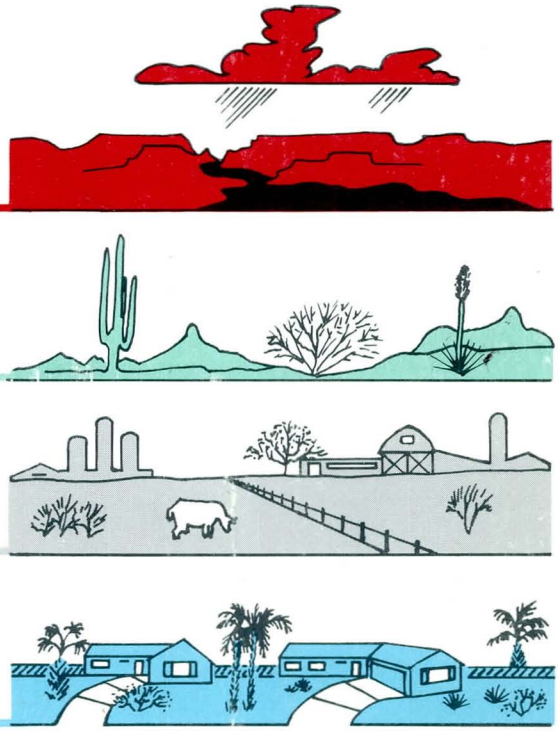

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Appendices for
A HYDROLOGIC ANALYSIS
OF THE
WHITE TANKS F.R.S. #3 & #4

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

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Appendix for

A HYDROLOGY ANALYSIS OF THE WHITE TANKS FLOOD RETARDING STRUCTURES #3 AND #4

Prepared by

Flood Control District of Maricopa County
Hydrology Division
Watershed Management Branch

Valerie Rice, Hydrologist
Doug Plasencia, Hydrologist

October 1989

Appendices for
A HYDROLOGIC ANALYSIS
OF THE
WHITE TANKS F.R.S. #3 & #4

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II. INTRODUCTION

The purpose of this study was to determine current hydrologic conditions; evaluate the White Tanks Structures for stage, storage, and discharge requirements as specified by the Arizona Department of Water Resources (ADWR), Dam Safety Section; and to provide recommendations for modification of the structures if Dam Safety criteria were not met.

The Appendices contains all the documentation for the White Tanks Analysis.

I. REFERENCES

1. Culvert Program, developed using U.S. Department of Transportation's Hydraulic Design of Highway Culverts (Highway Engineering Circular #5) as a guide.

2. Lawrence, Dan Roger, Guidelines for the Determination of Spillway Capacity Requirements, Arizona State Department of Water Resources, Division of Dam Safety, February 1984.

3. Miller, J.F., R.H. Frederick and R.F. Tracey. Precipitation - Frequency Atlas of the Western United States, VIII: Arizona, NOAA Atlas 2, National Weather Service, National Oceanic and Atmospheric Administration, Silver Spring, MD., 1973.

4. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-1 Flood Hydrology Package, Version of January 31, 1985, Davis, California.

5. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Version of September 1988, Davis California.

6. U.S. Department of Agriculture, Soil Conservation Service in cooperation with University of Arizona Agricultural Experiment Station, Soil Survey of Maricopa County, Arizona, Central Part, Issued September 1977.

7. U.S. Department of Agriculture, Soil Conservation Service, Technical Release 55 - Urban Hydrology for Small Watersheds, June 1986.

8. U.S. Department of Commerce, Hydrometeorological Report No. 49 - Probable Maximum Precipitation Estimates, Colorado River and Great Basin Drainages, 1977.

APPENDIX A

Maintenance Responsibility for White Tank Structures
Contracts and Agreements

Exhibit A-1
Letter to Board of Directors
from Flood Control District
June 29, 1964
Maintenance Responsibility
of White Tank Structure

JUN 30 1964

Flood Control District
of
Maricopa County
4701 EAST WASHINGTON STREET
PHOENIX 34, ARIZONA

June 29, 1964

Board of Directors
Flood Control District
Maricopa County
Phoenix, Arizona

Honorable Board:

Confirming conversation of this date with the County Manager, enclosed herewith are 4 copies of a Maintenance Contract with the Maricopa Municipal Water District No. 1, to cover the maintenance of McMicken Dam, the outlet channel, the two small SCS Dams Nos. 3 and 4, and the inter-connecting dikes and channels.

This contract has been prepared in compliance with the resolution passed by the Board of Supervisors on May 2, 1956, wherein the Board of Supervisors agreed to maintain the structures referred to as McMicken Dam and which resolution referred to structures in Trilby Wash area, for which McMicken Dam provided protection.

This matter was brought to the attention of the Citizens' Advisory Board last year, and that Board recommended that this obligation be activated and that a contract be prepared for such services. This contract, 4 copies of which are attached, is the result. This contract has been prepared and approved by the attorneys for the Flood Control District and the Maricopa Municipal Water District No. 1. The Citizens' Advisory Board has verbally approved the contract, and this action will be made a matter of record at the next meeting of the Advisory Board.

The District Engineer of the Maricopa Municipal Water District No. 1 has advised that the average annual maintenance cost of these structures has not exceeded $4,000, and this contract has been prepared accordingly. The Maricopa Municipal Water District No. 1 will submit to this office a detailed break-down of their annual costs for this fiscal year. This cost report will be examined by this office before being recommended for payment.

It is recommended, therefore, that this contract be approved by the Board of Directors and that 3 of the 4 copies be returned after being properly signed.

Sincerely,

John C. Lowry
Chief Engineer & General Manager

Encl. 4 copies Maintenance Contract

Exhibit A-2
Maintenance Contract between Flood Control District
and Maricopa Municipal Water District #1.
July 6, 1964

6464

JUN 1964
RECEIVED
FLOOD CONTROL
DISTRICT

MAINTENANCE CONTRACT

This Contract is made and entered into at Phoenix, Arizona this 6th day of July, 1964 by and between the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZONA, hereinafter designated as "The District" and MARICOPA MUNICIPAL WATER DISTRICT No. 1, hereinafter designated as "The Contractor".

WITNESSETH:

RECITALS:

WHEREAS, The Contractor has the labor, materials, equipment and supervisory personnel with which to maintain in good working condition McMicken Dam and outlet channel and S. C. S. Dams No. 3 and No. 4 and the interconnecting dikes and channels, including adjoining flood control structures and The District desires to have The Contractor so maintain the same on the terms and conditions hereinafter set forth.

For and in consideration of the mutual agreements and covenants herein contained and to be mutually kept and performed by the parties hereto, the parties agree:

1. The Contractor agrees to operate and furnish the labor, materials and equipment and to supervise and provide for the removal of debris, repair and otherwise maintain and keep in good working condition McMicken Dam and outlet channel, S. C. S. Dams No. 3 and No. 4 and the interconnecting dikes and channels, together with the adjoining flood control structures, all of which

are located in Maricopa County, Arizona.

2. The District agrees to reimburse and pay to The Contractor the actual costs and expenses incurred by The Contractor for doing and performing the work and services set forth in paragraph 1 above, PROVIDED HOWEVER, the maximum amount which The District agrees to pay to The Contractor, unless this sum is revised as hereinafter set forth, during the fiscal year July 1, 1963 through June 30, 1964 and during any fiscal year during the renewed periods of this contract, shall not exceed the sum of four thousand dollars ($4,000.00). The parties further agree, however, that The Contractor may give The District sixty (60) days written notice that additional expenses for performing the work and services required in paragraph 1 will be incurred in excess of the aforesaid four thousand dollars ($4,000.00) and if The District does not approve the additional expenses as contained in the notice within the sixty (60) days period, then The Contractor shall have no further obligation to perform the work and services contained in paragraph 1 hereof and shall be relieved of any further liability as hereinafter set forth in paragraph 4 hereof.

3. The Contractor agrees that when it seeks its reimbursement of its costs and expenses for performing the work and services as set forth in paragraph 1 above, it shall furnish to The District invoices or statements in support of its claims. Such reimbursement shall include, among other things, that part of The Contractor's general administrative and overhead expenses which are attributable to its performance of the work and services hereunder, provided however, The Contractor shall forthwith submit to The District the

accounting method or formula for which it will seek reimbursement of general administrative and overhead expenses for The District's approval and in any event such general administrative and overhead expenses shall not exceed twenty per cent (20%) of the total amount reimbursed under this contract. The Contractor further agrees that all withholding, social security and other taxes or employees' expenses shall be administered, paid and be the sole and exclusive responsibility of The Contractor.

4. The Contractor further agrees that it shall indemnify, save and hold harmless The District for any claims or causes of action arising out of the work and services to be performed by The Contractor pursuant to paragraph 1 above or for any claims or causes of action against The Contractor arising out of the use, maintenance or operation of the McMicken Dam facilities as herein set forth. However, should The Contractor cease to be obligated to perform the work and services required under this contract, then The Contractor's liability and indemnification to The District under this paragraph shall immediately cease except as to those matters that may have theretofore occurred.

5. This Agreement will automatically be renewed annually unless The District or The Contractor serve written notice of their intention to terminate the agreement at least thirty (30) days prior to the expiration of the calendar year following the date of this agreement or of any succeeding fiscal year during the period of the renewed contract.

6. The parties recognize that from time to time, due to

accidental, natural or other causes, through no fault on the part of The Contractor or The District, there may be damage, repairs or maintenance to the structures exceeding the normal authorized maintenance costs and at such times after written notice to The District and inspection by both parties, The Contractor shall, following approval by The District of the additional expense, proceed to effect the necessary repairs or maintenance. The Contractor will thereafter be reimbursed by The District for such work provided the amount does not exceed the sum authorized and approved by The District.

IN WITNESS WHEREOF, the parties hereto hereunto execute this Agreement in quadruplicate originals on the date first hereinabove written.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

ATTEST:

Ellen Woodell
~~Secretary~~
Clerk

By Ruth A. O'Neil
Chairman, Board of Directors

MARICOPA MUNICIPAL WATER DISTRICT No. 1

By H S Raymond

Exhibit A-3
Letter to Flood Control District
from Board of Directors.
July 7, 1964
Approval of Maintenance Contract
for White Tanks Structures

July 7, 1964

John C. Lowry
Chief Engineer & General Manager
Maricopa County Flood Control District
Phoenix, Arizona

Dear Mr. Lowry:

In accordance with your recommendation, the Board of Supervisors in regular session July 6, 1964, approved a maintenance contract between the Maricopa Municipal Water District No. 1 and the Flood Control District, covering the maintenance of McMicken Dam, the outlet channel, the two small SCS Dams Nos. 3 and 4, and the inter-connecting dikes and channels.

Accordingly, we are returning herewith three executed copies of said contract, retaining the original for our files.

Very truly yours,

BOARD OF SUPERVISORS

By_____
Tony Soza, Acting Clerk

md
Encl.

... channel, S. C. S. Dams

Exhibit A-4

Agreement between Flood Control District
and Maricopa County Municipal Water Conservation District No. 1
November 28, 1966
Maintenance Contract with Irrigation District

AGREEMENT

THIS AGREEMENT made and entered into at Phoenix, Arizona, on this, the 28th day of November, 1966, by and between the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZONA, a Flood Control District organized under and pursuant to the laws of the State of Arizona, hereinafter designated "Flood Control District", and the MARICOPA COUNTY MUNICIPAL WATER CONSERVATION DISTRICT NO. 1 an Irrigation District organized under and pursuant to the laws of the State of Arizona, hereinafter designated "Irrigation District".

W I T N E S S E T H :

THAT, WHEREAS, Flood Control District has the responsibility of operating and maintaining certain flood control works, consisting in the main of McMicken Dam and outlet channel, S.C.S. Dams No. 3 and No. 4, and interconnecting dikes and channels and related and adjoining flood control works, all located within the County of Maricopa, State of Arizona, and desires that said flood control works be maintained in proper working condition, and operated in a good and workmanlike manner; and

WHEREAS, Irrigation District has available and is able forthwith to secure the necessary labor, materials, equipment and supervisory personnel necessary and required for the proper maintenance and operation of said flood control works.

NOW, THEREFORE, for and in consideration of the mutual covenants and agreements hereinafter set forth and contained on the part of the parties hereto to be by them respectively kept and performed, said parties hereto agree as follows:

1. That the Irrigation District shall, for the period beginning as of the 1st day of July, 1966, and ending on the 30th day of June, 1967, and from year to year thereafter, in a good and workmanlike manner, keep, maintain and operate said flood control works in a proper condition and manner and

in accordance with instructions and procedures given by the Flood Control District, provided, however, that the Irrigation District shall not be required to do or perform any work in relation to keeping, maintaining and operating said flood control works in a proper condition and manner, the cost of which shall be in excess of the amount which the Flood Control District shall theretofor have obligated itself to pay to the Irrigation District for such work.

2. That for the period beginning as of the 1st day of July, 1966, and ending on the 30th day of June, 1967, the Flood Control District shall pay to the Irrigation District a sum not in excess of FOUR THOUSAND ($4,000.00) DOLLARS for keeping, maintaining and operating said flood control works in a proper condition and manner.

3. That the Flood Control District shall, prior to the 1st day of June of each and every year beginning on the 1st day of June, 1967, estimate the amount that the Flood Control District shall provide for keeping, maintaining and operating said flood control works in a proper condition and manner during the period of each year, respectively, beginning on said 1st day of June, 1967. The Irrigation District shall not, during any such period, be required to do and perform any work upon said flood control works, the cost of which shall be in excess of said estimated amount, nor shall it perform any work upon or in relation to the maintenance and operation of said flood control works not previously authorized in writing by the Flood Control District. That in the event that the Irrigation District shall, at any time, by notice in writing given to the Flood Control District, advise the Flood Control District that the cost of doing the work done or to be done and performed by the Irrigation District during the period then in effect will be in excess of the amount estimated by the Flood Control District to cover the cost of such work, then and in such event the Flood Control District shall forthwith give notice in writing to the Irrigation District of its approval for the performance of the work to be done, the cost

of which will be in excess of said estimated amount for such work, and in the further event that such notice shall not be received by the Irrigation District within fifteen (15) days from and after the giving of said notice by the Irrigation District to the Flood Control District, then and in such events the Irrigation District shall have no further obligation to do and perform any further or additional work in relation to the maintenance and operation of said works, the cost of which will be in excess of the amount estimated by the Flood Control District to cover the cost of such work.

4. That the Irrigation District shall, from time to time, as it shall determine, present to the Flood Control District a detailed and itemized statement, with supporting invoices, of the cost of the work performed by the Irrigation District in relation to the maintenance and operation of said flood control works, including among other things, that part of the Irrigation District's general administrative and over-head expenses which are attributable to the maintenance and operation of said flood control works, provided, however, that in no event shall the amount of the Irrigation District's general administrative and over-head expenses exceed twenty per cent (20%) of the total cost to the Irrigation District of performing said work of maintaining and operating said flood control works, and notwithstanding anything herein to the contrary, any and all withholding, social security and other taxes and expenses of any and all employees engaged in the performance of the work of maintaining and operating said flood control works shall be the sole and exclusive responsibility of and shall be paid by the Irrigation District.

5. That the parties hereto recognize and agree that from time to time as a result of accidental, natural or other causes, and through no fault of the parties hereto, or either of them, there may be unusual damage to said flood control works requiring repairs and maintenance thereto exceeding normal repairs and maintenance, and in the event of any such eventuality the parties hereto shall determine and

agree upon the amount of the additional costs and expenses to be incurred as the result of such extraordinary causes, and in the event that the parties hereto shall agree upon the amount of said additional costs and expenses resulting from such extraordinary causes, then and in such event the Irrigation District shall proceed to do and perform the additional work made necessary by such extraordinary causes, and upon the completion thereof the Flood Control District shall pay to the Irrigation District the cost to the Irrigation District of performing such work, together with that part of the Irrigation District's general administrative and over-head expenses which are attributable to the performance of such extraordinary work.

6. That this Agreement shall be automatically renewed from year to year from and after the 1st day of July, 1967, unless the Flood Control District or the Irrigation District shall serve notice in writing, upon the other of them within thirty (30) days prior to the end of the period then in effect of its desire to terminate this Agreement at the end of said period, and upon the giving of such notice this Agreement shall terminate and end on the 30th day of June following the date on which such notice was given.

IN WITNESS WHEREOF, the parties hereto have caused their respective names to be hereto subscribed and their respective corporate seals to be hereto affixed on this, the 7th day of November, 1966.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZONA

By _____

MARICOPA COUNTY MUNICIPAL WATER CONSERVATION DISTRICT NO. 1

By _____

STATE OF ARIZONA)
) ss.
County of Maricopa)

On this, the 7th day of November, 1966, before me, the undersigned Notary Public, personally appeared _____, who acknowledged

himself to be the [illegible] of the FLOOD CONTROL DISTRICT OF MARICOPA COUNTY, ARIZONA, a Flood Control District organized under and pursuant to the laws of the State of Arizona, and that he, as such officer, being duly authorized so to do, executed the foregoing instrument for the purpose therein contained by signing the name of the Flood Control District by himself as such officer.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

[illegible]
Notary Public

My commission expires:
My Commission Expires Dec. 6, 1968

STATE OF ARIZONA)
) ss.
County of Maricopa)

On this, the 9th day of December, 1966, before me, the undersigned Notary Public, personally appeared Floyd O. Allen, who acknowledged himself to be the Secretary - Manager of the MARICOPA COUNTY MUNICIPAL WATER CONSERVATION DISTRICT NO. 1, an Irrigation District organized under and pursuant to the laws of the State of Arizona, and that he, as such officer, being duly authorized so to do, executed the foregoing instrument for the purposes therein contained by signing the name of the Irrigation District by himself as such officer.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.

Marcella W. Martin
Notary Public

My commission expires:
July 28, 1968

Col. Lowe

File

REPORT ON WHITE TANKS STRUCTURES NOS. 3 AND 4

Introduction. By letter of January 28, 1971, from the Assistant District Engineer, the Maricopa County Municipal Water District proposed to transfer to the Flood Control District, at no cost, all lands it controls for White Tanks Structures Nos. 3 and 4. When the matter was presented to the Citizens' Advisory Board for recommendation, they requested that a study be made of the desirability of having tests performed and a stability analysis prepared, probably by a consultant, before further action be considered.

Inasmuch as these were known to be Soil Conservation Service structures, the matter was discussed with the SCS staff to determine what information they could furnish. They stated that construction information was undoubtedly available and on December 2, 1971, they furnished a copy of the specifications, together with laboratory analyses of the soils used, under which the dams were constructed. These data have been studied and the following report is furnished.

Name. The structures are designated "White Tanks Project retarding structures No. 3 and No. 4" in the agreement between SCS and the Agua Fria SCD November 30, 1953. The contract specifications describe them as "White Tanks Structures Numbers 3 and 4".

CONSTRUCTION

Period. The invitation for bids was issued January 14, 1954; bids were opened February 8, 1954; work was to start within 20 days and be completed within 210 days after receipt of notice to proceed. The dams were completed in 1954.

Scope of Work.

Structure No. 3: 7667' long, 30' high, 10' crest, 375,000 cu. yds. embankment, 3 outlet structures.

Structure No. 4: 6839' long, 20' high, 10' crest, 175,000 cu. yds. embankment, 2 outlet structures.

Quality of Materials. Extensive laboratory testing was performed on materials from specified areas proposed for use, and only materials conforming to the requirements of the specifications were approved. A number of the reports of soils analyses (dated September and October 1952) were furnished. They included data on maximum density, composition, slope design, tests of facing material against erosion, and optimum moisture content. The curves showed generally that the optimum moisture content for maximum density was about 12%; that percentage was later used in the specifications. The embankments consisted of a central core and a blanket of granular facing material, all compacted to specification.

Borrow Areas. Borrow areas were specified, and clearing and stripping of the areas were required before borrow materials could be removed.

Outlet Structures. These were installed by the Maricopa County Municipal Water Conservation District No. 1. Anti-seep rings were installed around the outlet structures.

Subgrade Preparation. The subgrade was ripped for bonding, sprinkled and compacted in the same manner as the embankment.

Construction Method. Embankment materials, both core and facing, were compacted in layers not greater than 6", for the full width of the embankment. Material was required to have a water content, by sprinkling or moistening of approximately 12% prior to compaction. All embankment materials were required to be compacted to 95% of Standard Proctor Density as determined by laboratory tests.

Performance of Work. Laboratory tests and field inspection reports of the work performed during construction cannot be located after a lapse of 18 years since work was performed. However, Mr. J. J. Turner, now State Construction Engineer for SCS, supervised this project and states he will, if required, give personal certification that all work was performed in accordance with the specifications. The State Conservationist confirms that a soils laboratory was set up on the job and frequent tests were taken to confirm compliance with the specifications, and that no controversies arose during construction concerning adequate compaction of earth fill embankments.

HISTORY

The soundness and stability of the dams may also be measured by their condition 18 years after construction. By visual inspection, both dams are in good condition, with no cracks or slides or apparent subsidence. The largest storm in the area within recent years occurred in September 1970. Because of alterations in watershed limits, the inflow into Structure No. 4 exceeded its designed capacity and water exited in the designed emergency spillway on the west, and also around the east side of the dam. However, this greater-than-design inflow caused no visible damage to the structure.

Maintenance Obligation. I have examined the files for documents spelling out the obligation of the FCD to maintain these structures, and note the following:

a. In resolution adopted January 14, 1954, the County of Maricopa assumed the obligation of maintenance and operation of the Trilby Wash (Mc Micken Dam) flood control structure. There has been no subsequent formal transfer of this responsibility to the FCD and it may be advisable to obtain a legal opinion whether it is desirable that this be done. There was no mention in this resolution of White Tanks Structures Nos. 3 and 4.

b. (1) By agreement, dated November 30, 1953, between the Agua Fria Soil Conservation District and the Soil Conservation Service, the Agua Fria SCD agreed to maintain and operate White Tanks Structures Nos. 3 and 4.

(2) By Cooperative Agreement, dated December 3, 1953, Maricopa County Municipal Water Conservation District Number One agreed to accept the obligation of operation and maintenance of the structures.

(3) By agreement, dated November 28, 1966, between the Flood Control District of Maricopa County and Maricopa County Municipal Water Conservation District No. 1, it was stated that the FCD "has the responsibility of operating and maintaining certain flood control works, consisting in the main of McMicken Dam and outlet channel, SCS Dams No. 3 and No. 4 and interconnecting dikes and channels", etc. I am not sure that this constitutes a legal transfer of responsibility, and again it may be advisable to obtain a legal opinion whether it is desirable that a more formal transfer or acceptance be made.

Conclusions. It is concluded that White Tanks Structures Nos. 3 and 4 were constructed in accordance with standard flood control construction practices by Soil Conservation Service Contract; that suitable laboratory analyses were made of proposed borrow materials; that the design was based on obtaining embankments compacted to densities which are currently used by SCS; and that the supervisor of construction and the State Conservationist state that Standard SCS construction inspection and laboratory investigations of the work were made during construction.

L. E. Ohsiek

L. E. OHSIEK

LEO/aa

Exhibit A-6
Letter to Maricopa County Municipal Water Conservation District No. 1
from Flood Control District
May 19, 1975
Termination of Agreement
to Maintain White Tanks Structures

May 19, 1975

Maricopa County Municipal Water
Conservation District No. 1
P. O. Box 730
Peoria, Arizona 85345

Dear Sir:

Reference is made to an agreement between your organization and the Flood Control District of Maricopa County dated November 28, 1966 relating to operation and maintenance of McMicken Dam and Dams No. 3 and 4. Paragraph Six of this agreement provides for termination of the agreement by either party upon serving notice in writing to the other within thirty days prior to the end of the period of the contract then in effect.

This letter serves as official notice that the Flood Control District desires to terminate this agreement on June 30, 1975. Inasmuch as the Flood Control District has assumed operation and maintenance responsibility of all structures covered by the agreement, and your organization has transferred title to the Flood Control District for lands involved, no reasons exist to continue this agreement.

These flood control structures were designed and constructed so that flood waters may be discharged directly into the Beardsley Canal at various places. It is desired that your organization continue to operate gates as necessary to permit floodwaters to enter the Beardsley Canal, as you so desire. The Flood Control District will maintain responsibility for maintenance of these gates.

