HYDRAULIC ANALYSIS
FOR THE CACHE LA POUDRE RIVER
NEAR THE LAPORTE DIVERSION DAM

(Prepared in Support of a Letter of Map Revision Based on More Detailed Data)

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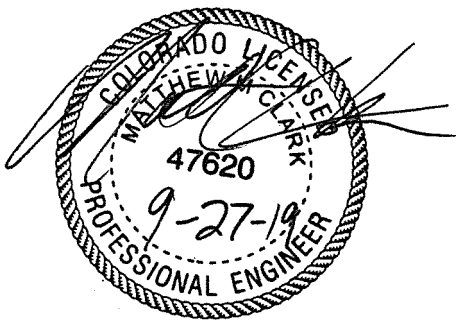

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I. STUDY DESCRIPTION

In 2019 planned repairs to the Laporte Diversion Dam, by the Larimer and Weld Irrigation Company, spurred an investigation of the effective hydraulic modeling along the Cache La Poudre River (CLPR) near Laporte Colorado, this investigation revealed discrepancies between the modeled crest height of the Laporte Diversion Dam and the surveyed crest height. Due to this discrepancy a more detailed review of the effective model in the vicinity of the dam was needed. A vicinity map of the study reach is provided as Figure 1.1. The current study reach of the CLPR is a Federal Emergency Management Agency (FEMA) regulated river, in Sections 29, 30, 31, and 32, of Township 8N, Range 69W of Larimer County, Colorado and is located within the jurisdictions of Larimer County.

The Cache la Poudre River has its origins in the Rocky Mountains, in both Roosevelt National Forest and Rocky Mountain National Park, located west of the City of Fort Collins, Colorado. The river conveys flows from the mouth of the Poudre Canyon, southeast to its confluence with the South Platte River east of Greeley, Colorado. The Laporte Dam is located approximately 4,300 feet upstream of the Overland Trail bridge. The dam was first constructed in the early 1900's and diverts water from the Poudre River to the New Mercer Ditch and the Little Cache La Poudre Ditch. As identified on Figure 1.1, the study reach for this study extends from approximately 2,770 feet upstream Laporte Diversion Dam to 1,500 feet upstream of the Overland Trail Bridge.

1.1 Purpose

The purpose of this study is to develop updated hydraulic modeling and flood hazard mapping, along with corresponding documentation for the corrected effective conditions, through the study area with respect to the FEMA regulated Cache la Poudre River floodplain and floodway. In addition, this study will be sent to FEMA as a letter of map revision (LOMR) request to update the flood hazard information and mapping within the study reach.

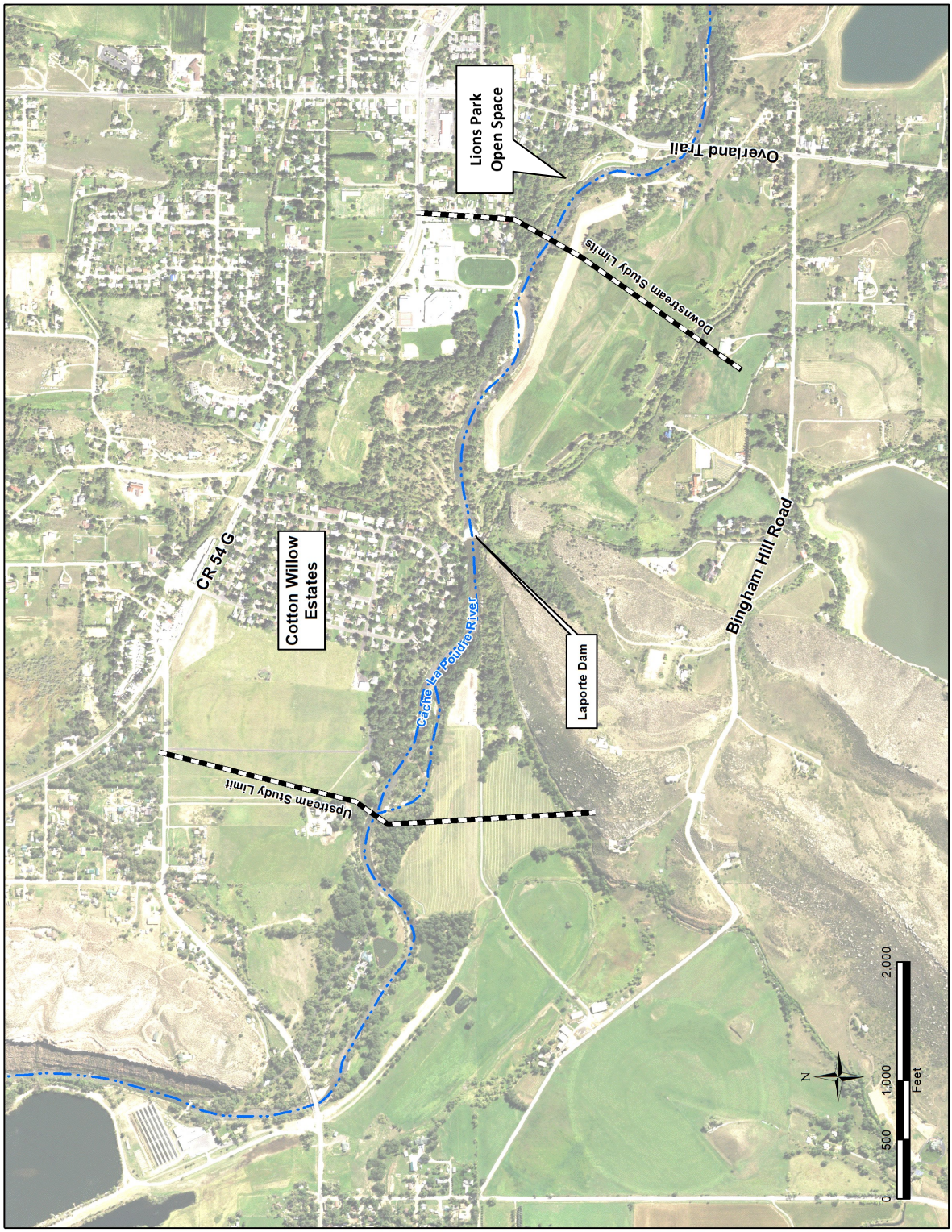


Figure 1.1 Vicinity Map.

II. BACKGROUND

2.1 Flooding Source and History

The Cache al Poudre River through the study reach is a FEMA regulated flooding source with detailed base flood elevations (BFEs) and a floodway. The current study evaluates new topographic information with respect to the FEMA regulated Cache la Poudre River.

The Cache la Poudre River is a major tributary to the South Platte River and approximately 1,120 square miles of the drainage basin are tributary to the River at Fort Collins. Fort Collins is located where it is today because of a flood that destroyed the original Military Post, Camp Collins, near present day Laporte. Annual peak flows are typically driven by snowmelt runoff and generally occur from April to July. Severe thunderstorms can also cause flooding problems, especially during rain-on-snow events. The most notable flood occurred in 1904 and resulted in the death of a Fort Collins resident. In spring 1999, a rain-on-snow event caused severe channel erosion and threatened many properties. The most recent flood event occurred in September 2013 and was the largest flood event on the Poudre River since 1930. The 2013 event was caused by heavy and prolonged rainfall, with some areas of the city receiving up to 12 inches of rain within a week long period.

2.2 Previous Studies

Hydrology for the Cache la Poudre River was developed by the United States Army Corps of Engineers (USACE) in 1988. The original hydraulic study supporting the effective FIS information within the majority of the City of Fort Collins was conducted by the United States Army Corps of Engineers (USACE), Omaha district, and Simons, Li & Associates in 1994. In 2006, FEMA approved the Oxbow Levee LOMR (FEMA Case Number: 06-08-B336P) for the construction of the Oxbow Levee between Linden Street and Lincoln Avenue. The HEC-2 hydraulic models associated with the revised condition of this LOMR were obtained and considered to be the effective models for the portion of this study located downstream of Wood Street.

In 2006, FEMA adopted the Digital Flood Insurance Rate Map (DFIRM) update for Larimer County that was conducted as part of FEMA's Map Modernization Program. As part of the DFIRM update, Larimer County retained Ayres Associates to restudy approximately 5.5 miles of the river, extending from Wood Street (approximately 1,600 feet downstream of the Shields Street Bridge) upstream to Watson Lake. The restudy, which was completed in 2005, utilized 1999 photogrammetric developed 2-foot contour maps for overbank cross sectional data and flood hazard mapping. In-channel survey data, including bridges and culverts, were collected by Ayres Associates and incorporated into the cross sectional data and hydraulic model. The HEC-RAS, version 3.1.2, hydraulic models associated with the 2005 restudy were obtained and considered to be the effective models for study reach.

In 2019, Anderson Consulting Engineers (ACE) submitted a LOMR request to FEMA for the CLPR adjacent to Lions Open Space (LOMR No. 19-08-0367P), which is approximately 3,600 feet downstream of the Laporte Dam. This LOMR reflected the bank restoration as-built conditions in the Lions Open Space.

It is expected that this LOMR will be approved in the winter of 2019. Based on direction given by FEMA reviewers, the current hydraulic study will assume that the Lions Open Space LOMR is effective. The 2019 Lions Open Space LOMR HEC-RAS version 5.0.3 hydraulic models were obtained and are considered effective downstream of the Laporte Dam.

III. STUDY LIMITS

Figure 1.1 provides a site map for the current study reach. The ***study reach*** extends from Cross Section 260703 DF, located 2,755 feet downstream of the Larimer County Road 54G Bridge, to Cross Section 255245, located 1,500 feet upstream of the Overland Trail Bridge. The length of the ***study reach*** is approximately 5,508 feet (1.0 miles).

As part of the DFIRM conversion, the effective Flood Insurance Study (FIS) for Larimer County was originally published in December 2006. Since this time, the FIS has been updated three times due to Physical Map Revisions (PMRs) on Dry Creek, Spring Creek, and the Little Thompson River, with the most recent revision of the FIS published in February 2013. Pertinent effective floodway data tables and flood profiles (193P and 194P) were obtained and reviewed as part of this study. Effective Flood Insurance Rate Maps (FIRMs) that will be impacted by this study are 08069C0743F, 08069C0960F, 080690744F, 08069C0957F. Additionally, LOMR 17-08-0129P which became effective in October 2017, updated the river stationing within the study reach. Pertinent effective floodway data tables and flood profiles (192P and 193P) were obtained and reviewed as part of this study. Copies of the effective floodway data tables, flood profiles, and FIRM Panels that were obtained and reviewed for the study reach have been included in Appendix C.1. Copies of the annotated floodway data tables, flood profiles, and FIRM Panels that were obtained and reviewed from the Lions Open Space (LOMR No. 19-08-0367P) have also been included in Appendix C.1.

IV. MAPPING

4.1 Effective Condition

Topographic mapping for the effective 2005 study (upstream of Cross Section 235947) was provided to Ayres Associates by Larimer County. This 2-foot topographic mapping was obtained from aerial photogrammetry flown in 1999 and was available in digital format for use with this study. Larimer County was not responsible for providing survey data. It is noted that all topographic mapping and hydraulic models utilized for the effective studies are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29). As noted on the effective FIRM panels, FEMA utilized a constant conversion factor of 3.0-feet to convert all flood hazard information from NGVD29 to NAVD88 on the Cache la Poudre River as part of the DFIRM update.

The post-project condition analyses, from the 2019 Lions Open Space LOMR, associated with the improvements to the left river bank utilized an as-built survey collected by AVI P.C. in December 2016. This survey data was utilized as a supplement to the LiDAR data collected by Ayres Associates in May 2013 on behalf of Larimer County and the City of Fort Collins.

4.2 Corrected Effective Condition

In October 2013, FEMA retained PhotoScience, Inc. to collect new aerial imagery and LiDAR data, vertically referenced to NAVD88, following the September flood event along the front range and South Platte River. The LiDAR data was utilized to develop 0.7 meter resolution digital elevation models (DEM). The post-flood DEM was supplemented by 1-foot contours generated from detailed survey of the Laporte Dam collected by King Surveyors in April 2018.

4.3 Horizontal Datum

All mapping and survey data utilized as part of this project is based on the Colorado State Plane horizontal datum NAD 83. Ayres Associates provided the Colorado Water Conservation Board with digital aerial imagery and orthophotography services for the South Platte River from the Weld/Adams County line downstream to Sterling and the Poudre River and Big Thompson River from their canyon mouth to their confluences with the South Platte. Digital aerial imagery was acquired on Saturday, September 14, 2013.

V. HYDROLOGY

Hydrology for the effective studies were developed by the USACE in 1988, using the HEC-1 hydrologic model. Results of the 1988 hydrology study have been provided in Appendix C.1. This same hydrology was used as the basis for the hydraulic analyses of the Poudre River completed as part of the current study.

Table 5.1 Cache la Poudre River FIS Hydrology (from USACE, April 1988).

Location	Peak Discharge (cfs)			
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Bluff Line Gage	6,490	11,800	15,100	26,300
Upstream of Dry Creek Confluence	5,370	10,200	13,300	24,100

The hydraulic analyses completed for the effective FIS utilized more detailed discharge profiles than those reported in Table 5.1. In addition to potential inflows to the river from tributaries, the USACE hydrologic study considered the attenuation of flood peaks along the river. The detailed results of the USACE study were incorporated into the previous analyses as indicated by the variation in discharges given as input in the effective HEC-RAS models for the study reach. Table 5.2 provides the discharges utilized in the effective hydraulic models within the study reach.

Table 5.2 Discharges Utilized in the Hydraulic Models.

Cross Section ID/Station	Peak Discharge (cfs)				Location
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
CACHE LA POUDRE RIVER MAIN CHANNEL					
255245	5,900	11,000	14,400	25,300	D/S Study Limit
255648	5,900	11,000	14,400	25,300	
256927	5,900	11,000	14,400	25,300	
257939	5,900	11,000	14,400	25,300	D/S Laporte Dam
257969	5,900	11,000	14,400	25,300	U/S Laporte Dam
258507	5,900	11,000	14,400	25,300	
259082	6,400	11,000	14,700	25,800	
259903	6,400	11,000	14,700	25,800	
260703	6,400	11,000	14,700	25,800	U/S Study Limit

VI. EFFECTIVE CONDITION DOCUMENTATION

As previously mentioned, the effective Flood Insurance Study (FIS) information for the study reach was obtained from the revised FIS for Larimer County and Incorporated Areas (February 6, 2013) and the Lions Open Space LOMR (No. 19-08-0367P). Flood hazard information published in the effective FIS and FIRM panels for the study reach originated from the October 2005 floodplain restudy conducted by Ayres Associates as part for the Larimer County DFIRM conversion. HEC-RAS version 3.1.2 was utilized to conduct the 2005 restudy. The study limits for the 2005 restudy extended from Cross Section 2358947 upstream to Watson Lake. The effective HEC-RAS models, digital topographic and flood hazard information, and the floodplain modeling report from the 2005 restudy were obtained from Larimer County. Additionally the presumed effective models and mapping associated with the Lions LOMR were obtained from the ACE Library. Pertinent information from the effective FIS and FIRM panels have been provided as documentation in Appendix C.1. A summary of the effective models obtained for the current study is provided in Table 6.1.

Table 6.1 Summary of Effective Models.

Model Name: (Plan Name)	Source of Model (Study Name/ Author, Date)	Events Modeled	Description
Upper.prj (100-YR Half Foot Floodway)	DFIRM Restudy (Ayres, 2005) Incorporated into Effective FIS (FEMA, 2013)	1% Annual Chance and Half-Foot Floodway	Computes water surface profile for the 1% annual chance event and the half-foot rise floodway near the Laporte Dam
Upper.prj (500-YR)		0.2% Annual Chance	Computes water surface profile for the modeled event near the Laporte Dam
Upper.prj (10-, 50-YR)		10%-, 2% Annual Chance	Computes water surface profile for the modeled events near the Laporte Dam
Lion_LOMR.prj (Post-Project-Half-Ft-FW)	Lions Open Space LOMR (ACE, 2019)	1% Annual Chance and Half-Foot Floodway	Computes water surface profile for the 1% annual chance event and the half-foot rise floodway upstream of Overland Trail
Lion_LOMR.prj (Post-Project-0.2%-Ann Chance)		0.2% Annual Chance	Computes water surface profile for the modeled event upstream of Overland Trail
Lion_LOMR.prj (Post-Project 1% 2% 10% Ann Chance)		1%-, 2%-, 10% Annual Chance	Computes water surface profile for the modeled events upstream of Overland Trail

Effective water surface elevations were obtained from the floodway data table published in the effective Larimer County FIS [FEMA, 2013], the Lions LOMR, and the National Flood Hazard Layer database from FEMA. The effective graphical water surface profiles and the effective floodway data table are provided in Appendix C.1. The annotated graphical water surface profiles and the floodway data table from the Lions LOMR are also provided in Appendix C.1. Table 6.2 presents a summary of the effective water surface elevations for the current study reach. The effective 1% and 0.2% annual chance floodplain delineations are shown on the effective FIRM panels provided in Appendix C.1. The floodplain/floodway

delineations and BFE information shown on the effective FIRM panel were also obtained electronically for this study and cross checked with the FIRM panel for consistency.

Table 6.2 Effective FEMA Water Surface Profiles.

Cross Section ID: Station	Water Surface Elevations (ft, NAVD)				Location
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
As Reported In:	LARIMER COUNTY FIS [FEMA, 2013] Profiles 193P and 194P	LARIMER COUNTY FIS [FEMA, 2013] Profiles 193P and 194P	LARIMER COUNTY FIS [FEMA, 2013] Floodway Data Table 4/ Profiles 193P and 194P	LARIMER COUNTY FIS [FEMA, 2013] Profiles 193P and 194P	
255245 [1]	5063.5	5065.5	5066.3	5068.0	D/S Study Limit
255648:DE [1]	5065.5	5067.5	5068.3	5069.71	
256927:DF [2]	5071.4	5073.5	5074.3	5075.6	
257939 [2]	5075.8	5078.4	5079.6	5081.1	D/S Laporte Dam
257969:DG [2]	5077.4	5079.3	5080.4	5082.1	Crest of Laporte Dam
258507 [2]	5082.1	5084.2	5085.7	5085.7	
259082:DH [2]	5085.3	5087.5	5088.6	5090.6	
259903 [2]	5089.1	5090.2	5090.8	5092.4	
260703:DI [2]	5091.7	5092.5	5093.0	5094.1	U/S Study Limit

[1] Elevations obtained from Lions Open Space LOMR

[2] Elevations obtained from FIS Floodway Data Table; all other elevations obtained from FEMA's National Flood Hazard Layer database.

VII. DUPLICATE EFFECTIVE HYDRAULIC ANALYSES

The duplicate effective analysis involved obtaining the effective hydraulic models developed by Ayres for the 2005 DFIRM restudy and by ACE for the 2019 Lions Open Space LOMR, and re-running them and comparing the results with the data published in the effective FIS report. The objectives of the duplicate effective analysis were to ensure that the computer models used as the basis for the current study are the models utilized for the effective FIS.

7.1 Definition of Hydraulic Models

The source and limits of the effective models utilized for the current study were previously listed and described in Table 6.1. The plans from the effective HEC-RAS model developed as part of the 2005 restudy and the Lions LOMR were obtained and re-run in HEC-RAS (Version 5.0.7). Table 7.1 lists the model/plan names utilized in the duplicate effective analysis and the corresponding effective model/plan names.

Table 7.1 Summary of Duplicate Effective Models.

Model Name: (Plan Name)	Source of Model (Study Name/ Author, Date)	Events Modeled	Description
Upper.prj (100-YR Half Foot Floodway)	DFIRM Restudy (Ayres, 2005) Incorporated into Effective FIS (FEMA, 2013)	1% Annual Chance and Half-Foot Floodway	Computes water surface profile for the 1% annual chance event and the half-foot rise floodway near the Laporte Dam
Upper.prj (500-YR)		0.2% Annual Chance	Computes water surface profile for the modeled event near the Laporte Dam
Upper.prj (10-, 50-YR)		10%-, 2% Annual Chance	Computes water surface profile for the modeled events near the Laporte Dam
Lion_LOMR.prj (Post-Project-Half-Ft-FW)	Lions Open Space LOMR (ACE, 2019)	1% Annual Chance and Half-Foot Floodway	Computes water surface profile for the 1% annual chance event and the half-foot rise floodway upstream of Overland Trail
Lion_LOMR.prj (Post-Project-0.2%-Ann Chance)		0.2% Annual Chance	Computes water surface profile for the modeled event upstream of Overland Trail
Lion_LOMR.prj (Post-Project 1% 2% 10% Ann Chance)		1%-, 2%-, 10% Annual Chance	Computes water surface profile for the modeled events upstream of Overland Trail

7.2 Starting Water Surface Elevations and Roughness Coefficients

Starting water surface elevations for all models were unmodified from that of the effective models. Manning's n coefficients and other modeling parameters for all cross section were also unmodified from the effective models.

