECTION 107.6 PUBLIC CONVENIENCE AND SAFETY:

The Contractor shall at all times so conduct his work as to assure the least possible obstruction to traffic and adjacent residents. The safety, convenience, and the protection of persons and property, of the general public and residents along the street, highway, and areas adjacent to the work area shall be provided for by the Contractor.

SUBSECTION 107.6.1 CONTRACTOR'S MARSHALING YARD: Contractors shall notify the Engineer when using vacant property to park and service equipment and store material for use on the Contracting Agency construction contracts.

(A) Any use of vacant property adjacent to or near the project for parking or servicing equipment and/or storing of material will require the Contractor to obtain written approval from the property owner.

(B) A copy of the property owner's approval shall be submitted to the Engineer, stating the use of the Marshaling Yard in connection with the project.

(C) The Yard shall be adequately maintained to control dust and mud from leaving the property.

(D) Work in the Marshaling Yard shall be scheduled so as to comply with the Agency Noise Ordinance.

(E) Equipment, materials, etc., shall be located so as to minimize impact on adjacent properties.

(F) The Contractor shall clean up property promptly upon completion of use.

(G) Contractor's notification to the Engineer shall specify in detail how the Contractor proposes to comply with (C) through (F) above.

(H) The Contractor shall obtain a written release from the property owner after completion of use. A copy of the release shall be presented to the Engineer.

SUBSECTION 107.6.2 NOISE LEVEL: The Contractor shall comply with the Agency Code concerning work hours and noise level during construction.

SUBSECTION 107.6.3 PROJECT SIGNS ALLOWANCE: Contractor shall provide and install five project information signs, at locations to be determined by the Engineer, before beginning construction to inform the public of the forthcoming project, construction dates, and suggested alternate travel routes. Project signs shall include the names of all agencies participating in the project. The signs shall also include the 24-hour hot line complaint telephone number. Signs shall be constructed in accordance with the "Project Sign Information" drawing to be provided to the Contractor at the pre-construction meeting. The signs shall be installed at the location(s) approved by the Engineer. The Contractor shall maintain the signs as necessary, and update the information as requested by the Engineer. Payment shall be made according to the allowance in the Bidding Schedule in installments of 50% upon installation, and the remaining 50% upon final payment for the work by bid schedule.

ITEM 107-2 PROJECT SIGNS ALLOWANCE

SUBSECTION 107.6.4 PUBLIC INFORMATION AND NOTIFICATION: The Contractor shall employ a specialty public information service as a subcontractor to provide the community relations program for the project as described herein. The name and address of the public information subcontractor shall be submitted with the bid as specified in subsection 102.6 of the Supplementary General Conditions. Contractor shall work closely with his subcontractor in developing and carrying out the community relations program, but shall not expect to actually perform the work of providing the public information services. Contractor shall submit a history of the subcontactor's qualifications and experience in public information services at the pre-construction conference for acceptance by the Engineer. The community relations program shall be designed to run the full length of calendar days in the contract for this project. The program will include but not be limited to:

Printing and distributing a pre-construction information letters, public notices and news letters to all residents, business, schools, farm operations, etc. within 1 mile of the project area.

The Contractor will use these or other means to inform the local citizens of necessary operations which create high noise levels, street closures, limited access, detour locations, haul route and material delivery routes, hours of construction and disruption of bus, trash, school bus and other delivery/pick-up routes.

The Contractor will be required to furnish a private line telephone to be used solely for receiving incoming calls from local citizens with questions or complaints concerning construction operations or procedures. The Contractor shall publish this telephone number and maintain a 24-hour answering service. The answering service shall be operated by Contractor personnel during all hours that work is being performed on the job site. The Contractor shall maintain a log of incoming calls, responses, and action taken which shall be submitted to the Engineer weekly and/or upon request.

Prior to the start of work, the Contractor shall notify, by letter, all affected businesses and residents of construction plans and schedules within the geographic area identified above. In addition, all schools and emergency services which serve the geographic area will also be notified even though they may be located outside the geographic area described above. The letter shall contain, as a minimum, the following information:

1. Name of Contractor
2. 24-hour telephone compliant number
3. Brief description of the project
4. Name of Contractor project Superintendent
5. Name of Engineer
6. Name of area supervisor
7. Construction schedule including anticipated work hours
8. Traffic regulations including land restrictions

The Contractor shall submit a Public Information and Notification Plan to the Engineer at the pre-construction meeting. No payments shall be made for this item unitl the Engineer approves the plan.

The plan and work which is eligible for reimbursement shall include: meetings with impacted businesses, schools, emergency services, residents, etc.; scheduling; preparation and distribution of newsletter at least bi-weekly; and maintaining a 24-hour telephone hot line for complaints.

The Contractor shall submit a final report/evaluation of the Public Information and Notification process performed for this project. This report shall be submitted before the Contractor receives final payment.

Any items not listed here and listed in Section 401, Subsection 104.4 or any other Section or Subsection of this Special Provision that requires the Contractor to inform the public will be responsibility of the General Contractor.

It will be up to the General Contractor to delegate that authority to the Public Information SubConsultant. The cost of such item will not be paid from this allowance. However, this cost will be incidental to the bid item cost for constructing such item.

Payment will be based on invoices, and will be for a total amount not to exceed the amount shown in the bid schedule to the item, "PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE", for work performed in notifying and coordinating with the local population impacted by this project. To cover the cost for administration and supervision, the General Contractor may add an amount equal to not more than 5 percent of the accumulated total invoiced billing for actual public infomatiion services provided by a Subcontractor. This cost for administration and supervision will be considered included in the "PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE".

ITEM 107-3 PUBLIC INFORMATION AND NOTIFICATION ALLOWANCE

SUBSECTION 107.7 BARRICADES AND WARNING SIGNS:

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and safety of the public. Roads, partially or fully closed to traffic, shall be protected by effective barricades, and obstructions shall be illuminated during hours of darkness. Suitable warning signs shall be provided to properly control and direct traffic.

The Contractor shall erect warning signs in advance of any place on the project where operations may interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides With an existing road. Such warning signs shall be constructed and erected in accordance with the Traffic Barricade Manual prepared or adopted by the Contacting Agency's Traffic Engineering Department which is hereby made a part of these specifications.

SUBSECTION 107.8 USE OF EXPLOSIVES:

The use of explosives will **NOT** be permitted.

SUBSECTION 107.9 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE:

The Contractor shall limit all construction activities to the areas shown in the plans and shall not disturb any areas other than as required for construction as shown on the plans.

Under no circumstances shall the disposal of debris from construction operations create a blemish on the landscape. Material which is to be stockpiled or disposed of off-site shall not encroach on running or intermittent streams, or other waters of the U.S. unless the Contractor has obtained the appropriate permits in accordance with applicable state and federal regulations.

The Contractor shall protect-in-place all existing structures and other features along the project areas and as may be identified on the plans, including but not limited to irrigation facilities, roadways, fencing, walls, signs, and other structures and features near construction activities.

The Contractor will grade all Temporary Construction and Permanent Easement areas, and project areas which are disturbed during construction to the lines and grades shown on the plans, or as a minimum, where no lines and grades are shown, to a condition similar to or better than the pre-existing condition.

The Contractor shall restore the area of all temporary drain locations to as good as or better than pre-existing conditions, including backfilling any temporary ditches and removing any temporary berms and pipes.

The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location and shall not move them until directed.

The Contractor shall be responsible for all damage or injury to property of any character, during the prosecution of the work, resulting from any act, omission, neglect, or misconduct in his manner or method of executing the work, or at any time due to defective work or materials, and said responsibility will not be released until the project shall have been completed and accepted.

When or where any direct or indirect damage or injury is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work, or in consequence of the nonexecution thereof by the Contractor, he shall restore, at no cost to the Contracting Agency, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as may be directed, or he shall make good such damage or injury in an acceptable manner. Such damage will include but not be limited to landscaped areas. The contractor shall regrade the disturbed area as directed and restore the surface material to match existing in type and quality.

When construction is within temporary construction easements, the Contractor shall restore all disturbed areas to a condition equal to or better than the existing improvements. Such restoration will include but not be limited to asphalt, walkways, fences, lights, sprinklers, landscaping, etc. In the case of landscaping, the Contractor may remove and store sod and plant material. If, in the determination of the Engineer, the sod and/or plant material did not survive the transplanting in good condition, the Contractor shall replace the sod and/or plant material to match in type and quality. Also, the Contractor may salvage any sprinkler system materials, lighting materials, etc. In the event that it is not feasible to reinstall the salvaged material, new material shall be installed.

The Contractor shall not dump spoil or waste material on private property without first obtaining from the owner written permission for such dumping. All such dumping shall be in strict conformance with the Grading and Drainage Ordinance of the Contracting Agency.

Access to private property shall be maintained to keep inconvenience to the property owner to a minimum. Prior to any construction in front of driveways the Contractor shall notify the property owner 24 hours in advance. Inconvenience caused by construction across driveways and sidewalks shall be kept to a minimum by restoring the serviceability as soon as possible. If it is necessary to leave open excavation for a long period of time, the Contractor shall provide structurally adequate steel plates to bridge the excavation.

SUBSECTION 107.10 CONTRACTOR'S RESPONSIBILITY FOR WORK:

The Contractor shall properly guard, protect, and take every precaution necessary against injury or damage to all finished or partially finished work, by the action of the elements or from any other cause until the entire project is completed and accepted by the Engineer. The Contractor shall rebuild, repair, restore, and make good all injuries or damages to any portion of the work before final acceptance at no cost to the Contracting Agency. Partial payment for completed portions of the work shall not release the Contractor from such responsibility.

In case of suspension of the work for any cause whatever, the Contractor shall be responsible for the project and shall take such precautions as may be necessary to prevent damage to the project and shall erect any necessary temporary structures, signs, or other facilities at no cost to the Contracting Agency.

The Contractor shall be responsible for completing work under the following conditions:

A) Contractor is advised that the work will be subject to flows of water of varying amounts. Owner assumes no responsibility for notifying Contractor of any anticipated flows, nor for any damages incurred by Contractor to its equipment or to any of the Contractor's work as a result of any flows of water.

B) No payment will be made for providing excavation protective works for such things as dewatering. The cost thereof shall be included in the bid price for the construction or installation of the items to which said excavation protective works are incidental or appurtenant.

C) The Contractor shall take all necessary precautions to protect his work from damage that may be caused by stormwater runoff and ponding.

D) The Contractor shall take all necessary action to protect the public from the construction work area.

E) The Contractor shall maintain dust control measures at all times during the project.

F) The Contractor shall not remove any vegegation, plants and/or trees outside the rights-of-way.

G) The Contractor shall take all necessary action to protect the public from the construction work area.

H) The Contractor shall take all necessary action to ensure that all construction materials are stored in such a manner that storm runoff from the storage area does not divert the flows or block the historical runoff patterns.

