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August 27, 2018

RE: City of La Crosse
Ebner Coulee Flow Calibration
SEH No. LACRS 142540 14.00

Mr. Christopher Olds, PE
Floodplain Engineer
Wisconsin Department of Natural Resources
101 S Webster Street
Madison, WI 53703

Dear Mr. Olds:

This letter is a follow-up to the December 4, 2017 letter to you which outlined the ongoing Ebner Coulee Floodway FIRM Mapping project. We have included that letter (Phase 2 Wisconsin DNR Submittal Letter.pdf) and its attachments with this submittal for your information. Subsequent to that letter, additional analysis and data collection has taken place regarding the historical rainfall events and resultant flooding in the Ebner Coulee watershed. This letter provides a summary of the historical rainfall model calibration and initial results for discussion. We are seeking concurrence from the Wisconsin DNR on any future Letter of Map Revision submittal.

SEH had previously discussed the approach of calibrating the modeling to available historical rainfall and flooding data for use in updating floodplain mapping. Based on these earlier conversations, this approach appears to be acceptable to the Wisconsin DNR. The July 2017 rainfall and resulting runoff event provided a significant calibration event which we are proposing to utilize as the primary calibration event for the hydrologic and hydraulic modeling of the Ebner Coulee system.

In July 2017, major rainfall and flooding occurred in the La Crosse area, resulting from 6.26 inches (as reported at the Weather Forecast Office located about 1 mile from the Ebner Coulee watershed) of rain that fell in under 12 hours over the area which includes the Ebner Coulee watershed.

To collect data for calibration from this event, the city conducted a survey of the citizens living within the Ebner Coulee watershed area. A multiple choice survey was sent to 480 residents; this survey aimed to determine who had flooding on or near their property and who may be able to assist with collection of high water marks. There were 163 survey responses. The vast majority of responses reported that they did not have flooding on their property. There were also a number of “yes” respondents that yielded both anecdotal evidence and elevation surveys of high water marks in several areas. Several respondents also provided photo evidence taken after the flooding. See the attached “Survey Example Response” for an example of the survey sent and resulting resident response. Based on this survey, several residents were followed up with to assist with collection of high water marks.

There were two primary areas in the Ebner Coulee watershed in which significant water outside the channel was noted by the survey responses. The first was to the west of the railroad tracks just north of Farnam Street. Based on a discussion with City Maintenance Staff, this flooding most likely occurred as a result of the partial plugging of the Farnam Street culvert that Ebner Coulee empties into. While the plugged condition may have exacerbated upstream flooding, this condition makes model calibration in this area difficult because the degree of plugging is unknown, making it difficult to recreate in a hydraulic model. Although, it would be fairly safe to assume that upstream flooding is likely greater under a plugged culvert condition than that of unrestricted flow conditions (as is typically assumed in modeling systems).

The second area in which flooding was noted is near Floral Lane just northwest of the location in which Ebner Coulee exits the confined valley section and enters the channelized raised berm section. The information from the 2017 event in this area provided useful information for further refinement in the estimated discharge associated with the 2017 flood event and used when calibrating the model.

Based on information collected from the 2017 event, the three barrel culvert crossing (shown in Figure 1 below) had two barrels completely plugged and one barrel fully open and unrestricted. This caused a significant amount of flow to overtop and travel in the overbanks. Figure 1 also depicts the collected field topographic survey which outlines the edge of this overtopping flow and is based on interviews with the residents and photographic data. The information collected in this area will be valuable in further refining the model calibration as this project moves forward into the development of a calibrated hydrologic model for support of a Letter of Map Revision (LOMR).

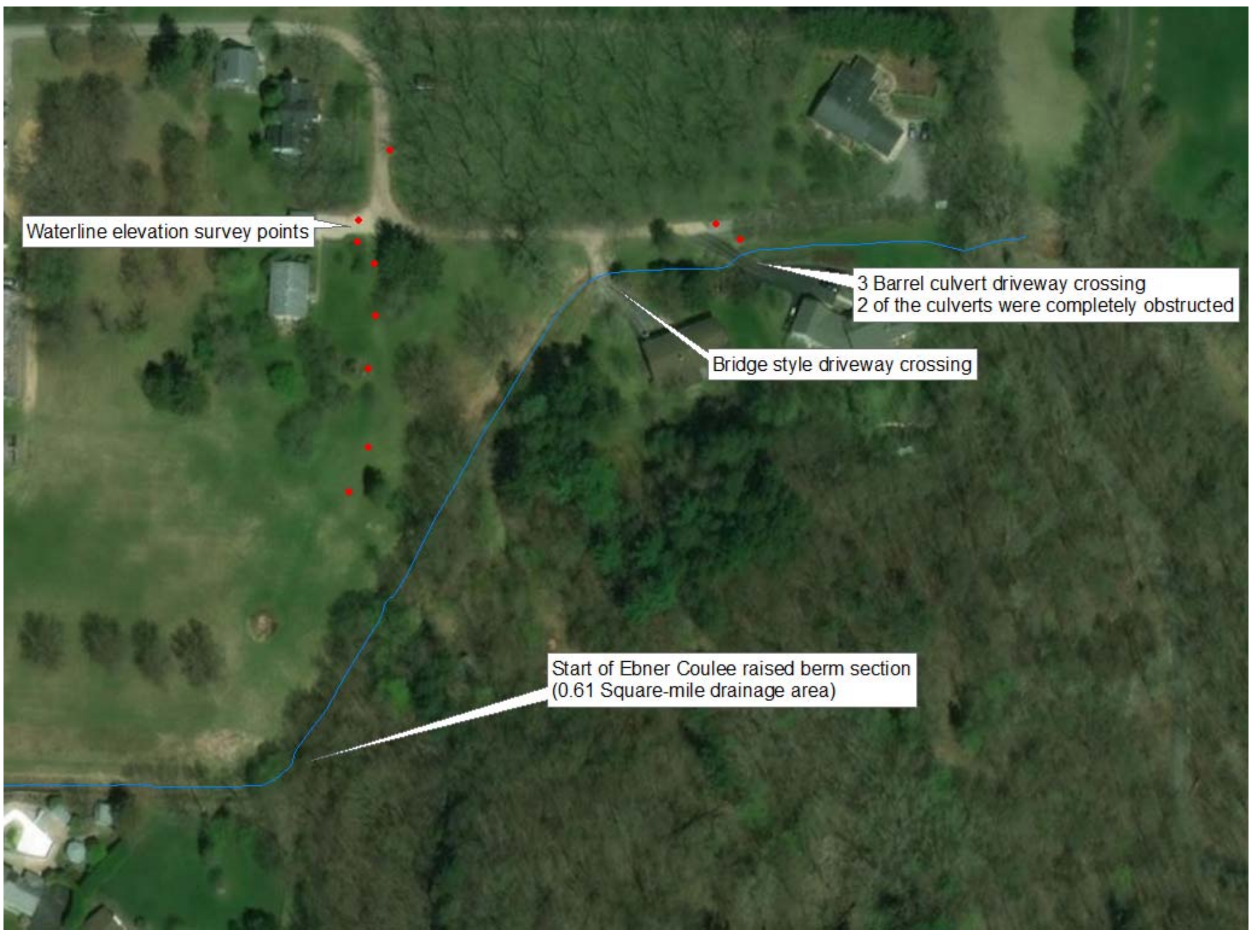

Figure 1. Upstream End of Channelized Portion of Ebner Coulee

Lastly, the many “no flooding observed” type responses to the survey are also useful. As shown in previous work (Figure 4 of “Phase2_Memo_Draft” attached), the 2017 flows obtained from the model calibrated to the FIS flows were mapped with the 1D/2D coupled HEC-RAS model. A number of the survey respondents who were located within an area which should have been flooded based on the anticipated inundation area shown in the Figure, did not have any flooding during the 2017 event. If the published FIS values, and therefore the 2017 flood mapping calibrated to those values were correct, we would have expected to see a significant number of survey responses indicating flooded properties however this was not the case.

In summary, all of the information reviewed and collected to date, along with our updated hydrologic and hydraulic modeling, shows that the effective Flood Insurance Rate Map (FIRM) significantly overestimates the flood risk for the study area. This appears to be primarily due to an overestimation of flow rates within the system. Based on a hydrologic model which replicates the Ebner Coulee flow rates given in the Flood Insurance Study (FIS), a flow rate of approximately 1000 cfs should have been produced from the 6.26 inch rainfall of July 2017. The highwater marks, reported flooding extents, and damage reports collected from the 2017 event appear that the associated flow rates appear closer to a range of 300 to 400 cfs. Utilizing these calibrated flow values from the 2017 event, we would expect the 1-percent exceedance discharge to be reduced to a range of 450 to 600 cfs. This is a significant reduction from the effective 1-percent discharge of 1,430 cfs utilized to produce the effective FIRM.

LOMR APPROACH

Due to the significance of the potential reduction in discharge rates for the 1-percent event, we propose to include additional detailed calibration analyses moving forward into a LOMR submittal. We have outlined the proposed plan to further calibrate and verify the 1-percent flow in support of a LOMR for the Ebner Coulee area. Prior to moving forward with this plan and spending additional resources, we would like to confirm that the DNR would support a LOMR based on a calibration to the citizen survey information identified above and detailed calibration methodology outlined below.

Detailed Hydrologic Calibration

A HEC-HMS model was built for the area and calibrated to output the published FIS 1-percent peak flow value of 1,430 cfs using an MSE3 distribution with Atlas 14 rainfall depths. This was done with the published drainage area of 0.9 square miles. A copy of the model was made where the drainage area was adjusted to the correct 0.61 square miles draining to the top of the effective model and into the channelized ditch section. The July 2017 rainfall hyetograph was then added to the calibrated model to estimate the expected flow rate assuming the 1,430 cfs was the appropriate 1-percent discharge. Other published Atlas 14 rainfall depths were also modeled with the calibrated model to create a plot of the return period versus discharge for the system.

Moving forward additional survey is proposed in the area where overtopping occurred near Floral Lane. This would include a topographic survey of the channel and the driveway culverts and bridge crossings.

This additional survey information will be utilized to develop a refined estimate of the "actual" peak flow rate of the 2017 event based on field estimates. We anticipate accomplishing this by creating a detailed SRH2D or RAS2D model of the area in which the overtopping and flooding occurred due to the plugged culverts. This area is chosen for several reasons. First, it is a controlled area where the flow is still fairly contained compared to that of the downstream system. Second, the inflows/contributing watershed area to this location is very clear and well defined. Third, the conditions of the culverts during the storm are known and easy to define in the model. We know from photos that two of the three culverts at the first driveway crossing were plugged. Discharge rates would be modified in the modeling until the resulting flooding approximates the surveyed high water marks. The high water marks are in a relatively flat area, so the flood extents should be fairly sensitive to flow rate changes and thus more easily calibrated.

Finally, the estimated return period of the 2017 storm will be utilized to create a new calibrated HMS model which can then be utilized to recreate calibrated frequency based events These discharge rates would calibrated flows at the top of the model for use in the LOMR submittal. These values could be scaled as necessary for the 0.9 square mile drainage area to be consistent with that of the effective study.

Utilizing the updated peak discharge values, the hydraulic model developed as part of this study, which is a coupled 1D/2D model, would be utilized to estimate the proposed flood inundation mapping resulting from the various frequency events. Due to the regulatory framework, we understand that it may be necessary to develop a fully 1-dimensional model that replicates the 1D/2D results for the LOMR submittal. The developed 1D/2D model is likely a more accurate representation of this system.

On behalf of the City of La Crosse, we would like to request a written formal response confirming that the Wisconsin DNR would support the aforementioned methodology with a Letter of Map Revision submittal for this area. The City is planning to move forward with compilation of a LOMR submittal package subsequent to receipt of the Wisconsin DNR response.

We look forward to hearing from you and continuing this study of the Ebner Coulee watershed.

Sincerely,

SHORT ELLIOTT HENDRICKSON INC.

Brad T Woz

Brad T Woznak, PE,PH,CFM
Senior Professional Engineer

btw

Ebner Fact Sheet
Phase 1 Technical Report
Phase 2_Memo_Draft
Phase 2 Wisconsin DNR Submittal Letter
Survey Example Response

c: Michelle Hase – Wisconsin DNR, Water Management Engineer
Bernard Lenz,PE – City of La Crosse
Lewis Kuhlman – City of La Crosse

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Ebner Coulee Floodway Remapping Study

October 2017 Fact Sheet

The Ebner Coulee watershed (as delineated for this study) is shown above along with the study limits.

Hydrologic Analysis

Estimating how much water is flowing down the Coulee.

