City of Henderson
Department of Public Works, Engineering Division
Land Development and Flood Control

Hydrology Study Submittal Checklist and Application

Hydrology Study Title SNWA River Mountain Solar Date 04-21-2015

Submittal Type (Check One):

- ☐ New Hydrology Study
- ☒ Addendum (response to comments)
- ☐ Supplemental (information for a previous submittal)
- ☐ Update (after original approval)

The items listed below are the minimum required for submittal. For adequate review, all items identified in the *Clark County Regional Flood Control District Hydrologic Criteria and Drainage Design Manual* must be included. Note: Attention to the City of Henderson section of the manual is critical.

For Addendums, Updates, and Supplemental Submittals:

- ☒ Original Study Number. PHYD - 2015730019

All submittals *must* include:

- ☒ This form;
- ☒ One (1) copy of the hydrology study, addendum, or update; including
- ☒ One (1) copy of related maps folded to 8 ½" x 11"
- ☒ Standard Form 1, wet stamped, signed and dated by a State of Nevada Professional Engineer and bound as the first page of the study, addendum, or update.
- ☒ Letter signed by the engineer certifying that all items on the CD match the paper versions and bound into the study behind Standard Form 1 (or 2, when required).
- ☒ One (1) CD containing PDF versions of all of the above items.

New submittals *must* also include:

- ☐ Community Development Permit Number: C UP-14 - 500508-A1
  - ❖ (Tentative Map, Design Review, etc.)
- ☐ Completed Standard Form 2, bound into the study behind Standard Form 1
- ☐ Submittal fee based on acreage:
  $750.00 – Up to 5 Acres
  $2000.00 – 5.1 to 320 Acres
  $4000.00 – 320.1 to 2560 Acres
  $6000.00 – 2560.1+ Acres

Addendum submittals *must* also include:

- ☒ Copy of City of Henderson comment letter, bound into each copy behind Standard Form 1.
- ☒ No charge for first addendum. **$400.00 submittal fee for each subsequent addendum.**

Update submittals *must* also include:

- ☐ **Within** one (1) year of original approval: $400 submittal fee.
- ☐ **Over** one (1) year from original approval: Fee based upon acreage, see above.
- ☐ Copy of approval letter for original study bound into each copy behind Standard Form 1

Technical Drainage Study

Southern Nevada Water Authority River Mountains Solar

1299 Burkholder Blvd

Henderson, NV 89015

April 21, 2015

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: SNWA River Mountain Solar Date: 4/21/15

Location of Development: a) Descriptive (Cross Streets) North/South: Richard Bunker Ave.

East/West: Burkholder Boulevard

b) Section: 14 Township: 22 S Range: 63 E

c) APN : 179-15-301-001

Name of Owner: United States of America c/o Southern Nevada Water Authority

Telephone No.: 702-856-3500 Fax No.: E-Mail Address:

Address: 1299 Richard Bunker Ave, Henderson, NV 89015

Contact Person-Name: Mark Fountain **Telephone No.:** 602-522-7700

* **E-Mail Address:** Mark.Fountain@hdrinc.com **Fax No.:** 602-522-7707

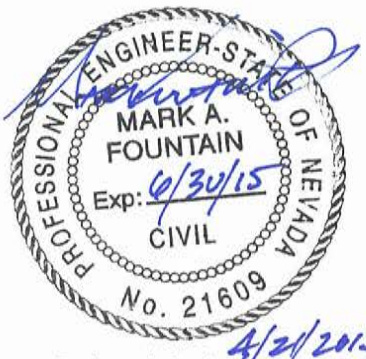
Firm: HDR

Address: 3200 E Camelback Road, Suite 350, Phoenix, AZ 85018

Type of Land Development/Land Disturbance Process:

	Rezoning		Subdivision Map		Clearing and Grading Only
	Parcel Map		Planned Unit Development		Other (Please specify below)
	Large Parcel Map	X	Building Permit		

1. Total Owned Land Area: At Site: 127 acres Being Developed/Disturbed: 92 acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes** ☒ No
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ Yes** ☒ No
4. Proposed type of development (Residential, Commercial, Etc.): Solar generation
5. Approximate upstream land area which drains to the subject site:
6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: River Mountains Water Treatment Facility Technical Drainage Study
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: west side and north side of the Site
8. Briefly describe your proposed schedule for the subject project: Grading plan submittal to City of Henderson on May 5th, IFC drawings to contractor on June 1



4/21/2015

Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

*New Required Field

**Review and concurrence of the Clark County Regional Flood Control District is required.

Revision	Date

Local Entity File No.

REFERENCE:

STANDARD FORM 1

Updated 05/01/2008

CITY OF HENDERSON
240 Water Street
P. O. Box 95050
Henderson, NV 89009-5050

March 9, 2015

Mark A. Fountain, P.E.
HDR
3200 E. Camelback Road, Ste. 350
Phoenix, AZ 85018

Re: Technical Drainage Study
SNWA River Mountain Solar
Permit Number: PHYD 2015730019

Dear Mr. Fountain:

This letter provides comments on the above referenced drainage study dated February 13, 2015. The City of Henderson reviewed this study and based on the documents submitted, **we have the following comments**:

1. The project site is located on and proposes to discharge to property under the jurisdiction of the Bureau of Reclamation. The engineer must coordinate with the Bureau of Reclamation for the proposed improvements.

2. The project proposes rip rap within what appears to be a power line easement at the northeast corner of the project (see sheet C-802). Documentation must be provided which indicates that this is allowed within the easement or written permission must be obtained from the easement grantee.

3. The Rational Method Hydrology calculations are based on rainfall for the McCarran Airport Rainfall Area. Per CCRFCD HCDDM Figure 513, the watershed does not lie within the McCarran Airport Rainfall Area. The hydrology and all subsequent calculations must be revised.

4. The Standard Form 4 must be revised as the overland flow length for several basins exceeds the 500 foot maximum per CCRFCD HCDDM Equation 602.

5. As proposed, the development of the site will increase runoff at the northwest corner of the site from 86 cfs to 133 cfs (more when the hydrology is revised per comment #3). This is an increase of 55%. A discussion of the impacts to downstream properties must be provided and additional may be necessary showing that downstream facilities can handle the increase in flow. If downstream properties and facilities cannot handle the additional flow, the design must be revised to mitigate the increase.

6. The design of the spreader basins must be revised to include a low flow outlet.

7. Figure 4, Existing Subbasin Map, must be revised to remove the proposed improvements from the map.

8. Figure 6, Proposed Subbasin Map, must be revised to address the following:

    a. The bar scale distance increments are labeled incorrectly
    b. The labels for the culvert inverts overwrite the text for P-A6, A-7-N, P-A11, PA-3, and for the flow rate at P-A8

9. A section or construction note must be provided for the swales adjacent to the site roadways to show how the flow is contained and conveyed along the roadway in subbasins B-2-S, B-4-S, A-6-S, and A-8-S.

10. Numerous culverts do not contain callouts to the rip rap sizes and grouting as determined in the calculations. Confirm all culvert outlet rip rap callouts are accurate.

11. The Engineers seal on the Standard Form 1 did not include all of the information required by the Nevada Administration Code. The seal must include the license expiration date, the signature of the engineer, and the date of signature. Please verify that all documents requiring an engineer's seal includes all of the required information.

12. The project proposes to use NDOT standard details. The appropriate details must be called out in the construction note or the details must be provided within the plan if the proposed improvement doesn't conform to the standard.

13. Provide a detailed response to any drainage study comments from other agencies in the next submittal (i.e. SNWA, CCPW, BOR, etc.).

14. The following grading plan comments must be addressed with the next submittal:

    a. Sheet C-801: Revise the leader line for construction note 8 at P-A10 to be directed to the single culvert
    b. Sheet C-801: Add the width to construction note 4 in subbasin A-10
    c. Sheet C-801: Revise construction note to refer to Detail 3
    d. Sheet C-802: Provide a construction note for the rip rap in subbasin OFF-D1
    e. Sheet C-802: Provide construction note 7 for the channel upstream of OFF-D3 to indicate rip rap to be in agreement with the calculations
    f. Sheet C-804: Show rip rap at P-A4 to agree with the calculations

Any work within washes or channels conveying jurisdictional Waters of the United States (e.g. Lower Las Vegas Wash), regardless of whether the flow is ephemeral or perennial, may require concurrence from the U.S. Army Corps of Engineers.

Projects that disturb over one (1) acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection: (1) a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site, (2) a request for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until paving, building construction or planting has covered all stripped or disturbed surface areas. For more information, including forms and applications contact the Nevada Division of Environmental Protection at http://ndep.nv.gov/bwpc/storm01.htm or call (775) 687-9429.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, the information submitted by the above named engineering firm may be superseded. Compliance with the regulatory elements and design standards specified in the Uniform Regulations for the Control of Drainage does not imply a guarantee that properties will be free from flooding or flood damage.

Please contact me if you have any questions concerning these comments.

Sincerely,

Albert J. Jankowiak, P.E., CFM
Project Engineer II

Reviewer: Chris O. Stone, P.E., Willdan Engineering

Date:	Tuesday, April 21, 2015
Project:	SNWA River Mountains Solar Permit Number: PHYD 2015730019
To:	Albert J. Jankowiak, PE - City of Henderson
From:	Mark Fountain, PE, ENV SP, CFM
Subject:	Technical Drainage Study Review Comment Responses
Attachments	Attachment 1 – Bureau of Reclamation Review Letter

Memo

Dear Mr. Jankowiak, PE, CFM

A Technical Drainage study for the River Mountains Solar project was submitted to the City of Henderson on February 13, 2015. The following are responses addressing the comments we received from the City of Henderson on March 9, 2015. Comment responses from HDR are italicized.

1. The project site is located on and proposes to discharge to property under the jurisdiction of the Bureau of Reclamation. The engineer must coordinate with the Bureau of Reclamation for the proposed improvements.

   A copy of the Drainage Study was provided to the Bureau of Reclamation (BOR) to have the proposed improvements reviewed. Attached is the response email we received from the BOR where it states that a technical review is not required as long as they are provided with written verification that the City of Henderson has reviewed and approved the Study.

2. The project proposes rip rap within what appears to be a power line easement at the northeast comer of the project (see sheet C-802). Documentation must be provided which indicates that this is allowed within the easement or written permission must be obtained from the easement grantee.

   Riprap has been removed from this area. Plans have been updated to reflect this change (Sheet C-802).

hdrinc.com

3200 E. Camelback Road, Suite 350, Phoenix, AZ 85018
T 602.522.7700

3. The Rational Method Hydrology calculations are based on rainfall for the McCarran Airport Rainfall Area. Per CCRFCD HCDDM Figure 513, the watershed does not lie within the McCarran Airport Rainfall Area. The hydrology and all subsequent calculations must be revised.

   The hydrology calculations were revised using the Time-Intensity-Frequency curves found in section 500 of the CCRFCD HCDDM for the rainfall data outside of the McCarran Airport area. Calculations were based on the rainfall isopluvials found in Figures 501 – 512 within Appendix A – Hydrologic Calculations.

4. The Standard Form 4 must be revised as the overland flow length for several basins exceeds the 500 foot maximum per CCRFCD HCDDM Equation 602.

   Overland flow lengths have been revised to meet the 500 foot maximum.

5. As proposed, the development of the site will increase runoff at the northwest corner of the site from 86 cfs to 133 cfs (more when the hydrology is revised per comment #3). This is an increase of 55%. A discussion of the impacts to downstream properties must be provided and additional may be necessary showing that downstream facilities can handle the increase in flow. If downstream properties and facilities cannot handle the additional flow, the design must be revised to mitigate the increase.

   Per phone conversation with Mr. Albert Jankowiak *on April 13, 2015, Section V-7 was pointed out as a discussion of the impacts, and per his advisement additional text was included. This text consists of acknowledging the flow increases, identifying the next facility downstream is 0.5-miles downstream, providing a statement that it is the engineers opinion that the increase in proposed flows will be attenuated due to the additional downstream tributary area and longer flow path, and a statement that there will be no adverse effect on these downstream facilities.*

6. The design of the spreader basins must be revised to include a low flow outlet.

   A drain was provided for each of the proposed spreader basins.

7. Figure 4, Existing Subbasin Map, must be revised to remove the proposed improvements from the map.

   Figure 4 was revised to remove proposed improvements.

8. Figure 6, Proposed Subbasin Map, must be revised to address the following:

   a. The bar scale distance increments are labeled incorrectly
   b. The labels for the culvert inverts overwrite the text for P-A6, A-7-N, P-AII, PA-3, and for the flow rate at P-A8

   The distance increments on the bar scale have been corrected. Inverts were removed from Figure 6, see Figure 7 for inverts.

9. A section or construction note must be provided for the swales adjacent to the site roadways to show how the flow is contained and conveyed along the roadway in subbasins B-2-S, B-4-S, A-6-S, and A-8-S.

Plans now include construction note identifying the berm detail for the locations mentioned above. The berm detail has been revised to show two scenarios: berm with road and berm with no road.

10. Numerous culverts do not contain callouts to the rip rap sizes and grouting as determined in the calculations. Confirm all culvert outlet rip rap callouts are accurate.

Plans have been updated to include a culvert table with riprap sizes and outlet protection specifications. Please see Sheet C-501.

11. The Engineers seal on the Standard Form 1 did not include all of the information required by the Nevada Administration Code. The seal must include the license expiration date, the signature of the engineer, and the date of signature. Please verify that all documents requiring an engineer's seal includes all of the required information.

Acknowledged.

12. The project proposes to use NDOT standard details. The appropriate details must be called out in the construction note or the details must be provided within the plan if the proposed improvement doesn't conform to the standard.

Key Note 8 states the standard detail name and type. Culvert sizing is included in Culvert Schedule on sheet C-501.

13. Provide a detailed response to any drainage study comments from other agencies in the next submittal (i.e. SNWA, CCPW, BOR, etc.).

No other drainage study comments have been provided.

14. The following grading plan comments must be addressed with the next submittal:
    a. Sheet C-801: Revise the leader line for construction note 8 at P-A 10 to be directed to the single culvert
    This culvert was removed.

    b. Sheet C-801: Add the width to construction note 4 in subbasin A-10
    Updated to show road width of 20'.

    c. Sheet C-801: Revise construction note to refer to Detail 3
    Updated.

    d. Sheet C-802: Provide a construction note for the rip rap in subbasin OFF-D1
    Updated.

    e. Sheet C-802: Provide construction note 7 for the channel upstream of OFF-D3 to indicate rip rap to be in agreement with the calculations
    Updated.

f. Sheet C-804: Show rip rap at P-A4 to agree with the calculations
Calculations updated to show earth at this location, velocities within limits. No riprap to be installed upstream of culvert P-A4. Riprap is specified downstream of P-A4.

Any work within washes or channels conveying jurisdictional Waters of the United States (e.g. Lower Las Vegas Wash), regardless of whether the flow is ephemeral or perennial, may require concurrence from the U.S. Army Corps of Engineers.

Acknowledged.

Projects that disturb over one (1) acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection: (1) a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site, (2) a request for inclusion in the Stormwater General Permit No. NVRIOOOOO. A phased construction unit in a contiguous subdivision is considered under construction until paving, building construction or planting has covered all stripped or disturbed surface areas. For more information, including forms and applications contact the Nevada Division of Environmental Protection at http://ndep.nv.gov/bwpc/stormO l.htm or call (775) 687-9429.

Preparation of SWPPP and NOI submission is in process.

Please be aware that as additional information becomes available and/or restudies of Flood Insurance Studies are performed, the information submitted by the above named engineering firm may be superseded. Compliance with the regulatory elements and design standards specified in the Uniform Regulations for the Control of Drainage does not imply a guarantee that properties will be free from flooding or flood damage.

Acknowledged.

If you have any questions or would like additional supporting information for the development of the comment responses here-in, please do not hesitate to contact me by phone at 602.522.7700 or by email at mark.fountain@hdrinc.com.

Sincerely,

Mark Fountain, PE, ENV SP, CFM
Water Resources Project Manager

cc. - file

Drago, Chad

From: Erika Brosz <ebrosz@sunedison.com>
Sent: Tuesday, April 07, 2015 1:55 PM
To: Drago, Chad; Christina White
Subject: FW: Drainage Report for River Mountains Solar Project

FYI

Erika Brosz, PE
Design Manager
(650) 868-0549

From: Streier, Faye [mailto:fstreier@usbr.gov]
Sent: Tuesday, April 07, 2015 1:47 PM
To: Erika Brosz
Cc: Rebecca (Becci) Rogers; Marc Maynard; Gary Wood; Chiaki Lowrey
Subject: Drainage Report for River Mountains Solar Project

Erika,

Thanks for sending the Technical Drainage Study for the River Mountains Solar Project. I understand from you and Gary Wood that the Study will be submitted to the City of Henderson, who has jurisdiction for flood control in this location, for review to confirm that the study is consistent with the Clark County Flood Control manual requirements. The Bureau of Reclamation does not need to perform a technical review of the Study if we are provided written verification that the City of Henderson has reviewed the Study and approved it for form and content.

--
Faye Streier
National Environmental Policy Act Coordinator
Bureau of Reclamation, Lower Colorado Region
P.O. Box 61470
Boulder City, NV 89006
Office- 702-293-8132
Cell- 702-379-5197
Fax- 702-293-8418
fstreier@usbr.gov

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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: SNWA River Mnt Solar	Map ID:
Firm Name: HDR	Engineer: Mark Fountain
Address: 3200 E Camelback Road, Suite 350	
City: Phoenix	State: AZ Zip: 85018
Phone Number: 602-522-7700	Fax Number: 602-522-7707
Property Owner: United States of America c/o Southern Nevada Water Aut	
Address: 1299 Richard Bunker Ave	
City: Henderson	State: NV Zip: 89015

Reviewed By:	Date Received:	Date Accepted for Review:

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

This document is intended as an aid in preparing Technical Drainage Studies. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.

If items are not applicable for the subject site, provide N/A.

I. GENERAL REQUIREMENT

Yes	No	
X		Design Manual **Standard Form 1** with the engineer's seal and signature.
X		Design Manual **Standard Form 4**. See Appendix A (spreadsheet)
X		2 copies of the 24" x 36" Drainage Plan.
N/A		A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge. Same property owner

II. MAPS AND EXHIBITS

Yes	No	
X		A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.
X		A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes	No	
X		Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.
X		On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs.
X		Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes	No	
X		Sheet size: 24” x 36” sealed by a registered engineer in the State of Nevada.
X		Minimum scale: 1” = 60’.
X		Project name.
X		Vicinity Map with local and major cross streets.
X		Revision box.
X		North arrow and bar scale.
X		Engineer’s/consultant’s address and phone number.
X		Elevation datum and benchmark.
X		Legend for symbols and abbreviations.
X		Cut/fill scarps, where applicable.
X		Street names, grades, widths.
N/A		Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street.
X		Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
N/A		Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
X		Proposed typical street sections.

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
N/A		Streets with off-set crowns.
x		Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
x		Property lines.
N/A		Right-of-way lines and widths, existing and proposed.
x		Existing improvements and their elevations.
x		Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
N/A		Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
x		Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
N/A		Location and cross-section of street capacity calculations.
x		Cross-sectional detail for channels, including cutoff wall locations.
x		Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
N/A		Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
N/A		Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
N/A		Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
n/A		Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
n/a		Building and/or lot numbers.
n/a		Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
n/a		Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
n/a		For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.
n/a		Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
n/a		Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
n/a		Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
x		Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
x		Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models. Rational Method
x		Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models. Rational Method
x		Use of correct precipitation values in and around the McCarran Airport rainfall area.
x		A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
x		A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.
x		Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
x		On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
N/A		Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:	**STANDARD FORM 2**

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes	No	
n/a		Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
n/a		Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q_{100} and Q_{10} flows representing the worst case for interior and all perimeter streets. Q_{100} d x v $\leq$ 8. Q_{10} d x v $\leq$ 6 and 12 foot dry lane for rights-of-way $\geq$ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
n/a		A summary table of interior and exterior street capacity calculations showing the street name, Q_{100} flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
n/a		Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
n/a		Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses, where appropriate.
n/a		Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q_{100} weir height or flow depth, whichever is greater.
n/a		A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
n/a		Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
x		Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
x		The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
n/a		Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).

REFERENCE:	**STANDARD FORM 2**

April 21, 2015

City of Henderson
Attn: Albert Jankowiak, PE, CFM
240 Water Street, MSC 112
Henderson, NV 89015

Mr. Jankowiak,
This letter certifies to the best of my knowledge that all items on the included data CD within the report match the printed paper versions.

Please feel free to contact us with any questions at 602.792.8800.

Sincerely,

Mark Fountain, PE, ENV SP, CFM
Water Resources Project Manager

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Technical Drainage Study

SNWA River Mountains Solar

1299 Burkholder Blvd

Henderson, NV 89015

April 21, 2015

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602.522.7700

Table of Contents

II. General Location and Development Description

A. Location of Property

The Southern Nevada Water Authority (SNWA) River Mountains Solar project (see **Figure 1 – Location and Vicinity Map**) is in the city of Henderson, Clark County, State of Nevada within:

- The SW ¼ and W ½ of the SE ¼ of Section 14, Township 22 S, Range 63 E
- The S ½ of Section 15, Township 22 S, Range 63 E
- The N ½ of Sections 22, Township 22 S, Range 63 E

The project is confined by the River Mountains Water Treatment Facility (RMWTF), inside a fully fenced perimeter. The site can be accessed through Burkholder Blvd adjacent to the west and south property boundaries. The proposed project site is enclosed on the south by the Western Area Power Administration Power Line Corridor easement and on the east by the Navajo IPP-McCullough Power Line corridor easement.

Adjacent to the property site is the River Mountains Water Treatment Facility. Surrounding developments include the Newport Electrical Substation, Burkholder Reservoir, and River Mountains Pumping Station as well as residential development to the west and south of the site.

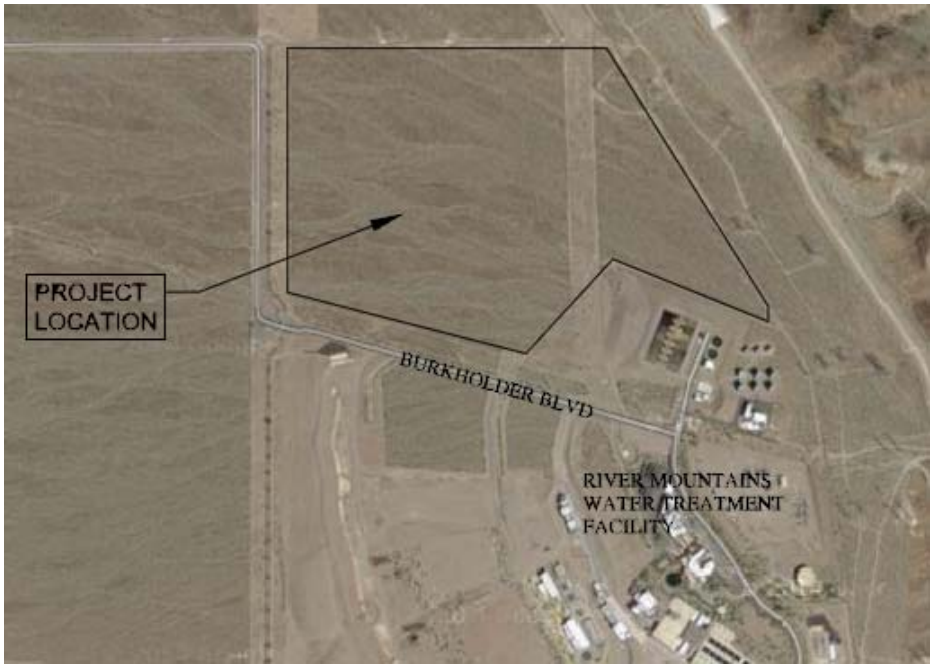

Figure 1 - Project Location

As shown in **Figure 3 - Regional Flood Control Facilities,** the regional flood control facilities in vicinity, but not adjacent, to the proposed project site are East C-1 Detention Basin, East C-1 Levee, Drake Channel, and C-1 Channel. The site is located within the C1-51A drainage basin of the Las Vegas Valley map reflected on **Figure 2 - Drainage Basins**. Figure 2 and 3 are taken from the 2013 Las Vegas Valley Flood Control Master Plan Update.

B. Description of Property

The existing conditions at the 92-acre site are characterized as barren with very sparse desert vegetation. Multipe washes run across the site and large boulders are seen on the top surface of the terrain. The general slope of the undulating terrain is to the northwest with an overall grade of approximately 4%. There are no existing irrigation facilities on the Site. Upstream of the site there is an existing Federal Emergency Management Agency (FEMA) accredited East C-1 levee which protects the River Mountains Water Treatment Facility from the 100-year return event from the River Mountains which are part of the Lake Mead National Recreation Area..

The proposed project will consist of photovoltaic panel array systems designed to help meet the power needs of the River Mountains Water Treatment Facility. The facility currenlty obtains their hydropower from Hoover Dam and a few smaller solar arrays.

III. Drainage Basin Description

A. Off-Site Drainage Description

The proposed SNWA River Mountain Solar project site is located to the west of the River Mountains. Uphill of the site there is an existing FEMA accredited East C-1 levee which protects the River Mountains Water Treatment Facility from the 100-year return event offsite flows from the adjacent mountains to the east. The off-site drainage potentially impacting the project site is local runoff from the east which enters through discrete washes as shown in **Figure 4 – Existing Subbasin Map**.

As the project is protected by the above mentioned FEMA accredited levee, off-site flows from non-discrete locations will not occur. There is no evidence of recent non-discrete flows coming onto the site. See **Figure 5 – FIRM Panel** for the location of the existing FEMA accredited levee with respect to the proposed project site.

Existing land use within the upstream basins are limited to the existing SNWA Treatment Plant and the Navajo IPP-McCullough Power Line corridor easement. There are no proposed developments within the upstream basin.

The hydrologic soil group for the site and the upstream basins is Type A as defined by the NRCS Soil Survey included in **Appendix A – Hydrologic Calculations**. The vegetation is sparse desert vegetation. The slope of the site is approximately 4% to the northwest. There are no man made conveyances on the site. Natural conveyances found on-site consist of incised desert washes flowing in a riverine condition.

B. On-Site Drainage Description

Existing Condition:
The on-site drainage areas are shown on **Figure 6 – Proposed Subbasin Map**. The site is undeveloped and generally slopes from southeast to northwest at 4%. In the

existing condition, there are six subbasins that enter the site through riverine condition (Existing Subbasins A –F).

Existing Basins 'A' and 'B' discharge from the site along the west side through the existing SNWA fence to the east side of Burkholder Boulevard. The existing flows then drain to the north along the east side of Burkholder Boulevard to concentration point (CP) 'A' which is a 24-inch corrgated metal pipe (CMP) culvert and CP 'B' which is also a 24-inch CMP culvert. In the existing condition, these culverts are not sized for the 100-year flow. As flow ponds behind existing cuvlert A it spills over into existing culvert B, which then spills over the existing Burkholder Boulevard to the west. Discharges through existing culverts A and B are conveyed to their respective downstream concentration points designated and EX-DS-A and EX-DS-B. The culvert/weir calculations for these locations can be found in **Appendix B – Hydraulic Calculations**.

Four of the washes convey on-site flow as concentrated flow through at-grade trail crossings, designated as CP 'C', 'D', 'E', and 'F' along the north side of the Site. See **Table 1 – Existing Condition Flow Summary**.

Concentration Point	Q_{10}(cfs)	Q_{100} (cfs)
Ex A	23	80
Ex B	10	33
Ex C	2	7
Ex D	9	32
Ex E	1	1
Ex F	7	23
EX-DS-A	16	18
EX-DS-B	17	95

Table 1 – Existing Condition Flow Summary

Proposed Condition:
Proposed on-site runoff will be intercepted through a series of swales,ditches, and collected at on-site. Discharge from Basins 'A' and 'B' will be collected into spreader basins. Collected stormwater will then discharges from the spreader basins by way of rip-rap protected weirs at existing natural flowpaths elevations to mimic the historic condition at the edge of spreader basins. The spreader basins will be drained with 18-inch pipes. The purpose the drain pipes is not to convey design flows, but to prevent ponded water from remaining in the spreader basins after the event has passed.

Proposed Basins 'C', D', 'E', and 'F' will discharge through the existing at grade trail crossings on the north side of the Site. The existing structures are capable of handling the proposed flows. Proposed Basins 'C', 'E', and 'F' do not increase flows above the existing condition. Proposed Basin 'D' increases flows slightly which causes a minimal increase in flow depth. See **Section V – 7 – Downstream Impact** for a comparison of dishcarges and depths.

Based upon the proposed improvements, discharge from the site will continue to exit at their historic locations. The proposed discharges will be slightly higher than the existing in some locations as a result of the proposed site conditions. It is anticipated that discharges exiting the proposed project site will result in minimal differences from the existing condition as discussed in **Section V – 7 – Downstream Impact.**

Hydrologic analyses were prepared to estimate the peak on-site runoff under both existing and proposed conditions are included in **Appendix A – Hydrologic Calculations**. See **Table 2 – Proposed Condition Flow Summary**.

Concentration Point	Q_{10}(cfs)	Q_{100} (cfs)
A-6-S	10	21
A-7-S	5	11
A-8-S	9	19
A-9-S	9	20
B-2-S	7	15
B-3-S	8	16
B-4-N	1	3
B-4-S	7	16
D-1-N	2	5
D-1-S	8	16
OFF-A4-S	5	18
OFF-A5-N	1	4
OFF-A5-S	4	15
OFF-C1	1	1
OFF-D3	7	24
OFF-E	1	1
OFF-F	7	23
P-E1	1	1
P-E2	1	1
P-A4	5	18
P-A3	6	22
P-A2	6	22
P-A5	6	19
A-9-N	1	2
P-A8	24	58
P-A7	27	65
P-A6	35	81
P-A1	34	79
P-A	41	108
P-OFF-D2	7	23
P-D1	11	23
P-D	15	41
P-B4	8	18
P-B3	17	36
P-B2	23	50
P-OFF-B2	24	52
P-B	24	52
DS-A	17	19
DS-B	48	141

Table 2 – Proposed Condition Flow Summary

C. Master Planning Information

Upstream of the site are two Master Plan Update (MPU) facilities (see **Figure 3 - Regional Flood Control Facilities**). These facilities can be found on Figure F-47 of the 2013 Las Vegas Valley Flood Control MPU and can be identified as the East C-1 Detention Basin and East C-1Levee, MPU regional Facility number C1DC 0303 and C1HV 0300, respectively. Discharges from the East C-1 Detention Basin are routed to the Northeast C-1 Levee and diverted in a northwesterly direction across the alluvial fan to the east end of the Drake Channel and ultimately into the C-1 Channel.

The East C-1 Levee was constructed as part of the East C-1 Detention Basin in April, 1998. Both the detention basin and the levee were constructed to protect the RMWTF, effectively truncating the apex of the alluvial fan spreading west from the River Mountains escarpment. Based on the Ten Year Construction Program Fiscal Year 2013-2022, there are no proposed or under construction master plan facilities on the subject site.

D. Floodplain Information

The proposed project is located within a previous identified FEMA Flood Insurance Rate Map (FIRM). The project site is depicted upon the effective FIRM panel dated November 16, 2011 and can be identified as community panels No. 320004F and 320005F (Panel 2610 and 2620 of 4090), containing the City of Henderson and City of Boulder. The project site is shown within a shaded Zone X, which is described as an area of the 100-year floodplain determined to be less than one foot in depth. A copy of the FEMA FIRM is found in **Figure 5 – FIRM Panel**.

As there are no FEMA Special Floodplain Hazard Areas located on the site, there are no calculated floodplains for the proposed conditions.

E. Previous Drainage Studies

During our research, a previous drainage study was identified and an excerpt is included in **Appendix C.** See **Appendix D – Data CD** for a copy of the entire report:

- River Mountains Water Treatment Facility (RMWTF), Final Technical Drainage Study prepared by Montgomery Watson/CH2M Hill for Southern Nevada Water Authority.

The 100-year discharge for the entry culvert to the site was obtained from the above report. Subbasin 8C was identified to have a discharge of 130 cfs and was utilized to size the proposed entry culverts at the entry road on the south side of the site. The discharge from these culverts continues to the west and into the existing onsite retention basin.

IV. Proposed Drainage Facilities

A. General Description

The general approach to the proposed drainage facilities is to discharge flows at the historic discharge locations. The discharges are slightly larger than the existing conditions, but will have minimal impact to the downstream properties. Upstream flows will be routed through and around the Site and discharged at historic locations. The proposed drainage facilities are shown in **Figure 7 - Drainage Plan**.

The proposed drainage system will include a network of channels consisting of: rip-rap lined channels, where velocities are greater than 5 feet per second (fps) but less than 10 fps, and compacted native soil channels where velocities are less than 5 fps.

1. The proposed local drainage system captures runoff from the solar fields with a berm and swale. This flow is routed to the edges of the solar fields to collector channels. At road crossings the collector channels are piped under the road.

   Discharges from on-site basins contributing to CP ‘A’ and ‘B’ are collected through the above mentioned berms and swales into spreader basins. The flow then discharges out of the spreader basins through rip-rap lined weirs for connection into the downstream existing natural flowpaths to mimic the historic condition.

   Discharges from onsite basins contributing to CP ‘C’, ‘D’, ‘E’ and ‘F’ are also collected through the above mentioned berms and swales and discharged at concentration points along north edge of the site. The discharges along the north edge are at-grade trail crossings. The at-grade trail crossings have a capacity to handle approximatley a depth of 1-foot of flow over them. In the proposed condition, CP ‘C’, ‘E’, and ‘F’ handle the same or less flow then in the existing at depths less than 0.5-feet. CP ‘D’ has a flow depth of 0.38-feet which is 0.06-feet higher than the existing, which is well below the 1-foot capacity.

2. The proposed local off-site drainage system captures upstream runoff impacting the site and routes it through and around the site.

   Basin ‘Off-E’ has a relatively small drainage area and discharges to the existing at-grade trail crossing at CP ‘P-E’

   Basin ‘Off-D3’ discharges to the north of the site. This runoff is captured on the upstream side of the site and routed via a channel to CP ‘P-D’.

   Basin ‘Off-C-1’ has a relatively small drainage area and discharges to the existing at-grade trail crossing at CP ‘P-C’.

   CP ‘P-B’ includes on-site and off-site drainage basins. Flow is conveyed through or around the site into spreader basin ‘Off-B1’. SB ‘Off-B1’ discharges through two weirs which spread flows back to the existing condition and ultimately into existing Culvert ‘B’.

CP ‘P-A5’ and on-site basins are conveyed through the center of the site and into spreader basin ‘P-A1’. Spreader basin ‘P-A1’ discharges through two weirs which spread the flows back to the existing condition and ultimately into existing Culvert ‘A’.

Discharge from basins ‘Off-A4-S’, ‘Off-A3’, and ‘Off-A2’ area captured and routed around the southern portion of the site. The flow goes through proposed culvert ‘P-A4’ which passes the flow under the site fence. The channel then is routed to the west, under the entry road through culvert ‘P-A3’, towards spreader basin ‘P-A2’. Spreader basin ‘P-A2’ discharges through two weirs which spread the flows back to the historic discharge locations and ultimately into Existing Culvert ‘A’.

3. A regional flood control system is not located at, does not pass through, and does not contribute off-site discharges to the site, therefore no additional regional flood control system analysis is requried.

B. Maintenance

To preserve the design integrity and purpose of the proposed drainage system, ongoing maintenance of the recommended design is required. A maintenance program is the responsibility of private developers for facilities on private property, within all drainage easements, private streets, and right-of-ways unless accepted by the City or County. Failure to provide routine pre and post storm maintenance can jeopardize the design of the drainage system as it is intended through the project’s plans and specifications causing it to perform inadequately and lead to a reduced level of protection for the site.

C. Compliance with Regulations and Adopted Plans

1. The site is in compliance with all Master Planned Flood Control Facilities. All off-site and onsite flows are being returned to their historic flow paths.

2. FEMA floodplains do not exist on-site, therefore compliance with FEMA floodplain regulations is not applicable.

3. The site is not located on an active alluvial fan as the FEMA acredited levee East C-1, located to the east diverts off-site flows. As such, compliance with rules and regulations for developments on alluvial fans is not applicable.

4. The site is in compliance with the previously approved drainage studies for the subject site as all off-site and onsite flows are being returned to their historic flow paths.

5. The site does not include opportunities for Low Impact Development. Construction best management practices will be implemented to meet NPDES requirements.

6. There are no requests for variances from the requirements of the drainage criteria or local entities’ development code.

7. Efforts have been made to be in practical compliance with the Uniform Regulations.

8. The hydrologic and hydraulic design of the proposed facilities have used the Clark County HCDDM (MANUAL) and other generally accepted engineering practices.

D. Hydrologic Analyses

Hydrologic analyses were calculated using the rational method outlined in the Clark County Drainage Manual (HCDDM). Time of concentration calculations were calculated using the flow paths and methodology called out in the HCDDM. Rainfall is per **Figure 501 – 512** at the center of the Site**,** adjusted depths per **Table 501,** Ratio to 1-hour durations per **Table 504,** and 1-hour depths per Equations 501 – 502. Rainfall calculations are included along with the existing and proposed rational method calculation within **Appendix A – Hydrologic Calculations.**

Rational 'C' values for the existing condition were taken from **Table 601** as 'Undeveloped Areas':

- C_{10}=0.25
- C_{100}=0.50

Proposed Rational 'C' values were calculated using a weighted average of existing desert and impervious area. The impervious area for the solar panels was calculated as the average horizontal area of the panels as they rotate throughout the day. The average was determined using: at night the panels are "stowed" at 60-degrees from horizontal – 12-hours, on average at midday the panels are at horizontal – 4 hours, and at midmorning and midafternoon the panels are at 30-degrees (4 hours + 4 hours). This approach is deemed conservative due to the fact that the panels create disconnected impervious areas. Runoff falls from the panels, and hits the bare earth and infiltrates. See **Appendix B – Hydrologic Calculations** for weighted 'C' value calculations.

Rational 'C' values for the proposed condition:

- Bare earth: C_{10}=0.25, C_{100}=0.50
- Impervious Area: C_{10}=0.85 C_{100}=0.95
- Solar field (weighted): C_{10}=0.54 C_{100}=0.68

1. Existing off-site and on-site hydrologic calculations were based upon the subbasins as shown in **Figure 4 – Existing Subbasin Map** and are found in **Appendix A – Hydrologic Calculations**.

2. Existing off-site and proposed on-site hydrologic calculations were based upon the proposed subbasins as shown in **Figure 6 – Proposed Subbasin Map** and are found in **Appendix A – Hydrologic Calculations**.

3. The upstream watershed outside of the SNWA facility will not be developed as it is within the Navajo IPP-McCullough Power Line corridor easement . Thus developd off-site hydrologic calculations are not provided. Future development upstream of the solar facility within the SNWA campus is unknown at this time, but will be controlled by SNWA administration. Any development that will occur will be required to perform additional

hydrology and hydraulics, seperate from this deliverable, to ensure no adverse affect occurs on the site.

E. Facility Design Calculations

1. Design calculations for the proposed drainage system are based upon the Clark County Drainage Manual (CCDM) and generally accepted engineering practices.
    a. Channel calculations use Manning's Equation and 'n' values shown in **Table 702** of the HCDDM.Channel calculations were completed using Bentely's Flowmaster hydraulic program with outputs and summaries included in **Appendix B – Hydraulic Calculations.** Manning's roughness 'n' values are per the HCCDM:
        - Bare earth: n=0.22
        - Rip-rap: n=0.35

        Rip-rap for the channels is specified for velocities greater than 5 fps. Channels specified here-in for bare earth will encounter lower discharges and velocities. All channels have velocities lower than 8.5 fps and thus a D_{50} = 6-inch is sufficient per **Figure II-C-1** found in **Appendix B – Hydraulic Calculations**.

    b. Culvert calculations are calculated per the HCDDM using Bentley's CulvertMaster hydraulics program with outputs and summaries included in **Appendix B – Hydraulic Calculations.** Manning's roughness 'n' values are per the HCCDM:
        - HDPE (smooth wall): n=0.013
        - CMP: n=0.024

        Outlet protection at culverts is based upon the exit velocity calculated for the culverts on **Figure II-C-1** found in **Appendix B – Hydraulic Calculations**. Length of outlet protection is 3*D (36" and less) and 4*D (42" and greater) per HCDDM **Figure 712**.
        - V < 8.5 fps – D50 = 6-inch
        - V < 12.5 fps – D50=12-inch
        - V > 12.5 fps – Grouted Riprap

    c. Spreader basin weir calculations and at-grade trail crossings were calculated using the broad crested weir equation. Weir calculations were completed using Bentley's Flowmaster hydraulic program with outputs and summaries included in **Appendix B – Hydraulic Calculations**. To complete the weir calcualtions for the spreader basins, it was assumed that the flow was evenly distributed between weirs with the same crest elevation.

        Outlet protection at the spreader basin outfalls should be protected by heavy riprap (D_{50} = 18-inches) as defined by **Table 1102** of the HCDDM and Uniform Stardard Specification Section 610.02.04 of the Region Transportation Commission of Southern Nevada.

V. Conclusions

1. The site is in general conformance and compliance with the “Drainage Laws”.

2. The site is in compliance with the previously approved drainage studies for the subject site as all off-site and on-site flows are being returned to their historic flow paths.

3. FEMA floodplains do not exist on-site, therefore compliance with FEMA floodplain regulations is not applicable.

4. The hydrologic and hydraulic design of the proposed facilities have used the Clark County HCDDM (MANUAL) and other generally accepted engineering practices

5. Efforts have been made to be in practical compliance with the Uniform Regulations.

6. The proposed drainage facilities will be effective in controlling storm runoff. The 100-year storm is the design event for the Site.

7. There are minimal impacts that the proposed development has on off-site property and facilities. It is anticipated that discharges exiting the proposed project site will result in minimal differences from the existing condition.

   As discussed in **Section III-B – On-Site Drainage Description**, Existing Culverts A and B are not sized for the 100-year storm, causing existing stormwater flows to overtop Burkholder Boulevard and discharge downstream into the existing undeveloped land also owned by SNWA. This situation will be maintained in the proposed condition as well. The increase in water surface elevations and velocities downstream of Existing Culverts A and B are minimal. The engineer acknowledges the flow increases. The next facility downstream of these culverts are two 12-inch driveway culverts located at S Magic Way approximately 0.5 miles downstream. It is in the engineers opinion that due to the increase in downstream tributary area and additional flows path, attenuation of the flow will occur and there will be no adverse effect on the downstream facilities. See **Table 5 - Flow Summary** below for a summary of the Existing and Proposed flows and **Table 3 – West Outfall Summary** below for a comparison of the channel flow depths and velocities downsteam of existing culverts A and B.

Concentration Point	Condition	Q_{100} (cfs)	Flow Depth (ft)	Velocity (fps)
EX-DS-A	Existing	18	0.4	7.2
DS-A	Proposed	19	0.5	7.3
EX-DS-B	Existing	95	0.7	9.9
DS-B	Proposed	141	0.8	11.2

Table 3 – West Outfall Summary

Proposed discharges at concentration points ‘C’, ‘E’, and ‘F’ through the at-grade trail crossings do not have flow increases. Concentration point ‘D’ has a minimal increase and a resulting minimal increase in water surface elvation at the crossing. It is anticipated that discharges exiting the proposed project site will result in minimal differences from the existing condition.. See **Table 4 – North Outfall Summary.**

Concentration Point	Condition	Q_{100} (cfs)	Flow Depth above crest (ft)
EX C	Existing	7	0.15
OFF-C1	Proposed	1	0.04
EX D	Existing	32	0.32
P-D	Proposed	41	0.38
EX E	Existing	1	0.06
OFF-E	Proposed	1	0.06
EX F	Existing	23	0.39
OFF-F	Proposed	23	0.39

Table 4 – North Outfall Summary

Flow Summary	100-year (cfs)	
Discharge Point	Existing	Proposed
A	80	108
DS-A	18	19
B	33	52
DS-B	95	141
C	7	1
D	32	41
E	1	1
F	23	23

Table 5 – Flow Summary

VI. References

1. River Mountain Water Treatment Facility (RMWTF) Final Technical Drainage Study by Montgomery Watson/CH2M Hill. December 1, 1997.

2. 2013 Las Vegas Valley Regional Flood Master Plan Update. Facility Inventory Figure F-47. http://gustfront.ccrfcd.org/FileLibrary2/FileLibrary.aspx

3. Clark County Regional Flood Control District Ten Year Construction Program Fiscal Year 2013-2022. http://gustfront.ccrfcd.org/pdf_arch1/Administrative/Ten%20Year%20Program/Ten%20Year%202013-2022.pdf

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5. Bentley Systems Inc. Culvertmaster, Version V3.3, 2015. (03.03.00.04)

6. Clark Country Regional Flood Control District. Floodzone and Floodview Advanced and Interactive Maps. http://www.ccrfcd.org/gis.htm. Accessed January 14, 2015.

