

DS #:

4869

APN:

137-33-810-004

PROJECT:

Summerlin Village 24- Parcel COS-3 Wash

SUBMITTAL:

1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS INTER-OFFICE MEMORANDUM		DATE: April 6, 2017
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	
	Summerlin Village 24 – Parcel COS-3 Wash	
Cross Streets:	Open Space between Parcel H and Parcel I	COPIES TO:
File Number:	F:\Depot\DSMemos\DS4869A.doc	GCW Engineers & Surveyors
Parcel Number:	137-33-810-004	Howard Hughes Company, LLC
Zoning Action:	FMP-62680	Bart Anderson, P.E., DevCo
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	3/23/2017	4/6/2017	See Comments Below	\$400.00	479460: \$400
TOTAL FEES (LDDRS):				\$400.00	----

REMARKS:

The Drainage Study for the subject project has been reviewed and:

	is approved subject to conformance to all City standards and the following conditions:
X	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

- The subject "COS-3" wash is a common lot and public drainage easement to be privately maintained by the developer and future *Homeowners Association*. Record as such in the final map.
- In **Figure 6 (HEC-RAS Cross Section Exhibit)** of the subject project, **River Station 550**, as the interface between COS-3 and the downstream COS-4 shows non-matching flow parameters as compared to Figure 7R of the COS-4 Study. River Station 550 shows velocity of 13.61 ft/s and Froude Number 2.56 in the subject project versus velocity of 15.31 ft/s and Froude Number of 3.03 in the COS-4 Study. Please explain the discrepancy in the next submittal.
- Provide a 12'-wide maintenance access road throughout the whole Parcel COS-3 for maintenance crew of the developer and the future Homeowners Association.

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

END OF REMARKS
ays

T/R/S: T20S/R59E/33
AREA K-33

 *** FAX TX REPORT ***

TRANSMISSION OK

JOB NO. 3594
 DESTINATION ADDRESS 7028042299
 PSWD/SUBADDRESS
 DESTINATION ID
 ST. TIME 04/06 17:08
 USAGE T 00' 27
 PGS. 1
 RESULT OK

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LETTER OF TRANSMITTAL



Project No.: 62024-226-3
Date: March 23, 2017

To: **City of Las Vegas**
333 N. Rancho Drive
Las Vegas, NV 89106

Attention: Flood Control - Albert Sung, PE

Subject: **Technical Drainage Study for Summerlin Village 24 Parcel COS-3 Wash**

Sent Via: Hand Delivery

Items being sent:

1 Copy of the TDS
1 Copy of Improvement Plans (rolled)
1 CD (bound)

These items are submitted:

- | | |
|---|---|
| ☐ At your request | ☒ For your action |
| ☒ For your approval | ☐ For your files |
| ☐ For your review and comments | ☐ For your information |

Acknowledgment of receipt:

☒ **Required**

Received by: _____

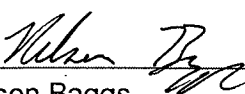
Date: _____

Time: _____

Remarks:

Cordially,

GCW, INC.



Nelson Baggs

Engineering Intern

Copies to: Brian Schmidt, GCW
Grant Tokumi, GCW
Vicki Marjerrison, GCW
Josh Johnson, GCW
Jennifer Veras, GCW

1555 South Rainbow Boulevard
Las Vegas, Nevada 89146



O 702.804.2000
F 702.804.2299



info@gcwengineering.com
gcwengineering.com

**TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24
PARCEL COS-3 WASH**

62024-226-3

March 2017

Prepared for:

**The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450**

GCV
ENGINEERS \ SURVEYORS

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: Summerlin Village 24 Parcel COS-3 Wash Date: March 2017

Location of Development a) Descriptive (Cross Streets) North/South: Sky Vista Drive

East/West: Crossbridge Drive

b) Section: 33 Township: 20S Range: 59E

c) APN: 137-33-810-004

Name of Owner: The Howard Hughes Company, LLC.

Telephone No.: 791-4300 Fax No. 791-4450 E-Mail Address: Not available

Address: 10801 W. Charleston Blvd, 3rd Floor, Las Vegas, Nevada 89135

Contact Person-Name: Grant Tokumi, P.E.

Telephone No.: (702) 804-2000

* E-Mail Address: GTokumi@gcwengineering.com

Fax No.: (702) 804-2299

Firm: GCW, INC.

Address: 1555 S. Rainbow Blvd, Las Vegas, NV 89146

Type of Land Development/Land Disturbance

☐	Rezoning	☐	Subdivision Map	☐	Clearing and Grading Only
☐	Parcel Map	☐	Planned Unit Development	☒	Other (Please specify below)
☐	Large Parcel Map	☐	Building Permit	Storm Drain and Channel Improvements	

1. Total Owned Land Area: At Site: 396.57 ± acres Being Developed/Disturbed: 6.76 ± 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

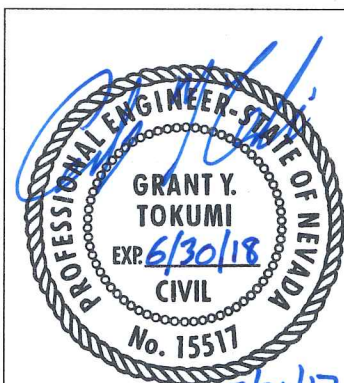
4. Proposed type of development (Residential, Commercial, Etc.): Storm Drain and Channel Improvements

5. Approximate upstream land area which drains to the subject site: 530.6 ± acres

6. Has the site drainage been evaluated in the past? ☒ Yes ☐ No If yes, please identify documentation: Update #2 to the Conceptual Drainage Study for Summerlin Village 24, GCW; Update to the Technical Drainage Study for Village 24 Parcel COS-4, GCW; Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements - Crossbridge Drive (Crossbridge Unit 1 to Sun Creek Road), GCW; Update #2 to the Technical Drainage Study for Summerlin Village 24 Unit 1 Improvements Including Parcels "A" & "B" Mass Grading, GCW.

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: Existing wash south of Village 24

8. Briefly describe your proposed schedule for the subject project: ASAP



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.

Local Entity File No.	Revision	Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: Summerlin Village 24 Parcel COS-3 Wash

Map ID:

Firm Name: GCW, Inc

Engineer: Grant Tokumi

Address: 1555 S Rainbow Blvd

City: Las Vegas

State: NV

Zip: 89146

Phone Number: (702) 804-2000

Fax Number: (702) 804-2297

Property Owner: The Howard Hughes Company, LLC

Address: 10801 W. Charleston Blvd, 3rd Floor

City: Las Vegas

State: Nevada

Zip: 89135

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

☒ _____ Design Manual **Standard Form 1** with the engineer's seal and signature.

☒ _____ Design Manual **Standard Form 4**.

☒ _____ 2 copies of the 24" x 36" Drainage Plan.

_____ NA A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

Yes No

☒ _____ A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.

☒ _____ 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

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes No

- ☒ _____ Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.
- ☒ _____ 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.
- ☒ _____ Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes No

- ☒ _____ Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.
- ☒ _____ Minimum scale: 1" = 60'.
- ☒ _____ Project name.
- ☒ _____ Vicinity Map with local and major cross streets.
- ☒ _____ Revision box.
- ☒ _____ North arrow and bar scale.
- ☒ _____ Engineer's/consultant's address and phone number.
- ☒ _____ Elevation datum and benchmark.
- ☒ _____ Legend for symbols and abbreviations.
- ☒ _____ Cut/fill scarps, where applicable.
- ☒ _____ Street names, grades, widths.
- ☒ _____ 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.
- ☒ _____ 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.
- _____ N/A Proposed typical street sections.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
☐	<u>N/A</u>	Streets with off-set crowns.
☒	☐	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
☒	☐	Property lines.
☒	☐	Right-of-way lines and widths, existing and proposed.
☒	☐	Existing improvements and their elevations.
☒	☐	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
☒	☐	Concentration points and drainage flow direction with Q100 and V100 and D100 in streets.
☒	☐	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
☐	<u>N/A</u>	Location and cross-section of street capacity calculations.
☒	☐	Cross-sectional detail for channels, including cutoff wall locations.
☒	☐	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.
☒	☐	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
☐	<u>N/A</u>	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.
☒	☐	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
☒	☐	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.
☐	<u>NA</u>	Building and/or lot numbers.
☐	<u>NA</u>	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
☒	☐	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

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes No

- ☐ NA 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.
- ☐ NA 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 Q100 flows.
- ☐ NA Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
- ☐ NA Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes No

- ☒ ☐ Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
- ☒ ☐ 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.
- ☒ ☐ 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.
- ☒ ☐ Use of correct precipitation values in and around the McCarran Airport rainfall area.
- ☒ ☐ A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
- ☒ ☐ A summary table of stormwater flows showing basin area, Q10 and Q100 for both individual basins and combined basin flows, where applicable.
- ☒ ☐ Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
- ☒ ☐ On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
- ☐ NA Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes No

- | | | |
|---------|-----------|--|
| _____ | <u>NA</u> | Flow split calculations and supporting documentation or reference for the method of flow split calculations used. |
| _____ | <u>NA</u> | Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q100 and Q10 flows representing the worst case for interior and all perimeter streets. Q100 d x v < 8. Q10 d x v < 6 and 12 foot dry lane for rights-of-way > 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan. |
| _____ | <u>NA</u> | A summary table of interior and exterior street capacity calculations showing the street name, Q100 flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria. |
| _____ | <u>NA</u> | Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.) |
| _____ | <u>NA</u> | 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. |
| _____ | <u>NA</u> | 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 Q100 weir height or flow depth, whichever is greater. |
| X _____ | _____ | <p>A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones.</p> <ul style="list-style-type: none"> • 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. |
| _____ | <u>NA</u> | 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. |
| _____ | <u>NA</u> | Provide BMP type, size and supporting calculations for parking lots and LIDs (if required). |

REFERENCE:

STANDARD FORM 2



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

The following checklist is intended as a supplemental guide for the engineer preparing a Technical Drainage Study submittal to the City of Las Vegas. This supplement focuses on requirements specific to the City of Las Vegas. The requirements presented are in addition to the Clark County Regional Flood Control District (CCRFCDD) Manual Standard Form 2. The listed items are the minimum information required prior to the City performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the CCRFCDD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCDD Standard Form 2 prior to the City accepting a new drainage study for review. The engineer must contact the Flood Control Section at (702) 229-6541 to schedule a submittal appointment.

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

I. GENERAL REQUIREMENT		
Yes	No	
	N/A	A notarized letter from the adjacent property owner(s) allowing off-site grading. (A copy of the letter must be received prior to final acceptance of the drainage study.)
X		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
X		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. <u>GT</u> by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas.

II. GRADING PLAN INFORMATION		
Yes	No	
X		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
X		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. Note: Proposed top of curb elevations must be provided for both sides of roadways even if only half street construction is required.
X		Label existing topography at a minimum 5 foot elevation interval including adjacent developments, finished floor elevations of existing buildings and top of existing curbs extending 100 feet around the perimeter of the site. (*Measured from the centerline of the adjacent roadway.)

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
X		Proposed on-site and off-site storm drains and other flood control facilities with plan and profile sheets for public storm drains showing the class of pipe, (Class III, IV, V, etc.), design hydraulic grade line, (HGL) and 100 year storm flow. A public drainage easement must be provided over on-site storm drains conveying off-site flows. An overflow path must be provided over all storm drains.
X		All existing and "to be constructed" walls with cross-sections showing wall type, (e.g. block wall, retaining wall, flood wall, etc.), with limits clearly defined, adjacent ground elevations. Wall heights must meet current ordinances and in no case exceed 14 feet above the adjacent property.
	N/A	Street slopes for both interior and perimeter streets. Note: The minimum slope for a roadway is 0.4 percent, a minimum 18-inch storm drain must be provided where minimum slopes cannot be met.
	N/A	Back of lot elevations and lot drainage pattern for all lots including common lots.
	N/A	Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.
X		On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners. (The project must pass flows through the site every 600 feet where the project is blocking flow paths.)
	N/A	This project uses a solid grouted stem wall (or approved alternate) at the back of sidewalk to provide erosion protection for landscaped areas where the depth of flow in the roadway exceeds the back of walk elevation. A corresponding cross-section detail is included.
	N/A	Commercial and Common Lot Landscape areas are not allowed to drain over the sidewalk. The grading plans show flow lines with grades and sidewalk under drains for all landscape areas draining to the public ROW.

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.
X		Ten-foot wide public drainage easements to be privately maintained are allowed for flow less than 20 cfs. The depth of flow entering the easement must be checked using the submerged weir calculation.
	N/A	The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.
	N/A	Minimum finish floor elevation is 6 inches above highest adjacent top of curb. Finish floor calculations must include allowances for super elevations on curves and velocity head for tee intersections.
	N/A	Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
	N/A	Lots with "B and C Type Drainage" that drain from one lot to another through a drainage easement shall be required to install an underground nuisance drainage system or a 2-foot valley gutter. 16" x 24" minimum block wall openings are required for both options.
	N/A	Bubblers are required across 80 foot and greater ROW streets. When flows exceed 10 cfs, bubblers larger than 18 inches will be required up to a maximum of 36". Inlets must be sized to match the pipe size provided.

- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

This document is intended as an aid in preparing Technical Drainage Studies for the City of Las Vegas. 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.

**TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24
PARCEL COS-3 WASH**

62024-226-3

March 2017

Prepared for:

**The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450**

Prepared by:

**GCW, INC.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299**

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I. INTRODUCTION

The Howard Hughes Company, LLC, is proposing to construct channel improvements including slope stabilization measures for Parcel COS-3 for approximately 1,900 linear feet. The channel improvements will extend southeast from the Western Wash along Parcel COS-3 adjacent to Parcels H and I to Parcel F. Parcel COS-3 includes a designated Waters of the U.S. (WOTUS), the established adjacent development setback from the WOTUS, and proposed channel improvements. Since Parcel COS-3 contains a designated WOTUS, the existing channel bottom and flowline will remain in its natural condition with proposed channel stabilization measures along the north and south side of the channel, including slope protection and cut-off walls. The proposed channel improvements provide adequate grading for the interim and ultimate development conditions adjacent to the WOTUS in Parcel COS-3.

A comprehensive conceptual drainage study for the Summerlin Village 24, entitled *Update #2 to the Conceptual Drainage Study for Summerlin Village 24* (Reference 1, hereinafter referred to as the CDS Study), was approved by City of Las Vegas (CLV) on October 9, 2014. The CDS Study presented ultimate conditions onsite drainage patterns and major storm drain facilities within the exterior and interior roadways required for Village 24 development. Pertinent referenced material from the CDS Study has been included in Appendix C. Note that the proposed improvements are consistent with the CDS Study.

The *Update to the Technical Drainage Study for Summerlin Village 24 Parcel COS-4* (Reference 2, hereinafter, referred to as the COS-4 Study) was approved by CLV on September 12, 2016. The COS-4 Study provided the design for the COS-4 improvements, located immediately downstream of the COS-3 channel. Pertinent referenced material from the COS-4 Study has been included in Appendix C.

The *Update #6 to the Technical Drainage Study for Summerlin Village Unit 2 Improvements* (Reference 3, hereinafter, referred to as the Unit 2 Study) was approved by CLV on March 24, 2016. The Unit 2 Study provided hydrologic analysis of the area as well as hydraulic analysis of the Western wash and the 54-inch RCP that drains to the channel just south of the proposed COS-3 improvements. Pertinent referenced material from the Unit 2 Study has been included in Appendix C.

The *Update #2 to the Technical Drainage Study for Summerlin Village 24 Unit 1 Improvements including Parcels "A" & "B"* (Reference 4, hereinafter, referred to as the Unit 1 Study) was approved by CLV on March 20, 2006. The Unit 1 Study provided additional hydrologic analysis of the area. Pertinent referenced materials from the Unit 1 Study have been included in Appendix C.

The purpose of this report is to accompany the improvement plans, to provide detailed hydrologic and hydraulic analyses for the site, and to determine adequate protection for the project from offsite and onsite flows. The following tasks were performed in the preparation of this report:

- ♦ Identify previous drainage studies for the project site and surrounding areas.
- ♦ Determine the FEMA floodplain designation for the project site.
- ♦ Identify existing and proposed regional drainage facilities adjacent to the site.
- ♦ Identify existing, proposed, and ultimate drainage areas and facilities that affect the site.
- ♦ Recommend channel stabilization measures along the north and south side of the wash.
- ♦ Estimate peak runoff impacting the proposed grading and storm drain during the 10-year and 100-year return period storms for existing and proposed conditions.
- ♦ Prepare hydraulic analyses for storm drain and proposed channel improvements

II. LOCATION AND DESCRIPTION

The project site is located within Summerlin Village 24 between Crossbridge Drive and Charleston Boulevard in Section 33, Township 20 South, Range 59 East, M.D.M., in the City of Las Vegas, Nevada. The site is presently undeveloped with sparse vegetation and alluvial washes. The proposed improvements will provide protection for the existing WOTUS as well as active use trails for the Village 24 development. Please see Figure 1 and Figure 2 for the vicinity and location of the project site.

PROJECT
SITE

VILLAGE
24

RED ROCK CANYON RD

ALTA DR

CHARLESTON BLVD

SUMMERLIN PKWY

DESERT INN RD

FLAMINGO RD

GRAPHIC SCALE



(IN FEET)

1 inch = 5000 ft.



VILLAGE 24 - US WATERS

COS-3 WASH

FIGURE 1

VICINITY MAP

GCVV
ENGINEERS \ SURVEYORS

1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcwengineering.com

PROJECT
SITE

VILLAGE
24

RED ROCK CANYON RD

SKY VISTA DR

DESERT MOON RD

ALTA DR

DESERT HIGHLANDS DR

CHARLESTON BLVD

GRAPHIC SCALE



(IN FEET)

1 inch = 1500 ft.



VILLAGE 24 - US WATERS

COS-3 WASH

FIGURE 2

LOCATION MAP

GCV
ENGINEERS SURVEYORS

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F: 702.804.2299
gcvengineering.com

III. **FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOOD HAZARD ANALYSIS**

Based on the Flood Insurance Rate Map (FIRM) Community Panel 32003C 2150 E and Panel 32003C 2125E, dated September 27, 2002, the project site lies within a FEMA-designated Zone X. Areas designated as Zone X are described as being outside the 500-year floodplain and not located in a FEMA-designated Special Flood Hazard Area. Figure 3 shows the site denoted on a portion of the aforementioned FIRM.

IV. **CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT (CCRFCD) FACILITIES**

Figure 4 is reproduced from Figure F-29 of the 2013 Clark County Regional Flood Control District (CCRFCD) (Reference 5, hereinafter referred to as the 2013 MPU). This figure depicts the project site in relation to existing and proposed CCRFCD Facilities. As is shown on the figure, the proposed channel improvements are not adjacent to any CCRFCD Facilities. Flows from the proposed Parcel COS-3 Channel will ultimately discharge into the existing Red Rock Detention Basin (RRWA 0716) located south of Village 24. Note that the proposed improvements are consistent with the 2013 MPU and will not have an adverse impact on downstream facilities or properties.

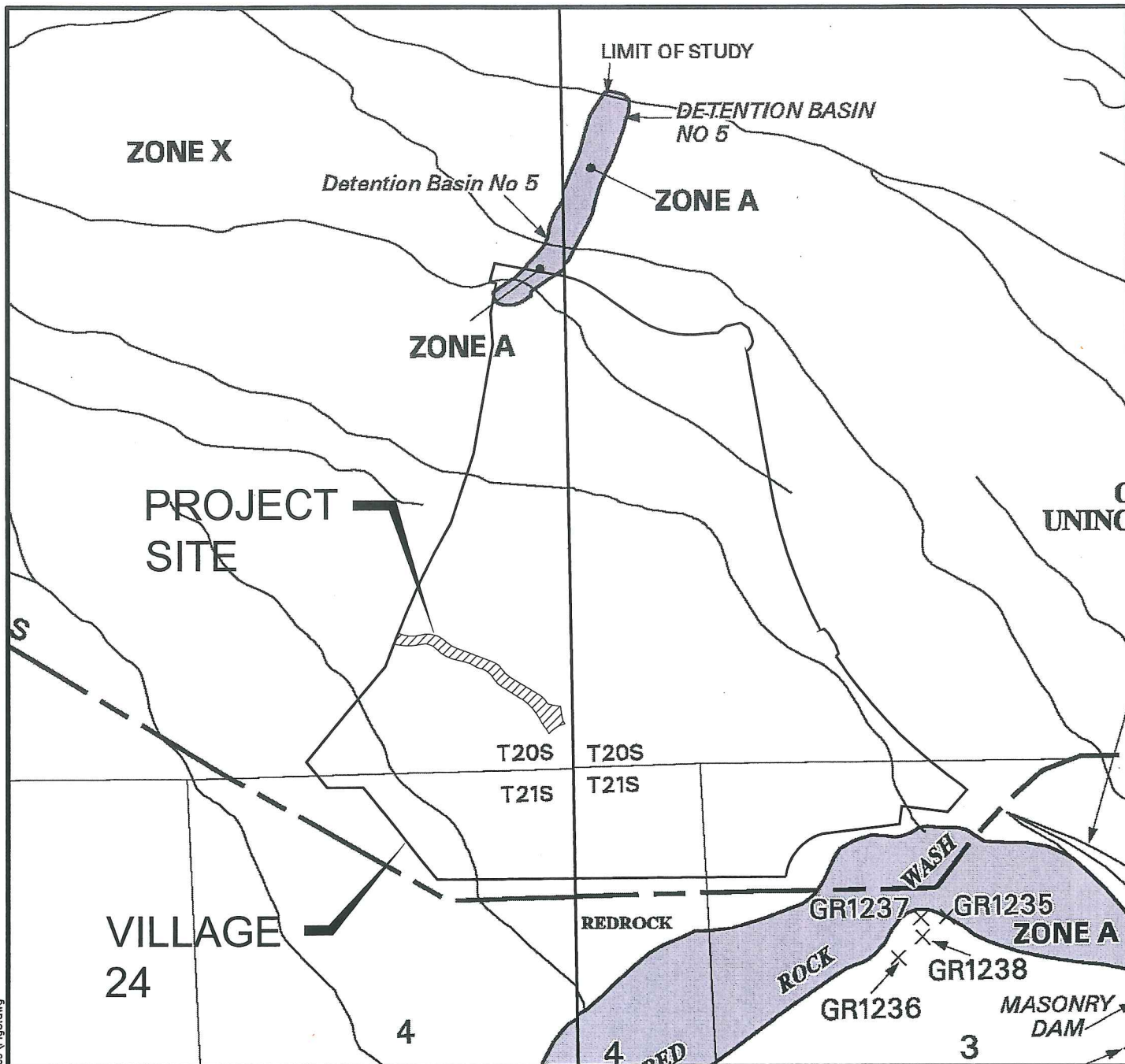
V. **HYDROLOGY**

The methodology presented in this study is in compliance with the *CCRFCD Hydrologic Criteria and Drainage Design Manual* (Reference 8, hereinafter referred to as the Manual).

Drainage Areas and Flow Patterns - The subbasins and flow patterns used to determine the existing/interim conditions flow rates impacting the proposed channel improvements onsite and offsite to the south were referenced from the Unit 2 Study and then prorated based on cfs per acre to determine the flows. The areas for the subbasins north of the project site used to determine the existing/ interim conditions flow have been revised from the Unit 2 Study. Hydrologic calculations have been provided in appendix A. The onsite proposed conditions flow patterns match existing flow patterns. The project site lies within Subbasin OFF11B shown on the referenced Unit 2 Study Figure 7U3R – Interim Conditions Drainage Map included in

Appendix C. A unit flow rate (cfs/acre) for the subbasins were calculated by dividing the total flow rate of the subbasin by the overall subbasin area. The total flow rate generated by the areas shown on Figure 5 is approximated by multiplying the calculated unit flow rate (cfs/acre) by the delineated portion of tributary area (acres). Flows generated by the prorated subbasins will discharge to the south to the COS-4 wash and ultimately into the existing wash south of Village 24. Prorate calculations for the site have been included on Figure 5. Pertinent reference material has been included in Appendix C.

The subbasins and flow patterns used to determine the ultimate conditions onsite flow rates were referenced from the CDS Study. The project site lies within Subbasin COS-3 shown on the referenced CDS Study Figure 6U2 – Ultimate Conditions Drainage Basin Map included in Appendix C. Flows generated by the site will discharge to the south and into the COS-4 wash and ultimately into the existing wash south of Village 24. Pertinent reference material has been included in Appendix C.



PANEL 2125 E

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

PANEL 2125 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COMMUNITY	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	35279	2125	E
UNINCORPORATED AREAS	32003	2125	E

Notice to User: The Map Number shown below should be used when placing map order; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2125 E

MAP REVISED:
SEPTEMBER 27, 2002

Federal Emergency Management Agency

PANEL 2150 E

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

PANEL 2150 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

COMMUNITY	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	35279	2150	E
UNINCORPORATED AREAS	32003	2150	E

Notice to User: The Map Number shown below should be used when placing map order; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2150 E

MAP REVISED:
SEPTEMBER 27, 2002

Federal Emergency Management Agency

GRAPHIC SCALE

1500 0 750 1500

(IN FEET)
1 inch = 1500 ft.

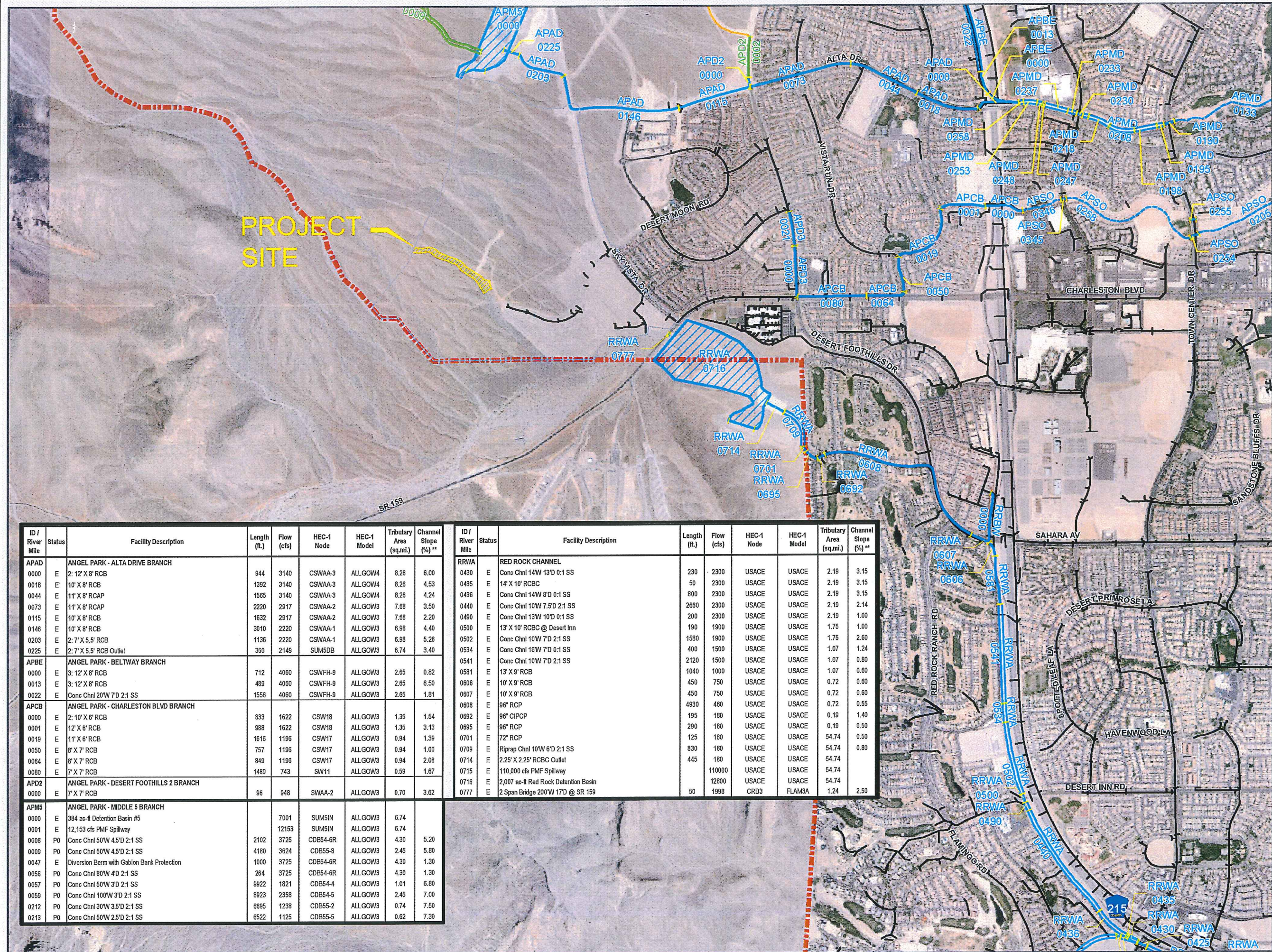
NORTH

VILLAGE 24 - US WATERS
COS-3 WASH

FIGURE 3
F.I.R.M.

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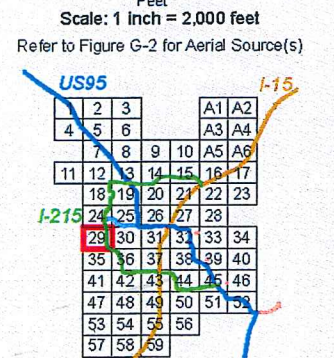
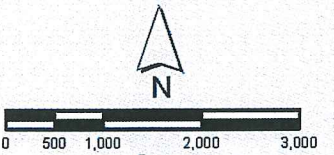


2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 29
FLOOD CONTROL FACILITIES

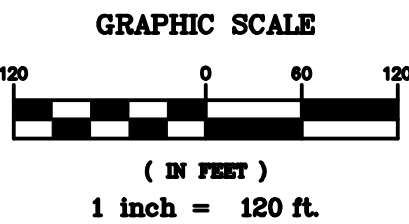
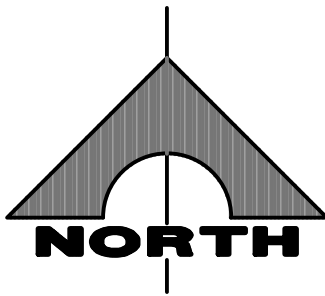
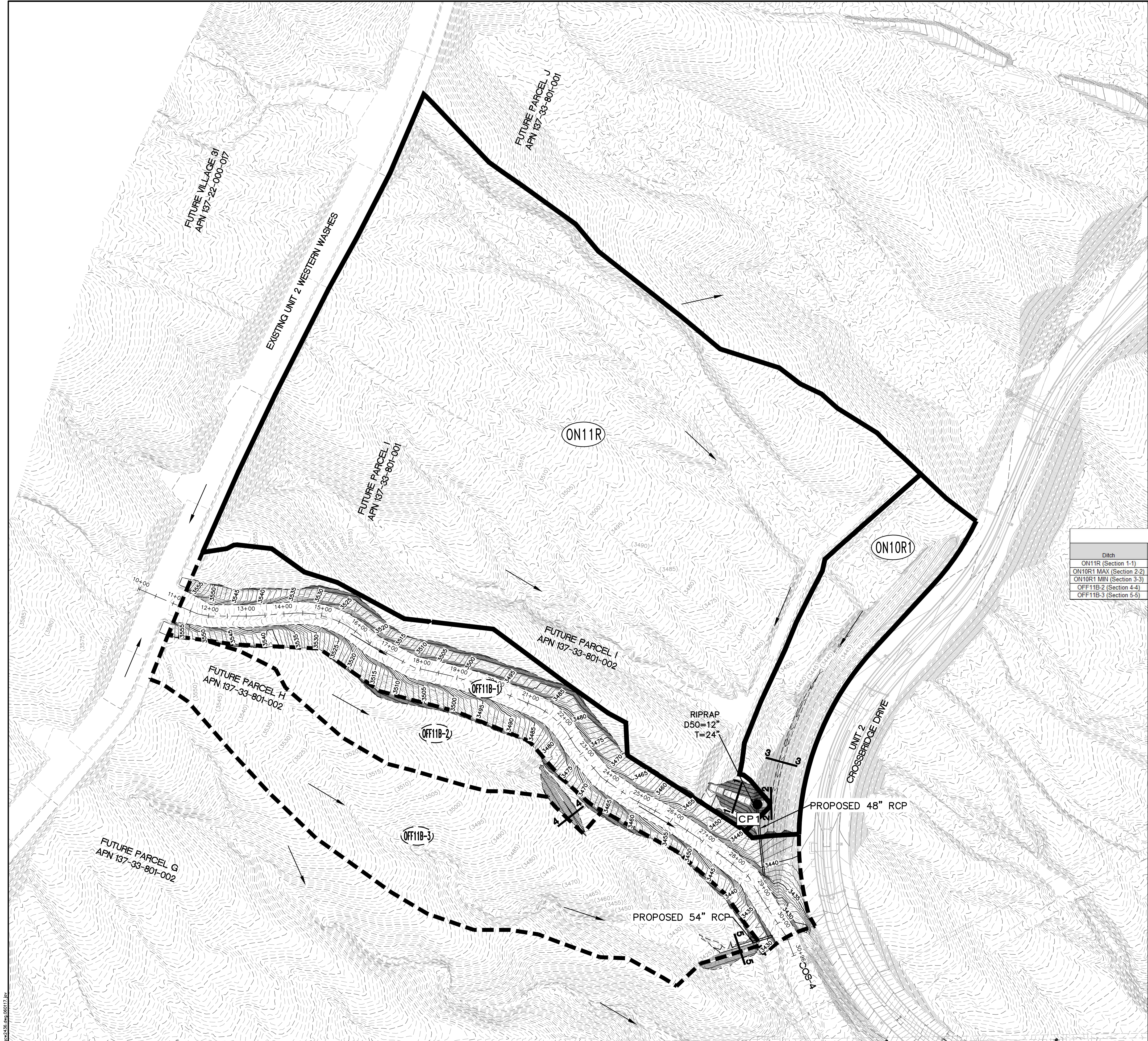
- LEGEND**
- Ultimate Development Boundary
 - Existing Facilities
 - Category A Proposed Facilities
 - Category B Proposed Facilities
 - Local Existing Facilities
 - Local Proposed Facilities
 - Detention Basin
 - Stormdrain
 - Lined Channel
 - Unlined Channel
 - Levee/Dike
 - Natural Wash/Floodway
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

FIGURE 4



VI. EXISTING/ INTERIM CONDITIONS

Existing conditions for the project were addressed in the Unit 2 Study. Pertinent reference materials have been included in Appendix C. Currently runoff west of the COS-3 channel improvements enters the existing Unit 2 Western Wash Channel where a portion of the flow (720 cfs) is diverted into natural washes through Parcel COS-3, to the COS-4 channel, and ultimately into the existing washes south of Village 24. Offsite flows impacting the existing project site have been referenced and prorated from the Unit 1 and Unit 2 Study. See referenced Figure 7U3R – Interim Conditions Drainage Map from the Unit 2 Study included in Appendix C. Interim conditions flows generated north of Parcel COS-3 will be conveyed parallel with the parcel and enter the channel near the downstream end via a proposed 48-inch RCP. Interim conditions flows generated south of Parcel COS-3 will be conveyed parallel with the parcel and enter the channel near the downstream end via a proposed 54-inch RCP. Figure 5 depicts the existing/interim drainage patterns used in the hydrologic analysis. Table 1 summarizes the prorated proposed conditions offsite flow rates and has been included on Figure 5.



LEGEND

- SUBBASIN BOUNDARY
- PRORATED SUBBASIN BOUNDARY
- OFF11B DRAINAGE SUBBASIN
- OFF11B-2 PRORATED DRAINAGE SUBBASIN
- FLOW DIRECTION
- CP1 CONCENTRATION POINT

SUMMARY OF INTERIM CONDITIONS HEC-1 MODEL			
SB OR CP	AREA (AC)	100 YR (CFS)	10 YR (CFS)
ON10R1	4.7	14	6
ON11R	38.5	109	49
CP1	-	122	55

INTERIM/ PROPOSED CONDITION PRORATED FLOW SUMMARY			
Offsite Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B*	153	56.8	2.69
Offsite Prorated Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B-1	23	8.7	2.69
OFF11B-2	8	3.1	2.69
OFF11B-3	30	11.2	2.69

*Referenced from the Unit 2 Study

100-YEAR DITCH/BERM CHARACTERISTICS									
Ditch	Slope (%)	Q ₁₀₀ (cfs)	Depth of flow (ft)	Velocity (ft/s)	Bottom Width (ft)	Type	Side Slopes	Reqd d ₅₀ (in)	Tributary Subbasin
ON11R (Section 1-1)	5.00	109	2.08	7.16	15	TRAP	2:1 / 2:1	12	ON11R
ON10R1 MAX (Section 2-2)	0.60	14	0.70	3.10	5	TRAP	2:1 / 2:1	N/A	ON10R1
ON10R1 MIN (Section 3-3)	0.60	14	1.25	2.81	0	V	3:1 / 3:1	N/A	ON10R1
OFF11B-2 (Section 4-4)	0.90	8	0.91	3.22	0	V	3:1 / 3:1	N/A	OFF11B-2
OFF11B-3 (Section 5-5)	0.60	38	1.25	3.71	4.5	TRAP	3:1 / 3:1	N/A	OFF11B-2 + OFF11B-3

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 PARCEL C08-3 WASH

INTERIM CONDITIONS DRAINAGE MAP

DRAWING

FIG-5

OF SHTS

DESIGN: 1555 S. RAINBOW BLVD.

DRAWN: LAS VEGAS, NV 89146

CHECK: T: 702.804.2000

ISSUE DATE: F: 702.804.2299

ISSUE EDITOR: gowenengineering.com

PLOT DATE: 03-21-17

PLOT TIME: 15:45:41

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DESCRIPTION

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APP

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ENGINEERS' SURVEYORS

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**TABLE 1
INTERIM/ PROPOSED CONDITION
PRORATED FLOW SUMMARY**

Offsite Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B*	153	56.8	2.69
Offsite Prorated Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B-1	23	8.7	2.69
OFF11B-2	8	3.1	2.69
OFF11B-3	30	11.2	2.69

*Referenced from the Unit 2 Study

In order to maintain drainage patterns approved in the CDS Study, ditches/berms have been provided along the northern and southern boundary of the project site. Flows tributary to the proposed ditches/berms to the south have been referenced and prorated from the Unit 2 Study Interim Drainage Conditions Figure 7U3R. Flows tributary to the proposed ditches/berms to the north have been prorated from the updated hydrologic calculations provided in Appendix A. Flows impacting the northern boundary of the site will be directed to the proposed 48-inch RCP stub extending north from the downstream end of the wash. The 48-inch RCP stub has been provided for interim and future development of Parcel I. Flows impacting the southern boundary of Parcel COS-3 will be directed to the proposed 54-inch RCP stub extending south from the downstream end of the wash. The proposed 54-inch RCP stub is for future development of Parcel H. A riprap pad will be provided for both proposed RCPs where flow is entering the wash. The starting water surface elevations for the pipes have been conservatively set to top of pipe. Copies of the inlet control, outlet protection, and hydraulic models have been included in Appendix B. Pertinent reference materials have been included in Appendix C. Information for the berms/ditches has been included on Figure 5. All offsite ditches/berms are summarized in Table 2. Normal depth calculations for the ditches have been included in Appendix B. Pertinent reference materials have been included in Appendix C.

TABLE 2
100-YEAR DITCH/BERM CHARACTERISTICS

Ditch*	Slope (%)	Q₁₀₀ (cfs)	Depth of flow (ft)	Velocity (ft/s)	Bottom Width (ft)	Provided D₅₀ (in)	Tributary Subbasins
ON11R (Section 1-1)	5.00	109	2.08	7.16	15	12	ON11R
ON10R1 MAX (Section 2-2)	0.60	14	0.70	3.10	5	N/A	ON10R1
ON10R1 MIN (Section 3-3)	0.50	14	1.25	2.97	0	N/A	ON10R1
OFF11B-2 (Section 4-4)	0.90	8	0.91	3.22	0	N/A	OFF11B-2
OFF11B-3 (Section 5-5)	0.50	38	1.25	3.71	4.5	N/A	OFF11B-2 + OFF11B-3

*See Figure 5

VII. ULTIMATE CONDITIONS

Ultimate Conditions for the proposed Parcel COS-3 channel improvements have been referenced from the CDS Study. Ultimate conditions flows generated within Parcel COS-3 will discharge southeasterly to the existing COS-4 wash. Pertinent referenced materials from the CDS Study have been included in Appendix C.

The proposed 48-inch RCP has been provided for the future development of Parcel I and has been designed to convey the Interim conditions flow rate of 122 cfs because it represents the worst case flow rate. The proposed 54-inch RCP is for the future development of Parcel H and has been designed to convey the entire ultimate conditions flow rate of 155 cfs. Copies of the hydraulic models have been included in Appendix B. Pertinent referenced materials from the CDS Study have been included in Appendix C.

Finished floor elevations for the future developments adjacent to parcel COS-3 wash will be set at 18-inches above the adjacent channel water surface elevation.

VIII. RECOMMENDED FACILITY DESIGN

The referenced COS-4 Study HEC-RAS Model runs from the western boundary channel to southern boundary of Village 24. It assumes the COS-4 channel improvements are constructed and the COS-3 Parcel is in existing conditions. Copies of the referenced models have been included Appendix C.

The proposed Parcel COS-3 channel improvements have been designed using the ultimate conditions flow rates referenced from the CDS and the COS-4 Study for the 100-year storm event since it represents the worst-case flow along Parcel COS-3. Hydraulic modeling for the proposed channel improvements were performed within the U.S. Army Corps of Engineers HEC-RAS River Analysis System computer program version 4.1.0 (Reference 7). Corresponding stations correlating the hydraulic model stationing with the improvement plan centerline stationing have been included on Table 3 and on Figure 6. HEC-RAS output summary and station locations have been included on Figure 6. In general, HEC-RAS cross sections have been provided at 50 foot intervals to match the COS-4 HEC-RAS station locations.

Mixed, subcritical, and supercritical flow regimes for the proposed COS-3 channel reach were modeled and reviewed. Results indicate that the supercritical flow regime best represents the hydraulics of the Parcel COS-3 berm/channel improvements and governs the proposed design of the channel improvements. Table 3 summarizes the HEC-RAS results using the supercritical flow regime with the calculated freeboard and super-elevation to evaluate the proposed channel wall heights necessary for the proposed channel. Where velocities are greater than 5 feet per second, rock-lining has been proposed with a 6-foot to 8-foot deep concrete cut-off wall to provide erosion protection along the proposed Parcel COS-3 berms.

Super-elevation heights along the proposed berms along the existing Parcel COS-3 were calculated using Equation 740 from the Manual. Freeboard for the proposed berms was calculated with Equation 748 from the Manual. Copies of the HEC-RAS models (including digital files) using a mixed flow regime for the ultimate conditions flow rates has been included in Appendix B. The following model has been included in Appendix B: COS3-4ULT.

Expansion and contraction coefficients for the proposed channel cross sections and transitions have been utilized in the model according to the HEC-RAS River Analysis System Hydraulic Reference Manual (Reference 8, HEC-RAS Manual). In general, contraction and expansion coefficients at the cross sections assume values of 0.05 and 0.1, respectively, for gradual transitions under supercritical flow.

Please note that the starting water surface elevation at the upstream end of the COS-3 model is referenced from the Unit 2 Study CRR2A and CRR2B HEC-RAS Models at the existing Western Wash located at the western boundary of Village 24. The water surface elevation at the downstream end is referenced from the COS-4 Study. Copies of the referenced models have been included Appendix C.

TABLE 3
HEC-RAS SUMMARY – SUPERCRITICAL FLOW (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Super- elevation	Total Depth	Chnl Height
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)
2699	11+21	720	3552.00	3553.80	1.80	6.47	87.06	1.01	0	0.0	3.0	5.0
2650	11+63	720	3548.00	3549.13	1.13	14.98	77.67	3.31	0	0.0	2.5	4.0
2600	12+09	720	3544.00	3545.78	1.78	11.52	65.23	2.01	0	0.0	3.1	4.0
2575	12+33	720	3543.00	3544.16	1.16	11.65	65.16	2.04	0	0.0	2.5	4.0
2550	12+54	720	3541.00	3542.53	1.53	11.90	67.10	2.14	0	0.0	2.9	4.0
2500	12+98	720	3538.00	3539.73	1.73	10.89	67.43	1.86	0	0.0	3.1	5.0
2450	13+55	720	3534.00	3535.63	1.63	12.09	61.26	2.13	0	0.0	3.0	5.0
2425	13+85	720	3532.00	3533.74	1.74	11.39	57.83	1.89	0	0.0	3.1	5.0
2400	14+17	720	3530.00	3531.76	1.76	10.81	64.21	1.83	0	0.0	3.1	4.0
2350	14+55	720	3527.84	3529.20	1.36	11.07	61.31	1.85	250	0.5	3.1	4.0
2300	14+82	720	3525.91	3527.19	1.28	12.33	65.15	2.23	250	0.6	3.2	4.0
2250	15+08	720	3524.00	3525.53	1.53	12.22	53.12	1.96	250	0.5	3.4	4.0
2225	15+45	720	3521.00	3522.82	1.82	13.53	46.05	2.11	250	0.5	3.8	4.0
2200	15+72	720	3519.00	3521.24	2.24	11.49	66.25	2.02	250	0.5	4.2	5.0
2175	15+93	720	3518.00	3519.71	1.71	11.25	64.98	1.94	250	0.5	3.6	5.0
2150	16+13	720	3516.00	3518.20	2.20	11.50	63.43	1.99	0	0.0	3.6	5.0
2125	16+50	720	3513.00	3514.96	1.96	12.34	58.78	2.18	0	0.0	3.3	6.0
2100	16+84	720	3511.00	3512.58	1.58	11.88	59.55	2.07	0	0.0	2.9	5.0
2050	17+16	720	3509.00	3510.22	1.22	11.97	64.59	2.15	450	0.3	2.9	4.0
1975	17+91	720	3503.11	3505.18	2.07	10.47	69.88	1.83	450	0.3	3.7	5.0
1900	18+67	720	3498.25	3499.83	1.58	11.58	63.90	2.04	0	0.0	2.9	5.0
1825	19+56	720	3492.70	3494.20	1.50	11.00	66.01	1.9	0	0.0	2.8	5.0
1800	19+88	720	3490.80	3492.21	1.41	10.65	59.24	1.72	0	0.0	2.7	6.0
1750	20+18	720	3489.00	3490.12	1.12	11.68	59.65	1.97	0	0.0	2.4	6.0
1650	21+00	720	3483.81	3485.43	1.62	11.03	64.62	1.9	200	0.6	3.6	5.0
1600	21+60	720	3479.84	3480.94	1.10	12.30	68.12	2.25	200	0.8	3.2	4.0
1545	22+12	720	3476.56	3477.97	1.41	10.48	67.71	1.76	200	0.6	3.3	4.0
1500	22+81	720	3471.78	3473.00	1.22	12.64	57.59	2.19	0	0.0	2.6	4.0
1450	23+23	720	3468.69	3469.99	1.30	12.38	65.16	2.25	470	0.3	3.0	4.0
1375	24+04	720	3463.55	3464.93	1.38	12.12	66.37	2.19	470	0.3	3.0	4.0
1300	24+62	720	3459.09	3461.11	2.02	10.97	66.41	1.91	0	0.0	3.4	5.0
1225	25+37	720	3453.90	3455.83	1.93	11.54	70.39	2.13	0	0.0	3.3	5.0
1150	26+15	720	3450.00	3451.22	1.22	10.14	66.54	1.67	0	0.0	2.5	5.0
1075	26+89	720	3444.00	3446.17	2.17	12.21	62.84	2.18	0	0.0	3.6	6.0
1050	27+21	720	3442.00	3443.87	1.87	12.24	63.13	2.19	0	0.0	3.2	5.0

TABLE 3
HEC-RAS SUMMARY – SUPERCRITICAL FLOW (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Top Width	Froude #	Radius	Super- elevation	Total Depth	Chnl Height
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)			(ft)	(ft)	(ft)
1000	27+52	720	3440.48	3442.10	1.62	11.06	67.54	1.93	0	0.0	2.9	4.0
960	27+94	720	3438.00	3440.00	2.00	10.26	64.63	1.69	560	0.2	3.5	6.0
925	28+29	720	3436.00	3437.20	1.20	11.97	56.43	2.04	560	0.2	2.7	6.0
850	29+08	799	3430.64	3432.82	2.18	10.54	72.11	1.78	560	0.2	3.7	4.0
775	30+01	799	3424.00	3425.99	1.99	13.38	51.57	2.19	0	0.0	3.4	6.0
700	30+61	799	3421.00	3422.42	1.42	14.43	60.51	2.66	0	0.0	2.8	6.0
550	-	1031	3415.41	3416.66	1.25	13.61	86.65	2.56	0	0.0	2.6	4.0

*See Figure 6

Scour

Scour calculations were performed for velocities in the flow corridor exceeding five (5) fps to determine erosion control measures to prevent undercutting of the proposed channel improvements. A 6-foot to 8-foot deep minimum vertical riprap cutoff wall is designed along the toe of the proposed channel improvements. Scour calculations are included in Appendix B. The results from the calculations are summarized in Table 4.

TABLE 4
COS-3 - SCOUR WALL CALCULATIONS (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Calculated Scour Depth	Depth Required	Provided Scour Protection
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
2699	11+21	720	3552	3553.8	1.80	6.47	6.28	8.08	8
2650	11+63	720	3548	3549.13	1.13	14.98		7.05	
2600	12+09	720	3544	3545.78	1.78	11.52	<1	1.37	6
2575	12+33	720	3543	3544.16	1.16	11.65		0.49	
2550	12+54	720	3541	3542.53	1.53	11.9		0.76	
2500	12+98	720	3538	3539.73	1.73	10.89	1.53	2.53	
2450	13+55	720	3534	3535.63	1.63	12.09		3.59	
2425	13+85	720	3532	3533.74	1.74	11.39	<1	2.92	
2400	14+17	720	3530	3531.76	1.76	10.81	3.33	5.17	
2350	14+55	720	3527.84	3529.2	1.36	11.07		4.99	
2300	14+82	720	3525.91	3527.19	1.28	12.33		4.17	
2250	15+08	720	3524	3525.53	1.53	12.22		4.25	
2225	15+45	720	3521	3522.82	1.82	13.53		4.79	
2200	15+72	720	3519	3521.24	2.24	11.49	<1	1.83	7
2175	15+93	720	3518	3519.71	1.71	11.25		0.95	
2150	16+13	720	3516	3518.2	2.20	11.5	3.74	5.64	
2125	16+50	720	3513	3514.96	1.96	12.34		6.61	6
2100	16+84	720	3511	3512.58	1.58	11.88	<1	1.88	
2050	17+16	720	3509	3510.22	1.22	11.97		0.86	

TABLE 4
COS-3 - SCOUR WALL CALCULATIONS (ULTIMATE CONDITIONS)

Sta*	Plan Sta	ULT Q	FL Elevation	WS Elevation	Depth	Vel	Calculated Scour Depth	Depth Required	Provided Scour Protection
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(ft)
1975	17+91	720	3503.11	3505.18	2.07	10.47	2.22	3.91	6
1900	18+67	720	3498.25	3499.83	1.58	11.58		3.84	
1825	19+56	720	3492.7	3494.2	1.50	11		3.52	
1800	19+88	720	3490.8	3492.21	1.41	10.65		5.30	
1750	20+18	720	3489	3490.12	1.12	11.68		5.09	
1650	21+00	720	3483.81	3485.43	1.62	11.03		4.41	
1600	21+60	720	3479.84	3480.94	1.10	12.3		2.78	
1545	22+12	720	3476.56	3477.97	1.41	10.48	1.99	2.71	
1500	22+81	720	3471.78	3473	1.22	12.64		1.55	
1450	23+23	720	3468.69	3469.99	1.30	12.38	<1	0.99	
1375	24+04	720	3463.55	3464.93	1.38	12.12		0.82	
1300	24+62	720	3459.09	3461.11	2.02	10.97	1.16	2.62	
1225	25+37	720	3453.9	3455.83	1.93	11.54		2.73	
1150	26+15	720	3450	3451.22	1.22	10.14	3.85	4.18	
1075	26+89	720	3444	3446.17	2.17	12.21		5.85	
1050	27+21	720	3442	3443.87	1.87	12.24		5.25	
1000	27+52	720	3440.48	3442.1	1.62	11.06	<1	1.40	
960	27+94	720	3438	3440	2.00	10.26	3.54	5.08	
925	28+29	720	3436	3437.21	1.21	11.95		5.02	
850	29+08	799	3430.64	3432.82	2.18	10.54	3.21	4.97	
775	30+01	799	3424	3425.99	1.99	13.38		5.56	

IX. CONCLUSIONS AND RECOMMENDATIONS

1. Methodology used in this report is in compliance with Clark County Regional Flood Control District (CCRFCD) criteria.
2. The proposed project lies within a Zone X. Therefore, the project is not currently located in a FEMA-designated Special Flood Hazard Area.
3. The site is not adjacent to any CCRFCD Facilities.
4. The portion of the site designated as a WOTUS will remain natural.
5. The recommended channel system proposes a natural bottom channel with concrete/rock-lined sides and a 6-foot to 8-foot cutoff wall along the northern and southern banks of the channel. Detailed hydraulic modeling of the proposed Parcel COS-3 channel improvements from the Unit 2 Western Washes to the COS-4 Wash shows that the design flows will be contained within the channel and will not adversely impact the stilling downstream COS-4 improvements. The design flows are based on the approved CDS Study ultimate conditions drainage patterns.
6. The proposed 48-inch RCP and 54-inch RCP will collect flows generated north and south of the wash.
7. Proposed offsite ditches/berms located on the north and south sides of Parcel COS-3 will convey offsite flows to the proposed RCPs, into the wash, and ultimately to existing washes south of Village 24 to be consistent with the ultimate Village 24 drainage patterns.
8. All finished floors adjacent to the Parcel COS-3 channel improvements will be designed as required by CLV Criteria.
9. The proposed drainage patterns in this report are generally consistent with those presented in the CDS, COS-4, Unit 1, and Unit 2 Studies.
10. The proposed improvements do not significantly alter existing peak flows or the character of flows downstream of the project.

11. Runoff generated from, or conveyed by, the project will not adversely impact any downstream properties and facilities.

X. REFERENCES

1. GCW, Inc., *Update #2 to the Conceptual Drainage Study for Summerlin Village 24*. September 2014.
2. GCW, Inc., *Update to the Technical Drainage Study for Summerlin Village 24 Parcel COS-4*. August 2016.
3. GCW, Inc., *Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Crossbridge Drive (Crossbridge Unit 1 to Sun Creek Road)*. March 2016.
4. GCW, Inc., *Update #2 to the Technical Drainage Study for Summerlin Village 24 Unit 1 Improvements Including Parcels "A" & "B" Mass Grading*. February 2006.
5. CCRFCD 2013 Las Vegas Valley Flood Control Master Plan Update. 2013.
6. U.S. Army Corps of Engineers, *HEC-1 Flood Hydrograph Package*, June 1998.
7. U.S. Army Corps of Engineers, *HEC-RAS River Analysis System*. January 2010. Version 4.1.0.
8. Clark County Regional Flood Control District (CCRFCD) *Hydrologic Criteria and Drainage Design Manual*. August 1999.
9. U.S. Army Corps of Engineers, *HEC-RAS River Analysis System Hydraulic Reference Manual*. January 2010. Version 4.1.

**TECHNICAL DRAINAGE STUDY FOR
SUMMERLIN V24 PARCEL COS-3 WASH
APPENDIX LAYOUT**

Appendix A. Hydrologic Calculations and Information

1. Interim Conditions Prorate Calculations
2. Proposed/ Interim Conditions Standard Form 4
3. Proposed/ Interim Conditions HEC-1 Model

Appendix B. Hydraulic Calculations

1. Manning's "n" Calculation
2. Inlet Control Calculations
3. Outlet Protection Calculations
4. Ditch Calculations
5. SF6 Models
6. Scour Wall Calculations
7. COS-3 HEC-RAS Model: COS3-4ULT.prj
8. CD Containing HEC-RAS Model
9. D-Load Calculations

Appendix C. Referenced Materials

1. Limited Geotechnical Evaluation US Waters – Wash COS-3 and COS-4 Summerlin Village 24 Las Vegas, Nevada
 - a) Figure 2A – Alignment Map Overview
 - b) Figure 2C – Alignment Map
 - c) Figure 2D – Alignment Map
 - d) Boring Logs for B-7, B-8, and B-9
 - e) Summary of Test Results (D50)
 - f) Photos of Test Locations
2. Update #2 to the Conceptual Drainage Study for Summerlin Village 24
 - a) CLV Approval Letter
 - b) Figure 6U – Ultimate Conditions Drainage Map
 - c) Figure 8U2 – Proposed Facilities Drainage Map
3. Update to the Technical Drainage Study for Village 24 Parcel COS-4
 - a) CLV Approval Letter
 - b) Figure 7R Proposed Conditions HEC-RAS Exhibit
 - c) COS3-4: Ultimate Conditions HEC-RAS Model
4. Update #6 to the Technical Drainage Study for Summerlin Village 24 Unit 2 Improvements – Crossbridge Drive (Crossbridge Unit 1 to Sun Creek Road)
 - a) CLV Approval Letter
 - b) Figure 7U3R – Interim Conditions Drainage Map
 - c) Figure 8U3R - HEC-RAS Cross Section Exhibit
 - d) Proposed/ Interim Conditions Standard Form 4
 - e) Proposed/ Interim Conditions HEC-1 Model
 - f) Flow Split Calculation (Weir)
 - g) SF6 Model: Mainline No. 1: Existing Wash to Crossbridge to Parcel J (Ultimate)
 - h) Western Boundary Ultimate Conditions HEC-RAS Model: CRR2A_ULT.prj
 - i) Western Boundary Ultimate Conditions HEC-RAS Model: CRR2B_720.prj
 - j) Improvement Plan Sheets: 1, 6, 16-19, 32A, 37
5. Update #2 to the Technical Drainage Study for Summerlin Village 24 Unit 1 Improvements Including Parcels "A" and "B" Mass Grading
 - a) CLV Approval Letter

- b) Interim Conditions Standard Form 4
- c) Existing Conditions HEC-1 Model

APPENDIX A

Hydrologic Calculations and Information

INTERIM/ PROPOSED CONDITION PRORATED FLOW SUMMARY			
Offsite Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B*	153	56.8	2.69
Offsite Prorated Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B-1	23	8.7	2.69
OFF11B-2	8	3.1	2.69
OFF11B-3	30.0	11.2	2.69

*Referenced from the Unit 2 Study

COS3.OUT

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1*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 08FEB17 TIME 16:41:44
*
*****

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*****
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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X X XXXXXXX XXXXX X
X X X X X XX
X X X X X X
XXXXXX XXXX X XXXXX X
X X X X X X
X X X X X X
X X XXXXXXX XXXXX XXX

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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

1 HEC-1 INPUT PAGE 1

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

*DIAGRAM

*** FREE ***

```

1 ID *****
2 ID * .....
3 ID * : .....
4 ID * : SUMMERLIN VILLAGE 24 .....
5 ID * : US WATERS - COS-3 WASH .....
6 ID * : PROPOSED/INTERIM CONDITIONS .....
7 ID * : .....
8 ID * : RETURN PERIOD --- 100 & 10 .....
9 ID * : DISTRIBUTION --- 6-HOUR SDN3 .....
10 ID * : PROJECT NO --- 62024.226.3 .....
11 ID * : FILENAME --- COS3.H1 .....
12 ID * : DATE MODELED --- 01/30/2017 .....
13 ID * : MODELED BY --- NAB .....
14 ID * : .....
15 ID * : .....
16 ID * : .....
17 ID *****
18 ID
19 ID JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
20 ID
21 ID FREQUENCY DARF
22 ID
23 ID 100-YR 1.00
24 ID 10-YR 0.575
25 ID
26 IT 5 0 0 300
27 IO 5 0 0
28 IN 5 0 0
29 JR PREC 1 0.575

```

```

30 KK ON10R1*
31 KM REVISED FROM UNIT 2 STUDY
32 BA .00730
33 PB 3.34
34 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
35 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
36 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
37 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
38 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
39 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
40 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
41 PC .998 .999 1.00
42 LS 0 88.0
43 UD .100

```

```

44 KK ON11R
45 KM REVISED FROM UNIT 1 STUDY
46 BA .0602
47 PB 3.34
48 LS 0 88
49 UD 0.115

```

1 HEC-1 INPUT PAGE 2

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

COS3.OUT

50 KK CP1
51 KM COMBINATION POINT
52 KM COMBINE ON10R1 & ON11R
53 HC 2
*
54 ZZ

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT
LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
30 ON10R1*
. .
44 . ON11R
. .
50 CP1.....

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 08FEB17 TIME 16:41:44 *

* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *

* : *
* : SUMMERLIN VILLAGE 24 *
* : US WATERS - COS-3 WASH *
* : PROPOSED/INTERIM CONDITIONS *
* : *
* : RETURN PERIOD --- 100 & 10 *
* : DISTRIBUTION --- 6-HOUR SDN3 *
* : PROJECT NO --- 62024.226.3 *
* : FILENAME --- COS3.H1 *
* : DATE MODELED --- 01/30/2017 *
* : MODELED BY --- NAB *
* : *
* : *
* : *

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

FREQUENCY	DARF
100-YR	1.00
10-YR	0.575

27 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 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 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 .57

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

COS3.OUT

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION	
				RATIO 1	RATIO 2
				1.00	.57
HYDROGRAPH AT					
+	ON10R1*	.01	1 FLOW TIME	14. 3.50	6. 3.50
HYDROGRAPH AT					
+	ON11R	.06	1 FLOW TIME	109. 3.58	49. 3.58
2 COMBINED AT					
+	CP1	.07	1 FLOW TIME	122. 3.58	55. 3.58

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

APPENDIX B

Hydraulic Calculations

Mannings N Calculator Using Equation 732 in the HCDDM		
d_{50} (in)	d_{50} (ft)	n
12	1	0.040

PIPE CULVERT

CP1 48" RCP

INPUT

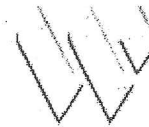
Pipe Diameter	48 in
Number of Pipes	1
Length	182.1 ft
Slope	1.50 %
Manning's 'n'	0.013
Flow "Q"	122 cfs
Entrance Coef.	0.35
Tail Water	0 ft

INLET

Thin Edge	7.34 ft
Sq. Edge	6.40 ft
Beveled	5.76 ft
Tapered	5.42 ft.

OUTLET

Head Water	4.22 ft
Critical	3.32 ft
Velocity	9.71 ft/s



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PIPE CULVERT

OFF11B-3 54" RCP

INPUT

Pipe Diameter	54 in
Number of Pipes	1
Length	55.4 ft
Slope	1.00 %
Manning's 'n'	0.013
Flow "Q"	38 cfs
Entrance Coef.	0.35
Tail Water	0 ft

INLET

Thin Edge	2.59 ft
Sq. Edge	2.47 ft
Beveled	2.42 ft
Tapered	2.57 ft.

OUTLET

Head Water	N/A ft
Critical	1.77 ft
Velocity	2.39 ft/s



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	Pipe Culvert Outlet Protection	
	48-inch RCP	
	Known:	
	Q= Flow (cfs)	122
	D= Diameter of Pipe (ft)	4.0
	Ø= Expansion angle of the culvert flow (typ=20o)	20.0
	V= Allowable downstream velocity (typ=8 ft/s)	5
	Fr= Froude Number (0 if full)	0.00
	Yn= Depth of flow in Pipe Culvert (ft)*	0.00
	* Not necessary if Fr<1	
	Solve For:	
	D ₅₀ = Required Rip-rap size (ft)	1.05
	D ₅₀ = Required Rip-rap size (in)	12.6
	D ₅₀ = Required Rip-rap size (in)	13
	A _t = Req'd Area of flow at allowable velocity (ft ²)	24.4
	Y _t = Tailwater depth (ft)	1.60
	L= Length of Protection (ft)	15.5
	Equations are valid for given hydraulic parameters	
	Equations from CCRFCD Manual	
	$(d_{50}/D)*(Y_t/D)1.2/(Q/D^{2.5})=0.023$	Eq. 760
	Da=1/2(D+Yn) (used in place of D if Fr>1)	Eq. 762
	$L=(1/(2 \tan \emptyset))(A_t/Y_t-W)$	Eq. 764
	A _t =Q/V	Eq. 765

	Pipe Culvert Outlet Protection	
	54-inch RCP	
	Known:	
	Q= Flow (cfs)	155
	D= Diameter of Pipe (ft)	4.5
	Ø= Expansion angle of the culvert flow (typ=20o)	20.0
	V= Allowable downstream velocity (typ=8 ft/s)	5
	Fr= Froude Number (0 if full)	0.00
	Yn= Depth of flow in Pipe Culvert (ft)*	0.00
	* Not necessary if Fr<1	
	Solve For:	
	D ₅₀ = Required Rip-rap size (ft)	1.12
	D ₅₀ = Required Rip-rap size (in)	13.5
	D ₅₀ = Required Rip-rap size (in)	14
	A _t = Req'd Area of flow at allowable velocity (ft ²)	31.0
	Y _t = Tailwater depth (ft)	1.80
	L= Length of Protection (ft)	17.5
	Equations are valid for given hydraulic parameters	
	Equations from CCRFCD Manual	
	$(d_{50}/D)*(Y_t/D)1.2/(Q/D^{2.5})=0.023$	Eq. 760
	Da=1/2(D+Yn) (used in place of D if Fr>1)	Eq. 762
	$L=(1/(2 \tan \emptyset))(A_t/Y_t-W)$	Eq. 764
	$A_t=Q/V$	Eq. 765

TRAPEZOIDAL CHANNEL

ON11R

Flow "Q" 109 cfs

Manning's "n" 0.040

Slope (%) 5.00

Bottom Width 15.0 ft

Side Slope (Lt) 2.0 H:1V

Side Slope (Rt) 2.0 H:1V

Radius 0.0 ft

OUTPUT:

Velocity 7.16 ft/sec

Depth 0.91 ft

Freeboard 1.17 ft

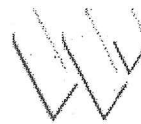
Total Depth 2.08 ft

Froude No. 1.39

Superelevation 0.00 ft

Normal depth calculations using Manning's equation

$Fb = 1 + 0.025Vd^{1/3}$ Supercritical; $0.5 + V^2/2g$ Subcritical



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RIPRAP CHANNEL

ON11R

Flow "Q" 109 cfs

Manning's "n" 0.039

Slope (%) 5.00

Bottom Width 15.0 ft

Side Slope (Lt) 2.0 H:1V

Side Slope (Rt) 2.0 H:1V

Specific Gravity 2.50

OUTPUT:

Velocity 7.27 ft/s

Depth 0.89 ft

Freeboard 1.17 ft

Total Depth 2.06 ft

Froude No. 1.43

Riprap Size D50 11.3 in



G. C. WALLACE COMPANIES

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TRAPEZOIDAL CHANNEL

ON10R1 MAX

Flow "Q"	14 cfs
Manning's "n"	0.025
Slope (%)	0.60
Bottom Width	5.0 ft
Side Slope (Lt)	2.0 H:1V
Side Slope (Rt)	2.0 H:1V
Radius	0.0 ft

OUTPUT:

Velocity	3.10 ft/sec
Depth	0.70 ft
Freeboard	0.65 ft
Total Depth	1.35 ft
Froude No.	0.72 ft
Superelevation	0.00 ft

Normal depth calculations using Manning's equation

$Fb = 1 + 0.025Vd^{1/3}$ Supercritical; $0.5 + V^2/2g$ Subcritical



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TRAPEZOIDAL CHANNEL

ON10R1 MIN

Flow "Q" 14 cfs

Manning's "n" 0.025

Slope (%) 0.50

Bottom Width 0.0 ft

Side Slope (Lt) 3.0 H:1V

Side Slope (Rt) 3.0 H:1V

Radius 0.0 ft

OUTPUT:

Velocity 2.97 ft/sec

Depth 1.25 ft

Freeboard 0.64 ft

Total Depth 1.89 ft

Froude No. 0.66 ft

Superelevation 0.00 ft

Normal depth calculations using Manning's equation

$F_b = 1 + 0.025Vd^{1/3}$ Supercritical; $0.5 + V^2/2g$ Subcritical



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TRAPEZOIDAL CHANNEL

OFF11B-2

Flow "Q"	8 cfs
Manning's "n"	0.025
Slope (%)	0.90
Bottom Width	0.0 ft
Side Slope (Lt)	3.0 H:1V
Side Slope (Rt)	3.0 H:1V
Radius	0.0 ft

OUTPUT:

Velocity	3.22 ft/sec
Depth	0.91 ft
Freeboard	0.66 ft
Total Depth	1.57 ft
Froude No.	0.84 ft
Superelevation	0.00 ft

Normal depth calculations using Manning's equation

$Fb = 1 + 0.025Vd^{(1/3)}$ Supercritical; $0.5 + V^2/2g$ Subcritical



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TRAPEZOIDAL CHANNEL

OFF11B-3

Flow "Q"	38 cfs
Manning's "n"	0.025
Slope (%)	0.50
Bottom Width	4.5 ft
Side Slope (Lt)	3.0 H:1V
Side Slope (Rt)	3.0 H:1V
Radius	0.0 ft

OUTPUT:

Velocity	3.71 ft/sec
Depth	1.25 ft
Freeboard	0.71 ft
Total Depth	1.96 ft
Froude No.	0.71 ft
Superelevation	0.00 ft

Normal depth calculations using Manning's equation

$Fb = 1 + 0.025Vd^{(1/3)}$ Supercritical; $0.5 + V^2/2g$ Subcritical



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Storm Drain Hydraulics Calculations

G.C. Wallace, Inc.

48" RCP (CP1) INTERIM

DATE: 02/08/17

FILE: SF6.xls

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Summary of Results

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Storm Drain Hydraulics Calculations

CONDUIT DATA										FLOW DATA										ENERGY LOSS DATA																				EGL & HGL				COMMENTS										
																				PIPE	TRANSITION																																	
STATION			PIPE	BOX		IRREG		#	INVERT ELEV		L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole			Junction			Contraction/ Inlet			Expansion/Outlet			Bend				Misc		CONDUIT		TRANSITION		FULL/										
FROM	TO	T/R	D	SPAN	RISE	AREA	HYD RAD		D/S	U/S	(ft)	(%)	(ft ²)		(cfs)	(ft/s)	(ft)	(ft/ft)	S _f	H _f	H _f	Θ	K _{mh}	H _{mh}	Θ	K _j	H _i	Inlet/ Cont	K _i	H _e	Θ	K _e	H _o	R _{bend}	Θ	K _b	H _b	H _m	Total	U/S EGL	U/S HGL	U/S EGL	U/S HGL	PART FLOW	CRTL									
1	100.00		48							32.26																				Outlet K _e = 1.0																								
2	100.00	282.10	R	48				1	32.26	34.99	182.1	1.50%	12.57	0.0049	102	8.12	1.02	0.0050	0.0050	0.92																												PART	D/S					
3	282.10								34.99																																													
4																																																						
5																																																						
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Summary of Results

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Storm Drain Hydraulics Calculations

CONDUIT DATA										FLOW DATA										ENERGY LOSS DATA																				EGL & HGL				COMMENTS				
																				PIPE	TRANSITION																											
STATION			PIPE	BOX		IRREG		#	INVERT ELEV		L	S	A	Φ	Q	V	V2/2g	Sf	Ave.	Frict	Frict	Manhole		Junction		Contraction/ Inlet		Expansion/Outlet		Bend			Misc		CONDUIT		TRANSITION		FULL/									
FROM	TO	T/R	D	SPAN	RISE	AREA	HYD RAD		D/S	U/S	(ft)	(%)	(ft²)		(cfs)	(ft/s)	(ft)	(ft/ft)	S _f	H _f	H _f	Θ	K _{mh}	H _{mh}	Θ	K _i	H _i	Inlet/	K _i	H _c	Θ	K _o	H _o	R _{bend}	Θ	K _b	H _b	H _m	Total	U/S	U/S	U/S	U/S	PART	CRTL			
(ft)	(ft)		(in)	(ft)	(ft)	(ft²)	(ft)		(ft)	(ft)	(ft)								(ft/ft)	(ft)	(ft)	(deg)	(ft)	(ft)	(deg)		(ft)	Cont		(ft)	(deg)		(ft)	(ft)	(deg)	(ft)	(ft)	(ft)	EGL	HGL	EGL	HGL	FLOW					
1	100.00		54							23.99																																						
2	100.00	155.40	R	54				1	23.99	24.54	55.4	1.00%	15.90	0.0049	155	9.75	1.47	0.0062	0.0062	0.34																			0.00	30.52	29.04			FULL	D/S			
3	155.40								24.54																																							
4																																																
5																																																
6																																																
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(Equation 724)

Where;

Z_t = The Total Scour Depth That Can Occur At A Structure.

Z_{lt} = The Long-Term Bed Elevation Changes Depth. (See attached worksheet.)

Z_a = The Anti-Dune Trough Depth

Z_{bs} = Bend-Scour Component of Total Scour Depth

Z_{cs} = Contraction-Scour Component of Total Scour Depth

Z_{cs} = Local Scour at Abutments Depth

$$Z_t = \{Z_{lt} + (1/2)Z_a + Z_{bs} + Z_{cs} + Z_s\}$$

Z_t = The Total Scour Depth That Can Occur At A Structure.

Z_{lt} = The Long-Term Bed Elevation Changes Depth. (See attached worksheet.)

Z_a = The Anti-Dune Trough Depth

Z_{bs} = Bend-Scour Component of Total Scour Depth

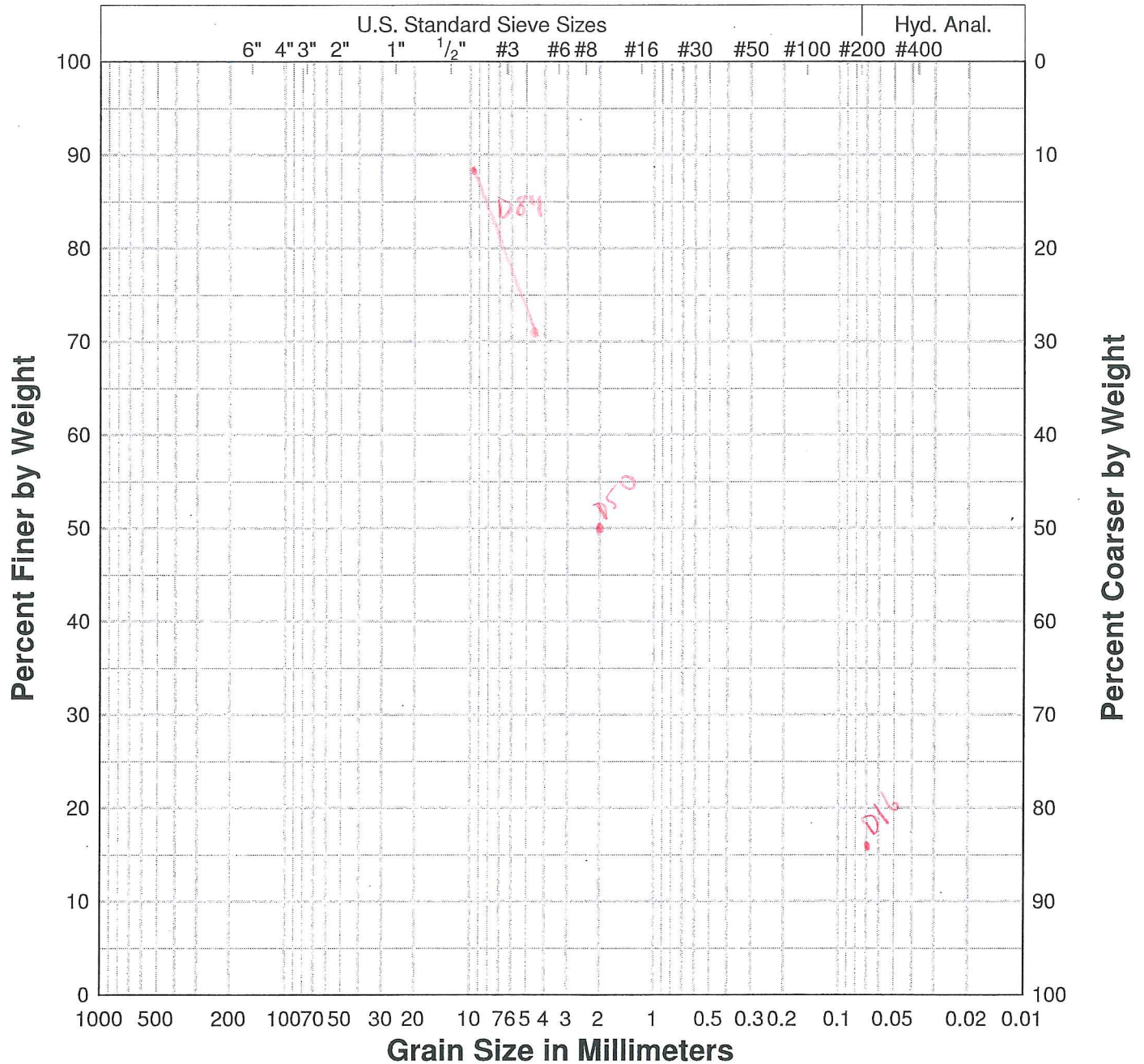
Z_{cs} = Contraction-Scour Component of Total Scour Depth

Z_{cs} = Local Scour at Abutments Depth

(Equation 708) Where; V = Average Channel Velocity; fps			Anti-Dune Trough Depth; Z_a $Z_a = (1/2)(0.14)(2\pi V^2/g) = 0.0137V^2$; Anti-Dune Trough Depth
(Equation 709) Where; V = Average Channel Velocity; fps Y_{MAX} = Maximum Depth of Flow Immediately Upstream of Bend; ft Y_n = Hydraulic Depth of Flow Immediately Upstream of Bend; ft (Flow Area/ Flow Top Width) S_{e1} = Energy Slope Immediately Upstream of Bend (or Bed Slope for Uniform Conditions), ft/ft α = Angle Formed by the Projection of the Channel Centerline from the Point of Curvature to a Point Which Meets a Line Tangent to the Outer Bank of the Channel, degrees			Bend-Scour Depth; Z_{bs} $Z_{bs} = (0.0685Y_{MAX}^{0.8}Y_n^{0.4}S_e^{0.5})[2.1\sin^2(\alpha/2)/\cos \alpha]^{0.2} - 1]$
(Equation 712) Where; Y = Average Depth of Flow in the Main Channel or Overbank at the Approach Section; ft If V_c < V; use live bed contraction scour equations; if not assume clear-water contraction.			Critical Velocity Above Which Material Will Be Transported; V_c $V_c = 10.95 Y^{(1/6)} d_{50}^{(1/3)}$ Above Which Material Will Be Transported
(Equation 713) (Equation 714) Where; Y₂ = Average Depth After Scour Contracted Section; ft Y₁ = Average Depth in the Main Channel or Floodplain at the Approach Section; ft Y_o = Average Depth in the Main Channel or Floodplain at the Contracted Section Before Scour; ft Q₁ = Flow in the Main Channel or Floodplain at the Approach Section, Which is Transporting Sediment; cfs Q₂ = Flow in the Main Channel or Floodplain at the Contracted Section, Which is Transporting Sediment; cfs W₁ = Top Width of the Active Flow Area at the Approach Section; ft W₂ = Top Width of the Active Flow Area at the Contracted Section; ft K₁ = Exponent for Mode of Bed Material Transport			Live-Bed Contraction Scour; Z_{cs} $Y_2 = Y_1[Q_2/Q_1]^{(6/7)}[W_1/W_2]^{K_1}$ $Z_{cs} = Y_2 - Y_o$ Live-Bed Contraction Scour Live-Bed Contraction Scour
(Equation 715) (Equation 716) Where; d_m = Diameter of the Smallest Non-Transportable Particle in the Bed Material (1.25 d₅₀) in the Contracted Section; ft d₅₀ = Median Diameter of the Bed Material; ft C = 120 for English Units (40 for Metric)			Clear-Water Contraction Scour; Z_{cs} $Y_2 = [Q_2^2/Cd_m^{(2/3)}W_2^{2(3/7)}]$ $Z_{cs} = Y_2 - Y_o$ Clear-Water Contraction Scour Clear-Water Contraction Scour
(Equation 717) Where; Y₁ = Depth of Flow at the Toe of the Abutment on the Overbank or in the Main Channel; ft K₁ = Correction Factor for Abutment Shape 1.00, for Vertical-Wall Abutment 0.82, for Vertical-Wall Abutment with Wing Walls 0.55, for Spill-Through Abutment Specify K₁ Value K₂ = Correction Factor for Angle of Attack(θ) of Flow With Abutment, θ = 90 degrees When Abutments are Perpendicular to the Flow, θ < 90 degrees if Embankment Points Downstream, and θ > 90 If Embankment Points Upstream (θ/90)^{0.4} Specify θ Value; degrees			Local Scour At Abutments; Z_s $Z_s = 4Y_1(K_1/0.55)K_2Fr_1^{0.33}$ Local Scour at Abutments (HIRE)
(Equation 718) Where; K₁ = Correction Factor for Abutment Shape 1.1, for Square Nose 1.0, for Round Nose, Circular Cylinder and Group of Cylinders 0.9, for Sharp Nose (Triangular) Specify K₁ Value K₂ = Correction Factor for Angle of Attack(θ) of Flow With Abutment, θ = 90 degrees When Abutments are Perpendicular to the Flow, θ < 90 degrees if Embankment Points Downstream, and θ > 90 If Embankment Points Upstream (θ/90)^{0.4} Specify θ Value; degrees L' = Length of Abutment (Embankment) Projected Normal to Flow; ft Y_a = Average Depth of Flow on the Flow on the Floodplain at the Approach Section (Y₁); ft Fr = Froude Number of the Floodplain at the Approach Section V_a = Average Velocity of the Approach Flow V_a; fps A_a = Flow Area of the Approach Section Obstructed by the Abutment and Embankment; ft			Local Scour at Abutments (FROELICH) $Z_s = 2.27K_1K_2(L')^{0.43}Y_a^{0.57}Fr_1^{0.61} + Y_a$ Local Scour at Abutments (FROELICH)

Cross Section Location	Approach Flowrate CFS Q ₁	Contracted Flowrate CFS Q ₂	Approach Top Width Feet W ₁	Contracted Top Width Feet W ₂	Average Velocity FPS V _m	Maximum Depth Upstream of Bend Feet Y _{max}	Hydraulic Depth Upstream of Bend Feet Y _b	Approach Depth Feet Y ₁	Average Depth In Main Channel Feet Y _a	Embankment Length Main Channel Feet L'	Average Depth After Contraction Scour Feet Y ₂	Soil Particle Size Feet d ₅₀	Critical Velocity FPS V _c	Energy Slope At Approach Section ft/ft S _{a2}	α Degrees	Froude Number Fr ₁	Long-Term Bed Elevation Changes Feet Z ₄	Anti-Dune Trough Feet Z _a	Anti-Dune Trough Feet Z ₃	Bend Scour Feet Z _{ba}	Bend Scour Feet Z _{bs}	Contraction Scour Feet Z _{ca}	Contraction Scour Feet Z _{cs}	Local Scour Feet Z _l	Total Scour Feet Z _t	Proposed Minimum Depth of Footings Z _f	Factor of Safety
2699-2650	720	720	87.06	77.67	10.73	1.8	1.28	1.8	1.47	42.14	1.93	0.00984	2.59	0.0167	0.00	1.01	-3.3	1.58	0.73	-5.30	0.00	0.46	0.46	1.80	6.28	8.00	1.3
2650-2500	720	720	77.67	65.16	12.19	1.13	0.63	1.13	1.47	124.59	1.25	0.00984	2.39	0.2276	0.00	3.31	18.3	2.04	0.73	-2.20	0.00	-0.21	0.00	0.00	-17.55	6.00	NA
2500-2450	720	720	67.43	61.26	11.49	1.73	1.01	1.73	1.68	51.59	1.83	0.00984	2.57	0.0605	0.00	2.02	-0.5	1.81	0.84	-3.33	0.00	0.15	0.15	0.00	1.53	6.00	3.9
2450-2400	720	720	61.26	57.83	11.43	1.63	0.98	1.63	1.71	66.08	1.69	0.00984	2.55	0.0818	0.00	1.61	1.7	1.79	0.86	-3.54	0.00	-0.02	0.00	0.00	-0.89	6.00	NA
2400-2225	720	720	64.21	46.05	11.99	1.76	1.05	1.76	1.48	117.88	2.14	0.00984	2.58	0.0583	0.00	1.83	-1.9	1.97	0.74	-2.84	0.00	0.66	0.66	0.00	3.33	6.00	1.8
2225-2150	720	720	46.05	46.05	11.94	1.82	1.20	1.82	1.99	73.81	1.82	0.01312	2.85	0.0740	27.00	1.68	1.9	1.95	1.00	0.79	0.79	-0.17	0.00	0.00	-0.16	6.00	NA
2150-2125	720	720	63.43	58.78	11.92	2.20	1.00	2.20	2.08	37.32	2.30	0.01312	2.95	0.0704	0.00	1.99	-0.3	1.95	1.04	-5.08	0.00	0.22	0.22	2.20	3.74	7.00	1.9
2125-1975	720	720	58.78	58.78	11.67	1.96	0.99	1.96	1.71	139.14	1.96	0.01312	2.89	0.0859	0.00	2.18	3.2	1.86	0.85	-3.68	0.00	0.25	0.25	0.00	-2.08	6.00	NA
1975-1600	720	720	69.88	59.24	11.24	2.07	1.00	2.07	1.49	352.91	2.28	0.01312	2.92	0.0598	13.00	1.83	-0.7	1.73	0.74	-0.58	0.00	0.80	0.80	0.00	2.22	6.00	2.7
1600-1545	720	720	68.12	67.71	11.39	1.10	0.88	1.10	1.26	51.00	1.10	0.00656	2.08	0.0925	19.00	2.25	2.1	1.78	0.63	0.09	0.09	-0.15	0.00	0.00	-1.36	6.00	NA
1545-1500	720	720	67.71	57.59	11.56	1.41	1.04	1.41	1.32	62.44	1.55	0.00656	2.17	0.0538	0.00	1.76	-1.1	1.83	0.66	-3.48	0.00	0.24	0.24	0.00	1.99	6.00	3.0
1500-1300	720	720	57.59	57.59	12.03	1.22	1.01	1.22	1.48	148.36	1.22	0.00656	2.12	0.08487	0.00	2.19	2.1	1.98	0.74	-3.15	0.00	-0.26	0.00	0.00	-1.41	6.00	NA
1300-1225	720	720	66.41	66.41	11.26	2.02	1.01	2.02	1.98	69.30	2.02	0.00656	2.30	0.0649	15.00	1.91	-0.1	1.74	0.99	-0.27	0.00	0.04	0.04	0.00	1.16	6.00	5.2
1225-1150	720	720	70.39	66.54	10.84	1.93	0.90	1.93	1.58	81.26	2.00	0.00656	2.29	0.0838	0.00	2.13	3.1	1.61	0.79	-3.48	0.00	0.42	0.42	0.00	-1.88	6.00	NA
1150-1050	720	720	66.54	62.84	11.53	1.22	1.09	1.22	1.75	94.86	1.26	0.00656	2.12	0.0472	0.00	1.67	-3.0	1.82	0.88	-2.14	0.00	-0.49	0.00	0.00	3.85	6.00	1.6
1050-960	720	720	63.13	63.13	11.19	1.87	0.94	1.87	1.83	69.40	1.87	0.00656	2.28	0.0866	0.00	2.19	2.5	1.71	0.92	-3.41	0.00	0.04	0.04	0.00	-1.50	6.00	NA
960-925	720	720	64.63	56.43	11.12	2.00	1.10	2.00	1.61	36.40	2.17	0.00656	2.30	0.0493	0.00	1.69	-0.2	1.69	0.80	-3.41	0.00	0.56	0.56	2.00	3.54	6.00	1.7
925-850	720	720	56.43	56.43	11.26	1.21	1.07	1.21	1.70	78.08	1.21	0.00656	2.12	0.0735	32.00	2.04	0.4	1.74	0.85	0.62	0.62	-0.49	0.00	0.00	1.05	6.00	5.7
850-700	799	799	72.11	51.57	12.78	2.18	1.08	2.18	1.86	145.69	2.66	0.00656	2.33	0.0549	0.00	1.78	-1.5	2.24	0.93	-4.18	0.00	0.79	0.79	0.00	3.21	6.00	1.9

B-7



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

$$\frac{\left[\frac{D_{84}}{D_{50}} \right]}{2} = \frac{\left[\frac{0.02625}{0.00656} + \frac{0.00656}{0.00025} \right]}{2} = 15.17$$

$$\begin{aligned} D_{84} &= 8 \text{ mm} = 0.026246714 \\ D_{50} &= 2 \text{ mm} = 0.00656168 \\ D_{16} &= 0.075 \text{ mm} = 0.000246063 \end{aligned}$$

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$q_s = C_1 (Y)^{C_2} (V)^{C_3}$								
d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
$G_F=1.0$								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
$G_F=2.0$								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
$G_F=3.0$								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
$G_F=4.0$								
C_1				1.05×10^{-5}				
C_2				0.21				
C_3				3.71				

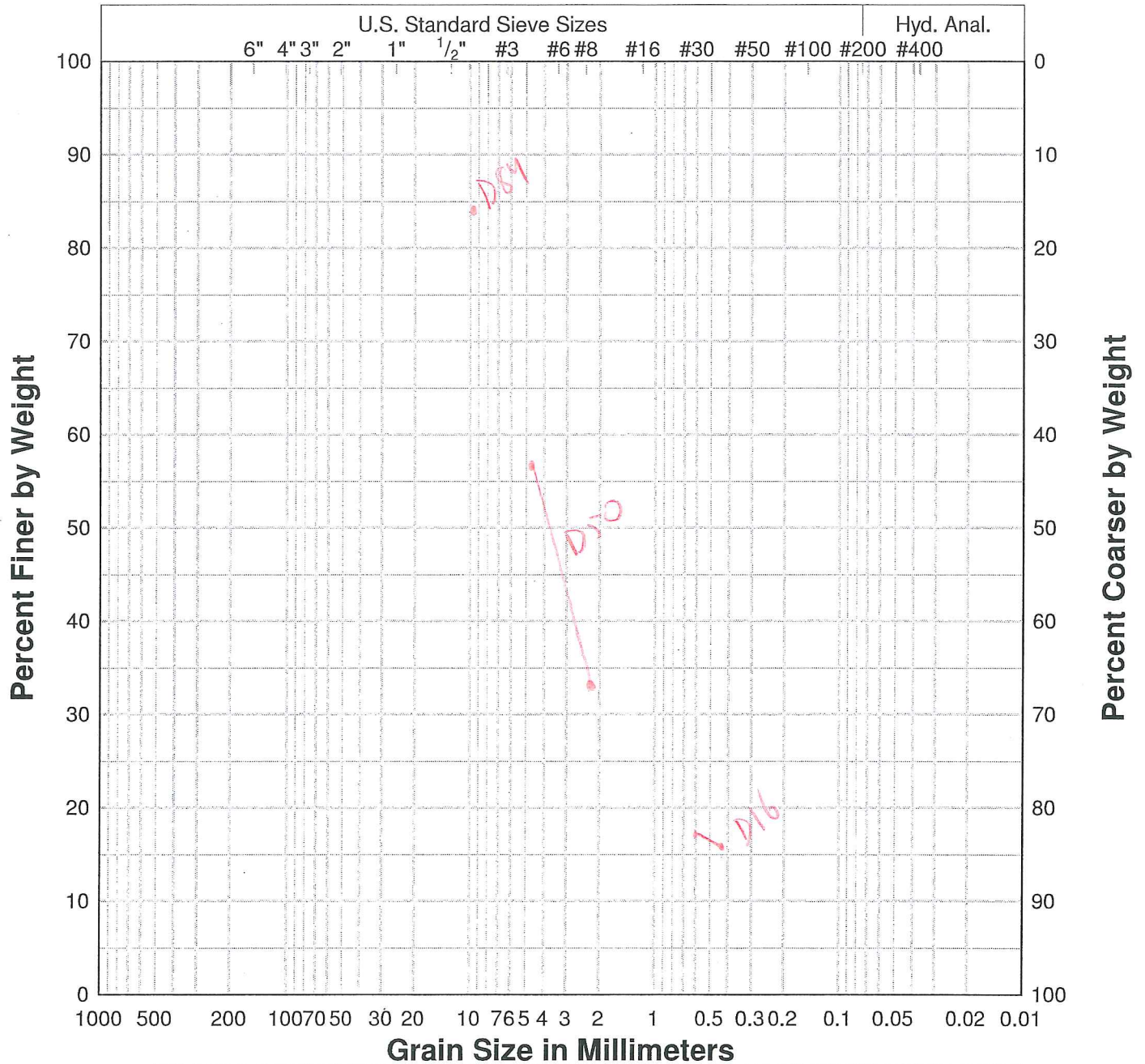
Definitions: q_s =Unit sediment transport rate in ft²/s (unbulked); V =Velocity in ft/s; Y =Depth in ft;
 G_F =Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

B-8



$$\frac{\left[\frac{D_{84}}{D_{50}} + \frac{D_{50}}{D_{16}} \right]}{2} = \frac{\left[\frac{0.07117}{0.01312} + \frac{0.01312}{0.00131} \right]}{2} = 6.2$$

$$D_{84} = 9.5 \text{ mm} = 0.071167979$$

$$D_{50} = 2 \text{ mm} = 0.01312326$$

$$D_{16} = 0.75 \text{ mm} = 0.001317726$$

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$q_s = C_1 (Y)^{C_2} (V)^{C_3}$								
d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
$G_F=1.0$								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
$G_F=2.0$								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
$G_F=3.0$								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
$G_F=4.0$								
C_1				1.05×10^{-5}				
C_2				0.21				
C_3				3.71				

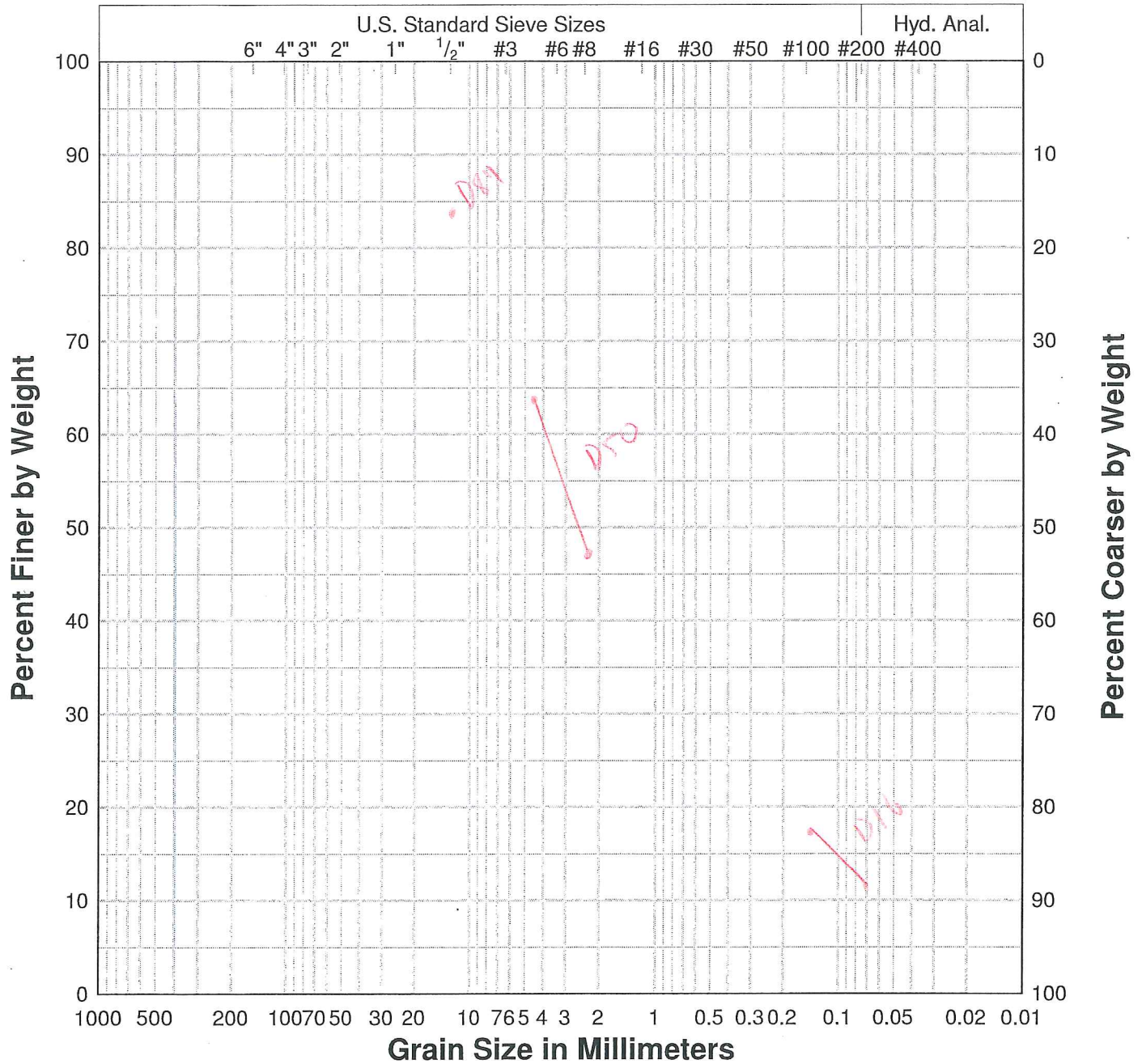
Definitions: q_s =Unit sediment transport rate in ft²/s (unbulked); V =Velocity in ft/s; Y =Depth in ft;
 G_F =Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

B-9



$$\frac{\left[\frac{D_{84}}{D_{50}} + \frac{D_{50}}{D_{10}} \right]}{2} = \left[\frac{0.04101}{0.00984} + \frac{0.00984}{0.00047} \right] = 17.52$$

$$\begin{aligned} D_{84} &= 12.5 \text{ mm} = 0.041010491 \\ D_{50} &= 3 \text{ mm} = 0.00984752 \\ D_{10} &= 0.075 \text{ mm} = 0.000426189 \end{aligned}$$

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

POWER EQUATIONS FOR TOTAL BED MATERIAL DISCHARGE IN SAND- AND FINE-GRAVEL-BED STREAMS

$q_s = C_1 (Y)^{C_2} (V)^{C_3}$								
d_{50}								
(mm)	0.1	0.25	0.5	1.0	2.0	3.0	4.0	5.0
(inches)	0.00394	0.00984	0.0197	0.0394	0.0787	0.118	0.157	0.197
$G_F=1.0$								
C_1	3.30×10^{-5}	1.42×10^{-6}	7.6×10^{-6}	5.62×10^{-6}	5.64×10^{-6}	6.32×10^{-6}	7.10×10^{-6}	7.78×10^{-6}
C_2	0.715	0.495	0.28	0.06	-0.14	-0.24	-0.30	-0.34
C_3	3.30	3.61	3.82	3.93	3.95	3.92	3.89	3.87
$G_F=2.0$								
C_1		1.59×10^{-5}	9.8×10^{-6}	6.94×10^{-6}	6.32×10^{-6}	6.62×10^{-6}	6.94×10^{-6}	
C_2		0.51	0.33	0.12	-0.09	-0.196	-0.27	
C_3		3.55	3.73	3.86	3.91	3.91	3.90	
$G_F=3.0$								
C_1			1.21×10^{-5}	9.14×10^{-6}	7.44×10^{-6}			
C_2			0.36	0.18	-0.02			
C_3			3.66	3.76	3.86			
$G_F=4.0$								
C_1				1.0510^{-5}				
C_2				0.21				
C_3				3.71				

Definitions: q_s =Unit sediment transport rate in ft²/s (unbulked); V =Velocity in ft/s; Y =Depth in ft;
 G_F =Gradation coefficient = $(d_{84}/d_{50} + d_{50}/d_{16})/2$.