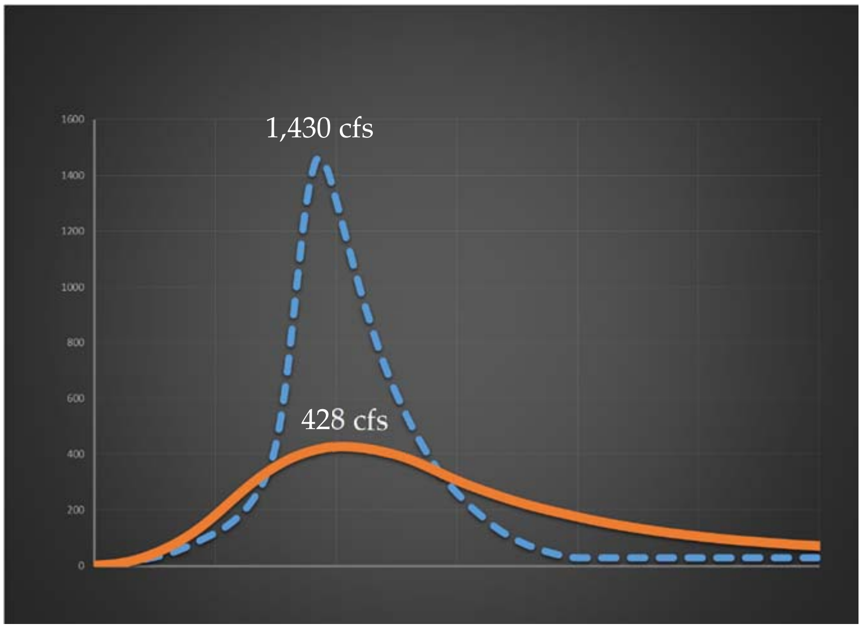
The first study task of the study was to develop an estimate of the peak discharge rates for Ebner Coulee utilizing the regional regression equations. This method is based on equations developed by the USGS to estimate the flood discharge rates based on watershed characteristics and comparing those characteristics to those of gaged streams in which data exists for peak flow rate estimation. In contrast, the peak flow rates utilized for the FEMA flood mapping of Ebner Coulee were developed with computer based rainfall-runoff modeling. This method requires the modeler to input the watershed characteristics and a rainfall event with the model output being the estimated flood discharge rate.

Project Background

The flooding associated with Ebner Coulee has been analyzed multiple times since the late 1970s. Various methods have been employed in an effort to develop a better estimate and understanding of the flooding resulting from rainfall events within the Ebner Coulee watershed.

This study incorporates a methodology developed by the US Geologic Survey (USGS) to estimate the magnitude of runoff from the watershed combined with the most up to date version of software developed by the US Army Corps of Engineers (USACE) for estimating the resulting flooding.

This new methodology could be used to support a change to the FEMA Flood Insurance Rate Map (FIRM).



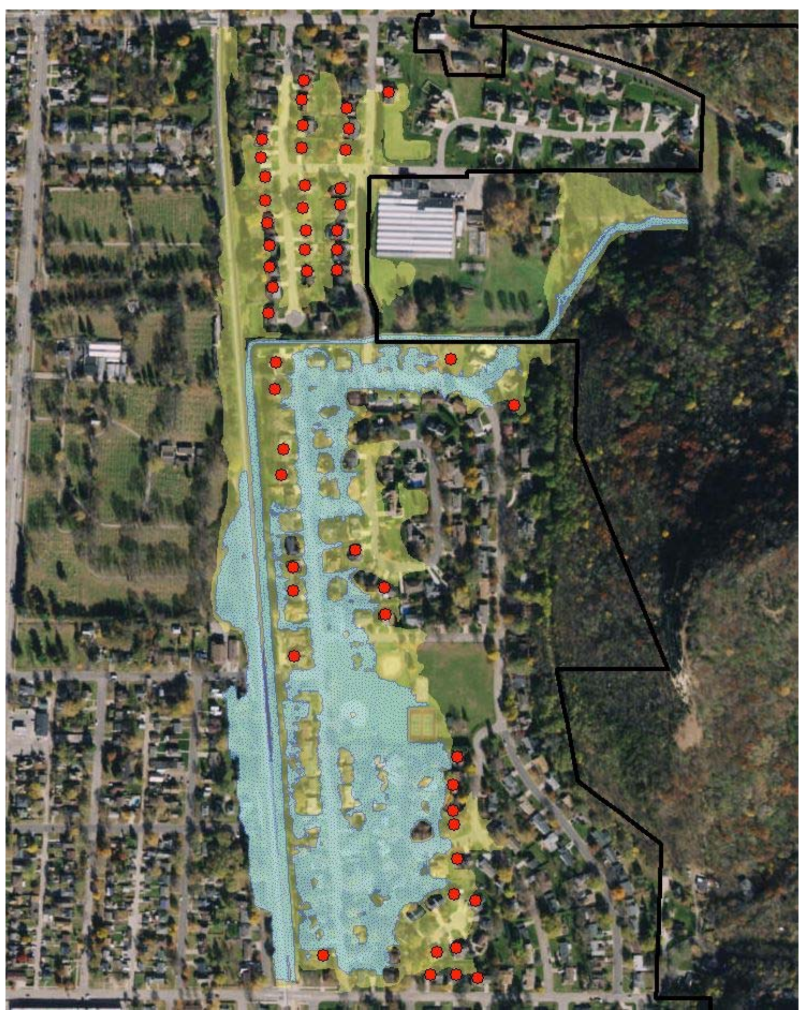
The calculated flood discharge rates from this study meet the FEMA requirements for being statistically significant for a map revision. However without "measureable" scientific data it is difficult to defend one method of developing the discharge rates over the other.

Figure depicting the 1-percent probability peak discharge rates for Ebner Coulee. (FEMA-blue line; USGS-orange line)

Flooding Analysis

Estimating the extents of flooding for the amount of water flowing through the system.

The USACE software HEC-RAS (two-dimensional capabilities) was utilized to estimate the locations in which floodwaters overflow from the Ebner Coulee channel and the resultant flood inundation area.



Potential FIRM Modifications

Potential residential structures removed from the 1-percent floodplain and mandatory flood insurance requirements:

- 25 structures south and east of the channelized portion.
- 27 structures to the north of the East-West channelized portion.

In addition to a number of structures potentially removed from the mandatory flood insurance requirements, those not removed (or who elect to purchase flood insurance) would likely see a decrease in flood insurance premiums due to a decrease in the 1-percent flood elevations.

Ebner Coulee Flood Elevations Comparison Table

FIS Cross-section	1-percent Flood Elevations (feet, NAVD88)		
	FIS	2017 SEH Study	Reduction
A	659.6	656.9	-2.7
B	659.7	658.3	-1.4
C	660.5	658.9	-1.6
D	661.6	660.0	-1.6
E	662.4	660.9	-1.5
F	664.7	663.8	-0.9
G	665.9	665.5	-0.4
H	667.9	666.6	-1.3

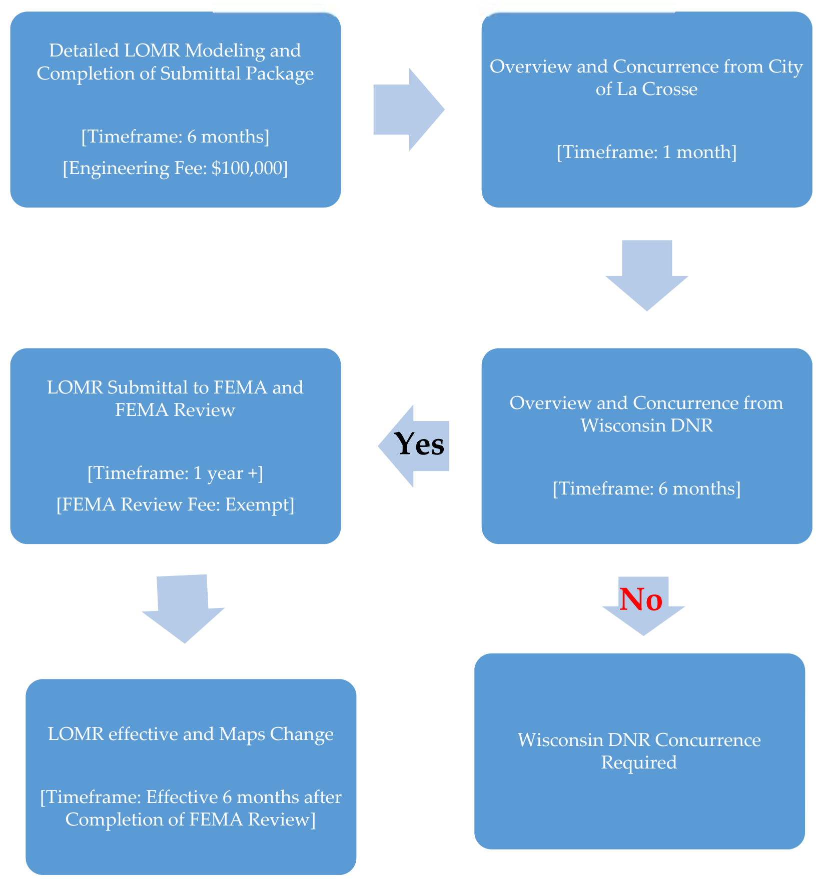
Next Steps

The study results provide an insight into the potential map changes from a restudy of the Ebner Coulee system. In order for any mapping changes to be recognized by insurance and lending institutions a FEMA Letter of Map Revision is necessary.

Potential Roadblock

Initial discussions with the Wisconsin DNR floodplain staff indicate that it is unlikely DNR will concur with a LOMR request based on differing hydrologic methods alone. Without finding specific errors in the existing hydrologic analysis or providing calibration based data supporting the change; DNR concurrence may not be attainable and LOMR submittal not possible.

LOMR Process Outline

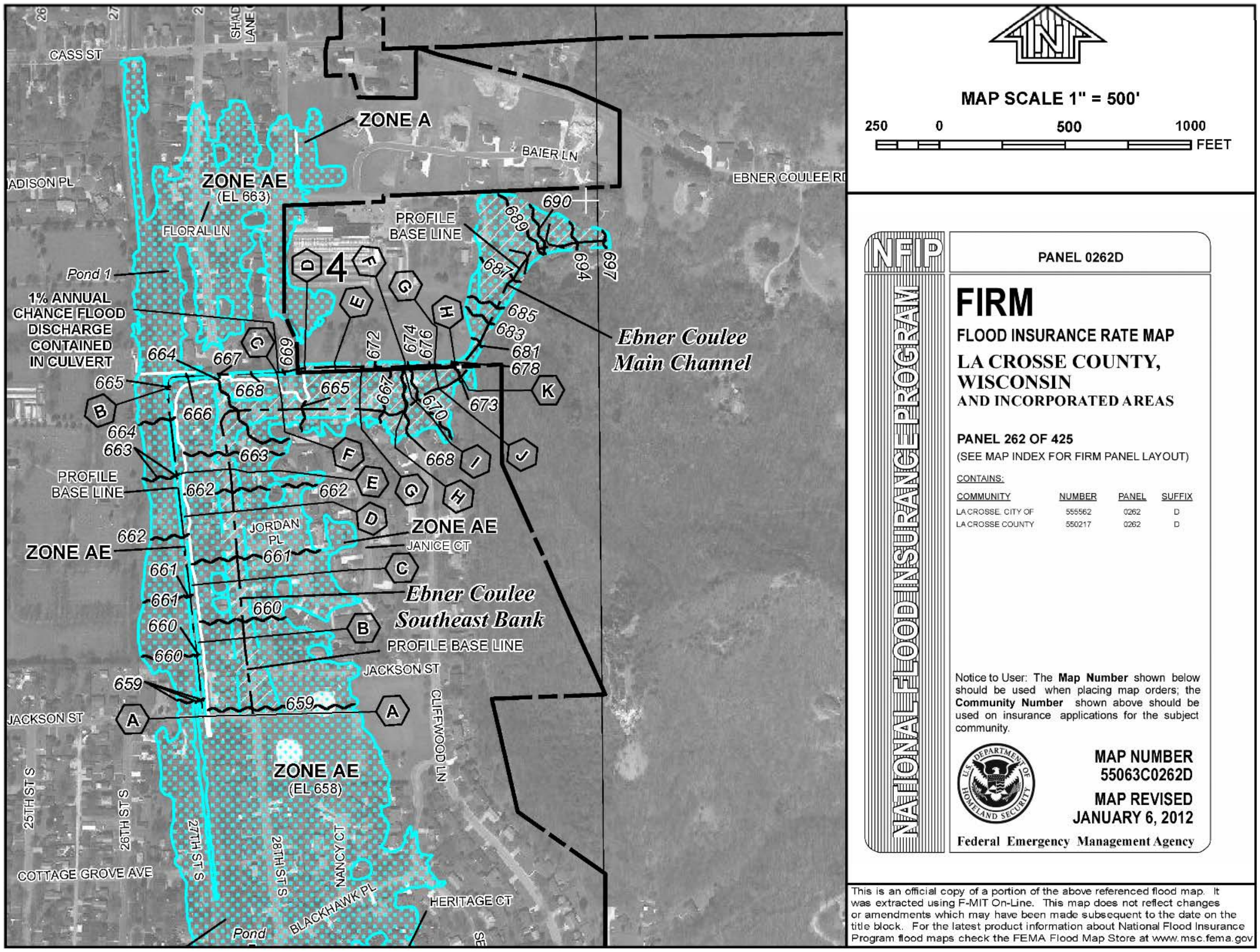


USGS stream gaging may be a means to obtain more accurate peak flow estimates for Ebner Coulee. USGS staff indicate that approximately 10-15 years of gage data collection would be required to obtain peak flood estimates.

