



COCHISE COUNTY PROCUREMENT DEPARTMENT

1415 Melody Lane, Building C, Bisbee, AZ 85603
Phone: (520) 432-8391 Fax: (520) 432-8397
Website: www.cochise.az.gov

Project: Fry Townsite Floodplain Map Revision
Administering Agency: Cochise County Highway & Floodplain Department
Contract No. : PSA 13-27-HFP-04
Contract Description: Letter of Map Revision Document to FEMA to Update Floodplain Hazard Mapping.

Amendment No. 1

THIS AGREEMENT, originally executed on February 20, 2013, by and between the County of Cochise (County) and West Consultants, Inc. (Consultant), is amended as follows:

Task Schedule:

Subject to the terms and conditions set forth in this agreement, Consultant shall provide the services as described in the updated Scope of Work dated April 9, 2013, Exhibit "A".

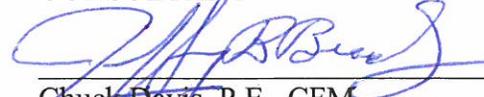
Compensation:

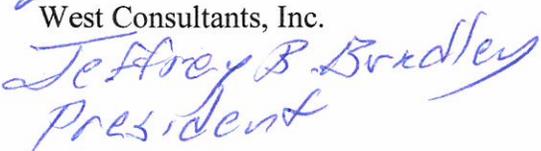
Updated cost estimate not to exceed \$60,847.50, as described in the Cost Estimate dated March 27, 2013, Exhibit "B".

With the exception of the above, all other provisions of this agreement are unchanged.

This Amendment is entered this 15th day of APRIL 2013.

CONSULTANT



Chuck Davis, P.E., CFM
West Consultants, Inc.

President

COUNTY OF COCHISE

Ann English, Chairman
Cochise County Board of Supervisors

EXHIBIT “A”



Fry Townsite Letter of Map Revision Scope of Work

April 9, 2013

As requested by the Cochise County Highway and Floodplain Department (CCHFD), this scope of work (SOW) specifies how WEST Consultants, Inc. (WEST) will analyze and delineate floodplains throughout the Fry Townsite area in Sierra Vista, Arizona (henceforth referred to as simply the Project Area) to submit a Letter of Map Revision (LOMR) document to FEMA to update the floodplain hazard mapping in the Project Area. As defined herein, the study reach is made up of the Fry Drainage Channel from the Carmichael Avenue alignment at the upstream end to Tacoma Street at the downstream end (floodplain mapping will end at 7th Street upstream of the downstream boundary of the study reach). “Fry Drainage Channel,” “Vista Village Drainageway,” and “Fab Avenue Wash” may be used interchangeably throughout the SOW herein to describe portions of the study reach, explained in greater detail below.

This study reach can be broken into three primary sub-reaches:

- Reach 1 – the 0.25-mile open channel reach from the current limit of FEMA mapping at the boundary of the City of Sierra Vista and Cochise County (just south of Fry Blvd.) along the Fab Avenue Wash (this limit of study line is approximately along the Carmichael Avenue alignment) downstream to the upstream face of the culvert in the alley between Carmichael Avenue and Canyon Drive, including the detention basin between North Avenue and Canyon Drive;
- Reach 2 – the culvert from the alley between Carmichael Avenue and Canyon Drive at the upstream end (the culvert is approximately 0.1 miles south of Theater Drive) to 2nd Street at the downstream end; and
- Reach 3 – the 0.45-mile open channel reach from the 2nd Street alignment at the upstream end to Tacoma Street at the downstream end (floodplain mapping will end at 7th Street upstream of the downstream boundary of the study reach).

On the Flood Insurance Rate Map (FIRM) panels, FEMA refers to the portion of the study reach defined above as Reach 1 as the Fab Avenue Wash, and FEMA refers to the portion of the study reach defined above as Reach 3 as the Vista Village Drainageway. WEST will be coordinating with CCHFD to refine the exact study extents for mapping purposes depending on the preliminary results of the study.