SUBSECTION 107.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES:

At points where the Contractor's operations are adjacent to properties of utility firms or other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.

The Contractor shall cooperate with the owners of any underground or overhead utilities in their removal and rearrangement operations in order that these operations may progress in a reasonable manner, that duplication of work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted.

If any utility service is interrupted as a result of accidental breakage, the Contractor shall promptly notify the proper authority and shall cooperate with the said authority in the restoration of service. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

The Contractor shall expose all underground utilities and structures which might interfere with the construction of the project, in order to permit survey location prior to construction.

The Contractor shall assume full responsibility for damages to any underground facility/utility as a result of failing to obtain information as to its location, failing to excavate in a careful, prudent manner or failing to take measures for protection of the facilities/utilities. The Contractor is liable to the owner of the underground facility/utility for the total cost of the repair.

SUBSECTION 107.12 FURNISHING RIGHT-OF-WAY:

The Contracting Agency will provide right-of-way, easements, and temporary construction easements (TCE) for all work in advance of construction. Any exceptions will be indicated in the special provisions.

SUBSECTION 107.13 PERSONAL LIABILITY OF PUBLIC OFFICIALS:

In carrying out any provisions of these specifications, or in exercising any power or authority granted to them by or within the scope of the contact, there shall be no liability upon the Contracting Agency, Engineer, or their authorized representatives, either personally or as officials of the Contracting Agency, it being understood that in all such matters they act solely as agents and representatives of the Contracting Agency.

SUBSECTION 107.14 NO WAIVER OF LEGAL RIGHTS:

Upon completion of the work, the Contacting Agency will expeditiously make final inspection and notify the Contractor of acceptance. Such final acceptance, however, shall not preclude or stop the Contracting Agency from correcting any measurement, estimate, or certificate made before or after completion of the work, nor shall the Contracting Agency be precluded or stopped from recovering from the Contractor or his surety, or both, such overpayment as it may sustain, or by failure on the part of the Contractor to fulfill his obligations under the contract. A waiver on the part of the Contracting Agency of any breach of any part of the contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the contract and in addition to any specific remedy provided the Contracting Agency in the contract documents, shall be liable to the Contracting Agency for latent defects, fraud or such gross mistakes as may amount to fraud, or as regards the Contracting Agency's rights under any warranty or guaranty or remedy required by law.

End of Section

SECTION 108 COMMENCEMENT, PROSECUTION AND PROGRESS

SUBSECTION 108.1 NOTICE TO PROCEED:

Contractor shall commence work within seven (7) calendar days after the Notice to Proceed and complete all work within **one hundred and fifty (150)** calendar days beginning with the date specified in the Notice to Proceed.

The Contractor shall notify the Field Engineering Inspection Section 24 hours in advance of the time and place where work will begin and the Survey Section 2 working days in advance for staking.

SUBSECTION 108.2 SUBLETTING OF CONTRACT:

For this project, Contractor shall perform, with its own organization, work amounting to 50 percent or more of the total contract cost.

The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the contract or contracts, or of his right, title, or interest therein, without written consent of the Contracting Agency.

Subcontracts shall be in accordance with and the Contractor shall be bound by the following provisions:

(A) All subcontracts shall be subject to the approval of the Engineer.

(B) All subcontracts shall be in writing and shall provide that all work to be performed thereunder shall be performed in accordance with the terms of the contract.

(C) Subcontractors shall conform to the regulations governing employment of labor.

(D) The subcontracting of any portion of the work will in no way release the Contractor of his liability under the contract and bonds.

(E) On all contracts for pipeline construction, roadway construction or roadway maintenance, the Contractor shall perform, with his own organization, work amounting to not less than 50 percent of the total contract cost.

On other types of contracts the individual agency shall determine the percentage or waive this requirement.

SUBSECTION 108.3 CORRESPONDENCE TO THE CONTRACTOR:

A written notice, to the Contractor from the Contracting Agency, shall be considered delivered and the service thereof completed, when said notice is posted, by certified mail, to the said Contractor at his last given address, or delivered in person to the Contractor or his authorized representative on the work.

SUBSECTION 108.4 CONTRACTOR'S CONSTRUCTION SCHEDULE:

Contractor shall submit a proposed work schedule to Engineer at the pre-construction meeting for review before starting work using the Primavera or other similar software program that is acceptable to the Engineer. Weekly updates shall be submitted to Engineer at the weekly coordination meeting.

Contractor shall be solely responsible for the planning, scheduling and execution of the work to assure timely completion of the project.

SUBSECTION 108.4.1 CONTRACTOR'S BILLING SCHEDULE: The Contractor shall furnish the Engineer an Estimated Billing Schedule which shall include the estimated amount of each billing for the total project at the pre-construction conference, and thereafter at monthly intervals as agreed to between the Contractor and Engineer.

SUBSECTION 108.5 LIMITATION OF OPERATIONS:

The normal work week shall be 40 hours, Monday through Friday, and the work hours will be determined at the pre-construction meeting. This does not imply that this contract can be completed on time utilizing normal working hours. The Contractor shall furnish sufficient forces and shall work such hours including night shifts and overtime operations as necessary to ensure the completion of the work within the time required. To work other than normal working hours, for other than emergency situations, the Contractor shall give the Engineer at least 24 hours advance notification and receive written approval before working. Should the Contractor elect to perform any work after regular working hours, on weekends, or legal holidays, any charges incurred by the Owner for inspection of the work, surveys or tests of materials will be deducted from monies due or to become due to the Contractor.

The Contractor shall conduct the work at all times in such a manner and sequence that will assure the least interference with traffic and inconvenience to the public. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience.

All traffic affected by the construction will be regulated in accordance with the current Traffic Barricade Manual prepared or adopted by the Contracting Agency's Traffic Engineering Department.

Except in emergencies endangering life or property, written permission shall be obtained from the Engineer to perform any work after regular working hours, on weekends, or legal holidays. Prior to the start of such work, the Contractor shall arrange with the Engineer for the continuous or periodical inspection of the work, surveys and tests of materials, when necessary.

If, in the opinion of the Engineer, the Contractor has fallen behind the approved progress schedule, the Contractor shall take such steps as may be required by the Engineer, including but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such tune as the work is back on schedule. He shall also submit for approval no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the approved rate of progress will be regained, all at no additional cost to the Contracting Agency.

SUBSECTION 108.6 CHARACTER OF WORKMEN; METHODS AND EQUIPMENT:

The Contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time required by the specifications.

All workmen shall be competent and have sufficient skill, knowledge and experience in their class of work and in the operation of equipment required to perform all work properly and satisfactorily.

Any person employed by the Contractor or any Subcontractor who, in the opinion of the Engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed from the work by the Contractor or Subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer. The Contractor or Subcontractor shall keep the Contracting Agency harmless from damages or claims for compensation that may occur in the enforcement of this section.

Should the Contractor or Subcontractor fail to remove such person as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may suspend the work by written notice until such orders are complied with.

All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to produce a satisfactory quality of work. Equipment used on any portion of the project shall be such that it will not damage property adjacent to the work area.

When the methods and equipment to be used by the Contractor in accomplishing the construction are not prescribed, the Contractor is free to use any methods or equipment that he demonstrates to the satisfaction of the Engineer will accomplish the work in conformity with the requirements of the specifications.

When the specifications state the construction shall be performed by the use of certain methods and equipment, such methods and equipment shall be used unless others are authorized by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified, he may request authority from the Engineer to do so. The request shall be in writing and shall include a full description of the methods and equipment proposed to be used and an explanation of the reasons for desiring to make the change. If approval is given, it will be on the condition that the Contractor will be fully responsible for producing construction work in conformity with the specifications. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet the specifications, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining construction with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in basis of payment for the construction items involved nor in contract time as result of authorizing a change in methods or equipment under these provisions.

SUBSECTION 108.7 DETERMINATION AND EXTENSION OF CONTRACT TIME:

The number of calendar days allowed for the completion of the work included in the contract will be as stated in the proposal and will be known as the contract time.

When the contract time is on a calendar day basis it shall consist of the number of calendar days specified, including all weekends and legal holidays. All calendar days elapsing between the effective dates of any written notice from the Engineer to suspend work and to resume work following suspensions, not the fault of the Contractor, shall be excluded.

When the contract completion time is a fixed calendar date it shall be the date on which all work on the project shall be completed and meet final inspection.

If the Contractor finds it impossible for reasons beyond his control to complete the work within contract time as specified or as extended, he shall immediately submit a written request to the Engineer for an extension of time setting forth therein the reasons which he believes will justify the granting of his request. The Contractor's plea that insufficient time was specified is not a valid reason for extension of time. If the Engineer' finds that the work was delayed because of conditions beyond the control and through no fault of the Contractor, he may extend the time for completion in such amount as the conditions justify. The extended time for completion shall then be in full force and effect the same as though it were the original time for completion.

SUBSECTION 108.8 GUARANTEE AND WARRANTEE PROVISIONS:

The Contractor shall guarantee the work against defective workmanship or materials for a period of 1 year from the date of its final acceptance under the contract, ordinary wear and tear and unusual abuse or neglect excepted.

Any omission on the part of the Engineer to condemn defective work or materials at the time of construction shall not be deemed an acceptance, and the Contractor will be required to correct defective work or materials at any time before final acceptance and within 1 year thereafter.

Should any defects develop within 1 year from the date of final acceptance due to faults in workmanship or materials the Contractor shall, within 14 calendar days of receipt of written notice from the Contracting Agency, begin making the necessary repairs to the satisfaction of the Engineer. Such work shall include the repair or replacement of other

work or materials damaged or affected by making the above repairs or corrective work, all at no additional cost to the Contracting Agency.

If defects develop which are determined by the Engineer to be an emergency, the Engineer shall notify the Contractor, via the most expeditious means, regarding the nature and condition of the defects. In turn, the Contractor shall immediately dispatch necessary forces to correct the defect or the emergency condition. If the Contractor, in his initial action, resolves the emergency condition but not the defect, a letter as discussed above will follow and normal procedures for corrections will be employed. If immediate or appropriate action, satisfactory to the Engineer, is not taken by the Contractor, of if the Contractor cannot be contacted, the Engineer will deploy necessary forces to correct and/or secure the deficiency. Costs of the Engineer's action shall be paid by the Contractor and/or his bonding agency. Should it later be determined that the defects requiring such emergency action are not the responsibility of the Contractor, the Contractor will be paid for all costs incurred as a result of these demands in accordance with Subsection 109.5. Such action by the Engineer will not relieve the Contractor of the guarantees required by this section or elsewhere in the Contract Documents.

In case of work, materials, or equipment for which written warranties are required by the special provisions, the Contractor shall provide or secure from the appropriate Subcontractor or supplier such warranties addressed to and in favor of the Contracting Agency and deliver same to the Engineer prior to final acceptance of the work. Delivery of such warranties shall not relieve the Contractor from any obligation assumed under any other provisions of the contract.