7. USDA Soil Survey. http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Area inquiry. Accessed January 12, 2015.

Figures

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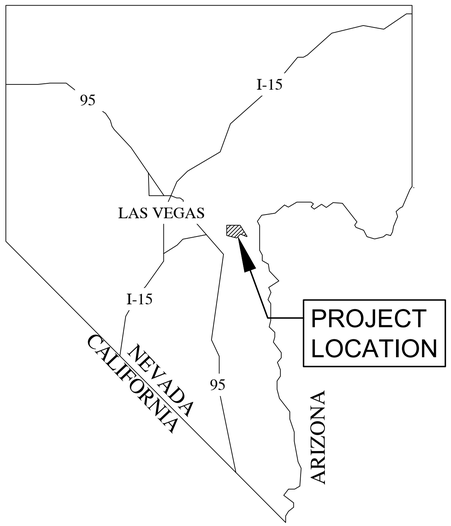
SNWA RIVER MOUNTAINS SOLAR

1299 BURKHOLDER BLVD
HENDERSON, NV, 89015



VICINITY MAP

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OR
RECORDING

SNWA RIVER MOUNTAINS SOLAR
SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:
PROJECT LOCATION

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

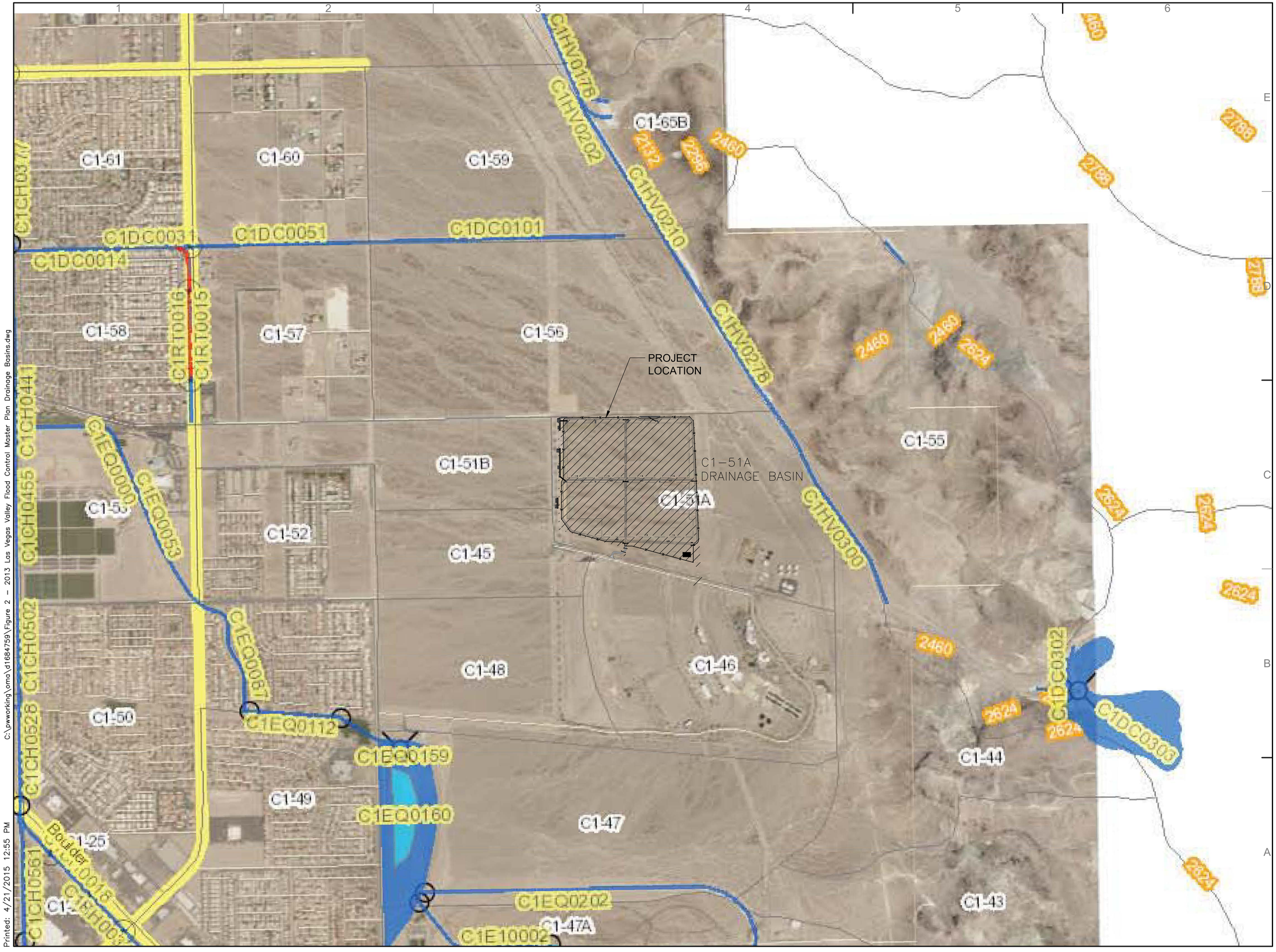
DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	JM

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
NO SCALE

SHEET NO.:
FIG. 1

Printed: 4/21/2015 12:54 PM C:\pwworking\omd\d1684759\Figure 1 – Project Location.dwg
C:\pwworking\omd\d1684759\Figure 1 – Project Location.dwg, PLOT: 4/21/2015 12:54:36 PM, yamenta



Printed: 4/21/2015 12:55 PM C:\pwworking\omd\d1684759\Figure 2 - 2013 Las Vegas Valley Flood Control Master Plan Drainage Basins.dwg

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SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:
2013 LAS VEGAS VALLEY FLOOD CONTROL MASTER PLAN DRAINAGE BASINS

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04-21-15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	JM

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
AS SHOWN

SHEET NO.:
FIG. 2

FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

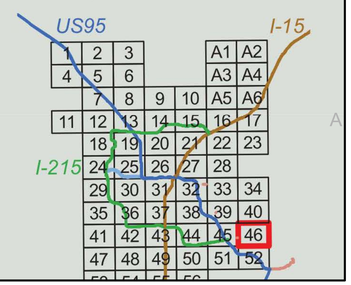
N

0 500 1,000 2,000 3,000

Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)



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OR
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SNWA RIVER MOUNTAINS SOLAR
SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:
REGIONAL FLOOD CONTROL FACILITIES

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

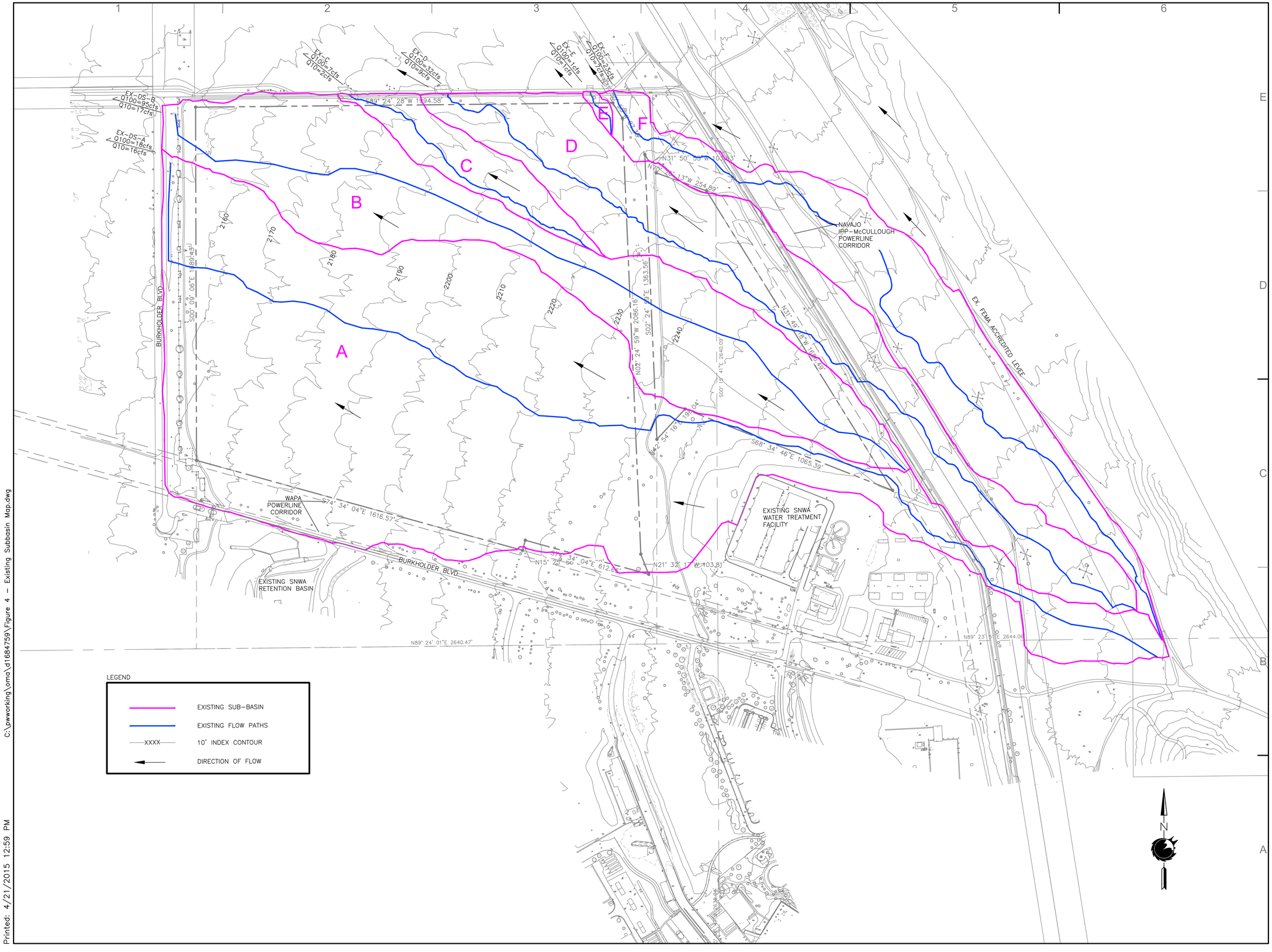
DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
NO SCALE

SHEET NO.:
FIG. 3

Printed: 4/21/2015 12:57 PM
C:\pwworking\oma\d1684759\Figure 3 - Regional Flood Control Facilities.dwg
PLOT: 4/21/2015 12:56:59 PM, jarmenta
C:\pwworking\oma\d1684759\Figure 3 - Regional Flood Control Facilities.dwg



Printed: 4/21/2015 12:59 PM C:\pwworking\ornd\d1684759\Figure 4 – Existing Subbasin Map.dwg

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SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA WATER AUTHORITY

1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:

EXISTING SUBBASIN MAP

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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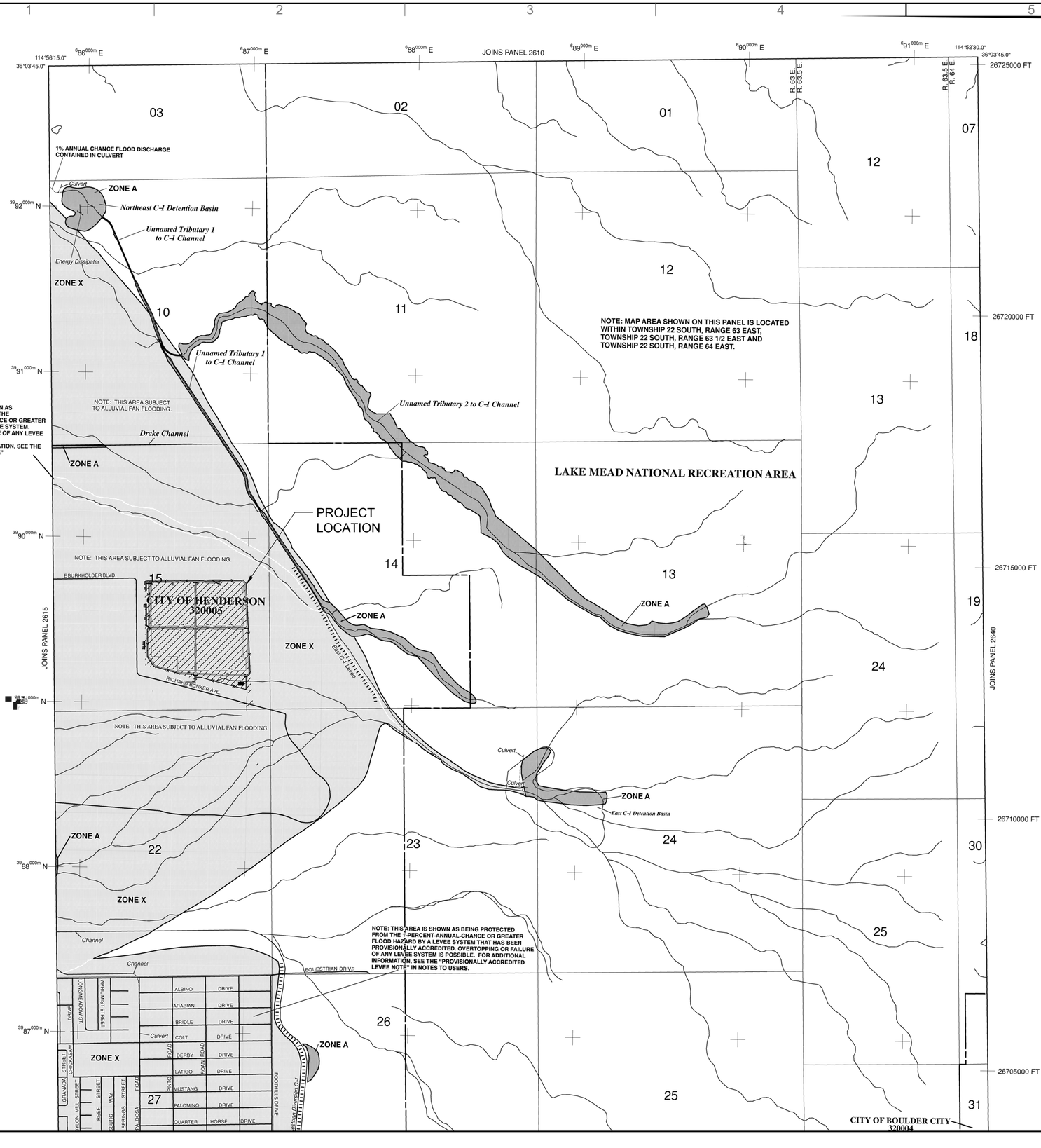
NO.	REVISION	DATE	INIT.

DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
1"=200'

SHEET NO.:
FIG. 4



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** No Base Flood Elevations determined.
- **ZONE AE** Base Flood Elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275 000m N — 1000-meter Universal Transverse Mercator grid ticks, zone 11
- 6000000 FT — 5000-foot grid ticks: Nevada State Plane coordinate system, east zone (FIPSZONE 2701), Transverse Mercator
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
August 16, 1995

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
September 27, 2002

November 16, 2011 - to incorporate previously issued Letters of Map Revision, to reflect updated topographic information, to change floodway, to add Base Flood Elevations, to update corporate limits, to change Base Flood Elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to delete Special Flood Hazard Areas, to change zone designations, and to add roads and road names.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP

PANEL 2620F

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2620 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOULDER CITY, CITY OF	320004	2620	F
HENDERSON, CITY OF	320005	2620	F

FLOOD INSURANCE PROGRAM

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SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: FIRM PANEL

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04-21-15
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ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE: ISSUED FOR TENDER

SCALE: AS SHOWN

SHEET NO.: FIG. 5

Printed: 4/21/2015 1:08 PM C:\pwworking\ema\d1684759\Figure 5 - FIRM Panel.dwg
C:\pwworking\ema\d1684759\Figure 5 - FIRM Panel.dwg, Plot, 4/21/2015 1:08:42 PM, yamanta

6

LEGEND

- PROPOSED SUBBASIN
- (D-1-N) SUBBASIN LABEL
- Q100=XXcfs / V100=XXfps DISCHARGE, VELOCITY, & DIRECTION OF FLOW

0 110' 220' 440'

SCALE: 1" = 110'

E D C B A

Printed: 4/21/2015 2:15 PM C:\pwworking\omd\d1684759\Figure 6 - Proposed Subbasin Map.dwg

C:\pwworking\omd\d1684759\Figure 6 - Proposed Subbasin Map.dwg, PLOT, 4/21/2015 2:14:11 PM, yamenta

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SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA
WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:
PROPOSED SUBBASIN MAP

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/15
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ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
1"=110'

SHEET NO.:
FIG. 6

Figure 7 – Drainage Plan

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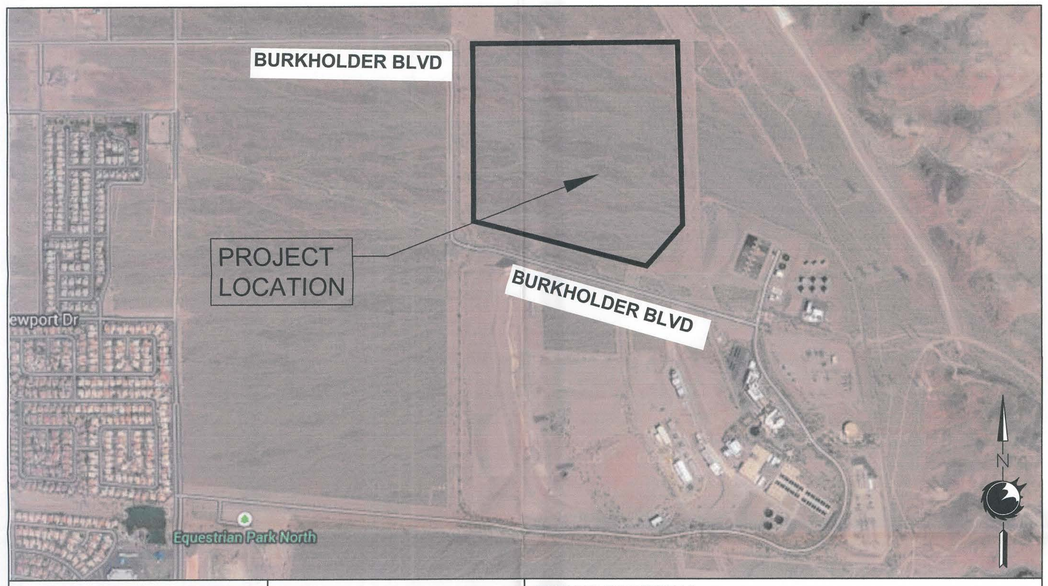
602.522.7700

SNWA RIVER MOUNTAINS SOLAR

1299 BURKHOLDER BLVD

HENDERSON, NV, 89015

FIGURE 7 - DRAINAGE PLAN



CIVIL SHEETS	
SHEET NUMBER	SHEET TITLE
C-800	DRAINAGE MAP COVER SHEET
C-801	DRAINAGE MAP
C-802	DRAINAGE MAP
C-803	DRAINAGE MAP
C-804	DRAINAGE MAP
C-301	CIVIL SECTIONS
C-501	ROAD, GRADING, & EROSION & SEDIMENT CONTROL DETAILS
C-502	FENCE & GATE DETAILS

PROJECT DEVELOPER

SUNEDISON
600 CLIPPER DRIVE
BELMONT, CA, 94002
(650) 453-5600

PROJECT ENGINEER:
ERIKA BROSZ, PE
EBROSZ@SUNEDISON.COM

CIVIL ENGINEER

MARK FOUNTAIN, P.E.
HDR ENGINEERING
101 N. 1ST AVE SUITE 1950
PHOENIX, AZ 85003-1923
(602) 522-7700

LICENSED ENGINEER:
NV PE REG# 021609
EXPIRATION: 06/30/2015

SCOPE OF WORK

THIS DESIGN PACKAGE PROVIDES CIVIL DRAWINGS FOR THE INSTALLATION OF A 18,000 KW DC RATED PHOTOVOLTAIC SYSTEM AT 1299 BURKHOLDER BLVD IN HENDERSON, NV. ENVIRONMENTAL PLANS ARE NOT PART OF THE SCOPE OF THIS PLAN SET.

APPLICABLE CODES AND STANDARDS

- INTERNATIONAL BUILDING CODE 2012
- CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

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4/21/2015

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SEE CIVIL CONSTRUCTION DOCUMENTS

SNWA RIVER MOUNTAINS SOLAR
SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:
DRAINAGE MAP TITLE SHEET

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
NO SCALE

SHEET NO.:
C-800

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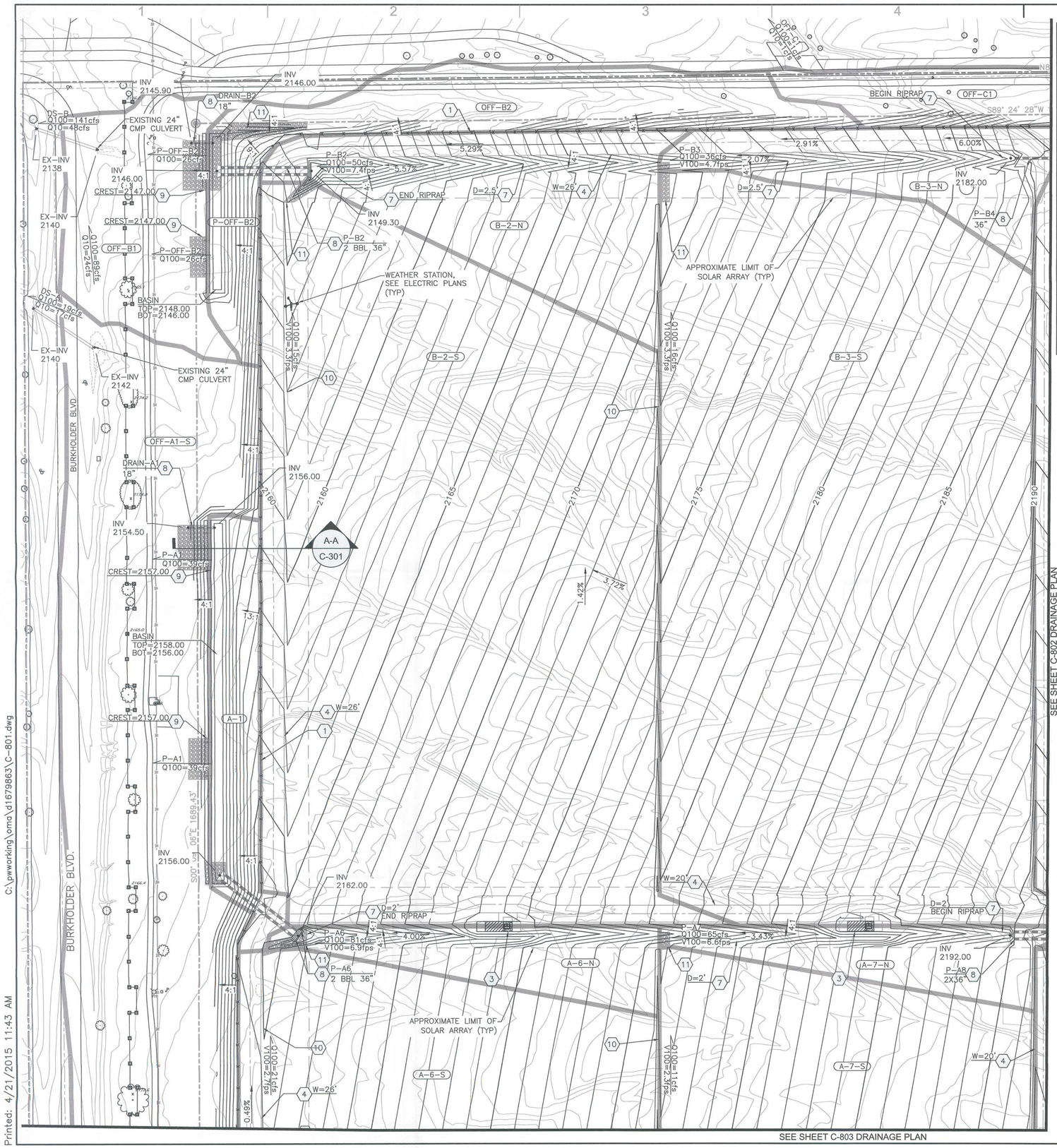

GRADING LEGEND:

- PROJECT PROPERTY LINE
- SETBACK LINE
- NEW INTERIOR ACCESS ROAD (GRAVEL)
- NEW PERIMETER FENCE
- EX. MINOR CONTOUR
- 1510 — EX. MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 1510 — PROPOSED MAJOR CONTOUR
- (1.4%) — EX. SLOPE
- 1.4% — PROPOSED SLOPE
- NEW ABC ENTRANCE ROAD
- X–X / XX (#) — CULVERT NAME AND SIZE
- (#) XXXX.XX — SITE COORDINATE POINT WITH ELEVATION
- A–7–N — SUBBASIN NAME

SHEET NOTES

1. PHOTOVOLTAIC PANELS, INVERTER SKIDS, AND SWITCHGEAR EQUIPMENT LOCATIONS SHOWN FOR REFERENCE ONLY.
2. TO PROTECT EQUIPMENT FROM POTENTIAL PONDING OR SHALLOW OVERLAND STORMWATER FLOWS, ALL EQUIPMENT PADS (FOR INVERTERS, SWITCHGEAR, ETC.) SHALL BE ELEVATED A MINIMUM OF 6" ABOVE FINISHED GRADE.
3. EXISTING DIRT ROADS WITHIN EXISTING EASEMENTS SHALL BE MAINTAINED FOR PUBLIC ACCESS. CONTRACTOR SHALL FIELD VERIFY ALL DIRT ROADS PRIOR TO CONSTRUCTION.
4. CULVERT ELEVATIONS ARE TO THE CENTER OF THE PIPE GROUP INVERT.
5. CONTOURS REFLECT FINAL GRADES.
6. REPLACE 4" OF SALVAGED TOPSOIL AND DESERT ROCK AFTER MASS GRADING. SEE TOPSOIL SPREADING AND DESERT ROCK PLATING NOTES ON SHEET C-004.

KEY NOTES:

NOTE: NOT ALL KEY NOTES ARE USED ON EACH SHEET

1. CONSTRUCT 7'-HIGH CHAIN LINK SECURITY FENCING PER DETAILS, C-502.
2. NON-MOTORIZED ACCESS GATE WITH CLEAR OPENING WIDTH OF 20' PER DETAIL 1, C-502. INSTALL KNOX COMPANY KEY BOX PER CITY OF HENDERSON FIRE DEPARTMENT.
3. INVERTER PAD, SEE ELECTRICAL SHEETS, EQUIPMENT PAD SURFACING PER DETAIL 2, C-501.
4. SITE ROADWAY, COMPACTED NATIVE SOIL PER DETAIL 1, C-501.
5. ABC ENTRANCE ROAD. SEE DETAIL 10, C-501.
6. CONSTRUCT EARTHEN CHANNEL PER DETAIL 3, C-501.
7. CONSTRUCT RIPRAP CHANNEL PER DETAIL 5, C-501. RIPRAP NOT SHOWN FOR CLARITY.
8. CONSTRUCT HDPE CULVERT , SIZE AND INVERT PER PLAN. CONSTRUCT METAL END SECTION TYPE 2 AT INLET AND OUTLET PER NDOT STANDARD DETAIL R-2.2.1. SEE SHEET C-501, CULVERT SCHEDULE TABLE.
9. CONSTRUCT RIPRAP SPREADER BASIN WEIR PER DETAIL 8, C-502.
10. CONSTRUCT DRAINAGE BERM PER DETAIL 8, C-501.
11. CONSTRUCT 12" THICK D50=6" RIPRAP PAD PER DETAIL 7, C-502. LIMITS PER PLAN.

N

0 60' 120' 240'

SCALE: 1" = 60'

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PROFESSIONAL ENGINEER — MARK A. FOUNTAIN — Exp: 6/30/15 — CIVIL — No. 21609 — STATE OF NEVADA

4/21/2015

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SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: DRAINAGE PLAN

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04-21-15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE: ISSUED FOR TENDER

SCALE: 1"=60'

SHEET NO.: C-801

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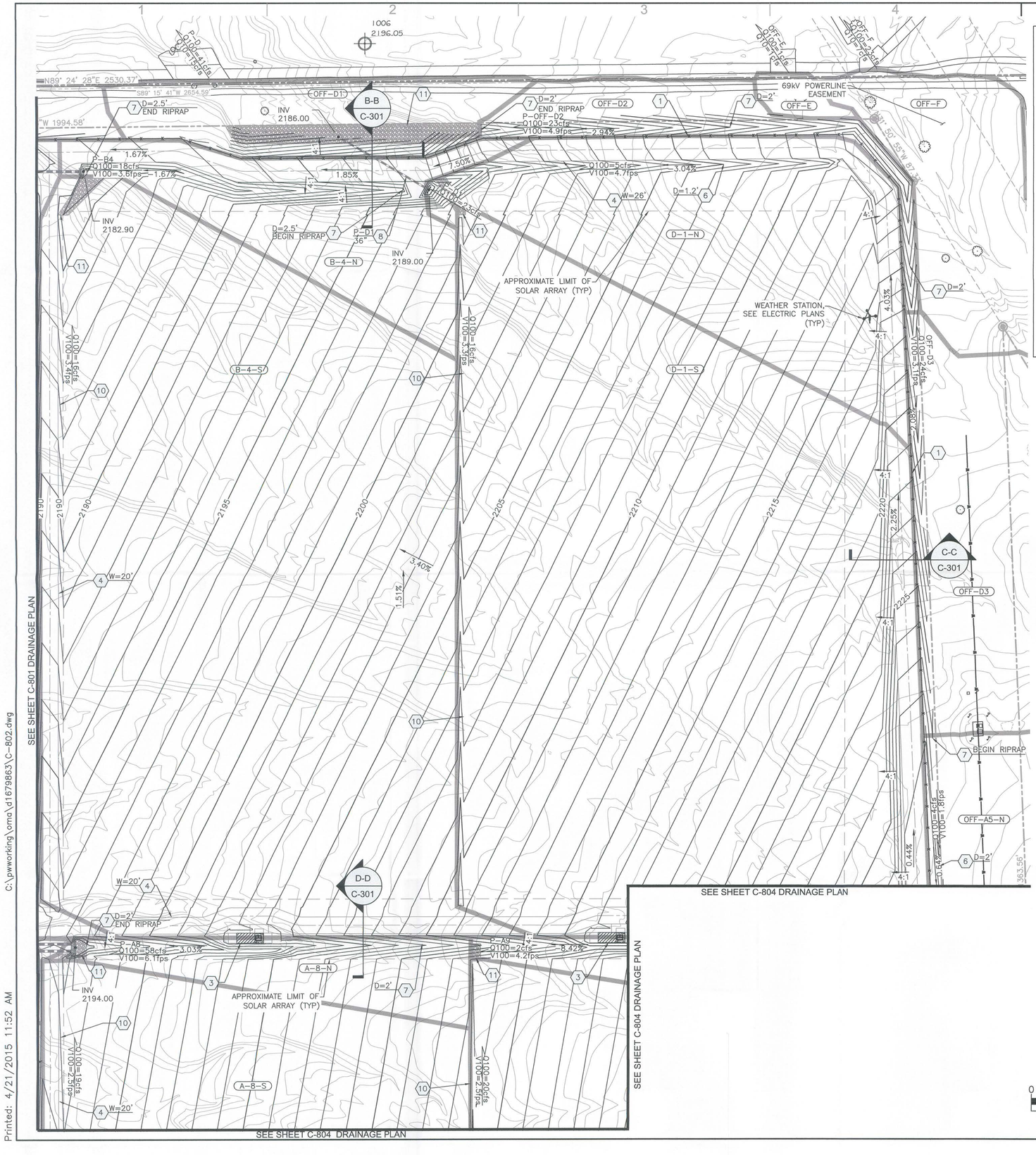

GRADING LEGEND:

- PROJECT PROPERTY LINE
- SETBACK LINE
- NEW INTERIOR ACCESS ROAD (GRAVEL)
- NEW PERIMETER FENCE
- EX. MINOR CONTOUR
- 1510 — EX. MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 1510 — PROPOSED MAJOR CONTOUR
- (1.4%) — EX. SLOPE
- 1.4% — PROPOSED SLOPE
- NEW ABC ENTRANCE ROAD
- X–X / XX (#) — CULVERT NAME AND SIZE
- (#) XXXX.XX — SITE COORDINATE POINT WITH ELEVATION
- (A–7–N) — SUBBASIN NAME

SHEET NOTES

1. PHOTOVOLTAIC PANELS, INVERTER SKIDS, AND SWITCHGEAR EQUIPMENT LOCATIONS SHOWN FOR REFERENCE ONLY.
2. TO PROTECT EQUIPMENT FROM POTENTIAL PONDING OR SHALLOW OVERLAND STORMWATER FLOWS, ALL EQUIPMENT PADS (FOR INVERTERS, SWITCHGEAR, ETC.) SHALL BE ELEVATED A MINIMUM OF 6" ABOVE FINISHED GRADE.
3. EXISTING DIRT ROADS WITHIN EXISTING EASEMENTS SHALL BE MAINTAINED FOR PUBLIC ACCESS. CONTRACTOR SHALL FIELD VERIFY ALL DIRT ROADS PRIOR TO CONSTRUCTION.
4. CULVERT ELEVATIONS ARE TO THE CENTER OF THE PIPE GROUP INVERT.
5. CONTOURS REFLECT FINAL GRADES.
6. REPLACE 4" OF SALVAGED TOPSOIL AND DESERT ROCK AFTER MASS GRADING. SEE TOPSOIL SPREADING AND DESERT ROCK PLATING NOTES ON SHEET C-004.

KEY NOTES:

NOTE: NOT ALL KEY NOTES ARE USED ON EACH SHEET

1. CONSTRUCT 7'-HIGH CHAIN LINK SECURITY FENCING PER DETAILS, C-502.
2. NON-MOTORIZED ACCESS GATE WITH CLEAR OPENING WIDTH OF 20' PER DETAIL 1, C-502. INSTALL KNOX COMPANY KEY BOX PER CITY OF HENDERSON FIRE DEPARTMENT.
3. INVERTER PAD, SEE ELECTRICAL SHEETS, EQUIPMENT PAD SURFACING PER DETAIL 2, C-501.
4. SITE ROADWAY, COMPACTED NATIVE SOIL PER DETAIL 1, C-501.
5. ABC ENTRANCE ROAD. SEE DETAIL 10, C-501.
6. CONSTRUCT EARTHEN CHANNEL PER DETAIL 3, C-501.
7. CONSTRUCT RIPRAP CHANNEL PER DETAIL 5, C-501. RIPRAP NOT SHOWN FOR CLARITY.
8. CONSTRUCT HDPE CULVERT , SIZE AND INVERT PER PLAN. CONSTRUCT METAL END SECTION TYPE 2 AT INLET AND OUTLET PER NDOT STANDARD DETAIL R-2.2.1. SEE SHEET C-501, CULVERT SCHEDULE TABLE.
9. CONSTRUCT RIPRAP SPREADER BASIN WEIR PER DETAIL 8, C-502.
10. CONSTRUCT DRAINAGE BERM PER DETAIL 8, C-501.
11. CONSTRUCT 12" THICK D50=6" RIPRAP PAD PER DETAIL 7, C-502. LIMITS PER PLAN.

N

0 60' 120' 240'

SCALE: 1" = 60'

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SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER:
NV-13-0023

SHEET TITLE:
DRAINAGE PLAN

SHEET SIZE:
ARCH "D"
24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE:
ISSUED FOR TENDER

SCALE:
1"=60'

SHEET NO.:
C-802

Printed: 4/21/2015 11:52 AM
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C:\pwworking\ornd\d1679863C-802.dwg, Plot: 4/21/2015 11:52:33 AM, rammetta

GRADING LEGEND:

- PROJECT PROPERTY LINE
- SETBACK LINE
- NEW INTERIOR ACCESS ROAD (GRAVEL)
- NEW PERIMETER FENCE
- EX. MINOR CONTOUR
- 1510 — EX. MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 1510 — PROPOSED MAJOR CONTOUR
- (1.4%) — EX. SLOPE
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- NEW ABC ENTRANCE ROAD
- X–X / XX (#) — CULVERT NAME AND SIZE
- (#) XXXX.XX — SITE COORDINATE POINT WITH ELEVATION
- (A–7–N) — SUBBASIN NAME

N

0 60' 120' 240'

SCALE: 1" = 60'

SHEET NOTES

1. PHOTOVOLTAIC PANELS, INVERTER SKIDS, AND SWITCHGEAR EQUIPMENT LOCATIONS SHOWN FOR REFERENCE ONLY.
2. TO PROTECT EQUIPMENT FROM POTENTIAL PONDING OR SHALLOW OVERLAND STORMWATER FLOWS, ALL EQUIPMENT PADS (FOR INVERTERS, SWITCHGEAR, ETC.) SHALL BE ELEVATED A MINIMUM OF 6" ABOVE FINISHED GRADE.
3. EXISTING DIRT ROADS WITHIN EXISTING EASEMENTS SHALL BE MAINTAINED FOR PUBLIC ACCESS. CONTRACTOR SHALL FIELD VERIFY ALL DIRT ROADS PRIOR TO CONSTRUCTION.
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6. REPLACE 4" OF SALVAGED TOPSOIL AND DESERT ROCK AFTER MASS GRADING. SEE TOPSOIL SPREADING AND DESERT ROCK PLATING NOTES ON SHEET C-004.

KEY NOTES:

NOTE: NOT ALL KEY NOTES ARE USED ON EACH SHEET

1. CONSTRUCT 7'-HIGH CHAIN LINK SECURITY FENCING PER DETAILS, C-502.
2. NON-MOTORIZED ACCESS GATE WITH CLEAR OPENING WIDTH OF 20' PER DETAIL 1, C-502. INSTALL KNOX COMPANY KEY BOX PER CITY OF HENDERSON FIRE DEPARTMENT.
3. INVERTER PAD, SEE ELECTRICAL SHEETS, EQUIPMENT PAD SURFACING PER DETAIL 2, C-501.
4. SITE ROADWAY, COMPACTED NATIVE SOIL PER DETAIL 1, C-501.
5. ABC ENTRANCE ROAD. SEE DETAIL 10, C-501.
6. CONSTRUCT EARTHEN CHANNEL PER DETAIL 3, C-501.
7. CONSTRUCT RIPRAP CHANNEL PER DETAIL 5, C-501. RIPRAP NOT SHOWN FOR CLARITY.
8. CONSTRUCT HDPE CULVERT , SIZE AND INVERT PER PLAN. CONSTRUCT METAL END SECTION TYPE 2 AT INLET AND OUTLET PER NDOT STANDARD DETAIL R-2.2.1. SEE SHEET C-501, CULVERT SCHEDULE TABLE.
9. CONSTRUCT RIPRAP SPREADER BASIN WEIR PER DETAIL 8, C-502.
10. CONSTRUCT DRAINAGE BERM PER DETAIL 8, C-501.
11. CONSTRUCT 12" THICK D50=6" RIPRAP PAD PER DETAIL 7, C-502. LIMITS PER PLAN.

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PROFESSIONAL ENGINEER-STATE OF NEVADA
MARK A. FOUNTAIN
Exp 6/30/15
CIVIL
NO. 21609
4/21/2015

SEAL FOR DRAINAGE REPORT USE ONLY
SEE CIVIL CONSTRUCTION DOCUMENTS

SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: DRAINAGE MAP

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE: ISSUED FOR TENDER

SCALE: 1"=60'

SHEET NO.: C-803

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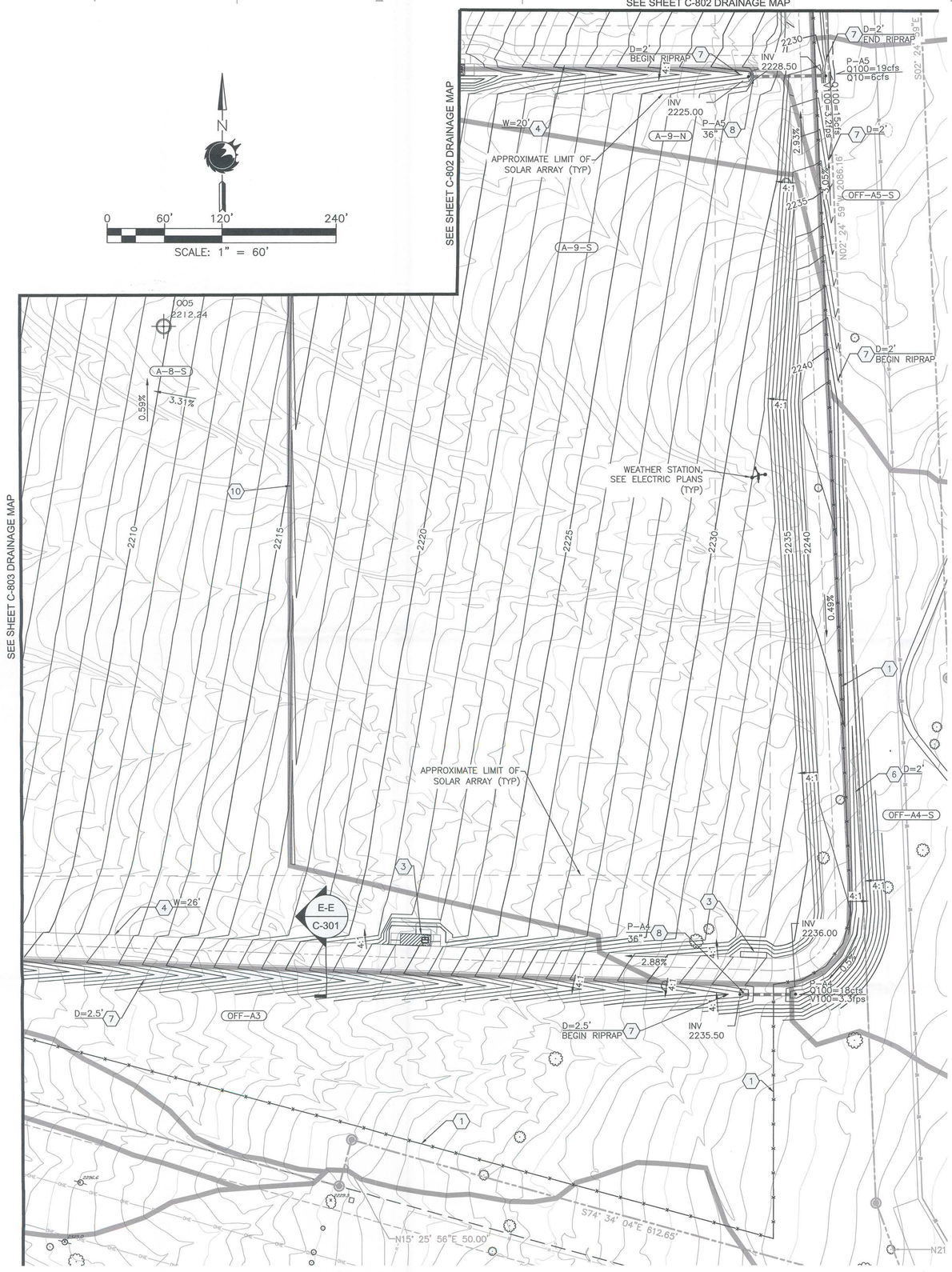

GRADING LEGEND:

- PROJECT PROPERTY LINE
- SETBACK LINE
- NEW INTERIOR ACCESS ROAD (GRAVEL)
- NEW PERIMETER FENCE
- EX. MINOR CONTOUR
- 1510 — EX. MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 1510 — PROPOSED MAJOR CONTOUR
- (1.4%) — EX. SLOPE
- 1.4% — PROPOSED SLOPE
- NEW ABC ENTRANCE ROAD
- X–X / XX (#) — CULVERT NAME AND SIZE
- (#) XXXX.XX — SITE COORDINATE POINT WITH ELEVATION
- (A–7–N) — SUBBASIN NAME

SHEET NOTES

1. PHOTOVOLTAIC PANELS, INVERTER SKIDS, AND SWITCHGEAR EQUIPMENT LOCATIONS SHOWN FOR REFERENCE ONLY.
2. TO PROTECT EQUIPMENT FROM POTENTIAL PONDING OR SHALLOW OVERLAND STORMWATER FLOWS, ALL EQUIPMENT PADS (FOR INVERTERS, SWITCHGEAR, ETC.) SHALL BE ELEVATED A MINIMUM OF 6" ABOVE FINISHED GRADE.
3. EXISTING DIRT ROADS WITHIN EXISTING EASEMENTS SHALL BE MAINTAINED FOR PUBLIC ACCESS. CONTRACTOR SHALL FIELD VERIFY ALL DIRT ROADS PRIOR TO CONSTRUCTION.
4. CULVERT ELEVATIONS ARE TO THE CENTER OF THE PIPE GROUP INVERT.
5. CONTOURS REFLECT FINAL GRADES.
6. REPLACE 4" OF SALVAGED TOPSOIL AND DESERT ROCK AFTER MASS GRADING. SEE TOPSOIL SPREADING AND DESERT ROCK PLATING NOTES ON SHEET C-004.