Revision	Date

REFERENCE:

TABLE 703A

Determination of Long Term Bed Elevation Changes, Zlt:

2699-2650

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.28	ft
V = flow velocity in upstream channel, (in fps)	6.47	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	87.06	ft
So = upstream channel slope, (in ft/ft)	0.095	ft/ft
L = entire upstream channel length, (in ft)	42.14	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1 \cdot (Yh^{C2}) \cdot (V^{C3})$	0.0	cfs/ft
$Qs = \text{total sediment transport rate} = qs \cdot TW$	0.8	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0170	109.7	6.6	82.2	1.90	1.34	0.8

Equilibrium slope

«Compare to Qs
Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1 \cdot (Yh^{C2}) \cdot (V^{C3})$	0.0	cfs/ft
$Qs = \text{total sediment transport rate} = qs \cdot TW$	0.8	cfs

Zlt Calculation:

$Zlt = \text{long term bed elevation changes} = (Se - So) \cdot L$

-3.3	ft
------	----

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Project Description

Manning Formula

Normal Depth

Section Definitions

Roughness Segment Definitions

Worksheet for 2699-2650

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.90	ft
Elevation Range	3548.00 to 3552.00	ft
Flow Area	109.74	ft ²
Wetted Perimeter	82.79	ft
Hydraulic Radius	1.33	ft
Top Width	82.17	ft
Normal Depth	1.90	ft
Critical Depth	1.90	ft
Critical Slope	0.01697	ft/ft
Velocity	6.56	ft/s
Velocity Head	0.67	ft
Specific Energy	2.57	ft
Froude Number	1.00	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.90	ft
Critical Depth	1.90	ft
Channel Slope	0.01700	ft/ft
Critical Slope	0.01697	ft/ft

Project Description

Manning Formula

Normal Depth

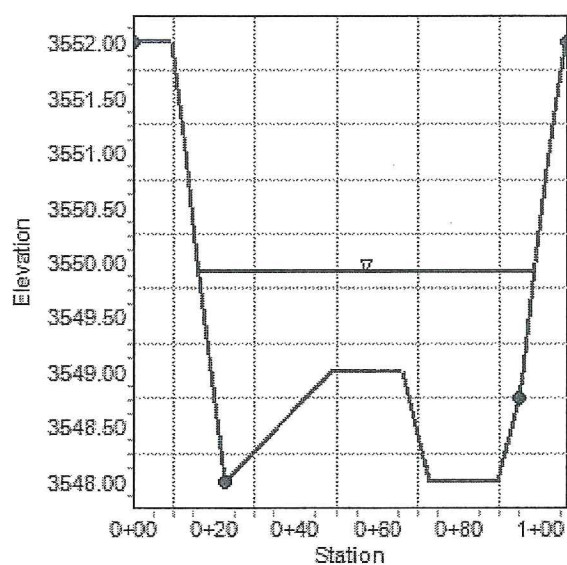
Input Data

0.01700 ft/ft

1.90 ft

720.00 . ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2650-2500

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.63	ft
V = flow velocity in upstream channel, (in fps)	14.98	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	77.67	ft
So = upstream channel slope, (in ft/ft)	0.080	ft/ft
L = entire upstream channel length, (in ft)	124.59	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.3	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	22.2	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.2270	45.7	15.8	65.0	1.40	0.70	22.2

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.3	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	22.2	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

18.3	ft
------	----

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Project Description

Input Data

Station (ft)

Elevation (ft)

Roughness Segment Definitions

Start Station

Ending Station

Roughness Coefficient

(0+36, 3543.00)	(0+75, 3539.00)	0.040
(0+75, 3539.00)	(1+35, 3538.64)	0.035
(1+35, 3538.64)	(1+57, 3543.00)	0.040

Worksheet for 2650-2500

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.40	ft
Elevation Range	3538.00 to 3543.00	ft
Flow Area	45.66	ft ²
Wetted Perimeter	65.18	ft
Hydraulic Radius	0.70	ft
Top Width	64.96	ft
Normal Depth	1.40	ft
Critical Depth	2.26	ft
Critical Slope	0.01620	ft/ft
Velocity	15.77	ft/s
Velocity Head	3.86	ft
Specific Energy	5.26	ft
Froude Number	3.32	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.40	ft
Critical Depth	2.26	ft
Channel Slope	0.22700	ft/ft
Critical Slope	0.01620	ft/ft

Cross Section for 2650-2500

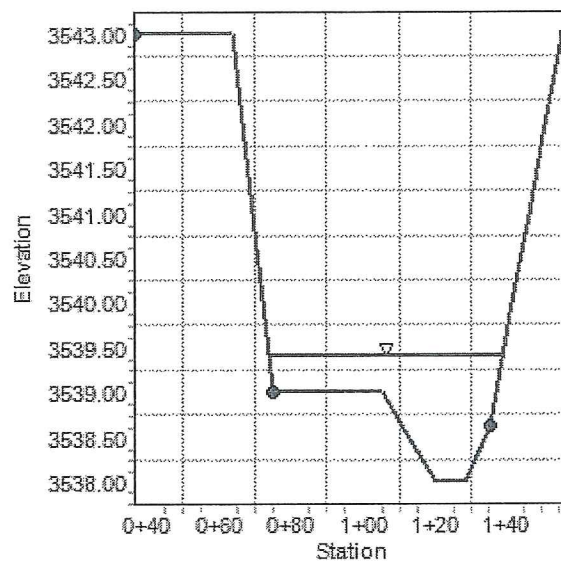
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.22700 ft/ft
Normal Depth 1.40 ft
Discharge 720.00 ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2500-2450

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.01	ft
V = flow velocity in upstream channel, (in fps)	10.89	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	67.43	ft
So = upstream channel slope, (in ft/ft)	0.078	ft/ft
L = entire upstream channel length, (in ft)	51.59	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = $C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	5.1	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0670	64.3	11.2	61.6	1.70	1.04	5.1	«Compare to Qs Computed Above

Equilibrium slope

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = $C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
Qs = total sediment transport rate = qs*TW	5.1	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

-0.5	ft
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if: Se > So then aggradation occurs
Se < So then degradation occurs

Project Description

Manning Formula

Normal Depth

Section Definitions

Station (ft)	Elevation (ft)
0+30	3539.00
0+55	3539.00
0+58	3538.00
0+61	3537.00
0+64	3536.00
0+67	3535.00
0+67	3535.00
0+85	3535.00
0+91	3535.00
1+04	3534.00
1+14	3534.00
1+25	3535.00
1+27	3536.00
1+27	3536.06
1+29	3537.00
1+32	3538.00
1+35	3539.00
1+38	3540.00
1+43	3540.00

0.035

Worksheet for 2500-2450

Input Data

Start Station	Ending Station	Roughness Coefficient
(1+27, 3536.00)	(1+43, 3540.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.70	ft
Elevation Range	3534.00 to 3540.00 ft	
Flow Area	64.28	ft ²
Wetted Perimeter	61.99	ft
Hydraulic Radius	1.04	ft
Top Width	61.57	ft
Normal Depth	1.70	ft
Critical Depth	2.29	ft
Critical Slope	0.01573	ft/ft
Velocity	11.20	ft/s
Velocity Head	1.95	ft
Specific Energy	3.65	ft
Froude Number	1.93	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.70	ft
Critical Depth	2.29	ft

Worksheet for 2500-2450

GVF Output Data

Channel Slope	0.06700	ft/ft
Critical Slope	0.01573	ft/ft

Cross Section for 2500-2450

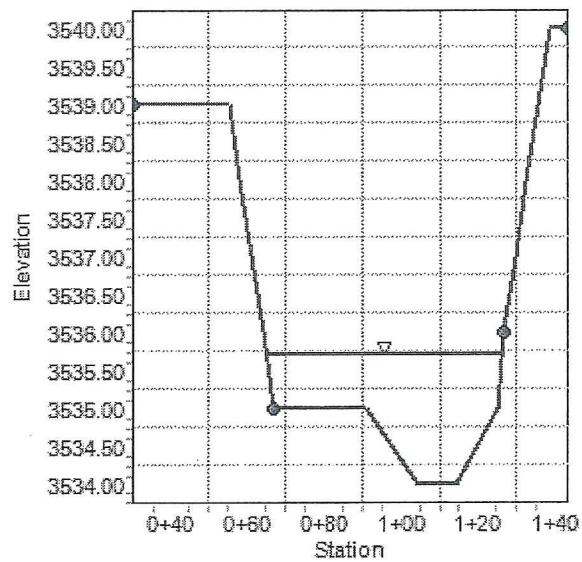
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.06700 ft/ft
Normal Depth 1.70 ft
Discharge 720.00 ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2450-2400

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.98	ft
V = flow velocity in upstream channel, (in fps)	12.09	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	61.3	ft
So = upstream channel slope, (in ft/ft)	0.061	ft/ft
L = entire upstream channel length, (in ft)	66.08	ft

Sediment Transport Rate, q_s in Upstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1*(Yh^C2)*(V^C3)$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s*TW$	7.0	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft ²)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0870	59.9	12.0	62.8	1.64	0.95	7.0	«Compare to Qs Computed Above

Sediment Transport Rate, q_s in Downstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1*(Yh^C2)*(V^C3)$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s*TW$	7.0	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

1.7	ft
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if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Worksheet for 2450-2400

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.08700	ft/ft
Discharge	720.00	ft³/s
Section Definitions		

Station (ft)	Elevation (ft)
0+00	3535.00
0+28	3535.00
0+32	3535.00
0+48	3534.00
0+52	3533.00
0+57	3532.00
0+61	3531.00
0+61	3530.92
0+68	3531.00
0+86	3531.00
1+00	3530.00
1+13	3530.00
1+16	3531.00
1+22	3531.84
1+23	3532.00
1+26	3533.00
1+30	3534.00
1+33	3535.00
1+36	3536.00
1+50	3537.00
1+59	3537.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
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Worksheet for 2450-2400

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00, 3535.00)	(0+61, 3531.00)	0.040
(0+61, 3531.00)	(1+22, 3531.84)	0.035
(1+22, 3531.84)	(1+59, 3537.00)	0.040

Options

Current Roughness vweighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.64	ft
Elevation Range	3530.00 to 3537.00 ft	
Flow Area	59.92	ft ²
Wetted Perimeter	63.10	ft
Hydraulic Radius	0.95	ft
Top Width	62.75	ft
Normal Depth	1.64	ft
Critical Depth	2.30	ft
Critical Slope	0.01595	ft/ft
Velocity	12.02	ft/s
Velocity Head	2.24	ft
Specific Energy	3.89	ft
Froude Number	2.17	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		

Worksheet for 2450-2400

GVF Output Data

Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.64	ft
Critical Depth	2.30	ft
Channel Slope	0.08700	ft/ft
Critical Slope	0.01595	ft/ft

Cross Section for 2450-2400

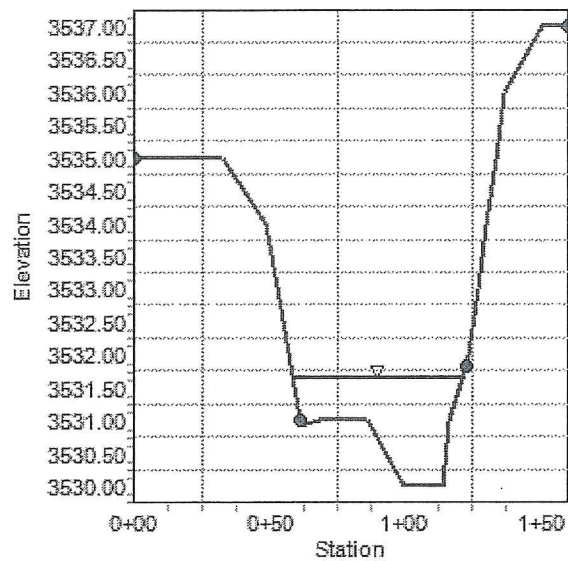
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.08700 ft/ft
Normal Depth 1.64 ft
Discharge 720.00 ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2400-2225

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.05	ft
V = flow velocity in upstream channel, (in fps)	10.81	fps
C1 = sand material constant	0.00000662	
C2 = sand material constant	-0.20	
C3 = sand material constant	3.91	
TW = top width of upstream channel, (in ft)	64.21	ft
So = upstream channel slope, (in ft/ft)	0.076	ft/ft
L = entire upstream channel length, (in ft)	117.88	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1 * (Yh^{C2}) * (V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs * TW$	4.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0600	62.8	11.5	51.6	1.98	1.22	4.6

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1 * (Yh^{C2}) * (V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs * TW$	4.6	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) * L$$

-1.9	ft
------	----

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Worksheet for 2400-2225

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.06000 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00	3528.00
0+01	3528.00
0+03	3527.00
0+05	3526.00
0+26	3525.00
0+29	3524.00
0+33	3523.00
0+37	3522.00
0+40	3521.12
0+43	3521.00
0+63	3521.00
0+67	3522.00
0+70	3523.00
0+86	3523.00
1+00	3522.46
1+02	3523.00
1+04	3524.00
1+07	3525.00
1+10	3526.00
1+43	3526.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3528.00)	(0+40, 3521.12)	0.040

Worksheet for 2400-2225

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+40, 3521.12)	(1+00, 3522.46)	0.035
(1+00, 3522.46)	(1+43, 3526.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.98	ft
Elevation Range	3521.00 to 3528.00 ft	
Flow Area	62.79	ft²
Wetted Perimeter	52.27	ft
Hydraulic Radius	1.20	ft
Top Width	51.62	ft
Normal Depth	1.98	ft
Critical Depth	2.58	ft
Critical Slope	0.01681	ft/ft
Velocity	11.47	ft/s
Velocity Head	2.04	ft
Specific Energy	4.02	ft
Froude Number	1.83	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.98	ft

Worksheet for 2400-2225

GVF Output Data

Critical Depth	2.58	ft
Channel Slope	0.06000	ft/ft
Critical Slope	0.01681	ft/ft

Cross Section for 2400-2225

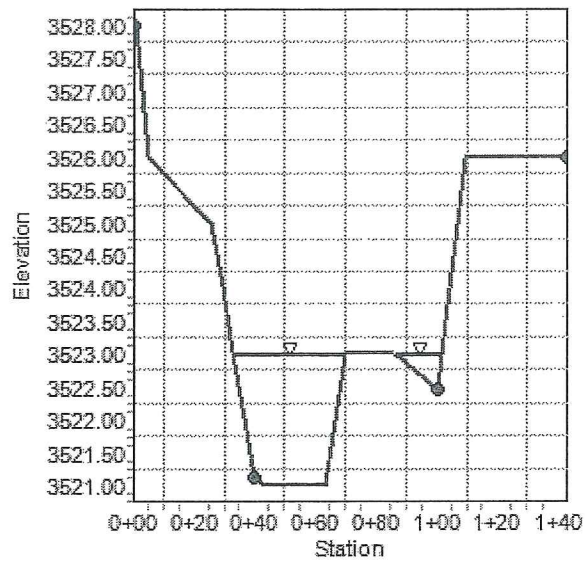
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.06000	ft/ft
Normal Depth	1.98	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2225-2150

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.20	ft
V = flow velocity in upstream channel, (in fps)	13.53	fps
C1 = sand material constant	0.00000694	
C2 = sand material constant	-0.27	
C3 = sand material constant	3.90	
TW = top width of upstream channel, (in ft)	46.05	ft
So = upstream channel slope, (in ft/ft)	0.068	ft/ft
L = entire upstream channel length, (in ft)	73.81	ft

Sediment Transport Rate, q_s in Upstream Channel Calculation:

q_s = sediment transport rate = $C1 \cdot (Yh^{C2}) \cdot (V^{C3})$	0.2	cfs/ft
Q_s = total sediment transport rate = $q_s \cdot TW$	7.9	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft ²)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0940	58.7	12.3	62.9	2.12	0.93	7.9

8Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, q_s in Downstream Channel Calculation:

q_s = sediment transport rate = $C1 \cdot (Yh^{C2}) \cdot (V^{C3})$	0.1	cfs/ft
Q_s = total sediment transport rate = $q_s \cdot TW$	7.9	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) \cdot L$$

1.9	ft
-----	----

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Worksheet for 2225-2150

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.09400 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00	3524.00
0+01	3524.00
0+03	3523.00
0+05	3522.00
0+29	3521.00
0+31	3520.00
0+33	3519.00
0+36	3518.00
0+38	3517.36
0+39	3517.00
0+42	3516.00
0+53	3516.00
0+60	3517.00
0+83	3518.00
0+96	3518.00
0+98	3517.90
0+98	3518.00
1+02	3519.00
1+06	3520.00
1+11	3521.00
1+16	3522.00
1+49	3522.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
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Worksheet for 2225-2150

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00, 3524.00)	(0+38, 3517.36)	0.040
(0+38, 3517.36)	(0+98, 3517.90)	0.035
(0+98, 3517.90)	(1+49, 3522.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.12	ft
Elevation Range	3516.00 to 3524.00 ft	
Flow Area	58.67	ft²
Wetted Perimeter	63.41	ft
Hydraulic Radius	0.93	ft
Top Width	62.94	ft
Normal Depth	2.12	ft
Critical Depth	2.80	ft
Critical Slope	0.01596	ft/ft
Velocity	12.27	ft/s
Velocity Head	2.34	ft
Specific Energy	4.46	ft
Froude Number	2.24	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
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Worksheet for 2225-2150

GVF Output Data

Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.12 ft
Critical Depth	2.80 ft
Channel Slope	0.09400 ft/ft
Critical Slope	0.01596 ft/ft

Cross Section for 2225-2150

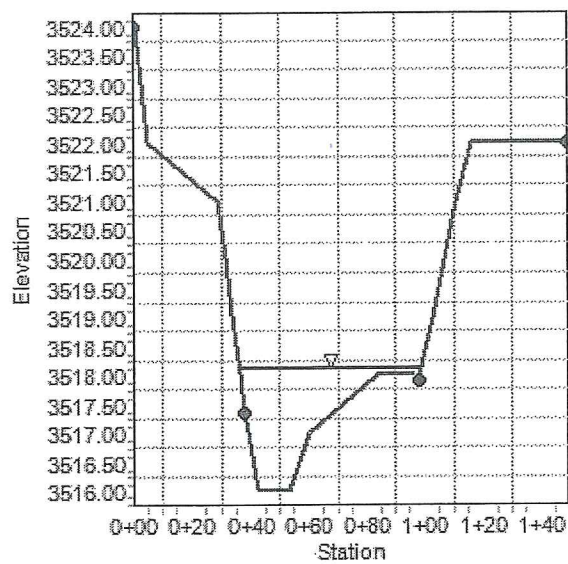
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.09400	ft/ft
Normal Depth	2.12	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2150-2125

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)

1.00 ft

V = flow velocity in upstream channel, (in fps)

11.50 fps

C1 = sand material constant

0.00000694

C2 = sand material constant

-0.27

C3 = sand material constant

3.90

TW = top width of upstream channel, (in ft)

63.43 ft

So = upstream channel slope, (in ft/ft)

0.080 ft/ft

L = entire upstream channel length, (in ft)

37.32 ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 \cdot (Y_h^{C2}) \cdot (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s \cdot TW$$

6.0 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0730	61.5	11.7	59.2	2.02	1.04	6.0	«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 \cdot (Y_h^{C2}) \cdot (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s \cdot TW$$

6.0 cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) \cdot L$$

-0.3 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 2150-2125

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.07300 ft/ft
Discharge 720.00 ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	3523.00
0+08	3523.00
0+10	3522.00
0+12	3521.00
0+17	3520.00
0+36	3519.00
0+39	3518.00
0+42	3517.00
0+45	3516.00
0+46	3515.87
0+48	3515.00
0+50	3514.00
0+53	3513.00
0+64	3513.00
0+75	3514.00
1+06	3514.94
1+07	3515.00
1+11	3516.00
1+16	3517.00
1+20	3518.00
1+25	3519.00
1+52	3520.00
1+68	3521.00
1+70	3522.00
1+78	3522.00

Roughness Segment Definitions

Worksheet for 2150-2125

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+00, 3523.00)	(0+46, 3515.87)	0.040
(0+46, 3515.87)	(1+06, 3514.94)	0.035
(1+06, 3514.94)	(1+78, 3522.00)	0.040

Options

Current Roughness vweighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.02	ft
Elevation Range	3513.00 to 3523.00 ft	
Flow Area	61.53	ft ²
Wetted Perimeter	59.62	ft
Hydraulic Radius	1.03	ft
Top Width	59.16	ft
Normal Depth	2.02	ft
Critical Depth	2.66	ft
Critical Slope	0.01555	ft/ft
Velocity	11.70	ft/s
Velocity Head	2.13	ft
Specific Energy	4.14	ft
Froude Number	2.02	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s

Worksheet for 2150-2125

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	2.02	ft
Critical Depth	2.66	ft
Channel Slope	0.07300	ft/ft
Critical Slope	0.01555	ft/ft

Cross Section for 2150-2125

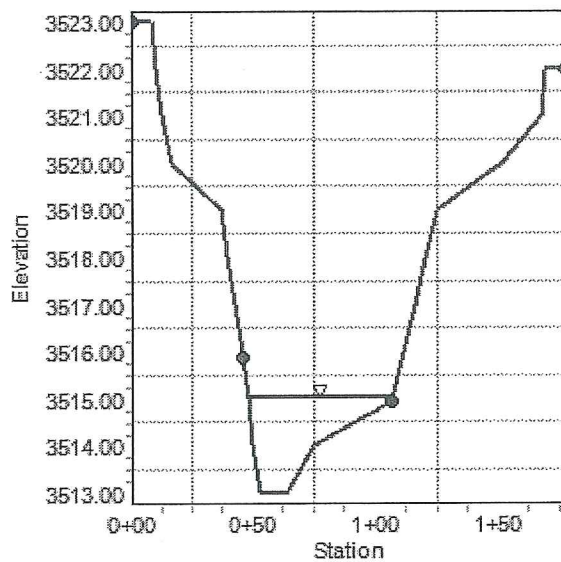
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.07300	ft/ft
Normal Depth	2.02	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

2125-1975

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.99	ft
V = flow velocity in upstream channel, (in fps)	12.34	fps
C1 = sand material constant	0.00000694	
C2 = sand material constant	-0.27	
C3 = sand material constant	3.90	
TW = top width of upstream channel, (in ft)	58.78	ft
So = upstream channel slope, (in ft/ft)	0.071	ft/ft
L = entire upstream channel length, (in ft)	139.14	ft

Sediment Transport Rate, q_s in Upstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s*TW$	7.4	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0940	61.2	11.8	69.0	1.95	0.89	7.4	«Compare to Qs Computed Above

Sediment Transport Rate, q_s in Downstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s*TW$	7.4	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

3.2 ft

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Worksheet for 2125-1975

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.09400 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00	3513.00
0+05	3513.00
0+07	3512.00
0+09	3511.00
0+11	3510.00
0+36	3509.00
0+42	3508.00
0+45	3507.00
0+48	3506.00
0+51	3505.00
0+52	3504.80
0+96	3504.00
1+13	3503.11
1+16	3504.00
1+20	3505.00
1+24	3506.00
1+28	3507.00
1+55	3508.00
1+62	3508.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3513.00)	(0+52, 3504.80)	0.040
(0+52, 3504.80)	(1+13, 3503.11)	0.035

Worksheet for 2125-1975

Input Data

Start Station	Ending Station	Roughness Coefficient
(1+13, 3503.11)	(1+62, 3508.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.95	ft
Elevation Range	3503.11 to 3513.00 ft	
Flow Area	61.21	ft²
Wetted Perimeter	69.30	ft
Hydraulic Radius	0.88	ft
Top Width	68.98	ft
Normal Depth	1.95	ft
Critical Depth	2.57	ft
Critical Slope	0.01655	ft/ft
Velocity	11.76	ft/s
Velocity Head	2.15	ft
Specific Energy	4.10	ft
Froude Number	2.20	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.95	ft
Critical Depth	2.57	ft

Worksheet for 2125-1975

GVF Output Data

Channel Slope	0.09400	ft/ft
Critical Slope	0.01655	ft/ft

Cross Section for 2125-1975

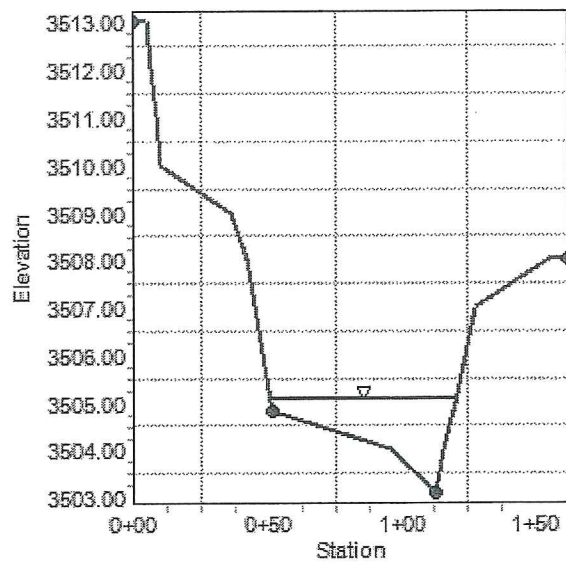
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.09400	ft/ft
Normal Depth	1.95	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1975-1600

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.00	ft
V = flow velocity in upstream channel, (in fps)	10.47	fps
C1 = sand material constant	0.00000694	
C2 = sand material constant	-0.27	
C3 = sand material constant	3.90	
TW = top width of upstream channel, (in ft)	69.88	ft
So = upstream channel slope, (in ft/ft)	0.066	ft/ft
L = entire upstream channel length, (in ft)	352.91	ft

Sediment Transport Rate, q_s in Upstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s*TW$	4.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft ²)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0640	68.8	10.5	69.2	1.23	0.99	4.6	«Compare to Qs Computed Above

Sediment Transport Rate, q_s in Downstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s*TW$	4.6	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

-0.7 ft

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Worksheet for 1975-1600

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.06400 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+73	3484.00
-0+51	3480.00
-0+50	3479.84
-0+41	3480.00
-0+02	3480.00
0+04	3480.00
0+11	3480.40
0+12	3481.00
0+15	3482.00
0+18	3483.00
0+20	3484.00
0+39	3485.00
0+67	3486.00
0+74	3487.00
0+95	3487.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+73, 3484.00)	(-0+50, 3479.84)	0.040
(-0+50, 3479.84)	(0+11, 3480.40)	0.035
(0+11, 3480.40)	(0+95, 3487.00)	0.040

Options

Current Roughness Weighted Method Pavlovskii's Method

Worksheet for 1975-1600

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.23	ft
Elevation Range	3479.84 to 3487.00	ft
Flow Area	68.75	ft ²
Wetted Perimeter	69.39	ft
Hydraulic Radius	0.99	ft
Top Width	69.15	ft
Normal Depth	1.23	ft
Critical Depth	1.75	ft
Critical Slope	0.01653	ft/ft
Velocity	10.47	ft/s
Velocity Head	1.70	ft
Specific Energy	2.93	ft
Froude Number	1.85	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.23	ft
Critical Depth	1.75	ft
Channel Slope	0.06400	ft/ft
Critical Slope	0.01653	ft/ft

Cross Section for 1975-1600

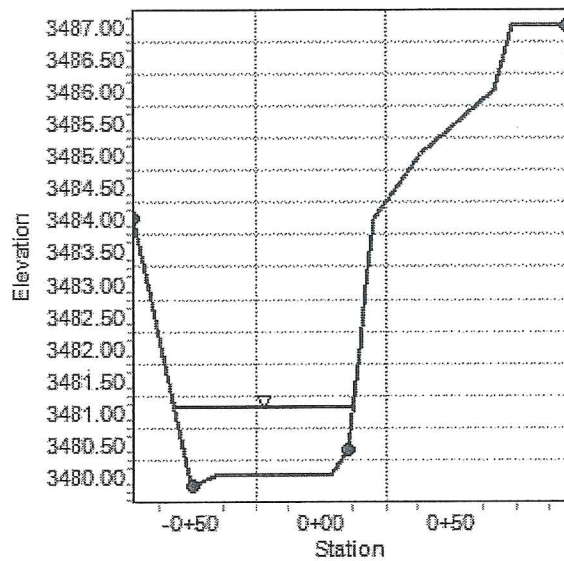
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.06400	ft/ft
Normal Depth	1.23	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1600-1545

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.88	ft
V = flow velocity in upstream channel, (in fps)	12.30	fps
C1 = sand material constant	0.00000744	
C2 = sand material constant	-0.02	
C3 = sand material constant	3.86	
TW = top width of upstream channel, (in ft)	68.12	ft
So = upstream channel slope, (in ft/ft)	0.064	ft/ft
L = entire upstream channel length, (in ft)	51.00	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 * (Yh^{C2}) * (V^{C3}) \quad 0.1 \quad \text{cfs/ft}$$

$$Q_s = \text{total sediment transport rate} = q_s * TW \quad 8.2 \quad \text{cfs}$$

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.1050	58.1	12.4	66.4	1.23	0.88	8.2	«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 * (Yh^{C2}) * (V^{C3}) \quad 0.1 \quad \text{cfs/ft}$$

$$Q_s = \text{total sediment transport rate} = q_s * TW \quad 8.2 \quad \text{cfs}$$

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) * L$$

2.1	ft
-----	----

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 1600-1545

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.10500 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+21	3481.00
-0+17	3481.00
-0+04	3480.00
-0+01	3479.00
0+02	3478.00
0+06	3477.00
0+06	3477.00
0+07	3476.56
0+39	3476.88
0+39	3476.88
0+43	3476.92
0+52	3477.00
0+57	3477.09
0+68	3477.28
0+70	3478.00
0+74	3479.00
0+78	3480.00
0+82	3481.00
1+30	3481.58
1+33	3481.58

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+21, 3481.00)	(0+07, 3476.56)	0.040

Worksheet for 1600-1545

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+07, 3476.56)	(0+68, 3477.28)	0.035
(0+68, 3477.28)	(1+33, 3481.58)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.23	ft
Elevation Range	3476.56 to 3481.58 ft	
Flow Area	58.13	ft²
Wetted Perimeter	66.65	ft
Hydraulic Radius	0.87	ft
Top Width	66.40	ft
Normal Depth	1.23	ft
Critical Depth	1.91	ft
Critical Slope	0.01628	ft/ft
Velocity	12.38	ft/s
Velocity Head	2.38	ft
Specific Energy	3.61	ft
Froude Number	2.33	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.23	ft

Worksheet for 1600-1545

GVF Output Data

Critical Depth	1.91	ft
Channel Slope	0.10500	ft/ft
Critical Slope	0.01628	ft/ft

Cross Section for 1600-1545

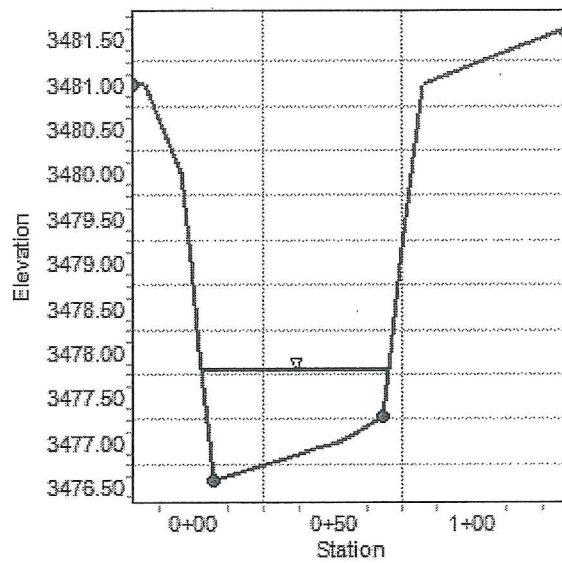
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.10500 ft/ft
Normal Depth 1.23 ft
Discharge 720.00 ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1545-1500

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)

V = flow velocity in upstream channel, (in fps)

C1 = sand material constant

C2 = sand material constant

C3 = sand material constant

TW = top width of upstream channel, (in ft)

So = upstream channel slope, (in ft/ft)

L = entire upstream channel length, (in ft)

1.04 ft
10.48 fps
0.00000744
-0.02
3.86
67.71 ft
0.077 ft/ft
62.44 ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

qs = sediment transport rate = $C1 \cdot (Yh^{C2}) \cdot (V^{C3})$

0.1 cfs/ft

Qs = total sediment transport rate = $qs \cdot TW$

4.4 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft ²)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0590	66.8	10.8	61.3	1.37	1.09	4.4	«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

qs = sediment transport rate = $C1 \cdot (Yh^{C2}) \cdot (V^{C3})$

0.1 cfs/ft

Qs = total sediment transport rate = $qs \cdot TW$

4.4 cfs

Zlt Calculation:

Zlt = long term bed elevation changes = $(Se - So) \cdot L$

-1.1 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 1545-1500

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.05900 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00	3476.00
0+19	3476.00
0+33	3475.00
0+36	3474.00
0+39	3473.00
0+42	3472.00
0+43	3471.78
0+90	3472.00
0+97	3473.00
1+04	3473.33
1+06	3474.00
1+08	3475.00
1+11	3476.00
1+14	3477.00
1+30	3478.00
1+30	3478.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3476.00)	(0+43, 3471.78)	0.040
(0+43, 3471.78)	(1+04, 3473.33)	0.035
(1+04, 3473.33)	(1+30, 3478.00)	0.040

Worksheet for 1545-1500

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.37	ft
Elevation Range	3471.78 to 3478.00	ft
Flow Area	66.84	ft²
Wetted Perimeter	61.57	ft
Hydraulic Radius	1.09	ft
Top Width	61.27	ft
Normal Depth	1.37	ft
Critical Depth	1.92	ft
Critical Slope	0.01603	ft/ft
Velocity	10.77	ft/s
Velocity Head	1.80	ft
Specific Energy	3.17	ft
Froude Number	1.82	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.37	ft
Critical Depth	1.92	ft
Channel Slope	0.05900	ft/ft
Critical Slope	0.01603	ft/ft

Cross Section for 1545-1500

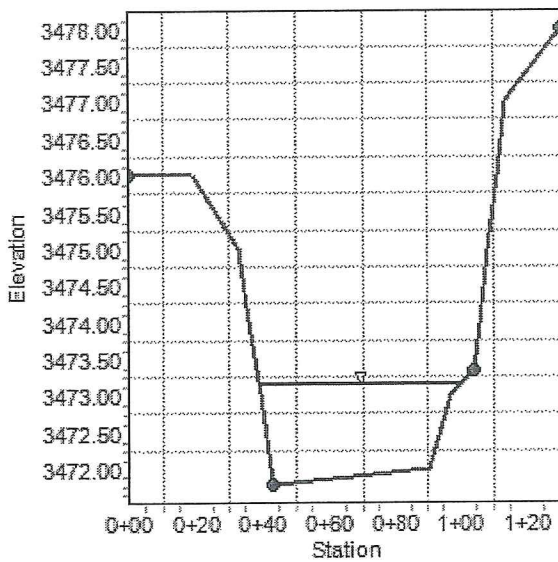
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.05900	ft/ft
Normal Depth	1.37	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1500-1300

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.01	ft
V = flow velocity in upstream channel, (in fps)	12.64	fps
C1 = sand material constant	0.00000744	
C2 = sand material constant	-0.02	
C3 = sand material constant	3.86	
TW = top width of upstream channel, (in ft)	57.59	ft
So = upstream channel slope, (in ft/ft)	0.086	ft/ft
L = entire upstream channel length, (in ft)	148.36	ft

Sediment Transport Rate, q_s in Upstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1 * (Yh^{C2}) * (V^{C3})$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s * TW$	7.7	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft ²)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.1000	58.9	12.2	65.8	1.90	0.89	7.7

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, q_s in Downstream Channel Calculation:

$q_s = \text{sediment transport rate} = C1 * (Yh^{C2}) * (V^{C3})$	0.1	cfs/ft
$Q_s = \text{total sediment transport rate} = q_s * TW$	7.7	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) * L$$

2.1	ft
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if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Worksheet for 1500-1300

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.10000 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-1+35	3465.00
-1+04	3465.00
-0+83	3464.00
-0+80	3463.00
-0+78	3462.00
-0+75	3461.00
-0+74	3460.55
-0+29	3460.00
-0+14	3459.09
-0+12	3460.00
-0+09	3461.00
-0+07	3462.00
-0+05	3463.00
0+13	3463.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-1+35, 3465.00)	(-0+74, 3460.55)	0.040
(-0+74, 3460.55)	(-0+14, 3459.09)	0.035
(-0+14, 3459.09)	(0+13, 3463.00)	0.040

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method

Worksheet for 1500-1300

Options

Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth		1.90	ft
Elevation Range	3459.09 to 3465.00 ft		
Flow Area		58.88	ft ²
Wetted Perimeter		66.31	ft
Hydraulic Radius		0.89	ft
Top Width		65.82	ft
Normal Depth		1.90	ft
Critical Depth		2.57	ft
Critical Slope		0.01628	ft/ft
Velocity		12.23	ft/s
Velocity Head		2.32	ft
Specific Energy		4.23	ft
Froude Number		2.28	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.90	ft
Critical Depth	2.57	ft
Channel Slope	0.10000	ft/ft
Critical Slope	0.01628	ft/ft

Cross Section for 1500-1300

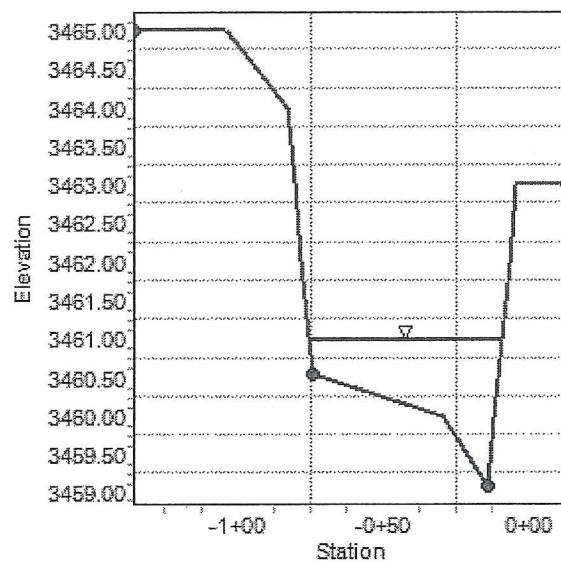
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.10000	ft/ft
Normal Depth	1.90	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1300-1225

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)

1.01 ft

V = flow velocity in upstream channel, (in fps)

10.97 fps

C1 = sand material constant

0.00000744

C2 = sand material constant

-0.02

C3 = sand material constant

3.86

TW = top width of upstream channel, (in ft)

66.41 ft

So = upstream channel slope, (in ft/ft)

0.075 ft/ft

L = entire upstream channel length, (in ft)

69.30 ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 \cdot (Y_h^{C2}) \cdot (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s \cdot TW$$

5.1 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0730	66.9	10.8	70.8	1.98	0.94	5.1	«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 \cdot (Y_h^{C2}) \cdot (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s \cdot TW$$

5.1 cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) \cdot L$$

-0.1 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 1300-1225

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.07300 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+08	3460.00
0+11	3460.00
0+11	3460.00
0+41	3459.00
0+46	3458.00
0+46	3458.00
0+50	3457.00
0+50	3456.99
0+54	3456.00
0+57	3455.47
0+86	3455.00
0+92	3455.00
1+02	3455.00
1+09	3454.00
1+15	3453.93
1+17	3453.90
1+17	3454.00
1+22	3455.00
1+26	3456.00
1+31	3457.00
1+35	3458.00
1+42	3458.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
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Worksheet for 1300-1225

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+08, 3460.00)	(0+57, 3455.47)	0.040
(0+57, 3455.47)	(1+17, 3453.90)	0.035
(1+17, 3453.90)	(1+42, 3458.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.98	ft
Elevation Range	3453.90 to 3460.00 ft	
Flow Area	66.91	ft ²
Wetted Perimeter	71.16	ft
Hydraulic Radius	0.94	ft
Top Width	70.82	ft
Normal Depth	1.98	ft
Critical Depth	2.52	ft
Critical Slope	0.01680	ft/ft
Velocity	10.76	ft/s
Velocity Head	1.80	ft
Specific Energy	3.78	ft
Froude Number	1.95	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
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Worksheet for 1300-1225

GVF Output Data

Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.98 ft
Critical Depth	2.52 ft
Channel Slope	0.07300 ft/ft
Critical Slope	0.01680 ft/ft

Project Description

Manning Formula

Normal Depth

720.00 ft³/s

Determination of Long Term Bed Elevation Changes, Zlt:

1225-1150

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.90	ft
V = flow velocity in upstream channel, (in fps)	11.54	fps
C1 = sand material constant	0.00000744	
C2 = sand material constant	-0.02	
C3 = sand material constant	3.86	
TW = top width of upstream channel, (in ft)	70.39	ft
So = upstream channel slope, (in ft/ft)	0.048	ft/ft
L = entire upstream channel length, (in ft)	81.26	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	6.6	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0860	61.3	11.7	65.4	1.05	0.94	6.6

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	6.6	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

3.1	ft
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if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Project Description

Manning Formula

Normal Depth

Section Definitions

Station (ft)	Elevation (ft)
-1+19	3459.00
-1+06	3459.00
-1+04	3458.00
-1+02	3457.00
-1+00	3456.00
-0+71	3455.00
-0+63	3454.00
-0+59	3453.00
-0+55	3452.00
-0+51	3451.00
-0+48	3450.17
-0+11	3450.00
0+00	3450.00
0+07	3450.00
0+12	3450.33
0+14	3451.00
0+17	3452.00
0+19	3453.00
0+23	3454.00
0+41	3455.00
0+48	3455.00
0+53	3455.00

Start Station	Ending Station	Roughness Coefficient
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Worksheet for 1225-1150

Input Data

Start Station	Ending Station	Roughness Coefficient
(-1+19, 3459.00)	(-0+48, 3450.17)	0.040
(-0+48, 3450.17)	(0+12, 3450.33)	0.035
(0+12, 3450.33)	(0+53, 3455.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.05	ft
Elevation Range	3450.00 to 3459.00 ft	
Flow Area	61.31	ft ²
Wetted Perimeter	65.68	ft
Hydraulic Radius	0.93	ft
Top Width	65.42	ft
Normal Depth	1.05	ft
Critical Depth	1.68	ft
Critical Slope	0.01615	ft/ft
Velocity	11.74	ft/s
Velocity Head	2.14	ft
Specific Energy	3.19	ft
Froude Number	2.14	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
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Worksheet for 1225-1150

GVF Output Data

Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.05 ft
Critical Depth	1.68 ft
Channel Slope	0.08600 ft/ft
Critical Slope	0.01615 ft/ft

Cross Section for 1225-1150

Project Description

Friction Method

Manning Formula

Solve For

Normal Depth

Input Data

Channel Slope

0.08600 ft/ft

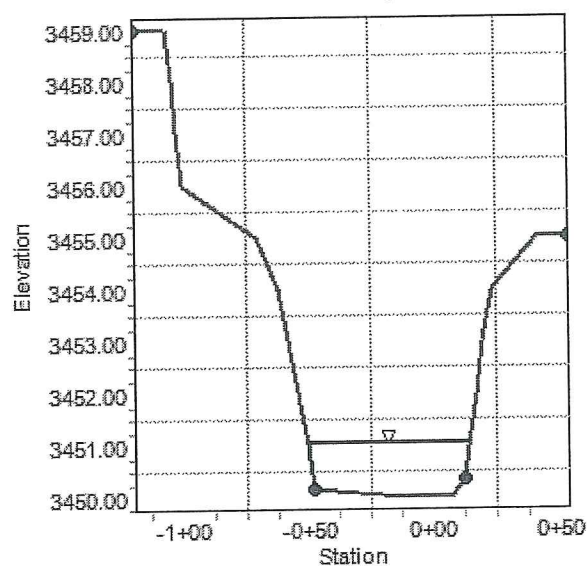
Normal Depth

1.05 ft

Discharge

720.00 ft³/s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1150-1050

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)

1.09 ft

V = flow velocity in upstream channel, (in fps)

10.14 fps

C1 = sand material constant

0.00000744

C2 = sand material constant

-0.02

C3 = sand material constant

3.86

TW = top width of upstream channel, (in ft)

66.54 ft

So = upstream channel slope, (in ft/ft)

0.084 ft/ft

L = entire upstream channel length, (in ft)

94.86 ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 \cdot (Y_h^{C2}) \cdot (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s \cdot TW$$

3.8 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0530	70.4	10.2	64.2	2.05	1.10	3.8

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 \cdot (Y_h^{C2}) \cdot (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s \cdot TW$$

3.8 cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) \cdot L$$

-3.0 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 1150-1050

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.05300 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00	3448.00
0+06	3448.00
0+14	3447.00
0+17	3446.00
0+19	3445.00
0+22	3444.00
0+23	3443.40
0+31	3443.00
0+34	3442.00
0+40	3442.00
0+46	3443.00
0+57	3443.00
0+70	3443.00
0+83	3443.37
0+86	3444.00
0+89	3445.00
0+93	3446.00
0+97	3447.00
1+01	3448.00
1+21	3448.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 3448.00)	(0+23, 3443.40)	0.040

Worksheet for 1150-1050

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+23, 3443.40)	(0+83, 3443.37)	0.035
(0+83, 3443.37)	(1+21, 3448.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.05	ft
Elevation Range	3442.00 to 3448.00 ft	
Flow Area	70.36	ft ²
Wetted Perimeter	64.68	ft
Hydraulic Radius	1.09	ft
Top Width	64.22	ft
Normal Depth	2.05	ft
Critical Depth	2.54	ft
Critical Slope	0.01602	ft/ft
Velocity	10.23	ft/s
Velocity Head	1.63	ft
Specific Energy	3.67	ft
Froude Number	1.72	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.05	ft

Worksheet for 1150-1050

GVF Output Data

Critical Depth	2.54	ft
Channel Slope	0.05300	ft/ft
Critical Slope	0.01602	ft/ft

Cross Section for 1150-1050

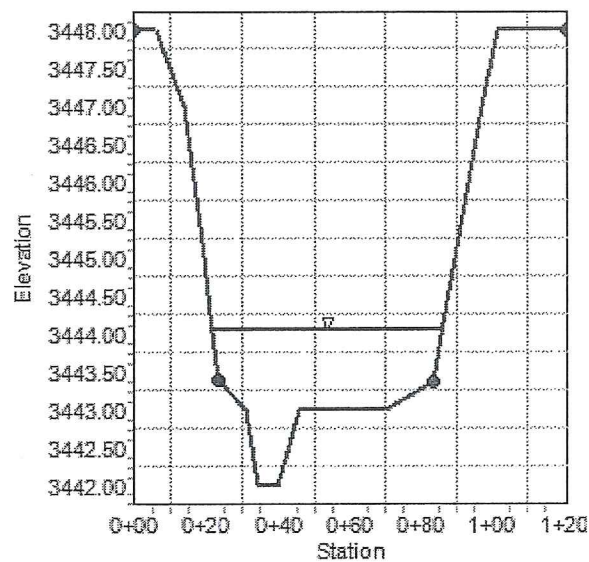
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.05300	ft/ft
Normal Depth	2.05	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

1050-960

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)
V = flow velocity in upstream channel, (in fps)
C1 = sand material constant
C2 = sand material constant
C3 = sand material constant
TW = top width of upstream channel, (in ft)
So = upstream channel slope, (in ft/ft)
L = entire upstream channel length, (in ft)

0.94 ft
12.24 fps
0.00000744
-0.02
3.86
63.13 ft
0.058 ft/ft
69.40 ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 * (Y_h^{C2}) * (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s * TW$$

7.4 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0930	59.0	12.2	63.3	1.81	0.93	7.4

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 * (Y_h^{C2}) * (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s * TW$$

7.4 cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) * L$$

2.5 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 1050-960

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.09300 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+02	3444.00
0+03	3443.00
0+07	3442.00
0+11	3441.00
0+15	3440.00
0+17	3439.54
0+18	3439.00
0+20	3438.00
0+24	3438.00
0+35	3439.00
0+42	3439.00
0+72	3439.00
0+78	3439.42
0+80	3440.00
0+83	3441.00
0+86	3442.00
0+89	3443.00
0+92	3444.00
1+21	3444.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+02, 3444.00)	(0+17, 3439.54)	0.040
(0+17, 3439.54)	(0+78, 3439.42)	0.035

Worksheet for 1050-960

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+78, 3439.42)	(1+21, 3444.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.81	ft
Elevation Range	3438.00 to 3444.00 ft	
Flow Area	59.00	ft²
Wetted Perimeter	63.91	ft
Hydraulic Radius	0.92	ft
Top Width	63.33	ft
Normal Depth	1.81	ft
Critical Depth	2.49	ft
Critical Slope	0.01596	ft/ft
Velocity	12.20	ft/s
Velocity Head	2.31	ft
Specific Energy	4.13	ft
Froude Number	2.23	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.81	ft
Critical Depth	2.49	ft

Worksheet for 1050-960

GVF Output Data

Channel Slope	0.09300	ft/ft
Critical Slope	0.01596	ft/ft

Cross Section for 1050-960

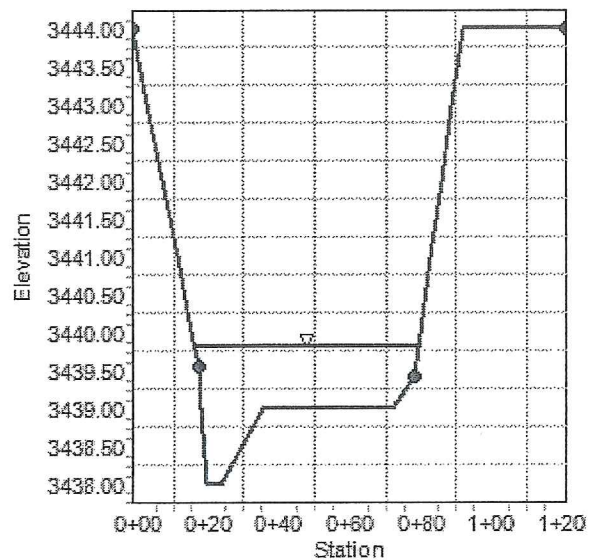
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.09300	ft/ft
Normal Depth	1.81	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

960-925

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.10	ft
V = flow velocity in upstream channel, (in fps)	10.26	fps
C1 = sand material constant	0.00000744	
C2 = sand material constant	-0.02	
C3 = sand material constant	3.86	
TW = top width of upstream channel, (in ft)	64.63	ft
So = upstream channel slope, (in ft/ft)	0.055	ft/ft
L = entire upstream channel length, (in ft)	36.40	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	3.8	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0500	68.8	10.5	59.1	1.35	1.16	3.8	«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	3.8	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

-0.2	ft
------	----

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 960-925

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.05000 ft/ft
Discharge 720.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+01	3442.00
0+12	3441.00
0+16	3440.00
0+19	3439.00
0+23	3438.00
0+25	3437.33
0+26	3437.00
0+30	3436.00
0+58	3436.00
0+71	3436.00
0+75	3436.00
0+79	3437.00
0+86	3437.48
0+87	3438.00
0+89	3439.00
0+92	3440.00
0+94	3441.00
0+97	3442.00
1+18	3443.00
1+30	3443.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+01, 3442.00)	(0+25, 3437.33)	0.040

Worksheet for 960-925

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+25, 3437.33)	(0+86, 3437.48)	0.035
(0+86, 3437.48)	(1+30, 3443.00)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.35 ft
Elevation Range	3436.00 to 3443.00 ft
Flow Area	68.81 ft ²
Wetted Perimeter	59.46 ft
Hydraulic Radius	1.16 ft
Top Width	59.13 ft
Normal Depth	1.35 ft
Critical Depth	1.87 ft
Critical Slope	0.01548 ft/ft
Velocity	10.46 ft/s
Velocity Head	1.70 ft
Specific Energy	3.06 ft
Froude Number	1.71
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	1.35 ft

Worksheet for 960-925

GVF Output Data

Critical Depth	1.87	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.01548	ft/ft

Cross Section for 960-925

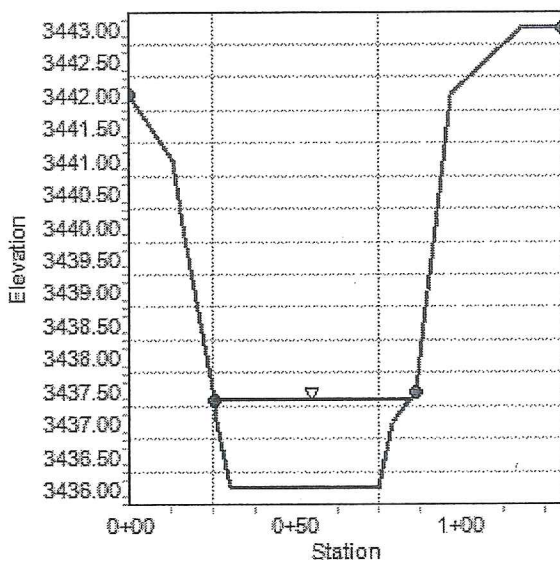
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.05000	ft/ft
Normal Depth	1.35	ft
Discharge	720.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

925-850

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)
V = flow velocity in upstream channel, (in fps)
C1 = sand material constant
C2 = sand material constant
C3 = sand material constant
TW = top width of upstream channel, (in ft)
So = upstream channel slope, (in ft/ft)
L = entire upstream channel length, (in ft)

1.07 ft
11.95 fps
0.00000744
-0.02
3.86
56.46 ft
0.069 ft/ft
78.08 ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 * (Y_h^{C2}) * (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s * TW$$

6.0 cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below	
0.0740	71.2	11.2	71.4	2.09	1.00	6.0	«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$$q_s = \text{sediment transport rate} = C1 * (Y_h^{C2}) * (V^{C3})$$

0.1 cfs/ft

$$Q_s = \text{total sediment transport rate} = q_s * TW$$

6.0 cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) * L$$

0.4 ft

if: Se > So then aggradation occurs
Se < So then degradation occurs

Worksheet for 925-850

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.07400 ft/ft
Discharge 799.00 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
-0+44	3437.00
0+04	3433.00
0+08	3432.00
0+13	3431.00
0+15	3430.64
0+27	3431.00
0+33	3432.00
0+38	3432.00
0+59	3432.00
0+69	3432.00
0+73	3432.00
0+75	3432.40
0+77	3433.00
0+80	3434.00
0+84	3435.00
0+88	3436.00
0+91	3437.00
1+18	3438.00
1+19	3438.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+44, 3437.00)	(0+15, 3430.64)	0.040
(0+15, 3430.64)	(0+75, 3432.40)	0.035

Worksheet for 925-850

Input Data

Start Station	Ending Station	Roughness Coefficient
(0+75, 3432.40)	(1+19, 3438.00)	0.040

Options

Current Roughness vweighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	2.09	ft
Elevation Range	3430.64 to 3438.00 ft	
Flow Area	71.21	ft ²
Wetted Perimeter	71.76	ft
Hydraulic Radius	0.99	ft
Top Width	71.38	ft
Normal Depth	2.09	ft
Critical Depth	2.69	ft
Critical Slope	0.01659	ft/ft
Velocity	11.22	ft/s
Velocity Head	1.96	ft
Specific Energy	4.04	ft
Froude Number	1.98	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.09	ft
Critical Depth	2.69	ft

Worksheet for 925-850

GVF Output Data

Channel Slope	0.07400	ft/ft
Critical Slope	0.01659	ft/ft

Determination of Long Term Bed Elevation Changes, Zlt:

850-700

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	1.08	ft
V = flow velocity in upstream channel, (in fps)	10.54	fps
C1 = sand material constant	0.00000744	
C2 = sand material constant	-0.02	
C3 = sand material constant	3.86	
TW = top width of upstream channel, (in ft)	72.10	ft
So = upstream channel slope, (in ft/ft)	0.066	ft/ft
L = entire upstream channel length, (in ft)	145.69	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1 \cdot (Yh^{C2}) \cdot (V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs \cdot TW$	4.8	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft ²)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.0560	72.8	11.0	62.5	1.71	1.17	4.8

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1 \cdot (Yh^{C2}) \cdot (V^{C3})$	0.1	cfs/ft
$Qs = \text{total sediment transport rate} = qs \cdot TW$	4.8	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So) \cdot L$$

-1.5	ft
------	----

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Project Description

Manning Formula

Normal Depth

Section Definitions

Station (ft)	Elevation (ft)
-0+53	3429.00
-0+47	3428.00
-0+41	3427.00
-0+39	3426.62
-0+35	3426.00
-0+29	3425.00
-0+25	3424.00
-0+20	3423.00
-0+15	3422.00
0+37	3421.00
0+40	3421.00
0+44	3423.00
0+72	3424.10
0+72	3424.05
0+72	3424.06
0+72	3424.07
0+72	3424.07
0+72	3424.08
0+74	3425.33
0+82	3429.01
0+91	3429.13
0+91	3429.16
0+94	3429.14

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
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Worksheet for 850-700

Input Data

Start Station	Ending Station	Roughness Coefficient
(-0+53, 3429.00)	(-0+15, 3422.00)	0.040
(-0+15, 3422.00)	(0+72, 3424.10)	0.035
(0+72, 3424.10)	(0+94, 3429.14)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.71	ft
Elevation Range	3421.00 to 3429.16 ft	
Flow Area	72.84	ft ²
Wetted Perimeter	62.98	ft
Hydraulic Radius	1.16	ft
Top Width	62.47	ft
Normal Depth	1.71	ft
Critical Depth	2.32	ft
Critical Slope	0.01592	ft/ft
Velocity	10.97	ft/s
Velocity Head	1.87	ft
Specific Energy	3.58	ft
Froude Number	1.79	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.71	ft

Worksheet for 850-700

GVF Output Data

Critical Depth	2.32	ft
Channel Slope	0.05600	ft/ft
Critical Slope	0.01592	ft/ft

Cross Section for 850-700

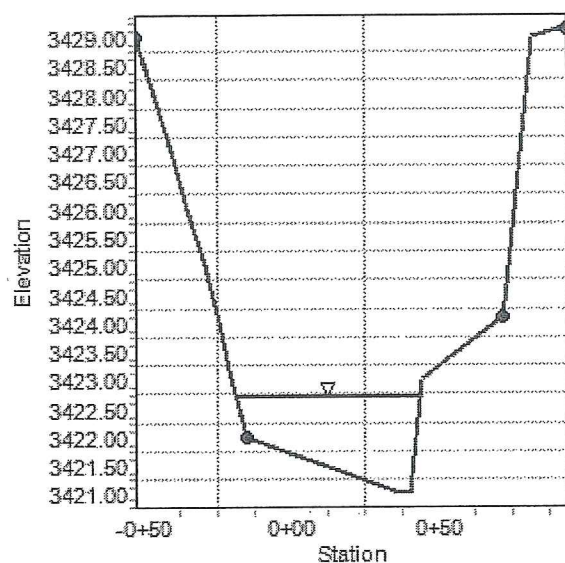
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope	0.05600	ft/ft
Normal Depth	1.71	ft
Discharge	799.00	ft ³ /s

Cross Section Image



Determination of Long Term Bed Elevation Changes, Zlt:

700-550

Long term bed elevation changes consist of either a general degradation or aggradation of the bed level over a long period of time. Determination of the long term bed elevation changes consists of determining the sediment transport rate of the upstream channel and then computing the equilibrium slope in the downstream channel that gives an equivalent sediment transport rate. The following procedure can be used to determine the depth of either degradation or aggradation that may occur within the stream channel.

Known/Input:

Yh = hydraulic depth in upstream channel, (in ft)	0.92	ft
V = flow velocity in upstream channel, (in fps)	14.43	fps
C1 = sand material constant	0.00000744	
C2 = sand material constant	-0.02	
C3 = sand material constant	3.86	
TW = top width of upstream channel, (in ft)	60.51	ft
So = upstream channel slope, (in ft/ft)	0.059	ft/ft
L = entire upstream channel length, (in ft)	95.00	ft

Sediment Transport Rate, qs in Upstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.2	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	13.5	cfs

Equilibrium Slope, Se in Downstream Channel Calculation:

The equilibrium slope is computed using a trial and error procedure by which a given slope is chosen to compute the flow conditions in the downstream channel and from the flow conditions the sediment transport rate is calculated. When the computed rate is equal to the sediment transport rate in the upstream channel, the equilibrium slope has been found.

Flow conditions for each trial slope can be computed using normal depth. The following table can be used for data entry of flow conditions related to the equilibrium slope.

Trial Slope (ft/ft)	Area (ft^2)	Velocity (fps)	Top Width (ft)	Flow Depth (ft)	Hydraulic Depth (ft)	Qs (cfs) from below
0.1105	78.5	13.1	87.2	1.28	0.90	13.5

Equilibrium slope

«Compare to Qs Computed Above

Sediment Transport Rate, qs in Downstream Channel Calculation:

$qs = \text{sediment transport rate} = C1*(Yh^{C2})*(V^{C3})$	0.2	cfs/ft
$Qs = \text{total sediment transport rate} = qs*TW$	13.5	cfs

Zlt Calculation:

$$Zlt = \text{long term bed elevation changes} = (Se - So)*L$$

4.9	ft
-----	----

if: $Se > So$ then aggradation occurs
 $Se < So$ then degradation occurs

Project Description

Input Data

Station (ft)

Elevation (ft)

0+11	3429.88
0+11	3429.81
0+12	3429.53
0+13	3429.14
0+21	3420.00
0+30	3418.00
0+38	3416.00
0+56	3415.41
1+13	3416.00
1+27	3417.00
1+43	3418.00
1+49	3418.03
1+51	3418.99
1+59	3423.28
1+73	3423.87
1+74	3423.92
1+75	3423.93
1+75	3423.94
1+77	3423.97

Start Station

Ending Station

Roughness Coefficient

(0+11, 3429.88)	(0+21, 3420.00)	0.040
(0+21, 3420.00)	(1+49, 3418.03)	0.035

Worksheet for 700-550

Input Data

Start Station	Ending Station	Roughness Coefficient
(1+49, 3418.03)	(1+77, 3423.97)	0.040

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	1.28	ft
Elevation Range	3415.41 to 3429.88 ft	
Flow Area	78.46	ft ²
Wetted Perimeter	87.31	ft
Hydraulic Radius	0.90	ft
Top Width	87.19	ft
Normal Depth	1.28	ft
Critical Depth	2.04	ft
Critical Slope	0.01574	ft/ft
Velocity	13.14	ft/s
Velocity Head	2.68	ft
Specific Energy	3.97	ft
Froude Number	2.44	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.28	ft
Critical Depth	2.04	ft

Worksheet for 700-550

GVF Output Data

Channel Slope	0.11050	ft/ft
Critical Slope	0.01574	ft/ft

Cross Section for 700-550

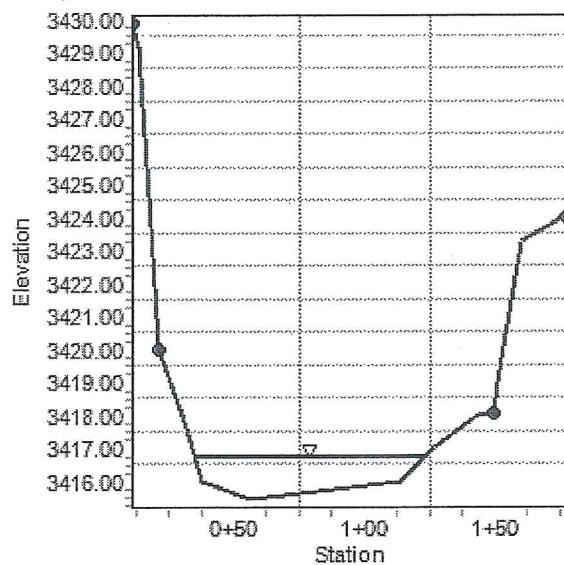
Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.11050 ft/ft
Normal Depth 1.28 ft
Discharge 1031.00 ft³/s

Cross Section Image

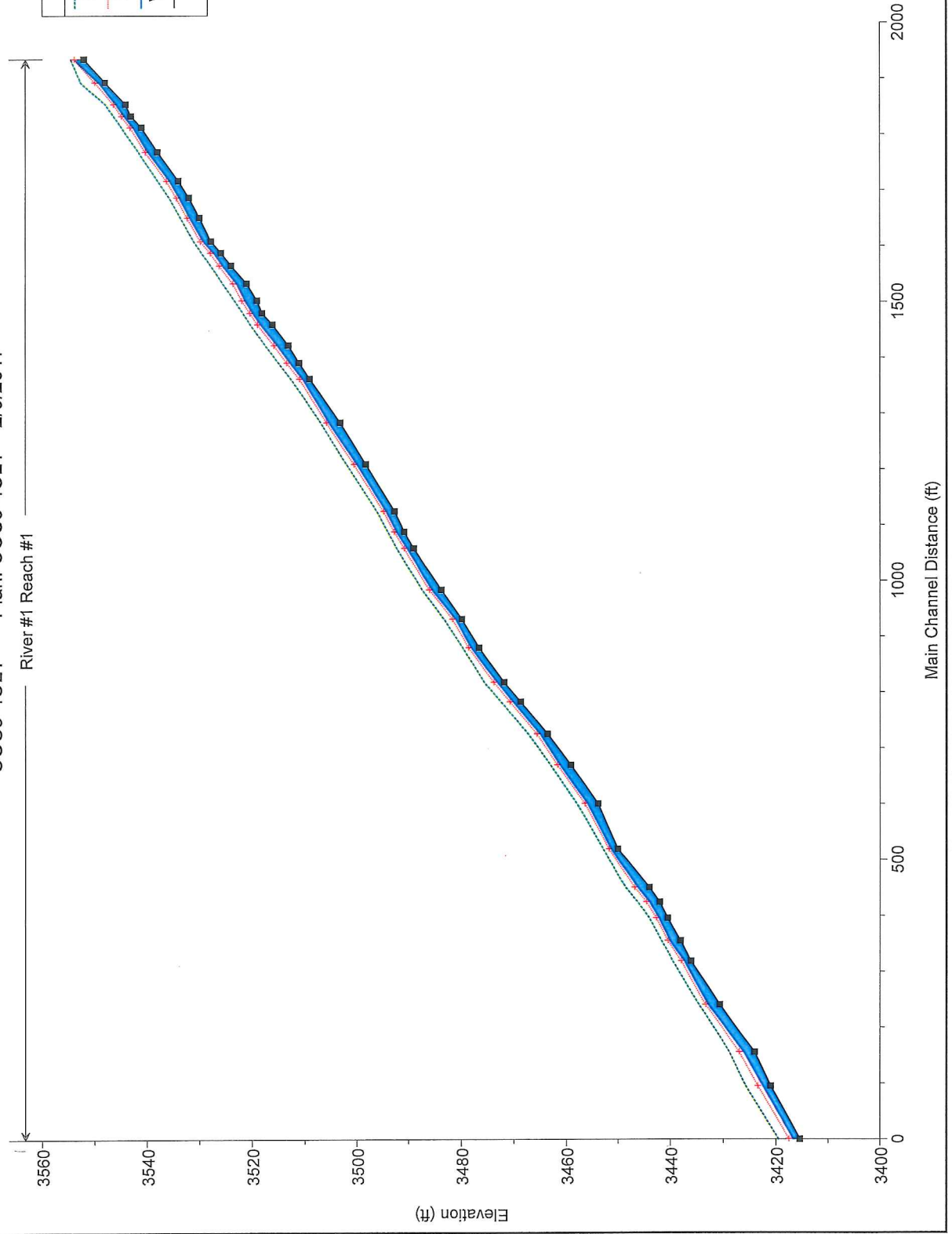


HEC-RAS Plan: COS3-4ULT River: River #1 Reach: Reach #1 Profile: Profile 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach #1	2699	Profile 1	720.00	3552.00	3553.80	3553.80	3554.45	0.016665	6.47	111.37	87.06	1.01
Reach #1	2650	Profile 1	720.00	3548.00	3549.13	3549.90	3552.57	0.227580	14.98	48.67	77.67	3.31
Reach #1	2600	Profile 1	720.00	3544.00	3545.78	3546.37	3547.81	0.072328	11.52	63.51	65.23	2.01
Reach #1	2575	Profile 1	720.00	3543.00	3544.16	3544.77	3546.25	0.074154	11.65	62.88	65.16	2.04
Reach #1	2550	Profile 1	720.00	3541.00	3542.53	3543.15	3544.68	0.082523	11.90	62.01	67.10	2.14
Reach #1	2500	Profile 1	720.00	3538.00	3539.73	3540.27	3541.54	0.060520	10.89	67.81	67.43	1.86
Reach #1	2450	Profile 1	720.00	3534.00	3535.63	3536.28	3537.89	0.081765	12.09	59.92	61.26	2.13
Reach #1	2425	Profile 1	720.00	3532.00	3533.74	3534.34	3535.75	0.061685	11.39	63.62	57.83	1.89
Reach #1	2400	Profile 1	720.00	3530.00	3531.76	3532.30	3533.56	0.058327	10.81	67.43	64.21	1.83
Reach #1	2350	Profile 1	720.00	3527.84	3529.20	3529.76	3531.06	0.059441	11.07	66.21	61.31	1.85
Reach #1	2300	Profile 1	720.00	3525.91	3527.19	3527.85	3529.52	0.090618	12.33	59.43	65.15	2.23
Reach #1	2250	Profile 1	720.00	3524.00	3525.53	3526.23	3527.80	0.064900	12.22	60.48	53.12	1.96
Reach #1	2225	Profile 1	720.00	3521.00	3522.82	3523.57	3525.55	0.073961	13.53	55.18	46.05	2.11
Reach #1	2200	Profile 1	720.00	3519.00	3521.24	3521.84	3523.25	0.073305	11.49	63.88	66.25	2.02
Reach #1	2175	Profile 1	720.00	3518.00	3519.71	3520.28	3521.65	0.066117	11.25	65.11	64.98	1.94
Reach #1	2150	Profile 1	720.00	3516.00	3518.20	3518.79	3520.24	0.070448	11.50	63.26	63.43	1.99
Reach #1	2125	Profile 1	720.00	3513.00	3514.96	3515.65	3517.33	0.085947	12.34	58.35	58.78	2.18
Reach #1	2100	Profile 1	720.00	3511.00	3512.58	3513.22	3514.77	0.076437	11.88	60.61	59.55	2.07
Reach #1	2050	Profile 1	720.00	3509.00	3510.22	3510.86	3512.44	0.083920	11.97	60.45	64.59	2.15
Reach #1	1975	Profile 1	720.00	3503.11	3505.18	3505.67	3506.84	0.059775	10.47	70.02	69.88	1.83
Reach #1	1900	Profile 1	720.00	3498.25	3499.83	3500.42	3501.87	0.074108	11.58	63.17	63.90	2.04
Reach #1	1825	Profile 1	720.00	3492.70	3494.20	3494.74	3496.04	0.063794	11.00	66.70	66.01	1.90
Reach #1	1800	Profile 1	720.00	3490.80	3492.21	3492.73	3493.94	0.050095	10.65	68.72	59.24	1.72
Reach #1	1750	Profile 1	720.00	3489.00	3490.12	3490.74	3492.21	0.067550	11.68	62.77	59.65	1.97
Reach #1	1650	Profile 1	720.00	3483.81	3485.43	3485.98	3487.28	0.063921	11.03	66.48	64.62	1.90
Reach #1	1600	Profile 1	720.00	3479.84	3480.94	3481.59	3483.23	0.092510	12.30	60.09	68.12	2.25
Reach #1	1545	Profile 1	720.00	3476.56	3477.97	3478.47	3479.64	0.053789	10.48	70.48	67.71	1.76
Reach #1	1500	Profile 1	720.00	3471.78	3473.00	3473.70	3475.44	0.084868	12.64	57.92	57.59	2.19
Reach #1	1450	Profile 1	720.00	3468.69	3469.99	3470.65	3472.33	0.092623	12.38	59.06	65.16	2.25
Reach #1	1375	Profile 1	720.00	3463.55	3464.93	3465.57	3467.16	0.086768	12.12	60.70	66.37	2.19
Reach #1	1300	Profile 1	720.00	3459.09	3461.11	3461.65	3462.94	0.064885	10.97	66.78	66.41	1.91
Reach #1	1225	Profile 1	720.00	3453.90	3455.83	3456.42	3457.85	0.083756	11.54	63.47	70.39	2.13
Reach #1	1150	Profile 1	720.00	3450.00	3451.22	3451.88	3452.79	0.047244	10.14	72.57	66.54	1.67
Reach #1	1075	Profile 1	720.00	3444.00	3446.17	3446.82	3448.46	0.086674	12.21	59.53	62.84	2.18
Reach #1	1050	Profile 1	720.00	3442.00	3443.87	3444.54	3446.19	0.086551	12.24	59.30	63.13	2.19
Reach #1	1000	Profile 1	720.00	3440.48	3442.10	3442.65	3443.95	0.066598	11.06	66.47	67.54	1.93
Reach #1	960	Profile 1	720.00	3438.00	3440.00	3440.48	3441.63	0.049297	10.26	70.80	64.63	1.69
Reach #1	925	Profile 1	720.00	3436.00	3437.20	3437.86	3439.43	0.073497	11.97	60.16	56.43	2.04
Reach #1	850	Profile 1	799.00	3430.64	3432.82	3433.32	3434.48	0.054851	10.54	77.59	72.11	1.78
Reach #1	775	Profile 1	799.00	3424.00	3425.99	3426.80	3428.77	0.082168	13.38	59.72	51.57	2.19
Reach #1	700	Profile 1	799.00	3421.00	3422.42	3423.31	3425.66	0.034712	14.43	55.35	60.51	2.66
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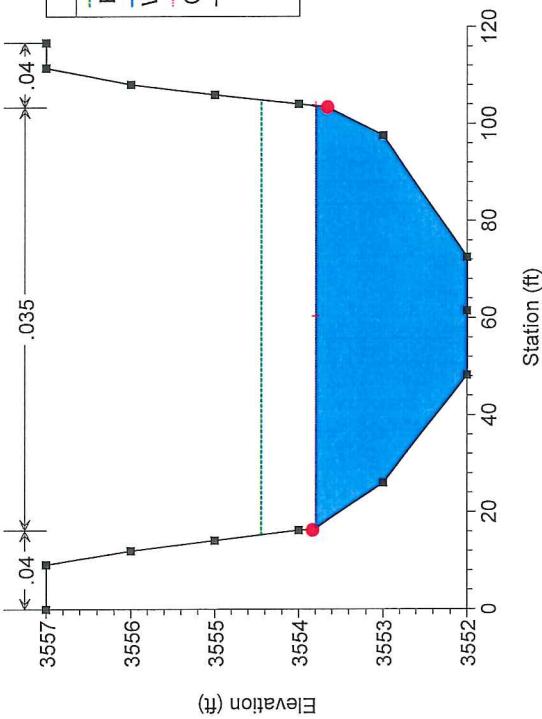
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River #1 Reach #1



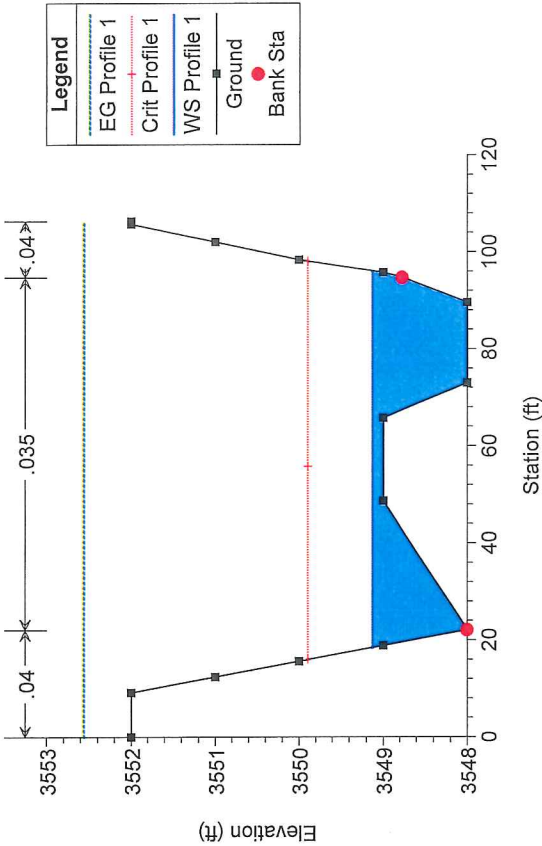
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2699



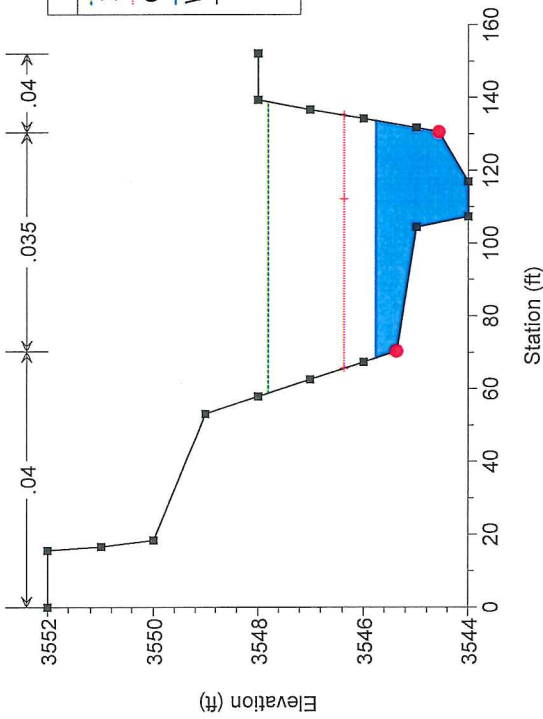
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2650



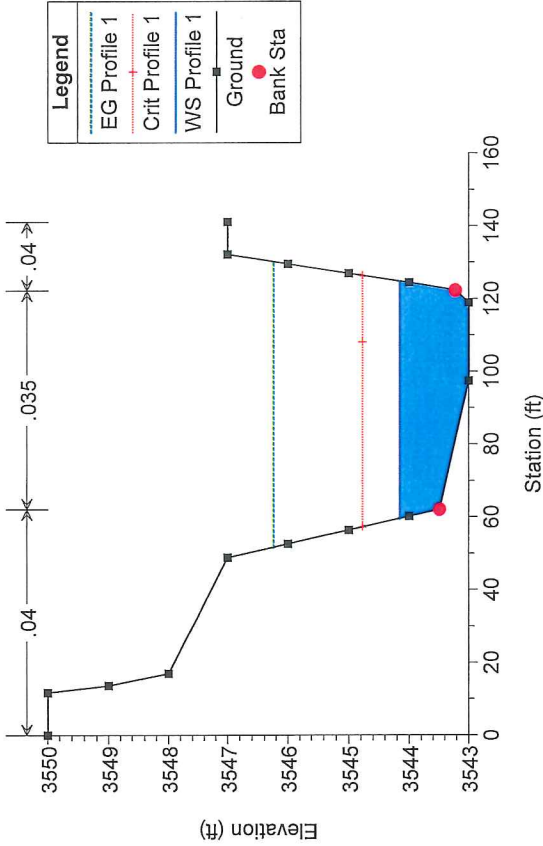
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2600



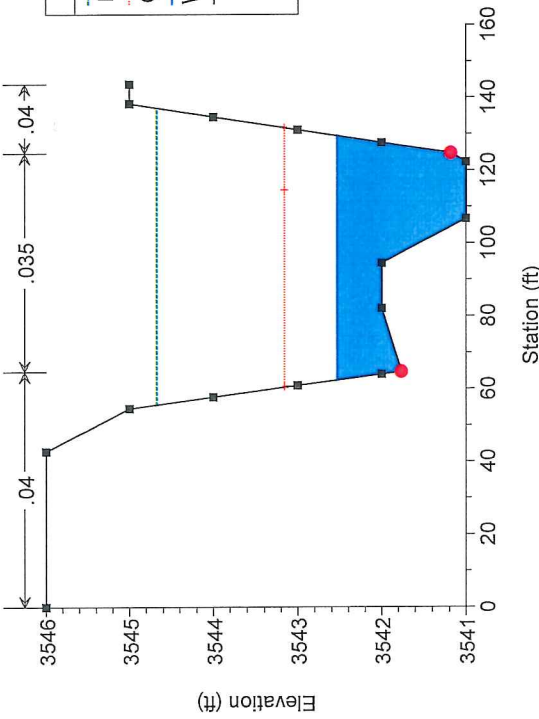
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2575



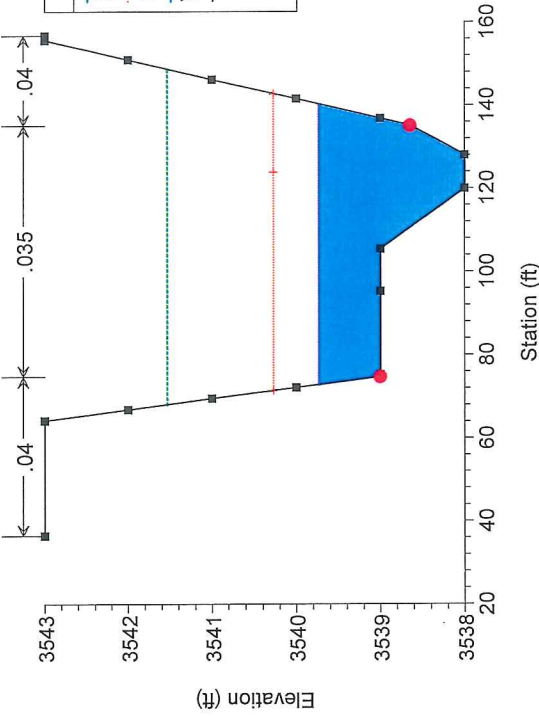
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2550



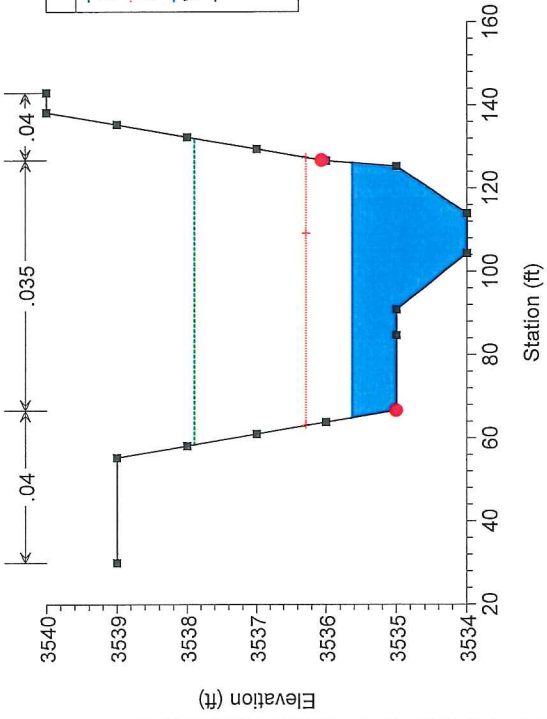
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2500



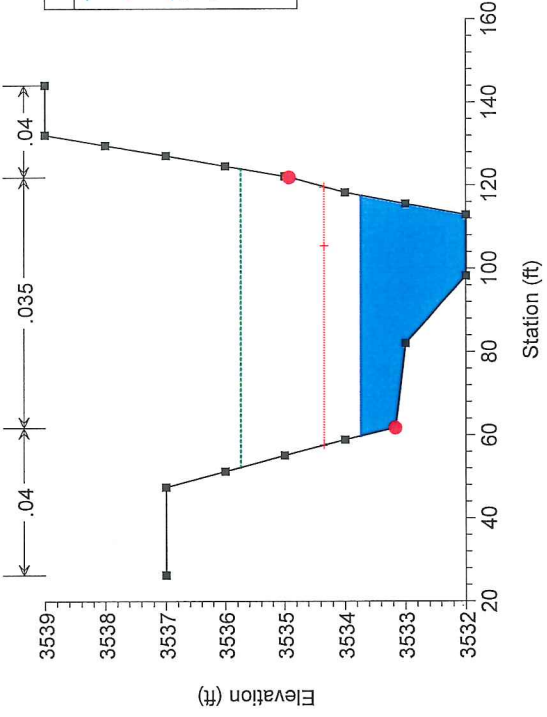
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2450



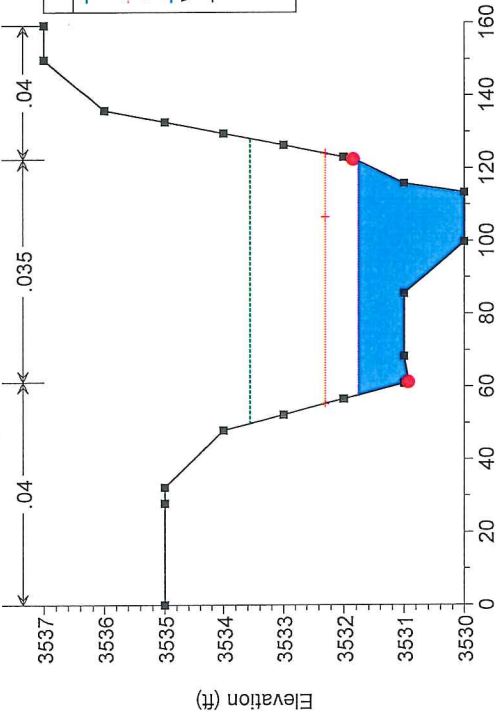
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2425



COS3-4ULT Plan: COS3-4ULT 2/9/2017

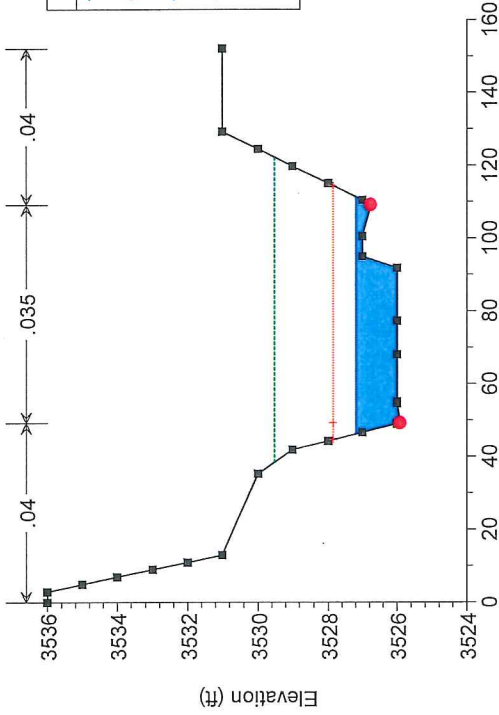
River = River #1 Reach = Reach #1 RS = 2400



Station (ft)

COS3-4ULT Plan: COS3-4ULT 2/9/2017

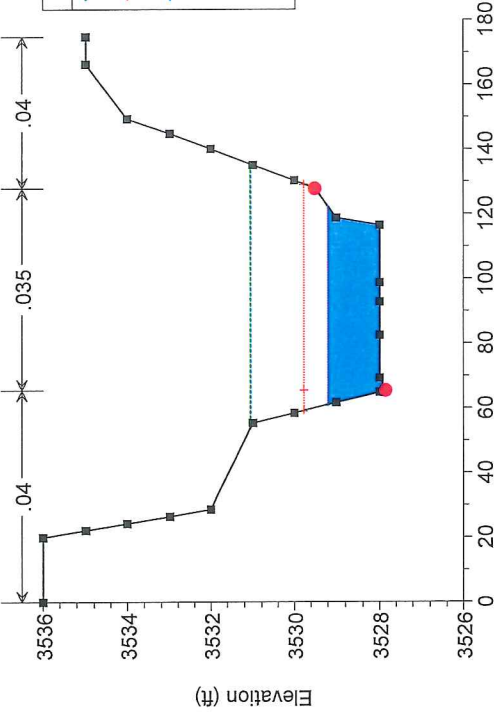
River = River #1 Reach = Reach #1 RS = 2300



Station (ft)

COS3-4ULT Plan: COS3-4ULT 2/9/2017

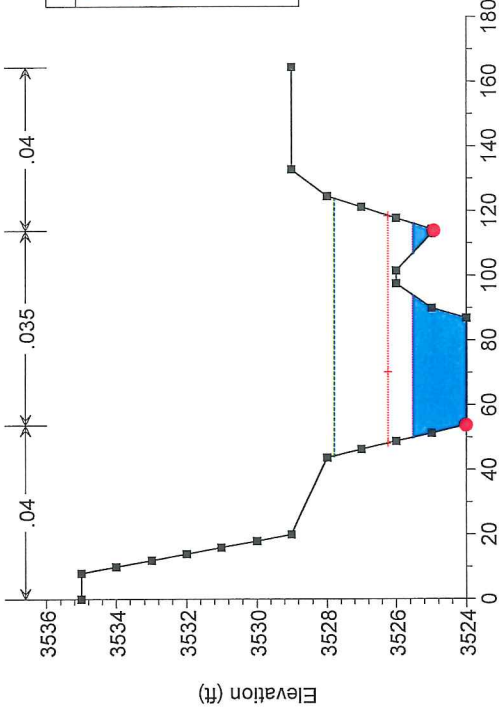
River = River #1 Reach = Reach #1 RS = 2350



Station (ft)