7.3 Floodplain/Floodway Analyses and Results

The duplicate effective HEC-RAS models were used to re-analyze all floodplain and floodway scenarios. The results were then compared to the values published in the effective FIS; the comparison of floodplain water surface elevations is given in Table 7.2. As indicated in Table 7.2, the water surface elevations for the 1% annual chance event are identical between the effective and the duplicate effective models for the cross sections that are included in the floodway data table. Table 7.3 provides a comparison of the duplicate effective half-foot rise floodway results to the information provided on the effective floodway data tables provided in Appendix C.1. Results of the duplicate effective analysis were identical to the effective. Based on the duplicate effective analysis, it was concluded that hydraulic models obtained for the current study correctly reproduce the results published in the effective FIS.

Electronic copies of the duplicate effective HEC-RAS models utilized for the current study are provided as digital data in Appendix F.1 on the disk included with this report. HEC-RAS output reports for the separated duplicate effective hydraulic models are also provided in Appendix F.2 on the disk included with this report.

Table 7.2 Effective and Duplicate Effective 1% Annual Chance Water Surface Profiles.

Effective Cross Section ID	Duplicate Effective Cross Section Station/ID	Effective Condition[1] 1% Annual Chance Water Surface Elevations (ft, NAVD)	Duplicate Effective Condition 1% Annual Chance Water Surface Elevations (ft, NAVD)	Difference in Water Surface Elevattions[2]	Location
CACHE LA POUDRE RIVER UPSTREAM OF OVERLAND TRAIL					
	255245 [3]	5066.3	5066.3	0.0	D/S Study Limit
DE	255648 [3]	5068.3	5068.3	0.0	
DF	256927 [4]	5074.3	5074.3	0.0	
	257939 [4]	5079.6	5079.6	0.0	D/S Laporte Dam
DG	257969 [4]	5080.4	5080.4	0.0	Crest of Laporte Dam
	258507 [4]	5085.7	5085.7	0.0	
DH	259082 [4]	5088.6	5088.6	0.0	
	259903 [4]	5090.8	5090.8	0.0	
DI	260703 [4]	5093.0	5093.0	0.0	U/S Study Limit

[1] Effective water surface elevations reported in Larimer County FIS Floodway Data Table or Flood Profile and Lions Open Space LOMR, see table 6.2 for specifics

[2] Difference in WSEL = Duplicate Effective WSEL – Effective WSEL

[3] Duplicate Effective water surface elevations obtained from Lions Open Space LOMR model

[4] Duplicate effective water surface elevations obtained from Ayres "Upper" model

The effective water surface elevations listed above were converted from NGVD 1929 to NAVD 1988 by adding 3.0 feet; the conversion factor used to prepare the FIS as part of the DFIRM conversion.

Table 7.3 Effective and Duplicate Effective Half-Foot Floodway Results.

Effective Cross Section ID	Duplicate Effective Cross Section Station/ID	Effective Condition[1]							Duplicate Effective Condition[2]							Location
		Floodway			Base Flood Water Surface Elevation (ft, NAVD)				Floodway			Base Flood Water Surface Elevation (ft, NAVD)				
		Width (ft)	Section Area (sq ft)	Mean Velocity (fps)	Regulatory	Without Floodway	With Floodway	Increase	Width (ft)	Section Area (sq ft)	Mean Velocity (fps)	Regulatory	Without Floodway	With Floodway	Increase	
CACHE LA POUDRE RIVER UPSTREAM OF OVERLAND TRAIL																
	255245	---	---	---	---	---	---	---	488	2393	6.0	5066.3	5066.3	5066.7	0.5	D/S Study Limit
DE	255648	270	1617	8.9	5068.3	5068.3	5068.8	0.5	270	1617	8.9	5068.3	5068.3	5068.8	0.5	
DF	256927	809	2,923	4.9	5074.3	5074.3	5074.5	0.2	809	2,923.3	4.9	5074.3	5074.3	5074.5	0.2	
	257939	---	---	---	---	---	---	---	201	2,023.2	8.8	5079.6	5079.6	5079.6	0.1	D/S Laporte Dam
DF	257969	809	2,923	4.9	5080.4	5080.4	5080.4	0.2	161	2,028.3	14.2	5080.4	5080.4	5080.4	0.0	Crest of Laporte Dam
	258507	---	---	---	---	---	---	---	304	3,705.6	7.7	5085.7	5085.7	5085.7	0.0	
DH	259082	570	4,303	4.6	5088.6	5088.6	5088.6	0.0	570	4,303.1	4.6	5088.6	5088.6	5088.6	0.0	
	259903	---	---	---	---	---	---	---	1208	3,901.5	3.8	5090.8	5090.8	5088.3	0.5	
DI	260703	1,687	4,796	3.1	5093.0	5093.0	5093.5	0.5	1687	4,796.2	3.1	5093.0	5093.0	5090.5	0.5	U/S Study Limit

[1] Effective floodway information reported in Larimer County FIS Floodway Data Table.

[2] Duplicate effective results obtained from Ayres "Upper" model and Lions Open Space LOMR Model see Table 6.1 for specifics

VIII. CORRECTED EFFECTIVE HYDRAULIC ANALYSIS

From the effective/base model, a corrected effective condition model was created. Converting the effective Poudre River model to a corrected effective condition model involved the following steps:

(a) removing interpolated cross sections within the study reach;

(b) adding five new cross sections within the study reach to provide additional detail and deleting two cross sections;

(c) re-cutting the cross sections based on new topography;

(d) adding 3.00 feet (per conversion factor used to prepare the FIS as part of the DFIRM conversion) to the effective "Upper" geometric data to convert from NGVD 1929 to NAVD 88;

(e) modeling the Laporte Dam as an in-line structure;

(f) re-stationing cross sections based on the changes made in previous studies;

(g) running the model in HEC-RAS 5.0.7

The newly modeled cross sections were generally defined using the FEMA post-flood DEM (collected in the November 2013), then supplemented by topography generated from Kings's detailed survey of the Laporte Dam (April 2018). The two exceptions being the upstream and downstream study limits study reach, where the effective cross section geometry was unchanged in order to promote upstream and downstream tie-ins.

8.1 Corrected Effective Analyses

8.1.1 Definition of Hydraulic Models

The effort associated with the corrected effective modeling consisted of altering the duplicate effective HEC-RAS plans into two new plans within HEC-RAS. The corrected effective HEC-RAS plans are identified in Table 8.1.

Table 8.1 Summary of Corrected Effective Models.

Corrected Effective Model Name: (Plan Name)	Events Modeled	Description
LOMR_Upper.prj: Plan (CE)	10-, 2-, 1-, and 0.2-Percent Annual Chance	Computes water surface profile for the modeled event within the current study reach
LOMR_Upper.prj: Plan (CE 0.5-FT Floodway)	1-Percent Annual Chance and Half-Foot Floodway	Computes water surface profile for the 1-percent annual chance event and the half-foot rise floodway within the current study reach

8.1.2 Starting Water Surface Elevations and Roughness Coefficients

Starting water surface elevations for the corrected effective HEC-RAS plans were set to match the effective water surface elevations for Cross Section 249707 as reported in Table 6.2. A summary of boundary conditions utilized in the corrected effective analyses are presented in Table 8.2. Manning's n values representing corrected effective conditions were unchanged from the effective model, with overbank values ranging from 0.020 (for paved surfaces) to 0.090 (for heavily vegetated areas) and in-channel values range from 0.035 (for unvegetated areas) to 0.080 (for heavily vegetated areas).

Table 8.2 Summary of Boundary Conditions for the Corrected Effective Analysis.

Recurrence Interval	Boundary Condition	Value	Source[1]
10-Percent Annual Chance	Known Water Surface Elevation	5032.69 ft, NAVD88	Effective FIS [FEMA, 2013]
2-Percent Annual Chance	Known Water Surface Elevation	5035.22 ft, NAVD88	
1-Percent Annual Chance	Known Water Surface Elevation	5036.55 ft, NAVD88	
0.2-Percent Annual Chance	Known Water Surface Elevation	5039.66 ft, NAVD88	
Floodway	Known Water Surface Elevation	5036.55 ft, NAVD88	

8.1.3 Cross Sectional Modifications

A total of five (5) cross sections were added to the effective model to provide additional detail in the study reach while two (2) were deleted, bringing the total number of modeled cross sections within the study reach to ten (10). Of the 10 cross sections 8 of them were defined using the FEMA post-flood topography supplemented by Kings's 2018 detailed survey of the Laporte Dam. The other two cross sections, at the upstream and downstream study limits of the corrected effective model, were unchanged from the effective model to facilitate upstream and downstream tie-ins. Table 8.3 summarizes the cross-sectional changes conducted for the corrected effective analysis, including a comparison of effective and corrected effective main channel reach lengths.

In addition to adding cross sections the hydraulic baseline was adjusted to better represent the existing plan form of the river. Modeled corrected effective cross sections are stationed based on the adjusted hydraulic baseline. Additionally, the effective stationing was adjusted to reflect changes in the baseline due to LOMR 17-08-0129P which became effective in October 2017.

Table 8.3 Corrected Effective Cross Section Modifications.

Duplicate Effective Station	Duplicate Effective Main Channel Reach Length	Corrected Effective Cross section ID	Corrected Effective Main Channel Reach Length	Description of Corrected Effective Changes
255245	335.00	255245	335.00	Same as Effective
255648	380.00	255648	380.00	Geometry Revised
---	---	256356	708.00	Added
256927	332.20	256977	332.20	Geometry Revised
---	---	257465	488.00	Added
---	---	257981	516.28	Added
257939	1,012.28 [1]	---	---	Deleted
257969	30.00	---	---	Deleted
---	---	258030	49.00	Added
258507	538.00	258557	527.00	Geometry Revised
259082	574.56 [1]	259132	574.56	Geometry Revised
---	---	259510	378.40	Added
259903	821.17	259953	443.37	Geometry Revised
260703	799.19	260753	799.19	Same as Effective
Total Length	**4,108**	**Total Length**	**4,108**	

[1]Channel length includes lengths from downstream interpolated cross-sections

8.1.4 Floodplain/Floodway Analyses and Results

Table 8.4 presents a comparative summary of the duplicate effective and corrected effective floodplain model results. As reported in Table 8.4, differences in water surface elevations from -1.2 to 4.1 feet were noted between the duplicate effective and corrected effective results. The differences in water surface elevations reported in Table 8.4 can be attributed to the updated modeling techniques most notably additional cross sections, removal of interpolated cross sections, modeling of the Laporte Dam as an inline weir, and updated topography. It should be noted that the crest elevation of the Laporte Dam in this effective/duplicate effective model is 5073.5 (NAVD88). The 2018 King survey determined that the actual crest elevation of the dam is 5076.7 (NAVD88) which is 3.2 feet higher than the effective model.

Table 8.4 Duplicate Effective and Corrected Effective Water Surface Profiles.

Effective Cross Section ID	Cross Section Station Effective/Corrected Effective	Duplicate Effective Condition Water Surface Elevations (ft, NAVD)				Corrected Effective Water Surface Elevations (ft, NAVD)				Difference in Water Surface Elevations (ft)				Location
		10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
CACHE LA POUDRE RIVER UPSTREAM OF OVERLAND TRAIL RD														
	255245	5063.4	5065.5	5066.3	5068	5063.5	5065.5	5066.3	5068.0	0.1	-0.1	0.0	0.0	D/S Study Limit
DE	255648	5065.5	5067.5	5068.3	5069.7	5065.5	5067.5	5068.3	5070.0	0.0	0.0	0.0	0.3	
	256356 [1]	*5068.6*	*5070.7*	*5071.5*	*5072.8*	5068.4	5070.7	5071.7	5073.7	-0.3	0.0	0.2	0.9	
DF	256927/256977	5071.4	5073.5	5074.3	5075.6	5071.4	5073.3	5074.0	5075.8	0.0	-0.2	-0.3	0.2	
	257465 [1]	*5073.5*	*5075.9*	*5076.8*	*5078.3*	5074.5	5075.9	5076.6	5078.9	1.0	0.0	-0.2	0.6	
	257981 [1]	*5075.8*	*5078.4*	*5079.5*	*5081.1*	5075.8	5078.2	5079.5	5082.3	0.0	-0.2	0.0	1.2	D/S Laporte Dam
	257939 [2]	5075.8	5078.4	5079.6	5081.1	*5076.8*	*5079.0*	*5080.2*	*5082.7*	1.0	0.6	0.6	1.6	D/S Laporte Dam
DG	257969 [2]	5077.4	5079.3	5080.4	5082.1	*5080.3*	*5082.0*	*5082.8*	*5084.5*	2.9	2.7	2.4	2.4	Crest of Laporte Dam
	258030 [1]	*5077.5*	*5079.4*	*5080.5*	*5082.2*	5081.6	5083.1	5083.8	5085.1	4.1	3.7	3.3	2.9	Face of Laporte Dam
	258507/258557	5081.8	5084.2	5085.7	5085.7	5082	5084.1	5084.8	5086.9	0.2	-0.1	-0.9	1.2	
DH	259082/259132	5085.3	5087.5	5088.6	5090.6	5085.7	5087.3	5088.1	5090.2	0.4	-0.2	-0.5	-0.4	
	259510 [1]	*5087.9*	*5089.3*	*5090.1*	*5091.8*	5086.7	5088.3	5089.1	5091.3	-1.2	-1.0	-1.0	-0.5	
	259903/259953	5089.1	5090.2	5090.8	5092.4	5088.4	5089.3	5090	5091.9	-0.7	-0.9	-0.8	-0.5	
DI	260703/260753	5091.7	5092.5	5093	5094.1	5091.8	5092.8	5093.3	5094	0.1	0.3	0.3	-0.1	U/S Study Limit

[1] Corrected Effective cross section number only
[2] Effective cross section number only
Italicized values are interpolated

Table 8.5 Duplicate Effective and Corrected Effective Half-Foot Floodway Results.

	Duplicate Effective Cross Section Station/ID	Duplicate Effective Condition							Corrected Effective Condition							Location
		Floodway			Base Flood Water Surface Elevation (ft, NAVD)[1]				Floodway			Base Flood Water Surface Elevation (ft, NAVD)				
		Width (ft)	Section Area (sq ft)	Mean Velocity (fps)	Regulatory	Without Floodway	With Floodway	Increase	Width (ft)	Section Area (sq ft)	Mean Velocity (fps)	Regulatory	Without Floodway	With Floodway	Increase	
CACHE LA POUDRE RIVER UPSTREAM OF OVERLAND TRAIL RD																
	255245	488	2393	6.0	5066.3	5066.3	5066.7	0.5	488	2397	6.0	5066.3	5066.3	5066.7	0.4	D/S Study Limit
DE	255648	270	1617	8.9	5068.3	5068.3	5068.8	0.5	270	1618	8.9	5068.3	5068.3	5068.8	0.5	
	256356 [1]	---	---	---	---	---	---	---	685	3559	4.1	5071.7	5071.7	5072.0	0.3	
DF	256927/256977	809	2,923.3	4.9	5074.3	5074.3	5074.5	0.2	687	2162	6.7	5074.0	5074.0	5074.0	0.0	
	257465 [1]	---	---	---	---	---	---	---	452	1605	9.0	5076.6	5076.6	5076.6	0.0	
	257980 [1]	---	---	---	---	---	---	---	225	2057	7.0	5079.5	5079.5	5079.5	0.0	D/S Laporte Dam
	257939 [2]	201	2,023.2	8.8	5079.6	5079.6	5079.6	0.1	---	---	---	---	---	---	---	D/S Laporte Dam
DG	257969 [2]	161	2,028.3	14.2	5080.4	5080.4	5080.4	0.0	---	---	---	---	---	---	---	Crest of Laporte Dam
	258030 [1]	---	---	---	---	---	---	---	526	2549.7	5.7	5083.8	5083.8	5083.9	0.1	Face of Laporte Dam
	258507/258557	304	3,705.6	7.7	5085.7	5085.7	5085.7	0.0	497	1603.1	9.0	5084.8	5084.8	5084.8	0.0	
DH	259082/259132	570	4,303.1	4.6	5088.6	5088.6	5088.6	0.0	730	3108.8	4.6	5088.1	5088.1	5088.2	0.1	
	259510 [1]	---	---	---	---	---	---	---	808	3171.6	4.6	5089.1	5089.1	5089.2	0.1	
	259903/259953	1208	3,901.5	3.8	5090.8	5090.8	5088.3	0.5	1,215	3162.4	4.7	5090.0	5090.0	5090.4	0.4	
DI	260703/260753	1687	4,796.2	3.1	5093.0	5093.0	5090.5	0.5	1,607	4625.3	3.2	5093.3	5093.3	5093.4	0.1	U/S Study Limit

[1] Converted from NGVD 1929 by adding 3.0 feet
[2] Corrected Effective cross section number only
[3] Effective cross section number only

Table 8.5 provides a comparison of the duplicate effective half-foot rise floodway results to the information provided in the effective floodway data table. Within the study reach there is an increase in reported floodway widths up to 193 feet. However, the increases in the floodway widths are be attributed to different methodologies for determining floodway width values. The effective/duplicate effective values are reported directly from HEC-RAS top width output whereas the values reported for the corrected effective condition are the actual mapped floodway widths. The mapped corrected effective floodway is generally narrower than the effective, this is due to updated modeling techniques, specifically due to the Cotton Willow Estates neighborhood along the north side of the study reach was modeled as an ineffective flow area. The neighborhood is modeled as an ineffective flow area due to the prevalence for fencing and other undocumented obstructions which will impede flow.

Electronic copies of the corrected effective HEC-RAS models utilized for the current study are provided as digital data in Appendix F.1 on the disk included with this report. Digital HEC-RAS output reports for the corrected effective hydraulic models are also provided in Appendix F.2 on the disk included with this report.

8.2 Corrected Effective Floodplain and Floodway Mapping

Within the project area both the floodplain is generally similar to the effective flood hazards. As mentioned above, the mapped floodway is narrower than the effective due updated modeling techniques. Sheet 2 in Appendix D.1 shows the comparison of Corrected Effective and Effective mapping

8.3 Downstream and Upstream Tie-In

At the downstream study limit, Cross Section 255245, effective water surface elevations, floodway data, and flood hazard delineations for all modeled flood events match effective water surface elevations within 0.1 feet. At the upstream study limit, Cross Section 260703, all modeled flood events match effective water surface elevations within 0.3 feet. Both upstream and downstream corrected effective water surface elevations match effective water surface elevations with the FEMA allowable limit of 0.5 feet. Horizontal tie-in locations with the effective flood hazard delineations are illustrated on the workmaps included with this study, as well as the annotated FIRM included in Appendix D.3. Annotated floodway data tables and flood profiles have also been included in Appendix D.3 to illustrate post-project condition tie-ins with effective information.

8.4 Impacts

As previously discussed and presented in Table 8.4, the corrected effective analysis both reduces and increases water surface elevations through the study reach when compared to effective conditions. As presented on the workmap and annotated FIRM, due to the increased and decreased BFE's multiple

existing structures and private properties will be subjected to both positive and negative changes regarding floodplain elevations. Some individual structures on Sheet 3 have been shown to be removed from the half-foot floodway.

As presented on the BFE comparison table included in Appendix E.2, increases in 1-percent annual chance water surface elevations will occur at Cross Section 257980 when corrected effective conditions are compared to effective conditions. This increase is attributed to the modeling of the Laporte Dam as an inline weir and utilized the correct weir crest elevation as well as updated modeling and mapping techniques through the study reach. **It should be noted that changes in BFE's are not due to any manmade changes within the study reach.** A copy of the public notification regarding this LOMR is included in Appendix B. ACE will assist Larimer County in the production of individual property owner notifications, along with maps identifying the change between effective and post-project 1-percent annual water surface elevations and the 1- and 0.2-percent annual floodplain delineations.

IX. REFERENCES

Ayres Associates, Floodplain Restudy – Cache La Poudre River, Larimer County Colorado, (Prepared in Support of the Larimer County DFIRM), October 2005.

Anderson Consulting Engineers, Lions Open Space Hydraulic Modeling and Flood Hazard Mapping Study in Support of a Letter of Map Revision (LOMR), May 2019.

Chow, V.T., 1959. Open-Channel Hydraulics. McGraw-Hill Book Company, New York.

Federal Emergency Management Agency, Flood Insurance Rate Map, Larimer County, Colorado and Incorporated Areas, Panels 0976F and 0977G.

Federal Emergency Management Agency, Flood Insurance Study, Larimer County, Colorado and Incorporated Areas, Volumes 1 & 3, Revised February 6, 2013.

United State Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS River Analysis System, Version 4.1, 2010.

United State Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS River Analysis System User's Manual, Version 4.1, 2010.

United State Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS River Analysis System Hydraulic Reference Manual, Version 4.1, 2010.

United State Army Corps of Engineers, Omaha District, Engineering Division Technical Report, Hydrologic Analysis of the Cache la Poudre River Basin, April 1988.

United States Geological Survey, 1989. Guide for Selecting Manning's n Roughness Coefficients for Natural Channels and Floodplains. Water Supply Paper 2339.