KEY NOTES:

NOTE: NOT ALL KEY NOTES ARE USED ON EACH SHEET

1. CONSTRUCT 7'-HIGH CHAIN LINK SECURITY FENCING PER DETAILS, C-502.
2. NON-MOTORIZED ACCESS GATE WITH CLEAR OPENING WIDTH OF 20' PER DETAIL 1, C-502. INSTALL KNOX COMPANY KEY BOX PER CITY OF HENDERSON FIRE DEPARTMENT.
3. INVERTER PAD, SEE ELECTRICAL SHEETS, EQUIPMENT PAD SURFACING PER DETAIL 2, C-501.
4. SITE ROADWAY, COMPACTED NATIVE SOIL PER DETAIL 1, C-501.
5. ABC ENTRANCE ROAD. SEE DETAIL 10, C-501.
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10. CONSTRUCT DRAINAGE BERM PER DETAIL 8, C-501.
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MARK A. FOUNTAIN
Exp: 6/30/15
CIVIL
No. 21507
4/21/2015

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SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: DRAINAGE MAP

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04-21-15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	MF

PROJECT PHASE: ISSUED FOR TENDER

SCALE: 1"=60'

SHEET NO.: C-804

Printed: 4/21/2015 11:49 AM
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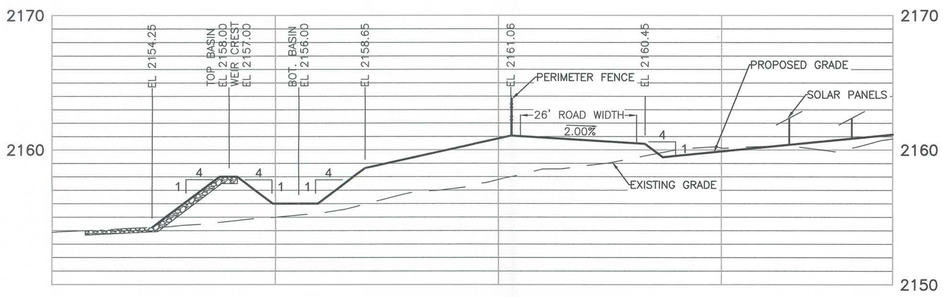
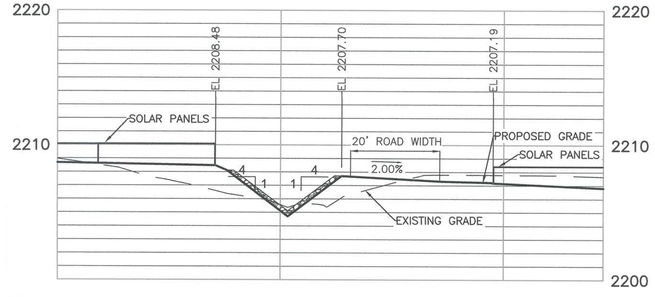
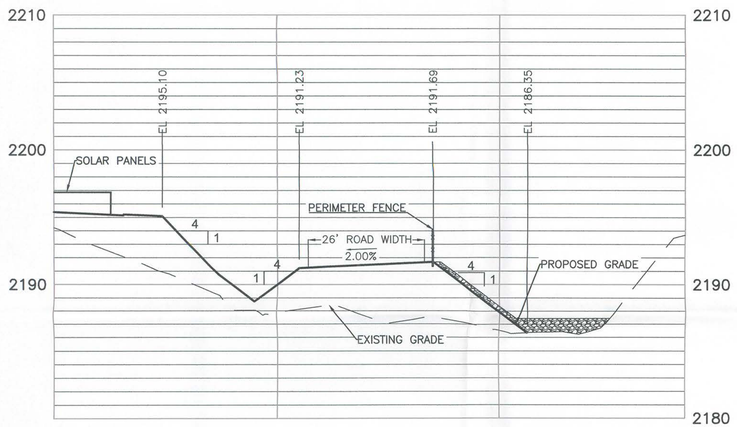


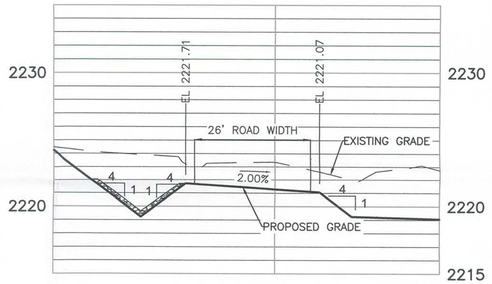
A-A
SECTION A-A
SCALE: 3/4" = 1'-0"



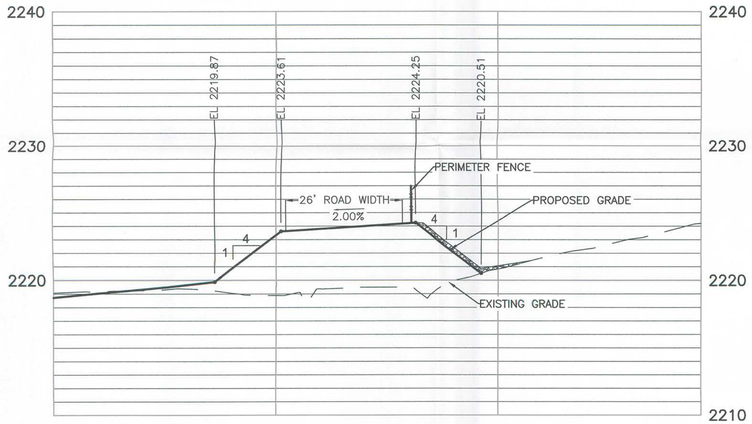
D-D
SECTION D-D
SCALE: 3/4" = 1'-0"



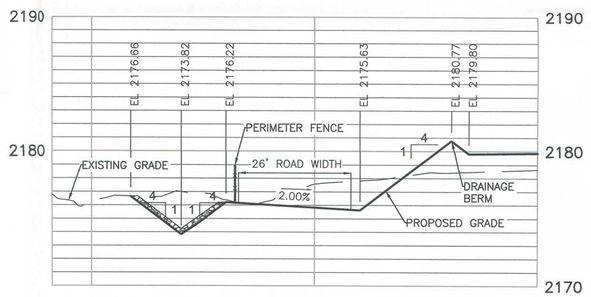
B-B
SECTION B-B
SCALE: 3/4" = 1'-0"



E-E
SECTION E-E
SCALE: 3/4" = 1'-0"



C-C
SECTION C-C
SCALE: 3/4" = 1'-0"



F-F
SECTION E-E
SCALE: 3/4" = 1'-0"

SHEET NOTES

1. REFER TO SHEETS C-401 TO C-404 FOR SECTION LOCATIONS.

LEGEND

RIPRAP LINED CHANNEL

CITY ENGINEER DATE

CITY APPROVAL OF THE IMPROVEMENT PLANS IS GRANTED FOR ONE (1) YEAR ONLY. PLANS MUST BE RESUBMITTED FOR REVIEW AND APPROVAL TO THE PUBLIC WORKS DEPARTMENT, IF WORK IS NOT COMPLETED BY _____, 20__.

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STAMP:

PROFESSIONAL ENGINEER-STATE OF NEVADA
MARK A. FOUNTAIN
Exp: 12/31/15
CIVIL
NO. 21609
4/21/2015

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SEE CIVIL CONSTRUCTION DOCUMENTS

SNWA RIVER MOUNTAINS SOLAR

SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: CIVIL SECTIONS

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	JM

PROJECT PHASE: ISSUED FOR TENDER

SCALE: AS SHOWN

SHEET NO.: C-301

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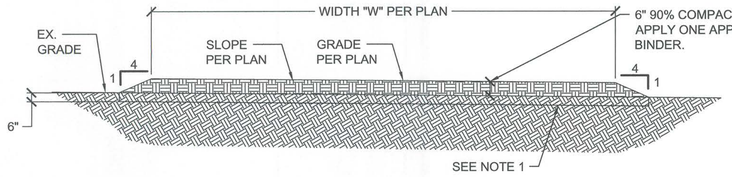
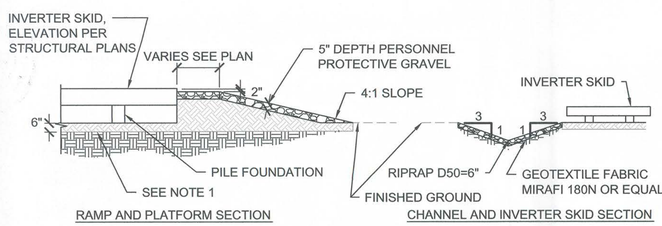
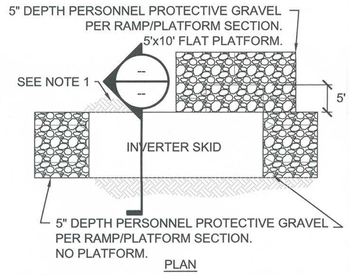


1 -- SITE ACCESSS ROAD

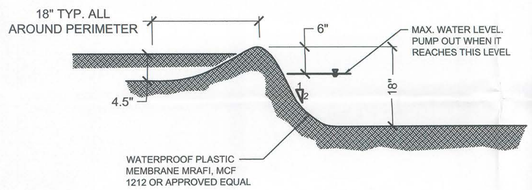
SCALE: 1/4" = 1'-0"

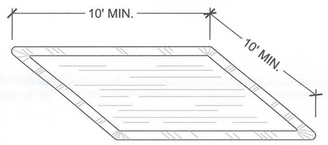




2 -- EQUIPMENT PAD SURFACING

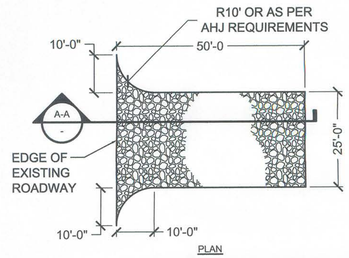
SCALE: NTS

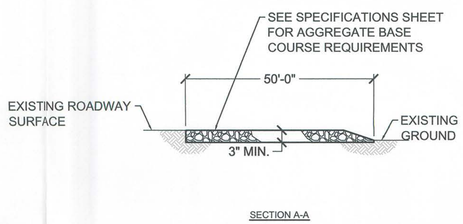




4 -- TEMPORARY WASHOUT PIT

SCALE: NTS

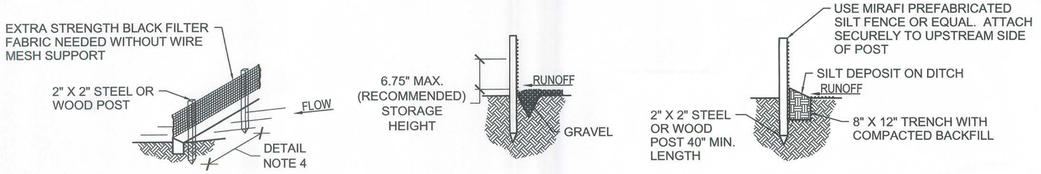




7 -- TEMPORARY CONSTRUCTION ENTRANCE

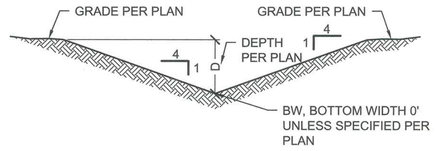
SCALE: NTS

DETAIL NOTES:
1. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN NECESSARY.
2. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTALY STABILIZED.
3. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.
4. 10' MAX. SPACING WITH WIRE SUPPORT FENCE. 6' MAX SPACING WITHOUT WIRE SUPPORT FENCE



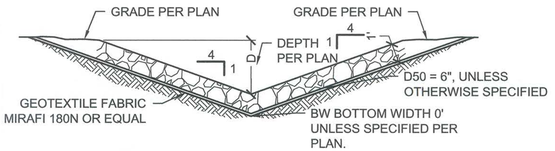
9 -- SILT FENCE DETAILS

SCALE: NTS



3 -- EARTHEN CHANNEL

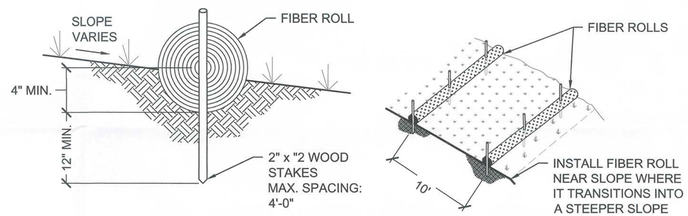
SCALE: 1/4" = 1'-0"



5 -- RIPRAP CHANNEL

SCALE: 1/4" = 1'-0"

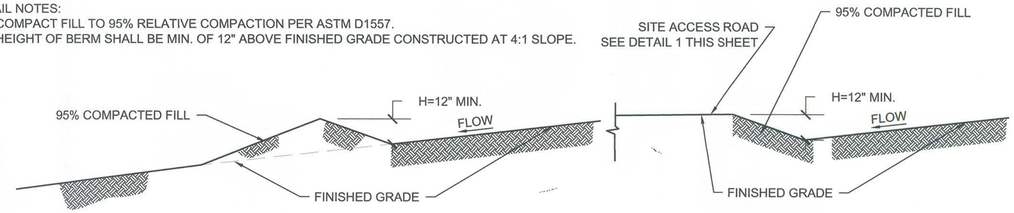
DETAIL NOTES:
1. INSTALL FIBER ROLL ALONG A LEVEL CONTOUR



6 -- FIBER ROLL INSTALLATION DETAIL

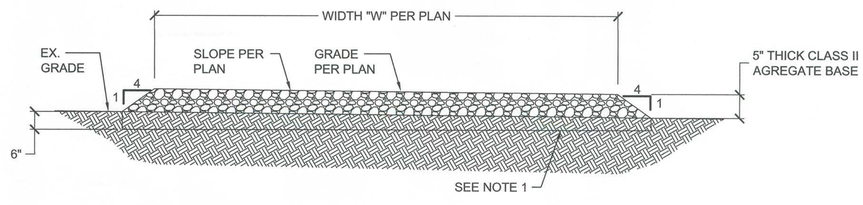
SCALE: NTS

DETAIL NOTES:
1. COMPACT FILL TO 95% RELATIVE COMPACTION PER ASTM D1557.
2. HEIGHT OF BERM SHALL BE MIN. OF 12" ABOVE FINISHED GRADE CONSTRUCTED AT 4:1 SLOPE.



8 -- EARTH BERM DETAIL

SCALE: NTS



10 -- ABC ENTRANCE ROAD

SCALE: 1/4" = 1'-0"

SHEET NOTES

1. THE UPPER 6" OF EXPOSED SUBGRADE SHALL BE SCARIFIED AND UNIFORMLY COMPACTED TO AT LEAST 90% OF ASTM D1557 AT 0 TO 2% OVER OPTIMUM MOISTURE CONTENT FOR THE ENTIRE CLEAR WIDTH OF THE ACCESS ROADWAY, OR PER GEOTECHNICAL REPORT, WHICHEVER IS GREATER.

CITY ENGINEER DATE

CITY APPROVAL OF THE IMPROVEMENT PLANS IS GRANTED FOR ONE (1) YEAR ONLY. PLANS MUST BE RESUBMITTED FOR REVIEW AND APPROVAL TO THE PUBLIC WORKS DEPARTMENT, IF WORK IS NOT COMPLETED BY _____, 20___.

CULVERT SCHEDULE

CULVERT NAME	TYPE/ SIZE	LENGTH OF PIPE	LENGTH OF OUTLET PROTECTION (1)
PA-3	HDPE/ 36"	70Ft	9 FT, GROUTED RIPRAP AT OUTLET
P-A4	HDPE/ 36"	50Ft	9 FT, D50=6" RIPRAP AT OUTLET
P-A5	HDPE/ 36"	71Ft	9 FT, GROUTED RIPRAP AT OUTLET
P-A6	HDPE/ 2X36"	108Ft EACH	9 FT, GROUTED RIPRAP AT OUTLET
P-A8	HDPE/ 2X36"	60Ft EACH	9 FT, D50=6" RIPRAP AT OUTLET
P-B2	HDPE/ 2X36"	103Ft EACH	9 FT, GROUTED RIPRAP AT OUTLET
P-B4	HDPE/ 36"	71Ft	9 FT, D50=6" RIPRAP AT OUTLET
P-D1	HDPE/ 24"	121Ft	6 FT,D50=6" RIPRAP AT OUTLET
P-E1	HDPE/ 18"	61Ft	4.5 FT, D50=6" RIPRAP AT OUTLET
P-E2	HDPE/ 18"	47Ft	4.5 FT, D50=6" RIPRAP AT OUTLET
DRAIN-B2	HDPE/ 18"	20Ft	4.5 FT, D50=6" RIPRAP AT OUTLET
DRAIN-A1	HDPE/ 18"	26Ft	4.5 FT, D50=6" RIPRAP AT OUTLET
DRAIN-A2	HDPE/ 18"	23Ft	4.5 FT, D50=6" RIPRAP AT OUTLET

(1) SEE DETAILS 7 AND 9 ON SHEET C-502 FOR RIPRAP AND GROUTED RIPRAP DETAILS.

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HDR

STAMP:

PROFESSIONAL ENGINEER STATE OF NEVADA MARK A. FOUNTAIN Exp: 6/30/15 CIVIL No. 21609 4/21/2015

SEAL FOR DRAINAGE REPORT USE ONLY SEE CIVIL CONSTRUCTION DOCUMENTS

SNWA RIVER MOUNTAINS SOLAR
SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: ROAD, GRADING, & EROSION & SEDIMENT CONTROL DETAILS

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)

0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/15
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	JM

PROJECT PHASE: ISSUED FOR TENDER

SCALE: AS SHOWN

SHEET NO.: C-501

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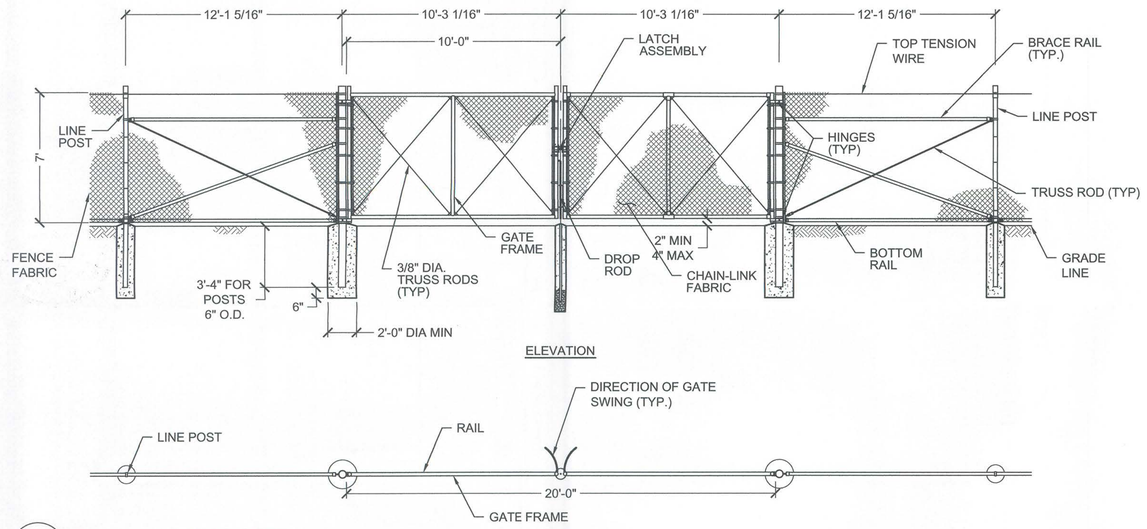
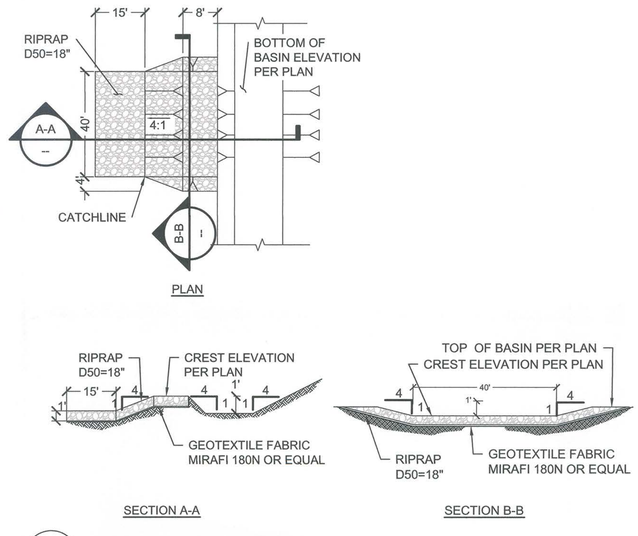


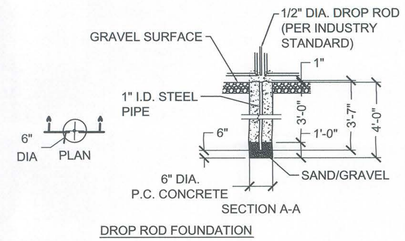
1 — TYPICAL ACCESS GATE
SCALE: NTS

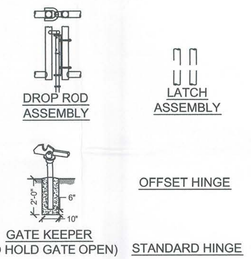


8 — SPREADER BASIN WEIR DETAIL
SCALE: NTS

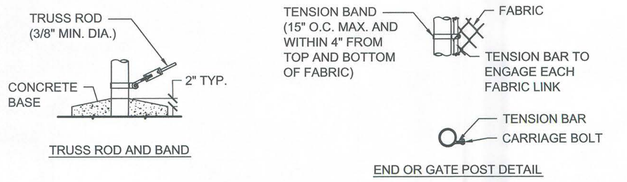
SHEET NOTES

1. WIRE TIES, RAILS, POSTS, AND BRACES SHALL BE CONSTRUCTED ON THE SECURE SIDE OF THE FENCE ALIGNMENT. CHAIN-LINK FABRIC SHALL BE PLACED ON THE OPPOSITE SIDE OF THE SECURE AREA.
2. C-SECTION POSTS SHALL BE INSTALLED SO THAT THE VOID INSIDE THE POST IS COMPLETELY FILLED WITH CONCRETE UP TO THE TOP OF THE FOUNDATION.
3. SWING GATES SHALL BE CONSTRUCTED WITH DROP RODS, PADLOCKS, LATCH ASSEMBLY, AND GATE KEEPERS EXCEPT AS NOTED.
4. ALL GATE FRAMES SHALL BE A MINIMUM 1-7/8" NOMINAL (ROUND) OR 2" NOMINAL (SQUARE). GATE FRAMES SHALL BE OF WELDED CONSTRUCTION OR SHALL BE ASSEMBLED USING HEAVY FITTINGS. AT THE CONTRACTOR'S OPTION A WELDED HORIZONTAL BRACE MAY BE USED IN LIEU OF TRUSS RODS TO BRACE ALL WELDED GATE FRAMES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROPER RIGID CONSTRUCTION OF ALL GATES SUPPLIED.
5. GATES SHALL BE DESIGNATED AS FOLLOWS:
   - FENCE TYPE - FE5, FE6, ETC.
   - FABRIC WIDTH - INCHES
   - TYPE OPENING - SO (SINGLE), - DO (DOUBLE)
   - HINGE - RA (STANDARD), - HO (OFFSET)
   - OPENING - INCHES (CLEAR OPENING BETWEEN GATE POSTS)
   - EXAMPLES: FE6-120-DO-RA-144, FE5-120-SO-HO-144

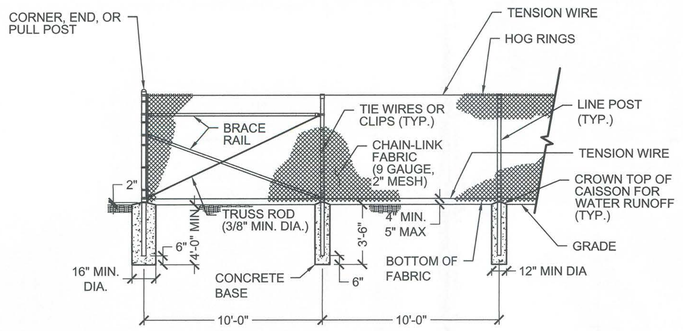




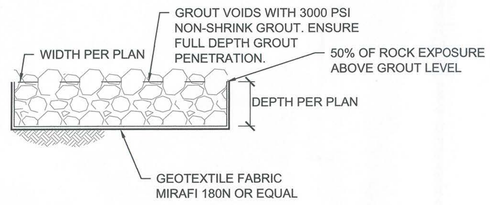
2 — ACCESS GATE DETAILS
SCALE: NTS



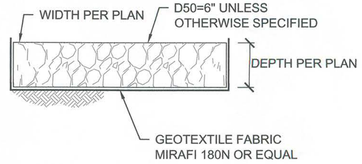
4 — CHAINLINK FENCE FASTENING DETAIL
SCALE: NTS



3 — PERIMETER FENCE-ELEVATION
SCALE: 1/4" = 1'-0"



9 — GROUTED RIPRAP DETAIL
SCALE: NTS



7 — RIPRAP PAD DETAIL
SCALE: NTS

STEEL POST SCHEDULE

USE AND SECTION	MINIMUM OUTSIDE DIMENSIONS (NOMINAL)		
	FABRIC LESS THAN 72"	FABRIC 72" TO 96"	FABRIC OVER 96"
CORNER, END & PULL POSTS TUBULAR - ROUND TUBULAR - SQUARE C-SECTION (ROLL-FORMED)	2.375" O.D. 2.00" SQ. 3.50" X 3.50"	2.375" O.D. 2.00" SQ. 3.50" X 3.50"	2.375" O.D. 2.00" SQ. -
LINE POSTS TUBULAR - ROUND H-SECTION C-SECTION (ROLL-FORMED)	1.9" O.D. 2.25" X 1.70" 1.875" X 1.625"	2.375" O.D. 2.25" X 1.70" 2.25" X 1.70"	2.375" O.D. 2.00" SQ. -
TOP, BOTTOM, & BRACE RAILS TUBULAR - ROUND TUBULAR - SQUARE H-SECTION C-SECTION (ROLL-FORMED)	1.66" O.D. 1.50" O.D. 1.625" X 1.50" 1.625" X 1.25"		

CITY ENGINEER _____ DATE

CITY APPROVAL OF THE IMPROVEMENT PLANS IS GRANTED FOR ONE (1) YEAR ONLY. PLANS MUST BE RESUBMITTED FOR REVIEW AND APPROVAL TO THE PUBLIC WORKS DEPARTMENT, IF WORK IS NOT COMPLETED BY _____, 20___.

Call before you Dig — Avoid cutting underground utility lines. It's easy. Call 811 or 1-800-227-2800

Call before you Overhead — AVOID OVERHEAD POWER LINE CONTACT. IT'S COSTLY. 1-702-227-2929 NEVADA POWER ENVIRONMENT AND SAFETY SERVICES DEPARTMENT

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HDR

STAMP:

PROFESSIONAL ENGINEER — STATE OF NEVADA — MARK A. FOUNTAIN — Exp: 6/30/15 — CIVIL — No. 21609

SEAL FOR DRAINAGE REPORT USE ONLY
SEE CIVIL CONSTRUCTION DOCUMENTS

SNWA RIVER MOUNTAINS SOLAR
SOUTHERN NEVADA WATER AUTHORITY
1299 BURKHOLDER BLVD
HENDERSON, NV 89015

PROJECT NUMBER: NV-13-0023

SHEET TITLE: FENCE & GATE DETAILS

SHEET SIZE: ARCH "D" 24" X 36" (610 x 914)
0 ½" 1"

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NO.	REVISION	DATE	INIT.

DATE:	04/21/2015
DRAWN BY:	YA
ENGINEER:	CD
APPROVED BY:	JM

PROJECT PHASE: ISSUED FOR TENDER

SCALE: AS SHOWN

SHEET NO.: C-502

Printed: 4/21/2015 11:57 AM
C:\pwworking\cma\d1679863\C-502.dwg
C:\pwworking\cma\d1679863\C-502.dwg, PLOT, 4/21/2015 11:57:01 AM, yasmeeta

A

Appendix A: Hydrologic Calculations

hdrinc.com 3200 E. Camelback Road, Suite 350 Phoenix, AZ 85018
602.522.7700

SNWA River Mountains Solar
Rainfall Calculations
4/21/2015

Step 1:

Rainfall Depths (Fig. 501-512)

Return Period (yr)	6-Hr Depth(in)	24-Hr Depth(in)
2	1.00	1.20
5	1.20	1.60
10	1.50	2.00
25	1.85	2.40
50	2.10	2.80
100	2.20	3.00

Step 2:

1 Hr. Depths (Eq. 501-502)	Depth (in)
Y2 (2 year, 1 hr)	0.77
Y100 (100 year, 1 hour))	1.71

Step 3:

Adjusted Depths (Table 501), 1 hour depths taken from Standard Form 3

Return Period (yr)	1-Hr Depth(in)	Adjustment Factor (table 501)	Adjusted 1-hr Depth (in)
2	0.77	1.00	0.77
5	1.00	1.16	1.16
10	1.15	1.24	1.43
25	1.35	1.33	1.80
50	1.55	1.39	2.15
100	1.71	1.43	2.45

Table 504

Duration (min)	Ratio to 1-hour
5	0.29
10	0.45
15	0.57
30	0.79

Step 4:

Durations less than 1 hour (Using Table 504)

		Duration (min)							
		5		10		15		30	
Return Period (yr)	Adjusted 1-Hr Depth(in)	Depth (1) (in)	Intensity (in/hr)	Depth (1) (in)	Intensity (in/hr)	Depth (1) (in)	Intensity (in/hr)	Depth (1) (in)	Intensity (in/hr)
2	0.77	0.22	2.68	0.35	2.08	0.44	1.76	0.61	1.22
5	1.16	0.34	4.04	0.52	3.13	0.66	2.64	0.92	1.83
10	1.43	0.41	4.96	0.64	3.85	0.81	3.25	1.13	2.25
25	1.80	0.52	6.25	0.81	4.85	1.02	4.09	1.42	2.84
50	2.15	0.62	7.50	0.97	5.82	1.23	4.91	1.70	3.40
100	2.45	0.71	8.51	1.10	6.60	1.39	5.58	1.93	3.86

(1) Depths determined using "Table 504 - Factor for Durations of Less Than One-hour"
(2) Rainfall depths utilize Figures 501-512 centered on the the Site.

PRECIPITATION ADJUSTMENT RATIOS

Recurrence Interval	Ratio to NOAA Atlas 2
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

NOTE:
1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

Revision	Date

REFERENCE:
USACE, Los Angeles District, 1988

FACTORS FOR DURATIONS OF LESS THAN ONE-HOUR

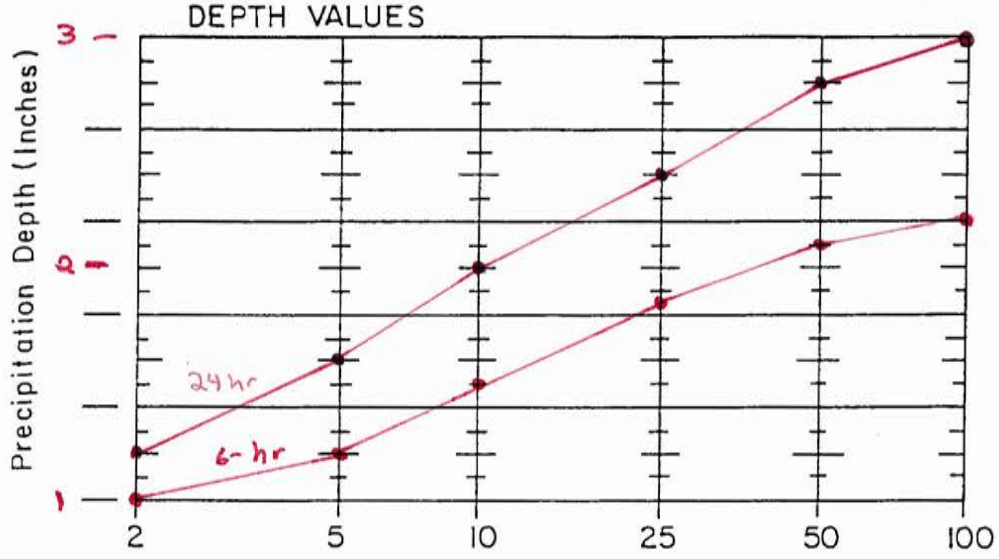
Duration (min)	5	10	15	30
Ratio to 1-hour	0.29	0.45	0.57	0.79

NOTE: 1. Multiply the 1-hour precipitation depths by the above ratios to obtain the precipitation depths for storm durations of less than 1-hour.

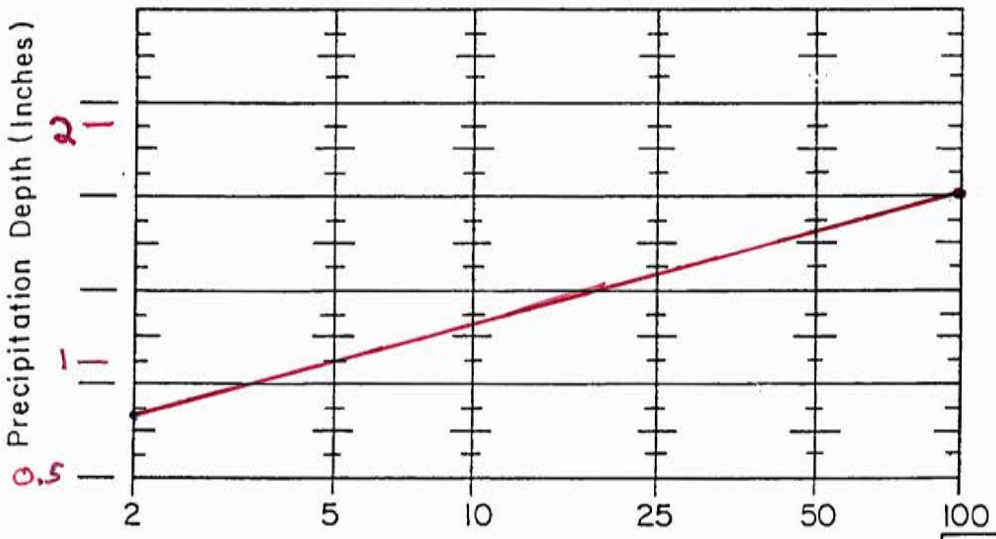
Revision	Date

PRECIPITATION DEPTH VERSUS RETURN PERIOD

A. PLOT OF 6-HOUR AND 24-HOUR PRECIPITATION DEPTH VALUES



B. PLOT OF 1-HOUR PRECIPITATION DEPTH VALUES

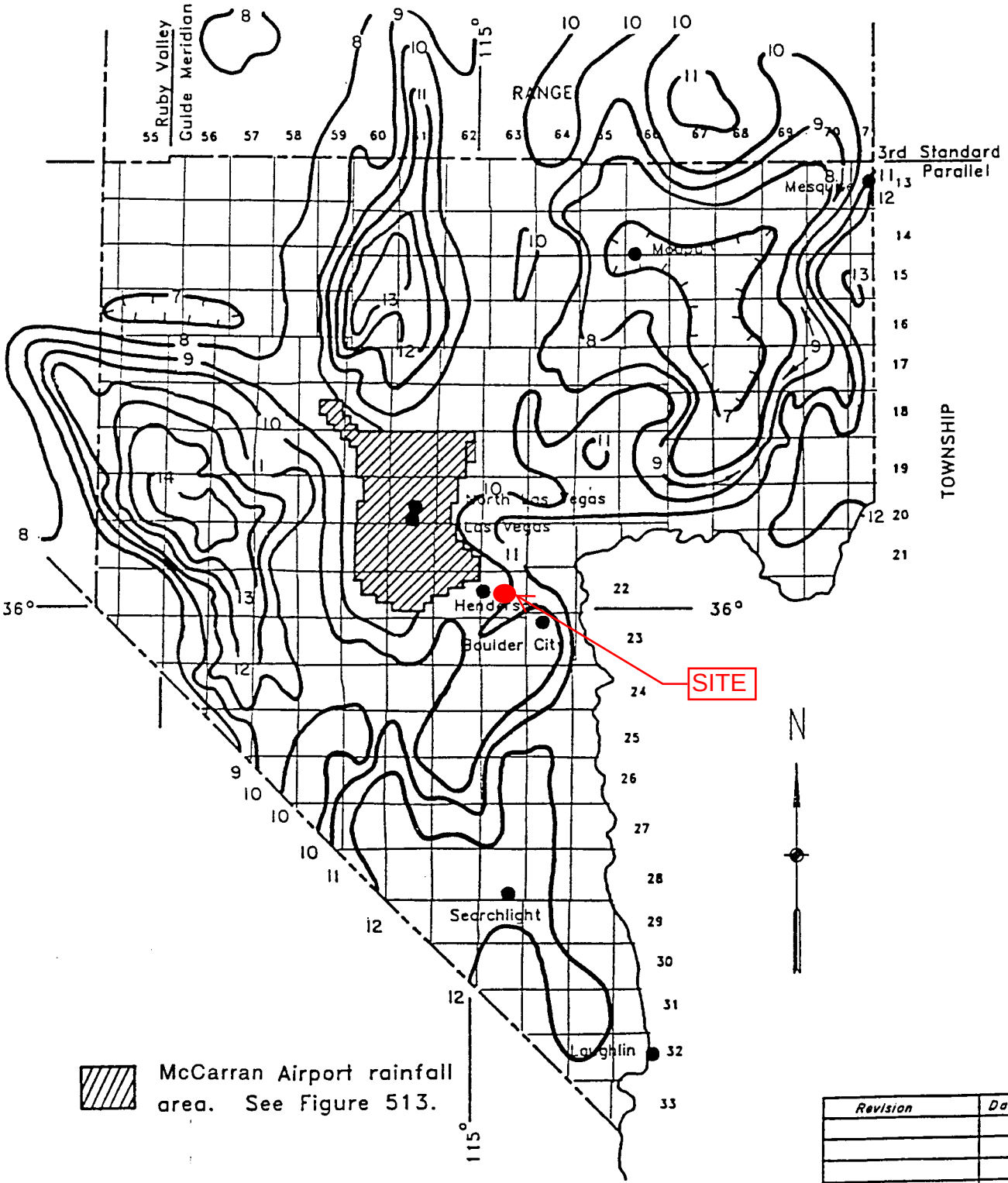


Revision	Date

REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973

STANDARD FORM 3

RAINFALL DEPTH-DURATION-FREQUENCY
2-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



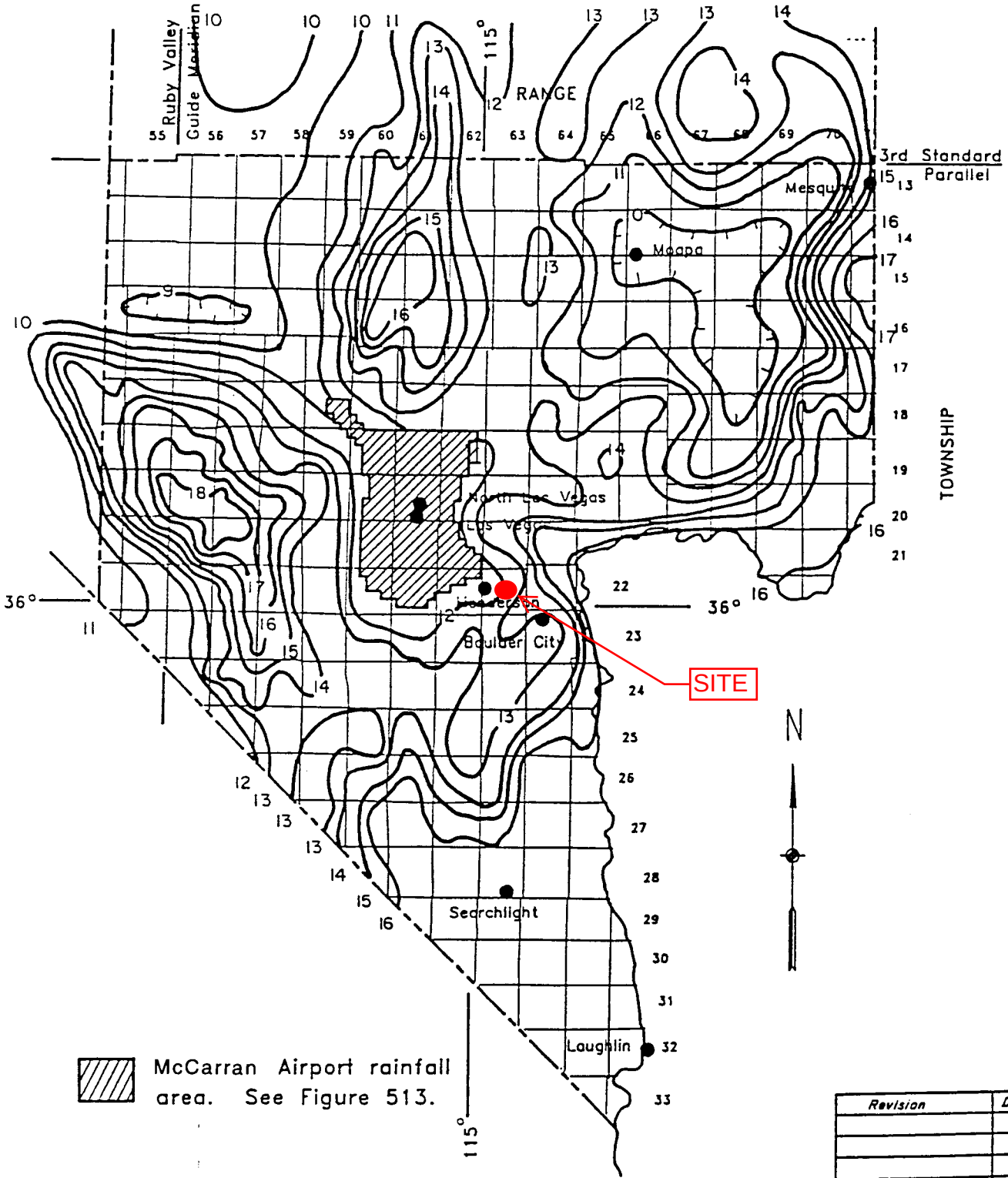
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 501

RAINFALL DEPTH-DURATION-FREQUENCY
5-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



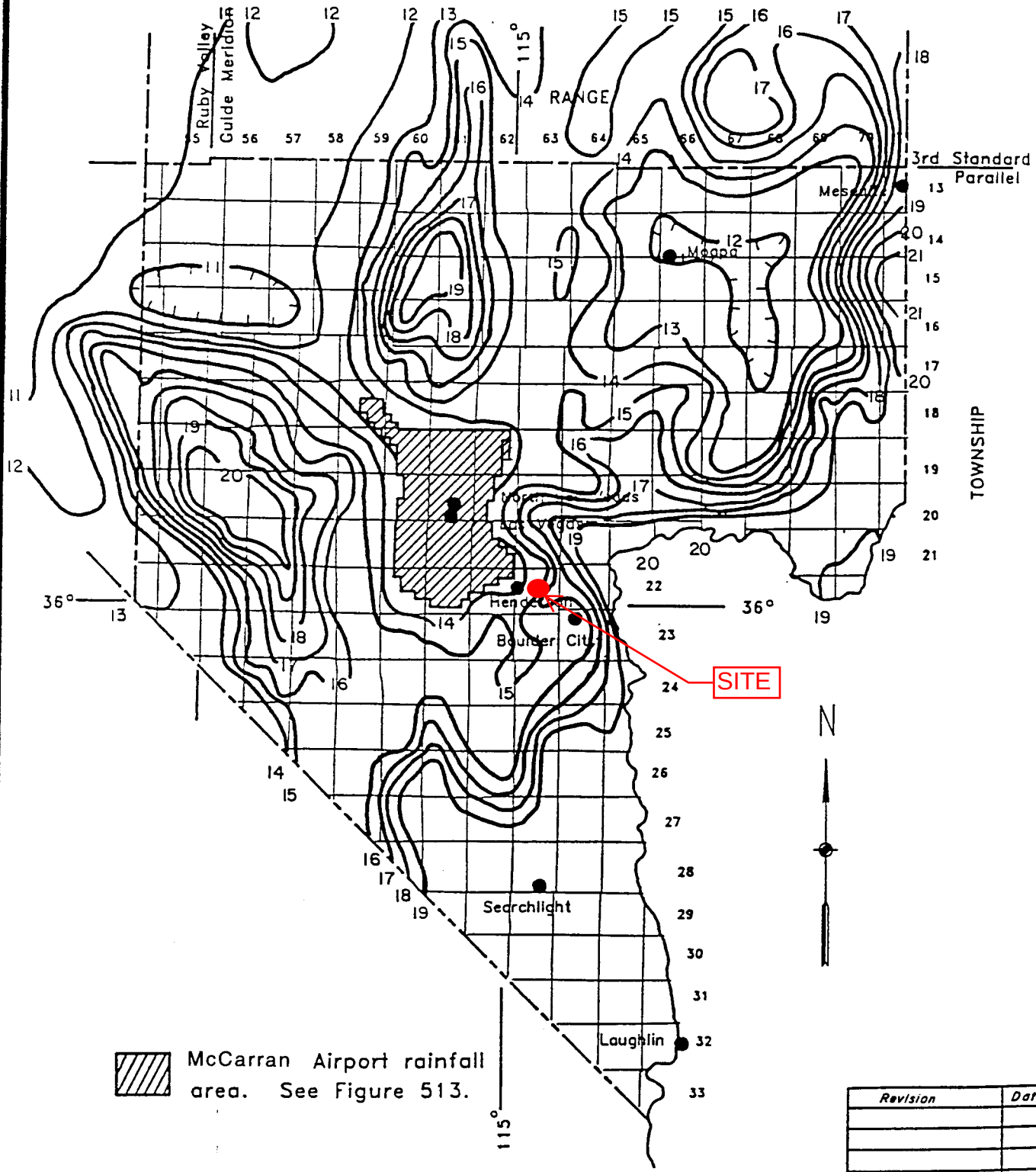
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 502