Please acknowledge receipt of this letter indicating your concurrence or objection to the termination of this agreement.

Sincerely,

Board of Directors, Flood Control District

Bob Stark
Chairman

	O & M
Remarks:	

Exhibit A-7
Letter to Agua Fria-New River NRCD
from Flood Control District
November 11, 1987
Maintenance Agreement

FLOOD CONTROL DISTRICT
of
Maricopa County

3335 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 262-1501

D. E. Sagramoso, P.E., Chief Engineer and General Manager

BOARD of DIRECTORS
Fred Koory, Jr., Chairman
George L. Campbell
Carole Carpenter
Tom Freestone
Ed Pastor

11-18-87

Mr. Joe A. Falbo
Agua Fria - New River NRCD
Post Office Box 730
Peoria, Arizona 85345

Dear Mr. Falbo:

Last year you asked that the District acknowledge that the Agua Fria - New River NRCD has no responsibility for the operation, maintenance, or control of the White Tanks structures; and is free from any and all claims which might arise from the existence and use of the structures.

Enclosed is a copy of a Resolution of our Board of Directors regarding White Tanks #3 and #4. This should alleviate your concerns.

Sincerely,

D. E. Sagramoso, P. E.

Enclosure

Coord: LCL
DAB
SLS

File: SO.1

Exhibit A-8
Resolution FCD 86-19
White Tanks #3 and #4

RESOLUTION FCD 86-19

White Tanks #3 and #4

WHEREAS, White Tanks Floodwater Retarding Structures #3 and #4 were built in western Maricopa County in 1954 with the participating agencies being the Agua Fria Soil Conservation District, the Maricopa County Municipal Water Conservation District, and the Soil Conservation Service, and

WHEREAS, the Work Plan for the White Tanks Watershed Protection Project specified that the Soil Conservation Service would build the structures and the Agua Fria Soil Conservation District would assume overall responsibility for future operation and maintenance of this project, with the Agua Fria Soil Conservation District arranging with the Maricopa County Municipal Water Conservation District #1 to assume responsibility for inspection and maintenance of the structures, and

WHEREAS, in 1965 the Flood Control District assumed financial responsibility for maintaining these structures by reimbursing the Maricopa County Municipal Water Conservation District #1 for the maintenance costs and in 1975 by maintaining the structures with Flood Control District personnel.

WHEREAS, the Flood Control District recognizes that there are some concerns involving the two structures including the potential need to acquire right-of-way and/or flowage easements at the outlets and emergency spillways as well as the unsafe condition of White Tanks Dam #4;

WHEREAS, the Flood Control District, for all intents and purposes, has assumed ownership and operation and maintenance responsibility for White Tanks Dams #3 and #4.

NOW, THEREFORE, BE IT RESOLVED, that the Flood Control District hereby acknowledges that the Agua Fria Soil Conservation District, or the Agua Fria--New River Natural Resource Conservation District as it is now known, has no responsibility for the operation, maintenance, or control of White Tanks #3 or White Tanks #4 and, therefore, is free of any and all claims which might arise from the existence and use of the structures.

DATED this 5th day of September, 1987.

Fred Koory Jr.
Chairman, Board of Directors
Flood Control District of Maricopa County

Attest:

Cleve Herrington
Clerk of the Board

APPENDIX B

Precipitation Data

APPENDIX B-1

100 Year Storm

Table B-1
100-Year Precipitation for
White Tanks Structures
(Reference 3)

Return Period (Years)	Precipitation Values (inches)			
	6 hour duration		24 hour duration	
	Map Value	Corrected Value	Map Value	Corrected Value
2			1.5	1.5
5			2.1	2.2
10			2.6	2.6
25			3.2	3.15
50			3.7	3.65
100			4.1	4.20

NOTE: There is a possibility of making an error while reading the maps because, (1) a site is not easy to locate precisely on a series of 12 maps, (2) there may be some slight registration differences in printing, and (3) precise interpolation between isolines is difficult. In order to minimize any errors in reading the maps, these values should be plotted on the diagram "Precipitation Depth versus Return Period" Fig. 1.

Figure B-1
White Tanks Structures
(Reference 3)

Project No. White Tanks Station (VAR)

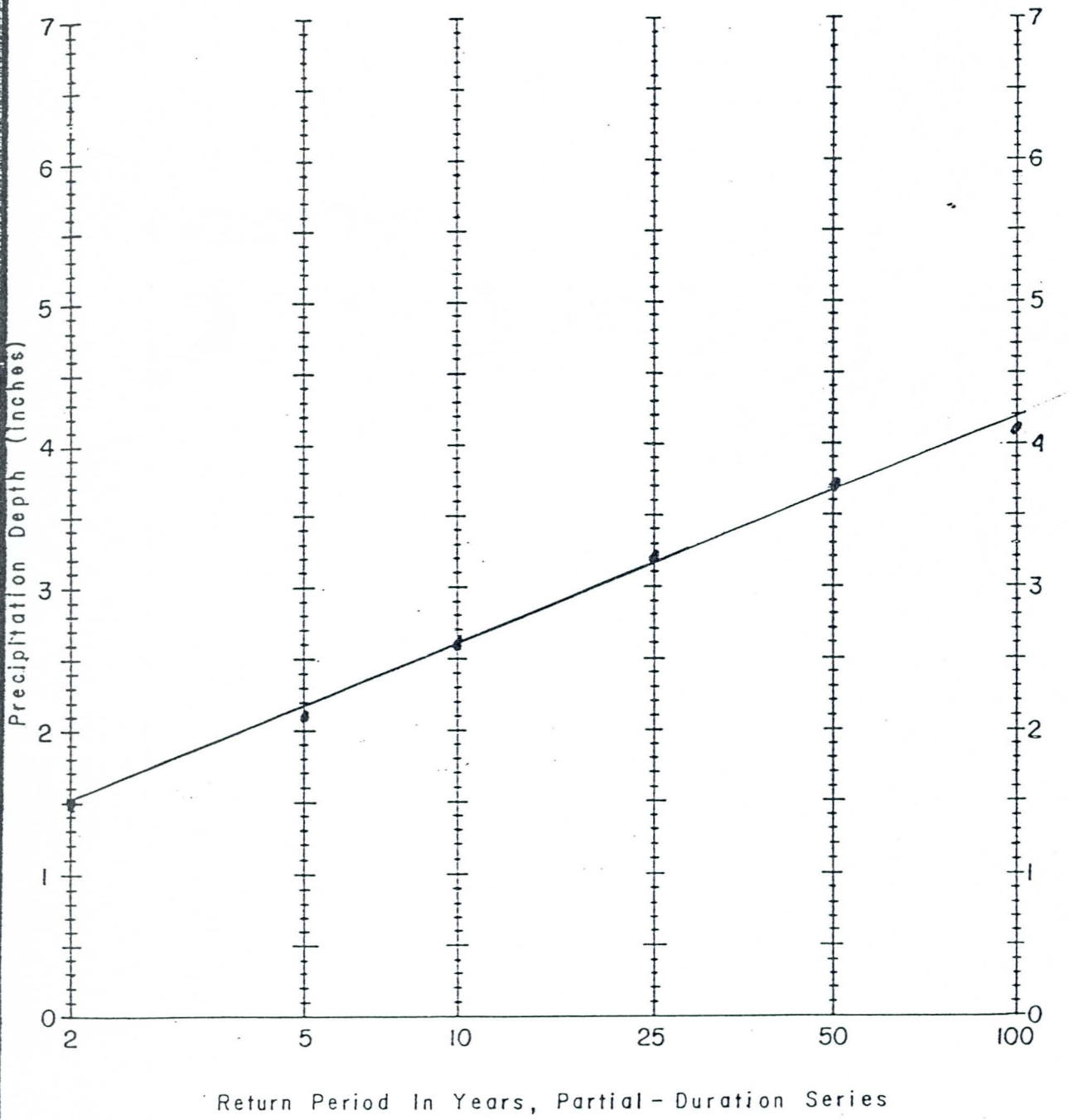


Figure 1 Precipitation Depth Versus Return Period for Partial – Duration Series

Figure B-2
2-Year 24-Hour Precipitation Isopluvials
(Reference 3)

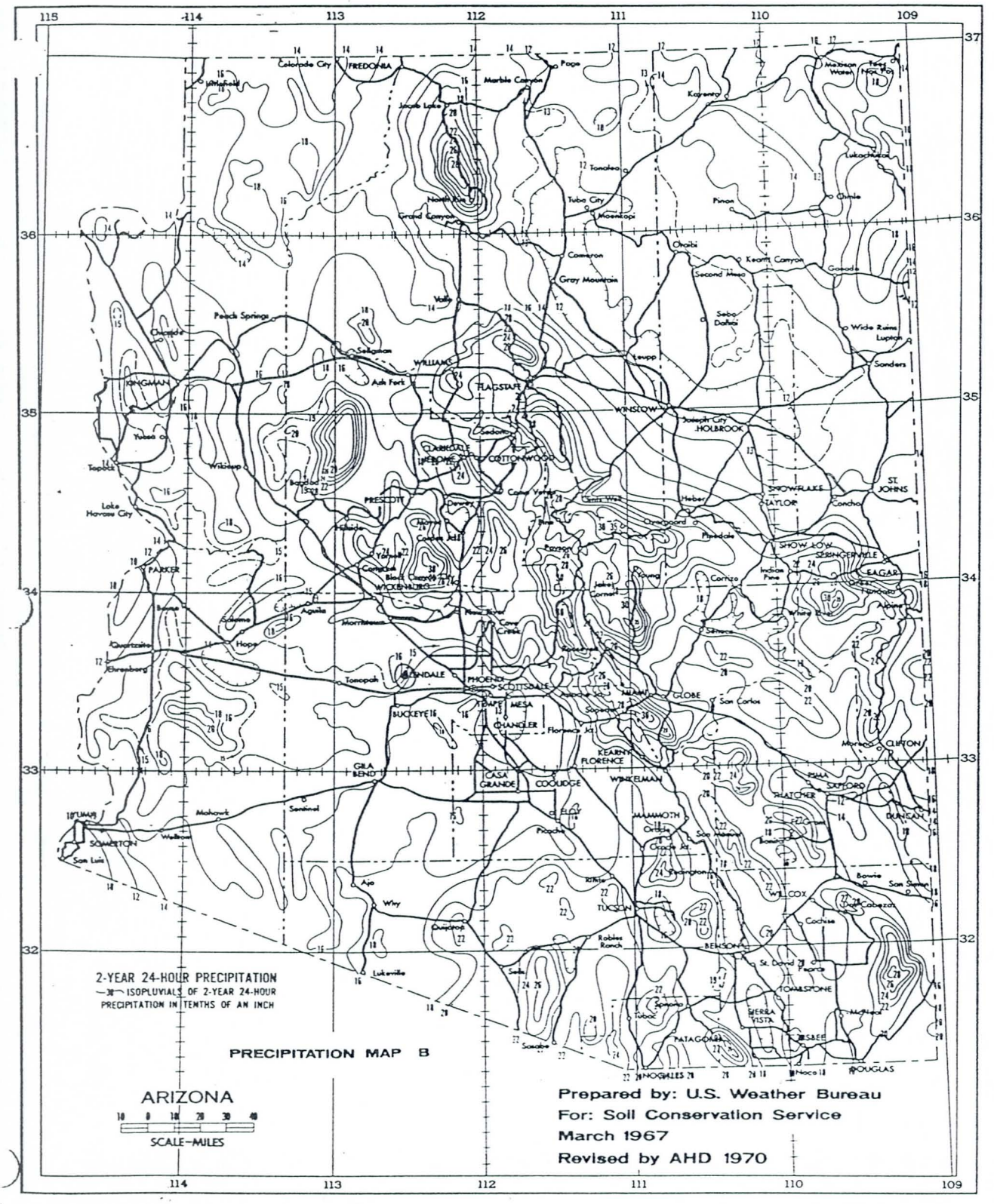


Figure B-3
5-Year, 24-Hour Precipitation Isopluvials
(Reference 3)

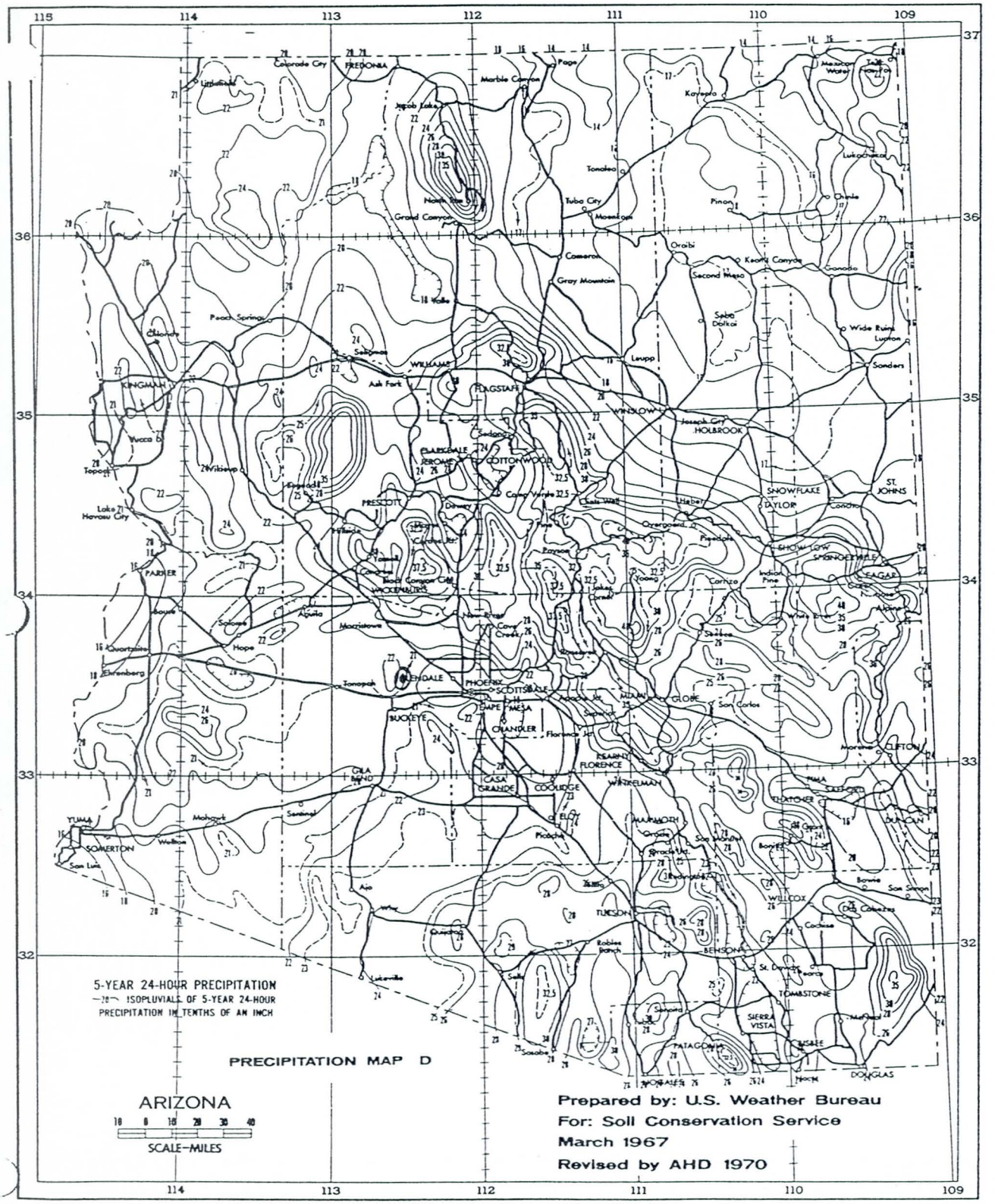


Figure B-4
10-Year, 24-Hour Precipitation Isopluvials
(Reference 3)

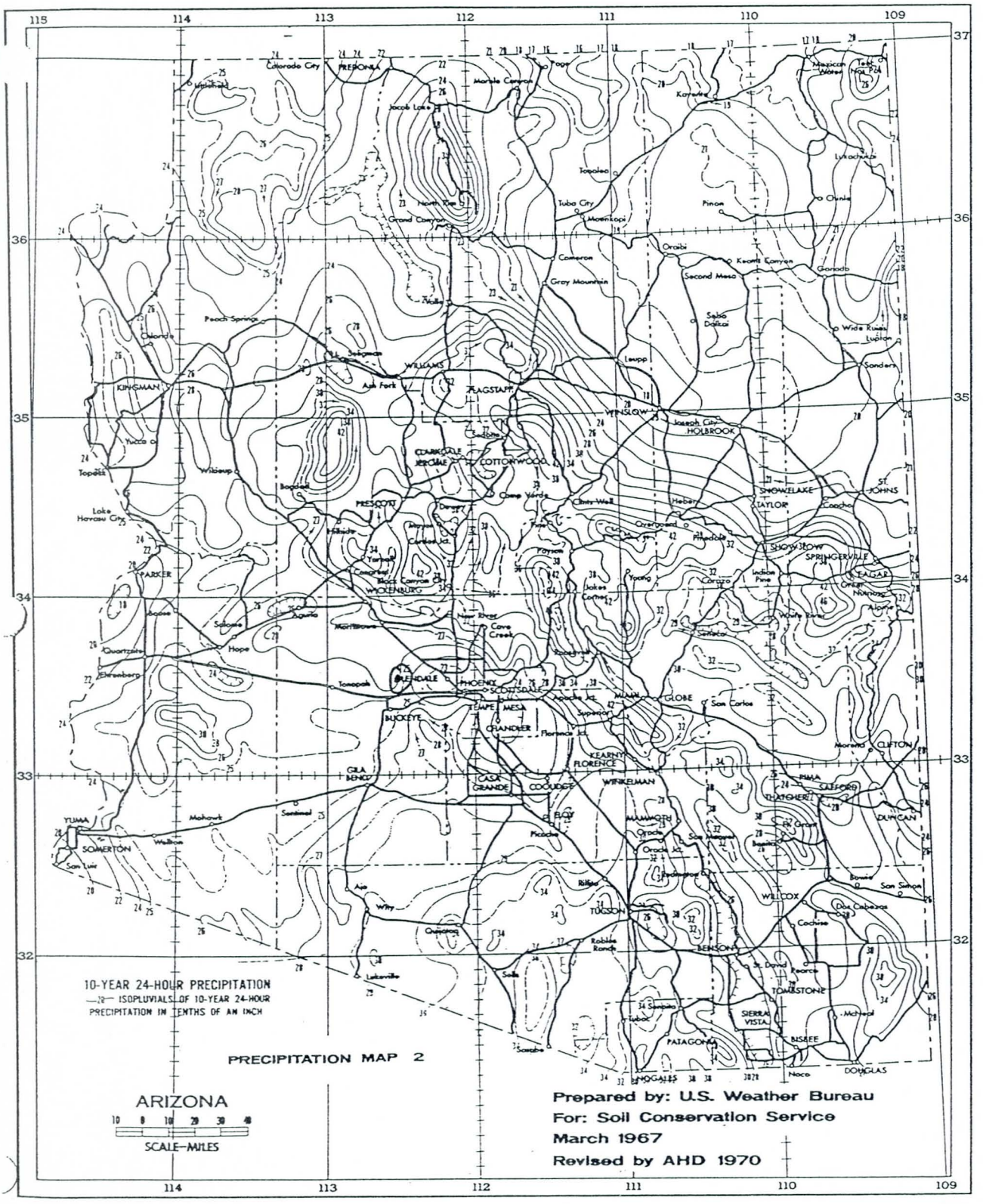


Figure B-5
25-Year, 24-Hour Precipitation Isopluvials
(Reference 3)

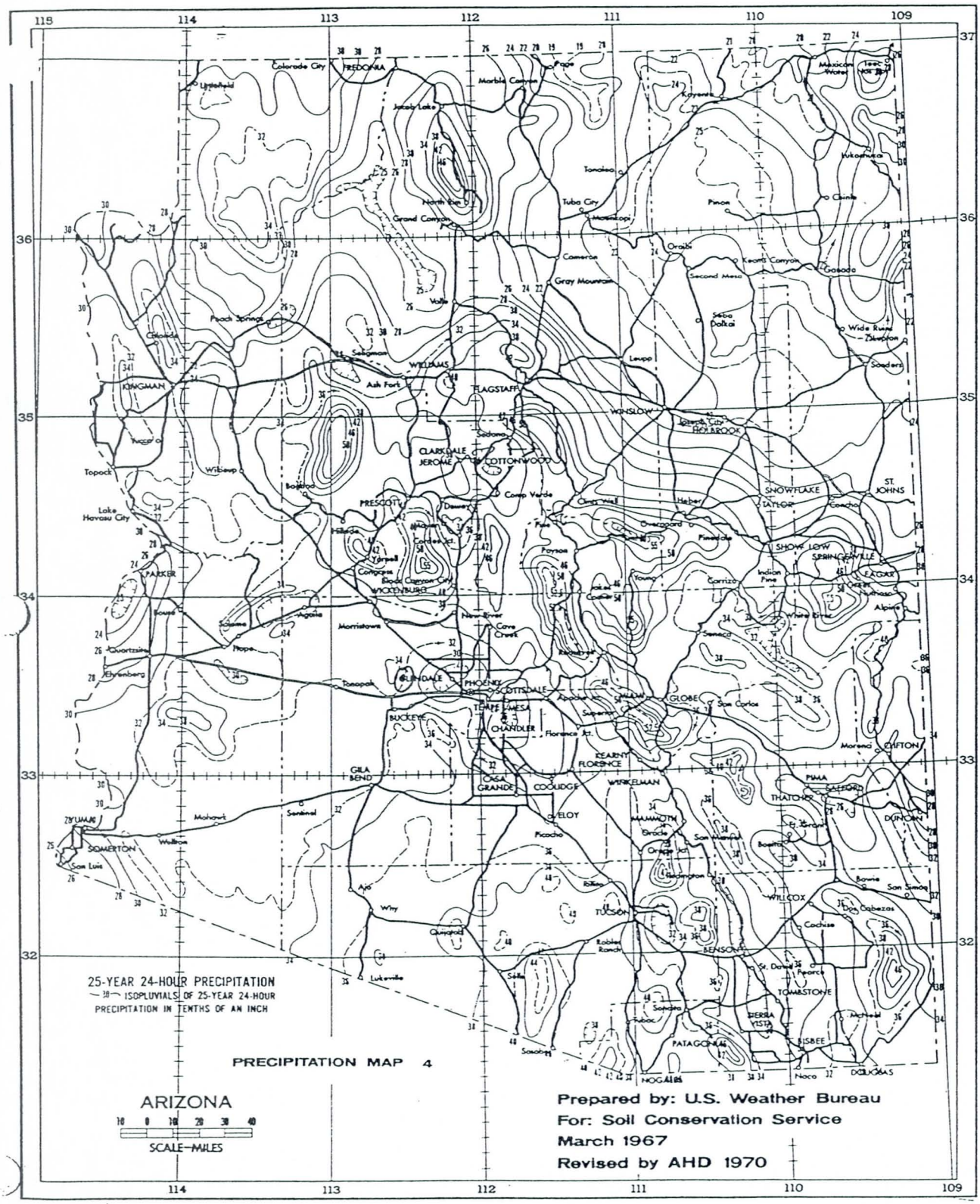


Figure B-6
50-Year, 24-Hour Precipitation Isopluvials
(Reference 3)