The warrantees and guarantees provided in this subsection of the contract documents shall be in addition to and not in limitation of any other warrantees, guarantees or remedies required by law.

SUBSECTION 108.9 FAILURE TO COMPLETE ON TIME:

The actual cost per calendar day incurred by the District for Administrative and Inspection Services on this project will be added to the daily charges as indicated by **TABLE 108-1, LIQUIDATED DAMAGES,** and will be deducted from money due or to become due to the Contractor for each and every calendar day that work shall remain incomplete after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer. Nothing contained in this provision shall prohibit the Owner from deducting from money due or to become due to the Contractor for any other costs incurred by the Owner directly attributable to the delay in completing this contract.

For each and every calendar day that work shall remain incomplete after the time specified for the completion of the work in the proposal, or as adjusted by the Engineer, the sum per calendar day shown in table 108-1, unless otherwise specified in the proposal form, may be deducted from monies due to or to become due to the Contractor, not as a forfeit or penalty but as liquidated damages. This sum is fixed and agreed upon between the parties because the actual loss to the Contracting Agency and to the public caused by delay in completion will be impractical and extremely difficult to ascertain and determine.

Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion, or after the date to which the time fixed for its completion may have been extended, will in no way operate as a waiver on the part of the Contracting Agency of any of its rights under the contract.

TABLE 108-1		
LIQUIDATED DAMAGES		
Original Contract Amount		**Daily Charges**
From More Than	To and Including	Calendar Day or Fixed Date
$ 0	$ 25,000	$ 210
25,000	50,000	250
50,000	100,000	280
100,000	500,000	430
500,000	1,000,000	570

TABLE 108-1		
LIQUIDATED DAMAGES		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day or Fixed Date
1,000,000	2,000,000	710
2,000,000	5,000,000	1,070
5,000,000	10,000,000	1,420
10,000,000	-	1,780

SUBSECTION 108.10 FORFEITURE AND DEFAULT OF CONTRACT:

It is further agreed to by the Contractor that if he:

(A) Fails to begin the work under the contract within a reasonable time, or

(B) Fails to perform the work with sufficient workmen and equipment or with sufficient materials to assure the prompt completion of said work, or

(C) Performs the work unsuitably or neglects or refuses to remove materials or to perform anew such work as may be rejected as unacceptable and unsuitable, or

(D) Discontinues the prosecution of the work, or

(E) Fails to resume work which has been discontinued within a reasonable time after notice to do so, or

(F) At any time colluded with any party or parties, or

(G) Allows any final judgment to stand against him unsatisfied for a period of 14 calendar days, or

(H) For any cause whatsoever, fails to carry on the work in an acceptable manner, the Engineer will give notice in writing to the Contractor and his surety of such delay, neglect, or default, and advise them that the work must be resumed immediately.

If the Contractor or surety, within a period of 14 calendar days after such notice, has not proceeded in accordance therewith, then the Contracting Agency will, upon written notification from the Engineer of the fact of such delay, neglect or default and the Contractor's failure to comply with such notice, have full power and authority without violating the contract, to take the prosecution of the work out of the hands of the Contractor. The Contracting Agency may appropriate or use any or all materials and equipment on the ground as may be suitable and acceptable and may enter into an agreement for the completion of said contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of said contract in an acceptable manner.

All costs and charges incurred by the Contracting Agency, together with the cost of completing the work under contract, will be deducted from any monies due or which may become due said Contractor. If such expense exceeds the sum which would have been payable under the contract, then the Contractor and the surety shall be liable and shall pay to the Contracting Agency the amount of such excess.

SUBSECTION 108.11 TERMINATION OF CONTRACT:

The Contracting Agency may terminate the contract or a portion thereof if conditions encountered during the progress of the work make it impossible or impracticable to proceed with the work or a local or national emergency exists.

When contracts, or any portion thereof, are terminated before completion of all work in the contract, adjustments in the amount bid for the pay items will be made on the actual quantity of work performed and accepted, or as mutually agreed for pay items of work partially completed or not started. No claim for loss of anticipated profits will be considered.

Termination of the contract or any portion thereof shall not relieve the Contractor of his responsibilities for the completed work nor the surety of its obligation for and concerning any just claims arising out of the work performed.

End of Section

SECTION 109 MEASUREMENTS AND PAYMENTS

SUBSECTION 109.1 MEASUREMENT OF QUANTITIES:

All work completed under the contract will be measured by the Engineer according to United States standard measures. The methods of measurement and computation to be used in determination of quantities of materials furnished and of work performed under the contract will be those methods generally recognized as conforming to good engineering practice.

A station, when used as a definition or term of measurement, will be 100 linear feet.

Unless otherwise specified, longitudinal measurements will be made along the grade line.

Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the plans or ordered in writing by the Engineer.

The term ton will mean the short ton consisting of 2,000 pounds avoirdupois.

Unless otherwise specified, structures will be measured according to neat lines shown on the plans or as altered to fit field conditions.

In computing volumes of excavations or fill, the average end area method or other acceptable methods as determined by the Engineer will be used.

Volumes will be computed at 60°F, using ASTM D-1250 for Asphalt or ASTM D-633 for Tars.

Lumber will be measured by the thousand board foot measure actually used in the work. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term lump sum, when used as a pay item, will mean complete payment for the work described.

Sundry items which have a basis for measurement and payment herein and which are incidental to or required in the construction of the work but are not included as items in the bid schedule shall be considered an integral part of the contract, and all labor, materials, etc. required for such items shall be furnished by the Contractor and the cost of same included in the unit price bid.

SUBSECTION 109.2 SCOPE OF PAYMENT:

Measurement and payment for pay items in the proposal will be as indicated in the applicable standard specification or in the special provisions.

When payment is specified to be made on the basis of weight, the weighing shall be done on certified platform scales sealed by the State Inspector or the City Sealer of Weights and Measures as defined by ARS Sections 44-2112 and 44-2116. The Contractor shall furnish the Engineer with duplicate Weighmaster's Certificates showing the actual net weights together with the information required by ARS Section 44-2142. The Contracting Agency will accept the certificates as evidence of the weight delivered.

Payment for the various items in the proposal will be made at the unit price bid in the proposal, and shall be compensation in full for furnishing all labor, materials, equipment and appurtenances necessary to complete the work in a satisfactory manner as shown on the plans and as required in the specifications, with all connections, testing, and related work completed. Each item, fixture, piece of equipment, etc., shall be complete with all necessary connections and appurtenances, for the satisfactory use and operation of said item. No additional payment will be made for work related to any item unless specifically called for in the proposal. This compensation shall also cover

all risk, loss, damage or expense of whatever character arising out of the nature of the work or the prosecution thereof, subject to the provisions of Section 107. Payment shall not be made for unused materials.

SUBSECTION 109.3 ASSIGNMENT OF PAYMENTS:

The Contractor shall not assign payments of a contract or any portion thereof without approval of surety and written consent of the Contracting Agency.

Claims for monies due or to become due the Contractor may be assigned to a bank, trust company, or other financing institution, and may thereafter be further assigned and reassigned to any such institution. Any such assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in such financing. Any assignment of money shall be subject to all proper setoffs and withholdings in favor of the Contracting Agency and to all deductions provided for in these specifications.

SUBSECTION 109.4 COMPENSATION FOR ALTERATION OF WORK:

SUBSECTION 109.4.1 BY THE CONTRACTING AGENCY: Compensation for alternations of work will be:

(A) For a decrease greater than 20 percent in either the total cost of the contract or the total cost of a major item and when a reasonable cost analysis supports an increase in the pro rata share of fixed cost chargeable to this item in total, an increase adjustment in the monies due the Contractor may be made. This adjusted compensation will not exceed 80 percent of the original lump sum contract amount or, if for a unit price item, the adjustment will not exceed 80 percent of the original extended until bid price. This does not apply to items labeled as contingent bid item in the bid proposal.

(B) For an increase greater than 20 percent, any adjustment made will only apply to that cost in excess of 120 percent of the original bidding schedule. If either party presents a reasonable cost analysis that shows a change in the pro rata share of fixed costs chargeable to this item in total, an increase or decrease adjustment will be made. This increase or decrease adjustment will be made on such basis as is necessary to cover a reasonable estimate of cost, plus an allowance, not to exceed 15 percent, for overhead and profit. If the parties are unable to reach an agreement, the Engineer has the authority to order the excess work done on an actual cost basis as specified in Subsection 109.5.

(C) For either an increase or decrease in cost, no claim shall be made by the Contractor for any loss of anticipated profits.

SUBSECTION 109.4.2 DUE TO PHYSICAL CONDITIONS: Compensation for alternation of work due to physical conditions will be:

(A) If the Engineer, after his investigation of the site conditions, agrees that they materially differ from those indicated in the contract and would cause an increase in the Contractor's bid cost of accomplishing the work, new unit bid prices or a lump sum cost (for the additional work only) may be negotiated. If the parties are unable to reach an agreement on price, the Engineer has the authority to order this additional work accomplished on an actual cost basis as specified in Subsection 109.5.

(B) If the Engineer, after his investigation of the site conditions, finds that these conditions do not materially differ from those indicated in the contract, he has the authority to order the work to be accomplished at the original bid price(s).

SUBSECTION 109.4.3 DUE TO EXTRA WORK: If the Contractor can present valid, factual evidence, satisfactory to the Engineer, that the work in question is an item not provided for in the contract as awarded then a unit bid price or lump sum cost, for this item only, may be negotiated. If the parties are unable to reach an agreement on price or cost, the Engineer has the authority to order the extra work accomplished on an actual cost basis as specified in Subsection 109.5.

SUBSECTION 109.4.4 MADE AT THE CONTRACTOR'S REQUEST: Any alterations, if approved, will be a reduction in cost or at no additional cost to the Contracting Agency.

SUBSECTION 109.4.5 DUE TO FAILURE OF CONTRACTOR TO PROPERLY MAINTAIN THE PROJECT:

(A) For any suspension of work during normal working hours due to failure of the Contractor to properly maintain the project, there will be no additional compensation or time allowed.

(B) If the Engineer provides the Contractor with a written order to provide adequate maintenance of traffic, adequate cleanup, adequate dust control or to correct deficiencies resulting from abnormal weather conditions and the Contractor fails to comply in the time frame specified, the Contracting Agency may have the work accomplished by other sources.

The Contracting Agency will deduct the cost of accomplishing the work from monies due or to become due to the Contractor. Computation of the cost will be in accordance with Subsection 109.5.4.2.

SUBSECTION 109.4.6 ALLOWABLE MARK-UPS:

Only the allowable mark-ups as defined in Subsection 109.5 shall be allowed. Additional compensation for other items shall not be considered or allowed.