APPENDIX A

MT-2 FORMS

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.**

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 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
080101	Larimer County	CO	08069C	0744F, 0743F, 0960F, 0957F	02/06/13

2. a. Flooding Source: Cache La Poudre 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: Laporte Dam LOMR

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: $_____

☒ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **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: Matthew M Clark, P.E.	Company: Anderson Consulting Engineers	
Mailing Address: 375 E Horsetooth Road, Bldg 5 Fort Collins, CO 80525	Daytime Telephone No.: 970-226-0120	Fax No.: 970-226-0121
	E-Mail Address: Matt.Clark@acewater.com	
Signature of Requester (required):	Date:	

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: Devin Traff, P.E., County Engineer	Community Name: Larimer County	
Mailing Address: 200 W Oak Street,Suite 3000 Fort Collins, CO 80521	Daytime Telephone No.: 970-498-5731	Fax No.:
	E-Mail Address: traffdc@co.larimer.co.us	
Community Official's Signature (required):	Date:	

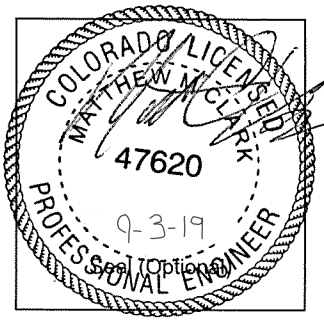
CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

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: Matthew M Clark, P.E.	License No.: 47620		Expiration Date: 10/31/2019
Company Name: Anderson Consulting Engineers	Telephone No.: 970-226-0120		Fax No.: 970-226-0121
Signature:	Date:	E-Mail Address: Matt.Clark@acewater.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



See 10 (Optional)

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

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, 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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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: Cache La Poudre 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)

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*	1,500 ft US of Overland Trail	255245	5066.26	5066.26
Upstream Limit*	2,755 ft DS of County Rd 54G	260753	5092.87	5093.28

*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 ver. 5.0.7

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: Upper.prj_	Plan Name: DupEff.UpperFP/FW	File Name: Upper.prj_	Plan Name: DupEff.UpperFP/FW	NGVD29_
Corrected Effective Model*	File Name: LOMR_Upper.prj_	Plan Name: CE_	File Name: LOMR_Upper.prj_	Plan Name: CE 0.5-FT Floodway_	NAVD88_
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:	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: 1) Post-flood, 2) Structure Survey

Source: 1) FEMA, 2) King Surveyors Date: 1) 2013, 2) 2018

Accuracy: 1) 0.7 meter 2) 1-ft contour

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

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 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, 1800 South Bell Street, Arlington, VA 20598-3005, 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; 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: Cache La Poudre River

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: Laporte Diversion Dam

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

   Location of Structure: In channel 4,300-ft US of Overland Trail Bridge

   Downstream Limit/Cross Section: 257981 (5,478-ft US of Overland Trail Bridge)

   Upstream Limit/Cross Section: 258030 (4,310-ft DS of County Road 54G Bridge)

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)
☐ Shape (culverts only)
☐ Material
☐ Beveling or Rounding
☐ Wing Wall Angle
☐ Skew Angle
☐ Distances Between Cross Sections
☐ Erosion Protection
☐ Low Chord Elevations – Upstream and Downstream
☐ Top of Road Elevations – Upstream and Downstream
☐ Structure Invert Elevations – Upstream and Downstream
☐ 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: Cache La Poudre River
Name of Structure: Laporte Diversion 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: Larimer and Weld Reservoir Company

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 _____ Permitting Agency or Organization _____

   a. ☐ Local Government Dam ☒ Private Dam

   Provided 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.

THIS STUDY DOES NOT INCLUDE DESIGN. THIS IS A LOMR STUDY BASED ON CORRECTED EFFECTIVE ELEVATION DATA.

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~~ CORRECTED EFFECTIVE
10-year (10%)	5077.4	5081.6
50-year (2%)	5079.3	5083.1
100-year (1%)	5080.4	5083.8
500-year (0.2%)	5082.1	5085.1
Normal Pool Elevation	5073.1	5076.7

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_A = _____ psf; P_p = _____ 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	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 fomal 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 DOCUMENTION

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.

APPENDIX B

NOTIFICATIONS

The Larimer County Engineering Department, in accordance with National Flood Insurance Program regulation 65.7(b)(1), hereby gives notice of Larimer County's intent to revise the flood hazard information near the Laporte Diversion Dam, generally 4,300 upstream of Overland Trail. Specifically, the flood hazard information will be revised along the Cache la Poudre River from a point 1,500 feet upstream of Overland Trail Bridge to a point approximately 2,755 feet downstream of Larimer County Road 54G Bridge. As a result of the revision, the floodway will generally narrow throughout the study reach, the 1-percent annual chance water-surface elevations shall increase and decrease, and the 1-percent-annual-chance floodplain will widen and narrow within the area of revision. Maps and detailed analysis of the revision can be reviewed at the Larimer County Engineering Department at 200 W. Oak Street #3000, Fort Collins, CO 80521. Interested persons may call Devin Traff at (970) 498-5729 for additional information from 8:00 am to 5:00 pm.

APPENDIX C

PROJECT INFORMATION/ BACKUP DOCUMENTATION

APPENDIX C.1

EFFECTIVE INFORMATION

USACE CACHE LA POUDRE RIVER HYDROLOGY

~~Xerox copy~~

Grimm

ENGINEERING DIVISION TECHNICAL REPORT

HYDROLOGIC ANALYSIS

of the

CACHE LA POUDRE RIVER BASIN

1988 UPDATE - FINAL REPORT

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS

OMAHA, NEBRASKA

APRIL 1988

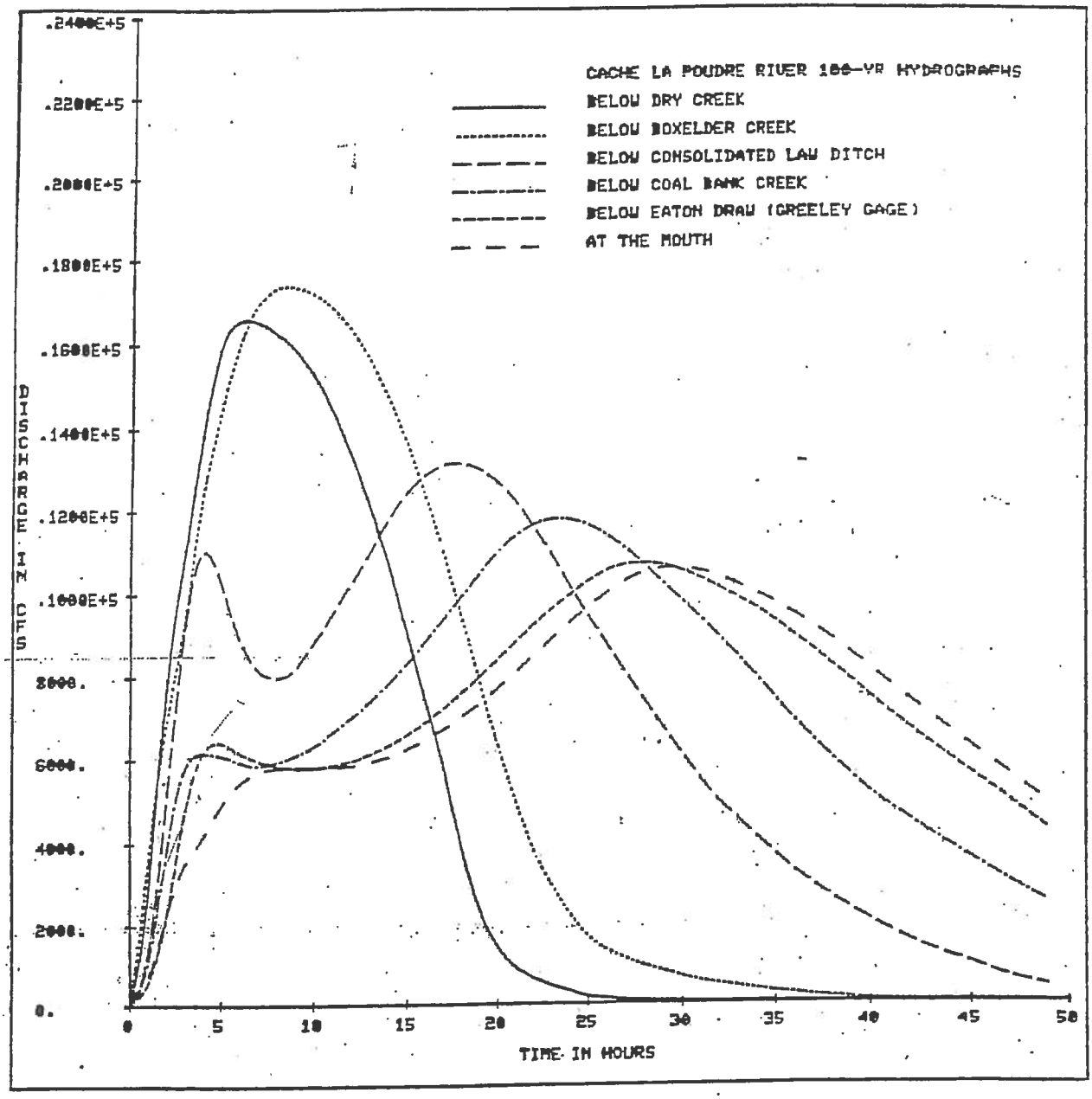
table 7

Discharge Frequency Relationships

Cache la Poudre River

(Discharge values in cubic feet per second)

Location	10 year	25 year	50 year	100 year	500 year
Bluff line gage	6490	9210	11800	15100	26300
Abv. Dry Creek	5370	7820	10200	13300	24100
Bel. Dry Creek	6700	9760	12700	16600	30100
Abv. Boxelder Cr.	5820	8610	11400	15000	27900
Bel. Boxelder Cr.	6750	9990	13200	17400	32400
Abv. Law Ditch	4590	7090	9640	13100	26100
Bel. Law Ditch	4620	7140	9720	13200	26300
Abv. Coalbank Cr.	3870	6120	8470	11700	24200
Bel. Coalbank Cr.	3900	6170	8540	11800	24400
Abv. Eaton Draw	3400	5470	7660	10700	22700
Bel. Eaton Draw	3400	5470	7660	10700	22700
Mouth	3310	5360	7550	10600	22800



REF.: Engineering Division Technical Report.
Hydrologic Analysis of the Cache La Poudre River Basin
1988 Update - Final Report
Corps of Engineers
Omaha, Nebraska
April, 1988

CACHE LA POUDRE RIVER
100-YEAR HYDROGRAPHS
ROUTED ALONG MAIN STEM

FIGURE 10

FLOODPLAIN MODELING REPORT FOR 2005 RESTUDY

HYDRAULIC ANALYSES

General Approach

The Cache la Poudre River was analyzed with version 3.1.2 of HEC-RAS. In order to conform to a LOMR submittal for the recently installed pedestrian bridge immediately downstream of Overland Trail Road, the Poudre River study area was broken into two segments by modeling in HEC-RAS as two independent projects. The "Lower" project extends from approximately ¼ mile downstream of Shields Street (CR 17) to a point approximately ¼ mile downstream of Overland Trail Road (CR 21), overlapping the "Overland LOMR" reach's lowest three cross-sections. The "Upper" project overlaps the three upstream-most sections in the Overland LOMR reach and continues upstream to a point just downstream of Watson Lake.

Each project has several different plans corresponding to different modeling scenarios because the flow patterns in the river vary significantly for the different recurrence interval floods modeled. Separate geometry files were occasionally needed to model the more frequent flood discharges (typically the 10- and 50-year events) from those that were used to model the 100- and 500-year flood discharges.

Junction and Split Reach Modeling Approach

The most significant split occurs in the lower reach where a right-bank spill occurs just upstream of Taft Hill Road. This spill remains separate from the main channel for approximately one mile before it re-joins the main channel. The spill occurs over a perched right bank berm that acts as an informal levee. Because this levee cannot meet FEMA criteria for a certified levee, two modeling scenarios were run for this reach. The first scenario assumes that the levee remains intact. This scenario allows flow to overtop the bank by way of a lateral weir. Overtopping flows are directed into a separate reach where it remains until it rejoins the main channel downstream of Taft Hill Road. BFEs to the north or inside of the high right bank were established by this profile. The second scenario modeled assumes that the right bank levee has failed and flow is inter-mingled between the main channel and right overbank. This "Levees Failed" model makes no significant distinction between flow in the main channel and the right overbank. Because this scenario contains more area available to convey flood flows, water surface elevations from this model are generally lower than those in the "Levees Intact" model with a few minor exceptions. Water surface elevations from this model were used to map BFEs to the south or outside of the high right bank.

The flow split that occurs at Taft Hill Road through the relief culverts to the north of the main bridge includes some roadway overtopping. Because of the complex configuration of the modeling of this split with an in-line weir and culvert in close proximity, the roadway overtopping was simulated through an off-line weir calculation, and the flow was removed upstream and replaced downstream of the roadway crossing.

For split flow reaches and lateral weirs, HEC-RAS was initially allowed to optimize the upstream energy grade to determine the flow distribution between the reaches. Once

the balance was achieved, the optimization was turned off and the computed flow distribution was "hard-wired" into the flow file.

The 500-year profile for the Overland LOMR reach includes a significant spill of nearly 5000 cfs that occurs over the abandoned Burlington Northern Railroad grade. It has been assumed that this flow remains south of the railroad embankment until it is forced to flow back into the main channel at section 240753 in the Lower Project.

A small portion of the 100-year discharge escapes from the main channel reach just upstream of the Larimer & Weld Canal diversion structure. The loss of flow is small enough that it was deemed inappropriate to reduce the main channel discharge. However, the flow is significant enough that its effects downstream of the spill were mapped as shallow flooding and ponding north of the Canal. Shallow flooding depths and ponding elevations were determined with off-line weir calculations.

Channel Roughness

Manning's n-values were initially selected based on engineering judgment, field reconnaissance, established tabular data, and values used in the effective hydraulic studies of the reach. The typical initial n-values ranged from 0.03 to 0.04 in the main channel and from 0.03 to 0.20 in the overbanks. Some initial overbank values were set lower than this range in order to simulate water flowing through wet ponds.

Some calibration data was obtained from Larimer County staff from the flood that occurred in 1983. That flood had a discharge of 6,600 cfs, very close to the 10-year flood discharge of 5,900 cfs. Anecdotal evidence from this flood resulted in a single calibration point just upstream of the Overland Trail Bridge where the water surface crested at the elevation of the Cache la Poudre Elementary School running track at an elevation of approximately 5064 feet (NGVD 29). In order to generate a water surface elevation close to this calibration point, main-channel n-values had to be raised significantly higher than those typically considered to be the maximum for this type of channel. Further conversations with Larimer County staff indicated that there was significant debris blocking the Overland Trail Road bridge opening during this event effectively reducing its capacity and invalidating any attempts to calibrate to this water surface elevation. While there is evidence of debris blockages it is Larimer County policy not to consider debris blockages when determining base flood elevations.

Cross-Section Modifications

Ineffective Flow designations were used where necessary to represent contractions and expansions of the flow around roadway embankments and other physical obstructions.

Several tools were used to artificially reduce the conveyance in the overbanks of the river at various locations. Blocked obstructions were used in overbank ponds created by gravel mining operations to permanently remove conveyance. This was necessary to minimize the over-estimation of conveyance by HEC-RAS due to the assumptions inherent in its one-dimensional solution algorithm. The elevations of the blocked

obstructions were set at the spill elevations of the ponds, typically found at their downstream end. In some cases, where the ponds were long with respect to the floodplain axis, the blocked obstruction elevation was increased in the upstream direction. Roughness coefficients in the overbanks were also modified to assist in the preservation of continuity through the main channel and overbanks.

At the gravel pit bridge, located half-way between Taft Hill Road and Shields Street, the 100-year levees failed simulation was artificially forcing all of the discharge through the structure, when in reality, a large portion of flow would have remained in the right overbank. This resulted in a significant artificial backwater projecting for a distance upstream yielding a higher water surface elevation in the levees failed model than existed in the levees intact model. To correct for this, the flow through the bridge was reduced by an amount equivalent to the flow in the right overbank at the approach to the bridge.

The upstream and downstream face sections of the Shields Street and Taft Hill Road bridges were modified to account for the skew of the cross-sections. This effectively reduces the available flow area to a more realistic value given the direction of flow entering the bridge. The bridge pier was also skewed to account for its additional blockage to flow. Because flow in the overbanks of the river at this location will generally align to flow perpendicular to the roadway alignment, the overbanks and roadway profile was not skewed.

Floodway Modeling

Larimer County regulates a half-foot rise floodway. Therefore, only the half-foot floodway model is included with this report.

Every effort was made to match the effective floodway delineation on the Poudre River wherever possible. This was based on the presumption that the effective floodway delineation was based on equal conveyance reduction. Where matching the effective delineation caused a greater-than-allowable rise or a negative surcharge, the floodway delineation was allowed to widen in an attempt to achieve a rise within tolerance. In rare circumstances, the effective floodway delineation did not relate well to the flow patterns in the updated 100-year model (e.g. sometimes the effective floodway delineation was outside of ineffective flow areas). Matching the effective floodway delineation in these areas would have created an overly restrictive delineation. In cases like this, the floodway was allowed to contract.

Based on direction from Michael Baker Jr., The floodway through the reach containing the informal levee was delineated based on regulatory base flood elevations as determined by the Levees Failed model.

Errors, Warnings & Notes

An extensive effort was applied to minimize the number of warnings and notes generated by the models.

The most common type of warning that exists in the models indicates the possible need for additional cross-sections. These warnings include conveyance ratio, energy loss and change in velocity head warnings. The minimum cross-section spacing for the Poudre River was initially determined by evaluating the gradient of the stream to be 800-feet. At those locations reporting this type of warning which also contained questionable results, a sensitivity analysis was undertaken to determine if additional cross-sections would enhance the results. Most often, this sensitivity analysis resulted in little or no improvement in results so the call for additional sections is unwarranted. The results of this investigation, along with the already dense cross-section spacing, which is in compliance with FEMA standards, support maintaining the current cross section spacing.

Vertical extensions occur at various locations throughout the model. They primarily occur at "interior" edges of cross-sections (i.e. where there are two parallel reaches and the end of one cross-section lies at the start of the next cross-section). Vertical extensions have been deemed acceptable in this circumstance due to the water-to-water interface.

Close attention was given when the model failed to balance the energy equation between sections, particularly when the program defaulted to critical depth. Many of these warnings have been eliminated, but some persist in the modeling. At these locations, various methods were applied in an attempt to eliminate the warning, including sensitivity analyses to determine if additional cross-sections would eliminate the critical depth default. Those locations that still contain this warning have been deemed to be control sections at which critical depth is a valid solution. Various types of physical conditions led to this conclusion including changes in bed slope, significant obstructions to flow and constrictions in channel width among others.

A warning indicating that the inline structure solution failed to converge occurred at two locations in the Lower Project. At these locations, an independent off-line weir calculation was made to determine the accuracy of the computed water surface elevation. This verification revealed that the water surface was within acceptable tolerances which indicates that the warnings can be ignored.

Boundary Conditions

The starting water surface elevation for the Lower Project was taken from the HEC-2 water surface profile analysis last revised by Ayres Associates in 2000 for the City of Fort Collins. This analysis, which is presented in the report titled "Hydraulic Analyses for the Cache la Poudre River Floodway Revisions," modeled the floodplain hydraulics in the Poudre River from Interstate Highway 25 to Taft Hill Road and is the basis for the previously effective floodplain delineation in Larimer County downstream of Taft Hill Road.