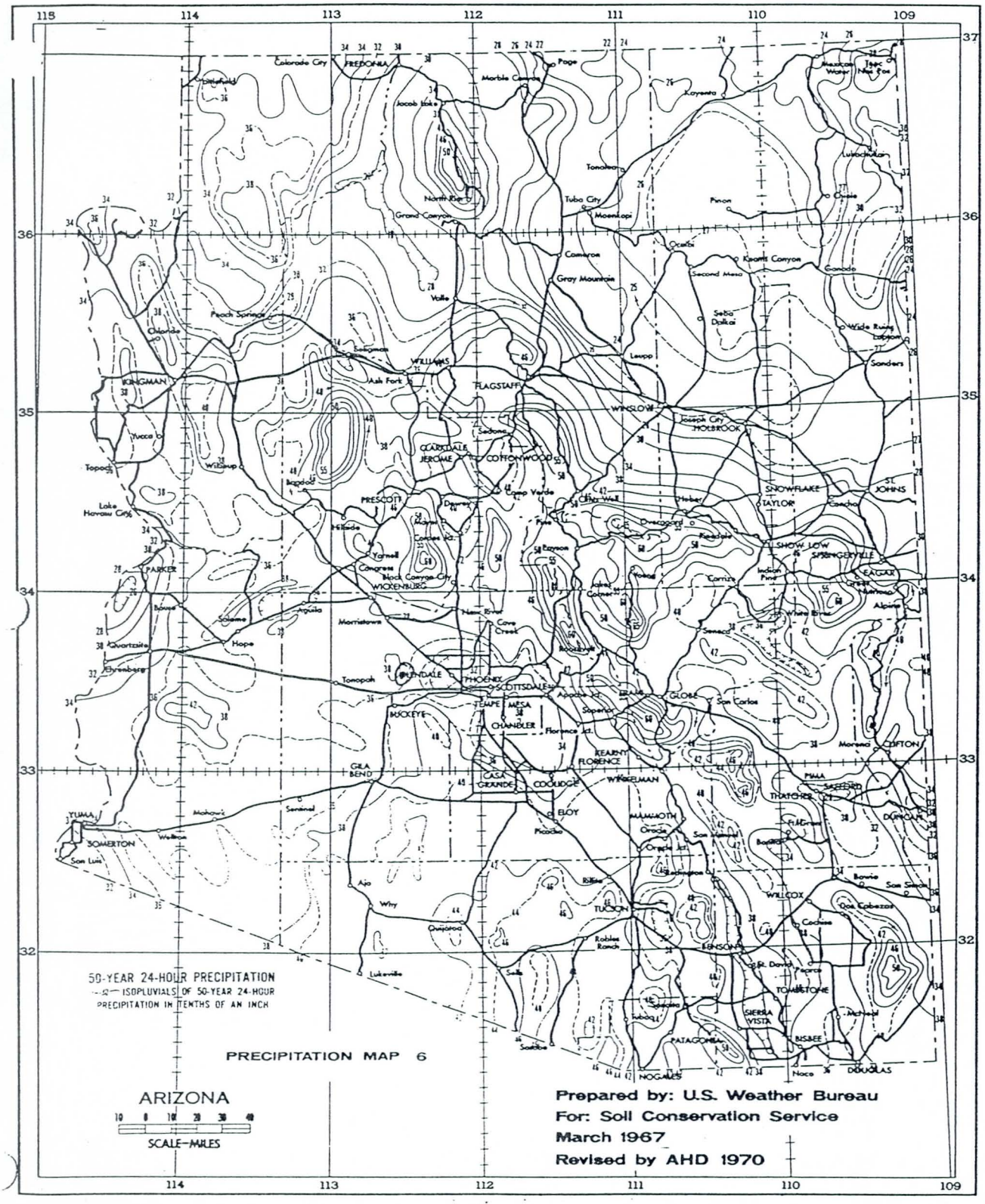
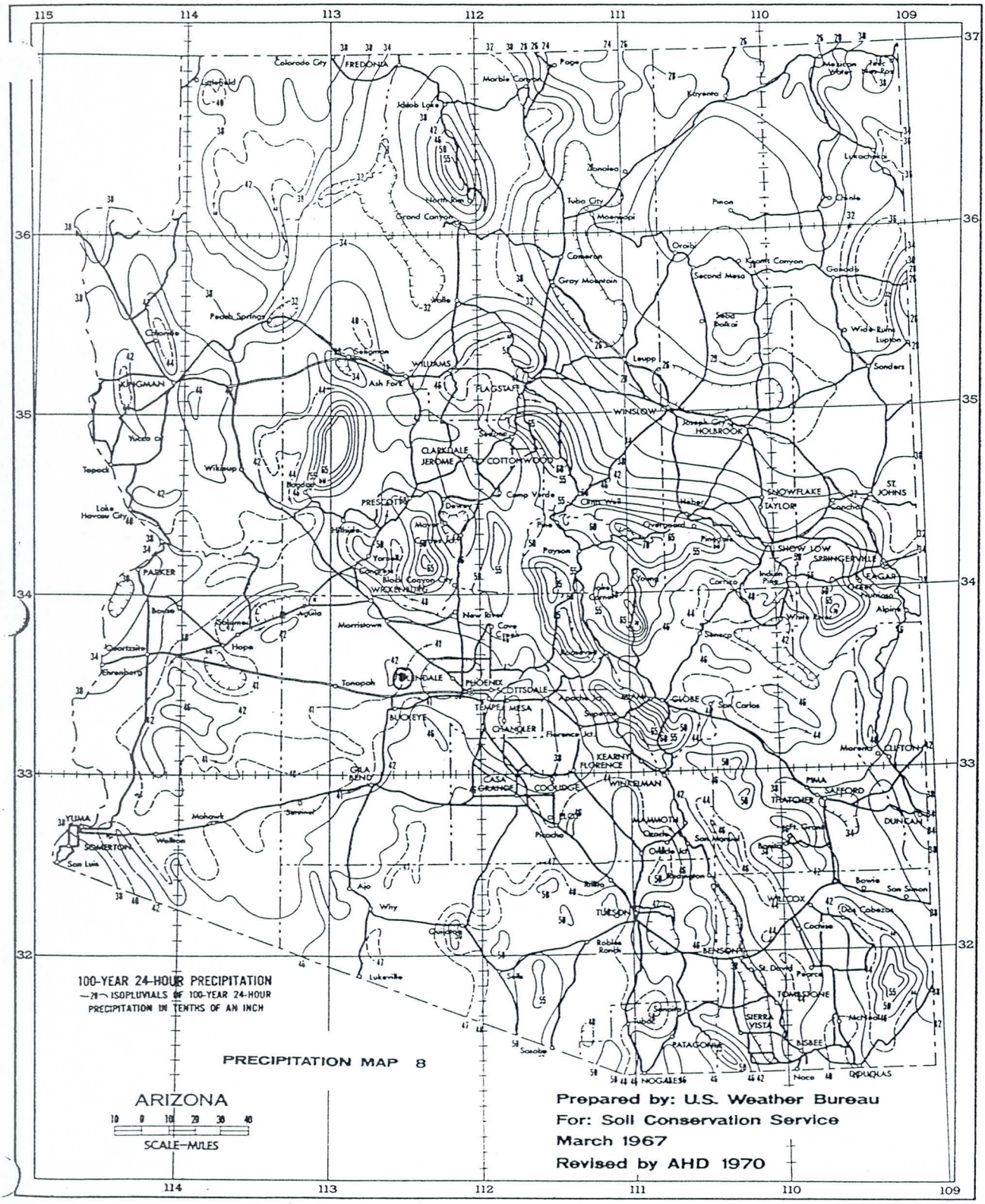


Figure B-7
100-Year, 24-Hour Precipitation Isopluvials
(Reference 3)



APPENDIX B-2

Probable Maximum Precipitation

Table B-2--General-storm PMP computations for the White Tank Structures (Reference 8)

Drainage White Tanks #3 Area 21.32 mi^2 (km^2)

Latitude 33° 32', Longitude 112° 28' of basin center

Month July

Step	Duration (hrs) 6	12	18	24	48	72	
A. Convergence PMP							
1. Drainage average value from one of figures 2.5 to 2.16	12.4 in. (mm)						
2. Reduction for barrier-elevation [fig. 2.18]	87 %						
3. Barrier-elevation reduced PMP [step 1 X step 2]	10.8 in. (mm)						
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	75	89	96	100	112	116	%
5. Convergence PMP for indicated durations [steps 3 X 4]	8.1	9.6	10.4	10.8	12.1	12.5	in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	8.1	1.5	.8	.4	1.3	.4	in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	95	99	100	100	100	100	%
8. Areally reduced PMP [step 6 X step 7]	7.8	1.5	.8	.4	1.3	.4	in. (mm)
9. Drainage average PMP [accumulated values of step 8]	7.8	9.3	10.1	10.5	11.8	12.2	in. (mm)
B. Orographic PMP							
1. Drainage average orographic index from figure 3.11a to d. (REVISED)	2.0 in. (mm)						
2. Areal reduction [figure 3.20]	98 %						
3. Adjustment for month [one of figs. 3.12 to 3.17]	83 %						
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	1.6 in. (mm)						
5. Durational variation [table ~~8.6~~ 3.9]	36	63	84	100	139	157	%
6. Orographic PMP for given durations [steps 4 X 5]	.6	1.0	1.3	1.6	2.2	2.5	in. (mm)
C. Total PMP							
1. Add steps A9 and B6	8.4	10.3	11.4	12.1	14.0	14.7	in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

Table B-3--General-storm PMP computations for the White Tank Structures (Reference 8)

Drainage White Tanks #3 Area 21.2 mi^2 (km^2)

Latitude 33° 32′, Longitude 112° 28′ of basin center

Month Aug.

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16 13.8 in. (mm)						
2. Reduction for barrier-elevation [fig. 2.18] 87%						
3. Barrier-elevation reduced PMP [step 1 X step 2] 12.00 in. (mm)						
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	75	89	96	100	112	116 %
5. Convergence PMP for indicated durations [steps 3 X 4]	9.0	10.7	11.5	12.0	13.4	13.9 in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	9.0	1.7	.8	.5	1.4	.5 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	95	99	100	100	100	100 %
8. Areally reduced PMP [step 6 X step 7]	8.6	1.7	.8	.5	1.4	.5 in. (mm)
9. Drainage average PMP [accumulated values of step 8]	8.6	10.3	11.1	11.6	13.0	13.5 in. (mm)
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d. (REVISED) 2.0 in. (mm)						
2. Areal reduction [figure 3.20] 98%						
3. Adjustment for month [one of figs. 3.12 to 3.17] 100 %						
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3] 2.0 in. (mm)						
5. Durational variation [table ~~3.6~~ 3.9]	36	63	84	100	139	157 %
6. Orographic PMP for given durations [steps 4 X 5]	.7	1.3	1.7	2.0	2.8	3.1 in. (mm)
C. Total PMP						
1. Add steps A9 and B6	9.3	11.6	12.8	13.6	15.3	16.6 in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

Table B-4 --General-storm PMP computations for the White Tank Structures (Reference 8)

Drainage White Tanks #3 Area 21.32 mi^2 (km^2)

Latitude 33° 32', Longitude 112° 28' of basin center

Month Sept.

Step	Duration (hrs) 6	12	18	24	48	72
A. Convergence PMP						
1. Drainage average value from one of figures 2.5 to 2.16	13.8 in. (mm)					
2. Reduction for barrier-elevation [fig. 2.18]	87 %					
3. Barrier-elevation reduced PMP [step 1 X step 2]	12.0 in. (mm)					
4. Durational variation [figs. 2.25 to 2.27 and table 2.7].	75	89	96	100	112	116 %
5. Convergence PMP for indicated durations [steps 3 X 4]	9.0	10.7	11.5	12.0	13.4	13.9 in. (mm)
6. Incremental 10 mi^2 (26 km^2) PMP [successive subtraction in step 5]	9.0	1.7	.8	.5	1.4	.5 in. (mm)
7. Areal reduction [select from figs. 2.28 and 2.29]	95	99	100	100	100	100 %
8. Areally reduced PMP [step 6 X step 7]	8.6	1.7	.8	.5	1.4	.5 in. (mm)
9. Drainage average PMP [accumulated values of step 8]	8.6	10.3	11.1	11.6	13.0	13.5 in. (mm)
B. Orographic PMP						
1. Drainage average orographic index from figure 3.11a to d. (REVISED)	2.0 in. (mm)					
2. Areal reduction [figure 3.20]	98 %					
3. Adjustment for month [one of figs. 3.12 to 3.17]	100 %					
4. Areally and seasonally adjusted PMP [steps 1 X 2 X 3]	2.0 in. (mm)					
5. Durational variation [table ~~3.6~~ 3.9]	36	63	84	100	139	157 %
6. Orographic PMP for given durations [steps 4 X 5]	.7	1.3	1.7	2.0	2.8	3.1 in. (mm)
C. Total PMP						
1. Add steps A9 and B6	9.3	11.6	12.8	13.6	15.8	16.6 in. (mm)

2. PMP for other durations from smooth curve fitted to plot of computed data.

3. Comparison with local-storm PMP (see sec. 6.3).

Table B-5 --Local-storm PMP computation for White Tank Structures
(Reference 8)

Drainage White Tanks #3 Area 21.32 mi^2 (km^2)
Latitude 33° 32' Longitude 112° 28' Minimum Elevation 1700 ft (m)

Steps correspond to those in sec. 6.3A.

1. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 11.7 in. (mm)

2. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m): 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 1 by step 2a. 11.7 in. (mm)

3. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.2

	Duration (hr)									
	1/4	1/2	3/4	1	2	3	4	5	6	
4. Durational variation for 6/1-hr ratio of step 3 [table 4.4].	74	89	95	100	110	115	118	119	120	%
5. 1-mi^2 (2.6-km^2) PMP for indicated durations [step 2b X step 4].	8.7	10.4	11.1	11.7	12.9	13.5	13.8	13.9	14.0	in. (mm)
6. Areal reduction [fig. 4.9].	63	68	72	73	76	78	80	81	82	%
7. Areal reduced PMP [steps 5 X 6].	5.5	7.1	8.0	8.5	9.8	10.5	11.0	11.3	11.5	in. (mm)
8. Incremental PMP [successive subtraction in step 7].				8.5	1.3	.7	.5	.3	.2	in. (mm)
	5.5	1.6	.9	.5	} 15-min. increments					

9. Time sequence of incremental PMP according to:

   Hourly increments [table 4.7]. .3 .7 8.5 1.3 .5 .2 in. (mm)

   Four largest 15-min. increments [table 4.8]. 5.5 1.6 .9 .5 in. (mm)

Table B-6 --Local-storm PMP computation for White Tank Structures (Reference 8)

Steps correspond to those in sec. 6.3B.

1. Place idealized isohyetal pattern [fig. 4.10] over drainage adjusted to 1:500,000 scale to obtain most critical placement.

2. Note the isohyets within drainage.

3. Average 1-hr 1-mi^2 (2.6-km^2) PMP for drainage [fig. 4.5]. 11.7 in. (mm)

4. a. Reduction for elevation. [No adjustment for elevations up to 5,000 feet (1,524 m), 5% decrease per 1,000 feet (305 m) above 5,000 feet (1,524 m)]. 100 %

   b. Multiply step 3 by step 4a. 11.7 in. (mm)

5. Average 6/1-hr ratio for drainage [fig. 4.7]. 1.2

6. Obtain isohetal labels for 15-min incremental and the highest PMP from table 4.5 corresponding 6/1-hr ratio of step 5.

PMP Increment	Isohyet A	B	C	D	E	F	G	H	I	J	
Highest 1-hr	100	82	58	44	32	23	16	13	12	11	
Highest 15-min.	74	56	32	21	14	8	7	6	5	4	
2nd "	15	15	15	12	9	6	4	3	3	3	
3rd "	6	6	6	6	5	5	3	2	2	2	in %
4th "	5	5	5	5	4	4	2	2	2	2	

7. Obtain isohyetal labels in % of 1-hr PMP for 2nd to 6th highest hourly incremental PMP values from table 4.6 using 6/1-hr ratio of step 5.

2nd Highest 1-hr PMP	11	11	11	11	10	8	7	5	5	5	
3rd "	4	4	4	4	4	4	4	4	4	4	
4th "	3	3	3	3	3	3	3	3	3	3	in %
5th "	2	2	2	2	2	2	2	2	2	2	
6th "	1	1	1	1	1	1	1	1	1	1	

8. Multiply steps 6 and 7 by step 4b to get incremental isohyetal labels of PMP.

Highest 15-min.	8.7	6.6	3.7	2.5	1.6	.9	.8	.7	.6	.5	
2nd "	1.8	1.8	1.8	1.4	1.1	.7	.5	.4	.4	.4	
3rd "	.7	.7	.7	.7	.6	.6	.4	.2	.2	.2	
4th "	.6	.6	.6	.6	.5	.5	.2	.2	.2	.2	
Highest 1-hr	11.7	9.6	6.8	5.1	3.7	2.7	1.9	1.5	1.4	1.3	in in. (mm)
2nd "	1.3	1.3	1.3	1.3	1.2	.9	.8	.6	.6	.6	
3rd "	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	
4th "	.4	.4	.4	.4	.4	.4	.4	.4	.4	.4	
5th "	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	
6th "	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	

9. Arrange values of step 8 in time sequence [tables 4.7 and 4.8].

	1	2	3	4	5	6	
Hourly	.2	.5	11.7	1.3	.4	.1	.2

APPENDIX C

Hydrograph Parameters

APPENDIX C-1

Hydrograph Parameters for White Tanks #3

Table C-1
Lag Time Calculations
for White Tanks #3
(Reference 7)

4-19-88 GLV

White Tanks #3:

Recalculation of lag time for subbasins using PHX. MTN S-Graphs.

$$LAG = 1.2\left(\frac{L \cdot L_{CA}}{S^{1/2}}\right)^{0.38}$$

Subbasin	L	miles L_{CA}	Ft/mi. S	HRS T_{LAG}	MIN. T_{LAG}
1	7.62	4.34	317	1.52	91.10
2	4.79	2.74	480	.99	59.26
3	4.31	2.31	380	.93	55.77
4	2.33	1.08	987	.46	27.81
5	1.81	1.27	523	.50	30.07
11	1.81	.61	111	.51	30.55

Table C-2
Subbasin Parameters
for White Tanks #3
(Reference 7)

4-12-88

White Tanks #3:

mi² Area	Subbasin	Ft. Channel Length	Slope	ft/s Velocity	Tc	* TLAG ++	CN
5.24	1 (MTN)	40,230	.06	3.9	3.03	109.2 1.82	88
1.33	2 (MTN)	25,310	.091	4.8	1.62	58.2 0.97	88
3.09	3 (MTN)	22,750	.072	4.3	1.63	58.8 0.98	88
1.61	4 (MTN)	12,560	.187	7.0	0.66	24.0 0.40	88
0.66	5 (MTN)	9,555	.099	5.1	0.68	24.6 0.41	87
1.87	6 (VLY)	14,330	.0188	2.2	2.51	90.6 1.51	88
1.67	7 (VLY)	15,205	.108	5.4	1.48	53.4 0.89	84
2.98	8 (VLY)	18,760	.0286	2.7	2.63	94.8 1.58	81
0.67	9 (VLY)	5,785	.0069	1.3	1.94	93.0 1.55	76
1.10	10 (VLY)	14,580	.016	2.1	2.63	94.8 1.58	78
1.11	11 (MTN)	6475 9,555	.144 .021	2.3	1.85	66.6 1.11	87
21.32							

* $T_{LAG} = 3/5\ T_c$

++ MTN. Watershed LAG Times have been re-calculated

Table C-3
Time of Concentration for Subbasin 1
in White Tanks #3
(Reference 7)

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project White Tanks #3 By GLV Date 4-13-88

~~Location~~ Subbasin 1 Checked _____ Date _____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		0.13				
3. Flow length, L (total L $\leq$ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.4				
5. Land slope, s	ft/ft	.40				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.16	+		=	.16

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	40,230				
9. Watercourse slope, s	ft/ft	.06				
10. Average velocity, V (figure 3-1)	ft/s	3.9				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	2.87	+		=	2.87

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	—
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					3.03

Table C-4
Time of Concentration for Subbasin 2
in White Tanks #3
Worksheet 3: Time of concentration (T_c) or travel time (T_t)
(Reference 7)

Project White Tanks #3 By GLV Date 4-13-89

~~Location~~ Subbasin 2 Checked _____ Date _____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		.13				
3. Flow length, L (total L ≤ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.4				
5. Land slope, s	ft/ft	.40				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.16	+		=	.16

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	25,310				
9. Watercourse slope, s	ft/ft	.091				
10. Average velocity, V (figure 3-1)	ft/s	4.8				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	1.46	+		=	1.62

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	—

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.62

Table C-5
Time of Concentration for Subbasin 3
in White Tanks #3
(Reference 7)

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project White Tanks #3 By GLV Date 4-13-83

~~Location~~ Subbasin 3 Checked _____ Date _____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.13			
3. Flow length, L (total L ≤ 300 ft) ..... ft		300			
4. Two-yr 24-hr rainfall, P_2 ..... in		1.40			
5. Land slope, s ..... ft/ft		.40			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t ..... hr		.16	+		= .16

Shallow concentrated flow	Segment ID				
7. Surface description (paved or unpaved)					
8. Flow length, L ..... ft		22,750			
9. Watercourse slope, s ..... ft/ft		.072			
10. Average velocity, V (figure 3-1) ..... ft/s		4.3			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr		1.47	+		= 1.47

Channel flow	Segment ID				
12. Cross sectional flow area, a ..... ft^2					
13. Wetted perimeter, p_w ..... ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... ft					
15. Channel slope, s ..... ft/ft					
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... ft/s					
18. Flow length, L ..... ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr			+		= —

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.63

Table C-6
Time of Concentration for Subbasin 4
in White Tanks #3
(Reference 7)

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project White Tanks #3 By GLV Date 4-13-88

~~Location~~ Subbasin 4 Checked _____ Date _____

Circle one: Present Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		0.13				
3. Flow length, L (total L $\leq$ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.40				
5. Land slope, s	ft/ft	.40				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.16	+		=	.16

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	12,560				
9. Watercourse slope, s	ft/ft	.187				
10. Average velocity, V (figure 3-1)	ft/s	7.0				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	.50	+		=	.50

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 0.66

Table C-7
Time of Concentration for Subbasin 5
in White Tanks #3
(Reference 7)

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project White Tanks #3 By GLV Date 4-13-88

Location Subbasin 5 Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		0.13				
3. Flow length, L (total L ≤ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.40				
5. Land slope, s	ft/ft	.40				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	.16	+		=	.16

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	9,555				
9. Watercourse slope, s	ft/ft	.099				
10. Average velocity, V (figure 3-1)	ft/s	5.1				
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	.52	+		=	.52

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=	—
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					.68

Table C-8
Time of Concentration for Subbasin 6
in White Tanks #3

Worksheet 3: Time of concentration (T_c) or travel time (T_t)
(Reference 7)

Project White Tanks #3 By GLV Date 4-13-88

~~Location~~ Subbasin 6 Checked _____ Date _____

Circle one: Present Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		0.13			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.40			
5. Land slope, s	ft/ft	.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	.70	+	=	.70

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	14,330			
9. Watercourse slope, s	ft/ft	.0188			
10. Average velocity, V (figure 3-1)	ft/s	2.2			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+	=	1.8

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+	=	—

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 2.51

Table C-9
Time of Concentration for Subbasin 7
in White Tanks #3
(Reference 7)

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project White Tanks #3 By GLV Date 4-13-88

Location Subbasin 7 Checked ____ Date ____

Circle one: Present Developed

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		0.13			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.40			
5. Land slope, s	ft/ft	.010			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.70	+	=	.70

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	15,208			
9. Watercourse slope, s	ft/ft	.108			
10. Average velocity, V (figure 3-1)	ft/s	5.4			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	.78	+	=	.78

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=	—
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				1.48

Table C-10
Time of Concentration for Subbasin 8
in White Tanks #3

Worksheet 3: Time of concentration (T_c) or travel time (T_t)
(Reference 7)

Project White Tanks #3 By GLV Date 4-13-88

~~Location~~ Subbasin 8 Checked _____ Date _____

Circle one: Present Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		0.13			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.40			
5. Land slope, s	ft/ft	.010			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.70	+		= .70

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	18,760			
9. Watercourse slope, s	ft/ft	.0286			
10. Average velocity, V (figure 3-1)	ft/s	2.7			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	1.93	+		= 1.93

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		= —
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				= 2.63

Table C-11
Time of Concentration for Subbasin 9
in White Tanks #3
Worksheet 3: Time of concentration (T_c) or travel time (T_t)
(Reference 9)

Project White Tanks #3 By GLV Date 4-12-88

Location Subbasin 9 Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)	Segment ID				
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		0.13			
3. Flow length, L (total L ≤ 300 ft) ..... ft		300			
4. Two-yr 24-hr rainfall, P_2 ..... in		1.40			
5. Land slope, s ..... ft/ft		.010			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t ..... hr		.70	+		= .70