USGS Stream gaging costs:

- *Gage purchase and installation: approx. $12,000.*
- *Annual operation and maintenance: approx. $12,000/year*

Effective Flood Insurance Rate Map (FIRM) for Ebner Coulee



The information contained in this fact sheet was prepared by Short Elliott Hendrickson, Inc. as part of the Ebner Coulee Floodway FIRM Mapping Study.

Questions Regarding this Study:

Mr. Bernard Lenz – City of La Crosse; Lenzb@cityoflacrosse.org; 608.789.7364

Mr. Brad Woznak – SEH Inc.; bwoznak@sehinc.com; 651.490.2125

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Technical Feasibility Report

Ebner Coulee Floodway FIRM Remapping

La Crosse, WI

LACRS 142540 | August 22, 2017

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August 22, 2017

RE: Ebner Coulee Floodway FIRM Remapping
Technical Feasibility Report
La Crosse, WI
SEH No. LACRS 142540 4.00

Mr. Bernard Lenz
City of La Crosse
400 La Crosse Street
La Crosse, WI 54601

Dear Mr. Lenz:

Attached please find a Draft submittal of the Technical Feasibility Report for the Ebner Coulee FIRM remapping study. This report is intended to provide a summary of the modeling process and results along with an estimation of what a proposed FIRM revision would look like along with highlighting the differences between the effective FIRM and potential mapping revisions.

Please feel free to contact me if you have any questions or would like any additional information. We will be pleased to meet with you at your earliest convenience to discuss this report.

Sincerely,

Brad T Woz

Brad Woznak,PE,PH,CFM
Senior Professional Engineer

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Technical Feasibility Report

Technical Feasibility Report
La Crosse, WI

Prepared for:
City of La Crosse

Prepared by:
Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
St Paul, MN 55110
651.490.2000

I, Brad Woznak,PE,PH,CFM, hereby certify that I am a registered Professional Engineer in the State of Wisconsin in accordance with ch. A-E 4, Wis. Adm. Code and that this report has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code.

E-36737 12/08/2017

Brad Woznak,PE,PH,CFM PE Number Date
Senior Professional Engineer

WISCONSIN
BRAD T.
WOZNAK
E-36737
RIVER FALLS,
WI
PROFESSIONAL ENGINEER
12/08/2017

SEH

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Ebner Coulee Floodway FIRM Remapping

Prepared for City of La Crosse

1 Purpose of the Study

The purpose of this project is to reevaluate and update the hydrologic and hydraulic analysis of the Ebner Coulee watershed and floodplain using an updated modeling methodology to more accurately depict the flow and conveyance conditions of this complex urban floodplain system. The analysis was performed on behalf of the City of La Crosse, Wisconsin by Short Elliott Hendrickson Inc. (SEH). The goal of this reevaluation study is to determine if use of an alternate hydrology method and the inclusion of additional topographic mapping in the upper part of the watershed would result in significantly different mapping of the 1-percent floodplain as compared to FEMA's effective Flood Insurance Rate Map (FIRM) for the area.

1.1 Background Information

The Ebner Coulee system in this area has been modeled multiple times in an effort to represent flooding conditions of this complex system. The system was initially studied by the US Army Corps of Engineers in the late 1970s or early 1980s utilizing the programs available at that time including the USACE program HEC-1 for development of the inflow hydrographs, USACE "Spill" program for estimation of the flow splits in the system, USACE HEC-2 model for estimation of the backwater impacts on the floodwater conveyance systems, and the USACE UNET model for estimation of water surface elevations and flow attenuation in the "ponded" areas of the floodplain. This methodology appears to still be the effective methodology for the area north of Jackson Street for the effective FEMA Flood Insurance Study (FIS), which is dated January 6, 2012. The area north of Jackson Street was re-evaluated by Mead & Hunt for the City of La Crosse in 1998 with the hydrologic analysis utilizing HEC-1 for development of the inflow hydrograph and HEC-RAS for the hydraulic analysis of the system. Based on available information, it appears that neither flow attenuation nor storage routing was utilized to attenuate the inflow hydrograph as it moves through the system.

The original hydrologic analysis of Ebner Coulee was supported based on calculations utilizing the Bureau of Public Roads Method, also called the Cook Method, with scaling of the flood frequency information from Gilmore Creek in Winona, MN. Subsequent hydrologic analyses by both the USACE analyses and the update by Mead & Hunt utilized the SCS unit hydrograph method for estimation of the inflow hydrographs for analysis of the Ebner Coulee system, with peak flow rates similar to those developed in the original analysis. In a letter dated September 29, 1994, Mr. Charles Melching, Ph.D., PE, hydraulic engineer at the USGS, recommended an alternative method such as the USGS developed regional regression equations for estimation of the peak flow rates for watersheds as steep as Ebner Coulee (Appendix A). The hydrologic analysis for this study will utilize the current version of the USGS regional regression equations for Wisconsin (Flood-Frequency Characteristics of Wisconsin Streams; USGS Water-Resources Investigations Report 03-4250).

Since completion of the effective FEMA hydrology and hydraulic studies, updated modeling methodologies that allow for both unsteady flow routing of hydrographs through a system and two-dimensional flow capabilities have been incorporated into the HEC-RAS program which allows for an inflow hydrograph to be routed over a two dimensional terrain surface. This study will combine the revised hydrologic analysis following the USGS regional regression methods with the unsteady, two-dimensional flow capabilities of the HEC-RAS model in an effort to provide a better representation of the flow characteristics within the Ebner Coulee system.

2 Hydrologic and Hydraulic Study

2.1 Hydrologic Analysis

The drainage area to the upstream limit of the Ebner Coulee study reach was delineated as part of this study utilizing available LIDAR topographic data and determined to be 0.61 square miles. The drainage area to the downstream limit of the model at Farnam Street was estimated at 1.13 square miles. The drainage area listed in the effective FIS is 0.9 square miles for all of the Ebner Coulee reach studied, which appears to be calculated to the point near the end of the lettered cross-sections at Jackson Street. Two inflow hydrographs were developed for this study, one for the upstream 0.61 square mile watershed added at the upstream model limits and a second to account for additional flow from the total 0.88 square mile watershed (near FEMA cross-section A). Initially the additional flow was to be added to the main channel between FEMA lettered cross-sections A and B, but based on the initial results of the two-dimensional HEC-RAS model, this flow is unable to enter the Ebner Coulee main channel and likely stays on the west side of the railroad tracks and therefore is not entered into the modeling.

The peak flow rates for this study were calculated using the regression equations and methodology provided in the USGS Water-Resources Investigations Report 03-4250. Data for input into the regression equations was estimated using GIS from a LIDAR-derived DEM and available land use information, in lieu of utilizing the . Table 1 provides a summary of the calculated peak flow rates from the USGS regression equations from this analysis along with the peak flow rates given in the effective FIS.

Table 1 – Summary of Peak Flow Rates

Source	Location	Drainage Area (sq mi.)	Peak Flow (cfs)
Effective FIS	All Locations	0.9	1430
USGS Regression Equations	Upstream Limit	0.6	360
USGS Regression Equations	Jackson Street	0.9	428[1]

[1] Flow from additional drainage area as calculated from the USGS regional regression equations based on the additional contributing area, which due to initial 2D analysis is not added to the modeling.

A check for the statistical significance of the calculated peak flow rates was also completed according to the language provided in FEMA's Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix C. It was determined that a new flood insurance study could be warranted based on the calculated peak flow rates versus those used in the effective FIS.

The hydrologic analysis was completed as an initial task to this study and is summarized in detail in a memorandum dated August 18, 2017 to Mr. Bernard Lenz (Appendix B). A figure showing the drainage area delineation is also included in Appendix B.

2.2 Hydraulic Analysis

2.2.1 Model Structure and Geometric Data

This analysis includes the Ebner Coulee system within the City of La Crosse from approximately 1,500 feet east of 29th Street S at the upstream limit to Farnam Street at the downstream limit, shown on Figure 1. Ebner Coulee leaves the steeper bluff area approximately 950 feet east of 29th Street S and enters a leveed channel that runs west to 500 feet downstream of 29th Street S, where it makes a ninety degree turn southward to follows east of and along an existing railroad track. The channel flows approximately 2,500 feet south to Farnam Street, where it enters an 8-foot by 10-foot reinforced concrete box culvert.

Three hydraulic models were prepared as part of this analysis, and are described in the following sections of this Report. Each model incorporates the revised hydrology described previously in this report, but has a unique structure which allows for the floodplain boundary to be estimated using different methodologies. Two of the models incorporate two-dimensional hydraulic computations, which can be leveraged to better represent the complex flow conditions present in the Ebner Coulee system. If it is determined that this project is to move forward with a Letter of Map Revision (LOMR) submittal to FEMA, it may be necessary to convert any two-dimensional modeling results back into a one-dimensional model because current FEMA regulatory framework (particularly for Floodway determination) is based on a one-dimensional modeling approach.

2.2.1.1 One-dimensional HEC-RAS model

The effective FIS model is a one-dimensional model with two separate reaches to represent the Ebner Coulee system: one reach to capture the conveyance down the main channel of Ebner Coulee, and the second reach to represent the flow that breaks out from the main channel and is conveyed in the southerly direction along 28th Street S. The geometric data included in the effective FIS model also included lateral structures to represent the levees along the channel, which controlled the flow between the main channel and the 28th Street reach. The only modification made to this model for this study was to incorporate the lower flow rates calculated using the USGS regression equations to evaluate the effects of the lower discharge rates on the calculated water surface elevations.

2.2.1.2 One-dimensional / Two-dimensional Integrated HEC-RAS model

An integrated one-dimensional / two-dimensional (1D/2D) HEC-RAS model was also developed to analyze the performance of the Ebner Coulee system. This integrated 1D/2D model incorporated the main channel cross-section geometry from the effective FIS hydraulic model along with the 1D hydraulic structure calculations along the main channel where flow is largely one-dimensional. This model also allows for two-dimensional calculations in the overbank areas where more complex flow patterns exist and the general direction of the flow may not be as easily discerned.

The upstream boundary condition was defined using the revised flow hydrograph developed as part of this study, which is shown on Figure 3 of the hydrologic memorandum included in Appendix B of this report. This flow hydrograph was routed into the one-dimensional channel at the upstream limit of the model, and the flow split occurring throughout the system was defined by the lateral structures along the 1D/2D interface. Flow exceeding the capacity of the main channel was routed over the lateral structures into the 2D flow area.

For this modeling approach, the main Ebner Coulee channel and channel structures are captured in the one-dimensional portion of the model and overbank area previously modeled with a separate channel reach along 28th Street S is modeled with the two-dimensional capabilities of HEC-RAS.

2.2.1.3 Two-dimensional Only HEC-RAS model

A two-dimensional only HEC-RAS model was developed primarily to evaluate the potential flow patterns and areas in which channel flow can break out and interact with the adjacent floodplain with the underlying terrain surface as determined by the model with minimal “influence” by the modeler. This approach also allows for the “visualization” of potential flow breakout areas.

The upstream boundary condition was defined using the revised flow hydrograph developed as part of this study, which is shown on Figure 3 of the hydrologic memorandum included in Appendix B of this report. This flow hydrograph was routed into the two-dimensional model in the main channel at the upstream limit of the model, and the flow split occurring throughout the system was defined by two-dimensional model mesh. Two-dimensional cell faces were aligned with ridges including the existing levees to ensure proper flow routing. Flow exceeding the capacity of the main channel was routed into the residential areas along Ebner Coulee which were also represented with the 2D flow area.

2.2.2 Vertical Datum

All vertical geometry data, water surface profile elevations, and flood boundary elevations used in the model input and results are referenced to NAVD88. For the City of La Crosse, NGVD29 and NAVD88 are approximately the same vertical elevation, with a conversion of +0.01 feet from NGVD29 to NAVD88 listed in Table 12 of the effective FIS.

2.2.3 Special Modeling Considerations

Neither the effective hydrologic or hydraulic models, nor the modeling completed for this study accounts for the potential of overland flow removal from the floodplain due to the storm sewer system along 28th Street S. While it is likely that the storm sewer size is not sufficient enough to provide a significant reduction of flood elevations or extents, it may be desirable to investigate the potential effects of the underlying storm sewer prior to pursuit of a LOMR.

2.3 Study Results

2.3.1 Revised Flood Boundary Results

2.3.1.1 One-dimensional HEC-RAS model

Figure 2 shows the results of the one-dimensional HEC-RAS model with the yellow depicting the effective FEMA 1-percent floodplain, and the blue showing the revised 1-percent floodplain based on updated modeling results from this study. Based on these modeling results, approximately 10 acres could be removed from floodplain and 20 residential structures removed as depicted on Figure 2.

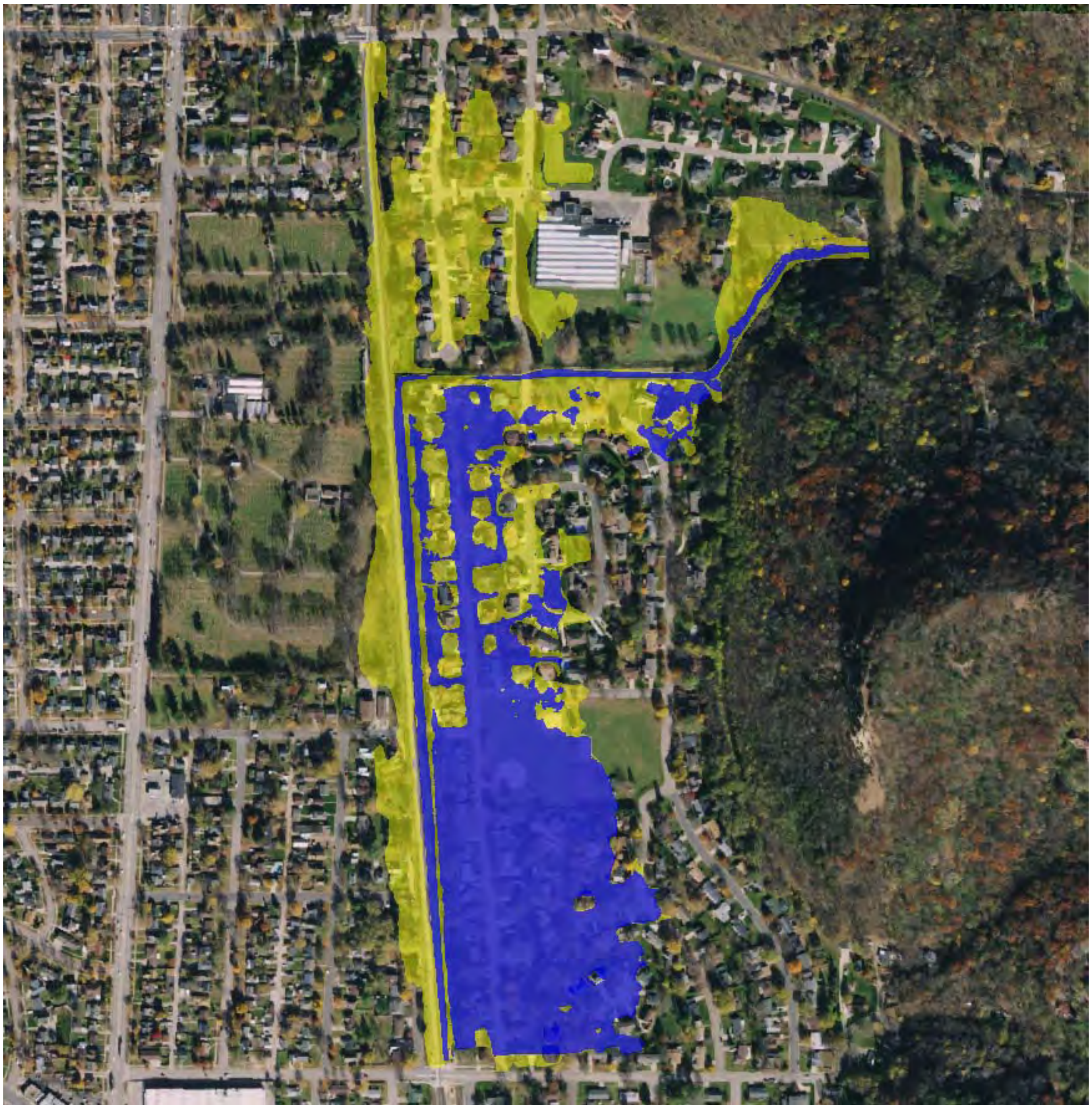


Figure 2 – Results of 1D HEC-RAS Model

2.3.1.2 One-dimensional / Two-dimensional Integrated HEC-RAS model

Figure 3 shows the results of the one-dimensional/two-dimensional integrated HEC-RAS model with the yellow depicting the effective FEMA 1-percent floodplain, and the blue showing the revised 1-percent floodplain based on modeling results from this study. Based on these modeling results, approximately 14 acres could be removed from floodplain and 24 residential structures removed as depicted on Figure 3.

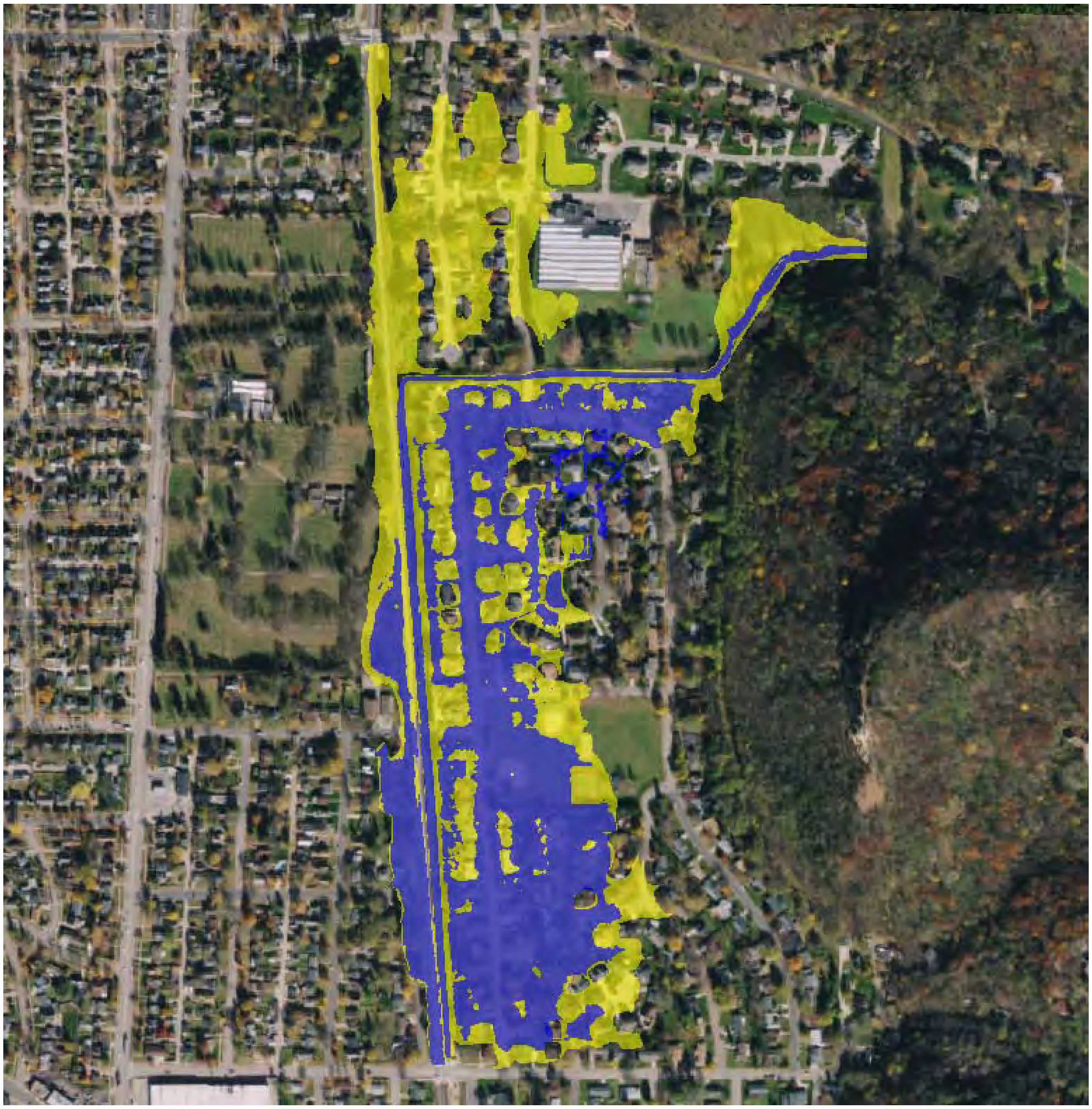


Figure 3 – Results of 1D/2D Integrated HEC-RAS Model

2.3.1.3 Two-dimensional Only HEC-RAS model

Figure 4 shows the results of the two-dimensional HEC-RAS model with the yellow depicting the effective FEMA 1-percent floodplain, and the blue showing the revised 1-percent floodplain based on updated modeling results from this study. Based on these modeling results, approximately 12 acres could be removed from floodplain and 22 residential structures removed as depicted on Figure 4.

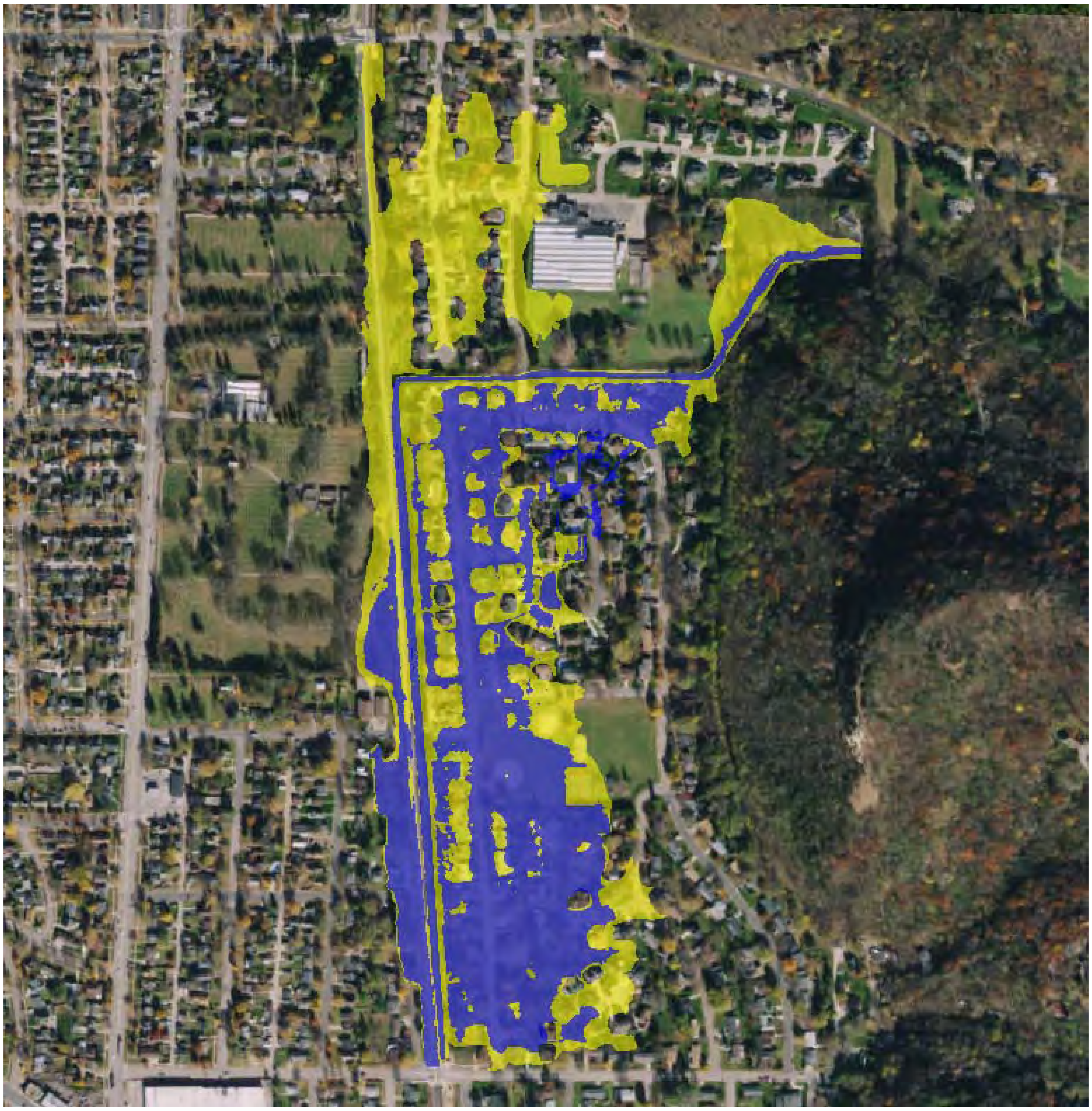


Figure 4 – Results of 2D HEC-RAS Model

2.3.2 Revised Flood Elevation Results

Table 2 – Summary of Hydraulic Modeling Results for Left Overbank Area of Ebner Coulee (Residential Area along 28th Street S East of Ebner Coulee main channel)

FIS Cross-section	Water Surface Elevations (feet, NAVD88)			
	FIS	1D Steady Model	1D/2D Model	2D Only Model
A	659.6	657.4	656.9	657.0
B	659.7	658.3	658.3	658.4
C	660.5	659.0	658.9	659.3
D	661.6	659.9	660.0	660.2
E	662.4	661.1	660.9	661.1
F	664.7	663.1	663.8	663.9
G	665.9	664.3	665.5	665.3
H	667.9	666.3	666.6	666.4

2.4 Anticipated LOMR Process

While the results of the 1D/2D and 2D only HEC-RAS modeling along with the updated hydrologic analysis may better represent the Ebner Coulee system, moving the project forward to a LOMR will most easily be accomplished with conversion back to a one-dimensional only model. The most appropriate means for capturing this would be to update the topography for the effective HEC-RAS model and "calibrate" the results and flow rates within the model to those given by the two-dimensional modeling methodologies.