Poudre River Station 235947	
Recurrence Interval (Years)	Starting Water Surface Elevation (ft, NGVD 29)
10	4975.55
50	4977.38
100	4978.32
500	4981.87

Poudre River 100-YR Hydrology	
Computer River Station	***Discharge***
(ft)	***(cfs)***
265297	14700
259082	14400
252100	14400
249797	14300
246128	14100
245054	13600
244388	14100
240160	13900

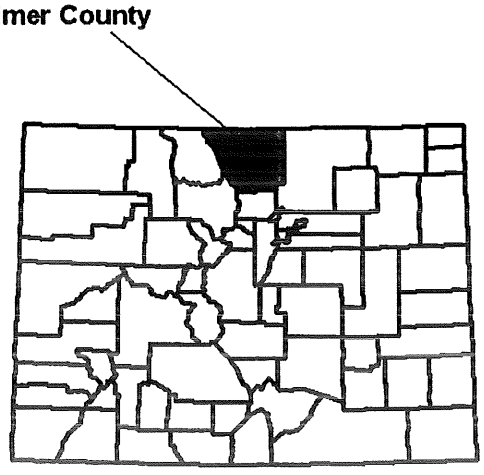
Poudre River 500-YR Hydrology	
Computer River Station	***Discharge***
(ft)	***(cfs)***
265297	25800
259082	25300
252100	25300
246128	25200
245054	22200
244388	25200
240753	24800

2013 FIS INFORMATION

FLOOD INSURANCE STUDY

LARIMER COUNTY, COLORADO
AND INCORPORATED AREAS
VOLUME 1 OF 4

Community Name	Community Number
LARIMER COUNTY	
(UNINCORPORATED AREAS)	080101
BERTHOUD, TOWN OF	080296
ESTES PARK, TOWN OF	080193
FORT COLLINS, CITY OF	080102
JOHNSTOWN, TOWN OF	080250
LOVELAND, CITY OF	080103
TIMNATH, TOWN OF	080005
WELLINGTON, TOWN OF	080104



REVISED: FEBRUARY 6, 2013

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
08069CV001D

Table 2 – Summary of Discharges (Continued)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Percent Annual Chance	2-Percent Annual Chance	1-Percent Annual Chance	0.2-Percent Annual Chance
Boxelder Creek (Continued)					
At County Road 54	--[1]	952	3,958	6,978	--[1]
Downstream of I-25 Near Wellington	24.46	900	1,670	2,140	3,100
Upstream of I-25 Near Wellington	13.86	480	920	1,170	1,690
Upstream of C&S Railroad	12.68	480	900	1,140	1,640
Upstream of Windsor Ditch	10.84	470	850	1,080	1,530
Boxelder Creek Overflow Channel					
At State Highway 14	--[1]	74	510	1,342	--[1]
At C&S Railroad	--[1]	45	839	2,317	--[1]
At Vine Drive	--[1]	23	701	1,840	--[1]
At Larimer and Weld Canal	--[1]	33	1,111	3,450	--[1]
At County Road 50	--[1]	17	1,112	3,450	--[1]
At County Road 52	--[1]	0	1,486	4,069	--[1]
Buckhorn Creek					
At Confluence with Big Thompson River	142.90	6,844	15,090	20,244	36,000
At Masonville Below Redstone Creek	122.50	6,321	13,593	18,059	32,000
At Masonville Above Redstone Creek	92.00	4,674	10,321	13,862	24,000
Cache La Poudre Lowflow Channel					
Upstream of Convergence with Cache La Poudre River	--[1]	--[1]	--[1]	1,309	--[1]
At Fossil Creek Ditch Diversion Dam	--[1]	--[1]	--[1]	12,071	--[1]
Cache La Poudre LPATH					
Upstream of Convergence with Cache La Poudre River	--[1]	--[1]	1,142	3,983	16,015
Cache La Poudre River					
Downstream of Confluence with Boxelder Creek	1,537	6,750	13,200	17,400	32,400
Upstream of Confluence with Boxelder Creek	1,537	5,820	11,400	15,000	27,900
Downstream of Confluence with Dry Creek	--[1]	6,700	12,700	16,600	30,100
Upstream of Confluence with Dry Creek	--[1]	5,370	10,200	13,300	24,100

[1] Not Determined

FLOODING SOURCE		FLOODWAY			1-PERCENT ANNUAL CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD)	WITHOUT FLOODWAY (FEET NAVD)	WITH FLOODWAY (FEET NAVD)	INCREASE (FEET)
CACHE LA POUDRE RIVER								
CX	247,787	242	1,240	11.5	5,027.1[2] 5,027.2[3]	5,027.1	5,027.3	0.2
CY	248,897	185	1,265	11.3	5,033.2	5,033.2	5,033.2	0.0
CZ	249,797	174	1,308	10.9	5,038.4	5,038.4	5,038.4	0.0
DA	251,777	258	1,717	8.4	5,047.7	5,047.7	5,047.7	0.0
DB	252,327	212	1,235	11.9	5,050.5	5,050.5	5,050.5	0.0
DC	253,541	124	1,042	13.8	5,057.6	5,057.6	5,057.6	0.0
DD	254,560	277	1,581	9.1	5,062.4	5,062.4	5,062.4	0.0
DE	255,598	270	1,767	8.2	5,069.1	5,069.1	5,069.3	0.2
DF	256,927	809	2,923	4.9	5,074.3	5,074.3	5,074.5	0.2
DG	257,969	161	2,028	14.2	5,080.4	5,080.4	5,080.4	0.0
DH	259,082	570	4,303	4.6	5,088.6	5,088.6	5,088.6	0.0
DI	260,703	1,687	4,796	3.1	5,093.0	5,093.0	5,093.5	0.5
DJ	261,610	985	3,595	3.7	5,098.0	5,098.0	5,098.4	0.4
DK	262,380	1,150	3,752	3.9	5,100.6	5,100.6	5,101.0	0.4
DL	263,459	351	1,506	10.4	5,104.7	5,104.7	5,104.7	0.0
DM	263,564	386	3,633	4.8	5,110.4	5,110.4	5,110.4	0.0
DN	263,971	328	1,881	7.8	5,110.9	5,110.9	5,111.0	0.1
DO	265,046	332	2,197	6.7	5,118.0	5,118.0	5,118.1	0.1
DP	265,297	259	1,719	8.6	5,118.9	5,118.9	5,119.0	0.1

[1]Feet above mouth [2]Levees Failed [3]Levees Intact

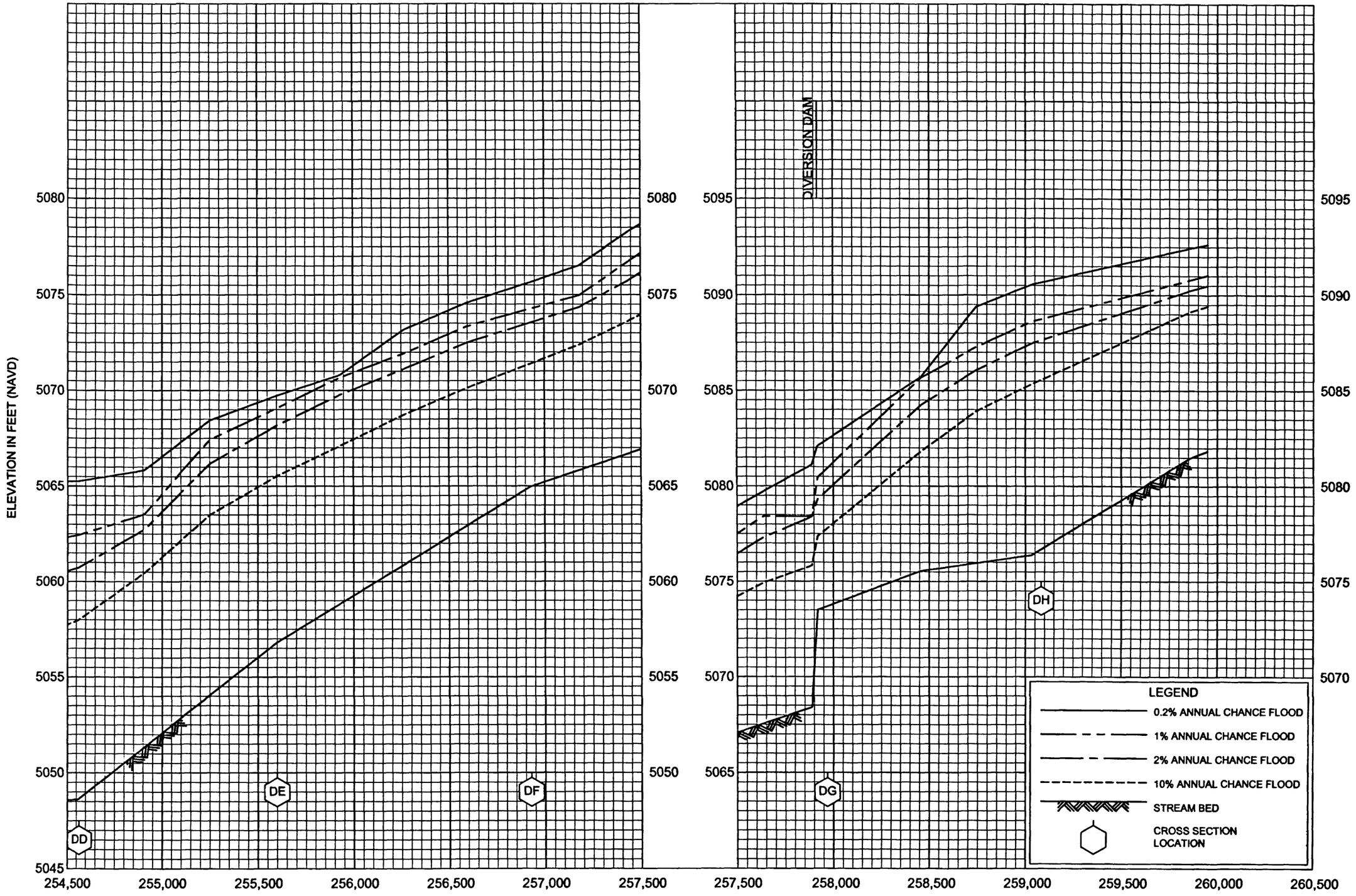
TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

CACHE LA POUDRE RIVER



FLOOD PROFILES

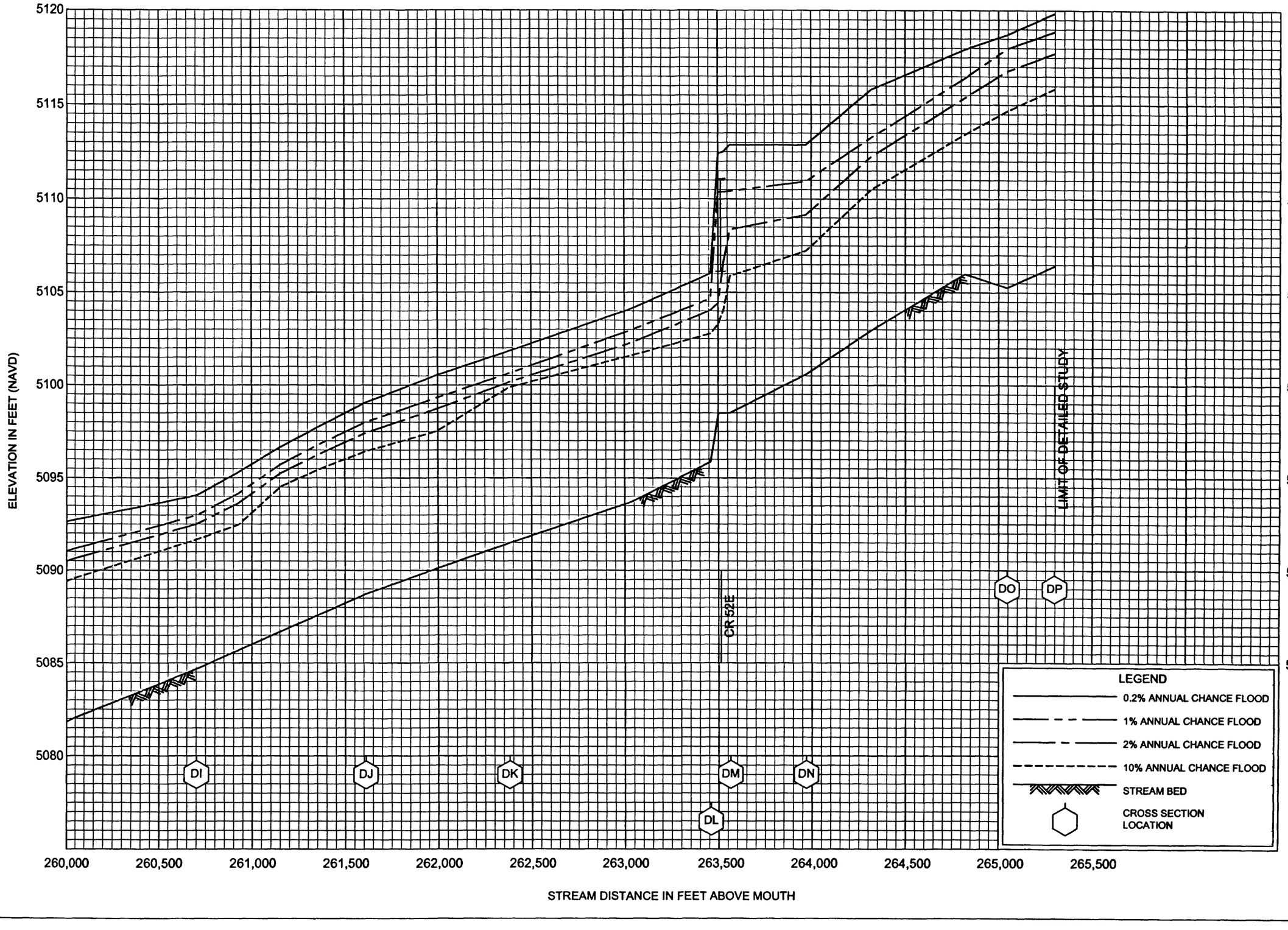
CACHE LA POUDRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO

AND INCORPORATED AREAS

193P



FLOOD PROFILES

CACHE LA POUDRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO

AND INCORPORATED AREAS

194P

NOTES TO USERS

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Visit http://www.fema.gov/pdf/fhm/frm_gsah.pdf for information on levees and the risk of flooding in areas shown as being protected by levees.

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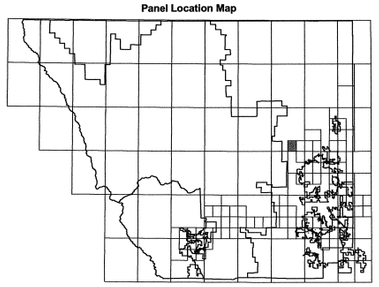
Larimer County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)	Flooding Source	Vertical Datum Offset (ft)
Cache La Poudre River	3.0		

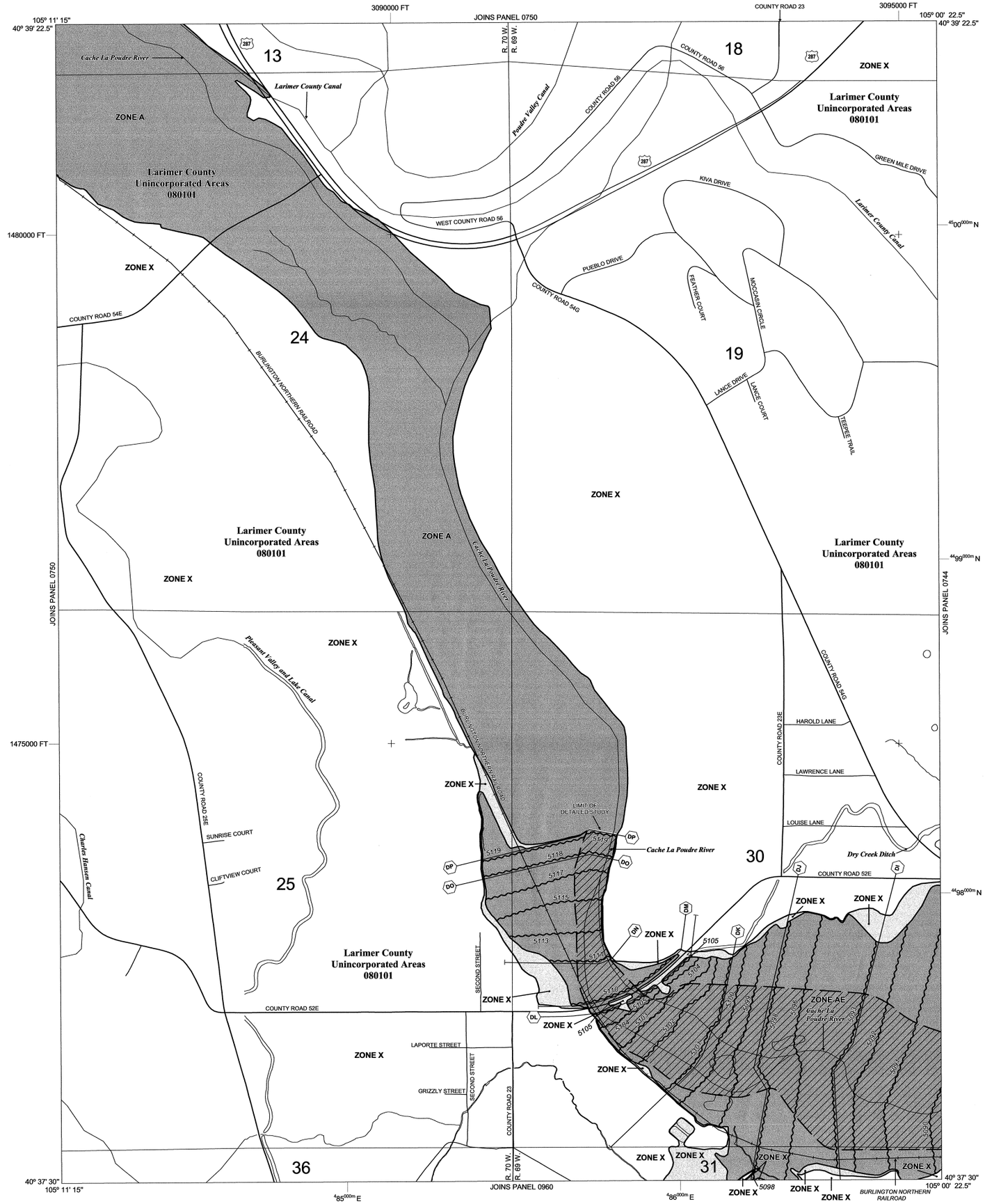
Example: To convert Cache La Poudre River elevations to NAVD 88, 3.0 feet were added to the NGVD 29 elevations.

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard Information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 8 NORTH, RANGE 69 WEST, AND TOWNSHIP 8 NORTH, RANGE 70 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

Floodplain boundary
Floodway boundary
Zone D boundary
Boundary dividing Special Flood Hazard Area zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A — Cross section line
104° 50' 37.5" , 39° 30' 00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
3180000 FT — 5000-foot ticks: Colorado State Plane coordinate system, North zone, Lambert Conformal Conic projection
4276000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
KK6400 — National Geodetic Survey bench mark (see explanation in Notes to Users section of this FIRM panel)

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 19, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0743F

FIRM

FLOOD INSURANCE RATE MAP
LARIMER COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 743 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0743	F

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
08069C0743F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency

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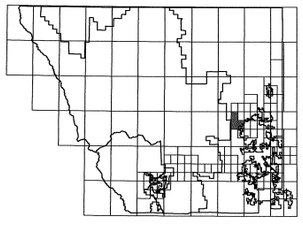

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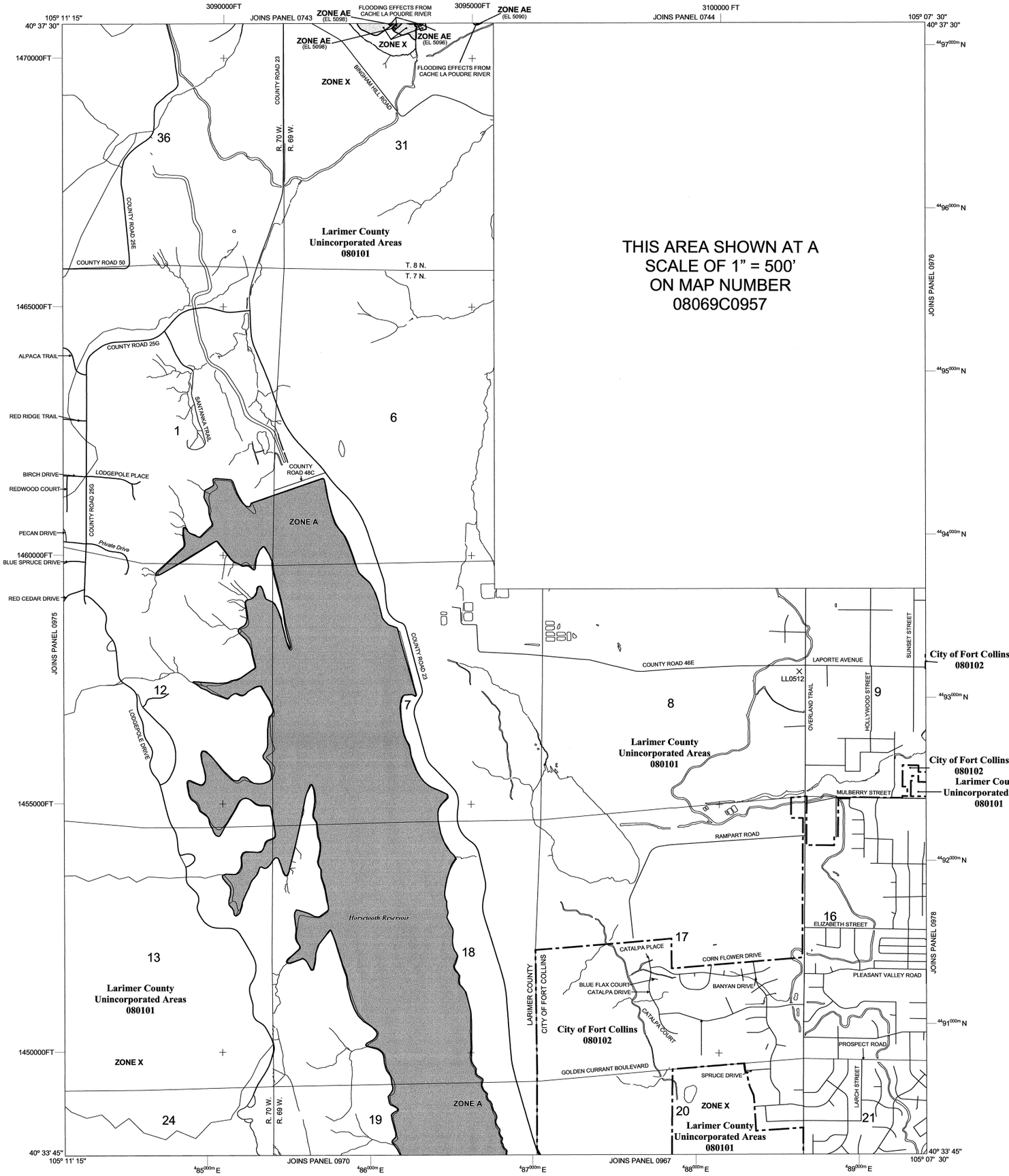

THIS AREA SHOWN AT A SCALE OF 1" = 500' ON MAP NUMBER 08069C0957

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 7 NORTH, RANGE 69 WEST, AND TOWNSHIP 8 NORTH, RANGE 70 WEST AND TOWNSHIP 7 NORTH, RANGE 70 WEST, TOWNSHIP 8 NORTH, RANGE 69 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

Floodplain boundary
Floodway boundary
Zone D boundary
Boundary dividing Special Flood Hazard Area zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A — Cross section line
104° 50' 37.5" , 39° 30' 00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
3180000 FT — 5000-foot ticks: Colorado State Plane coordinate system, North zone, Lambert Conformal Conic projection
4276000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
KK6400 — National Geodetic Survey bench mark (see explanation in Notes to Users section of this FIRM panel)

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 19, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0960F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 960 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FORT COLLINS, CITY OF	080102	0960	F
LARIMER COUNTY	080101	0960	F

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 08069C0960F

EFFECTIVE DATE DECEMBER 19, 2006

Federal Emergency Management Agency

NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

FEMA recommends that a Flood Insurance Policy be purchased for structures in areas where **levees** are shown as providing protection from the 1% annual chance flood. Flooding is not covered by standard property/fire/dwelling insurance policies nor is it covered by Homeowners Insurance, Renters Insurance, Condominium Owners Insurance, or Commercial Property Insurance. Contact your insurance agent and local floodplain administrator for further information.