Shallow concentrated flow	Segment ID				
7. Surface description (paved or unpaved)					
8. Flow length, L ..... ft		5,785			
9. Watercourse slope, s ..... ft/ft		.0069			
10. Average velocity, V (figure 3-1) ..... ft/s		1.3			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr		1.24	+		= 1.24

Channel flow	Segment ID				
12. Cross sectional flow area, a ..... ft^2					
13. Wetted perimeter, p_w ..... ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ..... ft					
15. Channel slope, s ..... ft/ft					
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V ..... ft/s					
18. Flow length, L ..... ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t ..... hr			+		= —

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.94

Table C-12
Time of Concentration for Subbasin 10
in White Tanks #3
(Reference 7)

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Project White Tanks #3 By GLV Date 4-13-88

~~Location~~ Subbasin 10 Checked ____ Date ____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		0.13			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.40			
5. Land slope, s	ft/ft	.010			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	.70	+		= .70

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	14,580			
9. Watercourse slope, s	ft/ft	.016			
10. Average velocity, V (figure 3-1)	ft/s	2.1			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	1.93	+		= 1.93

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		= —

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 2.63

Table C-13
Time of Concentration for Subbasin 11
in White Tanks #3

Worksheet 3: Time of concentration (T_c) or travel time (T_t)
(Reference 7)

Project White Tanks #3 By RLV Date 4-13-88

~~Location~~ Subbasin 11 Checked _____ Date _____

Circle one: Present Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		.013				
3. Flow length, L (total L ≤ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.40				
5. Land slope, s	ft/ft	.40				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.16	+		=	.16

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	9,555				
9. Watercourse slope, s	ft/ft	.021				
10. Average velocity, V (figure 3-1)	ft/s	2.3				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	1.15	+		=	1.15

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	—
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					1.85

(210-VI-TR-55, Second Ed., June 1986)

D-

APPENDIX C-2

Hydrograph Parameters for White Tanks #4

Table C-14
Hydrograph Parameters
for White Tanks #4

SUBBASIN	AREA (sq.mi.)	LENGTH (feet)	SLOPE (ft/ft)	Tc (hours)	Tlag * (hours)	Lca (feet)	Tlag ** (hours)
1	1.43	12,580	0.102	-	-	6500	0.46
2	1.38	13,175	0.097	-	-	7000	0.49
3	1.99	10,800	0.040	1.15	0.69	-	-
4	1.55	15,370	0.117	-	-	6000	0.46
5	0.54	6800	0.019	1.10	0.66	-	-
6	0.59	7550	0.010	1.55	0.93	-	-
7	1.88	15,130	0.013	2.53	1.52	-	-
8	0.52	7575	0.125	-	-	4000	0.34
9	0.94	9325	0.012	1.79	1.07	-	-
10	0.47	5775	0.013	1.23	0.74	-	-
11A	0.056	2300	0.014	0.59	0.35	-	-
11B	0.34	6200	0.011	1.26	0.76	-	-
11C	0.43	8000	0.012	1.62	0.97	-	-
11D	1.35	11,200	0.012	2.09	1.25	-	-
12	0.97	3800	0.011	1.08	0.65	-	-
13	1.87	1000	0.020				
		10,000	.0047	3.27	1.96	-	-

* Tlag = .6*Tc (for valley subbasins)

** Tlag = $1.2\left(\frac{L*Lca}{S^{1/2}}\right)^{.38}$ (for Mountainous subbasins)

Table C-15

Time of Concentration for Subbasin 3
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By ____ Date ____

Location Sub 3 Checked ____ Date ____

Circle one: Present Developed

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.08			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.21	+	=	.21

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	10800			
9. Watercourse slope, s	ft/ft	.019			
10. Average velocity, V (figure 3-1)	ft/s	2.22			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=	.94

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+	=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.15

Table C-16

Time of Concentration for Subbasin 5
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By ____ Date ____

Location Sub 5 Checked ____ Date ____

Circle one: Present Developed ____

Circle one: T_c T_t through subarea ____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		.15				
3. Flow length, L (total L ≤ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.4				
5. Land slope, s	ft/ft	.05				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		+		=	.25

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	6800				
9. Watercourse slope, s	ft/ft	.019				
10. Average velocity, V (figure 3-1)	ft/s	2.22				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	.85

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					1.10

Table C-17

Time of Concentration for Subbasin 6
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By VAR Date _____

Location Sub 6 Checked _____ Date _____

Circle one: (Present) Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.05			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr		+		= .25

Shallow concentrated flow		Segment ID			
7. Surface description (paved or (unpaved))					
8. Flow length, L	ft	7550			
9. Watercourse slope, s	ft/ft	.010			
10. Average velocity, V (figure 3-1)	ft/s	1.61			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		= 1.30

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				1.55

Table C-18

Time of Concentration for Subbasin 7
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By _____ Date _____

Location Sub 7 Checked _____ Date _____

Circle one: Present Developed

Circle one: T_c T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.05			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr		+		= .25

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	15,130			
9. Watercourse slope, s	ft/ft	.013			
10. Average velocity, V (figure 3-1)	ft/s	1.84			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		= 2.28

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 2.53

Table C-19

Time of Concentration for Subbasin 9
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By VAR Date _____

Location Sub 9 Checked _____ Date _____

Circle one: (Present) Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.025			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr		+		= .33

Shallow concentrated flow		Segment ID			
7. Surface description (paved or (unpaved))					
8. Flow length, L	ft	9325			
9. Watercourse slope, s	ft/ft	.012			
10. Average velocity, V (figure 3-1)	ft/s	1.77			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		= 1.46

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.79

Table C-20

Time of Concentration for Subbasin 10
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By UMC Date _____

Location Sub 10 Checked _____ Date _____

Circle one: Present Developed _____

Circle one: T_c T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.02			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr		+		= .36

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	5775			
9. Watercourse slope, s	ft/ft	.013			
10. Average velocity, V (figure 3-1)	ft/s	1.84			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		= .87

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr				1.23

Table C-21

Time of Concentration for Subbasin 11A
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By VAR Date _____

Location 11 A Checked _____ Date _____

Circle one: (Present) Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		.15				
3. Flow length, L (total L $\leq$ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.4				
5. Land slope, s	ft/ft	.05				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.25	+		=	.25

Shallow concentrated flow		Segment ID				
7. Surface description (paved or (unpaved))						
8. Flow length, L	ft	2300				
9. Watercourse slope, s	ft/ft	.014				
10. Average velocity, V (figure 3-1)	ft/s	1.9				
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	.34	+		=	.34

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=	
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					.59

Table C-22

Time of Concentration for Subbasin 11B
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By VAR Date _____

Location 11B Checked _____ Date _____

Circle one: Present Developed _____

Circle one: T_c T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L $\leq$ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.05			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.25	+		= .25

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	6200			
9. Watercourse slope, s	ft/ft	.011			
10. Average velocity, V (figure 3-1)	ft/s	1.7			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	1.01	+		= 1.01

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.26

Table C-23

Time of Concentration for Subbasin 11C
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By VAR Date _____

Location 11C Checked _____ Date _____

Circle one: (Present) Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.02			
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$ Compute T_t	hr	.36	+		= .36

Shallow concentrated flow		Segment ID			
7. Surface description (paved or (unpaved))					
8. Flow length, L	ft	8000			
9. Watercourse slope, s	ft/ft	.012			
10. Average velocity, V (figure 3-1)	ft/s	1.77			
11. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr	1.26	+		= 1.26

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\ r^{2/3}\ s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 1.62

Table C-24

Time of Concentration for Subbasin 11D
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By ____ Date ____

Location 11D Checked ____ Date ____

Circle one: (Present) Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.025			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	.33	+		= 33

Shallow concentrated flow		Segment ID			
7. Surface description (paved or (unpaved))					
8. Flow length, L	ft	11,200			
9. Watercourse slope, s	ft/ft	.012			
10. Average velocity, V (figure 3-1)	ft/s	1.77			
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	1.78	+		= 1.78

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 2.09

Table C-25

Time of Concentration for Subbasin 12
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By VAR Date _____

Location 12 Checked _____ Date _____

Circle one: (Present) Developed _____

Circle one: (T_c) T_t through subarea _____

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID				
1. Surface description (table 3-1)						
2. Manning's roughness coeff., n (table 3-1) ..		.15				
3. Flow length, L (total L ≤ 300 ft)	ft	300				
4. Two-yr 24-hr rainfall, P_2	in	1.4				
5. Land slope, s	ft/ft	.011				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	.46	+		=	.46

Shallow concentrated flow		Segment ID				
7. Surface description (paved or unpaved)						
8. Flow length, L	ft	3800				
9. Watercourse slope, s	ft/ft	.011				
10. Average velocity, V (figure 3-1)	ft/s	1.7				
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	.62	+		=	.62

Channel flow		Segment ID				
12. Cross sectional flow area, a	ft^2					
13. Wetted perimeter, p_w	ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft					
15. Channel slope, s	ft/ft					
16. Manning's roughness coeff., n						
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s					
18. Flow length, L	ft					
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=	
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr					1.08

Table C-26

Time of Concentration for Subbasin 13
in White Tanks #4

Worksheet 3: Time of concentration (T_c) or travel time (T_t) (Reference 7)

Project White Tanks #4 By ____ Date ____

Location 13 Checked ____ Date ____

Circle one: (Present) Developed

Circle one: (T_c) T_t through subarea

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to T_c only)		Segment ID			
1. Surface description (table 3-1)					
2. Manning's roughness coeff., n (table 3-1) ..		.15			
3. Flow length, L (total L ≤ 300 ft)	ft	300			
4. Two-yr 24-hr rainfall, P_2	in	1.4			
5. Land slope, s	ft/ft	.02			
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$ Compute T_t	hr	.36	+		= .36

Shallow concentrated flow		Segment ID			
7. Surface description (paved or unpaved)					
8. Flow length, L	ft	1000	11,000		
9. Watercourse slope, s	ft/ft	.02	.0047		
10. Average velocity, V (figure 3-1)	ft/s	2.22	1.1		
11. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr	.13	+	2.78	= 2.91

Channel flow		Segment ID			
12. Cross sectional flow area, a	ft^2				
13. Wetted perimeter, p_w	ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r	ft				
15. Channel slope, s	ft/ft				
16. Manning's roughness coeff., n					
17. $V = \frac{1.49\,r^{2/3}\,s^{1/2}}{n}$ Compute V	ft/s				
18. Flow length, L	ft				
19. $T_t = \frac{L}{3600\,V}$ Compute T_t	hr		+		=

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19) ..... hr 3.27

APPENDIX D

Structure Specifications

APPENDIX D-1

White Tanks #3

Stage-Storage-Discharge Relationships

Exhibit D-1
White Tanks #3 Structure Specifications

PROJECT TITLE: White Tanks #3

WATERSHED AND RELATIONSHIP TO OTHER STRUCTURES
Eastern slopes of the White Tanks Mountains

LOCATION: Township, range, section; description from well known physical features; how to get there.

T2N R2W Sections 4, 5, 8 & 9

Take Northern Avenue to just west of the Beardsley Canal and then south using the top of the training dike to the north end of the structure.

AUTHORIZATION: Pilot

FEDERAL SPONSOR: Soil Conservation Service

LOCAL SPONSOR(S): Maricopa County Municipal Water Conservation District No. 1

DOCUMENTATION: e.g., Watershed workplan title/date; supplements EIS date approved

CONTRACTOR: Danens, Shelton & Betts

DATE OF CONSTRUCTION AWARD:

DATE OF FINAL ACCEPTANCE: 1954

FUNCTIONAL DESCRIPTION: How it works.

This structure collects runoff water from the eastern slopes of the White Tanks Mountains, impounds it and releases it through 3 gated outlets or over the emergency spillway at the south end of the structure. A diversion dike west of the Beardsley canal starts at Northern Avenue and runs south to the structure. Water released from this structure will go into the Beardsley Canal or into the desert washes.

PROJECT FEATURES:
Type of structure.....Compacted Earthfill
Top of structure elevation.....1216.0
Length of structure.....7,667 LF
Maximum height.....30 feet
Top crest width.....10 feet
Spillway crest elevation.....1210.0
Spillway capacity.....11,750 CFS
Drainage area.....24 square miles
Storage capacity.....2,655 acre feet
Maximum water surface elevation.....1213.0
Freeboard
Peak inflow
Peak outflow
Drawdown time.....80 hours
Principal outlet discharge rate
Principal outlet structure.....3 ungated pipes - 2 ea. 48" RCP
1 ea. 24" RCP

LEVEL OF PROTECTION:

Total Costs for White Tanks #3 & #4

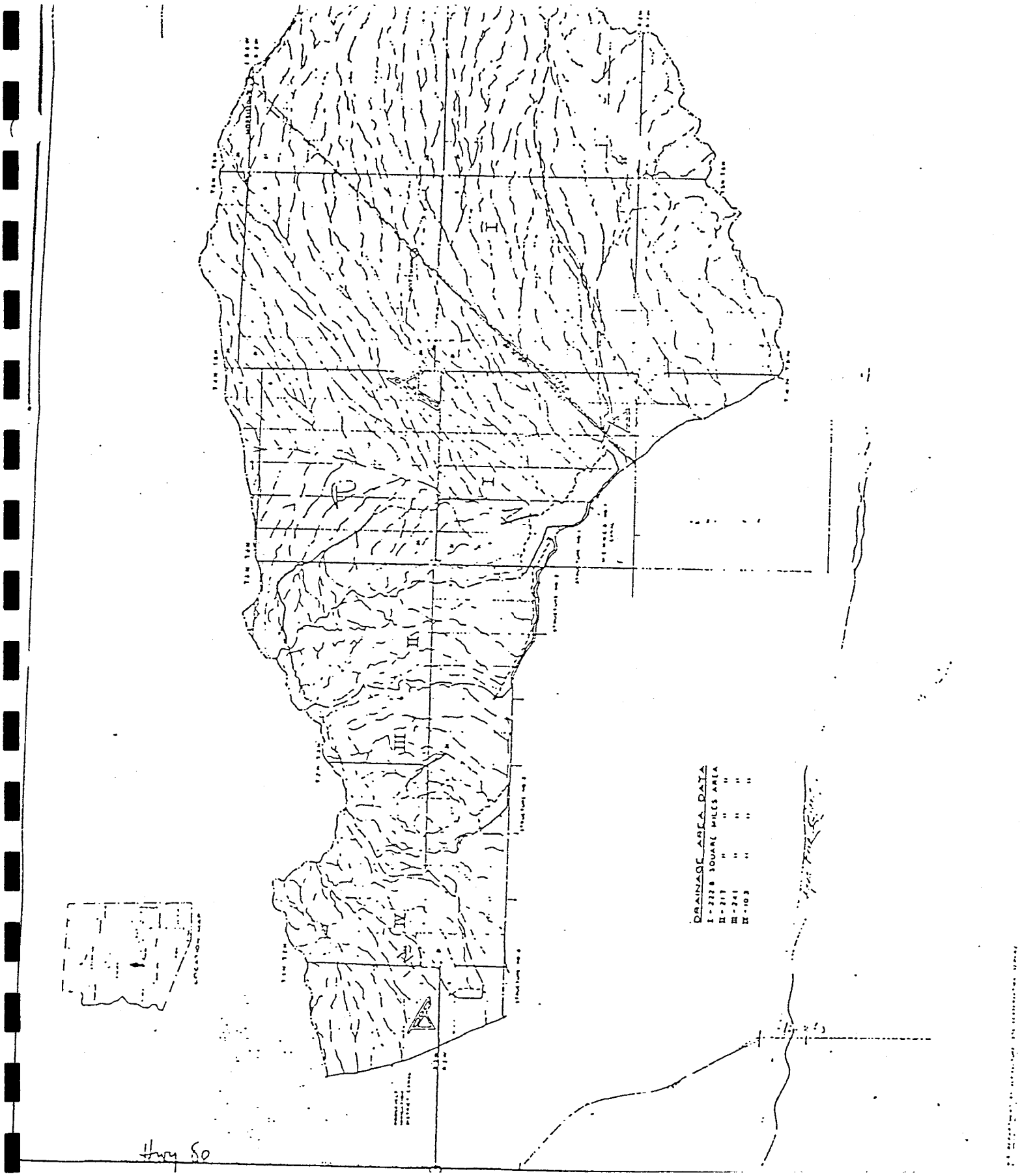
Federal: $199,088
Local: Land, relocations, engineers;
Total $218,287

ADWR Operational Certificate Issued: date October 16, 1974

ENCLOSURES:
Site Map
Stage Storage Curve
Storage Discharge Summary
Area & Capacity Curve - Attached
Spillway Discharge Curve - Attached
Outlet "M" Discharge Curve - Attached

Dam Safety Status:

Exhibit D-1
(continued)



MAINTENANCE RESPONSIBILITIES

Structure:
White Tanks #3 6A200

Bank Protection - Riprap		acres
Bridges - Pedestrian		each
Bridges - Vehicle		each
Culverts, Box		each
Culverts, Pipe		each
Drainage Channel - Lined		feet
Drainage Channel - Unlined		miles
Drop Structure		each
Embankment	30	acres
Embankment, Soil Cement		acres
Fencing	15,044	feet
Floodway - Lined		feet
Floodway - Unlined		acres
Gated Outlet	3	each
Gates	6	each
Gutters, Concrete		feet
High Flow	26	acres
Landscape		acres
Low Flow	34	acres
Manholes		each
Meter Houses		each
Outlet Structure		each
Pilot Channel		miles
Pool Area	384	acres
Principal Outlet	195	feet
Ramps, Concrete		feet
Retaining Wall		feet
Right-of-Way		acres
River Clearing		acres
Roads - Asphalt		miles
Roads - Dirt	3.7	miles
Side Inlet		each
Spillway - Earth	12	acres
Spillway - Lined		feet
Stilling Basins		each
Stormdrain Pipe		feet
Trash Racks		each
Vegetative Drains		each

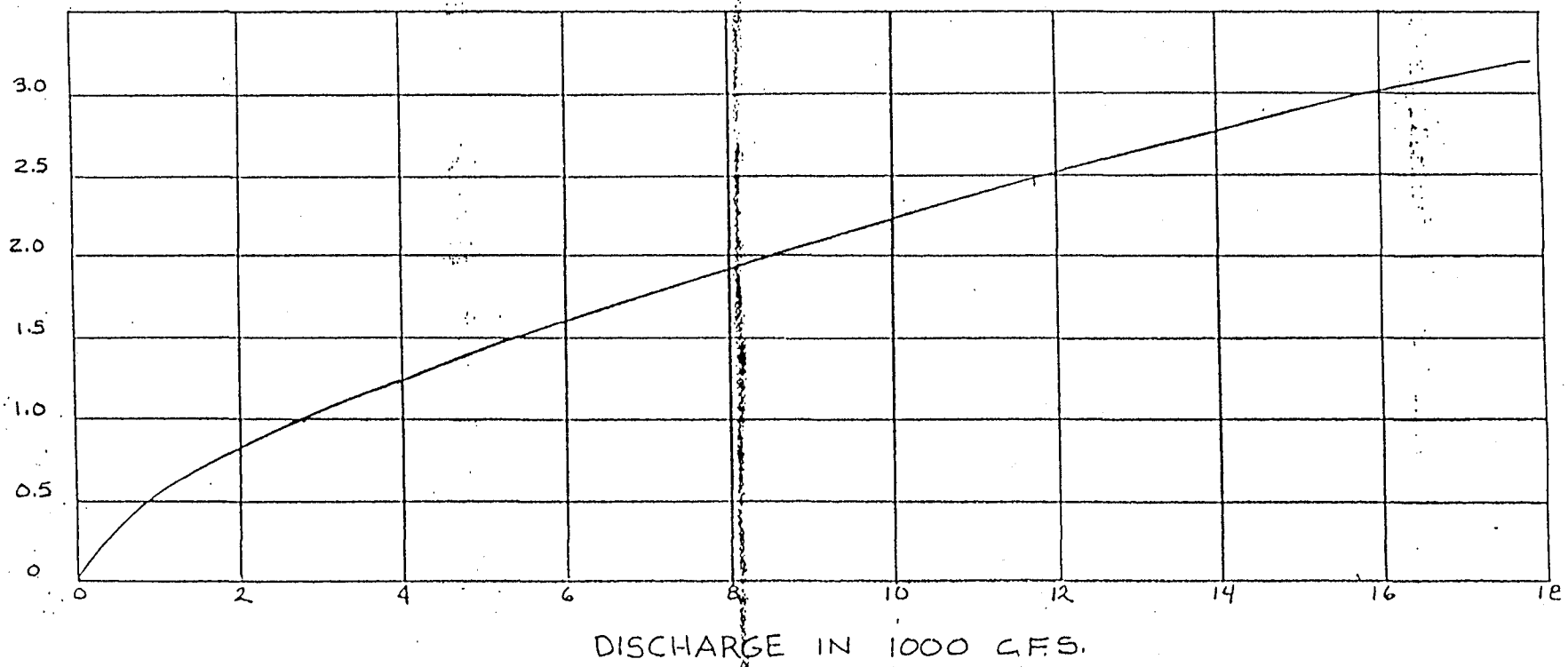
Table D-1
White Tanks #3 Discharge
- Stage Rating Curve

~~TD-28~~

White Tanks #3:

Emergency Spillway Crest = 1209.0

Elev.	Outlets k	l	m	Spillway	Total
1190	Assumed Closed			–	
1192				–	
1195	~~80~~	~~83~~	~~17~~	–	~~100~~
1200	~~140~~	~~135~~	~~28~~	–	~~303~~
1205	~~175~~	~~175~~	~~36~~	–	~~386~~
~~1210~~ 1209	~~208~~	~~208~~	~~42~~	–	~~458~~
~~1212~~ 1211	~~220~~	~~218~~	~~45~~	8600	~~9083~~
~~1213~~ 1212	~~225~~	~~224~~	~~46~~	15,800	~~16,295~~
~~1215~~ 1214	~~235~~	~~237~~	~~48~~	31,200	~~31,720~~
~~1216~~ 1215	~~240~~	~~243~~	~~49~~	39,200	~~39,732~~
1218	~~250~~	~~255~~	~~51~~		
1220	~~260~~	~~266~~	~~53~~		

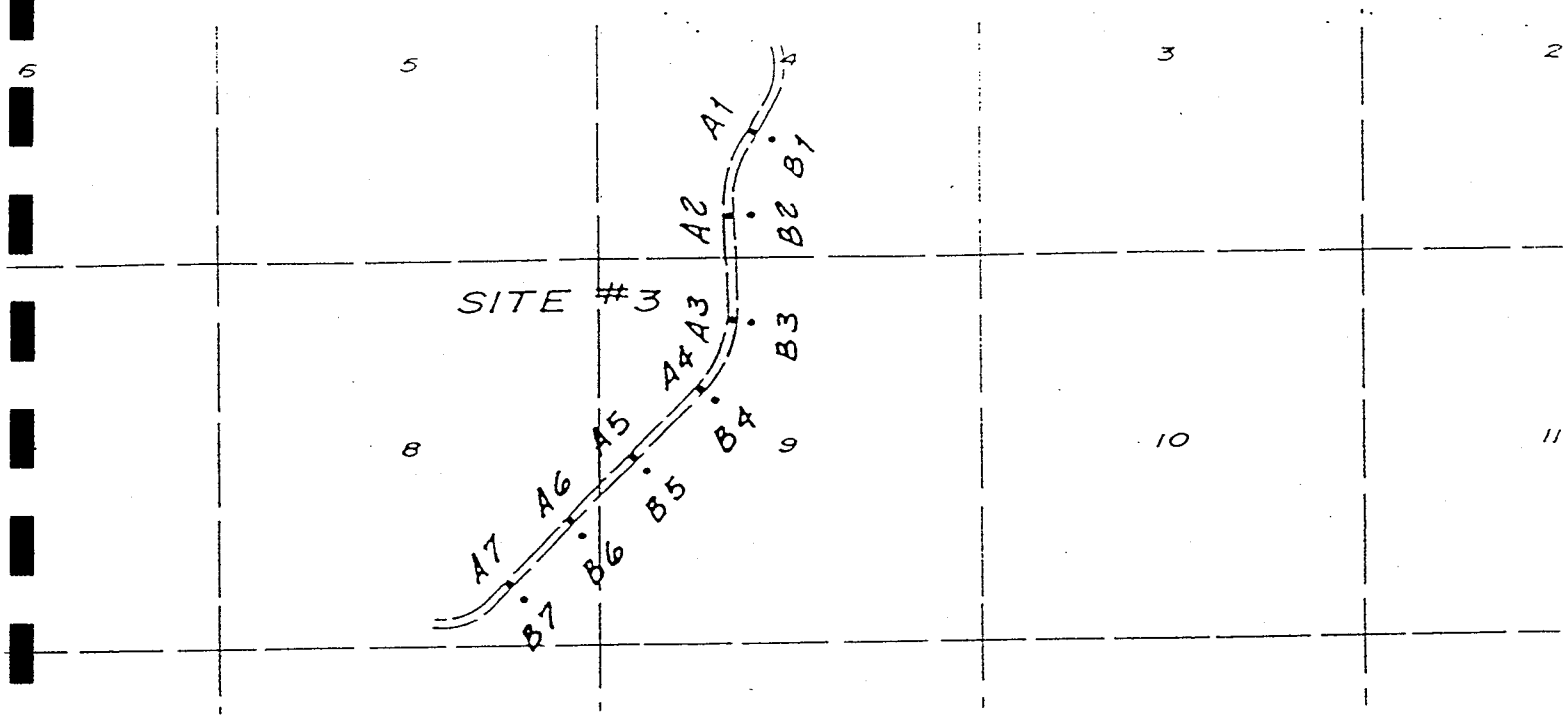


SPILLWAY DISCHARGE CURVE - STRUCTURE NO. 3

Figure D-1
Spillway Discharge Curve
for White Tanks #3

Figure D-2

Adjusted Elevations for White Tanks #3
(SCS)



No.	07/86	Adjusted * Elevation	Station
A-1	1208.348	1212.1	10+00
A-2	1208.622	1212.4	19+95
A-3	1208.849	1212.63	30+00
A-4	1209.542	1213.32	40+00
A-5	1210.939	1214.72	49+88
A-6	1211.163	1214.94	60+08
A-7	1211.017	1214.8	70+07
B-1	1198.268	1202.05	10+00
B-2	1189.701	1193.48	19+95
B-3	1187.264	1191.05	30+00
B-4	1189.354	1193.14	40+00
B-5	1187.837	1191.62	49+88
B-6	1186.724	1190.51	60+08
B-7	1192.518	1199.30	70+07

* TBM was located at the intersection of Jackrabbit Trail and McDowell Road.