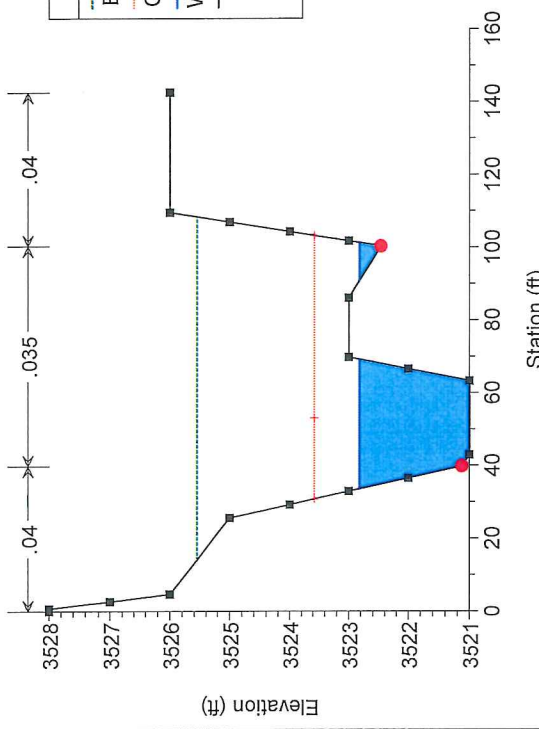
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 2250

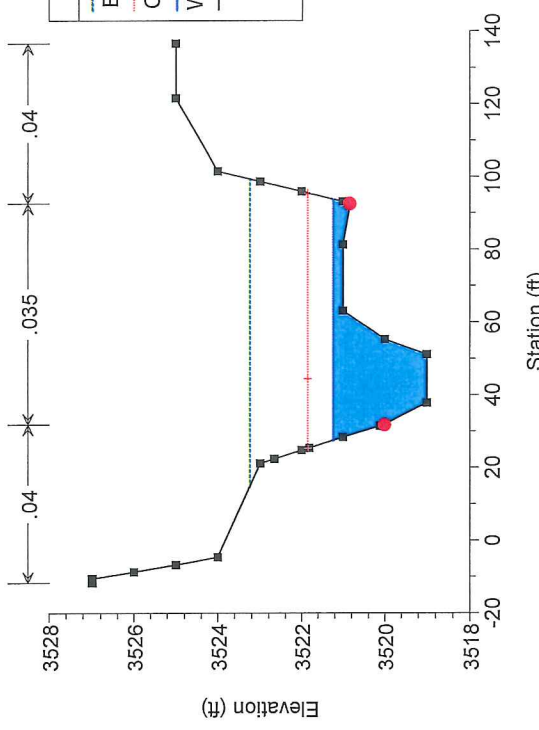


Station (ft)

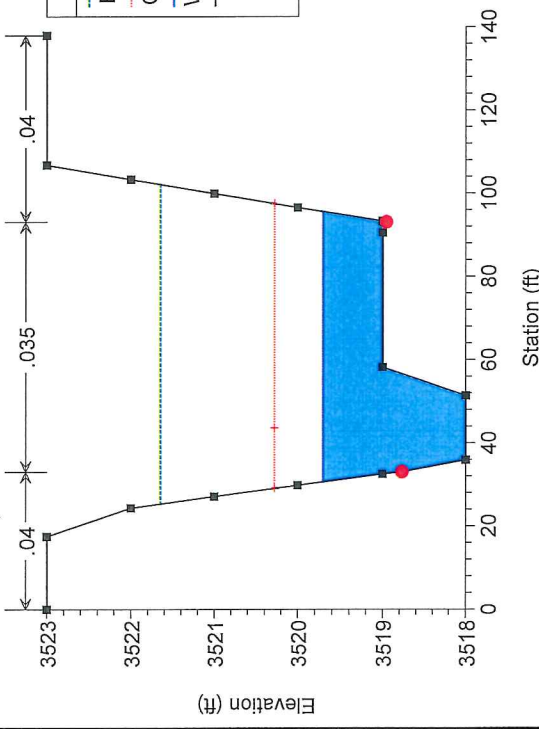
COS3-4ULT Plan: COS3-4ULT 2/9/2017
 River = River #1 Reach = Reach #1 RS = 2225



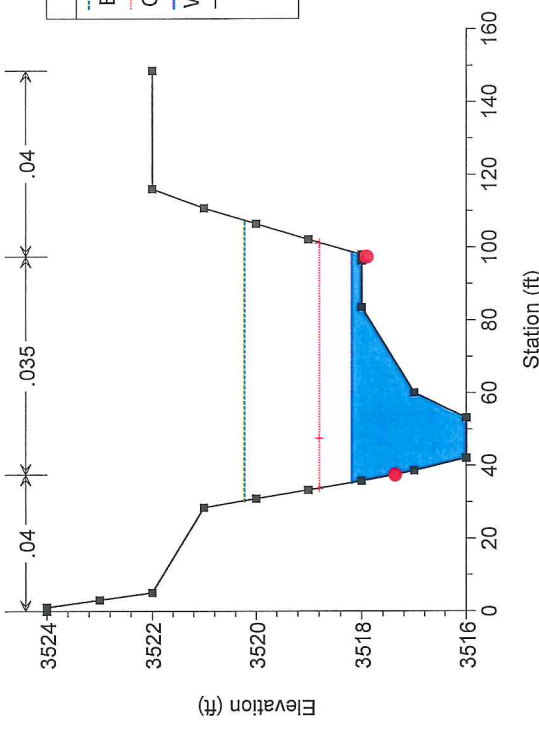
COS3-4ULT Plan: COS3-4ULT 2/9/2017
 River = River #1 Reach = Reach #1 RS = 2200

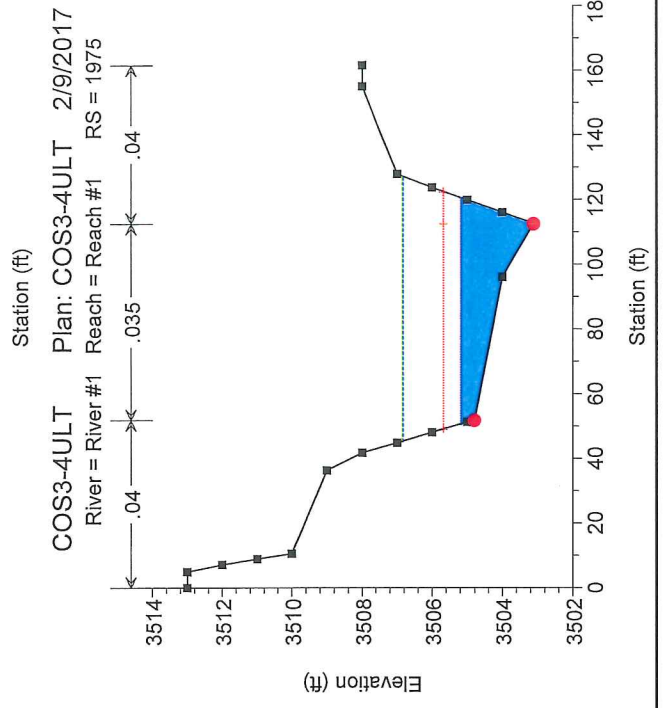
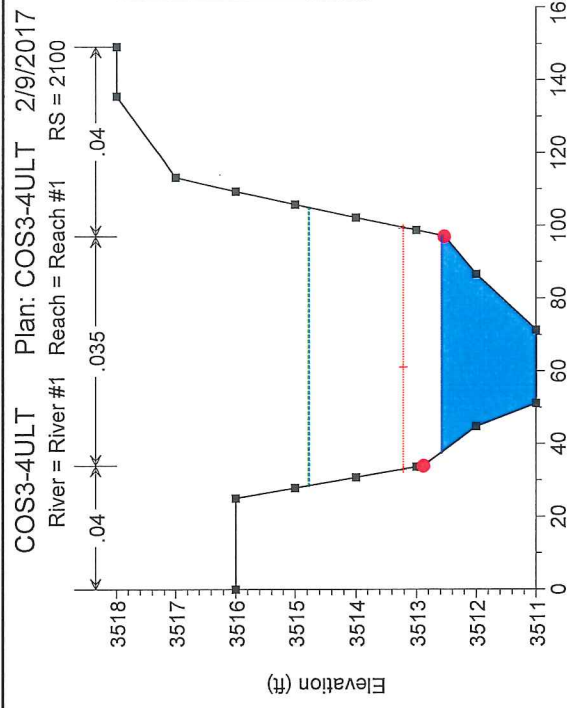
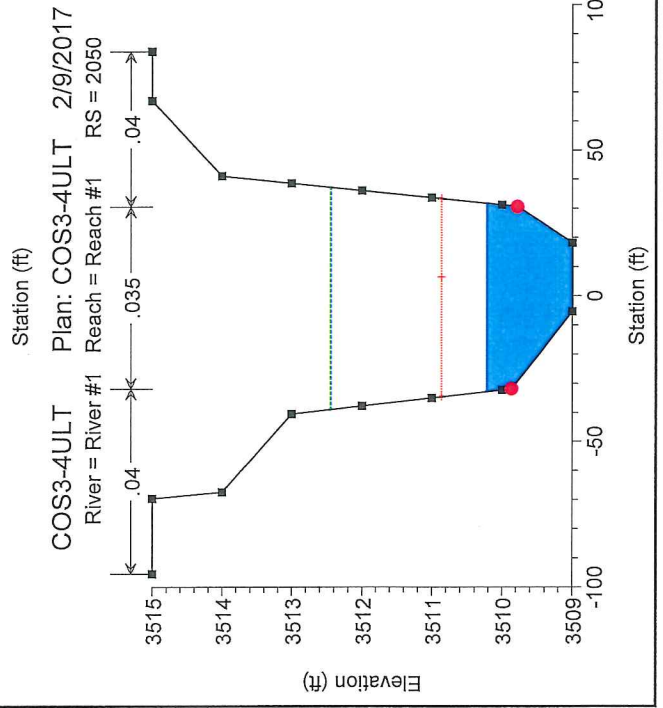
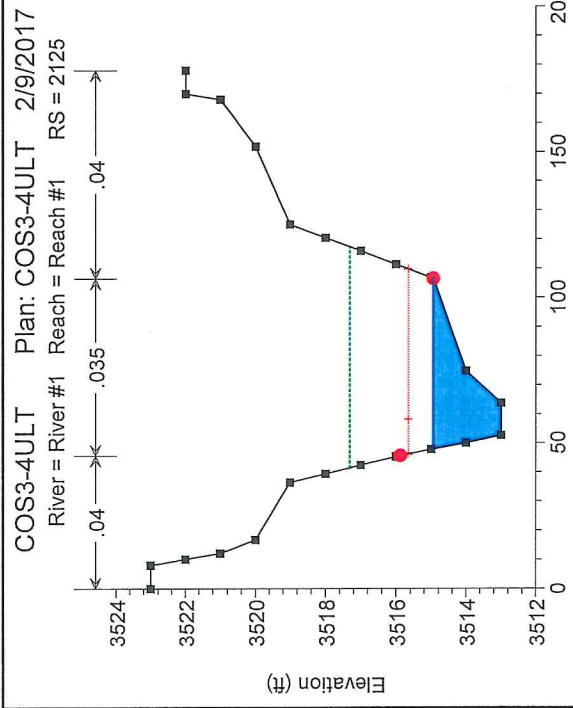


COS3-4ULT Plan: COS3-4ULT 2/9/2017
 River = River #1 Reach = Reach #1 RS = 2175



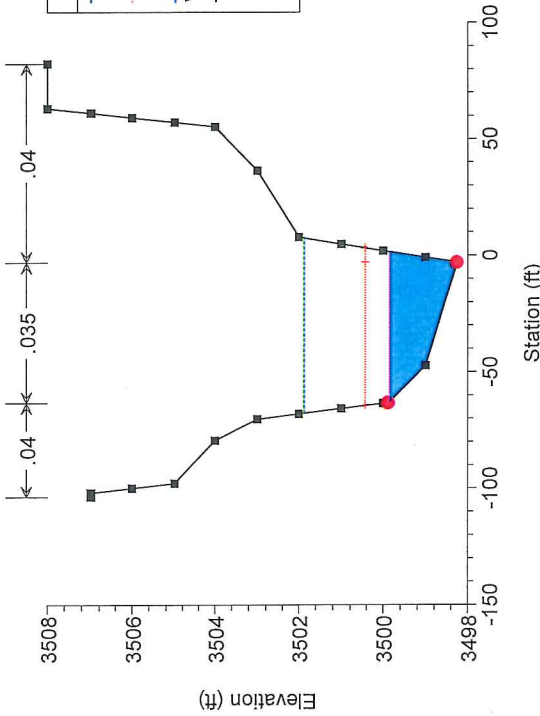
COS3-4ULT Plan: COS3-4ULT 2/9/2017
 River = River #1 Reach = Reach #1 RS = 2150





COS3-4ULT Plan: COS3-4ULT 2/9/2017

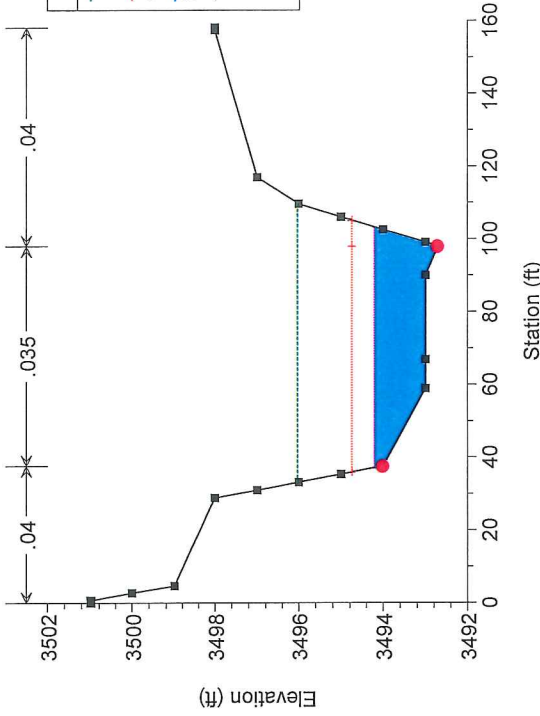
River = River #1 Reach = Reach #1 RS = 1900



COS3-4ULT

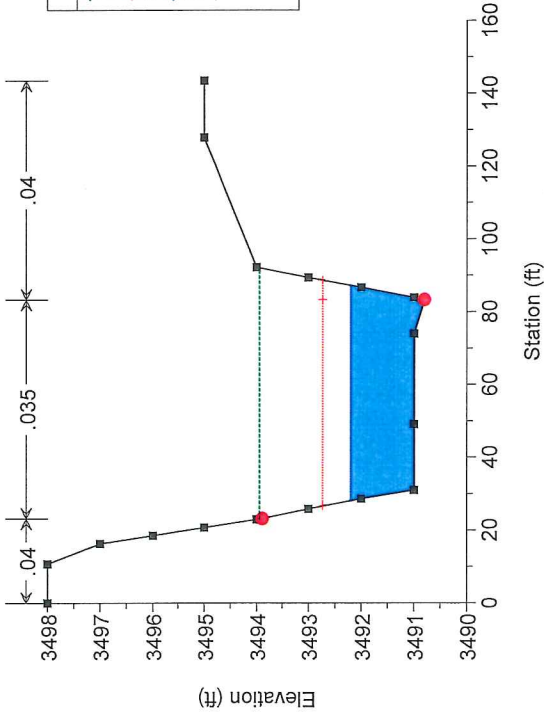
Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 1825



COS3-4ULT Plan: COS3-4ULT 2/9/2017

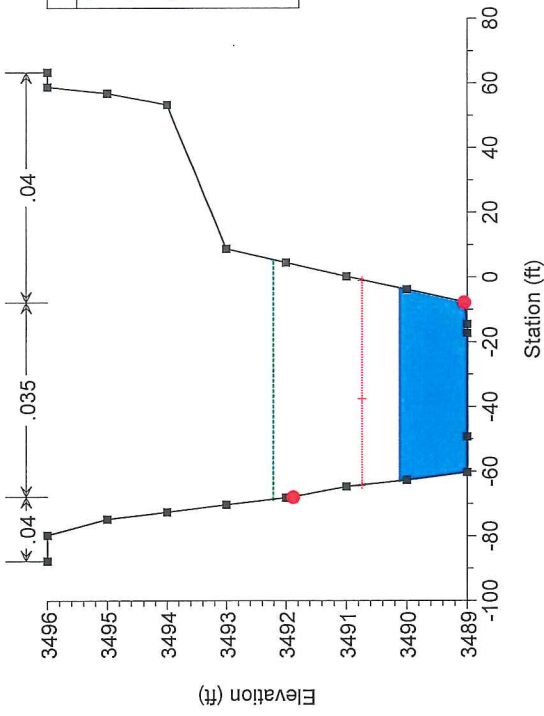
River = River #1 Reach = Reach #1 RS = 1800

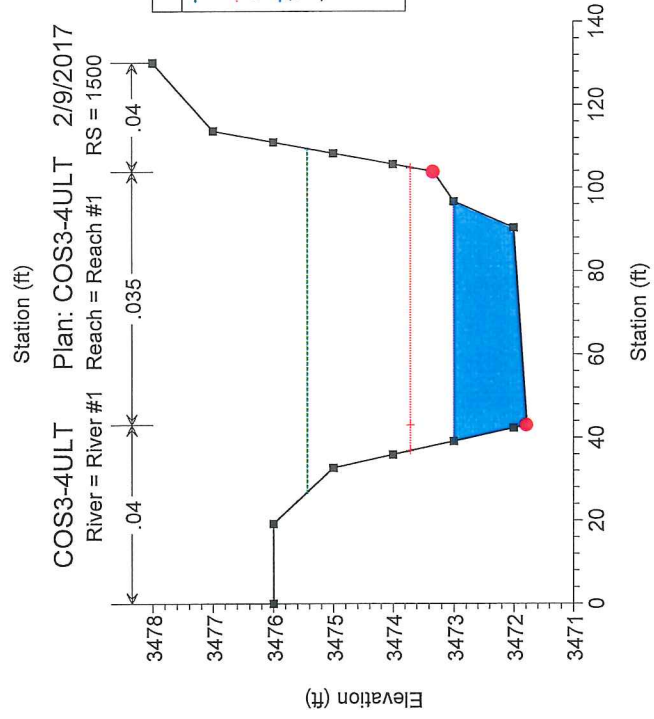
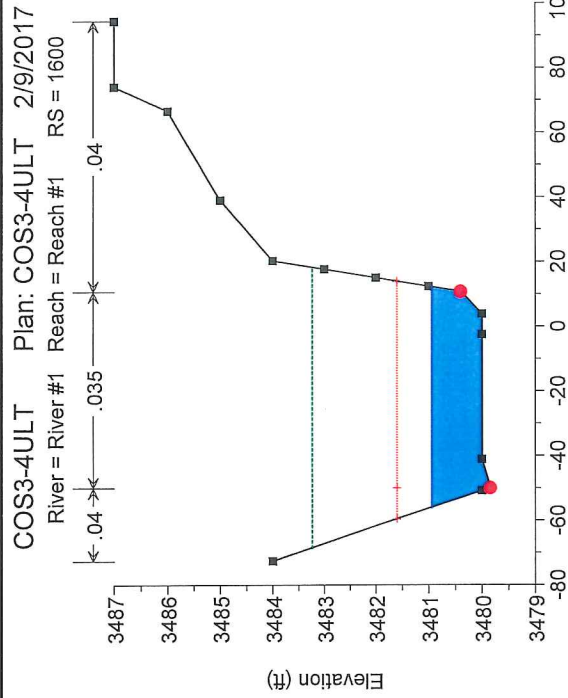
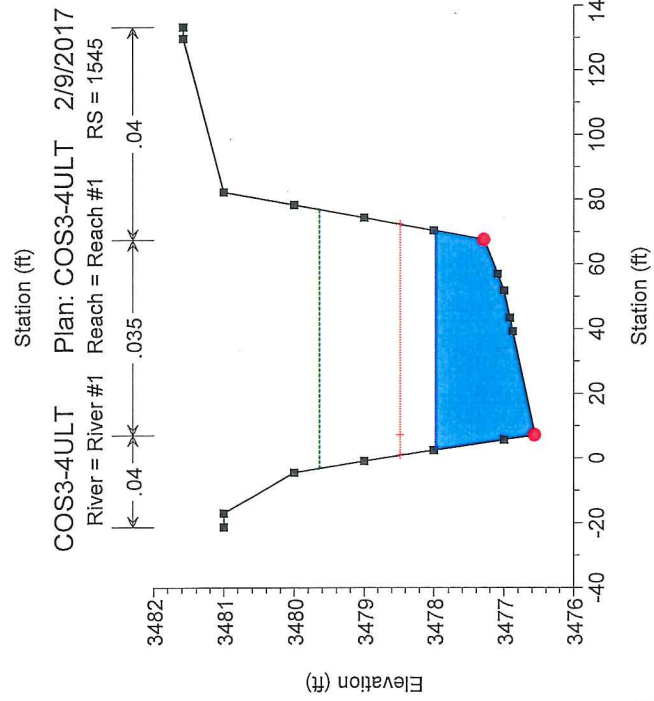
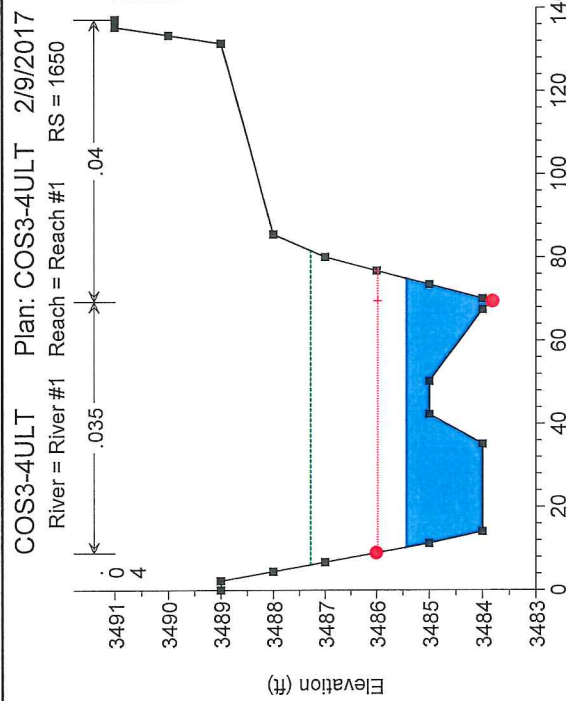


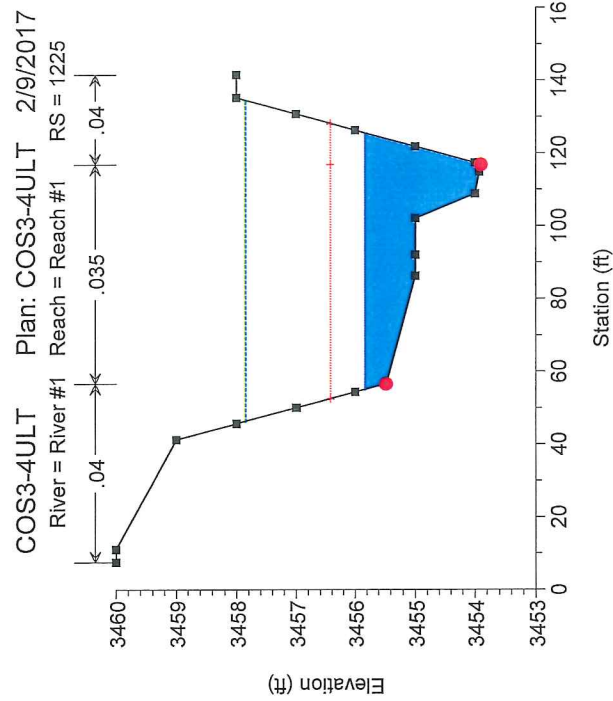
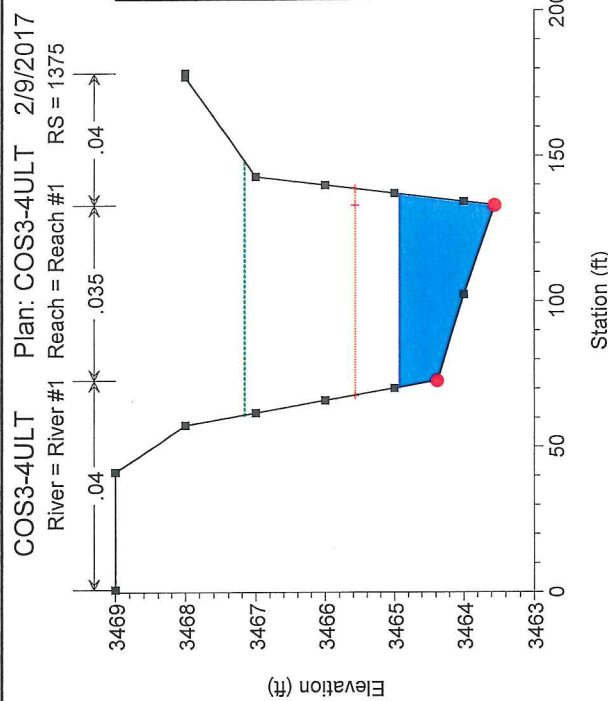
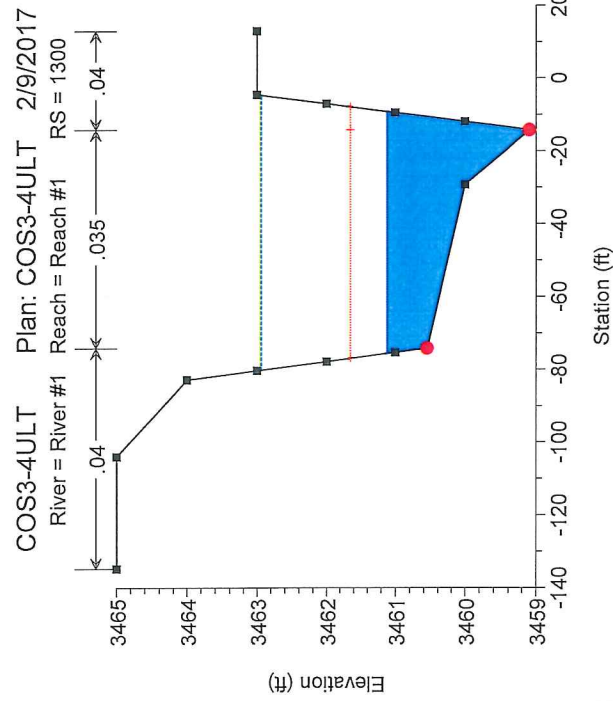
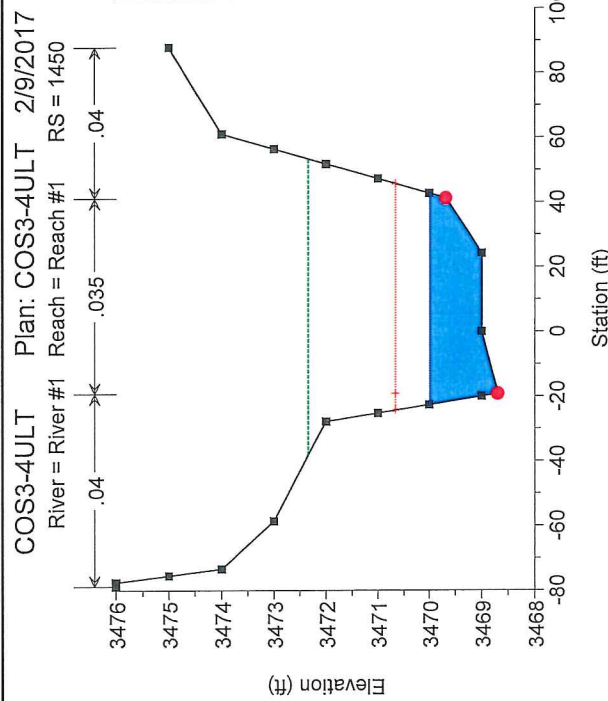
COS3-4ULT

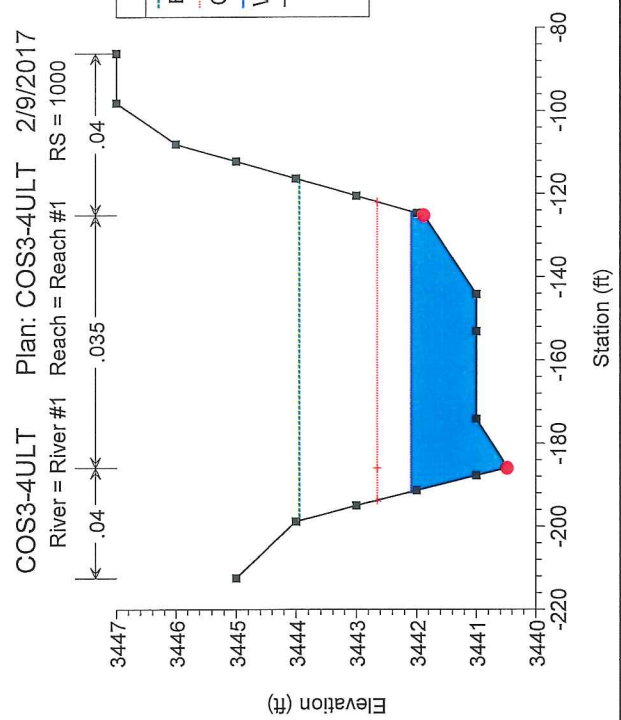
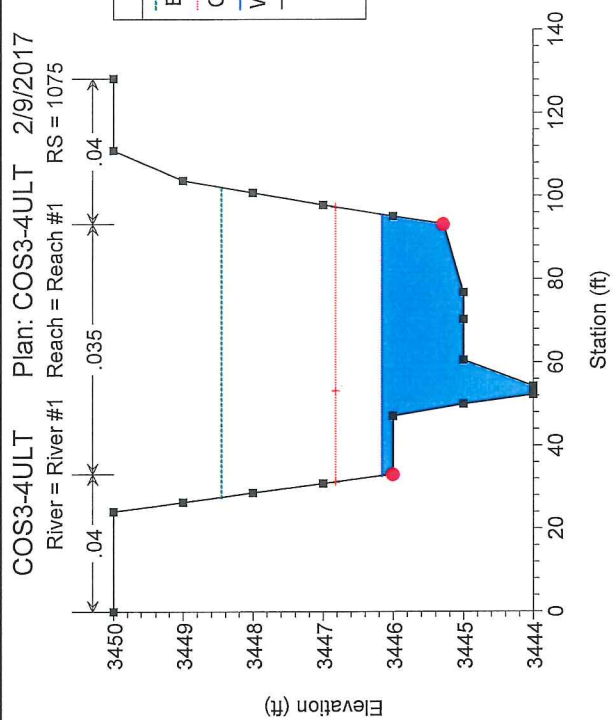
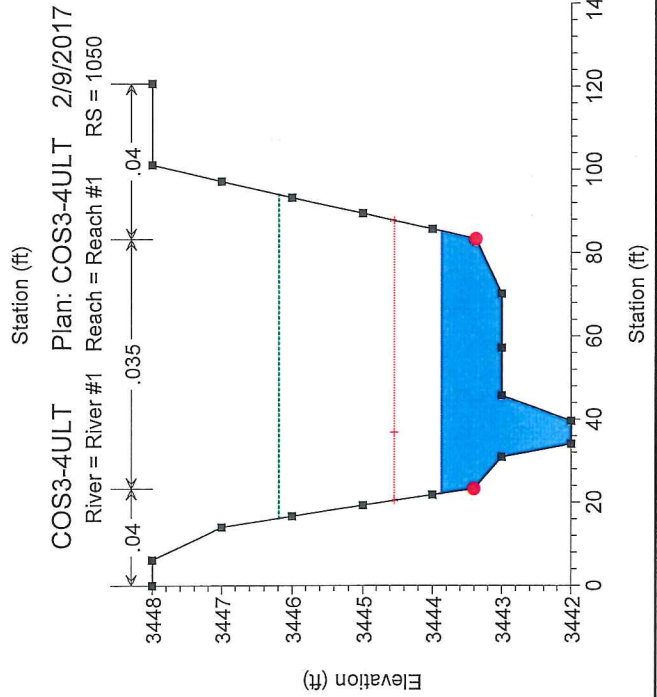
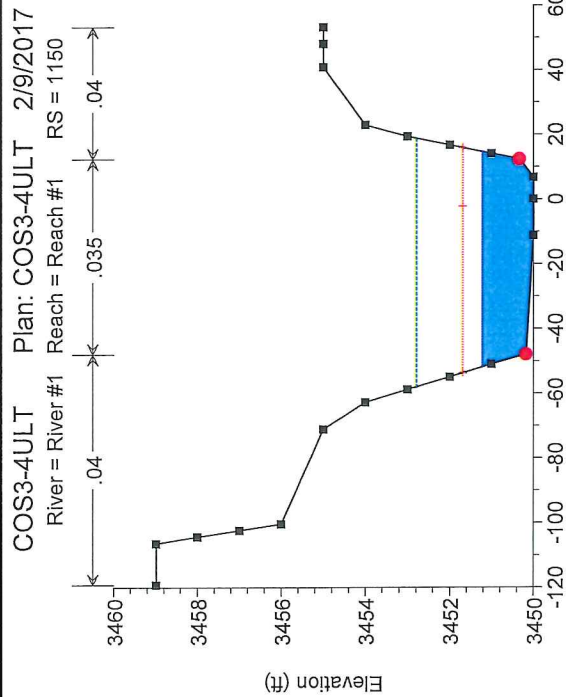
Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 1750



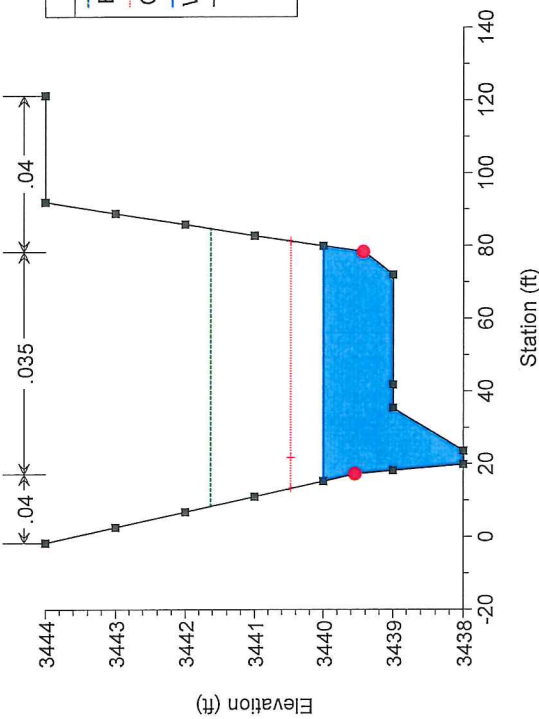






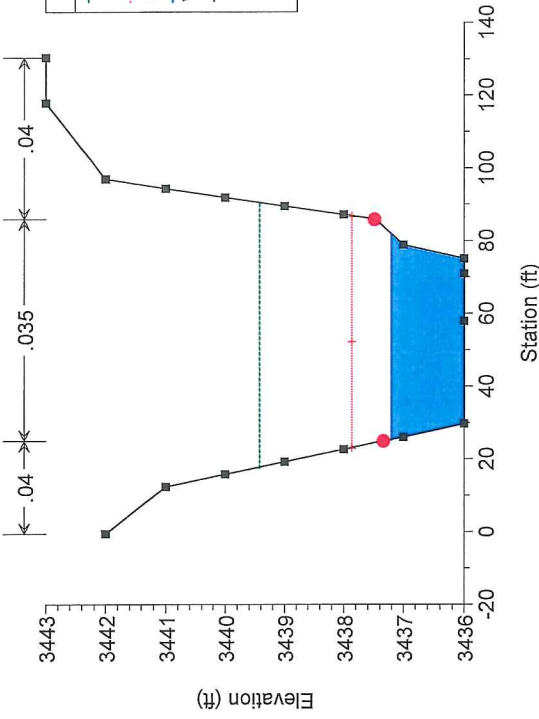
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 960



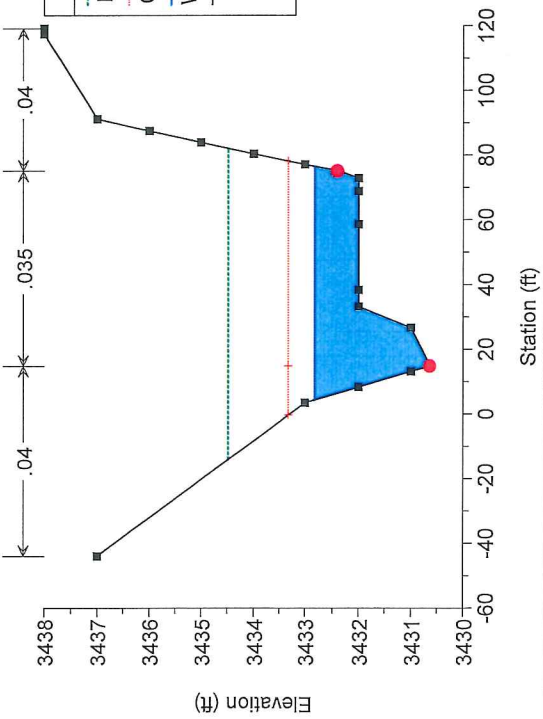
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 925



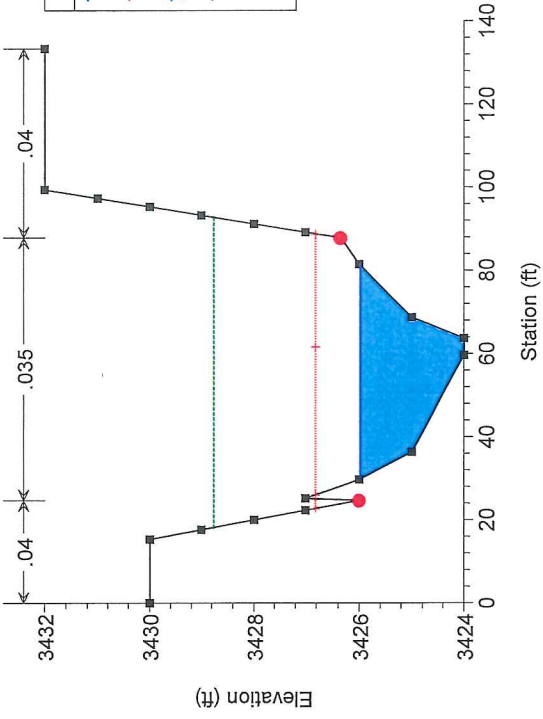
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 850



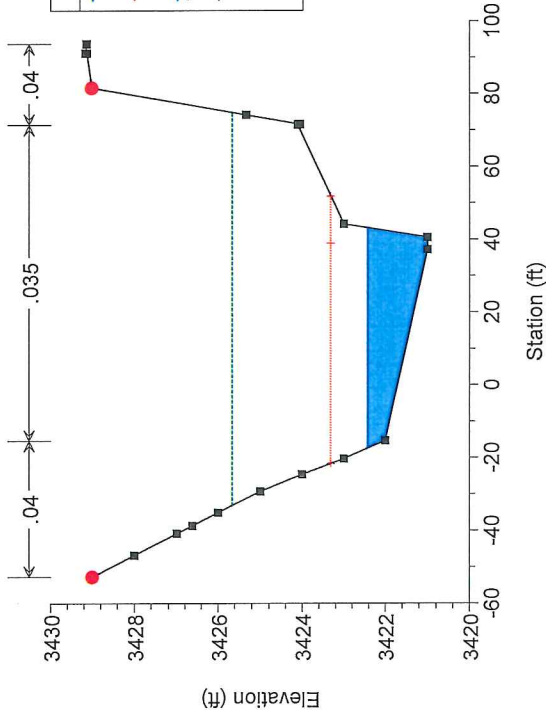
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 775



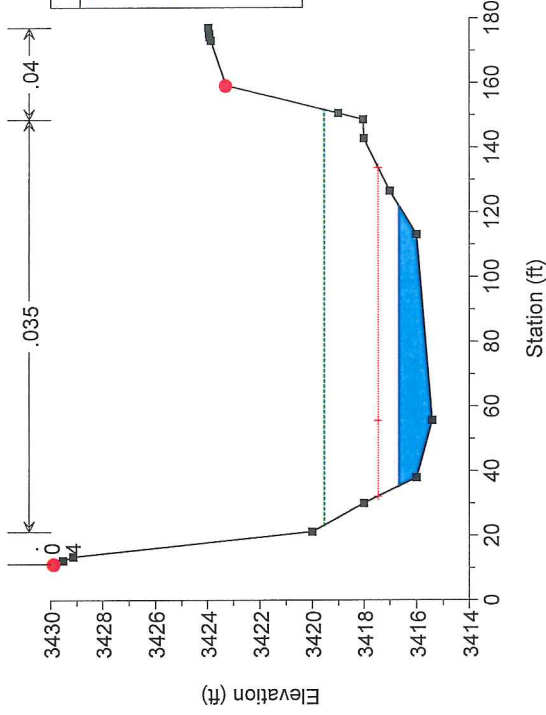
COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 700



COS3-4ULT Plan: COS3-4ULT 2/9/2017

River = River #1 Reach = Reach #1 RS = 550



HEC-RAS Version 4.1.0 Jan 2010
 U.S. Army Corps of Engineers
 Hydrologic Engineering Center
 609 Second Street
 Davis, California

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X   X   XXXXXX   XXXX   XXXX   XX   XXXX
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PROJECT DATA

Project Title: COS3-4ULT
 Project File : COS3-4ULT.prj
 Run Date and Time: 2/9/2017 10:20:44 AM

Project in English units

PLAN DATA

Plan Title: COS3-4ULT
 Plan File : f:\Projects\600\62024-226-3\Division\Fctl\Calcs\HEC-RAS\FINAL\COS3-4ULT.p05

Geometry Title: COS3-4ULT
 Geometry File : f:\Projects\600\62024-226-3\Division\Fctl\Calcs\HEC-RAS\FINAL\COS3-4ULT.g03

Flow Title : COS3-4ULT
 Flow File : f:\Projects\600\62024-226-3\Division\Fctl\Calcs\HEC-RAS\FINAL\COS3-4ULT.f01

Plan Summary Information:

Number of:	Cross Sections = 42	Multiple Openings = 0
	Culverts = 0	Inline Structures = 0
	Bridges = 0	Lateral Structures = 0

Computational Information

Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 40
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method: Average Conveyance
Computational Flow Regime: Supercritical Flow

FLOW DATA

Flow Title: COS3-4ULT
 Flow File : f:\Projects\600\62024-226-3\Division\Fctl\Calcs\HEC-RAS\FINAL\COS3-4ULT.f01

Flow Data (cfs)

River	Reach	RS	Profile 1
River #1	Reach #1	2699	720
River #1	Reach #1	850	799
River #1	Reach #1	550	1031

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
River #1	Reach #1	Profile 1	Known WS = 3555.35	Known WS = 3416.57

GEOMETRY DATA

Geometry Title: COS3-4ULT
 Geometry File : f:\Projects\600\62024-226-3\Division\Fctl\Calcs\HEC-RAS\FINAL\COS3-4ULT.g03

CROSS SECTION

RIVER: River #1

REACH: Reach #1 RS: 2699

INPUT

Description:

Station Elevation Data	num=	17
Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev		
0 3557 9.18 3557 12 3556 14.11 3555 16.24 3554		
16.27 3553.83 25.99 3553 48.26 3552 61.42 3552 72.45 3552		

97.59 3553 103.46 3553.65 104.12 3554 106.02 3555 108.12 3556
 111.57 3557 116.79 3557

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 16.27 .035 103.46 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 16.27 103.46 42.1399842.1399842.13998 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2650

INPUT

Description:

Station Elevation Data num= 16
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 3552 9.15 3552 12.39 3551 15.63 3550 18.87 3549
 22.1 3548 48.68 3549 65.83 3549 73 3548 89.58 3548
 94.79 3548.77 95.76 3549 98.4 3550 102.11 3551 105.82 3552
 106.37 3552

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .04 22.1 .035 94.79 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 22.1 94.79 38.96 38.96 38.96 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2600

INPUT

Description:

Station Elevation Data num= 18
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 3552 15.56 3552 16.67 3551 18.43 3550 53.16 3549
 57.87 3548 62.58 3547 67.31 3546 70.3 3545.37 104.34 3545
 107.26 3544 116.88 3544 130.54 3544.57 131.63 3545 134.18 3546
 136.72 3547 139.38 3548 152.17 3548

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .04 70.3 .035 130.54 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 70.3 130.54 21.35 21.35 21.35 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2575

INPUT

Description:

Station Elevation Data num= 17
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 3550 11.67 3550 13.67 3549 16.95 3548 48.85 3547
 52.67 3546 56.45 3545 60.22 3544 62.15 3543.49 97.34 3543
 118.84 3543 122.28 3543.22 124.36 3544 126.93 3545 129.57 3546
 132.21 3547 141.17 3547

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .04 62.15 .035 122.28 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 62.15 122.28 20 20 20 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2550

INPUT

Description:

Station Elevation Data num= 17
 Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev Sta Elev
 0 3546 42.81 3546 54.54 3545 57.77 3544 60.94 3543
 63.96 3542 64.67 3541.76 81.99 3542 94.42 3542 106.65 3541
 122.28 3541 124.74 3541.18 127.55 3542 131.13 3543 134.74 3544
 138.34 3545 143.73 3545

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .04 64.67 .035 124.74 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 64.67 124.74 44.28 44.28 44.28 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2500

INPUT

Description:

Station	Elevation	Data	num=	18	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
36.47	3543	64.21	3543	66.85	3542	69.5	3541	72.15	3540			
74.79	3539	75.1	3539	95.26	3539	105.38	3539	119.94	3538			
127.97	3538	135.11	3538.64	136.83	3539	141.56	3540	146.24	3541			
150.96	3542	155.65	3543	156.79	3543							

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
36.47	.04	74.79	.035	135.11	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
74.79	135.11		51.59	51.59	51.59		.05	.1	

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2450

INPUT

Description:

Station	Elevation	Data	num=	19	Sta	Elev	Sta	Elev	Sta	Elev
29.99	3539	55.24	3539	58.13	3538	60.99	3537	63.84	3536	
66.7	3535	66.71	3535	84.69	3535	90.87	3535	104.35	3534	
113.97	3534	125.24	3535	126.68	3536	126.78	3536.06	129.49	3537	
132.38	3538	135.33	3539	138.28	3540	143.09	3540			

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
29.99	.04	66.7	.035	126.78	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
66.7	126.78		30	30	30		.05	.1	

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2425

INPUT

Description:

Station	Elevation	Data	num=	18	Sta	Elev	Sta	Elev	Sta	Elev
26.28	3537	47.46	3537	51.29	3536	55.13	3535	58.92	3534	
61.78	3533.16	82.07	3533	98.22	3532	112.89	3532	115.54	3533	
118.36	3534	122	3534.92	122.2	3535	124.69	3536	127.18	3537	
129.68	3538	132.17	3539	144.25	3539					

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
26.28	.04	61.78	.035	122	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
61.78	122		36.08	36.08	36.08		.05	.1	

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2400

INPUT

Description:

Station	Elevation	Data	num=	21	Sta	Elev	Sta	Elev	Sta	Elev
0	3535	27.9	3535	32.32	3535	47.97	3534	52.26	3533	
56.57	3532	60.88	3531	61.29	3530.92	68.32	3531	85.51	3531	
99.72	3530	113.24	3530	115.7	3531	122.45	3531.84	123.01	3532	
126.35	3533	129.58	3534	132.74	3535	135.89	3536	149.75	3537	
159.32	3537									

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
0	.04	61.29	.035	122.45	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
61.29	122.45		42.3	42.3	42.3		.05	.1	

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2350

INPUT

Description:

Station	Elevation	Data	num=	25	Sta	Elev	Sta	Elev	Sta	Elev
0	3536	19.97	3536	22.13	3535	24.29	3534	26.46	3533	

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28.63	3532	55.34	3531	58.44	3530	61.65	3529	64.89	3528
65.51	3527.84	69.23	3528	82.49	3528	92.75	3528	98.68	3528
116.47	3528	118.75	3529	127.97	3529.5	130.29	3530	135.03	3531
140.1	3532	144.88	3533	149.36	3534	166.32	3535	174.82	3535

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 65.51 .035 127.97 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 65.51 127.97 20.9 20.9 20.9 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2300

INPUT

Description:

Station	Elevation	Data	num=	27	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3536	2.93	3536	4.93	3535	6.94	3534	8.94	3533		
10.94	3532	12.94	3531	35.33	3530	41.87	3529	44.25	3528		
46.63	3527	49.01	3526	49.26	3525.91	54.58	3526	55.12	3526		
68	3526	77.3	3526	91.78	3526	94.93	3527	100.47	3527		
109.25	3526.75	110.42	3527	115.11	3528	119.8	3529	124.53	3530		
129.26	3531	152.17	3531								

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 49.26 .035 109.25 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 49.26 109.25 22.6 22.6 22.6 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2250

INPUT

Description:

Station	Elevation	Data	num=	25	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3535	8.03	3535	10.01	3534	12	3533	13.99	3532		
15.98	3531	17.97	3530	19.96	3529	43.8	3528	46.3	3527		
48.8	3526	51.31	3525	53.82	3524	86.82	3524	89.87	3525		
97.54	3526	101.48	3526	113.05	3525	113.93	3524.92	114.22	3525		
117.69	3526	121.14	3527	124.59	3528	132.85	3529	164.54	3529		

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 53.82 .035 113.93 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 53.82 113.93 32.08 32.08 32.08 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2225

INPUT

Description:

Station	Elevation	Data	num=	20	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3528	.7	3528	2.67	3527	4.64	3526	25.65	3525		
29.26	3524	32.88	3523	36.51	3522	39.83	3521.12	42.92	3521		
63.29	3521	66.57	3522	69.75	3523	86.1	3523	100.3	3522.46		
101.72	3523	104.33	3524	106.94	3525	109.55	3526	142.54	3526		

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 39.83 .035 100.3 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 39.83 100.3 30.4 30.4 30.4 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2200

INPUT

Description:

Station	Elevation	Data	num=	24	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-11.67	3527	-10.51	3527	-8.68	3526	-6.72	3525	-4.62	3524		
21.17	3523	22.39	3522.66	24.77	3522	25.45	3521.81	28.37	3521		
31.48	3520.12	31.91	3520	37.84	3519	51.12	3519	55.25	3520		
63.07	3521	81.32	3521	92.63	3520.83	93.11	3521	95.88	3522		
98.67	3523	101.46	3524	121.57	3525	136.63	3525				

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 39.83 .035 100.3 .04

-11.67	.04	31.91	.035	92.63	.04				
Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.		
31.91	92.63		22.8 22.8	22.8		.05	.1		

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2175

INPUT

Description:

Station	Elevation	Data	num=	18					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3523	17.48	3523	24.32	3522	27.07	3521	29.83	3520
32.47	3519	33.07	3518.76	35.87	3518	51.35	3518	58.16	3519
90.45	3519	93.09	3518.95	93.27	3519	96.56	3520	99.95	3521
103.36	3522	106.78	3523	138	3523				

Manning's n	Values	num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	33.07	.035	93.09	.04				

Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
33.07	93.09		20.61 20.61	20.61		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2150

INPUT

Description:

Station	Elevation	Data	num=	22					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3524	1.08	3524	3.08	3523	5.07	3522	28.51	3521
30.95	3520	33.38	3519	35.82	3518	37.54	3517.36	38.66	3517
42.08	3516	53.15	3516	60.05	3517	83.48	3518	96.24	3518
97.51	3517.9	97.93	3518	102.19	3519	106.45	3520	110.78	3521
116.05	3522	148.68	3522						

Manning's n	Values	num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	37.54	.035	97.51	.04				

Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
37.54	97.51		37.32 37.32	37.32		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2125

INPUT

Description:

Station	Elevation	Data	num=	25					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3523	8.08	3523	10.08	3522	12.07	3521	16.73	3520
36.41	3519	39.4	3518	42.37	3517	45.21	3516	45.61	3515.87
47.71	3515	49.98	3514	52.58	3513	63.7	3513	74.69	3514
106.47	3514.94	106.76	3515	111.33	3516	115.91	3517	120.49	3518
125.1	3519	151.85	3520	168	3521	169.99	3522	177.97	3522

Manning's n	Values	num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	45.61	.035	106.47	.04				

Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
45.61	106.47		31.28 31.28	31.28		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 2100

INPUT

Description:

Station	Elevation	Data	num=	18					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3516	25.04	3516	27.91	3515	30.78	3514	33.69	3513
34.06	3512.88	44.82	3512	51.14	3511	71.25	3511	86.59	3512
97.08	3512.53	98.71	3513	102.18	3514	105.79	3515	109.41	3516
113.23	3517	135.61	3518	149.3	3518				

Manning's n	Values	num=	3						
Sta	n Val	Sta	n Val	Sta	n Val				
0	.04	34.06	.035	97.08	.04				

Bank Sta: Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
34.06	97.08		28.98 28.98	28.98		.05	.1

CROSS SECTION

RIVER: River #1

REACH: Reach #1 RS: 2050

INPUT

Description:

Station	Elevation	Data	num=	18	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-95.47	3515	-69.69	3515	-67.4	3514	-40.59	3513	-37.82	3512			
-35.05	3511	-32.3	3510	-31.87	3509.86	-5.39	3509	18.14	3509			
30.59	3509.78	31.13	3510	33.61	3511	36.09	3512	38.59	3513			
41.15	3514	67	3515	83.9	3515							

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
-95.47	.04	-31.87	.035	30.59	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
-31.87	30.59		78.88	78.88	78.88		.05	.1	

CROSS SECTION

RIVER: River #1

REACH: Reach #1 RS: 1975

INPUT

Description:

Station	Elevation	Data	num=	19	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3513	4.95	3513	7.11	3512	8.93	3511	10.63	3510			
36.37	3509	41.83	3508	44.9	3507	48.11	3506	51.33	3505			
51.92	3504.8	96.06	3504	112.59	3503.11	116.04	3504	119.91	3505			
123.77	3506	127.96	3507	155.05	3508	161.62	3508					

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
0	.04	51.92	.035	112.59	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
51.92	112.59		74.56	74.56	74.56		.05	.1	

CROSS SECTION

RIVER: River #1

REACH: Reach #1 RS: 1900

INPUT

Description:

Station	Elevation	Data	num=	23	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-103.63	3507	-101.93	3507	-99.92	3506	-97.9	3505	-79.46	3504			
-70.24	3503	-67.99	3502	-65.73	3501	-63.48	3500	-63.18	3499.87			
-47.33	3499	-3.02	3498.25	-.89	3499	1.95	3500	4.83	3501			
7.89	3502	36.43	3503	55.28	3504	57.25	3505	59.22	3506			
61.2	3507	63.17	3508	82.36	3508							

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
-103.63	.04	-63.18	.035	-3.02	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
-63.18	-3.02		84.6000184	6000184	60001		.05	.1	

CROSS SECTION

RIVER: River #1

REACH: Reach #1 RS: 1825

INPUT

Description:

Station	Elevation	Data	num=	20	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3501	.68	3501	2.69	3500	4.7	3499	28.86	3498			
31.01	3497	33.16	3496	35.41	3495	37.66	3494	58.99	3493			
66.85	3493	90	3493	98.08	3492.7	99.12	3493	102.54	3494			
106.05	3495	109.67	3496	116.98	3497	157.42	3498	158.14	3498			

Manning's n	Values	num=	3	Sta	n Val	Sta	n Val
0	.04	37.66	.035	98.08	.04		

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
37.66	98.08		36.88	36.88	36.88		.05	.1	

CROSS SECTION

RIVER: River #1

REACH: Reach #1 RS: 1800

INPUT

Description:

Station	Elevation	Data	num=	19	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3498	10.76	3498	16.24	3497	18.47	3496	20.69	3495			
22.92	3494	23.17	3493.88	25.82	3493	28.57	3492	30.98	3491			
49.14	3491	74.04	3491	83.31	3490.8	83.89	3491	86.66	3492			
89.42	3493	92.19	3494	127.85	3495	143.5	3495					

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .04 23.17 .035 83.31 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 23.17 83.31 29.55 29.55 29.55 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1750

INPUT

Description:
 Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-87.68	3496	-79.69	3496	-74.77	3495	-72.55	3494	-70.33	3493
-68.11	3492	-67.83	3491.87	-64.69	3491	-62.67	3490	-60.3	3489
-49.32	3489	-17.32	3489	-14.53	3489	-7.69	3489.04	-3.76	3490
.3	3491	4.51	3492	8.82	3493	53.41	3494	56.95	3495
58.95	3496	63.42	3496						

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -87.68 .04 -67.83 .035 -7.69 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 -67.83 -7.69 74.6400174.6400174.64001 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1650

INPUT

Description:
 Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3489	2.25	3489	4.48	3488	6.72	3487	8.95	3486
11.21	3485	14.09	3484	35.09	3484	42.24	3485	50.22	3485
67.43	3484	69.47	3483.81	70.08	3484	73.43	3485	76.75	3486
80.09	3487	85.59	3488	131.47	3489	133.46	3490	135.46	3491
137.29	3491								

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .04 8.95 .035 69.47 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 8.95 69.47 52.68 52.68 52.68 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1600

INPUT

Description:
 Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-72.6	3484	-50.78	3480	-49.86	3479.84	-41.09	3480	-2.49	3480
3.82	3480	10.75	3480.4	12.37	3481	15.03	3482	17.69	3483
20.34	3484	39.01	3485	66.68	3486	74.2	3487	94.56	3487

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -72.6 .04 -49.86 .035 10.75 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 -49.86 10.75 51 51 51 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1545

INPUT

Description:
 Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-21.24	3481	-17.05	3481	-4.42	3480	-9	3479	2.46	3478
5.68	3477	5.7	3477	7.1	3476.56	39.19	3476.88	39.2	3476.88
43.34	3476.92	51.77	3477	56.93	3477.09	67.53	3477.28	70.37	3478
74.34	3479	78.31	3480	82.29	3481	129.76	3481.58	133.34	3481.58

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 -21.24 .04 7.1 .035 67.53 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 7.1 67.53 62.4399962.4399962.43999 .05 .1

CROSS SECTION

RIVER: River #1
REACH: Reach #1 RS: 1500

INPUT

Description:

Station Elevation Data		num=	16	
Sta	Elev	Sta	Elev	Sta
0	3476	19.24	3476	32.72
42.31	3472	43.01	3471.78	90.44
105.71	3474	108.35	3475	111.02
130.2	3478			

Manning's n Values		num=	3	
Sta	n Val	Sta	n Val	Sta
0	.04	43.01	.035	103.93

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	43.01	103.93		34.84	34.84	34.84		.05	.1

CROSS SECTION

RIVER: River #1
REACH: Reach #1 RS: 1450

INPUT

Description:

Station Elevation Data		num=	19	
Sta	Elev	Sta	Elev	Sta
-78.82	3476	-77.49	3476	-75.42
-27.86	3472	-25.24	3471	-22.63
0	3469	24.2	3469	41.17
51.75	3472	56.42	3473	61.08

Manning's n Values		num=	3	
Sta	n Val	Sta	n Val	Sta
-78.82	.04	-19.21	.035	41.17

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	-19.21	41.17		57.48	57.48	57.48		.05	.1

CROSS SECTION

RIVER: River #1
REACH: Reach #1 RS: 1375

INPUT

Description:

Station Elevation Data		num=	15	
Sta	Elev	Sta	Elev	Sta
.83	3469	41.31	3469	57.38
70.21	3465	72.83	3464.37	102.3
137.07	3465	139.91	3466	142.78

Manning's n Values		num=	3	
Sta	n Val	Sta	n Val	Sta
.83	.04	72.83	.035	132.96

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	72.83	132.96		56.04	56.04	56.04		.05	.1

CROSS SECTION

RIVER: River #1
REACH: Reach #1 RS: 1300

INPUT

Description:

Station Elevation Data		num=	14	
Sta	Elev	Sta	Elev	Sta
-134.81	3465	-104.01	3465	-82.89
-75.34	3461	-74.21	3460.55	-29.31
-9.49	3461	-7.01	3462	-4.53

Manning's n Values		num=	3	
Sta	n Val	Sta	n Val	Sta
-134.81	.04	-74.21	.035	-14.2

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	-74.21	-14.2		69.3000369	369.3000369	30003		.05	.1

CROSS SECTION

RIVER: River #1
REACH: Reach #1 RS: 1225

INPUT

Description:

Station Elevation Data		num=	22	
Sta	Elev	Sta	Elev	Sta
7.58	3460	11.1	3460	11.13
45.74	3458	50.07	3457	50.09
86.24	3455	92.03	3455	102.11
116.88	3453.9	117.35	3454	121.82
135.3	3458	141.57	3458	

Manning's n Values num= 3
 Sta n Val Sta n Val
 7.58 .04 56.72 .035 116.88 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 56.72 116.88 81.2599981.2599981.25999 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1150

INPUT
Description:

Station Elevation Data num= 22

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-119.23	3459	-106.39	3459	-104.39	3458	-102.4	3457	-100.41	3456
-71.09	3455	-62.79	3454	-58.86	3453	-54.93	3452	-51	3451
-47.94	3450.17	-11.31	3450	0	3450	6.78	3450	12.33	3450.33
14.1	3451	16.74	3452	19.37	3453	22.95	3454	40.88	3455
48.09	3455	53.23	3455						

Manning's n Values num= 3
 Sta n Val Sta n Val
 -119.23 .04 -47.94 .035 12.33 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 -47.94 12.33 68.6100168.6100168.61001 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1075

INPUT
Description:

Station Elevation Data num= 21

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3450	24.12	3450	26.37	3449	28.63	3448	30.87	3447
33.11	3446	47.08	3446	47.13	3446	50	3445	52.22	3444
54.21	3444	60.55	3445	70.34	3445	76.76	3445	93.24	3445.29
95.13	3446	97.88	3447	100.8	3448	103.72	3449	110.96	3450
128.27	3450								

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 33.11 .035 93.24 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 33.11 93.24 26.25 26.25 26.25 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1050

INPUT
Description:

Station Elevation Data num= 20

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	3448	6.14	3448	14.03	3447	16.62	3446	19.22	3445
21.76	3444	23.25	3443.4	30.89	3443	34.06	3442	39.62	3442
45.64	3443	57.11	3443	70.17	3443	83.32	3443.37	85.69	3444
89.46	3445	93.24	3446	97.22	3447	101.21	3448	120.74	3448

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .04 23.25 .035 83.32 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 23.25 83.32 28.95 28.95 28.95 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 1000

INPUT
Description:

Station Elevation Data num= 17

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-212.47	3445	-198.86	3444	-195.01	3443	-191.38	3442	-187.74	3441
-185.85	3440.48	-174.18	3441	-153.11	3441	-144.11	3441	-125.14	3441.88
-124.63	3442	-120.48	3443	-116.34	3444	-112.19	3445	-108	3446
-98.06	3447	-86.13	3447						

Manning's n Values num= 3
 Sta n Val Sta n Val
 -212.47 .04 -185.85 .035 -125.14 .04

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 -185.85 -125.14 40.45 40.45 40.45 .05 .1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 960

INPUT

Description:

Station	Elevation	Data	num=	19						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
-1.69	3444	2.54	3443	6.76	3442	10.99	3441	15.22	3440	
17.23	3439.54	18.2	3439	19.84	3438	23.56	3438	35.38	3439	
41.74	3439	71.99	3439	78.3	3439.42	79.86	3440	82.72	3441	
85.8	3442	88.75	3443	91.95	3444	121.26	3444			

Manning's n Values			num=	3
Sta	n Val	Sta	n Val	Sta
-1.69	.04	17.23	.035	78.3

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	17.23	78.3		36.4	36.4	36.4		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 925

INPUT

Description:

Station	Elevation	Data	num=	20						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
-.52	3442	12.39	3441	15.82	3440	19.24	3439	22.66	3438	
25.02	3437.33	26.05	3437	29.75	3436	57.88	3436	70.89	3436	
75.01	3436	78.82	3437	85.94	3437.48	87.16	3438	89.49	3439	
91.82	3440	94.36	3441	96.93	3442	117.95	3443	130.39	3443	

Manning's n Values			num=	3
Sta	n Val	Sta	n Val	Sta
-.52	.04	25.02	.035	85.94

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	25.02	85.94		78.0800178	0800178	08001		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 850

INPUT

Description:

Station	Elevation	Data	num=	19						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
-44	3437	3.5	3433	8.31	3432	13.12	3431	14.88	3430.64	
26.61	3431	33.21	3432	38.27	3432	58.58	3432	68.82	3432	
72.9	3432	75.11	3432.4	77.1	3433	80.42	3434	83.94	3435	
87.57	3436	91.2	3437	117.5	3438	119.18	3438			

Manning's n Values			num=	3
Sta	n Val	Sta	n Val	Sta
-44	.04	14.88	.035	75.11

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	14.88	75.11		85.14	85.14	85.14		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 775

INPUT

Description:

Station	Elevation	Data	num=	21						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
0	3430	15.35	3430	17.67	3429	20.01	3428	22.36	3427	
24.71	3426	25.18	3427	29.69	3426	36.31	3425	59.62	3424	
63.69	3424	68.72	3425	81.5	3426	87.88	3426.35	89.19	3427	
91.21	3428	93.26	3429	95.31	3430	97.36	3431	99.42	3432	
133.4	3432									

Manning's n Values			num=	3
Sta	n Val	Sta	n Val	Sta
0	.04	24.71	.035	87.88

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	24.71	87.88		60.55	60.55	60.55		.05	.1

CROSS SECTION

RIVER: River #1
 REACH: Reach #1 RS: 700

INPUT

Description:

Station	Elevation	Data	num=	23						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta
-52.69	3429	-46.77	3428	-40.84	3427	-38.66	3426.62	-35.05	3426	

COS3-4ULT.rep

-29.31	3425	-24.65	3424	-20.31	3423	-15.28	3422	37.2	3421
40.47	3421	44.18	3423	71.5	3424.1	71.59	3424.05	71.62	3424.06
71.62	3424.07	71.64	3424.07	71.64	3424.08	74.18	3425.33	81.66	3429.01
91.16	3429.13	91.16	3429.16	93.73	3429.14				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-52.69	.04	-15.28	.035	71.5	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
-52.69		81.66		95	95	95		.05	.1

CROSS SECTION

RIVER: River #1
REACH: Reach #1 RS: 550

INPUT

Description:

Station	Elevation	Data	num=	19					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
11.21	3429.88	11.42	3429.81	12.31	3429.53	13.49	3429.14	21.19	3420
30.02	3418	37.95	3416	55.68	3415.41	113.05	3416	126.51	3417
142.74	3418	148.65	3418.03	150.59	3418.99	159.22	3423.28	173.11	3423.87
174.2	3423.92	175.09	3423.93	175.27	3423.94	177.01	3423.97		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
11.21	.04	21.19	.035	148.65	.04

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
11.21		159.22		0	0	0		.05	.1

SUMMARY OF MANNING'S N VALUES

River: River #1

Reach	River Sta.	n1	n2	n3
Reach #1	2699	.04	.035	.04
Reach #1	2650	.04	.035	.04
Reach #1	2600	.04	.035	.04
Reach #1	2575	.04	.035	.04
Reach #1	2550	.04	.035	.04
Reach #1	2500	.04	.035	.04
Reach #1	2450	.04	.035	.04
Reach #1	2425	.04	.035	.04
Reach #1	2400	.04	.035	.04
Reach #1	2350	.04	.035	.04
Reach #1	2300	.04	.035	.04
Reach #1	2250	.04	.035	.04
Reach #1	2225	.04	.035	.04
Reach #1	2200	.04	.035	.04
Reach #1	2175	.04	.035	.04
Reach #1	2150	.04	.035	.04
Reach #1	2125	.04	.035	.04
Reach #1	2100	.04	.035	.04
Reach #1	2050	.04	.035	.04
Reach #1	1975	.04	.035	.04
Reach #1	1900	.04	.035	.04
Reach #1	1825	.04	.035	.04
Reach #1	1800	.04	.035	.04
Reach #1	1750	.04	.035	.04
Reach #1	1650	.04	.035	.04
Reach #1	1600	.04	.035	.04
Reach #1	1545	.04	.035	.04
Reach #1	1500	.04	.035	.04
Reach #1	1450	.04	.035	.04
Reach #1	1375	.04	.035	.04
Reach #1	1300	.04	.035	.04
Reach #1	1225	.04	.035	.04
Reach #1	1150	.04	.035	.04
Reach #1	1075	.04	.035	.04
Reach #1	1050	.04	.035	.04
Reach #1	1000	.04	.035	.04
Reach #1	960	.04	.035	.04
Reach #1	925	.04	.035	.04
Reach #1	850	.04	.035	.04
Reach #1	775	.04	.035	.04
Reach #1	700	.04	.035	.04
Reach #1	550	.04	.035	.04

SUMMARY OF REACH LENGTHS

River: River #1

Reach	River Sta.	Left	Channel	Right
Reach #1	2699	42.13998	42.13998	42.13998
Reach #1	2650	38.96	38.96	38.96
Reach #1	2600	21.35	21.35	21.35
Reach #1	2575	20	20	20
Reach #1	2550	44.28	44.28	44.28

Reach #1	2500	51.59	51.59	51.59
Reach #1	2450	30	30	30
Reach #1	2425	36.08	36.08	36.08
Reach #1	2400	42.3	42.3	42.3
Reach #1	2350	20.9	20.9	20.9
Reach #1	2300	22.6	22.6	22.6
Reach #1	2250	32.08	32.08	32.08
Reach #1	2225	30.4	30.4	30.4
Reach #1	2200	22.8	22.8	22.8
Reach #1	2175	20.61	20.61	20.61
Reach #1	2150	37.32	37.32	37.32
Reach #1	2125	31.28	31.28	31.28
Reach #1	2100	28.98	28.98	28.98
Reach #1	2050	78.88	78.88	78.88
Reach #1	1975	74.56	74.56	74.56
Reach #1	1900	84.60001	84.60001	84.60001
Reach #1	1825	36.88	36.88	36.88
Reach #1	1800	29.55	29.55	29.55
Reach #1	1750	74.64001	74.64001	74.64001
Reach #1	1650	52.68	52.68	52.68
Reach #1	1600	51	51	51
Reach #1	1545	62.43999	62.43999	62.43999
Reach #1	1500	34.84	34.84	34.84
Reach #1	1450	57.48	57.48	57.48
Reach #1	1375	56.04	56.04	56.04
Reach #1	1300	69.30003	69.30003	69.30003
Reach #1	1225	81.25999	81.25999	81.25999
Reach #1	1150	68.61001	68.61001	68.61001
Reach #1	1075	26.25	26.25	26.25
Reach #1	1050	28.95	28.95	28.95
Reach #1	1000	40.45	40.45	40.45
Reach #1	960	36.4	36.4	36.4
Reach #1	925	78.08001	78.08001	78.08001
Reach #1	850	85.14	85.14	85.14
Reach #1	775	60.55	60.55	60.55
Reach #1	700	95	95	95
Reach #1	550	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: River #1

Reach	River Sta.	Contr.	Expan.
Reach #1	2699	.05	.1
Reach #1	2650	.05	.1
Reach #1	2600	.05	.1
Reach #1	2575	.05	.1
Reach #1	2550	.05	.1
Reach #1	2500	.05	.1
Reach #1	2450	.05	.1
Reach #1	2425	.05	.1
Reach #1	2400	.05	.1
Reach #1	2350	.05	.1
Reach #1	2300	.05	.1
Reach #1	2250	.05	.1
Reach #1	2225	.05	.1
Reach #1	2200	.05	.1
Reach #1	2175	.05	.1
Reach #1	2150	.05	.1
Reach #1	2125	.05	.1
Reach #1	2100	.05	.1
Reach #1	2050	.05	.1
Reach #1	1975	.05	.1
Reach #1	1900	.05	.1
Reach #1	1825	.05	.1
Reach #1	1800	.05	.1
Reach #1	1750	.05	.1
Reach #1	1650	.05	.1
Reach #1	1600	.05	.1
Reach #1	1545	.05	.1
Reach #1	1500	.05	.1
Reach #1	1450	.05	.1
Reach #1	1375	.05	.1
Reach #1	1300	.05	.1
Reach #1	1225	.05	.1
Reach #1	1150	.05	.1
Reach #1	1075	.05	.1
Reach #1	1050	.05	.1
Reach #1	1000	.05	.1
Reach #1	960	.05	.1
Reach #1	925	.05	.1
Reach #1	850	.05	.1
Reach #1	775	.05	.1
Reach #1	700	.05	.1
Reach #1	550	.05	.1

design data 7

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CONCRETE PIPE SELECTION: Trench Installations

Trench conduits are usually installed in relatively narrow trenches excavated in undisturbed soil and back-filled to the original ground surface.

When a rigid conduit is installed in a narrow trench and backfilled, the backfill material will tend to settle. This downward movement generates frictional forces along the trench walls, which act upward to help support the weight of the backfill material. The magnitude of the frictional forces depends on the unit weight of the backfill material w , the value of Rankine's lateral pressure ratio K , and the coefficient of sliding friction μ' between the backfill material and the trench walls.

The backfill load on a conduit installed in a trench condition is equal to the weight of the mass of fill material within the trench less the summation of the frictional load transfers, and is expressed by the equation:

$$W_d = C_d w B_d^2$$

where

W_d = backfill load, pounds per linear foot

C_d = load coefficient for trench condition

w = unit weight of backfill material, pounds per cubic foot

B_d = width of trench at the top of the conduit, feet

Figures 2 through 5, based on the above equation, enable a direct determination of backfill load for a given trench width and depth of cover. As the trench width increases for a given depth of cover and pipe diameter, a point is reached at which an embankment condition develops. The curves showing pipe size indicate the limiting trench width for each pipe diameter beyond which greater trench widths will not affect the load. When this condition occurs, the load on the conduit remains constant. This load should be determined by the intersection of the vertical line representing the depth of cover and the dashed line representing the particular pipe diameter under consideration. For intermediate pipe sizes not shown in Figures 2 through 5, interpolation should be used.

The field supporting strength of a concrete pipe line is dependent on the inherent strength of the pipe, the type of foundation on which the pipe is installed and the compaction of the sidefill material adjacent to the pipe. A common method used to determine the inherent strength of a pipe is the three-edge bearing test, in which the pipe is subjected to concentrated loads at the crown and invert. The load that a pipe will support under this condition of loading is called the *three-edge bearing strength* and is expressed in pounds per linear foot.

ASTM Specification C14 covers three strength classes for non-reinforced concrete pipe — Class 1, 2 and 3. These three classes are specified to meet ultimate loads, expressed in terms of minimum strength in three-edge-bearing as listed in Table I.

TABLE I: Strength Requirements Non-reinforced Concrete Pipe ASTM C14

Pipe Diameter, Inches	Minimum Three-Edge Bearing Strengths, Pounds per Linear Foot		
	Class 1	Class 2	Class 3
4	1500	2000	2400
6	1500	2000	2400
8	1500	2000	2400
10	1600	2000	2400
12	1800	2250	2600
15	2000	2600	2900
18	2200	3000	3300
21	2400	3300	3850
24	2600	3600	4400
27	2800	3950	4600
30	3000	4300	4750
33	3150	4400	4875
36	3300	4500	5000

Another means of expressing pipe strength is in terms of D-load. The D-load of a pipe is the supporting strength of a pipe loaded under three-edge-bearing test conditions expressed in pounds per linear foot per foot of inside diameter. Thus the bearing strength may be converted to D-load by dividing by the inside diameter in feet.

ASTM Specification C76 specifies five strength classes reinforced concrete pipe. These strength classes are expressed in terms of D-load at 0.01-inch crack and for ultimate load. The D-load to produce the 0.01-inch crack $D_{0.01}$ is the maximum load applied to the concrete pipe before a crack occurs having a width of 0.01-inch measured at close intervals, throughout a length of at least 1-foot. The D-load to produce ultimate load D_u is the maximum three-edge-bearing test load carried by a pipe, expressed as D-load. Table II lists 0.01-inch crack and ultimate D-loads for the strength classes covered by ASTM Specification C76.

TABLE II: Strength Requirements Reinforced Concrete Pipe ASTM C76

Strength Class	Minimum D-Load in Three-Edge Bearing Pounds per Linear Foot per Foot of Internal Diameter	
	0.01 Inch Crack- $D_{0.01}$	Ultimate- D_u
I	800	1200
II	1000	1500
III	1350	2000
IV	2000	3000
V	3000	3750

PROGRAM SAMM

D-LOAD REQUIREMENTS FOR A 48 IN. DIAMETER CIRCULAR PIPE

 P I P E D A T A

DIAMETER (in.)	48.00
WALL B, THICKNESS (in.)	5.000

I N S T A L L A T I O N C O N D I T I O N S

MINIMUM DEPTH OF FILL (ft.)	0.50
MAXIMUM DEPTH OF FILL (ft.)	20.00
SOIL DENSITY (lb/cu. ft.)	140.0
SPECIFIED BEDDING FACTOR	1.90
INSTALLATION TYPE	TRENCH
TRENCH WIDTH (ft.)	8.83
SOIL LATERAL PRESSURE/FRICTION TERM (KMU')	0.1650
PARAMETERS TO COMPUTE TRANSITION WIDTH	
POSITIVE PROJECTION RATIO	1.00
POSITIVE SETTLEMENT RATIO	0.50
SOIL LATERAL PRESSURE/FRICTION TERM (KMU)	0.1924
SOIL LATERAL PRESSURE COEFFICIENT	0.33

A D D I T I O N A L L O A D S

LIVE LOAD	AASHTO HS-20
NO SURCHARGE LOAD	

F A C T O R S O F S A F E T Y

FACTOR OF SAFETY ON 0.01 INCH CRACK D-LOAD (EARTH,LIVE).	1.00; 1.00
FACTOR OF SAFETY ON ULTIMATE LOAD (EARTH,LIVE) IN ACCORDANCE WITH ASTM C 76	
DL.01 LESS THAN 2000 LBS/FT/FT	1.5
DL.01 GREATER THAN 3000 LBS/FT/FT	1.25
DL.01 BETWEEN 2000 AND 3000 LBS/FT/FT	INTERPOLATED

RESULTS OF ANALYSIS

```

SSSSSSSSS  AAAAAAAAAA  MMM  MMM  MMM  MMM
SS          AA      AA  MM M M MM  MM M M MM
SSSSSSSSS  AAAAAAAAAA  MM  M  MM  MM  M  MM
          SS  AA      AA  MM      MM  MM      MM
SSSSSSSSS  AA      AA  MM      MM  MM      MM

```

PROGRAM SAMM

AMERICAN CONCRETE PIPE ASSOCIATION
VERSION 2.0 - 1 SEPTEMBER 1990

Program SAMM computes earth loads on concrete pipe in accordance with the methods presented in the Concrete Pipe Design Manual (March 1990) and the Concrete Pipe Handbook (January 1988), published by the American Concrete Pipe Association. The user must select input values suitable to his specific installation. The information presented in the computer output is for review, interpretation, application and approval by a qualified engineer who must assume full responsibility for verifying that said output is appropriate and correct. There are no express or implied warranties. The use of this product does not constitute endorsement by ACPA or any other agents.

PIPE DEPTH (ft.)	-----EARTH LOAD-----			LIVE LOAD (lb/ft)	SURCH LOAD (lb/ft)	TOTAL LOAD (lb/ft)	BED FACT	REQUIRED D-LOAD	
	ARCHING	>TRANS	LOAD (lb/ft)					0.01 in. ULT. (lb/ft/ft)	
0.5	1.02	Y	345.	2584.	0.	2929.	1.90	385.	578.
1.0	1.04	Y	704.	2331.	0.	3035.	1.90	399.	599.
1.5	1.06	Y	1078.	2623.	0.	3701.	1.90	487.	731.
2.0	1.08	Y	1467.	2475.	0.	3942.	1.90	519.	778.
2.5	1.11	Y	1872.	1994.	0.	3866.	1.90	509.	763.
3.0	1.13	Y	2293.	1474.	0.	3766.	1.90	496.	743.
3.5	1.15	Y	2731.	1226.	0.	3957.	1.90	521.	781.
4.0	1.18	Y	3187.	1039.	0.	4226.	1.90	556.	834.
4.5	1.20	Y	3662.	893.	0.	4555.	1.90	599.	899.
5.0	1.23	Y	4156.	778.	0.	4933.	1.90	649.	974.
5.5	1.25	Y	4670.	684.	0.	5353.	1.90	704.	1057.
6.0	1.28	Y	5204.	606.	0.	5811.	1.90	765.	1147.
6.5	1.31	Y	5761.	542.	0.	6303.	1.90	829.	1244.
7.0	1.34	Y	6340.	487.	0.	6827.	1.90	898.	1348.
7.5	1.37	Y	6943.	441.	0.	7384.	1.90	972.	1457.
8.0	1.40	Y	7570.	401.	0.	7971.	1.90	1049.	1573.
8.5	1.43	Y	8222.	366.	0.	8589.	1.90	1130.	1695.
9.0	1.46	Y	8884.	336.	0.	9220.	1.90	1213.	1820.
9.5	1.46	Y	9394.	309.	0.	9703.	1.90	1277.	1915.
10.0	1.47	Y	9917.	286.	0.	10203.	1.90	1343.	2014.
10.5	1.47	Y	10429.	265.	0.	10694.	1.90	1407.	2111.
11.0	1.47	Y	10940.	246.	0.	11187.	1.90	1472.	2208.
11.5	1.47	Y	11452.	230.	0.	11681.	1.90	1537.	2306.
12.0	1.47	N	11954.	215.	0.	12169.	1.90	1601.	2402.
12.5	1.46	N	12345.	201.	0.	12546.	1.90	1651.	2476.
13.0	1.45	N	12729.	189.	0.	12918.	1.90	1700.	2550.

13.5	1.43	N	13106.	177.	0.	13283.	1.90	1748.	2622.
14.0	1.42	N	13475.	167.	0.	13643.	1.90	1795.	2693.
14.5	1.41	N	13838.	158.	0.	13996.	1.90	1842.	2762.
15.0	1.40	N	14195.	149.	0.	14344.	1.90	1887.	2831.
15.5	1.39	N	14544.	141.	0.	14685.	1.90	1932.	2898.
16.0	1.38	N	14887.	134.	0.	15021.	1.90	1976.	2965.
16.5	1.36	N	15224.	127.	0.	15351.	1.90	2020.	3020.
17.0	1.35	N	15555.	121.	0.	15676.	1.90	2063.	3062.
17.5	1.34	N	15879.	115.	0.	15994.	1.90	2105.	3102.
18.0	1.33	N	16197.	110.	0.	16307.	1.90	2146.	3140.
18.5	1.32	N	16510.	105.	0.	16615.	1.90	2186.	3177.
19.0	1.31	N	16817.	100.	0.	16917.	1.90	2226.	3213.
19.5	1.30	N	17118.	96.	0.	17213.	1.90	2265.	3247.
20.0	1.29	N	17413.	92.	0.	17505.	1.90	2303.	3280.

PROGRAM SAMM

D-LOAD REQUIREMENTS FOR A 54 IN. DIAMETER CIRCULAR PIPE

P I P E D A T A

DIAMETER (in.)	54.00
WALL B, THICKNESS (in.)	5.500

I N S T A L L A T I O N C O N D I T I O N S

MINIMUM DEPTH OF FILL (ft.)	2.00
MAXIMUM DEPTH OF FILL (ft.)	40.00
SOIL DENSITY (lb/cu. ft.)	140.0
SPECIFIED BEDDING FACTOR	1.90
INSTALLATION TYPE	TRENCH
TRENCH WIDTH (ft.)	8.40
SOIL LATERAL PRESSURE/FRICTION TERM (KMU')	0.1650
PARAMETERS TO COMPUTE TRANSITION WIDTH	
POSITIVE PROJECTION RATIO	1.00
POSITIVE SETTLEMENT RATIO	0.50
SOIL LATERAL PRESSURE/FRICTION TERM (KMU)	0.1924
SOIL LATERAL PRESSURE COEFFICIENT	0.33

A D D I T I O N A L L O A D S

LIVE LOAD	AASHTO HS-20
NO SURCHARGE LOAD	

F A C T O R S O F S A F E T Y

FACTOR OF SAFETY ON 0.01 INCH CRACK D-LOAD (EARTH, LIVE)	1.00; 1.00
FACTOR OF SAFETY ON ULTIMATE LOAD (EARTH, LIVE) IN ACCORDANCE WITH ASTM C 76	
DL.01 LESS THAN 2000 LBS/FT/FT	1.5
DL.01 GREATER THAN 3000 LBS/FT/FT	1.25
DL.01 BETWEEN 2000 AND 3000 LBS/FT/FT	INTERPOLATED

RESULTS OF ANALYSIS

```

SSSSSSSSS  AAAAAAAAAA  MMM  MMM  MMM  MMM
SS          AA      AA   MM M M MM  MM M M MM
SSSSSSSSS  AAAAAAAAAA  MM  M  MM  MM  M  MM
          SS  AA      AA   MM      MM  MM      MM
SSSSSSSSS  AA      AA   MM      MM  MM      MM

```

PROGRAM SAMM

AMERICAN CONCRETE PIPE ASSOCIATION
VERSION 2.0 - 1 SEPTEMBER 1990

Program SAMM computes earth loads on concrete pipe in accordance with the methods presented in the Concrete Pipe Design Manual (March 1990) and the Concrete Pipe Handbook (January 1988), published by the American Concrete Pipe Association. The user must select input values suitable to his specific installation. The information presented in the computer output is for review, interpretation, application and approval by a qualified engineer who must assume full responsibility for verifying that said output is appropriate and correct. There are no express or implied warranties. The use of this product does not constitute endorsement by ACPA or any other agents.

PIPE DEPTH (ft.)	-----EARTH LOAD-----			LIVE	SURCH	TOTAL	BED	REQUIRED D-LOAD	
	ARCHING	>TRANS	LOAD	LOAD	LOAD	LOAD	FACT	0.01 in. ULT.	
	FACTOR		(lb/ft)	(lb/ft)	(lb/ft)	(lb/ft)		(lb/ft/ft)	
2.0	1.07	Y	1630.	2359.	0.	3989.	1.90	466.	700.
3.0	1.11	Y	2536.	1581.	0.	4117.	1.90	482.	722.
4.0	1.16	Y	3508.	1119.	0.	4627.	1.90	541.	812.
5.0	1.20	Y	4552.	840.	0.	5393.	1.90	631.	946.
6.0	1.25	Y	5673.	657.	0.	6331.	1.90	740.	1111.
7.0	1.30	Y	6877.	529.	0.	7407.	1.90	866.	1299.
8.0	1.33	N	8073.	436.	0.	8509.	1.90	995.	1493.
9.0	1.31	N	8915.	366.	0.	9282.	1.90	1086.	1628.
10.0	1.28	N	9725.	312.	0.	10037.	1.90	1174.	1761.
11.0	1.26	N	10504.	270.	0.	10773.	1.90	1260.	1890.
12.0	1.24	N	11252.	235.	0.	11487.	1.90	1344.	2015.
13.0	1.21	N	11972.	207.	0.	12179.	1.90	1424.	2137.
14.0	1.19	N	12664.	184.	0.	12847.	1.90	1503.	2254.
15.0	1.17	N	13329.	164.	0.	13493.	1.90	1578.	2367.
16.0	1.15	N	13969.	147.	0.	14116.	1.90	1651.	2477.
17.0	1.13	N	14584.	133.	0.	14717.	1.90	1721.	2582.
18.0	1.11	N	15175.	121.	0.	15296.	1.90	1789.	2684.
19.0	1.09	N	15744.	110.	0.	15854.	1.90	1854.	2781.
20.0	1.07	N	16291.	101.	0.	16392.	1.90	1917.	2876.
21.0	1.06	N	16816.	93.	0.	16909.	1.90	1978.	2967.
22.0	1.04	N	17322.	86.	0.	17407.	1.90	2036.	3036.
23.0	1.02	N	17807.	80.	0.	17887.	1.90	2092.	3090.
24.0	1.00	N	18275.	74.	0.	18349.	1.90	2146.	3141.
25.0	0.99	N	18724.	69.	0.	18793.	1.90	2198.	3188.
26.0	0.97	N	19156.	64.	0.	19220.	1.90	2248.	3233.
27.0	0.96	N	19571.	60.	0.	19631.	1.90	2296.	3274.
28.0	0.94	N	19970.	56.	0.	20027.	1.90	2342.	3313.
29.0	0.93	N	20354.	53.	0.	20407.	1.90	2387.	3349.
30.0	0.91	N	20723.	50.	0.	20773.	1.90	2430.	3383.

34.0	0.86	N	22063.	40.	0.	22102.	1.90	2585.	3499.
35.0	0.84	N	22366.	38.	0.	22404.	1.90	2620.	3524.
36.0	0.83	N	22657.	36.	0.	22693.	1.90	2654.	3547.
37.0	0.82	N	22938.	34.	0.	22972.	1.90	2687.	3569.
38.0	0.81	N	23207.	32.	0.	23240.	1.90	2718.	3589.
39.0	0.79	N	23467.	31.	0.	23497.	1.90	2748.	3608.
40.0	0.78	N	23716.	30.	0.	23745.	1.90	2777.	3626.

APPENDIX C

Reference Materials

LIMITED GEOTECHNICAL EVALUATION
US WATERS – WASH COS-3 AND COS-4
SUMMERLIN VILLAGE 24
LAS VEGAS, NEVADA

PROJECT NO.: E-15-021
APRIL 22, 2015

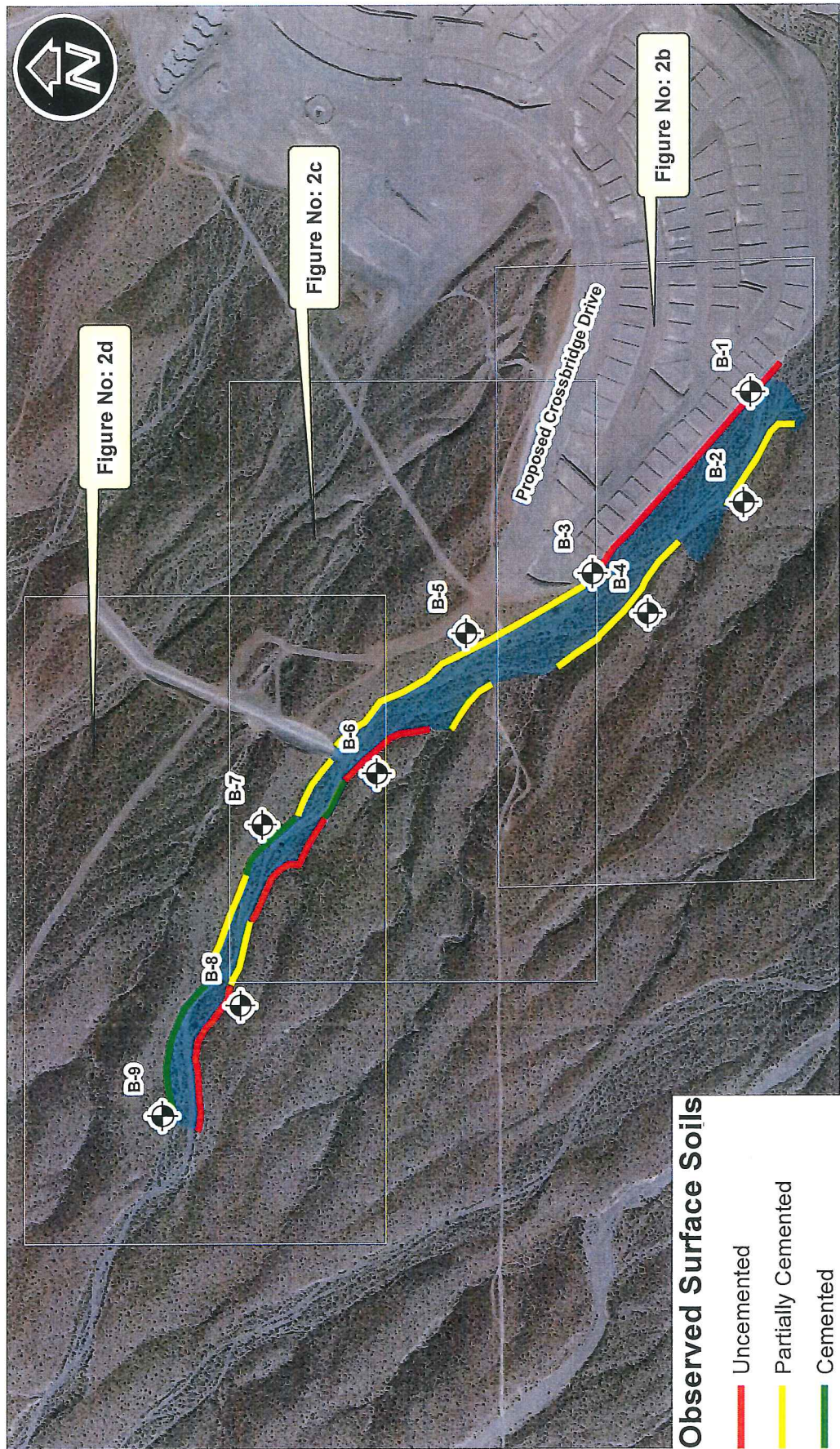
Prepared for:



Prepared by:



NOVA GEOTECHNICAL & INSPECTION SERVICES
4480 WEST HACIENDA AVENUE
SUITE 104
LAS VEGAS, NEVADA 89118
Phone: (702) 873-3478
Fax: (702) 873-2199



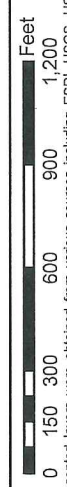
Observed Surface Soils

- Uncemented
- Partially Cemented
- Cemented

Legend

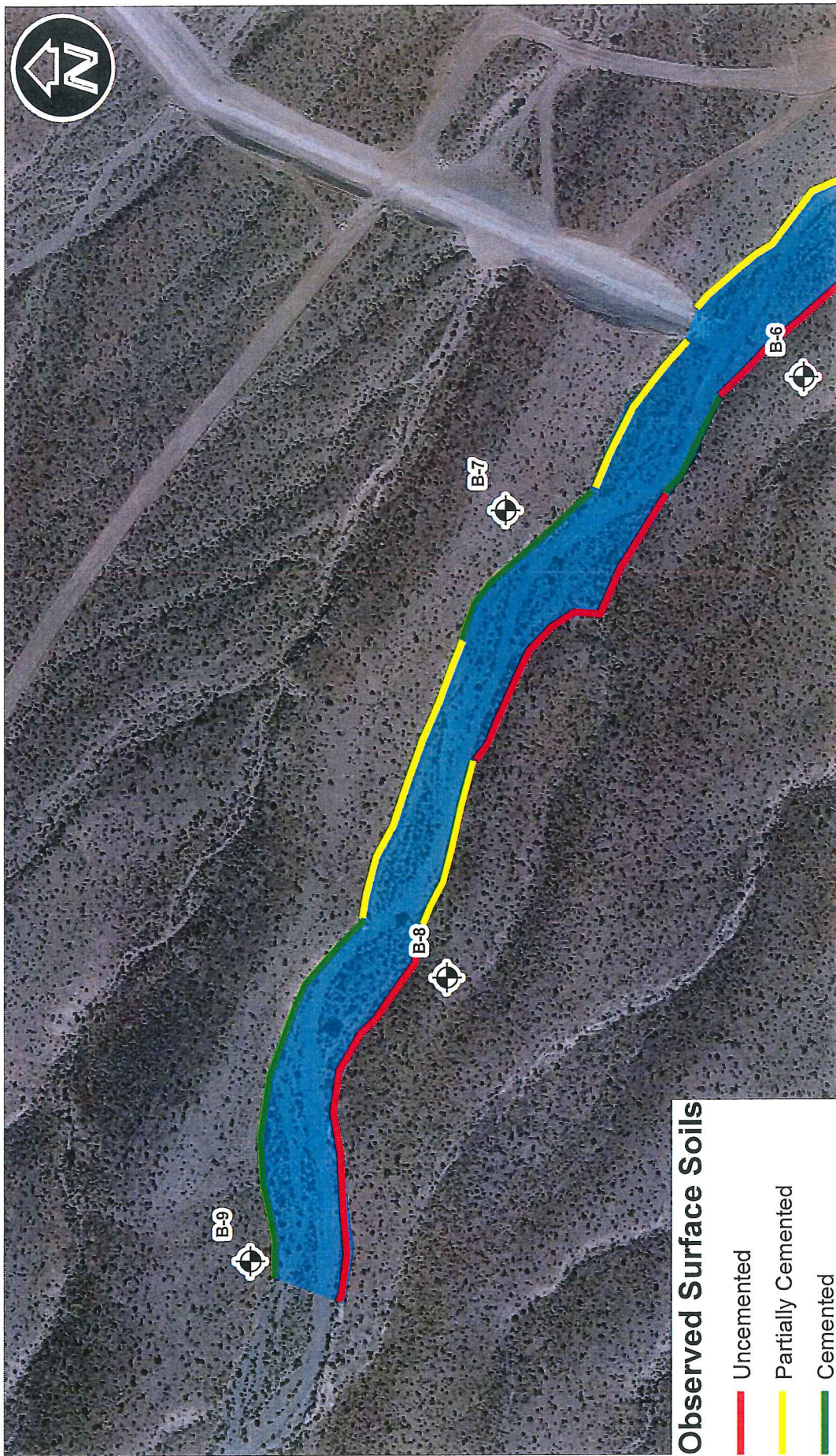
B-9 Approximate Boring Location

Approximate Area of Inundation (by others)



The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD, GIZMO, CFCDD, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT:	ALIGNMENT OVERVIEW MAP	
	CLIENT:	PROJECT NO: E-15-021	FIGURE NO: 2a
LIMITED GEOTECHNICAL EVALUATION Summerlin Village 24 US Waters - Wash COS-3 and COS-4 Las Vegas, Nevada The Howard Hughes Corporation			



Observed Surface Soils

- Uncemented
- Partially Cemented
- Cemented

Legend

B-9 Approximate Boring Location

Approximate Area of Inundation (by others)



The presented layers were obtained from various sources including ESRI, USGS, USDA, CCBD, GIZMO, CCFCO, GIS User Community among others. The GIS information is presented for reference only. No warranties, either expressed or implied, are intended or made. If you have any questions regarding this information, please contact NOVA.