SUBSECTION 109.5 ACTUAL COST WORK:

The compensation for actual cost work performed by the Contractor (Subcontractor) shall be determined by the Engineer in the following manner.

SUBSECTION 109.5.1 EQUIPMENT: FOR all equipment, the use of which has been authorized by the Engineer, except for small tools and manual equipment, the Contractor will be paid in accordance with the latest Schedule of Equipment Rates used by the Arizona Department of Transportation.

SUBSECTION 109.5.2 MATERIAL: For all material, accepted by the Engineer and used in the work, the Contractor will be paid the actual cost of such material including transportation cost, to which total cost will be added a sum equal to 15 percent thereof.

SUBSECTION 109.5.3 LABOR: For all labor and for the foreman, when he is in direct charge of the operation, the Contractor will be paid:

(A) The actual wages paid plus the current percentage thereof as determined by the Arizona Department of Transportation which is deemed to cover the Contractor's cost incurred as a result of payment imposed by State or Federal Law and payments that are made to, or on behalf of, the workman other than the actual wage. Actual wage is defined as the required current hourly rate paid to the labor classification concerned and does not include any fringe benefits or dislocation allowances. If the Contractor is not required to pay fringe benefits equivalent to the Current rates published in the Federal Register, an equitable deduction will be made from the current percentage established by the Arizona Department of Transportation.

(B) For the first $50,000 of labor cost computed under paragraph (A) above, the Contractor will be paid an amount equal to (15) fifteen percent for overhead and profit.

(C) For all labor cost computed under paragraph (A) above, in excess of $50,000 but not exceeding $100,000, the Contractor will be paid an amount equal to (12) twelve percent for overhead and profit.

(D) For any labor cost computed under paragraph (A) above in excess of $100,000 the Contractor will be paid an amount equal to (10) ten percent for overhead and profit.

SUBSECTION 109.5.4 WORK PERFORMED BY SUBCONTRACTORS OR OTHER SOURCES:

SUBSECTION 109.5.4.1 WORK PERFORMED BY SUBCONTRACTORS: If it is determined by the Engineer that portions of the Actual Cost Work to be performed requires specialized labor or equipment not normally used by the Contractor and such work is then authorized to be performed by a subcontractor(s), the subcontractor(s) will be paid by the Contractor in accordance with the actual cost work procedures outlined herein. The Contractor will be paid by the Contracting Agency the full amount of the subcontract plus the following percentages for administration and supervision.

(A) For the first $10,000 accumulated total of all change order work performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is $3,000 or less, the Contractor will be paid $300 for administration and supervision.

(B) For all change order work in excess of $10,000 accumulated total performed by subcontractors (less mark-up for overhead and profit), the Contractor will be paid an amount equal to 5 percent of the accumulated total for administration and supervision.

SUBSECTION 109.5.4.2 WORK PERFORMED BY OTHER SOURCES: If the Contracting Agency has work performed by other sources, in accordance with Subsection 109.4.5 (B), the Contracting Agency will deduct, from monies due or to become due to the Contractor, the full amount of the cost of accomplishing the work by other sources plus the following percentages for administration and supervision:

(A) For the first $10,000 accumulated total of work performed by other sources, the Contracting Agency will deduct an amount equal to 10 percent of the accumulated total for administration and supervision. If the accumulated total is $3,000 or less, the Contracting Agency will deduct $300 for administration and supervision.

(B) For all work in excess of $10,000 accumulated total performed by other sources, the Contracting Agency will deduct an amount equal to 5 percent of the accumulated total for administration and supervision.

SUBSECTION 109.5.5 DOCUMENTATION:

(A) Except in emergency situations, the Contracting Agency will not be liable for any Actual Cost Work performed by the Contractor prior to written authorization by the Engineer or prior to full execution of a written agreement by all parties concerned.

(B) Payment for work performed on an actual cost basis will not be made until the Contractor has furnished the Engineer, on forms agreed to by the Contracting Agency, duplicate itemized statements of such work, including subcontractor(s) costs, detailed as follows:

1. Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

2. Designation, dates, daily hours, total hours, rental rates and extension for each unit of equipment, and machinery.

3. Quantities of material, prices, extension and transportation cost on a daily basis. These charges shall be substantiated by vendor invoices.

(C) The Engineer will compare his records with the statement furnished by the Contractor, resolving any differences and making the required adjustments. This statement when agreed upon and signed by both parties, shall be the basis of payment for the work performed.

SUBSECTION 109.5.6 BONDS AND INSURANCE: The Contractor shall be paid for the actual cost plus (10%) ten percent for Administrative cost when the Contractor can provide evidence of payment for premiums on required payment and performance bonds, premiums on railroad and/or airport extended liability insurance, and premiums for property damage and/or public liability insurance. No duplication of payment for Contractor's costs included under Subsection 109.5.3(A) will be allowed.

SUBSECTION 109.5.7 AUTHORITY OF ENGINEER: The Engineer is in charge of Actual Cost Work and has the authority to direct which labor and equipment will be used, to suspend operations, and to refuse to pay for any labor or equipment which he feels is not doing productive work.

SUBSECTION 109.6 PAYMENT FOR IMPROVEMENT DISTRICT PROJECTS:

Payment to the Contractor shall be made in accordance with ARS Sections 9-621 to 9-710, both inclusive.

As soon as the Contractor has fulfilled his contract, the Superintendent of Streets shall estimate the benefits arising from the work and make assessments to cover the work performed and specified in the contract, including incidental expenses in accordance with ARS Section 9-686.

The Contractor agrees to accept payment in the form of Assessments with attached Warrants and/or Improvement Bonds at the rate of interest declared in the resolution of intention prepared by the Contracting Agency.

SUBSECTION 109.7 PAYMENT FOR BOND ISSUE AND BUDGET PROJECTS:

(A) **Partial Payments:** The Contracting Agency will make a partial payment to the Contractor on the basis of an estimate prepared by the Contractor or Engineer for work completed through the last day of the preceding calendar month. Payment will be within 14 calendar days after the estimate has been certified and approved by the Engineer and received by the owner.

The Contracting Agency will retain 10 percent of all estimates as a guarantee for complete performance of the contract in accordance with ARS Section 34-221, unless the Contractor elects to deposit securities in accordance with ARS Section 34-221, Paragraph 5.

When the Contractor is fifty percent completed, one-half of the amount retained shall be paid to the Contractor provided he is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent completed, no more than five percent of the amount of any subsequent progress payments made under the contract will be retained providing the Contractor is making satisfactory progress on the project. Except that, if at any time the owner determines satisfactory progress is not being made, ten percent retention shall be reinstated for all progress payments made under the contract subsequent to the determination. Payment or release of retained funds shall be made to the Contractor within thirty (30) days following final payment to the Contractor, and Contractor furnishing to Engineer satisfactory receipts for all labor and material billed and waivers of liens from any and all persons and Subcontractors holding claims against the work. Additionally, Contractor shall furnish a completed Certificate of Performance to Engineer evidencing it has satisfactorily discharged all its duties in connection with the work to be performed under this Contract. The Certificate of Performance document is Attachment 2 of the Contract agreement.
Any material or equipment which will become an integral part of the completed project will be considered for partial payment in the Contractor's monthly progress payments. The intent of making partial payments is to provide the Contractor payment for direct material or equipment purchased. The purpose is to minimize the effect of escalating costs by procuring key materials. It is not the intent to pay for all materials but only those meeting the following conditions.

(1) A total value of all items requested for payment must be greater than $20,000. No payment will be processed until the material or equipment has been observed, reviewed or verified by the Contracting Agent representative. Only the material or equipment meeting the requirements of the

plans and specifications will be paid. Payment for material or equipment does not constitute final acceptance.

(2) Materials or equipment must be stored or stockpiled either on site, in a warehouse, or secured storage area. The Contractor assumes all responsibility for protection of these materials or equipment and shall insure them to cover loss or damage to same without additional liability or added costs to the Agency for providing this security, insurance, and storage.

(3) The Contractor will provide access to the storage area or warehouse upon request of the Contracting Agent's representative for the purpose of verifying the inventory of items paid for under this section. None of the materials or equipment paid for under this section will be removed from the storage site until incorporated into the work of the project. The storage site shall be within the general geographical area of the project.

(4) The Contractor shall provide a paid invoice and/or lien waiver for items paid for under this section. The Agency will not pay more than the invoice price for the item or items, less retention.

(5) The Engineer may exclude individual payment requests which in the Engineer's judgement do not warrant storage and prepayment under the intent of this section.

(B) **Final Payment:** When the project has been accepted as provided in Section 105, and within 340 calendar days after final inspection of work completed under the contract, the Engineer will render to the Contracting Agency and the Contractor, a final estimate which will show the amount of work performed and accepted under the contract. All prior estimates and partial payments will be subject to correction in the final estimate for payment.

The final payment will be made to Contractor by Owner within thirty (30) days following receipt of Engineer's final estimate and receipt by Owner of Consent of Contractor's Surety to said final payment. If payment will be longer than thirty (30) days as aforesaid, Owner will provide Contractor specific written findings for reasons justifying the delay in payment.

The acceptance of the project and the making of the final payment shall not constitute a waiver by the Contracting Agency/Owner of any claims arising from faulty or defective work appearing after the completion or from failure of the Contractor to comply with the requirements of the contract documents.

SUBSECTION 109.8 PAYMENT FOR DELAY:

The procedures contained in this Subsection shall not be construed to void any provision of the contract which require notice of delays, provides for negotiation of other procedures for settlement or provide for liquidated damages.

SUBSECTION 109.8.1 FAILURE TO LOCATE OR INCORRECT LOCATION OF UTILITIES: ARS 40-360 states "that if the owner or operator fails to locate or incorrectly locates the underground facility, pursuant to this article, the owner or operator becomes liable for resulting damages, costs and expense to the injured party." The Contracting Agency will deny any claims for damages or delays if another owner or operator is at fault.

SUBSECTION 109.8.2 CONTRACTING AGENCY DELAYS: ARS 34-221 states "A contract for the procurement of construction shall include a provision which provides for negotiations between the Agent and the Contractor for the recovery of damages related to expenses incurred by the Contractor for a delay for which the Agent is responsible, which is unreasonable under the circumstances and which was not within the contemplation of the parties to the contract."

In this case, if the Contractor sustains damages which could not have been avoided by the judicious handling of forces, equipment and plant or by reasonable revision in the Contractor's schedule of operation, the compensation for

such damages will be negotiated. The Contractor shall notify the Engineer of the condition in writing by the next work day. Failure to notify the Engineer within this time may be just cause to reject any claims for such damages.

Compensation for such damages will be negotiated as follows:

(A) The Engineer shall be satisfied that the Contractor has made every reasonable effort to prosecute the work despite any delays encountered or revisions in the Contractor's scheduling of work.

(B) The Compensation paid to the Contractor shall be in accordance with Section 109.