FCD Elevation	1075.80
SCS Elevation	- 1072.019

	3.781

Table D-2

Determination of Spillway Capacity Requirements
for White Tanks #3

Hazard Potential Classification:

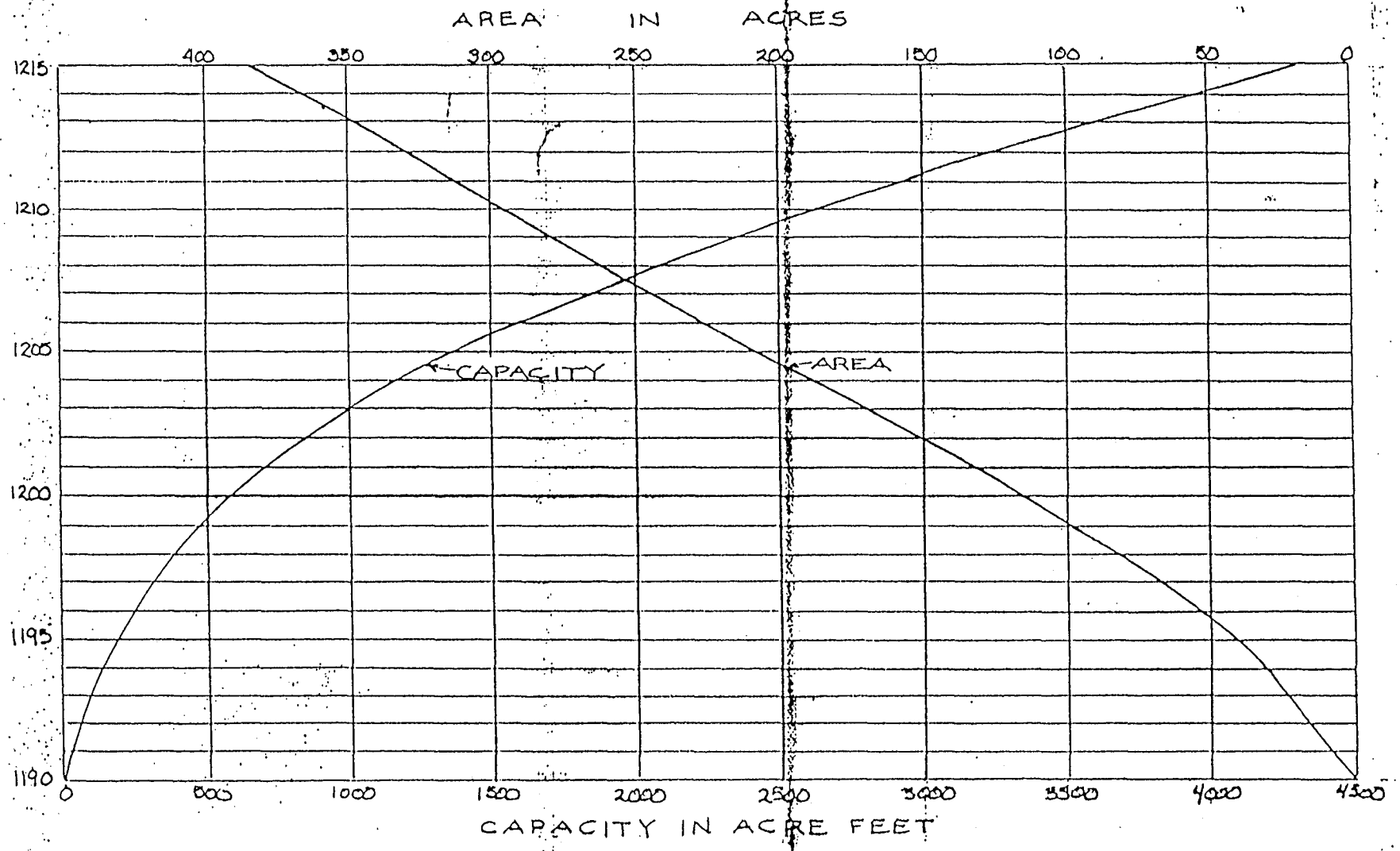
Land Use Conditions	Category	Urban Development	Economic Loss
Existing	Significant	No urban development and no more than a small number of habitable structures	Appreciable (Notable agriculture, industry, or other structures
Future	High	Urban development with more than a small number of habitable structures	Excessive (extensive community, industry, ag.)

Size Classifications:

Category		Rating Factor
Maximum Height	25 feet	1
Reservoir Capacity	3432 acre-feet	3
		---
		4 (Medium Dam)

Recommended Spillway Design Floods:

Hazard Category	Size Designation	Inflow Design Flood Magnitude
Significant	Medium	1/2 PMF
High	Medium	1/2 PMF to PMF



AREA & CAPACITY CURVES - STRUCTURE NO. 3

Figure D-3
Area & Capacity Curves White Tanks #3

Table D-3
White Tanks #3 Stage-Storage Curve

White Tanks Structures
Stage/Storage Curves

Structure #3

	Station	Elevation	Pipe Size
Invert Elevation of Spillways:	K: 29 + 00	1193.65	48"
	L: 46 + 00	1191.68	48"
	M: 63 + 80	1192.556	24"

Control Points of Emergency Spillways:
NE end: 1214
SW end: 1209

ELEVATION (msl)	VOLUME (acre-feet)
1188	73.2
1190	116.1
1192	155
1194	243
1196	370
1198	567
1200	866
1202	1234
1204	1628
1206	2096
1208	2723
1210	3432
1212	4111
1214	5230
1216	6068

APPENDIX D-2

White Tanks #4

Stage-Storage-Discharge Relationships

Exhibit D-2
White Tanks #4 Structure Specifications

PROJECT TITLE: White Tanks Retarding Dam No. 4

WATERSHED AND RELATIONSHIP TO OTHER STRUCTURES:

Avondale Wash a tributary to the Gila River

LOCATION: Township, range, section; description from well known physical feature; how to get there:

Sections 5 and 6, T1N, R2W, G&SRB&M

AUTHORIZATION: Pilot

FEDERAL SPONSOR: Soil Conservation Service (1954)

LOCAL SPONSOR(S): Maricopa County Municipal Water Conservation District No. 1

DOCUMENTATION: Watershed Workplan title/date; supplements EIS date approved.

CONTRACTOR: Donen & Sons

DATE OF CONSTRUCTION AWARD:

DATE OF FINAL ACCEPTANCE: 1954

FUNCTIONAL DESCRIPTION:

This structure collects the runoff water from the southeastern slopes of the White Tanks Mountains, impounds it and released it through 2 each gated outlets or through the emergency spillways. This drainage area has been split by the Interstate 10 Highway. It passes under I-10 via several routes; 4 each 10' X 8' culverts directly north of the structure and through 5 each culverts at the underpass for Jackrabbit Trail. There are 19 CMP pipe between the culverts listed above. There is also a large borrow pit north of the structure. The capacity of this borrow has not been calculated.

PROJECT FEATURES:

Type of structure	Compacted earth fill
Top of structure elevation	1056.0
Length of structure	6,839 L.F.
Maximum Height	20 feet
Top Crest Width	10 feet
Spillway Crest Elevation	1050.0
Spillway Capacity	
Drainage Area	14.23 square miles
Storage Capacity	2250 acre feet
Maximum Water Surface Elevation	1053.0
Freeboard	
Peak inflow	
Drawdown Time	118 hours
Principal Outlet Discharge Rate	30" RCP = 75 cfs 36" RCP = 108 cfs
Principal Outlet Structure	2 gated pipes 1 each 30" RCP

1 each 36" RCP

Diversion dikes at both ends
of Structure

* Emergency Spillways (2), one at each end of the structure

LEVEL OF PROTECTION:

COSTS:

FEDERAL: $199,088

LOCAL: Land, relocations, engineers; Total $218,287

TOTAL COST OF PROJECT: $377,258

ADWR OPERATIONAL CERTIFICATE ISSUED: October 16, 1974

DAM SAFETY STATUS: UNSAFE

ENCLOSURES: Site Map Attached
Stage Storage Curve
Stage Discharge Curve
Storage Discharge Summary
Area and Capacity Curve
Spillway Discharge Curve

MAINTENANCE RESPONSIBILITIES

Structure: White Tanks #4 6A201

Bank Protection - Riprap		acres
Bridges - Pedestrian		each
Bridges - Vehicle		each
Culverts, Box		each
Culverts, Pipe		each
Drainage Channel - Lined		feet
Drainage Channel - Unlined		miles
Drop Structure		each
Embankment	25	acres
Embankment, Soil Cement		acres
Fencing	13,218	feet
Floodway - Lined		feet
Floodway - Unlined		acres
Gated Outlet	2	each
Gates	7	each
Gutters, Concrete		feet
High Flow	4	acres
Landscape		acres
Low Flow		acres
Manholes	18.5	each
Meter Houses		each
Outlet Structure		each
Pilot Channel		miles
Pool Area	221	acres
Principal Outlet	130	feet
Ramps, Concrete		feet
Retaining Wall		feet
Right-of-Way		acres
River Clearing		acres
Roads - Asphalt		miles
Roads - Dirt	4.4	miles
Side Inlet		each
Spillway - Earth	7.4	acres
Spillway - Lined		feet
Stilling Basins		each
Stormdrain Pipe		feet
Trash Racks		each
Vegetative Drains		each

Figure D-4
Stage-Storage-Discharge Curves
for White Tanks #4

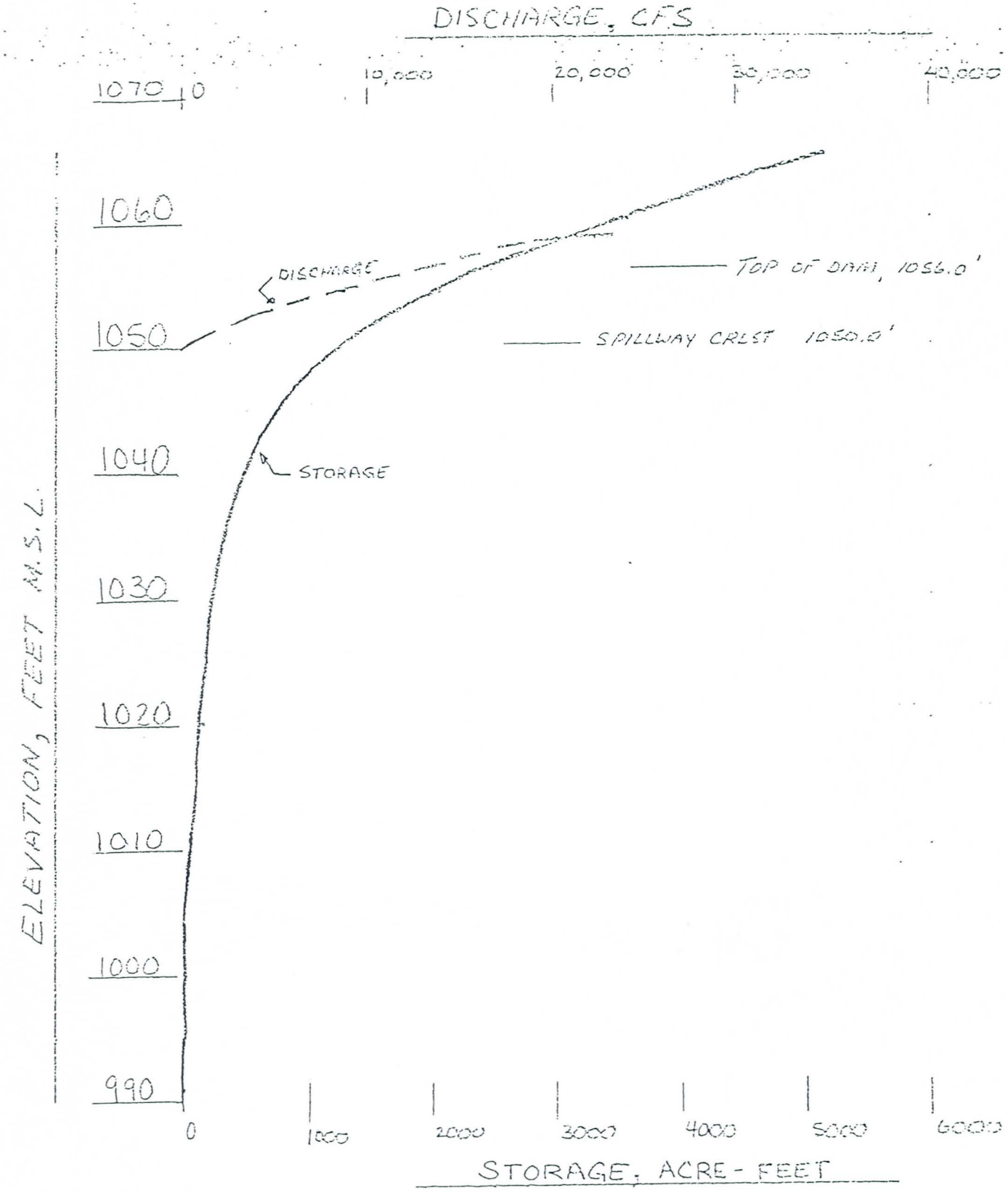


FIGURE 3 STAGE-STORAGE AND STAGE DISCHARGE RELATIONSHIPS FOR WHITE TANKS #4 FRS.

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 29           KK    SUB2  COMBINE WITH REMAINING UNDIVERTED FLOW FROM SUB1
 30           HC       2

 31           KK    EXIT
 32           KM   THIS HYDROGRAPH IS WHAT FLOWS PAST WT4 UNDER JACKRABBIT RD.
 33           KM   AND OVER JACKRABBIT RD. NORTH OF I-10
 34           KM   3500 CFS FLOWS SOUTH IN JACKRABBIT RD CHANNEL TO THE FRS.  MAXIMUM
 35           KM   CAPACITY OF THE CHANNEL IS 3500 - SEE ERTEC REPORT.
 36           DT    JACK
 37           DI       0     3500    10000   100000
 38           DQ       0     3500     3500     3500

 39           KK   SUB2RRETRIEVED FLOW UNDER JACKRABBIT OVERPASS
 40           KM   THIS FLOW IS DISCHARGE THRU CHANNEL UNDER I-10 AT JACKRABBIT ROAD
 41           DR    JACK
              * RETRIEVE DIVERTED FLOW (CULVERT FLOW) FROM SUB 1

 42           KK   CULVS RETRIEVED CULVERT FLOW
 43           DR    DIV1

 44           KK   FROVT RETRIEVED FLOW (FREEWAY OVERTOPPING) FROM SUB1
 45           DR    DIV2

 46           KK    SUB3  SUB-BASIN #3
 47           BA     .92
 48           UD     .25

 49           KK     FRS TOTAL FLOW ENTERING WHITE TANKS 4 FRS
 50           KM  COMBINE FLOW FROM CULVERTS OUT OF SUB1, FREEWAY OVERTOP, AND
 51           KM  FLOW IN JACKRABBIT UNDERPASS CHANNEL WITH FLOWS IN SUB3.
 52           KM  THIS IS TOTAL FLOW INTO WT4 FRS.
 53           HC       4

 54           KK    DAM       ROUTE FLOWS THRU FLOOD RETARDING STRUCTURE
 55           KO       1       2
 56           RS       1    STOR    1407
 57           SV       0       1     3.5    14.2    23.7    54.6      85     129     167     206
 58           SV     371     471     771    1407    2371    3581    5141    6811
 59           SE     991     993     995     999    1002    1006    1010    1015    1019    1023
 60           SE    1037    1040    1045    1050    1055    1060    1065    1070
 61           SQ       0    1000    3000    9000   17300   23000
 62           SE    1050    1051  1052.3  1054.5  1057.7  1058.5
 63           SS    1050       0       0       0
 64           ST    1056    6839     2.2     1.5
 65           KP       2
 66           RS       1    STOR       0
 67           ZZ
```

Table D-4
Stage-Discharge Curve
for White Tanks #4

Table D-5
White Tanks #4
Stage/Storage Curve

White Tanks Structures
Stage/Storage Curves

Structure #4

Bottom elevation of the excavation pit: 998.0

Top elevation of the excavation pit: 1040.0

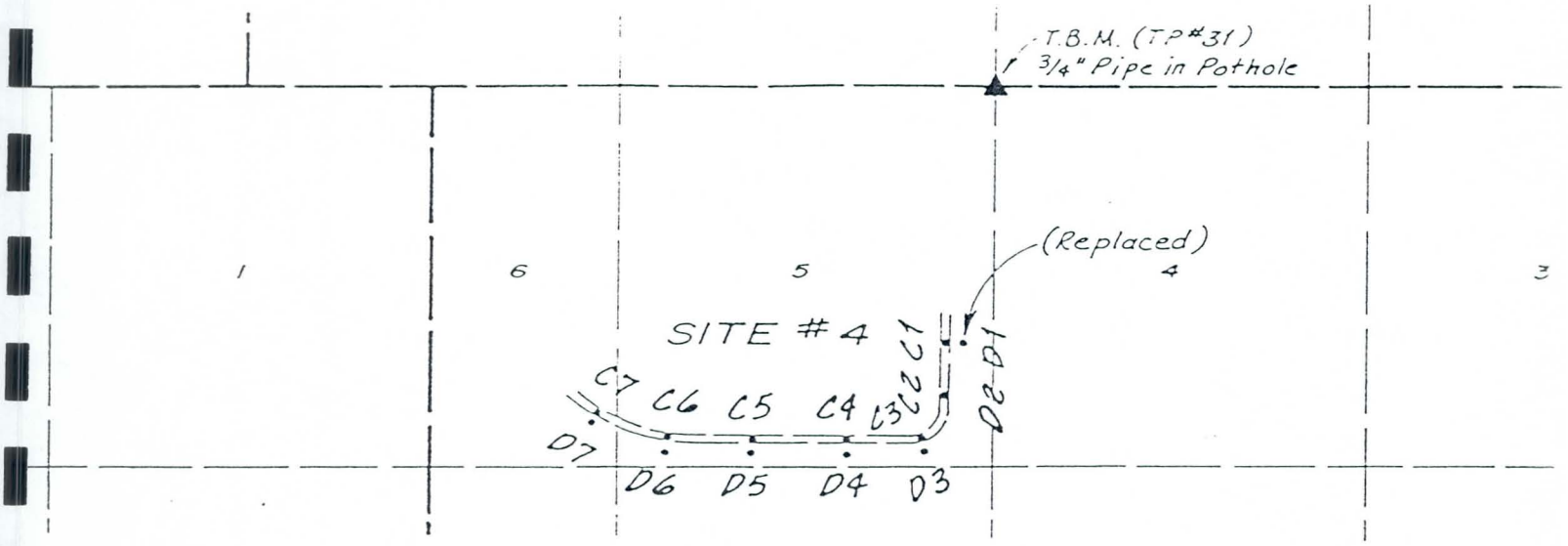
	Station	Elevation	Pipe Size
Invert Elevations of the Spillways:	N: 17 + 32	1039.18	30"
	O: 58 + 50	1041.68	36"

Elevation of the Emergency Spillways: West end - 1048.5; East end - 1049.0

ELEVATION (msl)	VOLUME (acre-feet)
1000	2.4
1010	49.8
1020	135
1030	239
1040 (in the pit)	370
1040 (next to the dam)	90
1040 (total)	460
1042	550
1044	667
1046	840
1048	1051
1050	1317
1052	1666
1054	2082
1056	2561

Figure D-5

Adjusted Elevations for White Tanks #4
(SCS)



No.	07/86	Adjusted * Elevation	Station
C-1	1051.059	1054.9	00+47
C-2	1051.666	1055.5	10+00
C-3	1051.596	1055.4	19+62
C-4	1051.642	1055.4	29+59
C-5	1052.182	1056.0	39+64
C-6	1052.045	1055.8	49+68
C-7	1051.498	1055.3	59+87
D-1	1046.492	1050.27	00+47
D-2	1037.935	1041.72	10+00
D-3	1033.022	1036.80	19+62
D-4	1032.609	1036.39	29+59
D-5	1035.132	1038.91	39+64
D-6	1036.165	1039.95	49+68
D-7	1039.749	1043.53	59+87

* TBM was located at the intersection of Jackrabbit Trail and McDowell Road.

FCD Elevation	1075.80
SCS Elevation	- 1072.019

	3.781

Table D-6

Determination of Spillway Capacity Requirements
for White Tanks #4

Hazard Potential Classification:

Land Use Conditions	Category	Urban Development	Economic Loss
Existing	Significant	No urban development and no more than a small number of habitable structures	Appreciable (Notable agriculture, industry, or other structures
Future	High	Urban development with more than a small number of habitable structures	Excessive (extensive community, industry, ag.)

Size Classifications:

Category		Rating Factor
Maximum Height	17 feet	0
Reservoir Capacity	1184 acre-feet	2
		---
		2 (Small Dam)

Recommended Spillway Design Floods:

Hazard Category	Size Designation	Inflow Design Flood Magnitude
Significant	Small	100 year to 1/2 PMF
High	Small	1/2 PMF

APPENDIX E

Culvert Capacities for White Tanks #3 Watershed

APPENDIX E-1

Culvert Capacities for Olive Avenue at Beardsley Canal
(Present and Proposed)

Table E-1
Olive Avenue Culvert Capacity (existing)
(Reference 1)

```
*********************
*  CULVERT PROGRAM  *
*********************
```

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT NO. : DATE : 09-26-1989 TIME : 23:41:03
PROJECT NAME :
COMPUTED BY : CHK BY :

****

HYDRAULIC ANALYSIS OF 2 - 7.6 FT. X 40.00 FT. P.C.
n = 0.0300

OUTLET CONTROL GOVERNS

HEADWATER COMPUTATION

INLET CONT.					OUTLET CONTROL HW = H+ho-LSo					
Q	HW/D	HW	Ke	H	Dc	(Dc+D)/2	TW	ho	LSo	HW
850.00	1.06	8.04	0.20	2.24	5.32	6.46	1.00	6.46	0.40	8.30

CONTROL HW= 8.30 OUTLET VEL=12.53 DHW=1275.90 AHW= 8.30 DN= 7.60

Table E-2
Olive Avenue Culvert Capacity (proposed)
(Reference 1)