RAINFALL DEPTH-DURATION-FREQUENCY
10-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



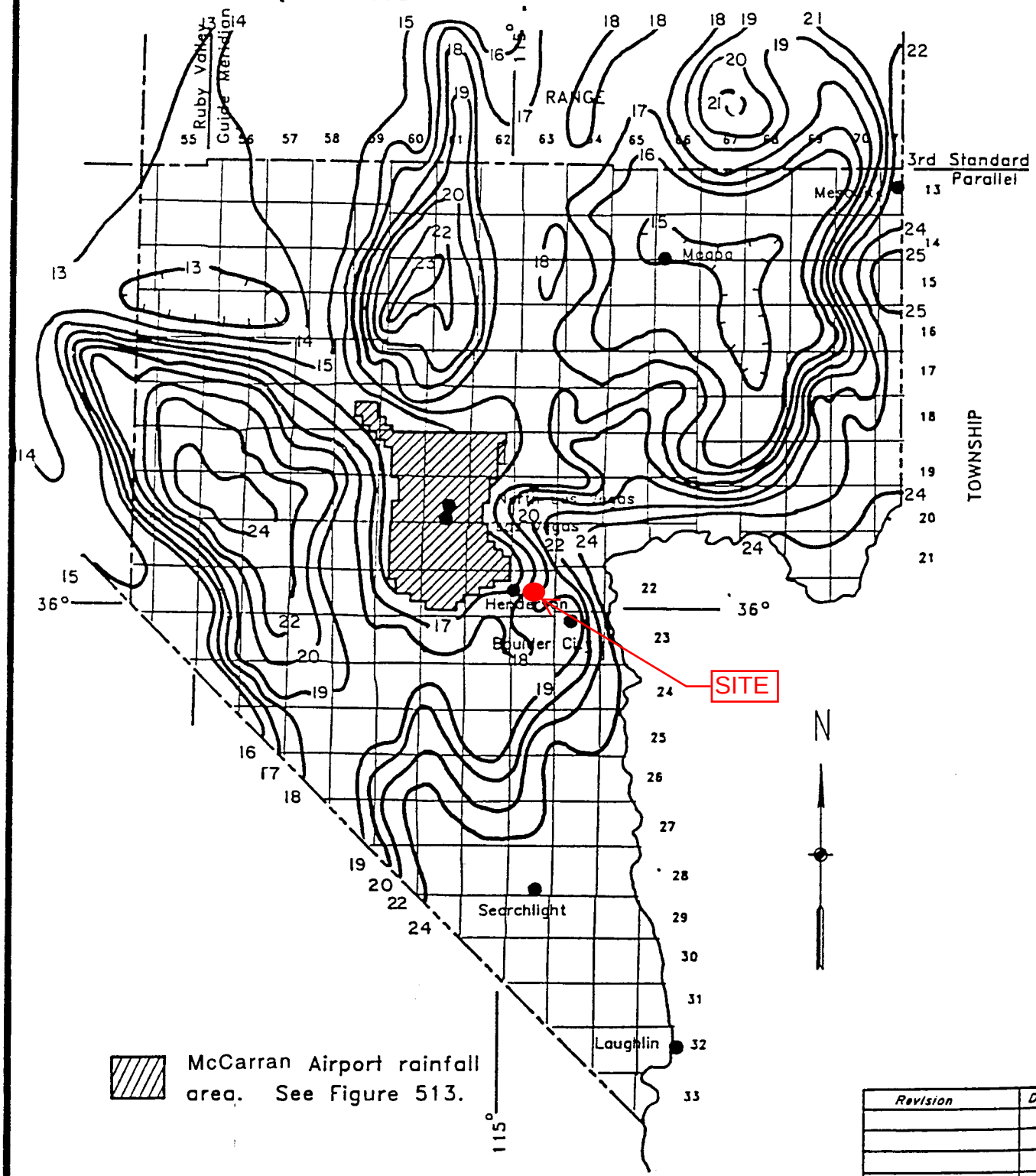
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 503

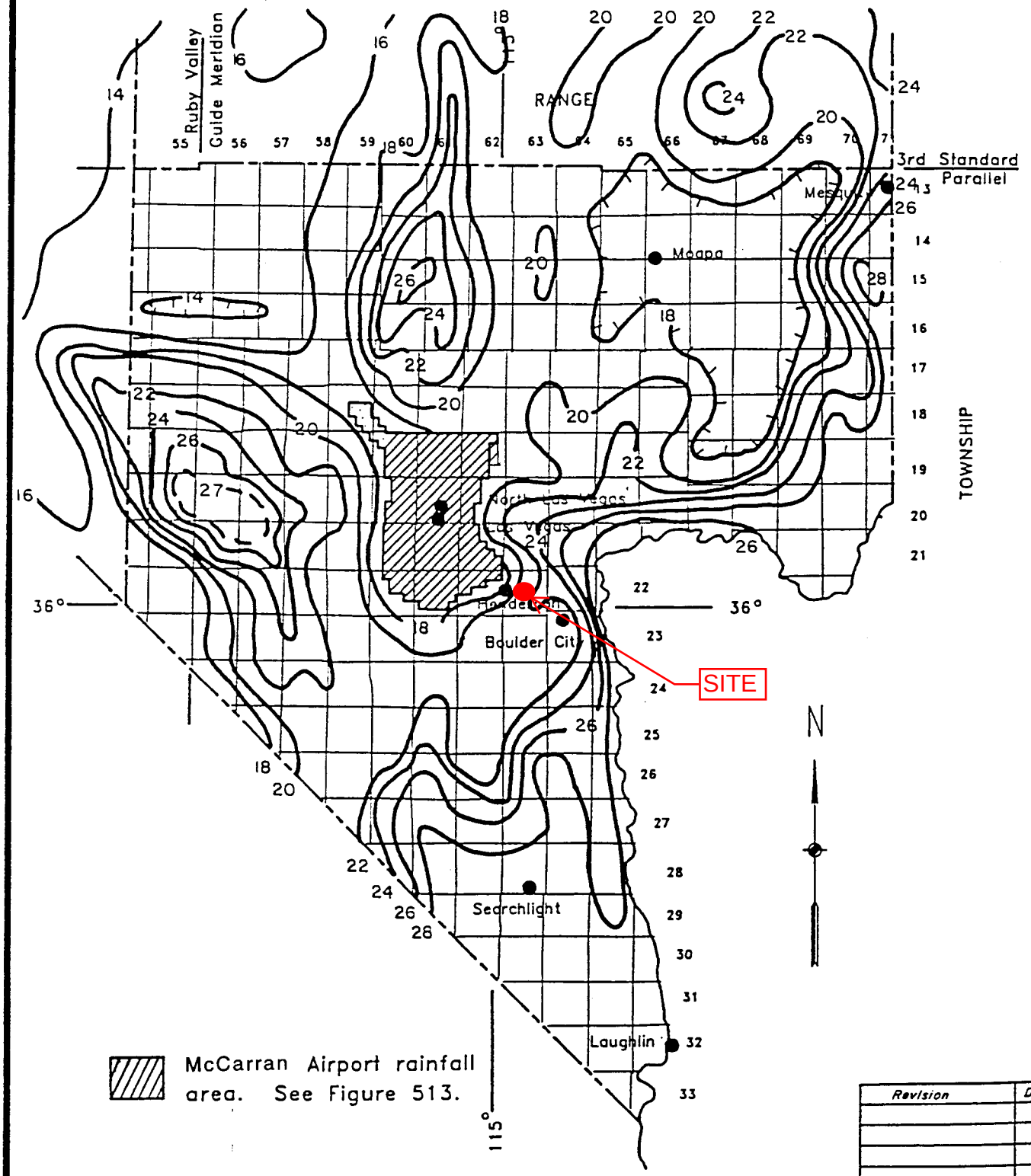
RAINFALL DEPTH-DURATION-FREQUENCY
25-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 504

RAINFALL DEPTH-DURATION-FREQUENCY
50-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



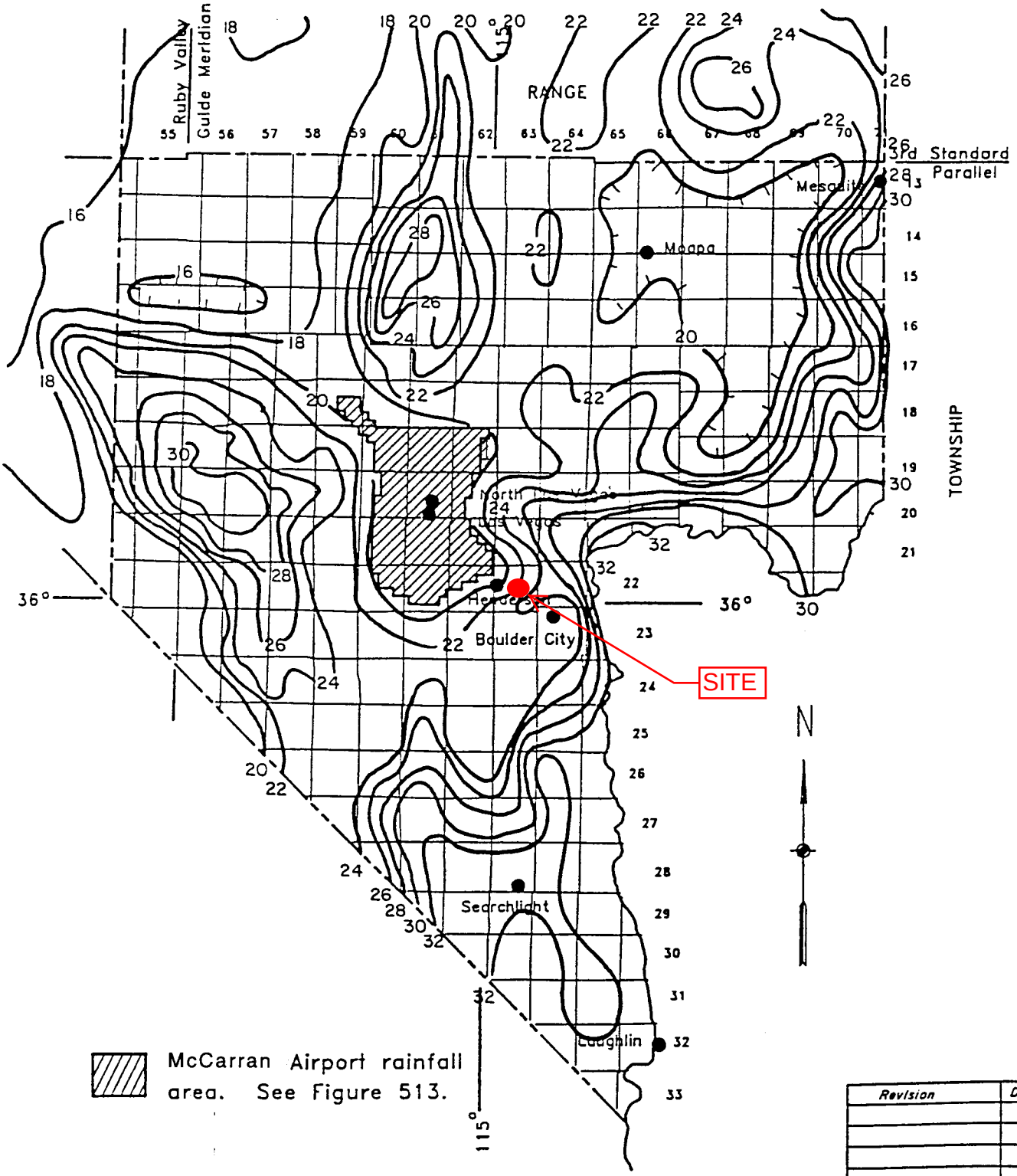
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 505

RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



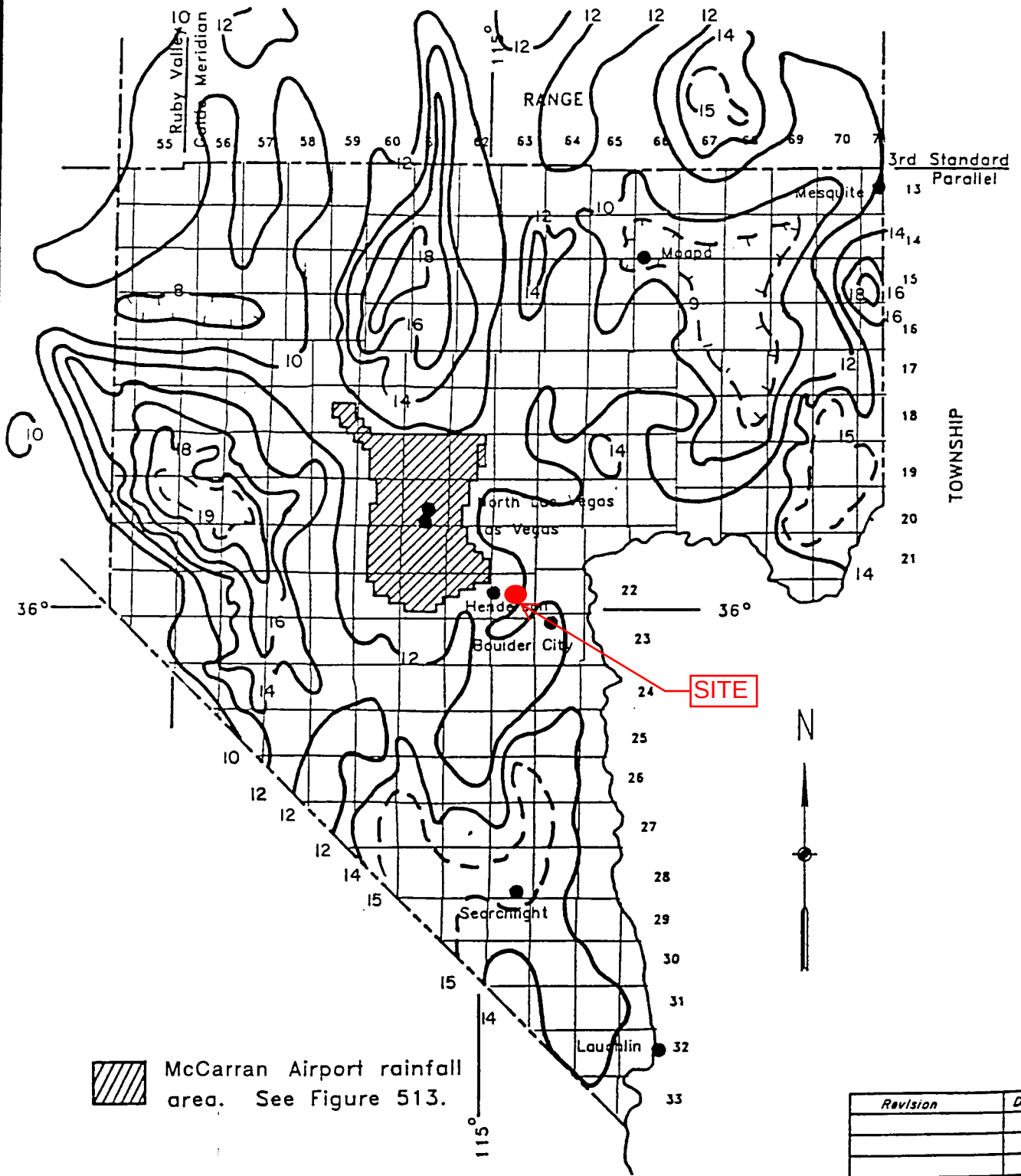
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 506

RAINFALL DEPTH-DURATION-FREQUENCY
2-YEAR, 24-HOUR
(DEPTHS IN TENTHS OF INCHES)



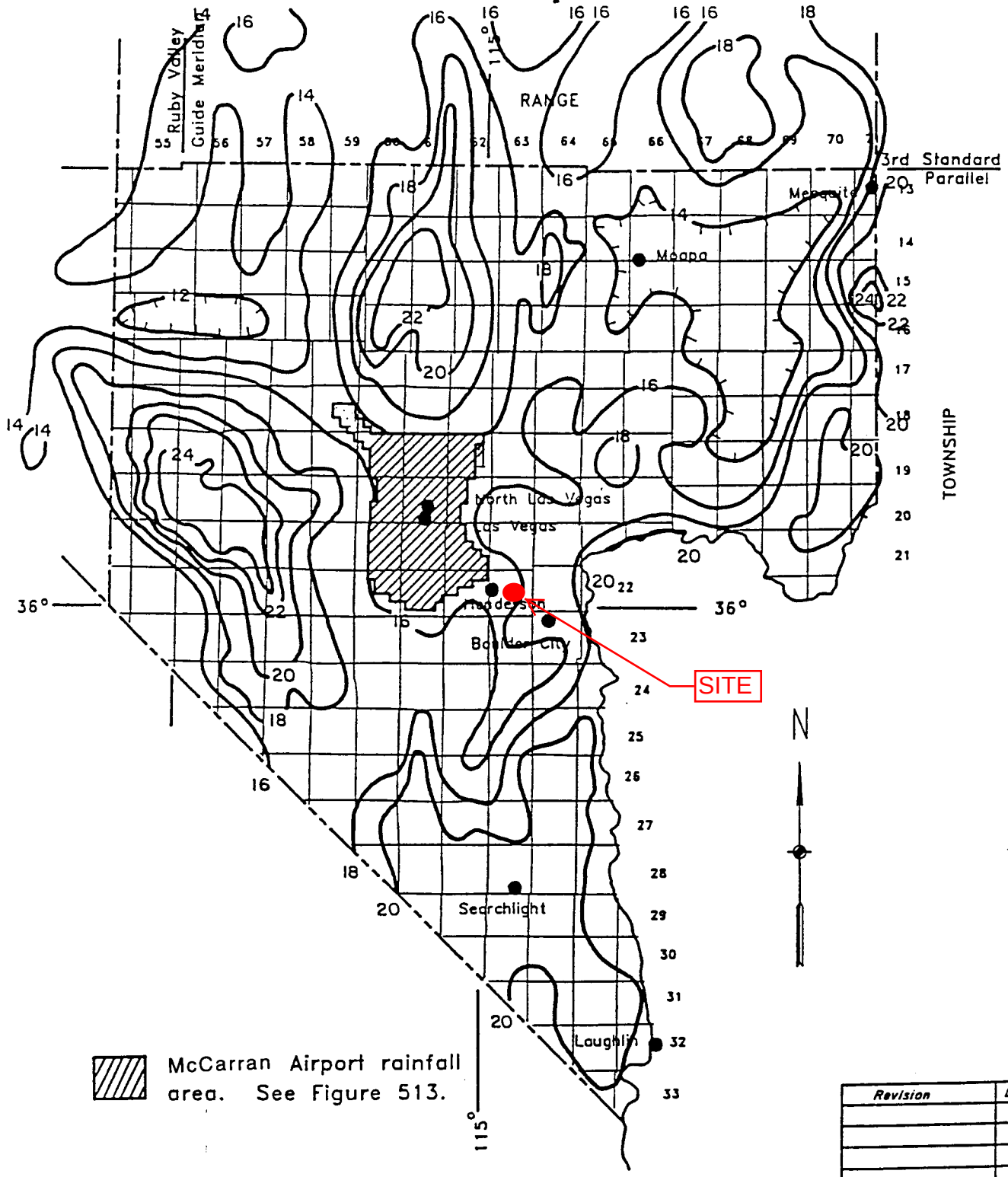
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 507

RAINFALL DEPTH-DURATION-FREQUENCY
5-YEAR, 24-HOUR
(DEPTHS IN TENTHS OF INCHES)



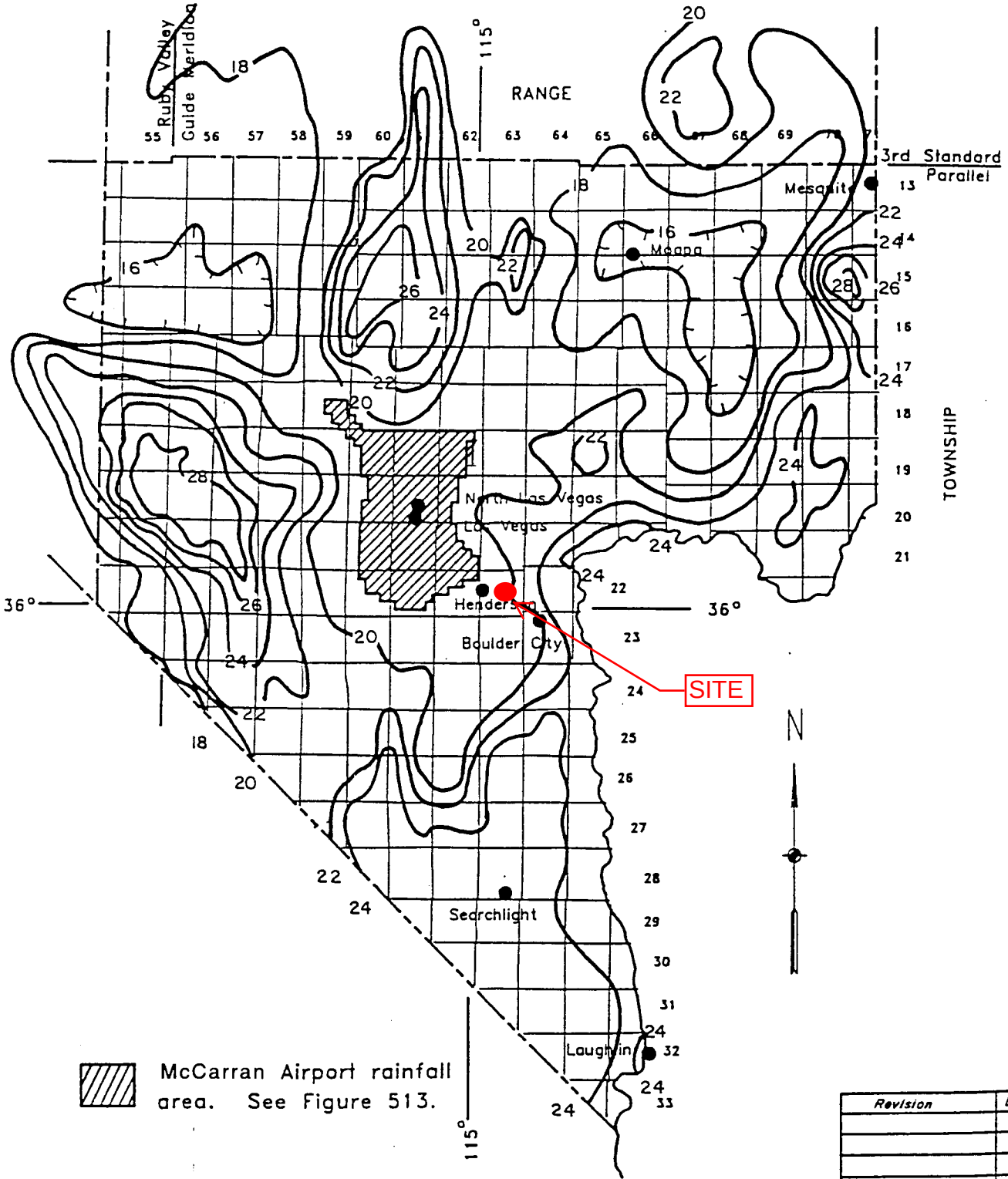
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 508

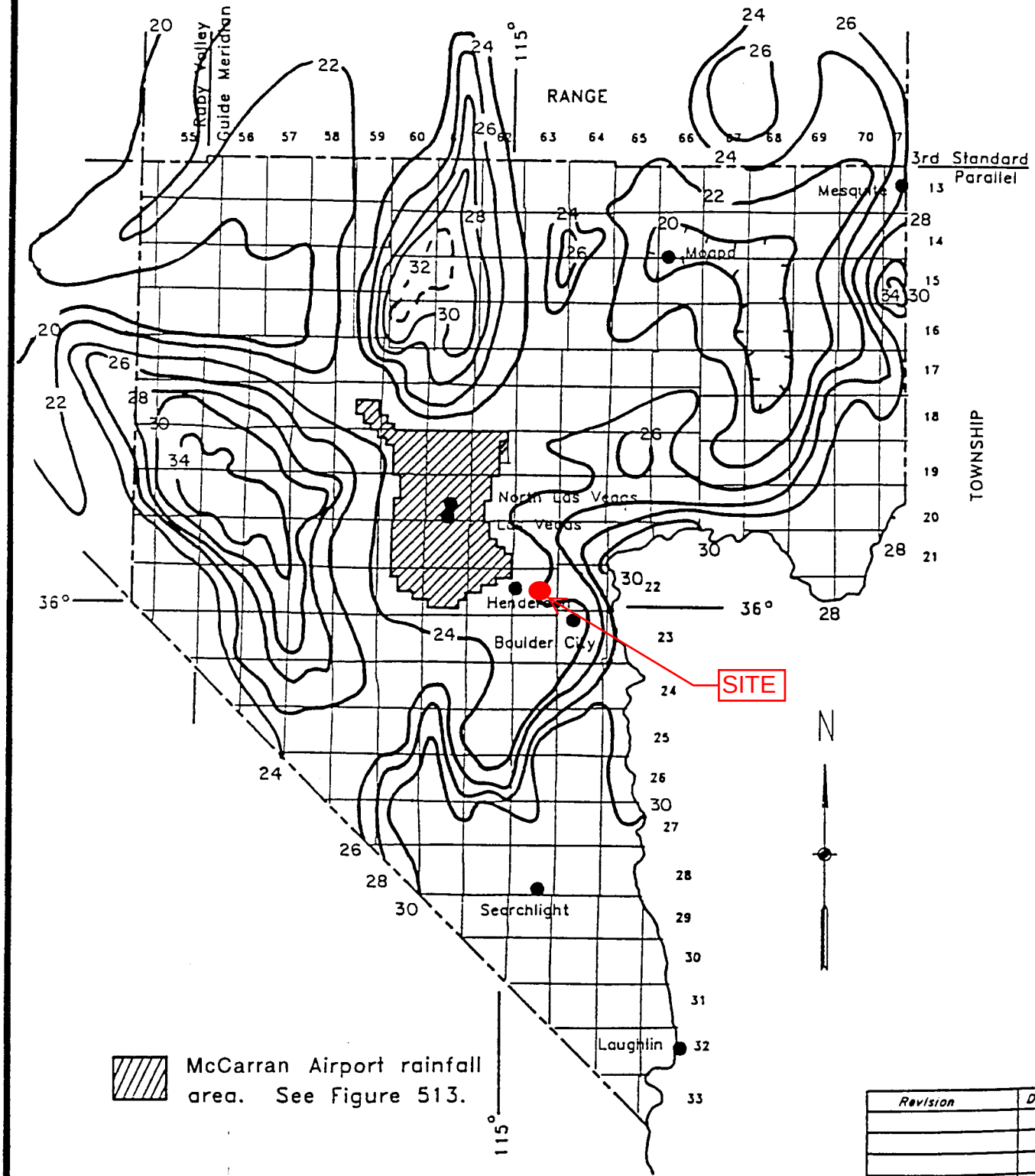
RAINFALL DEPTH-DURATION-FREQUENCY
10-YEAR, 24-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 509

RAINFALL DEPTH-DURATION-FREQUENCY
25-YEAR, 24-HOUR
(DEPTHS IN TENTHS OF INCHES)



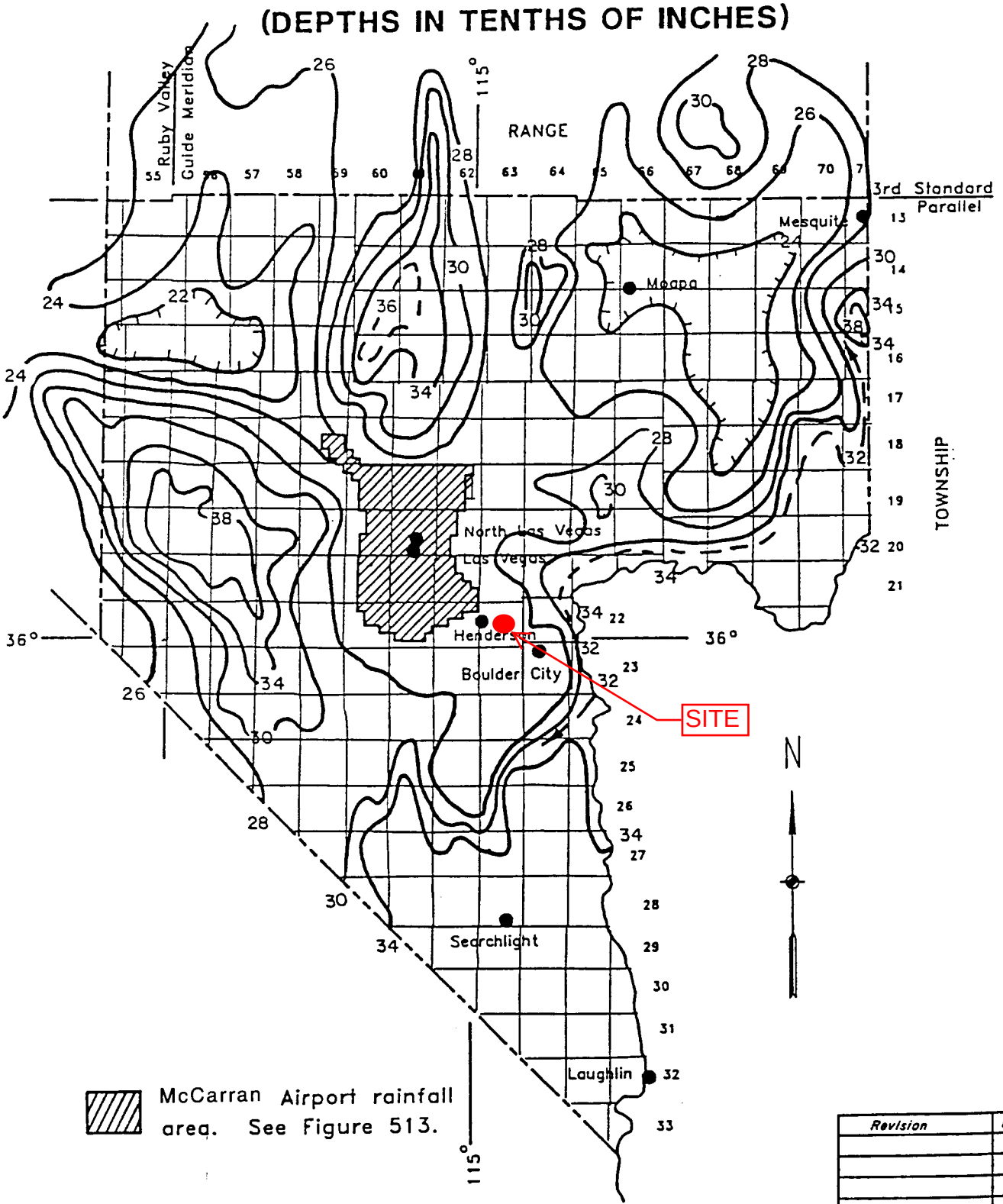
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 510

RAINFALL DEPTH-DURATION-FREQUENCY
50-YEAR, 24-HOUR
(DEPTHS IN TENTHS OF INCHES)



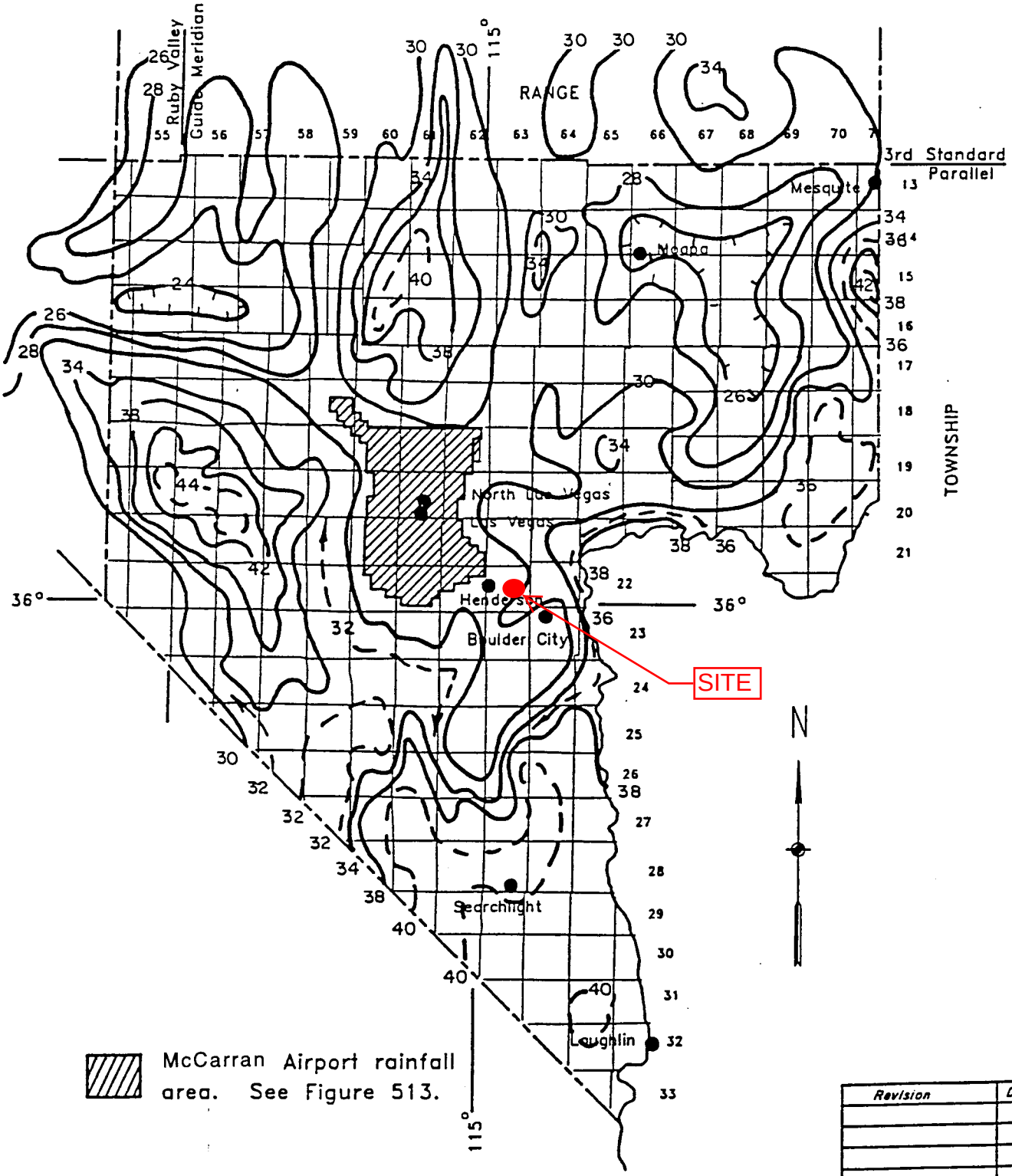
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 5.11

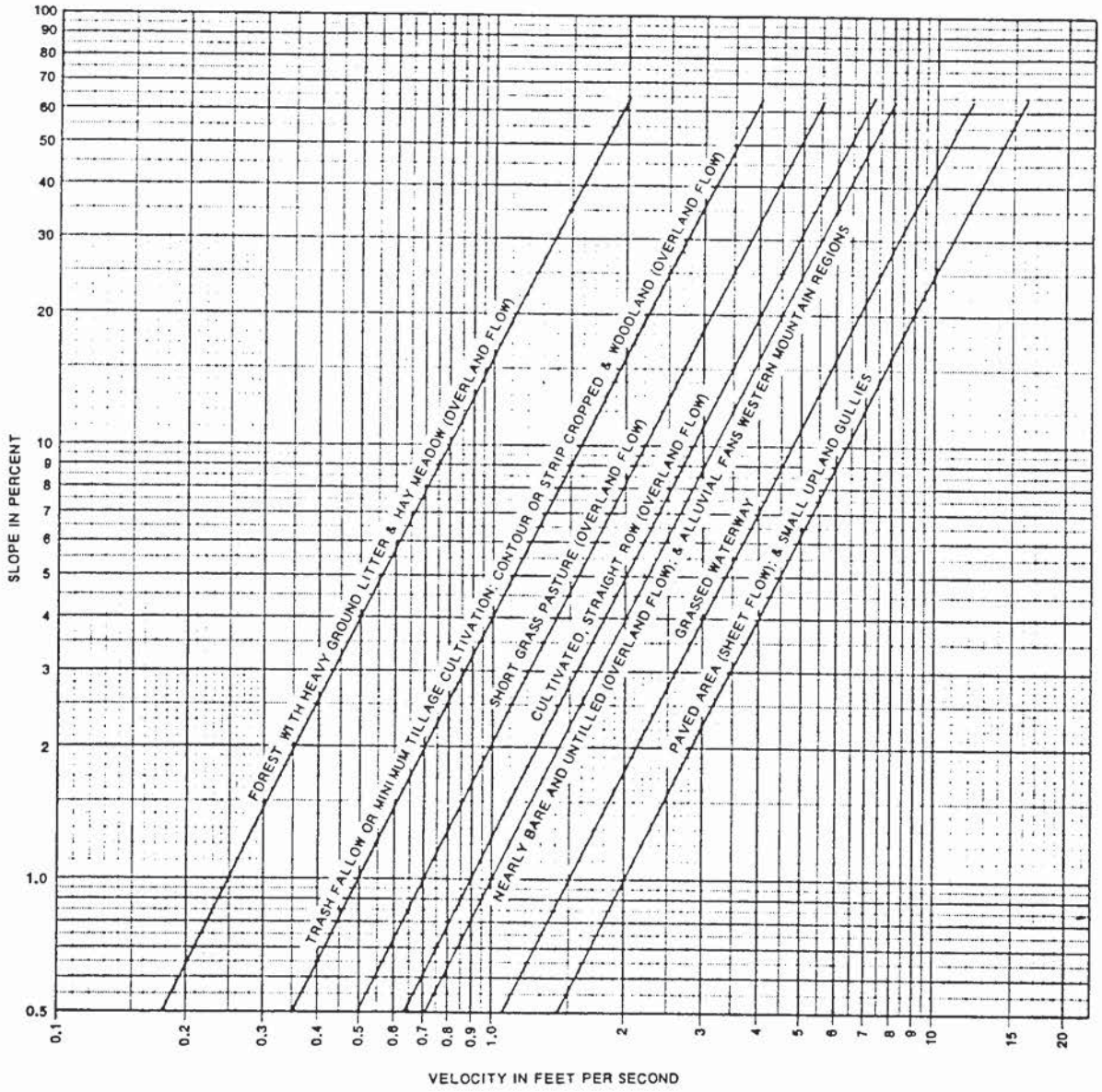
RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 24-HOUR
(DEPTHS IN TENTHS OF INCHES)



Revision	Date

WRC ENGINEERING	REFERENCE: NOAA ATLAS 2, VOLUME VII NEVADA, 1973	FIGURE 512

TRAVEL TIME VELOCITY



Revision	Date

WRC ENGINEERING	**REFERENCE:** SCS National Engineering Handbook Section 4, Hydrology, March, 1985	**FIGURE 602**

RATIONAL FORMULA METHOD RUNOFF COEFFICIENTS AND AVERAGE PERCENT IMPERVIOUS AREA

LAND USE OR SURFACE CHARACTERISTICS	AVERAGE PERCENT IMPERVIOUS AREA	RUNOFF COEFFICIENTS 10-YEAR		100-YEAR	
		GRASS[1]	DESERT[2]	GRASS[1]	DESERT[2]
Business and Commercial:					
Downtown Areas	95	.88	.88	.89	.89
Neighborhood Areas	70	.70	.75	.80	.83
Residential (Average Lot Size):					
1/8 Acre or less (Multi-Unit)	65	.68	.73	.78	.80
1/4 Acre	38	.55	.62	.65	.74
1/3 Acre	30	.50	.57	.60	.70
1/2 Acre	25	.45	.53	.55	.67
1 Acre	20	.40	.49	.50	.64
2 Acre	12	.35	.45	.40	.60
Industrial:	72	.72	.76	.82	.84
Open Space: (Lawns, Parks, Golf Courses)	5	.10	-	.30	-
Undeveloped Areas: (Natural Vegetation)	0	-	.25	-	.50
Streets and Roads:					
Paved	100	.90		.93	
Gravel	20	.40		.50	
Drives and Walks:	95	.88		.89	
Roofs:	90	.85		.87	

Notes:

1 Grass - Grassed Landscaping or Irrigated Vegetation
2 Desert - Desert Landscaping or Natural Vegetation

Revision	Date

WRC ENGINEERING

REFERENCE: USDCM, DRCOG, 1969 (with modifications)

TABLE 601

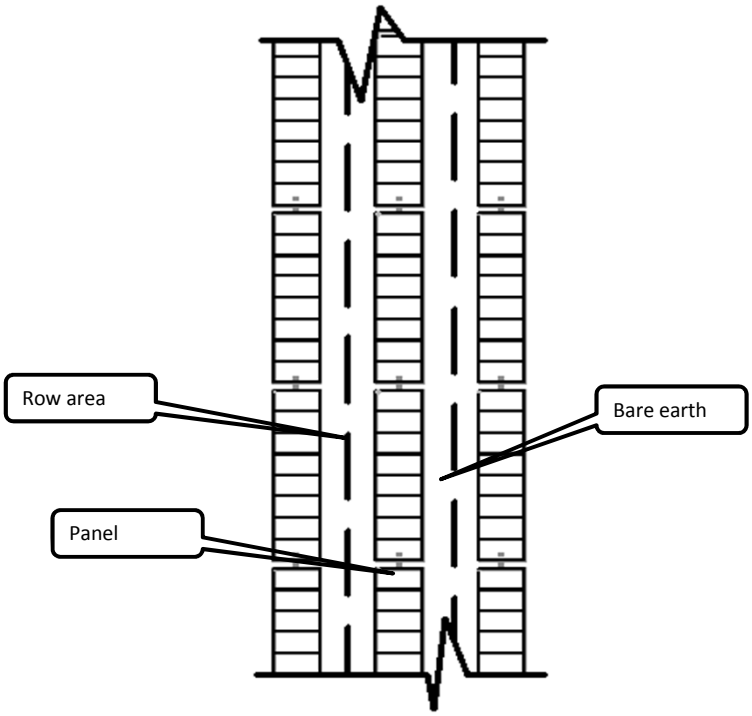
SNWA River Mountains Solar
Weighted 'C' Value Calculations
4/21/2015

		Desert		Panels			
Solar Row	Total Area (sf)	Area (sf)	C100	Area (sf)	C100	Composite C100	Composite C10 (1)
Average impervious over 24 hours	3705	2233	0.5	1472	0.95	0.68	0.54

Average Panel Area Calculation

Panel angle to horizontal (degrees)	Panel Area (sf)	Average time at angle (2)
0	2089	4
30	1806	8
60 (night)	1043	12
	1472	weighted average of panel area over time (sf)

(1) Using a C100 and Table 601 to find a comparable C10
(2) Assumes a standard 12-hour day



Typical Solar Row

SNWA River Mountains Solar
Subbasin Values
4/21/2015

				Overland (1)		Tt (1)			
Basin	**Area (sf)**	**Area (ac)**	**Total Length**	**Length**	**Slope**	**Up Elev**	**Down Elev**	**C10**	**C100**
A-1	29899	0.7	231	0	-	-	2156	0.54	0.68
A-10	33699	0.8	876	0	-	-	2165	0.54	0.68
A-11	39143	0.9	1035	0	-	-	2195	0.54	0.68
A-6-N	29596	0.7	421	0	-	-	2164	0.54	0.68
A-6-S	500683	11.5	1378	500	3.51	2167	2165	0.54	0.68
A-7-N	28221	0.6	472	0	-	-	2180	0.54	0.68
A-7-S	242594	5.6	957	447	3.51	2184	2181	0.54	0.68
A-8-N	32326	0.7	473	0	-	-	2196	0.54	0.68
A-8-S	466427	10.7	1608	500	3.35	2201	2196	0.54	0.68
A-9-N	37616	0.9	532	500	3.35	2234	2210	0.54	0.68
A-9-S	477166	11.0	1356	500	3.35	2218	2213	0.54	0.68
B-2-N	70117	1.6	409	0	-	-	2150	0.54	0.68
B-2-S	360083	8.3	1127	470	3.72	2163	2154	0.54	0.68
B-3-N	39406	0.9	458	0	-	-	2168	0.54	0.68
B-3-S	385930	8.9	1152	495	3.75	2178	2169	0.54	0.68
B-4-N	58503	1.3	515	443	3.4	2185	2184	0.54	0.68
B-4-S	369436	8.5	1142	500	3.4	2193	2184	0.54	0.68
D-1-N	112961	2.6	624	500	3.4	2220	2191	0.54	0.68
D-1-S	383904	8.8	1148	500	3.4	2207	2199	0.54	0.68
OFF-A4-S	752122	17.3	3384	150	3.7	2339	2237	0.25	0.5
OFF-A1-S	488564	11.2	611	0	-	-	2143	0.25	0.5
OFF-A2	69042	1.6	1387	0	-	-	2165	0.25	0.5
OFF-A3	258127	5.9	1005	0	-	-	2199	0.25	0.5
OFF-A5-N	143873	3.3	1537	150	3.7	2274	2228	0.25	0.5
OFF-A5-S	493160	11.3	1667	150	3.7	2288	2229	0.25	0.5
OFF-B1	48341	1.1	122	0	-	-	2140	0.25	0.5
OFF-B2	61637	1.4	83	0	-	-	2146	0.25	0.5
OFF-C1	24656	0.6	381	50	6	2183	2168	0.25	0.5
OFF-D1	39427	0.9	335	0	-	-	2180	0.25	0.5
OFF-D2	28004	0.6	685	0	-	-	2197	0.25	0.5
OFF-D3	979504	22.5	3512	150	4.1	2336	2216	0.25	0.5
OFF-E	4392	0.1	112	50	2.8	2209	2208	0.25	0.5
OFF-F	1041571	23.9	4120	150	2.5	2340	2206	0.25	0.5
P-E1	41722	1.0	456	150	4.1	2222	2203	0.25	0.5
P-E2	34083	0.8	533	150	4.1	2225	2202	0.25	0.5
P-A4	752122	17.3	3384	150	3.7	2339	2237	0.25	0.50
P-A3	1010249	23.2	4389	150	3.7	2339	2199	0.25	0.50
P-A2	1079291	24.8	5776	150	3.7	2339	2165	0.25	0.50
P-A5	637033	14.6	1667	150	3.7	2288	2229	0.25	0.50
P-A9	1151815	26.4	2199	150	3.7	2288	2229	0.38	0.58
P-A8	1650568	37.9	2672	150	3.7	2288	2196	0.43	0.61
P-A7	1921383	44.1	3144	150	3.7	2288	2180	0.44	0.62
P-A6	2451662	56.3	3565	150	3.7	2288	2164	0.46	0.63
P-A1	2451662	56.3	3796	150	3.7	2288	2156	0.46	0.63
P-A	4095322	94.0	4407	150	3.7	2288	2143	0.38	0.58
P-OFF-D2	1007508	23.1	4197	150	4.1	2336	2197	0.25	0.50
P-D1	536008	12.3	1148	500	3.4	2207	2199	0.54	0.68
P-D	1582943	36.3	4532	150	4.1	2336	2180	0.35	0.56
P-B4	427939	9.8	1142	500	3.4	2193	2184	0.54	0.68
P-B3	886974	20.4	1600	500	3.4	2193	2168	0.54	0.68
P-B2	1317174	30.2	2009	500	3.4	2193	2150	0.54	0.68
P-OFF-B2	1378811	31.7	2092	500	3.4	2193	2146	0.53	0.67
P-B	1427152	32.8	2214	500	3.4	2193	2140	0.52	0.66

(1) Overland values and upper elevations only provided for upstream subbasins
(2) "Ex" designates existing subbasin or concentration point.