SUBSECTION 109.8.3 EXTENSION OF CONTRACT TIME: For any such delays, the contract time will be adjusted in accordance with Subsection 108.7.

TABLE 109-1	
DOLLAR VALUE OF MAJOR ITEM	
Original Contract Amount	Dollar Value of Major Item
$0.00 to $1,000,000.00	$50,000 or 10% of original contract amount, whichever is less
$1,000,000.00 to $5,000,000.00	5.0% of original contract amount
$5,000,000.00 or greater	$250,000.00 or 2.5% of original contract amount whichever is greater

End of Section

SECTION 110 NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION

SUBSECTION 110 NOTIFICATION OF CHANGED CONDITIONS AND DISPUTE RESOLUTION:

The Contractor and Owner will follow the established rules of the Maricopa County Procurement Code.

End of Section

ATTACHMENT 1

SGC FCD 2000C028

ATTACHMENT 1 SGC ECD 2000C028

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
ARIZONA-NEVADA AREA OFFICE
3636 NORTH CENTRAL AVENUE, SUITE 760
PHOENIX, ARIZONA 85012-1936

FLOOD CONTROL DISTRICT
RECEIVED
AUG 21 '00
C-H & GM | FINANCE
PIO | PLANNING
ADMIN | O & M
REG | P & PM
ENG | FILE
CONTRACTS
ROUTING RBS

REPLY TO
Office of the Chief
Regulatory Branch

August 17, 2000

Mr. Robert B. Stevens
Maricopa County Flood Control District
2801 West Durango Street
Phoenix, Arizona 85009-6356

File Number: 984-0495-LSF

Dear Mr. Stevens:

This is in reply to your June 7, 2000 letter concerning your proposal to repair the existing White Tanks Flood Retarding Structure #3 to meet Arizona Department of Water Resource's dam safety requirements, including: 1. The extension of three outlet pipes (Total Permanent Impacts 0.028-acres/Total Temporary Impacts 0.075-acres) within jurisdictional waters (North Outlet w/.006-acres permanent impact/.019-acres temporary impact; Central Outlet w/.012-acres permanent impact/.023-acres temporary impact; and South Outlet w/ .010-acres permanent impact/.033-acres temporary impact); 2. The construction of soil buttresses adjacent to the three outlets; 3. The installation of graded sand diaphragm filters around the outlet pipes; 4. The modification of the trash racks on the outlet works; and 5. The placement of riprap armoring (25-feet long by 3-feet deep) at the northern outlet in the unnamed washes at (Sections 4, 5, 8, & 9, T2N, R2W), Maricopa County, Arizona.

The Corps of Engineers has determined, under Section 404 of the Clean Water Act (33 U.S.C. 1344), that your proposed activity complies with the terms of Nationwide Permit No. 3, "Maintenance." You must comply with all terms and applicable conditions (regional, general, and 401 conditions) described in Enclosure 1 and complete the compliance statement (Enclosure 2).

Furthermore, you must comply with the following **Special Condition(s)**:

1. Should previously unknown historic or archaeological remains be discovered while accomplishing activities authorized by this permit, the permittee shall immediately cease work in the area of discovery and this office shall be immediately notified to insure compliance with paragraph 12.(Historic Properties) of the Nationwide Permit General Conditions. The permittee is restricted from entering any archeological sites on or adjacent to the project area.

2. If the permittee encounters an individual tortoise or its burrow prior to or during any activities authorized by this permit the permittee shall utilize the Arizona Game and Fish Department's "Guidelines for Handling Sonoran Desert Tortoises Encountered on Development Projects" (copy enclosed).

3. The work area shall be restored after construction to an environmentally acceptable condition. All disturbed project areas that are non-structural shall be re-seeded with a locally native seed mix, and watercourse morphology shall be re-established to match pre-construction configurations.

4. Construction material placed within the Corps' jurisdictional area shall be free of substances which can cause or contribute to the pollution of waters of the United States.

5. If utilized, riprap shall be washed prior to placement to remove fines which may cause a violation of the turbidity water quality standard.

6. All work shall be conducted in a manner that minimizes the potential for the discharge of pollutants from action-related machinery or materials inside the Corps' jurisdictional area.

7. Pollution from the operation, repair, maintenance, and storage of equipment in the construction area shall be immediately removed from and properly disposed outside of the Corps' jurisdictional area. Spills shall be immediately cleaned up and properly disposed. Substances such as fuel, lubricants, solvents, and other hazardous materials shall not be stored within the Corp's jurisdictional area.

8. No disposal of construction or demolition wastes, contaminated water or any other pollutant is authorized within or adjacent to the watercourse.

9. No excavation, fill, or leveling is permitted in the watercourses, outside the boundaries of the permitted work areas. Work shall be contained within the boundaries of these work areas. These areas shall be clearly marked prior to the start of any construction activities, and the contractor(s) shall be thoroughly familiarized with this boundary.

10. No fill shall be taken from the watercourses, outside the boundaries of the permitted work areas. Fill shall come from an area outside the Ordinary High Water Mark that does not impact the watercourses. Fill shall be free of any contaminants or pollutants.

11. During construction the work sites shall be maintained such that no construction debris or material spillover is allowed in the watercourses. Upon completion of the work all construction debris, excess material, residues, construction equipment, and other non-native material shall be removed from the jobsite, and outside of the Corps' jurisdictional area.

12. Prior to initiating construction activities under this permit, the permittee shall ensure that the contractor(s) has been provided with a copy of the Section 404 authorization. This is intended to confirm that the contractor(s) has read, understood, and agrees to comply with the terms and conditions of this Section 404 authorization. The permittee shall provide the Corps written confirmation of this requirement prior to initiating construction activities, with the contractor's signature, contractor's license number, phone number, and address included on the confirmation.

13. The permittee shall allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished within the terms and conditions of the permit.

This letter of verification is valid for a period not to exceed two years unless the nationwide permit is modified, reissued, or revoked before that time. It is incumbent upon you to remain informed of changes to the nationwide permits.

A nationwide permit does not grant any property rights or exclusive privileges. Also, it does not authorize any injury to the property or rights of others or authorize interference with any existing or proposed Federal project. Furthermore, it does not obviate the need to obtain other Federal, state, or local authorizations required by law.

Thank you for participating in our regulatory program. If you have questions, please contact Larry S. Flatau at (602) 640-5385 x 225.

Sincerely,

Cindy Lester

Cindy Lester
Chief, Arizona Section
Regulatory Branch

Enclosures

GUIDELINES FOR HANDLING SONORAN DESERT TORTOISES ENCOUNTERED ON DEVELOPMENT PROJECTS

Arizona Game and Fish Department
Revised January 17, 1997

The Arizona Game and Fish Department (Department) has developed the following guidelines to reduce potential impacts to desert tortoises, and to promote the continued existence of tortoises throughout the state. These guidelines apply to short-term and/or small-scale projects, depending on the number of affected tortoises and specific type of project.

Desert tortoises of the Sonoran population are those occurring south and east of the Colorado River. Tortoises encountered in the open should be moved out of harm's way to adjacent appropriate habitat. If an occupied burrow is determined to be in jeopardy of destruction, the tortoise should be relocated to the nearest appropriate alternate burrow or other appropriate shelter, as determined by a qualified biologist. Tortoises should be moved less than 48 hours in advance of the habitat disturbance so they do not return to the area in the interim. Tortoises should be moved quickly, kept in an upright position at all times and placed in the shade. Separate disposable gloves should be worn for each tortoise handled to avoid potential transfer of disease between tortoises. Tortoises must not be moved if the ambient air temperature exceeds 105 degrees fahrenheit unless an alternate burrow is available or the tortoise is in imminent danger.

A tortoise may be moved up to two miles, but no further than necessary from its original location. If a release site, or alternate burrow, is unavailable within this distance, and ambient air temperature exceeds 105 degrees fahrenheit, the Department should be contacted to place the tortoise into a Department-regulated desert tortoise adoption program. Tortoises salvaged from projects which result in substantial permanent habitat loss (e.g. housing and highway projects), or those requiring removal during long-term (longer than one week) construction projects, will also be placed in desert tortoise adoption programs. *Managers of projects likely to affect desert tortoises should obtain a scientific collecting permit from the Department to facilitate temporary possession of tortoises.* Likewise, if large numbers of tortoises (>5) are expected to be displaced by a project, the project manager should contact the Department for guidance and/or assistance.

Please keep in mind the following points:

- These guidelines do not apply to the Mohave population of desert tortoises (north and west of the Colorado River). Mohave desert tortoises are specifically protected under the Endangered Species Act, as administered by the U.S. Fish and Wildlife Service.

- These guidelines are subject to revision at the discretion of the Department. We recommend that the Department be contacted during the planning stages of any project that may affect desert tortoises.

- Take, possession, or harassment of wild desert tortoises is prohibited by state law. Unless specifically authorized by the Department, or as noted above, project personnel should avoid disturbing any tortoise.

RAC:NLO:rc

ATTACHMENT 2

SGC FCD 2000C028

ATTACHMENT 2 SGC FCD 2000C028

Bolin Laboratories Inc.

17631 N. 25th Avenue • Phoenix, Arizona 85023
(602) 942 8220 • FAX (602) 942 1050

Maricopa County Flood Control
Environmental Branch
2801 West Durango
Phoenix, AZ 85009
Attn: Dave Gardner

Received: 10/23/98
Reported: 0/00/00
Invoice No: 000000

Project Name: White Tanks #3

PARAMETER	METHOD	RESULTS	UNITS	PQL	DATE ANALYZED
Matrix: Solid Sample No: 9810-07581-001 Sample ID: WT-3 29+00			Time Sampled: 12:50 Date Sampled: 10/23/1998		
Asbestos	PLM	10	% Chrysoltile		10/26/98
Matrix: Solid Sample No: 9810-07581-002 Sample ID: WT-3 46+00			Time Sampled: 12:50 Date Sampled: 10/23/1998		
Asbestos	PLM	10	% Chrysotile		10/26/98
Matrix: Solid Sample No: 9810-07581-003 Sample ID: WT-3 63+80			Time Sampled: 12:50 Date Sampled: 10/23/1998		
Asbestos	PLM	10	% Chrysotile		10/26/98

Asbestos performed by Legend Technical Services, St.Paul MN, #AZ0557.
Other Material: <1% cell, 88% non, <1% glass

Authorized Signatory
ADHS License No.: AZ0004

CONSTRUCTION QUALITY ASSURANCE PLAN

(Revised August 3, 2001)

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT FCD 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

PCN 470-04-30

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22867
ALEXANDER W.
GOURLAY
Date Signed 8-3-01
ARIZONA, U.S.A.