NOVA Geotechnical & Inspection Services	PROJECT: Limited Geotechnical Evaluation Summerlin Village 24 US Waters - Wash COS-3 and COS-4 Las Vegas, Nevada CLIENT: The Howard Hughes Corporation	ALIGNMENT MAP PROJECT NO: E-15-021 FIGURE NO: 2d
--	--	---

BORING LOG B-7

CLIENT: THE HOWARD HUGHES CORPORATION		PROJECT: V24 US WATERS COS-3 & COS-4 EVALUATION	
BORING LOCATION: SEE SITE MAP		ELEVATION (ft): NA	SITE: NWC CHARLESTON BOULEVARD & SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Silty SAND with some caliche gravel, debris, brown, slightly moist	Loose
		SPT		50/2"	1	GM		Silty GRAVEL with sand, cobbles, brown, slightly moist	V.Dense
		B			2			CALICHE (Cemented sand & gravel), light brown, dry	Hard
					3				M.Hard-Hard
		SPT		50/2"	5				Hard
					6				M.Hard
					7	GM		Silty GRAVEL with sand, cobbles, partially cemented, light brown, dry	V.Dense-M.Hard
					8			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
					9				Hard
		SPT		50/1"	10				V.Hard
		B			12				Hard
		SPT		50/2"	15				

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION
BN = BULL NOSE C = CORE

**NOVA
GEOTECHNICAL
AND INSPECTION
SERVICES**

NOTES:
Groundwater not encountered within the depths drilled

DATE DRILLED:	PAGE NO:
3/17/15	1 of 2
PROJECT NO.:	PLATE NO.:
E-15-021	7

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-7

CLIENT:

THE HOWARD HUGHES CORPORATION

PROJECT:

V24 US WATERS COS-3 & COS-4 EVALUATION

BORING LOCATION:

SEE SITE MAP

ELEVATION (ft):

NA

SITE:

NWC CHARLESTON BOULEVARD & SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
		B			16			CALICHE (Cemented sand & gravel), lightbrown, dry	M.Hard-hard
					17				
					18				M.Hard
		SPT		50/5"	19	GM		Silty GRAVEL with sand, cobbles, brown, partially cemented, dry	V.Dense- M.Hard
					20				
					21				
					22				V.Dense
					23				
		SPT		50/5"	24				
					25				
								Bottom of Boring at 25.5 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION
BN = BULL NOSE C = CORE

**NOVA
GEOTECHNICAL
AND INSPECTION
SERVICES**

NOTES:

Groundwater not encountered within the depths drilled

DATE DRILLED:

3/17/15

PROJECT NO.:

E-15-021

PAGE NO:

2 of 2

PLATE NO.:

7

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-8

CLIENT:	PROJECT:
THE HOWARD HUGHES CORPORATION	V24 US WATERS COS-3 & COS-4 EVALUATION
BORING LOCATION:	ELEVATION (ft):
SEE SITE MAP	NA
	SITE:
	NWC CHARLESTON BOULEVARD & SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Silty SAND with gravel, cobbles, brown, slightly moist	Loose
					1	GM		Silty GRAVEL with sand, occasional cobbles, light brown, slightly moist	Dense
		SPT		87	2				V.Dense
					3			-partially cemented, dry	V.Dense- M.Hard
		SPT		50/5"	4				
					5				
		B			6			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
					7				
					8	GM		Silty GRAVEL with sand, occasional cobbles, light brown, slightly moist	V.Dense
					9				
					10	SM		Gravelly SAND with silt, light brown, slightly moist	
		SPT		87	11				
					12				
					13	GM		Silty GRAVEL with sand, occasional cobbles, light brown, slightly moist	
					14				
					15				

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION
BN = BULL NOSE C = CORE

NOVA GEOTECHNICAL AND INSPECTION SERVICES	NOTES: Groundwater not encountered within the depths drilled	DATE DRILLED:	PAGE NO:
		3/18/15	1 of 2
		PROJECT NO.:	PLATE NO.:
		E-15-021	8

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-8

CLIENT: THE HOWARD HUGHES CORPORATION	PROJECT: V24 US WATERS COS-3 & COS-4 EVALUATION
BORING LOCATION: SEE SITE MAP	ELEVATION (ft): NA
SITE: NWC CHARLESTON BOULEVARD & SKY VISTA DRIVE	

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
		SPT	88	88	16	SM	[Pattern]	Gravelly SAND with silt, light brown, slightly moist	V.Dense
		B	B		17		[Pattern]		
			B		18		[Pattern]		
			B		19		[Pattern]		
		SPT	98	98	20		[Pattern]		
			98		21		[Pattern]		
Bottom of Boring at 21.5 feet									

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.	* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION BN = BULL NOSE C = CORE
--	---

NOVA GEOTECHNICAL AND INSPECTION SERVICES	NOTES: Groundwater not encountered within the depths drilled	DATE DRILLED:	PAGE NO:
		3/18/15	2 of 2
		PROJECT NO.:	PLATE NO.:
		E-15-021	8

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.

BORING LOG B-9

CLIENT:

THE HOWARD HUGHES CORPORATION

PROJECT:

V24 US WATERS COS-3 & COS-4 EVALUATION

BORING LOCATION:

SEE SITE MAP

ELEVATION (ft):

NA

SITE:

NWC CHARLESTON BOULEVARD & SKY VISTA DRIVE

MOISTURE CONTENT %	DRY DENSITY PCF	SAMPLE TYPE*	SAMPLE	BLOWS/FT	DEPTH, FT	USCS SYMBOL	GRAPHIC	SOIL DESCRIPTION	CONSISTENCY
					0	SM		Gravelly SAND with silt, occasional cobbles, brown, slightly moist	Loose
					1				M.Dense
					2	GM		Silty GRAVEL with sand, cobbles, light brown, slightly moist	V.Dense
		SPT		91	3				
		B			4			-partially cemented, dry	V.Dense- M.Hard
					5				
					6	SM		Gravelly SAND with silt, light brown, slightly moist	Dense
					7				
		SPT		46	8	GM		Silty GRAVEL with sand, cobbles, light brown, slightly moist	V.Dense
					9			CALICHE (Cemented sand & gravel), light brown, dry	M.Hard
					10				
					11				
		SPT		50/3"	12				M.Hard- Hard
					13				
					14				
					15			Bottom of Boring at 15 feet	

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

* SAMPLE TYPE: R = RING B = BAG SPT = STANDARD PENETRATION
BN = BULL NOSE C = CORE

**NOVA
GEOTECHNICAL
AND INSPECTION
SERVICES**

NOTES:

Groundwater not encountered within the depths drilled

DATE DRILLED:

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E-15-021

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THIS SUMMARY APPLIES ONLY AT THIS LOCATION AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER WITH TIME AND AT OTHER LOCATIONS.



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Las Vegas, NV 89118
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F (702) 873-2199

SUMMARY OF TEST RESULTS

Boring & Depth	B-1 @ 2-7 ft.	B-4 @ 20-25 ft.	B-5 @ 4-9 ft.	B-7 @ 15-20 ft.	B-8 @ 15-20 ft.	B-9 @ 2-7 ft.
Sieve	% PASSING					
2in.	100	100	100	100	100.0	100
1 1/2in.	100	100	100	100	100.0	96
1in.	97	99	100	100	100.0	95
3/4in.	96	96	91	97	98.9	93
1/2in.	87	90	83	92	91.9	84
3/8in.	80	83	76	88	84.1	78
#4	60	65	58	71	56.5	64
#8	44	47	42	53	33.6	47
#10	42	43	39	50	30.2	43
#16	35	33	33	40	22.4	35
#30	29	25	27	32	17.3	27
#40	27	22	26	30	15.8	25
#50	25	20	24	28	14.7	23
#100	21	15	20	22	12.0	18
#200	15	11	14	16	8.6	12
LL*	NV	NV	NV	NV	NV	NV
PI**	NP	NP	NP	NP	NP	NP
USCS	SM	SP-SM	SM	SM	SP-SM	SM
OMC %	6.0	4.5		5.5		
MDD pcf	142.5	148.8		146.5		
ϕ °	32	35		47		
C, psf	1696	930		135		
SO ₄ %***	0.011	0.005		0.004	0.003	
Na ₂ SO ₄ %***	0.016	0.007		0.006	0.004	
Solubility***	0.068	0.030		0.046	0.032	

* NV = No Value (soil did not exhibit a liquid limit)

** NP = Non-Plastic

*** Performed by others

OMC = Optimum Moisture Content

MDD = Maximum Dry Density

ϕ = Friction Angle

C = Cohesion



West Wash Containment 5



West Wash Containment 6

NOVA Geotechnical & Inspection Services	PROJECT: Limited Geotechnical Evaluation Summerlin Village 24 US Waters – Wash COS-3 and COS-4 Las Vegas, Nevada	PHOTOGRAPHS	
	CLIENT: The Howard Hughes Corporation	PROJECT NO: E-15-021	PLATE NO: B7



West Wash Containment 7



West Wash Containment 8 (Southern end)

NOVA Geotechnical & Inspection Services	PROJECT: Limited Geotechnical Evaluation Summerlin Village 24 US Waters – Wash COS-3 and COS-4 Las Vegas, Nevada	PHOTOGRAPHS	
	CLIENT: The Howard Hughes Corporation	PROJECT NO: E-15-021	PLATE NO: B8

**UPDATE #2 TO THE
CONCEPTUAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24**

62024-320

September 2014

Prepared for:

**The Howard Hughes Company, LLC
10801 W. Charleston Blvd., 3rd Floor
Las Vegas, Nevada 89135
Phone: (702) 791-4300
Fax: (702) 791-4450**



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		June 24, 2014
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
	Summerlin Village 24 - Conceptual - Update	G.C. Wallace
Cross Streets:	NWC of Charleston Boulevard at Red Rock Detention Basin	Howard Hughes Corp.
File Number:	F:\Depot\DSMEMOS\DS3505E.doc	Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-010	CCRFC
Zoning Action:		CCPW
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES X NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Trn. No.
1 st Submittal	2/13/2004	2/27/2004	Not Approved	\$400.00	119424: \$400
2 nd Submittal	3/19/2004	4/2/2004	Conditional Approval	\$400.00	121560: \$400
CCRFC	5/18/2004	6/1/2004	Concurrence	N/C	N/C
CCPW	5/27/2004	6/10/2004	Concurrence	N/C	N/C
3 rd Submittal	6/11/2014	6/24/2014	See Comments Below	\$100.00	359768: \$100
TOTAL FEES (LDDRS):				\$900.00	

REMARKS:

3rd Submittal: Update to re-vitalize the conceptual drainage study for Summerlin Village 24

The Drainage Study for the subject project has been reviewed and:

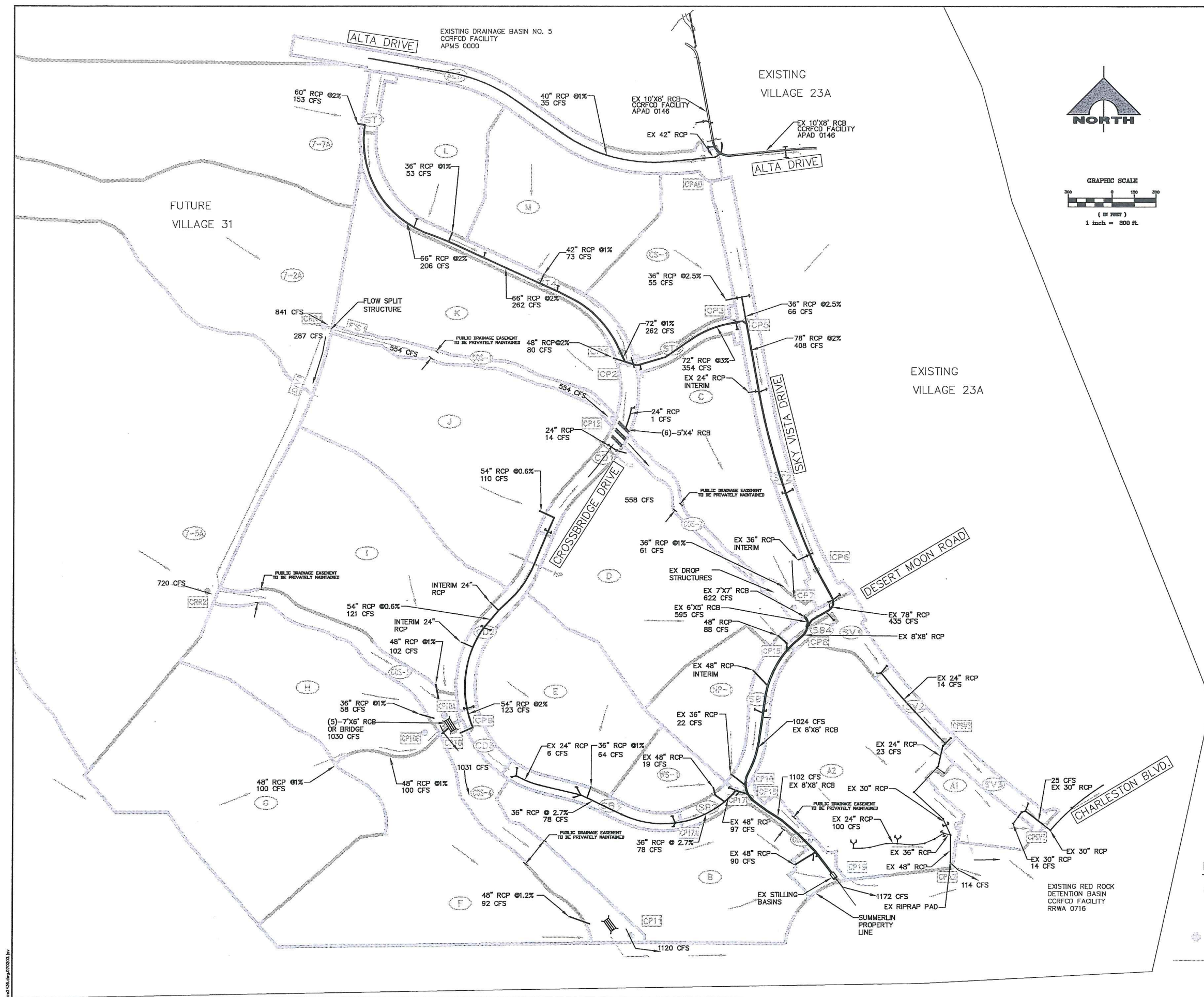
X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	must have Clark County Department of Development Services concurrence

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

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Amendment and accepted by the City of Las Vegas Flood Control Section. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the City of Las Vegas reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

END OF REMARKS
B&H/ays

T/R/S: T20S/R59E/22
AREA K-22



[\[PDF\] https://doi.org/10.2196/jmir.2014.24122](#)

THE HOWARD HUGHES COMPANY, LLC	SUMMERLIN VILLAGE 24	FIGURE 8U2 PROPOSED FACILITIES DRAINAGE MAP	 G. C. WALLACE COMPANIES ENGINEERS PLANNERS SURVEYORS 1535 S. RAINBOW BLVD - LAS VEGAS, NV 89146 T: 702.844.2000 - F: 702.844.2299 - GCWALLACE.COM	PROJECT NO. 62024-320	DESIGN: RRD, DBC	DRAWN:	CHECK:	PLOT DATE: 09-28-14	PLOT TIME: 1:41:27	DATE	REV	DESCRIPTION	DATE	AGEN APP	GCW APP	DATE:

HTE: 00-00000

**UPDATE TO THE
TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24
PARCEL COS-4**

62024-234

August 2016

Prepared by:

**GCW, Inc.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299**

GCV
ENGINEERS & SURVEYORS

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		September 12, 2016
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	
	Summerlin Village 24 – Parcel COS-4 - Update	
Cross Streets:	West of Sky Vista Drive & Charleston Blvd.	
File Number:	F:\Depot\DSMemos\DS4775C.doc	
Parcel Number:	137-33-801-002	
Zoning Action:	FMP-62680	
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X
COPIES TO:		
		GCW Engineers / Surveyors
		Howard Hughes Company, LLC
		Bart Anderson, P.E., DevCo

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	12/31/2015	1/25/2016	Not Approved	\$400.00	428201: \$400
2 nd Submittal	3/10/2016	4/7/2016	Approved	\$400.00	436539: \$400
3 rd Submittal	8/24/2016	9/12/2016	See Comments Below	\$100.00	456091: \$100
TOTAL FEES (LDDRS):				\$900.00	----

REMARKS:**3rd Submittal: Update #1 to revise channel side slopes from 2:1 to 3:1 or 4:1**

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

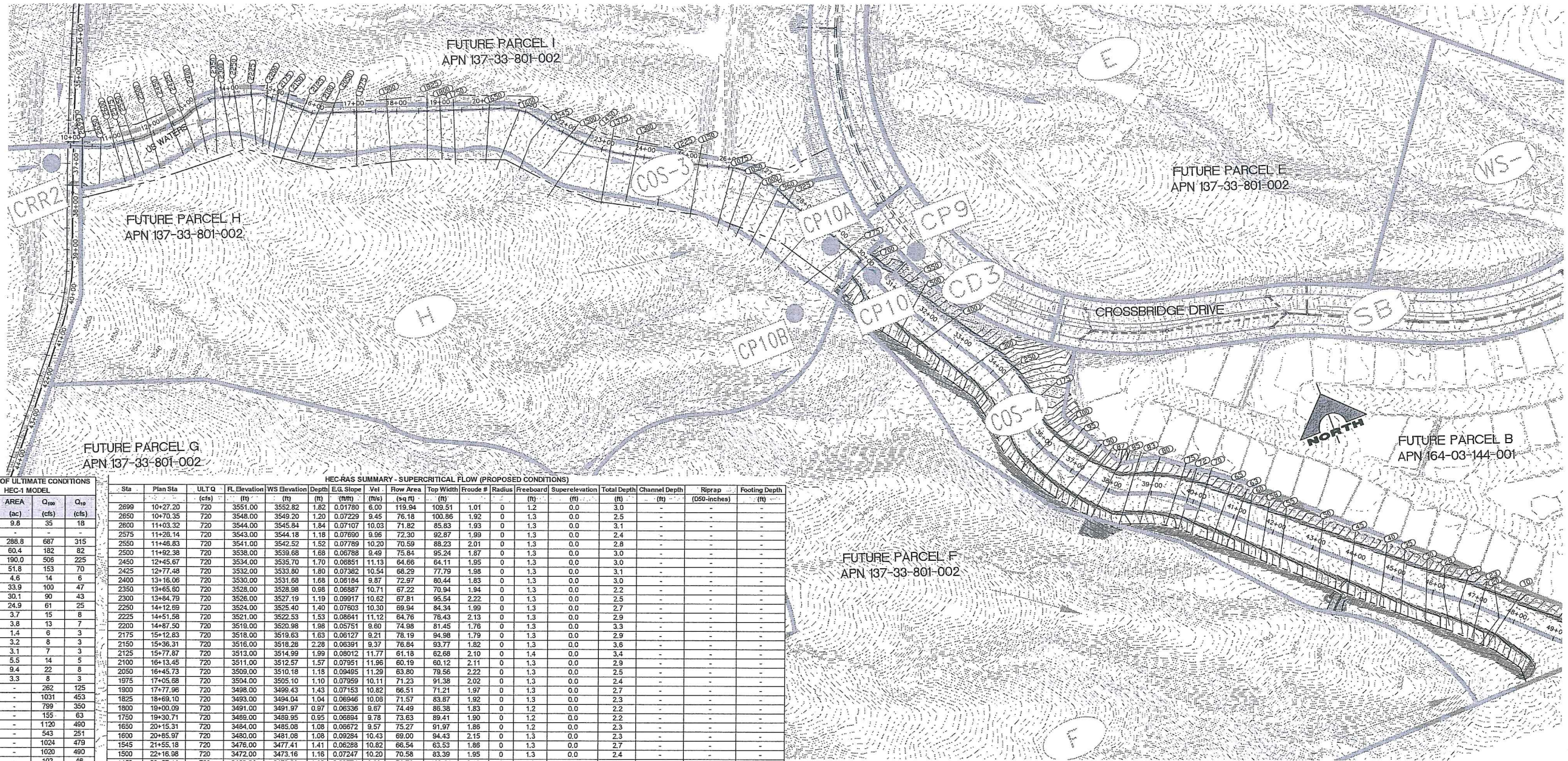
- The subject "COS-4" wash is a common lot and public drainage easement to be privately maintained by the developer and future *Homeowners Association*. Record as such in the final map.

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Update and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

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

END OF REMARKS
ays

T/R/S: T20S/R59E/33
AREA K-33



SUMMARY OF ULTIMATE CONDITIONS

HEC-1 MODEL

SC OR CP	AREA (ac)	C ₁₀₀ (cfs)	C ₁₀ (cfs)
ALTA	9.6	35	18
7-2A	288.8	687	315
7-2B	60.4	182	82
7-5A	180.0	505	225
7-7A	51.8	153	70
A1	4.6	14	6
A2	33.9	100	47
B	30.1	90	43
C	24.9	61	25
CD1	3.7	15	8
CD2	3.8	13	7
CD3	1.4	6	3
COS-1	3.2	8	3
COS-2	3.1	7	3
COS-3	5.5	14	5
COS-4	9.4	22	8
COS-5	3.3	8	3
CP1	-	262	125
CP10	-	1031	453
CP10A	-	799	350
CP10B	-	155	63
CP11	-	1120	490
CP12	-	543	251
CP15	-	1034	479
CP16	-	1020	460
CP17	-	102	46
CP17A	-	78	34
CP18	-	1102	525
CP19	-	1172	558
CP2	-	354	164
CP3	-	356	165
CP5	-	408	192
CP6	-	435	204
CP7	-	595	274
CP8	-	549	246
CP9	-	123	52
CPA2	-	114	54
CPAD	-	40	21
CPSV2	-	23	12
CPSV3	-	25	12
CRR1	-	841	386
CRR2	-	720	313
CS-1	16.8	55	27
D	34.8	88	37
DIV1	-	287	132
E	24.1	64	27
F	37.8	92	36
FS1	-	554	255
G	42.6	100	39
H	22.1	58	24
I	38.6	102	43
J	43.6	110	46
K	29.6	80	34
L	15.3	53	26
M	22.0	73	36
NP-1	10.5	22	8
RETID1	-	287	132
SB1	3.5	14	7
SB2	1.3	5	3
SB3	3.5	13	7
SB4	0.5	2	1
ST1	1.1	5	2
ST2	9.6	33	17
ST4	6.0	22	12
ST6	1.8	8	4
SV1	3.6	14	8
SV2	2.1	9	4
SV3	2.7	11	6
WS-1	5.9	19	9

HEC-RAS SUMMARY - SUPERCRITICAL FLOW (PROPOSED CONDITIONS)

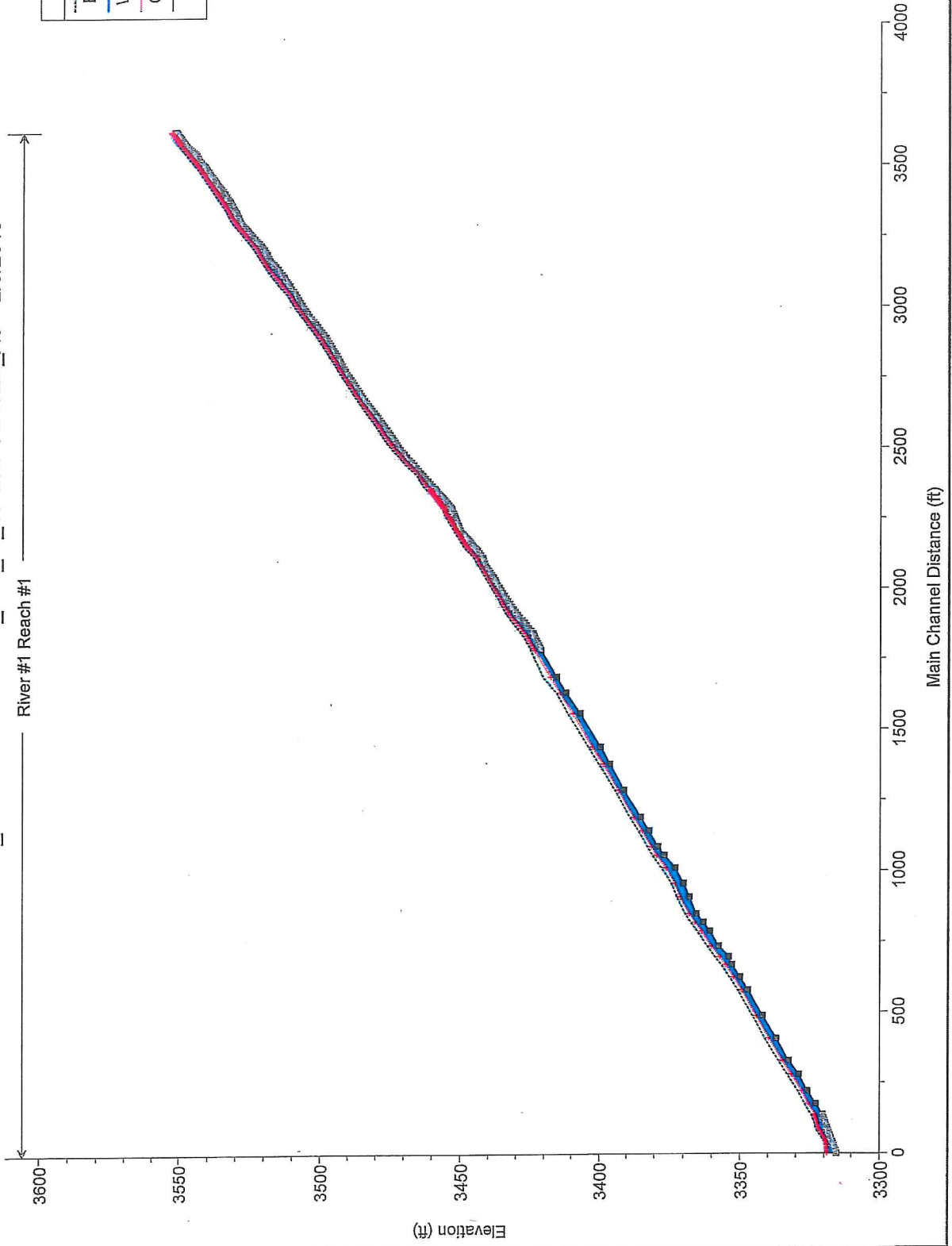
Sta	Plan Sta	ULTD	FL Elevation (cfs)	WS Elevation (ft)	Depth (ft)	E.G. Slope (ft/m)	Vel (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude #	Radius	Freeboard	Superelevation (ft)	Total Depth (ft)	Channel Depth (ft)	Riprap (ft)	Footing Depth (ft)
2699	10+27.20	720	3551.00	3552.82	1.82	0.01780	6.00	119.94	109.51	1.01	0	1.2	0.0	3.0	-	-	-
2650	10+70.35	720	3548.00	3549.20	1.20	0.07229	9.45	76.18	100.86	1.92	0	1.3	0.0	2.5	-	-	-
2600	11+03.32	720	3544.00	3545.84	1.84	0.07107	10.03	71.82	85.83	1.93	0	1.3	0.0	3.1	-	-	-
2575	11+26.14	720	3543.00	3544.18	1.18	0.07690	9.96	72.30	92.87	1.99	0	1.3	0.0	2.4	-	-	-
2550	11+46.83	720	3541.00	3542.52	1.52	0.07789	10.20	70.59	88.23	2.01	0	1.3	0.0	2.8	-	-	-
2500	11+92.38	720	3538.00	3539.68	1.68	0.06788	9.49	75.84	95.24	1.87	0	1.3	0.0	3.0	-	-	-
2450	12+45.67	720	3534.00	3535.70	1.70	0.06851	11.13	64.66	64.11	1.95	0	1.3	0.0	3.0	-	-	-
2425	12+77.48	720	3532.00	3533.80	1.80	0.07382	10.54	68.29	77.79	1.98	0	1.3	0.0	3.1	-	-	-
2400	13+16.09	720	3530.00	3531.68	1.68	0.06184	9.87	72.97	80.44	1.83	0	1.3	0.0	3.0	-	-	-
2350	13+65.80	720	3528.00	3528.98	0.98	0.06887	10.71	67.22	70.94	1.84	0	1.3	0.0	2.2	-	-	-
2300	13+84.79	720	3526.00	3527.19	1.19	0.09917	10.62	67.81	95.54	2.22	0	1.3	0.0	2.5	-	-	-
2250	14+12.69	720	3524.00	3525.40	1.40	0.07603	10.30	69.94	84.34	1.99	0	1.3	0.0	2.7	-	-	-
2225	14+51.58	720	3522.53	3523.53	1.53	0.08641	11.12	64.76	76.43	2.13	0	1.3	0.0	2.9	-	-	-
2200	14+87.50	720	3518.00	3520.98	1.98	0.05751	9.80	74.98	81.45	1.76	0	1.3	0.0	3.3	-	-	-
2175	15+12.63	720	3518.00	3519.63	1.63	0.06127	9.21	78.19	94.98	1.79	0	1.3	0.0	2.9	-	-	-
2150	15+36.31	720	3516.00	3518.28	2.28	0.06391	9.37	76.84	93.77	1.82	0	1.3	0.0	3.6	-	-	-
2125	15+77.87	720	3513.00	3514.99	1.99	0.08012	11.77	61.18	62.68	2.10	0	1.4	0.0	3.4	-	-	-
2100	16+13.45	720	3511.00	3512.57	1.57	0.07951	11.96	60.19	60.12	2.11	0	1.3	0.0	2.9	-	-	-
2050	16+45.73	720	3509.00	3510.18	1.18	0.09495	11.29	63.80	79.36	2.22	0	1.3	0.0	2.5	-	-	-
1975	17+05.88	720	3504.00	3505.10	1.10	0.07959	10.11	71.23	91.38	2.02	0	1.3	0.0	2.4	-	-	-
1900	17+77.06	720	3498.00	3499.43	1.43	0.07153	10.82	66.51	71.21	1.97	0	1.3	0.0	2.7	-	-	-
1825	18+69.10	720	3493.00	3494.04	1.04	0.06946	10.06	71.57	83.87	1.92	0	1.3	0.0	2.3	-	-	-
1800	19+00.09	720	3491.00	3491.97	0.97	0.06336	9.67	74.49	88.38	1.83	0	1.2	0.0	2.2	-	-	-
1750	19+30.71	720	3489.00	3489.95	0.95	0.06894	9.78	73.83	89.41	1.90	0	1.2	0.0	2.2	-	-	-
1650	20+15.31	720	3484.00	3485.08	1.08	0.06672	9.57	75.27	91.97	1.86	0	1.2	0.0	2.3	-	-	-
1600	20+85.97	720	3480.00	3481.08	1.08	0.09284	10.43	69.00	94.43	2.15	0	1.3	0.0	2.3	-	-	-
1545	21+55.18	720	3476.00	3477.41	1.41	0.06288	10.82	66.54	63.53	1.86	0	1.3	0.0	2.7	-	-	-
1500	22+16.98	720	3472.00	3473.16	1.16	0.07247	10.20	70.58	83.39	1.95	0	1.3	0.0	2.4	-	-	-
1450	22+57.11	720	3469.00	3470.08	1.08	0.09774	9.63	74.76	120.81	2.16	0	1.2	0.0	2.3	-	-	-
1375	23+18.82	720	3464.00	3464.85	0.85	0.10041	9.95	72.34	113.47	2.20	0	1.2	0.0	1.9	-	-	-
1300	23+79.17	720	3459.00	3460.38	1.38	0.14232	10.60	67.95	125.87	2.54	0	1.3	0.0	2.7	-	-	-
1225	24+69.35	720	3453.00	3455.14	2.14	0.07647	9.08	79.32	116.12	1.94	0	1.3	0.0	3.4	-	-	-
1150	25+29.34	720	3450.00	3450.83	0.83	0.05257	8.35	86.22	108.32	1.65	0	1.2	0.0	2.0	-	-	-
1075	26+10.01	720	3444.00	3445.70	1.70	0.09472	10.60	67.95	92.07	2.17	0	1.3	0.0	3.0	-	-	-
1050	26+45.61	720	3442.00	3443.67	1.67	0.08044	9.46	76.09	108.82	1.99	0	1.3	0.0	3.0	-	-	-
1000	26+85.80	720	3441.00	3442.09	1.09	0.05654	8.82	81.62	99.76	1.72	0	1.2	0.0	2.3	-	-	-
960	27+27.71	720	3438.00	3439.74	1.74	0.05955	8.77	82.13	104.98	1.75	0	1.3	0.0	3.0	-	-	-
925	27+63.01	720	3436.00	3437.31	1.31	0.06483	9.33	77.15	95.87	1.83	0	1.3	0.0	2.6	-	-	-
850	28+47.94	799	3431.00	3432.83	1.83	0.04554	9.30	85.55	81.97	1.60	0	1.3	0.0	3.1	-	-	-
775	29+42.50	799	3424.00	3426.14	2.14	0.07972	11.29	70.76	77.14	2.08	0	1.4	0.0	3.5	-	-	-
700	30+14.92	799	3421.00	3422.63	1.63	0.07188	11.72	68.18	61.95	1.97	0	1.3	0.0	3.0	8.0	12 (LOB, ROB)	5.0
550	31+10.26	1031	3415.41	3416.57	1.16	0.17749	15.31	67.34	84.94	3.03	0	1.4	0.0	2.6	7.9	12 (LOB, ROB)	5.0
500	31+64.49	1031	3412.00	3413.63	1.63	0.04875	10.50	98.19	81.79	1.69	0	1.3	0.0	2.9	6.3	12 (LOB, ROB)	5.0
400	32+40.88	1031	3406.78	3408.68	1.88	0.06763	13.05	79.00	59.63	2.00	0	1.4	0.0	3.1	6.7	12 (LOB, ROB)	5.0
300	33+62.68	1031	3399.62	3401.75	2.13	0.05580	11.32	91.05	73.33	1.79	0	1.4	0.0	3.5	7.4	12 (LOB, ROB)	5.0
250	34+23.30	1031	3396.22	3397.86	1.64	0.06966	11.58	89.06	83.52	1.98	0	1.3	0.0	3.0	6.6	12 (LOB, ROB)	5.0
175	35+17.24	1031	3390.96	3392.49	1.53	0.05287	10.80	95.42	80.80	1.75	0	1.3	0.0	2.8	5.4	12 (LOB, ROB)	5.0
100	36+14.97	1031	3384.96	3386.83	1.87	0.06390	11.00	93.74	88.25	1.88	0	1.3	0.0	3.2	5.4	12 (LOB, ROB)	5.0
55	36+61.08	1031	3381.89	3383.76	1.83	0.06328	11.08	93.05	85.80	1.87	0	1.3	0.0	3.2	5.9	12 (LOB, ROB)	5.0
80	37+17.65	1031	3378.92	3380.53	1.61	0.05983	10.70	96.40	85.88	1.78	0	1.3	0.0	2.9	5.8	12 (LOB, ROB)	5.0
87	37+48.34	1031	3376.89	3378.73	1.84	0.06041	10.86	94.92	87.03	1.83	0	1.3	0.0	3.2	6.8	12 (LOB, ROB)	5.0
85	37+92.84	1031	3373.00	3375.53	2.53	0.07229	11.58	89.02	85.09	2.00	0	1.4	0.0	3.9	7.8	12 (LOB, ROB)	5.0
83	38+47.42	1031	3370.00	3372.59	2.59	0.05168	10.24	100.69	89.58	1.70	0	1.4	0.0	3.9	8.8	12 (LOB, ROB)	5.0
80	38+85.33	1031	3368.00	3370.81	2.81	0.03483	9.51	108.36	79.19	1.43	0	1.3	0.0	4.1	8.2	12 (LOB, ROB)	5.0
75	39+56.20	1031	3365.45	3367.41	1.96	0.06844	11.15	92.44	87.16	1.91	0	1.3	0.0	3.3	6.2	12 (LOB, ROB)	5.0
72	39+85.09	1031	3363.00	3365.27	2.27	0.07219	11.49	89.69	86.27	1.99	0	1.4	0.0	3.6	6.8	12 (LOB, ROB)	5.0
70	40+17.18	1031	3360.73	3362.89	2.16	0.07417	11.59	88.92	86.24	2.01	0	1.4	0.0	3.5	6.2	12 (LOB, ROB)	5.0
65	40+70.16	1031	3357.57	3359.69	2.12	0.05975	10.91	94.46	85.53	1.83	0	1.3	0.0	3.4	6.3	12 (LOB, ROB)	5.0
63	41+07.62	1031	3354.00	3356.45	2.45	0.09845	12.07	86.45	89.79	2.18	0	1.4	0.0	3.5	6.8	12 (LOB, ROB)	5.0
60	41+35.51	1031	3353.00	3354.59	1.59	0.06063	11.22	91.92	86.41	1.92	0	1.3	0.0	2.9	5.8	12 (LOB, ROB)	5.0
58	41+79.54	1031	3350.00	3351.73	1.73	0.06451	11.12	92.40	86.13	1.90	0	1.3	0.0	3.0	6.0	12 (LOB, ROB)	5.0
55	42+25.29	1031	3347.25	3348.89	1.64	0.06410	10.82	95.27	92.32	1.88	0	1.3	0.0	3.0	5.6	12 (LOB, ROB)	5.0
50	43+17.42	1031	3341.92	3343.85	1.93	0.05019	10.28	100.34	87.46	1.69	0	1.3	0.0	3.2	6.1	12 (LOB, ROB)	5.0
45	43+97.91	1120	3337.00	3339.06	2.06	0.06600	11.24	96.34	87.31	1.85	0	1.4	0.0	3.4	5.8	12 (LOB, ROB)	5.0
40	44+77.01	1120	3332.62	3334.11	1.49	0.06336	11.39	99.64	87.53	1.89	0	1.3	0.0	2.8	4.8	12 (LOB, ROB)	5.0
35	45+24.82	1120	3329.00	3330.90	1.90	0.06755	11.61	96.45	87.91	1.95	0	1.4	0.0	3.3	4.1	12 (LOB, ROB)	5.0
30	45+54.77	1120	3325.94	3327.82	1.88	0.06062	11.28	100.82	86.29	1.87	0	1.3	0.0	2.8	4.9	12 (LOB, ROB)	5.0
28	46+27.38	1120	3323.00	3324.04	2.04	0.04714	10.57	105.99	85.48	1.64	0	1.4	0.0	3.4	6.5	12 (LOB, ROB)	5.0
25	46+58.69	1120	3320.66	3322.57	1.91	0.06501	11.59	96.06	85.19	1.92	0	1.4	0.0	3.3	6.5	12 (LOB, ROB)	5.0
23	47+13.40	1120	3319.00	3321.67	2.67	0.02571	8.77	127.70	86.71	1.27	0	1.3	0.0	4.0	7.1	12 (LOB, ROB)	5.0
20	47+62.46	1120	3317.00	3318.72	1.72	0.04930	8.62	130.79	151.91	1.62	0	1.3	0.0	3.0	7.0	12 (LOB, ROB)	5.0
10	47+78.43	1120	3315.37	3318.63	3.26	0.015766	7.46	152.66	92.55	1.02	0	1.3	0.0	4.7	6.9	12 (LOB, ROB)	5.0

HEC-RAS Plan: COS-3-4 ULT_W_XS River: River #1 Reach: Reach #1 Profile: Profile 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach #1	2699	Profile 1	720.00	3551.00	3552.82	3552.82	3553.38	0.017799	6.00	119.94	109.51	1.01
Reach #1	2650	Profile 1	720.00	3548.00	3549.20	3549.61	3550.59	0.072287	9.45	76.18	100.86	1.92
Reach #1	2600	Profile 1	720.00	3544.00	3545.84	3546.30	3547.40	0.071074	10.03	71.82	85.83	1.93
Reach #1	2575	Profile 1	720.00	3543.00	3544.18	3544.63	3545.72	0.076902	9.96	72.30	92.87	1.99
Reach #1	2550	Profile 1	720.00	3541.00	3542.52	3543.00	3544.13	0.077894	10.20	70.59	88.23	2.01
Reach #1	2500	Profile 1	720.00	3538.00	3539.68	3540.11	3541.08	0.067884	9.49	75.84	95.24	1.87
Reach #1	2450	Profile 1	720.00	3534.00	3535.70	3536.32	3537.62	0.068506	11.13	64.66	64.11	1.95
Reach #1	2425	Profile 1	720.00	3532.00	3533.80	3534.30	3535.52	0.073815	10.54	68.29	77.79	1.98
Reach #1	2400	Profile 1	720.00	3530.00	3531.68	3532.14	3533.20	0.061837	9.87	72.97	80.44	1.83
Reach #1	2350	Profile 1	720.00	3528.00	3528.98	3529.50	3530.76	0.068865	10.71	67.22	70.94	1.94
Reach #1	2300	Profile 1	720.00	3526.00	3527.19	3527.69	3528.94	0.099165	10.62	67.81	95.54	2.22
Reach #1	2250	Profile 1	720.00	3524.00	3525.40	3525.90	3527.04	0.076026	10.30	69.94	84.34	1.99
Reach #1	2225	Profile 1	720.00	3521.00	3522.53	3523.15	3524.45	0.086411	11.12	64.76	76.43	2.13
Reach #1	2200	Profile 1	720.00	3519.00	3520.98	3521.40	3522.41	0.057514	9.60	74.98	81.45	1.76
Reach #1	2175	Profile 1	720.00	3518.00	3519.63	3520.01	3520.94	0.061270	9.21	78.19	94.98	1.79
Reach #1	2150	Profile 1	720.00	3516.00	3518.28	3518.68	3519.64	0.063912	9.37	76.84	93.77	1.82
Reach #1	2125	Profile 1	720.00	3513.00	3514.99	3515.62	3517.14	0.080117	11.77	61.18	62.68	2.10
Reach #1	2100	Profile 1	720.00	3511.00	3512.57	3513.26	3514.80	0.079511	11.96	60.19	60.12	2.11
Reach #1	2050	Profile 1	720.00	3509.00	3510.18	3510.75	3512.16	0.094947	11.29	63.80	79.56	2.22
Reach #1	1975	Profile 1	720.00	3504.00	3505.10	3505.56	3506.69	0.079593	10.11	71.23	91.38	2.02
Reach #1	1900	Profile 1	720.00	3498.00	3499.43	3499.99	3501.25	0.071531	10.82	66.51	71.21	1.97
Reach #1	1825	Profile 1	720.00	3493.00	3494.04	3494.51	3495.61	0.069458	10.06	71.57	83.87	1.92
Reach #1	1800	Profile 1	720.00	3491.00	3491.97	3492.40	3493.42	0.063356	9.67	74.49	86.38	1.83
Reach #1	1750	Profile 1	720.00	3489.00	3489.95	3490.40	3491.44	0.068938	9.78	73.63	89.41	1.90
Reach #1	1650	Profile 1	720.00	3484.00	3485.08	3485.50	3486.50	0.066724	9.57	75.27	91.97	1.86
Reach #1	1600	Profile 1	720.00	3480.00	3481.08	3481.57	3482.77	0.092844	10.43	69.00	94.43	2.15
Reach #1	1545	Profile 1	720.00	3476.00	3477.41	3478.09	3479.22	0.062879	10.82	66.54	63.53	1.86
Reach #1	1500	Profile 1	720.00	3472.00	3473.16	3473.65	3474.78	0.072471	10.20	70.58	83.39	1.95
Reach #1	1450	Profile 1	720.00	3469.00	3470.08	3470.49	3471.52	0.097735	9.63	74.76	120.81	2.16
Reach #1	1375	Profile 1	720.00	3464.00	3464.65	3465.09	3466.19	0.100405	9.95	72.34	113.47	2.20
Reach #1	1300	Profile 1	720.00	3459.00	3460.36	3460.81	3462.10	0.142321	10.60	67.95	125.87	2.54
Reach #1	1225	Profile 1	720.00	3453.00	3455.14	3455.51	3456.42	0.076467	9.08	79.32	116.12	1.94
Reach #1	1150	Profile 1	720.00	3450.00	3450.83	3451.15	3451.91	0.052570	8.35	86.22	108.32	1.65
Reach #1	1075	Profile 1	720.00	3444.00	3445.70	3446.23	3447.44	0.094723	10.60	67.95	92.07	2.17
Reach #1	1050	Profile 1	720.00	3442.00	3443.67	3444.07	3445.06	0.080435	9.46	76.09	108.82	1.99
Reach #1	1000	Profile 1	720.00	3441.00	3442.09	3442.45	3443.29	0.056540	8.82	81.62	99.78	1.72
Reach #1	950	Profile 1	720.00	3438.00	3439.74	3440.09	3440.93	0.059547	8.77	82.13	104.98	1.75
Reach #1	925	Profile 1	720.00	3436.00	3437.31	3437.73	3438.66	0.064827	9.33	77.15	95.87	1.83
Reach #1	850	Profile 1	799.00	3431.00	3432.83	3433.29	3434.17	0.045544	9.30	85.95	81.97	1.60
Reach #1	775	Profile 1	799.00	3424.00	3426.14	3426.71	3428.12	0.079717	11.29	70.76	77.14	2.08
Reach #1	700	Profile 1	799.00	3421.00	3422.63	3423.31	3424.76	0.017883	11.72	68.18	61.95	1.97
Reach #1	550	Profile 1	1031.00	3415.41	3416.57	3417.45	3420.20	0.177489	15.31	67.34	84.94	3.03
Reach #1	500	Profile 1	1031.00	3412.00	3413.63	3414.13	3415.34	0.048751	10.50	98.19	81.79	1.69
Reach #1	400	Profile 1	1031.00	3406.78	3408.46	3409.33	3411.10	0.067625	13.05	79.00	59.63	2.00
Reach #1	300	Profile 1	1031.00	3399.62	3401.75	3402.34	3403.74	0.055802	11.32	91.05	73.33	1.79
Reach #1	250	Profile 1	1031.00	3396.22	3397.66	3398.47	3399.94	0.069659	11.58	89.06	83.52	1.98
Reach #1	175	Profile 1	1031.00	3390.96	3392.49	3393.03	3394.31	0.052872	10.80	95.42	80.80	1.75
Reach #1	100	Profile 1	1031.00	3384.96	3386.83	3387.38	3388.71	0.063903	11.00	93.74	88.25	1.88
Reach #1	95	Profile 1	1031.00	3381.93	3383.76	3384.32	3385.67	0.063279	11.08	93.05	85.80	1.87
Reach #1	90	Profile 1	1031.00	3378.92	3380.53	3381.06	3382.31	0.055828	10.70	96.40	85.68	1.78
Reach #1	87	Profile 1	1031.00	3376.89	3378.73	3379.27	3380.56	0.060414	10.86	94.92	87.03	1.83
Reach #1	85	Profile 1	1031.00	3373.00	3375.53	3376.13	3377.61	0.072293	11.58	89.02	85.09	2.00
Reach #1	83	Profile 1	1031.00	3370.00	3372.59	3373.07	3374.22	0.051683	10.24	100.69	89.58	1.70
Reach #1	80	Profile 1	1031.00	3368.00	3370.81	3371.22	3372.21	0.034825	9.51	108.36	79.19	1.43
Reach #1	75	Profile 1	1031.00	3365.45	3367.41	3367.97	3369.34	0.066435	11.15	92.44	87.16	1.91
Reach #1	72	Profile 1	1031.00	3363.00	3365.27	3365.87	3367.32	0.072189	11.49	89.69	86.27	1.99
Reach #1	70	Profile 1	1031.00	3360.73	3362.89	3363.51	3364.98	0.074165	11.59	88.92	86.24	2.01
Reach #1	65	Profile 1	1031.00	3357.57	3359.59	3360.13	3361.44	0.059753	10.91	94.46	85.53	1.83
Reach #1	63	Profile 1	1031.00	3354.00	3356.45	3357.10	3358.71	0.089445	12.07	85.45	89.79	2.18
Reach #1	60	Profile 1	1031.00	3353.00	3354.59	3355.16	3356.54	0.066028	11.22	91.92	86.41	1.92
Reach #1	58	Profile 1	1031.00	3350.05	3351.73	3352.30	3353.66	0.064511	11.16	92.40	86.13	1.90
Reach #1	55	Profile 1	1031.00	3347.25	3348.89	3349.42	3350.71	0.064104	10.82	95.27	92.32	1.88
Reach #1	50	Profile 1	1031.00	3341.92	3343.85	3344.33	3345.49	0.050192	10.28	100.34	87.46	1.69
Reach #1	45	Profile 1	1120.00	3337.00	3339.06	3339.64	3341.03	0.060595	11.24	99.64	87.31	1.85
Reach #1	40	Profile 1	1120.00	3332.62	3334.11	3334.71	3336.12	0.063364	11.39	98.36	87.53	1.89
Reach #1	35	Profile 1	1120.00	3329.00	3330.90	3331.52	3332.99	0.067550	11.61	96.45	87.91	1.95
Reach #1	30	Profile 1	1120.00	3325.94	3327.22	3327.82	3329.21	0.060616	11.33	98.82	86.29	1.87
Reach #1	28	Profile 1	1120.00	3323.00	3325.04	3325.54	3326.77	0.047744	10.57	105.99	85.88	1.68
Reach #1	25	Profile 1	1120.00	3320.66	3322.57	3323.20	3324.66	0.065007	11.59	96.60	85.19	1.92
Reach #1	23	Profile 1	1120.00	3319.00	3321.67	3321.93	3322.86	0.025710	8.77	127.70	86.71	1.27
Reach #1	20	Profile 1	1120.00	3317.00	3318.72	3319.13	3319.87	0.049295	8.62	130.79	151.91	1.62
Reach #1	10	Profile 1	1120.00	3315.37	3318.83	3318.83	3319.67	0.015766	7.46	152.66	92.55	1.02

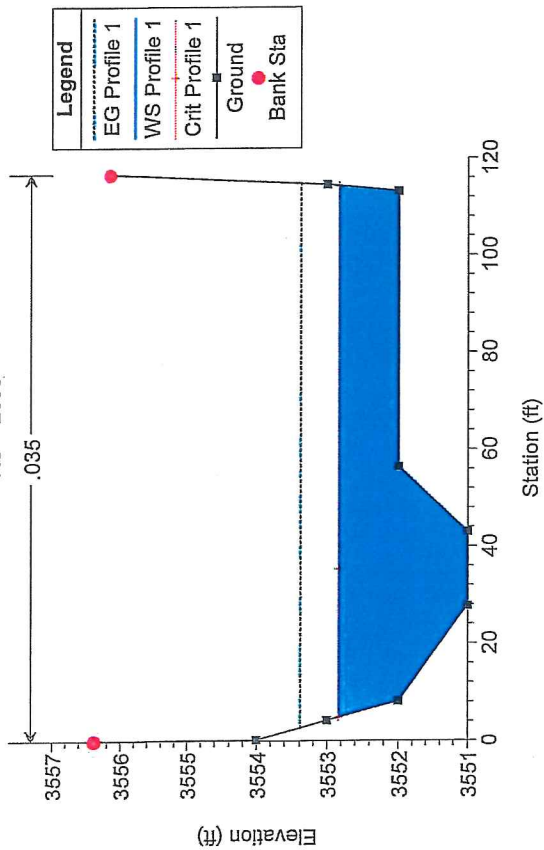
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016

River #1 Reach #1

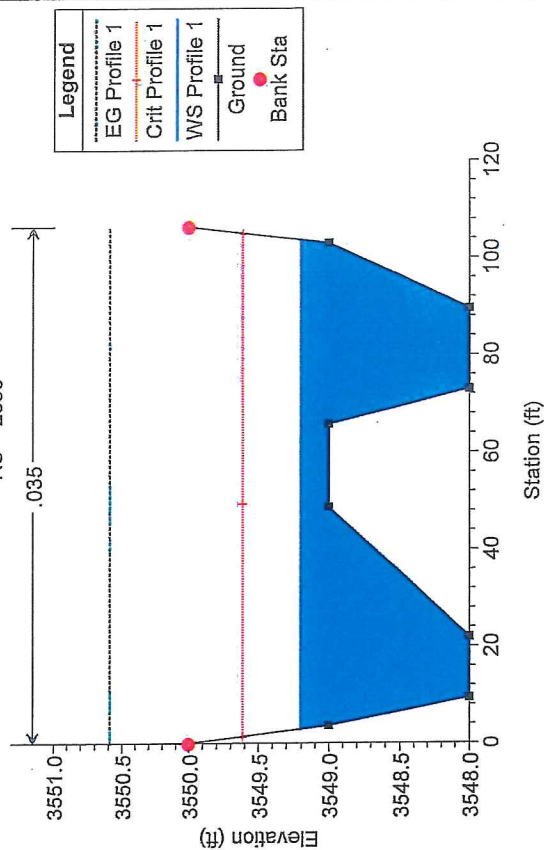


Legend	
	EG Profile 1
	WS Profile 1
	Crit Profile 1
	Ground

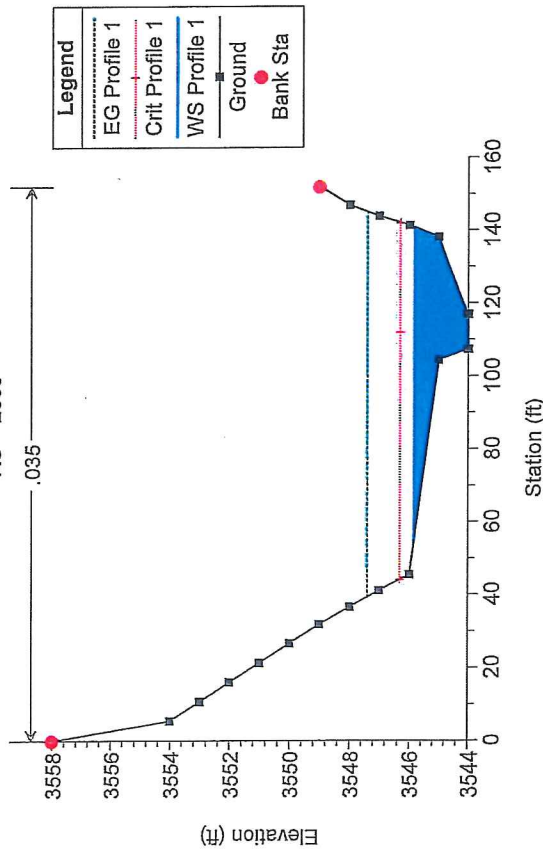
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016
RS = 2699



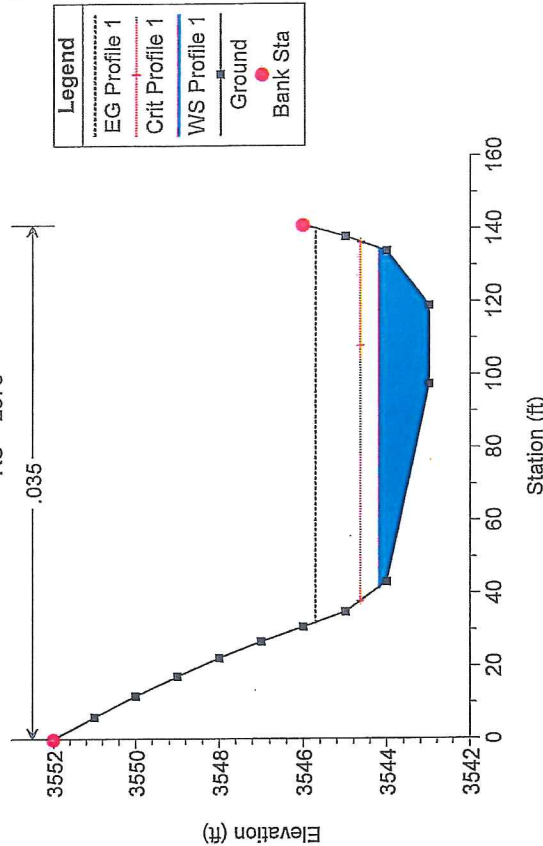
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RS = 2650



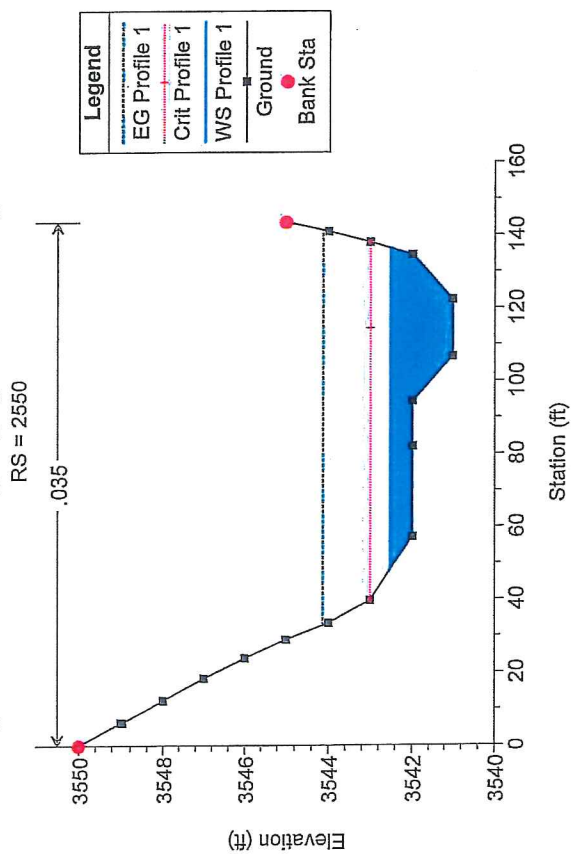
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RS = 2600



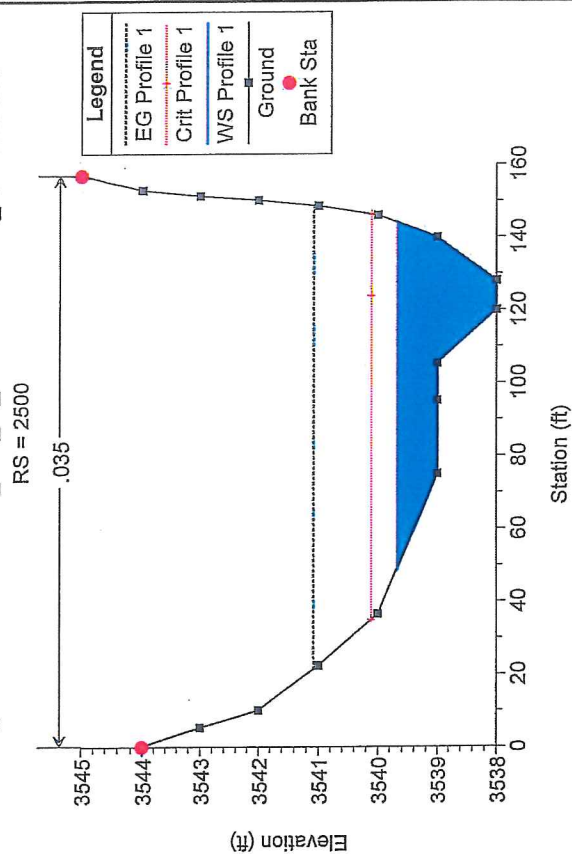
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016
RS = 2575



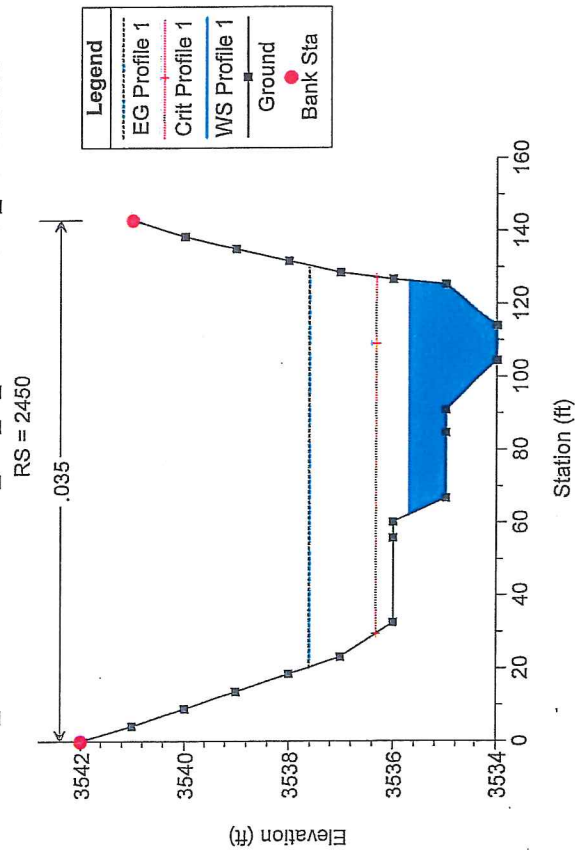
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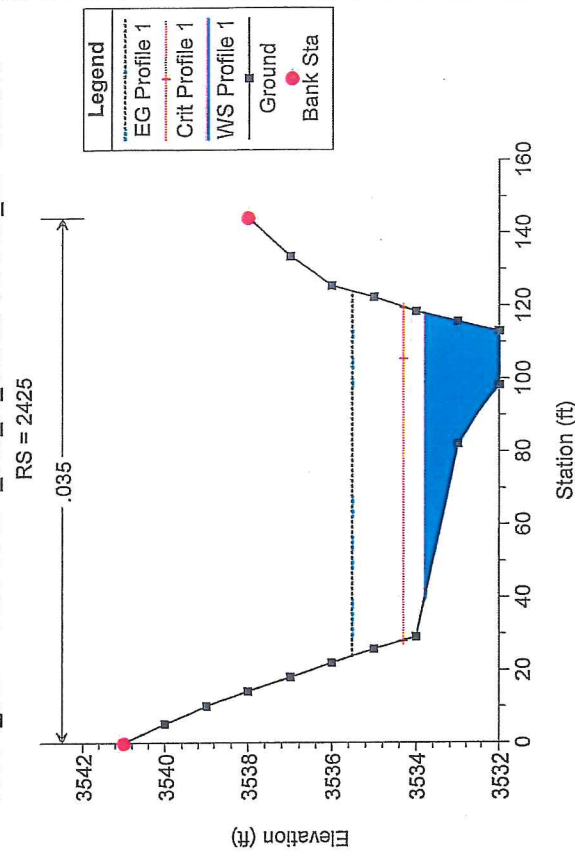
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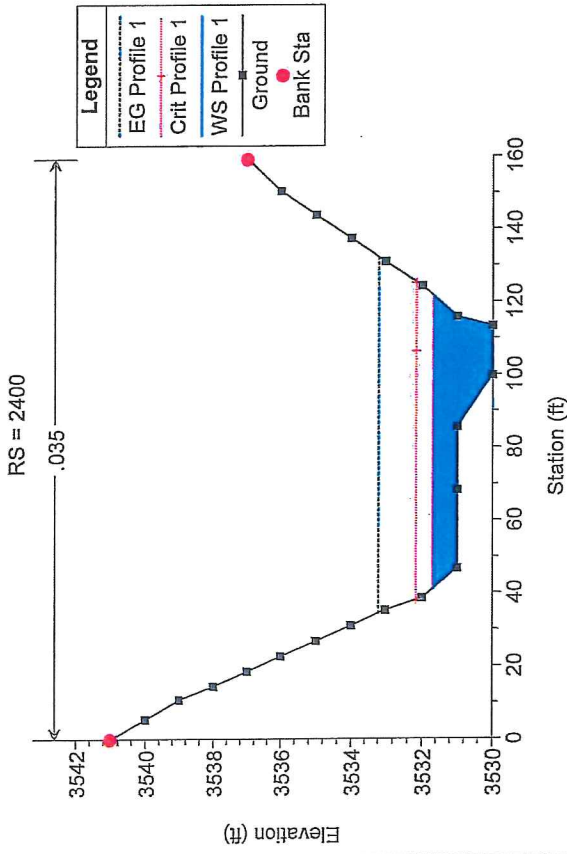
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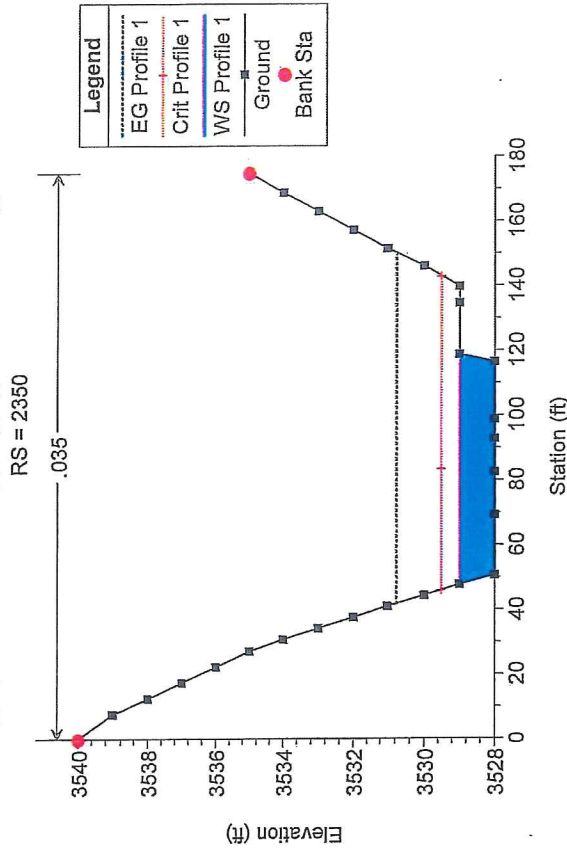
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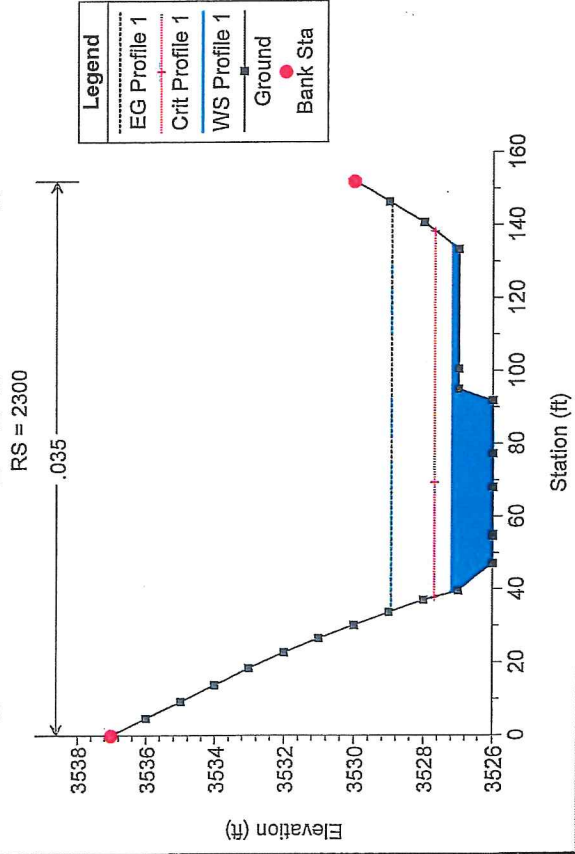
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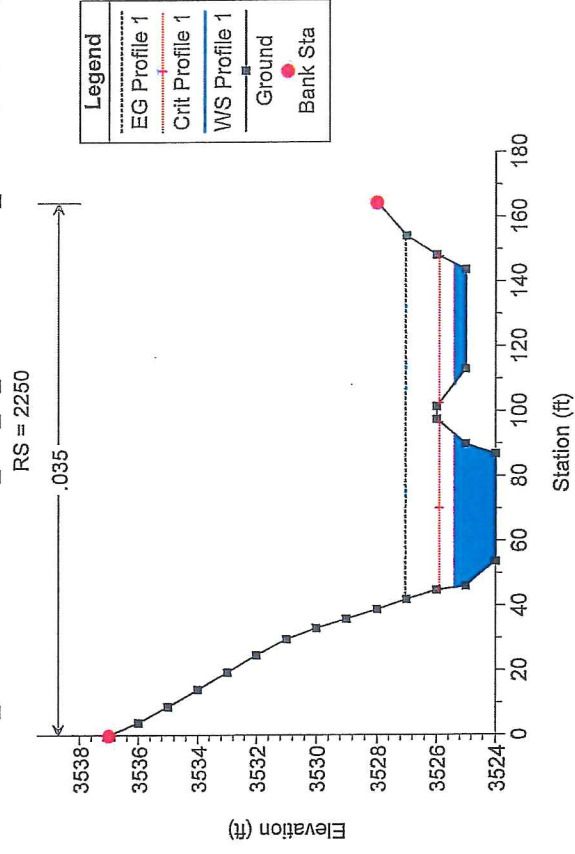
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COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016

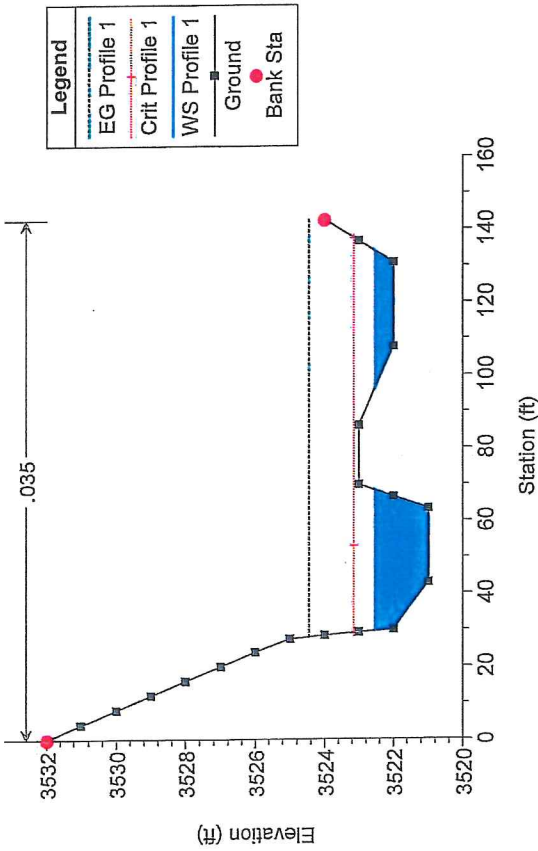


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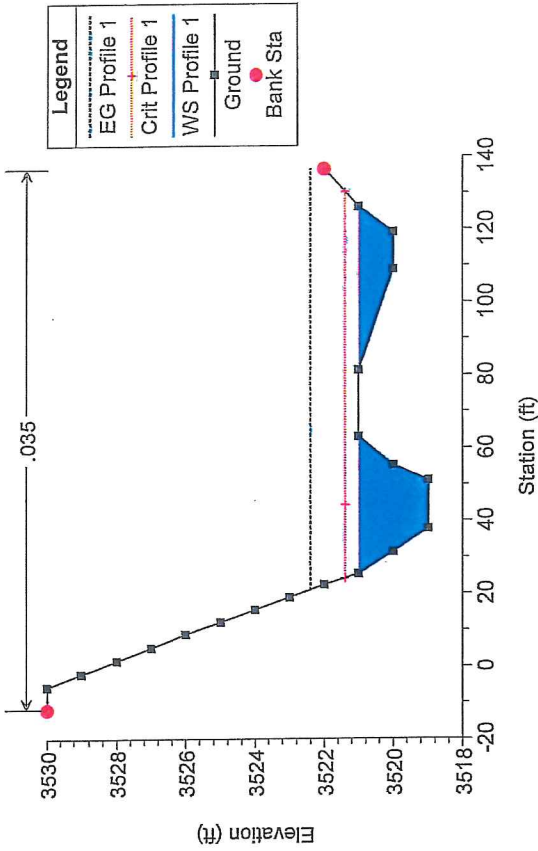
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RS = 2225



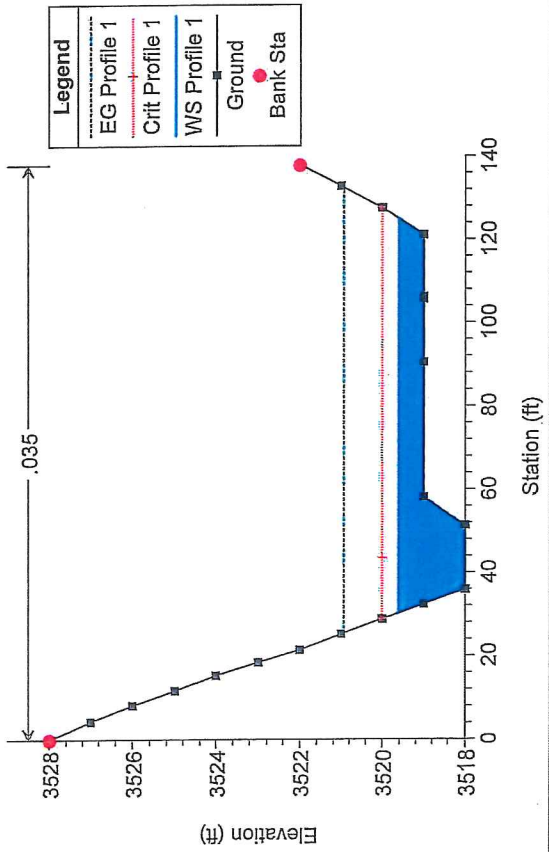
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RS = 2200



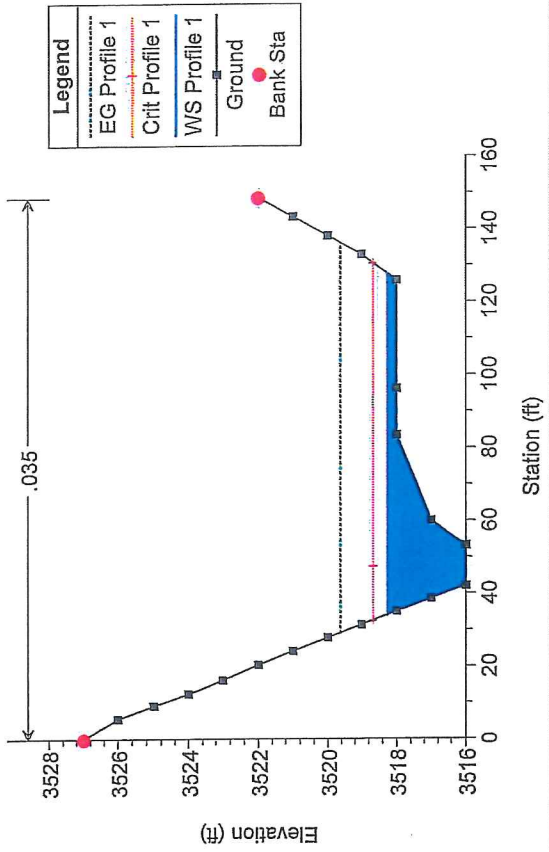
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016

RS = 2175

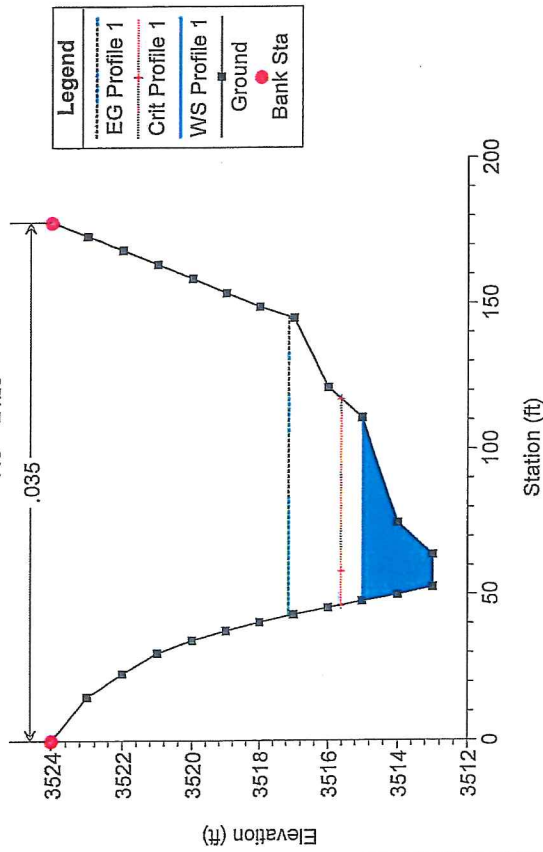


COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016

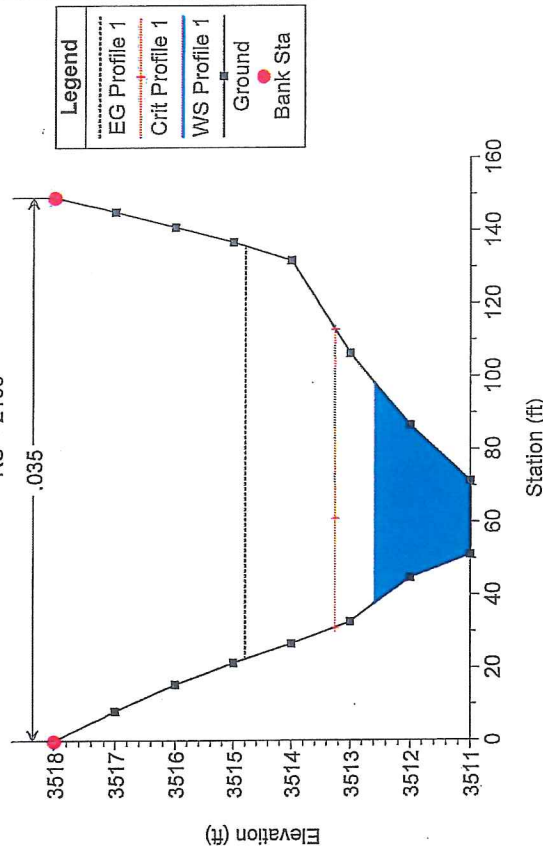
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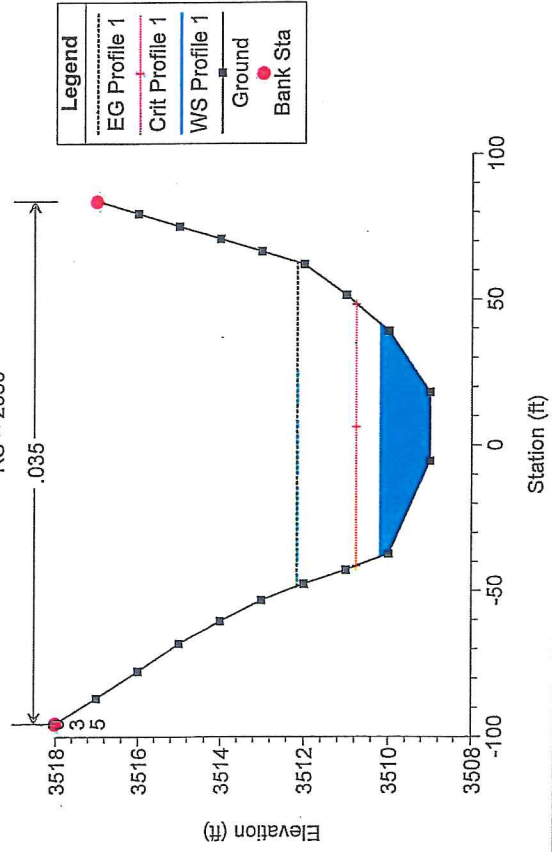
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RS = 2125



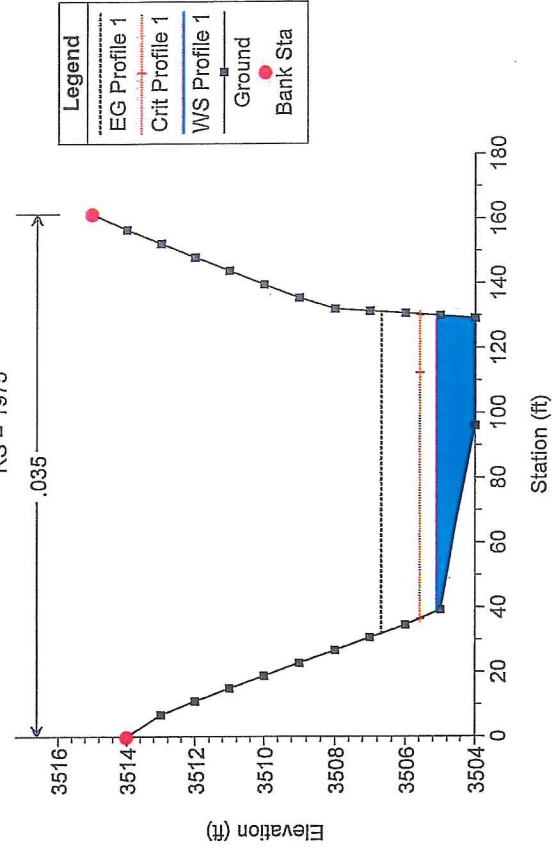
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RS = 2100



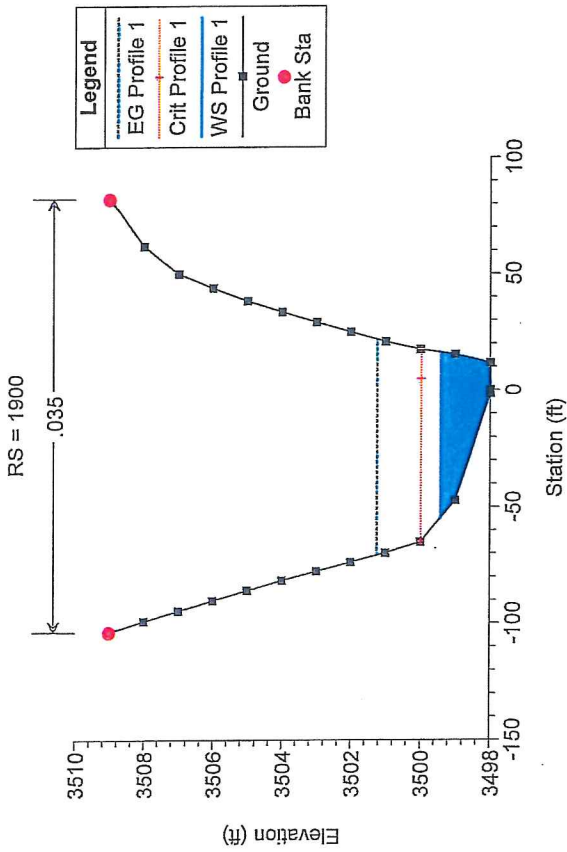
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016
RS = 2050



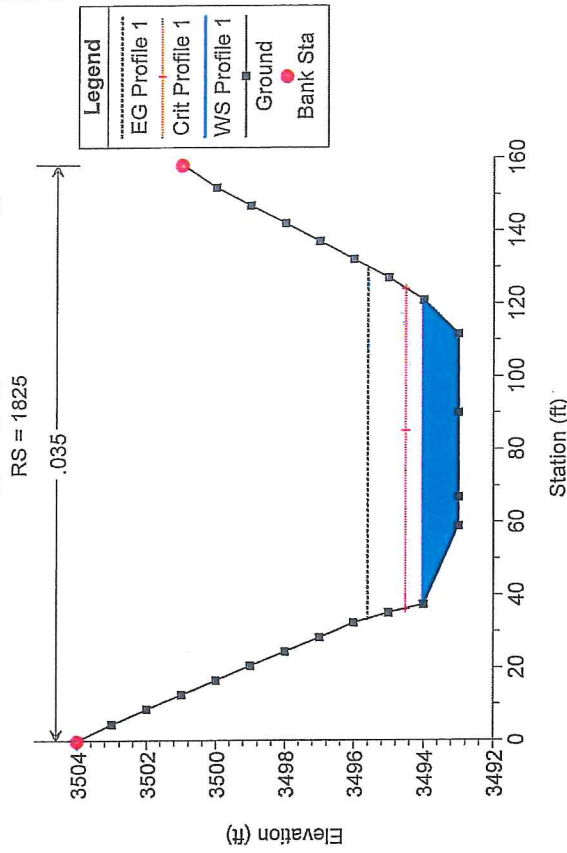
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016
RS = 1975