```
*************************
*  BOX CULVERT PROGRAM  *
*************************
```

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT NO. : DATE : 09-26-1989 TIME : 23:42:43
PROJECT NAME :
COMPUTED BY : CHK BY :

****

HYDRAULIC ANALYSIS OF A 9 - 12.00 X 7.00 X 100.00 C.B.C.

INLET CONTROL GOVERNS

	INLET CONT.				OUTLET CONTROL HW = H+ho-LSo					
Q	HW/D	HW	Ke	H	Dc	(Dc+D)/2	TW	ho	LSo	HW
6080.00	1.03	7.24	0.40	1.55	4.62	5.81	2.00	5.81	1.00	6.36

CONTROL HW = 7.24 OUTLET VEL. = 19.43 DHW = 1275.44 DN = 2.90

APPENDIX E-2

Culvert Capacities for Northern Avenue at the Beardsley Canal
(Present and Proposed)

Table E-3
Northern Avenue Culvert Capacity (existing)
(Reference 1)

```
*********************
*  CULVERT PROGRAM  *
*********************

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT    NO. :                DATE : 09-26-1989  TIME : 23:41:52
PROJECT   NAME :
COMPUTED    BY :                     CHK BY :
*****************************************************************

    HYDRAULIC ANALYSIS OF  2 -  6.0 FT. X  60.00 FT.  P.C.
                      n = 0.0300

                     OUTLET CONTROL GOVERNS

                    HEADWATER   COMPUTATION

      INLET CONT.                 OUTLET CONTROL HW = H+ho-LSo
   Q      HW/D   HW      Ke     H     Dc  (Dc+D)/2  TW    ho    LSo   HW
------- ------ ----    ---- ----- ----- ------  ----- ----- ----- ------

 660.00  1.41  8.44    0.20  4.48  4.94   5.47   1.00  5.47  0.40   9.55

CONTROL HW= 9.55  OUTLET VEL=13.24  DHW=1233.95  AHW=   9.60  DN= 6.00
```

Table E-4
Northern Avenue Culvert Capacity (proposed)
(Reference 1)