SNWA River Mountains Solar
Time of Concentration(Standard Form 4) and Flow Calculations
4/21/2015

Sub-Basin Data				Initial/Overland (ti)			Travel Time (tt)				tc Check			Final tc	Modified Rational Runoff Calculations							
Concentration Point	K=C10	Area (ac)	Area (sq mi)	Length (ft)	Slope	ti (min)	Length (ft)	Slope (%) (1)	Velocity (fps) (2)	tt (min)	tc (EQ 601)	Total Length (ft)	tc(EQ 604)	(min)	C100	I100 (in/hr) (3)	K (Local adjustment factor)	**Q100 (cfs)**	I10 (in/hr) (3)	C10	**Q10(cfs)**
Ex A	0.25	93	0.145	150	2.5	13.8	5723	3.4	3.7	25.8	40	5873	43	40	0.5	3.44	0.5	**80**	2.00	0.25	**23**
Ex B	0.25	35	0.054	150	2.5	13.8	4058	3.6	3.8	17.8	32	4208	33	32	0.5	3.82	0.5	**33**	2.23	0.25	**10**
Ex C	0.25	5	0.008	150	2.5	13.8	1295	4.2	4.05	5.3	19	1445	18	18	0.5	5.23	0.5	**7**	3.05	0.25	**2**
Ex D	0.25	31	0.049	150	2.5	13.8	3274	3.6	3.8	14.4	28	3424	29	28	0.5	4.09	0.5	**32**	2.39	0.25	**9**
Ex E	0.25	0.33	0.001	20	2.5	5.1	139	5.8	4.85	0.5	6	159	11	6	0.5	8.51	0.5	**1**	4.96	0.25	**1**
Ex F	0.25	24.08	0.038	150	2.5	13.8	3940	3.4	3.65	18.0	32	4090	33	32	0.5	3.82	0.5	**23**	2.23	0.25	**7**
A-6-S	0.54	11.49	0.018	500	3.51	14.9	878	0.2	0.56	26.1	41	1378	18	18	0.68	5.35	0.5	**21**	3.12	0.54	**10**
A-7-S	0.54	5.57	0.009	447	3.51	14.1	510	0.6	1.4	6.1	20	957	15	15	0.68	5.58	0.5	**11**	3.25	0.54	**5**
A-8-S	0.54	10.71	0.017	500	3.35	15.1	1108	0.5	1.12	16.5	32	1608	19	19	0.68	5.23	0.5	**19**	3.05	0.54	**9**
A-9-S	0.54	10.95	0.017	500	3.35	15.1	856	0.6	1.4	10.2	25	1356	18	18	0.68	5.35	0.5	**20**	3.12	0.54	**9**
B-2-S	0.54	8.27	0.013	470	3.72	14.2	657	1.4	2.27	4.8	19	1127	16	16	0.68	5.46	0.5	**15**	3.18	0.54	**7**
B-3-S	0.54	8.86	0.014	495	3.75	14.5	657	1.4	2.27	4.8	19	1152	16	16	0.68	5.46	0.5	**16**	3.18	0.54	**8**
B-4-N	0.54	1.34	0.002	443	3.4	14.2	72	1.4	2.27	0.5	15	515	13	13	0.68	6.19	0.5	**3**	3.61	0.54	**1**
B-4-S	0.54	8.48	0.013	500	3.4	15.1	642	1.4	2.36	4.5	20	1142	16	16	0.68	5.46	0.5	**16**	3.18	0.54	**7**
D-1-N	0.54	2.59	0.004	500	3.4	15.1	124	3.0	3.44	0.6	16	624	13	13	0.68	5.99	0.5	**5**	3.49	0.54	**2**
D-1-S	0.54	8.81	0.014	500	3.4	15.1	648	1.2	2.18	5.0	20	1148	16	16	0.68	5.46	0.5	**16**	3.18	0.54	**8**
OFF-A4-S	0.25	17.27	0.027	150	3.7	12.2	3234	3.2	3.55	15.2	27	3384	29	27	0.50	4.21	0.5	**18**	2.45	0.25	**5**
OFF-A5-N	0.25	3.30	0.005	150	3.7	12.2	1387	3.3	3.65	6.3	19	1537	19	19	0.50	5.23	0.5	**4**	3.05	0.25	**1**
OFF-A5-S	0.25	11.32	0.018	150	3.7	12.2	1517	3.9	3.9	6.5	19	1667	19	19	0.50	5.23	0.5	**15**	3.05	0.25	**4**
OFF-C1	0.25	0.57	0.001	50	6	6.0	331	4.5	4.25	1.3	7	381	12	7	0.50	7.75	0.5	**1**	4.52	0.25	**1**
OFF-D3	0.25	22.49	0.035	150	4.1	11.8	3362	3.6	3.75	14.9	27	3512	30	27	0.50	4.32	0.5	**24**	2.52	0.25	**7**
OFF-E	0.25	0.10	0.000	50	2.8	7.7	62	1.6	2.54	0.4	8	112	11	8	0.50	7.37	0.5	**1**	4.30	0.25	**1**
OFF-F	0.25	23.91	0.037	150	2.5	13.8	3970	3.4	3.65	18.1	32	4120	33	32	0.50	3.82	0.5	**23**	2.23	0.25	**7**
P-E1	0.25	0.96	0.001	150	4.1	11.8	306	6.2	5.04	1.0	13	456	13	13	0.50	6.19	0.5	**1**	3.61	0.25	**1**
P-E2	0.25	0.78	0.001	150	4.1	11.8	383	6.0	5	1.3	13	533	13	13	0.50	6.19	0.5	**1**	3.61	0.25	**1**
P-A4	0.25	17.27	0.027	150	3.7	12.2	3234	3.2	3.55	15.2	27	3384	29	27	0.50	4.21	0.5	**18**	2.45	0.25	**5**
P-A3	0.25	23.19	0.036	150	3.7	12.2	4239	3.3	3.65	19.4	32	4389	34	32	0.50	3.82	0.5	**22**	2.23	0.25	**6**
P-A2	0.25	24.78	0.039	150	3.7	12.2	5626	3.1	3.5	26.8	39	5776	42	39	0.50	3.49	0.5	**22**	2.03	0.25	**6**
P-A5	0.25	14.62	0.023	150	3.7	12.2	1517	3.9	3.9	6.5	19	1667	19	19	0.50	5.23	0.5	**19**	3.05	0.25	**6**
A-9-N	0.54	0.86	0.001	500	3.35	15.1	32	4.0	3.95	0.1	15	532	13	13	0.68	6.19	0.5	**2**	3.61	0.54	**1**
P-A8	0.43	37.89	0.059	150	3.7	9.6	2522	3.6	3.8	11.1	21	2672	25	21	0.61	5.00	0.5	**58**	2.92	0.43	**24**
P-A7	0.44	44.11	0.069	150	3.7	9.4	2994	3.6	3.8	13.1	23	3144	27	23	0.62	4.78	0.5	**65**	2.79	0.44	**27**
P-A6	0.46	56.28	0.088	150	3.7	9.1	3415	3.6	3.8	15.0	24	3565	30	24	0.63	4.55	0.5	**81**	2.65	0.46	**35**
P-A1	0.46	56.28	0.088	150	3.7	9.1	3646	3.6	3.8	16.0	25	3796	31	25	0.63	4.43	0.5	**79**	2.59	0.46	**34**
P-A	0.38	94.02	0.147	150	3.7	10.3	4257	3.4	3.7	19.2	30	4407	34	30	0.58	3.98	0.5	**108**	2.32	0.38	**41**
P-OFF-D2	0.25	23.13	0.036	150	4.1	11.8	4047	3.4	3.7	18.2	30	4197	33	30	0.50	3.98	0.5	**23**	2.32	0.25	**7**
P-D1	0.54	12.31	0.019	500	3.4	15.1	648	1.2	2.18	5.0	20	1148	16	16	0.68	5.46	0.5	**23**	3.18	0.54	**11**
P-D	0.35	36.34	0.057	150	4.1	10.4	4382	3.6	3.75	19.5	30	4532	35	30	0.56	3.98	0.5	**41**	2.32	0.35	**15**
P-B4	0.54	9.82	0.015	500	3.4	15.1	642	1.4	2.36	4.5	20	1142	16	16	0.68	5.46	0.5	**18**	3.18	0.54	**8**
P-B3	0.54	20.36	0.032	500	3.4	15.1	1100	2.3	3.02	6.1	21	1600	19	19	0.68	5.23	0.5	**36**	3.05	0.54	**17**
P-B2	0.54	30.24	0.047	500	3.4	15.1	1509	2.8	3.38	7.4	22	2009	21	21	0.68	4.89	0.5	**50**	2.85	0.54	**23**
P-OFF-B2	0.53	31.65	0.049	500	3.4	15.4	1592	3.0	3.44	7.7	23	2092	22	22	0.67	4.89	0.5	**52**	2.85	0.53	**24**
P-B	0.52	32.76	0.051	500	3.4	15.7	1714	3.1	3.5	8.2	24	2214	22	22	0.66	4.78	0.5	**52**	2.79	0.52	**24**

(1) Slope calculated as S = High Elev - Low Elev / Length
(2) Velocity taken from CCRFCD HCDDM Figure 602 for Paved Area and Small Upland Gullies
(3) Utilitizes Table 506 from HCDDM
(4) "Ex" designates existing subbasin or concentration point.

Flow Summary	100-year (cfs)	
Discharge Point	Existing	Proposed
A	80	108
DS-A	18	19
B	33	52
DS-B	95	141
C	7	1
D	32	41
E	1	1
F	23	23

United States Department of Agriculture

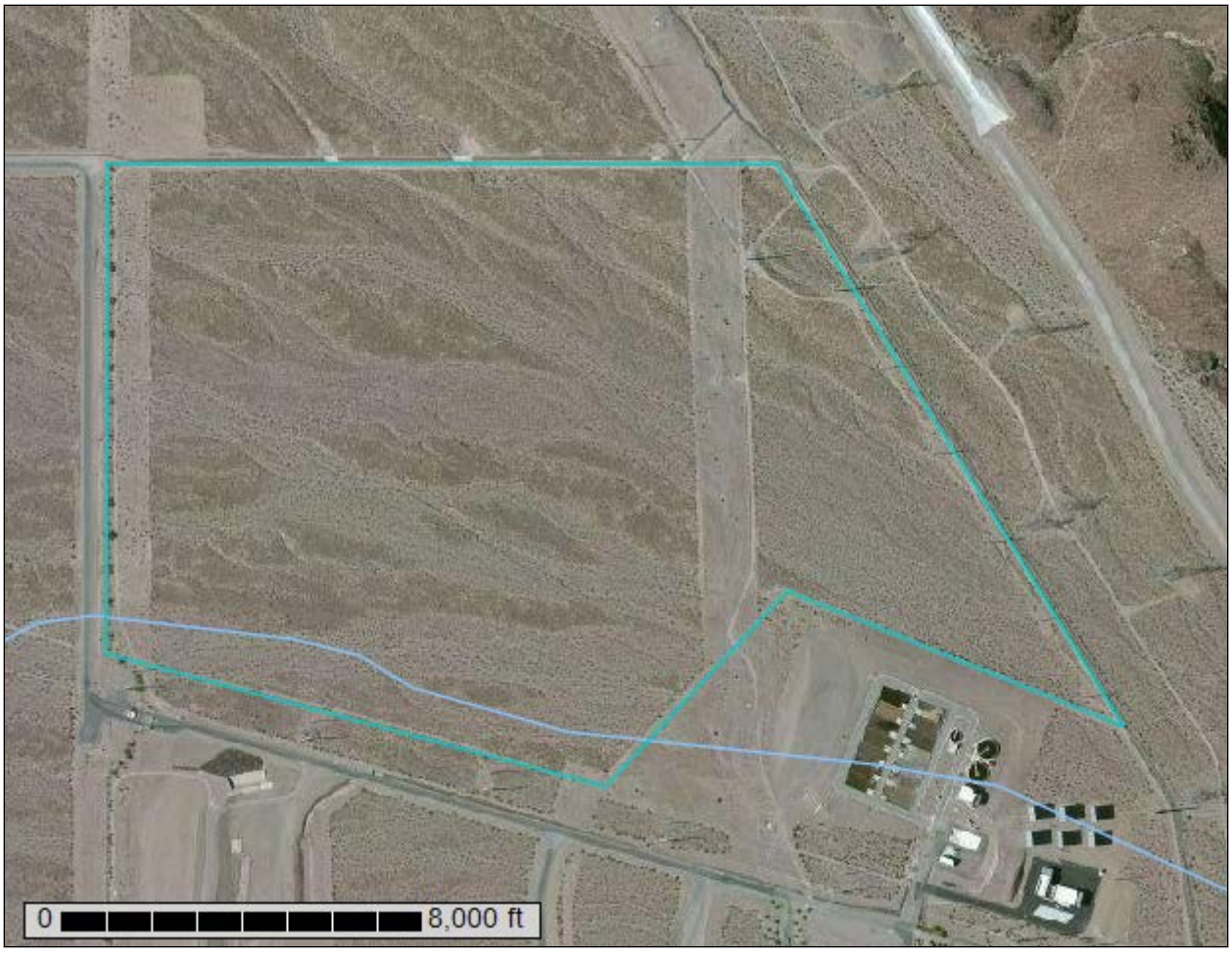
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Clark County Area, Nevada; and Las Vegas Valley Area, Nevada, Part of Clark County

SNWA Soil Classification



January 12, 2015

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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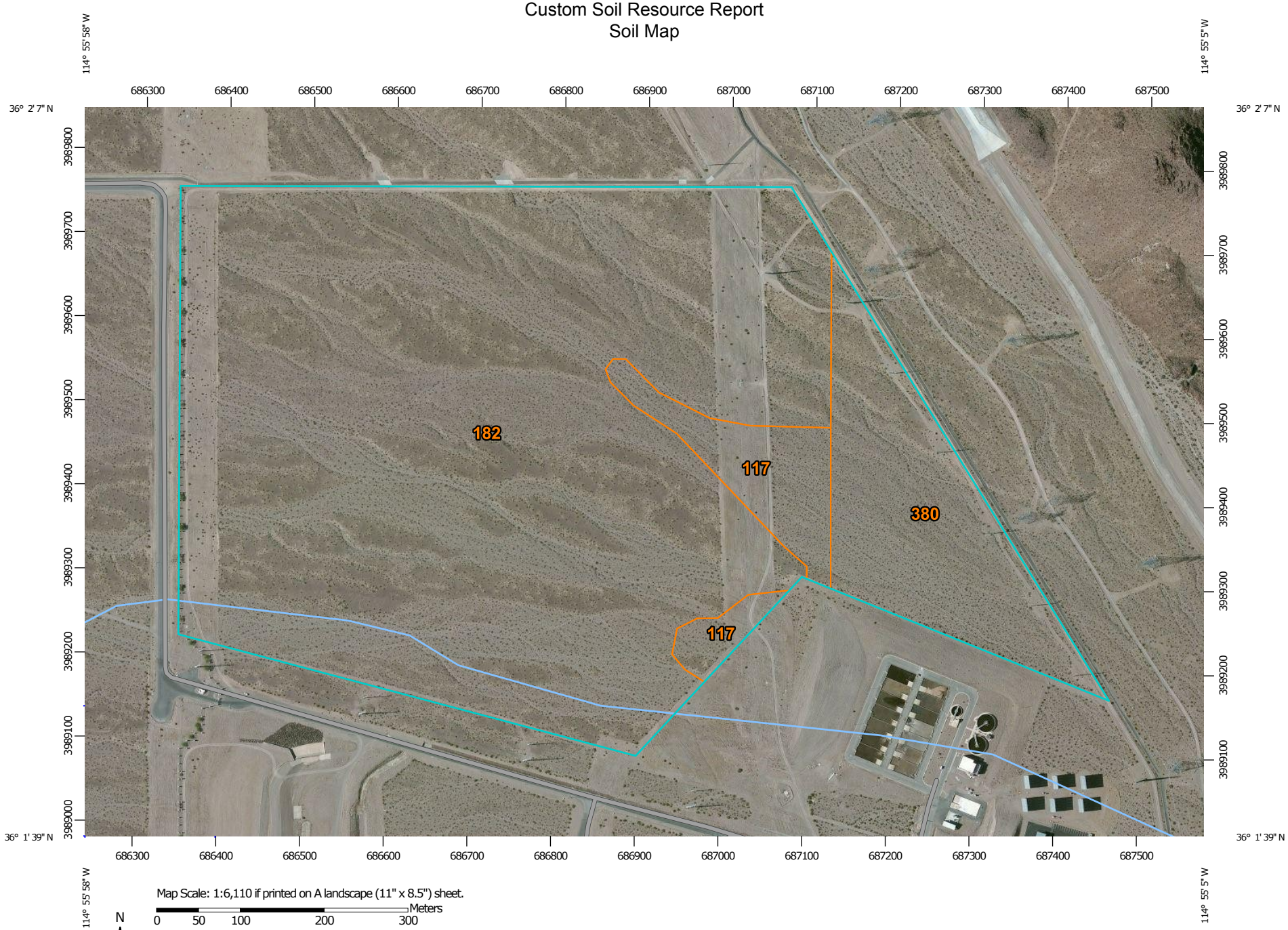
Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clark County Area, Nevada
Survey Area Data: Version 10, Aug 22, 2014

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County
Survey Area Data: Version 10, Aug 22, 2014

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 26, 2011—Jun 2, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting

Map Unit Legend

Clark County Area, Nevada (NV755)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
380	Tonopah-Arizo association	16.6	12.7%
Subtotals for Soil Survey Area		**16.6**	**12.7%**
Totals for Area of Interest		**130.1**	**100.0%**

Las Vegas Valley Area, Nevada, Part of Clark County (NV788)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
117	Arizo very gravelly fine sandy loam, 2 to 8 percent slopes	7.4	5.7%
182	Caliza-Pittman-Arizo complex, 0 to 8 percent slopes	106.1	81.6%
Subtotals for Soil Survey Area		**113.5**	**87.3%**
Totals for Area of Interest		**130.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially

where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Clark County Area, Nevada

380—Tonopah-Arizo association

Map Unit Setting

National map unit symbol: hqwy
Elevation: 1,710 to 4,360 feet
Mean annual precipitation: 5 to 7 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Tonopah and similar soils: 45 percent
Arizo and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tonopah

Setting

Landform: Fan remnants
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 1 inches: extremely gravelly sandy loam
H2 - 1 to 9 inches: very gravelly sandy loam
H3 - 9 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Limy 5-7 p.z. (R030XB005NV)
Other vegetative classification: Limy 5-7 p.z. (030XB005NV_3)

Description of Arizo

Setting

Landform: Fan aprons
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from mixed sources

Typical profile

H1 - 0 to 2 inches: very gravelly loamy sand
H2 - 2 to 6 inches: sand
H3 - 6 to 60 inches: stratified very gravelly coarse sand to extremely gravelly sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rare
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: Limy 5-7 p.z. (R030XB005NV)
Other vegetative classification: Limy 5-7 p.z. (030XB005NV_3)

Minor Components

Typic haplodurids

Percent of map unit: 8 percent
Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Limy 5-7 p.z. (R030XB005NV)
Other vegetative classification: Limy 5-7 p.z. (030XB005NV_3)

Arizo

Percent of map unit: 5 percent
Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: Valley wash (R030XB028NV)

Typic torriorthents

Percent of map unit: 2 percent
Landform: Fan skirts

Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: Limy 5-7 p.z. (R030XB005NV)
Other vegetative classification: Limy 5-7 p.z. (030XB005NV_3)

Las Vegas Valley Area, Nevada, Part of Clark County

117—Arizo very gravelly fine sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hr9g
Elevation: 1,500 to 4,500 feet
Mean annual precipitation: 4 to 8 inches
Mean annual air temperature: 64 to 70 degrees F
Frost-free period: 220 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Arizo and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arizo

Setting

Landform: Inset fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 6 inches: very gravelly fine sandy loam
H2 - 6 to 60 inches: stratified cobbly coarse sand to extremely gravelly loamy sand

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)

182—Caliza-Pittman-Arizo complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: hr9z
Elevation: 750 to 4,000 feet
Mean annual precipitation: 4 to 10 inches
Mean annual air temperature: 57 to 68 degrees F
Frost-free period: 180 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Caliza and similar soils: 60 percent
Pittman and similar soils: 20 percent
Arizo and similar soils: 15 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Caliza

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 2 inches: extremely cobbly fine sandy loam
H2 - 2 to 14 inches: very gravelly sandy loam
H3 - 14 to 60 inches: stratified extremely gravelly coarse sand to very gravelly loamy sand

Properties and qualities

Slope: 2 to 8 percent
Percent of area covered with surface fragments: 5.0 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)

Description of Pittman

Setting

Landform: Fan remnants
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 2 inches: extremely cobbly fine sandy loam
H2 - 2 to 23 inches: stratified extremely gravelly coarse sand to gravelly loam
H3 - 23 to 32 inches: indurated
H4 - 32 to 50 inches: cemented
H5 - 50 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 2 to 8 percent
Percent of area covered with surface fragments: 2.0 percent
Depth to restrictive feature: 20 to 30 inches to petrocalcic; 28 to 60 inches to cemented horizon
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)

Description of Arizo

Setting

Landform: Channels
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 8 inches: very gravelly loamy sand
H2 - 8 to 60 inches: stratified cobbly coarse sand to extremely gravelly sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: Occasional
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Valley wash (R030XB028NV)

Minor Components

Nickel

Percent of map unit: 5 percent
Landform: Pediments
Down-slope shape: Convex
Across-slope shape: Convex
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)

B

Appendix B: Hydraulic Calculations

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602.522.7700

SNWA River Mountains Solar
Channel Summary **Riprap 'n' value = 0.035** **earthen 'n' value = 0.022**
4/21/2015

Concentration Point	Q100 (cfs)	Slope (ft/ft)	BW (ft)	Left Side Slope (H:V)	Right Side Slope (H:V)	Surface	'n' value	Flow Depth (ft)	Velocity (fps)	Channel Depth (ft)	Note
Ex A	80	0.0160	2	25	8	Earth	0.022	0.9	5.2	1.1	*Ex road side ditch
P-A	108	0.0160	2	25	8	Earth	0.022	1.0	5.6	1.1	*Ex road side ditch
EX-DS-A	18	0.0500	4	4	4	Earth	0.022	0.4	7.2	2	*Ex wash downstream of Ex Culvert A
DS-A	19	0.0500	4	4	4	Earth	0.022	0.5	7.3	2	*Ex wash downstream of Ex Culvert A
EX-DS-B	95	0.0510	10	8	4	Earth	0.022	0.7	9.9	3	*Ex wash downstream of Ex Culvert B
DS-B	141	0.0510	10	8	4	Earth	0.022	0.8	11.2	3	*Ex wash downstream of Ex Culvert B
A-6-S	21	0.0065	0	4	30	Earth	0.022	0.7	2.7	1	
A-7-S	11	0.0065	0	4	30	Earth	0.022	0.5	2.3	1	
A-8-S	19	0.0057	0	4	30	Earth	0.022	0.7	2.5	1	
A-9-S	20	0.0057	0	4	30	Earth	0.022	0.7	2.5	1	
B-2-S	15	0.0141	0	4	30	Earth	0.022	0.5	3.3	1	
B-3-S	16	0.0140	0	4	30	Earth	0.022	0.5	3.3	1	
B-4-S	16	0.0150	0	4	30	Earth	0.022	0.5	3.4	1	
D-1-N	5	0.0304	0	4	4	Earth	0.022	0.5	4.7	1.2	
D-1-S	16	0.0150	0	4	30	Earth	0.022	0.5	3.4	1	
OFF-A5-N	4	0.0064	0	25	4	Earth	0.022	0.4	1.8	2	
OFF-A5-S	15	0.0303	0	4	25	Riprap	0.035	0.6	3.2	2	
OFF-D3	24	0.0208	0	4	25	Riprap	0.035	0.7	3.1	2	
P-A4	18	0.0050	0	4	4	Earth	0.022	1.2	3.3	2	
P-A3	22	0.0400	0	4	4	Riprap	0.035	1.0	5.3	2.5	
P-A2	22	0.0050	4	4	4	Riprap	0.035	1.1	2.4	2.5	
A-9-N	2	0.0408	0	4	4	Earth	0.022	0.4	4.2	2	
P-A8	58	0.0303	0	4	4	Riprap	0.035	1.5	6.1	2	
P-A7	65	0.0343	0	4	4	Riprap	0.035	1.6	6.6	2	
P-A6	81	0.0343	0	4	4	Riprap	0.035	1.7	6.9	2	
P-OFF-D2	23	0.0313	0	4	4	Riprap	0.035	1.1	4.9	2	
P-B4	18	0.0167	0	4	4	Riprap	0.035	1.1	3.6	2.5	
P-B3	36	0.0207	0	4	4	Riprap	0.035	1.4	4.7	2.5	
P-B2	50	0.0557	0	4	4	Riprap	0.035	1.3	7.4	2.5	

(1) "Ex" designates existing subbasin or concentration point.

Trapezoidal Channel (Channel Calcs.fm8) Report

Label	Friction Method	Roughness Coefficient	Channel Slope (ft/ft)	Normal Depth (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Discharge (ft^3/s)	Velocity (ft/s)	Froude Number	Flow Type
A-6-S	Manning Formula	0.022	0.00650	0.68	4.00	30.00	0.00	21.00	2.65	0.80	Subcritical
A-7-S	Manning Formula	0.022	0.00650	0.54	4.00	30.00	0.00	11.00	2.26	0.77	Subcritical
A-8-S	Manning Formula	0.022	0.00570	0.67	4.00	30.00	0.00	19.00	2.46	0.75	Subcritical
A-9-S	Manning Formula	0.022	0.00570	0.69	4.00	30.00	0.00	20.00	2.49	0.75	Subcritical
B-2-S	Manning Formula	0.022	0.01400	0.52	4.00	30.00	0.00	15.00	3.25	1.12	Supercritical
B-3-S	Manning Formula	0.022	0.01400	0.53	4.00	30.00	0.00	16.00	3.30	1.13	Supercritical
B-4-S	Manning Formula	0.022	0.01500	0.53	4.00	30.00	0.00	16.00	3.39	1.16	Supercritical
D-1-N	Manning Formula	0.022	0.03000	0.52	4.00	4.00	0.00	5.00	4.66	1.61	Supercritical
D-1-S	Manning Formula	0.022	0.01500	0.53	4.00	30.00	0.00	16.00	3.39	1.16	Supercritical
OFF-A5-N	Manning Formula	0.022	0.00640	0.39	25.00	4.00	0.00	4.00	1.81	0.72	Subcritical
OFF-A5-S	Manning Formula	0.035	0.03000	0.57	4.00	25.00	0.00	15.00	3.18	1.05	Supercritical
OFF-D3	Manning Formula	0.035	0.02100	0.73	4.00	25.00	0.00	24.00	3.13	0.91	Subcritical
P-A4	Manning Formula	0.022	0.00500	1.17	4.00	4.00	0.00	18.00	3.28	0.75	Subcritical
P-A3	Manning Formula	0.035	0.04000	1.02	4.00	4.00	0.00	22.00	5.31	1.31	Supercritical
P-A2	Manning Formula	0.035	0.00500	1.10	4.00	4.00	4.00	22.00	2.38	0.49	Subcritical
A-9-N	Manning Formula	0.022	0.04080	0.35	4.00	4.00	0.00	2.00	4.15	1.76	Supercritical
P-A8	Manning Formula	0.035	0.03030	1.54	4.00	4.00	0.00	58.00	6.09	1.22	Supercritical
P-A7	Manning Formula	0.035	0.03430	1.57	4.00	4.00	0.00	65.00	6.57	1.31	Supercritical
P-A6	Manning Formula	0.035	0.03430	1.71	4.00	4.00	0.00	81.00	6.94	1.32	Supercritical
P-OFF-D2	Manning Formula	0.035	0.03130	1.08	4.00	4.00	0.00	23.00	4.90	1.17	Supercritical
P-B4	Manning Formula	0.035	0.01670	1.11	4.00	4.00	0.00	18.00	3.64	0.86	Subcritical
P-B3	Manning Formula	0.035	0.02070	1.39	4.00	4.00	0.00	36.00	4.69	0.99	Subcritical
P-B2	Manning Formula	0.035	0.05570	1.30	4.00	4.00	0.00	50.00	7.38	1.61	Supercritical
EX-P-A	Manning Formula	0.022	0.01600	0.90	25.00	8.00	2.00	80.00	5.23	1.33	Supercritical
P-A	Manning Formula	0.022	0.01600	1.02	25.00	8.00	2.00	108.00	5.64	1.36	Supercritical
EX-DS-A	Manning Formula	0.022	0.05000	0.44	4.00	4.00	4.00	18.00	7.20	2.20	Supercritical
DS-A	Manning Formula	0.022	0.05000	0.45	4.00	4.00	4.00	19.00	7.32	2.21	Supercritical
EX-DS-B	Manning Formula	0.022	0.05100	0.68	8.00	4.00	10.00	95.00	9.91	2.41	Supercritical
DS-B	Manning Formula	0.022	0.05100	0.84	8.00	4.00	10.00	141.00	11.15	2.48	Supercritical

SNWA River Mountains Solar
Culvert Summary
4/21/2015

Culvert Location	Q100 (cfs)	INV Up	INV Down	L (ft)	Type	Size (in)	Barrels	Outlet Velocity (fps) (2)	Minimum D50 Riprap Size (in)	Length of outlet protection (ft) (1)	HWE (ft)	Headwater Depth (ft)	Allowable headwater depth	Note
EX A	80	2142.0	2140	83	CMP	24	1	7.0	-	-	2145.1	3.1	2.5	Existing culvert is undersized for Q100. 62 cfs overtops and discharges to Existing Culvert B. Q100=18 cfs to EX-DS-A. In 10-year 7 cfs weirs to Existing Culvert B with Q10=16 cfs to EX-DS-A.
P-A	108	2142.0	2140	83	CMP	24	1	7.2	-	-	2145.26	3.3	2.5	Existing culvert is undersized for Q100. 89 cfs overtops and discharges to Existing Culvert B. Q100=19 cfs to DS-A. In 10-year 24cfs weirs to Existing Culvert B with Q10=17cfs to DS-A.
EX B	95	2140.0	2138	75	CMP	24	1	8.2	-	-	2144.16	4.2	3.5	Ex-DS-B Q100=95 cfs includes 62 cfs from the overtopping of EX Culvert A. In 10-year Ex-DS-B Q10=17 cfs includes 7 cfs from the overtopping of Existing Culvert A.
P-B	141	2140.0	2138	75	CMP	24	1	8.5	-	-	2144.41	4.4	3.5	DS-B Q100=141cfs includes 89 cfs from the overtopping of EX Culvert A. In 10-year DS-B Q10=48cfs includes 24cfs from the overtopping of EX Culvert A.
P-A3	22	2201.5	2198	70	HDPE	36	1	13.9	Grouted Riprap	9	2203.9	2.4	2.5	
P-A4	18	2236.0	2235.5	50	HDPE	36	1	7.7	6	9	2238.14	2.1	2.5	
P-A5	19	2228.5	2225	71	HDPE	36	1	16.2	Grouted Riprap	9	2230.71	2.2	2.5	
P-A6	81	2162.0	2156	108	HDPE	36	2	17.4	Grouted Riprap	9	2165.48	3.5	3.5	
P-A8	58	2194.0	2192	60	HDPE	36	2	4.7	6	9	2196.82	2.8	3	
P-B2	50	2149.3	2146	103	HDPE	36	2	12.8	Grouted Riprap	9	2151.88	2.6	2.7	
P-B4	18	2182.9	2182	71	HDPE	36	1	8.4	6	9	2185.04	2.1	2.6	
P-D1	23	2189.0	2186	121	HDPE	24	1	11.9	6	6	2192.45	3.4	3.5	part of existing washbank protection
P-E1	1	2200.0	2198.5	61	HDPE	18	1	5.2	6	4.5	2200.57	0.6	2	
P-E2	1	2201.5	2200	47	HDPE	18	1	5.9	6	4.5	2202.16	0.7	2	
Drain B2	(3)	2146.0	2145.9	20	HDPE	18	1	(3)	6	4.5	(3)	(3)	(3)	Drain pipe - riprap part of existing weir riprap
Drain A1	(3)	2156.0	2154.5	26	HDPE	18	1	(3)	6	4.5	(3)	(3)	(3)	Drain pipe - riprap part of existing weir riprap
Drain A2	(3)	2157.0	2156.9	23	HDPE	18	1	(3)	6	4.5	(3)	(3)	(3)	

(1) Length of outlet protection is 3*D (36" and less) and 4*D (42" and greater) per HCDDM Figure 712
(2) Per FHWA "Hydraulic Deisgn of Energy Dissapators for Culverts and Channels" Sept. 1983, Figure II-C-1. D50=6" < 8.5fps, D50=12" < 12.5fps, Grouted Riprap > 12.5fps

Culvert Analysis Report
EX A

Comments: q100= 80 cfs goes to existing Culvert A. q100=18 cfs through the pipe and 62 cfs weir to existing culvert B.

Analysis Component			
Storm Event	Design	Discharge	80.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	80.00 cfs	Check Discharge	80.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,140.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	18.27 cfs	2,145.10 ft	7.04 ft/s
Weir	Broad Crested	61.80 cfs	2,145.10 ft	N/A
Total	----------	80.07 cfs	2,145.10 ft	N/A

Culvert Analysis Report
EX A

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,145.10	ft	Discharge	18.27	cfs
Inlet Control HW Elev.	2,145.10	ft	Tailwater Elevation	2,140.00	ft
Outlet Control HW Elev.	2,144.68	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.55				

Grades					
Upstream Invert	2,142.00	ft	Downstream Invert	2,140.00	ft
Length	83.00	ft	Constructed Slope	0.024096	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.54	ft
Slope Type	Mild		Normal Depth	1.57	ft
Flow Regime	Subcritical		Critical Depth	1.54	ft
Velocity Downstream	7.04	ft/s	Critical Slope	0.025210	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,144.68	ft	Upstream Velocity Head	0.74	ft
Ke	0.50		Entrance Loss	0.37	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,145.10	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
EX A

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	61.80	cfs	Allowable HW Elevation	2,145.10	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,144.50	ft	Headwater Elevation	2,145.10	ft

Culvert Analysis Report
EX A 10-yr

Comments: q10= 23 cfs goes to existing Culvert A. q10=16 cfs through the pipe and 7 cfs weir to existing culvert B.

Analysis Component			
Storm Event	Design	Discharge	23.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	23.00 cfs	Check Discharge	23.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,140.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	16.52 cfs	2,144.63 ft	6.82 ft/s
Weir	Broad Crested	6.50 cfs	2,144.63 ft	N/A
Total	----------	23.02 cfs	2,144.63 ft	N/A

Culvert Analysis Report
EX A 10-yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,144.63	ft	Discharge	16.52	cfs
Inlet Control HW Elev.	2,144.63	ft	Tailwater Elevation	2,140.00	ft
Outlet Control HW Elev.	2,144.51	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.32				

Grades					
Upstream Invert	2,142.00	ft	Downstream Invert	2,140.00	ft
Length	83.00	ft	Constructed Slope	0.024096	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.44	ft
Slope Type	Steep		Normal Depth	1.44	ft
Flow Regime	Supercritical		Critical Depth	1.47	ft
Velocity Downstream	6.82	ft/s	Critical Slope	0.023111	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,144.51	ft	Upstream Velocity Head	0.70	ft
Ke	0.50		Entrance Loss	0.35	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,144.63	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
EX A 10-yr

Component:Weir

Hydraulic Component(s): Broad Crested			
Discharge	6.50 cfs	Allowable HW Elevation	2,144.63 ft
Weir Coefficient	3.33 US	Length	40.00 ft
Crest Elevation	2,144.50 ft	Headwater Elevation	2,144.63 ft

Culvert Analysis Report
EX B

Comments: q100=95 cfs to existing Culvert B. Includes additional 62 cfs from Existing Culvert A weir.

Analysis Component			
Storm Event	Design	Discharge	95.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	95.00 cfs	Check Discharge	95.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,138.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	23.64 cfs	2,144.16 ft	8.21 ft/s
Weir	Broad Crested	71.41 cfs	2,144.16 ft	N/A
Total	----------	95.05 cfs	2,144.16 ft	N/A

Culvert Analysis Report
EX B

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,144.16	ft	Discharge	23.64	cfs
Inlet Control HW Elev.	2,144.16	ft	Tailwater Elevation	2,138.00	ft
Outlet Control HW Elev.	2,143.94	ft	Control Type	Inlet Control	
Headwater Depth/Height	2.08				

Grades					
Upstream Invert	2,140.00	ft	Downstream Invert	2,138.00	ft
Length	75.00	ft	Constructed Slope	0.026667	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.73	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.73	ft
Velocity Downstream	8.21	ft/s	Critical Slope	0.034341	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,143.94	ft	Upstream Velocity Head	0.88	ft
Ke	0.50		Entrance Loss	0.44	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,144.16	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
EX B

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	71.41	cfs	Allowable HW Elevation	2,144.16	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,143.50	ft	Headwater Elevation	2,144.16	ft

Culvert Analysis Report
EX B 10-yr

Comments: q10=17 cfs to existing Culvert B. Includes additional 7 cfs from Existing Culvert A weir.

Analysis Component			
Storm Event	Design	Discharge	17.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	17.00 cfs	Check Discharge	17.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,138.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	17.00 cfs	2,142.78 ft	7.15 ft/s
Weir	Broad Crested	0.00 cfs	2,142.78 ft	N/A
Total	----------	17.00 cfs	2,142.78 ft	N/A

Culvert Analysis Report
EX B 10-yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,142.78	ft	Discharge	17.00	cfs
Inlet Control HW Elev.	2,142.78	ft	Tailwater Elevation	2,138.00	ft
Outlet Control HW Elev.	2,142.56	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.39				

Grades					
Upstream Invert	2,140.00	ft	Downstream Invert	2,138.00	ft
Length	75.00	ft	Constructed Slope	0.026667	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.42	ft
Slope Type	Steep		Normal Depth	1.42	ft
Flow Regime	Supercritical		Critical Depth	1.49	ft
Velocity Downstream	7.15	ft/s	Critical Slope	0.023637	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,142.56	ft	Upstream Velocity Head	0.72	ft
Ke	0.50		Entrance Loss	0.36	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,142.78	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
EX B 10-yr

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	0.00	cfs	Allowable HW Elevation	2,142.78	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,143.50	ft	Headwater Elevation	N/A	ft

Culvert Analysis Report
P-A

Comments: q100= 108 cfs goes to existing Culvert A. q100=19 cfs through the pipe and 89 cfs weir to existing culvert B.

Analysis Component			
Storm Event	Design	Discharge	108.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	108.00 cfs	Check Discharge	108.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,140.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	19.21 cfs	2,145.26 ft	7.23 ft/s
Weir	Broad Crested	88.96 cfs	2,145.26 ft	N/A
Total	----------	108.17 cfs	2,145.26 ft	N/A

Culvert Analysis Report
P-A

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,145.26	ft	Discharge	19.21	cfs
Inlet Control HW Elev.	2,145.26	ft	Tailwater Elevation	2,140.00	ft
Outlet Control HW Elev.	2,144.77	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.63				

Grades					
Upstream Invert	2,142.00	ft	Downstream Invert	2,140.00	ft
Length	83.00	ft	Constructed Slope	0.024096	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	1.58	ft
Slope Type	Mild		Normal Depth	1.66	ft
Flow Regime	Subcritical		Critical Depth	1.58	ft
Velocity Downstream	7.23	ft/s	Critical Slope	0.026493	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,144.77	ft	Upstream Velocity Head	0.74	ft
Ke	0.50		Entrance Loss	0.37	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,145.26	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
P-A

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	88.96	cfs	Allowable HW Elevation	2,145.26	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,144.50	ft	Headwater Elevation	2,145.26	ft

Culvert Analysis Report
P-A 10-yr

Comments: q10= 41 cfs goes to existing Culvert A. q10=17 cfs through the pipe and 24 cfs weir to existing culvert B.