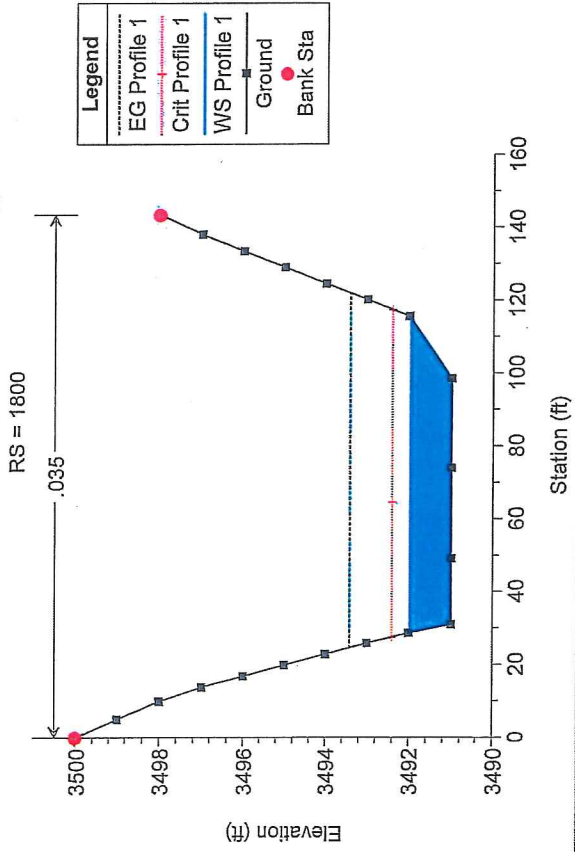
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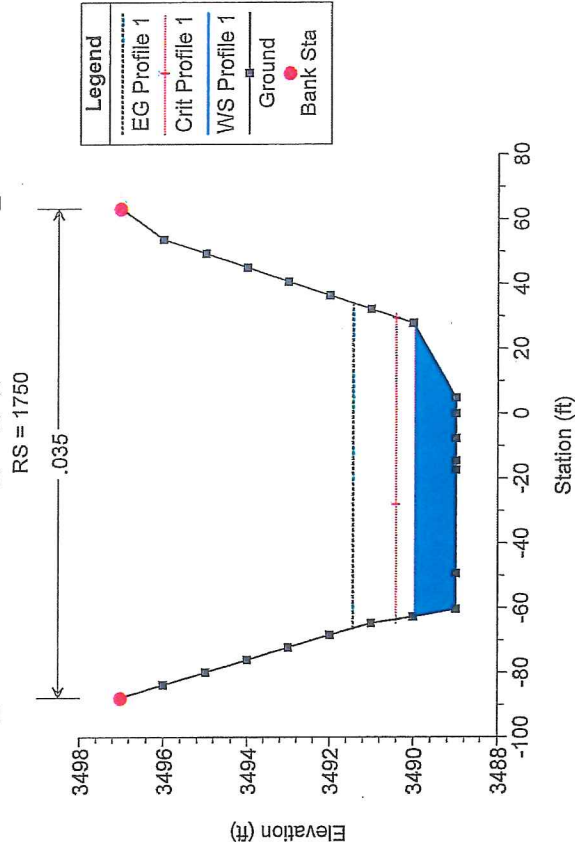
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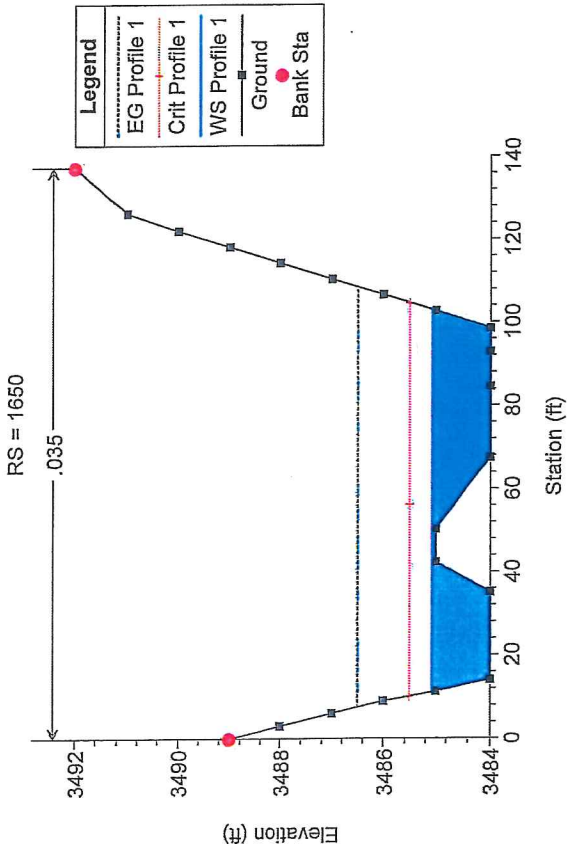
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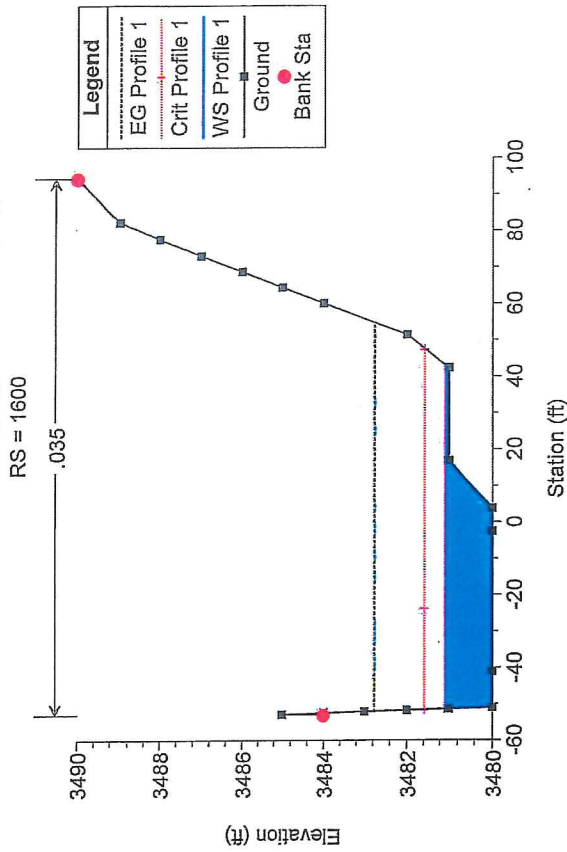
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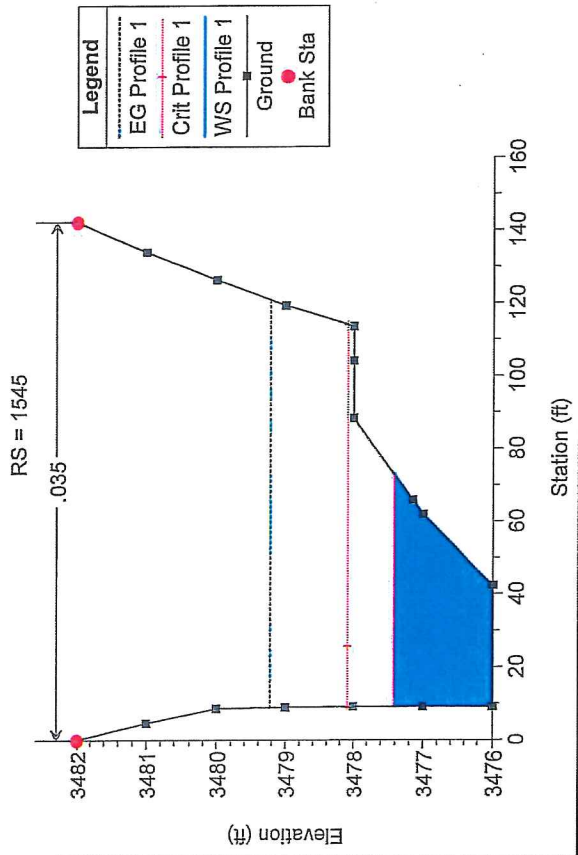
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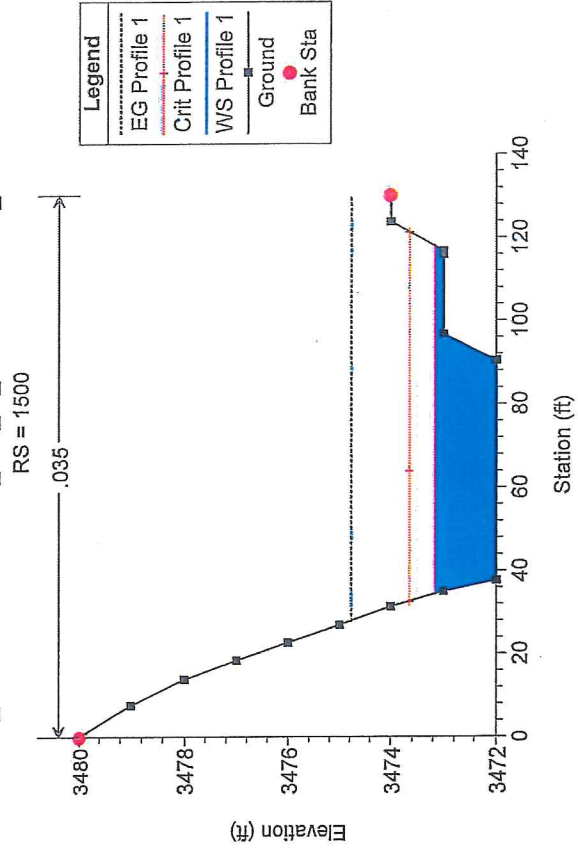
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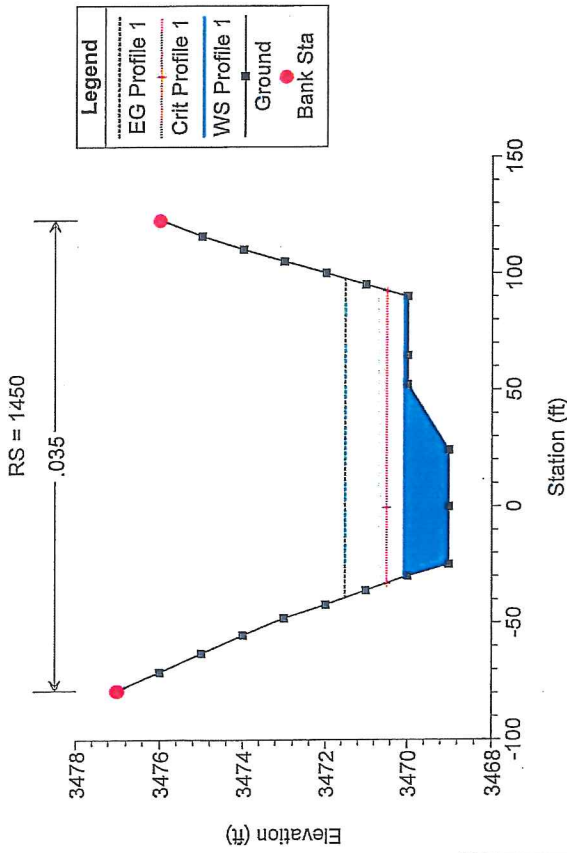
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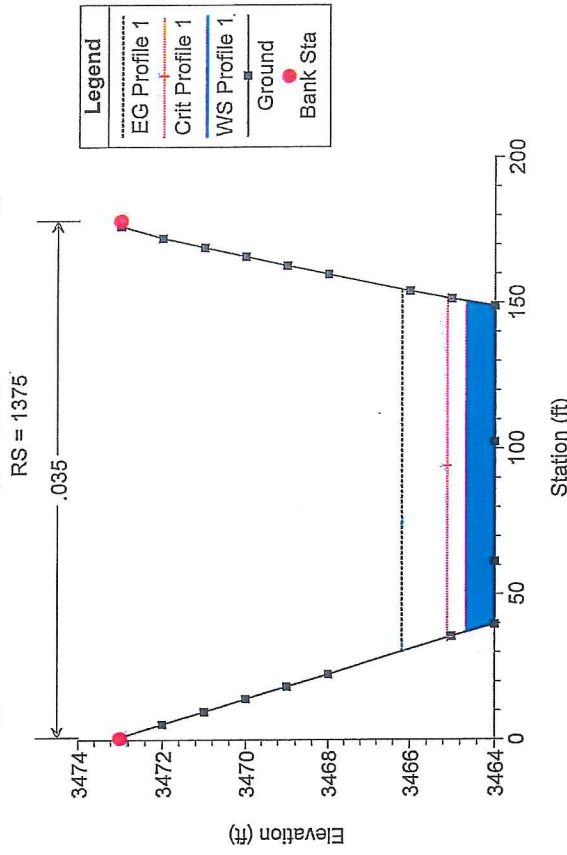
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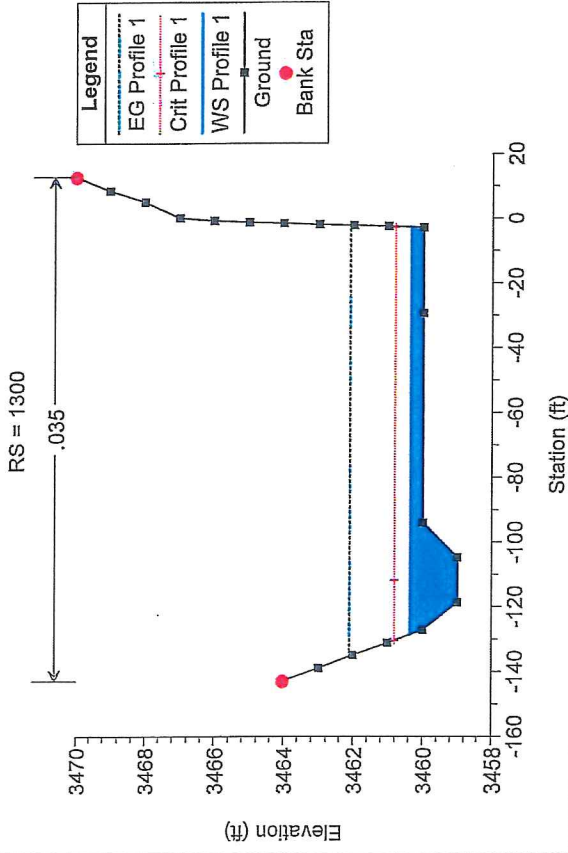
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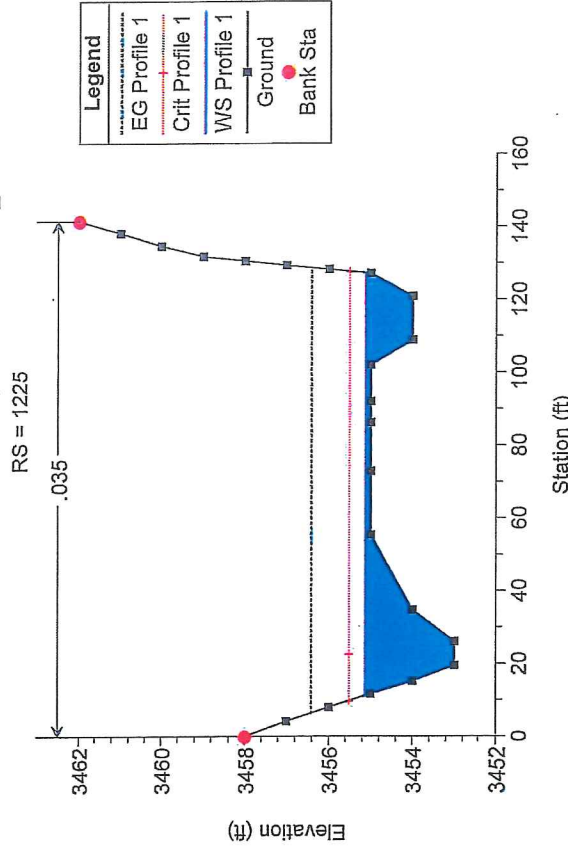
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COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016

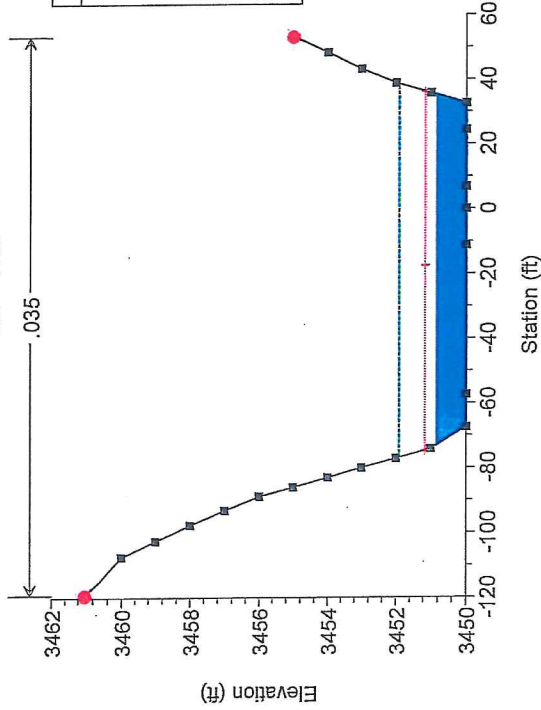


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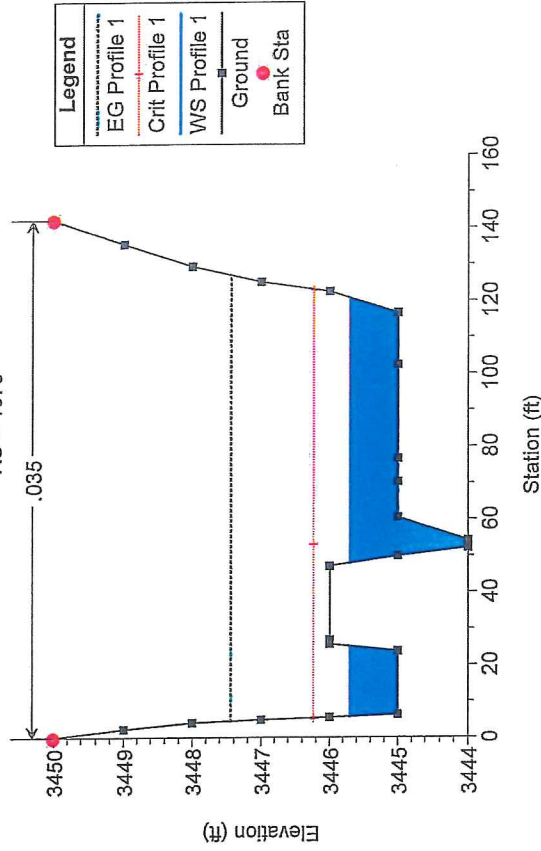
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RS = 1150



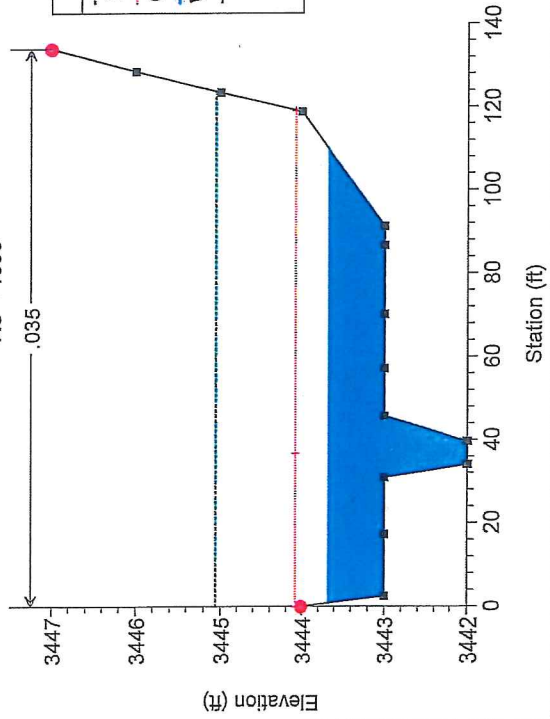
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RS = 1075



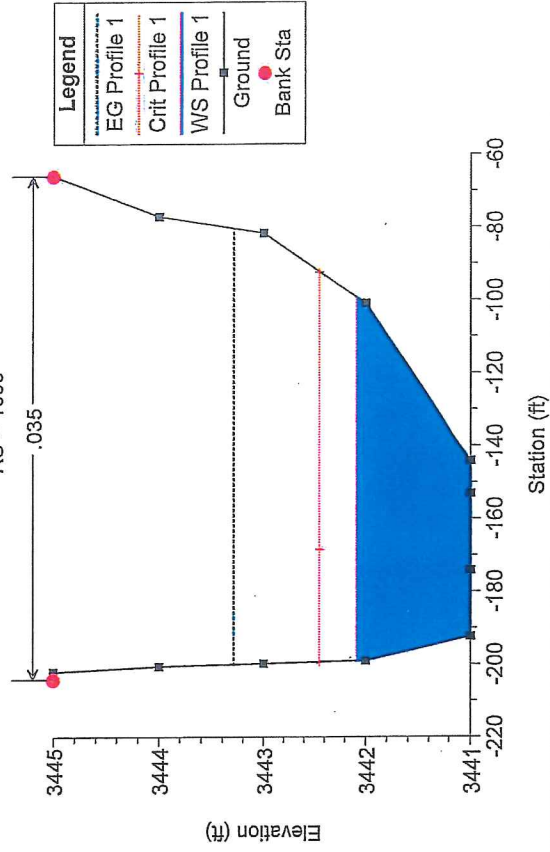
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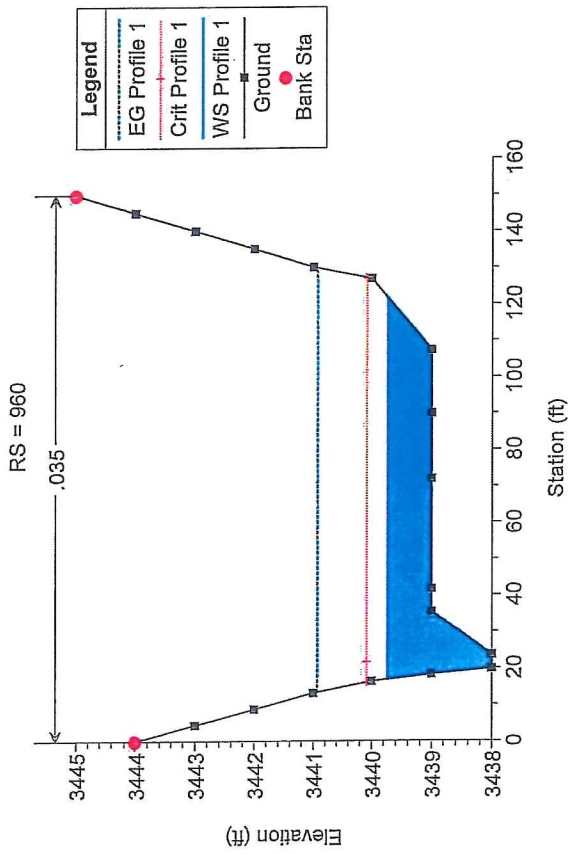


COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016

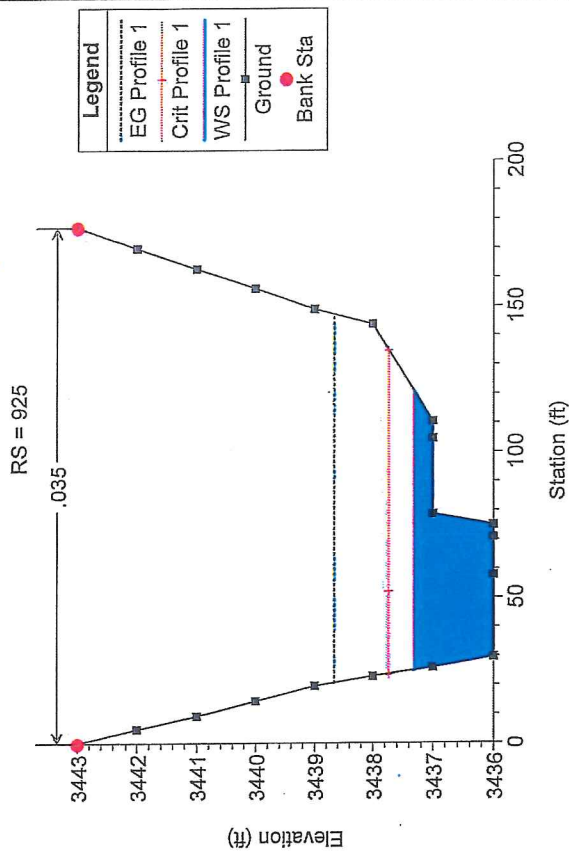
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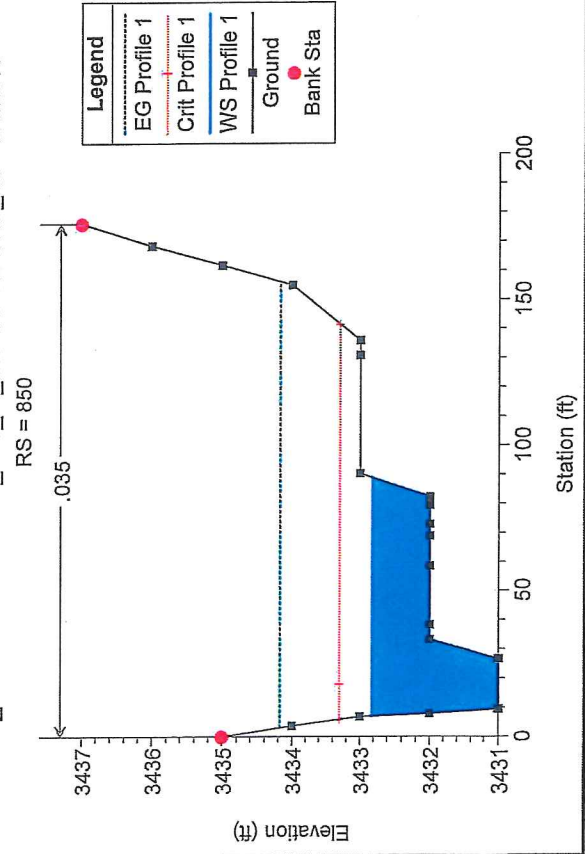
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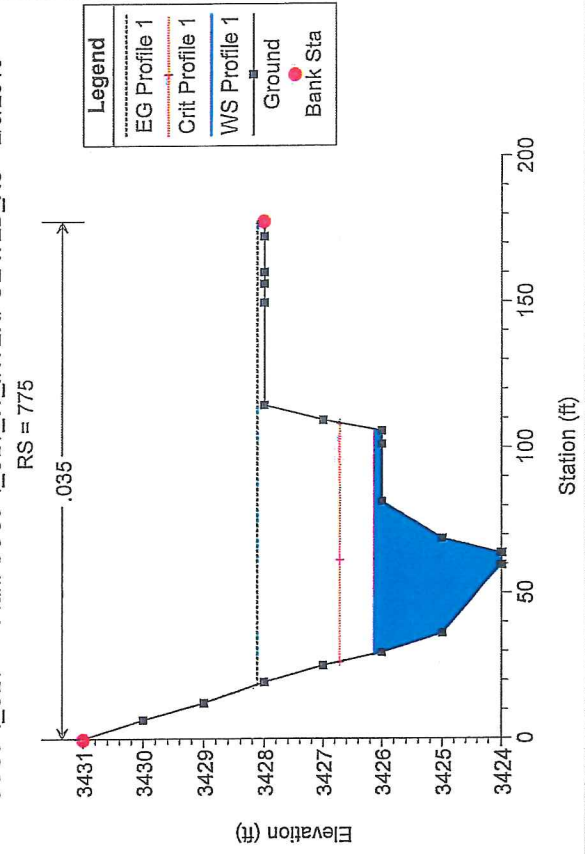
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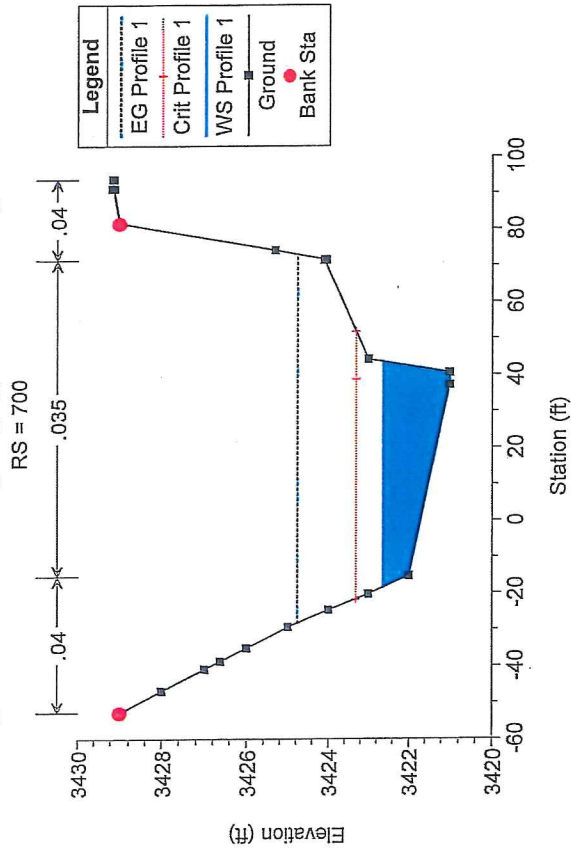
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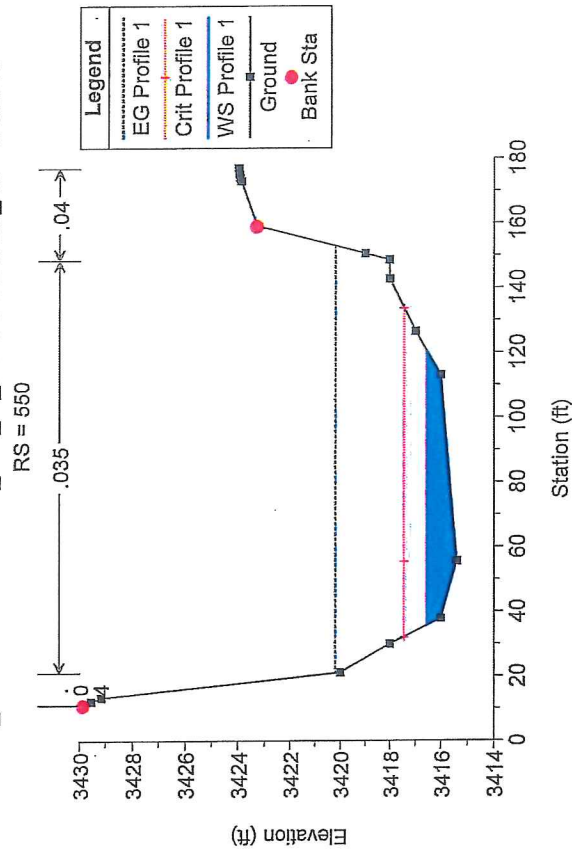
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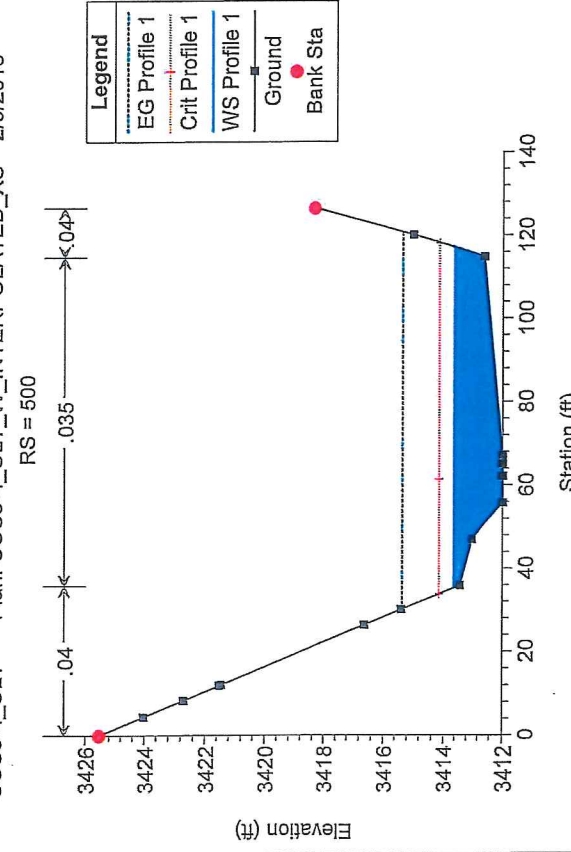
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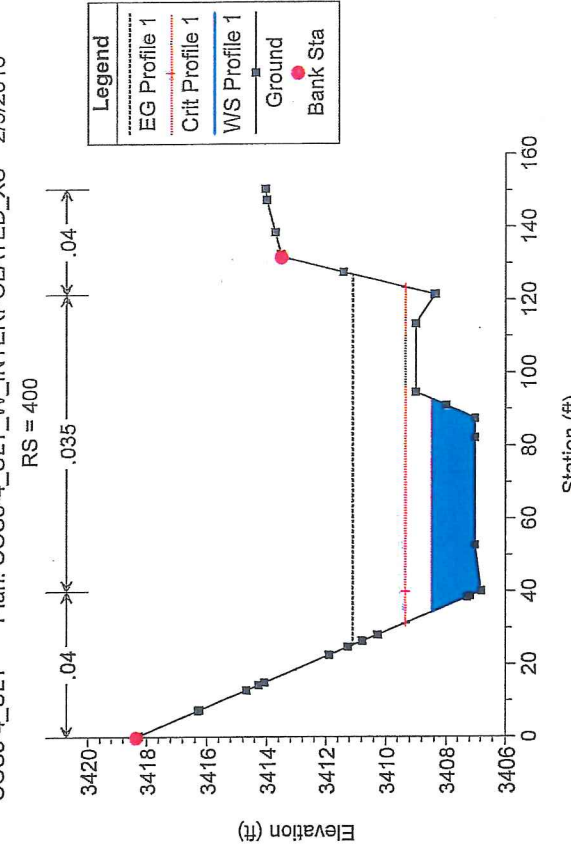
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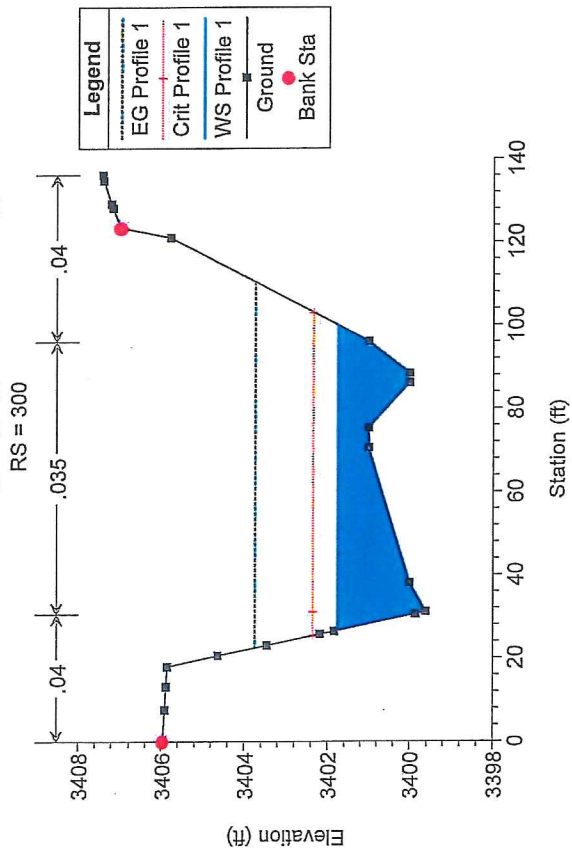
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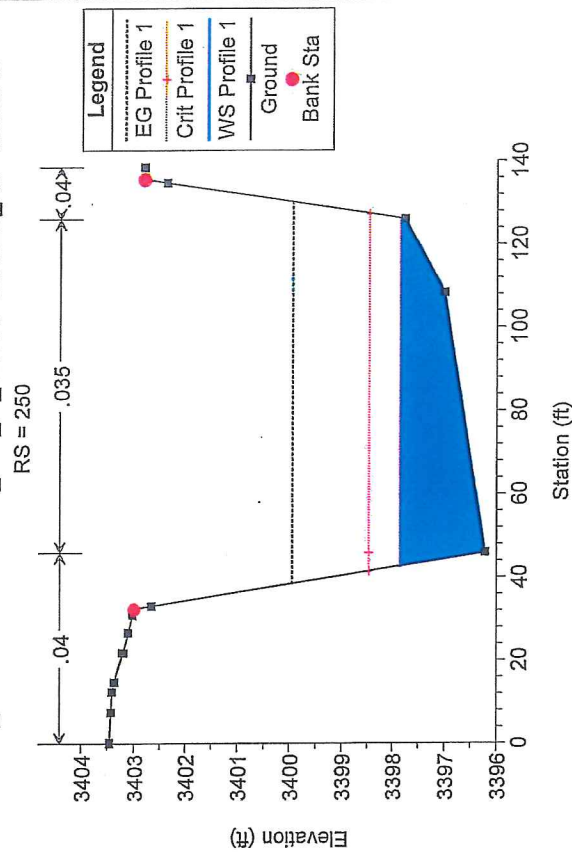
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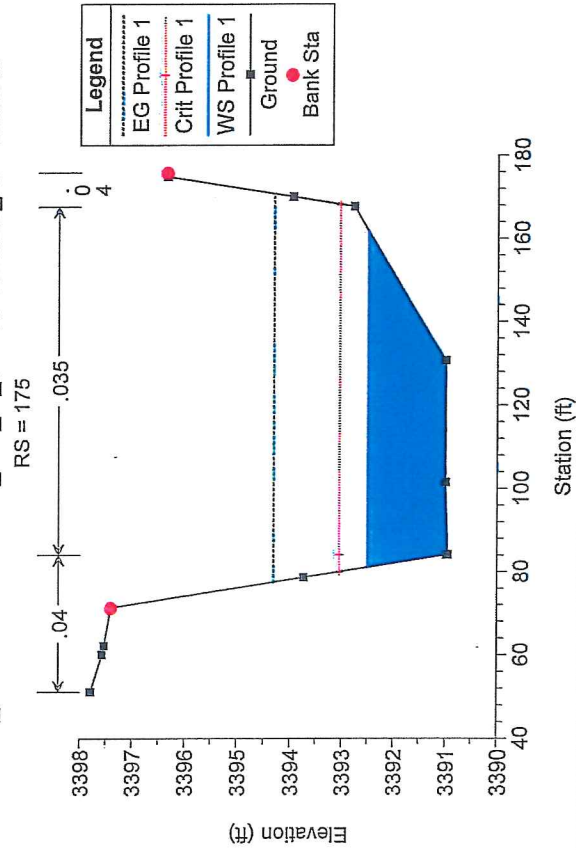
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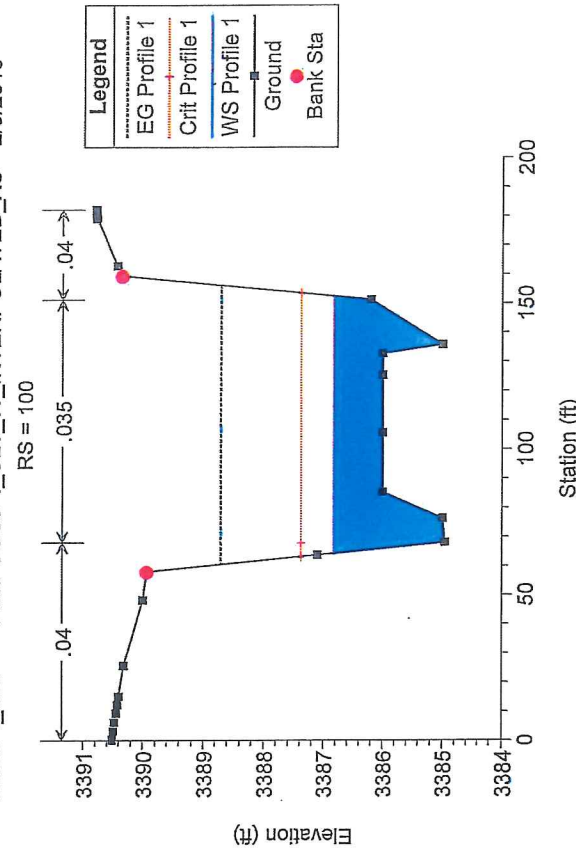
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016



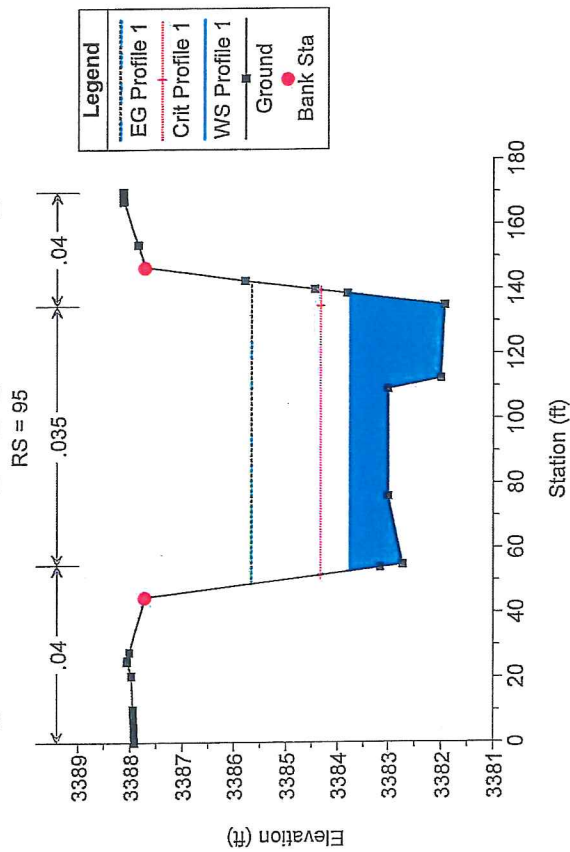
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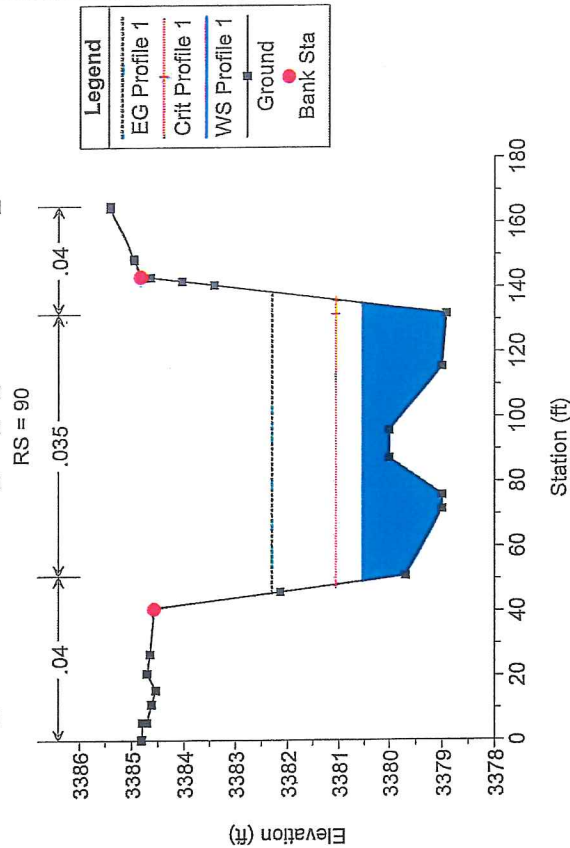
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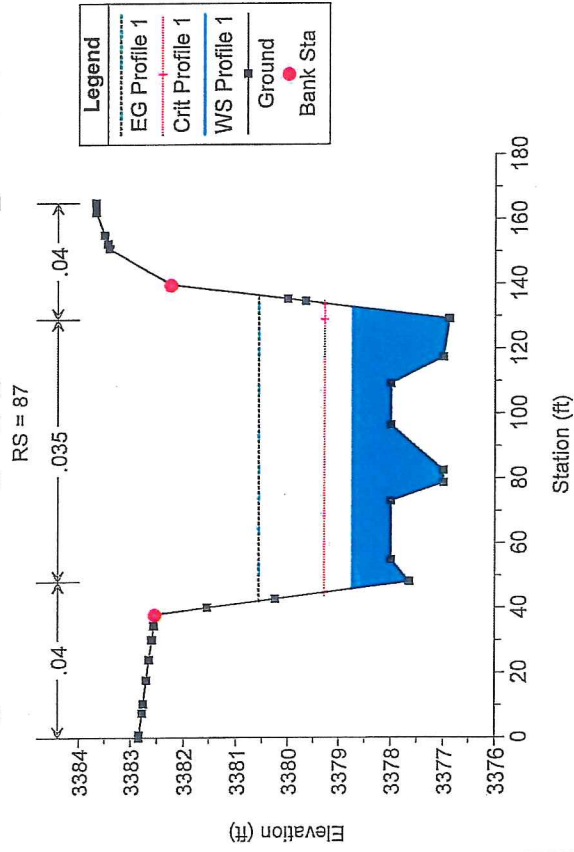
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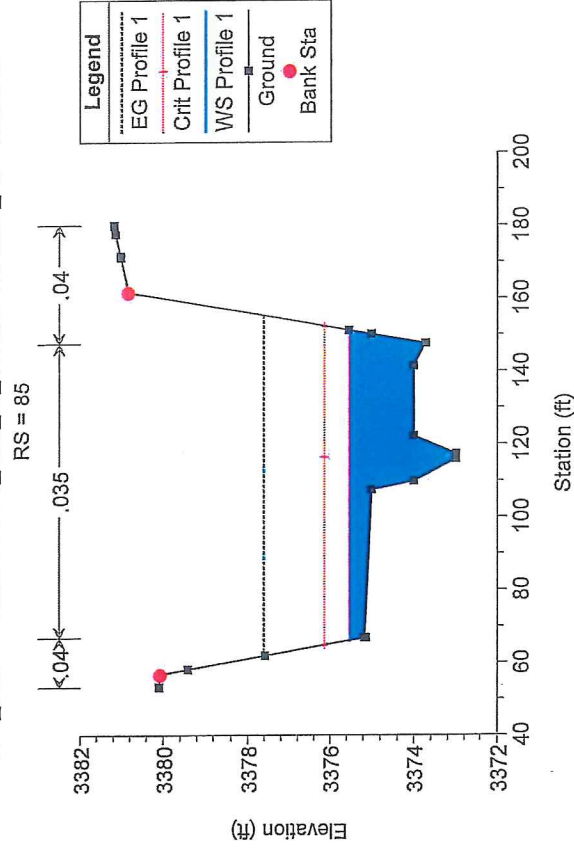
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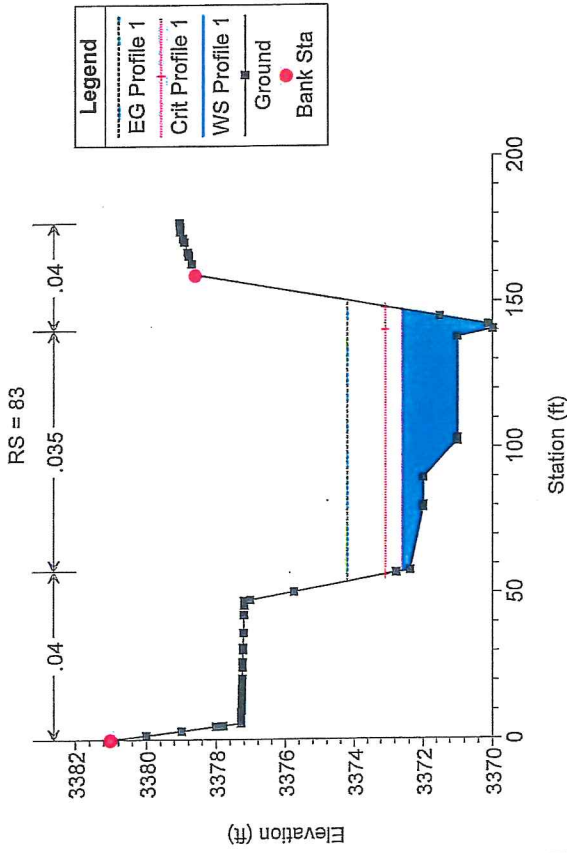
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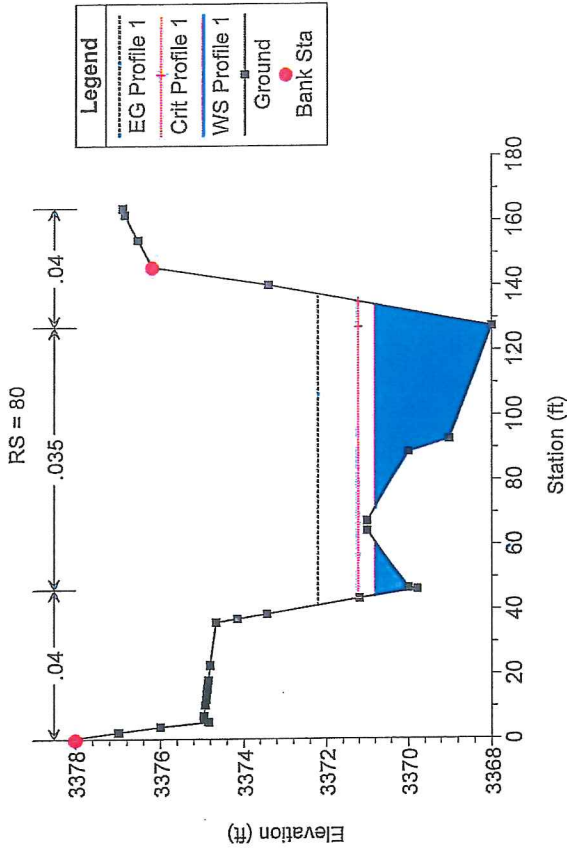
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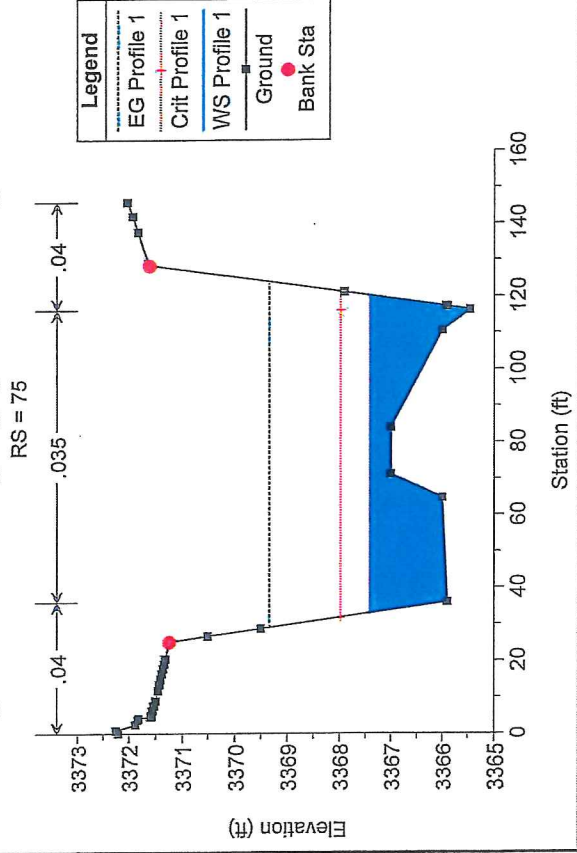
COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016



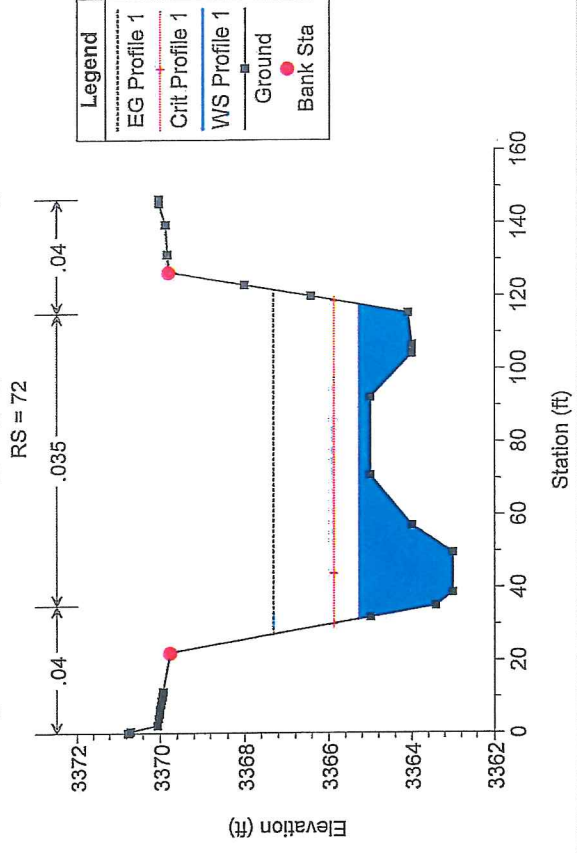
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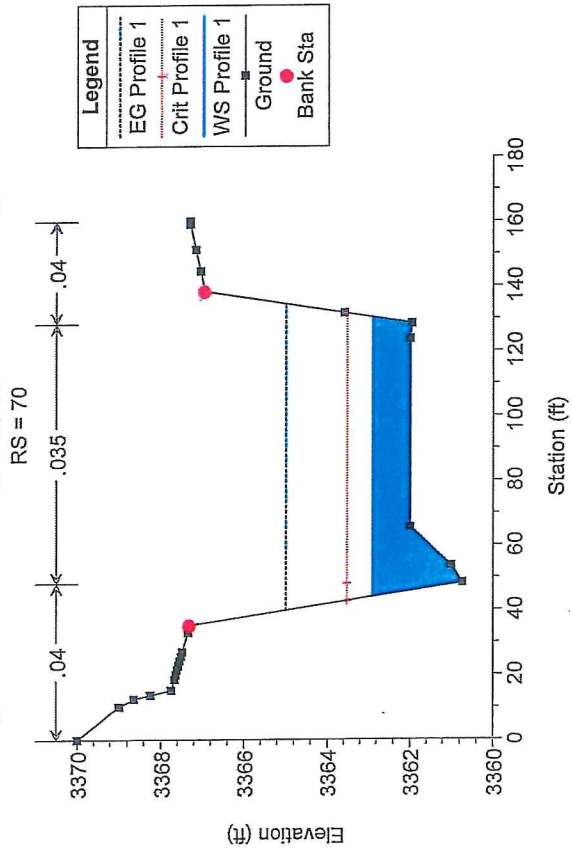
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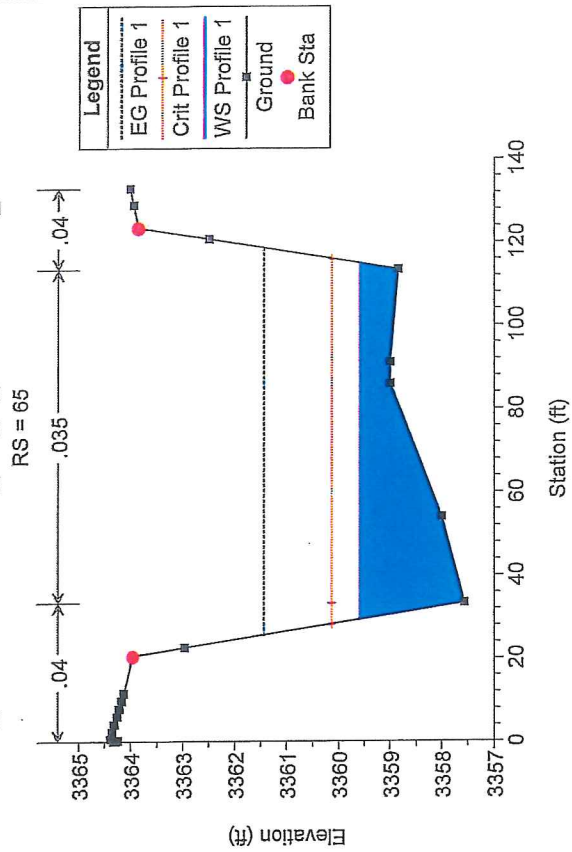
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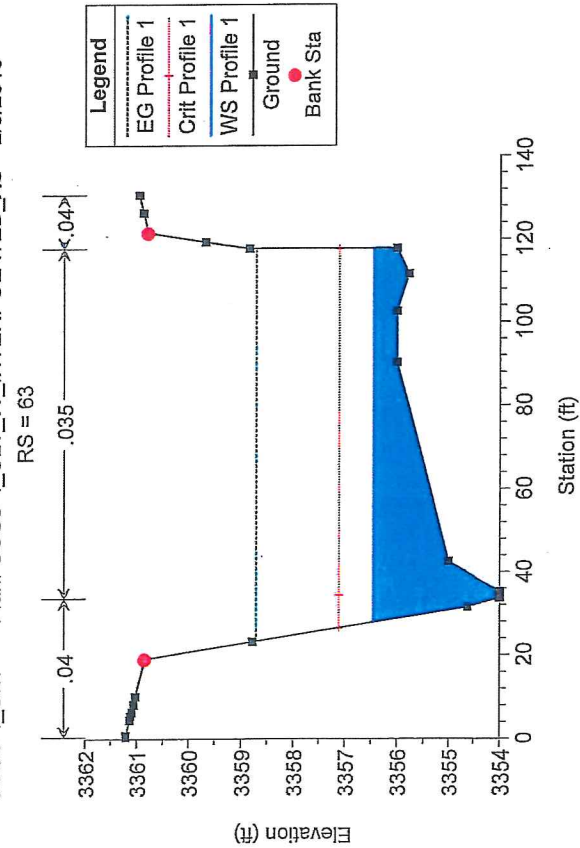
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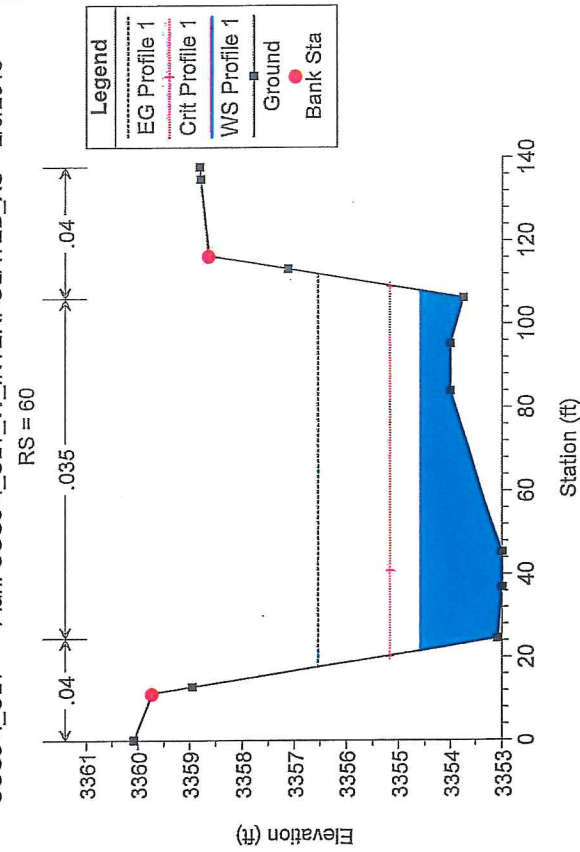
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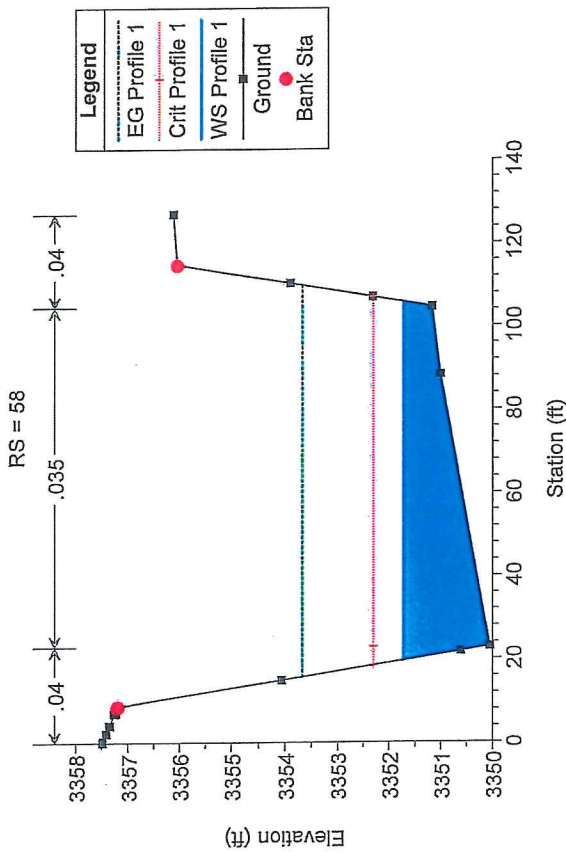
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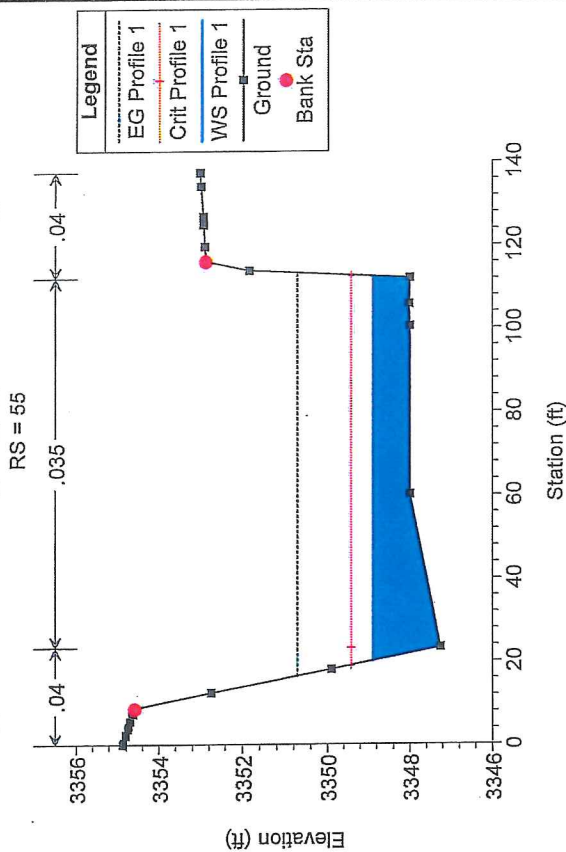
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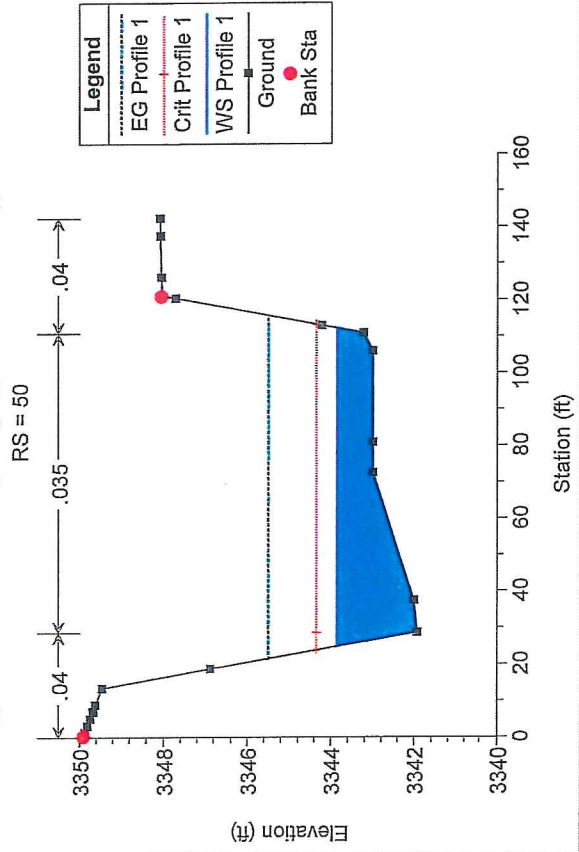
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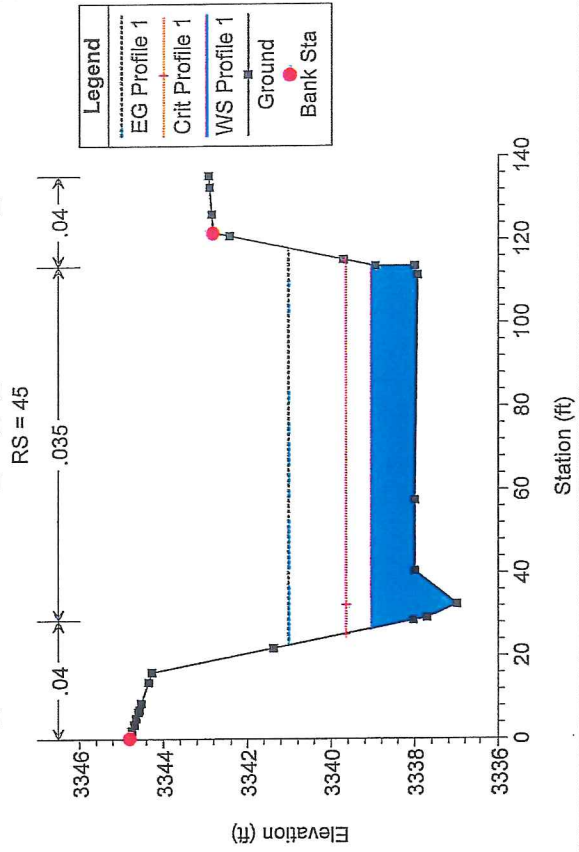
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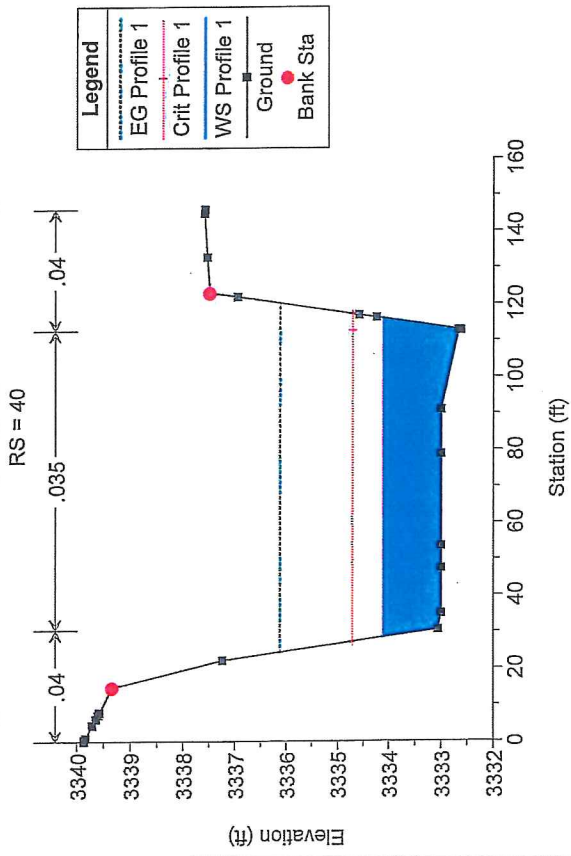
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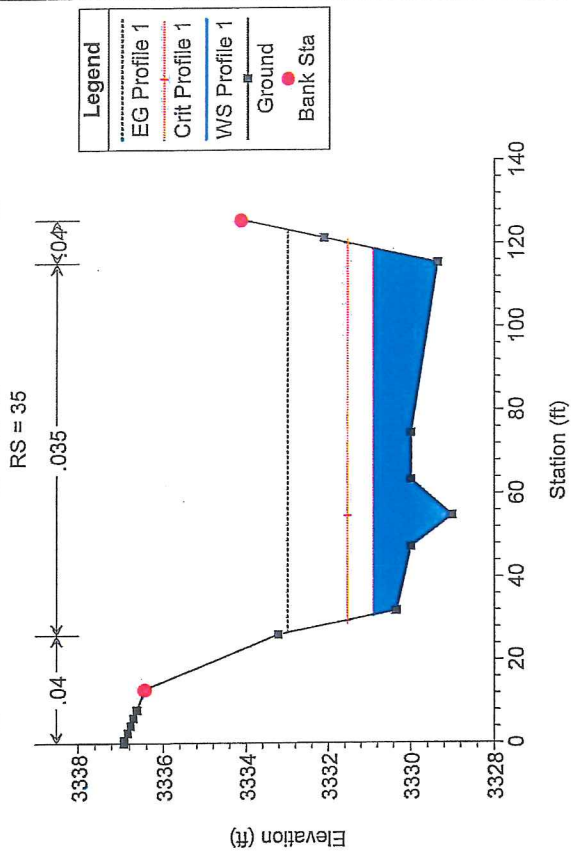
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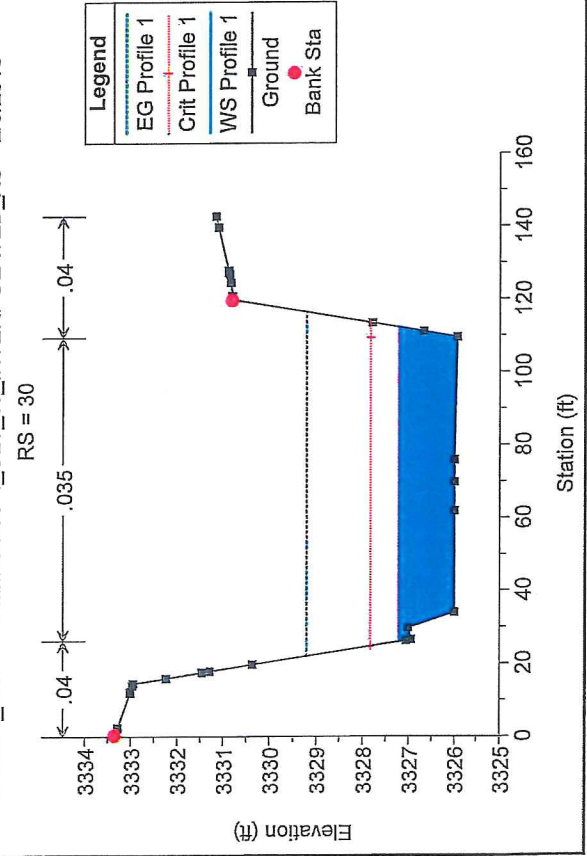
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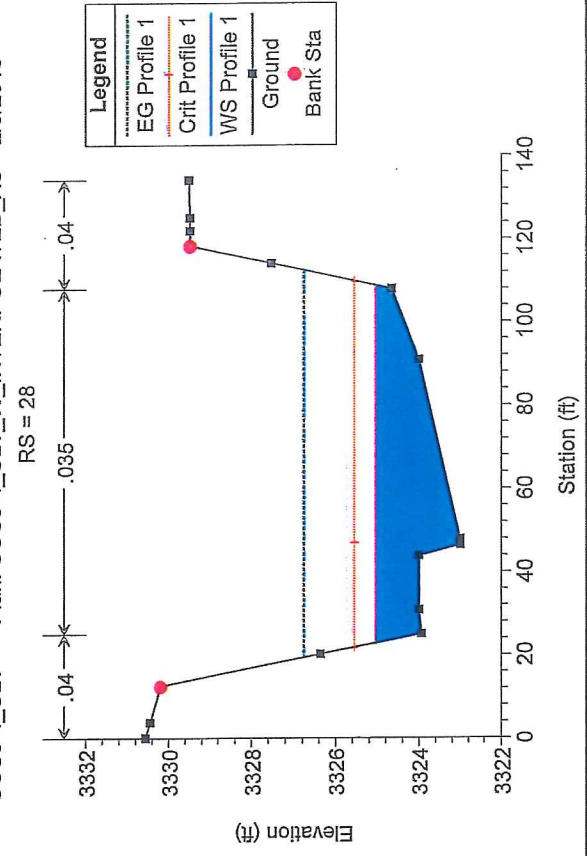
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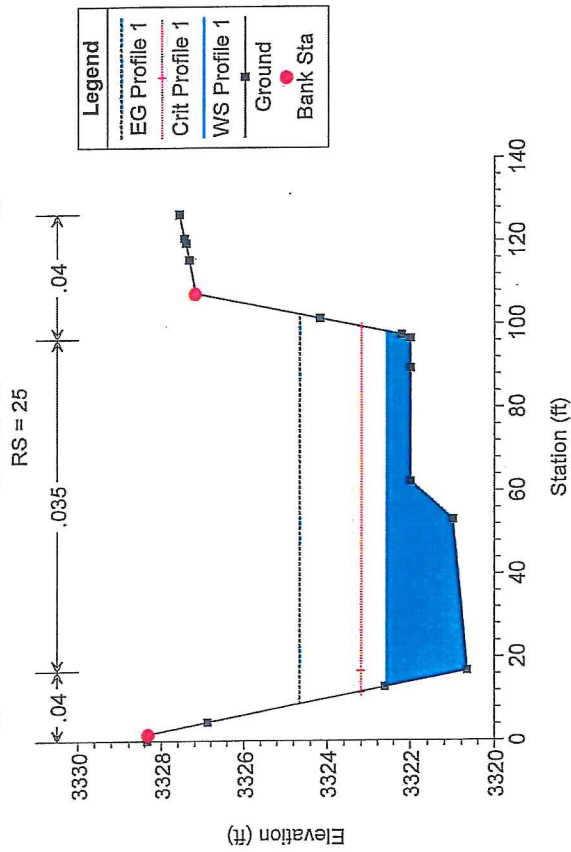
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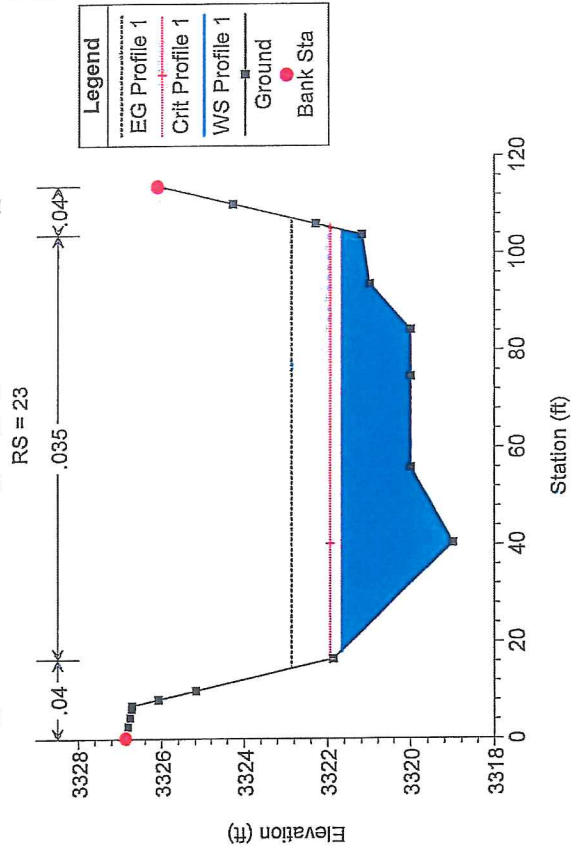
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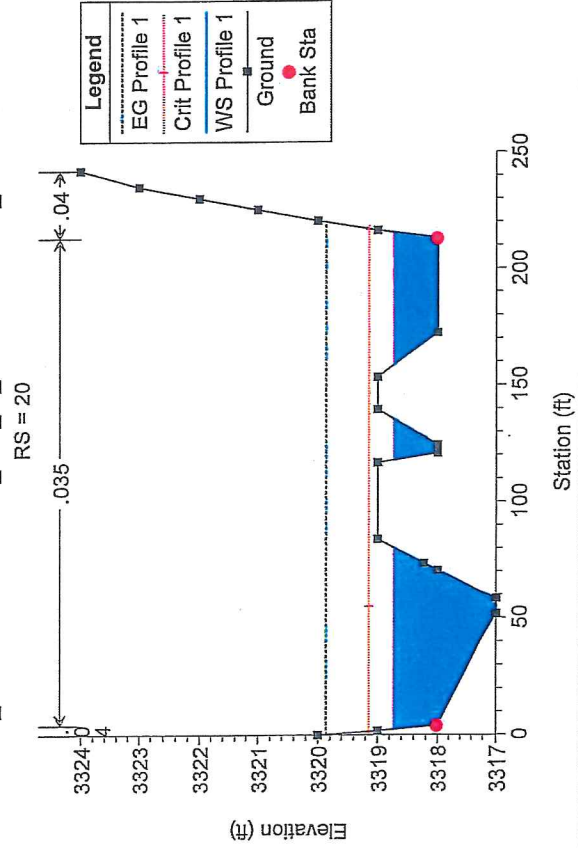
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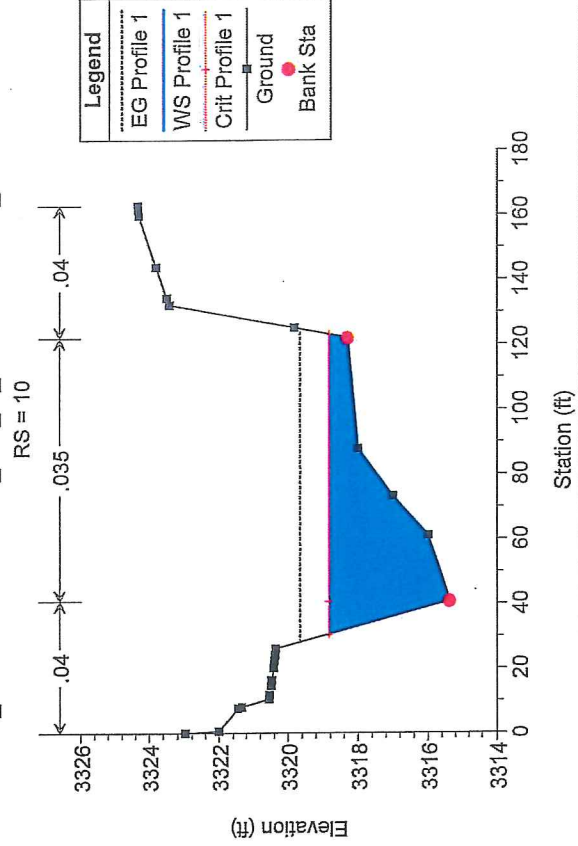
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COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016



COS3-4_ULT Plan: COS3-4_ULT_W_INTERPOLATED_XS 2/9/2016



**UPDATE #6 TO THE
TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24 UNIT 2 IMPROVEMENTS -
CROSSBRIDGE DRIVE
(CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD)**

62024-222

March 2016

Prepared by:

**GCW, Inc.
1555 S. Rainbow Blvd.
Las Vegas, Nevada 89146
Phone: (702) 804-2000
Fax: (702) 804-2299**

GCW
ENGINEERS & SURVEYORS

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		March 24, 2016
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	COPIES TO:
Summerlin Village 24 Unit 2 Improvements – Update #6 Crossbridge Drive Improvements (from Crossbridge Unit 1 to Sun Creek Road)		GCW Engineers/Surveyors
Cross Streets:	SWC of Sky Vista Drive & Alta Drive	Howard Hughes Corp.
File Number:	F:\Depot\DSMemos\DS4136L.doc	Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-015	
Zoning Action:	N/A	
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES X NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Transaction #
1 st Submittal	2/21/2007	3/29/2007	Not Approved	\$400.00	63487: \$400
2 nd Submittal	5/4/2007	5/29/2007	Not Approved	\$400.00	68552: \$400
3 rd Submittal	5/15/2014 & 6/5/2014	6/9/2014	Conditional Approval	\$400.00	357117: \$400
4 th Submittal	9/22/2014	10/7/2014	Approved	\$100.00	371022: \$100
5 th Submittal	11/6/2014	11/26/2014	Approved	\$100.00	376121: \$100
6 th Submittal	2/10/2015	2/24/2015	Not Approved	\$100.00	385212: \$100
7 th Submittal	5/14/2015	6/15/2015	Not Approved	\$400.00	397629: \$400
8 th Submittal	6/22/2015	7/7/2015	Approved	\$100.00	402841: \$100
9 th Submittal	10/6/2015	10/22/2015	Not Approved	\$400.00	417806: \$400
10 th Submittal	11/4/2015	11/18/2015	Approved	\$400.00	421434: \$400
11 th Submittal	3/7/2016	3/24/2016	See Comments Below	\$100.00	435704: \$100
TOTAL FEES (LDDRS):				\$2,900.00	

REMARKS:

11th Submittal: Update #6 to remove two previously proposed 24"-stub

10th Submittal: Addendum #3 to Update #3

9th Submittal: Addendum #2 to Update #3

8th Submittal: Update #4 for Sky Vista Drive Improvements – Revise the connection angle of a 48"-Stub to Future Parcel K at the intersection of Crossbridge Drive and Sun Creek Road

6th & 7th Submittals: Update #3 and Addendum to construct a channel along the west boundary of Village 24 and Extend Crossbridge Drive beyond Sun Creek Road

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.



LEGEND

- SUBBASIN BOUNDARY
- PRORATED SUBBASIN BOUNDARY
- ON8R DRAINAGE SUBBASIN
- PRORATED DRAINAGE SUBBASIN
- CRR1 CONCENTRATION POINT
- FLOW DIRECTION

SUMMARY OF HYD-MODEL INTERIM CONDITION

Event	Area (ac)	Q ₁₀₀ (cfs)	Q ₁₀ (cfs)	Q ₅ (cfs)
RG6	40.16	122	3.04	56
RG6D	4.79	14	2.92	6
RG6E	44.8	123	2.75	54
RG6F	17.2	48	2.79	21
ON8R*	24.9	76	3.05	34
CP1	1.8	7	4	17
CP2	1.8	7	4	17
CP3	1.8	7	4	17
CP8	1.8	7	4	17
CP9	1.8	7	4	17
CP11	1.8	7	4	17
CP12	1.8	7	4	17

SUMMARY OF PRORATED STORM FLOWS INTERIM CONDITION

Parent Subbasin	Area (ac)	Q ₁₀₀ (cfs)	Unit Flow (cfs/ac)	Q ₁₀ (cfs)	Unit Flow (cfs/ac)
RG6-1	24.42	3.04	74	1.39	34
D1A	1.82	2.92	5	1.25	3
D1B	2.43	2.92	7	1.25	3
D2	0.75	2.92	2	1.25	1
E1	2.34	2.75	7	1.21	4
E2A	8.53	2.75	23	1.21	10
E2B	7.06	2.75	19	1.21	9
E3A	23.03	2.75	63	1.21	28
E3B	3.84	2.75	11	1.21	5
F1	1.55	2.79	4	1.22	2
F2	3.87	2.79	11	1.22	5
F3	11.79	2.79	33	1.22	14
ON8R-1	3.77	3.05	12	1.37	5

CROSS SECTION

DISCHARGE (cfs)	ACTUAL DEPTH (ft)	VELOCITY (ft/s)	SCOUR PROTECTION REQUIRED
CH1	1900	0.8	3.2
CH2	1900	1.2	11.2
CH3	1900	0.8	8.5

Note: Table is referenced from the Unit 1 Improvements.

FIGURE 7.30R INTERIM CONDITION DRAINAGE MAP

UNIT 2 IMPROVEMENTS

UNIT 3 IMPROVEMENTS

UNIT 4 IMPROVEMENTS

UNIT 5 IMPROVEMENTS

UNIT 6 IMPROVEMENTS

UNIT 7 IMPROVEMENTS

UNIT 8 IMPROVEMENTS

UNIT 9 IMPROVEMENTS

UNIT 10 IMPROVEMENTS

UNIT 11 IMPROVEMENTS

UNIT 12 IMPROVEMENTS

UNIT 13 IMPROVEMENTS

UNIT 14 IMPROVEMENTS

UNIT 15 IMPROVEMENTS

UNIT 16 IMPROVEMENTS

UNIT 17 IMPROVEMENTS

UNIT 18 IMPROVEMENTS

UNIT 19 IMPROVEMENTS

UNIT 20 IMPROVEMENTS

UNIT 21 IMPROVEMENTS

UNIT 22 IMPROVEMENTS

UNIT 23 IMPROVEMENTS

UNIT 24 IMPROVEMENTS

UNIT 25 IMPROVEMENTS

UNIT 26 IMPROVEMENTS

UNIT 27 IMPROVEMENTS

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UNIT 31 IMPROVEMENTS

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UNIT 91 IMPROVEMENTS

UNIT 92 IMPROVEMENTS

UNIT 93 IMPROVEMENTS

UNIT 94 IMPROVEMENTS

UNIT 95 IMPROVEMENTS

UNIT 96 IMPROVEMENTS

UNIT 97 IMPROVEMENTS

UNIT 98 IMPROVEMENTS

UNIT 99 IMPROVEMENTS

UNIT 100 IMPROVEMENTS

HYDROLOGIC CRITERIA AND DESIGN MANUAL

TIME OF CONCENTRATION

SUMMERLIN VILLAGE 24

UNIT 2 IMPROVEMENTS

PROPOSED/INTERIM CONDITIONS

Project No: 62024-221
Date: 23-Feb-15
Calculated by: JYAMMC

G. C. WALLACE, INC.
Engineers/Planners/Surveyors

SUB-BASIN DATA				INITIAL / OVERLAND TIME (Tt)			TRAVEL TIME (Tt)				Tc CHECK				Tc		Tlag		REMARKS
DESIG:	DEV/JEX. (D or E)	CN (16)	K (2)	AREA Ac (3)	AREA Sq Mi (4)	INITIAL LENGTH Feet (5)	SLOPE % (6)	Tt Min (7)	TRAVEL LENGTH Feet (8)	SLOPE % (9a)	V1 VELOCITY fps (9b)	V2 VELOCITY fps (10)	Tt Min (11)	TOTAL LENGTH Feet (12)	Tc = (L/180)*10 Min (13)	Min (14)	Hours (15)		
(1)																			
Precipitation values for basins are referenced from the Conceptual Drainage Study. OFF11A includes the areas for OFF12 through OFF17; OFF11B includes a portion of the area for ON12.																			
OFF11A	E	88	0.7718	91.6	0.14308	500	8.0	5.6	3875	7.3	1.3	1.3	1.3	1.3	N/A	6.0	0.150	3.43	
OFF11B	E	88	0.7718	56.8	0.0888	500	7.2	5.6	3410	6.1	1.3	1.3	1.3	1.3	N/A	5.8	0.158	3.34	
Parameters are referenced from the SWPA Update and the Conceptual Drainage Study. For the proposed/interim conditions, the subbasin is assumed undeveloped; therefore the CN used is for subbasin OFF5 from the Conceptual Drainage Study; precipitation value is from subbasin 7-2A from the SWPA Update. The area and lag time have been revised for the present study.																			
7-2A*	E	88	0.7718	283.5	0.14308	500	9.0	6.4	9490	7.2	1.3	1.3	1.3	1.3	N/A	22.5	0.275	3.50	
Crossbridge Drive and onsite areas draining towards Crossbridge Drive; precipitation value for all basins and CN for Crossbridge Drive are taken from the Conceptual Drainage Study Update #2.																			
ON7R*	E	88	0.7718	7.3	0.01145	500	7.2	6.8	1165	5.2	1.3	1.3	1.3	1.3	N/A	1.0	0.110	3.34	
ON8R*	E	88	0.7718	27.2	0.04245	500	7.0	6.9	1430	6.1	1.3	1.3	1.3	1.3	N/A	1.3	0.113	3.34	
ON10R	E	88	0.7718	5.4	0.00845	65	10.8	2.2	190	7.4	1.3	1.3	1.3	1.3	N/A	2.8	0.100	3.34	
CD1	D	94	0.8508	3.7	0.00575	25	2.0	1.8	870	0.6	1.3	1.3	1.3	1.3	1.3	1.3	0.087	3.38	
CD2	D	94	0.8508	3.8	0.00594	25	2.0	1.8	1100	0.6	1.3	1.3	1.3	1.3	1.3	1.3	0.113	3.37	
CD3	D	94	0.8508	1.4	0.00219	35	2.0	2.1	490	6.3	1.3	1.3	1.3	1.3	1.3	1.3	0.050	3.36	
Offsite area draining towards existing Unit 1 improvements; precipitation value and CN are taken from the Conceptual Drainage Study																			
ON7R2	E	88	0.7718	20.4	0.00319	500	9.4	5.3	1280	6.4	1.3	1.3	1.3	1.3	N/A	1.2	0.102	3.34	
Rough-graded Crossbridge Drive and Alta Drive with offsite (RG6); precipitation for RG6 is a portion of basin RG6 in the Village 23A Rough Grade Study																			
RG6	E	90.2	0.8008	40.2	0.00625	500	6.6	6.3	1230	5.2	1.3	1.3	1.3	1.3	N/A	1.0	0.107	3.29	
CBRG	E	94	0.8508	12.2	0.01909	45	2.0	2.4	2090	0.5	1.3	1.3	1.3	1.3	N/A	23.5	0.235	3.34	
These subbasins are subdivided from Basin RG6 which is from the Village 23A Rough Grade Study; areas and lag times are revised; precipitation and CN are from the Village 23A Rough Grade Study																			
RG6A	E	88	0.7718	10.2	0.01697	500	7.0	6.9	1925	7.6	1.3	1.3	1.3	1.3	N/A	1.3	0.115	3.29	
RG6B	E	88	0.7718	44.3	0.06929	500	6.4	4.9	3735	6.8	1.3	1.3	1.3	1.3	N/A	5.3	0.193	3.29	
RG6C*	E	88	0.7718	30.7	0.04793	240	8.0	4.9	2450	5.3	1.3	1.3	1.3	1.3	N/A	7.9	0.115	3.29	
RG6D	E	88	0.7718	4.8	0.00748	500	7.4	6.3	425	6.8	1.3	1.3	1.3	1.3	N/A	1.9	0.100	3.29	
RG6E	E	88	0.7718	44.8	0.07000	500	9.2	5.3	2450	5.0	1.3	1.3	1.3	1.3	N/A	23.5	0.198	3.29	
RG6F	E	88	0.7718	17.2	0.02635	500	5.8	5.7	1205	5.4	1.3	1.3	1.3	1.3	N/A	1.9	0.115	3.29	
Tc = Tt + Tt Tlag = 0.6 Tc Tt = 1.8 (1.1 - K) L ^{1/2} / S ^{1/3} K = 0.0132 (CN) - 0.39																			
For the travel time (Tt) calculations, V1 applies to the first 500 feet of travel distance; V2 applies to the remaining travel distance.																			
Existing: V1 = 14.9*(S/100) ^{1/2} V2 = 29.4*(S/100) ^{1/2}																			
Developed: V1 = 20.2*(S/100) ^{1/2} V2 = 30.6*(S/100) ^{1/2}																			
REFERENCE:																			
STANDARD FORM 4																			

Int-V24-PrSplit.OUT

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*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 17MAR15 TIME 15:28:15
*
*****

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*****
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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X X XXXXXX XXXX X
X X X X XX
X X X X X
XXXXXX XXXX X XXXX X
X X X X X
X X X X X
X X XXXXXX XXXX XXX

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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 -AMSK- 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

HEC-1 INPUT

PAGE 1

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
1 ID *****
2 ID SUMMERLIN VILLAGE 24
3 ID UNIT 2 IMPROVEMENTS
4 ID PROPOSED/INTERIM CONDITIONS
5 ID PROPOSED FLOW SPLIT AT VILLAGE 24 BOUNDARY
6 ID
7 ID RETURN PERIOD 100/10-YEAR
8 ID DISTRIBUTION 6-HOUR SDN3
9 ID PROJECT NO 62024-221
10 ID FILENAME INT-V24-PRSPILT.H1
11 ID DATE 3/04/15
12 ID
13 ID
14 ID DEPTH AREA REDUCTION FACTOR
15 ID DARFS RERERENCED FROM THE CONCEPTUAL DRAINAGE STUDY
16 ID SQ MILES DARF
17 ID 0-.1 1.0
18 ID .1-.3 .988
19 ID .3-.5 .980
20 ID .5-.7 .976
21 ID .7-.9 .972
22 ID .9-2.0 .950
23 ID 10-YEAR .575
24 ID
25 ID
26 ID
27 IT 5 0 0 300
28 IO 5
29 IN 5 0 0
30 JR PREC 1 .988 .980 .976 .972 .950 .575
*

```

```

31 KK RG6*
32 KM SUBBASIN RG6*
33 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
34 KM AREA AND CURVE NUMBER REVISED TO INCLUDE UNIT 2 IMPROVEMENTS
35 KM INCLUDES ROUGH-GRADED ALTA AND SKY VISTA DRIVES AND OFFSITE AREA TO THE NORT
36 BA .06275
37 PB 3.29
38 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
39 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
40 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
41 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
42 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
43 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
44 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
45 PC .998 .999 1.00
46 LS 0 90.2
47 UD .107
*
* END RUNOFF TO ALTA DRIVE
*
* BEGIN RUNOFF TO MULTIPLE CULVERTS AT CROSSBRIDGE DRIVE
*

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HEC-1 INPUT

PAGE 2

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
48 XK 7-2B

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49 KM SUBBASIN 7-2B
 * REFERENCED FROM THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL MASTER PL
 50 BA 0.0944
 51 PB 3.58
 52 LS 0 88
 53 UD 0.149
 *

54 KK 7-2Br
 55 KM ROUTE 7-2Br TO CP12
 56 RD 9490 .072 .025 TRAP 0 50
 *

57 KK 7-2A*
 58 KM SUBBASIN 7-2A* (SUBBASIN OFF5 IN THE CONCEPTUAL DRAINAGE STUDY)
 * REFERENCED FROM THE 2006 SUMMERLIN WEST PLANNING AREA FLOOD CONTROL MASTER PL
 * FOR INTERIM CONDITION, THIS BASIN ASSUMED UNDEVELOPED
 * AREA AND LAG TIME HAVE BEEN REVISED FOR INTERIM, UNDEVELOPED CONDITIONS
 59 BA .44300
 60 PB 3.50
 61 LS 0 88
 62 UD 0.275
 *

63 KK CRR1
 64 KM CONCENTRATION POINT CRR1
 65 KM COMBINE 7-2B AND 7-2A* NEAR VILLAGE 24 BOUNDARY
 66 HC 2
 *

67 KK DCRR1
 68 KM DIVERT FLOW FROM EXISTING WASH AT VILLAGE 24 BOUNDARY
 69 KM DIVERTED FLOW (DIVS) TURNS SOUTH
 70 LT DIVS
 71 DI 0 760
 72 DQ 0 259
 *

73 KK RG6C
 74 KM SUBBASIN RG6C
 75 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
 76 BA .04793
 77 PB 3.29
 78 LS 0 88
 79 UD 0.118
 *

80 KK CP12A
 81 KM CONCENTRATION POINT CP12 (AT UPSTREAM SIDE OF BRIDGE)
 82 KM COMBINE CRR1 AND RG6C AT CULVERTS CROSSING CROSSBRIDGE DRIVE
 83 HC 2
 *

HEC-1 INPUT

PAGE 3

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

84 KK CD1
 85 KM SUBBASIN CD1
 86 KM PORTION OF CROSSBRIDGE DRIVE
 * REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
 87 BA .00578
 88 PB 3.38
 89 LS 0 94
 90 UD 0.097
 *

91 KK CP12B
 92 KM CONCENTRATION POINT CP12 (AT DOWNSTREAM SIDE OF BRIDGE)
 93 KM COMBINE CP12A AND CD1
 94 HC 2
 *

* END RUNOFF TO CULVERTS AT CROSSBRIDGE DRIVE
 * BEGIN RUNOFF TO EXISTING 7' BY 7' RCB - PART OF UNIT 1 IMPROVEMENTS
 *

95 KK C
 96 KM SUBBASIN PARCEL C
 97 KM DEVELOPED SUBBASIN ADDED TO THIS FILE TO FIND WORST-CASE FLOW AT
 98 KM EXISTING 7' BY 7' RCB - PARCEL C IS NOT PROPOSED FOR DEVELOPMENT AT THIS TIME
 * REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
 99 BA .03888
 100 PB 3.37
 101 LS 0 85.7
 102 UD 0.165
 *

103 KK ON7R2
 104 KM SUBBASIN ON7R2
 105 BA .03191
 106 PB 3.34
 107 LS 0 88
 108 UD 0.102
 *

109 KK CPRCB
 110 KM CONCENTRATION POINT CPRCB AT EXISTING RCB AT CROSSBRIDGE
 111 KM COMBINE CP12B, FUTURE PARCEL C AND ON7R2
 112 HC 3

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* BEGIN RUNOFF TO PROPOSED STORM DRAIN STARTING IN CROSSBRIDGE DRIVE, EXTENDING
 * EAST IN SUNCREEK AND SOUTH IN SKY VISTA AND
 * CONNECTING TO EXISTING STORM DRAIN IN SKY VISTA
 *

113 KK CBRG
 114 KM SUBBASIN CBRG
 115 KM A PORTION OF ROUGH GRADED CROSSBRIDGE DRIVE
 116 BA .01909
 117 PB 3.34
 118 LS 0 94

HEC-1 INPUT

PAGE 4

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

119 UD 0.235
 *

120 KK ST6*
 121 KM SUBBASIN ST6
 122 KM SUNCREEK ROAD
 * REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
 * AREA SLIGHTLY REVISED
 123 BA .00284
 124 PB 3.34
 125 LS 0 94
 126 UD 0.075
 *

127 KK CP5
 128 KM CONCENTRATION POINT CP5
 129 KM COMBINE ST6 AND CBRG IN STORM DRAIN AT INTERSECTION OF
 130 KM SUNCREEK ROAD AND SKY VISTA DRIVE
 131 HC 2
 *
 * BEGIN RUNOFF TO PROPOSED STORM DRAIN IN SKY VISTA
 *

132 KK RG6D
 133 KM SUBBASIN RG6D
 134 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
 135 BA .00748
 136 PB 3.29
 137 LS 0 88
 138 UD 0.100
 *

139 KK RG6A
 140 KM SUBBASIN RG6A
 141 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
 142 BA .01597
 143 PB 3.29
 144 LS 0 88
 145 UD 0.119
 *

146 KK RG6Ar
 147 KM ROUTE RG6A TO CP6
 148 RD 2880 .056 .025 TRAP 0 50
 *

149 KK RG6B
 150 KM SUBBASIN RG6B
 151 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
 152 BA .06920
 153 PB 3.29
 154 LS 0 88
 155 UD 0.163
 *

HEC-1 INPUT

PAGE 5

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

156 KK RG6Br
 157 KM ROUTE RG6B TO CP6
 158 RD 2740 .055 .025 TRAP 0 50
 *

159 KK RG6E
 160 KM SUBBASIN RG6E
 161 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
 162 BA .07000
 163 PB 3.29
 164 LS 0 88
 165 UD 0.138
 *

166 KK CP6
 167 KM CONCENTRATION POINT CP6
 168 KM COMBINE RG6A, RG6B AND RG6E AT STUB TO SKY VISTA STORM DRAIN
 169 HC 3
 *

170 KK CP7
 171 KM CONCENTRATION POINT CP7
 172 KM COMBINE RG6D AND CP6 IN STORM DRAIN UPSTREAM OF INTERSECTION OF
 173 KM SUNCREEK ROAD AND SKY VISTA DRIVE

174 HC 2
*
175 KK CP8
176 KM CONCENTRATION POINT CP8
177 KM COMBINE CP5 AND CP7 IN STORM DRAIN AT INTERSECTION OF
178 KM SUNCREEK ROAD AND SKY VISTA DRIVE
179 HC 2
*
180 KK ST2
181 KM SUBBASIN ST2
182 KM SKY VISTA DRIVE FROM ALTA DRIVE TO CROSSBRIDGE DRIVE
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
183 BA .01563
184 PB 3.34
185 LS 0 94
186 UD 0.140
*
187 KK RG6F
188 KM SUBBASIN RG6F
189 KM A PORTION OF SUBBASIN RG6 FROM THE VILLAGE 23A ROUGH GRADE STUDY
190 KM DRAINS TO TEMPORARY STUB TO THE SKY VISTA STORM DRAIN
191 BA .02689
192 PB 3.29
193 LS 0 88
194 UD 0.115
*

HEC-1 INPUT

PAGE 6

1

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
195 KK CP9
196 KM CONCENTRATION POINT CP9
197 KM COMBINE CP8, RG6F AND ST2 IN SKY VISTA STORM DRAIN
198 HC 3
*
199 KK CP9B
200 KM COMBINE CPRCB AND CP9 IN UNIT 1 CROSSBRIDGE DRIVE STORM DRAIN
201 HC 2
*
* BEGIN OFFSITE WESTERN BOUNDARY AND ONSITE RUNOFF TO EXISTING WASH SOUTH OF UNI
*
202 KK RRTDS
203 KM RETRIEVE DIVERTED FLOW
204 DR DIVS
*
205 KK OFF6
206 KM SUBBASIN OFF6
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
207 BA .00550
208 PB 3.43
209 LS 0 88
210 UD 0.050
*
211 KK OFF7
212 KM OFFSITE SUBBASIN OFF7
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
213 BA .11888
214 PB 3.43
215 LS 0 88
216 UD 0.174
*
217 KK OFF8
218 KM OFFSITE SUBBASIN OFF8
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
219 BA .02153
220 PB 3.43
221 LS 0 88
222 UD 0.113
*
223 KK OFF9
224 KM OFFSITE SUBBASIN OFF9
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
225 BA .00694
226 PB 3.43
227 LS 0 88
228 UD 0.077
*

HEC-1 INPUT

PAGE 7

1

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
229 KK OFF10
230 KM OFFSITE SUBBASIN OFF10
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
231 BA .01161
232 PB 3.43
233 LS 0 88
234 UD 0.088