```
*************************
*  BOX CULVERT PROGRAM  *
*************************
```

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT NO. : DATE : 09-26-1989 TIME : 23:43:53
PROJECT NAME :
COMPUTED BY : CHK BY :

****

HYDRAULIC ANALYSIS OF A 8 - 12.00 X 8.00 X 100.00 C.B.C.

INLET CONTROL GOVERNS

INLET CONT.			OUTLET CONTROL HW = H+ho-LSo							
Q	HW/D	HW	Ke	H	Dc	(Dc+D)/2	TW	ho	LSo	HW
7060.00	1.09	8.71	0.40	2.01	5.52	6.76	2.00	6.76	0.67	8.10

CONTROL HW = 8.71 OUTLET VEL. = 18.31 DHW = 1233.11 DN = 4.02

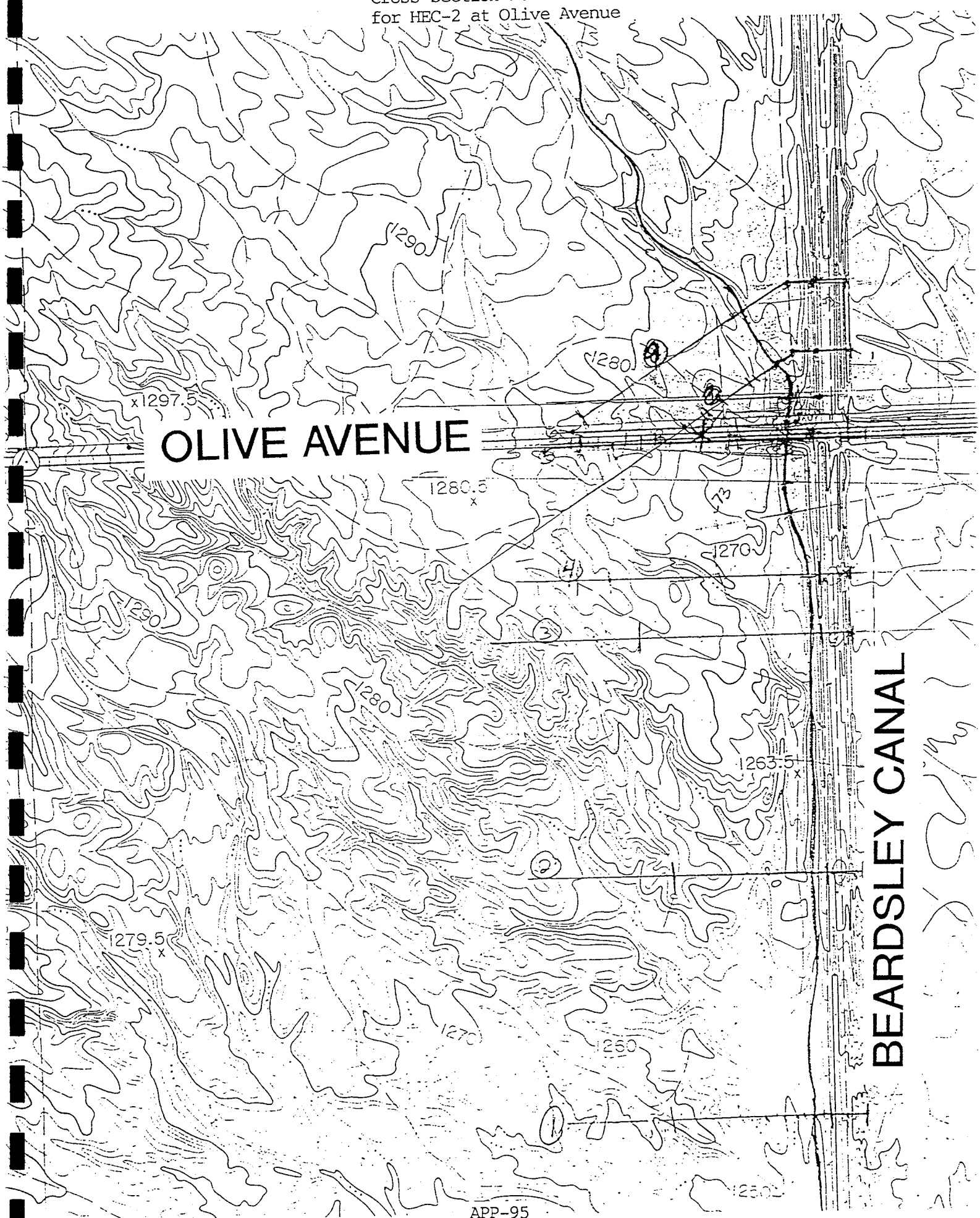
APPENDIX F

Cross-Section Locations and Survey Data for the HEC-2 Analysis on Olive and Northern Avenues

APPENDIX F-1

Cross-Section Locations and Survey Data
for the HEC-2 Analysis on Olive Avenue

Figure F-1
Cross-Section Locations
for HEC-2 at Olive Avenue



Olive Ave X-section's
@
Beardsley Canal

T. III B. Pappe — July 20, 1988
Overcast
1 V. Rice — Calm

Exhibit F-1
Olive Avenue Cross-Section
Survey Notes

	BS	HI	FS	Elev
*BM1	6.88	~~1258.86~~		~~1251.98~~
*158+73.76	6.05	1258.03	~~6.05~~	1251.98
159+00			5.85	1252.18
160+00			5.30	1252.73
161+00			4.79	1253.24
162+00			4.14	1253.89
163+00			3.42	1254.61
164+00			2.79	1255.24

(1)

Iron pipe in Handhole @ Olive Ave (2)
Perryville Rd alignment. Existing
Stationing 158+73.76

* Later info obtained indicated that the elevations given on the contour map at reference points were for top of Asphalt and not for the Iron pipe in the Handhole.
WJG

②

	BS	HI	FS	Elev
T.P.	6.00	1261.24 ~~1262.07~~	2.79	1255.24 ~~1256.09~~
165+00			5.55	1255.69
166+00			4.97	1256.27
167+00			4.34	1256.90
168+00			3.35	1257.89
169+00			2.61	1258.63
T.P.	6.89	1265.52 ~~1266.35~~	2.61	1258.63 ~~1251.46~~
170+00			5.97	1259.55

③

	BS	HI	FS	Elev
171+00			5.03	1260.49
172+00			4.24	1261.28
173+00			3.47	1262.05
174+00			2.51	1263.01 ~~1263.84~~
T.P.	6.39	1269.40 ~~1270.23~~	2.51	1263.01 ~~1263.84~~
175+00			5.71	1263.69
176+00			5.02	1264.38
177+00			4.48	1264.92

④

	BS	HI	FS	Elev
179+00			3.89	1265.51
179+00			3.03	1266.37
T.P.	6.87	1273.24 ~~1274.07~~	3.03	1266.37 ~~1267.20~~
180+00			5.92	1267.32
181+00			4.81	1268.43
182+00			3.51	1269.73
183+00			1.74	1271.50
T.P.	7.24	1278.74 ~~1277.57~~	1.74	1271.50 ~~1272.33~~

(4)

	BS	HI	FS	Elev	
184+02 ([illegible])			5.28	1273.46	℄
184+86 ([illegible])			2.90	1275.84	℄ Lambley Canal
185+00 ([illegible])			2.56	1276.18	
185+12.69			2.35	1276.39	
BM2	2.71	~~1279.22~~	3.06	1275.68 ~~1276.54~~	Rebar in Handhole @ ℄ Olive Ave
T.P.	1.63	~~1272.20~~	8.65	~~1270.57~~	187+00
T.P.	3.42	~~1269.19~~	6.43	~~1265.77~~	177+00

5

	BS	HI	FS	Elev	
T.P.			7.05	~~1262.14~~	172+00
	2.44	~~1264.58~~			
T.P.			6.83	~~1257.75~~	167+00
	3.21	1260.96			
T.P.			6.21	~~1254.75~~	162+00
	3.67	~~1258.42~~			
BM 1			6.42	~~1257.00~~	1251.98

	BS	HI	FS	Elev		
BM_2	4.93	1280.61 ~~1281.44~~		1275.68 ~~1276.51~~	Rebar in Handhole @ ℄ Olive Ave ~~1276.51~~	185+12.69
185+40			3.98	1276.63	Crest of Road	
186+00			4.17	1276.44	℄ Olive	
187+00			4.65	1275.96	℄ Olive	
188+00			4.61	1276.00	℄ Olive	
189+00			4.49	1276.12	℄ Olive	
190+00			4.57	1276.04	℄ Olive	
T.P.	9.02	1285.06 ~~1285.91~~	4.57	1276.04 ~~1276.07~~		

7

	BS	HI	FS	Elev	
191+00			7.75	1277.31	℄ Olive
192+00			5.82	1279.24	
193+00			4.88	1280.18	
T.P.			4.88	1280.18 ~~1281.01~~	
	2.96	~~1283.19~~			
T.P.			7.02	~~1276.75~~	
	4.76	~~1281.11~~			
CM2			5.21	~~1276.50~~	~~1276.51~~

Exhibit F-2
Wash Cross-Section
North of Olive Avenue
(Cross-Section #6)
Survey Notes

(8)

	BS	HI	FS	Elev	Level X-section
				1275.68 ~~1276.51~~	
BM2	5.37	1281.01			Rebar in Handhole @ Olive Rd & Bradley Canal
0+00 (13[illegible])			5.1	1275.9	Top of Bank - West side of Bradley Canal 40 N. of Olive
0+83 (916[illegible])			7.0	1274.0	Top of Slope
0+95 ([illegible])			12.2	1268.8	Bottom of Slope
1+15 ([illegible])			12.8	1268.2	Invert of wash @ Culverts
1+40 ([illegible])			12.4	1268.61	wash bottom
1+57 ([illegible])			11.8	1269.2	wash bottom
1+70 ([illegible])			8.7	1272.3	top of wash

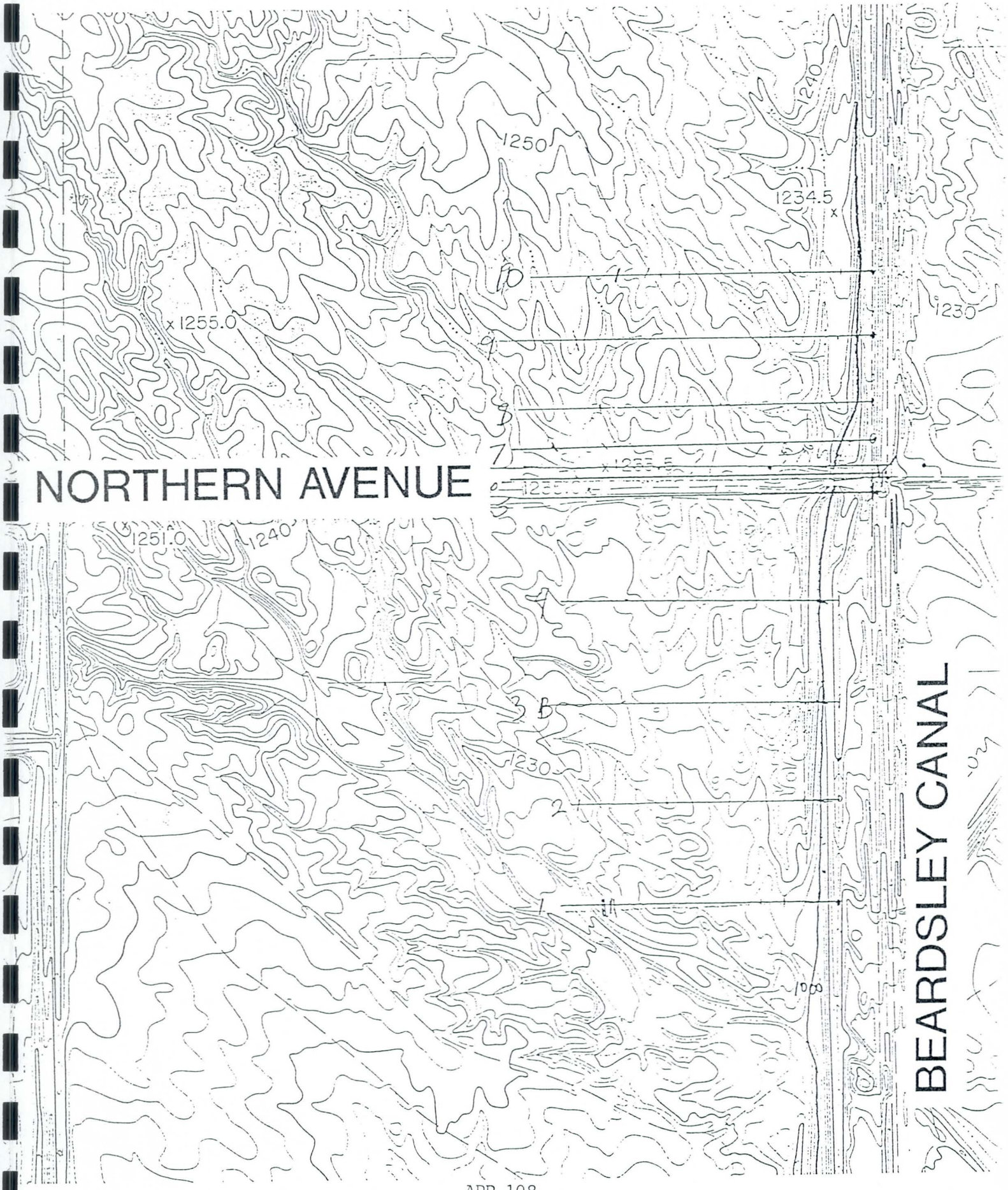
(9)

	BS	HI	FS	Elev		
2+00 (11:25)			7.8	1273.2		
BM_2			5.33	1275.68		
				HI = ~~1281.04~~ 1281.01		
	1	7.2	CMP	7.9 at top of Culvert	1273.1	Culvert 1265.2
	1	8'	CMP	7.7 at top of Culvert	1273.3	1265.3

APPENDIX F-2

Cross-Section Locations and Survey Data
for the HEC-2 Analysis on Northern Avenue

Figure F-2
Cross-Section Locations
for HEC-2 at Northern Avenue



Northern Ave X-Section

@

Beardsly Canal

T. III B. Page July 20, 1988

1 V. Rice Overcast

Calm

Hot

Exhibit F-3
Northern Avenue Cross-Section
Survey Notes

	BS	HI	FS	Elev
*BM3	4.27	~~1222.75~~		~~1218.08~~
*BM1	3.93	1222.01	~~3.95~~	1218.08
T.P.	5.79	1224.76 ~~1225.10~~	3.04	1218.97 ~~1219.31~~
T.P.	5.13	1227.54 ~~1227.88~~	2.35	1222.41 ~~1222.75~~
T.P.	2.59	1228.88 1229.22	1.25	1226.29 ~~1226.63~~
T.P.	5.39	1228.40 ~~1228.74~~	5.87	1223.01 ~~1223.35~~
T.P.	5.15	1229.66 ~~1230.00~~	3.89	1224.51 ~~1224.85~~

(1)

Large Nail in Road @ Aerial Cross
Northern Ave + Berryville Rd.
(on top of Asphalt)

* Later info obtained indicated that the elevations given on the contour map at reference points were for top of Asphalt and not for the Large nail in the Handhole.
WSP

Exhibit F-3
(continued)

(2)

	BS	HI	FS	Elev	
T.P.	8.52	1234.49 ~~1234.93~~	3.69	1225.97 ~~1226.31~~	
BM 4	0.53	1234.50 ~~1234.84~~	0.52	1233.97 ~~1234.31~~	Nail in North end of concrete Headwall of Lateral irrigation ditch East of Riverside Canal (West Headwall) Marked TBM-A
T.P.	3.62	1230.20 ~~1230.54~~	7.92	1226.58 ~~1226.92~~	
T.P.	3.50	1228.75 ~~1229.09~~	4.95	1225.25 ~~1225.59~~	
T.P.	5.02	1228.69 ~~1229.03~~	5.08	1223.67 ~~1224.01~~	
T.P.	2.42	1228.14 ~~1228.48~~	2.97	1225.72 ~~1226.06~~	
