



Innovative approaches
Practical results
Outstanding service

Letter of Map Revision Request

Colorado River at Buchanan Dam and Inks Lake

Prepared for:



AUGUST 2017



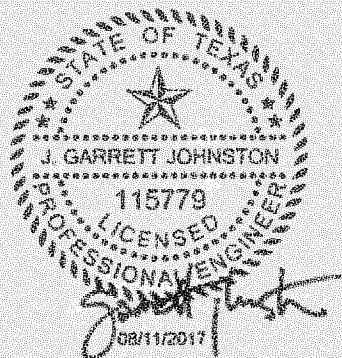


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Colorado River at Buchanan Dam and Inks Lake

Prepared for:



FREESE AND NICHOLS, INC.
TEXAS REGISTERED
ENGINEERING FIRM
F-2144

Prepared by:

FREESE AND NICHOLS, INC.
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LCR16109

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1.0 BACKGROUND

The Lower Colorado River Authority (LCRA) contracted with Freese and Nichols, Inc. (FNI) to provide professional engineering services to analyze flood operations for Buchanan Dam under LCRA's increased operational capabilities. Two changes to the effective floodplain maps are requested herein:

- Revisions to the 1% and 0.2% floodplain extents for the 14- and 16-gate spillway channels downstream of Buchanan Dam, and
- Addition of the floodway between Buchanan and Inks dams.

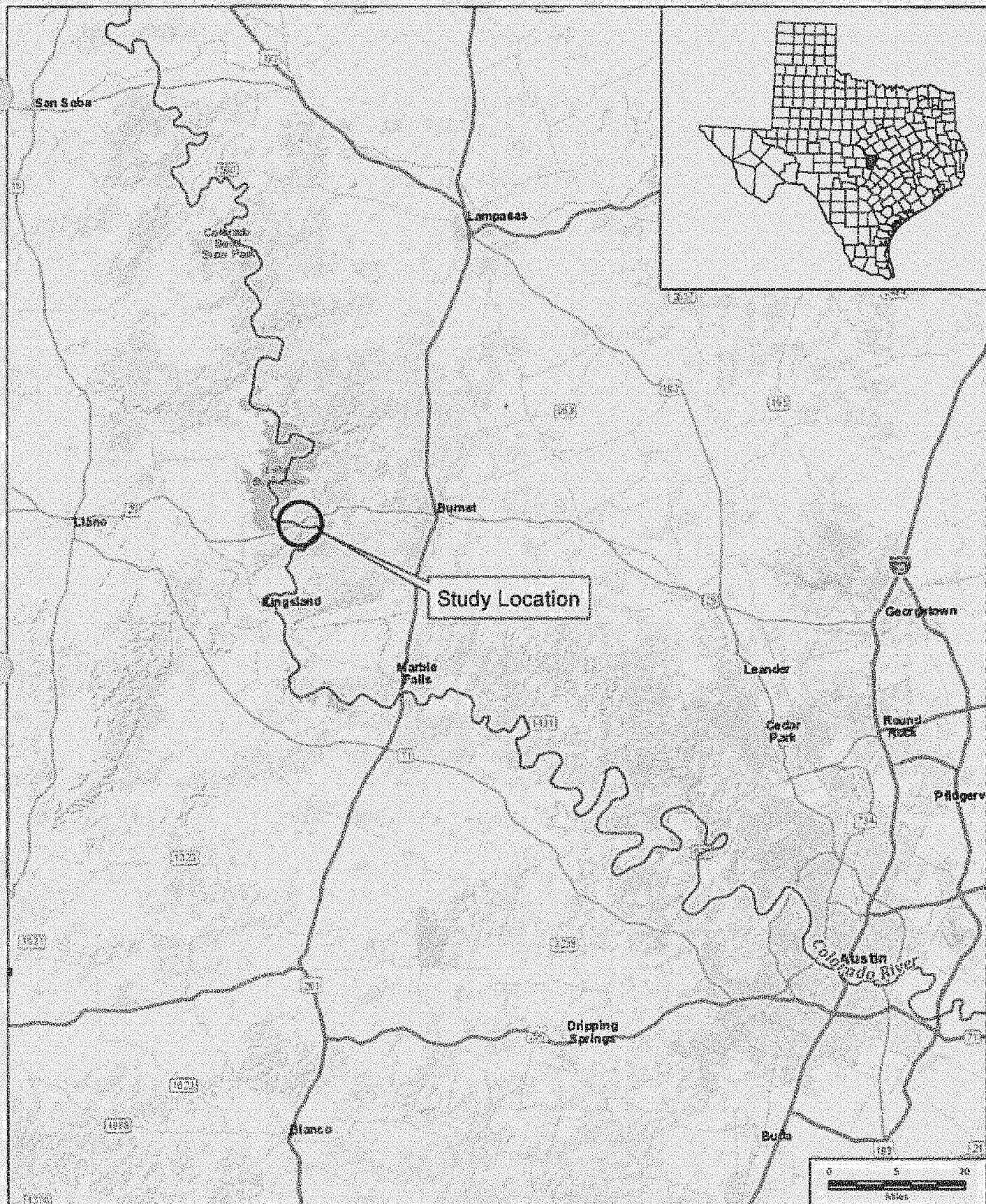
This Letter of Map Revision (LOMR) request serves as documentation for an update to the hydraulic modeling in this area. Completed MT-2 forms are provided in Appendix A. All elevations in this report are in feet above NAVD88.

1.1 LOCATION

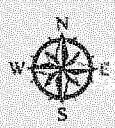
Buchanan Dam is the first dam of the Highland Lakes, a series of six reservoirs located on the Colorado River in Central Texas operated by LCRA. The dam is located approximately 12 miles west of Burnet, Texas and forms Lake Buchanan. Releases from the dam are made through the powerhouse and four spillways. The powerhouse is south of the four spillways and discharges directly into Inks Lake. From north to south, the spillways include the following:

- 1,100-foot wide overflow spillway
- 16-gate spillway with sixteen 33-foot by 15.5-foot tainter gates
- 14-gate spillway with fourteen 33-foot by 15.5-foot tainter gates
- 7-gate spillway with seven 40-foot by 25.5-foot tainter gates

Inks Dam is the second dam of the Highland Lakes and forms Inks Lake located directly downstream of Buchanan Dam. Inks Dam spillway consists of an 871-foot wide overflow section. The location of the study area is shown as Figure 1. Buchanan Dam and each of the four spillways are shown as Figure 2.



FREESE AND NICHOLS
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 512-417-3100



LOWER COLORADO RIVER AUTHORITY
 Lake Buchanan Dam and Inks Lake LOMR

Study Location Map

PN-JOB NO. LCR16108
 FILE NAME Figure 1 - Study Location Map.mxd
 DATE 12/20/2016
 ABSOLUTE SCALE 1:500,000
 RELATIVE SCALE 1 INCH REPRESENTS 50.000 Feet
 DRAWN BY 44748

1

FIGURE



Figure 2: Buchanan Dam with Spillways

2.0 HYDROLOGY AND RESERVOIR SIMULATION

2.1 EFFECTIVE HYDROLOGY

The current effective hydrology for the Colorado River was originally developed as a part of a 2002 U.S. Army Corps of Engineers-LCRA study. Hydrologic modeling was performed to develop storm hydrographs from the various subbasins within the Colorado River Basin for each frequency event. The hydrology developed for the current effective Flood Insurance Study (FIS) used a rating curve for the spillway at Inks Dam which referenced a legacy vertical datum rather than NAVD88.

2.2 PROPOSED HYDROLOGY REVISIONS

The rating curve for the Inks Dam Spillway has been revised by LCRA based on new survey data of the spillway crest and a physical hydraulic model study. Correcting the spillway rating curve led to a reduction in corresponding discharge for water surface elevations in Inks Lake for all frequency events except the 500-year flood. To maintain the current effective floodplain in Inks Lake for each frequency event, the corresponding peak discharge from Buchanan Dam was reduced for the 10-, 25-, and 100-year events. LCRA has verified that Buchanan Dam is capable of reducing peak discharge for each frequency event without changes to upstream floodplain elevations. Current effective floodplain elevations and corresponding peak discharges are shown in Table 2-1 below.

Table 2-1: Updated Peak Discharges at Buchanan Dam

Event	Inks Lake and Dam Peak WSE (ft-NAVD88)	Effective Peak Discharge at Buchanan Dam (cfs)	Updated Peak Discharge at Buchanan Dam (cfs)
10-Year	895.0	56,600	48,500
25-Year	897.0	81,000	74,500
100-Year	901.7	157,000	152,000
500-Year	909.0	308,000	308,000

3.0 HYDRAULICS

3.1 EFFECTIVE HYDRAULIC MODELS

The current effective FEMA model of the Colorado River from Buchanan Dam to Inks Dam is a HEC-RAS 1D steady-state model with an issuance date of March 5, 2012 (Burnet County, City of Marble Falls) and May 2, 2012 (Ulan County). This hydraulic model was originally developed as part of the 2002 U.S. Army Corps of Engineers-LCRA Flood Damage Evaluation Project and later became the basis of the FEMA regulatory floodplain. As previously described, the revised Buchanan Dam operations maintain the existing FEMA 100-year floodplain in Inks Lake. Therefore, this LOMR makes no changes to the 100-year floodplain along Inks Lake. There is no current effective floodway along Inks Lake.

The Buchanan Dam spillway channels are currently mapped as Zone A. No current effective hydraulic models are available for the spillway channels. The models and mapping presented in this report have been developed by FNI.

3.2 INKS LAKE FLOODWAY (STEADY 1D HEC-RAS)

FNI delineated the Inks Lake floodway as part of the Buchanan Dam flood operations analysis. Based on FEMA Guidelines, the maximum allowable floodway surcharge above the 100-year floodplain is 1.0 feet. Encroachments were added in the current effective model and adjusted to maintain surcharges between 0.0 and 1.0 feet, as executed in HEC-RAS version 5.0.3. The resulting floodway data table (FWDT) is provided on the next page. The resulting floodway delineation is provided in Appendix B – Exhibit 1: *Hydraulic Work Map*, and Exhibits 4 – 8: *Annotated FIRM Panels*. A HEC-RAS summary table for the floodway run is provided in Appendix C. A shapefile of the delineated floodway is provided on the disc in Appendix D.

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE ¹	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
COLORADO RIVER								
BT	2,190,459	1145.0	57849.2	2.6	901.7	901.7	902.7	1.0
BU	2,192,445	1375.0	63492.0	2.4	901.8	901.8	902.8	1.0
BV	2,194,594	1240.0	53009.4	2.9	901.8	901.8	902.8	1.0
BW	2,197,761	1545.0	52601.3	2.9	901.9	901.9	902.9	1.0
BX	2,200,765	1310.0	39055.4	3.9	901.9	901.9	902.9	1.0
BY	2,204,505	985.0	29058.2	5.2	902.3	902.3	903.2	0.9
BZ	2,207,347	1300.0	26234.7	5.8	903.1	903.1	903.9	0.9
CA	2,210,575	820.0	13563.1	11.2	903.7	903.7	904.6	0.8

¹Stream distance in feet from Matagorda Bay

FEDERAL EMERGENCY MANAGEMENT AGENCY		FLOODWAY DATA	
BURNET COUNTY, TX AND INCORPORATED AREAS		COLORADO RIVER	

TABLE 1

3.3 BUCHANAN DAM SPILLWAY CHANNELS (UNSTEADY 2D HEC-RAS)

To delineate 100-year and 500-year floodplains for the Buchanan Dam spillway channels, FNI prepared a two-dimensional (2D) hydraulic model with HEC-RAS version 5.0.3. Terrain data for the model was developed by combining two datasets. For topography above Inks Lake, FNI used lidar data provided by LCRA. This data was collected in 2007 at a resolution to provide average point spacing of 0.7 meters (2.3 feet) along the Colorado River and 1.4 meters (4.6 feet) outside the riparian corridor. Lidar data was provided in LAS binary format. FNI converted the lidar data to a bare earth raster Digital Elevation Model (DEM) with 2-foot by 2-foot cell size using the LP360 software package. For bathymetry below Inks Lake, FNI used topography data developed by the Texas Water Development Board for their 2007 volumetric and sedimentation survey of the lake. The bathymetry was provided as a 1-foot by 1-foot raster DEM. The two DEMs were combined with HEC-RAS to generate the model terrain. All model elevation data references NAVD88.

There are three major road crossings in the model area. The original TX-29 truss bridge and the replacement concrete bridge constructed in 2002 cross over Inks Lake within the 2D flow area boundaries. Both bridges have minimum low chord elevations well above the Inks Lake 500-year flood elevation of 908.0 ft-NAVD88. Impact on water surface elevations in the Buchanan spillway channels would be negligible, so their decks and piers were not included in the model. TX-29 also crosses the 16-gate spillway channel (called the "Colorado Relief Draw" on TxDOT plans) just upstream of the confluence with Inks Lake. The bridge deck and piers were not modeled explicitly, but roughness values in this area were adjusted to match observed data. The 2D model does account for the hydraulic effects caused by bridges using the terrain data, including constrictions, expansion, and ineffective flow areas.

3.3.1 2D Flow Area

The two-dimensional flow area is bounded on the upstream by Buchanan Dam and on the downstream by the cross section at River Station 2200765 in the FEMA effective hydraulic model. The downstream boundary condition was assigned as the rating curve for Inks Dam. Energy losses between the boundary cross section and Inks Dam were checked in the FEMA effective model and found to be negligible. The starting lake level for Inks Lake was set at the maximum normal pool elevation of 888.63 ft-NAVD88. A sensitivity analysis was conducted on the grid cell size, time step, and equation set. The final parameters selected for use were a 40-foot cell size, 0.5-second time step, and full momentum equations. More detailed information is provided in Appendix A – *Buchanan Dam Flood Operations Analysis* (FNI, December 2016).

3.3.2 Hydraulic Roughness

Roughness values for the model are depicted in Appendix B – Exhibit 2: *Hydraulic Work Map*. These roughness values were developed from several sources. The 2011 National Land Cover Database (NLCD)

was used to apply spatially-varying roughness values. Land cover classifications were correlated with Manning's roughness factors using aerial imagery and prevailing industry guidelines. Polygons along the spillway channels and Inks Lake were added to provide increased resolution to the roughness values in these locations. Finally, structure polygons were developed in LP360 using the 2007 LCRA lidar points. These polygons were assigned a Manning's roughness factor of 1.0, so water can be stored in the areas but cannot flow through them easily.

3.3.3 100-Year and 500-Year Scenarios

FNI developed two model plans to define the regulatory floodplain. The 100-Year and 500-Year plans introduce stepped inflow hydrographs at each of the four spillways and the hydropower plant at Buchanan Dam. Each step represents a gate operation scenario developed in the LCRA's 2002 flood damage evaluation (FDEP) project, as described below. The scenarios are intended to bracket the extent of inundation for any possible release scenario for each of the two frequency events.

- A. Current gate opening sequence used at Lake Buchanan, as described in the Highland Lakes Operating Guidelines (2012).
- B. Prioritizes the 16-gate spillway with the 14-gate spillway and, if necessary, the 7-gate spillway passing the remainder of the peak flow.
- C. Prioritizes the 14-gate spillway with limited flow through the 16-gate spillway (2 gates for the 100-year event, and 10 gates for the 500-year event) and the remainder of the flow released through the 7-gate spillway.
- D. Prioritizes the 14-gate spillway with the 16-gate spillway and, if necessary, the 7-gate spillway passing the remainder of the peak flow.
- E. Opens 5 gates at the 7-gate spillway. The remainder of the flow is released following the current gate opening sequence.
- F. Opens all 7 gates at the 7-gate spillway. The remainder of the flow is released following the current gate opening sequence.

As discussed in Section 2.0, peak discharge for the 100-year event was reduced from the effective value. The scenarios for both the 100-year and 500-year events were also modified to separate flows that were combined in the 2002 study for more accurate modeling, including the hydropower releases and overflow spillway discharges. For each of the two plans, each scenario is held for two hours to allow the model to achieve quasi-steady-state conditions. Table 3-1 shows the 100-year release scenarios. Table 3-2 shows the 500-year release scenarios.

Table 3-1: 100-Year Release Scenarios

Scenario	Releases (cfs)					Total Discharge (cfs)
	Hydropower	7-Gate	14-Gate	16-Gate	Overflow Spillway	
A) Current	5,700	0	102,674	43,189	437	152,000
B) 16-Gate	5,700	0	38,434	107,428	437	152,000
C) 14-Gate norm	5,700	29,760	102,674	13,429	437	152,000
D) 14-Gate w/16-GateOF	5,700	0	102,674	43,189	437	152,000
E) 5 of 7 Gates	5,700	98,777	26,943	20,143	437	152,000
F) 7 of 7 Gates	5,700	138,287	7,334	241	437	152,000

Table 3-2: 500-Year Release Scenarios

Scenario	Releases (cfs)					Total Discharge (cfs)
	Hydropower	7-Gate	14-Gate	16-Gate	Overflow Spillway	
A) Current	5,700	48,128	121,327	122,945	9,900	308,000
B) 16-Gate	5,700	48,128	121,327	122,945	9,900	308,000
C) 14-Gate norm	5,700	94,232	121,327	76,841	9,900	308,000
D) 14-Gate w/16-GateOF	5,700	48,128	121,327	122,945	9,900	308,000
E) 5 of 7 Gates	5,700	109,812	121,327	61,261	9,900	308,000
F) 7 of 7 Gates	5,700	153,736	121,327	17,336	9,900	308,000

To produce the final 100-year and 500-year floodplain delineations, the peak water surface raster of each scenario was prepared separately by exporting the quasi-steady-state results from RAS Mapper. The rasters were then merged, keeping the highest water surface elevation at each point. These merged 100-year and 500-year water surface rasters were then used to delineate the spillway channel Zone AE and Zone X floodplains and flood profiles. The resulting floodplain delineations are provided in Appendix B, Exhibit 3: *Hydraulic Results*, and Exhibits 4 – 8: *Annotated FIRM Panels*. The resulting profiles are provided in Appendix B, Exhibits 9 – 10: *Water Surface Profiles*. A shapefile of the delineated floodplain is provided on the disc in Appendix D.

3.4 MAPPING CHANGES

The proposed mapping changes are indicated on copies of the current FIRM panels in Appendix B. Although the changes span a relatively short river reach, the reach divides Burnet County and Llano County at the intersection of five separate FIRM panels. Therefore, panels 48299C0250C, 48299C0375C, 48053C0475F, 48053C0300F, and 48053C0450F are being submitted for changes. Inundated areas were mapped using terrain data that was developed by combining two datasets. For topography above Inks Lake, FNI used Lidar data provided by LCRA. This data was collected in 2007 at a resolution to provide

average point spacing of 0.7 meters (2.3 feet) along the Colorado River and 1.4 meters (4.6 feet) outside the riparian corridor. For bathymetry below Inks Lake, FNI used topography data developed by TWDB for their 2007 volumetric and sedimentation survey of the lake. The bathymetry was provided as a 1-foot by 1-foot raster DEM. The two DEMs were combined with HEC-RAS to generate the model terrain. A digital elevation model (DEM) of the terrain is provided on the disc in Appendix D.

4.0 SUMMARY

Based on the latest operation plan for Buchanan Dam, FNI has prepared a floodway for Inks Lake (i.e. the Colorado River between Buchanan Dam and Inks Dam). FNI has also prepared Zone AE and Zone X floodplain delineations for the Buchanan Dam spillway channels.

The completed FEMA MT-2 forms are provided in Appendix A. Maps and profiles are provided in Appendix B. Tabular model output data for the floodway model is provided in Appendix C. Digital data, including models and GIS shapefiles, are provided in Appendix D.

Appendix A: Forms and Supporting Information

Exhibit 1	FEMA Application/Certification Forms (MT-2)
Exhibit 2	Supporting Documentation Memo
Exhibit 3	Certification of Public Notification
Exhibit 4	Buchanan Dam Flood Operations Analysis (Draft)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
OVERVIEW & CONCURRENCE FORM

OMB No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1600 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. Please do not send your completed survey to the above address.

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301	City of Katy	TX	48473C	0005D	02/08/83
480287	Harris County	TX	48201C	0220G	09/28/90
481209	Bumet County	TX	48053C	0300F	03/15/12
480093	Marble Falls, City of				
481209	Bumet County	TX	48053C	0450F	03/15/12

2. a. Flooding Source: Buchanan Dam Spillway Channels

b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Buchanan Dam Spillway Channels

4. FEMA zone designations affected: AE, X (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

a. The basis for this revision request is (check all that apply)

☐ Physical Change ☒ Improved Methodology/Data ☐ Regulatory Floodway Revision ☐ Base Map Changes
☐ Coastal Analysis ☒ Hydraulic Analysis ☒ Hydrologic Analysis ☐ Corrections
☒ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
☒ New Topographic Data ☐ Other (Attach Description)

Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures:

☐ Channelization

☐ Levee/Floodwall

☐ Bridge/Culvert

☒ Dam

☐ Fill

☐ Other (Attach Description)

6. ☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included?

☒ Yes

Fee amount: \$9,250

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/fm_fees.shm for Fee Amounts and Exemptions.

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Garrett Johnston, P.E., CFM

Company: Freese and Nichols, Inc

Mailing Address:
10431 Morado Circle, Unit 300
Austin, TX 78759

Daytime Telephone No.: 512-617-3160

Fax No.:

E-Mail Address: [jjg@freese.com](mailto:jgj@freese.com)

Signature of Requester (required):

Date: December 21, 2016

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title:

Community Name:

Mailing Address:

Daytime Telephone No.:

Fax No.:

E-Mail Address:

Community Official's Signature (required):

Date:

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Garrett Johnston, P.E., CFM

License No.: (TX) 115779

Expiration Date: 09/30/2017

Company Name: Freese and Nichols, Inc.

Telephone No.: (512) 617-3160

Fax No.: (512) 617-3101

Signature:

Date:
12/21/2016

E-Mail Address: [jjg@freese.com](mailto:jgj@freese.com)

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)

Required If ...

- | | |
|---|--|
| ☒ Riverine Hydrology and Hydraulics Form (Form 2) | New or revised discharges or water-surface elevations |
| ☒ Riverine Structures Form (Form 3) | Channel is modified, addition/revision of bridge/culverts,
addition/revision of levee/floodwall, addition/revision of dam |
| ☐ Coastal Analysis Form (Form 4) | New or revised coastal elevations |
| ☐ Coastal Structures Form (Form 5) | Addition/revision of coastal structure |
| ☐ Alluvial Fan Flooding Form (Form 6) | Flood control measures on alluvial fans |

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. Please do not send your completed survey to the above address.

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☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301	City of Katy	TX	48473C	0005D	02/08/83
480257	Harris County	TX	48201C	0220G	09/26/90
481209	Burnet County	TX	48053C	0300F	03/15/12
480093	Marble Falls, City of				
481209	Ulano County	TX	48298C	0375C	05/02/12

2. a. Flooding Source: Colorado River

b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
☐ Alluvial fan ☒ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: Inks Lake Floodway

4. FEMA zone designations affected: AE (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

a. The basis for this revision request is (check all that apply)

☐ Physical Change ☒ Improved Methodology/Data ☒ Regulatory Floodway Revision ☐ Base Map Changes
☐ Coastal Analysis ☒ Hydraulic Analysis ☒ Hydrologic Analysis ☒ Corrections
☒ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
☒ New Topographic Data ☐ Other (Attach Description)

Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☐ Levee/Floodwall ☐ Bridge/Culvert
☒ Dam ☐ Fill ☐ Other (Attach Description)

6. ☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included?

☒ Yes

Fee amount: \$9,250

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fim/fm_fees.shtml for Fee Amounts and Exemptions.

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Garrett Johnston, P.E., CFM

Company: Freese and Nichols, Inc

Mailing Address:
10431 Morado Circle, Unit 300
Austin, TX 78759

Daytime Telephone No.: 512-617-3160

Fax No.:

E-Mail Address: [gj@freese.com](mailto:gjn@freese.com)

Signature of Requester (required):

Date: December 21, 2016

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title:

Community Name:

Mailing Address:

Daytime Telephone No.:

Fax No.:

E-Mail Address:

Community Official's Signature (required)

Date

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Garrett Johnston, P.E., CFM

License No.: (TX) 118779

Expiration Date: 09/30/2017

Company Name: Freese and Nichols, Inc.

Telephone No.: (512) 617-3160

Fax No.: (512) 617-3101

Signature:

Date:
12/21/2016

E-Mail Address: [gj@freese.com](mailto:gjn@freese.com)

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)

Required if ...

- | | |
|---|--|
| ☒ Riverine Hydrology and Hydraulics Form (Form 2) | New or revised discharges or water-surface elevations |
| ☒ Riverine Structures Form (Form 3) | Channel is modified, addition/revision of bridge/culverts,
addition/revision of levee/floodwall, addition/revision of dam |
| ☐ Coastal Analysis Form (Form 4) | New or revised coastal elevations |
| ☐ Coastal Structures Form (Form 5) | Addition/revision of coastal structure |
| ☐ Alluvial Fan Flooding Form (Form 6) | Flood control measures on alluvial fans |

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
RIVERINE HYDROLOGY & HYDRAULICS FORM

OMB No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1600 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. Please do not send your completed survey to the above address.

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C. § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/OMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Buchanan Dam Spillway Channels

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

- | | | |
|--|--|--|
| ☐ Not revised (skip to section B) | ☐ No existing analysis | ☒ Improved data |
| ☐ Alternative methodology | ☐ Proposed Conditions (CLOMR) | ☐ Changed physical condition of watershed |

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
----------	-------------------------	---------------------	---------------

3. Methodology for New Hydrologic Analysis (check all that apply)

- | | |
|---|--|
| ☐ Statistical Analysis of Gage Records | ☐ Precipitation/Runoff Model → Specify Model: _____ |
| ☐ Regional Regression Equations | ☒ Other (please attach description) |

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation.

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	_____	_____	_____	_____
Upstream Limit*	_____	_____	_____	_____

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS 5.0.3

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4. Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____
Corrected Effective Model*	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____
Existing or Pre-Project Conditions Model	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____
Revised or Post-Project Conditions Model	File Name: _____ BuchananSpillways	Plan Name: _____ p06	File Name: _____	Plan Name: _____	_____
Other - (attach description)	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A certified topographic work map must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: Lidar

Source: Lower Colorado River Authority

Date: 2007

Accuracy: 0.7-meter spacing

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach a copy of the effective FIRM and/or FBFM, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☒ Yes ☐ No
- a. For CLOMR requests, if either of the following is true, please submit evidence of compliance with Section 65.12 of the NFIP regulations:
- The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
 - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.
- b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☒ Yes ☐ No
If Yes, please attach proof of property owner notification and acceptance (if available). Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.
2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No
If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.
3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☒ No
If Yes, attach evidence of regulatory floodway revision notification. As per Paragraph 65.7(h)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)
4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Colorado River

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

- | | | |
|--|--|--|
| ☐ Not revised (skip to section B) | ☐ No existing analysis | ☒ Improved data |
| ☐ Alternative methodology | ☐ Proposed Conditions (CLOMR) | ☐ Changed physical condition of watershed |

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)
D/S Buchanan Dam	...	157,000	152,000

3. Methodology for New Hydrologic Analysis (check all that apply)

- | | |
|---|--|
| ☐ Statistical Analysis of Gage Records | ☐ Precipitation/Runoff Model → Specify Model: _____ |
| ☐ Regional Regression Equations | ☒ Other (please attach description) |

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☒ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit*	<u>Study Section BT</u>	<u>2190459</u>	<u>901.7</u>	<u>901.7</u>
Upstream Limit*	<u>Study Section CA</u>	<u>2210575</u>	<u>903.8</u>	<u>903.7</u>

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: HEC-RAS 5.0.3

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____
Corrected Effective Model*	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____
Existing or Pre-Project Conditions Model	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____
Revised or Post-Project Conditions Model	File Name: _____	Plan Name: _____	File Name: <u>Inks_Floodway</u>	Plan Name: <u>p01</u>	<u>NAVD-88</u>
Other - (attach description)	File Name: _____	Plan Name: _____	File Name: _____	Plan Name: _____	_____

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A certified topographic work map must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: Lidar

Source: Lower Colorado River Authority

Date: 2007

Accuracy: 0.7-meter spacing

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach a copy of the effective FIRM and/or FBFM, at the same scale as the original, annotated to show the boundaries of the revised 1%- and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%- and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☒ No
- a. For CLOMR requests, if either of the following is true, please submit evidence of compliance with Section 65.12 of the NFIP regulations:
- The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
 - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.
- b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☒ No
If Yes, please attach proof of property owner notification and acceptance (if available). Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.
2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No
- If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 Instructions for more information.
3. For LOMR requests, is the regulatory floodway being revised? ☒ Yes ☐ No
- If Yes, attach evidence of regulatory floodway revision notification. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)
4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

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PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

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DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Colorado River/Buchanan Dam

Note: Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below.

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Buchanan Dam

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☒ Dam

Location of Structure: On Colorado River, between Buchanan Lake and Inks Lake

Downstream Limit/Cross Section: 2211345

Upstream Limit/Cross Section: 2211345

2. Name of Structure: _____

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

3. Name of Structure: _____

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: _____

Name of Structure: _____

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the _____-year flood.

The design elevation in the channel is based on (check one):

- ☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

- ☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

- ☐ Levees (Attach Section E (Levee/Floodwall)) ☐ Drop structures ☐ Superelevated sections
☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin (Attach Section D (Dam/Basin)) ☐ Energy dissipator
☐ Weir ☐ Other (Describe): _____

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

C. BRIDGE/CULVERT

Flooding Source: _____

Name of Structure: _____

1. This revision reflects (check one):

- ☐ Bridge/culvert not modeled in the FIS
☐ Modified bridge/culvert previously modeled in the FIS
☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): _____

If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

- | | |
|---|--|
| ☐ Dimensions (height, width, span, radius, length) | ☐ Distances Between Cross Sections |
| ☐ Shape (culverts only) | ☐ Erosion Protection |
| ☐ Material | ☐ Low Chord Elevations – Upstream and Downstream |
| ☐ Beveling or Rounding | ☐ Top of Road Elevations – Upstream and Downstream |
| ☐ Wing Wall Angle | ☐ Structure Invert Elevations – Upstream and Downstream |
| ☐ Skew Angle | ☐ Stream Invert Elevations – Upstream and Downstream |
| | ☐ Cross-Section Locations |

4. Sediment Transport Considerations

Are the hydraulics of the structure affected by sediment transport? ☐ Yes ☐ No

If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

D. DAM/BASIN

Flooding Source: Colorado River

Name of Structure: Buchanan Dam

1. This request is for (check one): ☒ Existing dam/basin ☐ New dam/basin ☐ Modification of existing dam/basin
2. The dam/basin was designed by (check one): ☐ Federal agency ☒ State agency ☐ Private organization ☐ Local government agency

Name of the agency or organization: Lower Colorado River Authority

3. The Dam was permitted as (check one): ☐ Federal Dam ☒ State Dam

Provide the permit or identification number (ID) for the dam and the appropriate permitting agency or organization

Permit or ID number TX00989 Permitting Agency or Organization Texas Commission on Environmental Quality

- a. ☐ Local Government Dam ☐ Private Dam

Provide related drawings, specification and supporting design information.

4. Does the project involve revised hydrology? ☒ Yes ☐ No

If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2).

Was the dam/basin designed using critical duration storm? (must account for the maximum volume of runoff)

☒ Yes, provide supporting documentation with your completed Form 2.

☐ No, provide a written explanation and justification for not using the critical duration storm.

5. Does the submittal include debris/sediment yield analysis? ☐ Yes ☒ No

If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why debris/sediment analysis was not considered?

6. Does the Base Flood Elevation behind the dam/basin or downstream of the dam/basin change? ☒ Yes ☐ No

If Yes, complete the Riverine Hydrology & Hydraulics Form (Form 2) and complete the table below.

FREQUENCY (% annual chance)	Stillwater Elevation Behind the Dam/Basin	
	FIS	REVISED
10-year (10%)	<u>1020.5</u>	<u>1020.61</u>
50-year (2%)	<u>1020.5</u>	<u>1020.61</u>
100-year (1%)	<u>1021.0</u>	<u>1021.0</u>
500-year (0.2%)	<u>1022.7</u>	<u>1022.7</u>
Normal Pool Elevation	<u>1020.26</u>	<u>1020.61</u>

7. Please attach a copy of the formal Operation and Maintenance Plan

E. LEVEE/FLOODWALL

1. System Elements

a. This Levee/Floodwall analysis is based on (check one):

- ☐ upgrading of
an existing
levee/floodwall
system ☐ a newly
constructed
levee/floodwall
system ☐ reanalysis of
an existing
levee/floodwall
system

b. Levee elements and locations are (check one):

- ☐ earthen embankment, dike, berm, etc. Station _____ to _____
☐ structural floodwall Station _____ to _____
☐ Other (describe): _____ Station _____ to _____

c. Structural Type (check one): ☐ monolithic cast-in place reinforced concrete ☐ reinforced concrete masonry block ☐ sheet piling
☐ Other (describe): _____

d. Has this levee/floodwall system been certified by a Federal agency to provide protection from the base flood?

☐ Yes ☐ No

If Yes, by which agency?

e. Attach certified drawings containing the following information (indicate drawing sheet numbers):

- | | |
|--|----------------------|
| 1. Plan of the levee embankment and floodwall structures. | Sheet Numbers: _____ |
| 2. A profile of the levee/floodwall system showing the Base Flood Elevation (BFE), levee and/or wall crest and foundation, and closure locations for the total levee system. | Sheet Numbers: _____ |
| 3. A profile of the BFE, closure opening outlet and inlet invert elevations, type and size of opening, and kind of closure. | Sheet Numbers: _____ |
| 4. A layout detail for the embankment protection measures. | Sheet Numbers: _____ |
| 5. Location, layout, and size and shape of the levee embankment features, foundation treatment, floodwall structure, closure structures, and pump stations. | Sheet Numbers: _____ |

2. Freeboard

a. The minimum freeboard provided above the BFE is:

Riverine

- | | | |
|--|------------------------------|-----------------------------|
| 3.0 feet or more at the downstream end and throughout | ☐ Yes | ☐ No |
| 3.5 feet or more at the upstream end | ☐ Yes | ☐ No |
| 4.0 feet within 100 feet upstream of all structures and/or constrictions | ☐ Yes | ☐ No |

Coastal

- | | | |
|---|------------------------------|-----------------------------|
| 1.0 foot above the height of the one percent wave associated with the 1%-annual-chance stillwater surge elevation or maximum wave runup (whichever is greater). | ☐ Yes | ☐ No |
| 2.0 feet above the 1%-annual-chance stillwater surge elevation | ☐ Yes | ☐ No |

Please note, occasionally exceptions are made to the minimum freeboard requirement. If an exception is requested, attach documentation addressing Paragraph 65.10(b)(1)(ii) of the NFIP Regulations.

If No is answered to any of the above, please attach an explanation.

b. Is there an indication from historical records that ice-jamming can affect the BFE? ☐ Yes ☐ No

If Yes, provide ice-jam analysis profile and evidence that the minimum freeboard discussed above still exists.

3. Closures

a. Openings through the levee system (check one): ☐ exists ☐ does not exist

If opening exists, list all closures:

Channel Station	Left or Right Bank	Opening Type	Highest Elevation for Opening Invert	Type of Closure Device

(Extend table on an added sheet as needed and reference)

Note: Geotechnical and geologic data

In addition to the required detailed analysis reports, data obtained during field and laboratory investigations and used in the design analysis for the following system features should be submitted in a tabulated summary form. (Reference U.S. Army Corps of Engineers [USACE] EM-1110-2-1906 Form 2086)

4. Embankment Protection

- a. The maximum levee slope land side is: _____
- b. The maximum levee slope flood side is: _____
- c. The range of velocities along the levee during the base flood is: _____ (min.) to _____ (max.)
- d. Embankment material is protected by (describe what kind): _____
- e. Riprap Design Parameters (check one): ☐ Velocity ☐ Tractive stress
Attach references

Reach	Sideslope	Flow Depth	Velocity	Curve or Straight	Stone Riprap			Depth of Toedown
					D ₁₀₀	D ₅₀	Thickness	
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								
Sta to								

(Extend table on an added sheet as needed and reference each entry)

- f. Is a bedding/filter analysis and design attached? ☐ Yes ☐ No
- g. Describe the analysis used for other kinds of protection used (include copies of the design analysis):

Attach engineering analysis to support construction plans.

5. Embankment And Foundation Stability

- a. Identify locations and describe the basis for selection of critical location for analysis:

- ☐ Overall height: Sta.: _____, height _____ ft.
- ☐ Limiting foundation soil strength:
- Strength ϕ = _____ degrees, c = _____ psf
- Slope: SS = _____ (h) to _____ (v)
- (Repeat as needed on an added sheet for additional locations)
- b. Specify the embankment stability analysis methodology used (e.g., circular arc, sliding block, infinite slope, etc.):

- c. Summary of stability analysis results:

E. LEVEE/FLOODWALL (CONTINUED)

5. Embankment And Foundation Stability (continued)

Case	Loading Conditions	Critical Safety Factor	Criteria (Min.)
I	End of construction		1.3
II	Sudden drawdown		1.0
III	Critical flood stage		1.4
IV	Steady seepage at flood stage		1.4
VI	Earthquake (Case I)		1.0

(Reference: USACE EM-1110-2-1913 Table 6-1)

d. Was a seepage analysis for the embankment performed? ☐ Yes ☐ No

If Yes, describe methodology used: _____

e. Was a seepage analysis for the foundation performed? ☐ Yes ☐ No

f. Were uplift pressures at the embankment landside toe checked? ☐ Yes ☐ No

g. Were seepage exit gradients checked for piping potential? ☐ Yes ☐ No

h. The duration of the base flood hydrograph against the embankment is _____ hours.

Attach engineering analysis to support construction plans.

6. Floodwall And Foundation Stability

a. Describe analysis submittal based on Code (check one) ☐ UBC (1988) ☐ Other (specify): _____

b. Stability analysis submitted provides for: ☐ Overturning ☐ Sliding If not, explain: _____

c. Loading included in the analyses were: ☐ Lateral earth @ $P_h =$ _____ psf; $P_v =$ _____ psf

☐ Surcharge-Slope @ _____ ☐ surface _____ psf

☐ Wind @ $P_w =$ _____ psf

☐ Seepage (Uplift): _____ ☐ Earthquake @ $P_{eq} =$ _____ %g

☐ 1%-annual-chance significant wave height: _____ ft.

☐ 1%-annual-chance significant wave period: _____ sec.

d. Summary of Stability Analysis Results: Factors of Safety
Itemize for each range in site layout dimension and loading condition limitation for each respective reach.

Loading Condition	Criteria (Min)		Sta		To	
	Overturn	Sliding	Overturn	Sliding	Overturn	Sliding
Dead & Wind	1.5	1.5				
Dead & Soil	1.5	1.5				
Dead, Soil, Flood, & Impact	1.5	1.5				
Dead, Soil, & Seismic	1.3	1.3				

(Ref: FEMA 114 Sept 1986; USACE EM 1110-2-2502)
Note: (Extend table on an added sheet as needed and reference)

E. LEVEE/FLOODWALL (CONTINUED)

6. Floodwall And Foundation Stability (continued)

e. Foundation bearing strength for each soil type:

Bearing Pressure	Sustained Load (psf)	Short Term Load (psf)
Computed design maximum		
Maximum allowable		

- f. Foundation scour protection ☐ is, ☐ is not provided. If provided, attach explanation and supporting documentation.
Attach engineering analysis to support construction plans.

7. Settlement

- a. Has anticipated potential settlement been determined and incorporated into the specified construction elevations to maintain the established freeboard margin? ☐ Yes ☐ No
- b. The computed range of settlement is _____ ft. to _____ ft.
- c. Settlement of the levee crest is determined to be primarily from : ☐ Foundation consolidation ☐ Embankment compression
☐ Other (Describe): _____
- d. Differential settlement of floodwalls ☐ has ☐ has not been accommodated in the structural design and construction.
Attach engineering analysis to support construction plans.

8. Interior Drainage

- a. Specify size of each interior watershed:
Draining to pressure conduit: _____ acres
Draining to ponding area: _____ acres
- b. Relationships Established
- | | | |
|------------------------------------|------------------------------|-----------------------------|
| Ponding elevation vs. storage | ☐ Yes | ☐ No |
| Ponding elevation vs. gravity flow | ☐ Yes | ☐ No |
| Differential head vs. gravity flow | ☐ Yes | ☐ No |
- c. The river flow duration curve is enclosed: ☐ Yes ☐ No
- d. Specify the discharge capacity of the head pressure conduit: _____ cfs
- e. Which flooding conditions were analyzed?
- | | | |
|-------------------------------------|------------------------------|-----------------------------|
| * Gravity flow (Interior Watershed) | ☐ Yes | ☐ No |
| * Common storm (River Watershed) | ☐ Yes | ☐ No |
| * Historical ponding probability | ☐ Yes | ☐ No |
| * Coastal wave overtopping | ☐ Yes | ☐ No |
- If No for any of the above, attach explanation.
- e. Interior drainage has been analyzed based on joint probability of interior and exterior flooding and the capacities of pumping and outlet facilities to provide the established level of flood protection. ☐ Yes ☐ No If No, attach explanation.
- g. The rate of seepage through the levee system for the base flood is _____ cfs
- h. The length of levee system used to drive this seepage rate in item g: _____ ft.

E. LEVEE/FLOODWALL (CONTINUED)

8. Interior Drainage (continued)

- i. Will pumping plants be used for interior drainage? ☐ Yes ☐ No
- If Yes, include the number of pumping plants: _____. For each pumping plant, list:

	Plant #1	Plant #2
The number of pumps		
The ponding storage capacity		
The maximum pumping rate		
The maximum pumping head		
The pumping starting elevation		
The pumping stopping elevation		
Is the discharge facility protected?		
Is there a flood warning plan?		
How much time is available between warning and flooding?		

Will the operation be automatic? ☐ Yes ☐ No

If the pumps are electric, are there backup power sources? ☐ Yes ☐ No

(Reference: USACE EM-1110-2-3101, 3102, 3103, 3104, and 3105)

Include a copy of supporting documentation of data and analysis. Provide a map showing the flooded area and maximum ponding elevations for all interior watersheds that result in flooding.

9. Other Design Criteria

a. The following items have been addressed as stated:

Liquefaction ☐ is ☐ is not a problem

Hydrocompaction ☐ is ☐ is not a problem

Heave differential movement due to soils of high shrink/swell ☐ is ☐ is not a problem

b. For each of these problems, state the basic facts and corrective action taken:

Attach supporting documentation

c. If the levee/floodwall is new or enlarged, will the structure adversely impact flood levels and/or flow velocities floodside of the structure?
☐ Yes ☐ No Attach supporting documentation

d. Sediment Transport Considerations:

Was sediment transport considered? ☐ Yes ☐ No

If Yes, then fill out Section F (Sediment Transport). If No, then attach your explanation for why sediment transport was not considered.

10. Operational Plan And Criteria

a. Are the planned/installed works in full compliance with Part 65.10 of the NFIP Regulations? ☐ Yes ☐ No

b. Does the operation plan incorporate all the provisions for closure devices as required in Paragraph 65.10(c)(1) of the NFIP regulations?
☐ Yes ☐ No

c. Does the operation plan incorporate all the provisions for interior drainage as required in Paragraph 65.10(c)(2) of the NFIP regulations?
☐ Yes ☐ No If the answer is No to any of the above, please attach supporting documentation.

E. LEVEE/FLOODWALL (CONTINUED)

11. Maintenance Plan

Please attach a copy of the formal maintenance plan for the levee/floodwall

12. Operations and Maintenance Plan

Please attach a copy of the formal Operations and Maintenance Plan for the levee/floodwall.

CERTIFICATION OF THE LEVEE DOCUMENTATION

This certification is to be signed and sealed by a licensed registered professional engineer authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.10(e) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: _____ License No.: _____ Expiration Date: _____

Company Name: _____ Telephone No.: _____ Fax No.: _____

Signature: _____ Date: _____ E-Mail Address: _____

F. SEDIMENT TRANSPORT

Flooding Source: _____

Name of Structure: _____

If there is any indication from historical records that sediment transport (including scour and deposition) can affect the Base Flood Elevation (BFE), and/or based on the stream morphology, vegetative cover, development of the watershed and bank conditions, there is a potential for debris and sediment transport (including scour and deposition) to affect the BFEs, then provide the following information along with the supporting documentation:

Sediment load associated with the base flood discharge: Volume _____ acre-feet

Debris load associated with the base flood discharge: Volume _____ acre-feet

Sediment transport rate _____ (percent concentration by volume)

Method used to estimate sediment transport: _____

Most sediment transport formulas are intended for a range of hydraulic conditions and sediment sizes; attach a detailed explanation for using the selected method.

Method used to estimate scour and/or deposition: _____

Method used to revise hydraulic or hydrologic analysis (model) to account for sediment transport: _____

Please note that bulked flows are used to evaluate the performance of a structure during the base flood; however, FEMA does not map BFEs based on bulked flows.

If a sediment analysis has not been performed, an explanation as to why sediment transport (including scour and deposition) will not affect the BFEs or structures must be provided.

MEMORANDUM



Innovative approaches
Practical results
Outstanding service

10431 Morado Circle, Suite 300 • Austin, Texas 78759 • 512-617-3100 • fax 512-617-3101

www.freese.com

TO: Federal Emergency Management Agency

FROM: Grady Hillhouse, P.E.

SUBJECT: Colorado River at Buchanan Dam and Inks Lake LOMR Request
Supporting Documentation

DATE: March 1, 2016

PROJECT: LCR16019

This memorandum provides supporting information requested on the MT-2 forms submitted with the Colorado River at Buchanan Dam and Inks Lake LOMR Request.

In response to MT-2 Form 2 (Riverine Hydrology and Hydraulics), Part A, Item 3, we submit the following description:

The hydrology developed for the current effective Flood Insurance Study (FIS) used a rating curve for the spillway at Inks Dam which referenced a legacy vertical datum rather than NAVD88. Correcting the spillway rating curve led to a reduction in corresponding discharge for water surface elevations in Inks Lake for all frequency events except the 500-year flood. To maintain the current effective floodplain in Inks Lake for each frequency event, the corresponding peak discharge from Buchanan Dam was reduced for the 10-, 25-, and 100-year events. LCRA has verified that the Buchanan Dam is capable of reducing peak discharge for each frequency event without changes to upstream floodplain elevations. Current effective floodplain elevations and corresponding peak discharges are shown in the table below.

Event	Inks Lake and Dam Peak WSE (ft-NAVD88)	Effective Peak Discharge at Buchanan Dam (cfs)	Updated Peak Discharge at Buchanan Dam (cfs)
10-Year	895.0	56,600	48,500
25-Year	897.0	81,000	74,500
100-Year	901.7	157,000	152,000
500-Year	909.0	308,000	308,000

In response to MT-2 Form 3 (Riverine Structures), Part C, Item 5, we submit the following explanation:

Accumulation of sediment within Lake Buchanan and Inks Lake is monitored by the Lower Colorado River Authority with assistance from the Texas Water Development Board. Sedimentation within the flood surcharge pool for either reservoir has been negligible. Most sedimentation occurs within the reservoirs below the normal water surface. Additionally, flow in



the spillway channels downstream of Lake Buchanan occurs only during infrequent releases from the dam. There is no indication from historical records, including historical aerial imagery and historical topographic data, that the hydraulics of the studied area are affected by sediment transport (including scour, deposition, and/or channel migration).

In response to MT-2 Form 3, Part D, Item 4, we submit the following documentation:

Buchanan Dam complies with hydrologic and hydraulic criteria for the State of Texas, which include being capable of safely passing a design storm which has a critical size, orientation, and duration.

In response to MT-2 Form 3, Part D, Item 7, we submit the following explanation:

Operation and maintenance information for Buchanan Dam is considered sensitive information pertaining to Critical Infrastructure as defined by the National Homeland Security Act of 2002 and further defined in Chapter 421 and Section 418.181, Texas Government Code. As such, this information is restricted from public release or access. If specific information regarding the operation and maintenance of Buchanan Dam is required, please contact:

Nathan Gullo
Safety of Dams Lead
Lower Colorado River Authority
Nathan.Gullo@LCRA.ORG

Please do not hesitate to contact me should you have any questions about this documentation. Thank you.

Sincerely,

Grady Hillhouse, P.E.
(512) 617-3186
Grady.Hillhouse@freese.com

December 2016
Lower Colorado River Authority
{Affected property owner mailing address}
Re: Notification of Flood Hazard Revisions

Dear Mr./Ms./Mr. and Mrs. {Affected property owner}

The Flood Insurance Rate Map (FIRM) for a community depicts the floodplain, the area which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the base flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

Freese and Nichols, Inc. (FNI) is applying for a Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (DHS-FEMA) on behalf of the Lower Colorado River Authority (LCRA) to revise FIRM panels 48299C0250C, 48299C0375C, 48053C0475F, 48053C0300F, and 48053C0450F along Inks Lake downstream of Buchanan Dam. FNI is proposing to revise the FIRM to reflect an updated hydraulic analysis of the dam.

LCRA, in accordance with National Flood Insurance Program regulation 65.7(b)(1), hereby gives notice of LCRA's intent to establish the 1% annual chance (100-year) floodway of Inks Lake between Buchanan Dam and Inks Dam, and to establish the 1% annual chance Zone AE floodplain (100-year) and 0.2% annual chance Zone X floodplain (500-year) along the Buchanan Dam 14-Gate Spillway Channel and the Buchanan Dam 16-Gate Spillway Channel, both between Buchanan Dam and Inks Lake.

This letter is to inform you of flood hazard revisions along Inks Lake and between Buchanan Dam and Inks Lake, as depicted on the attached map. Additional maps and detailed analysis of the flood hazard revision can be reviewed in the attached PDF.

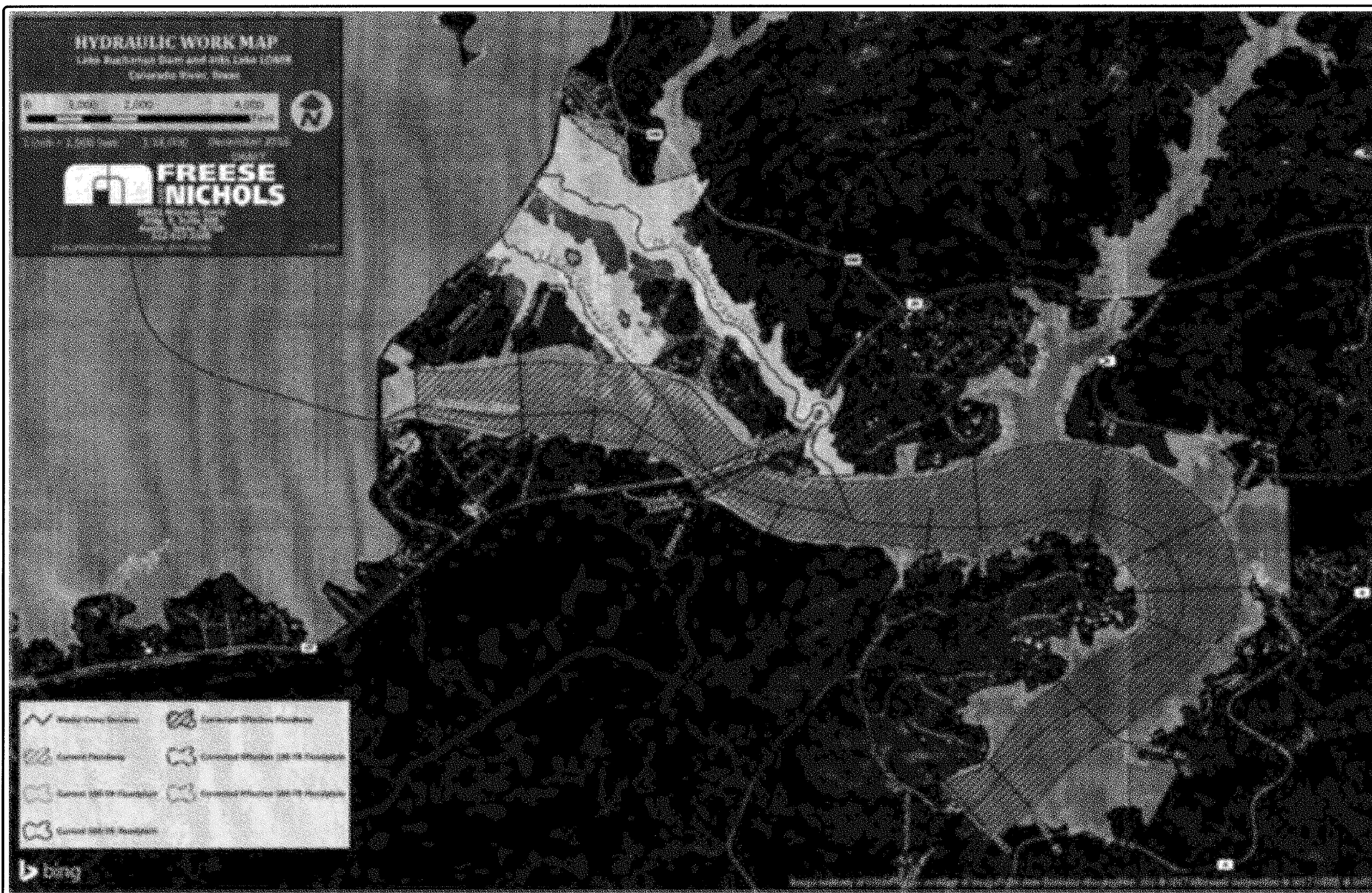
If you have any questions or concerns about the proposed project or its effect on your property, you may contact _____ at LCRA at _____@lcra.org.

Sincerely,

Garrett Johnston, P.E., CFM
Freese and Nichols, Inc.
10431 Morado Circle, Suite 300
Austin, Texas 78759
(512) 617-3160
jgj@freese.com

Appendix B: Maps and Profiles

Exhibit 1	Hydraulic Work Map (Inks Lake Floodway)
Exhibit 2	Hydraulic Work Map (Buchanan Dam Spillway Channels)
Exhibit 3	Hydraulic Results (Buchanan Dam Spillway Channels)
Exhibit 4	Annotated FIRM Panel: 48053C0 300F
Exhibit 5	Annotated FIRM Panel: 48053C0 450F
Exhibit 6	Annotated FIRM Panel: 48053C0 475F
Exhibit 7	Annotated FIRM Panel: 48299C0 250C
Exhibit 8	Annotated FIRM Panel: 48299C0 375C
Exhibit 9	Water Surface Profile – Buchanan Dam 14-Gate Spillway Channel
Exhibit 10	Water Surface Profile – Buchanan Dam 16-Gate Spillway Channel



2D HYDRAULIC WORK MAP

Upper Buchanan Dam and Mill Creek Confluence

Colorado River, Texas



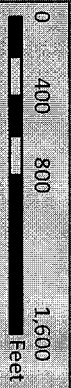
1:50,000 Scale Map 1:50,000 Scale Map



**FRESE
NICHOLS**

2D Flow	Developed Forest 25.75	Forest 25.75
Land cover (Barren) 25.75	Developed High 25.75	Developed Intermediate 25.75
Building 25.75	Developed Low 25.75	Open water 25.75
Lake 25.75	Developed Medium 25.75	Shrubland 25.75
Rough terrain 25.75	Developed Low area 25.75	Rough terrain 25.75

2D HYDRAULIC RESULTS MAP
Lake Buchanan Dam and Inks Lake LOMR
Colorado River, Texas



1 inch = 800 feet

1:9,600

December 2016

DRAFT



FRESESE AND NICHOLS
10431 Morado Circle
Bldg. 5, Suite 300
Austin, Texas 78759
512-617-3100

HAVER, DESIGN/LOMR Figures 2D Hydraulic Results Map.mxd

LC16109

Spillway Channel BFEs (5-ft)

2D Results - 100-YR

Inundation Depth (ft)

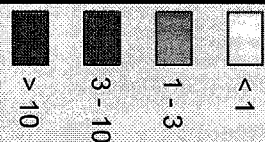
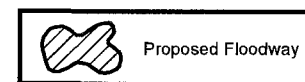
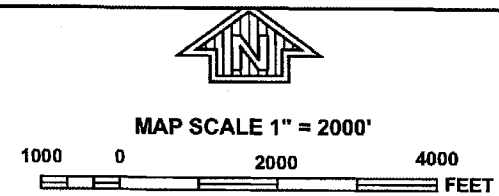
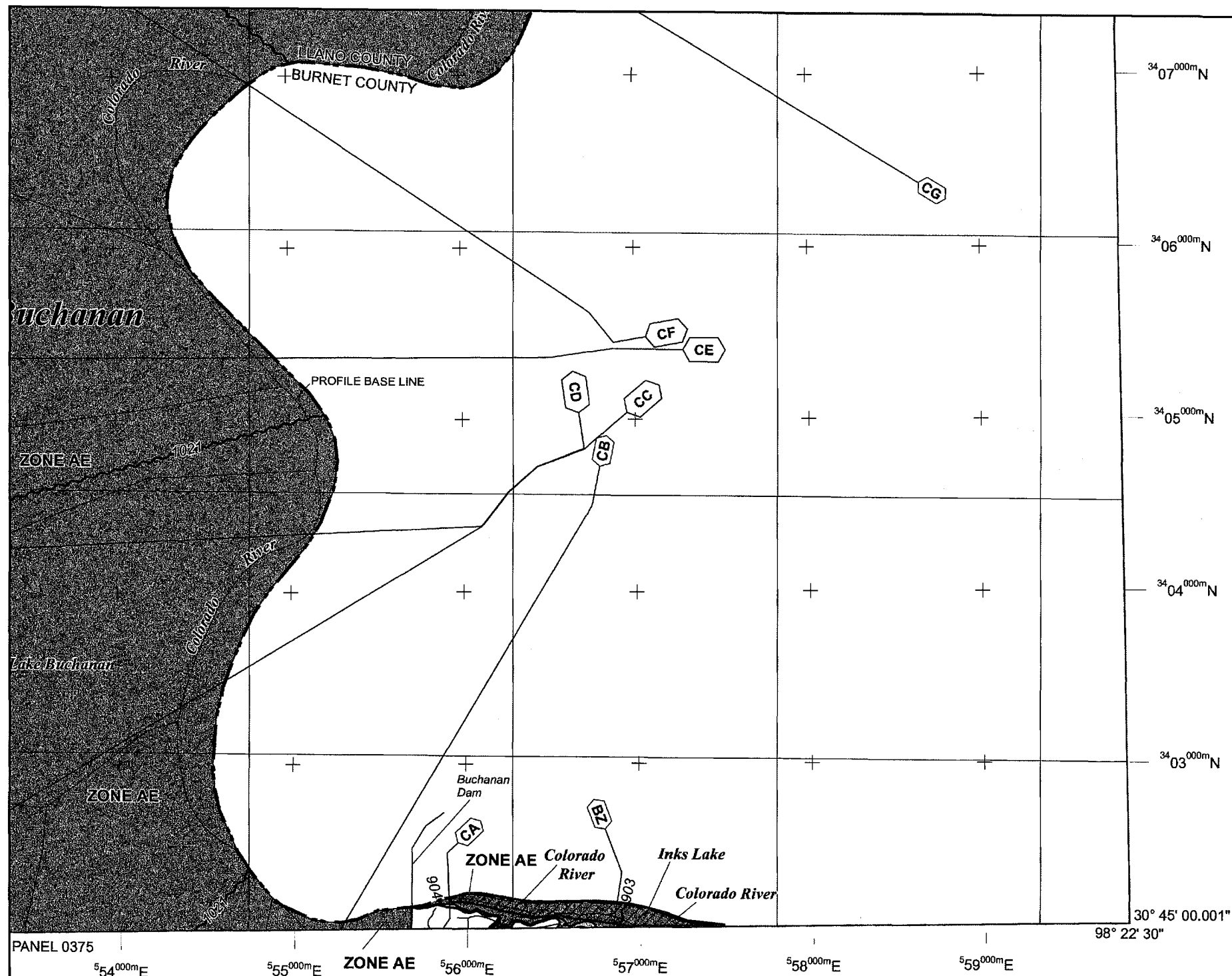


Figure 2D Hydraulic Results Map.mxd



NFIP **PANEL 0250C**

FIRM
FLOOD INSURANCE RATE MAP
LLANO COUNTY,
TEXAS
AND INCORPORATED AREAS

PANEL 250 OF 700
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

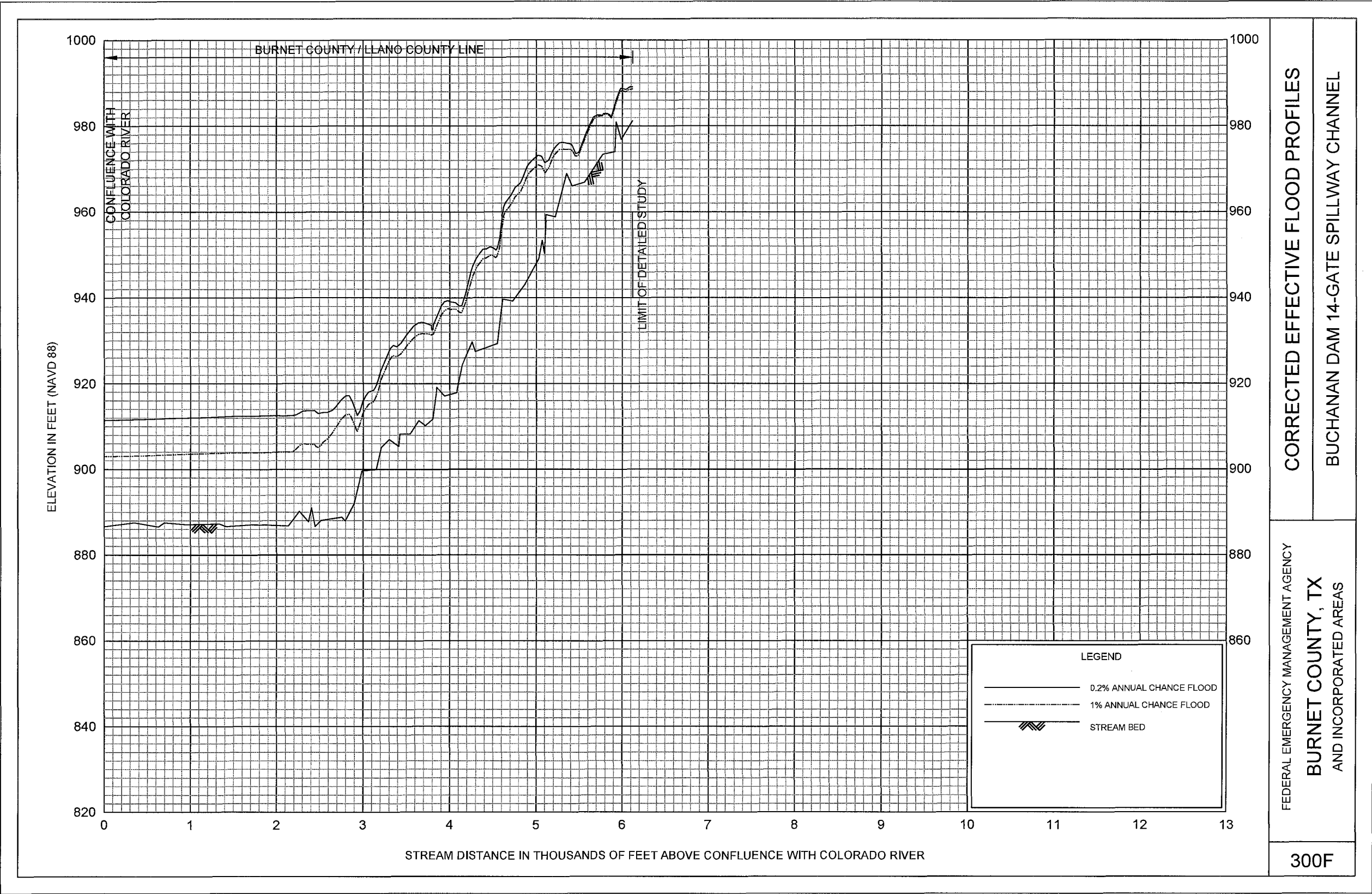
COMMUNITY	NUMBER	PANEL	SUFFIX
LLANO COUNTY, UNINCORPORATED AREAS	481234	0250	C

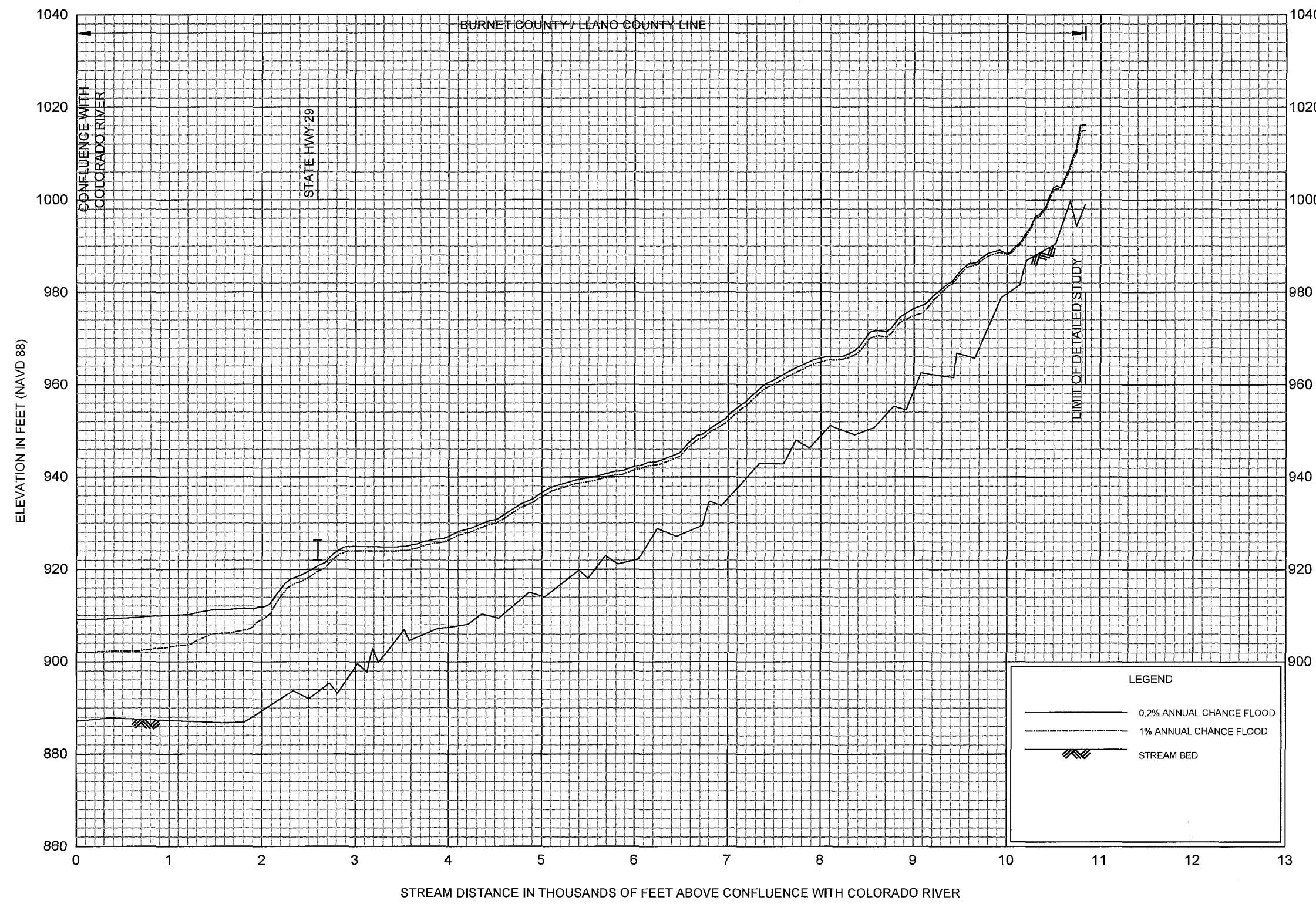
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
48299C0250C
EFFECTIVE DATE
MAY 2, 2012

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





CORRECTED EFFECTIVE FLOOD PROFILES

BUCHANAN DAM 16-GATE SPILLWAY CHANNEL

FEDERAL EMERGENCY MANAGEMENT AGENCY

BURNET COUNTY, TX
AND INCORPORATED AREAS

300F

Appendix C: Model Output

Exhibit 1 Profile Summary Table – Inks Lake Floodway Model

HEC-RAS Plan: FLOODWAY River: Colorado Reach: 1

Reach	River Sta	Profile	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
1	2210575. Buchanan Dam	100YR	903.73		905.96	910.15	90377.32	60096.23	1526.43		2617.13	2833.79	
1	2210575. Buchanan Dam	FLOODWAY	904.55	0.83	906.63	820.00	91465.08	59549.54	985.39	2040.00	2617.13	2833.79	2860.00
1	2208646.	100YR	903.57		904.21	1411.16	50615.80	100891.80	492.39		2041.30	2628.57	
1	2208646.	FLOODWAY	904.32	0.76	905.01	1210.00	45813.16	105727.50	459.30	1450.00	2041.30	2628.57	2660.00
1	2207347.	100YR	903.08		903.79	1588.42	29981.98	119523.10	2484.93		829.03	1486.90	
1	2207347.	FLOODWAY	903.94	0.86	904.61	1300.00	30449.99	119442.80	2107.18	300.00	829.03	1486.90	1600.00
1	2206407.	100YR	902.63		903.44	1645.74	27273.22	122931.40	1795.42		63.49	731.51	
1	2206407.	FLOODWAY	903.55	0.92	904.31	1410.00	27618.24	123069.00	1312.77	-620.00	63.49	731.51	790.00
1	2204974.	100YR	902.59		903.02	1468.06	975.27	149970.60	1054.16		2289.23	3367.47	
1	2204974.	FLOODWAY	903.51	0.92	903.92	1085.00	29.15	151957.50	13.30	2285.00	2289.23	3367.47	3370.00
1	2204859.	100YR	902.59		902.99	1344.55	681.42	150307.00	1011.54		1371.11	2434.16	
1	2204859.	FLOODWAY	903.51	0.92	903.89	1080.00	3.31	151822.00	174.64	1370.00	1371.11	2434.16	2450.00
1	2204800 SH 29 - New BR U	100YR	902.55		902.98	1280.79	485.45	150248.40	1266.11		1371.11	2434.16	
1	2204800 SH 29 - New BR U	FLOODWAY	903.47	0.92	903.88	1047.00	24.56	151646.00	329.45	1370.00	1371.11	2434.16	2450.00
1	2204800 SH 29 - New BR D	100YR	902.53		902.96	1280.49	462.66	150312.80	1224.56		1369.67	2436.48	
1	2204800 SH 29 - New BR D	FLOODWAY	903.46	0.92	903.87	1037.00		151922.70	77.28	1370.00	1369.67	2436.48	2440.00
1	2204742.	100YR	902.54		902.94	1347.37	637.48	150383.90	978.66		1369.67	2436.48	
1	2204742.	FLOODWAY	903.47	0.92	903.85	1070.00		151979.20	20.82	1370.00	1369.67	2436.48	2440.00
1	2204694.	100YR	902.27		902.87	1307.57	371.18	149055.10	2573.74		1205.58	2076.74	
1	2204694.	FLOODWAY	903.21	0.94	903.79	1010.00	397.87	150286.00	1316.10	1150.00	1205.58	2076.74	2160.00
1	2204662 SH 29 - ExistingBR U	100YR	902.21		902.86	1254.41	427.99	148907.50	2664.57		1205.58	2076.74	
1	2204662 SH 29 - ExistingBR U	FLOODWAY	903.15	0.94	903.77	980.46	442.33	150365.00	1192.63	1150.00	1205.58	2076.74	2160.00
1	2204662 SH 29 - ExistingBR D	100YR	902.20		902.85	1254.34	420.67	148908.40	2670.93		1205.24	2076.26	
1	2204662 SH 29 - ExistingBR D	FLOODWAY	903.14	0.94	903.77	970.45	435.01	150508.00	1057.00	1150.00	1205.24	2076.26	2150.00
1	2204648.	100YR	902.22		902.83	1306.77	363.09	149069.30	2567.64		1205.24	2076.26	
1	2204648.	FLOODWAY	903.16	0.94	903.74	1000.00	390.21	150431.00	1178.83	1150.00	1205.24	2076.26	2150.00
1	2204505.	100YR	902.28		902.72	1231.55	627.42	150626.40	746.15		537.95	1516.85	
1	2204505.	FLOODWAY	903.21	0.94	903.64	985.00	16.79	151965.70	17.51	535.00	537.95	1516.85	1520.00
1	2203450.	100YR	902.02		902.54	1137.62	344.63	150968.90	686.51		255.03	1245.83	
1	2203450.	FLOODWAY	902.98	0.96	903.48	995.00	0.01	151970.60	29.35	255.00	255.03	1245.83	1250.00
1	2200765.	100YR	901.92		902.16	1556.00	670.31	150843.80	485.93		462.92	1768.31	
1	2200765.	FLOODWAY	902.90	0.98	903.13	1310.00	101.72	151876.10	22.19	460.00	462.92	1768.31	1770.00
1	2199845.	100YR	901.94		902.08	1887.90	642.47	151041.20	316.32		772.37	2396.62	
1	2199845.	FLOODWAY	902.92	0.98	903.06	1680.00	427.87	151561.50	10.61	720.00	772.37	2396.62	2400.00

HEC-RAS Plan: FLOODWAY River: Colorado Reach: 1 (Continued)

Reach	River Sta	Profile	W.S. Elev (ft)	Prof Delta WS (ft)	E.G. Elev (ft)	Top Width Act (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Enc Sta L (ft)	Ch Sta L (ft)	Ch Sta R (ft)	Enc Sta R (ft)
1	2197761	100YR	901.86		902.00	1683.85	203.07	151597.80	199.15		537.79	2034.12	
1	2197761	FLOODWAY	902.85	0.99	902.99	1545.00	237.92	151760.90	1.19	490.00	537.79	2034.12	2035.00
1	2196364	100YR	901.87		901.95	2760.68	1561.53	149956.60	481.91		1341.92	3213.64	
1	2196364	FLOODWAY	902.86	0.99	902.94	1875.00	3.11	151995.10	1.78	1340.00	1341.92	3213.64	3215.00
1	2195410	100YR	901.85		901.93	2181.65	221.91	151289.30	488.76		1432.97	3134.09	
1	2195410	FLOODWAY	902.85	0.99	902.92	1705.00	5.24	151993.90	0.87	1430.00	1432.97	3134.09	3135.00
1	2194594	100YR	901.78		901.91	1924.34	1276.91	150257.50	465.59		801.74	2039.92	
1	2194594	FLOODWAY	902.78	0.99	902.90	1240.00	2.87	151997.10	0.02	800.00	801.74	2039.92	2040.00
1	2192445	100YR	901.77		901.86	2053.52	1173.02	150700.30	126.72		1428.01	2795.09	
1	2192445	FLOODWAY	902.76	0.99	902.85	1375.00	5.37	151983.90	10.76	1425.00	1428.01	2795.09	2800.00
1	2190459	100YR	901.72		901.83	1500.87	504.08	151345.30	150.59		998.21	2137.89	
1	2190459	FLOODWAY	902.72	1.00	902.82	1145.00	6.10	151990.70	3.18	995.00	998.21	2137.89	2140.00
1	2189622 Inks Dam	100YR	901.70		901.81	1455.27	111.06	151781.50	107.41		400.68	1750.33	
1	2189622 Inks Dam	FLOODWAY	902.70	1.00	902.81	1355.00	0.58	151987.60	11.86	400.00	400.68	1750.33	1755.00