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22867
ALEXANDER W.
GOURLAY
Date Signed 8-3-01
ARIZONA, U. S. A.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
CONTRACT FCD 2000C028
PCN 470-04-30
WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS
CONSTRUCTION QUALITY ASSURANCE PLAN

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

CONTRACT 2000C028

WHITE TANKS FRS#3
INTERIM DAM SAFETY IMPROVEMENTS

PCN 470-04-30

CONSTRUCTION QUALITY ASSURANCE PLAN

1.0 INTRODUCTION

This Construction Quality Assurance Plan (CQA Plan) applies to the provision of Construction Quality Assurance services for the procurement and construction of components of the Interim Dam Safety Improvements Project for the White Tanks FRS #3 (07.28).

1.1 PLAN PURPOSE

The purpose of this plan is to provide a project-specific technical guide to the Owner and its representatives to ensure a quality project, defensible documentation, and conformance with the drawings and specifications. This plan has been prepared on behalf of the Flood Control District of Maricopa County (the District), the owner and operator of the White Tanks FRS #3 located in west Phoenix, near the White Tanks mountains. This CQA Plan has been prepared by Dames & Moore as part of the Interim Dam Safety Project; White Tanks FRS #3, Contract No. FCD98-11.

1.2 SCOPE OF THIS DOCUMENT

This plan addresses the quality control and assurance of the construction work associated with this project. Assurance in the quality expected on this project and conformance with approved drawings and Special Provisions relies upon the execution of this plan, specifically the field monitoring and documentation of the activities. This CQA Plan therefore outlines in detail the CQA procedures that are provided and shall be considered in conjunction with the project contract, drawings, and Special Provisions. The construction activities requiring CQA procedures in this document include:

- Meetings
- Measurement and Payment Verification
- Site Visits and Observations
- Earthwork
- Corrugated Metal Piping
- Concrete

Any conflict between the requirements of this document and the approved drawings and Special Provisions shall be reported to the Engineer, for clarification or adjudication, as required. In general, however, the requirements of the Special Provisions shall prevail.

1.3 DEFINITION OF QUALITY CONTROL VERSUS QUALITY ASSURANCE

There is often considerable confusion between the definition of quality control and quality assurance. This document refers to the provision of quality control and quality assurance for various components of the project:

- **Quality Control** refers to those actions taken by all parties involved in the construction, including the Contractor, those parties charged with procurement and installation of manufactured materials, and the placement and compaction of the soil materials, which provide a means to determine and sometimes quantify the characteristics of the product. The results of a quality control program are compared to the Special Provisions or other contractual or regulatory requirements. During each aspect of the handling of these materials, quality control is provided by the manufacturer,. fabricator, or installer of materials, or the supplier and earthworks contractor for the soils, to ensure that the materials and workmanship conform to the plans and Special Provisions. Quality control responsibility is retained by the Contractor, suppliers, and manufacturers because these entities have the most direct control over qualifications of personnel, specialized experience or expertise, choice in type and quantity of equipment, scheduling, sequencing, and workmanship that all factor in to the quality of the finished project.

- **Quality Assurance** is a planned and systematic pattern of all means and actions intended to provide adequate confidence that the materials and procedures conform to the plans and Special Provisions, and any applicable regulatory requirements. Quality assurance can either be provided by the Owner, or their designated representative, which is often an independent consulting, engineering, or construction management firm. Although quality assurance is as important during all phases of the project, construction quality assurance is often in association with those actions taken in relation to the installation of the geosynthetics materials, installation of structural concrete, and the placement and compaction of the soils materials. CQA is a critical component of a project because field conditions are the most variable and the most difficult to control and documentation is being recognized as invaluable to Owners and regulatory agencies.

2.0 PARTIES TO THE WORK AND RESPONSIBILITIES

The successful completion of the production and installation of the interim dam safety project is dependent on the interaction and cooperation of many parties. The following parties are represented in the project.

Engineer. The Engineer for this project is the Flood Control District.

Engineer of Record. The Engineer of Record for this project is URS Dames & Moore of Phoenix, Arizona.

General/Earthwork Contractor. The General/Earthwork Contractor is responsible for the mass earthworks, development of final slopes, placement of diaphragm filter sand, placement of riprap, placement of geotextile, placement and compaction of structural fill.

Subcontractors. The Subcontractor is retained directly by the General/Earthwork Contractor and is likely responsible for specialty work such as surveying, fencing, concrete, commercial sand and rock suppliers, etc.

Geosynthetics Manufacturer. The Manufacturer(s) of the geotextile filter fabric.

CQA Consultant. The CQA Consultant is responsible for the monitoring and documentation of the construction activities of the General/Earthworks Contractor.

CQA Director. The CQA Director, a designated person of the District or CQA Consultant, is responsible for overseeing the CQA Consultant and participates in the monitoring and documentation of the activities of the General/Earthworks Contractor.

Soils Laboratory. The Soils Laboratory is a party, independent of the General/Earthwork Contractor, that is responsible for the laboratory testing and reporting to verify the soil materials' conformance to the Special Provisions. In addition, quality control testing may be conducted to determine the as-compacted conditions of the soil materials for conformance with the Special Provisions. The Soils Laboratory testing can be retained by the District or the Engineer.

Owner. The Owner is the Flood Control District of Maricopa County (the District).

Responsible Regulatory Agencies. The regulatory agency for the design and construction of the Interim Dam Safety Project: FRS #3 is Arizona Department of Water Resources (ADWR).

2.1 CQA TEAM

The CQA Director assigned by the District will be the Owner's representative during the construction phase of the project.

- **CQA Director.** The CQA Director shall be a registered professional engineer (P.E.) in the state of Arizona and is responsible for all of the activities of the CQA Consultant. The CQA Project Director will be kept appraised of field progress and decisions and will visit the site to review the operations and progress by the CQA Consultant.

The CQA Consultant is responsible for the provision of construction quality assurance services for the construction of the Interim Dam Safety Project. The personnel of the CQA Consultant include:

- **CQA Consultant Manager.** The CQA Consultant Manager shall be a registered professional engineer (P.E.) in the state of Arizona and is responsible for all of the activities of the CQA Consultant. Duties include final reviewing all on-site activities, laboratory test results, and directly addressing any deficiencies that are encountered. In addition, the CQA Consultant Manager will be kept appraised of field progress and decisions and will visit the site to review the operations and progress by the CQA Consultant team members.

- **CQA Construction Manager.** The CQA Construction Manager, demonstrating experience in construction and field oversight, will be involved in design and construction issues and provide liaison activities which bridge the two phases of the project, and provide construction management insight and guidance as needed to the CQA Representatives in the field on a daily basis, and assist with quantity verification and scheduling.

- **CQA Project Engineer.** The Project Engineer, who is intimately knowledgeable with the design calculations and design intent, will interface in the field to provide technical guidance.

- **CQA Field Representative.** The on-site construction representative of the CQA Consultant, the CQA Field Representative, liaisons directly with the CQA Director, the General/Earthworks Contractor, and will coordinate with CQA Technicians on site.

- **CQA Field Technicians.** The CQA Field Technicians, either employed by the CQA Consultant or by an independent construction materials testing (CMT) company, performs soil materials testing, primarily compaction density testing. CQA Field Technicians may be used on an on-call, as-needed basis.

The specific functions and responsibilities of these personnel are presented in the following sections.

2.1.1 CQA Director

The CQA Director is the Owner's representative administers the contract and technical direction for the CQA Consultant. In particular, the CQA Director:

- Reviews the design, Plans, and Special Provisions for the project.
- Co-administers the CQA program with the CQA Consultant.
- Receives and reviews weekly reports, and provides final reviews laboratory and field test data submitted by the CQA Consultant.
- Participated in progress meetings.
- Periodically visits the site to review progress of the CQA program.
- Participates in any proposals for changes to the design, Plans, or Special Provisions that may be necessitated by field conditions.
- Receives and reviews the draft and final CQA report.

2.1.2 CQA Consultant Manager

The CQA Consultant Manager is the professional engineer (P.E.) in direct charge of the CQA program and certifies the work for submittal to the *regulatory agency*. In particular, the CQA Consultant Manager:

- Reviews the design, Plans, and Special Provisions for the project.
- Co-administers the CQA program with the District, including the supervision of the CQA Construction Manager, CQA Project Engineer, and CQA Field Representative.
- Review progress with the CQA Construction Manager and CQA Field Representative, review of all daily and weekly reports, review and interpretation of all laboratory test data, and engineering review of any aspects of the liner system during installation.
- Periodically visits the site to review progress of the CQA program.
- Participate in any proposals for changes to the design, Plans, or Special Provisions that may be necessitated by field conditions.
- Prepares, with the CQA Construction Manager and CQA Field Representative, the draft and final CQA report.

2.1.3 CQA Construction Manager

The CQA Construction Manager is involved in the office and fieldwork and will conduct the following:

- Attend Pre-Bid and Pre-Construction conferences.
- Attend periodic progress meetings and conduct site visit.
- Scheduling of CQA team.
- Supervises and reviews daily field reports from CQA Field Representative and Technicians.
- Review the schedule and progress to-date and provide recommendations for corrective actions, if any.
- Observe construction procedures and, with the CQA Project Engineer, assess that the intent of design is being met.
- Assist in resolving potential issues that may come up, including, but not limited to, schedules, non-conformance to drawings and Special Provisions, methods, equipment, payment, and sequencing.
- Prepare a weekly summary report for the designated District representative that outlines progress, problems, and resolutions.
- Assist with punch list development and final inspections.
- Assist with preparing draft and final CQA Report.

2.1.4 CQA Project Engineer

The CQA Project Engineer will be an integral part of the team both in the office and field, by conducting the following:

- Review of Contractor submittals.
- Review of CQA/QC results.
- Review of daily field notes.
- Assist with final acceptance of construction and report.
- Attend progress meetings (as necessary).

- Conduct routine site visits.
- Provide design clarification in general.
- Provide technical direction on critical start-up activities.
- Review material gradations and selection submittals.

2.1.5 CQA Field Representative

The CQA Field Manager is the full-time (or part-time) on-site representative of the CQA Consultant. The CQA Field Representative:

- Serves as the on-site representative of the CQA Consultant and supervises all other CQA Field Technicians.

- Reviews the CQA Plan, project Plans, and Special Provisions for the site, and ensures that all CQA Field Technicians are fully informed of the requirements of the work.

- Assigns the daily responsibilities of all CQA Field Technicians, to ensure that all relevant activities of the General/Earthworks Contractor are monitored and documented.

- The CQA Field Representative shall prepare daily field reports (notes) documenting the activities of the General/Earthworks Contractor for each day worked.

- Attends all progress meetings as required plus any activity-specific meetings necessary to review the installation of a critical component and/or CQA activities.

- Collects, collates, and reviews the documentation provided by the General/Earthwork Contractor and their suppliers of the materials to be used on the project.

- Observing and verifying by review of data made available by the contractor that construction is performed to the depths, lines, and grades as indicated on the drawings.

- Selects sample locations for conformance testing of all soils in accordance with the frequencies and test requirements specified, forwards these samples to the Soils Laboratory, and reviews all results for conformance and acceptability.

- When necessary, designates another of the on-site CQA personnel to act on his behalf whenever he is absent from the site, to ensure continuity during operations.

- Prepares, with the CQA team, the final completion report.

In addition, the CQA Field Representative regularly reports on both a verbal basis, and through periodic submittal of the daily CQA reports, to the designated District Representative to ensure that any problems are identified and communicated to all parties of the project on a timely basis.

2.1.6 CQA Field Technicians

One or more CQA Field Technicians will be assigned to the project on an on-call basis to ensure that the activities of the Earthworks Contractor are adequately tested for quality control and documented. The activities to be monitored, and duties to be carried out within the scope of the overall CQA program include:

- Schedule, observe, perform, and/or report construction materials testing.
- Examination of all soils delivered to the site and collection of samples for laboratory testing for conformance to the Special Provisions. Testing type and frequency is estimated in Table 1, however the actual test selection and frequency of testing will be a the discretion of the CQA team and the District based on field conditions and construction sequence.
- Testing, monitoring, and documenting the placement, backfilling, and compaction of all earthwork components and material types. Testing will include field moisture determinations, field compaction density by nuclear methods and by sand cone methods.

3.0 MEETINGS

Meetings of all parties are required at various times during the project based on the following objectives:

- Establish work schedules.
- Review Progress.
- Resolve problems.
- Generally maintain good lines of communication.

3.1 PRECONSTRUCTION MEETING

The Pre-construction Meeting is held in advance of the start of construction, to introduce all parties, and resolve any particular issues prior to the commencement of work, and to establish the requirements for construction quality assurance.

The following is a typical agenda for a pre-construction meeting:

- Use of site by contractor and owner.
- Owner's contract or site requirements.
- Construction facilities and temporary controls provided by Contractor.
- Survey layout.
- Security protocols.
- Housekeeping procedures.
- Public relations and confidentiality protocols.
- Inspections required.
- Quality control of major or critical activities in the project and a methodology.
- Proposed schedules and sequence of activities.
- Identification of the responsibilities project team.
- The timing and distribution of project correspondence.
- Establish the lines of authority and communication.
- Health and safety.

The Pre-construction Meeting, may also be concluded with a site walk-around to determine the status of activities, and re-discuss items during the meeting (if necessary).

This meeting shall be documented by the CQA Consultant and minutes prepared and circulated to all present, plus any other interested parties.

3.2 PROGRESS MEETINGS

Periodic progress meetings shall be held on a schedule to be determined by the CQA Consultant and the District in order to review the status of the schedule, problems, and measures for resolution of problems. These meetings shall be documented, as required, and the decisions reached promulgated to all affected parties.

Areas of concern and potential future problems shall also be outlined, and addressed at the next planned Progress Meeting, unless of sufficient importance or urgency as to warrant an *ad hoc* meeting.

The following is a typical agenda for a progress meeting:

- Review minutes of previous meetings.
- Review work progress.
- Field observations, problems, and decisions.
- Identification of problem which impede planned progress.
- Review submittals schedule and status of submittals.

- Review health and safety concerns and issues.
- Revisions to progress schedule.
- Corrective measures to regain projected schedules.
- Planned progress during succeeding work period.
- Coordination of projected progress.
- Effect of proposed changes on progress schedule and coordination.
- Potential change conditions or review of change order submittals.

4.0 MEASUREMENT AND PAYMENT VERIFICATION

Based on the final contract documents and bid schedule, the quantities are verified in the field using total count of items or survey of in-place volumes. Measurement calculation shall be initiated in the field by the CQA Representative and supported by independent registered land surveyor. The calculations are reviewed or checked by a second method to assess reasonableness. Report estimated pay measurements and explain any discrepancies.

4.1 PAYMENT REVIEW AND APPROVAL

Upon request of the District, review Contractor pay requests to render an independent opinion of progress and equitable request amount. The review is to include a written analysis discussing the major pay items and any discrepancy or suggested revision. Finally, the CQA Representative is to provide conclusions and recommendations for approval or rejection.

5.0 SITE VISITS AND GENERAL OBSERVATIONS

The CQA Project Director, CQA Project Engineer, or CQA Construction Manager shall conduct site visits, to ensure that all outstanding issues are resolved on a timely basis, and to review personally the progress and methodology of the Contractor and Subcontractor. The schedule of these site visits will be determined by project demands. In addition, the CQA Project Director, CQA Project Engineer, or CQA Construction Manager will have to make site visits when a problem arises which cannot be easily resolved or which impacts the design of the facility. In that regard, the CQA Project Director should make periodic site visits in order to review the progress and any aspects of the project that are particularly critical to the performance of the system.

6.0 EARTHWORK CQA

The earthwork, on-site soils fill, engineered fills, and rock associated with the Interim Dam Safety Project will consist of a variety of materials. The construction quality assurance of these soil materials is presented in the following subsections.

6.1 SOILS TESTING

6.1.1 Laboratory Soils Testing

Laboratory testing of the soils materials to be used at the site shall be carried out for the purpose of materials selection prior to construction and for materials quality control and evaluation during construction operations.

6.1.2 Laboratory Conformance and Quality Control Testing

Conformance testing associated with the selection of suitable materials for use in the project will be carried out by the Soils Laboratory and evaluated by the Engineer, the District, and the CQA Consultant in advance of the commencement of construction.

Tests are to be carried out to provide quality control and ensure that the source of the materials does not vary significantly or adversely from one area of the source to another and that the properties that are required in the Special Provisions are met. The frequency and need for a given test is shown in Table 1.

Mechanical Sieve Testing of foundation subgrade and soil buttress material must be completed prior to material placement. If any sieve test yields results outside of the specified gradation, the Engineer must review and approve the test results before material placement. If the foundation subgrade or soil buttress material is outside of the specified gradation, a field change may be considered.

6.1.3 Laboratory Testing Frequency

The frequency of testing required during the selection process for soil materials is a function of the quantity of each soil type required, in addition to the existing documentation of the source. In general, however, testing shall be conducted in accordance with the requirements of the project Special Provisions, and, at a minimum frequency as shown in Table 1 for material for each test procedure.

It should be noted that in all cases, at least one test shall be carried out, regardless of the quantity of materials placed and compacted, where relevant. The CQA Consultant shall review all

laboratory test results and forward a summary of all testing to the designated District Representative and the Earthworks Contractor.

The CQA Representative shall coordinate the following laboratory testing:

- Nuclear moisture-density relation testing in accordance with ASTM D698.
- Relative density determinations in accordance with ASTM Methods D4253 and D4254.
- Sieve analysis in accordance with ASTM 422.

6.1.4 Field Soils Testing

The CQA Consultant shall be responsible for providing field *in situ* testing of the soils after placement and compaction, to determine their as-compacted properties and confirm conformance with the Special Provisions. Field quality control testing is carried out as a component of the construction quality assurance program by the CQA Consultant. The principal *in situ* testing carried out is the field determination of density and moisture content.

The CQA Representative shall conduct the following field soils testing activities:

- Nuclear moisture-density relation testing using a gauge in accordance with ASTM D2922 and D3017.
- Moisture-density relationship testing using the sand cone method in accordance with ASTM 1556.

6.2 CONTRACTOR'S MATERIAL SUBMITTALS

The CQA Representative shall conduct the following activities regarding contractor's materials submittals:

- Log the receipt of contractor's submittals and correspondence.
- Review submittals for schedules.
- Review quality control plan.
- Review submittal for corrugated metal pipe and accessories.
- Review submittals for geotextile filter fabric materials.
- Review submittals for import riprap materials.
- Review submittals for import filter sand materials.

- Review submittals for import drain sand.
- Review submittals for concrete.
- Review submittals for pneumatically placed mortar materials.
- Review submittals for landfill and disposal documentation.
- Review submittals for measurement and pay requests.
- Review submittals for as-built data.

6.3 OBSERVATIONS

The CQA Representative shall conduct the following observations:

- General/earthwork contractor's daily activities.
- Subcontractor's daily activities.
- Surveyor's activities.
- Removal of outlet headwall structure.
- Excavation limits.
- Borrow excavation and stockpiling.
- Pipe placement.
- Moisture conditioning.
- Filter sand placement.
- Fill placement.
- Geotextile filter fabric placement.
- Trash rack installation.
- As-built survey data collection.
- Construction materials testing.

6.4 EXCAVATIONS

The CQA Representative shall conduct the following prior to and during excavation:

- Verify the excavation limits are established and agreed upon.
- Verify clearing, grubbing, and stripping has been conducted as necessary.

- Verify the excavation is conducted to the limits and thickness required as shown on the drawings.
- Observe field conditions and evaluate laboratory data performed during construction to verify the foundation meets the gradation requirements as required in the specifications. Samples are to be collected and gradation tests performed to evaluate filter match with the diaphragm filter sand.

  [**Note:** If a filter match is not achieved, the native foundation material shall be rejected, and one remedy to consider is overexcavation to a depth of 2 feet and replace with soil buttress fill material and compact in thin lifts.]
- Observe that the native foundation materials are prepared in accordance with the requirements of the Special Provisions, including scarification, moisture conditioning, and recompacting.
- Observe and verify unsuitable material (i.e. concrete, shotcrete, oversize rock) does not get commingled with structural fill that may be reused.

6.5 DIAPHRAGM FILTER SAND

The CQA Representative shall conduct the following prior to and during placement of filter sand:

- Verify the subgrade (foundation) is prepared and ready to receive sand.
- Observe the placement per project Special Provisions.
- Observe the compaction by method, equipment, and number of passes that may be necessary to achieve the desired results in the project Special Provisions.
- Observe and verify the field density based on relative determinations.
- Verify the sand is placed to the limits and thickness required as shown on the drawings. The thickness of 3 feet shown on the drawings is considered a minimum with a maximum of 3.5 feet. The Contractor shall target the dimension of 3 feet to the extent possible.
- Observe sand placement is not adversely affected or is damaged during placement of structural fill.

6.6 DRAIN SAND

The CQA representative shall conduct the following prior to and during placement of drain sand.

- Verify the subgrade (foundation) is prepared and ready to receive drain sand.

- Observe the placement per project Special Provisions.
- Observe the compaction by method, equipment, and number of passes that may be necessary to achieve the desired results in the project Special Provisions.
- Observe and verify the field density based on relative determinations.
- Verify the drain sand is placed to the limits and thickness required as shown on the drawings.
- Observe drain sand placement is not adversely affected or is damaged during placement of structural fill.