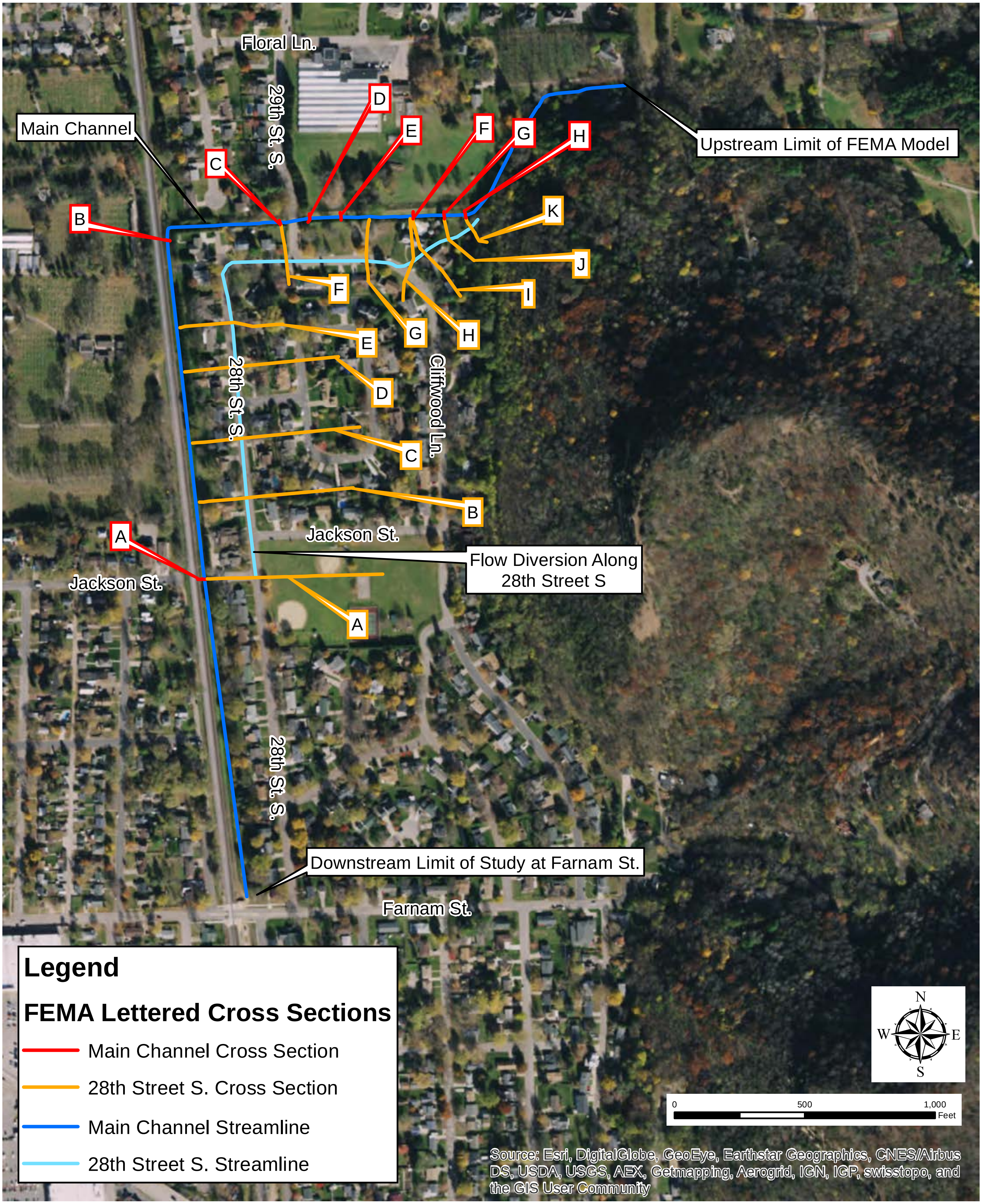
As FEMA policies become updated to address two-dimensional modeling, it may become possible to utilize an integrated 1D/2D model or 2D only as the effective model for the Ebner Coulee system.

If the results depicted in this study appear adequate enough, the next step in the process will be to open dialogue with Wisconsin DNR staff on the preliminary results of this study and anticipated desire of the City to move forward with a LOMR from FEMA.

btw

Figures

Figure 1 – Ebner Coulee System Overview Map



Path: D:\La Crosse RAS 2D\GIS\Feasibility Report Figure1.mxd

SEH

Project Number: 142540
Print Date: 8/22/2017

Map by: rpichelmann
Projection: NAD1983 StatePlane WI South
Source: ESRI, FEMA & SEH

EBNER COULEE FLOODWAY FIRM REMAPPING

La Crosse, WI

FIGURE 1

System Overview

Appendix A

September 29, 1994 Letter from USGS to Wisconsin DNR

CC: LARRY KIRCH

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Water Resources Division
102 East Main Street, 4th Floor
Urbana, Illinois 61801

September 29, 1994

Mr. Robert Watson, P.E.
Assistant-Chief Dam Safety-Floodplain Management Section
Bureau of Water Regulation and Zoning
Wisconsin Department of Natural Resources
101 South Webster Street
Box 7921
Madison, Wisconsin 53707

Dear Mr. Watson:

This letter is in response to your July 1, 1994 letter reviewing the "Hydrologic Analysis of Ebner Coulee at LaCrosse, Wisconsin" that was submitted to Gary Lepak of Wisconsin Department of Natural Resources (WDNR) by the U.S. Geological Survey (USGS) on April 1, 1994. Pages 1 and 2 of your letter indicate that redoing the hydrologic analysis of Ebner Coulee is beyond the scope of the study originally recommended to the Federal Emergency Management Agency (FEMA) by WDNR. Complete details of the WDNR proposal to FEMA were not available to the Illinois District of the USGS. Therefore, the project proposal prepared by the Illinois District of the USGS to FEMA indicated that a review of the hydrologic procedures applied in the original Flood Insurance Study was needed for several reasons (discussed in detail below). Because FEMA did not contend this issue, the new hydrologic analysis was done.

The primary reason the new hydrologic analysis was done was that sufficient information to reproduce the design hydrographs applied in the original floodplain delineation was not provided in the Flood Insurance Study report (Federal Emergency Management Agency, 1984) and supporting reports (U.S. Army Corps of Engineers, 1976 and 1967). In particular, no information is given regarding (1) the loss rates applied to the design rain storms, and (2) the temporal distribution and duration of the design storm. The selection of the loss rates is extremely important to the determination of the volume of runoff and the peak discharge. The primary evidence supporting the design hydrographs applied in the original Flood Insurance Study were the results of the Bureau of Public Roads method, the Cook method, and scaling of flood frequency from Gilmore Creek at Winona, Minnesota. This support was questionable because the Bureau of Public Roads and Cook methods are highly empirical and inappropriate for a watershed as steep as Ebner Coulee, and the scaling procedures applied are inconsistent with current recommended procedures. Further, the results of the hydrologic analysis done by the consultants who designed the Ebner Coulee box culvert differed significantly from the original Flood Insurance Study. These analyses raised concerns in the City of La Crosse regarding the original hydrologic analysis.

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By__________

Upon detailed review of the procedures applied in the original Flood Insurance Study additional inconsistencies were found in the application of the methods. These inconsistencies were of two general types: inconsistencies with respect to current practice and inconsistencies in the computational results and procedures. The scaling of flood-frequency information from Gilmore Creek at Winona, Minnesota involved inconsistencies with respect to current practice for floodplain delineation. The Gilmore Creek flood-frequency analysis was done graphically. This procedure was acceptable at the time the analysis was done (1967) because the U.S. Water Resources Council had not yet recommended that the Log Pearson Type III approach be used for all flood studies. However, at the time the Flood Insurance Study was done the Log Pearson Type III approach was the standard for all flood studies, and it seems recomputation of the flood frequency by this approach would have been appropriate. Further, the area scaling ratio applied in the original Flood Insurance Study has been superseded by the equations developed by Krug and others (1986).

The computations for the synthetic-hydrograph methods were inconsistent in the procedures applied and the computational results. For the Rational Method, in order to obtain a peak discharge of 1,010 cubic feet per second (ft^3/s) for an area of 470 acres with a runoff coefficient of 0.41 the design rainfall must be 5.24 inches per hour (in./hr). This value is considerably less than the 5.85 in./hr obtained from U.S. National Weather Service Technical Publication 40 (Hershfield, 1961) for a storm duration of 20 minutes at La Crosse, Wisconsin. For the Clark Unit Hydrograph Method, the hydrographs measured on Gilmore Creek were computed in a questionable manner so that the unit hydrographs determined from the five largest floods would have nearly identical peak-discharges. Further, the optimal value of the watershed storage coefficient determined for Gilmore Creek by the U.S. Army Corps of Engineers (1976) was much higher than that determined by the USGS by calibration of HEC-1 to the five largest floods. The storage coefficient applied to Ebner Coulee, as a result of the analysis done by the U.S. Army Corps of Engineers (1976), seems unrealistically high for such a steep, small watershed.

On page 2 of your letter it is implied that the USGS analysis seems predisposed to reducing the peak discharges and the width of the regulatory floodplain. This is incorrect. The quote from page 1 of the Hydrology Report must be read in full context, specifically:

> "Whereas the 10-percent exceedance probability flood is considerably less than the 1-percent exceedance probability flood used to define the regulatory floodplain, operation of the box culvert <u>could potentially</u> lead to a significant reduction of the regulatory floodplain."

This is a fairly obvious statement that improvements in drainage could reduce the regulatory floodplain. This was the motivation for doing the reevaluation of the floodplain along Ebner Coulee. The later statements in the Hydrology Report speculating that the design discharges applied in the original Flood Insurance Study might be unrealistically high were made on the basis of the results of the scaling of frequency data from hydrologically similar watersheds and the results of TR55 simulation. These results indicated that the best estimate of the 1-percent exceedance-probability flood is around 1,050 ft^3/s as opposed to the 1,430 ft^3/s applied in the original Flood Insurance Study. In fact for some of the synthetic methods applied, 1,430 ft^3/s was greater than the 0.002-percent exceedance-probability flood. 0.2% ?

The point is well taken on page 2 of your letter regarding the volume of runoff being at least as important if not more important than the peak discharge. However, three factors should be considered. First, computation of the volume of direct runoff is highly dependent on the loss rates applied, which are not reported in the original Flood Insurance Study. Second, because the synthetic hydrograph methods applied are based on the Unit Hydrograph the volume of direct runoff is directly proportional to the magnitude of the peak discharge if the shapes of the design hydrographs are similar. Thus, if the peak discharge decreased 40 percent, the volume of direct runoff would also decrease 40 percent. The attached figure compares the one-percent exceedance-probability flood computed with TR55 and that determined in the original Flood Insurance Study (the TR55 result was shifted 7 hours so that the peak times of the two hydrographs are similar). It can be seen that the peak regions of the hydrographs are similar but the rising and recession limbs of the hydrographs are significantly different. Despite these differences in shape, the ratio of the depth of direct runoff 3.40 in./2.48 in. = 1.37 is similar to the ratio of the peak discharges 1,430 ft^3/s/1,030 ft^3/s = 1.39. Third, the volume of spill is also related to the amount of time that the runoff rate exceeds the capacity of leveed Ebner Coulee channel. Computation of spill for a flatter, more attenuated hydrograph, such as estimated in TR55, would result in more water remaining in the main channel of Ebner Coulee and less water spilling into the flood-prone neighborhoods upstream of the entrance to the box culvert.

Finally, the USGS is the nation's earth-science agency. The mission of the USGS is to collect and analyze data and present the results of these analyses to cooperating agencies and the general public in an unbiased, scientific way that allows users to make informed decisions on water-resources issues. Therefore, the USGS normally does not make recommendations regarding how the results of data collection and analyses done by the USGS should be applied. Further, the FEMA Guidelines and Specifications for Study Contractors indicate that if questions arise regarding the appropriate analyses (hydrologic or hydraulic) to apply these questions should be submitted to the Regional Project Officer for resolution. It is our understanding that WDNR acts as Regional Project Officer for FEMA. Thus, the "Hydrologic Analysis of Ebner Coulee at La Crosse, Wisconsin" was submitted to Gary Lepak for review and comment.

Your letter advises that application of the hydrologic analyses from the original Flood Insurance Study is preferred. Therefore, the USGS will continue the study applying the hydrographs computed in the original Flood Insurance Study as input to Ebner Coulee as simulated with a combination of HEC-1 and HEC-2. The HEC-2 models provided to the USGS on computer diskette along with your letter will be modified to account for the operation of the box culvert.

Finally, it would be greatly appreciated if WDNR could send electronic copies of the HEC-1 output containing the design hydrographs applied as input to Ebner Coulee in the original Flood Insurance Study if available. These hydrographs may be included in the microfiche documents that detail the original Flood Insurance Study. However, electronic copies of this information would greatly facilitate the completion of the project.

Thank you very much for your comments. I hope this letter clears up any misunderstandings between WDNR and the USGS regarding the reasons for and results of the "Hydrologic Analysis of Ebner Coulee at La Crosse, Wisconsin." If WDNR has any questions regarding this letter or the progress of the remapping project, please call me at (217) 398-5374.