Visit http://www.fema.gov/pdf/fhm/frm_gsah.pdf for information on levees and the risk of flooding in areas shown as being protected by levees.

The **projection** used in the preparation of this map was State Plane Colorado North (feet). The **horizontal datum** was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

Spatial Reference System Division
National Geodetic Survey, NOAA
Silver Spring Metro Center
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

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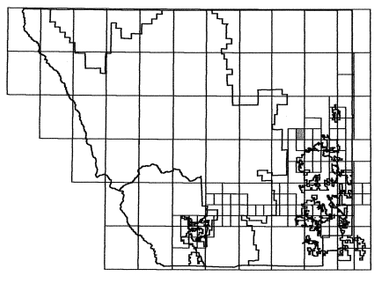
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov.

Larimer County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)	Flooding Source	Vertical Datum Offset (ft)
Cache La Poudre River	3.0		

Example: To convert Cache La Poudre River elevations to NAVD 88, 3.0 feet were added to the NGVD 29 elevations.

Panel Location Map



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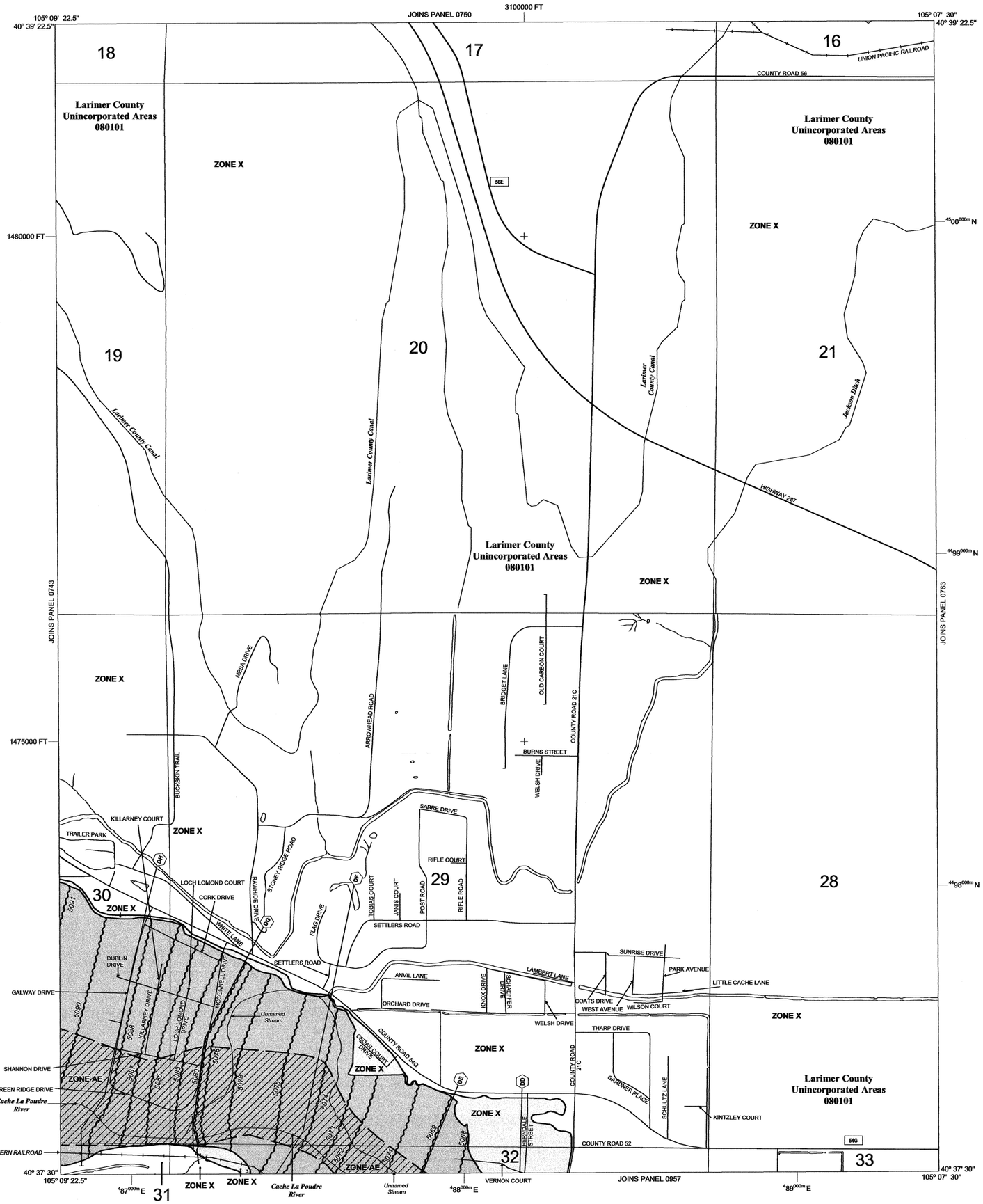

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 8 NORTH, RANGE 69 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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ZONE A	No Base Flood Elevations determined.
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FLOODWAY AREAS IN ZONE AE

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OTHER FLOOD AREAS

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Floodway boundary
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Boundary dividing Special Flood Hazard Area zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
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MAP REPOSITORY
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EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
DECEMBER 19, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

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250 0 500 1000 FEET
150 0 150 300 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0744F

FIRM

FLOOD INSURANCE RATE MAP
LARIMER COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 744 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0744	F

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
08069C0744F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency

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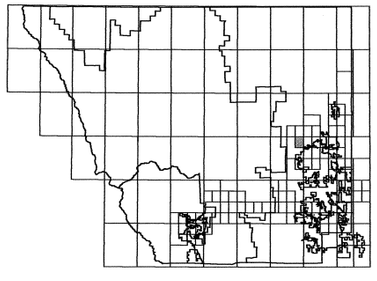

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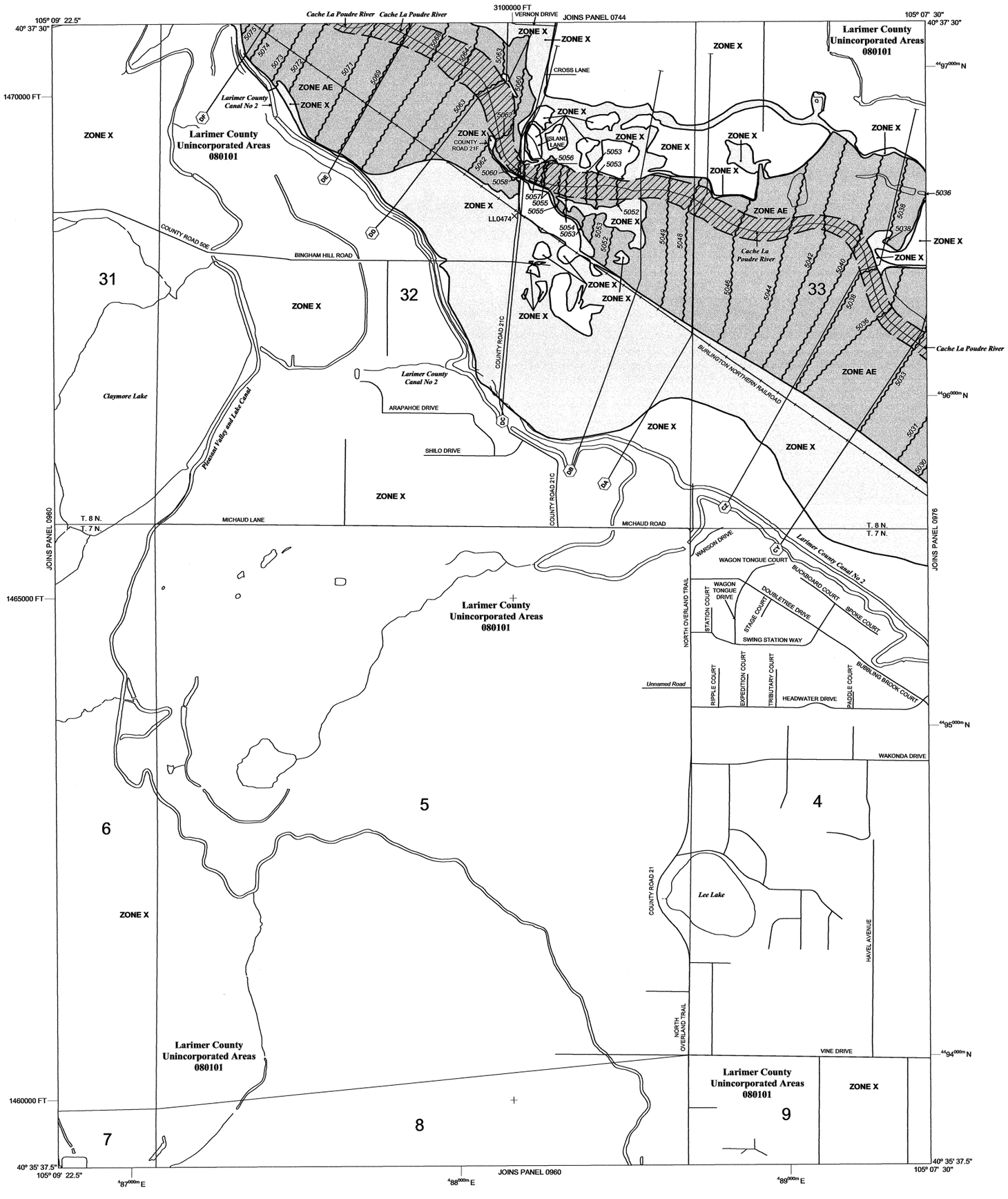

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LEGEND

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MAP REPOSITORY
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EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
DECEMBER 19, 2006

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250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0957F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 957 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0957	F

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
08069C0957F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

LIONS OPEN SPACE LOMR
ANNOTATED FLOODWAY DATA TABLE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
CACHE LA POUDRE RIVER								
CX	247,837	242	1,240	11.5	5,027.1[2] 5,027.2[3]	5,027.1	5,027.3	0.2
CY	248,947	185	1,265	11.3	5,033.2	5,033.2	5,033.2	0
CZ	249,847	174	1,308	10.9	5,038.4	5,038.4	5,038.4	0
DA	251,827	258	1,717	8.4	5,047.7	5,047.7	5,047.7	0
DB	252,377	212	1,235	11.9	5,050.5	5,050.5	5,050.5	0
DC	253,591	124	1,042	13.8	5,057.6	5,057.6	5,057.6	0
DOWNSTREAM STUDY LIMIT								
	253,671	128	1,330	10.7	5059.7	5059.7	5059.7	0.0
	254,075	610	2,892	5.0	5062.9	5062.9	5062.9	0.0
	254,209	778	3,815	3.8	5063.3	5063.3	5063.3	0.0
	254,377	806	4,124	3.5	5063.6	5063.6	5063.6	0.0
	254,520	770	4,389	3.3	5063.8	5063.8	5063.9	0.1
DD	254,596	759	3,783	3.8	5064.0	5064.0	5064.0	0.1
	254,910	650	2,713	5.3	5064.6	5064.6	5065.0	0.4
	255,245	488	2,393	6.0	5066.3	5066.3	5066.7	0.5
DE	255,648	270	1,617	8.9	5068.3	5068.3	5068.8	0.5
DF	256,977	809	2,919	4.9	5074.3	5074.3	5074.5	0.2
UPSTREAM STUDY LIMIT								
DG	258,019	161	2,028	14.2	5,080.4	5,080.4	5,080.4	0
DH	259,132	570	4,303	4.6	5,088.6	5,088.6	5,088.6	0
DI	260,753	1,687	4,796	3.1	5,093.0	5,093.0	5,093.5	0.5
DJ	261,660	985	3,595	3.7	5,098.0	5,098.0	5,098.4	0.4

[1] Feet above mouth [2]Levees Failed [3]Levees Intact

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

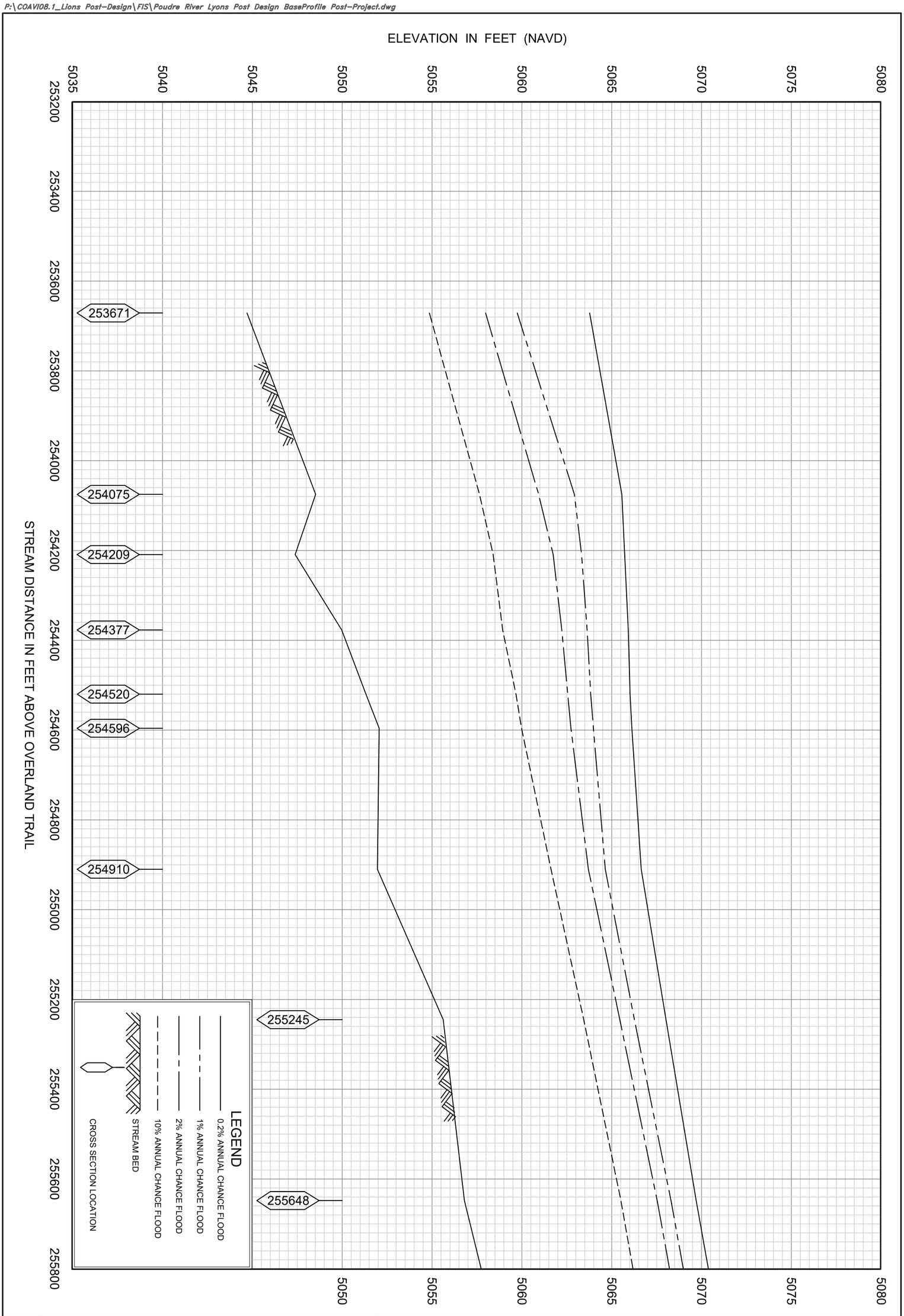
LARIMER COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

CACHE LA POUDRE RIVER

LIONS OPEN SPACE LOMR
POST-PROJECT FLOOD PROFILES

P:\COAVI08.1_Lions Post-Design\FIS\Poudre River Lyons Post Design BaseProfile Post-Project.dwg



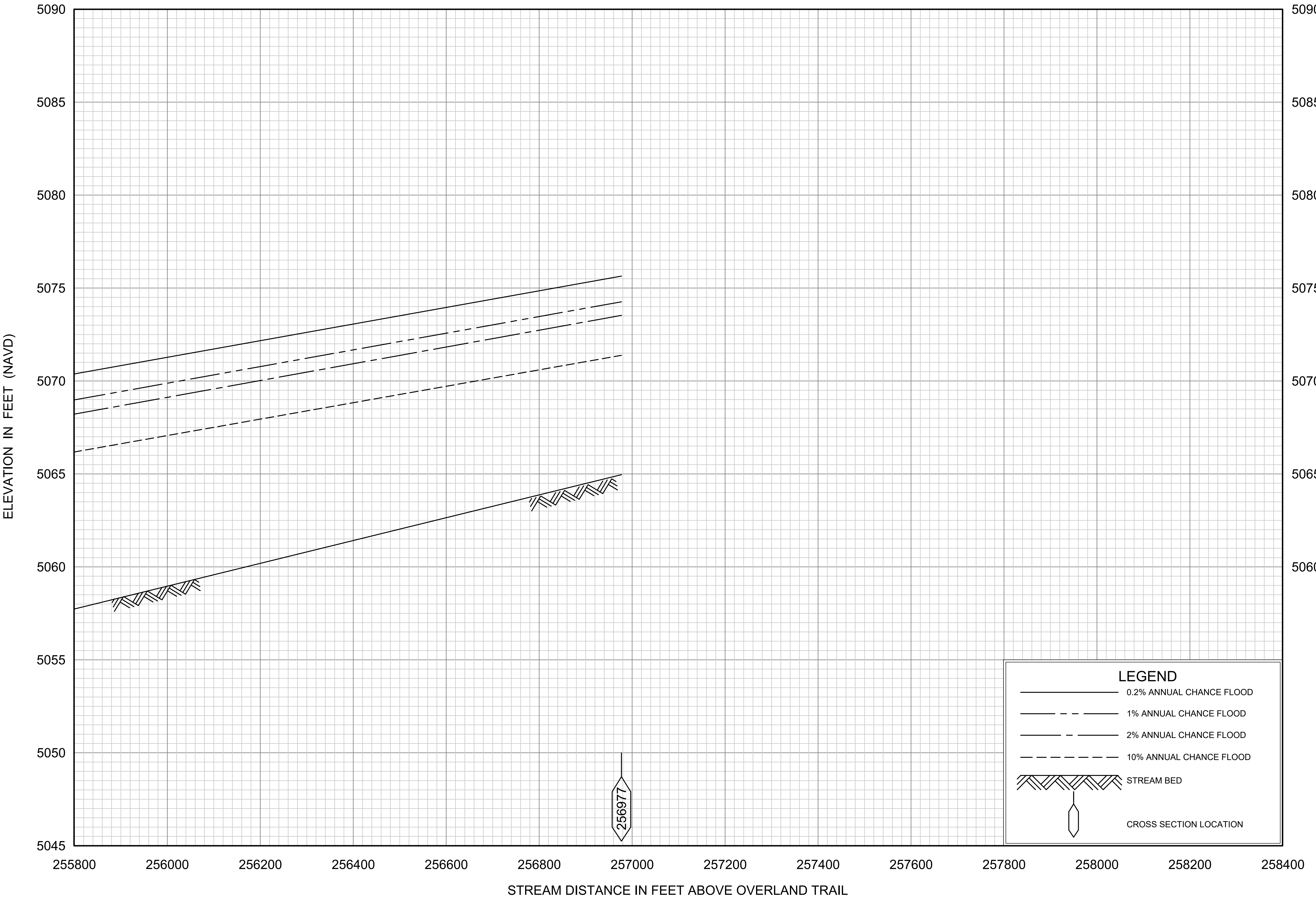
C.3.3

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO
AND INCORPORATED AREAS

FLOOD PROFILES

CACHE LA POUDRE RIVER - POST-PROJECT



FLOOD PROFILES

CACHE LA POUDRE RIVER - POST-PROJECT

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO
AND INCORPORATED AREAS

C.3.4

P:\COAVI08.1_Lions Post-Design\FIS\Poudre River Lyons Post Design BaseProfile Post-Project.dwg

LIONS OPEN SPACE LOMR
ANNOTATED FLOOD PROFILES

ELEVATION IN FEET (NAVD)

5055 5050 5045 5040 5035 5030 5025 5020

5070 5065 5060 5055 5050 5045 5040 5035

POUDRE TRAIL PEDESTRIAN BRIDGE

Downstream

Study Limit

CR 74E/ TRAIL ROAD

CZ DA DB DC

LEGEND

- 0.2% ANNUAL CHANCE FLOOD
- 1% ANNUAL CHANCE FLOOD
- 2% ANNUAL CHANCE FLOOD
- 10% ANNUAL CHANCE FLOOD
- STREAM BED
- CROSS SECTION LOCATION

249,050 249,550 250,050 250,550 251,050 251,050 252,050 252,050 252,550 253,050 253,550 254,050 254,550 255,050

REVISED DATA

STREAM DISTANCE IN FEET ABOVE MOUTH

REVISED TO REFLECT LOMR EFFECTIVE: October 26, 2017

FLOOD PROFILES

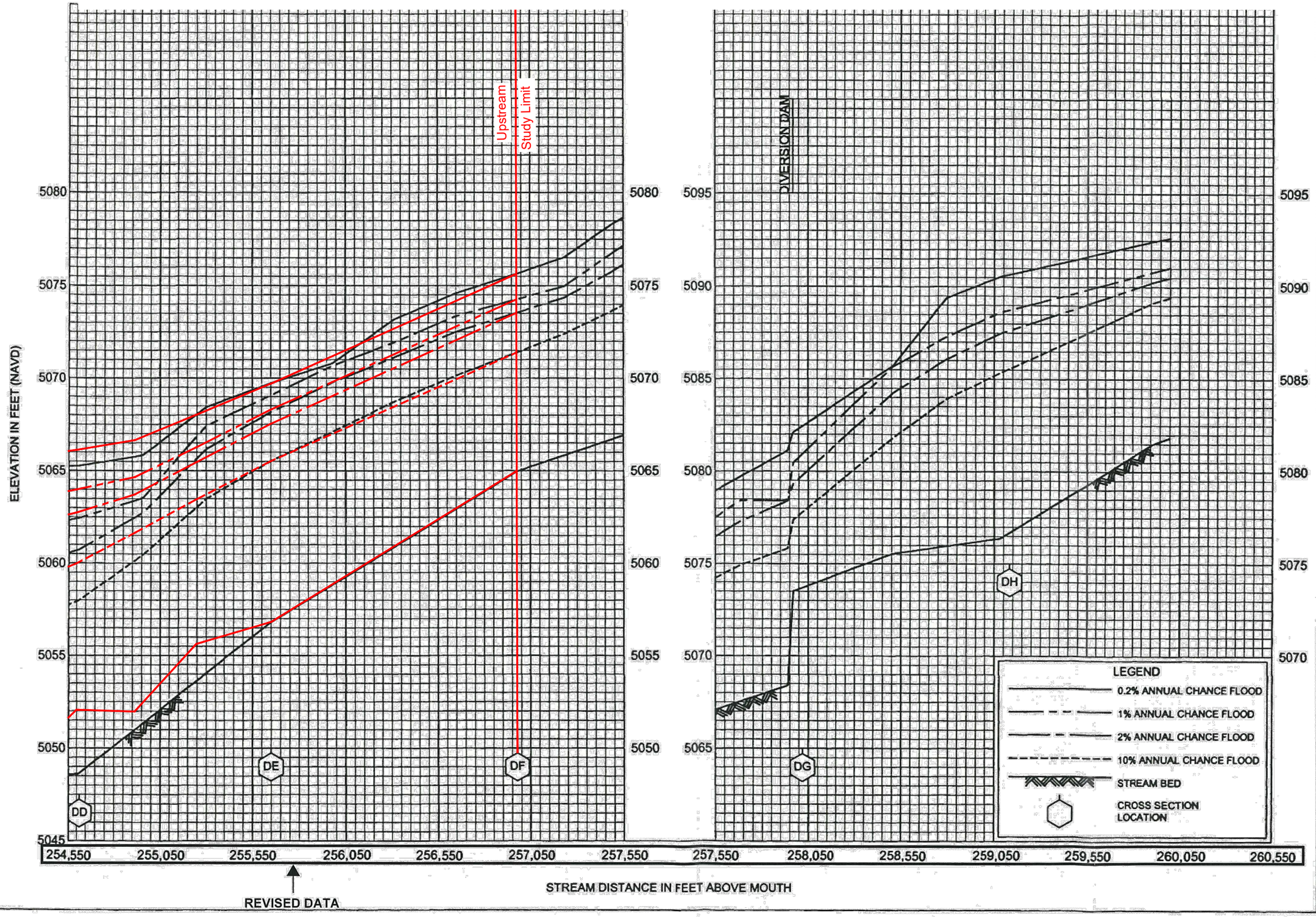
CACHE LA POUDRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO

AND INCORPORATED AREAS

192P



REVISED TO REFLECT LOMR EFFECTIVE: October 26, 2017

FLOOD PROFILES

CACHE LA POUDRE RIVER

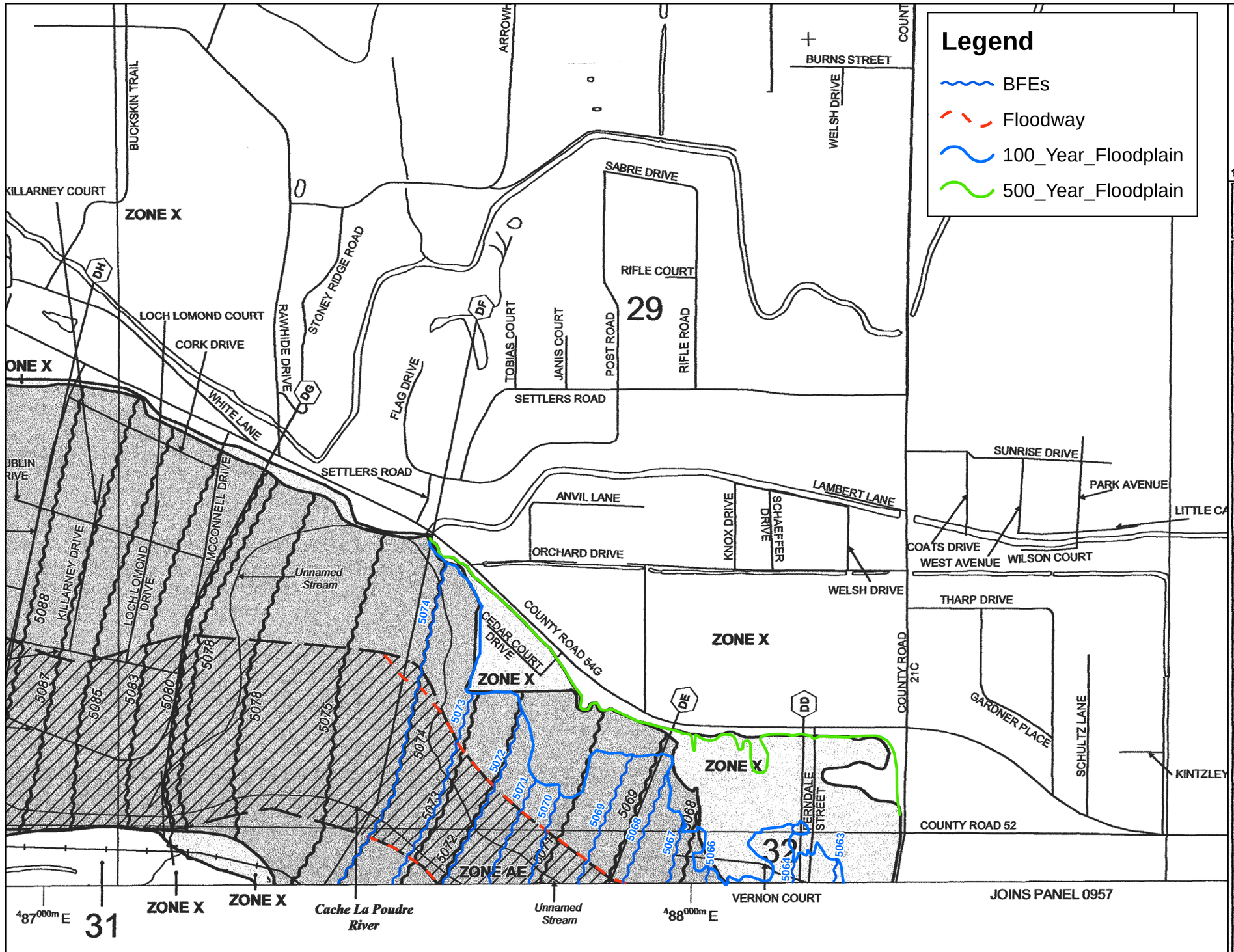
FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO

AND INCORPORATED AREAS

193P

LIONS OPEN SPACE LOMR
ANNOTATED FIRM PANELS



Legend

- BFEs
- Floodway
- 100_Year_Floodplain
- 500_Year_Floodplain

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

PANEL 0744F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 744 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0744	F

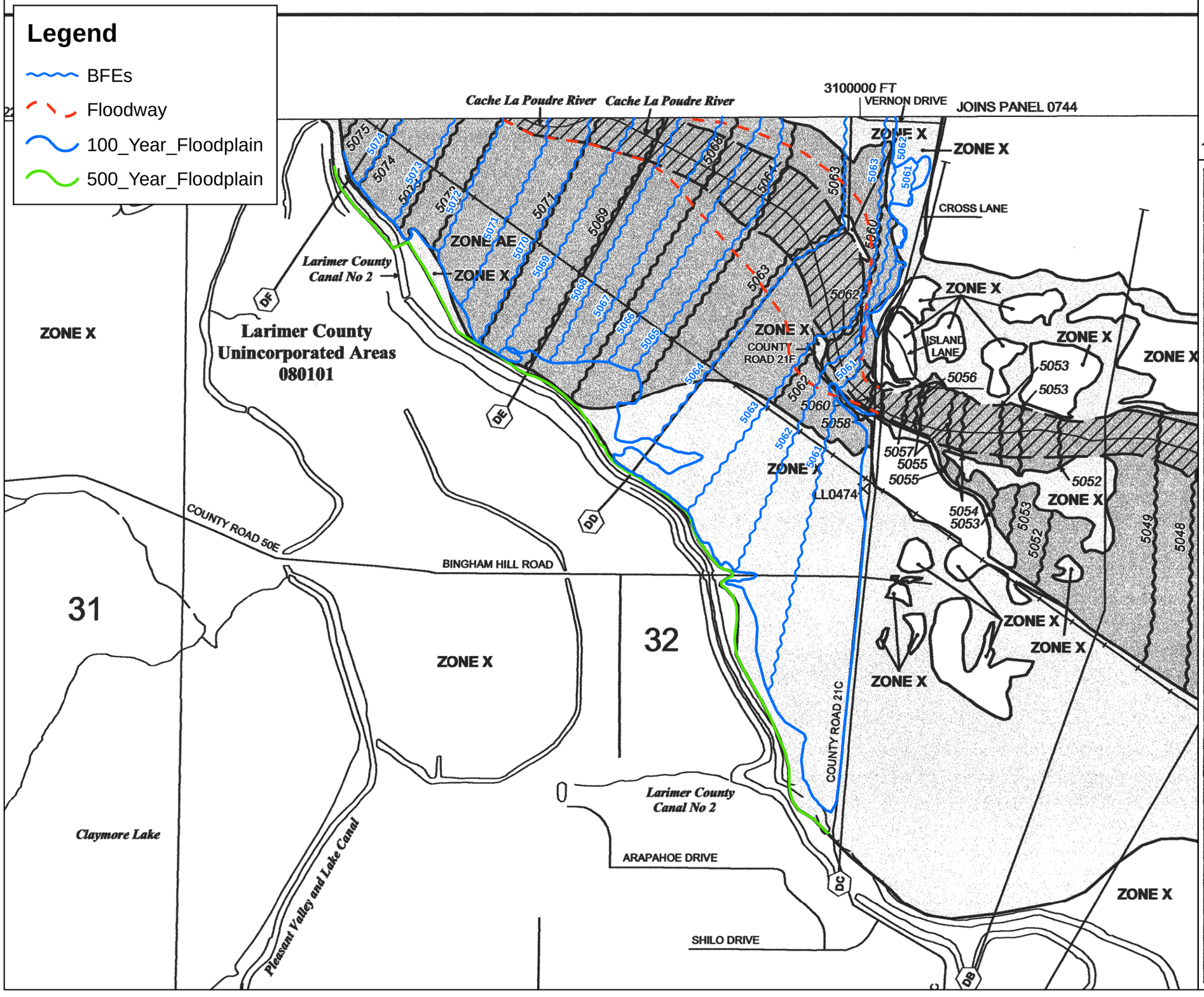
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08069C0744F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 8 NORTH, RANGE 69 WEST.



MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

PANEL 0957F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 957 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0957	F

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
08069C0957F

EFFECTIVE DATE
DECEMBER 19, 2006

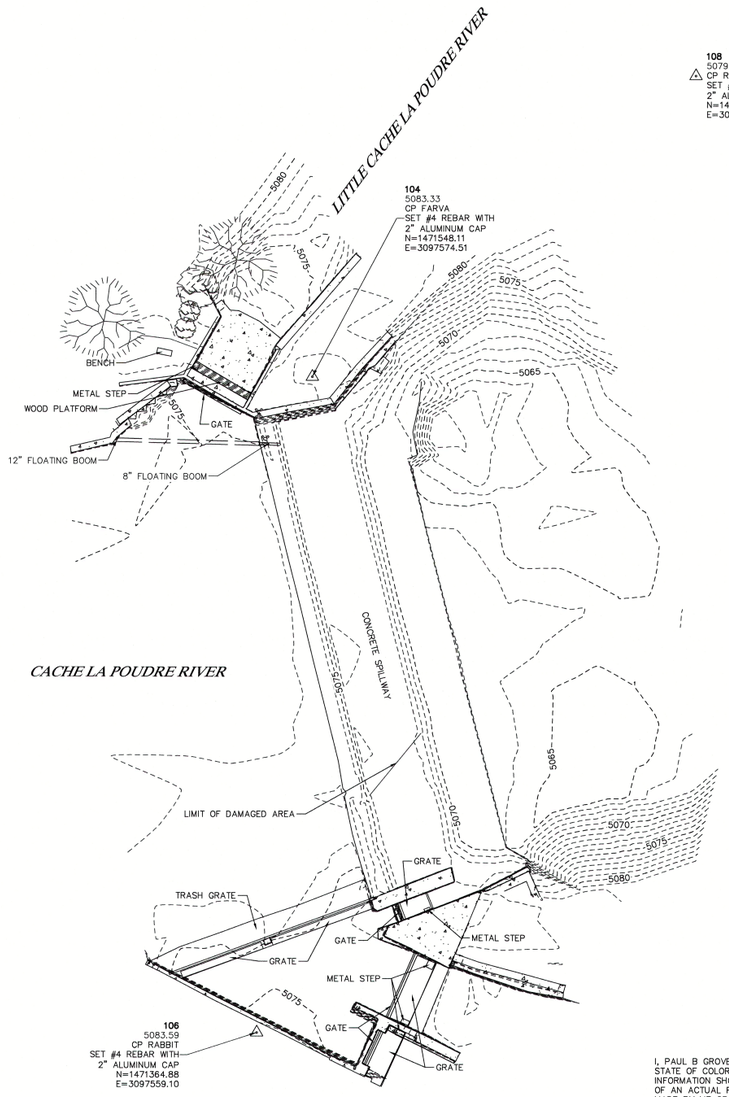
Federal Emergency Management Agency

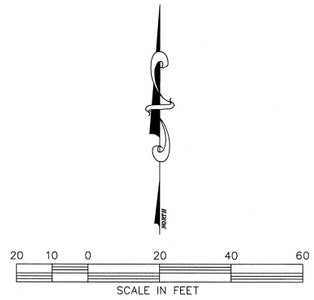
APPENDIX C.2

CORRERCTED EFFECTIVE INFORMATION

TOPOGRAPHIC SURVEY

OF
LAPORTE DAM,
LAPORTE, CO





LEGEND

EDGE OF LANDSCAPING	SHRUB
PIPE	DECIDUOUS TREE
4876 ONE FOOT CONTOUR	STEEL POST
4835 5 FOOT CONTOUR	CONTROL POINT
	NGS CONTROL
	BENCHMARK

VERTICAL DATUM:
BENCHMARK: CITY OF FORT COLLINS BENCHMARK FC 42-97, NAVD88 ELEVATION=4969.93

HORIZONTAL DATUM:
COLORADO STATE PLANE COORDINATES NAD 83(2011) DATUM. HORIZONTAL CONTROL BASED UPON TRIMBLE VRS NETWORK.

NOTE:
1. THIS DRAWING IS AT MODIFIED STATE PLANE. TO REDUCE TO STATE PLANE COORDINATES, SCALE AT 0.99973537 (1.00026470) ABOUT THE ORIGIN 0,0.

2. ALL PROPERTY PINS, INTERSECTION MONUMENTS, AND SECTION CORNERS DISTURBED DURING CONSTRUCTION MUST BE REFERENCED AND REPLACED UNDER THE SUPERVISION OF A LICENSED SURVEYOR.

3. THIS AUTOCAD DRAWING CONTAINS INFORMATION THAT IS NOT VISIBLE ON THE PLOTTED COPY. TO OBTAIN ALL THE INFORMATION THAT IS AVAILABLE IN THIS DRAWING, ALL THE AUTOCAD LAYERS MUST BE TURNED ON AND THAWED.

4. THE SIZE, TYPE AND LOCATION OF ALL KNOWN UNDERGROUND UTILITIES ARE APPROXIMATE WHEN SHOWN ON THESE DRAWINGS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO VERIFY THE EXISTENCE OF ALL UNDERGROUND UTILITIES IN THE AREA OF THE WORK BEFORE COMMENCING NEW CONSTRUCTION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES AND SHALL BE RESPONSIBLE FOR ALL UNKNOWN UNDERGROUND UTILITIES.

5. ALL PROJECT CONTROL LISTED HEREON IS PROVIDED AS A COURTESY. IT IS THE RESPONSIBILITY OF THE RECIPIENT TO VERIFY THE ACCURACY OF THE COORDINATES AND ELEVATIONS SHOWN PRIOR TO USING THEM FOR ANY PURPOSES.

6. ANY LOT LINES, RIGHT OF WAYS OR EASEMENTS SHOWN ARE APPROXIMATE AND ARE NOT TO BE RELIED UPON FOR FUTURE IMPROVEMENTS.

I, PAUL B GROVES, A DULY REGISTERED LAND SURVEYOR IN THE STATE OF COLORADO, DO HEREBY STATE THAT THE GRADES AND INFORMATION SHOWN HEREON WERE DETERMINED FROM THE RESULTS OF AN ACTUAL FIELD SURVEY PERFORMED ON APRIL 4TH OF 2018 MADE BY ME OR UNDER MY SUPERVISION AND THE INFORMATION SHOWN HEREON IS TRUE AND CORRECT TO THE BEST OF MY BELIEF AND KNOWLEDGE.

COLORADO LICENSED
PAUL B. GROVES
38209
6/12/19
PROFESSIONAL LAND SURVEYOR

PAUL B. GROVES FOR AND ON BEHALF OF KING SURVEYORS
LS 38209

NOTICE

According to Colorado law you must commence any legal action based upon any defect in this survey within three years after you first discover such defect. In no event may any action based upon any defect in this survey be commenced more than ten years from the date of the certification shown hereon. (13-80-105 C.R.S. 2012)

DATE: 4/10/2018
FILE NAME: 20180131TOP
SCALE: 1"=20'
DRAWN BY: CDL
CHECKED BY: TW

KING SURVEYORS
650 E. Garden Drive | Windsor, Colorado 80550
phone: (970) 686-5011 | fax: (970) 686-5821

REVISIONS: DATE:

TOPOGRAPHIC SURVEY
FOR
ANDERSON CONSULTING ENGINEERS
375 E HORSETOOTH ROAD, BUILDING 5
FORT COLLINS, CO 80525

PROJECT #: 20180131

1

SHEET 1 OF 1

V:\20180131\DWG\20180131TOP.dwg, 6/12/2019 11:27:04 AM, 1:1

APPENDIX D

HYDRAULIC INFORMATION

APPENDIX D.1

FLOODPLAIN AND FLOODWAY WORK MAPS

9/4/2019 11:08 AM

LEGEND

EFFECTIVE CONDITION		CORRECTED EFFECTIVE
	HALF-FOOT FLOODWAY	
	1% ANNUAL CHANCE FLOODPLAIN	
	0.2% ANNUAL CHANCE FLOODPLAIN	
	SPECIAL FLOOD HAZARD ZONE	
5240	BASE FLOOD ELEVATION	5240
	GUTTER LINE	
	MAJOR CONTOURS	
	MINOR CONTOURS	
	CORPORATE LIMITS**	
	PARCEL BOUNDARIES**	
	CROSS SECTION	238183
	CROSS SECTION ID	N/A
	PROFILE BASELINE	

LARIMER COUNTY ROAD 54G
CORK DR.
GALWAY DR.
DUBLIN DR.
KILLARNEY DR.
LOCH LOMOND DR.
MCCONNELL DRIVE
SHANNON DR.
GREEN RIDGE DR
CACHE LA POUDRE RIVER
UPSTREAM STUDY LIMIT
DOWNSTREAM STUDY LIMIT
2610+00
2600+00
2590+00
2580+00
2570+00
2560+00
2550+00
2540+00

5093 5092 5091 5090 5088 5087 5085 5083 5080 5078 5078 5075 5074 5073 5072 5071 5070 5069 5068 5067 5066 5065

MAPPING DATUMS:

VERTICAL DATUM = NAVD88.

HORIZONTAL DATUM = NAD 83

NOTES:

*FLOODPLAIN AND FLOODWAY LINES SHOWN IN ORDER OF PRECEDENCE

**CORPORATE LIMIT AND PARCEL BOUNDARY INFORMATION WAS OBTAINED FROM LARIMER COUNTY

1.) EFFECTIVE LINEWORK PER THE EFFECTIVE LARIMER COUNTY FIS (FEBRUARY 2013)

2.) CORRECTED EFFECTIVE CONTOURS DEVELOPED FROM LIDAR DATA COLLECTED BY PHOTSCIENCE (OCTOBER 2013).

3.) AERIAL PHOTOGRAPH FLOWN BY AYRES ASSOCIATES (SEPTEMBER 2013).

GRAPHICAL SCALE IN FT:
0 125 250 500

P:\COLWIC2017\COLWIC2017.05_LAPORTE DAM DESIGN\ACAD\FLOODPLAIN_DWGS\LAPORTE DAM FLOOD HAZARD WORKMAP_EXTENDED.DWG

Anderson Consulting Engineers, Inc
Civil • Water Resources • Environmental
375 East Horsetooth Road, Building 5, Fort Collins, CO 80525
Phone (970) 226-0120 Fax (970) 226-0121
www.aceweb.com

EFFECTIVE FLOODPLAIN AND FLOODWAY WORKMAP

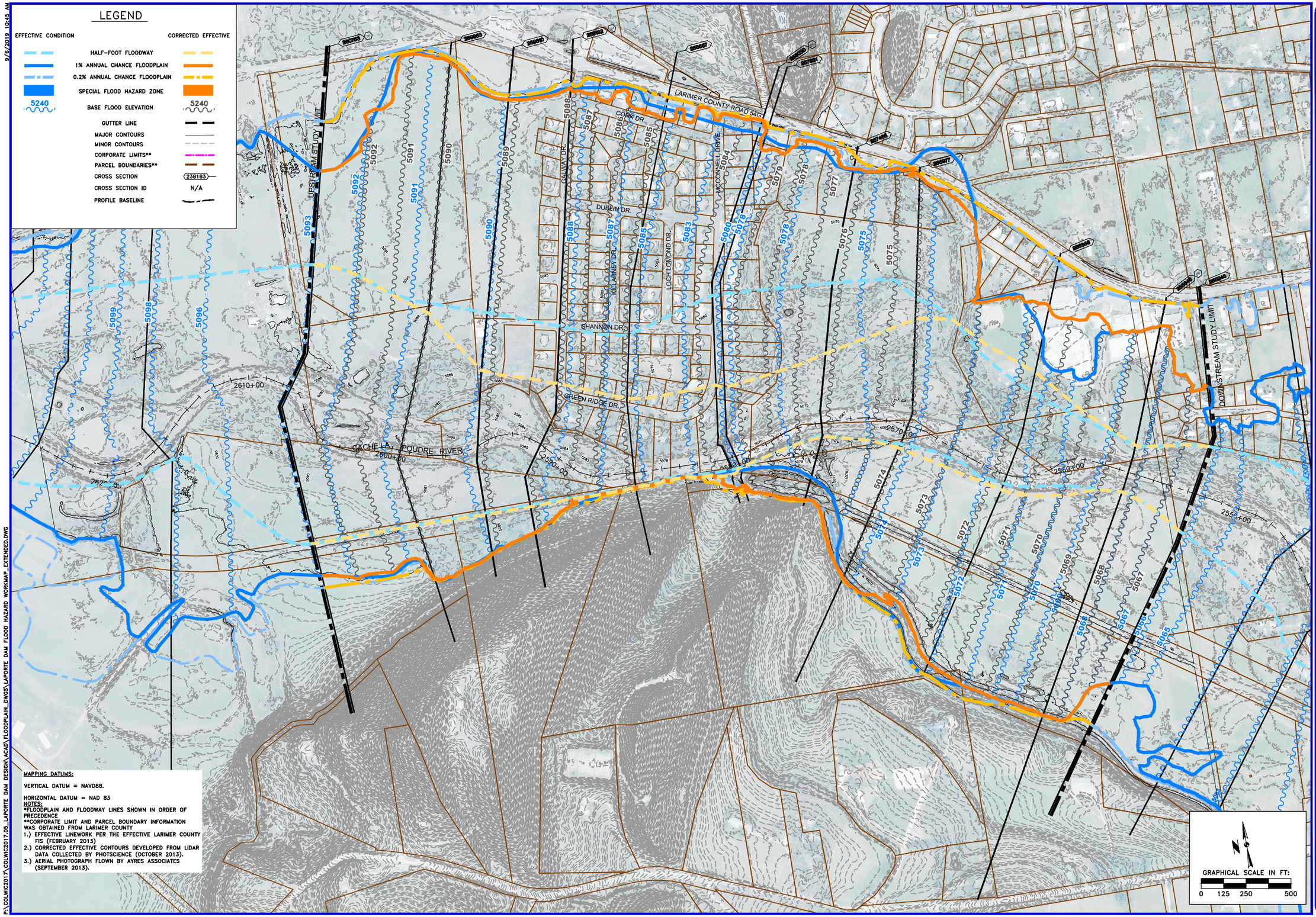
CACHE LA POUDRE RIVER LAPORTE DAM REACH LOMR

DRAWN BY:	MMC
DESIGNED BY:	MMC
CHECKED BY:	JMA
PROJECT NUMBER:	COLWIC2017.05
DATE:	8/23/19
FIGURE:	D.1 EFF

9/6/2019 10:45 AM

LEGEND

EFFECTIVE CONDITION		CORRECTED EFFECTIVE
	HALF-FOOT FLOODWAY	
	1% ANNUAL CHANCE FLOODPLAIN	
	0.2% ANNUAL CHANCE FLOODPLAIN	
	SPECIAL FLOOD HAZARD ZONE	
5240	BASE FLOOD ELEVATION	5240
	GUTTER LINE	
	MAJOR CONTOURS	
	MINOR CONTOURS	
	CORPORATE LIMITS**	
	PARCEL BOUNDARIES**	
	CROSS SECTION	238183
	CROSS SECTION ID	N/A
	PROFILE BASELINE	



MAPPING DATUMS:

VERTICAL DATUM = NAVD88.

HORIZONTAL DATUM = NAD 83

NOTES:

*FLOODPLAIN AND FLOODWAY LINES SHOWN IN ORDER OF PRECEDENCE

**CORPORATE LIMIT AND PARCEL BOUNDARY INFORMATION WAS OBTAINED FROM LARIMER COUNTY

1.) EFFECTIVE LINEWORK PER THE EFFECTIVE LARIMER COUNTY FIS (FEBRUARY 2013)

2.) CORRECTED EFFECTIVE CONTOURS DEVELOPED FROM LIDAR DATA COLLECTED BY PHOTSCIENCE (OCTOBER 2013).

3.) AERIAL PHOTOGRAPH FLOWN BY AYRES ASSOCIATES (SEPTEMBER 2013).

GRAPHICAL SCALE IN FT:
0 125 250 500

Anderson Consulting Engineers, Inc
Civil • Water Resources • Environmental
Fort Collins, Colorado 80524
Phone (970) 226-0120 Fax (970) 226-0121
www.aceengr.com

EFFECTIVE COMPARED TO CORRECTED EFFECTIVE FLOODPLAIN AND FLOODWAY WORKMAP

CACHE LA POUDRE RIVER LAPORTE DAM REACH LOMR

COLORADO LICENSED
REGISTERED
47620
9-5-19
PROFESSIONAL ENGINEER

DRAWN BY:	MMC
DESIGNED BY:	MMC
CHECKED BY:	JMA
PROJECT NUMBER:	COLWIC2017.05
DATE:	9/5/2019
FIGURE:	D.1 EFFvsCE

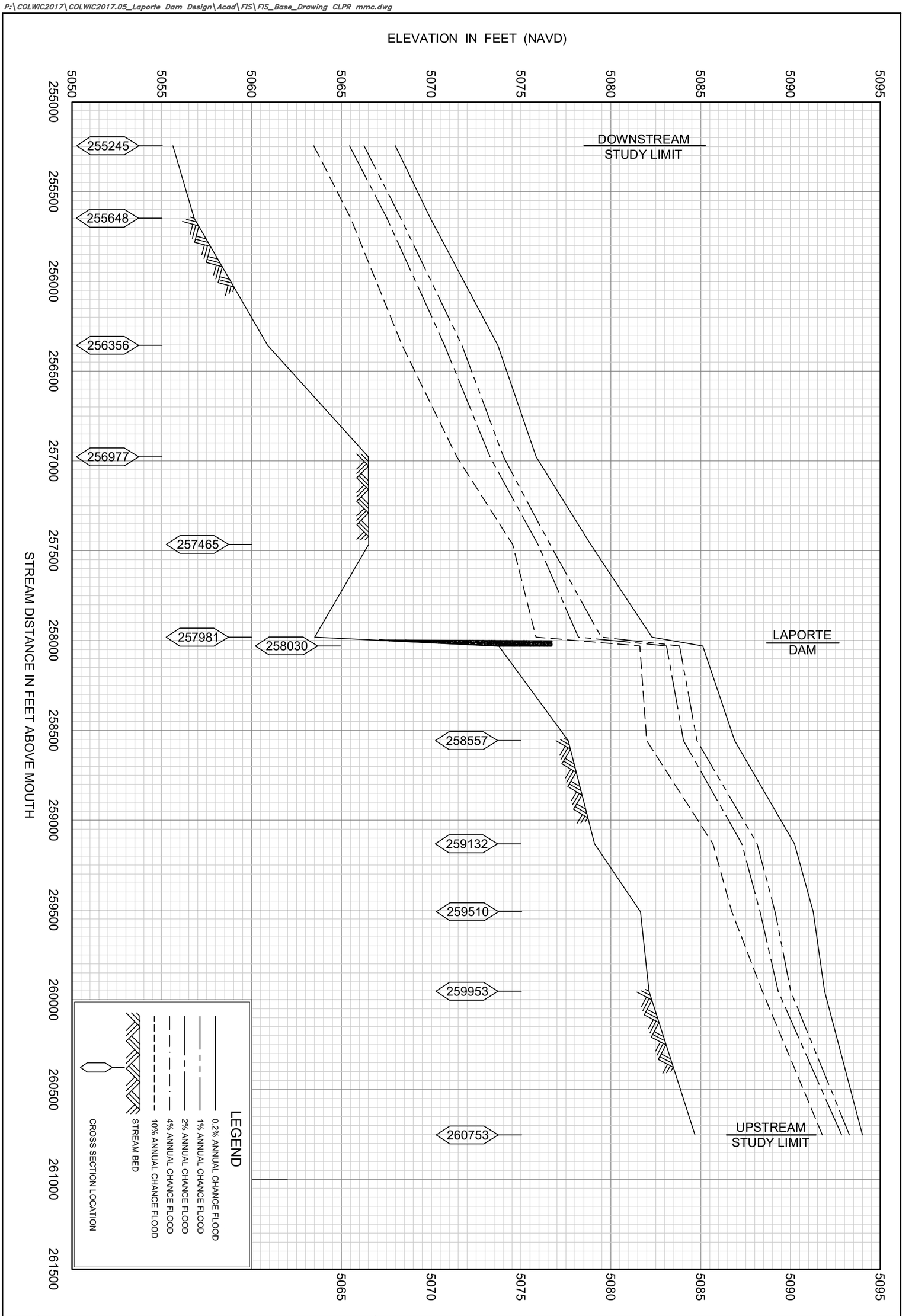
P:\COLWIC2017\COLWIC2017.05_LAPORTE DAM DESIGN\ACAD\FLOODPLAIN_DWGS\LAPORTE DAM FLOOD HAZARD WORKMAP_EXTENDED.DWG

APPENDIX D.2

GRAPHICAL WATER SURFACE PROFILES

CORRECTED EFFECTIVE GRAPHICAL
WATER SURFACE ELEVATION PLOTS

P:\COLWIC2017\COLWIC2017.05_Laporte Dam Design\Acad\FIS\FIS_Base_Drawing CLPR mmc.dwg

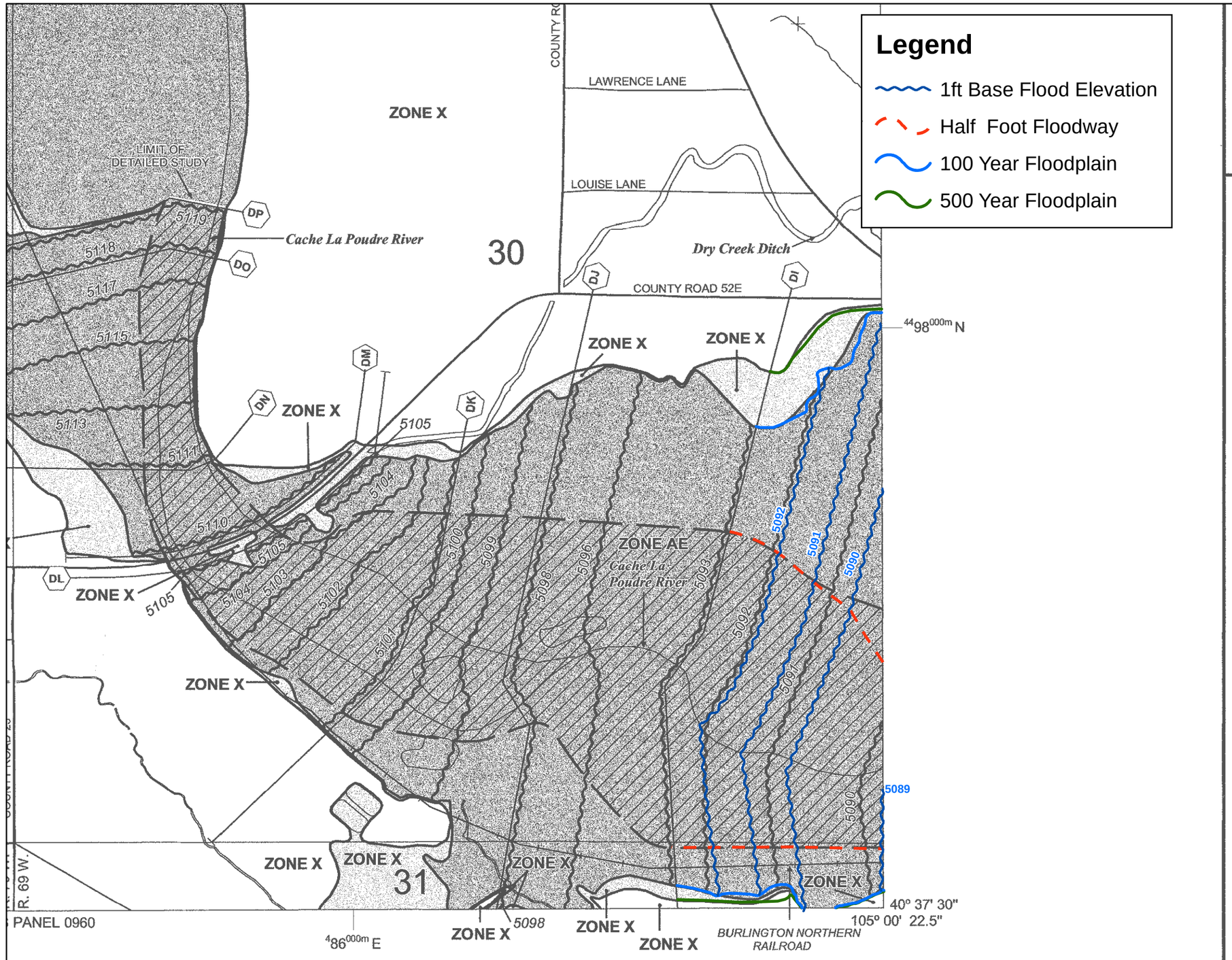


1	FEDERAL EMERGENCY MANAGEMENT AGENCY LARIMER COUNTY, CO AND INCORPORATED AREAS	FLOOD PROFILES CACHE LA POUDRE RIVER

APPENDIX D.3

ANNOTATED FIRM, FLOODWAY DATA TABLE,
AND WATER SURFACE PROFILES

ANNOTATED FIRM



NSHIP 8 NORTH, RANGE 69 WEST, AND TOWNSHIP 8 NORTH, RANGE 70 WEST.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0743F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 743 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

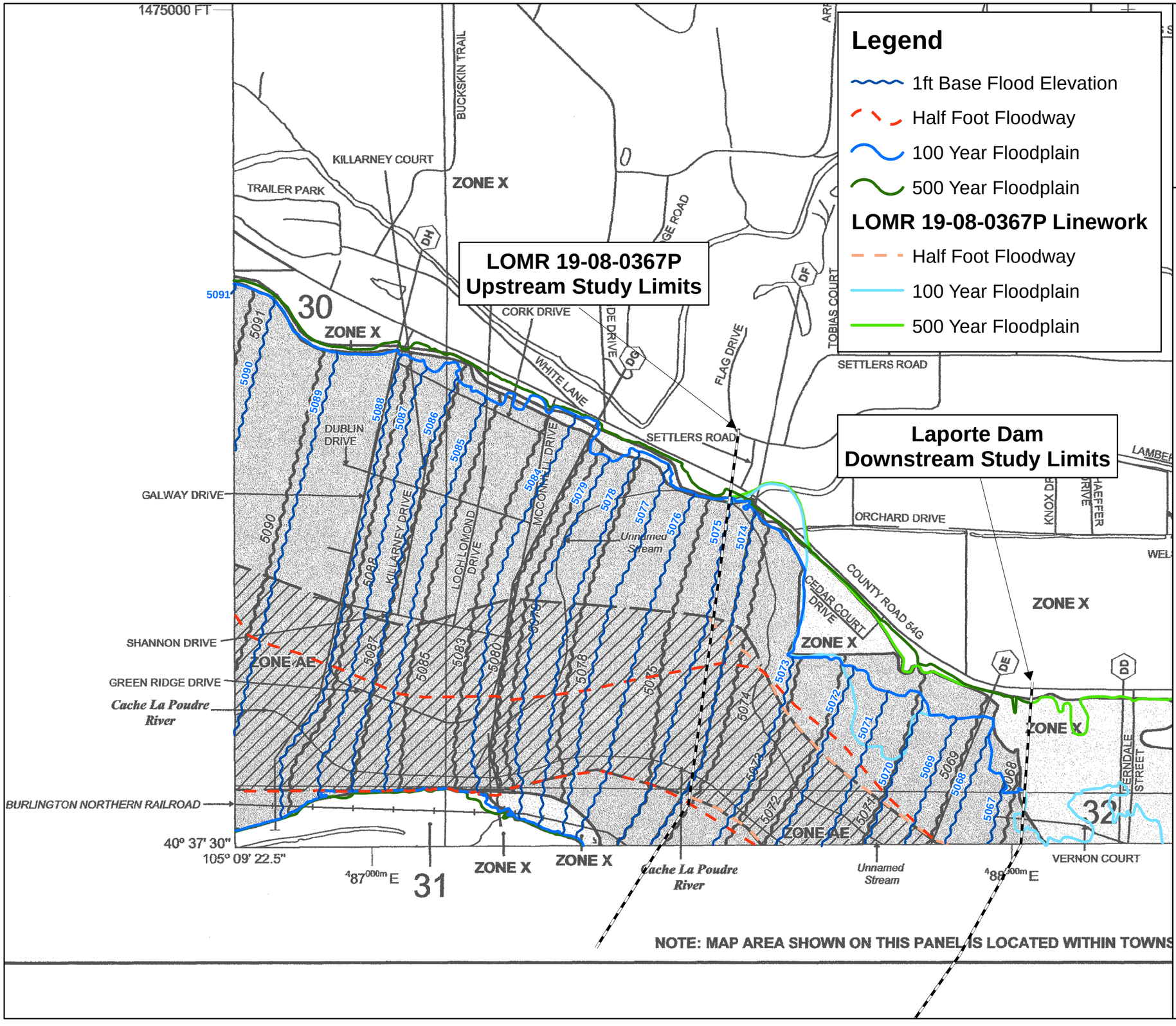
COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0743	F