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*
235 KK COFF10
236 KM DUMMY
237 KM COMBINE DIVS, OFF6, OFF7, OFF8, OFF9 AND OFF10
238 HC 6
*
239 KK OFF11A
240 KM SUBBASIN OFF11A
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24
* CONSISTS OF THE AREA FOR SUBBASINS OFF12 THROUGH OFF17
241 BA .14308
242 PB 3.43
243 LS 0 88
244 UD 0.160
*
245 KK CRR2
246 KM CONCENTRATION POINT CRR2
247 KM COMBINE COFF10 AND OFF11-A
248 HC 2
*
249 KK ON11
250 KM ONSITE SUBBASIN ON11
* REFERENCED FROM THE TECHNICAL DRAINAGE STUDY FOR SUMMERLIN VILLAGE 24 UNIT 1
* IMPROVEMENTS INCLUDING PARCELS "A" AND "B" MASS GRADING
251 BA .05391
252 PB 3.34
253 LS 0 88
254 UD 0.115
*
255 KK ON7R
256 KM SUBBASIN ON7R
257 BA .01145
258 PB 3.34
259 LS 0 88
260 UD 0.110
*

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HEC-1 INPUT

PAGE 8

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1
LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
261 KK ON8R
262 KM SUBBASIN ON8R
263 BA .04245
264 PB 3.34
265 LS 0 88
266 UD 0.113
*
267 KK CP1
268 KM CONCENTRATION POINT CP1
269 KM COMBINE ON7R AND ON8R AT STORM DRAIN STUB
270 HC 2
*
271 KK CD2
272 KM SUBBASIN CD2
273 KM PORTION OF CROSSBRIDGE DRIVE
* REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY UPDATE #2
274 BA .00594
275 PB 3.37
276 LS 0 94
277 UD 0.113
*
278 KK ON10R
279 KM SUBBASIN ON10R
280 KM AREA BETWEEN EXISTING BERM AND CROSSBRIDGE DRIVE
281 BA .00845
282 PB 3.34
283 LS 0 88
284 UD 0.100
*
285 KK CP2
286 KM CONCENTRATION POINT CP2
287 KM COMBINE CP1, CD2 AND ON10R IN STORM DRAIN IN CROSSBRIDGE
288 HC 3
*
289 KK CP2r
290 KM ROUTE CP2 TO CP11
291 RD 1885 .056 .025 TRAP 0 50
*
292 KK OFF11B
293 KM SUBBASIN OFF11B
294 BA .08867
295 PB 3.34
296 LS 0 88
297 UD 0.158
*

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HEC-1 INPUT

PAGE 9


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Int-V24-PrSplit.OUT
* :
* : SUMMERLIN VILLAGE 24 : *
* : UNIT 2 IMPROVEMENTS : *
* : PROPOSED/INTERIM CONDITIONS : *
* : PROPOSED FLOW SPLIT AT VILLAGE 24 BOUNDARY : *
* : ..... : *
* : RETURN PERIOD --- 100/10-YEAR : *
* : DISTRIBUTION --- 6-HOUR SDN3 : *
* : PROJECT NO --- 62024-221 : *
* : FILENAME --- INT-V24-PRSPPLIT.H1 : *
* : DATE --- 3/04/15 : *
* : ..... : *

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DEPTH AREA REDUCTION FACTOR
DARFS REFERENCED FROM THE CONCEPTUAL DRAINAGE STUDY
SQ MILES DARF
0-.1 1.0
.1-.3 .988
.3-.5 .980
.5-.7 .976
.7-.9 .972
.9-2.0 .950
10-YEAR .575

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28 IO OUTPUT CONTROL VARIABLES
      IPRNT 5 PRINT CONTROL
      IPLOT 0 PLOT CONTROL
      IQSCAL 0. HYDROGRAPH PLOT SCALE

```

```

IT HYDROGRAPH TIME DATA
    NMIN 5 MINUTES IN COMPUTATION INTERVAL
    IDATE 1 0 STARTING DATE
    ITIME 0000 STARTING TIME
    NQ 300 NUMBER OF HYDROGRAPH ORDINATES
    NDDATE 2 0 ENDING DATE
    NDTIME 0055 ENDING TIME
    ICENT 19 CENTURY MARK

```

```

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

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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 .99 .98 .98 .97 .95 .57

```

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO PRECIPITATION						
				RATIO 1 1.00	RATIO 2 .99	RATIO 3 .98	RATIO 4 .98	RATIO 5 .97	RATIO 6 .95	RATIO 7 .57
HYDROGRAPH AT +	RG6*	.06	1 FLOW TIME	122. 3.50	120. 3.50	118. 3.50	118. 3.50	117. 3.50	114. 3.50	56. 3.50
HYDROGRAPH AT +	7-2B	.09	1 FLOW TIME	182. 3.58	179. 3.58	177. 3.58	176. 3.58	175. 3.58	170. 3.58	82. 3.58
ROUTED TO +	7-2Br	.09	1 FLOW TIME	174. 3.83	172. 3.83	170. 3.83	169. 3.83	168. 3.83	163. 3.83	82. 3.92
HYDROGRAPH AT +	7-2A*	.44	1 FLOW TIME	653. 3.67	643. 3.67	636. 3.67	632. 3.67	629. 3.67	609. 3.67	287. 3.67
2 COMBINED AT +	CRR1	.54	1 FLOW TIME	785. 3.75	773. 3.75	764. 3.75	760. 3.75	756. 3.75	732. 3.75	331. 3.83
DIVERSION TO +	DIVS	.54	1 FLOW TIME	268. 3.75	264. 3.75	261. 3.75	259. 3.75	258. 3.75	249. 3.75	113. 3.83
HYDROGRAPH AT +	DCRR1	.54	1 FLOW TIME	518. 3.75	510. 3.75	504. 3.75	501. 3.75	498. 3.75	482. 3.75	218. 3.83
HYDROGRAPH AT +	RG6C	.05	1 FLOW TIME	85. 3.58	84. 3.58	83. 3.58	82. 3.58	82. 3.58	79. 3.58	38. 3.58

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2 COMBINED AT	CP12A	.59	1	FLOW TIME	566. 3.75	556. 3.75	550. 3.75	547. 3.75	544. 3.75	527. 3.75	234. 3.83
+											
HYDROGRAPH AT	CD1	.01	1	FLOW TIME	13. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	7. 3.50
+											
2 COMBINED AT	CP12B	.59	1	FLOW TIME	572. 3.75	562. 3.75	556. 3.75	553. 3.75	550. 3.75	532. 3.75	237. 3.75
+											
HYDROGRAPH AT	C	.04	1	FLOW TIME	61. 3.58	60. 3.58	59. 3.58	59. 3.58	58. 3.58	56. 3.58	25. 3.58
+											
HYDROGRAPH AT	ON7R2	.03	1	FLOW TIME	60. 3.50	59. 3.50	58. 3.50	58. 3.50	58. 3.50	56. 3.50	26. 3.50
+											
3 COMBINED AT	CPRCB	.66	1	FLOW TIME	656. 3.67	644. 3.67	637. 3.67	633. 3.67	629. 3.67	609. 3.67	269. 3.75
+											
HYDROGRAPH AT	CBRG	.02	1	FLOW TIME	34. 3.67	33. 3.67	33. 3.67	33. 3.67	33. 3.67	32. 3.67	17. 3.67
+											
HYDROGRAPH AT	ST6*	.00	1	FLOW TIME	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	7. 3.50	4. 3.50
+											
2 COMBINED AT	CP5	.02	1	FLOW TIME	38. 3.58	37. 3.58	37. 3.58	37. 3.58	36. 3.58	35. 3.58	19. 3.58
+											
HYDROGRAPH AT	RG6D	.01	1	FLOW TIME	14. 3.50	14. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	6. 3.50
+											
HYDROGRAPH AT	RG6A	.02	1	FLOW TIME	28. 3.58	28. 3.58	28. 3.58	27. 3.58	27. 3.58	26. 3.58	13. 3.58
+											
ROUTED TO	RG6Ar	.02	1	FLOW TIME	27. 3.67	27. 3.67	26. 3.67	26. 3.67	26. 3.67	25. 3.67	12. 3.75
+											
HYDROGRAPH AT	RG6B	.07	1	FLOW TIME	116. 3.58	114. 3.58	113. 3.58	113. 3.58	112. 3.58	108. 3.58	51. 3.58
+											
ROUTED TO	RG6Br	.07	1	FLOW TIME	111. 3.67	109. 3.67	108. 3.67	108. 3.67	107. 3.67	104. 3.67	48. 3.75
+											
HYDROGRAPH AT	RG6E	.07	1	FLOW TIME	123. 3.58	121. 3.58	119. 3.58	119. 3.58	118. 3.58	114. 3.58	54. 3.58
+											
3 COMBINED AT	CP6	.16	1	FLOW TIME	239. 3.58	235. 3.58	232. 3.58	230. 3.58	229. 3.58	222. 3.67	102. 3.67
+											
2 COMBINED AT	CP7	.16	1	FLOW TIME	252. 3.58	247. 3.58	245. 3.58	243. 3.58	242. 3.58	234. 3.58	106. 3.67
+											
2 COMBINED AT	CP8	.18	1	FLOW TIME	289. 3.58	284. 3.58	281. 3.58	280. 3.58	278. 3.58	269. 3.58	125. 3.67
+											
HYDROGRAPH AT	ST2	.02	1	FLOW TIME	33. 3.58	32. 3.58	32. 3.58	32. 3.58	32. 3.58	31. 3.58	17. 3.58
+											
HYDROGRAPH AT	RG6F	.03	1	FLOW TIME	48. 3.58	47. 3.58	46. 3.58	46. 3.58	46. 3.58	44. 3.58	21. 3.58
+											
3 COMBINED AT	CP9	.23	1	FLOW TIME	370. 3.58	364. 3.58	360. 3.58	358. 3.58	356. 3.58	344. 3.58	160. 3.58
+											
2 COMBINED AT	CP9B	.89	1	FLOW TIME	1000. 3.67	983. 3.67	973. 3.67	967. 3.67	961. 3.67	931. 3.67	422. 3.67
+											
HYDROGRAPH AT	RETDS	.00	1	FLOW TIME	268. 3.75	264. 3.75	261. 3.75	259. 3.75	258. 3.75	249. 3.75	113. 3.83
+											
HYDROGRAPH AT	OFF6	.01	1	FLOW TIME	13. 3.50	13. 3.50	13. 3.50	13. 3.50	13. 3.50	12. 3.50	6. 3.50
+											
HYDROGRAPH AT	OFF7	.12	1	FLOW	206.	203.	201.	199.	198.	192.	91.
+											

					Int-V24-PrSplit.OUT							
TIME					3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT	OFF8	.02	1	FLOW	40.	40.	39.	39.	39.	38.	18.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
HYDROGRAPH AT	OFF9	.01	1	FLOW	15.	15.	14.	14.	14.	14.	7.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	
HYDROGRAPH AT	OFF10	.01	1	FLOW	24.	23.	23.	23.	23.	22.	11.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	
6 COMBINED AT	COFF10	.16	1	FLOW	498.	489.	484.	481.	478.	463.	212.	
+				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.58	
HYDROGRAPH AT	OFF11A	.14	1	FLOW	256.	252.	249.	248.	246.	239.	113.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
2 COMBINED AT	CRR2	.31	1	FLOW	749.	736.	728.	724.	720.	697.	325.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
HYDROGRAPH AT	ON11	.05	1	FLOW	97.	96.	95.	94.	94.	91.	44.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
HYDROGRAPH AT	ON7R	.01	1	FLOW	21.	20.	20.	20.	20.	19.	9.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.58	
HYDROGRAPH AT	ON8R	.04	1	FLOW	77.	75.	75.	74.	74.	72.	34.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
2 COMBINED AT	CP1	.05	1	FLOW	97.	96.	95.	94.	94.	91.	44.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
HYDROGRAPH AT	CD2	.01	1	FLOW	13.	13.	13.	12.	12.	12.	7.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	
HYDROGRAPH AT	ON10R	.01	1	FLOW	16.	16.	16.	15.	15.	15.	7.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	
3 COMBINED AT	CP2	.07	1	FLOW	126.	124.	122.	122.	121.	117.	57.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.58	
ROUTED TO	CP2r	.07	1	FLOW	123.	121.	120.	119.	118.	114.	57.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67	
HYDROGRAPH AT	OFF11B	.09	1	FLOW	153.	151.	149.	149.	148.	143.	68.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
4 COMBINED AT	CP11	.52	1	FLOW	1123.	1104.	1092.	1086.	1080.	1045.	492.	
+				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	
HYDROGRAPH AT	CD3	.00	1	FLOW	6.	6.	6.	6.	6.	6.	3.	
+				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL			VOLUME
						PEAK	TIME TO PEAK		
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1	RATIO=	.00							
7-2Bx	MANE	4.00	174.34	232.00	2.35	5.00	174.33	230.00	2.35

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1178E+02 EXCESS= .0000E+00 OUTFLOW= .1181E+02 BASIN STORAGE= .4691E-02 PERCENT ERROR= -.3

FOR PLAN = 1	RATIO=	.00							
7-2Bx	MANE	4.00	171.85	232.00	2.31	5.00	171.52	230.00	2.31

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1158E+02 EXCESS= .0000E+00 OUTFLOW= .1161E+02 BASIN STORAGE= .4663E-02 PERCENT ERROR= -.3

FOR PLAN = 1	RATIO=	.00							
7-2Bx	MANE	4.00	170.18	232.00	2.28	5.00	169.65	230.00	2.28

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1145E+02 EXCESS= .0000E+00 OUTFLOW= .1148E+02 BASIN STORAGE= .4643E-02 PERCENT ERROR= -.3

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FOR PLAN = 1	RATIO=	.00							
7-2Br	MANE	4.00	169.35	232.00	2.27	5.00	168.71	230.00	2.27
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1139E+02 EXCESS= .0000E+00 OUTFLOW= .1141E+02 BASIN STORAGE= .4634E-02 PERCENT ERROR= -.3									
FOR PLAN = 1	RATIO=	.00							
7-2Br	MANE	4.00	168.52	232.00	2.25	5.00	167.77	230.00	2.25
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1132E+02 EXCESS= .0000E+00 OUTFLOW= .1135E+02 BASIN STORAGE= .4624E-02 PERCENT ERROR= -.3									
FOR PLAN = 1	RATIO=	.00							
7-2Br	MANE	4.00	163.92	232.00	2.18	5.00	162.58	230.00	2.18
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1096E+02 EXCESS= .0000E+00 OUTFLOW= .1099E+02 BASIN STORAGE= .4519E-02 PERCENT ERROR= -.3									
FOR PLAN = 1	RATIO=	.00							
7-2Br	MANE	5.00	81.92	235.00	1.02	5.00	81.92	235.00	1.02
CONTINUITY SUMMARY (AC-FT) - INFLOW= .5098E+01 EXCESS= .0000E+00 OUTFLOW= .5120E+01 BASIN STORAGE= .3825E-02 PERCENT ERROR= -.5									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.25	27.73	221.00	2.08	5.00	27.10	220.00	2.08
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1766E+01 EXCESS= .0000E+00 OUTFLOW= .1768E+01 BASIN STORAGE= .1546E-02 PERCENT ERROR= -.2									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.25	27.28	221.00	2.04	5.00	26.65	220.00	2.04
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1736E+01 EXCESS= .0000E+00 OUTFLOW= .1738E+01 BASIN STORAGE= .1534E-02 PERCENT ERROR= -.2									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.50	26.88	220.50	2.02	5.00	26.47	220.00	2.03
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1718E+01 EXCESS= .0000E+00 OUTFLOW= .1720E+01 BASIN STORAGE= .1509E-02 PERCENT ERROR= -.2									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.50	26.73	220.50	2.01	5.00	26.32	220.00	2.01
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1708E+01 EXCESS= .0000E+00 OUTFLOW= .1710E+01 BASIN STORAGE= .1505E-02 PERCENT ERROR= -.2									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.50	26.58	220.50	2.00	5.00	26.17	220.00	2.00
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1697E+01 EXCESS= .0000E+00 OUTFLOW= .1700E+01 BASIN STORAGE= .1501E-02 PERCENT ERROR= -.2									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.25	25.85	221.00	1.93	5.00	25.22	220.00	1.93
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1641E+01 EXCESS= .0000E+00 OUTFLOW= .1643E+01 BASIN STORAGE= .1497E-02 PERCENT ERROR= -.2									
FOR PLAN = 1	RATIO=	.00							
RG6Ar	MANE	4.25	12.14	225.25	.88	5.00	12.12	225.00	.88
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7467E+00 EXCESS= .0000E+00 OUTFLOW= .7478E+00 BASIN STORAGE= .1509E-02 PERCENT ERROR= -.3									
FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.50	112.81	220.50	2.08	5.00	111.33	220.00	2.08
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7667E+01 EXCESS= .0000E+00 OUTFLOW= .7672E+01 BASIN STORAGE= .1184E-02 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.50	110.95	220.50	2.04	5.00	109.48	220.00	2.05
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7536E+01 EXCESS= .0000E+00 OUTFLOW= .7541E+01 BASIN STORAGE= .1174E-02 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.50	109.72	220.50	2.02	5.00	108.25	220.00	2.02
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7448E+01 EXCESS= .0000E+00 OUTFLOW= .7453E+01 BASIN STORAGE= .1167E-02 PERCENT ERROR= -.1									

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FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.50	109.10	220.50	2.01	5.00	107.63	220.00	2.01
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7405E+01 EXCESS= .0000E+00 OUTFLOW= .7410E+01 BASIN STORAGE= .1164E-02 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.50	108.48	220.50	2.00	5.00	107.01	220.00	2.00
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7361E+01 EXCESS= .0000E+00 OUTFLOW= .7366E+01 BASIN STORAGE= .1160E-02 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.50	105.07	220.50	1.93	5.00	103.62	220.00	1.94
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7121E+01 EXCESS= .0000E+00 OUTFLOW= .7126E+01 BASIN STORAGE= .1142E-02 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
RG6Br	MANE	4.75	49.71	223.25	.88	5.00	47.83	225.00	.88
CONTINUITY SUMMARY (AC-FT) - INFLOW= .3241E+01 EXCESS= .0000E+00 OUTFLOW= .3244E+01 BASIN STORAGE= .1381E-02 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	4.00	125.91	216.00	2.17	5.00	122.95	215.00	2.17
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7905E+01 EXCESS= .0000E+00 OUTFLOW= .7910E+01 BASIN STORAGE= .8482E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	4.00	123.91	216.00	2.14	5.00	120.97	215.00	2.14
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7772E+01 EXCESS= .0000E+00 OUTFLOW= .7777E+01 BASIN STORAGE= .8409E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	4.00	122.58	216.00	2.11	5.00	119.65	215.00	2.11
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7683E+01 EXCESS= .0000E+00 OUTFLOW= .7688E+01 BASIN STORAGE= .8359E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	4.00	121.92	216.00	2.10	5.00	118.99	215.00	2.10
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7639E+01 EXCESS= .0000E+00 OUTFLOW= .7644E+01 BASIN STORAGE= .8335E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	4.00	121.25	216.00	2.09	5.00	118.33	215.00	2.09
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7595E+01 EXCESS= .0000E+00 OUTFLOW= .7600E+01 BASIN STORAGE= .8310E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	4.25	117.43	216.75	2.02	5.00	113.57	215.00	2.02
CONTINUITY SUMMARY (AC-FT) - INFLOW= .7352E+01 EXCESS= .0000E+00 OUTFLOW= .7356E+01 BASIN STORAGE= .9335E-03 PERCENT ERROR= -.1									
FOR PLAN = 1	RATIO=	.00							
CP2r	MANE	5.00	57.17	220.00	.94	5.00	57.17	220.00	.94
CONTINUITY SUMMARY (AC-FT) - INFLOW= .3422E+01 EXCESS= .0000E+00 OUTFLOW= .3425E+01 BASIN STORAGE= .1241E-02 PERCENT ERROR= -.1									

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

Worksheet for Rectangular Weir - 84 COS-3

Project Description

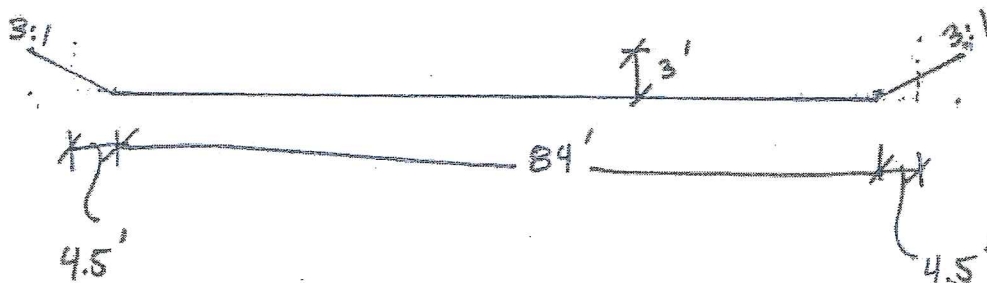
Solve For: Headwater Elevation

Input Data

Discharge	720.00	ft ³ /s
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	2.70	US
Crest Length	93.00	ft
Number Of Contractions	0	

Results

Headwater Elevation	2.02	ft
Headwater Height Above Crest	2.02	ft
Tailwater Height Above Crest	0.00	ft
Flow Area	187.70	ft ²
Velocity	3.84	ft/s
Wetted Perimeter	97.04	ft
Top Width	93.00	ft



Cross Section for Rectangular Weir - 84 COS-3

Project Description

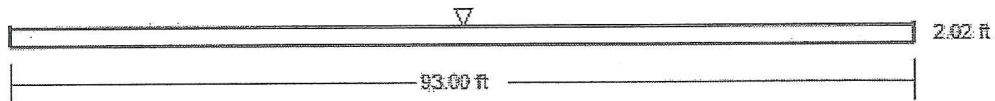
Solve For

Headwater Elevation

Input Data

Discharge	720.00	ft ³ /s
Headwater Elevation	2.02	ft
Crest Elevation	0.00	ft
Tailwater Elevation	0.00	ft
Weir Coefficient	2.70	US
Crest Length	93.00	ft
Number Of Contractions	0	

Cross Section Image



V: 1
H: 1

Storm Drain Hydraulics Calculations

G.C. Wallace, Inc.

Hydraulic Calculations for Main Line No. 1: Existing Wash to Crossbridge to Parcel J (Ultimate)

DATE 10/27/15 FILE: SF6.xls

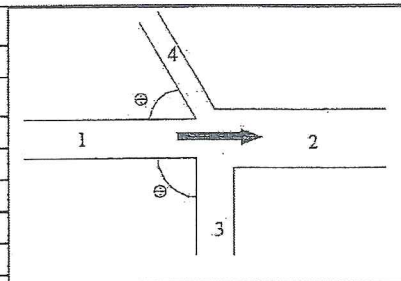
[illegible]

NOTE: 126 cfs is from Parcel J; 134 cfs = 126 cfs + 8 cfs (from parcel I); 142 cfs = 134 cfs + 8 cfs (from parcel I); 153 cfs = 142 cfs + 11 cfs from subbasin CD2.

Junction Head Loss Calculation

Known

Diameter of Pipe 1 (in)	54.0
Diameter of Pipe 2 (in)	54.0
Diameter of Pipe 3 (in)	24.0
Diameter of Pipe 4 (in)*	24.0
Flow in Pipe 1 (cfs)	118
Flow in Pipe 2 (cfs)	123
Flow in Pipe 3 (cfs)	3
Flow in Pipe 4 (cfs)*	3
Angle of Pipe 3	72
Angle of Pipe 4*	85



*Optional

Headloss is applied at Entrance to Ju

Solve For

Insert Loss in Misc. Loss Column and
leave Junction Loss Column Blank

Area of Pipe 1 (ft ²)	15.90
Area of Pipe 2 (ft ²)	15.90
Area of Pipe 3 (ft ²)	3.14
Area of Pipe 4 (ft ²)	3.14

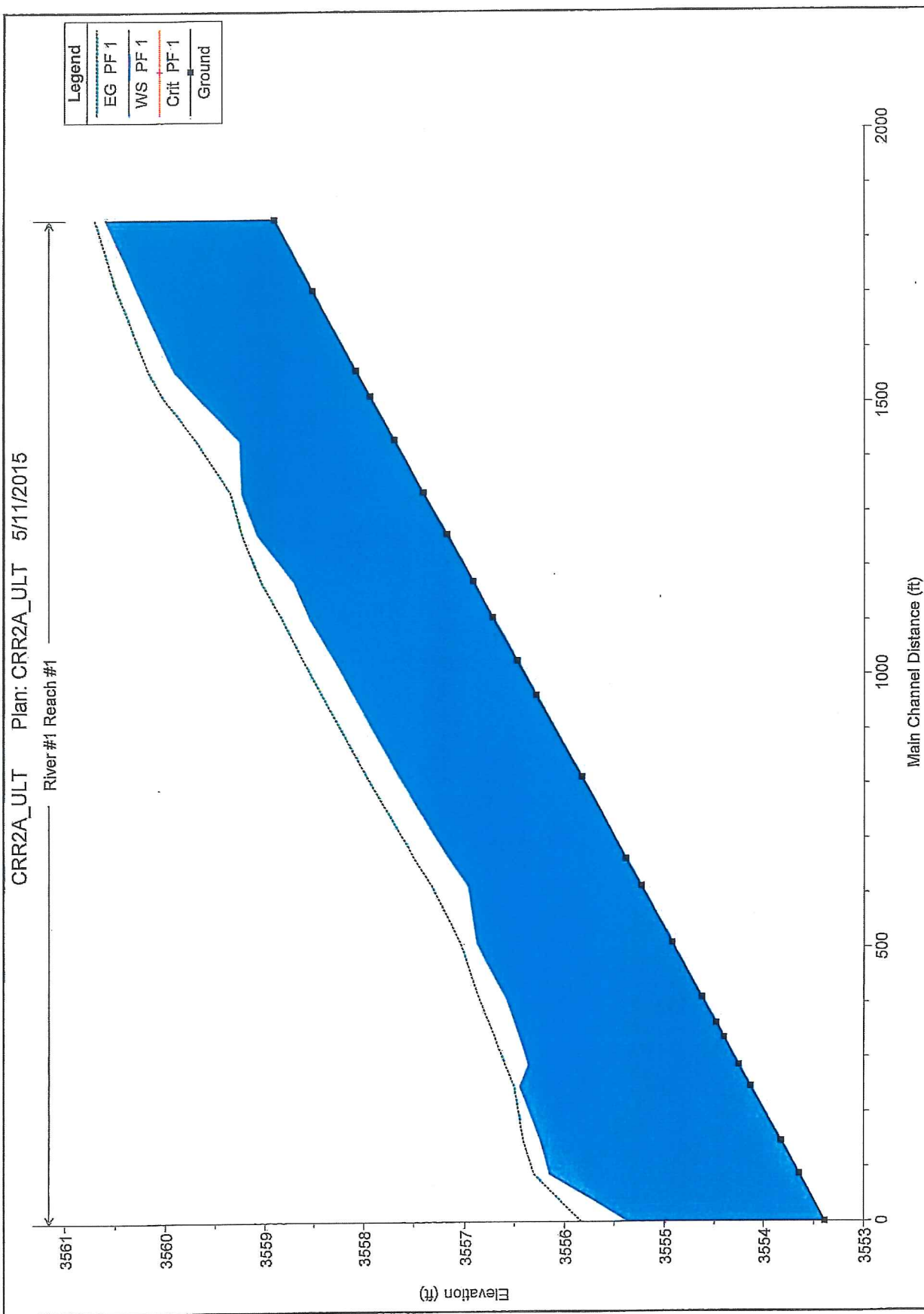
Head Loss at Junction (ft) **0.15**

Equation Used:

Incorporates Pressure plus Momentum Laws

$$H_j = \left(\frac{Q_2^2}{A_2 \cdot g} - \frac{Q_1^2}{A_1 \cdot g} - \frac{Q_3^2 \cdot \cos(\text{Ang}3)}{A_3 \cdot g} - \frac{Q_4^2 \cdot \cos(\text{Ang}4)}{A_4 \cdot g} \right) \cdot 2 / (A_1 + A_2) - D_1 + D_2$$

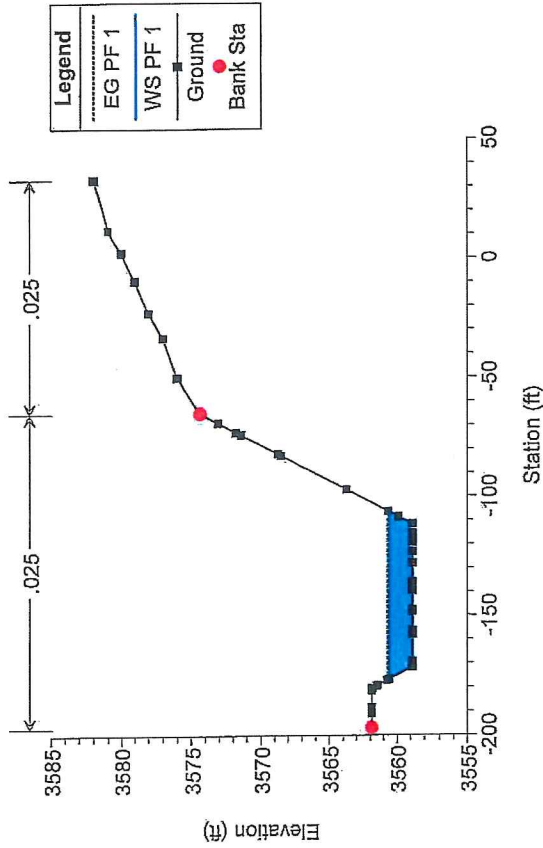
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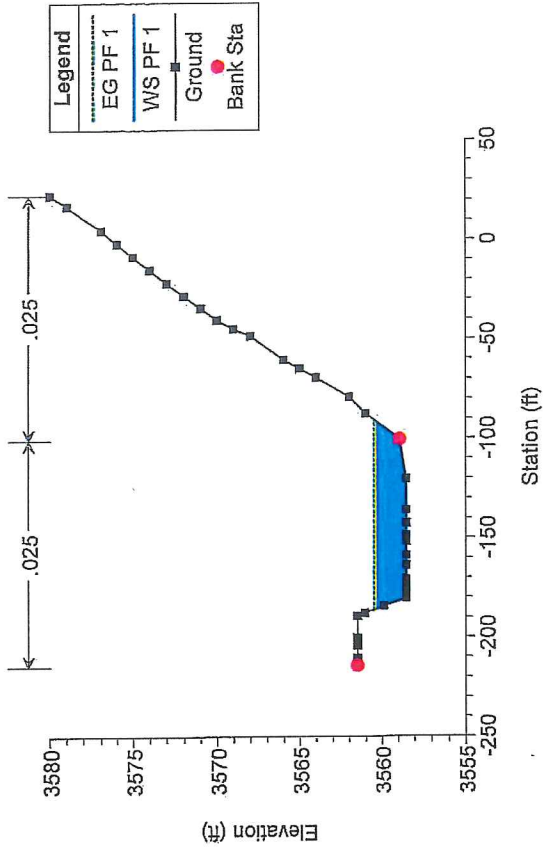
HEC-RAS Plan: CRR2A_ULT River: River #1 Reach: Reach #1 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach #1	4600	PF 1	287.00	3558.90	3560.60		3560.70	0.001055	2.60	110.46	70.22	0.37
Reach #1	4450	PF 1	540.00	3558.51	3560.27		3560.49	0.002007	3.73	147.43	93.60	0.51
Reach #1	4300	PF 1	540.00	3558.07	3559.91		3560.16	0.002367	4.20	135.97	88.08	0.58
Reach #1	4250	PF 1	540.00	3557.93	3559.67		3560.02	0.003441	4.76	113.39	70.46	0.68
Reach #1	4150	PF 1	540.00	3557.69	3559.24		3559.68	0.004955	5.33	101.30	69.92	0.78
Reach #1	4100	PF 1	540.00	3557.40	3559.22		3559.34	0.001553	2.73	197.70	166.71	0.43
Reach #1	4000	PF 1	540.00	3557.17	3559.07		3559.22	0.001360	3.18	174.20	107.98	0.42
Reach #1	3915	PF 1	540.00	3556.91	3558.70		3559.03	0.003103	4.61	117.16	70.76	0.63
Reach #1	3850	PF 1	540.00	3556.71	3558.54		3558.83	0.002567	4.39	127.50	79.10	0.58
Reach #1	3770	PF 1	540.00	3556.47	3558.28		3558.61	0.003030	4.59	117.65	70.17	0.62
Reach #1	3700	PF 1	540.00	3556.28	3558.09		3558.41	0.003009	4.56	118.30	70.82	0.62
Reach #1	3650	PF 1	540.00	3555.83	3557.63		3557.96	0.003031	4.57	118.06	70.88	0.62
Reach #1	3400	PF 1	540.00	3555.38	3557.15		3557.49	0.003268	4.89	115.25	70.60	0.65
Reach #1	3350	PF 1	540.00	3555.23	3556.96		3557.31	0.003518	4.80	112.56	70.35	0.67
Reach #1	3250	PF 1	540.00	3554.92	3556.87		3557.04	0.001403	3.32	165.04	94.64	0.43
Reach #1	3150	PF 1	540.00	3554.62	3556.58		3556.85	0.002284	4.18	129.21	71.76	0.55
Reach #1	3100	PF 1	540.00	3554.48	3556.49		3556.75	0.002105	4.07	132.64	72.06	0.53
Reach #1	3000	PF 1	540.00	3554.40	3556.44		3556.69	0.001994	4.00	134.97	72.27	0.52
Reach #1	2990	PF 1	540.00	3554.25	3556.36		3556.59	0.001762	3.88	139.99	73.81	0.49
Reach #1	2950	PF 1	540.00	3554.13	3556.44		3556.50	0.000582	1.92	281.15	181.38	0.27
Reach #1	2850	PF 1	540.00	3553.83	3556.23		3556.41	0.001145	3.36	160.62	73.46	0.40
Reach #1	2825	PF 1	540.00	3553.65	3556.15		3556.31	0.002565	3.20	168.51	75.00	0.38
Reach #1	2800	PF 1	720.00	3553.39	3555.35	3554.99	3555.83	0.010419	5.58	129.09	71.72	0.73

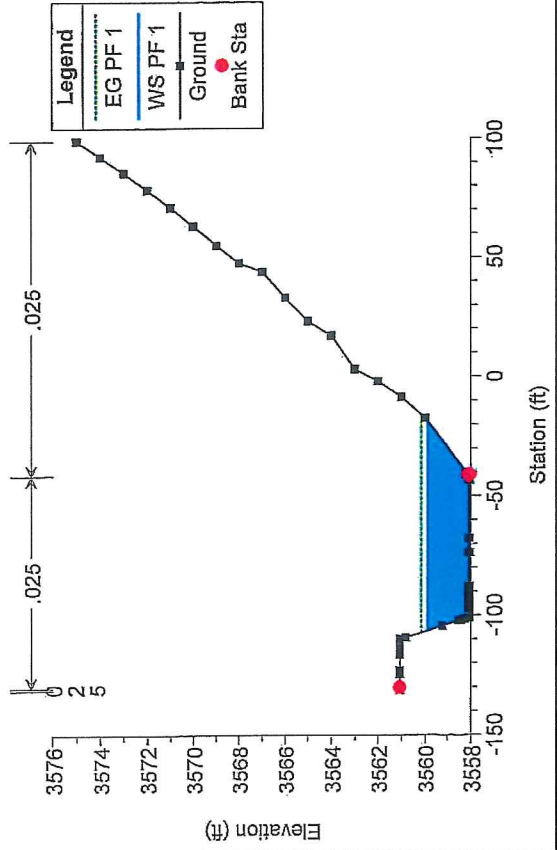
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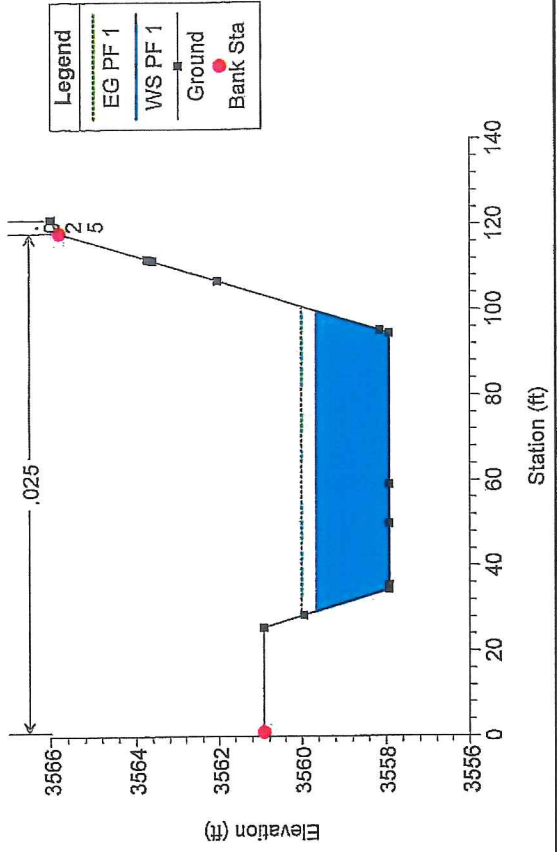
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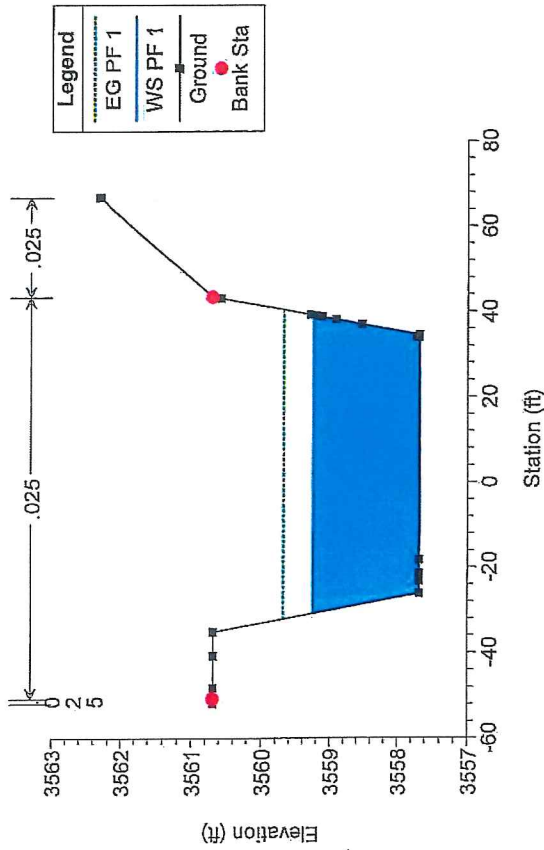
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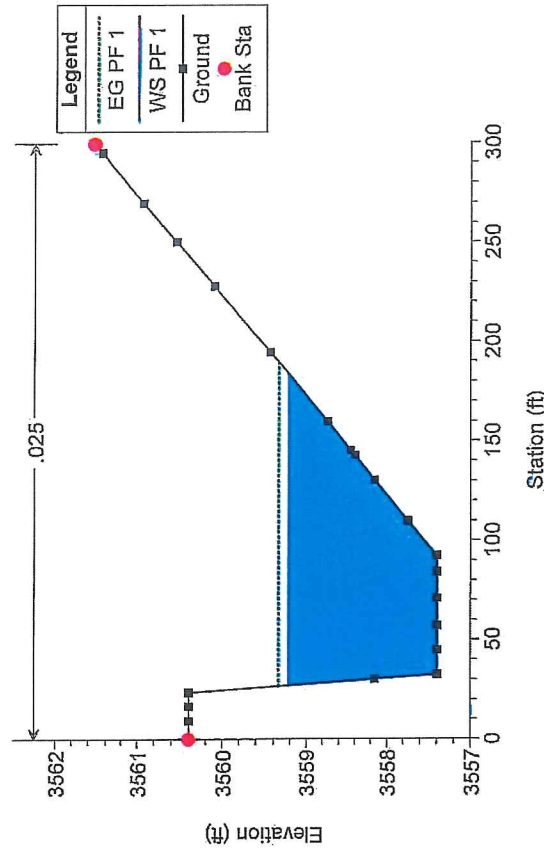
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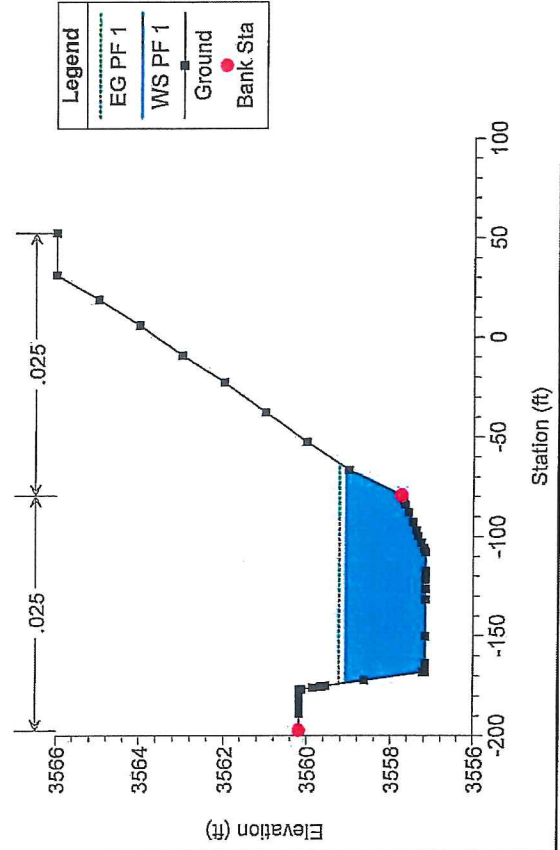
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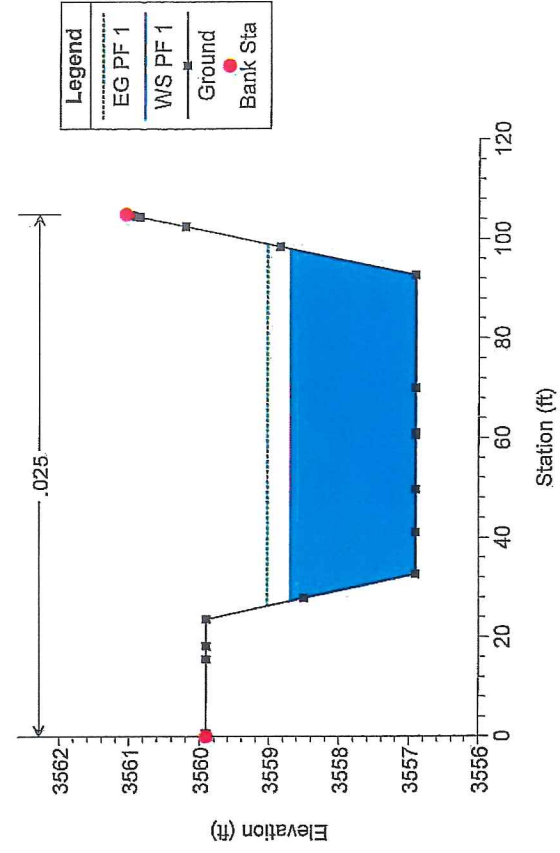
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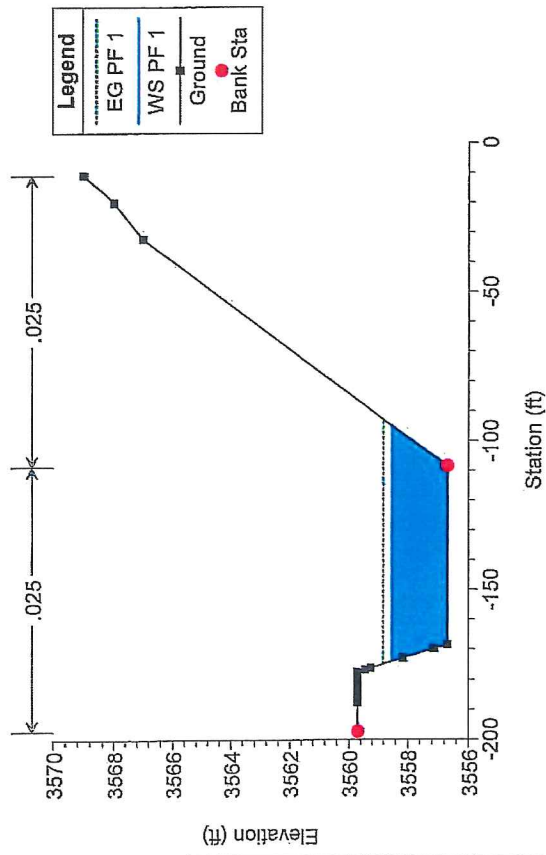
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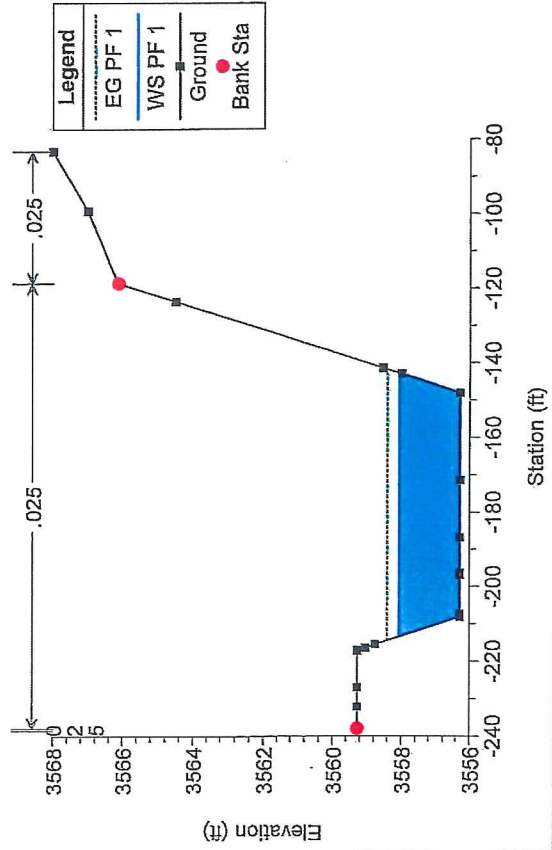
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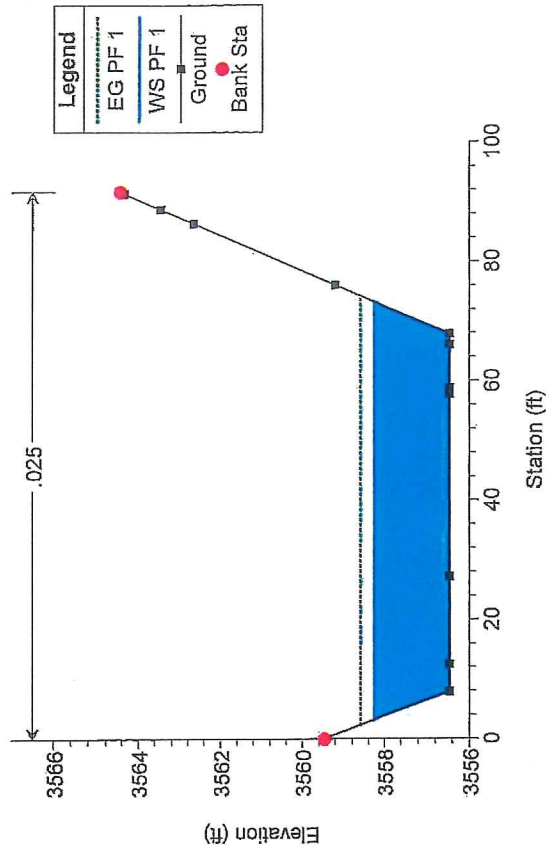
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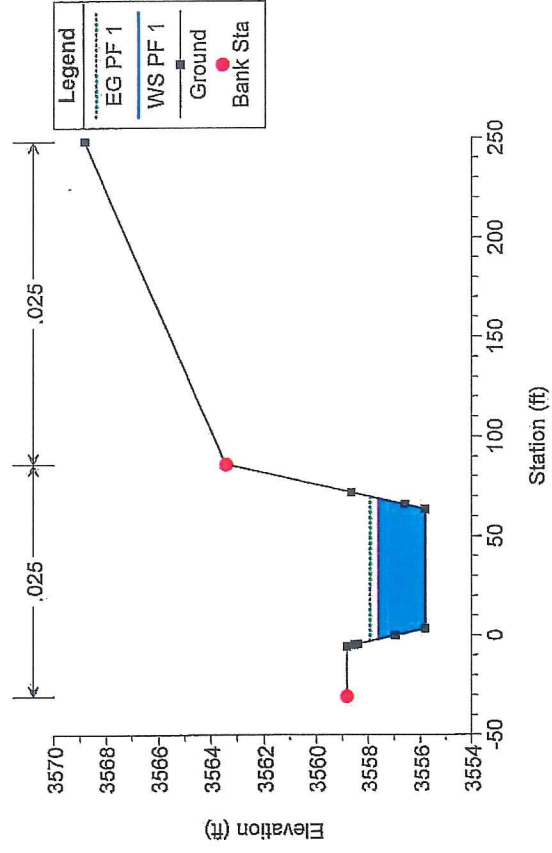
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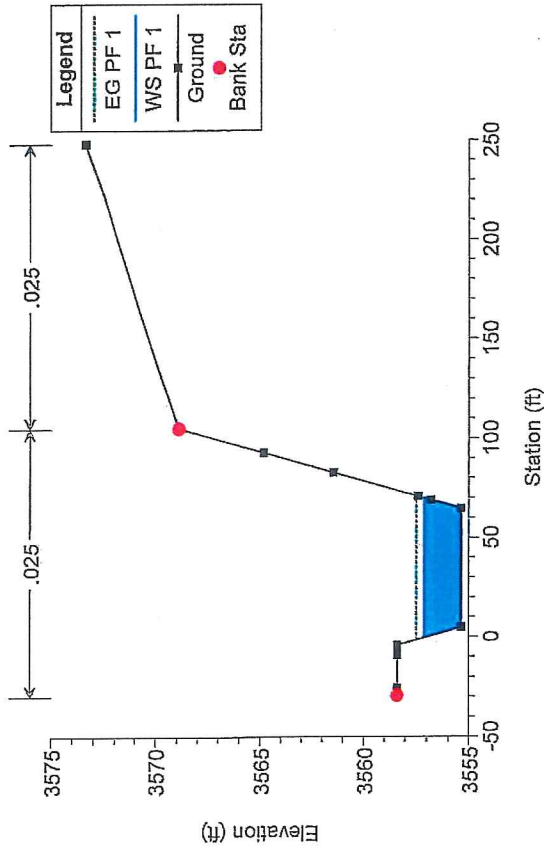
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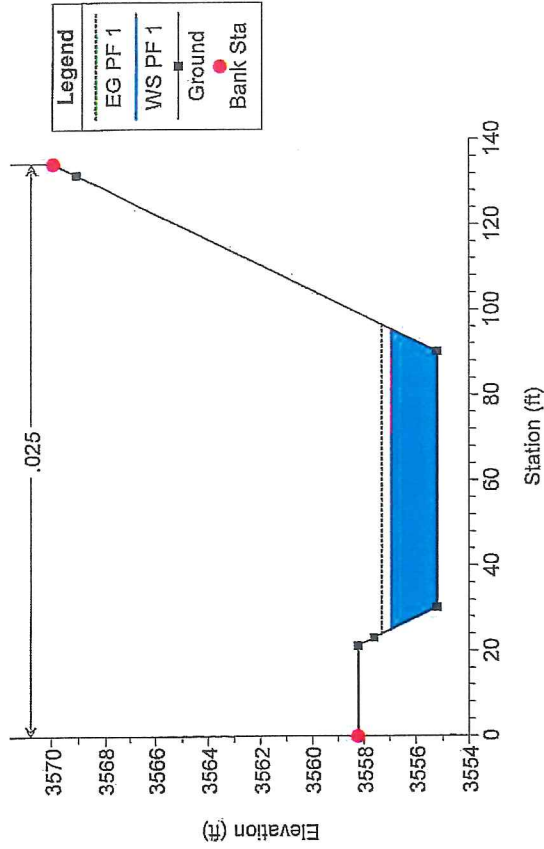
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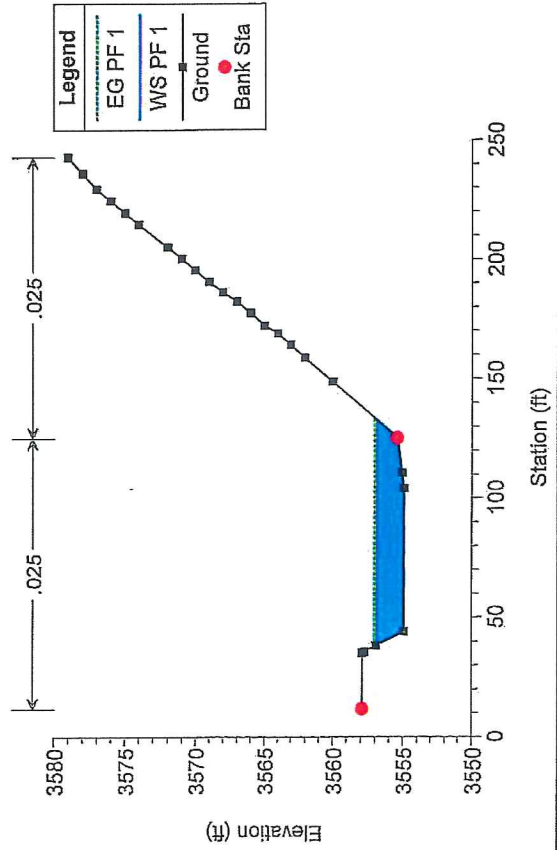
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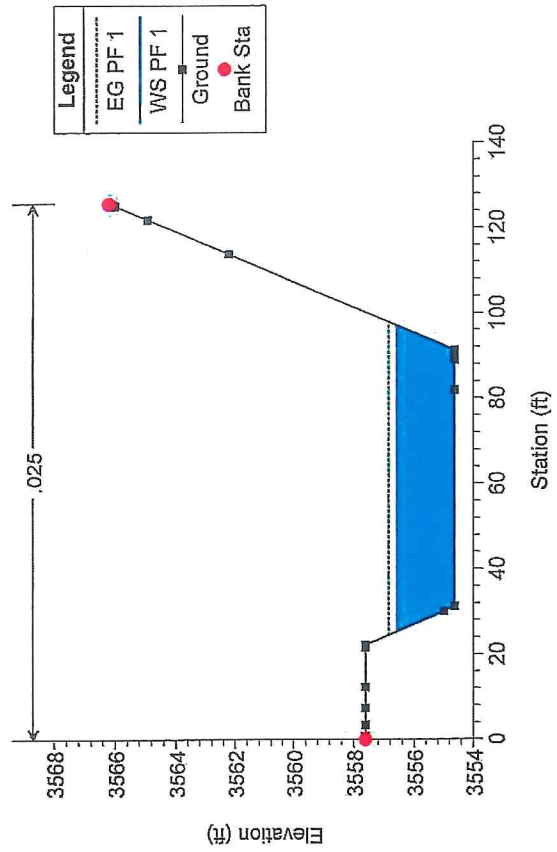
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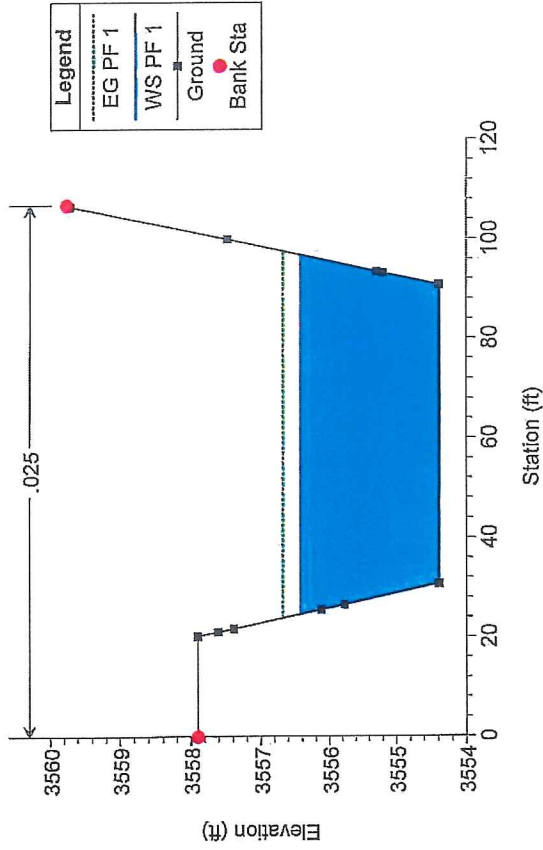
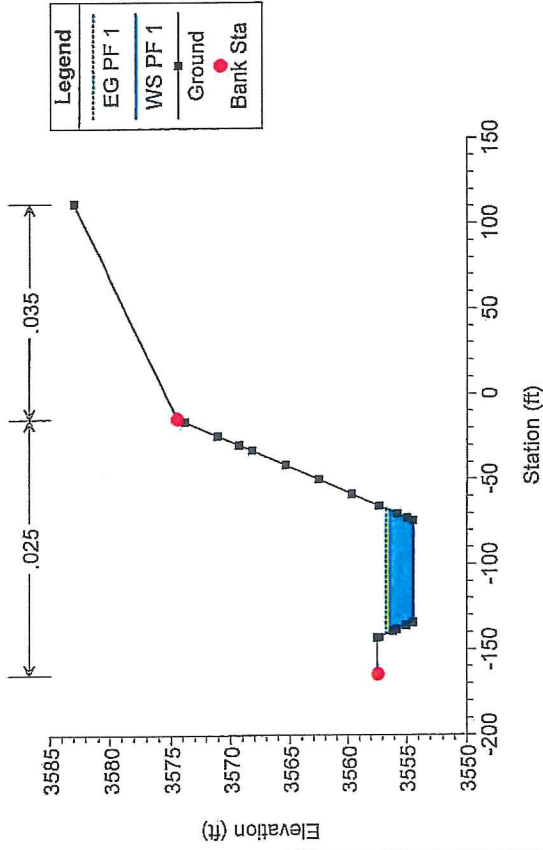
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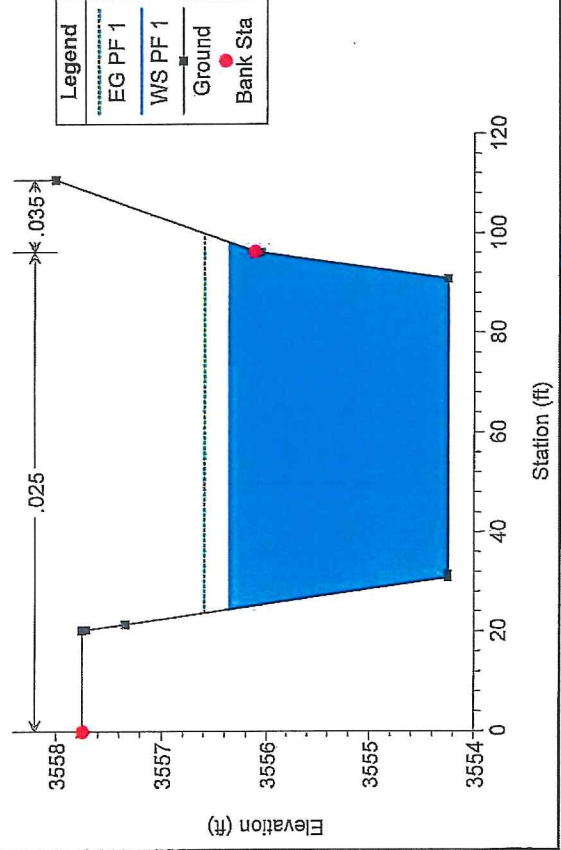
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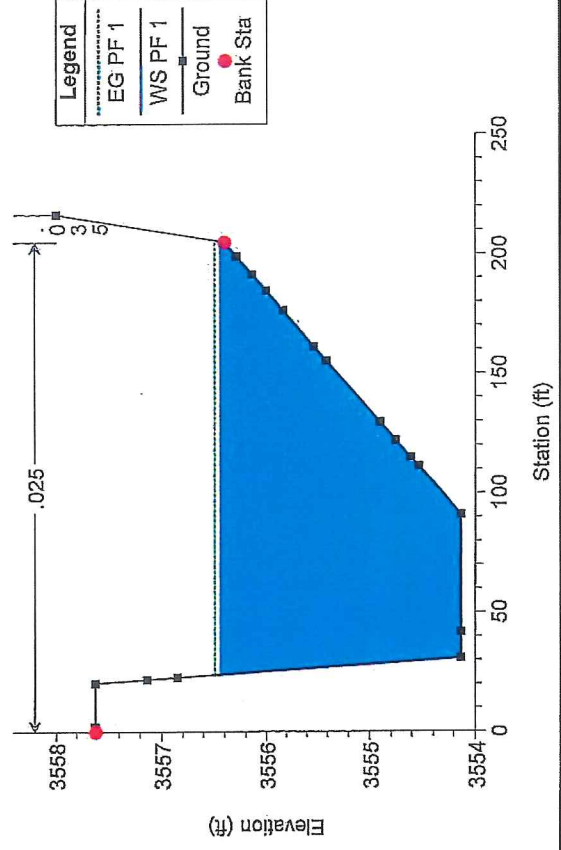
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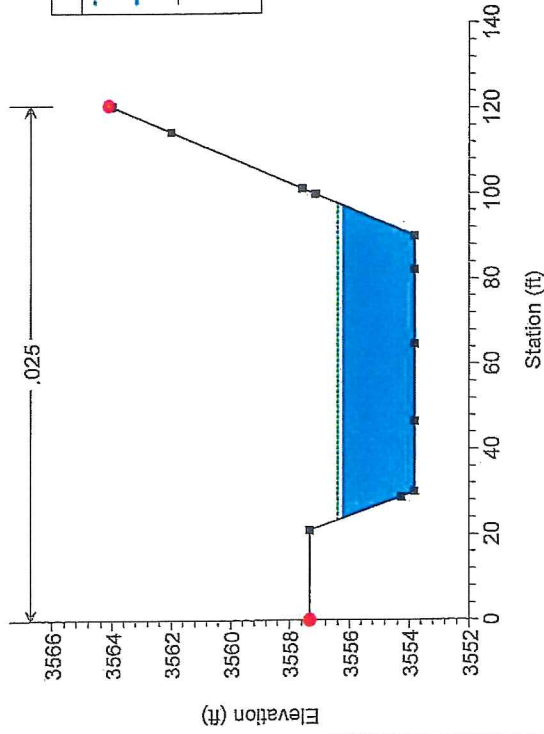
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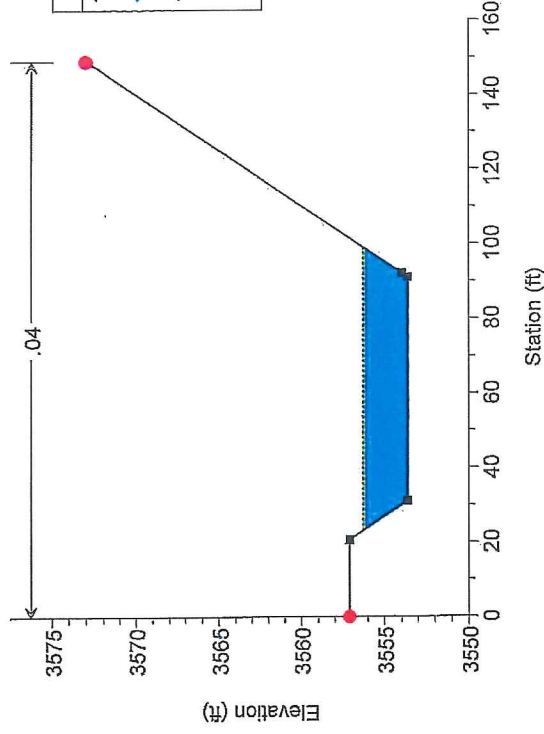
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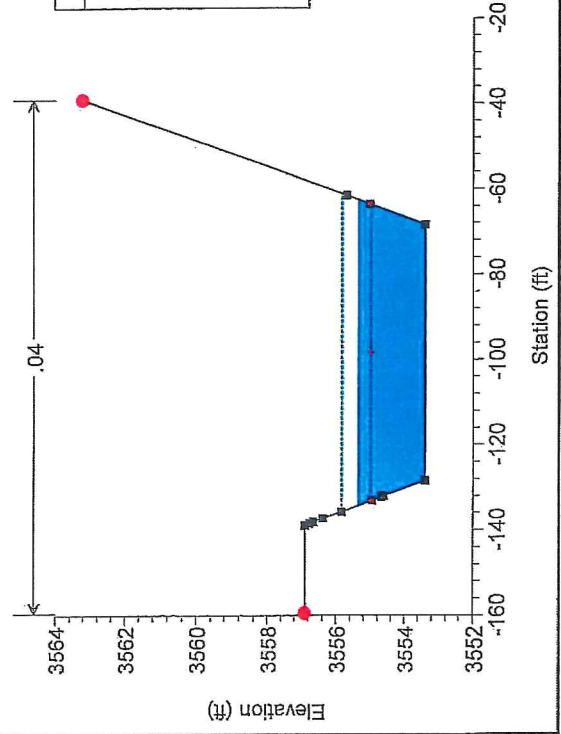
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CRR2A_ULT Plan: CRR2A_ULT 5/11/2015



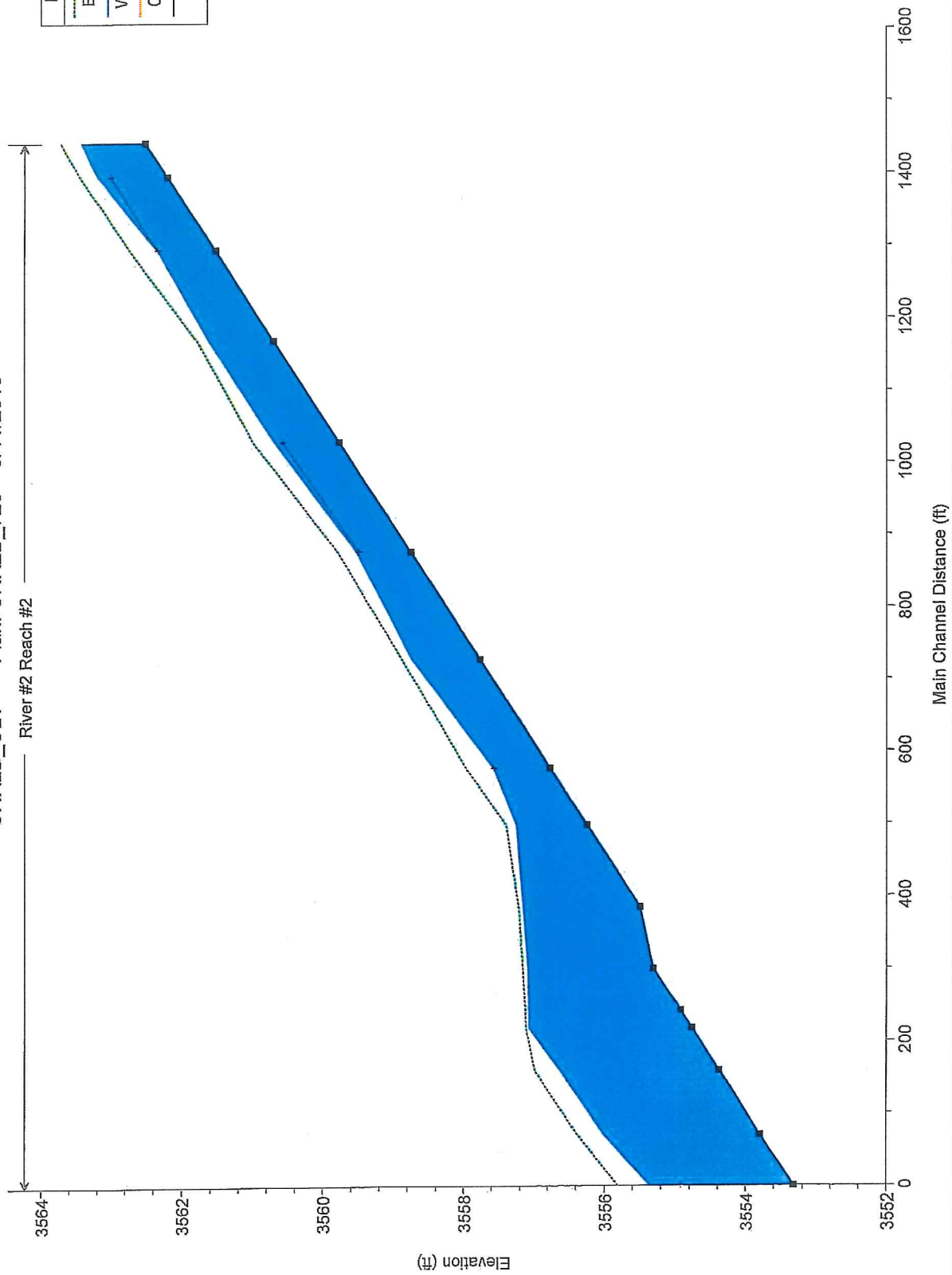
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CRR2B_ULT Plan: CRR2B_720 5/11/2015

River #2 Reach #2

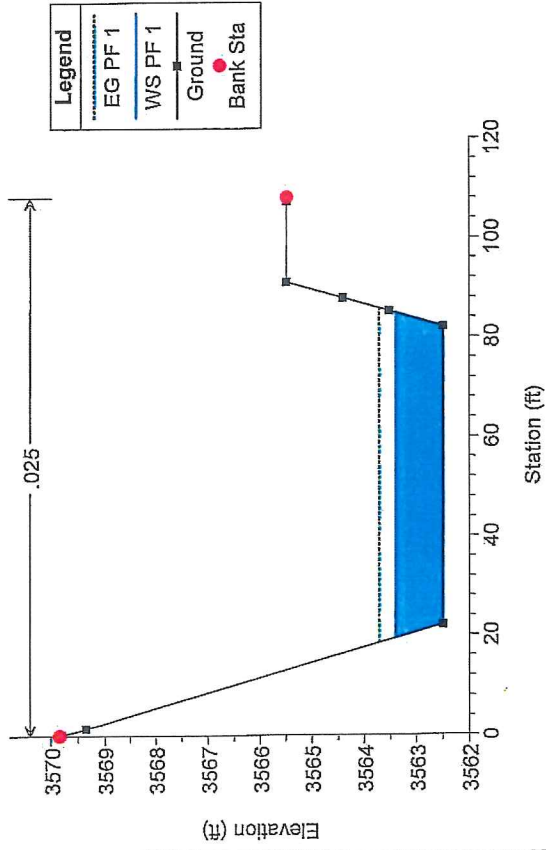
Legend	
EG PF 1	
WS PF 1	
Crit PF 1	
Ground	



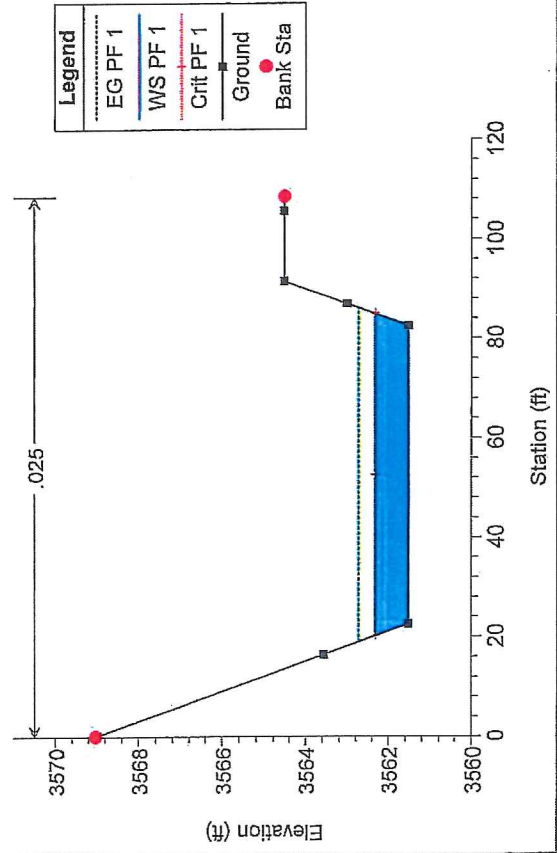
HEC-RAS Plan: CRR2B_720 River: River #2 Reach: Reach #2 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach #2	1700	PF 1	253.00	3562.50	3563.42		3563.72	0.006525	4.39	57.59	65.52	0.83
Reach #2	1600	PF 1	253.00	3562.19	3563.18	3563.00	3563.44	0.004988	4.04	62.65	66.08	0.73
Reach #2	1450	PF 1	253.00	3561.52	3562.33	3562.33	3562.72	0.010098	5.03	50.30	64.83	1.01
Reach #2	1320	PF 1	253.00	3560.89	3561.61		3561.77	0.004698	3.25	77.89	109.26	0.68
Reach #2	1150	PF 1	253.00	3559.76	3560.68	3560.57	3560.98	0.006537	4.40	57.56	65.51	0.83
Reach #2	1000	PF 1	253.00	3558.75	3559.61	3559.48	3559.78	0.009409	4.13	61.24	100.83	0.93
Reach #2	850	PF 1	253.00	3557.76	3558.73		3558.87	0.003843	3.03	83.45	111.63	0.62
Reach #2	700	PF 1	253.00	3556.76	3557.57	3557.57	3557.96	0.010075	5.02	50.38	64.97	1.01
Reach #2	630	PF 1	253.00	3556.24	3557.25		3557.39	0.003639	3.01	84.14	109.36	0.60
Reach #2	550	PF 1	253.00	3555.49	3557.15		3557.22	0.000662	2.03	124.87	81.48	0.29
Reach #2	525	PF 1	253.00	3555.31	3557.08		3557.16	0.000707	2.19	115.79	70.63	0.30
Reach #2	425	PF 1	253.00	3554.93	3557.07		3557.12	0.000371	1.78	142.35	72.92	0.22
Reach #2	400	PF 1	253.00	3554.77	3557.07		3557.11	0.000292	1.83	154.83	75.14	0.20
Reach #2	350	PF 1	720.00	3554.38	3556.62		3556.98	0.006645	4.83	149.16	73.39	0.60
Reach #2	250	PF 1	720.00	3553.79	3556.00		3556.37	0.006873	4.88	147.61	73.34	0.61
Reach #2	100	PF 1	720.00	3553.33	3555.35	3554.93	3555.81	0.009436	5.42	132.73	71.31	0.70

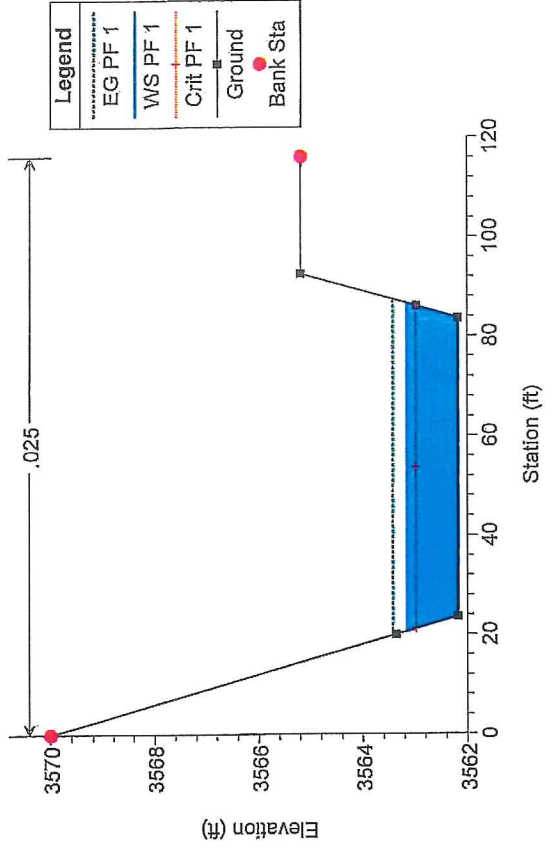
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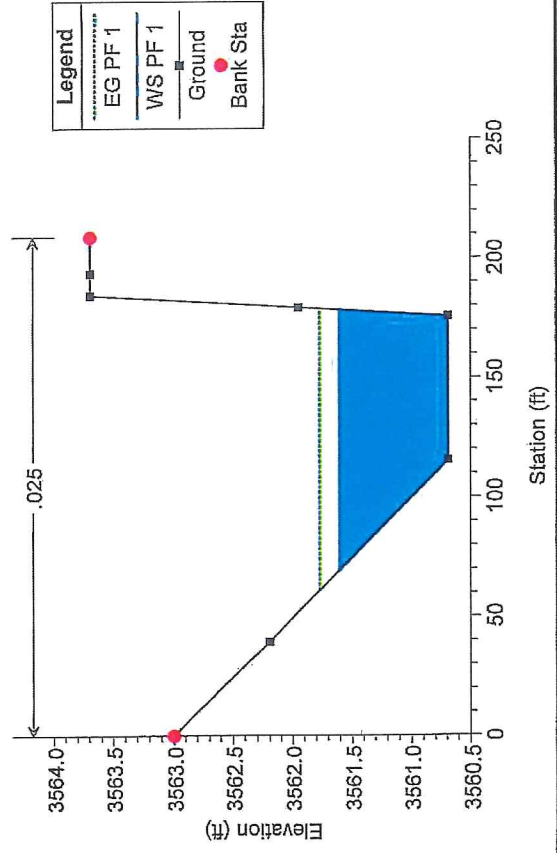
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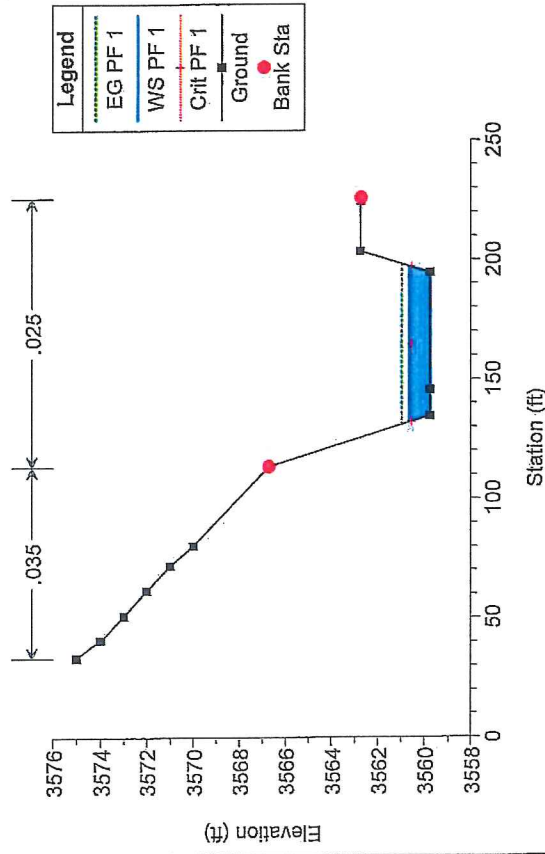
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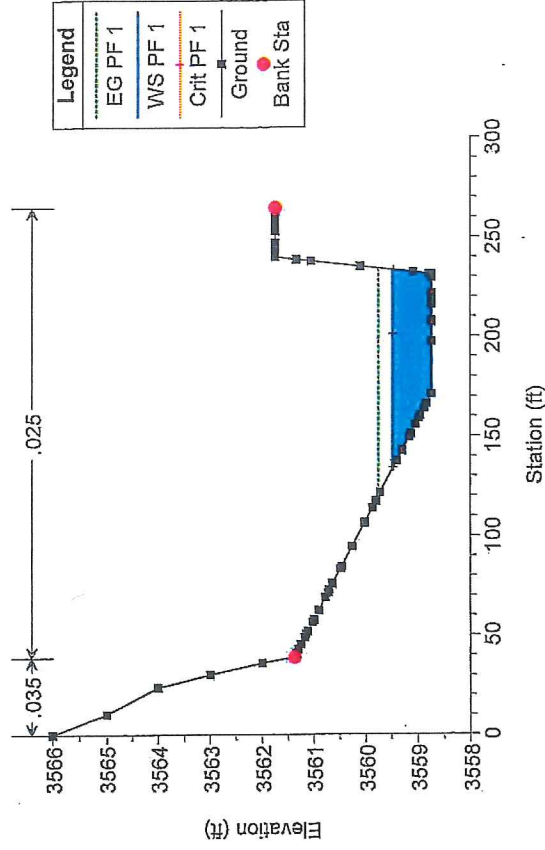
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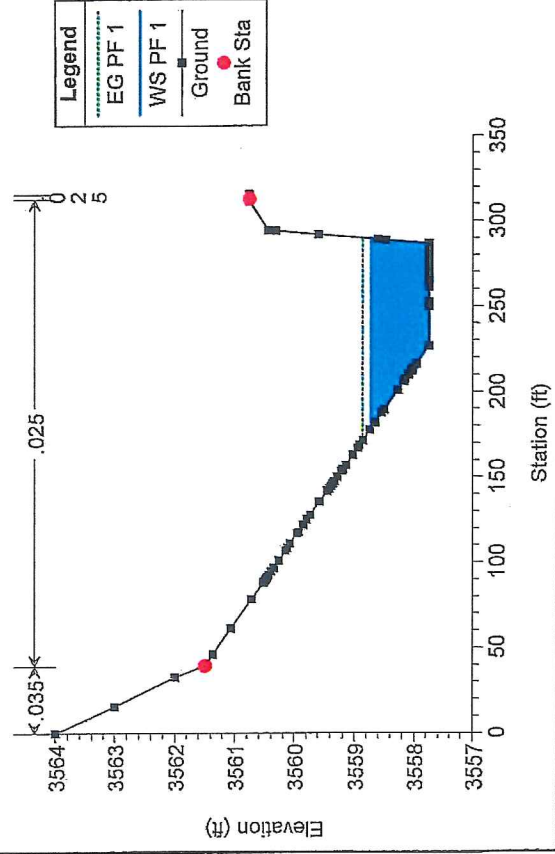
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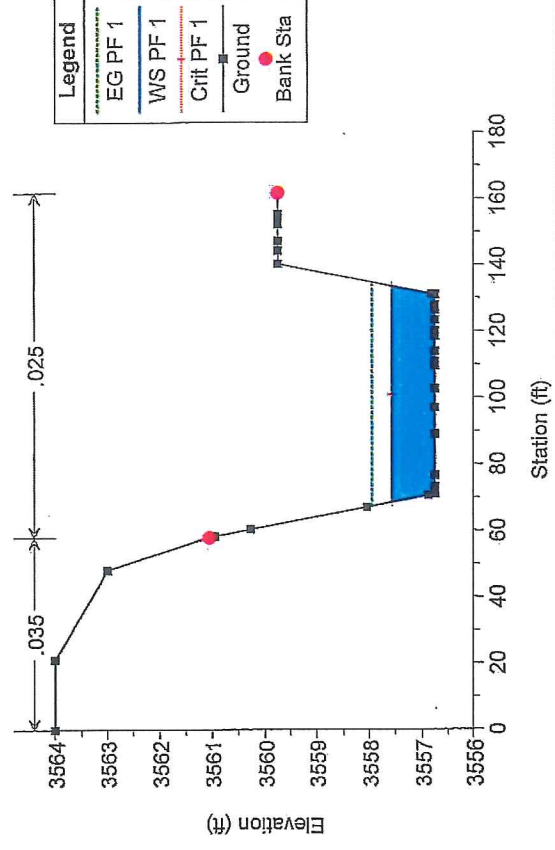
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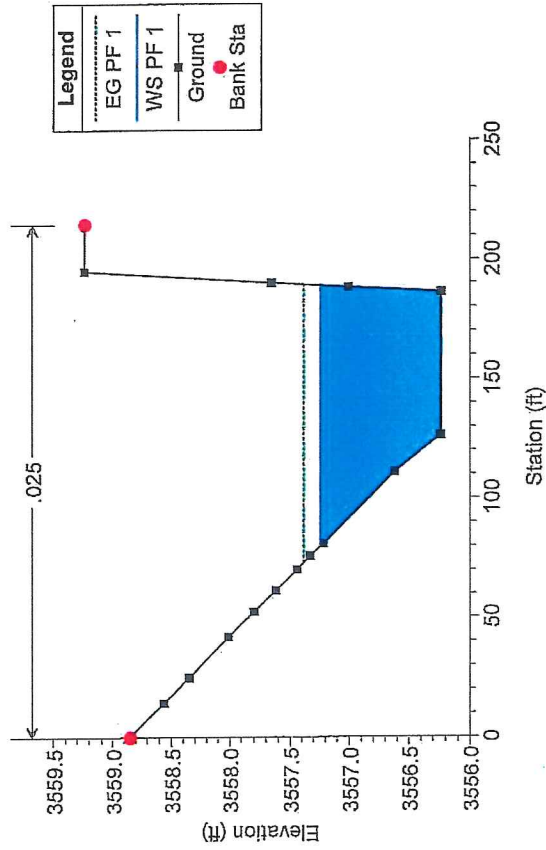
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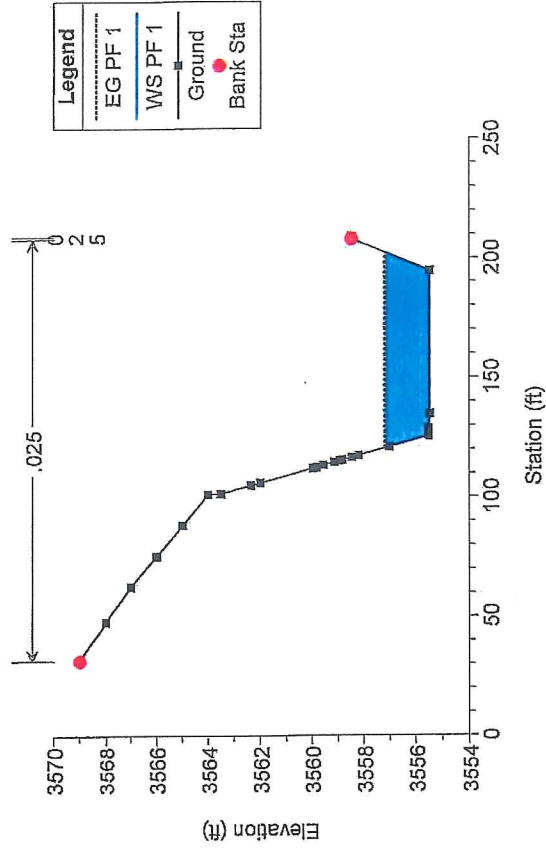
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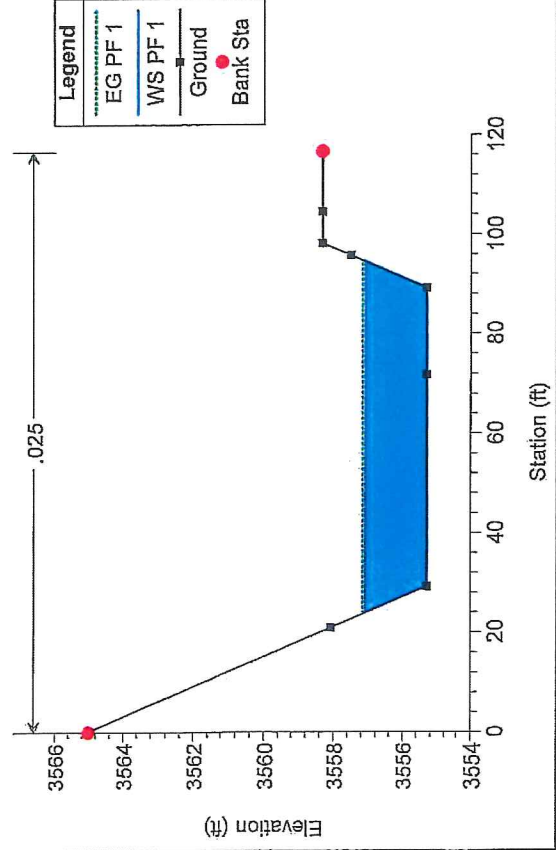
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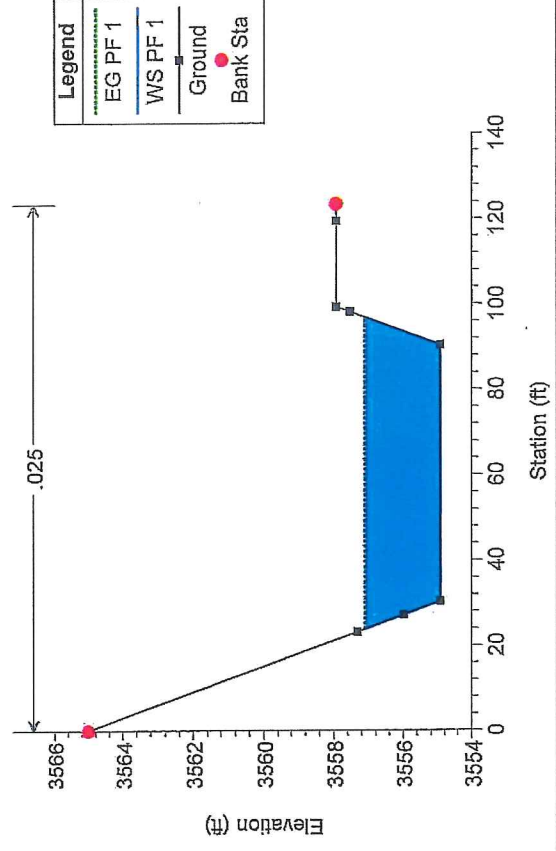
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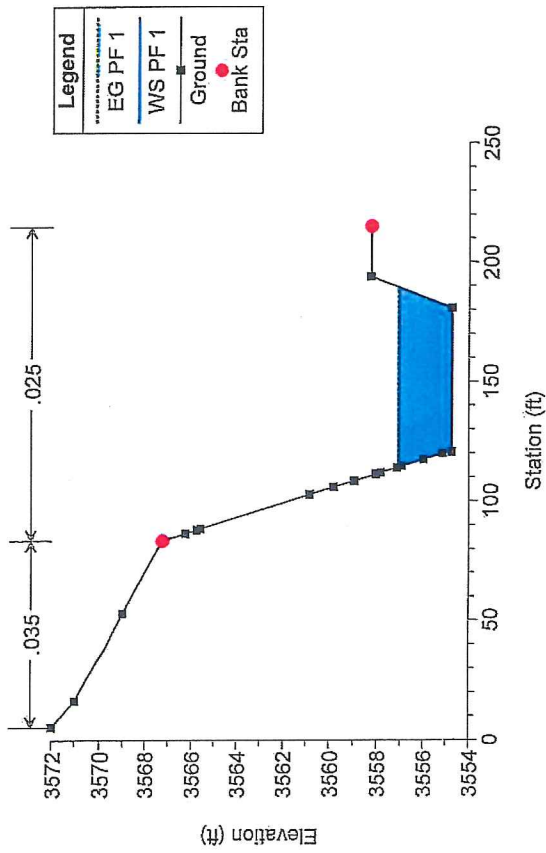
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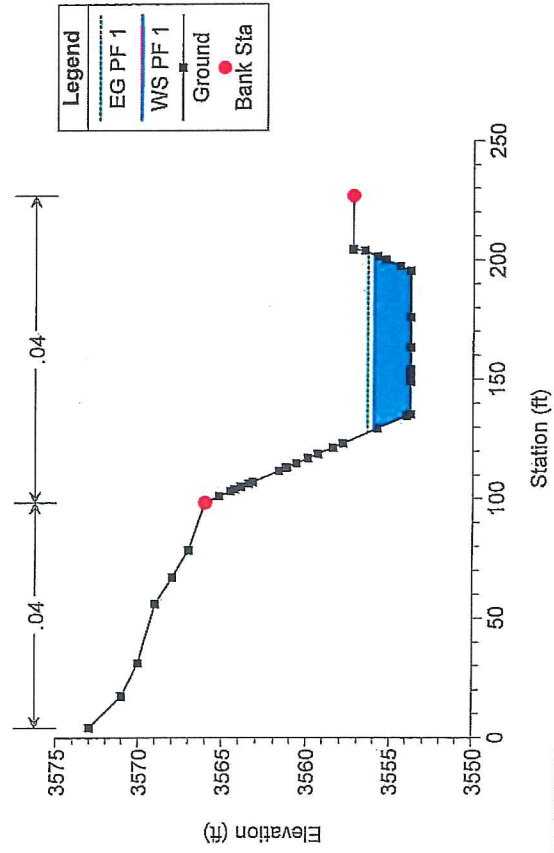
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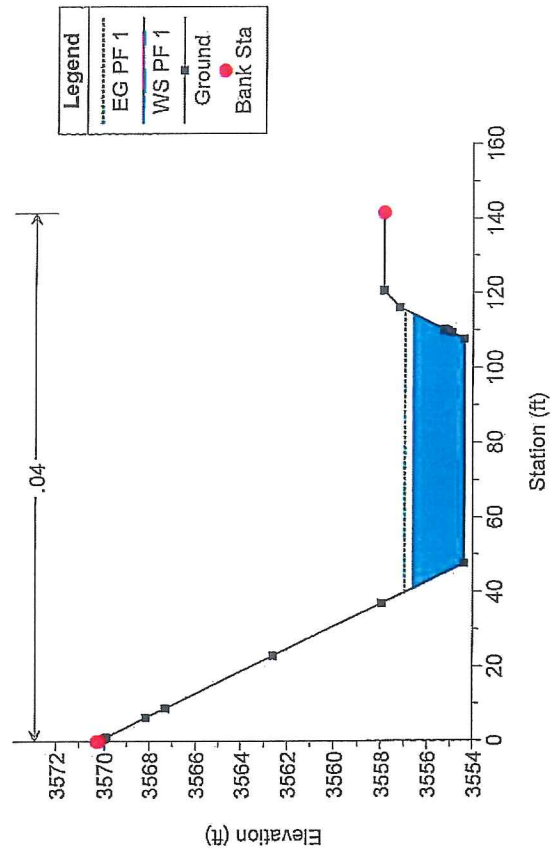
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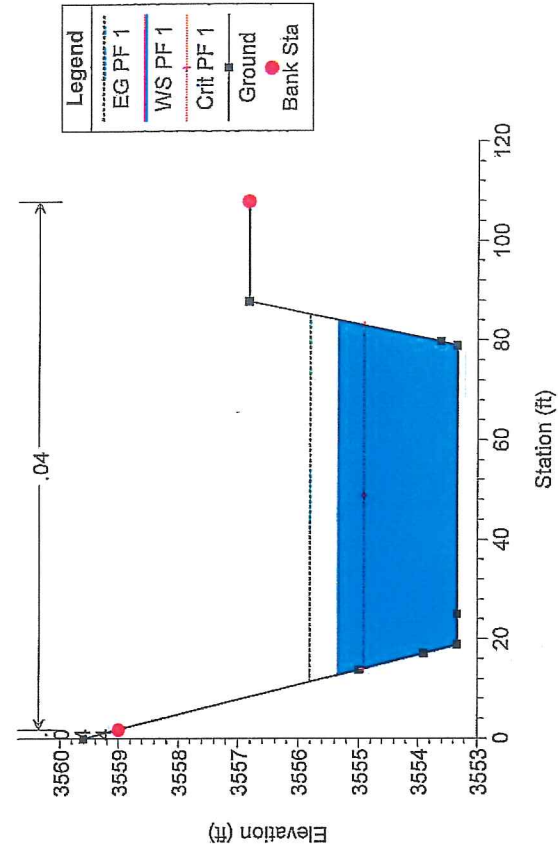
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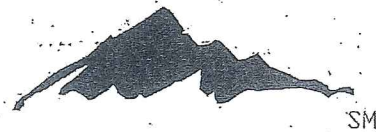
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CRR2B_ULT Plan: CRR2B_720 5/11/2015



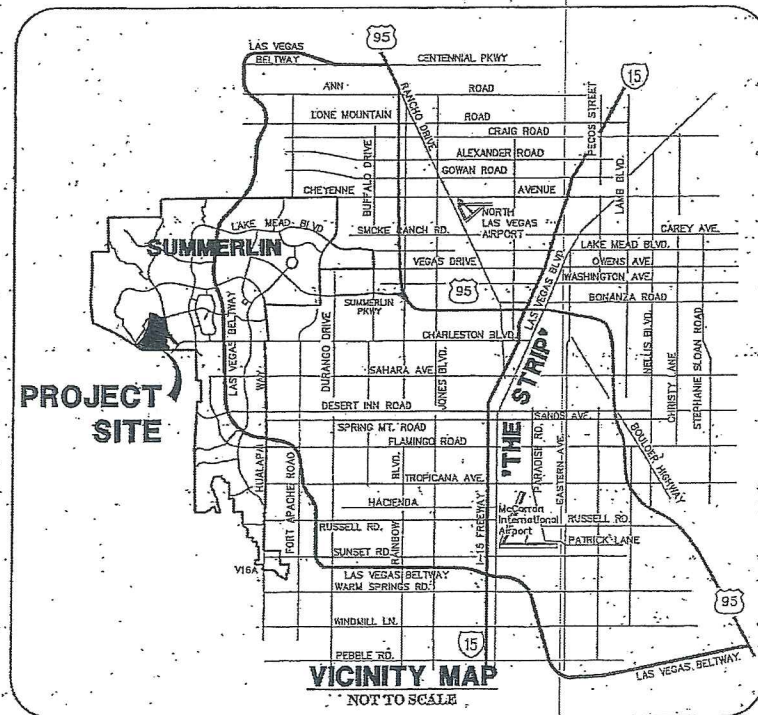
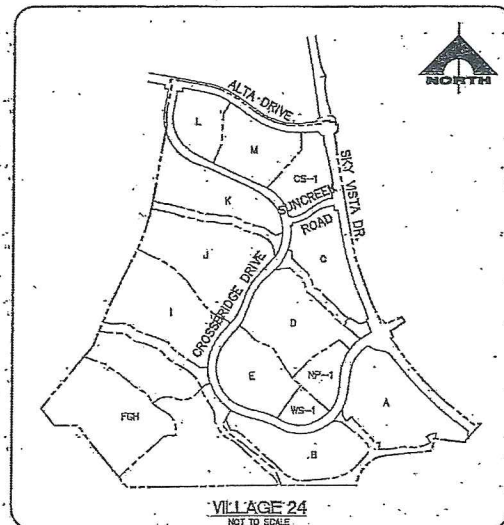
SUMMERLIN



VILLAGE 24 CROSSBRIDGE DRIVE UNIT 2 IMPROVEMENT PLANS FROM CROSSBRIDGE UNIT 1 TO SUNCREEK ROAD

SID #812 PROJECT 9A, 9B & 10A
2015

A.P.N. 137-33-801-002



DRAINAGE CERTIFICATION
I CERTIFY THAT THE DRAINAGE PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.
Joshua L. Johnson 11/17/15
CITY ENGINEER P.E. 15789

Allen Pavelich 1-14-16
ALLEN PAVELICH, P.E. #2 6029
CITY ENGINEER
CITY OF LAS VEGAS, NEVADA
APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAINAGE AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV BUILDING AND SAFETY DEPARTMENT
THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT.
Chris Knight 1-13-16
CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY

APPROVED FOR CONSTRUCTION
Kevin Orrock
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE 12/15/15
DRAWINGS: 1-3, 5-7, 10-23, 32, 37-41, & 53

THE HOWARD HUGHES COMPANY, LLC
Kevin Orrock 11/16/15
KEVIN ORROCK
VICE PRESIDENT

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3	NOTE SHEET
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5	MASTER UTILITY PLAN - WATER
6	MASTER UTILITY PLAN - STORM DRAIN
7	MASTER UTILITY PLAN - SEWER
8	ROADWAY PLAN AND PROFILE 1
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53	FLOW CONTROL VALVE DETAILS



GCW ENGINEERS & SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
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gcwengineering.com

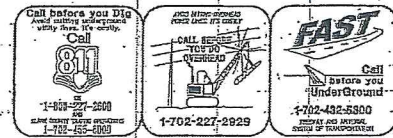
THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

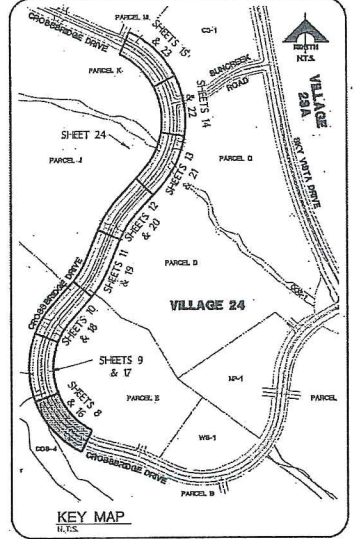
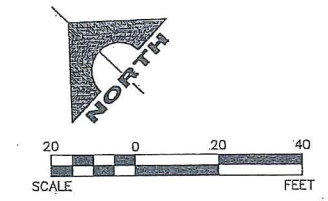
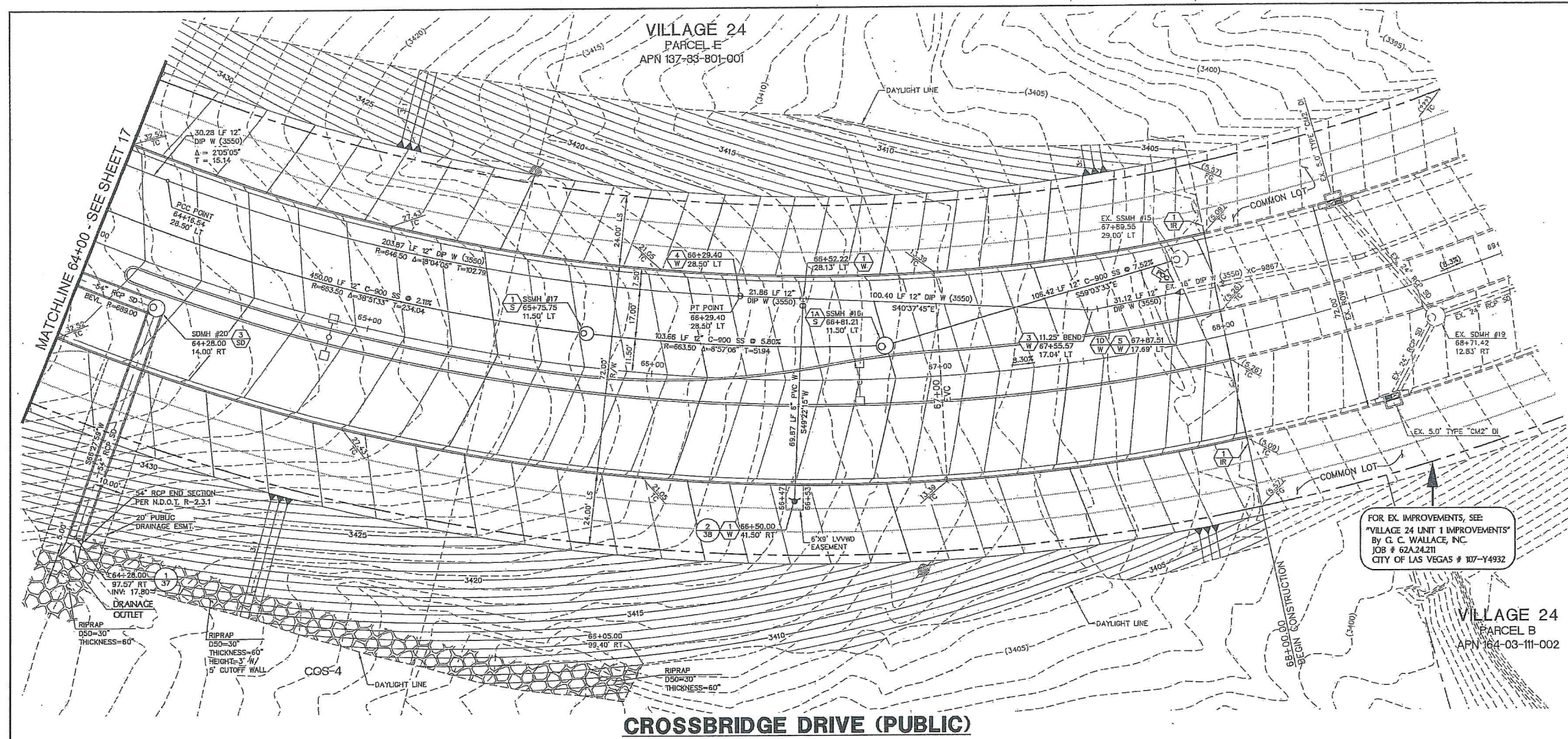
DRAWING
1
1 OF 53 SHEETS

SID NO. 812 PROJECT 9A, 9B AND 10A

OWNER/DEVELOPER
THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

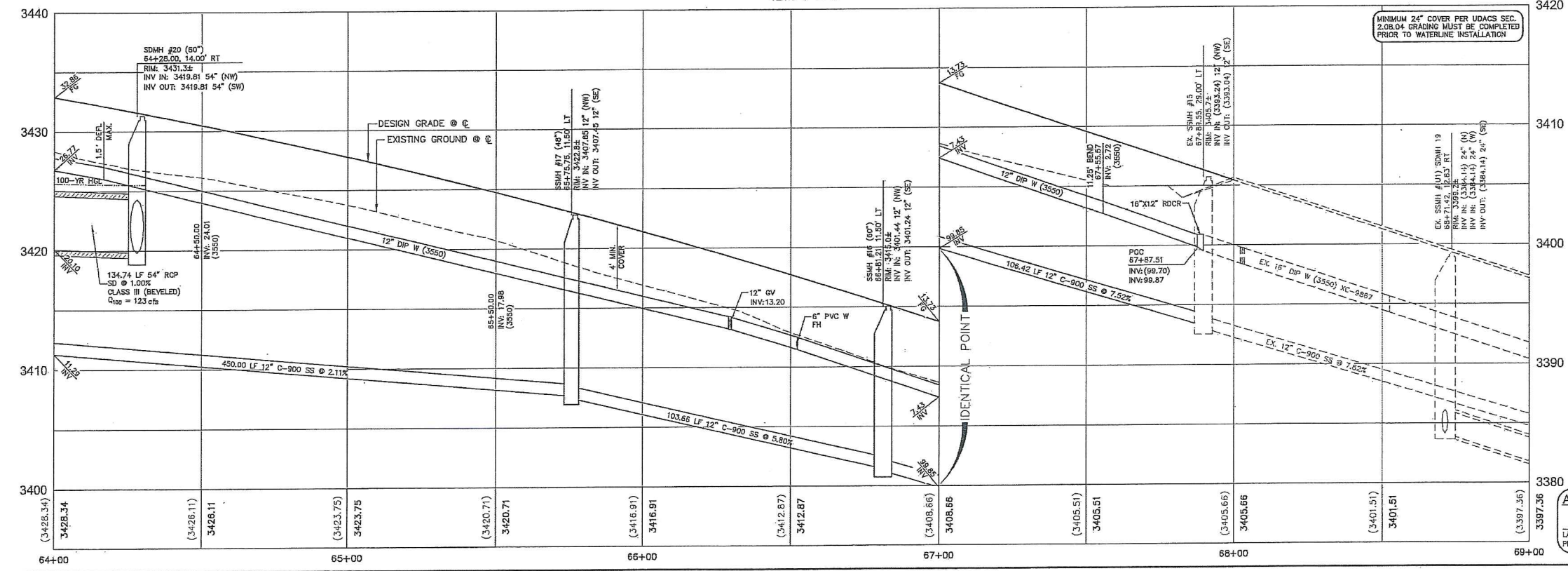
ENGINEER
GCW ENGINEERS & SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2259
gcwengineering.com





CROSSBRIDGE DRIVE (PUBLIC)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'



FAST
Call before you Dig
1-702-432-5300

Call before you Dig
1-800-227-2690

Call before you Dig
1-702-227-2929

NOTE
THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS.

BASIS OF BEARINGS
SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM (FEET)	NAVD 88 DATUM (METERS)
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.53	989.574

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE: _____

PROJECT NO.
62024-222

DESIGNER GHW
DRAWN GHW
CHECK GHW

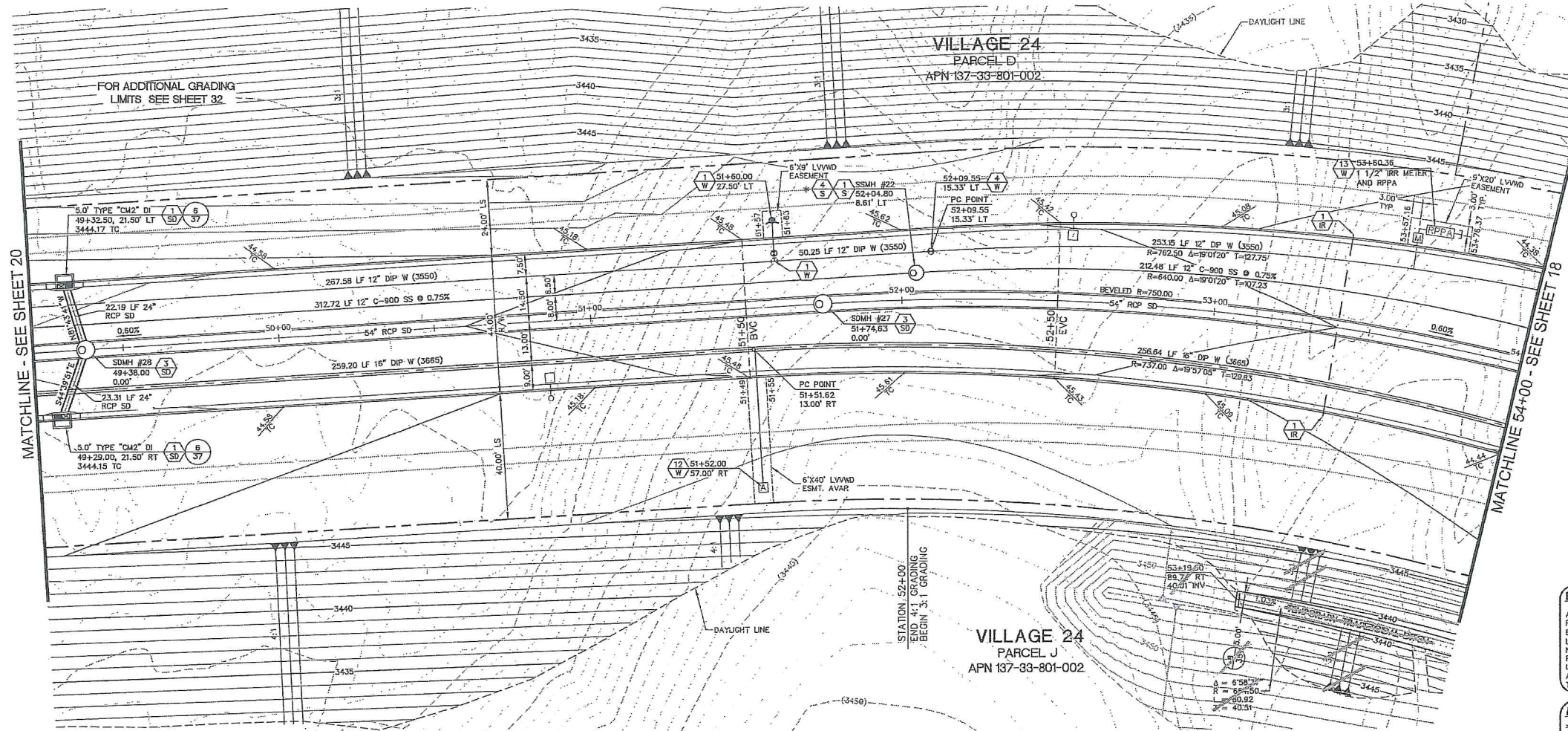
PLOT DATE: 10-28-15
PLOT TIME: 11:08:48

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD., LAS VEGAS, NV 89146
T: 702.804.2000 • F: 702.804.2299 • GCWALLACE@GMAIL.COM

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
CROSSBRIDGE DRIVE
UTILITY PLAN AND PROFILE 1

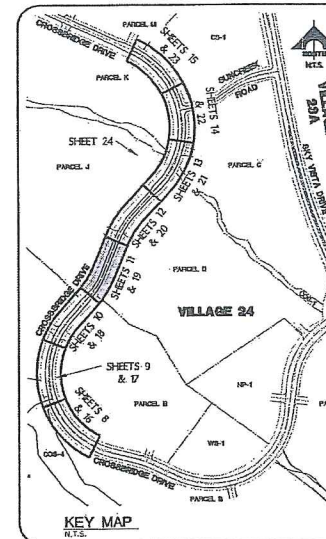
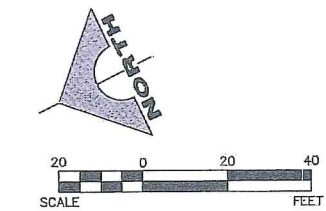
DRAWING
16
16 OF 53 SHTS

SID NO. 812 PROJECT 2



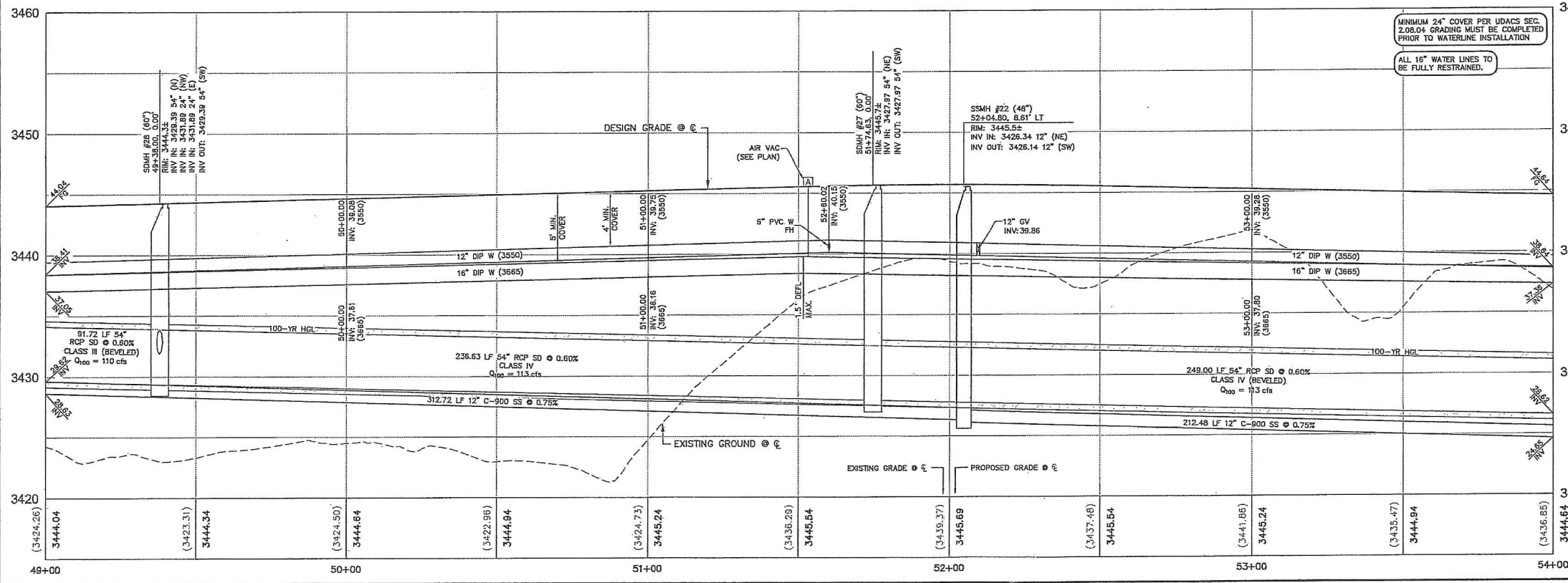
CROSSBRIDGE DRIVE (PUBLIC)

SCALE: HORIZ 1" = 20'
VERT. 1" = 5'



REDUCED PRESSURE PRINCIPLE ASSEMBLY, (1) 1-1/2"
APPROVED REDUCED PRESSURE PRINCIPLE ASSEMBLY(S) SHALL BE INSTALLED PER THE UDACS PLATE NO. 8. PRE FINISHED HYDRO COM. BACK FLOW ENCLOSURES WITH A FINISHED COLOR OF SIERRA TAN, MODEL 2005-AK, (OR LWWO APPROVED EQUAL BY ENGINEER) SHALL BE USED FOR 1 1/2" RPPA'S. NO WATER SHALL BE TAKEN FROM A SERVICE REQUIRING BACKFLOW PREVENTION UNTIL THE RPPA HAS BEEN SUCCESSFULLY TESTED BY THE LWWO. ANY BLOCK WALL OR OTHER FENCE MATERIAL SHALL BE DESIGNED AND CONSTRUCTED AROUND THE OUTSIDE OF THE EASEMENT(S), TO ALLOW THE DISTRICT DIRECT ACCESS FROM THE ADJACENT RIGHT-OF-WAY.

MANHOLE NOTE
* 4" OF CLSM AROUND THE OUTSIDE OF MANHOLES SSMH #22 AND SSMH #24.



Call before you Dig
before you Under Ground
1-702-432-5300
FLOOD AND LIFTING
DESIGN OF SUBSTATION

Call before you Dig
before you Under Ground
1-702-227-2929

NOTE
THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS.

BASIS OF BEARINGS
SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 85 DATUM
CLV BM No. D358	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD. & WEST OF DETENTION BASIN.	3245.63	989.574

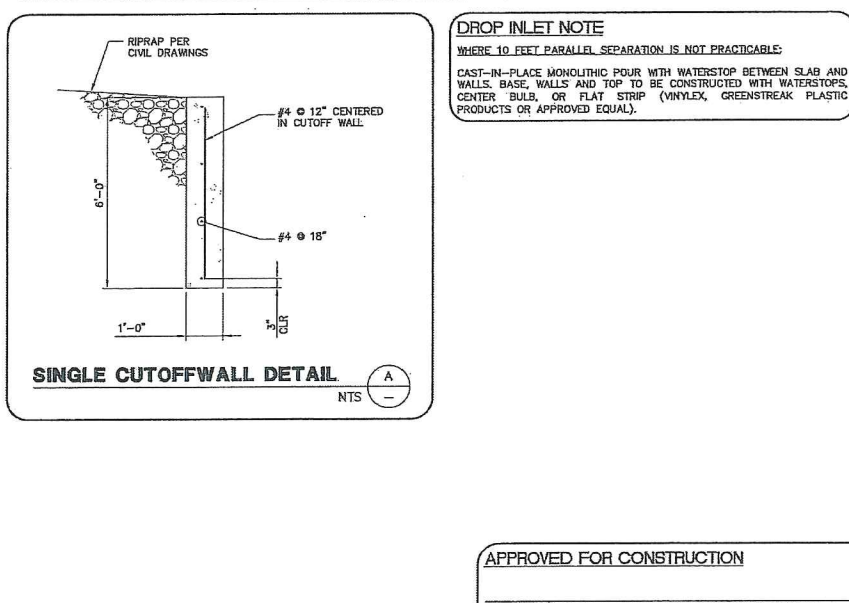
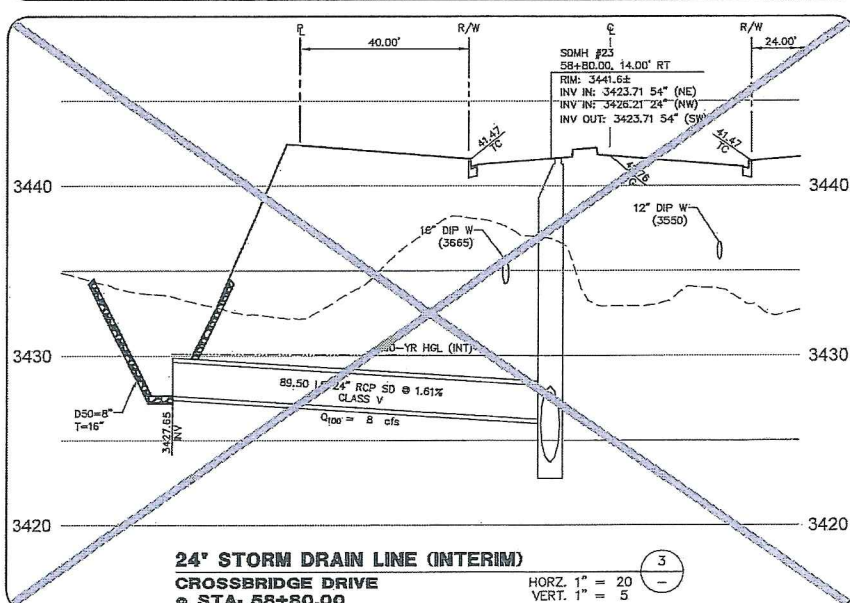
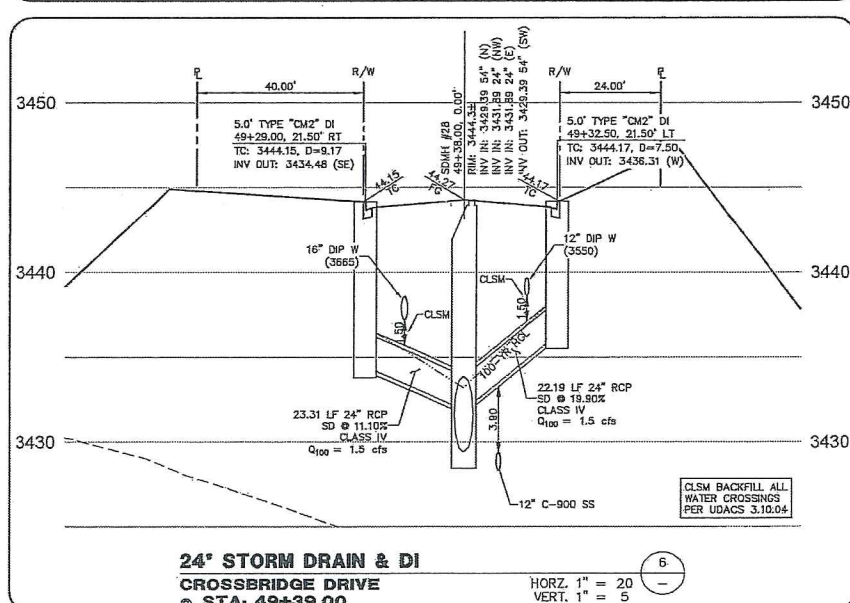
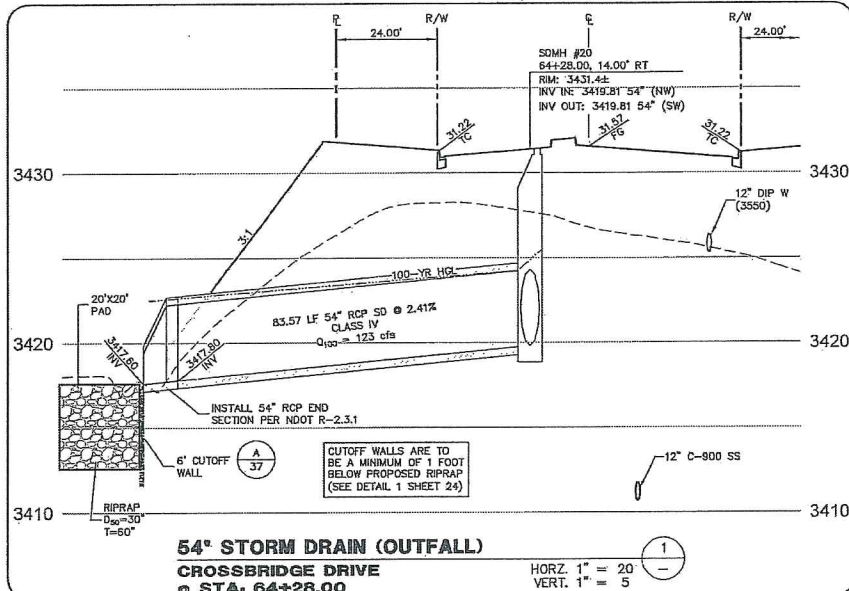
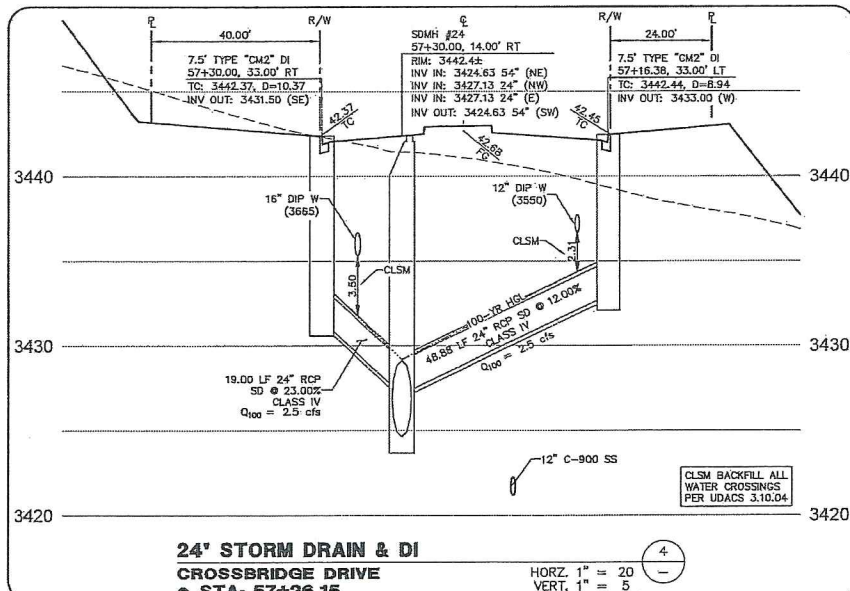
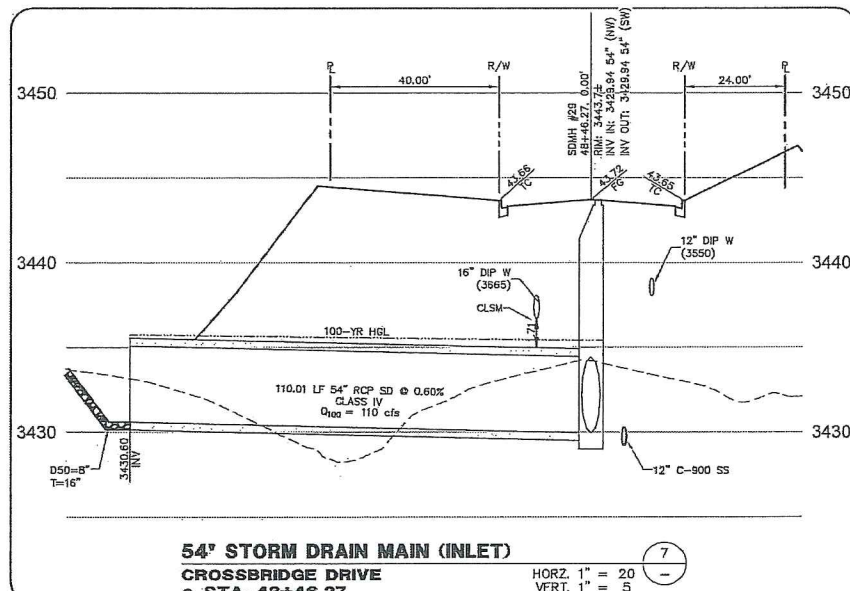
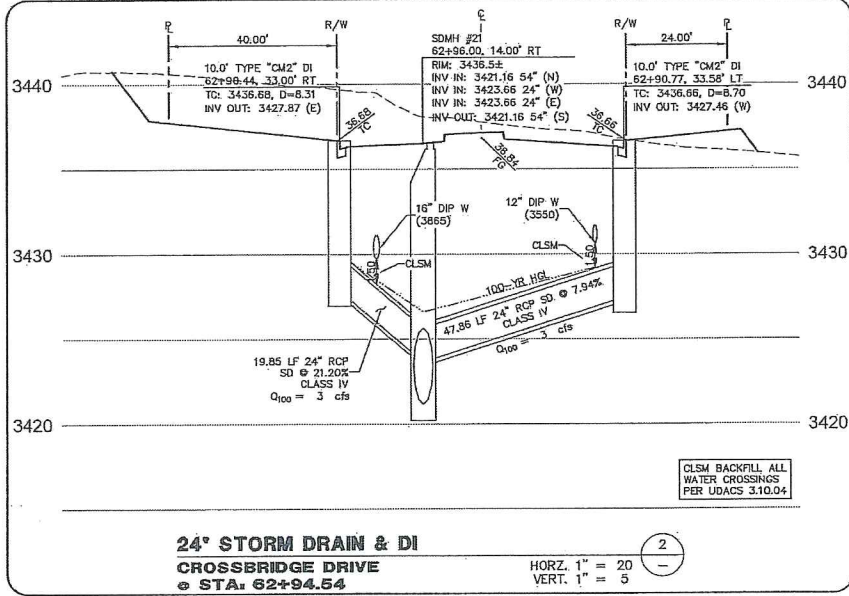
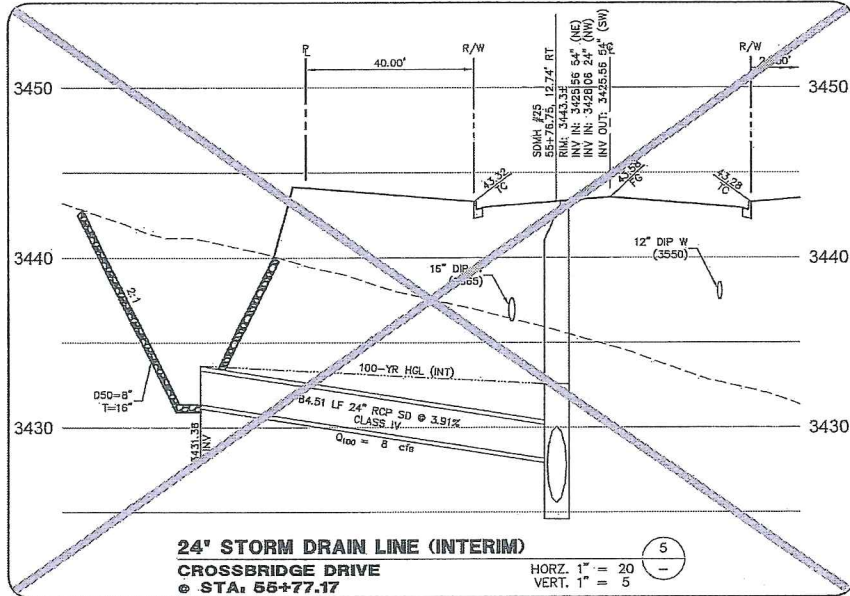
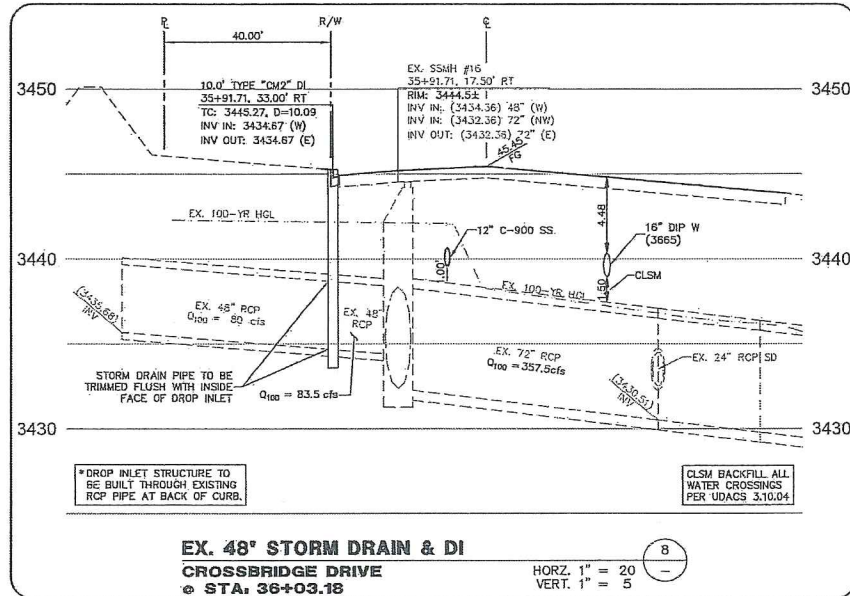
BENCHMARK

APPROVED FOR CONSTRUCTION
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123547 DATE:

PROJECT NO. 62024-222
DESIGN: GHW
DRAWN: GHW
CHECK: GHW
PLOT DATE: 03-07-18
PLOT TIME: 12:55:25
DATE: 03/07/2019

G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
355 S. RAINBOW BLVD., LAS VEGAS, NV 89146
TEL: 702.804.2000 • FAX: 702.804.2299 • GCVALLACE.COM

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS
CROSSBRIDGE DRIVE
UTILITY PLAN AND PROFILE 4
DRAWING 19 OF 53 SHTS



DROP INLET NOTE
WHERE 10 FEET PARALLEL SEPARATION IS NOT PRACTICABLE:
CAST-IN-PLACE MONOLITHIC POUR WITH WATERSTOP BETWEEN SLAB AND WALLS, BASE, WALLS AND TOP TO BE CONSTRUCTED WITH WATERSTOPS, CENTER BUILT OR PLAT STRIP (VINYLEX, GREENSTREAK, PLASTIC PRODUCTS OR APPROVED EQUAL).

APPROVED FOR CONSTRUCTION
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
PROJECT NO. 123947 DATE:

DATE: 03/07/2018

CSW APP

DATE

AGEN APP

DATE

DESCRIPTION

PROJECT NO.
62024-222

DESIGN: GSW

DRAWN: GSW

CHECK: JJJ

PLOT DATE: 03-07-18

PLOT TIME: 12:35:45

REVISIONS

NO.	DATE	DESCRIPTION
1	03/07/18	ISSUED FOR BIDDING

G.C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS
1555 S. RAINBOW BLVD., LAS VEGAS, NV 89146
TEL: 702.894.2000 FAX: 702.894.2299 GCWALLACE.COM

LAS VEGAS

Project: 62024-222 DWG: Production V:\62024\37.LAT1.dwg
Lupa Gracida

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - CROSSBRIDGE DRIVE UNIT 2
IMPROVEMENT PLANS

LATERAL DETAILS 1

DRAWING
37
37 OF 53 SHOTS

03/07/2018 12:35:45

BID NO. 812 PROJECT 9A, 9B AND 10A

TIT 270-5

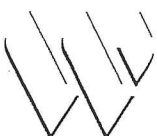
**UPDATE #2
TO THE
TECHNICAL DRAINAGE STUDY
FOR
SUMMERLIN VILLAGE 24
UNIT 1 IMPROVEMENTS
INCLUDING
PARCELS "A" & "B" MASS GRADING**

62A.24.211

February 2006

Prepared for:

**The Howard Hughes Corporation
a Delaware Corporation
10000 West Charleston Blvd., Ste. 200
Las Vegas, Nevada 89135
Phone: (702) 791- 4300
Fax: (702) 791- 4453**


G. C. WALLACE COMPANIES
ENGINEERS | PLANNERS | SURVEYORS

RECEIVED

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		MAR 24 2006 March 20, 2006
TO: Land Development Services Department of Public Works		FROM: G.C. WALLACE Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT: Technical Drainage Study for: SMRLN V24 Unit 1 Improvements including Parcels A & B Mass Grading - Update #2		COPIES TO: G. C. Wallace, Inc.
Cross Streets:	NWC of Sky Vista Dr. & Charleston Blvd.	Howard Hughes Corp.
File Number:	F:\Depot\DSMEMOS\DS3551E.doc	Bart Anderson, P.E., DevCo
Parcel Number:	137-22-000-013	CCRFC
Zoning Action:		
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES X	NO

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Trn. No.
1 st Submittal	4/5/2004	4/19/2004	Not Approved	\$400.00	122481: \$400
2 nd Submittal	5/27 & 6/18/2004	6/21/2004	Conditional Approval	\$400.00	126058: \$400
CCRFC	8/6/2004	8/16/2004	Concurrence	N/C	N/C
3 rd Submittal	12/8/2004	12/22/2004	Approved	\$100.00	13371: \$100
4 th Submittal	2/28/2006 & 3/17/2006	3/20/2006	See Comments Below	\$100.00	39635: \$100
			TOTAL FEES (LDDRS):	\$1,000.00	---

REMARKS:

3rd Submittal: Update to Extend Full Street Improvements of Crossbridge Drive from Station 80+50 to Station 68+00 to cover the frontage of Parcel B

4th Submittal: Update #2 to Validate the previous approval because that was more than a year ago

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.

The following comments are repeated until they are complete:

- The plan and profile sheets show that street improvements, storm drain, earthen berms and channels are to be constructed. The flood control facilities will be considered interim until the full improvements for Crossbridge Drive are constructed. The Howard Hughes Corporation is required to maintain the interim drainage facilities until the improvements are accepted by the City of Las Vegas. The City does not accept interim facilities for maintenance.*
- The proposed Berm 1 and Berm 2 (Figure 7) must be bonded for construction. Prior to final plan approval the developer must complete a Maintenance and Liability Agreement for the interim drainage improvements (off-site berms) and post a minimum maintenance bond of \$25,000.00.*

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

G.C. Wallace, Inc.										SUMMERLIN VILLAGE 24										BY: ALG		DATE: 03/31/04	
File: existing-SF4.WB2										INTERIM CONDITIONS (OFF-SITE EXISTING)													
Project No.: 62024-001																							
SUB-BASIN DATA					INITIAL / OVERLAND TIME (Ti)					TRAVEL TIME (Tt)					Tc CHECK		Tc	Tag	REMARKS				
DESIG:	DEV/EX. (D or E)	CN	K	AREA Ac (3)	AREA MI ²	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	TOTAL LENGTH Ft (11)	Tc = (L/180)*1 Min (12)								
(1)			(2)																				
ON7R	E	88.0	0.7716	38.67	0.06042	500	5.8	7.4	3374	5.8	3.6	7.1	9.1	3574	16.5		0.165						
ON8R	E	88.0	0.7716	53.87	0.08417	500	4.0	6.3	3291	5.7	3.5	7.0	9.0	3791	17.3		0.173						
ON9R	E	88.0	0.7716	11.33	0.01770	500	5.6	7.4	2230	6.3	3.7	7.4	6.2	2730	13.6		0.136						
ON10R	E	88.0	0.7716	22.58	0.03528	500	7.4	6.8	2115	5.7	3.5	7.0	6.2	2615	13.0		0.130						
ON11	E	88.0	0.7716	34.50	0.05391	500	7.4	6.8	1465	5.5	3.5	6.8	4.8	1965	11.5		0.115						
ON12	E	88.0	0.7716	7.14	0.01116	500	7.4	6.8	1140	6.1	3.7	7.3	3.7	1640	10.5		0.105						
OFF1	E	88.0	0.7716	0.28	0.00044	500	8.7	6.4	122	12.3	5.2	10.3	0.4	622	6.8		0.068						
OFF5	E	88.0	0.7716	295.18	0.46122	500	12.0	5.8	1113.28	7.0	3.9	7.8	24.9	11613	30.6		0.306						
OFF6	E	88.0	0.7716	3.52	0.00550	150	10.0	3.4	502	11.8	5.1	10.1	1.6	652	5.0		0.050						
OFF7	E	88.0	0.7716	76.08	0.11688	500	8.9	6.4	4574	6.8	3.9	7.7	11.0	5074	17.4		0.174						
OFF8	E	88.0	0.7716	13.78	0.02153	500	7.2	6.8	1554	6.8	3.9	7.7	4.5	2054	11.3		0.113						
OFF9	E	88.0	0.7716	4.44	0.00694	500	8.8	6.4	427	13.1	5.4	10.6	1.3	927	7.7		0.077						
OFF10	E	88.0	0.7716	7.43	0.01161	500	9.2	6.3	898	10.0	4.7	9.3	2.5	1398	8.8		0.088						
OFF11	E	88.0	0.7716	96.53	0.15083	500	8.0	6.6	7813	7.3	4.0	7.9	17.4	8313	24.0		0.240						
SB1	D	91.0	0.8112	7.72	0.01206	60	2.0	3.2	2109	5.9	4.9	7.4	5.3	2169	22.1		8.5	0.085					
Ti = 1.8 (1.1 - K) L ^{1/2} / S ^{1/3} K = 0.0132 (CN) - 0.39										V1 applies to the first 500 feet of travel distance; V2 applies to the remaining travel distance.										Developed V2 = 30.6*(S/100) ^{1/2}			
REFERENCE :										STANDARD FORM 4													


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 31MAR04 TIME 13:41:59
*
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*****
*
* U.S. ARMY CORPS OF ENGINEERS
* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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

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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 AMFT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT

PAGE 1

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

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*DIAGRAM
1 ID *****
2 ID * .....
3 ID * : SUMMERLIN VILLAGE 24 : *
4 ID * : UNIT 1 IMPROVEMENTS : *
5 ID * : EXISTING CONDITIONS : *
6 ID * : ONSITE AND OFFSITE : *
7 ID * : .....
8 ID * : .....
9 ID * : RETURN PERIOD 10/100-YEAR : *
10 ID * : DISTRIBUTUION 6-HOUR SDN3 : *
11 ID * : PROJECT NO 62024-001 : *
12 ID * : FILENAME INT.H1 : *
13 ID * : DATE 3/22/04 : *
14 ID * : .....
15 ID
16 ID DEPTH AREA REDUCTION FACTOR
17 ID SQ MILES DAF
18 ID 0-.1 1.0
19 ID .1-.3 .988
20 ID .3-.5 .980
21 ID .5-.7 .976
22 ID .7-.9 .972
23 ID 1.0-2.0 .950
24 ID
25 ID
26 IT 5 0 0 300
27 IO 5
28 IN 5 0 0
29 JR PREC 1 .988 .980 .976 .972 .950
*

30 KK OFF9
31 KM SUBBASIN OFF9
32 KM AREA ACRES
33 BA .00694
34 PB 3.43
35 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
36 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
37 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
38 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
39 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
40 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
41 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
42 PC .998 .999 1.00
43 LS 0 88
44 UD 0.077
*

45 KK OFF10
46 KM SUBBASIN OFF10
47 KM AREA ACRES
48 BA .01161
49 PB 3.43
50 LS 0 88

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1

HEC-1 INPUT

PAGE 2

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

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51 UD 0.088
*

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52      KK      OFF7
53      KM      SUBBASIN OFF7
54      KM              AREA      ACRES
55      BA      .11888
56      PB      3.43
57      LS      0      88
58      UD      0.174
      *

59      KK      OFF8
60      KM      SUBBASIN OFF8
61      KM              AREA      ACRES
62      BA      .02153
63      PB      3.43
64      LS      0      88
65      UD      0.113
      *

66      KK      ON11
67      KM      SUBBASIN ON11
68      KM              AREA      ACRES
69      BA      .05391
70      PB      3.34
71      LS      0      88
72      UD      0.115
      *

73      KK      CP1
74      KM      CONCENTRATION POINT CP1
75      KM      COMBINE ON11, OFF7, OFF8, OFF10 AND OFF9
76      HC      5
      *

77      KK      OFF11
78      KM      SUBBASIN OFF11
79      KM              AREA      ACRES
80      BA      .15083
81      PB      3.39
82      LS      0      88
83      UD      0.240
      *

84      KK      CP11
85      KM      CONCENTRATION POINT CP11
86      KM      COMBINE OFF11 AND CP1
87      HC      2
      *