6.7 GEOTEXTILE FILTER FABRIC

The CQA Representative shall conduct the following prior to and during placement of geotextile filter fabric:

- Verify the subgrade is prepared and ready to receive fabric.
- Observe the deployment per manufacturer's recommendations and project Special Provisions.
- Verify the fabric is placed to the limits required as shown on the drawings.
- Verify overlap dimensions are achieved.
- Observe fabric is anchored properly to resist uplifting due to wind and sliding during drain sand placement.
- Observe rock placement and verify that fabric does not move or is damaged.

6.8 SOIL BUTTRESS FILL

The CQA Representative shall conduct the following prior to and during soil buttress fill or structural fill placement:

- Verify subgrade (foundation) is ready to receive fill materials, subgrade has been reviewed and approved by District and ADWR.
- Soil buttress fill materials shall consist of inorganic soils free of debris and gradation.
- Monitor loose lift thickness is within specification.
- Verify clearing, grubbing, or stripping necessary to eliminate organic matter.
- The soil should be within the required moisture content in the range for which the specified compaction is attainable.

- Coordinate field density testing and review results immediately (same day).
- Removal of oversize rocks beyond the required gradation may be accomplished by screen, handpicking, or scarification and windowing.
- The CQA Field Manager shall monitor material selection and placement.

6.9 RIPRAP

The CQA Representative shall conduct the following prior to and during placement of riprap:

- Verify the subgrade is prepared and ready to receive riprap.
- Verify the riprap meets the gradation requirements.
- Observe the placement per project Special Provisions.
- Verify the riprap is placed to the limits and thickness required as shown on the drawings.
- Observe hand placement of riprap to achieve desired results and intent of project requirements.

7.0 CORRUGATED METAL PIPING CQA

The CQA Representative shall ensure the manufacturer submits the appropriate certification of pipe and fitting materials for the application of this project.

7.1 SHIPPING, HANDLING, AND STORAGE

The CQA Representative shall be on-site at the time of receipt of material and observe off-loading procedures. The following verifications shall be made:

- Pipe and fitting material complies with specification requirements.
- Pipe and fitting material to be off-loaded is not damaged before or during off-loading operations.
- The pipe materials are placed out of the traffic so that damage does not occur.
- Inappropriate equipment and procedures such as fork lifts used with separation 2 by 4 boards.
- The pipe ends are kept clean and free of soil and debris during handling and storage.
- The pipe is inspected for possible damage within one hour of installation.

7.2 PIPE INSTALLATION

The CQA Representative shall monitor the installation of pipe at all times to the greatest extent possible. The CQA Representative shall ensure that in his absence the Owner's Representative or Contractor's superintendent is present during pipe placement, joining, and backfilling.

The CQA Representative shall observe several activities that may be occurring simultaneously, including, but not limited to, the following:

- Verify the pipe cutting procedure and work crew is qualified and to cut and demolish one (1) foot of the existing pipe. Verify the cut is marked and cut adequately to provide a uniform, tight butt joint between the two pipes.
- Verify the area to receive pipe is marked and the alignment and grade is correct.
- Verify the concrete foundation is ready to receive corrugated metal pipe, and has been reviewed and approved by District and ADWR prior to placement pipe.
- Upon observation and complete inspection of the installed pipe, the placement of backfill materials shall be monitored to prevent any dumping of bulk material directly onto the top of the pipe. Also observe the careful placement of the required uniform 6 inch loose lift on either side of the pipe and observe that proper haunching is being conducted.
- Observe that successive lifts of select material are properly placed without displacing the pipe and that the pipe is held firmly in place by the compacted fill.
- Document all verifications and observations made, including the number of passes with compaction equipment.

8.0 CONCRETE STRUCTURES

The CQA Representative shall perform sampling, laboratory testing, observation and monitoring for forms, reinforcement steel, and cast-in-place concrete pipe collar and encasement structure activities.

8.1 CONCRETE TESTING

Conformance testing of cast-in-place concrete and pneumatically-placed mortar will be conducted and evaluated by the Engineer, the District, and the CQA Consultant during construction.

8.1.1 Testing Frequency

The CQA Representative shall coordinate sampling, field testing, and laboratory testing at the following frequency:

Test	Frequency
Slump	1/9 CY
Concrete Compressive Strength	1 Set/ 18 CY
Mortar Compressive Strength	1 Set/ 500 SF

8.1.2 Field Sampling

Sampling shall be conducted of fresh concrete and pneumatically placed mortar (shotcrete). Samples of cured mortar panels shall also be collected of shotcrete.

8.1.3 Field Testing

The CQA Consultant shall be responsible for providing field sampling and testing of fresh concrete and mortar to determine their as delivered properties and confirm conformance with the Special Provisions. Field quality control testing is carried out as a component of the construction quality assurance program by the CQA Consultant.

The CQA Consultant shall conduct the following field concrete testing activities:

- Concrete field sampling and slump testing in accordance with ASTM C143.
- Mortar coring and cube preparation in accordance with ASTM C31.

8.1.4 Laboratory Testing

Conformance testing of the soils materials to be used at the site shall be carried out for the purpose of materials quality control and evaluation during construction.

The CQA Representative shall coordinate the following laboratory testing:

- Mortar cube compressive strength in accordance with ASTM C109.
- Concrete compressive strength in accordance with ASTM C39.

8.2 FORMS

The CQA Representative shall conduct the following prior to and during installation of forms:

- Verify subgrade is ready to received concrete, limits of excavation in accordance of drawings, elevation of subgrade, and compaction of subgrade.
- Observe forms are installed to limits, lines, elevations, depths required for pipe placement.
- Observe forms are supported and braced to prevent blow-out or movement.

8.3 STEEL REINFORCEMENT

The CQA Representative shall conduct the following prior to and during installation of forms:

- Observe rebar size, length, spacing, clearance, and placement.
- Observe "J" bolt imbed size, length, spacing and placement.

8.4 CAST-IN-PLACE CONCRETE

The CQA Representative shall conduct the following prior to and during installation of forms:

- Verify the forms, reinforcement steel, and "J" bolt imbeds are ready to receive concrete.
- Verify forms and reinforcement steel has been inspected and approved by the District and ADWR prior to concrete placement.
- Verify material submittal for concrete mix has been reviewed and approved.
- Verify CMT technician is ready to sample and test fresh concrete mix.
- Observe sampling testing of fresh concrete for slump and cylinders.
- Observe pour, placement, consolidation, screening, and finishing of fresh cast-in-place concrete.
- Observe position/placement of reinforcement steel and "J" bolt imbeds.
- Observe raking surface to receive additional concrete.
- Observe bonding agent is used on surface to receive additional concrete.

9.0 FIELD DOCUMENTATION

9.1 DAILY FIELD REPORTS

The CQA Representative shall document in his/her daily field reports following:

- Name
- Company name
- Date
- Start time and ending time
- Weather
- Job reference number
- Contractor or subcontractor onsite
- Major equipment onsite and/or used (or list)
- Page number
- Visitors to the site
- Activities performed that consumed the day
- Activities performed started or restarted that day
- Activities performed started or completed critical to the project
- Reference attached test results, sketches, etc

9.2 LOG FORMS

The CQA Representative shall use and maintain the following log forms:

- Soil sample collection and laboratory chain-of-custody
- Soil density results
- Concrete/mortar test results
- Contractor submittals
- Photographs
- Daily field reports
- Record of conversation

9.3 PHOTOGRAPHS

The CQA Representative shall document the following project activities using photographs:

- Existing conditions
- Progress of key activities at the various steps or phases of implementation
- Areas or items that are planned to be buried and not expected to be seen
- Completed components of work as project progress
- Completed project from various views (taken in last few days of work)

Photos are developed in duplicate to provide the District a full set of photo documentation.

10.0 CQA FINAL REPORT

Upon completion of the project, the CQA Consultant will prepare the CQA Final Report. This report will be the final record of the Construction Quality Assurance information for the site. In general, the report shall include all submittal items discussed in this CQA Plan. This shall include, at a minimum:

- The pipe manufacturer's certification and warranty documents.
- Field notes from the installation procedure, including such information as weather and unusual circumstances.
- Summary tables of results for soils.
- The geotextile filter fabric manufacturer's data.
- Compilation of copies of photo documentation.
- Field notes during construction and installation.
- The results of all soils testing, including both *in situ* field testing and laboratory testing in an appendix.

The report shall also provide a narrative description, in general, of the site's construction, noting all unusual occurrences encountered (i.e., failed seams, extreme weather, etc.). The report will be stamped by a Registered Professional Engineer to certify construction was completed in general accordance with approved design drawings, special provisions and other applicable contract documents, with exceptions noted. This report shall be provided to the District shortly after the completion of work.

TABLES

TABLE 1

MINIMUM CQA/QC EARTHWORK TESTING REQUIRED
CONTRACT FCD 2000C028
PCN 470-04-30
WHITE TANKS FRS#3
INTERIM DAM SAFETY

Test Methods		Frequency of Tests			
Reference	**Description**	**Subgrade**	**Soil Buttress Fill**	**Drain Sand**	**Diaphragm Filter Sand**
ASTM D422	Laboratory Test for particle size	3/outlet location per material	1/250 cy per material or change in material	1/100 cy	1/100 cy
ASTM D698	Laboratory Test for compaction-standard	1/outlet location per material	1/1000 cy per material or change in material	0	0
ASTM D4253	Laboratory Test for maximum index density using a vibrating table	0	0	1/500 cy per material or change of material source	1/500 cy per material or change of material source
ASTM D4254	Laboratory Test for minimum index density calculation relative density	0	0	1/500 cy per material or change of material source	1/500 cy per material or change of material source
ASTM D4643	Laboratory Test for Moisture content (oven-dry)	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests
ASTM D4318	Atterberg limits	3/outlet location per material	1/250 cy per material or change in material	0	0
ASTM D4564	Field test for Density of Soil in Place by Sleeve Method	0	0	0	2/lift
ASTM D1556	Field Test for In-place density by sand cone method	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests	1/10 nuclear tests
ASTM D2922	Field Test for In-place density by nuclear gauge	5/lift	5/lift	2/lift	2/lift
ASTM D3017	Field test for moisture content	As needed – to be verified by other field test methods	As needed – to be verified by other field test methods	As needed – to be verified by other field test methods	As needed – to be verified by other field test methods
ASTM D2434	Permeability of Granular Soils - Rigid Wall – Constant Head	0	0	1/material source	1/material source

1. The frequency of testing presented in this table is based on the minimum testing required. Final frequency and quantity of tests per method per material will be at the discretion of the District and CQA Consultant.
2. At any time the material and/or source changes, additional laboratory testing may be required at the discretion of the District and CQA Consultant.
3. The latest revision of ASTM test procedure shall apply.

TABLE 2

ESTIMATED MATERIAL QUANTITIES
CONTRACT FCD 2000C028
PCN 470-04-30
WHITE TANKS FRS#3
INTERIM DAM SAFETY

Material	Estimated Quantity
Diaphragm Filter Sand	330 cy
Drain Sand	115 cy
Soil Buttress Fill	5,060 cy