DRAINAGE AND TRANSPORTATION INFORMATION SHEET
(Rev. 12/2005)

PROJECT TITLE: Preliminary Hydraulic Analysis for Mirehaven Arroyo Crossing ZONE MAP/DRG. FILE: H-9 / D013
DRB#: _____ EPC: _____ WORK ORDER: _____

LEGAL DESCRIPTION: Tierra Pintada

CITY ADDRESS: _____

ENGINEERING FIRM: Bohannan Huston, Inc CONTACT: Craig W. Hoover, P.E.
ADDRESS: 7500 Jefferson ST NE PHONE: 505-798-7835
CITY, STATE: Albuquerque, NM ZIP CODE: 87109

OWNER: Western Albuquerque Land Holding, LLC CONTACT: Jeff Garrett
ADDRESS: P.O. Box 56790 PHONE: 602-427-4064
CITY, STATE: Albuquerque, NM ZIP CODE: 87187

ARCHITECT: _____ CONTACT: _____
ADDRESS: _____ PHONE: _____
CITY, STATE: _____ ZIP CODE: _____

SURVEYOR: _____ CONTACT: _____
ADDRESS: _____ PHONE: _____
CITY, STATE: _____ ZIP CODE: _____

CONTRACTOR: _____ CONTACT: _____
ADDRESS: _____ PHONE: _____
CITY, STATE: _____ ZIP CODE: _____

TYPE OF SUBMITTAL:
- ☒ DRAINAGE REPORT
- ☐ DRAINAGE PLAN 1st SUBMITTAL
- ☐ DRAINAGE PLAN RESUBMITTAL
- ☐ CONCEPTUAL G & D PLAN
- ☐ GRADING PLAN
- ☐ EROSION CONTROL PLAN
- ☐ ENGINEER'S CERT (HYDROLOGY)
- ☐ CLOMR/LOMR
- ☐ TRAFFIC CIRCULATION LAYOUT
- ☐ ENGINEER CERT (TCL)
- ☐ ENGINEER CERT (DRB SITE PLAN)
- ☐ OTHER (SPECIFY)

CHECK TYPE OF APPROVAL SOUGHT:
- ☐ SIA/FINANCIAL GUARANTEE RELEASE
- ☐ PRELIMINARY PLAT APPROVAL
- ☐ S. DEV. PLAN FOR SUB'D APPROVAL
- ☐ S. DEV. FOR BLDG. PERMIT APPROVAL
- ☐ SECTOR PLAN APPROVAL
- ☐ FINAL PLAT APPROVAL
- ☐ FOUNDATION PERMIT APPROVAL
- ☐ BUILDING PERMIT APPROVAL
- ☐ CERTIFICATE OF OCCUPANCY (PERM)
- ☐ CERTIFICATE OF OCCUPANCY (TEMP)
- ☒ GRADING PERMIT APPROVAL
- ☐ PAVING PERMIT APPROVAL
- ☒ WORK ORDER APPROVAL
- ☐ OTHER (SPECIFY):

WAS A PRE-DESIGN CONFERENCE ATTENDED:
- ☐ YES
- ☒ NO
- ☐ COPY PROVIDED

Rec 1/10/12

SUBMITTED BY: _____ DATE: January 10, 2012

Requests for approvals of Site Development Plans and/or Subdivision Plats shall be accompanied by a drainage submittal. The particular nature, location and scope to the proposed development define the degree of drainage detail. One or more of the following levels of submittal may be required based on the following:

1. **Conceptual Grading and Drainage Plan**: Required for approval of Site Development Plans greater than five (5) acres and Sector Plans.
2. **Drainage Plans**: Required for building permits, grading permits, paving permits and site plans less than five (5) acres.
3. **Drainage Report**: Required for subdivision containing more than ten (10) lots or constituting five (5) acres or more.

Bohannan Huston

Engineering
Spatial Data
Advanced Technologies

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Albuquerque, NM
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toll free: 800.877.5332

CLIENT/COURIER TRANSMITTAL

To: Curtis A. Cherne, P.E.
City Hydrologist, Section Manager
City of Albuqerque
P.O. Box 1293
Albuquerque, NM 87103

Phone: (505) 924-3986
Job No.: 20110349.014.01 WRABQ

Requested by: Craig / srd

Date: January 10, 2012

Time Due:
- ☐ This A.M.
- ☒ This P.M.
- ☐ Rush _____
- ☐ By Tomorrow

Job Name: APS-WALH Offsite Infrastr/Studies

DELIVERY VIA

- ☒ Courier ☐ Federal Express
- ☐ Mail ☐ UPS
- ☐ Other

PICK UP

Item: ____

ITEM NO.	QUANTITY	DESCRIPTION
1	1	Mirehaven Arroyo Crossing Design Analysis Report
2	1	Drainage and Transportation Information Sheet

COMMENTS / INSTRUCTIONS

REC'D BY:_____ **DATE:**_____ **TIME:**_____

Bohannan Huston

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January 10, 2012

Curtis A. Cherne, P.E.
City Hydrologist, Section Manager
City of Albuquerque
P.O. Box 1293
Albuquerque, NM 87103

RE: Mirehaven Arroyo Crossing Design Analysis Report

Dear Mr. Cherne:

Enclosed please find one copy of the Mirehaven Arroyo Crossing Design Analysis Report (DAR) and the Drainage and Transportation Information Sheet. A copy of the DAR is also being provided concurrently to the Albuquerque Metropolitan Arroyo Flood Control Authority.

If you have any questions or concerns, please do not hesitate to contact me at 505-798-7835.

Sincerely,

for

Craig W. Hoover, P.E.
Senior Vice President
Water Resources Group

CWH/srd

Enclosures

cc: Brad Bingham, P.E. (w/encl.)

P:\20110349\Correspondence\Letters\Mirehaven COA Cover letter.docx

Bohannan Huston

Engineering
Spatial Data
Advanced Technologies

MEMORANDUM

TO: CURTIS CHERNE, P.E.
CITY OF ALBUQUERQUE
BRAD BINGHAM, P.E.
AMAFCA

FROM: CRAIG HOOVER, P.E.
BOHANNAN HUSTON, INC.
CHAD GRIMSHAW, P.E., CFM
BOHANNAN HUSTON, INC.

DATE: JANUARY 10, 2012

SUBJECT: PRELIMINARY HYDRAULIC ANALYSIS FOR MIREHAVEN ARROYO CROSSING

This technical memorandum is submitted for review and approval by the City of Albuquerque (COA) and the Albuquerque Metropolitan Arroyo Flood Control Authority (AMAFCA). The purpose of this technical memorandum is to present the hydraulic analysis necessary to develop a recommended concept for the proposed crossing at Tierra Pintada Street / Mirehaven Arroyo and associated arroyo improvements immediately upstream and downstream of the proposed crossing structure. This analysis is based upon hydraulic criteria presented in COA's Development Process Manual (DPM) and AMAFCA's Sediment and Erosion Design Guide. The primary results of the hydraulic analysis include the determination of the 100-year water surface elevation (WSEL) at the crossing, the crossing length, and required arroyo improvements. These improvements include the design of the recommended crossing structure as well as riprap-lined training dikes and re-aligned banks immediately upstream and downstream, respectively, of the crossing structure to aid in the stabilization of the arroyo. Specific tasks included: 1) establishing the design (100-year) flow rate for developed conditions from a review of previous hydrologic studies in the project area, 2) developing of hydraulic options to provide a crossing that meets COA's DPM and AMAFCA requirements, 3) obtaining as-built plans for existing utilities and check for potential conflicts with proposed road crossing and foundation, 4) developing conceptual cost estimates for all considered hydraulic options, and 5) providing a conceptual layout of the recommended hydraulic option.

A review of previous hydrologic studies included the following:

- *West I-40 DMP, Volume I, Drainage Management Plan* by BHI in June 2000
- *Revised Drainage Report for The Crossing, Units 1 & 2* by BHI in October 1996
- *Drainage Report for Westland Phase I Subdivision – DRAFT* by BHI in November 1995
- *Las Lomitas Unit IIB - Mirehaven Arroyo Scourwall Analysis and Design* by Avid Engineering Co. in October 1994

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The design flow rate for the Mirehaven Arroyo is based on the flow rates in the arroyo as established by the West I-40 DMP. Per the West I-40 DMP, the developed conditions flow rate in the Mirehaven Arroyo at this location is 1,495 cubic feet per second (cfs).

Hydraulic analysis was based on the following criteria, where applicable:

- Closed conduit sections will be designed as flowing full and, whenever possible, under pressure, unless areas are prone to high sediment potential or adverse backwater conditions
- Street crossing structures shall be capable of passing the 100-year frequency design storm flows
- The hydraulic grade line (HGL) for the 100-year developed conditions flow of 1,495 cfs should not be higher than the proposed roadway surface
- A conduit designed for pressurized conditions may discharge into a body of water (i.e. detention pond), a natural watercourse or arroyo, an open channel (either improved or unimproved), or another closed conduit

This memo discusses the analysis approach, major advantages/disadvantages and approximate cost estimate for the recommended option.

Recommended Option: Triple Reinforced Concrete Pipe Culvert (7.5-foot diameter))

BHI utilized the Drainage Structure Analyzer module within Bentley InRoads Storm and Sanitary XM Edition V08.09.03.06 to appropriately size this reinforced concrete pipe culvert (RCP). Please refer to Appendix A for model output of full-flow culvert capacity. The typical roadway section B-B and proposed roadway profile for Tierra Pintada Street as well as 1-foot contour mapping collected for the project site were used to determine the available headwater depth measured from the upstream invert of the proposed culvert. BHI selected the overtopping elevation as the western right-of-way (ROW) fill elevation of 5,297.3 feet (based on the North American Vertical Datum of 1988). Assuming a maximum out slope of 3:1 (H:V) from the western ROW in the typical roadway section, the low ground (invert) elevation is 5,284.3 feet yielding a maximum allowable headwater depth of 13.0 feet. However, placing the upstream invert of the proposed culvert at this low ground elevation will buck existing grade, given that the downstream invert elevation at a 3:1 out slope would yield 5,285.4 feet.

BHI acquired and reviewed the Mirehaven Arroyo Improvements Design Plans from AMAFCA to explore the possibility of lowering the downstream invert and using a channel-lined transition to restore the channel to existing grade. However, lowering the channel would require a wider cross section that would infringe upon a 15-foot wide maintenance road in the left overbank and a 7-foot wide right overbank. Instead, BHI raised the upstream invert elevation from 5,284.3 to 5,286.5 feet while maintaining the downstream invert elevation at 5,285.4 feet to achieve a minimum pipe slope of 0.5 percent. The resulting maximum allowable headwater depth of 10.8 feet was used for this analysis. This option also includes the conceptual design for two upstream training dikes (one on each side of culvert) and riprap lining along channel bed and banks. Please refer to Figure 1 for the horizontal layout of the proposed box culvert and associated arroyo improvements. The training dikes will consist of compacted soil with eight-foot top widths (2H:1V fore slope, 3H:1V back slope), extending from the culvert headwall to existing ground at approximately 5,293.50 feet in elevation. The training dikes and existing channel banks immediately downstream of the crossing will be lined with wire-enclosed riprap along the fore slopes (facing the channel) at a 1.0-foot thickness, with a minimum toe-down depth of three feet. The wire tied riprap (fore slope armoring) will tie into the culvert headwall through use of steel anchors. Additionally, the channel bed upstream to a distance of one-third the average dike length and downstream to the existing grade control structure will be armored with wire-

enclosed riprap. The channel and bank armoring will extend from the proposed concrete end wall 55-feet downstream to the future drop structure location; vertical riprap extents downstream of the crossing will protect up to the top of existing banks, or seven-feet above the channel invert. The proposed culvert will require a straight headwall (75-feet in length) and end wall (50-feet in length) that will tie into the training dikes and re-aligned downstream banks, respectively, as shown in Figure 1. Finally, cut-off walls will be included as necessary to prevent either piping or headcutting/channel incision.

The estimated construction cost of the triple RCP option is approximately $333,300 not including New Mexico Gross Receipts Tax (see Appendix B for cost estimate). There are a number of existing utilities in Tierra Pintada that could impact the proposed RCPs. Currently, three water lines of various sizes and materials (10" PVC, 36" concrete, 48" concrete) and one eight-inch gas line run parallel to Tierra Pintada Street. According to the as-built plans for Stormcloud Offsite Tierra Pintada Street / Arroyo Vista Blvd dated June 26, 2007, all three water lines have been re-directed with vertical bends to run underneath the Mirehaven Arroyo channel at the downstream end of the proposed crossing, lying approximately 5 and 2 feet below the existing and proposed channel invert, respectively. Although an eight-inch HP coated steel gas line is present within the project area, its vertical depth remains unknown. All horizontal and vertical locations of existing utilities will be confirmed as part of the design phase to avoid utility conflicts.