```

HEC-1 INPUT

PAGE 3

```

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

88      KK      ON10R
89      KM      SUBBASIN ON10R
90      KM              AREA      ACRES
91      BA      .03528
92      PB      3.34
93      LS      0      88
94      UD      0.130
      *

95      KK      ON9R
96      KM      SUBBASIN ON9R
97      KM              AREA      ACRES
98      BA      .01770
99      PB      3.34
100     LS      0      88
101     UD      0.136
      *

102     KK      CP2
103     KM      CONCENTRATION POINT CP2
104     KM      COMBINE ON9R AND ON10R
105     HC      2
      *

106     KK      SB1
107     KM      ONSITE SUBBASIN SB1
108     KM              AREA      ACRES
109     BA      .01206
110     PB      3.34
111     LS      0      91
112     UD      .085
      *

113     KK      SB2
114     KM      ONSITE SUBBASIN SB2
115     KM              AREA      ACRES
116     BA      .00202
117     LS      0      94
118     UD      0.051
      *

119     KK      SB3
120     KM      ONSITE SUBBASIN SB3
121     KM              AREA      ACRES
122     BA      .00553
123     LS      0      94
124     UD      0.089
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```

[illegible][illegible]

192 LS 0 94
 193 UD 0.050
 *
 194 KK CP7
 195 KM CONCENTRATION POINT CP7
 196 KM COMBINE SB4 AND RG6*
 197 HC 2
 *

1

HEC-1 INFUT

PAGE 6

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

198 KK CP8
 199 KM CONCENTRATION POINT CP18
 200 KM COMBINE CP6 AND CP7
 201 HC 2
 *

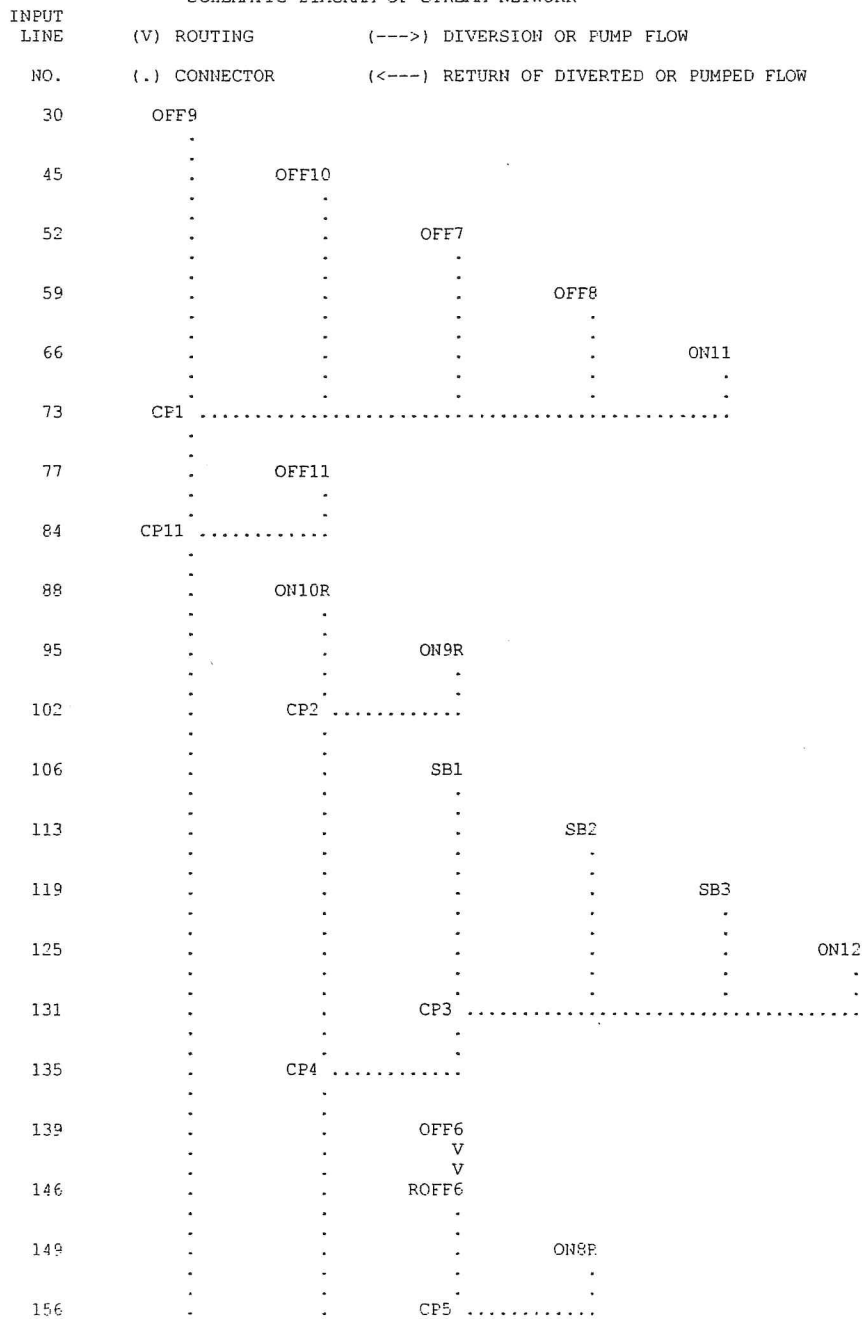
202 KK CP9
 203 KM CONCENTRATION POINT CP19
 204 KM COMBINE CP8 AND CP5
 205 HC 2
 *

206 KK CP10
 207 KM CONCENTRATION POINT CP10
 208 KM COMBINE CP9 AND CP4
 209 HC 2
 *

210 ZZ

1

SCHEMATIC DIAGRAM OF STREAM NETWORK



```

160      .      .      .      OFF5
      .      .      .      V
      .      .      .      V
167      .      .      .      ROFF5
      .      .      .      .
170      .      .      .      ON7R
      .      .      .      .
177      .      .      .      CP6 .....
      .      .      .      .
181      .      .      .      RG6*
      .      .      .      .
188      .      .      .      .      SB4
      .      .      .      .
194      .      .      .      CP7 .....
      .      .      .      .
198      .      .      .      CP8 .....
      .      .      .      .
202      .      .      CP9 .....
      .      .      .
206      .      CP10 .....

```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1 *****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 31MAR04 TIME 13:41:59 *
* *****

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*****
* U.S. ARMY CORPS OF ENGINEERS *
* HYDROLOGIC ENGINEERING CENTER *
* 609 SECOND STREET *
* DAVIS, CALIFORNIA 95616 *
* (916) 756-1104 *
* *****

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*****
* : SUMMERLIN VILLAGE 24 : *
* : UNIT 1 IMPROVEMENTS : *
* : EXISTING CONDITIONS : *
* : ONSITE AND OFFSITE : *
* : : *
* : RETURN PERIOD 10/100-YEAR : *
* : DISTRIBUTUION 6-HOUR SDN3 : *
* : PROJECT NO 62024-001 : *
* : FILENAME INT.H1 : *
* : DATE 3/22/04 : *
* : : *
*****

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DEPTH AREA REDUCTION FACTOR

SQ MILES	DARF
0-.1	1.0
.1-.3	.988
.3-.5	.980
.5-.7	.976
.7-.9	.972
1.0-2.0	.950

27 IO

OUTPUT CONTROL VARIABLES

```

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

```

IT

HYDROGRAPH TIME DATA

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NMIN 5 MINUTES IN COMPUTATION INTERVAL
IDATE 1 0 STARTING DATE
ITIME 0000 STARTING TIME
NQ 300 NUMBER OF HYDROGRAPH ORDINATES
NDDATE 2 0 ENDING DATE
NDTIME 0055 ENDING TIME
ICENT 19 CENTURY MARK

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COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

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ENGLISH UNITS

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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

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JF

MULTI-PLAN OPTION

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NPLAN 1 NUMBER OF PLANS

```


+	OFF5	.46	1	FLOW TIME	632. 3.75	622. 3.75	615. 3.75	612. 3.75	609. 3.75	590. 3.75
ROUTED TO										
+	ROFF5	.46	1	FLOW TIME	636. 3.83	626. 3.83	619. 3.83	616. 3.83	613. 3.83	594. 3.83
HYDROGRAPH AT										
+	ON7R	.06	1	FLOW TIME	103. 3.58	102. 3.58	101. 3.58	100. 3.58	99. 3.58	96. 3.58
2 COMBINED AT										
+	CP6	.52	1	FLOW TIME	692. 3.83	681. 3.83	673. 3.83	670. 3.83	666. 3.83	646. 3.83
HYDROGRAPH AT										
+	RG6*	.34	1	FLOW TIME	490. 3.67	482. 3.67	477. 3.67	474. 3.67	472. 3.67	457. 3.67
HYDROGRAPH AT										
+	SB4	.00	1	FLOW TIME	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50	5. 3.50
2 COMBINED AT										
+	CP7	.34	1	FLOW TIME	492. 3.67	484. 3.67	479. 3.67	476. 3.67	474. 3.67	459. 3.67
2 COMBINED AT										
+	CP8	.86	1	FLOW TIME	1138. 3.75	1120. 3.75	1107. 3.75	1101. 3.75	1095. 3.75	1061. 3.75
2 COMBINED AT										
+	CP9	.96	1	FLOW TIME	1265. 3.75	1245. 3.75	1231. 3.75	1224. 3.75	1217. 3.75	1179. 3.75
2 COMBINED AT										
+	CP10	1.05	1	FLOW TIME	1364. 3.67	1341. 3.67	1326. 3.67	1318. 3.67	1310. 3.67	1268. 3.67

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	DT (MIN)	INTERPOLATED TO COMPUTATION INTERVAL		VOLUME (IN)
							PEAK (CFS)	TIME TO PEAK (MIN)	
FOR PLAN = 1	RATIO=	.00							
ROFF6	MANE	3.25	11.19	224.25	2.21	5.00	10.97	225.00	2.20

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6455E+00 EXCESS= .0000E+00 OUTFLOW= .6479E+00 BASIN STORAGE= .1677E-02 PERCENT ERROR= -.6

FOR PLAN = 1	RATIO=	.00							
ROFF6	MANE	3.25	11.01	224.25	2.17	5.00	10.81	225.00	2.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6346E+00 EXCESS= .0000E+00 OUTFLOW= .6368E+00 BASIN STORAGE= .1666E-02 PERCENT ERROR= -.6

FOR PLAN = 1	RATIO=	.00							
ROFF6	MANE	3.25	10.90	224.25	2.15	5.00	10.70	225.00	2.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6273E+00 EXCESS= .0000E+00 OUTFLOW= .6295E+00 BASIN STORAGE= .1659E-02 PERCENT ERROR= -.6

FOR PLAN = 1	RATIO=	.00							
ROFF6	MANE	3.25	10.84	224.25	2.13	5.00	10.64	225.00	2.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6237E+00 EXCESS= .0000E+00 OUTFLOW= .6258E+00 BASIN STORAGE= .1656E-02 PERCENT ERROR= -.6

FOR PLAN = 1	RATIO=	.00							
ROFF6	MANE	3.25	10.78	224.25	2.12	5.00	10.59	225.00	2.12

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6200E+00 EXCESS= .0000E+00 OUTFLOW= .6222E+00 BASIN STORAGE= .1652E-02 PERCENT ERROR= -.6

FOR PLAN = 1	RATIO=	.00							
ROFF6	MANE	3.25	10.45	224.25	2.05	5.00	10.29	225.00	2.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6001E+00 EXCESS= .0000E+00 OUTFLOW= .6022E+00 BASIN STORAGE= .1633E-02 PERCENT ERROR= -.6

FOR PLAN = 1	RATIO=	.00							
ROFF5	MANE	5.00	636.36	230.00	2.21	5.00	636.36	230.00	2.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5424E+02 EXCESS= .0000E+00 OUTFLOW= .5426E+02 BASIN STORAGE= .1971E-02 PERCENT ERROR= .0

FOR PLAN = 1	RATIO=	.00							
ROFF5	MANE	5.00	626.21	230.00	2.17	5.00	626.21	230.00	2.17

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5332E+02 EXCESS= .0000E+00 OUTFLOW= .5334E+02 BASIN STORAGE= .1953E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
ROFF5 MANE 5.00 619.45 230.00 2.14 5.00 619.45 230.00 2.14

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5271E+02 EXCESS= .0000E+00 OUTFLOW= .5273E+02 BASIN STORAGE= .1941E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
ROFF5 MANE 5.00 616.07 230.00 2.13 5.00 616.07 230.00 2.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5240E+02 EXCESS= .0000E+00 OUTFLOW= .5243E+02 BASIN STORAGE= .1934E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
ROFF5 MANE 5.00 612.69 230.00 2.12 5.00 612.69 230.00 2.12

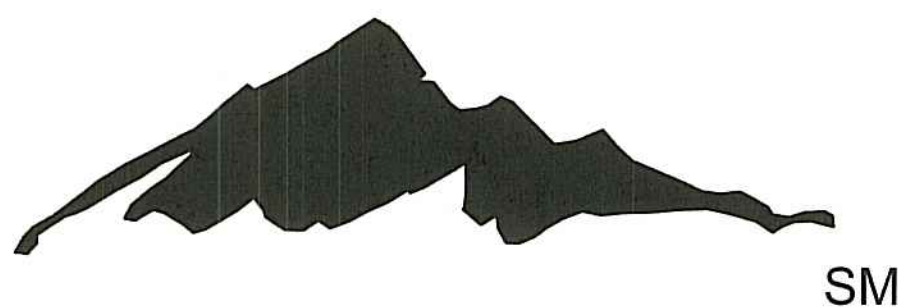
CONTINUITY SUMMARY (AC-FT) - INFLOW= .5210E+02 EXCESS= .0000E+00 OUTFLOW= .5212E+02 BASIN STORAGE= .1928E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
ROFF5 MANE 5.00 594.09 230.00 2.05 5.00 594.09 230.00 2.05

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5042E+02 EXCESS= .0000E+00 OUTFLOW= .5044E+02 BASIN STORAGE= .1894E-02 PERCENT ERROR= -.1

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

SUMMERLIN



VILLAGE 24 COS 3 WASH IMPROVEMENT PLANS

2017

A.P.N. 137-33-810-004

NON-SID

INDEX OF SHEETS		
NO.	DWG	DESCRIPTION
1	1	COVER SHEET
2	2	GENERAL NOTES
3	3	HORIZONTAL CONTROL 1
4	4	HORIZONTAL CONTROL 2
5	5	GRADING OVERALL
6	6	PLAN AND PROFILE 1
7	7	PLAN AND PROFILE 2
8	8	PLAN AND PROFILE 3
9	9	PLAN AND PROFILE 4
10	10	PLAN AND PROFILE 5
11	11	PLAN AND PROFILE 6
12	12	PLAN AND PROFILE 7
13	13	PLAN AND PROFILE 8
14	14	PLAN AND PROFILE 9
15	15	DETAIL SHEET 1
16	16	DETAIL SHEET 2



FOR AGENCY REVIEW - NOT FOR CONSTRUCTION

DESCRIPTION

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DATE

DATE

PROJECT NO.

62024-226-3

DESIGN: MOJ

DRAWN: MOJ

CHECK: JJJ

PLOT DATE: 03-17-17

PLOT TIME: 08:35:01

1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gwenengineering.com

ENGINEERS \ SURVEYORS

f:\Projects\62024-226-3\DWG\production\V24-226-3_CV.dwg

Matthew Burge

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-3 WASH IMPROVEMENT PLANS

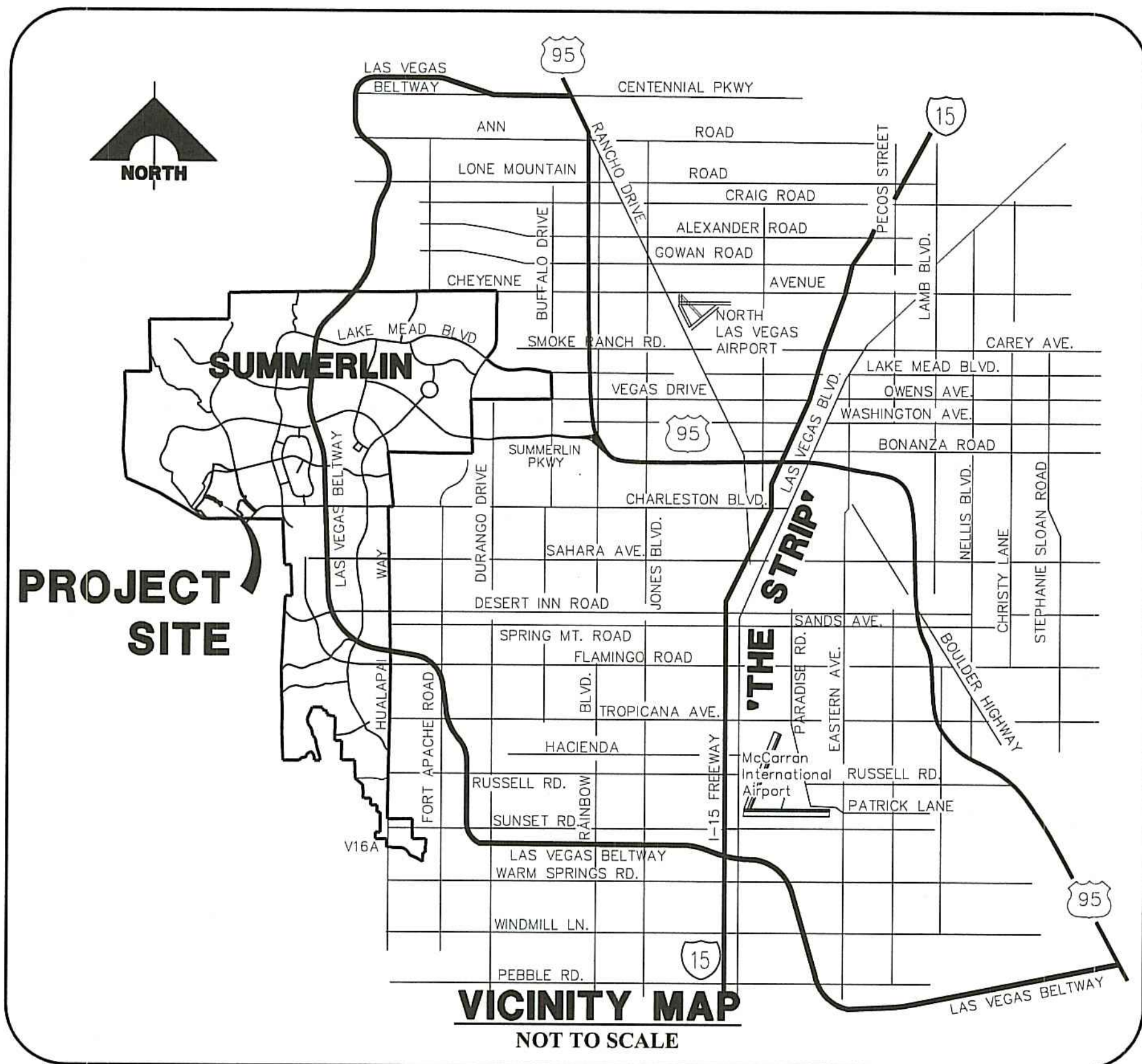
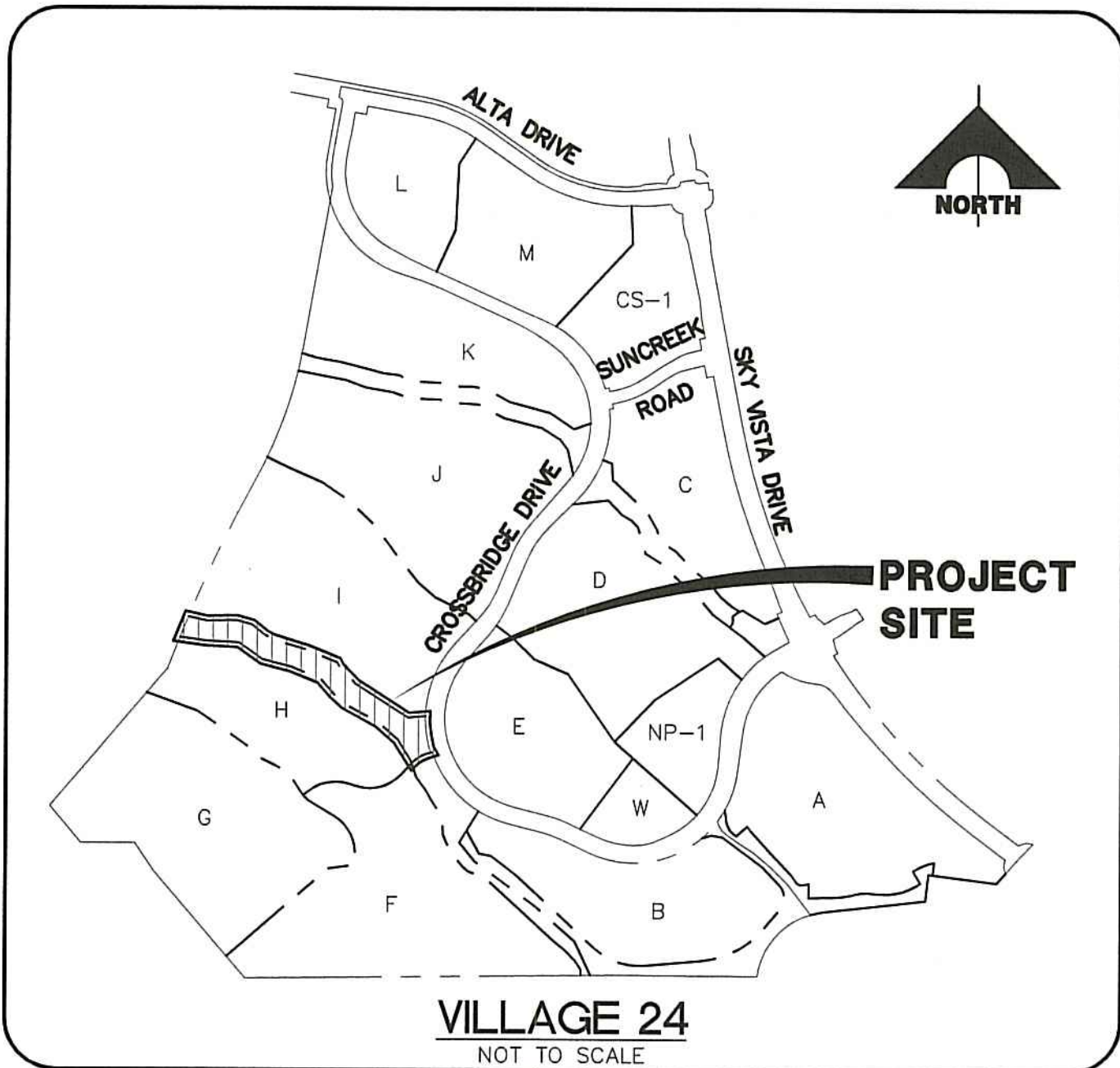
COVER SHEET

DRAWING

1

1 OF 16 SHTS

#



OWNER/DEVELOPER

THE HOWARD HUGHES COMPANY, LLC
10801 W. CHARLESTON BLVD., 3RD FLOOR
LAS VEGAS, NEVADA 89146
OFFICE PHONE NO. (702) 791-4300

ENGINEER

GCV
ENGINEERS \ SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gwenengineering.com



DRAINAGE CERTIFICATION

I CERTIFY THAT THE GRADING PLANS ARE IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE AT THE CITY OF LAS VEGAS FOR THIS PROJECT.

JOSHUA L. JOHNSON P.E. 15789

DATE

ALLEN PAVELKA: PE, PE# 9029

DATE

CITY ENGINEER

CITY OF LAS VEGAS, NEVADA

APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHTS-OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER "DEVIATIONS FROM STANDARDS". THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN "DEVIATIONS FROM STANDARDS" IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.

CLV PLANNING DEPARTMENT

THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE CITY OF LAS VEGAS PLANNING DEPARTMENT

CHRIS KNIGHT, DIRECTOR BUILDING AND SAFETY

DATE

THE HOWARD HUGHES COMPANY, LLC

KEVIN ORROCK
VICE PRESIDENT

DATE

CLV #

1. IN THE EVENT THAT ANY UNFORESEEN CONDITIONS NOT COVERED BY THESE NOTES ARE ENCOUNTERED DURING GRADING OPERATIONS, THE OWNER/ENGINEER SHALL BE IMMEDIATELY NOTIFIED FOR DIRECTION.
2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM ALL NECESSARY CUTS AND FILLS WITHIN THE LIMITS OF THIS PROJECT AND THE RELATED OFF-SITE WORK SO AS TO GENERATE THE DESIRED SUBGRADE, FINISH GRADES AND SLOPES SHOWN.
3. CONTRACTOR SHALL TAKE FULL RESPONSIBILITY FOR ALL EXCAVATION, ADEQUATE SHORING SHALL BE DESIGNED AND PROVIDED BY THE CONTRACTOR TO PREVENT UNDERMINING OF ANY ADJACENT FEATURES OR FACILITIES AND/OR CAVING OF THE EXCAVATION.
4. THE CONTRACTOR IS WARNED THAT AN EARTHWORK BALANCE WAS NOT NECESSARILY THE INTENT OF THIS PROJECT. ANY ADDITIONAL MATERIAL REQUIRED OR LEFTOVER FROM THE FOLLOWING EARTHWORK OPERATIONS BECOMES THE RESPONSIBILITY OF THE CONTRACTOR.
5. THE GRADING CONTRACTOR IS RESPONSIBLE TO COORDINATE WITH THE OWNER TO PROVIDE FOR THE REQUIREMENTS OF THE PROJECT STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND ASSOCIATED PERMIT.
6. CONTRACTOR SHALL GRADE TO THE LINES AND ELEVATIONS SHOWN ON THE PLANS WITHIN THE FOLLOWING HORIZONTAL AND VERTICAL TOLERANCES AND DEGREES OF COMPACTION, IN THE AREAS INDICATED:

	HORIZONTAL	VERTICAL	COMPACTION
A. PAVEMENT AREA SUBGRADE	0.1"±	+0.0' TO -0.1'	SEE SOILS REPORT
B. ENGINEERED FILL	0.5"±	+0.1' TO -0.1'	SEE SOILS REPORT
7. ALL CUT AND FILL SLOPES SHALL BE PROTECTED UNTIL EFFECTIVE EROSION CONTROL HAS BEEN ESTABLISHED.
8. THE USE OF POTABLE WATER WITHOUT A SPECIAL PERMIT FOR BUILDING OR CONSTRUCTION PURPOSES INCLUDING CONSOLIDATION OF BACKFILL OR DUST CONTROL IS PROHIBITED. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FOR CONSTRUCTION WATER.
9. THE CONTRACTOR SHALL MAINTAIN THE STREETS, SIDEWALKS AND ALL OTHER PUBLIC RIGHT-OF-WAY IN A CLEAN, SAFE AND USABLE CONDITION. ALL SPILLS OF SOIL, ROCK OR CONSTRUCTION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE PUBLICLY OWNED PROPERTY DURING CONSTRUCTION AND UPON COMPLETION OF THE PROJECT. ALL ADJACENT PROPERTY, PRIVATE OR PUBLIC SHALL BE MAINTAINED IN A CLEAN, SAFE AND USABLE CONDITION.
10. IN THE EVENT THAT ANY TEMPORARY CONSTRUCTION ITEM IS REQUIRED THAT IS NOT SHOWN ON THESE DRAWINGS, SUCH ITEM SHALL BE PROVIDED, AS DIRECTED BY THE ENGINEER, AT THE CONTRACTOR'S EXPENSE TO THE CITY OF LAS VEGAS. TEMPORARY CONSTRUCTION INCLUDES DITCHES, BERMS, ROAD SIGNS AND BARRICADES, ETC.

REvised 4/15/10

1. THE OWNER, SITE DEVELOPER, CONTRACTOR AND/OR THEIR AUTHORIZED AGENTS SHALL EACH DAY REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED TO, OR ACCUMULATE IN, THE PUBLIC RIGHTS OF WAYS OF THE CITY OF LAS VEGAS AS A RESULT OF CONSTRUCTION ACTIVITIES ASSOCIATED WITH THIS SITE DEVELOPMENT OR CONSTRUCTION PROJECT. SUCH MATERIALS SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
2. ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED BY THE OWNER AND HIS OR HER AGENTS DUE TO UNFORESEEN EROSION POTENTIAL. IF A BEST MANAGEMENT PLAN DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN THE CITY OF LAS VEGAS AND THE LAS VEGAS VALLEY CONSTRUCTION SITE BEST MANAGEMENT PRACTICES MANUAL.
3. TEMPORARY OR PERMANENT STABILIZATION PRACTICES WILL BE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. CONSTRUCTION ACTIVITY MAY, AFTER SECTION TO NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, REFER TO NVIA.5.
4. AT A MINIMUM, THE CONTRACTOR OR HIS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS, AND AREAS EXPOSED TO EROSION, TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS AND ALL BMPs WEEKLY AND WITHIN 24 HOURS AFTER ANY ACTUAL RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR HIS AGENT SHALL UPDATE OR MODIFY THE STORMWATER POLLUTION PREVENTION PLAN TO REFLECT ANY CHANGES TO CONSTRUCTION ACTIVITIES. WHEN TO APPLY, SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NVR100000, SECTION 1A.12.
5. ACCUMULATED SEDIMENT IN BMPs SHALL BE REMOVED WITHIN SEVEN DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, AND SHALL BE REMOVED WHEN THE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", LATEST EDITION; THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST REVISION EDITION; THE "SUMMIT IMPROVEMENT STANDARDS" FOR PAVING IN THE SUMMERLIN AREA; AND OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY; THE UNIFORM BUILDING CODE; AND ALL LOCAL CITY ORDINANCES AND ORDINANCES APPLICABLE, EXCEPT AS NOTED ON THIS SHEET AS "DEVIATIONS FROM STANDARDS".
2. THE EXISTENCE AND LOCATION OF ANY OVERHEAD OR UNDERGROUND UTILITY LINES, PIPE OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A RESEARCH OF THE AVAILABLE RECORDS. EXISTING UTILITIES AS SHOWN FROM CLV PLANS LIBRARY ARE APPROXIMATE AND FOR RECORD PURPOSES. EXISTING UTILITIES ARE LOCATED APPROXIMATELY ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. EXISTING UTILITY SERVICE LATERALS MAY NOT BE SHOWN ON THE PLANS. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL UNDERGROUND AND OVERHEAD INTERFERENCE'S WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO PREVENT DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COST AND LIABILITY IN CONNECTION THEREWITH.
3. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING UTILITY LINES, STRUCTURES AND STREET IMPROVEMENTS WHICH ARE SHOWN ON PLANS FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED SATISFACTORY TO THE CITY ENGINEER AND OWNING UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.
4. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS, ANY REVISIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE CITY ENGINEER.
5. TYPE V CEMENT SHALL BE USED IN ALL OFF-SITE CONCRETE WORK. CONCRETE TO BE 3000 P.S.I. MINIMUM @ 28 DAYS. MIX DESIGNS TO BE APPROVED BY THE CITY, PRIOR TO THE USE ON THE PROJECT.
6. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION.
7. EXPANSION JOINTS REQUIRED, MAXIMUM EVERY 300' IN EXTRUDED-TYPE CURB.
8. AC PAVEMENT TO BE ONE-HALF INCH (1/2") ABOVE LIP OF ALL GUTTERS AFTER CONSTRUCTION, EXCEPT AT SIDEWALK RAMPS AND CROSS GUTTERS.
9. CURB AND GUTTER FOUND TO BE UNACCEPTABLE TO THE CITY OF LAS VEGAS SHALL BE REMOVED AND REPLACED PER STANDARD DRAWING 216.
10. SIDEWALK RAMPS SHALL BE CONSTRUCTED IN EACH QUADRANT OF AN INTERSECTION PER STANDARD DRAWING 235. EXACT LOCATION OF RAMPS MAY BE ADJUSTED IN THE FIELD BY A CITY INSPECTOR.
11. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND INGRESS AND EGRESS TO NEW CONSTRUCTION, THE EXTENT OF THE TRANSITIONS TO BE AS SHOWN ON PLANS.

12. ALL GRADING WORK SHALL CONFORM TO THE SOILS REPORT AS PREPARED BY NOVA GEOTECHNICAL & INSPECTION SERVICES, PROJECT NUMBER E-15-086, MAY 21, 2015, APPROVED BY THE CITY ENGINEER, AND AS SHOWN ON THESE PLANS.

13. EXACT LOCATION OF ALL SAWCUT LINES MAY BE ADJUSTED OR DETERMINED IN THE FIELD BY A CITY OF LAS VEGAS ENGINEER IF LOCATION ON PLANS IS NOT CLEARLY SHOWN, OR EXISTING PAVEMENT CONDITION REQUIRES RELOCATIONS

14. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED AND ADJUSTED PER AVAILABLE RECORDS IN ACCORDANCE WITH N.R.S. STATUTE NO. 625.380 & CITY OF LAS VEGAS TITLE 18, APPENDIX D.

15. UTILITY COMPANY METER BOXES, MANHOLE LIDS, VALVE COVERS, ETC., SHALL BE LOCATED OUT OF DRIVEWAYS, DRIVEWAY APRONS, FLOWLINES, AND CROSS GUTTERS UNLESS WRITTEN APPROVAL IS GRANTED BY THE UTILITY COMPANY AND THE CITY ENGINEER.

WALL NOTES:

16. ALL WALLS, NEW OR EXISTING, ARE ONLY SHOWN ON CIVIL PLANS FOR THE PURPOSE OF REVIEWING GRADING RELATIONSHIPS; FLOOD CONTROL AND SIGHT DISTANCE AT INTERSECTIONS. NEW WALLS REQUIRE A SEPARATE PERMIT AND INSPECTION BY THE BUILDING DEPARTMENT.

17. ASPHALT MIX DESIGN MUST BE SUBMITTED AND APPROVED BY THE CITY ENGINEER PRIOR TO THE PLACEMENT OF ASPHALT WITHIN CITY RIGHT OF WAY.

18. CONTRACTOR SHALL ADJUST ALL NEW AND EXISTING INLETS, VALVE BOXES, MANHOLE RIMS, AND SEWER CLEAN OUTS, ETC. TO FINISH GRADE AS APPLICABLE WHETHER OR NOT THEY ARE SHOWN ON THE PLANS.

19. MATERIALS, HANDLING AND PLACEMENT OF PORTLAND CEMENT CONCRETE SHALL BE IN ACCORDANCE WITH APPLICABLE SECTIONS OF NDOT OR THE CLARK COUNTY AREA SPECIFICATIONS (AS APPLICABLE) AND THE PLANS AND DETAILS SHOWN HEREON.

20. WHEN INSTALLING UNDERGROUND FACILITIES THAT REQUIRE UNDERGROUND LOCATING DEVICES SUCH AS MARKER BALLS, LOCATING RIBBON, ETC, THE CONTRACTOR SHALL PROVIDE WRITTEN DOCUMENTATION TO THE OFFSITE INSPECTION AND TESTING CERTIFYING THAT ALL DEVICES HAVE BEEN PLACED AND VERIFIED TO BE IN GOOD WORKING CONDITION PRIOR TO THE CONSTRUCTION OF ANY ROAD BASE.

21. SANITARY SEWER AND STORM DRAIN FINAL LOCATION MAP(S) SHALL BE PROVIDED TO THE CITY PRIOR TO ACCEPTANCE OF FACILITY VIDEO INSPECTION. THE MAP(S) SHALL INCLUDE THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MAINS, STORM DRAIN MAINS, MANHOLES, TRANSITION STRUCTURES, STORM DRAIN LATERALS AT THE CONNECTION TO THE STORM DRAIN MAIN, AND STORM DRAIN LATERALS TO A DROP INLET, THE CONNECTION OF SEWER SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXIT THE PUBLIC RIGHT-OF-WAY, AND STORM DRAIN LATERALS TO A DRAINAGE DITCH. THE LOCATION OF EACH LATERAL SHALL BE DESCRIBED BY COORDINATES WHICH SHALL BE BASED ON THE OFFICIAL HORIZONTAL AND VERTICAL CONTROL NETWORKS OF THE CITY OF LAS VEGAS. A LEGENDIC COMMA DELIMITED FILE FOR THE SANITARY SEWER AND STORM DRAIN COORDINATES SHALL ALSO ACCOMPANY THE SANITARY SEWER AND STORM DRAIN FINAL LOCATION MAP(S).

OR
SANITARY SEWER AND STORM DRAIN FACILITIES SHOWN ON THESE PLANS SHALL BE USED TO MEET THE REQUIREMENTS ON NRS 455 AND SHALL SHOW AT A MINIMUM THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MANHOLES, STORM DRAIN MANHOLES, STORM DRAIN LATERALS, AND THE CONNECTION TO THE STORM DRAIN MANHOLE OF THE UTILITY TO BE CONSTRUCTED. THE PLANS SHALL ALSO SHOW THE SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXIT THE PUBLIC RIGHT-OF-WAY. ANY DEVIATIONS FROM THE INFORMATION SHOWN SHALL BE NOTED AND SUBMITTED AS A REVISION TO THE PLANS AND APPROVED PRIOR TO ACCEPTANCE OF FACILITY VIDEO INSPECTION.

22. CCTV VIDEO INSPECTION IS REQUIRED FOR ALL SEWER AND STORM DRAINS. THE CCTV VIDEO INSPECTIONS NEED TO BE PERFORMED PER THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS LATEST EDITION.

23. A SEPARATE BORING PERMIT IS REQUIRED FOR ALL BORING ACTIVITIES.

REVISÉ 02/03/15

NO PORTION OF THE SITE FALLS WITHIN A FEMA DESIGNATED SPECIAL FLOOD HAZARD AREA. SITE LOCATED ON PANEL 32003C2150E, DATED SEPTEMBER 27, 2002, TO REFLECT A LOMR. THIS PANEL SHOWS THAT THE PROJECT IS LOCATED WITHIN A ZONE X AND NOT LOCATED WITHIN A FEMA DESIGNATED 100-YEAR ZONE A OR SPECIAL FLOOD HAZARD AREA.

	PROPOSED UTILITIES		DRAWING NUMBER FOR DETAIL W/ REF. TO THE SHEET WHERE IT IS SHOWN
	EXISTING UTILITIES		STANDARD DRAWING NUMBER
	FUTURE UTILITIES		GOVERNING AGENCY
	SECTION LINE		BENCHMARK
	EASEMENT LINE		POT HOLE LOCATION
	RIGHT-OF-WAY LINE		EXISTING NVR RS-100
	PROPERTY LINE		EXISTING DROP INLET
	CENTERLINE		PROPOSED DROP INLET
	100 YR HYDRAULIC GRADE LINE (ULT)		FUTURE DROP INLET
	100 YR HYDRAULIC GRADE LINE (INT)		EXISTING GATE VALVE
	PROPOSED UTILITY (BY OTHERS)		PROPOSED GATE VALVE
	PROPOSED SEWER LINE W/MH		FUTURE GATE VALVE
	FUTURE SEWER LINE W/MH		EXISTING WATER METER
	EXISTING SEWER LINE W/MH		PROPOSED WATER METER
	EXISTING WATER LINE & GATE VALVE		EXISTING TRAFFIC SIGNAL PULL BOX
	PROPOSED WATER LINE & GATE VALVE		PROPOSED SIGNAL PULLBOX
	FUTURE WATER LINE & GATE VALVE		EXISTING TELEPHONE MANHOLE
	2" G		EXISTING POWER POLE
	2-6" E		EXISTING ELEC MARKER
	CATV		EXISTING TRAFFIC SIGNAL
	TEL		PROPOSED TRAFFIC SIGNAL
	OHP		EXISTING FIRE HYDRANT
	EXISTING OVERHEAD AND POWER POLES		PROPOSED FIRE HYDRANT
	PROPOSED STORM DRAIN W/MH		FUTURE FIRE HYDRANT
	EXISTING STORM DRAIN W/MH		EXISTING UTILITY BOX
	FUTURE STORM DRAIN W/MH		EXISTING METER BOX
	EXISTING SIDEWALK AND RAMP		PROPOSED CONTOUR
	CONSTRUCT CURB DEPRESSION FOR FUTURE HANDICAP RAMP		EXISTING CONTOUR
	VIEW FENCE		SPOT ELEVATION
	NEW ABANDONED PIPE		EXISTING SPOT ELEVATION
	EXISTING ABANDONMENT		FUTURE SPOT ELEVATION
	SAWCUT		EXISTING CLARK COUNTY STREET LIGHT (STLT)
	STEEL CASING		ROAD SLOPE
	APPROXIMATE PAVEMENT RESTORATION		EXISTING SUMMERLIN STREET LIGHT (STLT)
	TO BE ABANDONED PROFILE HATCH		PROPOSED SUMMERLIN STREET LIGHT (STLT)
	WATER STUB WITH BLOW-OFF		3:1 SLOPE UNLESS OTHERWISE NOTED ON PLAN
	FUTURE WATER STUB WITH BLOW-OFF		
	SEWER STUB WITH CAP		
	FUTURE SEWER STUB WITH CAP		
	EDGE OF PAVEMENT		
	OUTSIDE EDGE		
	CUT LIMIT LINE		
	FILL LIMIT LINE		

AC	ASPHALT CONCRETE, ACRE	FH	FIRE HYDRANT	RCB	REINFORCED CONCRETE BOX
ACP	ASBESTOS CEMENT PIPE	FL	FLOW LINE	RCP	REINFORCED CONCRETE PIPE
ADD'L	ADDITIONAL	FO	FIBER OPTIC	RD	ROAD
ADP	ADDITIONAL POINT	FRP	FIBERGLASS REINFORCED PLASTIC	RDWY	ROADWAY
APN	ASSESSOR'S PARCEL NUMBER	FT	FOOT/FEET	REC	RECTANGULAR
APPROX	APPROXIMATELY	FTG	FOOTING	REF	REFERENCE
AASHO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS	FUT	FUTURE	REIN	REINFORCED
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	G	GAS	REOD	REQUIRED
AVE	AVENUE	GA	GAS, GUY, GUY ANCHOR	RM	ROOM
AVAR	AIR VALVE, AIR RELEASE ASSEMBLY	GB	GRADE BREAK	RND	ROUND
AWWA	AMERICAN WATER WORKS ASSOCIATION	GND	GROUND	R/W	RIGHT OF WAY
BC	BANK OF CURB	GRD	GRADE, GROUND	RP	RADIUS POINT
BCR	BEGIN CURB RETURN	HGT	HEIGHT	RPM	RAISED PAVEMENT MARKERS
BLM	BUREAU OF LAND MANAGEMENT	HDWL	HEADWALL	RSQV	RESILIENT SEAT GATE VALVE
BND	BOULEVARD	HGL	HYDRAULIC GRADE LINE	S	SOUTH
BM	BENCHMARK	HORIZ	HORIZONTAL	SC	SCHEDULE
BO	BLOW-OFF	HPS	HIGH PRESSURE SODIUM	SD	STORM DRAIN
BVECS	BEGIN VERTICAL CURVE ELEVATION	IBC	INTERNATIONAL BUILDING CODE	SDM	STORM DRAIN MANHOLE
BW	BEGIN VERTICAL CURVE STATION	INT	INTERIOR	SECT	SECTION
CB	CENTERLINE	INTM	INTERIM	SF	SQUARE FOOT/FEET
C, C	CURB AND GUTTER	JT	JOINT	SHLDR	SHOULDER
CCM	UNDERGROUND CABLE TV	LT	LENGTH	SHT	SHEET
CATV	CLARK COUNTY BENCH MARK	LF	LINEAR FEET	SIS	SUMMERLIN IMPROVEMENT
CCPW	CLARK COUNTY PUBLIC WORKS	LP	LAP OF GUTTER	SL	STANDARD
CCWRO	CLARK COUNTY WATER	LQ	LIGHT POLE	SP	SERVICE POINT
CFS	CUFT PER SECOND	LSC	LANDSCAPE	SR	SEWER RECLAIM MAIN
CIP	CORRUGATED IRON PIPE	LWMD	LAS VEGAS VALLEY WATER DISTRICT	SS	SANITARY SEWER
CIPM	CAST IN PLACE	MAX	MAXIMUM	SSMH	SANITARY SEWER MANHOLE
CIR	CAST-IN-PLACE PIPE	MH	MANHOLE	STA	STATION
CIRP	CIRCLE	MIN	MINIMUM	STD	STANDARD
CLR	CLEAR OR CLEARANCE	MJ	MORTAR JOINT	STL	STEEL
CLSM	CONTROLLED LOW STRENGTH MATERIAL	MOP	MESA PARK	STRUCT	STRUCTURE
CLV	CITY OF LAS VEGAS	MOD	MODIFY/MODIFIED	SVZ	SIGHT VISIBILITY ZONE
CMP	CORRUGATED METAL PIPE	MON	MONUMENT	SW	SIDEWALK
CNU	CONCRETE MASONRY UNIT	N	NORTH	SWG	SOUTHWEST GAS
CNCV	CITY OF NORTH LAS VEGAS	NPH	MILES PER HOUR	T	TOP OF CURB
CONC	CONCRETE	NDOT	NEVADA DEPARTMENT OF TRANSPORTATION	TAN	TANGENT
COND	CONDUIT	NO	NUMBER	TB	TOP OF BERM
COORD	CONSTRUCT OR CONSTRUCTION COORDINATE	NOSH	STATE OF NEVADA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	TCE	TEMPORARY CONSTRUCTION ESMT
CEP	CORNER	NVE	NEVADA ENERGY	TEL,TELE	TELEPHONE
CEPF	CORRUGATED POLYETHYLENE PIPE	NTS	NOT TO SCALE	TEMP	TEMPORARY
CT	CUBIC YARD(S)	OB	OVERBUILT	TO	TOP OF FINISH
CV	DELTA	OC	ON CENTER	TOF	TOP OF GRADE
DES	DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEM (LATEST EDITION)	OHC	OVERHEAD COX COMMUNICATION	TMH	TOP OF MANHOLE
DEFL	DEFLECTION	OHP	OVERHEAD POWER LINE	TOF	TOP OF POLE
DI	DESIGN GRADE	P	PULL BOX	TOF	TOP OF TELEPHONE POLE
DIA	DIAMETER	PBS	PLANTIMIX BITUMINOUS SURFACE	TRANS	TRANSITION
DIST	DIAMETER-IRON PIPE	PC	POINT OF CURVE, PRESSURE CLASS	TRW	TOP OF RETAINING WALL
DR	DRIVE	PCC	POINT OF COMPOUND CURVE	TS	TRAFFIC SIGNAL
DS	DOWNSPOUT	PE	PROJECT ENGINEER OR POLYETHYLENE	TW	TOP OF WALL
DW	DRAWING	PED	PEDESTRIAN	TY	TYPICAL
DWG	DRAWING	PGL	PROFILE, GRADE LINE	UDACS	UNIFORM DESIGN AND CONSTRUCTION STANDARDS FOR WATER DISTRIBUTION SYSTEMS (LATEST EDITION)
E	EAST	PH	PIE	UG	UNDERGROUND
E	ELECTRICAL	PI	POINT OF INTERSECTION	ULT	ULTIMATE
ELEC	ELEVATION	PV	POST INDICATOR VALVE	USD	UNIFORM DESIGN AND CONSTRUCTION STANDARDS
ELEC	ELECTRIC	PLCP	PROPERTY LINE	USDOCA	UNIFORM STD. DRAWINGS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS CLARK COUNTY AREA, NEVADA (LATEST EDITION)
EMT	EASEMENT	PMF	PAVEMENT MARKING FILM	UT	UNDERGROUND TELEPHONE
EXT	EXTEND	PMB	POINT OF BEGINNING	VAR	VARIABLE/VARIES
EXT	EXTENSION	POC	POINT ON CURVE	VC	VERTICAL CURVE
EXP	EXPANSION	P.O.C.	POINT OF CONNECTION	VCP	VITRIFIED CLAY PIPE
EXP	EXPANSION JOINT	POT	POINT ON TANGENT	VERT	VERTICAL
FC	FACE OF CURB	PP	POWER POLE	VG	VALLEY GUTTER
FF, FFE	FINISH GRADE ELEVATION	PRC	POINT OF REVERSE CURVE	VOL	VOLUME
FG	FINISH GRADE	PRVC	POINT OF REVERSE VERTICAL CURVE	W	WATER, WEST
		PSI	POUNDS PER SQUARE INCH	W/	WITH
		PNT	POINT OF TANGENCY	WOTUS	WATERS OF THE UNITED STATES
		PVC	POLYVINYL CHLORIDE	WT	WEIGHT
		PVI	POINT OF VERTICAL INTERSECTION	WTR	WATER
		PVMT	PAVEMENT	XING	CROSSING
		PSZ	PRESSURE ZONE	Y	YARD, YARD DRAIN
		R, RAD	RADIAL, RADIUS	Z	PRESSURE ZONE
		R, RT	RIGHT		

1. NONE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS
DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE
OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BM #	DESCRIPTION	NAVD 88 DATUM	NAVD 88 DATUM
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN	3246.63 (FEET)	989.574 (METERS)

Call before you dig
Avoid cutting underground utility lines. It's costly.