Sincerely,

Charles S. Melching

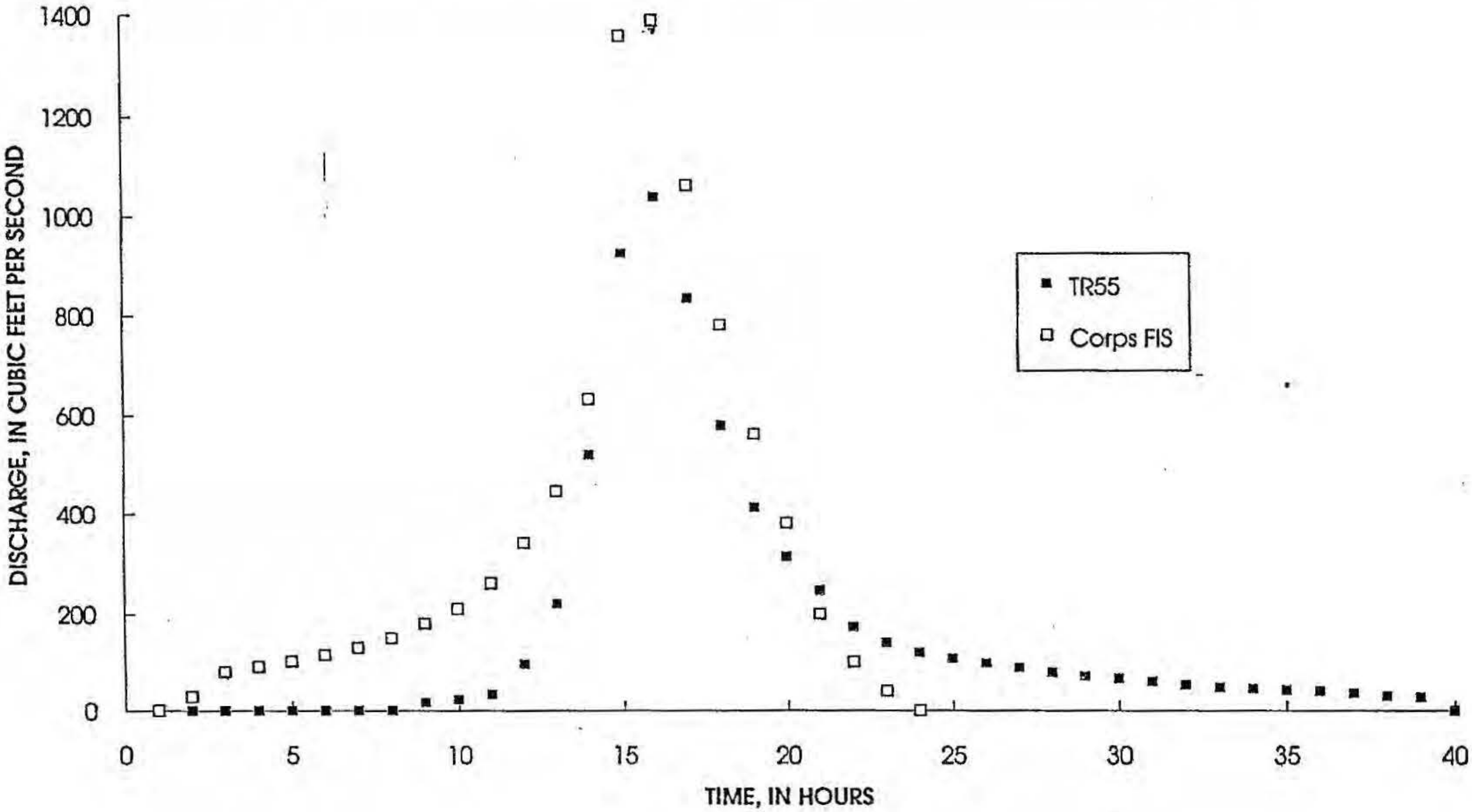
Charles S. Melching, Ph.D., P.E.
Hydraulic Engineer

copy to: Mr. Larry Kirch
City Planner
400 La Crosse St.
La Crosse, WI 54601

Mr. Eric Berman
Federal Emergency
Management Agency
Natural Hazards Division
175 W. Jackson Blvd.
Chicago, IL 60604

Mr. Todd Stuntebeck
U.S. Geological Survey
6417 Normandy Lane
Madison, WI 53719-1133

Comparison of one-percent exceedance-probability flood computed with TR55 and the Clark unit hydrograph method in the original Flood Insurance Study (FIS)



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U.S. Army Corps of Engineers, 1967, Report of the survey of State Road and Ebner Coulees, Wisconsin for flood control: St. Paul District, St. Paul, Minnesota.

U.S. Army Corps of Engineers, 1976, Flood control-State Road and Ebner Coulees, Wisconsin, General design memorandum, Phase 1, Plan formulation and hydrology: St. Paul District, St. Paul, Minnesota.

Appendix B

August 18, 2017 SEH Hydrologic Analysis Summary Memorandum

Building a Better World for All of Us®

MEMORANDUM

TO: Mr. Bernard Lenz

FROM: Brad Woznak, PE, PH, CFM

DATE: August 18, 2017

RE: Ebner Coulee Floodway FIRM Remapping: Hydrologic Analysis

Background

The City of La Crosse has engaged SEH to determine the feasibility of submitting a Letter of Map Revision (LOMR) to FEMA for the Ebner Coulee Floodway and Floodplain. The City has requested that this work be completed in phases, with the first task focusing on the hydrology of the Ebner Coulee system. The peak discharge rates for Ebner Coulee reported in the effective FEMA Flood Insurance Study (FIS) were supported using the Bureau of Public Roads Method, also called the Cook Method, with scaling of flood frequency from Gilmore Creek at Winona, MN. According to a letter from the USGS to the WiDNR dated September 29, 1994, "the Bureau of Public Roads and Cook methods are highly empirical and inappropriate for a watershed as steep as Ebner Coulee, and the [flood frequency] scaling procedures applied are inconsistent with current recommended procedures."

In order to determine the feasibility of submitting a LOMR to FEMA based primarily on revised hydrology, SEH has reviewed the existing FEMA Flood Insurance Study (FIS) and model information, and estimated new peak flow values entering the modeled area using the methods described in Water Resources Investigation Report 03-4250 "Flood-Frequency Characteristics of Wisconsin Streams". A new flood hydrograph was then developed using HEC-HMS, and FEMA's guidelines were used to determine if the results are statistically significant enough to warrant modification of the FIS/FIRM. This memorandum provides a summary of the hydrologic analysis completed by SEH.

Hydrology Analysis

Data Collection

The effective FIS was obtained from the FEMA web portal and the effective HEC-RAS model was obtained from the Wisconsin DNR through the Surface Water Data Viewer tool. FEMA GIS data including the Special Flood Hazard Area map, cross-sections, and streamline were also obtained and will be used as a starting point for any future modifications to the hydraulic model. The City of La Crosse GIS staff provided a one meter resolution LiDAR-derived DEM for the county and the city. The city's storm sewer GIS database was also provided.

Review of Existing FIS and Available Models

The FEMA effective HEC-RAS model extends from Farnam Street (downstream limit) to 950 feet east of 29th Street S (upstream limit); this is where Ebner Coulee leaves the bluff area and enters the flatter residential area. Figure 1. (attached) shows the FEMA lettered cross-sections and streamlines. There are two streamlines; the north and west streamline is for the main channel, and the south and east streamline is for flow that diverts out of the main channel and flows through the residential area. Some flow also diverts to the north and is included in the FEMA mapping, but the cross-sections do not extend to the north.

The drainage area listed in Table 8 (included below) of the La Crosse County FIS is 0.9 square miles for all flows in the Ebner Coulee main channel and Ebner Coulee Southeast bank models. Based on modern LiDAR data, the drainage area to the upstream limit of the model is 0.61 square miles, and the drainage area to the downstream limit of the model at Farnam Street is 1.13 square miles, as shown in Figure 1 (attached). The drainage area to FEMA's most downstream lettered cross-section, A, was calculated using LiDAR to be 0.88 square miles. Based on this LiDAR calculation and USGS quad maps, it appears that the drainage area of 0.9 square miles indicated in the FIS was originally calculated to the point at the end of the lettered cross-sections near Jackson Street, and then reported in the FIS as the drainage area for all parts of the model. An approach such as this is often taken as a conservative means used to account for all runoff that may be entering the system and entering it into the model at the upstream end of the study reach. In this case, the unsteady UNET model utilizes the available watershed storage to attenuate peak flows as they move through the system.

Our approach varies from this in that we will develop two inflow hydrographs; one for the upstream 0.61 square mile watershed, and another for the total 0.88 square mile watershed. The upstream hydrograph will be added to the model within Ebner Coulee at the upstream limits of the study and the second flow hydrograph will be added to the model at the point where that flow enters the system.

Table 8 of the Effective FEMA FIS – Summary of Discharges

		Peak Discharges (cubic feet per second)			
Flooding Source and Location	Drainage Area (square miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
EBNER COULEE MAIN CHANNEL					
Upstream of Overflow to Ebner Coulee Southeast Bank	0.9	N/A	N/A	1,430	N/A
Upstream of South 29th Street	0.9	N/A	N/A	301	N/A
Approximately 1240 feet Upstream of Farnam Street	0.9	N/A	N/A	247	N/A
EBNER COULEE SOUTHEAST BANK					
Upstream of South 29th Street	0.9	N/A	N/A	820	N/A
Approximately 1260 feet Upstream of Farnam Street	0.9	N/A	N/A	836	N/A

Table 8 of the La Crosse County FIS shows that for the 1% Annual Chance Flood, a peak discharge rate of 1430 cfs was used for the main channel of Ebner Coulee upstream of the overflow location. Table 8 also shows that less than 300 cfs of the 1430 cfs starting flow remains in the channel by the time it reaches Jackson Street. The remainder overflows out of the main channel and is modeled separately. The focus of Task 1 is only to estimate the peak flow at the upstream end of the modeled reach, a two-dimensional HEC-RAS model will be utilized to estimate the flow characteristics for the floodplain and channel conveyance systems as part of Task 2.

USGS Regression Analysis & Flood-Frequency Equations using W-RIR 03-4250
Regression equations are relations between flood-frequency and drainage-basin characteristics that have been developed by a multiple-regression analysis. The peak flow in Ebner Coulee was estimated using the regression equations and methodology provided in USGS Water-Resources Investigations Report 03-4250. This process involved delineating a new watershed to the upstream limit of the effective HEC-RAS model based on the LiDAR-derived DEM, and estimating the percentage of forested area and the approximate slope through the watershed using GIS. The watershed draining to the upstream limit of the model is 0.61 square miles as shown in Figure 1 (attached). The flood-frequency equations provided in the USGS document were then used to estimate the peak discharge rates. Table 1 shows the resulting peak flow for the 100-year event. Plus and minus one standard error were also calculated using the ESE (equivalent standard error) provided in the USGS document; this is also shown in Table 1.

Table 1: Regression Analysis & Flood-Frequency Equation Results

Source	Location	Drainage Area (SqMi)	Peak Flow (cfs)	ESE (%)	Minus 1 Standard Error (cfs)	Plus 1 Standard Error(cfs)
FEMA Effective	All Locations	0.9	1430.0			
Regression Eq.	Upstream Limit of Fema Model	0.61	360.8	44	202.0	519.5
Regression Eq.	Jackson Street	0.88	428.5	44	240.0	617.0
Regression Eq.	Farnman Street	1.13	494.7	44	277.0	712.3

Check for Statistical Significance per FEMA Guidelines

According to language provided in FEMA's Guidelines and Specifications for Flood Hazard Mapping Partners, Appendix C, the hydrologic analysis should base the test for significance on the confidence limits, plus or minus one standard error, of the more recent analysis:

> *"The Mapping Partner performing the hydrologic analysis should base the test for significance on the confidence limits of the more recent analysis. Plus or minus one standard error, which is equivalent to a 68-percent confidence interval, should be used to determine if the effective and new base flood discharges are significantly different. If the effective base flood discharges are within the 68-percent confidence interval (one standard error) of the new base flood discharges, the new estimates are not considered statistically different and there is no need for a new study based only on changes in the flood discharges. If the effective discharges fall outside the 68-percent confidence interval (one standard error) of the new discharges, the estimates are considered significantly different and a new study may be warranted based on changes in the flood discharges."*

Figure 2 (below) shows that the effective 100 year peak flow of 1430 cfs is well above the flow calculated in the regression analysis, and also well outside of the 68-percent confidence interval (one standard error); indicating a new study is warranted based on the changes in the flood discharges alone.