The specific tasks are as follows:

Task 1. Data Collection and Review

Portions of both the Vista Village Drainageway and the Fab Avenue Wash have been studied by FEMA using detailed methods and are mapped as Zone AE floodplains. The effective FEMA hydraulic model will be obtained from the FEMA Project Library and from the City of Sierra Vista along with any other available hydrologic data (e.g., HEC-1 files, reports, hand calculations, etc.). The input and results from the effective model will be reviewed along with the effective Flood Insurance Study (FIS) and effective FIRMs. WEST will also obtain available topographic and structure survey data for the Project Area from City of Sierra Vista as well as appropriate drainage plans from nearby subdivisions.

Two site visits to the Project Area will be conducted help identify areas where model cross-sections are most effective and allow estimation of roughness coefficients. Difference between the effective model and the existing conditions in the field will be documented. A photo log of field observations will be prepared after the site visit.

Task 2. Field Survey Collection

WEST will subcontract with Gilbert Technical Services (GTS) to complete the following tasks related to field survey collection.

Sub-Task A. Research and field reconnaissance of survey control points for the project area.

Sub-Task B. Collection of ground points for drainage channel cross sections for Reach 1 and Reach 3 as defined above. For Reach 1, natural channel cross sections shall be collected every 200' in the riverine direction for the entire 0.25-mile open channel section. Information defining the upstream end of the culvert at the downstream end of Reach 1 (coincident with the upstream end of Reach 2) shall be surveyed as well (e.g., culvert invert elevation, culvert dimensions, culvert headwall dimensions and elevations, etc.).

For Reach 2, a detailed culvert survey will be performed by GTS to represent the ~1,600-foot long culvert (dimensions of the circular culvert throughout as well as the locations of breaks in slope). The City of Sierra Vista will provide topography created from aerial photography flown by Fort Huachuca recently to represent ground elevations in the subdivision overlaying the culvert and the surrounding watershed in the case that the capacity of the culvert is overwhelmed and overland flow occurs. If the CCHFD grants an optional task, GTS can survey cross sections capturing the ground elevation in the subdivision every 200 feet in the riverine direction for the distance from the upstream end of the culvert to the downstream end of the culvert to define natural ground elevations as well to improve on the accuracy of the flown topography.

For Reach 3, roadway profiles will be collected by GTS at 8 roadway crossings as well as State Route 90, and characterization of culvert/bridge crossings will be performed at roadway crossings over the Vista Village Drainageway in the study reach containing culvert/bridge crossings (between 3 and 4 crossings). Culvert/bridge crossing characterizations shall include elevations of upstream/downstream invert and all relevant dimensions defining the crossing structure (including, but not limited to, low chord and

high chord bridge deck measurements, culvert crown elevations, culvert dimensions, etc.). Cross sections and roadway profiles shall be approximately two-hundred fifty (250) feet in length centered on the channel. Roadway crossings shall include 5 cross sections, two capturing the natural ground upstream/downstream of the influence of the structure construction on the channel shape, two capturing the ground elevations at the upstream/downstream faces of the roadway crossing, and one along the centerline of the roadway crossing. Additional cross sections shall be collected every 200 feet in the riverine direction between roadway crossings and downstream of 7th Street to State Route 90. Information defining the downstream end of the culvert for Reach 2 (coincident with the upstream end of Reach 3) shall be surveyed as well (e.g., culvert invert elevation, culvert dimensions, culvert headwall dimensions and elevations, etc.).

Survey deliverables will be ASCII point data in the locally applicable state plane coordinate system referencing the NAVD88 vertical datum. Field sketches of the upstream and downstream faces of culvert structures and roadway profiles are required.

Sub-Task C. Prepare project survey report.

Task 3. Hydrologic Analysis

According to the FIS for Cochise County, peak flows for both the Fab Avenue Wash and the Vista Village Drainageway in the Project Area were based on a report titled “Hydrologic and Hydraulic Investigations Report for the City of Sierra Vista” (Simons & Li, 1986). This report based the hydrologic analysis on HEC-1 modeling documented in the Simons & Li report (1986). Fab Avenue Wash and Vista Village Drainageway are part of the Graveyard Gulch Basin and the headwaters to the basin are all southeast of Buffalo Soldier Trail. According the 1986 SLA report, the drainage area for the Vista Village Drainageway is 0.4 square miles. Since the methods used in the original Simons & Li study (1986) may be dated due to additional development within the study watershed, WEST will review these hydrologic models and update them as needed to represent the existing watershed characteristics to estimate peak flows in the Project Area. This task assumes that the HEC-1 models from the original Simons & Li report (1986) will be available electronically for review and possible updates.

The effective hydrology seems to be incongruous with current methods for hydrologic modeling. There are very large changes in flow rates for very small increases in drainage area. Figure 1 below shows (1) the effective flows in the Fab Avenue Wash near the detention basin (128 cfs) and in the Vista Village Drainageway near 7th Street (670 cfs); and (2) the flows leaving the detention basin (60 cfs), at the upstream end of the culvert (260 cfs), and at the downstream end of the culvert (460 cfs) reported in the 1986 SLA report that WEST recently received from the City of Sierra Vista.

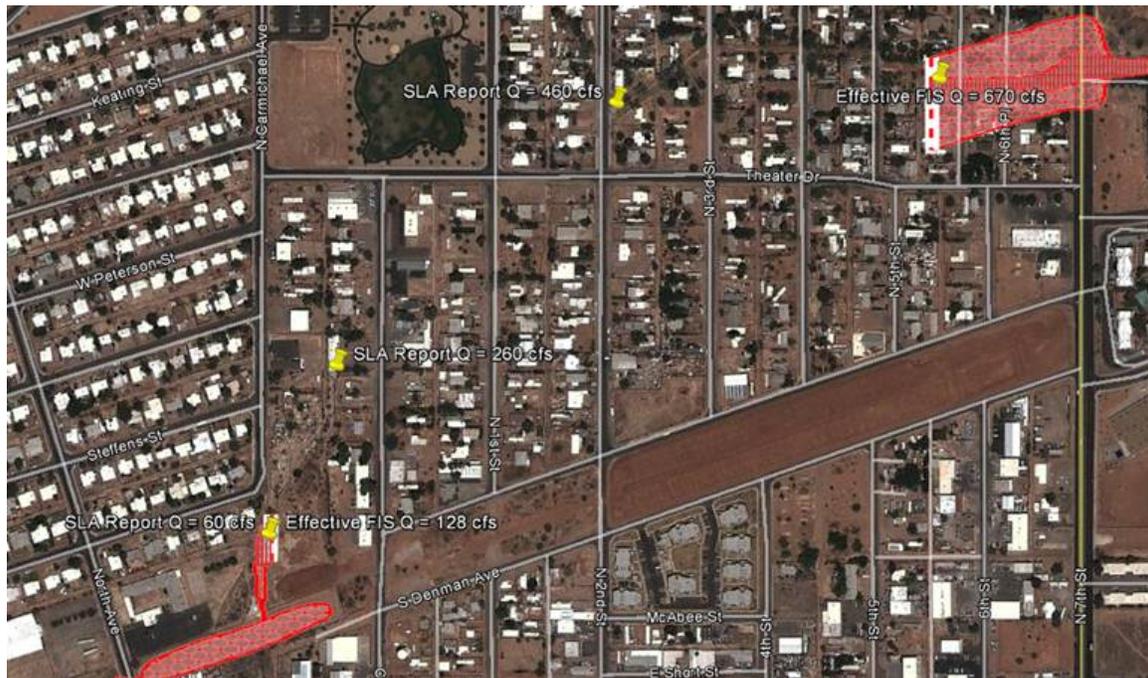


Figure 1. Effective FIS flows versus SLA (1986) flows in the Project Area

Because these large flow changes are not justified given the small increases in drainage areas, WEST will use HEC-HMS to update the hydrologic model for the study area. To account for all the flow changes along the wash, the hydrology model will extend to State Route 90 as shown in Figure 2 below. The total drainage area for the basin is approximately 1.5 square miles. The final hydrology model boundaries will be based upon existing topography in the area as well as discussions with CCHFD staff.

It is important to provide a detailed engineering review of the Project Area to determine how many subbasins should be included to best represent the hydrologic conditions of the study watershed. Subbasins will be selected based on topography, land use, field reconnaissance, desired flow change locations, etc. Revision of the basin delineation may take place based on changes in hydrologic/hydraulic characteristics such as slope, channel geometry, and landuse. It is assumed that sufficient data will be available to define topography, landuse, and soils type for the hydrologic model.