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
08069C0743F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNS

Legend

- 1ft Base Flood Elevation
- Half Foot Floodway
- 100 Year Floodplain
- 500 Year Floodplain

LOMR 19-08-0367P Linework

- Half Foot Floodway
- 100 Year Floodplain
- 500 Year Floodplain

LOMR 19-08-0367P
Upstream Study Limits

Laporte Dam
Downstream Study Limits

105° 09' 22.5"
40° 37' 30"

1470000 FT

3100000 FT

Cache La Poudre River Cache La Poudre River

VERNON DRIVE

JOINS PANE

ZONE AE

ZONE X

Larimer County Canal No 2

DF

DE

DD

Larimer County
Unincorporated Areas
080101

COUNTY ROAD 21F

ISLAND LANE

CROSS LANE

LL0474

COUNTY ROAD 50E

BINGHAM HILL ROAD

31

32

5075 5073 5074 5074 5073 5072 5071 5070 5069 5068 5067 5072 5069 5068 5067 5066 5064 5063 5062 5060 5058 5057 5055 5055 5054 5053 5053 5056

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0957F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 957 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

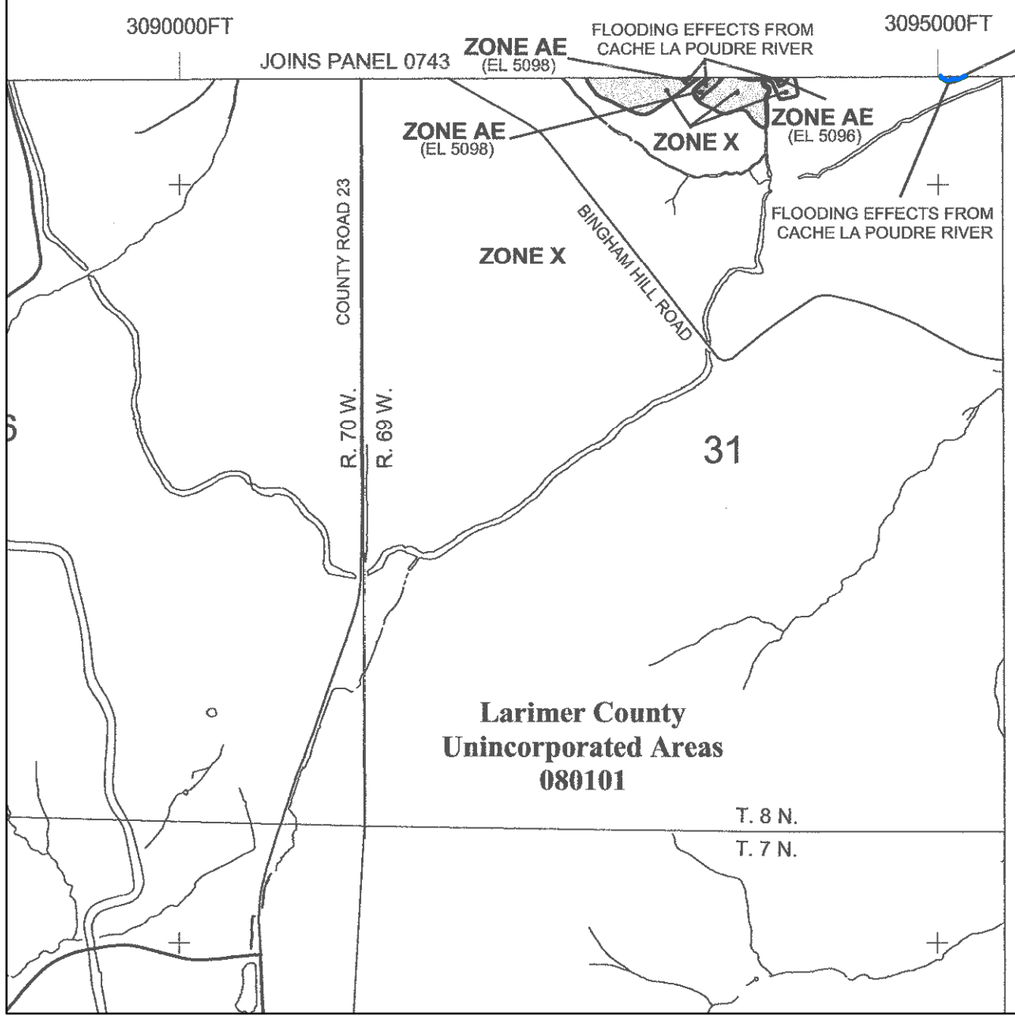
COMMUNITY	NUMBER	PANEL	SUFFIX
LARIMER COUNTY	080101	0957	F

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
08069C0957F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency



3100000 FT
JOINS PANEL 0744

Legend

100 Year Floodplain

500 Year Floodplain

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0960F

FIRM

FLOOD INSURANCE RATE MAP

LARIMER COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 960 OF 1420

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
FORT COLLINS, CITY OF	080102	0960	F
LARIMER COUNTY	080101	0960	F

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
08069C0960F

EFFECTIVE DATE
DECEMBER 19, 2006

Federal Emergency Management Agency

THIS AREA SHOW
SCALE OF 1" =
ON MAP NUME
08069C095

ANNOTATED FLOODWAY DATA TABLE

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
CACHE LA POUDRE RIVER								
DD	254,596	759	3,783	3.8	5,064.0	5,064.0	5,064.0	0.1
DOWNSTREAM STUDY LIMIT								
	255,245	488	2397	6.0	5066.3	5066.3	5066.7	0.4
DE	255,648	270	1618	8.9	5068.3	5068.3	5068.8	0.5
DF	256,977	685	3559	4.1	5071.7	5071.7	5072.0	0.3
	257,465	687	2162	6.7	5074.0	5074.0	5074.0	0.0
	257,981	452	1605	9.0	5076.6	5076.6	5076.6	0.0
	258,030	225	2057	7.0	5079.5	5079.5	5079.5	0.0
	258,557	497	1603.1	9.0	5084.8	5084.8	5084.8	0.0
DH	259,132	730	3108.8	4.6	5088.1	5088.1	5088.2	0.1
	259,510	808	3171.6	4.6	5089.1	5089.1	5089.2	0.1
	259,953	1,215	3162.4	4.7	5090.0	5090.0	5090.4	0.4
DI	260,753	1,607	4625.3	3.2	5093.3	5093.3	5093.4	0.1
UPSTREAM STUDY LIMIT								
DJ	261,660	985	3,595	3.7	5,098.0	5,098.0	5,098.4	0.4

[1] Feet above mouth [2]Levees Failed [3]Levees Intact

TABLE 4

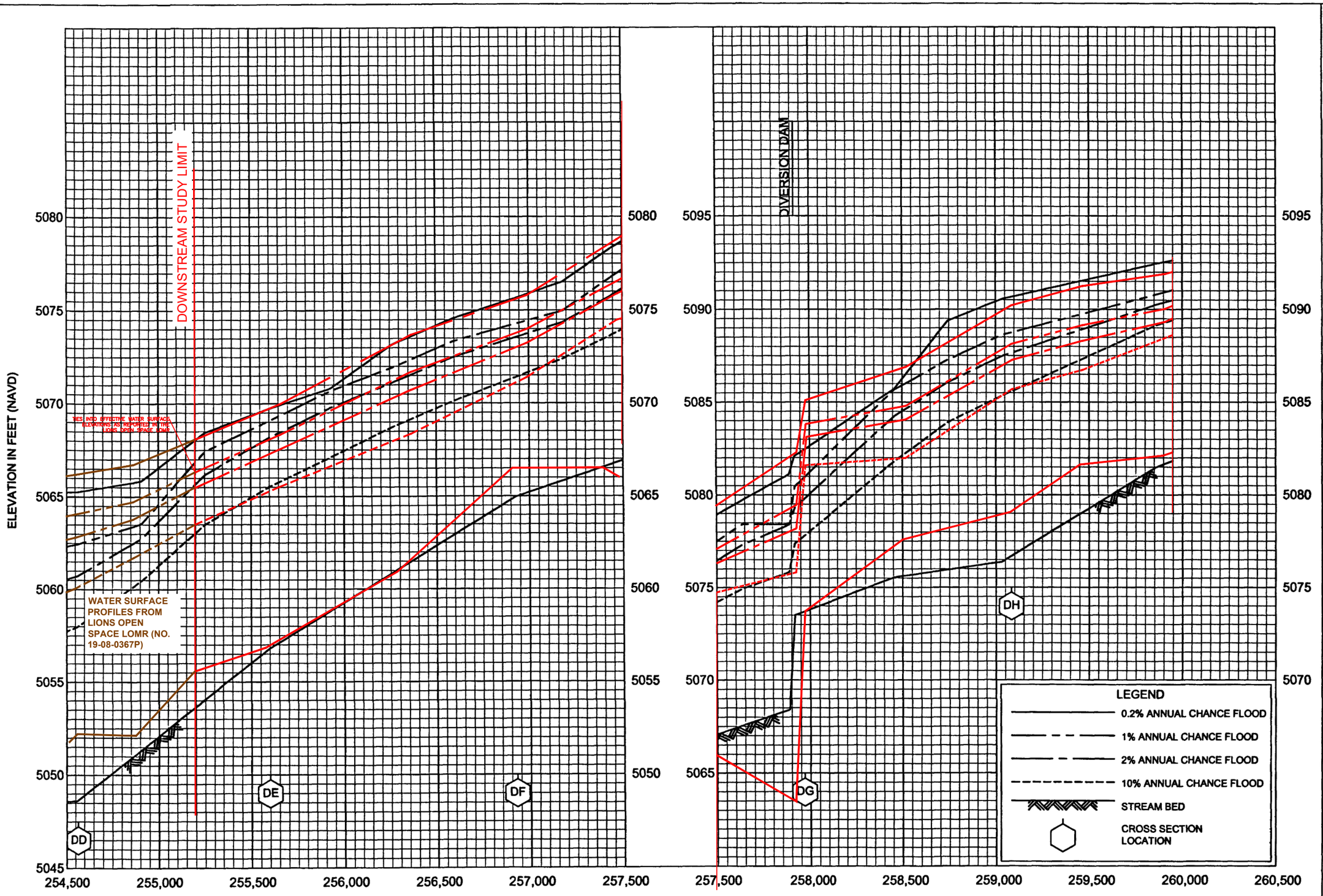
FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO
AND INCORPORATED AREAS

FLOODWAY DATA

CACHE LA POUDRE RIVER

ANNOTATED GRAPHICAL WATER SURFACE ELEVATION PLOTS



FLOOD PROFILES

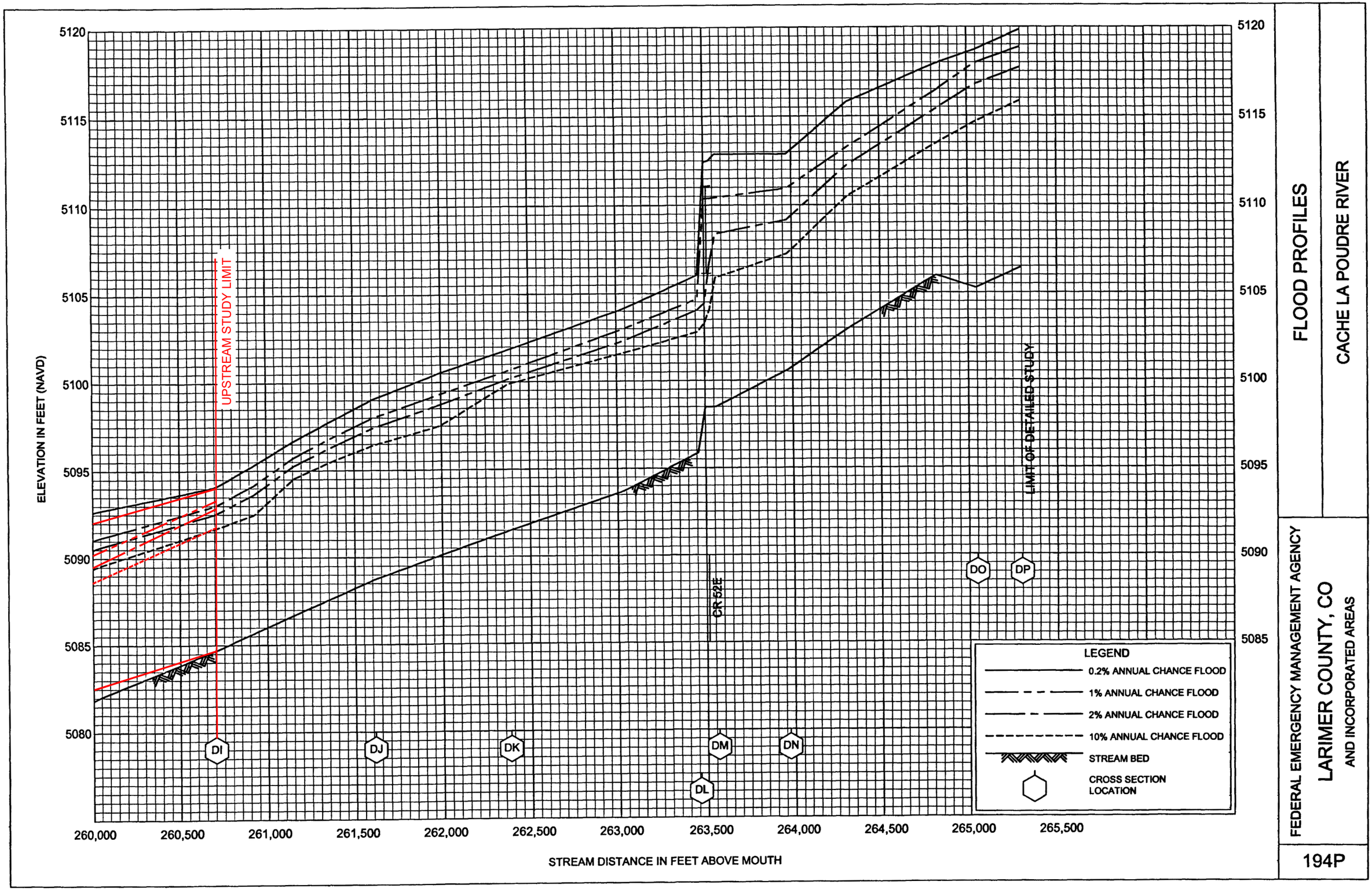
CACHE LA POUDRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO

AND INCORPORATED AREAS

193P



FLOOD PROFILES

CACHE LA POUDRE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

LARIMER COUNTY, CO

AND INCORPORATED AREAS

194P

APPENDIX E

COMPARISON AND AGREEMENT TABLES

APPENDIX E.1

DISCHARGE PROFILE COMPARISON TABLES

Peak Discharge (cfs)													
Cross Section ID/Station	Effective				Corrected Effective				Difference				Location
	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance	
CACHE LA POUDRE RIVER MAIN CHANNEL													
255245	5,900	11,000	14,400	25,300	5,900	11,000	14,400	25,300	0.0	0.0	0.0	0.0	D/S Study Limit
255648	5,900	11,000	14,400	25,300	5,900	11,000	14,400	25,300	0.0	0.0	0.0	0.0	
256356	--	--	--	--	5,900	11,000	14,400	25,300	--	--	--	--	
256927/256977	5,900	11,000	14,400	25,300	5,900	11,000	14,400	25,300	0.0	0.0	0.0	0.0	
257465	--	--	--	--	5,900	11,000	14,400	25,300	--	--	--	--	
257981	--	--	--	--	5,900	11,000	14,400	25,300	--	--	--	--	
257939	5,900	11,000	14,400	25,300	--	--	--	--	--	--	--	--	
257969	5,900	11,000	14,400	25,300	--	--	--	--	--	--	--	--	
258030	--	--	--	--	5,900	11,000	14,400	25,300	0.0	0.0	0.0	0.0	D/S Laporte Dam
258507/258557	5,900	11,000	14,400	25,300	5,900	11,000	14,400	25,300	0.0	0.0	0.0	0.0	U/S Laporte Dam
259082/259132	5,900	11,000	14,400	25,300	5,900	11,000	14,400	25,300	0.0	0.0	0.0	0.0	
259510	--	--	--	--	6,400	11,000	14,700	25,800	--	--	--	--	
259903/259953	6,400	11,000	14,700	25,800	6,400	11,000	14,700	25,800	0.0	0.0	0.0	0.0	
260703/260753	6,400	11,000	14,700	25,800	6,400	11,000	14,700	25,800	0.0	0.0	0.0	0.0	U/S Study Limit

APPENDIX E.2

BFE COMPARISON TABLE

BFE Comparison Table

Project Name :	**Laporte Dam LOMR**
Flooding Source:	**Cache La Poudre River**
Company:	**Anderson Consulting Engineers, Inc.**
Completed By:	**MMC**

SOURCE DATA						**COMPARISONS**	
HYDRAULIC CROSS-SECTION INFO.			**BASE FLOOD ELEVATIONS (NAVD)**				
Effective Cross-Section ID	**Duplicate Effective Cross-Section ID**	**Corrected Effective Cross Section ID**	**EFF.**	**DUP. EFF.**	**CORR. EFF.**	**DUP. EFF vs. EFF.**	**DUP. EFF. vs. CORR. EFF.**
			BFE	**BFE**	**BFE**	**BFE**	**BFE**
	255245	255245	---	5066.26	5066.26	---	0.00
DE	255648	255648	5068.30	5068.30	5068.30	0.00	0.00
	---	256356	---	---	5071.71	---	---
DF	256927	256977	5074.30	5074.26	5074.02	-0.04	-0.24
---	---	257465	---	---	5076.61	---	---
---	---	257981	---	---	5079.46	---	---
---	257939	---	5079.60	5079.55	---	-0.05	---
DG	257969	---	5080.40	5080.43	---	0.03	---
---	---	258030	---	---	5083.82	---	---
---	258507	258557	5085.70	5085.65	5084.79	-0.05	-0.86
DH	259082	259132	5088.60	5088.60	5088.14	0.00	-0.46
---	---	259510	---	---	5089.14		---
---	259903	259953	5090.80	5090.77	5090.01	---	-0.76
DI	260703	260753	5093.00	5092.97	5093.28	-0.03	0.31

APPENDIX E.3

MAP-MODEL AGREEMENT TABLE

LOMR AGREEMENT TABLE

PROJECT NAME: Laporte Dam LOMR

COMPANY: Anderson Consulting Engineers, Inc.

COMPLETED BY: MOT

Community(ies): Larimer County

Flooding Source(s): Cache La Poudre River

Date: 9/1/2019

Cross Section ID	Channel Distance (ft)			Cumulative Channel Distance (ft)			Base Floodplain Width (ft)			Comments
	Model	Map	% Difference	Model	Map	% Difference	Model[a]	Map	Difference (ft)	
255245	-	-	-	-	-	-	1774	1558	***216***	Effective XS, this discrepancy exists in the effective model and map.
255648	380	380	0%	380	380	0%	2275	2274	1	
256356	708	708	0%	1088	1088	0%	2103	2101	2	
256977	332.2	332.2	0%	1420	1420	0%	2313	2314	1	
257465	488	488.3	0%	1908	1909	0%	1876	1871	5	
257981	516.28	516.0	0%	2424	2424	0%	1920	1928	8	The left water surface extent intersects a blocked obstruction.
258030	49.0	48.9	0%	2473	2473	0%	2136	2136	0	
258557	527.0	527.1	0%	3000	3000	0%	2077	2077	0	
259132	574.6	574.6	0%	3575	3575	0%	2516	2518	2	
259510	378.4	378.4	0%	3953	3953	0%	2546	2546	0	
259953	443.4	443.4	0%	4397	4397	0%	2927	2927	0	
260753	799.2	799.2	0%	5196	5196	0%	2400	2317	***83***	Effective XS, this discrepancy exists in the effective model and map.
ACCEPTABLE TOLERANCES =	**+/- 5% of Model**			**+/- 5% of Model**			**+/- 25 Feet**			

[a]Total Floodplain Width = Station WS Right - Station WS Left

APPENDIX F

DIGITAL DATA