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PRELIMINARY DRAINAGE REPORT
FOR
NAKOMA SKY
PHASE 1 AND PHASE 2
(MASS GRADING AND SITE PLAN)
LOCATED WITHIN A PORTION OF SECTION 07, T12S, R14E, G&SRM
TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA
TOWN OF ORO VALLEY PROJECT NUMBER: OV1601351

October 5, 2016

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DAVID W.
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ARIZONA, U.S.A.
Expires 06/30/19

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1.0 INTRODUCTION

This Preliminary Drainage Report has been prepared in support of the proposed grading site plan for the residential and commercial Nakoma Sky development formally know as Rooney Ranch Area Z. It has been agreed by the town staff that is Preliminary Drainage Report be prepared to identify the onsite hydrologic and hydraulics stormwater runoff necessary to support the mass grading for Nakoma Sky. The specific details and calculations of those drainage features that are to be constructed as a part of the actual grading and paving improvement plans (such as scuppers, curb openings etc.) will be discussed in the drainage report that will accompany those plans. A final drainage report will be submitted in support of the final construction design and improvements and FSP per each phase of development.

The proposed Nakoma Sky development contains a gross area of approximately 79.5 acres. The project site is bounded on the southeast and east by the Canada Del Oro Wash, on the north by private property, on the southwest and west by North 1st Avenue. This site is more specifically described as being a portion of Section 7, Township 12 South, Range 14 East, Gila and Salt River Meridian, Town of Oro Valley, Pima County, Arizona.

On-site stormwater runoff drains from the north to the south predominately by natural drainage swales and overland sheet flow. The average slope of the site is greater than 2.2 percent. Existing site vegetation consists primarily of native desert brush, cactus, Mesquite and Palo Verde trees. Portions of the eastern boundary of the site are located within the Wash A watershed, the remaining portions are located within the Wash B watershed. Storm water runoff that exits the site is conveyed in existing box culverts, stormdrains, constructed channels, and natural washes where it is ultimately intercepted by the Canada Del Oro Wash.

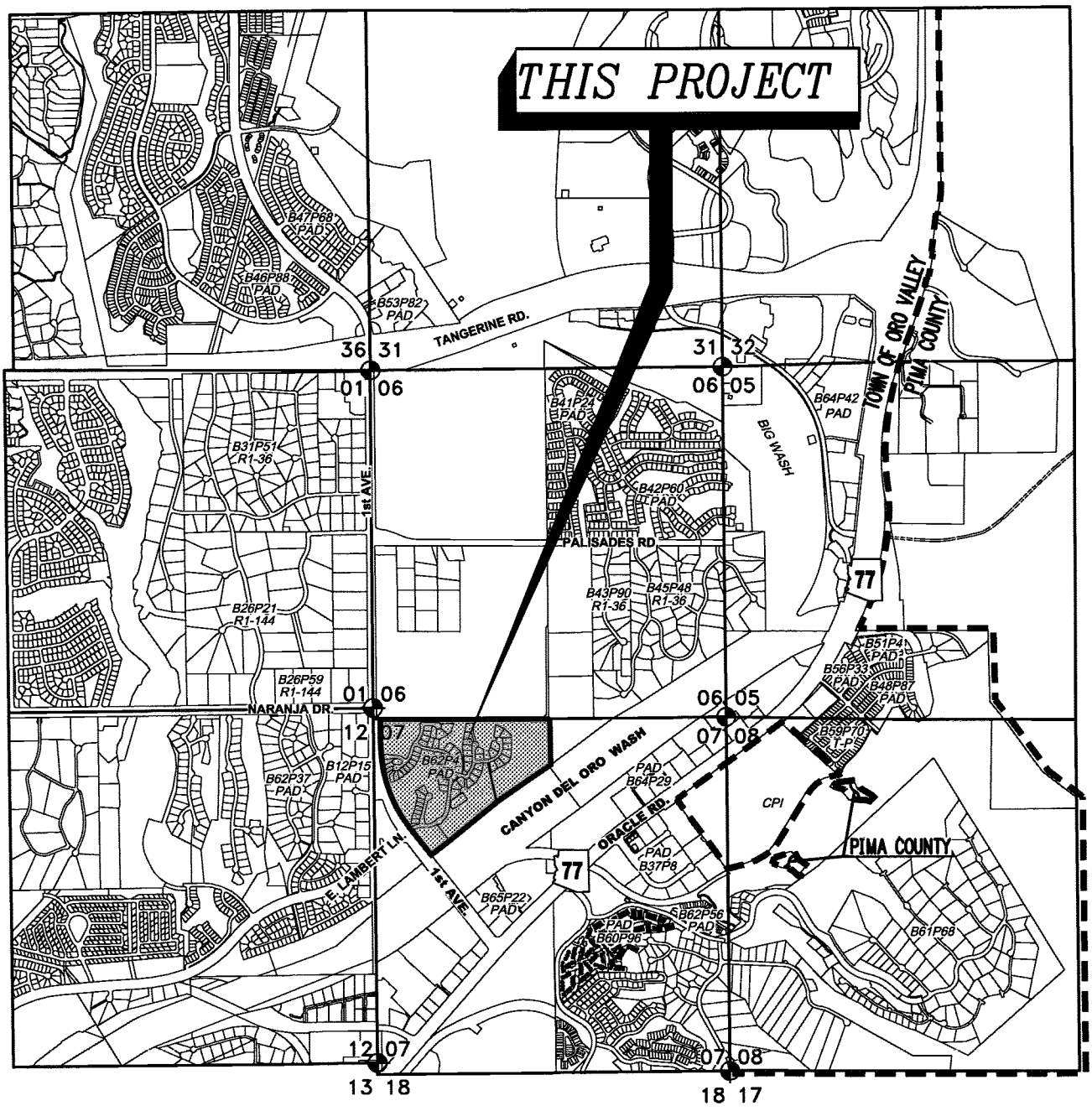
This project is located in The Town of Oro Valley and is required to comply with any drainage requirements set forth by the town. The Town has declared the entire town as being within a Critical Basin. However, this site is eligible for consideration of a variance/detention waiver on the basis that "the project is directly adjacent to a public wash and the outflow introduced by the development

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can be demonstrated not to affect the peak flow rate within said wash". A detention waiver request has been submitted to the town and is under consideration. The detention waiver request is submitted under a separate cover. Finally, rain water harvesting basins are proposed throughout the site to satisfy the town's requirements. This is further discussed in the hydraulics section (Section 5.7) of this report.

The southern portion of the Nakoma Sky project site is located within a Zone AE, which is defined as areas determined to be inside of the 100-year chance floodplain. The remaining areas of the project site are located within a Zone X, which is defined as areas determined to be outside of the 500-year chance floodplain, and shown on FIRM Panels 04019C1080L & 04019C1090L, effective date June 16, 2011 (see Figure 2). A Conditional Letter of Map Revision (CLOMR) has been prepared by the WLB Group to remove this area from the FEMA Zone AE through the use of fill and bank protection adjacent to the Canada Del Oro Wash. The CLOMR and is currently under review, and pending approval by the communities and FEMA.

According to the Town of Oro Valley Floodplain Ordinance, Article 17-3 (Section 17-3-2), non-FEMA washes and/or sheet flow areas within the project site having a 100-year peak discharges of 50 cfs or more must have floodplains mapped. As discussed previously, there are six floodplains on-site that exceed 50 cfs; therefore, this ordinance is applicable to this project. Under existing conditions, Wash A (CP A) is the main wash that flows through the center of the site discharging directly into the Canada Del Oro Wash and has a peak flow discharge of 827cfs. Wash B (CP B) is located in the northwestern portion of the site and has a discharge of 265 cfs



3"= 1 MILE

LOCATION MAP

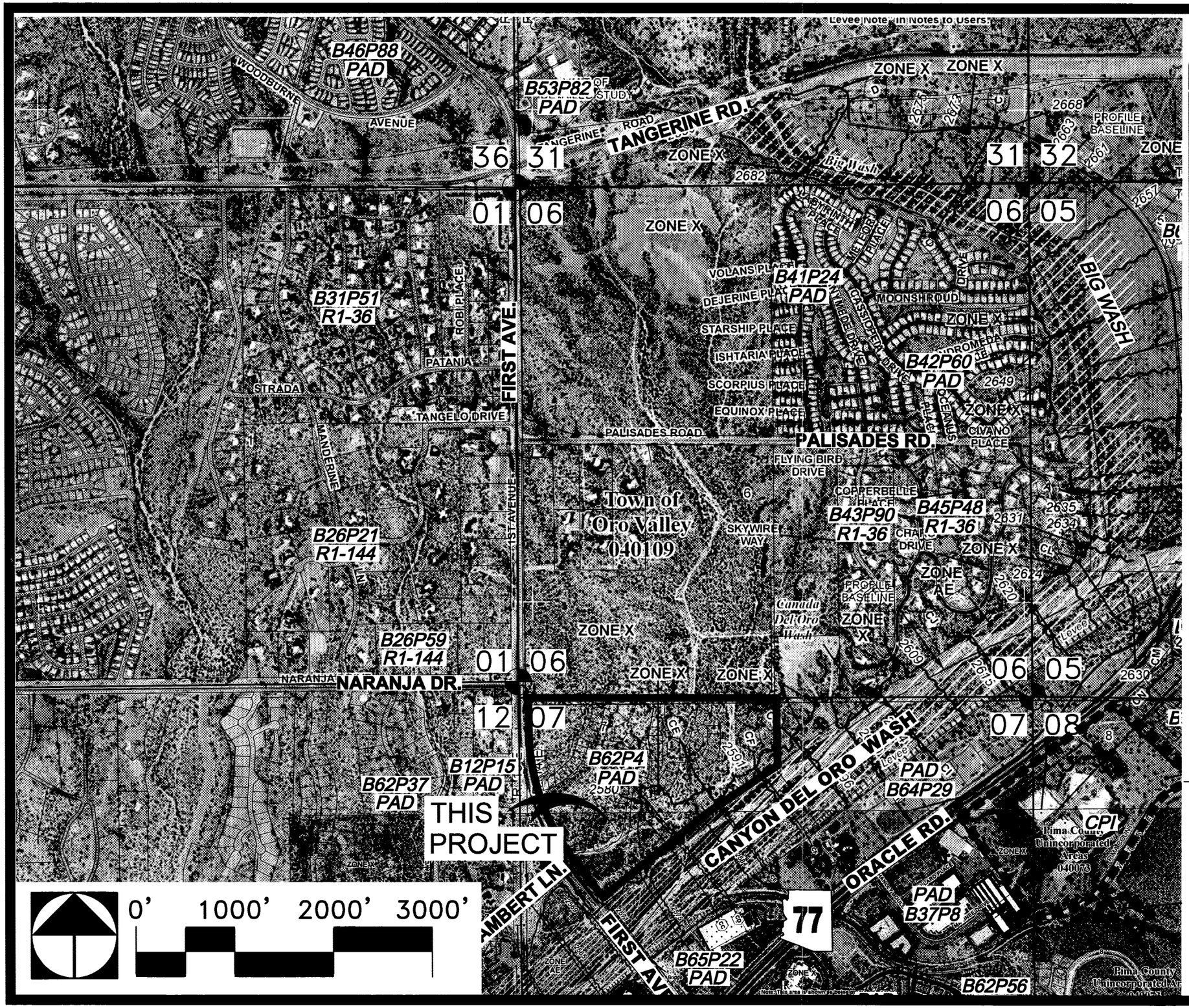
A PORTION OF SECTION 7,
TOWNSHIP 12S, RANGE 14E, G.&S.R.M.
TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA

The WLB Group INC. **WLB**

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FIGURE 1

O:\18105TY-003 - Nakoma Sky\03 Hydro\Exhibits\FSP Exhibits\FIG1 LOCATION MAP.dwg Plotted: Oct 04 2016



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1090L

FIRM

FLOOD INSURANCE RATE MAP

PIMA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 1090 OF 4750

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ORO VALLEY, TOWN OF	040109	1090	L
PIMA COUNTY	040073	1090	L

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

MAP NUMBER
04019C1090L

MAP REVISED
JUNE 16, 2011

Federal Emergency Management Agency

EFFECTIVE FIRM MAP
NAKOMA SKY
TOWN OF ORO VALLEY
PIMA COUNTY, ARIZONA
FIGURE 2

WLB JOB # 181057-Y002-0400
AUGUST 2016

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1.1 OBJECTIVES

The objective of this report is to evaluate the conveyance of on-site runoff associated with the proposed Nakoma Sky Phase project, and more specifically 1A and Phase 1B. In addition, a drainage concept that will safely and efficiently utilize the project site and maintain the natural drainage patterns of the adjacent land has been provided. This has been accomplished by:

1. Development of a design that complies with both the Development Standards Code of The Town of Oro Valley, 2013, and the Drainage Criteria Manual, 2010 Edition (References 2 and 3).

2. Estimation of the hydrologic and hydraulic conditions given the proposed future densities, i.e. post-development 100-year peak stormwater discharges.

3. Estimation of the locations and sizes of hydraulic structures used in the conveyance of stormwater runoff.

4. Design of channels to convey the 100-year peak discharge in a safe and non-erosive manner.

5. Estimation of the 100-year floodplain limits, elevations, and encroachments.

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1.2 PROCEDURES

The general procedure within this design report was to estimate the stormwater runoff rates and then design facilities that will accept, convey, direct, and span these discharges. The actual procedure is more specifically described as follows:

1. Offsite and on-site watersheds are delineated using 1" = 200' and 1'=60' topography NAVD 88 with 1' contour intervals. Watershed areas were determined using the software package AutoDesk/AutoCAD 2015 (Reference 5). Basin coefficients and imperviousness values were based on parameters found within Town of Oro Valley Drainage Criteria Manual (Reference 2).

2. The 2-, 10-, 50- and 100-year pre-development peak stormwater discharges affecting this project were estimated in accordance with the Rational Method (onsite) and HEC-HMS (offsite). Computer printouts of this spreadsheet have been included inAppendix A of this report.

3. Sidewalk scupper openings were sized and rated using the weir equation ($Q = C_{rect}L(L+1.8W)Y_i^{3/2}$). A weir coefficient value of 2.3 has been selected to model a depressed curb opening as a Broad-Crested weir. The sidewalk scuppers rated for this development are Type 3 Sidewalk Scupper of COT/PC Standard Detail 205.5 and Type 2 Sidewalk Scupper of COT/PC Standard Detail 205. Ratings for this structure have been outlined and formatted on a spreadsheet and are included in Appendix B of this report.

4. Proposed storm pipe systems have been rated, using Bentley StormCAD v8.1, by Bentley Systems and utilizes the AASHTO method (Reference 8). The results of these calculations are included in Appendix B of this report.

5. Channel cross-sections were analyzed using the FlowMaster software package (Reference 7). The results of these calculations are included in Appendix B of this report. The analysis

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was performed using the Manning's Formula as the friction method. Roughness coefficients of 0.016 thru 0.065 were used to represent the characteristics of the channels. The results of these calculations are included in Appendix B of this report.

6. Rock sizing, for various rock-lined scour protection structures, was based upon the HEC-14. This method has been outlined and formatted on a spreadsheet and has been included in Appendix B of this report.

7. Culverts were analyzed at different stages using the HY-8 software package (Reference 6). The results of these calculations are included in Appendix B of this report.

8. Curb inlets and grates have been rated using the Urban Drainage Design Program, HY-22, Federal Highway Administration, Third Edition, 2013 (Reference 9).

9. "First Flush" stormwater pollution facilities, to be installed at discharge points of all proposed parking lots, have been designed to retain the runoff volume generated by the first 30 minutes of the 2-year storm event. Runoff, for storm events greater than the 2-year storm, will overtop these basins and be conveyed to the next hydraulic structure as sheet flow.

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2.0 EXISTING CONDITIONS DRAINAGE

Existing conditions has been previously analyzed and approved in the "*Existing Drainage and Floodplains Analysis for The North 1ST Avenue Properties*" prepared by the WLB Group Inc, dated September 16, 2015 and revised February 11, 2016. See the excerpted Pre-Development Watershed Map (Figure 3 & 4) for watershed basin and sub-basin delineations, concentration points, and floodplain boundaries.

ON-SITE DRAINAGE

In accordance with Development Standards Code of the Town of Oro Valley, 2013, and the Drainage Criteria Manual, 2010 Edition, two methods for hydrology were utilized; the Rational Method for the onsite and local watersheds and Rainfall-Runoff Modeling (HEC-HMS) excerpted from the "*Existing Drainage and Floodplains Analysis for The North 1ST Avenue Properties*" prepared by the WLB Group Inc., dated September 16, 2015 and revised February 11, 2016. The Rational Method was utilized to determine peak runoff rates for drainage areas less than 100 acres. The Hydrologic Modeling System, HEC-HMS 4.2.1, provided by the US Army Corps of Engineers Hydrologic Engineering Center was used to determine peak runoff rates for drainage areas greater than 100 acres. These methods and formulas are discussed in greater detail later in this section of the report.

The site is currently mostly native desert landscape, with some existing stormdrain outlets and constructed channels along the existing alignment of North 1st Avenue. On-site flows are collected throughout the site by several unnamed washes which converge into two different washes (Wash A and Wash B) throughout the site. These washes will direct the runoff to the south through the project site and ultimately into the Cañada Del Oro Wash.

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OFF-SITE DRAINAGE

The offsite watersheds have been previously analyzed and approved in the "*Existing Drainage and Floodplains Analysis for The North 1ST Avenue Properties*" prepared by the WLB Group Inc, dated September 16, 2015 and revised February 11, 2016. The offsite watersheds extend north of Tangerine Road and into Rancho Vistoso Neighborhood 5. The offsite watersheds contain a mixture of commercial/residential developments along with vacant land. These offsite watersheds are located within 1 or 2 main watersheds and have been evaluated with the developed weighted runoff coefficient in addition to evaluating the natural trend, collection points of runoff, and calculate discharges in the existing condition that represents commercial and residential developments. These concentration points are depicted on Figure 3 (excerpted from approved report), the Pre-Developed Watershed Map, and include both the off- and on-site sub-basins as one, providing a cumulative estimation of the discharges at key points affecting the property, and its future design. The numbering scheme is built in such a fashion as to designate sub-basins (CP A3 is a sub-basin of CP A, etc.). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the sub-watersheds including the remaining areas (see Figure 3).

The offsite conditions can be described as having a vegetative covering of approximately 25 percent of grass and brush. The impervious cover has been estimated to be 0% to 60% for the existing residential developments, commercial developments, and roads. Soil characteristics and vegetative cover are based on the typical soil profiles and information provided in the Soil Survey. The offsite topography was provided by Pima Association of Governments (PAG) 2008 topography. This method utilizes Light Detection and Ranging (LIDAR), LIDAR, which is a remote sensing system used to collect topographic data. This data is collected using aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and has a published vertical precision of 15 centimeters (6 inches). The 2008 PAG Lidar is a 1 foot contour interval based on NAVD 88 datum.

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3.0 PROPOSED CONDITIONS DRAINAGE DESIGN

Under post-development conditions the site has been divided into 3 major watersheds in order to and evaluate the conveyance of the runoff in conjunction with the grading features of the proposed development. These concentration points define the on-site watersheds, and are numbered in such a fashion as to designate sub-basins (CP B1 is a sub-basin of CP B, etc.). There are a total of 35 sub-watersheds defined within these concentration points, ranging in size from 0.3 acres to 557 acres, and having 100-year peak discharges of 2.0 cfs and 827 cfs, respectively.

The conveyance of runoff through the proposed development will be accomplished by a system of channels, reinforced concrete and metal pipe culverts and catchbasins. The On-Site Developed Conditions Watershed Maps (Figure 5) define the basin delineations and concentration points has been prepared to show the proposed sub-basins and drainage infrastructure.

STORMWATER DETENTION BASINS

This project is located in The Town of Oro Valley and is required to comply with any drainage requirements set forth by the town. This site is eligible for a variance/detention waiver on the basis that "the project is directly adjacent to a public wash and the outflow introduced by the development can be demonstrated not to affect the peak flow rate within said wash". A detention waiver request has been submitted to the town and is under consideration. The detention waiver request is submitted under a separate cover.

Rain water harvesting basins are proposed throughout the site to satisfy the Town's requirements. This is further discussed in the hydraulics section (Section 5.7) of this report.

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FIRST FLUSH

Each paved surface concentration point location will require a structure or system to minimize pollutants that enter into the drainage ways and ultimately into the town's natural watercourses. These systems will be designed to capture and filter out pollutants that adhere to the pavement surface. The stormwater that discharges off the pavement surfaces will discharge immediately into structures that contain Triton Filter Catch Basin & T-DAM filter inserts. Catch basin filter inserts produced by Revel Environmental Manufacturing Inc. (REM) called Triton Filter Catch Basin inserts and T-DAM filters will be utilized within the parking lots for any pavement stormwater discharges. Information on the Triton Filter Catch Basin & T-DAM filter inserts is provided in Appendix B (if applicable).

First flush basin structures are intended to reduce the amount of pavement surface contaminants discharged from the project site during the first half-inch depth of runoff over the entire parking lot paved surfaces. There are several parking areas throughout the site in Watersheds A and B, so first flush BMP's will be utilized within this development. Please refer to the hydraulics section (Section 5.2) and Appendix B for the details and calculations.

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4.0 SPECIAL CONDITIONS

There are no special conditions for the development of this project that require deviation from standard procedures and submittal requirements as defined by the town. Floodplain Use Permits have been prepared for specific portions of the property that fall within the requirements for their use per the Type II Grading permit. Other portions of the development will not require Floodplain Use Permits as the on-site stormwater will be directed through the site via stormdrain, thus eliminating the local regulatory floodplains under post-developed conditions. A Floodplain use Permit will be required for any development within a floodplain.

STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

A Stormwater Pollution Prevention Plan (SWPPP) is a document of Best Management Practices (BMPs) planned for the project, a revegetation and/or soil stabilization plan, an implementation and maintenance plan for the SWPPP, and the location of the BMPs or sediment control devices. The SWPPP guidelines are supplied by the National Pollutant Discharge Elimination System (NPDES) and the Arizona Department of Environmental Quality (ADEQ).

Projects authorized under the Construction General Permit (CGP) will be required to supply a Notice of Intent (NOI) letter and a SWPPP. The SWPPP required under the CGP will be submitted (under separate cover) for this project when the final layout has been completed.

Projects authorized under the Multi-Sector General Permit (MSGP) will be required to supply portions of the Notice of Intent (NOI) letter and a SWPPP under the MSGP. Furthermore, documentation of industrial activities Standard Industrial Classification (SIC) Codes will need to be included within the MSGP.

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404 COMPLIANCE STATEMENT

This development, Nakoma Sky, contains a gross area of approximately 79.5 acres. The site is located in a portion of Section 07, Township 12 South, Range 14 East, Gila and Salt River Meridian, Pima County, Arizona.

I, David Little, am a Registered Professional Civil Engineer in the State of Arizona and am responsible for the preparation of the report for the above-referenced project. I attest to the following statement:

This project has been determined to be jurisdictional pursuant to Section 404 of the Federal Water Pollution Control Act amendments of 1972, 33 USC 1334.

ATTESTED TO THIS 30th DAY OF September, 2016

COUNTY OF PIMA)
) SS
STATE OF ARIZONA)

THIS STATEMENT WAS ACKNOWLEDGED BEFORE ME THIS 30th DAY OF September, 2016

NOTARY PUBLIC Clare L. Leeper

MY COMMISSION EXPIRES FEB. 12, 2017

OFFICIAL SEAL
CLARE L. LEEPER
NOTARY PUBLIC-ARIZONA
PIMA COUNTY
My Comm. Exp. Feb. 12, 2017

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5.0 HYDROLOGIC AND HYDRAULIC RESULTS

5.1 HYDROLOGIC RESULTS

The following tables are found in this section:

- Table of Hydrologic Soil Types.
- Table of Off-Site/On-Site Pre Developed 2-, 10-, 50-, and 100-Year Discharges (Excerpt from Approved Drainage report-see Appendix F).
- Table of Post Developed 2-, 10-, 50-, and 100-Year Discharges

Existing conditions has been previously analyzed and approved in the "*Existing Drainage and Floodplains Analysis for The North 1ST Avenue Properties*" prepared by the WLB Group Inc, dated September 16, 2015 and revised February 11, 2016. See the excerpted Pre-Development Watershed Map (Figure 3 & 4) for watershed basin and sub-basin delineations, concentration points, and floodplain boundaries. This information has been excerpted from the approved report and attached in Appendix A of this report.

In accordance with Development Standards Code of The Town of Oro Valley, 2013, and the Drainage Criteria Manual, 2010 Edition, two methods for hydrology were utilized; the Rational Method and Rainfall-Runoff Modeling (HEC-HMS). The Rational Method was utilized to determine peak runoff rates for drainage areas less than 100 acres. The Hydrologic Modeling System, HEC-HMS 4.2.1, provided by the US Army Corps of Engineers Hydrologic Engineering Center was used to determine peak runoff rates for drainage areas greater than 100 acres. These methods and formulas are discussed in greater detail later in this section of the report.

5.2 Soils

According to a soil map for the Eastern Part of Pima County Arizona, provided by the United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS), there are 3 different soils identified within the project watersheds. The soil survey is attached in Appendix A and can also be found on Figure 3. Soil types vary greatly across the watersheds for the project. Soil characteristics and vegetative cover are based on the typical soil profiles and information provided in

the Soil Survey. Three hydrologic soil group types have been identified at the site and are described in the following table on the next page.

TABLE OF HYDROLOGIC SOIL TYPES	
SOIL DESCRIPTION	**HYDROLOGIC SOIL TYPE**
Tubac Gravelly Loam	100% - C
Pinaleno-Stagecoach Complex	100% - B
Pinaleno-Stagecoach-Palos Verdes Complex	82% - B & 18% - C

5.3 Topography

One-foot contour mapping was developed for the project area and were obtained using a method called Digital Photogrammetric Mapping (DPM). DPMutilizes first order stereo plotters to perform the photogrammetric approach of collecting the digital terrain modeling (DTM) with full planimetrics. PC-based VR-1 software is used in the real-time stereo compilation and in generating contours from the DTM. This method adheres to the National Map Accuracy Standards, which means, at least 90% of contours must be within ½ of the contour interval and well defined objects must be within 1/40" horizontal position at map scale. Furthermore, spot elevations must be within ¼ of the contour interval. The photogrammetric mapping generated 1' and 5' contour intervals on the NAVD 88 datum.

As mentioned earlier, Pima Association of Governments (PAG) 2008 topography was used for the offsite topography. Pima County chose a method called Light Detection and Ranging (LIDAR), LIDAR, which is a remote sensing system used to collect topographic data. This data is collected using aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and has a published vertical precision of 15 centimeters (6 inches). The 2008 PAG Lidar is a 1 foot contour interval based on NAVD 88 datum.

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5.4 Rational Method

In the Town of Oro Valley Drainage Criteria Manual (2010 Edition), the rational method is utilized for uniform drainage areas that are less than 100 acres in size. The rational method calculates a peak flow discharge (Q) based on the runoff coefficient (C), average rainfall intensity of calculated rainfall duration for a selected rainfall return period (i, inches/hr), and the contributing drainage area (A, <100acres).

The runoff coefficient (C) is determined based on the soil type, vegetative types and densities, and the existing or projected land use character. The average rainfall intensity (i) is obtained from an intensity-duration-frequency (I-D-F) graph. The Time of Concentration (T_c) is a function of the rainfall intensity (i). Per TOV Criteria minimum rainfall duration of 5 minutes is usedif the calculated T_c is less than 5 minutes. The T_c should not exceed 60 minutes. The 1 hour rainfall depths for the 2-, 10-, 50- and 100-year storm events were obtained from National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14).

The 2-, 10-, 50- and the 100-year storm events were analyzed using the Rational Method for all drainage areas less than 100 acres and T_c less than 60 minutes, which would include onsite portions on watershed A, B, and C. The hydrologic worksheets utilizing the rational method and associated project variables are included in Appendix A.

5.5 HEC-HMS Method

5.5.1 Rainfall

Rainfall Depth-Duration-Frequency (D-D-F) data from NOAA Atlas 14 was used for design storms in the analyses. The rainfall data is shown in Appendix A. The rainfall depths were used to develop frequency design storms within the HEC-HMS model. In accordance with the TOV Manual, a 3-hour design storm was used for drainage areas greater than 100 acres, but less than 10 square miles. A 24-hour design storm was used for drainage areas greater than 10 square miles. The 2-, 10-, 50- and the 100-year storm events were analyzed for all drainage areas greater than 100 acres.

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5.5.2 Runoff

The Clark Unit Hydrograph Method was used to develop runoff hydrographs for the analysis. This method requires the estimation and input of three parameters; the Time of Concentration (Tc), the Storage Coefficient (R), and a Time-Area Relation. The Times of Concentration was determined using Equation 4-1 from the ADOT Manual which is classified for desert/mountain regions. The Storage Coefficient (R) was determined using Equation 4-4 from the ADOT Manual. HEC-HMS uses a default time-area relation curve within the program in the Clark Unit Hydrograph calculation. Calculations and estimated values for the Clark Unit Hydrograph input parameters are provided in AppendixF.

5.6 Hydrologic Results

5.6.1 Existing Conditions

The site consists primarily of native desert landscape, with some existing informal trails, dirt roads and minor clearing grading in the area of the alignment of the existing main sewer line. On-site flows are collected throughout the site by a few unnamed washes which converge into two different main washes (Wash A and Wash B) along the eastern and western boundaries of the site. These washes will direct the runoff to the south through the project site and through culvert crossing beneath 1st Avenue (Wash B) or through the Nakoma Sky (Wash A) and continue south in natural drainage course ultimately entering the Cañada Del Oro Wash, located adjacent to the site.

Under existing conditions the site has a vegetative covering of approximately 25 percent of grass and brush. The impervious cover has been estimated to be 0% to 10% for the existing residential developments and roads. The soils for the project site consist of Pinaleno-Stagecoach-Palos Verdes Complex and Pinaleno-Stagecoach Complex. According to the U.S. National Resources Conservation Service (NRCS), the Pinaleno-Stagecoach-Palos Verdes Complex is 82% Soil Group B and 18% Soil Group C; the Pinaleno-Stagecoach Complex is 100% Soil Group B.

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The site has been divided into 3 main watersheds in order to evaluate the natural trend, collection points of runoff, and calculate discharges in the existing condition. These concentration points are depicted on Figure 3, the Pre-Developed Watershed Map, and include both the off- and on-site sub-basins as one, providing a cumulative estimation of the discharges at key points affecting the property, and its future design. The numbering scheme is built in such a fashion as to designate sub-basins (CP A1 is a sub-basin of CP A, etc.). These concentration points have been labeled to coincide with the existing drainage report for the 1st Avenue properties identifying the existing on- and off-site hydrologic and hydraulics impacting these 3 properties (Villages at Silverhawke, Sanctuary at Silverhawke, and Nakoma Sky) (see report attached in Appendix G). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the sub-watersheds including the remaining areas (see Figure 3). These watersheds have been determined to have areas ranging from 14.3 to 557 acres, with 100-year peak discharges of 49.8 to 827 cfs, respectively. The Rational Method, as directed by the town, was used to model the hydrologic conditions of these watersheds. The estimated watershed areas, with corresponding 2-, 10-, 50- and 100-year peak discharge rates, for each proposed concentration point are provided in the following table (excerpt from Existing Drainage and Floodplains Analysis for the *N. 1st Avenue* Properties Report, only the concentration points that directly impact Nakoma Sky either onsite or offsite are listed below):

Table of Off-Site/On-Site Pre Developed 2-, 10-, 50-, and 100-Year Discharges

Concentration Point	Drainage Area (ac)	2-Year (cfs)	10-Year (cfs)	50-Year (cfs)	100-Year (cfs)
A** (onsite)	557	195	419	713	827
A1** (onsite)	19.2	11.4	24.1	43	49.8
A2** (offsite)	51.2	16.8	35.5	60	69.4
Nakoma Sky** (offsite)	506	175	370	628	728
B* A** (onsite)	94.7	51	129	249	265

B1* (onsite)	14.3	18.1	35	61	63
B2* (offsite)	18.7	8.2	29	61	66
B3* (offsite)	48.8	30	72	138	147
B4* (offsite)	28.8	22	52	98	104
C* (onsite)	16.6	14.8	41	82	88

*Rational Modeling Method – First Avenue Properties Drainage Report

** HEC-HMS Modeling Method – First Avenue Properties Drainage Report

5.6.1 Post Developed Conditions

The post-development drainage concept is an analysis of the proposed commercial/residential design known as Nakoma Sky. Under post-development conditions the site has been divided into 3 major watersheds, in order to evaluate the on-site runoff of the proposed development and maintain consistency with the "*Existing Drainage and Floodplains Analysis for The North 1ST Avenue Properties*" prepared by the WLB Group Inc (see attached report in Appendix G) . The numbering scheme is built in such a fashion as to designate sub-basins (CP A1.1 is a sub-basin of CP A, etc.). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the sub-watersheds including the remaining areas (See Figure 5 – Post-Development Watershed Map). Any sub-watersheds that require hydraulics (i.e. culverts, constructed channels, scuppers, etc.) are defined in greater detail in the Table of Hydraulic Structures, and Table of Constructed Drainageways, that follow in the Hydraulic Results section of this report.

Under post developed conditions, Concentration Point's A & B are not modeled because the proposed developed will have a very low impact on the peak discharge on the basis of the proximately of the development within the watershed and the Times of concentration (Tc). The Nakoma sky development is located at the very downstream end of the watershed and discharges directly into the Canada Del Oro Wash (see Figure 3). As a result, onsite developed local watersheds have a calculated Tc of 5 minutes and the overall watersheds range from 26 min to 2 hours resulting in very little impact to onsite discharge if any at all.

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There are a total of 35 sub-watersheds defined within these concentration points, ranging in size from 0.3 acres to 557 acres, and having 100-year peak discharges of 2.0 cfs and 827 cfs, respectively. Runoff Coefficients ranged from 0.35 to 0.96, Imperviousness Factors from 5 to 80 percent, and a Vegetative Cover Density of 25 percent were used to model developed conditions. The Rational Method was used to model the hydrologic conditions of these watersheds. The estimated watershed areas, with corresponding 2-, 10-, 50- and 100-year peak discharge rates, for each proposed concentration point are provided in the following table on the following page:

Table of Post Developed 2-, 10-, 50-, and 100-Year Discharges

Conc. Point	Drainage Area (ac)	2-Year (cfs)	10-Year (cfs)	50-Year (cfs)	100-Year (cfs)
A*	557	195	419	713	827
A1.1	1.87	5.0	9.2	13.1	15.0
A1.2	0.37	0.7	1.5	2.3	2.7
A1.3	0.60	1.1	2.5	3.8	4.4
A1.4	1.08	1.9	4.4	6.8	7.9
A1.5	0.92	2.5	4.5	6.5	7.4
A1.5a	0.78	2.1	3.8	5.5	6.3
A1.6	1.00	1.8	4.1	6.3	7.3
A1.7	5.36	12.1	24.2	35.8	41.1
A1.8	1.44	3.9	7.1	10.1	11.5
A1.9	1.25	2.8	5.6	8.3	9.6
A1.9a	0.22	0.9	1.4	1.8	2.0
A1.10	1.09	4.6	7.0	9.0	10.1
A2	1.20	3.2	5.9	8.4	9.6
A3	2.88	7.8	14.1	20.2	23.1
A4	0.96	2.6	4.7	6.7	7.7
A5	1.62	4.4	7.9	11.4	13.0
A6	0.89	2.4	4.4	6.3	7.1

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A7	13.17	23.7	54.2	83.2	96.5
A7.1	3.13	5.6	12.9	19.8	22.9
A7.2	0.93	1.7	3.8	5.9	6.8
A7.3	0.70	3.0	4.5	5.8	6.5
A8	0.95	1.7	3.9	6.0	7.0
A9	4.31	8.7	18.5	27.9	32.3
B	102.8	70.3	173.0	277.5	304.4
B1	21.3	19.9	59.2	102.6	111.7
B2	81.3	55.6	136.7	219.3	240.6
B3	76.9	52.6	129.4	207.6	227.7
B4	0.75	2.0	3.7	5.3	6.0
B5	0.54	1.5	2.6	3.8	4.3
B6	0.52	1.4	2.5	3.7	4.2
B7	4.55	7.9	17.9	25.5	30.0
C	14.67	21.1	49.3	75.0	85.8
C1	9.36	16.2	36.9	52.5	61.6
C2	0.42	1.8	2.7	3.5	3.9
C3	1.03	4.4	6.6	8.5	9.6
C4	0.45	1.9	2.9	3.7	4.2
C5	0.82	1.5	3.4	5.2	6.0
C6	0.28	0.5	1.1	1.7	2.0

*Discharge recorded from First Avenue Drainage Report-See Appendix F

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5.7 HYDRAULIC RESULTS

The following tables are found in this section:

- Table of Hydraulic Structures
- Table of Proposed Constructed Drainageways

See the Post-Development Watershed Map (Figure 5) for basin delineations, concentration points, and hydraulic structure locations.

The conveyance of runoff through the proposed development is accomplished by a system of channels, reinforced concrete and metal pipe culverts, and catch basins. Each hydraulic structure has been labeled in such a fashion as to relate to the designated sub-basins (CP A1.1 is a sub-basin of CP A, etc.). As a reminder from the Hydrologic Results Section of this report, the site has been divided into 3 major watersheds in order to evaluate the conveyance of onsite runoff associated with the proposed site grading.

Watershed A:

The storm water discharges from proposed private and residential lots have been combined into one watershed concentrating runoff at concentration point 1.0. The watershed has been divided into 22 sub watersheds in order to evaluate the amount of discharge and depth of flow in the channels and culverts. These twenty-one sub watersheds are labeled CP's A1.1, A1.2, A1.3, A1.4, A1.5, A1.5a, A1.6, A1.7, A1.8, A1.9, A1.10, A2, A3, A4, A5, A6, A7, A7.1, A7.2, A7.3, A8 & A9 on Figure 5, to correspond with the major watershed A. At CP A9, a discharge of 32.3 cfs will discharge through a 32-foot Type 3 sidewalk scupper and into Wash A (west) drainageway. At CP A7.3, a discharge of 6.5 cfs will discharge through an 8-foot Type 3 sidewalk scupper w/Triton First Flush and in a constructed channel (D) drainageway to CP A7. At CP A7.1, a peak discharge of 22.9 cfs will discharge through 1-24" SRP w/headwall (Culvert #4) and directed east to CP A7. At CP A7, a peak discharge of 96.5 cfs will discharge through 1-48" SRP w/headwall and directed southeast to a junction structure (See stormdrain Run A7). At CP A6, a peak discharge 7.1 cfs will discharge

through a modified Type 5 catch basin w/ 1 EF-1 grate and directs the flow north in to a junction structure (See stormdrain Run A7). Stormdrain Run A7 discharges a combined flow of 103.6 cfs through a 48" SRP into Wash A (West). The stormdrain outlet elevation was modeled with 10-year storm event water surface elevation for Wash A (West). At CP A5, a discharge of 13.0 cfs will discharge through a 12-foot Type 3 sidewalk scupper w/Triton First Flush and into Wash A (west) drainageway.

At CP A4, a peak discharge of 7.7cfs will discharge through 1 EF-1 grate into a modified Type 4 catch basin and directs the flow east through 1-18" SRP to Wash A (West - see Stormdrain Run A4). At CP A3, a peak discharge of 23.1cfs will discharge through 3 EF-1 grates into a modified Type 4 catch basin and directs the flow east through 1-24" SRP to Wash A (West - see Stormdrain Run A3).

At CP A1.8, a discharge of 11.5 cfs will discharge through a 12-foot Type 3 sidewalk scupper and to CP A1.7. At CP A1.7, a peak discharge of 41.1 cfs will discharge through 1-36" SRP w/headwall and directed southwest to a junction structure (See stormdrain Run A1). At CP A1.6, a peak discharge of 7.3cfs will discharge through 1 EF-1 grate into a modified Type 4 catch basin and directs the flow east through 1-24" SRP to junction structure (see Stormdrain Run A1). At CP A1.5, a peak discharge of 7.4cfs will discharge through a separate modified Type 5 catch basin with 1 EF-1 grate and directs the flow southeast through 1-24" SRP to junction structure (see Stormdrain Run A1). At CP A1.5a, a peak discharge of 6.3cfs will discharge through a separate modified Type 4 catch basin with 2 EF-1 grate and directs the flow southeast through 1-42" SRP to junction structure (see Stormdrain Run A1). At CP A1.4, a peak discharge of 6.7cfs will discharge through 1 EF-1 grate into a modified Type 4 catch basin and directs the flow east through 1-24" SRP to junction structure (see Stormdrain Run A1). At CP A1.3, a peak discharge of 4.4cfs will discharge through 1 EF-1 grate into a modified Type 4 catch basin and directs the flow east through 1-18" SRP to junction structure (see Stormdrain Run A1). At CP A2, a peak discharge of 9.6cfs will discharge through 2 EF-1 grates into a modified Type 4 catch basin and directs the flow west through 1-24" SRP to CP A1.1 (West - see Stormdrain Run A1). At CP A1.1, a peak discharge of 15cfs will discharge through 4 EF-1 grates into a modified Type 4 catch basin and directs the flow east through 1-42" SRP to

junction structure (see Stormdrain Run A1). Stormdrain outlets directly into the Canada Del Oro Wash, and was calculated with a tailwater elevation of 2576.9 (Computed by the CLOMR Application). This tailwater elevation is the 10-year storm event.

Watershed B:

The storm water discharges from proposed private roadway and residential lots have been combined into one watershed concentrating runoff at Concentration Point B. The watershed has been divided into 6 sub watersheds in order to evaluate the amount of discharge and depth of flow in the channels and culverts. These 6 sub watersheds are labeled CPs B1, B2, B3, B4, B5, B6, & B7 on Figure 5, to correspond with the major watershed B. At CP B7, a peak discharge of 30 cfs will discharge through 1-30" SRP w/headwall and directed south into Wash B (East) (See Culvert 1). At CP B6, a discharge of 4.2 cfs will discharge through a 4-foot Type 3 sidewalk scupper w/Triton First Flush and to and directed south into Wash B (East). At CP B4, a discharge of 6.0 cfs will discharge through an 8-foot Type 3 sidewalk scupper and directed south into Wash B (East). At CP B3, a peak discharge of 228 cfs will be split between 2 culvert crossings. At elevation 2626.3, Culvert 2 will discharge 73.3 cfs and Culvert 3 will discharge 154.7 cfs for a total of 228 cfs, which exceeds the peak discharge of CP B3. Therefore, the two culverts will accept the peak discharge at CP B3 without overtopping the road. Culvert 3 will discharge through 3-36" SRPs w/headwall and direct the flow (154.7) southwest into Wash B (East). Culvert 2 will discharge through 2-30" SRPs w/headwall and direct the flow (73.3) southwest into Wash B (West).

Watershed C:

The storm water discharges from proposed private roadway and residential lots have been combined into one watershed concentrating runoff at Concentration Point C. The watershed has been divided into 6 sub watersheds in order to evaluate the amount of discharge and depth of flow in the channels and culverts. These 6 sub watersheds are labeled CPs C1, C2, C3, C4, C5, & C6 on Figure 5, to correspond with the major watershed C. At CP C6, a peak discharge of 2.0cfs will discharge into a modified Type 4 catch basin and directs the flow south through 1-18" SRP to a manhole (see Stormdrain Run C). At CP C5, a peak discharge of 6.0cfs will discharge into a

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modified Type 4 catch basin and directs the flow south through 1-18" SRP to CP C4 (see Stormdrain Run C). At CP C4, a peak discharge of 4.2cfs will discharge through a modified Type 3 catch basin w/4-foot wing, and the flow will be directed south through 1-18" SRP to a junction structure (see Stormdrain Run C). At CP C3, a peak discharge of 9.6cfs will discharge into a modified Type 3 catch basin w/12' wing, and the flow will be directed north through 1-18" SRP to a junction structure (see Stormdrain Run C). At CP C1, a peak discharge of 61.6 cfs will discharge through 1-42" SRP w/headwall and directed south to a junction structure(See Stormdrain Run C). Stormdrain Run C discharges a collected 83.4 to CP C through a 42" SRP.

The following table below is a table of the proposed hydraulic structures. Refer to Appendix B of this report for details and supporting calculations of hydraulic structures.

TABLE OF HYDRAULIC STRUCTURES		
CP	**Q100 (cfs)**	**STRUCTURE**
A (Wash A West)	728*	Pedestrian Bridge, 40 foot with concrete apron, HW=1.86, V_{100}=6.64 fps
A (Wash A East)	728*	10'x4' RCBS (3-cells); 17.5 LF, 1.89% Slope, HW=4.12' ; V_{100}=11.43 fps
A1.1**	15.0	Type 4 Catch Basin w/ 4 EF-1 Grates 1-42" SRP; 56.23 LF @ 1.12% slope, HW=3.07', V_{100}=12.6fps
A1.3**	4.4	Type 4 Catch Basin w/ 1 EF-1 Grate 1-18" SRP; 81.02 LF @ 1.00% slope, HW=2.3', V_{100}=2.49 fps
A1.4**	6.7	Type 4 Catch Basin w/ 1 EF-1 Grate 1-24" SRP; 93.25 LF @ 1.00% slope, HW=2.14', V_{100}=2.51 fps
A1.5**	7.4	Type 5 Catch Basin w/ 1 EF-1 Grate 1-24" SRP; 29.3 LF @ 2.00% slope, HW=1.4', V_{100}=8.26 fps
A1.5a**	6.3	Type 4 Catch Basin w/ 2 EF-1 Grate 1-42" SRP; 106.5 LF @ 1.00% slope, HW=2.54', V_{100}=11.12 fps
A1.6**	7.3	Type 4 Catch Basin w/ 1 EF-1 Grate 1-24" SRP; 70.01 LF @ 3.00% slope, HW=0.96', V_{100}=9.54 fps
A1.7**	41.1	1-36" SRP; 211.21 LF @ 1.00% slope, HW=1.81', V_{100}=9.6 fps

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TABLE OF HYDRAULIC STRUCTURES		
CP	**Q100 (cfs)**	**STRUCTURE**
A1.8	11.5	12' Wide Type 3 Sidewalk Scupper (3 Cells) w/6" Curb Reveal
A1.9a	2.0	2.5' Wide Type 2 Sidewalk Scupper (1 Cell) w/First Flush Filtration
A2	9.6	Type 4 Catch Basin w/ 2 EF-1 Grates 1-24" SRP; 261.06 LF @ 0.5% slope, HW=3.68', V_{100}=3.06 fps
A3	23.1	Type 4 Catch Basin w/ 3 EF-1 Grates 1-24" SRP; 29.34 LF @ 3.49% slope, HW=1.71', V_{100}=13.73 fps
A4	7.7	Type 4 Catch Basin w/ 1 EF-1 Grate 1-18" SRP; 50.86 LF @ 2.00% slope, HW=1.22', V_{100}=4.73 fps
A5	13.0	12' Wide Type 3 Sidewalk Scupper (3 Cells) w/6" Curb Reveal
A6**	7.1	Type 5 Catch Basin w/ 1 EF-1 Grate, 1-18" SRP; 13.97 LF @ 1.00% slope, HW=3.22', V_{100}=4.07 fps
A7**	96.5	1-48" SRP; 57.16 LF @ 2.00% slope, HW=4.54', V_{100}=7.68 fps
A7.3	6.5	8' Wide Type 3 Sidewalk Scupper (2 Cells) w/6" Curb Reveal
A9	32.3	32' Wide Type 3 Sidewalk Scupper (8 Cells) w/First Flush Filtration
A1.10	10.1	24' Long Slotted Drain; 1-18" SRP, 26 LF @ 1.0% (MIN) w/First Flush Filtration
Culvert #1 (CP B7)	30.0	1-30" SRP; 105.9 LF @ 1.50% slope; HW=3.15, V_{100}=10.5 fps
Culvert #2 (CP B3)	73.3* (228)	2-30" SRP; 104.5 LF @ 4.04% slope; HW=3.8, V_{100}=9.1 fps
Culvert #3 (CP B3)	154.7* (228)	3-36" SRP; 94.4 LF @ 1.00% slope; HW=4.1, V_{100}=10.3 fps
Culvert #4 (CP A7.1)	22.9	1-24" SRP; 114.0 LF @ 0.50% slope, HW=3.4, V_{100}=8.04 fps
Culvert #5	157.6* (534)	4-36" SRP; 47.48 LF @ 1.28% slope, HW=3.4, V_{100}=9.86 fps
Culvert #6	398* (534)	4-60" SRP; 50.64 LF @ 2.82% slope, HW=4.1, V_{100}=13.8 fps

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TABLE OF HYDRAULIC STRUCTURES		
CP	**Q100 (cfs)**	**STRUCTURE**
Culvert #7	172.4* (534)	2-54" SRP; 54.66 LF @ 1.95% slope, HW=4.6, V_{100}=11.8 fps
B4	6.0	8' Wide Type 3 Sidewalk Scupper (2 Cells) w/6" Curb Reveal
B5	4.3	4' Wide Type 3 Sidewalk Scupper (1 Cells) w/6" Curb Reveal
B6	4.2	4' Wide Type 3 Sidewalk Scupper (1 Cells) w/6" Curb Reveal
C1	61.6	1-42" SRP; 114.94 LF @ 2.50% slope, HW=2.5', V_{100}=15.47 fps
C3	9.6	Type 3 Catch Basin w/ 12' Wing, 1-18" SRP; 10.93 LF @ 1.00% slope, HW=1.62', V_{100}=5.43 fps
C4	4.2	Type 5 Catch Basin w/ 1 EF-1 Grate, 1-18" SRP; 59.45 LF @ 0.50% slope, HW=1.93', V_{100}=5.77 fps
C5	6.0	Type 4 Catch Basin w/ 1 EF-1 Grate 1-18" SRP; 12.5 LF @ 0.50% slope, HW=2.16', V_{100}=3.4 fps
C6	2.0	Type 4 Catch Basin w/ 1 EF-1 Grate 1-18" SRP; 26.84 LF @ 2.32% slope, HW=2.05', V_{100}=1.13 fps

*Split Flow Discharge value
** See Plan View (Figure 5) for complete Storm Drain System description

TABLE OF CONSTRUCTED CHANNELS									
X-SEC	**Q100 (cfs)**	**V100 (fps)**	**fb**	**d**	**D**	**SLOPE (%)**	**Bw**	**SS**	**n**
B (A7.1)	16.1*	2.63	0.24'	1.32'	1.56'	0.50	4'	1 & 0	0.036
C (A7)	48.9*	4.07	0.26'	1.05'	1.31'	1.00	6'	3 & 1	0.022
D (A7)	48.9*	6.86	0.29'	1.02'	1.31'	3.70	6'	1	0.036
E (A1.9)	9.6	2.82	0.14'	0.72'	0.86'	1.00	4'	1	0.036
F (A1.7)	14.5*	2.82	0.22'	1.21'	1.43'	1.00	0'	1 & 6	0.036

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TABLE OF CONSTRUCTED CHANNELS									
X-SEC	Q100 (cfs)	V100 (fps)	fb	d	D	SLOPE (%)	Bw	SS	n
G (A1.7)	4.5*	2.57	0.07'	0.26'	0.33'	1.00	6'	1 & 4	0.022
H (A1.7)	8.7*	3.23	0.09'	0.39'	0.48'	1.00	6'	1 & 4	0.022
I (A1.6)	7.3	2.79	0.08'	0.33'	0.41'	1.00	6'	1 & 10	0.022
J (C5)	6.0	3.27	0.10'	0.42'	0.52'	2.50	4'	1	0.036
K (C5)	6.0	1.94	0.13'	0.71'	0.84'	0.50	4'	1 & 0	0.036

* Pro-rated Discharge of the 100-Year storm event

FLOODPLAIN MODELING RESULTS

As described previously, the southern portion of the Nakoma Sky project site is located within a Zone AE, which is defined as areas determined to be inside of the 100-year chance floodplain. The remaining areas of the project site is located within a Zone X, which is defined as areas determined to be outside of the 500-year chance floodplain, and shown on FIRM Panels 04019C1080L & 04019C1090L, effective date June 16, 2011 (see Figure 2). A Conditional Letter of Map Revision (CLOMR) has been prepared by the WLB Group to remove this area from the FEMA Zone AE through the use of fill and bank protection adjacent to the Canada Del Oro Wash. The CLOMR and is currently under review, and pending approval by the communities and FEMA.

According to the Town of Oro Valley Floodplain Ordinance, Article 17-3 (Section 17-3-2), non-FEMA washes and/or sheet flow areas within the project site having a 100-year peak discharges of 50 cfs or more must have floodplains mapped. As discussed previously, there are six floodplains on-site that exceed 50 cfs; therefore, this ordinance is applicable to this project. Under existing conditions, Wash A (CP A) is the main wash that flows through the center of the site discharging directly into the Canada Del Oro Wash and has a peak flow discharge of 827cfs. Wash B (CP B) is located adjacent in the northwestern portion of the site and has a discharge of 265 cfs.

The intent of this analysis is to evaluate the encroachment of the project into the floodplain as defined by these post developed HEC-RAS models. All new buildings Finish Floor Elevations and

equipment will be elevated to a minimum 1 foot above the water surface elevations. The existing Wash A & B floodplains are very broad, with sheet flooding in many braids and naturals channels. Using these peak flow discharge values, 2015 NAVD topography, and the cross section locations, The WLB Group Inc. has determined split flow computations for post developed HEC-RAS models in order to determine the water surface elevations (WSEL) and the impacts of the proposed development encroachment.

All the washes have the potential of sediment aggradation and degradation as a result of existing bed slope and equilibrium bed slope changes associated to the proposed hydraulic structures (pivot points) present within the drainageway. When a channel reaches the equilibrium condition, there is no channel aggradation or degradation for the study reach. The structures design potentially collect sediment upstream of the culvert as a result of the headwater depth increases depending on storm event frequency and creating long term degradation on the downstream creating a clear water sediment flow condition. A total scour analysis has been conducted to determine the erosion protection for the developments adjacent to the drainageways. An equilibrium slope analysis (Simons, Li and Associates, 1985) has been used for controlled washes (washes with a pivot point; hydraulic structure). When the existing bed slope is lesser than equilibrium slope upstream/downstream of a hydraulic structure (pivot point), it results in aggradation. When aggradation is evident, the long term scour depth will be zero as part of the total scour depth from structures design. The long-term equilibrium is dynamic and subtracting the aggradation depth from the total scour depth might under-estimate the total scour depth. A Level 1 Analysis (Arizona State Standard 5-96) models the washes that are uncontrolled (no structures present) for long term degradation. The culverts (pivot points) are located upstream of the site improvements displaying a long term degradation within the total scour as a result (see total scour worksheets attached in Appendix B). It is a recommendation that sediment stakes be installed upstream of the culverts to help monitor sediment aggradation, areas identified to have potential sedimentation aggradation are recommended to have routine maintenance and inspection to ensure adequate performance for the life of the natural drainageway. The drainageway will be inspected after every major storm event and cleared of all organic and inorganic debris. The drainageway shall be cleaned and cleared of any sedimentation accumulated upstream of any bridges, culverts or stormdrain after a major storm

event or once every 24 months, whichever occurs first. Finally, inspection of the drainageways and maintenance records is to occur on an annual basis.

WASH A (East & West):

Under post developed conditions, Wash A has been modeled using the computer software HEC-RAS v5.0, in order to determine the floodplain limits, depths and Erosion Hazard Setbacks. The site layout proposes development in the middle of the very wide and broad sheet flooding floodplain in Wash A dividing the flow (see Figure 5). This split flow condition resulted in 2 separate washes, Wash A East and Wash A West, resulting in four separate models (see Appendix B for models). Each wash has 1 model for the complete reach, and the other to determine the split flow calculation. In addition, the overall reach models have 2 separate profilesmodeling the floodplain. Profile 1 is the split flow discharge and the second profile is the full discharge (728 cfs) for Wash A (Profile 1 is shown in the HEC-RAS worksheets attached in Appendix B). At Wash A West, headwater elevation of 2600.2 will create a split flow discharge of 196 cfs to exit the floodplain and discharge east into Wash A East (modeled through a lateral weir technique to determine the amount of flow exiting the model). At Wash A East, headwater elevation of 2601.05 will create a split flow discharge of 186 cfs to exit the floodplain and discharge east into Wash A West (modeled through a lateral weir technique to determine the amount of flow exiting the model). A hypothetical roadway embankment has been modeled representing the future phases of this development, which is a proposed maintenance yard finished grade. This embankment is a modeling approach in order to drive up headwater to determine what is exiting through the lateral weir. The development encroaches into the floodplain, so bank protection will be installed along the floodplain boundary. The total scour depths vary from 3-5 feet, and a recommended minimum 5-foot toe down depth below the thalweg of the channel for all protection located within either of these washes will be required for erosion protection (See Total scour calculations attached in Appendix B).

WASH B (East & West):

Under post developed conditions, Wash B has been modeled using the computer software HEC-RAS v5.0, in order to determine the floodplain limits, depths and Erosion Hazard Setbacks. The site layout proposes development in the middle of the very wide and broad sheet flooding floodplain in

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Wash B dividing the flow (see Figure 5). This split flow condition resulted in 2 separate washes, Wash B East and Wash B West splitting flow around the proposed park, resulting in two separate models (see Appendix B for models). Each wash has 1 model for the complete reach, and will maintain the natural wash sand bottom (404 jurisdictional limits). At Wash B East, headwater elevation of 2626.3 will create a split flow discharge of 73.3 cfs to exit the floodplain and discharge east into Wash B West (modeled through a lateral weir technique and HY8 software to determine the amount of flow exiting the model). Upstream of the culverts, an artificial lateral weir was modeled mimicking the ground surface to determine how much flow is discharging to the 2-30" SRP's (Culvert Crossing 2) as the headwater depth increases at the 3-36" SRP's (Culvert Crossing 3).

At Wash B West, the discharge of 73.3 cfs will be combined with a stormwater discharging from 1st Avenue for a combined peak flow of 145.9 cfs for the remaining cross sections downstream and through the existing gunite channel. Both models started with the known water surface elevation of 2594.92, which is the "As-Built" headwater elevation at the entrance of the existing RCBC at 1st Avenue (see Figure 5). The total scour depths vary from 2-3 feet, and a recommended minimum 3-foot toe down depth below the thalweg of the channel for all protection located within either of these washes will be required for erosion protection (See Total scour calculations attached in Appendix B).

The results of the modeling provide water surface elevations that will be used to provide minimum finished floor elevations at least 1 foot above the calculated WSEL during production of the construction documents. The HEC-RAS output can be found within Appendix B, while the electronic data files are contained on a CD found at the back of this report.

DETENTION

This site is eligible for a variance/detention waiver on the basis that "the project is directly adjacent to a public wash and the outflow introduced by the development can be demonstrated not to affect the peak flow rate within said wash". A detention waiver request has been submitted to the town and is under consideration. Finally, rain water harvesting basins are proposed throughout the site to satisfy the Town's requirements.

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5.8 Maintenance and Inspection Plan

Per Section 2.4.1 of the TOV Drainage Criteria Manual all stormwater management structures (BMPs) are required to have routine maintenance and inspection. These structures should be inspected after every major storm event and cleared of all organic and inorganic debris. The following table below illustrates an inspection schedule along with the recommended corrective action to ensure adequate performance for the life of the stormwater management structures (BMPs). Finally, inspection of the stormdrain and maintenance records is to occur on an annual basis. Refer to Appendix B of this report for details and supporting calculations of hydraulic structures.

MAINTENANCE AND INSPECTION PLAN FOR STORMWATER MANAGEMENT STRUCTURES (BMPS)		
	INSPECTION SCHEDULE	**CORRECTIVE ACTIONS**
VEGETATED AREAS	Annually Early spring and after heavy rains	- Inspect all slopes and embankments, replant areas or with sparse growth as needed. - Armor rill erosion areas with riprap or divert the runoff to a stable area - Inspect and repair down-slope of all spreaders and turn-outs for erosion - Mow vegetation as specified for the area
OPEN CHANNELS, SWALES & DITCHES	Annually Early spring and late fall and after heavy rains	- Remove obstructions, sediments or debris from channels, swale and/or ditches - Repair any erosion of the channel/swale/ditch lining - Remove Woody Vegetation growing through riprap - Repair any slumping sideslopes or rill erosion - Repair riprap where underlying filter fabric orgravel is showing or if stones have dislodged - Mow vegetated Channels, swales, and ditches
CULVERTS	Annually Early spring and late fall and after heavy rains	- Remove accumulated sediments and debris at the inlet, outlet or within the conduit - Repair any erosion damage at the culvert's inlet and outlet - Remove all obstructions to flow - Repair riprap where underlying filter fabric or gravel is showing or if stones have dislodged at inlets and outlets
CATCHBASINS	Annually Early	- Remove accumulated sediments and debris from the

.	spring or as needed	bottom of the basin and the inlet grates. - Remove floating debris and oils (using oil absorptive pads) from any trap - Inspect or replace any first flush media when applicable
ROADWAYS & PARKING AREAS	Annually Early spring or as needed	- Clear and remove accumulated sand/sediment in parking lots and along roadways - Ensure that stormwater runoff is not impeded by false ditches of sediment in the shoulder - Repair any slumping sideslopes or rill erosion
DETENTION & WATER HARVESTING BASINS	Annually Early spring and after heavy rains	- Inspect the embankments for settlement, slope erosion, piping, and slumping - Inspect the outlet structure for obstructions and broken structures - Remove and dispose of sediments and debris within the control structures (Inlet and outlet) - Repair riprap where underlying filter fabric or gravel is showing or if stones have dislodged in sideslopes and spillway areas - Remove and dispose of sediments and debris within the impoundment area (basin) - Mow the embankments to control woody vegetation - Clean basin of debris, sediment, and hydrocarbons
PROPRIETARY DEVICES	As specified by manufacturer	- Contract with a third-party for inspection and maintenance - Follow manufacture's plan for cleaning of devices
OTHER PRACTICES	As specified for devices	- Contact the department for appropriate inspection and maintenance requirements for other drainage control and runoff treatment measures.

The annual inspection report shall contain the following summaries:

- A statement that no maintenance is needed at that time, or a list of repairs and work to be done to correct deficiencies to avoid potential problems. This work shall be followed with a letter written by an Arizona Registered Landscape Architect and Engineer verifying the date of maintenance activities and description that the recommended work has been satisfactorily completed and complies with the approved improvement plans. The responsible individual (architect, HOA, etc.) shall provide these maintenance records to the Town of Oro Valley on a yearly basis.

- Subject to Town Engineer's written approval, basin maintenance schedules may be modified following a three-year period of operation. Supporting documentation for such a request is to include, at a minimum: (1) past maintenance records and photographs spanning the previous three years (if applicable); (2) Current photographs of the basin and basin appurtenances; (3) a written explanation for the request to modify the maintenance requirements.

BASIN ACCESS AND MAINTENANCE

Drainage specifications relating to vegetation:

The Detention and Water Harvesting Basins throughout the project site will also provide 4-inches of water harvesting facilities. As a result, native vegetation has been planted in these areas. When conducting drainage maintenance, adhere to the following guidance as it pertains to vegetation in the basins:

1. Minimum disturbance shall occur within the mitigation area, with emphasis on promoting the reestablishment of the habitat. Primarily, maintenance shall be to maintain basin sediment traps to remove excess sediment. NO VEHICULAR TRAFFIC SHALL OCCUR OUTSIDE OF THE DEFINED ACCESS ROUTE OR SEDIMENT TRAP AREAS.

2. Vegetation shall remain in natural state. No pruning or alteration of vegetation in the basins shall occur to the vegetation unless specified within the report. Specifically, leave all native desert trees in their natural multi-trunk form, leave all native desert shrubs in their natural form and allow new native trees, shrubs, grasses and forbs to grow from seed in the basins and channel.

3. To prevent loss of vegetation due to spread of fire and extreme competition from nonnative species, remove nonnative invasive Buffelgrass, Johnson Grass, and Fountain Grass or any additional invasive nonnative plants as specified within the annual report if they appear in the basins or channel. NOTE: Ensure that

personnel conducting basin maintenance can distinguish between native grasses and non-native grasses. Remove only non-native invasive grasses.

4. If thinning of vegetation becomes necessary to maintain a discharge appropriate to a basin roughness coefficient , selectively trim vegetation in the following order:
   a.) First, remove any non-native trees that may have self-seeded in the basins. NOTE: Ensure that personnel conducting channel maintenance can distinguish between native trees and non-native trees. Remove only non-native trees.
   b.) Second, if additional trimming is needed to maintain basin conveyance, selectively trim low branches on native trees and thin the branches of native shrubs. Tree pruning shall be conducted by a Certified Arborist in coordination with the Landscape Architect of Record. This should only be done to achieve necessary discharge characteristics and should be kept to a minimum.
   c.) The irrigation system shall be programmed and maintained for a three-year period. The first year shall consist of regular watering periods to promote growth and establish the newly planted and salvaged vegetation. Tree stations shall be programmed to encourage deep watering and promote strong root systems. Shrubs and accent stations shall be programmed to promote and maintain growth. The second and third year, station programming shall be set to wean plant material from the irrigation system. Stations shall have longer durations between run times until plant material can sustain growth without supplemental irrigation. The irrigation controller shall be re-programmed every month to obtain this objective. The irrigation system shall be maintained as part of the overall maintenance program. Irrigation breaks and equipment failure shall be repaired until the end of the three-year establishment period. At the end of the three-year establishment

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period, the irrigation system shall be turned off at the ball-valve point of connection and the system abandoned.

Erosion Control

The erosion protection methods and structures proposed are riprap splash pads. The riprap and structure sizing was determined utilizing the AASHTO RDG Manual and the FHWA Hydraulic Engineering Circular No. 14 (HEC-14), 3rd edition Manual. Permanent erosion protection will be installed at the outlet of each hydraulic structure (culvert, channels, etc.). The culverts discharging directly into the Canada Del Oro Wash (CDO) are an exception to permanent erosion protection at the Outlet. Pima County Regional Flood Control does not want any permanent erosion protection as instructed in the CLOMR report.

Scour depth was determined utilizing procedures as outlined by the Standards Manual for Drainage Design and Floodplain Management in Tucson, Arizona (July 1998). The long term degradation was computed using the Level 1 analysis (Arizona State Standard 5-96) for all uncontrolled washes. For controlled washes (reservoir, sand or gravel pits, or hydraulic structures that significantly reduce the sediment supply creating a clear water downstream condition), the Equilibrium Slope Analysis is used to estimate long-term degradation without extensive data or modeling. The long term degradation is included within the total scour calculation attached in Appendix B. Riprap is required at all curb openings, scupper and culvert outlets (grouted Riprap for outlet velocities >10fps) and constructed channels. Under post developed conditions, permanent erosion protection will be installed at the outlet of each hydraulic structure (culverts, channels, sidewalk scuppers, etc...). Some of the approved erosion protection methods and structures used are riprap splash pads and preformed scour holes, concrete and/or gunite lining, revegetation and vegetative lining, stormwater management (detention) basins, and the preservation of natural channels. The riprap splash pads and hand-placed rock (D_{50}). See Figure 5 for some proposed erosion control locations and the Rip Rap Splash Pad worksheets attached in Appendix B.

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First Flush

First flush is being addressed in the storm drain systems with the installation of the Triton Catch Basin and Trench Drain Filter inserts produced by Revel Environmental Manufacturing Inc. The filter inserts are inserted into a catch basin, trench drain, and/or sidewalk scupper to remove sediment, oil, and debris from urban runoff.

Each major concentration point that discharges directly off the parking lot pavement surfaces will require this filter or a similar one to minimize non-point source pollutants that enter into the drainage ways and ultimately into the town's natural watercourses. These filters will capture and eliminate pollutants that adhere to the pavement surface like hydrocarbons and other contaminants such as metals, sand, silt and litter from stormwater runoff. The filter is a non-reactive High Impact Polystyrene plastic construction with U.V. inhibitors. The exterior side of the filter is constructed with a Type 304 Stainless Steel and can be easily removed for ease of maintenance. The media is non-hazardous, per EPA and OSHA standards, and is easily installed into new and existing catch basins, trench drains, and sidewalk scuppers. These filters also meet Best Available Technology (BAT) for use in stormwater Best Management Practices (BMP). More detailed information on the Triton Filter Inserts is provided in Appendix B.

First flush basin filter inserts are intended to reduce the amount of pavement surface contaminants discharged for the project site during the first half-inch depth of runoff over the entire parking lot paved surface. Regular Maintenance inspection and/or replacement will be required for any storm event exceeding the 10-year event. These first flush devices shall be inspected and maintained according to manufacture's recommendations. See Appendix B for manufacture specifications.

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6.0 CONCLUSION

This preliminary drainage study grading and site plan for the development of Nakoma Sky has been analyzed within this report and a workable drainage concept has been developed, that is compliant with Town of Oro Valley Standards. This concept will provide for the safe and efficient collection and conveyance of all on-site and off-site generated runoff. Development of this project, in accordance with the drainage concept, will not produce any adverse effects for adjacent or downstream property owners. However, deviation in construction from the improvement plans, which have been based upon this drainage report, may nullify the conclusions of this report, as may variations in climatic conditions, vegetation and erosion/deposition.

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7.0 REFERENCES

1. Highway Drainage Design Manual, Hydrology, FHW A-A293-281, March, 1993, prepared by Arizona Department of Transportation

2. Drainage Criteria Manual of The Town of Oro Valley, Pima County, Arizona, 2010 Edition, Prepared by DMA Engineering, LLC. And Town of Oro Valley Department of Public Works Staff, 11000 N. La Cañada Drive, Oro Valley, Arizona 85737

3. Oro Valley Town Code, Current through Ordinance (O)13-20, passed September 18, 2013, Code Publishing Company, Seattle, Washington.

4. FIRM Panel 04019C1090L, revision date: June 16, 2011, Federal Emergency Management Administration (FEMA) Flood Insurance Rate Map.

5. AutoCAD, v2017 Civil 3D, by AutoDesk, 111 McInnis Parkway, San Rafael, CA 94903

6. HY-8, v7.4, July 28, 2016, Federal Highway Administration, Department of Transportation, 400 Seventh St., S.W. Washington, D.C. 20590.

7. FlowMaster, v8i, Bentley Systems, Inc., 27 Siemons Company Drive, Watertown, Ct. 06795.

8. StormCAD, v5.6, Bentley Systems, Inc., 27 Siemons Company Drive, Watertown, Ct. 06795.

9. HY-22, Urban Drainage Design Program, by the Federal Highway Administration, Third Edition, 2013.

10. HEC-RAS River Analysis System, Version 5.0.3, US Army Corps of Engineers Hydrologic Engineering Center: 609 Second Street; Davis, CA 95616.

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LIMITATIONS

The above services consist of professional opinions and conclusions by a consulting civil engineer. The only warranty or guarantee made by the Consultant, in connection with the services performed for this project, is that such services are performed with the care and skill ordinarily exercised by members of the profession practicing under similar conditions, at the same time, and in the same or a similar locality. No other warranty, expressed or implied, is made or intended by rendering such consulting services, nor by furnishing written reports of the findings.

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Figure 3 –Watershed Map (1 pocket)

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Figure 4 – Pre-Developed Watershed Map (1 pocket)

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Figure 5 – Post-Development Watershed Map (2 pockets, Sheets 1-2)

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Data CD (1 pocket)

APPENDIX A
HYDROLOGIC COMPUTATIONS

NOAA 14 PRECIPITATION

NOAA Atlas 14, Volume 1, Version 5
Location name: Oro Valley, Arizona, US*
Coordinates: 32.4109, -110.9569
Elevation: 2646ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval(years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.247 (0.218-0.282)	0.319 (0.283-0.365)	0.423 (0.371-0.481)	0.501 (0.438-0.569)	0.607 (0.524-0.687)	0.687 (0.586-0.781)	0.770 (0.647-0.877)	0.854 (0.706-0.977)	0.965 (0.779-1.11)	1.05 (0.832-1.22)
10-min	0.376 (0.332-0.430)	0.485 (0.430-0.556)	0.643 (0.565-0.732)	0.762 (0.666-0.866)	0.923 (0.797-1.05)	1.05 (0.892-1.19)	1.17 (0.985-1.34)	1.30 (1.07-1.49)	1.47 (1.19-1.69)	1.60 (1.27-1.86)
15-min	0.466 (0.412-0.533)	0.602 (0.533-0.689)	0.797 (0.700-0.907)	0.944 (0.826-1.07)	1.14 (0.988-1.30)	1.30 (1.11-1.47)	1.45 (1.22-1.66)	1.61 (1.33-1.84)	1.82 (1.47-2.10)	1.98 (1.57-2.30)
30-min	0.627 (0.554-0.718)	0.810 (0.718-0.927)	1.07 (0.943-1.22)	1.27 (1.11-1.45)	1.54 (1.33-1.75)	1.75 (1.49-1.98)	1.96 (1.65-2.23)	2.17 (1.79-2.48)	2.45 (1.98-2.83)	2.67 (2.11-3.10)
60-min	0.776 (0.686-0.888)	1.00 (0.889-1.15)	1.33 (1.17-1.51)	1.57 (1.38-1.79)	1.91 (1.65-2.16)	2.16 (1.84-2.46)	2.42 (2.04-2.76)	2.68 (2.22-3.07)	3.03 (2.45-3.50)	3.30 (2.62-3.84)
2-hr	0.900 (0.799-1.02)	1.15 (1.02-1.31)	1.50 (1.33-1.70)	1.77 (1.55-2.00)	2.14 (1.87-2.42)	2.44 (2.09-2.74)	2.74 (2.32-3.09)	3.04 (2.53-3.45)	3.46 (2.81-3.95)	3.79 (3.01-4.37)
3-hr	0.955 (0.853-1.08)	1.21 (1.08-1.37)	1.56 (1.39-1.77)	1.84 (1.62-2.08)	2.23 (1.95-2.52)	2.54 (2.18-2.87)	2.86 (2.42-3.25)	3.20 (2.66-3.65)	3.68 (2.97-4.23)	4.06 (3.19-4.71)
6-hr	1.11 (0.987-1.25)	1.39 (1.24-1.57)	1.75 (1.56-1.98)	2.05 (1.81-2.31)	2.47 (2.16-2.77)	2.80 (2.42-3.15)	3.16 (2.68-3.56)	3.52 (2.94-3.99)	4.04 (3.27-4.60)	4.45 (3.53-5.12)
12-hr	1.26 (1.14-1.41)	1.58 (1.42-1.76)	1.97 (1.77-2.21)	2.29 (2.05-2.56)	2.74 (2.42-3.05)	3.09 (2.70-3.44)	3.45 (2.97-3.86)	3.83 (3.24-4.31)	4.34 (3.59-4.94)	4.75 (3.86-5.45)
24-hr	1.48 (1.35-1.63)	1.85 (1.69-2.04)	2.32 (2.11-2.56)	2.70 (2.45-2.98)	3.23 (2.91-3.58)	3.65 (3.26-4.05)	4.09 (3.62-4.56)	4.55 (3.97-5.10)	5.18 (4.44-5.87)	5.67 (4.80-6.48)
2-day	1.64 (1.50-1.81)	2.06 (1.89-2.27)	2.59 (2.37-2.85)	3.03 (2.76-3.33)	3.64 (3.28-4.00)	4.12 (3.68-4.55)	4.62 (4.09-5.14)	5.15 (4.49-5.76)	5.87 (5.03-6.65)	6.43 (5.43-7.38)
3-day	1.75 (1.60-1.93)	2.19 (2.00-2.41)	2.78 (2.53-3.06)	3.26 (2.96-3.59)	3.95 (3.55-4.35)	4.51 (4.01-4.99)	5.10 (4.49-5.68)	5.73 (4.97-6.43)	6.63 (5.61-7.52)	7.35 (6.11-8.44)
4-day	1.85 (1.70-2.05)	2.33 (2.12-2.56)	2.96 (2.69-3.26)	3.49 (3.16-3.84)	4.26 (3.82-4.70)	4.90 (4.34-5.42)	5.59 (4.88-6.22)	6.32 (5.44-7.10)	7.38 (6.19-8.40)	8.26 (6.78-9.51)
7-day	2.14 (1.94-2.36)	2.68 (2.44-2.96)	3.42 (3.10-3.78)	4.05 (3.66-4.48)	4.99 (4.45-5.52)	5.76 (5.08-6.42)	6.62 (5.76-7.43)	7.55 (6.46-8.55)	8.90 (7.44-10.2)	10.0 (8.22-11.7)
10-day	2.39 (2.18-2.64)	3.00 (2.72-3.30)	3.80 (3.45-4.19)	4.49 (4.06-4.96)	5.49 (4.91-6.07)	6.33 (5.59-7.01)	7.23 (6.31-8.07)	8.21 (7.05-9.25)	9.63 (8.06-11.0)	10.8 (8.87-12.5)
20-day	3.12 (2.84-3.43)	3.91 (3.57-4.30)	4.95 (4.51-5.46)	5.82 (5.27-6.41)	7.04 (6.32-7.77)	8.03 (7.14-8.89)	9.08 (7.98-10.1)	10.2 (8.85-11.5)	11.8 (9.99-13.4)	13.0 (10.9-15.0)
30-day	3.79 (3.49-4.14)	4.75 (4.36-5.17)	5.93 (5.43-6.46)	6.89 (6.29-7.50)	8.20 (7.43-8.95)	9.23 (8.30-10.1)	10.3 (9.18-11.3)	11.4 (10.1-12.7)	12.9 (11.2-14.5)	14.1 (12.0-16.0)
45-day	4.61 (4.25-5.00)	5.76 (5.31-6.27)	7.13 (6.56-7.75)	8.18 (7.52-8.90)	9.57 (8.74-10.4)	10.6 (9.64-11.6)	11.7 (10.5-12.8)	12.7 (11.4-14.0)	14.1 (12.4-15.7)	15.1 (13.2-17.0)
60-day	5.20 (4.79-5.65)	6.50 (5.98-7.08)	8.05 (7.40-8.75)	9.24 (8.48-10.0)	10.8 (9.87-11.8)	12.0 (10.9-13.1)	13.2 (11.9-14.5)	14.3 (12.8-15.8)	15.9 (14.0-17.7)	17.0 (14.9-19.2)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

POST-DEVELOPED HYDROLOGIC COMPUTATIONS
(RATIONAL WORKSHEETS)

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$. ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	410.0
D Height, feet =	10.0
Kb =	0.040

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.1	2	0.08	0.04	128.8	0.083	5.00	0.072	0.57
	5	0.08	0.04	128.8	0.083	6.00	0.067	0.81
	10	0.08	0.04	128.8	0.083	7.10	0.063	1.01
	50	0.08	0.04	128.8	0.083	8.90	0.058	1.27
	100	0.08	0.04	128.8	0.083	9.90	0.055	1.39

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	1.87
Nat./Rural	A3 =	0.00
	A, acres =	**1.87**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.87	1.87	1.87	1.87	1.87
Discharge, Q	**5.0**	**7.1**	**9.2**	**13.1**	**15.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	215.0
D Height, feet =	55.0
Kb =	0.200

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.2	2	0.04	0.20	1350.7	0.083	5.00	0.058	1.26
	5	0.04	0.20	1350.7	0.083	6.00	0.054	1.45
	10	0.04	0.20	1350.7	0.083	7.10	0.051	1.62
	50	0.04	0.20	1350.7	0.083	8.90	0.046	1.83
	100	0.04	0.20	1350.7	0.083	9.90	0.045	1.92

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.37
	A, acres =	**0.37**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.37	0.37	0.37	0.37	0.37
Discharge, Q	**0.7**	**1.1**	**1.5**	**2.3**	**2.7**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	255.0
D Height, feet =	12.8
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.3	2	0.05	0.10	264.0	0.083	5.00	0.073	0.51
	5	0.05	0.10	264.0	0.083	6.00	0.068	0.75
	10	0.05	0.10	264.0	0.083	7.10	0.064	0.96
	50	0.05	0.10	264.0	0.083	8.90	0.059	1.22
	100	0.05	0.10	264.0	0.083	9.90	0.056	1.34

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.60
	A, acres =	**0.60**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.60	0.60	0.60	0.60	0.60
Discharge, Q	**1.1**	**1.7**	**2.5**	**3.8**	**4.4**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$. ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	300.0
D Height, feet =	30.0
Kb =	0.200

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.4	2	0.06	0.20	528.0	0.083	5.00	0.091	0.42
	5	0.06	0.20	528.0	0.083	6.00	0.085	0.12
	10	0.06	0.20	528.0	0.083	7.10	0.080	0.15
	50	0.06	0.20	528.0	0.083	8.90	0.073	0.48
	100	0.06	0.20	528.0	0.083	9.90	0.071	0.62

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	1.08
	A, acres =	**1.08**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.08	1.08	1.08	1.08	1.08
Discharge, Q	**1.9**	**3.1**	**4.4**	**6.8**	**7.9**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	280.0
D Height, feet =	1.5
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.5	2	0.05	0.03	28.3	0.083	5.00	0.074	0.44
	5	0.05	0.03	28.3	0.083	6.00	0.069	0.69
	10	0.05	0.03	28.3	0.083	7.10	0.065	0.90
	50	0.05	0.03	28.3	0.083	8.90	0.060	1.17
	100	0.05	0.03	28.3	0.083	9.90	0.057	1.29

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.92
Nat./Rural	A3 =	0.00
	A, acres =	**0.92**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.92	0.92	0.92	0.92	0.92
Discharge, Q	**2.5**	**3.5**	**4.5**	**6.5**	**7.4**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	350.0
D Height, feet =	1.5
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.5a	2	0.07	0.03	22.6	0.083	5.00	0.089	0.30
	5	0.07	0.03	22.6	0.083	6.00	0.083	0.00
	10	0.07	0.03	22.6	0.083	7.10	0.078	0.26
	50	0.07	0.03	22.6	0.083	8.90	0.071	0.58
	100	0.07	0.03	22.6	0.083	9.90	0.069	0.72

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.78	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**0.78**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.78	0.78	0.78	0.78	0.78
Discharge, Q	**2.1**	**2.9**	**3.8**	**5.5**	**6.3**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	275.0
D Height, feet =	10.5
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.6	2	0.05	0.10	201.6	0.083	5.00	0.082	0.04
	5	0.05	0.10	201.6	0.083	6.00	0.077	0.31
	10	0.05	0.10	201.6	0.083	7.10	0.072	0.55
	50	0.05	0.10	201.6	0.083	8.90	0.066	0.85
	100	0.05	0.10	201.6	0.083	9.90	0.063	0.98

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	1.00
	A, acres =	**1.00**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.00	1.00	1.00	1.00	1.00
Discharge, Q	**1.8**	**2.9**	**4.1**	**6.3**	**7.3**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	860.0
D Height, feet =	45.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.7	2	0.16	0.03	276.3	0.083	5.00	0.064	0.94
	5	0.16	0.03	276.3	0.083	6.00	0.060	1.16
	10	0.16	0.03	276.3	0.083	7.10	0.056	1.34
	50	0.16	0.03	276.3	0.083	8.90	0.052	1.57
	100	0.16	0.03	276.3	0.083	9.90	0.050	1.67

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	2.68
Nat./Rural	A3 =	2.68
	A, acres =	**5.36**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C[2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.45	0.56	0.64	0.75	0.78
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	5.36	5.36	5.36	5.36	5.36
Discharge, Q	**12.1**	**17.8**	**24.2**	**35.8**	**41.1**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$. ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	860.0
D Height, feet =	45.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.8	2	0.16	0.03	276.3	0.083	5.00	0.064	0.94
	5	0.16	0.03	276.3	0.083	6.00	0.060	1.16
	10	0.16	0.03	276.3	0.083	7.10	0.056	1.34
	50	0.16	0.03	276.3	0.083	8.90	0.052	1.57
	100	0.16	0.03	276.3	0.083	9.90	0.050	1.67

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	1.44
Nat./Rural	A3 =	0.00
	A, acres =	**1.44**

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.44	1.44	1.44	1.44	1.44
Discharge, Q	**3.9**	**5.4**	**7.1**	**10.1**	**11.5**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	543.0
D Height, feet =	59.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.9	2	0.10	0.03	573.7	0.083	5.00	0.041	2.12
	5	0.10	0.03	573.7	0.083	6.00	0.038	2.25
	10	0.10	0.03	573.7	0.083	7.10	0.036	2.37
	50	0.10	0.03	573.7	0.083	8.90	0.033	2.52
	100	0.10	0.03	573.7	0.083	9.90	0.031	2.58

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.22
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	1.03
	A, acres =	**1.25**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.45	0.55	0.64	0.75	0.78
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.25	1.25	1.25	1.25	1.25
Discharge, Q	**2.8**	**4.1**	**5.6**	**8.3**	**9.6**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$. ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	120.0
D Height, feet =	0.5
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.9a	2	0.02	0.03	22.0	0.083	5.00	0.053	1.52
	5	0.02	0.03	22.0	0.083	6.00	0.049	1.70
	10	0.02	0.03	22.0	0.083	7.10	0.046	1.85
	50	0.02	0.03	22.0	0.083	8.90	0.042	2.04
	100	0.02	0.03	22.0	0.083	9.90	0.041	2.12

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.22	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**0.22**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.85	0.87	0.90	0.93	0.94
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.22	0.22	0.22	0.22	0.22
Discharge, Q	**0.9**	**1.1**	**1.4**	**1.8**	**2.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	300.0
D Height, feet =	1.5
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A1.10	2	0.06	0.03	26.4	0.083	5.00	0.078	0.23
	5	0.06	0.03	26.4	0.083	6.00	0.073	0.49
	10	0.06	0.03	26.4	0.083	7.10	0.069	0.72
	50	0.06	0.03	26.4	0.083	8.90	0.063	1.00
	100	0.06	0.03	26.4	0.083	9.90	0.061	1.12

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	1.09
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.00
	A, acres =	**1.09**

Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]				
1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]				
0.85	0.87	0.9	0.93	0.94
0.54	0.63	0.69	0.79	0.81
0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.85	0.87	0.90	0.93	0.94
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.09	1.09	1.09	1.09	1.09
Discharge, Q	**4.6**	**5.7**	**7.0**	**9.0**	**10.1**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	310.0
D Height, feet =	1.5
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A2	2	0.06	0.03	25.5	0.083	5.00	0.081	0.12
	5	0.06	0.03	25.5	0.083	6.00	0.075	0.39
	10	0.06	0.03	25.5	0.083	7.10	0.071	0.62
	50	0.06	0.03	25.5	0.083	8.90	0.065	0.91
	100	0.06	0.03	25.5	0.083	9.90	0.062	1.04

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C[2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	1.20	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**1.20**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.20	1.20	1.20	1.20	1.20
Discharge, Q	**3.2**	**4.5**	**5.9**	**8.4**	**9.6**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$. ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	410.0
D Height, feet =	2.1
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A3	2	0.08	0.03	26.4	0.083	5.00	0.092	0.44
	5	0.08	0.03	26.4	0.083	6.00	0.086	0.13
	10	0.08	0.03	26.4	0.083	7.10	0.080	0.13
	50	0.08	0.03	26.4	0.083	8.90	0.074	0.47
	100	0.08	0.03	26.4	0.083	9.90	0.071	0.61

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	2.88
Nat./Rural	A3 =	0.00
	A, acres =	**2.88**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C[2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	2.88	2.88	2.88	2.88	2.88
Discharge, Q	**7.8**	**10.9**	**14.1**	**20.2**	**23.1**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	315.0
D Height, feet =	1.6
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A4	2	0.06	0.03	26.8	0.083	5.00	0.080	0.15
	5	0.06	0.03	26.8	0.083	6.00	0.075	0.42
	10	0.06	0.03	26.8	0.083	7.10	0.070	0.65
	50	0.06	0.03	26.8	0.083	8.90	0.064	0.94
	100	0.06	0.03	26.8	0.083	9.90	0.062	1.06

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.96
Nat./Rural	A3 =	0.00
	A, acres =	**0.96**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.96	0.96	0.96	0.96	0.96
Discharge, Q	**2.6**	**3.6**	**4.7**	**6.7**	**7.7**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	315.0
D Height, feet =	1.6
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A5	2	0.06	0.03	26.8	0.083	5.00	0.080	0.15
	5	0.06	0.03	26.8	0.083	6.00	0.075	0.42
	10	0.06	0.03	26.8	0.083	7.10	0.070	0.65
	50	0.06	0.03	26.8	0.083	8.90	0.064	0.94
	100	0.06	0.03	26.8	0.083	9.90	0.062	1.06

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	1.62	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**1.62**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.62	1.62	1.62	1.62	1.62
Discharge, Q	**4.4**	**6.1**	**7.9**	**11.4**	**13.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$. ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	375.0
D Height, feet =	1.9
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A6	2	0.07	0.03	26.8	0.083	5.00	0.087	0.22
	5	0.07	0.03	26.8	0.083	6.00	0.082	0.07
	10	0.07	0.03	26.8	0.083	7.10	0.076	0.33
	50	0.07	0.03	26.8	0.083	8.90	0.070	0.64
	100	0.07	0.03	26.8	0.083	9.90	0.067	0.78

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.89	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**0.89**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.89	0.89	0.89	0.89	0.89
Discharge, Q	**2.4**	**3.4**	**4.4**	**6.3**	**7.1**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	850.0
D Height, feet =	53.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A7	2	0.16	0.10	329.2	0.083	5.00	0.124	2.06
	5	0.16	0.10	329.2	0.083	6.00	0.116	1.65
	10	0.16	0.10	329.2	0.083	7.10	0.109	1.29
	50	0.16	0.10	329.2	0.083	8.90	0.100	0.84
	100	0.16	0.10	329.2	0.083	9.90	0.096	0.64

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	13.17
	A, acres =	**13.17**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	13.17	13.17	13.17	13.17	13.17
Discharge, Q	**23.7**	**37.9**	**54.2**	**83.2**	**96.5**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	600.0
D Height, feet =	50.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A7.1	2	0.11	0.10	440.0	0.083	5.00	0.095	0.62
	5	0.11	0.10	440.0	0.083	6.00	0.089	0.30
	10	0.11	0.10	440.0	0.083	7.10	0.084	0.03
	50	0.11	0.10	440.0	0.083	8.90	0.077	0.32
	100	0.11	0.10	440.0	0.083	9.90	0.074	0.47

Step 2. Compute Rational Method Discharge, Q

$Q = C\ i\ A$

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	3.13
	A, acres =	**3.13**

Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]				
1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]				
0.85	0.87	0.9	0.93	0.94
0.54	0.63	0.69	0.79	0.81
0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	3.13	3.13	3.13	3.13	3.13
Discharge, Q	**5.6**	**9.0**	**12.9**	**19.8**	**22.9**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	200.0
D Height, feet =	10.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A7.2	2	0.04	0.10	264.0	0.083	5.00	0.065	0.92
	5	0.04	0.10	264.0	0.083	6.00	0.060	1.14
	10	0.04	0.10	264.0	0.083	7.10	0.056	1.33
	50	0.04	0.10	264.0	0.083	8.90	0.052	1.56
	100	0.04	0.10	264.0	0.083	9.90	0.050	1.66

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.93	0.36	0.48	0.58	0.71	0.74
	A, acres =	**0.93**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.93	0.93	0.93	0.93	0.93
Discharge, Q	**1.7**	**2.7**	**3.8**	**5.9**	**6.8**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	275.0
D Height, feet =	10.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A7.3	2	0.05	0.10	192.0	0.083	5.00	0.084	0.03
	5	0.05	0.10	192.0	0.083	6.00	0.078	0.25
	10	0.05	0.10	192.0	0.083	7.10	0.073	0.49
	50	0.05	0.10	192.0	0.083	8.90	0.067	0.80
	100	0.05	0.10	192.0	0.083	9.90	0.064	0.93

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.70
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.00
	A, acres =	**0.70**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C[2]	0.85	0.87	0.9	0.93	0.94
	0.54	0.63	0.69	0.79	0.81
	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.85	0.87	0.90	0.93	0.94
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.70	0.70	0.70	0.70	0.70
Discharge, Q	**3.0**	**3.7**	**4.5**	**5.8**	**6.5**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	470.0
D Height, feet =	5.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A8	2	0.09	0.03	56.2	0.083	5.00	0.078	0.26
	5	0.09	0.03	56.2	0.083	6.00	0.073	0.52
	10	0.09	0.03	56.2	0.083	7.10	0.068	0.75
	50	0.09	0.03	56.2	0.083	8.90	0.062	1.03
	100	0.09	0.03	56.2	0.083	9.90	0.060	1.15

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.95
	A, acres =	**0.95**

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.95	0.95	0.95	0.95	0.95
Discharge, Q	**1.7**	**2.7**	**3.9**	**6.0**	**7.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	925.0
D Height, feet =	18.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
A9	2	0.18	0.03	102.7	0.083	5.00	0.090	0.37
	5	0.18	0.03	102.7	0.083	6.00	0.084	0.07
	10	0.18	0.03	102.7	0.083	7.10	0.079	0.19
	50	0.18	0.03	102.7	0.083	8.90	0.073	0.52
	100	0.18	0.03	102.7	0.083	9.90	0.070	0.66

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	1.00
Nat./Rural	A3 =	3.31
	A, acres =	**4.31**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C[2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.40	0.51	0.61	0.73	0.76
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	4.31	4.31	4.31	4.31	4.31
Discharge, Q	**8.7**	**13.3**	**18.5**	**27.9**	**32.3**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	6390.0
D Height, feet =	160.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B	2	1.21	0.10	132.2	0.650	1.90	0.653	0.14
	5	1.21	0.10	132.2	0.600	2.30	0.607	0.36
	10	1.21	0.10	132.2	0.550	2.90	0.556	0.30
	50	1.21	0.10	132.2	0.500	3.80	0.502	0.08
	100	1.21	0.10	132.2	0.500	4.00	0.492	0.40

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	102.84
	A, acres =	**102.84**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	1.90	2.30	2.90	3.80	4.00
Area, A	102.84	102.84	102.84	102.84	102.84
Discharge, Q	**70.3**	**113.5**	**173.0**	**277.5**	**304.4**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	2435.0
D Height, feet =	116.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B1	2	0.46	0.10	251.5	0.300	2.60	0.293	0.35
	5	0.46	0.10	251.5	0.300	3.20	0.271	1.46
	10	0.46	0.10	251.5	0.250	4.80	0.232	0.89
	50	0.46	0.10	251.5	0.200	6.80	0.203	0.17
	100	0.46	0.10	251.5	0.200	7.10	0.200	0.00

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
Land Use	Area (acres)		Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	21.26	0.36	0.48	0.58	0.71	0.74
	A, acres =	**21.26**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	2.60	3.20	4.80	6.80	7.10
Area, A	21.26	21.26	21.26	21.26	21.26
Discharge, Q	**19.9**	**32.7**	**59.2**	**102.6**	**111.7**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	6390.0
D Height, feet =	160.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B2	2	1.21	0.10	132.2	0.650	1.90	0.653	0.14
	5	1.21	0.10	132.2	0.600	2.30	0.607	0.36
	10	1.21	0.10	132.2	0.550	2.90	0.556	0.30
	50	1.21	0.10	132.2	0.500	3.80	0.502	0.08
	100	1.21	0.10	132.2	0.500	4.00	0.492	0.40

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	81.29
	A, acres =	**81.29**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	1.90	2.30	2.90	3.80	4.00
Area, A	81.29	81.29	81.29	81.29	81.29
Discharge, Q	**55.6**	**89.7**	**136.7**	**219.3**	**240.6**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	5740.0
D Height, feet =	140.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B3	2	1.09	0.10	128.8	0.650	1.90	0.624	1.31
	5	1.09	0.10	128.8	0.600	2.30	0.580	0.99
	10	1.09	0.10	128.8	0.550	2.90	0.531	0.94
	50	1.09	0.10	128.8	0.500	3.80	0.479	1.03
	100	1.09	0.10	128.8	0.500	4.00	0.470	1.49

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	76.93	0.36	0.48	0.58	0.71	0.74
	A, acres =	**76.93**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	1.90	2.30	2.90	3.80	4.00
Area, A	76.93	76.93	76.93	76.93	76.93
Discharge, Q	**52.6**	**84.9**	**129.4**	**207.6**	**227.7**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	515.0
D Height, feet =	16.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B4	2	0.10	0.03	164.0	0.083	5.00	0.058	1.23
	5	0.10	0.03	164.0	0.083	6.00	0.054	1.43
	10	0.10	0.03	164.0	0.083	7.10	0.051	1.60
	50	0.10	0.03	164.0	0.083	8.90	0.047	1.81
	100	0.10	0.03	164.0	0.083	9.90	0.045	1.90

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.75
Nat./Rural	A3 =	0.00
	A, acres =	**0.75**

	Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]	1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C[2]					
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.75	0.75	0.75	0.75	0.75
Discharge, Q	**2.0**	**2.8**	**3.7**	**5.3**	**6.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	515.0
D Height, feet =	22.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B5	2	0.10	0.03	225.6	0.083	5.00	0.053	1.51
	5	0.10	0.03	225.6	0.083	6.00	0.049	1.68
	10	0.10	0.03	225.6	0.083	7.10	0.046	1.84
	50	0.10	0.03	225.6	0.083	8.90	0.042	2.03
	100	0.10	0.03	225.6	0.083	9.90	0.041	2.11

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.54
Nat./Rural	A3 =	0.00
	A, acres =	**0.54**

Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]				
1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C[2]				
0.85	0.87	0.9	0.93	0.94
0.54	0.63	0.69	0.79	0.81
0.36	0.48	0.58	0.71	0.74

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.54	0.54	0.54	0.54	0.54
Discharge, Q	**1.5**	**2.0**	**2.6**	**3.8**	**4.3**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	450.0
D Height, feet =	15.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B6	2	0.09	0.03	176.0	0.083	5.00	0.053	1.48
	5	0.09	0.03	176.0	0.083	6.00	0.050	1.66
	10	0.09	0.03	176.0	0.083	7.10	0.047	1.81
	50	0.09	0.03	176.0	0.083	8.90	0.043	2.01
	100	0.09	0.03	176.0	0.083	9.90	0.041	2.09

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.52	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**0.52**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.54	0.63	0.69	0.79	0.81
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.52	0.52	0.52	0.52	0.52
Discharge, Q	**1.4**	**2.0**	**2.5**	**3.7**	**4.2**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	1075.0
D Height, feet =	68.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
B7	2	0.20	0.10	334.0	0.100	4.80	0.141	2.06
	5	0.20	0.10	334.0	0.100	5.60	0.133	1.66
	10	0.20	0.10	334.0	0.100	6.80	0.124	1.19
	50	0.20	0.10	334.0	0.100	7.90	0.117	0.85
	100	0.20	0.10	334.0	0.100	8.90	0.112	0.59

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	4.55	0.36	0.48	0.58	0.71	0.74
	A, acres =	**4.55**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	4.80	5.60	6.80	7.90	8.90
Area, A	4.55	4.55	4.55	4.55	4.55
Discharge, Q	**7.9**	**12.2**	**17.9**	**25.5**	**30.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	1288.0
D Height, feet =	83.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C	2	0.24	0.10	340.2	0.150	4.00	0.165	0.74
	5	0.24	0.10	340.2	0.150	5.00	0.151	0.07
	10	0.24	0.10	340.2	0.150	5.80	0.143	0.35
	50	0.24	0.10	340.2	0.150	7.20	0.132	0.91
	100	0.24	0.10	340.2	0.150	7.90	0.127	1.14

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	14.67	0.36	0.48	0.58	0.71	0.74
	A, acres =	**14.67**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	4.00	5.00	5.80	7.20	7.90
Area, A	14.67	14.67	14.67	14.67	14.67
Discharge, Q	**21.1**	**35.2**	**49.3**	**75.0**	**85.8**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	660.0
D Height, feet =	17.0
Kb =	0.100

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C1	2	0.13	0.10	136.0	0.150	4.80	0.146	0.19
	5	0.13	0.10	136.0	0.150	5.60	0.138	0.60
	10	0.13	0.10	136.0	0.150	6.80	0.128	1.09
	50	0.13	0.10	136.0	0.150	7.90	0.121	1.45
	100	0.13	0.10	136.0	0.100	8.90	0.116	0.78

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.00	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	9.36	0.36	0.48	0.58	0.71	0.74
	A, acres =	**9.36**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	4.80	5.60	6.80	7.90	8.90
Area, A	9.36	9.36	9.36	9.36	9.36
Discharge, Q	**16.2**	**25.2**	**36.9**	**52.5**	**61.6**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	350.0
D Height, feet =	10.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C2	2	0.07	0.03	150.9	0.083	5.00	0.049	1.68
	5	0.07	0.03	150.9	0.083	6.00	0.046	1.85
	10	0.07	0.03	150.9	0.083	7.10	0.043	1.99
	50	0.07	0.03	150.9	0.083	8.90	0.040	2.17
	100	0.07	0.03	150.9	0.083	9.90	0.038	2.25

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C [2]				
Comm./Ind.	A1 =	0.42	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**0.42**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.85	0.87	0.90	0.93	0.94
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.42	0.42	0.42	0.42	0.42
Discharge, Q	**1.8**	**2.2**	**2.7**	**3.5**	**3.9**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	430.0
D Height, feet =	10.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C3	2	0.08	0.03	122.8	0.083	5.00	0.058	1.23
	5	0.08	0.03	122.8	0.083	6.00	0.054	1.43
	10	0.08	0.03	122.8	0.083	7.10	0.051	1.60
	50	0.08	0.03	122.8	0.083	8.90	0.047	1.81
	100	0.08	0.03	122.8	0.083	9.90	0.045	1.90

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)		Q2	Q5	Q10	Q50	Q100
			1-hr. Precipitation - P1, (in.)[2]				
			1.15	1.51	1.79	2.46	2.76
			Runoff Coefficient – C[2]				
Comm./Ind.	A1 =	1.03	0.85	0.87	0.9	0.93	0.94
Mod. Urban	A2 =	0.00	0.54	0.63	0.69	0.79	0.81
Nat./Rural	A3 =	0.00	0.36	0.48	0.58	0.71	0.74
	A, acres =	**1.03**					

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.85	0.87	0.90	0.93	0.94
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	1.03	1.03	1.03	1.03	1.03
Discharge, Q	**4.4**	**5.4**	**6.6**	**8.5**	**9.6**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	430.0
D Height, feet =	10.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C4	2	0.08	0.03	122.8	0.083	5.00	0.058	1.23
	5	0.08	0.03	122.8	0.083	6.00	0.054	1.43
	10	0.08	0.03	122.8	0.083	7.10	0.051	1.60
	50	0.08	0.03	122.8	0.083	8.90	0.047	1.81
	100	0.08	0.03	122.8	0.083	9.90	0.045	1.90

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.45
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.00
	A, acres =	**0.45**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.85	0.87	0.90	0.93	0.94
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.45	0.45	0.45	0.45	0.45
Discharge, Q	**1.9**	**2.3**	**2.9**	**3.7**	**4.2**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	340.0
D Height, feet =	8.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C5	2	0.06	0.03	124.2	0.083	5.00	0.052	1.57
	5	0.06	0.03	124.2	0.083	6.00	0.048	1.74
	10	0.06	0.03	124.2	0.083	7.10	0.045	1.89
	50	0.06	0.03	124.2	0.083	8.90	0.042	2.07
	100	0.06	0.03	124.2	0.083	9.90	0.040	2.16

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

	Q2	Q5	Q10	Q50	Q100
	1-hr. Precipitation - P1, (in.)[2]				
	1.15	1.51	1.79	2.46	2.76
Land Use	Runoff Coefficient – C [2]				
Comm./Ind.	0.85	0.87	0.9	0.93	0.94
Mod. Urban	0.54	0.63	0.69	0.79	0.81
Nat./Rural	0.36	0.48	0.58	0.71	0.74

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.82
	A, acres =	**0.82**

	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.82	0.82	0.82	0.82	0.82
Discharge, Q	**1.5**	**2.4**	**3.4**	**5.2**	**6.0**

[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

Step 1. Compute Time of Concentration, Tc

$Tc = 11.4\ L^{0.5}\ Kb^{0.52}\ S^{-.31}\ i^{-0.38}$ ADOT Eqn. 2.2

where:

Tc = Time of Concentration, hrs
L = Length of the longest flow path, miles
Kb = Watershed resistance coefficient, per ADOT manual[1]
S = Slope of the longest flow path, ft/mile
i = Average rainfall intensity, inches/hour

Length, feet =	165.0
D Height, feet =	4.0
Kb =	0.025

Concentration Point	Event, year	Length, mi	Kb	S, ft/mi	Trial Tc, hr (estimate)	i, in/hr (from IDF)[2]	Calculated Tc, hr (from equation)	Tc %-ile Difference
C6	2	0.03	0.03	128.0	0.083	5.00	0.036	2.37
	5	0.03	0.03	128.0	0.083	6.00	0.033	2.49
	10	0.03	0.03	128.0	0.083	7.10	0.031	2.59
	50	0.03	0.03	128.0	0.083	8.90	0.029	2.72
	100	0.03	0.03	128.0	0.083	9.90	0.028	2.77

Step 2. Compute Rational Method Discharge, Q

Q= C i A

where:

C = Runoff Coefficient
i = Average rainfall intensity, inches/hour
A = Drainage Area of watershed, acres

Land Use	Area (acres)	
Comm./Ind.	A1 =	0.00
Mod. Urban	A2 =	0.00
Nat./Rural	A3 =	0.28
	A, acres =	**0.28**

Q2	Q5	Q10	Q50	Q100
1-hr. Precipitation - P1, (in.)[2]				
1.15	1.51	1.79	2.46	2.76
Runoff Coefficient – C [2]				
0.85	0.87	0.9	0.93	0.94
0.54	0.63	0.69	0.79	0.81
0.36	0.48	0.58	0.71	0.74

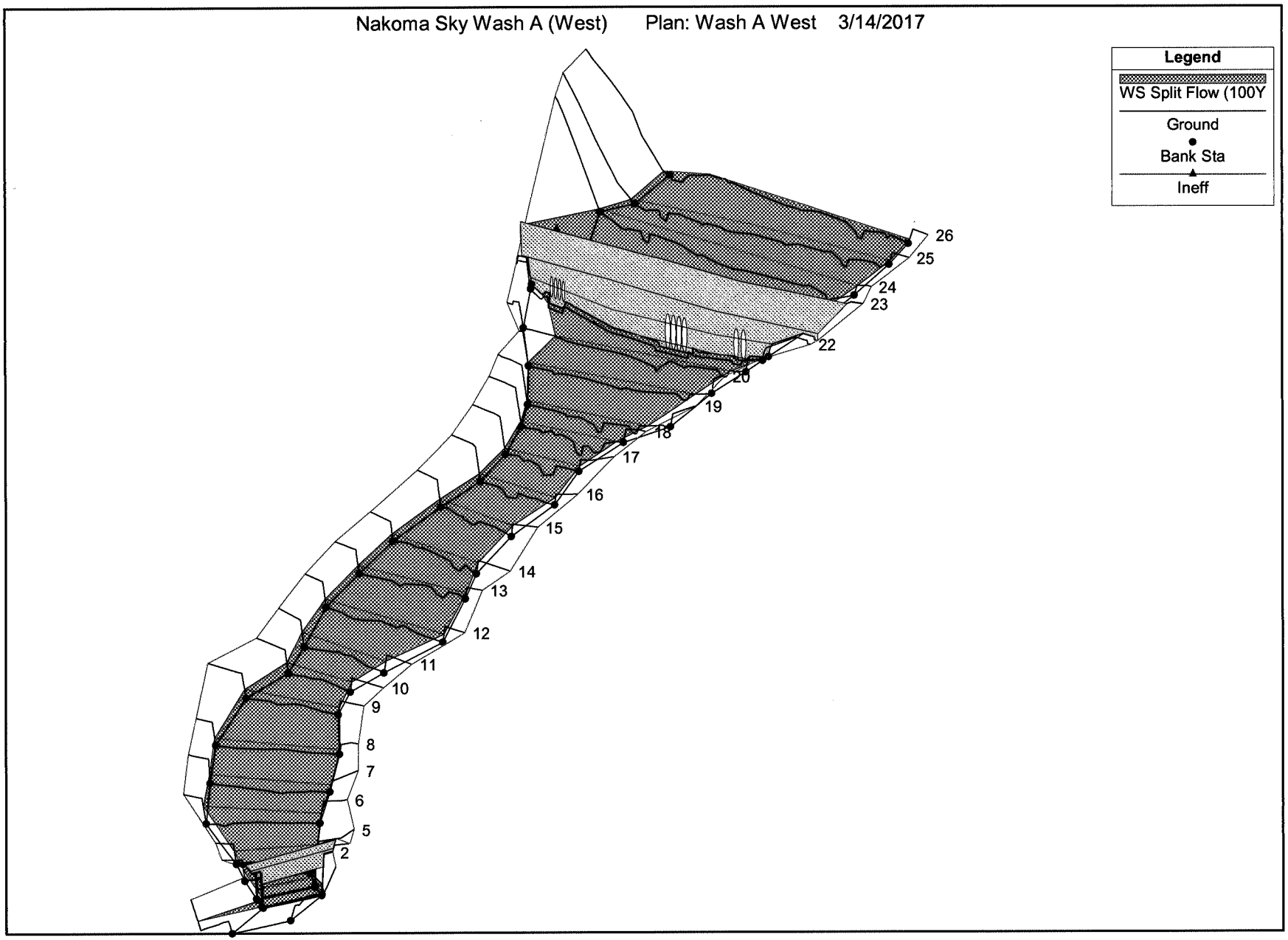
	Q2	Q5	Q10	Q50	Q100
Weighted Runoff Coefficient, C	0.36	0.48	0.58	0.71	0.74
Rainfall Intensity, i	5.00	6.00	7.10	8.90	9.90
Area, A	0.28	0.28	0.28	0.28	0.28
Discharge, Q	**0.5**	**0.8**	**1.1**	**1.7**	**2.0**

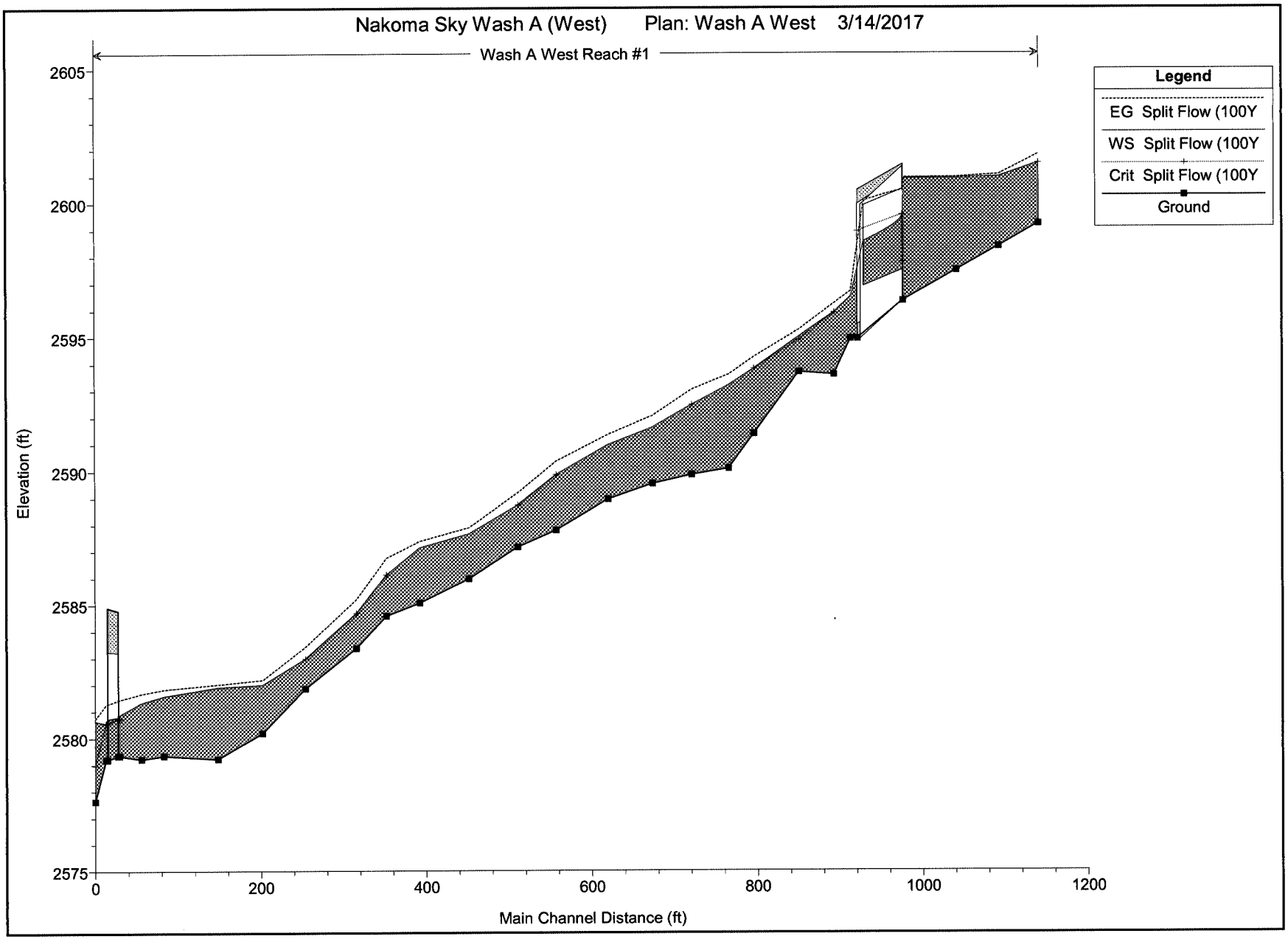
[1] ADOT's "Highway Drainage Design Manual - Hydrology", 2014

[2] Town of Oro Valley "Drainage Criteria Manual", 2010

APPENDIX B
HYDRAULIC COMPUTATIONS

WASH A (WEST) FLOODPLAIN (HEC-RAS) MODEL
(POST DEVELOPED MODEL)


Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
Legend
WS Split Flow (100Y
Ground
Bank Sta
Ineff
26
25
24
23
22
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
2


Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
Wash A West Reach #1
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Elevation (ft)
2605
2600
2595
2590
2585
2580
2575
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

Plan: Wash A West Wash A West Reach #1 RS: 26 Profile: Split Flow (100Y

E.G. Elev (ft)	2601.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.040	0.047	0.060
W.S. Elev (ft)	2601.47	Reach Len. (ft)	48.30	48.30	48.30
Crit W.S. (ft)	2601.47	Flow Area (sq ft)	0.53	158.20	1.84
E.G. Slope (ft/ft)	0.033159	Area (sq ft)	0.53	158.20	1.84
Q Total (cfs)	728.00	Flow (cfs)	1.69	722.41	3.90
Top Width (ft)	255.88	Top Width (ft)	1.51	248.72	5.64
Vel Total (ft/s)	4.53	Avg. Vel. (ft/s)	3.16	4.57	2.13
Max Chl Dpth (ft)	2.26	Hydr. Depth (ft)	0.35	0.64	0.33
Conv. Total (cfs)	3997.9	Conv. (cfs)	9.3	3967.2	21.4
Length Wtd. (ft)	48.30	Wetted Per. (ft)	1.67	249.58	5.68
Min Ch El (ft)	2599.21	Shear (lb/sq ft)	0.66	1.31	0.67
Alpha	1.01	Stream Power (lb/ft s)	2.09	5.99	1.42
Frctn Loss (ft)	0.47	Cum Volume (acre-ft)	0.03	4.38	0.14
C & E Loss (ft)	0.07	Cum SA (acres)	0.04	3.38	0.14

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 25 Profile: Split Flow (100Y

E.G. Elev (ft)	2601.04	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.08	Wt. n-Val.	0.040	0.052	0.060
W.S. Elev (ft)	2600.96	Reach Len. (ft)	51.02	51.02	51.02
Crit W.S. (ft)		Flow Area (sq ft)	0.34	319.78	1.23
E.G. Slope (ft/ft)	0.004537	Area (sq ft)	0.34	319.78	1.23
Q Total (cfs)	728.00	Flow (cfs)	0.34	726.71	0.95
Top Width (ft)	260.53	Top Width (ft)	1.16	255.52	3.85
Vel Total (ft/s)	2.27	Avg. Vel. (ft/s)	1.02	2.27	0.77
Max Chl Dpth (ft)	2.61	Hydr. Depth (ft)	0.29	1.25	0.32
Conv. Total (cfs)	10808.4	Conv. (cfs)	5.1	10789.2	14.1
Length Wtd. (ft)	51.02	Wetted Per. (ft)	1.30	256.74	3.90
Min Ch El (ft)	2598.35	Shear (lb/sq ft)	0.07	0.35	0.09
Alpha	1.00	Stream Power (lb/ft s)	0.07	0.80	0.07
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.03	4.12	0.14
C & E Loss (ft)	0.02	Cum SA (acres)	0.04	3.10	0.13

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: Wash A West Wash A West Reach #1 RS: 24 Profile: Split Flow (100Y

E.G. Elev (ft)	2600.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.040	0.057	0.060
W.S. Elev (ft)	2600.92	Reach Len. (ft)	64.77	64.77	64.77
Crit W.S. (ft)		Flow Area (sq ft)	2.39	572.76	0.23
E.G. Slope (ft/ft)	0.000816	Area (sq ft)	2.39	572.76	0.23
Q Total (cfs)	728.00	Flow (cfs)	1.97	725.98	0.05

Plan: Wash A West Wash A West Reach #1 RS: 24 Profile: Split Flow (100Y (Continued)

Top Width (ft)	272.36	Top Width (ft)	3.14	268.09	1.13
Vel Total (ft/s)	1.27	Avg. Vel. (ft/s)	0.82	1.27	0.23
Max Chl Dpth (ft)	3.45	Hydr. Depth (ft)	0.76	2.14	0.20
Conv. Total (cfs)	25486.6	Conv. (cfs)	69.0	25415.7	1.9
Length Wtd. (ft)	64.77	Wetted Per. (ft)	3.49	269.09	1.20
Min Ch El (ft)	2597.47	Shear (lb/sq ft)	0.03	0.11	0.01
Alpha	1.00	Stream Power (lb/ft s)	0.03	0.14	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.03	3.59	0.14
C & E Loss (ft)	0.00	Cum SA (acres)	0.04	2.79	0.13

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: Wash A West Wash A West Reach #1 RS: 23 Profile: Split Flow (100Y

E.G. Elev (ft)	2600.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.055	0.043	0.040
W.S. Elev (ft)	2600.92	Reach Len. (ft)	63.73	63.73	63.73
Crit W.S. (ft)	2597.78	Flow Area (sq ft)	16.21	899.08	57.67
E.G. Slope (ft/ft)	0.000085	Area (sq ft)	16.21	899.08	151.56
Q Total (cfs)	728.00	Flow (cfs)	6.32	689.76	31.92
Top Width (ft)	318.02	Top Width (ft)	8.22	242.39	67.41
Vel Total (ft/s)	0.75	Avg. Vel. (ft/s)	0.39	0.77	0.55
Max Chl Dpth (ft)	4.58	Hydr. Depth (ft)	1.97	3.71	2.06
Conv. Total (cfs)	78926.7	Conv. (cfs)	685.7	74780.5	3460.6
Length Wtd. (ft)	63.73	Wetted Per. (ft)	9.05	245.49	28.09
Min Ch El (ft)	2596.34	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.02	Stream Power (lb/ft s)	0.00	0.01	0.01
Frctn Loss (ft)		Cum Volume (acre-ft)	0.02	2.50	0.03
C & E Loss (ft)		Cum SA (acres)	0.03	2.41	0.08

Plan: Wash A West Wash A West Reach #1 RS: 22 Profile: Split Flow (100Y

E.G. Elev (ft)	2596.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.20	Wt. n-Val.		0.050	
W.S. Elev (ft)	2596.49	Reach Len. (ft)	20.18	20.18	20.18
Crit W.S. (ft)		Flow Area (sq ft)		148.95	
E.G. Slope (ft/ft)	0.020469	Area (sq ft)		148.95	
Q Total (cfs)	533.60	Flow (cfs)		533.60	
Top Width (ft)	191.92	Top Width (ft)		191.92	
Vel Total (ft/s)	3.58	Avg. Vel. (ft/s)		3.58	
Max Chl Dpth (ft)	1.58	Hydr. Depth (ft)		0.78	
Conv. Total (cfs)	3729.6	Conv. (cfs)		3729.6	
Length Wtd. (ft)	20.18	Wetted Per. (ft)		194.11	
Min Ch El (ft)	2594.91	Shear (lb/sq ft)		0.98	
Alpha	1.00	Stream Power (lb/ft s)		3.51	
Frctn Loss (ft)	0.45	Cum Volume (acre-ft)	0.02	2.45	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.03	2.09	0.03

Errors Warnings and Notes

Warning:	Divided flow computed for this cross-section.
Note:	Manning's n values were composited to a single value in the main channel.

Plan: Wash A West Wash A West Reach #1 RS: 21 Profile: Split Flow (100Y

E.G. Elev (ft)	2596.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.043	
W.S. Elev (ft)	2595.89	Reach Len. (ft)	42.14	42.14	42.14
Crit W.S. (ft)	2595.89	Flow Area (sq ft)		115.12	
E.G. Slope (ft/ft)	0.024321	Area (sq ft)		115.12	
Q Total (cfs)	533.60	Flow (cfs)		533.60	
Top Width (ft)	171.21	Top Width (ft)		171.21	
Vel Total (ft/s)	4.63	Avg. Vel. (ft/s)		4.63	
Max Chl Dpth (ft)	2.32	Hydr. Depth (ft)		0.67	
Conv. Total (cfs)	3421.6	Conv. (cfs)		3421.6	
Length Wtd. (ft)	42.14	Wetted Per. (ft)		171.87	
Min Ch El (ft)	2593.57	Shear (lb/sq ft)		1.02	
Alpha	1.00	Stream Power (lb/ft s)		4.71	
Frctn Loss (ft)	0.78	Cum Volume (acre-ft)	0.02	2.39	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	2.01	0.03

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 20 Profile: Split Flow (100Y

E.G. Elev (ft)	2595.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.039	0.040
W.S. Elev (ft)	2594.99	Reach Len. (ft)	54.69	54.69	54.69
Crit W.S. (ft)	2594.87	Flow Area (sq ft)		129.90	0.14
E.G. Slope (ft/ft)	0.014564	Area (sq ft)		129.90	0.14
Q Total (cfs)	533.60	Flow (cfs)		533.40	0.20
Top Width (ft)	162.58	Top Width (ft)		162.04	0.54
Vel Total (ft/s)	4.10	Avg. Vel. (ft/s)		4.11	1.46
Max Chl Dpth (ft)	1.32	Hydr. Depth (ft)		0.80	0.26
Conv. Total (cfs)	4421.6	Conv. (cfs)		4419.9	1.7
Length Wtd. (ft)	54.69	Wetted Per. (ft)		162.34	0.75
Min Ch El (ft)	2593.67	Shear (lb/sq ft)		0.73	0.17
Alpha	1.00	Stream Power (lb/ft s)		2.99	0.25
Frctn Loss (ft)	1.00	Cum Volume (acre-ft)	0.02	2.27	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	1.85	0.03

Errors Warnings and Notes

Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.

Plan: Wash A West Wash A West Reach #1 RS: 19 Profile: Split Flow (100Y

E.G. Elev (ft)	2594.24	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.042	0.040
W.S. Elev (ft)	2593.81	Reach Len. (ft)	30.43	30.43	30.43
Crit W.S. (ft)	2593.81	Flow Area (sq ft)		100.62	0.19
E.G. Slope (ft/ft)	0.023581	Area (sq ft)		100.62	0.19
Q Total (cfs)	533.60	Flow (cfs)		533.20	0.40
Top Width (ft)	118.93	Top Width (ft)		118.29	0.63
Vel Total (ft/s)	5.29	Avg. Vel. (ft/s)		5.30	2.07

Plan: Wash A West Wash A West Reach #1 RS: 19 Profile: Split Flow (100Y (Continued)

Max Chl Dpth (ft)	2.45	Hydr. Depth (ft)		0.85	0.30
Conv. Total (cfs)	3474.9	Conv. (cfs)		3472.3	2.6
Length Wtd. (ft)	30.43	Wetted Per. (ft)		119.20	0.88
Min Ch El (ft)	2591.36	Shear (lb/sq ft)		1.24	0.32
Alpha	1.00	Stream Power (lb/ft s)		6.59	0.67
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)	0.02	2.12	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.03	1.67	0.03

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 18 Profile: Split Flow (100Y

E.G. Elev (ft)	2593.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.		0.034	0.040
W.S. Elev (ft)	2593.18	Reach Len. (ft)	44.90	44.90	44.90
Crit W.S. (ft)		Flow Area (sq ft)		104.79	0.29
E.G. Slope (ft/ft)	0.008958	Area (sq ft)		104.79	0.29
Q Total (cfs)	533.60	Flow (cfs)		533.17	0.43
Top Width (ft)	94.15	Top Width (ft)		93.38	0.76
Vel Total (ft/s)	5.08	Avg. Vel. (ft/s)		5.09	1.47
Max Chl Dpth (ft)	3.11	Hydr. Depth (ft)		1.12	0.38
Conv. Total (cfs)	5637.7	Conv. (cfs)		5633.2	4.5
Length Wtd. (ft)	44.90	Wetted Per. (ft)		94.74	1.08
Min Ch El (ft)	2590.07	Shear (lb/sq ft)		0.62	0.15
Alpha	1.00	Stream Power (lb/ft s)		3.15	0.22
Frctn Loss (ft)	0.54	Cum Volume (acre-ft)	0.02	2.05	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	1.60	0.03

Plan: Wash A West Wash A West Reach #1 RS: 17 Profile: Split Flow (100Y

E.G. Elev (ft)	2593.02	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.58	Wt. n-Val.	0.040	0.039	0.040
W.S. Elev (ft)	2592.44	Reach Len. (ft)	47.04	47.04	47.04
Crit W.S. (ft)	2592.44	Flow Area (sq ft)	0.33	86.74	0.42
E.G. Slope (ft/ft)	0.016974	Area (sq ft)	0.33	86.74	0.42
Q Total (cfs)	533.60	Flow (cfs)	0.70	531.93	0.97
Top Width (ft)	75.89	Top Width (ft)	0.82	74.15	0.92
Vel Total (ft/s)	6.10	Avg. Vel. (ft/s)	2.10	6.13	2.29
Max Chl Dpth (ft)	2.60	Hydr. Depth (ft)	0.41	1.17	0.46
Conv. Total (cfs)	4095.6	Conv. (cfs)	5.4	4082.8	7.4
Length Wtd. (ft)	47.04	Wetted Per. (ft)	1.16	74.64	1.30
Min Ch El (ft)	2589.84	Shear (lb/sq ft)	0.30	1.23	0.34
Alpha	1.01	Stream Power (lb/ft s)	0.64	7.55	0.79
Frctn Loss (ft)	0.71	Cum Volume (acre-ft)	0.02	1.95	0.03
C & E Loss (ft)	0.04	Cum SA (acres)	0.03	1.51	0.03

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical

Errors Warnings and Notes (Continued)

	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 16 Profile: Split Flow (100Y

E.G. Elev (ft)	2592.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.	0.040	0.039	0.040
W.S. Elev (ft)	2591.60	Reach Len. (ft)	53.52	53.52	53.52
Crit W.S. (ft)		Flow Area (sq ft)	0.64	99.43	0.60
E.G. Slope (ft/ft)	0.013520	Area (sq ft)	0.64	99.43	0.60
Q Total (cfs)	533.60	Flow (cfs)	1.51	530.71	1.38
Top Width (ft)	81.37	Top Width (ft)	1.12	79.14	1.10
Vel Total (ft/s)	5.30	Avg. Vel. (ft/s)	2.34	5.34	2.29
Max Chl Dpth (ft)	2.09	Hydr. Depth (ft)	0.57	1.26	0.55
Conv. Total (cfs)	4589.1	Conv. (cfs)	13.0	4564.3	11.9
Length Wtd. (ft)	53.52	Wetted Per. (ft)	1.61	79.39	1.55
Min Ch El (ft)	2589.51	Shear (lb/sq ft)	0.34	1.06	0.33
Alpha	1.01	Stream Power (lb/ft s)	0.79	5.64	0.75
Frctn Loss (ft)	0.68	Cum Volume (acre-ft)	0.02	1.85	0.02
C & E Loss (ft)	0.02	Cum SA (acres)	0.02	1.43	0.03

Plan: Wash A West Wash A West Reach #1 RS: 15 Profile: Split Flow (100Y

E.G. Elev (ft)	2591.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.38	Wt. n-Val.	0.040	0.040	0.040
W.S. Elev (ft)	2590.96	Reach Len. (ft)	63.03	63.03	63.03
Crit W.S. (ft)		Flow Area (sq ft)	1.38	106.32	0.70
E.G. Slope (ft/ft)	0.012039	Area (sq ft)	1.38	106.32	0.70
Q Total (cfs)	533.60	Flow (cfs)	3.93	528.08	1.59
Top Width (ft)	82.36	Top Width (ft)	1.67	79.49	1.19
Vel Total (ft/s)	4.92	Avg. Vel. (ft/s)	2.85	4.97	2.28
Max Chl Dpth (ft)	2.03	Hydr. Depth (ft)	0.82	1.34	0.59
Conv. Total (cfs)	4863.3	Conv. (cfs)	35.8	4812.9	14.5
Length Wtd. (ft)	63.03	Wetted Per. (ft)	2.35	79.63	1.67
Min Ch El (ft)	2588.93	Shear (lb/sq ft)	0.44	1.00	0.31
Alpha	1.01	Stream Power (lb/ft s)	1.26	4.98	0.72
Frctn Loss (ft)	0.99	Cum Volume (acre-ft)	0.02	1.73	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.02	1.33	0.03

Plan: Wash A West Wash A West Reach #1 RS: 14 Profile: Split Flow (100Y

E.G. Elev (ft)	2590.35	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.	0.040	0.041	0.040
W.S. Elev (ft)	2589.85	Reach Len. (ft)	46.44	46.44	46.44
Crit W.S. (ft)	2589.85	Flow Area (sq ft)	1.44	92.24	0.56
E.G. Slope (ft/ft)	0.021115	Area (sq ft)	1.44	92.24	0.56
Q Total (cfs)	533.60	Flow (cfs)	5.54	526.49	1.57
Top Width (ft)	94.34	Top Width (ft)	1.73	91.55	1.05
Vel Total (ft/s)	5.66	Avg. Vel. (ft/s)	3.84	5.71	2.80
Max Chl Dpth (ft)	2.07	Hydr. Depth (ft)	0.83	1.01	0.53
Conv. Total (cfs)	3672.1	Conv. (cfs)	38.1	3623.2	10.8
Length Wtd. (ft)	46.44	Wetted Per. (ft)	2.40	91.77	1.50
Min Ch El (ft)	2587.77	Shear (lb/sq ft)	0.79	1.33	0.49
Alpha	1.01	Stream Power (lb/ft s)	3.04	7.56	1.38

Plan: Wash A West Wash A West Reach #1 RS: 14 Profile: Split Flow (100Y (Continued)

Frctn Loss (ft)	0.99	Cum Volume (acre-ft)	0.01	1.58	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.02	1.21	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 13 Profile: Split Flow (100Y

E.G. Elev (ft)	2589.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.	0.040	0.039	0.036
W.S. Elev (ft)	2588.72	Reach Len. (ft)	58.79	58.79	58.79
Crit W.S. (ft)	2588.72	Flow Area (sq ft)	0.45	96.73	0.87
E.G. Slope (ft/ft)	0.021600	Area (sq ft)	0.45	96.73	0.87
Q Total (cfs)	533.60	Flow (cfs)	1.17	528.88	3.55
Top Width (ft)	110.58	Top Width (ft)	0.98	108.26	1.34
Vel Total (ft/s)	5.44	Avg. Vel. (ft/s)	2.63	5.47	4.06
Max Chl Dpth (ft)	1.58	Hydr. Depth (ft)	0.46	0.89	0.65
Conv. Total (cfs)	3630.7	Conv. (cfs)	8.0	3598.6	24.1
Length Wtd. (ft)	58.79	Wetted Per. (ft)	1.33	108.50	1.82
Min Ch El (ft)	2587.14	Shear (lb/sq ft)	0.45	1.20	0.65
Alpha	1.00	Stream Power (lb/ft s)	1.18	6.57	2.63
Frctn Loss (ft)	0.77	Cum Volume (acre-ft)	0.01	1.48	0.02
C & E Loss (ft)	0.07	Cum SA (acres)	0.02	1.10	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 12 Profile: Split Flow (100Y

E.G. Elev (ft)	2587.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.040	0.039	0.040
W.S. Elev (ft)	2587.64	Reach Len. (ft)	59.45	59.45	59.45
Crit W.S. (ft)		Flow Area (sq ft)	0.74	136.48	0.67
E.G. Slope (ft/ft)	0.008835	Area (sq ft)	0.74	136.48	0.67
Q Total (cfs)	533.60	Flow (cfs)	1.46	530.86	1.28
Top Width (ft)	125.61	Top Width (ft)	1.21	123.24	1.15
Vel Total (ft/s)	3.87	Avg. Vel. (ft/s)	1.99	3.89	1.92
Max Chl Dpth (ft)	1.68	Hydr. Depth (ft)	0.61	1.11	0.58
Conv. Total (cfs)	5677.0	Conv. (cfs)	15.6	5647.8	13.6
Length Wtd. (ft)	59.45	Wetted Per. (ft)	1.72	123.32	1.63
Min Ch El (ft)	2585.96	Shear (lb/sq ft)	0.24	0.61	0.23
Alpha	1.01	Stream Power (lb/ft s)	0.47	2.37	0.43

Plan: Wash A West Wash A West Reach #1 RS: 12 Profile: Split Flow (100Y (Continued)

Frctn Loss (ft)	0.51	Cum Volume (acre-ft)	0.01	1.32	0.02
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.94	0.02

Plan: Wash A West Wash A West Reach #1 RS: 11 Profile: Split Flow (100Y

E.G. Elev (ft)	2587.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.040	0.045	0.040
W.S. Elev (ft)	2587.13	Reach Len. (ft)	40.49	40.49	40.49
Crit W.S. (ft)		Flow Area (sq ft)	2.00	132.00	2.28
E.G. Slope (ft/ft)	0.008188	Area (sq ft)	2.00	132.00	2.28
Q Total (cfs)	533.60	Flow (cfs)	5.31	521.94	6.36
Top Width (ft)	92.98	Top Width (ft)	2.21	88.58	2.20
Vel Total (ft/s)	3.92	Avg. Vel. (ft/s)	2.65	3.95	2.79
Max Chl Dpth (ft)	2.07	Hydr. Depth (ft)	0.91	1.49	1.04
Conv. Total (cfs)	5896.8	Conv. (cfs)	58.6	5767.9	70.2
Length Wtd. (ft)	40.49	Wetted Per. (ft)	2.86	88.63	3.02
Min Ch El (ft)	2585.06	Shear (lb/sq ft)	0.36	0.76	0.39
Alpha	1.01	Stream Power (lb/ft s)	0.95	3.01	1.08
Frctn Loss (ft)	0.59	Cum Volume (acre-ft)	0.01	1.14	0.02
C & E Loss (ft)	0.04	Cum SA (acres)	0.01	0.80	0.02

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: Wash A West Wash A West Reach #1 RS: 10 Profile: Split Flow (100Y

E.G. Elev (ft)	2586.74	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.62	Wt. n-Val.	0.040	0.049	0.040
W.S. Elev (ft)	2586.12	Reach Len. (ft)	36.68	36.68	36.68
Crit W.S. (ft)	2586.12	Flow Area (sq ft)	1.19	82.20	1.12
E.G. Slope (ft/ft)	0.032813	Area (sq ft)	1.19	82.20	1.12
Q Total (cfs)	533.60	Flow (cfs)	5.35	523.29	4.95
Top Width (ft)	68.99	Top Width (ft)	1.55	65.94	1.50
Vel Total (ft/s)	6.31	Avg. Vel. (ft/s)	4.48	6.37	4.41
Max Chl Dpth (ft)	1.55	Hydr. Depth (ft)	0.77	1.25	0.75
Conv. Total (cfs)	2945.7	Conv. (cfs)	29.5	2888.8	27.3
Length Wtd. (ft)	36.68	Wetted Per. (ft)	2.19	65.96	2.12
Min Ch El (ft)	2584.57	Shear (lb/sq ft)	1.11	2.55	1.09
Alpha	1.01	Stream Power (lb/ft s)	5.00	16.25	4.79
Frctn Loss (ft)	0.94	Cum Volume (acre-ft)	0.01	1.04	0.02
C & E Loss (ft)	0.03	Cum SA (acres)	0.01	0.73	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 9 Profile: Split Flow (100Y

E.G. Elev (ft)	2585.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.51	Wt. n-Val.	0.040	0.038	0.040
W.S. Elev (ft)	2584.68	Reach Len. (ft)	61.49	61.49	61.49
Crit W.S. (ft)	2584.68	Flow Area (sq ft)	0.62	91.55	1.05
E.G. Slope (ft/ft)	0.020441	Area (sq ft)	0.62	91.55	1.05
Q Total (cfs)	533.60	Flow (cfs)	1.78	528.25	3.57
Top Width (ft)	92.73	Top Width (ft)	1.13	90.00	1.60
Vel Total (ft/s)	5.72	Avg. Vel. (ft/s)	2.86	5.77	3.38
Max Chl Dpth (ft)	1.33	Hydr. Depth (ft)	0.55	1.02	0.66
Conv. Total (cfs)	3732.2	Conv. (cfs)	12.4	3694.8	25.0
Length Wtd. (ft)	61.49	Wetted Per. (ft)	1.58	90.02	2.07
Min Ch El (ft)	2583.35	Shear (lb/sq ft)	0.50	1.30	0.65
Alpha	1.01	Stream Power (lb/ft s)	1.44	7.49	2.20
Frctn Loss (ft)	1.31	Cum Volume (acre-ft)	0.01	0.97	0.02
C & E Loss (ft)	0.02	Cum SA (acres)	0.01	0.66	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 8 Profile: Split Flow (100Y

E.G. Elev (ft)	2583.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.	0.040	0.039	0.040
W.S. Elev (ft)	2582.97	Reach Len. (ft)	51.99	51.99	51.99
Crit W.S. (ft)	2582.97	Flow Area (sq ft)	0.23	99.59	0.55
E.G. Slope (ft/ft)	0.022247	Area (sq ft)	0.23	99.59	0.55
Q Total (cfs)	533.60	Flow (cfs)	0.49	531.53	1.58
Top Width (ft)	116.22	Top Width (ft)	0.67	114.50	1.05
Vel Total (ft/s)	5.32	Avg. Vel. (ft/s)	2.14	5.34	2.86
Max Chl Dpth (ft)	1.13	Hydr. Depth (ft)	0.34	0.87	0.53
Conv. Total (cfs)	3577.5	Conv. (cfs)	3.3	3563.7	10.6
Length Wtd. (ft)	51.99	Wetted Per. (ft)	0.96	114.50	1.49
Min Ch El (ft)	2581.84	Shear (lb/sq ft)	0.33	1.21	0.52
Alpha	1.00	Stream Power (lb/ft s)	0.71	6.45	1.48
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)	0.01	0.83	0.02
C & E Loss (ft)	0.08	Cum SA (acres)	0.01	0.52	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 7 Profile: Split Flow (100Y

E.G. Elev (ft)	2582.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.	0.040	0.036	0.030
W.S. Elev (ft)	2581.99	Reach Len. (ft)	53.80	53.80	53.80
Crit W.S. (ft)		Flow Area (sq ft)	0.57	156.84	0.42
E.G. Slope (ft/ft)	0.004176	Area (sq ft)	0.57	156.84	0.42
Q Total (cfs)	533.60	Flow (cfs)	0.72	532.30	0.58
Top Width (ft)	112.29	Top Width (ft)	1.07	110.58	0.64
Vel Total (ft/s)	3.38	Avg. Vel. (ft/s)	1.26	3.39	1.39
Max Chl Dpth (ft)	1.81	Hydr. Depth (ft)	0.53	1.42	0.65
Conv. Total (cfs)	8257.1	Conv. (cfs)	11.1	8237.0	9.0
Length Wtd. (ft)	53.80	Wetted Per. (ft)	1.51	110.60	1.46
Min Ch El (ft)	2580.18	Shear (lb/sq ft)	0.10	0.37	0.07
Alpha	1.01	Stream Power (lb/ft s)	0.12	1.25	0.10
Frctn Loss (ft)	0.13	Cum Volume (acre-ft)	0.01	0.68	0.01
C & E Loss (ft)	0.02	Cum SA (acres)	0.01	0.38	0.01

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: Wash A West Wash A West Reach #1 RS: 6 Profile: Split Flow (100Y

E.G. Elev (ft)	2582.01	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.040	0.037	0.040
W.S. Elev (ft)	2581.91	Reach Len. (ft)	65.33	65.33	65.33
Crit W.S. (ft)		Flow Area (sq ft)	1.09	203.24	3.40
E.G. Slope (ft/ft)	0.001640	Area (sq ft)	1.09	203.24	3.40
Q Total (cfs)	533.60	Flow (cfs)	1.07	527.68	4.85
Top Width (ft)	108.55	Top Width (ft)	1.48	104.46	2.61
Vel Total (ft/s)	2.57	Avg. Vel. (ft/s)	0.98	2.60	1.43
Max Chl Dpth (ft)	2.70	Hydr. Depth (ft)	0.74	1.95	1.30
Conv. Total (cfs)	13174.8	Conv. (cfs)	26.4	13028.6	119.8
Length Wtd. (ft)	65.33	Wetted Per. (ft)	2.09	104.49	3.69
Min Ch El (ft)	2579.21	Shear (lb/sq ft)	0.05	0.20	0.09
Alpha	1.01	Stream Power (lb/ft s)	0.05	0.52	0.13
Frctn Loss (ft)	0.17	Cum Volume (acre-ft)	0.01	0.46	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	0.25	0.01

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: Wash A West Wash A West Reach #1 RS: 5 Profile: Split Flow (100Y

E.G. Elev (ft)	2581.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.	0.040	0.038	0.040
W.S. Elev (ft)	2581.58	Reach Len. (ft)	27.27	27.27	27.27
Crit W.S. (ft)		Flow Area (sq ft)	1.11	131.39	2.06
E.G. Slope (ft/ft)	0.004820	Area (sq ft)	1.11	131.39	2.06
Q Total (cfs)	533.60	Flow (cfs)	1.86	527.47	4.26
Top Width (ft)	77.06	Top Width (ft)	1.49	73.54	2.03
Vel Total (ft/s)	3.97	Avg. Vel. (ft/s)	1.68	4.01	2.07
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)	0.74	1.79	1.01
Conv. Total (cfs)	7685.5	Conv. (cfs)	26.8	7597.3	61.4
Length Wtd. (ft)	27.27	Wetted Per. (ft)	2.11	73.67	2.87

Plan: Wash A West Wash A West Reach #1 RS: 5 Profile: Split Flow (100Y (Continued)

Min Ch El (ft)	2579.34	Shear (lb/sq ft)	0.16	0.54	0.22
Alpha	1.02	Stream Power (lb/ft s)	0.27	2.15	0.45
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	0.00	0.21	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	0.12	0.01

Plan: Wash A West Wash A West Reach #1 RS: 4 Profile: Split Flow (100Y

E.G. Elev (ft)	2581.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.040	0.039	0.040
W.S. Elev (ft)	2581.33	Reach Len. (ft)	26.09	26.09	26.09
Crit W.S. (ft)		Flow Area (sq ft)	2.03	112.72	1.53
E.G. Slope (ft/ft)	0.006852	Area (sq ft)	2.03	112.72	1.53
Q Total (cfs)	533.60	Flow (cfs)	4.97	525.21	3.42
Top Width (ft)	65.66	Top Width (ft)	2.09	61.82	1.75
Vel Total (ft/s)	4.59	Avg. Vel. (ft/s)	2.45	4.66	2.23
Max Chl Dpth (ft)	2.12	Hydr. Depth (ft)	0.97	1.82	0.87
Conv. Total (cfs)	6446.4	Conv. (cfs)	60.0	6345.0	41.3
Length Wtd. (ft)	26.09	Wetted Per. (ft)	2.85	61.86	2.47
Min Ch El (ft)	2579.21	Shear (lb/sq ft)	0.30	0.78	0.26
Alpha	1.02	Stream Power (lb/ft s)	0.75	3.63	0.59
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)	0.00	0.13	0.01
C & E Loss (ft)	0.02	Cum SA (acres)	0.00	0.07	0.01

Plan: Wash A West Wash A West Reach #1 RS: 3 Profile: Split Flow (100Y

E.G. Elev (ft)	2581.44	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.56	Wt. n-Val.	0.040	0.030	0.030
W.S. Elev (ft)	2580.88	Reach Len. (ft)	1.77	1.77	1.77
Crit W.S. (ft)	2580.73	Flow Area (sq ft)	0.35	88.33	0.41
E.G. Slope (ft/ft)	0.008423	Area (sq ft)	0.35	88.33	0.41
Q Total (cfs)	533.60	Flow (cfs)	0.44	532.43	0.73
Top Width (ft)	58.84	Top Width (ft)	0.47	57.84	0.53
Vel Total (ft/s)	5.99	Avg. Vel. (ft/s)	1.25	6.03	1.80
Max Chl Dpth (ft)	1.54	Hydr. Depth (ft)	0.75	1.53	0.77
Conv. Total (cfs)	5814.2	Conv. (cfs)	4.8	5801.4	8.0
Length Wtd. (ft)	1.77	Wetted Per. (ft)	1.59	57.84	1.63
Min Ch El (ft)	2579.34	Shear (lb/sq ft)	0.12	0.80	0.13
Alpha	1.01	Stream Power (lb/ft s)	0.15	4.84	0.24
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.00	0.07	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.04	0.01

Plan: Wash A West Wash A West Reach #1 RS: 2.5 BR U Profile: Split Flow (100Y

E.G. Elev (ft)	2581.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.040	0.030	0.030
W.S. Elev (ft)	2580.80	Reach Len. (ft)	13.00	13.00	13.00
Crit W.S. (ft)	2580.74	Flow Area (sq ft)	0.32	83.67	0.36
E.G. Slope (ft/ft)	0.010093	Area (sq ft)	0.32	83.67	0.36
Q Total (cfs)	533.60	Flow (cfs)	0.41	532.49	0.69
Top Width (ft)	58.78	Top Width (ft)	0.44	57.84	0.50
Vel Total (ft/s)	6.33	Avg. Vel. (ft/s)	1.32	6.36	1.90
Max Chl Dpth (ft)	1.46	Hydr. Depth (ft)	0.71	1.45	0.73
Conv. Total (cfs)	5311.3	Conv. (cfs)	4.1	5300.3	6.9
Length Wtd. (ft)	13.00	Wetted Per. (ft)	1.50	57.84	1.54
Min Ch El (ft)	2579.34	Shear (lb/sq ft)	0.13	0.91	0.15
Alpha	1.01	Stream Power (lb/ft s)	0.17	5.80	0.28

Plan: Wash A West Wash A West Reach #1 RS: 2.5 BR U Profile: Split Flow (100Y (Continued)

Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.00	0.07	0.01
C & E Loss (ft)	0.02	Cum SA (acres)	0.00	0.04	0.01

Plan: Wash A West Wash A West Reach #1 RS: 2.5 BR D Profile: Split Flow (100Y

E.G. Elev (ft)	2581.28	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.56	Wt. n-Val.	0.040	0.030	0.030
W.S. Elev (ft)	2580.73	Reach Len. (ft)	1.69	1.69	1.69
Crit W.S. (ft)	2580.57	Flow Area (sq ft)	0.37	88.99	0.41
E.G. Slope (ft/ft)	0.008212	Area (sq ft)	0.37	88.99	0.41
Q Total (cfs)	533.60	Flow (cfs)	0.47	532.40	0.73
Top Width (ft)	58.84	Top Width (ft)	0.48	57.83	0.53
Vel Total (ft/s)	5.94	Avg. Vel. (ft/s)	1.26	5.98	1.79
Max Chl Dpth (ft)	1.54	Hydr. Depth (ft)	0.77	1.54	0.77
Conv. Total (cfs)	5888.2	Conv. (cfs)	5.2	5875.0	8.1
Length Wtd. (ft)	1.69	Wetted Per. (ft)	1.61	57.83	1.63
Min Ch El (ft)	2579.19	Shear (lb/sq ft)	0.12	0.79	0.13
Alpha	1.01	Stream Power (lb/ft s)	0.15	4.72	0.23
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.00	0.04	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.02	0.01

Plan: Wash A West Wash A West Reach #1 RS: 2 Profile: Split Flow (100Y

E.G. Elev (ft)	2581.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.70	Wt. n-Val.	0.040	0.030	0.030
W.S. Elev (ft)	2580.56	Reach Len. (ft)	13.03	13.03	13.03
Crit W.S. (ft)	2580.56	Flow Area (sq ft)	0.29	79.43	0.33
E.G. Slope (ft/ft)	0.012000	Area (sq ft)	0.29	79.43	0.33
Q Total (cfs)	533.60	Flow (cfs)	0.42	532.53	0.65
Top Width (ft)	58.73	Top Width (ft)	0.43	57.83	0.47
Vel Total (ft/s)	6.67	Avg. Vel. (ft/s)	1.41	6.70	2.00
Max Chl Dpth (ft)	1.37	Hydr. Depth (ft)	0.69	1.37	0.69
Conv. Total (cfs)	4871.2	Conv. (cfs)	3.8	4861.4	6.0
Length Wtd. (ft)	13.03	Wetted Per. (ft)	1.44	57.83	1.45
Min Ch El (ft)	2579.19	Shear (lb/sq ft)	0.15	1.03	0.17
Alpha	1.01	Stream Power (lb/ft s)	0.22	6.90	0.34
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.00	0.04	0.01
C & E Loss (ft)	0.18	Cum SA (acres)	0.00	0.02	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross
	sections.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: Wash A West Wash A West Reach #1 RS: 1 Profile: Split Flow (100Y

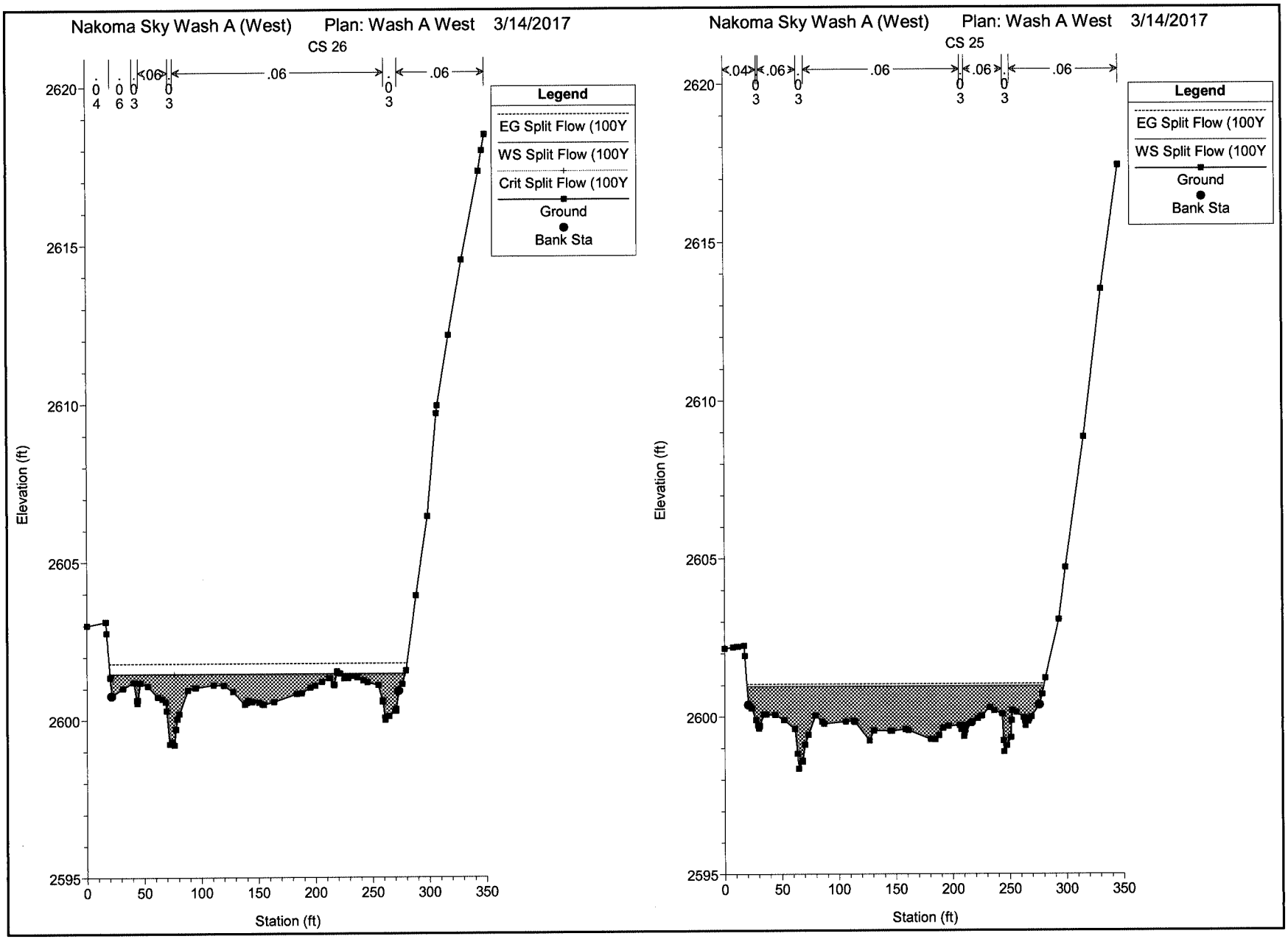
E.G. Elev (ft)	2580.73	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.037	0.036	0.039
W.S. Elev (ft)	2580.64	Reach Len. (ft)			
Crit W.S. (ft)	2578.99	Flow Area (sq ft)	17.00	174.13	43.71

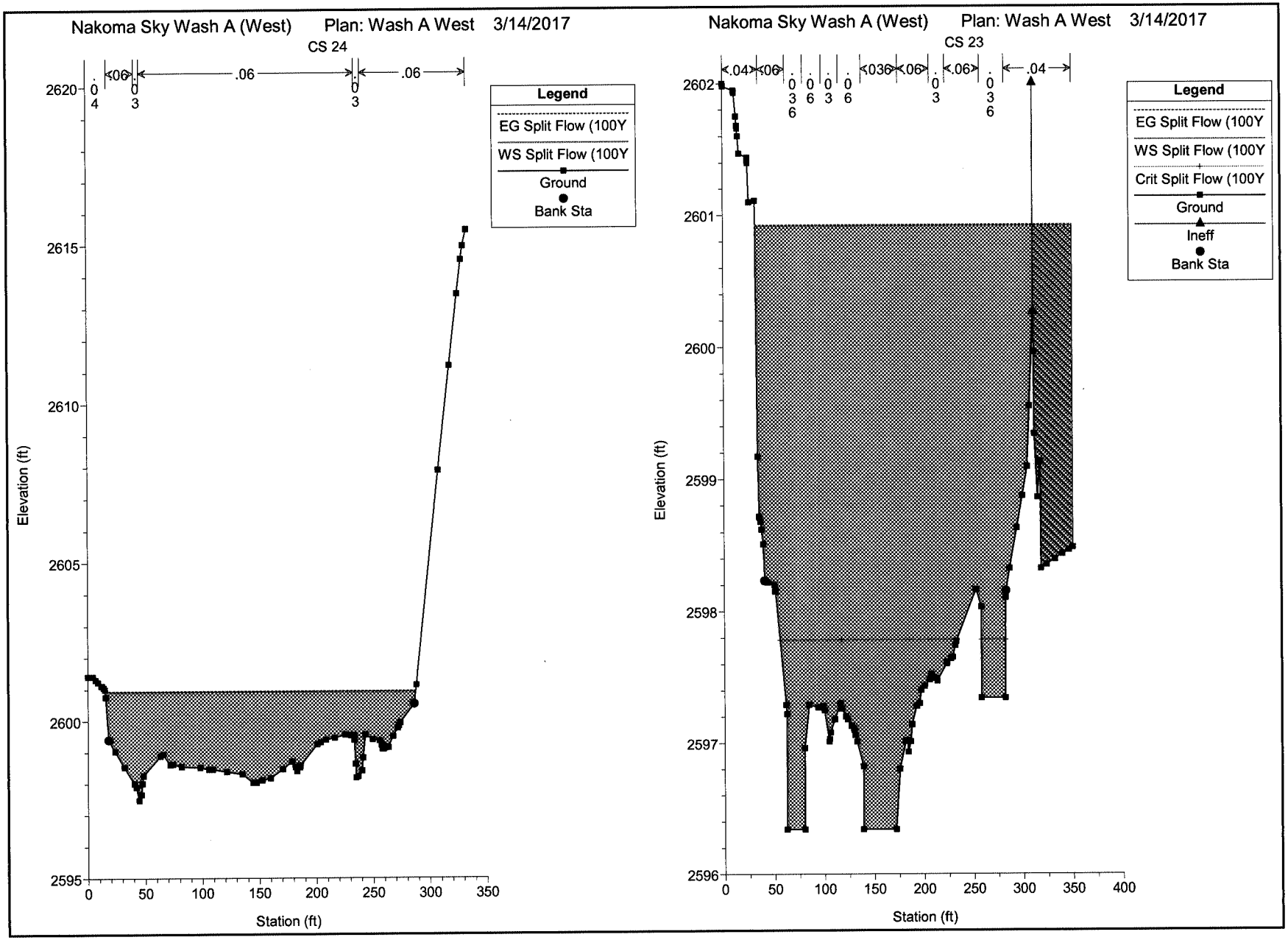
Plan: Wash A West Wash A West Reach #1 RS: 1 Profile: Split Flow (100Y (Continued)

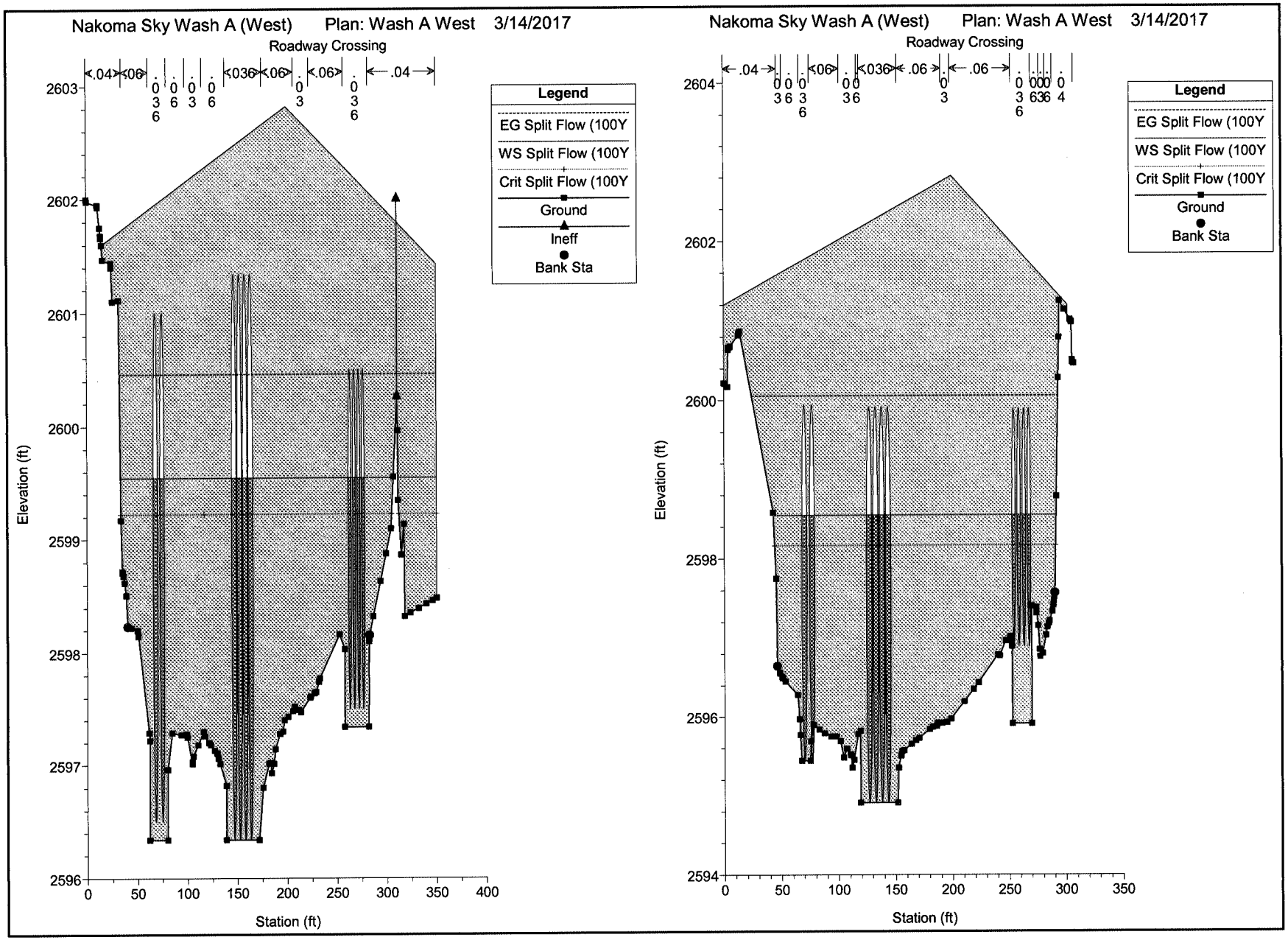
E.G. Slope (ft/ft)	0.000913	Area (sq ft)	17.00	174.13	43.71
Q Total (cfs)	533.60	Flow (cfs)	21.84	452.84	58.92
Top Width (ft)	115.91	Top Width (ft)	23.54	57.85	34.52
Vel Total (ft/s)	2.27	Avg. Vel. (ft/s)	1.29	2.60	1.35
Max Chl Dpth (ft)	3.01	Hydr. Depth (ft)	0.72	3.01	1.27
Conv. Total (cfs)	17655.5	Conv. (cfs)	722.8	14983.4	1949.4
Length Wtd. (ft)		Wetted Per. (ft)	24.14	57.85	35.34
Min Ch El (ft)	2577.63	Shear (lb/sq ft)	0.04	0.17	0.07
Alpha	1.16	Stream Power (lb/ft s)	0.05	0.45	0.10
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

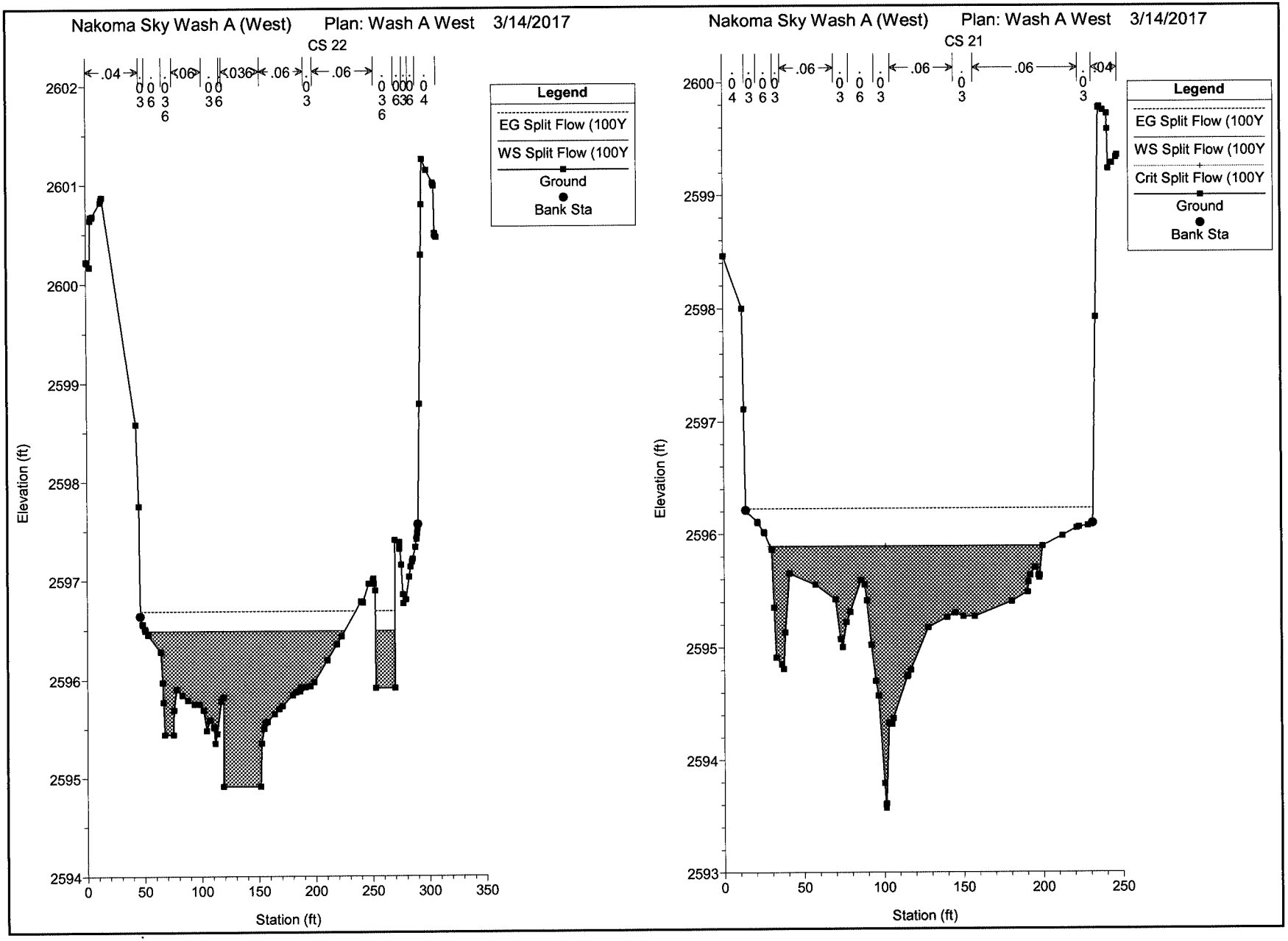
Errors Warnings and Notes

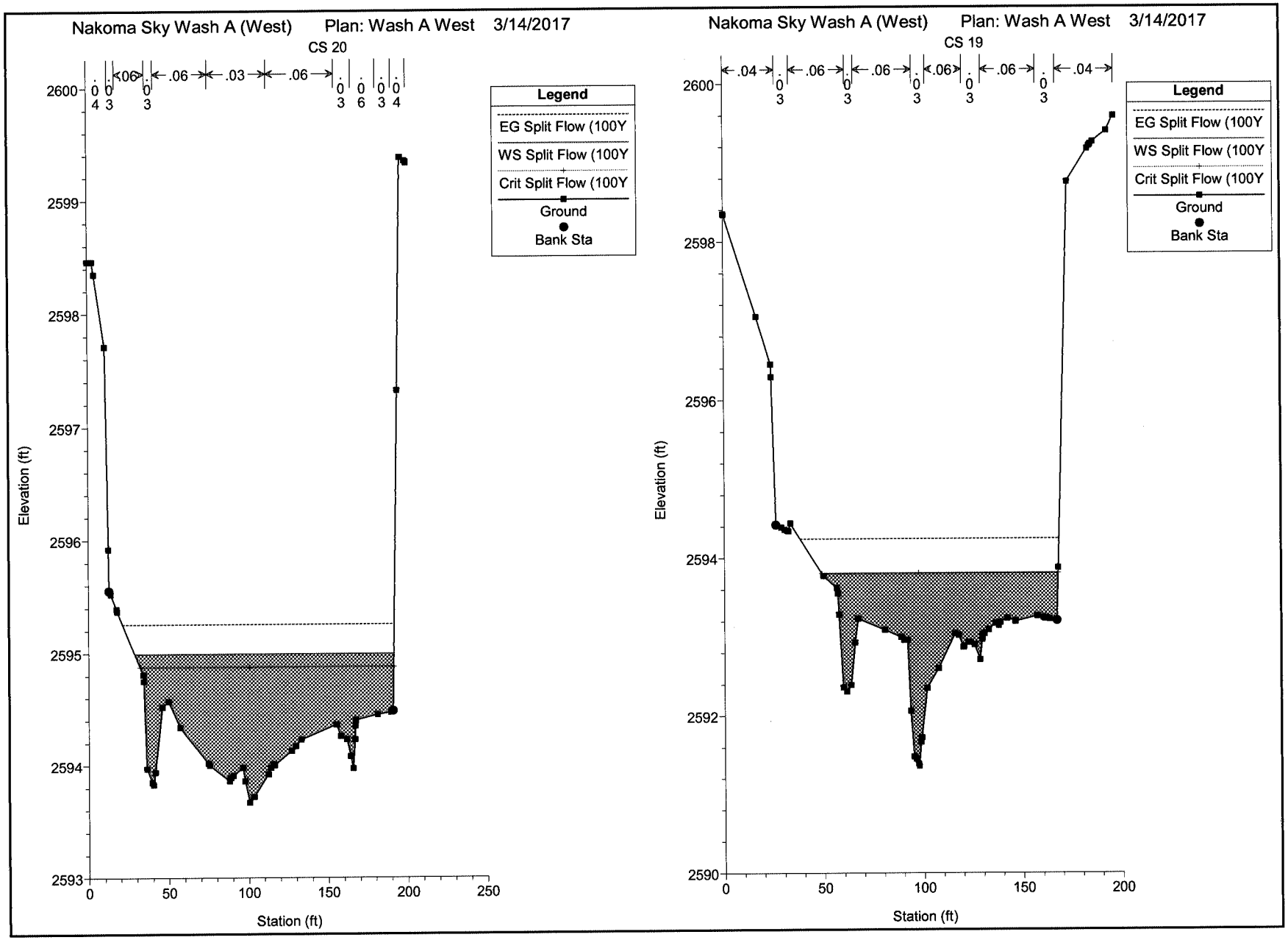
Warning:	Divided flow computed for this cross-section.

