

**Wedge Parkway Extension
Hydraulic Report
Whites Creek Branch 3**

RETURN TO WASHOE
COUNTY ENGINEERING

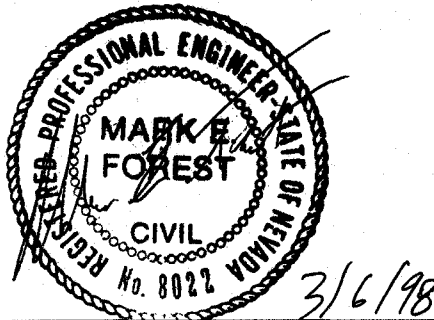
Rec 3/9/98

Prepared For:

CFA
1150 Corporate Boulevard
Reno, Nevada 89502

Prepared By:

WRC Nevada, Inc.
1575 Delucchi Lane, Suite 207A
Reno, Nevada 89502
(702) 332-3737
(702) 332-3740 Fax



Mark E. Forest, P.E.
Principal Engineer

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INTRODUCTION AND PURPOSE

This report was prepared to support the design of the Wedge Parkway extension from Whites Creek Lane to Arrow Creek Parkway. Construction plans prepared by CFA dated December 12, 1997 were used for these analyses. Arrow Creek Parkway will be constructed as a part of Special Assessment District #23 from the Arrow Creek Development to the extension of Wedge Parkway. The Wedge Parkway extension will connect Arrow Creek Parkway to the existing end of Wedge Parkway at Whites Creek Lane providing a connection to the Mount Rose Highway. This segment of Wedge Parkway is approximately 2000 feet long.

This segment of Wedge Parkway is impacted by the third branch of Whites Creek as shown on the Flood Insurance Rate Map (FIRM) prepared by the Federal Emergency Management Agency (FEMA) which is provided as Figure 1. In the case of Whites Creek, the FIRM is not used by Washoe County for floodplain management purposes. Washoe County has adopted special standards for the Whites Creek floodplain. These standards require that a project be evaluated based on two different discharge values. These values are significantly greater than those used by FEMA in preparation of the FIRM shown as Figure 1. The flow rates for these two events were defined in the *Preliminary Whites Creek Basin Management Study* (CBA, 1994) prepared for Washoe County and are currently being used by Washoe County as a basis for drainage design in the Whites Creek area. These flow rates are 1,100 cfs which is to be used for design of hydraulic structures and 3,000 cfs which is to be used for floodplain management activities. An approximate floodplain map was prepared by CBA based on the potential flow rate of 3,000 cfs on each branch of Whites Creek. This map is shown as Figure 2.

The purpose of this report is to present the approximate limits of flooding associated with the "design" and "floodplain management" events on Whites Creek Branch 3 in the vicinity of the proposed roadway improvements and evaluate the project impact on the floodplain. A previous study (HLA, August 1997) was prepared for Arrow Creek Parkway. This report supplements this previous report by providing the pre- and post-project analyses for Whites Creek Branch 3. The Wedge Parkway extension was not addressed in this previous study.

This report describes the methods of analysis and assumptions employed and presents the results of the analysis for both pre- and post-project conditions. The report addresses only Whites Creek flows and does not address roadway drainage or drainage from other smaller watersheds impacting this segment of the

roadway. Preparation of the plans and specifications and all other roadway drainage elements are being performed by CFA.

DESCRIPTION OF PROJECT AREA

The project is located in the southwest Truckee Meadows in unincorporated Washoe County. The proposed roadway is located near the center of Section 20, T18N, R20E (Figures 1 and 2). Grades in the area near the roadway are approximately 3% and fall toward the east and northeasterly directions. Figure 3 is a copy of the floodplain map for a portion of Whites Creek Branches 2 and 3 in the vicinity of this project prepared as a part of the Hydraulic Report for Special Assessment District #23 (HLA, 1997). As can be seen, the "floodplain management event" of 3,000 cfs produces a wide shallow floodplain with very shallow average depths (1 to 2 feet).

REPORT REVISIONS

This report was originally submitted on December 19, 1997. The revisions to the original report which have been included in this revised version, include:

- The culvert design was modified by CFA to lengthen some of the culverts and to decrease skew angle. The modified culvert dimensions have been incorporated into the hydraulic analyses contained in Appendices 4 and 5.
- The roadway profile between 65+00 and 69+00 was modified by CFA. The modified profile has been incorporated into the hydraulic analyses contained in Appendices 4 and 5.
- The rip-rap sizing calculations were modified to reflect the revised design. The revised calculations are contained in Appendix 5.
- The revised plan sheets have been included in Appendix 1.
- Additional explanation was added to the report pertaining to recommendations, erosion control of the roadway embankment and erosion control at culvert outlets was added to the report text.

STUDY LIMITATIONS

This study was prepared for the limited purpose of evaluating the impacts of flooding associated with Whites Creek on the proposed Wedge Parkway extension based on flow rates defined by Washoe County (CBA, 1994), and evaluation of the impacts of this segment of the roadway on the 3,000 cfs floodplains as well as recommendations for additional design considerations for the roadway drainage structures related to erosion at the outlets of the culverts. The analysis is based on the proposed roadway improvement plans prepared by CFA. WRC has not reviewed the drainage design for the remainder of the roadway and is not making any statements or assurances regarding any aspects of the design not specifically described herein.

Based upon the requirements imposed by Washoe County, WRC used the discharge values presented in the *Preliminary Whites Creek Basin Management Study*. WRC does not make any assurances regarding the adequacy of these values to represent a specific recurrence interval and is not assuming that these flows are representative of a 100-year design event. Should the design flows be modified as a result of more detailed studies, or construction or grading occur in or near the Whites Creek floodplain resulting in a change to flow patterns or depth of flow, the conclusions of this report may no longer be applicable.

BACKGROUND

PREVIOUS STUDIES

The floodplain associated with Whites Creek Branch 3 was delineated by FEMA in the late 1970's. This floodplain is shown on the current FEMA Flood Insurance Rate Map (FIRM) Panel 3170E dated September 29, 1994 (Figure 1). The FEMA analysis was based on approximate methods of analysis that yielded relatively narrow floodplains for each of the four branches of Whites Creek. Later studies were performed for the Nevada Department of Transportation (NDOT) that suggested that the 100-year discharge estimate for Whites Creek was much greater than the flow rates used by FEMA for the approximate analyses shown on the FIRM.

A detention basin site was investigated by NDOT and Washoe County for a location above the confluence of the four branches of Whites Creek to reduce the 100-year peak flows impacting Interstate 580 and the lower reach of the Whites Creek floodplain. Because area land owners opposed the detention basin concept, the planning of this facility was discontinued. Washoe County then contracted with CBA to prepare a basin management study for Whites Creek to identify the potential hazards associated with the larger flow estimate and develop a floodplain management strategy for the Whites Creek area. This report, titled *Preliminary Whites Creek Basin Management Study, Final Report* was completed in April 1994. This document is currently being used by Washoe County as the basis of floodplain management in the Whites Creek area. Related portions of this study are included in Appendix 1 showing the approximate flood limits identified by CBA and other design criteria recommendations made by CBA.

As described above, a previous study was prepared by Harding Lawson Associates for Special Assessment District #23 which identified the floodplains associated with the floodplain management event for Whites Creek Branches 1, 2 and 3. Figure 3 is a copy of the HLA floodplain map for the area impacting the Wedge Parkway Extension. The HLA floodplain delineation and hydraulic models were used as a basis for this study.

FEMA FLOODPLAIN MAPS

The Federal Emergency Management Agency (FEMA) prepares floodplain maps for the most significant flooding hazards in the communities that participate in the National Flood Insurance Program (NFIP). As

a condition of participation in the NFIP, the community must adopt a floodplain ordinance which enforces the minimum requirements of the NFIP. Washoe County entered the regular program of the NFIP on August 1, 1984. At that time a set of Flood Insurance Rate Maps (FIRM) were published.

The first set of FIRMs published in 1984 showed an approximate 100-year floodplain analysis for Whites Creek. Since that date, the Washoe County FIRMs have been revised several times, but the Whites Creek floodplain is still shown as an approximate study. The current FEMA FIRMs for the project area became effective on September 30, 1994.

The current FIRM for the project area, shown as Figure 1, shows an approximate flood zone for each branch of Whites Creek. The approximate location of Arrow Creek Parkway is shown on this map. Because the flood zone information is approximate, FEMA has not published estimated peak discharges or water surface elevations associated with these flood zones. This segment of Wedge Parkway is impacted by the third branch as shown on this map.

DESIGN CRITERIA

The hydraulic design criteria for this project includes:

- The "design" and "floodplain management" discharge values for Whites Creek branch 3 have been defined in the *Whites Creek Basin Management Study* (CBA, 1994) and are 1,100 and 3,000 cfs, respectively. The "design" values are typically recommended for the design of channels, culverts and other related drainage improvements. However, in this instance, design of the hydraulic structures for the design flow value could result in a diversion of the portion of the floodplain management flows of 3,000 cfs. Therefore, the design must consider the impact of the larger flow value.
- In order to minimize the potential diversion of flow by the roadway, the southern portion of this segment of Wedge Parkway was designed to be "at grade".
- Hydraulic analyses of the box and pipe culverts is based upon the methods described by the Federal Highway Administration (FHWA) in Hydraulic Design Series No. 5 (1986) and the computer program HY-8 developed for the FHWA (1996).

- Erosion protection at the culvert outlets is based on the Draft Washoe County Hydrologic Criteria and Drainage Design Manual. Verification of rip-rap sizes was performed using the Federal Highway Administration (FHWA) Hydraulic Engineering Circular HEC-14 (1983).

TOPOGRAPHIC DATA

Topographic mapping for the project site and surrounding area was prepared by Nevada Aerial Mapping based on aerial photographs taken on November 13, 1996. This mapping was prepared with a contour interval of one foot.

IMPROVEMENT PLANS

Selected sheets from the Wedge Parkway Roadway Improvement Plans, as prepared by CFA (February 25, 1998) are included in Appendix 1 for reference. These plans were used as the basis for the analyses contained in this report.

HYDRAULIC ANALYSES

SELECTION OF HYDRAULIC MODEL

HEC-RAS (VER. 2.1) was selected as the best tool currently available for performing the analysis of pre- and post-project conditions. The analysis is based on the following assumptions and boundary conditions:

- The flow regime is assumed to be subcritical. Even though the average slope is approximately 3%, flows in natural channels are rarely supercritical, especially when the flow is wide and shallow. The impacts on the flow profile that results from dune and anti-dune formations, debris and sediment movement and other factors often keep the flow depths near or above critical depth in natural channels. The analysis results in flow depths that are typically computed at critical depth. Therefore, the analysis is not highly sensitive to estimates of channel and overbank roughness.
- Flow depths at the first section are based on the slope-area method.
- HEC-RAS (VER. 2.1) is a one dimensional steady flow model. Since the flow interactions between channel braids may be dynamic, a one dimensional model only yields approximate results. The flow profile in each braid may differ from one another slightly. Modeling a lower flow rate would require a more complex analysis of the interaction of the channel braids and would require that the analysis be carried further upstream. Because of the one-dimensional limitation, the flow in the small primary channel varies significantly and in several sections the primary channel is indicated to be slightly above the water surface elevation. This is not a critical problem since the flow depths are shallow and the majority of the flow is in the right overbank.
- Manning's roughness values are based on field review.

WHITES CREEK BRANCH 3 - PRE-PROJECT CONDITION

A set of 9 cross sections were defined at an average spacing of approximately 150 feet as shown on Figure 3. The cross sections geometry and lengths between sections were obtained from the topographic maps by HLA using a digital terrain model. The orientation of the cross sections was selected to best describe the flow patterns associated with a 3,000 cfs event which was determined to be the event to be used for design

purposes. Accurate modeling of lower flows would require a different cross section orientation. The results of this analysis are contained in Appendix 3 with plotted cross sections.

WHITES CREEK BRANCH 3 - POST-PROJECT CONDITION ANALYSES

The design of Wedge Parkway considered the Whites Creek Branch 3 floodplain. The southern portion was designed to be at grade on the upstream side of the roadway section to allow flow in this portion of the floodplain to overtop the road as unrestricted as is possible for roadway construction across a shallow flood zone.

The northern portion of the roadway must be elevated to connect to Arrow Creek Parkway. Since this is the low point in the floodplain, three box culverts were placed at the primary channel locations to allow the flow to be spread between the channel braids and minimize downstream and upstream impacts. A vertical curve was placed just south of the intersection with Arrow Creek Parkway to provide for overtopping. The goal is to provide sufficient hydraulic capacity to be assured that 3,000 cfs can be conveyed through the Wedge Parkway extension without resulting in any diversion of flow across Arrow Creek Parkway into the Whites Creek Branch 2 floodplain.

Because the roadway is not perpendicular to the flow, use of HEC-RAS to model the post-project condition was more difficult. The portion of the roadway between stations 53+00 and 62+00 was designed to allow sheet flow over the roadway. This segment of the roadway is located slightly upstream of the northern segment of the roadway segment since the roadway is not perpendicular to flow. Based upon the pre-project condition analysis, approximately 30% of the flow is contained in the extreme right overbank where it would be directed toward the southern portion of the roadway segment. ^{~ 900 cfs} Therefore, the post-project condition analysis is more complex. The post-project condition analysis was performed as follows:

- The HEC-RAS model developed for the pre-project condition was modified to add the portion of Wedge Parkway from Station 58+00 to 69+00 which includes the three proposed box culverts.
- The extreme right overbank is not included in Sections 1, 1.2 and 1.5. Therefore, the flow rate is reduced in this segment of the channel reach to reflect the maximum flow rate that could likely be confined to this segment. The remainder of the flow is assumed to cross over the roadway to the

south of the end point of the cross section. To be conservative, the box culverts were designed based on the assumption that only 10% of the flow is directed over the roadway south of Station 62+00 resulting in a design flow rate for the segment from 62+00 to 69+00 of 2,700 cfs. If 30% of the flow overtops the roadway south of Station 62+00, this design flow would be reduced to 2,100 cfs.

- The culverts are modeled using the multiple opening box culvert analysis option in HEC-RAS. The FHWA methods are used for hydraulic performance calculations for the box culverts.

Using this approach, the maximum capacity of the three box culverts and overtopping section of the roadway were determined for a maximum upstream water surface elevation of 4622.0 which is approximately 0.2 feet below the crown elevation of Arrow Creek Parkway. This water surface elevation represents the maximum water surface elevation at the upstream side of the roadway that would pass 2,700 cfs between stations 62+00 and 69+00. This assumes that a minimum of 300 cfs would cross the roadway as shallow flow south of Station 62+00. If the entire 3,000 cfs in the Branch 3 floodplain was directed at the section of roadway between 62+00 and 69+00, the upstream water surface elevation would be approximately 4622.2 which would still be contained in Branch 3.

A second analysis was performed using the FHWA HY-8 program to verify the results and outlet velocity of the culverts for design of erosion control at the culvert outlets. Each culvert was analyzed separately and a composite rating curve was developed. These analyses and resulting rating curve are include in Appendix 4.

CULVERT OUTLET EROSION CONTROL AND ENERGY DISSIPATION

Erosion control and energy dissipation at the culvert outlets is recommended. To accomplish this energy dissipation, WRC is recommending the use of a pre-formed rip-rap scour hole. Rip-rap sizing calculations were performed based on the outlet splash pool equations contained in the Draft Washoe County Hydrologic Criteria and Drainage Design Manual (Figure 822 and Equations 829 and 830) (WRC, 1996). The results for each of the four culverts is contained in Appendix 4.

General design parameters for length, width, depth, rip-rap size, rip-rap thickness and general placement are contained in Appendix 4.

CONCLUSIONS AND RECOMMENDATIONS

The HEC-RAS results show that the three sets of box culverts have a combined capacity of approximately 2,000 cfs at the elevation of the low point at Station 68+35. At an elevation of 4622.0, the three sets of box culverts have a combined capacity of 2,600 cfs and approximately 100 cfs overtops that roadway with a maximum depth at Station 68+35 of 0.8 feet. This roadway overtopping would be approximately 120 feet wide (Station 67+90 to 69+00).

The independent analyses using HY-8 confirmed the HEC-RAS results. Since approximately 20 to 30% of the flow could potentially overtop the southern segment of the roadway, this segment of the roadway has more than adequate hydraulic capacity. The flow should return to sheet flow conditions a short distance downstream of the roadway.

The proposed condition hydraulic analysis causes a slight increase in the predicted water surface elevation upstream of Wedge Parkway. The change in the 3,000 cfs floodplain is shown on a set of the plan and profile sheets for Wedge Parkway contained in Appendix 4.

Erosion protection should be provided at the culvert outlets. Rip-rap sizing calculations have been prepared for two different outlet splash pool depths and are contain in Appendix 5.

Washoe County is also recommending erosion protection of the roadway embankment where overtopping is anticipated in a 3,000 cfs event. Since this is the western portion of the half street improvements, any permanent measures on the eastern edge of the roadway would need to be removed at the time of construction of the eastern half of the roadway. Based upon discussions with Washoe County and CFA, several alternatives were identified for providing some degree of temporary protection of the proposed improvements should an overtopping event occur. One alternative was to widen the east shoulder in the area where overtopping is possible to provide a buffer between the curb and the edge of fill. Another alternative would be to place rip-rap on the east slope in these areas to minimize the overtopping erosion potential. Because the depth is less than one foot, the duration is short, overtopping would only occur in an extreme event and the other half street improvements will be constructed at a later date, WRC recommends providing a minimum of a 10 foot shoulder behind the curb from Station 67+50 to 69+00 and from 53+00 to 62+50.

REFERENCES

Sources of information used in this analysis included the following references:

Cella Barr Associates, April 17, 1994, Preliminary Whites Creek Basin Management Study, Final Report.

CFA, Arrowcreek, Plan and Profile, Wedge Parkway, Sheets 5, 6 and 7 of 22, December 12, 1997 and February 25, 1998.

Federal Emergency Management Agency. September 30, 1994. Flood Insurance Study, Washoe County, Nevada.

Harding Lawson Associates, April 17, 1996, Pine Tree Ranch, Units 3 and 4, Hydraulic Report, Whites Creek Branches 3 and 4.

Harding Lawson Associates, August 25, 1997, Special Assessment District #23, Hydraulic Report, Whites Creek Branches 1, 2 and 3.

Kennedy/Jenks Consultants. October 1993. "Whites Creek Floodplain Analysis," letter report to Merit Homes.

Kennedy/Jenks Consultants. July 22, 1994. "Pine Tree Ranch Subdivision - Unit 1, Hydrologic and Floodplain Analysis," letter report to Merit Homes.

U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, September 1990. Computer Program 723-X6-L202A, HEC-2 (VER. 4.6.2), Water Surface Profiles.

U.S. Department of the Army, Corps of Engineers, July 1991, Engineer Manual, Hydraulic Design of Flood Control Channels.

U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, July 1995. HEC-RAS (VER. 1.2), River Analysis System.

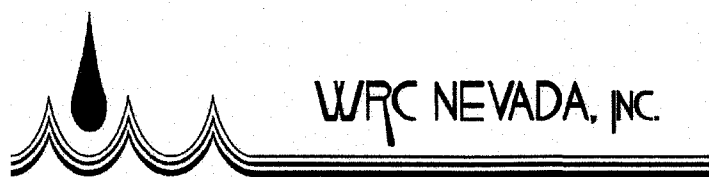
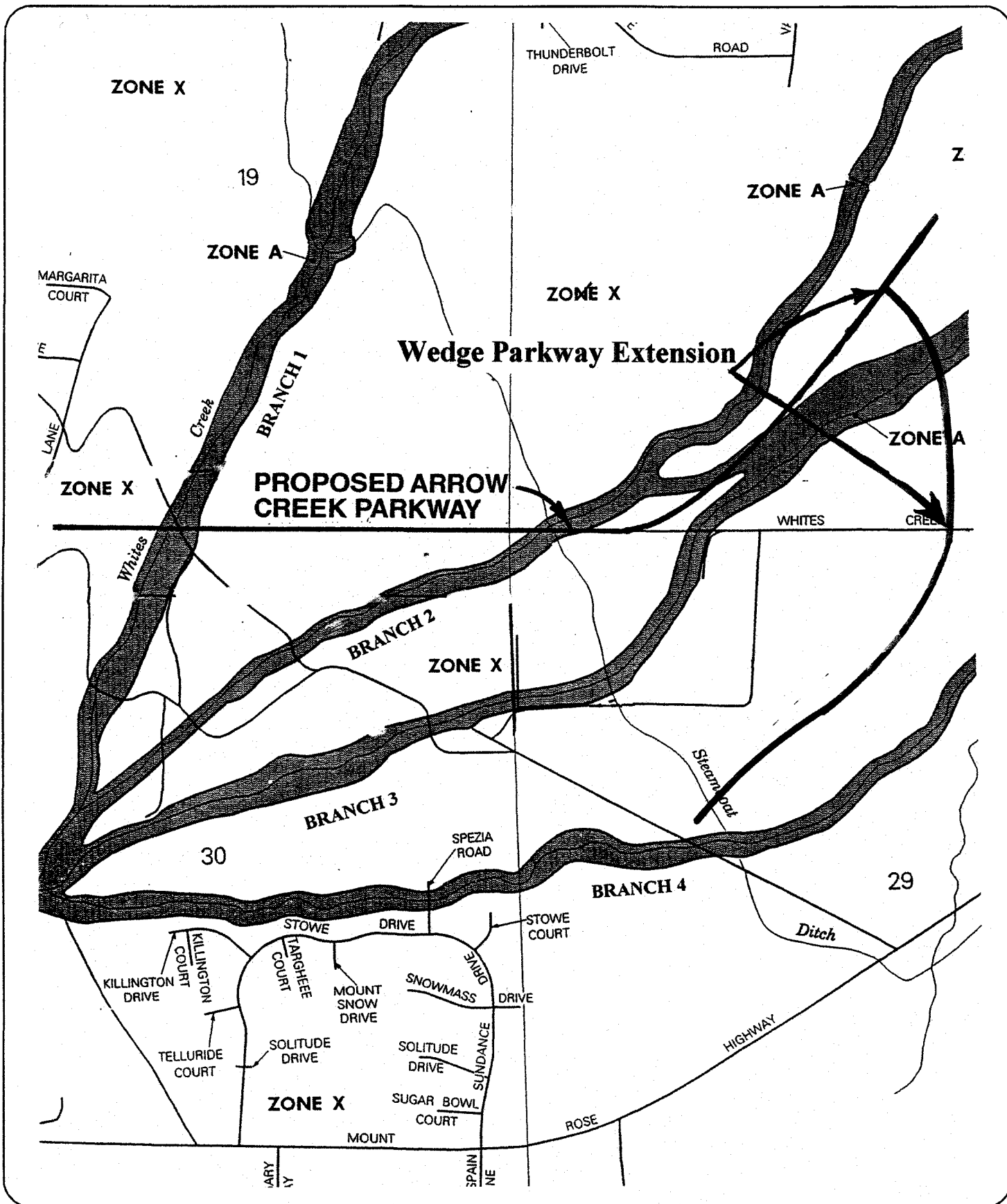
U.S. Department of Transportation, Federal Highway Administration. June 1967, Hydraulic Engineering Circular No. 11, Use of Riprap for Bank Protection.

U.S. Department of Transportation, Federal Highway Administration. September 1983, Hydraulic Engineering Circular No. 14, Hydraulic Design of Energy Dissipators for Culverts and Channels.

U.S. Department of Transportation, Federal Highway Administration. September 1986. Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5, September 1986.

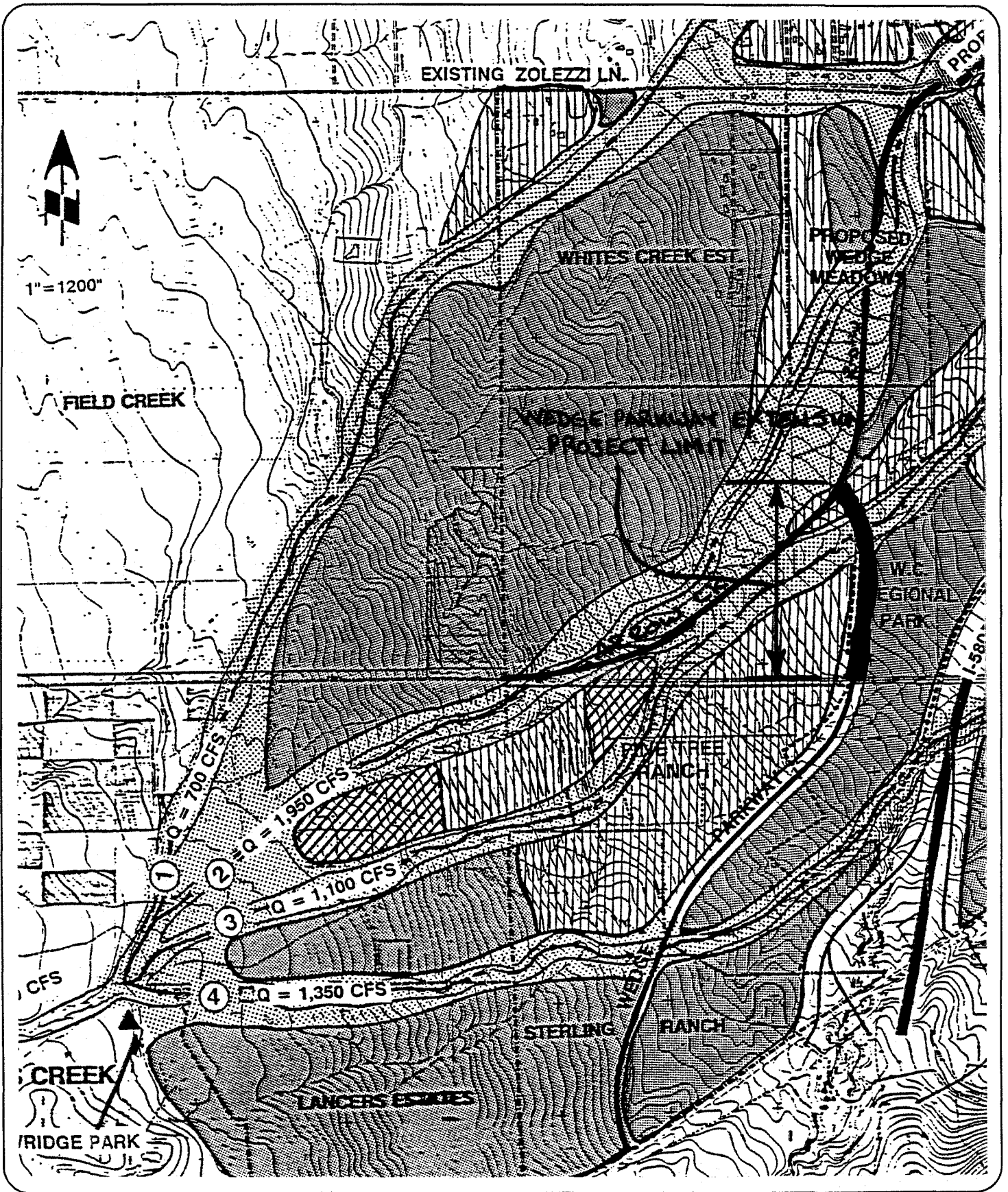
U.S. Department of Transportation, Federal Highway Administration. November 1995. Evaluating Scour at Bridges.