Recommendation

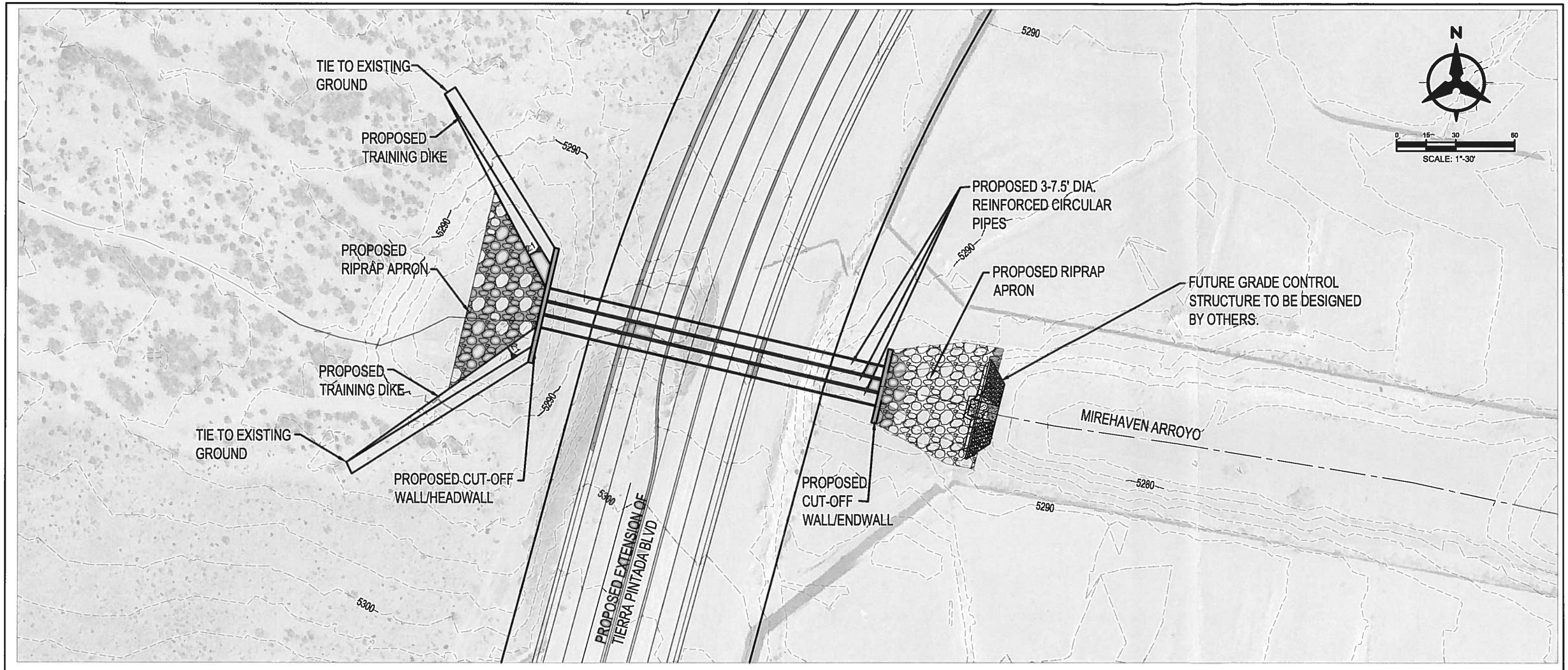
The triple RCP option is the preferred crossing recommendation based on cost, engineering requirements, impacts to aesthetical value and existing utilities, and suitability. This option produces the most desirable combination of the least adverse visual impact and disturbance to the arroyo, while providing the best engineering and cost-effective solution. The analysis and dimensions for this recommended option as described in this memo and shown in Figure 1 will serve as the basis for the design of the proposed triple RCPs and its associated channel improvements.

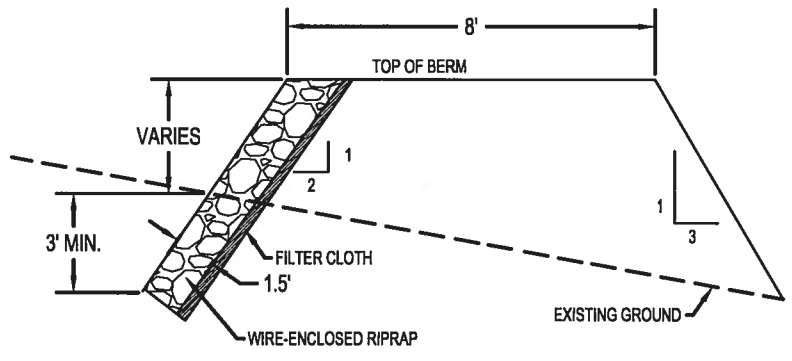
APPENDIX A

Hydraulic Model Output

APPENDIX B

Cost Estimate





TYPICAL DIKE SECTION WITH WIRE-ENCLOSED RIPRAP
NOT TO SCALE

P:\20110349\WR\Design\Plans\20110349_Mirehaven-Structure.dwg
Thu, 5-Jan-2012 - 10:16:am, Plotted by: CGRIMSHAW

Bohannan Huston

MIREHAVEN CROSSING STRUCTURE
FIGURE 1

DRAWN BY:	N.M.P.	DATE:	1-05-12
CHECKED BY:	C.P.G.	PROJECT NO.	20110349

APPENDIX A

Hydraulic Model Output

Mirehaven Full-Flow Capacity_RCPs

Analyzer Report

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Drainage Structure Analyzer

Culvert Hydraulic Analysis

Date: Tuesday, November 29, 2011 14:06:09

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Input Data

Shape	Circular
Material	RC C76-A
Roughness	0.013000
Entrance Edge	Square edge w/ headwall
Number of Barrels	3
Length	220.0000 ft
Slope	0.5000%
Tailwater	4.0000 ft
Inlet Control Equation	Regression
Size (W x T):	90.00 x 7.5000
Headwater	10.8000 ft

Output Results

Flow Rate	1603.4266 cfs
Control	Inlet
Capacity	1628.9021 cfs
Manning's Velocity	14.0101 ft/s
Headwater	10.8000 ft
Critical Depth	5.9710 ft
Normal Depth	6.0436 ft
Size (W x T):	90.00 x 7.5000

APPENDIX B

Cost Estimate

ENGINEERS OPINION OF PROBABLE COSTS
MIREHAVEN ARROYO
for 3-7.5' RCPs

Item No.	Short Description	Long Description	Estimate Unit Price	Quantity	Unit	Estimate Amount
6.050	MOB	Construction Mobilization,compl.	$12,400.00	1	LS	$12,400.00
4.010	STKG	Construction Staking, compl.	$5,000.00	1	LS	$5,000.00
30.010	FLOOD PROTECTION	Flood Protection, compl.	$7,400.00	1	LS	$7,400.00
30.020	NPDES PERMITTING	NPDES Permitting, compl.	$5,000.00	1	LS	$5,000.00
201.010	SITE CLEAR & GRUB	Site Clearing and Grubbing, compl.	$650.00	1	AC	$650.00
501.010	STRUCT, EXCAV/BF/COMP	Excavation, Backfill, and Compaction, related to construction of structures such as box culverts, wing walls, etc.,cip.	$15.00	4,010	CY	$60,150.00
510.100	CUT OFF WALL, PCC	Cut-off Wall, PC Concrete, incl. formwork, cip.	$650.00	30	CY	$19,500.00
603.080	DRAINAGE WIRE ENCLOSED RIPRAP	Wire-enclosed Riprap, cip.	$130.00	560	CY	$72,800.00
603.050	FILTER CLOTH	Filter Cloth, cip.	$0.15	11,500	SF	$1,725.00
701.210	TRCH, BF, >60" SWR, 12'-16'	Trenching, Backfilling, & Compaction, over 60" sewer pipe, 16' to 20' in depth, pipe not incl., compl.	$53.18	220	LF	$11,699.60
910.037	90" RCP, III	90" Reinforced Concrete pipe, Class III, furnish & place in open trench, cip.	$370.00	220	LF	$81,400.00

SUBTOTAL		$277,724.60
Contingency	20%	$55,544.92
SUBTOTAL		$333,269.52
NMGRT @ 7.00%		$23,328.87
GRAND TOTAL		**$356,598.00**

This estimate of construction cost is only an opinion. BHI cannot and does not guarantee that proposals, bids, or actual Construction Costs will not vary from this opinion.

Note:
1. Circular culvert assumed to be on 0-degree skew with design fill "A".
2. Quantities for Wire-Enclosed Riprap and Filter Cloth were based on area measurements of training dikes and channel beds and banks in ACAD. Assumed riprap thickness and toe-down depth of 1.5 feet.
3. Cut-off walls underlie headwall and endwall. Length and width of cut-off walls match those of corresponding endwall.