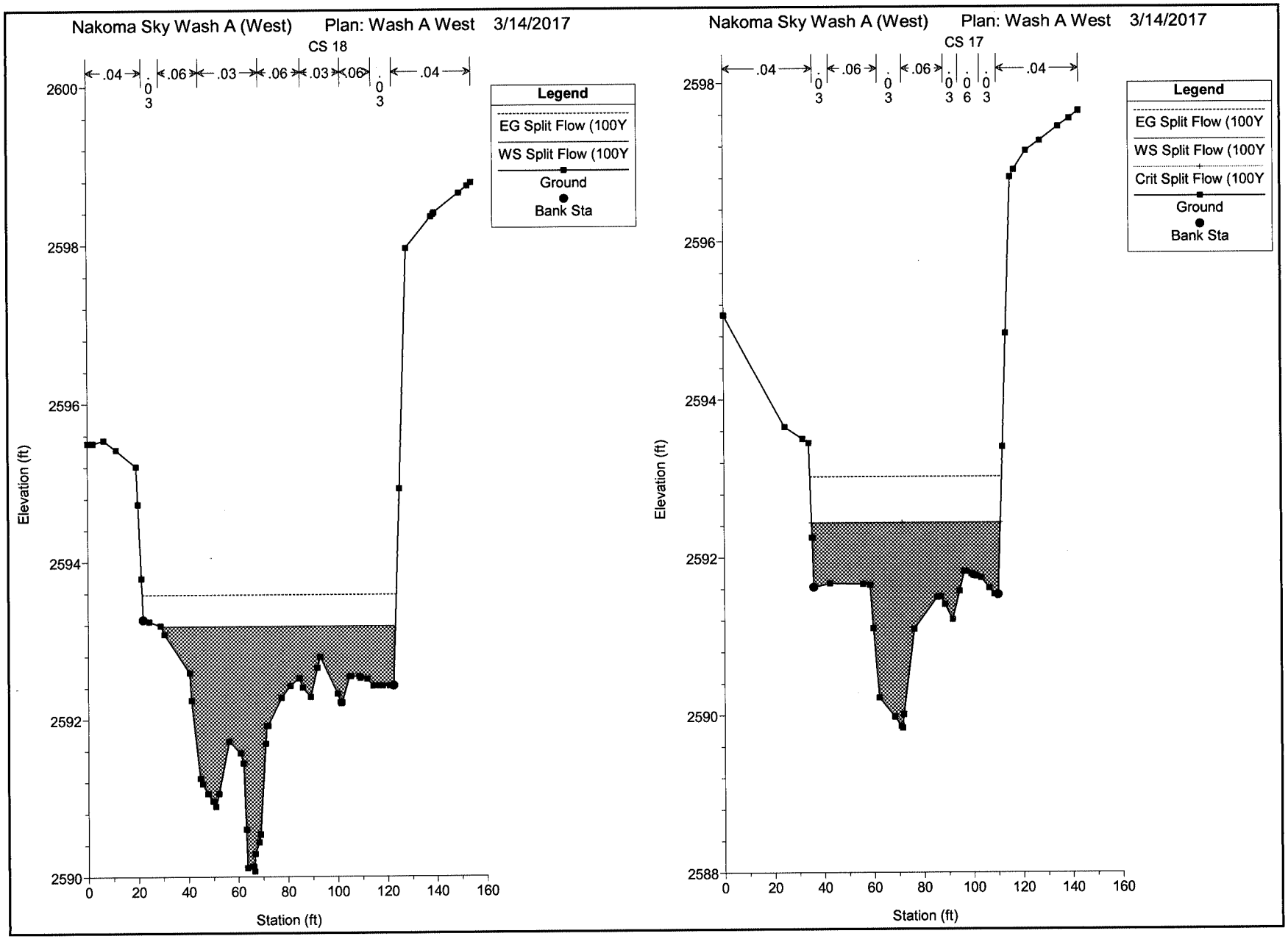

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 26
.04 .06 .03 .06 .03 .06 .03 .06
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0 50 100 150 200 250 300 350
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 25
.04 .06 .03 .06 .03 .06 .03 .06 .03
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0 50 100 150 200 250 300 350
Station (ft)

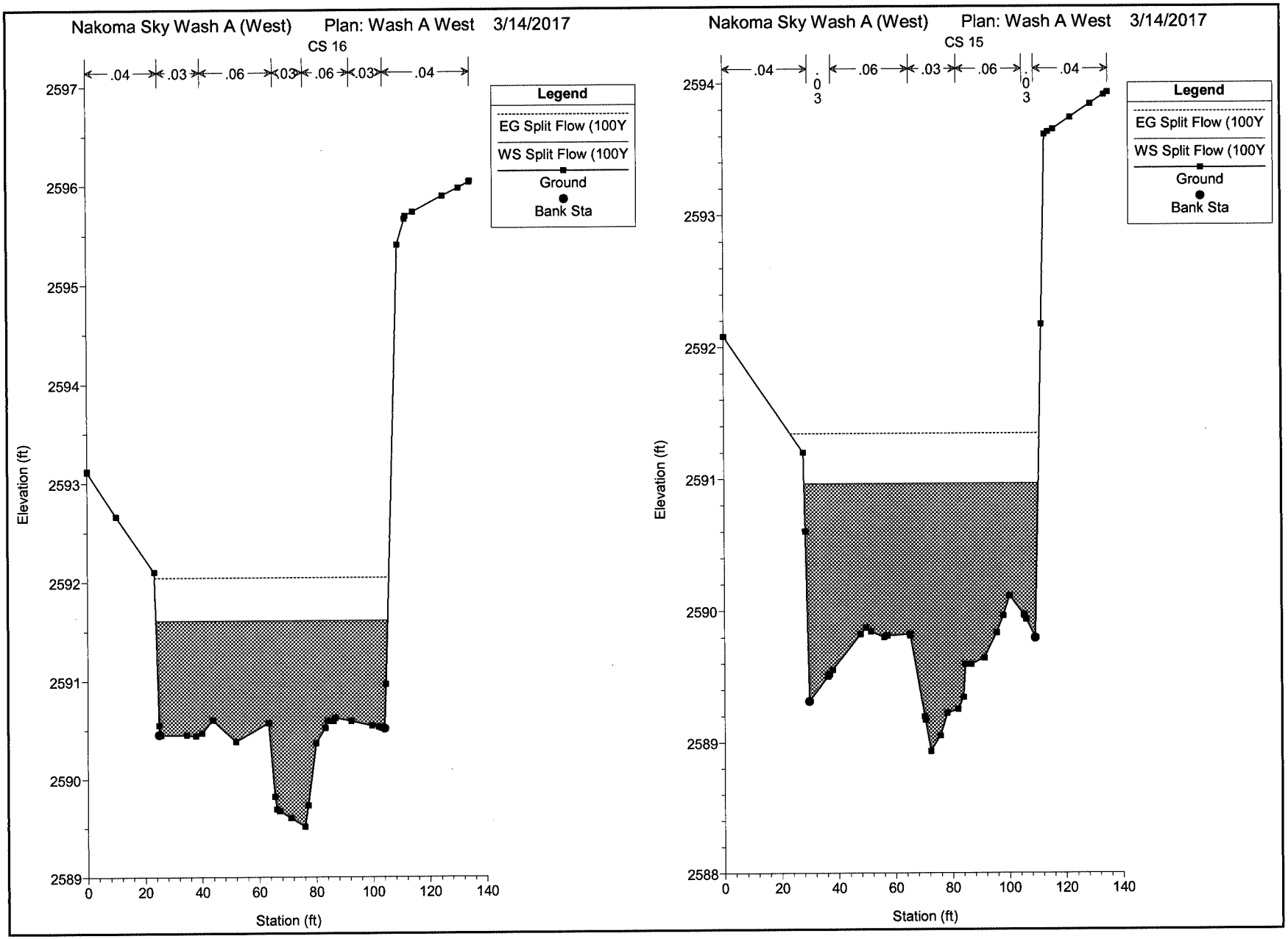

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 24
.04
.06
.03
.06
.03
.06
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0
50
100
150
200
250
300
350
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 23
.04
.06
.036
.06
.06
.04
.036
.06
.03
.06
.03
.06
.036
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
2602
2601
2600
2599
2598
2597
2596
0
50
100
150
200
250
300
350
400
Station (ft)

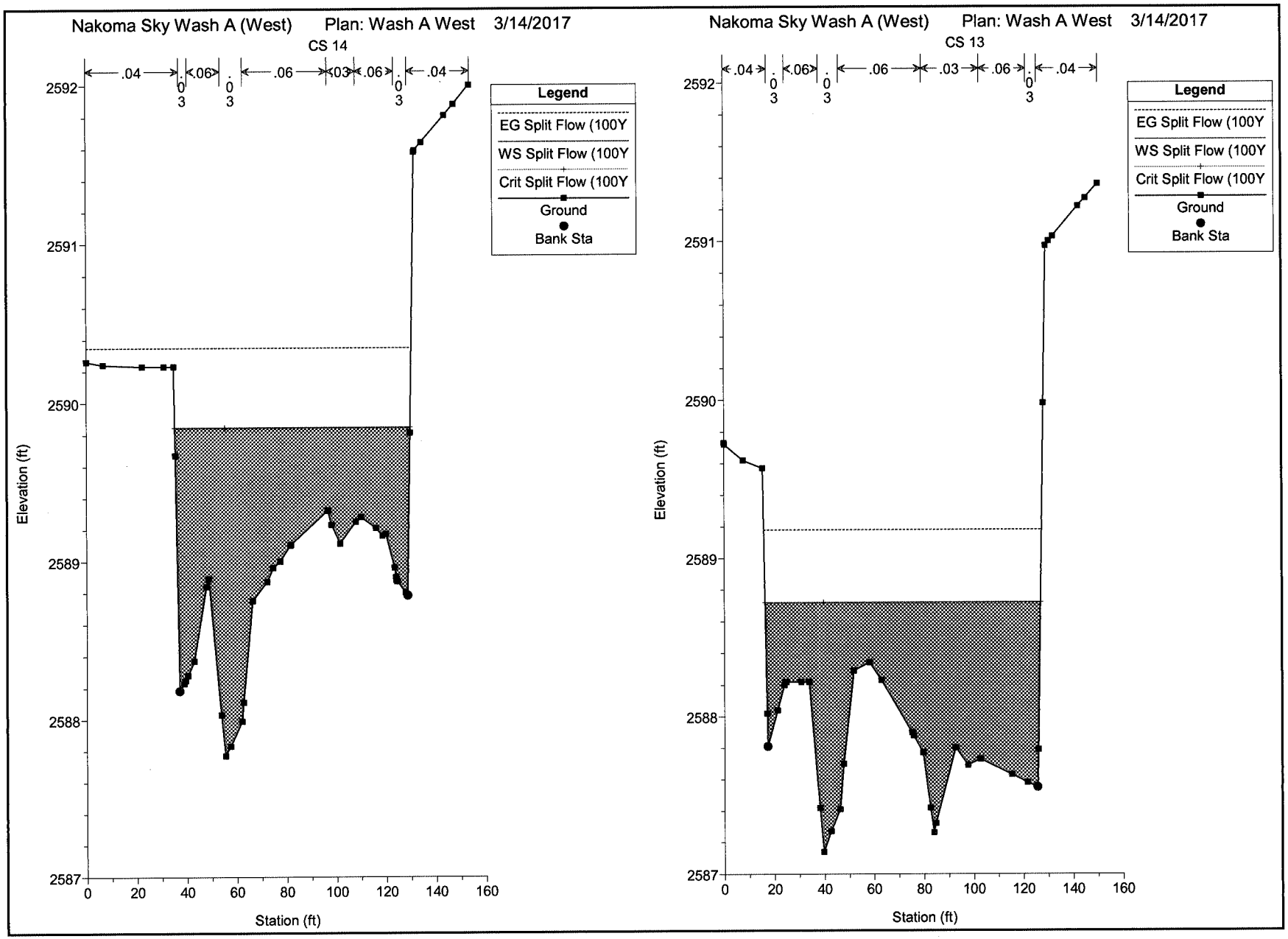

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
Roadway Crossing
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
Roadway Crossing
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)

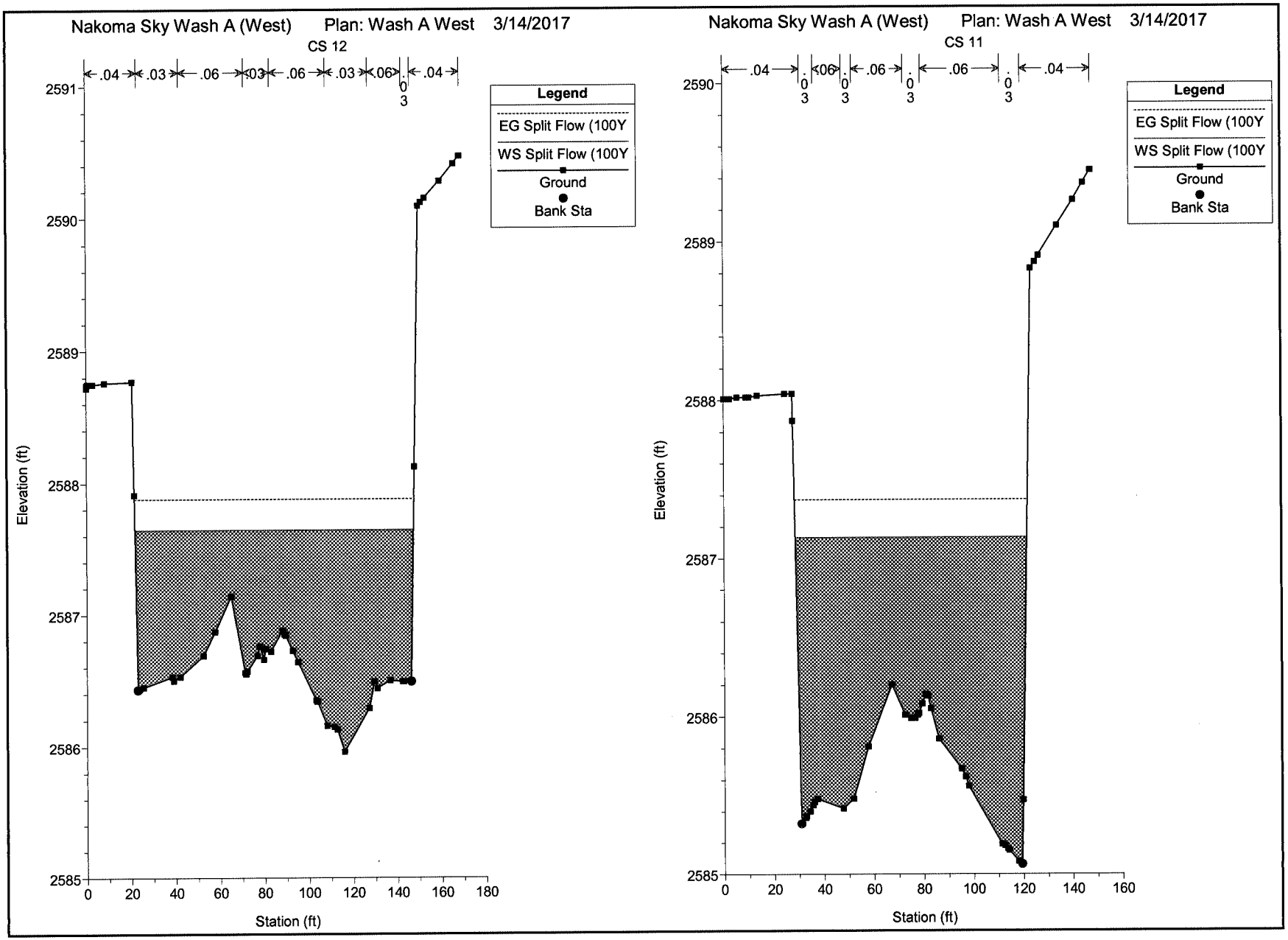

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 22
.04
.06
.036
.06
.06
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2602
2601
2600
2599
2598
2597
2596
2595
2594
0
50
100
150
200
250
300
350
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 21
.06
.06
.06
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2600
2599
2598
2597
2596
2595
2594
2593
0
50
100
150
200
250

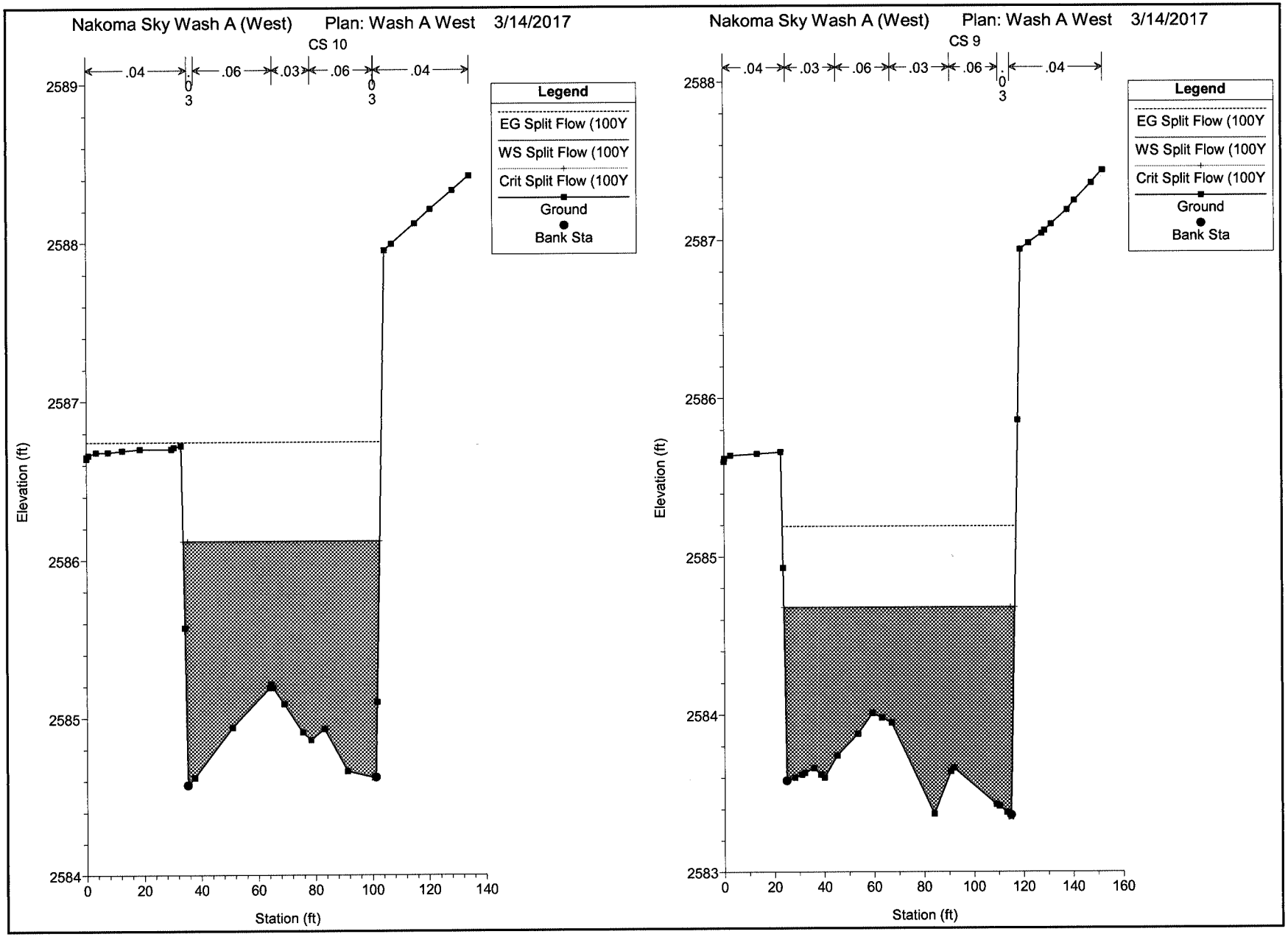

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 20
.04 .03 .06 .06 .03 .06 .03 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2600
2599
2598
2597
2596
2595
2594
2593
0
50
100
150
200
250
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 19
.04 .03 .06 .03 .06 .03 .06 .03 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2600
2598
2596
2594
2592
2590
0
50
100
150
200

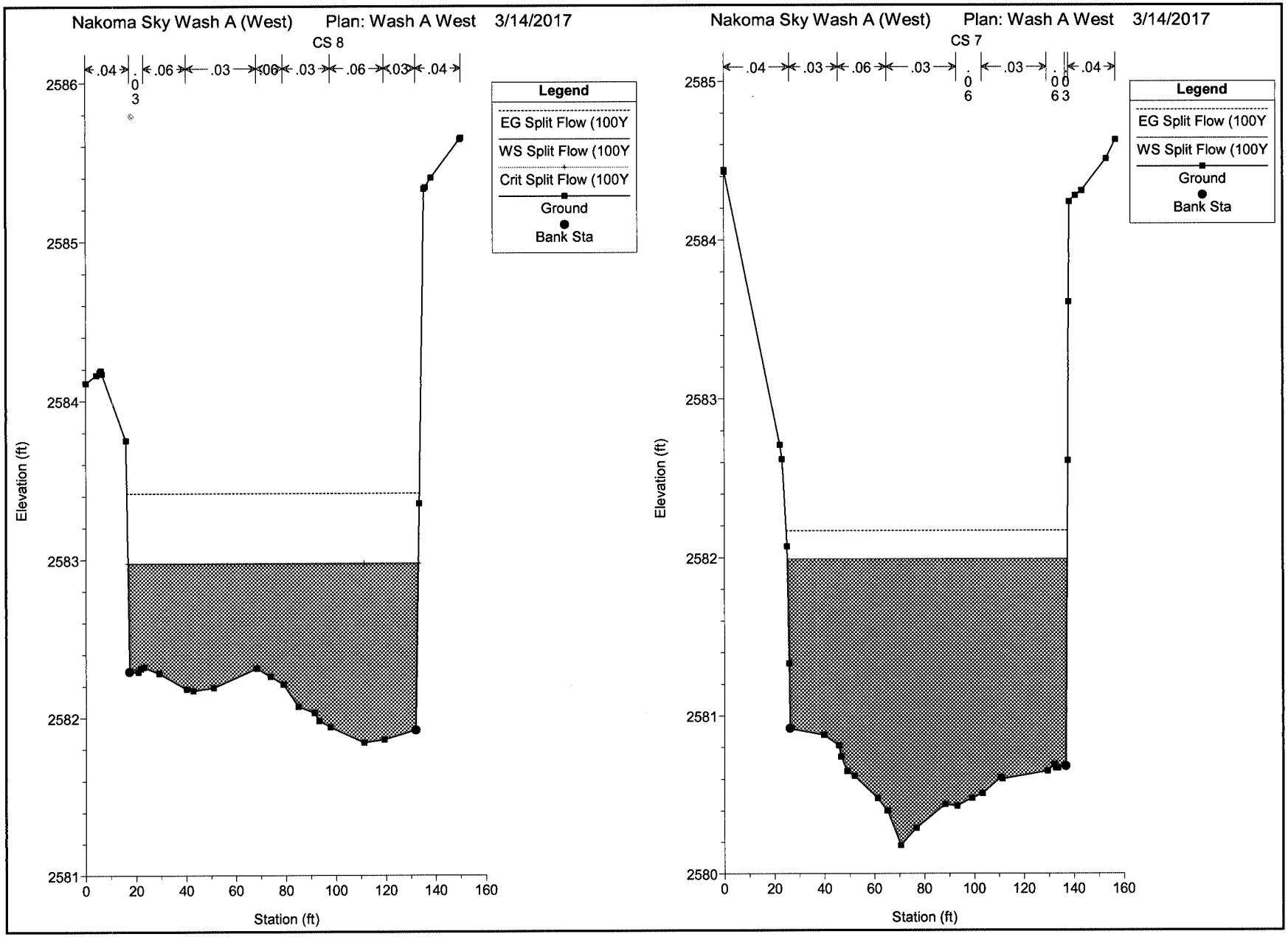

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 18
.04
.03
.06
.03
.06
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 17
.04
.03
.06
.03
.06
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)

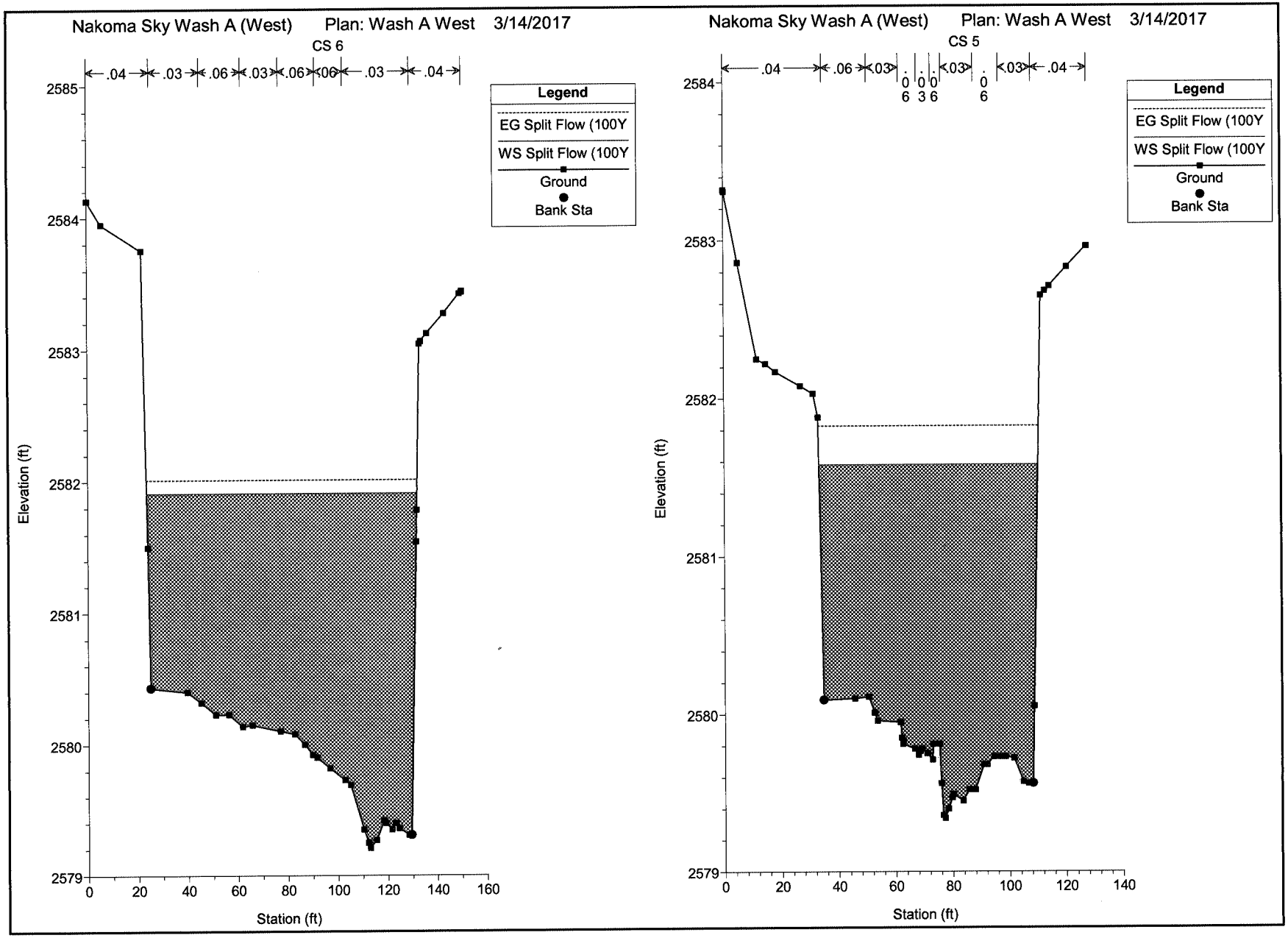

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 16
.04
.03
.06
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 15
.04
.03
.06
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)

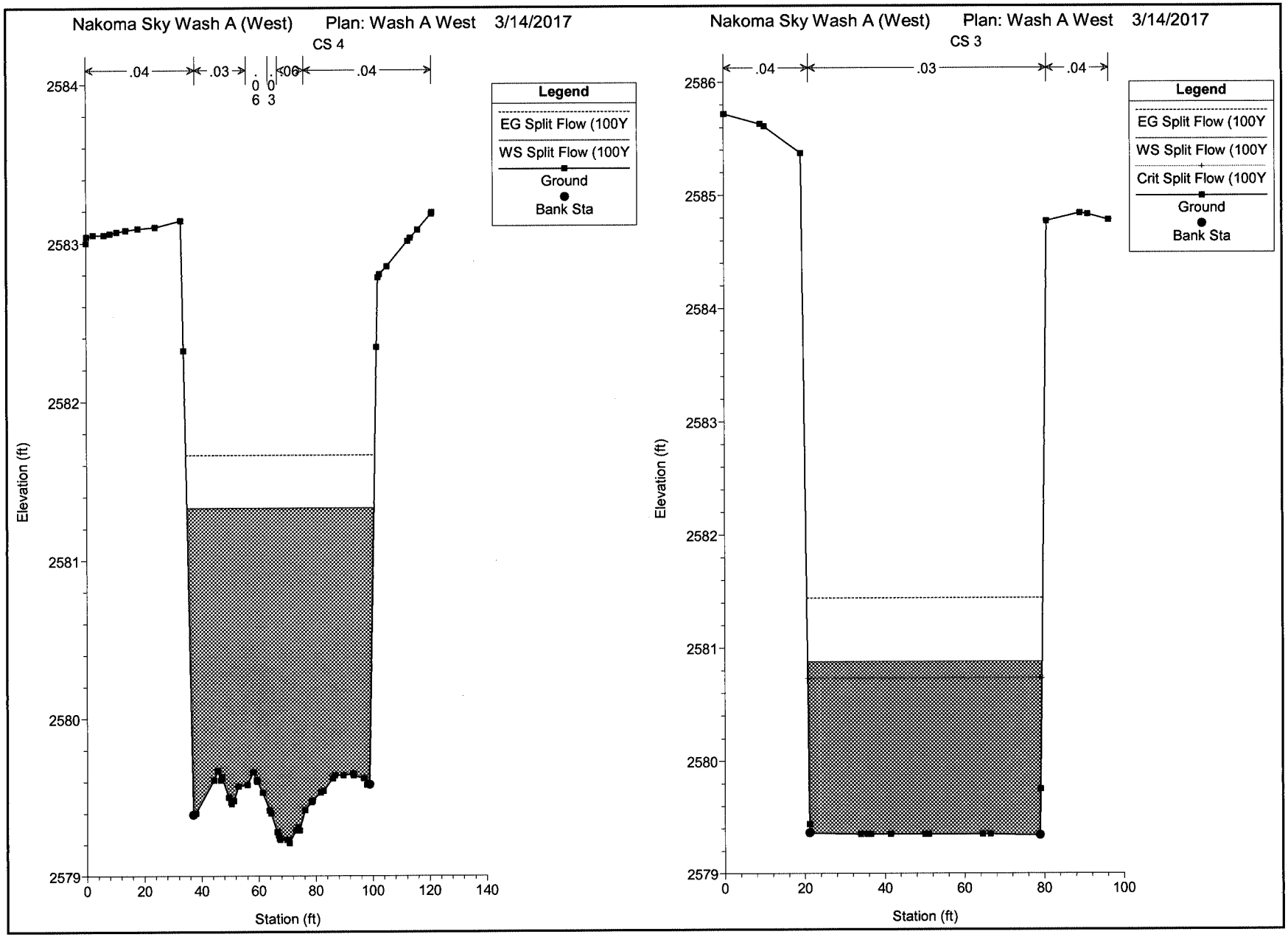

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 14
.04
.06
.03
.06
.04
.06
.03
.03
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2592
2591
2590
2589
2588
2587
0
20
40
60
80
100
120
140
160
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 13
.04
.06
.06
.03
.06
.04
.03
.03
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2592
2591
2590
2589
2588
2587
0
20
40
60
80
100
120
140
160
Station (ft)

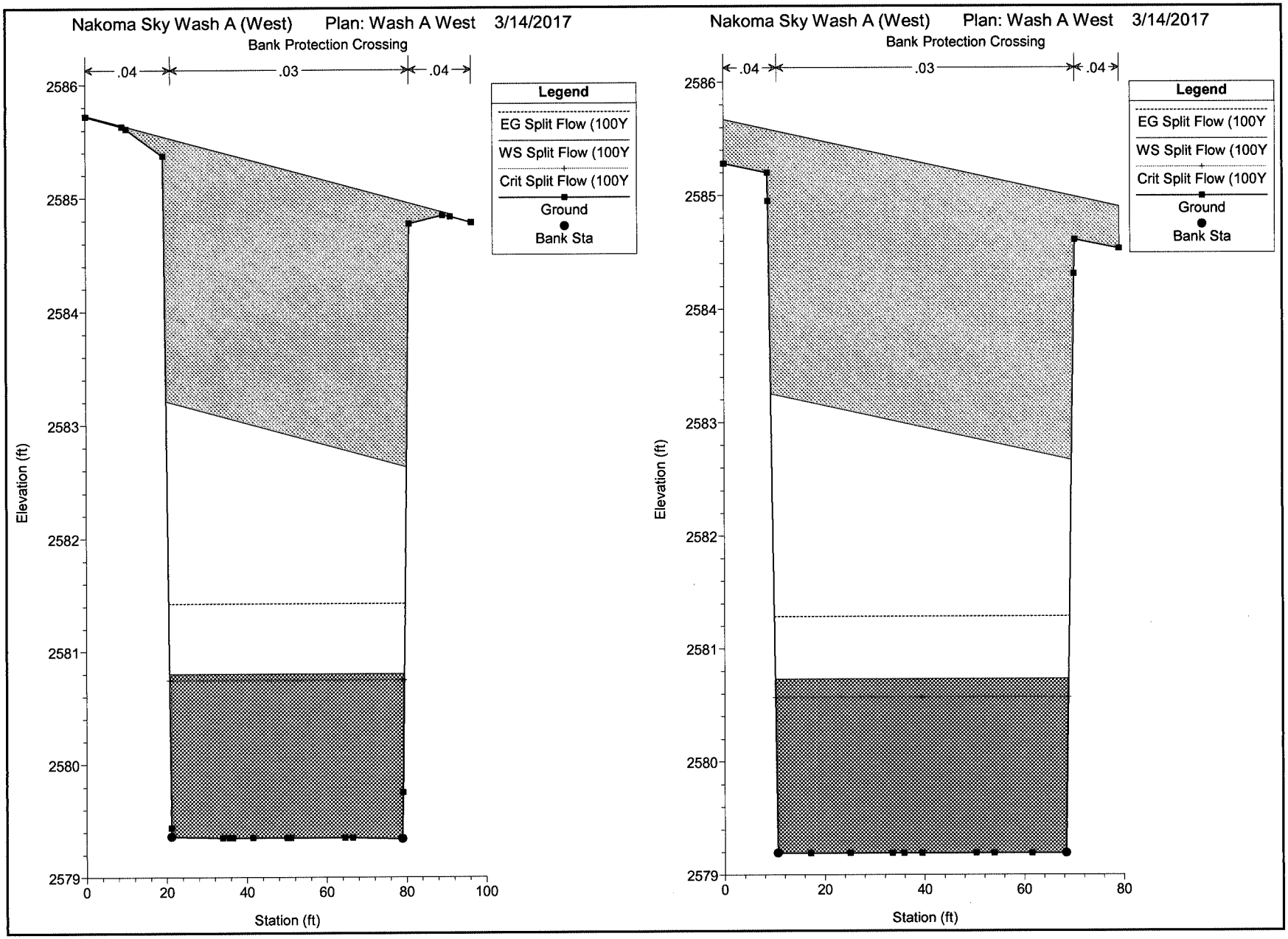

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 12
.04 .03 .06 .03 .06 .03 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2591
2590
2589
2588
2587
2586
2585
0 20 40 60 80 100 120 140 160 180
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 11
.04 .03 .06 .03 .06 .03 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2590
2589
2588
2587
2586
2585
0 20 40 60 80 100 120 140 160

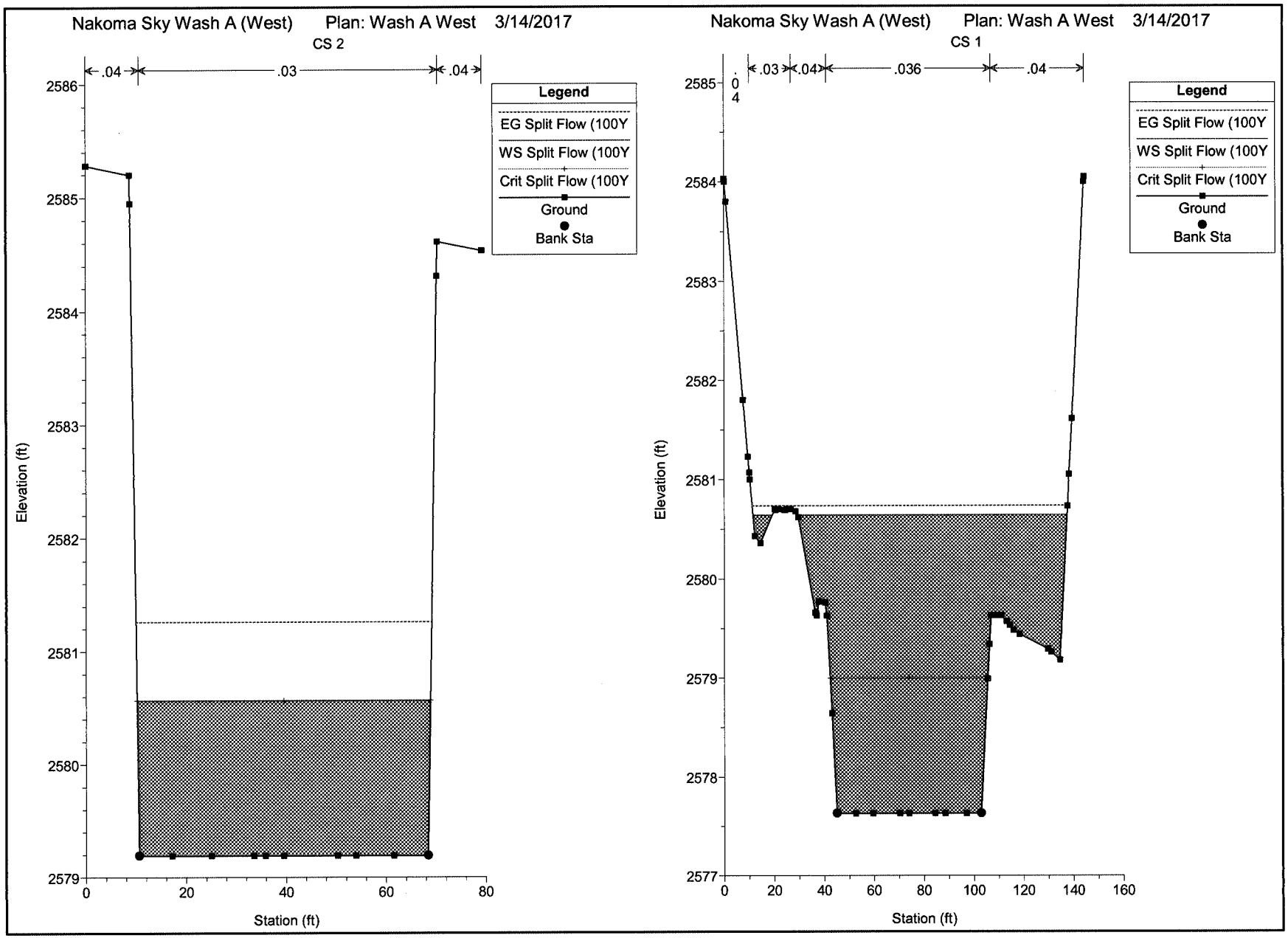

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 10
.04
.06
.03
.06
.04
0
3
0
3
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
2589
2588
2587
2586
2585
2584
Elevation (ft)
0
20
40
60
80
100
120
140
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 9
.04
.03
.06
.03
.06
.04
0
3
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
2588
2587
2586
2585
2584
2583
Elevation (ft)
0
20
40
60
80
100
120
140
160
Station (ft)


Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 8
.04 .03 .06 .03 .06 .03 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 7
.04 .03 .06 .03 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)

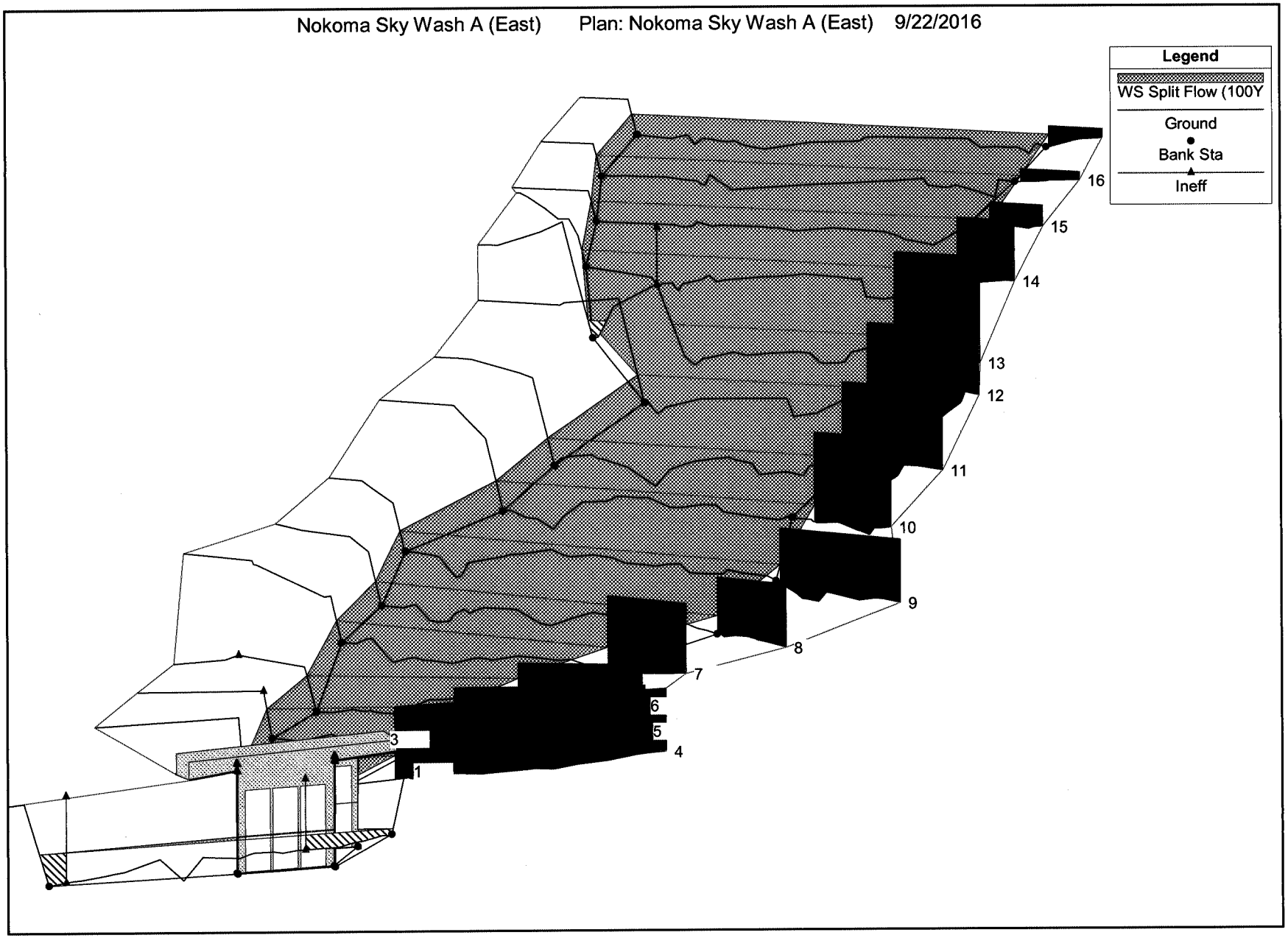

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 6
.04 .03 .06 .03 .06 .06 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2585
2584
2583
2582
2581
2580
2579
0 20 40 60 80 100 120 140 160
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 5
.04 .06 .03 .06 .03 .03 .03 .04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2584
2583
2582
2581
2580
2579
0 20 40 60 80 100 120 140
Station (ft)

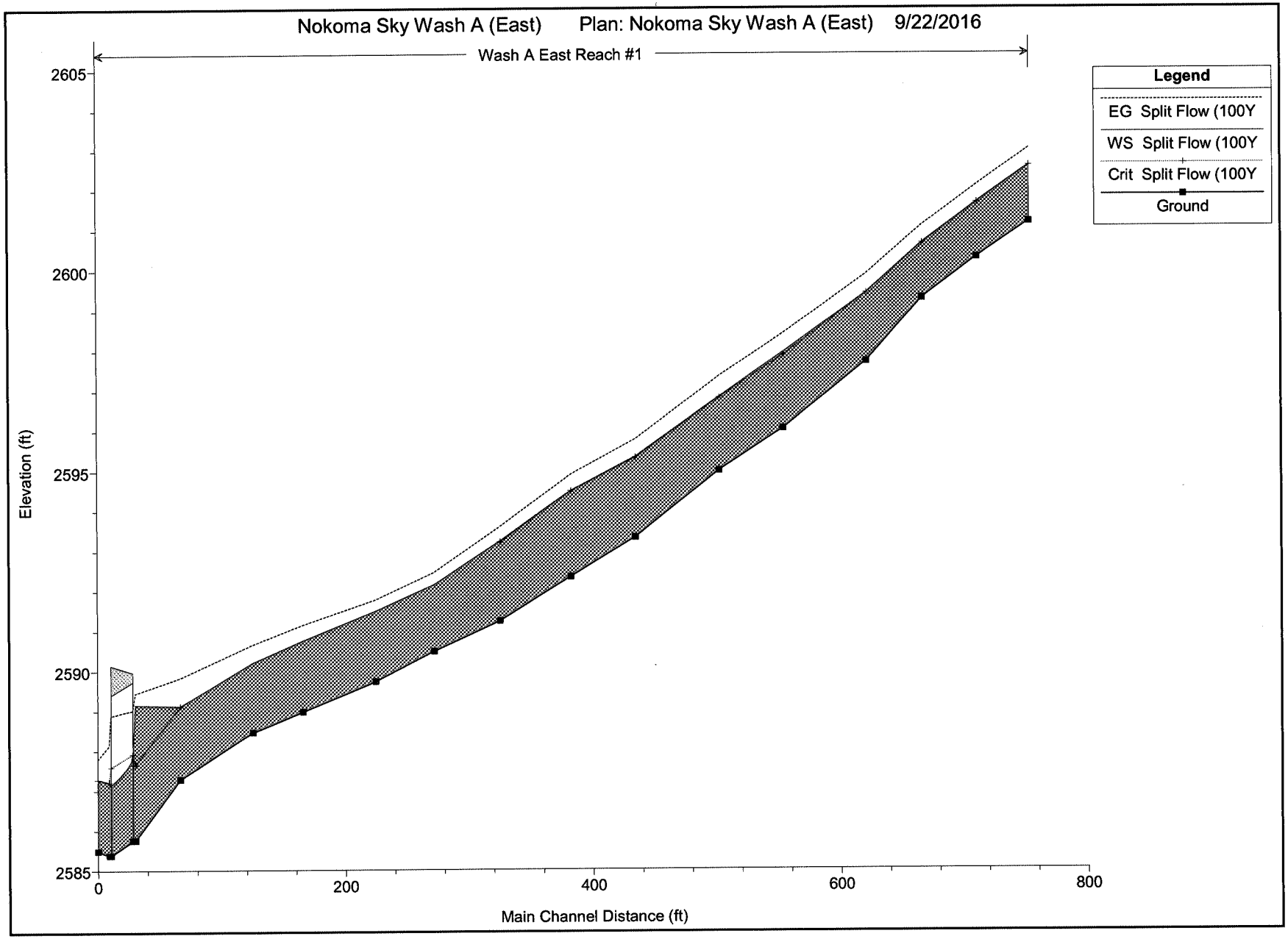

Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 4
.04
.03
.06
.04
0.063
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2584
2583
2582
2581
2580
2579
0
20
40
60
80
100
120
140
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 3
.04
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2586
2585
2584
2583
2582
2581
2580
2579
0
20
40
60
80
100
Station (ft)


Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
Bank Protection Crossing
.04
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2586
2585
2584
2583
2582
2581
2580
2579
0
20
40
60
80
100
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
Bank Protection Crossing
.04
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
2586
2585
2584
2583
2582
2581
2580
2579
0
20
40
60
80


Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 2
.04
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash A (West) Plan: Wash A West 3/14/2017
CS 1
.03
.04
.036
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)

WASH A (EAST) FLOODPLAIN (HEC-RAS) MODEL
(POST DEVELOPED MODEL)


Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
Legend
WS Split Flow (100Y
Ground
Bank Sta
Ineff
16
15
14
13
12
11
10
9
8
7
6
5
4
3
1


Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
Wash A East Reach #1
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Elevation (ft)
2605
2600
2595
2590
2585
0
200
400
600
800
Main Channel Distance (ft)

Plan: 1 Wash A East Reach #1 RS: 17 Profile: Split Flow (100Y

E.G. Elev (ft)	2603.02	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.	0.040	0.034	0.040
W.S. Elev (ft)	2602.58	Reach Len. (ft)	42.55	42.55	42.55
Crit W.S. (ft)	2602.58	Flow Area (sq ft)	0.67	135.91	1.00
E.G. Slope (ft/ft)	0.016436	Area (sq ft)	0.67	135.91	1.00
Q Total (cfs)	728.00	Flow (cfs)	1.72	723.49	2.79
Top Width (ft)	162.68	Top Width (ft)	1.09	159.58	2.01
Vel Total (ft/s)	5.29	Avg. Vel. (ft/s)	2.57	5.32	2.78
Max Chl Dpth (ft)	1.40	Hydr. Depth (ft)	0.61	0.85	0.50
Conv. Total (cfs)	5678.6	Conv. (cfs)	13.4	5643.4	21.7
Length Wtd. (ft)	42.55	Wetted Per. (ft)	1.70	159.74	2.25
Min Ch El (ft)	2601.18	Shear (lb/sq ft)	0.41	0.87	0.46
Alpha	1.01	Stream Power (lb/ft s)	1.04	4.65	1.27
Frctn Loss (ft)	0.78	Cum Volume (acre-ft)	0.06	1.85	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.07	1.86	0.04

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash A East Reach #1 RS: 16 Profile: Split Flow (100Y

E.G. Elev (ft)	2602.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.43	Wt. n-Val.	0.040	0.037	0.040
W.S. Elev (ft)	2601.66	Reach Len. (ft)	44.21	44.21	44.21
Crit W.S. (ft)	2601.66	Flow Area (sq ft)	0.66	137.63	1.04
E.G. Slope (ft/ft)	0.020783	Area (sq ft)	0.66	137.63	1.04
Q Total (cfs)	728.00	Flow (cfs)	1.46	723.25	3.29
Top Width (ft)	165.38	Top Width (ft)	2.24	161.10	2.04
Vel Total (ft/s)	5.23	Avg. Vel. (ft/s)	2.20	5.26	3.17
Max Chl Dpth (ft)	1.37	Hydr. Depth (ft)	0.30	0.85	0.51
Conv. Total (cfs)	5049.8	Conv. (cfs)	10.1	5016.8	22.8
Length Wtd. (ft)	44.21	Wetted Per. (ft)	2.53	161.53	2.28
Min Ch El (ft)	2600.29	Shear (lb/sq ft)	0.34	1.11	0.59
Alpha	1.01	Stream Power (lb/ft s)	0.75	5.81	1.87
Frctn Loss (ft)	0.90	Cum Volume (acre-ft)	0.06	1.72	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.07	1.71	0.04

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash A East Reach #1 RS: 15 Profile: Split Flow (100Y

E.G. Elev (ft)	2601.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.45	Wt. n-Val.	0.040	0.037	0.040
W.S. Elev (ft)	2600.65	Reach Len. (ft)	45.27	45.27	45.27
Crit W.S. (ft)	2600.65	Flow Area (sq ft)	2.81	133.27	0.99
E.G. Slope (ft/ft)	0.020123	Area (sq ft)	2.81	133.27	0.99
Q Total (cfs)	728.00	Flow (cfs)	6.60	718.36	3.04

Plan: 1 Wash A East Reach #1 RS: 15 Profile: Split Flow (100Y (Continued)

Top Width (ft)	155.56	Top Width (ft)	9.16	144.38	2.02
Vel Total (ft/s)	5.31	Avg. Vel. (ft/s)	2.35	5.39	3.06
Max Chl Dpth (ft)	1.36	Hydr. Depth (ft)	0.31	0.92	0.49
Conv. Total (cfs)	5131.9	Conv. (cfs)	46.5	5064.0	21.5
Length Wtd. (ft)	45.27	Wetted Per. (ft)	9.44	144.46	2.25
Min Ch El (ft)	2599.28	Shear (lb/sq ft)	0.37	1.16	0.56
Alpha	1.02	Stream Power (lb/ft s)	0.88	6.25	1.70
Frctn Loss (ft)	0.96	Cum Volume (acre-ft)	0.06	1.58	0.02
C & E Loss (ft)	0.00	Cum SA (acres)	0.06	1.55	0.04

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash A East Reach #1 RS: 14 Profile: Split Flow (100Y

E.G. Elev (ft)	2599.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.	0.040	0.040	0.040
W.S. Elev (ft)	2599.41	Reach Len. (ft)	67.19	67.19	67.19
Crit W.S. (ft)	2599.41	Flow Area (sq ft)	0.64	131.82	0.65
E.G. Slope (ft/ft)	0.022174	Area (sq ft)	0.64	131.82	0.65
Q Total (cfs)	728.00	Flow (cfs)	1.55	724.63	1.81
Top Width (ft)	147.85	Top Width (ft)	1.81	144.41	1.63
Vel Total (ft/s)	5.47	Avg. Vel. (ft/s)	2.44	5.50	2.79
Max Chl Dpth (ft)	1.71	Hydr. Depth (ft)	0.35	0.91	0.40
Conv. Total (cfs)	4888.8	Conv. (cfs)	10.4	4866.2	12.2
Length Wtd. (ft)	67.19	Wetted Per. (ft)	2.18	144.83	1.81
Min Ch El (ft)	2597.70	Shear (lb/sq ft)	0.41	1.26	0.50
Alpha	1.01	Stream Power (lb/ft s)	0.99	6.93	1.38
Frctn Loss (ft)	1.30	Cum Volume (acre-ft)	0.06	1.44	0.02
C & E Loss (ft)	0.00	Cum SA (acres)	0.06	1.40	0.03

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash A East Reach #1 RS: 13 Profile: Split Flow (100Y

E.G. Elev (ft)	2598.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.	0.040	0.040	
W.S. Elev (ft)	2597.93	Reach Len. (ft)	51.85	51.85	51.85
Crit W.S. (ft)	2597.86	Flow Area (sq ft)	1.24	99.49	
E.G. Slope (ft/ft)	0.016282	Area (sq ft)	1.24	102.58	0.78
Q Total (cfs)	548.70	Flow (cfs)	3.61	545.09	
Top Width (ft)	94.18	Top Width (ft)	1.94	90.41	1.83
Vel Total (ft/s)	5.45	Avg. Vel. (ft/s)	2.91	5.48	

Plan: 1 Wash A East Reach #1 RS: 13 Profile: Split Flow (100Y (Continued)

Max Chl Dpth (ft)	1.90	Hydr. Depth (ft)	0.64	1.17	
Conv. Total (cfs)	4300.1	Conv. (cfs)	28.3	4271.8	
Length Wtd. (ft)	51.85	Wetted Per. (ft)	2.58	85.39	
Min Ch El (ft)	2596.03	Shear (lb/sq ft)	0.49	1.18	
Alpha	1.01	Stream Power (lb/ft s)	1.43	6.49	
Frctn Loss (ft)	1.06	Cum Volume (acre-ft)	0.06	1.26	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.05	1.22	0.03

Errors Warnings and Notes

Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.

Plan: 1 Wash A East Reach #1 RS: 12 Profile: Split Flow (100Y

E.G. Elev (ft)	2597.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.52	Wt. n-Val.	0.040	0.044	0.040
W.S. Elev (ft)	2596.81	Reach Len. (ft)	67.76	67.76	67.76
Crit W.S. (ft)	2596.80	Flow Area (sq ft)	2.81	90.31	1.94
E.G. Slope (ft/ft)	0.026205	Area (sq ft)	2.81	90.31	1.94
Q Total (cfs)	548.70	Flow (cfs)	12.08	528.06	8.56
Top Width (ft)	90.75	Top Width (ft)	3.95	84.01	2.79
Vel Total (ft/s)	5.77	Avg. Vel. (ft/s)	4.30	5.85	4.40
Max Chl Dpth (ft)	1.83	Hydr. Depth (ft)	0.71	1.07	0.70
Conv. Total (cfs)	3389.6	Conv. (cfs)	74.6	3262.1	52.8
Length Wtd. (ft)	67.76	Wetted Per. (ft)	4.65	84.24	3.10
Min Ch El (ft)	2594.98	Shear (lb/sq ft)	0.99	1.75	1.03
Alpha	1.01	Stream Power (lb/ft s)	4.25	10.26	4.52
Frctn Loss (ft)	1.55	Cum Volume (acre-ft)	0.05	1.15	0.02
C & E Loss (ft)	0.03	Cum SA (acres)	0.05	1.12	0.03

Errors Warnings and Notes

Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.

Plan: 1 Wash A East Reach #1 RS: 11 Profile: Split Flow (100Y

E.G. Elev (ft)	2595.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.	0.040	0.039	0.040
W.S. Elev (ft)	2595.33	Reach Len. (ft)	52.08	52.08	52.08
Crit W.S. (ft)	2595.32	Flow Area (sq ft)	1.78	100.51	1.76
E.G. Slope (ft/ft)	0.020069	Area (sq ft)	1.78	100.51	1.76
Q Total (cfs)	548.70	Flow (cfs)	6.64	535.56	6.51
Top Width (ft)	117.73	Top Width (ft)	2.17	112.87	2.69
Vel Total (ft/s)	5.27	Avg. Vel. (ft/s)	3.73	5.33	3.70
Max Chl Dpth (ft)	2.01	Hydr. Depth (ft)	0.82	0.89	0.65
Conv. Total (cfs)	3873.3	Conv. (cfs)	46.9	3780.5	45.9
Length Wtd. (ft)	52.08	Wetted Per. (ft)	2.99	113.14	2.99
Min Ch El (ft)	2593.32	Shear (lb/sq ft)	0.75	1.11	0.74
Alpha	1.01	Stream Power (lb/ft s)	2.78	5.93	2.73
Frctn Loss (ft)	0.86	Cum Volume (acre-ft)	0.05	1.00	0.02
C & E Loss (ft)	0.01	Cum SA (acres)	0.04	0.96	0.02

Plan: 1 Wash A East Reach #1 RS: 10 Profile: Split Flow (100Y

E.G. Elev (ft)	2594.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.	0.040	0.034	0.040
W.S. Elev (ft)	2594.48	Reach Len. (ft)	57.33	57.33	57.33
Crit W.S. (ft)	2594.48	Flow Area (sq ft)	6.69	99.15	1.99
E.G. Slope (ft/ft)	0.013764	Area (sq ft)	6.69	99.15	1.99
Q Total (cfs)	548.70	Flow (cfs)	22.43	519.91	6.36
Top Width (ft)	129.13	Top Width (ft)	9.07	117.24	2.82
Vel Total (ft/s)	5.09	Avg. Vel. (ft/s)	3.35	5.24	3.19
Max Chl Dpth (ft)	2.14	Hydr. Depth (ft)	0.74	0.85	0.71
Conv. Total (cfs)	4677.0	Conv. (cfs)	191.2	4431.6	54.2
Length Wtd. (ft)	57.33	Wetted Per. (ft)	9.91	117.40	3.18
Min Ch El (ft)	2592.34	Shear (lb/sq ft)	0.58	0.73	0.54
Alpha	1.03	Stream Power (lb/ft s)	1.95	3.81	1.72
Frctn Loss (ft)	1.01	Cum Volume (acre-ft)	0.04	0.88	0.02
C & E Loss (ft)	0.02	Cum SA (acres)	0.04	0.82	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash A East Reach #1 RS: 9 Profile: Split Flow (100Y

E.G. Elev (ft)	2593.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.	0.040	0.042	0.040
W.S. Elev (ft)	2593.23	Reach Len. (ft)	53.15	53.15	53.15
Crit W.S. (ft)	2593.21	Flow Area (sq ft)	1.61	111.57	1.18
E.G. Slope (ft/ft)	0.023426	Area (sq ft)	1.61	111.57	1.18
Q Total (cfs)	548.70	Flow (cfs)	6.34	538.27	4.09
Top Width (ft)	157.81	Top Width (ft)	1.89	153.68	2.24
Vel Total (ft/s)	4.80	Avg. Vel. (ft/s)	3.93	4.82	3.48
Max Chl Dpth (ft)	2.00	Hydr. Depth (ft)	0.85	0.73	0.53
Conv. Total (cfs)	3585.0	Conv. (cfs)	41.4	3516.8	26.7
Length Wtd. (ft)	53.15	Wetted Per. (ft)	2.80	153.88	2.46
Min Ch El (ft)	2591.23	Shear (lb/sq ft)	0.84	1.06	0.70
Alpha	1.00	Stream Power (lb/ft s)	3.31	5.12	2.44
Frctn Loss (ft)	1.12	Cum Volume (acre-ft)	0.04	0.74	0.01
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	0.65	0.02

Errors Warnings and Notes

Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.

Plan: 1 Wash A East Reach #1 RS: 8 Profile: Split Flow (100Y

E.G. Elev (ft)	2592.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.	0.040	0.044	0.040
W.S. Elev (ft)	2592.15	Reach Len. (ft)	47.50	47.50	47.50
Crit W.S. (ft)		Flow Area (sq ft)	0.12	121.65	1.70
E.G. Slope (ft/ft)	0.018948	Area (sq ft)	0.12	121.65	1.70
Q Total (cfs)	548.70	Flow (cfs)	0.14	542.51	6.05
Top Width (ft)	144.87	Top Width (ft)	0.13	142.07	2.67

Plan: 1 Wash A East Reach #1 RS: 8 Profile: Split Flow (100Y (Continued)

Vel Total (ft/s)	4.44	Avg. Vel. (ft/s)	1.20	4.46	3.56
Max Chl Dpth (ft)	1.67	Hydr. Depth (ft)	0.89	0.86	0.64
Conv. Total (cfs)	3986.1	Conv. (cfs)	1.0	3941.1	44.0
Length Wtd. (ft)	47.50	Wetted Per. (ft)	1.02	142.23	2.93
Min Ch El (ft)	2590.48	Shear (lb/sq ft)	0.13	1.01	0.69
Alpha	1.00	Stream Power (lb/ft s)	0.16	4.51	2.44
Frctn Loss (ft)	0.68	Cum Volume (acre-ft)	0.04	0.60	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.03	0.47	0.01

Plan: 1 Wash A East Reach #1 RS: 7 Profile: Split Flow (100Y

E.G. Elev (ft)	2591.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.040	0.041	0.040
W.S. Elev (ft)	2591.49	Reach Len. (ft)	58.81	58.81	58.81
Crit W.S. (ft)		Flow Area (sq ft)	0.32	128.45	1.11
E.G. Slope (ft/ft)	0.011232	Area (sq ft)	0.32	128.45	1.11
Q Total (cfs)	548.70	Flow (cfs)	0.47	545.58	2.66
Top Width (ft)	114.92	Top Width (ft)	0.28	112.53	2.11
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)	1.46	4.25	2.38
Max Chl Dpth (ft)	1.76	Hydr. Depth (ft)	1.14	1.14	0.53
Conv. Total (cfs)	5177.4	Conv. (cfs)	4.4	5147.9	25.1
Length Wtd. (ft)	58.81	Wetted Per. (ft)	1.42	112.63	2.36
Min Ch El (ft)	2589.73	Shear (lb/sq ft)	0.16	0.80	0.33
Alpha	1.01	Stream Power (lb/ft s)	0.23	3.40	0.79
Frctn Loss (ft)	0.61	Cum Volume (acre-ft)	0.04	0.46	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.03	0.33	0.01

Plan: 1 Wash A East Reach #1 RS: 6 Profile: Split Flow (100Y

E.G. Elev (ft)	2591.15	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.040	0.036	0.040
W.S. Elev (ft)	2590.76	Reach Len. (ft)	40.23	40.23	40.23
Crit W.S. (ft)		Flow Area (sq ft)	2.18	104.52	3.16
E.G. Slope (ft/ft)	0.009593	Area (sq ft)	2.18	104.52	3.16
Q Total (cfs)	548.70	Flow (cfs)	6.53	532.36	9.81
Top Width (ft)	80.32	Top Width (ft)	1.62	75.11	3.59
Vel Total (ft/s)	4.99	Avg. Vel. (ft/s)	2.99	5.09	3.11
Max Chl Dpth (ft)	1.79	Hydr. Depth (ft)	1.35	1.39	0.88
Conv. Total (cfs)	5602.2	Conv. (cfs)	66.6	5435.3	100.2
Length Wtd. (ft)	40.23	Wetted Per. (ft)	2.93	75.15	4.00
Min Ch El (ft)	2588.97	Shear (lb/sq ft)	0.45	0.83	0.47
Alpha	1.02	Stream Power (lb/ft s)	1.33	4.24	1.47
Frctn Loss (ft)	0.48	Cum Volume (acre-ft)	0.04	0.31	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.03	0.20	0.01

Plan: 1 Wash A East Reach #1 RS: 5 Profile: Split Flow (100Y

E.G. Elev (ft)	2590.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.45	Wt. n-Val.	0.040	0.044	0.040
W.S. Elev (ft)	2590.21	Reach Len. (ft)	59.06	59.06	59.06
Crit W.S. (ft)		Flow Area (sq ft)	10.23	90.59	1.42
E.G. Slope (ft/ft)	0.015435	Area (sq ft)	10.23	90.59	1.42
Q Total (cfs)	548.70	Flow (cfs)	54.44	489.70	4.56
Top Width (ft)	71.06	Top Width (ft)	6.76	62.32	1.98
Vel Total (ft/s)	5.37	Avg. Vel. (ft/s)	5.32	5.41	3.21
Max Chl Dpth (ft)	1.75	Hydr. Depth (ft)	1.51	1.45	0.72

Plan: 1 Wash A East Reach #1 RS: 5 Profile: Split Flow (100Y (Continued)

Conv. Total (cfs)	4416.5	Conv. (cfs)	438.2	3941.6	36.7
Length Wtd. (ft)	59.06	Wetted Per. (ft)	8.25	62.35	2.45
Min Ch El (ft)	2588.46	Shear (lb/sq ft)	1.19	1.40	0.56
Alpha	1.01	Stream Power (lb/ft s)	6.36	7.57	1.80
Frctn Loss (ft)	0.80	Cum Volume (acre-ft)	0.03	0.22	0.01
C & E Loss (ft)	0.03	Cum SA (acres)	0.02	0.14	0.01

Plan: 1 Wash A East Reach #1 RS: 4 Profile: Split Flow (100Y

E.G. Elev (ft)	2589.84	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.71	Wt. n-Val.	0.040	0.030	0.040
W.S. Elev (ft)	2589.12	Reach Len. (ft)	36.24	36.24	36.24
Crit W.S. (ft)	2589.12	Flow Area (sq ft)	21.58	60.53	3.62
E.G. Slope (ft/ft)	0.012007	Area (sq ft)	21.58	60.53	3.62
Q Total (cfs)	548.70	Flow (cfs)	95.70	438.91	14.09
Top Width (ft)	60.31	Top Width (ft)	17.83	39.17	3.31
Vel Total (ft/s)	6.40	Avg. Vel. (ft/s)	4.43	7.25	3.89
Max Chl Dpth (ft)	1.84	Hydr. Depth (ft)	1.21	1.55	1.10
Conv. Total (cfs)	5007.6	Conv. (cfs)	873.3	4005.6	128.6
Length Wtd. (ft)	36.24	Wetted Per. (ft)	18.99	39.20	3.88
Min Ch El (ft)	2587.28	Shear (lb/sq ft)	0.85	1.16	0.70
Alpha	1.12	Stream Power (lb/ft s)	3.78	8.39	2.72
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.01	0.11	0.00
C & E Loss (ft)	0.12	Cum SA (acres)	0.01	0.07	0.00

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash A East Reach #1 RS: 3 Profile: Split Flow (100Y

E.G. Elev (ft)	2589.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.		0.030	
W.S. Elev (ft)	2589.15	Reach Len. (ft)	21.15	21.15	21.15
Crit W.S. (ft)	2587.66	Flow Area (sq ft)		125.56	
E.G. Slope (ft/ft)	0.001526	Area (sq ft)	0.04	125.56	0.04
Q Total (cfs)	548.70	Flow (cfs)		548.70	
Top Width (ft)	37.05	Top Width (ft)	0.03	37.00	0.03
Vel Total (ft/s)	4.37	Avg. Vel. (ft/s)		4.37	
Max Chl Dpth (ft)	3.39	Hydr. Depth (ft)		3.39	
Conv. Total (cfs)	14044.3	Conv. (cfs)		14044.3	
Length Wtd. (ft)	21.15	Wetted Per. (ft)		37.00	
Min Ch El (ft)	2585.76	Shear (lb/sq ft)		0.32	
Alpha	1.00	Stream Power (lb/ft s)		1.41	
Frctn Loss (ft)		Cum Volume (acre-ft)	0.00	0.04	0.00
C & E Loss (ft)		Cum SA (acres)	0.00	0.04	0.00

Plan: 1 Wash A East Reach #1 RS: 2 Profile: Split Flow (100Y

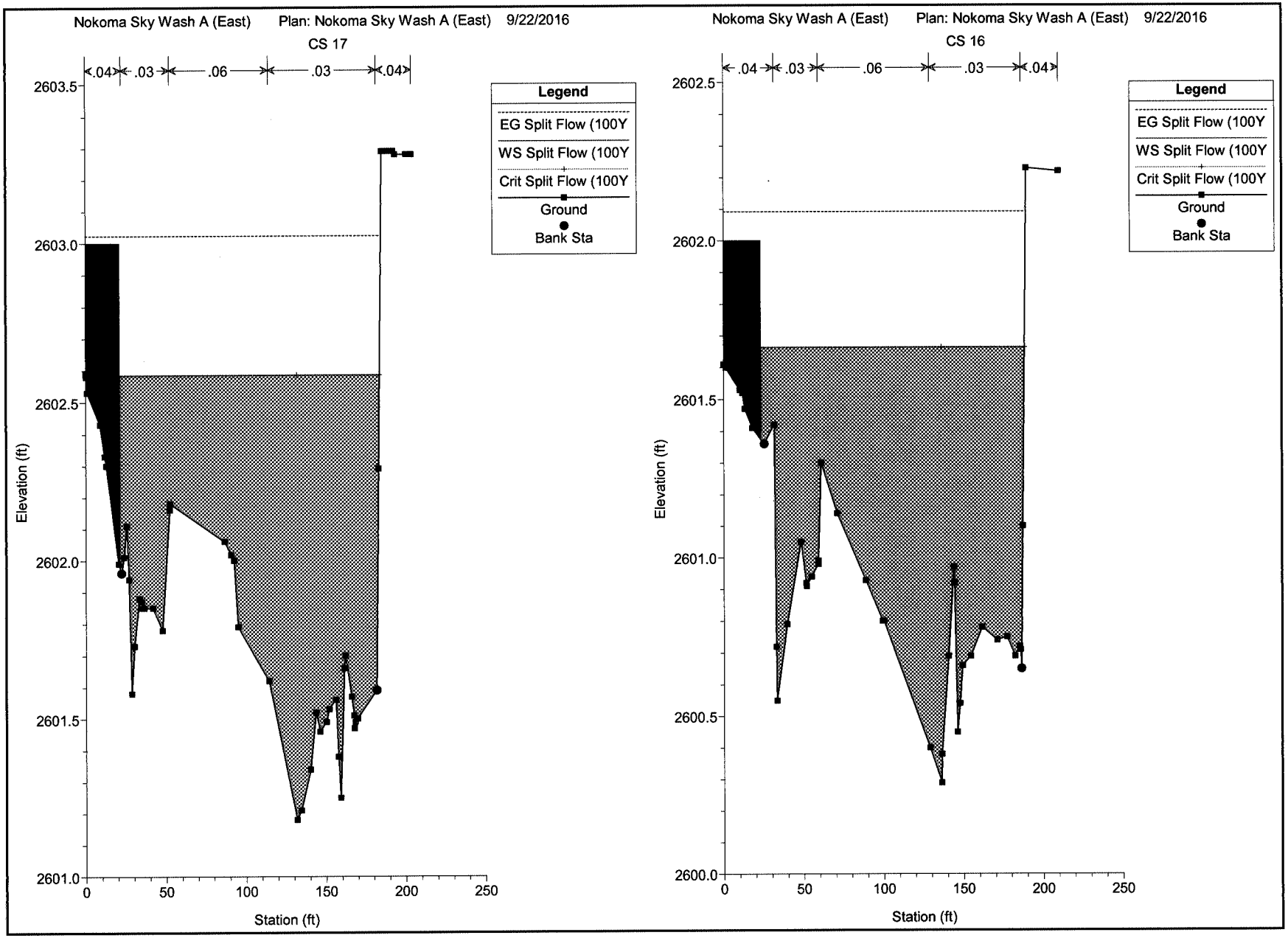
E.G. Elev (ft)	2588.14	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.030	0.030	0.000
W.S. Elev (ft)	2587.22	Reach Len. (ft)	9.10	9.10	9.10
Crit W.S. (ft)	2587.22	Flow Area (sq ft)	0.01	71.38	0.01
E.G. Slope (ft/ft)	0.010698	Area (sq ft)	0.01	71.38	0.01
Q Total (cfs)	548.70	Flow (cfs)	0.00	548.70	0.00
Top Width (ft)	38.86	Top Width (ft)	0.01	38.84	
Vel Total (ft/s)	7.68	Avg. Vel. (ft/s)	0.16	7.69	0.12
Max Chl Dpth (ft)	1.84	Hydr. Depth (ft)	0.92	1.84	0.92
Conv. Total (cfs)	5305.0	Conv. (cfs)	0.0	5305.0	0.0
Length Wtd. (ft)	9.10	Wetted Per. (ft)	1.84	38.84	1.84
Min Ch El (ft)	2585.38	Shear (lb/sq ft)	0.00	1.23	
Alpha	1.00	Stream Power (lb/ft s)	0.00	9.43	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	0.00	0.02	0.00
C & E Loss (ft)	0.12	Cum SA (acres)	0.00	0.02	0.00

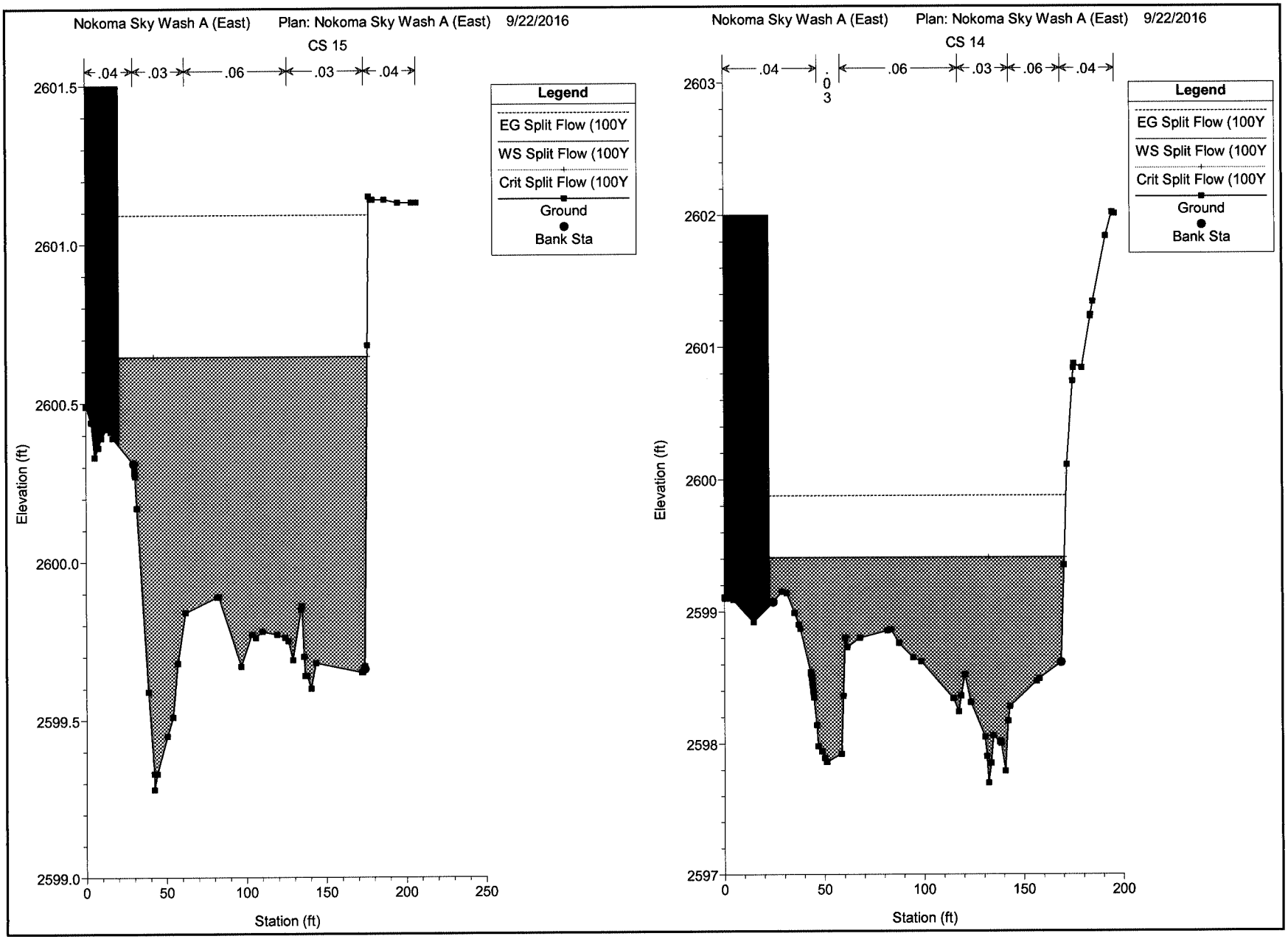
Errors Warnings and Notes

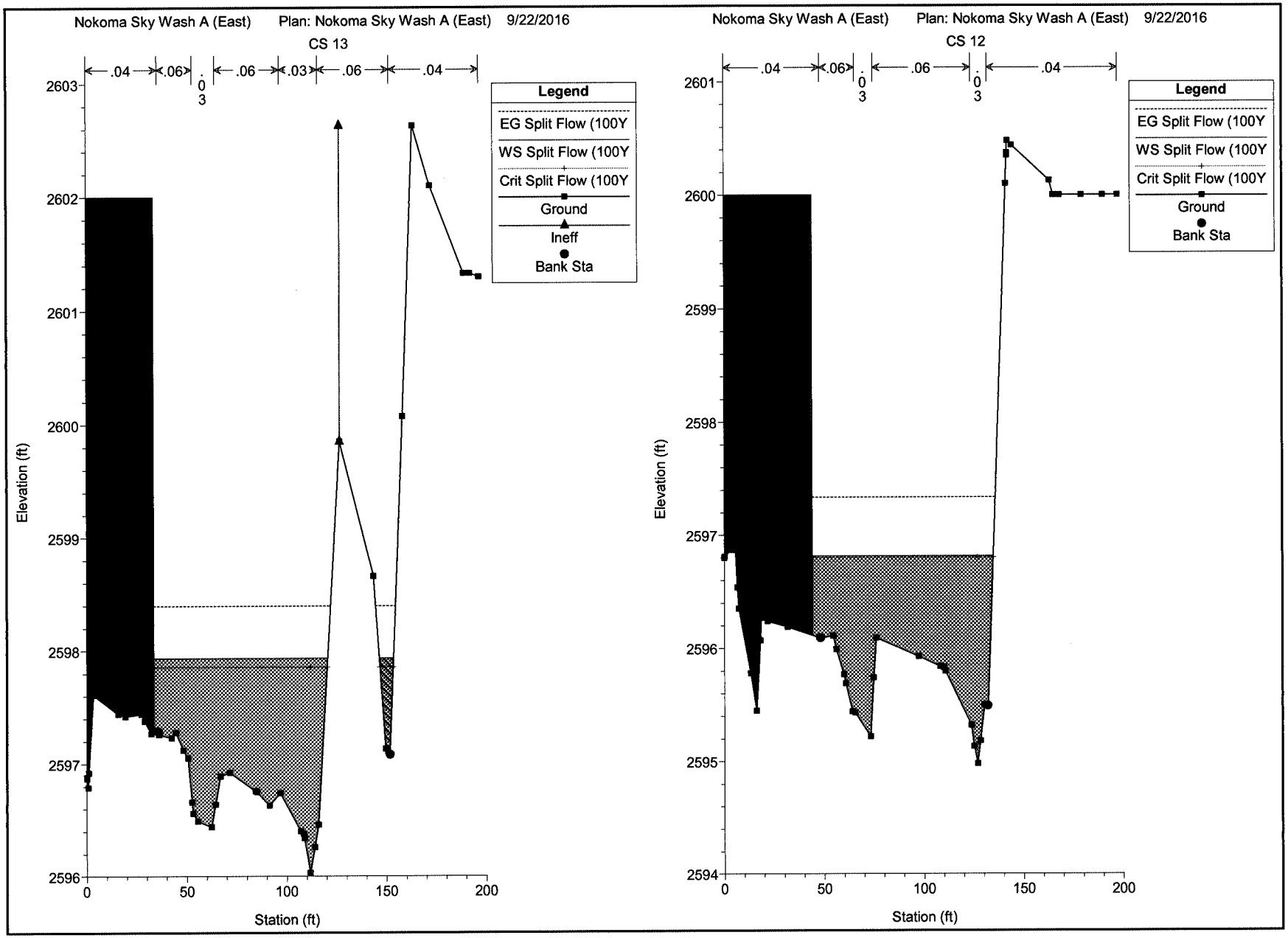
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
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Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

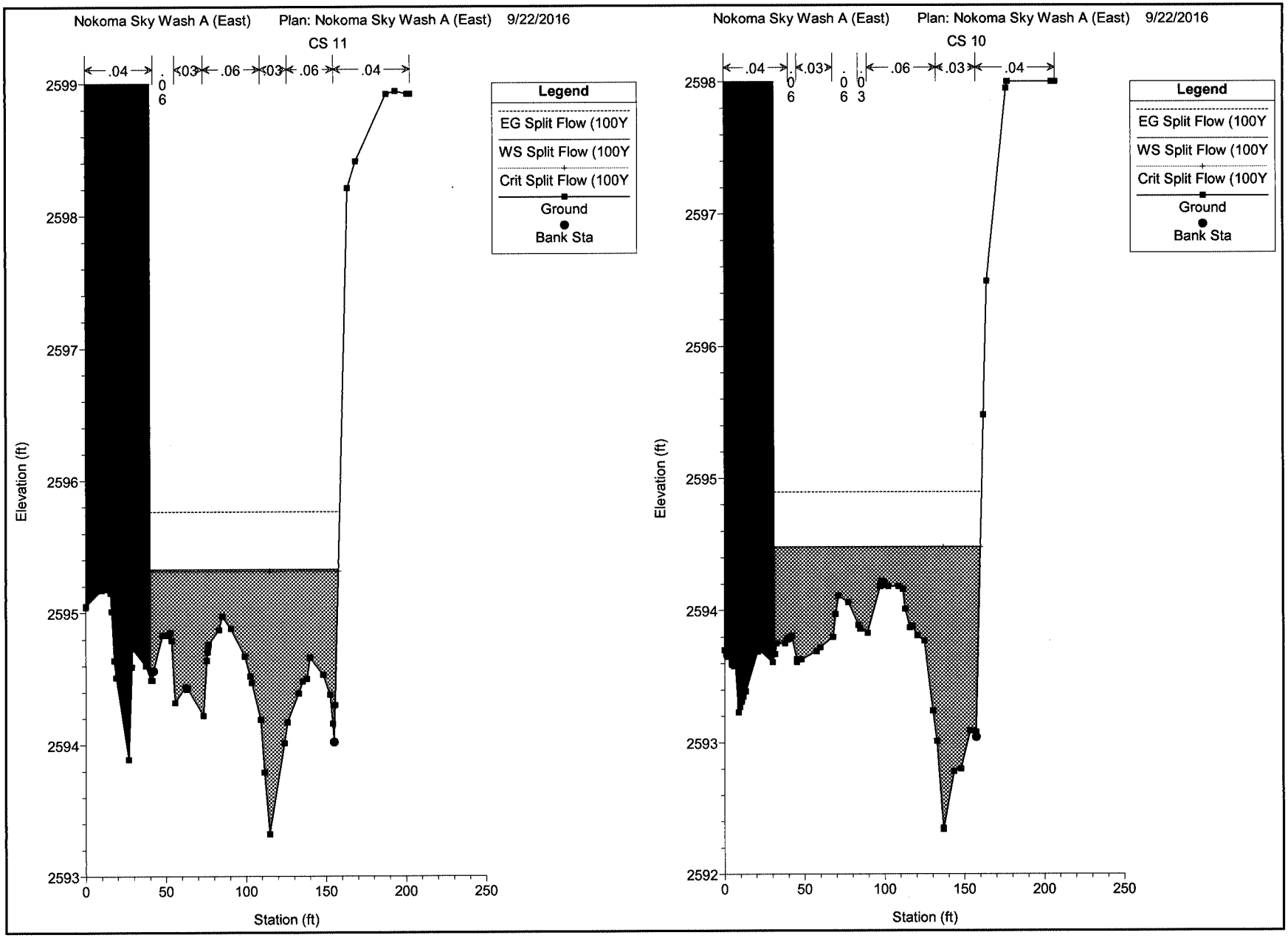
Plan: 1 Wash A East Reach #1 RS: 1 Profile: Split Flow (100Y

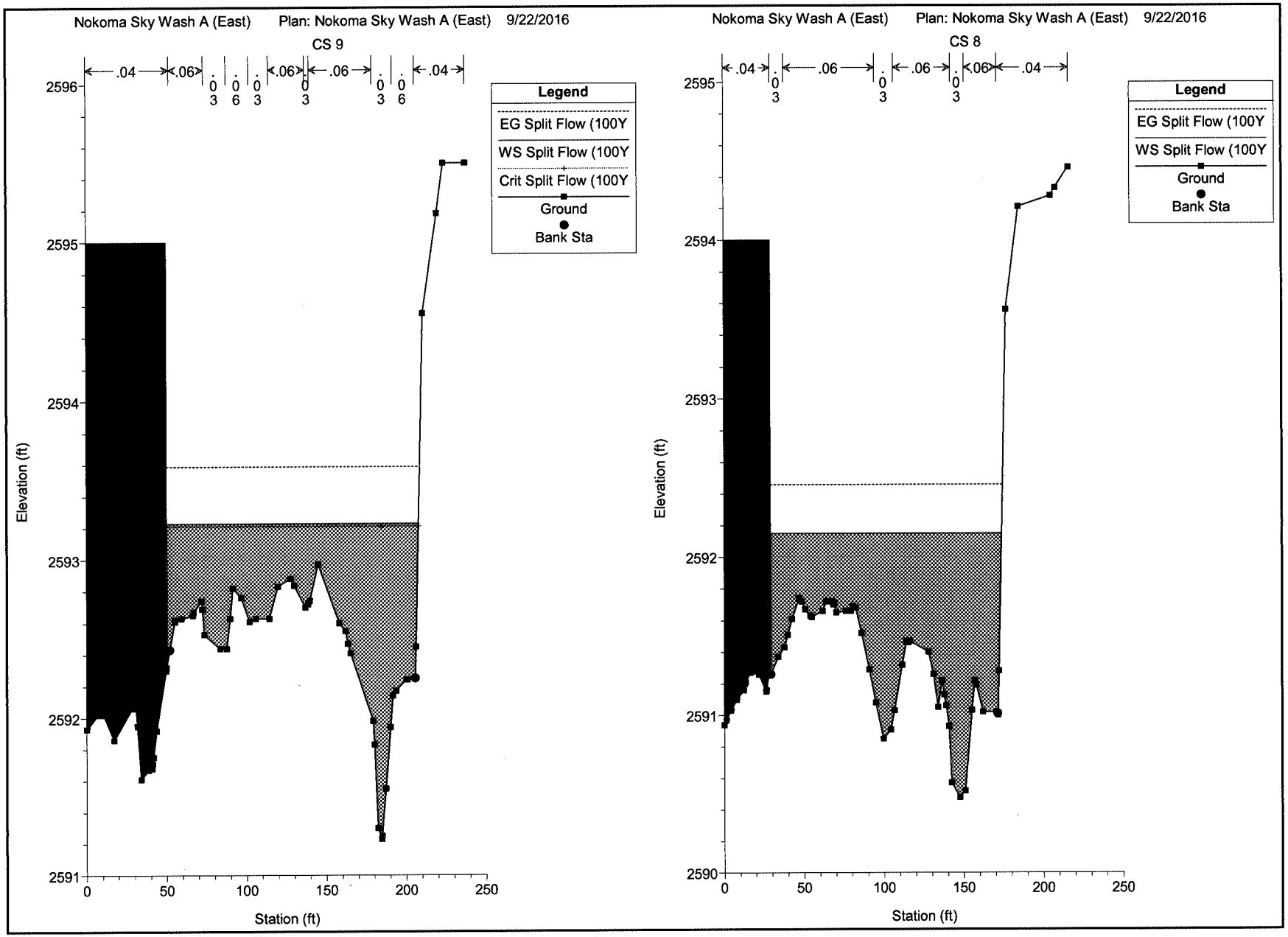
E.G. Elev (ft)	2587.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.		0.040	
W.S. Elev (ft)	2587.29	Reach Len. (ft)			
Crit W.S. (ft)	2587.29	Flow Area (sq ft)		96.47	
E.G. Slope (ft/ft)	0.022753	Area (sq ft)	0.07	126.54	3.03
Q Total (cfs)	548.70	Flow (cfs)		548.70	
Top Width (ft)	140.58	Top Width (ft)	0.50	136.27	3.81
Vel Total (ft/s)	5.69	Avg. Vel. (ft/s)		5.69	
Max Chl Dpth (ft)	1.80	Hydr. Depth (ft)		1.02	
Conv. Total (cfs)	3637.6	Conv. (cfs)		3637.6	
Length Wtd. (ft)		Wetted Per. (ft)		95.16	
Min Ch El (ft)	2585.49	Shear (lb/sq ft)		1.44	
Alpha	1.00	Stream Power (lb/ft s)		8.19	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

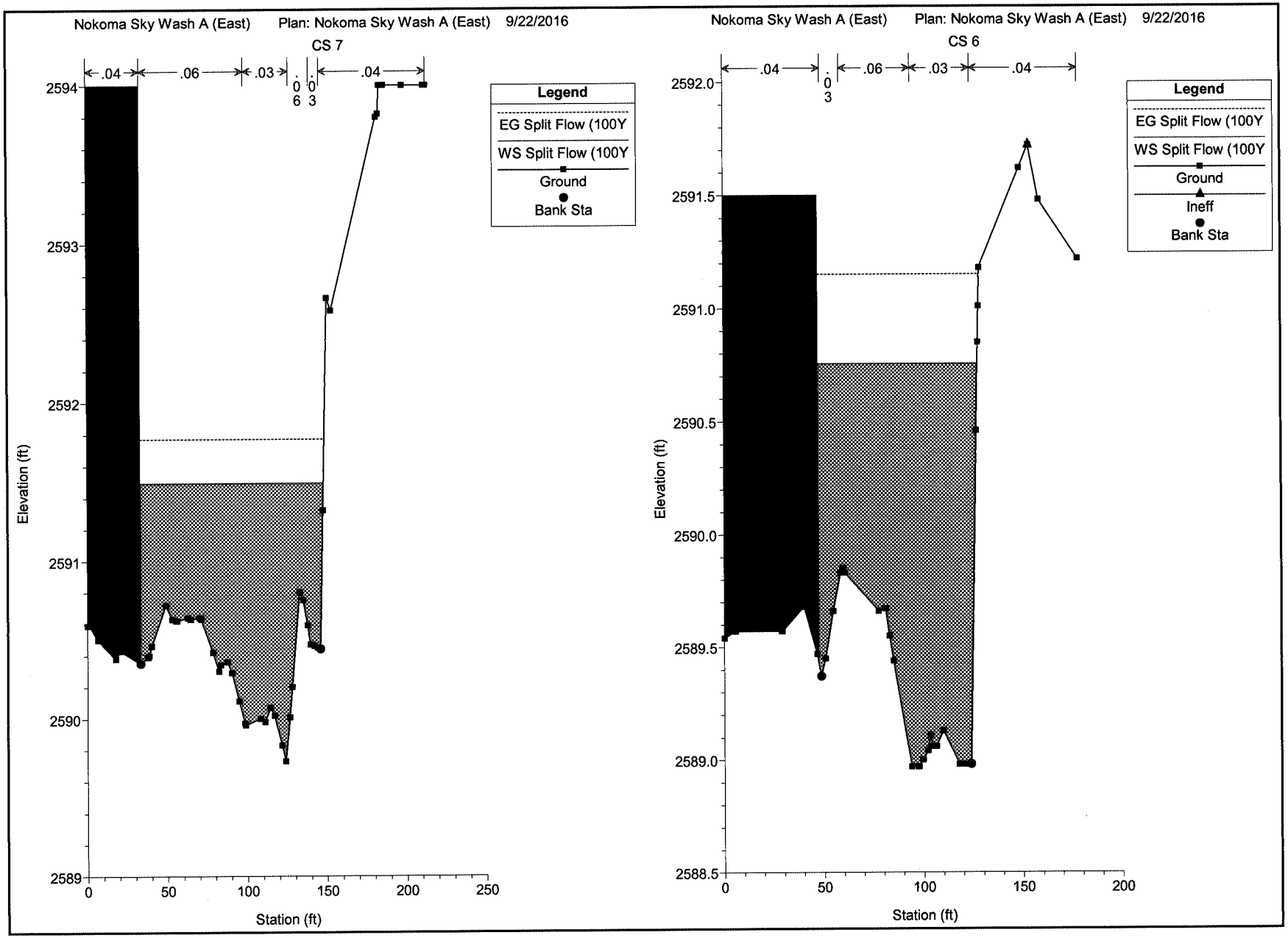

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 17
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.03
.06
.03
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2603.5
2603.0
2602.5
2602.0
2601.5
2601.0
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 16
.04
.03
.06
.03
.04
2602.5
2602.0
2601.5
2601.0
2600.5
2600.0
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta

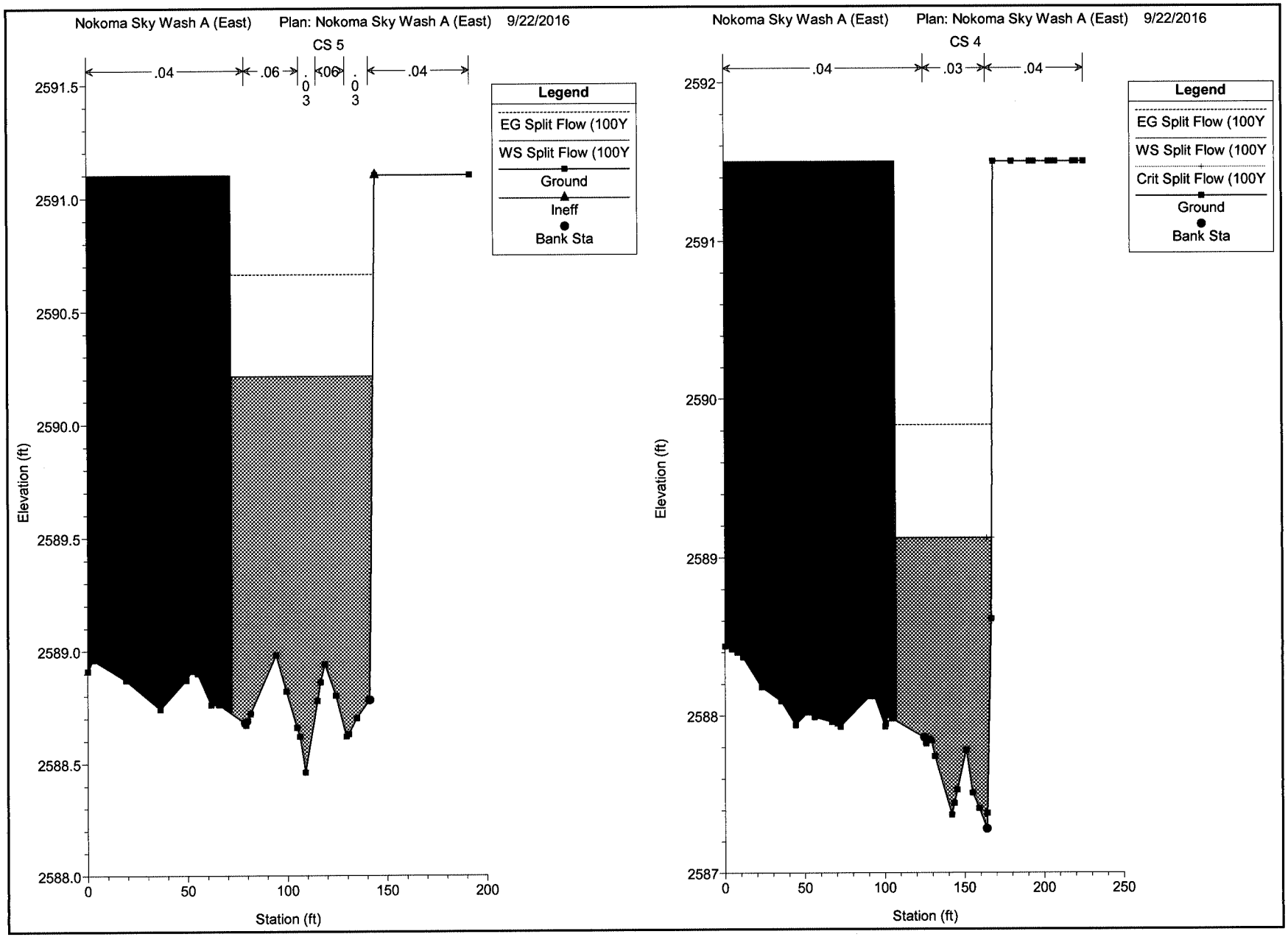

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 15
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2601.5
2601.0
2600.5
2600.0
2599.5
2599.0
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 14
.04
.03
.06
.03
.06
.04
2603
2602
2601
2600
2599
2598
2597
Elevation (ft)
0
50
100
150
200
Station (ft)
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta

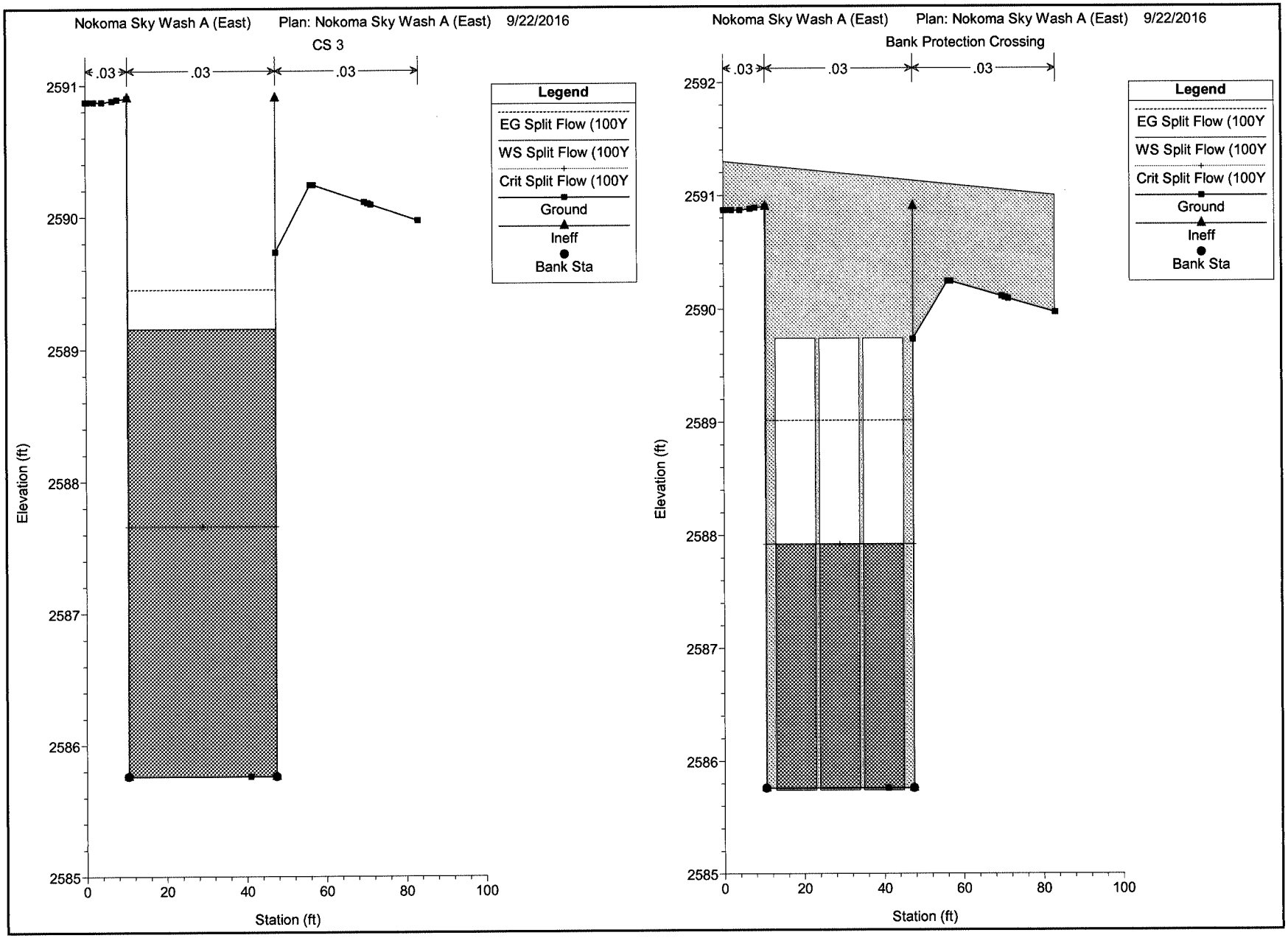

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 13
.04
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Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 12
.04
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Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
Station (ft)

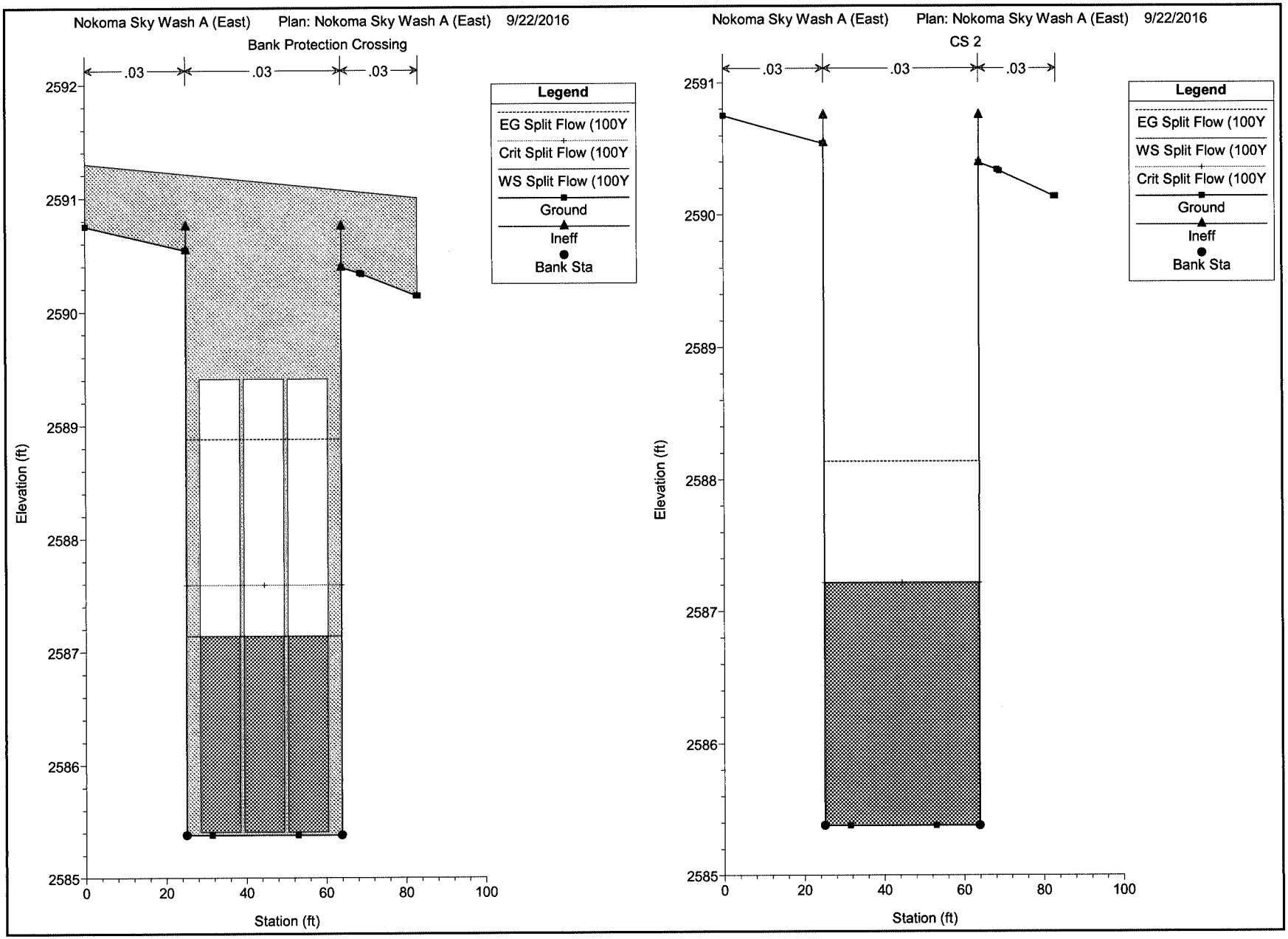

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 11
.04
.06
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.03
.06
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2599
2598
2597
2596
2595
2594
2593
0
50
100
150
200
250
Station (ft)
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 10
.04
.06
.03
.06
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.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2598
2597
2596
2595
2594
2593
2592
0
50
100
150
200
250
Station (ft)

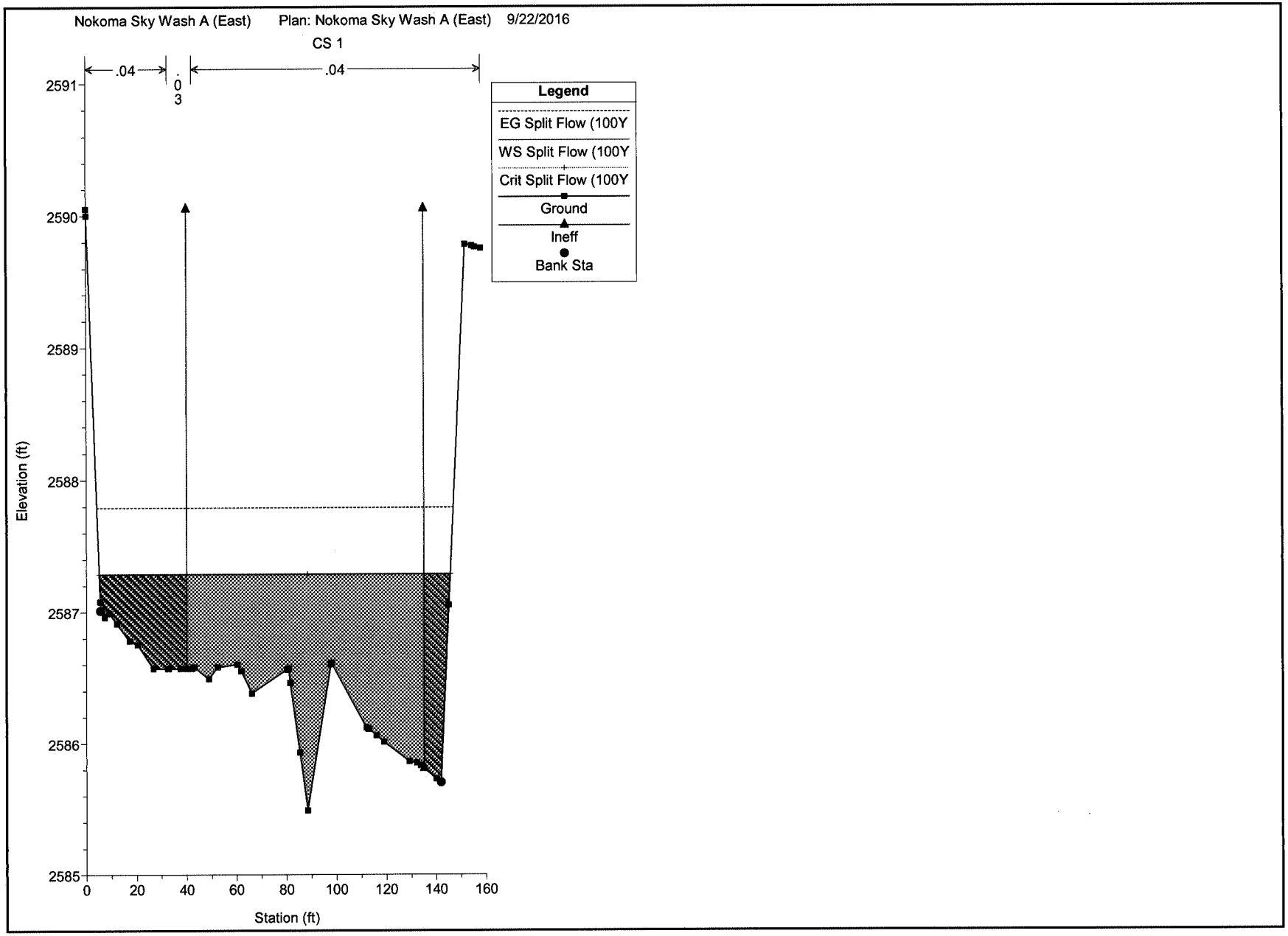

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 9
.04
.06
.03
.06
.03
.06
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.03
.06
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Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
2596
2595
2594
2593
2592
2591
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 8
.04
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.06
.03
.06
.03
.06
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
2595
2594
2593
2592
2591
2590
Elevation (ft)
0
50
100
150
200
250
Station (ft)


Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 7
.04
.06
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2594
2593
2592
2591
2590
2589
0
50
100
150
200
250
Station (ft)
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 6
.04
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
2592.0
2591.5
2591.0
2590.5
2590.0
2589.5
2589.0
2588.5
0
50
100
150
200
Station (ft)

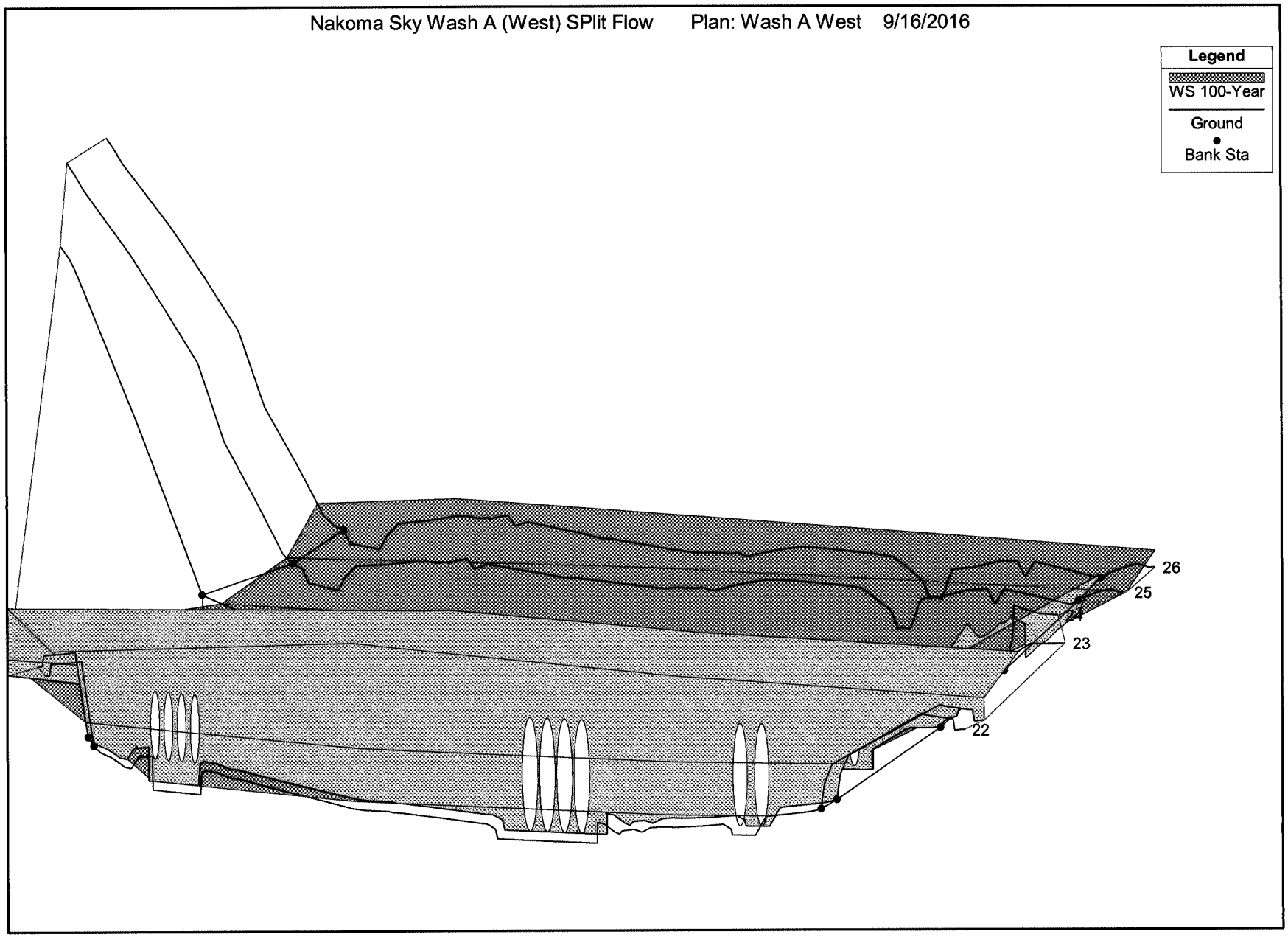

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 5
.04
.06
.03
.06
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
2591.5
2591.0
2590.5
2590.0
2589.5
2589.0
2588.5
2588.0
0
50
100
150
200
Station (ft)
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 4
.04
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Bank Sta
Elevation (ft)
2592
2591
2590
2589
2588
2587
0
50
100
150
200
250
Station (ft)

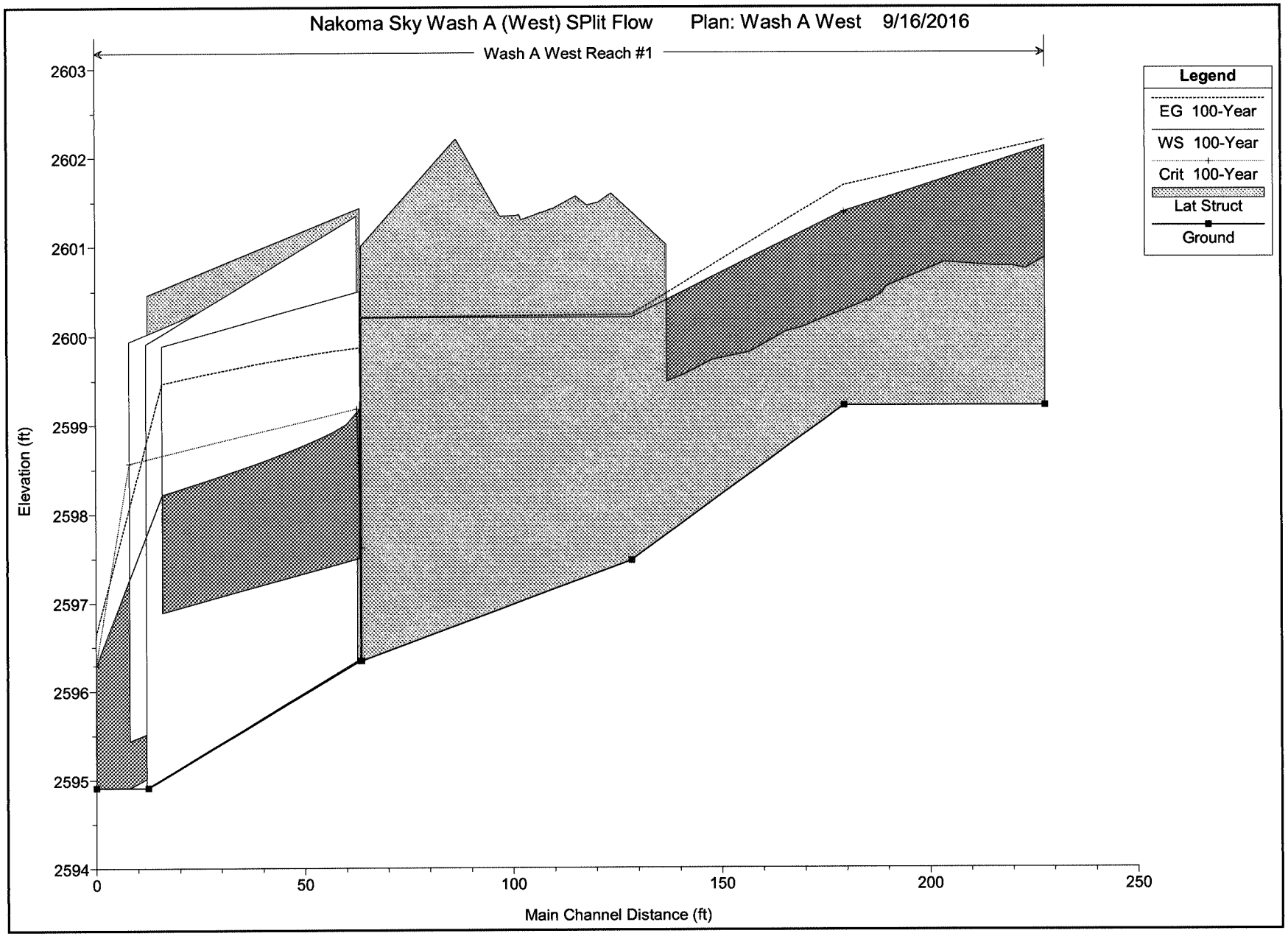

Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 3
.03
.03
.03
2591
2590
2589
2588
2587
2586
2585
Elevation (ft)
0
20
40
60
80
100
Station (ft)
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
Bank Protection Crossing
.03
.03
.03
2592
2591
2590
2589
2588
2587
2586
2585
Elevation (ft)
0
20
40
60
80
100
Station (ft)
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta


Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
Bank Protection Crossing
.03
.03
.03
Legend
EG Split Flow (100Y
Crit Split Flow (100Y
WS Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
2592
2591
2590
2589
2588
2587
2586
2585
0
20
40
60
80
100
Station (ft)
Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 2
.03
.03
.03
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
2591
2590
2589
2588
2587
2586
2585
0
20
40
60
80
100
Station (ft)


Nokoma Sky Wash A (East) Plan: Nokoma Sky Wash A (East) 9/22/2016
CS 1
.04
.03
.04
Legend
EG Split Flow (100Y
WS Split Flow (100Y
Crit Split Flow (100Y
Ground
Ineff
Bank Sta
Elevation (ft)
2591
2590
2589
2588
2587
2586
2585
0
20
40
60
80
100
120
140
160
Station (ft)

WASH A SPLIT FLOW MODELS (EAST & WEST)
FLOODPLAIN (HEC-RAS) MODEL
(POST DEVELOPED MODEL)


Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
Legend
WS 100-Year
Ground
Bank Sta
26
25
24
23
22


Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
Wash A West Reach #1
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Lat Struct
Ground
Elevation (ft)
2603
2602
2601
2600
2599
2598
2597
2596
2595
2594
0
50
100
150
200
250
Main Channel Distance (ft)

Plan: 1 Wash A West Reach #1 RS: 26 Profile: 100-Year

E.G. Elev (ft)	2602.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.	0.036	0.056	0.060
W.S. Elev (ft)	2602.12	Reach Len. (ft)	48.30	48.30	48.30
Crit W.S. (ft)		Flow Area (sq ft)	17.02	324.03	6.45
E.G. Slope (ft/ft)	0.004439	Area (sq ft)	17.02	324.03	6.45
Q Total (cfs)	728.00	Flow (cfs)	44.05	675.12	8.84
Top Width (ft)	281.52	Top Width (ft)	18.64	254.47	8.41
Vel Total (ft/s)	2.09	Avg. Vel. (ft/s)	2.59	2.08	1.37
Max Chl Dpth (ft)	2.91	Hydr. Depth (ft)	0.91	1.27	0.77
Conv. Total (cfs)	10926.5	Conv. (cfs)	661.1	10132.8	132.6
Length Wtd. (ft)	48.30	Wetted Per. (ft)	19.41	255.33	8.52
Min Ch El (ft)	2599.21	Shear (lb/sq ft)	0.24	0.35	0.21
Alpha	1.01	Stream Power (lb/ft s)	0.63	0.73	0.29
Frctn Loss (ft)	0.48	Cum Volume (acre-ft)	0.02	1.43	0.08
C & E Loss (ft)	0.02	Cum SA (acres)	0.04	1.26	0.11

Plan: 1 Wash A West Reach #1 RS: 25 Profile: 100-Year

E.G. Elev (ft)	2601.68	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.040	0.056	0.060
W.S. Elev (ft)	2601.38	Reach Len. (ft)	51.02	51.02	51.02
Crit W.S. (ft)	2601.38	Flow Area (sq ft)	1.97	139.86	0.24
E.G. Slope (ft/ft)	0.059569	Area (sq ft)	1.97	139.86	0.24
Q Total (cfs)	620.11	Flow (cfs)	6.32	613.44	0.36
Top Width (ft)	267.15	Top Width (ft)	11.99	253.27	1.88
Vel Total (ft/s)	4.36	Avg. Vel. (ft/s)	3.20	4.39	1.51
Max Chl Dpth (ft)	2.17	Hydr. Depth (ft)	0.16	0.55	0.13
Conv. Total (cfs)	2540.7	Conv. (cfs)	25.9	2513.4	1.5
Length Wtd. (ft)	51.02	Wetted Per. (ft)	12.02	254.13	1.90
Min Ch El (ft)	2599.21	Shear (lb/sq ft)	0.61	2.05	0.46
Alpha	1.00	Stream Power (lb/ft s)	1.95	8.98	0.70
Frctn Loss (ft)	0.27	Cum Volume (acre-ft)	0.01	1.17	0.08
C & E Loss (ft)	0.08	Cum SA (acres)	0.02	0.98	0.10

Plan: 1 Wash A West Reach #1 RS: 24 Profile: 100-Year

E.G. Elev (ft)	2600.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.	0.040	0.056	
W.S. Elev (ft)	2600.20	Reach Len. (ft)	64.77	64.77	64.77
Crit W.S. (ft)		Flow Area (sq ft)	0.67	381.09	

Plan: 1 Wash A West Reach #1 RS: 24 Profile: 100-Year (Continued)

E.G. Slope (ft/ft)	0.001581	Area (sq ft)	0.67	381.09	
Q Total (cfs)	533.60	Flow (cfs)	0.50	533.10	
Top Width (ft)	263.20	Top Width (ft)	1.66	261.54	
Vel Total (ft/s)	1.40	Avg. Vel. (ft/s)	0.75	1.40	
Max Chl Dpth (ft)	2.73	Hydr. Depth (ft)	0.40	1.46	
Conv. Total (cfs)	13421.2	Conv. (cfs)	12.7	13408.6	
Length Wtd. (ft)	64.77	Wetted Per. (ft)	1.84	262.54	
Min Ch El (ft)	2597.47	Shear (lb/sq ft)	0.04	0.14	
Alpha	1.00	Stream Power (lb/ft s)	0.03	0.20	
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	0.01	0.86	0.08
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	0.68	0.10

Plan: 1 Wash A West Reach #1 RS: 23 Profile: 100-Year

E.G. Elev (ft)	2600.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.056	0.043	0.040
W.S. Elev (ft)	2600.20	Reach Len. (ft)	63.73	63.73	63.73
Crit W.S. (ft)	2597.62	Flow Area (sq ft)	10.59	725.75	103.37
E.G. Slope (ft/ft)	0.000083	Area (sq ft)	10.59	725.75	103.37
Q Total (cfs)	533.60	Flow (cfs)	3.24	484.60	45.76
Top Width (ft)	316.90	Top Width (ft)	7.49	242.39	67.02
Vel Total (ft/s)	0.64	Avg. Vel. (ft/s)	0.31	0.67	0.44
Max Chl Dpth (ft)	3.86	Hydr. Depth (ft)	1.41	2.99	1.54
Conv. Total (cfs)	58415.6	Conv. (cfs)	355.2	53050.6	5009.8
Length Wtd. (ft)	63.73	Wetted Per. (ft)	8.03	245.49	69.64
Min Ch El (ft)	2596.34	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.05	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)		0.04	
C & E Loss (ft)		Cum SA (acres)	0.01	0.30	0.05

Plan: 1 Wash A West Reach #1 RS: 22 Profile: 100-Year

E.G. Elev (ft)	2596.64	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.		0.048	
W.S. Elev (ft)	2596.29	Reach Len. (ft)			
Crit W.S. (ft)	2596.29	Flow Area (sq ft)		113.27	
E.G. Slope (ft/ft)	0.040751	Area (sq ft)		113.27	
Q Total (cfs)	533.60	Flow (cfs)		533.60	
Top Width (ft)	169.31	Top Width (ft)		169.31	
Vel Total (ft/s)	4.71	Avg. Vel. (ft/s)		4.71	

Plan: 1 Wash A West Reach #1 RS: 22 Profile: 100-Year (Continued)

Max Chl Dpth (ft)	1.38	Hydr. Depth (ft)		0.67	
Conv. Total (cfs)	2643.3	Conv. (cfs)		2643.3	
Length Wtd. (ft)		Wetted Per. (ft)		171.18	
Min Ch El (ft)	2594.91	Shear (lb/sq ft)		1.68	
Alpha	1.00	Stream Power (lb/ft s)		7.93	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Plan: 1 Wash A West Reach #1 RS: 22.5 Culv Group: Culvert #1 Profile: 100-Year

Q Culv Group (cfs)	127.65	Culv Full Len (ft)	
# Barrels	2	Culv Vel US (ft/s)	7.70
Q Barrel (cfs)	63.82	Culv Vel DS (ft/s)	11.02
E.G. US. (ft)	2600.21	Culv Inv El Up (ft)	2596.50
W.S. US. (ft)	2600.20	Culv Inv El Dn (ft)	2595.44
E.G. DS (ft)	2596.64	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	2596.29	Culv Exit Loss (ft)	2.46
Delta EG (ft)	3.57	Culv Entr Loss (ft)	0.46
Delta WS (ft)	3.91	Q Weir (cfs)	
E.G. IC (ft)	2599.86	Weir Sta Lft (ft)	
E.G. OC (ft)	2600.21	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	2598.83	Weir Max Depth (ft)	
Culv WS Outlet (ft)	2597.21	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.65	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.32	Min El Weir Flow (ft)	2601.44