Each of the steps listed above for the hydrologic analysis will ensure compliance with FEMA standards for hydrologic modeling, and each will be explicitly documented for use in the final FEMA figures, exhibits, and reporting (Task 5 below).



Figure 2. Approximate study boundaries for the HEC-HMS modeling

Task 4. Hydraulic Analysis

Using the flow rates determined from the hydrologic analysis, WEST will perform a hydraulic analysis for the Fry Avenue Wash / Vista Village Drainageway in the Project Area. Because of the complicated issues regarding the flow patterns around the long culvert (i.e., Reach 2) and the drainage basin in Reach 1, WEST will create a FLO-2D model of a portion of the Project Area. The goal of the FLO-2D model will be to better define the hydraulics of the culvert in Reach 2, to map any overland flow in the case where the culvert at the entrance to Reach 2 is overwhelmed, and to better define the flow change locations in the HEC-RAS model that will be used to map floodplains in open channel portions of the study area.

The approximate extents of the FLO-2D model will be defined by the drainage boundaries for the watershed along with Fry Blvd on the south, 7th Street on the east, and Charles Drive on the north. This area is approximately 1/3 of a square mile. It appears that any breakout flows from the culvert will drain to the north and end up in the park at Carmichael Avenue and Tacoma Street. The actual extents of the FLO-2D boundary will be determined based on the observations from the field and discussions with CCHFD staff. WEST will select an appropriate grid size and define buildings using area reduction factors (ARFs). The culvert in Reach 2 will be defined using the EPA-SWMM model dynamically linked at runtime to the FLO-2D model. The hydrologic inputs to the FLO-2D model will be determined from the HEC-HMS model. Note that if the FLO-2D boundary needs to be significantly expanded to capture the overland flooding, then that portion of this task will have to be re-scoped. Also note that it is assumed that the topography used for the hydrology study (supplemented by the survey) will be sufficient to capture the flooding locations if the culvert at the basin is overwhelmed. If this is not the case, additional survey will be needed to better define the topography and the FLO-2D grid will need to be updated. Because of the uncertainty regarding the topography in

the overbank areas, it is assumed that any flooding areas in the overbank areas mapped using FLO-2D will be mapped on the FIRM panels as Zone A floodplains.

Once the FLO-2D modeling effort is complete, the Duplicate Effective Model, Corrected Effective Model (if required), and Existing Conditions model will be developed using the one-dimensional program HEC-RAS. Results of the Existing Conditions Model will be used to update the floodplain mapping in the Project Area.

WEST will construct and de-bug an Existing Conditions hydraulic model of Reaches 1, 2, and 3 using HEC-RAS. Reach 2 will be modeled as a culvert in HEC-RAS. The model parameters, especially the ones concerning the large culvert, inside HEC-RAS will be adjusted to agree with the results of the FLO-2D modeling. Manning's *n* roughness coefficients will be estimated during the field reconnaissance. The flow values determined from the hydrologic analysis (Task 3) will be used in the HEC-RAS model. The hydrology will also reflect any overland flooding defined by the FLO-2D model in the event that the culvert on the basin is overwhelmed. A floodway analysis will also be performed on the Existing Conditions HEC-RAS model developed as part of this task.

If the hydrology determined in Task 3 changes significantly enough from the effective hydrology that tying the floodplain downstream of the 7th Street alignment or upstream of Tacoma Street becomes impossible (due to significantly increased or decreased flooding elevations or significantly wider or narrower flooding widths), then WEST could complete an optional task of extending the hydraulic model downstream the additional 0.8 miles to the Arizona State Highway 90 alignment. This is the current limit of FEMA mapping, as downstream of Arizona State Highway 90 is not mapped due to Fort Huachuca. WEST will coordinate closely with CCHFD personnel to determine the necessity of this optional task as needed, and WEST will not begin working on this task without express written consent from CCHFD personnel.

The topography needed to develop cross sectional information for the HEC-RAS model as well as detailed structure surveys of the Vista Village Drainageway culverts for populating the hydraulic structure data required in the HEC-RAS model will be created and delivered to the county as part of Task 2 (Field Survey Collection).

Task 5. FEMA Data Development and LOMR Application

The HEC-RAS model of the Fry Drainage Channel in the Project Area as determined in Task 4 will be the basis for the floodplain modeling and floodway encroachment modeling tasks to support FEMA mapping. The mapping extent will cover from Fry Blvd downstream to the 7th Street culvert. The area not previously mapped (i.e., Reach 2 and a portion of Reach 3) will now be mapped using the results of the hydraulic study. If all the flow is contained in the culvert in Reach 2, then a label on the floodplain maps will be included indicating that. If there is overland flooding described by the FLO-2D model, then those floodplains will be mapped using FLO-2D and labeled as Zone A floodplains. The limit of mapping proposed herein is 7th Street along Reach 3. The newly mapped floodplain upstream of 7th Street will tie in to the effective floodplain downstream of 7th Street as per the FEMA guidelines for tying an updated delineated floodplain into an existing delineated floodplain. If the tie-in proves impossible (as mentioned as a possibility in the conversation of the hydraulic analysis above), then the

mapping could be extended to Arizona State Highway 90. In this scenario, both the upstream and downstream ends of the proposed mapping area are labeled as “End of Study” on the effective floodplain maps, so no tie in effort would be required for the new floodplains. All updated floodplains and floodways in the Project Area will be delineated for the 100-year flood event. Workmaps showing the floodplain and floodway delineations and revised FIRM panels will be prepared for the map revision submittal. In addition, revised flood profile plots and output summary tables will be created.

A Letter of Map Revision (LOMR) submittal package will be prepared. This package will include copies of the hydraulic model input and output, completed FEMA certification forms, floodplain/floodway workmaps, and annotated FIRMs showing the proposed floodway and floodplain delineations. A CD with the HEC-RAS model files and GIS layers will also be provided. For map revisions within the State of Arizona, State Standard 1 (updated August 2012) requires a comprehensive Technical Support Data Notebook (TSDN). The TSDN will be prepared by WEST for the LOMR submittal.

WEST will coordinate with and respond to comments by CCHFD staff regarding the LOMR submittal. Also included in this task is follow-up with FEMA and their Technical Evaluation Contractor to clarify any questions related to the LOMR submittal or to furnish available information needed during the review process. It is assumed any fees associated with the LOMR application will be paid for by CCHFD.

Task 6. Public Communication

WEST will provide CCHFD with the necessary text for newspaper advertisements of the updates to the floodplain/floodway limits as required by FEMA. WEST and CCHFD will identify possible periodicals for publication meeting FEMA’s public communication requirements for flood studies used to update the NFIP information on FIRM panels and other FIS documentation.

EXHIBIT "B"

FEMA LOMR PACKAGE FOR THE FRY TOWNSITE IN SIERRA VISTA, AZ COCHISE COUNTY COMMUNITY DEVELOPMENT, HIGHWAY AND FLOODPLAIN DEPARTMENT CONSULTANT/SUBCONSULTANT ESTIMATED MANHOURS AND DIRECT LABOR

CONSULTANT/SUBCONSULTANT NAME:

WEST Consultants, Inc.

PROJECT NAME:

FEMA LOMR Package for the Fry Townsite in Sierra Vista, AZ

DATE:

March 27, 2013

DIRECT LABOR CLASSIFICATION

CONTRACT TASK/PHASE	PRINCIPAL	PROJECT MANAGER	STAFF ENGINEER	DRAFTER/ TECHNICIAN	CLERICAL			TOTAL MANHOURS	TOTAL LABOR
	\$ 227.00	\$ 174.00	\$ 110.00	\$ 91.00	\$ 51.00	(\$/HR)	(\$/HR)		
1. DATA COLLECTION AND REVIEW									
1.1 Data collection and review			12					12	\$ 1,320
1.2 Field reconnaissance			32					32	\$ 3,520
1.3 Field reconnaissance documentation		1	6		1			8	\$ 885
TASK 1 TOTAL		1	50		1			52	\$ 5,725
2. FIELD SURVEY COLLECTION									
2.1 Data collection and review									\$ 11,734
OPTIONAL TASK 2.2 Aerial photography of overland flow area above culvert									\$ 4,300
TASK 2 TOTAL									\$ 16,034
3. HYDROLOGIC ANALYSIS									
3.1 Review Simons & Li HEC-1 models		2	12					14	\$ 1,668
3.2 Develop HEC-HMS model	1	16	40	16				73	\$ 8,867
3.3 Respond to Cochise County review comments		2	4	2				8	\$ 970
TASK 3 TOTAL	1	20	56	18				95	\$ 11,505
4. HYDRAULIC ANALYSIS									
4.1 Develop duplicate effective model			4					4	\$ 440
4.2 Develop corrected effective model			4					4	\$ 440
4.3 Develop updated HEC-RAS model	0.5	2	16	8				26.5	\$ 2,950
4.4 Input culvert data into the HEC-RAS model	0.5	1	8					9.5	\$ 1,168
4.5 Develop culvert model for Reach 2		1	8					9	\$ 1,054
4.6 Develop overland FLO-2D model/EPA SWMM culvert model	1	8	48	48				105	\$ 11,267
4.7 Respond to Cochise County review comments		2	4	4				10	\$ 1,152
OPTIONAL TASK 4.8 Extend HEC-RAS model to Hwy 90 if hydrology changes significantly		0.5	4	2				6.5	\$ 709
TASK 4 TOTAL	2	14.5	96	62				174.5	\$ 19,179
5. FEMA DATA DEVELOPMENT AND LOMR APPLICATION									
5.1 Develop TSDN	1	6	24		4			35	\$ 4,115
5.2 Develop FEMA LOMR application forms		0.5	6					6.5	\$ 747
5.3 Develop GIS data deliverables		0.5	6	8				14.5	\$ 1,475
5.4 Develop workmaps and final figures	0.5	0.5	8	16				25	\$ 2,537
5.5 Respond to FEMA review comments		1	8	8				17	\$ 1,782
TASK 5 TOTAL	1.5	8.5	52	32	4			98	\$ 10,656

**FEMA LOMR PACKAGE FOR THE FRY TOWNSITE IN SIERRA VISTA, AZ
COCHISE COUNTY COMMUNITY DEVELOPMENT, HIGHWAY AND FLOODPLAIN DEPARTMENT
CONSULTANT/SUBCONSULTANT ESIMATED MANHOURS AND DIRECT LABOR**

CONSULTANT/SUBCONSULTANT NAME:

WEST Consultants, Inc.

PROJECT NAME:

FEMA LOMR Package for the Fry Townsite in Sierra Vista, AZ

DATE:

March 27, 2013

DIRECT LABOR CLASSIFICATION

CONTRACT TASK/PHASE	PRINCIPAL	PROJECT MANAGER	STAFF ENGINEER	DRAFTER/ TECHNICIAN	CLERICAL			TOTAL MANHOURS	TOTAL LABOR
	\$ 227.00	\$ 174.00	\$ 110.00	\$ 91.00	\$ 51.00	(\$/HR)	(\$/HR)		
6. PUBLIC COMMUNICATION									
6.1 Public meeting (including travel time and meeting materials development)		8						8	\$ 1,392
6.2 Public advertisement		1	4					5	\$ 614
TASK 6 TOTAL		9	4					13	\$ 2,006
SUB-TOTAL LABOR - REQUIRED TASKS (PLUS REQUIRED SURVEY)	4.5	52.5	254	110	5			426	\$ 60,095.50
SUB-TOTAL LABOR - OPTIONAL TASKS (PLUS OPTIONAL SURVEY)		0.5	4	2				6.5	\$ 5,009.00
SUB-TOTAL LABOR - ALL TASKS	4.5	53	258	112	5			432.5	\$ 65,104.50
7. DIRECT COSTS									
6.1 FEMA Data Request to obtain effective HEC-2 model									\$300
6.2 Mileage (2 round trips to Sierra Vista, 200 miles each way at \$0.565/mile)									\$452
TOTAL LABOR + DIRECT COSTS (REQUIRED TASKS ONLY)									\$ 60,847.50
TOTAL LABOR + DIRECT COSTS (REQUIRED + OPTIONAL TASKS)									\$ 65,856.50