Analysis Component			
Storm Event	Design	Discharge	41.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	41.00 cfs	Check Discharge	41.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,140.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	17.13 cfs	2,144.82 ft	6.85 ft/s
Weir	Broad Crested	23.93 cfs	2,144.82 ft	N/A
Total	----------	41.06 cfs	2,144.82 ft	N/A

Culvert Analysis Report
P-A 10-yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,144.82	ft	Discharge	17.13	cfs
Inlet Control HW Elev.	2,144.82	ft	Tailwater Elevation	2,140.00	ft
Outlet Control HW Elev.	2,144.57	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.41				

Grades					
Upstream Invert	2,142.00	ft	Downstream Invert	2,140.00	ft
Length	83.00	ft	Constructed Slope	0.024096	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.48	ft
Slope Type	Steep		Normal Depth	1.48	ft
Flow Regime	Supercritical		Critical Depth	1.49	ft
Velocity Downstream	6.85	ft/s	Critical Slope	0.023789	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,144.57	ft	Upstream Velocity Head	0.72	ft
Ke	0.50		Entrance Loss	0.36	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,144.82	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
P-A 10-yr

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	23.93	cfs	Allowable HW Elevation	2,144.82	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,144.50	ft	Headwater Elevation	2,144.82	ft

Culvert Design Report
P-A3

Peak Discharge Method: User-Specified					
Design Discharge	22.00	cfs	Check Discharge	22.00	cfs

Grades Model: Inverts					
Invert Upstream	2,201.50	ft	Invert Downstream	2,198.00	ft
Length	70.00	ft	Slope	0.050000	ft/ft
Drop	3.50	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	22.00	cfs	Bottom Elevation	2,198.00	ft
Depth	1.05	ft	Velocity	4.98	ft/s

Tailwater conditions for Check Storm.					
Discharge	22.00	cfs	Bottom Elevation	2,198.00	ft
Depth	1.05	ft	Velocity	4.98	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-36 inch Circular	22.00 cfs	2,203.90 ft	13.86 ft/s

Culvert Design Report
P-A3

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,203.90	ft	Discharge	22.00	cfs
Headwater Depth/Height	0.80		Tailwater Elevation	2,199.05	ft
Inlet Control HW Elev.	2,203.62	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,203.90	ft			

Grades					
Upstream Invert	2,201.50	ft	Downstream Invert	2,198.00	ft
Length	70.00	ft	Constructed Slope	0.050000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.83	ft
Slope Type	Steep		Normal Depth	0.78	ft
Flow Regime	Supercritical		Critical Depth	1.51	ft
Velocity Downstream	13.86	ft/s	Critical Slope	0.004268	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,203.90	ft	Upstream Velocity Head	0.59	ft
Ke	0.50		Entrance Loss	0.30	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,203.62	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-A4

Peak Discharge Method: User-Specified					
Design Discharge	18.00	cfs	Check Discharge	18.00	cfs

Grades Model: Inverts					
Invert Upstream	2,236.00	ft	Invert Downstream	2,235.50	ft
Length	50.00	ft	Slope	0.010000	ft/ft
Drop	0.50	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	18.00	cfs	Bottom Elevation	2,235.50	ft
Depth	0.92	ft	Velocity	5.27	ft/s

Tailwater conditions for Check Storm.					
Discharge	18.00	cfs	Bottom Elevation	2,235.50	ft
Depth	0.92	ft	Velocity	5.27	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-36 inch Circular	18.00 cfs	2,238.14 ft	7.65 ft/s

Culvert Design Report
P-A4

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,238.14	ft	Discharge	18.00	cfs
Headwater Depth/Height	0.71		Tailwater Elevation	2,236.42	ft
Inlet Control HW Elev.	2,237.93	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,238.14	ft			

Grades					
Upstream Invert	2,236.00	ft	Downstream Invert	2,235.50	ft
Length	50.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.10	ft
Slope Type	Steep		Normal Depth	1.06	ft
Flow Regime	Supercritical		Critical Depth	1.36	ft
Velocity Downstream	7.65	ft/s	Critical Slope	0.004111	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,238.14	ft	Upstream Velocity Head	0.52	ft
Ke	0.50		Entrance Loss	0.26	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,237.93	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-A5

Peak Discharge Method: User-Specified					
Design Discharge	19.00	cfs	Check Discharge	19.00	cfs

Grades Model: Inverts					
Invert Upstream	2,228.50	ft	Invert Downstream	2,225.00	ft
Length	18.00	ft	Slope	0.194444	ft/ft
Drop	3.50	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	19.00	cfs	Bottom Elevation	2,224.00	ft
Depth	0.98	ft	Velocity	4.97	ft/s

Tailwater conditions for Check Storm.					
Discharge	19.00	cfs	Bottom Elevation	2,224.00	ft
Depth	0.98	ft	Velocity	4.97	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-36 inch Circular	19.00 cfs	2,230.71 ft	16.21 ft/s

Culvert Design Report
P-A5

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,230.71	ft	Discharge	19.00	cfs
Headwater Depth/Height	0.74		Tailwater Elevation	2,224.98	ft
Inlet Control HW Elev.	2,230.22	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,230.71	ft			

Grades					
Upstream Invert	2,228.50	ft	Downstream Invert	2,225.00	ft
Length	18.00	ft	Constructed Slope	0.194444	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.67	ft
Slope Type	Steep		Normal Depth	0.52	ft
Flow Regime	Supercritical		Critical Depth	1.40	ft
Velocity Downstream	16.21	ft/s	Critical Slope	0.004144	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,230.71	ft	Upstream Velocity Head	0.54	ft
Ke	0.50		Entrance Loss	0.27	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,230.22	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-A6

Peak Discharge Method: User-Specified					
Design Discharge	81.00	cfs	Check Discharge	81.00	cfs

Grades Model: Inverts					
Invert Upstream	2,162.00	ft	Invert Downstream	2,156.00	ft
Length	108.00	ft	Slope	0.055556	ft/ft
Drop	6.00	ft			

Headwater Model: Unspecified

Tailwater Conditions: Constant Tailwater		
Tailwater Elevation	2,157.00	ft

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	2-36 inch Circular	81.00 cfs	2,165.48 ft	17.37 ft/s

Culvert Design Report
P-A6

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,165.48	ft	Discharge	81.00	cfs
Headwater Depth/Height	1.16		Tailwater Elevation	2,157.00	ft
Inlet Control HW Elev.	2,165.25	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,165.48	ft			

Grades					
Upstream Invert	2,162.00	ft	Downstream Invert	2,156.00	ft
Length	108.00	ft	Constructed Slope	0.055556	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.09	ft
Slope Type	Steep		Normal Depth	1.04	ft
Flow Regime	Supercritical		Critical Depth	2.07	ft
Velocity Downstream	17.37	ft/s	Critical Slope	0.005447	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	2,165.48	ft	Upstream Velocity Head	0.94	ft
Ke	0.50		Entrance Loss	0.47	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,165.25	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	14.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-A8

Peak Discharge Method: User-Specified					
Design Discharge	58.00	cfs	Check Discharge	58.00	cfs

Grades Model: Inverts					
Invert Upstream	2,194.00	ft	Invert Downstream	2,192.00	ft
Length	60.00	ft	Slope	0.033333	ft/ft
Drop	2.00	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	58.00	cfs	Bottom Elevation	2,193.00	ft
Depth	1.47	ft	Velocity	6.67	ft/s

Tailwater conditions for Check Storm.					
Discharge	58.00	cfs	Bottom Elevation	2,193.00	ft
Depth	1.47	ft	Velocity	6.67	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	2-36 inch Circular	58.00 cfs	2,196.82 ft	4.65 ft/s

Culvert Design Report
P-A8

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,196.82	ft	Discharge	58.00	cfs
Headwater Depth/Height	0.94		Tailwater Elevation	2,194.47	ft
Inlet Control HW Elev.	2,196.58	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,196.82	ft			

Grades					
Upstream Invert	2,194.00	ft	Downstream Invert	2,192.00	ft
Length	60.00	ft	Constructed Slope	0.033333	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	2.47	ft
Slope Type	Steep		Normal Depth	1.00	ft
Flow Regime	N/A		Critical Depth	1.74	ft
Velocity Downstream	4.65	ft/s	Critical Slope	0.004624	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	2,196.82	ft	Upstream Velocity Head	0.72	ft
Ke	0.50		Entrance Loss	0.36	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,196.58	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	14.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Analysis Report
P-B

Comments: q100=141 cfs to existing Culvert B. Includes 89 cfs from Existing Culvert A in proposed condition.

Analysis Component			
Storm Event	Design	Discharge	141.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	141.00 cfs	Check Discharge	141.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,138.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	24.76 cfs	2,144.41 ft	8.47 ft/s
Weir	Broad Crested	116.39 cfs	2,144.41 ft	N/A
Total	----------	141.16 cfs	2,144.41 ft	N/A

Culvert Analysis Report
P-B

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,144.41	ft	Discharge	24.76	cfs
Inlet Control HW Elev.	2,144.41	ft	Tailwater Elevation	2,138.00	ft
Outlet Control HW Elev.	2,144.38	ft	Control Type	Inlet Control	
Headwater Depth/Height	2.21				

Grades					
Upstream Invert	2,140.00	ft	Downstream Invert	2,138.00	ft
Length	75.00	ft	Constructed Slope	0.026667	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.76	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.76	ft
Velocity Downstream	8.47	ft/s	Critical Slope	0.036855	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,144.38	ft	Upstream Velocity Head	0.97	ft
Ke	0.50		Entrance Loss	0.48	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,144.41	ft	Flow Control	N/A	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
P-B

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	116.39	cfs	Allowable HW Elevation	2,144.41	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,143.50	ft	Headwater Elevation	2,144.41	ft

Culvert Analysis Report
P-B 10-yr

Comments: q10=48 cfs to existing Culvert B. Includes 24 cfs from existing Culvert A in proposed condition.

Analysis Component			
Storm Event	Design	Discharge	48.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	48.00 cfs	Check Discharge	48.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	2,138.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	22.14 cfs	2,143.84 ft	7.86 ft/s
Weir	Broad Crested	25.92 cfs	2,143.84 ft	N/A
Total	----------	48.06 cfs	2,143.84 ft	N/A

Culvert Analysis Report
P-B 10-yr

Component:Culvert-1

Culvert Summary					
Computed Headwater Elevation	2,143.84	ft	Discharge	22.14	cfs
Inlet Control HW Elev.	2,143.84	ft	Tailwater Elevation	2,138.00	ft
Outlet Control HW Elev.	2,143.28	ft	Control Type	Inlet Control	
Headwater Depth/Height	1.92				

Grades					
Upstream Invert	2,140.00	ft	Downstream Invert	2,138.00	ft
Length	75.00	ft	Constructed Slope	0.026667	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	1.68	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	1.68	ft
Velocity Downstream	7.86	ft/s	Critical Slope	0.031313	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.024	
Section Material	CMP		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,143.28	ft	Upstream Velocity Head	0.77	ft
Ke	0.50		Entrance Loss	0.39	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,143.84	ft	Flow Control	Submerged	
Inlet Type	Mitered to slope		Area Full	3.1	ft²
K	0.02100		HDS 5 Chart	2	
M	1.33000		HDS 5 Scale	2	
C	0.04630		Equation Form	1	
Y	0.75000				

Culvert Analysis Report
P-B 10-yr

Component:Weir

Hydraulic Component(s): Broad Crested					
Discharge	25.92	cfs	Allowable HW Elevation	2,143.84	ft
Weir Coefficient	3.33	US	Length	40.00	ft
Crest Elevation	2,143.50	ft	Headwater Elevation	2,143.84	ft

Culvert Design Report
P-B2

Peak Discharge Method: User-Specified					
Design Discharge	50.00	cfs	Check Discharge	50.00	cfs

Grades Model: Inverts					
Invert Upstream	2,149.30	ft	Invert Downstream	2,146.00	ft
Length	103.00	ft	Slope	0.032039	ft/ft
Drop	3.30	ft			

Headwater Model: Unspecified

Tailwater Conditions: Constant Tailwater		
Tailwater Elevation	2,147.00	ft

	Name	Description	Discharge	HW Elev.	Velocity
x	Trial-1	2-36 inch Circular	50.00 cfs	2,151.88 ft	12.81 ft/s

Culvert Design Report
P-B2

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,151.88	ft	Discharge	50.00	cfs
Headwater Depth/Height	0.86		Tailwater Elevation	2,147.00	ft
Inlet Control HW Elev.	2,151.64	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,151.88	ft			

Grades					
Upstream Invert	2,149.30	ft	Downstream Invert	2,146.00	ft
Length	103.00	ft	Constructed Slope	0.032039	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.96	ft
Slope Type	Steep		Normal Depth	0.93	ft
Flow Regime	Supercritical		Critical Depth	1.61	ft
Velocity Downstream	12.81	ft/s	Critical Slope	0.004409	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	2				

Outlet Control Properties					
Outlet Control HW Elev.	2,151.88	ft	Upstream Velocity Head	0.65	ft
Ke	0.50		Entrance Loss	0.32	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,151.64	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	14.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-B4

Peak Discharge Method: User-Specified					
Design Discharge	18.00	cfs	Check Discharge	18.00	cfs

Grades Model: Inverts					
Invert Upstream	2,182.90	ft	Invert Downstream	2,182.00	ft
Length	71.00	ft	Slope	0.012676	ft/ft
Drop	0.90	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	18.00	cfs	Bottom Elevation	2,182.00	ft
Depth	0.98	ft	Velocity	4.68	ft/s

Tailwater conditions for Check Storm.					
Discharge	18.00	cfs	Bottom Elevation	2,182.00	ft
Depth	0.98	ft	Velocity	4.68	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-36 inch Circular	18.00 cfs	2,185.04 ft	8.41 ft/s

Culvert Design Report
P-B4

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,185.04	ft	Discharge	18.00	cfs
Headwater Depth/Height	0.71		Tailwater Elevation	2,182.98	ft
Inlet Control HW Elev.	2,184.82	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,185.04	ft			

Grades					
Upstream Invert	2,182.90	ft	Downstream Invert	2,182.00	ft
Length	71.00	ft	Constructed Slope	0.012676	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.03	ft
Slope Type	Steep		Normal Depth	1.00	ft
Flow Regime	Supercritical		Critical Depth	1.36	ft
Velocity Downstream	8.41	ft/s	Critical Slope	0.004111	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	3.00	ft
Section Size	36 inch		Rise	3.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,185.04	ft	Upstream Velocity Head	0.52	ft
Ke	0.50		Entrance Loss	0.26	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,184.82	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	7.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-D1

Peak Discharge Method: User-Specified					
Design Discharge	23.00	cfs	Check Discharge	23.00	cfs

Grades Model: Inverts					
Invert Upstream	2,189.00	ft	Invert Downstream	2,186.00	ft
Length	121.00	ft	Slope	0.024793	ft/ft
Drop	3.00	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	23.00	cfs	Bottom Elevation	2,186.00	ft
Depth	0.99	ft	Velocity	5.86	ft/s

Tailwater conditions for Check Storm.					
Discharge	23.00	cfs	Bottom Elevation	2,186.00	ft
Depth	0.99	ft	Velocity	5.86	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-24 inch Circular	23.00 cfs	2,192.45 ft	11.87 ft/s

Culvert Design Report
P-D1

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,192.45	ft	Discharge	23.00	cfs
Headwater Depth/Height	1.72		Tailwater Elevation	2,186.99	ft
Inlet Control HW Elev.	2,192.45	ft	Control Type	Inlet Control	
Outlet Control HW Elev.	2,192.22	ft			

Grades					
Upstream Invert	2,189.00	ft	Downstream Invert	2,186.00	ft
Length	121.00	ft	Constructed Slope	0.024793	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	1.18	ft
Slope Type	Steep		Normal Depth	1.17	ft
Flow Regime	Supercritical		Critical Depth	1.71	ft
Velocity Downstream	11.87	ft/s	Critical Slope	0.009682	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	2.00	ft
Section Size	24 inch		Rise	2.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,192.22	ft	Upstream Velocity Head	1.01	ft
Ke	0.50		Entrance Loss	0.50	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,192.45	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	3.1	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-E1

Peak Discharge Method: User-Specified					
Design Discharge	1.00	cfs	Check Discharge	1.00	cfs

Grades Model: Inverts					
Invert Upstream	2,200.00	ft	Invert Downstream	2,198.50	ft
Length	61.00	ft	Slope	0.024590	ft/ft
Drop	1.50	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	1.00	cfs	Bottom Elevation	2,198.50	ft
Depth	0.30	ft	Velocity	2.78	ft/s

Tailwater conditions for Check Storm.					
Discharge	1.00	cfs	Bottom Elevation	2,198.50	ft
Depth	0.30	ft	Velocity	2.78	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-18 inch Circular	1.00 cfs	2,200.57 ft	5.15 ft/s

Culvert Design Report
P-E1

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,200.57	ft	Discharge	1.00	cfs
Headwater Depth/Height	0.38		Tailwater Elevation	2,198.80	ft
Inlet Control HW Elev.	2,200.49	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,200.57	ft			

Grades					
Upstream Invert	2,200.00	ft	Downstream Invert	2,198.50	ft
Length	61.00	ft	Constructed Slope	0.024590	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.25	ft
Slope Type	Steep		Normal Depth	0.25	ft
Flow Regime	Supercritical		Critical Depth	0.37	ft
Velocity Downstream	5.15	ft/s	Critical Slope	0.004937	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	1.50	ft
Section Size	18 inch		Rise	1.50	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,200.57	ft	Upstream Velocity Head	0.13	ft
Ke	0.50		Entrance Loss	0.07	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,200.49	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	1.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

Culvert Design Report
P-E2

Peak Discharge Method: User-Specified					
Design Discharge	1.00	cfs	Check Discharge	1.00	cfs

Grades Model: Inverts					
Invert Upstream	2,201.50	ft	Invert Downstream	2,200.00	ft
Length	47.00	ft	Slope	0.031915	ft/ft
Drop	1.50	ft			

Headwater Model: Unspecified

Tailwater properties: Triangular Channel

Tailwater conditions for Design Storm.					
Discharge	1.00	cfs	Bottom Elevation	2,200.00	ft
Depth	0.30	ft	Velocity	2.78	ft/s

Tailwater conditions for Check Storm.					
Discharge	1.00	cfs	Bottom Elevation	2,200.00	ft
Depth	0.30	ft	Velocity	2.78	ft/s

Name	Description	Discharge	HW Elev.	Velocity
x Trial-1	1-12 inch Circular	1.00 cfs	2,202.16 ft	5.91 ft/s

Culvert Design Report
P-E2

Design:Trial-1

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	N/A	ft	Storm Event	Design	
Computed Headwater Elevation	2,202.16	ft	Discharge	1.00	cfs
Headwater Depth/Height	0.66		Tailwater Elevation	2,200.30	ft
Inlet Control HW Elev.	2,202.08	ft	Control Type	Entrance Control	
Outlet Control HW Elev.	2,202.16	ft			

Grades					
Upstream Invert	2,201.50	ft	Downstream Invert	2,200.00	ft
Length	47.00	ft	Constructed Slope	0.031915	ft/ft

Hydraulic Profile					
Profile	S2		Depth, Downstream	0.27	ft
Slope Type	Steep		Normal Depth	0.27	ft
Flow Regime	Supercritical		Critical Depth	0.42	ft
Velocity Downstream	5.91	ft/s	Critical Slope	0.005821	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Corrugated HDPE (Smooth Interior)		Span	1.00	ft
Section Size	12 inch		Rise	1.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	2,202.16	ft	Upstream Velocity Head	0.16	ft
Ke	0.50		Entrance Loss	0.08	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,202.08	ft	Flow Control	N/A	
Inlet Type	Square edge w/headwall		Area Full	0.8	ft²
K	0.00980		HDS 5 Chart	1	
M	2.00000		HDS 5 Scale	1	
C	0.03980		Equation Form	1	
Y	0.67000				

SNWA River Mountains Solar
Weir Summary
4/21/2015

Concentration Point	Q100 (cfs)	Number of weirs	Discharge per weir (cfs) (1)	Crest length (ft)	Crest breadth (ft)	Discharge per length (cfs/ft)	D50 Riprap Size for spillways (2)	Flow depth above crest (ft)	Weir depth (ft)
P-A1	79	2	39	40	8	1.0	18	0.51	1
P-A2	22	2	11	40	8	0.3	18	0.22	1
P-OFF-B2	52	2	26	40	8	0.6	18	0.39	1
EX C	7	1	7	45	18	-	-	0.15	1
OFF-C1	1	1	1	45	18	-	-	0.04	1
EX D	32	1	32	40	8	-	-	0.32	1
P-D	41	1	41	40	8	-	-	0.38	1
EX E	1	1	1	40	8	-	-	0.06	1
OFF-E	1	1	1	40	8	-	-	0.06	1
EX F	23	1	23	40	8	-	-	0.39	1
OFF-F	23	1	23	40	8	-	-	0.39	1

(1) Assumes that flow is evenly distributed between weirs of same elevation.
(2) Per Table 1102 of the HCDDM and Uniform Standard Specification Section 610.02.04 of the Region Transportation Commission of Southern Nevada.
(3) "Ex" designates existing subbasin or concentration point.

Broad Crested Weir (Channel Calcs.fm8) Report

Label	Discharge (ft³/s)	Headwater Elevation (ft)	Crest Elevation (ft)	Tailwater Elevation (ft)	Crest Surface Type	Crest Breadth (ft)	Crest Length (ft)	Headwater Height Above Crest (ft)	Tailwater Height Above Crest (ft)	Weir Coefficient (US)	Submergence Factor
Weir P-A1	39.00	2158.51	2158.00	0.00	Gravel	8.00	40.00	0.51	-2158.00	2.70	1.00
Weir P-A2	11.00	2166.22	2166.00	0.00	Gravel	8.00	40.00	0.22	-2166.00	2.60	1.00
Weir P-OFF-B2	26.00	2147.39	2147.00	0.00	Gravel	8.00	40.00	0.39	-2147.00	2.66	1.00
Weir EX C	7.00	2168.15	2168.00	2167.00	Gravel	18.00	45.00	0.15	-1.00	2.57	1.00
Weir OFF-C1	1.00	2168.04	2168.00	2167.00	Gravel	18.00	45.00	0.04	-1.00	2.52	1.00
Weir EX D	32.00	2179.32	2179.00	2178.00	Gravel	18.00	66.00	0.32	-1.00	2.63	1.00
Weir P-D	41.00	2179.38	2179.00	2178.00	Gravel	18.00	66.00	0.38	-1.00	2.65	1.00
Weir EX E	1.00	2208.06	2208.00	2207.00	Gravel	18.00	30.00	0.06	-1.00	2.53	1.00
Weir OFF-E	1.00	2208.06	2208.00	2207.00	Gravel	18.00	30.00	0.06	-1.00	2.53	1.00
Weir EX F	23.00	2206.39	2206.00	2205.00	Gravel	18.00	35.00	0.39	-1.00	2.66	1.00
Weir OFF-F	23.00	2206.39	2206.00	2205.00	Gravel	18.00	35.00	0.39	-1.00	2.66	1.00

Adjusted Weir Coefficient (US)	Flow Area (ft²)	Velocity (ft/s)	Wetted Perimeter (ft)	Top Width (ft)
2.70	20.31	1.92	41.02	40.00
2.60	8.96	1.23	40.45	40.00
2.66	15.65	1.66	40.78	40.00
2.57	6.94	1.01	45.31	45.00
2.52	1.92	0.52	45.09	45.00
2.63	21.36	1.50	66.65	66.00
2.65	25.07	1.64	66.76	66.00
2.53	1.68	0.60	30.11	30.00
2.53	1.68	0.60	30.11	30.00
2.66	13.79	1.67	35.79	35.00
2.66	13.79	1.67	35.79	35.00

MANNING'S ROUGHNESS COEFFICIENTS FOR CHANNEL LINING TYPES

Channel Material	Roughness Coefficient (n)	
	Normal	Maximum
Corrugated Metal	0.025	0.030
Concrete**		
1) Trowel finish	0.013	0.015
2) Float finish	0.015	0.016
3) Unfinished	0.017	0.020
4) Shotcrete, Good section	0.019	0.023
5) Shotcrete, wavy section	0.122	0.025
Asphalt (use maximum value when cars are present)	0.016	0.020
Soil-Cement	0.020	0.025
Constructed channels with earth or sand bottom, sides of		
1) Clean earth; straight	0.022	0.025
2) Earth with grass and weeds	0.025	0.030
3) Earth with trees and shrubs	0.032	0.040
4) Shotcrete	0.022	0.025
5) Soil-cement	0.025	0.028
6) Concrete	0.020	0.024
7) Dry rubble or riprap	0.033	0.036
Natural channels with sand bottom, sides of	0.035	0.045
1) Trees and shrubs	0.032	0.040
2) Rock		
Natural channel with rock bottom	0.060	0.090
Overbank floodplains		
1) Desert brush, normal density	0.060	0.080
2) Dense vegetation	0.100	0.160

• Adapted from Chow (1959) and Aldridge and Garrett (1973).
** Manning's Coefficients for Clear Water Only
__ City of Tucson Standards Manual for Drainage Design

Revision	Date

REFERENCE:

TABLE 702

MAXIMUM PERMISSIBLE MEAN CHANNEL VELOCITIES

Material / Lining	Maximum Permissible Mean Velocity (fps)
Natural and Improved Unlined Channels	
Fine sand,colloidal	1.50
Sandy loam,noncolloidal	1.75
Silt loam,noncolloidal	2.00
Alluvial silts,noncolloidal	2.00
Ordinary firm loam	2.50
Volcanic ash	2.50
Stiff clay,vary colloidal	3.75
Alluvial silts,colloidal	3.75
Shales and hardpans	6.00
Fine gravel	2.50
Graded loam to cobbles when noncolloidal	3.75
Graded silts to cobbles when colloidal	4.00
Coarse gravel,noncolloidal	4.00
Cobbles and shingles	5.00
Sandy silt	2.00
Silty clay	2.50
Clay	6.00
Poor sedimentary rock	10.0
Fully Lined Channels	
Unreinforced vegetation	5.0
Loose riprap	10.0
Grouted riprap	15.0
Gabions	15.0
Soil-Cement	15.0
Concrete	35.0

NOTES:
1. For composite lined channels, use the lowest of the maximum mean velocities for the materials used in the composite lining.
2. Deviations from the above values are only allowed with appropriate engineering analysis and/or suitable agreements for maintenance responsibilities.

Revision	Date

WRC ENGINEERING

REFERENCE: Natural-Fortier and Scobey, 1926
Fully Lined-Various Sources

TABLE 703

HYDRAULIC DATA FOR CULVERTS

(A) Manning's n-values for Corrugated Steel Pipe

Corrugations	Annular 2⅔" x ½"	Helical 1½" x ¼"[11, 12]		Helical 2⅔" x ½"				
	All Diam.	8"	10"	12"	18"	24"	36"	48"
Unpaved	.024	.012	.014	.011	.014	.016	.019	.020
25% Paved	.021					.015	.017	.020
Fully Paved	.012					.012	.012	.012

Corrugations	Annular 3" x 1"	Helical—3" x 1"					
	All Diam.	36"	48"	54"	60"	66"	72"
Unpaved	.027	.021	.023	.023	.024	.025	.026
25% Paved	.023	.019	.020	.020	.021	.022	.022
Fully Paved	.012	.012	.012	.012	.012	.012	.012

(B) Manning's n-values for Structural Plate Metal Pipe

Corrugations 6" x 2"	Diameters			
	5 ft	7 ft	10 ft	15 ft
Plain—unpaved	.033	.032	.030	.028
25% Paved	.028	.027	.026	.024

(C) Manning's n-values for Concrete Pipe/Culvert

TYPE	n-VALUE
Pre-Cast	0.012
Cast-in-Place	
With Steel Forms	0.013
With Wood Forms	0.015

Revision	Date

HYDRAULIC DATA FOR CULVERTS

(D) CULVERT ENTRANCE LOSSES

Type of Entrance	Entrance Coefficient, Ke
Pipe	
Headwall	
Grooved edge	0.20
Rounded edge (0.15D radius)	0.15
Rounded edge (0.25D radius	0.10
Square edge (cut concrete and CMP)	0.40
Headwall & 45° Wingwall	
Grooved edge	0.20
Square edge	0.35
Headwall with Parallel Wingwalls Spaced 1.25D apart	
Grooved edge	0.30
Square edge	0.40
Beveled edge	0.25
Projecting Entrance	
Grooved edge (RCP)	0.25
Square edge (RCP)	0.50
Sharp edge, thin wall (CMP)	0.90
Sloping Entrance	
Mitered to conform to slope	0.70
Flared-end Section	0.50
Box, Reinforced Concrete	
Headwall Parallel to Embankment (no wingwalls)	
Square edge on 3 edges	0.50
Rounded on 3 edges to radius of 1/12 barrel dimension	0.20
Wingwalls at 30° to 75° to barrel	
Square edged at crown	0.40
Crown edge rounded to radius of 1/12 barrel dimension	0.20
Wingwalls at 10° to 30° to barrel	
Square edged at crown	0.50
Wingwalls parallel (extension of sides)	
Square edged at crown	0.70

NOTE: The entrance loss coefficients are used to evaluate the culvert or sewer capacity operating under outlet control.

SLOPING RIPRAP CHANNEL DROP DESIGN CHART

MAXIMUM UNIT DISCHARGE q (cfs/ft)	ALLOWABLE CHUTE SLOPE - So FOR EACH RIPRAP CLASSIFICATION			LENGTH OF DOWNSTREAM APRON L_b (ft)
	Regular Riprap	Heavy Riprap	Grouted Riprap	
0 - 15	Not Allowed	0 to 7:1	7:1 to 4:1	15
15.1 - 20	Not Allowed	0 to 8:1	8:1 to 5:1	20
20.1 - 25	Not Allowed	0 to 10:1	10:1 to 6:1	20
25.1 - 30	Not Allowed	0 to 12:1	12:1 to 7:1	25
31.1 - 35	Not Allowed	0 to 13:1	13:1 to 8:1	25
> 35	Not Allowed	Not Allowed	Not Allowed	Not Allowed
Dr (V≤ 5fps)	Not Allowed	1.75'	2.6'	
Dr (V> 5fps)	Not Allowed	2.0'	3.0'	
Drw	Not Allowed	1.5 x Dr	1.25 x Dr	

NOTES:

1. See Figure 1102 for definition of symbols.
2. q = Unit discharge = VnYn, where Vn = average channel velocity and Yn = normal depth of the upstream channel.
3. So = Longitudinal channel slope expressed in feet horizontal per foot vertical.
4. Dr = Depth of riprap blanket in feet.
5. Drw = Depth of riprap blanket at the downstream face of the crest wall and in upstream apron.
6. Rock size, Dr, and Drw shall be the same throughout the drop structure.
7. Chute and channel side slopes shall not be steeper than 4:1.
8. Maximum allowable drop = 3.0'
9. See Section 700 for riprap gradation, classification and bedding requirements.
10. This chart is for ordinary riprap structures only. Other types of drop structures require their own hydraulic analysis.
11. See Table 1104 to calculate P.

Revision	Date

HEC-14 - Hydraulic Design of Energy Dissipators for Culverts and Channels, FHWA, Sept. 1983

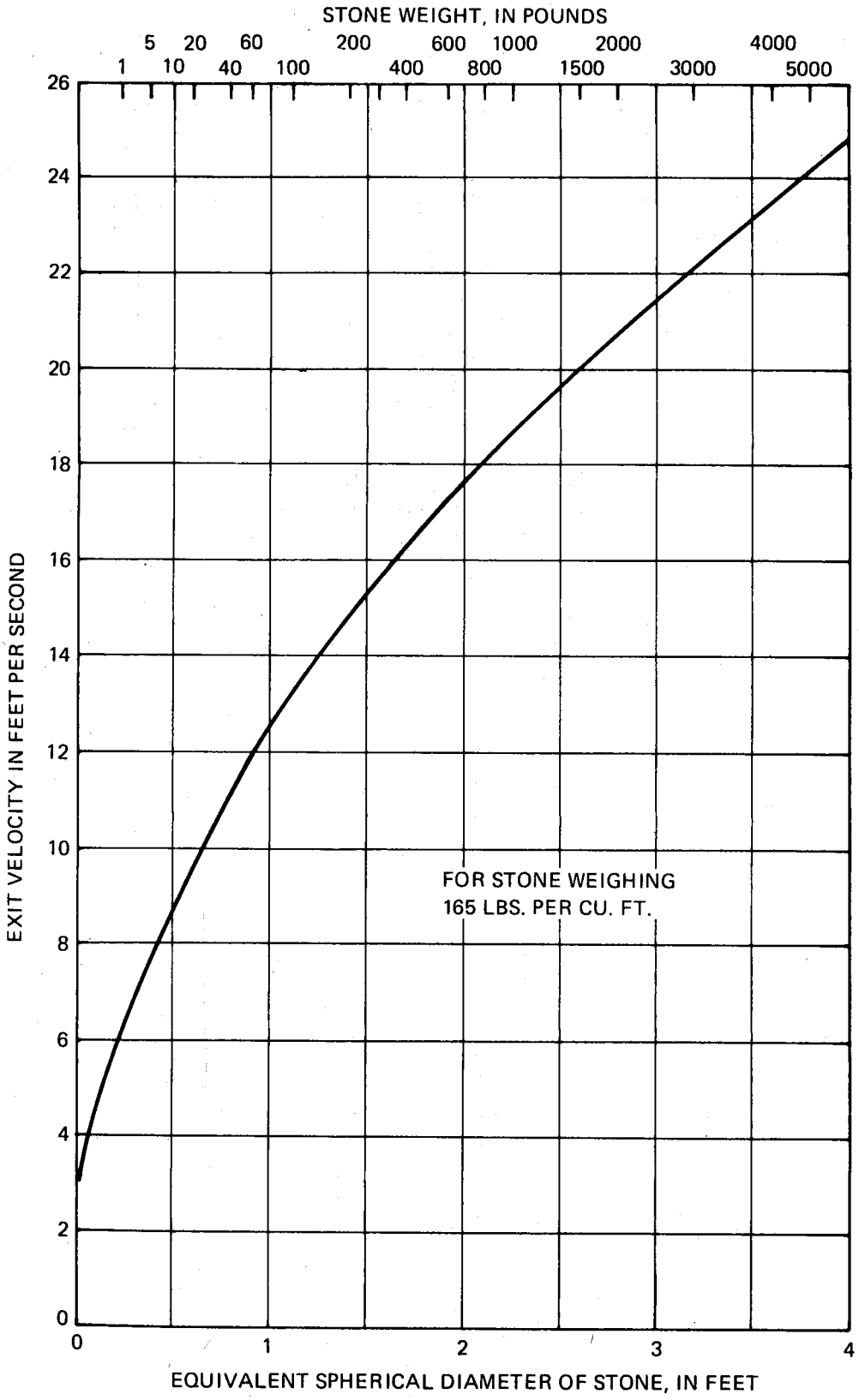


FIGURE II-C-1. RIPRAP SIZE FOR USE DOWNSTREAM OF ENERGY DISSIPATORS FROM REFERENCE II-C-1.

C

Appendix C: River Mountain Water Treatment Facility Technical Drainage Study Excerpts

hdrinc.com 3200 E. Camelback Road, Suite 350 Phoenix, AZ 85018
602.522.7700

FACILITY IDENTIFIER	DESCRIPTION
1A CHANN	2' B X 2:1 SIDE SLOPE
1B CHANN	2' B X 2:1 SIDE SLOPE
2A CHANN	2' B X 2:1 SIDE SLOPE
2B CHANN	2' B X 2:1 SIDE SLOPE
3A CHANN	4' B X 4:1 SIDE SLOPE
3B CHANN	5' B X 4:1 SIDE SLOPE
5A CHANN	5' B X 4:1 SIDE SLOPE
5B CHANN	20' B X 3:1 SIDE SLOPE
6 CHANN	5' B X 4:1 SIDE SLOPE
8 CHANN	4' B X 1:1 SIDE SLOPE
1B CULV	24" RCP
1A-8 CULV	(2) 23"x14" ELLIPTICAL RCP
1B-3 CULV	36" RCP
2A,B,C CULV	18" RCP
2-4 CULV	24" RCP
4-6 CULV	(2) 30"x19" ELLIPTICAL RCP
8-7 CULV	(2) 3'x2' RCB
5B CULV	30" RCP
CIIT 0246	8.5' ROCK LEVEE
CIIT 0492	EAST C-1 DETENTION BASIN
78" OF	78" PLANT OVERFLOW
96" OF	96" PLANT OVERFLOW

SOUTHERN NEVADA WATER AUTHORITY
1900 E. FLAMINGO ROAD SUITE 170
LAS VEGAS, NEVADA 89119
(702) 862-3400
PROJECT LOCATION: CLARK CO. NV

VERIFY SCALE
BAR REPRESENTS ONE AND ONE-HALF INCHES ON ORGINAL

RIVER MOUNTAINS WATER TREATMENT FACILITY
DRAINAGE PLAN

SCALE 1"=400'
FILE NAME: o:\land\cmwtf\hydrolog\sub_area.dgn
02-DEC-1997 09:55

MWHill
A Joint Venture
3014 WEST CHARLESTON BLVD.
LAS VEGAS, NEVADA 89102-1944
DSGN: CHK: APVD:
DR:

CONTRACT NO.

DRAWING NO.
FIGURE 3-1
SHEET ____ OF ____

100 YEAR STORM EVENT WITH OVERFLOW

HEC-1 MODEL

```
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *               MAY   1991              *
 *            VERSION 4.0.1E             *
 *                                       *
 *  RUN DATE  08/06/1997  TIME  13:21:56 *
 *                                       *
 *****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 551-1748             *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X              X
XXXXXXX  XXXX     X       XXXXX  X
X     X  X        X              X
X     X  X        X     X        X
X     X  XXXXXXX  XXXXX          XXX
```

`
`
`
`

M A C I N T O S H ®
2 0 0 0 T I M E S T E P
V E R S I O N : 4.0.1E

Hydrotech Microsystems
P.O. Box 40184
Portland, OR 97240-0184
(503) 257-6926

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
                  * RMTPOFLOW.DAT changes the oriface coefficient at detention basin from 0.7
                  * to 0.65 - MW, 8/97
                  *
                  * Revised detention basin volumes; spillway at 2186' - MW, 7/18/97
                  *
                  * Revised to include sediment volume at bottom of basin; set spillway at 2185'
                  * and low-level outlet to include sed - MW, 6/6/97
                  *
                  * Revised 5/28/97 to include new detention basin storage curve - MW, 5/28/97
                  *
                  * This model (RMTP.DAT) includes the areas south of the NPC Powerline
                  * Corridor only (southeast portion of the River Mtns site), plus an area near
                  * the solids drying beds and overflows from the treatment plant and is used to
                  * size the onsite detention basin.  A low-level outlet is used at the detention
```

```
                * basin.  Downstream pipe flow should not exceed 500 cfs; try one 48-inch
                * diameter pipe.
                *
                * This file is for the SNWA River Mountains On-Site hydrology and is a
                * revision to a previous preliminary analysis performed in 12/95.  Changes
                * to onsite subareas reflect the current/latest (2/97) site layout.  It also
                * includes two offsite subareas from the Newport Electrical Substation offsite
                * analysis.  This analysis assumes a berm will be constructed to protect the
                * site from these offsite flows from the east.  Therefore, the two offsite areas
                * are combined together, but not with onsite subareas.  This model assumes
                * that subareas 1A through 8 are tributary to an onsite detention basin.
                * The 100-yr, 6-hr recipitation depth is 3.22-inches per CCRFCD 1991 MPU
                * C-1 Channel hydrology for subareas C4B and C3B2 which encompass nearly the
                * entire Strawman Site.  This depth includes the 1.43 NOAA 100-yr adjustment
                * factor - MW, 2/97
                *
                *DIAGRAM
            1   ID          SNWA River Mountains Water Treatment Facility
            2   ID          ONSITE RUNOFF PLUS TREATMENT PLANT OVERFLOW
            3   ID          FILE:  RMTP.DAT
            4   ID          Prepared by MONTGOMERY WATSON - 3/97
            5   ID
            6   ID          Ratio    Subareas      Area (sq mi)     DARF
            7   ID          -----    --------      ------------     ----
            8   ID            1     individual     0.05 - 0.09      1.00
            9   ID            2                        0.5          0.98
           10   ID            3                        1.0          0.97
           11   ID
*** FREE ***
           12   IT       5       0       0     150
           13   IO       5       0       0
           14   IN       5       0       0
           15   JR    PREC    1.00    0.98    0.97
                *
                * ******************************************************************************
                *
                * The first portion of this data file models rainfall/runoff from the project
                * site; the second portion includes an overflow from the treatment plant.  Both
                * are tributary to the onsite detention basin which is modeled at the end of
                * this data file.
                *
                * ******************************************************************************
                *
                * Begin the runoff portion of the model
                *
1                                       HEC-1 INPUT                                    PAGE  2

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

           16   KK      1A   RUNOFF FROM SUBAREA 1A
                * assume 47% open, 53% industrial/high; all A soil
           17   KM      This subarea is at the east property line of the site at the drying beds
           18   BA  0.0581
           19   PB    3.22
                * Use SDN#3 for areas less than 10 sq mi
           20   PC    .000    .020    .057    .070    .087    .108    .124    .130    .130    .130
           21   PC    .130    .130    .130    .133    .140    .142    .148    .158    .172    .181
           22   PC    .190    .197    .199    .200    .201    .204    .214    .229    .241    .249
           23   PC    .251    .256    .270    .278    .281    .283    .295    .322    .352    .409
           24   PC    .499    .590    .710    .744    .781    .812    .819    .835    .851    .856
           25   PC    .860    .868    .876    .888    .910    .926    .937    .950    .970    .976
           26   PC    .982    .985    .987    .989    .990    .993    .993    .994    .995    .998
           27   PC    .998    .999    1.00
                *
           28   LS       0      78
           29   UD   0.219
                *

           30   KK      1B  RUNOFF FROM SUBAREA 1B
                * assume 43% open, 57% industrial/high; all A soil
           31   BA  0.0335
```

```
 32          LS       0      79
 33          UD   0.174
             *

 34          KK 1BSPLIT
 35          KM       Assume that 50% goes to subarea 3 and 50% goes to subarea 8
 36          DT 1BSPLIT
 37          DI      0.     10.    100.  10000.
 38          DQ      0.     5.     50.   5000.
             *

 39          KK    1B_R ROUTE REMAINING 50% OF SUBAREA 1B TO SUBAREA 1A AND 8 IN A CHANNEL
 40          RK    1700  0.0050   0.025       0    TRAP      10       2
             *

 41          KK    1A_CCOMBINE ROUTED SUBAREA 1B RUNOFF WITH SUBAREA 1A HYDROGRAPH
 42          HC       2
             *

 43          KK      1R ROUTE SUBAREA 1A TO THE WEST ALONG THE N-SIDE OF THE ROAD TO SUBAREA 8
 44          RK    1250   0.040   0.030       0    TRAP      10       2
             *

 45          KK       8   RUNOFF FROM SUBAREA 8
 46          KM       This hydrograph enters the north end of the detention basin
 47          BA  0.1199
 48          LS       0      79
 49          UD   0.502
             *
1                                        HEC-1 INPUT                                        PAGE  3

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

 50          KK      8C COMBINE SUBAREA 8 RUNOFF WITH ROUTED SUBAREA 1A HYDROGRAPH
 51          HC       2
             *
             * This ends the portion of the onsite runoff that drains to the detention basin
             * through subarea 8
             *
             * ***********************
             *

 52          KK       2  RUNOFF FROM SUBAREA 2
 53          KM      This subarea is one-half open, one-half industrial
 54          BA  0.0265
 55          LS       0      77
 56          UD   0.194
             *

 57          KK      2R ROUTE COMBINED SUBAREA 2 TO THE SOUTH & WEST TO SUBAREA 4 IN A CHANNEL
 58          RK    1400  0.0214   0.030       0    TRAP      10       2
             *

 59          KK       4   RUNOFF FROM SUBAREA 4
 60          KM      This subarea is 30% open, 70% industrial
 61          BA  0.0271
 62          LS       0      83
 63          UD   0.194
             *

 64          KK      4C  COMBINE ROUTED SUBAREA 2 + SUBAREA 4
 65          HC       2
             *

 66          KK      4R ROUTE COMBINED SUBAREA 4 TO SUBAREA 6 IN A CHANNEL
 67          RK     950  0.0347   0.030       0    TRAP      10       2
             *

 68          KK       6   RUNOFF FROM SUBAREA 6
 69          KM      This subarea is 40% open and 60% buried reservoir (use industrial/low for
 70          KM       the reservoir portion, to be conservative)
```

```
 71          BA  0.0546
 72          LS       0      77
 73          UD   0.216
             *


 74          KK      6C  COMBINE ROUTED SUBAREA 4 + SUBAREA 6
 75          KM       This hydrograph enters the detention basin
             *
 76          HC       2
             *
             * This ends the portion of the onsite runoff that drains to the detention basin
             * through subarea 6
             *
             * ************************
             *
```



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


 77          KK 1BSPLIT
 78          KM          RECALL DIVERTED FLOW FROM SUBAREA 1B
 79          DR 1BSPLIT
             *


 80          KK    1B_R ROUTE 50% OF SUBAREA 1B TO SUBAREA 3 IN A CHANNEL
 81          RK    1700  0.0050   0.025       0    TRAP      10       2
             *


 82          KK       3  RUNOFF FROM SUBAREA 3
 83          BA  0.0356
             * assume 1/2 open, 1/2 industrial/high; all A soil
 84          LS       0      77
 85          UD   0.322
             *


 86          KK      3C  COMBINE SUBAREA 3 + ROUTED SUBAREA 1B
             *
 87          HC       2
             *


 88          KK      3R ROUTE COMBINED SUBAREA 3 TO THE WEST IN A CHANNEL ALONG THE PROPOSED RO
 89          KM        TO SUBAREA 5
 90          RK    1900  0.0211   0.030       0    TRAP      10       2
             *


 91          KK       5   RUNOFF FROM SUBAREA 5
 92          BA  0.0541
 93          LS       0      80
 94          UD   0.185
             *


 95          KK      5C  COMBINE SUBAREA 5 + ROUTED SUBAREA 3
 96          KM       This hydrograph enters the south end of the detention basin
 97          HC       2
             *
             * This ends the portion of the onsite runoff that drains to the detention basin
             * through subarea 5
             *
             * ************************
             *


 98          KK       7   RUNOFF FROM SUBAREA 7
 99          KM        This is the detention basin itself
100          BA  0.0301
101          LS       0      65
102          UD   0.108
             *
```



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

```
103         KK  INFLOW  COMBINE SUBAREAS 5, 6, 7 & 8 AS TOTAL RUNOFF INFLOW TO THE DET . BASIN
104         KO       1
105         HC       4
            *
            * ****************************************************************************
            *
            * The following is the model for the treatment plant overflow
            *
            * Input the overflow hydrograph; assume an instantaneous outflow of 800 mgd
            * (or 1,238 cfs) continues for 1 hour, then tapers off to zero in 5 min; to
            * do this, leave time interval for input data at 5 minutes; note that this
            * scenario is much more serious than a 100-year event (100-year runoff plus a
            * failure at the treatment plant).

106         KKOVERFLOW
107         KO       1
108         BA     0.0
109         QI    1238    1238    1238    1238    1238    1238    1238    0.01       0
            *
            * ****************************************************************************
            *

110         KK COMBINE
111         KM        Combine runoff portion of the model with the treatment plant overflow;
112         KM        this is the total inflow to the detention basin.
113         HC       2
            *
            * ****************************************************************************
            *

114         KK     DET
115         KM       This is the onsite detention basin with inflow only from both onsite
116         KM       runoff and the treatment plant overflow; maximum stage should be less
117         KM       than 2183 ft.
118         KO       1
            * Starting condition (field 3 of RS card) is 0 ac-ft of storage:
119         RS       1    STOR     0.1
            * SV     0    0.03    0.15    0.47    1.20    2.49    4.81    8.49   13.65   20.
            * SV 29.05   39.31   51.53   66.34   83.81  104.22  128.06
            * SV     0       0       0       0       0       0    2.32    6.00   11.16   18.
            * SV 26.56   36.82   49.04   63.85   81.32  101.73  125.57
120         SV       0    0.42    1.37    3.45    7.10   12.49   19.56   28.52   39.13   51.40
121         SV   65.19   80.13   96.63  114.02
122         SE    2177    2178    2179    2180    2181    2182    2183    2184    2185    2186
123         SE    2187    2188    2189    2190
            * Try one 48-in diameter outlet pipe; use oriface coefficient of 0.65
            * SL2177.5   12.57     0.7     0.5
124         SL  2177.5   12.57    0.65     0.5
            * SS2185.0     100     3.3     1.5
125         SS  2186.0     200     3.3     1.5
            *
            * ****************************************************************************
            *
            * The last two subareas are not tributary to the detention basin and are not
            * developed as part of Phase 1 of the RMTP facilities; therefore, the following
            * data are for existing conditions at subareas 9 and 10; both subareas sheet
            * flow to the western property line and are left as individual subareas (not
            * combined with other areas):
            *
1                                       HEC-1 INPUT                                    PAGE  6

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

126         KK       9  RUNOFF FROM SUBAREA 9
            * This subarea is the southwest portion of the site that does not enter the
            * detention basin.
127         KM      This subarea is all open/A soil
128         BA  0.0790
            * use CN for A soil/open (63)
129         LS       0      63
```

1	0145	22	1.	*	1	0455	60	107.	*	1	0805	98	0.	*	1	1115	136	0.
1	0150	23	1.	*	1	0500	61	102.	*	1	0810	99	0.	*	1	1120	137	0.
1	0155	24	1.	*	1	0505	62	93.	*	1	0815	100	0.	*	1	1125	138	0.
1	0200	25	1.	*	1	0510	63	80.	*	1	0820	101	0.	*	1	1130	139	0.
1	0205	26	1.	*	1	0515	64	66.	*	1	0825	102	0.	*	1	1135	140	0.
1	0210	27	1.	*	1	0520	65	54.	*	1	0830	103	0.	*	1	1140	141	0.
1	0215	28	2.	*	1	0525	66	44.	*	1	0835	104	0.	*	1	1145	142	0.
1	0220	29	4.	*	1	0530	67	37.	*	1	0840	105	0.	*	1	1150	143	0.
1	0225	30	6.	*	1	0535	68	30.	*	1	0845	106	0.	*	1	1155	144	0.
1	0230	31	7.	*	1	0540	69	24.	*	1	0850	107	0.	*	1	1200	145	0.
1	0235	32	8.	*	1	0545	70	21.	*	1	0855	108	0.	*	1	1205	146	0.
1	0240	33	8.	*	1	0550	71	18.	*	1	0900	109	0.	*	1	1210	147	0.
1	0245	34	10.	*	1	0555	72	16.	*	1	0905	110	0.	*	1	1215	148	0.
1	0250	35	11.	*	1	0600	73	14.	*	1	0910	111	0.	*	1	1220	149	0.
1	0255	36	12.	*	1	0605	74	12.	*	1	0915	112	0.	*	1	1225	150	0.
1	0300	37	12.	*	1	0610	75	10.	*	1	0920	113	0.	*				
1	0305	38	14.	*	1	0615	76	8.	*	1	0925	114	0.	*				
				*					*					*				

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 327.	3.67		59.	28.	28.	28.
		(INCHES)	1.238	1.239	1.239	1.239
		(AC-FT)	29.	29.	29.	29.

CUMULATIVE AREA = 0.44 SQ MI

*** ***

```
              **************
              *            *
106 KK        *       DET  *
              *            *
              **************
```

110 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

111 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	STOR	TYPE OF INITIAL CONDITION
RSVRIC	0.10	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

112 SV	STORAGE	0.0	0.4	1.4	3.5	7.1	12.5	19.6	28.5	39.1	51.4
		65.2	80.1	96.6	114.0						
114 SE	ELEVATION	2177.00	2178.00	2179.00	2180.00	2181.00	2182.00	2183.00	2184.00	2185.00	2186.00
		2187.00	2188.00	2189.00	2190.00						

116 SL LOW-LEVEL OUTLET

ELEVL	2177.50	ELEVATION AT CENTER OF OUTLET
CAREA	12.57	CROSS-SECTIONAL AREA
COQL	0.65	COEFFICIENT
EXPL	0.50	EXPONENT OF HEAD

117 SS SPILLWAY

CREL	2186.00	SPILLWAY CREST ELEVATION
SPWID	200.00	SPILLWAY WIDTH
COQW	3.30	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

***

COMPUTED OUTFLOW-ELEVATION DATA

OUTFLOW	0.00	0.00	91.55	98.91	107.56	117.86	130.34	145.78	165.37	191.04
ELEVATION	2177.00	2177.50	2179.45	2179.78	2180.19	2180.74	2181.46	2182.45	2183.87	2186.00
OUTFLOW	197.67	238.05	343.47	544.80	873.48	1360.19	2036.22	2933.06	4081.06	5511.67
ELEVATION	2186.04	2186.17	2186.37	2186.65	2187.01	2187.45	2187.97	2188.57	2189.24	2190.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.21	0.42	1.37	2.31	2.99	3.45	4.16	6.13	7.10
OUTFLOW	0.00	0.00	46.33	80.25	91.55	98.91	103.61	107.56	117.86	122.59
ELEVATION	2177.00	2177.50	2178.00	2179.00	2179.45	2179.78	2180.00	2180.19	2180.74	2181.00
STORAGE	9.56	12.49	15.67	19.56	27.35	28.52	39.13	51.40	52.01	53.71
OUTFLOW	130.34	139.00	145.78	153.68	165.37	167.06	179.45	191.04	197.67	238.05
ELEVATION	2181.46	2182.00	2182.45	2183.00	2183.87	2184.00	2185.00	2186.00	2186.04	2186.17
STORAGE	56.50	60.38	65.19	65.36	71.93	79.67	80.13	89.49	96.63	100.88
OUTFLOW	343.47	544.80	861.97	873.48	1360.19	2036.22	2079.09	2933.06	3651.68	4081.06
ELEVATION	2186.37	2186.65	2187.00	2187.01	2187.45	2187.97	2188.00	2188.57	2189.00	2189.24
STORAGE	114.02									
OUTFLOW	5511.67									
ELEVATION	2190.00									

****

HYDROGRAPH AT STATION DET
PLAN 1, RATIO = 0.98

****

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	0.1	2177.2	1		0410	51	130.	9.4	2181.4	1		0820	101	0.	0.2	2177.5
1		0005	2	0.	0.1	2177.2	1		0415	52	130.	9.5	2181.4	1		0825	102	0.	0.2	2177.5
1		0010	3	0.	0.1	2177.2	1		0420	53	130.	9.5	2181.4	1		0830	103	0.	0.2	2177.5
1		0015	4	0.	0.1	2177.2	1		0425	54	129.	9.3	2181.4	1		0835	104	0.	0.2	2177.5
1		0020	5	0.	0.1	2177.2	1		0430	55	129.	9.0	2181.4	1		0840	105	0.	0.2	2177.5
1		0025	6	0.	0.1	2177.2	1		0435	56	128.	8.8	2181.3	1		0845	106	0.	0.2	2177.5
1		0030	7	0.	0.1	2177.2	1		0440	57	127.	8.6	2181.3	1		0850	107	0.	0.2	2177.5
1		0035	8	0.	0.1	2177.2	1		0445	58	127.	8.4	2181.2	1		0855	108	0.	0.2	2177.5
1		0040	9	0.	0.1	2177.2	1		0450	59	126.	8.3	2181.2	1		0900	109	0.	0.2	2177.5
1		0045	10	0.	0.1	2177.2	1		0455	60	126.	8.2	2181.2	1		0905	110	0.	0.2	2177.5
1		0050	11	0.	0.1	2177.2	1		0500	61	125.	8.0	2181.2	1		0910	111	0.	0.2	2177.5
1		0055	12	0.	0.1	2177.2	1		0505	62	125.	7.8	2181.1	1		0915	112	0.	0.2	2177.5
1		0100	13	0.	0.1	2177.2	1		0510	63	124.	7.6	2181.1	1		0920	113	0.	0.2	2177.5
1		0105	14	0.	0.1	2177.2	1		0515	64	123.	7.2	2181.0	1		0925	114	0.	0.2	2177.5
1		0110	15	0.	0.1	2177.2	1		0520	65	121.	6.8	2180.9	1		0930	115	0.	0.2	2177.5
1		0115	16	0.	0.1	2177.2	1		0525	66	119.	6.3	2180.8	1		0935	116	0.	0.2	2177.5
1		0120	17	0.	0.1	2177.2	1		0530	67	116.	5.8	2180.6	1		0940	117	0.	0.2	2177.5
1		0125	18	0.	0.1	2177.2	1		0535	68	113.	5.2	2180.5	1		0945	118	0.	0.2	2177.5
1		0130	19	0.	0.1	2177.2	1		0540	69	110.	4.6	2180.3	1		0950	119	0.	0.2	2177.5
1		0135	20	0.	0.1	2177.2	1		0545	70	107.	4.0	2180.2	1		0955	120	0.	0.2	2177.5
1		0140	21	0.	0.1	2177.2	1		0550	71	104.	3.4	2180.0	1		1000	121	0.	0.2	2177.5
1		0145	22	0.	0.1	2177.3	1		0555	72	98.	2.9	2179.7	1		1005	122	0.	0.2	2177.5
1		0150	23	0.	0.1	2177.3	1		0600	73	92.	2.3	2179.5	1		1010	123	0.	0.2	2177.5
1		0155	24	0.	0.1	2177.3	1		0605	74	85.	1.8	2179.2	1		1015	124	0.	0.2	2177.5
1		0200	25	0.	0.1	2177.3	1		0610	75	78.	1.3	2178.9	1		1020	125	0.	0.2	2177.5
1		0205	26	0.	0.1	2177.4	1		0615	76	63.	0.9	2178.5	1		1025	126	0.	0.2	2177.5
1		0210	27	0.	0.2	2177.4	1		0620	77	51.	0.5	2178.1	1		1030	127	0.	0.2	2177.5
1		0215	28	0.	0.2	2177.4	1		0625	78	26.	0.3	2177.8	1		1035	128	0.	0.2	2177.5
1		0220	29	0.	0.2	2177.4	1		0630	79	8.	0.2	2177.6	1		1040	129	0.	0.2	2177.5
1		0225	30	1.	0.2	2177.5	1		0635	80	4.	0.2	2177.5	1		1045	130	0.	0.2	2177.5
1		0230	31	6.	0.2	2177.6	1		0640	81	3.	0.2	2177.5	1		1050	131	0.	0.2	2177.5
1		0235	32	7.	0.2	2177.6	1		0645	82	2.	0.2	2177.5	1		1055	132	0.	0.2	2177.5
1		0240	33	8.	0.2	2177.6	1		0650	83	2.	0.2	2177.5	1		1100	133	0.	0.2	2177.5

1	0245	34	9.	0.3	2177.6	*	1	0655	84	1.	0.2	2177.5	*	1	1105	134	0.	0.2	2177.5
1	0250	35	10.	0.3	2177.6	*	1	0700	85	1.	0.2	2177.5	*	1	1110	135	0.	0.2	2177.5
1	0255	36	11.	0.3	2177.6	*	1	0705	86	1.	0.2	2177.5	*	1	1115	136	0.	0.2	2177.5
1	0300	37	12.	0.3	2177.6	*	1	0710	87	1.	0.2	2177.5	*	1	1120	137	0.	0.2	2177.5
1	0305	38	13.	0.3	2177.6	*	1	0715	88	0.	0.2	2177.5	*	1	1125	138	0.	0.2	2177.5
1	0310	39	16.	0.3	2177.7	*	1	0720	89	0.	0.2	2177.5	*	1	1130	139	0.	0.2	2177.5
1	0315	40	26.	0.3	2177.8	*	1	0725	90	0.	0.2	2177.5	*	1	1135	140	0.	0.2	2177.5
1	0320	41	46.	0.4	2178.0	*	1	0730	91	0.	0.2	2177.5	*	1	1140	141	0.	0.2	2177.5
1	0325	42	56.	0.7	2178.3	*	1	0735	92	0.	0.2	2177.5	*	1	1145	142	0.	0.2	2177.5
1	0330	43	79.	1.3	2179.0	*	1	0740	93	0.	0.2	2177.5	*	1	1150	143	0.	0.2	2177.5
1	0335	44	93.	2.4	2179.5	*	1	0745	94	0.	0.2	2177.5	*	1	1155	144	0.	0.2	2177.5
1	0340	45	106.	3.9	2180.1	*	1	0750	95	0.	0.2	2177.5	*	1	1200	145	0.	0.2	2177.5
1	0345	46	114.	5.4	2180.5	*	1	0755	96	0.	0.2	2177.5	*	1	1205	146	0.	0.2	2177.5
1	0350	47	121.	6.7	2180.9	*	1	0800	97	0.	0.2	2177.5	*	1	1210	147	0.	0.2	2177.5
1	0355	48	125.	7.8	2181.1	*	1	0805	98	0.	0.2	2177.5	*	1	1215	148	0.	0.2	2177.5
1	0400	49	127.	8.6	2181.3	*	1	0810	99	0.	0.2	2177.5	*	1	1220	149	0.	0.2	2177.5
1	0405	50	129.	9.1	2181.4	*	1	0815	100	0.	0.2	2177.5	*	1	1225	150	0.	0.2	2177.5
						*							*							

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 130.	4.25		58.	28.	28.	28.
		(INCHES)	1.234	1.234	1.234	1.234
		(AC-FT)	29.	29.	29.	29.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (AC-FT)	(HR)				
10.	4.25	3.	2.	2.	2.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (FEET)	(HR)				
2181.45	4.25	2179.02	2178.19	2178.19	2178.19

CUMULATIVE AREA = 0.44 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN		RATIO 1
					0.98
HYDROGRAPH AT					
+	1A	0.06	1	FLOW	54.
				TIME	3.67
HYDROGRAPH AT					
+	1B	0.03	1	FLOW	35.
				TIME	3.58
DIVERSION TO					
+	1BSPLIT	0.03	1	FLOW	18.
				TIME	3.58
HYDROGRAPH AT					
+	1BSPLIT	0.03	1	FLOW	18.
				TIME	3.58
ROUTED TO					
+	1B_R	0.03	1	FLOW	18.
				TIME	3.67

2 COMBINED AT

+	1A_C	0.09	1	FLOW	71.
				TIME	3.67
ROUTED TO					
+	1R	0.09	1	FLOW	69.
				TIME	3.67
HYDROGRAPH AT					
+	8	0.12	1	FLOW	77.
				TIME	4.00
2 COMBINED AT					
+	8C	0.21	1	FLOW	130.
				TIME	3.83
HYDROGRAPH AT					
+	2	0.03	1	FLOW	24.
				TIME	3.67
ROUTED TO					
+	2R	0.03	1	FLOW	24.
				TIME	3.67
HYDROGRAPH AT					
+	4	0.03	1	FLOW	33.
				TIME	3.58
2 COMBINED AT					
+	4C	0.05	1	FLOW	56.
				TIME	3.67
ROUTED TO					
+	4R	0.05	1	FLOW	55.
				TIME	3.67
HYDROGRAPH AT					
+	6	0.05	1	FLOW	48.
				TIME	3.67
2 COMBINED AT					
+	6C	0.11	1	FLOW	104.
				TIME	3.67
HYDROGRAPH AT					
+	1BSPLIT	0.00	1	FLOW	18.
				TIME	3.58
ROUTED TO					
+	1B_R	0.00	1	FLOW	18.
				TIME	3.67
HYDROGRAPH AT					
+	3	0.04	1	FLOW	26.
				TIME	3.75
2 COMBINED AT					
+	3C	0.04	1	FLOW	43.
				TIME	3.75
ROUTED TO					
+	3R	0.04	1	FLOW	42.
				TIME	3.75
HYDROGRAPH AT					
+	5	0.05	1	FLOW	58.
				TIME	3.58
2 COMBINED AT					
+	5C	0.09	1	FLOW	93.
				TIME	3.67
HYDROGRAPH AT					

```
+                     7      0.03     1   FLOW          16.
                                          TIME        3.58

  4 COMBINED AT
+                INFLOW      0.44     1   FLOW         327.
                                          TIME        3.67

 ROUTED TO
+                   DET      0.44     1   FLOW         130.
                                          TIME        4.25

                                     ** PEAK STAGES IN FEET **
                                     1   STAGE     2181.45
                                         TIME        4.25

 HYDROGRAPH AT
+                     9      0.08     1   FLOW          33.
                                          TIME        3.58

 HYDROGRAPH AT
+                    10      0.13     1   FLOW         169.
                                          TIME        3.58
1
                                     SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                         (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                    INTERPOLATED TO
                                                                 COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)      (MIN)      (IN)     (MIN)     (CFS)      (MIN)       (IN)

        FOR PLAN = 1  RATIO= 0.98
            1B_R  MANE         2.48     17.73    219.98      0.65      5.00     17.73    220.00        0.66

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1164E+01 EXCESS=0.0000E+00 OUTFLOW=0.1168E+01 BASIN STORAGE=0.2090E-04 PERCENT ERROR=  -0.3

        FOR PLAN = 1  RATIO= 0.98
             1R  MANE         0.67     71.15    221.54      1.03      5.00     69.40    220.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5018E+01 EXCESS=0.0000E+00 OUTFLOW=0.5022E+01 BASIN STORAGE=0.2476E-04 PERCENT ERROR=  -0.1

        FOR PLAN = 1  RATIO= 0.98
             2R  MANE         1.36     23.95    221.78      1.18      5.00     23.88    220.00        1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1668E+01 EXCESS=0.0000E+00 OUTFLOW=0.1670E+01 BASIN STORAGE=0.5310E-05 PERCENT ERROR=  -0.1

        FOR PLAN = 1  RATIO= 0.98
             4R  MANE         0.59     55.77    220.89      1.38      5.00     55.35    220.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3941E+01 EXCESS=0.0000E+00 OUTFLOW=0.3943E+01 BASIN STORAGE=0.6175E-05 PERCENT ERROR=  -0.1

        FOR PLAN = 1  RATIO= 0.98
            1B_R  MANE         2.48     17.73    219.98     -1.00      5.00     17.73    220.00       -1.00

        FOR PLAN = 1  RATIO= 0.98
             3R  MANE         1.54     42.98    228.05      1.80      5.00     42.32    225.00        1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3414E+01 EXCESS=0.0000E+00 OUTFLOW=0.3416E+01 BASIN STORAGE=0.5772E-04 PERCENT ERROR=  -0.1
```

*** NORMAL END OF HEC-1 ***

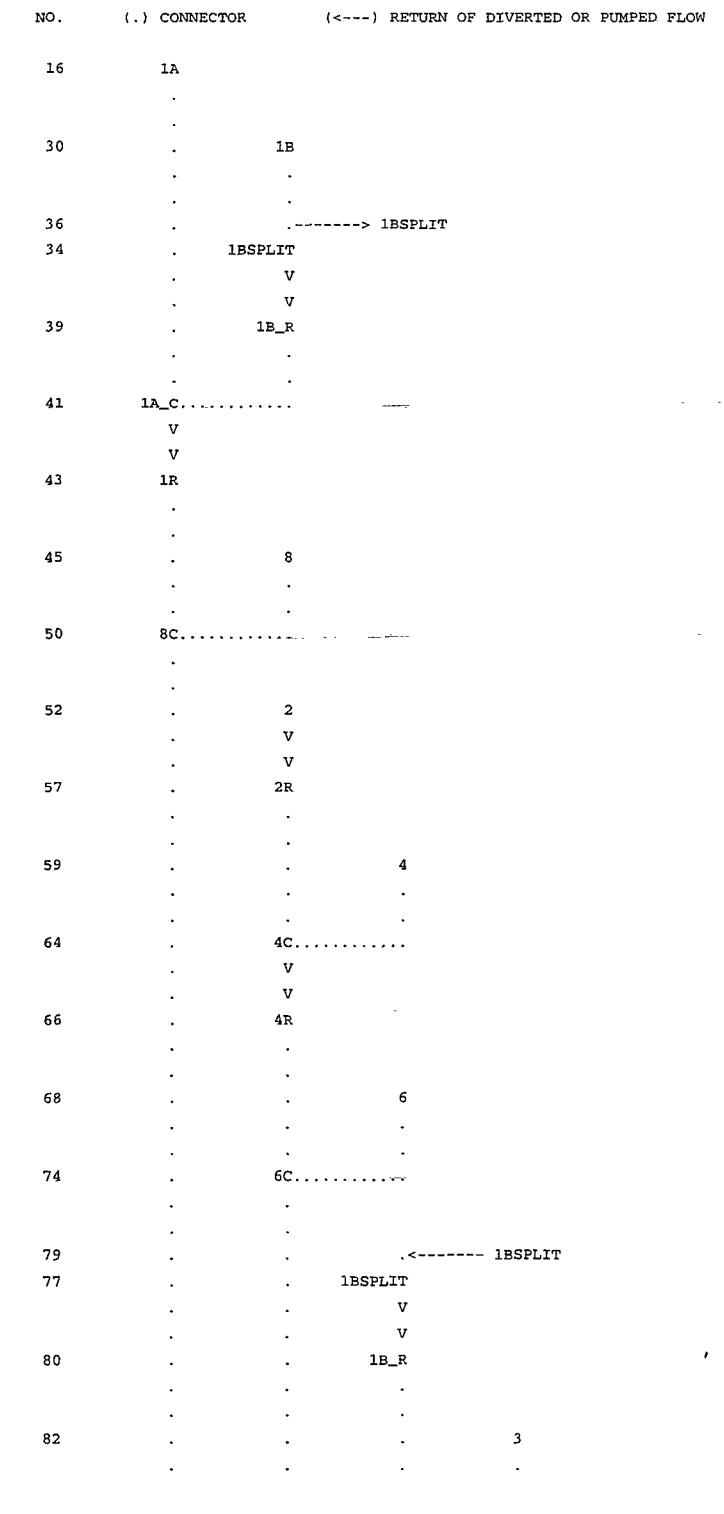
Total job elapsed time = 00 min 29 sec

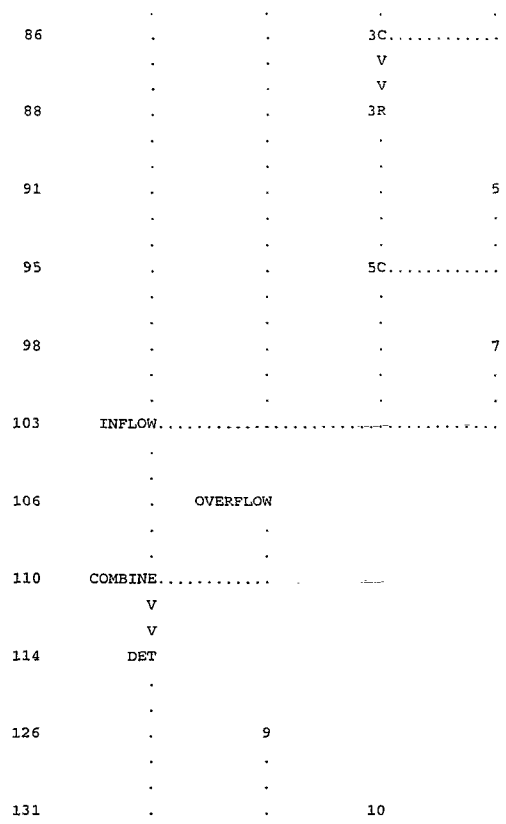
```
130           UD   0.128
                   *

131           KK      10  RUNOFF FROM SUBAREA 10
                   * This subarea is the north portion of the site
132           BA  0.1290
133           LS       0      84
134           UD   0.179
                   *
135           ZZ
```

1

SCHEMATIC DIAGRAM OF STREAM NETWORK





(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               MAY   1991              *
*            VERSION 4.0.1E             *
*                                       *
*  RUN DATE  08/06/1997  TIME  13:21:56 *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```

SNWA River Mountains Water Treatment Facility
ONSITE RUNOFF PLUS TREATMENT PLANT OVERFLOW
FILE: RMTP.DAT
Prepared by MONTGOMERY WATSON - 3/97

Ratio	Subareas	Area (sq mi)	DARF
1	individual	0.05 - 0.09	1.00
2		0.5	0.98
3		1.0	0.97

13 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	150	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	1 0	ENDING DATE
NDTIME	1225	ENDING TIME

ICENT 19 CENTURY MARK

COMPUTATION INTERVAL 0.08 HOURS
TOTAL TIME BASE 12.42 HOURS

ENGLISH UNITS
DRAINAGE AREA SQUARE MILES
PRECIPITATION DEPTH INCHES
LENGTH, ELEVATION FEET
FLOW CUBIC FEET PER SECOND
STORAGE VOLUME ACRE-FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
1.00 0.98 0.97

*** ***

****
* *
103 KK * INFLOW * COMBINE SUBAREAS 5, 6, 7 & 8 AS TOTAL RUNOFF INFLOW TO THE DET . BASIN
* *
****

104 KO OUTPUT CONTROL VARIABLES
IPRNT 1 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

105 HC HYDROGRAPH COMBINATION
ICOMP 4 NUMBER OF HYDROGRAPHS TO COMBINE

***

HYDROGRAPH AT STATION INFLOW
SUM OF 4 HYDROGRAPHS
PLAN 1, RATIO = 1.00

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0310	39	21.	1		0620	77	7.	1		0930	115	0.
1		0005	2	0.	1		0315	40	36.	1		0625	78	5.	1		0935	116	0.
1		0010	3	0.	1		0320	41	69.	1		0630	79	4.	1		0940	117	0.
1		0015	4	0.	1		0325	42	127.	1		0635	80	3.	1		0945	118	0.
1		0020	5	0.	1		0330	43	212.	1		0640	81	2.	1		0950	119	0.
1		0025	6	0.	1		0335	44	299.	1		0645	82	2.	1		0955	120	0.
1		0030	7	0.	1		0340	45	339.	1		0650	83	1.	1		1000	121	0.
1		0035	8	0.	1		0345	46	337.	1		0655	84	1.	1		1005	122	0.
1		0040	9	0.	1		0350	47	308.	1		0700	85	1.	1		1010	123	0.
1		0045	10	0.	1		0355	48	268.	1		0705	86	1.	1		1015	124	0.
1		0050	11	0.	1		0400	49	230.	1		0710	87	1.	1		1020	125	0.
1		0055	12	0.	1		0405	50	197.	1		0715	88	0.	1		1025	126	0.
1		0100	13	0.	1		0410	51	166.	1		0720	89	0.	1		1030	127	0.
1		0105	14	0.	1		0415	52	137.	1		0725	90	0.	1		1035	128	0.
1		0110	15	0.	1		0420	53	114.	1		0730	91	0.	1		1040	129	0.
1		0115	16	0.	1		0425	54	100.	1		0735	92	0.	1		1045	130	0.
1		0120	17	0.	1		0430	55	95.	1		0740	93	0.	1		1050	131	0.
1		0125	18	0.	1		0435	56	99.	1		0745	94	0.	1		1055	132	0.
1		0130	19	0.	1		0440	57	105.	1		0750	95	0.	1		1100	133	0.
1		0135	20	0.	1		0445	58	107.	1		0755	96	0.	1		1105	134	0.

1	0140	21	1.	*	1	0450	59	109.	*	1	0800	97	0.	*	1	1110	135	0.	
1	0145	22	1.	*	1	0455	60	110.	*	1	0805	98	0.	*	1	1115	136	0.	
1	0150	23	2.	*	1	0500	61	105.	*	1	0810	99	0.	*	1	1120	137	0.	
1	0155	24	2.	*	1	0505	62	95.	*	1	0815	100	0.	*	1	1125	138	0.	
1	0200	25	2.	*	1	0510	63	82.	*	1	0820	101	0.	*	1	1130	139	0.	
1	0205	26	2.	*	1	0515	64	68.	*	1	0825	102	0.	*	1	1135	140	0.	
1	0210	27	2.	*	1	0520	65	56.	*	1	0830	103	0.	*	1	1140	141	0.	
1	0215	28	2.	*	1	0525	66	46.	*	1	0835	104	0.	*	1	1145	142	0.	
1	0220	29	4.	*	1	0530	67	38.	*	1	0840	105	0.	*	1	1150	143	0.	
1	0225	30	6.	*	1	0535	68	31.	*	1	0845	106	0.	*	1	1155	144	0.	
1	0230	31	8.	*	1	0540	69	25.	*	1	0850	107	0.	*	1	1200	145	0.	
1	0235	32	8.	*	1	0545	70	21.	*	1	0855	108	0.	*	1	1205	146	0.	
1	0240	33	9.	*	1	0550	71	19.	*	1	0900	109	0.	*	1	1210	147	0.	
1	0245	34	11.	*	1	0555	72	16.	*	1	0905	110	0.	*	1	1215	148	0.	
1	0250	35	12.	*	1	0600	73	14.	*	1	0910	111	0.	*	1	1220	149	0.	
1	0255	36	13.	*	1	0605	74	12.	*	1	0915	112	0.	*	1	1225	150	0.	
1	0300	37	13.	*	1	0610	75	11.	*	1	0920	113	0.	*					
1	0305	38	15.	*	1	0615	76	9.	*	1	0925	114	0.	*					
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW				
		6-HR	24-HR	72-HR	12.42-HR	
+ (CFS)	(HR)					
		(CFS)				
+ 339.	3.67	61.	29.	29.	29.	
		(INCHES)	1.285	1.285	1.285	1.285
		(AC-FT)	30.	30.	30.	30.

CUMULATIVE AREA = 0.44 SQ MI

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HYDROGRAPH AT STATION INFLOW
SUM OF 4 HYDROGRAPHS
PLAN 1, RATIO = 0.98

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0310	39	20.	*	1		0620	77	7.	*	1		0930	115	0.
1		0005	2	0.	*	1		0315	40	34.	*	1		0625	78	5.	*	1		0935	116	0.
1		0010	3	0.	*	1		0320	41	65.	*	1		0630	79	4.	*	1		0940	117	0.
1		0015	4	0.	*	1		0325	42	120.	*	1		0635	80	3.	*	1		0945	118	0.
1		0020	5	0.	*	1		0330	43	203.	*	1		0640	81	2.	*	1		0950	119	0.
1		0025	6	0.	*	1		0335	44	287.	*	1		0645	82	2.	*	1		0955	120	0.
1		0030	7	0.	*	1		0340	45	327.	*	1		0650	83	1.	*	1		1000	121	0.
1		0035	8	0.	*	1		0345	46	326.	*	1		0655	84	1.	*	1		1005	122	0.
1		0040	9	0.	*	1		0350	47	297.	*	1		0700	85	1.	*	1		1010	123	0.
1		0045	10	0.	*	1		0355	48	259.	*	1		0705	86	1.	*	1		1015	124	0.
1		0050	11	0.	*	1		0400	49	223.	*	1		0710	87	0.	*	1		1020	125	0.
1		0055	12	0.	*	1		0405	50	190.	*	1		0715	88	0.	*	1		1025	126	0.
1		0100	13	0.	*	1		0410	51	160.	*	1		0720	89	0.	*	1		1030	127	0.
1		0105	14	0.	*	1		0415	52	133.	*	1		0725	90	0.	*	1		1035	128	0.
1		0110	15	0.	*	1		0420	53	111.	*	1		0730	91	0.	*	1		1040	129	0.
1		0115	16	0.	*	1		0425	54	97.	*	1		0735	92	0.	*	1		1045	130	0.
1		0120	17	0.	*	1		0430	55	92.	*	1		0740	93	0.	*	1		1050	131	0.
1		0125	18	0.	*	1		0435	56	96.	*	1		0745	94	0.	*	1		1055	132	0.
1		0130	19	0.	*	1		0440	57	102.	*	1		0750	95	0.	*	1		1100	133	0.
1		0135	20	0.	*	1		0445	58	104.	*	1		0755	96	0.	*	1		1105	134	0.
1		0140	21	1.	*	1		0450	59	106.	*	1		0800	97	0.	*	1		1110	135	0.
1		0145	22	1.	*	1		0455	60	107.	*	1		0805	98	0.	*	1		1115	136	0.
1		0150	23	1.	*	1		0500	61	102.	*	1		0810	99	0.	*	1		1120	137	0.
1		0155	24	1.	*	1		0505	62	93.	*	1		0815	100	0.	*	1		1125	138	0.
1		0200	25	1.	*	1		0510	63	80.	*	1		0820	101	0.	*	1		1130	139	0.
1		0205	26	1.	*	1		0515	64	66.	*	1		0825	102	0.	*	1		1135	140	0.
1		0210	27	1.	*	1		0520	65	54.	*	1		0830	103	0.	*	1		1140	141	0.
1		0215	28	2.	*	1		0525	66	44.	*	1		0835	104	0.	*	1		1145	142	0.
1		0220	29	4.	*	1		0530	67	37.	*	1		0840	105	0.	*	1		1150	143	0.
1		0225	30	6.	*	1		0535	68	30.	*	1		0845	106	0.	*	1		1155	144	0.

1	0230	31	7.	*	1	0540	69	24.	*	1	0850	107	0.	*	1	1200	145	0.
1	0235	32	8.	*	1	0545	70	21.	*	1	0855	108	0.	*	1	1205	146	0.
1	0240	33	8.	*	1	0550	71	18.	*	1	0900	109	0.	*	1	1210	147	0.
1	0245	34	10.	*	1	0555	72	16.	*	1	0905	110	0.	*	1	1215	148	0.
1	0250	35	11.	*	1	0600	73	14.	*	1	0910	111	0.	*	1	1220	149	0.
1	0255	36	12.	*	1	0605	74	12.	*	1	0915	112	0.	*	1	1225	150	0.
1	0300	37	12.	*	1	0610	75	10.	*	1	0920	113	0.	*				
1	0305	38	14.	*	1	0615	76	8.	*	1	0925	114	0.	*				
				*					*					*				

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)				
		(CFS)			
+ 327.	3.67	59.	28.	28.	28.
		(INCHES) 1.238	1.239	1.239	1.239
		(AC-FT) 29.	29.	29.	29.

CUMULATIVE AREA = 0.44 SQ MI

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HYDROGRAPH AT STATION INFLOW
SUM OF 4 HYDROGRAPHS
PLAN 1, RATIO = 0.97

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0310	39	19.	*	1		0620	77	7.	*	1		0930	115	0.
1		0005	2	0.	*	1		0315	40	33.	*	1		0625	78	5.	*	1		0935	116	0.
1		0010	3	0.	*	1		0320	41	63.	*	1		0630	79	4.	*	1		0940	117	0.
1		0015	4	0.	*	1		0325	42	117.	*	1		0635	80	3.	*	1		0945	118	0.
1		0020	5	0.	*	1		0330	43	198.	*	1		0640	81	2.	*	1		0950	119	0.
1		0025	6	0.	*	1		0335	44	280.	*	1		0645	82	2.	*	1		0955	120	0.
1		0030	7	0.	*	1		0340	45	320.	*	1		0650	83	1.	*	1		1000	121	0.
1		0035	8	0.	*	1		0345	46	319.	*	1		0655	84	1.	*	1		1005	122	0.
1		0040	9	0.	*	1		0350	47	292.	*	1		0700	85	1.	*	1		1010	123	0.
1		0045	10	0.	*	1		0355	48	254.	*	1		0705	86	1.	*	1		1015	124	0.
1		0050	11	0.	*	1		0400	49	219.	*	1		0710	87	0.	*	1		1020	125	0.
1		0055	12	0.	*	1		0405	50	187.	*	1		0715	88	0.	*	1		1025	126	0.
1		0100	13	0.	*	1		0410	51	158.	*	1		0720	89	0.	*	1		1030	127	0.
1		0105	14	0.	*	1		0415	52	130.	*	1		0725	90	0.	*	1		1035	128	0.
1		0110	15	0.	*	1		0420	53	109.	*	1		0730	91	0.	*	1		1040	129	0.
1		0115	16	0.	*	1		0425	54	95.	*	1		0735	92	0.	*	1		1045	130	0.
1		0120	17	0.	*	1		0430	55	91.	*	1		0740	93	0.	*	1		1050	131	0.
1		0125	18	0.	*	1		0435	56	95.	*	1		0745	94	0.	*	1		1055	132	0.
1		0130	19	0.	*	1		0440	57	100.	*	1		0750	95	0.	*	1		1100	133	0.
1		0135	20	0.	*	1		0445	58	102.	*	1		0755	96	0.	*	1		1105	134	0.
1		0140	21	1.	*	1		0450	59	104.	*	1		0800	97	0.	*	1		1110	135	0.
1		0145	22	1.	*	1		0455	60	105.	*	1		0805	98	0.	*	1		1115	136	0.
1		0150	23	1.	*	1		0500	61	100.	*	1		0810	99	0.	*	1		1120	137	0.
1		0155	24	1.	*	1		0505	62	91.	*	1		0815	100	0.	*	1		1125	138	0.
1		0200	25	1.	*	1		0510	63	78.	*	1		0820	101	0.	*	1		1130	139	0.
1		0205	26	1.	*	1		0515	64	65.	*	1		0825	102	0.	*	1		1135	140	0.
1		0210	27	1.	*	1		0520	65	53.	*	1		0830	103	0.	*	1		1140	141	0.
1		0215	28	2.	*	1		0525	66	44.	*	1		0835	104	0.	*	1		1145	142	0.
1		0220	29	3.	*	1		0530	67	36.	*	1		0840	105	0.	*	1		1150	143	0.
1		0225	30	5.	*	1		0535	68	29.	*	1		0845	106	0.	*	1		1155	144	0.
1		0230	31	7.	*	1		0540	69	24.	*	1		0850	107	0.	*	1		1200	145	0.
1		0235	32	7.	*	1		0545	70	20.	*	1		0855	108	0.	*	1		1205	146	0.
1		0240	33	8.	*	1		0550	71	18.	*	1		0900	109	0.	*	1		1210	147	0.
1		0245	34	9.	*	1		0555	72	16.	*	1		0905	110	0.	*	1		1215	148	0.
1		0250	35	11.	*	1		0600	73	14.	*	1		0910	111	0.	*	1		1220	149	0.
1		0255	36	11.	*	1		0605	74	12.	*	1		0915	112	0.	*	1		1225	150	0.
1		0300	37	11.	*	1		0610	75	10.	*	1		0920	113	0.	*					
1		0305	38	13.	*	1		0615	76	8.	*	1		0925	114	0.	*					
					*						*						*					

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 320.	3.67		57.	28.	28.	28.
		(INCHES)	1.215	1.215	1.215	1.215
		(AC-FT)	28.	28.	28.	28.

CUMULATIVE AREA = 0.44 SQ MI

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              *            *
106 KK        *  OVERFLOW  *
              *            *
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107 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

14 IN TIME DATA FOR INPUT TIME SERIES

JXMIN		5	TIME INTERVAL IN MINUTES
JXDATE	1	0	STARTING DATE
JXTIME		0	STARTING TIME

SUBBASIN RUNOFF DATA

108 BA SUBBASIN CHARACTERISTICS

TAREA	0.00	SUBBASIN AREA

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HYDROGRAPH AT STATION OVERFLOW

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	1238.	1		0310	39	0.	1		0620	77	0.	1		0930	115	0.
1		0005	2	1238.	1		0315	40	0.	1		0625	78	0.	1		0935	116	0.
1		0010	3	1238.	1		0320	41	0.	1		0630	79	0.	1		0940	117	0.
1		0015	4	1238.	1		0325	42	0.	1		0635	80	0.	1		0945	118	0.
1		0020	5	1238.	1		0330	43	0.	1		0640	81	0.	1		0950	119	0.
1		0025	6	1238.	1		0335	44	0.	1		0645	82	0.	1		0955	120	0.
1		0030	7	1238.	1		0340	45	0.	1		0650	83	0.	1		1000	121	0.
1		0035	8	0.	1		0345	46	0.	1		0655	84	0.	1		1005	122	0.
1		0040	9	0.	1		0350	47	0.	1		0700	85	0.	1		1010	123	0.
1		0045	10	0.	1		0355	48	0.	1		0705	86	0.	1		1015	124	0.
1		0050	11	0.	1		0400	49	0.	1		0710	87	0.	1		1020	125	0.
1		0055	12	0.	1		0405	50	0.	1		0715	88	0.	1		1025	126	0.
1		0100	13	0.	1		0410	51	0.	1		0720	89	0.	1		1030	127	0.
1		0105	14	0.	1		0415	52	0.	1		0725	90	0.	1		1035	128	0.
1		0110	15	0.	1		0420	53	0.	1		0730	91	0.	1		1040	129	0.
1		0115	16	0.	1		0425	54	0.	1		0735	92	0.	1		1045	130	0.
1		0120	17	0.	1		0430	55	0.	1		0740	93	0.	1		1050	131	0.
1		0125	18	0.	1		0435	56	0.	1		0745	94	0.	1		1055	132	0.
1		0130	19	0.	1		0440	57	0.	1		0750	95	0.	1		1100	133	0.
1		0135	20	0.	1		0445	58	0.	1		0755	96	0.	1		1105	134	0.
1		0140	21	0.	1		0450	59	0.	1		0800	97	0.	1		1110	135	0.
1		0145	22	0.	1		0455	60	0.	1		0805	98	0.	1		1115	136	0.
1		0150	23	0.	1		0500	61	0.	1		0810	99	0.	1		1120	137	0.
1		0155	24	0.	1		0505	62	0.	1		0815	100	0.	1		1125	138	0.

1	0200	25	0.	*	1	0510	63	0.	*	1	0820	101	0.	*	1	1130	139	0.
1	0205	26	0.	*	1	0515	64	0.	*	1	0825	102	0.	*	1	1135	140	0.
1	0210	27	0.	*	1	0520	65	0.	*	1	0830	103	0.	*	1	1140	141	0.
1	0215	28	0.	*	1	0525	66	0.	*	1	0835	104	0.	*	1	1145	142	0.
1	0220	29	0.	*	1	0530	67	0.	*	1	0840	105	0.	*	1	1150	143	0.
1	0225	30	0.	*	1	0535	68	0.	*	1	0845	106	0.	*	1	1155	144	0.
1	0230	31	0.	*	1	0540	69	0.	*	1	0850	107	0.	*	1	1200	145	0.
1	0235	32	0.	*	1	0545	70	0.	*	1	0855	108	0.	*	1	1205	146	0.
1	0240	33	0.	*	1	0550	71	0.	*	1	0900	109	0.	*	1	1210	147	0.
1	0245	34	0.	*	1	0555	72	0.	*	1	0905	110	0.	*	1	1215	148	0.
1	0250	35	0.	*	1	0600	73	0.	*	1	0910	111	0.	*	1	1220	149	0.
1	0255	36	0.	*	1	0605	74	0.	*	1	0915	112	0.	*	1	1225	150	0.
1	0300	37	0.	*	1	0610	75	0.	*	1	0920	113	0.	*				
1	0305	38	0.	*	1	0615	76	0.	*	1	0925	114	0.	*				
				*					*					*				

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1238.	0.08	112.	54.	54.	54.
		(INCHES) 0.000	0.000	0.000	0.000
		(AC-FT) 55.	55.	55.	55.

CUMULATIVE AREA = 0.00 SQ MI

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HYDROGRAPH AT STATION OVERFLOW

PLAN 1, RATIO = 1.00

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	1238.	*	1		0310	39	0.	*	1		0620	77	0.	*	1		0930	115	0.
1		0005	2	1238.	*	1		0315	40	0.	*	1		0625	78	0.	*	1		0935	116	0.
1		0010	3	1238.	*	1		0320	41	0.	*	1		0630	79	0.	*	1		0940	117	0.
1		0015	4	1238.	*	1		0325	42	0.	*	1		0635	80	0.	*	1		0945	118	0.
1		0020	5	1238.	*	1		0330	43	0.	*	1		0640	81	0.	*	1		0950	119	0.
1		0025	6	1238.	*	1		0335	44	0.	*	1		0645	82	0.	*	1		0955	120	0.
1		0030	7	1238.	*	1		0340	45	0.	*	1		0650	83	0.	*	1		1000	121	0.
1		0035	8	0.	*	1		0345	46	0.	*	1		0655	84	0.	*	1		1005	122	0.
1		0040	9	0.	*	1		0350	47	0.	*	1		0700	85	0.	*	1		1010	123	0.
1		0045	10	0.	*	1		0355	48	0.	*	1		0705	86	0.	*	1		1015	124	0.
1		0050	11	0.	*	1		0400	49	0.	*	1		0710	87	0.	*	1		1020	125	0.
1		0055	12	0.	*	1		0405	50	0.	*	1		0715	88	0.	*	1		1025	126	0.
1		0100	13	0.	*	1		0410	51	0.	*	1		0720	89	0.	*	1		1030	127	0.
1		0105	14	0.	*	1		0415	52	0.	*	1		0725	90	0.	*	1		1035	128	0.
1		0110	15	0.	*	1		0420	53	0.	*	1		0730	91	0.	*	1		1040	129	0.
1		0115	16	0.	*	1		0425	54	0.	*	1		0735	92	0.	*	1		1045	130	0.
1		0120	17	0.	*	1		0430	55	0.	*	1		0740	93	0.	*	1		1050	131	0.
1		0125	18	0.	*	1		0435	56	0.	*	1		0745	94	0.	*	1		1055	132	0.
1		0130	19	0.	*	1		0440	57	0.	*	1		0750	95	0.	*	1		1100	133	0.
1		0135	20	0.	*	1		0445	58	0.	*	1		0755	96	0.	*	1		1105	134	0.
1		0140	21	0.	*	1		0450	59	0.	*	1		0800	97	0.	*	1		1110	135	0.
1		0145	22	0.	*	1		0455	60	0.	*	1		0805	98	0.	*	1		1115	136	0.
1		0150	23	0.	*	1		0500	61	0.	*	1		0810	99	0.	*	1		1120	137	0.
1		0155	24	0.	*	1		0505	62	0.	*	1		0815	100	0.	*	1		1125	138	0.
1		0200	25	0.	*	1		0510	63	0.	*	1		0820	101	0.	*	1		1130	139	0.
1		0205	26	0.	*	1		0515	64	0.	*	1		0825	102	0.	*	1		1135	140	0.
1		0210	27	0.	*	1		0520	65	0.	*	1		0830	103	0.	*	1		1140	141	0.
1		0215	28	0.	*	1		0525	66	0.	*	1		0835	104	0.	*	1		1145	142	0.
1		0220	29	0.	*	1		0530	67	0.	*	1		0840	105	0.	*	1		1150	143	0.
1		0225	30	0.	*	1		0535	68	0.	*	1		0845	106	0.	*	1		1155	144	0.
1		0230	31	0.	*	1		0540	69	0.	*	1		0850	107	0.	*	1		1200	145	0.
1		0235	32	0.	*	1		0545	70	0.	*	1		0855	108	0.	*	1		1205	146	0.
1		0240	33	0.	*	1		0550	71	0.	*	1		0900	109	0.	*	1		1210	147	0.
1		0245	34	0.	*	1		0555	72	0.	*	1		0905	110	0.	*	1		1215	148	0.
1		0250	35	0.	*	1		0600	73	0.	*	1		0910	111	0.	*	1		1220	149	0.

1	0255	36	0.	*	1	0605	74	0.	*	1	0915	112	0.	*	1	1225	150	0.	
1	0300	37	0.	*	1	0610	75	0.	*	1	0920	113	0.	*					
1	0305	38	0.	*	1	0615	76	0.	*	1	0925	114	0.	*					
				*					*					*					

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1238.	0.08		112.	54.	54.	54.
		(INCHES)	0.000	0.000	0.000	0.000
		(AC-FT)	55.	55.	55.	55.

CUMULATIVE AREA = 0.00 SQ MI

HYDROGRAPH AT STATION OVERFLOW
PLAN 1, RATIO = 0.98

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	1238.	*	1		0310	39	0.	*	1		0620	77	0.	*	1		0930	115	0.
1		0005	2	1238.	*	1		0315	40	0.	*	1		0625	78	0.	*	1		0935	116	0.
1		0010	3	1238.	*	1		0320	41	0.	*	1		0630	79	0.	*	1		0940	117	0.
1		0015	4	1238.	*	1		0325	42	0.	*	1		0635	80	0.	*	1		0945	118	0.
1		0020	5	1238.	*	1		0330	43	0.	*	1		0640	81	0.	*	1		0950	119	0.
1		0025	6	1238.	*	1		0335	44	0.	*	1		0645	82	0.	*	1		0955	120	0.
1		0030	7	1238.	*	1		0340	45	0.	*	1		0650	83	0.	*	1		1000	121	0.
1		0035	8	0.	*	1		0345	46	0.	*	1		0655	84	0.	*	1		1005	122	0.
1		0040	9	0.	*	1		0350	47	0.	*	1		0700	85	0.	*	1		1010	123	0.
1		0045	10	0.	*	1		0355	48	0.	*	1		0705	86	0.	*	1		1015	124	0.
1		0050	11	0.	*	1		0400	49	0.	*	1		0710	87	0.	*	1		1020	125	0.
1		0055	12	0.	*	1		0405	50	0.	*	1		0715	88	0.	*	1		1025	126	0.
1		0100	13	0.	*	1		0410	51	0.	*	1		0720	89	0.	*	1		1030	127	0.
1		0105	14	0.	*	1		0415	52	0.	*	1		0725	90	0.	*	1		1035	128	0.
1		0110	15	0.	*	1		0420	53	0.	*	1		0730	91	0.	*	1		1040	129	0.
1		0115	16	0.	*	1		0425	54	0.	*	1		0735	92	0.	*	1		1045	130	0.
1		0120	17	0.	*	1		0430	55	0.	*	1		0740	93	0.	*	1		1050	131	0.
1		0125	18	0.	*	1		0435	56	0.	*	1		0745	94	0.	*	1		1055	132	0.
1		0130	19	0.	*	1		0440	57	0.	*	1		0750	95	0.	*	1		1100	133	0.
1		0135	20	0.	*	1		0445	58	0.	*	1		0755	96	0.	*	1		1105	134	0.
1		0140	21	0.	*	1		0450	59	0.	*	1		0800	97	0.	*	1		1110	135	0.
1		0145	22	0.	*	1		0455	60	0.	*	1		0805	98	0.	*	1		1115	136	0.
1		0150	23	0.	*	1		0500	61	0.	*	1		0810	99	0.	*	1		1120	137	0.
1		0155	24	0.	*	1		0505	62	0.	*	1		0815	100	0.	*	1		1125	138	0.
1		0200	25	0.	*	1		0510	63	0.	*	1		0820	101	0.	*	1		1130	139	0.
1		0205	26	0.	*	1		0515	64	0.	*	1		0825	102	0.	*	1		1135	140	0.
1		0210	27	0.	*	1		0520	65	0.	*	1		0830	103	0.	*	1		1140	141	0.
1		0215	28	0.	*	1		0525	66	0.	*	1		0835	104	0.	*	1		1145	142	0.
1		0220	29	0.	*	1		0530	67	0.	*	1		0840	105	0.	*	1		1150	143	0.
1		0225	30	0.	*	1		0535	68	0.	*	1		0845	106	0.	*	1		1155	144	0.
1		0230	31	0.	*	1		0540	69	0.	*	1		0850	107	0.	*	1		1200	145	0.
1		0235	32	0.	*	1		0545	70	0.	*	1		0855	108	0.	*	1		1205	146	0.
1		0240	33	0.	*	1		0550	71	0.	*	1		0900	109	0.	*	1		1210	147	0.
1		0245	34	0.	*	1		0555	72	0.	*	1		0905	110	0.	*	1		1215	148	0.
1		0250	35	0.	*	1		0600	73	0.	*	1		0910	111	0.	*	1		1220	149	0.
1		0255	36	0.	*	1		0605	74	0.	*	1		0915	112	0.	*	1		1225	150	0.
1		0300	37	0.	*	1		0610	75	0.	*	1		0920	113	0.	*					
1		0305	38	0.	*	1		0615	76	0.	*	1		0925	114	0.	*					
					*						*						*					

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1238.	0.08		112.	54.	54.	54.

(INCHES)	0.000	0.000	0.000	0.000
(AC-FT)	55.	55.	55.	55.

CUMULATIVE AREA = 0.00 SQ MI

HYDROGRAPH AT STATION OVERFLOW
PLAN 1, RATIO = 0.97

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	1238.	1		0310	39	0.	1		0620	77	0.	1		0930	115	0.
1		0005	2	1238.	1		0315	40	0.	1		0625	78	0.	1		0935	116	0.
1		0010	3	1238.	1		0320	41	0.	1		0630	79	0.	1		0940	117	0.
1		0015	4	1238.	1		0325	42	0.	1		0635	80	0.	1		0945	118	0.
1		0020	5	1238.	1		0330	43	0.	1		0640	81	0.	1		0950	119	0.
1		0025	6	1238.	1		0335	44	0.	1		0645	82	0.	1		0955	120	0.
1		0030	7	1238.	1		0340	45	0.	1		0650	83	0.	1		1000	121	0.
1		0035	8	0.	1		0345	46	0.	1		0655	84	0.	1		1005	122	0.
1		0040	9	0.	1		0350	47	0.	1		0700	85	0.	1		1010	123	0.
1		0045	10	0.	1		0355	48	0.	1		0705	86	0.	1		1015	124	0.
1		0050	11	0.	1		0400	49	0.	1		0710	87	0.	1		1020	125	0.
1		0055	12	0.	1		0405	50	0.	1		0715	88	0.	1		1025	126	0.
1		0100	13	0.	1		0410	51	0.	1		0720	89	0.	1		1030	127	0.
1		0105	14	0.	1		0415	52	0.	1		0725	90	0.	1		1035	128	0.
1		0110	15	0.	1		0420	53	0.	1		0730	91	0.	1		1040	129	0.
1		0115	16	0.	1		0425	54	0.	1		0735	92	0.	1		1045	130	0.
1		0120	17	0.	1		0430	55	0.	1		0740	93	0.	1		1050	131	0.
1		0125	18	0.	1		0435	56	0.	1		0745	94	0.	1		1055	132	0.
1		0130	19	0.	1		0440	57	0.	1		0750	95	0.	1		1100	133	0.
1		0135	20	0.	1		0445	58	0.	1		0755	96	0.	1		1105	134	0.
1		0140	21	0.	1		0450	59	0.	1		0800	97	0.	1		1110	135	0.
1		0145	22	0.	1		0455	60	0.	1		0805	98	0.	1		1115	136	0.
1		0150	23	0.	1		0500	61	0.	1		0810	99	0.	1		1120	137	0.
1		0155	24	0.	1		0505	62	0.	1		0815	100	0.	1		1125	138	0.
1		0200	25	0.	1		0510	63	0.	1		0820	101	0.	1		1130	139	0.
1		0205	26	0.	1		0515	64	0.	1		0825	102	0.	1		1135	140	0.
1		0210	27	0.	1		0520	65	0.	1		0830	103	0.	1		1140	141	0.
1		0215	28	0.	1		0525	66	0.	1		0835	104	0.	1		1145	142	0.
1		0220	29	0.	1		0530	67	0.	1		0840	105	0.	1		1150	143	0.
1		0225	30	0.	1		0535	68	0.	1		0845	106	0.	1		1155	144	0.
1		0230	31	0.	1		0540	69	0.	1		0850	107	0.	1		1200	145	0.
1		0235	32	0.	1		0545	70	0.	1		0855	108	0.	1		1205	146	0.
1		0240	33	0.	1		0550	71	0.	1		0900	109	0.	1		1210	147	0.
1		0245	34	0.	1		0555	72	0.	1		0905	110	0.	1		1215	148	0.
1		0250	35	0.	1		0600	73	0.	1		0910	111	0.	1		1220	149	0.
1		0255	36	0.	1		0605	74	0.	1		0915	112	0.	1		1225	150	0.
1		0300	37	0.	1		0610	75	0.	1		0920	113	0.					
1		0305	38	0.	1		0615	76	0.	1		0925	114	0.					

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1238.	0.08	112.	54.	54.	54.
		(INCHES) 0.000	0.000	0.000	0.000
		(AC-FT) 55.	55.	55.	55.

CUMULATIVE AREA = 0.00 SQ MI

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          **************
          *            *
114 KK    *       DET  *
          *            *
          **************

118 KO          OUTPUT CONTROL VARIABLES
                     IPRNT          1  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

               HYDROGRAPH ROUTING DATA

119 RS          STORAGE ROUTING
                     NSTPS          1  NUMBER OF SUBREACHES
                      ITYP       STOR  TYPE OF INITIAL CONDITION
                     RSVRIC       0.10  INITIAL CONDITION
                         X        0.00 WORKING R AND D COEFFICIENT

120 SV            STORAGE        0.0       0.4       1.4       3.5       7.1      12.5      19.6      28.5      39.1      51.4
                                65.2      80.1      96.6     114.0

122 SE          ELEVATION     2177.00   2178.00   2179.00   2180.00   2181.00   2182.00   2183.00   2184.00   2185.00   2186.00
                           2187.00   2188.00   2189.00   2190.00

124 SL          LOW-LEVEL OUTLET
                     ELEVL     2177.50  ELEVATION AT CENTER OF OUTLET
                     CAREA       12.57  CROSS-SECTIONAL AREA
                      COQL        0.65  COEFFICIENT
                      EXPL        0.50  EXPONENT OF HEAD

125 SS          SPILLWAY
                      CREL     2186.00  SPILLWAY CREST ELEVATION
                     SPWID      200.00  SPILLWAY WIDTH
                      COQW        3.30  WEIR COEFFICIENT
                      EXPW        1.50  EXPONENT OF HEAD

                                    ***

                                COMPUTED OUTFLOW-ELEVATION DATA

      OUTFLOW       0.00      0.00     91.55     98.91    107.56    117.86    130.34    145.78    165.37    191.04
    ELEVATION    2177.00   2177.50   2179.45   2179.78   2180.19   2180.74   2181.46   2182.45   2183.87   2186.00

      OUTFLOW     197.67    238.05    343.47    544.80    873.48   1360.19   2036.22   2933.06   4081.06   5511.67
    ELEVATION    2186.04   2186.17   2186.37   2186.65   2187.01   2187.45   2187.97   2188.57   2189.24   2190.00

                            COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

      STORAGE       0.00      0.21      0.42      1.37      2.31      2.99      3.45      4.16      6.13      7.10
      OUTFLOW       0.00      0.00     46.33     80.25     91.55     98.91    103.61    107.56    117.86    122.59
    ELEVATION    2177.00   2177.50   2178.00   2179.00   2179.45   2179.78   2180.00   2180.19   2180.74   2181.00

      STORAGE       9.56     12.49     15.67     19.56     27.35     28.52     39.13     51.40     52.01     53.71
      OUTFLOW     130.34    139.00    145.78    153.68    165.37    167.06    179.45    191.04    197.67    238.05
    ELEVATION    2181.46   2182.00   2182.45   2183.00   2183.87   2184.00   2185.00   2186.00   2186.04   2186.17

      STORAGE      56.50     60.38     65.19     65.36     71.93     79.67     80.13     89.49     96.63    100.88
      OUTFLOW     343.47    544.80    861.97    873.48   1360.19   2036.22   2079.09   2933.06   3651.68   4081.06
    ELEVATION    2186.37   2186.65   2187.00   2187.01   2187.45   2187.97   2188.00   2188.57   2189.00   2189.24

      STORAGE     114.02
      OUTFLOW    5511.67
    ELEVATION    2190.00

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                                HYDROGRAPH AT STATION      DET
                                  PLAN 1,   RATIO =  1.00

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	0.1	2177.2	1		0410	51	152.	18.9	2182.9	1		0820	101	0.	0.2	2177.5
1		0005	2	126.	8.2	2181.2	1		0415	52	152.	18.9	2182.9	1		0825	102	0.	0.2	2177.5
1		0010	3	146.	15.8	2182.5	1		0420	53	152.	18.7	2182.9	1		0830	103	0.	0.2	2177.5
1		0015	4	159.	23.3	2183.4	1		0425	54	151.	18.4	2182.8	1		0835	104	0.	0.2	2177.5
1		0020	5	170.	30.7	2184.2	1		0430	55	151.	18.0	2182.8	1		0840	105	0.	0.2	2177.5
1		0025	6	178.	38.0	2184.9	1		0435	56	150.	17.7	2182.7	1		0845	106	0.	0.2	2177.5
1		0030	7	185.	45.3	2185.5	1		0440	57	149.	17.4	2182.7	1		0850	107	0.	0.2	2177.5
1		0035	8	188.	48.2	2185.7	1		0445	58	149.	17.1	2182.6	1		0855	108	0.	0.2	2177.5
1		0040	9	187.	46.9	2185.6	1		0450	59	148.	16.8	2182.6	1		0900	109	0.	0.2	2177.5
1		0045	10	186.	45.7	2185.5	1		0455	60	147.	16.5	2182.6	1		0905	110	0.	0.2	2177.5
1		0050	11	184.	44.4	2185.4	1		0500	61	147.	16.2	2182.5	1		0910	111	0.	0.2	2177.5
1		0055	12	183.	43.1	2185.3	1		0505	62	146.	15.9	2182.5	1		0915	112	0.	0.2	2177.5
1		0100	13	182.	41.9	2185.2	1		0510	63	145.	15.5	2182.4	1		0920	113	0.	0.2	2177.5
1		0105	14	181.	40.6	2185.1	1		0515	64	144.	15.0	2182.4	1		0925	114	0.	0.2	2177.5
1		0110	15	180.	39.4	2185.0	1		0520	65	143.	14.5	2182.3	1		0930	115	0.	0.2	2177.5
1		0115	16	178.	38.1	2184.9	1		0525	66	142.	13.8	2182.2	1		0935	116	0.	0.2	2177.5
1		0120	17	177.	36.9	2184.8	1		0530	67	140.	13.2	2182.1	1		0940	117	0.	0.2	2177.5
1		0125	18	175.	35.7	2184.7	1		0535	68	139.	12.4	2182.0	1		0945	118	0.	0.2	2177.5
1		0130	19	174.	34.5	2184.6	1		0540	69	137.	11.7	2181.9	1		0950	119	0.	0.2	2177.5
1		0135	20	173.	33.3	2184.5	1		0545	70	134.	10.9	2181.7	1		0955	120	0.	0.2	2177.5
1		0140	21	171.	32.1	2184.3	1		0550	71	132.	10.1	2181.6	1		1000	121	0.	0.2	2177.5
1		0145	22	170.	31.0	2184.2	1		0555	72	130.	9.3	2181.4	1		1005	122	0.	0.2	2177.5
1		0150	23	169.	29.8	2184.1	1		0600	73	127.	8.6	2181.3	1		1010	123	0.	0.2	2177.5
1		0155	24	167.	28.7	2184.0	1		0605	74	125.	7.8	2181.1	1		1015	124	0.	0.2	2177.5
1		0200	25	166.	27.5	2183.9	1		0610	75	122.	7.0	2181.0	1		1020	125	0.	0.2	2177.5
1		0205	26	164.	26.4	2183.8	1		0615	76	118.	6.3	2180.8	1		1025	126	0.	0.2	2177.5
1		0210	27	162.	25.3	2183.6	1		0620	77	115.	5.5	2180.6	1		1030	127	0.	0.2	2177.5
1		0215	28	161.	24.2	2183.5	1		0625	78	111.	4.8	2180.4	1		1035	128	0.	0.2	2177.5
1		0220	29	159.	23.1	2183.4	1		0630	79	107.	4.1	2180.2	1		1040	129	0.	0.2	2177.5
1		0225	30	157.	22.1	2183.3	1		0635	80	103.	3.4	2180.0	1		1045	130	0.	0.2	2177.5
1		0230	31	156.	21.0	2183.2	1		0640	81	96.	2.7	2179.6	1		1050	131	0.	0.2	2177.5
1		0235	32	154.	20.0	2183.1	1		0645	82	89.	2.1	2179.3	1		1055	132	0.	0.2	2177.5
1		0240	33	153.	19.0	2182.9	1		0650	83	82.	1.5	2179.1	1		1100	133	0.	0.2	2177.5
1		0245	34	151.	18.0	2182.8	1		0655	84	67.	1.0	2178.6	1		1105	134	0.	0.2	2177.5
1		0250	35	149.	17.1	2182.7	1		0700	85	53.	0.6	2178.2	1		1110	135	0.	0.2	2177.5
1		0255	36	147.	16.2	2182.5	1		0705	86	26.	0.3	2177.8	1		1115	136	0.	0.2	2177.5
1		0300	37	145.	15.2	2182.4	1		0710	87	4.	0.2	2177.5	1		1120	137	0.	0.2	2177.5
1		0305	38	143.	14.3	2182.3	1		0715	88	1.	0.2	2177.5	1		1125	138	0.	0.2	2177.5
1		0310	39	141.	13.5	2182.1	1		0720	89	0.	0.2	2177.5	1		1130	139	0.	0.2	2177.5
1		0315	40	140.	12.7	2182.0	1		0725	90	0.	0.2	2177.5	1		1135	140	0.	0.2	2177.5
1		0320	41	138.	12.1	2181.9	1		0730	91	0.	0.2	2177.5	1		1140	141	0.	0.2	2177.5
1		0325	42	137.	11.9	2181.9	1		0735	92	0.	0.2	2177.5	1		1145	142	0.	0.2	2177.5
1		0330	43	138.	12.1	2181.9	1		0740	93	0.	0.2	2177.5	1		1150	143	0.	0.2	2177.5
1		0335	44	140.	12.9	2182.1	1		0745	94	0.	0.2	2177.5	1		1155	144	0.	0.2	2177.5
1		0340	45	142.	14.1	2182.2	1		0750	95	0.	0.2	2177.5	1		1200	145	0.	0.2	2177.5
1		0345	46	145.	15.4	2182.4	1		0755	96	0.	0.2	2177.5	1		1205	146	0.	0.2	2177.5
1		0350	47	148.	16.6	2182.6	1		0800	97	0.	0.2	2177.5	1		1210	147	0.	0.2	2177.5
1		0355	48	150.	17.6	2182.7	1		0805	98	0.	0.2	2177.5	1		1215	148	0.	0.2	2177.5
1		0400	49	151.	18.3	2182.8	1		0810	99	0.	0.2	2177.5	1		1220	149	0.	0.2	2177.5
1		0405	50	152.	18.7	2182.9	1		0815	100	0.	0.2	2177.5	1		1225	150	0.	0.2	2177.5

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 188.	0.58		155.	83.	83.	83.
		(INCHES)	3.286	3.645	3.645	3.645
		(AC-FT)	77.	85.	85.	85.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (AC-FT)	(HR)				
48.	0.58	23.	11.	11.	11.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (FEET)	(HR)				

2185.74 0.58 2183.19 2180.44 2180.44 2180.44

CUMULATIVE AREA = 0.44 SQ MI

HYDROGRAPH AT STATION DET
PLAN 1, RATIO = 0.98

DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	0.0	2177.0	1		0410	51	151.	18.2	2182.8	1		0820	101	0.	0.2	2177.5
1		0005	2	126.	8.1	2181.2	1		0415	52	151.	18.2	2182.8	1		0825	102	0.	0.2	2177.5
1		0010	3	146.	15.7	2182.5	1		0420	53	150.	18.0	2182.8	1		0830	103	0.	0.2	2177.5
1		0015	4	159.	23.2	2183.4	1		0425	54	150.	17.6	2182.7	1		0835	104	0.	0.2	2177.5
1		0020	5	169.	30.6	2184.2	1		0430	55	149.	17.3	2182.7	1		0840	105	0.	0.2	2177.5
1		0025	6	178.	37.9	2184.9	1		0435	56	148.	16.9	2182.6	1		0845	106	0.	0.2	2177.5
1		0030	7	185.	45.2	2185.5	1		0440	57	148.	16.6	2182.6	1		0850	107	0.	0.2	2177.5
1		0035	8	188.	48.1	2185.7	1		0445	58	147.	16.2	2182.5	1		0855	108	0.	0.2	2177.5
1		0040	9	187.	46.8	2185.6	1		0450	59	146.	16.0	2182.5	1		0900	109	0.	0.2	2177.5
1		0045	10	186.	45.6	2185.5	1		0455	60	146.	15.7	2182.5	1		0905	110	0.	0.2	2177.5
1		0050	11	184.	44.3	2185.4	1		0500	61	145.	15.4	2182.4	1		0910	111	0.	0.2	2177.5
1		0055	12	183.	43.0	2185.3	1		0505	62	145.	15.1	2182.4	1		0915	112	0.	0.2	2177.5
1		0100	13	182.	41.8	2185.2	1		0510	63	144.	14.7	2182.3	1		0920	113	0.	0.2	2177.5
1		0105	14	181.	40.5	2185.1	1		0515	64	143.	14.2	2182.2	1		0925	114	0.	0.2	2177.5
1		0110	15	180.	39.3	2185.0	1		0520	65	141.	13.6	2182.2	1		0930	115	0.	0.2	2177.5
1		0115	16	178.	38.0	2184.9	1		0525	66	140.	13.0	2182.1	1		0935	116	0.	0.2	2177.5
1		0120	17	177.	36.8	2184.8	1		0530	67	138.	12.3	2182.0	1		0940	117	0.	0.2	2177.5
1		0125	18	175.	35.6	2184.7	1		0535	68	136.	11.6	2181.8	1		0945	118	0.	0.2	2177.5
1		0130	19	174.	34.4	2184.6	1		0540	69	134.	10.9	2181.7	1		0950	119	0.	0.2	2177.5
1		0135	20	173.	33.2	2184.4	1		0545	70	132.	10.1	2181.6	1		0955	120	0.	0.2	2177.5
1		0140	21	171.	32.0	2184.3	1		0550	71	130.	9.3	2181.4	1		1000	121	0.	0.2	2177.5
1		0145	22	170.	30.9	2184.2	1		0555	72	127.	8.6	2181.3	1		1005	122	0.	0.2	2177.5
1		0150	23	168.	29.7	2184.1	1		0600	73	125.	7.8	2181.1	1		1010	123	0.	0.2	2177.5
1		0155	24	167.	28.6	2184.0	1		0605	74	122.	7.0	2181.0	1		1015	124	0.	0.2	2177.5
1		0200	25	165.	27.4	2183.9	1		0610	75	119.	6.3	2180.8	1		1020	125	0.	0.2	2177.5
1		0205	26	164.	26.3	2183.8	1		0615	76	115.	5.5	2180.6	1		1025	126	0.	0.2	2177.5
1		0210	27	162.	25.2	2183.6	1		0620	77	111.	4.8	2180.4	1		1030	127	0.	0.2	2177.5
1		0215	28	160.	24.1	2183.5	1		0625	78	107.	4.1	2180.2	1		1035	128	0.	0.2	2177.5
1		0220	29	159.	23.0	2183.4	1		0630	79	103.	3.4	2180.0	1		1040	129	0.	0.2	2177.5
1		0225	30	157.	22.0	2183.3	1		0635	80	96.	2.7	2179.7	1		1045	130	0.	0.2	2177.5
1		0230	31	156.	20.9	2183.2	1		0640	81	89.	2.1	2179.4	1		1050	131	0.	0.2	2177.5
1		0235	32	154.	19.9	2183.0	1		0645	82	82.	1.6	2179.1	1		1055	132	0.	0.2	2177.5
1		0240	33	152.	18.9	2182.9	1		0650	83	69.	1.0	2178.7	1		1100	133	0.	0.2	2177.5
1		0245	34	150.	17.9	2182.8	1		0655	84	54.	0.6	2178.2	1		1105	134	0.	0.2	2177.5
1		0250	35	148.	17.0	2182.6	1		0700	85	30.	0.3	2177.8	1		1110	135	0.	0.2	2177.5
1		0255	36	147.	16.0	2182.5	1		0705	86	5.	0.2	2177.6	1		1115	136	0.	0.2	2177.5
1		0300	37	145.	15.1	2182.4	1		0710	87	1.	0.2	2177.5	1		1120	137	0.	0.2	2177.5
1		0305	38	143.	14.2	2182.2	1		0715	88	1.	0.2	2177.5	1		1125	138	0.	0.2	2177.5
1		0310	39	141.	13.4	2182.1	1		0720	89	0.	0.2	2177.5	1		1130	139	0.	0.2	2177.5
1		0315	40	139.	12.6	2182.0	1		0725	90	0.	0.2	2177.5	1		1135	140	0.	0.2	2177.5
1		0320	41	137.	12.0	2181.9	1		0730	91	0.	0.2	2177.5	1		1140	141	0.	0.2	2177.5
1		0325	42	137.	11.7	2181.8	1		0735	92	0.	0.2	2177.5	1		1145	142	0.	0.2	2177.5
1		0330	43	137.	11.8	2181.9	1		0740	93	0.	0.2	2177.5	1		1150	143	0.	0.2	2177.5
1		0335	44	139.	12.6	2182.0	1		0745	94	0.	0.2	2177.5	1		1155	144	0.	0.2	2177.5
1		0340	45	142.	13.7	2182.2	1		0750	95	0.	0.2	2177.5	1		1200	145	0.	0.2	2177.5
1		0345	46	144.	15.0	2182.3	1		0755	96	0.	0.2	2177.5	1		1205	146	0.	0.2	2177.5
1		0350	47	147.	16.1	2182.5	1		0800	97	0.	0.2	2177.5	1		1210	147	0.	0.2	2177.5
1		0355	48	148.	17.0	2182.6	1		0805	98	0.	0.2	2177.5	1		1215	148	0.	0.2	2177.5
1		0400	49	150.	17.6	2182.7	1		0810	99	0.	0.2	2177.5	1		1220	149	0.	0.2	2177.5
1		0405	50	151.	18.0	2182.8	1		0815	100	0.	0.2	2177.5	1		1225	150	0.	0.2	2177.5

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW (CFS) 6-HR	24-HR	72-HR	12.42-HR
188.	0.58	155.	82.	82.	82.

(INCHES)	3.269	3.594	3.594	3.594
(AC-FT)	77.	84.	84.	84.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (AC-FT)	(HR)				
48.	0.58	22.	11.	11.	11.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (FEET)	(HR)				
2185.73	0.58	2183.13	2180.39	2180.39	2180.39

CUMULATIVE AREA = 0.44 SQ MI

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HYDROGRAPH AT STATION DET
PLAN 1, RATIO = 0.97

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DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE	DA	MON	HRMN	ORD	OUTFLOW	STORAGE	STAGE
1		0000	1	0.	0.0	2177.0	1		0410	51	150.	17.9	2182.8	1		0820	101	0.	0.2	2177.5
1		0005	2	126.	8.1	2181.2	1		0415	52	150.	17.8	2182.8	1		0825	102	0.	0.2	2177.5
1		0010	3	146.	15.7	2182.5	1		0420	53	150.	17.6	2182.7	1		0830	103	0.	0.2	2177.5
1		0015	4	159.	23.2	2183.4	1		0425	54	149.	17.3	2182.7	1		0835	104	0.	0.2	2177.5
1		0020	5	169.	30.6	2184.2	1		0430	55	148.	16.9	2182.6	1		0840	105	0.	0.2	2177.5
1		0025	6	178.	37.9	2184.9	1		0435	56	147.	16.5	2182.6	1		0845	106	0.	0.2	2177.5
1		0030	7	185.	45.2	2185.5	1		0440	57	147.	16.2	2182.5	1		0850	107	0.	0.2	2177.5
1		0035	8	188.	48.1	2185.7	1		0445	58	146.	15.9	2182.5	1		0855	108	0.	0.2	2177.5
1		0040	9	187.	46.8	2185.6	1		0450	59	146.	15.6	2182.4	1		0900	109	0.	0.2	2177.5
1		0045	10	186.	45.6	2185.5	1		0455	60	145.	15.3	2182.4	1		0905	110	0.	0.2	2177.5
1		0050	11	184.	44.3	2185.4	1		0500	61	144.	15.0	2182.4	1		0910	111	0.	0.2	2177.5
1		0055	12	183.	43.0	2185.3	1		0505	62	144.	14.7	2182.3	1		0915	112	0.	0.2	2177.5
1		0100	13	182.	41.8	2185.2	1		0510	63	143.	14.3	2182.2	1		0920	113	0.	0.2	2177.5
1		0105	14	181.	40.5	2185.1	1		0515	64	142.	13.8	2182.2	1		0925	114	0.	0.2	2177.5
1		0110	15	180.	39.3	2185.0	1		0520	65	141.	13.2	2182.1	1		0930	115	0.	0.2	2177.5
1		0115	16	178.	38.0	2184.9	1		0525	66	139.	12.6	2182.0	1		0935	116	0.	0.2	2177.5
1		0120	17	177.	36.8	2184.8	1		0530	67	137.	11.9	2181.9	1		0940	117	0.	0.2	2177.5
1		0125	18	175.	35.6	2184.7	1		0535	68	135.	11.2	2181.8	1		0945	118	0.	0.2	2177.5
1		0130	19	174.	34.4	2184.6	1		0540	69	133.	10.5	2181.6	1		0950	119	0.	0.2	2177.5
1		0135	20	173.	33.2	2184.4	1		0545	70	131.	9.7	2181.5	1		0955	120	0.	0.2	2177.5
1		0140	21	171.	32.0	2184.3	1		0550	71	128.	8.9	2181.3	1		1000	121	0.	0.2	2177.5
1		0145	22	170.	30.9	2184.2	1		0555	72	126.	8.2	2181.2	1		1005	122	0.	0.2	2177.5
1		0150	23	168.	29.7	2184.1	1		0600	73	124.	7.4	2181.1	1		1010	123	0.	0.2	2177.5
1		0155	24	167.	28.6	2184.0	1		0605	74	120.	6.7	2180.9	1		1015	124	0.	0.2	2177.5
1		0200	25	165.	27.4	2183.9	1		0610	75	117.	5.9	2180.7	1		1020	125	0.	0.2	2177.5
1		0205	26	164.	26.3	2183.8	1		0615	76	113.	5.2	2180.5	1		1025	126	0.	0.2	2177.5
1		0210	27	162.	25.2	2183.6	1		0620	77	109.	4.5	2180.3	1		1030	127	0.	0.2	2177.5
1		0215	28	160.	24.1	2183.5	1		0625	78	105.	3.8	2180.1	1		1035	128	0.	0.2	2177.5
1		0220	29	159.	23.0	2183.4	1		0630	79	100.	3.1	2179.8	1		1040	129	0.	0.2	2177.5
1		0225	30	157.	22.0	2183.3	1		0635	80	93.	2.5	2179.5	1		1045	130	0.	0.2	2177.5
1		0230	31	156.	20.9	2183.2	1		0640	81	86.	1.9	2179.2	1		1050	131	0.	0.2	2177.5
1		0235	32	154.	19.9	2183.0	1		0645	82	78.	1.3	2178.9	1		1055	132	0.	0.2	2177.5
1		0240	33	152.	18.9	2182.9	1		0650	83	61.	0.8	2178.4	1		1100	133	0.	0.2	2177.5
1		0245	34	150.	17.9	2182.8	1		0655	84	48.	0.5	2178.1	1		1105	134	0.	0.2	2177.5
1		0250	35	148.	16.9	2182.6	1		0700	85	13.	0.3	2177.6	1		1110	135	0.	0.2	2177.5
1		0255	36	146.	16.0	2182.5	1		0705	86	2.	0.2	2177.5	1		1115	136	0.	0.2	2177.5
1		0300	37	145.	15.1	2182.4	1		0710	87	1.	0.2	2177.5	1		1120	137	0.	0.2	2177.5
1		0305	38	143.	14.2	2182.2	1		0715	88	0.	0.2	2177.5	1		1125	138	0.	0.2	2177.5
1		0310	39	141.	13.3	2182.1	1		0720	89	0.	0.2	2177.5	1		1130	139	0.	0.2	2177.5
1		0315	40	139.	12.5	2182.0	1		0725	90	0.	0.2	2177.5	1		1135	140	0.	0.2	2177.5
1		0320	41	137.	11.9	2181.9	1		0730	91	0.	0.2	2177.5	1		1140	141	0.	0.2	2177.5
1		0325	42	136.	11.6	2181.8	1		0735	92	0.	0.2	2177.5	1		1145	142	0.	0.2	2177.5
1		0330	43	137.	11.7	2181.9	1		0740	93	0.	0.2	2177.5	1		1150	143	0.	0.2	2177.5
1		0335	44	139.	12.4	2182.0	1		0745	94	0.	0.2	2177.5	1		1155	144	0.	0.2	2177.5
1		0340	45	141.	13.5	2182.1	1		0750	95	0.	0.2	2177.5	1		1200	145	0.	0.2	2177.5
1		0345	46	144.	14.8	2182.3	1		0755	96	0.	0.2	2177.5	1		1205	146	0.	0.2	2177.5
1		0350	47	146.	15.9	2182.5	1		0800	97	0.	0.2	2177.5	1		1210	147	0.	0.2	2177.5

1	0355	48	148.	16.7	2182.6	*	1	0805	98	0.	0.2	2177.5	*	1	1215	148	0.	0.2	2177.5
1	0400	49	149.	17.3	2182.7	*	1	0810	99	0.	0.2	2177.5	*	1	1220	149	0.	0.2	2177.5
1	0405	50	150.	17.7	2182.7	*	1	0815	100	0.	0.2	2177.5	*	1	1225	150	0.	0.2	2177.5
						*							*						

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	12.42-HR
+ (CFS)	(HR)					
		(CFS)				
+ 188.	0.58		154.	82.	82.	82.
		(INCHES)	3.261	3.571	3.571	3.571
		(AC-FT)	76.	84.	84.	84.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (AC-FT)	(HR)				
48.	0.58	22.	11.	11.	11.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	12.42-HR
+ (FEET)	(HR)				
2185.73	0.58	2183.11	2180.37	2180.37	2180.37

CUMULATIVE AREA = 0.44 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION		
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3
					1.00	0.98	0.97
HYDROGRAPH AT							
+	1A	0.06	1	FLOW	56.	54.	53.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	1B	0.03	1	FLOW	37.	35.	35.
				TIME	3.58	3.58	3.58
DIVERSION TO							
+	1BSPLIT	0.03	1	FLOW	18.	18.	17.
				TIME	3.58	3.58	3.58
HYDROGRAPH AT							
+	1BSPLIT	0.03	1	FLOW	18.	18.	17.
				TIME	3.58	3.58	3.58
ROUTED TO							
+	1B_R	0.03	1	FLOW	18.	18.	17.
				TIME	3.67	3.67	3.67
2 COMBINED AT							
+	1A_C	0.09	1	FLOW	74.	71.	70.
				TIME	3.67	3.67	3.67
ROUTED TO							
+	1R	0.09	1	FLOW	72.	69.	68.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	8	0.12	1	FLOW	80.	77.	76.
				TIME	4.00	4.00	4.00
2 COMBINED AT							
+	8C	0.21	1	FLOW	134.	130.	127.
				TIME	3.83	3.83	3.83

HYDROGRAPH AT							
+	2	0.03	1	FLOW	25.	24.	24.
				TIME	3.67	3.67	3.67
ROUTED TO							
+	2R	0.03	1	FLOW	25.	24.	23.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	4	0.03	1	FLOW	34.	33.	32.
				TIME	3.58	3.58	3.58
2 COMBINED AT							
+	4C	0.05	1	FLOW	58.	56.	55.
				TIME	3.67	3.67	3.67
ROUTED TO							
+	4R	0.05	1	FLOW	57.	55.	54.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	6	0.05	1	FLOW	50.	48.	47.
				TIME	3.67	3.67	3.67
2 COMBINED AT							
+	6C	0.11	1	FLOW	107.	104.	102.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	1BSPLIT	0.00	1	FLOW	18.	18.	17.
				TIME	3.58	3.58	3.58
ROUTED TO							
+	1B_R	0.00	1	FLOW	18.	18.	17.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	3	0.04	1	FLOW	27.	26.	26.
				TIME	3.75	3.75	3.75
2 COMBINED AT							
+	3C	0.04	1	FLOW	45.	43.	42.
				TIME	3.75	3.75	3.75
ROUTED TO							
+	3R	0.04	1	FLOW	44.	42.	41.
				TIME	3.75	3.75	3.75
HYDROGRAPH AT							
+	5	0.05	1	FLOW	60.	58.	57.
				TIME	3.58	3.58	3.58
2 COMBINED AT							
+	5C	0.09	1	FLOW	96.	93.	91.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	7	0.03	1	FLOW	17.	16.	15.
				TIME	3.58	3.58	3.58
4 COMBINED AT							
+	INFLOW	0.44	1	FLOW	339.	327.	320.
				TIME	3.67	3.67	3.67
HYDROGRAPH AT							
+	OVERFLOW	0.00	1	FLOW	1238.	1238.	1238.
				TIME	0.08	0.08	0.08
2 COMBINED AT							
+	COMBINE	0.44	1	FLOW	1238.	1238.	1238.
				TIME	0.08	0.08	0.08

```
 ROUTED TO
+                    DET      0.44     1   FLOW         188.      188.      188.
                                           TIME         0.58      0.58      0.58

                                      ** PEAK STAGES IN FEET **
                                      1   STAGE      2185.74   2185.73   2185.73
                                          TIME         0.58      0.58      0.58

 HYDROGRAPH AT
+                     9      0.08     1   FLOW          35.       33.       32.
                                           TIME         3.58      3.58      3.58

 HYDROGRAPH AT
+                     10     0.13     1   FLOW         174.      169.      166.
                                           TIME         3.58      3.58      3.58
1
                                      SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                          (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                          INTERPOLATED TO
                                                                      COMPUTATION INTERVAL
          ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                    PEAK                                     PEAK

                                (MIN)     (CFS)     (MIN)      (IN)     (MIN)     (CFS)     (MIN)       (IN)

         FOR PLAN = 1  RATIO= 1.00
             1B_R  MANE         2.52     18.16    221.09      0.68      5.00     17.81    220.00       0.68

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1208E+01 EXCESS=0.0000E+00 OUTFLOW=0.1211E+01 BASIN STORAGE=0.2093E-04 PERCENT ERROR=  -0.3

         FOR PLAN = 1  RATIO= 0.98
             1B_R  MANE         2.48     17.73    219.98      0.65      5.00     17.73    220.00       0.66

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1164E+01 EXCESS=0.0000E+00 OUTFLOW=0.1168E+01 BASIN STORAGE=0.2090E-04 PERCENT ERROR=  -0.3

         FOR PLAN = 1  RATIO= 0.97
             1B_R  MANE         2.55     17.26    220.79      0.64      5.00     16.92    220.00       0.64

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1143E+01 EXCESS=0.0000E+00 OUTFLOW=0.1145E+01 BASIN STORAGE=0.2768E-04 PERCENT ERROR=  -0.2

         FOR PLAN = 1  RATIO= 1.00
               1R  MANE         0.80     73.01    221.32      1.07      5.00     71.58    220.00       1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5201E+01 EXCESS=0.0000E+00 OUTFLOW=0.5204E+01 BASIN STORAGE=0.2421E-04 PERCENT ERROR=   0.0

         FOR PLAN = 1  RATIO= 0.98
               1R  MANE         0.67     71.15    221.54      1.03      5.00     69.40    220.00       1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.5018E+01 EXCESS=0.0000E+00 OUTFLOW=0.5022E+01 BASIN STORAGE=0.2476E-04 PERCENT ERROR=  -0.1

         FOR PLAN = 1  RATIO= 0.97
               1R  MANE         0.67     69.22    221.68      1.01      5.00     67.67    220.00       1.01

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4917E+01 EXCESS=0.0000E+00 OUTFLOW=0.4920E+01 BASIN STORAGE=0.2372E-04 PERCENT ERROR=  -0.1

         FOR PLAN = 1  RATIO= 1.00
               2R  MANE         1.34     24.88    221.17      1.23      5.00     24.82    220.00       1.23
```

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1733E+01 EXCESS=0.0000E+00 OUTFLOW=0.1735E+01 BASIN STORAGE=0.4188E-05 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 0.98

2R	MANE	1.36	23.95	221.78	1.18	5.00	23.88	220.00	1.18

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1668E+01 EXCESS=0.0000E+00 OUTFLOW=0.1670E+01 BASIN STORAGE=0.5310E-05 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 0.97

2R	MANE	1.34	23.50	222.46	1.16	5.00	23.42	220.00	1.16

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.1636E+01 EXCESS=0.0000E+00 OUTFLOW=0.1638E+01 BASIN STORAGE=0.4904E-05 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 1.00

4R	MANE	0.61	57.76	221.15	1.43	5.00	57.32	220.00	1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.4083E+01 EXCESS=0.0000E+00 OUTFLOW=0.4085E+01 BASIN STORAGE=0.6394E-05 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 0.98

4R	MANE	0.59	55.77	220.89	1.38	5.00	55.35	220.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3941E+01 EXCESS=0.0000E+00 OUTFLOW=0.3943E+01 BASIN STORAGE=0.6175E-05 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 0.97

4R	MANE	0.66	54.71	220.88	1.35	5.00	54.36	220.00	1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3871E+01 EXCESS=0.0000E+00 OUTFLOW=0.3873E+01 BASIN STORAGE=0.6091E-05 PERCENT ERROR= 0.0

FOR PLAN = 1 RATIO= 1.00

1B_R	MANE	2.52	18.16	221.09	-1.00	5.00	17.81	220.00	-1.00

FOR PLAN = 1 RATIO= 0.98

1B_R	MANE	2.48	17.73	219.98	-1.00	5.00	17.73	220.00	-1.00

FOR PLAN = 1 RATIO= 0.97

1B_R	MANE	2.55	17.26	220.79	-1.00	5.00	16.92	220.00	-1.00

FOR PLAN = 1 RATIO= 1.00

3R	MANE	1.52	44.40	227.97	1.87	5.00	43.55	225.00	1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3538E+01 EXCESS=0.0000E+00 OUTFLOW=0.3541E+01 BASIN STORAGE=0.5828E-04 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 0.98

3R	MANE	1.54	42.98	228.05	1.80	5.00	42.32	225.00	1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3414E+01 EXCESS=0.0000E+00 OUTFLOW=0.3416E+01 BASIN STORAGE=0.5772E-04 PERCENT ERROR= -0.1

FOR PLAN = 1 RATIO= 0.97

3R	MANE	1.52	41.95	227.61	1.76	5.00	41.15	225.00	1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW=0.3342E+01 EXCESS=0.0000E+00 OUTFLOW=0.3345E+01 BASIN STORAGE=0.5323E-04 PERCENT ERROR= -0.1

*** NORMAL END OF HEC-1 ***

Total job elapsed time = 01 min 17 sec

D

Appendix D: Data CD

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