Plan: 1 Wash A West Reach #1 RS: 22.5 Culv Group: Culvert #2 Profile: 100-Year

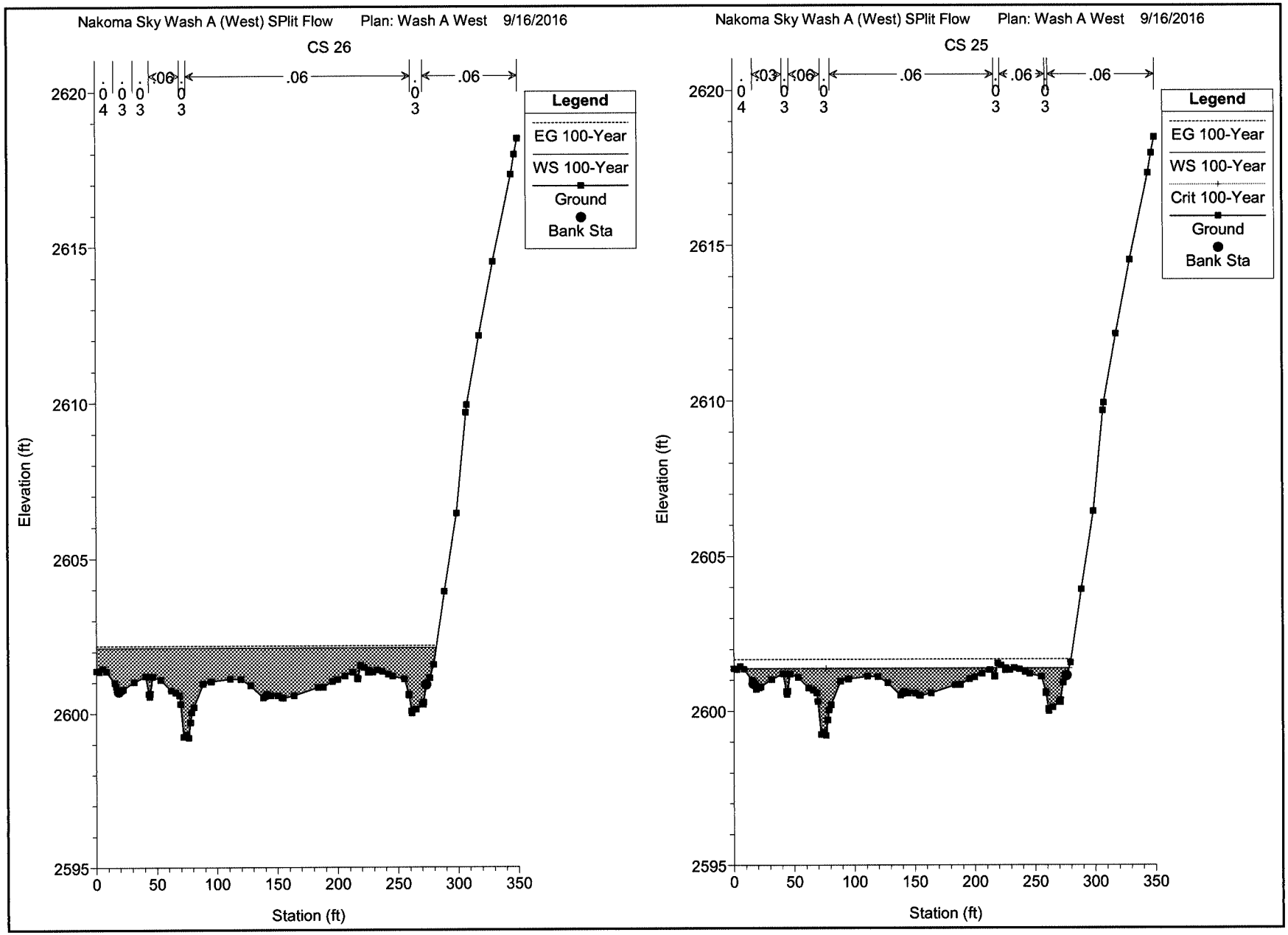
Q Culv Group (cfs)	297.82	Culv Full Len (ft)	
# Barrels	4	Culv Vel US (ft/s)	7.83
Q Barrel (cfs)	74.46	Culv Vel DS (ft/s)	13.05
E.G. US. (ft)	2600.21	Culv Inv El Up (ft)	2596.34
W.S. US. (ft)	2600.20	Culv Inv El Dn (ft)	2594.91
E.G. DS (ft)	2596.64	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	2596.29	Culv Exit Loss (ft)	2.58
Delta EG (ft)	3.57	Culv Entr Loss (ft)	0.48
Delta WS (ft)	3.91	Q Weir (cfs)	
E.G. IC (ft)	2599.80	Weir Sta Lft (ft)	
E.G. OC (ft)	2600.21	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	2598.78	Weir Max Depth (ft)	
Culv WS Outlet (ft)	2596.57	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.40	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.44	Min El Weir Flow (ft)	2601.44

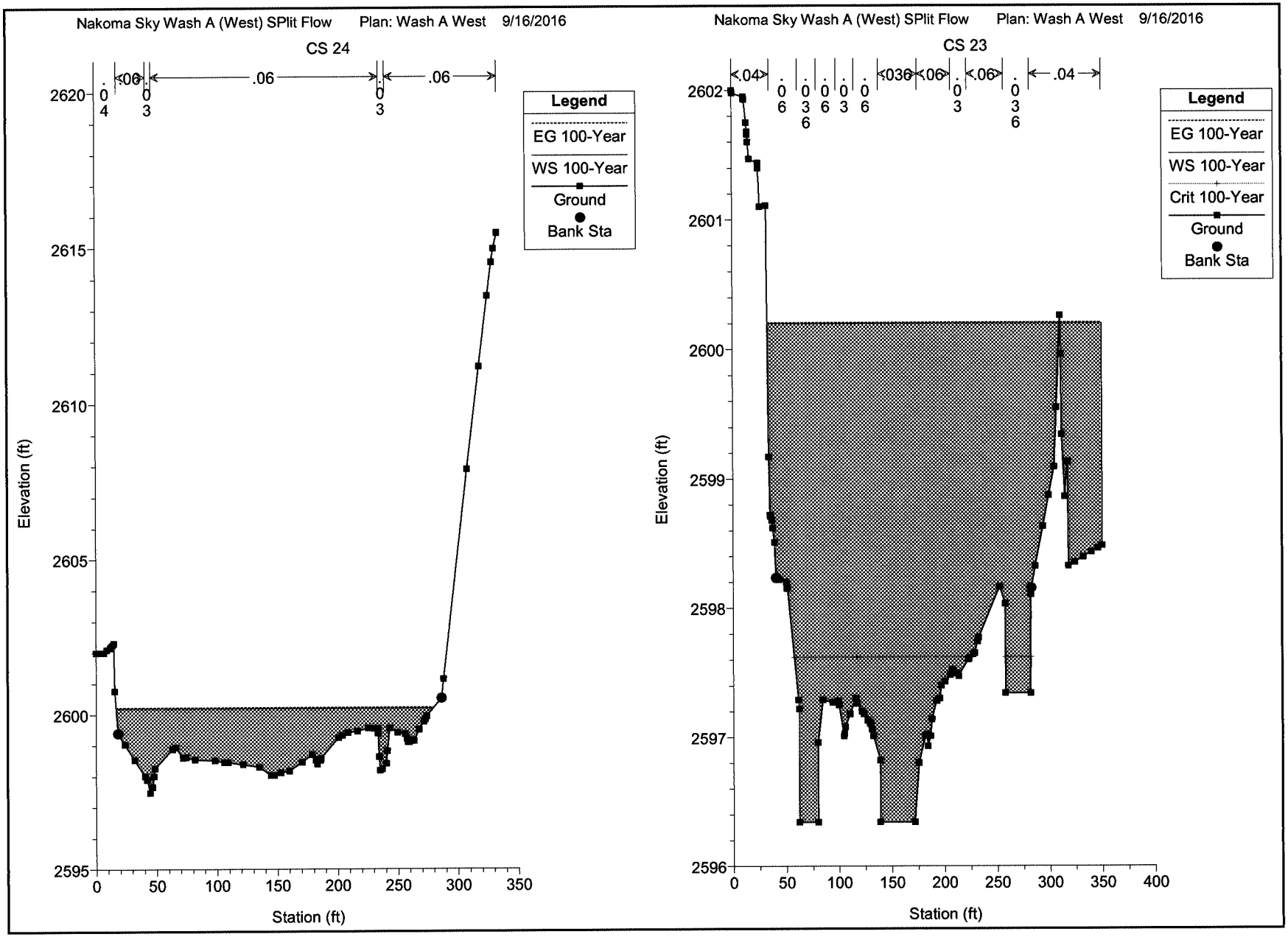
Plan: 1 Wash A West Reach #1 RS: 22.5 Culv Group: Culvert #3 Profile: 100-Year

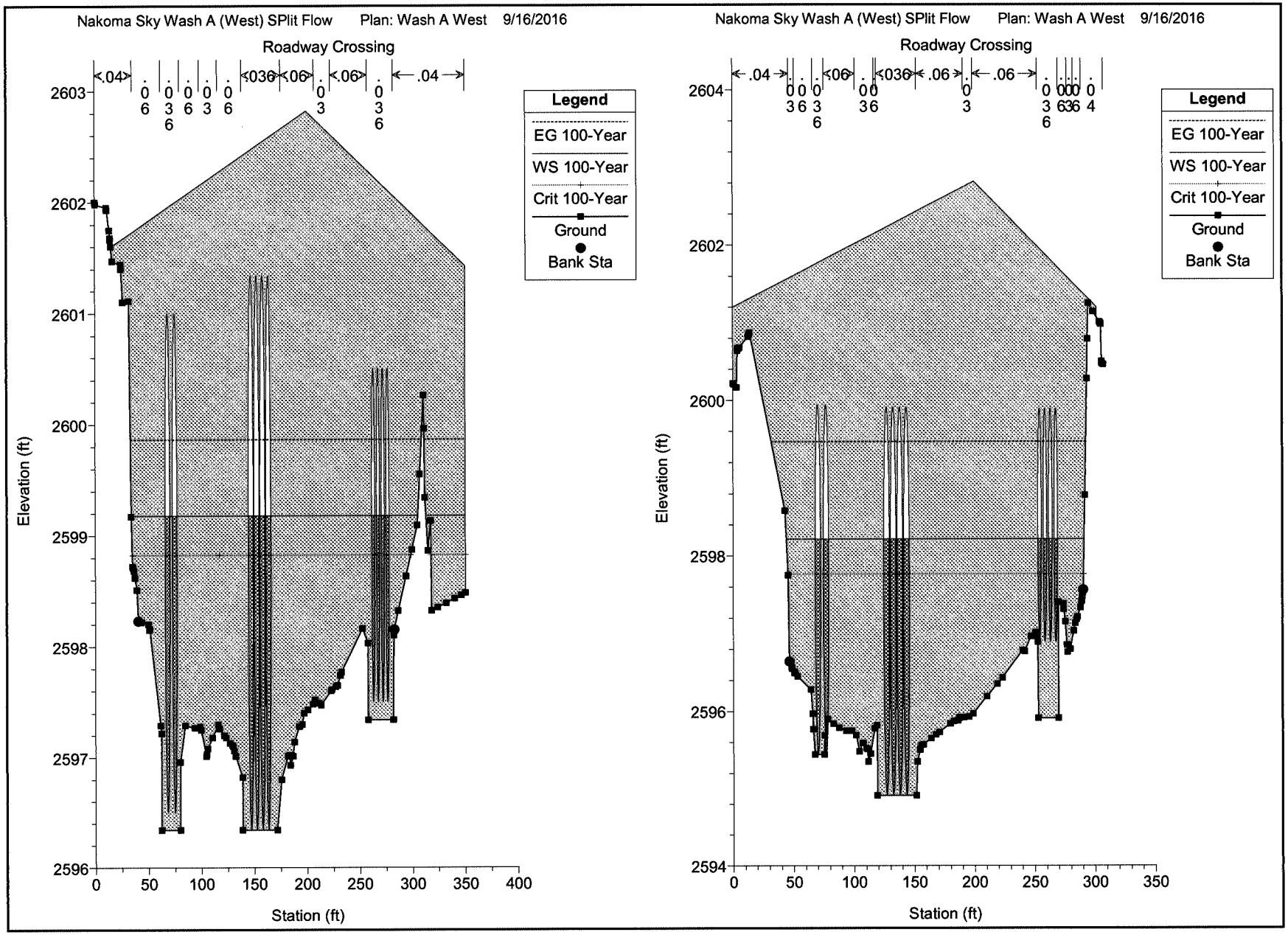
Q Culv Group (cfs)	108.13	Culv Full Len (ft)	
# Barrels	4	Culv Vel US (ft/s)	6.63
Q Barrel (cfs)	27.03	Culv Vel DS (ft/s)	8.99
E.G. US. (ft)	2600.21	Culv Inv El Up (ft)	2597.50
W.S. US. (ft)	2600.20	Culv Inv El Dn (ft)	2596.89
E.G. DS (ft)	2596.64	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	2596.29	Culv Exit Loss (ft)	2.83
Delta EG (ft)	3.57	Culv Entr Loss (ft)	0.34
Delta WS (ft)	3.91	Q Weir (cfs)	
E.G. IC (ft)	2599.99	Weir Sta Lft (ft)	
E.G. OC (ft)	2600.21	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	2599.18	Weir Max Depth (ft)	
Culv WS Outlet (ft)	2598.21	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.24	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	1.68	Min El Weir Flow (ft)	2601.44

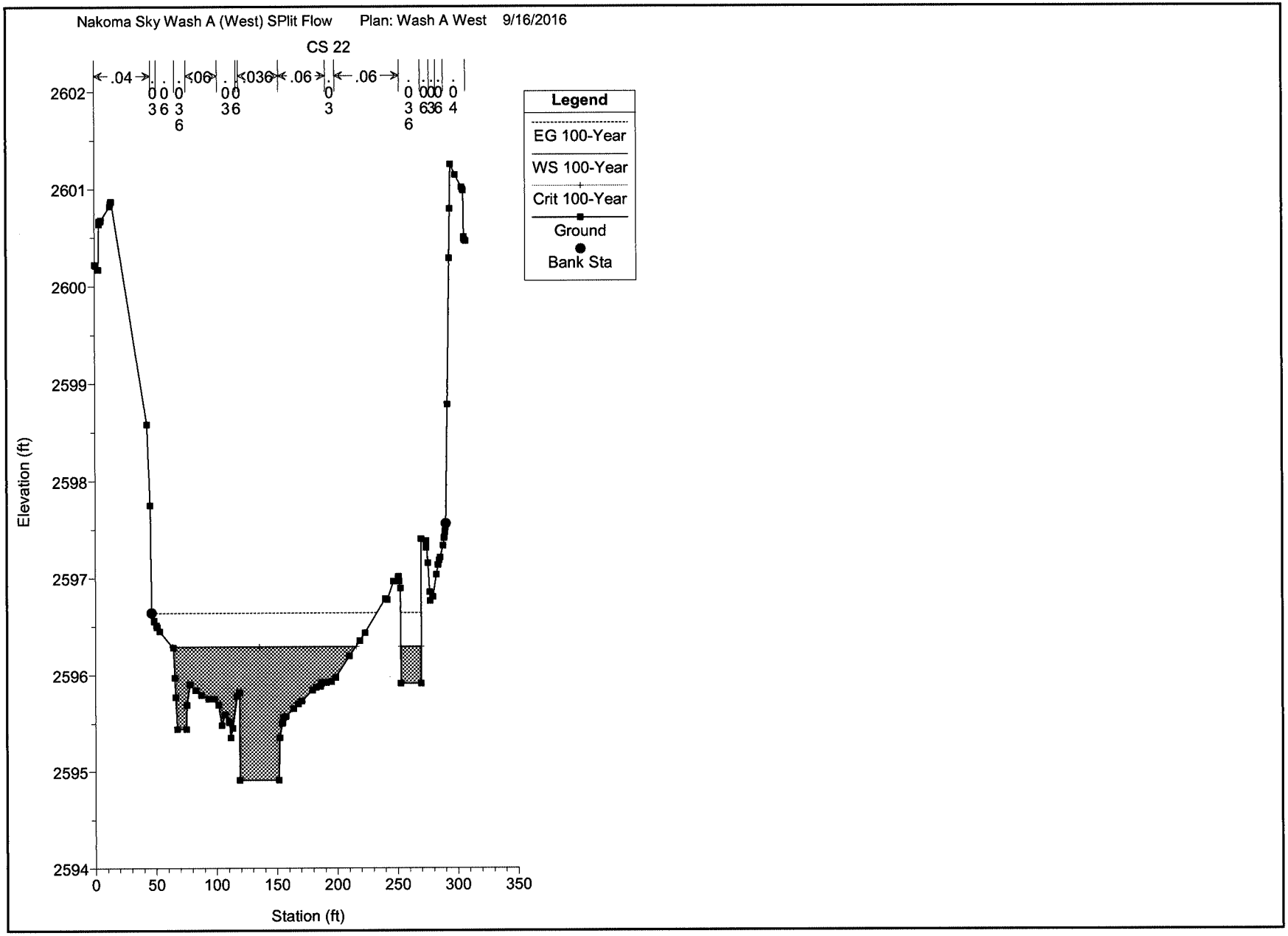
Plan: 1 Wash A West Reach #1 RS: 25.8 Lateral Structure Profile: 100-Year

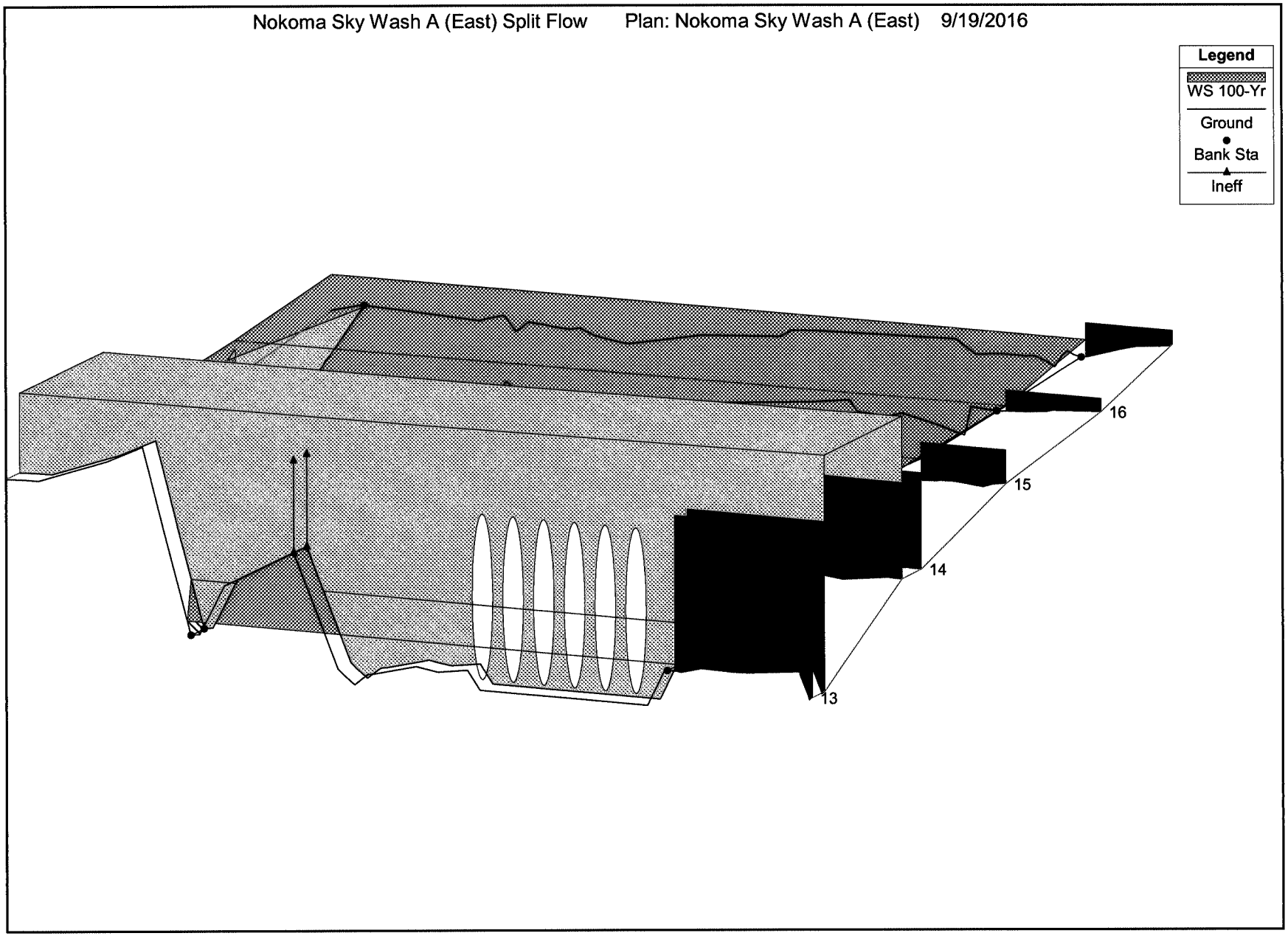
E.G. US. (ft)	2602.19	Weir Sta US (ft)	0.00
W.S. US. (ft)	2602.12	Weir Sta DS (ft)	90.86
E.G. DS (ft)	2600.21	Min El Weir Flow (ft)	2599.48
W.S. DS (ft)	2600.20	Wr Top Wdth (ft)	90.86
Q US (cfs)	728.00	Weir Max Depth (ft)	1.31
Q Leaving Total (cfs)	195.68	Weir Avg Depth (ft)	1.05
Q DS (cfs)	533.60	Weir Flow Area (sq ft)	95.25
Perc Q Leaving	26.70	Weir Coef (ft^1/2)	2.000
Q Weir (cfs)	195.68	Weir Submerg	0.00
Q Gates (cfs)		Q Gate Group (cfs)	
Q Culv (cfs)		Gate Open Ht (ft)	
Q Lat RC (cfs)		Gate #Open	
Q Outlet TS (cfs)	0.00	Gate Area (sq ft)	
Q Breach (cfs)		Gate Submerg	
Breach Avg Velocity (ft/s)		Gate Invert (ft)	
Breach Flow Area (sq ft)		Gate Weir Coef	
Breach WD (ft)			
Breach Top El (ft)			
Breach Bottom El (ft)			
Breach SSL (ft)			
Breach SSR (ft)			

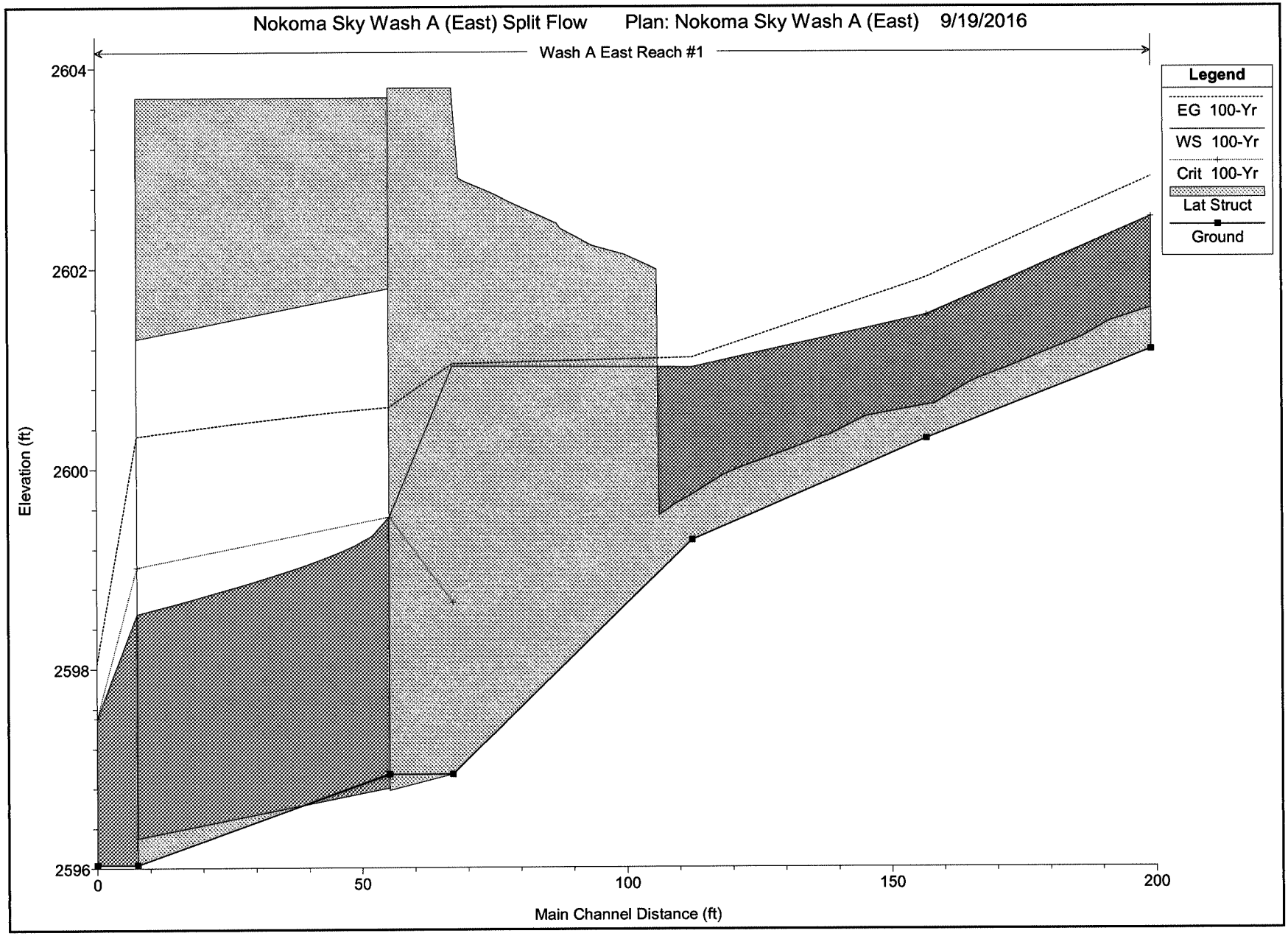

Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
CS 26
.04 .03 .03 .06 .03 .06 .06 .03
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0 50 100 150 200 250 300 350
Station (ft)
Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
CS 25
.04 .03 .03 .06 .03 .06 .03 .06 .03
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0 50 100 150 200 250 300 350
Station (ft)


Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
CS 24
.04
.06
.06
.06
.03
.03
Legend
EG 100-Year
WS 100-Year
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0
50
100
150
200
250
300
350
Station (ft)
Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
CS 23
.04
.06
.03
.06
.03
.06
.03
.06
.06
.03
.04
.03
.06
.06
.03
.06
.04
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Bank Sta
Elevation (ft)
2602
2601
2600
2599
2598
2597
2596
0
50
100
150
200
250
300
350
400
Station (ft)


Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
Roadway Crossing
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash A (West) SPlit Flow Plan: Wash A West 9/16/2016
Roadway Crossing
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Bank Sta
Elevation (ft)
Station (ft)


Nakoma Sky Wash A (West) SPlit Flow
Plan: Wash A West
9/16/2016
CS 22
.04
.06
.036
.06
.06
Legend
EG 100-Year
WS 100-Year
Crit 100-Year
Ground
Bank Sta
Elevation (ft)
2602
2601
2600
2599
2598
2597
2596
2595
2594
0
50
100
150
200
250
300
350
Station (ft)


Nokoma Sky Wash A (East) Split Flow
Plan: Nokoma Sky Wash A (East) 9/19/2016
Legend
WS 100-Yr
Ground
Bank Sta
Ineff
16
15
14
13


Nokoma Sky Wash A (East) Split Flow
Plan: Nokoma Sky Wash A (East) 9/19/2016
Wash A East Reach #1
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Lat Struct
Ground
Elevation (ft)
2604
2602
2600
2598
2596
0
50
100
150
200
Main Channel Distance (ft)

Plan: 1 Wash A East Reach #1 RS: 17 Profile: 100-Yr

E.G. Elev (ft)	2602.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.040	0.033	0.030
W.S. Elev (ft)	2602.50	Reach Len. (ft)	42.55	42.55	42.55
Crit W.S. (ft)	2602.50	Flow Area (sq ft)	0.58	135.28	7.46
E.G. Slope (ft/ft)	0.015988	Area (sq ft)	0.58	135.28	7.46
Q Total (cfs)	728.00	Flow (cfs)	1.38	685.18	41.44
Top Width (ft)	182.72	Top Width (ft)	1.09	173.78	7.85
Vel Total (ft/s)	5.08	Avg. Vel. (ft/s)	2.37	5.06	5.56
Max Chl Dpth (ft)	1.32	Hydr. Depth (ft)	0.53	0.78	0.95
Conv. Total (cfs)	5757.5	Conv. (cfs)	10.9	5418.8	327.8
Length Wtd. (ft)	42.55	Wetted Per. (ft)	1.61	173.94	8.92
Min Ch El (ft)	2601.18	Shear (lb/sq ft)	0.36	0.78	0.83
Alpha	1.00	Stream Power (lb/ft s)	0.85	3.93	4.64
Frctn Loss (ft)	0.72	Cum Volume (acre-ft)	0.01	0.74	0.07
C & E Loss (ft)	0.01	Cum SA (acres)	0.02	0.65	0.08

Plan: 1 Wash A East Reach #1 RS: 16 Profile: 100-Yr

E.G. Elev (ft)	2601.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.040	0.037	0.030
W.S. Elev (ft)	2601.53	Reach Len. (ft)	44.21	44.21	44.21
Crit W.S. (ft)	2601.53	Flow Area (sq ft)	0.35	119.10	19.59
E.G. Slope (ft/ft)	0.017997	Area (sq ft)	0.35	119.10	19.59
Q Total (cfs)	659.44	Flow (cfs)	0.50	532.93	126.02
Top Width (ft)	186.75	Top Width (ft)	2.24	165.09	19.42
Vel Total (ft/s)	4.74	Avg. Vel. (ft/s)	1.40	4.47	6.43
Max Chl Dpth (ft)	1.24	Hydr. Depth (ft)	0.16	0.72	1.01
Conv. Total (cfs)	4915.6	Conv. (cfs)	3.7	3972.5	939.3
Length Wtd. (ft)	44.21	Wetted Per. (ft)	2.39	165.52	20.56
Min Ch El (ft)	2600.29	Shear (lb/sq ft)	0.17	0.81	1.07
Alpha	1.07	Stream Power (lb/ft s)	0.23	3.62	6.89
Frctn Loss (ft)	0.26	Cum Volume (acre-ft)	0.01	0.62	0.06
C & E Loss (ft)	0.08	Cum SA (acres)	0.01	0.48	0.06

Plan: 1 Wash A East Reach #1 RS: 15 Profile: 100-Yr

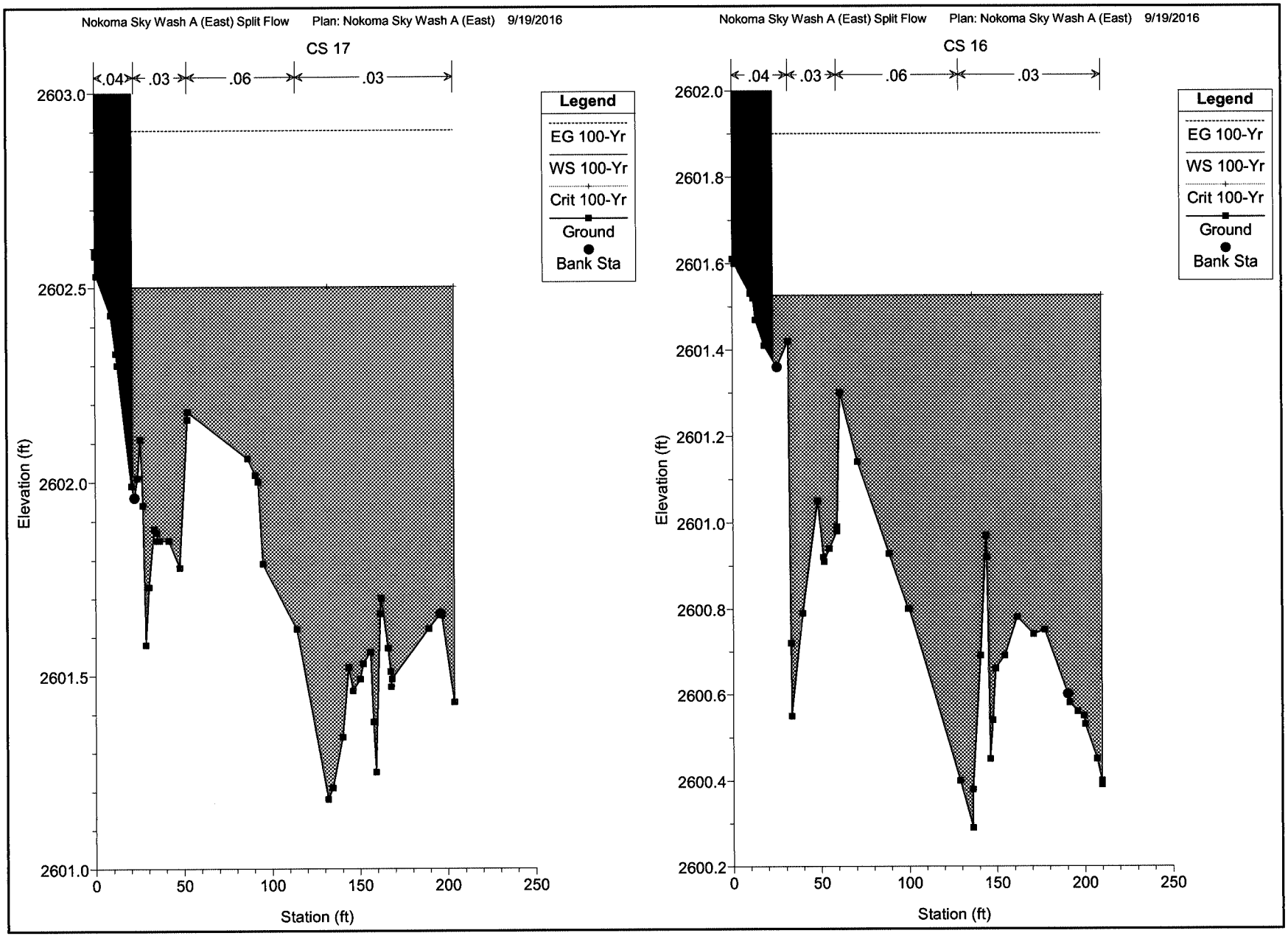
E.G. Elev (ft)	2601.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.040	0.038	0.030
W.S. Elev (ft)	2601.01	Reach Len. (ft)	45.27	45.27	45.27
Crit W.S. (ft)		Flow Area (sq ft)	6.13	184.00	41.57
E.G. Slope (ft/ft)	0.002650	Area (sq ft)	6.13	184.00	41.57
Q Total (cfs)	569.20	Flow (cfs)	8.57	442.39	118.24
Top Width (ft)	186.35	Top Width (ft)	9.16	143.18	34.01
Vel Total (ft/s)	2.46	Avg. Vel. (ft/s)	1.40	2.40	2.84
Max Chl Dpth (ft)	1.73	Hydr. Depth (ft)	0.67	1.29	1.22
Conv. Total (cfs)	11056.8	Conv. (cfs)	166.5	8593.5	2296.8
Length Wtd. (ft)	45.27	Wetted Per. (ft)	9.80	143.26	35.29
Min Ch El (ft)	2599.28	Shear (lb/sq ft)	0.10	0.21	0.19
Alpha	1.03	Stream Power (lb/ft s)	0.14	0.51	0.55
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.01	0.46	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.01	0.33	0.03

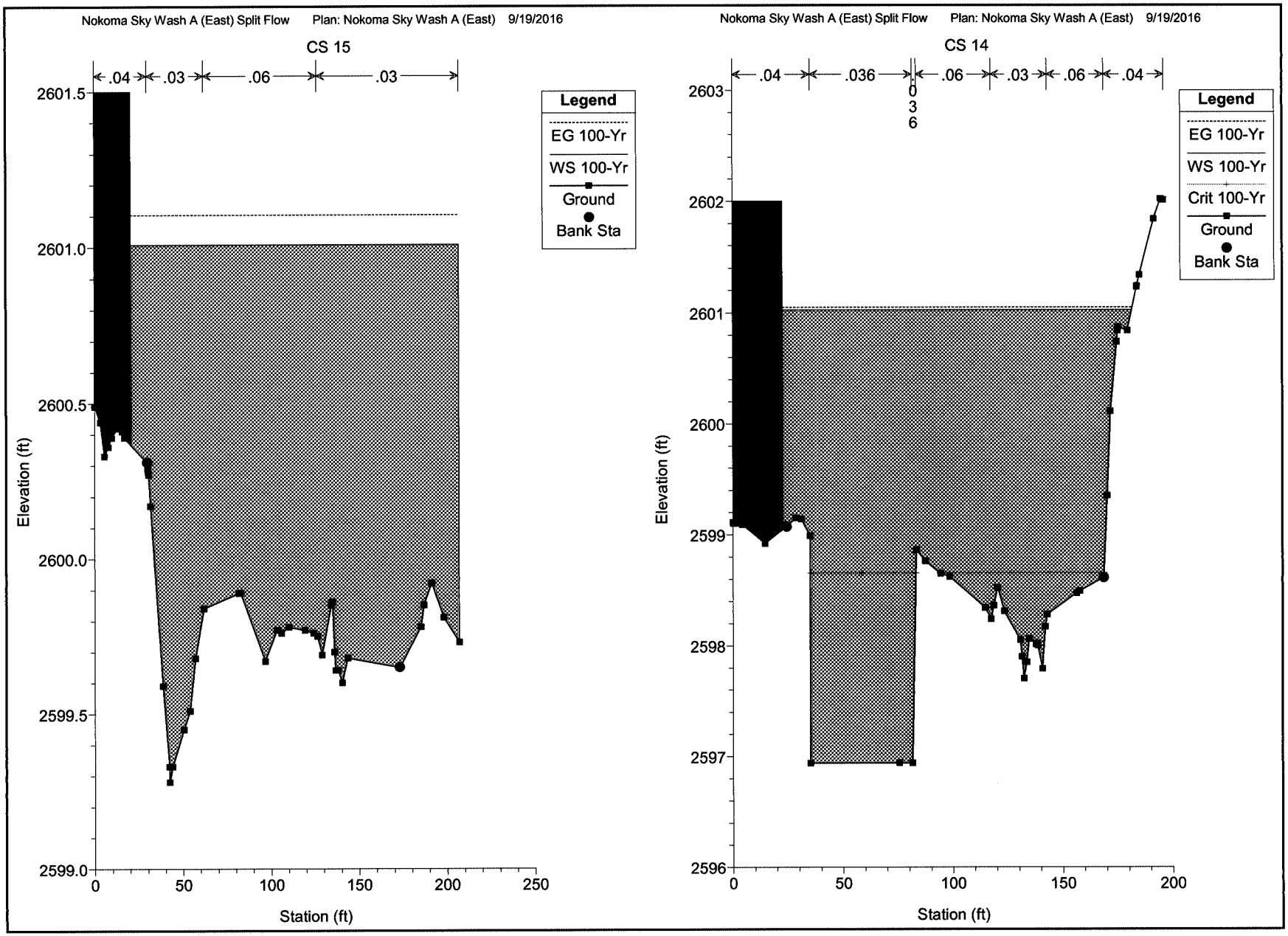
Plan: 1 Wash A East Reach #1 RS: 14 Profile: 100-Yr

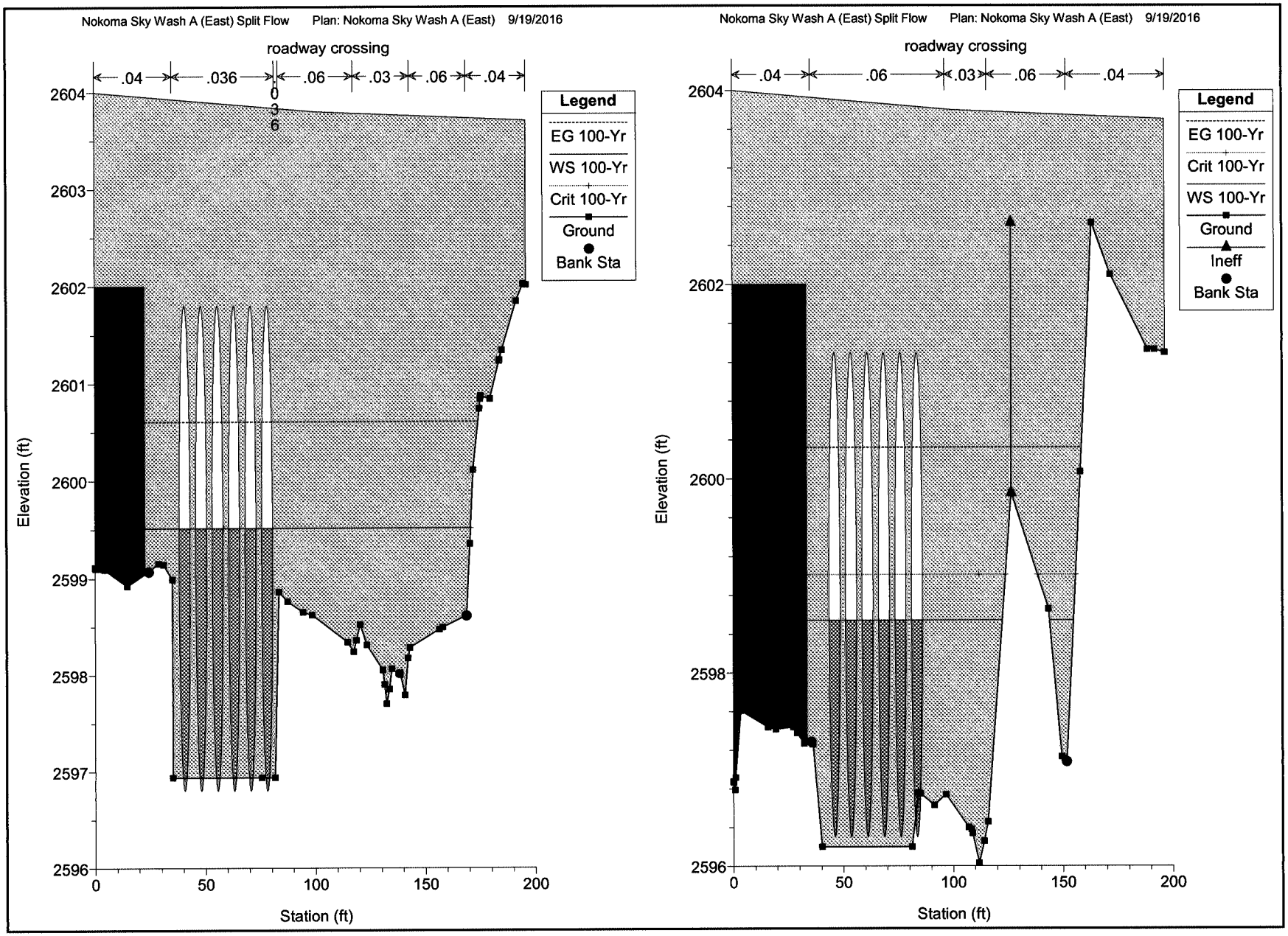
E.G. Elev (ft)	2601.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.040	0.046	0.040
W.S. Elev (ft)	2601.03	Reach Len. (ft)	67.19	67.19	67.19
Crit W.S. (ft)	2598.66	Flow Area (sq ft)	3.56	440.20	7.86
E.G. Slope (ft/ft)	0.000337	Area (sq ft)	3.56	440.20	7.86
Q Total (cfs)	548.69	Flow (cfs)	2.33	542.57	3.79
Top Width (ft)	158.99	Top Width (ft)	1.81	144.41	12.77
Vel Total (ft/s)	1.21	Avg. Vel. (ft/s)	0.65	1.23	0.48
Max Chl Dpth (ft)	4.08	Hydr. Depth (ft)	1.97	3.05	0.62
Conv. Total (cfs)	29882.9	Conv. (cfs)	127.0	29549.4	206.5
Length Wtd. (ft)	67.19	Wetted Per. (ft)	3.79	147.42	13.21
Min Ch El (ft)	2596.94	Shear (lb/sq ft)	0.02	0.06	0.01
Alpha	1.02	Stream Power (lb/ft s)	0.01	0.08	0.01
Frctn Loss (ft)		Cum Volume (acre-ft)		0.14	
C & E Loss (ft)		Cum SA (acres)	0.00	0.18	0.01

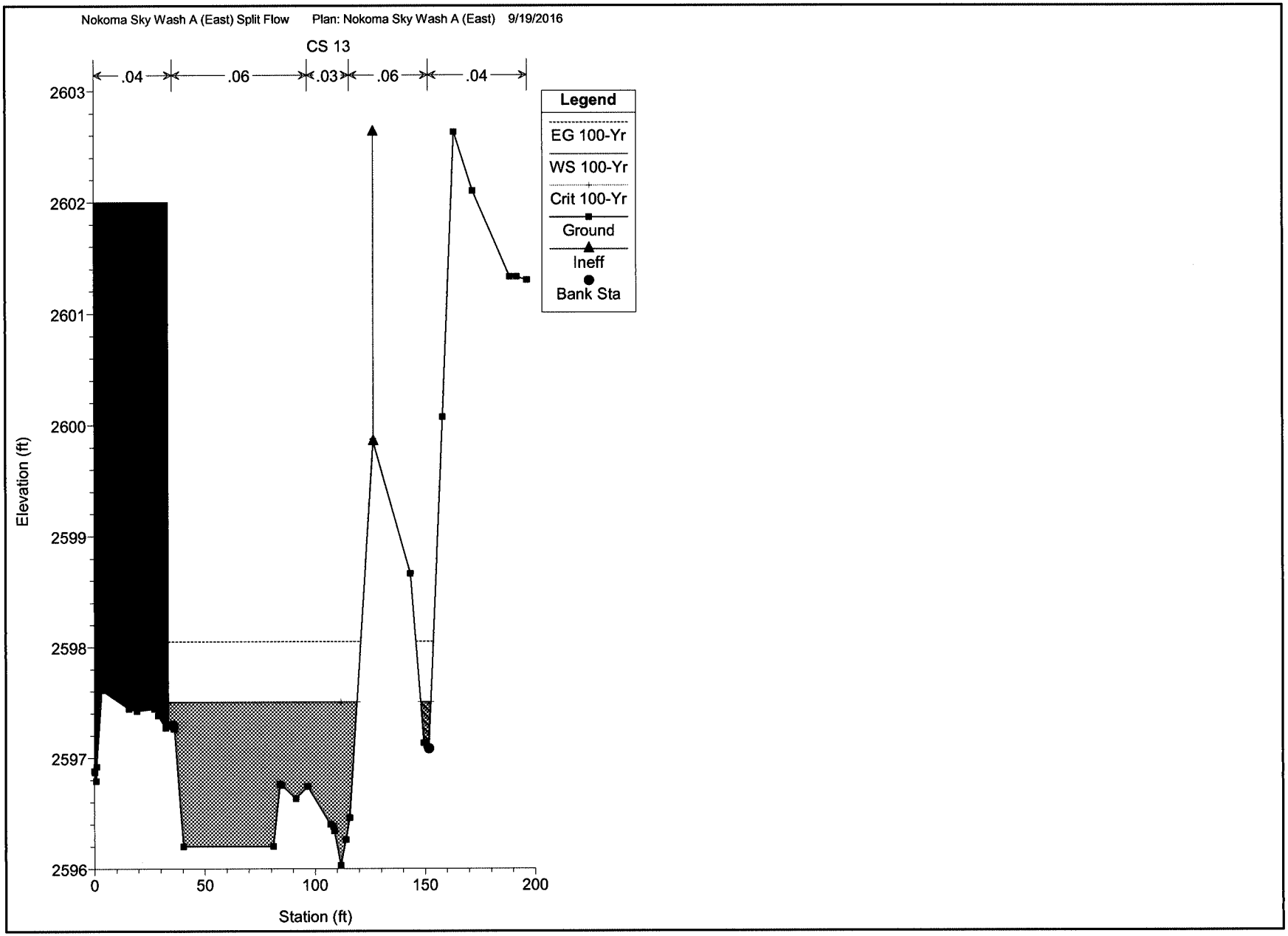
Plan: 1 Wash A East Reach #1 RS: 13 Profile: 100-Yr

E.G. Elev (ft)	2598.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.54	Wt. n-Val.	0.040	0.049	
W.S. Elev (ft)	2597.51	Reach Len. (ft)			
Crit W.S. (ft)	2597.51	Flow Area (sq ft)	0.41	92.43	
E.G. Slope (ft/ft)	0.033364	Area (sq ft)	0.41	93.59	0.19
Q Total (cfs)	548.69	Flow (cfs)	0.92	547.77	
Top Width (ft)	90.22	Top Width (ft)	1.94	87.36	0.91
Vel Total (ft/s)	5.91	Avg. Vel. (ft/s)	2.25	5.93	
Max Chl Dpth (ft)	1.47	Hydr. Depth (ft)	0.21	1.10	
Conv. Total (cfs)	3003.9	Conv. (cfs)	5.0	2998.9	
Length Wtd. (ft)		Wetted Per. (ft)	2.15	84.08	
Min Ch El (ft)	2596.03	Shear (lb/sq ft)	0.40	2.29	
Alpha	1.00	Stream Power (lb/ft s)	0.89	13.57	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

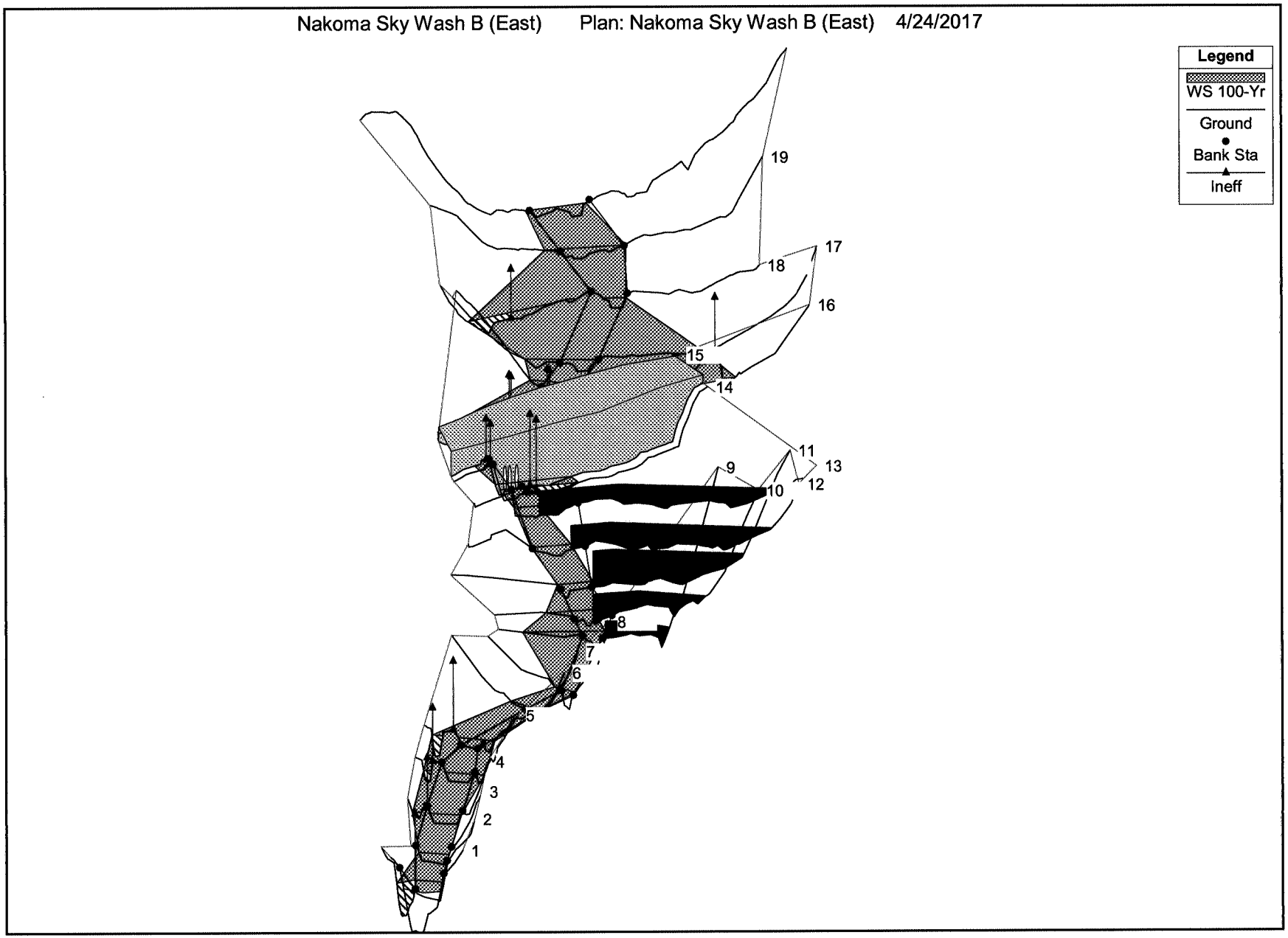

Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
CS 17
.04
.03
.06
.03
2603.0
2602.5
2602.0
2601.5
2601.0
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
CS 16
.04
.03
.06
.03
2602.0
2601.8
2601.6
2601.4
2601.2
2601.0
2600.8
2600.6
2600.4
2600.2
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta

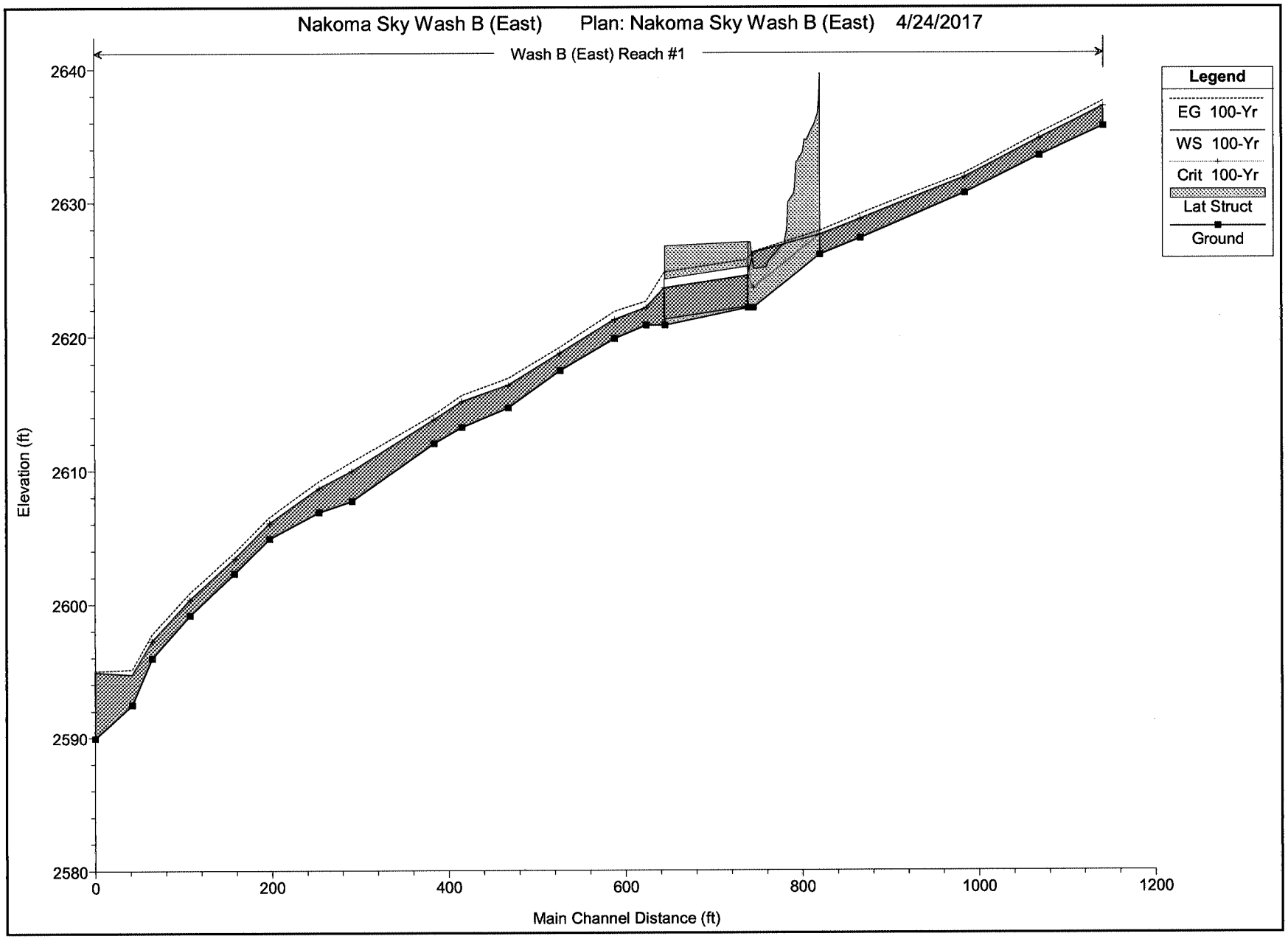

Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
CS 15
.04
.03
.06
.03
Legend
EG 100-Yr
WS 100-Yr
Ground
Bank Sta
2601.5
2601.0
2600.5
2600.0
2599.5
2599.0
Elevation (ft)
0
50
100
150
200
250
Station (ft)
Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
CS 14
.04
.036
.06
.03
.06
.04
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
2603
2602
2601
2600
2599
2598
2597
2596
Elevation (ft)
0
50
100
150
200
Station (ft)


Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
roadway crossing
.04
.036
.06
.03
.06
.04
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
roadway crossing
.04
.06
.03
.06
.04
Legend
EG 100-Yr
Crit 100-Yr
WS 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Nokoma Sky Wash A (East) Split Flow Plan: Nokoma Sky Wash A (East) 9/19/2016
CS 13
.04
.06
.03
.06
.04
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
2603
2602
2601
2600
2599
2598
2597
2596
0
50
100
150
200
Station (ft)

WASH B (EAST) FLOODPLAIN (HEC-RAS) MODEL
(POST DEVELOPED MODEL)


Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
Legend
WS 100-Yr
Ground
Bank Sta
Ineff
19
18
17
16
15
14
11
13
12
10
9
8
7
6
5
4
3
2
1


Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
Wash B (East) Reach #1
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Lat Struct
Ground
Elevation (ft)
2640
2630
2620
2610
2600
2590
2580
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

Plan: 1 Wash B (East) Reach #1 RS: 20 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2637.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.		0.030	0.060
W.S. Elev (ft)	2637.17	Reach Len. (ft)	72.55	72.55	72.55
Crit W.S. (ft)	2637.17	Flow Area (sq ft)		39.30	0.15
E.G. Slope (ft/ft)	0.015218	Area (sq ft)		39.30	0.15
Q Total (cfs)	196.00	Flow (cfs)		195.95	0.05
Top Width (ft)	56.92	Top Width (ft)		52.78	4.14
Vel Total (ft/s)	4.97	Avg. Vel. (ft/s)		4.99	0.33
Max Chl Dpth (ft)	1.49	Hydr. Depth (ft)		0.74	0.04
Conv. Total (cfs)	1588.8	Conv. (cfs)		1588.4	0.4
Length Wtd. (ft)	72.55	Wetted Per. (ft)		53.31	4.14
Min Ch El (ft)	2635.68	Shear (lb/sq ft)		0.70	0.03
Alpha	1.01	Stream Power (lb/ft s)		3.49	0.01
Frctn Loss (ft)	1.06	Cum Volume (acre-ft)	0.08	0.80	0.40
C & E Loss (ft)	0.01	Cum SA (acres)	0.32	0.78	0.66

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 19 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2635.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.35	Wt. n-Val.	0.060	0.030	0.060
W.S. Elev (ft)	2634.76	Reach Len. (ft)	84.46	84.46	84.46
Crit W.S. (ft)	2634.76	Flow Area (sq ft)	0.07	40.74	1.84
E.G. Slope (ft/ft)	0.014127	Area (sq ft)	0.07	40.74	1.84
Q Total (cfs)	196.00	Flow (cfs)	0.03	194.56	1.41
Top Width (ft)	70.90	Top Width (ft)	1.29	55.85	13.75
Vel Total (ft/s)	4.60	Avg. Vel. (ft/s)	0.40	4.78	0.77
Max Chl Dpth (ft)	1.30	Hydr. Depth (ft)	0.05	0.73	0.13
Conv. Total (cfs)	1649.1	Conv. (cfs)	0.2	1637.0	11.9
Length Wtd. (ft)	84.46	Wetted Per. (ft)	1.30	56.01	13.76
Min Ch El (ft)	2633.46	Shear (lb/sq ft)	0.04	0.64	0.12
Alpha	1.07	Stream Power (lb/ft s)	0.02	3.06	0.09
Frctn Loss (ft)	1.25	Cum Volume (acre-ft)	0.08	0.73	0.39
C & E Loss (ft)	0.02	Cum SA (acres)	0.32	0.69	0.64

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 18 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2632.13	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.035	0.033
W.S. Elev (ft)	2631.84	Reach Len. (ft)	118.53	118.53	118.53
Crit W.S. (ft)	2631.84	Flow Area (sq ft)		15.83	30.03
E.G. Slope (ft/ft)	0.015428	Area (sq ft)		15.83	74.55
Q Total (cfs)	196.00	Flow (cfs)		71.26	124.74
Top Width (ft)	125.49	Top Width (ft)		19.79	105.70
Vel Total (ft/s)	4.27	Avg. Vel. (ft/s)		4.50	4.15
Max Chl Dpth (ft)	2.01	Hydr. Depth (ft)		0.80	0.51
Conv. Total (cfs)	1578.0	Conv. (cfs)		573.7	1004.2
Length Wtd. (ft)	118.53	Wetted Per. (ft)		20.17	58.52
Min Ch El (ft)	2630.64	Shear (lb/sq ft)		0.76	0.49
Alpha	1.00	Stream Power (lb/ft s)		3.40	2.05
Frctn Loss (ft)	1.72	Cum Volume (acre-ft)	0.08	0.67	0.32
C & E Loss (ft)	0.01	Cum SA (acres)	0.32	0.62	0.53

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.
Note:	Manning's n values were composited to a single value in the main channel.

Plan: 1 Wash B (East) Reach #1 RS: 17 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2629.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.030	0.030	0.034
W.S. Elev (ft)	2628.74	Reach Len. (ft)	45.90	45.90	45.90
Crit W.S. (ft)	2628.74	Flow Area (sq ft)	0.60	27.07	15.65
E.G. Slope (ft/ft)	0.013662	Area (sq ft)	0.60	27.07	15.65
Q Total (cfs)	196.00	Flow (cfs)	0.73	137.11	58.15
Top Width (ft)	69.29	Top Width (ft)	6.36	32.87	30.06
Vel Total (ft/s)	4.52	Avg. Vel. (ft/s)	1.21	5.06	3.72
Max Chl Dpth (ft)	1.44	Hydr. Depth (ft)	0.10	0.82	0.52
Conv. Total (cfs)	1676.8	Conv. (cfs)	6.3	1173.1	497.5
Length Wtd. (ft)	45.90	Wetted Per. (ft)	6.38	33.08	30.16
Min Ch El (ft)	2627.30	Shear (lb/sq ft)	0.08	0.70	0.44
Alpha	1.08	Stream Power (lb/ft s)	0.10	3.53	1.64
Frctn Loss (ft)	0.55	Cum Volume (acre-ft)	0.08	0.62	0.20
C & E Loss (ft)	0.02	Cum SA (acres)	0.31	0.55	0.34

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 16 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2627.83	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.	0.050	0.036	0.040
W.S. Elev (ft)	2627.56	Reach Len. (ft)	74.88	74.88	74.88
Crit W.S. (ft)	2627.56	Flow Area (sq ft)	20.09	33.93	4.97
E.G. Slope (ft/ft)	0.010464	Area (sq ft)	23.16	33.93	4.97
Q Total (cfs)	196.00	Flow (cfs)	30.82	153.80	11.38
Top Width (ft)	115.53	Top Width (ft)	72.52	32.44	10.56
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	1.53	4.53	2.29
Max Chl Dpth (ft)	1.49	Hydr. Depth (ft)	0.33	1.05	0.47
Conv. Total (cfs)	1916.1	Conv. (cfs)	301.3	1503.5	111.3
Length Wtd. (ft)	74.88	Wetted Per. (ft)	60.45	32.56	10.60
Min Ch El (ft)	2626.07	Shear (lb/sq ft)	0.22	0.68	0.31
Alpha	1.52	Stream Power (lb/ft s)	0.33	3.09	0.70
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.07	0.58	0.19
C & E Loss (ft)	0.07	Cum SA (acres)	0.27	0.51	0.32

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 15 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2626.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.		0.030	
W.S. Elev (ft)	2626.23	Reach Len. (ft)	121.41	121.41	121.41
Crit W.S. (ft)	2623.57	Flow Area (sq ft)		96.19	
E.G. Slope (ft/ft)	0.000318	Area (sq ft)	14.07	116.94	73.61
Q Total (cfs)	153.48	Flow (cfs)		153.48	
Top Width (ft)	153.60	Top Width (ft)	40.16	55.05	58.39
Vel Total (ft/s)	1.60	Avg. Vel. (ft/s)		1.60	
Max Chl Dpth (ft)	4.13	Hydr. Depth (ft)		2.53	
Conv. Total (cfs)	8611.4	Conv. (cfs)		8611.4	
Length Wtd. (ft)	121.41	Wetted Per. (ft)		39.59	
Min Ch El (ft)	2622.10	Shear (lb/sq ft)		0.05	
Alpha	1.00	Stream Power (lb/ft s)		0.08	
Frctn Loss (ft)		Cum Volume (acre-ft)	0.03	0.45	0.12
C & E Loss (ft)		Cum SA (acres)	0.17	0.44	0.26

Plan: 1 Wash B (East) Reach #1 RS: 14 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2622.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.	0.030	0.030	
W.S. Elev (ft)	2622.12	Reach Len. (ft)	35.81	35.81	35.81
Crit W.S. (ft)	2622.12	Flow Area (sq ft)	4.47	24.70	
E.G. Slope (ft/ft)	0.012762	Area (sq ft)	23.55	24.70	
Q Total (cfs)	153.48	Flow (cfs)	17.83	135.65	
Top Width (ft)	70.74	Top Width (ft)	45.62	25.12	

Plan: 1 Wash B (East) Reach #1 RS: 14 Profile: 100-Yr Split Flo (Continued)

Vel Total (ft/s)	5.26	Avg. Vel. (ft/s)	3.99	5.49	
Max Chl Dpth (ft)	1.32	Hydr. Depth (ft)	0.60	0.98	
Conv. Total (cfs)	1358.6	Conv. (cfs)	157.8	1200.8	
Length Wtd. (ft)	35.81	Wetted Per. (ft)	7.41	25.39	
Min Ch El (ft)	2620.80	Shear (lb/sq ft)	0.48	0.77	
Alpha	1.03	Stream Power (lb/ft s)	1.92	4.26	
Frctn Loss (ft)	0.48	Cum Volume (acre-ft)	0.03	0.41	0.12
C & E Loss (ft)	0.01	Cum SA (acres)	0.05	0.33	0.18

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 13 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2621.81	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.58	Wt. n-Val.		0.030	
W.S. Elev (ft)	2621.24	Reach Len. (ft)	61.63	61.63	61.63
Crit W.S. (ft)	2621.24	Flow Area (sq ft)		25.21	
E.G. Slope (ft/ft)	0.014062	Area (sq ft)		25.21	
Q Total (cfs)	153.48	Flow (cfs)		153.48	
Top Width (ft)	22.29	Top Width (ft)		22.29	
Vel Total (ft/s)	6.09	Avg. Vel. (ft/s)		6.09	
Max Chl Dpth (ft)	1.43	Hydr. Depth (ft)		1.13	
Conv. Total (cfs)	1294.3	Conv. (cfs)		1294.3	
Length Wtd. (ft)	61.63	Wetted Per. (ft)		23.90	
Min Ch El (ft)	2619.81	Shear (lb/sq ft)		0.93	
Alpha	1.00	Stream Power (lb/ft s)		5.64	
Frctn Loss (ft)	0.87	Cum Volume (acre-ft)	0.02	0.39	0.12
C & E Loss (ft)	0.04	Cum SA (acres)	0.04	0.31	0.18

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 12 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2619.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.43	Wt. n-Val.		0.030	0.040
W.S. Elev (ft)	2618.74	Reach Len. (ft)	58.35	58.35	58.35
Crit W.S. (ft)	2618.74	Flow Area (sq ft)		29.03	0.10
E.G. Slope (ft/ft)	0.014216	Area (sq ft)		29.03	0.10
Q Total (cfs)	153.48	Flow (cfs)		153.41	0.08
Top Width (ft)	35.33	Top Width (ft)		33.97	1.36
Vel Total (ft/s)	5.27	Avg. Vel. (ft/s)		5.28	0.76
Max Chl Dpth (ft)	1.30	Hydr. Depth (ft)		0.85	0.07
Conv. Total (cfs)	1287.2	Conv. (cfs)		1286.6	0.6
Length Wtd. (ft)	58.35	Wetted Per. (ft)		34.72	1.37

Plan: 1 Wash B (East) Reach #1 RS: 12 Profile: 100-Yr Split Flo (Continued)

Min Ch El (ft)	2617.44	Shear (lb/sq ft)		0.74	0.06
Alpha	1.01	Stream Power (lb/ft s)		3.92	0.05
Frctn Loss (ft)	0.84	Cum Volume (acre-ft)	0.02	0.35	0.12
C & E Loss (ft)	0.01	Cum SA (acres)	0.04	0.27	0.18

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 11 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2616.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.	0.060	0.030	0.040
W.S. Elev (ft)	2616.38	Reach Len. (ft)	52.71	52.71	52.71
Crit W.S. (ft)	2616.38	Flow Area (sq ft)	0.76	26.32	1.00
E.G. Slope (ft/ft)	0.014548	Area (sq ft)	0.76	26.32	1.00
Q Total (cfs)	153.48	Flow (cfs)	1.29	150.13	2.06
Top Width (ft)	32.11	Top Width (ft)	1.09	27.90	3.12
Vel Total (ft/s)	5.47	Avg. Vel. (ft/s)	1.69	5.70	2.06
Max Chl Dpth (ft)	1.71	Hydr. Depth (ft)	0.70	0.94	0.32
Conv. Total (cfs)	1272.5	Conv. (cfs)	10.7	1244.7	17.1
Length Wtd. (ft)	52.71	Wetted Per. (ft)	1.79	28.20	3.19
Min Ch El (ft)	2614.67	Shear (lb/sq ft)	0.39	0.85	0.28
Alpha	1.07	Stream Power (lb/ft s)	0.65	4.84	0.59
Frctn Loss (ft)	0.59	Cum Volume (acre-ft)	0.02	0.32	0.12
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	0.23	0.18

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 10 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2615.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.030	0.036
W.S. Elev (ft)	2615.15	Reach Len. (ft)	31.42	31.42	31.42
Crit W.S. (ft)	2615.15	Flow Area (sq ft)		23.79	9.08
E.G. Slope (ft/ft)	0.008963	Area (sq ft)		23.79	9.08
Q Total (cfs)	153.48	Flow (cfs)		134.43	19.05
Top Width (ft)	41.60	Top Width (ft)		16.32	25.28
Vel Total (ft/s)	4.67	Avg. Vel. (ft/s)		5.65	2.10
Max Chl Dpth (ft)	1.94	Hydr. Depth (ft)		1.46	0.36
Conv. Total (cfs)	1621.2	Conv. (cfs)		1420.0	201.2
Length Wtd. (ft)	31.42	Wetted Per. (ft)		17.99	25.33
Min Ch El (ft)	2613.21	Shear (lb/sq ft)		0.74	0.20
Alpha	1.31	Stream Power (lb/ft s)		4.18	0.42

Plan: 1 Wash B (East) Reach #1 RS: 10 Profile: 100-Yr Split Flo (Continued)

Frctn Loss (ft)	0.27	Cum Volume (acre-ft)	0.02	0.28	0.11
C & E Loss (ft)	0.03	Cum SA (acres)	0.03	0.20	0.16

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 9 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2614.15	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.060	0.030	0.040
W.S. Elev (ft)	2613.81	Reach Len. (ft)	93.25	93.25	93.25
Crit W.S. (ft)	2613.81	Flow Area (sq ft)	1.68	22.02	19.40
E.G. Slope (ft/ft)	0.008165	Area (sq ft)	1.68	22.02	19.40
Q Total (cfs)	153.48	Flow (cfs)	2.65	116.43	34.40
Top Width (ft)	70.37	Top Width (ft)	1.98	16.95	51.44
Vel Total (ft/s)	3.56	Avg. Vel. (ft/s)	1.58	5.29	1.77
Max Chl Dpth (ft)	1.80	Hydr. Depth (ft)	0.85	1.30	0.38
Conv. Total (cfs)	1698.6	Conv. (cfs)	29.3	1288.6	380.7
Length Wtd. (ft)	93.25	Wetted Per. (ft)	2.82	17.15	51.47
Min Ch El (ft)	2612.01	Shear (lb/sq ft)	0.30	0.65	0.19
Alpha	1.73	Stream Power (lb/ft s)	0.48	3.46	0.34
Frctn Loss (ft)	0.87	Cum Volume (acre-ft)	0.02	0.27	0.10
C & E Loss (ft)	0.03	Cum SA (acres)	0.03	0.19	0.13

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 8 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2610.64	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.68	Wt. n-Val.	0.060	0.030	0.060
W.S. Elev (ft)	2609.96	Reach Len. (ft)	37.24	37.24	37.24
Crit W.S. (ft)	2609.96	Flow Area (sq ft)	0.58	22.84	1.27
E.G. Slope (ft/ft)	0.010868	Area (sq ft)	0.58	22.84	1.27
Q Total (cfs)	153.48	Flow (cfs)	0.55	152.00	0.93
Top Width (ft)	25.71	Top Width (ft)	2.55	14.77	8.39
Vel Total (ft/s)	6.22	Avg. Vel. (ft/s)	0.95	6.66	0.73
Max Chl Dpth (ft)	2.28	Hydr. Depth (ft)	0.23	1.55	0.15
Conv. Total (cfs)	1472.3	Conv. (cfs)	5.3	1458.1	8.9
Length Wtd. (ft)	37.24	Wetted Per. (ft)	2.59	15.61	8.39
Min Ch El (ft)	2607.67	Shear (lb/sq ft)	0.15	0.99	0.10
Alpha	1.14	Stream Power (lb/ft s)	0.14	6.61	0.08
Frctn Loss (ft)	0.37	Cum Volume (acre-ft)	0.02	0.22	0.08
C & E Loss (ft)	0.05	Cum SA (acres)	0.03	0.15	0.07

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical

Errors Warnings and Notes (Continued)

	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 7 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2609.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.51	Wt. n-Val.	0.040	0.030	0.055
W.S. Elev (ft)	2608.67	Reach Len. (ft)	55.95	55.95	55.95
Crit W.S. (ft)	2608.67	Flow Area (sq ft)	0.24	24.94	5.60
E.G. Slope (ft/ft)	0.009194	Area (sq ft)	0.24	24.94	5.60
Q Total (cfs)	153.48	Flow (cfs)	0.20	146.69	6.59
Top Width (ft)	39.32	Top Width (ft)	2.14	17.52	19.66
Vel Total (ft/s)	4.99	Avg. Vel. (ft/s)	0.83	5.88	1.18
Max Chl Dpth (ft)	1.81	Hydr. Depth (ft)	0.11	1.42	0.28
Conv. Total (cfs)	1600.7	Conv. (cfs)	2.1	1529.9	68.7
Length Wtd. (ft)	55.95	Wetted Per. (ft)	2.15	18.10	19.67
Min Ch El (ft)	2606.86	Shear (lb/sq ft)	0.06	0.79	0.16
Alpha	1.33	Stream Power (lb/ft s)	0.05	4.65	0.19
Frctn Loss (ft)	0.60	Cum Volume (acre-ft)	0.02	0.20	0.08
C & E Loss (ft)	0.02	Cum SA (acres)	0.03	0.14	0.06

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 6 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2606.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.45	Wt. n-Val.	0.030	0.030	0.030
W.S. Elev (ft)	2606.05	Reach Len. (ft)	39.82	39.82	39.82
Crit W.S. (ft)	2606.05	Flow Area (sq ft)	11.82	16.28	1.25
E.G. Slope (ft/ft)	0.012612	Area (sq ft)	11.82	16.28	18.84
Q Total (cfs)	153.48	Flow (cfs)	54.83	94.62	4.04
Top Width (ft)	43.02	Top Width (ft)	15.34	15.23	12.45
Vel Total (ft/s)	5.23	Avg. Vel. (ft/s)	4.64	5.81	3.24
Max Chl Dpth (ft)	2.59	Hydr. Depth (ft)	0.77	1.07	0.47
Conv. Total (cfs)	1366.7	Conv. (cfs)	488.2	842.6	35.9
Length Wtd. (ft)	39.82	Wetted Per. (ft)	16.21	15.23	2.81
Min Ch El (ft)	2604.89	Shear (lb/sq ft)	0.57	0.84	0.35
Alpha	1.05	Stream Power (lb/ft s)	2.66	4.89	1.13
Frctn Loss (ft)	0.55	Cum Volume (acre-ft)	0.01	0.17	0.06
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.12	0.04

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.

Errors Warnings and Notes (Continued)

Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 5 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2603.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.46	Wt. n-Val.	0.030	0.030	
W.S. Elev (ft)	2603.39	Reach Len. (ft)	50.61	50.61	50.61
Crit W.S. (ft)	2603.39	Flow Area (sq ft)	5.72	22.75	
E.G. Slope (ft/ft)	0.014961	Area (sq ft)	5.72	22.75	7.18
Q Total (cfs)	153.48	Flow (cfs)	26.44	127.04	
Top Width (ft)	40.59	Top Width (ft)	8.12	25.42	7.04
Vel Total (ft/s)	5.39	Avg. Vel. (ft/s)	4.62	5.58	
Max Chl Dpth (ft)	1.36	Hydr. Depth (ft)	0.70	0.90	
Conv. Total (cfs)	1254.8	Conv. (cfs)	216.1	1038.7	
Length Wtd. (ft)	50.61	Wetted Per. (ft)	8.59	25.71	
Min Ch El (ft)	2602.29	Shear (lb/sq ft)	0.62	0.83	
Alpha	1.01	Stream Power (lb/ft s)	2.87	4.61	
Frctn Loss (ft)	0.71	Cum Volume (acre-ft)	0.00	0.16	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.00	0.10	0.03

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 4 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2600.84	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.49	Wt. n-Val.		0.030	
W.S. Elev (ft)	2600.35	Reach Len. (ft)	43.08	43.08	43.08
Crit W.S. (ft)	2600.35	Flow Area (sq ft)		27.20	
E.G. Slope (ft/ft)	0.013184	Area (sq ft)		27.20	3.06
Q Total (cfs)	153.48	Flow (cfs)		153.48	
Top Width (ft)	34.67	Top Width (ft)		27.15	7.52
Vel Total (ft/s)	5.64	Avg. Vel. (ft/s)		5.64	
Max Chl Dpth (ft)	1.19	Hydr. Depth (ft)		1.00	
Conv. Total (cfs)	1336.7	Conv. (cfs)		1336.7	
Length Wtd. (ft)	43.08	Wetted Per. (ft)		27.53	
Min Ch El (ft)	2599.16	Shear (lb/sq ft)		0.81	
Alpha	1.00	Stream Power (lb/ft s)		4.59	
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)		0.13	0.04
C & E Loss (ft)	0.00	Cum SA (acres)		0.07	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.

Errors Warnings and Notes (Continued)

Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 3 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2597.73	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.		0.030	
W.S. Elev (ft)	2597.23	Reach Len. (ft)	22.38	22.38	22.38
Crit W.S. (ft)	2597.23	Flow Area (sq ft)		27.04	
E.G. Slope (ft/ft)	0.013513	Area (sq ft)		27.04	
Q Total (cfs)	153.48	Flow (cfs)		153.48	
Top Width (ft)	27.15	Top Width (ft)		27.15	
Vel Total (ft/s)	5.68	Avg. Vel. (ft/s)		5.68	
Max Chl Dpth (ft)	1.28	Hydr. Depth (ft)		1.00	
Conv. Total (cfs)	1320.3	Conv. (cfs)		1320.3	
Length Wtd. (ft)	22.38	Wetted Per. (ft)		27.62	
Min Ch El (ft)	2595.95	Shear (lb/sq ft)		0.83	
Alpha	1.00	Stream Power (lb/ft s)		4.69	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.10	0.04
C & E Loss (ft)	0.04	Cum SA (acres)		0.04	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (East) Reach #1 RS: 2 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2595.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.		0.030	0.030
W.S. Elev (ft)	2594.74	Reach Len. (ft)	41.86	41.86	41.86
Crit W.S. (ft)		Flow Area (sq ft)		47.17	0.11
E.G. Slope (ft/ft)	0.004390	Area (sq ft)		47.17	56.65
Q Total (cfs)	229.48	Flow (cfs)		229.08	0.40
Top Width (ft)	44.49	Top Width (ft)		25.40	19.08
Vel Total (ft/s)	4.85	Avg. Vel. (ft/s)		4.86	3.54
Max Chl Dpth (ft)	4.11	Hydr. Depth (ft)		1.86	1.13
Conv. Total (cfs)	3463.5	Conv. (cfs)		3457.4	6.1
Length Wtd. (ft)	41.86	Wetted Per. (ft)		26.20	0.10
Min Ch El (ft)	2592.46	Shear (lb/sq ft)		0.49	0.31
Alpha	1.00	Stream Power (lb/ft s)		2.40	1.09
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)		0.08	0.03
C & E Loss (ft)	0.09	Cum SA (acres)		0.03	0.01

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: 1 Wash B (East) Reach #1 RS: 1 Profile: 100-Yr Split Flo

E.G. Elev (ft)	2594.98	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.06	Wt. n-Val.		0.030	
W.S. Elev (ft)	2594.92	Reach Len. (ft)			
Crit W.S. (ft)	2591.99	Flow Area (sq ft)		120.66	
E.G. Slope (ft/ft)	0.000327	Area (sq ft)		120.66	
Q Total (cfs)	229.48	Flow (cfs)		229.48	
Top Width (ft)	36.58	Top Width (ft)		36.58	
Vel Total (ft/s)	1.90	Avg. Vel. (ft/s)		1.90	
Max Chl Dpth (ft)	4.99	Hydr. Depth (ft)		3.30	
Conv. Total (cfs)	12684.9	Conv. (cfs)		12684.9	
Length Wtd. (ft)		Wetted Per. (ft)		39.02	
Min Ch El (ft)	2589.93	Shear (lb/sq ft)		0.06	
Alpha	1.00	Stream Power (lb/ft s)		0.12	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Plan: 1 Wash B (East) Reach #1 RS: 14.5 Culv Group: Culvert #1 Profile: 100-Yr Split Flo

Q Culv Group (cfs)	153.48	Culv Full Len (ft)	
# Barrels	3	Culv Vel US (ft/s)	8.69
Q Barrel (cfs)	51.16	Culv Vel DS (ft/s)	8.70
E.G. US. (ft)	2626.27	Culv Inv El Up (ft)	2622.19
W.S. US. (ft)	2626.23	Culv Inv El Dn (ft)	2621.25
E.G. DS (ft)	2622.56	Culv Frctn Ls (ft)	0.08
W.S. DS (ft)	2622.12	Culv Exit Loss (ft)	2.19
Delta EG (ft)	3.71	Culv Entr Loss (ft)	0.58
Delta WS (ft)	4.11	Q Weir (cfs)	
E.G. IC (ft)	2626.27	Weir Sta Lft (ft)	
E.G. OC (ft)	2625.93	Weir Sta Rgt (ft)	
Culvert Control	Inlet	Weir Submerg	
Culv WS Inlet (ft)	2624.52	Weir Max Depth (ft)	
Culv WS Outlet (ft)	2623.58	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.33	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.33	Min El Weir Flow (ft)	2628.95

Errors Warnings and Notes

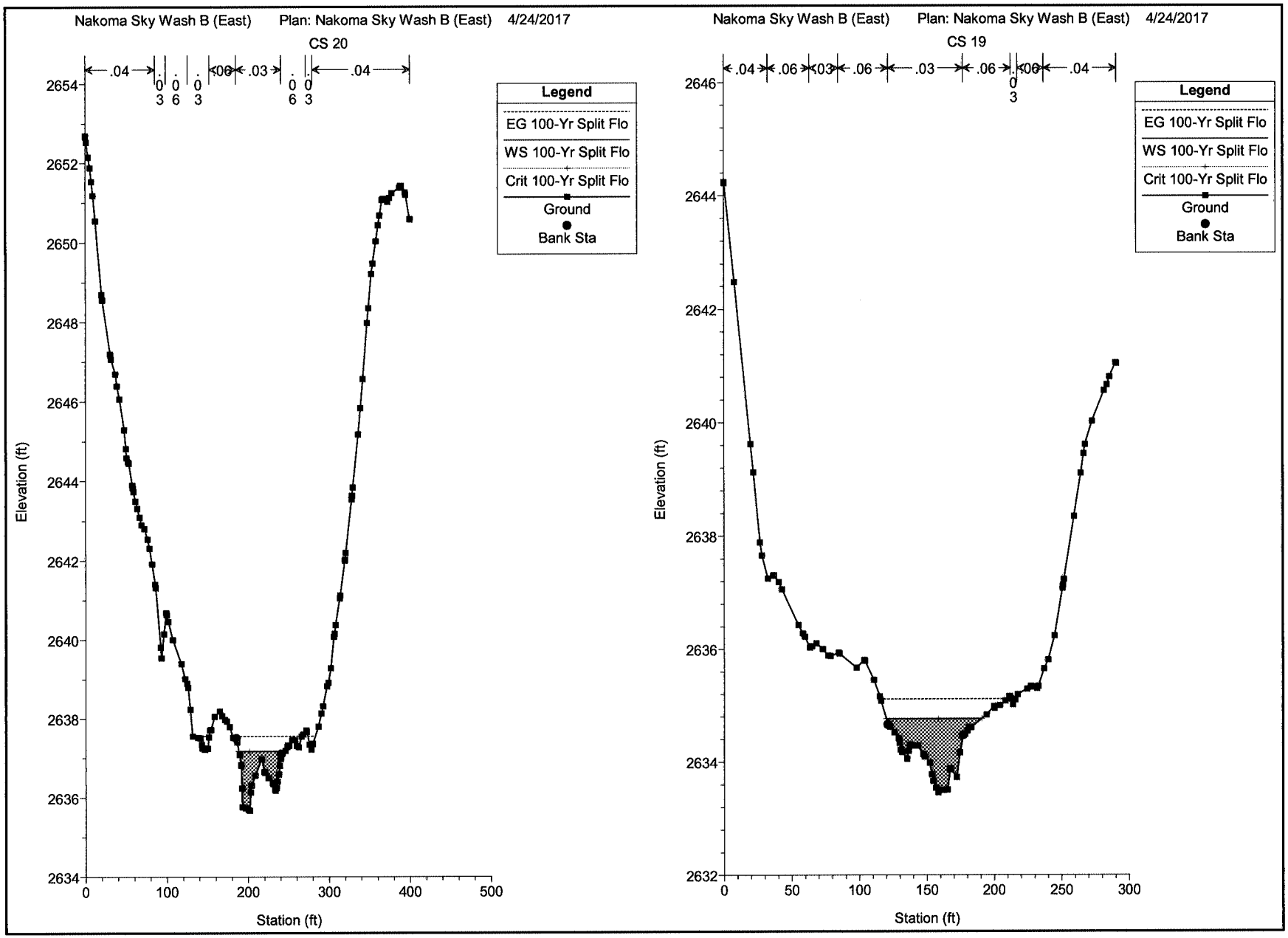
Note:	During subcritical analysis, the water surface at the outlet was within 0.01 feet of normal depth. Therefore, the
	inlet will be at normal depth.

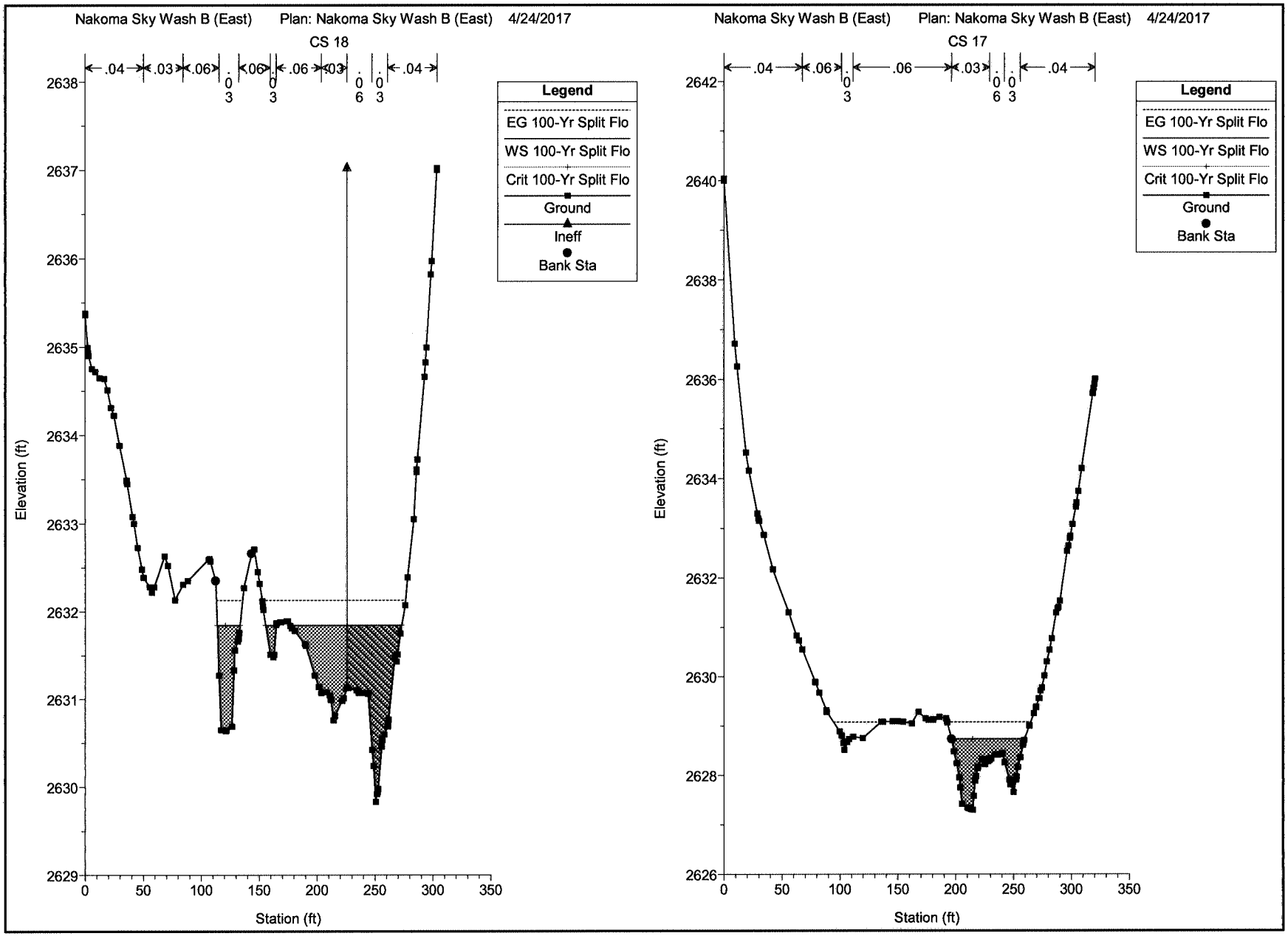
Plan: 1 Wash B (East) Reach #1 RS: 15.9 Lateral Structure Profile: 100-Yr Split Flo

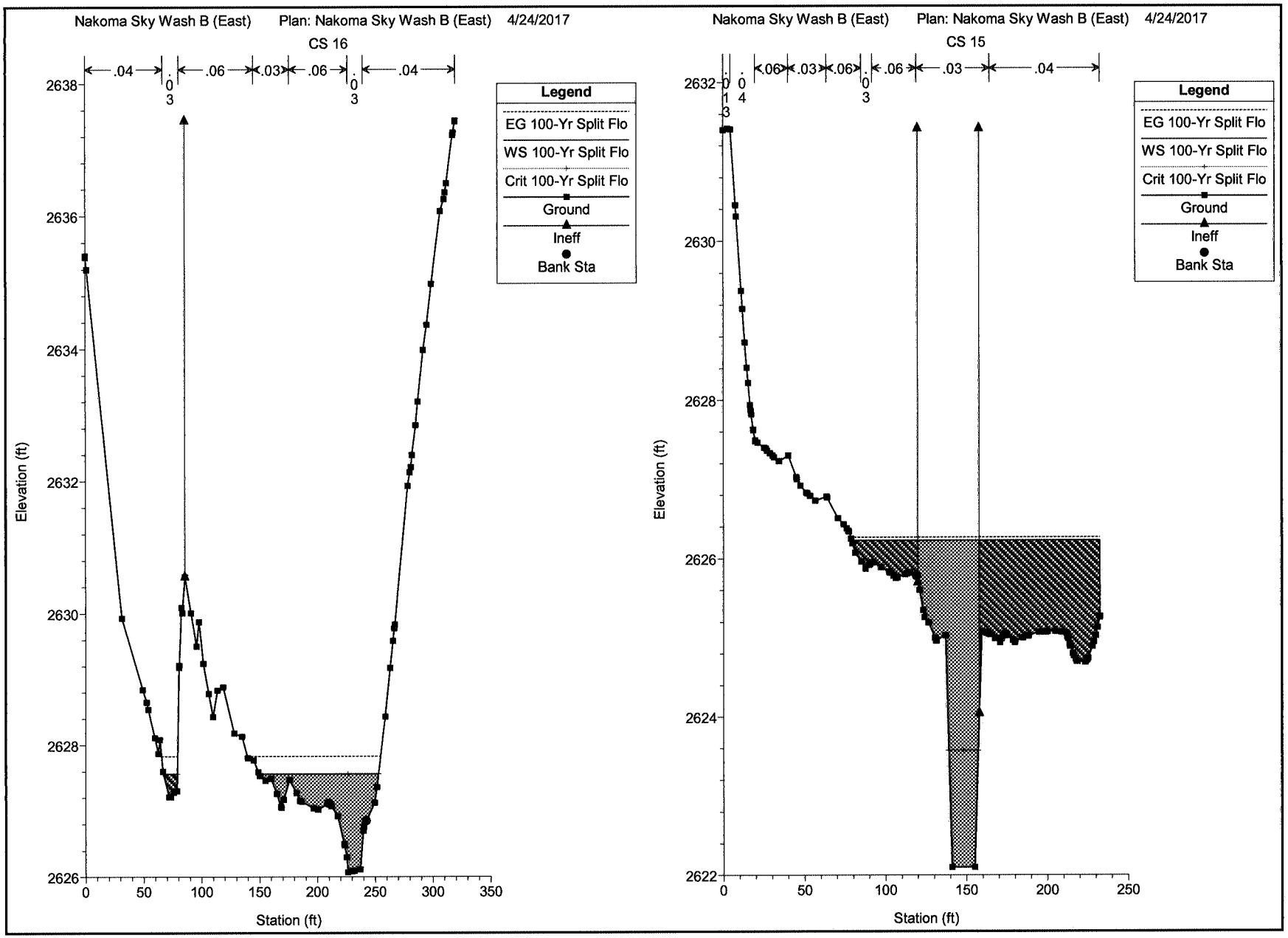
E.G. US. (ft)	2627.83	Weir Sta US (ft)	37.45
W.S. US. (ft)	2627.56	Weir Sta DS (ft)	78.65
E.G. DS (ft)	2626.08	Min El Weir Flow (ft)	2625.01
W.S. DS (ft)	2626.01	Wr Top Wdth (ft)	36.77
Q US (cfs)	196.00	Weir Max Depth (ft)	1.36
Q Leaving Total (cfs)	73.38	Weir Avg Depth (ft)	0.84
Q DS (cfs)	153.48	Weir Flow Area (sq ft)	30.96
Perc Q Leaving	38.02	Weir Coef (ft^1/2)	2.400
Q Weir (cfs)	73.38	Weir Submerg	0.00
Q Gates (cfs)		Q Gate Group (cfs)	
Q Culv (cfs)		Gate Open Ht (ft)	
Q Lat RC (cfs)		Gate #Open	
Q Outlet TS (cfs)	0.00	Gate Area (sq ft)	
Q Breach (cfs)		Gate Submerg	
Breach Avg Velocity (ft/s)		Gate Invert (ft)	
Breach Flow Area (sq ft)		Gate Weir Coef	
Breach WD (ft)			
Breach Top El (ft)			
Breach Bottom El (ft)			
Breach SSL (ft)			
Breach SSR (ft)			

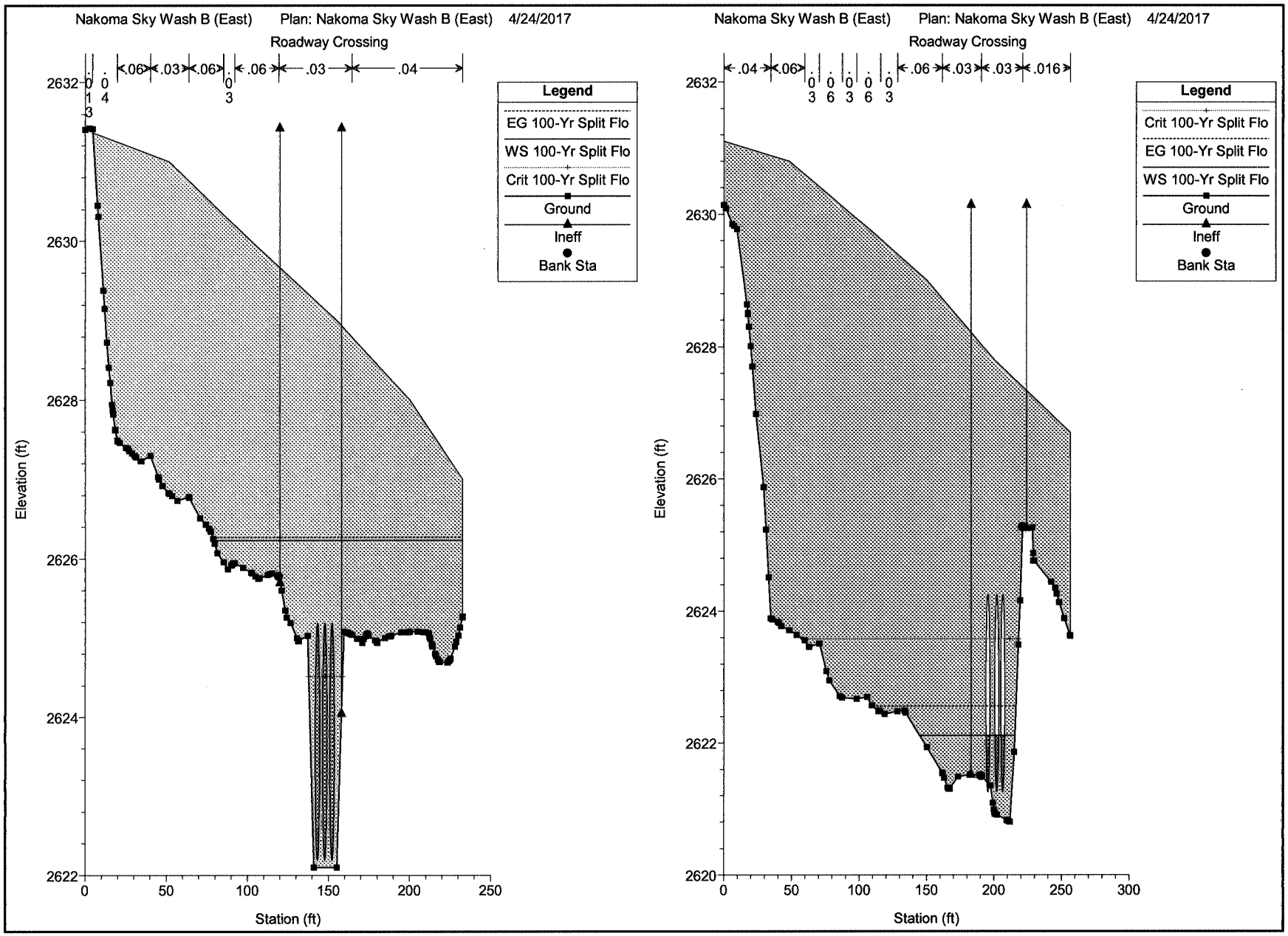
Errors Warnings and Notes

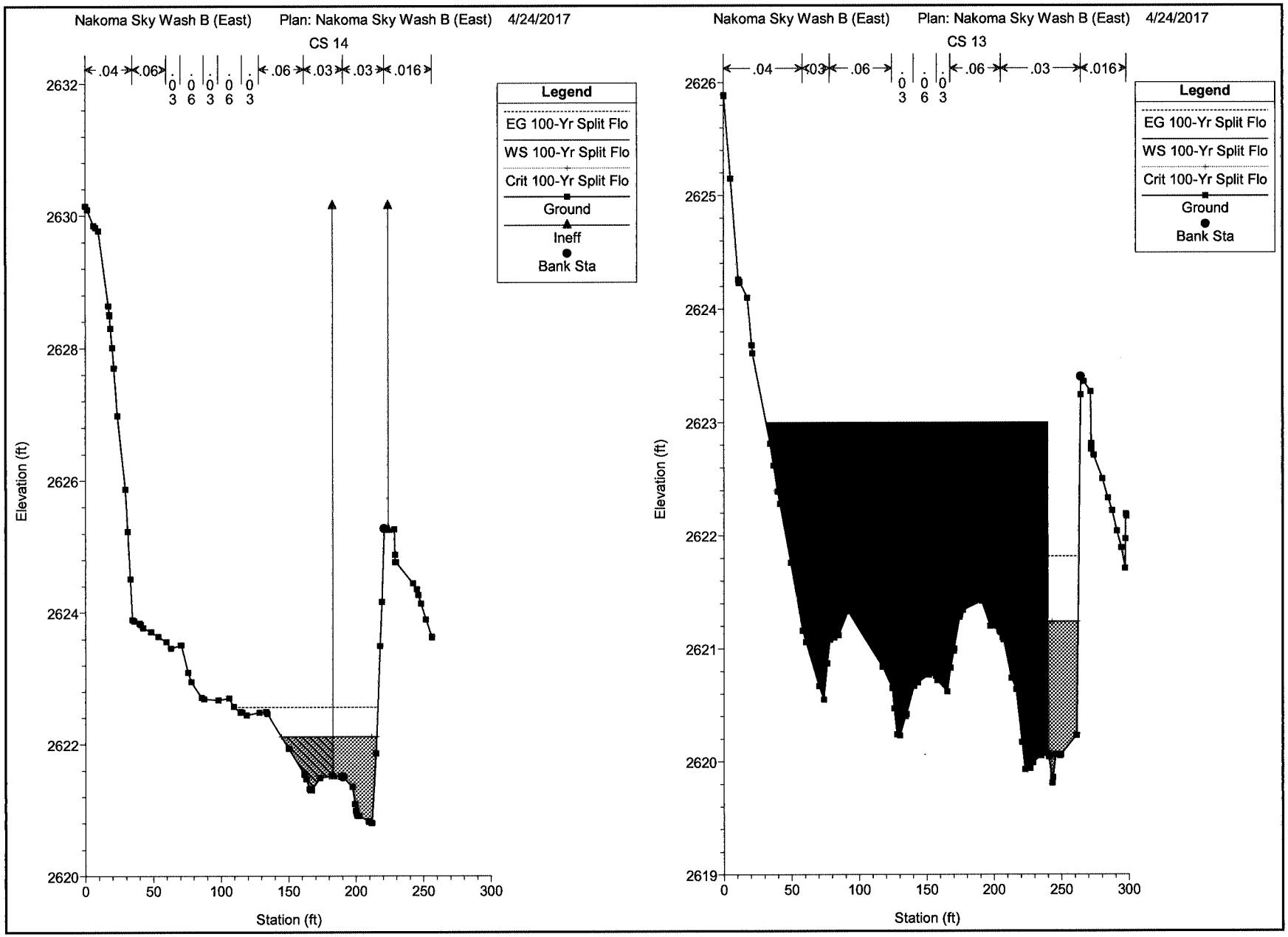
Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

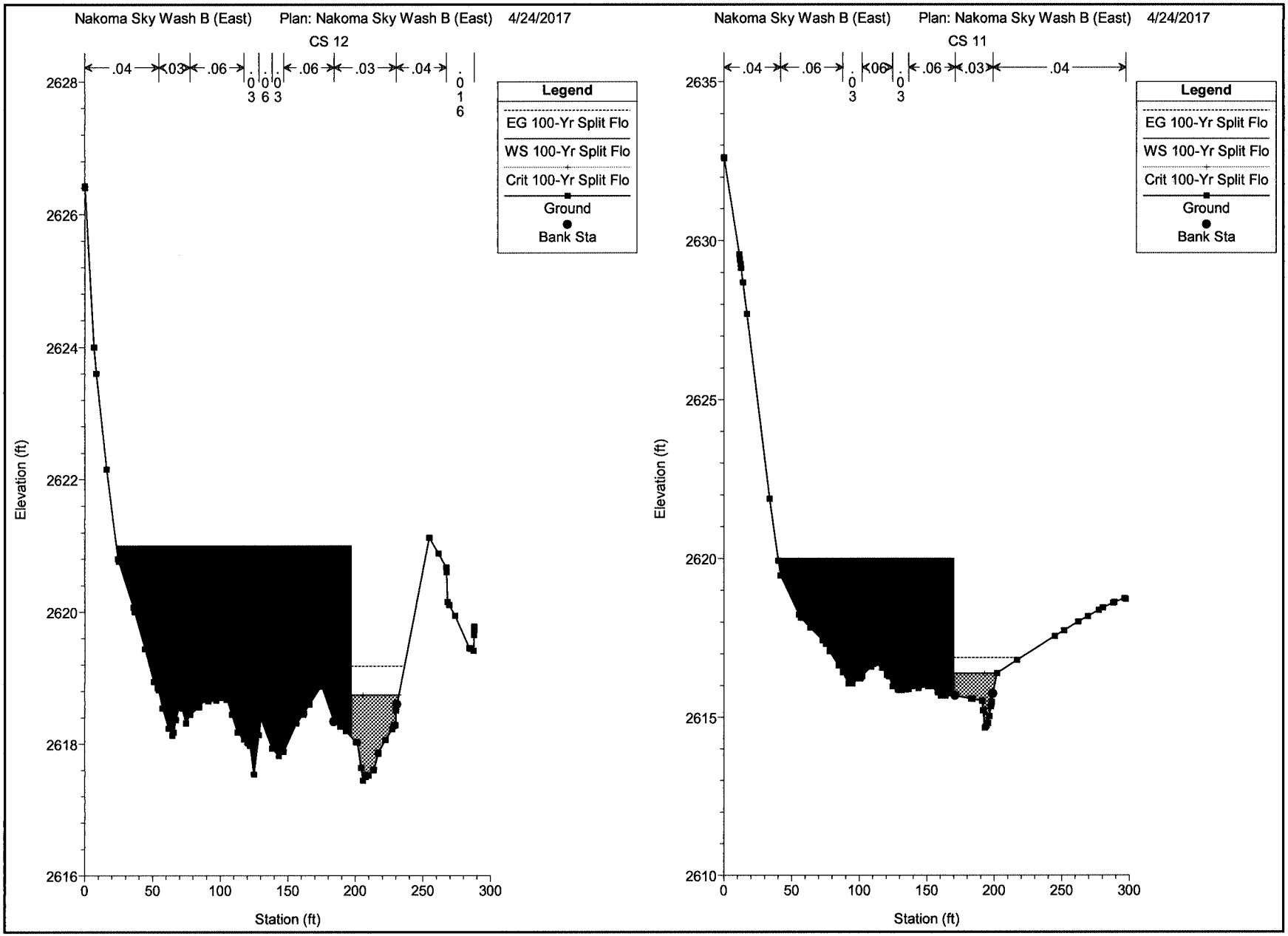

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 20
.04 .03 .06 .03 .06 .03 .04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)
2654
2652
2650
2648
2646
2644
2642
2640
2638
2636
2634
0
100
200
300
400
500
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 19
.04 .06 .03 .06 .03 .06 .03 .04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)
2646
2644
2642
2640
2638
2636
2634
2632
0
50
100
150
200
250
300

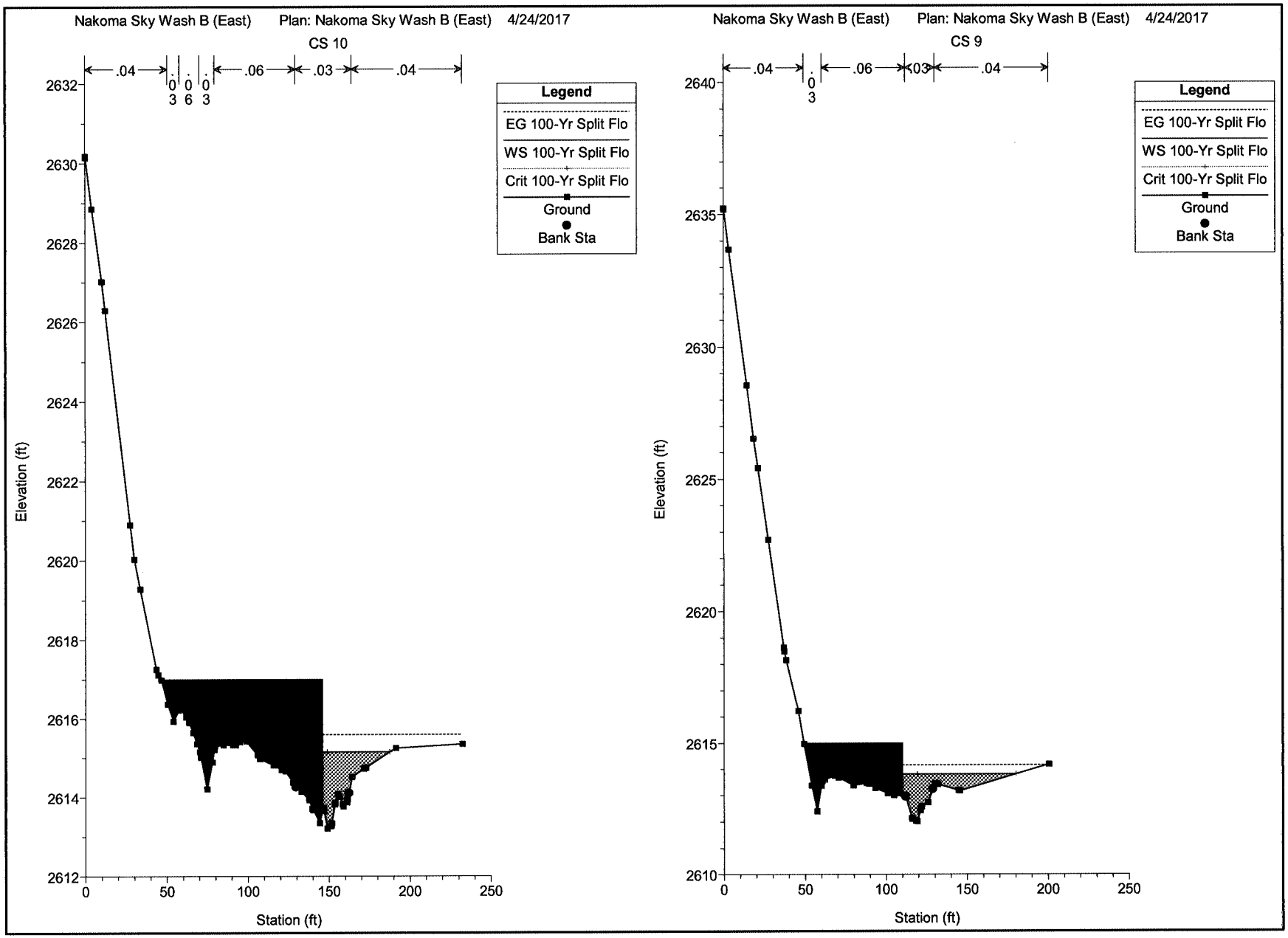

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 18
.04 .03 .06 .03 .06 .06 .03 .04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
2638
2637
2636
2635
2634
2633
2632
2631
2630
2629
0 50 100 150 200 250 300 350
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 17
.04 .06 .06 .03 .04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
2642
2640
2638
2636
2634
2632
2630
2628
2626
0 50 100 150 200 250 300 350
Station (ft)

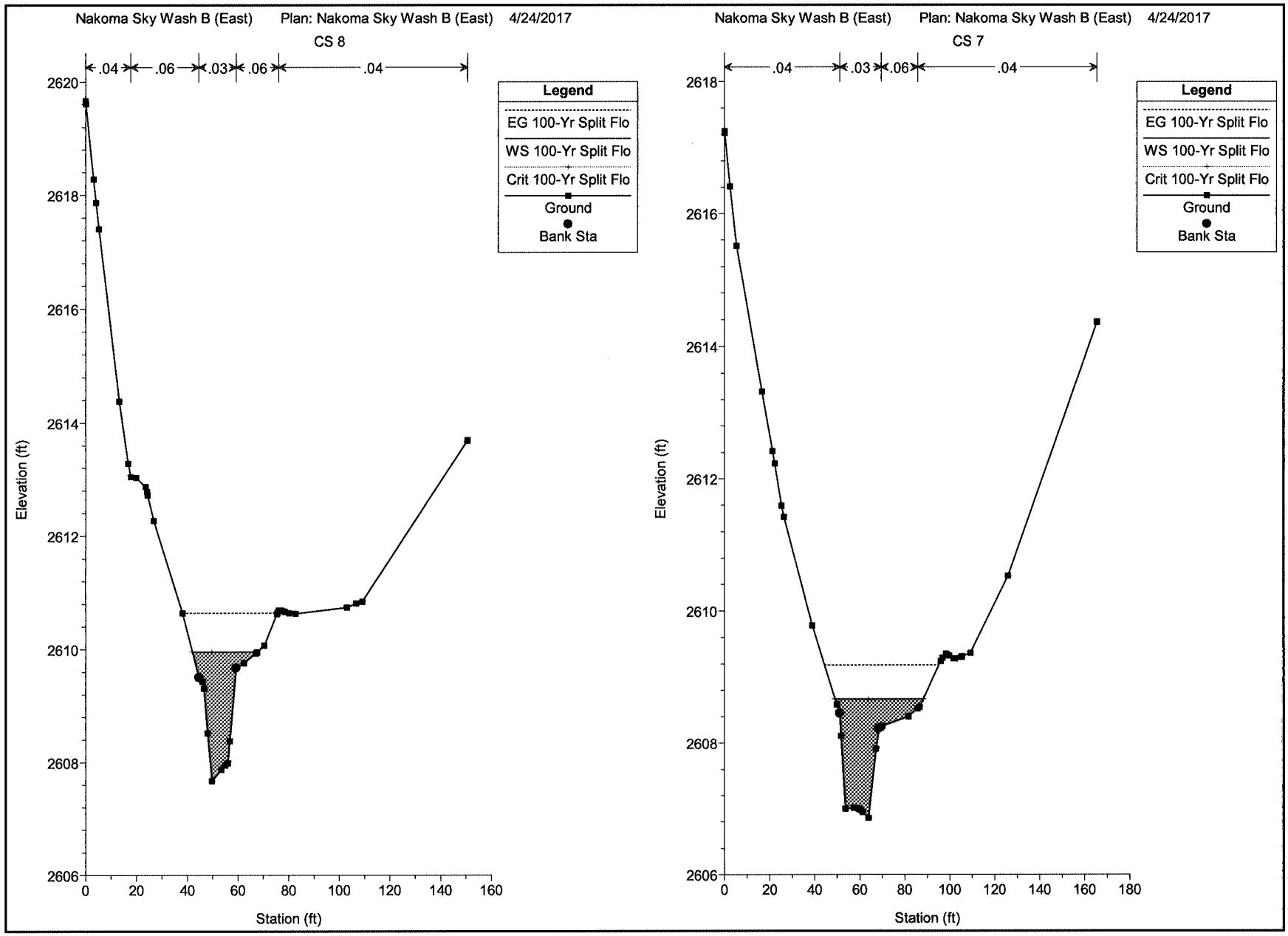

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 16
.04
.06
.03
.06
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 15
.06
.03
.06
.06
.03
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

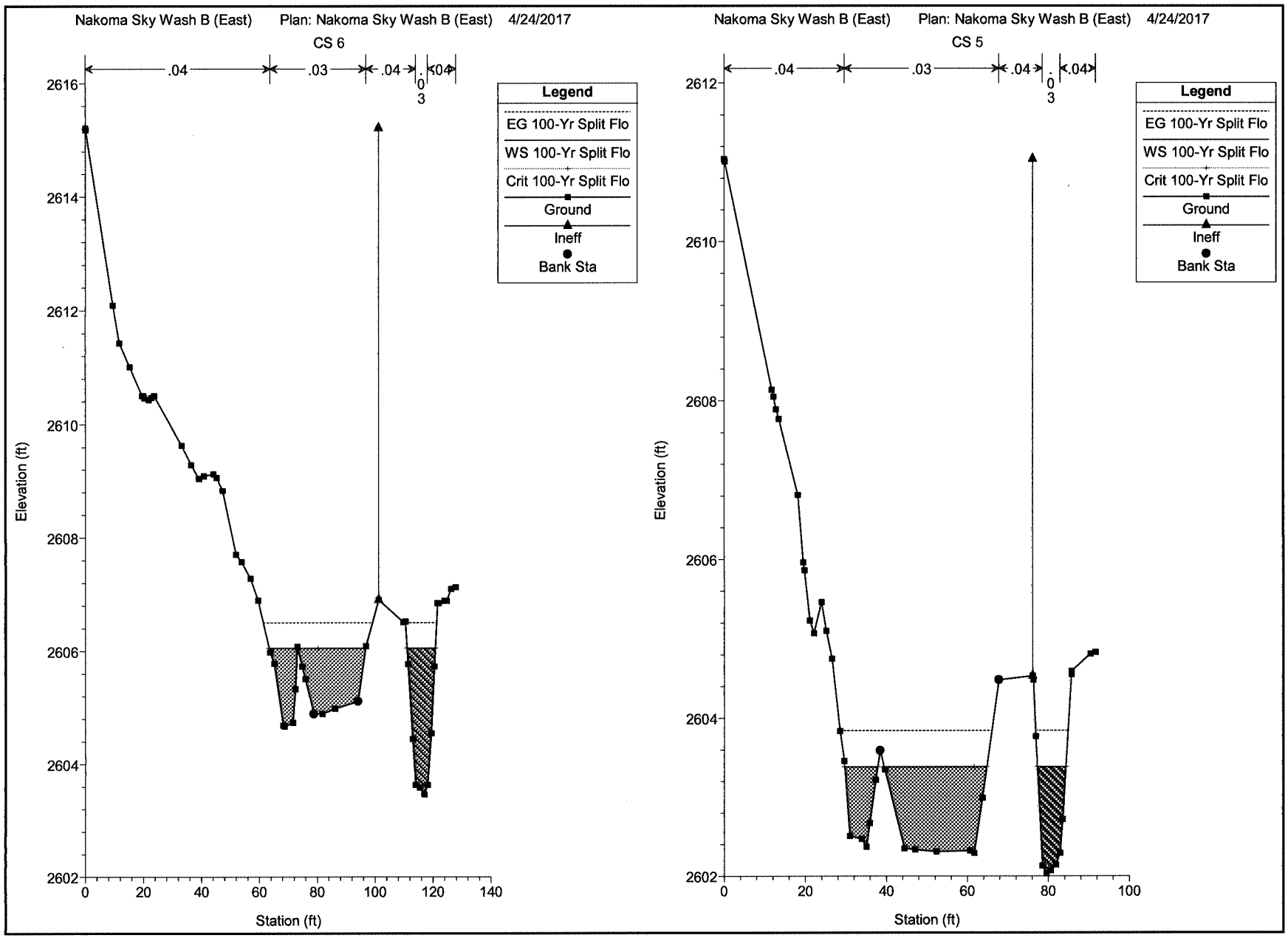

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
Roadway Crossing
.06 .03 .06 .06 .03 .04
.013 .04 .03
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
2632
2630
2628
2626
2624
2622
0 50 100 150 200 250
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
Roadway Crossing
.04 .06 .03 .06 .03 .06 .03 .06 .03 .03 .016
Legend
Crit 100-Yr Split Flo
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
2632
2630
2628
2626
2624
2622
2620
0 50 100 150 200 250 300
Station (ft)

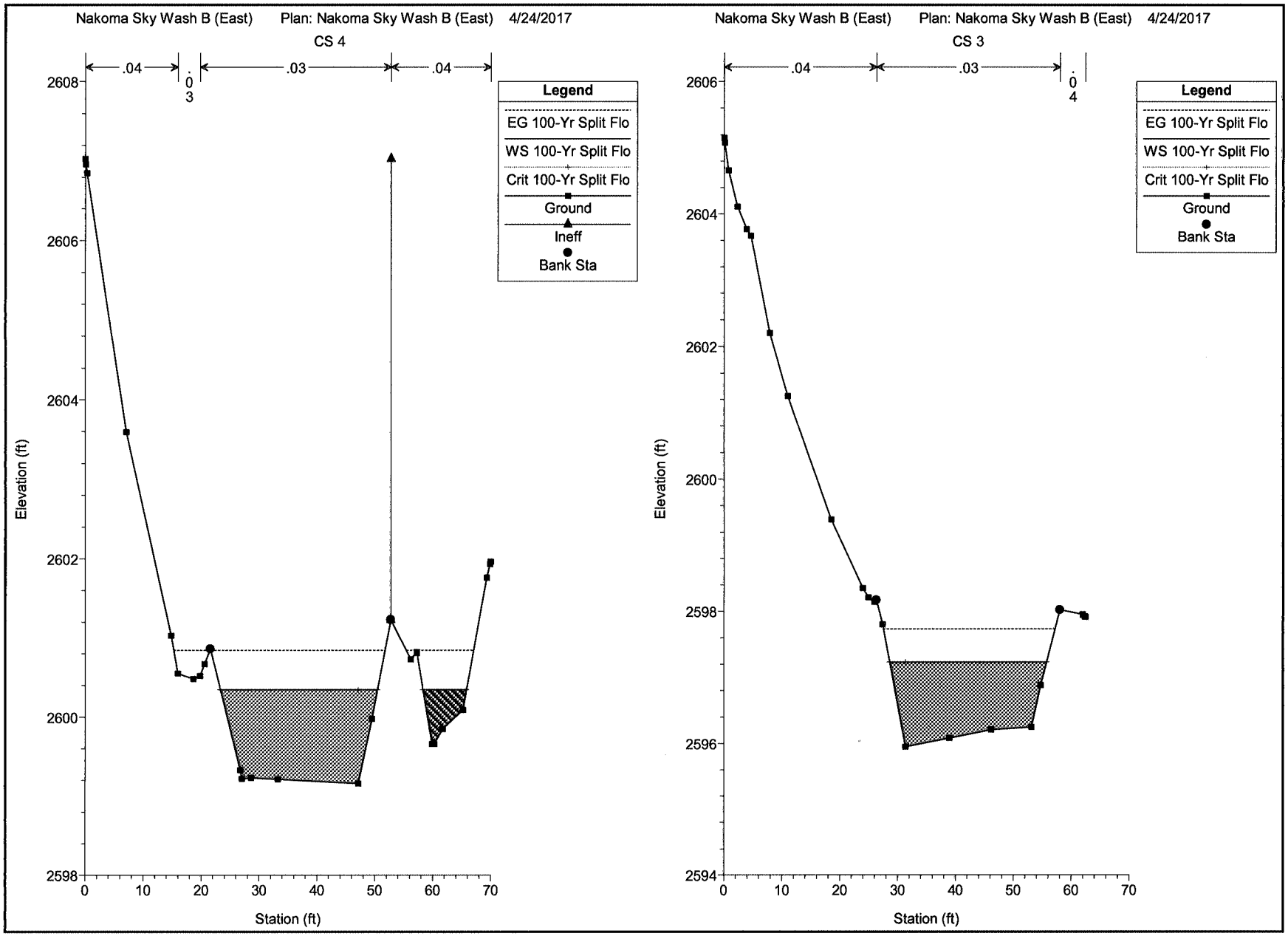

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 14
.04 .06 .03 .06 .03 .06 .03 .06 .03 .03 .016
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 13
.04 .03 .06 .03 .06 .03 .06 .03 .016
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)

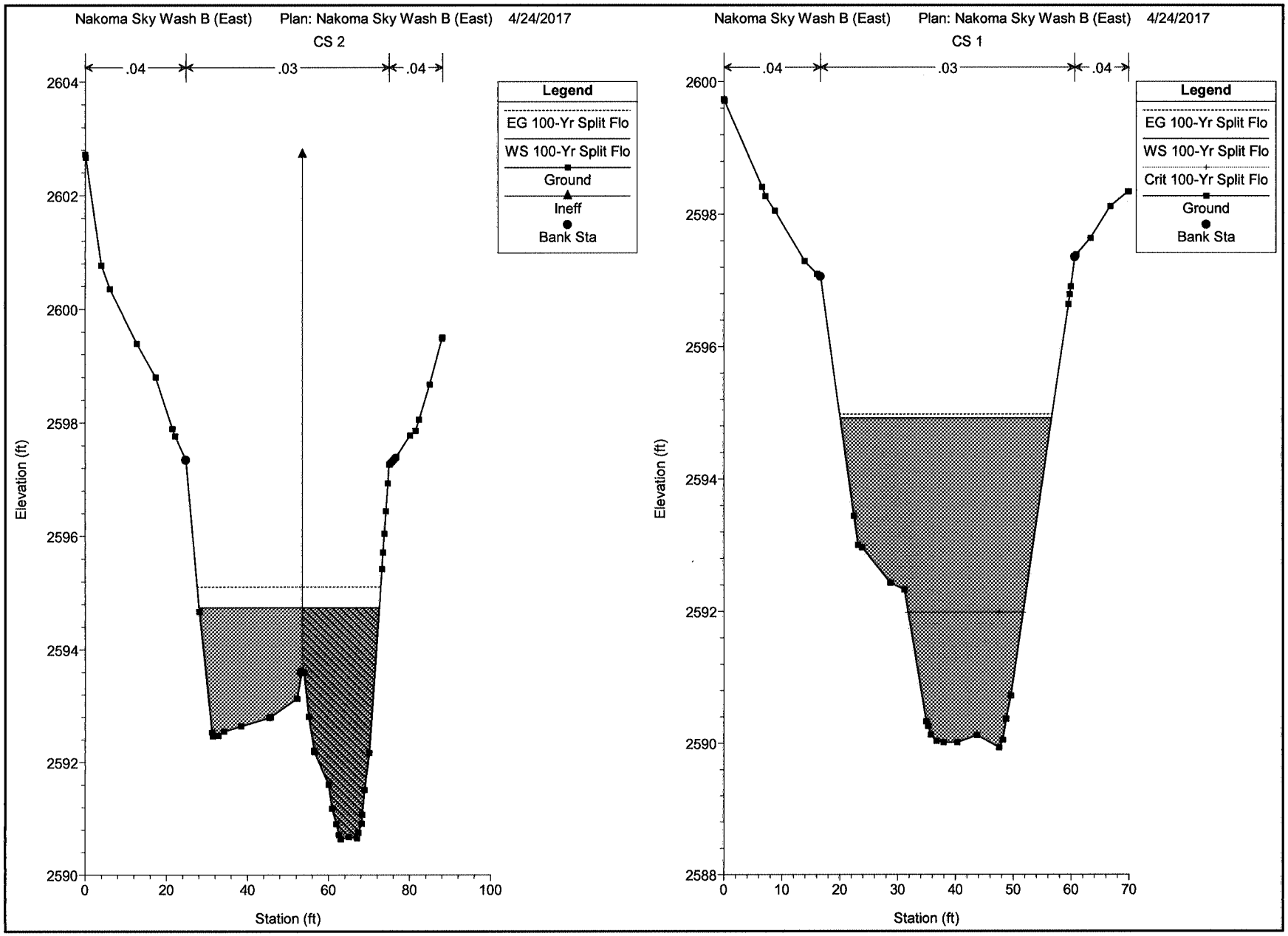

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 12
.04 .03 .06 .03 .06 .06 .03 .04 .016
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
2628
2626
2624
2622
2620
2618
2616
0 50 100 150 200 250 300
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 11
.04 .06 .03 .06 .03 .06 .03 .04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
2635
2630
2625
2620
2615
2610
0 50 100 150 200 250 300
Station (ft)


Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 10
.04
.03
.06
.03
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)
2632
2630
2628
2626
2624
2622
2620
2618
2616
2614
2612
0
50
100
150
200
250
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 9
.04
.06
.03
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)
2640
2635
2630
2625
2620
2615
2610
0
50
100
150
200
250

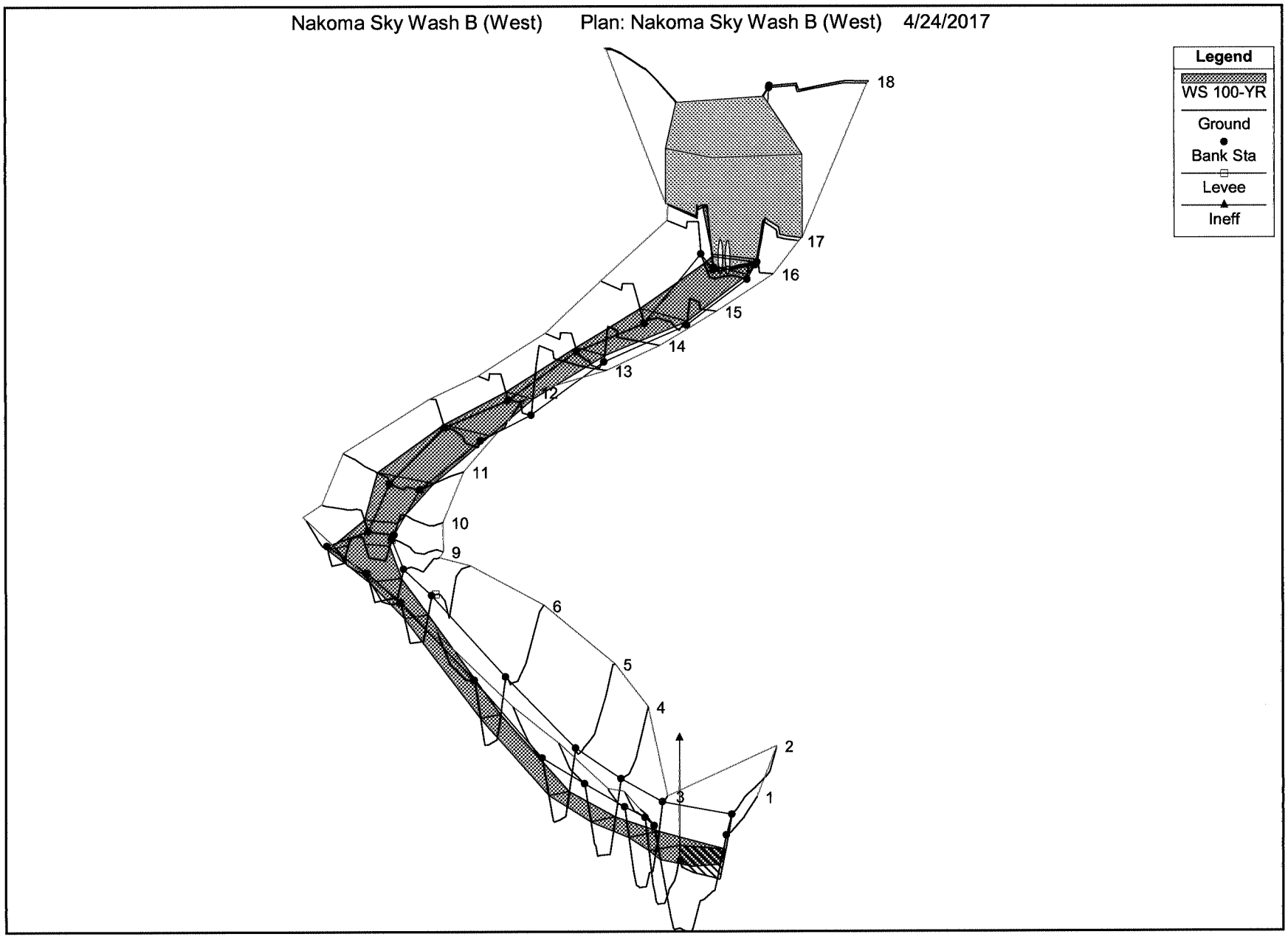

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 8
.04
.06
.03
.06
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 7
.04
.03
.06
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)

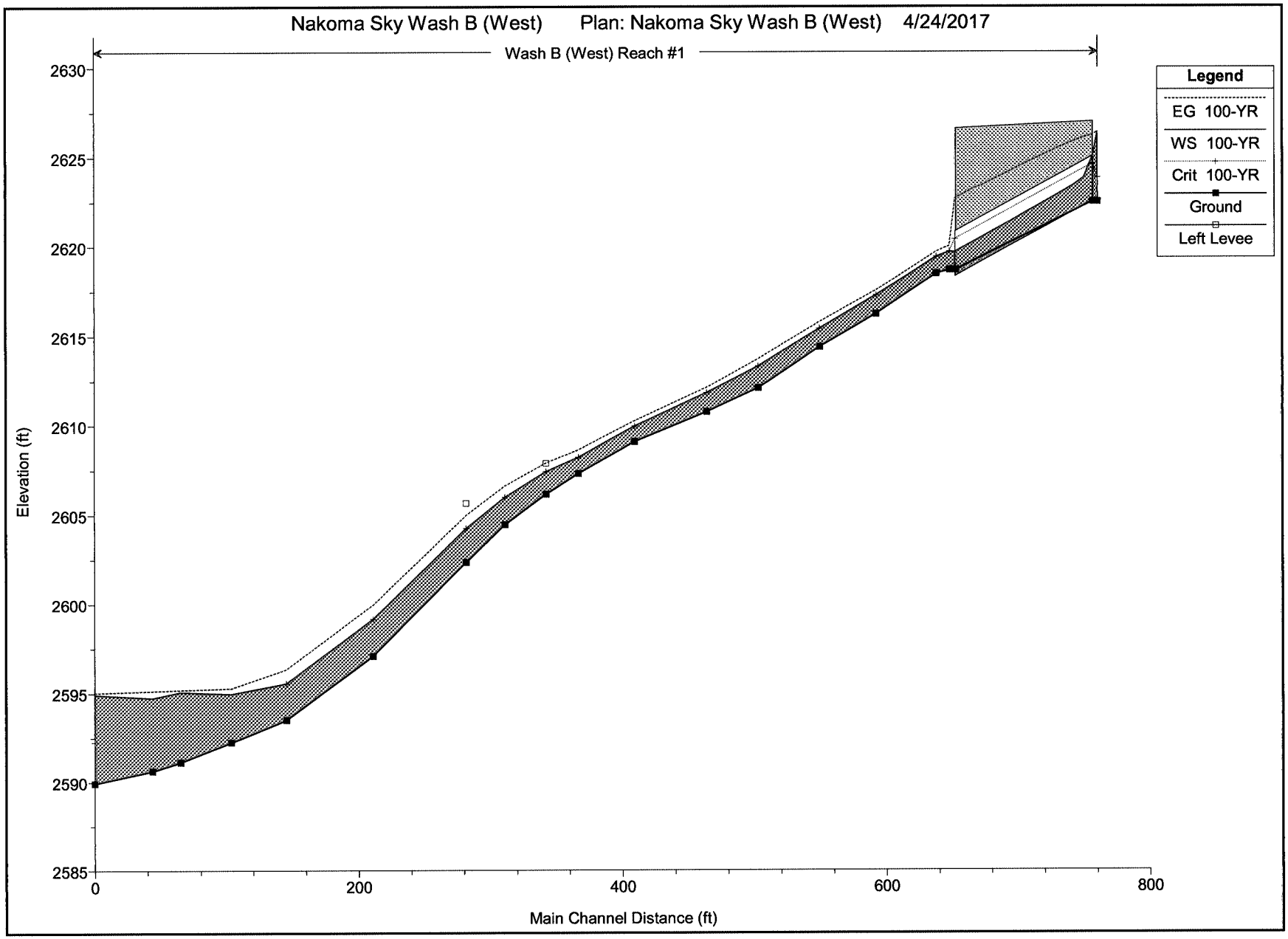

Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 6
.04
.03
.04
.04
.03
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2616
2614
2612
2610
2608
2606
2604
2602
0
20
40
60
80
100
120
140
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 5
.04
.03
.04
.04
.03
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2612
2610
2608
2606
2604
2602
0
20
40
60
80
100


Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 4
.04
.03
.04
.03
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 3
.04
.03
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)


Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 2
.04
.03
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (East) Plan: Nakoma Sky Wash B (East) 4/24/2017
CS 1
.04
.03
.04
Legend
EG 100-Yr Split Flo
WS 100-Yr Split Flo
Crit 100-Yr Split Flo
Ground
Bank Sta
Elevation (ft)
Station (ft)

WASH B (WEST) FLOODPLAIN (HEC-RAS) MODEL
(POST DEVELOPED MODEL)


Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
Legend
WS 100-YR
Ground
Bank Sta
Levee
Ineff
18
17
16
15
14
13
12
11
10
9
6
5
4
3
2
1


Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
Wash B (West) Reach #1
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Left Levee
Elevation (ft)
2630
2625
2620
2615
2610
2605
2600
2595
2590
2585
0
200
400
600
800
Main Channel Distance (ft)

Plan: 1 Wash B (West) Reach #1 RS: 18 Profile: 100-YR

E.G. Elev (ft)	2626.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.030	0.040
W.S. Elev (ft)	2626.37	Reach Len. (ft)	112.44	112.44	112.44
Crit W.S. (ft)	2623.83	Flow Area (sq ft)		58.14	13.14
E.G. Slope (ft/ft)	0.000190	Area (sq ft)		58.14	13.14
Q Total (cfs)	73.30	Flow (cfs)		67.02	6.28
Top Width (ft)	37.72	Top Width (ft)		23.23	14.50
Vel Total (ft/s)	1.03	Avg. Vel. (ft/s)		1.15	0.48
Max Chl Dpth (ft)	3.87	Hydr. Depth (ft)		2.50	0.91
Conv. Total (cfs)	5314.5	Conv. (cfs)		4859.4	455.1
Length Wtd. (ft)	112.44	Wetted Per. (ft)		26.52	14.58
Min Ch El (ft)	2622.50	Shear (lb/sq ft)		0.03	0.01
Alpha	1.17	Stream Power (lb/ft s)		0.03	0.01
Frctn Loss (ft)		Cum Volume (acre-ft)	0.01	0.43	0.00
C & E Loss (ft)		Cum SA (acres)	0.02	0.38	0.04

Plan: 1 Wash B (West) Reach #1 RS: 17 Profile: 100-YR

E.G. Elev (ft)	2620.01	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2619.68	Reach Len. (ft)	9.91	9.91	9.91
Crit W.S. (ft)	2619.68	Flow Area (sq ft)	0.03	15.46	0.57
E.G. Slope (ft/ft)	0.015961	Area (sq ft)	0.03	15.46	0.57
Q Total (cfs)	73.30	Flow (cfs)	0.03	71.69	1.58
Top Width (ft)	25.60	Top Width (ft)	0.30	24.20	1.10
Vel Total (ft/s)	4.56	Avg. Vel. (ft/s)	1.03	4.64	2.76
Max Chl Dpth (ft)	0.99	Hydr. Depth (ft)	0.11	0.64	0.52
Conv. Total (cfs)	580.2	Conv. (cfs)	0.3	567.5	12.5
Length Wtd. (ft)	9.91	Wetted Per. (ft)	0.36	24.22	1.48
Min Ch El (ft)	2618.69	Shear (lb/sq ft)	0.09	0.64	0.38
Alpha	1.02	Stream Power (lb/ft s)	0.09	2.95	1.06
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	0.01	0.42	0.00
C & E Loss (ft)	0.01	Cum SA (acres)	0.02	0.32	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 16 Profile: 100-YR

E.G. Elev (ft)	2619.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.036	0.030	
W.S. Elev (ft)	2619.41	Reach Len. (ft)	45.90	45.90	45.90
Crit W.S. (ft)	2619.41	Flow Area (sq ft)	0.06	17.23	
E.G. Slope (ft/ft)	0.016502	Area (sq ft)	0.06	17.23	
Q Total (cfs)	73.30	Flow (cfs)	0.08	73.22	
Top Width (ft)	31.80	Top Width (ft)	0.35	31.45	
Vel Total (ft/s)	4.24	Avg. Vel. (ft/s)	1.32	4.25	
Max Chl Dpth (ft)	0.94	Hydr. Depth (ft)	0.18	0.55	
Conv. Total (cfs)	570.6	Conv. (cfs)	0.6	570.0	
Length Wtd. (ft)	45.90	Wetted Per. (ft)	0.50	31.57	
Min Ch El (ft)	2618.47	Shear (lb/sq ft)	0.13	0.56	

Plan: 1 Wash B (West) Reach #1 RS: 14 Profile: 100-YR (Continued)

C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.25	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 13 Profile: 100-YR

E.G. Elev (ft)	2613.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2613.30	Reach Len. (ft)	39.11	39.11	39.11
Crit W.S. (ft)	2613.30	Flow Area (sq ft)	0.75	13.60	0.57
E.G. Slope (ft/ft)	0.014442	Area (sq ft)	0.75	13.60	0.57
Q Total (cfs)	73.30	Flow (cfs)	2.12	69.95	1.23
Top Width (ft)	19.81	Top Width (ft)	1.21	16.73	1.86
Vel Total (ft/s)	4.91	Avg. Vel. (ft/s)	2.84	5.14	2.17
Max Chl Dpth (ft)	1.23	Hydr. Depth (ft)	0.62	0.81	0.30
Conv. Total (cfs)	609.9	Conv. (cfs)	17.6	582.1	10.2
Length Wtd. (ft)	39.11	Wetted Per. (ft)	1.73	16.94	1.96
Min Ch El (ft)	2612.07	Shear (lb/sq ft)	0.39	0.72	0.26
Alpha	1.06	Stream Power (lb/ft s)	1.11	3.72	0.56
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)	0.01	0.37	0.00
C & E Loss (ft)	0.03	Cum SA (acres)	0.02	0.23	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 12 Profile: 100-YR

E.G. Elev (ft)	2612.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2611.81	Reach Len. (ft)	54.55	54.55	54.55
Crit W.S. (ft)	2611.81	Flow Area (sq ft)	1.69	15.84	0.08
E.G. Slope (ft/ft)	0.015124	Area (sq ft)	1.69	15.84	0.08
Q Total (cfs)	73.30	Flow (cfs)	3.52	69.69	0.09
Top Width (ft)	32.81	Top Width (ft)	6.41	25.69	0.71
Vel Total (ft/s)	4.16	Avg. Vel. (ft/s)	2.08	4.40	1.15
Max Chl Dpth (ft)	1.07	Hydr. Depth (ft)	0.26	0.62	0.11
Conv. Total (cfs)	596.0	Conv. (cfs)	28.6	566.7	0.8
Length Wtd. (ft)	54.55	Wetted Per. (ft)	6.43	25.82	0.75
Min Ch El (ft)	2610.74	Shear (lb/sq ft)	0.25	0.58	0.10
Alpha	1.07	Stream Power (lb/ft s)	0.52	2.55	0.12
Frctn Loss (ft)	0.75	Cum Volume (acre-ft)	0.01	0.36	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.21	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical

Errors Warnings and Notes (Continued)

	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 9 Profile: 100-YR

E.G. Elev (ft)	2607.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.		0.022	
W.S. Elev (ft)	2607.40	Reach Len. (ft)	31.12	31.12	31.12
Crit W.S. (ft)	2607.40	Flow Area (sq ft)		26.31	
E.G. Slope (ft/ft)	0.007641	Area (sq ft)		26.31	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	27.91	Top Width (ft)		27.91	
Vel Total (ft/s)	5.55	Avg. Vel. (ft/s)		5.55	
Max Chl Dpth (ft)	1.26	Hydr. Depth (ft)		0.94	
Conv. Total (cfs)	1669.1	Conv. (cfs)		1669.1	
Length Wtd. (ft)	31.12	Wetted Per. (ft)		28.90	
Min Ch El (ft)	2606.14	Shear (lb/sq ft)		0.43	
Alpha	1.00	Stream Power (lb/ft s)		2.41	
Frctn Loss (ft)	0.23	Cum Volume (acre-ft)		0.31	
C & E Loss (ft)	0.02	Cum SA (acres)		0.16	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

Plan: 1 Wash B (West) Reach #1 RS: 8 Profile: 100-YR

E.G. Elev (ft)	2606.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.		0.022	
W.S. Elev (ft)	2605.97	Reach Len. (ft)	29.40	29.40	29.40
Crit W.S. (ft)	2605.97	Flow Area (sq ft)		22.93	
E.G. Slope (ft/ft)	0.007030	Area (sq ft)		22.93	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	18.49	Top Width (ft)		18.49	
Vel Total (ft/s)	6.36	Avg. Vel. (ft/s)		6.36	
Max Chl Dpth (ft)	1.52	Hydr. Depth (ft)		1.24	
Conv. Total (cfs)	1740.1	Conv. (cfs)		1740.1	
Length Wtd. (ft)	29.40	Wetted Per. (ft)		19.25	
Min Ch El (ft)	2604.45	Shear (lb/sq ft)		0.52	
Alpha	1.00	Stream Power (lb/ft s)		3.33	
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.30	
C & E Loss (ft)	0.01	Cum SA (acres)		0.14	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate

Errors Warnings and Notes (Continued)

Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 5 Profile: 100-YR

E.G. Elev (ft)	2596.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.78	Wt. n-Val.		0.022	
W.S. Elev (ft)	2595.54	Reach Len. (ft)	41.71	41.71	41.71
Crit W.S. (ft)	2595.54	Flow Area (sq ft)		20.55	
E.G. Slope (ft/ft)	0.006902	Area (sq ft)		20.55	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	13.22	Top Width (ft)		13.22	
Vel Total (ft/s)	7.10	Avg. Vel. (ft/s)		7.10	
Max Chl Dpth (ft)	2.03	Hydr. Depth (ft)		1.55	
Conv. Total (cfs)	1756.2	Conv. (cfs)		1756.2	
Length Wtd. (ft)	41.71	Wetted Per. (ft)		14.45	
Min Ch El (ft)	2593.51	Shear (lb/sq ft)		0.61	
Alpha	1.00	Stream Power (lb/ft s)		4.35	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.22	
C & E Loss (ft)	0.14	Cum SA (acres)		0.09	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2595.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.022	
W.S. Elev (ft)	2594.95	Reach Len. (ft)	38.44	38.44	38.44
Crit W.S. (ft)		Flow Area (sq ft)		32.63	
E.G. Slope (ft/ft)	0.001942	Area (sq ft)		32.63	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	16.00	Top Width (ft)		16.00	
Vel Total (ft/s)	4.47	Avg. Vel. (ft/s)		4.47	
Max Chl Dpth (ft)	2.71	Hydr. Depth (ft)		2.04	
Conv. Total (cfs)	3310.6	Conv. (cfs)		3310.6	
Length Wtd. (ft)	38.44	Wetted Per. (ft)		17.73	
Min Ch El (ft)	2592.24	Shear (lb/sq ft)		0.22	
Alpha	1.00	Stream Power (lb/ft s)		1.00	
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)		0.19	
C & E Loss (ft)	0.06	Cum SA (acres)		0.07	

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: 1 Wash B (West) Reach #1 RS: 18 Profile: 100-YR

E.G. Elev (ft)	2626.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.030	0.040
W.S. Elev (ft)	2626.37	Reach Len. (ft)	112.44	112.44	112.44
Crit W.S. (ft)	2623.83	Flow Area (sq ft)		58.14	13.14
E.G. Slope (ft/ft)	0.000190	Area (sq ft)		58.14	13.14
Q Total (cfs)	73.30	Flow (cfs)		67.02	6.28
Top Width (ft)	37.72	Top Width (ft)		23.23	14.50
Vel Total (ft/s)	1.03	Avg. Vel. (ft/s)		1.15	0.48
Max Chl Dpth (ft)	3.87	Hydr. Depth (ft)		2.50	0.91
Conv. Total (cfs)	5314.5	Conv. (cfs)		4859.4	455.1
Length Wtd. (ft)	112.44	Wetted Per. (ft)		26.52	14.58
Min Ch El (ft)	2622.50	Shear (lb/sq ft)		0.03	0.01
Alpha	1.17	Stream Power (lb/ft s)		0.03	0.01
Frctn Loss (ft)		Cum Volume (acre-ft)	0.01	0.43	0.00
C & E Loss (ft)		Cum SA (acres)	0.02	0.38	0.04

Plan: 1 Wash B (West) Reach #1 RS: 17 Profile: 100-YR

E.G. Elev (ft)	2620.01	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2619.68	Reach Len. (ft)	9.91	9.91	9.91
Crit W.S. (ft)	2619.68	Flow Area (sq ft)	0.03	15.46	0.57
E.G. Slope (ft/ft)	0.015961	Area (sq ft)	0.03	15.46	0.57
Q Total (cfs)	73.30	Flow (cfs)	0.03	71.69	1.58
Top Width (ft)	25.60	Top Width (ft)	0.30	24.20	1.10
Vel Total (ft/s)	4.56	Avg. Vel. (ft/s)	1.03	4.64	2.76
Max Chl Dpth (ft)	0.99	Hydr. Depth (ft)	0.11	0.64	0.52
Conv. Total (cfs)	580.2	Conv. (cfs)	0.3	567.5	12.5
Length Wtd. (ft)	9.91	Wetted Per. (ft)	0.36	24.22	1.48
Min Ch El (ft)	2618.69	Shear (lb/sq ft)	0.09	0.64	0.38
Alpha	1.02	Stream Power (lb/ft s)	0.09	2.95	1.06
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	0.01	0.42	0.00
C & E Loss (ft)	0.01	Cum SA (acres)	0.02	0.32	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 16 Profile: 100-YR

E.G. Elev (ft)	2619.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.036	0.030	
W.S. Elev (ft)	2619.41	Reach Len. (ft)	45.90	45.90	45.90
Crit W.S. (ft)	2619.41	Flow Area (sq ft)	0.06	17.23	
E.G. Slope (ft/ft)	0.016502	Area (sq ft)	0.06	17.23	
Q Total (cfs)	73.30	Flow (cfs)	0.08	73.22	
Top Width (ft)	31.80	Top Width (ft)	0.35	31.45	
Vel Total (ft/s)	4.24	Avg. Vel. (ft/s)	1.32	4.25	
Max Chl Dpth (ft)	0.94	Hydr. Depth (ft)	0.18	0.55	
Conv. Total (cfs)	570.6	Conv. (cfs)	0.6	570.0	
Length Wtd. (ft)	45.90	Wetted Per. (ft)	0.50	31.57	
Min Ch El (ft)	2618.47	Shear (lb/sq ft)	0.13	0.56	

Plan: 1 Wash B (West) Reach #1 RS: 16 Profile: 100-YR (Continued)

Alpha	1.00	Stream Power (lb/ft s)	0.17	2.39	
Frctn Loss (ft)	0.79	Cum Volume (acre-ft)	0.01	0.42	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.31	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 15 Profile: 100-YR

E.G. Elev (ft)	2617.52	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2617.25	Reach Len. (ft)	42.79	42.79	42.79
Crit W.S. (ft)	2617.25	Flow Area (sq ft)	0.05	16.01	1.66
E.G. Slope (ft/ft)	0.018032	Area (sq ft)	0.05	16.01	1.66
Q Total (cfs)	73.30	Flow (cfs)	0.06	67.49	5.76
Top Width (ft)	35.11	Top Width (ft)	0.31	31.62	3.18
Vel Total (ft/s)	4.14	Avg. Vel. (ft/s)	1.25	4.22	3.47
Max Chl Dpth (ft)	1.04	Hydr. Depth (ft)	0.15	0.51	0.52
Conv. Total (cfs)	545.9	Conv. (cfs)	0.4	502.6	42.9
Length Wtd. (ft)	42.79	Wetted Per. (ft)	0.43	31.73	3.35
Min Ch El (ft)	2616.21	Shear (lb/sq ft)	0.12	0.57	0.56
Alpha	1.01	Stream Power (lb/ft s)	0.15	2.39	1.94
Frctn Loss (ft)	0.69	Cum Volume (acre-ft)	0.01	0.40	0.00
C & E Loss (ft)	0.01	Cum SA (acres)	0.02	0.28	0.02

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 14 Profile: 100-YR

E.G. Elev (ft)	2615.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2615.40	Reach Len. (ft)	46.53	46.53	46.53
Crit W.S. (ft)	2615.40	Flow Area (sq ft)	0.12	14.97	0.13
E.G. Slope (ft/ft)	0.014591	Area (sq ft)	0.12	14.97	0.13
Q Total (cfs)	73.30	Flow (cfs)	0.18	72.93	0.18
Top Width (ft)	21.62	Top Width (ft)	0.49	20.23	0.90
Vel Total (ft/s)	4.82	Avg. Vel. (ft/s)	1.54	4.87	1.35
Max Chl Dpth (ft)	1.03	Hydr. Depth (ft)	0.24	0.74	0.15
Conv. Total (cfs)	606.8	Conv. (cfs)	1.5	603.8	1.5
Length Wtd. (ft)	46.53	Wetted Per. (ft)	0.69	20.36	0.95
Min Ch El (ft)	2614.37	Shear (lb/sq ft)	0.16	0.67	0.13
Alpha	1.02	Stream Power (lb/ft s)	0.24	3.26	0.17
Frctn Loss (ft)	0.68	Cum Volume (acre-ft)	0.01	0.38	0.00

Plan: 1 Wash B (West) Reach #1 RS: 14 Profile: 100-YR (Continued)

C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.25	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 13 Profile: 100-YR

E.G. Elev (ft)	2613.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2613.30	Reach Len. (ft)	39.11	39.11	39.11
Crit W.S. (ft)	2613.30	Flow Area (sq ft)	0.75	13.60	0.57
E.G. Slope (ft/ft)	0.014442	Area (sq ft)	0.75	13.60	0.57
Q Total (cfs)	73.30	Flow (cfs)	2.12	69.95	1.23
Top Width (ft)	19.81	Top Width (ft)	1.21	16.73	1.86
Vel Total (ft/s)	4.91	Avg. Vel. (ft/s)	2.84	5.14	2.17
Max Chl Dpth (ft)	1.23	Hydr. Depth (ft)	0.62	0.81	0.30
Conv. Total (cfs)	609.9	Conv. (cfs)	17.6	582.1	10.2
Length Wtd. (ft)	39.11	Wetted Per. (ft)	1.73	16.94	1.96
Min Ch El (ft)	2612.07	Shear (lb/sq ft)	0.39	0.72	0.26
Alpha	1.06	Stream Power (lb/ft s)	1.11	3.72	0.56
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)	0.01	0.37	0.00
C & E Loss (ft)	0.03	Cum SA (acres)	0.02	0.23	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 12 Profile: 100-YR

E.G. Elev (ft)	2612.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2611.81	Reach Len. (ft)	54.55	54.55	54.55
Crit W.S. (ft)	2611.81	Flow Area (sq ft)	1.69	15.84	0.08
E.G. Slope (ft/ft)	0.015124	Area (sq ft)	1.69	15.84	0.08
Q Total (cfs)	73.30	Flow (cfs)	3.52	69.69	0.09
Top Width (ft)	32.81	Top Width (ft)	6.41	25.69	0.71
Vel Total (ft/s)	4.16	Avg. Vel. (ft/s)	2.08	4.40	1.15
Max Chl Dpth (ft)	1.07	Hydr. Depth (ft)	0.26	0.62	0.11
Conv. Total (cfs)	596.0	Conv. (cfs)	28.6	566.7	0.8
Length Wtd. (ft)	54.55	Wetted Per. (ft)	6.43	25.82	0.75
Min Ch El (ft)	2610.74	Shear (lb/sq ft)	0.25	0.58	0.10
Alpha	1.07	Stream Power (lb/ft s)	0.52	2.55	0.12
Frctn Loss (ft)	0.75	Cum Volume (acre-ft)	0.01	0.36	0.00
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.21	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical

Errors Warnings and Notes (Continued)

	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 11 Profile: 100-YR

E.G. Elev (ft)	2610.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2609.95	Reach Len. (ft)	42.52	42.52	42.52
Crit W.S. (ft)	2609.95	Flow Area (sq ft)	3.00	14.39	1.38
E.G. Slope (ft/ft)	0.012561	Area (sq ft)	3.00	14.39	1.38
Q Total (cfs)	73.30	Flow (cfs)	6.68	64.68	1.94
Top Width (ft)	36.80	Top Width (ft)	8.98	19.73	8.09
Vel Total (ft/s)	3.91	Avg. Vel. (ft/s)	2.22	4.49	1.41
Max Chl Dpth (ft)	0.88	Hydr. Depth (ft)	0.33	0.73	0.17
Conv. Total (cfs)	654.0	Conv. (cfs)	59.6	577.1	17.3
Length Wtd. (ft)	42.52	Wetted Per. (ft)	9.00	19.75	8.17
Min Ch El (ft)	2609.07	Shear (lb/sq ft)	0.26	0.57	0.13
Alpha	1.20	Stream Power (lb/ft s)	0.58	2.57	0.19
Frctn Loss (ft)	0.55	Cum Volume (acre-ft)	0.00	0.34	0.00
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	0.18	0.01

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 10 Profile: 100-YR

E.G. Elev (ft)	2608.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.42	Wt. n-Val.	0.036	0.030	0.036
W.S. Elev (ft)	2608.20	Reach Len. (ft)	24.44	24.44	24.44
Crit W.S. (ft)	2608.20	Flow Area (sq ft)	0.90	12.89	0.91
E.G. Slope (ft/ft)	0.013569	Area (sq ft)	0.90	12.89	0.91
Q Total (cfs)	73.30	Flow (cfs)	2.35	68.58	2.38
Top Width (ft)	18.74	Top Width (ft)	2.06	14.56	2.12
Vel Total (ft/s)	4.99	Avg. Vel. (ft/s)	2.61	5.32	2.60
Max Chl Dpth (ft)	0.90	Hydr. Depth (ft)	0.44	0.89	0.43
Conv. Total (cfs)	629.3	Conv. (cfs)	20.2	588.7	20.4
Length Wtd. (ft)	24.44	Wetted Per. (ft)	2.25	14.56	2.30
Min Ch El (ft)	2607.30	Shear (lb/sq ft)	0.34	0.75	0.34
Alpha	1.08	Stream Power (lb/ft s)	0.89	3.99	0.88
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)	0.00	0.32	0.00
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.17	0.00

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

Errors Warnings and Notes (Continued)

	1.4. This may indicate the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 9 Profile: 100-YR

E.G. Elev (ft)	2607.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.		0.022	
W.S. Elev (ft)	2607.40	Reach Len. (ft)	31.12	31.12	31.12
Crit W.S. (ft)	2607.40	Flow Area (sq ft)		26.31	
E.G. Slope (ft/ft)	0.007641	Area (sq ft)		26.31	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	27.91	Top Width (ft)		27.91	
Vel Total (ft/s)	5.55	Avg. Vel. (ft/s)		5.55	
Max Chl Dpth (ft)	1.26	Hydr. Depth (ft)		0.94	
Conv. Total (cfs)	1669.1	Conv. (cfs)		1669.1	
Length Wtd. (ft)	31.12	Wetted Per. (ft)		28.90	
Min Ch El (ft)	2606.14	Shear (lb/sq ft)		0.43	
Alpha	1.00	Stream Power (lb/ft s)		2.41	
Frctn Loss (ft)	0.23	Cum Volume (acre-ft)		0.31	
C & E Loss (ft)	0.02	Cum SA (acres)		0.16	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	Divided flow computed for this cross-section.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

Plan: 1 Wash B (West) Reach #1 RS: 8 Profile: 100-YR

E.G. Elev (ft)	2606.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.		0.022	
W.S. Elev (ft)	2605.97	Reach Len. (ft)	29.40	29.40	29.40
Crit W.S. (ft)	2605.97	Flow Area (sq ft)		22.93	
E.G. Slope (ft/ft)	0.007030	Area (sq ft)		22.93	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	18.49	Top Width (ft)		18.49	
Vel Total (ft/s)	6.36	Avg. Vel. (ft/s)		6.36	
Max Chl Dpth (ft)	1.52	Hydr. Depth (ft)		1.24	
Conv. Total (cfs)	1740.1	Conv. (cfs)		1740.1	
Length Wtd. (ft)	29.40	Wetted Per. (ft)		19.25	
Min Ch El (ft)	2604.45	Shear (lb/sq ft)		0.52	
Alpha	1.00	Stream Power (lb/ft s)		3.33	
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)		0.30	
C & E Loss (ft)	0.01	Cum SA (acres)		0.14	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate

Errors Warnings and Notes (Continued)

	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 7 Profile: 100-YR

E.G. Elev (ft)	2604.97	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.73	Wt. n-Val.		0.022	
W.S. Elev (ft)	2604.23	Reach Len. (ft)	70.73	70.73	70.73
Crit W.S. (ft)	2604.23	Flow Area (sq ft)		21.24	
E.G. Slope (ft/ft)	0.006819	Area (sq ft)		21.24	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	14.53	Top Width (ft)		14.53	
Vel Total (ft/s)	6.87	Avg. Vel. (ft/s)		6.87	
Max Chl Dpth (ft)	1.89	Hydr. Depth (ft)		1.46	
Conv. Total (cfs)	1766.8	Conv. (cfs)		1766.8	
Length Wtd. (ft)	70.73	Wetted Per. (ft)		15.55	
Min Ch El (ft)	2602.34	Shear (lb/sq ft)		0.58	
Alpha	1.00	Stream Power (lb/ft s)		4.00	
Frctn Loss (ft)	0.49	Cum Volume (acre-ft)		0.28	
C & E Loss (ft)	0.01	Cum SA (acres)		0.13	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.
Note:	Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

Plan: 1 Wash B (West) Reach #1 RS: 6 Profile: 100-YR

E.G. Elev (ft)	2599.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.80	Wt. n-Val.		0.022	
W.S. Elev (ft)	2599.14	Reach Len. (ft)	65.96	65.96	65.96
Crit W.S. (ft)	2599.14	Flow Area (sq ft)		20.32	
E.G. Slope (ft/ft)	0.006959	Area (sq ft)		20.32	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	12.84	Top Width (ft)		12.84	
Vel Total (ft/s)	7.18	Avg. Vel. (ft/s)		7.18	
Max Chl Dpth (ft)	2.06	Hydr. Depth (ft)		1.58	
Conv. Total (cfs)	1749.0	Conv. (cfs)		1749.0	
Length Wtd. (ft)	65.96	Wetted Per. (ft)		14.13	
Min Ch El (ft)	2597.08	Shear (lb/sq ft)		0.62	
Alpha	1.00	Stream Power (lb/ft s)		4.49	
Frctn Loss (ft)	0.46	Cum Volume (acre-ft)		0.25	
C & E Loss (ft)	0.01	Cum SA (acres)		0.11	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.