T.P.	3.21	1226.01 ~~1226.35~~	5.34	1222.80 ~~1223.14~~	

(3)

	BS	HI	FS	Elev	
				1214.90	
T.P.		1222.90	6.11	~~1220.74~~	
	3.00	~~1223.29~~			
				1217.81	
BM_3			5.09	~~1218.15~~	~~1218.06~~ Large nail in handhole

(4)

	BS	HI	FS	Elev	
BM 4	0.60	1234.57 ~~1234.91~~		1233.97 ~~1234.31~~	Nail in North end of Concrete Headwall of Lateral Irrigation ditch @ Beardsly Canal & Northern Ave TBM-A
0+00			1.4	1233.2	℄ Northern @ ℄ Beardsly Canal
1+00 E			5.3	1229.3	℄ Northern East of Beardsly Canal
2+00 E			7.0	1227.57	℄ Northern " " "
3+00 E			8.00	1226.57	℄ Northern " " "
T.P.	3.55	1230.13 ~~1230.47~~	7.99	1226.58 ~~1226.92~~	
4+00 E			4.2	1225.9	℄ Northern " " "
5+00 E			4.8	1225.33	℄ Northern " " "

(5)

	BS	HI	FS	Elev	
6+00E			5.1	1225.0	℄ Northern East of Beardsley Canal
7+00E			5.3	1224.83	℄ Northern " " "
8+00E			5.8	1224.3	℄ Northern " " "
T.P.	8.18	1234.33 ~~1234.67~~	3.98	1226.15 ~~1226.49~~	
BM4			0.37	1233.96 ~~1234.30~~	~~1234.31~~

Northern Ave
X-Sections @
Beardsley Canal

12/13/88
Clear
Calm
Cool

B. Poppe II III
V. Rice I

Exhibit F-4
Wash Cross-Section
North of Northern Avenue
(Cross-Section #6)
Survey Notes

	BS	HI	FS	Elev	
BM	6.14	1240.11		1233.97	TBM A Nail in North End of Concrete Headwall of Lateral Irrigation ditch @ Beardsly Canal and Northern Ave.
0+00 (0-20) (850)			6.9	1233.2	℄ Beardsly Canal @ ℄ Northern Ave
0+36W (0+16) (911)			5.6	1234.5	℄ Northern AVE.
1+00W (0+80) (950)			5.4	1234.7	℄ Northern
2+00W (1+80) (1050)			4.9	1235.2	℄ Northern
3+00W (2+80) (1150)			5.0	1235.1	℄ Northern
4+00 (3+80) (1250)			4.7	1235.4	℄ Northern
5+00 (4+80) (1350)			4.0	1236.1	℄ Northern
BM			6.14	1233.97	TBM A

Exhibit F-4
(continued)

	BS	HI	FS	Elev	
BM	6.00 ~~5.96~~	1239.97		1233.97	TBM A
0+00 (886)			4.0	1236.0	℄ of West Maintenance Rd of Beardsly Canal @ 40' North of Northern Ave
0+23 (909)			4.0	1236.0	T/S
0+41 (927)			10.3	1229.7	B/S
0+82 (968)			11.3	1228.7	T/S
0+98 (984)			15.6	1224.4	B/S
1+06 (992)			15.1	1224.9	Invert of 72" CMP
	1000 = 1+14				
1+22 (1008)			15.6	1224.4	Invert of 72" CMP

T/S = Top of Slope
B/S = Bottom of Slope

	BS	HI	FS	Elev	
1+32 (1018)			14.6	1225.4	B/S
1+48 (1034)			7.3	1232.7	T/S
1+93 (1079)			7.3	1232.7	
2+29 (1115)			5.7	1234.3	
2+59 (1145)			3.3	1236.7	
BM			6.00 ~~5.59~~	1233.97	TBM A

Exhibit F-4
(continued)

Tuthill Rd alignment
South of McDowell Rd
Profile

B. Pepper II
V. Rice I

12/13/88
Calm
Cool
Clear

Exhibit F-5
Tuthill Dike Cross-Section
Survey Notes

	BS	HI	FS	Elev	
BM	4.67	1104.89		1100.22	Top of Asphalt @ ℄ McDowell Rd. (Iron Pipe in Rd).
0+00			4.01	1100.88	℄ McDowell Rd. @ Tuthill Rd. alignment
1+00 S			5.2	1099.7	℄ Dike along Tuthill Rd. Alignment South of McDowell Rd.
2+00 S			6.2	1098.7	℄ Dike
3+00 S			8.1	1096.8	℄ Dike
T.P.	2.14	1099.04	7.99	1096.90	
4+00			3.3	1095.7	℄ Dike
5+00			4.6	1094.4	℄ Dike

Exhibit F-5 Cont.

App-119

	BS	HI	FS	Elev	
6+00			5.9	1093.1	℄ Dike
7+00			6.9	1092.1	℄ Dike
4 Box Culvert			19.6	1079.4	Invert
T.P.			2.99	1096.05	
	8.99	1105.04			
BM			4.79	1100.26	1100.22

Exhibit F-5
cont
App. 120

APPENDIX G

Proposed Olive Avenue Design Cross-Sections

Figure G-1
Proposed Olive Avenue
Design Water Surface Profile
for PMF & 100yr Storms

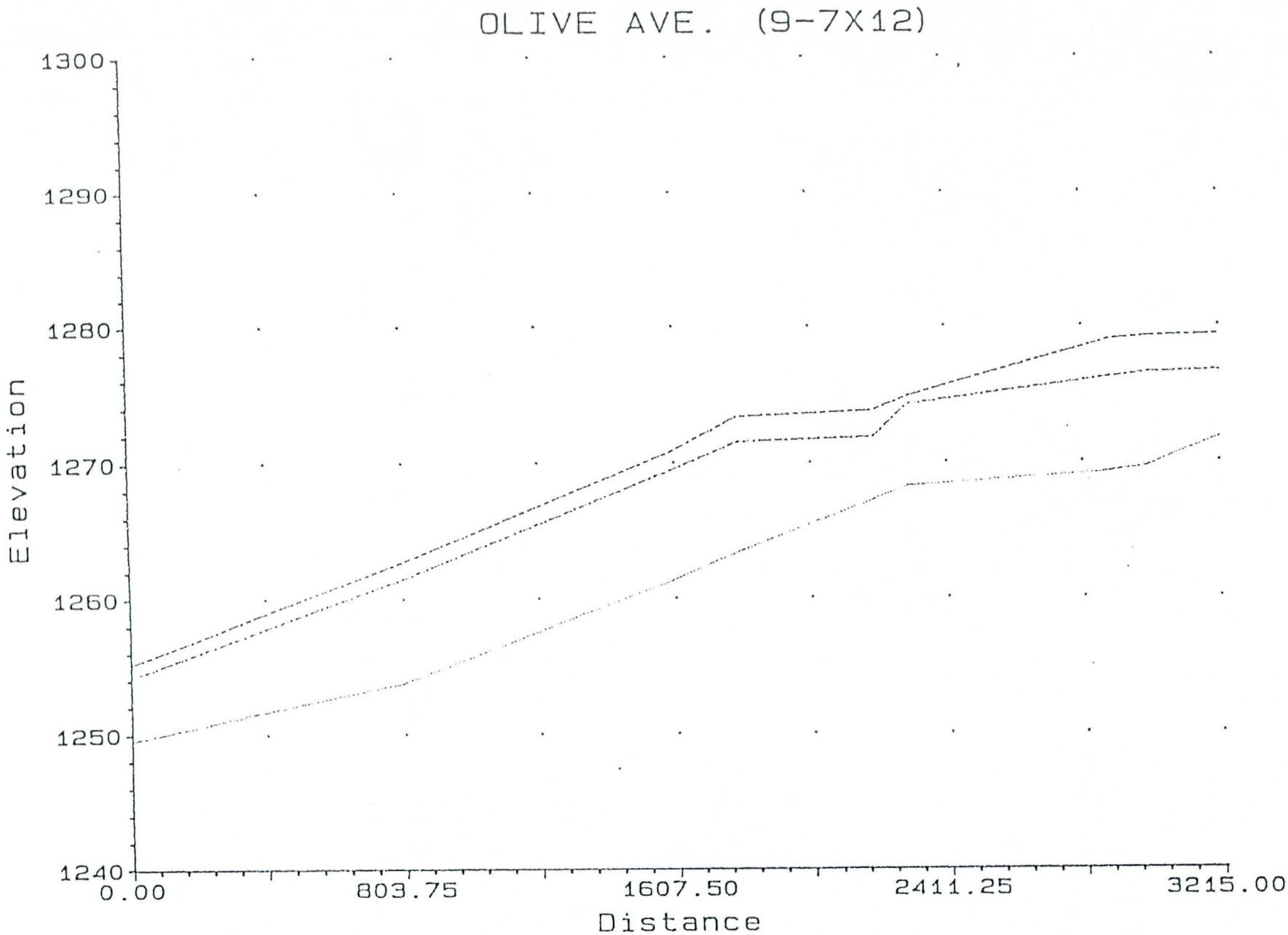


Figure G-2
Proposed

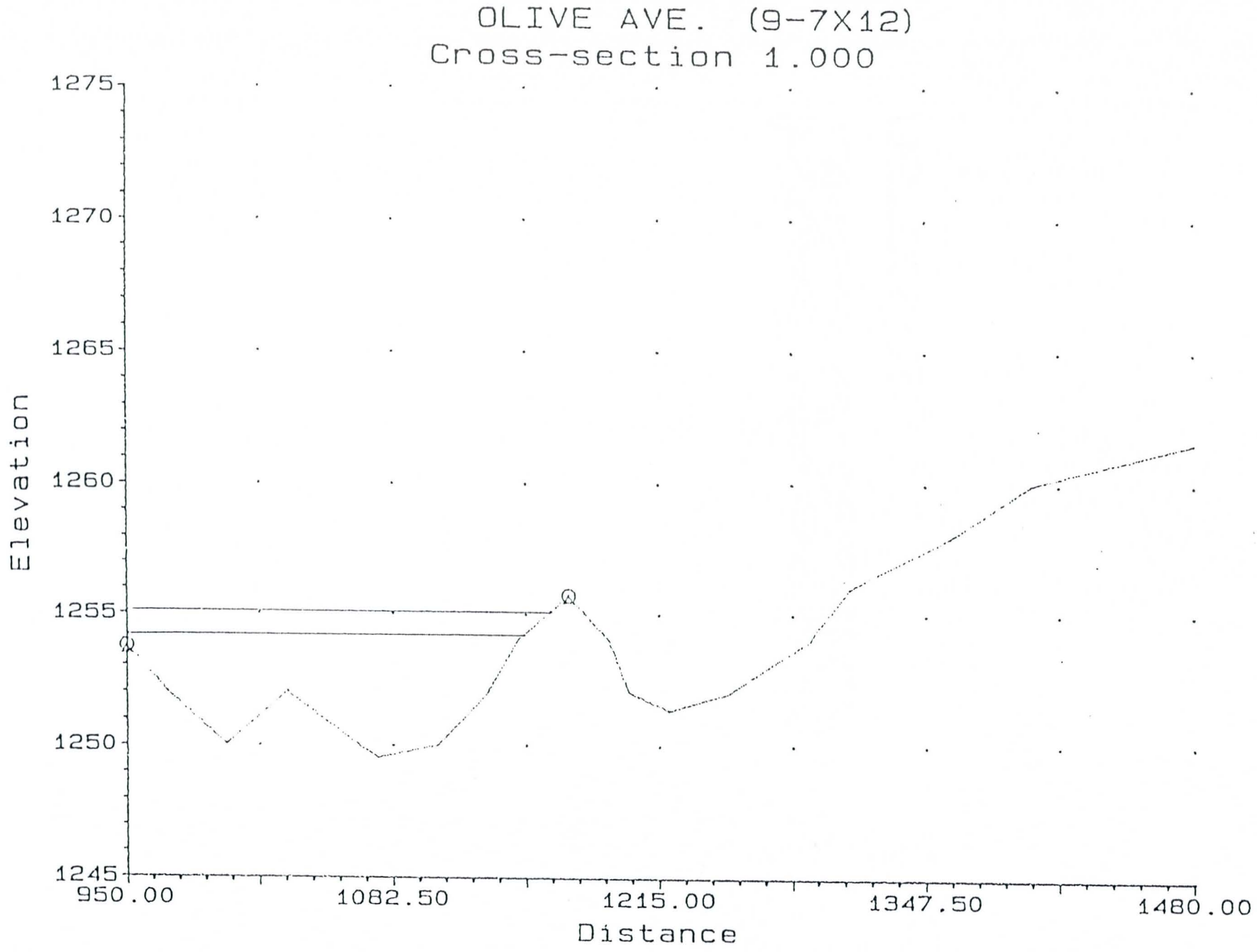


Figure G-3
Proposed

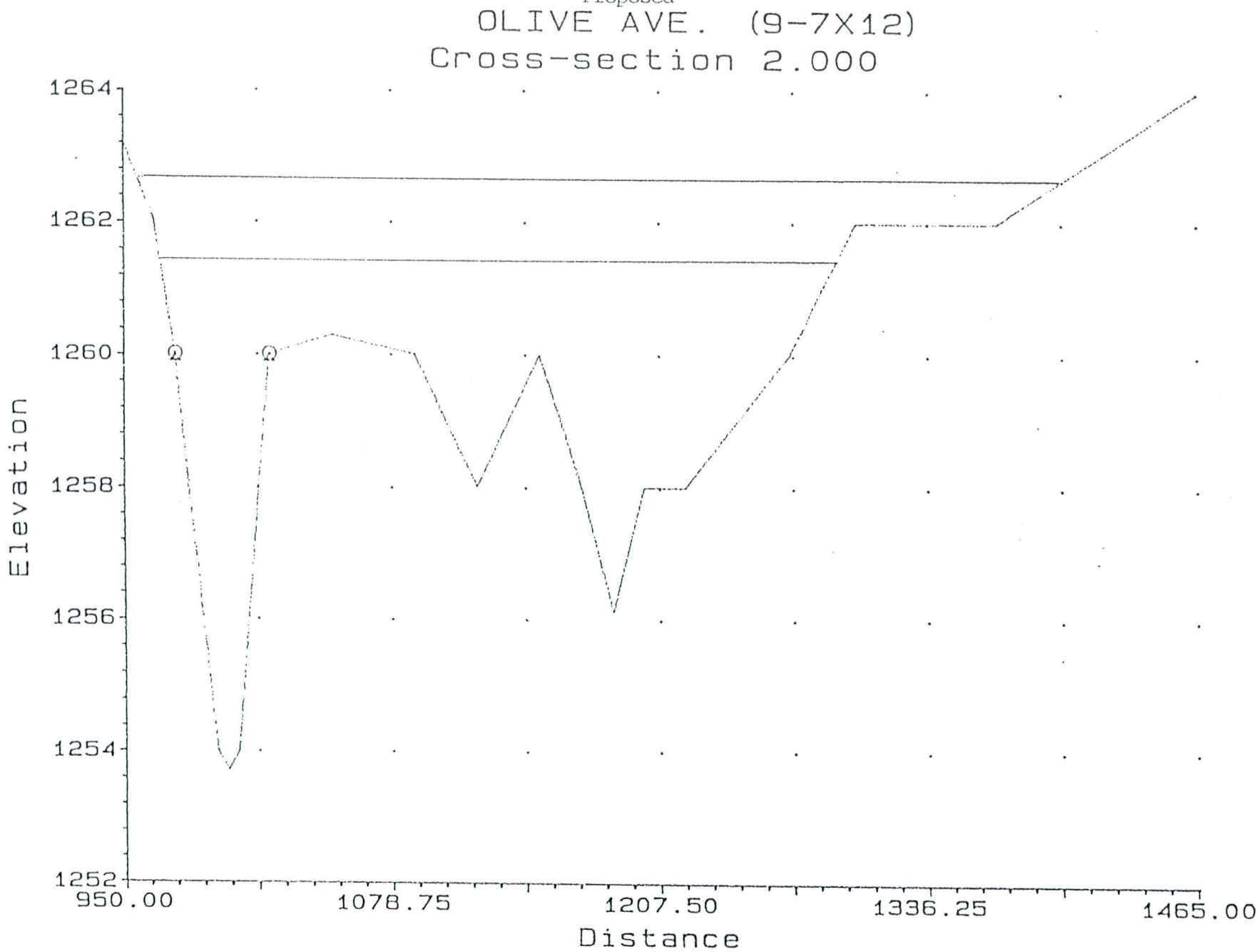


Figure G-4
Proposed

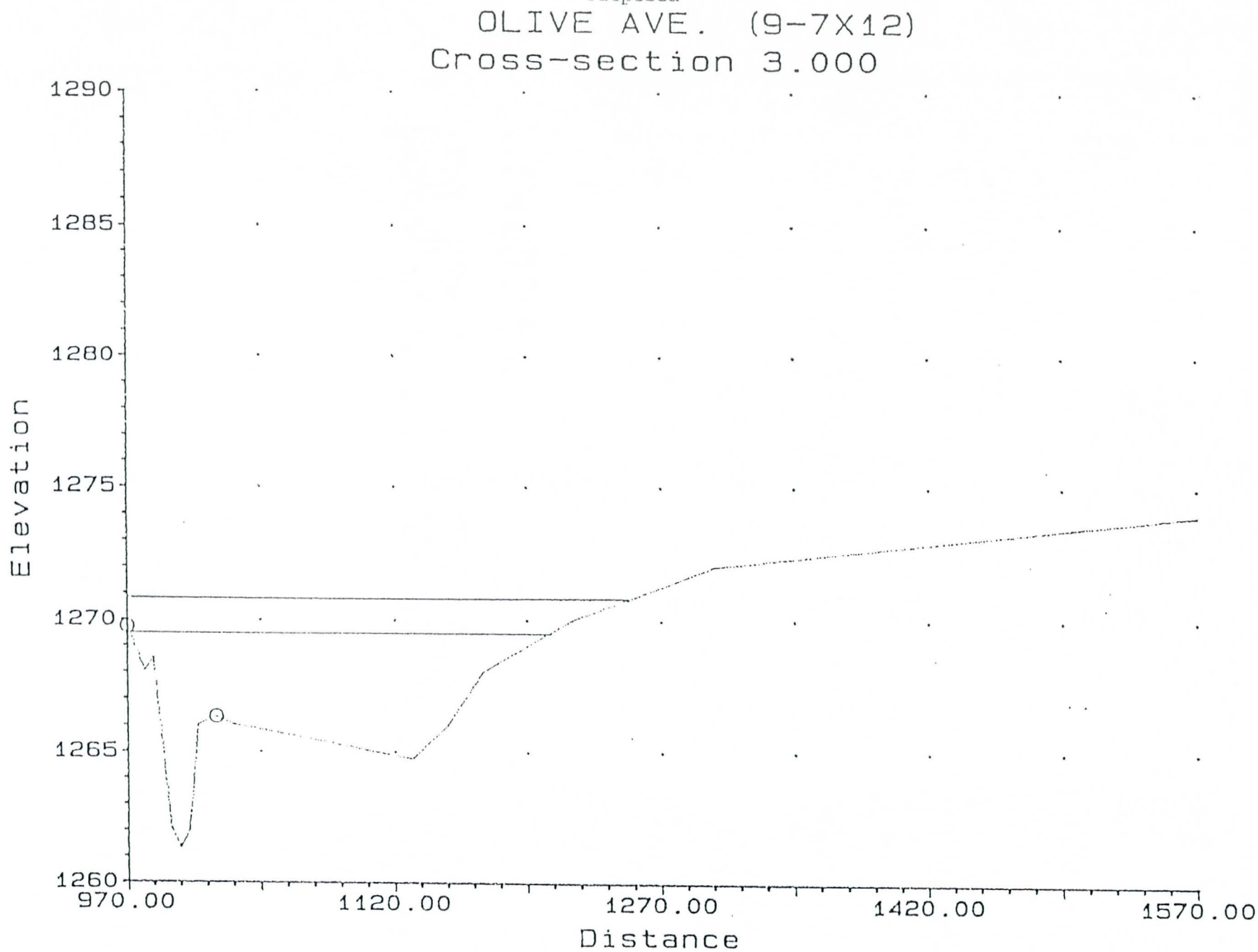


Figure G-5
Proposed

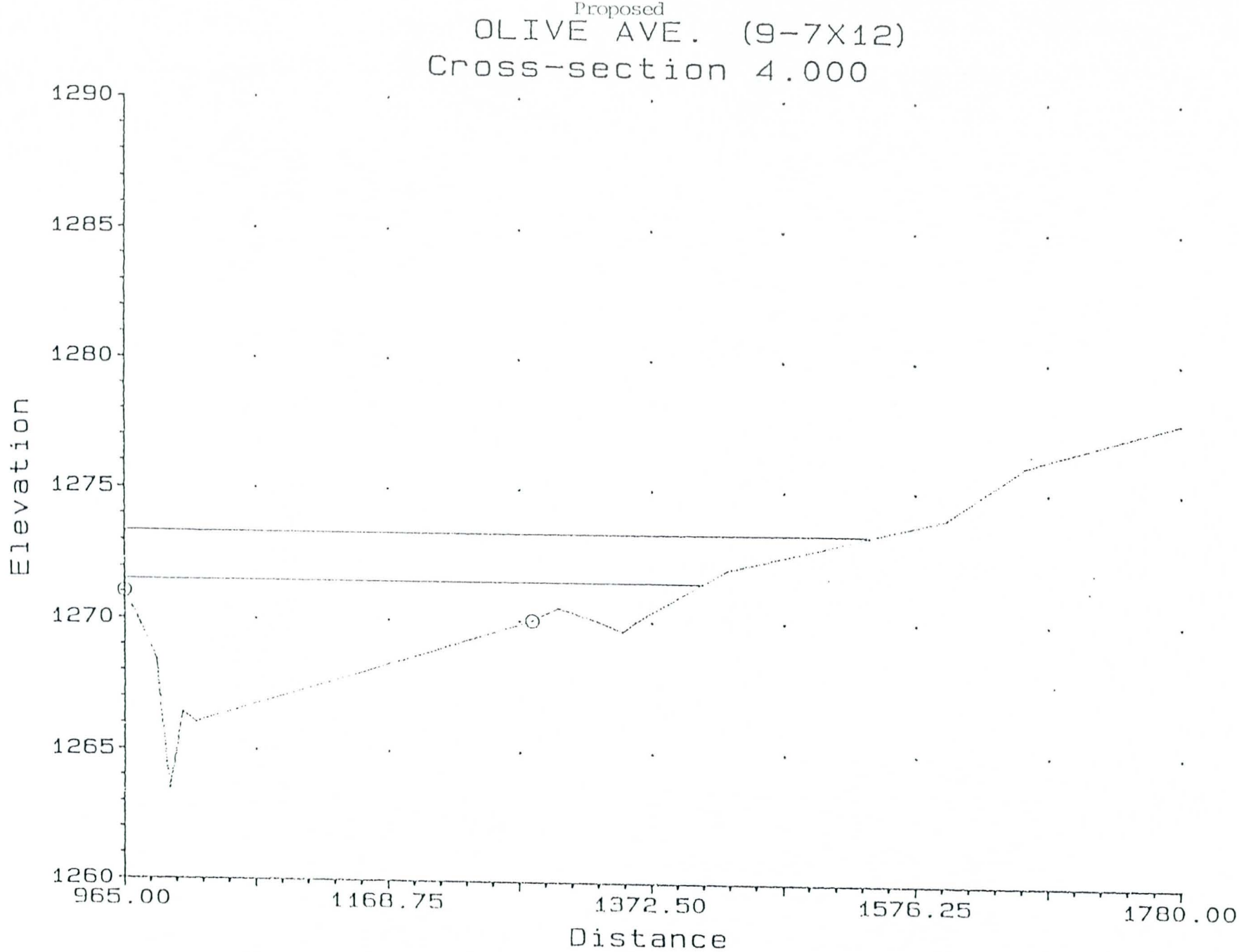


Figure G-6
Proposed

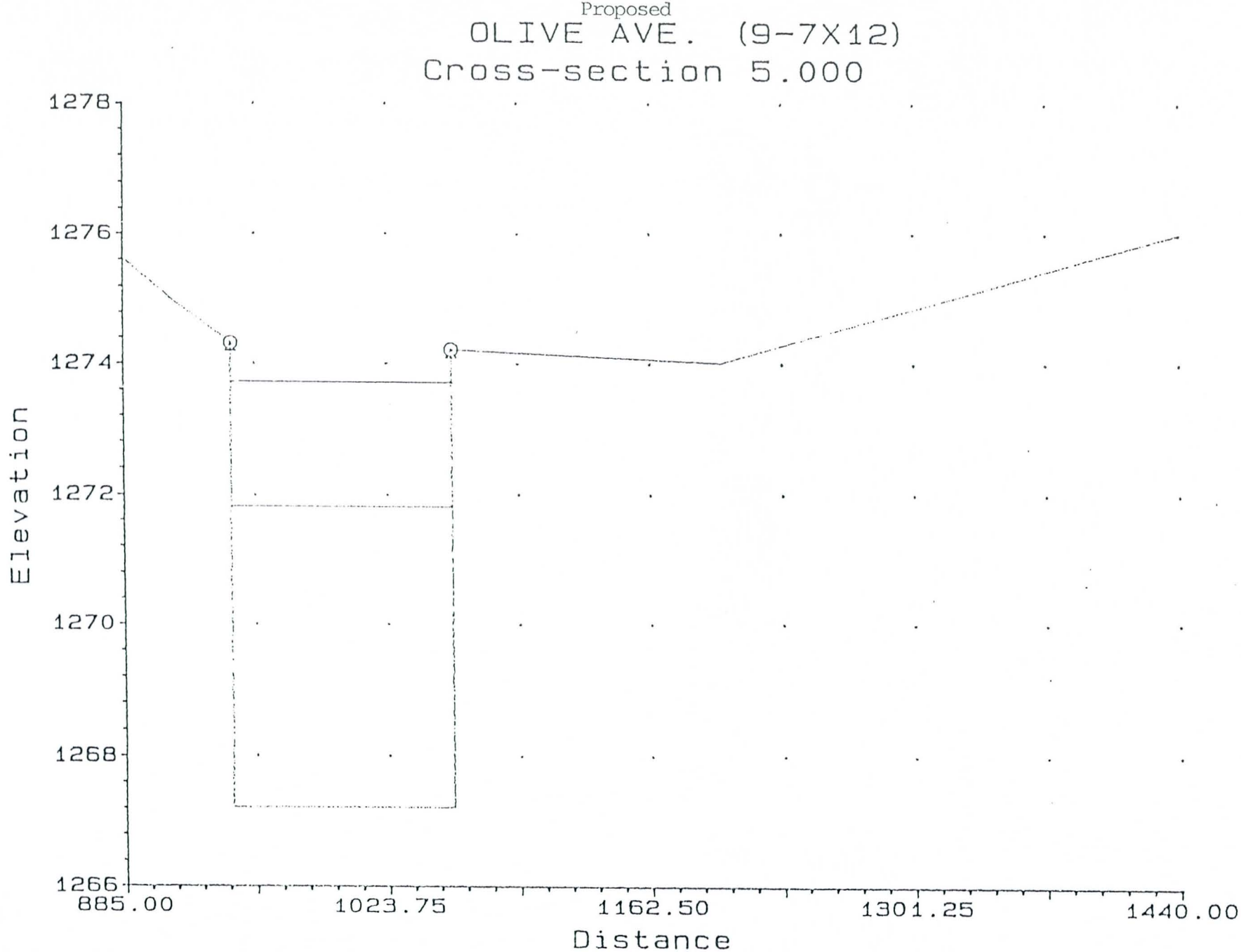


Figure G-7
Proposed

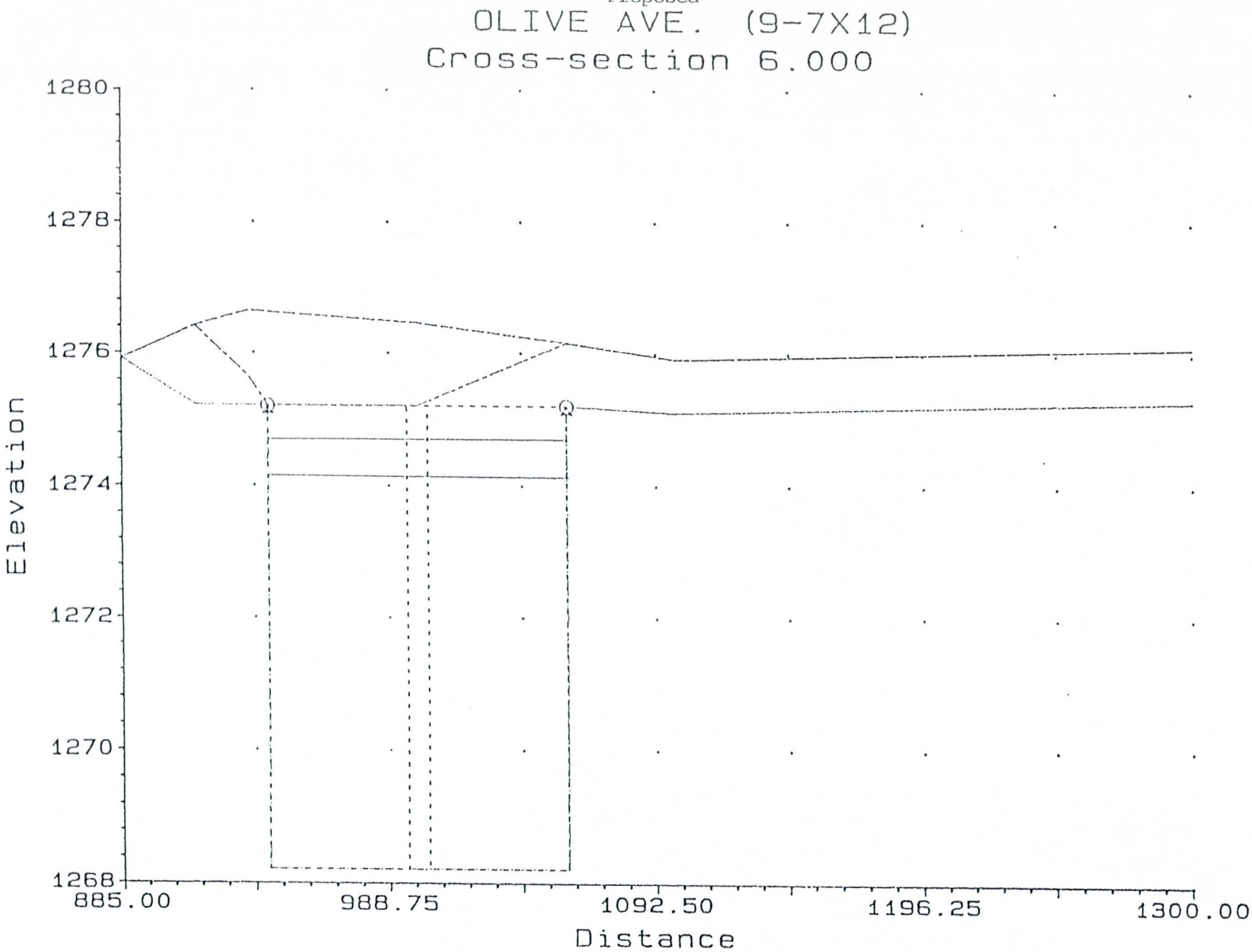


Figure G-8
Proposed

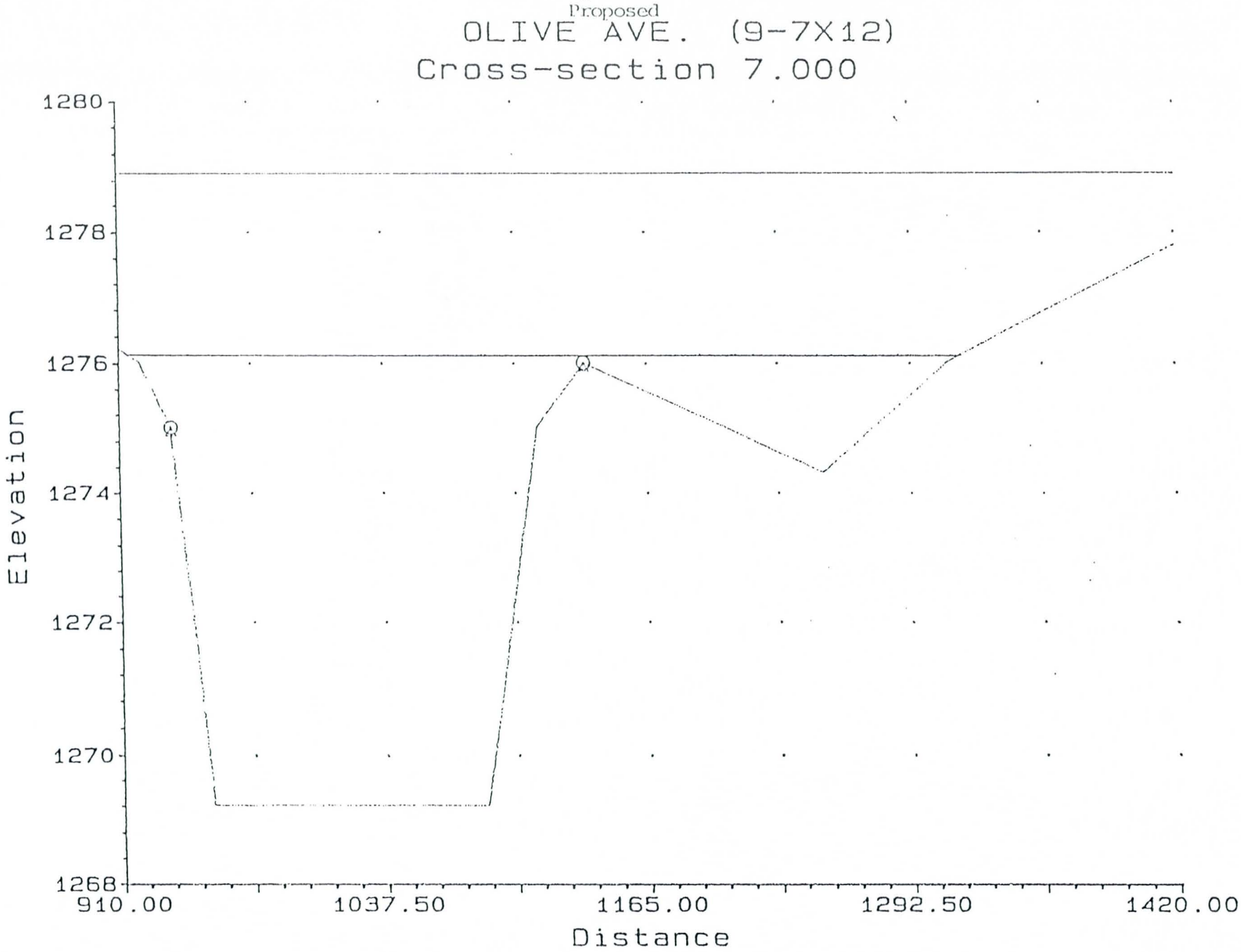


Figure G-9
Proposed

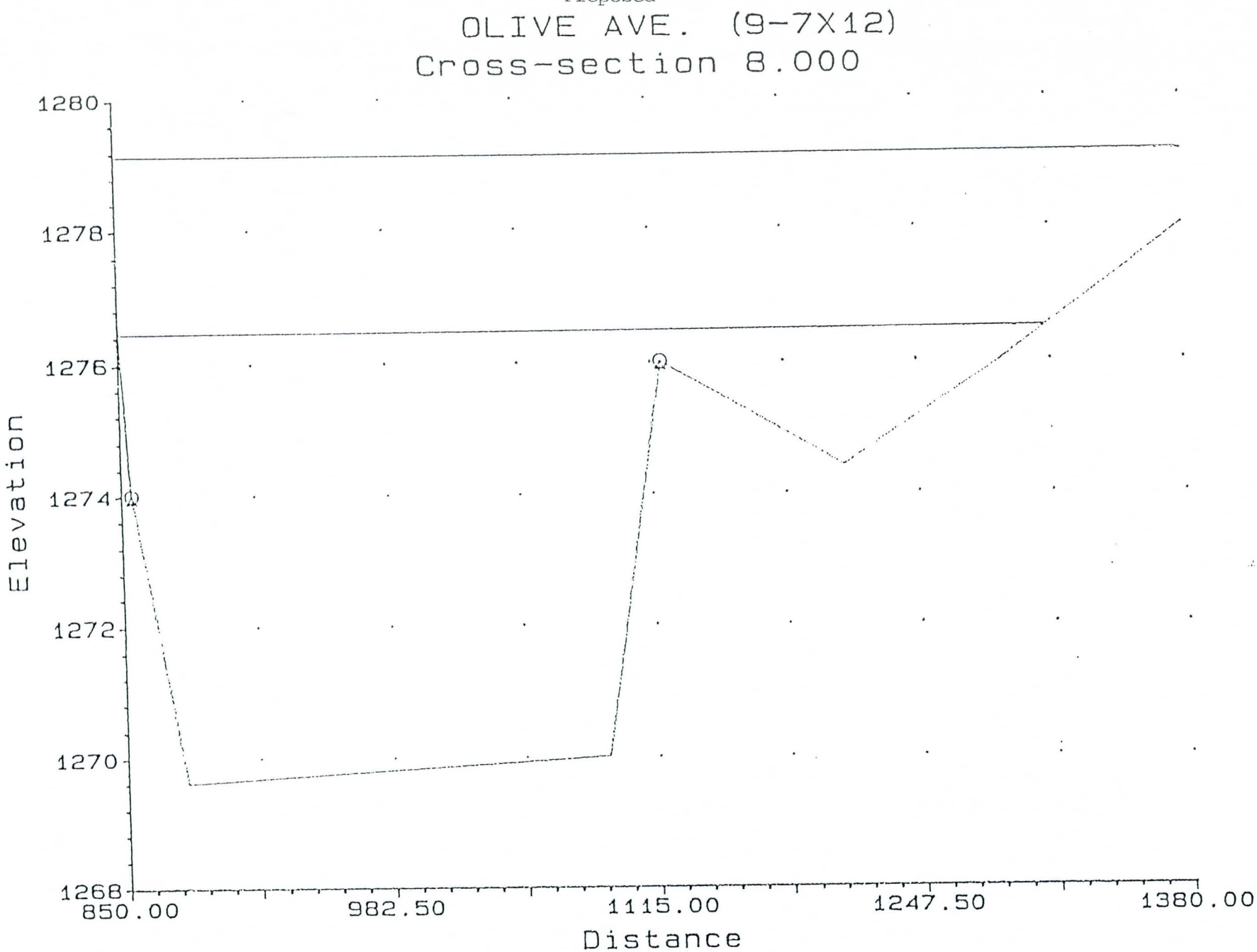
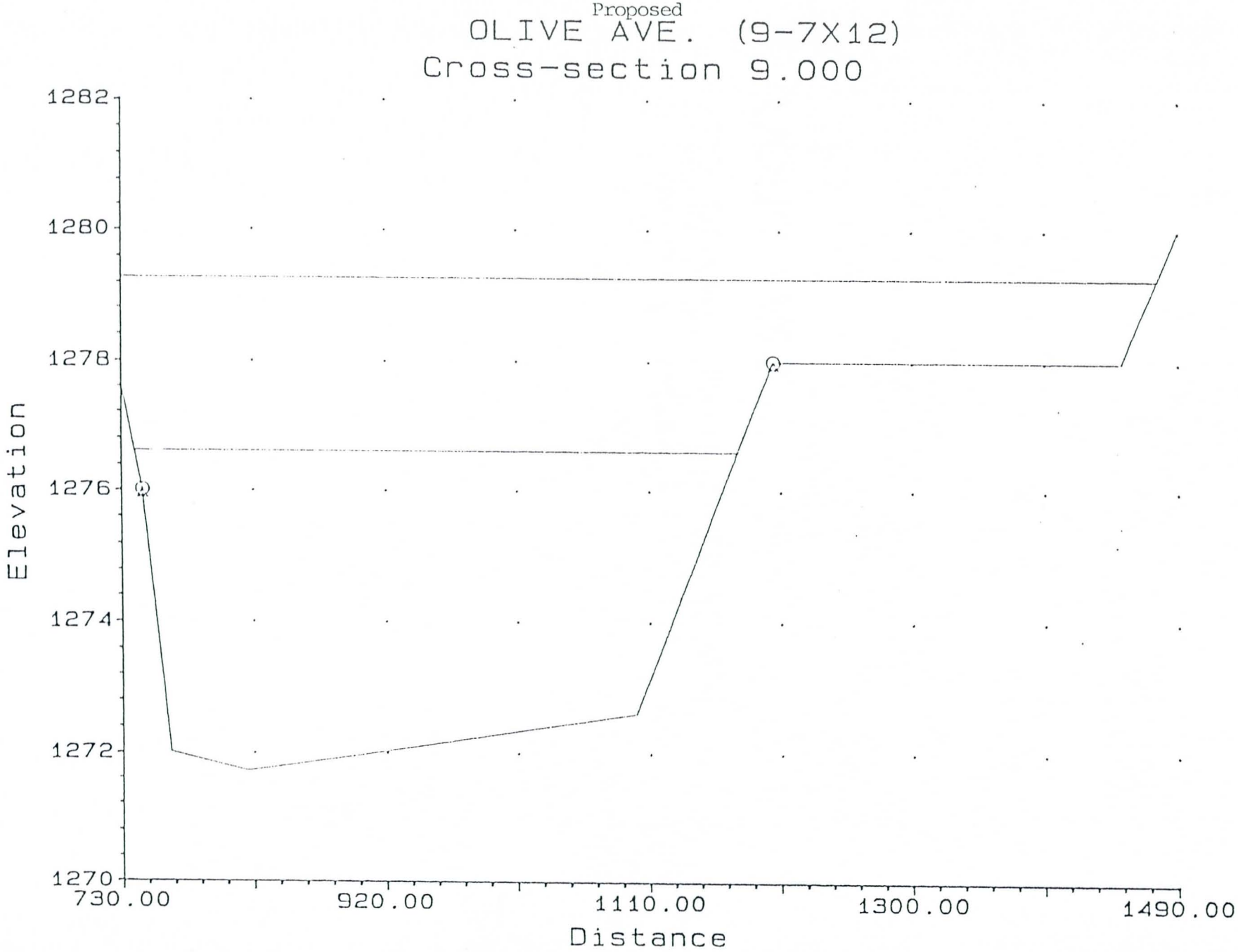


Figure G-10
Proposed



APPENDIX H

Wash West of Jackrabbit Trail
Culverts and Channel Capacities

Table H-1
Channel Capacity
for Wash West of Jackrabbit Trail

N= .03000
S= .007500 (FT/FT)
Z= 5.00:1
B= 54.0 (FT)
D= 3.50 (FT)

RESULTS:

Q= 2127.5 (CFS)	
A= 250.2 (SQ FT)	CRITICAL VELOCITY= 9.24 (FT/SEC)
V= 8.50 (FT/SEC)	FROUDE NUMBER= .893
W.S. WIDTH= 89.0 (FT)	SPECIFIC ENERGY, E= 4.62 (FT)
CRITICAL DEPTH= 3.27 (FT)	WETTED PERIMETER= 89.69 (FT)
CRITICAL SLOPE= .009573 (FT/FT)	HYDRAULIC RADIUS= 2.79 (FT)

Wash W. of Jackrabbit Trail
Channel Capacity at I-10 Ramps.

Capacity at Dike = 1514 cfs

Table H-2
Channel Capacity with Increased Bottom Width
for Wash West of Jackrabbit Trail

N= .03000
Q= 3730.0 (CFS)
S= .007500 (FT/FT)
Z= 5.00:1
D= 3.50 (FT)

RESULTS:
B= 101.0 (FT)
A= 414.9 (SQ FT)
V= 8.99 (FT/SEC)
W.S. WIDTH= 136.0 (FT)
CRITICAL DEPTH= 3.29 (FT)
CRITICAL SLOPE= .009276 (FT/FT)

CRITICAL VELOCITY= 9.64 (FT/SEC)
FROUDE NUMBER= .907
SPECIFIC ENERGY, E= 4.76 (FT)
WETTED PERIMETER= 136.73 (FT)
HYDRAULIC RADIUS= 3.03 (FT)

Wash W. of Jackrabbit Trail
Est. of Bottom width to contain all the flows. (100 yr)

Table H-3
Channel Capacity with Increased Depth
for Wash West of Jackrabbit Trail

N= .03000
Q= 3730.0 (CFS)
S= .007500 (FT/FT)
Z= 5.00:1
B= 54.0 (FT)

RESULTS:
D= 4.75 (FT)
A= 369.7 (SQ FT)
V= 10.09 (FT/SEC)
W.S. WIDTH= 101.5 (FT)
CRITICAL DEPTH= 4.56 (FT)
CRITICAL SLOPE= .008734 (FT/FT)

CRITICAL VELOCITY= 10.64 (FT/SEC)
FROUDE NUMBER= .932
SPECIFIC ENERGY, E= 6.33 (FT)
WETTED PERIMETER= 102.48 (FT)
HYDRAULIC RADIUS= 3.61 (FT)

Wash W. of Jackrabbit Trail
Depth required to contain all the flows (100 yr)

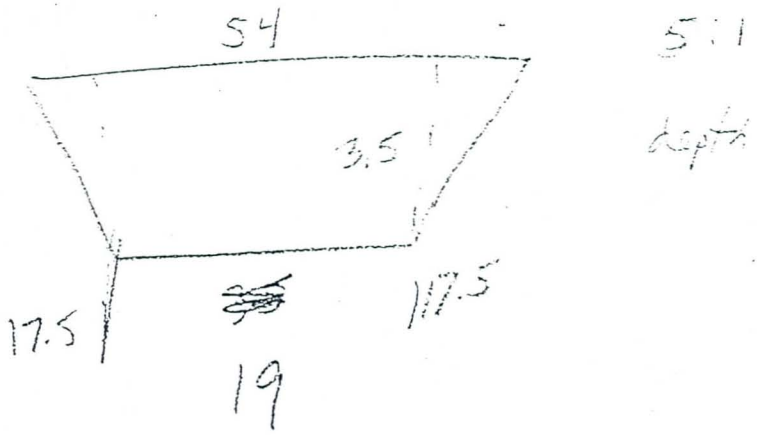
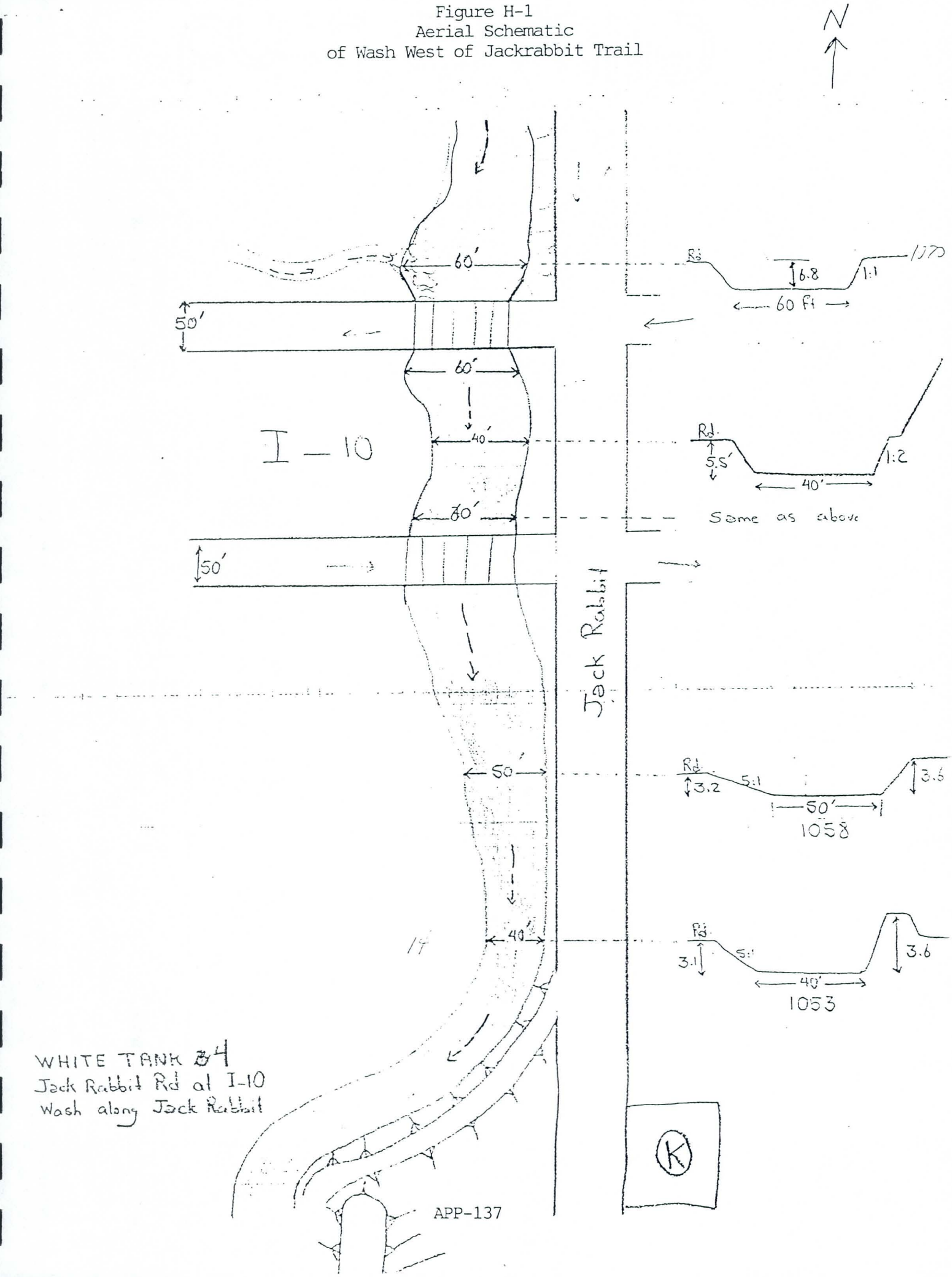


Figure H-1
Aerial Schematic
of Wash West of Jackrabbit Trail



Box Culverts under Jack Rabbit Rd. On-Ramp to I-10

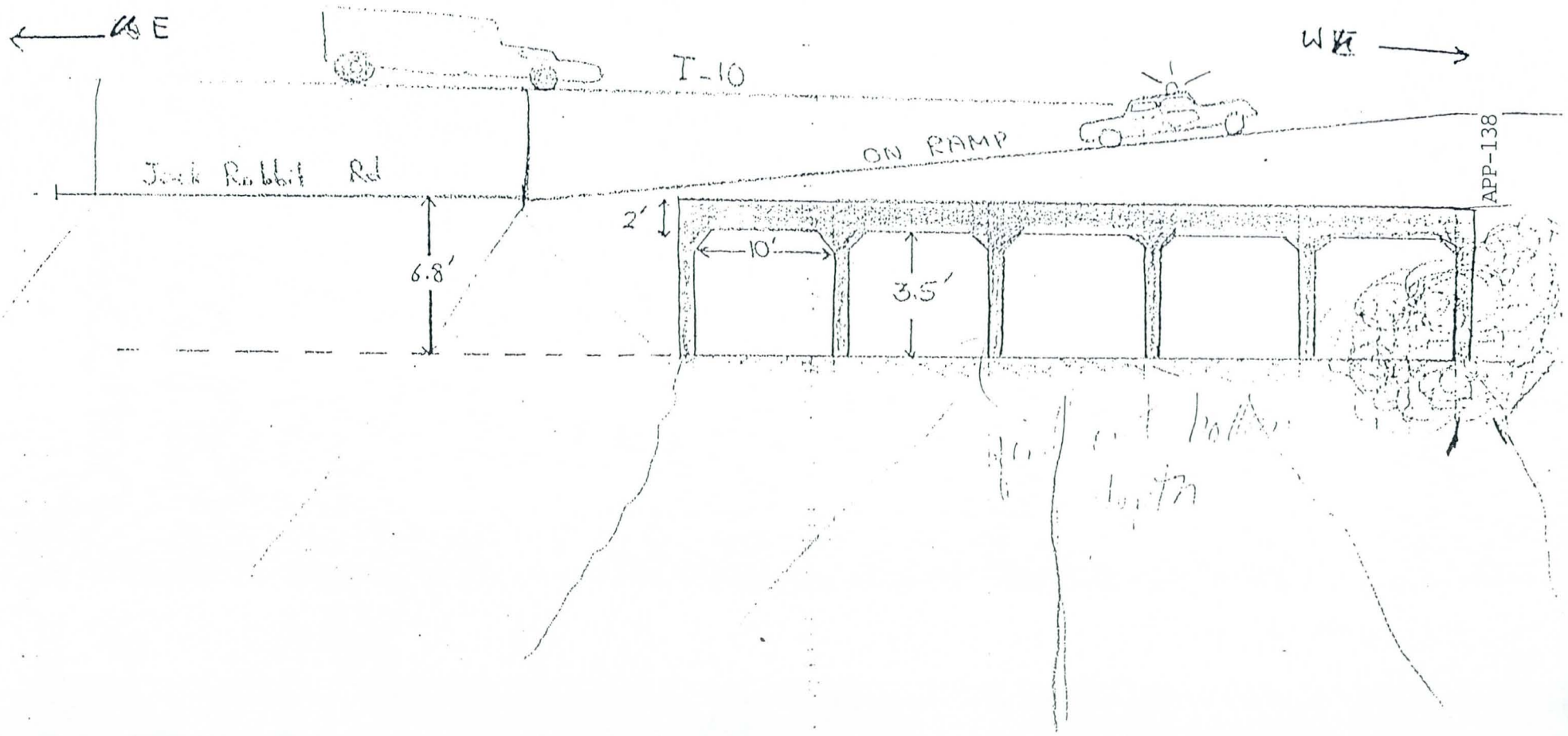


Figure H-2
Culvert Cross-Section
Wash West of Jackrabbit Trail