U.S. Department of Transportation, Federal Highway Administration. May 1987. HY8 Culvert



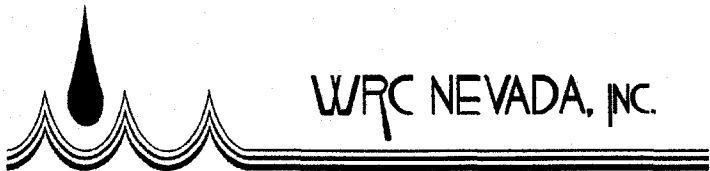
Wedge Parkway Extension
 FEMA Flood Insurance Rate Map
 Panel 3170E (09/30/94)
 Washoe County, Nevada

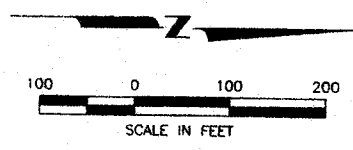
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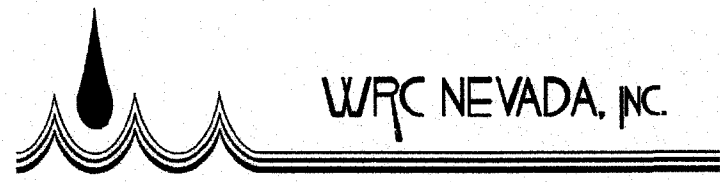
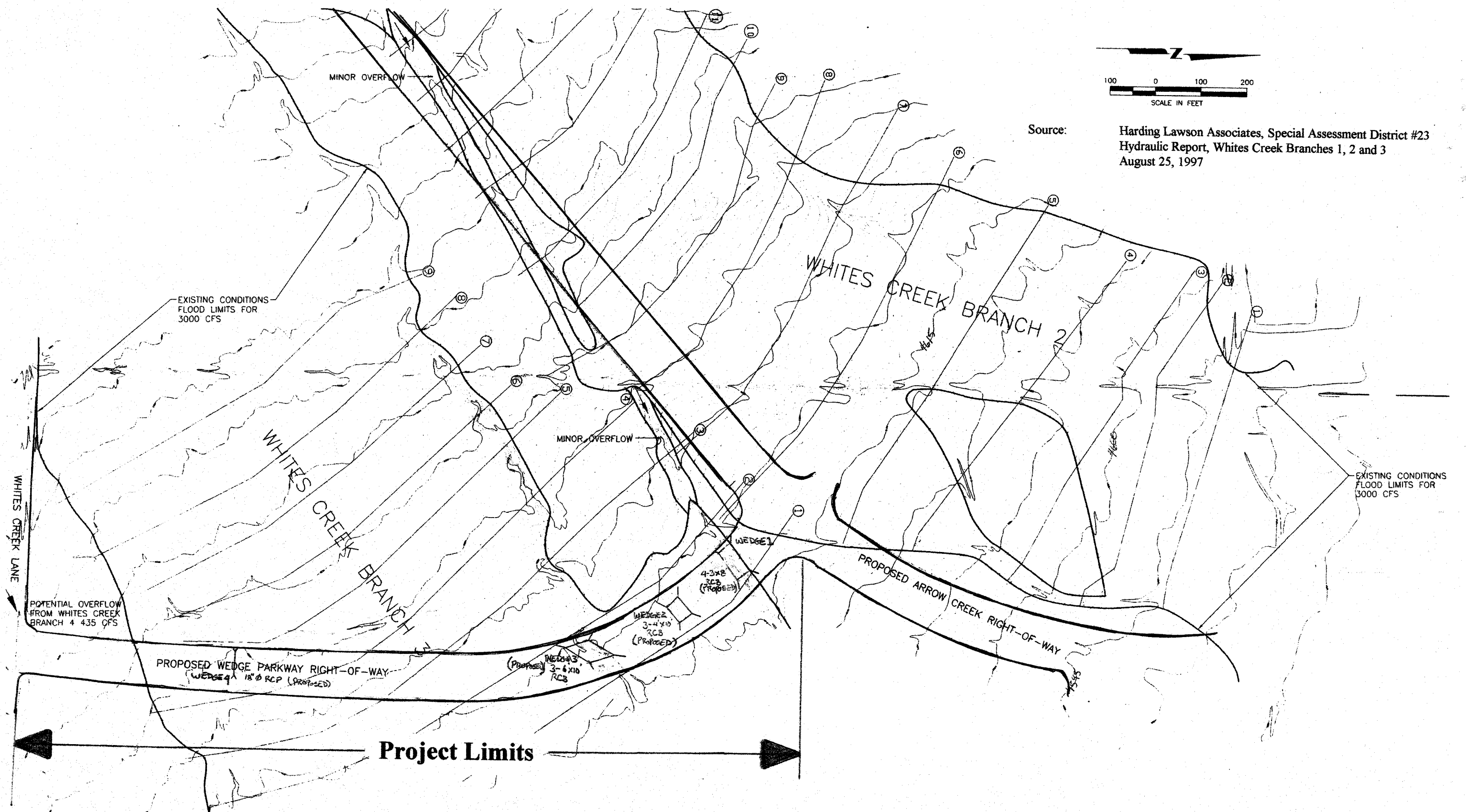
Wedge Parkway Extension
Whites Creek Basin Management
Study Floodplain Map
(CBA, 1994)

Figure
2





Source: Harding Lawson Associates, Special Assessment District #23
 Hydraulic Report, Whites Creek Branches 1, 2 and 3
 August 25, 1997



Wedge Parkway Extension
 Pre-Project Condition
 Floodplain Map
 Whites Creek Branches 2 and 3

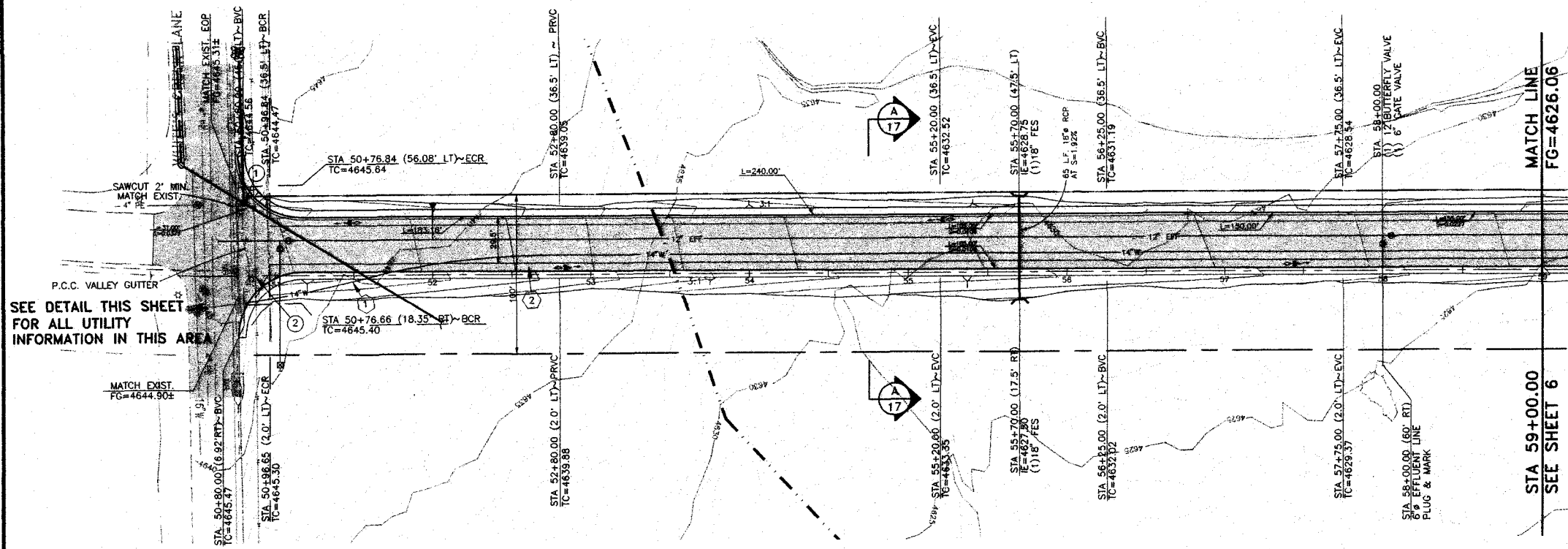
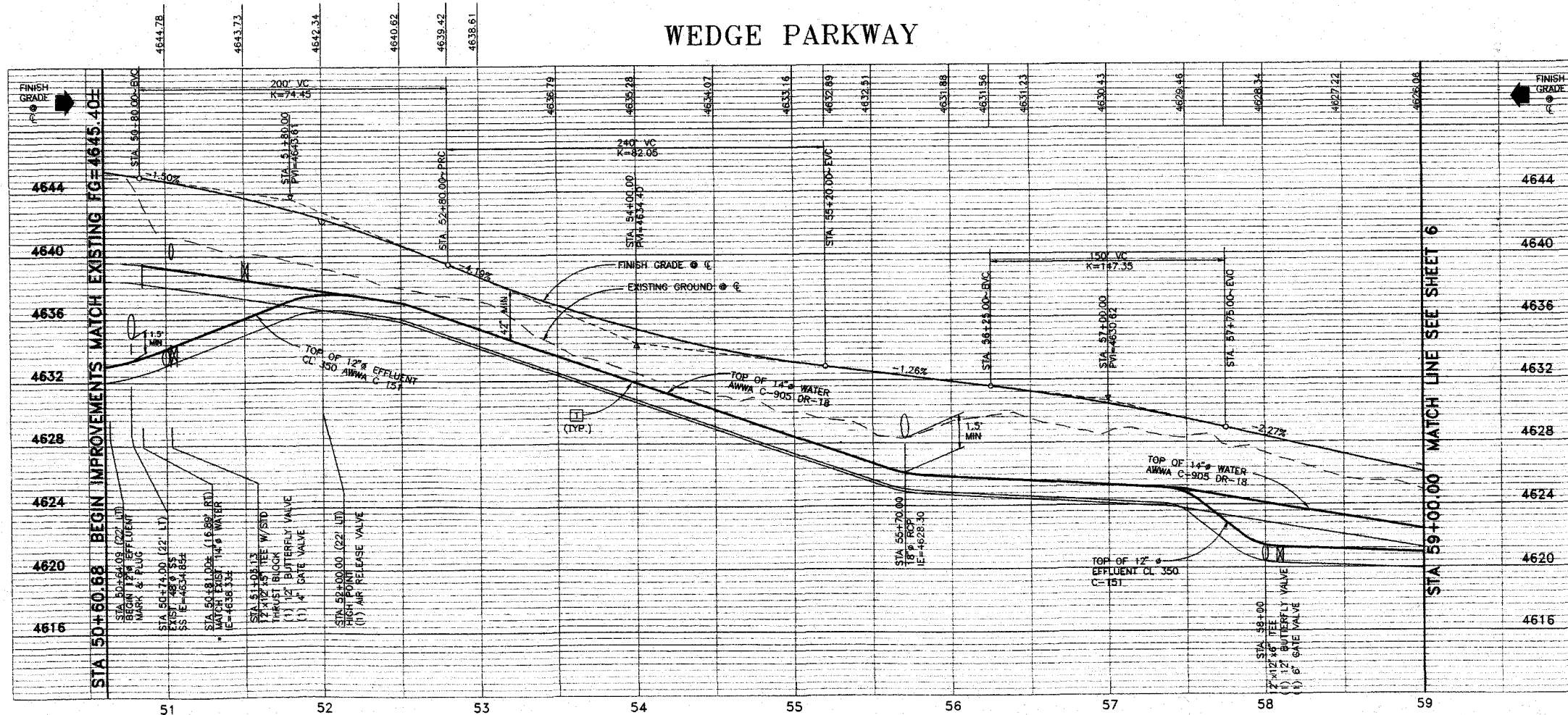
Figure
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APPENDIX 1

Wedge Parkway
Roadway Improvement Plans
(Selected Sheets)

VERTICAL: 1" = 4'

HORIZONTAL: 1" = 40'



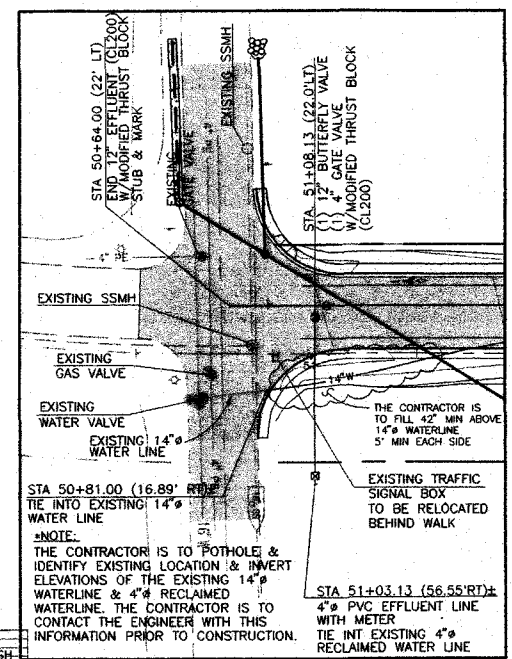
CURVE TABLE

NO.	DELTA	RADIUS	LENGTH	TANGENT
1	88°48'14"	40.00'	31.62'	39.17'
2	90°56'29"	40.00'	63.49'	63.49'

EFFLUENT & WATER CURVE TABLE

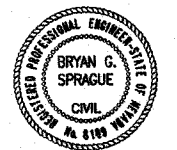
NO.	DELTA	RADIUS	LENGTH	TANGENT
1	07°51'57"	500.00'	68.64'	34.38'
2	14°36'52"	500.00'	127.53'	64.12'

CONSTRUCTION NOTE:
 (1) VERTICAL DEFLECTION OF EFFLUENT & WATER LINES SHALL NOT EXCEED 2" PER JOINT, UNLESS STATED OTHERWISE.



CAUTION - NOTICE TO CONTRACTOR

1. THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AND FEATURES AS SHOWN ON THESE PLANS IS BASED ON THE BEST INFORMATION AVAILABLE TO THE ENGINEER. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE.
2. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THESE LOCATIONS AND/OR ELEVATIONS AT THE PROPOSED POINTS OF CONNECTION AND IN AREAS OF POSSIBLE CONFLICT PRIOR TO BEGINNING CONSTRUCTION. SHOULD THE CONTRACTOR FIND ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, HE SHALL NOTIFY THE ENGINEER BEFORE PROCEEDING WITH CONSTRUCTION.
3. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REMOVE OR RELOCATE ALL EXISTING UTILITIES AND FEATURES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS. CONTRACTOR SHALL OBTAIN APPROVALS FROM THE GOVERNING AGENCIES, THE ENGINEER, AND THE UTILITY COMPANIES PRIOR TO SUCH REMOVAL AND/OR RELOCATION.



BENCH MARK:
 EXISTING BRASS CAP FOR SE CORNER
 OF SECTION 19, T.18N., R.19E., M.D.M.
 ELEVATION=4787.80

ARROWCREEK / WEDGE PARKWAYS EXTENSION PROJECT
 PLAN & PROFILE
 WEDGE PARKWAY
 WASHOE COUNTY
 NEVADA

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 1150 CORPORATE BLVD. RENO, NV 89502
 (702) 856-1150 FAX: (702) 856-1160

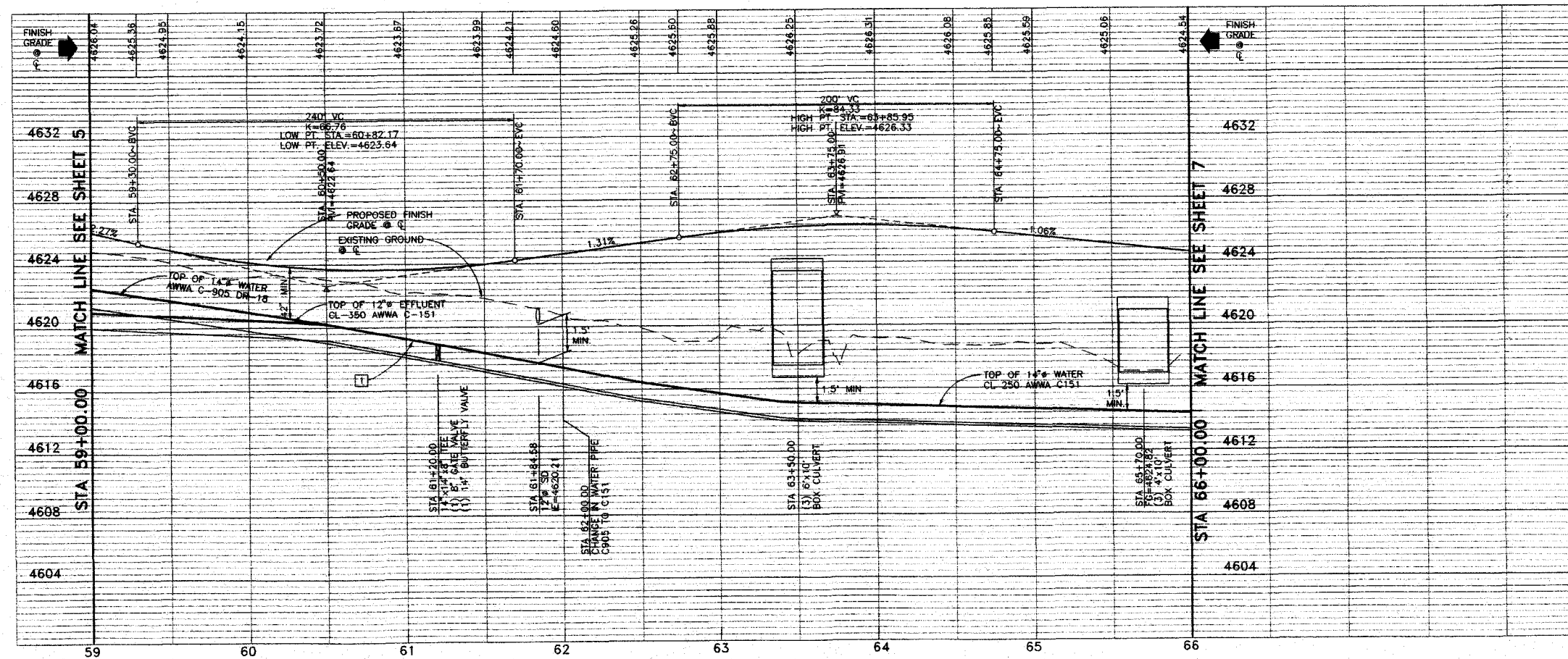
STATUS OF PLANS
 DATE: 11/21/97
 DATE: 12/12/97
 DATE: 2/25/98
 DATE: 4/1/98
 DATE: 4/1/98

PRELIMINARY
 INITIAL SUBMITTAL
 FINAL SUBMITTAL
 PLANS ARE PRELIMINARY AND SUBJECT TO CHANGE
 UNLESS STAMPED AND SIGNED APPROVED BY ALL
 APPROPRIATE GOVERNING AGENCIES

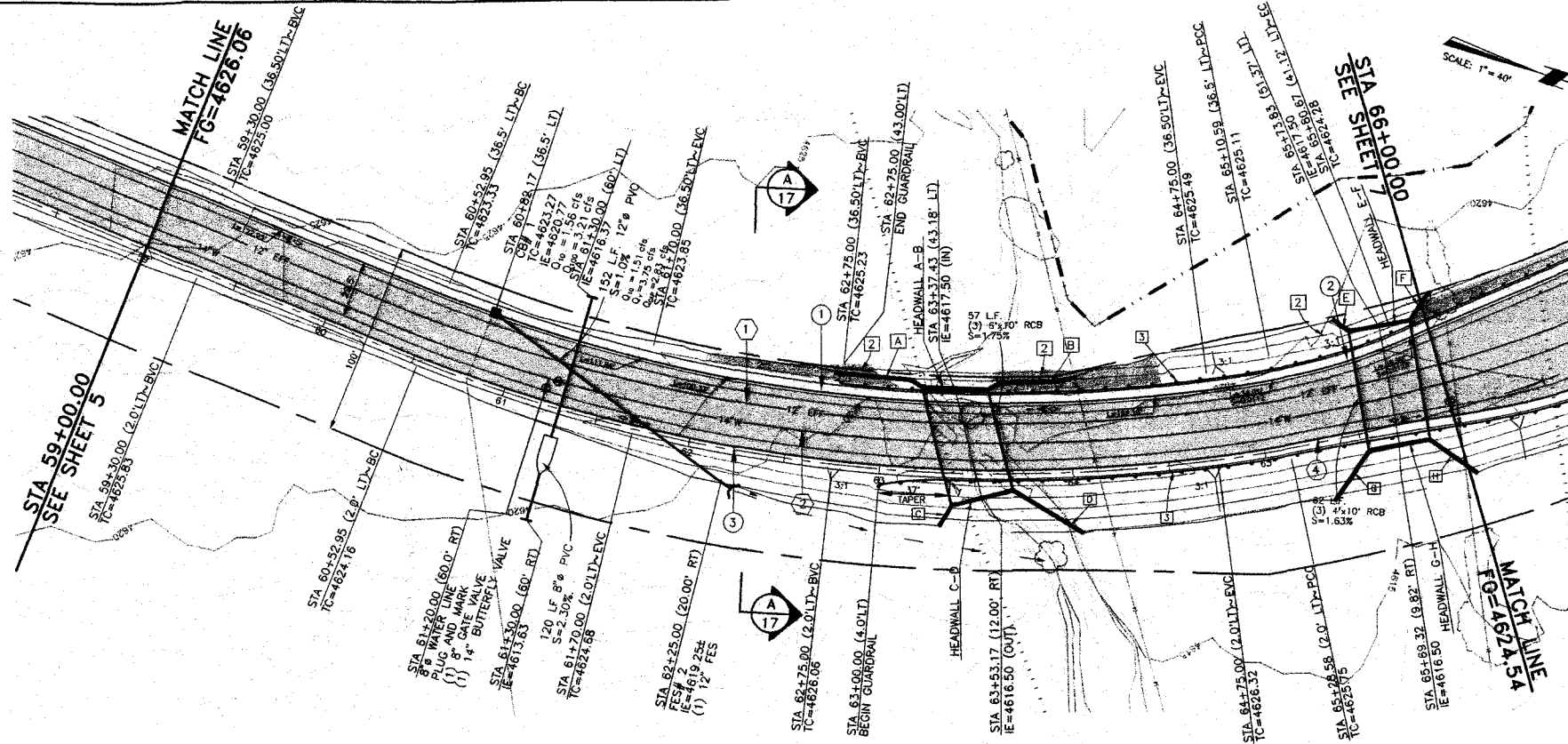
JOB NO. 88-003.27
 DESIGNED BY JAG
 PLOT DATE: 2/4/98

5
 22

VERTICAL: 1" = 4'



HORIZONTAL: 1" = 40'



NO.	DELTA	RADIUS	LENGTH	TANGENT
1	31°58'36"	783.50'	437.27'	224.49'
2	12°48'13"	300.00'	67.04'	33.68'
3	33°14'01"	818.00'	474.47'	244.12'
4	02°55'27"	1500.00'	76.55'	38.28'

NO.	DELTA	RADIUS	LENGTH	TANGENT
1	50°39'01"	840.00'	742.57'	397.52'
2	50°39'01"	850.00'	751.41'	402.25'

- CONSTRUCTION NOTES:**
- VERTICAL DEFLECTION OF EFFLUENT & WATER LINES SHALL NOT EXCEED 2" PER JOINT, UNLESS STATED OTHERWISE.
 - 2:1 SLOPES SHALL RECEIVE 6"-12" RIPRAP.
 - GUARD RAIL SHALL CONFORM TO R65-67 OF NDOT STANDARD DETAILS FOR ROAD & BRIDGE CONSTRUCTION, JULY 1995 EDITION. THE FACE OF RAIL SHALL BE LOCATED AT THE BACK OF WALK. CONSTRUCT A 2' SHOULDER AT THE BACK OF WALK AS SHOWN ON PLANS.

NO.	TW @ HIGH END	BW @ HIGH END	TW @ LOW END	BW @ LOW END	SKREW
A	4626.30	4617.60	4623.90	4621.10	15'
B	4626.50	4617.40	4623.90	4621.60	15'
C	4623.30	4616.50	4619.70	4618.80	0'
D	4626.20	4616.50	4618.50	4617.00	0'
E	4623.30	4617.50	4620.00	4619.80	0'
F	4624.30	4617.50	4619.30	4619.10	0'
G	4624.90	4616.50	4617.70	4617.20	0'
H	4624.60	4616.50	4617.40	4617.00	0'

CAUTION - NOTICE TO CONTRACTOR

- THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AND FEATURES AS SHOWN ON THESE PLANS IS BASED ON THE BEST INFORMATION AVAILABLE TO THE ENGINEER. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE.
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THESE LOCATIONS AND/OR ELEVATIONS AT THE PROPOSED POINTS OF CONNECTION AND IN AREAS OF POSSIBLE CONFLICT PRIOR TO BEGINNING CONSTRUCTION. SHOULD THE CONTRACTOR FIND ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, HE SHALL NOTIFY THE ENGINEER BEFORE PROCEEDING WITH CONSTRUCTION.
- IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REMOVE OR RELOCATE ALL EXISTING UTILITIES AND FEATURES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS. CONTRACTOR SHALL OBTAIN APPROVALS FROM THE GOVERNING AGENCIES, THE ENGINEER, AND THE UTILITY COMPANIES PRIOR TO SUCH REMOVAL AND/OR RELOCATION.



ARROWCREEK/WEDGE PARKWAYS EXTENSION
PLAN & PROFILE
 WEDGE PARKWAY
 WASHOE COUNTY, NEVADA

JOB NO. 88-003.27
 DESIGNED BY JAG
 PLOT DATE 2/24/98
 SHEET 8 OF 20

FILE NO. XY\PROJECTS\88003.27B\PP.DWG
 BENCH MARK:
 EXISTING BRASS CAP FOR SE CORNER
 OF SECTION 19, T.18N., R.19E., M.D.M.
 ELEVATION=4787.80

STATUS OF PLANS
 PRELIMINARY
 INITIAL SUBMITTAL
 FINAL SUBMITTAL
 DATE: 11/21/97
 DATE: 12/12/97
 DATE: 2/25/98
 PLANS ARE PRELIMINARY AND SUBJECT TO CHANGE UNTIL STAMPED AND SIGNED APPROVED BY ALL APPROPRIATE GOVERNING AGENCIES.

APPENDIX 2

Excerpts from Preliminary
Whites Creek Basin
Management Study

PRELIMINARY WHITES CREEK BASIN MANAGEMENT STUDY

(FINAL REPORT)

Prepared For:

WASHOE
COUNTY



DEPARTMENT
OF
PUBLIC WORKS

By
Flume
CBA

CELLA BARR
ASSOCIATES

777 Campus Commons Road, Suite 200
Sacramento, California 95825

August 17, 1994

CBA File No. 530013-01

Updated meteorological analyses are currently being performed as a part of the Washoe County Flood Control Master Plan. Upon completion of the updated meteorological analyses and their acceptance by Washoe County, it may be advantageous to revisit the adopted 5100 cfs value to determine if a revision is warranted.

B. Distribution of the 100-Year Discharge for Whites Creek Downstream of Shadowridge Park - Whites Creek at Shadowridge Park represents the location where flows are initially distributed across the lower Whites Creek watershed area under investigation. Flow is distributed into one or more of essentially four (4) channels that traverse the lower Whites Creek watershed, ultimately delivering proportionate runoff to the Steamboat Creek area east of U.S. 395. The flow distribution in the Shadowridge Park vicinity is impacted by the following:

1. The magnitude of the discharge collected at said location.
2. The extent to which existing vegetation within the channel becomes denuded by flood flows.
3. The existence of debris flow during a characteristic flood event.
4. The topographic definition of flow paths that exists immediately downstream prior to and during a given flood event.

During a 100-year flood event, it is CBA's opinion that, under existing conditions, it is not possible to accurately predict the distribution of the total discharge that will be allocated to each of the channels forming downstream of the Shadowridge Park area. Perhaps the most significant variable that limits the predictability of the distribution is the potential occurrence of debris flow within Whites Creek. Evidence of prior debris flows is readily identifiable in the field and is characterized by numerous residual large boulders that have been transported from the defined channel upstream of Shadowridge Park to various locations along channels and other areas downstream within the lower Whites Creek watershed. The occurrence of a debris flow will result in a slug of concentrated boulders, sediment and vegetation moving down the defined channel to be distributed at varying locations downstream of the defined channel as flow depth and velocities are diminished through expansion of the flow width.

The potential for debris flow can significantly impact the initial flow distribution originating at Shadowridge Park by effectively diverting flows in a random manner from one downstream channel to another and blocking some of the available flow areas during a given flooding event. For this reason, it is most appropriate to examine the flow distribution in terms of preferential values of proportional discharges to be applied to each downstream channel, from a future planning perspective for new development and infrastructure improvements. The flow distribution presented in the Whites Creek Detention Feasibility Study for NDOT would appear to be reasonable in this regard, as proportional discharges

are somewhat equitably allocated to each of the four (4) downstream flow paths and as these distributions have been applied to the design of downstream drainage structures at I-580.

The distribution recommended for adoption by CBA for each of the four primary channels is represented below:

Channel	Allocated Discharge
#1	700 cfs
#2	1950 cfs
#3	1100 cfs
#4	1350 cfs
Total	5100 cfs

These values may be applied to each channel as a future design capacity goal, but are not representative of actual existing conditions due to the dynamic unpredictability of the flow distribution and potential for debris flow. For floodplain management purposes, a probabilistic approach must also be applied to facilitate the selection of a 100-year discharge rate that may enter each of the four (4) channels downstream of Shadowridge Park under existing conditions.

Based on an assessment of probability, CBA has concluded that a flow of approximately 3000 cfs has a one percent (1%) chance of being delivered to any of the four (4) available flow paths in any given year (i.e., a 100-year event). This conclusion was derived as follows:

- 5100 cfs has a 1 in 100 chance of occurring at Shadowridge Park (100-year event).
- Conservatively, there is a 1 in 4 chance of the entire flow at Shadowridge Park being delivered to any of the four (4) downstream flow paths.
- 3000 cfs has a 1 in 25 chance of occurring at Shadowridge Park (25-year event).
- The product of the probabilities of the 1 in 4 chance (flow paths) and the 1 in 25 chance (25-year discharge at Shadowridge Park) is a 1 in 100 chance for 3000 cfs to be delivered to any of the four (4) flow paths, or a 100-year event.

CBA derived the 3000 cfs value for the 25-year discharge at Shadowridge Park by applying 25-year precipitation values represented on available NOAA atlases

to the HEC-1 model presented in the Whites Creek Detention Feasibility Study for NDOT. Since the standard for floodplain management in Washoe County and per FEMA is the 100-year event, floodplain conditions along each of the four (4) flow paths downstream of Shadowridge Park need to be established under the assumption that 3000 cfs is initially delivered to them. Until such time as structural measures are implemented that will serve to establish the flow distribution desired for 5100 cfs at Shadowridge Park, a flow of 3000 cfs being delivered to each flow path must be considered in the design of development projects within the lower Whites Creek watershed.

C. Existing Problem Areas - As a part of the field investigations performed by CBA staff and the review of available information, several problem areas or potential problem areas were identified within the lower Whites Creek watershed in terms of flooding potential associated with development projects and existing infrastructure improvements. The following listing represents a preliminary identification of potential problem locations that may merit further investigation as a part of future studies. It must be noted that CBA's conclusions are not substantiated by detailed calculations, but have been based upon engineering judgement; hence, the following listing may not be complete and/or some of the listed locations may be determined to not have problems from a flood hazard or capacity perspective upon closer, more detailed examination.

1. **Existing Culverts Along U.S. 395** - All of the existing drainage structures that drain Whites Creek flows are substantially inadequate to convey distributed discharges underneath the roadway during a 100-year flood event. The existing highway will cause upstream ponding of stormwater runoff and, when ponded flood waters reach sufficient levels, sheet flooding across the highway will occur.
2. **Old Virginia Street Culverts** - Inadequate drainage structures exist across Old Virginia Street, and similar conditions will prevail as described for U.S. 395.
3. **Zolezzi Lane Drainage Structures** - The drainage structure crossing of Zolezzi Lane that serves Channel #1 is of substantially insufficient capacity to pass the proportioned 100-year discharge. The existing roadway will divert some of the flow east along the south side of Zolezzi Lane and some of the flow will spill northerly across the roadway. At the intersection of Zolezzi Lane and U.S. 395, there is virtually no provision for accommodating runoff originating from Channel #2 (with some spillover flow from Channel #3), and flooding of this intersection will occur during a 100-year event.
4. **Existing Residential Structures Immediately Downstream of the Defined Channel at Shadowridge Park** - Several existing residential structures at this location are subject to a high flood and debris flow hazard during a 100-year flood event.

5. **Whites Creek Estates** - Some of the existing residential structures adjacent to Channel #1 have a potential for flooding during a 100-year event as induced by spillover from the channel at subdivision street crossings or by limitations in channel capacity.
6. **Lancers Estate** - Some of the residential lots backing up adjacent to the south of Channel #4 have a potential for flooding during a 100-year event.
7. **Existing Residential Structures South of Whites Creek Lane, West of the Proposed Pine Tree Ranch Subdivision** - Several of these structures have a potential for flooding from Channels #2 and #3 during a 100-year flooding event.
8. **Wedge Parkway** - Wedge Parkway is elevated from one to several feet above existing grade and crosses the lower Whites Creek watershed somewhat transversely to the direction of drainage flow. The newly constructed segment of Wedge Parkway between the Mt. Rose Highway and Whites Creek Lane will have a tendency to impound runoff in excess of the proportioned discharge of 1350 cfs for Channel #4 on the upstream side of the roadway and divert flow northeasterly along the west side of the roadway toward Whites Creek Lane. The existing drainage structure under construction across Channel #4 appears to have adequate capacity for the proportioned discharge for this flow path, provided the flow is delivered to the drainage structure itself. Currently, it is proposed that the proportioned flow within Channel #4 be channelized and delivered to the drainage structure as a part of the future development of Sterling Ranch.

It should be reiterated that the above observations and conclusions of system capacity problems are based upon preliminary investigations, only, and will require further substantiation as additional more detailed studies are performed.

III. QUALITATIVE EVALUATIONS OF FLOODING CONDITIONS

To date, floodplain administration within the lower Whites Creek watershed has been based primarily upon floodplain information presented on the FEMA Flood Insurance Rate Maps for Washoe County, Panel Numbers 1501 (Effective date: August 1, 1984) and 1463 (Effective date: April 16, 1990). The floodprone areas depicted for the lower Whites Creek watershed are represented as "Zone A" which indicates that they were originally studied using approximate methods only. Based upon CBA's experience as a Flood Insurance Study Contractor with FEMA, the degree of detail that would have been inherent to these approximate Zone A designations was undoubtedly minimal and, per FEMA guidelines, would have been limited to a cursory review of USGS quad sheets, aerial photographs, and primary low flow paths. It is CBA's professional opinion that the extent of the floodplains represented on these FEMA Flood Insurance Rate Maps for the lower Whites Creek watershed is significantly understated.

In order to accurately delineate the extent and characteristics of flood hazard areas within the lower Whites Creek watershed, a detailed hydrologic and hydraulic analysis will be needed, which is outside the scope of the current study. Such an analysis will need to include the following:

1. Refinement of the total 100-year discharge value of 5100 cfs for Whites Creek at Shadowridge Park, if appropriate.
2. Acquisition of current topographic mapping of the lower Whites Creek watershed with a minimum contour interval of two feet (2').
3. Hydraulic evaluations of flow characteristics across the lower Whites Creek watershed utilizing a combination of HEC-2 evaluations, normal depth calculations, weir flow calculations and culvert capacity calculations.

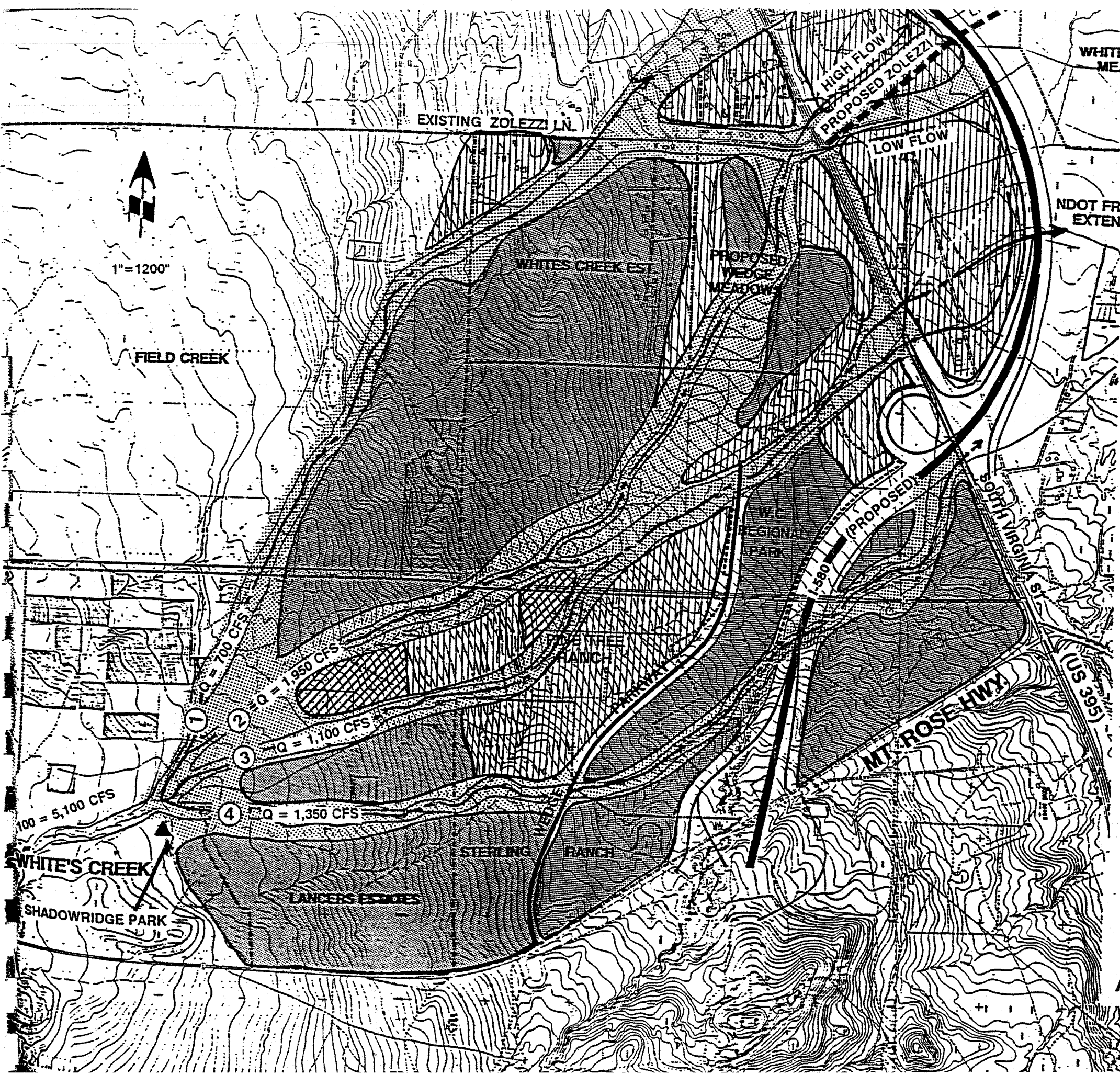
The detailed floodplain analysis should be performed at the earliest possible date in order to supplement the information contained in the current study; to more accurately define floodplain limits and characteristics; and to provide better information to be utilized in the design of new development and infrastructure projects. The analysis should consider both of the following assumptions pertinent to the flow distribution originating at Shadowridge Park:

- The existing conditions which create a potential for the total discharge of 3000 cfs (or a revised number, if applicable) being delivered to any of the four (4) downstream channels (see Section II.B.).
- Future conditions that would prevail if the flow distribution becomes fixed at Shadowridge Park through the implementation of structural measures or if the overall flow in Whites Creek is attenuated through implementation of other upstream structural measures.

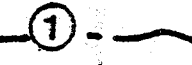





As a part of this study, CBA performed a very preliminary analysis to estimate the extent and magnitude of flooding that currently has a potential of occurring within the lower Whites Creek watershed during a 100-year storm event. This analysis utilized USGS quad sheets, current aerial photographs, field investigations, the 1966 topographic mapping acquired from NDOT and rough normal-depth calculations performed across hypothetical flat cross sections of varying widths and slopes. Based on evaluations of the above, it is CBA's opinion that, under existing conditions, much of the lower Whites Creek watershed would be subject to "shallow sheet flooding" during a 100-year event. Approximate flood zones and average 100-year flooding depths have been delineated and are represented on Exhibit D. The flood zone designations that have been utilized in the approximate floodprone area mapping represented on Exhibit D are:

- Minimal Flooding Potential, Average Depth Less Than 0.5 feet
- Sheet flow, Average Depth = 0.5 feet
- Sheet flow, Average Depth = 1 foot
- Sheet flow, Average Depth Greater Than 1 foot

The approximate floodprone areas have attempted to account for the impacts of the construction of Wedge Parkway and I-580. In determining the shallow flooding zones, CBA assumed that a discharge of 3000 cfs may be directed to any of the four (4) primary channels originating downstream of Shadowridge Park. At such time as structural measures are implemented to attenuate the total flow or define the flow distribution for the downstream flow paths originating near Shadowridge Park, the extent and severity of flooding for the downstream areas within the lower watershed will be appreciably reduced.



LEGEND

-  DRAINAGE CORRIDOR/
CORRIDOR NUMBER
 -  700 CFS CORRIDOR DISCHARGE VALUE
 -  > 1 FOOT
 -  1 FOOT
 -  0.5 FEET
 -  MINIMAL (LESS THAN 0.5 FEET)
- AVERAGE DEPTHS OF SHALLOW FLOODING ***

NOTE: FOR FINISHED FLOOR ELEVATION REQUIREMENTS FOR STRUCTURES IN EACH FLOOD ZONE, SEE SECTION VII.3. OF TEXT.

*100-YEAR, EXISTING CONDITIONS, ASSUMING TOTAL DISCHARGE OF 3,000 CFS ORIGINATING ALONG EACH DRAINAGE CORRIDOR DOWNSTREAM OF SHADOWRIDGE PARK (SEE SECTION II.B. OF TEXT)

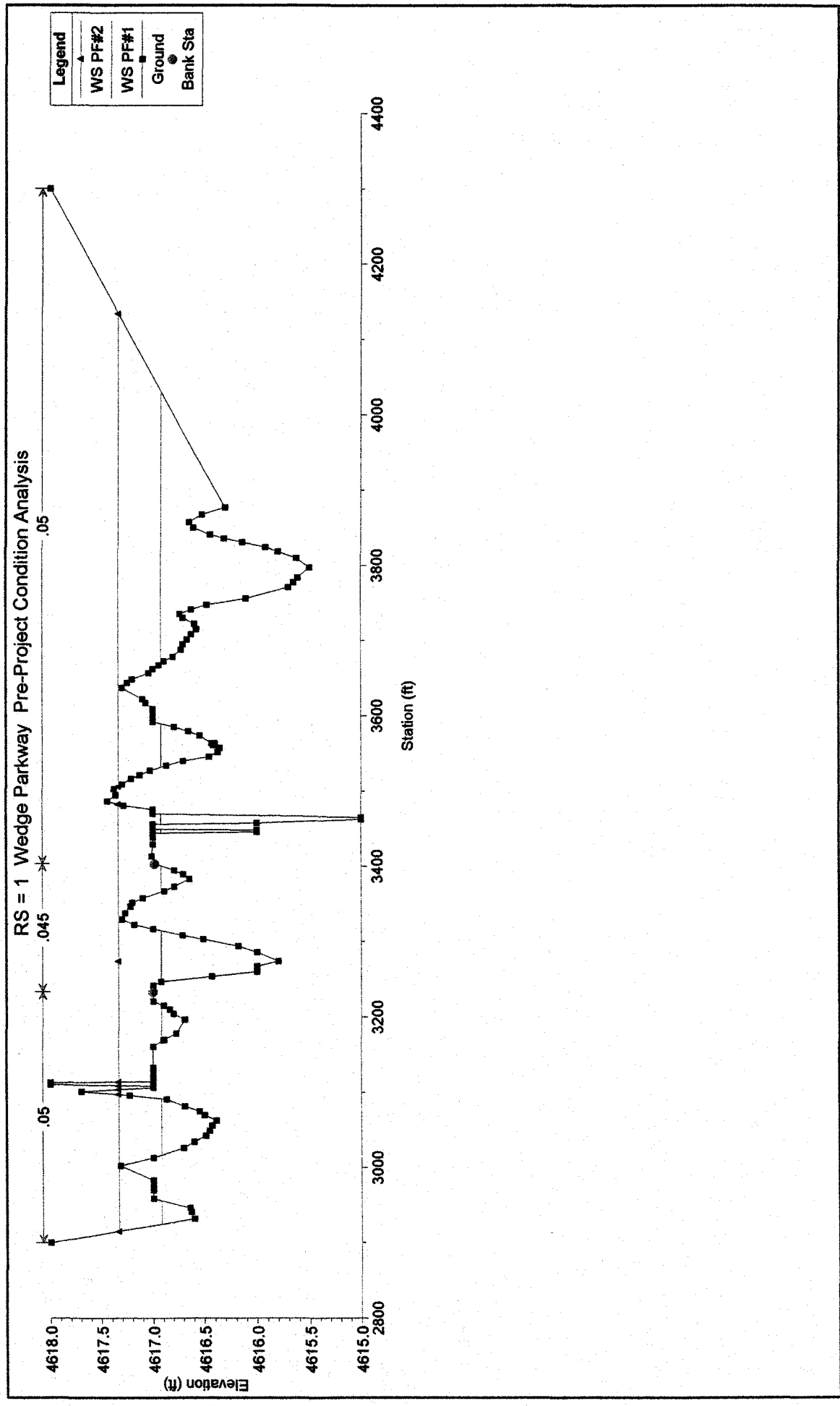
**WHITES CREEK BASIN MANAGEMENT
EXHIBIT D
MAP SHOWING PROPOSED
DRAINAGE CORRIDORS AND
APPROXIMATE FLOOD HAZARD INFORMATION**

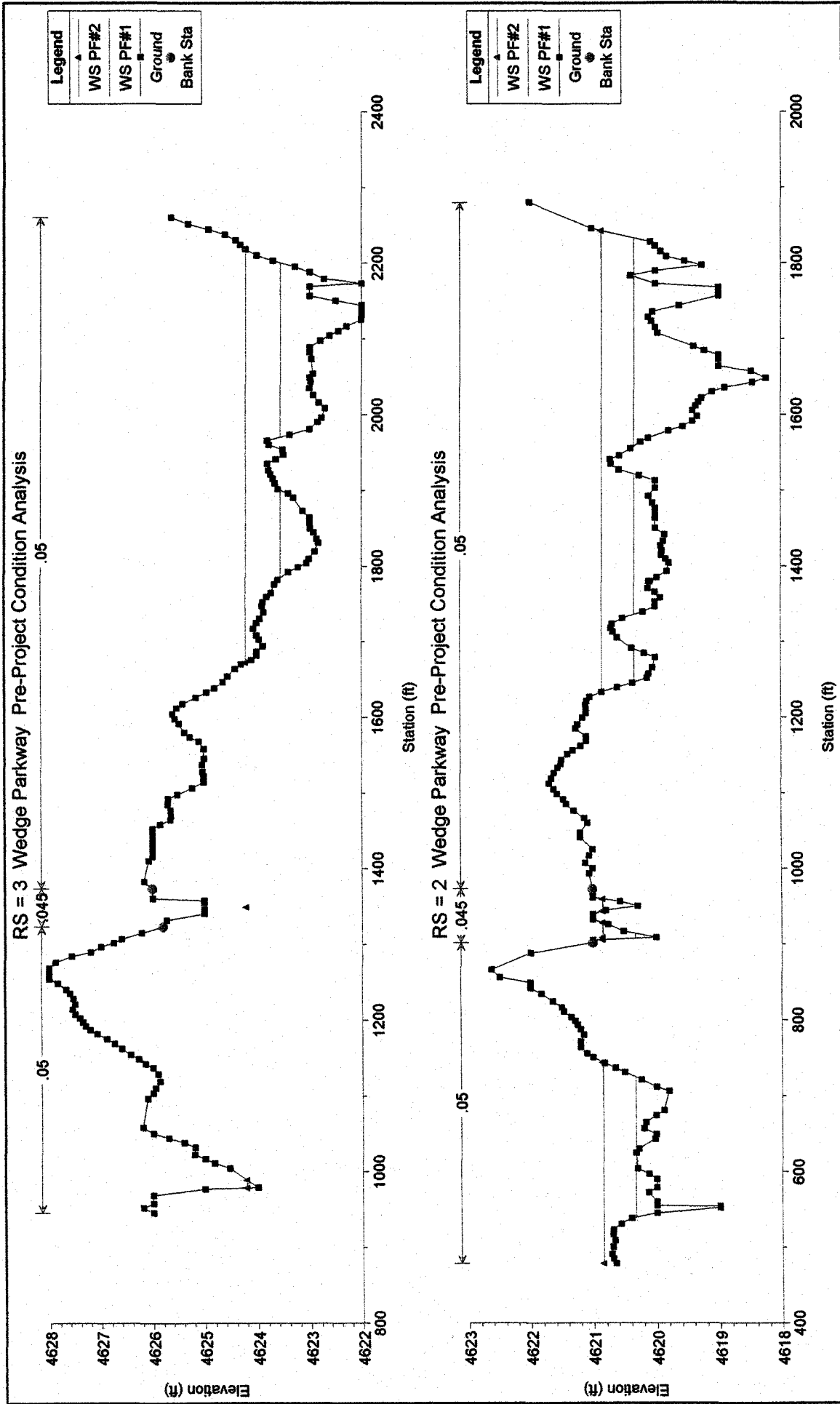
APPENDIX 3

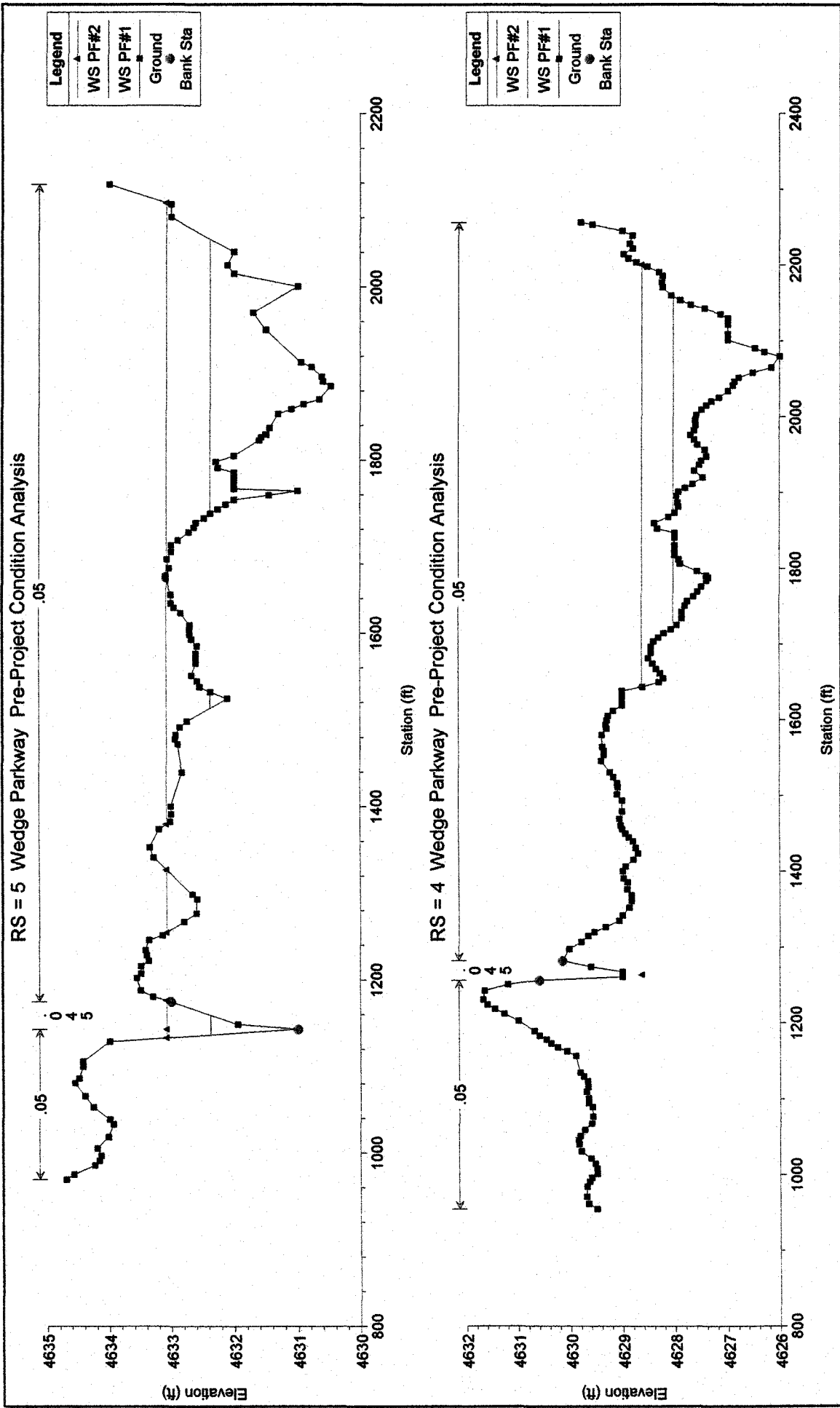
Whites Creek Branch 3
Hydraulic Analyses -
Pre-Project Condition

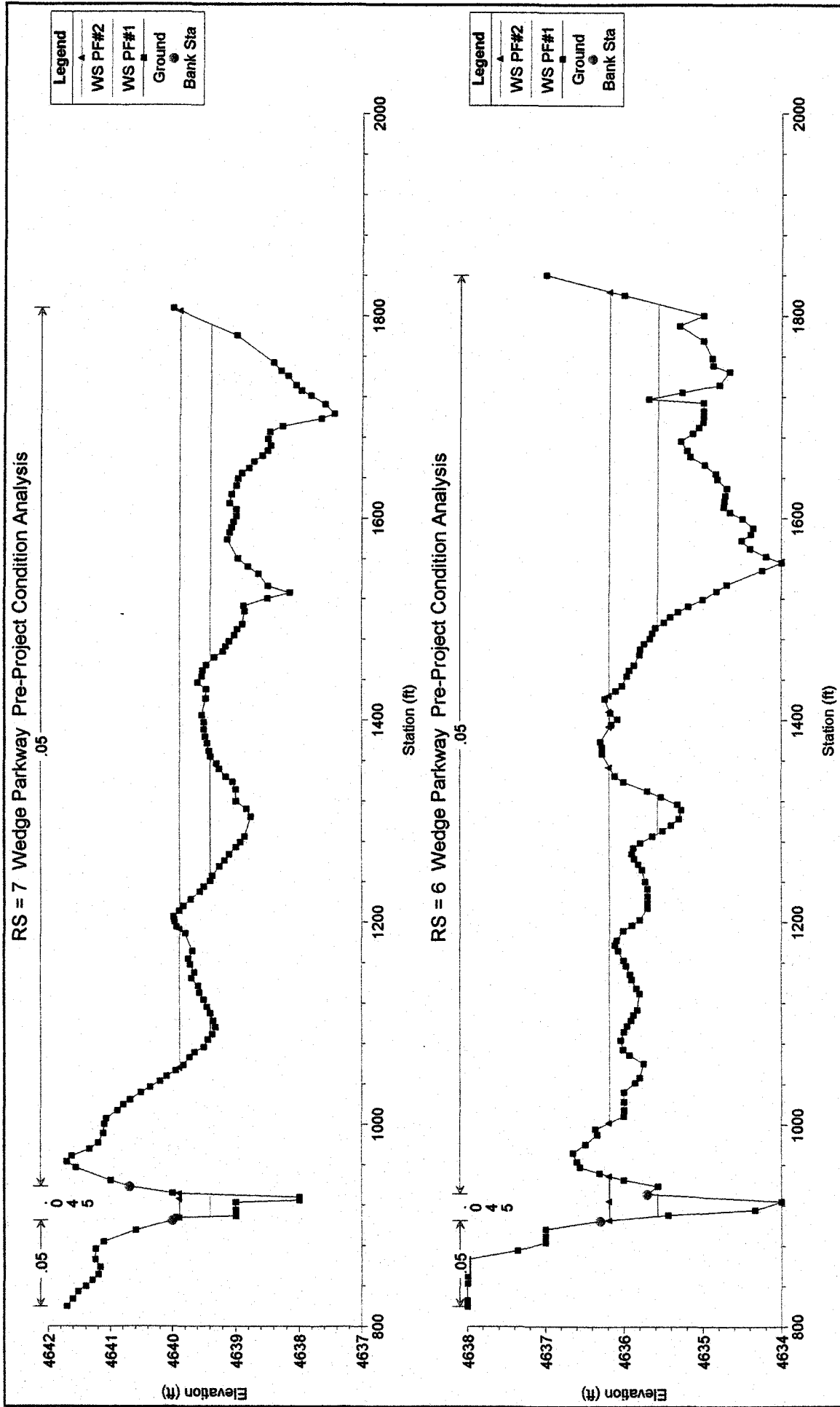
HEC-RAS Plan: Imported Pla River: 1 Reach: 1

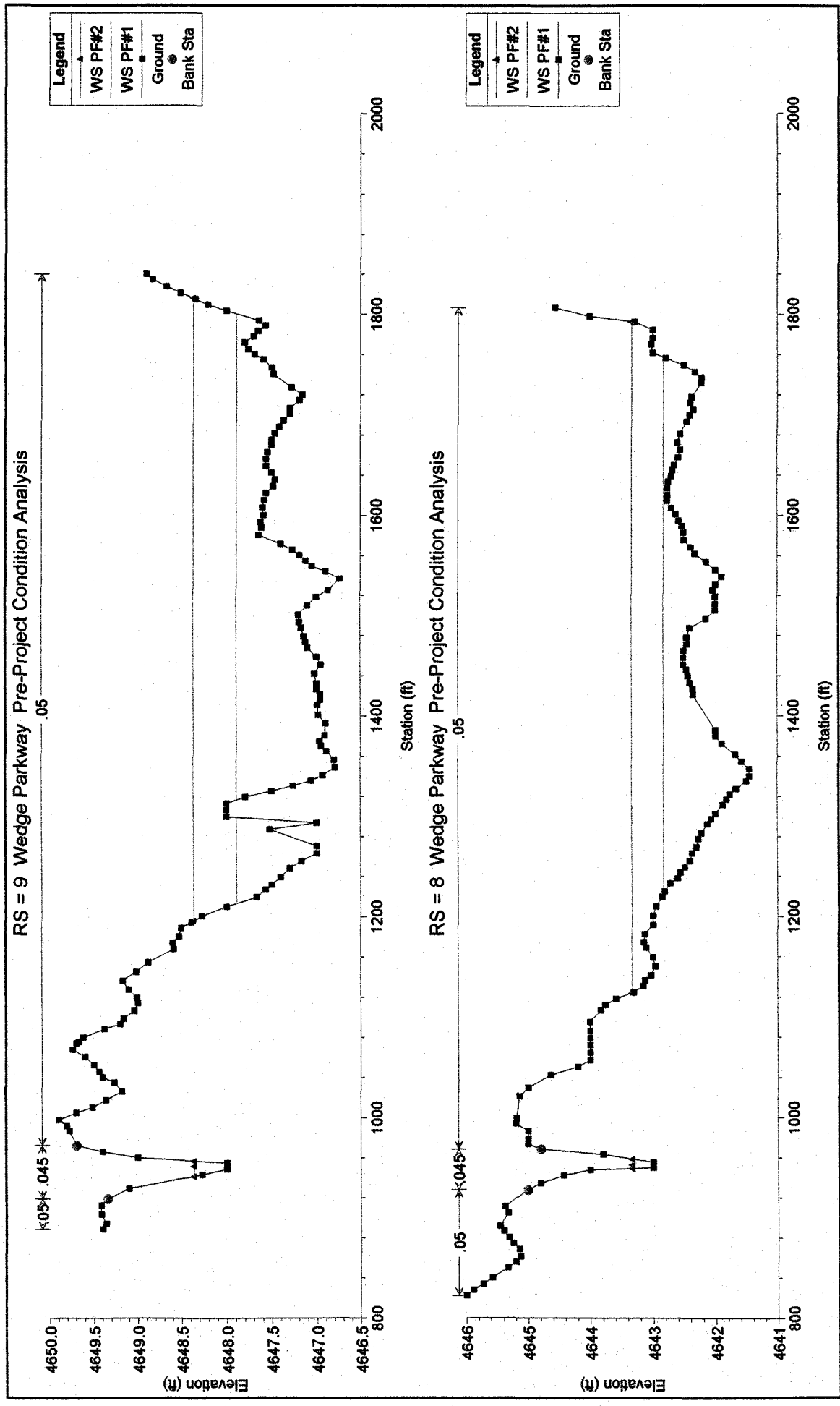
Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Ch
1	1	1100.00	4615.80	4616.92	4616.90	4617.12	0.036052	3.94	307.88	691.71	0.98
1	1	3000.00	4615.80	4617.33	4617.31	4617.61	0.036052	4.62	720.32	1183.49	1.02
1	2	1100.00	4620.00	4620.33	4620.23	4620.49	0.020177	1.26	352.67	693.68	0.59
1	2	3000.00	4620.00	4620.84	4620.69	4621.09	0.020909	2.28	763.98	913.59	0.70
1	3	1100.00	4625.00	4623.55	4623.55	4623.90	0.040850		232.29	354.79	0.00
1	3	3000.00	4625.00	4624.20	4624.20	4624.69	0.036704		535.12	555.23	0.00
1	4	1100.00	4629.00	4628.02	4628.02	4628.34	0.039074		243.28	411.42	0.00
1	4	3000.00	4629.00	4628.62	4628.62	4629.11	0.037697		534.57	557.19	0.00
1	5	1100.00	4631.00	4632.37	4632.19	4632.60	0.020902	2.79	287.32	357.99	0.73
1	5	3000.00	4631.00	4633.08	4632.98	4633.39	0.021797	4.12	668.82	825.78	0.82
1	6	1100.00	4634.00	4635.57	4635.57	4635.89	0.034976	6.00	246.55	373.97	1.07
1	6	3000.00	4634.00	4636.18	4636.18	4636.58	0.030559	6.99	601.96	810.03	1.06
1	7	1100.00	4638.00	4639.40	4639.32	4639.62	0.028413	3.91	292.71	498.43	0.88
1	7	3000.00	4638.00	4639.89	4639.86	4640.26	0.031557	5.83	614.67	752.99	1.01
1	8	1100.00	4643.00	4642.83	4642.81	4643.05	0.038021		287.21	534.50	0.00
1	8	3000.00	4643.00	4643.33	4643.28	4643.72	0.033654	2.45	596.74	678.33	0.85
1	9	1100.00	4648.00	4647.88	4647.75	4648.04	0.022024		346.92	570.02	0.00
1	9	3000.00	4648.00	4648.36	4648.23	4648.71	0.024663	2.10	636.61	635.25	0.73











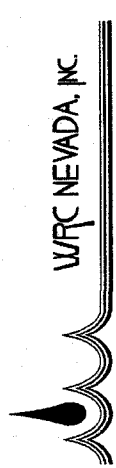
APPENDIX 4

Whites Creek Branch 3
Hydraulic Analyses -
Post-Project Condition

HEC-RAS Plan: Imported Pla River: 1 Reach: 1

Reach	River Sta	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit.W.S. (ft)	E.G. Elev (ft)	Vel Chnl (ft/s)	Vel Total (ft/s)	Vel Right (ft/s)	Vel Left (acre-ft)	Flow Area (sq ft)	Top Width (ft)	Froude # Ch
1	1	1100.00	4615.80	4616.90	4616.90	4617.13	3.43	3.73	4.04		295.19	676.26	0.86
1	1	2700.00	4615.80	4617.27	4617.27	4617.55	3.99	4.17	4.51		647.48	1137.81	0.90
1	1.2	1100.00	4617.55	4618.69	4618.65	4618.88	3.14	3.40	3.69	0.06	323.64	711.28	0.78
1	1.2	2700.00	4617.55	4619.08	4619.01	4619.31	3.61	3.78	4.06	0.22	715.12	1181.73	0.80
1	1.5	Multi Open											
1	2	1100.00	4620.00	4620.23	4620.23	4620.47	1.17	3.84	4.07	0.18	286.23	630.69	0.61
1	2	2700.00	4620.00	4622.30	4620.62	4622.32	0.96	1.06	1.09	1.42	2552.04	1375.41	0.13
1	3	1100.00	4625.00	4623.56	4623.56	4623.90	*	4.68	4.68	0.26	234.89	356.18	0.00
1	3	2700.00	4625.00	4624.12	4624.12	4624.59	*	5.49	5.50	2.97	491.58	545.66	0.00
1	4	1100.00	4629.00	4628.03	4628.03	4628.34	*	4.50	4.50	0.26	244.68	411.93	0.00
1	4	3000.00	4629.00	4628.62	4628.62	4629.11	*	5.60	5.60	2.97	535.66	557.26	0.00
1	5	1100.00	4631.00	4632.19	4632.19	4632.56	2.98	4.84	4.91	0.27	227.05	315.15	0.82
1	5	3000.00	4631.00	4632.98	4632.98	4633.38	3.65	5.09	5.16	2.99	589.52	703.43	0.77
1	6	1100.00	4634.00	4635.56	4635.56	4635.88	5.50	4.51	4.42	0.27	243.82	372.69	0.99
1	6	3000.00	4634.00	4636.18	4636.18	4636.57	6.23	4.95	4.87	3.00	606.31	813.20	0.94
1	7	1100.00	4638.00	4639.32	4639.32	4639.61	3.53	4.26	4.29	0.27	258.20	458.07	0.85
1	7	3000.00	4638.00	4639.85	4639.85	4640.26	5.33	5.14	5.13	3.00	583.95	745.03	0.94
1	8	1100.00	4643.00	4642.79	4642.79	4643.05	*	4.13	4.13	0.27	266.45	529.27	0.00
1	8	3000.00	4643.00	4643.29	4643.29	4643.72	2.16	5.27	5.28	3.00	568.96	676.23	0.79
1	9	1100.00	4648.00	4647.81	4647.75	4648.01	*	3.63	3.63	0.27	303.22	562.98	0.00
1	9	3000.00	4648.00	4648.29	4648.25	4648.69	1.93	5.06	5.08	3.00	592.52	627.38	0.74

* Due to one dimensional limitation of the model and very shallow flow depths, the primary channel does not contain flow in some sections. The model distributes the majority of the flow into the right overbank. Because of the very small primary channel capacity, this is not significant to the results.



HECRAS Plan: Imported Pla River: 1 Reacht: 1

Reacht	River Sta	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frcdn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
1	1	4617.13	4616.90	0.23			76.58	167.90	855.52	676.26
1	1	4617.55	4617.27	0.28			404.06	388.01	1907.93	1137.81
1	1.2	4618.88	4618.69	0.19	1.75	0.00	86.27	166.60	847.13	711.28
1	1.2	4619.31	4619.08	0.23	1.75	0.01	430.02	386.46	1883.51	1181.73
1	1.5	Mult Open								
1	2	4620.47	4620.23	0.24			85.00	0.59	1014.41	630.69
1	2	4622.32	4622.30	0.02			645.84	107.64	1946.53	1375.41
1	3	4623.90	4623.56	0.34	3.18	0.03		*	1100.00	356.18
1	3	4624.59	4624.12	0.47	0.18	0.14	0.30	*	2699.70	545.66
1	4	4628.34	4628.03	0.31	2.81	0.00		*	1100.00	411.93
1	4	4629.11	4628.62	0.49	2.71	0.01		*	3000.00	557.26
1	5	4632.56	4632.19	0.37	3.86	0.02	11.34	14.30	1074.36	315.15
1	5	4633.38	4632.98	0.41	3.46	0.01	37.49	79.38	2883.13	703.43
1	6	4635.88	4635.56	0.32	3.31	0.00		111.61	988.39	372.69
1	6	4636.57	4636.18	0.39	2.57	0.00		217.97	2782.03	813.20
1	7	4639.61	4639.32	0.28	3.34	0.00		41.53	1058.47	458.07
1	7	4640.26	4639.85	0.41	3.05	0.01		125.72	2874.28	745.03
1	8	4643.05	4642.79	0.26	3.15	0.00		*	1100.00	529.27
1	8	4643.72	4643.29	0.43	3.10	0.01		4.39	2995.61	676.23
1	9	4648.01	4647.81	0.20	4.95	0.01		*	1100.00	562.98
1	9	4648.69	4648.29	0.40	4.97	0.00		5.58	2994.42	627.38

* Due to one dimensional limitation of the model and very shallow flow depths, the primary channel does not contain flow in some sections. The model distributes the majority of the flow into the right overbank. Because of the very small primary channel capacity, this is not significant to the results.

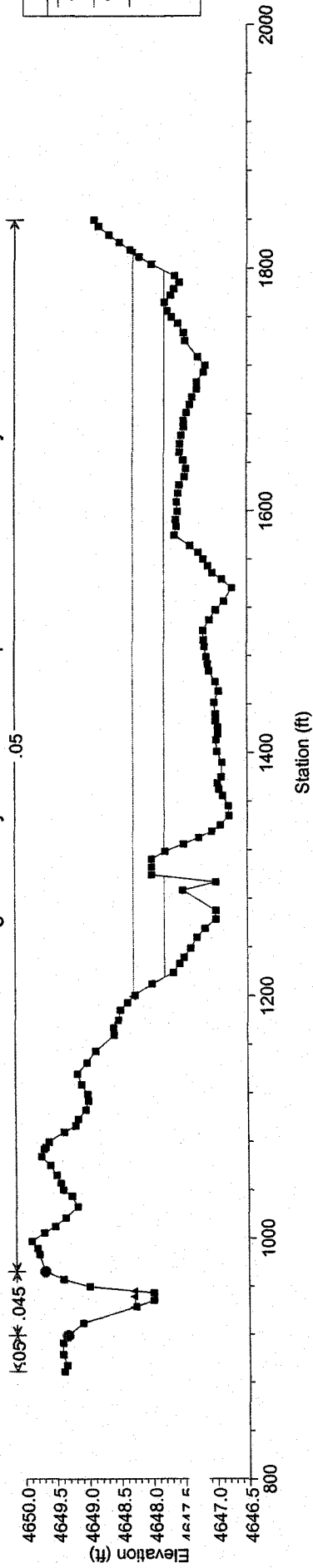
HEC-RAS Plan: Imported Pla River: 1 Reach: 1

Reach	River Sta	E.G. US. (ft)	W.S. US. (ft)	E.G. IC (ft)	E.G. OC (ft)	Min Top Rd (ft)	Culv Q (cfs)	Q Weir (cfs)	Delta WS (ft)	Culv Vel In (ft/s)	Culv Vel Out (ft/s)
1	1.5 Culv Grp #1	4621.19	4620.86	4619.94	4619.93	4621.16	450.51		1.80	7.68	4.69
1	1.5 Culv Grp #2	4619.98	4619.83	4619.89	4619.98	4623.60	328.14		0.97	7.06	4.63
1	1.5 Culv Grp #1	4621.88	4621.38	4623.08	4621.83	4621.16	967.34	101.44	1.91	10.08	10.08
1	1.5 Culv Grp #2	4622.29	4622.28	4622.25	4622.29	4623.60	880.95		3.01	9.82	14.04

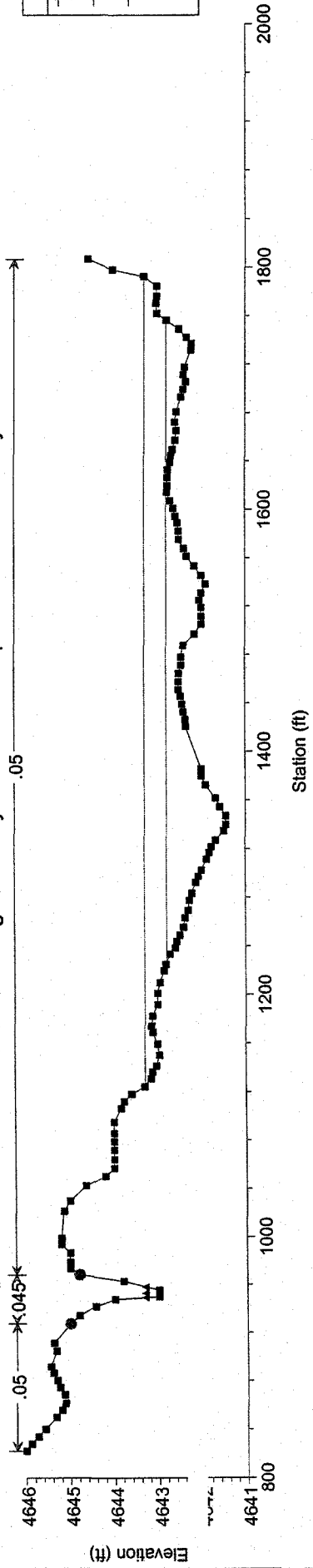
HEC-RAS Plan: Imported Pla River: 1 Reach: 1

Reach	River Sta	Q Total (cfs)	Flow Area (sq ft)	E.G. Elev (ft)	W.S. Elev (ft)	Top Width Act (ft)	Vel Total (ft/s)	Crit.W.S. (ft)	Left Stagn (ft)	Right Stagn (ft)
1	1.5 Culv Grp #1	771.86	167.41	4621.19	4620.86	266.21	4.61	4620.86	2900.00	3300.00
1	1.5 Culv Grp #2	328.14	111.16	4619.97	4619.83	194.17	2.95	4619.64	3300.00	4231.30
1	1.5 Culv Grp #1	1819.05	318.39	4621.88	4621.38	326.86	5.71	4621.63	2900.00	3300.00
1	1.5 Culv Grp #2	880.95	1890.05	4622.29	4622.28	999.77	0.47	4620.17	3300.00	4300.00

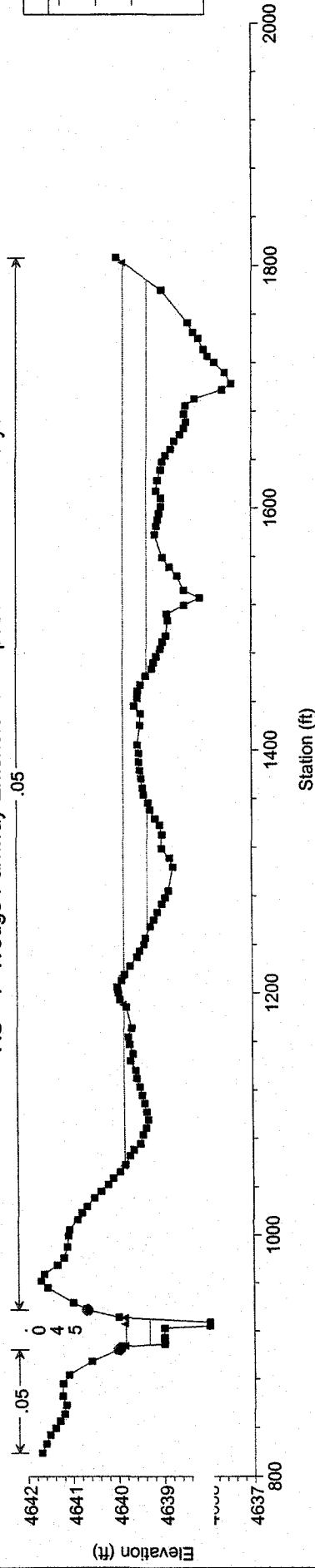
RS = 9 Wedge Parkway Extension - Proposed Condition Analysis



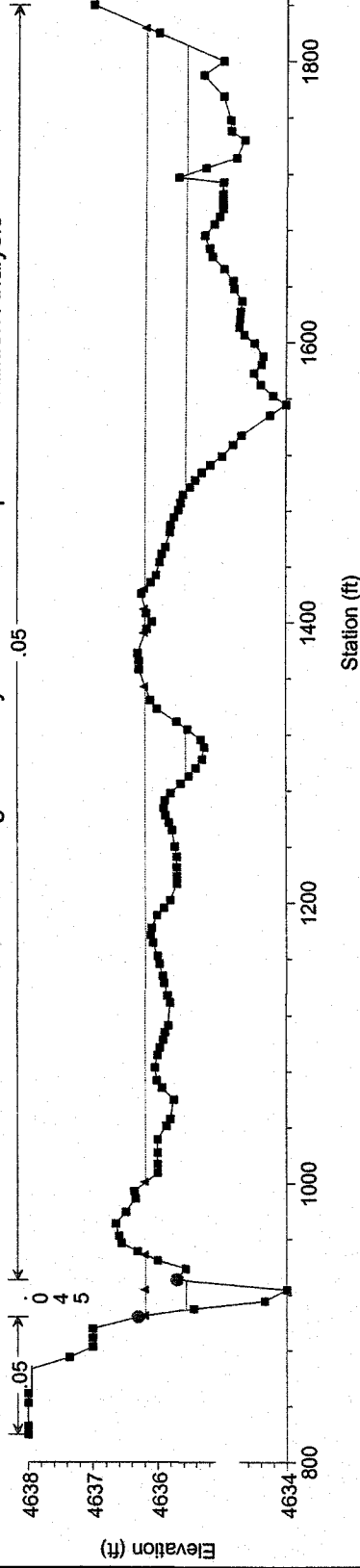
RS = 8 Wedge Parkway Extension - Proposed Condition Analysis



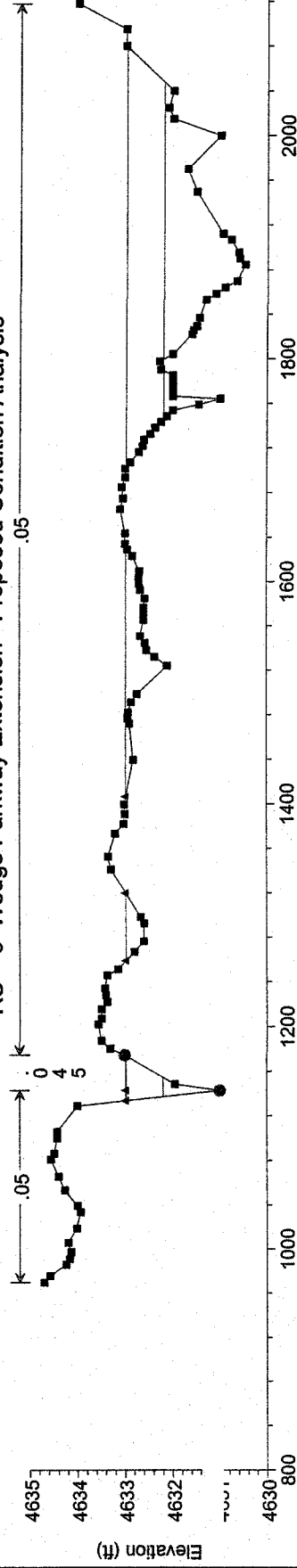
RS = 7 Wedge Parkway Extension - Proposed Condition Analysis



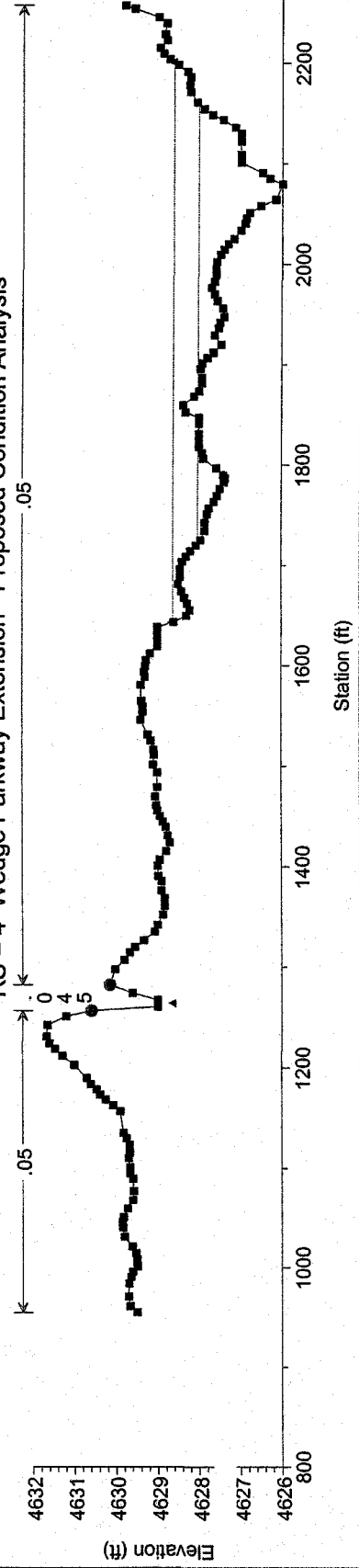
RS = 6 Wedge Parkway Extension - Proposed Condition Analysis



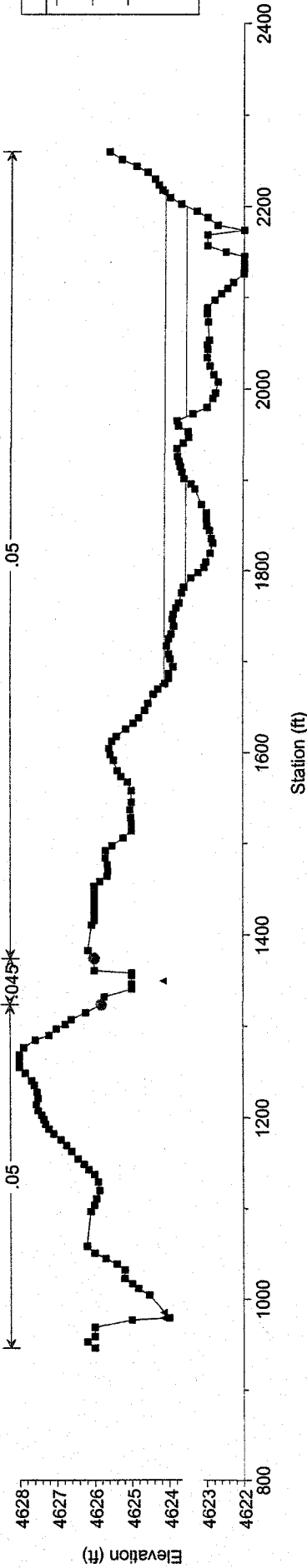
RS = 5 Wedge Parkway Extension - Proposed Condition Analysis



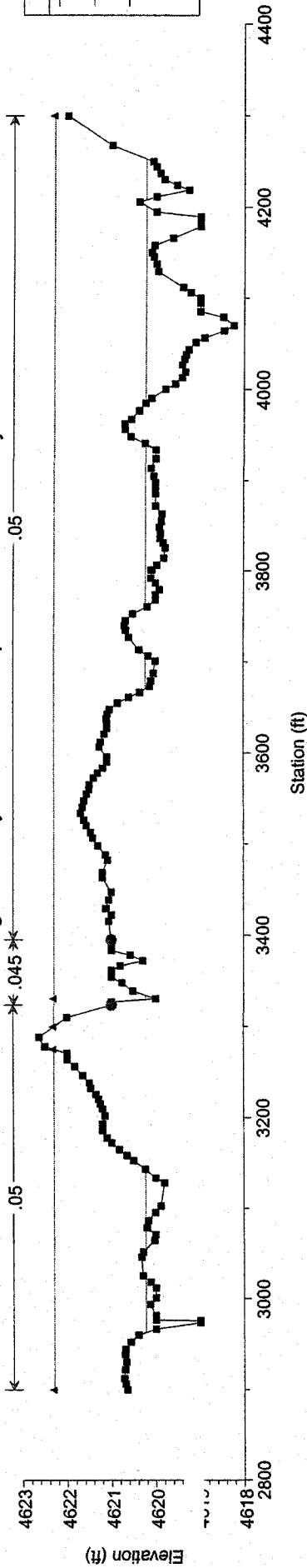
RS = 4 Wedge Parkway Extension - Proposed Condition Analysis



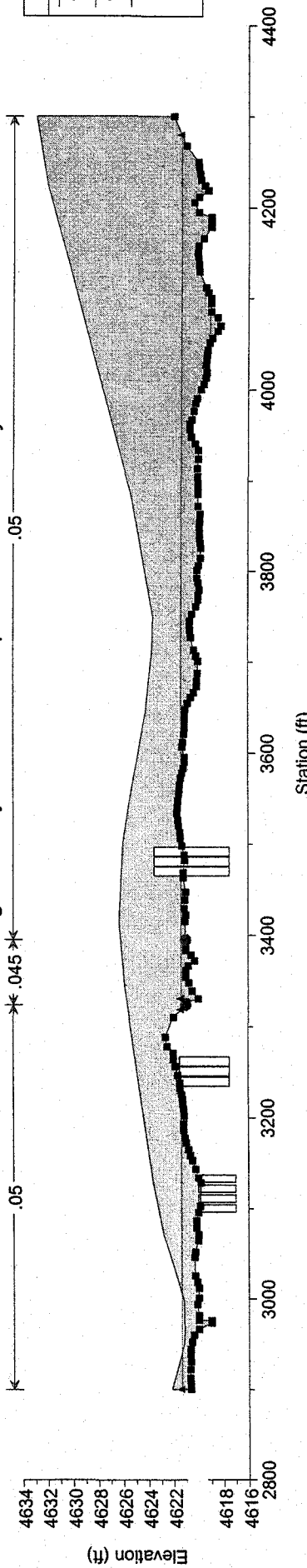
RS = 3 Wedge Parkway Extension - Proposed Condition Analysis



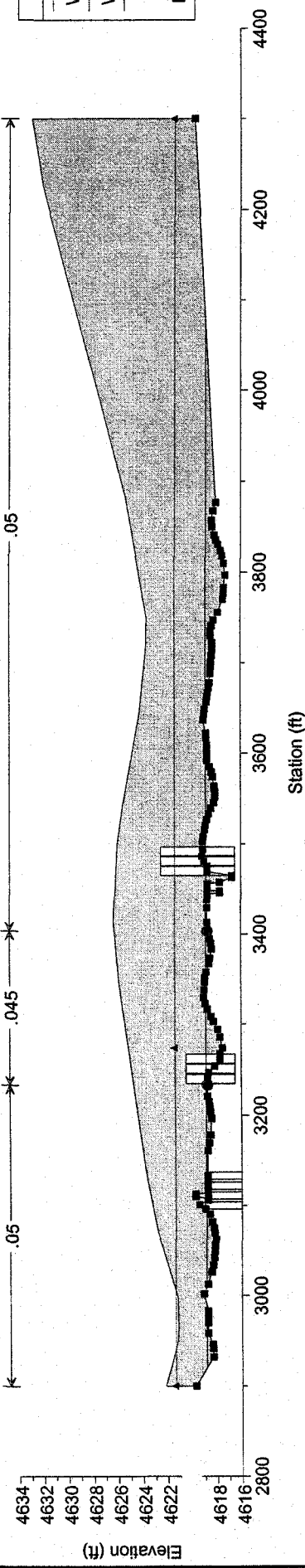
RS = 2 Wedge Parkway Extension - Proposed Condition Analysis



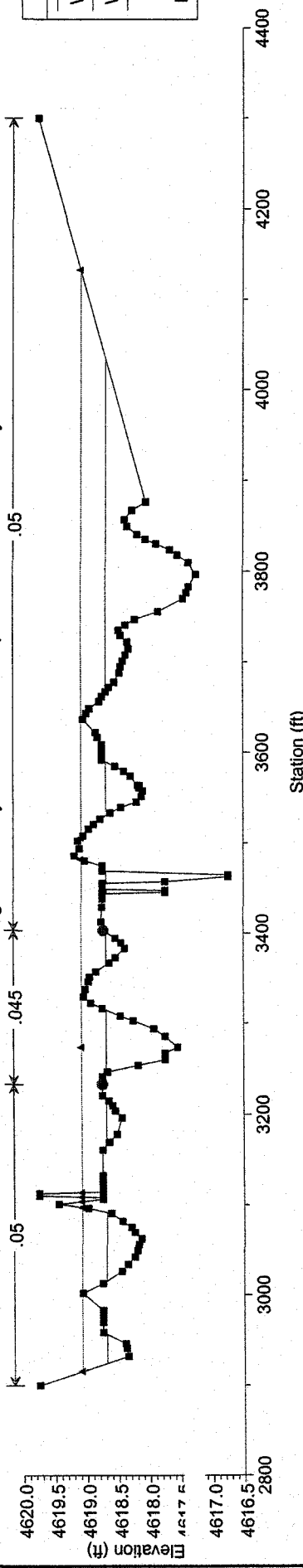
RS = 1.5 Wedge Parkway Extension - Proposed Condition Analysis



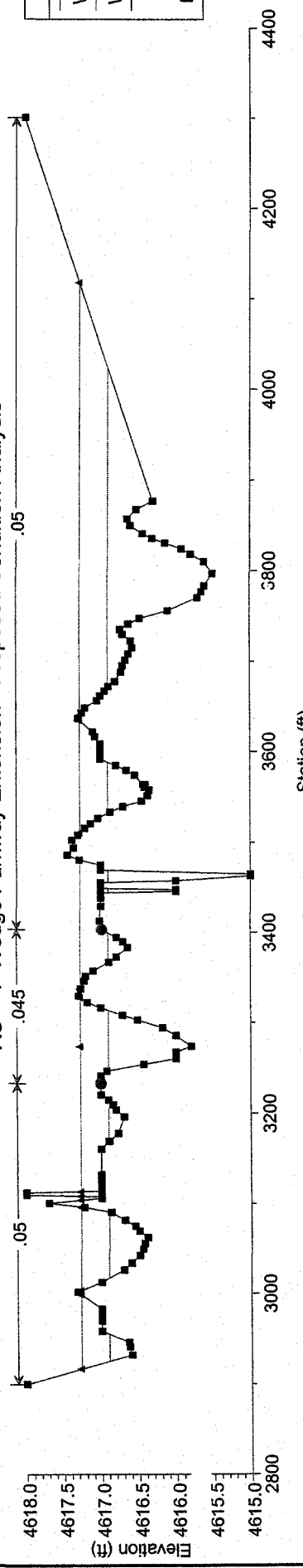
RS = 1.5 Wedge Parkway Extension - Proposed Condition Analysis



RS = 1.2 Wedge Parkway Extension - Proposed Condition Analysis

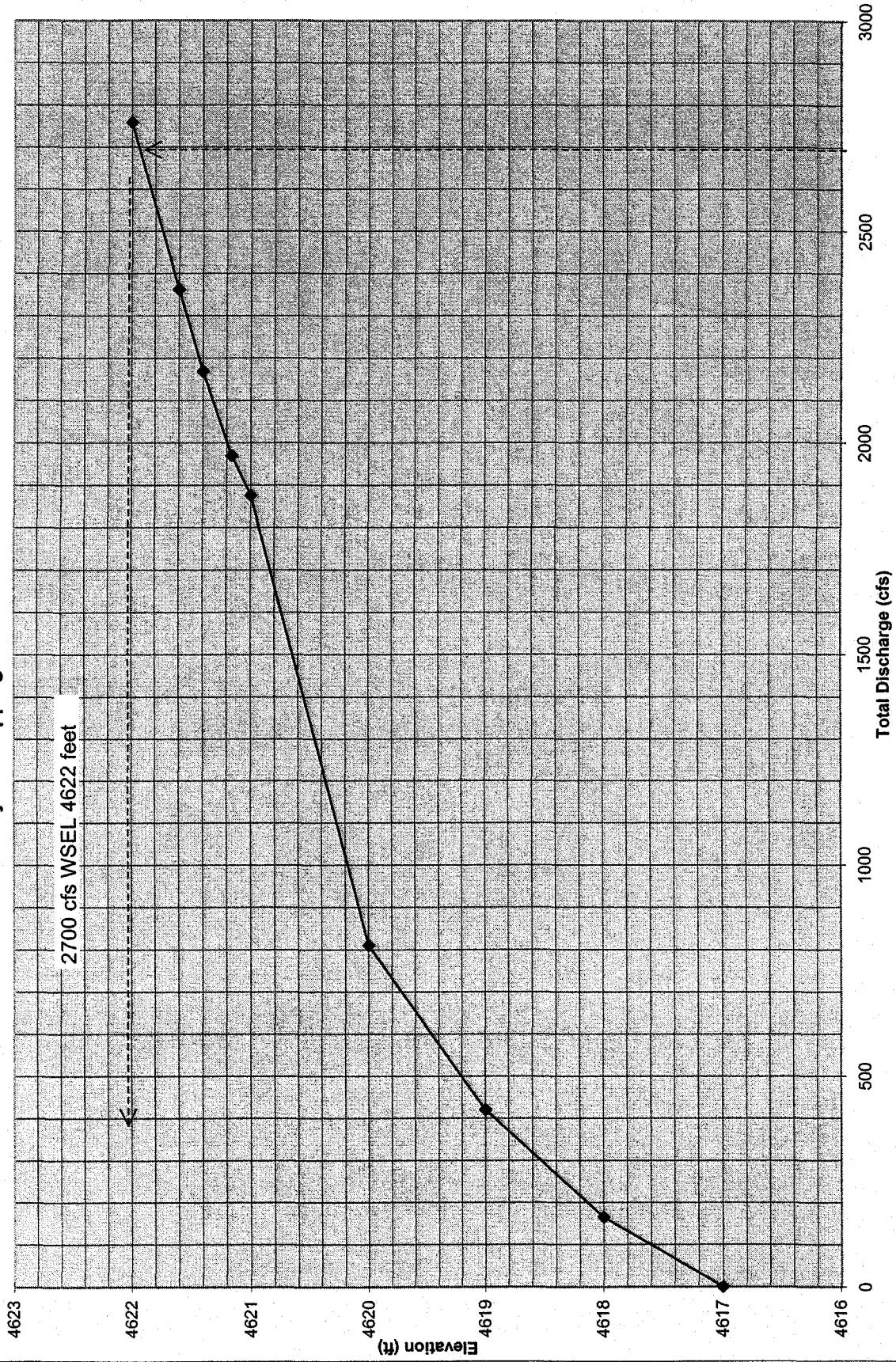


RS = 1 Wedge Parkway Extension - Proposed Condition Analysis

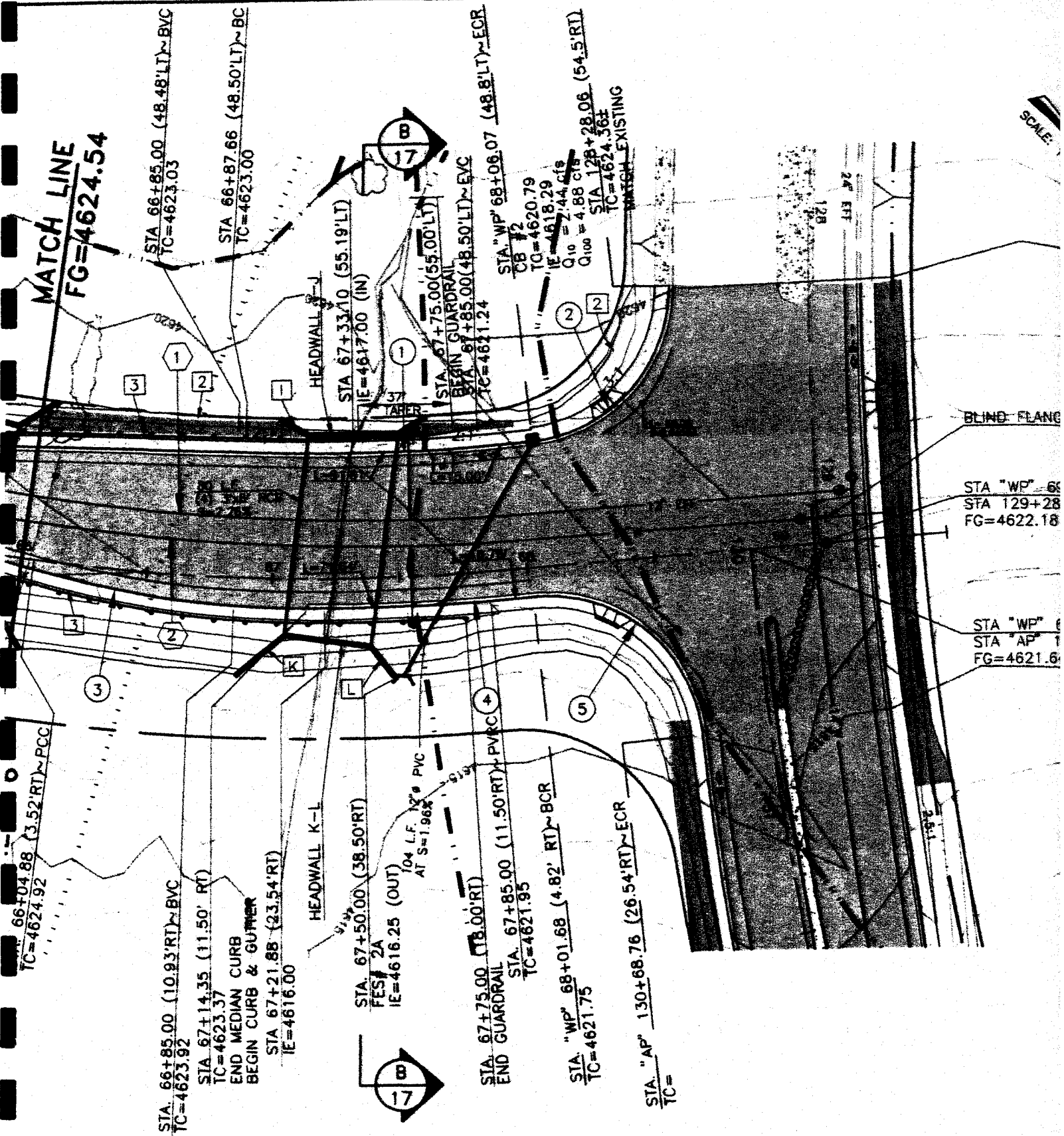


WEDGE PARKWAY EXTENSION HYDRAULIC REPORT -WHITES CREEK BRANCH 3

Wedge Parkway Culverts 1-3 Combined
With Roadway Overlapping Btwn Stations 67+50 and 69+00



WEDGE PARKWAY



24.34	24.01	23.64	23.46	22.64	21.85	21.52	21.16	21.58	21.88
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SCALE

STA. 66
TC=462.54

SI
TC
EN
BE



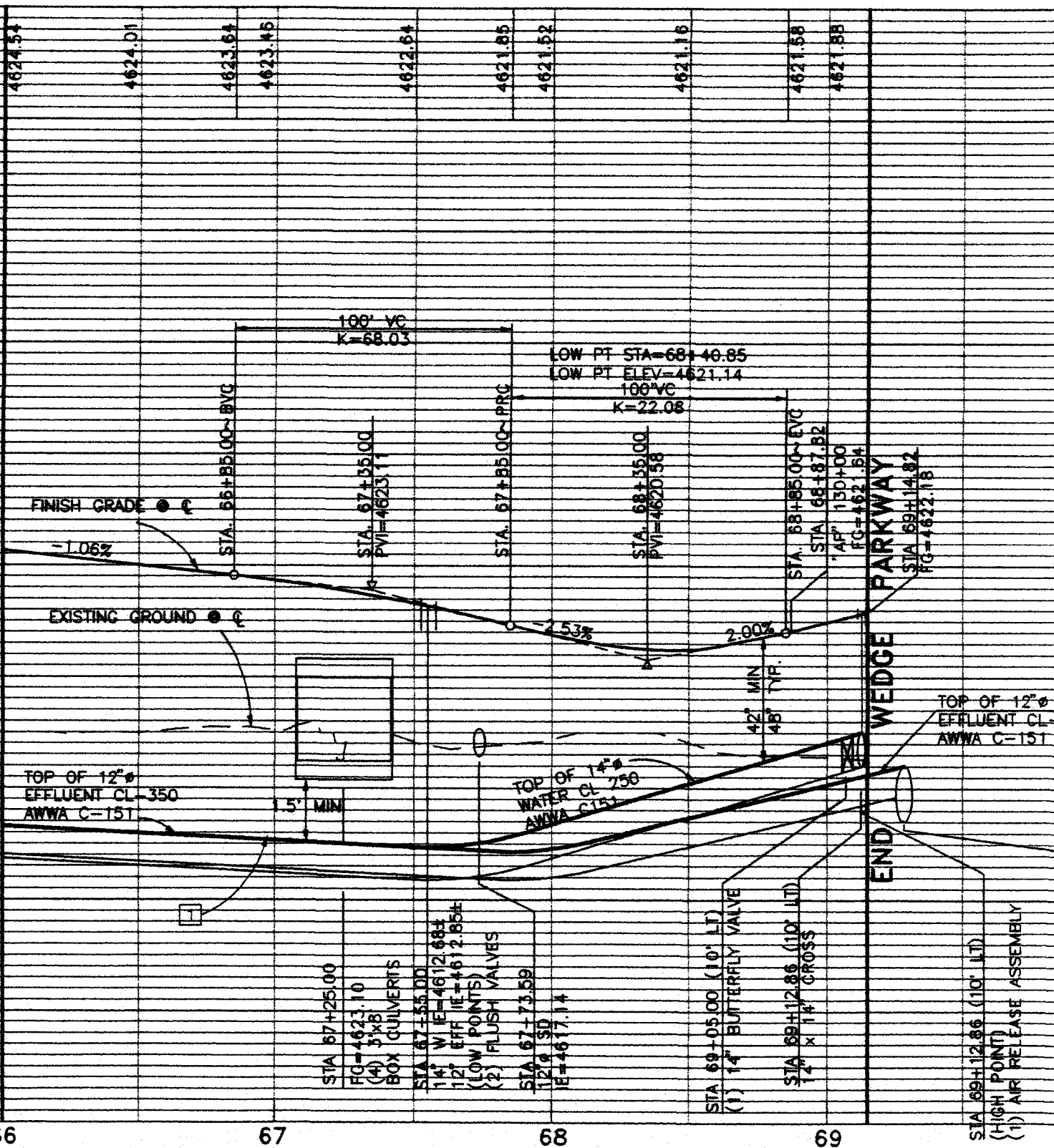
STA
ENI

STA
TC

STA.
TC=

WEDGE PARKWAY

STA 66+00.00 MATCH LINE SEE SHEET 6



HORIZONTAL: 1" = 40'

CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:18:23

FILE DATE: 03-05-1998
 FILE NAME: WEDGE1

FHWA CULVERT ANALYSIS
 HY-8, VERSION 6.0

C U L V E R T N O.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	4617.00	4616.25	82.00	4 RCB	8.00	3.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)

FILE: WEDGE1

DATE: 03-05-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
4617.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4618.34	150.0	150.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4619.15	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4619.83	450.0	450.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.54	600.0	600.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4621.32	750.0	742.1	0.0	0.0	0.0	0.0	0.0	7.53	4
4621.48	800.0	769.4	0.0	0.0	0.0	0.0	0.0	27.56	4
4622.05	1050.0	855.7	0.0	0.0	0.0	0.0	0.0	192.51	4
4622.28	1200.0	889.1	0.0	0.0	0.0	0.0	0.0	308.88	4
4622.47	1350.0	915.5	0.0	0.0	0.0	0.0	0.0	426.76	3
4622.65	1500.0	939.0	0.0	0.0	0.0	0.0	0.0	553.71	3
4621.16	715.5	715.5	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING

SUMMARY OF ITERATIVE SOLUTION ERRORS

FILE: WEDGE1

DATE: 03-05-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
4617.00	0.000	0.00	0.00	0.00
4618.34	0.000	150.00	0.00	0.00
4619.15	0.000	300.00	0.00	0.00
4619.83	0.000	450.00	0.00	0.00
4620.54	0.000	600.00	0.00	0.00
4621.32	-0.001	750.00	0.42	0.06
4621.48	-0.006	800.00	3.04	0.38
4622.05	-0.002	1050.00	1.75	0.17
4622.28	-0.002	1200.00	1.98	0.17
4622.47	-0.008	1350.00	7.75	0.57
4622.65	-0.006	1500.00	7.30	0.49

<1> TOLERANCE (ft) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 03-05-1998
CURRENT TIME: 11:18:23

FILE DATE: 03-05-1998
FILE NAME: WEDGE1

PERFORMANCE CURVE FOR CULVERT 1 - 4(8.00 (ft) BY 3.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	4617.00	0.00	-0.40	0-NF	0.00	0.00	0.00	0.35	0.00	0.00
150.00	4618.34	1.34	1.26	1-S2n	0.61	0.88	0.62	1.24	7.53	5.14
300.00	4619.15	2.15	1.71	1-S2n	0.94	1.40	1.00	1.69	9.37	6.58
450.00	4619.83	2.83	2.25	1-S2n	1.23	1.84	1.36	2.05	10.38	7.56
600.00	4620.54	3.54	2.90	1-S2n	1.50	2.22	1.66	2.35	11.27	8.33
742.06	4621.31	4.31	3.61	5-S2n	1.73	2.56	1.95	2.62	11.88	8.97
769.40	4621.48	4.48	3.76	5-S2n	1.77	2.62	2.00	2.71	12.00	9.16
855.74	4622.04	5.04	4.46	4-FFt	1.90	2.82	1.90	3.10	14.05	9.99
889.14	4622.28	5.28	4.84	4-FFt	1.95	2.89	1.95	3.31	14.21	10.42
915.49	4622.47	5.47	5.17	4-FFt	1.99	2.95	1.99	3.51	14.34	10.81
938.98	4622.64	5.64	5.49	4-FFt	2.03	3.00	2.03	3.70	14.45	11.17

El. inlet face invert 4617.00 ft El. outlet invert 4616.25 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT *****

INLET STATION 0.00 ft
 INLET ELEVATION 4617.00 ft
 OUTLET STATION 82.00 ft
 OUTLET ELEVATION 4616.25 ft
 NUMBER OF BARRELS 4
 SLOPE (V/H) 0.0091
 CULVERT LENGTH ALONG SLOPE 82.00 ft

***** CULVERT DATA SUMMARY *****

BARREL SHAPE BOX
 BARREL SPAN 8.00 ft
 BARREL RISE 3.00 ft
 BARREL MATERIAL CONCRETE
 BARREL MANNING'S n 0.012
 INLET TYPE CONVENTIONAL
 INLET EDGE AND WALL SQUARE EDGE (30-75 DEG. FLARE)
 INLET DEPRESSION NONE

CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:18:23

FILE DATE: 03-05-1998
 FILE NAME: WEDGE1

TAILWATER

***** REGULAR CHANNEL CROSS SECTION *****
 BOTTOM WIDTH 30.00 ft
 SIDE SLOPE H/V (X:1) 3.0
 CHANNEL SLOPE V/H (ft/ft) 0.025
 MANNING'S n (.01-0.1) 0.040
 CHANNEL INVERT ELEVATION 4616.60 ft
 CULVERT NO.1 OUTLET INVERT ELEVATION 4616.25 ft

***** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	4616.60	0.000	0.00	0.00	0.00
150.00	4617.49	0.958	0.89	5.14	1.39
300.00	4617.94	1.001	1.34	6.58	2.09
450.00	4618.30	1.023	1.70	7.56	2.65
600.00	4618.60	1.038	2.00	8.33	3.12
750.00	4618.87	1.048	2.27	8.97	3.54
800.00	4618.96	1.051	2.36	9.16	3.68
1050.00	4619.35	1.062	2.75	9.99	4.29
1200.00	4619.56	1.067	2.96	10.42	4.62
1350.00	4619.76	1.072	3.16	10.81	4.93
1500.00	4619.95	1.076	3.35	11.17	5.23

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
 EMBANKMENT TOP WIDTH 20.00 ft
 ***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION COORD. NO.	X ft	Y ft
1	2882.90	4623.02
2	2883.00	4622.52
3	2900.00	4622.18
4	2929.00	4621.58
5	2951.00	4621.20
6	2964.00	4621.16
7	2997.00	4621.20
8	3029.00	4621.85
9	3053.00	4622.40
10	3070.00	4622.80
11	3129.00	4623.64

SCALE: 1" = 40'

SEE SHEET 17
STA 66+00.00

MATCH LINE
FO=4624.54

F.F.
6"x70" RCB
7.75%

4"x10" RCB
1.63%

STA 63+33.17 (14.00' M.I.)
IE=4616.50 (OUT)

STA 64+75.00 (36.50' LT) ~ EVC
TC=4625.49

STA 65+10.59 (36.5' LT) ~ PCC
TC=4625.11

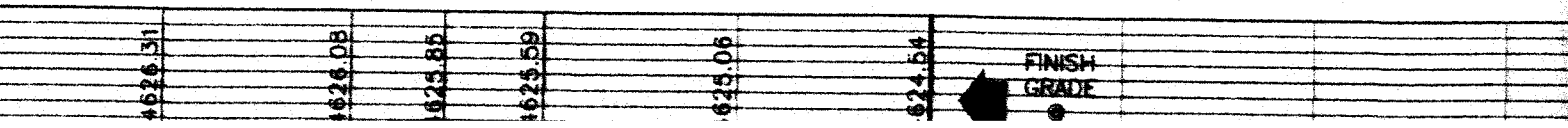
STA 65+73.93 (41.12' LT) ~ EVC
IE=4617.50
STA 65+80.67 (41.12' LT) ~ PCC
TC=4624.28

STA 64+75.00 (2.0' LT) ~ EVC
TC=4626.32

STA 65+28.58 (2.0' LT) ~ PCC
TC=4625.75

STA 65+69.32 (9.82' RT)
IE=4616.50
HEADWALL G-H

ARKWAY



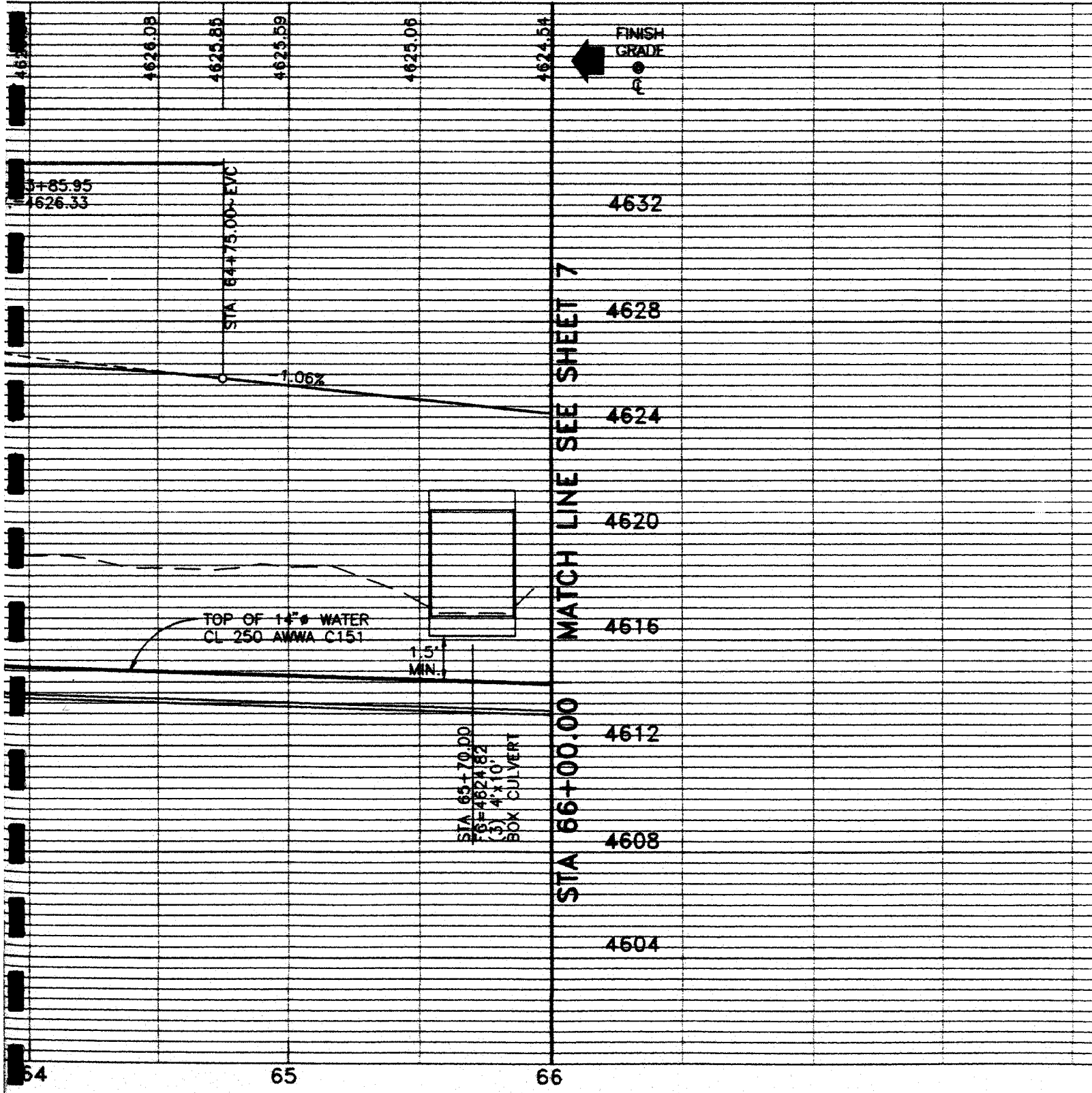
STA 64+7
TC=4626

STA 65+2
TC=4625

STA
IE=4

7

WAY



CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:23:44

FILE DATE: 03-05-1998
 FILE NAME: WEDGE2

FHWA CULVERT ANALYSIS
 HY-8, VERSION 6.0

C U L V E R T N O.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	4617.50	4616.50	63.01	3 RCB	10.00	6.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)

FILE: WEDGE2

DATE: 03-05-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
4617.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4619.98	150.0	150.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.30	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.60	450.0	450.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4621.03	600.0	600.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4621.48	750.0	718.3	0.0	0.0	0.0	0.0	0.0	27.87	4
4621.60	800.0	748.2	0.0	0.0	0.0	0.0	0.0	49.12	4
4622.02	1050.0	866.2	0.0	0.0	0.0	0.0	0.0	181.50	4
4622.21	1200.0	920.7	0.0	0.0	0.0	0.0	0.0	270.66	3
4622.39	1350.0	970.8	0.0	0.0	0.0	0.0	0.0	370.40	3
4622.54	1500.0	1016.3	0.0	0.0	0.0	0.0	0.0	476.65	3
4621.16	634.3	634.3	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS

FILE: WEDGE2

DATE: 03-05-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
4617.50	0.000	0.00	0.00	0.00
4619.98	0.000	150.00	0.00	0.00
4620.30	0.000	300.00	0.00	0.00
4620.60	0.000	450.00	0.00	0.00
4621.03	0.000	600.00	0.00	0.00
4621.48	-0.007	750.00	3.78	0.50
4621.60	-0.004	800.00	2.66	0.33
4622.02	-0.003	1050.00	2.33	0.22
4622.21	-0.008	1200.00	8.61	0.72
4622.39	-0.008	1350.00	8.78	0.65
4622.54	-0.006	1500.00	7.07	0.47

<1> TOLERANCE (ft) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:23:44

FILE DATE: 03-05-1998
 FILE NAME: WEDGE2

PERFORMANCE CURVE FOR CULVERT 1 - 3 (10.00 (ft) BY 6.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	4617.50	0.00	-1.00	0-NF	0.00	0.00	0.00	-0.50	0.00	0.00
150.00	4619.98	1.39	2.48	1-S2n	0.48	0.92	0.56	0.39	8.92	5.14
300.00	4620.30	2.21	2.80	1-S2n	0.79	1.46	0.93	0.84	10.76	6.58
450.00	4620.60	2.89	3.10	1-S2n	1.03	1.92	1.26	1.20	11.89	7.56
600.00	4621.03	3.53	3.42	1-S2n	1.26	2.32	1.58	1.50	12.65	8.33
718.35	4621.49	3.99	3.68	1-S2n	1.41	2.62	1.81	1.77	13.25	8.97
748.23	4621.60	4.10	3.75	1-S2n	1.45	2.69	1.87	1.86	13.34	9.16
866.17	4622.03	4.53	4.03	1-S2n	1.60	2.96	2.06	2.25	13.98	9.99
920.73	4622.22	4.72	4.16	1-S2n	1.67	3.09	2.19	2.46	14.03	10.42
970.82	4622.39	4.89	4.28	1-S2n	1.74	3.20	2.28	2.66	14.20	10.81
1016.28	4622.55	5.05	4.40	1-S2n	1.80	3.30	2.36	2.85	14.37	11.17

El. inlet face invert 4617.50 ft El. outlet invert 4616.50 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT *****
 INLET STATION 0.00 ft
 INLET ELEVATION 4617.50 ft
 OUTLET STATION 63.00 ft
 OUTLET ELEVATION 4616.50 ft
 NUMBER OF BARRELS 3
 SLOPE (V/H) 0.0159
 CULVERT LENGTH ALONG SLOPE 63.01 ft

***** CULVERT DATA SUMMARY *****
 BARREL SHAPE BOX
 BARREL SPAN 10.00 ft
 BARREL RISE 6.00 ft
 BARREL MATERIAL CONCRETE
 BARREL MANNING'S n 0.012
 INLET TYPE CONVENTIONAL
 INLET EDGE AND WALL SQUARE EDGE (30-75 DEG. FLARE)
 INLET DEPRESSION NONE

CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:23:44

FILE DATE: 03-05-1998
 FILE NAME: WEDGE2

TAILWATER

***** REGULAR CHANNEL CROSS SECTION *****
 BOTTOM WIDTH 30.00 ft
 SIDE SLOPE H/V (X:1) 3.0
 CHANNEL SLOPE V/H (ft/ft) 0.025
 MANNING'S n (.01-0.1) 0.040
 CHANNEL INVERT ELEVATION 4616.00 ft
 CULVERT NO.1 OUTLET INVERT ELEVATION 4616.50 ft

***** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

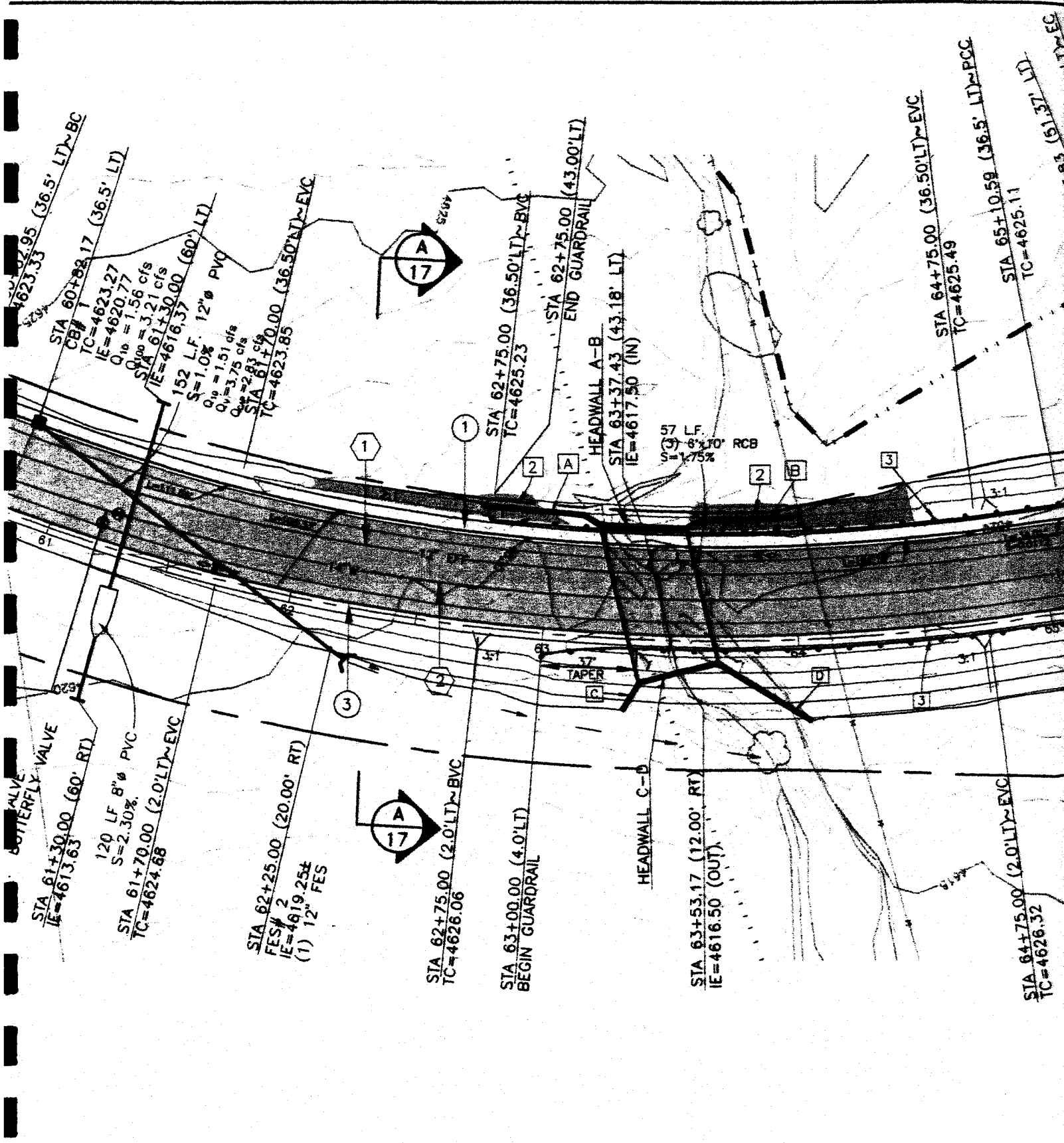
FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	4616.00	0.000	0.00	0.00	0.00
150.00	4616.89	0.958	0.89	5.14	1.39
300.00	4617.34	1.001	1.34	6.58	2.09
450.00	4617.70	1.023	1.70	7.56	2.65
600.00	4618.00	1.038	2.00	8.33	3.12
750.00	4618.27	1.048	2.27	8.97	3.54
800.00	4618.36	1.051	2.36	9.16	3.68
1050.00	4618.75	1.062	2.75	9.99	4.29
1200.00	4618.96	1.067	2.96	10.42	4.62
1350.00	4619.16	1.072	3.16	10.81	4.93
1500.00	4619.35	1.076	3.35	11.17	5.23

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
 EMBANKMENT TOP WIDTH 20.00 ft

***** USER DEFINED ROADWAY PROFILE

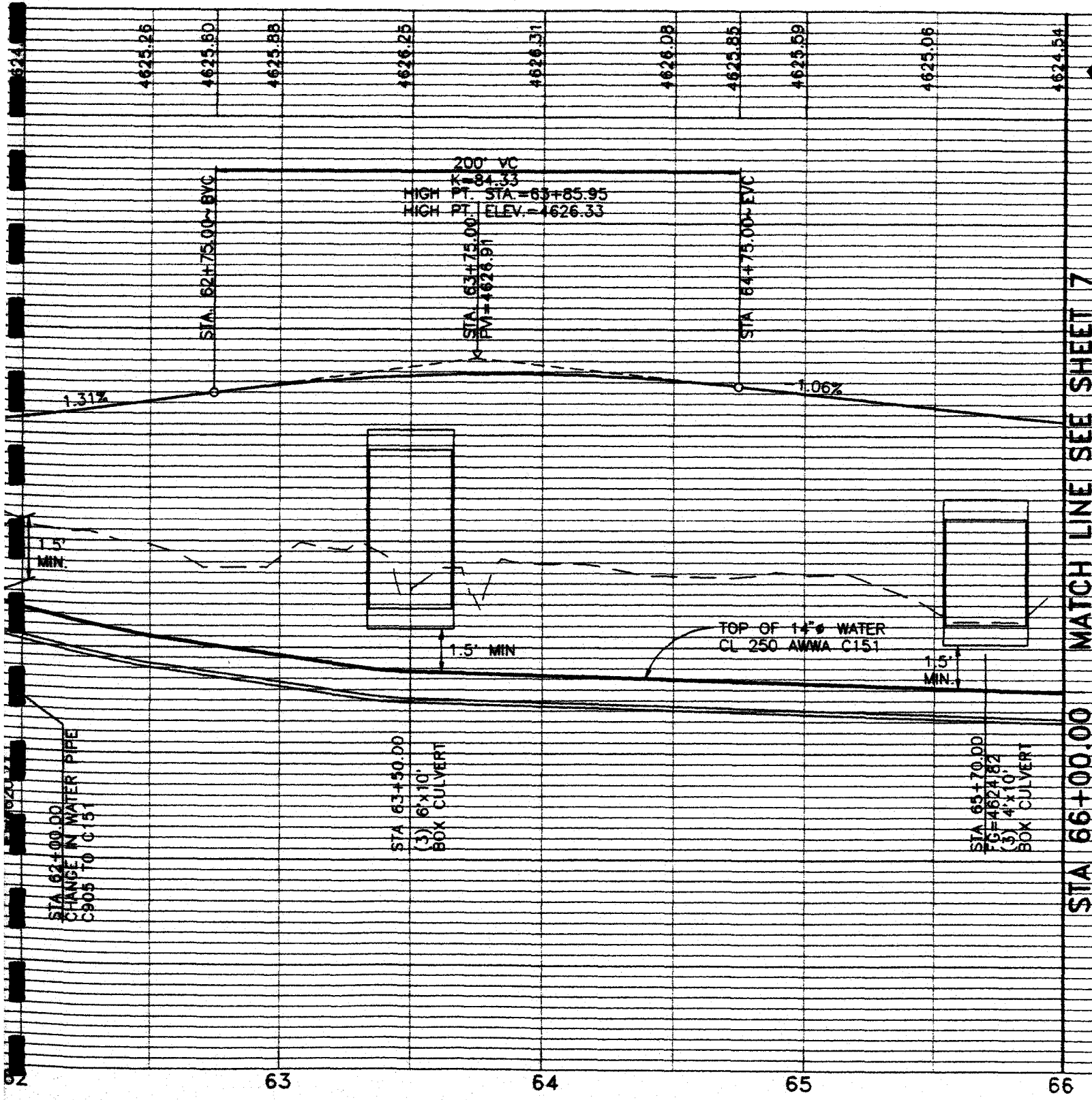
CROSS-SECTION COORD. NO.	X ft	Y ft
1	2882.90	4623.02
2	2883.00	4622.52
3	2900.00	4622.18
4	2929.00	4621.58
5	2951.00	4621.20
6	2964.00	4621.16
7	2997.00	4621.20
8	3029.00	4621.85
9	3053.00	4622.40
10	3070.00	4622.80
11	3129.00	4623.64



WEDGE PARKWAY

4623.67	4623.99	4624.21	4624.60	4625.26	4625.80	4625.88	4626.25	4626.31	4626.08	4625.85	4625.59
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WEDGE PARKWAY



MATCH LINE SEE SHEET 7
STA 66+00.00

HORIZONTAL: 1" = 40'

S B
S I E
STA
TC
STA
TC

CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:26:26

FILE DATE: 03-05-1998
 FILE NAME: WEDGE3

FHWA CULVERT ANALYSIS
 HY-8, VERSION 6.0

C U L V E R T N O.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	4617.50	4616.50	60.01	3 RCB	10.00	6.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs)

FILE: WEDGE3

DATE: 03-05-1998

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
4617.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4619.83	90.0	90.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.04	180.0	180.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.23	270.0	270.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.42	360.0	360.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.50	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4620.79	540.0	540.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4621.15	630.0	630.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4621.49	720.0	720.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4621.82	810.0	810.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4622.14	900.0	900.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4623.60	1323.6	1323.6	0.0	0.0	0.0	0.0	0.0	0.0	OVERTOPPING

SUMMARY OF ITERATIVE SOLUTION ERRORS

FILE: WEDGE3

DATE: 03-05-1998

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
4617.50	0.000	0.00	0.00	0.00
4619.83	0.000	90.00	0.00	0.00
4620.04	0.000	180.00	0.00	0.00
4620.23	0.000	270.00	0.00	0.00
4620.42	0.000	360.00	0.00	0.00
4620.50	0.000	400.00	0.00	0.00
4620.79	0.000	540.00	0.00	0.00
4621.15	0.000	630.00	0.00	0.00
4621.49	0.000	720.00	0.00	0.00
4621.82	0.000	810.00	0.00	0.00
4622.14	0.000	900.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 03-05-1998
 CURRENT TIME: 11:26:26

FILE DATE: 03-05-1998
 FILE NAME: WEDGE3

PERFORMANCE CURVE FOR CULVERT 1 - 3 (10.00 (ft) BY 6.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	4617.50	0.00	-1.00	0-NF	0.00	0.00	0.00	-0.50	0.00	0.00
90.00	4619.83	0.99	2.33	1-S2n	0.28	0.66	0.39	0.16	7.71	4.26
180.00	4620.04	1.57	2.54	1-S2n	0.57	1.04	0.63	0.49	9.53	5.49
270.00	4620.23	2.06	2.73	1-S2n	0.73	1.36	0.85	0.76	10.56	6.34
360.00	4620.42	2.49	2.92	1-S2n	0.87	1.65	1.06	0.99	11.31	7.01
400.00	4620.50	2.67	3.00	1-S2n	0.94	1.77	1.15	1.08	11.62	7.26
540.00	4620.79	3.28	3.29	1-S2n	1.16	2.16	1.44	1.38	12.48	8.04
630.00	4621.15	3.65	3.49	1-S2n	1.28	2.40	1.63	1.56	12.90	8.47
720.00	4621.49	3.99	3.69	1-S2n	1.39	2.62	1.80	1.72	13.33	8.85
810.00	4621.82	4.32	3.89	1-S2n	1.51	2.84	1.98	1.87	13.67	9.19
900.00	4622.14	4.64	4.11	1-S2n	1.62	3.04	2.14	2.02	14.01	9.51

El. inlet face invert 4617.50 ft El. outlet invert 4616.50 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT *****

INLET STATION 0.00 ft
 INLET ELEVATION 4617.50 ft
 OUTLET STATION 60.00 ft
 OUTLET ELEVATION 4616.50 ft
 NUMBER OF BARRELS 3
 SLOPE (V/H) 0.0167
 CULVERT LENGTH ALONG SLOPE 60.01 ft

***** CULVERT DATA SUMMARY *****

BARREL SHAPE BOX
 BARREL SPAN 10.00 ft
 BARREL RISE 6.00 ft
 BARREL MATERIAL CONCRETE
 BARREL MANNING'S n 0.012
 INLET TYPE CONVENTIONAL
 INLET EDGE AND WALL SQUARE EDGE (30-75 DEG. FLARE)
 INLET DEPRESSION NONE

CURRENT DATE: 12-16-1997
 CURRENT TIME: 11:35:08

FILE DATE: 12-16-1997
 FILE NAME: WEDGE4

FHWA CULVERT ANALYSIS
 HY-8, VERSION 6.0

C U L V E R T N O.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	4629.00	4627.80	55.01	1 RCP	1.50	1.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: WEDGE4 DATE: 12-16-1997

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
4629.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
4632.23	50.0	12.0	0.0	0.0	0.0	0.0	0.0	37.87	7
4632.76	100.0	13.6	0.0	0.0	0.0	0.0	0.0	85.99	3
4633.20	150.0	14.8	0.0	0.0	0.0	0.0	0.0	134.83	3
4633.59	200.0	15.8	0.0	0.0	0.0	0.0	0.0	183.92	3
4633.95	250.0	16.7	0.0	0.0	0.0	0.0	0.0	233.04	3
4634.29	300.0	17.3	0.0	0.0	0.0	0.0	0.0	282.41	3
4634.59	350.0	17.6	0.0	0.0	0.0	0.0	0.0	332.19	3
4634.89	400.0	18.0	0.0	0.0	0.0	0.0	0.0	381.81	3
4635.17	450.0	18.4	0.0	0.0	0.0	0.0	0.0	431.48	3
4635.44	500.0	18.7	0.0	0.0	0.0	0.0	0.0	481.18	3
4631.50	9.4	9.4	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: WEDGE4 DATE: 12-16-1997

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
4629.00	0.000	0.00	0.00	0.00
4632.23	-0.007	50.00	0.12	0.24
4632.76	-0.003	100.00	0.39	0.39
4633.20	-0.002	150.00	0.33	0.22
4633.59	-0.002	200.00	0.26	0.13
4633.95	-0.002	250.00	0.30	0.12
4634.29	-0.002	300.00	0.31	0.10
4634.59	-0.001	350.00	0.16	0.05
4634.89	-0.001	400.00	0.17	0.04
4635.17	-0.001	450.00	0.15	0.03
4635.44	0.000	500.00	0.10	0.02

<1> TOLERANCE (ft) = 0.010

<2> TOLERANCE (%) = 1.000

CURRENT DATE: 12-16-1997
 CURRENT TIME: 11:35:08

FILE DATE: 12-16-1997
 FILE NAME: WEDGE4

PERFORMANCE CURVE FOR CULVERT 1 - 1(1.50 (ft) BY 1.50 (ft)) RCP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	4629.00	0.00	-1.20	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
12.00	4631.81	2.81	1.89	5-S2n	0.94	1.31	0.99	1.21	9.77	4.49
13.62	4632.34	3.34	2.58	4-FFt	1.02	1.38	1.02	1.61	10.60	5.34
14.83	4632.78	3.78	3.27	4-FFt	1.10	1.43	1.10	1.90	10.69	5.92
15.83	4633.17	4.17	3.86	4-FFt	1.16	1.48	1.16	2.13	10.81	6.36
16.66	4633.52	4.52	4.37	4-FFt	1.22	1.50	1.22	2.33	10.80	6.73
17.28	4633.79	4.79	4.79	4-FFt	1.28	1.50	1.50	2.50	9.78	7.04
17.65	4634.10	4.96	5.10	4-FFt	1.32	1.50	1.50	2.66	9.99	7.32
18.02	4634.40	5.12	5.40	4-FFt	1.50	1.50	1.50	2.81	10.20	7.57
18.38	4634.68	5.29	5.68	4-FFt	1.50	1.50	1.50	2.94	10.40	7.80
18.72	4634.96	5.45	5.96	4-FFt	1.50	1.50	1.50	3.06	10.59	8.00

El. inlet face invert 4629.00 ft El. outlet invert 4627.80 ft
 El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT *****

INLET STATION 0.00 ft
 INLET ELEVATION 4629.00 ft
 OUTLET STATION 55.00 ft
 OUTLET ELEVATION 4627.80 ft
 NUMBER OF BARRELS 1
 SLOPE (V/H) 0.0218
 CULVERT LENGTH ALONG SLOPE 55.01 ft

***** CULVERT DATA SUMMARY *****

BARREL SHAPE CIRCULAR
 BARREL DIAMETER 1.50 ft
 BARREL MATERIAL CONCRETE
 BARREL MANNING'S n 0.012
 INLET TYPE CONVENTIONAL
 INLET EDGE AND WALL SQUARE EDGE WITH HEADWALL
 INLET DEPRESSION NONE

CURRENT DATE: 12-16-1997
 CURRENT TIME: 11:35:08

FILE DATE: 12-16-1997
 FILE NAME: WEDGE4

TAILWATER

***** REGULAR CHANNEL CROSS SECTION *****

BOTTOM WIDTH	2.00 ft
SIDE SLOPE H/V (X:1)	6.0
CHANNEL SLOPE V/H (ft/ft)	0.025
MANNING'S n (.01-0.1)	0.040
CHANNEL INVERT ELEVATION	4627.80 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	4627.80 ft

***** UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	4627.80	0.000	0.00	0.00	0.00
50.00	4629.01	0.720	1.21	4.49	1.88
100.00	4629.41	0.743	1.61	5.34	2.51
150.00	4629.69	0.757	1.90	5.92	2.96
200.00	4629.93	0.768	2.13	6.36	3.32
250.00	4630.13	0.777	2.33	6.73	3.63
300.00	4630.30	0.784	2.50	7.04	3.90
350.00	4630.46	0.791	2.66	7.32	4.15
400.00	4630.60	0.796	2.81	7.57	4.38
450.00	4630.74	0.801	2.94	7.80	4.59
500.00	4630.86	0.806	3.06	8.00	4.78

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	20.00 ft
CREST LENGTH	20.00 ft
OVERTOPPING CREST ELEVATION	4631.50 ft

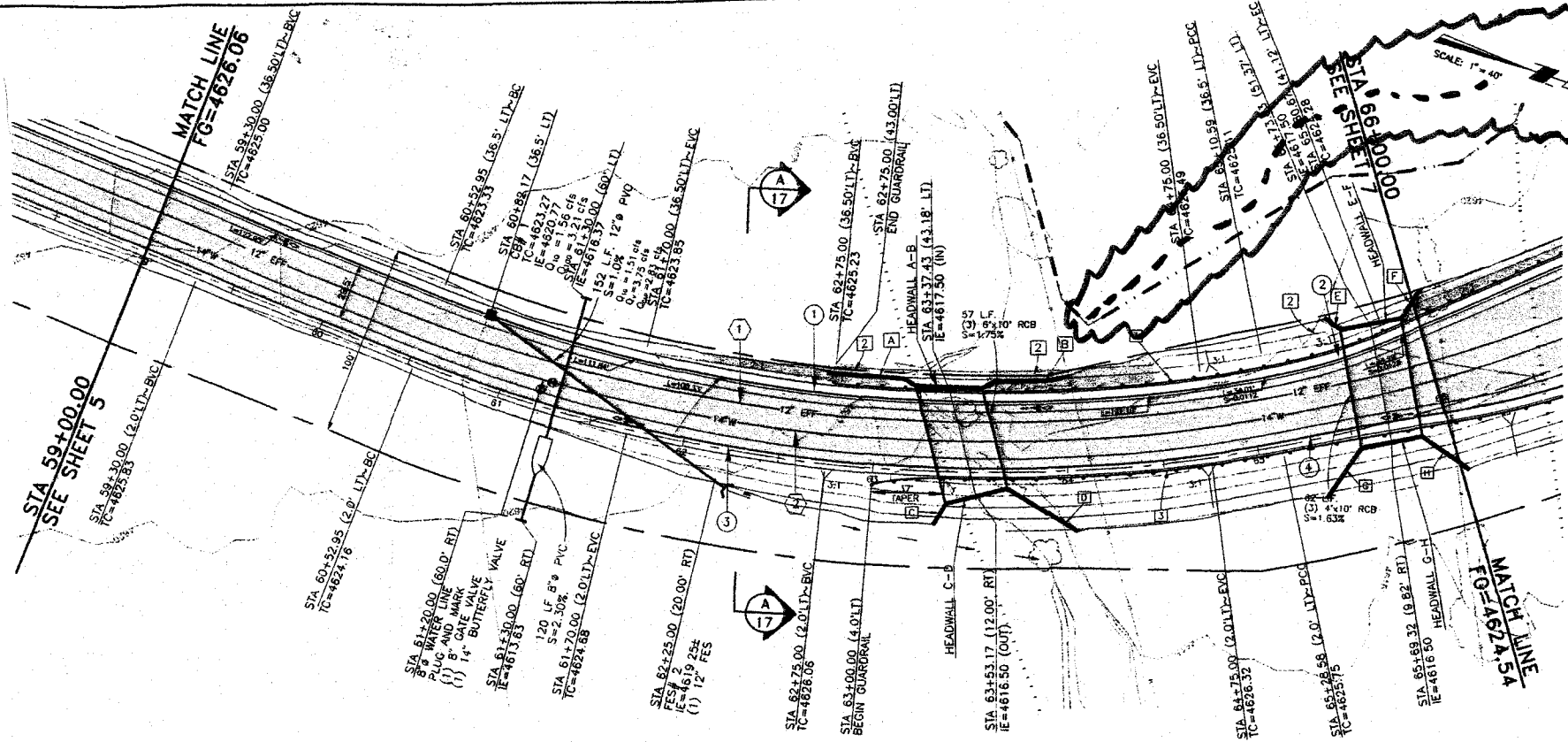
FLOOD PLAN LIMIT MODIFICATIONS RESULTING FROM PROPOSED IMPROVEMENTS BASED ON A FLOOD PLAN DESIGN DISCHARGE OF 3000 CFS

NO.	DELTA	RADIUS	LENGTH	TANGENT
1	50'39"01"	840.00'	742.57'	397.52'
2	50'39"01"	850.00'	751.41'	402.25'

NO.	DELTA	RADIUS	LENGTH	TANGENT
1	50'39"01"	840.00'	742.57'	397.52'
2	50'39"01"	850.00'	751.41'	402.25'

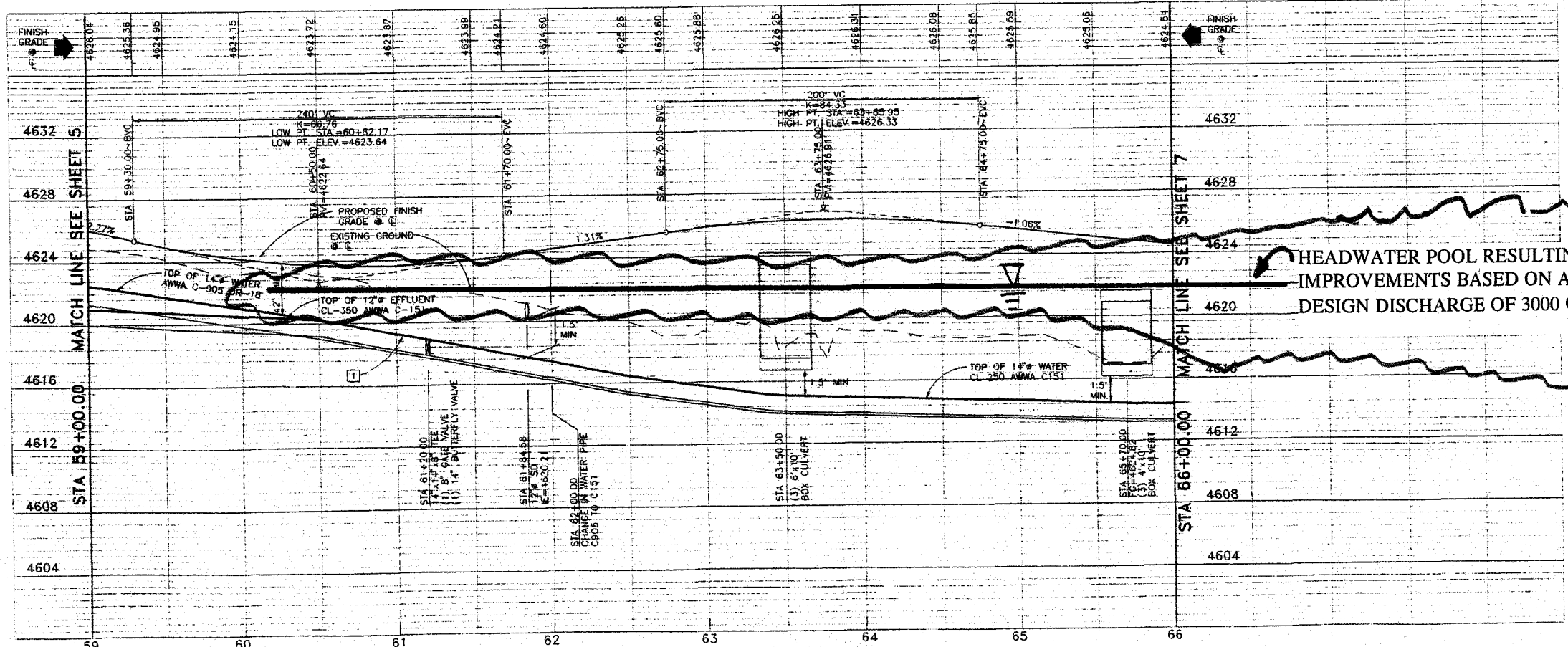
- CONSTRUCTION NOTES:**
- VERTICAL DEFLECTION OF EFFLUENT & WATER LINES SHALL NOT EXCEED 2" PER JOINT, UNLESS STATED OTHERWISE.
 - 2:1 SLOPES SHALL RECEIVE 6" - 12" RIPRAP.
 - GUARD RAIL SHALL CONFORM TO R65-67 OF NDOT STANDARD DETAILS FOR ROAD & BRIDGE CONSTRUCTION, JULY 1995 EDITION. THE FACE OF RAIL SHALL BE LOCATED AT THE BACK OF WALK. CONSTRUCT A 2" SHOULDER AT THE BACK OF WALK AS SHOWN ON PLANS.

CULVERT HEADWALL/WINGWALL ELEVATIONS					
NO.	TW @ HIGH END	BW @ HIGH END	TW @ LOW END	BW @ LOW END	SKEW
A	4826.30	4617.60	4623.90	4621.10	15'
B	4826.50	4617.40	4623.90	4621.60	15'
C	4623.30	4616.50	4619.70	4618.80	0'
D	4626.20	4616.50	4618.50	4617.00	0'
E	4623.30	4617.50	4620.00	4619.80	0'
F	4624.30	4617.50	4619.30	4619.10	0'
G	4624.90	4616.50	4617.70	4617.20	0'
H	4624.60	4616.50	4617.40	4617.00	0'



WEDGE PARKWAY

VERTICAL: 1" = 4'



HORIZONTAL: 1" = 40'

CAUTION - NOTICE TO CONTRACTOR

- THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AND FEATURES AS SHOWN ON THESE PLANS IS BASED ON THE BEST INFORMATION AVAILABLE TO THE ENGINEER. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE.
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THESE LOCATIONS AND/OR ELEVATIONS AT THE PROPOSED POINTS OF CONNECTION AND IN AREAS OF POSSIBLE CONFLICT PRIOR TO BEGINNING CONSTRUCTION. SHOULD THE CONTRACTOR FIND ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, HE SHALL NOTIFY THE ENGINEER BEFORE PROCEEDING WITH CONSTRUCTION.
- IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REMOVE OR RELOCATE ALL EXISTING UTILITIES AND FEATURES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS. CONTRACTOR SHALL OBTAIN APPROVALS FROM THE GOVERNING AGENCIES, THE ENGINEER, AND THE UTILITY COMPANIES PRIOR TO SUCH REMOVAL AND/OR RELOCATION.

HEADWATER POOL RESULTING FROM ROADWAY IMPROVEMENTS BASED ON A FLOOD PLAN DESIGN DISCHARGE OF 3000 CFS



BENCH MARK:
EXISTING BRASS CAP FOR SE CORNER
OF SECTION 19, T.8N., R.19E., M.D.M.
ELEVATION=4787.80

ARROWCREEK/WEDGE PARKWAYS EXTENSION
PLAN & PROFILE
WEDGE PARKWAY
WASHOE COUNTY, NEVADA

STATUS OF PLANS:
 PRELIMINARY
 INITIAL SUBMITTAL
 FINAL SUBMITTAL
 PLANS ARE FOR INFORMATION ONLY AND SUBJECT TO CHANGE WITHOUT NOTICE. APPROVED BY ALL APPROPRIATE GOVERNING AGENCIES.

DATE: 2/23/98

DATE: 11/21/97
DATE: 12/12/97
DATE: 2/23/98

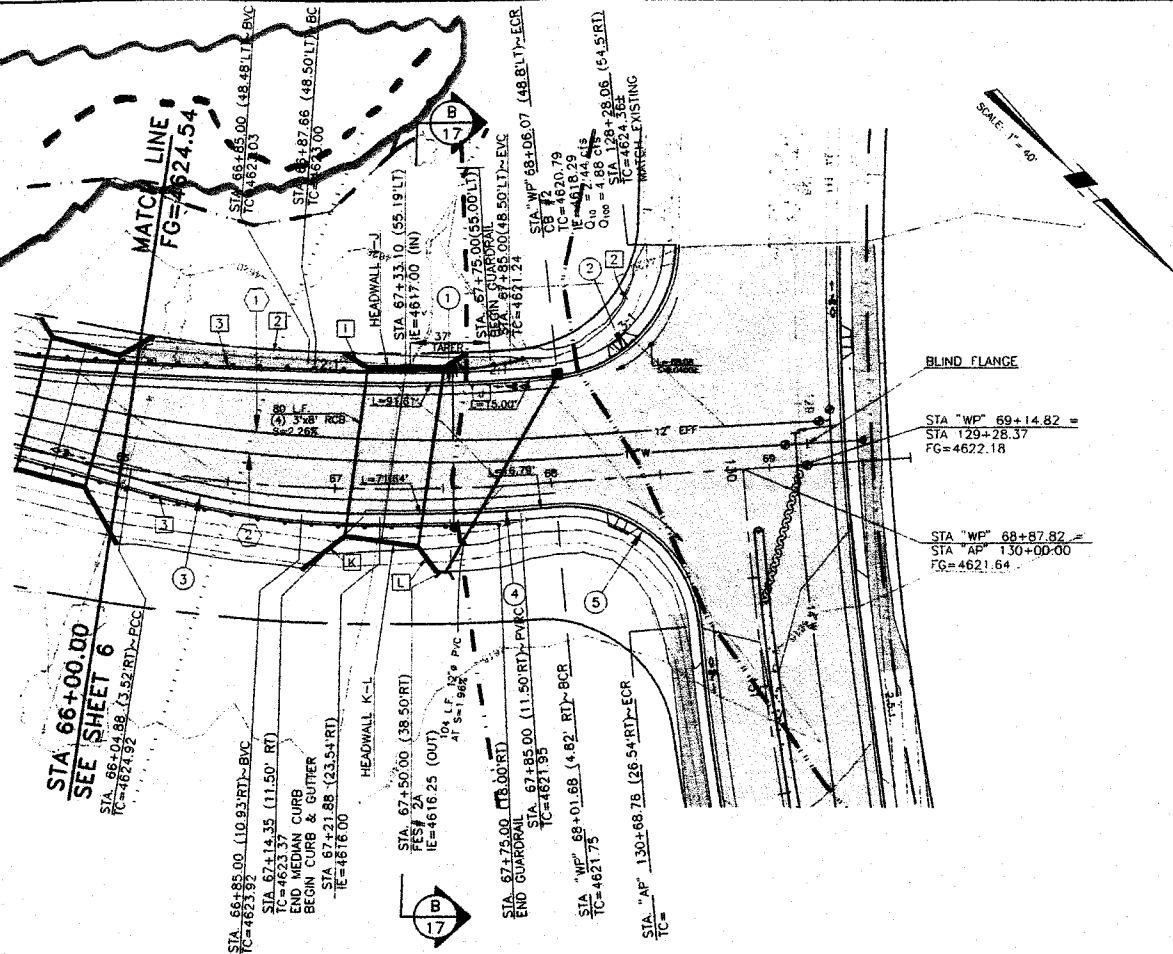
PLANNERS - ENGINEERS - SURVEYORS
LANDSCAPE ARCHITECTS
1150 CORPORATE BLVD. REDO, NV 89502
(702) 855-1150 FAX: (702) 855-1180

FILE NO. X:\PROJECTS\8803 278 VPP.DWG

JOB NO. 88-003.27
DESIGNED BY JAG
PLOT DATE: 2/24/98

SHEET 8 OF 20

FLOOD PLAIN LIMIT MODIFICATIONS RESULTING FROM PROPOSED IMPROVEMENTS BASED ON A FLOOD PLAIN DESIGN DISCHARGE OF 3000 CFS



CURVE TABLE				
NO.	DELTA	RADIUS	LENGTH	TANGENT
1	08°22'07"	771.50'	112.69'	56.44'
2	84°06'29"	60.00'	88.08'	54.13'
3	15°54'16"	400.00'	111.03'	55.88'
4	06°05'36"	831.50'	88.43'	44.26'
5	90°00'00"	60.00'	94.25'	60.01'

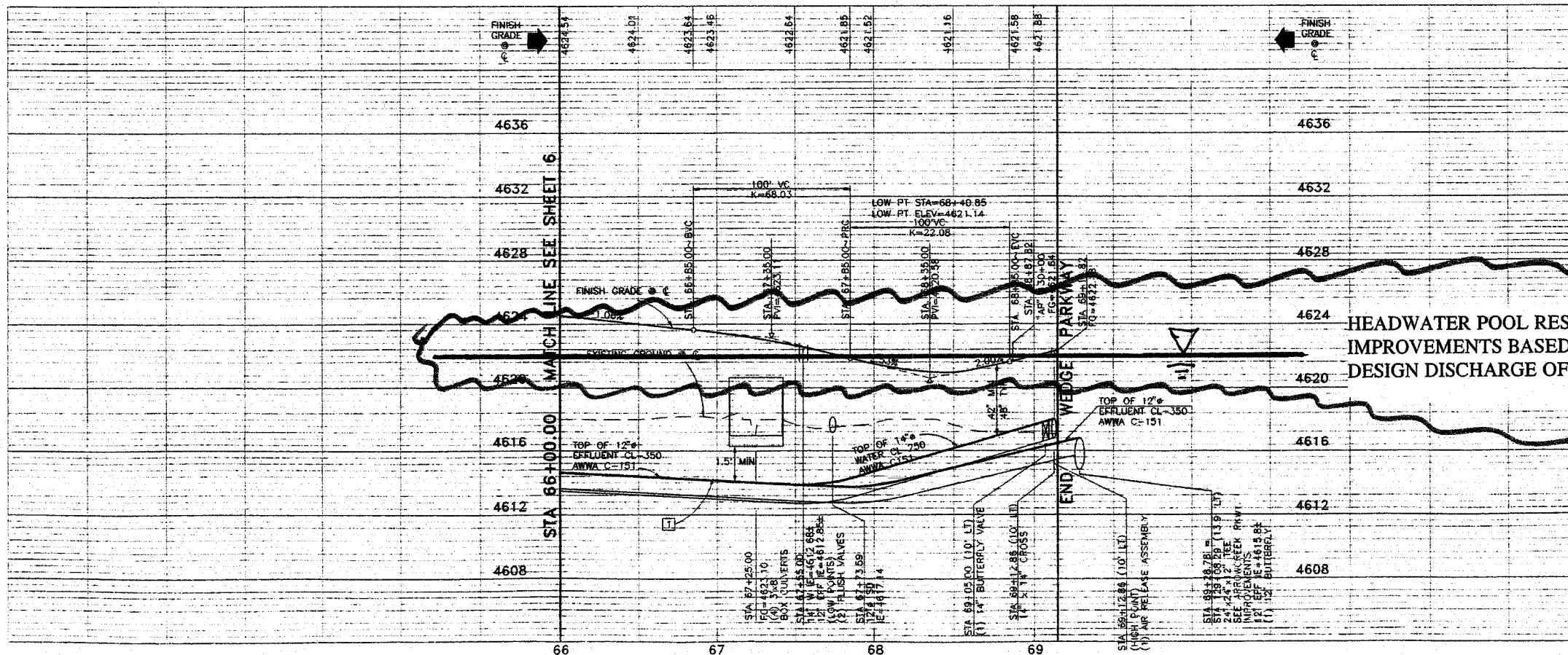
EFFLUENT & WATER CURVE TABLE				
NO.	DELTA	RADIUS	LENGTH	TANGENT
1	50°39'01"	840.00'	742.57'	397.52'
2	50°39'01"	850.00'	751.41'	402.25'

- CONSTRUCTION NOTES:**
- VERTICAL DEFLECTION OF EFFLUENT & WATER LINES SHALL NOT EXCEED 2" PER JOINT, UNLESS STATED OTHERWISE.
 - 2:1 & 2.5:1 SLOPES SHALL RECEIVE 6" - 12" RIPRAP.
 - GUARDRAIL SHALL CONFORM TO R65-67 OF NDOT STANDARD DETAILS FOR ROAD AND BRIDGE CONSTRUCTION, JULY 1993 EDITION. THE FACE OF RAIL SHALL BE LOCATED AT THE BACK OF WALK AS SHOWN ON PLANS.

CULVERT HEADWALL/WINGWALL ELEVATIONS					
NO.	TW @ HIGH END	BW @ HIGH END	TW @ LOW END	BW @ LOW END	SKEW
1	4623.30	4617.00	4620.40	4619.00	15°
2	4622.60	4617.00	4619.40	4619.00	15°
3	4623.10	4616.00	4617.90	4617.20	0°
4	4620.90	4616.00	4616.90	4616.60	0°

WEDGE PARKWAY

VERTICAL: 1" = 4'

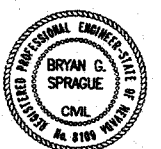


HORIZONTAL: 1" = 40'

HEADWATER POOL RESULTING FROM ROADWAY IMPROVEMENTS BASED ON A FLOOD PLAIN DESIGN DISCHARGE OF 3000 CFS

CAUTION - NOTICE TO CONTRACTOR

- THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AND FEATURES AS SHOWN ON THESE PLANS IS BASED ON THE BEST INFORMATION AVAILABLE TO THE ENGINEER. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE.
- IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THESE LOCATIONS AND/OR ELEVATIONS AT THE PROPOSED POINTS OF CONNECTION AND IN AREAS OF POSSIBLE CONFLICT PRIOR TO BEGINNING CONSTRUCTION. SHOULD THE CONTRACTOR FIND ANY DISCREPANCIES BETWEEN THE CONDITIONS EXISTING IN THE FIELD AND THE INFORMATION SHOWN ON THESE DRAWINGS, HE SHALL NOTIFY THE ENGINEER BEFORE PROCEEDING WITH CONSTRUCTION.
- IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO REMOVE OR RELOCATE ALL EXISTING UTILITIES AND FEATURES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS. CONTRACTOR SHALL OBTAIN APPROVALS FROM THE GOVERNING AGENCIES, THE ENGINEER, AND THE UTILITY COMPANIES PRIOR TO SUCH REMOVAL AND/OR RELOCATION.