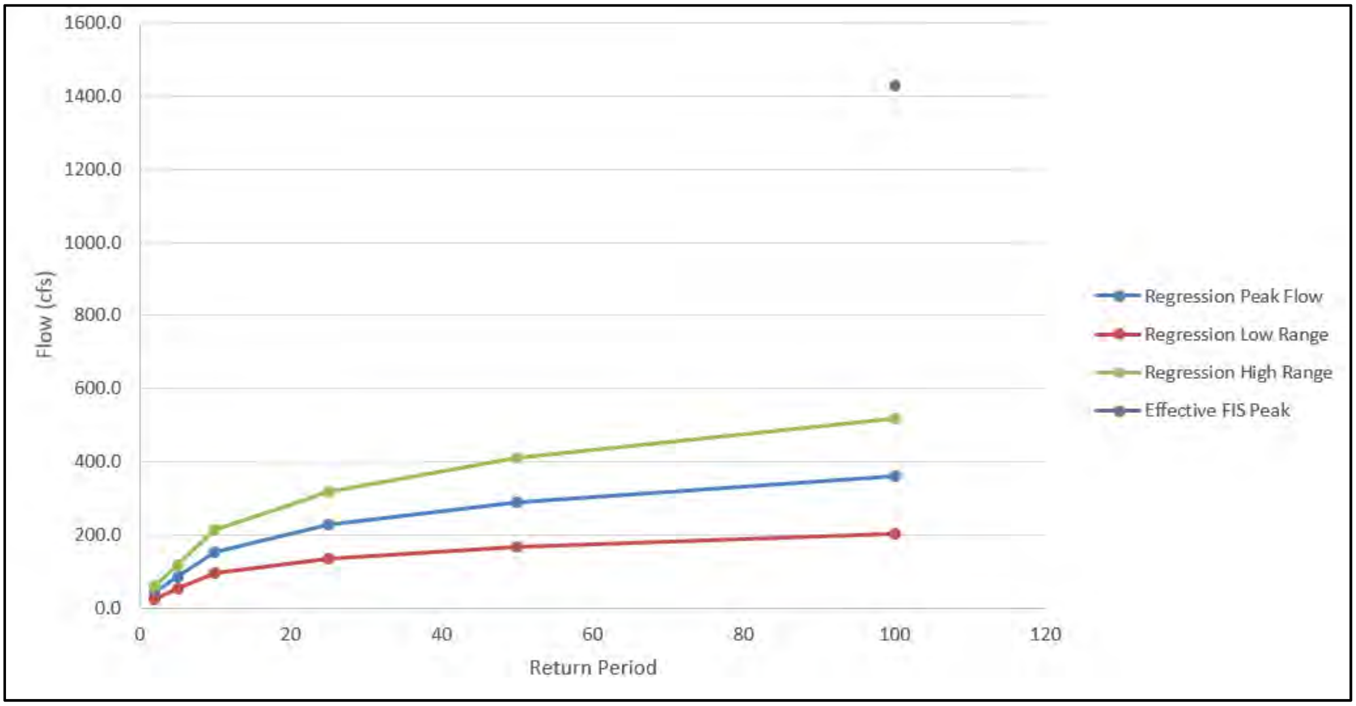

Figure 2: Statistical Summary

HEC-HMS Model

A HEC-HMS model was created to develop inflow hydrographs that could be associated with the calculated regression equation peak flows and used in an unsteady HEC-RAS analysis. Figure 3 (included on the following page) shows the inflow hydrograph developed using HEC-HMS, matching the regression equation peak flow estimate for the upstream limit of the Ebner Coulee hydraulic model. This hydrograph will be used in future hydraulic analyses.

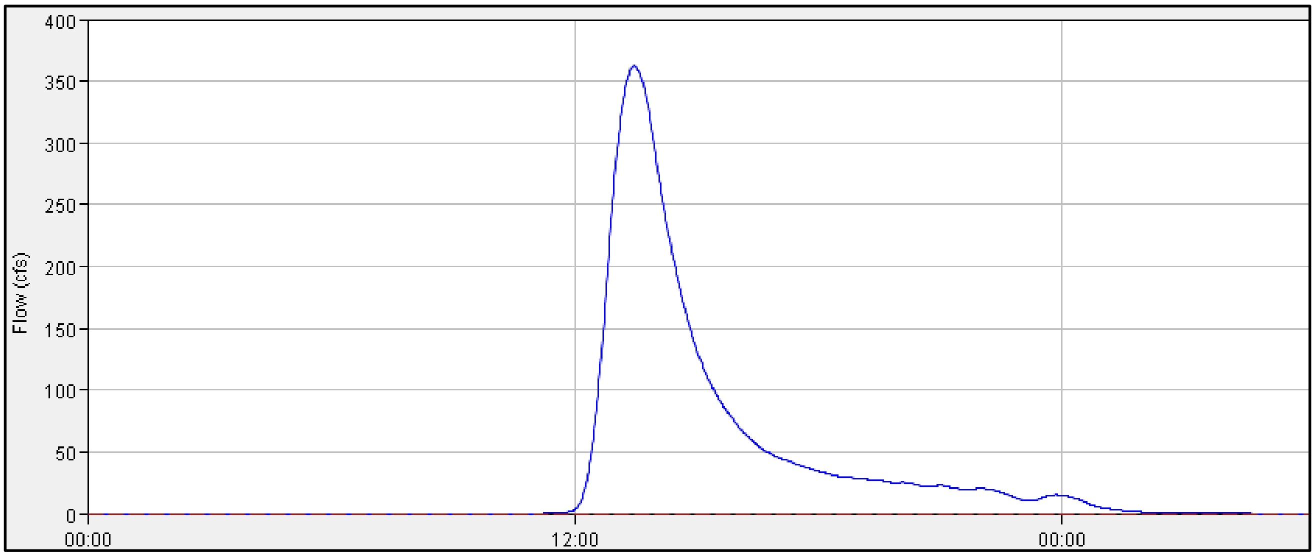

Figure 3: Ebner Coulee Inflow Hydrograph based on Regression Peak Flow Rate

R.M.
Attachment

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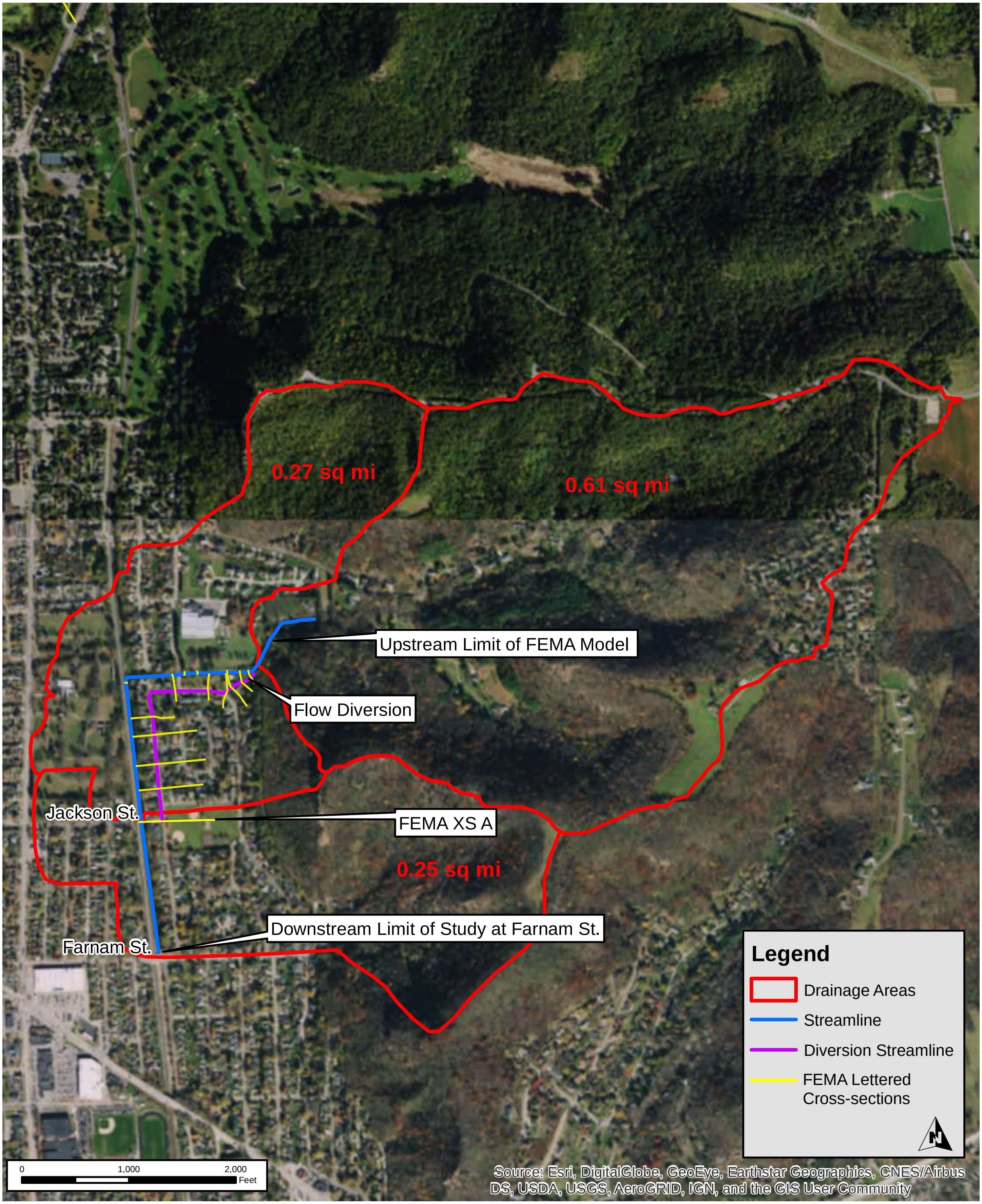

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SEH

Project Number: 142540
Print Date: 8/3/2017

Map by: rmondloch
Projection: NAD_1983_StatePlane_Wisconsin_South_FIPS_4803_Feet
Source: ESRI, FEMA & SEH

Ebner Coulee
La Crosse, WI

FIGURE 1
Drainage Areas

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Sustainable buildings, sound infrastructure, safe transportation systems, clean water, renewable energy and a balanced environment. Building a Better World for All of Us communicates a companywide commitment to act in the best interests of our clients and the world around us.

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Building a Better World for All of Us®

MEMORANDUM

TO: Mr. Bernard Lenz, PE

FROM: Brad Woznak, PE, PH, CFM
Riley Mondloch, EIT

DATE: December 4, 2017

RE: Ebner Coulee Modeling Phase 2 - Historic Rainfall Analysis

Background

During the first phase of this analysis, SEH estimated flow rates into Ebner Coulee using the USGS Regional Regression equations for Wisconsin and performed modeling to demonstrate that the FEMA effective flood maps may be overestimating floodplain extents due to an overestimation of peak flow rates. See Attachment 1 for the report from the first phase of this project. The results from the first phase of the report were presented to the City of La Crosse Floodplain Task Force Committee. The initial study indicated the potential for significantly lower discharge rates than those published in the effective FIS, which were based on a hydrologic analysis from the late 1970s. Because an overestimation of the flood risks can place an undue burden on the City's residents, the results of the first phase warranted additional analysis of the flow rates. The Wisconsin DNR and ultimately FEMA will require greater scientific justification and proof beyond a just utilization of the regional regression equations over that of the previous hydrologic methodology in order to concur with a letter of map revision based on revised flow rates.

This second phase of the project, discussed in this memo, involves utilizing a hydrologic model to develop peak flow rates, a methodology similar to that originally utilized for the effective FIS. SEH contacted the Wisconsin DNR for the effective hydrologic model and obtained a hardcopy output of the HEC-1 model dated September 1979. SEH performed an in-depth review of the effective HEC-1 model and it was determined that this model was only utilized to route hydrographs developed by other methods and does not perform any rainfall-runoff computations. Similar to the argument made by the USGS in September 1994, it does not appear that sufficient information is available in the FIS documentation to reproduce the design hydrographs from the original FIS. Given this reason, SEH developed a HEC-HMS model, with TR-55 methodology, to perform rainfall runoff-modeling for estimating peak discharge rates for Ebner Coulee. Once the HEC-HMS model was developed, calibration and verification was performed by analyzing historic rainfall events over the past 20 years to a hydrologic model that has been calibrated to first the 1430 cfs FIS discharge and then to peak flow rates developed utilizing the USGS regional regression equations.

The peak flow rates from the three most intense historic rainfalls were calculated with each of the models and results input into the 1D/2D HEC-RAS model developed during the first phase of the project. Floodplain mapping was generated for each of the models and overlaid on the same mapping in an effort to validate the model results to the inundation experienced in the field for each of the three events. Since major flooding has not been observed in this area with any storms over the last 20 years, if the model results indicate significant flooding for the three most intense historic events, it is likely that calculated peak runoff rates are being overestimated.

The ultimate goal of this study is to either verify that the FIS discharge rates are appropriate for the associated flood risk or if not, to develop a scientific methodology that can be moved forward for discussion with the Wisconsin DNR to obtain overview and concurrence in support of a Letter of Map Revision submittal to FEMA.

Daily and Hourly Historic Rainfall Analysis
There are two rainfall gauging stations of interest for this study with available data for daily rainfall totals. The first station is the La Crosse Municipal Airport, station number USW00014920. The second station is the La Crosse Weather Forecast Office, station number USC00474373. The Weather Forecast Office is a newer station and does not appear to have data before 2000. The Municipal Airport station is approximately 5 miles away from Ebner Coulee, and the Weather Forecast Office station is about 1 mile away from Ebner Coulee. Given the closer distance, it would be ideal to use the Weather Forecast Office data only, however this station does not record hourly rainfall data, so it was necessary to include hourly data from the Municipal Airport station. See attached Figure 1 for a map showing the weather station locations.

Daily rainfall totals between 2001 and November 2017 were obtained for both stations and used to select the peak rainfall event for each year. Rainfall depths of the peak storm for each year at both stations are shown in Table 2. The values at the Weather Forecast Office were slightly higher for most years. The duration of the rainfall events typically varied between 12 and 36 hours.