Errors Warnings and Notes (Continued)

Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 5 Profile: 100-YR

E.G. Elev (ft)	2596.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.78	Wt. n-Val.		0.022	
W.S. Elev (ft)	2595.54	Reach Len. (ft)	41.71	41.71	41.71
Crit W.S. (ft)	2595.54	Flow Area (sq ft)		20.55	
E.G. Slope (ft/ft)	0.006902	Area (sq ft)		20.55	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	13.22	Top Width (ft)		13.22	
Vel Total (ft/s)	7.10	Avg. Vel. (ft/s)		7.10	
Max Chl Dpth (ft)	2.03	Hydr. Depth (ft)		1.55	
Conv. Total (cfs)	1756.2	Conv. (cfs)		1756.2	
Length Wtd. (ft)	41.71	Wetted Per. (ft)		14.45	
Min Ch El (ft)	2593.51	Shear (lb/sq ft)		0.61	
Alpha	1.00	Stream Power (lb/ft s)		4.35	
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)		0.22	
C & E Loss (ft)	0.14	Cum SA (acres)		0.09	

Errors Warnings and Notes

Warning:	The energy equation could not be balanced within the specified number of iterations. The program used critical
	depth for the water surface and continued on with the calculations.
Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.
Warning:	The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate
	the need for additional cross sections.
Warning:	During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
	water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The
	program defaulted to critical depth.

Plan: 1 Wash B (West) Reach #1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2595.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.022	
W.S. Elev (ft)	2594.95	Reach Len. (ft)	38.44	38.44	38.44
Crit W.S. (ft)		Flow Area (sq ft)		32.63	
E.G. Slope (ft/ft)	0.001942	Area (sq ft)		32.63	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	16.00	Top Width (ft)		16.00	
Vel Total (ft/s)	4.47	Avg. Vel. (ft/s)		4.47	
Max Chl Dpth (ft)	2.71	Hydr. Depth (ft)		2.04	
Conv. Total (cfs)	3310.6	Conv. (cfs)		3310.6	
Length Wtd. (ft)	38.44	Wetted Per. (ft)		17.73	
Min Ch El (ft)	2592.24	Shear (lb/sq ft)		0.22	
Alpha	1.00	Stream Power (lb/ft s)		1.00	
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)		0.19	
C & E Loss (ft)	0.06	Cum SA (acres)		0.07	

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: 1 Wash B (West) Reach #1 RS: 3 Profile: 100-YR

E.G. Elev (ft)	2595.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.022	
W.S. Elev (ft)	2595.06	Reach Len. (ft)	21.31	21.31	21.31
Crit W.S. (ft)		Flow Area (sq ft)		55.43	
E.G. Slope (ft/ft)	0.000454	Area (sq ft)		55.43	
Q Total (cfs)	145.90	Flow (cfs)		145.90	
Top Width (ft)	19.99	Top Width (ft)		19.99	
Vel Total (ft/s)	2.63	Avg. Vel. (ft/s)		2.63	
Max Chl Dpth (ft)	3.94	Hydr. Depth (ft)		2.77	
Conv. Total (cfs)	6849.4	Conv. (cfs)		6849.4	
Length Wtd. (ft)	21.31	Wetted Per. (ft)		22.40	
Min Ch El (ft)	2591.12	Shear (lb/sq ft)		0.07	
Alpha	1.00	Stream Power (lb/ft s)		0.18	
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)		0.15	
C & E Loss (ft)	0.03	Cum SA (acres)		0.06	

Plan: 1 Wash B (West) Reach #1 RS: 2 Profile: 100-YR

E.G. Elev (ft)	2595.12	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.		0.022	
W.S. Elev (ft)	2594.73	Reach Len. (ft)	43.78	43.78	43.78
Crit W.S. (ft)		Flow Area (sq ft)		56.45	
E.G. Slope (ft/ft)	0.001513	Area (sq ft)		103.35	
Q Total (cfs)	285.00	Flow (cfs)		285.00	
Top Width (ft)	44.46	Top Width (ft)		44.46	
Vel Total (ft/s)	5.05	Avg. Vel. (ft/s)		5.05	
Max Chl Dpth (ft)	4.10	Hydr. Depth (ft)		2.96	
Conv. Total (cfs)	7326.5	Conv. (cfs)		7326.5	
Length Wtd. (ft)	43.78	Wetted Per. (ft)		21.19	
Min Ch El (ft)	2590.63	Shear (lb/sq ft)		0.25	
Alpha	1.00	Stream Power (lb/ft s)		1.27	
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.09	Cum SA (acres)		0.04	

Errors Warnings and Notes

Warning:	The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
	1.4. This may indicate the need for additional cross sections.

Plan: 1 Wash B (West) Reach #1 RS: 1 Profile: 100-YR

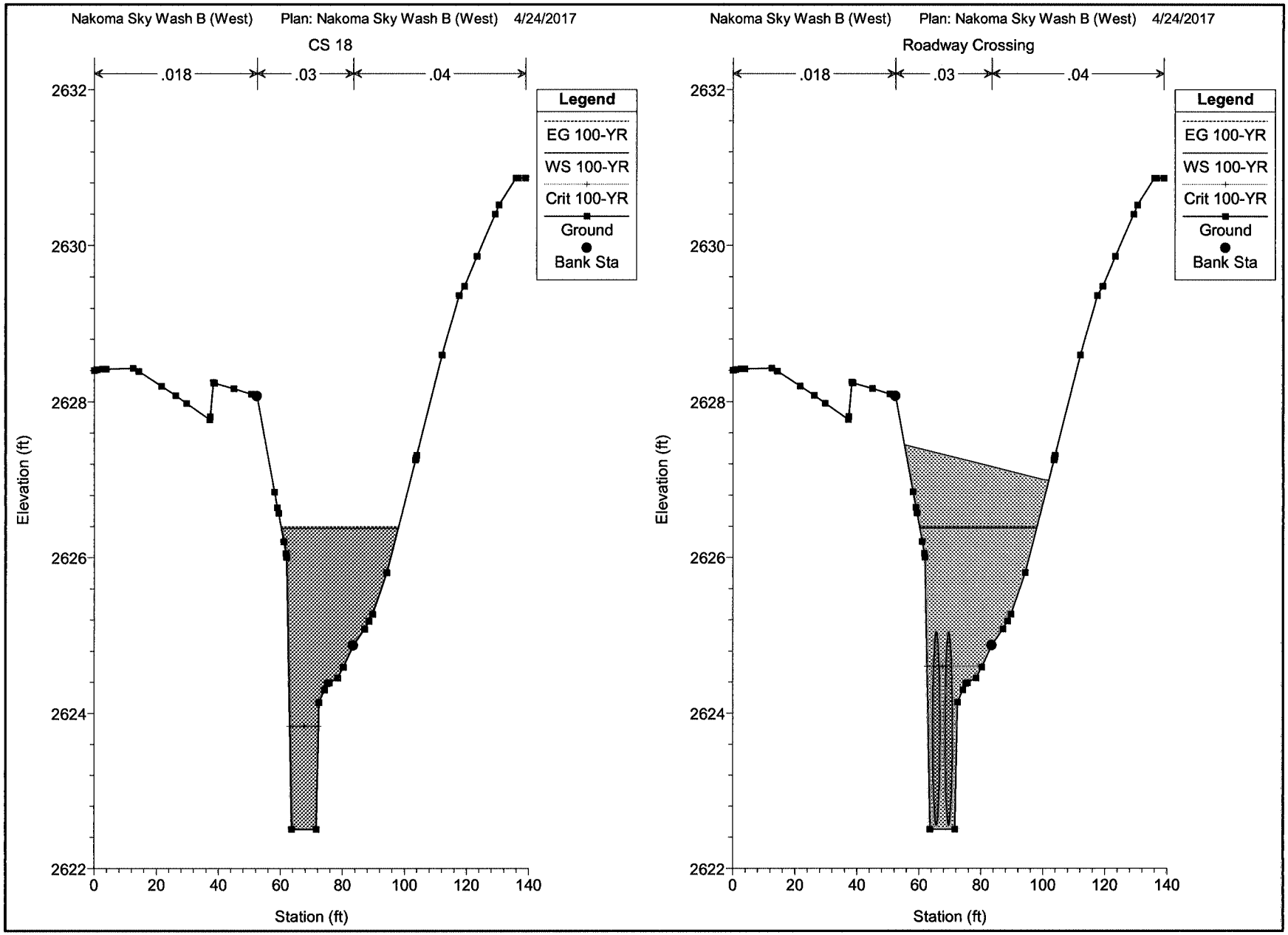
E.G. Elev (ft)	2595.01	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.		0.022	
W.S. Elev (ft)	2594.92	Reach Len. (ft)			
Crit W.S. (ft)	2592.25	Flow Area (sq ft)		120.66	
E.G. Slope (ft/ft)	0.000271	Area (sq ft)		120.66	
Q Total (cfs)	285.00	Flow (cfs)		285.00	
Top Width (ft)	36.58	Top Width (ft)		36.58	
Vel Total (ft/s)	2.36	Avg. Vel. (ft/s)		2.36	
Max Chl Dpth (ft)	4.99	Hydr. Depth (ft)		3.30	
Conv. Total (cfs)	17297.6	Conv. (cfs)		17297.6	
Length Wtd. (ft)		Wetted Per. (ft)		39.02	
Min Ch El (ft)	2589.93	Shear (lb/sq ft)		0.05	
Alpha	1.00	Stream Power (lb/ft s)		0.12	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

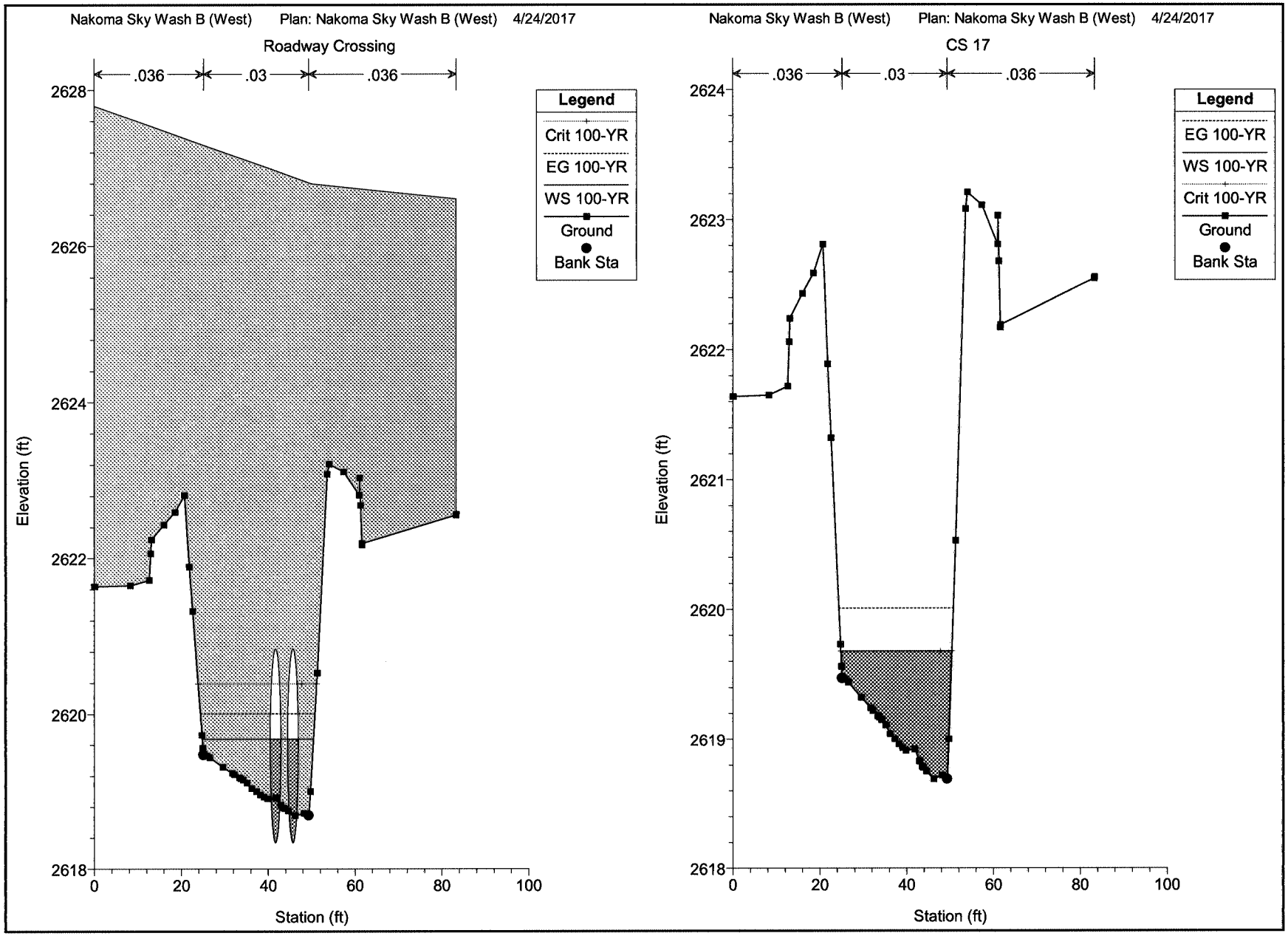
Plan: 1 Wash B (West) Reach #1 RS: 17.5 Culv Group: Culvert #1 Profile: 100-YR

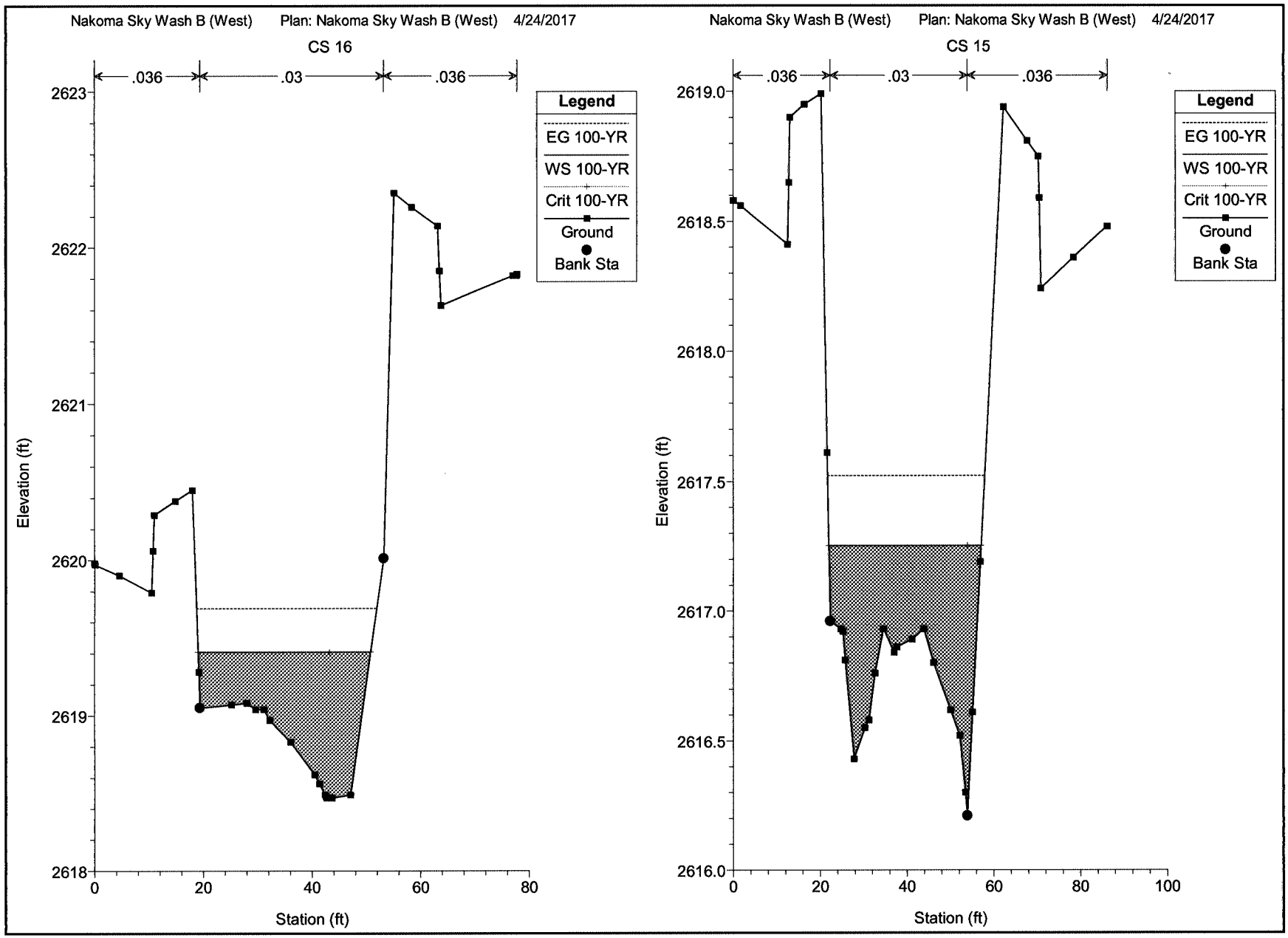
Q Culv Group (cfs)	73.30	Culv Full Len (ft)	
# Barrels	2	Culv Vel US (ft/s)	7.47
Q Barrel (cfs)	36.65	Culv Vel DS (ft/s)	13.89
E.G. US. (ft)	2626.39	Culv Inv El Up (ft)	2622.55
W.S. US. (ft)	2626.37	Culv Inv El Dn (ft)	2618.34
E.G. DS (ft)	2620.01	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	2619.68	Culv Exit Loss (ft)	2.66
Delta EG (ft)	6.39	Culv Entr Loss (ft)	0.17
Delta WS (ft)	6.70	Q Weir (cfs)	
E.G. IC (ft)	2626.39	Weir Sta Lft (ft)	
E.G. OC (ft)	2625.95	Weir Sta Rgt (ft)	
Culvert Control	Inlet	Weir Submerg	
Culv WS Inlet (ft)	2625.05	Weir Max Depth (ft)	
Culv WS Outlet (ft)	2619.66	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	1.32	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.05	Min El Weir Flow (ft)	2627.00

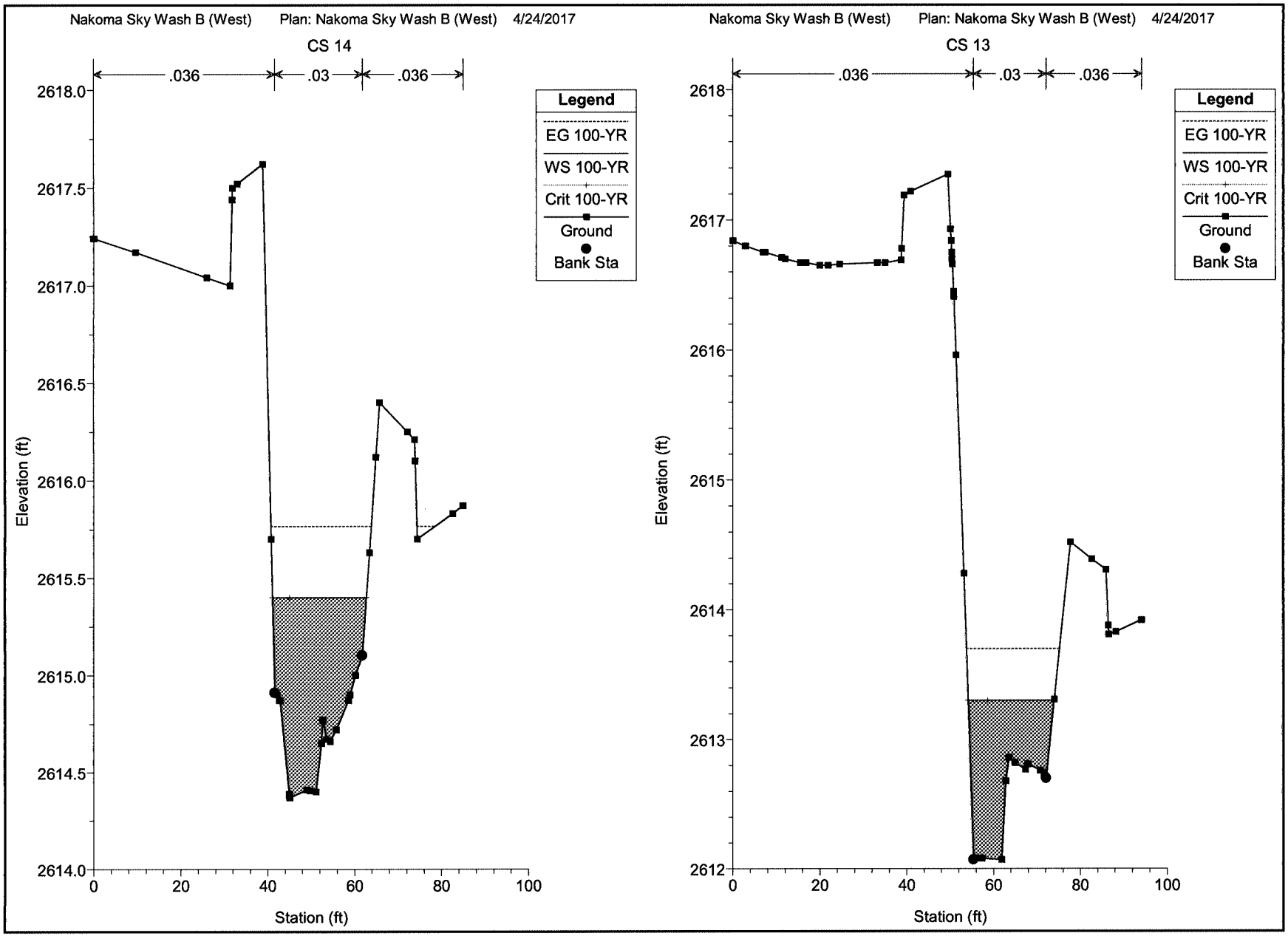
Errors Warnings and Notes

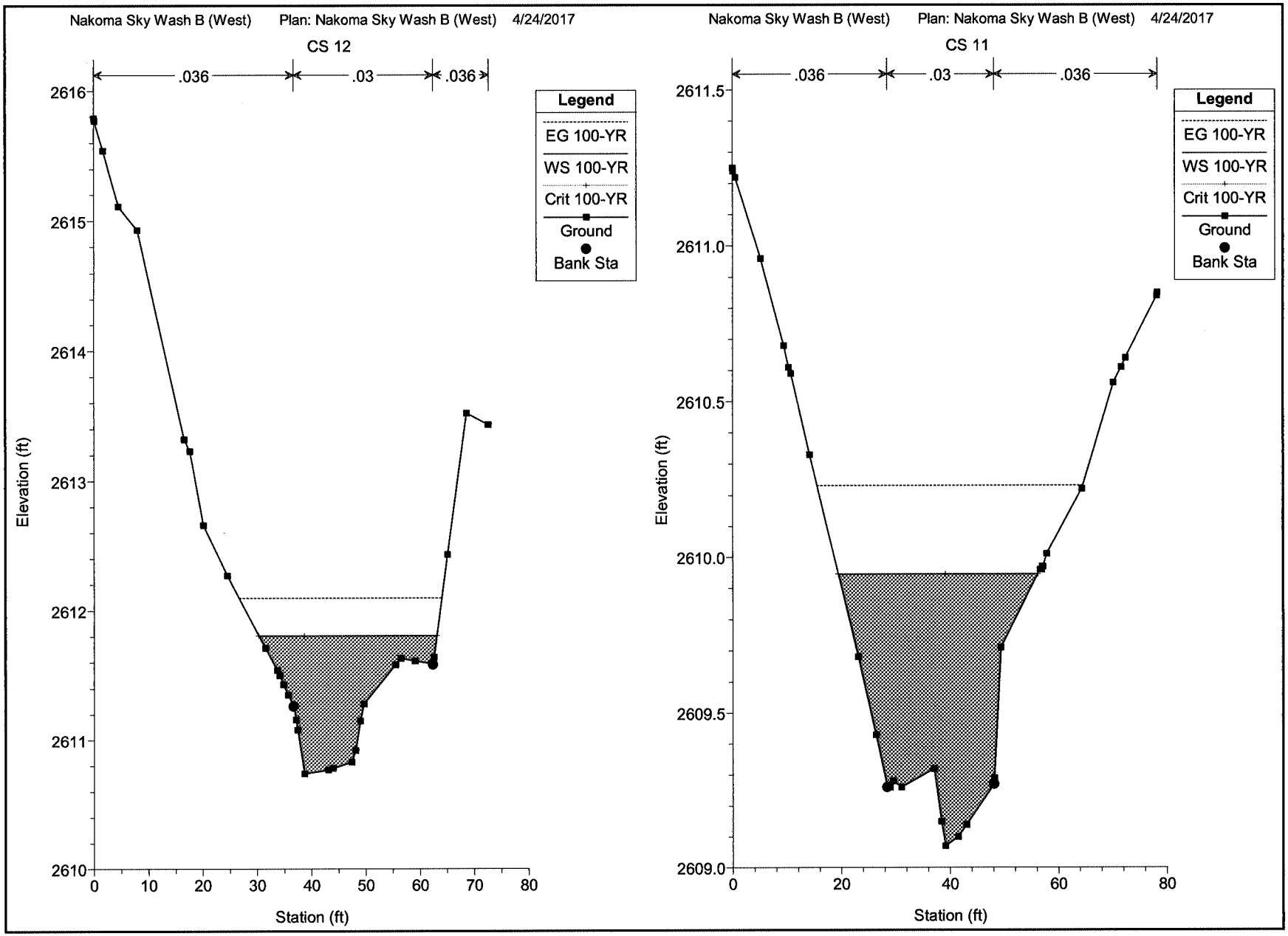
Warning:	Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section
	downstream of the culvert has supercritical flow.
Note:	During supercritical analysis, the culvert direct step method went to normal depth. The program then assumed
	normal depth at the outlet.
Note:	The flow in the culvert is entirely supercritical.

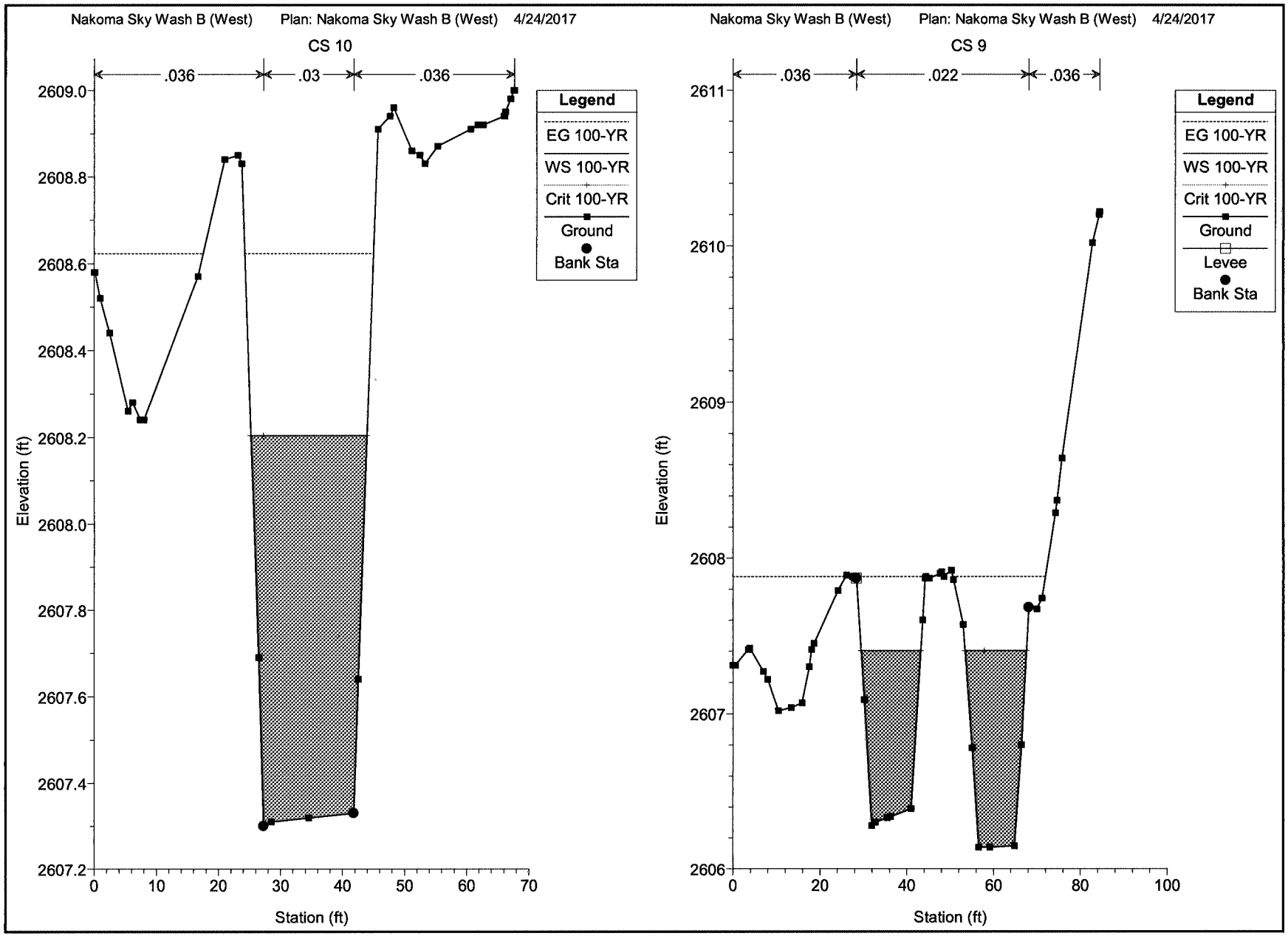

Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 18
.018
.03
.04
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2632
2630
2628
2626
2624
2622
0
20
40
60
80
100
120
140
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
Roadway Crossing
.018
.03
.04
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

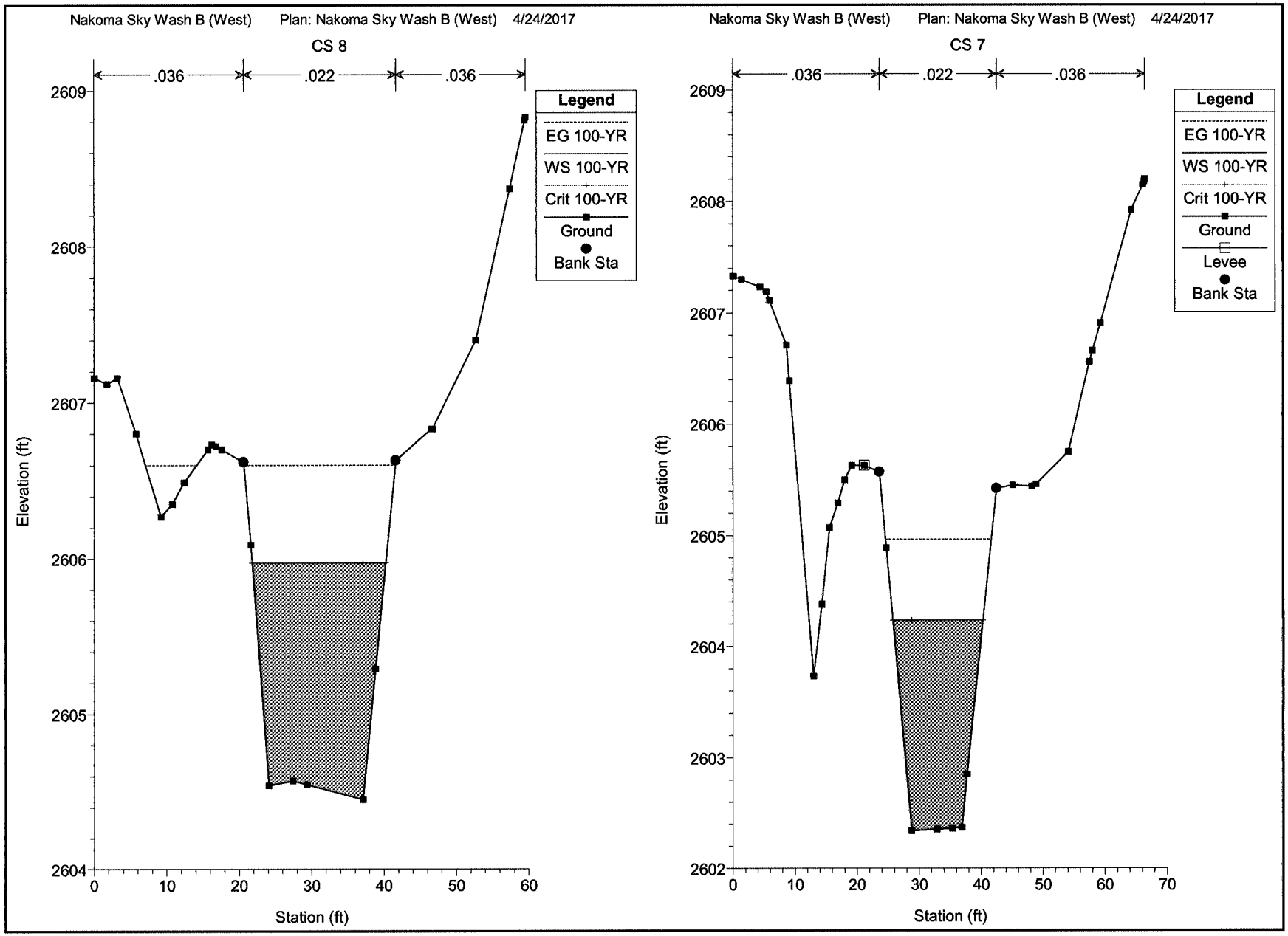

Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
Roadway Crossing
.036
.03
.036
Legend
Crit 100-YR
EG 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2628
2626
2624
2622
2620
2618
0
20
40
60
80
100
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 17
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2624
2623
2622
2621
2620
2619
2618
0
20
40
60
80
100

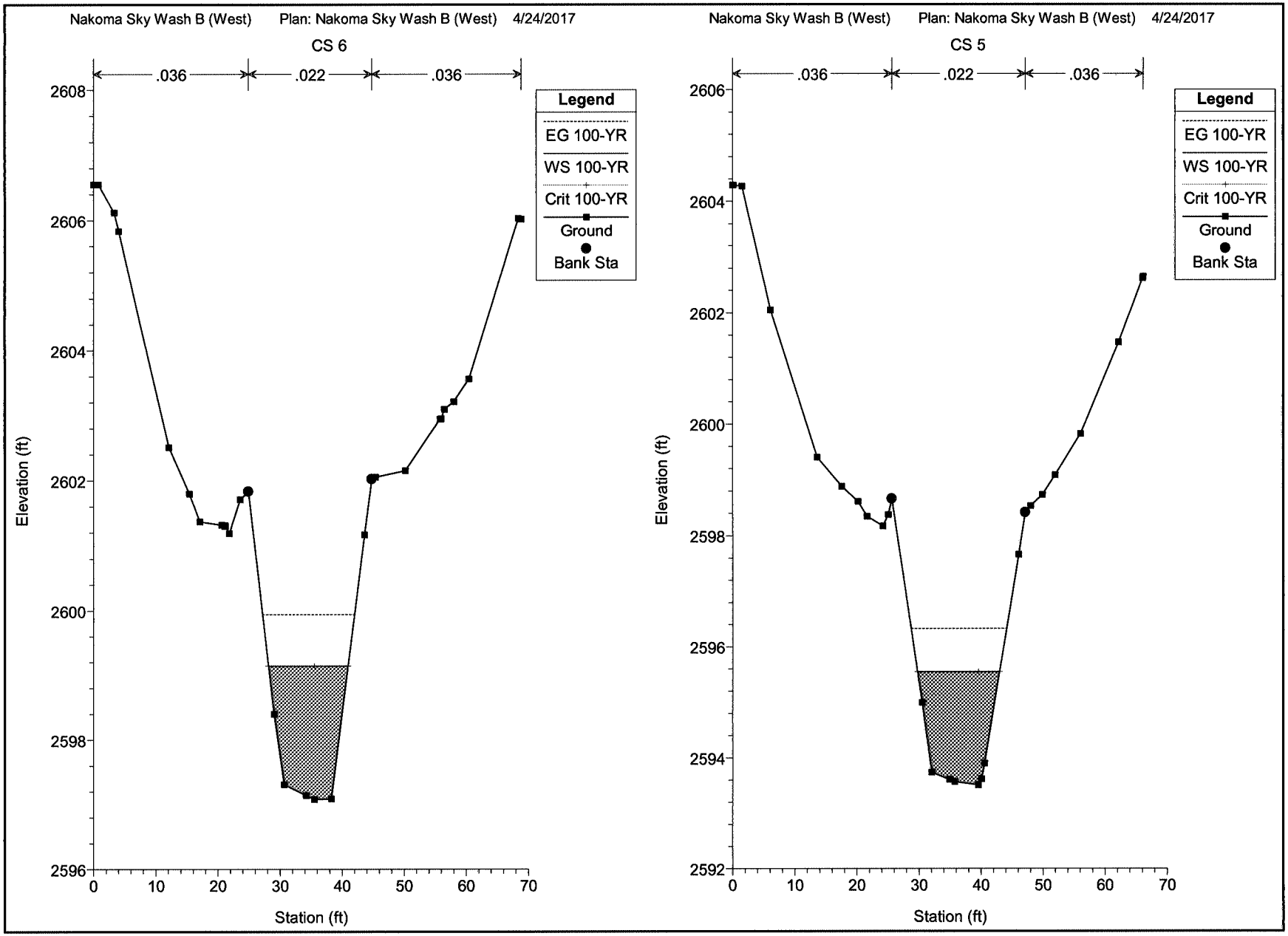

Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 16
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2623
2622
2621
2620
2619
2618
0
20
40
60
80
Station (ft)
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 15
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2619.0
2618.5
2618.0
2617.5
2617.0
2616.5
2616.0
0
20
40
60
80
100
Station (ft)

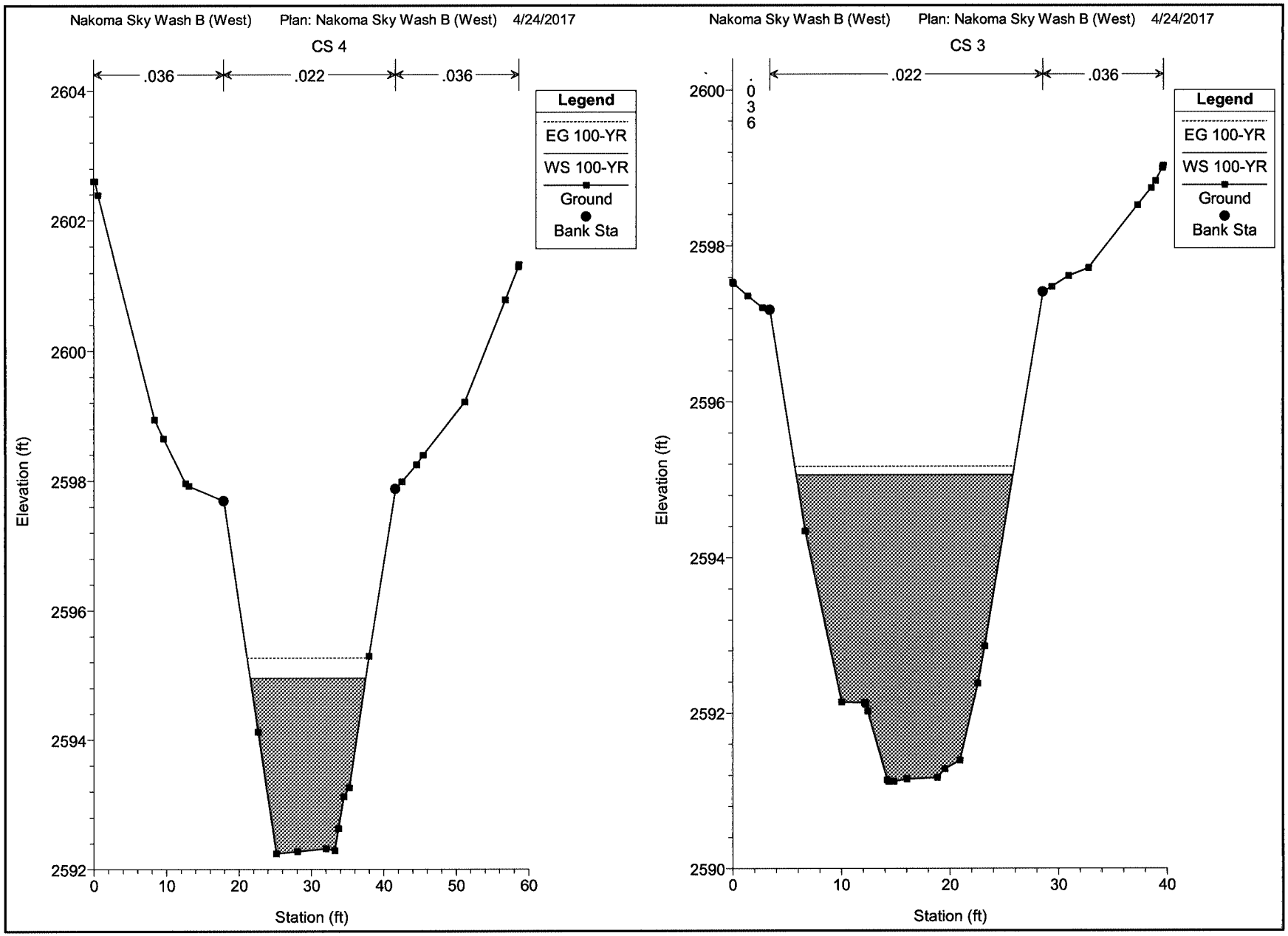

Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 14
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2618.0
2617.5
2617.0
2616.5
2616.0
2615.5
2615.0
2614.5
2614.0
0
20
40
60
80
100
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 13
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2618
2617
2616
2615
2614
2613
2612
0
20
40
60
80
100

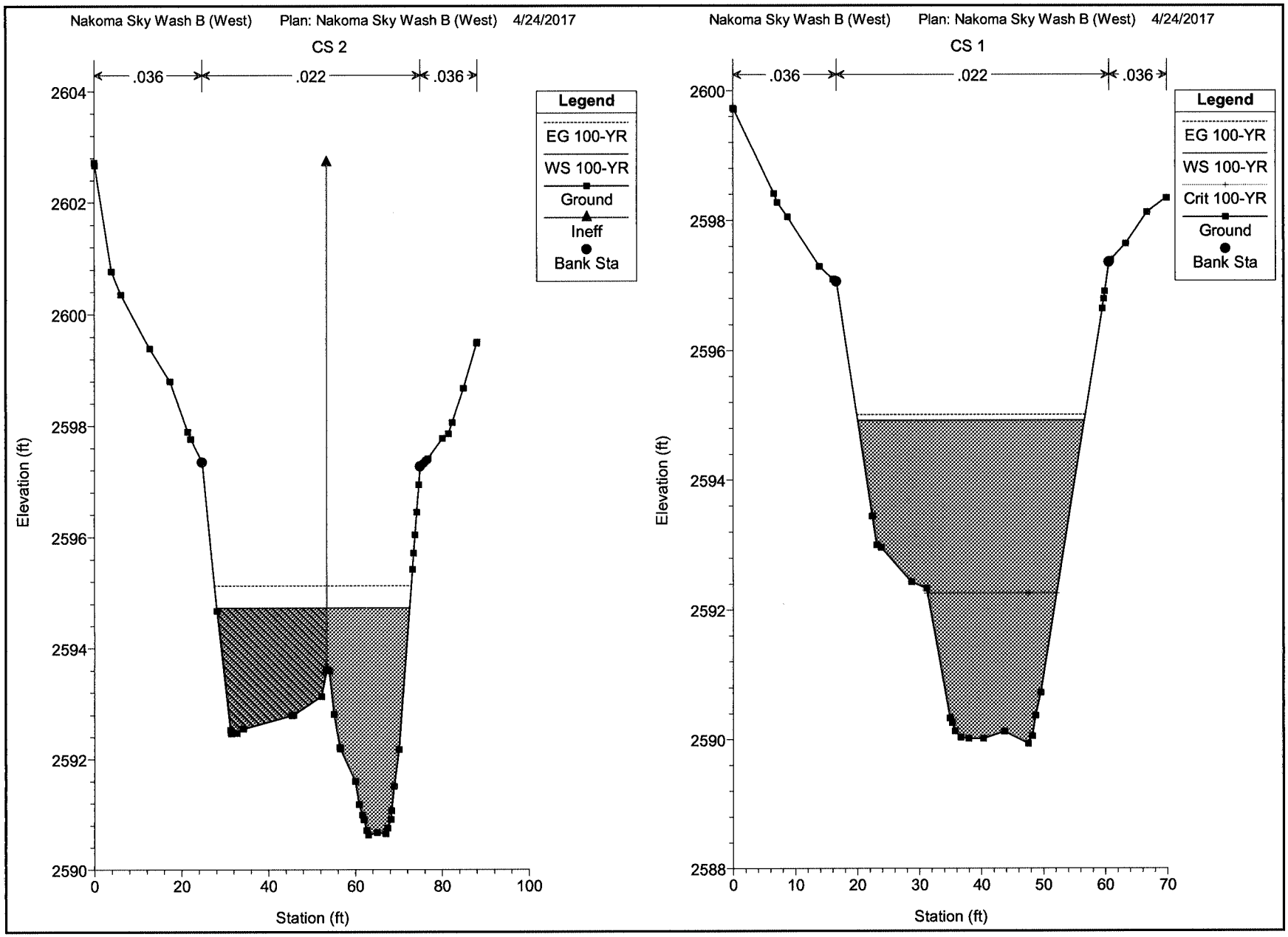

Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 12
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 11
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 10
.036
.03
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2609.0
2608.8
2608.6
2608.4
2608.2
2608.0
2607.8
2607.6
2607.4
2607.2
0
10
20
30
40
50
60
70
Station (ft)
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 9
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Levee
Bank Sta
Elevation (ft)
2611
2610
2609
2608
2607
2606
0
20
40
60
80
100
Station (ft)


Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 8
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2609
2608
2607
2606
2605
2604
0
10
20
30
40
50
60
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 7
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
2609
2608
2607
2606
2605
2604
2603
2602
0
10
20
30
40
50
60
70

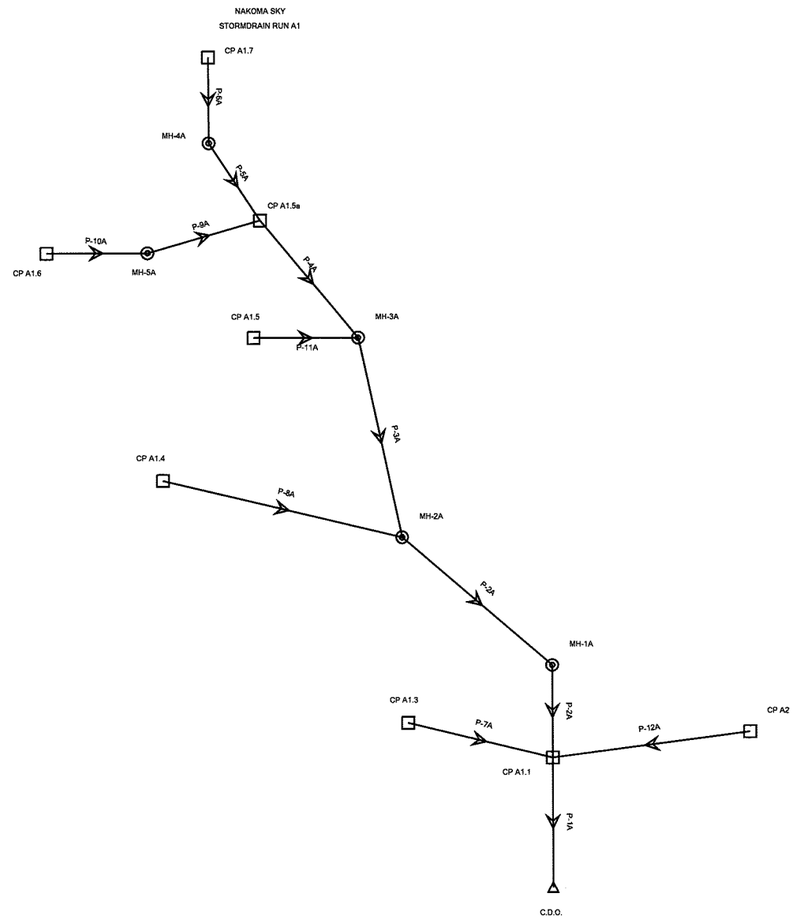

Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 6
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2608
2606
2604
2602
2600
2598
2596
0
10
20
30
40
50
60
70
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 5
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2606
2604
2602
2600
2598
2596
2594
2592
0
10
20
30
40
50
60
70


Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 4
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2604
2602
2600
2598
2596
2594
2592
0
10
20
30
40
50
60
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 3
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2600
2598
2596
2594
2592
2590
0
10
20
30
40


Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 2
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Nakoma Sky Wash B (West) Plan: Nakoma Sky Wash B (West) 4/24/2017
CS 1
.036
.022
.036
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

STORMDRAIN (STORMCAD) WORKSHEETS

Scenario: Base



Conduit FlexTable: WLB Group Table

Label	Upstream Structure	Flow (ft^3/s)	Length (User Defined) (ft)	Diameter (in)	Material	Number of Barrels	Velocity (ft/s)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Invert (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Stop) (ft)	Energy Grade Line (Out) (ft)
P-4A	CP A1.5a	65.60	106.5	42.0	Steel	1	11.12	2,589.50	2,586.84	2,588.04	2,584.30	2,590.45	2,586.56	2,583.24	2,587.31
P-3A	MH-3A	73.00	232.9	42.0	Steel	1	13.34	2,590.45	2,585.72	2,587.05	2,583.04	2,586.87	2,584.06	2,579.55	2,584.96
P-2A	MH-2A	80.90	168.4	42.0	Steel	1	8.41	2,586.87	2,583.11	2,584.21	2,579.35	2,582.27	2,582.02	2,576.82	2,583.12
P-2A	MH-1A	80.90	88.9	42.0	Steel	1	8.41	2,582.27	2,580.82	2,581.92	2,576.72	2,581.00	2,580.24	2,575.72	2,581.34
P-1A	CP A1.1	109.90	56.2	42.0	Steel	1	12.59	2,581.00	2,578.89	2,581.13	2,575.72	2,582.00	2,578.11	2,575.09	2,580.52
P-10A	CP A1.6	7.30	70.0	24.0	Steel	1	9.54	2,592.26	2,589.55	2,589.92	2,588.59	2,600.00	2,588.13	2,586.49	2,588.24
P-9A	MH-5A	7.30	82.9	18.0	Steel	1	4.13	2,600.00	2,588.01	2,588.27	2,586.49	2,589.50	2,587.61	2,584.00	2,587.87
P-8A	CP A1.4	7.90	93.3	24.0	Steel	1	2.51	2,586.95	2,584.18	2,584.28	2,581.80	2,586.87	2,584.06	2,580.87	2,584.16
P-7A	CP A1.3	4.40	81.0	18.0	Steel	1	2.49	2,580.31	2,580.39	2,580.48	2,577.81	2,581.00	2,580.24	2,577.00	2,580.34
P-6A	CP A1.7	41.10	211.2	36.0	Steel	1	10.27	2,592.00	2,589.92	2,590.87	2,587.83	2,589.50	2,588.75	2,585.52	2,589.27
P-5A	MH-4A	52.00	71.4	36.0	Steel	1	10.47	2,589.50	2,587.86	2,589.06	2,585.52	2,589.50	2,587.61	2,584.80	2,588.50
P-11A	CP A1.5	7.40	29.3	24.0	Steel	1	8.26	2,589.91	2,586.52	2,586.67	2,585.12	2,590.45	2,586.56	2,584.54	2,586.64
P-12A	CP A2	9.60	261.1	24.0	Steel	1	3.06	2,581.80	2,580.71	2,580.86	2,577.03	2,581.00	2,580.24	2,575.72	2,580.39

Conduit FlexTable: Culvert Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Diameter (in)	Slope (Calculated) (ft/ft)	Material	Flow (ft^3/s)	Flow / Capacity (Design) (%)	Velocity (ft/s)	Velocity (In) (ft/s)	Velocity (Out) (ft/s)	Depth (Normal) (ft)	Specific Energy (In) (in)	Specific Energy (Out) (in)	Manning's n	Upstream Structure Headloss (ft)	Headloss (ft)
P-4A	CP A1.5a	MH-3A	106.5	42.0	0.010	Steel	65.60	65.3	11.12	8.78	6.96	2.06	44.8	48.8	0.013	0.77	0.28
P-3A	MH-3A	MH-2A	232.9	42.0	0.015	Steel	73.00	59.3	13.34	9.25	7.59	1.94	48.1	64.9	0.013	0.84	1.65
P-2A	MH-2A	MH-1A	168.4	42.0	0.015	Steel	80.90	65.6	8.41	8.41	8.41	2.07	58.3	75.6	0.013	0.95	1.09
P-2A	MH-1A	CP A1.1	88.9	42.0	0.011	Steel	80.90	75.8	8.41	8.41	8.41	2.28	62.4	67.5	0.013	1.20	0.57
P-1A	CP A1.1	C.D.O.	56.2	42.0	0.011	Steel	109.90	103.2	12.59	12.00	12.44	2.98	64.9	65.1	0.013	1.35	0.78
P-10A	CP A1.6	MH-5A	70.0	24.0	0.030	Steel	7.30	18.6	9.54	4.90	2.64	0.58	16.0	21.0	0.013	0.12	1.42
P-9A	MH-5A	CP A1.5a	82.9	18.0	0.030	Steel	7.30	40.1	4.13	4.13	4.13	0.66	21.4	46.5	0.013	0.13	0.40
P-8A	CP A1.4	MH-2A	93.3	24.0	0.010	Steel	7.90	35.0	2.51	2.51	2.51	0.82	29.7	39.5	0.013	0.00	0.11
P-7A	CP A1.3	CP A1.1	81.0	18.0	0.010	Steel	4.40	41.9	2.49	2.49	2.49	0.68	32.1	40.1	0.013	0.03	0.14
P-6A	CP A1.7	MH-4A	211.2	36.0	0.011	Steel	41.10	58.9	10.27	7.82	5.81	1.66	36.5	45.0	0.013	0.31	1.17
P-5A	MH-4A	CP A1.5a	71.4	36.0	0.010	Steel	52.00	77.6	10.47	8.77	7.56	1.99	42.5	44.3	0.013	0.88	0.26
P-11A	CP A1.5	MH-3A	29.3	24.0	0.020	Steel	7.40	23.2	8.26	3.15	2.36	0.66	18.6	25.2	0.013	0.05	-0.04
P-12A	CP A2	CP A1.1	261.1	24.0	0.005	Steel	9.60	59.9	3.06	3.06	3.06	1.12	45.9	56.0	0.013	0.05	0.47

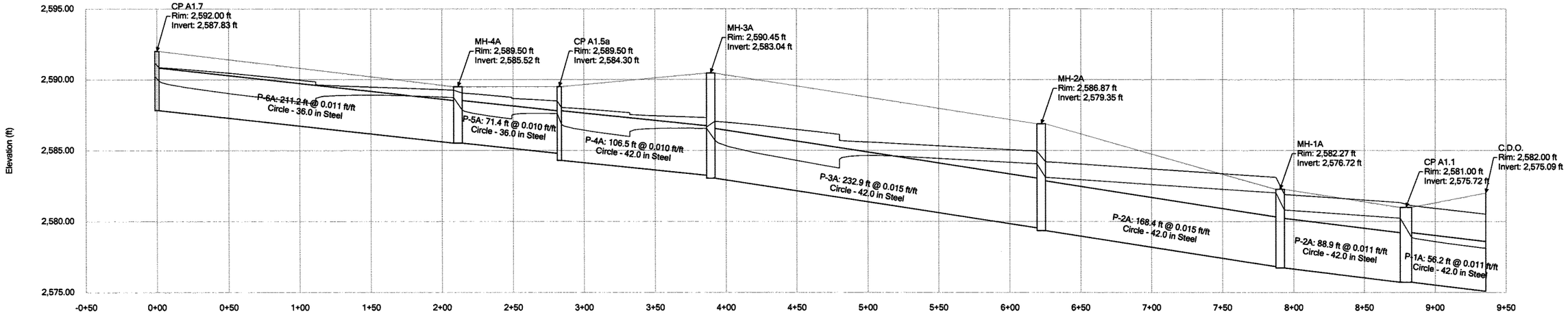
Network Elements FlexTable: AASHTO Headloss Table

Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (ft³/s)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (ft³/s)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
MH-5A	AASHTO	0.13	0.13	0.13	0.75			0.02	0.200	7.30	15.92	2.64	0.11	0.07	0.250	1.000	0.04	0.350	7.30	2.64	0.11	
MH-3A	AASHTO	0.84	0.84	0.84	0.75			0.24	0.323	65.60	27.45	6.96	0.75	0.33	0.250	1.000	0.26	0.350	65.60	6.96	0.75	
MH-2A	AASHTO	0.95	0.95	0.95	0.75			0.36	0.407	73.00	37.16	7.59	0.89	0.27	0.250	1.000	0.31	0.350	73.00	7.59	0.89	
MH-1A	AASHTO	1.20	1.20	1.20	0.75			0.55	0.497	80.90	49.44	8.41	1.10	0.27	0.250	1.000	0.38	0.350	80.90	8.41	1.10	
MH-4A	AASHTO	0.88	0.88	0.68	0.75			0.20	0.373	41.10	32.92	5.81	0.53	0.30	0.250	1.000	0.18	0.350	41.10	5.81	0.53	
CP A1.7	AASHTO	0.31	0.31	0.24	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.24	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP A1.5a	AASHTO	0.77	0.77	0.77	0.75			0.16	0.593	7.30	66.26	4.13	0.27	0.30	0.250	1.000	0.31	0.350	52.00	7.56	0.89	
CP A1.6	AASHTO	0.12	0.12	0.09	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.09	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP A1.4	Absolute	0.00	0.00	0.00	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.00	0.00	0.00	
CP A1.1	AASHTO	1.35	1.35	1.04	0.75			0.10	0.671	9.60	82.65	3.06	0.15	0.56	0.250	1.000	0.38	0.350	80.90	8.41	1.10	
CP A1.3	AASHTO	0.03	0.03	0.02	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.02	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP A1.5	AASHTO	0.05	0.05	0.04	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.04	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP A2	AASHTO	0.05	0.05	0.04	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.04	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
C.D.O.																						
P-4A		0.28				0.75	27.45															
P-3A		1.65				0.89	37.16															
P-2A		1.09				1.10	49.44															
P-2A		0.57				1.10	0.04															
P-1A		0.78				2.40	0.00															
P-10A		1.42				0.11	15.92															
P-9A		0.40				0.27	66.26															
P-8A		0.11				0.10	27.13															
P-7A		0.14				0.10	76.38															
P-6A		1.17				0.53	32.92															
P-5A		0.26				0.89	6.52															
P-11A		-0.04				0.09	77.73															
P-12A		0.47				0.15	82.65															

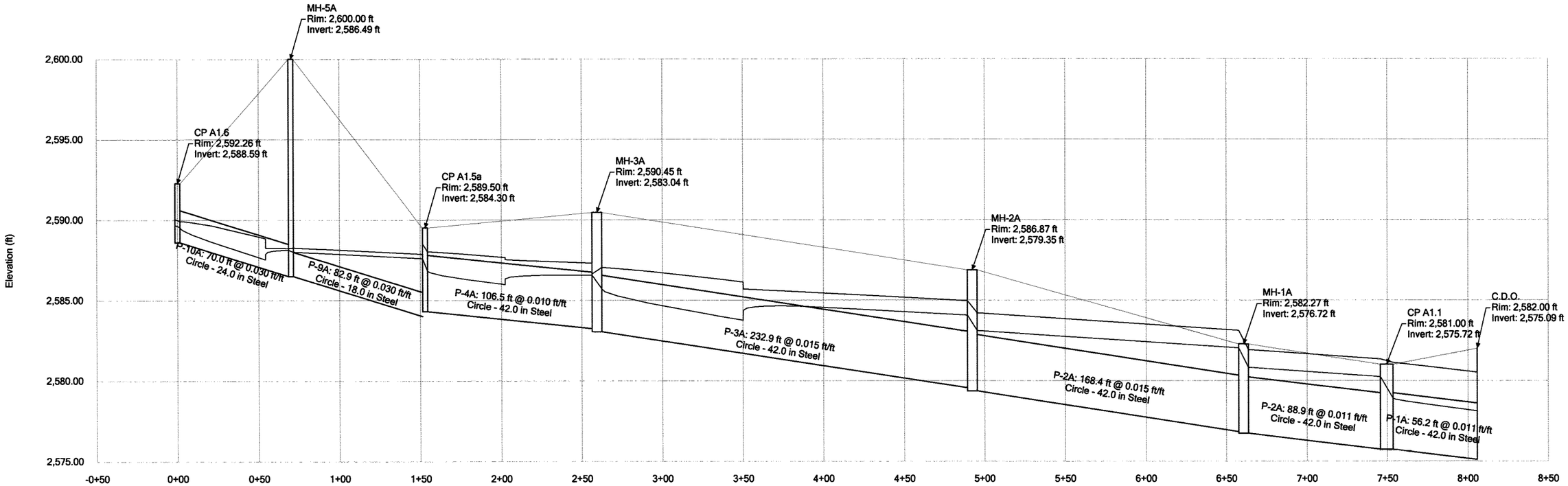
Network Elements FlexTable: AASHTO Headloss Table

Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
	0.007
	0.009
	0.006
	0.006
	0.011
	0.024
	0.005
	0.001
	0.002
	0.008
	0.008
	0.001
	0.002

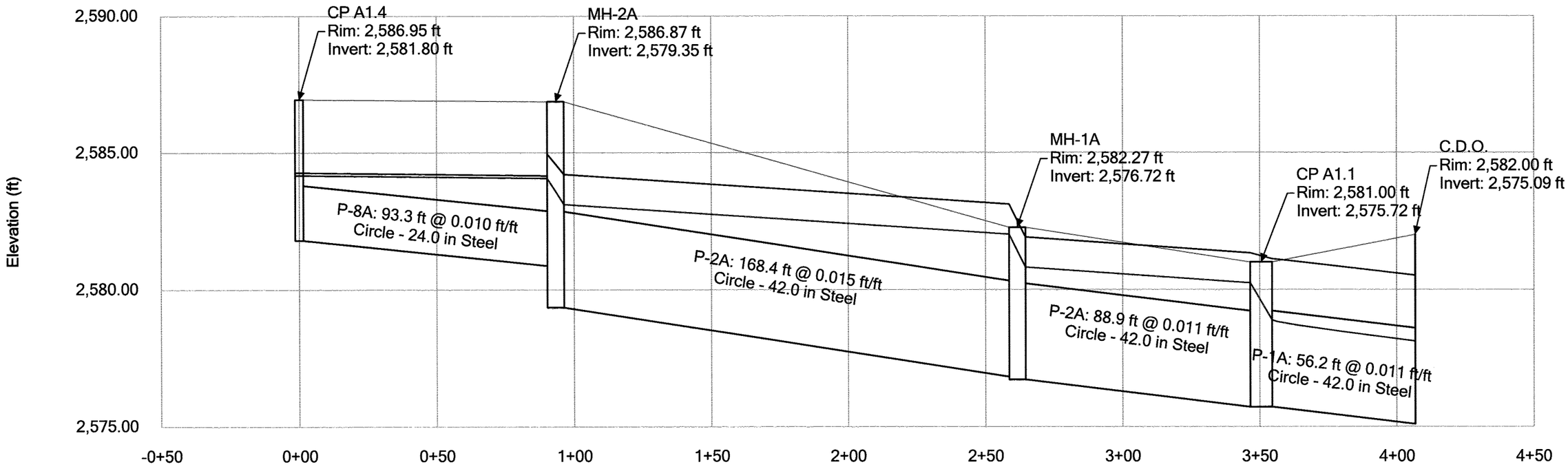
Profile Report
Engineering Profile - Profile - MainLine (Run A1.stsw)



Profile Report
Engineering Profile - Profile - CP A1.6 (Run A1.stsw)

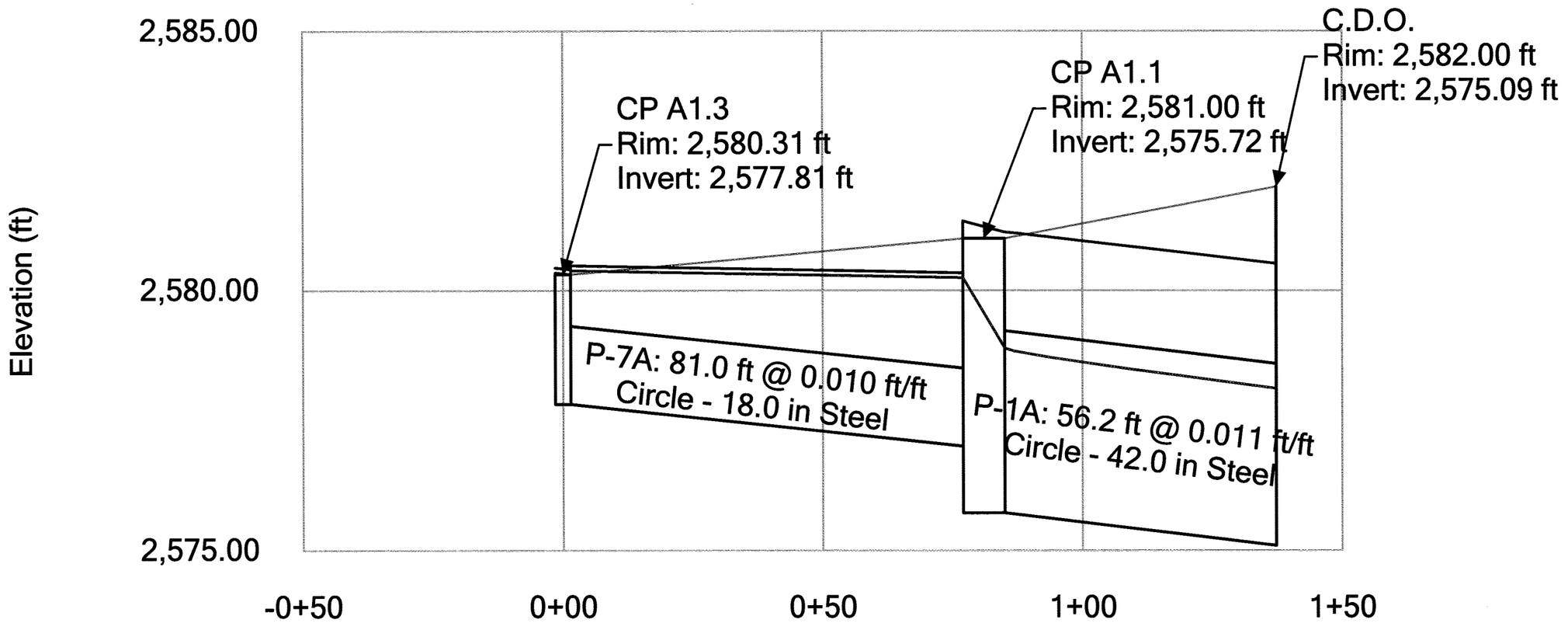


Profile Report
Engineering Profile - Profile - CP A1.4 (Run A1.stsw)

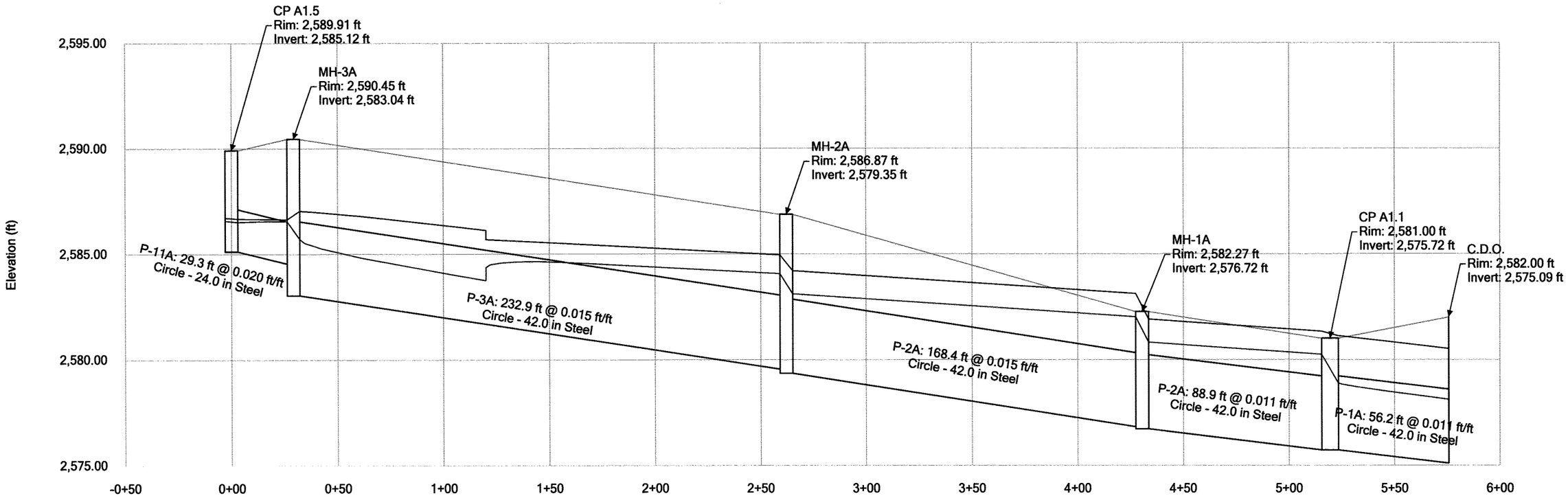


Profile Report

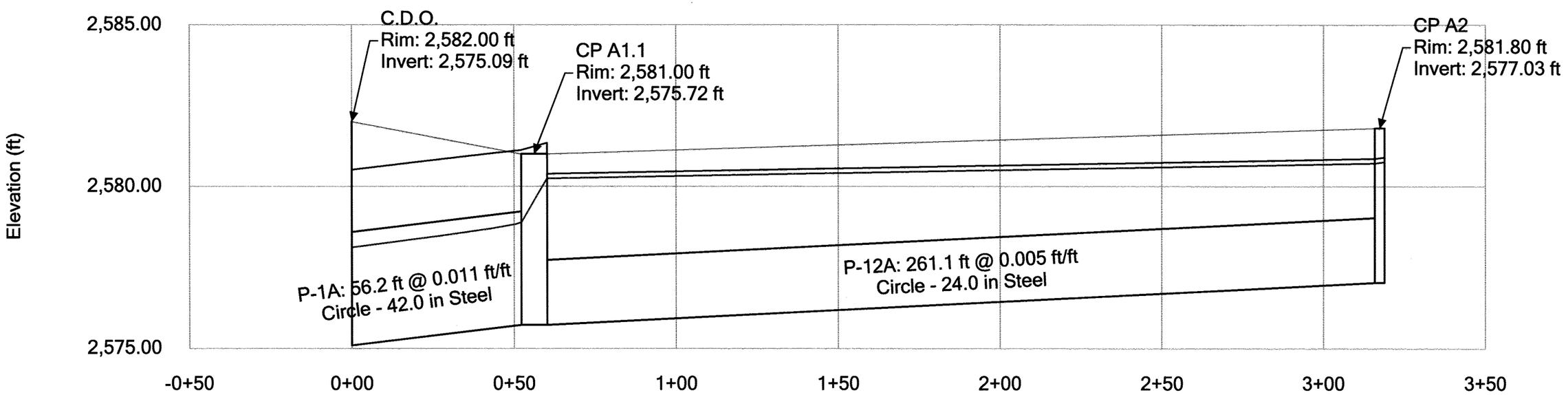
Engineering Profile - Profile - CP A1.3 (Run A1.stsw)



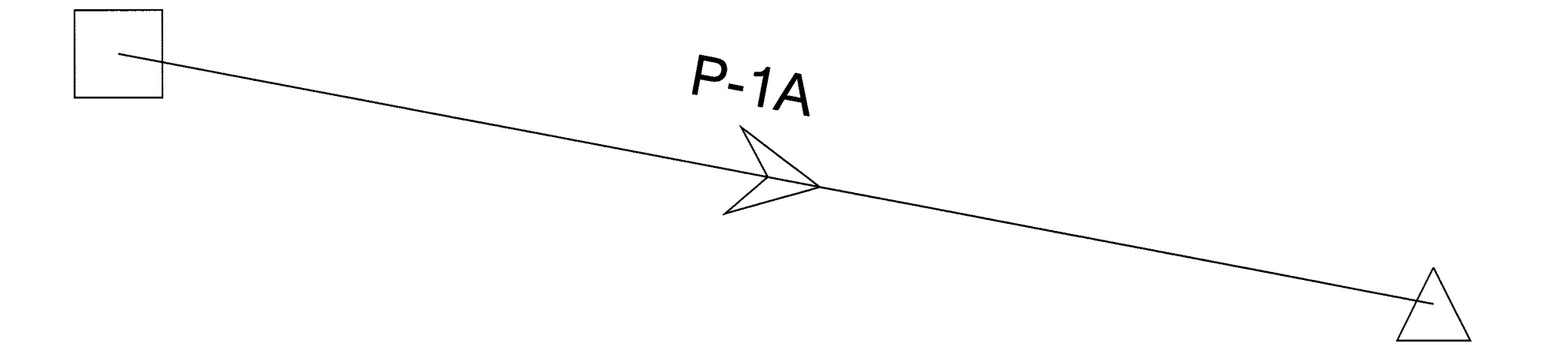
Profile Report
Engineering Profile - Profile - CP A1.5 (Run A1.stsw)



Profile Report
Engineering Profile - Profile - CP A2 (Run A1.stsw)



NAKOMA SKY
STORMDRAIN RUN A3



Conduit FlexTable: WLB Group Table

Label	Upstream Structure	Flow (ft^3/s)	Length (User Defined) (ft)	Diameter (in)	Material	Number of Barrels	Velocity (ft/s)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Invert (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Stop) (ft)	Energy Grade Line (Out) (ft)
P-1A	CP A3	23.10	29.3	24.0	Steel	1	13.73	2,588.57	2,583.93	2,584.94	2,582.22	2,586.00	2,582.43	2,581.20	2,584.45

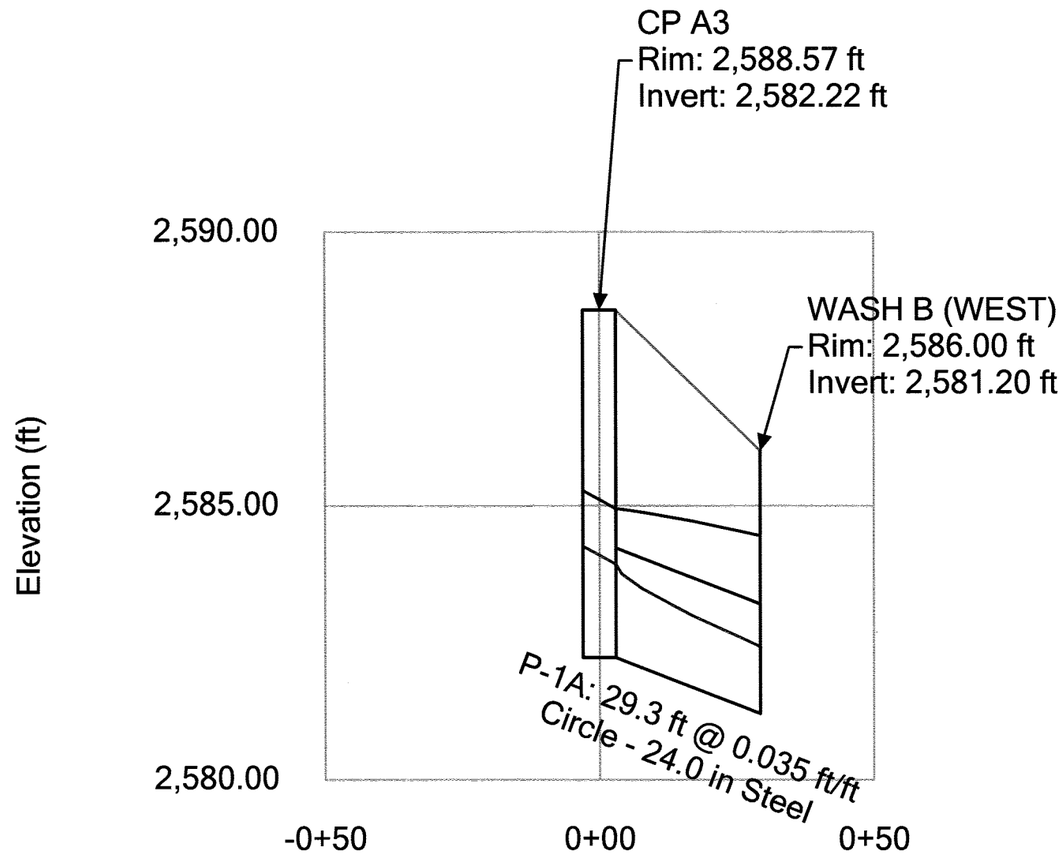
Conduit FlexTable: Culvert Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Diameter (in)	Slope (Calculated) (ft/ft)	Material	Flow (ft^3/s)	Flow / Capacity (Design) (%)	Velocity (ft/s)	Velocity (In) (ft/s)	Velocity (Out) (ft/s)	Depth (Normal) (ft)	Specific Energy (In) (in)	Specific Energy (Out) (in)	Manning's n	Upstream Structure Headloss (ft)	Headloss (ft)
P-1A	CP A3	WASH B (WEST)	29.3	24.0	0.035	Steel	23.10	54.8	13.73	8.08	11.40	1.06	32.7	39.0	0.013	0.33	1.50

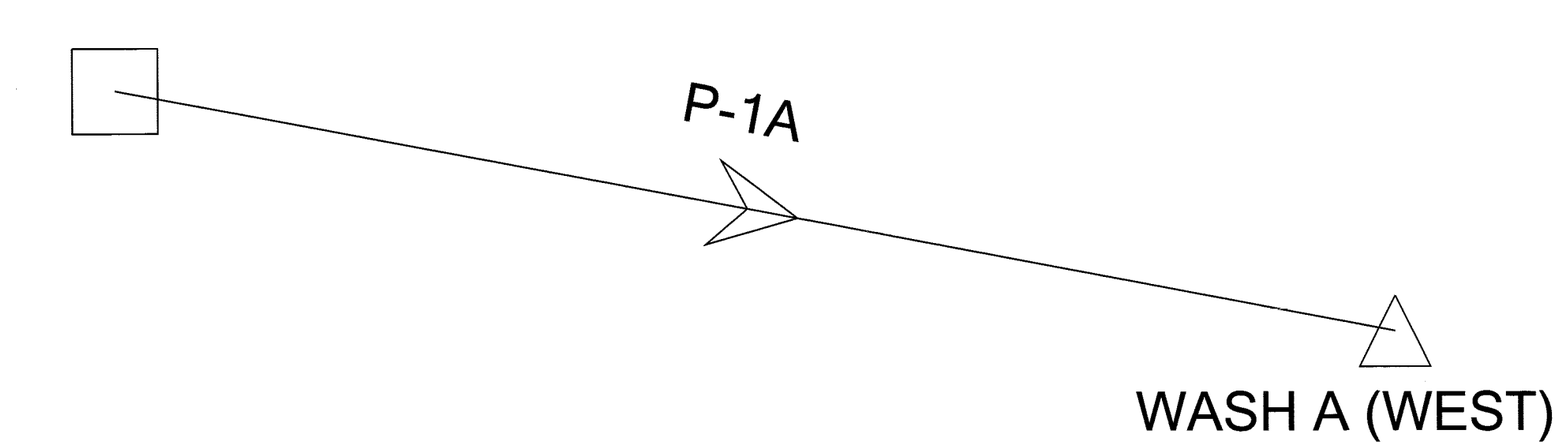
Network Elements FlexTable: AASHTO Headloss Table

Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (ft³/s)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (ft³/s)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
CP A3 WASH B (WEST) P-1A	AASHTO	0.33 1.50	0.33	0.25	0.00	 2.02	 0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.25	0.250	1.000	0.00	0.000	0.00	0.00	0.00	 0.017

Profile Report
Engineering Profile - Profile - 1 (Run A3.stsw)



NAKOMA SKY
STORMDRAIN RUN A4



Conduit FlexTable: WLB Group Table

Label	Upstream Structure	Flow (ft^3/s)	Length (User Defined) (ft)	Diameter (in)	Material	Number of Barrels	Velocity (ft/s)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Invert (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Stop) (ft)	Energy Grade Line (Out) (ft)
P-1A	CP A4	7.70	50.9	18.0	Steel	1	4.73	2,594.08	2,590.88	2,591.26	2,589.64	2,595.00	2,590.47	2,589.39	2,590.97

Conduit FlexTable: Culvert Table

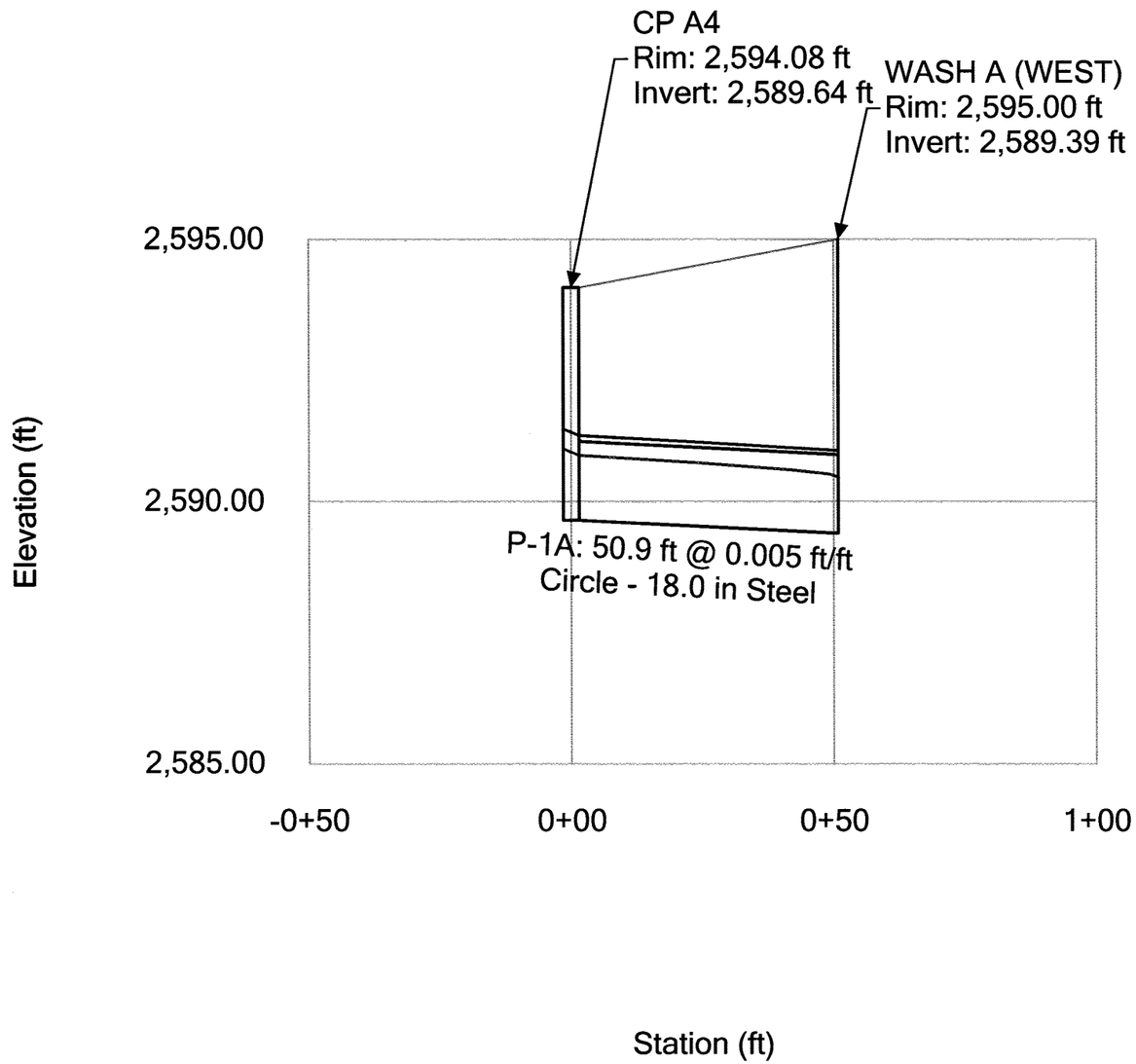
Label	Start Node	Stop Node	Length (User Defined) (ft)	Diameter (in)	Slope (Calculated) (ft/ft)	Material	Flow (ft^3/s)	Flow / Capacity (Design) (%)	Velocity (ft/s)	Velocity (In) (ft/s)	Velocity (Out) (ft/s)	Depth (Normal) (ft)	Specific Energy (In) (in)	Specific Energy (Out) (in)	Manning's n	Upstream Structure Headloss (ft)	Headloss (ft)
P-1A	CP A4	WASH A (WEST)	50.9	18.0	0.005	Steel	7.70	104.6	4.73	4.93	5.68	1.30	19.4	18.9	0.013	0.12	0.41

Network Elements FlexTable: AASHTO Headloss Table

Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (ft³/s)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (ft³/s)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
CP A4 WASH A (WEST) P-1A	AASHTO	0.12 0.41	0.12	0.09	0.00	 0.50	 0.00	0.00	0.000	0.00	0.00	0.00	0.00	0.09	0.250	1.000	0.00	0.000	0.00	0.00	0.00	0.006

Profile Report

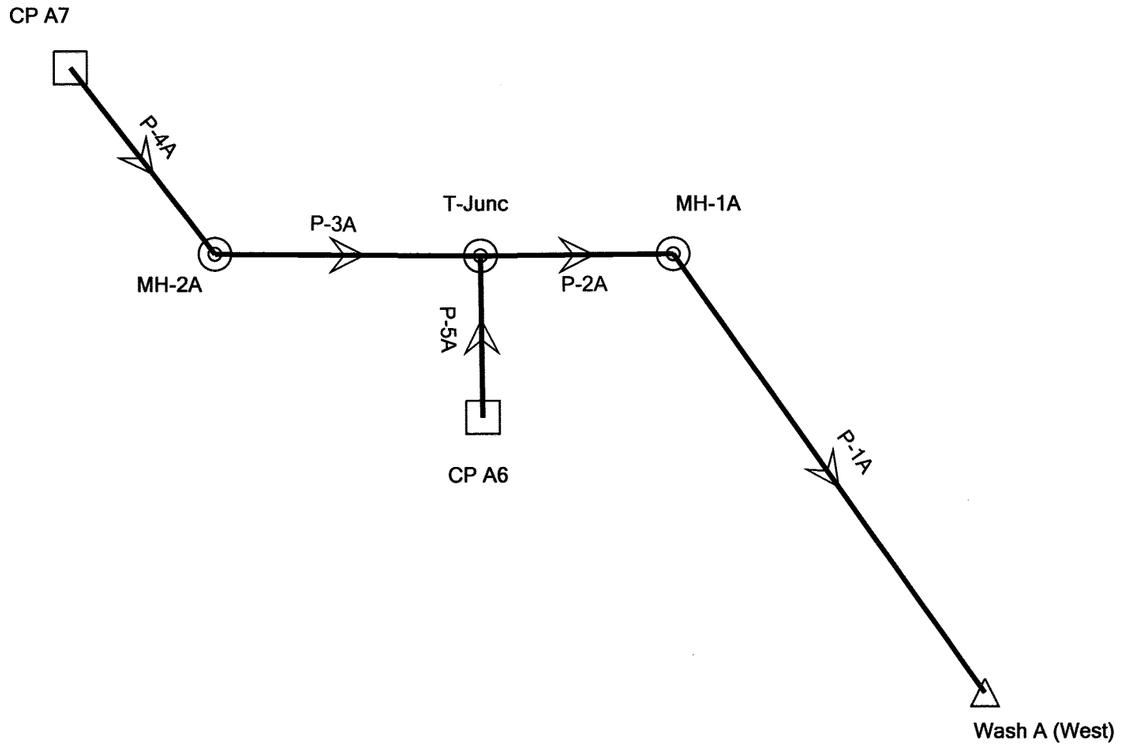
Engineering Profile - Profile - 1 (Run A4.stsw)



Scenario: Base

NAKOMA SKY

STORMDRAIN RUN A7



Conduit FlexTable: WLB Group Table

Label	Upstream Structure	Flow (cfs)	Length (User Defined) (ft)	Diameter (in)	Material	Number of Barrels	Velocity (ft/s)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Invert (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Stop) (ft)	Energy Grade Line (Out) (ft)
P-4A	CP A7	96.50	57.2	48.0	Steel	1	7.68	2,601.00	2,600.35	2,601.26	2,596.13	2,600.17	2,600.09	2,594.99	2,601.00
P-3A	MH-2A	96.50	59.2	48.0	Steel	1	7.68	2,600.17	2,599.43	2,600.34	2,594.89	2,600.08	2,599.16	2,594.52	2,600.08
P-2A	T-Junc	103.60	24.9	48.0	Steel	1	8.24	2,600.08	2,598.66	2,599.72	2,594.52	2,600.00	2,598.53	2,594.37	2,599.59
P-1A	MH-1A	103.60	204.4	48.0	Steel	1	9.19	2,600.00	2,597.71	2,599.04	2,594.37	2,598.50	2,596.43	2,593.35	2,597.98
P-5A	CP A6	7.20	14.0	18.0	Steel	1	4.07	2,599.64	2,599.22	2,599.48	2,596.00	2,600.08	2,599.16	2,594.52	2,599.42

Conduit FlexTable: Culvert Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Diameter (in)	Slope (Calculated) (ft/ft)	Material	Flow (cfs)	Flow / Capacity (Design) (%)	Velocity (ft/s)	Velocity (In) (ft/s)	Velocity (Out) (ft/s)	Depth (Normal) (ft)	Specific Energy (In) (in)	Specific Energy (Out) (in)	Manning's n	Upstream Structure Headloss (ft)	Headloss (ft)
P-4A	CP A7	MH-2A	57.2	48.0	0.020	Steel	96.50	47.6	7.68	7.68	7.68	1.94	61.6	72.2	0.013	0.15	0.26
P-3A	MH-2A	T-Junc	59.2	48.0	0.006	Steel	96.50	85.0	7.68	7.68	7.68	2.83	65.4	66.7	0.013	0.66	0.27
P-2A	T-Junc	MH-1A	24.9	48.0	0.006	Steel	103.60	92.9	8.24	8.24	8.24	3.05	62.4	62.6	0.013	0.50	0.13
P-1A	MH-1A	Wash A (West)	204.4	48.0	0.005	Steel	103.60	102.1	9.19	9.24	9.97	3.36	56.0	55.5	0.013	0.82	1.28
P-5A	CP A6	T-Junc	14.0	18.0	0.106	Steel	7.20	21.1	4.07	4.07	4.07	0.47	41.8	58.8	0.013	0.04	0.07

Network Elements FlexTable: AASHTO Headloss Table

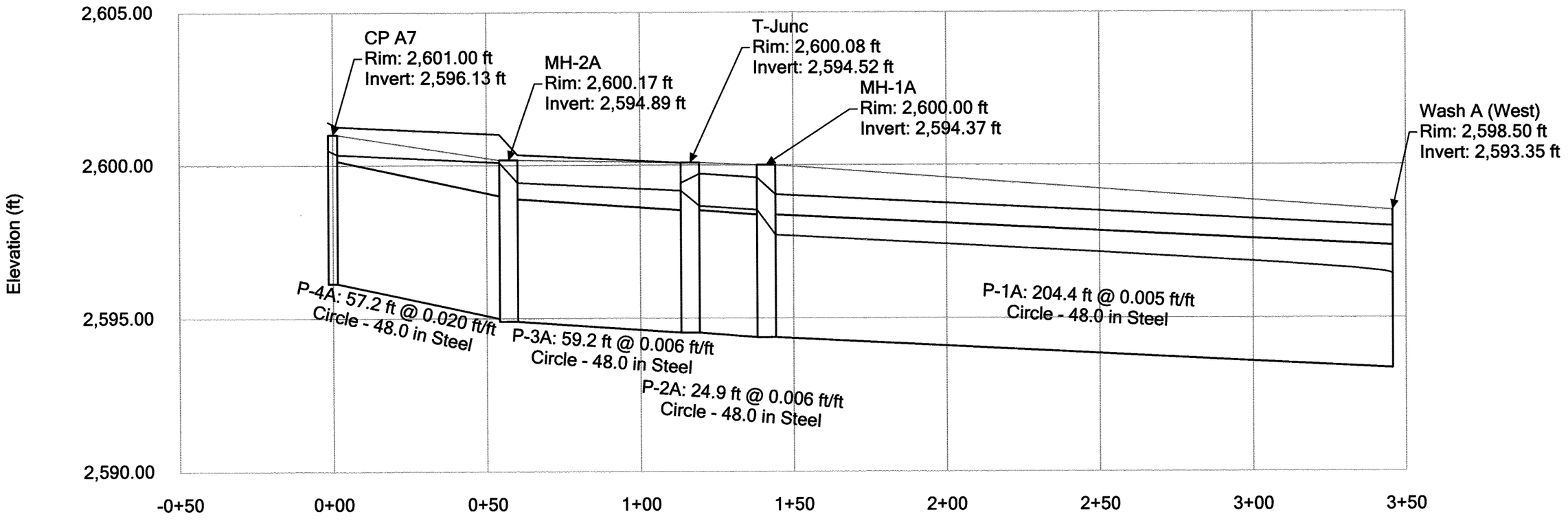
Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (cfs)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (cfs)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
MH-2A	AASHTO	0.66	0.66	1.02	0.92			0.47	0.512	96.50	52.04	7.68	0.92	0.23	0.250	0.500	0.32	0.350	96.50	7.68	0.92	
MH-1A	AASHTO	0.82	0.82	1.26	0.92			0.56	0.532	103.60	55.27	8.24	1.06	0.33	0.250	0.500	0.37	0.350	103.60	8.24	1.06	
T-Junc	AASHTO	0.50	0.50	0.77	0.92			0.18	0.700	7.20	90.11	4.07	0.26	0.26	0.250	0.500	0.32	0.350	96.50	7.68	0.92	
CP A7	AASHTO	0.15	0.15	0.23	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.23	0.250	0.500	0.00	0.000	0.00	0.00	0.00	
CP A6	AASHTO	0.04	0.04	0.06	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.06	0.250	0.500	0.00	0.000	0.00	0.00	0.00	
Wash A (West)																						
P-4A		0.26				0.92	52.04														1.06	0.005
P-3A		0.27				0.92	1.01														0.92	0.005
P-2A		0.13				1.06	55.27														0.00	0.005
P-1A		1.28				1.54	0.00														0.00	0.005
P-5A		0.07				0.26	90.11															0.005

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Network Elements FlexTable: AASHTO Headloss Table

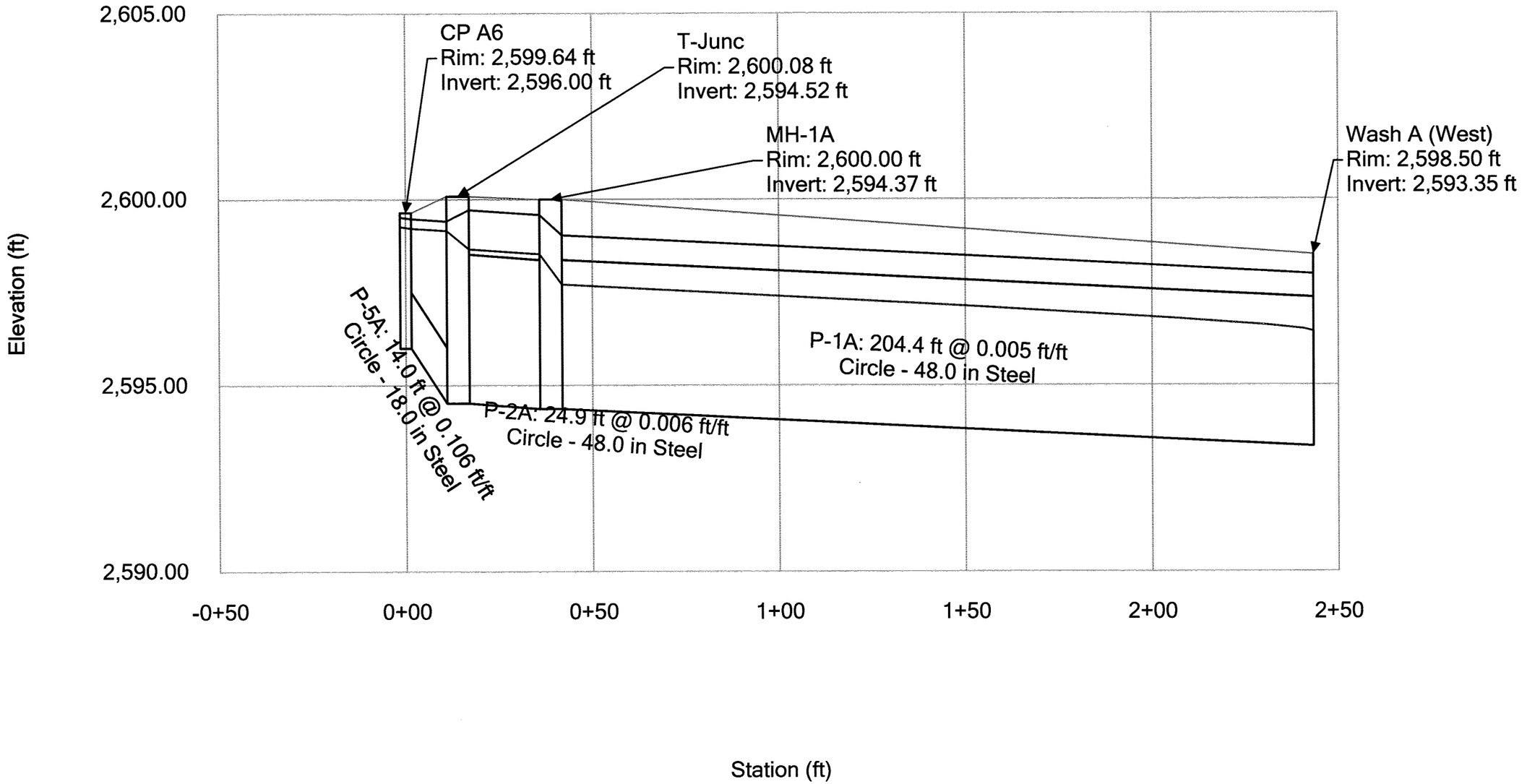
Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (cfs)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (cfs)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
MH-2A	AASHTO	0.66	0.66	1.02	0.92			0.47	0.512	96.50	52.04	7.68	0.92	0.23	0.250	0.500	0.32	0.350	96.50	7.68	0.92	
MH-1A	AASHTO	0.82	0.82	1.26	0.92			0.56	0.532	103.60	55.27	8.24	1.06	0.33	0.250	0.500	0.37	0.350	103.60	8.24	1.06	
T-Junc	AASHTO	0.50	0.50	0.77	0.92			0.18	0.700	7.20	90.11	4.07	0.26	0.26	0.250	0.500	0.32	0.350	96.50	7.68	0.92	
CP A7	AASHTO	0.15	0.15	0.23	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.23	0.250	0.500	0.00	0.000	0.00	0.00	0.00	
CP A6	AASHTO	0.04	0.04	0.06	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.06	0.250	0.500	0.00	0.000	0.00	0.00	0.00	
Wash A (West)																						
P-4A		0.26				0.92	52.04														0.92	0.005
P-3A		0.27				0.92	1.01														1.06	0.005
P-2A		0.13				1.06	55.27														0.92	0.005
P-1A		1.28				1.54	0.00														0.00	0.005
P-5A		0.07				0.26	90.11														0.00	0.005

Profile Report
Engineering Profile - Profile - CP A7 (RUN_A7.stsw)

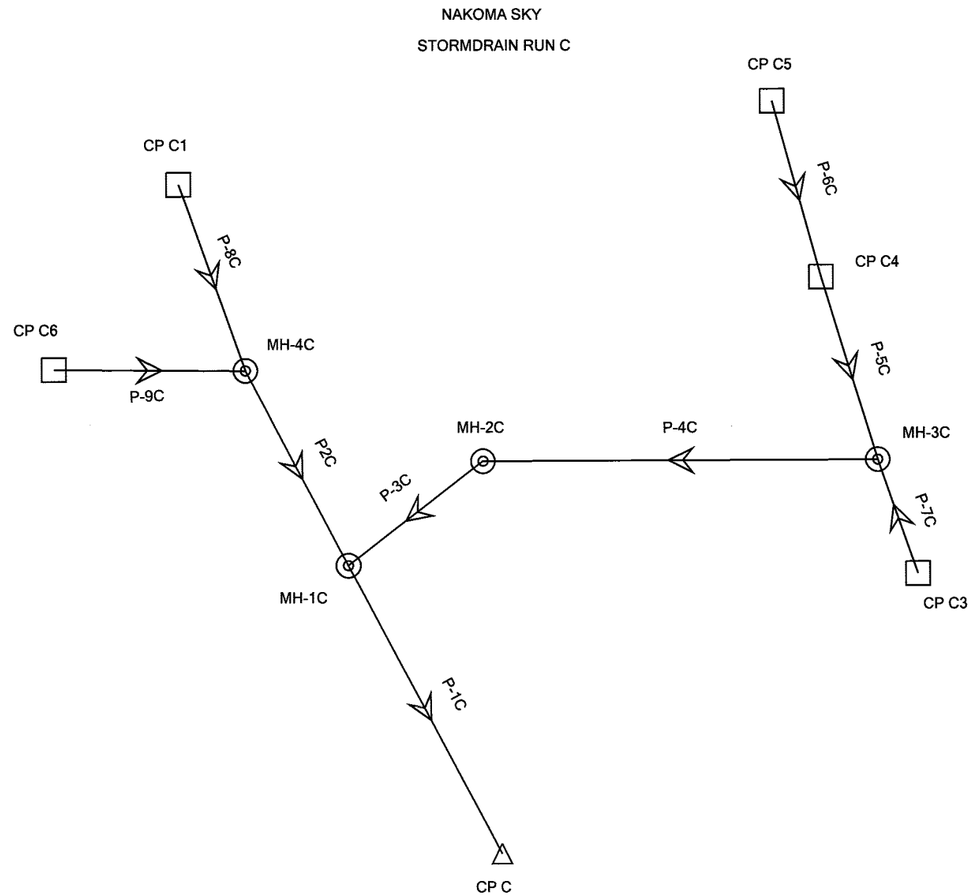


Profile Report

Engineering Profile - Profile - CP A6 (RUN_A7.stsw)



Scenario: Base



Conduit FlexTable: WLB Group Table

Label	Upstream Structure	Flow (ft^3/s)	Length (User Defined) (ft)	Diameter (in)	Material	Number of Barrels	Velocity (ft/s)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (In) (ft)	Energy Grade Line (In) (ft)	Invert (Start) (ft)	Elevation Ground (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Stop) (ft)	Energy Grade Line (Out) (ft)
P-1C	MH-1C	83.40	194.0	42.0	Steel	1	15.22	2,584.16	2,574.63	2,576.17	2,571.78	2,577.00	2,569.99	2,568.00	2,573.37
P-6C	CP C5	6.00	12.5	18.0	Steel	1	3.40	2,578.58	2,577.60	2,577.78	2,575.50	2,578.90	2,577.56	2,575.44	2,577.74
P-5C	CP C4	10.20	59.5	18.0	Steel	1	5.77	2,578.90	2,577.31	2,577.83	2,575.44	2,579.14	2,576.75	2,575.17	2,577.27
P-4C	MH-3C	19.80	193.0	30.0	Steel	1	6.82	2,579.14	2,576.07	2,576.45	2,574.17	2,582.55	2,575.76	2,573.01	2,576.01
P-3C	MH-2C	19.80	38.0	30.0	Steel	1	6.87	2,582.55	2,575.51	2,575.76	2,573.01	2,584.16	2,575.42	2,572.78	2,575.67
P-7C	CP C3	9.60	11.0	18.0	Steel	1	5.43	2,578.92	2,576.84	2,577.30	2,575.28	2,579.14	2,576.75	2,575.17	2,577.21
P-8C	CP C1	61.60	74.3	42.0	Steel	1	15.02	2,582.50	2,578.09	2,579.22	2,575.63	2,583.66	2,577.04	2,573.92	2,577.76
P2C	MH-4C	63.60	92.1	42.0	Steel	1	15.20	2,583.66	2,576.42	2,577.58	2,573.92	2,584.16	2,575.42	2,571.78	2,576.10
P-9C	CP C6	2.00	26.8	18.0	Steel	1	6.84	2,581.00	2,577.03	2,577.07	2,576.00	2,583.66	2,577.04	2,575.17	2,577.06

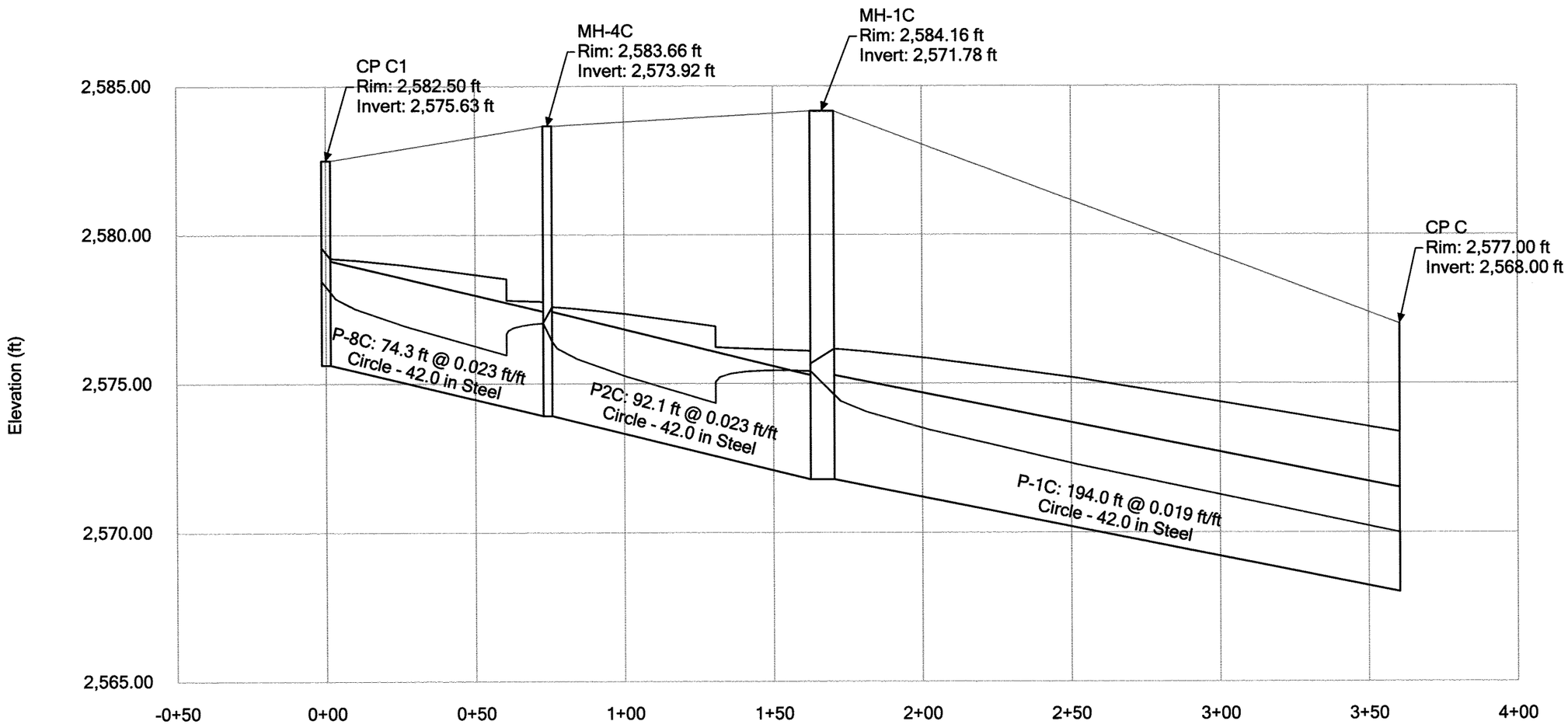
Conduit FlexTable: Culvert Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Diameter (in)	Slope (Calculated) (ft/ft)	Material	Flow (ft³/s)	Flow / Capacity (Design) (%)	Velocity (ft/s)	Velocity (In) (ft/s)	Velocity (Out) (ft/s)	Depth (Normal) (ft)	Specific Energy (In) (in)	Specific Energy (Out) (in)	Manning's n	Upstream Structure Headloss (ft)	Headloss (ft)
P-1C	MH-1C	CP C	194.0	42.0	0.019	Steel	83.40	59.4	15.22	9.95	14.74	1.94	52.6	64.4	0.013	0.79	4.64
P-6C	CP C5	CP C4	12.5	18.0	0.004	Steel	6.00	85.3	3.40	3.40	3.40	1.07	27.4	27.6	0.013	0.06	0.04
P-5C	CP C4	MH-3C	59.5	18.0	0.005	Steel	10.20	144.1	5.77	5.77	5.77	(N/A)	28.6	25.1	0.013	0.25	0.56
P-4C	MH-3C	MH-2C	193.0	30.0	0.006	Steel	19.80	62.3	6.82	4.93	4.03	1.43	27.4	36.0	0.013	0.67	0.31
P-3C	MH-2C	MH-1C	38.0	30.0	0.006	Steel	19.80	61.8	6.87	4.03	4.03	1.42	33.0	34.7	0.013	0.26	0.09
P-7C	CP C3	MH-3C	11.0	18.0	0.010	Steel	9.60	91.4	5.43	5.43	5.43	1.13	24.2	24.4	0.013	0.15	0.09
P-8C	CP C1	MH-4C	74.3	42.0	0.023	Steel	61.60	40.4	15.02	8.53	6.81	1.55	43.1	46.0	0.013	0.37	1.05
P2C	MH-4C	MH-1C	92.1	42.0	0.023	Steel	63.60	41.5	15.20	8.65	6.61	1.57	44.0	51.8	0.013	0.62	1.00
P-9C	CP C6	MH-4C	26.8	18.0	0.031	Steel	2.00	10.8	6.84	1.55	1.13	0.33	12.8	22.6	0.013	0.01	-0.01

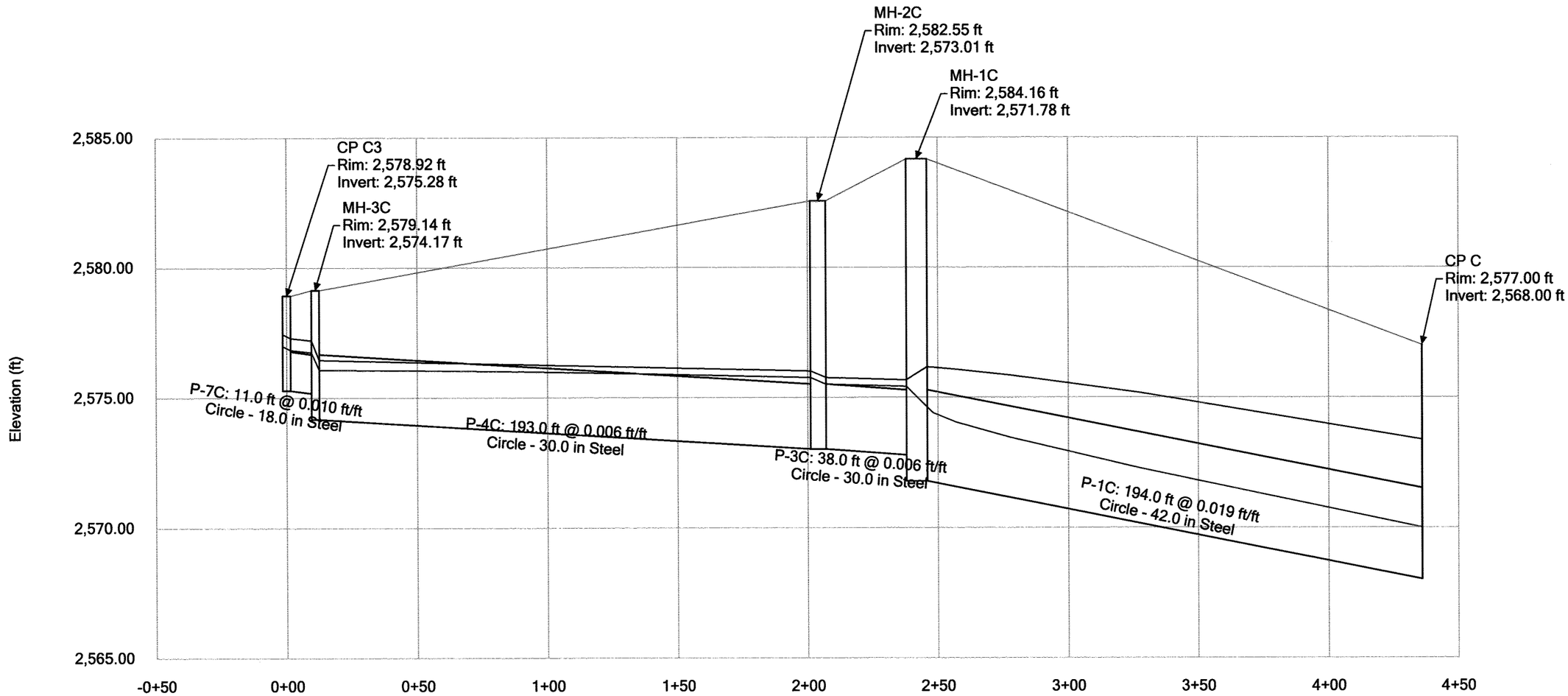
Network Elements FlexTable: AASHTO Headloss Table

Label	Headloss Method	Headloss (ft)	Adjusted Headloss (AASHTO) (ft)	Unadjusted Headloss (AASHTO) (ft)	Velocity Head (In-Governing) (ft)	Velocity Head (Out) (ft)	Bend Angle (Calculated) (degrees)	Bend Loss (AASHTO) (ft)	Bend Loss Coefficient (AASHTO)	Bend Loss Conduit Flow (AASHTO) (ft³/s)	Bend Loss Pipe Angle (AASHTO) (degrees)	Bend Loss Pipe Velocity (AASHTO) (ft/s)	Bend Loss Pipe Velocity Head (AASHTO) (ft)	Contraction Loss (AASHTO) (ft)	Contraction Loss Coefficient (AASHTO)	Correction factor for shaping (AASHTO)	Expansion Loss (AASHTO) (ft)	Expansion Loss Coefficient (AASHTO)	Expansion Loss Pipe Flow (AASHTO) (ft³/s)	Expansion Loss Pipe Velocity (AASHTO) (ft/s)	Expansion Loss Pipe Velocity Head (AASHTO) (ft)	Friction Slope (ft/ft)
MH-1C	AASHTO	0.79	0.79	0.79	3.38			0.17	0.661	19.80	80.31	4.03	0.25	0.38	0.250	1.000	0.24	0.350	63.60	6.61	0.68	
MH-2C	AASHTO	0.26	0.26	0.26	3.38			0.10	0.409	19.80	37.43	4.03	0.25	0.06	0.250	1.000	0.09	0.350	19.80	4.03	0.25	
MH-3C	AASHTO	0.67	0.67	0.67	3.38			0.40	0.768	10.20	106.93	5.77	0.52	0.09	0.250	1.000	0.18	0.350	10.20	5.77	0.52	
MH-4C	AASHTO	0.62	0.62	0.62	3.38			0.07	0.101	61.60	8.00	6.81	0.72	0.29	0.250	1.000	0.25	0.350	61.60	6.81	0.72	
CP C1	AASHTO	0.37	0.37	0.28	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.28	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP C3	AASHTO	0.15	0.15	0.11	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.11	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP C4	AASHTO	0.25	0.25	0.20	3.38			0.00	0.021	6.00	1.66	3.40	0.18	0.13	0.250	1.000	0.06	0.350	6.00	3.40	0.18	
CP C5	AASHTO	0.06	0.06	0.04	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.04	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP C6	AASHTO	0.01	0.01	0.01	0.00			0.00	0.000	0.00	0.00	0.00	0.00	0.01	0.250	1.000	0.00	0.000	0.00	0.00	0.00	
CP C																						
P-1C		4.64				3.38	0.00															0.014
P-6C		0.04				0.18	1.66															0.003
P-5C		0.56				0.52	106.93															0.009
P-4C		0.31				0.25	37.43															0.002
P-3C		0.09				0.25	80.31															0.002
P-7C		0.09				0.46	70.90															0.008
P-8C		1.05				0.72	8.00															0.020
P2C		1.00				0.68	0.26															0.016
P-9C		-0.01				0.02	61.91															0.000

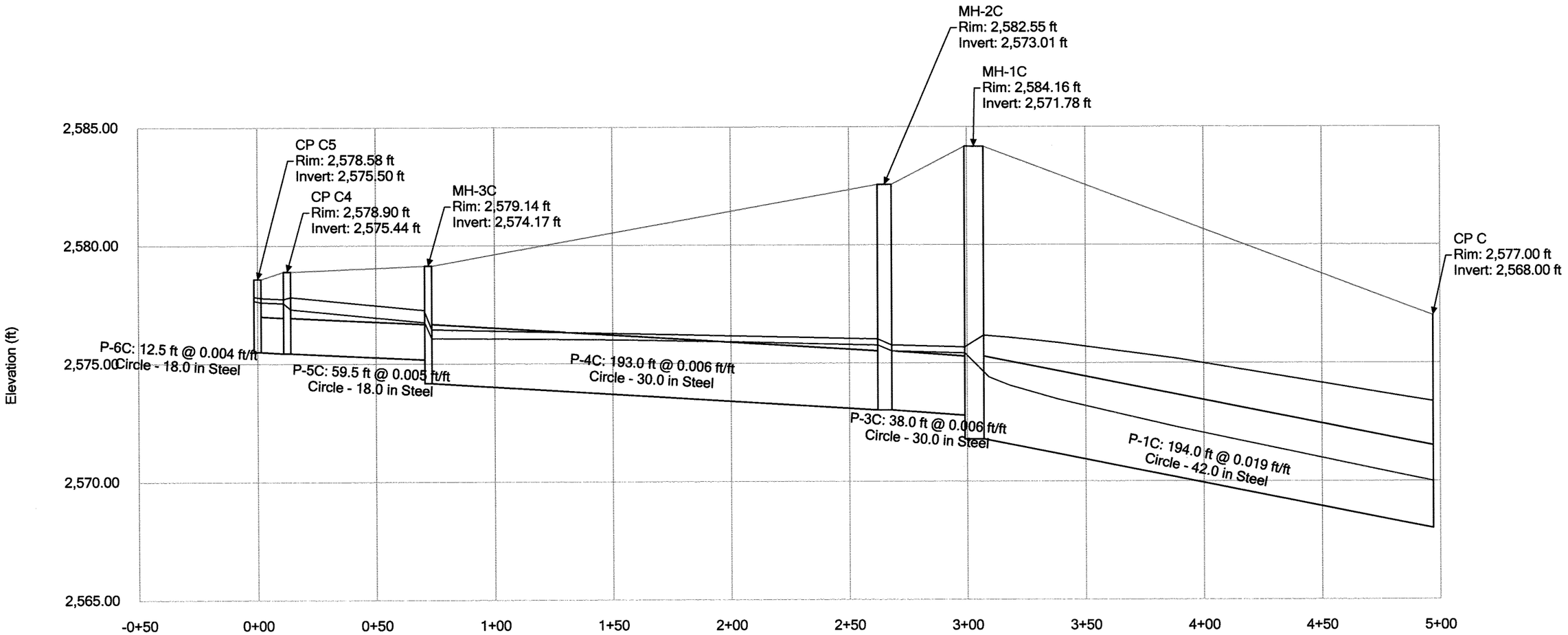
Profile Report
Engineering Profile - Profile - CP C1 (Run C.stsw)



Profile Report
Engineering Profile - Profile - CP C3 (Run C.stsw)

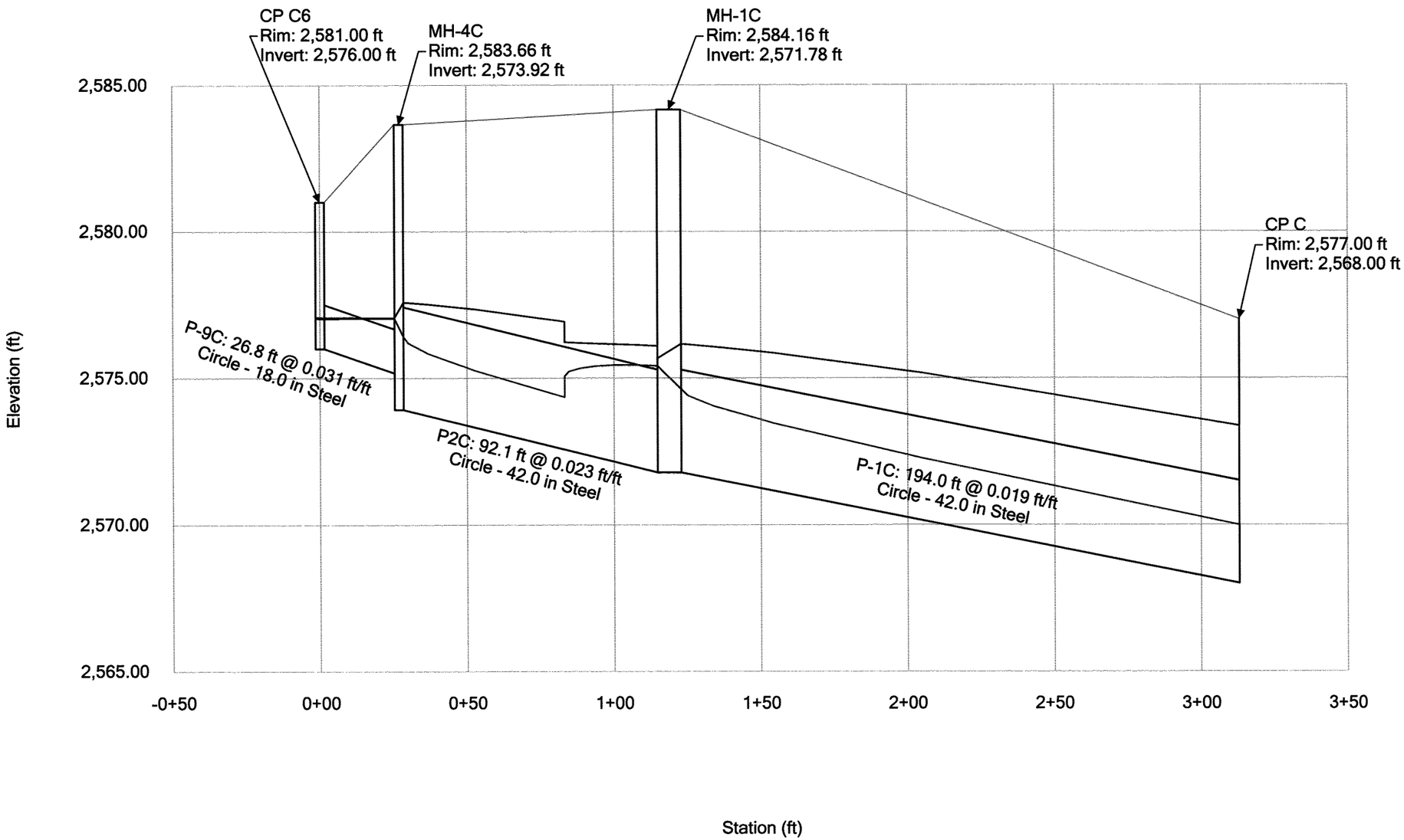


Profile Report
Engineering Profile - Profile - CP C5 (Run C.stsw)



Profile Report

Engineering Profile - Profile - CP C6 (Run C.stsw)



GRATE INLET (CATCH BASIN) WORKSHEETS

PROJECT:	**Nakoma Sky**				
WLB NO:	**181057-Y003-0400**				
DESCRIPTION:	**CP A1.1**		**Q100=**	15.00	
DATE:	**4/20/2017**				**Grate Layout**
Type of Grate	**EF-1**	**Width, ft**	**1.97**		**#1**
Number of Grates	**4**	**Length, ft**	**3.33**		**#2**
Area, ft^2	**18.67**	**Wing, ft**			**#3**
Perimeter, ft	**22.42**	**Y, ft**	**1.00**		**#4**
			Required Perimeter,ft (Clogging)	**10.00**	
GRATE INLET			**Required Area,ft (Clogging)**	**5.61**	

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	22.42	18.67	0.75	22.33	0.75	0.38
0.10	22.42	18.67	2.13	31.58	2.13	1.06
0.15	22.42	18.67	3.91	38.68	3.91	1.95
0.20	22.42	18.67	6.02	44.66	6.02	3.01
0.25	22.42	18.67	8.41	49.93	8.41	4.20
0.30	22.42	18.67	11.05	54.70	11.05	5.53
0.35	22.42	18.67	13.93	59.08	13.93	6.96
0.40	22.42	18.67	17.02	63.16	17.02	8.51
0.45	22.42	18.67	20.30	66.99	20.30	10.15
0.50	22.42	18.67	23.78	70.62	23.78	11.89
0.58	**22.42**	**18.67**	**30.02**	**76.32**	**30.02**	**15.01**
0.60	22.42	18.67	31.26	77.36	31.26	15.63
0.70	22.42	18.67	39.39	83.56	39.39	19.70
0.80	22.42	18.67	48.13	89.32	48.13	24.06
0.90	22.42	18.67	57.43	94.74	57.43	28.71
1.00	22.42	18.67	67.26	99.87	67.26	33.63
1.10	22.42	18.67	77.60	104.74	77.60	38.80
1.20	22.42	18.67	88.42	109.40	88.42	44.21
1.30	22.42	18.67	99.69	113.87	99.69	49.85
1.40	22.42	18.67	111.42	118.16	111.42	55.71
1.50	22.42	18.67	123.56	122.31	122.31	61.16

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet · .
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft^2*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown above

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A1.3 **Q100=** 4.40
DATE: 4/20/2017

Grate Layout (Sump)

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft²	**4.67**	**Wing, ft**	
Perimeter, ft	**10.60**	**Y, ft**	**1.00**

#1

Required Perimeter,ft (Clogging) **2.93**
Required Area,ft (Clogging) **1.64**

GRATE INLET

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	10.60	4.67	0.36	5.58	0.36	0.18
0.10	10.60	4.67	1.01	7.90	1.01	0.50
0.15	10.60	4.67	1.85	9.67	1.85	0.92
0.20	10.60	4.67	2.84	11.17	2.84	1.42
0.25	10.60	4.67	3.98	12.48	3.98	1.99
0.30	10.60	4.67	5.23	13.67	5.23	2.61
0.35	10.60	4.67	6.58	14.77	6.58	3.29
0.40	10.60	4.67	8.04	15.79	8.04	4.02
0.43	**10.60**	**4.67**	**8.81**	**16.28**	**8.81**	**4.41**
0.45	10.60	4.67	9.60	16.75	9.60	4.80
0.50	10.60	4.67	11.24	17.65	11.24	5.62
0.60	10.60	4.67	14.78	19.34	14.78	7.39
0.70	10.60	4.67	18.62	20.89	18.62	9.31
0.80	10.60	4.67	22.75	22.33	22.33	11.17
0.90	10.60	4.67	27.15	23.69	23.69	11.84
1.00	10.60	4.67	31.80	24.97	24.97	12.48
1.10	10.60	4.67	36.69	26.19	26.19	13.09
1.20	10.60	4.67	41.80	27.35	27.35	13.67
1.30	10.60	4.67	47.13	28.47	28.47	14.23
1.40	10.60	4.67	52.68	29.54	29.54	14.77
1.50	10.60	4.67	58.42	30.58	30.58	15.29

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown above

PROJECT:	**Nakoma Sky**				
WLB NO:	**181057-Y003-0400**				
DESCRIPTION:	**CP A1.4**		**Q100=**	7.90	
DATE:	**4/20/2017**				**Grate Layout (Sump)**
Type of Grate	**EF-1**	**Width, ft**	**1.97**		**#1**
Number of Grates	**1**	**Length, ft**	**3.33**		
Area, ft²	**4.67**	**Wing, ft**			
Perimeter, ft	**10.60**	**Y, ft**	**1.00**		
			Required Perimeter,ft (Clogging)	**5.27**	
GRATE INLET			**Required Area,ft (Clogging)**	**2.95**	

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	10.60	4.67	0.36	5.58	0.36	0.18
0.10	10.60	4.67	1.01	7.90	1.01	0.50
0.15	10.60	4.67	1.85	9.67	1.85	0.92
0.20	10.60	4.67	2.84	11.17	2.84	1.42
0.25	10.60	4.67	3.98	12.48	3.98	1.99
0.30	10.60	4.67	5.23	13.67	5.23	2.61
0.35	10.60	4.67	6.58	14.77	6.58	3.29
0.40	10.60	4.67	8.04	15.79	8.04	4.02
0.45	10.60	4.67	9.60	16.75	9.60	4.80
0.50	10.60	4.67	11.24	17.65	11.24	5.62
0.60	10.60	4.67	14.78	19.34	14.78	7.39
0.63	**10.60**	**4.67**	**15.80**	**19.77**	**15.80**	**7.90**
0.70	10.60	4.67	18.62	20.89	18.62	9.31
0.80	10.60	4.67	22.75	22.33	22.33	11.17
0.90	10.60	4.67	27.15	23.69	23.69	11.84
1.00	10.60	4.67	31.80	24.97	24.97	12.48
1.10	10.60	4.67	36.69	26.19	26.19	13.09
1.20	10.60	4.67	41.80	27.35	27.35	13.67
1.30	10.60	4.67	47.13	28.47	28.47	14.23
1.40	10.60	4.67	52.68	29.54	29.54	14.77
1.50	10.60	4.67	58.42	30.58	30.58	15.29

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown above

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A1.5 Q100= 7.4(Sump)
DATE: 4/20/2017

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**6.56**	**Wing, ft**	
Perimeter, ft	**7.27**		

GRATE INLET

DEPTH (FT)	PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)	
0.05	7.27	6.56	0.24	7.85	0.24
0.10	7.27	6.56	0.69	11.10	0.69
0.15	7.27	6.56	1.27	13.59	1.27
0.20	7.27	6.56	1.95	15.70	1.95
0.25	7.27	6.56	2.73	17.55	2.73
0.30	7.27	6.56	3.58	19.22	3.58
0.35	7.27	6.56	4.52	20.76	4.52
0.40	7.27	6.56	5.52	22.20	5.52
0.45	7.27	6.56	6.58	23.54	6.58
0.50	**7.27**	**6.56**	**7.71**	**24.82**	**7.71**
0.55	7.27	6.56	8.90	26.03	8.90
0.60	7.27	6.56	10.14	27.19	10.14
0.65	7.27	6.56	11.43	28.30	11.43
0.67	7.27	6.56	11.96	28.73	11.96
0.68	7.27	6.56	12.23	28.94	12.23
0.70	7.27	6.56	12.77	29.36	12.77
0.75	7.27	6.56	14.17	30.39	14.17

Type 5 Catch Basin PC/COT Std. Dtl. 307:

Length of Sump = Total Length of Grates
Length of Wing = 0.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 3.33 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[3] WEIR EQ.	[4] ORIFICE EQ.		
0.05	3.33	0.50	60.00	0.09	N/A	0.09	0.31
0.10	3.33	0.50	60.00	0.24	N/A	0.24	0.87
0.15	3.33	0.50	60.00	0.44	N/A	0.44	1.60
0.20	3.33	0.50	60.00	0.69	N/A	0.69	2.46
0.25	3.33	0.50	60.00	0.96	1.63	0.96	3.44
0.30	3.33	0.50	60.00	1.26	2.57	1.26	4.53
0.35	3.33	0.50	60.00	1.59	3.25	1.59	5.71
0.40	3.33	0.50	60.00	1.94	3.82	1.94	6.97
0.45	3.33	0.50	60.00	2.31	4.30	2.31	8.32
0.50	**3.33**	**0.50**	**60.00**	**2.71**	**4.74**	**2.71**	**9.74**
0.55	3.33	0.50	60.00	3.12	5.14	3.12	11.24
0.60	3.33	0.50	60.00	3.56	5.52	3.56	12.81
0.65	3.33	0.50	60.00	4.01	5.86	4.01	14.44
0.67	3.33	0.50	60.00	4.20	6.00	4.20	15.11
0.68	3.33	0.50	60.00	4.29	6.06	4.29	15.45
0.70	3.33	0.50	60.00	4.49	6.19	4.49	16.14
0.75	3.33	0.50	60.00	4.97	6.51	4.97	17.90

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$
3. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
4. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$

* Calculated clogging for Sump Conditions is 100% times the calculated perimeter for EF-1 Grate and 125% times the length of calculated length of curb inlet

PROJECT:	**Nakoma Sky**		
WLB NO:	**181057-Y003-0400**		
DESCRIPTION:	**CP A1.5a**	**Q100=**	6.30
DATE:	**4/20/2017**		

Grate Layout (Sump)

#1
#2

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**2**	**Length, ft**	**3.33**
Area, ft²	**9.33**	**Wing, ft**	
Perimeter, ft	**14.54**	**Y, ft**	**1.00**

Required Perimeter,ft (Clogging) **4.20**

Required Area,ft (Clogging) **2.36**

GRATE INLET

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	14.54	9.33	0.49	11.17	0.49	0.24
0.10	14.54	9.33	1.38	15.79	1.38	0.69
0.15	14.54	9.33	2.53	19.34	2.53	1.27
0.20	14.54	9.33	3.90	22.33	3.90	1.95
0.25	14.54	9.33	5.45	24.97	5.45	2.73
0.30	14.54	9.33	7.17	27.35	7.17	3.58
0.35	14.54	9.33	9.03	29.54	9.03	4.52
0.40	14.54	9.33	11.04	31.58	11.04	5.52
0.44	**14.54**	**9.33**	**12.60**	**33.01**	**12.60**	**6.30**
0.45	14.54	9.33	13.17	33.50	13.17	6.58
0.50	14.54	9.33	15.42	35.31	15.42	7.71
0.60	14.54	9.33	20.27	38.68	20.27	10.14
0.70	14.54	9.33	25.55	41.78	25.55	12.77
0.80	14.54	9.33	31.21	44.66	31.21	15.61
0.90	14.54	9.33	37.24	47.37	37.24	18.62
1.00	14.54	9.33	43.62	49.93	43.62	21.81
1.10	14.54	9.33	50.32	52.37	50.32	25.16
1.20	14.54	9.33	57.34	54.70	54.70	27.35
1.30	14.54	9.33	64.65	56.93	56.93	28.47
1.40	14.54	9.33	72.26	59.08	59.08	29.54
1.50	14.54	9.33	80.14	61.16	61.16	30.58

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown above

PROJECT:	**Nakoma Sky**				
WLB NO:	**181057-Y003-0400**				
DESCRIPTION:	**CP A1.6**		**Q100=**	7.30	
DATE:	**4/20/2017**				**Grate Layout (Sump)**
					#1
Type of Grate	**EF-1**	**Width, ft**	**1.97**		
Number of Grates	**1**	**Length, ft**	**3.33**		
Area, ft²	**4.67**	**Wing, ft**			
Perimeter, ft	**10.60**	**Y, ft**	**1.00**		
			Required Perimeter,ft (Clogging)	**4.87**	
GRATE INLET			**Required Area,ft (Clogging)**	**2.73**	

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	10.60	4.67	0.36	5.58	0.36	0.18
0.10	10.60	4.67	1.01	7.90	1.01	0.50
0.15	10.60	4.67	1.85	9.67	1.85	0.92
0.20	10.60	4.67	2.84	11.17	2.84	1.42
0.25	10.60	4.67	3.98	12.48	3.98	1.99
0.30	10.60	4.67	5.23	13.67	5.23	2.61
0.35	10.60	4.67	6.58	14.77	6.58	3.29
0.40	10.60	4.67	8.04	15.79	8.04	4.02
0.45	10.60	4.67	9.60	16.75	9.60	4.80
0.50	10.60	4.67	11.38	17.72	11.38	5.69
0.59	**10.60**	**4.67**	**14.56**	**19.24**	**14.56**	**7.28**
0.60	10.60	4.67	14.93	19.40	14.93	7.46
0.70	10.60	4.67	18.78	20.95	18.78	9.39
0.80	10.60	4.67	22.93	22.39	22.39	11.19
0.90	10.60	4.67	27.33	23.74	23.74	11.87
1.00	10.60	4.67	31.99	25.02	25.02	12.51
1.10	10.60	4.67	36.89	26.23	26.23	13.12
1.20	10.60	4.67	42.01	27.40	27.40	13.70
1.30	10.60	4.67	47.35	28.51	28.51	14.26
1.40	10.60	4.67	52.90	29.58	29.58	14.79
1.50	10.60	4.67	58.65	30.62	30.62	15.31

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown above

PROJECT:	**Nakoma Sky**				
WLB NO:	**181057-Y003-0400**				
DESCRIPTION:	**CP A3**			**Q100=**	23.10
DATE:	**4/24/2017**				

Grate Layout (Sump)

#1
#2
#3

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**4**	**Length, ft**	**3.33**
Area, ft²	**18.67**	**Wing, ft**	
Perimeter, ft	**18.48**	**Y, ft**	**1.00**

Required Perimeter,ft (Clogging) **15.40**

Required Area,ft (Clogging) **8.64**

GRATE INLET

DEPTH (FT)	* PERIM. (FT)	**AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	18.48	18.67	0.62	22.33	0.62	0.31
0.10	18.48	18.67	1.75	31.58	1.75	0.88
0.15	18.48	18.67	3.22	38.68	3.22	1.61
0.20	18.48	18.67	4.96	44.66	4.96	2.48
0.25	18.48	18.67	6.93	49.93	6.93	3.47
0.30	18.48	18.67	9.11	54.70	9.11	4.55
0.35	18.48	18.67	11.48	59.08	11.48	5.74
0.40	18.48	18.67	14.03	63.16	14.03	7.01
0.45	18.48	18.67	16.74	66.99	16.74	8.37
0.50	18.48	18.67	19.60	70.62	19.60	9.80
0.60	18.48	18.67	25.77	77.36	25.77	12.88
0.70	18.48	18.67	32.47	83.56	32.47	16.23
0.80	18.48	18.67	39.67	89.32	39.67	19.83
0.89	**18.48**	**18.67**	**46.24**	**94.00**	**46.24**	**23.12**
0.90	18.48	18.67	47.34	94.74	47.34	23.67
1.00	18.48	18.67	55.44	99.87	55.44	27.72
1.10	18.48	18.67	63.96	104.74	63.96	31.98
1.20	18.48	18.67	72.88	109.40	72.88	36.44
1.30	18.48	18.67	82.17	113.87	82.17	41.09
1.40	18.48	18.67	91.84	118.16	91.84	45.92
1.50	18.48	18.67	101.85	122.31	122.31	61.16

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown abc

PROJECT:	**Nakoma Sky**				
WLB NO:	**181057-Y003-0400**				
DESCRIPTION:	**CP A4**			**Q100=**	7.70
DATE:	**4/24/2017**				**Grate Layout (Sump)**
Type of Grate	**EF-1**	**Width, ft**	**1.97**		**#1**
Number of Grates	**2**	**Length, ft**	**3.33**		
Area, ft²	**9.33**	**Wing, ft**			
Perimeter, ft	**10.60**	**Y, ft**	**1.00**		
			Required Perimeter,ft (Clogging)		**5.13**
GRATE INLET			**Required Area,ft (Clogging)**		**2.88**

DEPTH (FT)	* PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	10.60	9.33	0.36	11.17	0.36	0.18
0.10	10.60	9.33	1.01	15.79	1.01	0.50
0.15	10.60	9.33	1.85	19.34	1.85	0.92
0.20	10.60	9.33	2.84	22.33	2.84	1.42
0.25	10.60	9.33	3.98	24.97	3.98	1.99
0.30	10.60	9.33	5.23	27.35	5.23	2.61
0.35	10.60	9.33	6.58	29.54	6.58	3.29
0.40	10.60	9.33	8.04	31.58	8.04	4.02
0.45	10.60	9.33	9.68	33.59	9.68	4.84
0.50	10.60	9.33	11.33	35.40	11.33	5.66
0.60	10.60	9.33	14.87	38.76	14.87	7.44
0.62	**10.60**	**9.33**	**15.39**	**39.21**	**15.39**	**7.70**
0.70	10.60	9.33	18.72	41.85	18.72	9.36
0.80	10.60	9.33	22.86	44.73	22.86	11.43
0.90	10.60	9.33	27.26	47.44	27.26	13.63
1.00	10.60	9.33	31.92	50.00	31.92	15.96
1.10	10.60	9.33	36.81	52.43	36.81	18.41
1.20	10.60	9.33	41.93	54.76	41.93	20.97
1.30	10.60	9.33	47.27	56.99	47.27	23.64
1.40	10.60	9.33	52.82	59.14	52.82	26.41
1.50	10.60	9.33	58.57	61.21	58.57	29.28

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet .
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A6 Q100= 7.1 (Sump)
DATE: 4/21/2017

Type of Grate	**EF-1**	**Width, ft**	**1.97**
Number of Grates	**1**	**Length, ft**	**3.33**
Area, ft^2	**6.56**	**Wing, ft**	
Perimeter, ft	**7.27**		

GRATE INLET

DEPTH (FT)	PERIM. (FT)	AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)	
0.05	7.27	6.56	0.24	7.85	0.24
0.10	7.27	6.56	0.69	11.10	0.69
0.15	7.27	6.56	1.27	13.59	1.27
0.20	7.27	6.56	1.95	15.70	1.95
0.25	7.27	6.56	2.73	17.55	2.73
0.30	7.27	6.56	3.58	19.22	3.58
0.35	7.27	6.56	4.52	20.76	4.52
0.40	7.27	6.56	5.52	22.20	5.52
0.45	7.27	6.56	6.58	23.54	6.58
0.50	**7.27**	**6.56**	**7.71**	**24.82**	**7.71**
0.55	7.27	6.56	8.90	26.03	8.90
0.60	7.27	6.56	10.14	27.19	10.14
0.65	7.27	6.56	11.43	28.30	11.43
0.67	7.27	6.56	11.96	28.73	11.96
0.68	7.27	6.56	12.23	28.94	12.23
0.70	7.27	6.56	12.77	29.36	12.77
0.75	7.27	6.56	14.17	30.39	14.17

Type 5 Catch Basin PC/COT Std. Dtl. 307:

Length of Sump = Total Length of Grates
Length of Wing = 0.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 3.33 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[3] WEIR EQ.	[4] ORIFICE EQ.		
0.05	3.33	0.50	60.00	0.09	N/A	0.09	0.31
0.10	3.33	0.50	60.00	0.24	N/A	0.24	0.87
0.15	3.33	0.50	60.00	0.44	N/A	0.44	1.60
0.20	3.33	0.50	60.00	0.69	N/A	0.69	2.46
0.25	3.33	0.50	60.00	0.96	1.63	0.96	3.44
0.30	3.33	0.50	60.00	1.26	2.57	1.26	4.53
0.35	3.33	0.50	60.00	1.59	3.25	1.59	5.71
0.40	3.33	0.50	60.00	1.94	3.82	1.94	6.97
0.45	3.33	0.50	60.00	2.31	4.30	2.31	8.32
0.50	**3.33**	**0.50**	**60.00**	**2.71**	**4.74**	**2.71**	**9.74**
0.55	3.33	0.50	60.00	3.12	5.14	3.12	11.24
0.60	3.33	0.50	60.00	3.56	5.52	3.56	12.81
0.65	3.33	0.50	60.00	4.01	5.86	4.01	14.44
0.67	3.33	0.50	60.00	4.20	6.00	4.20	15.11
0.68	3.33	0.50	60.00	4.29	6.06	4.29	15.45
0.70	3.33	0.50	60.00	4.49	6.19	4.49	16.14
0.75	3.33	0.50	60.00	4.97	6.51	4.97	17.90

1. Weir equation for grate inlet: $Q=3.0P_g Y^{3/2}$
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$
3. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
4. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$

* Calculated clogging for Sump Conditions is 100% times the calculated perimeter for EF-1 Grate and 125% times the length of calculated length of curb inlet

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP C3 **Q100= 9.6**
DATE: 4/24/2017

Type 3 Catch Basin PC/COT Std. Dtl. 308:

Length of Sump= 3.08' (3'-1")
Length of Wing = 12.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 15.08 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	15.08	0.50	60.00	0.39	N/A	0.39	0.39
0.10	15.08	0.50	60.00	1.10	N/A	1.10	1.10
0.15	15.08	0.50	60.00	2.01	N/A	2.01	2.01
0.20	15.08	0.50	60.00	3.10	N/A	3.10	3.10
0.25	15.08	0.50	60.00	4.34	7.38	4.34	4.34
0.30	15.08	0.50	60.00	5.70	11.66	5.70	5.70
0.35	15.08	0.50	60.00	7.18	14.74	7.18	7.18
0.40	15.08	0.50	60.00	8.77	17.28	8.77	8.77
0.45	**15.08**	**0.50**	**60.00**	**10.47**	**19.49**	**10.47**	**10.47**
0.50	15.08	0.50	60.00	12.26	21.48	12.26	12.26
0.55	15.08	0.50	60.00	14.15	23.30	14.15	14.15
0.60	15.08	0.50	60.00	16.12	24.98	16.12	16.12
0.65	15.08	0.50	60.00	18.18	26.56	18.18	18.18
0.70	15.08	0.50	60.00	20.31	28.05	20.31	20.31
0.75	15.08	0.50	60.00	22.53	29.46	22.53	22.53
0.80	15.08	0.50	60.00	24.82	30.81	24.82	24.82
0.85	15.08	0.50	60.00	27.18	32.11	27.18	27.18

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$ (*Depths less than 1.4'*)
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$ (*Depths greater than 1.4'*)

* Calculated length of curb opening equals length of scupper/Safety Factor to account for clogging 10/1.25= 8'

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP C4 **Q100= 4.2**
DATE: 4/24/2017

Type 3 Catch Basin PC/COT Std. Dtl. 308:

Length of Sump= 3.08' (3'-1")
Length of Wing = 4.00 *(Wing Lengths are 4', 8', 12' or 16')*
Total Length = 7.08 (Effective Opening)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	TOTAL COMBINED CAPACITY (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	7.08	0.50	60.00	0.18	N/A	0.18	0.18
0.10	7.08	0.50	60.00	0.51	N/A	0.51	0.51
0.15	7.08	0.50	60.00	0.95	N/A	0.95	0.95
0.20	7.08	0.50	60.00	1.46	N/A	1.46	1.46
0.25	7.08	0.50	60.00	2.04	3.47	2.04	2.04
0.30	7.08	0.50	60.00	2.68	5.47	2.68	2.68
0.35	7.08	0.50	60.00	3.37	6.92	3.37	3.37
0.40	7.08	0.50	60.00	4.12	8.11	4.12	4.12
0.45	**7.08**	**0.50**	**60.00**	**4.92**	**9.15**	**4.92**	**4.92**
0.50	7.08	0.50	60.00	5.76	10.08	5.76	5.76
0.55	7.08	0.50	60.00	6.64	10.94	6.64	6.64
0.60	7.08	0.50	60.00	7.57	11.73	7.57	7.57
0.65	7.08	0.50	60.00	8.53	12.47	8.53	8.53
0.70	7.08	0.50	60.00	9.54	13.17	9.54	9.54
0.75	7.08	0.50	60.00	10.58	13.83	10.58	10.58
0.80	7.08	0.50	60.00	11.65	14.47	11.65	11.65
0.85	7.08	0.50	60.00	12.76	15.07	12.76	12.76

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$ *(Depths less than 1.4')*
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$ *(Depths greater than 1.4')*

* Calculated length of curb opening equals length of scupper/Safety Factor to account for clogging 10/1.25= 8'

PROJECT:	**Nakoma Sky**				
WLB NO:	**181057-Y003-0400**				
DESCRIPTION:	**CP C5**		**Q100=**	6.00	
DATE:	**4/24/2017**				**Grate Layout (Su**
					#1
Type of Grate	**EF-1**	**Width, ft**	**1.97**		
Number of Grates	**1**	**Length, ft**	**3.33**		
Area, ft²	**4.67**	**Wing, ft**			
Perimeter, ft	**10.60**	**Y, ft**	**1.00**		
			Required Perimeter,ft (Clogging)	**4.00**	
GRATE INLET			**Required Area,ft (Clogging)**	**2.24**	

DEPTH (FT)	* PERIM. (FT)	**AREA (SQ.FT)	DISCHARGE (CFS)		CONTROL (CFS)	DESIGN (CFS)
			[1] WEIR EQ. (CFS)	[2] ORIFICE EQ. (CFS)		
0.05	10.60	4.67	0.36	5.58	0.36	0.18
0.10	10.60	4.67	1.01	7.90	1.01	0.50
0.15	10.60	4.67	1.85	9.67	1.85	0.92
0.20	10.60	4.67	2.84	11.17	2.84	1.42
0.25	10.60	4.67	3.98	12.48	3.98	1.99
0.30	10.60	4.67	5.23	13.67	5.23	2.61
0.35	10.60	4.67	6.58	14.77	6.58	3.29
0.40	10.60	4.67	8.04	15.79	8.04	4.02
0.45	10.60	4.67	9.60	16.75	9.60	4.80
0.50	10.60	4.67	11.24	17.65	11.24	5.62
0.52	**10.60**	**4.67**	**12.03**	**18.06**	**12.03**	**6.01**
0.60	10.60	4.67	14.78	19.34	14.78	7.39
0.70	10.60	4.67	18.62	20.89	18.62	9.31
0.80	10.60	4.67	22.75	22.33	22.33	11.17
0.90	10.60	4.67	27.15	23.69	23.69	11.84
1.00	10.60	4.67	31.80	24.97	24.97	12.48
1.10	10.60	4.67	36.69	26.19	26.19	13.09
1.20	10.60	4.67	41.80	27.35	27.35	13.67
1.30	10.60	4.67	47.13	28.47	28.47	14.23
1.40	10.60	4.67	52.68	29.54	29.54	14.77
1.50	10.60	4.67	58.42	30.58	30.58	15.29

1. Weir equation for grate inlet: $Q=3.0P_gY^{3/2}$ (*P_g is Disregarding bars and neglecting side agaisnt curb*)
Weir Operation continues from a depth of 0.01 to 1.4 feet
2. Orifice equation for grate inlet: $Q=5.35AY^{1/2}$ (*A Clear opening area of EF-1 grate equaling 4.66 ft²*)
Orifice Operation continues from a depth of 1.4 feet and greater
* Calculated clogging for Sump Conditions is 200% times the required perimeter.
** Calculated clogging for Sump Conditions is 200% times the required area.

Note: As per the clogging requirements, the grate inlet has been rated for 200% in sump,
doubling the controlled discharge requiring the design to be one half of the controlled discharge.
The required perimeter is computed using an EF-1 grate STD. DTL. 311 and the grate configuration shown abc

CULVERT WORKSHEETS

Table 1 - Summary of Culvert Flows at Crossing: CP A7.1

Headwater Elevation (ft)	Total Discharge (cfs)	1-24 SRP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2601.40	7.30	7.30	0.00	1
2601.60	9.07	9.07	0.00	1
2601.79	10.84	10.84	0.00	1
2601.98	12.61	12.61	0.00	1
2602.18	14.38	14.38	0.00	1
2602.39	16.15	16.15	0.00	1
2602.63	17.92	17.92	0.00	1
2602.89	19.69	19.69	0.00	1
2603.17	21.46	21.46	0.00	1
2603.43	22.90	22.90	0.00	1
2603.52	25.00	23.39	1.44	11
2603.50	23.29	23.29	0.00	Overtopping

Rating Curve Plot for Crossing: CP A7.1

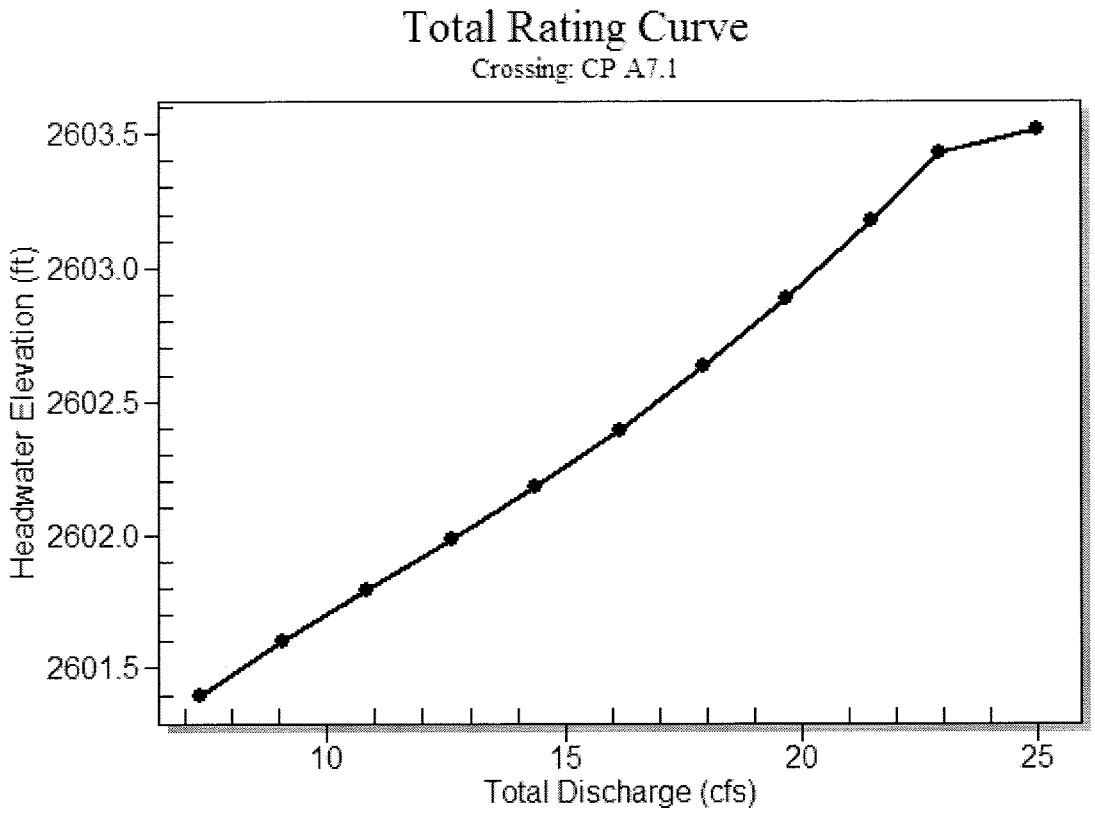


Table 2 - Culvert Summary Table: 1-24 SRP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
7.30	7.30	2601.40	1.400	0.0*	1-S2n	0.816	0.960	0.816	0.533	5.856	2.098
9.07	9.07	2601.60	1.600	0.672	1-S2n	0.923	1.073	0.923	0.607	6.192	2.263
10.84	10.84	2601.79	1.789	0.926	1-S2n	1.025	1.177	1.055	0.675	6.242	2.407
12.61	12.61	2601.98	1.980	1.200	1-S2n	1.125	1.274	1.125	0.739	6.708	2.534
14.38	14.38	2602.18	2.179	1.491	5-S2n	1.227	1.362	1.227	0.799	6.901	2.648
16.15	16.15	2602.39	2.394	1.802	5-S2n	1.332	1.444	1.368	0.856	6.852	2.752
17.92	17.92	2602.63	2.629	2.375	5-S2n	1.445	1.523	1.445	0.910	7.173	2.849
19.69	19.69	2602.89	2.889	2.693	5-S2n	1.578	1.593	1.578	0.962	7.219	2.938
21.46	21.46	2603.17	3.175	3.011	7-M2c	2.000	1.656	1.656	1.013	7.716	3.021
22.90	22.90	2603.43	3.428	3.267	7-M2c	2.000	1.702	1.702	1.052	8.037	3.085
25.00	23.39	2603.52	3.518	3.387	7-M2c	2.000	1.717	1.717	1.108	8.149	3.173

* Full Flow Headwater elevation is below inlet invert.

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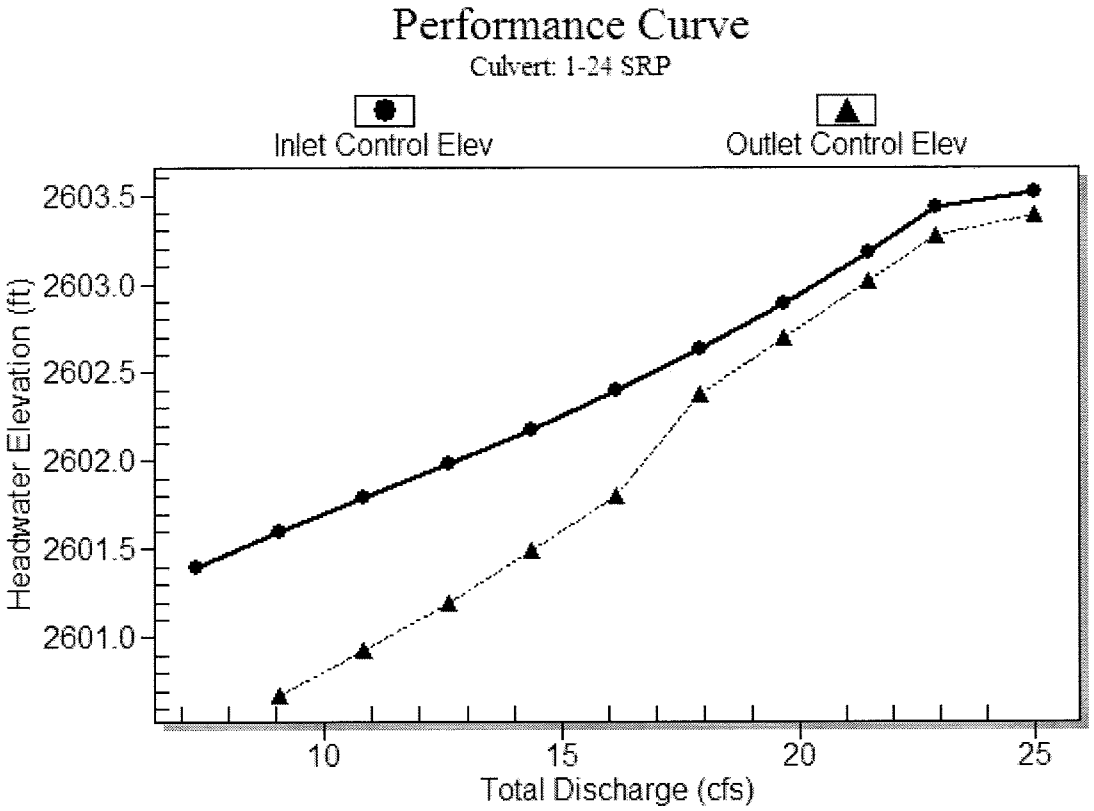
Straight Culvert

Inlet Elevation (invert): 2600.00 ft, Outlet Elevation (invert): 2599.25 ft

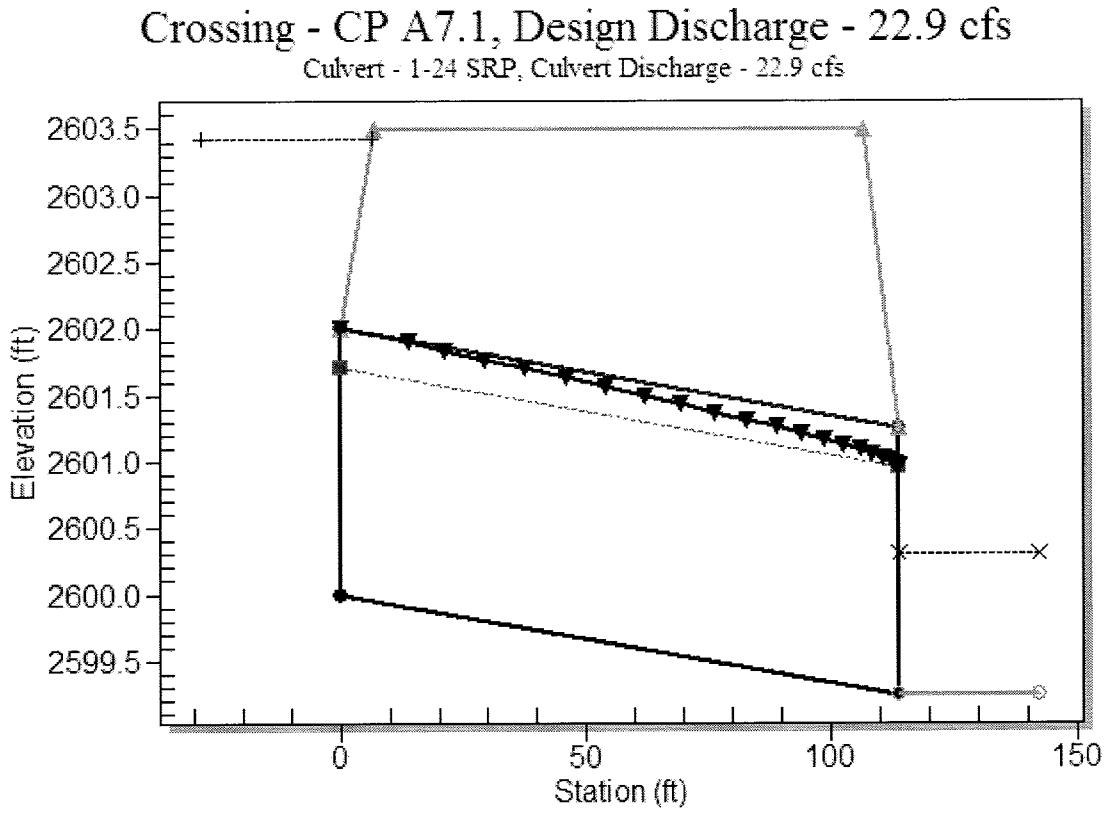
Culvert Length: 114.00 ft, Culvert Slope: 0.0066

****

Culvert Performance Curve Plot: 1-24 SRP



Water Surface Profile Plot for Culvert: 1-24 SRP



Site Data - 1-24 SRP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 2600.00 ft

Outlet Station: 114.00 ft

Outlet Elevation: 2599.25 ft

Number of Barrels: 1

Culvert Data Summary - 1-24 SRP

Barrel Shape: Circular

Barrel Diameter: 2.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: CP A7.1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
7.30	2599.78	0.53	2.10	0.17	0.53
9.07	2599.86	0.61	2.26	0.19	0.54
10.84	2599.92	0.67	2.41	0.21	0.54
12.61	2599.99	0.74	2.53	0.23	0.55
14.38	2600.05	0.80	2.65	0.25	0.55
16.15	2600.11	0.86	2.75	0.27	0.56
17.92	2600.16	0.91	2.85	0.28	0.56
19.69	2600.21	0.96	2.94	0.30	0.56
21.46	2600.26	1.01	3.02	0.32	0.57
22.90	2600.30	1.05	3.09	0.33	0.57
25.00	2600.36	1.11	3.17	0.35	0.57

Tailwater Channel Data - CP A7.1

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 6.00 ft

Side Slope (H:V): 1.00 (_:1)

Channel Slope: 0.0050

Channel Manning's n: 0.0300

Channel Invert Elevation: 2599.25 ft

Roadway Data for Crossing: CP A7.1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 200.00 ft

Crest Elevation: 2603.50 ft

Roadway Surface: Paved

Roadway Top Width: 100.00 ft

Table 1 - Summary of Culvert Flows at Crossing: CP B3a

Headwater Elevation (ft)	Total Discharge (cfs)	2-30 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2625.44	55.00	55.00	0.00	1
2625.53	57.00	57.00	0.00	1
2625.62	59.00	59.00	0.00	1
2625.72	61.00	61.00	0.00	1
2625.81	63.00	63.00	0.00	1
2625.92	65.00	65.00	0.00	1
2626.02	67.00	67.00	0.00	1
2626.13	69.00	69.00	0.00	1
2626.24	71.00	71.00	0.00	1
2626.36	73.00	73.00	0.00	1
2626.38	73.30	73.30	0.00	1
2626.50	75.35	75.35	0.00	Overtopping

Rating Curve Plot for Crossing: CP B3a

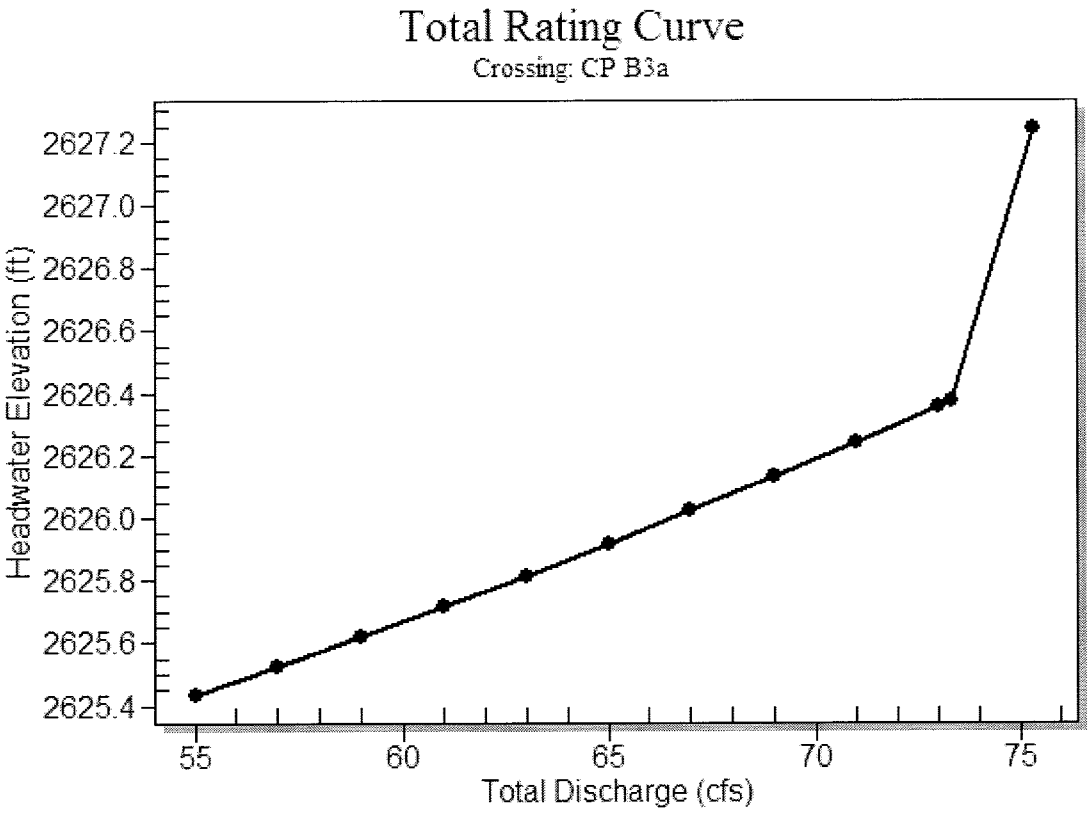


Table 2 - Culvert Summary Table: 2-30

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
55.00	55.00	2625.44	2.886	0.0*	5-S2n	0.927	1.786	1.012	1.038	14.254	8.506
57.00	57.00	2625.53	2.976	0.0*	5-S2n	0.945	1.818	1.032	1.052	14.405	8.583
59.00	59.00	2625.62	3.069	0.0*	5-S2n	0.963	1.849	1.050	1.066	14.575	8.657
61.00	61.00	2625.72	3.165	0.0*	5-S2n	0.981	1.880	1.074	1.079	14.624	8.729
63.00	63.00	2625.81	3.264	0.0*	5-S2n	0.998	1.910	1.097	1.092	14.692	8.800
65.00	65.00	2625.92	3.366	0.0*	5-S2n	1.016	1.938	1.118	1.105	14.788	8.869
67.00	67.00	2626.02	3.472	0.0*	5-S2n	1.033	1.967	1.138	1.118	14.897	8.936
69.00	69.00	2626.13	3.580	0.0*	5-S2n	1.050	1.994	1.157	1.130	15.007	9.002
71.00	71.00	2626.24	3.693	0.0*	5-S2n	1.067	2.020	1.176	1.142	15.123	9.067
73.00	73.00	2626.36	3.808	0.052	5-S2n	1.084	2.046	1.195	1.154	15.233	9.130
73.30	73.30	2626.38	3.826	0.070	5-S2n	1.086	2.049	1.199	1.156	15.243	9.139

* Full Flow Headwater elevation is below inlet invert.

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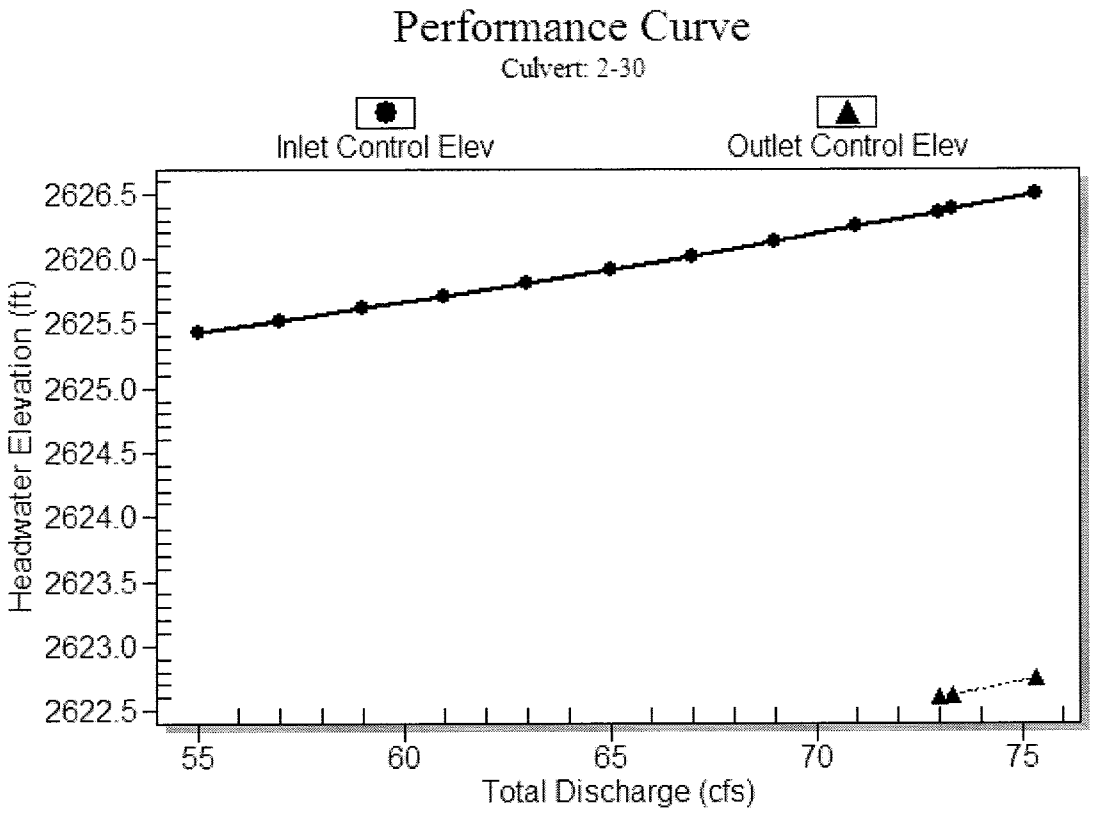
Straight Culvert

Inlet Elevation (invert): 2622.55 ft, Outlet Elevation (invert): 2618.34 ft

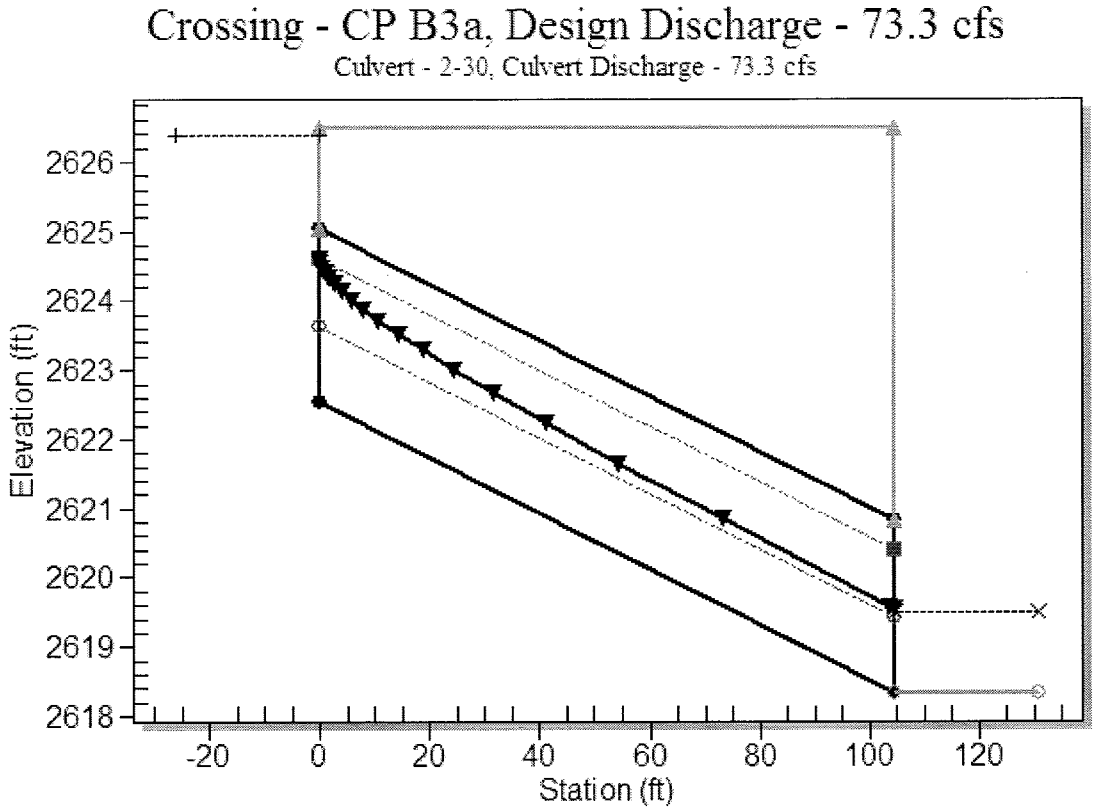
Culvert Length: 104.57 ft, Culvert Slope: 0.0403

****

Culvert Performance Curve Plot: 2-30



Water Surface Profile Plot for Culvert: 2-30



Site Data - 2-30

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 2622.55 ft

Outlet Station: 104.49 ft

Outlet Elevation: 2618.34 ft

Number of Barrels: 2

Culvert Data Summary - 2-30

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: CP B3a)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
55.00	2619.38	1.04	8.51	3.24	2.08
57.00	2619.39	1.05	8.58	3.28	2.09
59.00	2619.41	1.07	8.66	3.33	2.09
61.00	2619.42	1.08	8.73	3.37	2.09
63.00	2619.43	1.09	8.80	3.41	2.10
65.00	2619.45	1.11	8.87	3.45	2.10
67.00	2619.46	1.12	8.94	3.49	2.11
69.00	2619.47	1.13	9.00	3.53	2.11
71.00	2619.48	1.14	9.07	3.56	2.11
73.00	2619.49	1.15	9.13	3.60	2.12
73.30	2619.50	1.16	9.14	3.61	2.12

Tailwater Channel Data - CP B3a

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 6.00 (_:1)

Channel Slope: 0.0500

Channel Manning's n: 0.0250

Channel Invert Elevation: 2618.34 ft

Roadway Data for Crossing: CP B3a

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 150.00 ft

Crest Elevation: 2626.50 ft

Roadway Surface: Paved

Roadway Top Width: 104.49 ft

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP B6 **Q100=** 4.20
DATE: 4/24/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	4.00	0.50	60.00	0.10	N/A	0.10	0.08
0.10	4.00	0.50	60.00	0.29	N/A	0.29	0.22
0.15	4.00	0.50	60.00	0.53	N/A	0.53	0.40
0.20	4.00	0.50	60.00	0.82	N/A	0.82	0.62
0.25	4.00	0.50	60.00	1.15	1.96	1.15	0.86
0.30	4.00	0.50	60.00	1.51	3.09	1.51	1.13
0.35	4.00	0.50	60.00	1.90	3.91	1.90	1.43
0.40	4.00	0.50	60.00	2.33	4.58	2.33	1.75
0.45	4.00	0.50	60.00	2.78	5.17	2.78	2.08
0.50	4.00	0.50	60.00	3.25	5.70	3.25	2.44
0.55	4.00	0.50	60.00	3.75	6.18	3.75	2.81
0.60	4.00	0.50	60.00	4.28	6.63	4.28	3.21
0.65	4.00	0.50	60.00	4.82	7.04	4.82	3.62
0.70	4.00	0.50	60.00	5.39	7.44	5.39	4.04
0.75	4.00	0.50	60.00	6.02	7.84	6.02	4.52
0.80	**4.00**	**0.50**	**60.00**	**6.58**	**8.17**	**6.58**	**4.94**
0.83	4.00	0.50	60.00	7.01	8.41	7.01	5.26
0.85	4.00	0.50	60.00	7.21	8.52	7.21	5.41
0.90	4.00	0.50	60.00	7.86	8.85	7.86	5.89

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

Table 1 - Summary of Culvert Flows at Crossing: CP B3b

Headwater Elevation (ft)	Total Discharge (cfs)	3-36 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2625.50	121.00	121.00	0.00	1
2625.72	131.00	131.00	0.00	1
2625.99	142.40	142.40	0.00	1
2626.07	153.10	145.60	7.25	8
2626.11	163.80	147.39	16.01	5
2626.15	174.50	148.92	25.38	5
2626.18	185.20	150.25	34.61	4
2626.21	195.90	151.48	44.18	4
2626.24	206.60	152.61	53.83	4
2626.27	217.30	153.68	63.51	4
2626.30	228.00	154.68	72.94	3
2626.00	142.94	142.94	0.00	Overtopping

Rating Curve Plot for Crossing: CP B3b

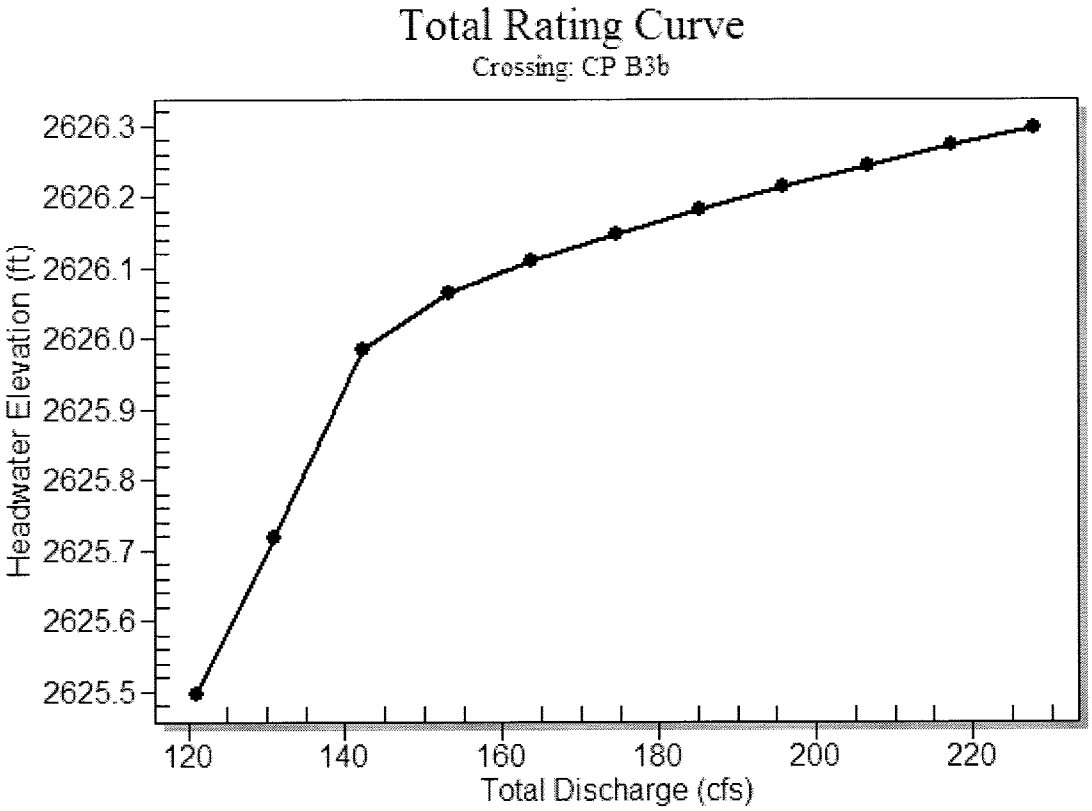


Table 2 - Culvert Summary Table: 3-36

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
121.00	121.00	2625.50	3.309	2.177	5-S2n	1.561	2.066	1.664	1.395	9.706	10.360
131.00	131.00	2625.72	3.528	2.442	5-S2n	1.639	2.150	1.748	1.437	9.903	10.567
142.40	142.40	2625.99	3.796	2.756	5-S2n	1.729	2.241	1.841	1.483	10.125	10.790
153.10	145.60	2626.07	3.875	3.214	5-S2n	1.754	2.265	1.868	1.524	10.172	10.987
163.80	147.39	2626.11	3.920	3.259	5-S2n	1.768	2.279	1.883	1.563	10.203	11.174
174.50	148.92	2626.15	3.959	3.297	5-S2n	1.780	2.290	1.896	1.601	10.229	11.353
185.20	150.25	2626.18	3.993	3.330	5-S2n	1.790	2.300	1.907	1.637	10.256	11.523
195.90	151.48	2626.21	4.024	3.362	5-S2n	1.800	2.309	1.917	1.672	10.278	11.686
206.60	152.61	2626.24	4.054	3.390	5-S2n	1.809	2.318	1.926	1.705	10.297	11.842
217.30	153.68	2626.27	4.082	3.418	5-S2n	1.818	2.325	1.935	1.738	10.315	11.993
228.00	154.68	2626.30	4.108	3.443	5-S2n	1.826	2.332	1.943	1.769	10.332	12.137

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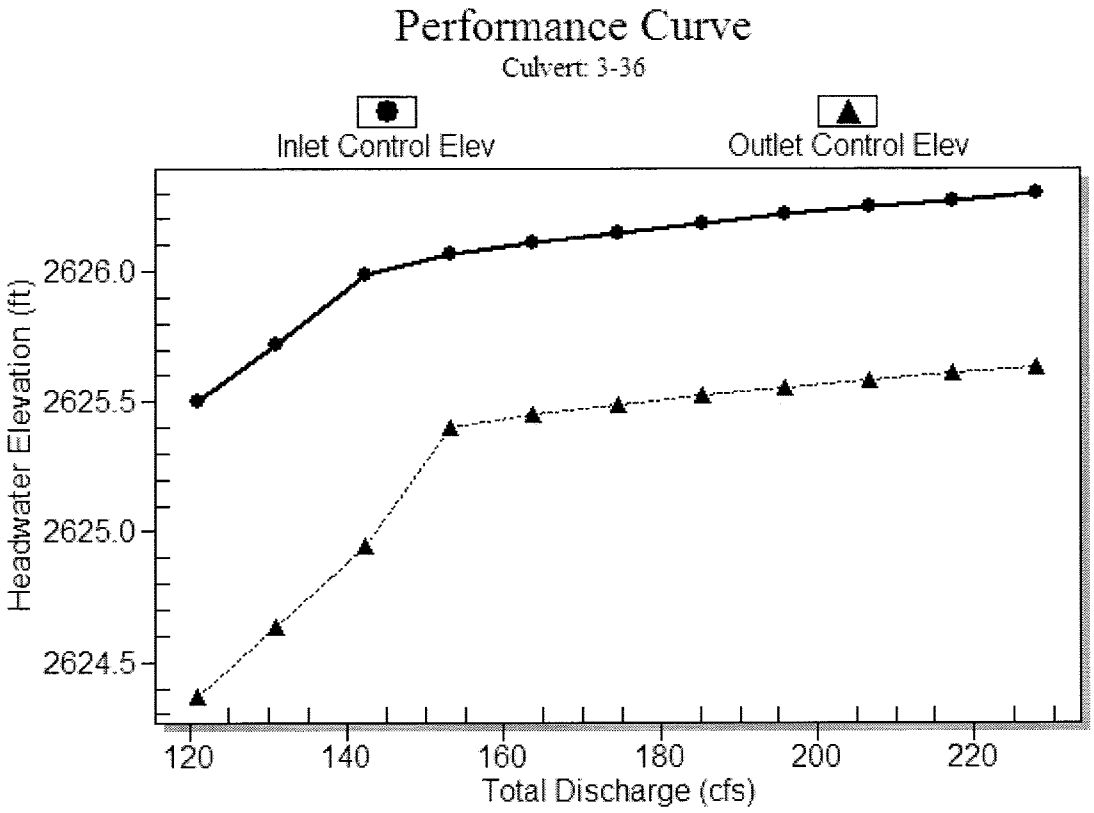
Straight Culvert

Inlet Elevation (invert): 2622.19 ft, Outlet Elevation (invert): 2621.25 ft

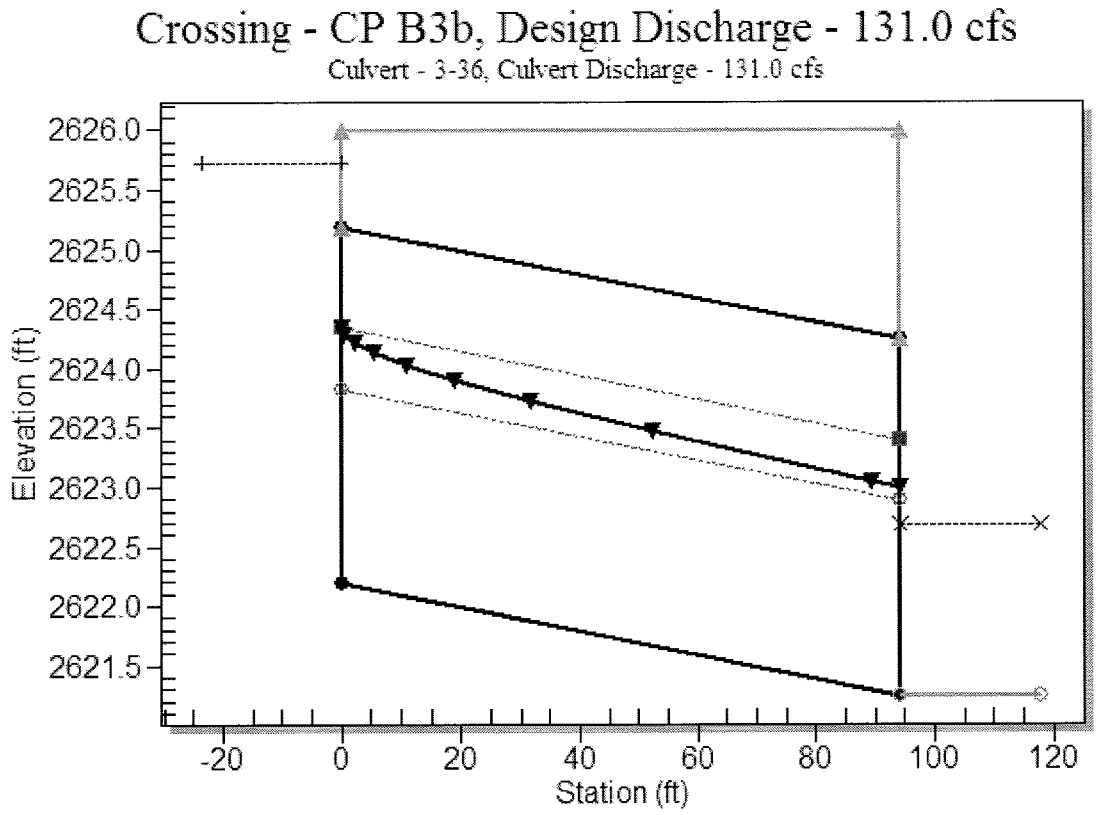
Culvert Length: 94.38 ft, Culvert Slope: 0.0100

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Culvert Performance Curve Plot: 3-36



Water Surface Profile Plot for Culvert: 3-36



Site Data - 3-36

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 2622.19 ft

Outlet Station: 94.38 ft

Outlet Elevation: 2621.25 ft

Number of Barrels: 3

Culvert Data Summary - 3-36

Barrel Shape: Circular

Barrel Diameter: 3.00 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: CP B3b)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
121.00	2622.65	1.40	10.36	4.35	2.19
131.00	2622.69	1.44	10.57	4.48	2.20
142.40	2622.73	1.48	10.79	4.63	2.21
153.10	2622.77	1.52	10.99	4.75	2.22
163.80	2622.81	1.56	11.17	4.88	2.23
174.50	2622.85	1.60	11.35	4.99	2.24
185.20	2622.89	1.64	11.52	5.11	2.24
195.90	2622.92	1.67	11.69	5.22	2.25
206.60	2622.96	1.71	11.84	5.32	2.26
217.30	2622.99	1.74	11.99	5.42	2.27
228.00	2623.02	1.77	12.14	5.52	2.27

Tailwater Channel Data - CP B3b

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 6.00 (_:1)

Channel Slope: 0.0500

Channel Manning's n: 0.0250

Channel Invert Elevation: 2621.25 ft

Roadway Data for Crossing: CP B3b

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 150.00 ft

Crest Elevation: 2626.00 ft

Roadway Surface: Paved

Roadway Top Width: 94.38 ft

Table 1 - Summary of Culvert Flows at Crossing: CP B7

Headwater Elevation (ft)	Total Discharge (cfs)	1-30" SRP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
2611.00	10.50	10.50	0.00	1
2611.22	12.95	12.95	0.00	1
2611.41	15.40	15.40	0.00	1
2611.60	17.85	17.85	0.00	1
2611.79	20.30	20.30	0.00	1
2611.98	22.75	22.75	0.00	1
2612.18	25.20	25.20	0.00	1
2612.39	27.65	27.65	0.00	1
2612.61	30.00	30.00	0.00	1
2612.86	32.55	32.55	0.00	1
2613.13	35.00	35.00	0.00	1
2614.00	41.98	41.98	0.00	Overtopping

Rating Curve Plot for Crossing: CP B7

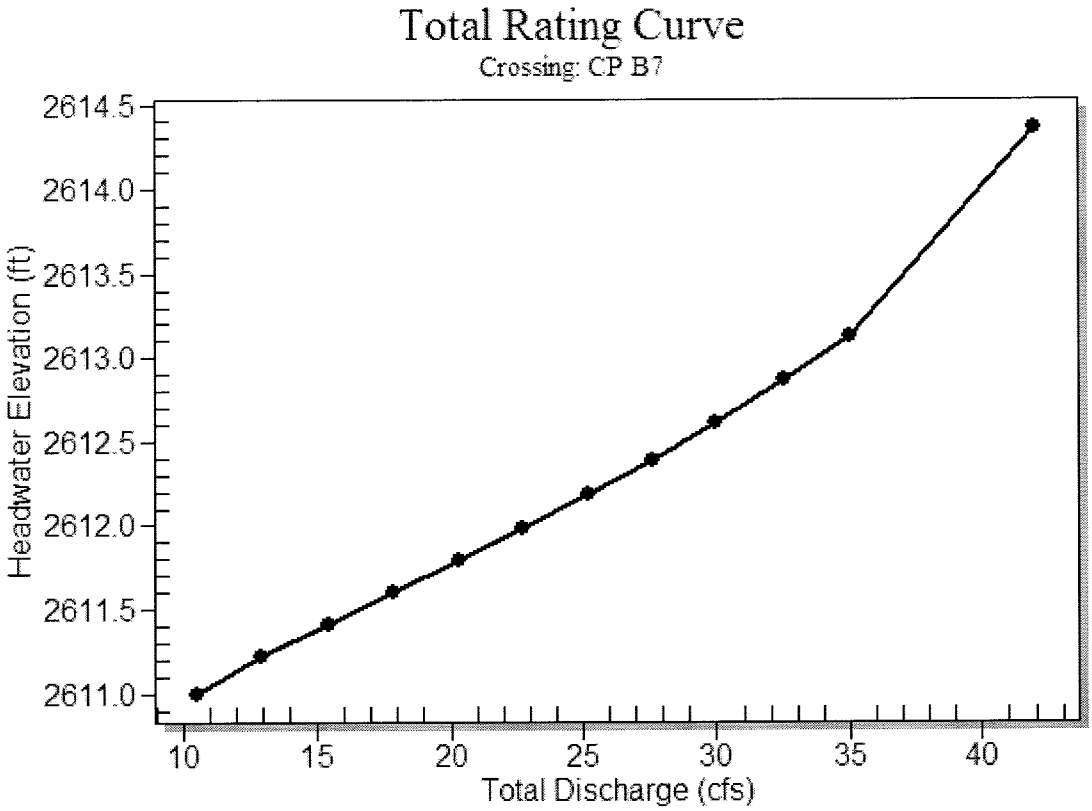


Table 2 - Culvert Summary Table: 1-30" SRP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10.50	10.50	2611.00	1.542	0.0*	1-S2n	0.725	1.082	0.757	0.859	8.075	2.371
12.95	12.95	2611.22	1.756	0.0*	1-S2n	0.809	1.210	0.847	0.929	8.535	2.499
15.40	15.40	2611.41	1.954	0.098	1-S2n	0.887	1.322	0.932	0.992	8.918	2.609
17.85	17.85	2611.60	2.143	0.325	1-S2n	0.960	1.428	1.020	1.048	9.156	2.707
20.30	20.30	2611.79	2.330	0.562	1-S2n	1.031	1.524	1.094	1.100	9.495	2.796
22.75	22.75	2611.98	2.521	0.816	5-S2n	1.099	1.620	1.167	1.148	9.788	2.877
25.20	25.20	2612.18	2.720	1.078	5-S2n	1.165	1.706	1.244	1.193	9.997	2.951
27.65	27.65	2612.39	2.931	1.358	5-S2n	1.230	1.791	1.314	1.235	10.235	3.020
30.00	30.00	2612.61	3.149	1.635	5-S2n	1.291	1.865	1.380	1.274	10.454	3.083
32.55	32.55	2612.86	3.403	2.229	5-S2n	1.358	1.940	1.452	1.313	10.668	3.146
35.00	35.00	2613.13	3.668	2.511	5-S2n	1.421	2.007	1.521	1.349	10.851	3.204

* Full Flow Headwater elevation is below inlet invert.

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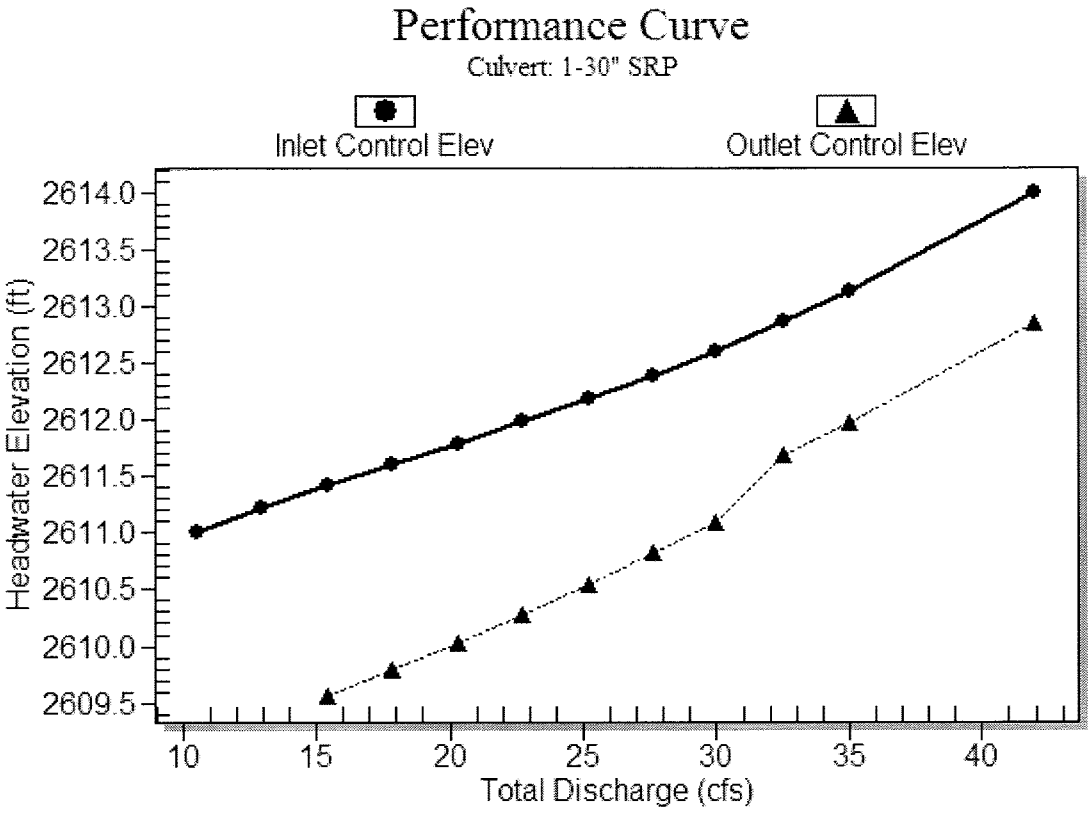
Straight Culvert

Inlet Elevation (invert): 2609.46 ft, Outlet Elevation (invert): 2607.88 ft

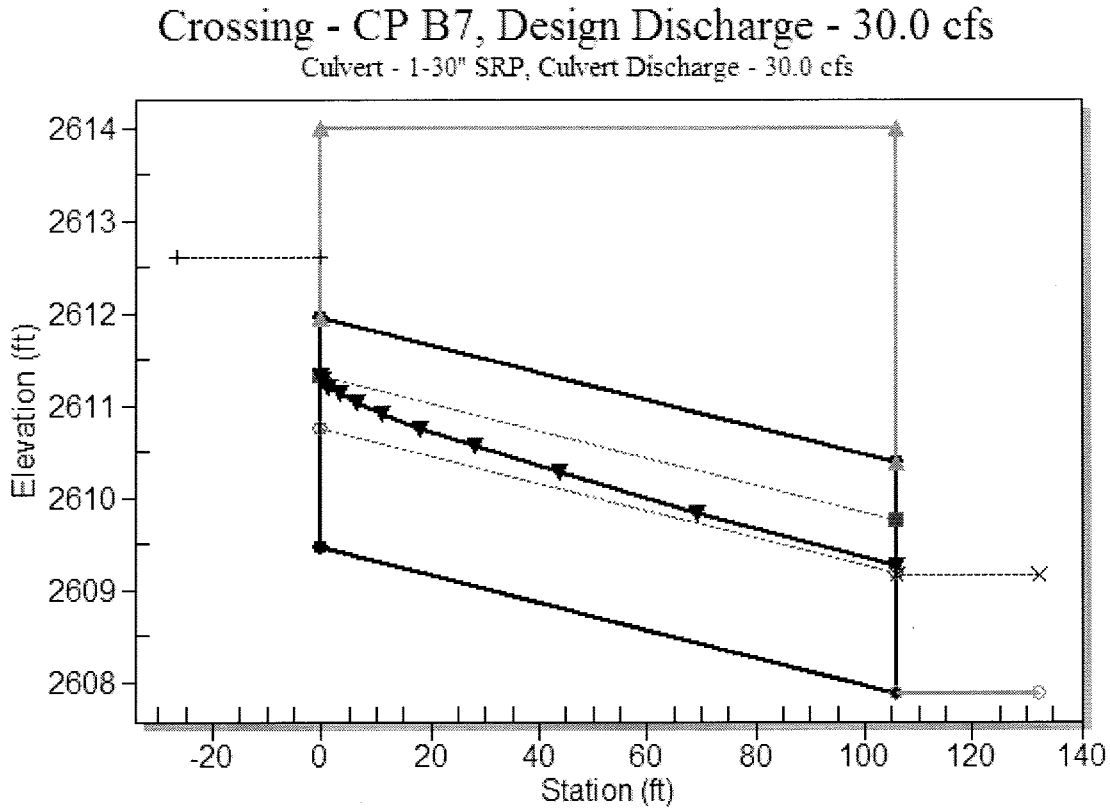
Culvert Length: 105.91 ft, Culvert Slope: 0.0149

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Culvert Performance Curve Plot: 1-30" SRP



Water Surface Profile Plot for Culvert: 1-30" SRP



Site Data - 1-30" SRP

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 2609.46 ft

Outlet Station: 105.90 ft

Outlet Elevation: 2607.88 ft

Number of Barrels: 1

Culvert Data Summary - 1-30" SRP

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material: Smooth HDPE

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: CP B7)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
10.50	2608.74	0.86	2.37	0.27	0.64
12.95	2608.81	0.93	2.50	0.29	0.65
15.40	2608.87	0.99	2.61	0.31	0.65
17.85	2608.93	1.05	2.71	0.33	0.66
20.30	2608.98	1.10	2.80	0.34	0.66
22.75	2609.03	1.15	2.88	0.36	0.67
25.20	2609.07	1.19	2.95	0.37	0.67
27.65	2609.12	1.24	3.02	0.39	0.68
30.00	2609.15	1.27	3.08	0.40	0.68
32.55	2609.19	1.31	3.15	0.41	0.68
35.00	2609.23	1.35	3.20	0.42	0.69

Tailwater Channel Data - CP B7

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 6.00 (_:1)

Channel Slope: 0.0050

Channel Manning's n: 0.0250

Channel Invert Elevation: 2607.88 ft

Roadway Data for Crossing: CP B7

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 200.00 ft

Crest Elevation: 2614.00 ft

Roadway Surface: Paved

Roadway Top Width: 105.90 ft

SIDEWALK SCUPPER WORKSHEETS

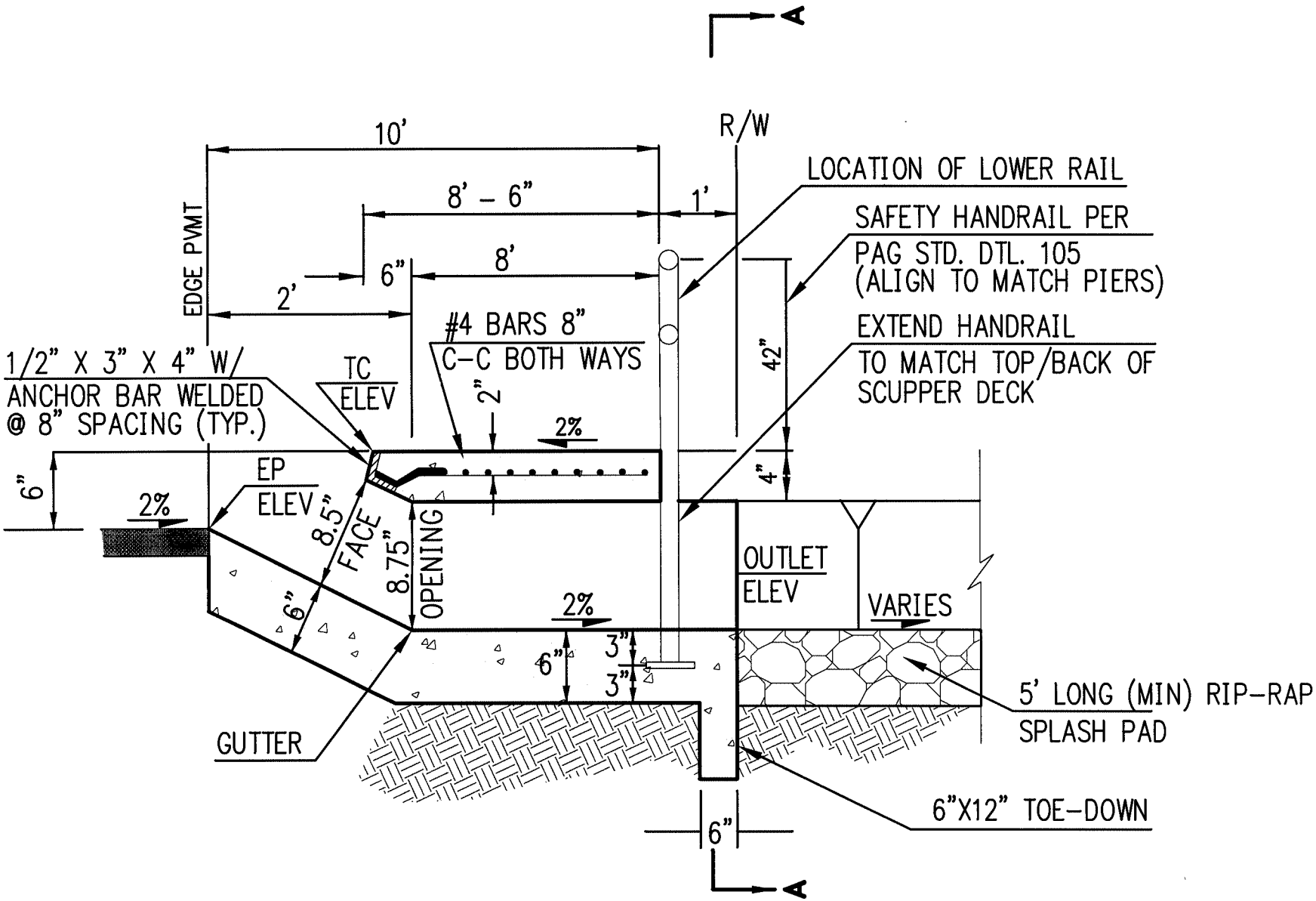
PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP 1.9a Q_{100} = 2.00
DATE: 4/20/2017

Calculation sheet for a Type 2 Sidewalk Scupper as per COT/PC Standard Detail 205 (1 Cell=2.5')

SCUPPER INLET

DEPTH (FT)	LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)			
				[1] WEIR EQ.	[2] ORIFICE EQ.	CONTROL	[3]DESIGN
0.05	2.50	0.50	60.0	0.08	N/A	0.08	0.07
0.10	2.50	0.50	60.0	0.24	N/A	0.24	0.19
0.15	2.50	0.50	60.0	0.44	N/A	0.44	0.35
0.20	2.50	0.50	60.0	0.67	N/A	0.67	0.54
0.25	2.50	0.50	60.0	0.94	1.22	0.94	0.75
0.30	2.50	0.50	60.0	1.23	1.93	1.23	0.99
0.35	2.50	0.50	60.0	1.55	2.44	1.55	1.24
0.38	2.50	0.50	60.0	1.75	2.70	1.75	1.40
0.40	2.50	0.50	60.0	1.90	2.86	1.90	1.52
0.45	2.50	0.50	60.0	2.26	3.23	2.26	1.81
0.49	**2.50**	**0.50**	**60.0**	**2.54**	**3.47**	**2.54**	**2.03**
0.50	2.50	0.50	60.0	2.65	3.56	2.65	2.12
0.55	2.50	0.50	60.0	3.06	3.86	3.06	2.45
0.60	2.50	0.50	60.0	3.49	4.14	3.49	2.79
0.65	2.50	0.50	60.0	3.93	4.40	3.93	3.14
0.70	2.50	0.50	60.0	4.39	4.65	4.39	3.51
0.75	2.50	0.50	60.0	4.87	4.88	4.87	3.90
0.80	2.50	0.50	60.0	5.37	5.11	5.11	4.09
0.85	2.50	0.50	60.0	5.88	5.32	5.32	4.26

1. Weir equation for curb inlet without depression: $Q=3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging


A
10'
R/W
8' – 6"
1'
LOCATION OF LOWER RAIL
SAFETY HANDRAIL PER
PAG STD. DTL. 105
(ALIGN TO MATCH PIERS)
EDGE PVMT
6"
8'
2'
#4 BARS 8"
C–C BOTH WAYS
EXTEND HANDRAIL
TO MATCH TOP/BACK OF
SCUPPER DECK
42"
1/2" X 3" X 4" W/
ANCHOR BAR WELDED
@ 8" SPACING (TYP.)
TC
ELEV
2"
2%
6"
EP
ELEV
2%
8.5"
FACE
8.75"
OPENING
4"
OUTLET
ELEV
VARIES
2%
6"
3"
3"
5' LONG (MIN) RIP–RAP
SPLASH PAD
GUTTER
6"X12" TOE–DOWN
6"
A

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A1.8 **Q100=** 11.50
DATE: 4/20/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	12.00	0.50	60.00	0.31	N/A	0.31	0.23
0.10	12.00	0.50	60.00	0.87	N/A	0.87	0.65
0.15	12.00	0.50	60.00	1.60	N/A	1.60	1.20
0.20	12.00	0.50	60.00	2.47	N/A	2.47	1.85
0.25	12.00	0.50	60.00	3.45	5.87	3.45	2.59
0.30	12.00	0.50	60.00	4.54	9.28	4.54	3.40
0.35	12.00	0.50	60.00	5.71	11.73	5.71	4.29
0.40	12.00	0.50	60.00	6.98	13.75	6.98	5.24
0.45	12.00	0.50	60.00	8.33	15.51	8.33	6.25
0.50	12.00	0.50	60.00	9.76	17.09	9.76	7.32
0.55	12.00	0.50	60.00	11.26	18.54	11.26	8.44
0.60	12.00	0.50	60.00	12.83	19.88	12.83	9.62
0.68	**12.00**	**0.50**	**60.00**	**15.31**	**21.74**	**15.31**	**11.48**
0.73	12.00	0.50	60.00	17.04	22.89	17.04	12.78
0.78	12.00	0.50	60.00	18.98	24.07	18.98	14.23
0.83	12.00	0.50	60.00	20.68	25.04	20.68	15.51
0.86	12.00	0.50	60.00	21.97	25.73	21.97	16.48
0.88	12.00	0.50	60.00	22.59	26.05	22.59	16.94
0.93	12.00	0.50	60.00	24.55	27.02	24.55	18.42

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A5 **Q100=** 13.00
DATE: 4/25/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	12.00	0.50	60.00	0.31	N/A	0.31	0.23
0.10	12.00	0.50	60.00	0.87	N/A	0.87	0.65
0.15	12.00	0.50	60.00	1.60	N/A	1.60	1.20
0.20	12.00	0.50	60.00	2.47	N/A	2.47	1.85
0.25	12.00	0.50	60.00	3.45	5.87	3.45	2.59
0.30	12.00	0.50	60.00	4.54	9.28	4.54	3.40
0.35	12.00	0.50	60.00	5.71	11.73	5.71	4.29
0.40	12.00	0.50	60.00	6.98	13.75	6.98	5.24
0.45	12.00	0.50	60.00	8.33	15.51	8.33	6.25
0.50	12.00	0.50	60.00	9.76	17.09	9.76	7.32
0.55	12.00	0.50	60.00	11.26	18.54	11.26	8.44
0.60	12.00	0.50	60.00	12.83	19.88	12.83	9.62
0.65	12.00	0.50	60.00	14.46	21.13	14.46	10.85
0.70	12.00	0.50	60.00	16.16	22.32	16.16	12.12
0.75	**12.00**	**0.50**	**60.00**	**18.07**	**23.53**	**18.07**	**13.55**
0.80	12.00	0.50	60.00	19.75	24.52	19.75	14.81
0.83	12.00	0.50	60.00	21.02	25.22	21.02	15.77
0.85	12.00	0.50	60.00	21.63	25.55	21.63	16.22
0.90	12.00	0.50	60.00	23.57	26.54	23.57	17.67

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A7.3 **Q100=** 6.50
DATE: 4/25/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	8.00	0.50	60.00	0.21	N/A	0.21	0.15
0.10	8.00	0.50	60.00	0.58	N/A	0.58	0.44
0.15	8.00	0.50	60.00	1.07	N/A	1.07	0.80
0.20	8.00	0.50	60.00	1.65	N/A	1.65	1.23
0.25	8.00	0.50	60.00	2.30	3.92	2.30	1.73
0.30	8.00	0.50	60.00	3.02	6.18	3.02	2.27
0.35	8.00	0.50	60.00	3.81	7.82	3.81	2.86
0.40	8.00	0.50	60.00	4.65	9.17	4.65	3.49
0.45	8.00	0.50	60.00	5.55	10.34	5.55	4.17
0.50	8.00	0.50	60.00	6.51	11.39	6.51	4.88
0.55	8.00	0.50	60.00	7.51	12.36	7.51	5.63
0.60	**8.00**	**0.50**	**60.00**	**8.64**	**13.32**	**8.64**	**6.48**
0.65	8.00	0.50	60.00	9.73	14.15	9.73	7.30
0.70	8.00	0.50	60.00	10.87	14.94	10.87	8.15
0.76	8.00	0.50	60.00	12.14	15.75	12.14	9.11
0.80	8.00	0.50	60.00	13.26	16.40	13.26	9.95
0.84	8.00	0.50	60.00	14.12	16.87	14.12	10.59
0.85	8.00	0.50	60.00	14.52	17.09	14.52	10.89
0.90	8.00	0.50	60.00	15.82	17.74	15.82	11.86

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP A9 **Q100=** 32.30
DATE: 4/25/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	32.00	0.50	60.00	0.82	N/A	0.82	0.62
0.10	32.00	0.50	60.00	2.33	N/A	2.33	1.75
0.15	32.00	0.50	60.00	4.28	N/A	4.28	3.21
0.20	32.00	0.50	60.00	6.58	N/A	6.58	4.94
0.25	32.00	0.50	60.00	9.20	15.67	9.20	6.90
0.30	32.00	0.50	60.00	12.09	24.73	12.09	9.07
0.35	32.00	0.50	60.00	15.24	31.28	15.24	11.43
0.40	32.00	0.50	60.00	18.62	36.67	18.62	13.96
0.45	32.00	0.50	60.00	22.22	41.36	22.22	16.66
0.50	32.00	0.50	60.00	26.02	45.58	26.02	19.52
0.55	32.00	0.50	60.00	30.02	49.43	30.02	22.52
0.60	32.00	0.50	60.00	34.21	53.01	34.21	25.65
0.65	32.00	0.50	60.00	38.57	56.36	38.57	28.93
0.70	**32.00**	**0.50**	**60.00**	**43.10**	**59.52**	**43.10**	**32.33**
0.75	32.00	0.50	60.00	48.19	62.76	48.19	36.14
0.80	32.00	0.50	60.00	52.66	65.39	52.66	39.50
0.83	32.00	0.50	60.00	56.06	67.27	56.06	42.04
0.85	32.00	0.50	60.00	57.68	68.13	57.68	43.26
0.90	32.00	0.50	60.00	62.84	70.77	62.84	47.13

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP B4 **Q100=** 6.00
DATE: 4/24/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	8.00	0.50	60.00	0.21	N/A	0.21	0.15
0.10	8.00	0.50	60.00	0.58	N/A	0.58	0.44
0.15	8.00	0.50	60.00	1.07	N/A	1.07	0.80
0.20	8.00	0.50	60.00	1.65	N/A	1.65	1.23
0.25	8.00	0.50	60.00	2.30	3.92	2.30	1.73
0.30	8.00	0.50	60.00	3.02	6.18	3.02	2.27
0.35	8.00	0.50	60.00	3.81	7.82	3.81	2.86
0.40	8.00	0.50	60.00	4.65	9.17	4.65	3.49
0.45	8.00	0.50	60.00	5.55	10.34	5.55	4.17
0.50	8.00	0.50	60.00	6.51	11.39	6.51	4.88
0.55	8.00	0.50	60.00	7.51	12.36	7.51	5.63
0.60	8.00	0.50	60.00	8.55	13.25	8.55	6.41
0.65	**8.00**	**0.50**	**60.00**	**9.64**	**14.09**	**9.64**	**7.23**
0.70	8.00	0.50	60.00	10.78	14.88	10.78	8.08
0.75	8.00	0.50	60.00	12.05	15.69	12.05	9.04
0.80	8.00	0.50	60.00	13.17	16.35	13.17	9.87
0.83	8.00	0.50	60.00	14.01	16.82	14.01	10.51
0.85	8.00	0.50	60.00	14.42	17.03	14.42	10.81
0.90	8.00	0.50	60.00	15.71	17.69	15.71	11.78

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP B5 **Q100=** 4.30
DATE: 4/24/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	4.00	0.50	60.00	0.10	N/A	0.10	0.08
0.10	4.00	0.50	60.00	0.29	N/A	0.29	0.22
0.15	4.00	0.50	60.00	0.53	N/A	0.53	0.40
0.20	4.00	0.50	60.00	0.82	N/A	0.82	0.62
0.25	4.00	0.50	60.00	1.15	1.96	1.15	0.86
0.30	4.00	0.50	60.00	1.51	3.09	1.51	1.13
0.35	4.00	0.50	60.00	1.90	3.91	1.90	1.43
0.40	4.00	0.50	60.00	2.33	4.58	2.33	1.75
0.45	4.00	0.50	60.00	2.78	5.17	2.78	2.08
0.50	4.00	0.50	60.00	3.25	5.70	3.25	2.44
0.55	4.00	0.50	60.00	3.75	6.18	3.75	2.81
0.60	4.00	0.50	60.00	4.28	6.63	4.28	3.21
0.65	4.00	0.50	60.00	4.82	7.04	4.82	3.62
0.70	4.00	0.50	60.00	5.39	7.44	5.39	4.04
0.75	4.00	0.50	60.00	6.02	7.84	6.02	4.52
0.80	**4.00**	**0.50**	**60.00**	**6.58**	**8.17**	**6.58**	**4.94**
0.83	4.00	0.50	60.00	7.01	8.41	7.01	5.26
0.85	4.00	0.50	60.00	7.21	8.52	7.21	5.41
0.90	4.00	0.50	60.00	7.86	8.85	7.86	5.89

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: CP B6 **Q100=** 4.20
DATE: 4/25/2017

Calculation sheet for a Type 3 Sidewalk Scupper as per PC/COT Standard Detail 205.5
MAX HW=0.833' (10-inches)

SCUPPER INLET

DEPTH (FT)	* LENGTH (FT)	OPENING (FT)	INCLINED TROAT ANGLE (ϕ)	DISCHARGE (CFS)		CONTROL (CFS)	[3]DESIGN (CFS)
				[1] WEIR EQ.	[2] ORIFICE EQ.		
0.05	4.00	0.50	60.00	0.10	N/A	0.10	0.08
0.10	4.00	0.50	60.00	0.29	N/A	0.29	0.22
0.15	4.00	0.50	60.00	0.53	N/A	0.53	0.40
0.20	4.00	0.50	60.00	0.82	N/A	0.82	0.62
0.25	4.00	0.50	60.00	1.15	1.96	1.15	0.86
0.30	4.00	0.50	60.00	1.51	3.09	1.51	1.13
0.35	4.00	0.50	60.00	1.90	3.91	1.90	1.43
0.40	4.00	0.50	60.00	2.33	4.58	2.33	1.75
0.45	4.00	0.50	60.00	2.78	5.17	2.78	2.08
0.50	4.00	0.50	60.00	3.25	5.70	3.25	2.44
0.55	4.00	0.50	60.00	3.75	6.18	3.75	2.81
0.60	4.00	0.50	60.00	4.28	6.63	4.28	3.21
0.65	4.00	0.50	60.00	4.82	7.04	4.82	3.62
0.70	4.00	0.50	60.00	5.39	7.44	5.39	4.04
0.75	4.00	0.50	60.00	6.02	7.84	6.02	4.52
0.80	**4.00**	**0.50**	**60.00**	**6.58**	**8.17**	**6.58**	**4.94**
0.83	4.00	0.50	60.00	7.01	8.41	7.01	5.26
0.85	4.00	0.50	60.00	7.21	8.52	7.21	5.41
0.90	4.00	0.50	60.00	7.86	8.85	7.86	5.89

1. Weir equation for curb inlet without depression: $Q=2.3LY^{3/2}$
2. Orifice equation for curb inlet, inclined throat, no depression: $Q=5.35A(Y-h/2\sin\phi)^{1/2}$
3. Design discharge equals Control discharge/1.25 to account for clogging

STREET RATING WORKSHEETS

Worksheet for Gutter - CP A6

Project Description

Solve For	Spread

Input Data

Channel Slope	0.00500	ft/ft
Discharge	7.20	ft^3/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	

Results

Spread	17.21	ft
Flow Area	2.96	ft^2
Depth	0.34	ft
Gutter Depression	0.00	ft
Velocity	2.43	ft/s

Cross Section for Gutter - CP A6

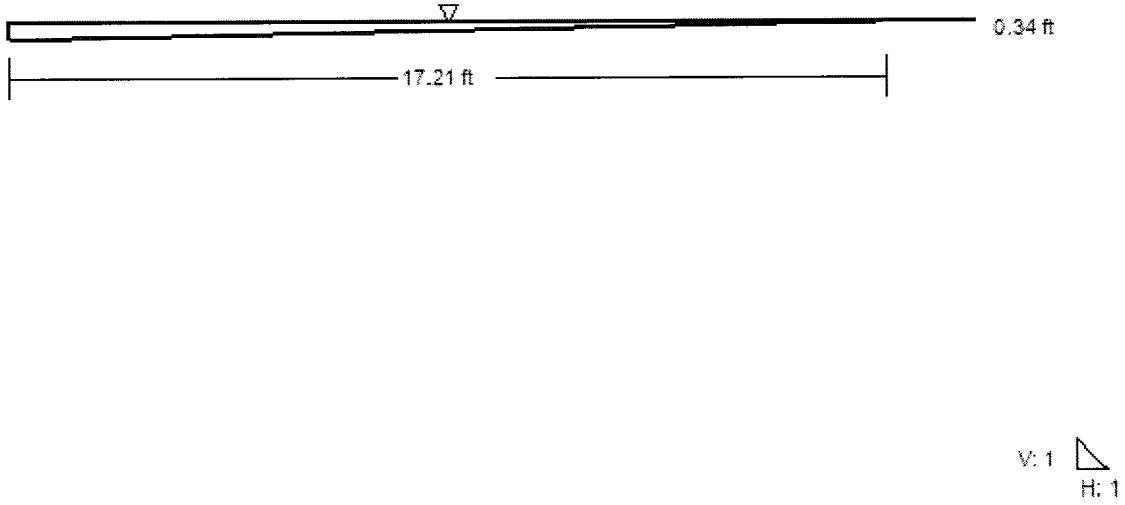
Project Description

Solve For	Spread

Input Data

Channel Slope	0.00500	ft/ft
Discharge	7.20	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Spread	17.21	ft
Roughness Coefficient	0.016	

Cross Section Image



Worksheet for Gutter - CP B4

Project Description

Solve For	Spread

Input Data

Channel Slope	0.07800	ft/ft
Discharge	6.00	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	

Results

Spread	9.60	ft
Flow Area	0.92	ft²
Depth	0.19	ft
Gutter Depression	0.00	ft
Velocity	6.51	ft/s

Cross Section for Gutter - CP B4

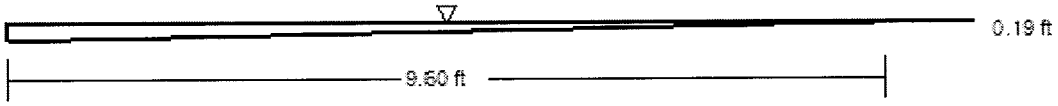
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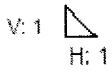
Solve For	Spread

Input Data

Channel Slope	0.07800	ft/ft
Discharge	6.00	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Spread	9.60	ft
Roughness Coefficient	0.016	

Cross Section Image





Worksheet for Gutter - CP B5

Project Description

Solve For	Spread

Input Data

Channel Slope	0.07800	ft/ft
Discharge	5.00	ft^3/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	

Results

Spread	8.97	ft
Flow Area	0.80	ft^2
Depth	0.18	ft
Gutter Depression	0.00	ft
Velocity	6.22	ft/s

Worksheet for Gutter - CP B5

Project Description

Solve For	Spread

Input Data

Channel Slope	0.07800	ft/ft
Discharge	4.30	ft^3/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	

Results

Spread	8.47	ft
Flow Area	0.72	ft^2
Depth	0.17	ft
Gutter Depression	0.00	ft
Velocity	5.99	ft/s

Cross Section for Gutter - CP B5

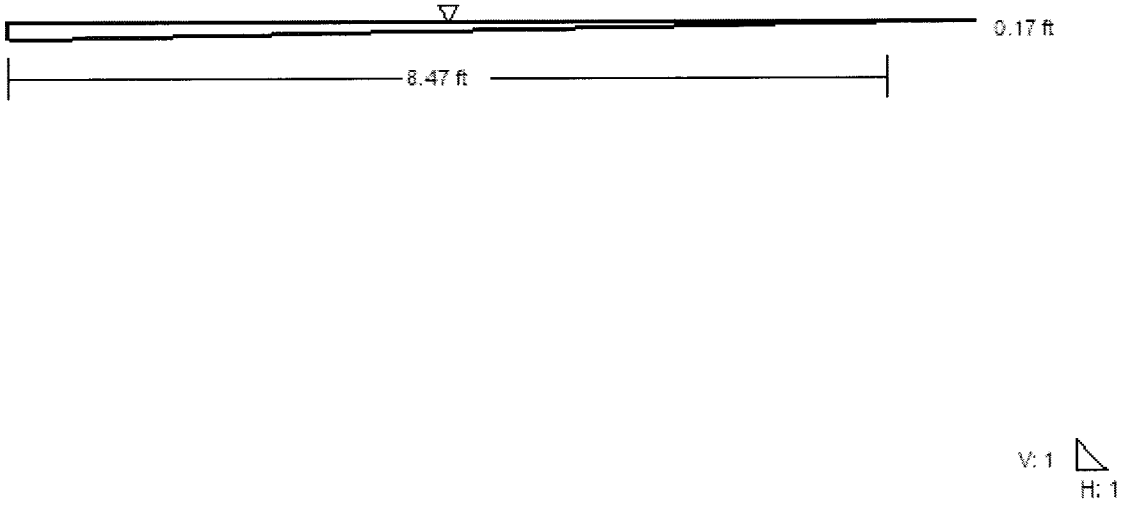
Project Description

Solve For	Spread

Input Data

Channel Slope	0.07800	ft/ft
Discharge	4.30	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Spread	8.47	ft
Roughness Coefficient	0.016	

Cross Section Image



Worksheet for Gutter - CP C3

Project Description

Solve For	Spread

Input Data

Channel Slope	0.02300	ft/ft
Discharge	9.60	ft^3/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	

Results

Spread	14.40	ft
Flow Area	2.07	ft^2
Depth	0.29	ft
Gutter Depression	0.00	ft
Velocity	4.63	ft/s

Cross Section for Gutter - CP C3

Project Description

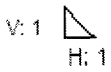
Solve For	Spread

Input Data

Channel Slope	0.02300	ft/ft
Discharge	9.60	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Spread	14.40	ft
Roughness Coefficient	0.016	

Cross Section Image





Worksheet for Gutter - CP C4

Project Description

Solve For	Spread

Input Data

Channel Slope	0.02300	ft/ft
Discharge	4.20	ft^3/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.016	

Results

Spread	10.56	ft
Flow Area	1.12	ft^2
Depth	0.21	ft
Gutter Depression	0.00	ft
Velocity	3.77	ft/s

Cross Section for Gutter - CP C4

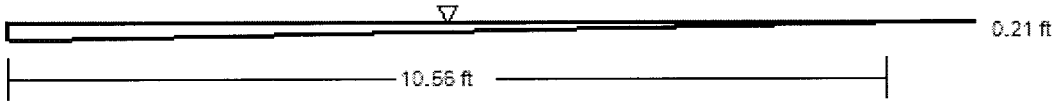
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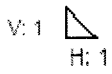
Solve For	Spread

Input Data

Channel Slope	0.02300	ft/ft
Discharge	4.20	ft³/s
Gutter Width	2.00	ft
Gutter Cross Slope	0.02	ft/ft
Road Cross Slope	0.02	ft/ft
Spread	10.56	ft
Roughness Coefficient	0.016	

Cross Section Image





PROPOSED CONSTRUCTED CHANNELS

Worksheet for XB (A7.1)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.00500	ft/ft
Left Side Slope	0.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	16.10	ft^3/s

Results

Normal Depth	1.32	ft
Flow Area	6.13	ft^2
Wetted Perimeter	7.18	ft
Hydraulic Radius	0.85	ft
Top Width	5.32	ft
Critical Depth	0.77	ft
Critical Slope	0.02788	ft/ft
Velocity	2.63	ft/s
Velocity Head	0.11	ft
Specific Energy	1.42	ft
Froude Number	0.43	
Flow Type	Subcritical	

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	1.32	ft
Critical Depth	0.77	ft
Channel Slope	0.00500	ft/ft

Worksheet for XB (A7.1)

GVF Output Data

Critical Slope	0.02788 ft/ft

Cross Section for XB (A7.1)

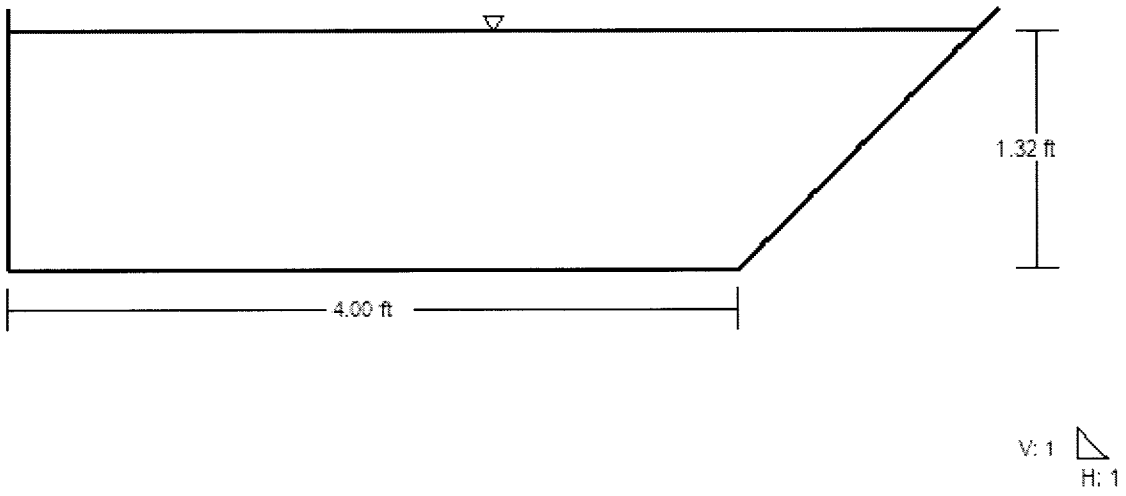
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.00500	ft/ft
Normal Depth	1.32	ft
Left Side Slope	0.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	16.10	ft³/s

Cross Section Image



Worksheet for XD (A7)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.03700	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	48.90	ft^3/s

Results

Normal Depth	1.02	ft
Flow Area	7.13	ft^2
Wetted Perimeter	8.87	ft
Hydraulic Radius	0.80	ft
Top Width	8.03	ft
Critical Depth	1.19	ft
Critical Slope	0.02176	ft/ft
Velocity	6.86	ft/s
Velocity Head	0.73	ft
Specific Energy	1.75	ft
Froude Number	1.28	
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	1.02	ft
Critical Depth	1.19	ft
Channel Slope	0.03700	ft/ft

Cross Section for XD (A7)

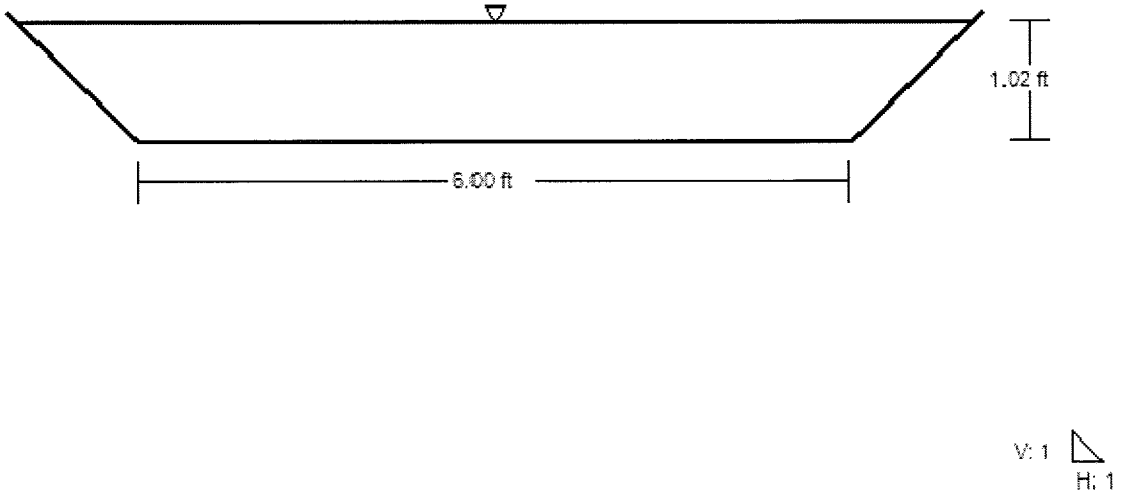
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.03700	ft/ft
Normal Depth	1.02	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	48.90	ft³/s

Cross Section Image



Worksheet for XE (A1.9)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.01000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	9.60	ft^3/s

Results

Normal Depth	0.72	ft
Flow Area	3.41	ft^2
Wetted Perimeter	6.04	ft
Hydraulic Radius	0.56	ft
Top Width	5.44	ft
Critical Depth	0.54	ft
Critical Slope	0.02697	ft/ft
Velocity	2.82	ft/s
Velocity Head	0.12	ft
Specific Energy	0.85	ft
Froude Number	0.63	
Flow Type	Subcritical	

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	0.72	ft
Critical Depth	0.54	ft
Channel Slope	0.01000	ft/ft

Cross Section for XE (A1.9)

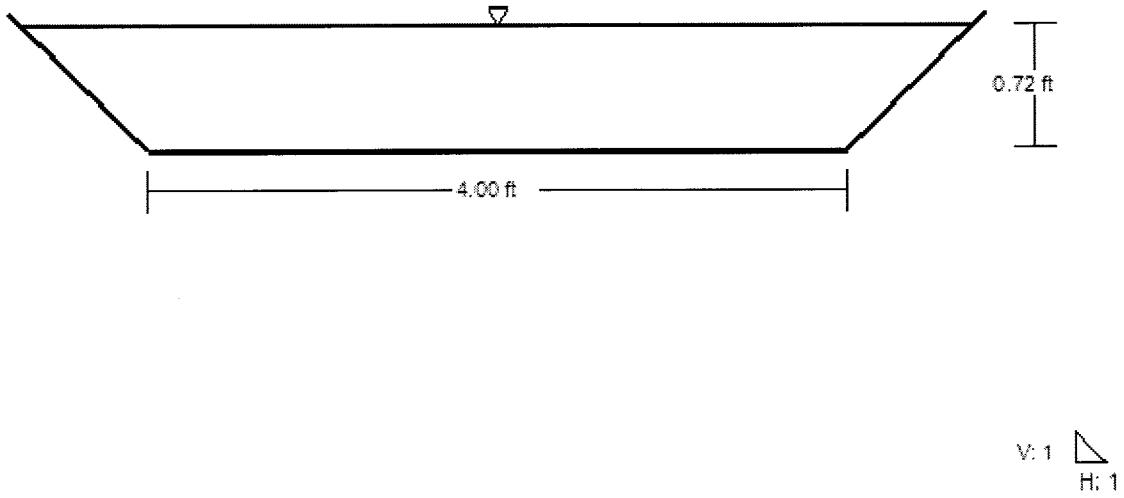
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.01000	ft/ft
Normal Depth	0.72	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	9.60	ft³/s

Cross Section Image



Worksheet for XF (A1.7)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.01000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	0.00	ft
Discharge	14.50	ft^3/s

Results

Normal Depth	1.21	ft
Flow Area	5.14	ft^2
Wetted Perimeter	9.08	ft
Hydraulic Radius	0.57	ft
Top Width	8.48	ft
Critical Depth	1.01	ft
Critical Slope	0.02596	ft/ft
Velocity	2.82	ft/s
Velocity Head	0.12	ft
Specific Energy	1.34	ft
Froude Number	0.64	
Flow Type	Subcritical	

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	1.21	ft
Critical Depth	1.01	ft
Channel Slope	0.01000	ft/ft

Cross Section for XF (A1.7)

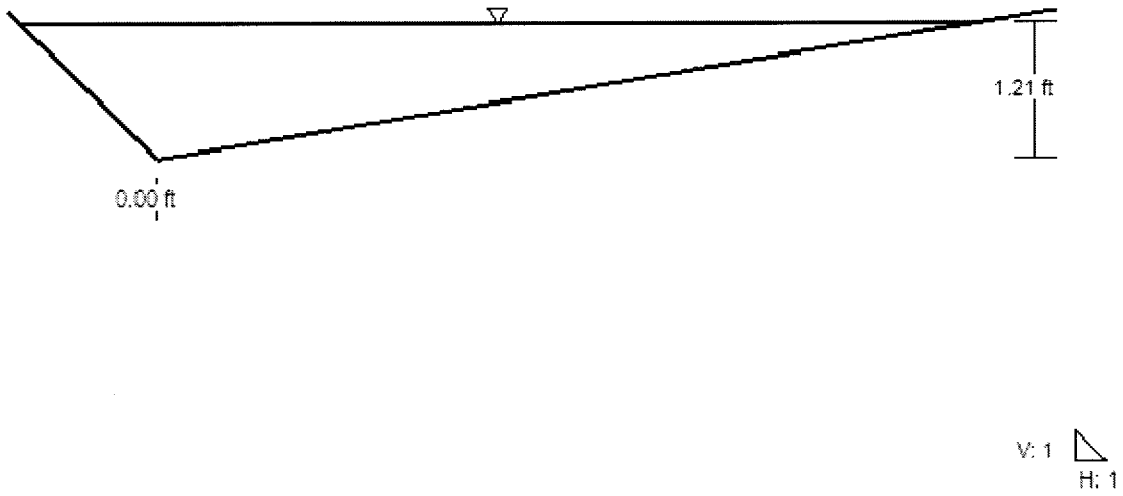
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.01000	ft/ft
Normal Depth	1.21	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	0.00	ft
Discharge	14.50	ft³/s

Cross Section Image



Worksheet for XG (A1.7)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.01000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	4.50	ft^3/s

Results

Normal Depth	0.26	ft
Flow Area	1.75	ft^2
Wetted Perimeter	7.46	ft
Hydraulic Radius	0.23	ft
Top Width	7.31	ft
Critical Depth	0.25	ft
Critical Slope	0.01182	ft/ft
Velocity	2.57	ft/s
Velocity Head	0.10	ft
Specific Energy	0.37	ft
Froude Number	0.93	
Flow Type	Subcritical	

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	0.26	ft
Critical Depth	0.25	ft
Channel Slope	0.01000	ft/ft

Cross Section for XG (A1.7)

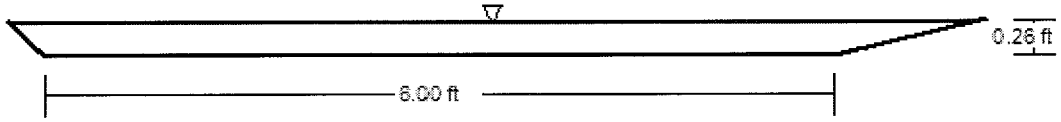
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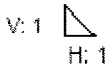
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.01000	ft/ft
Normal Depth	0.26	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	4.50	ft³/s

Cross Section Image





Worksheet for XH (A1.7)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.01000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	8.70	ft^3/s

Results

Normal Depth	0.39	ft
Flow Area	2.69	ft^2
Wetted Perimeter	8.14	ft
Hydraulic Radius	0.33	ft
Top Width	7.93	ft
Critical Depth	0.38	ft
Critical Slope	0.01051	ft/ft
Velocity	3.23	ft/s
Velocity Head	0.16	ft
Specific Energy	0.55	ft
Froude Number	0.98	
Flow Type	Subcritical	

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	0.39	ft
Critical Depth	0.38	ft
Channel Slope	0.01000	ft/ft

Cross Section for XH (A1.7)

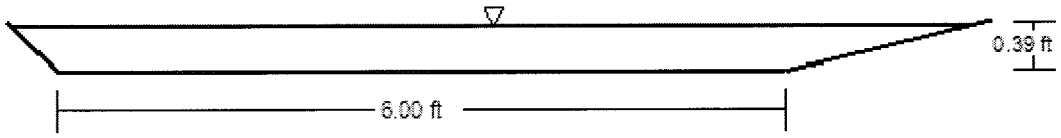
Project Description

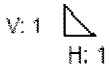
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.01000	ft/ft
Normal Depth	0.39	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	8.70	ft³/s

Cross Section Image





Worksheet for XI (A1.6)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.01000	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	7.30	ft^3/s

Results

Normal Depth	0.33	ft
Flow Area	2.61	ft^2
Wetted Perimeter	9.82	ft
Hydraulic Radius	0.27	ft
Top Width	9.67	ft
Critical Depth	0.32	ft
Critical Slope	0.01124	ft/ft
Velocity	2.79	ft/s
Velocity Head	0.12	ft
Specific Energy	0.45	ft
Froude Number	0.95	
Flow Type	Subcritical	

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	0.33	ft
Critical Depth	0.32	ft
Channel Slope	0.01000	ft/ft

Cross Section for XI (A1.6)

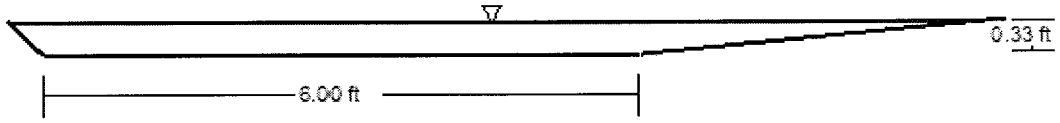
Project Description

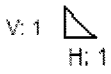
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.022	
Channel Slope	0.01000	ft/ft
Normal Depth	0.33	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	10.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	7.30	ft^3/s

Cross Section Image





Worksheet for XJ (C5)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.02500	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	6.00	ft^3/s

Results

Normal Depth	0.42	ft
Flow Area	1.84	ft^2
Wetted Perimeter	5.18	ft
Hydraulic Radius	0.35	ft
Top Width	4.83	ft
Critical Depth	0.40	ft
Critical Slope	0.02887	ft/ft
Velocity	3.27	ft/s
Velocity Head	0.17	ft
Specific Energy	0.58	ft
Froude Number	0.93	
Flow Type	Subcritical	

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	0.42	ft
Critical Depth	0.40	ft
Channel Slope	0.02500	ft/ft

Cross Section for XJ (C5)

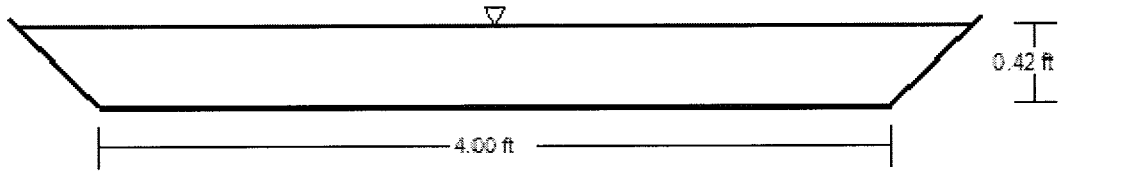
Project Description

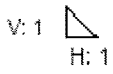
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.02500	ft/ft
Normal Depth	0.42	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	1.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	6.00	ft³/s

Cross Section Image





Worksheet for XK (C5)

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.00500	ft/ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	0.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	6.00	ft^3/s

Results

Normal Depth	0.71	ft
Flow Area	3.09	ft^2
Wetted Perimeter	5.71	ft
Hydraulic Radius	0.54	ft
Top Width	4.71	ft
Critical Depth	0.40	ft
Critical Slope	0.03052	ft/ft
Velocity	1.94	ft/s
Velocity Head	0.06	ft
Specific Energy	0.77	ft
Froude Number	0.42	
Flow Type	Subcritical	

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	0.71	ft
Critical Depth	0.40	ft
Channel Slope	0.00500	ft/ft

Cross Section for XK (C5)

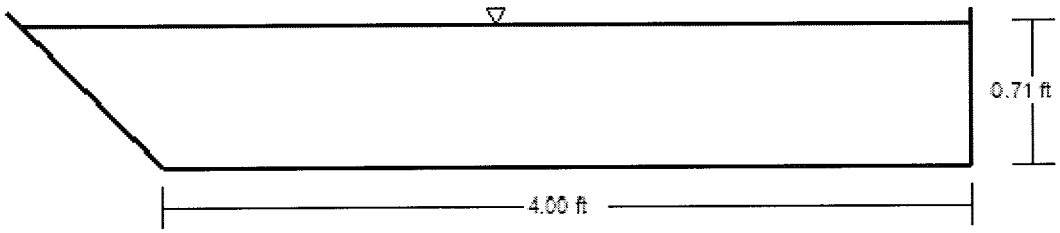
Project Description

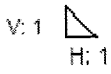
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.036	
Channel Slope	0.00500	ft/ft
Normal Depth	0.71	ft
Left Side Slope	1.00	ft/ft (H:V)
Right Side Slope	0.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	6.00	ft^3/s

Cross Section Image





TOTAL SCOUR CALCULATION WORKSHEETS

SCOUR CALCS

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: Total Scour Calculations - Wash A West (Post Developed)
DATE: 3/16/2017

Total Scour = (1) Design Scour Depth, Z_t + (2) Long Term Degradation, LTD

(1) Equation 6.3: Design Scour Depth Equation (excluding long-term aggradation/degradation)

$$Z_t = 1.3(Z_{gs} + 0.5\,Z_a + Z_{ls} + Z_{bs} + Z_{lft})$$

Where:

Z_t = Design scour depth, feet
Z_{gs} = General scour depth, feet (Equation 6.4)
Z_a = Anti-dune trough depth, feet (Equation 6.5)
Z_{ls} = Local scour depth, feet
Z_{bs} = Bend scour depth, feet (Equation 6.6)
Z_{lft} = Low-flow thalweg depth, feet
1.3 = Factor of safety to account for nonuniform flow distribution

Equation 6.4: General Scour Depth

$$Z_{gs} = Y_{max}\,[((0.0685V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))-1]$$

Where:

Z_{gs} = General scour depth, feet
V_m = Average velocity of flow, feet/s
Y_{max} = Maximum depth of flow, feet
Y_h = Hydraulic depth of flow, feet
S_e = Energy slope (or bed slope for uniform-flow condition), feet/feet
Note: Should Z_{gs} become negative, assume that the general-scour component is equal to zero (i.e., Z_{gs}=0)

Equation 6.5: Anti-Dune Trough Depth

$$Z_a = 0.0137V_m^2$$

Where:

Z_a = Anti-dune trough depth, feet

V_m = Average velocity of flow, feet/s

Equation 6.6: Bend Scour Equation

$$Z_{bs} = ((0.0685Y_{max}V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))[2.1((\sin^2(\alpha/2))/\cos\alpha)^{0.2} - 1]$$

Where:

Z_{bs} = Bend scour depth, feet

Y_h = Hydraulic depth of flow immediately upstream of bend, feet

V_{mb} = Average velocity of flow immediately upstream of bend, feet/s

Y_{max} = Maximum depth of flow immediately upstream of bend, feet

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

Equation 6.9: Local Scour Depth

$$Z_{ls} = 2.2Y\,(b_p/Y)^{0.65}\,F_u^{0.43}$$

Where:

Z_{ls} = Local scour depth, feet

Y = Flow depth, feet

b_p = Pier width normal to the flow direction, ft

F_u = Upstream Froude Number

Z_{lft}

Presently, there is no known methodology for predicting low-flow thalweg depth. In the Tucson area, if a low-flow thalweg is predicted to be present, it should be assumed to be at least two feet deep within regional watercourses, and at least one foot deep within all other watercourses, unless field observations dictate otherwise.

Cross Section	V_m, ft/s	Y_{max}, ft	Area, ft^2	Top Width, ft	Obstruction Width, ft (b_p)	S_e, ft/ft	α	Froude #	$\alpha/2$	$\sin^2(\alpha/2)$	$\cos\alpha$	Y_h, ft
26	4.57	0.64	160.57	255.88	0.0	0.0332	0.00	1.01	0	0.000	1.000	0.63
25	2.27	1.25	321.35	260.53	0.0	0.0045	0.00	0.36	0	0.000	1.000	1.23
24	1.27	2.14	575.38	272.36	0.0	0.0008	0.00	0.15	0	0.000	1.000	2.11
23	0.77	3.71	972.96	318.02	0.0	0.0001	0.00	0.07	0	0.000	1.000	3.06
22	3.95	0.90	184.46	205.26	0.0	0.0205	0.00	0.73	0	0.000	1.000	0.90
21	4.91	0.72	148.22	205.02	0.0	0.0246	0.00	1.02	0	0.000	1.000	0.72
20	4.44	0.98	164.26	168.77	0.0	0.0135	0.00	0.79	0	0.000	1.000	0.97
19	5.75	1.02	126.90	124.45	0.0	0.0234	0.00	1.00	0	0.000	1.000	1.02
18	5.13	1.41	142.31	101.92	0.0	0.0076	0.00	0.76	0	0.000	1.000	1.40
17	6.84	1.43	107.14	76.41	0.0	0.0180	0.00	1.01	0	0.000	1.000	1.40
16	5.93	1.54	123.80	81.93	0.0	0.0132	0.00	0.84	0	0.000	1.000	1.51
15	5.62	1.61	131.16	84.07	0.0	0.0125	0.00	0.78	0	0.000	1.000	1.56
14	6.34	1.24	115.86	94.81	0.0	0.0217	0.00	1.00	0	0.000	1.000	1.22
13	6.00	1.11	122.07	111.03	0.0	0.0209	0.00	1.00	0	0.000	1.000	1.10
12	4.12	1.42	177.82	126.24	0.0	0.0074	0.00	0.61	0	0.000	1.000	1.41
11	4.37	1.84	168.56	93.77	0.0	0.0078	0.00	0.57	0	0.000	1.000	1.80
10	7.04	1.53	104.48	69.58	0.0	0.0303	0.00	1.00	0	0.000	1.000	1.50
9	6.40	1.52	114.91	93.25	0.0	0.0194	0.00	0.91	0	0.000	1.000	1.23
8	5.92	1.07	123.56	116.64	0.0	0.0254	0.00	1.01	0	0.000	1.000	1.06
7	3.68	1.88	200.42	112.39	0.0	0.0039	0.00	0.47	0	0.000	1.000	1.78
6	3.11	2.50	239.24	105.97	0.0	0.0021	0.00	0.35	0	0.000	1.000	2.26
5	5.21	2.14	142.28	69.27	0.0	0.0060	0.00	0.63	0	0.000	1.000	2.05
4	5.22	2.21	141.92	66.47	0.0	0.0066	0.00	0.62	0	0.000	1.000	2.14
3	6.78	1.85	108.27	59.05	0.0	0.0082	0.00	0.88	0	0.000	1.000	1.83
2	7.42	1.69	98.76	58.94	0.0	0.0111	0.00	1.01	0	0.000	1.000	1.68
1	3.55	3.01	234.83	115.91	0.0	0.0017	0.00	0.36	0	0.000	1.000	2.03

Cross Section	Z_{gs}, ft	Z_a, ft	Z_{bs}, ft [1]	Z_{ls}, ft [2]	Z_{lft}, ft	Z_t, ft
26	-0.15	0.29	0.00	0.00	1.0	1.48
25	-0.48	0.07	0.00	0.00	1.0	0.76
24	-1.03	0.02	0.00	0.00	1.0	-0.01
23	-1.52	0.01	0.00	0.00	1.0	-0.66
22	-0.28	0.21	0.00	0.00	1.0	1.21
21	-0.11	0.33	0.00	0.00	1.0	1.59
20	-0.17	0.27	0.00	0.00	1.0	1.43
19	-0.15	0.45	0.00	0.00	1.0	1.69
18	-0.06	0.36	0.00	0.00	1.0	1.69
17	-0.10	0.64	0.00	0.00	1.0	2.00
16	-0.18	0.48	0.00	0.00	1.0	1.69
15	-0.24	0.43	0.00	0.00	1.0	1.55
14	-0.16	0.55	0.00	0.00	1.0	1.81
13	-0.13	0.49	0.00	0.00	1.0	1.77
12	-0.27	0.23	0.00	0.00	1.0	1.25
11	-0.45	0.26	0.00	0.00	1.0	1.06
10	-0.32	0.68	0.00	0.00	1.0	1.77
9	-0.14	0.56	0.00	0.00	1.0	1.85
8	-0.18	0.48	0.00	0.00	1.0	1.70
7	-0.35	0.19	0.00	0.00	1.0	1.09
6	-0.55	0.13	0.00	0.00	1.0	0.75
5	-0.23	0.37	0.00	0.00	1.0	1.49
4	-0.32	0.37	0.00	0.00	1.0	1.36
3	0.09	0.63	0.00	0.00	1.0	2.24
2	0.11	0.75	0.00	0.00	1.0	2.43
1	-0.11	0.17	0.00	0.00	1.0	1.38

(2) ADWR equation for LTD (Uncontrolled Drainageway)

(2) $LTD = Q_{100}^{0.6} * .02$

Location	Q_{100}, cfs	LTD, ft	
Wash A West	728	1.04	Note: Applies to Cross Sections 26 thru 23

(2) Equilibrium Slope Analysis equation for LTD

(2) $Z_{LTD} = L (S_0 - S_{eq})$

Where:

Z_{LTD} = the long-term scour, in feet

L =the distance upstream of the pivot point in feet

S_0 = the channel bed existing slope; feet/feet

S_{eq} = the channel bed equilibrium slope, feet/feet

Location	L, ft	S_0, ft/ft	S_{eq}, ft/ft	LTD, ft	
Wash A West	922	0.0163	0.01325	2.78	Note: Applies to Cross Sections 22 thru 1

Total Potential Scour Depth = Design Scour Depth, Z_t + Long Term Degradation, LTD

Location	Z_t, ft	LTD, ft	Total Potential Scour, ft
26	1.48	1.04	2.53
25	0.76	1.04	1.80
24	-0.01	1.04	1.03
23	-0.66	1.04	0.38
22	1.21	2.78	4.00
21	1.59	2.78	4.37
20	1.43	2.78	4.22
19	1.69	2.78	4.47
18	1.69	2.78	4.47
17	2.00	2.78	4.79
16	1.69	2.78	4.48
15	1.55	2.78	4.33
14	1.81	2.78	4.60
13	1.77	2.78	4.56
12	1.25	2.78	4.03
11	1.06	2.78	3.84
10	1.77	2.78	4.55
9	1.85	2.78	4.63
8	1.70	2.78	4.48
7	1.09	2.78	3.88
6	0.75	2.78	3.54
5	1.49	2.78	4.27
4	1.36	2.78	4.15
3	2.24	2.78	5.02
2	2.43	2.78	5.21
1	1.38	2.78	4.17

SCOUR CALCS

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: Total Scour Calculations - Wash A East (Post Developed)
DATE: 3/16/2017

Total Scour = (1) Design Scour Depth, Z_t + (2) Long Term Degradation, LTD

(1) Equation 6.3: Design Scour Depth Equation (excluding long-term aggradation/degradation)

$$Z_t = 1.3(Z_{gs} + 0.5\,Z_a + Z_{ls} + Z_{bs} + Z_{lft})$$

Where:

Z_t = Design scour depth, feet
Z_{gs} = General scour depth, feet (Equation 6.4)
Z_a = Anti-dune trough depth, feet (Equation 6.5)
Z_{ls} = Local scour depth, feet
Z_{bs} = Bend scour depth, feet (Equation 6.6)
Z_{lft} = Low-flow thalweg depth, feet
1.3 = Factor of safety to account for nonuniform flow distribution

Equation 6.4: General Scour Depth

$$Z_{gs} = Y_{max}\,[((0.0685V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))-1]$$

Where:

Z_{gs} = General scour depth, feet
V_m = Average velocity of flow, feet/s
Y_{max} = Maximum depth of flow, feet
Y_h = Hydraulic depth of flow, feet
S_e = Energy slope (or bed slope for uniform-flow condition), feet/feet
Note: Should Z_{gs} become negative, assume that the general-scour component is equal to zero (i.e., Z_{gs}=0)

Equation 6.5: Anti-Dune Trough Depth

$$Z_a = 0.0137V_m^2$$

Where:

Z_a = Anti-dune trough depth, feet

V_m = Average velocity of flow, feet/s

Equation 6.6: Bend Scour Equation

$$Z_{bs} = ((0.0685Y_{max}V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))[2.1((\sin^2(\alpha/2))/\cos\alpha)^{0.2} - 1]$$

Where:

Z_{bs} = Bend scour depth, feet

Y_h = Hydraulic depth of flow immediately upstream of bend, feet

V_{mb} = Average velocity of flow immediately upstream of bend, feet/s

Y_{max} = Maximum depth of flow immediately upstream of bend, feet

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

Equation 6.9: Local Scour Depth

$$Z_{ls} = 2.2Y\,(b_p/Y)^{0.65}\,F_u^{0.43}$$

Where:

Z_{ls} = Local scour depth, feet

Y = Flow depth, feet

b_p = Pier width normal to the flow direction, ft

F_u = Upstream Froude Number

Z_{lft}

Presently, there is no known methodology for predicting low-flow thalweg depth. In the Tucson area, if a low-flow thalweg is predicted to be present, it should be assumed to be at least two feet deep within regional watercourses, and at least one foot deep within all other watercourses, unless field observations dictate otherwise.

Cross Section	V_m, ft/s	Y_{max}, ft	Area, ft^2	Top Width, ft	Obstruction Width, ft (b_p)	S_e, ft/ft	α	Froude #	$\alpha/2$	$\sin^2(\alpha/2)$	$\cos\alpha$	Y_h, ft
17	5.32	0.85	137.58	162.68	0.0	0.0164	0.00	1.02	0	0.000	1.000	0.85
16	5.26	0.85	139.33	165.38	0.0	0.0208	0.00	1.01	0	0.000	1.000	0.84
15	5.41	0.92	136.58	155.55	0.0	0.0204	0.00	0.99	0	0.000	1.000	0.88
14	5.06	0.99	144.74	148.01	0.0	0.0174	0.00	0.90	0	0.000	1.000	0.98
13	6.02	1.40	121.70	96.40	0.0	0.0162	0.00	0.90	0	0.000	1.000	1.26
12	6.48	1.28	113.85	91.16	0.0	0.0268	0.00	1.01	0	0.000	1.000	1.25
11	5.70	1.10	129.13	118.17	0.0	0.0191	0.00	0.96	0	0.000	1.000	1.09
10	5.81	1.01	128.89	129.45	0.0	0.0152	0.00	1.02	0	0.000	1.000	1.00
9	5.29	0.88	138.50	158.13	0.0	0.0240	0.00	0.99	0	0.000	1.000	0.88
8	4.72	1.07	154.82	145.31	0.0	0.0173	0.00	0.80	0	0.000	1.000	1.07
7	4.49	1.43	163.16	115.50	0.0	0.0098	0.00	0.66	0	0.000	1.000	1.41
6	5.42	1.73	137.22	81.04	0.0	0.0085	0.00	0.73	0	0.000	1.000	1.69
5	6.63	1.57	110.68	71.23	0.0	0.0210	0.00	0.93	0	0.000	1.000	1.55
4	6.50	2.23	127.34	60.71	0.0	0.0059	0.00	0.77	0	0.000	1.000	2.10
3	4.80	4.10	151.78	39.33	0.0	0.0014	0.00	0.42	0	0.000	1.000	3.86
2	8.41	2.23	86.62	38.86	0.0	0.0099	0.00	0.99	0	0.000	1.000	2.23
1	6.24	1.23	116.65	141.48	0.0	0.0213	0.00	0.99	0	0.000	1.000	0.82

Cross Section	Z_{gs}, ft	Z_a, ft	Z_{bs}, ft [1]	Z_{ls}, ft [2]	Z_{lft}, ft	Z_t, ft
17	-0.04	0.39	0.00	0.00	1.0	1.76
16	-0.10	0.38	0.00	0.00	1.0	1.67
15	-0.10	0.40	0.00	0.00	1.0	1.70
14	-0.15	0.35	0.00	0.00	1.0	1.57
13	-0.14	0.50	0.00	0.00	1.0	1.77
12	-0.22	0.58	0.00	0.00	1.0	1.76
11	-0.14	0.45	0.00	0.00	1.0	1.70

10	-0.02	0.46	0.00	0.00	1.0	1.88
9	-0.14	0.38	0.00	0.00	1.0	1.61
8	-0.23	0.31	0.00	0.00	1.0	1.39
7	-0.30	0.28	0.00	0.00	1.0	1.28
6	-0.18	0.40	0.00	0.00	1.0	1.59
5	-0.27	0.60	0.00	0.00	1.0	1.74
4	0.14	0.58	0.00	0.00	1.0	2.23
3	0.00	0.32	0.00	0.00	1.0	1.71
2	0.20	0.97	0.00	0.00	1.0	2.82
1	0.02	0.53	0.00	0.00	1.0	2.02

(2) ADWR equation for LTD

(2) $LTD = Q_{100}^{0.6} * .02$

Location	**Q_{100}, cfs**	**LTD, ft**	
Wash A East	728	1.04	Note: Applies to Cross Sections 17 thru 13

(2) Equilibrium Slope Analysis equation for LTD

(2) $Z_{LTD} = L (S_0-S_{eq})$

Where:

Z_{LTD} = the long-term scour, in feet

L =the distance upstream of the pivot point in feet

S_0 = the channel bed existing slope; feet/feet

S_{eq} = the channel bed equilibrium slope, feet/feet

Location	**L, ft**	**S_0, ft/ft**	**S_{eq}, ft/ft**	**LTD, ft**	
Wash A West	554	0.0181	0.01597	1.15	Note: Applies to Cross Sections 13 thru 1 (Future Crossing)

Total Potential Scour Depth = Design Scour Depth, Z_t + Long Term Degradation, LTD

Location	Z_t, ft	LTD, ft	Total Potential Scour, ft
17	1.76	1.04	2.80
16	1.67	1.04	2.71
15	1.70	1.04	2.74
14	1.57	1.04	2.61
13	1.77	1.15	2.92
12	1.76	1.15	2.92
11	1.70	1.15	2.85
10	1.88	1.15	3.04
9	1.61	1.15	2.77
8	1.39	1.15	2.55
7	1.28	1.15	2.43
6	1.59	1.15	2.74
5	1.74	1.15	2.89
4	2.23	1.15	3.38
3	1.71	1.15	2.86
2	2.82	1.15	3.98
1	2.02	1.15	3.17

SCOUR CALCS

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: Total Scour Calculations - Wash B East (Post Developed)
DATE: 3/16/2017

Total Scour = (1) Design Scour Depth, Z_t + (2) Long Term Degradation, LTD

(1) Equation 6.3: Design Scour Depth Equation (excluding long-term aggradation/degradation)

$$Z_t = 1.3(Z_{gs} + 0.5\,Z_a + Z_{ls} + Z_{bs} + Z_{lft})$$

Where:

Z_t = Design scour depth, feet
Z_{gs} = General scour depth, feet (Equation 6.4)
Z_a = Anti-dune trough depth, feet (Equation 6.5)
Z_{ls} = Local scour depth, feet
Z_{bs} = Bend scour depth, feet (Equation 6.6)
Z_{lft} = Low-flow thalweg depth, feet
1.3 = Factor of safety to account for nonuniform flow distribution

Equation 6.4: General Scour Depth

$$Z_{gs} = Y_{max}\,[((0.0685V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))-1]$$

Where:

Z_{gs} = General scour depth, feet
V_m = Average velocity of flow, feet/s
Y_{max} = Maximum depth of flow, feet
Y_h = Hydraulic depth of flow, feet
S_e = Energy slope (or bed slope for uniform-flow condition), feet/feet
Note: Should Z_{gs} become negative, assume that the general-scour component is equal to zero (i.e., Z_{gs}=0)

Equation 6.5: Anti-Dune Trough Depth

$$Z_a = 0.0137V_m^2$$

Where:

Z_a = Anti-dune trough depth, feet

V_m = Average velocity of flow, feet/s

Equation 6.6: Bend Scour Equation

$$Z_{bs} = ((0.0685Y_{max}V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))[2.1((\sin^2(\alpha/2))/\cos\alpha)^{0.2} - 1]$$

Where:

Z_{bs} = Bend scour depth, feet

Y_h = Hydraulic depth of flow immediately upstream of bend, feet

V_{mb} = Average velocity of flow immediately upstream of bend, feet/s

Y_{max} = Maximum depth of flow immediately upstream of bend, feet

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

Equation 6.9: Local Scour Depth

$$Z_{ls} = 2.2Y\,(b_p/Y)^{0.65}\,F_u^{0.43}$$

Where:

Z_{ls} = Local scour depth, feet

Y = Flow depth, feet

b_p = Pier width normal to the flow direction, ft

F_u = Upstream Froude Number

Z_{lft}

Presently, there is no known methodology for predicting low-flow thalweg depth. In the Tucson area, if a low-flow thalweg is predicted to be present, it should be assumed to be at least two feet deep within regional watercourses, and at least one foot deep within all other watercourses, unless field observations dictate otherwise.

Cross Section	V_m, ft/s	Y_{max}, ft	Area, ft^2	Top Width, ft	Obstruction Width, ft (b_p)	S_e, ft/ft	α	Froude #	$\alpha/2$	$\sin^2(\alpha/2)$	$\cos\alpha$	Y_h, ft
20	4.99	0.74	39.22	56.65	0.0	0.0153	0.00	1.02	0	0.000	1.000	0.69
19	4.78	0.73	42.35	70.63	0.0	0.0143	0.00	0.99	0	0.000	1.000	0.60
18	4.56	0.79	45.11	124.75	0.0	0.0158	0.00	0.90	0	0.000	1.000	0.36
17	5.08	0.82	42.94	68.70	0.0	0.0139	0.00	0.99	0	0.000	1.000	0.63
16	4.61	1.03	57.65	115.00	0.0	0.0109	0.00	0.80	0	0.000	1.000	0.50
15	1.41	1.99	123.68	103.39	0.0	0.0003	0.00	0.18	0	0.000	1.000	1.20
14	4.89	0.85	38.75	66.38	0.0	0.0122	0.00	0.93	0	0.000	1.000	0.58
13	4.04	0.67	44.42	108.72	0.0	0.0115	0.00	0.87	0	0.000	1.000	0.41
12	4.06	0.49	44.84	116.52	0.0	0.0175	0.00	1.02	0	0.000	1.000	0.38
11	4.65	0.87	49.21	93.68	0.0	0.0107	0.00	0.88	0	0.000	1.000	0.53
10	5.06	0.92	34.04	54.29	0.0	0.0118	0.00	0.93	0	0.000	1.000	0.63
9	5.04	1.17	55.23	115.65	0.0	0.0085	0.00	0.82	0	0.000	1.000	0.48
8	6.65	1.59	25.92	27.08	0.0	0.0104	0.00	0.93	0	0.000	1.000	0.96

Cross Section	Z_{gs}, ft	Z_a, ft	Z_{bs}, ft [1]	Z_{ls}, ft [2]	Z_{lft}, ft	Z_t, ft
20	0.00	0.34	0.00	0.00	1.0	1.75
19	0.04	0.31	0.00	0.00	1.0	1.76
18	0.16	0.28	0.00	0.00	1.0	1.88
17	0.08	0.35	0.00	0.00	1.0	1.86
16	0.19	0.29	0.00	0.00	1.0	1.93
15	-0.15	0.03	0.00	0.00	1.0	1.13
14	0.11	0.33	0.00	0.00	1.0	1.87
13	0.10	0.22	0.00	0.00	1.0	1.72
12	0.02	0.23	0.00	0.00	1.0	1.62
11	0.16	0.30	0.00	0.00	1.0	1.89
10	0.13	0.35	0.00	0.00	1.0	1.93
9	0.47	0.35	0.00	0.00	1.0	2.37
8	0.39	0.61	0.00	0.00	1.0	2.60

(2) ADWR equation for LTD

(2) $LTD = Q_{100}^{0.6} * .02$

Location	Q_{100}, cfs	LTD, ft	
Wash A East	195	0.47	Note: Applies to Cross Sections 20 thru 13

(2) Equilibrium Slope Analysis equation for LTD

(2) $Z_{LTD} = L (S_0 - S_{eq})$

Where:

Z_{LTD} = the long-term scour, in feet

L =the distance upstream of the pivot point in feet

S_0 = the channel bed existing slope; feet/feet

S_{eq} = the channel bed equilibrium slope, feet/feet

Location	L, ft	S_0, ft/ft	S_{eq}, ft/ft	LTD, ft	
Wash A West	354	0.0141	0.01178	0.83	Note: Applies to Cross Sections 13 thru 8

Total Potential Scour Depth = Design Scour Depth, Z_t + Long Term Degradation, LTD

Location	Z_t, ft	LTD, ft	Total Potential Scour, ft
20	1.75	0.47	2.22
19	1.76	0.47	2.23
18	1.88	0.47	2.35
17	1.86	0.47	2.33
16	1.93	0.47	2.40
15	1.13	0.47	1.61
14	1.87	0.47	2.35
13	1.72	0.83	2.55
12	1.62	0.83	2.45
11	1.89	0.83	2.72
10	1.93	0.83	2.76
9	2.37	0.83	3.20
8	2.60	0.83	3.43

SCOUR CALCS

PROJECT: Nakoma Sky
WLB NO: 181057-Y003-0400
DESCRIPTION: Total Scour Calculations - Wash B West (Post Developed)
DATE: 3/16/2017

Total Scour = (1) Design Scour Depth, Z_t + (2) Long Term Degradation, LTD

(1) Equation 6.3: Design Scour Depth Equation (excluding long-term aggradation/degradation)

$$Z_t = 1.3(Z_{gs} + 0.5\,Z_a + Z_{ls} + Z_{bs} + Z_{lft})$$

Where:

Z_t = Design scour depth, feet
Z_{gs} = General scour depth, feet (Equation 6.4)
Z_a = Anti-dune trough depth, feet (Equation 6.5)
Z_{ls} = Local scour depth, feet
Z_{bs} = Bend scour depth, feet (Equation 6.6)
Z_{lft} = Low-flow thalweg depth, feet
1.3 = Factor of safety to account for nonuniform flow distribution

Equation 6.4: General Scour Depth

$$Z_{gs} = Y_{max}\,[((0.0685V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))-1]$$

Where:

Z_{gs} = General scour depth, feet
V_m = Average velocity of flow, feet/s
Y_{max} = Maximum depth of flow, feet
Y_h = Hydraulic depth of flow, feet
S_e = Energy slope (or bed slope for uniform-flow condition), feet/feet
Note: Should Z_{gs} become negative, assume that the general-scour component is equal to zero (i.e., Z_{gs}=0)

Equation 6.5: Anti-Dune Trough Depth

$$Z_a = 0.0137V_m^2$$

Where:

Z_a = Anti-dune trough depth, feet

V_m = Average velocity of flow, feet/s

Equation 6.6: Bend Scour Equation

$$Z_{bs} = ((0.0685Y_{max}V_m^{0.8})/(Y_h^{0.4}S_e^{0.3}))[2.1((\sin^2(\alpha/2))/\cos\alpha)^{0.2} - 1]$$

Where:

Z_{bs} = Bend scour depth, feet

Y_h = Hydraulic depth of flow immediately upstream of bend, feet

V_{mb} = Average velocity of flow immediately upstream of bend, feet/s

Y_{max} = Maximum depth of flow immediately upstream of bend, feet

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

Equation 6.9: Local Scour Depth

$$Z_{ls} = 2.2Y\,(b_p/Y)^{0.65}\,F_u^{0.43}$$

Where:

Z_{ls} = Local scour depth, feet

Y = Flow depth, feet

b_p = Pier width normal to the flow direction, ft

F_u = Upstream Froude Number

Z_{lft}

Presently, there is no known methodology for predicting low-flow thalweg depth. In the Tucson area, if a low-flow thalweg is predicted to be present, it should be assumed to be at least two feet deep within regional watercourses, and at least one foot deep within all other watercourses, unless field observations dictate otherwise.

Cross Section	V_m, ft/s	Y_{max}, ft	Area, ft^2	Top Width, ft	Obstruction Width, ft (b_p)	S_e, ft/ft	α	Froude #	$\alpha/2$	$\sin^2(\alpha/2)$	$\cos\alpha$	Y_h, ft
18	1.53	1.56	33.83	26.58	0.0	0.0006	0.00	0.22	0	0.000	1.000	1.27
17	4.09	0.50	12.50	25.26	0.0	0.0173	0.00	1.02	0	0.000	1.000	0.49
16	3.74	0.44	13.53	31.20	0.0	0.0173	0.00	0.99	0	0.000	1.000	0.43
15	3.74	0.39	13.65	34.63	0.0	0.0201	0.00	1.06	0	0.000	1.000	0.39
14	4.33	0.58	11.71	20.96	0.0	0.0161	0.00	1.00	0	0.000	1.000	0.56
13	4.54	0.64	11.52	19.10	0.0	0.0156	0.00	1.00	0	0.000	1.000	0.60
12	3.94	0.48	13.33	30.68	0.0	0.0169	0.00	1.00	0	0.000	1.000	0.43
11	4.12	0.57	13.48	30.03	0.0	0.0146	0.00	0.96	0	0.000	1.000	0.45
10	4.68	0.70	11.36	17.85	0.0	0.0143	0.00	0.99	0	0.000	1.000	0.64
9	5.27	0.87	23.37	26.95	0.0	0.0077	0.00	1.00	0	0.000	1.000	0.87

Cross Section	Z_{gs}, ft	Z_a, ft	Z_{bs}, ft [1]	Z_{ls}, ft [2]	Z_{lft}, ft	Z_t, ft
18	-0.31	0.03	0.00	0.00	1.0	0.94
17	-0.03	0.23	0.00	0.00	1.0	1.56
16	-0.03	0.19	0.00	0.00	1.0	1.51
15	-0.03	0.19	0.00	0.00	1.0	1.51
14	-0.02	0.26	0.00	0.00	1.0	1.61
13	-0.01	0.28	0.00	0.00	1.0	1.65
12	-0.01	0.21	0.00	0.00	1.0	1.56
11	0.02	0.23	0.00	0.00	1.0	1.63
10	0.01	0.30	0.00	0.00	1.0	1.70
9	0.16	0.38	0.00	0.00	1.0	2.00

(2) Equilibrium Slope Analysis equation for LTD

(2) $Z_{LTD} = L\ (S_0 - S_{eq})$

Where:

Z_{LTD} = the long-term scour, in feet

L =the distance upstream of the pivot point in feet

S_0 = the channel bed existing slope; feet/feet

S_{eq} = the channel bed equilibrium slope, feet/feet

Location	L, ft	S_0, ft/ft	S_{eq}, ft/ft	LTD, ft
Wash A West	648	0.0154	0.01404	0.90

Total Potential Scour Depth = Design Scour Depth, Z_t + Long Term Degradation, LTD

Location	Z_t, ft	LTD, ft	Total Potential Scour, ft
18	0.94	0.90	1.84
17	1.56	0.90	2.47
16	1.51	0.90	2.41
15	1.51	0.90	2.41
14	1.61	0.90	2.51
13	1.65	0.90	2.55
12	1.56	0.90	2.46
11	1.63	0.90	2.54
10	1.70	0.90	2.60
9	2.00	0.90	2.90

ROCK SIZING

&

RIPRAP PADS

Rip-Rap Apron Sizing

Rock Sizing Based Upon the Federal Highway Administration Hydraulic Design of Energy Dissipators for Culverts and Channels (Third Edition)

The WLB Group, Inc.
4444 East Broadway Blvd.
Tucson, Arizona 85711
Ph. (520) 881-7480
Fax (520) 881-7492

Site: ***Nakoma Sky***
Job Number: ***181057-Y003-0400***
Date: ***3/17/2017***

Rock Sizing Calculations

D50 Sizing:

D_{50}=0.2 D (Q/((g)^(1/2)*D^2.5))^(4/3)*(D/TW)

where:

D50 = The median diameter of the rock rip-rap, ft
Q = Design Discharge, cfs
D=Culvert Diameter (circular), ft
TW=Tailwater Dept, ft
g=Acceleration due to gravity, 32.2 ft/s^2

Class	D_{50}	Apron Length	Apron Depth
1	5	4D	3.5*D50
2	6	4D	3.3*D50
3	10	5D	2.4*D50
4	14	6D	2.2*D50
5	20	7D	2.0*D50
6	22	8D	2.0*D50

Rip-Rap Apron Sizing

Gravity= 32.2

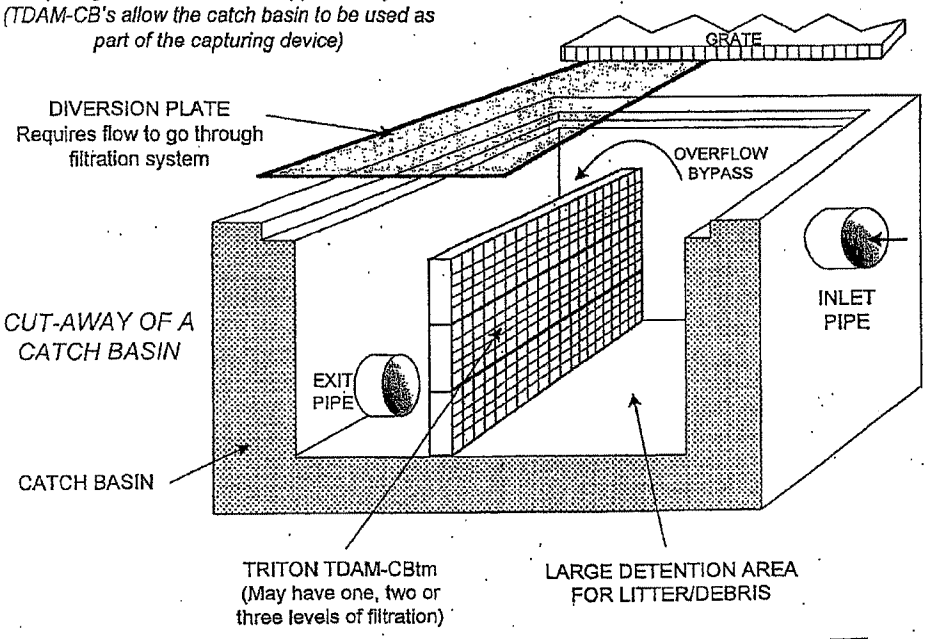
Culvert	Culvert Diameter (ft)	Tailwater Depth (ft)	Adjusted Tailwater Depth (ft)	Design Discharge (cfs)	D50 (ft)	D_{50} (in)	Recommended D_{50} (in)	Apron Length (ft)	Apron Depth (in)
A2	2.0	1.60	1.60	32.5	0.508	6.100	10.0	10.0	24.0
A3	2.0	1.50	1.50	33.3	0.560	6.721	10.0	10.0	24.0
A4	1.5	0.84	0.84	13.7	0.449	5.389	6.0	6.0	19.8
A7	1.5	1.01	1.01	19.8	0.610	7.324	10.0	7.5	24.0
Culvert #1	2.0	1.80	1.80	25.9	0.334	4.006	5.0	8.0	17.5
Culvert #2	2.5	0.80	1.00	50.5	1.087	13.045	14.0	15.0	30.8
Culvert #3	3.0	1.40	1.40	144.5	2.474	29.683	22.0	24.0	44.0
Culvert #4	2.0	1.10	1.10	17.8	0.331	3.976	5.0	8.0	17.5
Culvert #5	3.0	1.20	1.20	172.4	3.652	43.821	22.0	24.0	44.0
Culvert #6	5.0	1.20	2.00	398.0	3.383	40.597	22.0	40.0	44.0
Culvert #7	3.5	1.20	1.40	157.6	2.261	27.133	22.0	28.0	44.0
C	3.5	2.20	2.20	73.3	0.519	6.222	10.0	17.5	24.0

FIRST FLUSH

TRITON TDAM - CB's

(Designed for catch basin applications)
(TDAM-CB's allow the catch basin to be used as part of the capturing device)

Some covers may be solid or have open grates. For open grates a diversion plate may be necessary to avoid the bypassing of the TDAM.

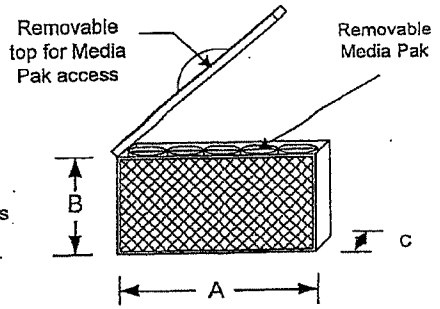


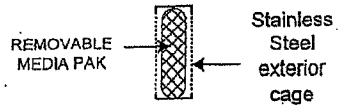
STANDARD DIMENSIONS

(CUSTOM SIZES AVAILABLE UPON REQUEST)

MODEL NO.	A	B*	C
TDAM12 - CB	11.5"	5.5"	1.5"
TDAM16 - CB	14.5"	5.5"	1.5"
TDAM18 - CB	17.5"	5.5"	1.5"
TDAM20 - CB	19.5"	11"	1.5"
TDAM24 - CB	23.5"	16"	1.5"
TDAM36 - CB	35.5"	22"	1.5"
TDAM48 - CB	47"	33"	1.5"

*Height (B) = The height of each TDAM – CB depends upon the inverts of the inlet and exit pipes. The heights listed are most common. REM will be glad to help you determine what height would work best for your specific catch basin.
For catch basins that have shallower depths, call REM Inc. to have a salesperson assist you. (888) 526-4736.





END VIEW

STANDARD FEATURES:

- Filter frame shall be made of Type 304 Stainless Steel, bottom and side plates to be 20ga., Type 304 Stainless Steel.
- Removable top shall be made of High Impact Polystyrene Plastic, with U.V. inhibitors. Made from over 40% recycled plastic.
- The exterior cage of the cartridges shall be made of 8 gauge stainless steel Type 304, having 2" square welded openings.
- Filter media cartridges are easily removed from units for easy maintenance.
- Filter design requires storm events to be filtered through Media Pak. This prevents flows from bypassing Media Pak, which filters out hydrocarbons and other pollutants.
- Disposable Cartridge Media Pak's are constructed from durable geo-textile polypropylene fabric.
- Media is non-hazardous, per EPA and OSHA standards.
- Please refer to manufacture's recommendations for an approved maintenance program.

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Patent Pending

PH: (888) 526-4736

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.

REM Inc.

TRITON TDAM - CB's

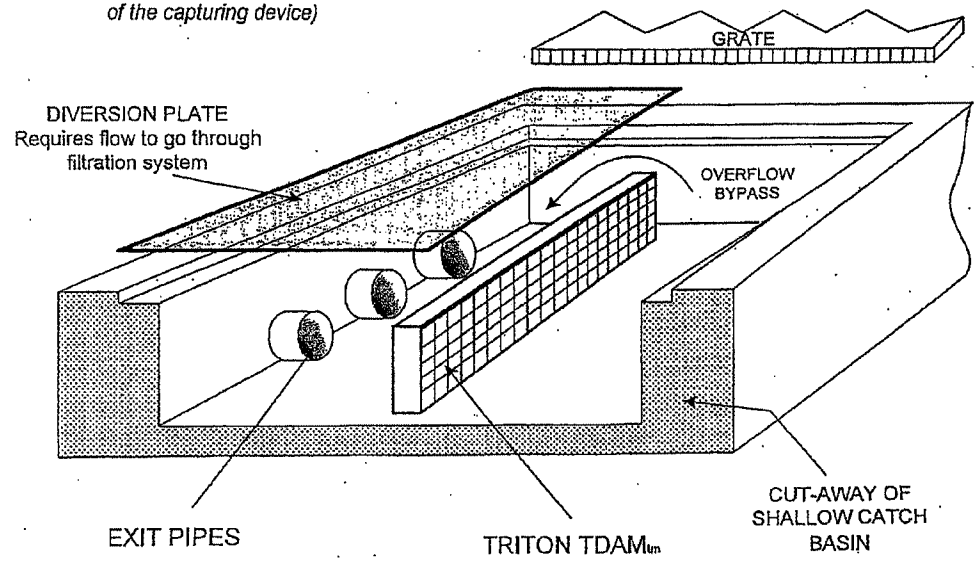
(Designed for catch basin applications)

SIZE	DRAWN BY:	FOR:	REV
	C.F.	Catch Basins	
SCALE	1/4 : 1	DATE: 2/12/2006	SET 1 OF 1

TRITON TDAM's

(Designed for low profile catch basin applications)
(TDAM's allow the catch basin to be used as part of the capturing device)

Some covers may be solid or have open grates. For open grates a diversion plate may be necessary to avoid the bypassing of the TDAM.

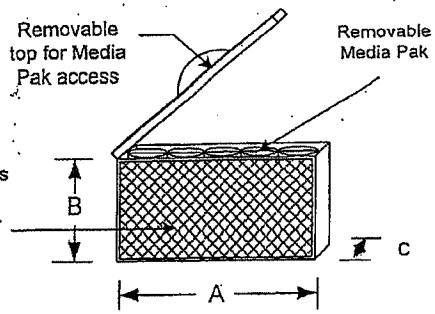


STANDARD DIMENSIONS

(CUSTOM SIZES AVAILABLE UPON REQUEST)

MODEL NO.	A	B*	C
TDAM4	3.5"	5.5"	1.5"
TDAM5	4.5"	5.5"	1.5"
TDAM6	5.5"	5.5"	1.5"
TDAM8	7.5"	5.5"	1.5"
TDAM10	9.5"	5.5"	1.5"
TDAM12	11.5"	5.5"	1.5"
TDAM15	14.5"	5.5"	1.5"
TDAM18	17.5"	5.5"	1.5"
TDAM20	19.5"	5.5"	1.5"
TDAM24	23.5"	5.5"	1.5"
TDAM36	35.5"	5.5"	1.5"

*Height (B) = Most shallow catch basins have at least 7" depths on average. For catch basins that have shallower depths or even deeper depths, custom sizes can be furnished.



END VIEW

STANDARD FEATURES:

- Filter frame shall be made of Type 304 Stainless Steel, bottom and side plates to be 20ga., Type 304 Stainless Steel.
- Removable top shall be made of High Impact Polystyrene Plastic, with U.V. inhibitors. Made from over 40% recycled plastic.
- The exterior cage of the cartridges shall be made of 8 gauge stainless steel Type 304, having 2" square welded openings.
- Filter media cartridges are easily removed from units for easy maintenance.
- Filter design requires storm events to be filtered through Media Pak. This prevents flows from bypassing Media Pak, which filters out hydrocarbons and other pollutants.
- Disposable Cartridge Media Pak's are constructed from durable geo-textile polypropylene fabric.
- Media is non-hazardous, per EPA and OSHA standards.
- Please refer to manufacture's recommendations for an approved maintenance program.

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Patent Pending

PH: (888) 526-4736

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REM Inc.

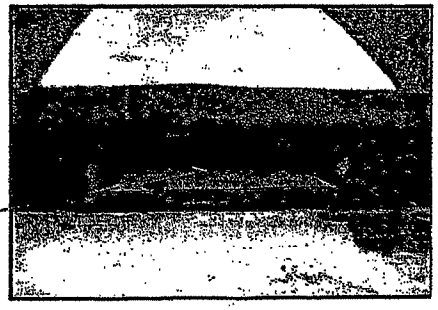
TRITON TDAM's

(Designed for low profile applications)

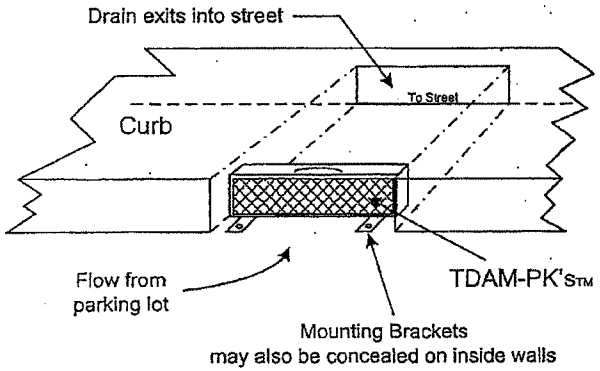
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	C.F.	Shallow Catch Basins	
SCALE	1/4 : 1	DATE: 1/12/2005	SET 1 OF 1

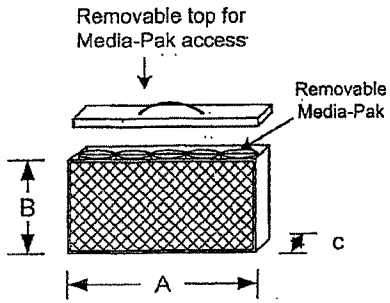
TRITON TDAM-PK'S™

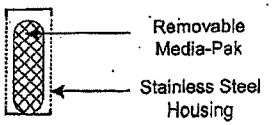
(Designed for Parkway Drains)
REM Inc. (888) 526-4736



Parkway Drains







END VIEW

STANDARD DIMENSIONS

(CUSTOM SIZES AVAILABLE UPON REQUEST)

MODEL NO.	A	B	C
TDAM12-PK	11.5"	3.5"	1.5"
TDAM18-PK	17.5"	3.5"	1.5"
TDAM24-PK	23.5"	3.5"	1.5"
TDAM30-PK	29.5"	3.5"	1.5"
TDAM36-PK	35"	3.5"	1.5"
TDAM42-PK	41"	3.5"	1.5"
TDAM48-PK	47"	3.5"	1.5"
TDAM54-PK	53"	3.5"	1.5"
TDAM60-PK	59"	3.5"	1.5"
TDAM66-PK	65"	3.5"	1.5"
TDAM72-PK	71"	3.5"	1.5"

NOTES:
TDAM-PK™ model numbers represent Parkway Drains width I.D. sizes. (Example: TDAM24-PK fits into a 24" wide Parkway Drain) The height of the units can be sized larger for higher drains openings if necessary. Most common height tends to be 4" tall, which will also allow for additional overflow within the drain.
Custom sizes can also be accommodated, please call our office and allow our staff to help you specify a specific requirement.

STANDARD FEATURES:

- Filter frame shall be made of Type 304 Stainless Steel, bottom and side plates to be 20ga., Type 304 Stainless Steel.
- Removable top shall be made of High Impact Polystyrene Plastic, with U.V. inhibitors. Made from over 40% recycled plastic.
- The exterior cage of the cartridges shall be made of 8 gauge stainless steel Type 304, having 2" square welded openings.
- Filter media cartridges are easily removed from units for easy maintenance.
- Filter design requires storm events to be filtered through Media Pak. This prevents flows from bypassing Media Pak, which filters out hydrocarbons and other pollutants.
- Disposable Cartridge Media Pak's are constructed from durable geo-textile polypropylene fabric.
- Media is non-hazardous, per EPA and OSHA standards.
- Please refer to manufacture's recommendations for an approved maintenance program.

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Patent Pending

PH: (888) 526-4736

DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.

REM Inc.

TRITON TDAM-PK's

(Designed for Parkway Drains and other application)

SIZE	DRAWN BY:	FOR:	REV
	C.F.	Parkway Drains	
SCALE	1/4 : 1	DATE: 5/12/2005	SHEET 1 OF 1

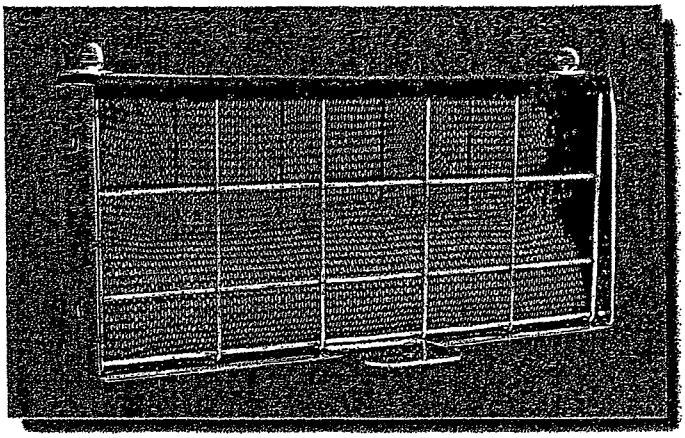
TRITON T-DAM FILTER™

Product Specification

TRENCH DRAIN FILTER INSERT

T-DAM FILTER

- Non-reactive High Impact Polystrene plastic construction with U.V. inhibitors.
- Exterior side constructed with Type 304 Stainless Steel.
- Filter Media-Pak available for the removal of hydrocarbons, metals, sand, silt, and litter.
- Filter Media-Pak is easily removed for ease of maintenance.
- Disposable Media-Pak is constructed from durable geo-textile polypropylene fabric.
- Media is nonhazardous, per EPA and OSHA standards.
- Patent Pending design with high nominal flow and high overflow capacities.
- Easy to install in new and existing trench drains.
- Meets Best Available Technology (BAT) for use in Stormwater Best Management Practices (BMP).
- Maintenance contracts, including recycling of all spent absorbents are available through REM Service Department.
- Servicing of filters on a regular basis is a requirement to meet most local and state BMP's.



MODEL TDAM12

TRITON T-DAM TRENCH DRAIN FILTER INSERT

REM has developed the TRITON T-DAM Trench Drain Filter Insert to help eliminate hydrocarbons and other contaminants such as metals, sand, silt and litter from stormwater runoff.

The TRITON T-DAM is designed to be inserted below the grate of trench drain inlets, and is a easy and cost effective solution to filtering your trench drains

Patent Pending

REM - HELPING KEEP YOUR WATERWAYS CLEAN

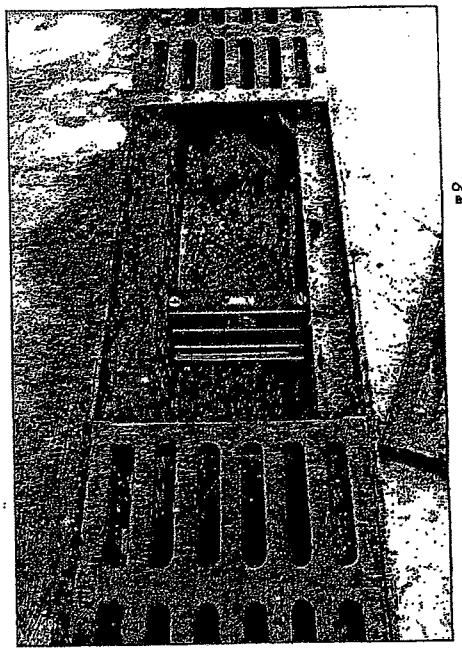
The most recent National Water Quality Inventory reports that runoff from urban areas is the leading source of impairments to surveyed estuaries and the third largest source of water quality impairments to surveyed lakes. In addition, population and development trends indicate that by 2010 more than half of the Nation will live in coastal towns and cities. Runoff from these rapidly growing urban areas will continue to degrade coastal waters.[1]

[1] Environmental Protection Agency's Office of Water EPA841–F–96–004G

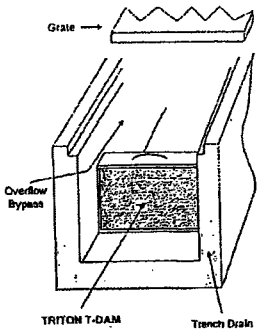
Revel Environmental Manufacturing, Inc.
www.remfilters.com
888-526-4736

MADE IN USA

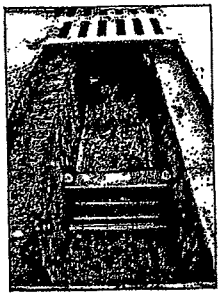
TRITON T-DAM TRENCH DRAIN FILTER™



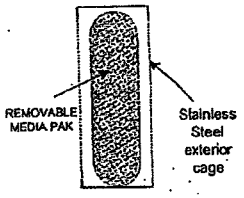
T-DAM INSTALLED



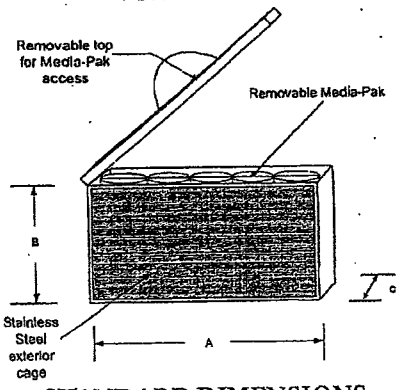
INSTALLED VIEW



T-DAM INSTALLED



END VIEW



NOTES:

1. T-DAMs can be customized to be adaptable to the many different types of trench drains available today.
2. T-DAM external cage shall be made of .162 diameter, 8 gauge Type 304 stainless steel.
3. Top cap is made of High Impact Polystyrene Plastic with U.V. inhibitors added.
4. Filter Media-Paks are easily removed from units for easy maintenance.
5. Filter design requires storm events to be filtered through Media-Pak. This prevents flows from bypassing Media-Pak, which filters out hydrocarbons and other pollutants.
6. Media-Paks can be customized for different removal needs.
7. The disposable Media-Pak is constructed from durable geo-textile polypropylene fabric.
8. Filter Media is non-hazardous per EPA and OSHA standards.
9. Please refer to manufacture's recommendations for an approved maintenance program.

STANDARD DIMENSIONS

MODEL*	A	B**	C
TDAM5	4.5"	5.5"	1.5"
TDAM6	5.5"	5.5"	1.5"
TDAM8	7.5"	5.5"	1.5"
TDAM10	9.5"	5.5"	1.5"
TDAM12	11.5"	5.5"	1.5"
TDAM15	14.5"	5.5"	1.5"
TDAM18	17.5"	5.5"	1.5"
TDAM20	19.5"	5.5"	1.5"
TDAM24	23.5"	5.5"	1.5"

note:
* Many other sizes are also available.
** Dimension "B" (height) can be customized as needed.

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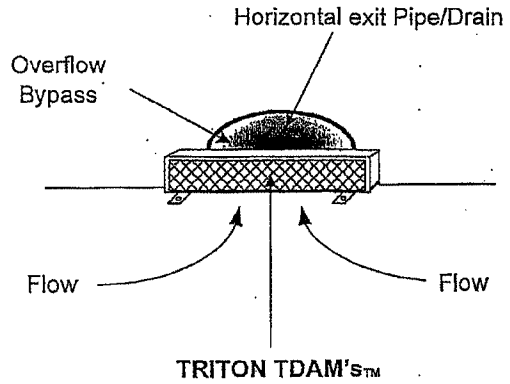
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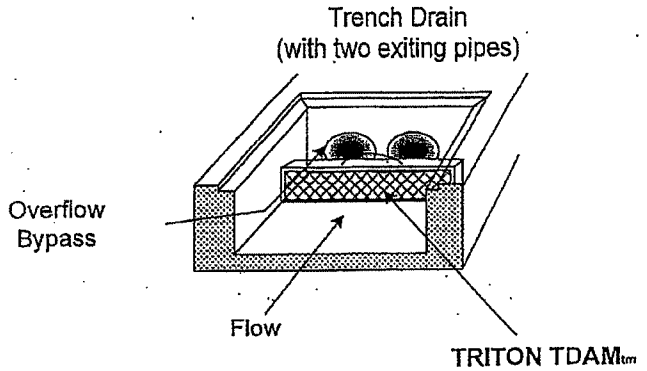
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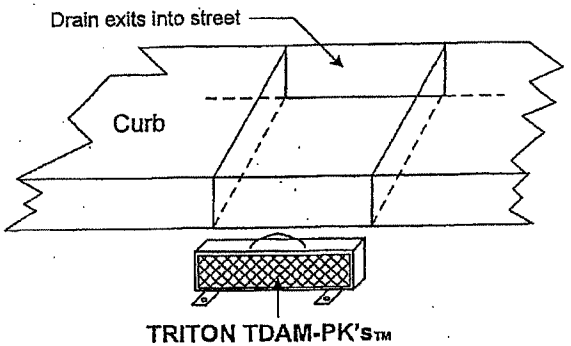
TDAM'S™ & TDAM-PK'S™

(Designed for Trench Drains, Horizontal Drains and other application)



Different Application for TRITON TDAM's & PK's





Notes:

- Filter frame shall be made of Type 304 Stainless Steel, bottom and side plates to be 20ga., Type 304 Stainless Steel.
- Removable top shall be made of High Impact Polystyrene Plastic, with U.V. inhibitors. Made from over 40% recycled plastic.
- The exterior cage of the cartridges shall be made of 8 gauge stainless steel Type 304, having 2" square welded openings.
- Filter media cartridges are easily removed from units for easy maintenance.
- Filter design requires storm events to be filtered through Media Pak. This prevents flows from bypassing Media Pak, which filters out hydrocarbons and other pollutants.
- Disposable Cartridge Media Pak's are constructed from durable geo-textile polypropylene fabric.
- Media is non-hazardous, per EPA and OSHA standards.
- Please refer to manufacture's recommendations for an approved maintenance program.

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Patent Pending

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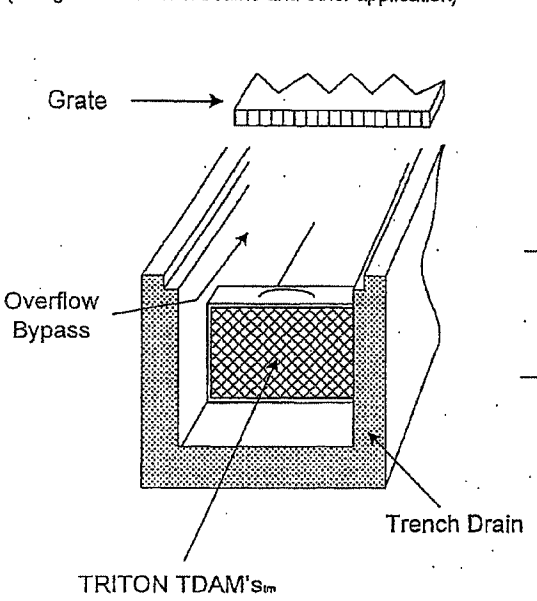
TRITON TDAM & - PK Series

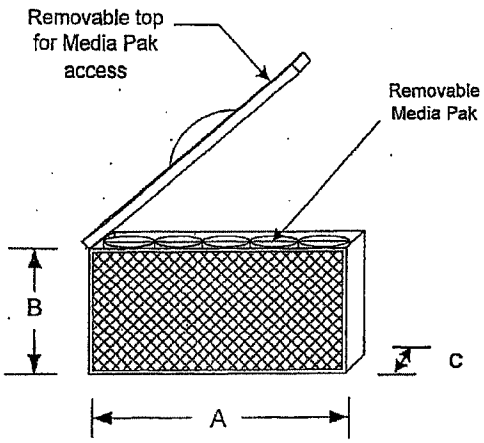
(Designed for Trench and Horizontal Drains and other application)

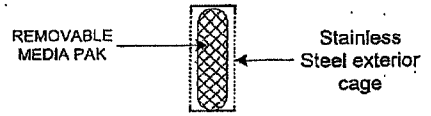
SIZE	DRAWN BY:	FOR:	REV
	C.F.	Trench Drains	
SCALE	1/4 : 1	DATE: 5/16/2005	SHEET 1 OF 1

TRITON TDAM's

(Designed for Trench Drains and other application)







END VIEW

STANDARD DIMENSIONS

(CUSTOM SIZES AVAILABLE UPON REQUEST)

MODEL NO.	A	B*	C
TDAM4	3.5"	5.5"	1.5"
TDAM5	4.5"	5.5"	1.5"
TDAM6	5.5"	5.5"	1.5"
TDAM8	7.5"	5.5"	1.5"
TDAM10	9.5"	5.5"	1.5"
TDAM12	11.5"	5.5"	1.5"
TDAM15	14.5"	5.5"	1.5"
TDAM18	17.5"	5.5"	1.5"
TDAM20	19.5"	5.5"	1.5"
TDAM24	23.5"	5.5"	1.5"

*Height (B) = Most trench drains have overall depths of 8" to 12". For trench drains with shallow depths or even deeper depths, custom sizes can be furnished.

NOTES:

TRITON TDAM™ Model numbers represent trench drain width I.D. sizes. (Example: TDAM10 fits into a 10" wide trench drain) The height of the units can be sized larger for deeper trench drains if necessary. Most common height tends to be 6" tall, which will also allow for additional overflow within the drain. TDAM's should be placed every three to four feet along the length of the trench drain.

Many other sizes are available, please call a distributor near you for more details on different filter sizes and application.

Notes:

- Filter frame shall be made of Type 304 Stainless Steel, bottom and side plates to be 20ga., Type 304 Stainless Steel.
- Removable top shall be made of High Impact Polystyrene Plastic, with U.V. inhibitors. Made from over 40% recycled plastic.
- The exterior cage of the cartridges shall be made of 8 gauge stainless steel Type 304, having 2" square welded openings.
- Filter media cartridges are easily removed from units for easy maintenance.
- Filter design requires storm events to be filtered through Media Pak. This prevents flows from bypassing Media Pak, which filters out hydrocarbons and other pollutants.
- Disposable Cartridge Media Pak's are constructed from durable geo-textile polypropylene fabric.
- Media is non-hazardous, per EPA and OSHA standards.
- Please refer to manufacture's recommendations for an approved maintenance program.

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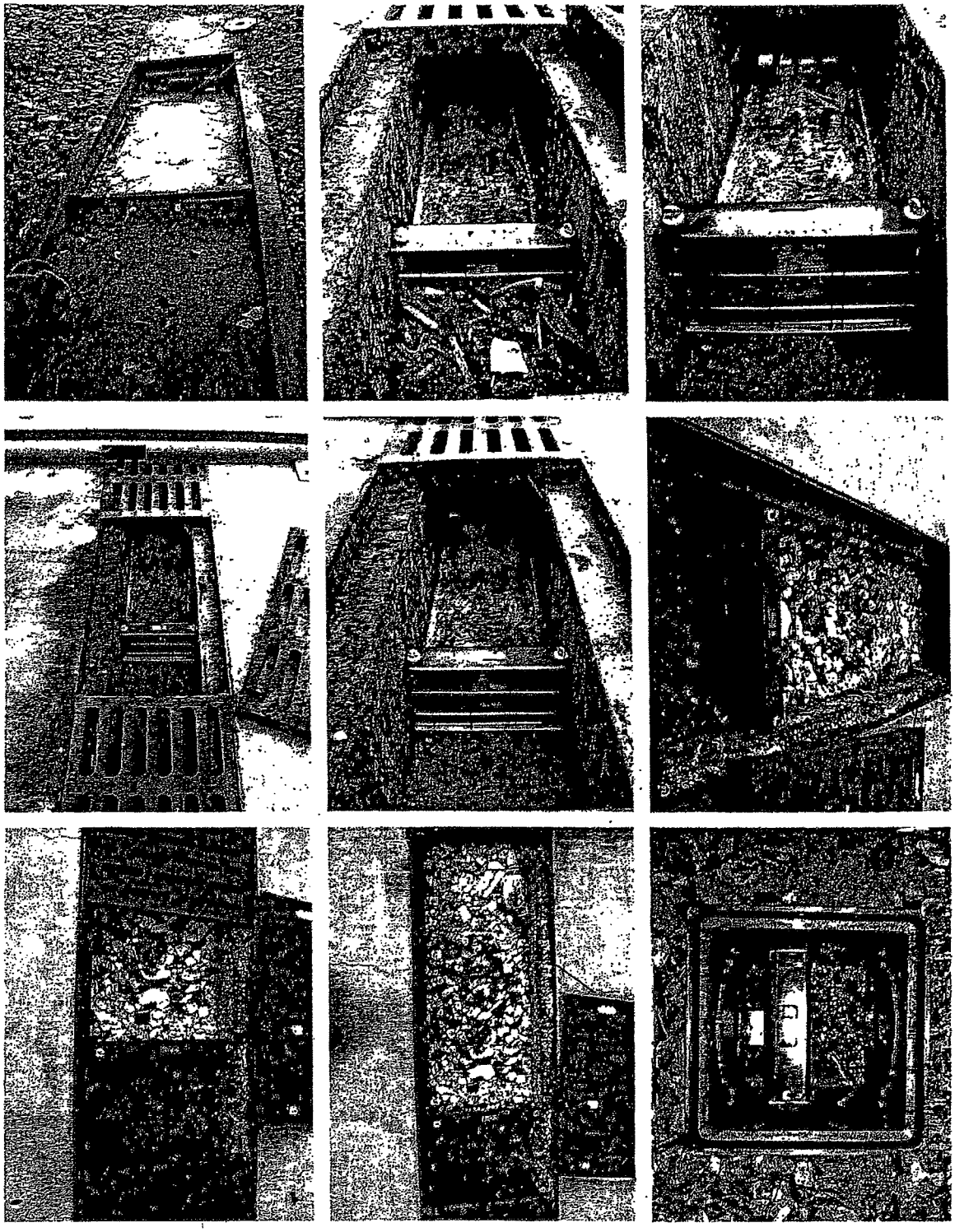
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REM Inc.

TRITON TDAM's

(Designed for Trench Drain and other application)

SIZE	DRAWN BY:	FOR:	REV
	C.F.	Trench Drains	
SCALE	1/4 : 1	DATE: 5/22/2005	SET 1 OF 1



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REVEL ENVIRONMENTAL MANUFACTURING, INC. (REM Inc.)
FLOW RATES for the TRITON T-DAM FILTERS

TRITON TDAM FILTERS	REM - BFTG* Flow Rate	REM - FOG** Flow Rate	REM - FOG - BFTG*** Flow Rate
Model:	CFS	CFS	CFS
TT2.0 (4" wide, Rounded bottom)	0.12	0.05	0.05
TDAM5 (5" Ht.) (Square)	0.24	0.1	0.1
TDAM5 (10" Ht.) "	0.49	0.2	0.2
TDAM6 (5" Ht.) "	0.29	0.11	0.11
TDAM6 (10" Ht.) "	0.59	0.23	0.23
TDAM8 (5" Ht.) "	0.39	0.15	0.15
TDAM8 (10" Ht.) "	0.78	0.3	0.3
TDAM10 (5" Ht.) "	0.49	0.19	0.19
TDAM10 (10" Ht.) "	0.98	0.38	0.38
TDAM12 (5" Ht.) "	0.59	0.26	0.26
TDAM12 (10" Ht.) "	1.18	0.52	0.52
TDAM15 (5" Ht.) "	0.74	0.28	0.28
TDAM15 (10" Ht.) "	1.47	0.56	0.56
TDAM18 (5" Ht.) "	0.88	0.34	0.34
TDAM18 (10" Ht.) "	1.76	0.68	0.68
TDAM24 (5" Ht.) "	1.18	0.45	0.45
TDAM24 (10" Ht.) "	2.35	0.9	0.9

Notes:

* REM - BFTG: Bioflex (BFTG) Media is designed to capture debris, trash and sediment while sustaining very high treatment rates. Mesh density of 3.5 ounces per square foot minimizes occlusion and blinding while capturing 100% of particles at 5mm or greater in size.

** REM - FOG: The FOG media is housed in a mono-filament weaved geotextile containment pack. FOG media effectively encapsulates liquefied petroleum hydrocarbons (Fats, Oils & Grease including animal fats). It's highly hydrophobic characteristic allows for increased polish of flow resulting in the reduction of Total Suspended Solids (TSS). TSS reduction includes (but is not limited to) debris, trash silt sediment and agglomerated heavy metals.

*** REM - FOG - BFTG: Media configuration utilizes both BFTG and FOG media strategies. The BFTG services as a pre-screen to treat for larger debris, trash and sediment, while the FOG media pack captures fine suspended solids and liquefied hydrocarbons.

The area above each TDAM has been designed to leave a 25% opening between the top of the filter and the bottom of the grate. This opening has been designed to allow for larger storm events to bypass the TDAM unobstructed, when needed.

REM technical support is available to assist with TRITON Series filter configurations, media strategies and customization of models.

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REM
www.remfilters.com

REVEL ENVIRONMENTAL MANUFACTURING, INC. (REM Inc.)
FLOW RATES AND VOLUME CAPACITIES for the TRITON SERIES DROP INLET FILTERS

TRITON DROP INLET FILTERS	REM - BFTG* Flow Rate	REM - FOG** Flow Rate	REM - FOG - BFTG*** Flow Rate	TOTAL FILTER BYPASS Flow Rate	FILTERS**** DEBRIS HOLDING CAPACITY
MODEL:	CFS	CFS	CFS	CFS	CUBIC FEET
TR12RD *Configured with:*					
Cartridge: TR7-CART (4) §	0.42	0.17	0.17	1.61	0.19
Cartridge: TR7-CART (8)	0.91	0.25	0.25	1.61	0.42
Cartridge: TR7-CART (16)	1.72	0.5	0.5	1.61	0.84
TR1212 *Configured with:*					
Cartridge: TR7-CART (4) §	0.42	0.17	0.17	1.61	0.19
Cartridge: TR7-CART (8)	0.91	0.25	0.25	1.61	0.45
Cartridge: TR7-CART (16)	1.72	0.5	0.5	1.61	0.85
TR16RD *Configured with:*					
Cartridge: TR7-CART (4) §	0.42	0.17	0.17	1.61	0.19
Cartridge: TR7-CART (8)	0.91	0.25	0.25	1.61	0.45
Cartridge: TR7-CART (16)	1.72	0.5	0.5	1.61	0.85
TR1616 *Configured with:*					
Cartridge: TR7-CART (4)	0.42	0.17	0.17	1.61	0.19
Cartridge: TR7-CART (8) §	0.91	0.25	0.25	1.61	0.69
Cartridge: TR7-CART (16)	1.72	0.5	0.5	1.61	1.83
TR18RD Configured with:					
Cartridge: TR7-CART (8) §	0.91	0.25	0.25	1.61	0.84
Cartridge: TR7-CART (16)	1.72	0.5	0.5	1.61	1.83
Cartridge: TR7-CART (32)	3.43	1	1	1.61	3.9
TR1818 Configured with:					
Cartridge: TR10-CART (8) §	1.63	0.38	0.38	5.14	1.04
Cartridge: TR10-CART (16)	3.07	0.79	0.79	5.14	2.32
Cartridge: TR10-CART (32)	5.2	1.61	1.61	5.14	5.03

TR1824 Configured with:					
Cartridge: TR10-CART (8) §	1.63	0.38	0.38	5.14	1.04
Cartridge: TR10-CART (16)	3.07	0.79	0.79	5.14	2.69
Cartridge: TR10-CART (32)	5.2	1.61	1.61	5.14	6.4
TR2024 Configured with:					
Cartridge: TR10-CART (8) §	1.63	0.38	0.38	5.14	1.04
Cartridge: TR10-CART (16)	3.07	0.79	0.79	5.14	2.9
Cartridge: TR10-CART (16)	5.2	1.61	1.61	5.14	7.1
TR24SR Configured with:					
Cartridge: TR14-CART (8) §	2.61	0.69	0.69	13.15	1.16
Cartridge: TR14-CART (16)	4.91	1.43	1.43	13.15	3.15
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	7.68
TR24RD Configured with:					
Cartridge: TR14-CART (8) §	2.61	0.69	0.69	13.15	1.16
Cartridge: TR14-CART (16)	4.91	1.43	1.43	13.15	2.72
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	6.1
TR2436SS Configured with:					
Cartridge: TR10-CART (8) (Qty 2) §	3.26	0.76	0.76	10.28	1.57
Cartridge: TR10-CART (16) (Qty 2)	6.14	2.76	2.76	10.28	5.37
Cartridge: TR10-CART (32) (Qty 2)	12.28	5.52	5.52	10.28	12.27
TR2436LS Configured with:					
Cartridge: TR10-CART (8) (Qty 2) §	3.26	0.76	0.76	10.28	1.57
Cartridge: TR10-CART (16) (Qty 2)	6.14	2.76	2.76	10.28	5.37
Cartridge: TR10-CART (32) (Qty 2)	12.28	5.52	5.52	10.28	12.27
TR2436 Configured with:					
Cartridge: TR14-CART (16) §	4.91	1.43	1.43	13.15	3.4
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	10
TR30RD Configured with:					
Cartridge: TR14-CART (8) §	2.61	0.69	0.69	13.15	1.16
Cartridge: TR14-CART (16)	4.91	1.43	1.43	13.15	3.6
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	9.3
TR3030 Configured with:					
Cartridge: TR14-CART (8) §	2.61	0.69	0.69	13.15	1.16
Cartridge: TR14-CART (16)	4.91	1.43	1.43	13.15	4.54
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	12.07

TR2448 Configured with:					
Cartridge: TR14-CART (8) (Qty 2) §	5.22	1.38	1.38	26.3	2.32
Cartridge: TR14-CART (16) (Qty 2)	9.82	2.86	2.86	26.3	6.3
Cartridge: TR14-CART (32) (Qty 2)	19.62	5.8	5.8	26.3	15.42
TR36SR - F Configured with:					
Cartridge: TR14-CART (16) §	4.91	1.43	1.43	13.15	6.74
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	16.74
TR36RD - F Configured with:					
Cartridge: TR14-CART (16) §	4.91	1.43	1.43	13.15	6.74
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	14.97
TR3648 - F Configured with:					
Cartridge: TR14-CART (16) §	4.91	1.43	1.43	13.15	6.74
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	19.49
TR42RD - F Configured with:					
Cartridge: TR14-CART (16) §	4.91	1.43	1.43	13.15	6.74
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	17.3
TR48RD - F Configured with:					
Cartridge: TR14-CART (16) §	4.91	1.43	1.43	13.15	6.74
Cartridge: TR14-CART (32)	9.81	2.9	2.9	13.15	20.01
TR4848 - F Configured with:					
Cartridge: TR24-CART (17) §	10.3	2.42	2.42	51.29	15.5
Cartridge: TR24-CART (34)	20.59	4.84	4.84	51.29	29.6

Notes:

§ Standard cartridge configuration for TRITON Drop Inlet Filters. Please specify if larger capacity cartridges are required.

* REM - BFTG: Bioflex (BFTG) Media is designed to capture debris, trash and sediment while sustaining very high treatment rates. Mesh density of 3.5 ounces per square foot minimizes occlusion and blinding while capturing 100% of particles at 5mm or greater in size.

** REM - FOG: The FOG media is housed in a mono-filament weaved geotextile containment pack. FOG media effectively encapsulates liquefied petroleum hydrocarbons (Fats, Oils & Grease including animal fats). It's highly hydrophobic characteristic allows for increased polish of flow resulting in the reduction of Total Suspended Solids (TSS). TSS reduction includes (but is not limited to) debris, trash silt sediment and agglomerated heavy metals.

*** REM - FOG - BFTG: Media configuration utilizes both BFTG and FOG media strategies. The BFTG services as a pre-screen to treat for larger debris, trash and sediment. The FOG Media-Pak captures fine suspended solids and liquefied hydrocarbons.

**** Filter debris capacities can be modified to utilize the maximum dimensions of each specific catch basin. The volumes listed here are based on a 3' X 3' catch basin. Volumes will either increase or decrease depending upon the size of the catch basin and the cartridge size used. REM technical support is available to assist with TRITON Series filter configurations, media strategies and customization of models.

APPENDIX C

PLANS, MAPS, AND FIGURES

FIGURES 3 & 4

Excerpted from First Avenue Properties Drainage Report

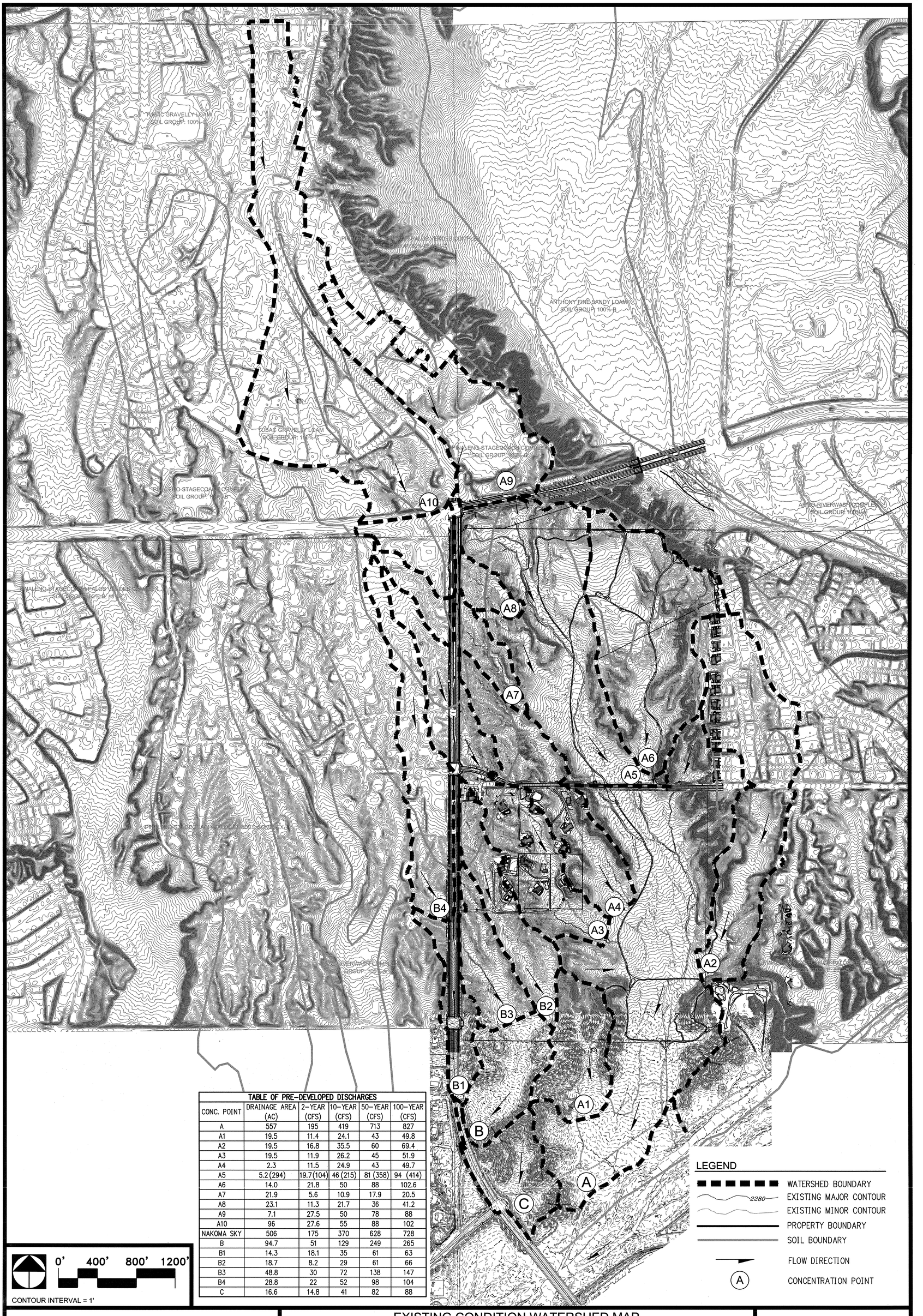


TABLE OF PRE-DEVELOPED DISCHARGES					
CONC. POINT	DRAINAGE AREA (AC)	2-YEAR (CFS)	10-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
A	557	195	419	713	827
A1	19.5	11.4	24.1	43	49.8
A2	19.5	16.8	35.5	60	69.4
A3	19.5	11.9	26.2	45	51.9
A4	2.3	11.5	24.9	43	49.7
A5	5.2 (294)	19.7 (104)	46 (215)	81 (358)	94 (414)
A6	14.0	21.8	50	88	102.6
A7	21.9	5.6	10.9	17.9	20.5
A8	23.1	11.3	21.7	36	41.2
A9	7.1	27.5	50	78	88
A10	96	27.6	55	88	102
NAKOMA SKY	506	175	370	628	728
B	94.7	51	129	249	265
B1	14.3	18.1	35	61	63
B2	18.7	8.2	29	61	66
B3	48.8	30	72	138	147
B4	28.8	22	52	98	104
C	16.6	14.8	41	82	88

LEGEND

- WATERSHED BOUNDARY
- 2280 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPERTY BOUNDARY
- SOIL BOUNDARY
- FLOW DIRECTION
- (A) CONCENTRATION POINT

0' 400' 800' 1200'

CONTOUR INTERVAL = 1'

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EXISTING CONDITION WATERSHED MAP

FIRST AVENUE PROPERTIES

FIRST AVENUE

TOWN OF ORO VALLEY, ARIZONA

FIGURE 3

WLB JOB # 107030-B001-0400
JULY 2015

O:\182053\L006 - Villages at Silverbrook\02 Hydro\Exhibits\EX03_WTRSHED.dwg Plotted: Apr 04, 2017

0' 60' 120' 180'

CONTOUR INTERVAL = 1'

B1

B

C

A

A1

Q_{100}=265cfs

WSEL=2599.0

CS 1

WSEL=2610.4

CS 2

WSEL=2617.9

CS 3

WSEL=2624.8

CS 4

WASH B LOWER

UPPER

CS 1

CS 6

LOWER

WSEL=2630.9

CS 5

WSEL=2677.3

WSEL=2637.3

Q_{100}=1966cfs

FEMA EFFECTIVE 100-YEAR
FLOODPLAIN LIMITS - ZONE AE

CROSS-SECTION 95 (FIS)
EFF 100-YR WSEL=2574.68
CEM 100-YR WSEL=2574.60

WSEL=2578.3

CS 2

Q_{100}=827cfs

WSEL=2574.8

CS 1

WSEL=2580.9

CS 3

WSEL=2583.2

CS 4

WASH A LOWER

WSEL=2591.9

CS 5

WSEL=2598.8

CS 5.5

WSEL=2608.1

CS 7

CS 6

WSEL=2637.3

MIDDLE

LOWER

CROSS-SECTION 96 (FIS)
EFF 100-YR WSEL=2579.53
CEM 100-YR WSEL=2579.81

CROSS-SECTION 97 (FIS)
EFF 100-YR WSEL=2580.34
CEM 100-YR WSEL=2580.96

CANADA DEL ORO
FLOW Q100=22,100 cfs

CROSS-SECTION 98 (FIS)
EFF 100-YR WSEL=2586.90
CEM 100-YR WSEL=2586.06

FEMA EFFECTIVE 100-YEAR
FLOODWAY

FEMA EFFECTIVE 100-YEAR
FLOODPLAIN LIMITS - ZONE AE

TABLE OF PRE-DEVELOPED DISCHARGES

CONC. POINT	DRAINAGE AREA (AC)	2-YEAR (CFS)	10-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
A	557	195	419	713	827
A1	19.2	11.4	24.1	43	49.8
A2	51.2	16.8	35.5	60	69.4
A3	44.8	11.9	26.2	45	51.9
A4	32	11.5	24.9	43	49.7
A5	64 (294)	19.7(104)	46 (215)	81 (358)	94 (414)
A6	57.6	21.8	50	86	102.6
A7	12.8	5.6	10.9	17.9	20.5
A8	19.2	11.3	21.7	36	41.2
A9	44.8	27.5	50	78	88
A10	96	27.6	55	88	102
NAKOMA SKY	506	175	370	628	728
B	94.7	51	129	249	265
B1	14.3	18.1	35	61	63
B2	18.7	8.2	29	61	66
B3	48.8	30	72	138	147
B4	28.8	22	52	98	104
C	16.6	14.8	41	82	88

TABLE EXCERPTED FROM FIRST AVENUE PROPERTIES DRAINAGE REPORT

LEGEND

- WATERSHED BOUNDARY
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPERTY BOUNDARY
- SOIL BOUNDARY
- FLOW DIRECTION
- CONCENTRATION POINT

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Q:\181057\Y-003 - Nakoma Sky\03 Hydro\Exhibits\FSP Exhibits\FIG4_EXISTING.dwg Plotted: May 01, 2017

EXISTING CONDITION WATERSHED MAP

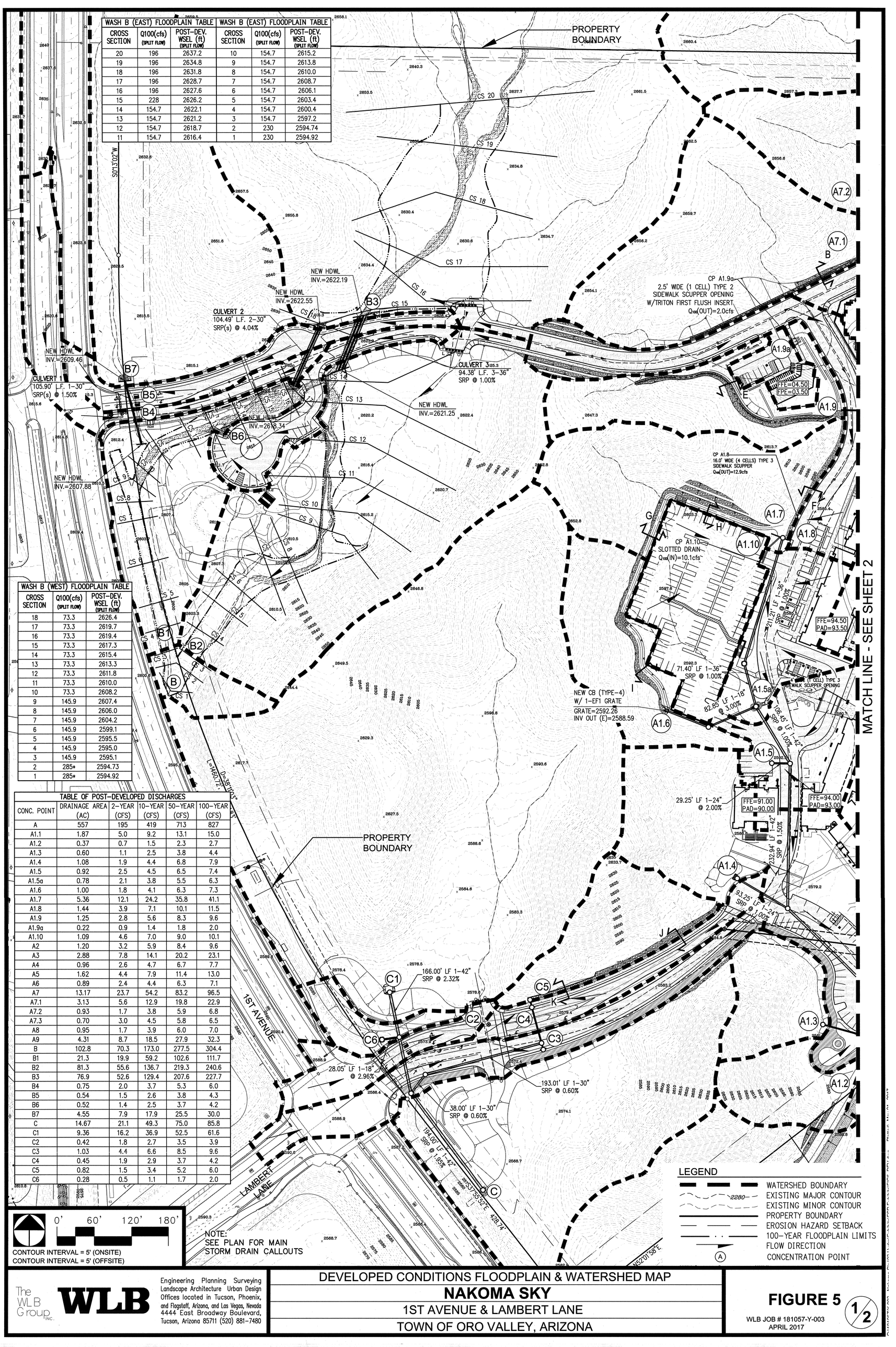
FIRST AVENUE PROPERTIES (NAKOMA SKY SITE)

FIRST AVENUE

TOWN OF ORO VALLEY, ARIZONA

FIGURE 4

WLB JOB # 182053-J002-0400
MAY 2017



DEVELOPED CONDITIONS FLOODPLAIN & WATERSHED MAP

NAKOMA SKY

1ST AVENUE & LAMBERT LANE

TOWN OF ORO VALLEY, ARIZONA

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FIGURE 5 1/2

WLB JOB # 181057-Y-003

APRIL 2017

TABLE OF HYDRAULIC STRUCTURES		
CONC. POINT	Q_{100} (CFS)	STRUCTURE
A (Wash A West)	534 (MAX)	PEDESTRIAN BRIDGE, 70 FOOT WITH CONCRETE APRON HW=1.86'; V_{100}=6.64fps
A (Wash A East)	548 (MAX)	10'X4' RCBC's (3-CELLS); 17.5 LF, 1.89% SLOPE HW=4.12'; V_{100}=11.43fps
A1.1**	15.0	TYPE 4 CATCH BASIN W/4 EF-1 GRATE. 1-42" SRP; 56.23 L.F. @ 1.12%, V_{100} =12.6fps, HW=3.07'
A1.3**	4.4	TYPE 4 CATCH BASIN W/1 EF-1 GRATE. 1-18" SRP; 81.02 L.F. @ 1.00%, V_{100} =2.49fps, HW=2.3'
A1.4**	6.7	TYPE 4 CATCH BASIN W/1 EF-1 GRATE. 1-24" SRP; 93.25 L.F. @ 1.00%, V_{100} =2.51fps, HW=2.14'
A1.5**	7.4	TYPE 5 CATCH BASIN W/1 EF-1 GRATE. 1-24" SRP; 29.3 L.F. @ 2.00%, V_{100} =8.26fps, HW=1.4'
A1.5a**	6.3	TYPE 4 CATCH BASIN W/2 EF-1 GRATE. 1-24" SRP; 106.5 L.F. @ 1.00%, V_{100} =11.12fps, HW=2.54'
A1.6**	7.3	TYPE 4 CATCH BASIN W/1 EF-1 GRATE. 1-24" SRP; 70.01 L.F. @ 3.00%, V_{100} =9.54fps, HW=0.96'
A1.7**	41.1	1-36" SRP'S; 211.2 L.F. @ 1.00%, V_{100}=9.6fps, HW=1.81'
A1.8	11.5	12' WIDE TYPE 3 SIDEWALK SCUPPER (3 CELLS) W/6" CURB REVEAL
A1.9a	2.0	2.5' WIDE TYPE 2 SIDEWALK SCUPPER (1 CELL) W/FIRST FLUSH FILTRATION
A2	9.6	TYPE 4 CATCH BASIN W/2 EF-1 GRATE. 1-24" SRP; 261.06 L.F. @ 0.5%, V_{100} =3.06fps, HW=3.68'
A3	23.1	TYPE 4 CATCH BASIN W/3 EF-1 GRATE. 1-24" SRP; 29.34 L.F. @ 3.49%, V_{100} =13.73fps, HW=1.71'
A4	7.7	TYPE 4 CATCH BASIN W/1 EF-1 GRATE. 1-18" SRP; 50.86 L.F. @ 2.00%, V_{100} =4.73fps, HW=1.22'
A5	13.0	12' WIDE TYPE 3 SIDEWALK SCUPPER (3 CELLS) W/6" CURB REVEAL
A6**	7.1	TYPE 5 CATCH BASIN W/1 EF-1 GRATE. 1-18" SRP; 13.97 L.F. @ 2.0%, V_{100} =4.07fps, HW=3.22'
A7**	96.5	1-48" SRP'S; 57.16 L.F. @ 2.00%, V_{100}=7.68fps, HW=4.54'
A7.3	6.5	8' WIDE TYPE 3 SIDEWALK SCUPPER (2 CELLS) W/6" CURB REVEAL
A9	32.3	32' WIDE TYPE 3 SIDEWALK SCUPPER (8 CELLS) W/FIRST FLUSH FILTRATION
A1.10	10.1	24' LONG SLOTTED DRAIN; 1-18" SRP, 26LF @ 1.0% (MIN) W/FIRST FLUSH FILTRATION
CULVERT #1 (CP B7)	30.0	1-30" SRP'S; 105.9 L.F. @ 1.50%, V_{100}=10.5fps, HW=3.15'
CULVERT #2 (CP B3)	73.3* (228)	2-30" SRP'S; 104.5 L.F. @ 4.04%, V_{100}=9.1fps, HW=3.8'
CULVERT #3 (CP B3)	154.7* (228)	3-36" SRP'S; 94.4 L.F. @ 1.00%, V_{100}=10.3fps, HW=4.1'
CULVERT #4 (CP A7.1)	22.9	1-24" SRP; 114.0 L.F. @ 0.50%, V_{100}=8.04fps, HW=3.4'
CULVERT #5	157.6* (534)	4-36" SRP'S; 47.48 L.F. @ 1.28%, V_{100}=9.86fps, HW=3.4'
CULVERT #6	398* (534)	4-60" SRP'S; 50.64 L.F. @ 2.82%, V_{100}=13.8fps, HW=4.1'
CULVERT #7	172.4* (534)	2-54" SRP'S; 54.66 L.F. @ 1.95%, V_{100}=11.8fps, HW=4.6'
B4	6.0	8' WIDE TYPE 3 SIDEWALK SCUPPER (2 CELLS) W/6" CURB REVEAL
B5	4.3	4' WIDE TYPE 3 SIDEWALK SCUPPER (1 CELL) W/6" CURB REVEAL
B6	4.2	4' WIDE TYPE 3 SIDEWALK SCUPPER (1 CELL) W/6" CURB REVEAL
C1	61.6	1-42" SRP; 114.94 L.F. @ 2.50%, V_{100}=15.47fps, HW=2.5'
C3	9.6	TYPE 3 CATCH BASIN W/12' WING, 1-18" SRP; 10.93 L.F. @ 1.00%, V_{100} =5.43fps, HW=1.62'
C4	4.2	TYPE 5 CATCH BASIN W/1 EF-1 GRATE. 1-18" SRP; 59.45 L.F. @ 0.50%, V_{100} =5.77fps, HW=1.93'
C5	6.0	TYPE 4 CATCH BASIN W/1 EF-1 GRATE. 1-18" SRP; 12.5 L.F. @ 0.50%, V_{100} =3.4fps, HW=2.16'
C6	2.0	TYPE 4 CATCH BASIN W/1 EF-1 GRATE. 1-18" SRP; 26.84 L.F. @ 2.32%, V_{100} =1.13fps, HW=2.05'

*SPLIT FLOW DISCHARGE VALUE
**SEE PLAN VIEW FOR COMPLETE STORM DRAIN SYSTEM DESCRIPTION

TABLE OF POST-DEVELOPED DISCHARGES					
CONC. POINT	DRAINAGE AREA (AC)	2-YEAR (CFS)	10-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
A	557	195	419	713	827
A1.1	1.87	5.0	9.2	13.1	15.0
A1.2	0.37	0.7	1.5	2.3	2.7
A1.3	0.60	1.1	2.5	3.8	4.4
A1.4	1.08	1.9	4.4	6.8	7.9
A1.5	0.92	2.5	4.5	6.5	7.4
A1.5a	0.78	2.1	3.8	5.5	6.3
A1.6	1.00	1.8	4.1	6.3	7.3
A1.7	5.36	12.1	24.2	35.8	41.1
A1.8	1.44	3.9	7.1	10.1	11.5
A1.9	1.25	2.8	5.6	8.3	9.6
A1.9a	0.22	0.9	1.4	1.8	2.0
A1.10	1.09	4.6	7.0	9.0	10.1
A2	1.20	3.2	5.9	8.4	9.6
A3	2.88	7.8	14.1	20.2	23.1
A4	0.96	2.6	4.7	6.7	7.7
A5	1.62	4.4	7.9	11.4	13.0
A6	0.89	2.4	4.4	6.3	7.1
A7	13.17	23.7	54.2	83.2	96.5
A7.1	3.13	5.6	12.9	19.8	22.9
A7.2	0.93	1.7	3.8	5.9	6.8
A7.3	0.70	3.0	4.5	5.8	6.5
A8	0.95	1.7	3.9	6.0	7.0
A9	4.31	8.7	18.5	27.9	32.3
B	102.8	70.3	173.0	277.5	304.4
B1	21.3	19.9	59.2	102.6	111.7
B2	81.3	55.6	136.7	219.3	240.6
B3	76.9	52.6	129.4	207.6	227.7
B4	0.75	2.0	3.7	5.3	6.0
B5	0.54	1.5	2.6	3.8	4.3
B6	0.52	1.4	2.5	3.7	4.2
B7	4.55	7.9	17.9	25.5	30.0
C	14.67	21.1	49.3	75.0	85.8
C1	9.36	16.2	36.9	52.5	61.6
C2	0.42	1.8	2.7	3.5	3.9
C3	1.03	4.4	6.6	8.5	9.6
C4	0.45	1.9	2.9	3.7	4.2
C5	0.82	1.5	3.4	5.2	6.0
C6	0.28	0.5	1.1	1.7	2.0

LEGEND

- WATERSHED BOUNDARY
- 2280 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EROSION HAZARD SETBACK
- 100-YEAR FLOODPLAIN LIMITS
- FLOW DIRECTION
- (A) CONCENTRATION POINT

0' 60' 120' 180'

CONTOUR INTERVAL = 5' (ONSITE)
CONTOUR INTERVAL = 5' (OFFSITE)

WASH A (EAST) FLOODPLAIN TABLE				
CROSS SECTION	Q100(cfs) (SPLIT FLOW)	POST-DEV. WSEL (ft) (SPLIT FLOW)	Q100(cfs) (FULL FLOW)	POST-DEV. WSEL (ft) (FULL FLOW)
17	728	2602.58	728	2602.58
16	728	2601.66	728	2601.66
15	728	2600.65	728	2600.65
14	728	2599.41	728	2599.41
13	548.7	2597.93	728	2598.17
12	548.7	2596.81	728	2597.02
11	548.7	2595.33	728	2595.54
10	548.7	2594.48	728	2594.65
9	548.7	2593.23	728	2593.38
8	548.7	2592.15	728	2592.37
7	548.7	2591.49	728	2591.78
6	548.7	2590.76	728	2591.10
5	548.7	2590.21	728	2590.33
4	548.7	2589.12	728	2589.81
3	548.7	2589.15	728	2589.86
2	548.7	2587.22	728	2587.61
1	548.7	2587.29	728	2587.50

WASH A (WEST) FLOODPLAIN TABLE				
CROSS SECTION	Q100(cfs) (SPLIT FLOW)	POST-DEV. WSEL (ft) (SPLIT FLOW)	Q100(cfs) (FULL FLOW)	POST-DEV. WSEL (ft) (FULL FLOW)
26	728	2601.47	728	2601.47
25	728	2600.96	728	2600.96
24	728	2600.92	728	2600.92
23	728	2600.92	728	2600.92
22	533.6	2596.49	728	2596.67
21	533.6	2595.89	728	2596.07
20	533.6	2594.99	728	2595.20
19	533.6	2593.81	728	2594.02
18	533.6	2593.18	728	2593.55
17	533.6	2592.44	728	2592.70
16	533.6	2591.60	728	2591.89
15	533.6	2590.96	728	2591.24
14	533.6	2589.85	728	2590.07
13	533.6	2588.72	728	2588.94
12	533.6	2587.64	728	2587.96
11	533.6	2587.13	728	2587.48
10	533.6	2586.12	728	2586.41
9	533.6	2584.68	728	2584.91
8	533.6	2582.97	728	2583.19
7	533.6	2581.99	728	2582.51
6	533.6	2581.97	728	2582.40
5	533.6	2581.51	728	2581.89
4	533.6	2581.33	728	2581.72
3	533.6	2580.88	728	2581.20
2	533.6	2580.56	728	2580.88
1	533.6	2580.64	728	2580.64

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DEVELOPED CONDITIONS FLOODPLAIN & WATERSHED MAP
NAKOMA SKY
1ST AVENUE & LAMBERT LANE
TOWN OF ORO VALLEY, ARIZONA

FIGURE 5 2/2
WLB JOB # 181057-Y-003
APRIL 2017

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Data CD (1 pocket)

APPENDIX D

ORO VALLEY DRAINAGE REPORT FORMAT/CHECKLIST

2.4 General Drainage Report Format for Development Plans And Preliminary Plats

Content of the drainage report will vary with the complexity of the development and corresponding study, but the format of the report shall follow the outline below. The following checklist, *with completed items checked*, is to be included with each drainage report submittal to the Town. **Omitting the checklist may result in the report not being reviewed and/or accepted**. For areas that are non-applicable, the submitter should indicate N/A along with a brief explanation.

2.4.1 Drainage Report Format/Checklist

Cover:

- ☑ Name, address, Township, Range, Section and Pima County Tax ID Code of the parcel, project or development for which the report is being submitted, as well as the Town of Oro Valley project number.
- ☑ Name and address of the client/owner of the parcel.
- ☑ Name and address of the engineering/consulting firm preparing the report.
- ☑ Submittal date.
- ☑ Name of person preparing the report, if other than registrant sealing the report.
- ☑ Seal and signature of Arizona Registered Professional Engineer meeting AZBTR specifications and requirements. (and/or on the table of contents)

Table of Contents:

- ☑ Seal and signature of Arizona Registered Professional Engineer (and/or on the report cover)

1. ***Introduction:***

- ☑ Project name and legal description.
- ☑ Vicinity Map.
- ☑ Include site location map identifying major features.
- ☑ Describe project type and size.
- ☑ Identify purpose and objectives of report (i.e. tentative plat, preliminary plat, development plan, etc.).
- ☑ Identify major drainage ways and existing drainage structures.

☑ Include general discussion on the topography and discuss in general the type of overland flow through the project site (i.e.: sheet flow, channelized flow etc…)

☐ Identify the zoning for the parcel and the zoning for parcels directly adjacent to the site.

☑ State whether the project site contains any Federal floodplains.

☑ State whether detention is required.

☑ State sources of other reports used for the study. These shall be included in the bibliography.

☑ Provide a comprehensive narrative that clearly states the drainage engineer's concepts, rationale, and assumptions. Include a discussion on the type of hydraulic and hydrologic models or analytical methods that will be used.

2. ***Existing Conditions Drainage:***

☑ On-site drainage.

i. Identify existing drainage network, patterns, watershed, and regulatory floodplain boundaries, local and Federal.

Note: local floodplain boundaries include those associated with 100-year flows of 50 cubic feet per second (cfs) or greater.

☑ Off-site drainage.

i. Note existing and future conditions, and drainage network entering the project site. Note any sheet flow conditions entering site.

ii. Identify existing regulatory floodplain boundaries as identified by the Town of Oro Valley (local floodplain) and/or FEMA (Federal floodplain) (Include a copy of the FIRM panel or applicable portion of the FIRM panel).

iii. Provide discussion describing contributing offsite watersheds and regulatory floodplain boundaries, Federal and local.

iv. Identify existing drainage studies for adjacent project sites or adjacent parcels that are impacted by or that impact the proposed project site. If a drainage study is not available for an adjacent site, provide an analysis indicating the degree of impacts.

3. ***Proposed Conditions Drainage Design***

☑ Include general description of proposed conditions, drainage facilities, and components.

☑ State storm water detention requirements for the proposed site as well as volume required, size and location of detention basins.

☑ Delineate pre-developed and post-developed runoff characteristics at concentration points exiting the site. While cumulative values for runoff exiting the proposed site at several concentration points may adhere to critical basin criteria, variation of runoff values at individual concentration points shall be addressed in the report. Variations in runoff at individual concentration points often impact individuals and/or small groups of property owners.

☑ Identify, in detail, proposed drainage structures or drainage facilities. Include design criteria and probable effects on the existing upstream and downstream drainage system.

☑ Identify and describe in detail first flush measures. Include design criteria.

4. ***Special Conditions:***

☑ Identify and discuss any special conditions that may require deviation from standard procedures and submittal requirements as presented in this DCM and/or the City of Tucson Drainage Manual. Special conditions may imply design exceptions, stipulations and permit issues (NPDES, FEMA), etc.

☐ Example Permits

☐ State – AZPDES Notice of Intent (NOI), Notice of Termination (NOT)

☐ Pima County – For flows of 3,000 cfs or greater

☑ Oro Valley – Floodplain Use, Grading, etc.

☑ 404 COMPLIANCE

5. ***Hydrologic and Hydraulic Analysis:***

☑ Hydrology

i. Identify and discuss in detail procedures, methods and assumptions used for hydrologic analysis.

ii. Include summary tables listing input parameters used in the analysis and the results of the analysis.

☑ Hydraulics

i. Identify and describe, in detail, procedures, methods and assumptions (with justification) used for all hydraulic conveyances analyzed, both onsite and offsite. Provide all formulae, coefficients, factors of safety applied, references, etc., applied to hydraulic computations.

ii. Include a summary table listing hydraulic conveyances (channels, culverts, weirs, etc.) that were analyzed with a comparison of upstream and downstream pre-developed verses post-developed peak discharges, concentration points, water surface elevations, free board and velocities.

iii. Provide standard detail number and/or regulatory agency for each standard detail referenced.

iv. Include a statement that all-weather access to habitable structures is achievable provided that all recommendations are followed. Provide a project grading figure which illustrates finished floor elevations; 100-year water surface elevations upstream, adjacent to and downstream of each habitable structure for each channel, sub-basin, structure, street, PAAL, etc. which conveys and/or ponds flows;

v. Provide a scour analysis that is commensurate with the anticipated degree of scour. This may be as simple as a determination of sufficient toe–down requirements.

☑ Floodplain Analysis

i. Describe the results of floodplain hydraulic analysis in terms of site design.

ii. Include method of floodplain boundary analysis and explain output messages and how coefficients were determined.

iii. When mapping the results of the floodplain analysis, ensure that there is consistency between chosen hydraulic cross-sections, topography and the floodplain boundary delineation. Provide the highest possible degree of resolution when interpolating between contour intervals.

☐ Storm Water Detention Calculations (Waiver Request)

i. Identify procedures, methods and assumptions. Indicate details of the methodology used such as storage/discharge or stage/discharge. Show how overflow conditions are addressed. Show how basin is drained completely, no water retained.

ii. Include Table of Volume of Storage required, and Location and Storage Volume required

iii. Include Tables for detention basins at the 2, 10, 50 and 100 year frequency events. Also include graphic hydrographs of the mitigation achieved by the detention basin.

☑ Drainage Structures Design

i. Identify procedures, methods and assumptions used for design of storm drains, culverts, etc.

ii. Include a summary table of drainage structures and flow values associated with structures.

☑ Erosion Control

i. Discuss procedures, methods and assumptions.

ii. Include discussion of Storm Water Pollution Prevention Plan submittal requirements.

iii. Discuss the need for bank protection, the proposed location, materials and freeboard.

iv. Discuss scour basin requirements, dimensions, and materials.

v. Discuss and calculate the erosion hazard zone setback (ERZ)

☑ Storm Water Quality and Quantity

i. Discuss first flush measures utilized and provide manufacturer's specification literature and/or supporting calculations.

ii. Discuss water harvesting measures that are utilized and ensure code compliance.

iii. Calculate the total impervious area of the development for future use in determining storm water fee. This calculation is not required for developments consisting of single family detached or two family residential subdivisions.

6. ***Conclusions and Recommendations:***

☑ Discuss overall project objectives.

❑ Affirm compliance with criteria set forth in this Manual and other Town of Oro Valley Standards.

❑ Discuss the influence of proposed development on existing conditions.

❑ Discuss the effectiveness of the drainage design to control damage from storm water downstream and upstream of project site.

❑ Discuss impacts to adjacent properties and watershed drainage.

❑ Discuss if and how drainage improvements will be phased.

❑ Provide a summary of report's findings.

❑ Provide detailed recommendations for, at a minimum:

i. providing all-weather access to all proposed habitable structures

ii. maintaining upstream and downstream water surface elevations and channel equilibria

iii. providing required detention

iv. first flush and water harvesting

v. maintenance requirements for basin and hydraulic structures

vi. erosion hazard setbacks

7. ***References:***

☑ List all references used.

Appendix A – Hydrologic Computations and Backup

☑ Include land use assumptions, existing and proposed.

☑ Include soils information and exhibits.

☑ Include peak flow calculations.

☑ Include detention inflow-outflow analysis and basin design calculations.

☑ Include computer input and output files in both hard copy and electronic format.

☐ Include electronic copies (AutoCAD/GIS) of basin delineations, flow paths, routing reaches, concentration points, and other supporting hydrologic data.

Appendix B – Hydraulic Computations and Backup

☑ Include channel design calculations.

☑ Include floodplain calculations and encroachment analyses. At a minimum, include assumptions, input/output data, cross-section number, water surface elevations, coefficients applied, top width, area, velocity, and Froude number. Clearly delineate existing/proposed floodplain limits and indicate existing/proposed water surface elevations.

☑ Cross-section and profile plots.

☑ Include erosion hazard setback calculations.

☑ Include culvert design calculations. Provide centerline profile of culvert structure indicating, at a minimum:

i. existing and proposed ground,

ii. existing and proposed HGL,

iii. backwater conditions,

iv. flowline and soffit of culvert,

v. headwater and tailwater elevations,

vi. inlet and outlet structures, and

vii. Inlet and outlet scour protection measures. Water surface profile is to extend from upstream to downstream flow continuation points.

☑ Include curb opening and catch basin calculations.

☑ Include storm drain calculations. Provide centerline profile of storm drain structure indicating, at a minimum:

i. existing and proposed ground,

ii. existing and proposed Hydraulic Grade Line (HGL)/ Energy Grade Line (EGL),

iii. flowline and soffit of storm drain, manholes, junctions, headwater and tailwater elevations,

iv. inlet and outlet structures, and

v. Inlet and outlet scour protection measures. Water surface profile is to extend from upstream to downstream flow continuation points.

☑ Include sediment and scour calculations.

☑ Include rip-rap sizing and stability analysis.

☑ Include finished floor elevations. (FIGURE 5)

i. Basis for setting finished floor elevations for floodplains and/or adjacent washes.

☑ Include computer input and output files in both hard copy and electronic format.

☐ Include electronic copies (AutoCAD/GIS) of floodplain delineations, cross section locations and 100 year water surface elevations.

Appendix C – Plans, Maps and Figures

☑ Include applicable plan set/sheets related to drainage activities and design.

☑ Include an Offsite Existing Conditions Watershed Map. This map is to be to scale, 24" x 36" plan sheet minimum, and shall delineate and illustrate, at a minimum:

i. north arrow

ii. Scale – as appropriate to fit in one exhibit

iii. topography and contour interval (if available)

iv. project site boundary

v. $Q_{100's}$ entering and exiting the site with accompanying drainage area in acres (or square miles, as applicable) and drainage area designation as identified on hydrologic computation sheets

vi. labeled 100-year floodplain limits for all $Q_{100} \geq 50$ cfs within 100-feet of the site boundary. Delineated floodplain limits are to include cross-sections

identified by number as indicated on hydraulic computation sheets, and 100-year water surface elevation. All existing drainage structures which may affect or be affected by the project are to be clearly identified

☑ Include an Onsite Existing Conditions Watershed Map. This map is to be to scale, 24" x 36" plan sheet minimum, and shall delineate and illustrate, at a minimum:

i. north arrow

ii. scale

iii. topography and contour interval

iv. site boundary

v. $Q_{100's}$ with accompanying drainage area in acres and drainage area designation as identified on hydrologic computation sheets

vi. labeled 100-year floodplain limits for all $Q_{100} \geq 50$ cfs. Delineated floodplain limits are to include cross-sections identified by number as indicated on hydraulic computation sheets, and 100-year water surface elevation. All existing drainage structures are to be clearly identified.

☑ Include an Onsite Developed Conditions Watershed Map. This map is to be to scale 24" x 36" plan sheet minimum, and shall delineate and illustrate, at a minimum:

i. north arrow

ii. scale

iii. topography and contour interval

iv. development improvements as depicted on the development plan or preliminary plat.

v. developed and existing $Q_{100's}$ entering and exiting the site with accompanying drainage area in acres and drainage area designation as identified on hydrologic computation sheets

vi. labeled 100-year floodplain limits, including encroachments for all $Q_{100} \geq 50$ cfs onsite and within 100-feet of the site boundary. Delineated floodplain limits are to include cross-sections identified by number as indicated on hydraulic computation sheets, and 100-year water surface elevation.

vii. For onsite flows carried within streets and parking areas, include flow arrows sufficient to illustrate drainage patterns with Q_{100} and drainage area

designation as identified on hydrologic computation sheets, within the streets and parking areas and at point of entry and point of discharge.

viii. All proposed drainage structures are to be clearly identified. Ten-year ponding limits with regard to dry-free lane requirements are to be delineated and clearly labeled.

ix. Regulatory erosion hazard setbacks are to be clearly delineated and labeled.

x. All other information as may be required by the Oro Valley Floodplain and Erosion Hazard Management Ordinance.

APPENDIX E

Vegetation Irrigation and Maintenance Schedule

VEGETATION IRRIGATION AND MAINTENANCE SCHEDULE

LANDSCAPE WATER PLAN

WINTER		SPRING			SUMMER		MONSOON				WINTER
MONTH											
1	2	3	4	5	6	7	8	9	10	11	12
YEAR 3:											
CONTINUE TO INCREASE IRRIGATION WATER USE AS NEEDED AS PLANTS MATURE UP TO, BUT NOT EXCEEDING, 100% ADWR VALUE BY END OF YEAR.											
187,453	201,265	211,131	226,917	232,836	232,836	161,407	161,407	182,915	197,319	189,426	185,480
		TOTAL (100% ADWR)		**356094 GAL/YEAR**							**2370393**
YEAR 4:											
BEGIN GRADUALLY DECREASING IRRIGATION TO BUFFER MEDIAN AND ROW AREAS IN ORDER TO REACH ZERO IRRIGATION IN THOSE AREAS BY END OF YEAR 5.											
140,590	150,949	158,348	170,188	174,627	174,627	121,055	121,055	137,186	147,989	142,070	139,110
		TOTAL (75% ADWR)		**267,070 GAL/YEAR**							**1777795**
YEAR 5:											
CONTINUE DECREASING IRRIGATION TO BUFFER, MEDIAN, AND ROW AREAS. BY END OF YEAR 5 IRRIGATION TO BUFFER, MEDIAN AND ROW AREAS MUST BE ZERO AND TOTAL AMOUNT OF WATER USED AT SITE MUST MEET 50% OF ADWR MATURITY VALUE. (AVERAGE MONTHLY WATER USE = 14,837 GAL/MONTH)											
93,727	100,633	105,566	113,458	116,418	116,418	80,703	80,703	91,457	98,660	94,713	92,740
		TOTAL (50% ADWR)		**178,047 GAL/YEAR**							**1185197**

APPENDIX F

EXISTING DRAINAGE AND FLOODPLAINS

FOR

THE NORTH 1ST AVENUE PROPERTIES

(APPROVAL LETTER ENCLOSED)

Town of Oro Valley
Development and Infrastructure Services

March 7, 2016

Corey Thompson, P.E.
The WLB Group, Inc.
Tucson, AZ 85711

RE: OV1501398, EXISTING DRAINAGE AND FLOODPLAIN ANALYSIS FOR THE FIRST AVENUE PROPERTIES; 3rd Submittal

Dear Corey,

We have completed the third review of Drainage Report for the Existing Drainage and Floodplain Analysis for the First Avenue Properties and do not have any additional comments.

You may contact me at (520) 229-4824 if you have any questions.

Sincerely,

Josh Potter, P.E.
Senior Civil Engineer
Attachment: Redlined Improvement Plans,

EXISTING DRAINAGE AND FLOODPLAIN ANALYSIS FOR THE NORTH 1ST AVENUE PROPERTIES

LOCATED WITHIN A PORTION OF SECTIONS 6 & 7, T12S, R14E, G&SRM TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA TOWN OF ORO VALLEY PROJECT NUMBER: OV1501398

September 16, 2015

Revised November 18, 2015

Revised February 11, 2016

PREPARED BY:

THE WLB GROUP, INC.

4444 East Broadway Boulevard

Tucson, Arizona 85711

PRINCIPAL INVESTIGATOR:

Erik Beam, CFM

Hydrologic/Hydraulic Designer



WLB No. 182053-A003-0400

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The WLB Group Inc.

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Digital Data CD ..... Back of Report Map Pocket

Registered Professional Engineer (Civil)
CERTIFICATE NO.
22217
COREY
THOMPSON
Date Signed 2-22-16
ARIZONA, U.S.A.
Expires 09/30/16

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APPENDICES

APPENDIX — SECTION 3

Appendix A - Hydrologic Data
- NOAA 14 Precipitation Data
- Soils Data
- Existing Condition HEC-HMS Data for Wash A
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  - Wash A6 (Villages at Silverhawke) – Existing Condition
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  - Wash B Lower (Nakoma Sky) – Existing Condition
  - Wash B Upper (Sanctuary At Silverhawke) – Existing Condition
  - Wash B2 (Sanctuary At Silverhawke) – Existing Condition

Appendix C – Figures
- Figure 3 – Pre-Development Watershed Map
- Figure 4 – Floodplain Map

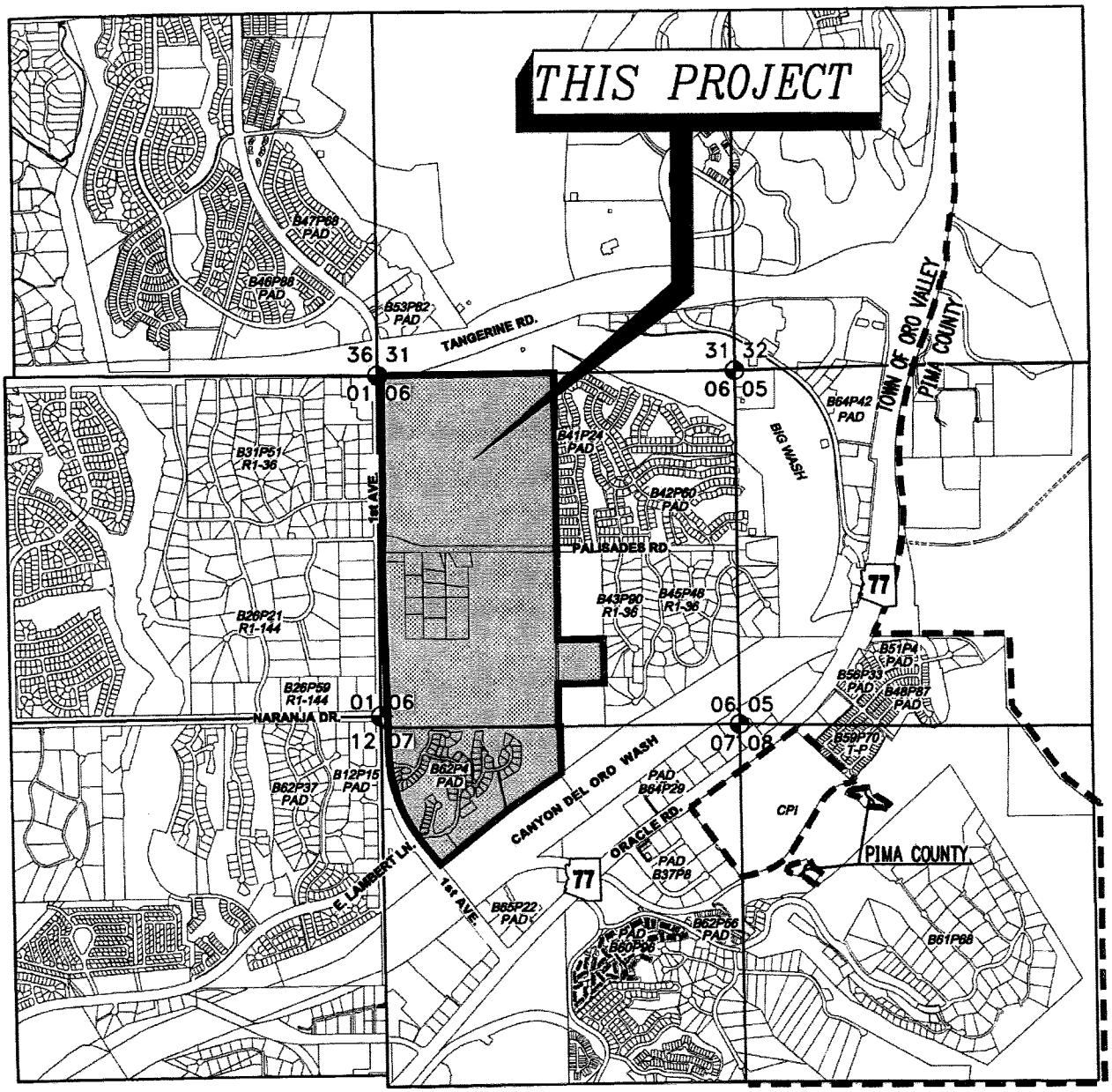
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1.0 INTRODUCTION

This drainage analysis has been prepared in support of the existing hydrologic and hydraulic conditions for the property east of North 1st Avenue that contain the following projects: Silverhawke, Sanctuary at Silverhawke and Nakoma Sky. The site is bounded on the west by the North 1st Avenue, on the south by Canada Del Oro Wash, on the north by East Tangerine Road, and on the east by Catalina Shadows Estates (Bk. 41 Pg. 24), property owned by the City of Tucson and property owned by Oro Valley Lofts LLC. The site is more specifically described as being a portion of Sections 6 & 7, Township 12 South, Range 14 East, Gila and Salt River Meridian, Town of Oro Valley, Pima County, Arizona.

On-site stormwater runoff drains from the north to the south predominately by natural drainage swales and overland sheet flow. The average slope of the site is approximately 1.5 to 3 percent. Existing site vegetation consists primarily of native desert brush, cactus, Mesquite and Palo Verde trees. Within these three properties, three major watersheds have been identified where stormwater runoff exits the project site at three points of concentration and ultimately discharging into the Cañada Del Oro Wash immediately downstream. There are unimproved dirt roads and trails throughout the project area. There is an area of low density residential development within the area of this analysis, located at the southeast corner ofPalisades Road and North 1st Avenue.

The southern portion of the Nakoma Sky project site is located within a Zone AE, which is defined as areas determined to be inside of the 100-year chance floodplain. The remaining areas of the project site is located within a Zone X, which is defined as areas determined to be outside of the 500-year chance floodplain, and shown on FIRM Panels 04019C1080L & 04019C1090L, effective date June 16, 2011 (see Figure 2). However, based on the Town of Oro Valley Floodplain Ordinance, Article 17-3 (Section 17-3-2), non-FEMA washes and/or sheet flow areas within the project site having a 100-year peak discharges of 50 cfs or more must have floodplains mapped. As discussed previously, there are six floodplains on-site that exceed 50 cfs; therefore, this ordinance is applicable to this project. Wash A (CP A) is the main wash that flows through the center of the site discharging directly into the Canada Del Oro Wash and has a peak flow discharge of 827cfs. Wash B (CP B) is located adjacent to the east right-of-way line of 1st Avenue and has a discharge of 265 cfs.



3"= 1 MILE

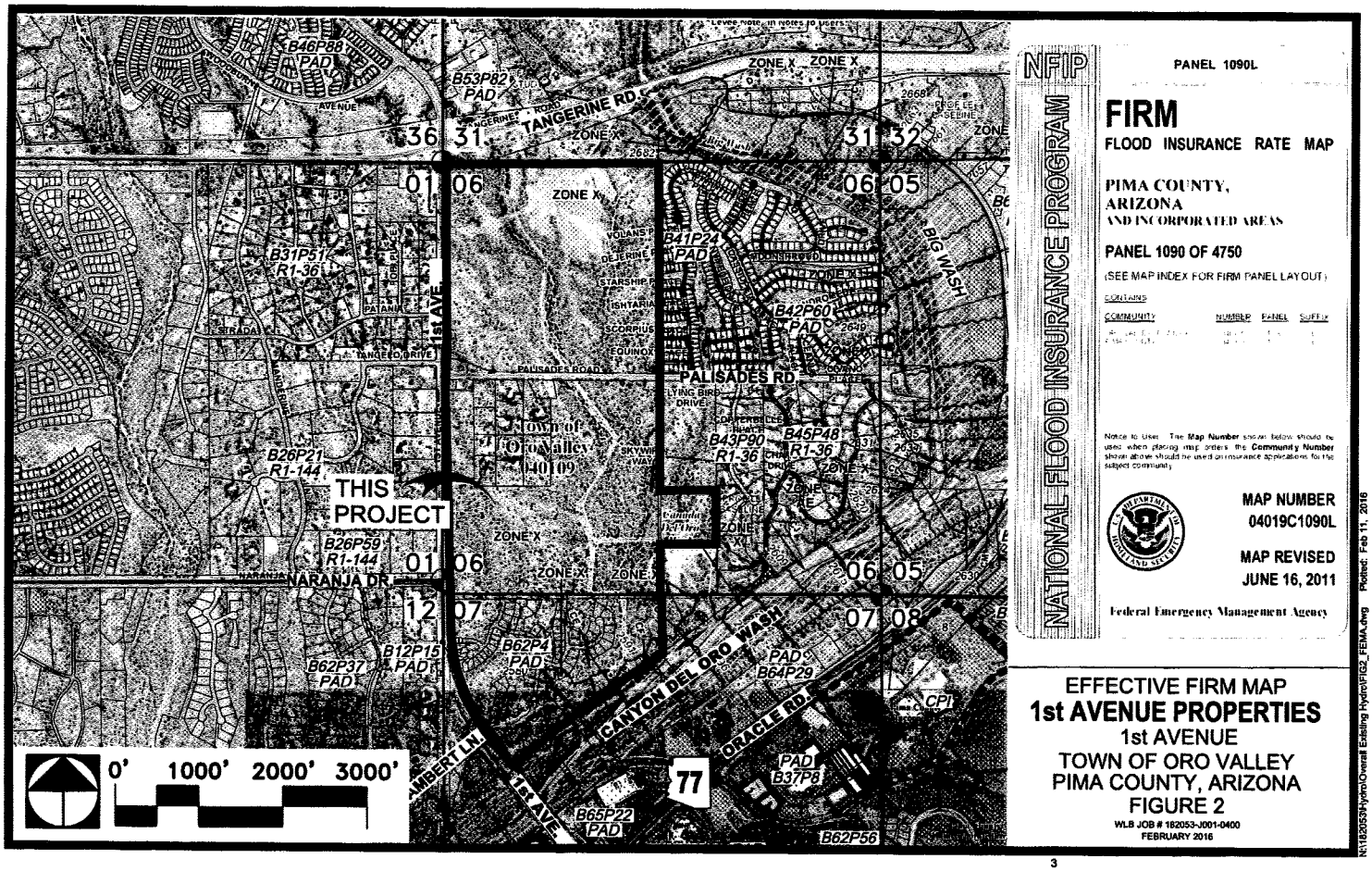
LOCATION MAP

A PORTION OF SECTIONS 6 & 7,
TOWNSHIP 12S, RANGE 14E, G.&S.R.M.
TOWN OF ORO VALLEY, PIMA COUNTY, ARIZONA

The WLB Group INC. WLB
Offices located in Tucson, Phoenix
and Las Vegas, NV
4444 East Broadway
Tucson, Arizona 85711 (520) 881-7480

FIGURE 1

N:\1182053\Hydro\Overall Existing Hydro\FIG1 LOCATION MAP.dwg Plotted: Feb 11, 2016



EFFECTIVE FIRM MAP

1st AVENUE PROPERTIES

1st AVENUE
TOWN OF ORO VALLEY
PIMA COUNTY, ARIZONA
FIGURE 2

WLB JOB # 182053-J001-0400
FEBRUARY 2016

N:\182053\Hydro\Overall Existing Hydro\FIG2_FEMA.dwg Plotted: Feb 11, 2016

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1.1 OBJECTIVES

The objective of this report is to analyze the existing hydrologic and hydraulic conditions evaluating the conveyance of on-site runoff associated with the 1st Avenue properties. This has been accomplished by:

1. Development of a design that complies with both the Development Standards Code of The Town of Oro Valley, 2013, and the Drainage Criteria Manual, 2010 Edition (References 2 and 3).

2. Estimation of the existing hydrologic and hydraulic conditions given the present densities, i.e. pre-development 100-year peak stormwater discharges.

3. Estimation of existing floodplain limits and erosion hazard setbacks for discharge values greater than 50 cfs.

1.2 PROCEDURES

The general procedure within this report was to estimate the stormwater runoff rates and then determine the hydraulic properties has the stormwater discharges through the properties. The actual procedure is more specifically described as follows:

1. On-site watersheds are delineated using 1" = 200' topography NAVD 88 with 1' contour intervals. Watershed areas were determined using the software package AutoDesk/AutoCAD 2007 (Reference 5). Basin coefficients and imperviousness values were based on parameters found within Town of Oro Valley Drainage Criteria Manual (Reference 2).

2. The 2-, 10-, 50- and 100-year pre-development peak stormwater discharges affecting this project were estimated in accordance with the Rational Method and HEC-HMS. Computer printouts of this spreadsheet have been included in Appendix A of this report.

3. All floodplain models greater than 50 cfs have been rated, using HEC-RAS 5.0 by The Army Corp of Engineers, Hydraulic Engineering Center. The results of these calculations are included in Appendix B of this report.

2.0 EXISTING CONDITIONS DRAINAGE

See the Watershed Map and Floodplain Map (Figure's 3 & 4) for basin delineations, concentration points, and floodplain limits.

ON-SITE DRAINAGE

In accordance with Development Standards Code of the Town of Oro Valley, 2013, and the Drainage Criteria Manual, 2010 Edition, two methods for hydrology were utilized; the Rational Method and Rainfall-Runoff Modeling (HEC-HMS). The Rational Method was utilized to determine peak runoff rates for drainage areas less than 100 acres. The Hydrologic Modeling System, HEC-HMS 3.4, provided by the US Army Corps of Engineers Hydrologic Engineering Center was used to determine peak runoff rates for drainage areas greater than 100 acres. These methods and formulas are discussed in greater detail later in this section of the report.

The site is currently mostly native desert landscape, with some existing culvert crossings, and a few existing residential lots and structures along the existing alignment of Palisades Drive. On-site flows are collected throughout the site by several unnamed washes which converge into two different washes (Wash A and Wash B) throughout the site. These washes will direct the runoff to the south through the project site and ultimately into the Cañada Del Oro Wash.

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OFF-SITE DRAINAGE

The offsite watersheds extend north of Tangerine Road and into Rancho Vistoso Neighborhood 5. These offsite watersheds contain a mixture of commercial and residential developments and vacant land. These offsite watersheds are located within 1 or 2 main watersheds and have been evaluated with the developed weighted runoff coefficient in addition to evaluating the natural trend, collection points of runoff, and calculate discharges in the existing condition that represents commercial and residential developments. These concentration points are depicted on Figure 3, the Pre-Developed Watershed Map, and include both the off- and on-site sub-basins as one, providing a cumulative estimation of the discharges at key points affecting the property, and its future design. The numbering scheme is built in such a fashion as to designate sub-basins (CP A3 is a sub-basin of CP A, etc.). These concentration points have been labeled to coincide with the onsite existing drainage for the 1st Avenue properties identifying the existing on-site and off-site hydrologic and hydraulics impacting these three properties (Villages at Silverhawke, Sanctuary at Silverhawke, and Nakoma Sky). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the sub-watersheds including the remaining areas (see Figure 3).

The offsite conditions can be described as having a vegetative covering of approximately 25 percent of grass and brush. The impervious cover has been estimated to be 0% to 60% for the existing residential developments, commercial developments, and roads. Soil characteristics and vegetative cover are based on the typical soil profiles and information provided in the Soil Survey. The offsite topography was provided by Pima Association of Governments (PAG) 2008 topography. This method utilizes Light Detection and Ranging (LIDAR), LIDAR, which is a remote sensing system used to collect topographic data. This data is collected using aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and has a published vertical precision of 15 centimeters (6 inches). The 2008 PAG Lidar is a 1 foot contour interval based on NAVD 88 datum.

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404 COMPLIANCE STATEMENT

This development, existing properties east of 1st Avenue contains a gross area of approximately 330 acres. The site is located in a portion of Sections 6 & 7, Township 12 South, Range 14 East, Gila and Salt River Meridian, Pima County, Arizona.

I, Corey Thompson, am a Registered Professional Civil Engineer in the State of Arizona and am responsible for the preparation of the report for the above-referenced project. I attest to the following statement:

This project has been determined to be jurisdictional pursuant to Section 404 of the Federal Water Pollution Control Act amendments of 1972, 33 USC 1334.

ATTESTED TO THIS 11TH DAY OF February, 2016

Corey Thompson

COUNTY OF PIMA)

) SS

STATE OF ARIZONA)

THIS STATEMENT WAS ACKNOWLEDGED BEFORE ME THIS 11TH DAY OF February, 2016

NOTARY PUBLIC

OFFICIAL SEAL
EDWARD J. RICE
NOTARY PUBLIC-ARIZONA
PIMA COUNTY
My Comm. Exp. April 25, 2017

MY COMMISSION EXPIRES

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3.0 HYDROLOGIC AND HYDRAULIC RESULTS

3.1 HYDROLOGIC RESULTS

The following tables are found in this section:

- Table of Hydrologic Soil Types.
- Table of 2-, 10-, 50-, and 100-Year Pre-Developed Peak Discharge Rates.

See the Off-Site/On-Site Existing Conditions Watershed Map (Figure's 3 & 4) for basin delineations and Concentration Points.

In accordance with Development Standards Code of The Town of Oro Valley, 2013, and the Drainage Criteria Manual, 2010 Edition, two methods for hydrology were utilized; the Rational Method and Rainfall-Runoff Modeling (HEC-HMS). The Rational Method was utilized to determine peak runoff rates for drainage areas less than 100 acres. The Hydrologic Modeling System, HEC-HMS 3.4, provided by the US Army Corps of Engineers Hydrologic Engineering Center was used to determine peak runoff rates for drainage areas greater than 100 acres. These methods and formulas are discussed in greater detail later in this section of the report.

3.2 Soils

According to a soil map for the Eastern Part of Pima County Arizona, provided by the United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS), there are 3 different soils identified within the project watersheds. The soil survey is attached in Appendix A and can also be found on Figure 3. Soil types vary greatly across the watersheds for the project. See Figure 3 for soil type distributions and boundaries within the watersheds. Soil characteristics and vegetative cover are based on the typical soil profiles and information provided in the Soil Survey. Three hydrologic soil group types have been identified at the site and are described in the following table on the next page.

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TABLE OF HYDROLOGIC SOIL TYPES	
SOIL DESCRIPTION	**HYDROLOGIC SOIL TYPE**
Tubac Gravelly Loam	100% - C
Pinaleno-Stagecoach Complex	100% - B
Pinaleno-Stagecoach-Palos Verdes Complex	82% - B & 18% - C

3.3 Topography

One-foot contour mapping was developed for the project area and were obtained using a method called Digital Photogrammetric Mapping (DPM). DPM utilizes first order stereo plotters to perform the photogrammetric approach of collecting the digital terrain modeling (DTM) with full planimetrics. PC-based VR-1 software is used in the real-time stereo compilation and in generating contours from the DTM. This method adheres to the National Map Accuracy Standards, which means, at least 90% of contours must be within ½ of the contour interval and well defined objects must be within 1/40" horizontal position at map scale. Furthermore, spot elevations must be within ¼ of the contour interval. The photogrammetric mapping generated 1' and 5' contour intervals on the NAVD 88 datum.

As mentioned earlier, Pima Association of Governments (PAG) 2008 topography was used for the offsite topography. They chose a method called Light Detection and Ranging (LIDAR), LIDAR, which is a remote sensing system used to collect topographic data. This datais collected using aircraft-mounted lasers capable of recording elevation measurements at a rate of 2,000 to 5,000 pulses per second and has a published vertical precision of 15 centimeters (6 inches). The 2008 PAG Lidar is a 1 foot contour interval based on NAVD 88 datum.

3.4 Rational Method

In the Town of Oro Valley Drainage Criteria Manual (2010 Edition), the rational method is utilized for uniform drainage areas that are less than 100 acres in size. The rational method calculates a peak

flow discharge (Q) based on the runoff coefficient (C), average rainfall intensity of calculated rainfall duration for a selected rainfall return period (i, inches/hr), and the contributing drainage area (A, <100acres).

The runoff coefficient (C) is determined based on the soil type, vegetative types and densities, and the existing or projected land use character. The average rainfall intensity (i) is obtained from an intensity-duration-frequency (I-D-F) graph. The Time of Concentration (T_c) is a function of the rainfall intensity (i). Per TOV Criteria minimum rainfall duration of 5 minutes is used if the calculated T_c is less than 5 minutes. The T_c should not exceed 60 minutes. The 1 hour rainfall depths for the 2-, 10-, 50- and 100-year storm events were obtained from National Oceanic and Atmospheric Administration Atlas 14 (NOAA 14).

The 2-, 10-, 50- and the 100-year storm events were analyzed using the Rational Method for all drainage areas less than 100 acres and T_c less than 60 minutes, which would include watershed B and C. The hydrologic worksheets utilizing the rational method and associated project variables are attached in Appendix A.

3.5 HEC-HMS Method

3.5.1 Rainfall

Rainfall Depth-Duration-Frequency (D-D-F) data from NOAA Atlas 14 was used for design storms in the analyses. The rainfall data is shown in Appendix A. The rainfall depths were used to develop frequency design storms within the HEC-HMS model. In accordance with the TOV Manual, a 3-hour design storm was used for drainage areas greater than 100 acres, but less than 10 square mile. A 24-hour design storm was used for drainage areas greater than 10 square mile. The 2-, 10-, 50- and the 100-year storm events were analyzed for all drainage areas greater than 100 acres.

3.5.2 Rainfall Losses

The Green & Ampt Method was utilized to estimate rainfall losses. The parameters used in this method were determined by the soil type and vegetative cover of the drainage basin. Using the data provided in the hydrologic soil types and vegetative cover were determined for drainage areas. Tables 3-1 and 3-2 from the ADOT Manual were used to determine the input parameters for individual soil types that are present within the project. The soil type varied throughout most drainage areas; therefore, composite hydraulic conductivity (XKSAT) values were determined based on soil subareas using Equation 3.1 of the ADOT drainage manual. Figure 3-3 of the ADOT Manual was then used to determine composite values of moisture deficit (DTHETA) and suction (PSIF) based on the composite XKSAT values. A weighted vegetative correction factor (Ck) was applied to the composite XKSAT value based on the vegetative cover of the subareas. A weighted initial loss value was determined based on existing and future land use. Developed impervious values were estimated based on future anticipated land uses. Calculations and estimated values are provided in Appendix A. The

3.5.3 Runoff

The Clark Unit Hydrograph Method was used to develop runoff hydrographs for the analysis. This method requires the estimation and input of three parameters; the Time of Concentration (Tc), the Storage Coefficient (R), and a Time-Area Relation. The Times of Concentration was determined using Equation 4-1 from the ADOT Manual which is classified for desert/mountain regions. The Storage Coefficient (R) was determined using Equation 4-4 from the ADOT Manual. HEC-HMS uses a default time-area relation curve within the program in the Clark Unit Hydrograph calculation. Calculations and estimated values for the Clark Unit Hydrograph input parameters are provided in AppendixA.

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3.6 Hydrologic Results

3.6.1 Existing Conditions

The site consists primarily of native desert landscape, with some existing trails, dirt roads and minor clearing grading in the area of the alignment of the existing main sewer line. On-site flows are collected throughout the site by a few unnamed washes which converge into two different main washes (Wash A and Wash B) along the eastern and western boundaries of the site. These washes will direct the runoff to the south through the project site and through culvert crossing beneath 1st Avenue (Wash B) or through the Nakoma Sky (Wash A) and continue south in natural drainage course ultimately entering the Cañada Del Oro Wash, located approximately 0.5 miles south.

Under existing conditions the site has a vegetative covering of approximately 25 percent of grass and brush. The impervious cover has been estimated to be 0% to 10% for the existing residential developments and roads. The soils for the project site consist of Pinaleno-Stagecoach-Palos Verdes Complex and Pinaleno-Stagecoach Complex. According to the U.S. National Resources Conservation Service (NRCS), the Pinaleno-Stagecoach-Palos Verdes Complex is 82% Soil Group B and 18% Soil Group C; the Pinaleno-Stagecoach Complex is 100% Soil Group B.

The site has been divided into 3 main watersheds in order to evaluate the natural trend, collection points of runoff, and calculate discharges in the existing condition. These concentration points are depicted on Figure 3, the Pre-Developed Watershed Map, and include both the off- and on-site sub-basins as one, providing a cumulative estimation of the discharges at key points affecting the property, and its future design. The numbering scheme is built in such a fashion as to designate sub-basins (CP A3 is a sub-basin of CP A, etc.). These concentration points have been labeled to coincide with the existing drainage report for the First Avenue properties identifying the existing on- and off-site hydrologic and hydraulics impacting these 3 properties (Villages at Silverhawke, Sanctuary at Silverhawke,

The WLB Group Inc.

and Nakoma Sky). All upstream sub-watersheds that contribute to the downstream sub-watershed concentration point have been calculated using the combined total area of the sub-watersheds including the remaining areas (see Figure 3). These watersheds have been determined to have areas ranging from 7.1 to 94.7 acres, with 100-year peak discharges of 88 to 265 cfs, respectively. The Rational Method, as directed by the town, was used to model the hydrologic conditions of these watersheds. The estimated watershed areas, with corresponding 2-, 10-, 50- and 100-year peak discharge rates, for each proposed concentration point are provided in the following table (excerpt from Existing Condition for the 1st Avenue Properties Report):

Table of Off-Site/On-Site Pre Developed 2-, 10-, 50-, and 100-Year Discharges

Concentration Point	Drainage Area (ac)	2-Year (cfs)	10-Year (cfs)	50-Year (cfs)	100-Year (cfs)
A	557	195	419	713	827
A1	19.2	11.4	24.1	43	49.8
A2	51.2	16.8	35.5	60	69.4
A3	44.8	11.9	26.2	45	51.9
A4	32	11.5	24.9	43	49.7
A5	64 (294)	19.7 (104)	46 (215)	81 (358)	94 (414)
A6	57.6	21.8	50	88	102.6
A7	12.8	5.6	10.9	17.9	20.5
A8	19.2	11.3	21.7	36	41.2
A9	44.8	27.5	50	78	88
A10	96	27.6	55	88	102
Nakoma Sky	506	175	370	628	728
B	94.7	51	129	249	265
B1	14.3	18.1	35	61	63
B2	18.7	8.2	29	61	66
B3	48.8	30	72	138	147

B4	28.8	22	52	98	104
C	16.6	14.8	41	82	88

4.0 CONCLUSION

The predeveloped conditions of the existing properties east of 1st Avenue have been analyzed in this report in compliance with Town of Oro Valley standards. This report and concepts developed within will provide for the safe and efficient collection and conveyance of all on-site and off-site generated runoff. Development of these properties, in accordance with the drainage concept, will not produce any adverse effects for adjacent or downstream property owners. However, deviation in construction from the improvement plans, which will be produced for these projects on these properties and be based on this drainage report, may nullify the conclusions of this report, as may variations in climatic conditions, vegetation and erosion/deposition.

The WLB Group Inc.

5.0 REFERENCES

1. Highway Drainage Design Manual, Hydrology, FHW A-A293-281, March, 1993, prepared by Arizona Department of Transportation

2. Drainage Criteria Manual of The Town of Oro Valley, Pima County, Arizona, 2010 Edition, Prepared by DMA Engineering, LLC. And Town of Oro Valley Department of Public Works Staff, 11000 N. La Cañada Drive, Oro Valley, Arizona 85737

3. Oro Valley Town Code, Current through Ordinance (O)13-20, passed September 18, 2013, Code Publishing Company, Seattle, Washington.

4. FIRM Panel 04019C1080L, revision date: June 16, 2011, Federal Emergency Management Administration (FEMA) Flood Insurance Rate Map.

5. AutoCAD, v2007 Land, by AutoDesk, 111 McInnis Parkway, San Rafael, CA 94903

6. HY-8, v7.2, July 20, 2009, Federal Highway Administration, Department of Transportation, 400 Seventh St., S.W. Washington, D.C. 20590.

7. FlowMaster, v8i, Bentley Systems, Inc., 27 Siemons Company Drive, Watertown, Ct. 06795.

APPENDIX A
HYDROLOGIC COMPUTATIONS

NOAA 14 PRECIPITATION DATA

Precipitation Frequency Data Server

NOAA Atlas 14, Volume 1, Version 5
Location name: Tucson, Arizona, US*
Latitude: 32.4657°, Longitude: -110.9760°
Elevation: ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.247 (0.218-0.283)	0.320 (0.283-0.367)	0.424 (0.372-0.484)	0.503 (0.439-0.573)	0.609 (0.525-0.692)	0.690 (0.588-0.786)	0.773 (0.649-0.884)	0.857 (0.708-0.983)	0.968 (0.782-1.12)	1.05 (0.835-1.23)
10-min	0.376 (0.332-0.432)	0.487 (0.431-0.559)	0.646 (0.566-0.737)	0.765 (0.668-0.872)	0.927 (0.799-1.05)	1.05 (0.894-1.20)	1.18 (0.988-1.34)	1.30 (1.08-1.50)	1.47 (1.19-1.71)	1.60 (1.27-1.87)
15-min	0.467 (0.412-0.535)	0.604 (0.534-0.693)	0.801 (0.702-0.914)	0.948 (0.828-1.08)	1.15 (0.990-1.31)	1.30 (1.11-1.48)	1.46 (1.23-1.67)	1.62 (1.34-1.86)	1.83 (1.48-2.11)	1.99 (1.57-2.32)
30-min	0.628 (0.555-0.721)	0.814 (0.719-0.933)	1.08 (0.945-1.23)	1.28 (1.11-1.46)	1.55 (1.33-1.76)	1.75 (1.49-2.00)	1.97 (1.65-2.25)	2.18 (1.80-2.50)	2.46 (1.99-2.85)	2.68 (2.12-3.12)
60-min	0.778 (0.686-0.892)	1.01 (0.890-1.16)	1.33 (1.17-1.52)	1.58 (1.38-1.80)	1.92 (1.65-2.18)	2.17 (1.85-2.47)	2.43 (2.04-2.78)	2.69 (2.23-3.09)	3.05 (2.46-3.52)	3.32 (2.63-3.87)
2-hr	0.899 (0.796-1.02)	1.15 (1.02-1.31)	1.50 (1.32-1.70)	1.77 (1.55-2.01)	2.14 (1.86-2.42)	2.44 (2.09-2.75)	2.74 (2.32-3.10)	3.05 (2.53-3.46)	3.46 (2.81-3.97)	3.79 (3.01-4.38)
3-hr	0.958 (0.853-1.09)	1.21 (1.08-1.38)	1.56 (1.39-1.78)	1.84 (1.62-2.09)	2.24 (1.95-2.53)	2.55 (2.19-2.88)	2.88 (2.42-3.27)	3.22 (2.67-3.67)	3.70 (2.97-4.25)	4.08 (3.20-4.73)
6-hr	1.12 (0.996-1.26)	1.40 (1.25-1.58)	1.77 (1.57-2.00)	2.07 (1.83-2.34)	2.50 (2.18-2.81)	2.84 (2.44-3.19)	3.20 (2.71-3.60)	3.57 (2.97-4.04)	4.09 (3.31-4.66)	4.51 (3.57-5.18)
12-hr	1.28 (1.15-1.43)	1.61 (1.45-1.80)	2.01 (1.80-2.25)	2.34 (2.08-2.61)	2.80 (2.46-3.11)	3.15 (2.75-3.51)	3.53 (3.03-3.94)	3.91 (3.31-4.40)	4.44 (3.67-5.04)	4.86 (3.94-5.57)
24-hr	1.51 (1.38-1.67)	1.89 (1.72-2.09)	2.37 (2.16-2.62)	2.77 (2.51-3.05)	3.31 (2.98-3.67)	3.75 (3.34-4.15)	4.20 (3.71-4.68)	4.67 (4.08-5.23)	5.32 (4.56-6.02)	5.83 (4.94-6.65)
2-day	1.69 (1.54-1.86)	2.12 (1.94-2.33)	2.67 (2.44-2.94)	3.13 (2.84-3.44)	3.76 (3.39-4.14)	4.26 (3.80-4.71)	4.78 (4.22-5.32)	5.33 (4.65-5.97)	6.08 (5.21-6.89)	6.68 (5.63-7.66)
3-day	1.80 (1.64-1.99)	2.26 (2.06-2.49)	2.87 (2.61-3.16)	3.37 (3.06-3.71)	4.09 (3.67-4.51)	4.67 (4.15-5.17)	5.29 (4.64-5.89)	5.95 (5.15-6.68)	6.88 (5.82-7.82)	7.63 (6.34-8.78)
4-day	1.91 (1.75-2.12)	2.40 (2.19-2.65)	3.06 (2.78-3.38)	3.62 (3.27-3.99)	4.42 (3.95-4.88)	5.08 (4.50-5.63)	5.80 (5.07-6.47)	6.57 (5.64-7.39)	7.68 (6.43-8.75)	8.59 (7.06-9.90)
7-day	2.21 (2.01-2.45)	2.78 (2.52-3.08)	3.55 (3.21-3.93)	4.21 (3.79-4.67)	5.19 (4.62-5.76)	6.00 (5.29-6.70)	6.90 (6.00-7.76)	7.87 (6.74-8.93)	9.29 (7.76-10.7)	10.5 (8.58-12.2)
10-day	2.48 (2.25-2.74)	3.10 (2.82-3.43)	3.95 (3.58-4.36)	4.67 (4.21-5.16)	5.72 (5.10-6.33)	6.59 (5.82-7.32)	7.54 (6.57-8.43)	8.56 (7.35-9.66)	10.1 (8.41-11.5)	11.3 (9.26-13.1)
20-day	3.24 (2.95-3.57)	4.07 (3.71-4.48)	5.17 (4.69-5.69)	6.07 (5.49-6.69)	7.36 (6.59-8.12)	8.39 (7.45-9.30)	9.50 (8.34-10.6)	10.7 (9.24-12.0)	12.3 (10.4-14.0)	13.7 (11.4-15.7)
30-day	3.95 (3.63-4.32)	4.96 (4.54-5.40)	6.20 (5.66-6.76)	7.21 (6.57-7.86)	8.59 (7.77-9.39)	9.68 (8.69-10.6)	10.8 (9.62-11.9)	12.0 (10.6-13.3)	13.6 (11.8-15.3)	14.9 (12.7-16.9)
45-day	4.81 (4.42-5.23)	6.02 (5.54-6.56)	7.46 (6.86-8.12)	8.57 (7.87-9.34)	10.0 (9.17-11.0)	11.2 (10.1-12.2)	12.3 (11.1-13.5)	13.4 (12.0-14.8)	14.8 (13.1-16.6)	16.0 (13.9-18.0)
60-day	5.46 (5.01-5.94)	6.83 (6.28-7.45)	8.48 (7.78-9.23)	9.74 (8.92-10.6)	11.4 (10.4-12.5)	12.7 (11.5-13.9)	13.9 (12.6-15.3)	15.2 (13.6-16.8)	16.8 (14.9-18.8)	18.1 (15.8-20.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

SOILS DATA

Soil Map—Pima County, Arizona, Eastern Part
(First Avenue Properties)



MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

Soil Survey Area: Pima County, Arizona, Eastern Part
Survey Area Data: Version 12, Oct 1, 2015

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

Date(s) aerial images were photographed: Jan 22, 2015—Feb 3, 2015

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

Map Unit Legend

Pima County, Arizona, Eastern Part (AZ669)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
5	Arizo-Riverwash complex, 0 to 3 percent slopes	31.7	3.5%
19	Comoro sandy loam, 0 to 2 percent slopes	3.2	0.4%
60	Pinaleno-Stagecoach complex, 5 to 16 percent slopes	248.7	27.5%
61	Pinaleno-Stagecoach-Palos Verdes complex, 10 to 35 percent slopes	468.7	51.8%
81	Tubac gravelly loam, 1 to 8 percent slopes	153.1	16.9%
Totals for Area of Interest		**905.3**	**100.0%**

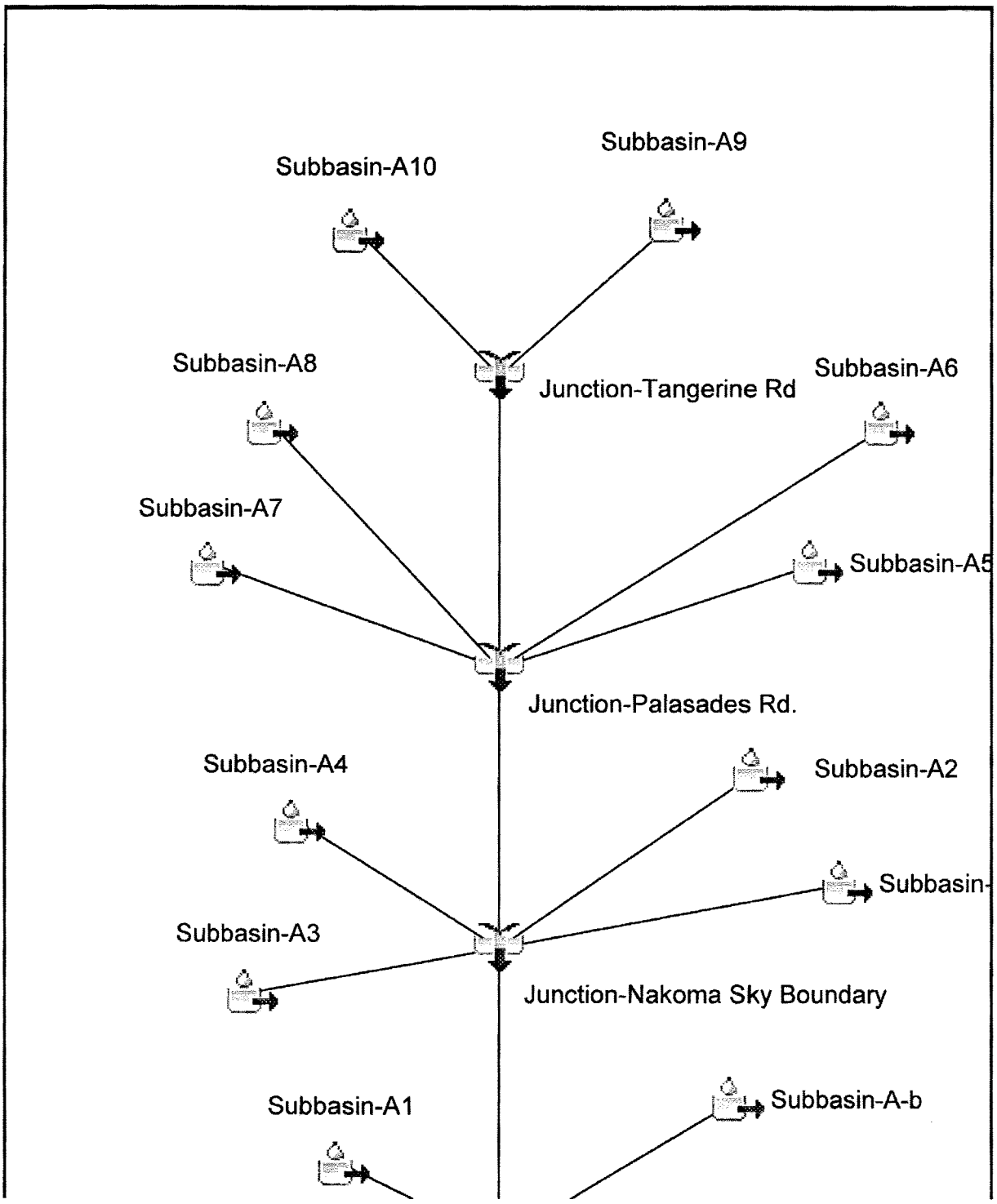
PRE DEVELOPED COMPUTATIONS
(HEC-HMS WORKSHEETS)

HEC-HMS

Project : Wash A

Basin Model : Major Watershed A

Sep 16 13:12:44 MST 2015



Project: Wash A Simulation Run: Run 2

Start of Run: 14May2015, 12:00
End of Run: 15May2015, 00:00
Compute Time: 16Sep2015, 13:03:18

Basin Model: Major Watershed A
Meteorologic Model: 2-yr; 3-hr
Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-A10	0.15	27.6	14May2015, 14:25	0.60
Subbasin-A9	0.07	27.5	14May2015, 14:05	0.82
Junction-Tangerine Rd	0.22	49.6	14May2015, 14:10	0.67
Subbasin-A5	0.10	19.7	14May2015, 14:10	0.33
Subbasin-A6	0.09	21.8	14May2015, 14:05	0.33
Subbasin-A8	0.03	11.3	14May2015, 13:55	0.60
Subbasin-A7	0.02	5.6	14May2015, 14:00	0.60
Junction-Palasades Rd	0.46	104.2	14May2015, 14:05	0.52
Subbasin-A-a	0.13	31.7	14May2015, 14:05	0.33
Subbasin-A2	0.08	16.8	14May2015, 14:10	0.47
Subbasin-A3	0.07	11.9	14May2015, 14:10	0.42
Subbasin-A4	0.05	11.5	14May2015, 14:05	0.42
Junction-Nakoma Sky Boundary	0.79	174.9	14May2015, 14:05	0.47
Subbasin-A-b	0.05	16.4	14May2015, 13:55	0.33
Subbasin-A1	0.03	11.4	14May2015, 13:50	0.33
CDO Wash (CP A)	0.87	194.7	14May2015, 14:05	0.46

Project: Wash A Simulation Run: Run 3 (10-yr; 3-hr)

Start of Run: 14May2015, 12:00 Basin Model: Major Watershed A
End of Run: 15May2015, 00:00 Meteorologic Model: 10-yr; 3-hr
Compute Time: 16Sep2015, 13:03:45 Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-A10	0.15	55.0	14May2015, 14:30	1.12
Subbasin-A9	0.07	50.0	14May2015, 14:05	1.37
Junction-Tangerine Rd	0.22	95.7	14May2015, 14:15	1.20
Subbasin-A5	0.10	45.7	14May2015, 14:10	0.82
Subbasin-A6	0.09	49.8	14May2015, 14:05	0.82
Subbasin-A8	0.03	21.7	14May2015, 13:55	1.12
Subbasin-A7	0.02	10.9	14May2015, 14:00	1.12
Junction-Palasades Rd	0.46	215.1	14May2015, 14:10	1.04
Subbasin-A-a	0.13	72.3	14May2015, 14:05	0.82
Subbasin-A2	0.08	35.5	14May2015, 14:10	0.97
Subbasin-A3	0.07	26.2	14May2015, 14:15	0.92
Subbasin-A4	0.05	24.9	14May2015, 14:05	0.92
Junction-Nakoma Sky Boundary	0.79	370.4	14May2015, 14:05	0.98
Subbasin-A-b	0.05	35.8	14May2015, 13:55	0.82
Subbasin-A1	0.03	24.1	14May2015, 13:50	0.82
CDO Wash (CP A)	0.87	418.6	14May2015, 14:05	0.96

Project: Wash A Simulation Run: Run 4

Start of Run: 14May2015, 12:00
End of Run: 15May2015, 00:00
Compute Time: 16Sep2015, 13:04:16

Basin Model: Major Watershed A
Meteorologic Model: 50-yr; 3-hr
Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-A10	0.15	88.4	14May2015, 14:25	1.77
Subbasin-A9	0.07	77.7	14May2015, 14:05	2.04
Junction-Tangerine Rd	0.22	149.8	14May2015, 14:15	1.85
Subbasin-A5	0.10	80.8	14May2015, 14:10	1.44
Subbasin-A6	0.09	88.1	14May2015, 14:05	1.44
Subbasin-A8	0.03	35.9	14May2015, 13:55	1.77
Subbasin-A7	0.02	17.9	14May2015, 14:00	1.77
Junction-Palasades Rd	0.46	358.1	14May2015, 14:05	1.67
Subbasin-A-a	0.13	128.0	14May2015, 14:05	1.44
Subbasin-A2	0.08	59.9	14May2015, 14:10	1.60
Subbasin-A3	0.07	44.6	14May2015, 14:15	1.55
Subbasin-A4	0.05	42.8	14May2015, 14:05	1.55
Junction-Nakoma Sky Boundary	0.79	628.3	14May2015, 14:05	1.61
Subbasin-A-b	0.05	63.9	14May2015, 13:55	1.44
Subbasin-A1	0.03	43.1	14May2015, 13:50	1.44
CDO Wash (CP A)	0.87	712.5	14May2015, 14:05	1.59

Project: Wash A Simulation Run: Run 1 (3-HR; 100-year)

Start of Run: 14May2015, 12:00
End of Run: 15May2015, 00:00
Compute Time: 16Sep2015, 13:07:49

Basin Model: Major Watershed A
Meteorologic Model: 100-yr; 3-hr
Control Specifications: Control 1

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
Subbasin-A10	0.15	102.0	14May2015, 14:25	2.04
Subbasin-A9	0.07	88.4	14May2015, 14:05	2.33
Junction-Tangerine Rd	0.22	171.8	14May2015, 14:15	2.14
Subbasin-A5	0.10	94.3	14May2015, 14:10	1.70
Subbasin-A6	0.09	102.6	14May2015, 14:05	1.70
Subbasin-A8	0.03	41.2	14May2015, 13:55	2.04
Subbasin-A7	0.02	20.5	14May2015, 14:00	2.04
Junction-Palasades Rd	0.46	413.9	14May2015, 14:05	1.95
Subbasin-A-a	0.13	149.2	14May2015, 14:05	1.70
Subbasin-A2	0.08	69.4	14May2015, 14:10	1.87
Subbasin-A3	0.07	51.9	14May2015, 14:15	1.81
Subbasin-A4	0.05	49.7	14May2015, 14:05	1.81
Junction-Nakoma Sky Boundary	0.79	728.1	14May2015, 14:05	1.88
Subbasin-A-b	0.05	74.1	14May2015, 13:55	1.70
Subbasin-A1	0.03	49.8	14May2015, 13:50	1.70
CDO Wash (CP A)	0.87	826.5	14May2015, 14:05	1.86

CLARK UNIT HYDROGRAPHS

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	4998514	0.18	5351	1.01345	0.51	171	168.73	0.818	0.797
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A-a)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**
and
$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	3526298	0.13	3539	0.67027	0.34	136	202.90	0.619	0.513
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A-b)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**
and
$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	1470015	0.05	1811	0.34299	0.17	35	102.04	0.466	0.360
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A1)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	845271	0.03	1657	0.31383	0.16	87	277.22	0.345	0.330
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A2)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	2266915	0.08	4304	0.81515	0.41	132	161.93	0.683	0.861
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A3)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**
and
$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	2015808	0.07	4695	0.8892	0.44	134	150.70	0.716	1.038
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A4)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	1359179	0.05	3214	0.60871	0.30	109	179.07	0.550	0.717
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A5)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	2806797	0.10	3628	0.68712	0.34	72	104.79	0.699	0.682
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A6)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**
and
$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	2400661	0.09	3088	0.58485	0.29	98	167.56	0.578	0.531
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A7)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**
and
$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	724751	0.03	1968	0.37273	0.19	58	155.61	0.416	0.508
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A8)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	724751	0.03	1968	0.37273	0.19	58	155.61	0.416	0.508
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A9)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**
and
$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	1814864	0.07	2954	0.55947	0.28	71	126.91	0.581	0.604
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

CLARK UNIT HYDROGRAPH PARAMETERS[1]

PROJECT: First Avenue & Naranja (Subbasin A10)
BY: EJB
DATE: 9/16/2015

$T_C = C*A^{0.1}*L^{0.25}*Lca^{0.25}*S^{-0.2}$ (Eq. 4-1) **Time of Concentration for Desert/ Mountain watershed**

and

$R = 0.37*T_c^{1.11}*L^{0.80}*A^{-0.57}$ (Eq. 4-4) **Storage Coefficient**

Where:

C = Clark Coefficient: Desert/Mountain = 2.4, Agricultural Fields = 7.2, Urban = 3.2
A = Area, mi^2
L = Length of the watercourse to the hydraulically most distant point, mi
Lca = Length measured from the CP along L to a point on L that is perpendicular to the watershed centroid, mi
S = Watercourse Slope, ft/mi
RTIMP = Effective impervious area, percent
T_c = Time of Concentration, hours
R = Storage Coefficient, hours
y= Change in elevation, ft

Watershed	C	A, ft^2	A, mi^2	L, ft	L, mi	L_{CA}, mi	y, ft	S, ft/mi	T_c, hr	R, hr
Mountainous	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Foothills	3.2	4144428	0.15	6092	1.15379	0.58	96	83.20	0.987	1.211
Foothills 2	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003
Valley	2.4	1	0.00	1	0.00019	0.00	1	5280.00	0.001	0.003

1 ADOTs "HIGHWAY DRAINAGE DESIGN MANUAL", MARCH, 1993

PRE-DEVELOPED HYDROLOGIC COMPUTATIONS
(RATIONAL WORKSHEETS)

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B (Existing)

DESIGN DATA

DESIGN FREQUENCY		**2 YEAR**
DRAINAGE AREA [AC]	A1	14.207
	A2	44.28
	A3	36.23
TOTAL AREA	At	94.71 [AC]
DRAINAGE LENGTH [FT]		6400 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		187.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		2.92 [%]
PRECIPITATION		
P= 6 HOUR		1.40 [IN]
P = 24 HOUR		2.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.00 [IN]
TIME OF CONCENTRATION		26 [min]
RAINFALL INTENSITY		1.71 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.91
	C2	0.16
	C3	0.28
WEIGHTED RUNOFF COEFFICIENT		0.318
PEAK DISCHARGE Qp = C i A		**51.4** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B (Existing)

DESIGN DATA

DESIGN FREQUENCY		**10 YEAR**
DRAINAGE AREA [AC]	A1	7.136
	A2	3.57
	A3	3.57
TOTAL AREA	At	14.27 [AC]
DRAINAGE LENGTH [FT]		3365 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		115.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.42 [%]
PRECIPITATION		
P= 6 HOUR		2.64 [IN]
P = 24 HOUR		3.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.57 [IN]
TIME OF CONCENTRATION		15 [min]
RAINFALL INTENSITY		3.59 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.94
	C2	0.37
	C3	0.5
WEIGHTED RUNOFF COEFFICIENT		0.688
PEAK DISCHARGE Qp = C i A		**35.2** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B (Existing)

DESIGN DATA

DESIGN FREQUENCY		**50 YEAR**
DRAINAGE AREA [AC]	A1	14.207
	A2	44.28
	A3	36.23
TOTAL AREA	At	94.71 [AC]
DRAINAGE LENGTH [FT]		6400.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		187.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		2.92 [%]
PRECIPITATION		
P= 6 HOUR		2.50 [IN]
P = 24 HOUR		3.60 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.44 [IN]
TIME OF CONCENTRATION		26 [min]
RAINFALL INTENSITY		4.20 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.95
	C2	0.52
	C3	0.63
WEIGHTED RUNOFF COEFFICIENT		0.63
PEAK DISCHARGE Qp = C i A		**249.3** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B (Existing)

DESIGN DATA

DESIGN FREQUENCY		**100 YEAR**
DRAINAGE AREA [AC]	A1	7.136
	A2	3.57
	A3	3.57
TOTAL AREA	At	14.27 [AC]
DRAINAGE LENGTH [FT]		3365.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		115.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.42 [%]
PRECIPITATION		
P= 6 HOUR		3.96 [IN]
P = 24 HOUR		4.80 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.42 [IN]
TIME OF CONCENTRATION		15 [min]
RAINFALL INTENSITY		5.55 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.96
	C2	0.57
	C3	0.68
WEIGHTED RUNOFF COEFFICIENT		0.79
PEAK DISCHARGE Qp = C i A		**62.7** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B1 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**2 YEAR**
DRAINAGE AREA [AC]	A1	7.136
	A2	3.57
	A3	3.57
TOTAL AREA	At	14.27 [AC]
DRAINAGE LENGTH [FT]		3365 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		115.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.42 [%]
PRECIPITATION		
P= 6 HOUR		1.40 [IN]
P = 24 HOUR		2.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.00 [IN]
TIME OF CONCENTRATION		15 [min]
RAINFALL INTENSITY		2.25 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.91
	C2	0.16
	C3	0.28
WEIGHTED RUNOFF COEFFICIENT		0.565
PEAK DISCHARGE Qp = C i A		**18.1** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B1 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**10 YEAR**
DRAINAGE AREA [AC]	A1	7.136
	A2	3.57
	A3	3.57
TOTAL AREA	At	14.27 [AC]
DRAINAGE LENGTH [FT]		3365 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		115.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.42 [%]
PRECIPITATION		
P= 6 HOUR		2.64 [IN]
P = 24 HOUR		3.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.57 [IN]
TIME OF CONCENTRATION		15 [min]
RAINFALL INTENSITY		3.59 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.94
	C2	0.37
	C3	0.5
WEIGHTED RUNOFF COEFFICIENT		0.688
PEAK DISCHARGE Qp = C i A		**35.2** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B1 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**50 YEAR**
DRAINAGE AREA [AC]	A1	7.136
	A2	3.57
	A3	3.57
TOTAL AREA	At	14.27 [AC]
DRAINAGE LENGTH [FT]		3365.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		115.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.42 [%]
PRECIPITATION		
P= 6 HOUR		2.50 [IN]
P = 24 HOUR		3.60 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.44 [IN]
TIME OF CONCENTRATION		15 [min]
RAINFALL INTENSITY		5.59 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.95
	C2	0.52
	C3	0.63
WEIGHTED RUNOFF COEFFICIENT		0.76
PEAK DISCHARGE Qp = C i A		**60.8** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B1 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**100 YEAR**
DRAINAGE AREA [AC]	A1	7.136
	A2	3.57
	A3	3.57
TOTAL AREA	At	14.27 [AC]
DRAINAGE LENGTH [FT]		3365.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		115.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.42 [%]
PRECIPITATION		
P= 6 HOUR		3.96 [IN]
P = 24 HOUR		4.80 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.42 [IN]
TIME OF CONCENTRATION		15 [min]
RAINFALL INTENSITY		5.55 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.96
	C2	0.57
	C3	0.68
WEIGHTED RUNOFF COEFFICIENT		0.79
PEAK DISCHARGE Qp = C i A		**62.7** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B2 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY			**2 YEAR**
DRAINAGE AREA [AC]		A1	0.000
		A2	14.94
		A3	3.73
TOTAL AREA		At	18.67 [AC]
DRAINAGE LENGTH [FT]			2696 [FT]
ELEVATION			
TOP OF DRAINAGE AREA			84.00
AT STRUCTURE			0.00
DRAINAGE AREA SLOPE [%]			3.12 [%]
PRECIPITATION			
P= 6 HOUR			1.40 [IN]
P = 24 HOUR			2.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.00 [IN]
TIME OF CONCENTRATION		13 [min]
RAINFALL INTENSITY		2.40 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.91
	C2	0.16
	C3	0.28
WEIGHTED RUNOFF COEFFICIENT		0.184
PEAK DISCHARGE Qp = C i A		**8.2** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B2 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**10 YEAR**
DRAINAGE AREA [AC]	A1	0.000
	A2	14.94
	A3	3.73
TOTAL AREA	At	18.67 [AC]
DRAINAGE LENGTH [FT]		2696 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		84.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.12 [%]
PRECIPITATION		
P= 6 HOUR		2.64 [IN]
P = 24 HOUR		3.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.57 [IN]
TIME OF CONCENTRATION		13 [min]
RAINFALL INTENSITY		3.85 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.94
	C2	0.37
	C3	0.5
WEIGHTED RUNOFF COEFFICIENT		0.396
PEAK DISCHARGE Qp = C i A		**28.5** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B2 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**50 YEAR**
DRAINAGE AREA [AC]	A1	0.000
	A2	14.94
	A3	3.73
TOTAL AREA	At	18.67 [AC]
DRAINAGE LENGTH [FT]		2696.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		84.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.12 [%]
PRECIPITATION		
P= 6 HOUR		2.50 [IN]
P = 24 HOUR		3.60 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.44 [IN]
TIME OF CONCENTRATION		13 [min]
RAINFALL INTENSITY		6.01 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.95
	C2	0.52
	C3	0.63
WEIGHTED RUNOFF COEFFICIENT		0.54
PEAK DISCHARGE Qp = C i A		**60.8** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B2 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**100 YEAR**
DRAINAGE AREA [AC]	A1	0.000
	A2	14.94
	A3	3.73
TOTAL AREA	At	18.67 [AC]
DRAINAGE LENGTH [FT]		2696.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		84.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		3.12 [%]
PRECIPITATION		
P= 6 HOUR		3.96 [IN]
P = 24 HOUR		4.80 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.42 [IN]
TIME OF CONCENTRATION		13 [min]
RAINFALL INTENSITY		5.96 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.96
	C2	0.57
	C3	0.68
WEIGHTED RUNOFF COEFFICIENT		0.59
PEAK DISCHARGE Qp = C i A		**65.9** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B3 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**2 YEAR**
DRAINAGE AREA [AC]	A1	9.763
	A2	29.29
	A3	9.76
TOTAL AREA	At	48.82 [AC]
DRAINAGE LENGTH [FT]		5307 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		142.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		2.68 [%]
PRECIPITATION		
P= 6 HOUR		1.40 [IN]
P = 24 HOUR		2.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.00 [IN]
TIME OF CONCENTRATION		23 [min]
RAINFALL INTENSITY		1.83 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.91
	C2	0.16
	C3	0.28
WEIGHTED RUNOFF COEFFICIENT		0.334
PEAK DISCHARGE Qp = C i A		**29.8** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B3 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**10 YEAR**
DRAINAGE AREA [AC]	A1	9.763
	A2	29.29
	A3	9.76
TOTAL AREA	At	48.82 [AC]
DRAINAGE LENGTH [FT]		5307 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		142.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		2.68 [%]
PRECIPITATION		
P= 6 HOUR		2.64 [IN]
P = 24 HOUR		3.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.57 [IN]
TIME OF CONCENTRATION		23 [min]
RAINFALL INTENSITY		2.88 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.94
	C2	0.37
	C3	0.5
WEIGHTED RUNOFF COEFFICIENT		0.510
PEAK DISCHARGE Qp = C i A		**71.8** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B3 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**50 YEAR**
DRAINAGE AREA [AC]	A1	9.763
	A2	29.29
	A3	9.76
TOTAL AREA	At	48.82 [AC]
DRAINAGE LENGTH [FT]		5307.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		142.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		2.68 [%]
PRECIPITATION		
P= 6 HOUR		2.50 [IN]
P = 24 HOUR		3.60 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.44 [IN]
TIME OF CONCENTRATION		23 [min]
RAINFALL INTENSITY		4.52 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.95
	C2	0.52
	C3	0.63
WEIGHTED RUNOFF COEFFICIENT		0.63
PEAK DISCHARGE Qp = C i A		**138.4** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B3 (Onsite Existing)

DESIGN DATA

DESIGN FREQUENCY		**100 YEAR**
DRAINAGE AREA [AC]	A1	9.763
	A2	29.29
	A3	9.76
TOTAL AREA	At	48.82 [AC]
DRAINAGE LENGTH [FT]		5307.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		142.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		2.68 [%]
PRECIPITATION		
P= 6 HOUR		3.96 [IN]
P = 24 HOUR		4.80 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.42 [IN]
TIME OF CONCENTRATION		23 [min]
RAINFALL INTENSITY		4.48 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.96
	C2	0.57
	C3	0.68
WEIGHTED RUNOFF COEFFICIENT		0.67
PEAK DISCHARGE Qp = C i A		**146.5** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B4 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**2 YEAR**
DRAINAGE AREA [AC]	A1	5.756
	A2	12.89
	A3	10.13
TOTAL AREA	At	28.78 [AC]
DRAINAGE LENGTH [FT]		2800 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		49.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		1.75 [%]
PRECIPITATION		
P= 6 HOUR		1.40 [IN]
P = 24 HOUR		2.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.00 [IN]
TIME OF CONCENTRATION		17 [min]
RAINFALL INTENSITY		2.13 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.91
	C2	0.16
	C3	0.28
WEIGHTED RUNOFF COEFFICIENT		0.352
PEAK DISCHARGE Qp = C i A		**21.6** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B4 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**10 YEAR**
DRAINAGE AREA [AC]	A1	5.756
	A2	12.89
	A3	10.13
TOTAL AREA	At	28.78 [AC]
DRAINAGE LENGTH [FT]		2800 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		49.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		1.75 [%]
PRECIPITATION		
P= 6 HOUR		2.64 [IN]
P = 24 HOUR		3.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.57 [IN]
TIME OF CONCENTRATION		17 [min]
RAINFALL INTENSITY		3.39 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.94
	C2	0.37
	C3	0.5
WEIGHTED RUNOFF COEFFICIENT		0.530
PEAK DISCHARGE Qp = C i A		**51.7** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B4 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**50 YEAR**
DRAINAGE AREA [AC]	A1	5.756
	A2	12.89
	A3	10.13
TOTAL AREA	At	28.78 [AC]
DRAINAGE LENGTH [FT]		2800.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		49.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		1.75 [%]
PRECIPITATION		
P= 6 HOUR		2.50 [IN]
P = 24 HOUR		3.60 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.44 [IN]
TIME OF CONCENTRATION		17 [min]
RAINFALL INTENSITY		5.29 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.95
	C2	0.52
	C3	0.63
WEIGHTED RUNOFF COEFFICIENT		0.64
PEAK DISCHARGE Qp = C i A		**98.2** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP B4 (Existing)

DESIGN DATA

DESIGN FREQUENCY		**100 YEAR**
DRAINAGE AREA [AC]	A1	5.756
	A2	12.89
	A3	10.13
TOTAL AREA	At	28.78 [AC]
DRAINAGE LENGTH [FT]		2800.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		49.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		1.75 [%]
PRECIPITATION		
P= 6 HOUR		3.96 [IN]
P = 24 HOUR		4.80 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.42 [IN]
TIME OF CONCENTRATION		17 [min]
RAINFALL INTENSITY		5.25 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.96
	C2	0.57
	C3	0.68
WEIGHTED RUNOFF COEFFICIENT		0.69
PEAK DISCHARGE Qp = C i A		**103.8** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP C (Existing)

DESIGN DATA

DESIGN FREQUENCY			**2 YEAR**
DRAINAGE AREA [AC]		A1	1.661
		A2	12.26
		A3	2.69
TOTAL AREA		At	16.61 [AC]
DRAINAGE LENGTH [FT]			1115 [FT]
ELEVATION			
TOP OF DRAINAGE AREA			82.00
AT STRUCTURE			0.00
DRAINAGE AREA SLOPE [%]			7.35 [%]
PRECIPITATION			
P= 6 HOUR			1.40 [IN]
P = 24 HOUR			2.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.00 [IN]
TIME OF CONCENTRATION		5 [min]
RAINFALL INTENSITY		3.50 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.91
	C2	0.16
	C3	0.28
WEIGHTED RUNOFF COEFFICIENT		0.254
PEAK DISCHARGE Qp = C i A		**14.8** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP C (Existing)

DESIGN DATA

DESIGN FREQUENCY		**10 YEAR**
DRAINAGE AREA [AC]	A1	1.661
	A2	12.26
	A3	2.69
TOTAL AREA	At	16.61 [AC]
DRAINAGE LENGTH [FT]		1115 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		82.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		7.35 [%]
PRECIPITATION		
P= 6 HOUR		2.64 [IN]
P = 24 HOUR		3.10 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		1.57 [IN]
TIME OF CONCENTRATION		5 [min]
RAINFALL INTENSITY		5.50 [IN/HR]
RUNOFF COEFFICIENT		
	C1	0.94
	C2	0.37
	C3	0.5
WEIGHTED RUNOFF COEFFICIENT		0.448
PEAK DISCHARGE Qp = C i A		**40.9** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP C (Existing)

DESIGN DATA

DESIGN FREQUENCY		**50 YEAR**
DRAINAGE AREA [AC]	A1	1.661
	A2	12.26
	A3	2.69
TOTAL AREA	At	16.61 [AC]
DRAINAGE LENGTH [FT]		1115.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		82.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		7.35 [%]
PRECIPITATION		
P= 6 HOUR		2.50 [IN]
P = 24 HOUR		3.60 [IN]

DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.44 [IN]
TIME OF CONCENTRATION		5 [min]
RAINFALL INTENSITY		8.54 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.95
	C2	0.52
	C3	0.63
WEIGHTED RUNOFF COEFFICIENT		0.58
PEAK DISCHARGE Qp = C i A		**82.4** [CFS]

HYDROLOGIC DESIGN DATA SHEET
RATIONAL METHOD

LOCATION DATA

LOCATION: Wash B

DRAINAGE CONCENTRATION POINT: CP C (Existing)

DESIGN DATA

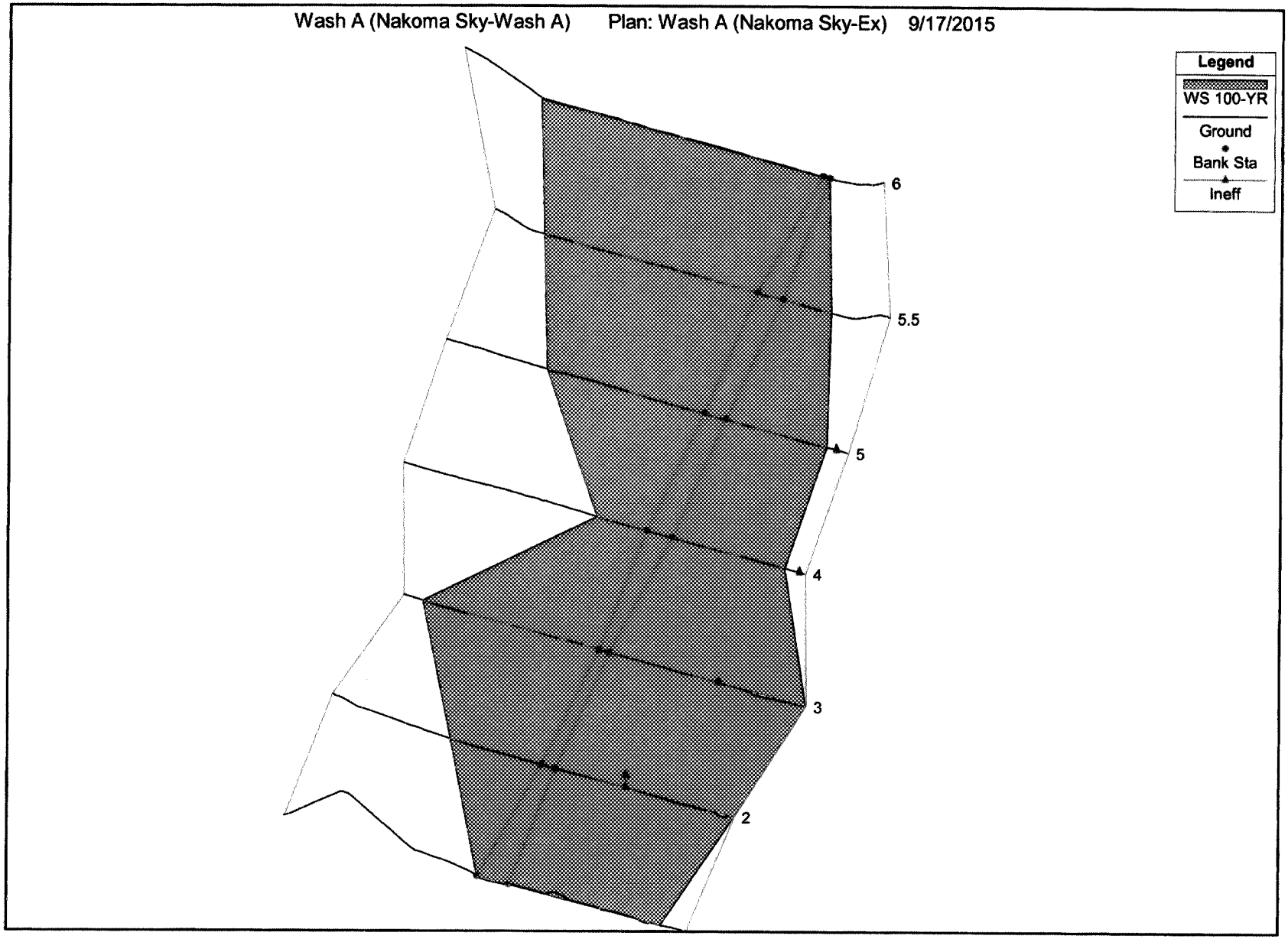
DESIGN FREQUENCY		**100 YEAR**
DRAINAGE AREA [AC]	A1	1.661
	A2	12.26
	A3	2.69
TOTAL AREA	At	16.61 [AC]
DRAINAGE LENGTH [FT]		1115.00 [FT]
ELEVATION		
TOP OF DRAINAGE AREA		82.00
AT STRUCTURE		0.00
DRAINAGE AREA SLOPE [%]		7.35 [%]
PRECIPITATION		
P= 6 HOUR		3.96 [IN]
P = 24 HOUR		4.80 [IN]

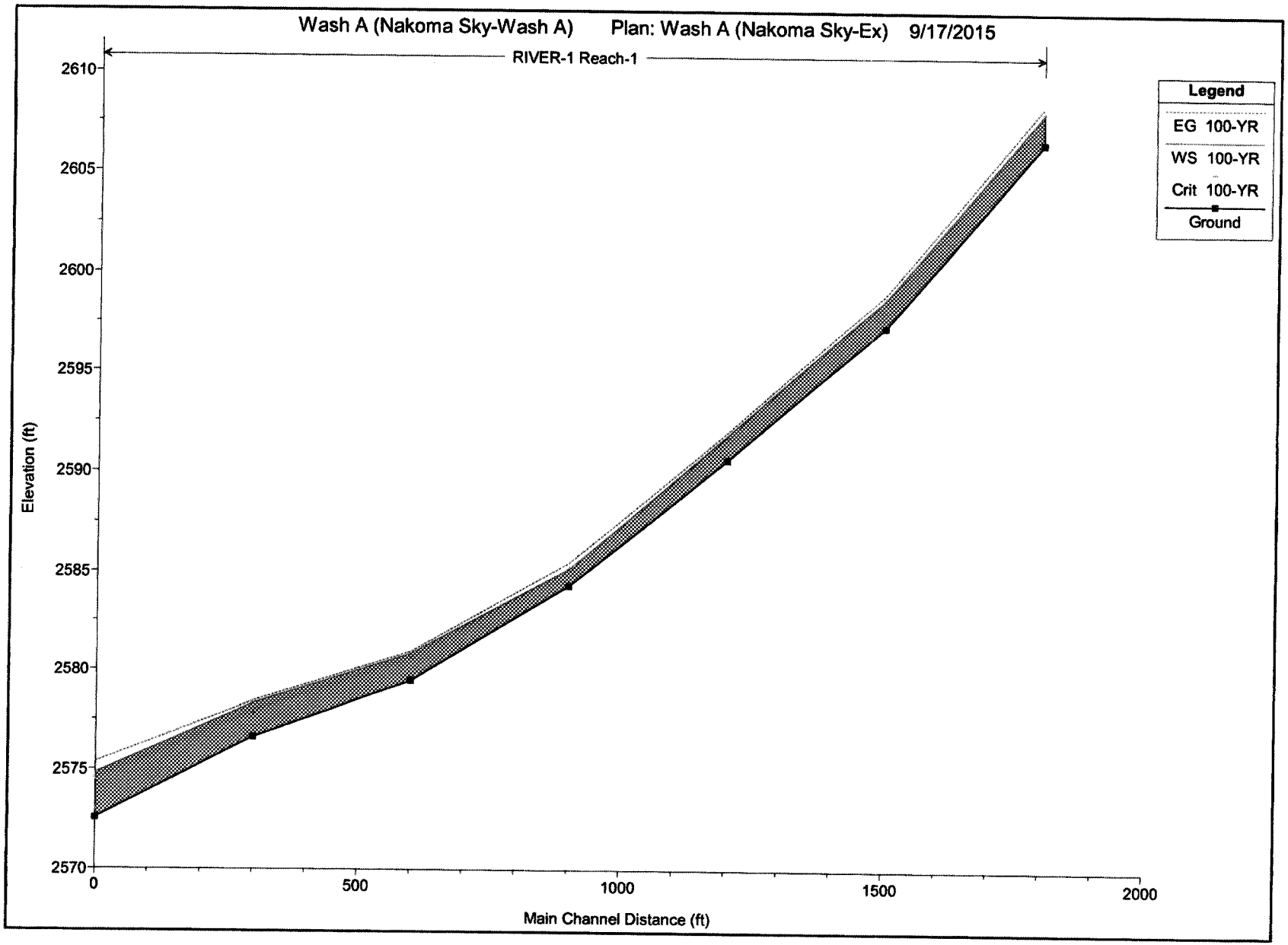
DESIGN COMPUTATIONS

PRECIPITATION P1 = 1 HOUR		2.42 [IN]
TIME OF CONCENTRATION		5 [min]
RAINFALL INTENSITY		8.47 [IN/HR]
RUNOFF COEFICIENT		
	C1	0.96
	C2	0.57
	C3	0.68
WEIGHTED RUNOFF COEFFICIENT		0.63
PEAK DISCHARGE Qp = C i A		**88.2** [CFS]

APPENDIX B
HYDRAULIC COMPUTATIONS

WASH A LOWER (NAKOMA SKY) HEC-RAS MODEL


Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
Legend
WS 100-YR
Ground
Bank Sta
Ineff
6
5.5
5
4
3
2


Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
RIVER-1 Reach-1
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Elevation (ft)
2610
2605
2600
2595
2590
2585
2580
2575
2570
0
500
1000
1500
2000
Main Channel Distance (ft)

Plan: 1 RIVER-1 Reach-1 RS: 6 Profile: 100-YR

E.G. Elev (ft)	2608.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.050	0.040	0.045
W.S. Elev (ft)	2608.08	Reach Len. (ft)	290.00	300.00	310.00
Crit W.S. (ft)	2608.08	Flow Area (sq ft)	0.00	10.76	146.53
E.G. Slope (ft/ft)	0.022671	Area (sq ft)	0.00	10.76	146.53
Q Total (cfs)	728.00	Flow (cfs)	0.00	49.09	678.91
Top Width (ft)	244.68	Top Width (ft)	0.11	13.97	230.61
Vel Total (ft/s)	4.63	Avg. Vel. (ft/s)	0.46	4.56	4.63
Max Chl Dpth (ft)	2.07	Hydr. Depth (ft)	0.04	0.77	0.64
Conv. Total (cfs)	4834.9	Conv. (cfs)	0.0	326.0	4508.9
Length Wtd. (ft)	308.25	Wetted Per. (ft)	0.13	14.61	231.67
Min Ch El (ft)	2606.55	Shear (lb/sq ft)	0.05	1.04	0.90
Alpha	1.00	Stream Power (lb/ft s)	0.02	4.76	4.15
Frctn Loss (ft)	9.02	Cum Volume (acre-ft)	5.49	1.58	5.63
C & E Loss (ft)	0.03	Cum SA (acres)	6.83	1.58	8.22

Plan: 1 RIVER-1 Reach-1 RS: 5.5 Profile: 100-YR

E.G. Elev (ft)	2599.00	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.043	0.050	0.050
W.S. Elev (ft)	2598.76	Reach Len. (ft)	379.57	300.00	217.65
Crit W.S. (ft)	2598.76	Flow Area (sq ft)	10.49	32.14	142.23
E.G. Slope (ft/ft)	0.039162	Area (sq ft)	10.49	32.14	142.23
Q Total (cfs)	728.00	Flow (cfs)	33.07	139.09	555.84
Top Width (ft)	378.60	Top Width (ft)	43.33	50.65	284.63
Vel Total (ft/s)	3.94	Avg. Vel. (ft/s)	3.15	4.33	3.91
Max Chl Dpth (ft)	1.60	Hydr. Depth (ft)	0.24	0.63	0.50
Conv. Total (cfs)	3678.7	Conv. (cfs)	167.1	702.9	2808.8
Length Wtd. (ft)	269.88	Wetted Per. (ft)	43.48	50.91	285.87
Min Ch El (ft)	2597.30	Shear (lb/sq ft)	0.59	1.54	1.22
Alpha	1.01	Stream Power (lb/ft s)	1.86	6.68	4.75
Frctn Loss (ft)	6.34	Cum Volume (acre-ft)	5.46	1.43	4.60
C & E Loss (ft)	0.03	Cum SA (acres)	6.68	1.36	6.39

Plan: 1 RIVER-1 Reach-1 RS: 5 Profile: 100-YR

E.G. Elev (ft)	2592.04	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.	0.050	0.040	0.044
W.S. Elev (ft)	2591.90	Reach Len. (ft)	362.39	300.00	235.94
Crit W.S. (ft)	2591.77	Flow Area (sq ft)	115.78	33.87	98.54
E.G. Slope (ft/ft)	0.015662	Area (sq ft)	115.78	33.87	98.54
Q Total (cfs)	728.00	Flow (cfs)	297.46	134.55	295.99
Top Width (ft)	414.38	Top Width (ft)	201.46	42.76	170.16
Vel Total (ft/s)	2.93	Avg. Vel. (ft/s)	2.57	3.97	3.00
Max Chl Dpth (ft)	1.84	Hydr. Depth (ft)	0.57	0.79	0.58
Conv. Total (cfs)	5817.2	Conv. (cfs)	2376.9	1075.2	2365.1
Length Wtd. (ft)	300.70	Wetted Per. (ft)	201.64	42.88	171.09
Min Ch El (ft)	2590.65	Shear (lb/sq ft)	0.56	0.77	0.56
Alpha	1.08	Stream Power (lb/ft s)	1.44	3.07	1.69
Frctn Loss (ft)	6.52	Cum Volume (acre-ft)	4.91	1.20	4.00
C & E Loss (ft)	0.02	Cum SA (acres)	5.62	1.04	5.25

Plan: 1 RIVER-1 Reach-1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2585.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	2585.21	Reach Len. (ft)	373.83	300.00	224.93
Crit W.S. (ft)	2585.21	Flow Area (sq ft)	75.97	39.77	61.42
E.G. Slope (ft/ft)	0.032033	Area (sq ft)	75.97	39.77	61.42
Q Total (cfs)	728.00	Flow (cfs)	265.13	226.73	236.14
Top Width (ft)	294.52	Top Width (ft)	144.56	50.07	99.90
Vel Total (ft/s)	4.11	Avg. Vel. (ft/s)	3.49	5.70	3.84
Max Chl Dpth (ft)	1.09	Hydr. Depth (ft)	0.53	0.79	0.61
Conv. Total (cfs)	4067.5	Conv. (cfs)	1481.4	1266.8	1319.4
Length Wtd. (ft)	295.05	Wetted Per. (ft)	144.64	50.08	99.96
Min Ch El (ft)	2584.31	Shear (lb/sq ft)	1.05	1.59	1.23
Alpha	1.15	Stream Power (lb/ft s)	3.67	9.05	4.72
Frctn Loss (ft)	4.19	Cum Volume (acre-ft)	4.11	0.95	3.57
C & E Loss (ft)	0.06	Cum SA (acres)	4.18	0.72	4.52

Plan: 1 RIVER-1 Reach-1 RS: 3 Profile: 100-YR

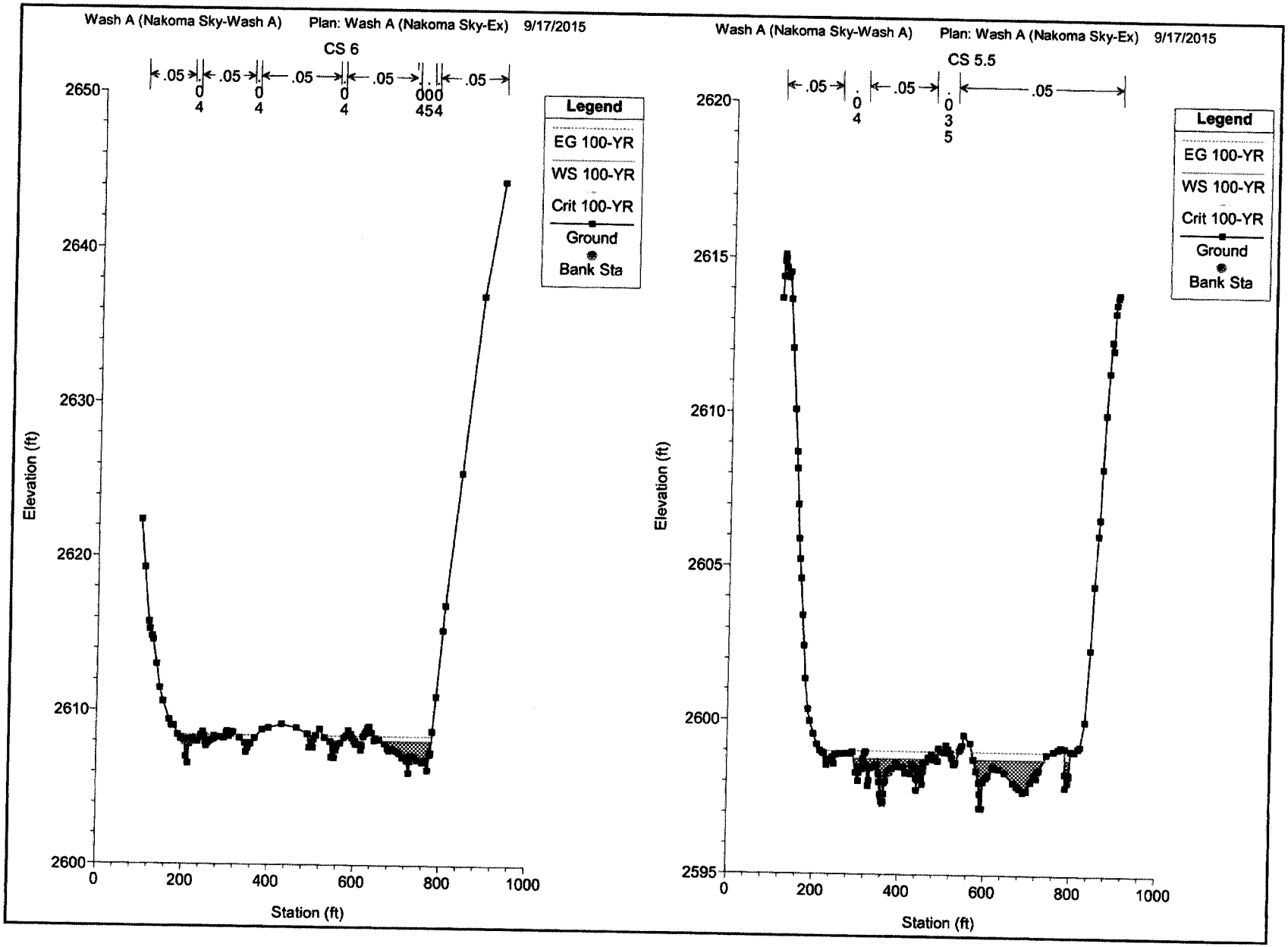
E.G. Elev (ft)	2580.96	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.050	0.040	0.044
W.S. Elev (ft)	2580.87	Reach Len. (ft)	201.23	300.00	395.97
Crit W.S. (ft)	2580.65	Flow Area (sq ft)	148.94	20.78	181.04
E.G. Slope (ft/ft)	0.008472	Area (sq ft)	413.70	20.78	181.04
Q Total (cfs)	826.50	Flow (cfs)	316.35	71.84	438.31
Top Width (ft)	732.08	Top Width (ft)	391.32	20.33	320.43
Vel Total (ft/s)	2.36	Avg. Vel. (ft/s)	2.12	3.46	2.42
Max Chl Dpth (ft)	3.68	Hydr. Depth (ft)	0.68	1.02	0.56
Conv. Total (cfs)	8979.7	Conv. (cfs)	3437.0	780.6	4762.1
Length Wtd. (ft)	325.80	Wetted Per. (ft)	217.66	20.43	320.88
Min Ch El (ft)	2579.46	Shear (lb/sq ft)	0.36	0.54	0.30
Alpha	1.06	Stream Power (lb/ft s)	0.77	1.86	0.72
Frctn Loss (ft)	2.51	Cum Volume (acre-ft)	2.01	0.74	2.94
C & E Loss (ft)	0.00	Cum SA (acres)	1.88	0.47	3.44

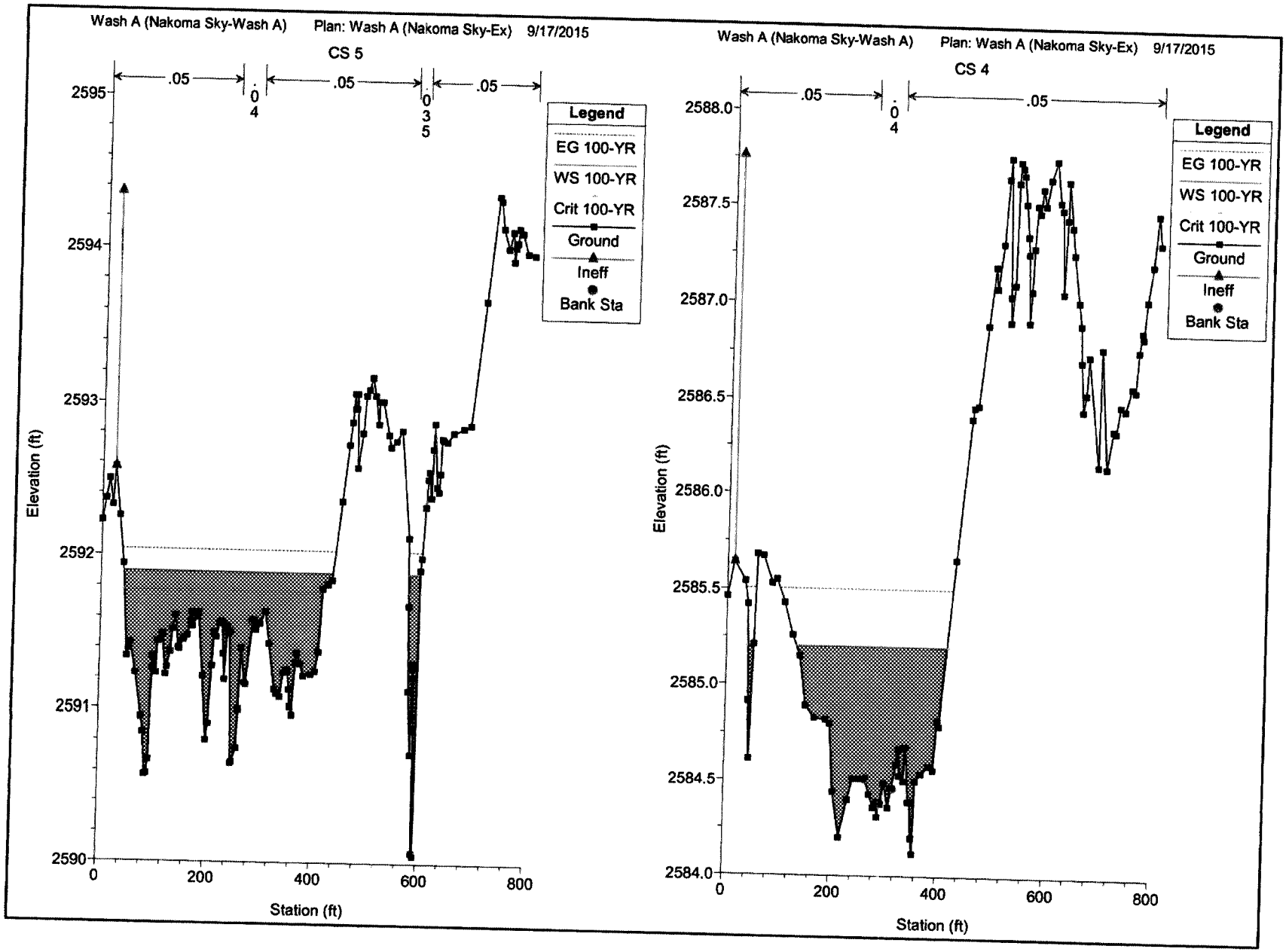
Plan: 1 RIVER-1 Reach-1 RS: 2 Profile: 100-YR

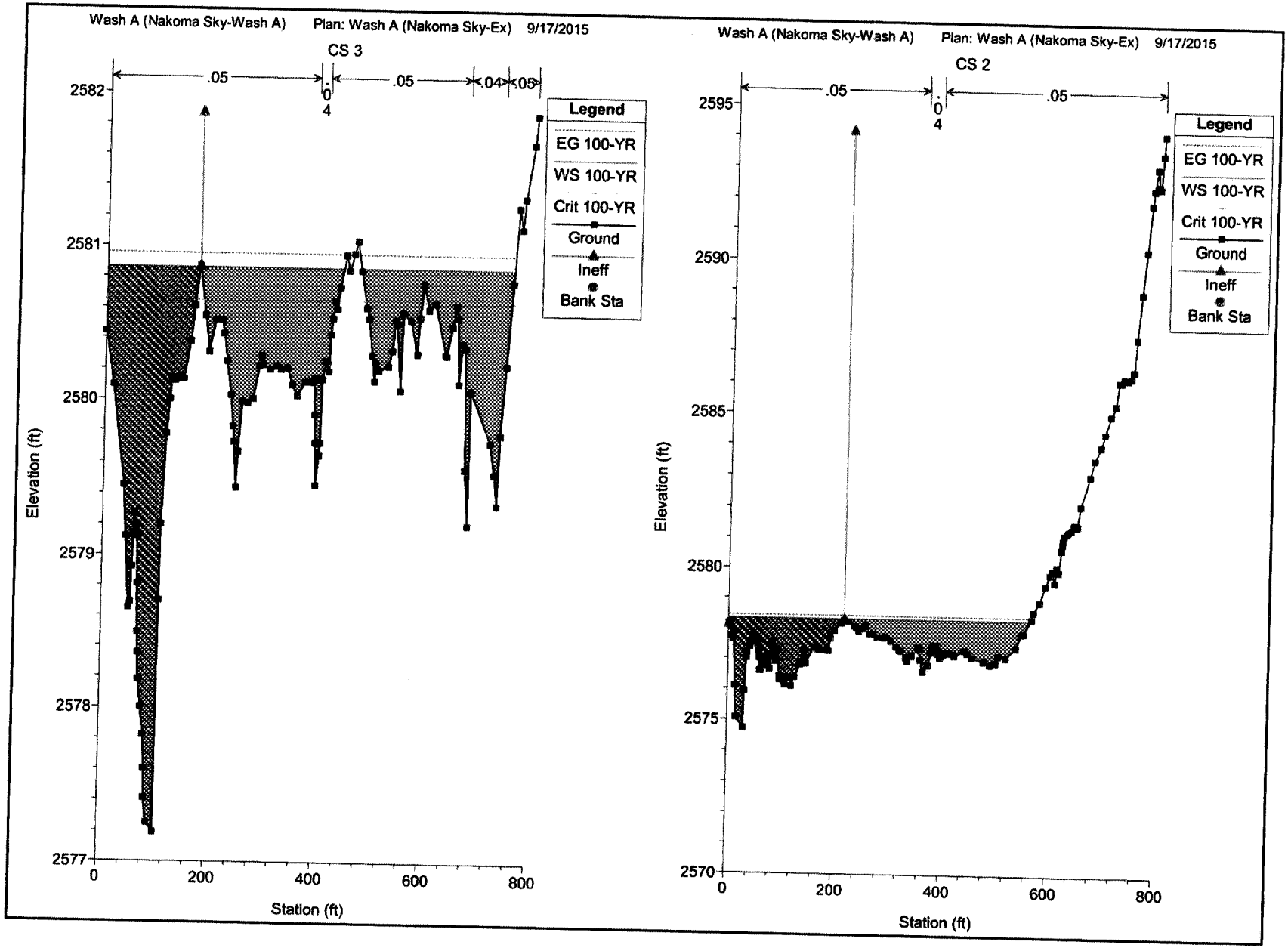
E.G. Elev (ft)	2578.44	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.12	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	2578.32	Reach Len. (ft)	32.84	300.00	552.09
Crit W.S. (ft)	2577.94	Flow Area (sq ft)	91.78	37.83	194.93
E.G. Slope (ft/ft)	0.007036	Area (sq ft)	388.53	37.83	194.93
Q Total (cfs)	826.50	Flow (cfs)	172.15	145.53	508.82
Top Width (ft)	565.87	Top Width (ft)	356.48	27.52	181.87
Vel Total (ft/s)	2.55	Avg. Vel. (ft/s)	1.88	3.85	2.61
Max Chl Dpth (ft)	3.60	Hydr. Depth (ft)	0.65	1.37	1.07
Conv. Total (cfs)	9853.3	Conv. (cfs)	2052.4	1734.9	6066.0
Length Wtd. (ft)	335.03	Wetted Per. (ft)	140.61	27.58	181.92
Min Ch El (ft)	2576.62	Shear (lb/sq ft)	0.29	0.60	0.47
Alpha	1.16	Stream Power (lb/ft s)	0.54	2.32	1.23
Frctn Loss (ft)	3.03	Cum Volume (acre-ft)	0.16	0.54	1.24
C & E Loss (ft)	0.04	Cum SA (acres)	0.15	0.31	1.15

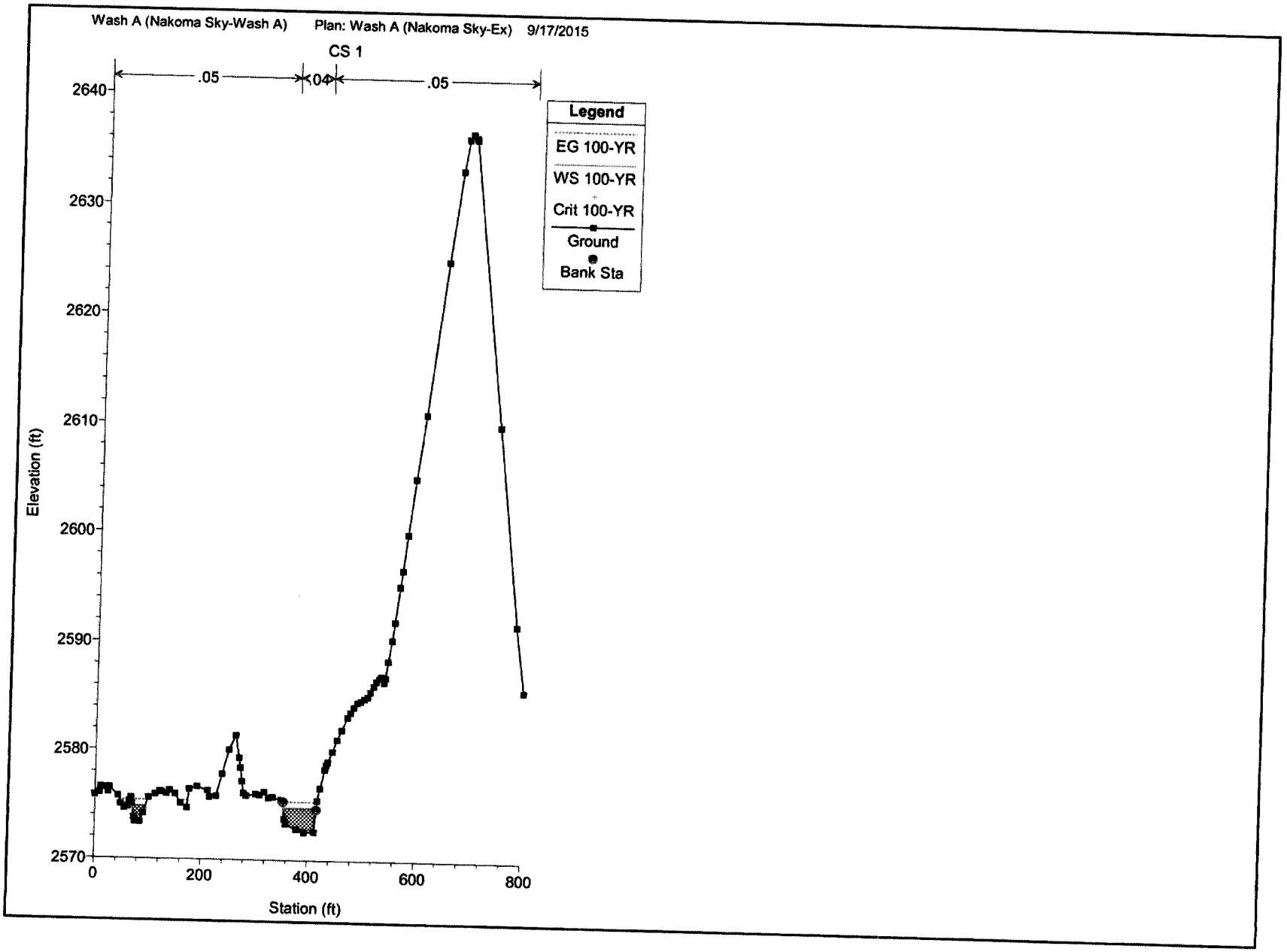
Plan: 1 RIVER-1 Reach-1 RS: 1 Profile: 100-YR

E.G. Elev (ft)	2575.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.55	Wt. n-Val.	0.050	0.040	0.050
W.S. Elev (ft)	2574.82	Reach Len. (ft)			
Crit W.S. (ft)	2574.57	Flow Area (sq ft)	28.36	118.47	0.02
E.G. Slope (ft/ft)	0.012024	Area (sq ft)	28.36	118.47	0.02
Q Total (cfs)	826.50	Flow (cfs)	91.26	735.22	0.01
Top Width (ft)	102.04	Top Width (ft)	39.70	62.08	0.27
Vel Total (ft/s)	5.63	Avg. Vel. (ft/s)	3.22	6.21	0.57
Max Chl Dpth (ft)	2.27	Hydr. Depth (ft)	0.71	1.91	0.09
Conv. Total (cfs)	7537.3	Conv. (cfs)	832.3	6704.9	0.1
Length Wtd. (ft)		Wetted Per. (ft)	40.06	63.00	0.32
Min Ch El (ft)	2572.55	Shear (lb/sq ft)	0.53	1.41	0.06
Alpha	1.12	Stream Power (lb/ft s)	1.71	8.76	0.03
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

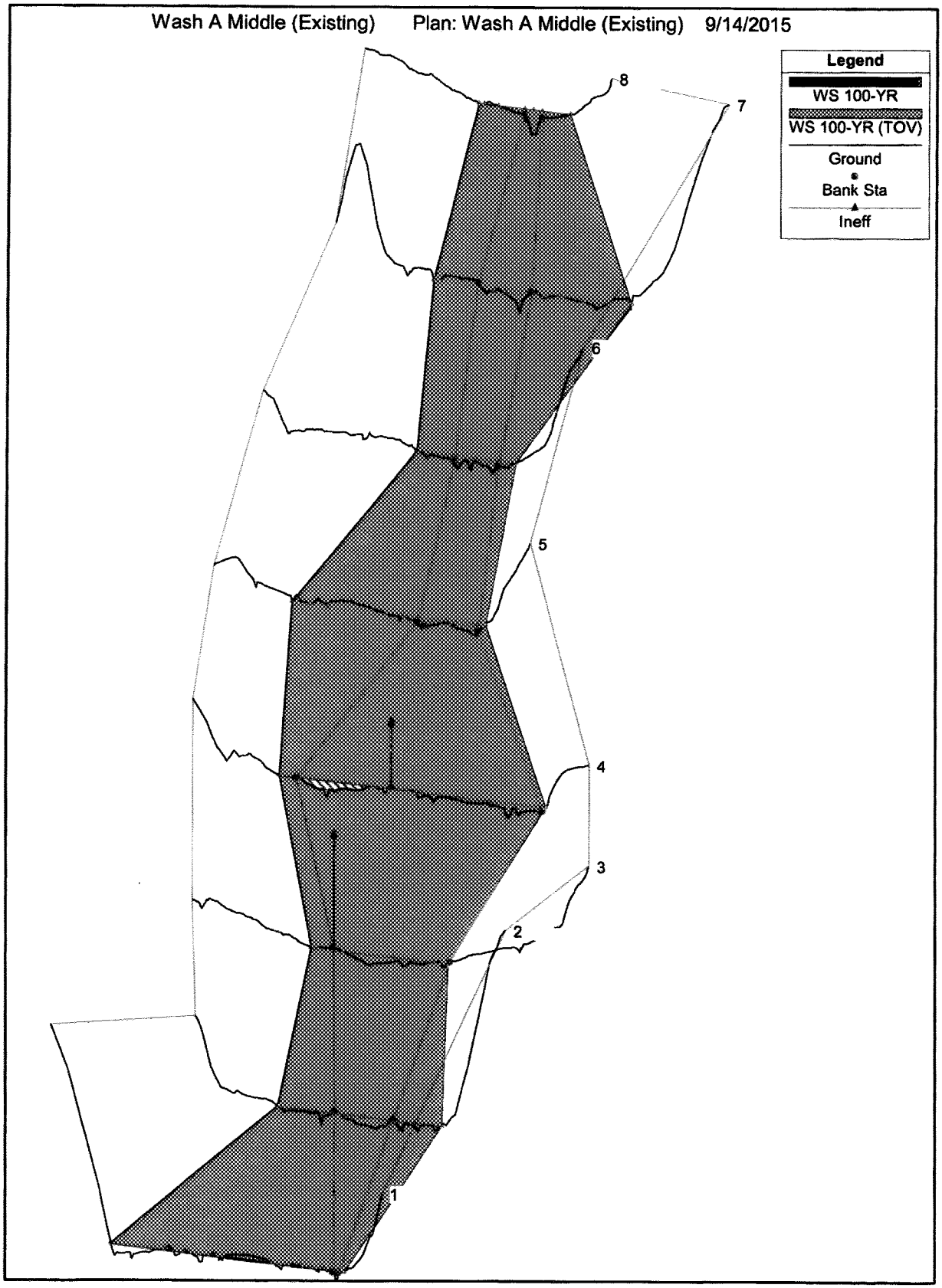

Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 6
.05
.05
.05
.05
.05
0.04
0.04
0.04
0.000454
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2650
2640
2630
2620
2610
2600
0
200
400
600
800
1000
Station (ft)
Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 5.5
.05
.05
.05
0.04
0.035
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2620
2615
2610
2605
2600
2595
0
200
400
600
800
1000
Station (ft)

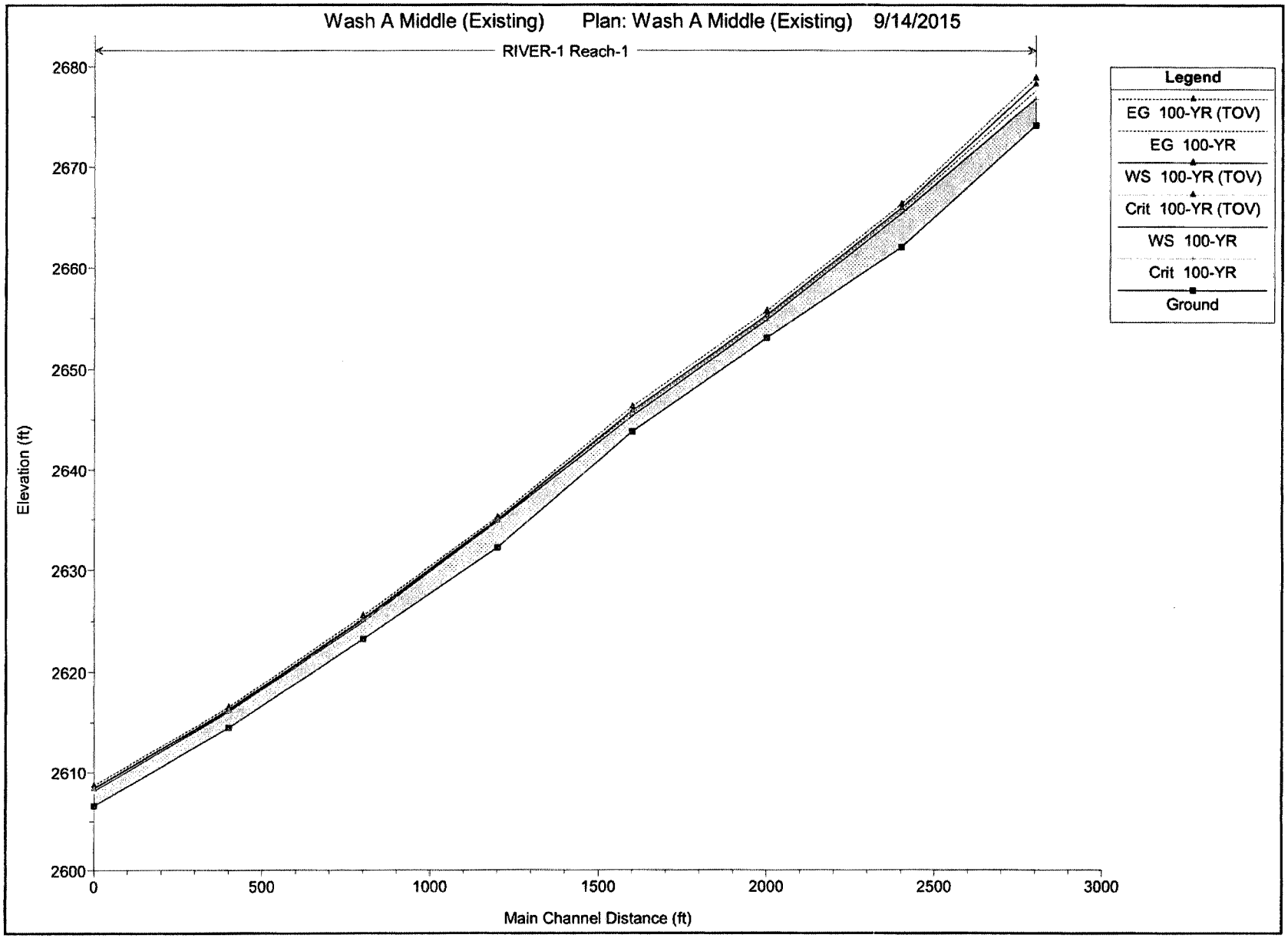

Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 5
.05
.04
.05
.035
.05
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
2595
2594
2593
2592
2591
2590
0
200
400
600
800
Station (ft)
Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 4
.05
.04
.05
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
2588.0
2587.5
2587.0
2586.5
2586.0
2585.5
2585.0
2584.5
2584.0
0
200
400
600
800
Station (ft)


Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 3
.05
.05
.04
.05
.0
4
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
2582
2581
2580
2579
2578
2577
0
200
400
600
800
Station (ft)
Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 2
.05
.05
.0
4
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
2595
2590
2585
2580
2575
2570
0
200
400
600
800
Station (ft)


Wash A (Nakoma Sky-Wash A) Plan: Wash A (Nakoma Sky-Ex) 9/17/2015
CS 1
.05
.04
.05
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2640
2630
2620
2610
2600
2590
2580
2570
0
200
400
600
800
Station (ft)

WASH A MIDDLE (Sanctuary At Silverhawke) HEC-RAS MODEL


Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
Legend
WS 100-YR
WS 100-YR (TOV)
Ground
Bank Sta
Ineff
8
7
6
5
4
3
2
1


Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
RIVER-1 Reach-1
Legend
EG 100-YR (TOV)
EG 100-YR
WS 100-YR (TOV)
Crit 100-YR (TOV)
WS 100-YR
Crit 100-YR
Ground
Elevation (ft)
2680
2670
2660
2650
2640
2630
2620
2610
2600
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)

Plan: A RIVER-1 Reach-1 RS: 8 Profile: 100-YR

E.G. Elev (ft)	2677.61	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.		0.045	
W.S. Elev (ft)	2676.83	Reach Len. (ft)	164.72	400.00	624.10
Crit W.S. (ft)	2676.83	Flow Area (sq ft)		58.66	
E.G. Slope (ft/ft)	0.026608	Area (sq ft)		58.66	
Q Total (cfs)	414.00	Flow (cfs)		414.00	
Top Width (ft)	38.14	Top Width (ft)		38.14	
Vel Total (ft/s)	7.06	Avg. Vel. (ft/s)		7.06	
Max Chl Dpth (ft)	2.66	Hydr. Depth (ft)		1.54	
Conv. Total (cfs)	2538.0	Conv. (cfs)		2538.0	
Length Wtd. (ft)	380.59	Wetted Per. (ft)		39.11	
Min Ch El (ft)	2674.17	Shear (lb/sq ft)		2.49	
Alpha	1.00	Stream Power (lb/ft s)	932.15	0.00	0.00
Frctn Loss (ft)	10.95	Cum Volume (acre-ft)	0.82	8.71	1.23
C & E Loss (ft)	0.14	Cum SA (acres)	1.96	11.39	2.95

Plan: A RIVER-1 Reach-1 RS: 7 Profile: 100-YR

E.G. Elev (ft)	2665.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.050	0.045	
W.S. Elev (ft)	2665.45	Reach Len. (ft)	386.38	400.00	413.49
Crit W.S. (ft)	2665.45	Flow Area (sq ft)	25.52	71.94	
E.G. Slope (ft/ft)	0.031223	Area (sq ft)	25.52	71.94	
Q Total (cfs)	414.00	Flow (cfs)	68.30	345.70	
Top Width (ft)	170.17	Top Width (ft)	74.65	95.52	
Vel Total (ft/s)	4.25	Avg. Vel. (ft/s)	2.68	4.81	
Max Chl Dpth (ft)	3.35	Hydr. Depth (ft)	0.34	0.75	
Conv. Total (cfs)	2343.0	Conv. (cfs)	386.5	1956.4	
Length Wtd. (ft)	398.65	Wetted Per. (ft)	74.90	96.24	
Min Ch El (ft)	2662.10	Shear (lb/sq ft)	0.66	1.46	
Alpha	1.13	Stream Power (lb/ft s)	1000.00	0.00	0.00
Frctn Loss (ft)	9.52	Cum Volume (acre-ft)	0.77	8.11	1.23
C & E Loss (ft)	0.03	Cum SA (acres)	1.82	10.77	2.95

Plan: A RIVER-1 Reach-1 RS: 6 Profile: 100-YR

E.G. Elev (ft)	2655.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2654.89	Reach Len. (ft)	600.75	400.00	193.39
Crit W.S. (ft)	2654.81	Flow Area (sq ft)	13.46	91.57	13.03
E.G. Slope (ft/ft)	0.018868	Area (sq ft)	13.46	91.57	13.03
Q Total (cfs)	414.00	Flow (cfs)	33.39	361.07	19.55
Top Width (ft)	201.62	Top Width (ft)	28.31	112.10	61.21
Vel Total (ft/s)	3.51	Avg. Vel. (ft/s)	2.48	3.94	1.50
Max Chl Dpth (ft)	1.80	Hydr. Depth (ft)	0.48	0.82	0.21
Conv. Total (cfs)	3014.0	Conv. (cfs)	243.1	2628.6	142.3
Length Wtd. (ft)	402.89	Wetted Per. (ft)	28.41	112.96	61.28
Min Ch El (ft)	2653.09	Shear (lb/sq ft)	0.56	0.95	0.25
Alpha	1.15	Stream Power (lb/ft s)	931.75	0.00	0.00
Frctn Loss (ft)	9.43	Cum Volume (acre-ft)	0.60	7.36	1.17
C & E Loss (ft)	0.01	Cum SA (acres)	1.37	9.82	2.66

Plan: A RIVER-1 Reach-1 RS: 5 Profile: 100-YR

E.G. Elev (ft)	2645.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2645.38	Reach Len. (ft)	476.45	400.00	322.11
Crit W.S. (ft)	2645.38	Flow Area (sq ft)	3.25	90.69	4.88
E.G. Slope (ft/ft)	0.029796	Area (sq ft)	3.25	90.69	4.88
Q Total (cfs)	414.00	Flow (cfs)	7.24	398.42	8.34
Top Width (ft)	174.79	Top Width (ft)	11.34	133.66	29.79
Vel Total (ft/s)	4.19	Avg. Vel. (ft/s)	2.23	4.39	1.71
Max Chl Dpth (ft)	1.56	Hydr. Depth (ft)	0.29	0.68	0.16
Conv. Total (cfs)	2398.4	Conv. (cfs)	42.0	2308.2	48.3
Length Wtd. (ft)	400.11	Wetted Per. (ft)	11.36	134.02	29.95
Min Ch El (ft)	2643.82	Shear (lb/sq ft)	0.53	1.26	0.30
Alpha	1.07	Stream Power (lb/ft s)	800.00	0.00	0.00
Frctn Loss (ft)	9.07	Cum Volume (acre-ft)	0.48	6.52	1.13
C & E Loss (ft)	0.03	Cum SA (acres)	1.09	8.69	2.46

Plan: A RIVER-1 Reach-1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2635.00	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.050	0.045	
W.S. Elev (ft)	2634.81	Reach Len. (ft)	411.70	400.00	387.84
Crit W.S. (ft)	2634.70	Flow Area (sq ft)	1.71	208.73	
E.G. Slope (ft/ft)	0.019713	Area (sq ft)	1.71	376.73	0.44
Q Total (cfs)	728.00	Flow (cfs)	2.93	725.07	
Top Width (ft)	537.37	Top Width (ft)	6.42	520.02	10.93
Vel Total (ft/s)	3.46	Avg. Vel. (ft/s)	1.72	3.47	
Max Chl Dpth (ft)	2.62	Hydr. Depth (ft)	0.27	0.65	
Conv. Total (cfs)	5185.1	Conv. (cfs)	20.9	5164.2	
Length Wtd. (ft)	400.02	Wetted Per. (ft)	6.44	321.82	
Min Ch El (ft)	2632.19	Shear (lb/sq ft)	0.33	0.80	
Alpha	1.01	Stream Power (lb/ft s)	1000.00	0.00	0.00
Frctn Loss (ft)	9.73	Cum Volume (acre-ft)	0.46	4.38	1.11
C & E Loss (ft)	0.01	Cum SA (acres)	1.00	5.69	2.31

Plan: A RIVER-1 Reach-1 RS: 3 Profile: 100-YR

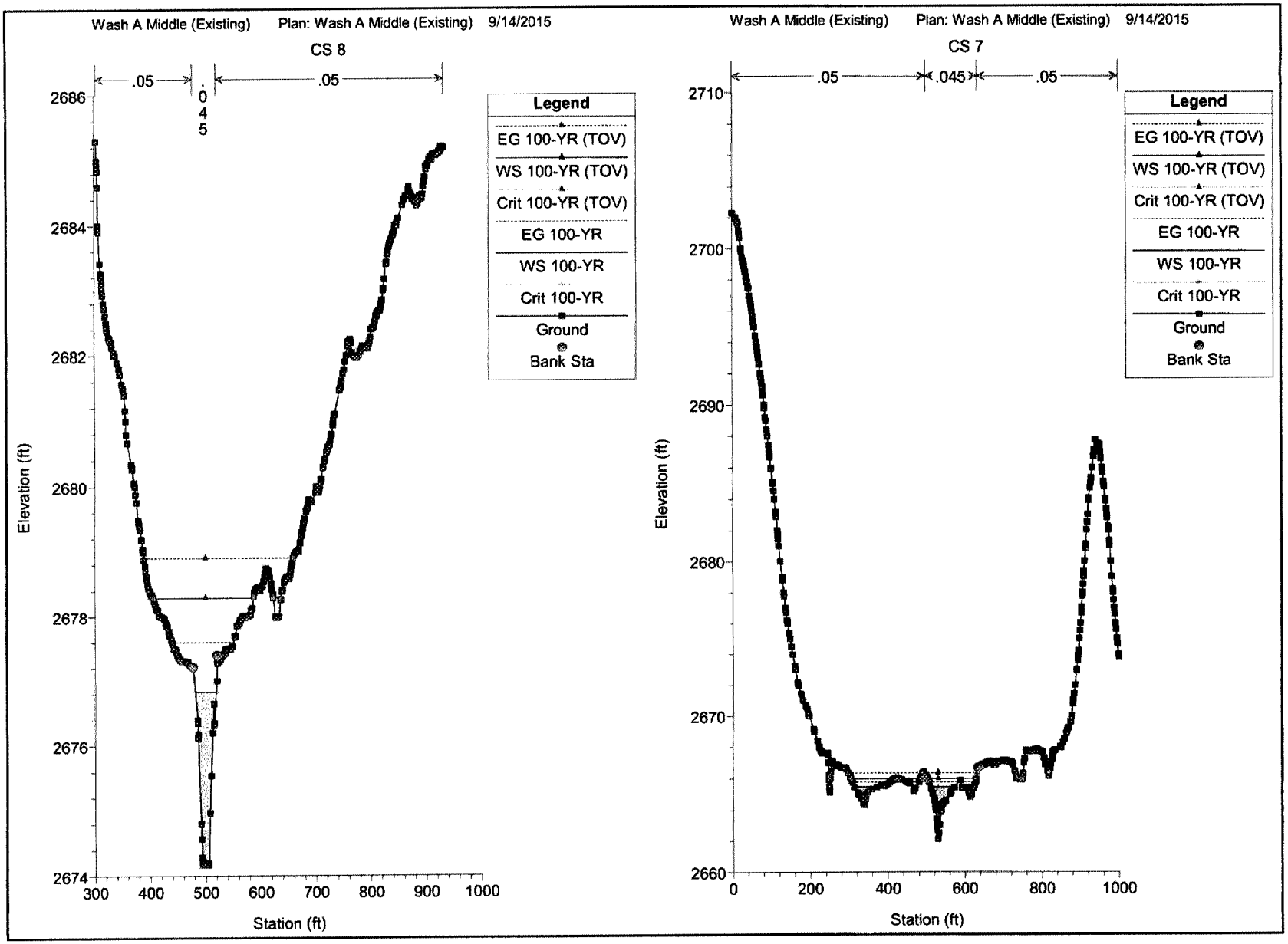
E.G. Elev (ft)	2625.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.045	
W.S. Elev (ft)	2624.93	Reach Len. (ft)	476.55	400.00	322.93
Crit W.S. (ft)	2624.92	Flow Area (sq ft)		159.05	
E.G. Slope (ft/ft)	0.030733	Area (sq ft)		159.05	0.90
Q Total (cfs)	728.00	Flow (cfs)		728.00	
Top Width (ft)	233.80	Top Width (ft)		225.91	7.89
Vel Total (ft/s)	4.58	Avg. Vel. (ft/s)		4.58	
Max Chl Dpth (ft)	1.70	Hydr. Depth (ft)		0.70	
Conv. Total (cfs)	4152.7	Conv. (cfs)		4152.7	
Length Wtd. (ft)	400.27	Wetted Per. (ft)		226.20	
Min Ch El (ft)	2623.23	Shear (lb/sq ft)		1.35	
Alpha	1.00	Stream Power (lb/ft s)	1000.00	0.00	0.00
Frctn Loss (ft)	8.95	Cum Volume (acre-ft)	0.45	1.92	1.10
C & E Loss (ft)	0.03	Cum SA (acres)	0.97	2.26	2.22

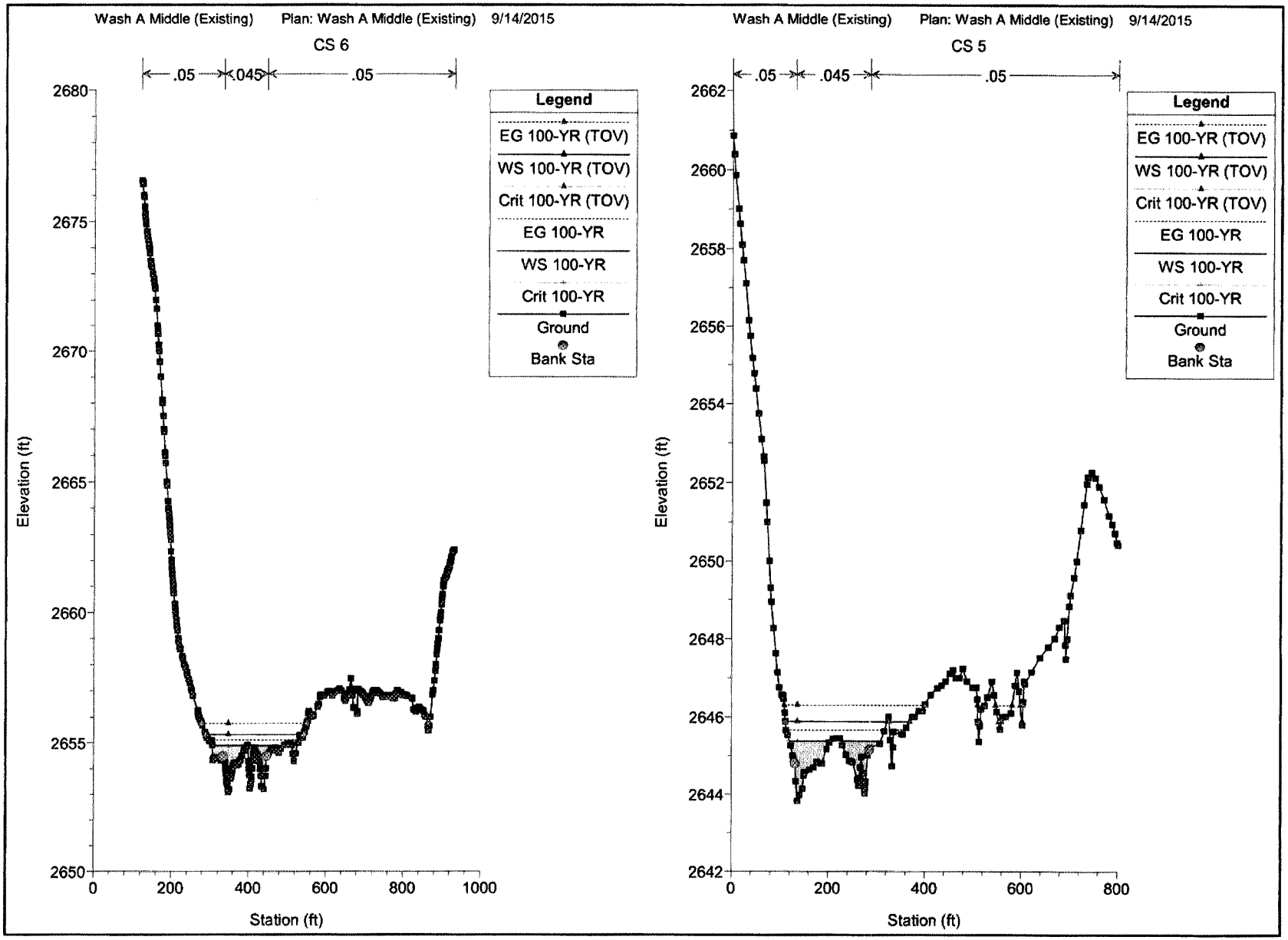
Plan: A RIVER-1 Reach-1 RS: 2 Profile: 100-YR

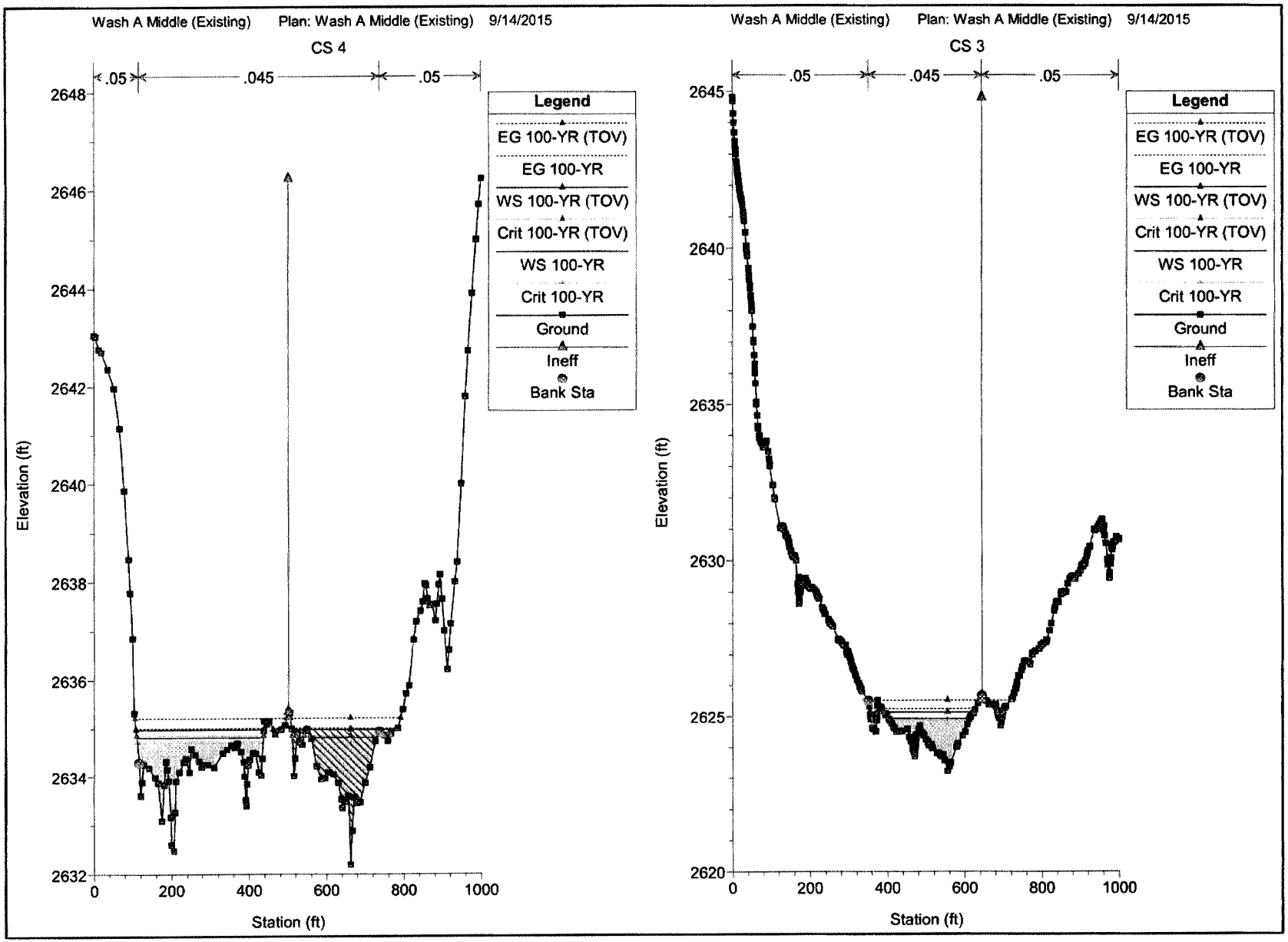
E.G. Elev (ft)	2616.28	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2616.06	Reach Len. (ft)	393.87	400.00	406.12
Crit W.S. (ft)	2615.93	Flow Area (sq ft)	44.91	123.89	49.35
E.G. Slope (ft/ft)	0.017005	Area (sq ft)	44.91	123.89	49.35
Q Total (cfs)	728.00	Flow (cfs)	104.20	525.48	98.32
Top Width (ft)	356.44	Top Width (ft)	96.63	126.58	133.23
Vel Total (ft/s)	3.34	Avg. Vel. (ft/s)	2.32	4.24	1.99
Max Chl Dpth (ft)	2.09	Hydr. Depth (ft)	0.46	0.98	0.37
Conv. Total (cfs)	5582.7	Conv. (cfs)	799.1	4029.6	754.0
Length Wtd. (ft)	402.83	Wetted Per. (ft)	97.28	126.72	133.85
Min Ch El (ft)	2614.45	Shear (lb/sq ft)	0.49	1.04	0.39
Alpha	1.28	Stream Power (lb/ft s)	1000.00	0.00	0.00
Frctn Loss (ft)	7.85	Cum Volume (acre-ft)	0.20	0.62	0.91
C & E Loss (ft)	0.01	Cum SA (acres)	0.44	0.65	1.70

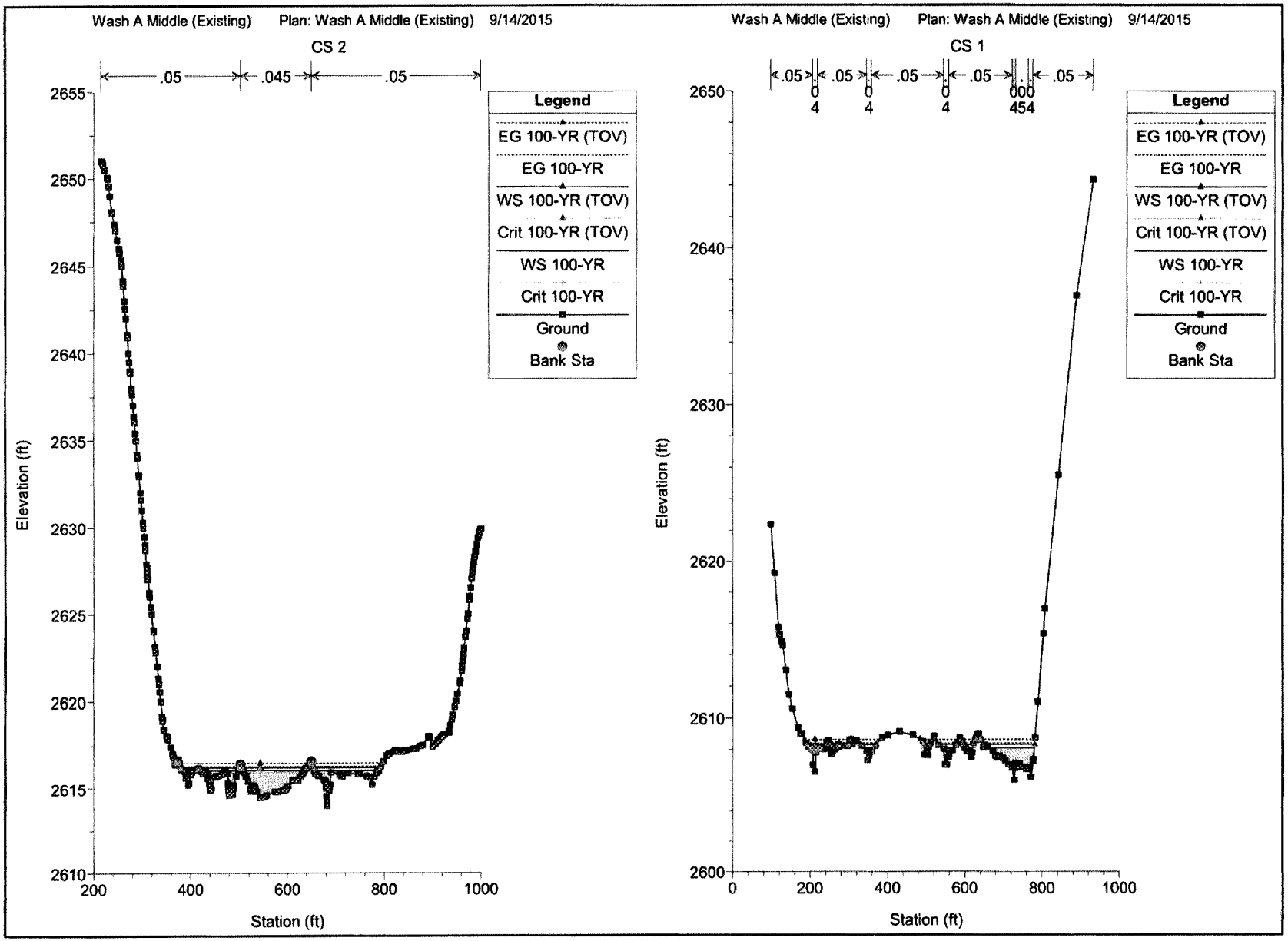
Plan: A RIVER-1 Reach-1 RS: 1 Profile: 100-YR

E.G. Elev (ft)	2608.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.050	0.040	0.045
W.S. Elev (ft)	2608.08	Reach Len. (ft)			
Crit W.S. (ft)	2608.08	Flow Area (sq ft)	0.00	10.78	146.87
E.G. Slope (ft/ft)	0.022557	Area (sq ft)	0.00	10.78	146.87
Q Total (cfs)	728.00	Flow (cfs)	0.00	49.12	678.88
Top Width (ft)	245.33	Top Width (ft)	0.11	13.97	231.25
Vel Total (ft/s)	4.62	Avg. Vel. (ft/s)	0.46	4.56	4.62
Max Chl Dpth (ft)	2.07	Hydr. Depth (ft)	0.04	0.77	0.64
Conv. Total (cfs)	4847.2	Conv. (cfs)	0.0	327.1	4520.2
Length Wtd. (ft)		Wetted Per. (ft)	0.14	14.61	232.31
Min Ch El (ft)	2606.55	Shear (lb/sq ft)	0.05	1.04	0.89
Alpha	1.00	Stream Power (lb/ft s)	933.40	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

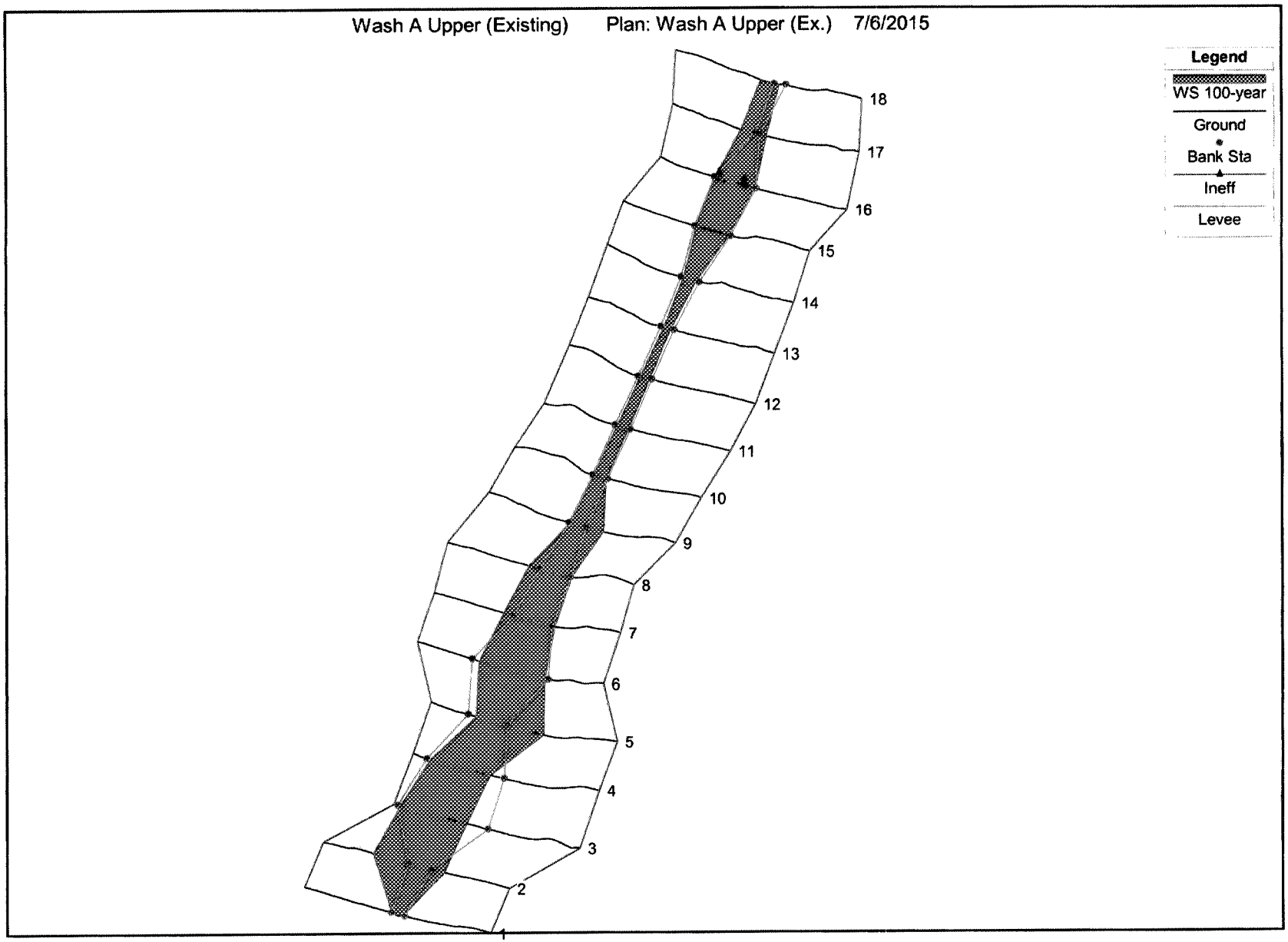

Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 8
.05
.045
.05
Legend
EG 100-YR (TOV)
WS 100-YR (TOV)
Crit 100-YR (TOV)
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 7
.05
.045
.05
Legend
EG 100-YR (TOV)
WS 100-YR (TOV)
Crit 100-YR (TOV)
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

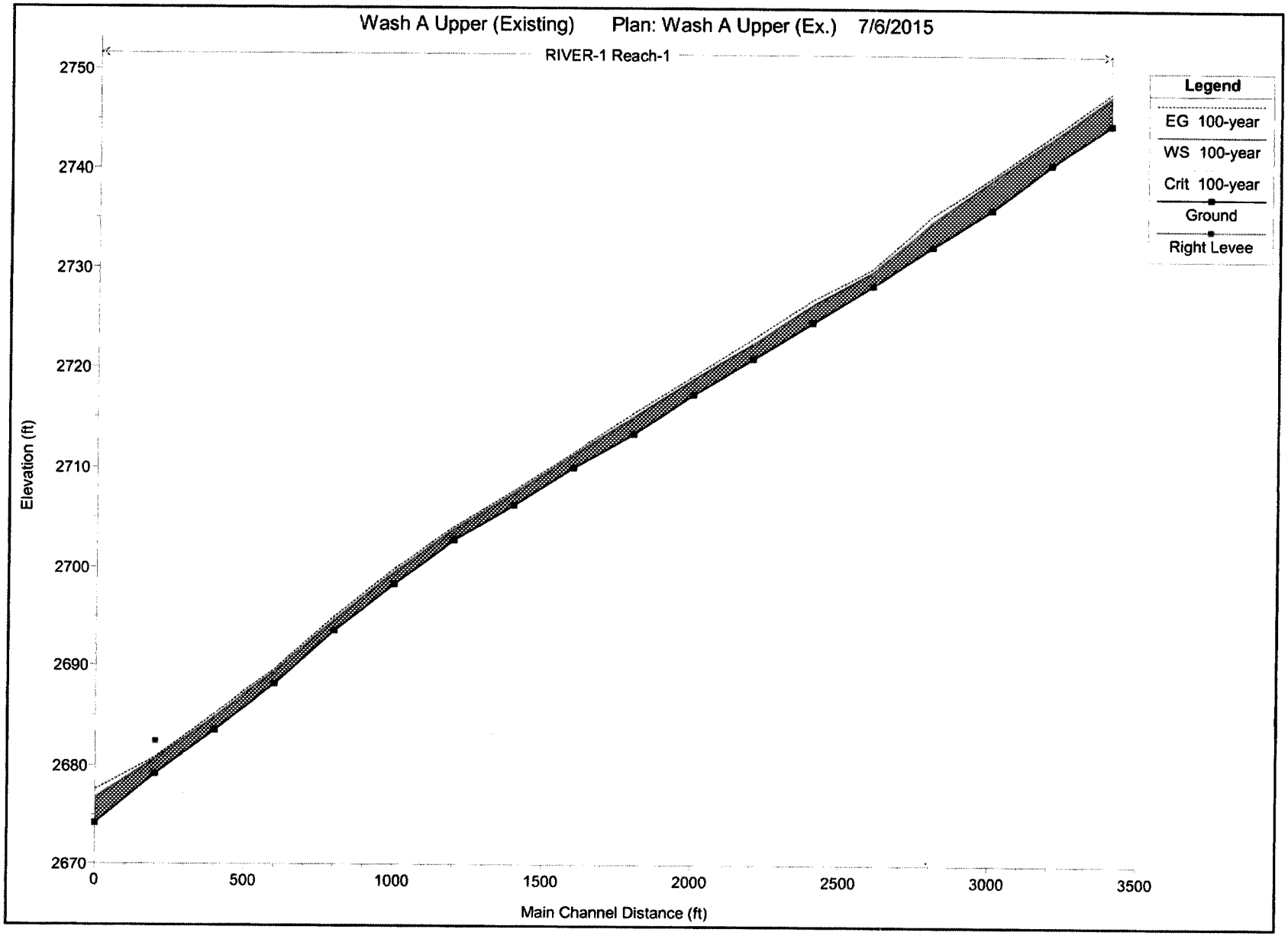

Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 6
.05
.045
.05
Legend
EG 100-YR (TOV)
WS 100-YR (TOV)
Crit 100-YR (TOV)
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2680
2675
2670
2665
2660
2655
2650
0
200
400
600
800
1000
Station (ft)
Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 5
.05
.045
.05
Legend
EG 100-YR (TOV)
WS 100-YR (TOV)
Crit 100-YR (TOV)
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2662
2660
2658
2656
2654
2652
2650
2648
2646
2644
2642
0
200
400
600
800
Station (ft)


Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 4
.05
.045
.05
Legend
EG 100-YR (TOV)
EG 100-YR
WS 100-YR (TOV)
Crit 100-YR (TOV)
WS 100-YR
Crit 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2648
2646
2644
2642
2640
2638
2636
2634
2632
0
200
400
600
800
1000
Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 3
.05
.045
.05
Legend
EG 100-YR (TOV)
EG 100-YR
WS 100-YR (TOV)
Crit 100-YR (TOV)
WS 100-YR
Crit 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2645
2640
2635
2630
2625
2620
0
200
400
600
800
1000


Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 2
.05
.045
.05
Legend
EG 100-YR (TOV)
EG 100-YR
WS 100-YR (TOV)
Crit 100-YR (TOV)
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2655
2650
2645
2640
2635
2630
2625
2620
2615
2610
200
400
600
800
1000
Wash A Middle (Existing) Plan: Wash A Middle (Existing) 9/14/2015
CS 1
.05
.05
.05
.05
.05
Legend
EG 100-YR (TOV)
EG 100-YR
WS 100-YR (TOV)
Crit 100-YR (TOV)
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2650
2640
2630
2620
2610
2600
0
200
400
600
800
1000

WASH A UPPER (Villages At Silverhawke) HEC-RAS MODEL


Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
Legend
WS 100-year
Ground
Bank Sta
Ineff
Levee
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1


Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
RIVER-1 Reach-1
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Right Levee
Elevation (ft)
2750
2740
2730
2720
2710
2700
2690
2680
2670
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)

Plan: 1 RIVER-1 Reach-1 RS: 18 Profile: 100-year

E.G. Elev (ft)	2747.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.040	0.045
W.S. Elev (ft)	2747.61	Reach Len. (ft)	96.30	200.00	301.11
Crit W.S. (ft)	2747.61	Flow Area (sq ft)		22.61	21.04
E.G. Slope (ft/ft)	0.015475	Area (sq ft)		22.61	21.04
Q Total (cfs)	171.80	Flow (cfs)		119.35	52.45
Top Width (ft)	61.26	Top Width (ft)		16.78	44.48
Vel Total (ft/s)	3.94	Avg. Vel. (ft/s)		5.28	2.49
Max Chl Dpth (ft)	2.91	Hydr. Depth (ft)		1.35	0.47
Conv. Total (cfs)	1381.0	Conv. (cfs)		959.4	421.6
Length Wtd. (ft)	222.14	Wetted Per. (ft)		18.53	44.51
Min Ch El (ft)	2744.70	Shear (lb/sq ft)		1.18	0.46
Alpha	1.37	Stream Power (lb/ft s)		6.22	1.14
Frctn Loss (ft)	3.04	Cum Volume (acre-ft)	0.30	4.43	0.55
C & E Loss (ft)	0.00	Cum SA (acres)	1.05	6.01	1.15

Plan: 1 RIVER-1 Reach-1 RS: 17 Profile: 100-year

E.G. Elev (ft)	2743.64	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2743.30	Reach Len. (ft)	243.42	200.00	154.60
Crit W.S. (ft)	2743.30	Flow Area (sq ft)	6.50	24.04	16.85
E.G. Slope (ft/ft)	0.012186	Area (sq ft)	6.50	24.04	16.85
Q Total (cfs)	171.80	Flow (cfs)	10.76	127.23	33.82
Top Width (ft)	82.01	Top Width (ft)	21.27	15.74	45.00
Vel Total (ft/s)	3.62	Avg. Vel. (ft/s)	1.65	5.29	2.01
Max Chl Dpth (ft)	2.65	Hydr. Depth (ft)	0.31	1.53	0.37
Conv. Total (cfs)	1556.3	Conv. (cfs)	97.5	1152.5	306.3
Length Wtd. (ft)	196.89	Wetted Per. (ft)	21.28	16.39	45.07
Min Ch El (ft)	2740.65	Shear (lb/sq ft)	0.23	1.12	0.28
Alpha	1.65	Stream Power (lb/ft s)	0.38	5.90	0.57
Frctn Loss (ft)	2.68	Cum Volume (acre-ft)	0.30	4.32	0.42
C & E Loss (ft)	0.03	Cum SA (acres)	1.03	5.94	0.84

Plan: 1 RIVER-1 Reach-1 RS: 16 Profile: 100-year

E.G. Elev (ft)	2739.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.		0.040	
W.S. Elev (ft)	2739.18	Reach Len. (ft)	444.57	200.00	62.67
Crit W.S. (ft)	2738.87	Flow Area (sq ft)		43.63	
E.G. Slope (ft/ft)	0.015276	Area (sq ft)		75.55	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	85.93	Top Width (ft)		85.93	
Vel Total (ft/s)	3.94	Avg. Vel. (ft/s)		3.94	
Max Chl Dpth (ft)	3.10	Hydr. Depth (ft)		0.81	
Conv. Total (cfs)	1390.0	Conv. (cfs)		1390.0	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		54.92	
Min Ch El (ft)	2736.08	Shear (lb/sq ft)		0.76	
Alpha	1.00	Stream Power (lb/ft s)		2.98	
Frctn Loss (ft)	3.84	Cum Volume (acre-ft)	0.28	4.09	0.39
C & E Loss (ft)	0.03	Cum SA (acres)	0.97	5.71	0.76

Plan: 1 RIVER-1 Reach-1 RS: 15 Profile: 100-year

E.G. Elev (ft)	2735.54	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.58	Wt. n-Val.		0.040	
W.S. Elev (ft)	2734.95	Reach Len. (ft)	270.54	200.00	128.80
Crit W.S. (ft)	2734.95	Flow Area (sq ft)		28.05	
E.G. Slope (ft/ft)	0.024865	Area (sq ft)		28.05	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	24.37	Top Width (ft)		24.37	
Vel Total (ft/s)	6.13	Avg. Vel. (ft/s)		6.13	
Max Chl Dpth (ft)	2.57	Hydr. Depth (ft)		1.15	
Conv. Total (cfs)	1089.5	Conv. (cfs)		1089.5	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		26.23	
Min Ch El (ft)	2732.38	Shear (lb/sq ft)		1.66	
Alpha	1.00	Stream Power (lb/ft s)		10.17	
Frctn Loss (ft)	3.85	Cum Volume (acre-ft)	0.28	3.85	0.39
C & E Loss (ft)	0.09	Cum SA (acres)	0.97	5.45	0.76

Plan: 1 RIVER-1 Reach-1 RS: 14 Profile: 100-year

E.G. Elev (ft)	2730.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.		0.040	
W.S. Elev (ft)	2729.89	Reach Len. (ft)	159.01	200.00	240.42
Crit W.S. (ft)	2729.74	Flow Area (sq ft)		39.34	
E.G. Slope (ft/ft)	0.015359	Area (sq ft)		39.34	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	42.26	Top Width (ft)		42.26	
Vel Total (ft/s)	4.37	Avg. Vel. (ft/s)		4.37	
Max Chl Dpth (ft)	1.47	Hydr. Depth (ft)		0.93	
Conv. Total (cfs)	1386.3	Conv. (cfs)		1386.3	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		42.58	
Min Ch El (ft)	2728.42	Shear (lb/sq ft)		0.89	
Alpha	1.00	Stream Power (lb/ft s)		3.87	
Frctn Loss (ft)	3.14	Cum Volume (acre-ft)	0.28	3.70	0.39
C & E Loss (ft)	0.02	Cum SA (acres)	0.97	5.30	0.76

Plan: 1 RIVER-1 Reach-1 RS: 13 Profile: 100-year

E.G. Elev (ft)	2727.03	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.		0.040	
W.S. Elev (ft)	2726.55	Reach Len. (ft)	147.73	200.00	251.75
Crit W.S. (ft)	2726.40	Flow Area (sq ft)		31.03	
E.G. Slope (ft/ft)	0.016007	Area (sq ft)		31.03	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	23.75	Top Width (ft)		23.75	
Vel Total (ft/s)	5.54	Avg. Vel. (ft/s)		5.54	
Max Chl Dpth (ft)	1.89	Hydr. Depth (ft)		1.31	
Conv. Total (cfs)	1357.9	Conv. (cfs)		1357.9	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		24.27	
Min Ch El (ft)	2724.66	Shear (lb/sq ft)		1.28	
Alpha	1.00	Stream Power (lb/ft s)		7.07	
Frctn Loss (ft)	3.91	Cum Volume (acre-ft)	0.28	3.54	0.39
C & E Loss (ft)	0.00	Cum SA (acres)	0.97	5.15	0.76

Plan: 1 RIVER-1 Reach-1 RS: 12 Profile: 100-year

E.G. Elev (ft)	2723.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.		0.040	
W.S. Elev (ft)	2722.61	Reach Len. (ft)	142.02	200.00	257.31
Crit W.S. (ft)	2722.61	Flow Area (sq ft)		30.32	
E.G. Slope (ft/ft)	0.024405	Area (sq ft)		30.32	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	31.13	Top Width (ft)		31.13	
Vel Total (ft/s)	5.67	Avg. Vel. (ft/s)		5.67	
Max Chl Dpth (ft)	1.61	Hydr. Depth (ft)		0.97	
Conv. Total (cfs)	1099.7	Conv. (cfs)		1099.7	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		31.43	
Min Ch El (ft)	2721.00	Shear (lb/sq ft)		1.47	
Alpha	1.00	Stream Power (lb/ft s)		8.33	
Frctn Loss (ft)	3.66	Cum Volume (acre-ft)	0.28	3.40	0.39
C & E Loss (ft)	0.06	Cum SA (acres)	0.97	5.02	0.76

Plan: 1 RIVER-1 Reach-1 RS: 11 Profile: 100-year

E.G. Elev (ft)	2719.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.040	
W.S. Elev (ft)	2719.00	Reach Len. (ft)	196.06	200.00	203.92
Crit W.S. (ft)		Flow Area (sq ft)		38.36	
E.G. Slope (ft/ft)	0.014209	Area (sq ft)		38.36	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	37.50	Top Width (ft)		37.50	
Vel Total (ft/s)	4.48	Avg. Vel. (ft/s)		4.48	
Max Chl Dpth (ft)	1.60	Hydr. Depth (ft)		1.02	
Conv. Total (cfs)	1441.3	Conv. (cfs)		1441.3	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		37.72	
Min Ch El (ft)	2717.40	Shear (lb/sq ft)		0.90	
Alpha	1.00	Stream Power (lb/ft s)		4.04	
Frctn Loss (ft)	3.74	Cum Volume (acre-ft)	0.28	3.24	0.39
C & E Loss (ft)	0.01	Cum SA (acres)	0.97	4.87	0.76

Plan: 1 RIVER-1 Reach-1 RS: 10 Profile: 100-year

E.G. Elev (ft)	2715.57	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.		0.040	
W.S. Elev (ft)	2715.19	Reach Len. (ft)	353.72	200.00	47.19
Crit W.S. (ft)	2715.18	Flow Area (sq ft)		34.33	
E.G. Slope (ft/ft)	0.025726	Area (sq ft)		34.33	
Q Total (cfs)	171.80	Flow (cfs)		171.80	
Top Width (ft)	44.34	Top Width (ft)		44.34	
Vel Total (ft/s)	5.00	Avg. Vel. (ft/s)		5.00	
Max Chl Dpth (ft)	1.78	Hydr. Depth (ft)		0.77	
Conv. Total (cfs)	1071.1	Conv. (cfs)		1071.1	
Length Wtd. (ft)	212.50	Wetted Per. (ft)		44.59	
Min Ch El (ft)	2713.41	Shear (lb/sq ft)		1.24	
Alpha	1.00	Stream Power (lb/ft s)		6.19	
Frctn Loss (ft)	3.87	Cum Volume (acre-ft)	0.28	3.07	0.39
C & E Loss (ft)	0.06	Cum SA (acres)	0.97	4.68	0.76

Plan: 1 RIVER-1 Reach-1 RS: 9 Profile: 100-year

E.G. Elev (ft)	2711.64	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.	0.045	0.040	
W.S. Elev (ft)	2711.45	Reach Len. (ft)	232.31	200.00	167.30
Crit W.S. (ft)	2711.36	Flow Area (sq ft)	16.41	39.23	
E.G. Slope (ft/ft)	0.013593	Area (sq ft)	16.41	39.23	
Q Total (cfs)	171.80	Flow (cfs)	27.93	143.87	
Top Width (ft)	105.66	Top Width (ft)	55.75	49.91	
Vel Total (ft/s)	3.09	Avg. Vel. (ft/s)	1.70	3.67	
Max Chl Dpth (ft)	1.35	Hydr. Depth (ft)	0.29	0.79	
Conv. Total (cfs)	1473.6	Conv. (cfs)	239.6	1234.0	
Length Wtd. (ft)	202.70	Wetted Per. (ft)	55.85	50.34	
Min Ch El (ft)	2710.10	Shear (lb/sq ft)	0.25	0.66	
Alpha	1.23	Stream Power (lb/ft s)	0.42	2.43	
Frctn Loss (ft)	3.84	Cum Volume (acre-ft)	0.21	2.90	0.39
C & E Loss (ft)	0.00	Cum SA (acres)	0.74	4.46	0.76

Plan: 1 RIVER-1 Reach-1 RS: 8 Profile: 100-year

E.G. Elev (ft)	2707.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2707.58	Reach Len. (ft)	193.14	200.00	206.84
Crit W.S. (ft)	2707.57	Flow Area (sq ft)	0.88	44.32	0.86
E.G. Slope (ft/ft)	0.028154	Area (sq ft)	0.88	44.32	0.86
Q Total (cfs)	171.80	Flow (cfs)	1.60	169.40	0.81
Top Width (ft)	109.11	Top Width (ft)	4.69	92.22	12.21
Vel Total (ft/s)	3.73	Avg. Vel. (ft/s)	1.81	3.82	0.94
Max Chl Dpth (ft)	1.28	Hydr. Depth (ft)	0.19	0.48	0.07
Conv. Total (cfs)	1023.9	Conv. (cfs)	9.5	1009.6	4.8
Length Wtd. (ft)	200.02	Wetted Per. (ft)	4.70	92.28	12.22
Min Ch El (ft)	2706.30	Shear (lb/sq ft)	0.33	0.84	0.12
Alpha	1.04	Stream Power (lb/ft s)	0.60	3.23	0.12
Frctn Loss (ft)	3.63	Cum Volume (acre-ft)	0.17	2.71	0.39
C & E Loss (ft)	0.00	Cum SA (acres)	0.58	4.13	0.74

Plan: 1 RIVER-1 Reach-1 RS: 7 Profile: 100-year

E.G. Elev (ft)	2704.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2703.93	Reach Len. (ft)	180.78	200.00	219.16
Crit W.S. (ft)	2703.82	Flow Area (sq ft)	2.34	100.51	5.29
E.G. Slope (ft/ft)	0.015531	Area (sq ft)	2.34	100.51	5.29
Q Total (cfs)	413.90	Flow (cfs)	3.67	403.73	6.50
Top Width (ft)	166.46	Top Width (ft)	9.90	124.23	32.32
Vel Total (ft/s)	3.83	Avg. Vel. (ft/s)	1.57	4.02	1.23
Max Chl Dpth (ft)	1.14	Hydr. Depth (ft)	0.24	0.81	0.16
Conv. Total (cfs)	3321.2	Conv. (cfs)	29.5	3239.6	52.2
Length Wtd. (ft)	200.07	Wetted Per. (ft)	9.91	124.38	32.38
Min Ch El (ft)	2702.79	Shear (lb/sq ft)	0.23	0.78	0.16
Alpha	1.08	Stream Power (lb/ft s)	0.36	3.15	0.19
Frctn Loss (ft)	4.24	Cum Volume (acre-ft)	0.16	2.38	0.38
C & E Loss (ft)	0.00	Cum SA (acres)	0.55	3.64	0.64

Plan: 1 RIVER-1 Reach-1 RS: 6 Profile: 100-year

E.G. Elev (ft)	2699.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.040	
W.S. Elev (ft)	2699.66	Reach Len. (ft)	55.85	200.00	340.05
Crit W.S. (ft)	2699.66	Flow Area (sq ft)		100.26	
E.G. Slope (ft/ft)	0.030634	Area (sq ft)		100.26	
Q Total (cfs)	413.90	Flow (cfs)		413.90	
Top Width (ft)	197.78	Top Width (ft)		197.78	
Vel Total (ft/s)	4.13	Avg. Vel. (ft/s)		4.13	
Max Chl Dpth (ft)	1.35	Hydr. Depth (ft)		0.51	
Conv. Total (cfs)	2364.8	Conv. (cfs)		2364.8	
Length Wtd. (ft)	189.66	Wetted Per. (ft)		198.14	
Min Ch El (ft)	2698.31	Shear (lb/sq ft)		0.97	
Alpha	1.00	Stream Power (lb/ft s)		3.99	
Frctn Loss (ft)	4.65	Cum Volume (acre-ft)	0.15	1.92	0.36
C & E Loss (ft)	0.00	Cum SA (acres)	0.53	2.90	0.55

Plan: 1 RIVER-1 Reach-1 RS: 5 Profile: 100-year

E.G. Elev (ft)	2695.05	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.045	0.040	
W.S. Elev (ft)	2694.77	Reach Len. (ft)	171.98	200.00	227.87
Crit W.S. (ft)	2694.77	Flow Area (sq ft)	27.82	78.59	
E.G. Slope (ft/ft)	0.020057	Area (sq ft)	27.82	78.59	
Q Total (cfs)	413.90	Flow (cfs)	59.39	354.51	
Top Width (ft)	190.46	Top Width (ft)	91.62	98.85	
Vel Total (ft/s)	3.89	Avg. Vel. (ft/s)	2.13	4.51	
Max Chl Dpth (ft)	1.21	Hydr. Depth (ft)	0.30	0.80	
Conv. Total (cfs)	2922.6	Conv. (cfs)	419.3	2503.2	
Length Wtd. (ft)	197.99	Wetted Per. (ft)	91.83	99.00	
Min Ch El (ft)	2693.56	Shear (lb/sq ft)	0.38	0.99	
Alpha	1.20	Stream Power (lb/ft s)	0.81	4.48	
Frctn Loss (ft)	3.66	Cum Volume (acre-ft)	0.14	1.51	0.36
C & E Loss (ft)	0.02	Cum SA (acres)	0.47	2.22	0.55

Plan: 1 RIVER-1 Reach-1 RS: 4 Profile: 100-year

E.G. Elev (ft)	2689.64	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.040	
W.S. Elev (ft)	2689.44	Reach Len. (ft)	179.89	200.00	219.93
Crit W.S. (ft)	2689.31	Flow Area (sq ft)		112.73	
E.G. Slope (ft/ft)	0.017131	Area (sq ft)		112.73	
Q Total (cfs)	413.90	Flow (cfs)		413.90	
Top Width (ft)	171.51	Top Width (ft)		171.51	
Vel Total (ft/s)	3.67	Avg. Vel. (ft/s)		3.67	
Max Chl Dpth (ft)	1.33	Hydr. Depth (ft)		0.66	
Conv. Total (cfs)	3162.3	Conv. (cfs)		3162.3	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		171.79	
Min Ch El (ft)	2688.10	Shear (lb/sq ft)		0.70	
Alpha	1.00	Stream Power (lb/ft s)		2.58	
Frctn Loss (ft)	4.41	Cum Volume (acre-ft)	0.08	1.07	0.36
C & E Loss (ft)	0.01	Cum SA (acres)	0.29	1.60	0.55

Plan: 1 RIVER-1 Reach-1 RS: 3 Profile: 100-year

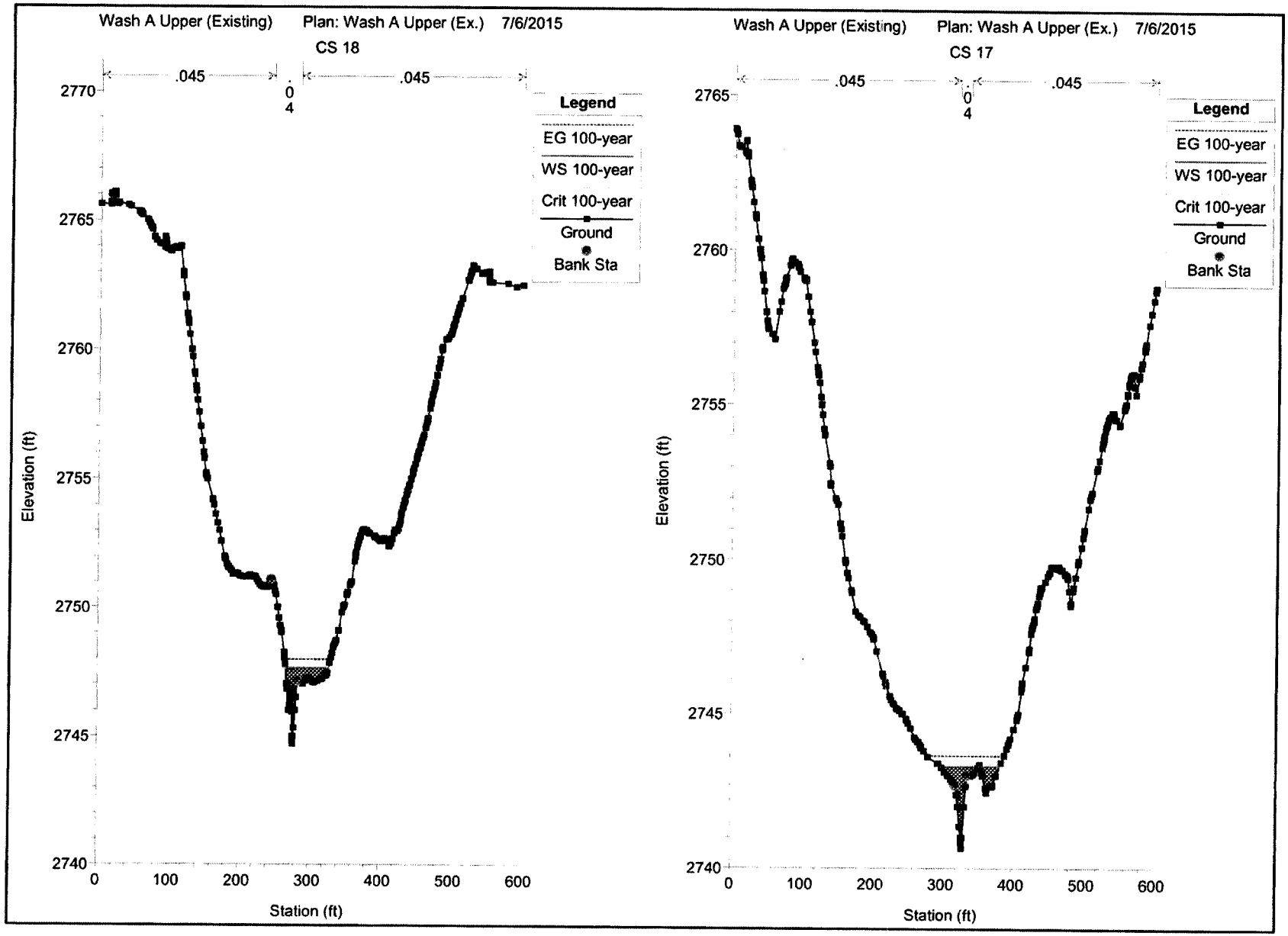
E.G. Elev (ft)	2685.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.040	
W.S. Elev (ft)	2684.93	Reach Len. (ft)	120.11	200.00	278.85
Crit W.S. (ft)	2684.93	Flow Area (sq ft)		95.19	
E.G. Slope (ft/ft)	0.029408	Area (sq ft)		95.19	
Q Total (cfs)	413.90	Flow (cfs)		413.90	
Top Width (ft)	168.54	Top Width (ft)		168.54	
Vel Total (ft/s)	4.35	Avg. Vel. (ft/s)		4.35	
Max Chl Dpth (ft)	1.37	Hydr. Depth (ft)		0.56	
Conv. Total (cfs)	2413.6	Conv. (cfs)		2413.6	
Length Wtd. (ft)	218.81	Wetted Per. (ft)		168.80	
Min Ch El (ft)	2683.56	Shear (lb/sq ft)		1.04	
Alpha	1.00	Stream Power (lb/ft s)		4.50	
Frctn Loss (ft)	4.21	Cum Volume (acre-ft)	0.08	0.59	0.36
C & E Loss (ft)	0.04	Cum SA (acres)	0.29	0.82	0.55

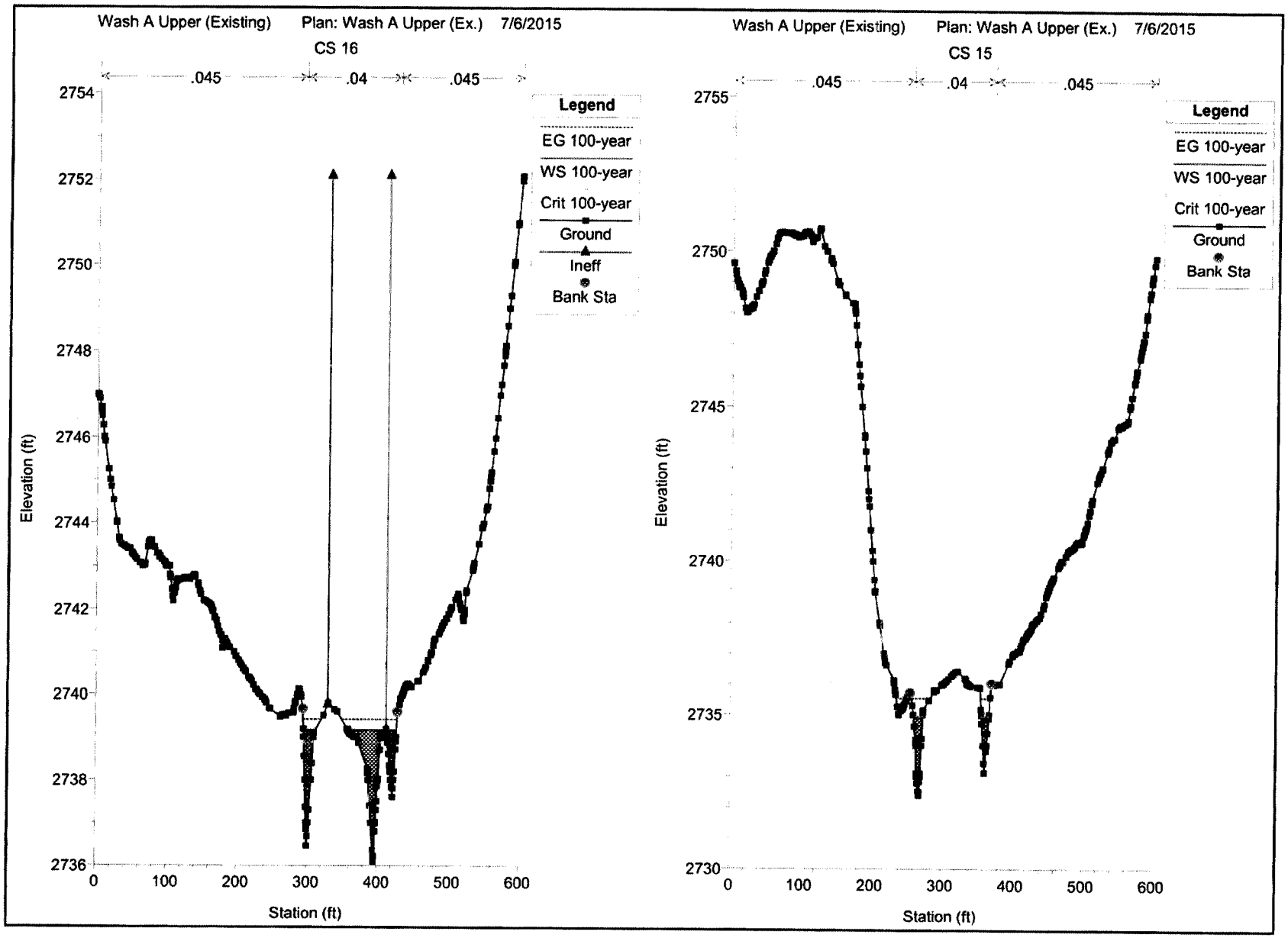
Plan: 1 RIVER-1 Reach-1 RS: 2 Profile: 100-year

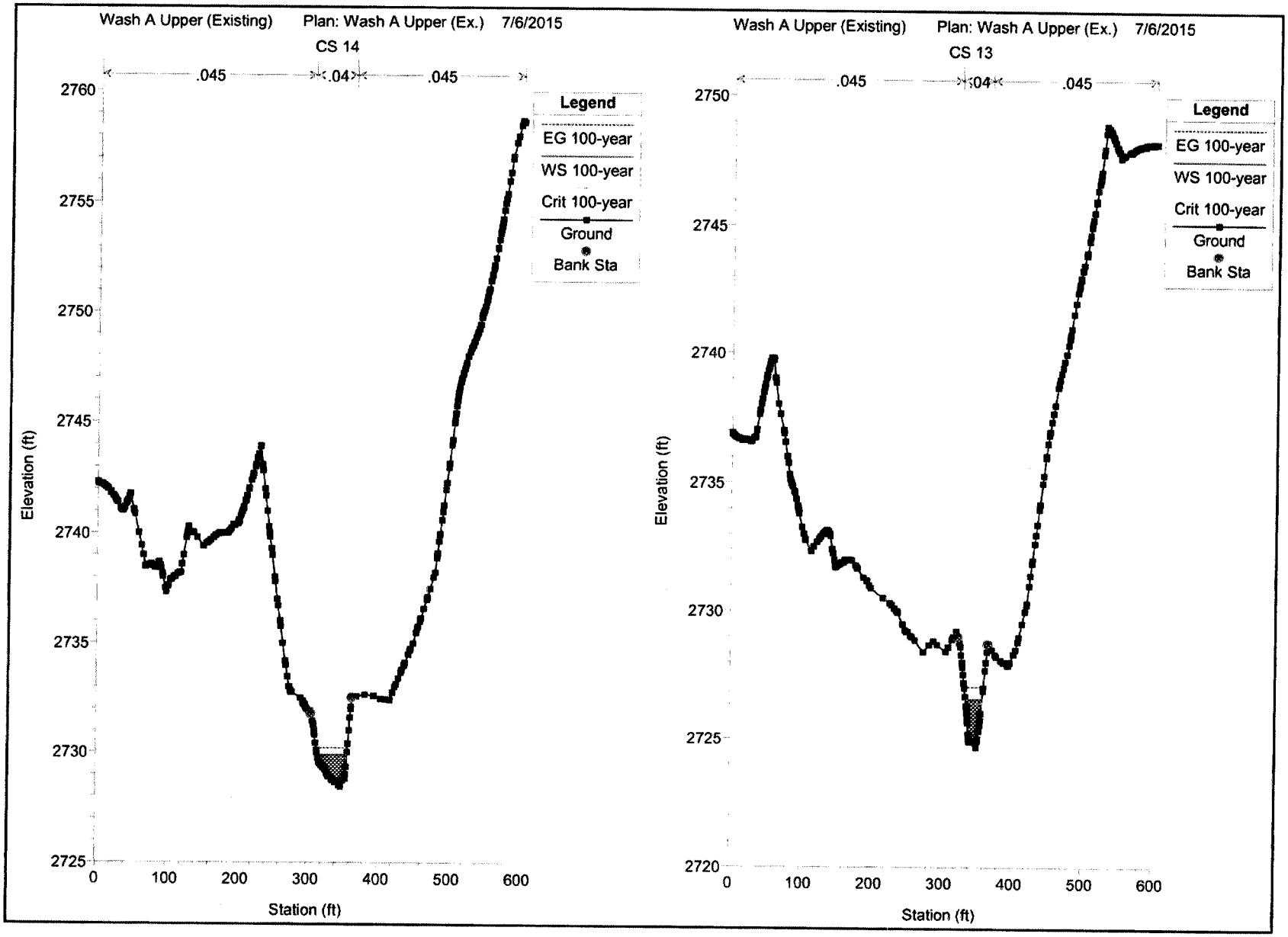
E.G. Elev (ft)	2680.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2680.72	Reach Len. (ft)	485.16	200.00	140.66
Crit W.S. (ft)	2680.59	Flow Area (sq ft)	11.81	51.96	75.16
E.G. Slope (ft/ft)	0.013570	Area (sq ft)	11.81	51.96	75.16
Q Total (cfs)	413.90	Flow (cfs)	19.73	176.71	217.46
Top Width (ft)	230.73	Top Width (ft)	41.19	74.46	115.07
Vel Total (ft/s)	2.98	Avg. Vel. (ft/s)	1.67	3.40	2.89
Max Chl Dpth (ft)	3.63	Hydr. Depth (ft)	0.29	0.70	0.65
Conv. Total (cfs)	3553.0	Conv. (cfs)	169.4	1516.9	1866.8
Length Wtd. (ft)	191.21	Wetted Per. (ft)	41.22	74.58	115.21
Min Ch El (ft)	2679.18	Shear (lb/sq ft)	0.24	0.59	0.55
Alpha	1.07	Stream Power (lb/ft s)	0.41	2.01	1.60
Frctn Loss (ft)	3.20	Cum Volume (acre-ft)	0.07	0.25	0.12
C & E Loss (ft)	0.06	Cum SA (acres)	0.23	0.26	0.19

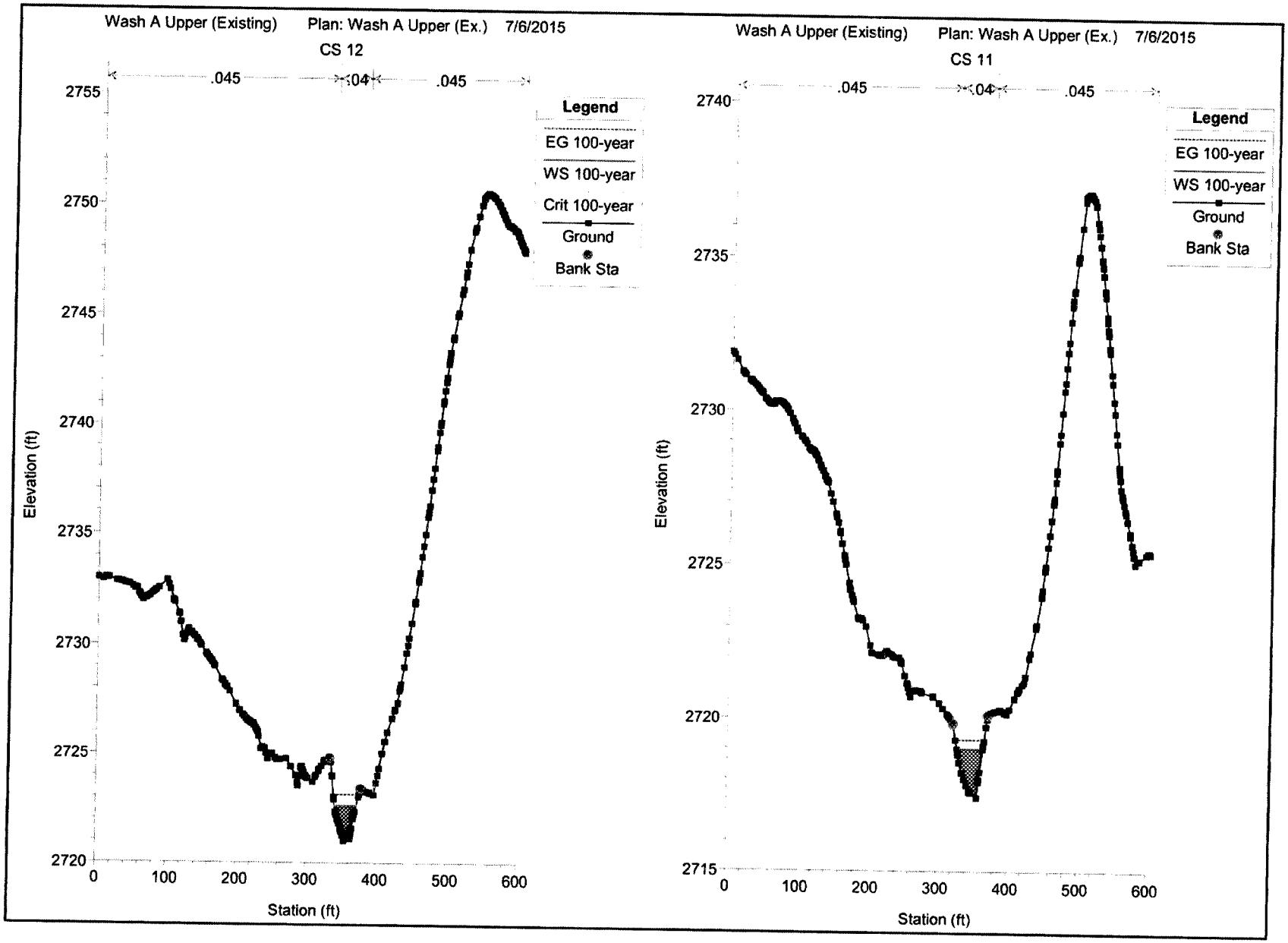
Plan: 1 RIVER-1 Reach-1 RS: 1 Profile: 100-year

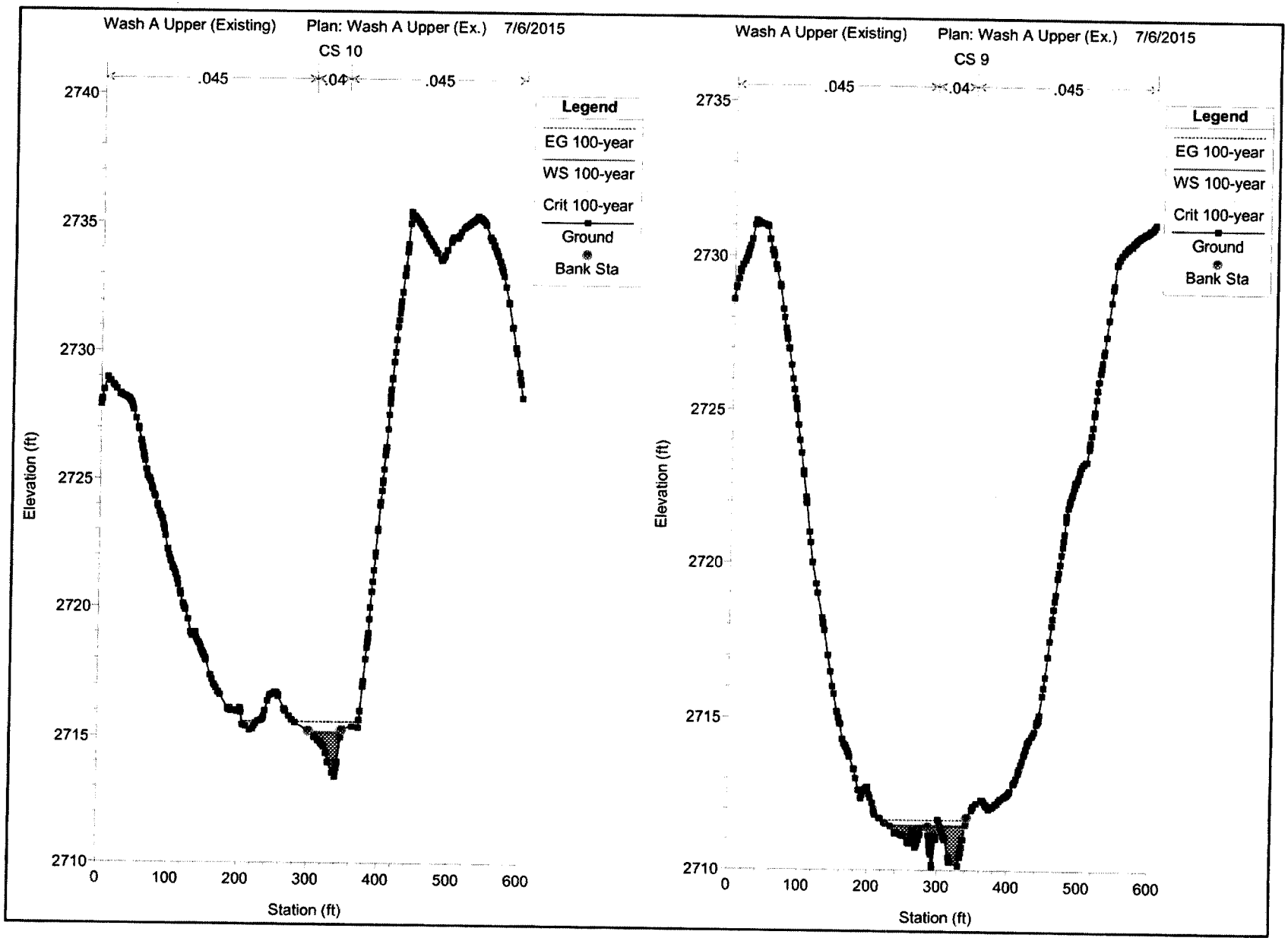
E.G. Elev (ft)	2677.61	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.78	Wt. n-Val.		0.040	
W.S. Elev (ft)	2676.83	Reach Len. (ft)			
Crit W.S. (ft)	2676.83	Flow Area (sq ft)		58.47	
E.G. Slope (ft/ft)	0.021176	Area (sq ft)		58.47	
Q Total (cfs)	413.90	Flow (cfs)		413.90	
Top Width (ft)	38.06	Top Width (ft)		38.06	
Vel Total (ft/s)	7.08	Avg. Vel. (ft/s)		7.08	
Max Chl Dpth (ft)	2.66	Hydr. Depth (ft)		1.54	
Conv. Total (cfs)	2844.3	Conv. (cfs)		2844.3	
Length Wtd. (ft)		Wetted Per. (ft)		39.02	
Min Ch El (ft)	2674.17	Shear (lb/sq ft)		1.98	
Alpha	1.00	Stream Power (lb/ft s)		14.02	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

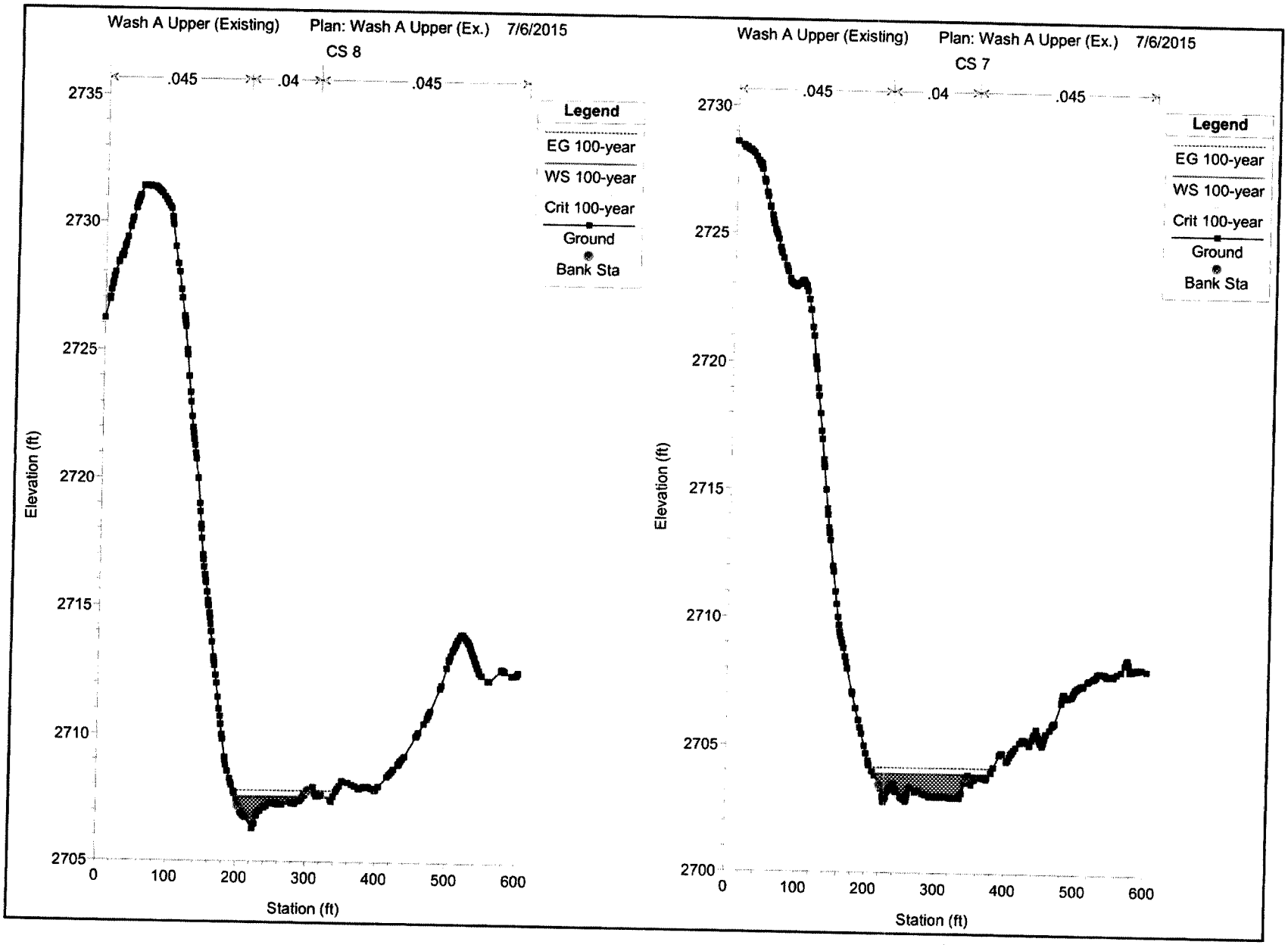

Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 18
.045
.045
0.04
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2770
2765
2760
2755
2750
2745
2740
0
100
200
300
400
500
600
Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 17
.045
.045
0.04
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2765
2760
2755
2750
2745
2740
0
100
200
300
400
500
600

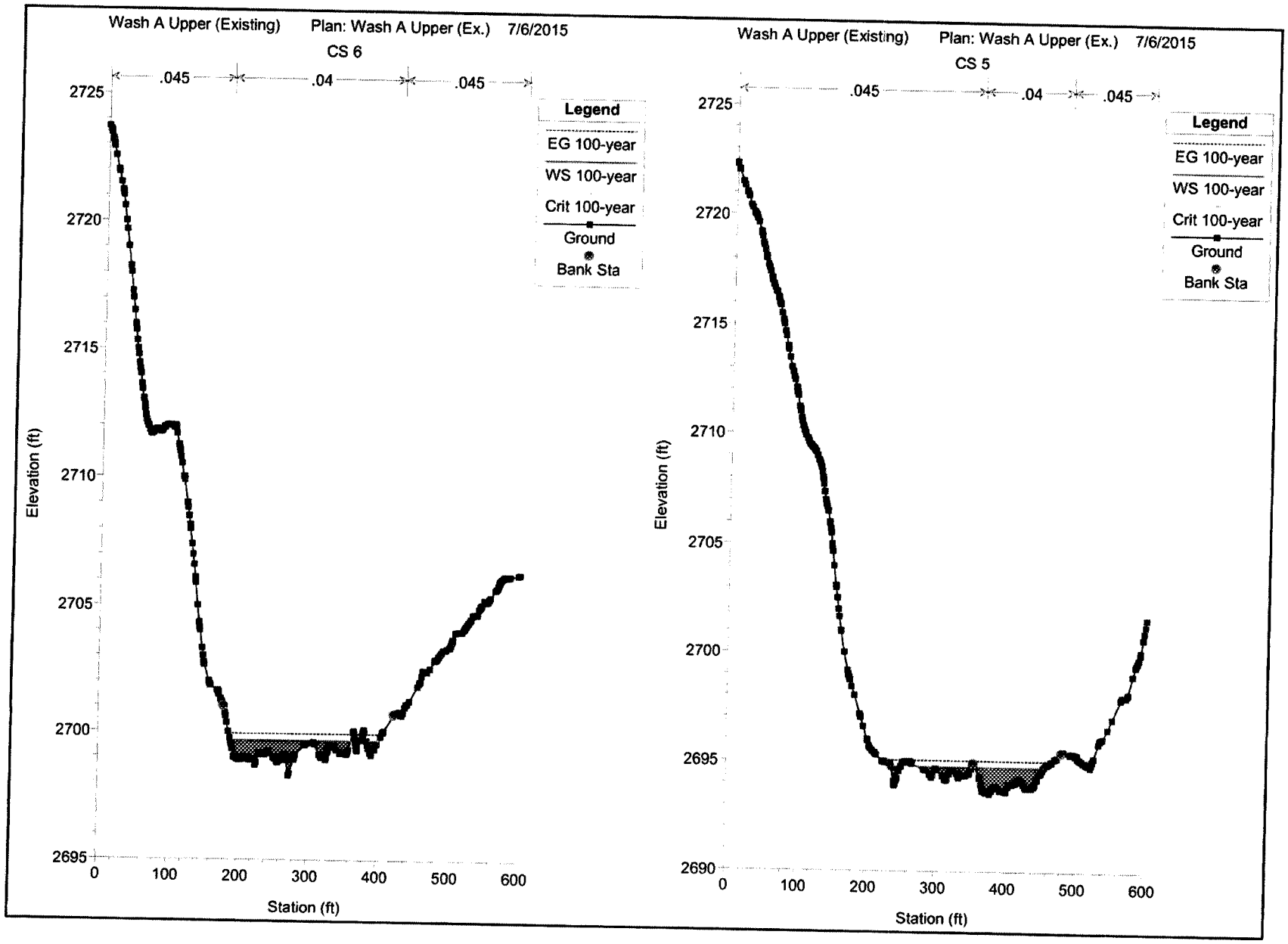

Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 16
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2754
2752
2750
2748
2746
2744
2742
2740
2738
2736
0
100
200
300
400
500
600
Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 15
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2755
2750
2745
2740
2735
2730
0
100
200
300
400
500
600

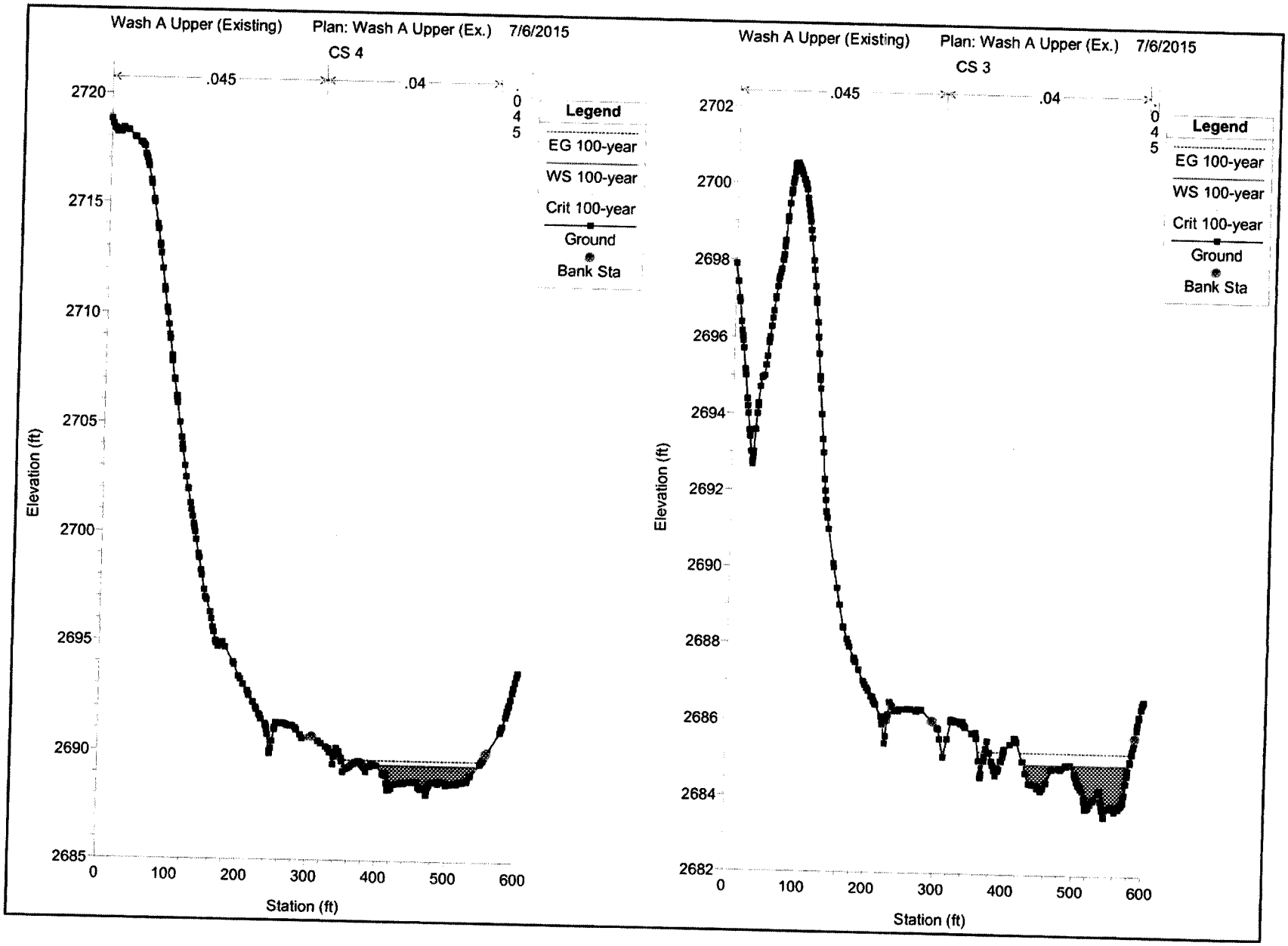

Wash A Upper (Existing)
Plan: Wash A Upper (Ex.)
7/6/2015
CS 14
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2760
2755
2750
2745
2740
2735
2730
2725
0
100
200
300
400
500
600
Wash A Upper (Existing)
Plan: Wash A Upper (Ex.)
7/6/2015
CS 13
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2750
2745
2740
2735
2730
2725
2720
0
100
200
300
400
500
600

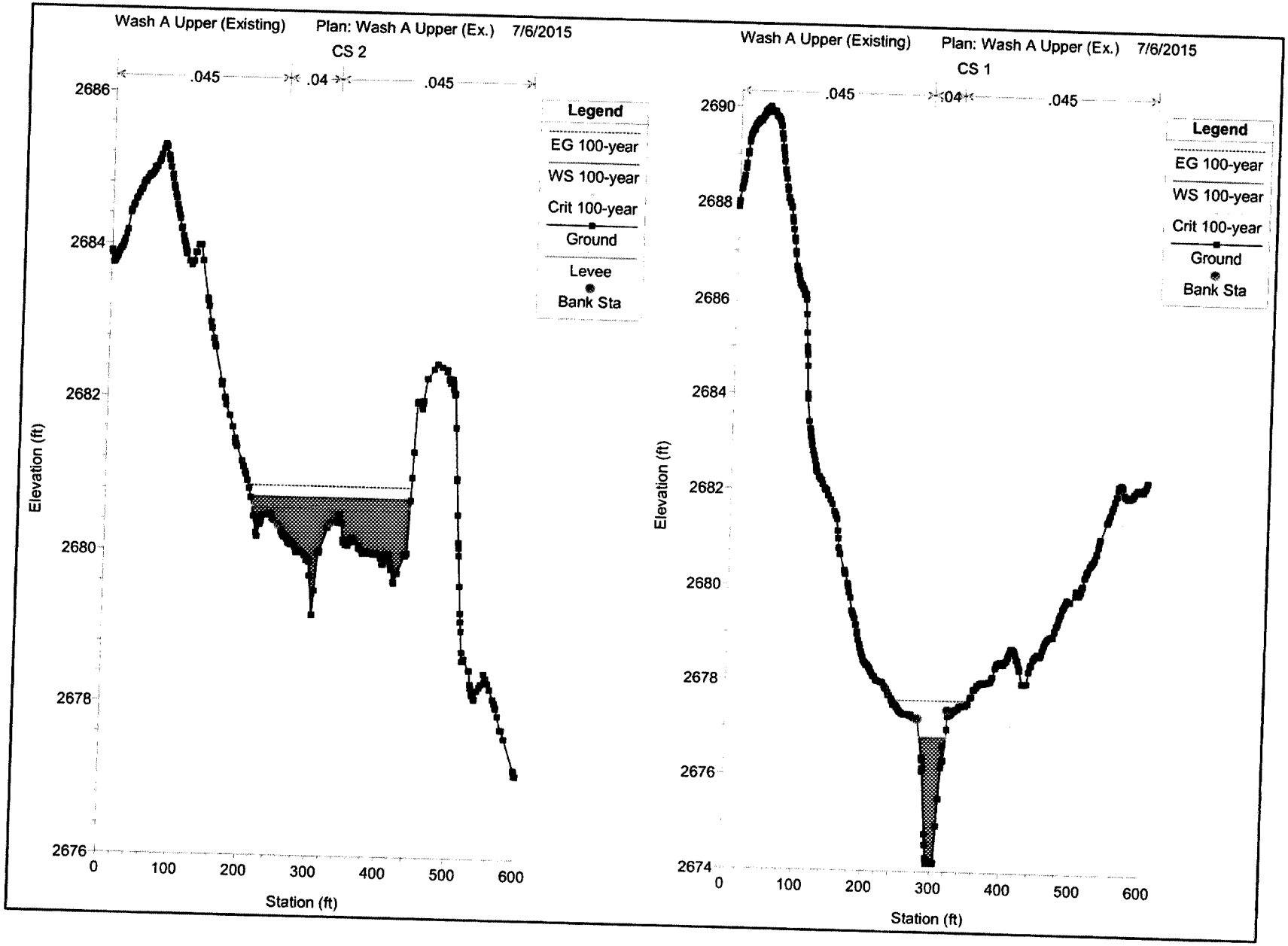

Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 12
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2755
2750
2745
2740
2735
2730
2725
2720
0
100
200
300
400
500
600
Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 11
.045
.04
.045
Legend
EG 100-year
WS 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2740
2735
2730
2725
2720
2715
0
100
200
300
400
500
600


Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 10
.045
.04
.045
2740
2735
2730
2725
2720
2715
2710
Elevation (ft)
0
100
200
300
400
500
600
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 9
.045
.04
.045
2735
2730
2725
2720
2715
2710
Elevation (ft)
0
100
200
300
400
500
600
Station (ft)
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta

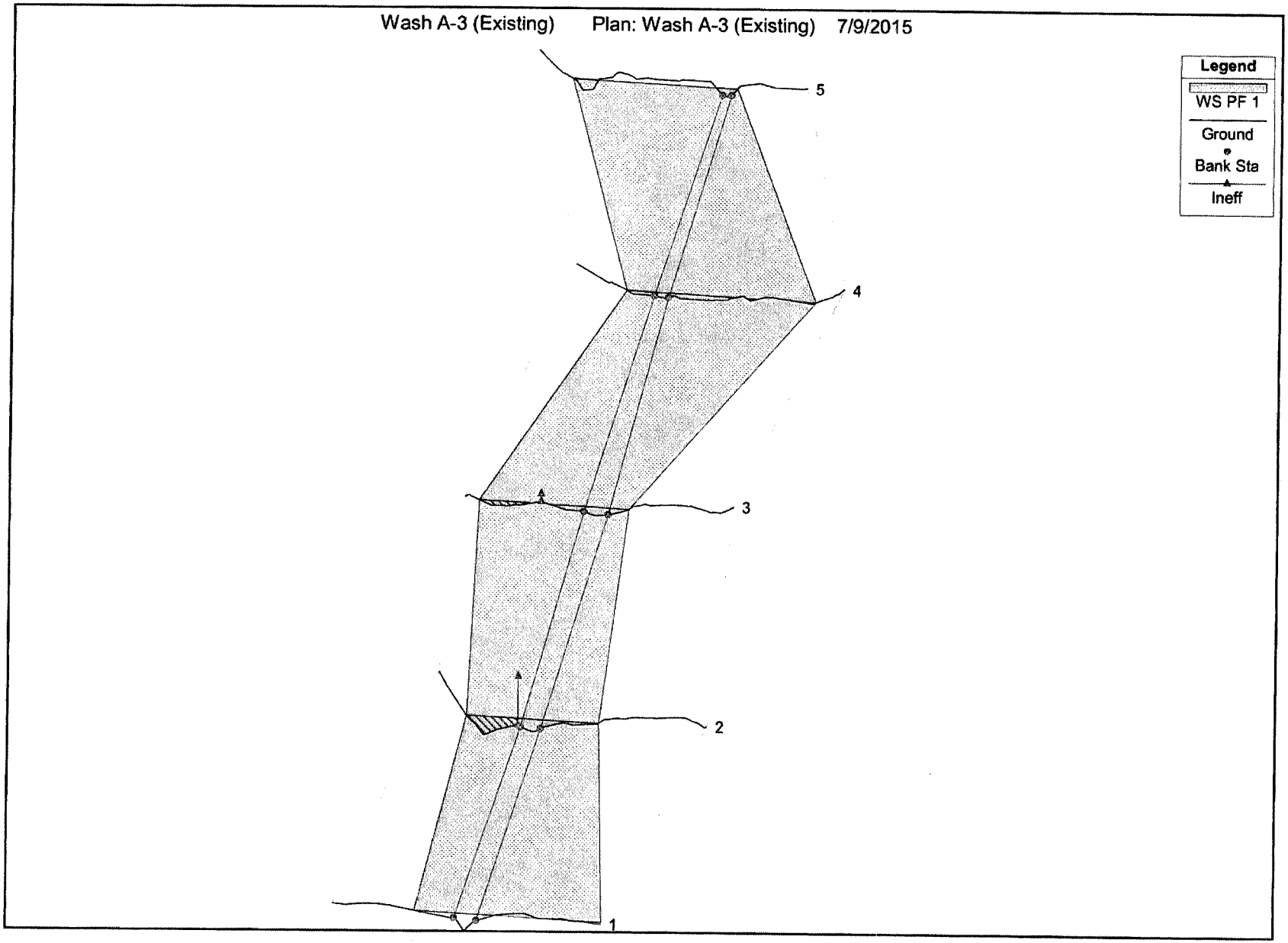

Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 8
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2735
2730
2725
2720
2715
2710
2705
0
100
200
300
400
500
600
Wash A Upper (Existing) Plan: Wash A Upper (Ex.) 7/6/2015
CS 7
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2730
2725
2720
2715
2710
2705
2700
0
100
200
300
400
500
600

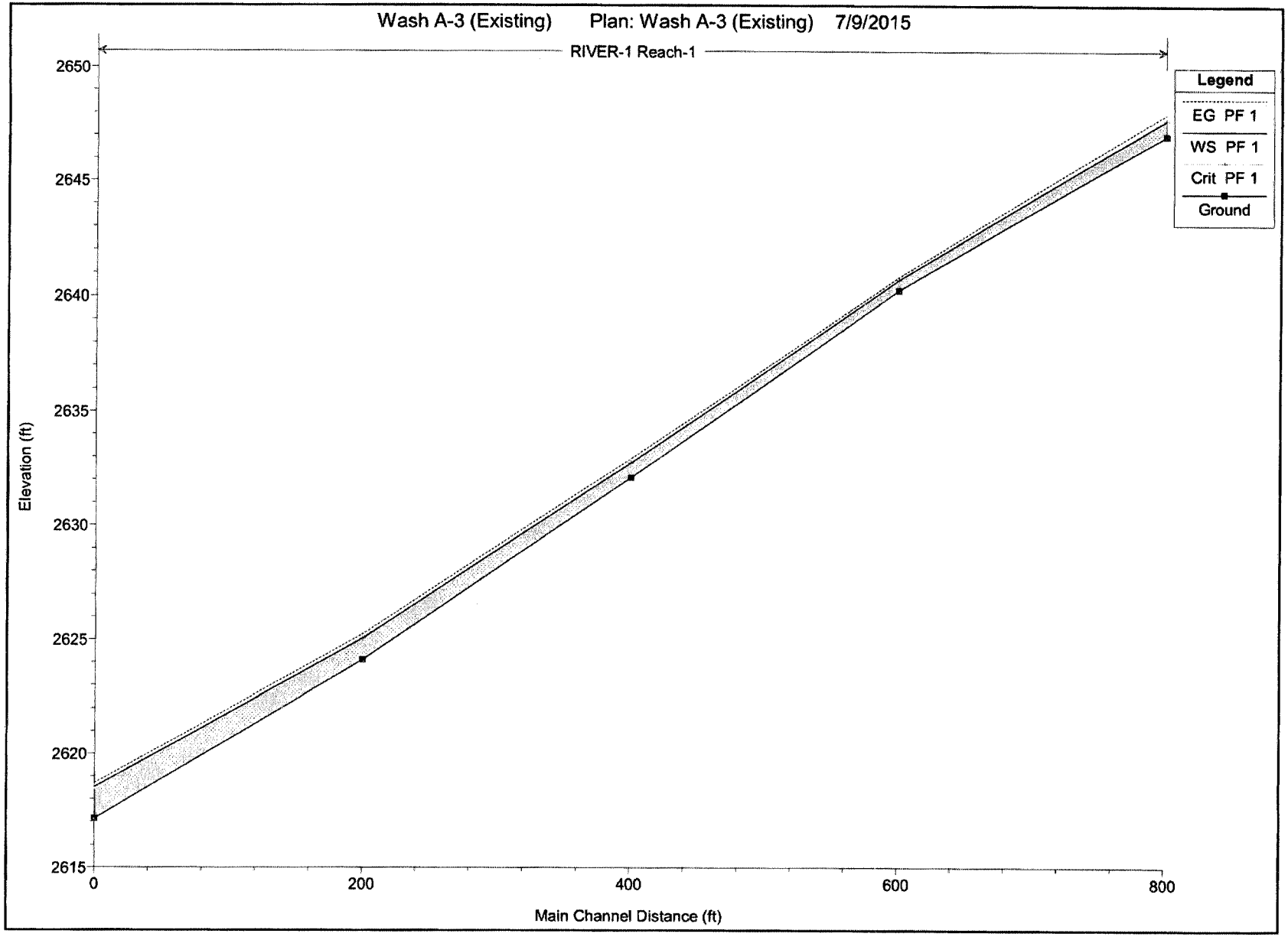

Wash A Upper (Existing)
Plan: Wash A Upper (Ex.)
7/6/2015
CS 6
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2725
2720
2715
2710
2705
2700
2695
0
100
200
300
400
500
600
Wash A Upper (Existing)
Plan: Wash A Upper (Ex.)
7/6/2015
CS 5
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)
2725
2720
2715
2710
2705
2700
2695
2690
0
100
200
300
400
500
600


Wash A Upper (Existing)
Plan: Wash A Upper (Ex.) 7/6/2015
CS 4
.045
.04
0
4
5
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
2720
2715
2710
2705
2700
2695
2690
2685
0
100
200
300
400
500
600
Station (ft)
Wash A Upper (Existing)
Plan: Wash A Upper (Ex.) 7/6/2015
CS 3
.045
.04
0
4
5
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
2702
2700
2698
2696
2694
2692
2690
2688
2686
2684
2682
0
100
200
300
400
500
600
Station (ft)


Wash A Upper (Existing)
Plan: Wash A Upper (Ex.) 7/6/2015
CS 2
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
Wash A Upper (Existing)
Plan: Wash A Upper (Ex.) 7/6/2015
CS 1
.045
.04
.045
Legend
EG 100-year
WS 100-year
Crit 100-year
Ground
Bank Sta
Elevation (ft)
Station (ft)

WASH A3 (Sanctuary At Silverhawke) HEC-RAS MODEL


Wash A-3 (Existing) Plan: Wash A-3 (Existing) 7/9/2015
Legend
WS PF 1
Ground
Bank Sta
Ineff
5
4
3
2
1


Wash A-3 (Existing) Plan: Wash A-3 (Existing) 7/9/2015
RIVER-1 Reach-1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
2650
2645
2640
2635
2630
2625
2620
2615
0
200
400
600
800
Main Channel Distance (ft)

Plan: A RIVER-1 Reach-1 RS: 5 Profile: PF 1

E.G. Elev (ft)	2647.95	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2647.69	Reach Len. (ft)	172.97	200.00	221.92
Crit W.S. (ft)	2647.69	Flow Area (sq ft)	0.98	3.27	8.86
E.G. Slope (ft/ft)	0.032046	Area (sq ft)	0.98	3.27	8.86
Q Total (cfs)	51.90	Flow (cfs)	2.51	16.18	33.21
Top Width (ft)	26.47	Top Width (ft)	3.41	5.08	17.98
Vel Total (ft/s)	3.96	Avg. Vel. (ft/s)	2.56	4.95	3.75
Max Chl Dpth (ft)	0.88	Hydr. Depth (ft)	0.29	0.64	0.49
Conv. Total (cfs)	289.9	Conv. (cfs)	14.0	90.4	185.5
Length Wtd. (ft)	200.08	Wetted Per. (ft)	3.45	5.10	18.21
Min Ch El (ft)	2646.99	Shear (lb/sq ft)	0.57	1.28	0.97
Alpha	1.08	Stream Power (lb/ft s)	150.00	0.00	0.00
Frctn Loss (ft)	6.73	Cum Volume (acre-ft)	0.13	0.12	0.21
C & E Loss (ft)	0.04	Cum SA (acres)	0.57	0.19	0.48

Plan: A RIVER-1 Reach-1 RS: 4 Profile: PF 1

E.G. Elev (ft)	2640.84	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2640.71	Reach Len. (ft)	261.73	200.00	136.79
Crit W.S. (ft)	2640.71	Flow Area (sq ft)	12.09	3.06	3.77
E.G. Slope (ft/ft)	0.035315	Area (sq ft)	12.09	3.06	3.77
Q Total (cfs)	51.90	Flow (cfs)	31.54	11.20	9.16
Top Width (ft)	75.91	Top Width (ft)	52.50	8.04	15.37
Vel Total (ft/s)	2.74	Avg. Vel. (ft/s)	2.61	3.66	2.43
Max Chl Dpth (ft)	0.44	Hydr. Depth (ft)	0.23	0.38	0.25
Conv. Total (cfs)	276.2	Conv. (cfs)	167.8	59.6	48.7
Length Wtd. (ft)	210.91	Wetted Per. (ft)	52.64	8.04	15.38
Min Ch El (ft)	2640.27	Shear (lb/sq ft)	0.51	0.84	0.54
Alpha	1.07	Stream Power (lb/ft s)	150.00	0.00	0.00
Frctn Loss (ft)	6.22	Cum Volume (acre-ft)	0.10	0.11	0.18
C & E Loss (ft)	0.01	Cum SA (acres)	0.46	0.16	0.39

Plan: A RIVER-1 Reach-1 RS: 3 Profile: PF 1

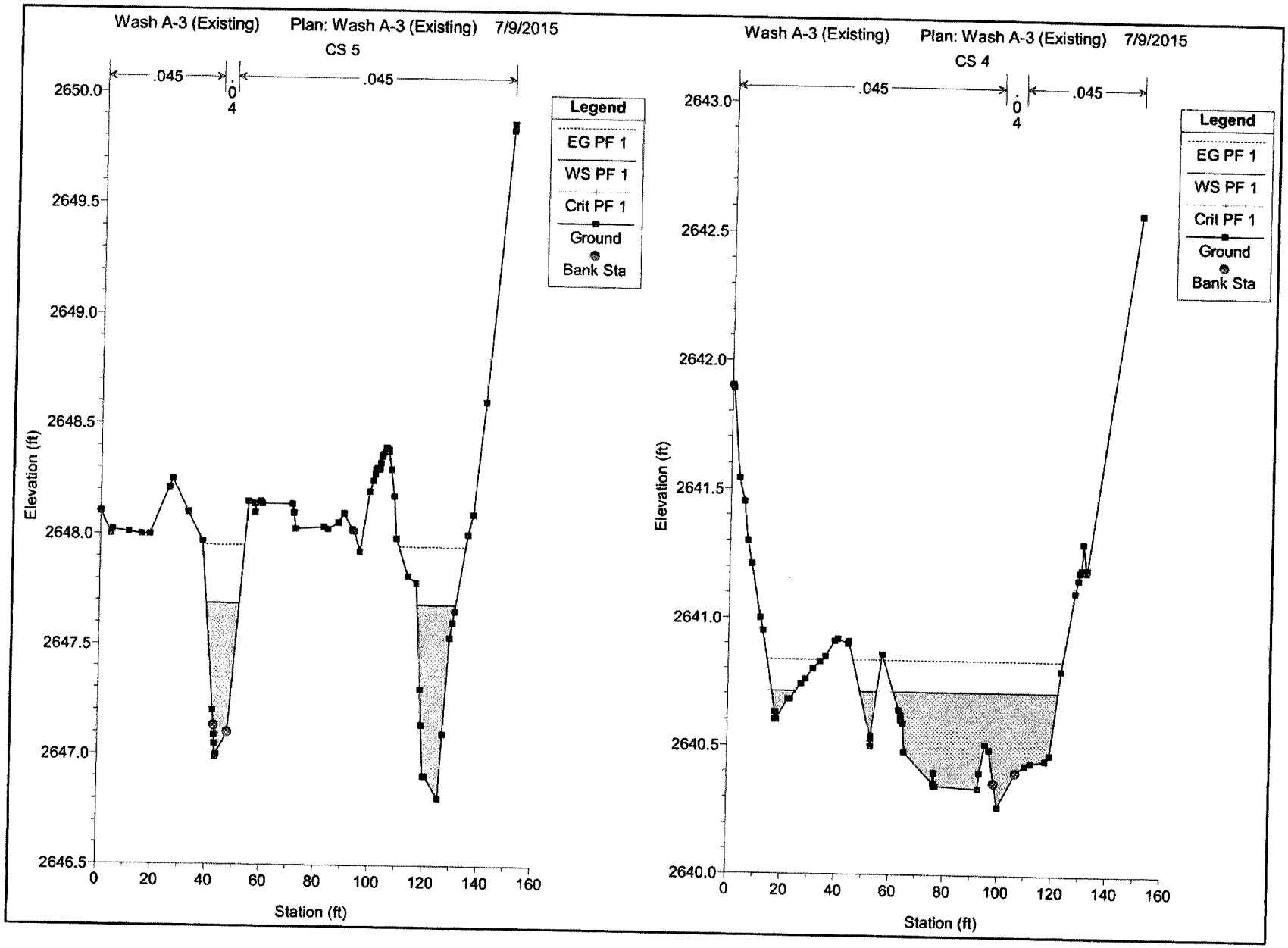
E.G. Elev (ft)	2632.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2632.73	Reach Len. (ft)	171.96	200.00	223.46
Crit W.S. (ft)	2632.73	Flow Area (sq ft)	3.58	7.73	5.40
E.G. Slope (ft/ft)	0.025019	Area (sq ft)	3.58	7.73	12.58
Q Total (cfs)	51.90	Flow (cfs)	8.47	31.42	12.00
Top Width (ft)	73.90	Top Width (ft)	11.74	13.42	48.74
Vel Total (ft/s)	3.11	Avg. Vel. (ft/s)	2.37	4.07	2.22
Max Chl Dpth (ft)	0.65	Hydr. Depth (ft)	0.31	0.58	0.28
Conv. Total (cfs)	328.1	Conv. (cfs)	53.6	198.7	75.9
Length Wtd. (ft)	197.73	Wetted Per. (ft)	11.76	13.42	19.45
Min Ch El (ft)	2632.08	Shear (lb/sq ft)	0.48	0.90	0.43
Alpha	1.25	Stream Power (lb/ft s)	150.00	0.00	0.00
Frctn Loss (ft)	3.67	Cum Volume (acre-ft)	0.05	0.09	0.15
C & E Loss (ft)	0.00	Cum SA (acres)	0.26	0.11	0.29

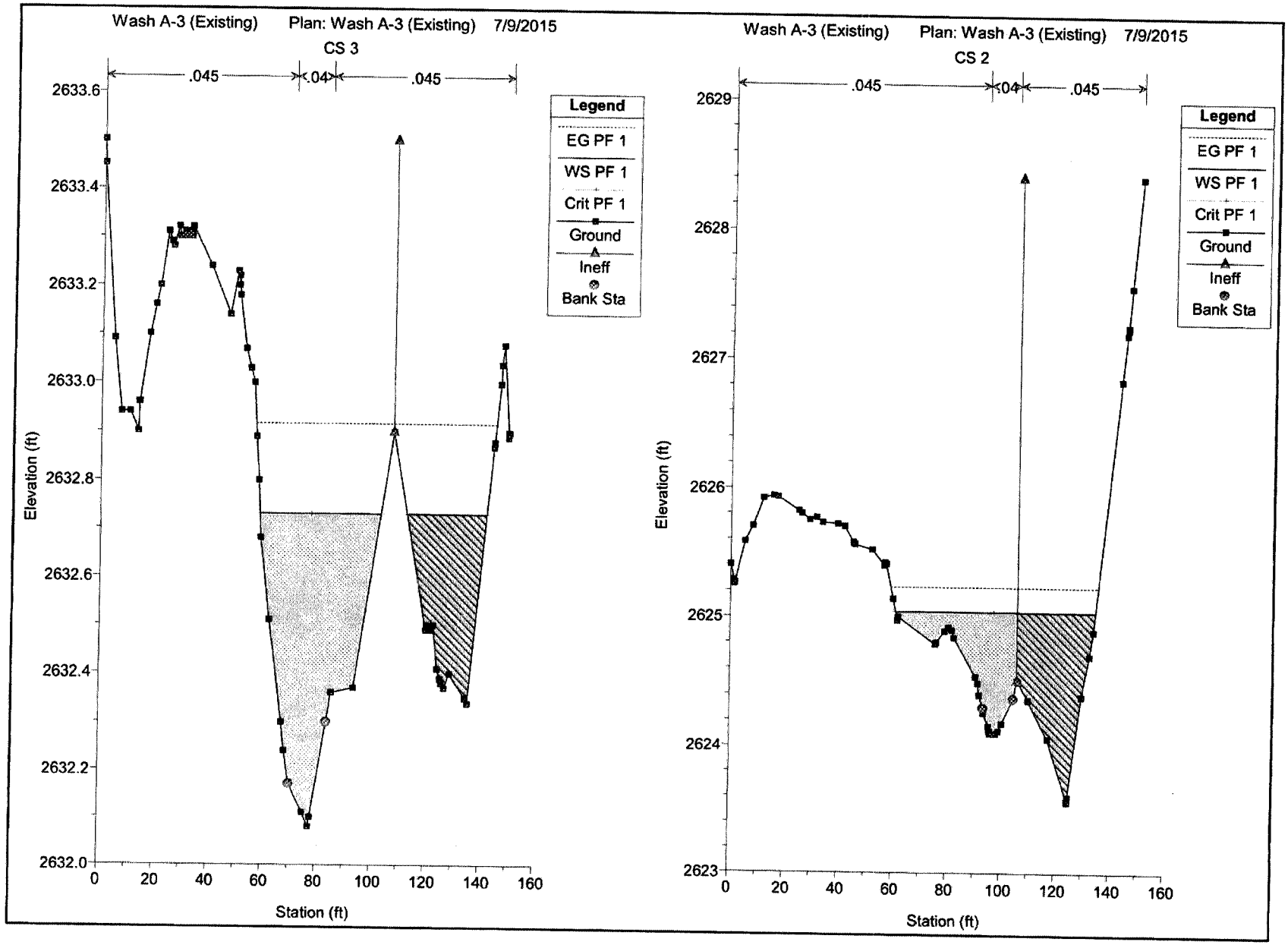
Plan: A RIVER-1 Reach-1 RS: 2 Profile: PF 1

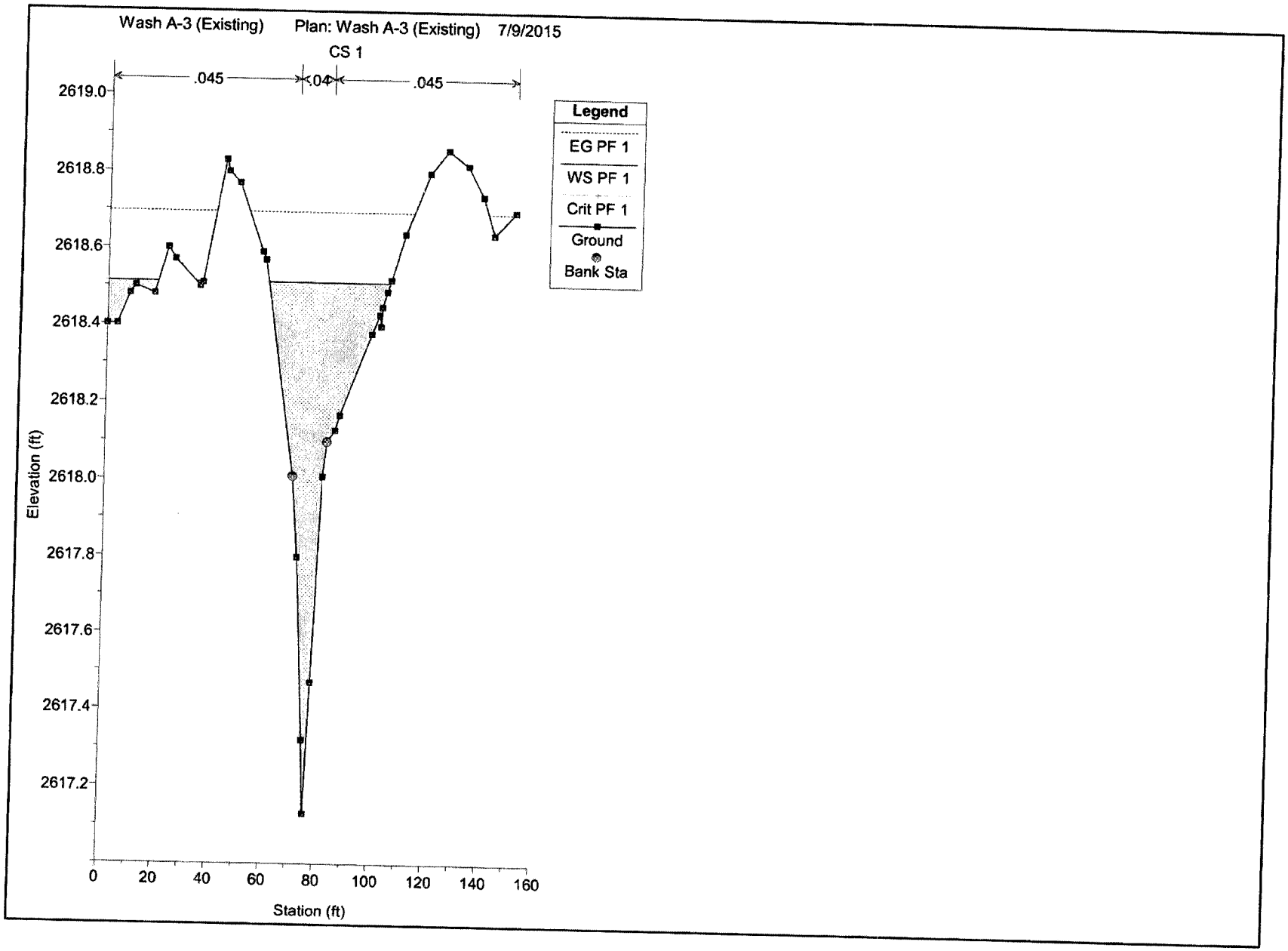
E.G. Elev (ft)	2625.23	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2625.04	Reach Len. (ft)	239.57	200.00	150.89
Crit W.S. (ft)	2625.04	Flow Area (sq ft)	7.82	9.45	0.85
E.G. Slope (ft/ft)	0.014314	Area (sq ft)	7.82	9.45	25.60
Q Total (cfs)	51.90	Flow (cfs)	11.95	37.57	2.38
Top Width (ft)	73.82	Top Width (ft)	32.45	11.16	30.22
Vel Total (ft/s)	2.86	Avg. Vel. (ft/s)	1.53	3.97	2.80
Max Chl Dpth (ft)	1.48	Hydr. Depth (ft)	0.24	0.85	0.60
Conv. Total (cfs)	433.8	Conv. (cfs)	99.9	314.0	19.9
Length Wtd. (ft)	201.92	Wetted Per. (ft)	32.47	11.18	1.42
Min Ch El (ft)	2624.10	Shear (lb/sq ft)	0.22	0.76	0.53
Alpha	1.50	Stream Power (lb/ft s)	150.00	0.00	0.00
Frctn Loss (ft)	2.77	Cum Volume (acre-ft)	0.03	0.05	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.18	0.05	0.09

Plan: A RIVER-1 Reach-1 RS: 1 Profile: PF 1

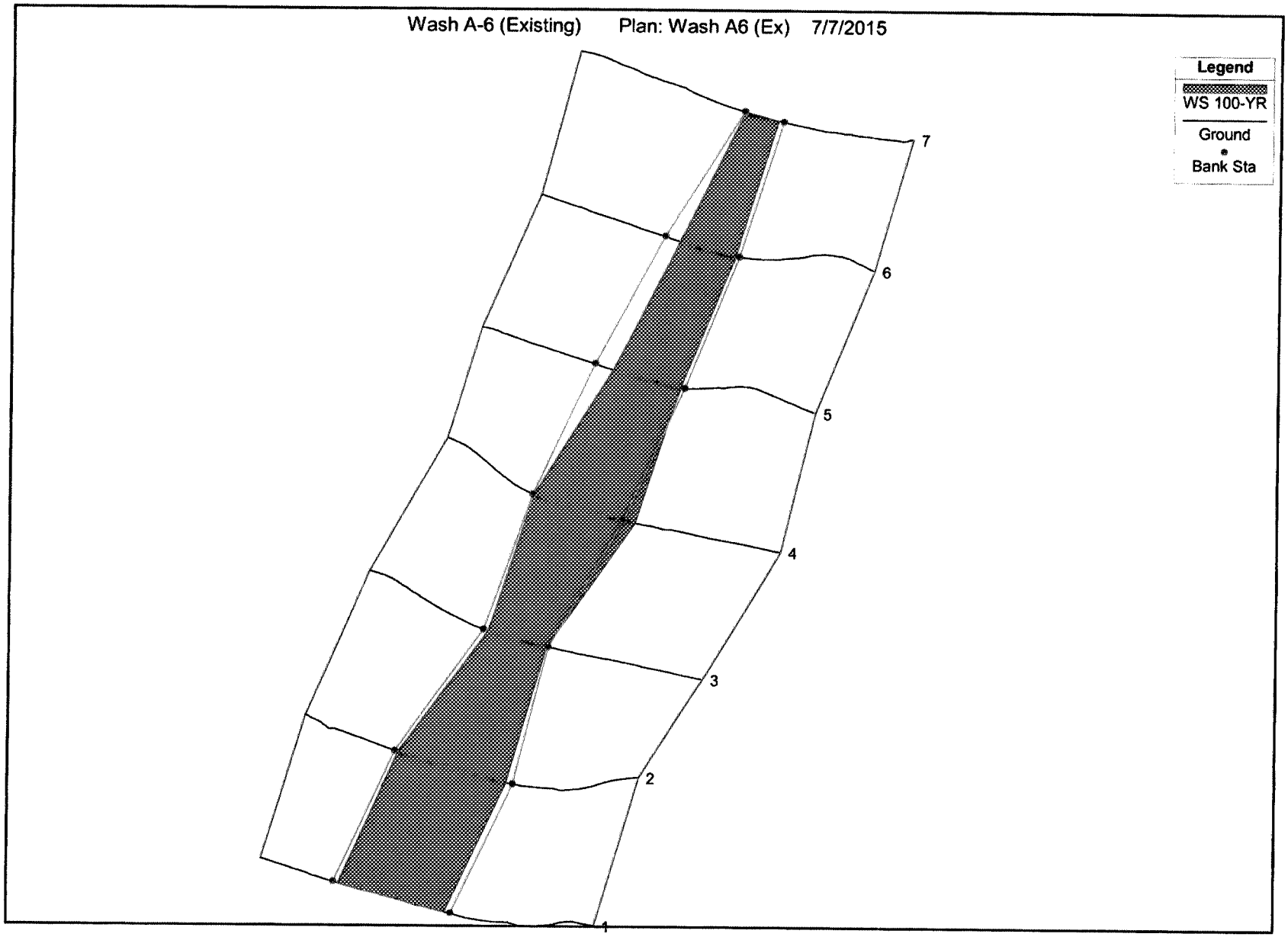
E.G. Elev (ft)	2618.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2618.51	Reach Len. (ft)			
Crit W.S. (ft)	2618.51	Flow Area (sq ft)	3.57	10.68	4.90
E.G. Slope (ft/ft)	0.013117	Area (sq ft)	3.57	10.68	4.90
Q Total (cfs)	51.90	Flow (cfs)	4.41	40.74	6.75
Top Width (ft)	66.16	Top Width (ft)	31.47	12.44	22.25
Vel Total (ft/s)	2.71	Avg. Vel. (ft/s)	1.23	3.81	1.38
Max Chl Dpth (ft)	1.38	Hydr. Depth (ft)	0.11	0.86	0.22
Conv. Total (cfs)	453.2	Conv. (cfs)	38.5	355.8	58.9
Length Wtd. (ft)		Wetted Per. (ft)	31.60	12.59	22.26
Min Ch El (ft)	2617.13	Shear (lb/sq ft)	0.09	0.69	0.18
Alpha	1.61	Stream Power (lb/ft s)	150.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

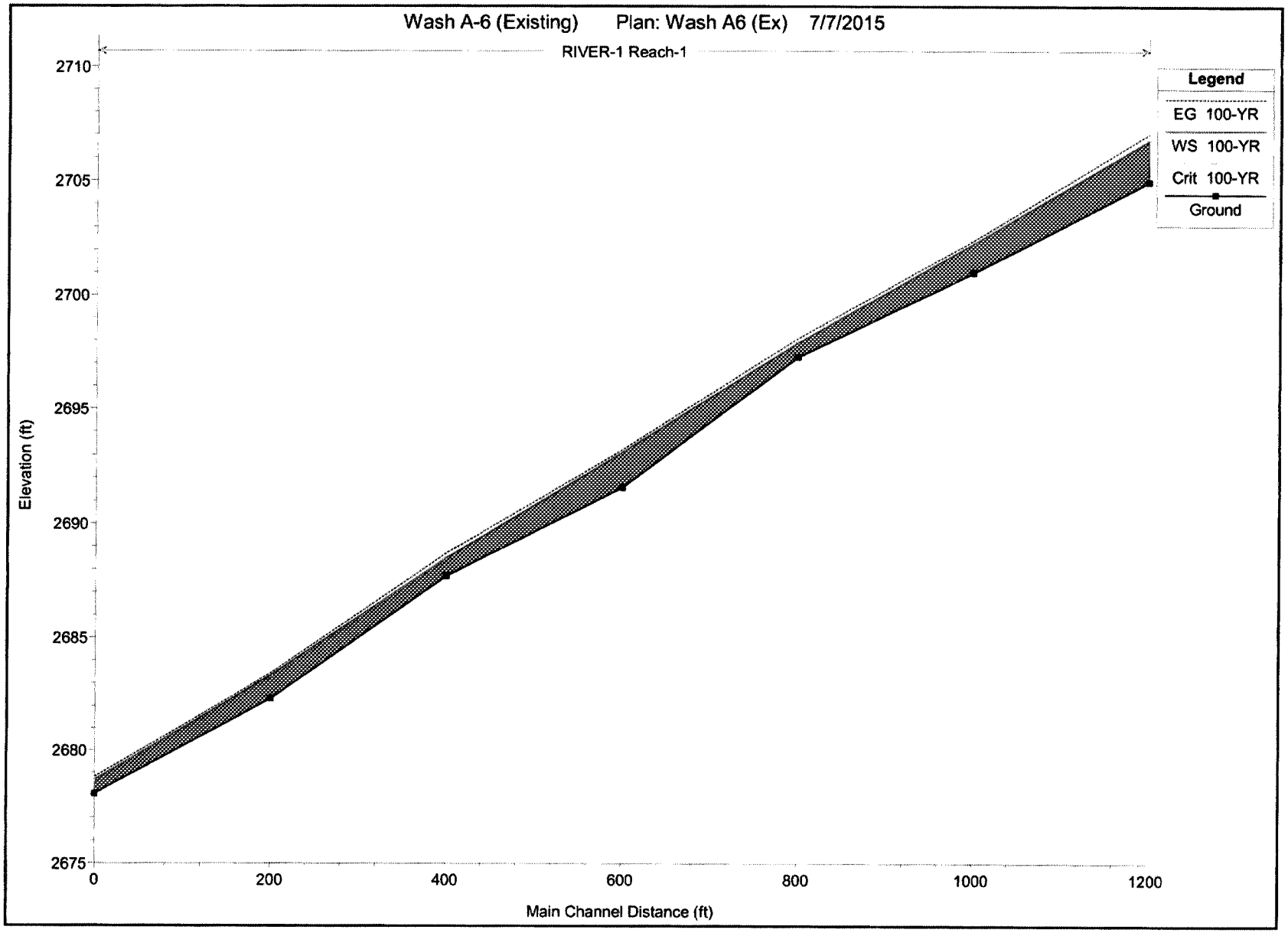

Wash A-3 (Existing) Plan: Wash A-3 (Existing) 7/9/2015
CS 5
.045
.045
0.04
2650.0
2649.5
2649.0
2648.5
2648.0
2647.5
2647.0
2646.5
Elevation (ft)
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Wash A-3 (Existing) Plan: Wash A-3 (Existing) 7/9/2015
CS 4
.045
.045
0.04
2643.0
2642.5
2642.0
2641.5
2641.0
2640.5
2640.0
Elevation (ft)
0
20
40
60
80
100
120
140
160
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


Wash A-3 (Existing) Plan: Wash A-3 (Existing) 7/9/2015
CS 3
.045
.04
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Wash A-3 (Existing) Plan: Wash A-3 (Existing) 7/9/2015
CS 2
.045
.04
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Wash A-3 (Existing)
Plan: Wash A-3 (Existing) 7/9/2015
CS 1
.045
.04
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
2619.0
2618.8
2618.6
2618.4
2618.2
2618.0
2617.8
2617.6
2617.4
2617.2
0
20
40
60
80
100
120
140
160
Station (ft)

WASH A6 (Villages At Silverhawke) HEC-RAS MODEL


Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
Legend
WS 100-YR
Ground
Bank Sta
7
6
5
4
3
2
1


Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
RIVER-1 Reach-1
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Elevation (ft)
2710
2705
2700
2695
2690
2685
2680
2675
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

Plan: 2 RIVER-1 Reach-1 RS: 7 Profile: 100-YR

E.G. Elev (ft)	2707.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.040	
W.S. Elev (ft)	2706.80	Reach Len. (ft)	231.02	200.00	168.09
Crit W.S. (ft)	2706.80	Flow Area (sq ft)		23.66	
E.G. Slope (ft/ft)	0.028117	Area (sq ft)		23.66	
Q Total (cfs)	102.60	Flow (cfs)		102.60	
Top Width (ft)	40.39	Top Width (ft)		40.39	
Vel Total (ft/s)	4.34	Avg. Vel. (ft/s)		4.34	
Max Chl Dpth (ft)	1.80	Hydr. Depth (ft)		0.59	
Conv. Total (cfs)	611.9	Conv. (cfs)		611.9	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		40.73	
Min Ch El (ft)	2705.00	Shear (lb/sq ft)		1.02	
Alpha	1.00	Stream Power (lb/ft s)		4.42	
Frctn Loss (ft)	4.05	Cum Volume (acre-ft)	0.00	0.94	
C & E Loss (ft)	0.05	Cum SA (acres)	0.01	2.41	

Plan: 2 RIVER-1 Reach-1 RS: 6 Profile: 100-YR

E.G. Elev (ft)	2702.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.		0.040	
W.S. Elev (ft)	2702.32	Reach Len. (ft)	166.41	200.00	232.24
Crit W.S. (ft)		Flow Area (sq ft)		34.70	
E.G. Slope (ft/ft)	0.015261	Area (sq ft)		34.70	
Q Total (cfs)	102.60	Flow (cfs)		102.60	
Top Width (ft)	66.91	Top Width (ft)		66.91	
Vel Total (ft/s)	2.96	Avg. Vel. (ft/s)		2.96	
Max Chl Dpth (ft)	1.32	Hydr. Depth (ft)		0.52	
Conv. Total (cfs)	830.5	Conv. (cfs)		830.5	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		67.12	
Min Ch El (ft)	2701.00	Shear (lb/sq ft)		0.49	
Alpha	1.00	Stream Power (lb/ft s)		1.46	
Frctn Loss (ft)	4.32	Cum Volume (acre-ft)	0.00	0.81	
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	2.17	

Plan: 2 RIVER-1 Reach-1 RS: 5 Profile: 100-YR

E.G. Elev (ft)	2698.12	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.20	Wt. n-Val.		0.040	
W.S. Elev (ft)	2697.93	Reach Len. (ft)	82.37	200.00	314.12
Crit W.S. (ft)	2697.93	Flow Area (sq ft)		28.88	
E.G. Slope (ft/ft)	0.032828	Area (sq ft)		28.88	
Q Total (cfs)	102.60	Flow (cfs)		102.60	
Top Width (ft)	75.19	Top Width (ft)		75.19	
Vel Total (ft/s)	3.55	Avg. Vel. (ft/s)		3.55	
Max Chl Dpth (ft)	0.65	Hydr. Depth (ft)		0.38	
Conv. Total (cfs)	566.3	Conv. (cfs)		566.3	
Length Wtd. (ft)	199.62	Wetted Per. (ft)		75.28	
Min Ch El (ft)	2697.28	Shear (lb/sq ft)		0.79	
Alpha	1.00	Stream Power (lb/ft s)		2.79	
Frctn Loss (ft)	4.46	Cum Volume (acre-ft)	0.00	0.66	
C & E Loss (ft)	0.03	Cum SA (acres)	0.01	1.84	

Plan: 2 RIVER-1 Reach-1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2693.24	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.045	0.040	
W.S. Elev (ft)	2693.14	Reach Len. (ft)	225.87	200.00	173.94
Crit W.S. (ft)		Flow Area (sq ft)	0.56	40.77	
E.G. Slope (ft/ft)	0.016201	Area (sq ft)	0.56	40.77	
Q Total (cfs)	102.60	Flow (cfs)	0.66	101.94	
Top Width (ft)	109.14	Top Width (ft)	3.78	105.36	
Vel Total (ft/s)	2.48	Avg. Vel. (ft/s)	1.17	2.50	
Max Chl Dpth (ft)	1.57	Hydr. Depth (ft)	0.15	0.39	
Conv. Total (cfs)	806.1	Conv. (cfs)	5.2	800.9	
Length Wtd. (ft)	200.08	Wetted Per. (ft)	3.83	106.03	
Min Ch El (ft)	2691.57	Shear (lb/sq ft)	0.15	0.39	
Alpha	1.01	Stream Power (lb/ft s)	0.17	0.97	
Frctn Loss (ft)	4.52	Cum Volume (acre-ft)	0.00	0.50	
C & E Loss (ft)	0.01	Cum SA (acres)	0.01	1.43	

Plan: 2 RIVER-1 Reach-1 RS: 3 Profile: 100-YR

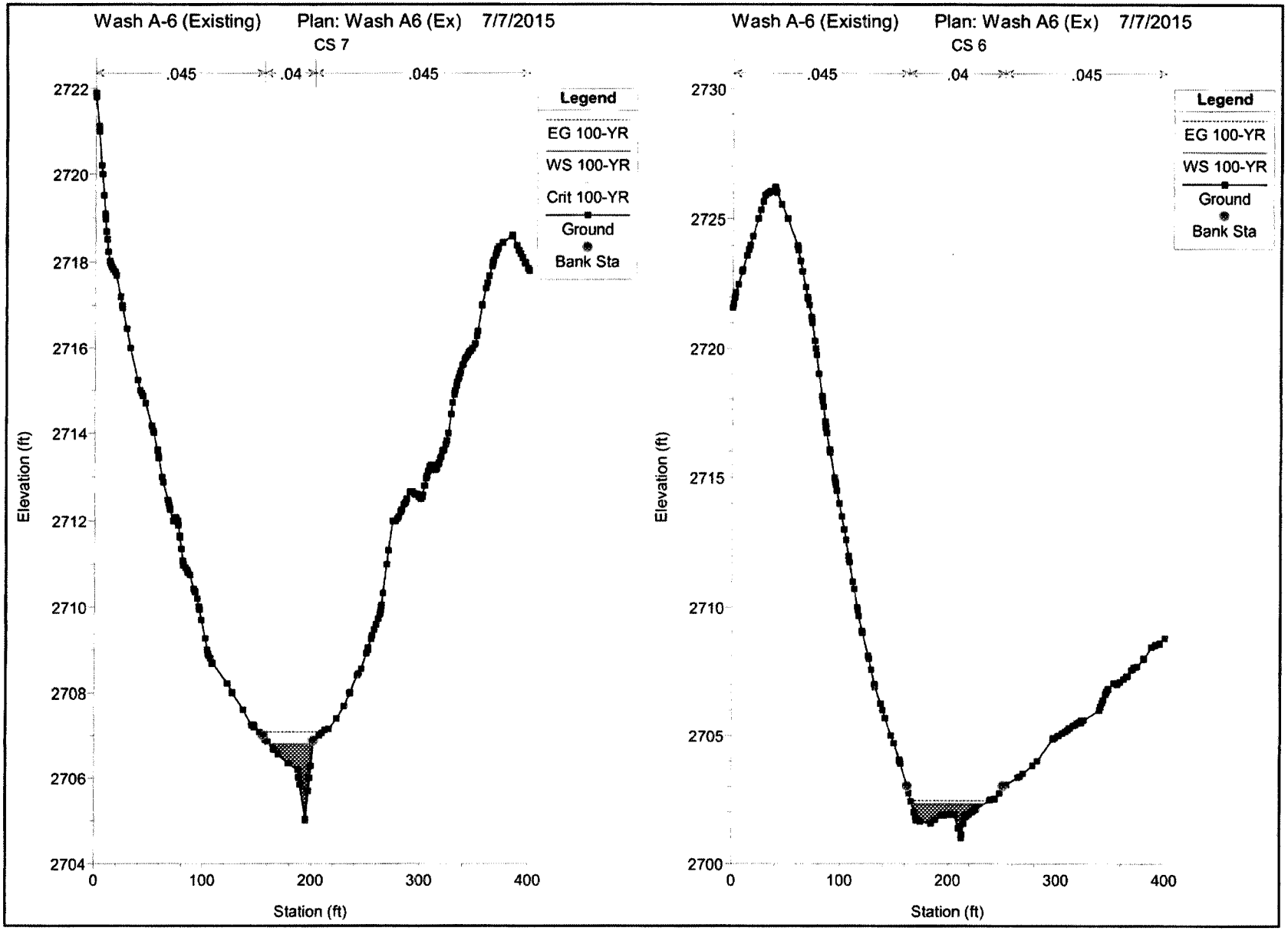
E.G. Elev (ft)	2688.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.040	
W.S. Elev (ft)	2688.50	Reach Len. (ft)	247.35	200.00	151.68
Crit W.S. (ft)	2688.50	Flow Area (sq ft)		27.99	
E.G. Slope (ft/ft)	0.033616	Area (sq ft)		27.99	
Q Total (cfs)	102.60	Flow (cfs)		102.60	
Top Width (ft)	70.85	Top Width (ft)		70.85	
Vel Total (ft/s)	3.67	Avg. Vel. (ft/s)		3.67	
Max Chl Dpth (ft)	0.80	Hydr. Depth (ft)		0.40	
Conv. Total (cfs)	559.6	Conv. (cfs)		559.6	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		70.90	
Min Ch El (ft)	2687.69	Shear (lb/sq ft)		0.83	
Alpha	1.00	Stream Power (lb/ft s)		3.04	
Frctn Loss (ft)	4.79	Cum Volume (acre-ft)		0.34	
C & E Loss (ft)	0.04	Cum SA (acres)		1.02	

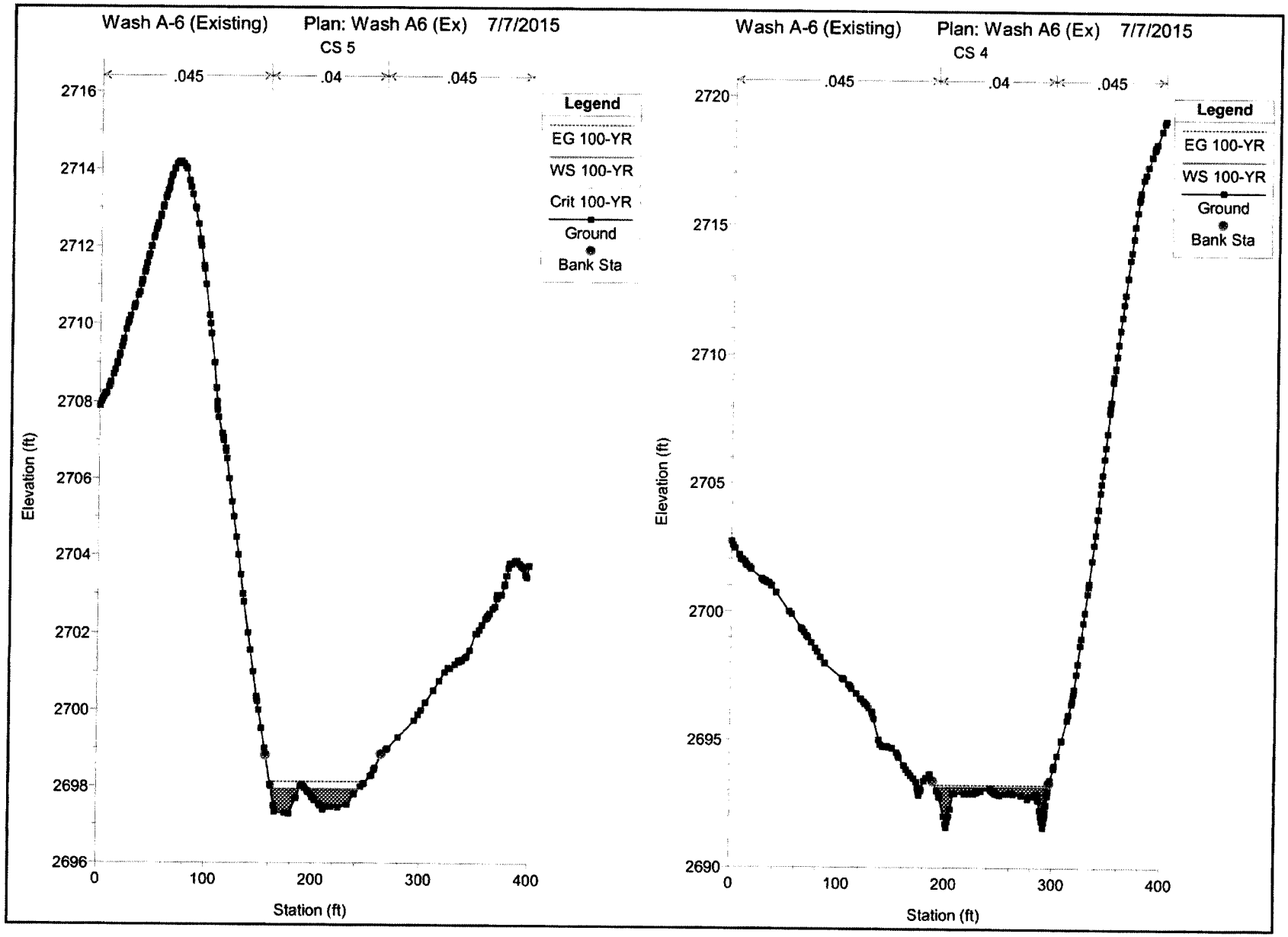
Plan: 2 RIVER-1 Reach-1 RS: 2 Profile: 100-YR

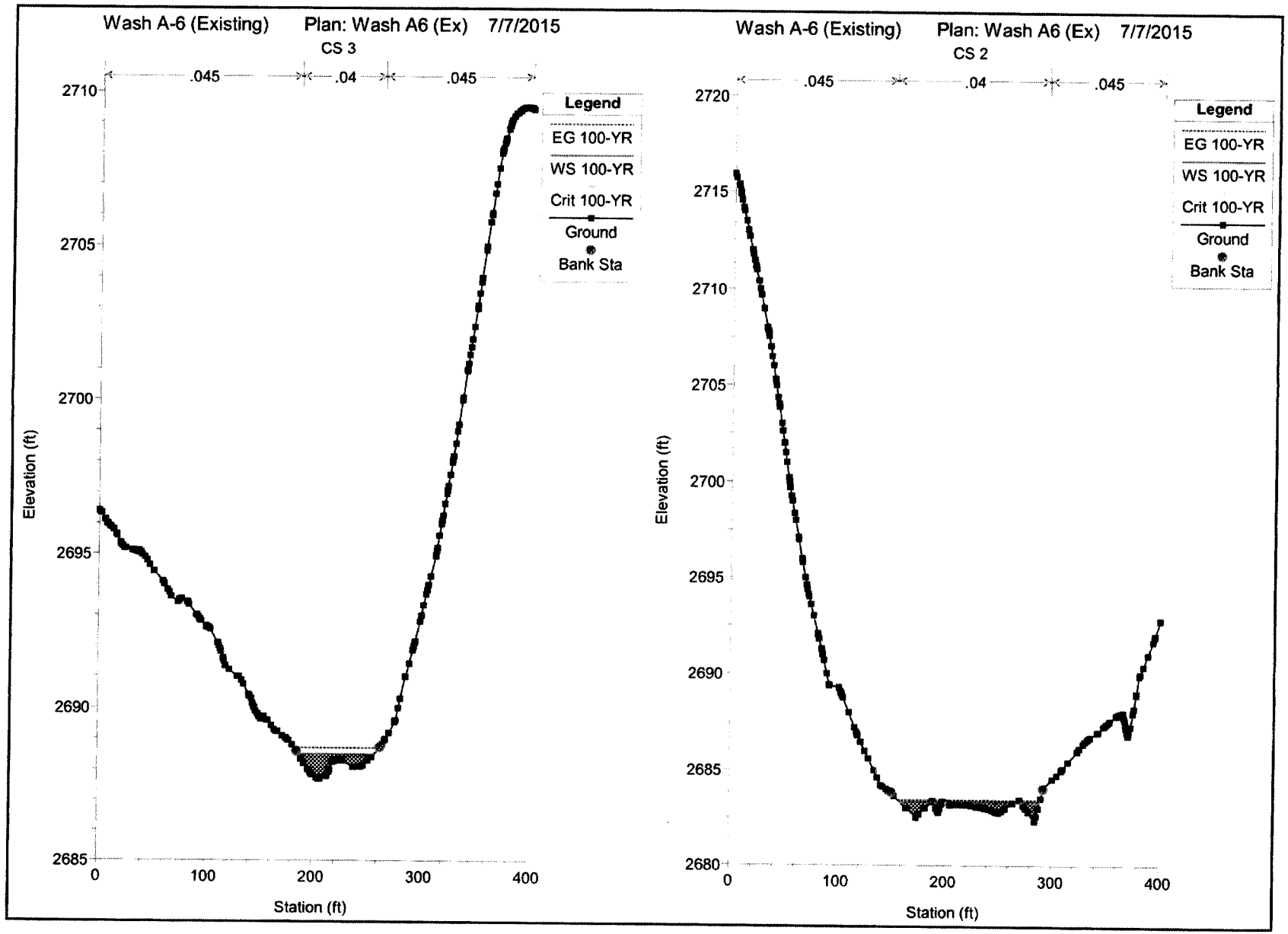
E.G. Elev (ft)	2683.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.		0.040	
W.S. Elev (ft)	2683.35	Reach Len. (ft)	239.16	200.00	159.29
Crit W.S. (ft)	2683.29	Flow Area (sq ft)		42.52	
E.G. Slope (ft/ft)	0.017921	Area (sq ft)		42.52	
Q Total (cfs)	102.60	Flow (cfs)		102.60	
Top Width (ft)	125.52	Top Width (ft)		125.52	
Vel Total (ft/s)	2.41	Avg. Vel. (ft/s)		2.41	
Max Chl Dpth (ft)	1.03	Hydr. Depth (ft)		0.34	
Conv. Total (cfs)	766.4	Conv. (cfs)		766.4	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		125.82	
Min Ch El (ft)	2682.32	Shear (lb/sq ft)		0.38	
Alpha	1.00	Stream Power (lb/ft s)		0.91	
Frctn Loss (ft)	4.65	Cum Volume (acre-ft)		0.18	
C & E Loss (ft)	0.00	Cum SA (acres)		0.57	

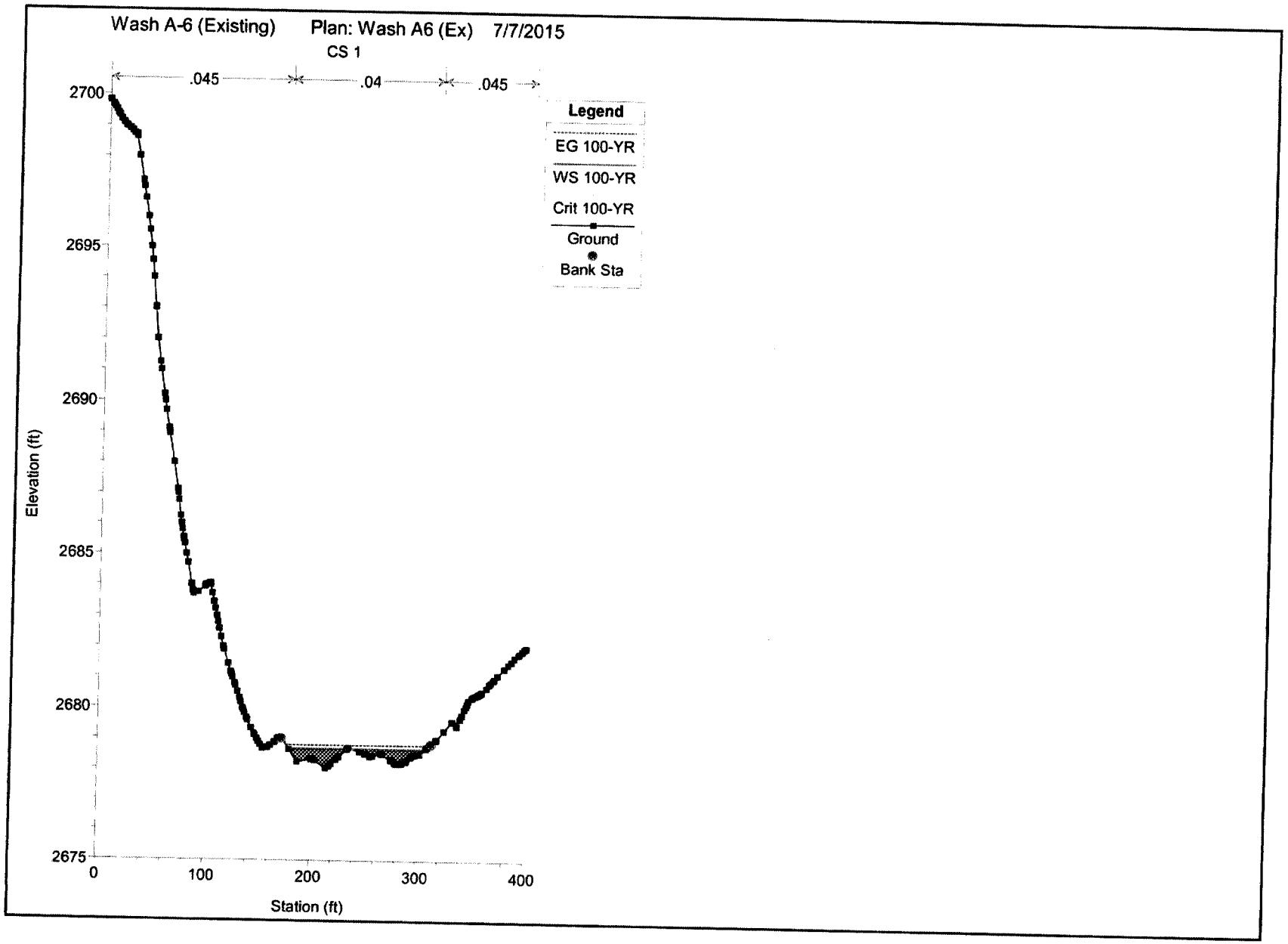
Plan: 2 RIVER-1 Reach-1 RS: 1 Profile: 100-YR

E.G. Elev (ft)	2678.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.		0.040	
W.S. Elev (ft)	2678.67	Reach Len. (ft)			
Crit W.S. (ft)	2678.67	Flow Area (sq ft)		35.68	
E.G. Slope (ft/ft)	0.031351	Area (sq ft)		35.68	
Q Total (cfs)	102.60	Flow (cfs)		102.60	
Top Width (ft)	123.41	Top Width (ft)		123.41	
Vel Total (ft/s)	2.88	Avg. Vel. (ft/s)		2.88	
Max Chl Dpth (ft)	0.63	Hydr. Depth (ft)		0.29	
Conv. Total (cfs)	579.5	Conv. (cfs)		579.5	
Length Wtd. (ft)		Wetted Per. (ft)		123.45	
Min Ch El (ft)	2678.04	Shear (lb/sq ft)		0.57	
Alpha	1.00	Stream Power (lb/ft s)		1.63	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

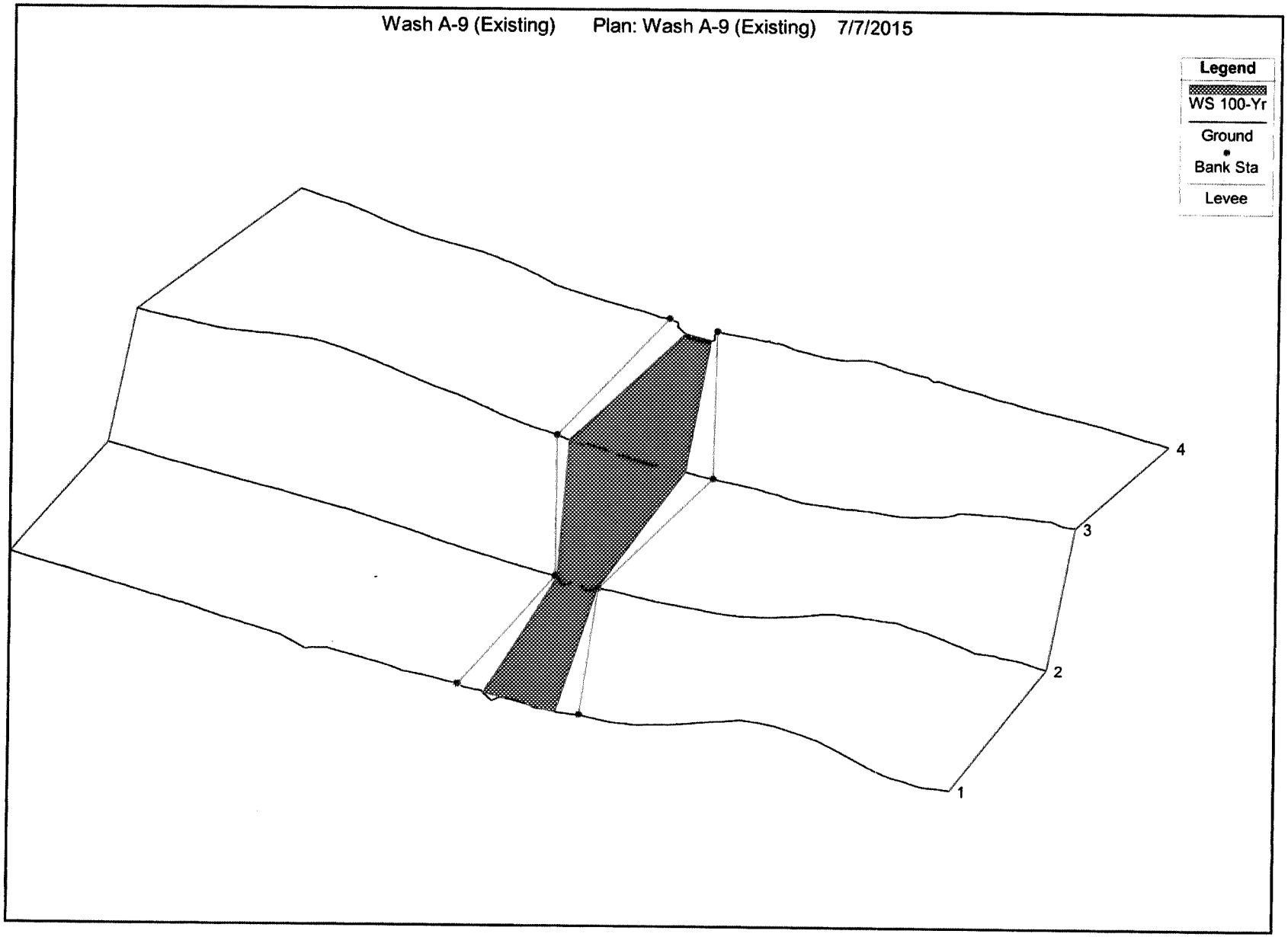

Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
CS 7
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2722
2720
2718
2716
2714
2712
2710
2708
2706
2704
0
100
200
300
400
Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
CS 6
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2730
2725
2720
2715
2710
2705
2700
0
100
200
300
400

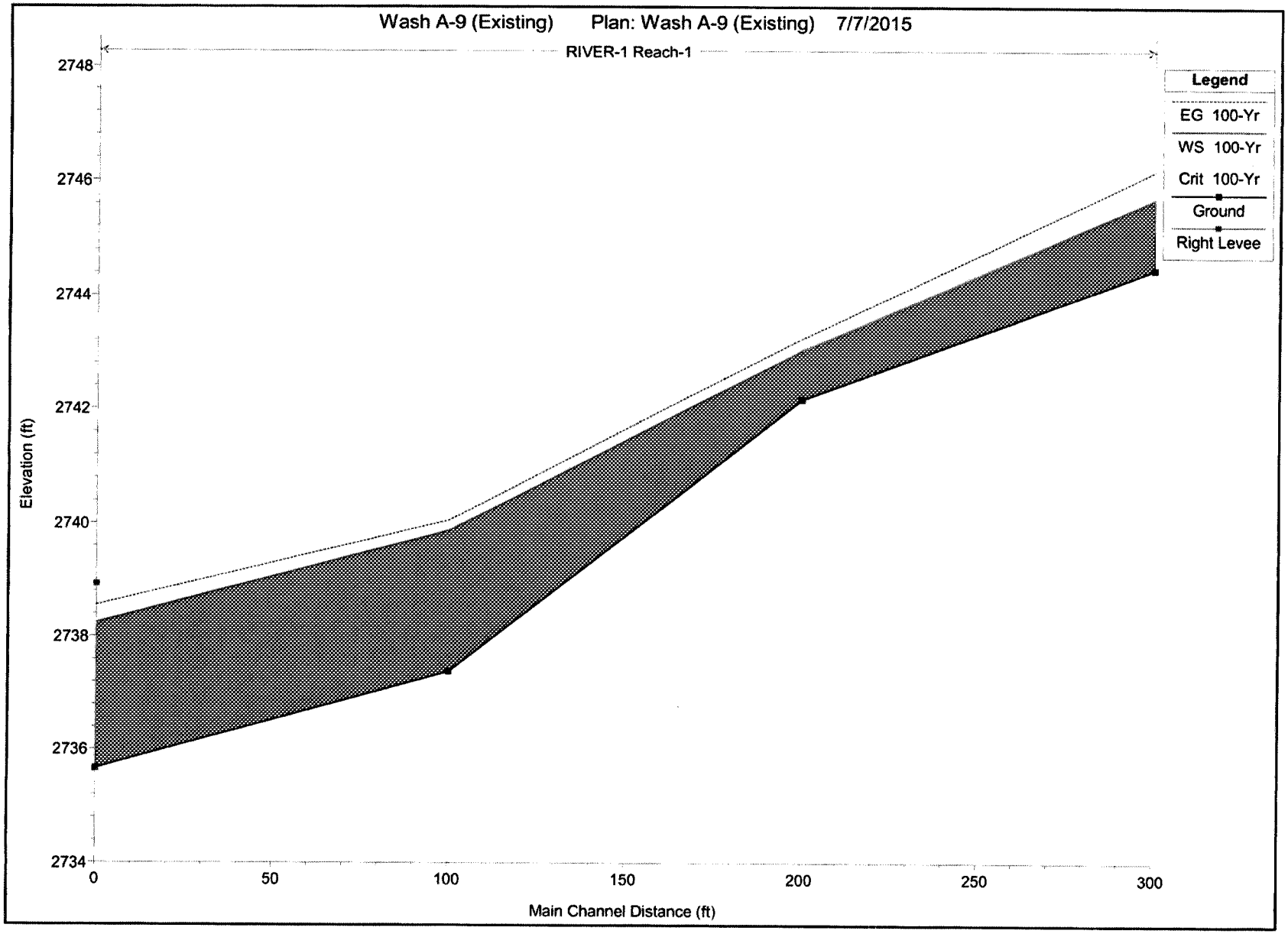

Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
CS 5
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2716
2714
2712
2710
2708
2706
2704
2702
2700
2698
2696
0
100
200
300
400
Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
CS 4
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2720
2715
2710
2705
2700
2695
2690
0
100
200
300
400


Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
CS 3
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2710
2705
2700
2695
2690
2685
0
100
200
300
400
Wash A-6 (Existing) Plan: Wash A6 (Ex) 7/7/2015
CS 2
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2720
2715
2710
2705
2700
2695
2690
2685
2680
0
100
200
300
400


Wash A-6 (Existing)
Plan: Wash A6 (Ex) 7/7/2015
CS 1
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
2700
2695
2690
2685
2680
2675
Elevation (ft)
0
100
200
300
400
Station (ft)

WASH A9 (Villages At Silverhawke) HEC-RAS MODEL


Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
Legend
WS 100-Yr
Ground
Bank Sta
Levee
4
3
2
1


Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
RIVER-1 Reach-1
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Right Levee
Elevation (ft)
2748
2746
2744
2742
2740
2738
2736
2734
0
50
100
150
200
250
300
Main Channel Distance (ft)

Plan: A RIVER-1 Reach-1 RS: 4 Profile: 100-Yr

E.G. Elev (ft)	2746.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.		0.040	
W.S. Elev (ft)	2745.70	Reach Len. (ft)	121.37	100.00	78.51
Crit W.S. (ft)	2745.70	Flow Area (sq ft)		15.87	
E.G. Slope (ft/ft)	0.024891	Area (sq ft)		15.87	
Q Total (cfs)	88.40	Flow (cfs)		88.40	
Top Width (ft)	16.68	Top Width (ft)		16.68	
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)		5.57	
Max Chl Dpth (ft)	1.23	Hydr. Depth (ft)		0.95	
Conv. Total (cfs)	560.3	Conv. (cfs)		560.3	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		17.14	
Min Ch El (ft)	2744.47	Shear (lb/sq ft)		1.44	
Alpha	1.00	Stream Power (lb/ft s)		8.02	
Frctn Loss (ft)	2.85	Cum Volume (acre-ft)		0.16	
C & E Loss (ft)	0.08	Cum SA (acres)		0.25	

Plan: A RIVER-1 Reach-1 RS: 3 Profile: 100-Yr

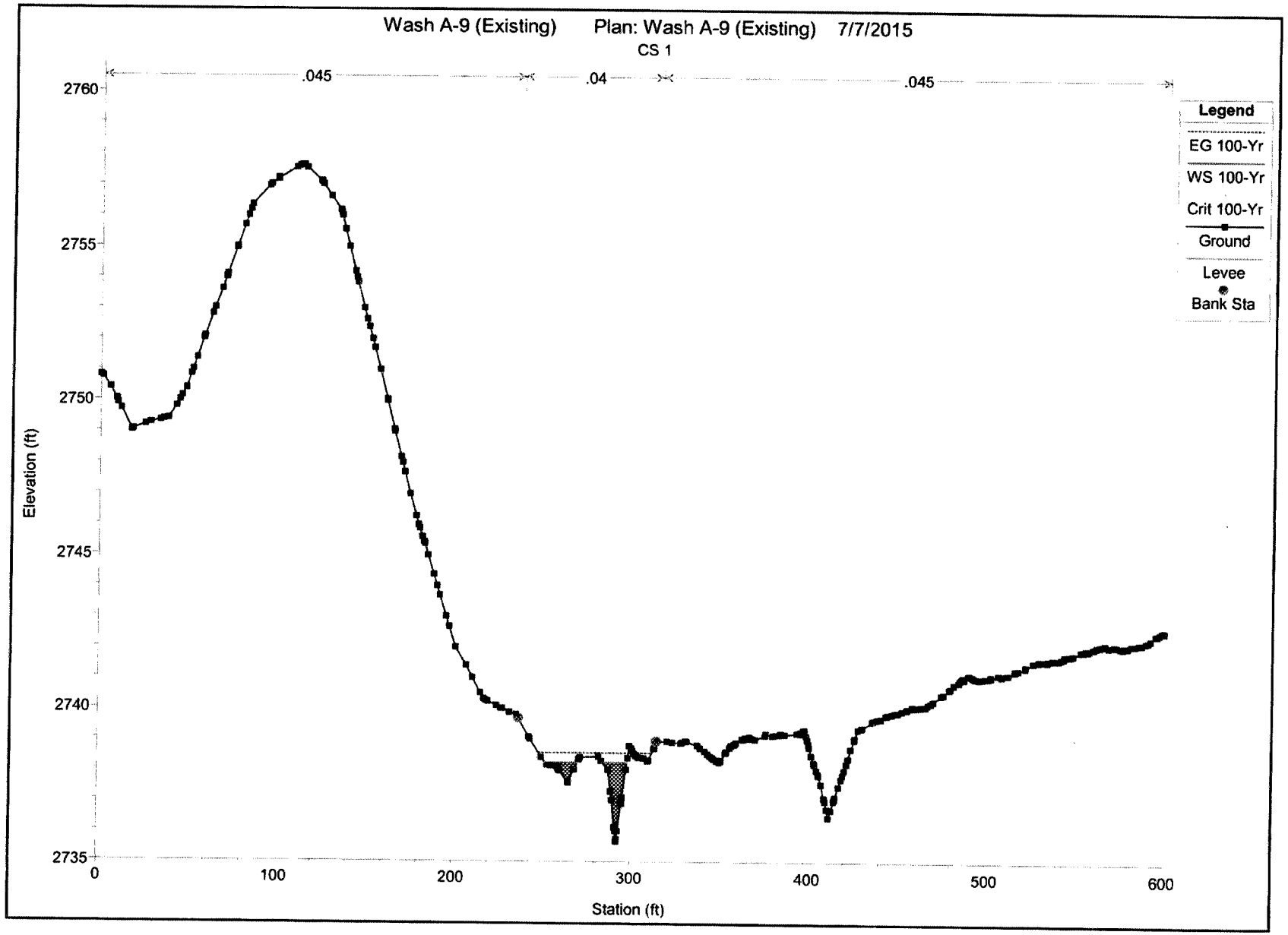
E.G. Elev (ft)	2743.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.040	
W.S. Elev (ft)	2743.04	Reach Len. (ft)	102.29	100.00	97.66
Crit W.S. (ft)	2743.04	Flow Area (sq ft)		24.04	
E.G. Slope (ft/ft)	0.033028	Area (sq ft)		24.04	
Q Total (cfs)	88.40	Flow (cfs)		88.40	
Top Width (ft)	59.66	Top Width (ft)		59.66	
Vel Total (ft/s)	3.68	Avg. Vel. (ft/s)		3.68	
Max Chl Dpth (ft)	0.88	Hydr. Depth (ft)		0.40	
Conv. Total (cfs)	486.4	Conv. (cfs)		486.4	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		59.82	
Min Ch El (ft)	2742.16	Shear (lb/sq ft)		0.83	
Alpha	1.00	Stream Power (lb/ft s)		3.05	
Frctn Loss (ft)	1.55	Cum Volume (acre-ft)		0.11	
C & E Loss (ft)	0.01	Cum SA (acres)		0.16	

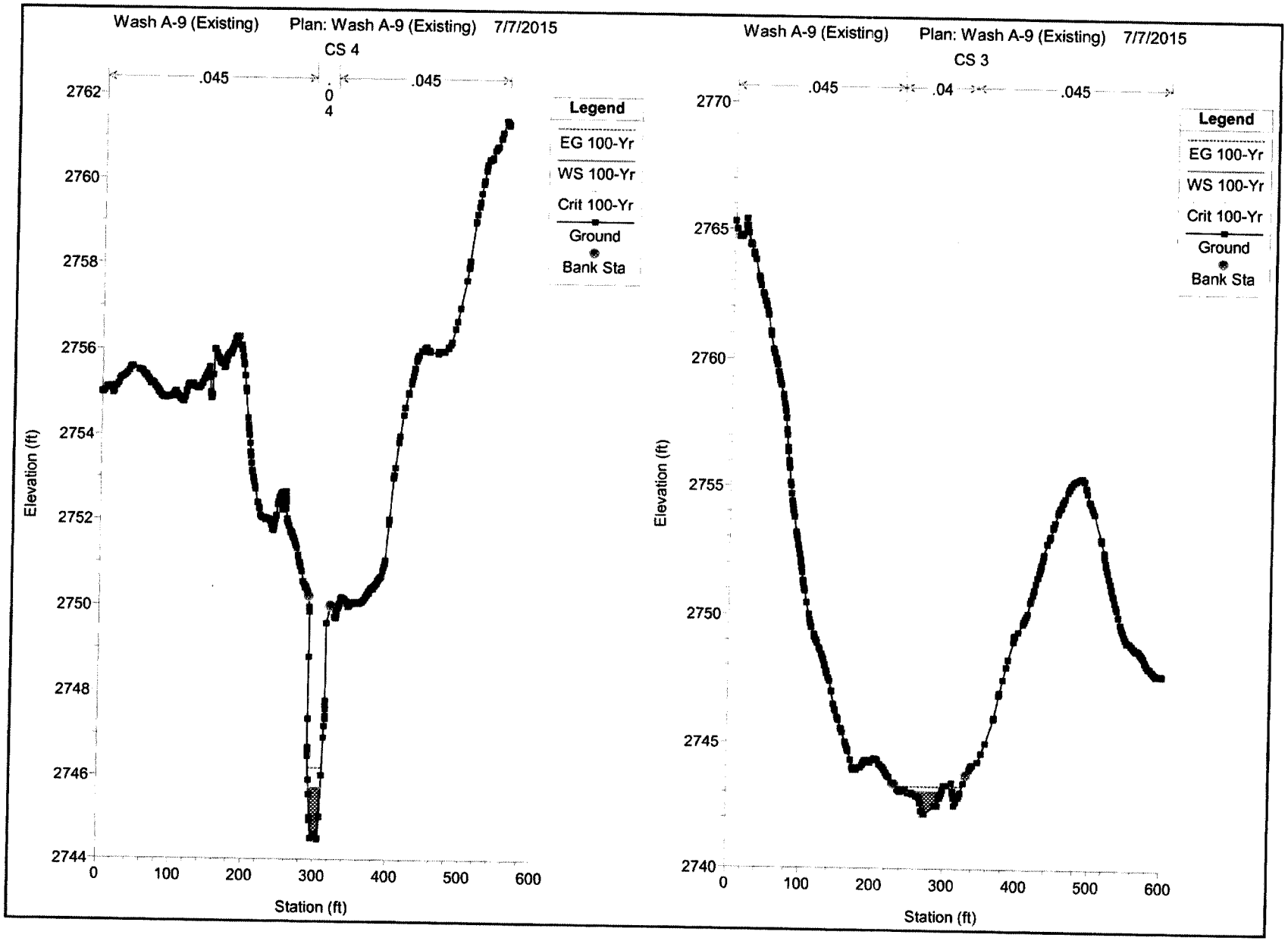
Plan: A RIVER-1 Reach-1 RS: 2 Profile: 100-Yr

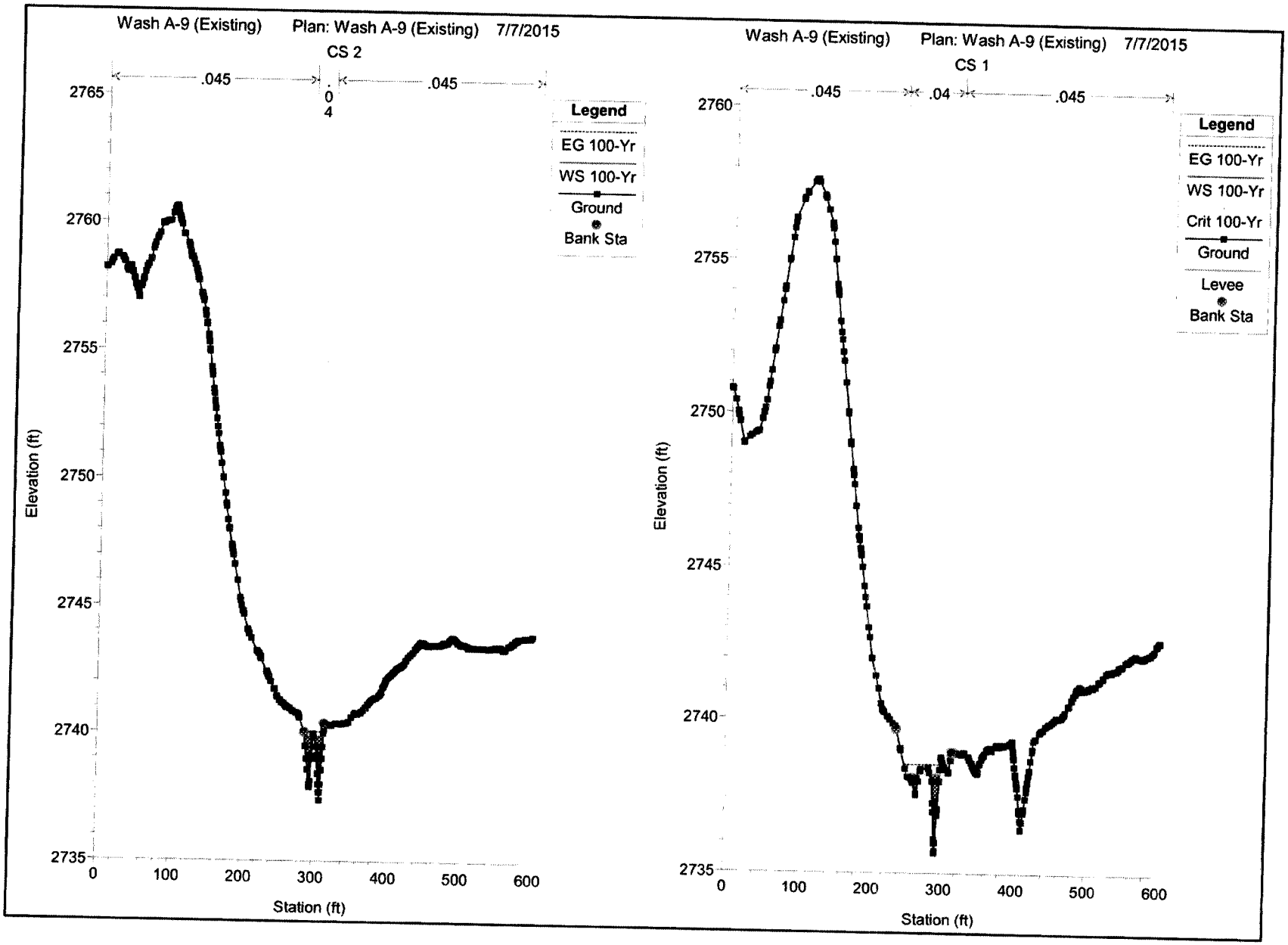
E.G. Elev (ft)	2740.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.		0.040	
W.S. Elev (ft)	2739.87	Reach Len. (ft)	132.99	100.00	66.75
Crit W.S. (ft)		Flow Area (sq ft)		25.76	
E.G. Slope (ft/ft)	0.008948	Area (sq ft)		25.76	
Q Total (cfs)	88.40	Flow (cfs)		88.40	
Top Width (ft)	24.88	Top Width (ft)		24.88	
Vel Total (ft/s)	3.43	Avg. Vel. (ft/s)		3.43	
Max Chl Dpth (ft)	2.49	Hydr. Depth (ft)		1.04	
Conv. Total (cfs)	934.5	Conv. (cfs)		934.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		26.68	
Min Ch El (ft)	2737.38	Shear (lb/sq ft)		0.54	
Alpha	1.00	Stream Power (lb/ft s)		1.85	
Frctn Loss (ft)	1.48	Cum Volume (acre-ft)		0.05	
C & E Loss (ft)	0.01	Cum SA (acres)		0.07	

Plan: A RIVER-1 Reach-1 RS: 1 Profile: 100-Yr

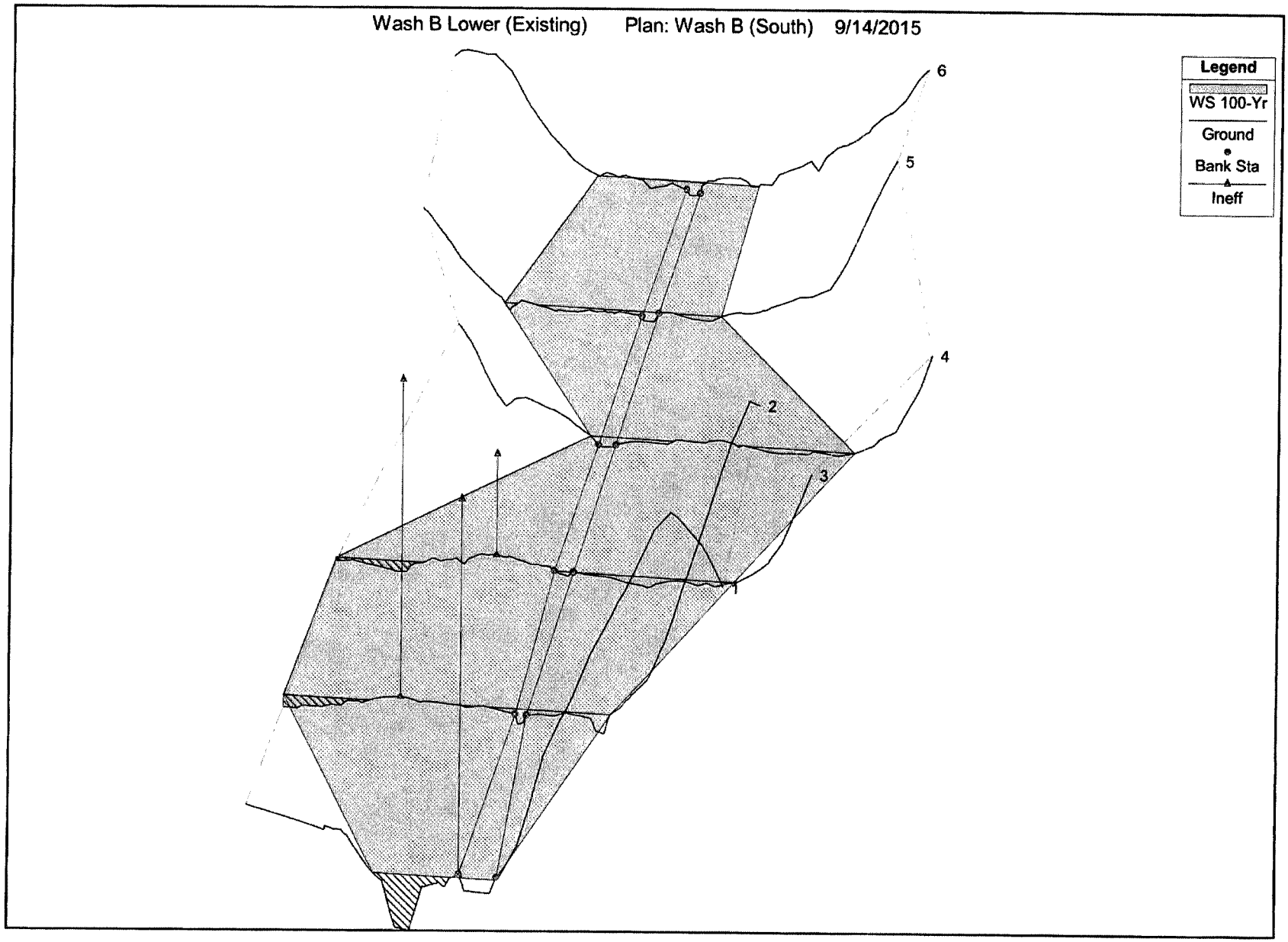
E.G. Elev (ft)	2738.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.040	
W.S. Elev (ft)	2738.24	Reach Len. (ft)			
Crit W.S. (ft)	2738.24	Flow Area (sq ft)		19.72	
E.G. Slope (ft/ft)	0.029290	Area (sq ft)		19.72	
Q Total (cfs)	88.40	Flow (cfs)		88.40	
Top Width (ft)	32.08	Top Width (ft)		32.08	
Vel Total (ft/s)	4.48	Avg. Vel. (ft/s)		4.48	
Max Chl Dpth (ft)	2.58	Hydr. Depth (ft)		0.61	
Conv. Total (cfs)	516.5	Conv. (cfs)		516.5	
Length Wtd. (ft)		Wetted Per. (ft)		33.29	
Min Ch El (ft)	2735.66	Shear (lb/sq ft)		1.08	
Alpha	1.00	Stream Power (lb/ft s)		4.86	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

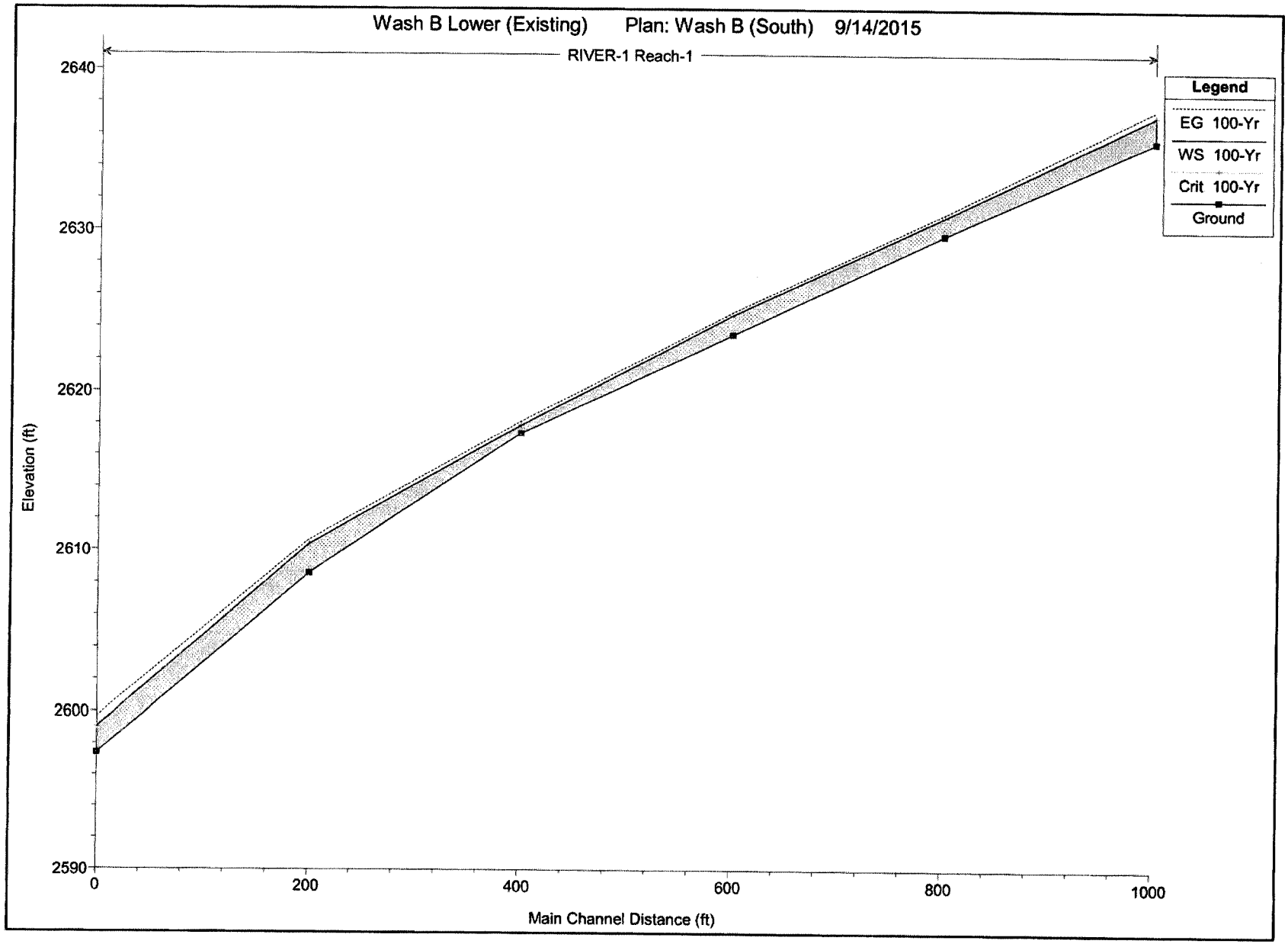

Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
CS 1
.045
.04
.045
2760
2755
2750
2745
2740
2735
Elevation (ft)
0
100
200
300
400
500
600
Station (ft)
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Levee
Bank Sta


Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
CS 4
.045
.045
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
CS 3
.045
.04
.045
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)


Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
CS 2
.045
.045
0
4
Legend
EG 100-Yr
WS 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Wash A-9 (Existing) Plan: Wash A-9 (Existing) 7/7/2015
CS 1
.045
.04
.045
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

WASH B LOWER (NAKOMA SKY) HEC-RAS MODEL


Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
Legend
WS 100-Yr
Ground
Bank Sta
Ineff
6
5
4
2
3
1


Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
RIVER-1 Reach-1
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Elevation (ft)
2640
2630
2620
2610
2600
2590
0
200
400
600
800
1000
Main Channel Distance (ft)

Plan: 1 RIVER-1 Reach-1 RS: 6 Profile: 100-Yr

E.G. Elev (ft)	2637.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2637.27	Reach Len. (ft)	266.74	200.00	130.23
Crit W.S. (ft)	2637.27	Flow Area (sq ft)	2.25	17.05	27.20
E.G. Slope (ft/ft)	0.021337	Area (sq ft)	2.25	17.05	27.20
Q Total (cfs)	196.00	Flow (cfs)	4.39	106.00	85.61
Top Width (ft)	69.69	Top Width (ft)	12.34	11.48	45.87
Vel Total (ft/s)	4.22	Avg. Vel. (ft/s)	1.95	6.22	3.15
Max Chl Dpth (ft)	1.59	Hydr. Depth (ft)	0.18	1.49	0.59
Conv. Total (cfs)	1341.8	Conv. (cfs)	30.0	725.7	586.1
Length Wtd. (ft)	177.13	Wetted Per. (ft)	12.63	11.65	45.99
Min Ch El (ft)	2635.68	Shear (lb/sq ft)	0.24	1.95	0.79
Alpha	1.42	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	3.98	Cum Volume (acre-ft)	0.93	0.35	1.18
C & E Loss (ft)	0.06	Cum SA (acres)	2.04	0.34	1.40

Plan: 1 RIVER-1 Reach-1 RS: 5 Profile: 100-Yr

E.G. Elev (ft)	2631.12	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2630.93	Reach Len. (ft)	243.45	200.00	156.06
Crit W.S. (ft)	2630.93	Flow Area (sq ft)	16.42	13.75	36.88
E.G. Slope (ft/ft)	0.023696	Area (sq ft)	16.42	13.75	36.88
Q Total (cfs)	196.00	Flow (cfs)	41.56	67.59	86.84
Top Width (ft)	155.98	Top Width (ft)	42.11	14.21	99.66
Vel Total (ft/s)	2.92	Avg. Vel. (ft/s)	2.53	4.92	2.35
Max Chl Dpth (ft)	1.15	Hydr. Depth (ft)	0.39	0.97	0.37
Conv. Total (cfs)	1273.3	Conv. (cfs)	270.0	439.1	564.1
Length Wtd. (ft)	205.82	Wetted Per. (ft)	42.15	14.46	99.91
Min Ch El (ft)	2629.78	Shear (lb/sq ft)	0.58	1.41	0.55
Alpha	1.42	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	4.12	Cum Volume (acre-ft)	0.87	0.28	1.09
C & E Loss (ft)	0.00	Cum SA (acres)	1.87	0.28	1.18

Plan: 1 RIVER-1 Reach-1 RS: 4 Profile: 100-Yr

E.G. Elev (ft)	2625.00	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2624.81	Reach Len. (ft)	221.88	200.00	177.88
Crit W.S. (ft)	2624.81	Flow Area (sq ft)	53.27	16.76	3.51
E.G. Slope (ft/ft)	0.017105	Area (sq ft)	53.27	16.76	3.51
Q Total (cfs)	196.00	Flow (cfs)	107.55	79.74	8.71
Top Width (ft)	166.06	Top Width (ft)	144.81	14.46	6.80
Vel Total (ft/s)	2.67	Avg. Vel. (ft/s)	2.02	4.76	2.48
Max Chl Dpth (ft)	1.21	Hydr. Depth (ft)	0.37	1.16	0.52
Conv. Total (cfs)	1498.7	Conv. (cfs)	822.3	609.7	66.6
Length Wtd. (ft)	216.67	Wetted Per. (ft)	144.95	14.49	6.87
Min Ch El (ft)	2623.60	Shear (lb/sq ft)	0.39	1.23	0.55
Alpha	1.65	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	6.25	Cum Volume (acre-ft)	0.68	0.21	1.01
C & E Loss (ft)	0.01	Cum SA (acres)	1.35	0.21	0.99

Plan: 1 RIVER-1 Reach-1 RS: 3 Profile: 100-Yr

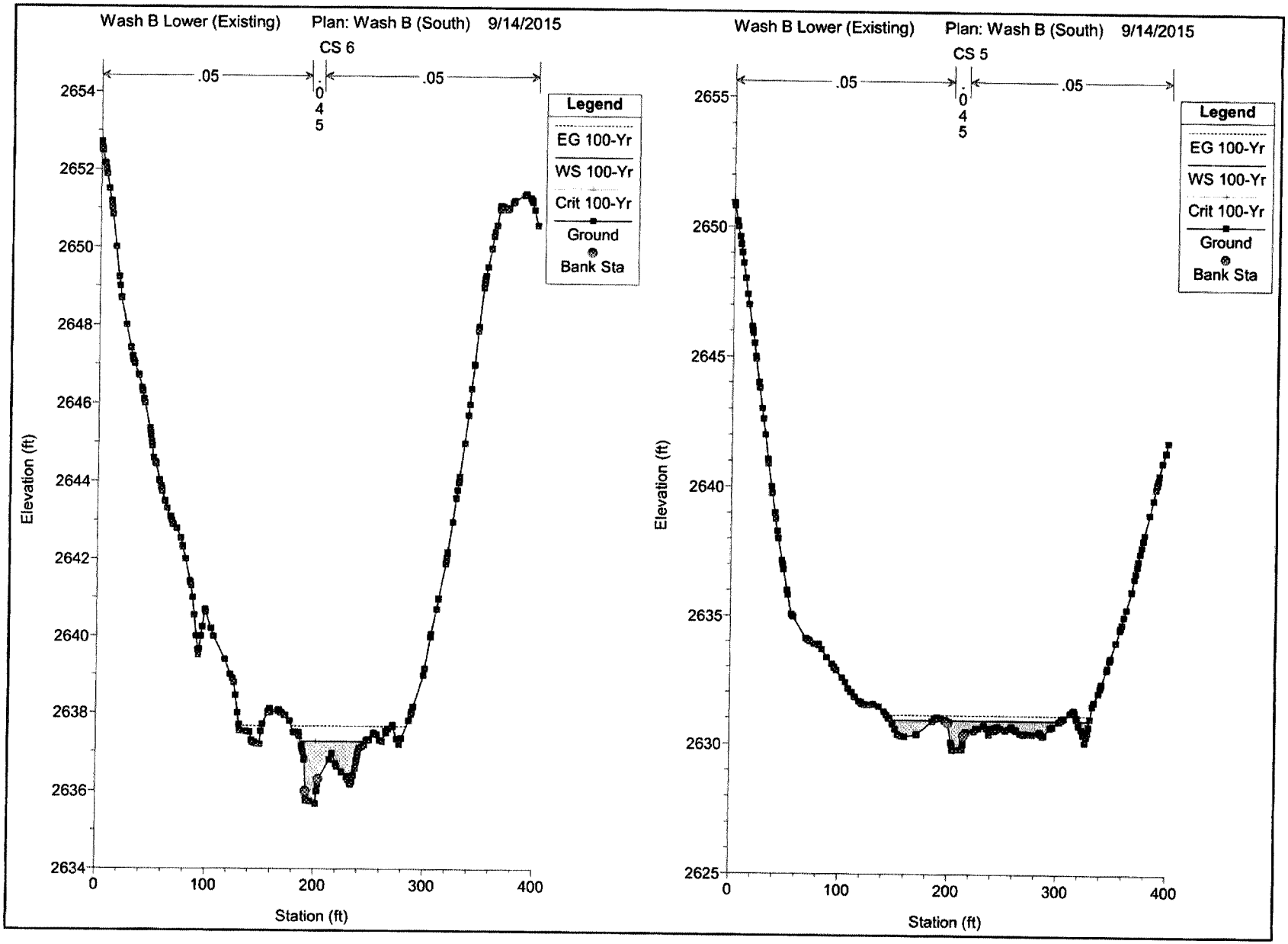
E.G. Elev (ft)	2618.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.050	0.045	
W.S. Elev (ft)	2617.92	Reach Len. (ft)	208.97	200.00	190.93
Crit W.S. (ft)	2617.92	Flow Area (sq ft)	63.68	4.12	
E.G. Slope (ft/ft)	0.047439	Area (sq ft)	63.68	4.12	46.00
Q Total (cfs)	265.00	Flow (cfs)	252.42	12.58	
Top Width (ft)	220.31	Top Width (ft)	132.69	14.80	72.81
Vel Total (ft/s)	3.91	Avg. Vel. (ft/s)	3.96	3.06	
Max Chl Dpth (ft)	1.27	Hydr. Depth (ft)	0.48	0.28	
Conv. Total (cfs)	1216.7	Conv. (cfs)	1158.9	57.7	
Length Wtd. (ft)	206.82	Wetted Per. (ft)	132.86	14.86	
Min Ch El (ft)	2617.42	Shear (lb/sq ft)	1.42	0.82	
Alpha	1.01	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	6.23	Cum Volume (acre-ft)	0.38	0.17	0.91
C & E Loss (ft)	0.00	Cum SA (acres)	0.64	0.14	0.83

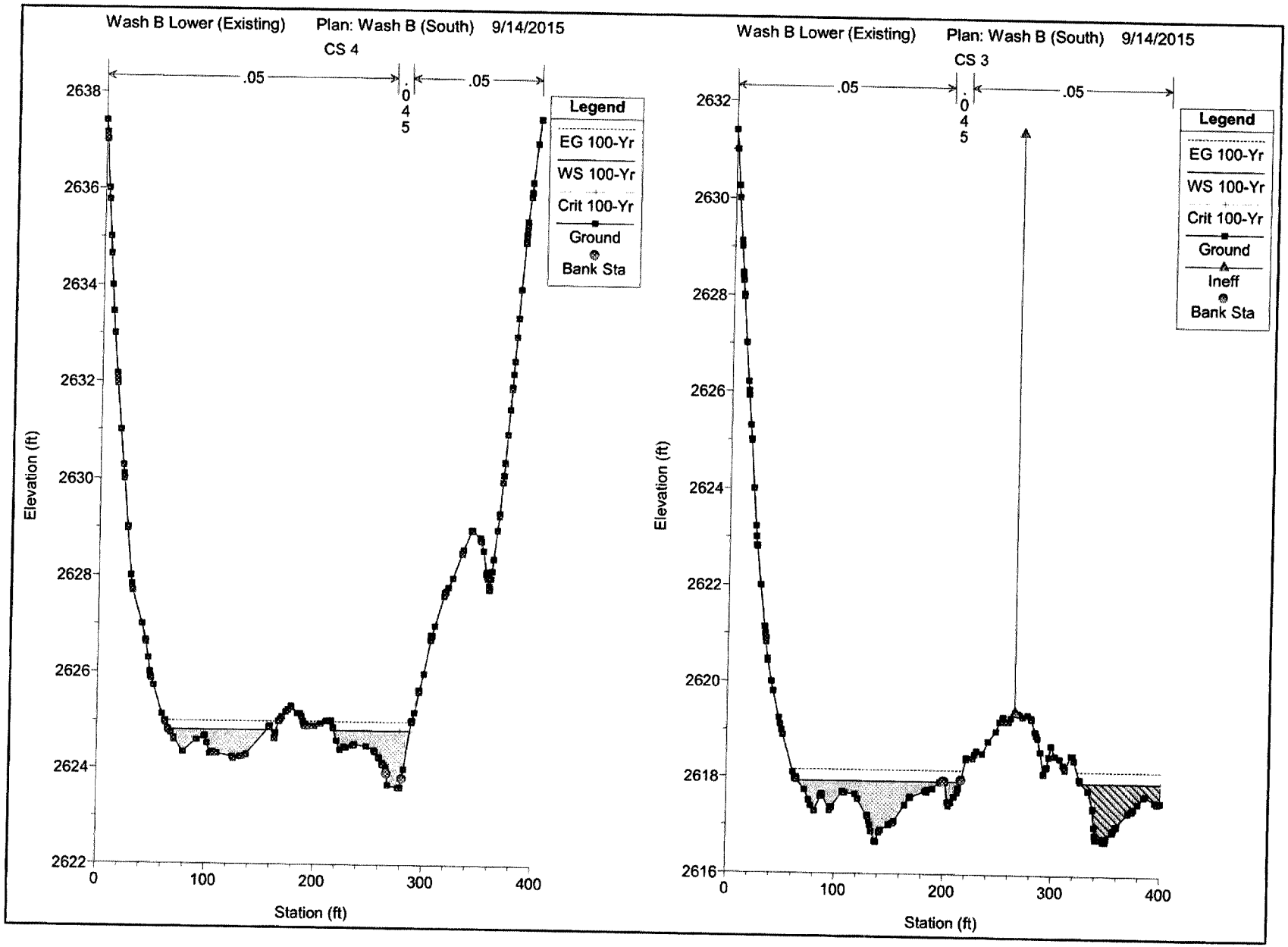
Plan: 1 RIVER-1 Reach-1 RS: 2 Profile: 100-Yr

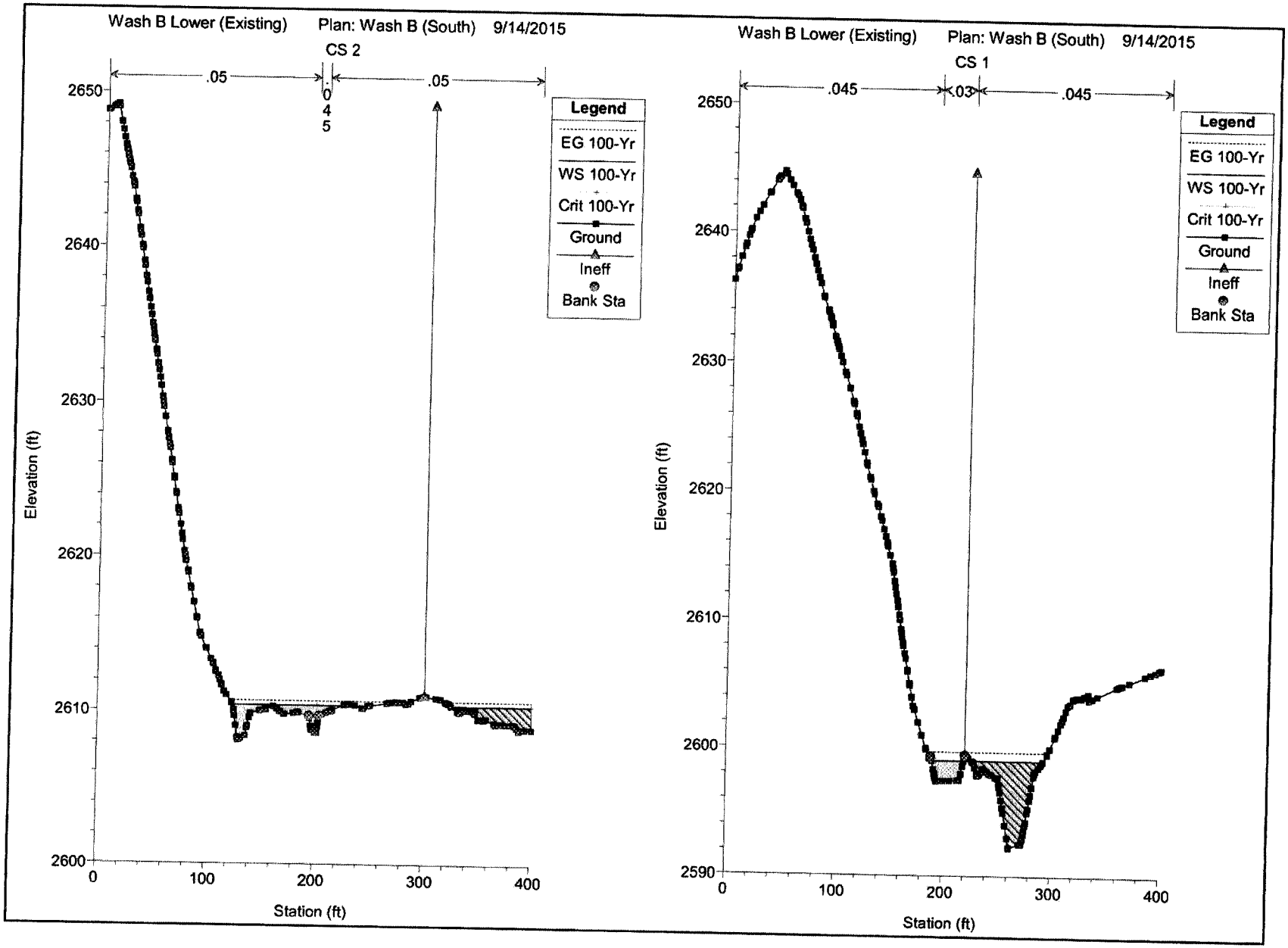
E.G. Elev (ft)	2610.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.	0.050	0.045	0.050
W.S. Elev (ft)	2610.38	Reach Len. (ft)	185.13	200.00	214.51
Crit W.S. (ft)	2610.38	Flow Area (sq ft)	49.79	13.58	8.50
E.G. Slope (ft/ft)	0.020804	Area (sq ft)	49.79	13.58	73.55
Q Total (cfs)	265.00	Flow (cfs)	167.28	81.32	16.40
Top Width (ft)	187.97	Top Width (ft)	70.95	9.13	107.90
Vel Total (ft/s)	3.69	Avg. Vel. (ft/s)	3.36	5.99	1.93
Max Chl Dpth (ft)	2.31	Hydr. Depth (ft)	0.70	1.49	0.25
Conv. Total (cfs)	1837.3	Conv. (cfs)	1159.8	563.8	113.7
Length Wtd. (ft)	195.76	Wetted Per. (ft)	71.75	9.62	34.10
Min Ch El (ft)	2608.57	Shear (lb/sq ft)	0.90	1.83	0.32
Alpha	1.35	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	3.02	Cum Volume (acre-ft)	0.11	0.12	0.65
C & E Loss (ft)	0.04	Cum SA (acres)	0.15	0.09	0.43

Plan: 1 RIVER-1 Reach-1 RS: 1 Profile: 100-Yr

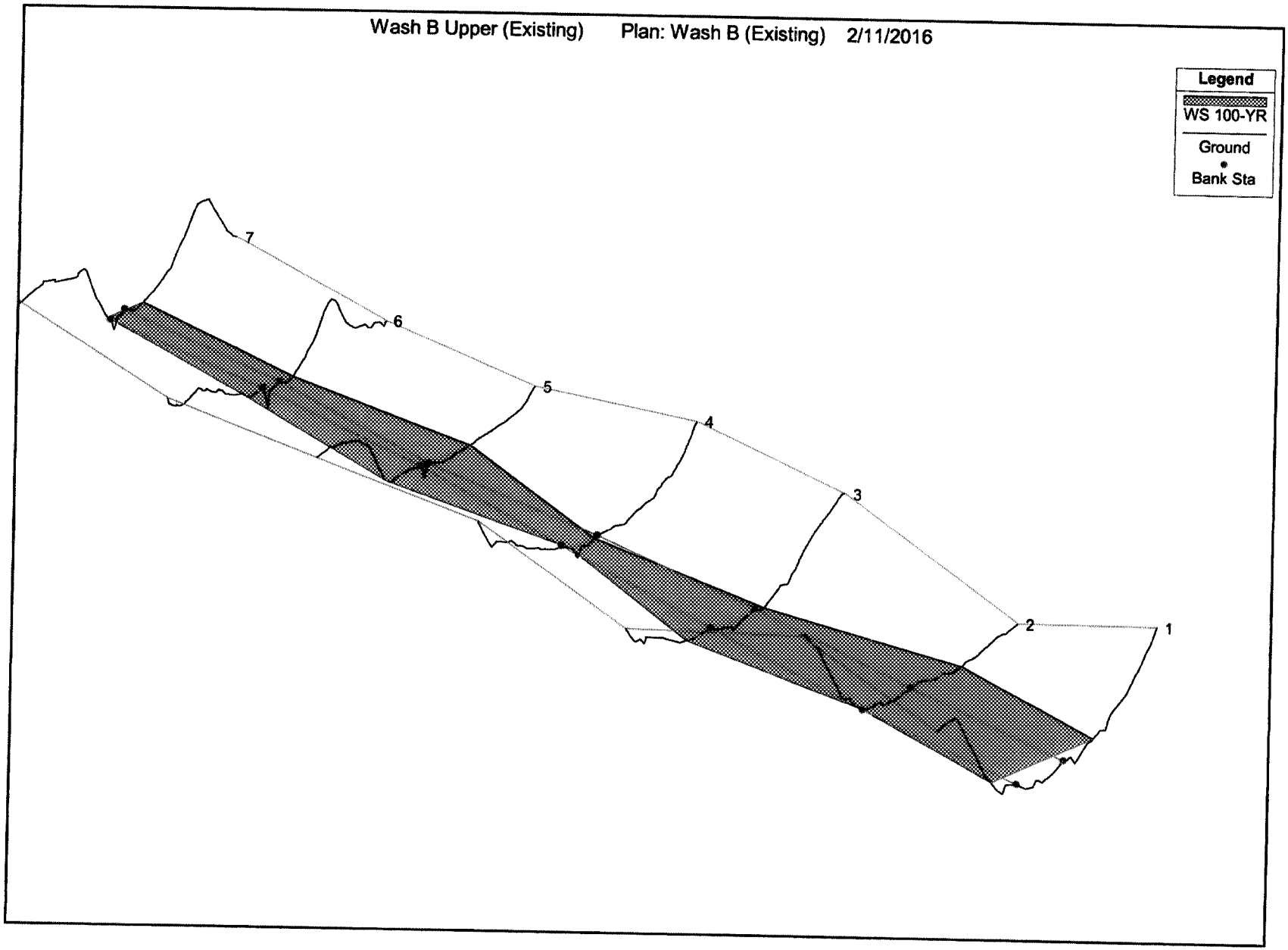
E.G. Elev (ft)	2599.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.66	Wt. n-Val.		0.030	
W.S. Elev (ft)	2599.03	Reach Len. (ft)			
Crit W.S. (ft)	2599.03	Flow Area (sq ft)		40.61	
E.G. Slope (ft/ft)	0.011898	Area (sq ft)		40.61	190.83
Q Total (cfs)	265.00	Flow (cfs)		265.00	
Top Width (ft)	96.36	Top Width (ft)		29.94	66.42
Vel Total (ft/s)	6.53	Avg. Vel. (ft/s)		6.53	
Max Chl Dpth (ft)	6.83	Hydr. Depth (ft)		1.36	
Conv. Total (cfs)	2429.4	Conv. (cfs)		2429.4	
Length Wtd. (ft)		Wetted Per. (ft)		30.59	
Min Ch El (ft)	2597.39	Shear (lb/sq ft)		0.99	
Alpha	1.00	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

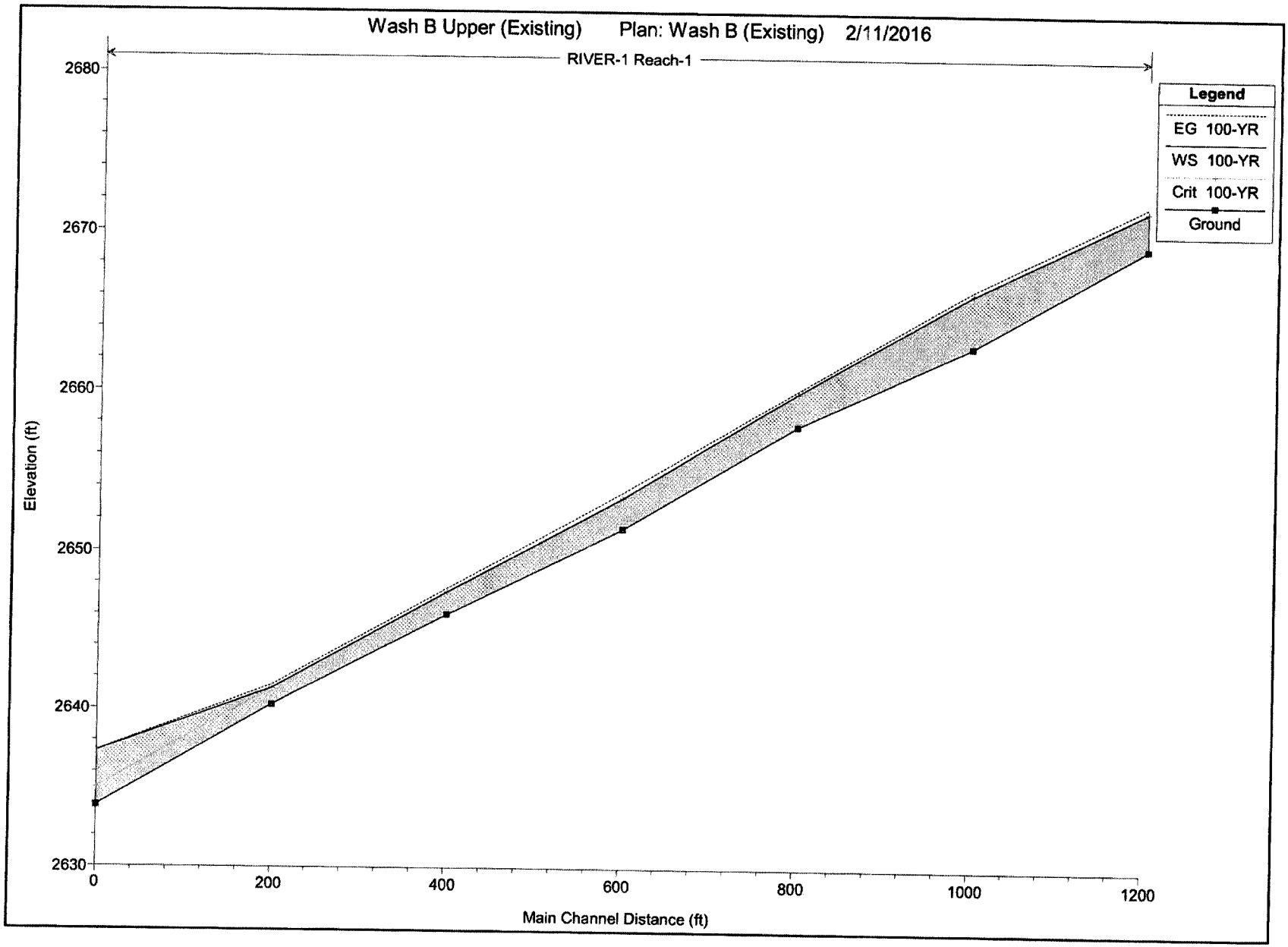

Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
CS 6
.05
.045
.05
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
2654
2652
2650
2648
2646
2644
2642
2640
2638
2636
2634
0
100
200
300
400
Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
CS 5
.05
.045
.05
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
2655
2650
2645
2640
2635
2630
2625
0
100
200
300
400


Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
CS 4
.05
.045
.05
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)
Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
CS 3
.05
.045
.05
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
CS 2
.05
.05
.045
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2650
2640
2630
2620
2610
2600
0
100
200
300
400
Wash B Lower (Existing) Plan: Wash B (South) 9/14/2015
CS 1
.045
.03
.045
Legend
EG 100-Yr
WS 100-Yr
Crit 100-Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
2650
2640
2630
2620
2610
2600
2590
0
100
200
300
400

WASH B UPPER (Sanctuary At Silverhawke) HEC-RAS MODEL


Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
Legend
WS 100-YR
Ground
Bank Sta
7
6
5
4
3
2
1


Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
RIVER-1 Reach-1
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Elevation (ft)
2680
2670
2660
2650
2640
2630
0
200
400
600
800
1000
1200
Main Channel Distance (ft)

Plan: 1 RIVER-1 Reach-1 RS: 7 Profile: 100-YR

E.G. Elev (ft)	2671.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2671.63	Reach Len. (ft)	186.99	200.00	212.89
Crit W.S. (ft)	2671.63	Flow Area (sq ft)	11.57	22.61	1.32
E.G. Slope (ft/ft)	0.019766	Area (sq ft)	11.57	22.61	1.32
Q Total (cfs)	138.40	Flow (cfs)	27.40	108.65	2.35
Top Width (ft)	62.26	Top Width (ft)	31.68	25.01	5.57
Vel Total (ft/s)	3.90	Avg. Vel. (ft/s)	2.37	4.81	1.77
Max Chl Dpth (ft)	2.33	Hydr. Depth (ft)	0.37	0.90	0.24
Conv. Total (cfs)	984.4	Conv. (cfs)	194.9	772.8	16.7
Length Wtd. (ft)	198.54	Wetted Per. (ft)	31.73	25.61	5.59
Min Ch El (ft)	2669.30	Shear (lb/sq ft)	0.45	1.09	0.29
Alpha	1.27	Stream Power (lb/ft s)	1.07	5.24	0.52
Frctn Loss (ft)	3.79	Cum Volume (acre-ft)	0.45	1.27	0.19
C & E Loss (ft)	0.01	Cum SA (acres)	1.06	1.36	0.46

Plan: 1 RIVER-1 Reach-1 RS: 6 Profile: 100-YR

E.G. Elev (ft)	2666.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2666.33	Reach Len. (ft)	218.22	200.00	181.29
Crit W.S. (ft)	2666.33	Flow Area (sq ft)	7.12	25.55	5.59
E.G. Slope (ft/ft)	0.018420	Area (sq ft)	7.12	25.55	5.59
Q Total (cfs)	138.40	Flow (cfs)	14.79	114.75	8.86
Top Width (ft)	77.55	Top Width (ft)	22.51	28.55	26.49
Vel Total (ft/s)	3.62	Avg. Vel. (ft/s)	2.08	4.49	1.59
Max Chl Dpth (ft)	3.33	Hydr. Depth (ft)	0.32	0.90	0.21
Conv. Total (cfs)	1019.8	Conv. (cfs)	109.0	845.5	65.3
Length Wtd. (ft)	204.69	Wetted Per. (ft)	22.54	30.39	26.55
Min Ch El (ft)	2663.00	Shear (lb/sq ft)	0.36	0.97	0.24
Alpha	1.33	Stream Power (lb/ft s)	0.75	4.34	0.38
Frctn Loss (ft)	4.04	Cum Volume (acre-ft)	0.41	1.16	0.17
C & E Loss (ft)	0.02	Cum SA (acres)	0.94	1.23	0.39

Plan: 1 RIVER-1 Reach-1 RS: 5 Profile: 100-YR

E.G. Elev (ft)	2660.20	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2660.02	Reach Len. (ft)	201.21	200.00	198.77
Crit W.S. (ft)	2660.02	Flow Area (sq ft)	29.44	11.67	5.60
E.G. Slope (ft/ft)	0.021187	Area (sq ft)	29.44	11.67	5.60
Q Total (cfs)	138.40	Flow (cfs)	75.22	53.76	9.42
Top Width (ft)	118.68	Top Width (ft)	75.94	14.14	28.60
Vel Total (ft/s)	2.96	Avg. Vel. (ft/s)	2.55	4.61	1.68
Max Chl Dpth (ft)	2.06	Hydr. Depth (ft)	0.39	0.83	0.20
Conv. Total (cfs)	950.8	Conv. (cfs)	516.7	369.3	64.7
Length Wtd. (ft)	200.29	Wetted Per. (ft)	75.99	14.84	28.67
Min Ch El (ft)	2657.96	Shear (lb/sq ft)	0.51	1.04	0.26
Alpha	1.37	Stream Power (lb/ft s)	1.31	4.79	0.43
Frctn Loss (ft)	4.84	Cum Volume (acre-ft)	0.32	1.08	0.15
C & E Loss (ft)	0.02	Cum SA (acres)	0.70	1.13	0.27

Plan: 1 RIVER-1 Reach-1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2653.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.		0.040	
W.S. Elev (ft)	2653.42	Reach Len. (ft)	208.53	200.00	190.94
Crit W.S. (ft)	2653.42	Flow Area (sq ft)		29.42	
E.G. Slope (ft/ft)	0.027815	Area (sq ft)		29.42	
Q Total (cfs)	138.40	Flow (cfs)		138.40	
Top Width (ft)	44.05	Top Width (ft)		44.05	
Vel Total (ft/s)	4.70	Avg. Vel. (ft/s)		4.70	
Max Chl Dpth (ft)	1.92	Hydr. Depth (ft)		0.67	
Conv. Total (cfs)	829.8	Conv. (cfs)		829.8	
Length Wtd. (ft)	199.98	Wetted Per. (ft)		44.47	
Min Ch El (ft)	2651.50	Shear (lb/sq ft)		1.15	
Alpha	1.00	Stream Power (lb/ft s)		5.40	
Frctn Loss (ft)	5.33	Cum Volume (acre-ft)	0.25	0.98	0.13
C & E Loss (ft)	0.03	Cum SA (acres)	0.52	1.00	0.21

Plan: 1 RIVER-1 Reach-1 RS: 3 Profile: 100-YR

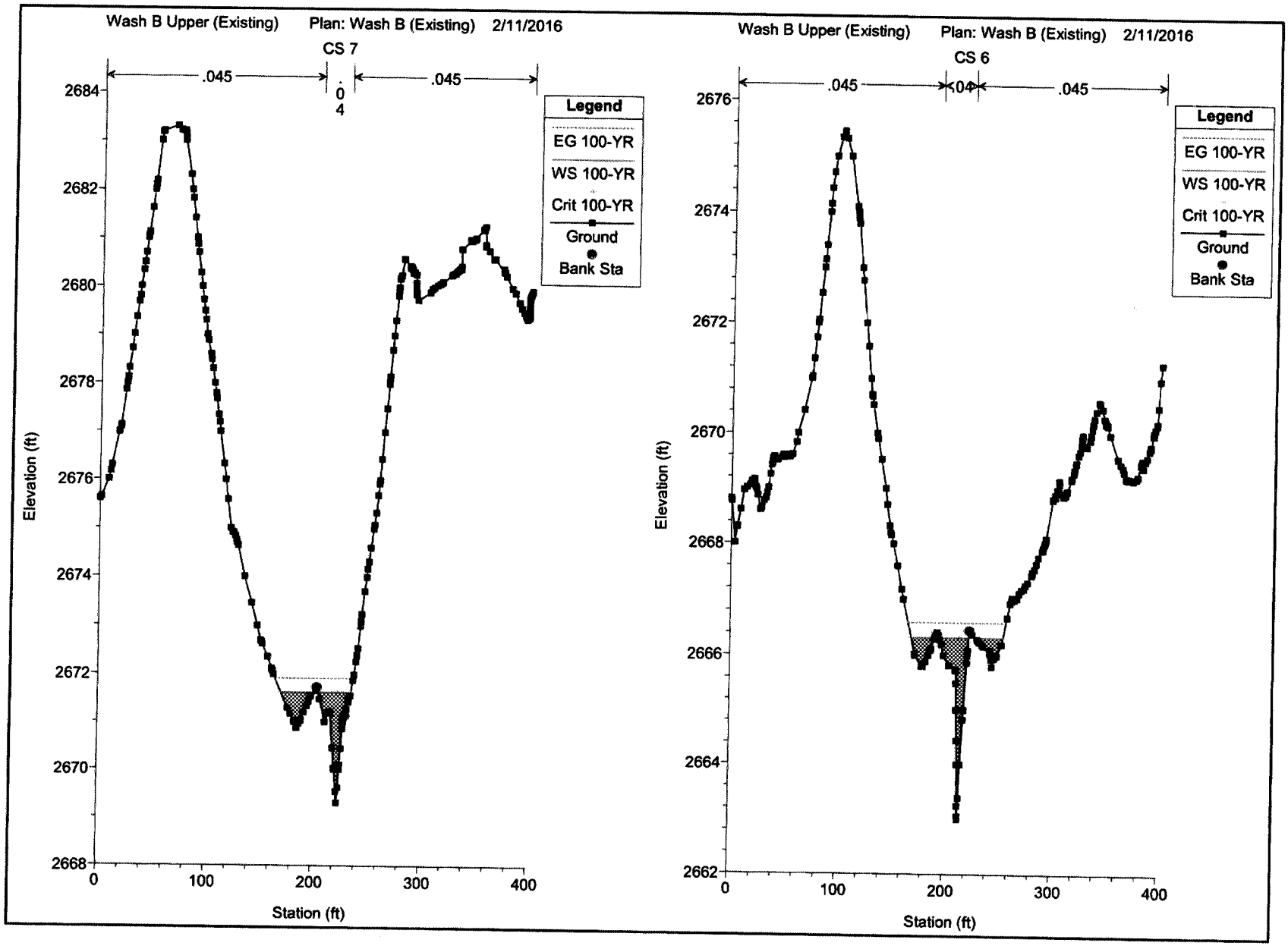
E.G. Elev (ft)	2647.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2647.47	Reach Len. (ft)	230.31	200.00	168.69
Crit W.S. (ft)	2647.47	Flow Area (sq ft)	1.03	34.78	1.88
E.G. Slope (ft/ft)	0.025545	Area (sq ft)	1.03	34.78	1.88
Q Total (cfs)	138.40	Flow (cfs)	1.25	135.50	1.64
Top Width (ft)	102.45	Top Width (ft)	9.30	65.24	27.92
Vel Total (ft/s)	3.67	Avg. Vel. (ft/s)	1.22	3.90	0.87
Max Chl Dpth (ft)	1.45	Hydr. Depth (ft)	0.11	0.53	0.07
Conv. Total (cfs)	865.9	Conv. (cfs)	7.8	847.8	10.3
Length Wtd. (ft)	201.21	Wetted Per. (ft)	9.31	65.45	27.92
Min Ch El (ft)	2646.02	Shear (lb/sq ft)	0.18	0.85	0.11
Alpha	1.10	Stream Power (lb/ft s)	0.21	3.30	0.09
Frctn Loss (ft)	4.97	Cum Volume (acre-ft)	0.25	0.83	0.13
C & E Loss (ft)	0.01	Cum SA (acres)	0.50	0.75	0.14

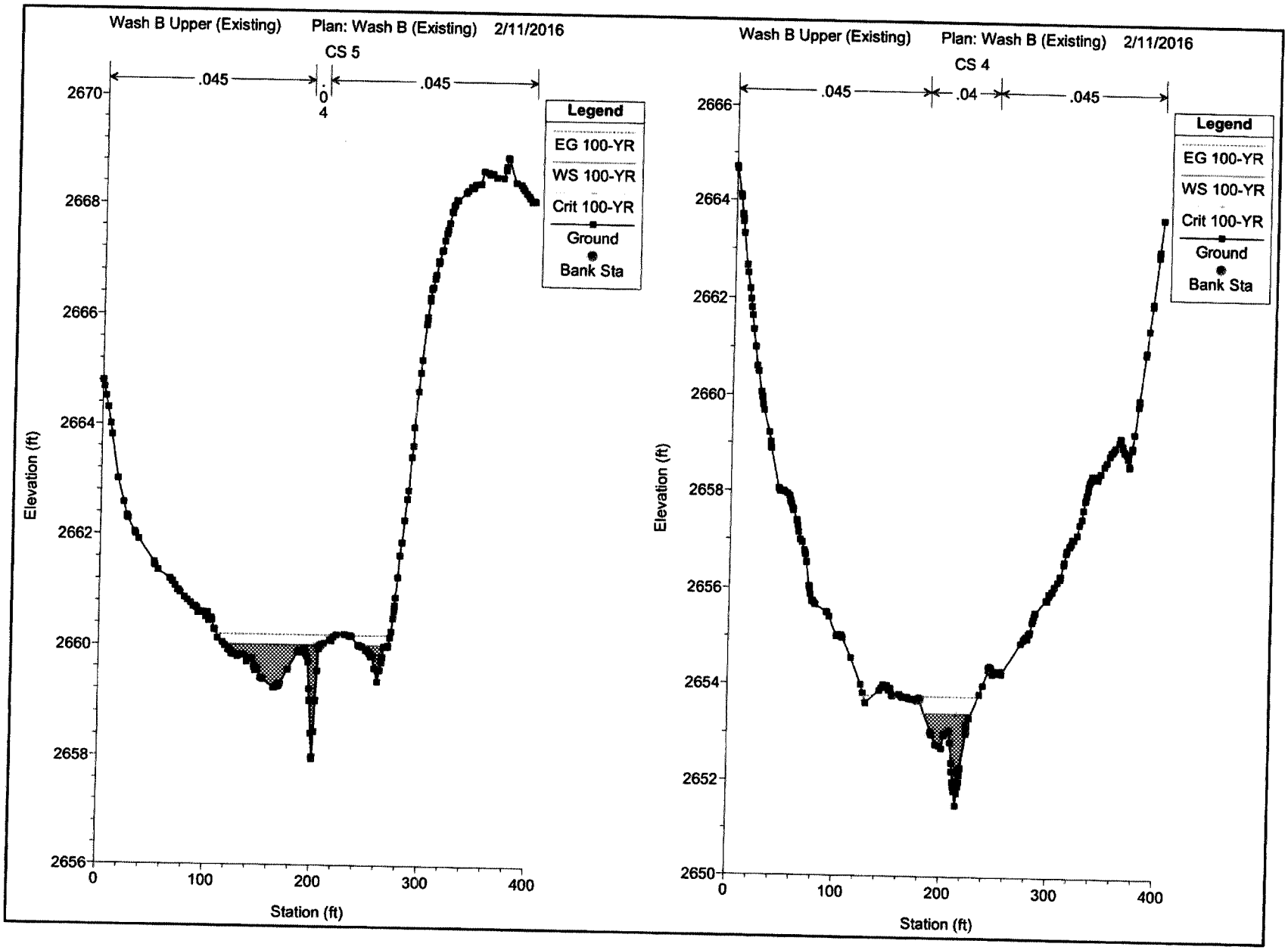
Plan: 1 RIVER-1 Reach-1 RS: 2 Profile: 100-YR

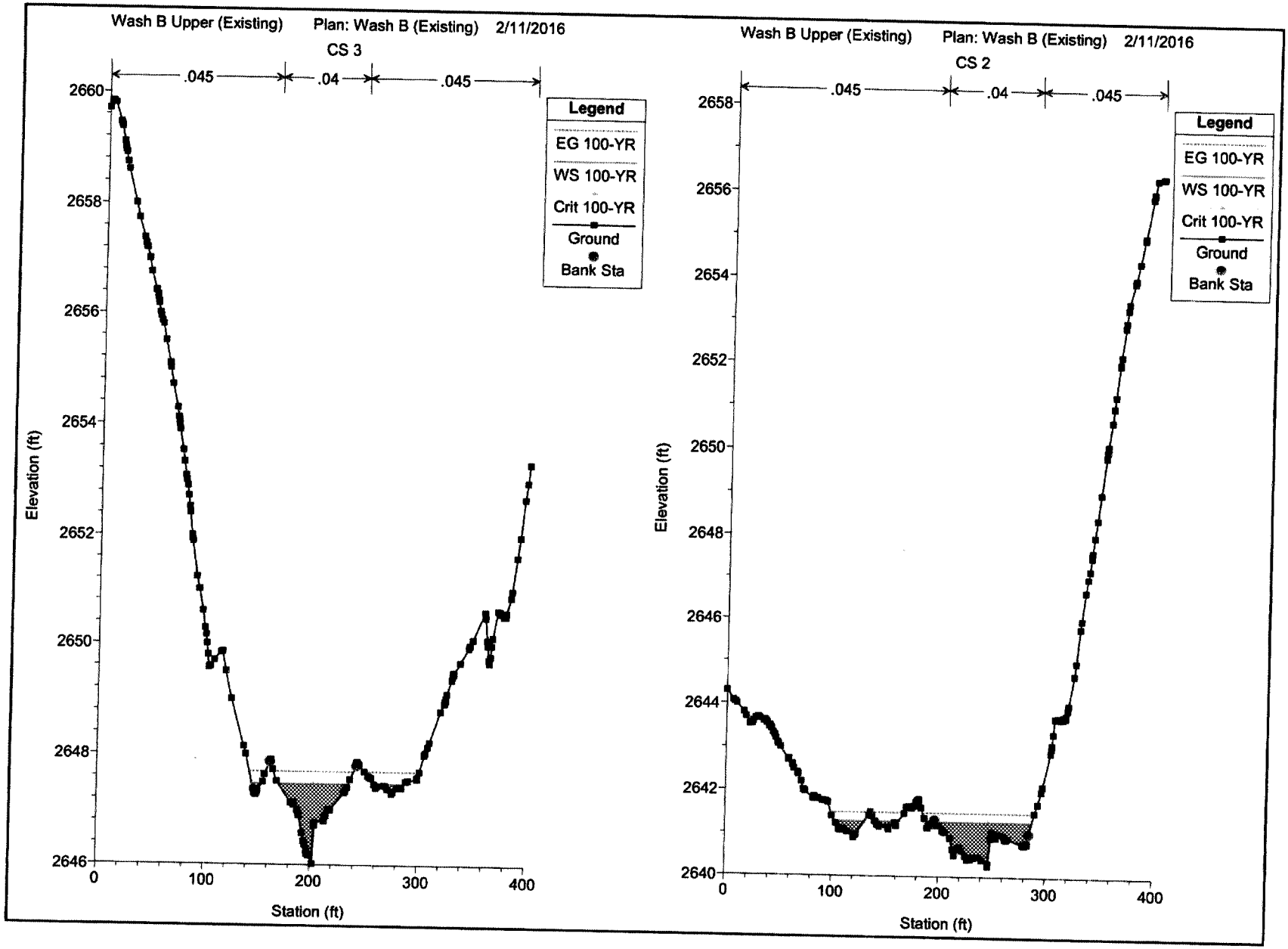
E.G. Elev (ft)	2641.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2641.29	Reach Len. (ft)	249.92	200.00	148.40
Crit W.S. (ft)	2641.29	Flow Area (sq ft)	9.03	47.41	0.42
E.G. Slope (ft/ft)	0.024105	Area (sq ft)	9.03	47.41	0.42
Q Total (cfs)	196.00	Flow (cfs)	14.36	181.06	0.58
Top Width (ft)	148.78	Top Width (ft)	58.05	87.83	2.90
Vel Total (ft/s)	3.45	Avg. Vel. (ft/s)	1.59	3.82	1.40
Max Chl Dpth (ft)	1.04	Hydr. Depth (ft)	0.16	0.54	0.14
Conv. Total (cfs)	1262.4	Conv. (cfs)	92.5	1166.2	3.8
Length Wtd. (ft)	201.06	Wetted Per. (ft)	58.10	87.99	2.91
Min Ch El (ft)	2640.25	Shear (lb/sq ft)	0.23	0.81	0.21
Alpha	1.15	Stream Power (lb/ft s)	0.37	3.10	0.30
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	0.22	0.65	0.12
C & E Loss (ft)	0.06	Cum SA (acres)	0.32	0.40	0.08

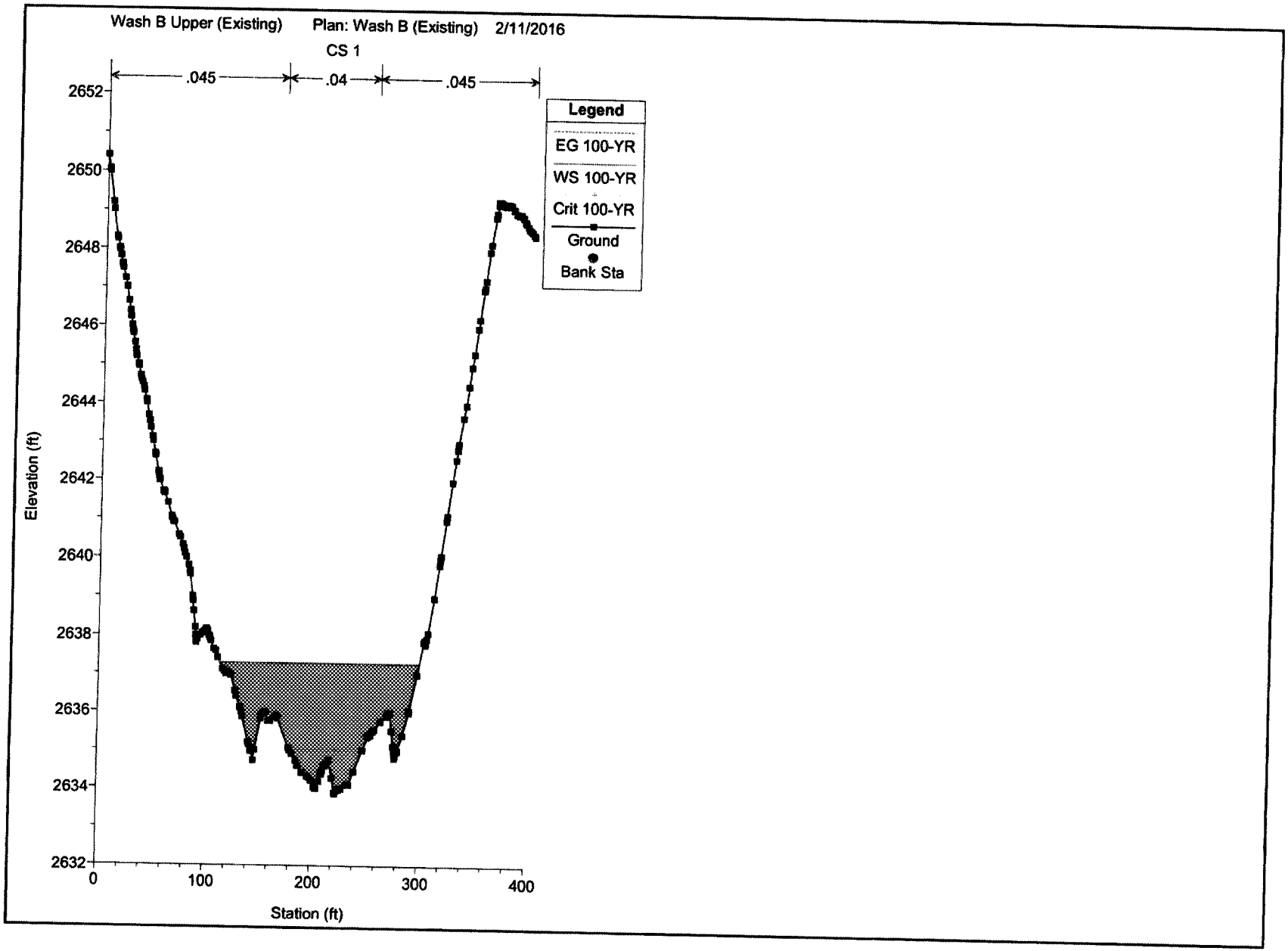
Plan: 1 RIVER-1 Reach-1 RS: 1 Profile: 100-YR

E.G. Elev (ft)	2637.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.045	0.040	0.045
W.S. Elev (ft)	2637.30	Reach Len. (ft)			
Crit W.S. (ft)	2635.01	Flow Area (sq ft)	68.88	233.78	72.31
E.G. Slope (ft/ft)	0.000074	Area (sq ft)	68.88	233.78	72.31
Q Total (cfs)	196.00	Flow (cfs)	22.91	145.70	27.40
Top Width (ft)	186.91	Top Width (ft)	54.28	85.86	46.77
Vel Total (ft/s)	0.52	Avg. Vel. (ft/s)	0.33	0.62	0.38
Max Chl Dpth (ft)	3.43	Hydr. Depth (ft)	1.27	2.72	1.55
Conv. Total (cfs)	22742.8	Conv. (cfs)	2657.9	16906.2	3178.8
Length Wtd. (ft)		Wetted Per. (ft)	54.53	86.07	47.07
Min Ch El (ft)	2633.87	Shear (lb/sq ft)	0.01	0.01	0.01
Alpha	1.18	Stream Power (lb/ft s)	0.00	0.01	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

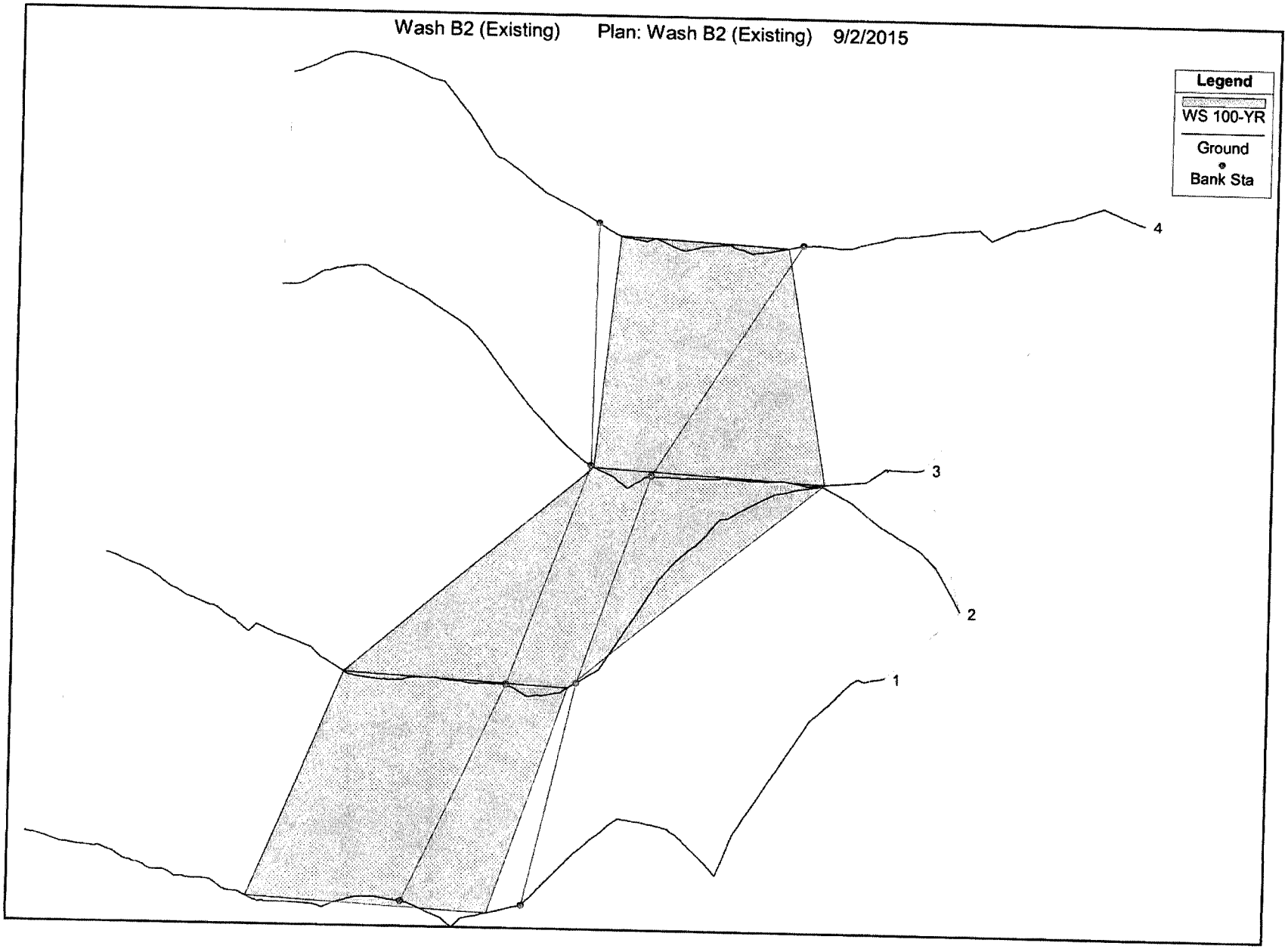

Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
CS 7
.045
.045
.04
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2684
2682
2680
2678
2676
2674
2672
2670
2668
0
100
200
300
400
Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
CS 6
.045
.045
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2676
2674
2672
2670
2668
2666
2664
2662
0
100
200
300
400

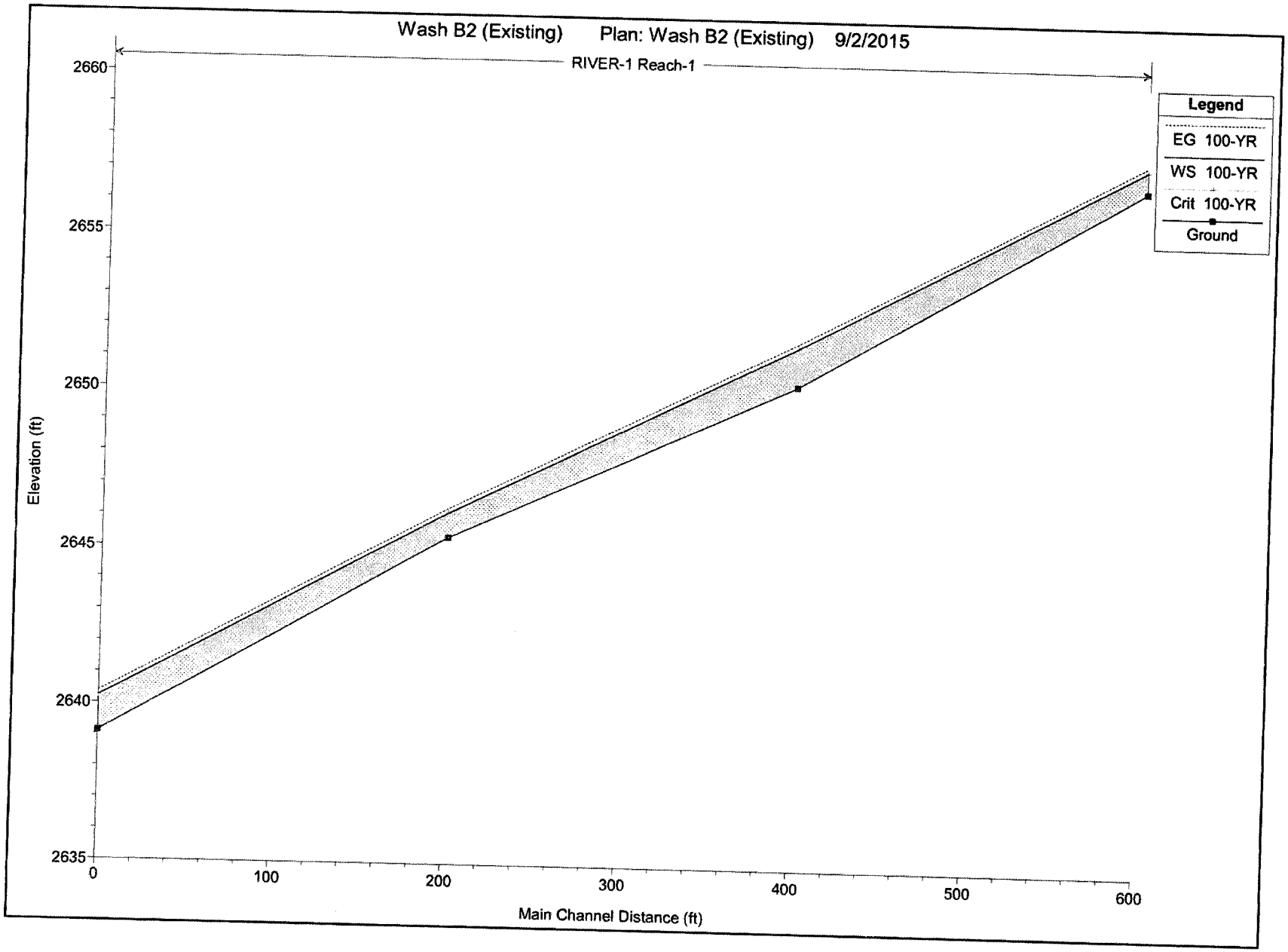

Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
CS 5
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
CS 4
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
CS 3
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
Wash B Upper (Existing) Plan: Wash B (Existing) 2/11/2016
CS 2
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Wash B Upper (Existing)
Plan: Wash B (Existing) 2/11/2016
CS 1
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
2652
2650
2648
2646
2644
2642
2640
2638
2636
2634
2632
0
100
200
300
400
Station (ft)

WASH B2 (Sanctuary At Silverhawke) HEC-RAS MODEL


Wash B2 (Existing) Plan: Wash B2 (Existing) 9/2/2015
Legend
WS 100-YR
Ground
Bank Sta
4
3
2
1


Wash B2 (Existing)
Plan: Wash B2 (Existing) 9/2/2015
RIVER-1 Reach-1
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Elevation (ft)
2660
2655
2650
2645
2640
2635
0
100
200
300
400
500
600
Main Channel Distance (ft)

Plan: A RIVER-1 Reach-1 RS: 4 Profile: 100-YR

E.G. Elev (ft)	2657.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.		0.040	
W.S. Elev (ft)	2657.46	Reach Len. (ft)	326.04	200.00	68.95
Crit W.S. (ft)	2657.46	Flow Area (sq ft)		21.88	
E.G. Slope (ft/ft)	0.035829	Area (sq ft)		21.88	
Q Total (cfs)	65.90	Flow (cfs)		65.90	
Top Width (ft)	77.91	Top Width (ft)		77.91	
Vel Total (ft/s)	3.01	Avg. Vel. (ft/s)		3.01	
Max Chl Dpth (ft)	0.68	Hydr. Depth (ft)		0.28	
Conv. Total (cfs)	348.2	Conv. (cfs)		348.2	
Length Wtd. (ft)	213.32	Wetted Per. (ft)		78.01	
Min Ch El (ft)	2656.78	Shear (lb/sq ft)		0.63	
Alpha	1.00	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	4.87	Cum Volume (acre-ft)	0.08	0.22	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.52	0.51	0.29

Plan: A RIVER-1 Reach-1 RS: 3 Profile: 100-YR

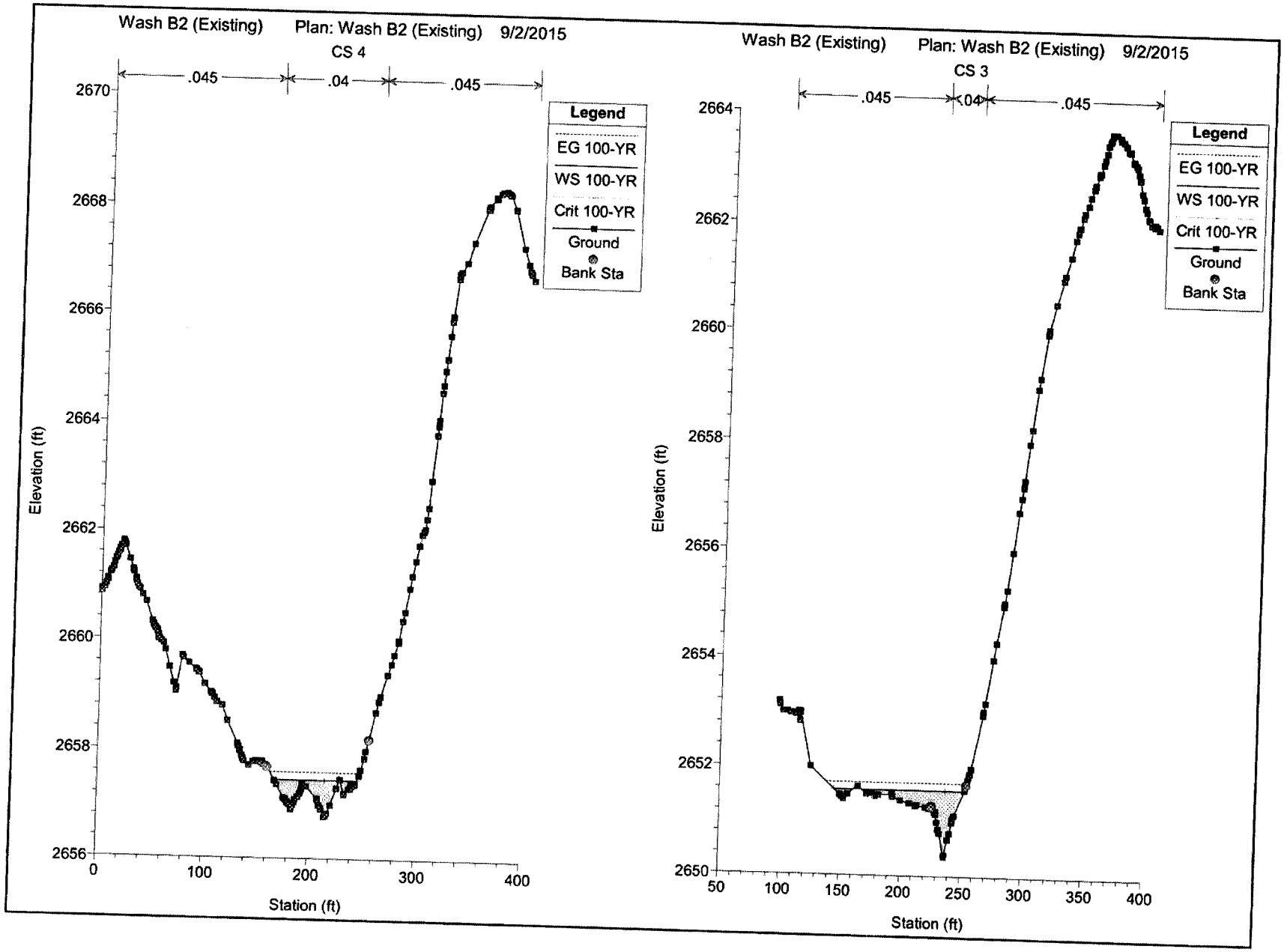
E.G. Elev (ft)	2651.73	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.	0.045	0.040	
W.S. Elev (ft)	2651.59	Reach Len. (ft)	282.04	200.00	112.07
Crit W.S. (ft)	2651.59	Flow Area (sq ft)	11.37	15.88	
E.G. Slope (ft/ft)	0.015812	Area (sq ft)	11.37	15.88	
Q Total (cfs)	65.90	Flow (cfs)	13.92	51.98	
Top Width (ft)	101.68	Top Width (ft)	74.70	26.98	
Vel Total (ft/s)	2.42	Avg. Vel. (ft/s)	1.22	3.27	
Max Chl Dpth (ft)	1.23	Hydr. Depth (ft)	0.15	0.59	
Conv. Total (cfs)	524.1	Conv. (cfs)	110.7	413.3	
Length Wtd. (ft)	196.15	Wetted Per. (ft)	74.70	27.09	
Min Ch El (ft)	2650.36	Shear (lb/sq ft)	0.15	0.58	
Alpha	1.50	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	3.75	Cum Volume (acre-ft)	0.04	0.13	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.24	0.27	0.29

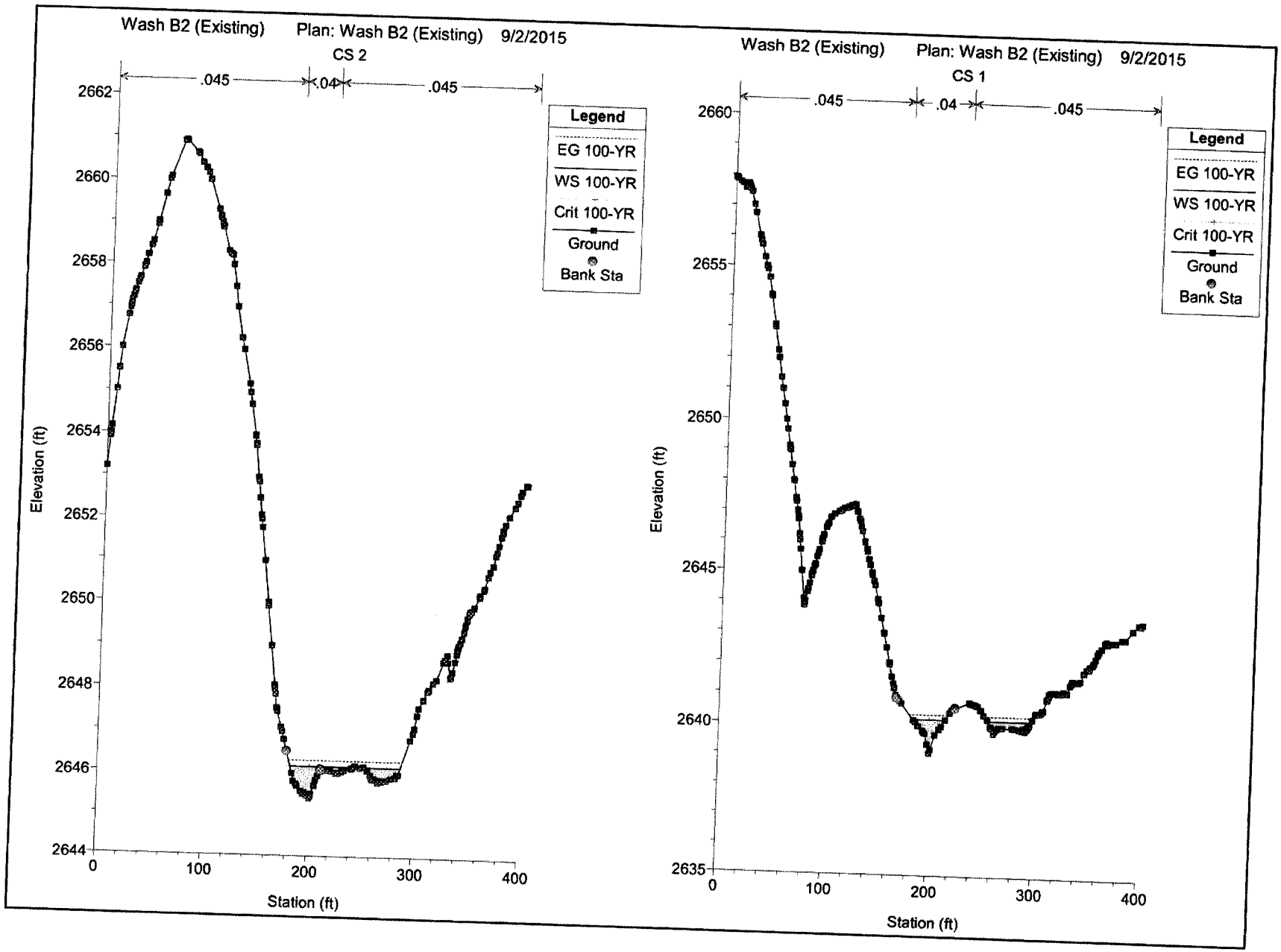
Plan: A RIVER-1 Reach-1 RS: 2 Profile: 100-YR

E.G. Elev (ft)	2646.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.		0.040	0.045
W.S. Elev (ft)	2646.17	Reach Len. (ft)	245.52	200.00	154.18
Crit W.S. (ft)	2646.17	Flow Area (sq ft)		13.63	11.10
E.G. Slope (ft/ft)	0.023571	Area (sq ft)		13.63	11.10
Q Total (cfs)	65.90	Flow (cfs)		47.13	18.77
Top Width (ft)	99.04	Top Width (ft)		28.78	70.25
Vel Total (ft/s)	2.67	Avg. Vel. (ft/s)		3.46	1.69
Max Chl Dpth (ft)	0.77	Hydr. Depth (ft)		0.47	0.16
Conv. Total (cfs)	429.2	Conv. (cfs)		307.0	122.2
Length Wtd. (ft)	186.49	Wetted Per. (ft)		28.84	70.28
Min Ch El (ft)	2645.39	Shear (lb/sq ft)		0.70	0.23
Alpha	1.32	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)	4.61	Cum Volume (acre-ft)		0.06	0.04
C & E Loss (ft)	0.00	Cum SA (acres)		0.14	0.20

Plan: A RIVER-1 Reach-1 RS: 1 Profile: 100-YR

E.G. Elev (ft)	2640.38	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.		0.040	0.045
W.S. Elev (ft)	2640.23	Reach Len. (ft)			
Crit W.S. (ft)	2640.23	Flow Area (sq ft)		13.48	9.86
E.G. Slope (ft/ft)	0.025925	Area (sq ft)		13.48	9.86
Q Total (cfs)	65.90	Flow (cfs)		45.79	20.11
Top Width (ft)	72.83	Top Width (ft)		31.37	41.47
Vel Total (ft/s)	2.82	Avg. Vel. (ft/s)		3.40	2.04
Max Chl Dpth (ft)	1.13	Hydr. Depth (ft)		0.43	0.24
Conv. Total (cfs)	409.3	Conv. (cfs)		284.4	124.9
Length Wtd. (ft)		Wetted Per. (ft)		31.47	41.51
Min Ch El (ft)	2639.10	Shear (lb/sq ft)		0.69	0.38
Alpha	1.17	Stream Power (lb/ft s)	400.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			


Wash B2 (Existing) Plan: Wash B2 (Existing) 9/2/2015
CS 4
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2670
2668
2666
2664
2662
2660
2658
2656
0
100
200
300
400
Wash B2 (Existing) Plan: Wash B2 (Existing) 9/2/2015
CS 3
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2664
2662
2660
2658
2656
2654
2652
2650
50
100
150
200
250
300
350
400


Wash B2 (Existing)
Plan: Wash B2 (Existing) 9/2/2015
CS 2
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2662
2660
2658
2656
2654
2652
2650
2648
2646
2644
0
100
200
300
400
Wash B2 (Existing)
Plan: Wash B2 (Existing) 9/2/2015
CS 1
.045
.04
.045
Legend
EG 100-YR
WS 100-YR
Crit 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
2660
2655
2650
2645
2640
2635
0
100
200
300
400

APPENDIX C
PLANS, MAPS, AND FIGURES

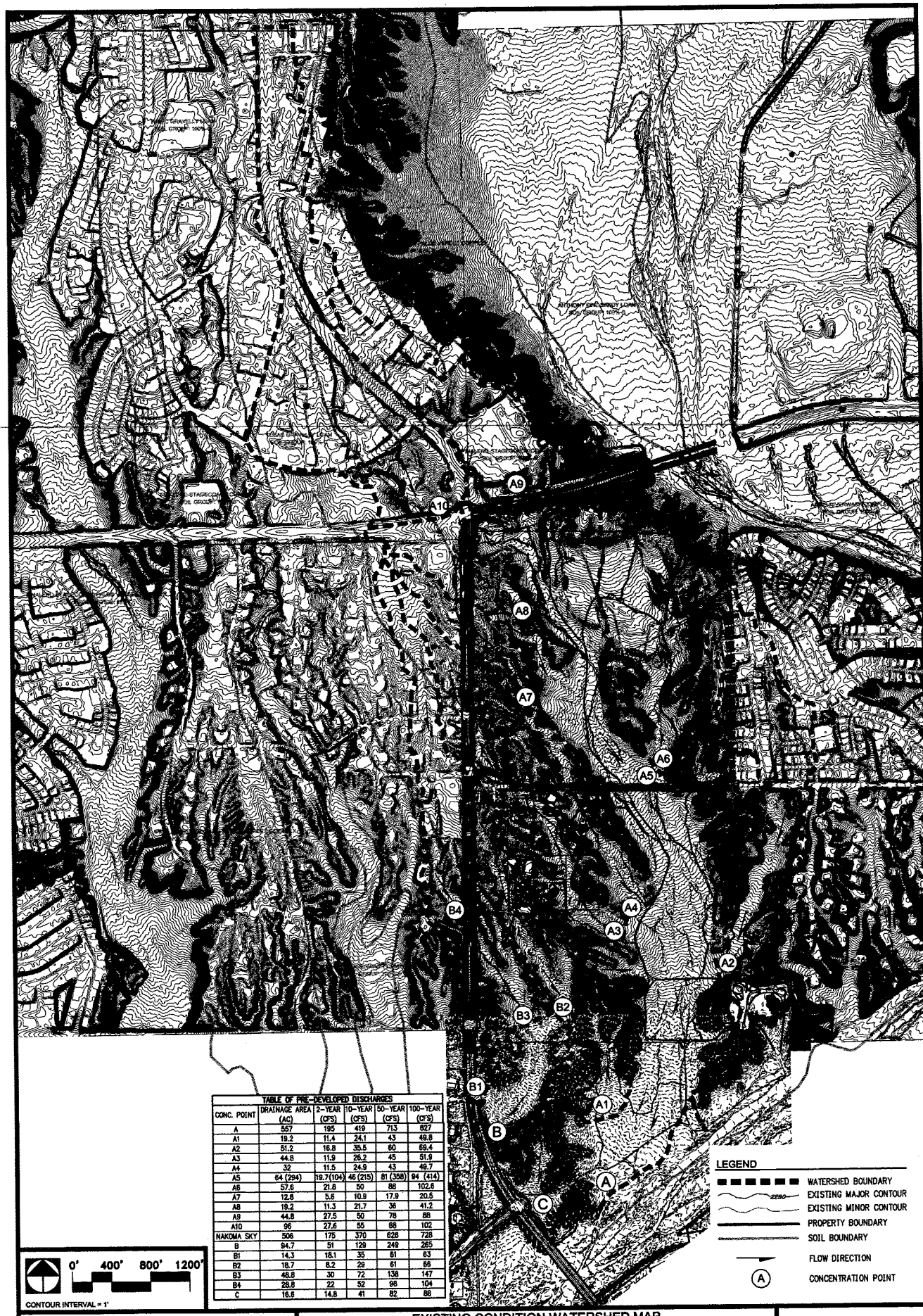


TABLE OF PRE-DEVELOPED DISCHARGES					
CONC. POINT	DRAINAGE AREA (AC)	2-YEAR (CFS)	10-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
A	557	195	419	713	827
A1	19.2	11.4	24.1	43	49.8
A2	51.2	16.8	35.5	60	69.4
A3	44.8	11.9	26.2	45	51.9
A4	32	11.5	24.9	43	49.7
A5	64 (294)	19.7(104)	46 (215)	81 (358)	94 (414)
A6	57.6	21.8	50	88	102.6
A7	12.8	5.6	10.9	17.9	20.5
A8	19.2	11.3	21.7	36	41.2
A9	44.8	27.5	50	78	88
A10	96	27.6	55	88	102
NAKOMA SKY	506	175	370	628	728
B	94.7	51	129	249	265
B1	14.3	18.1	35	61	63
B2	18.7	8.2	29	61	66
B3	48.8	30	72	138	147
B4	28.8	22	52	96	104
C	16.6	14.8	41	82	88

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Engineering Planning Surveying Landscape Architecture Urban Design
Offices located in Tucson, Phoenix, and Flagstaff, Arizona, and Las Vegas, Nevada
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EXISTING CONDITION WATERSHED MAP
FIRST AVENUE PROPERTIES
FIRST AVENUE
TOWN OF ORO VALLEY, ARIZONA

FIGURE 3

WLB JOB # 182053-J002-0400
FEBRUARY 2018

N:\182053\Hydro\Overall Existing Hydro\FIG3_WTRSHED.dwg Plotted: Feb 11, 2018

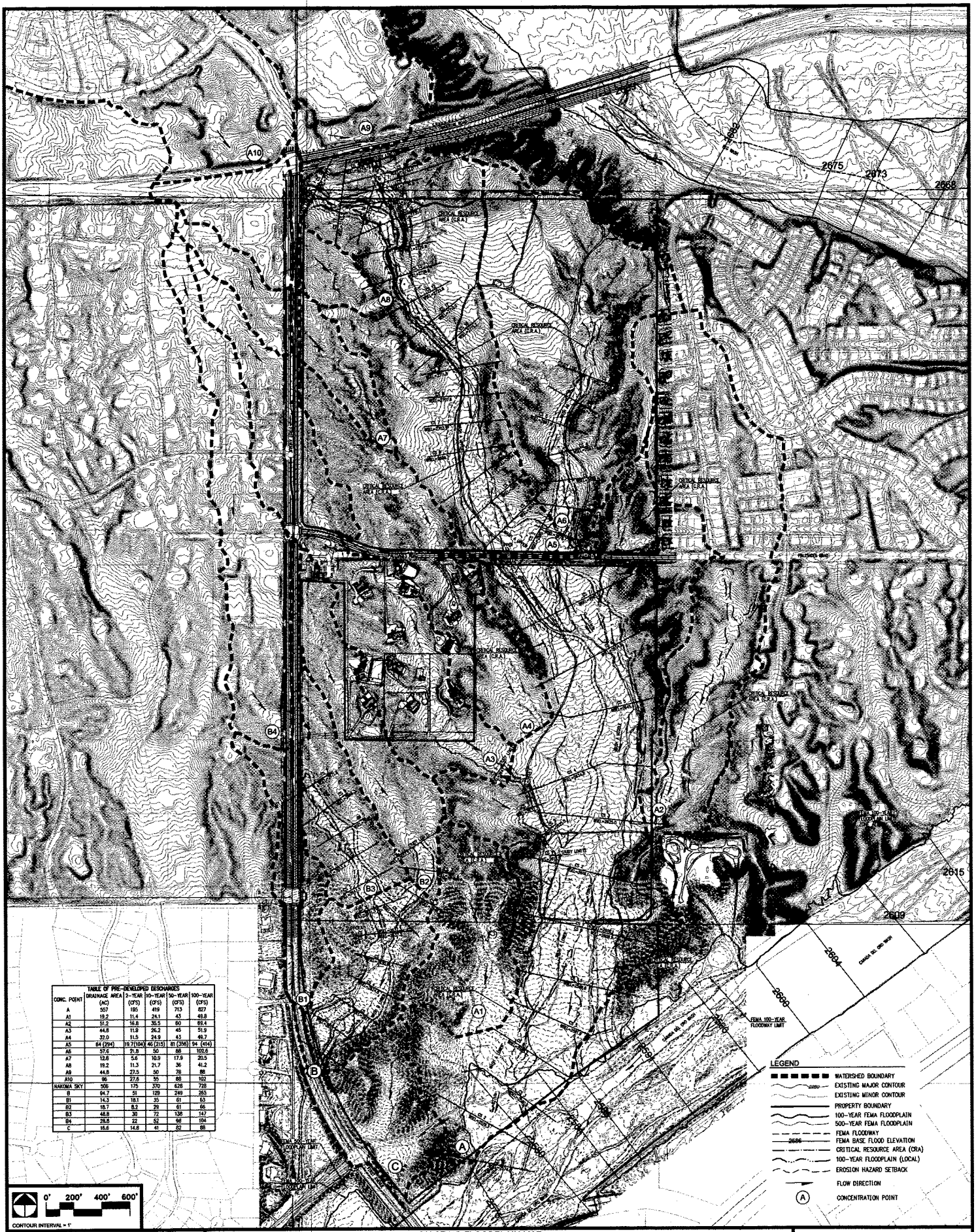


TABLE OF PRE-DEVELOPED DISCHARGES

CONC. POINT	DRAINAGE AREA (AC)	2-YEAR (CFS)	10-YEAR (CFS)	50-YEAR (CFS)	100-YEAR (CFS)
A	557	195	419	713	827
A1	19.2	11.4	24.1	43	49.8
A2	51.2	16.8	35.5	60	69.4
A3	44.8	11.9	26.2	45	51.9
A4	32.0	11.5	24.9	43	49.7
A5	84 (294)	19.7(104)	46 (215)	81 (356)	94 (414)
A6	57.6	21.8	50	88	102.6
A7	12.6	5.6	10.9	17.9	20.5
A8	19.2	11.3	21.7	36	41.2
A9	44.8	27.5	50	78	88
A10	96	27.8	55	89	102
NAKOMA SKY	506	175	370	628	728
B	94.7	51	129	249	293
B1	14.3	10.1	35	61	63
B2	18.7	8.2	29	51	60
B3	46.8	30	72	126	147
B4	29.8	22	52	98	104
C	16.6	14.8	41	82	98

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EXISTING FLOODPLAIN MAP
EXISTING WASH STUDY
FIRST AVENUE
TOWN OF ORO VALLEY, ARIZONA

FIGURE 4

WLB JOB # 152053-A003-0400
FEBRUARY 2015

N:\152053\Hydro\Overall Existing Hydro\FIG4_FLDPLN.dwg Plotted: Feb 11, 2015

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Data CD (1 pocket)

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LIMITATIONS

The above services consist of professional opinions and conclusions by a consulting civil engineer. The only warranty or guarantee made by the Consultant, in connection with the services performed for this project, is that such services are performed with the care and skill ordinarily exercised by members of the profession practicing under similar conditions, at the same time, and in the same or a similar locality. No other warranty, expressed or implied, is made or intended by rendering such consulting services, nor by furnishing written reports of the findings.