BENCH MARK:
EXISTING BRASS CAP FOR SE CORNER OF SECTION 19, T.18N., R.19E., M.D.M. ELEVATION=4787.80

ARROWCREEK/WEDGE PARKWAYS EXTENSION
PLAN & PROFILE
 WASHOE COUNTY NEVADA
 WEDGE PARKWAY

STATUS OF PLANS
 PRELIMINARY
 INITIAL SUBMITTAL
 FINAL SUBMITTAL
 PLANS ARE PRELIMINARY AND SUBJECT TO CHANGE UNTIL STAMPED AND SIGNED APPROVED BY ALL APPROPRIATE GOVERNING AGENCIES

DATE: 11/21/97
 DATE: 12/12/97
 DATE: 2/25/98

PLANNERS • ENGINEERS • SURVEYORS
cfa
 LANDSCAPE ARCHITECTS
 1150 CORPORATE BLVD. RENO, NV 89502
 (702) 858-1150 FAX: (702) 858-1160

JOB NO. 88-003.27
 DESIGNED BY JAG
 PLOT DATE: 2/24/98
 SHEET 9 OF 20

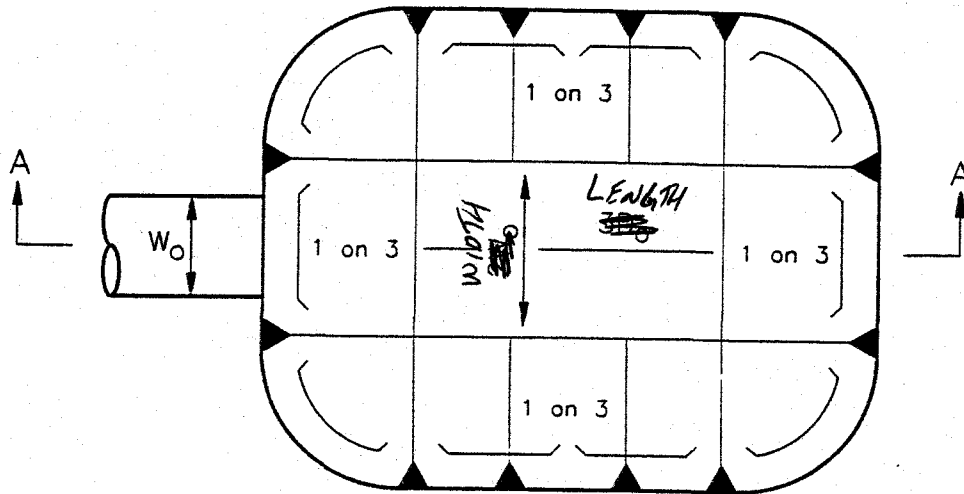
FILE NO.: X:\PROJECTS\88003.27B\VP.DWG

APPENDIX 5

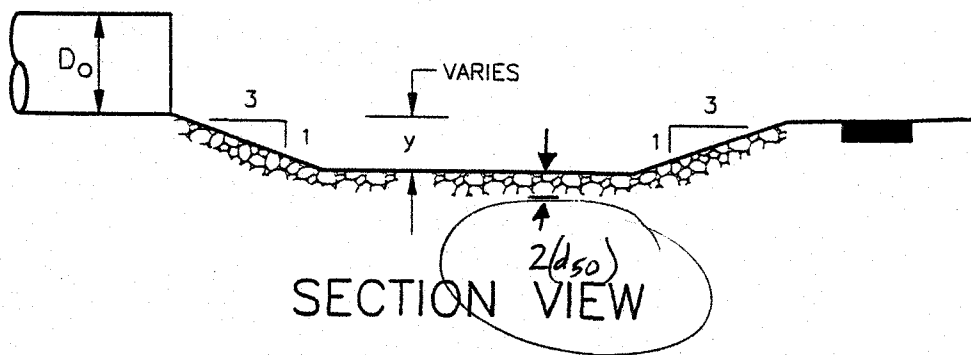
Rip-Rap Sizing Calculations

PREFORMED SCOUR HOLE

<u>STATION</u>	<u>WIDTH</u>	<u>LENGTH</u>	<u>y</u>	<u>d₅₀</u>
67+33	80'	9'	1.5'	1.3'
65+73	90'	12'	2.0'	1.0'
63+37	70'	18'	3.0'	1.2'



PLAN VIEW



SECTION VIEW

1878 1878872.DWG 1.1MS MKCZ.PCP 11-22-98 EJM

VERSION: 00-00-0000

REFERENCE: ASCE, 1975

WRC ENGINEERING, INC.

FIGURE

822



1575 DELUCCHI LANE, SUITE 207A
RENO, NEVADA 89502
PHONE NO. (702) 332-3737
FAX NO. (702) 332-3740

JOB NUMBER: 3008 SHEET 1 OF 1
JOB NAME: WEDGE PARKWAY
CALC. BY: MEF DATE 3/6/98
CHKD. BY: DATE / /
REV. BY: DATE / /

SUBJECT: WEDGE PARKWAY CULVERT OUTLET PROTECTION

LOCATION: STATION 67+33

SIZE: (4) 8' x 3' RCB

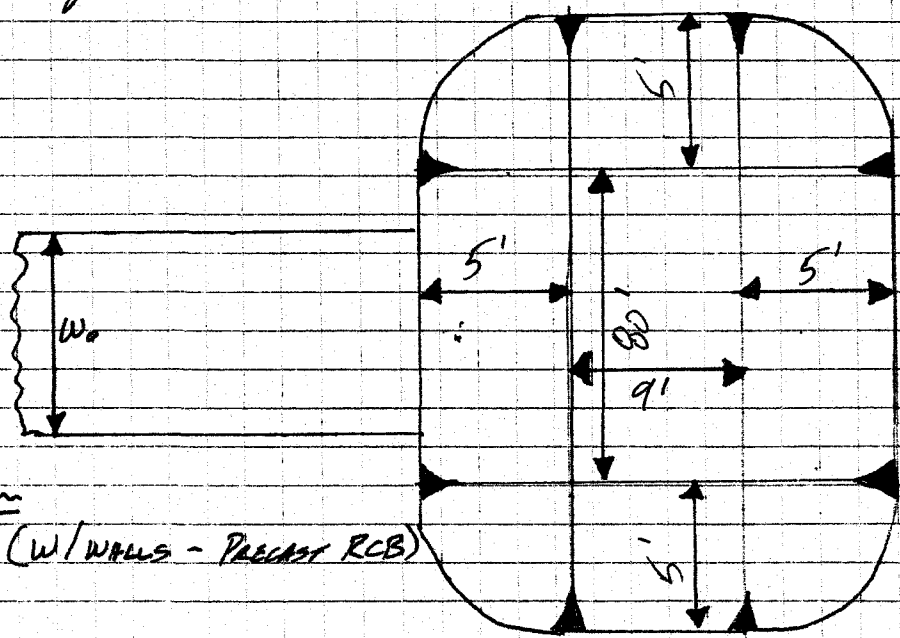
Q_{MAX}: 850 cfs (FOR 3000 cfs EVENT)

Q_{CELL}: 283 cfs

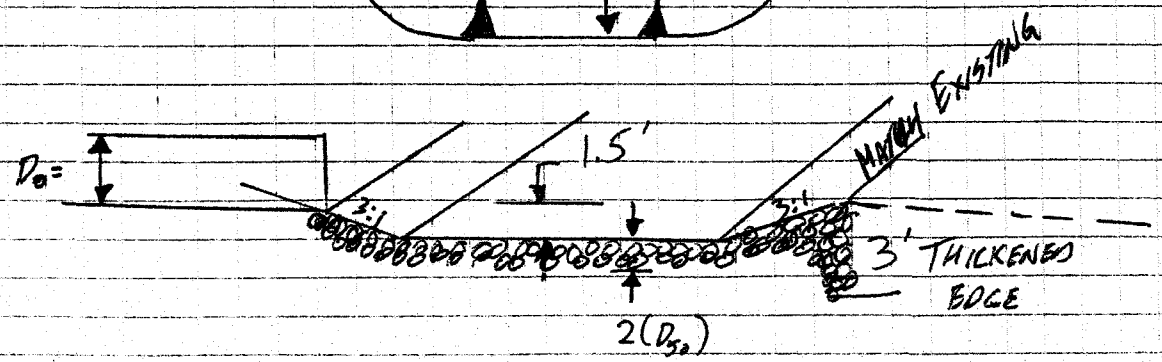
TW DEPTH: ~2.2'

PRE-FORMED SCOUR HOLE DIMENSIONS (FIGURE 822, WRC MANUAL)

FOR $y = D_o/2$ USING DATA FROM HY8 ANALYSIS



$w_o \approx$
(W/WALLS - PRECAST RCB)





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 RENO, NEVADA 89502
 PHONE NO. (702) 332-3737
 FAX NO. (702) 332-3740

JOB NUMBER: 3008 SHEET OF
 JOB NAME: WEDGE PARKWAY
 CALC. BY: MEF DATE 3/6/98
 CHKD. BY: DATE / /
 REV. BY: DATE / /

SUBJECT: WEDGE PARKWAY CULVERT OUTLET PROTECTION

Rip-Rap Springs - Station 67+33

For $Y = D_o/2$ EQUATION 829

$$d_{50} = \frac{0.0125 (Q)^{4/3}}{TW (D_o)}$$

$$= \frac{0.0125 (283)^{4/3}}{(2.2 \times 8)}$$

$Q = 283$
 $D = 8'$
 $TW = 2.2'$

$d_{50} = 1.3'$

For Comparison using FAWA HEC-14

$$Froude \# = \frac{V_{AVE}}{\sqrt{(32.2 \times Y_e)}}$$

$$= 2.29$$

$$V_{AVE} = \frac{Q}{A} = \frac{283}{(1.95 \times 8)}$$

$$= 18.14 \text{ ft/s}$$

$Y_e = 1.95$ from HY8

$$\frac{h_s}{Y_e} = \frac{\text{Scour Hole Depth}}{Y_e} = \frac{1.5}{1.95} = 0.77$$

From HEC-14 FIGURE X1-2 : $0.61 \leq \frac{d_{50}}{Y_e} \leq 0.7$

For $\frac{d_{50}}{Y_e} = 0.61$ $d_{50} = 1.2'$

For " = 0.7 $d_{50} = 1.4'$

$\therefore d_{50} = 1.3$ OK



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 FAX NO. (702) 332-3740

JOB NUMBER: 3008 SHEET 1 OF
 JOB NAME: WEDGE PARKWAY
 CALC. BY: HEF DATE 3/6/98
 CHKD. BY: DATE / /
 REV. BY: DATE / /

SUBJECT: WEDGE PARKWAY CULVERT OUTLET PROTECTION

LOCATION: STATION 65+73

SIZE: (3) 4'x10'

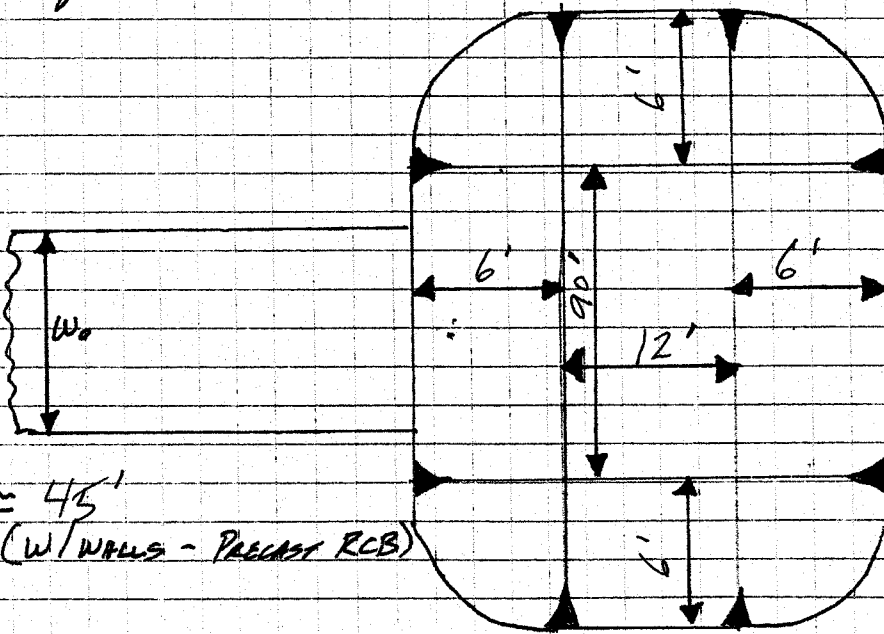
Q_{max} : 850 cfs (FOR 3000 cfs EVENT)

Q_{coll} : 283 cfs

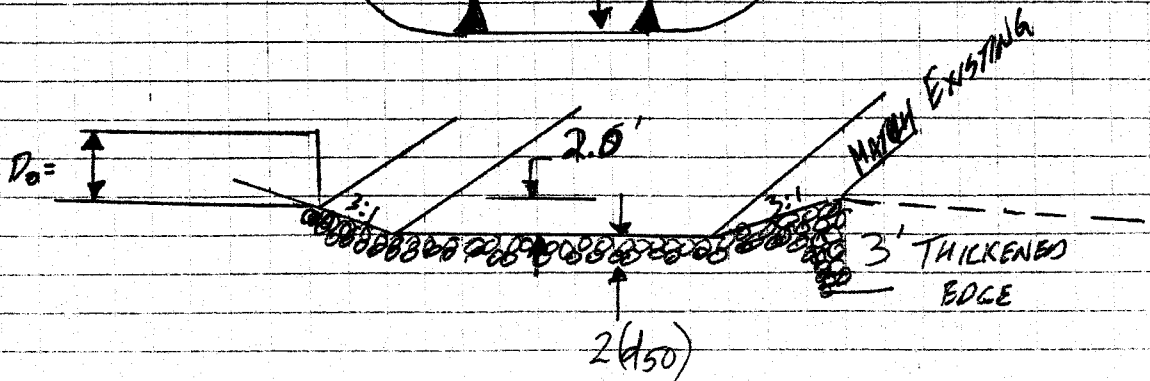
TW DEPTH: 2.3'

PRE-FORMED SCOUR HOLE DIMENSIONS (FIGURE 822, WRC MANUAL)

FOR $y = D_o/2$



$W_o \approx 4.5'$
 (W/WALLS - PRECAST RCBS)





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 RENO, NEVADA 89502
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 FAX NO. (702) 332-3740

JOB NUMBER: _____ SHEET _____ OF _____

JOB NAME: _____

CALC. BY: _____ DATE ___/___/___

CHKD. BY: _____ DATE ___/___/___

REV. BY: _____ DATE ___/___/___

SUBJECT: _____

RIP RAP GRINK - STATION 65+73

For $Y = D_o/2$ (EQ. 829)

$$d_{50} = \frac{0.0125 (Q)^{4/3}}{TW (D_o)}$$

$$Q = 283 \text{ cfs}$$

$$TW = 2.3'$$

$$D_o = 10'$$

$$= \frac{0.0125 (283)^{4/3}}{(2.3)(10)}$$

$$= 1.0'$$

BASED ON FHWA - HEC-14

$$FROUDE \# = \frac{V_{AVE}}{\sqrt{32.2(Y_e)}} = 1.70$$

$$V_{AVE} = \frac{283}{(2.05)^{10}} = 13.8$$

$$Y_e = 2.05$$

$$\frac{h_g}{Y_e} = \frac{2}{2.05} = 0.98$$

FROM FIGURE XI-2 $0.41 \leq \frac{d_{50}}{Y_e} \leq 0.50$

$$\text{FOR } \frac{d_{50}}{Y_e} = 0.41 \Rightarrow d_{50} = 0.84$$

$$\text{FOR } \frac{d_{50}}{Y_e} = 0.5 \Rightarrow d_{50} = 1.03$$

$$\therefore d_{50} = 1.0 \text{ OK}$$



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 FAX NO. (702) 332-3740

JOB NUMBER: 3008 SHEET 1 OF
 JOB NAME: WEDGE PARKWAY
 CALC. BY: MEF DATE 3/6/98
 CHKD. BY: DATE / /
 REV. BY: DATE / /

SUBJECT: WEDGE PARKWAY CULVERT OUTLET PROTECTION

LOCATION: STATION 63+37

SIZE: (3) 6' x 10' RCBS

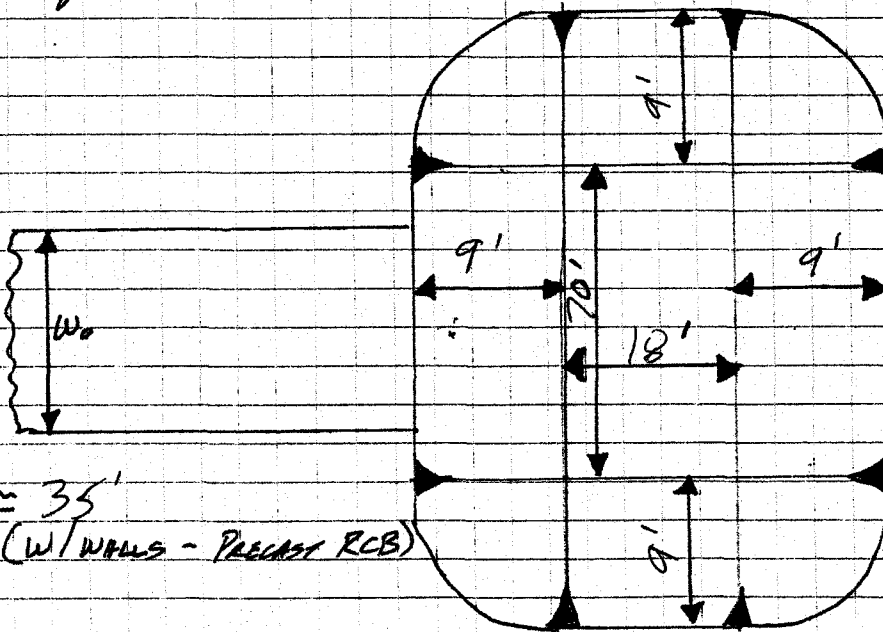
Q_{MAX} : 860 cfs (FOR 3000 CFS EVENT)

Q_{CALL} : 287 cfs

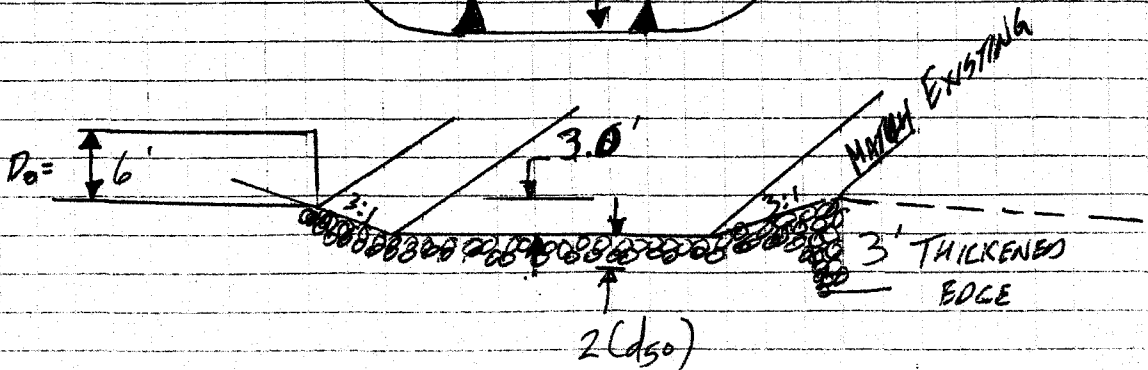
TW DEPTH: 2'

PRE-FORMED SCOUR HOLE DIMENSIONS (FIGURE 822, WRC MANUAL)

FOR $y = D_o/2$



$W_o \approx 35'$
 (W/WALLS - PRECAST RCB)





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 FAX NO. (702) 332-3740

JOB NUMBER: _____ SHEET ____ OF ____

JOB NAME: _____

CALC. BY: _____ DATE ___/___/___

CHKD. BY: _____ DATE ___/___/___

REV. BY: _____ DATE ___/___/___

SUBJECT: _____

RIP-RAP SIZING - STATION 63+37

For $Y_0 = D_0/2$ (EQ 629)

$$d_{50} = \frac{0.0125 (Q)^{4/3}}{TW(D_0)}$$

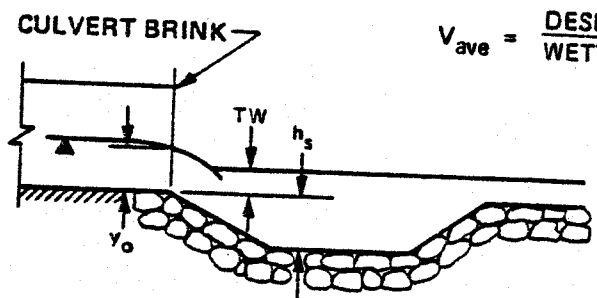
$$Q = 287 \text{ cfs}$$

$$TW = 2.0'$$

$$D_0 = 10'$$

$$= \frac{0.0125 (287)^{4/3}}{TW(D_0)}$$

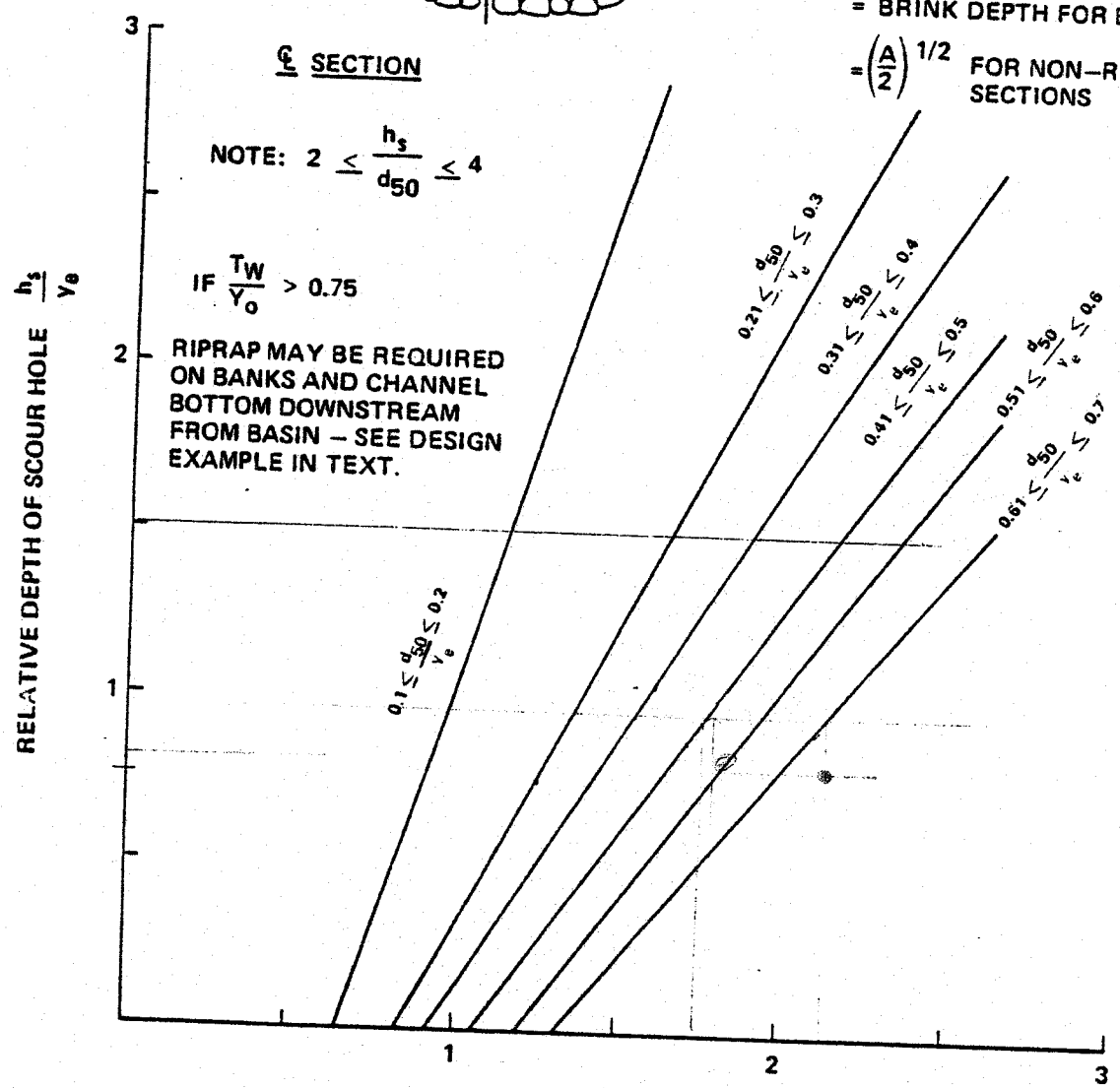
$$d_{50} = 1.2'$$



$$V_{ave} = \frac{\text{DESIGN DISCHARGE} - Q}{\text{WETTED AREA AT BRINK OF CULVERT}}$$

d_{50} = THE MEDIAN SIZE OF ROCK BY WEIGHT. ROUNDED ROCK OR ANGULAR ROCK.

Y_e = EQUIVALENT BRINK DEPTH = BRINK DEPTH FOR BOX CULVERT = $\left(\frac{A}{2}\right)^{1/2}$ FOR NON-RECTANGULAR SECTIONS



$$\text{FROUDE NUMBER} = \frac{V_{ave}}{\sqrt{(32.2)(Y_e)}}$$

SOURCE: FHWA HEC-14 "HYDRAULIC DESIGN OF ENERGY DISSIPATORS FOR CULVERTS AND CHANNELS" 1983.

FIGURE X1-2. RELATIVE DEPTH OF SCOUR HOLE VERSUS FROUDE NUMBER AT BRINK OF CULVERT WITH RELATIVE SIZE OF RIPRAP AS A THIRD VARIABLE



WRC NEVADA, INC.

1575 DELUCCHI LANE, SUITE 207A
 RENO, NEVADA 89502
 PHONE NO. (702) 332-3737
 FAX NO. (702) 332-3740

JOB NUMBER: 3008 SHEET 4 OF 4

JOB NAME: WEDGE PARKWAY

CALC. BY: SKG DATE 12/16/97

CHKD. BY: MEF DATE 12/16/97

REV. BY: DATE / /

SUBJECT: WEDGE PARKWAY CULVERT OUTLET RIPRAP SIZING

WEDGE A

SINGLE 18" DIA. RCP

 $Q_{DESIGN} = 10 cfs$

TAILWATER = 1.0 ft

RIPRAP SIZING

FOR $Y = D/2$

$$d_{50} = \frac{0.0125 (10)^{4/3}}{(10)(1.5)}$$

$$d_{50} = 0.18 \text{ ft} \\ = 2.15 \text{ INCH} \Rightarrow \underline{\underline{\text{USE } d_{50} \text{ MIN } 4" \phi}}$$

FOR $Y = D_0$

$$d_{50} = \frac{0.0082 (10)^{4/3}}{(1.0)(1.5)}$$

$$d_{50} = 0.12 \text{ ft} \\ = 1.41 \text{ INCH} \Rightarrow \underline{\underline{\text{USE } d_{50} \text{ MIN } 4" \phi}}$$