Call

OR
1-800-227-2600
AND
CLARK COUNTY TRAFFIC OPERATIONS
1-702-455-6000

AVOID HITTING OVERHEAD
POWER LINES. IT'S COSTLY

**CALL BEFORE
YOU DO
OVERHEAD**

1-702-227-2929

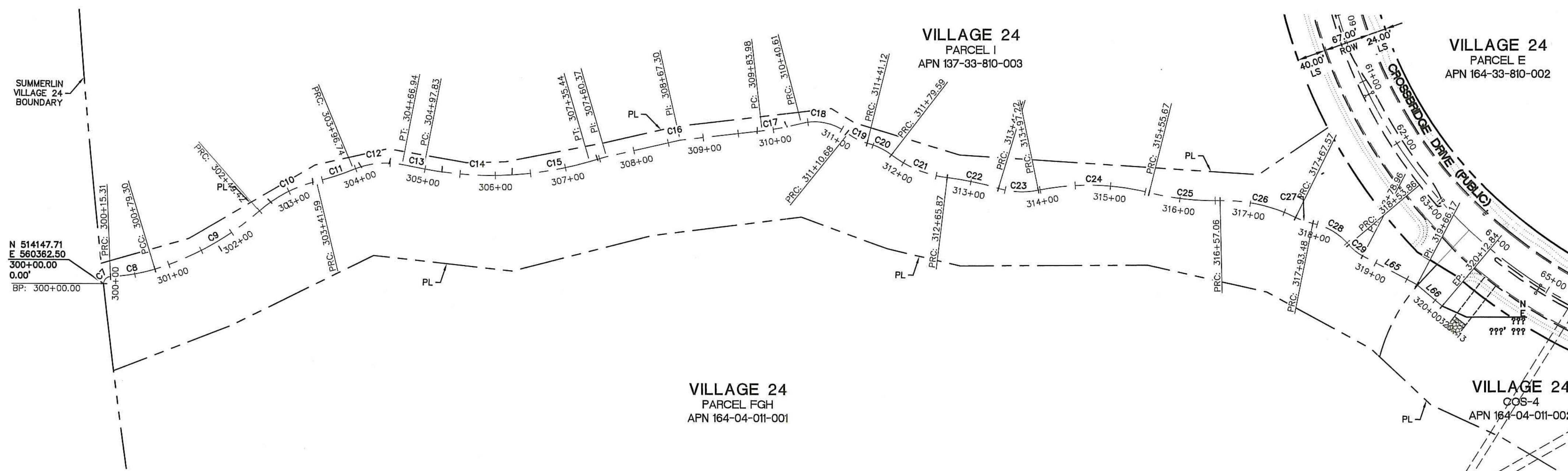
FAST

 **Call
before you
UnderGround**

1-702-432-5300

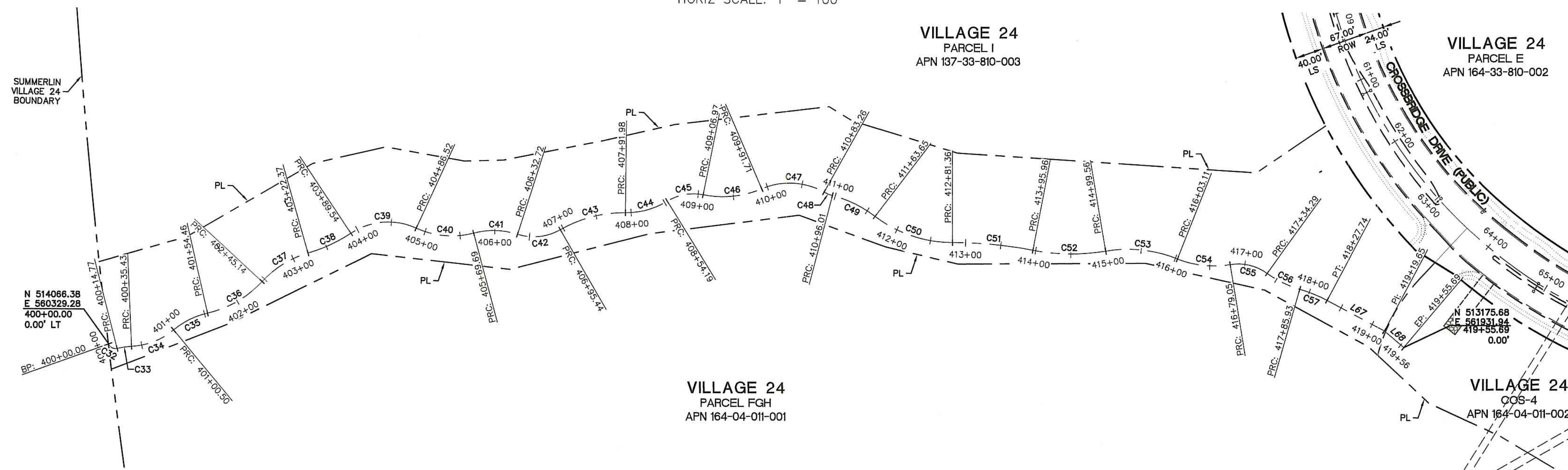
**FREEWAY AND ARTERIAL
SYSTEM OF TRANSPORTATION**

CLV +



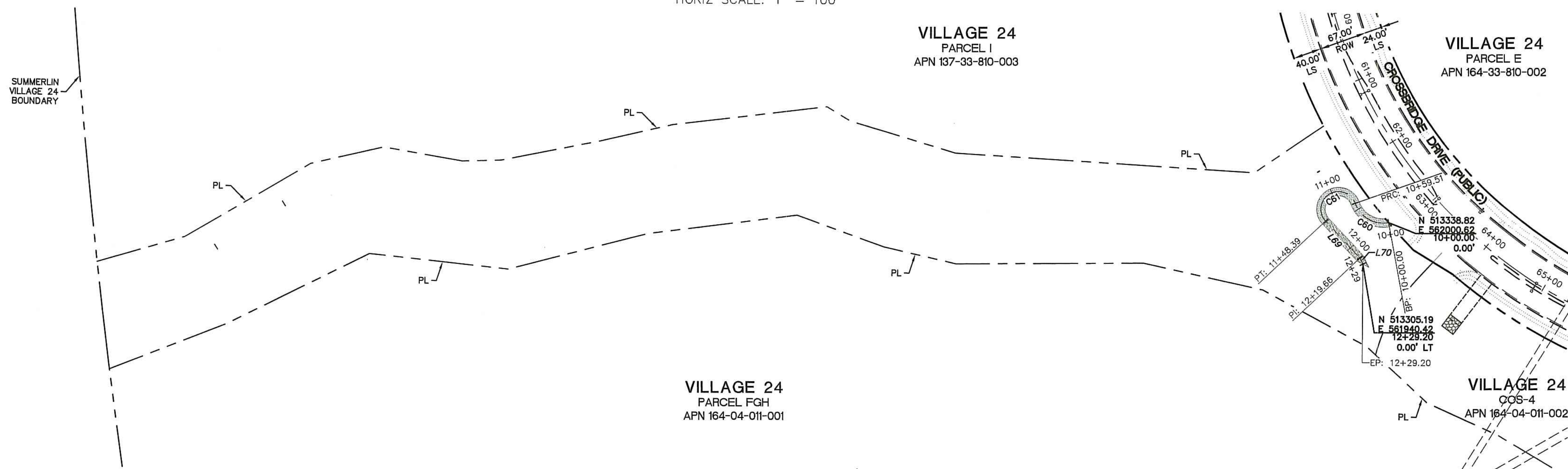
COS-3 LEFT TOP ALIGNMENT

HORIZ SCALE: 1" = 100'



COS-3 RIGHT TOP ALIGNMENT

HORIZ SCALE: 1" = 100'

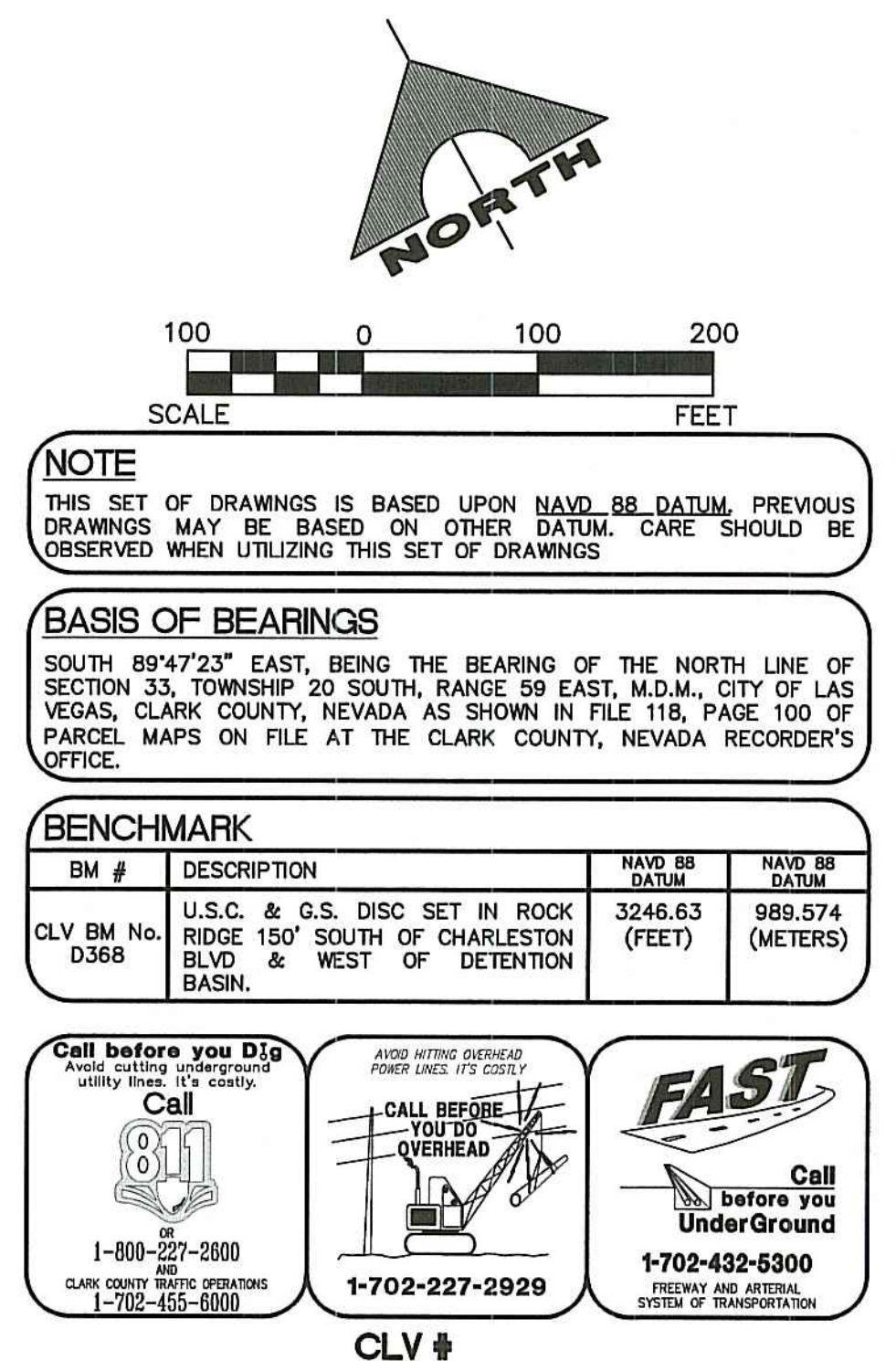


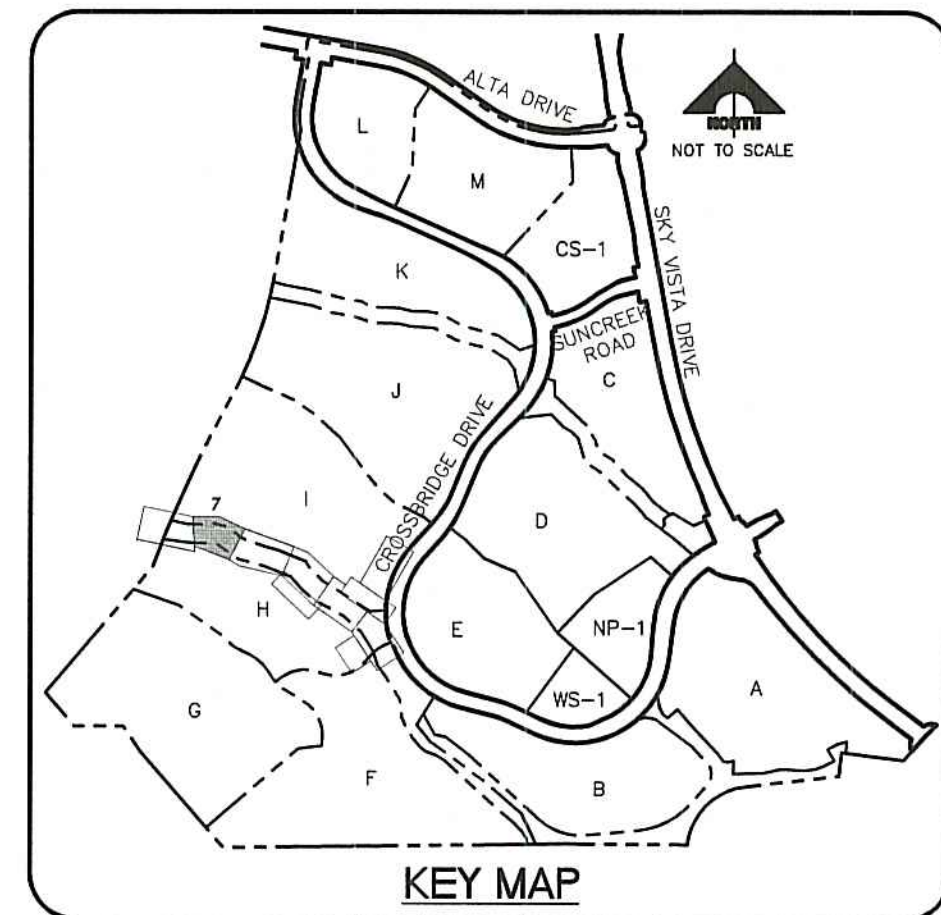
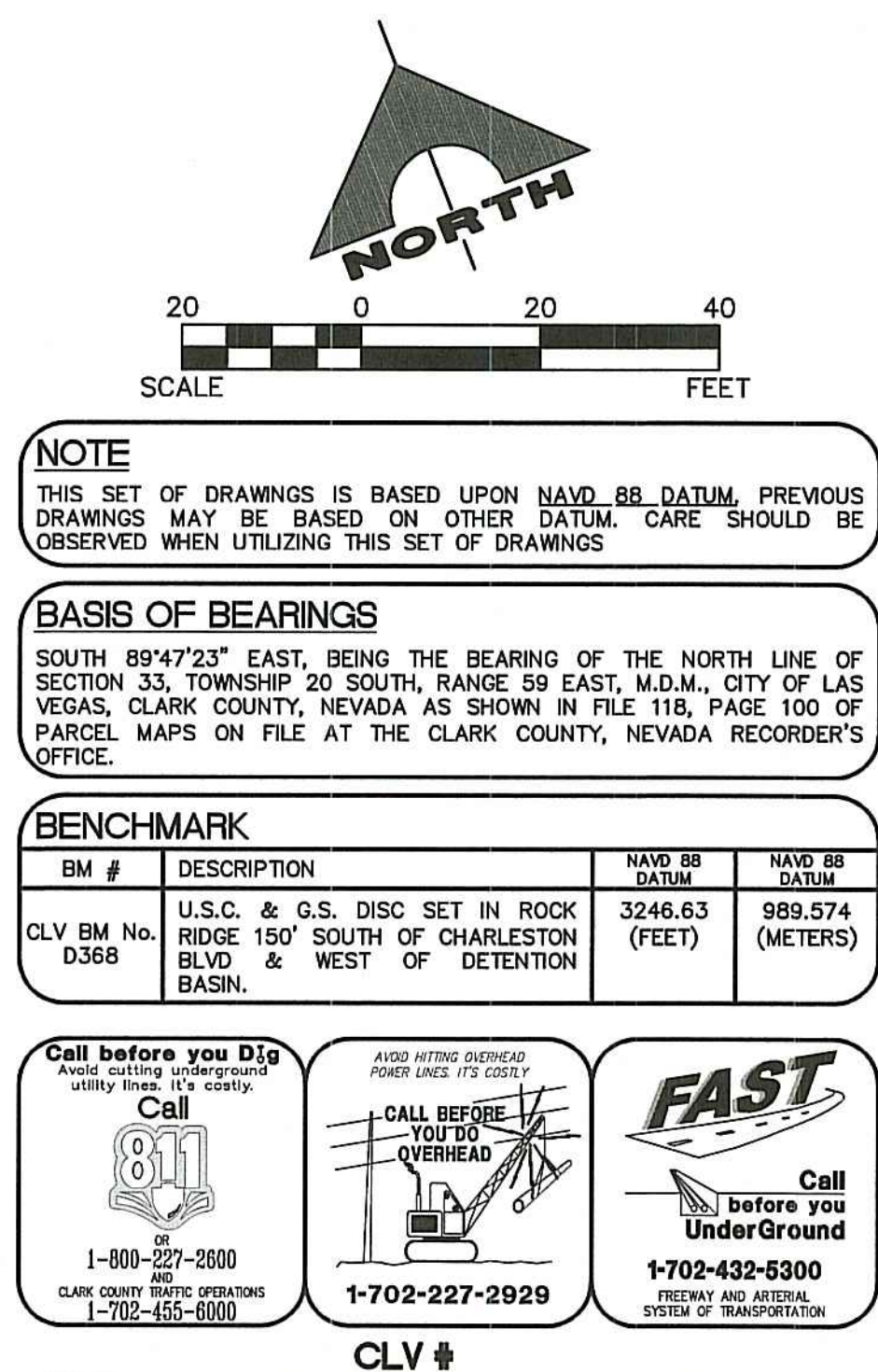
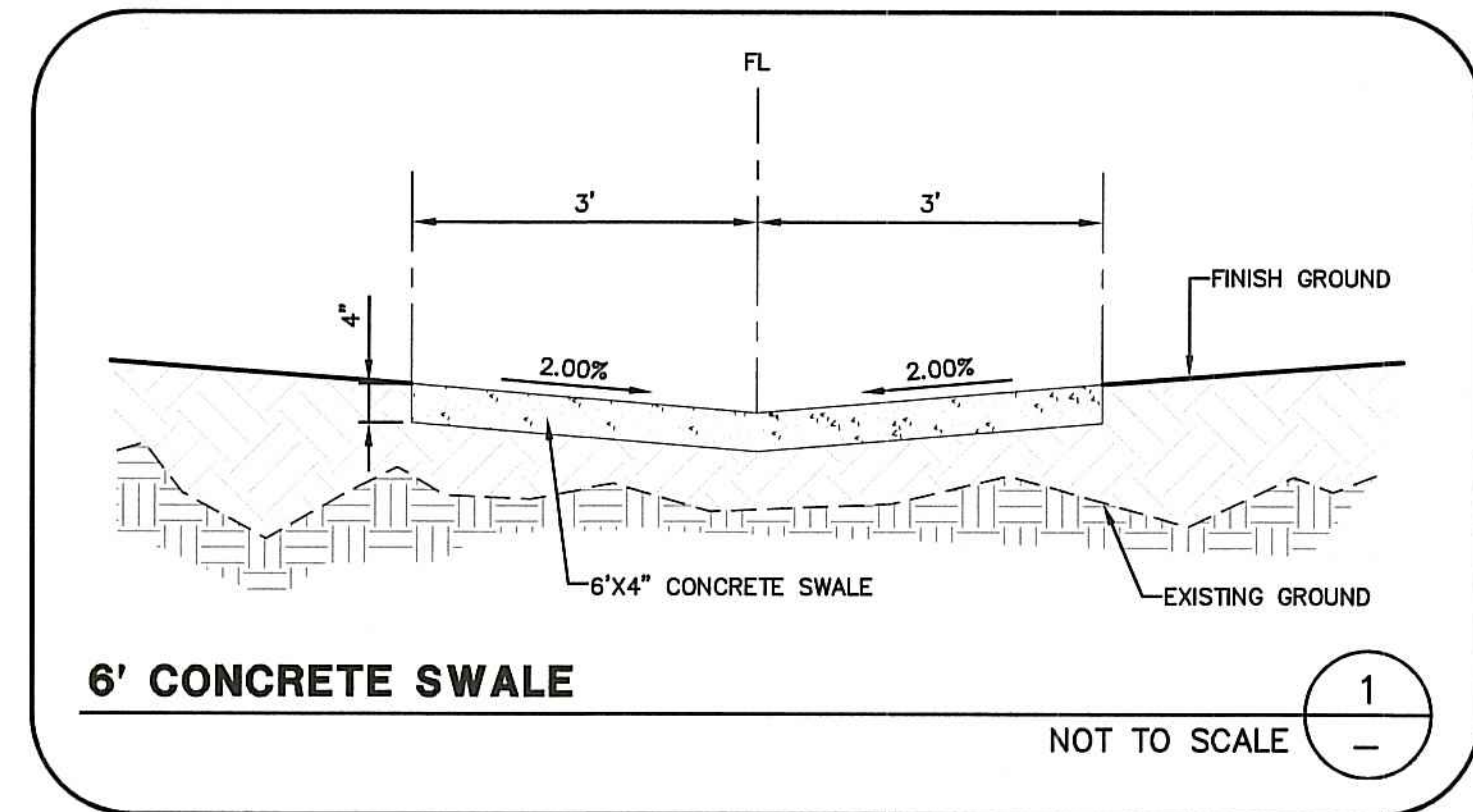
COS-3 MAINTENANCE ROAD ALIGNMENT

HORIZ SCALE: 1" = 100'

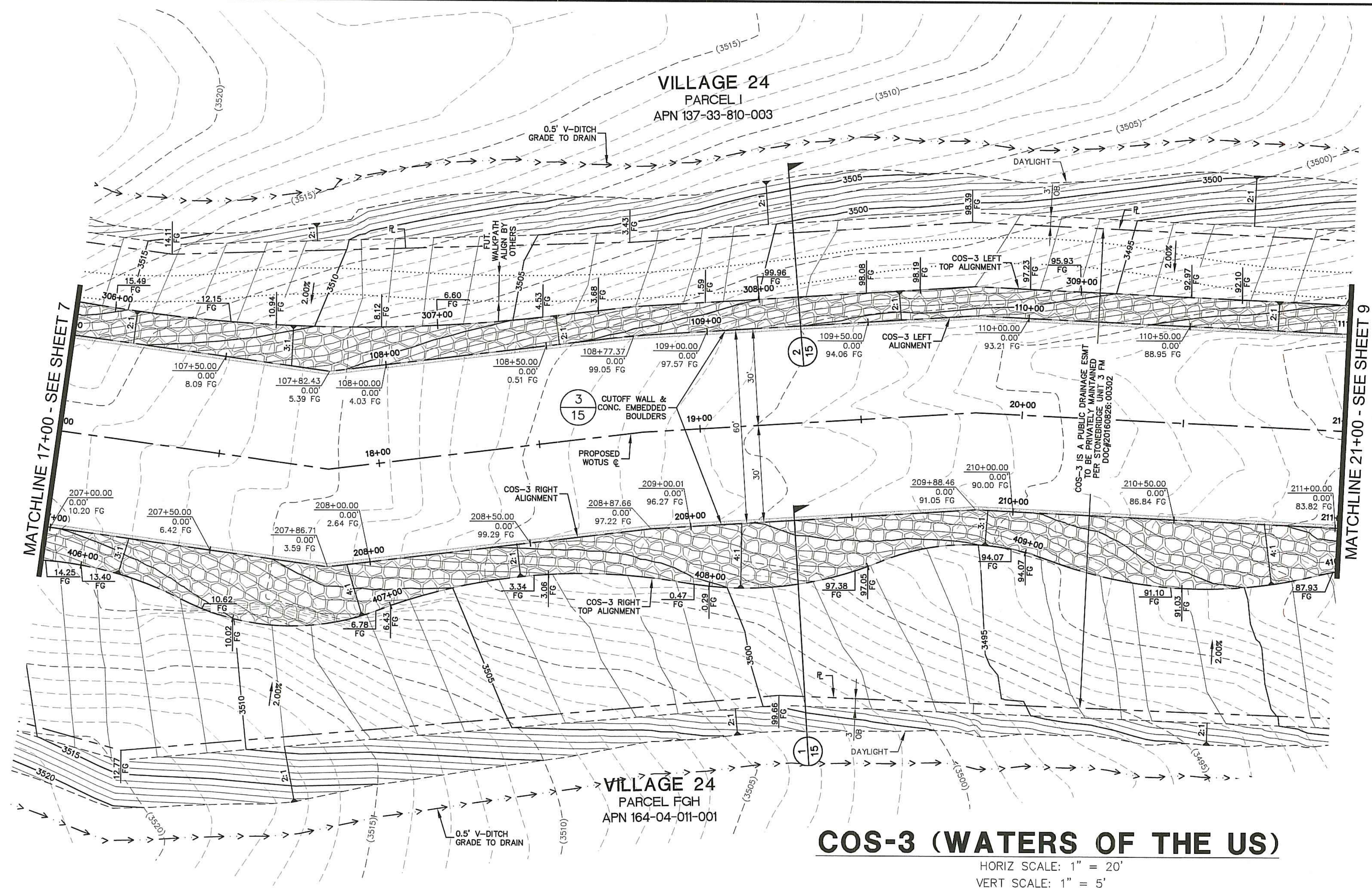
CURVE TABLE					CURVE TABLE				
CURVE #	LENGTH	RADIUS	TANGENT	DELTA	CURVE #	LENGTH	RADIUS	TANGENT	DELTA
C7	15.31'	10.01'	9.60'	87°35'46"	C39	96.98'	95.00'	53.19'	58°29'18"
C8	63.99'	250.00'	32.17'	14°39'52"	C40	83.18'	120.00'	43.34'	39°42'52"
C9	190.69'	400.00'	97.19'	27°18'51"	C41	63.02'	110.00'	32.40'	32°49'32"
C10	67.99'	100.00'	35.37'	38°57'17"	C42	62.73'	75.00'	33.33'	47°55'14"
C11	71.84'	150.00'	36.62'	27°26'26"	C43	96.54'	180.00'	49.46'	30°43'41"
C12	43.46'	50.00'	23.21'	49°48'04"	C44	62.21'	110.00'	31.96'	32°24'13"
C13	75.42'	260.00'	37.98'	16°37'15"	C45	52.78'	70.00'	27.72'	43°12'04"
C14	99.16'	2761.80'	49.58'	2°03'26"	C46	84.74'	140.00'	43.71'	34°40'44"
C15	122.49'	300.00'	62.11'	23°23'41"	C47	91.55'	100.00'	49.27'	52°27'20"
C16	231.57'	600.00'	117.24'	22°06'48"	C48	12.75'	50.00'	6.41'	14°36'26"
C17	41.93'	90.00'	21.35'	26°41'37"	C49	67.64'	170.00'	34.27'	22°47'50"
C18	92.13'	80.00'	51.94'	65°59'12"	C50	117.71'	180.00'	61.05'	37°28'05"
C19	32.53'	70.00'	16.56'	26°37'35"	C51	114.61'	600.00'	57.48'	10°56'38"
C20	38.48'	93.00'	19.52'	23°42'16"	C52	103.60'	290.00'	52.36'	20°28'07"
C21	86.28'	160.00'	44.22'	30°53'49"	C53	103.55'	190.00'	53.09'	31°13'32"
C22	74.34'	422.00'	37.27'	10°05'38"	C54	75.94'	140.00'	38.93'	31°04'48"
C23	57.00'	115.00'	29.10'	28°24'02"	C55	55.24'	70.00'	29.15'	45°12'46"
C24	158.45'	355.00'	80.57'	25°34'23"	C56	51.64'	150.00'	26.08'	19°43'24"
C25	101.39'	380.00'	51.00'	15°17'15"	C57	41.82'	200.00'	20.99'	11°58'49"
C26	110.51'	230.00'	56.34'	27°31'45"	C60	59.51'	42.00'	35.98'	81°10'37"
C27	25.91'	100.00'	13.03'	14°50'43"	C61	88.89'	25.00'	119.07'	203°42'52"
C28	60.38'	90.00'	31.37'	38°26'15"					
C29	25.11'	65.00'	12.71'	22°07'53"					
C32	14.77'	10.00'	9.11'	84°38'30"					
C33	20.65'	100.00'	10.36'	11°50'00"					
C34	65.08'	100.00'	33.74'	37°17'16"					
C35	53.95'	115.00'	27.48'	26°52'47"					
C36	90.68'	150.00'	46.77'	34°38'16"					
C37	77.23'	140.00'	39.63'	31°36'26"					
C38	67.17'	215.00'	33.86'	17°54'02"					

LINE TABLE		
LINE #	LENGTH	DIRECTION
L65	87.21'	S33°20'13"E
L66	46.67'	S20°50'34"E
L67	91.91'	S33°00'39"E
L68	36.04'	S20°50'34"E
L69	71.26'	S14°01'45"E
L70	9.54'	S3°03'30"W



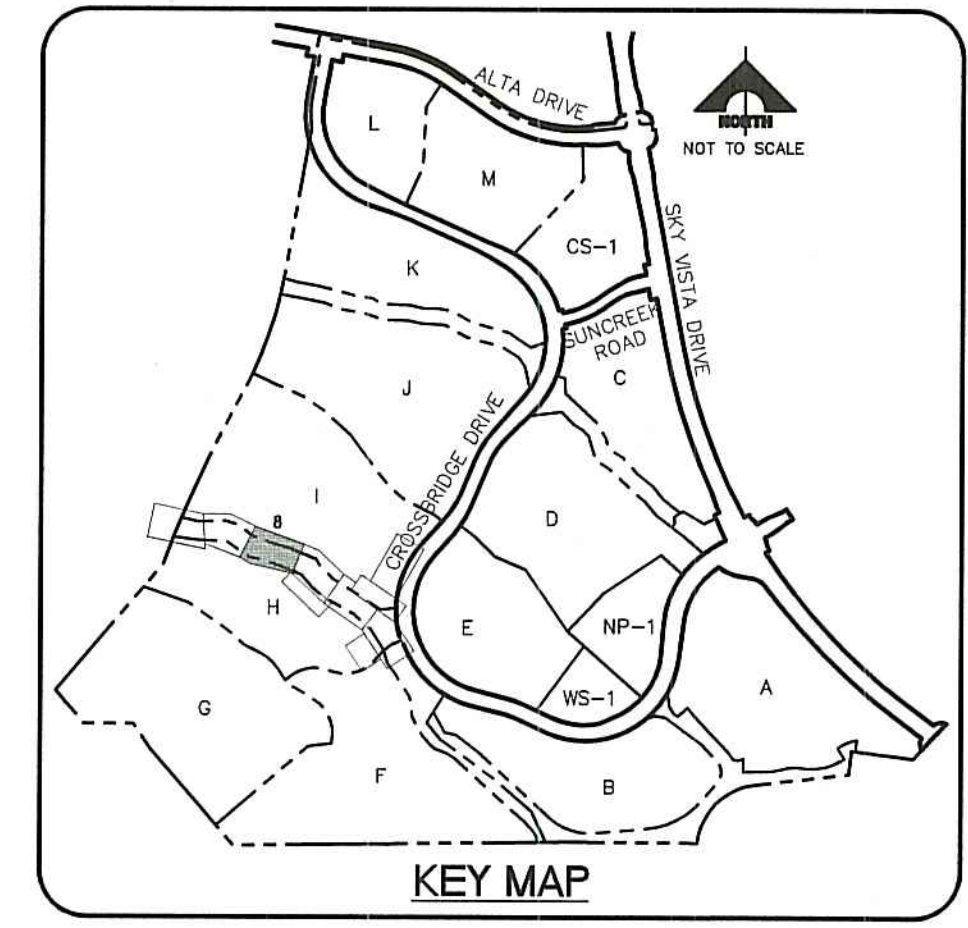
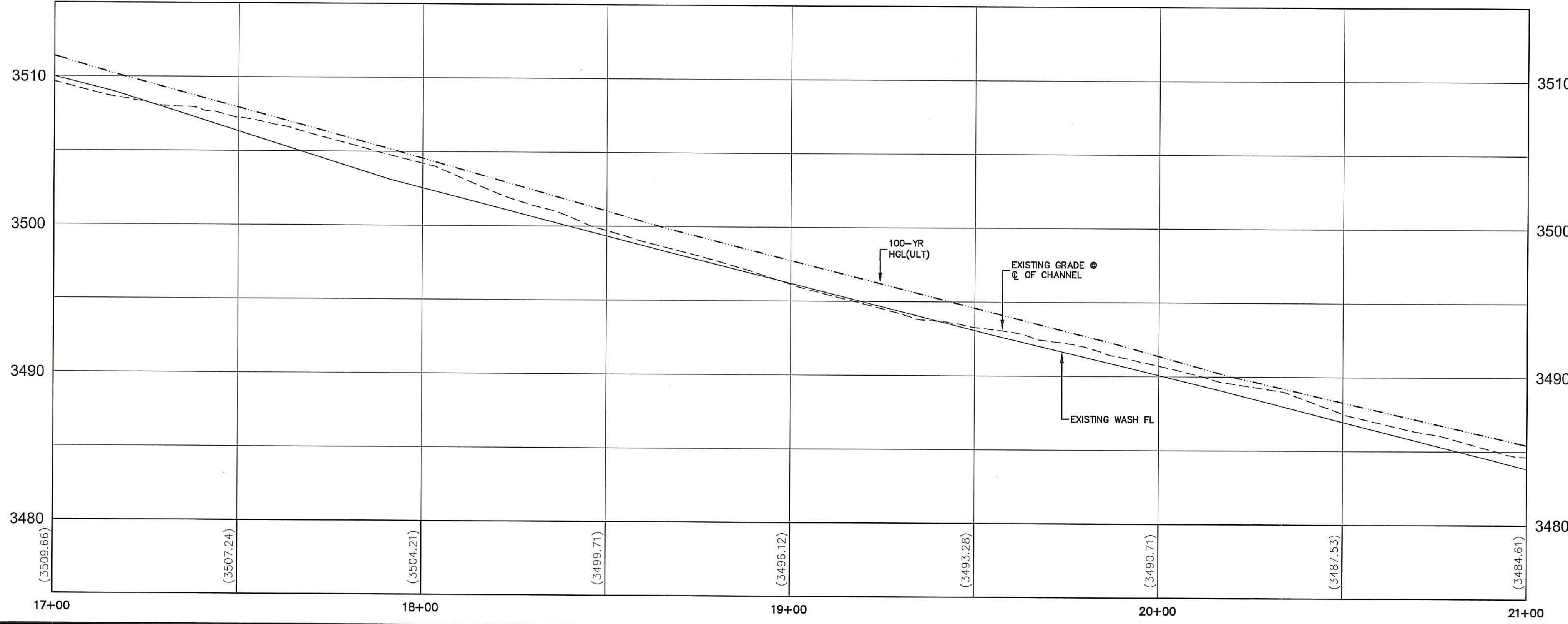


THE HOWARD HUGHES COMPANY, LLC	VILLAGE 24 – US WATERS COS-3 WASH IMPROVEMENT PLANS	PLAN AND PROFILE 2	DRAWING 7 7 OF 16 SHTS	GCV' ENGINEERS' SURVEYORS 1555 S. RAINBOW BLVD. LAS VEGAS, NV 89146 T: 702.804.2000 F: 702.804.2299 gcvengineering.com	PROJECT NO. 62024-226-3	DESIGN: MDB DRAWN: MDB CHECK: JJJ	PLOT DATE: 03-17-17 PLOT TIME: 08:35:17	REV DATE DESCRIPTION	DATE AGEN APP DATE GCW APP		DATE: 11/21/2014
					f:\Projects\62024-226-3\DWG\production\V24-226-3_GD.dwg Matthew Buge						



COS-3 (WATERS OF THE US)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 5'



NOTE

THIS SET OF DRAWINGS IS BASED UPON NAVD 88 DATUM. PREVIOUS DRAWINGS MAY BE BASED ON OTHER DATUM. CARE SHOULD BE OBSERVED WHEN UTILIZING THIS SET OF DRAWINGS

BASIS OF BEARINGS

SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 39 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 116, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

BENCHMARK

BM #	DESCRIPTION	NAVD 88 DATUM (FEET)	NAVD 88 DATUM (METERS)
CLV BM No. D368	U.S.C. & G.S. DISC SET IN ROCK RIDGE 150' SOUTH OF CHARLESTON BLVD & WEST OF DETENTION BASIN.	3246.63	989.574

Call before you Dig

Call 800-4-A-ROOT or 1-800-227-2800

Call before you Overhead

Call 1-702-227-2929

FAST

Call before you UnderGround

1-702-432-5300

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 - US WATERS
COS-3 WASH IMPROVEMENT PLANS

PLAN AND PROFILE 3

DRAWING
8
8 OF 16 SHTS

GCM'
ENGINEERS SURVEYORS

1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gcmengineering.com

PROJECT NO.
62024-226-3

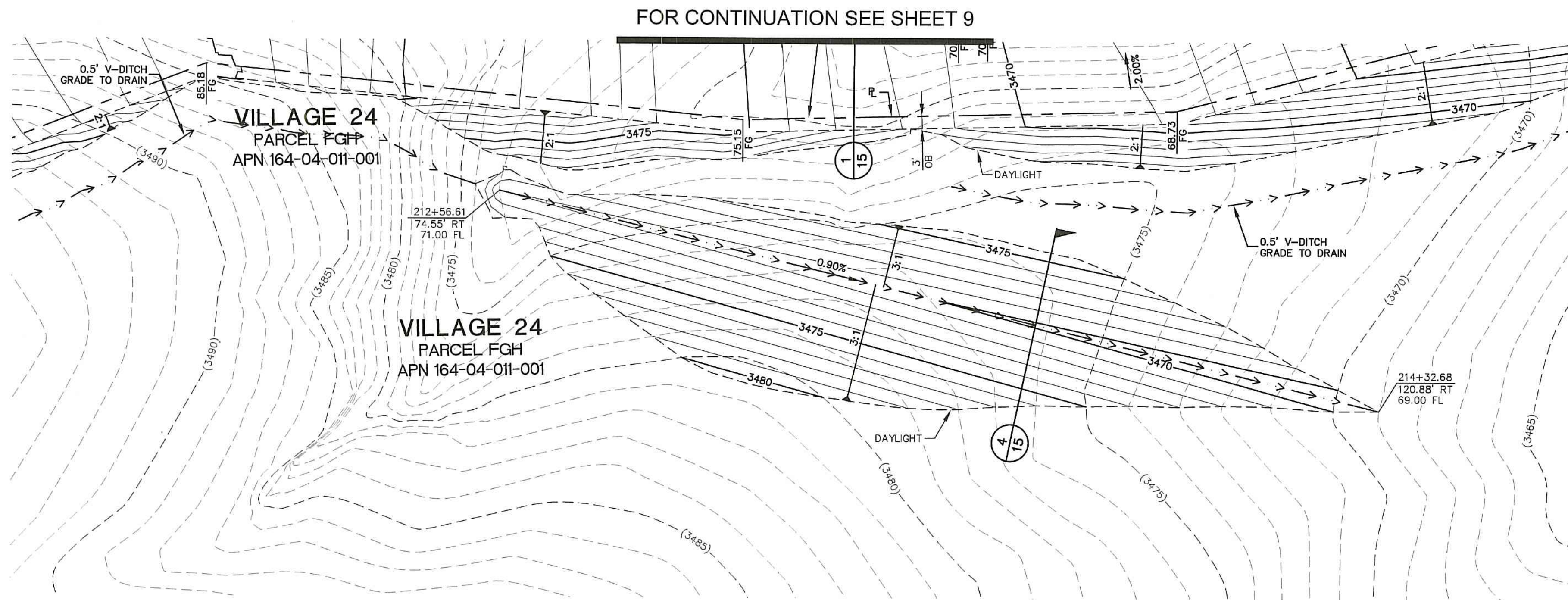
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CHECK: JJJ

PLOT DATE: 03-17-17
PLOT TIME: 08:32:04

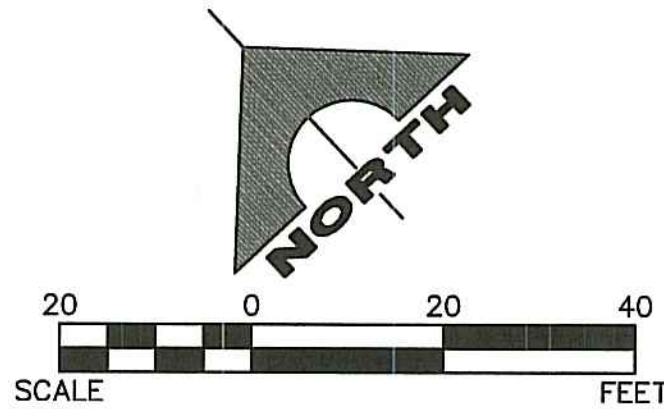
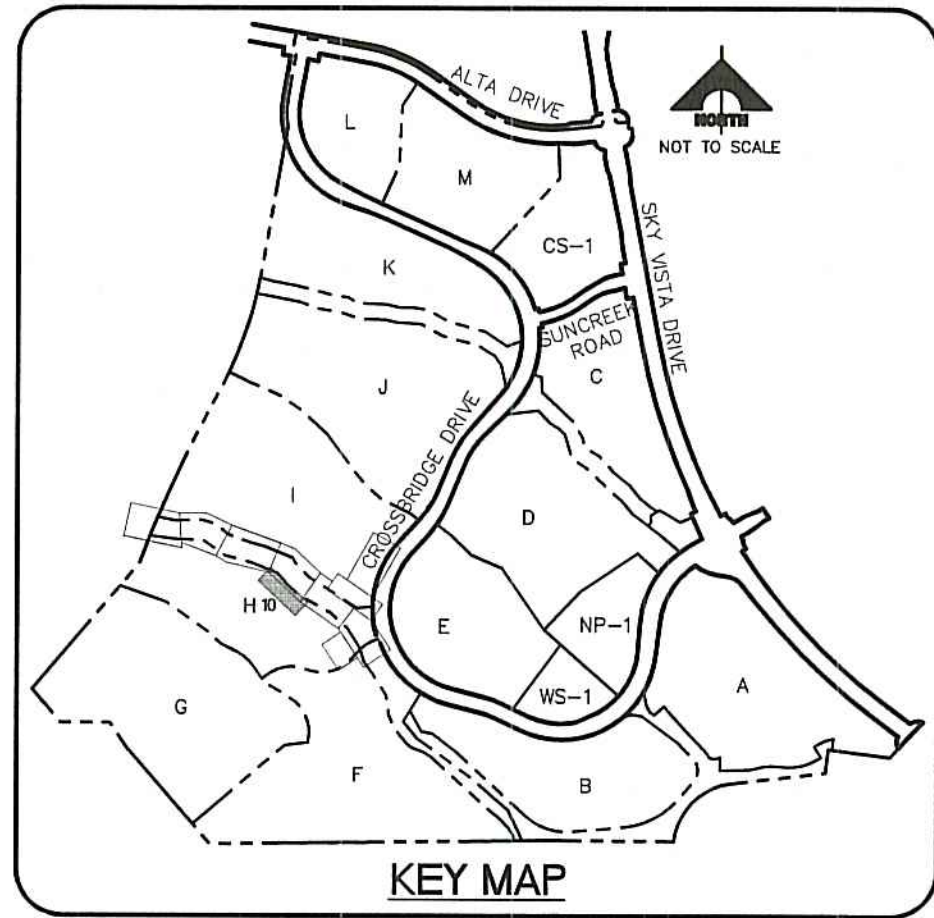
ENGINEER STATE OF NEVADA
JOSHUA L. JOHNSON
No. 15789

DATE	AGN APPI	DATE	GCW APP
11/21/2014			

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION



COS-3 SOUTH V-DITCH
HORIZ SCALE: 1" = 20'



NOTE
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SOUTH 89°47'23" EAST, BEING THE BEARING OF THE NORTH LINE OF SECTION 33, TOWNSHIP 20 SOUTH, RANGE 59 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AS SHOWN IN FILE 118, PAGE 100 OF PARCEL MAPS ON FILE AT THE CLARK COUNTY, NEVADA RECORDER'S OFFICE.

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Call before you Dig
Avoid cutting underground utility lines. It's costly.
1-800-227-2800
CLV #

Call before you Dig
Avoid hitting overhead power lines. It's costly.
1-702-227-2929
CLV #

FAST
Call before you UnderGround
1-702-432-6300
CLV #

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 - US WATERS
COS-3 WASH IMPROVEMENT PLANS
PLAN AND PROFILE 5

DRAWING
10
10 OF 16 SHTS

PROJECT NO.
62024-226-3

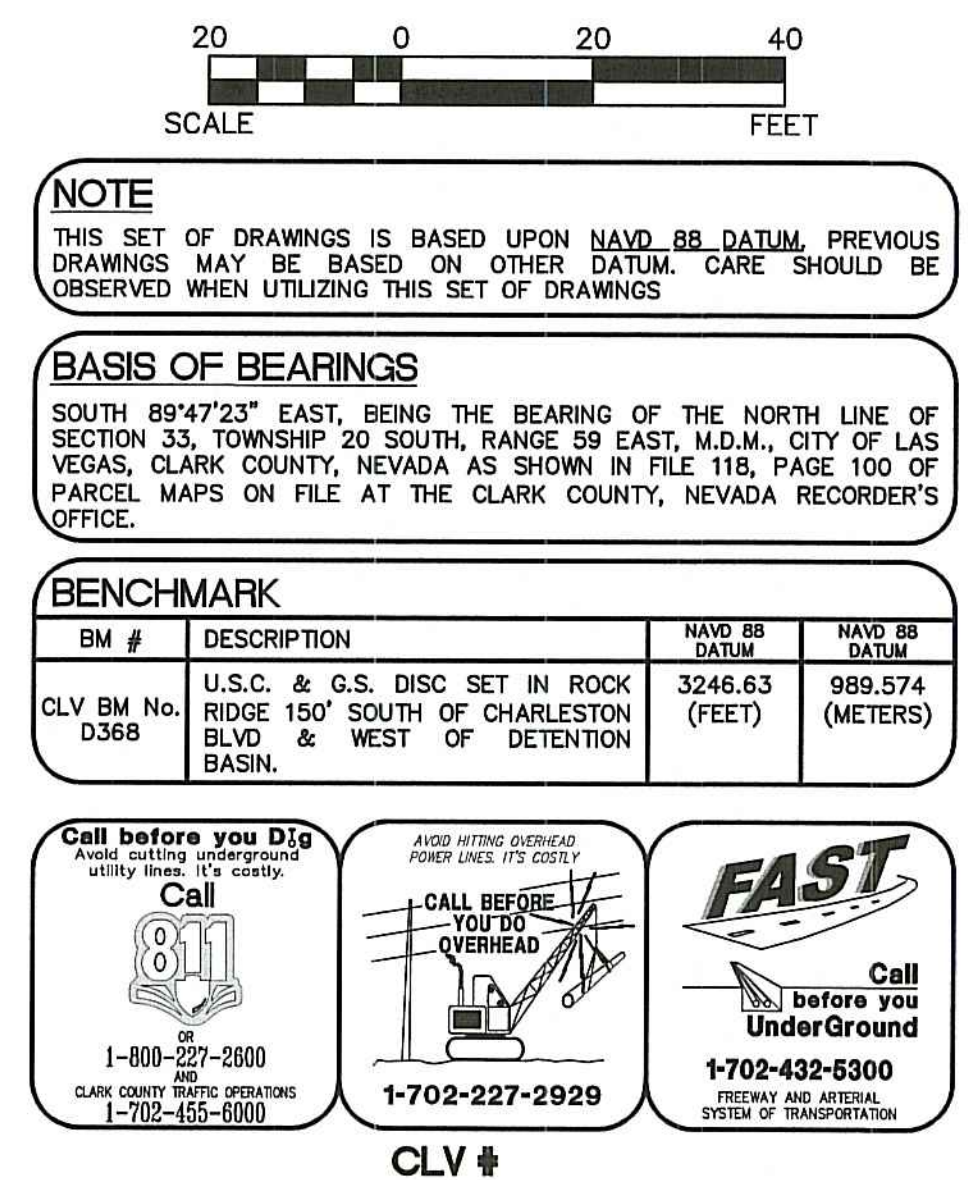
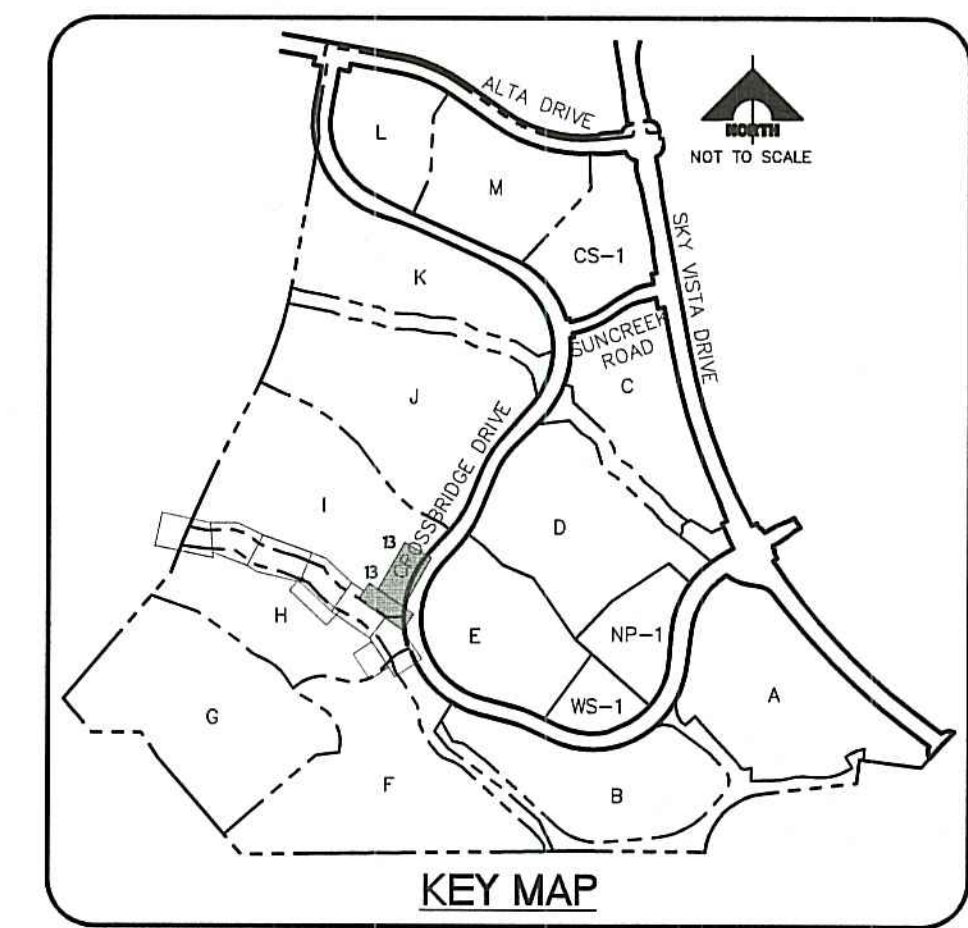
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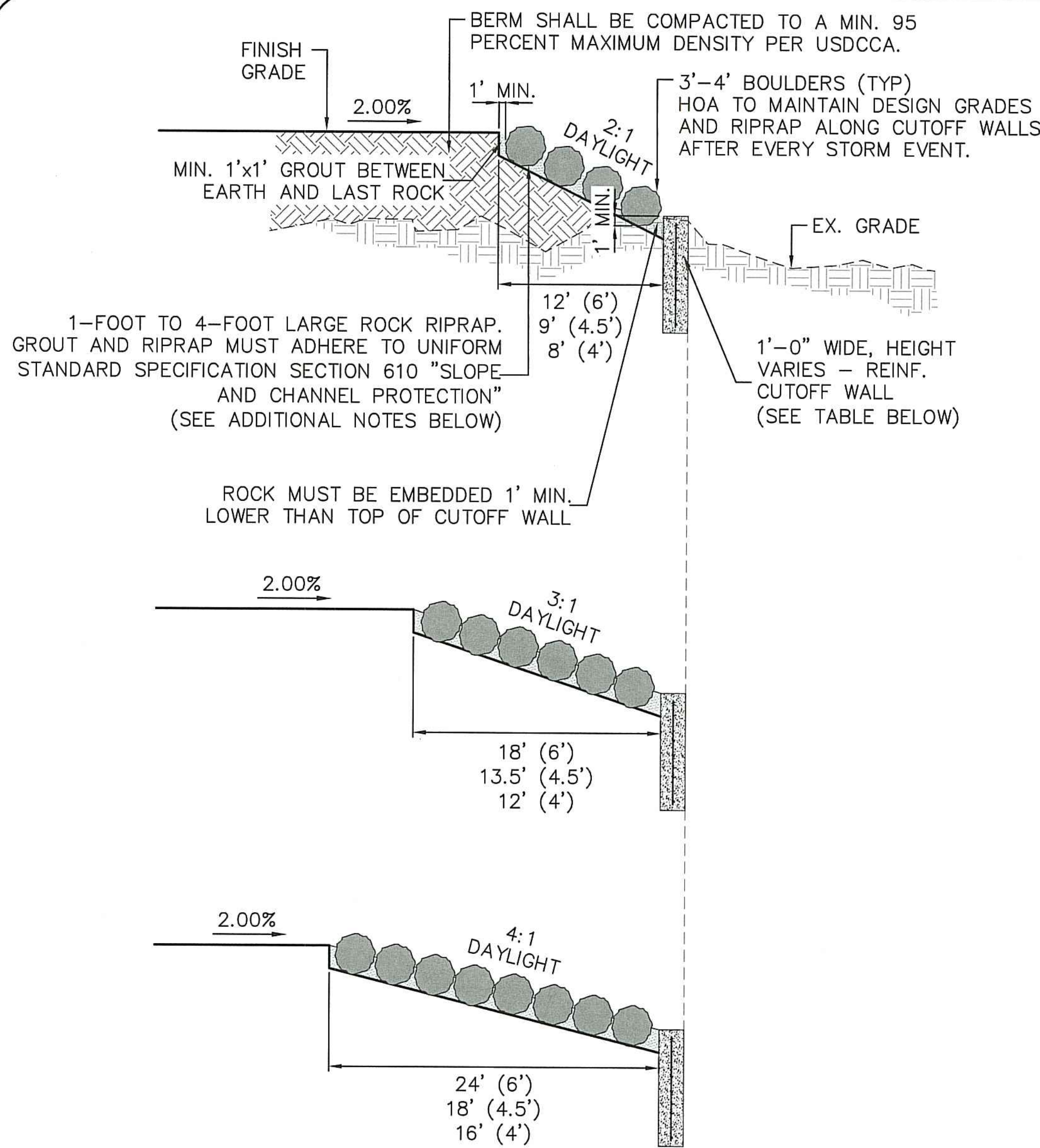
ENGINEER'S SURVEYORS
1555 S. RAINBOW BLVD.
LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299
gwenengineering.com

ENGINEER STATE OF NEVADA
JOSHUA J. JOHNSON
No. 15789
DATE: 11/21/2014

FOR AGENCY REVIEW - NOT FOR CONSTRUCTION



THE HOWARD HUGHES COMPANY, LLC VILLAGE 24 - US WATERS COS-3 WASH IMPROVEMENT PLANS PLAN AND PROFILE 8	1555 S. RAINBOW BLVD. LAS VEGAS, NV 89146 T: 702.804.2000 F: 702.804.2299 gowngengineering.com	PROJECT NO. 62024-226-3	
		DESIGN: MDB DRAWN: MDB CHECK: JJJ PLOT DATE: 03-17-17 PLOT TIME: 08:30:46	



NOTES:

1. WASHES MUST BE INSPECTED AND MAINTAINED AFTER EACH STORM EVENT. IF THE CUT-OFF WALL IS EXPOSED, BACKFILL MUST BE PLACED TO THE TOP OF CUT-OFF WALL, BENCHED 1-FOOT HORIZONTALLY AND GRADED TO A 3:1 SLOPE.
2. CONTRACTOR SHALL USE PRIMARILY 3-FOOT AND 4-FOOT LARGE ROCK (BOULDER) RIPRAP FOR SLOPE PROTECTION, WITH 1-FOOT AND 2-FOOT ROCK USED TO FILL VOIDS BETWEEN THE 3-FOOT AND 4-FOOT BOULDERS.
3. ALL VOIDS SHALL BE FILLED WITH GROUT TO A MINIMUM DEPTH OF HALF THE DEPTH OF THE ROCK/BOULDER.
4. BOTTOM ROW OF ROCK/BOULDER ADJACENT TO THE CUT-OFF WALL MUST BE EMBEDDED 1-FOOT BELOW THE TOP OF THE CUT-OFF WALL.
5. EXCLUDING THE BOTTOM ROW OF ROCK/BOULDER, THE BOTTOM OF ALL 3-FOOT AND 4-FOOT ROCK/BOULDER MUST BE A MINIMUM OF 1-FOOT BELOW THE TOP OF THE LOWER ROCK, AND 1-FOOT AND 2-FOOT ROCK MUST BE A MINIMUM OF 6" BELOW THE TOP OF THE LOWER ROCK.

SECTION 610
SLOPE AND CHANNEL PROTECTION ADDITIONAL NOTES

610.02.04 STONES FOR RIPRAP

- A. STONES USED FOR RIPRAP SHALL BE HARD, DURABLE, ANGULAR IN SHAPE, RESISTANT TO WEATHERING AND EROSION, AND FREE FROM SPOILS, CRACKS, AND ORGANIC MATTER.

ADD 4 AND 5 TO THIS SUBSECTION:

4. THE SPECIFIC GRAVITY OF THE CONCRETE EMBEDDED RIPRAP SHALL NOT BE LESS THAN 2.45.
5. THE NOMINAL STONE SIZE FOR THE GROUTED RIPRAP LARGE ROCK SHALL BE 3-FOOT TO 4-FOOT, WITH 1-FOOT TO 2-FOOT FILLER ROCK.

- C. CONTROL OF GRADATION WILL BE BY VISUAL INSPECTION.

REVISE SUBSECTION AS FOLLOWS:

1. THE CONTRACTOR SHALL PROVIDE A SAMPLE OF STONE OF AT LEAST 5 TONS MEETING THE GRADATION FOR GROUTED RIPRAP LARGE ROCK.

REVISE SUBSECTION D. AS FOLLOWS:

- D. CALICHE STONE OR CEMENTITIOUS MATERIALS MEETING THE REQUIREMENTS OF THIS SECTION MAY BE USED AS RIPRAP WITH PRIOR APPROVAL OF THE ENGINEER. CALICHE STONE OR CEMENTITIOUS MATERIAL MAY NOT BE USED FOR GROUTED RIPRAP LARGE ROCK.

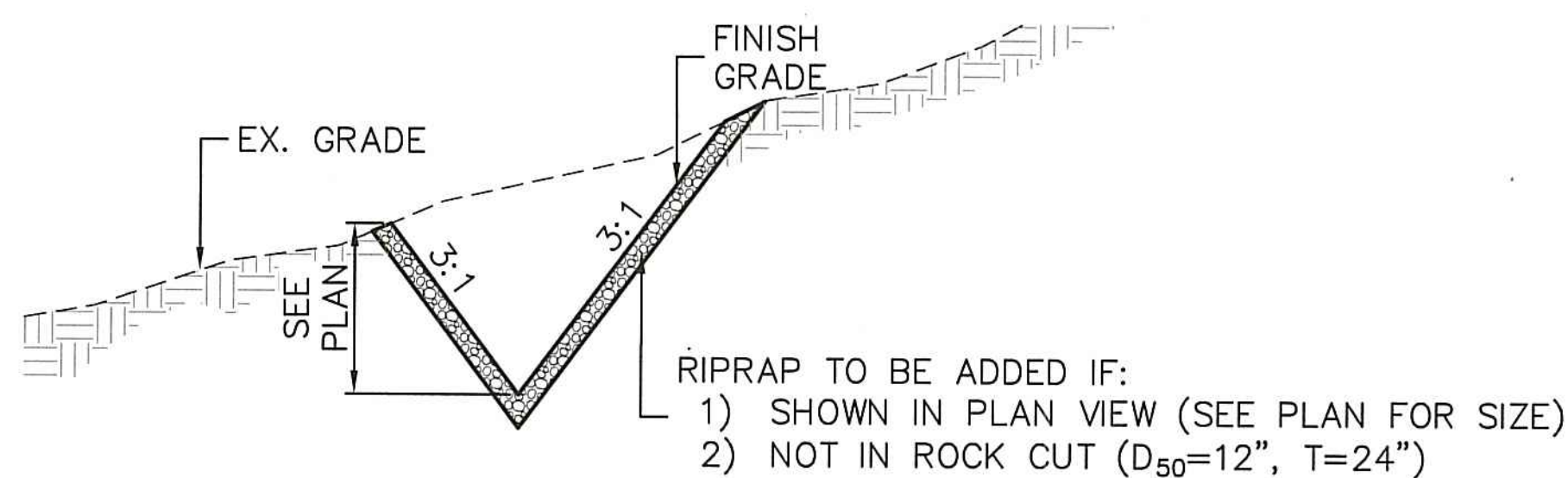
APPROXIMATE STATIONING OF BERM HEIGHTS FOR COS-3		
HEIGHT	STATION	COMMENTS
4'	101+19.01 & 201+19.01	BEGIN
TRANS	115+93.54 & 215+95.48	25' TRANSITION
4.5'	116+18.54 & 216+20.48	-
TRANS	- & 219+60.00	15' TRANSITION
6'	- & 219+75.00	-
-	120+64.27 & 220+25.71	END

APPROXIMATE STATIONING OF CUTOFF WALLS FOR COS-3		
HEIGHT	STATION	COMMENTS
8'	101+19.01 & 201+19.01	BEGIN
TRANS	101+65 & 201+65	10' TRANSITION
6'	101+75 & 201+75	-
TRANS	105+97 & 205+84	10' TRANSITION
7'	106+07 & 205+94	-
TRANS	106+58 & 206+42	10' TRANSITION
6'	106+68 & 206+52	-
-	120+64.27 & 220+25.71	END

GROUTED RIPRAP LARGE ROCK

NOT TO SCALE

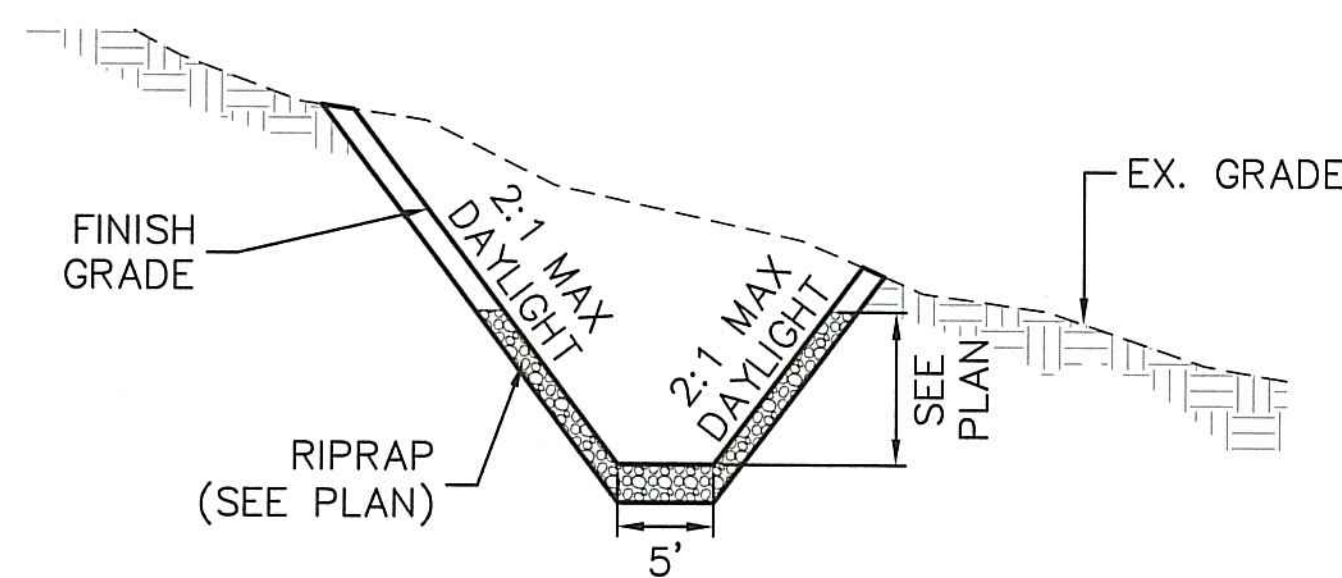
3



TYPICAL V-DITCH SECTION

NOT TO SCALE

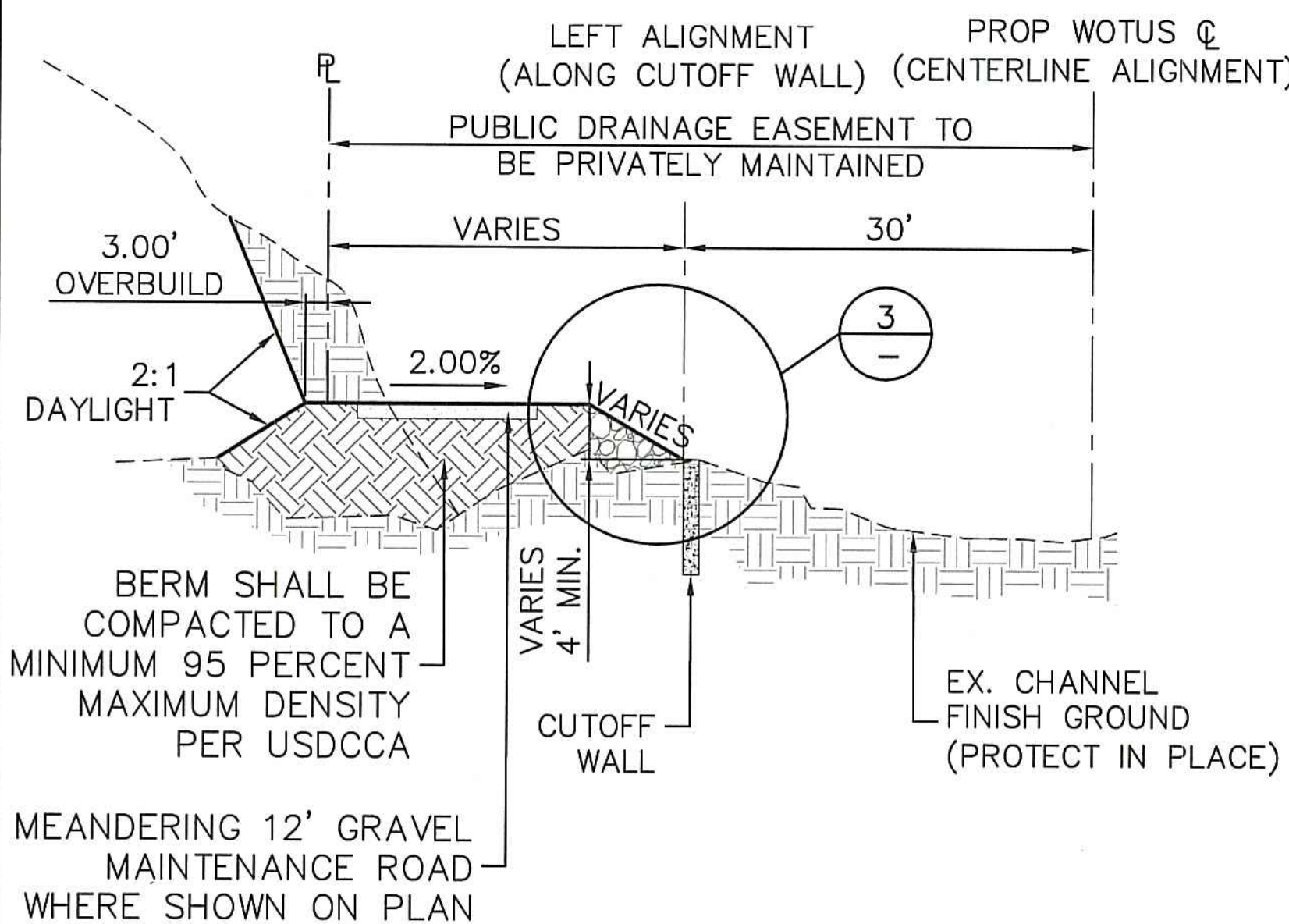
4



TYPICAL 5' DITCH SECTION

NOT TO SCALE

5

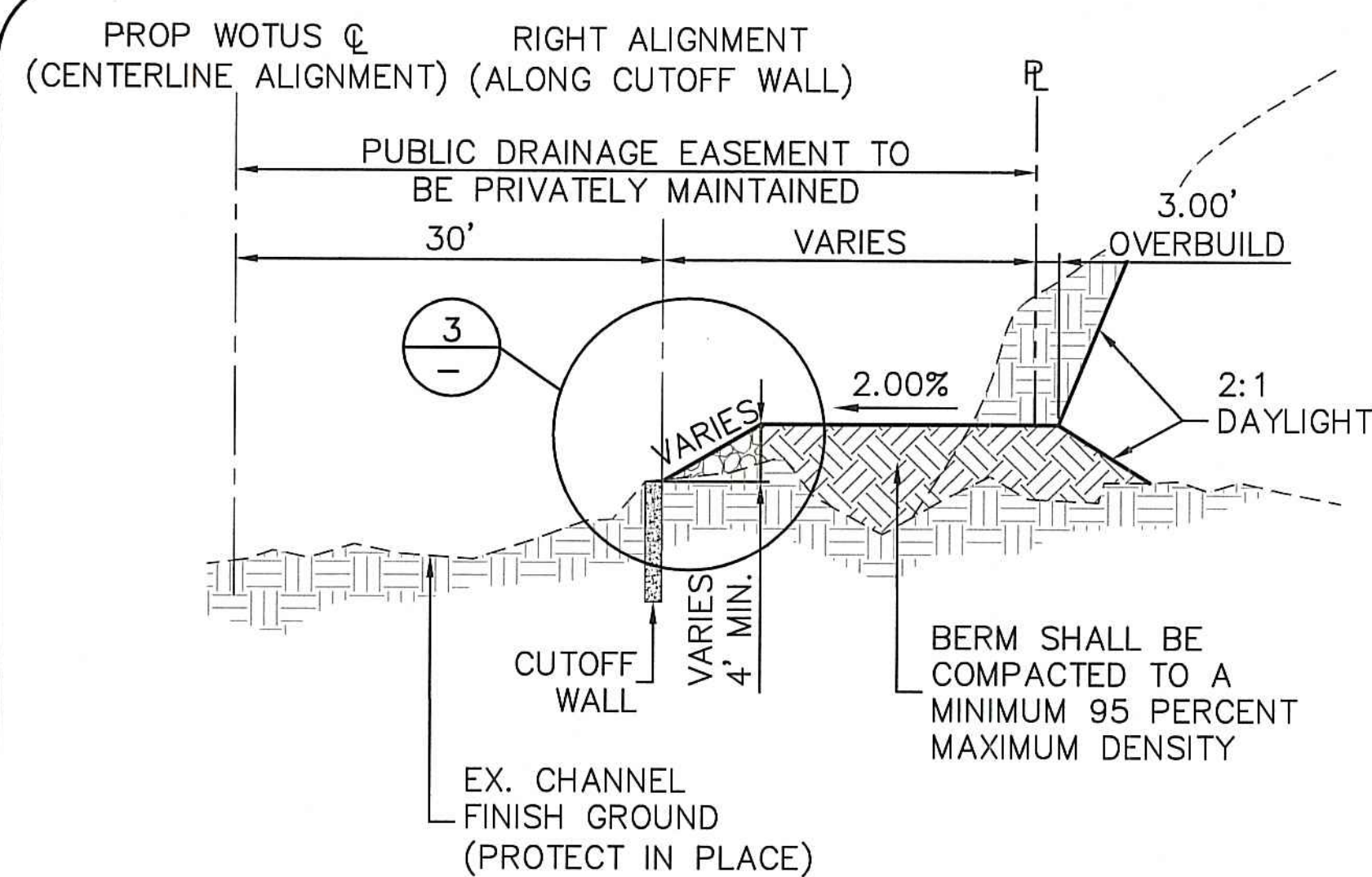


TYPICAL COS-3 LEFT ALIGNMENT BERM

STATION 101+19.01 TO 120+64.27

NOT TO SCALE

2



TYPICAL COS-3 RIGHT ALIGNMENT BERM

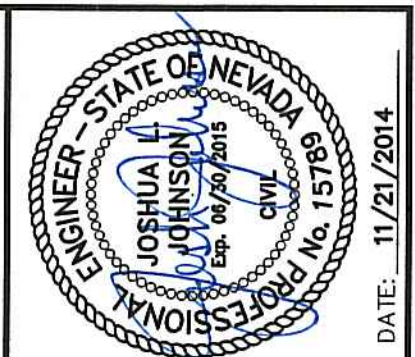
STATION 201+19.01 TO 220+25.71

NOT TO SCALE

1

RIPRAP GENERAL NOTE:
ALL RIPRAP, SHALL ADHERE TO REQUIREMENTS OF UNIFORM STANDARD SPECIFICATION SECTION 610 "SLOPE AND CHANNEL PROTECTION."

FOR GROUTED RIPRAP LARGE ROCK, SEE ADDITIONAL REQUIREMENTS TO SECTION 610 "SLOPE AND CHANNEL PROTECTION ADDITIONAL NOTES" PER DETAIL 3 SHEET 15.



DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

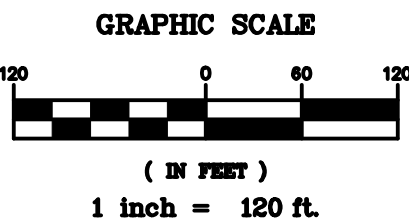
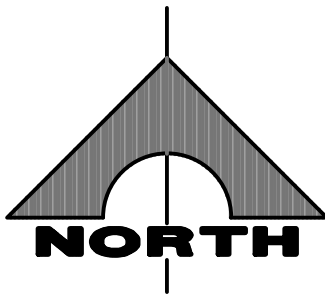
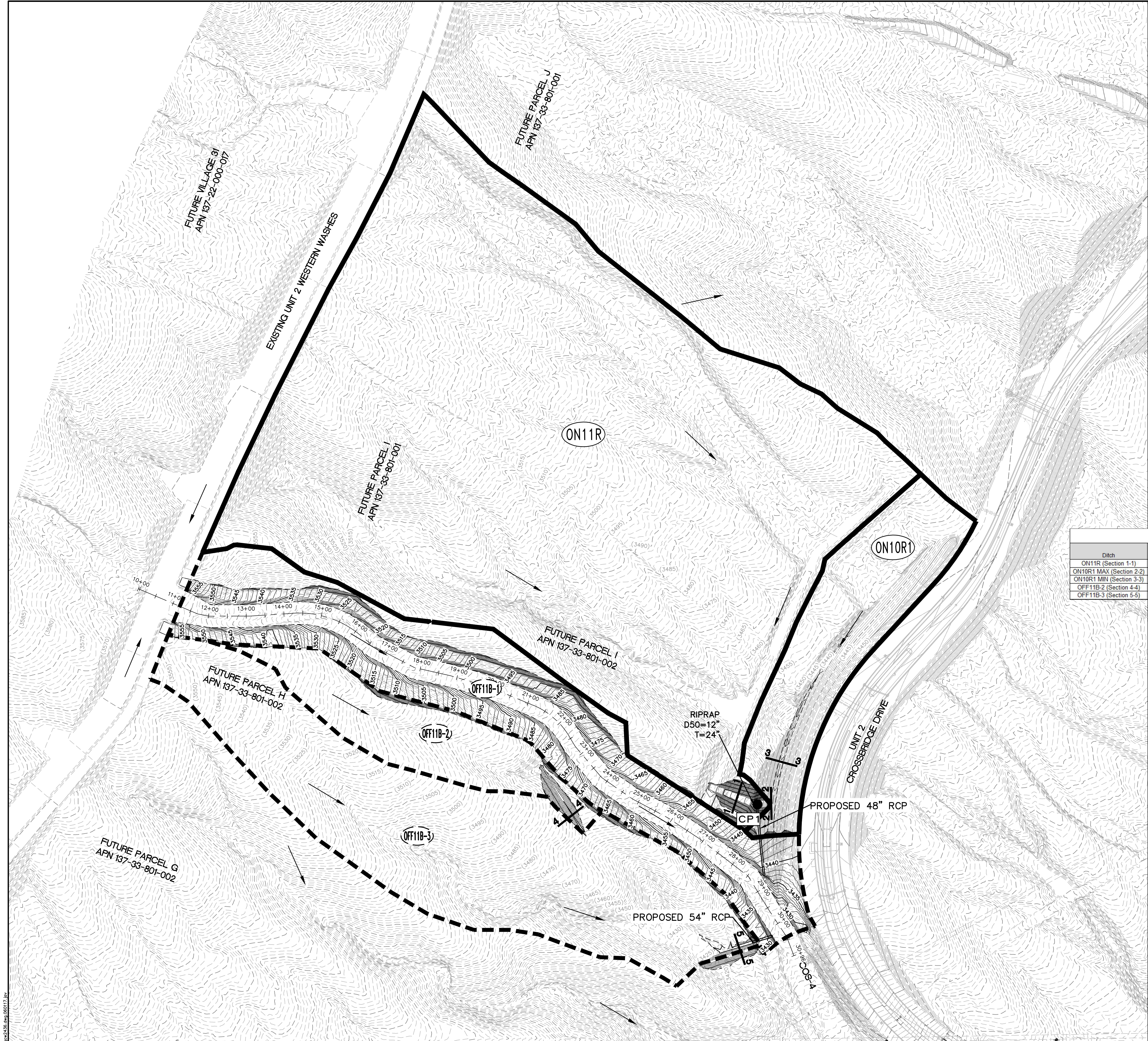
DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

DATE	AGENCY	DATE	AGENCY	DATE	AGENCY

CLV #

#



LEGEND

- SUBBASIN BOUNDARY
- PRORATED SUBBASIN BOUNDARY
- OFF11B DRAINAGE SUBBASIN
- OFF11B-2 PRORATED DRAINAGE SUBBASIN
- FLOW DIRECTION
- CP1 CONCENTRATION POINT

SUMMARY OF INTERIM CONDITIONS HEC-1 MODEL			
SB OR CP	AREA (AC)	100 YR (CFS)	10 YR (CFS)
ON10R1	4.7	14	6
ON11R	38.5	109	49
CP1	-	122	55

INTERIM/ PROPOSED CONDITION PRORATED FLOW SUMMARY			
Offsite Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B*	153	56.8	2.69
Offsite Prorated Basins			
Subbasin	Q ₁₀₀ (cfs)	Area (acres)	cfs/acre
OFF11B-1	23	8.7	2.69
OFF11B-2	8	3.1	2.69
OFF11B-3	30	11.2	2.69

*Referenced from the Unit 2 Study

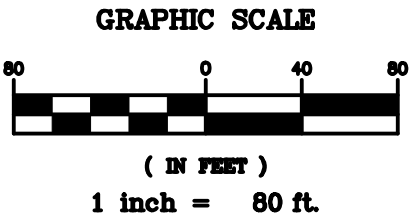
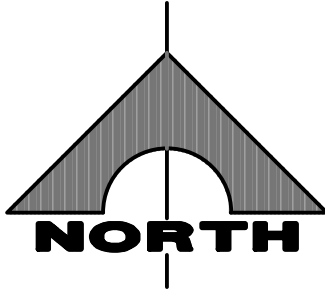
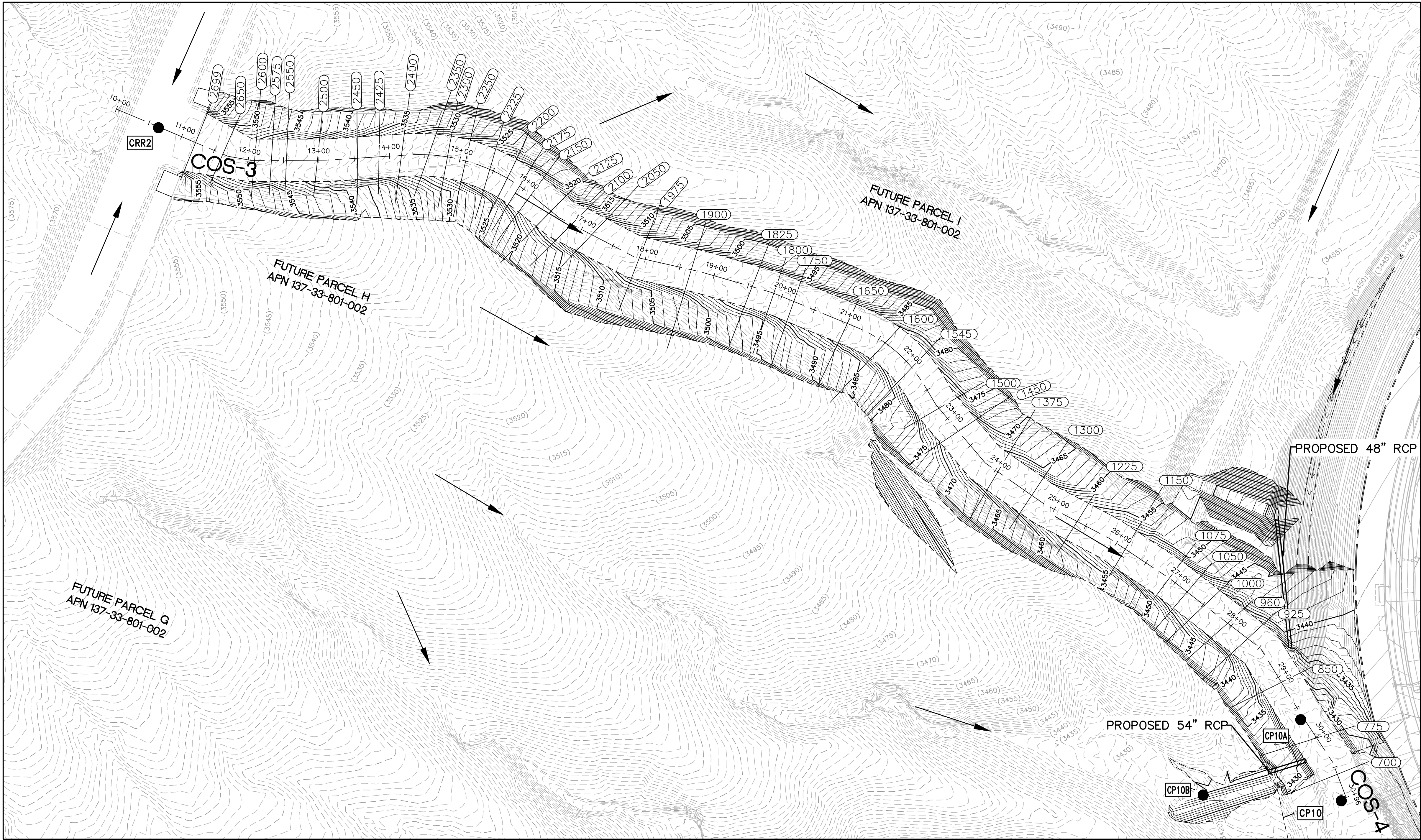
100-YEAR DITCH/BERM CHARACTERISTICS									
Ditch	Slope (%)	Q ₁₀₀ (cfs)	Depth of flow (ft)	Velocity (ft/s)	Bottom Width (ft)	Type	Side Slopes	Reqd d ₅₀ (in)	Tributary Subbasin
ON11R (Section 1-1)	5.00	109	2.08	7.16	15	TRAP	2:1 / 2:1	12	ON11R
ON10R1 MAX (Section 2-2)	0.60	14	0.70	3.10	5	TRAP	2:1 / 2:1	N/A	ON10R1
ON10R1 MIN (Section 3-3)	0.60	14	1.25	2.81	0	V	3:1 / 3:1	N/A	ON10R1
OFF11B-2 (Section 4-4)	0.90	8	0.91	3.22	0	V	3:1 / 3:1	N/A	OFF11B-2
OFF11B-3 (Section 5-5)	0.60	38	1.25	3.71	4.5	TRAP	3:1 / 3:1	N/A	OFF11B-2 + OFF11B-3

DESIGN:
DRAWN:
CHECK:
ISSUE DATE:
PLOT DATE: 03-21-17
PLOT TIME: 15:45:41

1555 S. RAINBOW BLVD.
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gownengineering.com

THE HOWARD HUGHES COMPANY, LLC
VILLAGE 24 PARCEL C08-3 WASH
INTERIM CONDITIONS DRAINAGE MAP

DRAWING
FIG-5
OF
SHTS



LEGEND

- CP10B CONCENTRATION POINT
- (1500) HEC-RAS CROSS SECTION
- FLOW DIRECTION

COS-3 - HYDRAULIC MODELS RESULTS SUMMARY AND SUPER-ELEVATION CALCULATIONS (ULTIMATE CONDITIONS)													
Sta	Plan Sta	ULT Q	FL Elevation	V/S Elevation	Depth	Vel	Top Width	Froude #	Radius	Freeboard	Super-elevation	Total Depth	Chnl Height
		(cfs)	(ft)	(ft)	(ft)	(ft/s)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)
2699	11+21	720	3552.00	3553.80	1.80	6.47	87.06	1.01	0	1.2	0.0	3.0	5.0
2650	11+63	720	3548.00	3549.13	1.13	14.98	77.57	3.31	0	1.4	0.0	2.5	4.0
2600	12+09	720	3544.00	3545.78	1.78	11.52	65.23	2.01	0	1.3	0.0	3.1	4.0
2575	12+33	720	3543.00	3544.16	1.16	11.65	65.16	2.04	0	1.3	0.0	2.5	4.0
2550	12+54	720	3541.00	3542.53	1.53	11.90	67.10	2.14	0	1.3	0.0	2.9	4.0
2500	12+98	720	3538.00	3539.73	1.73	10.89	67.43	1.86	0	1.3	0.0	3.1	5.0
2450	13+55	720	3534.00	3535.63	1.63	12.09	61.26	2.13	0	1.4	0.0	3.0	5.0
2425	13+85	720	3532.00	3533.74	1.74	11.39	57.83	1.89	0	1.3	0.0	3.1	5.0
2400	14+17	720	3530.00	3531.76	1.76	10.81	64.21	1.83	0	1.3	0.0	3.1	4.0
2350	14+55	720	3527.84	3529.20	1.36	11.07	61.31	1.85	250	1.3	0.5	3.1	4.0
2300	14+82	720	3526.91	3527.19	1.28	12.33	65.15	2.23	250	1.3	0.6	3.2	4.0
2250	15+08	720	3524.00	3525.53	1.53	12.22	53.12	1.96	250	1.4	0.5	3.4	4.0
2225	15+45	720	3521.00	3522.82	1.82	13.53	46.05	2.11	250	1.4	0.5	3.8	4.0
2200	15+72	720	3519.00	3521.24	2.24	11.49	66.25	2.02	250	1.4	0.5	4.2	5.0
2175	15+93	720	3518.00	3519.71	1.71	11.25	64.98	1.94	250	1.3	0.5	3.6	5.0
2150	16+13	720	3516.00	3518.20	2.20	11.50	63.43	1.99	0	1.4	0.0	3.6	5.0
2125	16+50	720	3513.00	3514.96	1.96	12.34	58.78	2.18	0	1.4	0.0	3.3	6.0
2100	16+84	720	3511.00	3512.58	1.58	11.88	59.55	2.07	0	1.3	0.0	2.9	5.0
2050	17+16	720	3509.00	3510.22	1.22	11.97	64.59	2.15	450	1.3	0.3	2.9	4.0
1975	17+91	720	3503.11	3505.18	2.07	10.47	69.88	1.83	450	1.3	0.3	3.7	5.0
1900	18+67	720	3498.25	3499.83	1.58	11.58	63.90	2.04	0	1.3	0.0	2.9	5.0
1825	19+56	720	3492.70	3494.20	1.50	11.00	66.01	1.9	0	1.3	0.0	2.8	5.0
1800	19+88	720	3490.80	3492.21	1.41	10.65	59.24	1.72	0	1.3	0.0	2.7	6.0
1750	20+18	720	3489.00	3490.12	1.12	11.68	59.65	1.97	0	1.3	0.0	2.4	6.0
1650	21+00	720	3483.81	3485.43	1.62	11.03	64.62	1.9	200	1.3	0.6	3.6	5.0
1600	21+60	720	3479.84	3480.94	1.10	12.30	68.12	2.25	200	1.3	0.8	3.2	4.0
1545	22+12	720	3476.56	3477.97	1.41	10.48	67.71	1.76	200	1.3	0.6	3.3	4.0
1500	22+81	720	3471.78	3473.00	1.22	12.64	57.59	2.19	0	1.3	0.0	2.6	4.0
1450	23+23	720	3468.69	3469.99	1.30	12.38	65.16	2.25	470	1.3	0.3	3.0	4.0
1375	24+04	720	3463.55	3464.93	1.38	12.12	66.37	2.19	470	1.3	0.3	3.0	4.0
1300	24+62	720	3459.09	3461.11	2.02	10.97	66.41	1.91	0	1.3	0.0	3.4	5.0
1225	25+37	720	3453.90	3455.83	1.93	11.54	70.39	2.13	0	1.4	0.0	3.3	5.0
1150	26+15	720	3450.00	3451.22	1.22	10.14	66.54	1.67	0	1.3	0.0	2.5	5.0
1075	26+89	720	3444.00	3446.17	2.17	12.21	62.84	2.18	0	1.4	0.0	3.6	6.0
1050	27+21	720	3442.00	3443.87	1.87	12.24	63.13	2.19	0	1.4	0.0	3.2	5.0
1000	27+52	720	3440.48	3442.10	1.62	11.06	67.54	1.93	0	1.3	0.0	2.9	4.0
960	27+94	720	3438.00	3440.00	2.00	10.26	64.63	1.69	560	1.3	0.2	3.5	6.0
925	28+29	720	3436.00	3437.20	1.20	11.97	56.43	2.04	560	1.3	0.2	2.7	6.0
850	29+08	799	3430.64	3432.82	2.18	10.54	72.11	1.78	560	1.3	0.2	3.7	4.0
775	30+01	799	3424.00	3425.99	1.99	13.38	51.57	2.19	0	1.4	0.0	3.4	6.0
700	30+61	799	3421.00	3422.42	1.42	14.43	60.51	2.66	0	1.4	0.0	2.8	6.0
550	-	1031	3415.41	3416.66	1.25	13.61	86.65	2.56	0	1.4	0.0	2.6	4.0

**ULTIMATE CONDITIONS	
FLOW SUMMARY TABLE	
CP	Q100 (cfs)
CRR2	720
CP10A	799
CP10B	155
CP10	1031

***Referenced from Figure 6U2 from the CDS Study

THE HOWARD HUGHES COMPANY, LLC

VILLAGE 24 PARCEL COS-3 WASH

HEC-RAS CROSS SECTION EXHIBIT

DRAWING
FIG-6
OF SHTS

GCV

ENGINEERS' SURVEYORS

gcvengineering.com

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LAS VEGAS, NV 89146
T: 702.804.2000
F: 702.804.2299

DESIGN:
DRAWN:
CHECK:
ISSUE DATE:
PLOT DATE: 03-21-17
PLOT TIME: 15:50:20

DATE: LAGEN: APP: DATE: GCW: APP: DATE: