FINAL

DRAINAGE REPORT

EL DORADO BLVD.

FROM 250 feet north of Woodbourne Drive to Clear Lake City Blvd. El Dorado Blvd.

HARRIS COUNTY PRECINCT 2

UPIN 17102MF0PM01

February 13, 2018

HARRIS COUNTY ENGINEERING DEPARTMENT

PREPARED BY :

Zarinkelk Engineering Services, Inc

617 Caroline St.

Houston, TX 77002

PH: (832) 242 2426

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FIRM REGISTRATION #: F004270

STATE OF TEXAS
MICHAEL J. BAGSTAD
81193
REGISTERED
PROFESSIONAL ENGINEER

Michael Bagstad
2-13-18

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1 Executive Summary

1.1 Authorization

Zarinkelk Engineering Services, Inc. (ZESI) was authorized to provide design and engineering services for the design of El Dorado Blvd. from approximately 250 feet north of Woodbourne Drive to Clear Lake City Blvd. El Dorado Blvd. is currently a one half boulevard section with the northbound lanes serving two-way traffic. The existing two-lane El Dorado Blvd. crosses the HCFCD regulated Horsepen Bayou (B104-00-00) with a three-span box beam bridge.

1.2 Purpose

The proposed project will add two southbound lanes to the roadway. El Dorado Blvd. will add impervious cover to the watershed. The two new southbound lanes of El Dorado Blvd. will cross Horsepen Bayou over a new bridge structure.

The purpose of this report is to present the results of the drainage study that has investigated the impact of the proposed El Dorado Blvd. on Horsepen Bayou within the project limits. The purpose is also to demonstrate that the improvements will be designed in such a way that they will have no impact on Horsepen Bayou.

1.3 Results

1.3.1 Impacts of El Dorado Blvd.

The addition of two new southbound lanes to El Dorado Blvd. will complete the boulevard section. The full boulevard was taken into account in the original design. Storm drain facilities were designed and constructed for the fully developed condition.

1.3.2 Impacts of New Bridge at Horsepen Bayou

The proposed new bridge across Horsepen Bayou will be located upstream of the existing bridge the standard median width of a boulevard section (32 feet).

The result of the addition of the new bridge is a slight increase in the WSEL at the immediate upstream and downstream cross sections. To compensate for this increase, channel lining and channel grading are proposed for portions of the channel beneath the bridge. The revised HEC-RAS model with the new bridge demonstrates that there is no increase in WSEL. The proposed project will cause no adverse impact to the receiving streams for storm events up to and including the 1% chance exceed-ance event.

2 Existing Conditions

2.1 Location

The El Dorado Blvd. project is located in the City of Houston, Harris County, Texas as shown in Exhibit 1- Vicinity Map. The project extends from Clear Lake City Blvd. on the north to approximately 250 feet north of Woodbourne Dr. on the south. It crosses Horsepen Bayou at the south end.

2.2 Flood Zones

According to the Federal Emergency Management Agency's Flood Insurance Rate Maps (FIRM Map Number 48201C1080M) for the project area revised in January 6, 2017, a portion of project area is located within the floodway and the 100-year floodplain of Horsepen Bayou (Exhibit 2). Also, a portion of Clear Lake City Blvd. where it intersects with El Dorado Blvd. is in the 500-year floodplain.

2.3 Right-of-Way

There is sufficient right-of-way (ROW) to complete the construction of the boulevard section. In addition there is open land adjacent to the ROW in an HOA landscape reserve that will be acquired.

2.4 El Dorado Blvd. Outfall

The El Dorado Blvd. storm drain outfalls to Horsepen Bayou through a 36-inch storm drain located west of the existing bridge. There is no proposed change to this outfall.

3 Proposed Improvements

3.1 El Dorado Blvd.

El Dorado Blvd. is currently a half boulevard section. The two northbound lanes are existing. This project will construct the two 12-foot southbound lanes to complete the boulevard section. The existing and proposed typical sections are shown in Exhibit 3. The existing grate inlets located at the curb line of the proposed southbound lanes will be removed and replaced by proposed ‘type BB’ inlets. The outfall to Horsepen Bayou will not be changed with this project.

3.2 Horsepen Bayou

Included with the road improvements is a new southbound bridge over Horsepen Bayou. It is proposed to match the existing bridge profile to minimize the impact on Horsepen Bayou. Matching closely means that the low chord elevations would be the same and the location and spacing of the piers beneath the new bridge match those of the existing bridge. The bridge inspection report of the existing bridge along with the proposed plan and profile on the new bridge are included in the Appendix A.

4 Analysis

4.1 Horsepen Bayou HEC-RAS Model

The proposed expansion of El Dorado Blvd. will cross the HCFCD regulated Horsepen Bayou (B104-00-00) with a three-span box beam bridge. Horsepen Bayou is a FEMA regulated stream with an effective HEC-RAS model, shown in Exhibit 4.

The proposed new bridge across Horsepen Bayou will be located upstream of the existing bridge a distance equal to the standard median width of 32 feet. The bridge inspection report and the proposed plan and profile on the new bridge are included in the Appendix. The piers of the new bridge will match the location of the piers of the existing bridge. In HEC-RAS the existing and proposed bridges are considered parallel. Parallel bridges are modeled as a single bridge in HEC-RAS. The new bridge is wider than the existing bridge. This causes an expected slight increase in the WSEL. A decrease in the average Manning's n value from 0.032 to 0.025 for channel lining and channel grading beneath the bridge are sufficient to counter act the effects of the widened bridge as shown below.

ZESI worked closely with Aviles Engineering, geotechnical sub consultant for the project, to develop a lining scenario consistent with their slope stability calculations. Below the normal water level the lining will consist of articulated block. This lining can be installed without having to dewater the channel. Articulated block has a Manning's n value of 0.03. Above the normal water level up to the high bank, the lining will consist of concrete slope paving with a Manning's n value of 0.015. This gives an average n value of 0.023 for the cross section within the limits of the 100-year WSEL. This lining system will extend upstream from the downstream face of the existing bridge to achieve an average n value for the model of 0.025. The detailed calculations of the composite Manning's n are included in the Appendix B.

Cross sections of both the existing and proposed new bridges are shown in Exhibit 5.

Table 4.1 shows the comparison of WSEL's for the effective model and the proposed model for the 100-year storm. A similar comparison was made for the 10-year storm to ensure that the new bridge will have no impact at both flow regimes. The comparison of the 10-year WSEL's is shown in Table 4.2.

Table: 4.1 – Comparison Results for 100-Year Flow

STATION	WS-Existing Condition	WS-Proposed Condition
16364.84	16.66	16.66
16480.97	16.72	16.72

Table: 4.2 – Comparison Results for 10-Year Flow

STATION	WS-Existing Condition	WS-Proposed Condition
16364.84	13.60	13.60
16480.97	13.64	13.64

While the immediate upstream and downstream cross sections are compared in these tables, review of the entire model output was also completed. It is not uncommon for changes made to the geometry at one location in the HEC-RAS model to cause unanticipated changes to the WSEL in another location of the stream. No such unanticipated changes were observed. The detailed output for both the existing effective and proposed models are included in Appendices C and D.

5 Results and Conclusion

5.1 El Dorado Blvd.

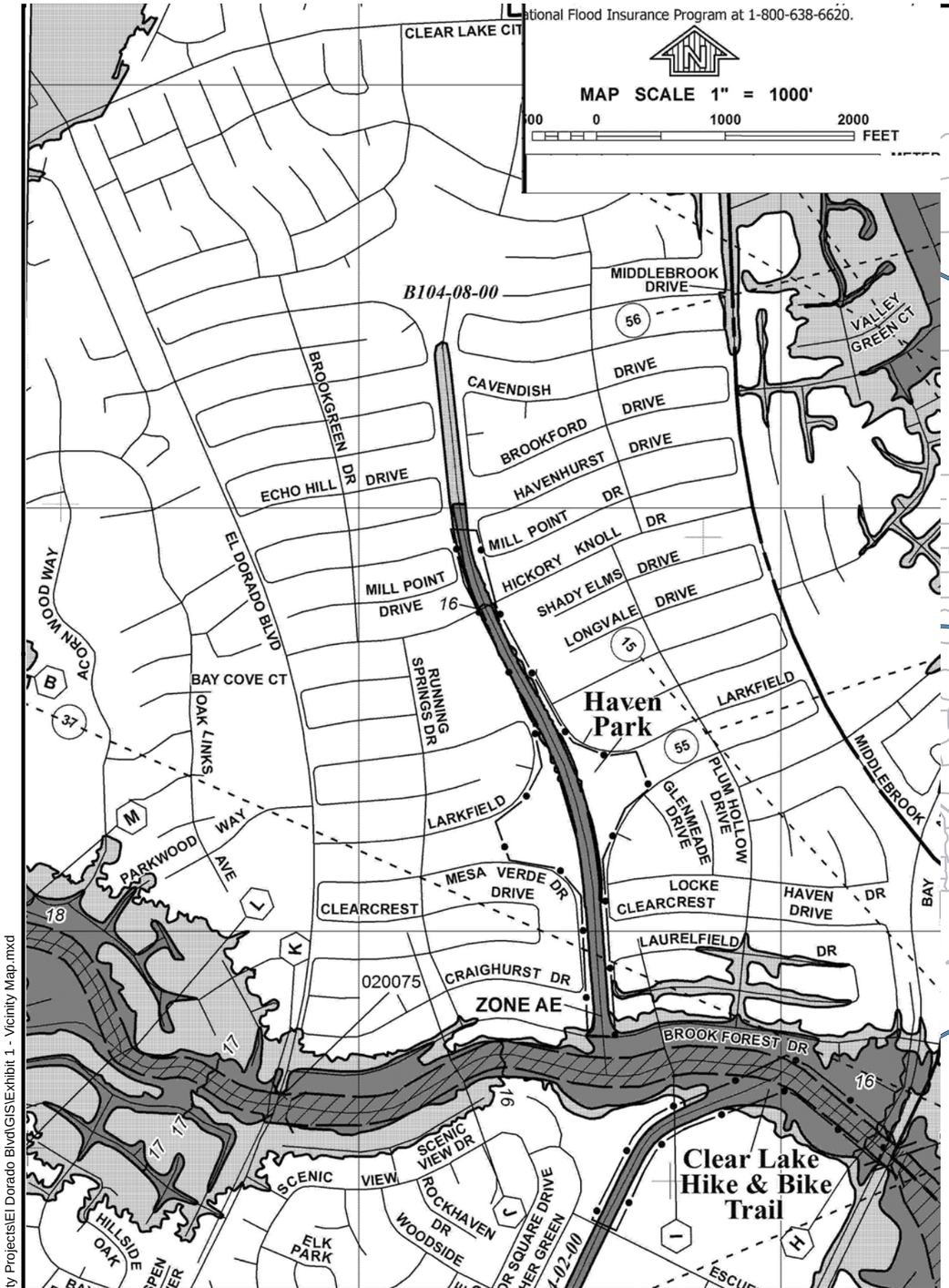
Existing drainage improvements along El Dorado Blvd. including the placement of inlets at the approximate location of the future west curb of the southbound lanes suggests that the future expansion of El Dorado Blvd. was included in the previous planning and design efforts. The detailed modeling prepared for this drainage study confirms that assumption.

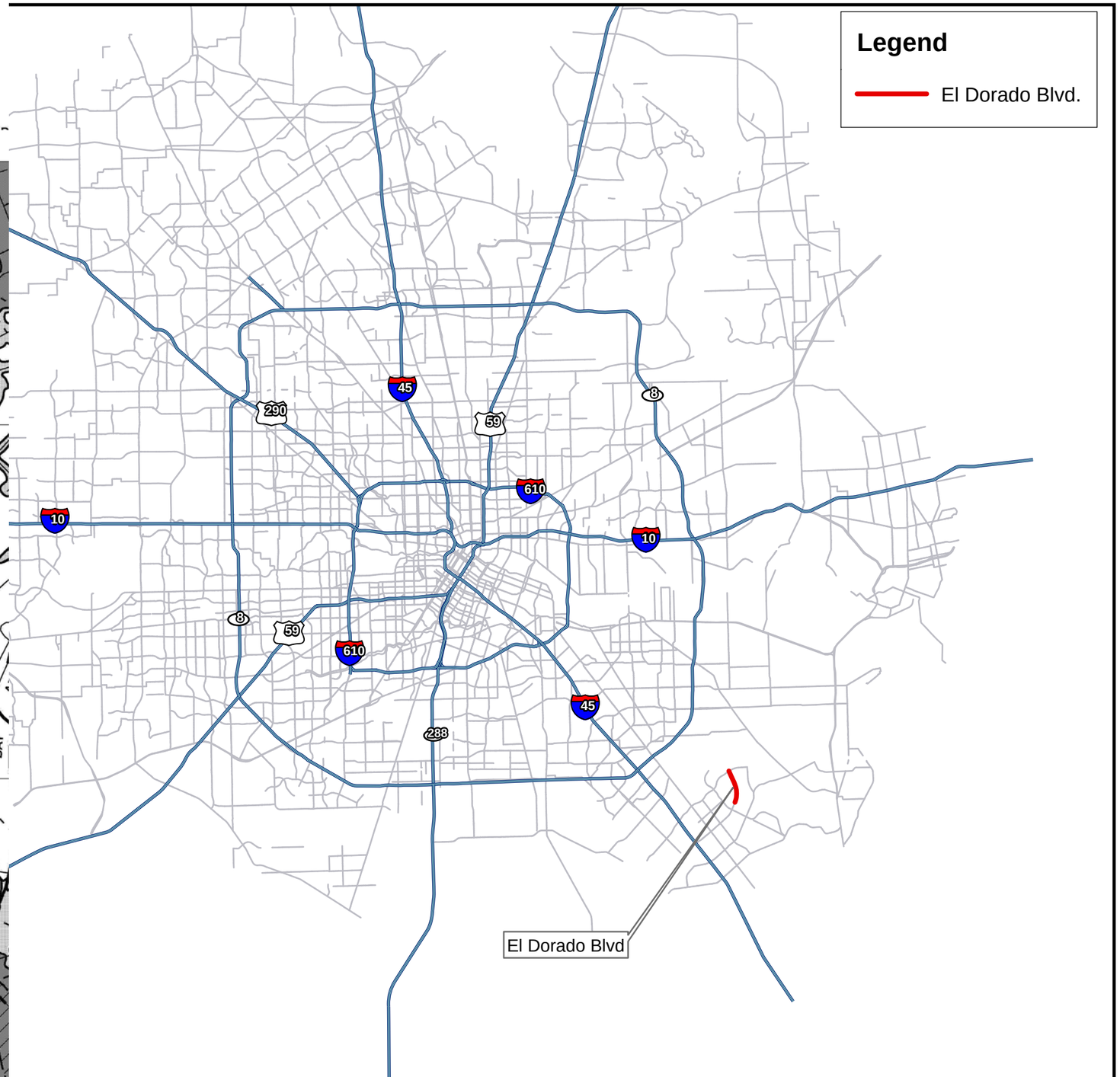
5.2 Horsepen Bayou

The proposed new crossing of Horsepen Bayou with the southbound El Dorado Blvd. bridge will cause a slight increase in the WSEL of the effective HEC-RAS model. Channel grading and lining improvements counter this effect and maintain a WSEL at or below the effective model. The proposed project will cause no adverse impact to the

receiving streams for storm events up to and including the 1% chance exceedance event.

Exhibits





KEY MAP NO. 578Y
FEMA FIRM # 48201C1080M

Harris County Mobility Projects
El Dorado Blvd
Clear Lake City Blvd. to Horsepen Bayou

Zarinkelk Engineering Services Inc.
617 Caroline St.
Houston, TX 77002
PH: 832-242-2426 FAX: 832-242-2445
Reg. No. F-004270

EXHIBIT 1
VICINITY MAP

Harris County - Unincorporated Area

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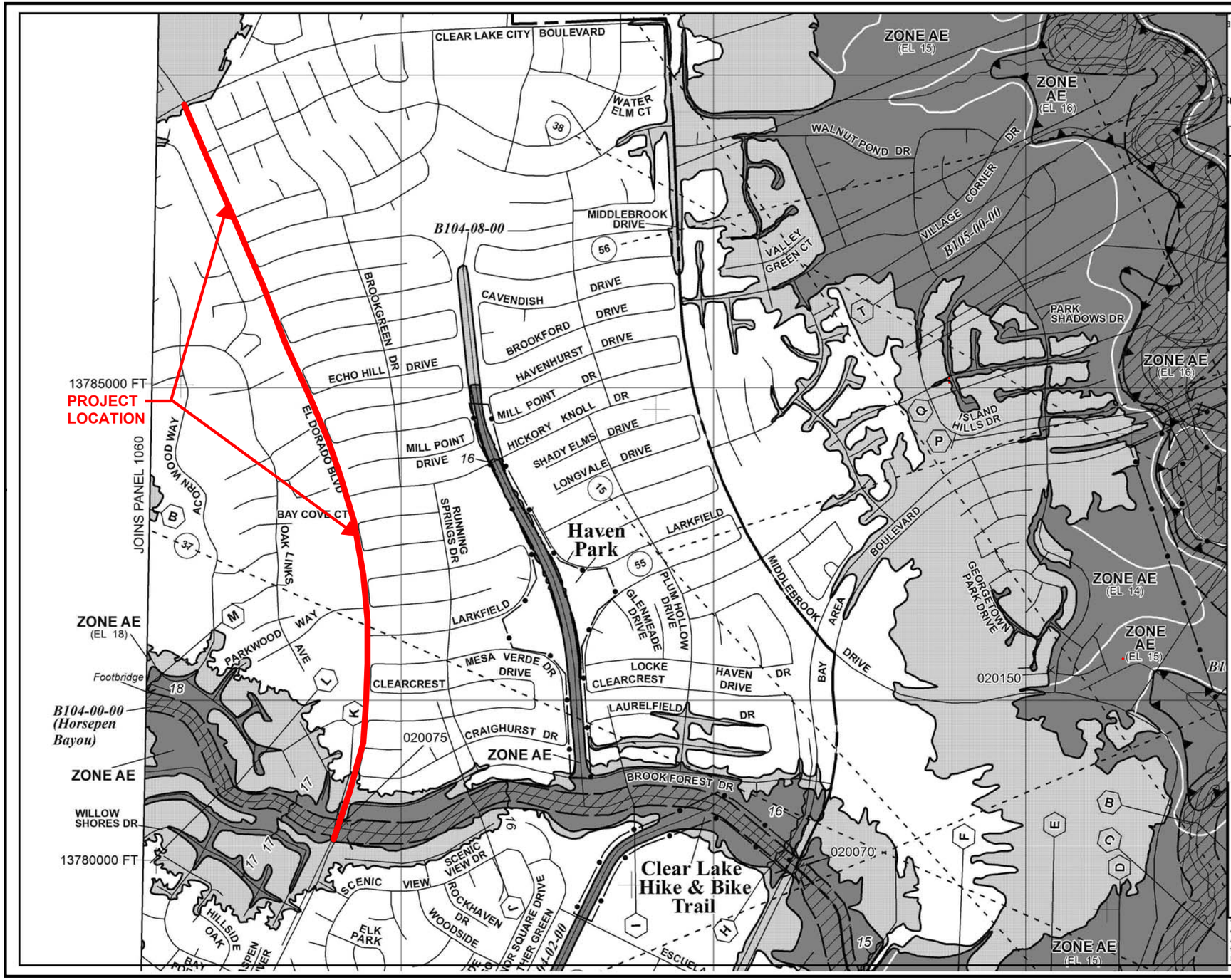

tional Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

00 0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1080M

FIRM

FLOOD INSURANCE RATE MAP

HARRIS COUNTY, TEXAS
AND INCORPORATED AREAS

PANEL 1080 OF 1150
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
HARRIS COUNTY	480287	1080	M
HOUSTON, CITY OF	480296	1080	M
PASADENA, CITY OF	480307	1080	M
TAYLOR LAKE VILLAGE, CITY OF	485513	1080	M

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

MAP NUMBER
48201C1080M

MAP REVISED
JANUARY 6, 2017

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

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KEY MAP NO. 578Y
FEMA FIRM # 48201C1080M

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EXHIBIT 2
FEMA FIRM # 48201C1080M
Harris County - Unincorporated Area

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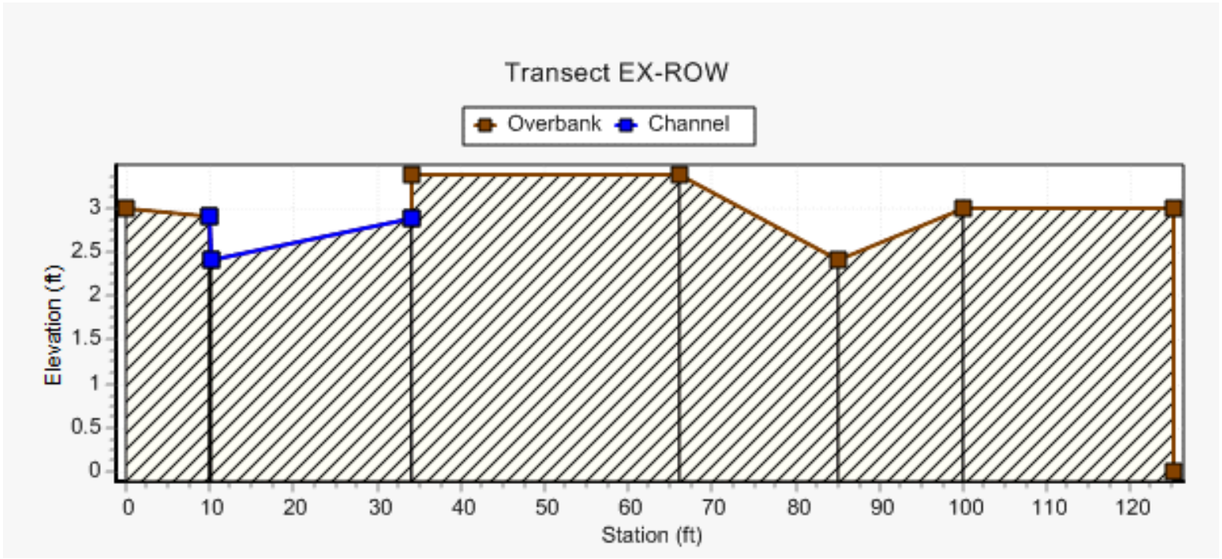

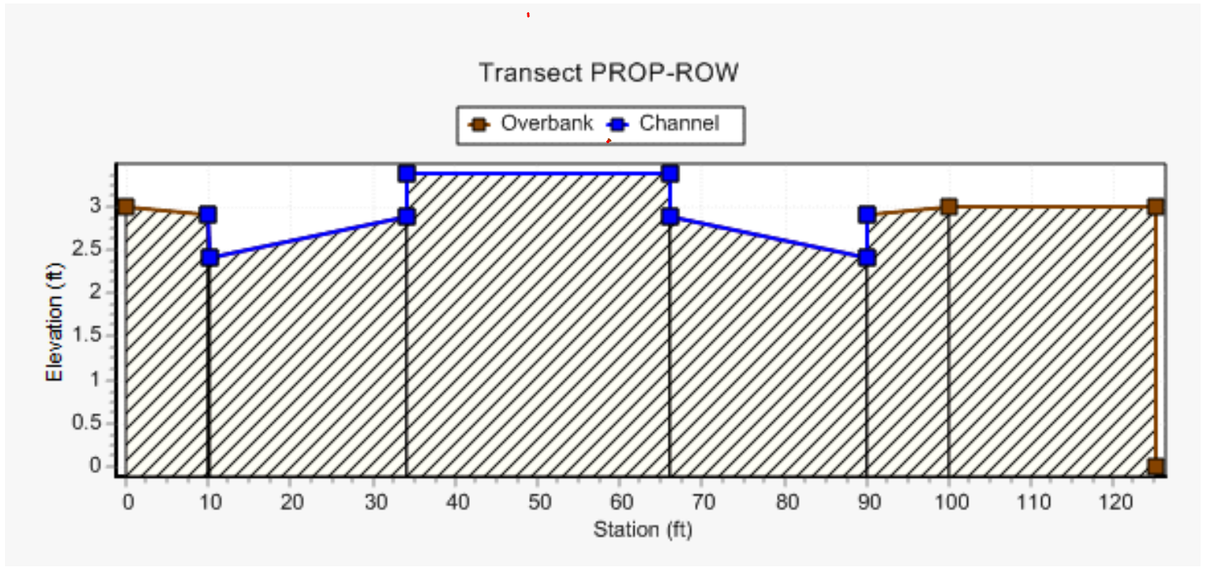

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KEY MAP NO. 578Y
FEMA FIRM # 48201C1080M

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El Dorado Blvd
Clear Lake City Blvd. to Horsepen Bayou

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PH: 832-242-2426 FAX: 832-242-2445
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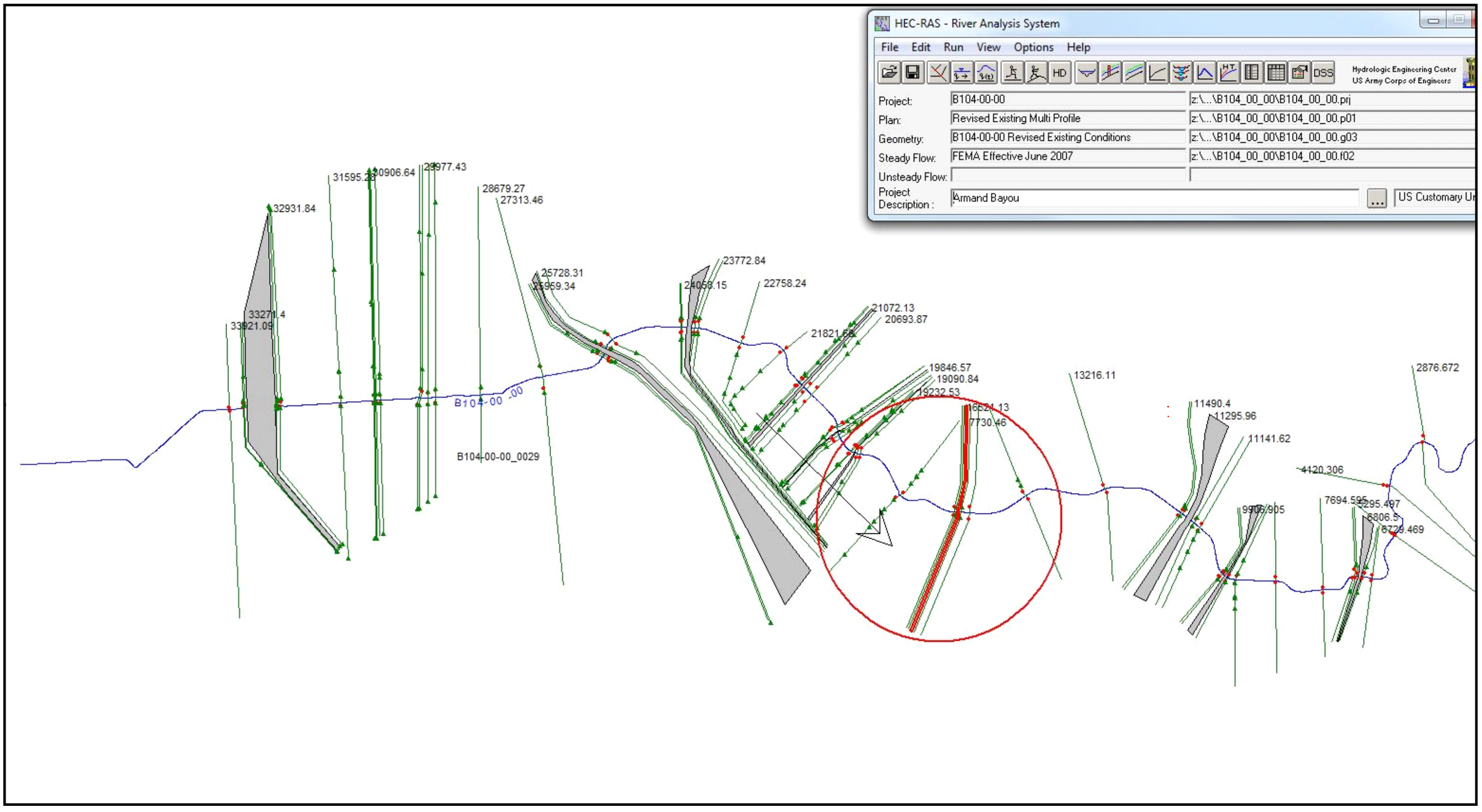
EXHIBIT 3
TYPICAL ROADWAY SECTIONS
Harris County - Unincorporated Area



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KEY MAP NO. 578Y
FEMA FIRM # 48201C1080M

Harris County Mobility Projects
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Clear Lake City Blvd. to Horsepen Bayou

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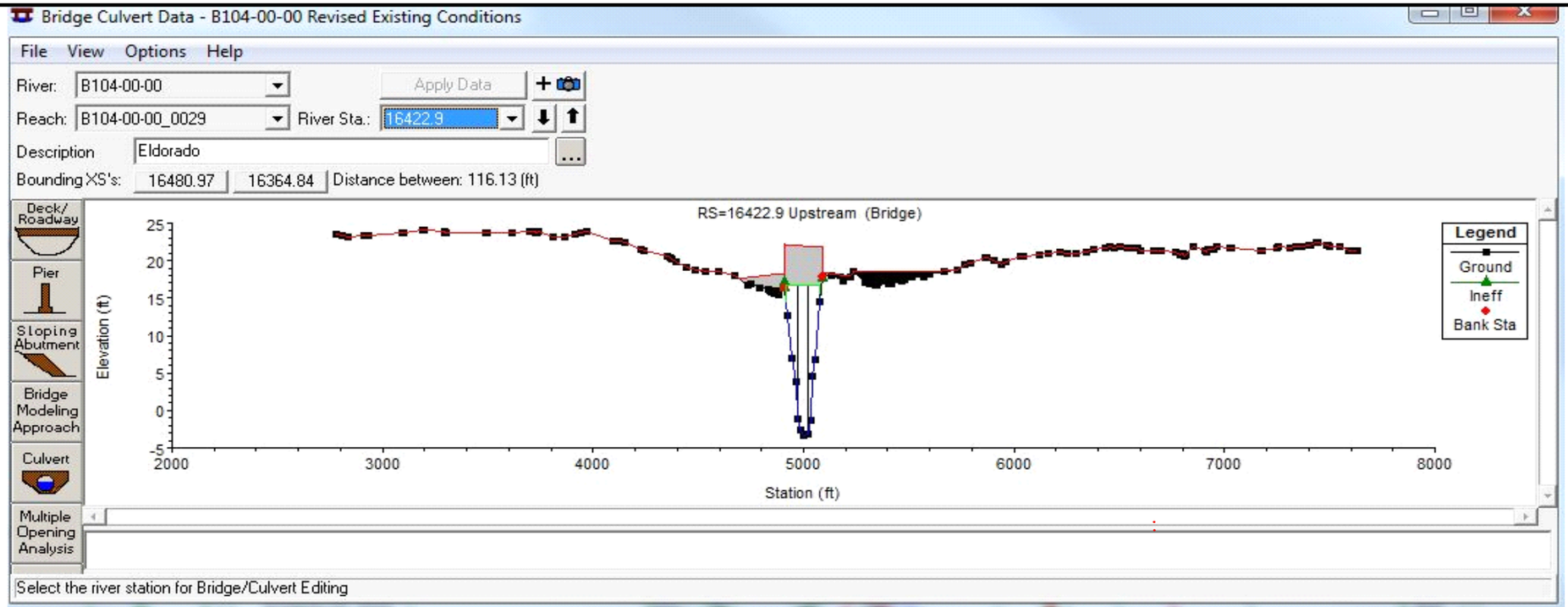
EXHIBIT 4
HORSEPEN BAYOU EFFECTIVE HEC-RAS MODEL
Harris County - Unincorporated Area



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KEY MAP NO. 578Y
FEMA FIRM # 48201C1080M

Harris County Mobility Projects
El Dorado Blvd
Clear Lake City Blvd. to Horsepen Bayou

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Reg. No. F-004270

EXHIBIT 5
EL DORADO BRIDGE CROSS SECTIONS EXISTING AND PROPOSED
Harris County - Unincorporated Area

Appendix A –
Bridge Inspection Report of Existing Bridge

Bridge Inspection Record

Texas Department of Transportation
Form 1085-R

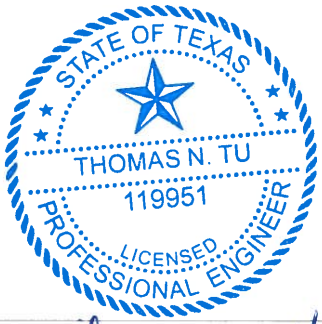
District: 12 County: 102 Cont-Sec: B219-05 Structure: 641 Route: EL DORADO BLVD Maint Sect:

Description: **Three Simple Span Prestressed Concrete Box Beam Bridge On Concrete Pile Bents**

Feature Crossed: **HORSEPEN BAYOU** Inspector's Signature: Date: **10/21/2015**

Company Name: **Barnhart Constructors, Inc. [F-669]** Inspector: **Thomas Tu, P.E.**

Rating	Description
-	- Not Applicable
9	- Excellent condition
8	- Very good condition
7	- Good condition - some minor problems
6	- Satisfactory condition - minor deterioration of structural elements (limited)
5	- Fair condition - minor deterioration of structural elements (extensive)
4	- Poor condition - deterioration significantly affects structural capacity
3	- Serious condition - deterioration seriously affects structural capacity
2	- Critical condition - bridge should be closed until repaired
1	- Failing condition - bridge closed but repairable
0	- Failed condition - bridge closed but beyond repair



11/24/2015

Deck (Item 58)

Min.			Rating
1	Deck - Rating Concrete	(1)	6
6	Wearing - Surface		-
6	Joints, Expansion, Open		-
6	Joints, Expansion, Sealed	(2)	7
6	Joints, Other		-
6	Drainage System		8
6	Curbs, Sidewalks & Parapets	(3)	7
6	Median Barrier		-
6	Railings	(4)	7
7	Railing Protective Coating	(5)	7
7	Delineation (curve markers)		-
	Other		-

Comments:

(1) Bridge deck surface has widespread minor map cracks, moderate scaling with exposed aggregate, minor spalls along deck joint over north interior bent and minor longitudinal cracks along beam joints. See photo.

(2) Minor to moderate debris has accumulated in strip seal expansion joints. Bridge deck has minor spalls along deck joint over north interior bent.

(3) Sidewalks and curbs have minor transverse cracks.

(4) Bridge rails have minor cracks.

(5) Chain link fence has minor rust in surface.

Superstructure (Item 59)

Min.			Rating
0	Main Members - Steel		-
0	Main Members - Concrete	(1)	7
0	Main Members - Timber		-
0	Main Members - Connections		-
1	Floor System Members		-
1	Floor System Connections		-
5	Secondary Members		-
5	Secondary Member Connections		-
6	Expansion Bearings		8
6	Fixed Bearings		8
6	Steel Protective Coating		-
	Other		-
	Component rating		7

Comments:

(1) West exterior beam in south span has a minor diagonal crack over west end of south abutment cap. Several beams have minor chips in soffit.

District: 12 County: 102 Cont-Sec: B219-05 Structure: 641 Route: EL DORADO BLVD Maint Sect:

Substructure (Item 60)

Min.			Rating
0	Abutment Caps		8
0	Above Ground		-
0	Below Ground or Foundation	(1)	7
0	Backwalls & Wingwalls	(2)	7
0	Intermediate Supports		
	Caps - Concrete	(3)	7
	Caps - Steel		-
	Caps - Timber		-
	Above Ground - Concrete		8
	Above Ground - Steel		-
	Above Ground - Timber		-
	Above Ground - Masonry		-
	Below Ground or Foundation		8
5	Collision Protection System		-
6	Steel Protective Coating		-
	Component rating		7

Comments:

(1) South abutment cap has minor undermining.

(2) Northeast wingwall has minor spalls.

(3) South interior bent cap has minor spalls with exposed stirrup in soffit at east end.

STATE OF TEXAS
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PROFESSIONAL ENGINEER

11/24/2015

Channel (Item 61)

Min.			Rating
0	Channel Banks	(1)	7
0	Channel Bed		8
5	Rip Rap, Toe Walls & Apron		-
5	Dikes		-
5	Jetties		-
	Other		-
	Component rating		7

Comments:

(1) Channel banks have minor erosion.

Culverts (Item 62)

Min.		Rating
0	Top Slabs	-
0	Bottom Slab or Footing	-
0	Abutments & Intermediate Supports	-
5	Headwalls & Wingwalls	-
	Other	-
	Component rating	N

District: 12 County: 102 Cont-Sec: B219-05 Structure: 641 Route: EL DORADO BLVD Maint Sect:

Approaches (Item 65)

Min.			Rating
0	Embankments	(1)	7
4	Embankment Retaining Walls		-
5	Slope Protection	(2)	7
5	Roadway Concrete	(3)	6
6	Relief Joints		8
6	Drainage		8
6	Guardfence		8
7	Delineation	(4)	7
7	Sight Distance		8
	Other		-
	Component rating		6

Comments:

(1) Northeast and southeast sidewalks have minor settlement.

(2) South bank under bridge has minor erosion under and along south abutment cap.

(3) Both approach slabs have minor cracks. North concrete advanced pavement has 3 square foot broken pieces and moderate map cracks; see photo. A few short approach roadway curbs are missing.

(4) No delineators at northeast and southwest corners of bridge.

Miscellaneous

Min.			Rating
7	Signs		-
7	Illumination		-
7	Warning Devices		-
7	Utility Lines	(1)	8
	Other		-

Comments:

(1) Two 4" diameter utility conduits and a 8" diameter utility pipe are attached to west side of bridge. A 12" diameter utility pipe is attached on east side of bridge.

Traffic Safety (Item 36)

		Rating
Traffic Safety Bridge Railings	(036.1)	1
Traffic Safety Transitions	(036.2)	0
Traffic Safety Approach Guardrail	(036.3)	0
Traffic Safety Approach Guardrail Ends	(036.4)	0

Comments:

T201 Aesthetic and T501 bridge rails

No approach guardfence at northwest and southeast corners of bridge.

Appraisal Ratings

		Rating
Waterway Adequacy	(071)	6
Approach Roadway Alignment	(072)	8

Comments:

STATE OF TEXAS
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11/24/2015

ASSUMED CONCRETE BRIDGE LOAD RATING

District: 12	**County:** 102	**Control:** B219	**Section:** 05	**Structure No.:** 641
Route: El Dorado Blvd.		**Feature Crossed:** Horsepen Bayou		
Inspection Date: October 21, 2015				
Description of Structure: Three Simple Span Prestressed Concrete Box Beam Bridge On Concrete Pile Bents				
Year Built: 1975	**Reconstruction:** 0000	**Design Load:** Unknown		

The Bridge Inspection file for this concrete structure indicates the structural details have not been located, and the reinforcing details are not known. Based upon our visual inspection of this structure, review of previous inspection reports, and engineering judgment, the bridge appears to be in stable condition. It has been carrying unrestricted traffic for many years with no significant signs of distress. Therefore, based upon the TxDOT Bridge Inspection Manual, December 2012, Figure 5-2, the Inventory Rating is assumed to be HS-15 and the Operating Rating is assumed to be HS-20.

RECOMMENDATIONS	
Inventory Rating	**HS-15 (227)**
Operating Rating	**HS-20 (236)**

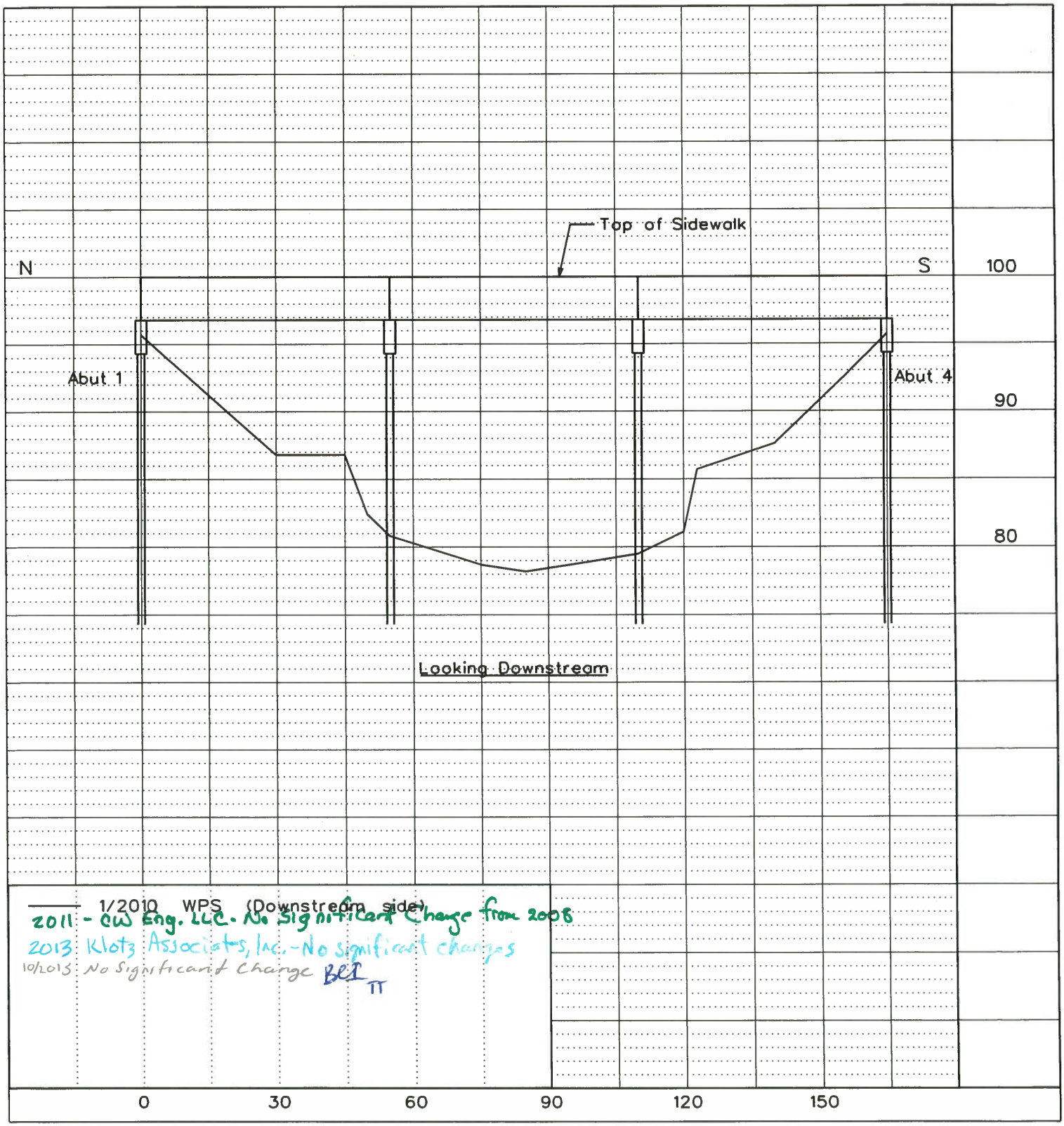
BARNHART CONSTRUCTORS INCORPORATED
TX REG #F-669

STATE OF TEXAS
THOMAS N. TU
119951
LICENSED PROFESSIONAL ENGINEER

11/24/2015

District 12 County 102 Cont-Sec B219-05 Structure 641 Route El Dorado Blvd

CHANNEL PROFILE SHEET



BRIDGE SUMMARY SHEET

Texas Department of Transportation

STATE OF TEXAS
THOMAS N. TU
119951
LICENSED PROFESSIONAL ENGINEER

Bridge I.D.: 12 - 102 - B219 - 05 - 641
Facility: El Dorado Blvd.
Feature X'ed: Horsepen Bayou
Bridge Owner: City of Houston

Company Name: Barnhart Constructors, Inc. F-669 *Signature:* *Date:* 11/24/2015

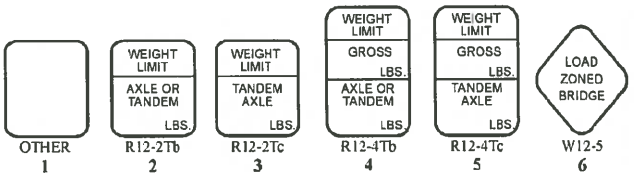
Selected Component Description and Rating:	Inspection Rating	Inventory Rating H	Inventory Rating HS	Operating Rating H	Operating Rating HS
Inspection Date: October 21, 2015					
Concrete Deck	6	15.0	15.0	20.0	20.0
Concrete Beam	7	15.0	15.0	20.0	20.0
Concrete Interior Bent Cap	7	15.0	15.0	20.0	20.0
Abutment Foundation	7	15.0	15.0	20.0	20.0
Load Rating		15.0	15.0	20.0	20.0

Comments and/or Upgrade Recommendations (if applicable):

North concrete advanced pavement has 3 square foot broken area; see photo.
Recommendation:
Remove loose concrete, then patch spall with asphalt or reinforced concrete.

Load Posting Limits for Present Condition (if applicable):

Inventory		Operating	
_____	lbs Gross	_____	lbs Gross
_____	lbs Tandem Axle	_____	lbs Tandem Axle
_____	lbs Axle or Tandem	_____	lbs Axle or Tandem
_____	Sign Code	_____	Sign Code →



OTHER 1 | R12-2Tb 2 | R12-2Tc 3 | R12-4Tb 4 | R12-4Tc 5 | W12-5 6

Posting Recommendation: Load posting not required at this time.

Previous Load Posting Recommendations:

_____	R12-2Tb	X	None
_____	R12-2Tc	_____	lbs Gross
_____	R12-4Tb	_____	lbs Tandem Axle
_____	R12-4Tc	_____	lbs Axle or Tandem

Observed Load Posting at Bridge:

_____	R12-2Tb	X	None
_____	R12-2Tc	_____	lbs Gross
_____	R12-4Tb	_____	lbs Tandem Axle
_____	R12-4Tc	_____	lbs Axle or Tandem
	Other:		Load Zoned Bridge

Material Needed

_____ - R12-2Tb
_____ - R12-2Tc
_____ - R12-4Tb
_____ - R12-4Tc
_____ - W12-5
_____ - Posts
_____ - Hardware Sets
_____ - Decals

COMPASS

	Advanced Warning (optional)		Bridge Approach	Bridge Approach	Advance Warning (optional)	
Sign Code						
Condition Code						
Maintenance Need						

A. Visible & Legible
B. Obscured by Vegetation
C. Sign Needs Cleaning
D. Improper Position
E. Damaged Beyond Repair
F. Sign Down
G. Sign Missing
H. Sign & Post Missing
J. Clear Vegetation
K. Clean Sign
L. Reposition Sign
M. Reposition Sign & Post
N. None
P. Replace Sign
S. Replace Sign & Post

Appendix B – Composite n Values

Composite n Values

Concrete liner (n Value): 0.015

Articulated concrete block (n Value): 0.03

All n Values based on HCFCD_PCPM_Dec2010 Manual

Chow (1959, page 136):

$$n = \frac{\left(P_1 n_1^{\,2} + P_2 n_2^{\,2} + P_3 n_3^{\,2} + P_4 n_4^{\,2}\right)^{1/2}}{P_{total}^{\,1/2}}$$

P is wetted perimeter.

Section	P1	P2	P3	P4	P5	P Total	n1	n2	n3	n4	n5	Composite n
New El Dorado	95.62	48.76	95.62	26.07	26.07	292.13	0.015	0.03	0.015	0.032	0.032	0.022
Existing El Dorado	90.42	59.15	90.42	49.50	49.50	339.00	0.015	0.03	0.015	0.032	0.032	0.024
Median Cross Section	93.02	53.96	93.02	37.78	37.78	315.57	0.015	0.03	0.015	0.032	0.032	0.023

Since we have composite n values for each section, weighted average n value can be calculated between two cross sections (16544.97 and 16364.84).

Cross section	Distance	n Values	Weighted Average "n"
16544.97	6.07	0.032	
Between Bridge & XS	33	0.023	
New El Dorado Bridge	35	0.022	
Median	32	0.023	
Existing El Dorado	35	0.024	
16364.84	39.07	0.032	
Total	180.13		0.025

Appendix C -
Detailed HEC-RAS Output – Effective Model

HEC-RAS Plan: B104 RVEX MP River: B104-00-00 Reach: B104-00-00_0029

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 # Chl
B104-00-00_0029	33921.09	1389	11.7	22.76		23.01	0.001649	3.95	352.04	88.45	0.31
B104-00-00_0029	33921.09	2056	11.7	24.87		24.97	0.000695	2.94	1382.01	1254.18	0.21
B104-00-00_0029	33921.09	2402	11.7	25		25.12	0.000828	3.26	1540.69	1268.64	0.23
B104-00-00_0029	33921.09	3321	11.7	26.05		26.11	0.000468	2.71	3341.91	2328.17	0.18
B104-00-00_0029	33632.02	1389	11.7	22.58	15.77	22.67	0.000362	2.36	589.63	90.4	0.16
B104-00-00_0029	33632.02	2056	11.7	24.76	16.76	24.83	0.000236	2.28	1811.58	1511.79	0.13
B104-00-00_0029	33632.02	2402	11.7	24.86	17.2	24.95	0.000295	2.56	1965.26	1559.21	0.15
B104-00-00_0029	33632.02	3321	11.7	25.96	18.26	26.01	0.000193	2.24	4374.31	5232.45	0.12
B104-00-00_0029	33611.02	1389	11.7	22.57	15.41	22.66	0.000311	2.39	581.26	85.54	0.15
B104-00-00_0029	33611.02	2056	11.7	24.73	16.37	24.82	0.000263	2.42	1350.47	2016.29	0.14
B104-00-00_0029	33611.02	2402	11.7	24.82	16.79	24.93	0.000336	2.76	1452.73	2063.93	0.16
B104-00-00_0029	33611.02	3321	11.7	25.95	17.82	26	0.000194	2.26	4247.79	5248.6	0.12
B104-00-00_0029	33271.4	Culvert									
B104-00-00_0029	32931.84	1389	11.86	21.74	15.49	21.87	0.000401	2.88	483.12	86.9	0.17
B104-00-00_0029	32931.84	2056	11.86	23.62	16.44	23.78	0.000484	3.2	643.07	414.98	0.19
B104-00-00_0029	32931.84	2402	11.86	24.55	16.89	24.68	0.000453	2.9	836.41	2389.37	0.18
B104-00-00_0029	32931.84	3321	11.86	25.94	17.83	25.99	0.000201	2.15	4987.31	7088.59	0.12
B104-00-00_0029	32851.1	1492	11.86	21.68	16.89	21.82	0.00075	3.03	492.96	86.45	0.22
B104-00-00_0029	32851.1	2202	11.86	23.56	17.82	23.73	0.00072	3.29	668.38	816.68	0.22
B104-00-00_0029	32851.1	2569	11.86	24.44	18.23	24.62	0.000676	3.38	764.83	1933.95	0.22
B104-00-00_0029	32851.1	3400	11.86	25.69	19.07	25.91	0.000688	3.79	947.26	6214.65	0.23
B104-00-00_0029	31595.28	1563	11.82	20.68	16.4	20.83	0.000833	3.1	504.06	92.64	0.23
B104-00-00_0029	31595.28	2302	11.82	22.6	17.24	22.77	0.000813	3.27	704.78	424.18	0.24
B104-00-00_0029	31595.28	2684	11.82	23.55	17.62	23.72	0.000761	3.26	823.35	1782.91	0.23
B104-00-00_0029	31595.28	3452	11.82	24.98	18.3	25.11	0.000549	3.05	1607.73	5635.34	0.21
B104-00-00_0029	30906.64	1563	11.27	20.02	16.09	20.2	0.001008	3.36	465.26	87.57	0.26
B104-00-00_0029	30906.64	2302	11.27	21.99	17.02	22.18	0.000885	3.55	648.53	107.64	0.25
B104-00-00_0029	30906.64	2684	11.27	22.93	17.4	23.12	0.000975	3.56	754.38	179.04	0.26
B104-00-00_0029	30906.64	3452	11.27	24.51	18.09	24.67	0.000758	3.28	1367.21	4174.88	0.23
B104-00-00_0029	30886.64	1563	11.27	20	16.09	20.17	0.001023	3.38	462.98	87.43	0.26
B104-00-00_0029	30886.64	2302	11.27	21.96	17.02	22.15	0.000895	3.57	645.55	112.37	0.25
B104-00-00_0029	30886.64	2684	11.27	22.9	17.41	23.1	0.00098	3.57	751.21	180.76	0.26
B104-00-00_0029	30886.64	3452	11.27	24.46	18.08	24.66	0.000884	3.53	977.26	4102.41	0.25
B104-00-00_0029	30856.34	1563	11.27	19.96	16.09	20.14	0.001042	3.4	460.02	87.25	0.26
B104-00-00_0029	30856.34	2302	11.27	21.93	17.02	22.13	0.000905	3.58	642.59	112.85	0.25
B104-00-00_0029	30856.34	2684	11.27	22.87	17.4	23.07	0.000986	3.59	747.16	183.75	0.26
B104-00-00_0029	30856.34	3452	11.27	24.43	18.08	24.62	0.000898	3.55	971.89	3974.38	0.25
B104-00-00_0029	30775.48	1654	11.27	19.83	16.22	20.04	0.001252	3.69	448.83	86.56	0.29
B104-00-00_0029	30775.48	2431	11.27	21.81	17.16	22.04	0.001052	3.85	631.23	112.2	0.27
B104-00-00_0029	30775.48	2831	11.27	22.75	17.54	22.98	0.001124	3.87	732.32	180.51	0.28
B104-00-00_0029	30775.48	3517	11.27	24.38	18.14	24.54	0.000816	3.35	1370.7	3333.51	0.24
B104-00-00_0029	29977.43	1654	9.64	19.01	16.02	19.11	0.001019	2.57	642.93	183.13	0.24
B104-00-00_0029	29977.43	2431	9.64	21.32	16.74	21.39	0.000468	2.17	1119.2	230.05	0.17
B104-00-00_0029	29977.43	2831	9.64	22.26	16.98	22.33	0.00038	2.11	1344.47	247.81	0.16
B104-00-00_0029	29977.43	3517	9.64	24.02	17.39	24.08	0.000273	1.9	1850.98	2621.63	0.14
B104-00-00_0029	29937.02	1654	9.64	18.98	15.67	19.07	0.000821	2.44	676.86	177.86	0.22
B104-00-00_0029	29937.02	2431	9.64	21.3	16.36	21.37	0.000408	2.15	1132.48	214.37	0.16
B104-00-00_0029	29937.02	2831	9.64	22.25	16.65	22.32	0.000349	2.11	1342.93	232.14	0.15
B104-00-00_0029	29937.02	3517	9.64	24.01	17.09	24.07	0.000253	1.95	1887.1	2608.48	0.14
B104-00-00_0029	29774.81	1728	9.64	18.51	16.01	18.87	0.001613	4.82	358.48	82.81	0.41
B104-00-00_0029	29774.81	2544	9.64	20.98	17	21.26	0.000943	4.28	594.56	110.39	0.32
B104-00-00_0029	29774.81	2959	9.64	21.94	17.41	22.22	0.000816	4.18	707.05	122.04	0.31
B104-00-00_0029	29774.81	3617	9.64	23.78	18.01	23.99	0.000673	3.71	974.6	2103.97	0.28

B104-00-00_0029	29620.56	1728	9.64	18.36	15.45	18.63	0.001121	4.22	409.89	89.26	0.35
B104-00-00_0029	29620.56	2544	9.64	20.89	16.34	21.12	0.000652	3.84	662.09	110.29	0.28
B104-00-00_0029	29620.56	2959	9.64	21.87	16.75	22.09	0.000597	3.82	774.3	121.87	0.27
B104-00-00_0029	29620.56	3617	9.64	23.7	17.31	23.89	0.000531	3.5	1034.49	2067.71	0.25
B104-00-00_0029	28679.27	1825	3.83	17.7	11.56	17.87	0.000439	3.32	550.16	81.38	0.22
B104-00-00_0029	28679.27	2693	3.83	20.45	12.82	20.62	0.000376	3.36	800.37	104.08	0.21
B104-00-00_0029	28679.27	3126	3.83	21.43	13.34	21.62	0.000387	3.44	909.16	158.04	0.22
B104-00-00_0029	28679.27	3744	3.83	23.24	14.03	23.4	0.00048	3.16	1184.37	1931.16	0.23
B104-00-00_0029	27313.46	3487	3.19	17.15	10.6	17.31	0.000368	3.21	1085.2	153.33	0.21
B104-00-00_0029	27313.46	5126	3.19	19.88	11.8	20.04	0.000478	3.21	1594.51	523.13	0.24
B104-00-00_0029	27313.46	5639	3.19	20.93	12.14	21.07	0.000396	2.94	1921.1	902.39	0.22
B104-00-00_0029	27313.46	6896	3.19	22.76	12.89	22.88	0.000267	2.68	2576.23	4459.12	0.18
B104-00-00_0029	25959.34	3554	0.31	16.69	8.03	16.85	0.000312	3.26	1088.6	131.18	0.2
B104-00-00_0029	25959.34	5226	0.31	19.26	9.73	19.46	0.00038	3.55	1477.35	716.41	0.22
B104-00-00_0029	25959.34	5710	0.31	20.39	10.16	20.56	0.000345	3.36	1720.85	2528.66	0.21
B104-00-00_0029	25959.34	6916	0.31	22.34	11.09	22.49	0.000294	3.18	2270.32	6134.35	0.2
B104-00-00_0029	25919.28	3554	0.31	16.67	8.06	16.83	0.000282	3.13	1135.44	135.11	0.19
B104-00-00_0029	25919.28	5226	0.31	19.26	9.75	19.44	0.000338	3.42	1525.94	590.39	0.21
B104-00-00_0029	25919.28	5710	0.31	20.38	10.16	20.55	0.000297	3.27	1745.95	2407.11	0.2
B104-00-00_0029	25919.28	6916	0.31	22.36	11.07	22.44	0.000152	2.54	10141.16	6233.05	0.14
B104-00-00_0029	25823.8 Bridge										
B104-00-00_0029	25728.31	4183	0.31	16.58	8.77	16.8	0.000392	3.72	1124.96	131.96	0.22
B104-00-00_0029	25728.31	6086	0.31	19.15	10.46	19.41	0.000392	4.1	1482.86	759.79	0.23
B104-00-00_0029	25728.31	6697	0.31	20.23	10.92	20.49	0.000374	4.05	1652.31	2144.69	0.23
B104-00-00_0029	25728.31	8322	0.31	22.02	12	22.3	0.000405	4.2	1979.1	5476.11	0.24
B104-00-00_0029	25536.03	4183	0.31	16.42	8.69	16.69	0.000531	4.17	1002.47	123.95	0.26
B104-00-00_0029	25536.03	6086	0.31	19	10.44	19.31	0.000599	4.45	1368.22	519.29	0.28
B104-00-00_0029	25536.03	6697	0.31	20.11	10.93	20.39	0.000542	4.26	1573.84	1461.34	0.26
B104-00-00_0029	25536.03	8322	0.31	21.93	12.09	22.21	0.000519	4.24	2026.99	5916.58	0.26
B104-00-00_0029	24058.15	4341	-4.78	15.96	6.11	16.1	0.000221	2.96	1468.43	155.9	0.17
B104-00-00_0029	24058.15	6191	-4.78	18.47	7.56	18.63	0.000252	3.25	1906.65	449.18	0.18
B104-00-00_0029	24058.15	6895	-4.78	19.62	8.04	19.78	0.000235	3.22	2142.43	1542.86	0.18
B104-00-00_0029	24058.15	8395	-4.78	21.47	8.97	21.63	0.00021	3.29	2592.06	5361.34	0.17
B104-00-00_0029	24038.15	4341	-4.78	15.95	6.12	16.09	0.000211	3.02	1439.44	142.44	0.17
B104-00-00_0029	24038.15	6191	-4.78	18.45	7.56	18.63	0.000229	3.41	1816.91	613.98	0.18
B104-00-00_0029	24038.15	6895	-4.78	19.58	8.04	19.77	0.000256	3.42	2015.36	1863.23	0.19
B104-00-00_0029	24038.15	8395	-4.78	21.43	8.97	21.63	0.000238	3.5	2425.64	5405.84	0.18
B104-00-00_0029	23905.5 Bridge										
B104-00-00_0029	23772.84	4341	-4.78	15.91	6.12	16.06	0.000213	3.03	1434.78	312.3	0.17
B104-00-00_0029	23772.84	6191	-4.78	18.41	7.57	18.59	0.000233	3.41	1813.05	863.36	0.18
B104-00-00_0029	23772.84	6895	-4.78	19.43	8.04	19.61	0.000256	3.45	1996.25	2158.52	0.2
B104-00-00_0029	23772.84	8395	-4.78	21.13	8.97	21.32	0.000239	3.55	2402.47	5214.67	0.19
B104-00-00_0029	23692.71	4341	-4.78	15.9	6.11	16.04	0.000216	3.02	1437.58	239.71	0.17
B104-00-00_0029	23692.71	6191	-4.78	18.4	7.56	18.57	0.000301	3.32	1865.54	1053.94	0.2
B104-00-00_0029	23692.71	6895	-4.78	19.42	8.04	19.58	0.000276	3.3	2093.07	1814.82	0.19
B104-00-00_0029	23692.71	8395	-4.78	21.12	8.97	21.29	0.000233	3.39	2517.86	5065.23	0.18
B104-00-00_0029	22758.24	4341	-1.81	15.68	7	15.83	0.000237	3.15	1379.08	155.64	0.18
B104-00-00_0029	22758.24	6191	-1.81	18.09	8.2	18.27	0.000336	3.43	2016.94	798.56	0.21
B104-00-00_0029	22758.24	6895	-1.81	19.16	8.62	19.33	0.000277	3.33	2783.07	1311.03	0.19
B104-00-00_0029	22758.24	8395	-1.81	20.94	9.43	21.08	0.000195	3.14	6201.77	2902.01	0.17
B104-00-00_0029	21821.68	4341	-1.41	15.47	6.14	15.62	0.000219	3.05	1454.33	194.09	0.17
B104-00-00_0029	21821.68	6191	-1.41	17.81	7.46	17.99	0.000257	3.4	2184.02	626.57	0.19
B104-00-00_0029	21821.68	6895	-1.41	18.93	7.91	19.1	0.000217	3.35	2860.4	1057.5	0.18
B104-00-00_0029	21821.68	8395	-1.41	20.76	8.77	20.91	0.00017	3.27	5220.51	1898.6	0.16
B104-00-00_0029	21072.13	4631	-2.89	15.34	4.79	15.46	0.000172	2.78	1668.62	165.81	0.15

B104-00-00_0029	21072.13	6657	-2.89	17.65	6.22	17.81	0.000219	3.15	2265.91	558.86	0.17
B104-00-00_0029	21072.13	7457	-2.89	18.79	6.7	18.94	0.000195	3.13	2964.03	973.06	0.17
B104-00-00_0029	21072.13	9032	-2.89	20.65	7.59	20.78	0.000151	3.06	5828.5	2310.96	0.15
B104-00-00_0029	21031.83	4804	-2.89	15.32	4.93	15.45	0.000179	2.9	1655.03	158.15	0.16
B104-00-00_0029	21031.83	6871	-2.89	17.62	6.36	17.8	0.000201	3.37	2190.78	551.76	0.17
B104-00-00_0029	21031.83	7716	-2.89	18.74	6.85	18.93	0.000192	3.42	2730.78	1001.39	0.17
B104-00-00_0029	21031.83	9243	-2.89	20.61	7.69	20.77	0.000157	3.35	5874.27	2265.14	0.16
B104-00-00_0029	20942.9 Bridge										
B104-00-00_0029	20853.92	4804	-2.89	15.29	4.94	15.43	0.000223	2.98	1609.8	174.56	0.17
B104-00-00_0029	20853.92	6871	-2.89	17.57	6.4	17.75	0.000252	3.36	2147.31	369.45	0.19
B104-00-00_0029	20853.92	7716	-2.89	18.68	6.92	18.85	0.000236	3.36	2563.67	516.78	0.18
B104-00-00_0029	20853.92	9243	-2.89	20.43	7.79	20.6	0.000221	3.37	3610.06	1907.82	0.18
B104-00-00_0029	20693.87	4804	-2.89	15.26	4.88	15.39	0.00024	2.9	1656.25	199.54	0.18
B104-00-00_0029	20693.87	6871	-2.89	17.54	6.34	17.69	0.000295	3.13	2277.91	477.27	0.2
B104-00-00_0029	20693.87	7716	-2.89	18.65	6.9	18.79	0.000288	3.02	2859.1	869.8	0.19
B104-00-00_0029	20693.87	9243	-2.89	20.42	7.83	20.54	0.000214	2.79	4942.17	1857.25	0.17
B104-00-00_0029	19846.57	4804	-6.72	15.05	4.09	15.19	0.00022	3.05	1576.57	160.8	0.17
B104-00-00_0029	19846.57	6871	-6.72	17.26	6.04	17.44	0.000286	3.44	2020.09	250.56	0.2
B104-00-00_0029	19846.57	7716	-6.72	18.38	6.59	18.55	0.000265	3.42	2368.23	486.77	0.19
B104-00-00_0029	19846.57	9243	-6.72	20.18	7.51	20.35	0.000212	3.37	3367.68	1097.53	0.17
B104-00-00_0029	19812.71	4804	-6.72	15.04	4.09	15.18	0.000257	3	1601.29	189.69	0.18
B104-00-00_0029	19812.71	6871	-6.72	17.26	6.04	17.43	0.000335	3.29	2086.03	264.45	0.21
B104-00-00_0029	19812.71	7716	-6.72	18.38	6.59	18.54	0.00031	3.21	2451.75	525.77	0.2
B104-00-00_0029	19812.71	9243	-6.72	20.18	7.5	20.33	0.000223	3.08	3556.66	1166.77	0.18
B104-00-00_0029	19737.92 Bridge										
B104-00-00_0029	19663.12	4804	-6.72	14.78	4.09	14.92	0.000216	2.99	1608.55	167.63	0.17
B104-00-00_0029	19663.12	6871	-6.72	17.16	6.04	17.34	0.000241	3.39	2030.38	266.66	0.18
B104-00-00_0029	19663.12	7716	-6.72	18.16	6.62	18.34	0.00028	3.44	2289.38	441.85	0.2
B104-00-00_0029	19663.12	9243	-6.72	20	7.56	20.17	0.000222	3.37	3528.68	1032.46	0.18
B104-00-00_0029	19580.65	4804	-6.72	14.75	4.09	14.89	0.000385	3.07	1564.04	244.14	0.21
B104-00-00_0029	19580.65	6871	-6.72	17.15	6.04	17.3	0.000312	3.13	2196.36	286.26	0.2
B104-00-00_0029	19580.65	7716	-6.72	18.15	6.59	18.3	0.00029	3.09	2496.91	371.11	0.19
B104-00-00_0029	19580.65	9243	-6.72	20	7.51	20.13	0.000237	2.93	3464.04	976.42	0.18
B104-00-00_0029	19232.53	4804	-5.45	14.64	4.33	14.79	0.000211	3.07	1566.22	153.11	0.17
B104-00-00_0029	19232.53	6871	-5.45	17.02	5.95	17.2	0.000283	3.35	2138.91	318.58	0.19
B104-00-00_0029	19232.53	7716	-5.45	18.03	6.47	18.2	0.000255	3.37	2519.54	441.31	0.19
B104-00-00_0029	19232.53	9243	-5.45	19.88	7.33	20.05	0.000202	3.34	3703.22	1478	0.17
B104-00-00_0029	19212.44	4804	-5.45	14.63	4.33	14.78	0.000211	3.07	1564.45	153.02	0.17
B104-00-00_0029	19212.44	6871	-5.45	17.01	5.96	17.19	0.000301	3.39	2096.73	315.41	0.2
B104-00-00_0029	19212.44	7716	-5.45	18.02	6.47	18.2	0.000282	3.4	2479.84	459.44	0.19
B104-00-00_0029	19212.44	9243	-5.45	19.88	7.33	20.05	0.000221	3.32	3633.34	1399.71	0.18
B104-00-00_0029	19151.64 Bridge										
B104-00-00_0029	19090.84	4804	-5.45	14.58	4.33	14.73	0.000221	3.12	1538.85	152.04	0.17
B104-00-00_0029	19090.84	6871	-5.45	16.93	5.95	17.13	0.000264	3.57	1926.49	179.15	0.19
B104-00-00_0029	19090.84	7716	-5.45	17.9	6.46	18.11	0.000267	3.66	2215.23	464.32	0.19
B104-00-00_0029	19090.84	9243	-5.45	19.75	7.31	19.95	0.000231	3.64	3751.35	1797.38	0.18
B104-00-00_0029	19010.58	4804	-5.45	14.55	4.33	14.71	0.000221	3.19	1507.35	143.45	0.17
B104-00-00_0029	19010.58	6871	-5.45	16.89	5.95	17.1	0.000277	3.68	1880.19	234.61	0.2
B104-00-00_0029	19010.58	7716	-5.45	17.86	6.45	18.08	0.000297	3.75	2255.19	568.5	0.2
B104-00-00_0029	19010.58	9243	-5.45	19.73	7.3	19.93	0.000233	3.7	3968.39	1789.61	0.18
B104-00-00_0029	17730.46	6520	-3.29	14.12	4.46	14.36	0.000329	3.96	1646.5	155.19	0.21
B104-00-00_0029	17730.46	9226	-3.29	16.36	6.44	16.69	0.000383	4.59	2011.69	171.22	0.24
B104-00-00_0029	17730.46	10458	-3.29	17.27	7.11	17.63	0.000392	4.82	2179.03	359.73	0.24
B104-00-00_0029	17730.46	12519	-3.29	19.19	8.05	19.56	0.000341	4.91	3587.74	1311.54	0.23

B104-00-00_0029	16521.13	6520	-3.29	13.67		13.93	0.000376	4.13	1578.8	154.57	0.23
B104-00-00_0029	16521.13	9226	-3.29	15.83		16.18	0.000446	4.75	1982.8	272.43	0.25
B104-00-00_0029	16521.13	10458	-3.29	16.75		17.13	0.000437	4.96	2248.82	317.44	0.25
B104-00-00_0029	16521.13	12519	-3.29	18.75		19.13	0.000367	5.04	3299.56	1025.43	0.24
B104-00-00_0029	16480.97	6520	-3.29	13.64	4.47	13.91	0.000372	4.14	1573.89	152.02	0.23
B104-00-00_0029	16480.97	9226	-3.29	15.8	6.44	16.16	0.000436	4.81	1918.27	166.83	0.25
B104-00-00_0029	16480.97	10458	-3.29	16.72	7.11	17.11	0.00045	5.05	2072.72	324.49	0.26
B104-00-00_0029	16480.97	12519	-3.29	18.71	8.05	19.12	0.000387	5.11	3158.93	1215.29	0.24
B104-00-00_0029	16422.9 Bridge										
B104-00-00_0029	16364.84	6520	-3.29	13.6	4.46	13.81	0.000371	3.69	1767.74	205.81	0.22
B104-00-00_0029	16364.84	9226	-3.29	15.75	6.44	16.02	0.000387	4.13	2232.54	225.92	0.23
B104-00-00_0029	16364.84	10458	-3.29	16.66	7.19	16.94	0.00038	4.29	2439.99	381.52	0.23
B104-00-00_0029	16364.84	12519	-3.29	18.46	8.25	18.75	0.000317	4.35	3313.01	552.61	0.22
B104-00-00_0029	16204.84	6520	-3.29	13.53		13.75	0.000396	3.74	1745.45	209.49	0.23
B104-00-00_0029	16204.84	9226	-3.29	15.69		15.95	0.000409	4.13	2242.31	253.28	0.24
B104-00-00_0029	16204.84	10458	-3.29	16.6		16.88	0.000399	4.26	2554.72	439.18	0.24
B104-00-00_0029	16204.84	12519	-3.29	18.42		18.7	0.000335	4.27	3420.96	637.94	0.22
B104-00-00_0029	14932.88	6649	-4.54	13	4.18	13.24	0.000405	3.91	1700.17	192.72	0.23
B104-00-00_0029	14932.88	9396	-4.54	15.13	5.86	15.44	0.000396	4.44	2148.14	236.56	0.24
B104-00-00_0029	14932.88	10654	-4.54	16.04	6.46	16.38	0.000388	4.64	2375.66	260.8	0.24
B104-00-00_0029	14932.88	12742	-4.54	17.91	7.39	18.26	0.000337	4.77	2951.81	533.4	0.23
B104-00-00_0029	13216.11	7080	-5.14	12.32		12.57	0.000371	4.02	1830.22	213.88	0.22
B104-00-00_0029	13216.11	10024	-5.14	14.41		14.74	0.00041	4.69	2351.63	292.4	0.24
B104-00-00_0029	13216.11	11330	-5.14	15.32		15.68	0.000415	4.92	2680.34	462.36	0.24
B104-00-00_0029	13216.11	13697	-5.14	17.28		17.65	0.000369	5.04	3746.91	625.21	0.23
B104-00-00_0029	11490.4	7850	-7.29	11.5	1.83	11.85	0.000459	4.76	1652.23	632.71	0.25
B104-00-00_0029	11490.4	11196	-7.29	13.95	3.6	14.11	0.000245	3.86	5838.17	812.03	0.19
B104-00-00_0029	11490.4	12594	-7.29	14.89	4.46	15.04	0.000227	3.85	6629.14	905.53	0.18
B104-00-00_0029	11490.4	15558	-7.29	16.94	5.99	17.09	0.000183	3.79	8640.35	1096.2	0.17
B104-00-00_0029	11450.35	7850	-7.29	11.48	1.83	11.83	0.000462	4.77	1648.76	627.04	0.25
B104-00-00_0029	11450.35	11196	-7.29	13.49	3.6	13.99	0.000556	5.71	2023.29	861.3	0.28
B104-00-00_0029	11450.35	12594	-7.29	14.36	4.46	14.91	0.000572	5.98	2189.64	876.08	0.29
B104-00-00_0029	11450.35	15558	-7.29	16.82	5.98	17.05	0.000263	4.52	7225.88	1064.11	0.2
B104-00-00_0029	11295.96 Bridge										
B104-00-00_0029	11141.62	7850	-7.29	11.36	1.83	11.71	0.000493	4.75	1653.91	330.33	0.26
B104-00-00_0029	11141.62	11196	-7.29	13.32	3.6	13.83	0.000562	5.69	1986.29	392.67	0.29
B104-00-00_0029	11141.62	12594	-7.29	14.03	4.46	14.6	0.000589	6.04	2121	549.7	0.29
B104-00-00_0029	11141.62	15558	-7.29	15.69	5.98	16.36	0.000598	6.6	2438.5	694.33	0.3
B104-00-00_0029	10978.64	7850	-7.29	11.34	1.83	11.59	0.000369	4.21	2688.82	407.46	0.23
B104-00-00_0029	10978.64	11196	-7.29	13.33	3.64	13.67	0.000404	4.93	3466.24	459.79	0.24
B104-00-00_0029	10978.64	12594	-7.29	14.05	4.61	14.42	0.000418	5.21	3762.02	483.73	0.25
B104-00-00_0029	10978.64	15558	-7.29	15.73	6.16	16.16	0.000414	5.61	4700.64	837.43	0.25
B104-00-00_0029	9906.905	7850	-8.32	11.05		11.25	0.000236	3.82	2791.12	483.27	0.19
B104-00-00_0029	9906.905	11196	-8.32	13.02		13.29	0.000271	4.49	3880.87	652.31	0.21
B104-00-00_0029	9906.905	12594	-8.32	13.73		14.03	0.00028	4.71	4372.79	717.03	0.21
B104-00-00_0029	9906.905	15558	-8.32	15.46		15.76	0.000266	4.9	5784.86	1046.98	0.21
B104-00-00_0029	9866.73	7850	-8.32	10.95	0.58	11.22	0.000298	4.21	2083.68	404.88	0.21
B104-00-00_0029	9866.73	11196	-8.32	12.84	2.16	13.24	0.000367	5.13	2573.18	582.79	0.24
B104-00-00_0029	9866.73	12594	-8.32	13.56	2.77	13.97	0.000377	5.36	3259.23	640.92	0.24
B104-00-00_0029	9866.73	15558	-8.32	15.28	4.06	15.7	0.000355	5.6	4924.2	874.64	0.24
B104-00-00_0029	9803.8 Bridge										
B104-00-00_0029	9740.892	7850	-8.32	10.76	0.58	11.04	0.000299	4.24	2015.88	313.05	0.21
B104-00-00_0029	9740.892	11196	-8.32	12.68	2.16	13.09	0.000374	5.2	2409.09	352.04	0.24
B104-00-00_0029	9740.892	12594	-8.32	13.39	2.78	13.86	0.000401	5.57	2563.86	375.17	0.25
B104-00-00_0029	9740.892	15558	-8.32	14.78	4.06	15.37	0.000452	6.26	2889.06	485.74	0.27

B104-00-00_0029	9563.455	7850	-8.32	10.76	0.58	10.94	0.00022	3.62	3837.27	816.38	0.18
B104-00-00_0029	9563.455	11196	-8.32	12.7	2.16	12.94	0.000259	4.33	5321.4	981.49	0.2
B104-00-00_0029	9563.455	12594	-8.32	13.46	2.77	13.67	0.000235	4.26	6881.47	1020.94	0.19
B104-00-00_0029	9563.455	15558	-8.32	14.9	4.06	15.12	0.000233	4.5	8387.81	1072.96	0.19
B104-00-00_0029	8749.762	7937	-7.48	10.5		10.73	0.000273	4.15	3032.39	536.72	0.2
B104-00-00_0029	8749.762	11340	-7.48	12.42		12.71	0.000307	4.82	4230.71	714.95	0.22
B104-00-00_0029	8749.762	12758	-7.48	13.13		13.44	0.000316	5.04	4758.31	758.55	0.22
B104-00-00_0029	8749.762	15800	-7.48	14.56		14.89	0.000321	5.39	5905.32	852.02	0.23
B104-00-00_0029	7694.595	8412	-9.06	10.2		10.45	0.000262	4.33	4338.31	908.01	0.2
B104-00-00_0029	7694.595	12119	-9.06	12.07		12.38	0.000307	5.07	6122.43	1005.59	0.22
B104-00-00_0029	7694.595	13656	-9.06	12.76		13.1	0.000323	5.34	6843.49	1068.69	0.22
B104-00-00_0029	7694.595	17098	-9.06	14.14		14.53	0.000356	5.9	8429.42	1259.79	0.24
B104-00-00_0029	6926.893	8412	-9.91	10.02		10.18	0.000462	3.55	5004.57	1414.48	0.19
B104-00-00_0029	6926.893	12119	-9.91	11.93		12.08	0.000415	3.75	7964.42	1690.37	0.19
B104-00-00_0029	6926.893	13656	-9.91	12.64		12.8	0.000398	3.82	9196.47	1780.36	0.19
B104-00-00_0029	6926.893	17098	-9.91	14.05		14.2	0.000379	3.98	11911.51	2086.46	0.18
B104-00-00_0029	6883.529	8412	-9.91	9.8	0.36	10.11	0.000693	4.89	3210.73	963.63	0.24
B104-00-00_0029	6883.529	12119	-9.91	11.6	2.57	11.99	0.000804	5.73	4181.23	1113.07	0.26
B104-00-00_0029	6883.529	13656	-9.91	12.26	5.31	12.69	0.000838	6.03	4547.8	1189.08	0.27
B104-00-00_0029	6883.529	17098	-9.91	13.81	6.69	14.13	0.000672	5.75	8389.81	1406.91	0.25
B104-00-00_0029	6806.5 Bridge										
B104-00-00_0029	6729.469	8412	-9.91	9.61	0.36	9.89	0.000718	4.65	3015.36	509.84	0.24
B104-00-00_0029	6729.469	12119	-9.91	11.41	2.6	11.78	0.000814	5.45	3984.44	1108.64	0.26
B104-00-00_0029	6729.469	13656	-9.91	12.08	5.3	12.49	0.000835	5.71	4362.28	1239.46	0.27
B104-00-00_0029	6729.469	17098	-9.91	13.41	6.34	13.82	0.000815	5.99	6784.83	2013.88	0.27
B104-00-00_0029	6546.744	8412	-9.91	9.51		9.66	0.000438	3.78	5557.6	1022.35	0.19
B104-00-00_0029	6546.744	12119	-9.91	11.31		11.48	0.000469	4.28	7521.15	1150	0.2
B104-00-00_0029	6546.744	13656	-9.91	11.98		12.18	0.000516	4.63	8346.23	1390.95	0.21
B104-00-00_0029	6546.744	17098	-9.91	13.29		13.5	0.000505	4.85	10204.38	1488.23	0.21
B104-00-00_0029	5295.497	8412	-11.65	8.68		9	0.000685	5.22	3838.34	747.79	0.24
B104-00-00_0029	5295.497	12119	-11.65	10.36		10.75	0.000807	6.09	5176.59	845.87	0.27
B104-00-00_0029	5295.497	13656	-11.65	10.97		11.39	0.000846	6.4	5704.38	884.49	0.28
B104-00-00_0029	5295.497	17098	-11.65	12.21		12.69	0.000943	7.08	6957.47	1455.22	0.29
B104-00-00_0029	4120.306	8412	-11.54	7.92		7.99	0.001548	2.65	4089.22	753.54	0.13
B104-00-00_0029	4120.306	12119	-11.54	9.58		9.66	0.001489	2.81	5506.79	907.73	0.13
B104-00-00_0029	4120.306	13656	-11.54	10.18		10.26	0.00151	2.91	6096.93	1013.96	0.13
B104-00-00_0029	4120.306	17098	-11.54	11.41		11.49	0.001496	3.04	7501.85	1512.7	0.13
B104-00-00_0029	2876.672	8412	-7.3	6.06	1.49	6.35	0.001002	5.03	3707.34	875.81	0.28
B104-00-00_0029	2876.672	12119	-7.3	7.72	3.68	8.05	0.001001	5.58	5302.92	1135.3	0.29
B104-00-00_0029	2876.672	13656	-7.3	8.3	4.09	8.63	0.001	5.77	5972.07	1198.25	0.29
B104-00-00_0029	2876.672	17098	-7.3	9.49	4.86	9.85	0.001001	6.15	7498.74	1358.85	0.3

Appendix D –
Detailed HEC-RAS Output – Proposed Model

HEC-RAS Plan: B104 PROP NB River: B104-00-00 Reach: B104-00-00_0029

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 # Chl
B104-00-00_0029	33921.09	1389	11.7	22.76		23.01	0.001649	3.95	352.04	88.45	0.31
B104-00-00_0029	33921.09	2056	11.7	24.87		24.97	0.000695	2.94	1382.01	1254.18	0.21
B104-00-00_0029	33921.09	2402	11.7	25		25.12	0.000828	3.26	1540.69	1268.64	0.23
B104-00-00_0029	33921.09	3321	11.7	26.05		26.11	0.000468	2.71	3341.91	2328.17	0.18
B104-00-00_0029	33632.02	1389	11.7	22.58	15.77	22.67	0.000362	2.36	589.63	90.4	0.16
B104-00-00_0029	33632.02	2056	11.7	24.76	16.76	24.83	0.000236	2.28	1811.58	1511.79	0.13
B104-00-00_0029	33632.02	2402	11.7	24.86	17.2	24.95	0.000295	2.56	1965.26	1559.21	0.15
B104-00-00_0029	33632.02	3321	11.7	25.96	18.26	26.01	0.000193	2.24	4374.31	5232.45	0.12
B104-00-00_0029	33611.02	1389	11.7	22.57	15.41	22.66	0.000311	2.39	581.26	85.54	0.15
B104-00-00_0029	33611.02	2056	11.7	24.73	16.37	24.82	0.000263	2.42	1350.47	2016.29	0.14
B104-00-00_0029	33611.02	2402	11.7	24.82	16.79	24.93	0.000336	2.76	1452.73	2063.93	0.16
B104-00-00_0029	33611.02	3321	11.7	25.95	17.82	26	0.000194	2.26	4247.79	5248.6	0.12
B104-00-00_0029	33271.4 Culvert										
B104-00-00_0029	32931.84	1389	11.86	21.74	15.49	21.87	0.000401	2.88	483.12	86.9	0.17
B104-00-00_0029	32931.84	2056	11.86	23.62	16.44	23.78	0.000484	3.2	643.07	414.98	0.19
B104-00-00_0029	32931.84	2402	11.86	24.55	16.89	24.68	0.000453	2.9	836.41	2389.37	0.18
B104-00-00_0029	32931.84	3321	11.86	25.94	17.83	25.99	0.000201	2.15	4987.31	7088.59	0.12
B104-00-00_0029	32851.1	1492	11.86	21.68	16.89	21.82	0.00075	3.03	492.96	86.45	0.22
B104-00-00_0029	32851.1	2202	11.86	23.56	17.82	23.73	0.00072	3.29	668.38	816.68	0.22
B104-00-00_0029	32851.1	2569	11.86	24.44	18.23	24.62	0.000676	3.38	764.83	1933.95	0.22
B104-00-00_0029	32851.1	3400	11.86	25.69	19.07	25.91	0.000688	3.79	947.26	6214.65	0.23
B104-00-00_0029	31595.28	1563	11.82	20.68	16.4	20.83	0.000833	3.1	504.06	92.64	0.23
B104-00-00_0029	31595.28	2302	11.82	22.6	17.24	22.77	0.000813	3.27	704.78	424.18	0.24
B104-00-00_0029	31595.28	2684	11.82	23.55	17.62	23.72	0.000761	3.26	823.35	1782.91	0.23
B104-00-00_0029	31595.28	3452	11.82	24.98	18.3	25.11	0.000549	3.05	1607.73	5635.34	0.21
B104-00-00_0029	30906.64	1563	11.27	20.02	16.09	20.2	0.001008	3.36	465.26	87.57	0.26
B104-00-00_0029	30906.64	2302	11.27	21.99	17.02	22.18	0.000885	3.55	648.53	107.64	0.25
B104-00-00_0029	30906.64	2684	11.27	22.93	17.4	23.12	0.000975	3.56	754.38	179.04	0.26
B104-00-00_0029	30906.64	3452	11.27	24.51	18.09	24.67	0.000758	3.28	1367.21	4174.88	0.23
B104-00-00_0029	30886.64	1563	11.27	20	16.09	20.17	0.001023	3.38	462.98	87.43	0.26
B104-00-00_0029	30886.64	2302	11.27	21.96	17.02	22.15	0.000895	3.57	645.55	112.37	0.25
B104-00-00_0029	30886.64	2684	11.27	22.9	17.41	23.1	0.00098	3.57	751.21	180.76	0.26
B104-00-00_0029	30886.64	3452	11.27	24.46	18.08	24.66	0.000884	3.53	977.26	4102.41	0.25
B104-00-00_0029	30856.34	1563	11.27	19.96	16.09	20.14	0.001042	3.4	460.02	87.25	0.26
B104-00-00_0029	30856.34	2302	11.27	21.93	17.02	22.13	0.000905	3.58	642.59	112.85	0.25
B104-00-00_0029	30856.34	2684	11.27	22.87	17.4	23.07	0.000986	3.59	747.16	183.75	0.26
B104-00-00_0029	30856.34	3452	11.27	24.43	18.08	24.62	0.000898	3.55	971.89	3974.38	0.25
B104-00-00_0029	30775.48	1654	11.27	19.83	16.22	20.04	0.001252	3.69	448.83	86.56	0.29
B104-00-00_0029	30775.48	2431	11.27	21.81	17.16	22.04	0.001052	3.85	631.23	112.2	0.27

B104-00-00_0029	30775.48	2831	11.27	22.75	17.54	22.98	0.001124	3.87	732.32	180.51	0.28
B104-00-00_0029	30775.48	3517	11.27	24.38	18.14	24.54	0.000816	3.35	1370.7	3333.51	0.24
B104-00-00_0029	29977.43	1654	9.64	19.01	16.02	19.11	0.001019	2.57	642.93	183.13	0.24
B104-00-00_0029	29977.43	2431	9.64	21.32	16.74	21.39	0.000468	2.17	1119.2	230.05	0.17
B104-00-00_0029	29977.43	2831	9.64	22.26	16.98	22.33	0.00038	2.11	1344.47	247.81	0.16
B104-00-00_0029	29977.43	3517	9.64	24.02	17.39	24.08	0.000273	1.9	1850.98	2621.63	0.14
B104-00-00_0029	29937.02	1654	9.64	18.98	15.67	19.07	0.000821	2.44	676.86	177.86	0.22
B104-00-00_0029	29937.02	2431	9.64	21.3	16.36	21.37	0.000408	2.15	1132.48	214.37	0.16
B104-00-00_0029	29937.02	2831	9.64	22.25	16.65	22.32	0.000349	2.11	1342.93	232.14	0.15
B104-00-00_0029	29937.02	3517	9.64	24.01	17.09	24.07	0.000253	1.95	1887.1	2608.48	0.14
B104-00-00_0029	29774.81	1728	9.64	18.51	16.01	18.87	0.001613	4.82	358.48	82.81	0.41
B104-00-00_0029	29774.81	2544	9.64	20.98	17	21.26	0.000943	4.28	594.56	110.39	0.32
B104-00-00_0029	29774.81	2959	9.64	21.94	17.41	22.22	0.000816	4.18	707.05	122.04	0.31
B104-00-00_0029	29774.81	3617	9.64	23.78	18.01	23.99	0.000673	3.71	974.6	2103.97	0.28
B104-00-00_0029	29620.56	1728	9.64	18.36	15.45	18.63	0.001121	4.22	409.89	89.26	0.35
B104-00-00_0029	29620.56	2544	9.64	20.89	16.34	21.12	0.000652	3.84	662.09	110.29	0.28
B104-00-00_0029	29620.56	2959	9.64	21.87	16.75	22.09	0.000597	3.82	774.3	121.87	0.27
B104-00-00_0029	29620.56	3617	9.64	23.7	17.31	23.89	0.000531	3.5	1034.49	2067.71	0.25
B104-00-00_0029	28679.27	1825	3.83	17.7	11.56	17.87	0.000439	3.32	550.16	81.38	0.22
B104-00-00_0029	28679.27	2693	3.83	20.45	12.82	20.62	0.000376	3.36	800.37	104.08	0.21
B104-00-00_0029	28679.27	3126	3.83	21.43	13.34	21.62	0.000387	3.44	909.16	158.04	0.22
B104-00-00_0029	28679.27	3744	3.83	23.24	14.03	23.4	0.00048	3.16	1184.37	1931.16	0.23
B104-00-00_0029	27313.46	3487	3.19	17.15	10.6	17.31	0.000368	3.21	1085.2	153.33	0.21
B104-00-00_0029	27313.46	5126	3.19	19.88	11.8	20.04	0.000478	3.21	1594.51	523.13	0.24
B104-00-00_0029	27313.46	5639	3.19	20.93	12.14	21.07	0.000396	2.94	1921.1	902.39	0.22
B104-00-00_0029	27313.46	6896	3.19	22.76	12.89	22.88	0.000267	2.68	2576.23	4459.12	0.18
B104-00-00_0029	25959.34	3554	0.31	16.69	8.03	16.85	0.000312	3.26	1088.6	131.18	0.2
B104-00-00_0029	25959.34	5226	0.31	19.26	9.73	19.46	0.00038	3.55	1477.35	716.41	0.22
B104-00-00_0029	25959.34	5710	0.31	20.39	10.16	20.56	0.000345	3.36	1720.85	2528.66	0.21
B104-00-00_0029	25959.34	6916	0.31	22.34	11.09	22.49	0.000294	3.18	2270.32	6134.35	0.2
B104-00-00_0029	25919.28	3554	0.31	16.67	8.06	16.83	0.000282	3.13	1135.44	135.11	0.19
B104-00-00_0029	25919.28	5226	0.31	19.26	9.75	19.44	0.000338	3.42	1525.94	590.39	0.21
B104-00-00_0029	25919.28	5710	0.31	20.38	10.16	20.55	0.000297	3.27	1745.95	2407.11	0.2
B104-00-00_0029	25919.28	6916	0.31	22.36	11.07	22.44	0.000152	2.54	10141.16	6233.05	0.14
B104-00-00_0029	25823.8 Bridge										
B104-00-00_0029	25728.31	4183	0.31	16.58	8.77	16.8	0.000392	3.72	1124.96	131.96	0.22
B104-00-00_0029	25728.31	6086	0.31	19.15	10.46	19.41	0.000392	4.1	1482.86	759.79	0.23
B104-00-00_0029	25728.31	6697	0.31	20.23	10.92	20.49	0.000374	4.05	1652.31	2144.69	0.23
B104-00-00_0029	25728.31	8322	0.31	22.02	12	22.3	0.000405	4.2	1979.1	5476.11	0.24
B104-00-00_0029	25536.03	4183	0.31	16.42	8.69	16.69	0.000531	4.17	1002.47	123.95	0.26
B104-00-00_0029	25536.03	6086	0.31	19	10.44	19.31	0.000599	4.45	1368.22	519.29	0.28

B104-00-00_0029	25536.03	6697	0.31	20.11	10.93	20.39	0.000542	4.26	1573.84	1461.34	0.26
B104-00-00_0029	25536.03	8322	0.31	21.93	12.09	22.21	0.000519	4.24	2026.99	5916.58	0.26
B104-00-00_0029	24058.15	4341	-4.78	15.96	6.11	16.1	0.000221	2.96	1468.43	155.9	0.17
B104-00-00_0029	24058.15	6191	-4.78	18.47	7.56	18.63	0.000252	3.25	1906.65	449.18	0.18
B104-00-00_0029	24058.15	6895	-4.78	19.62	8.04	19.78	0.000235	3.22	2142.43	1542.86	0.18
B104-00-00_0029	24058.15	8395	-4.78	21.47	8.97	21.63	0.00021	3.29	2592.06	5361.34	0.17
B104-00-00_0029	24038.15	4341	-4.78	15.95	6.12	16.09	0.000211	3.02	1439.44	142.44	0.17
B104-00-00_0029	24038.15	6191	-4.78	18.45	7.56	18.63	0.000229	3.41	1816.91	613.98	0.18
B104-00-00_0029	24038.15	6895	-4.78	19.58	8.04	19.77	0.000256	3.42	2015.36	1863.23	0.19
B104-00-00_0029	24038.15	8395	-4.78	21.43	8.97	21.63	0.000238	3.5	2425.64	5405.84	0.18
B104-00-00_0029	23905.5 Bridge										
B104-00-00_0029	23772.84	4341	-4.78	15.91	6.12	16.06	0.000213	3.03	1434.78	312.3	0.17
B104-00-00_0029	23772.84	6191	-4.78	18.41	7.57	18.59	0.000233	3.41	1813.05	863.36	0.18
B104-00-00_0029	23772.84	6895	-4.78	19.43	8.04	19.61	0.000256	3.45	1996.25	2158.52	0.2
B104-00-00_0029	23772.84	8395	-4.78	21.13	8.97	21.32	0.000239	3.55	2402.47	5214.67	0.19
B104-00-00_0029	23692.71	4341	-4.78	15.9	6.11	16.04	0.000216	3.02	1437.58	239.71	0.17
B104-00-00_0029	23692.71	6191	-4.78	18.4	7.56	18.57	0.000301	3.32	1865.54	1053.94	0.2
B104-00-00_0029	23692.71	6895	-4.78	19.42	8.04	19.58	0.000276	3.3	2093.07	1814.82	0.19
B104-00-00_0029	23692.71	8395	-4.78	21.12	8.97	21.29	0.000233	3.39	2517.86	5065.23	0.18
B104-00-00_0029	22758.24	4341	-1.81	15.68	7	15.83	0.000237	3.15	1379.08	155.64	0.18
B104-00-00_0029	22758.24	6191	-1.81	18.09	8.2	18.27	0.000336	3.43	2016.94	798.56	0.21
B104-00-00_0029	22758.24	6895	-1.81	19.16	8.62	19.33	0.000277	3.33	2783.07	1311.03	0.19
B104-00-00_0029	22758.24	8395	-1.81	20.94	9.43	21.08	0.000195	3.14	6201.77	2902.01	0.17
B104-00-00_0029	21821.68	4341	-1.41	15.47	6.14	15.62	0.000219	3.05	1454.33	194.09	0.17
B104-00-00_0029	21821.68	6191	-1.41	17.81	7.46	17.99	0.000257	3.4	2184.02	626.57	0.19
B104-00-00_0029	21821.68	6895	-1.41	18.93	7.91	19.1	0.000217	3.35	2860.4	1057.5	0.18
B104-00-00_0029	21821.68	8395	-1.41	20.76	8.77	20.91	0.00017	3.27	5220.51	1898.6	0.16
B104-00-00_0029	21072.13	4631	-2.89	15.34	4.79	15.46	0.000172	2.78	1668.62	165.81	0.15
B104-00-00_0029	21072.13	6657	-2.89	17.65	6.22	17.81	0.000219	3.15	2265.91	558.86	0.17
B104-00-00_0029	21072.13	7457	-2.89	18.79	6.7	18.94	0.000195	3.13	2964.03	973.06	0.17
B104-00-00_0029	21072.13	9032	-2.89	20.65	7.59	20.78	0.000151	3.06	5828.5	2310.96	0.15
B104-00-00_0029	21031.83	4804	-2.89	15.32	4.93	15.45	0.000179	2.9	1655.03	158.15	0.16
B104-00-00_0029	21031.83	6871	-2.89	17.62	6.36	17.8	0.000201	3.37	2190.78	551.76	0.17
B104-00-00_0029	21031.83	7716	-2.89	18.74	6.85	18.93	0.000192	3.42	2730.78	1001.39	0.17
B104-00-00_0029	21031.83	9243	-2.89	20.61	7.69	20.77	0.000157	3.35	5874.27	2265.14	0.16
B104-00-00_0029	20942.9 Bridge										
B104-00-00_0029	20853.92	4804	-2.89	15.29	4.94	15.43	0.000223	2.98	1609.8	174.56	0.17
B104-00-00_0029	20853.92	6871	-2.89	17.57	6.4	17.75	0.000252	3.36	2147.31	369.45	0.19
B104-00-00_0029	20853.92	7716	-2.89	18.68	6.92	18.85	0.000236	3.36	2563.67	516.78	0.18
B104-00-00_0029	20853.92	9243	-2.89	20.43	7.79	20.6	0.000221	3.37	3610.06	1907.82	0.18

B104-00-00_0029	20693.87	4804	-2.89	15.26	4.88	15.39	0.00024	2.9	1656.25	199.54	0.18
B104-00-00_0029	20693.87	6871	-2.89	17.54	6.34	17.69	0.000295	3.13	2277.91	477.27	0.2
B104-00-00_0029	20693.87	7716	-2.89	18.65	6.9	18.79	0.000288	3.02	2859.1	869.8	0.19
B104-00-00_0029	20693.87	9243	-2.89	20.42	7.83	20.54	0.000214	2.79	4942.17	1857.25	0.17
B104-00-00_0029	19846.57	4804	-6.72	15.05	4.09	15.19	0.00022	3.05	1576.57	160.8	0.17
B104-00-00_0029	19846.57	6871	-6.72	17.26	6.04	17.44	0.000286	3.44	2020.09	250.56	0.2
B104-00-00_0029	19846.57	7716	-6.72	18.38	6.59	18.55	0.000265	3.42	2368.23	486.77	0.19
B104-00-00_0029	19846.57	9243	-6.72	20.18	7.51	20.35	0.000212	3.37	3367.68	1097.53	0.17
B104-00-00_0029	19812.71	4804	-6.72	15.04	4.09	15.18	0.000257	3	1601.29	189.69	0.18
B104-00-00_0029	19812.71	6871	-6.72	17.26	6.04	17.43	0.000335	3.29	2086.03	264.45	0.21
B104-00-00_0029	19812.71	7716	-6.72	18.38	6.59	18.54	0.00031	3.21	2451.75	525.77	0.2
B104-00-00_0029	19812.71	9243	-6.72	20.18	7.5	20.33	0.000223	3.08	3556.66	1166.77	0.18
B104-00-00_0029	19737.92 Bridge										
B104-00-00_0029	19663.12	4804	-6.72	14.78	4.09	14.92	0.000216	2.99	1608.55	167.63	0.17
B104-00-00_0029	19663.12	6871	-6.72	17.16	6.04	17.34	0.000241	3.39	2030.38	266.66	0.18
B104-00-00_0029	19663.12	7716	-6.72	18.16	6.62	18.34	0.00028	3.44	2289.38	441.85	0.2
B104-00-00_0029	19663.12	9243	-6.72	20	7.56	20.17	0.000222	3.37	3528.68	1032.46	0.18
B104-00-00_0029	19580.65	4804	-6.72	14.75	4.09	14.89	0.000385	3.07	1564.04	244.14	0.21
B104-00-00_0029	19580.65	6871	-6.72	17.15	6.04	17.3	0.000312	3.13	2196.36	286.26	0.2
B104-00-00_0029	19580.65	7716	-6.72	18.15	6.59	18.3	0.00029	3.09	2496.91	371.11	0.19
B104-00-00_0029	19580.65	9243	-6.72	20	7.51	20.13	0.000237	2.93	3464.04	976.42	0.18
B104-00-00_0029	19232.53	4804	-5.45	14.64	4.33	14.79	0.000211	3.07	1566.22	153.11	0.17
B104-00-00_0029	19232.53	6871	-5.45	17.02	5.95	17.2	0.000283	3.35	2138.91	318.58	0.19
B104-00-00_0029	19232.53	7716	-5.45	18.03	6.47	18.2	0.000255	3.37	2519.54	441.31	0.19
B104-00-00_0029	19232.53	9243	-5.45	19.88	7.33	20.05	0.000202	3.34	3703.22	1478	0.17
B104-00-00_0029	19212.44	4804	-5.45	14.63	4.33	14.78	0.000211	3.07	1564.45	153.02	0.17
B104-00-00_0029	19212.44	6871	-5.45	17.01	5.96	17.19	0.000301	3.39	2096.73	315.41	0.2
B104-00-00_0029	19212.44	7716	-5.45	18.02	6.47	18.2	0.000282	3.4	2479.84	459.44	0.19
B104-00-00_0029	19212.44	9243	-5.45	19.88	7.33	20.05	0.000221	3.32	3633.34	1399.71	0.18
B104-00-00_0029	19151.64 Bridge										
B104-00-00_0029	19090.84	4804	-5.45	14.58	4.33	14.73	0.000221	3.12	1538.85	152.04	0.17
B104-00-00_0029	19090.84	6871	-5.45	16.93	5.95	17.13	0.000264	3.57	1926.49	179.15	0.19
B104-00-00_0029	19090.84	7716	-5.45	17.9	6.46	18.11	0.000267	3.66	2215.23	464.32	0.19
B104-00-00_0029	19090.84	9243	-5.45	19.75	7.31	19.95	0.000231	3.64	3751.35	1797.38	0.18
B104-00-00_0029	19010.58	4804	-5.45	14.55	4.33	14.71	0.000221	3.19	1507.35	143.45	0.17
B104-00-00_0029	19010.58	6871	-5.45	16.89	5.95	17.1	0.000277	3.68	1880.19	234.61	0.2
B104-00-00_0029	19010.58	7716	-5.45	17.86	6.45	18.08	0.000297	3.75	2255.19	568.5	0.2
B104-00-00_0029	19010.58	9243	-5.45	19.73	7.3	19.93	0.000233	3.7	3968.39	1789.61	0.18
B104-00-00_0029	17730.46	6520	-3.29	14.12	4.46	14.36	0.000329	3.96	1646.5	155.19	0.21
B104-00-00_0029	17730.46	9226	-3.29	16.36	6.44	16.69	0.000383	4.59	2011.69	171.22	0.24
B104-00-00_0029	17730.46	10458	-3.29	17.27	7.11	17.63	0.000392	4.82	2179.03	359.73	0.24

B104-00-00_0029	17730.46	12519	-3.29	19.19	8.05	19.56	0.000341	4.91	3587.74	1311.54	0.23
B104-00-00_0029	16521.13	6520	-3.29	13.67		13.93	0.000376	4.13	1578.8	154.57	0.23
B104-00-00_0029	16521.13	9226	-3.29	15.83		16.18	0.000446	4.75	1982.8	272.43	0.25
B104-00-00_0029	16521.13	10458	-3.29	16.75		17.13	0.000437	4.96	2248.82	317.44	0.25
B104-00-00_0029	16521.13	12519	-3.29	18.75		19.13	0.000367	5.04	3299.56	1025.43	0.24
B104-00-00_0029	16480.97	6520	-3.29	13.64	4.47	13.91	0.000372	4.14	1573.89	152.02	0.23
B104-00-00_0029	16480.97	9226	-3.29	15.8	6.44	16.16	0.000436	4.81	1918.27	166.83	0.25
B104-00-00_0029	16480.97	10458	-3.29	16.72	7.11	17.11	0.00045	5.05	2072.72	324.49	0.26
B104-00-00_0029	16480.97	12519	-3.29	18.71	8.05	19.12	0.000387	5.11	3158.93	1215.29	0.24
B104-00-00_0029	16422.9	Bridge									
B104-00-00_0029	16364.84	6520	-3.29	13.6	4.46	13.81	0.000371	3.69	1767.74	205.81	0.22
B104-00-00_0029	16364.84	9226	-3.29	15.75	6.44	16.02	0.000387	4.13	2232.54	225.92	0.23
B104-00-00_0029	16364.84	10458	-3.29	16.66	7.19	16.94	0.00038	4.29	2439.99	381.52	0.23
B104-00-00_0029	16364.84	12519	-3.29	18.46	8.25	18.75	0.000317	4.35	3313.01	552.61	0.22
B104-00-00_0029	16204.84	6520	-3.29	13.53		13.75	0.000396	3.74	1745.45	209.49	0.23
B104-00-00_0029	16204.84	9226	-3.29	15.69		15.95	0.000409	4.13	2242.31	253.28	0.24
B104-00-00_0029	16204.84	10458	-3.29	16.6		16.88	0.000399	4.26	2554.72	439.18	0.24
B104-00-00_0029	16204.84	12519	-3.29	18.42		18.7	0.000335	4.27	3420.96	637.94	0.22
B104-00-00_0029	14932.88	6649	-4.54	13	4.18	13.24	0.000405	3.91	1700.17	192.72	0.23
B104-00-00_0029	14932.88	9396	-4.54	15.13	5.86	15.44	0.000396	4.44	2148.14	236.56	0.24
B104-00-00_0029	14932.88	10654	-4.54	16.04	6.46	16.38	0.000388	4.64	2375.66	260.8	0.24
B104-00-00_0029	14932.88	12742	-4.54	17.91	7.39	18.26	0.000337	4.77	2951.81	533.4	0.23
B104-00-00_0029	13216.11	7080	-5.14	12.32		12.57	0.000371	4.02	1830.22	213.88	0.22
B104-00-00_0029	13216.11	10024	-5.14	14.41		14.74	0.00041	4.69	2351.63	292.4	0.24
B104-00-00_0029	13216.11	11330	-5.14	15.32		15.68	0.000415	4.92	2680.34	462.36	0.24
B104-00-00_0029	13216.11	13697	-5.14	17.28		17.65	0.000369	5.04	3746.91	625.21	0.23
B104-00-00_0029	11490.4	7850	-7.29	11.5	1.83	11.85	0.000459	4.76	1652.23	632.71	0.25
B104-00-00_0029	11490.4	11196	-7.29	13.95	3.6	14.11	0.000245	3.86	5838.17	812.03	0.19
B104-00-00_0029	11490.4	12594	-7.29	14.89	4.46	15.04	0.000227	3.85	6629.14	905.53	0.18
B104-00-00_0029	11490.4	15558	-7.29	16.94	5.99	17.09	0.000183	3.79	8640.35	1096.2	0.17
B104-00-00_0029	11450.35	7850	-7.29	11.48	1.83	11.83	0.000462	4.77	1648.76	627.04	0.25
B104-00-00_0029	11450.35	11196	-7.29	13.49	3.6	13.99	0.000556	5.71	2023.29	861.3	0.28
B104-00-00_0029	11450.35	12594	-7.29	14.36	4.46	14.91	0.000572	5.98	2189.64	876.08	0.29
B104-00-00_0029	11450.35	15558	-7.29	16.82	5.98	17.05	0.000263	4.52	7225.88	1064.11	0.2
B104-00-00_0029	11295.96	Bridge									
B104-00-00_0029	11141.62	7850	-7.29	11.36	1.83	11.71	0.000493	4.75	1653.91	330.33	0.26
B104-00-00_0029	11141.62	11196	-7.29	13.32	3.6	13.83	0.000562	5.69	1986.29	392.67	0.29
B104-00-00_0029	11141.62	12594	-7.29	14.03	4.46	14.6	0.000589	6.04	2121	549.7	0.29
B104-00-00_0029	11141.62	15558	-7.29	15.69	5.98	16.36	0.000598	6.6	2438.5	694.33	0.3
B104-00-00_0029	10978.64	7850	-7.29	11.34	1.83	11.59	0.000369	4.21	2688.82	407.46	0.23

B104-00-00_0029	10978.64	11196	-7.29	13.33	3.64	13.67	0.000404	4.93	3466.24	459.79	0.24
B104-00-00_0029	10978.64	12594	-7.29	14.05	4.61	14.42	0.000418	5.21	3762.02	483.73	0.25
B104-00-00_0029	10978.64	15558	-7.29	15.73	6.16	16.16	0.000414	5.61	4700.64	837.43	0.25
B104-00-00_0029	9906.905	7850	-8.32	11.05		11.25	0.000236	3.82	2791.12	483.27	0.19
B104-00-00_0029	9906.905	11196	-8.32	13.02		13.29	0.000271	4.49	3880.87	652.31	0.21
B104-00-00_0029	9906.905	12594	-8.32	13.73		14.03	0.00028	4.71	4372.79	717.03	0.21
B104-00-00_0029	9906.905	15558	-8.32	15.46		15.76	0.000266	4.9	5784.86	1046.98	0.21
B104-00-00_0029	9866.73	7850	-8.32	10.95	0.58	11.22	0.000298	4.21	2083.68	404.88	0.21
B104-00-00_0029	9866.73	11196	-8.32	12.84	2.16	13.24	0.000367	5.13	2573.18	582.79	0.24
B104-00-00_0029	9866.73	12594	-8.32	13.56	2.77	13.97	0.000377	5.36	3259.23	640.92	0.24
B104-00-00_0029	9866.73	15558	-8.32	15.28	4.06	15.7	0.000355	5.6	4924.2	874.64	0.24
B104-00-00_0029	9803.8 Bridge										
B104-00-00_0029	9740.892	7850	-8.32	10.76	0.58	11.04	0.000299	4.24	2015.88	313.05	0.21
B104-00-00_0029	9740.892	11196	-8.32	12.68	2.16	13.09	0.000374	5.2	2409.09	352.04	0.24
B104-00-00_0029	9740.892	12594	-8.32	13.39	2.78	13.86	0.000401	5.57	2563.86	375.17	0.25
B104-00-00_0029	9740.892	15558	-8.32	14.78	4.06	15.37	0.000452	6.26	2889.06	485.74	0.27
B104-00-00_0029	9563.455	7850	-8.32	10.76	0.58	10.94	0.00022	3.62	3837.27	816.38	0.18
B104-00-00_0029	9563.455	11196	-8.32	12.7	2.16	12.94	0.000259	4.33	5321.4	981.49	0.2
B104-00-00_0029	9563.455	12594	-8.32	13.46	2.77	13.67	0.000235	4.26	6881.47	1020.94	0.19
B104-00-00_0029	9563.455	15558	-8.32	14.9	4.06	15.12	0.000233	4.5	8387.81	1072.96	0.19
B104-00-00_0029	8749.762	7937	-7.48	10.5		10.73	0.000273	4.15	3032.39	536.72	0.2
B104-00-00_0029	8749.762	11340	-7.48	12.42		12.71	0.000307	4.82	4230.71	714.95	0.22
B104-00-00_0029	8749.762	12758	-7.48	13.13		13.44	0.000316	5.04	4758.31	758.55	0.22
B104-00-00_0029	8749.762	15800	-7.48	14.56		14.89	0.000321	5.39	5905.32	852.02	0.23
B104-00-00_0029	7694.595	8412	-9.06	10.2		10.45	0.000262	4.33	4338.31	908.01	0.2
B104-00-00_0029	7694.595	12119	-9.06	12.07		12.38	0.000307	5.07	6122.43	1005.59	0.22
B104-00-00_0029	7694.595	13656	-9.06	12.76		13.1	0.000323	5.34	6843.49	1068.69	0.22
B104-00-00_0029	7694.595	17098	-9.06	14.14		14.53	0.000356	5.9	8429.42	1259.79	0.24
B104-00-00_0029	6926.893	8412	-9.91	10.02		10.18	0.000462	3.55	5004.57	1414.48	0.19
B104-00-00_0029	6926.893	12119	-9.91	11.93		12.08	0.000415	3.75	7964.42	1690.37	0.19
B104-00-00_0029	6926.893	13656	-9.91	12.64		12.8	0.000398	3.82	9196.47	1780.36	0.19
B104-00-00_0029	6926.893	17098	-9.91	14.05		14.2	0.000379	3.98	11911.51	2086.46	0.18
B104-00-00_0029	6883.529	8412	-9.91	9.8	0.36	10.11	0.000693	4.89	3210.73	963.63	0.24
B104-00-00_0029	6883.529	12119	-9.91	11.6	2.57	11.99	0.000804	5.73	4181.23	1113.07	0.26
B104-00-00_0029	6883.529	13656	-9.91	12.26	5.31	12.69	0.000838	6.03	4547.8	1189.08	0.27
B104-00-00_0029	6883.529	17098	-9.91	13.81	6.69	14.13	0.000672	5.75	8389.81	1406.91	0.25
B104-00-00_0029	6806.5 Bridge										
B104-00-00_0029	6729.469	8412	-9.91	9.61	0.36	9.89	0.000718	4.65	3015.36	509.84	0.24
B104-00-00_0029	6729.469	12119	-9.91	11.41	2.6	11.78	0.000814	5.45	3984.44	1108.64	0.26
B104-00-00_0029	6729.469	13656	-9.91	12.08	5.3	12.49	0.000835	5.71	4362.28	1239.46	0.27
B104-00-00_0029	6729.469	17098	-9.91	13.41	6.34	13.82	0.000815	5.99	6784.83	2013.88	0.27

B104-00-00_0029	6546.744	8412	-9.91	9.51		9.66	0.000438	3.78	5557.6	1022.35	0.19
B104-00-00_0029	6546.744	12119	-9.91	11.31		11.48	0.000469	4.28	7521.15	1150	0.2
B104-00-00_0029	6546.744	13656	-9.91	11.98		12.18	0.000516	4.63	8346.23	1390.95	0.21
B104-00-00_0029	6546.744	17098	-9.91	13.29		13.5	0.000505	4.85	10204.38	1488.23	0.21
B104-00-00_0029	5295.497	8412	-11.65	8.68		9	0.000685	5.22	3838.34	747.79	0.24
B104-00-00_0029	5295.497	12119	-11.65	10.36		10.75	0.000807	6.09	5176.59	845.87	0.27
B104-00-00_0029	5295.497	13656	-11.65	10.97		11.39	0.000846	6.4	5704.38	884.49	0.28
B104-00-00_0029	5295.497	17098	-11.65	12.21		12.69	0.000943	7.08	6957.47	1455.22	0.29
B104-00-00_0029	4120.306	8412	-11.54	7.92		7.99	0.001548	2.65	4089.22	753.54	0.13
B104-00-00_0029	4120.306	12119	-11.54	9.58		9.66	0.001489	2.81	5506.79	907.73	0.13
B104-00-00_0029	4120.306	13656	-11.54	10.18		10.26	0.00151	2.91	6096.93	1013.96	0.13
B104-00-00_0029	4120.306	17098	-11.54	11.41		11.49	0.001496	3.04	7501.85	1512.7	0.13
B104-00-00_0029	2876.672	8412	-7.3	6.06	1.49	6.35	0.001002	5.03	3707.34	875.81	0.28
B104-00-00_0029	2876.672	12119	-7.3	7.72	3.68	8.05	0.001001	5.58	5302.92	1135.3	0.29
B104-00-00_0029	2876.672	13656	-7.3	8.3	4.09	8.63	0.001	5.77	5972.07	1198.25	0.29
B104-00-00_0029	2876.672	17098	-7.3	9.49	4.86	9.85	0.001001	6.15	7498.74	1358.85	0.3

Appendix – Correspondence

HARRIS COUNTY FLOOD CONTROL DISTRICT

April 19, 2017

Chip Taylor, PE, PTP, FITE
Project Manager

Marcus Stuckett, P.E., CFM
Planning Division

El Dorado Road Model Review

At the request of HCED, the Flood Control District has performed a cursory review of the El Dorado EPA-SWMM models. The review focused solely on the modeling techniques used for the existing and proposed models.

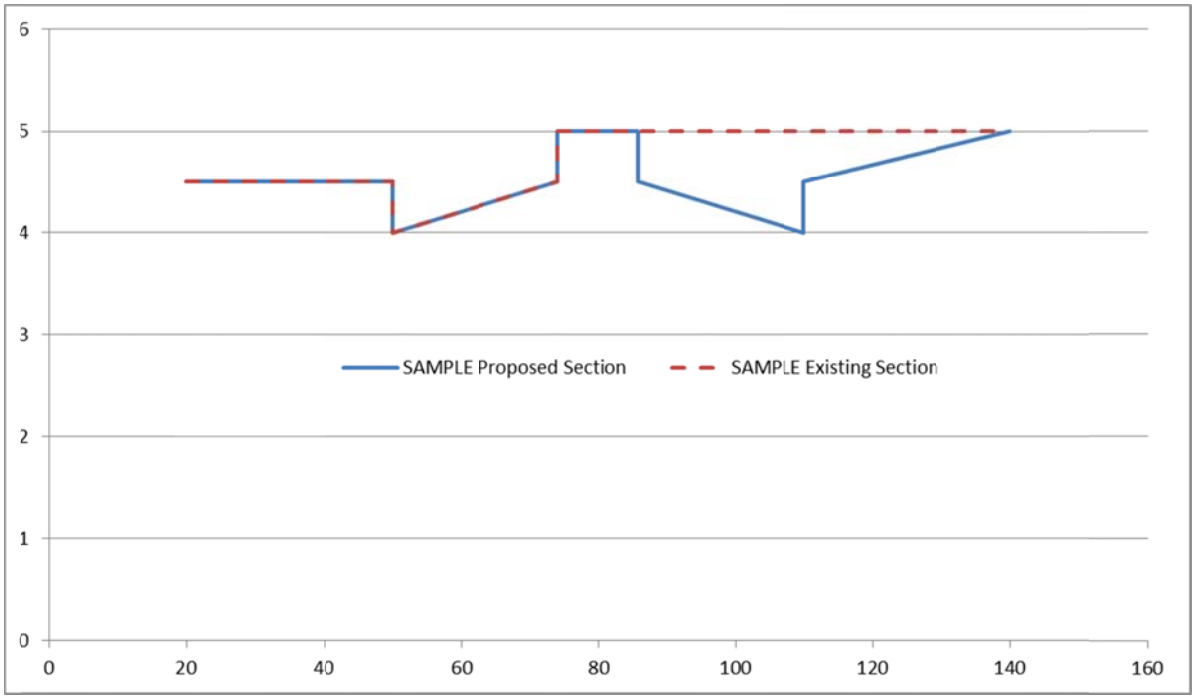
The comments are below:

1. Outfalls set to 'Free' should be set to 'Fixed' with an elevation at the top of pipe. This will likely increase hydraulic gradeline elevations, be sure to recheck them all to make sure they make sense.

2. Along El Dorado Road, there are some 'Conduits' that show a 1 foot 'Triangle Height' and others that show a 2 foot 'Triangle Height'. Understanding that these conduits are meant to model flow on the surface (in the streets), why does it change between sections? 'Conduit 85' is an example, but there may be others.

3. Why does the surface flow section stop approximately 1100 feet short of the intersection with Clear Lake City Blvd?

4. Surface flow is modeled as 100 foot wide section. Assuming that this is the entire ROW, how will the proposed conditions modeled? If it was only modeling the proposed road section, then it would only have a 24 foot 'Top Width' and for proposed it could be expected to increase to a 48 foot 'Top Width'. It would probably be more accurate to model the surface flow using the 'Irregular'. With this, the entire ROW on Eldorado Road could be modeled and the sections will clearly show the proposed section has added a lane. See example below.



Please note that HCFCD's review of these models did not include a detailed review to check and verify supporting data and calculations.

MYS

El Dorado April 19 2017 Review.doc

ZARINKELK ENGINEERING SERVICES,INC.
617 Caroline St. • Houston, Texas • 77002

MEMORANDUM

To: Chip Taylor, P.E., PTP, FITE

From: Michael Bagstad, P.E.

Subject: Response to HCFCD Comments on SWMM Models
El Dorado Blvd., Precinct 2 (UPIN 17102MF0PM01)
Response to HCFCD Comments, 4/19/17
(responded via emails on 4/20/17)

Date Prepared: June 20, 2017

The following comments were received from HCFCD:

1. *Outfalls set to 'Free' should be set to 'Fixed' with an elevation at the top of pipe.* ***Note:*** *this will likely increase hydraulic gradeline elevations, be sure to recheck them all to make sure they make sense.*

   Agree. They have fixed at top of pipe for 10- and 100-year. For the 2-year we will use free outfall.

2. *Along El Dorado Road, there are some 'Conduits' that show a 1 foot 'Triangle Height' and others that show a 2 foot 'Triangle Height'. Understanding that these conduits are meant to model flow on the surface (in the streets), why does it change between sections? 'Conduit 85' is an example, but there may be others.*

   Agree. It was a typo and they are fixed.

3. *Why does the surface flow section stop approximately 1100 feet short of the intersection with Clear Lake City Blvd.?*

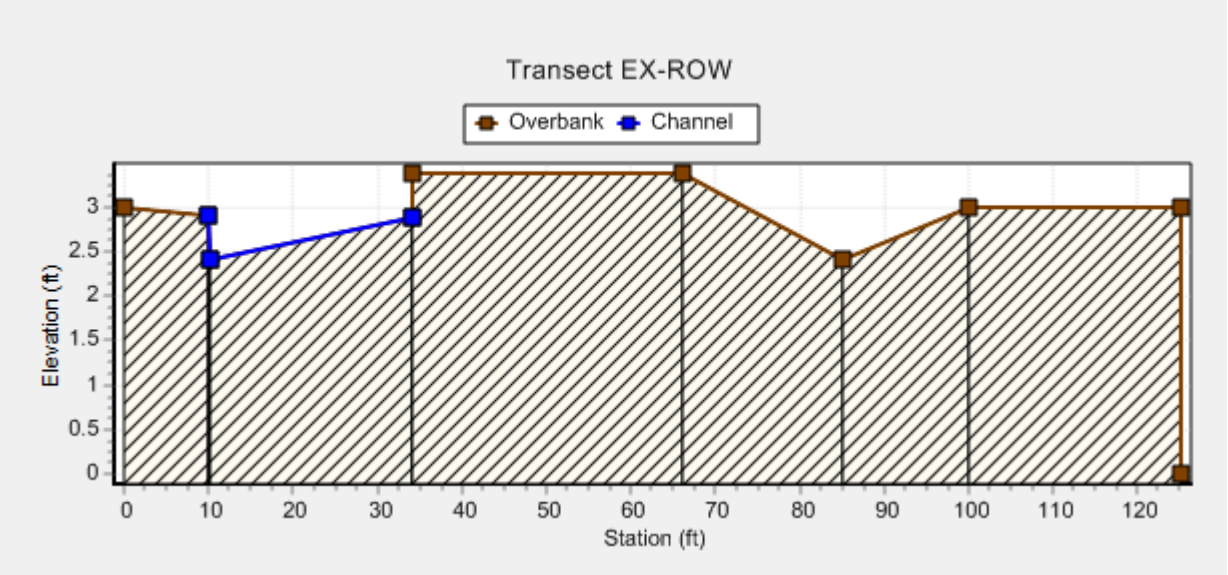
   The surface section now starts from Clear Lake City Blvd. and continues all the way to Horsepen Bayou.

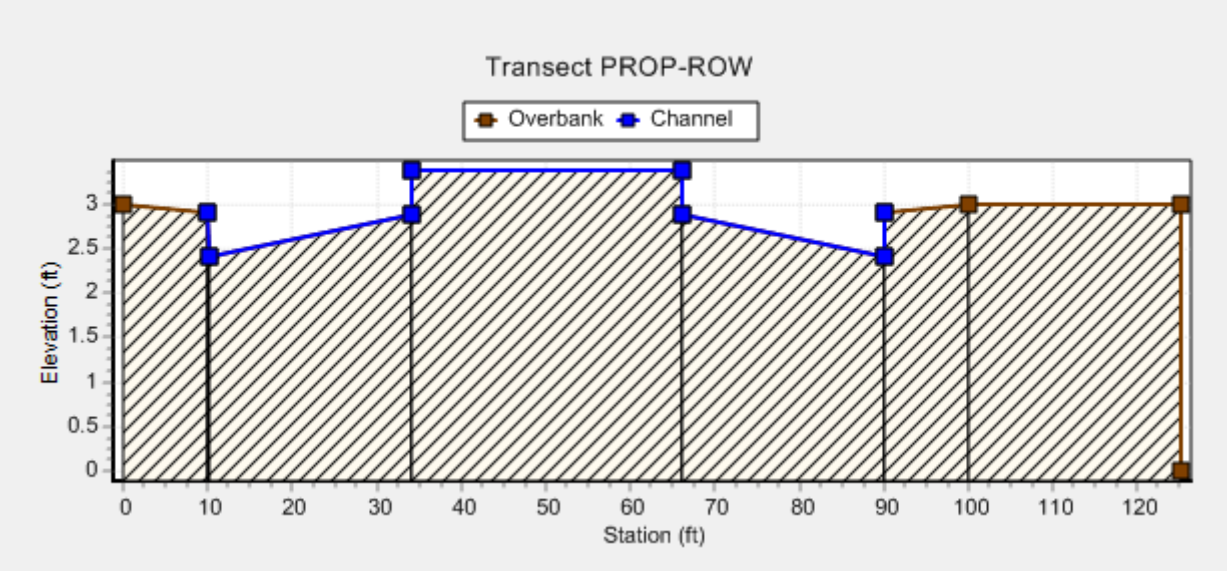
4. *Surface flow is modeled as 100 foot wide section. Assuming that this is the entire ROW, how will the proposed conditions be modeled? If it was only modeling the proposed road section, then it would only have a 24 foot 'Top Width' and for proposed it could be expected to increase to a 48 foot 'Top Width'.*

   RECOMMENDATION: It would probably be more accurate to model the surface flow using the 'Irregular'. With this, the entire ROW on Eldorado Road could be

modeled and the sections will clearly show the proposed section has added a lane.

Here are two cross sections to use instead of the generic inverted trapezoid. The existing section is looking downstream with the pavement on the left and the 25ôlandscape reserve on the right. 34ômedians are shown in both. 24ô pavement is added in the proposed. See the following pictures.





MEMORANDUM

HARRIS COUNTY FLOOD CONTROL DISTRICT

9900 Northwest Freeway
Houston, TX 77092
713-684-4000

DATE: May 25, 2017

TO: Chip Taylor, P.E., PTP, FITE
Project Manager

FROM: Marcus Stuckett, P.E., CFM MYS
Engineering Division

RE: El Dorado HEC-RAS Model Review

At the request of HCED, the Flood Control District has performed a cursory review of the referenced RAS model with the plan titled, *Proposed New Bridge Multi Profile*.

The comments for the models are as follows:

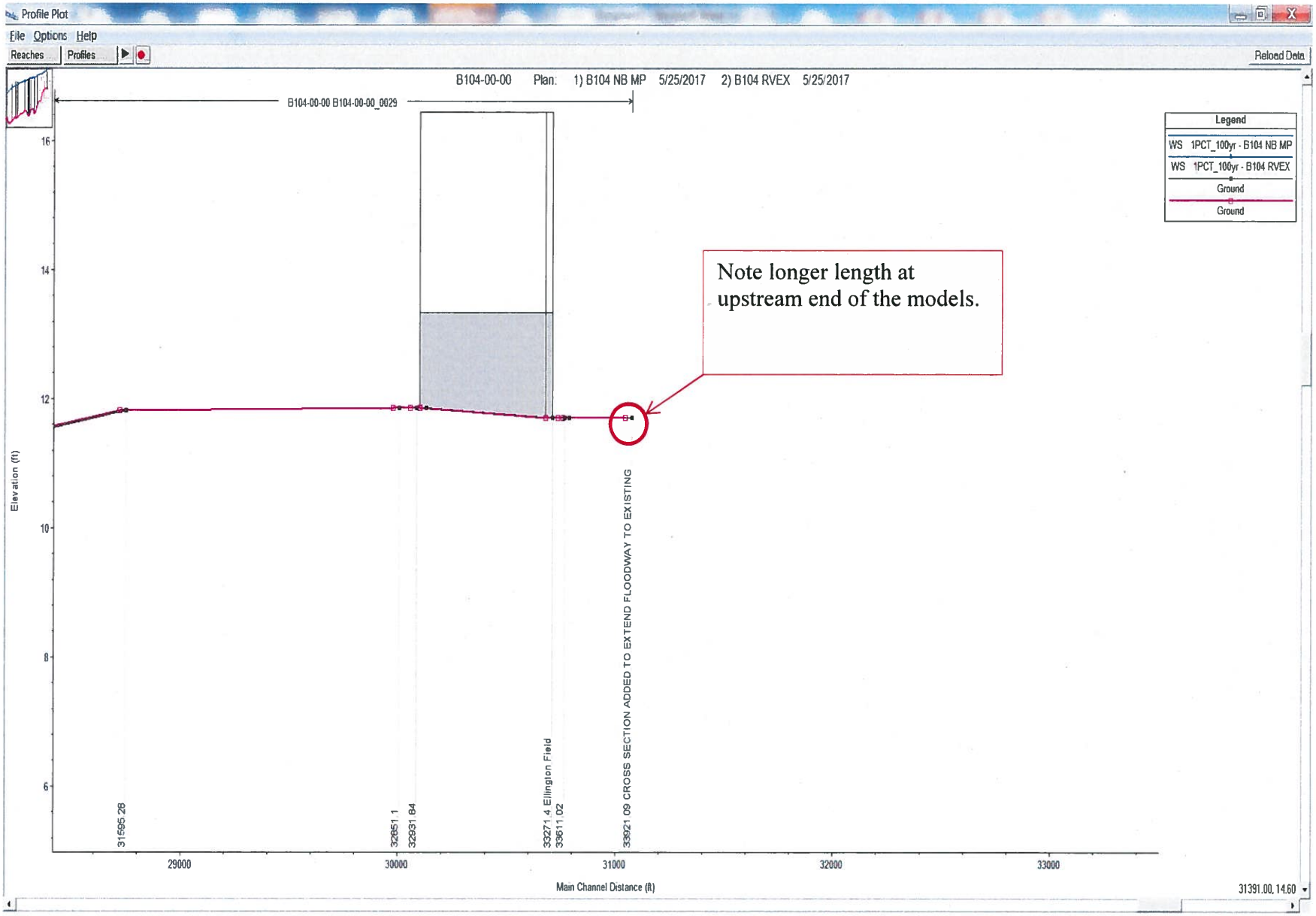
1. Both Revised Existing and Proposed Conditions Plan should be included in the same HEC-RAS model.

2. Change the proposed geometry file to match the name the proposed plan run.

3. Modify the revised exsiting distance between the proposed bridge to create an apples to apples comparison. Because this wasn't done, it may or may not require additional slope paving because the elevation comparisons are at two different locations although the Cross Section Name is the same. See figure attached.

MYS


Profile Plot
File Options Help
Reaches...
Profiles...
Reload Data
B104-00-00 Plan: 1) B104 NB MP 5/25/2017 2) B104 RVEX 5/25/2017
B104-00-00 B104-00-00_0029
Legend
WS 1PCT_100yr - B104 NB MP
WS 1PCT_100yr - B104 RVEX
Ground
Ground
Elevation (ft)
20
10
0
-10
Reach lengths do not match creating a longer total length for revised existing than proposed.
16204.84
16364.84
16454.91 New Eldorado
16544.97
16585.13
13000
13200
13400
13600
13800
14000
14200
Main Channel Distance (ft)
13790.14, 9.27


Profile Plot
File Options Help
Reaches
Profiles
Reload Data
B104-00-00 Plan: 1) B104 NB MP 5/25/2017 2) B104 RVEX 5/25/2017
B104-00-00 B104-00-00_0029
Legend
WS 1PCT_100yr - B104 NB MP
WS 1PCT_100yr - B104 RVEX
Ground
Ground
Note longer length at upstream end of the models.
Elevation (ft)
16
14
12
10
8
6
31595.28
32651.1
32931.84
33271.4 Ellington Field
33611.02
33921.09 CROSS SECTION ADDED TO EXTEND FLOODWAY TO EXISTING
29000
30000
31000
32000
33000
Main Channel Distance (ft)
31391.00, 14.60

ZARINKELK ENGINEERING SERVICES,INC.
617 Caroline St. • Houston, Texas • 77002

MEMORANDUM

To: Chip Taylor, P.E., PTP, FITE

From: Michael Bagstad, P.E.

Subject: Response to HCFCD Comments on El Dorado HEC-RAS Models
El Dorado Blvd., Precinct 2 (UPIN 17102MF0PM01)
Response to Comments
HCFCD 5/25/17

Date Prepared: May 26, 2017

The following comments were received from HCFCD:

1. *Both Revised Existing and Proposed Conditions plan should be included in the same HEC-RAS model.*

   Agreed. Now both existing and proposed plans can be found under same HEC-RAS model.

2. *Change the proposed geometry file to match the name proposed plan run.*

   Agree. For the proposed plan called ñProposed Multi Profileòthere is now a geometry named ñB 104-00-00 Proposed Conditionsò

3. *Modify the revised existing distance between the proposed bridge to create an apple to apple comparison. Because this wasn't done, it may or may not require additional slope paving because the elevation comparisons are at two different locations although the cross section name is the same. See figure attached.*

   The distance to the downstream cross section for station 17730.46 has been adjusted. The overall distance between river stations 17730.46 and 16364.84 are now exactly the same. Please refer to Table 1.

   Since the new bridge adds 64 feet to the upstream of the existing bridge, the two cross sections upstream of the existing bridge were moved by the same 64-foot distance as. Since the proposed model does not include cross sections 16480.97 and 16521.13, we interpolated to compare water surface elevations at these locations in the proposed model. The results are shown in Tables 2 and 3

for 10- and 100-year flows, respectively. A composite Manningôs n of 0.025 was used to simulate slope paving beneath the new bridge. WSELôs do not increase.

Table: 1 – Distance between cross sections

Exist. Model Dist. to DwnStrm Xsec				Prop. Model Dist. to DwnStrm Xsec			
STATION	LOB	CHANNEL	ROB	STATION	LOB	CHANNEL	ROB
17730.46	942.28	1209.33	1451.29	17730.46	878.28	1145.33	1387.29
16585.13	N/A	N/A	N/A	16585.13	40.7	40.16	41.08
16544.97	N/A	N/A	N/A	16544.97	176.23	180.13	198.01
16521.13	40.7	40.16	41.08	16521.13	N/A	N/A	N/A
16480.97	112.23	116.13	134.01	16480.97	N/A	N/A	N/A
16364.84	161.82	160	170.04	16364.84	161.82	160	170.04
Total	1257.03	1525.62	1796.42	Total	1257.03	1525.62	1796.42

Table: 2- Interpolation results-100 Year

STATION	WS-Existing Condition	WS-Proposed Condition
16364.84	16.66	16.64
16480.97	16.71	16.68
16521.13	16.75	16.69
16544.97	-	16.7

Table: 3- Interpolation results-10 Year

STATION	WS-Existing Condition	WS-Proposed Condition
16364.84	13.60	13.58
16480.97	13.65	13.62
16521.13	13.67	13.63
16544.97	-	13.64

Harris County Public Infrastructure Department
Architecture & Engineering Division
10555 NORTHWEST FREEWAY, HOUSTON, TX 77092 - OFFICE 713-956-3000

7/25/2017 6:56:54 AM

PROJECT REVIEW / ROUTING

Property Information

Commercial Property

Project Name:	El Dorado Blvd - Half Boulevard from 250 ft N of Woodbourne Dr to Clear Lake City Blvd
Application Type:	H.C. CIP & Design Services - Geotech Analysis
Address:	0 El Dorado Boulevard
City	Houston **State:** TX **Zip:** 77059

Property Owner's Information		Project Detail	
Name:	Harris County CIP	**Project Number.:**	1706280115
Address:	1001 Preston Street		
City	Houston **State:** TX **Zip:** 77002		
Contact No.:	(713) 755-7004	**Assigned:**	Kris Goparaju
Email:	Eric.Heppen@hcpid.org	**Status:**	Return to Customer

Applicant Information		Floodplain Information	
Name:	Harris County CIP	**Flood Zone:**	X-Unshaded
Address:	1001 Preston Street	**LOMR Case No.:**	__-__-_____
City	Houston **State:** TX **Zip:** 77002	**CLOMR Case No.:**	__-__-_____
Contact Person:	Chip Taylor	**Estimated Review Date:**	8/1/2017 11:00 AM
Contact No.:	(713) 755-7104		
Email:	chip.taylor@hcpid.org		

Permit Application Review 1

Date/Time:	Department	Review Comments		Reviewer
07/07/17 07:46 AM		Note	Routed to FCD Geotech for review.	Dennis Miller

Harris County Public Infrastructure Department
Architecture & Engineering Division
10555 NORTHWEST FREEWAY, HOUSTON, TX 77092 - OFFICE 713-956-3000

7/25/2017 6:56:54 AM

FCD Geotech Analysis		Permit Application Review 1		
Date/Time:	**Department**	**Review Comments**		**Reviewer**
07/24/17 04:27 PM	FCD Geotech Analysis	Dept Disapproval	Based on HCFCD technical review, the following comments are provided which should be addressed satisfactorily before the Aviles Geotechnical report is accepted as adequate. 1. The evaluation of channel stability appears to be entirely based on a sketch prepared in support of a Bridge Inspection Report for this site. The Bridge Inspection Report is not dated and it is not known If this represents existing conditions under the bridge. 2. The sketch from Bridge Inspection Report does not show any scale and dimensions. Elevation of existing top of bank in this sketch is shown as +95. There is no scale and dimensions of measurements. Hence this is not accepted by HCFCD as a basis for the Geotechnical Report. 3. HCFCD requests a scaled plan and profile drawing of bridge crossing based on survey data, with elevations shown properly for top of bank, existing side slopes, existing channel protection under the bridge crossing etc. This Exhibit should form the basis for evaluation by Aviles. 4. Aviles recommendation to use concrete lining and ACB for channel protection at the lower side is very vague. This should clearly stated based of elevation of channel banks and flow lines and preferably with a schematic diagram or properly marked on existing drawing prepared for this project. 5. Aviles considered existing side slopes of channel as ranging from 3.1H to 1V on South Bank to 3.4H to 1V on North Bank. The steeper section of channels is assumed with slopes < 1H:1V. HCFCD believes these steeper slopes of <1H:1V are neither stable nor does meet HFCD criteria even with concrete lining. 6. The site conditions below the existing bridge should be also considered in recommending erosion protection measurements. 7. Pictures of existing site conditions under the bridge be attached to the report. 8. Please note that HCFCD may have additional comments on the revised Geotechnical report.	Kris Goparaju

Harris County Engineering Department
10555 NORTHWEST FREEWAY, SUITE 120, HOUSTON, TX 77092 - OFFICE 713-274-3900

10/30/2017 3:32:26 PM

PROJECT REVIEW / ROUTING

Property Information

Commercial Property

Project Name: El Dorado Blvd - Half Boulevard from 250 ft N of Woodbourne Dr to Clear Lake City Blvd
Application Type: H.C. CIP & Design Services - Geotech Analysis
Address: 0 El Dorado Boulevard
City Houston **State:** TX **Zip:** 77059

Property Owner's Information		Project Detail	
Name:	Harris County CIP	**Project Number.:**	1706280115
Address:	1001 Preston Street		
City	Houston **State:** TX **Zip:** 77002		
Contact No.:	(713) 755-7004	**Assigned:**	Kris Goparaju
Email:	Eric.Heppen@hcpid.org	**Status:**	Return to Customer

Applicant Information		Floodplain Information	
Name:	Harris County CIP	**Flood Zone:**	X-Unshaded
Address:	1001 Preston Street	**LOMR Case No.:**	__-__-_____
City	Houston **State:** TX **Zip:** 77002	**CLOMR Case No.:**	__-__-_____
Contact Person:	Chip Taylor	**Estimated Review Date:**	11/7/2017 10:29 AM
Contact No.:	(713) 755-7104		
Email:	chip.taylor@hcpid.org		

Permit Application Review 1

Date/Time:	Department	Review Comments		Reviewer
07/07/17 07:46 AM		Note	Routed to FCD Geotech for review.	Dennis Miller

Harris County Engineering Department

10555 NORTHWEST FREEWAY, SUITE 120, HOUSTON, TX 77092 - OFFICE 713-274-3900

10/30/2017 3:32:26 PM

FCD Geotech Analysis		Permit Application Review 1		
Date/Time:	**Department**	**Review Comments**		**Reviewer**
07/24/17 04:27 PM	FCD Geotech Analysis	Dept Disapproval	Based on HCFCD technical review, the following comments are provided which should be addressed satisfactorily before the Aviles Geotechnical report is accepted as adequate. 1. The evaluation of channel stability appears to be entirely based on a sketch prepared in support of a Bridge Inspection Report for this site. The Bridge Inspection Report is not dated and it is not known If this represents existing conditions under the bridge. 2. The sketch from Bridge Inspection Report does not show any scale and dimensions. Elevation of existing top of bank in this sketch is shown as +95. There is no scale and dimensions of measurements. Hence this is not accepted by HCFCD as a basis for the Geotechnical Report. 3. HCFCD requests a scaled plan and profile drawing of bridge crossing based on survey data, with elevations shown properly for top of bank, existing side slopes, existing channel protection under the bridge crossing etc. This Exhibit should form the basis for evaluation by Aviles. 4. Aviles recommendation to use concrete lining and ACB for channel protection at the lower side is very vague. This should clearly stated based of elevation of channel banks and flow lines and preferably with a schematic diagram or properly marked on existing drawing prepared for this project. 5. Aviles considered existing side slopes of channel as ranging from 3.1H to 1V on South Bank to 3.4H to 1V on North Bank. The steeper section of channels is assumed with slopes < 1H:1V. HCFCD believes these steeper slopes of <1H:1V are neither stable nor does meet HFCD criteria even with concrete lining. 6. The site conditions below the existing bridge should be also considered in recommending erosion protection measurements. 7. Pictures of existing site conditions under the bridge be attached to the report. 8. Please note that HCFCD may have additional comments on the revised Geotechnical report.	Kris Goparaju

		Permit Application Review 2		
Date/Time:	**Department**	**Review Comments**		**Reviewer**
10/09/17 08:22 AM		Note	Routed to FCD Geotech for review.	Dennis Miller

Harris County Engineering Department

10555 NORTHWEST FREEWAY, SUITE 120, HOUSTON, TX 77092 - OFFICE 713-274-3900

10/30/2017 3:32:26 PM

FCD Geotech Analysis		Permit Application Review 2		
Date/Time:	**Department**	**Review Comments**		**Reviewer**
10/30/17 03:13 PM	FCD Geotech Analysis	Dept Disapproval	HCFCD completed review of the revised Geotechnical report prepared by Aviles Engineering, report no.: G125-17R1 dated 09-28-2017 and has the following comments; 1. It is observed that the design parameters utilized in evaluating the slope stability are based on laboratory tests for both rapid drawdown and long term cases. HCFCD requires use of effective stress shear parameters for both long term and rapid drawdown cases. 2. Estimation method used for determining effective cohesion is not accurate. 3. Method of determining the selected value of effective cohesion appears to be not rational.	Kris Goparaju
10/30/17 03:28 PM	FCD Geotech Analysis	Dept Disapproval	Comments continued; 4. Selected values for reduced/residual strength parameters of weathered soils as shown in Plate D-3a appears to be rather arbitrarily chosen than a consistent method of estimation. HCFCD requests the backup calculations and copy of any reference utilized for this. 5. HCFCD requires gINT file for the boring logs be forwarded by an email or thru e-Permits. 6. If existing slopes will be utilized under the proposed new bridge, the channel side slopes should be evaluated for slope stability based on revised soil parameters as discussed in item 4. If you have any questions, please contact HCFCD.	Kris Goparaju

Mike Bagstad

From: Taylor, Chip (Engineering) [Chip.Taylor@hcpid.org]
Sent: Wednesday, January 31, 2018 8:16 AM
To: Michael J. Bagstad, PE (mike.bagstad@zarinkelk.com)
Cc: Green, Cassandra (Engineering)
Subject: FW: El Dorado Drainage Report

Good Morning Mike,

Please review the below response from Kris Goparaju. Let me know if you have a different understanding; but I believe that this provides the response you need to submit the revised drainage report to me. We'll need that right away, along with your responses to comments on the original submittal.

Chip

From: Stuckett, Marcus (Flood Control) [mailto:Marcus.Stuckett@hcfcd.org]
Sent: Wednesday, January 31, 2018 7:08 AM
To: Taylor, Chip (Engineering)
Cc: Green, Cassandra (Engineering)
Subject: RE: El Dorado Drainage Report

Hey Chip,

Kris' response is:

"The Geotechnical report analyzed North bank with concrete lined slopes of 3.7H:1V and South bank with concrete lined slopes of 3.4H:1V. The results of analyses came satisfactory. Existing slopes presented in previous report are ranging from 3.4H:1V on North Bank and 3.1H:1V on South Bank. This apparently requires regrading and slope remediation with some fill. IF HCED want to proceed with this plan, I can accept this revised report."

Let me know if you still have questions.

Marcus Stuckett, P.E., CFM
Manager, Watershed Management Department
Harris County Flood Control District
10555 Northwest Freeway | Houston, Texas 77092
713-316-4866 (main) | 713-684-4113 (direct) | 713-684-4140 (fax)
marcus.stuckett@hcfcd.org | www.hcfcd.org