Hourly rainfall depths were only available at the Municipal Airport station and were obtained from two sources. The NOAA NCDC has hourly rainfall reports from 2003 to 2012 that contain data for this station. WeatherUnderground.com was used to obtain hourly data for 2001, 2002, and 2013-2017. Neither of these sources had hourly rainfall data for 1997 to 2000. The project scope indicated performing the analysis on rainfall data back to 1997, but no data was available at the Weather Forecast Office before 2001 and no hourly data was available at the Municipal Airport station before 2001. We reviewed the yearly peak daily rainfall totals from 1997 to 2000 and it does not appear that any major storms occurred in this time period, so removing these four years from the analysis, will not impact the results.

The historic rainfall data was used to create hourly increment unit hyetographs for the peak storm of each year. These are plots of time versus cumulative rainfall depth for each storm normalized to 1 inch of depth. They are then multiplied by the total depth for each storm; this methodology allowed use of the closer Weather Forecast Office depths with the rainfall distributions from the Municipal Airport Location.

Available rainfall data from WeatherUnderground.com is reported in increments less than an hour, this more detailed data was used to create hyetographs with 10 minute increments for the three largest events. The hyetographs with a shorter time increment better capture short, intense periods of rainfall and may result in higher, more realistic runoff hydrographs. Since the data obtained from Weather Underground has inconsistent recording times at this location, ranging from 3 minutes to 1 hour, it was necessary to interpolate between some records to create the consistent 10 minute increment distribution for input into the HEC-HMS model.

HMS Model Calibration
HEC-HMS version 4.2.1 was used for the hydrologic analysis for this phase of the project.

From a review of available documentation, it appears that the effective FIS hydrologic analysis developed the flood hydrograph by scaling of the flood frequency information from Gilmore Creek in Winona, MN based on calculations utilizing the Bureau of Public Roads Method, also called the Cook Method. The USACE HEC-1 model was utilized to route the hydrograph through the Ebner Coulee System with UNET modeling utilized to develop water surface elevations.

During the first phase of this project, SEH estimated flow rates using the USGS Regional Regression Equations for Wisconsin; that analysis resulted in flow rates much lower than the 1430 cfs depicted in the effective FIS as the 1-percent discharge. See Table 1 for the Regression Equation results.

Table 1: Phase 1 Regression Equation Results

Source	Location	Drainage Area (SqMi)	Peak Flow (cfs)	ESE (%)	Minus 1 Standard Error (cfs)	Plus 1 Standard Error(cfs)
FEMA Effective	All Locations	0.9	1430.0			
Regression Eq.	Upstream Limit of Fema Model	0.61	360.8	44	202.0	519.5
Regression Eq.	Jackson Street	0.88	428.5	44	240.0	617.0
Regression Eq.	Farnman Street	1.13	494.7	44	277.0	712.3

During the first phase of the project, a HEC-HMS model using the SCS hydrologic method was also developed as another means to estimate peak flow rates; this methodology resulted in flow rates higher than the Regression Equations (100-year discharge of 601 cfs for the 0.61 square mile drainage area to the upstream end of the model), but still significantly lower than the 1430 cfs effective flow rate. SCS hydrology with HEC-HMS is being used again for this second phase of the project to create a hydrologic model calibrated to the 1430 cfs for the 100 year event.

An area of 0.9 square miles was used for the calibrated watershed model, this area corresponds to the larger watershed to the top of Jackson Street, not the top of the Ebner Coulee drainage ditch. It was determined that this was the only drainage area utilized in the original FIS to obtain the 1-percent flow rate of 1430 cfs. Based on the hydrologic characteristics, the Curve number (CN) and time of concentration of 58 and 67 minutes, respectively, were estimated.

Executing the hydrologic model with these original parameters results in a flow rate of 892 cfs, well below the 1430 cfs desired for calibration, so the CN was increased to 65 and time of concentration was lowered to 49. These values result in a 100 year peak flow rate of 1431 cfs, making this the HEC-HMS model calibrated to the FIS flow rate. Changing the CN and time of concentration to these values is reasonable for the following reasons: The original CN corresponded to B classified soils, because that is the majority soil classification in this area according the NRCS soils data. The new value of 65 corresponds to the same land cover distribution, but with half C classified soils and half B classified soils. The NRCS soils data is very approximate, and there are some C soils in the drainage area, so using a balanced value is very reasonable. Estimating the time of concentration is relatively approximate, so lowering it by 18 minutes is not unrealistic given the steep slopes of the watershed.

HEC-HMS Hydrologic Modeling with FIS Calibrated Model

A HEC-HMS model run was developed for each year utilizing the FIS calibrated hydrologic model and the historic unit hyetograph distributions from the Municipal Airport station with La Crosse Weather Forecast Office station total depths. These depths should be more appropriate for the Ebner Coulee watershed given the closer distance, the rainfall distribution was assumed to be similar to that of the Municipal Airport. Table 2 shows the peak flow rate results for each storm from the FIS calibrated HMS model. The approximate duration over which the majority of the rainfall total fell is also shown in Table 2, note that the rainfall distributions varied greatly, so for some storms the rainfall total may have fallen continuously while for others may have been made up of several separate periods of rainfall. The Atlas 14 rainfall depths for the 1-, 2-, 10-, 50-, and 100-year, 24-hour storm events with MSE3 distributions were also modeled in the FIS calibrated model for comparison and are shown in Table 3.

Table 2: Highest Total Storm Depth per Year and FIS calibrated HEC-HMS Peak Flow Results

	Total Storm Depth (in)			
	Municipal Airport	Weather Forecast Office		
Year	USW00014920	USC00474373	Peak Flow(cfs)	Duration (hours)
2001	3.12	4.19	318	32
2002	2.7	2.9	77	45
2003	1.05	1.39	3	28
2004	3.53	2.76	53	41
2005	3.15	2.96	171	28
2006	1.82	2.89	110	25
2007	6.76	7.59	**326**	40
2008	4.4	5.31	**527**	36
2009	3.33	3.36	317	23
2010	3.87	3.99	148	29
2011	0.98	2.58	153	36
2012	1.61	1.63	11	15
2013	2.77	2.42	74	29
2014	1.16	2.77	117	22
2015	1.49	2.32	40	14
2016	4.7	4.28	111	32
2017	5.15	6.26	**996**	12

Table 3: Atlas 14 Depths with MSE3 Distribution Peak Flow Results

Storm	Atlas 14 Depth	Q Peak (cfs)
MSE3 - 1 yr, 24 hr	2.61	95
MSE3 - 2 yr, 24 hr	3.01	159
MSE3 - 10 yr, 24 hr	4.47	490
MSE3 - 50 yr, 24 hr	6.53	1093
MSE3 - 100 yr, 24 hr	7.57	1431

HEC-RAS Hydraulic Modeling

The unsteady 1D-2D coupled HEC-RAS model from the first phase of the project was used for this analysis. HEC-RAS version 5.0.3 was used. This model uses 1D techniques to represent flow within the ditched portion of Ebner Coulee, and 2D techniques for the floodplain areas, when flow spills out of the channel. This model was chosen because it the best mix of preserving the original FIS modeling methodology while incorporating 2D modeling techniques for the complex overbank flows that cannot be properly represented with 1D flow methods. The three highest peak flow historic events were modeled, the years of these events are 2007, 2008, and 2017.

The HEC-HMS model was calibrated with a drainage area of 0.9 square miles to match the drainage area in the original FIS study; from a review of the watershed, this corresponds to the area draining to the top of Jackson

Street. The historic flow hydrographs obtained from this FIS calibrated HEC-HMS model were input at Jackson Street in the HEC-RAS model, which differs from the effective FIS HEC-RAS model which included the hydrograph from this drainage area at the top of the model/start of the Ebner Coulee. To estimate the discharge at the upstream end of the Coulee, the FIS calibrated HEC-HMS model was duplicated and the drainage area was modified to 0.61 square miles, the area draining to the top of the coulee system. This was used to obtain the flow hydrograph at the top of the coulee system for the historic storms. Table 4 shows the historic peak flows to Jackson Street and the historic peak flows to the top of the Ebner Coulee ditch for the three storms modeled. Note that the hydrograph applied to the HEC-RAS model at Jackson Street is actually the result of the total hydrograph with the top of model hydrograph subtracted from it, so the flows below Jackson Street will be summed correctly. Travel time between the two points is minimal and was neglected with this methodology.

Table 4: Peak Flows of Hydrographs used in HEC-RAS (FIS calibrated HEC-HMS model)

	Peak Flow(cfs)	
Year	0.9 Sq-mi	0.61 Sq-mi
2007	326	221
2008	527	357
2017	996	675

Figures 2, 3, and 4 depict the inundation of these three historic events as modeled with the unsteady 1D-2D HEC-RAS model using hydrographs developed with the FIS calibrated HEC-HMS model. The FEMA effective 1-percent floodplain is also shown for comparison.

Historic Storms Compared to Regional Regression Equations

For phase 1 of the project, a HEC-HMS model was developed using the MSE3 distribution with a 7.1 inch 100 year, 24 hour rainfall depth and calibrated to output flows matching the results from the USGS Regional Regression Equations (RRE). Similar to the modeling performed with phase 2, there was a version of this model with a drainage area of 0.61 square miles (to the top of the coulee/start of model) and a model with a drainage area of 0.9 square miles (to Jackson Street) matching the original FIS drainage area.

The three peak historic rainfall events were modeled with these RRE calibrated HEC-HMS models to obtain peak flows and hydrographs for the historic events calibrated to the Regional Regression Equation results. The 10, 50, and 100 year events with MSE3 distributions and Atlas 14 rainfall depths were also modeled with this calibrated model for comparison. The RRE calibrated HEC-HMS model peak flow rates for the historic events are shown in Table 5; this is a revised version of Table 4 showing the RRE calibrated HEC-HMS model peak flow rates compared to the FIS calibrated HEC-HMS model peak flow rates. Table 6 shows the MSE3 distribution peak flow rates from the RRE calibrated HEC-HMS model; the 100 year MSE3 peak flow is higher than the Regression Equation peak flow rates because Atlas 14 rainfall depths are slightly higher than the regression equation publication rainfall depths. The RRE calibrated peak flows are lower in 2008 than they are in 2007, opposite as seen with the FIS calibrated model; this is because the RRE calibrated HMS models have a different curve number and required much higher time of concentration/lag time and the lower rainfall depth and resulting runoff volume results in lower peak runoff rates.

Table 5: FIS Calibrated Peak Flow Rates versus RRE Calibrated Peak Flow Rates

	FIS Calibrated Historic Peak Flow (cfs)		RRE Calibrated Historic Peak Flow (cfs)	
Year	0.9 Sq-mi	0.61 Sq-mi	0.9 Sq-mi	0.61 Sq-mi
2007	326	221	241	172
2008	527	357	169	151
2017	996	675	441	317

Table 6: MSE3 Peak Flows from RRE Calibrated HEC-HMS Model

		RRE Calibrated Model MSE3 Peak Flow (cfs)	
Storm	Atlas 14 Depth	0.9 Sq-mi	0.61 Sq-mi
MSE3 - 10 yr, 24 hr	4.47	42	29
MSE3 - 50 yr, 24 hr	6.53	360	302
MSE3 - 100 yr, 24 hr	7.57	486	414

The runoff hydrographs developed from the RRE calibrated models were modeled in HEC-RAS and the resulting flood inundation areas are also depicted in Figures 2, 3, and 4.The purpose of this is to compare the observed historic flooding in the area to that of the inundation areas calculated from the various hydrologic methodologies. The method which most closely matches that of historic observations would be the most appropriate to utilize to represent the flood risk for the area.

Results Discussion

From a review of the available rainfall data from the past 20 years of record, it is apparent that none of the historic rainfall events reproduced the 100 year published flow rate, despite the August 2007 (40-hour duration) storm having rainfall totals near the 100 year Atlas 14 totals. The reason for this is that the real-world rainfall events do not always follow the MSE3 distribution which was used to calibrate the model. It's important to note that the original design hydrograph used in the effective modeling is unknown and not available for calibration against. The MSE3 distribution is conservative because it is developed utilizing the critical duration events and is typically used for design purposes. This means that the "true" 100 year rainfall distribution may be less intense than the MSE3 distribution, but the MSE3 is currently the most widely accepted rainfall distribution for this area.

2007 Peak Event

The 2007 event had the highest rainfall total depth. The rainfall depth over 40 hours is almost equal to the 100 year Atlas 14 depth at the Weather Forecast Office. Approximately 6.7 inches of this total fell in approximately 25 hours, which makes this portion of the storm initially appear to approximate a 50 year, 24 hour event. However, the calculated peak flow rate is nowhere near the 1093 cfs associated with the 2-percent event. Figure 5 shows the cumulative rainfall of the 2007 storm and the resulting runoff hydrograph from the FIS calibrated model. There are three periods of higher intensity rainfall that produce separate runoff peaks, this is part of the reason the peak flow rate is much lower than 1093 cfs. Figure 6 shows the 2007 storm cumulative rainfall and the MSE distribution cumulative rainfall for a 100 year, 24 hour storm. The MSE3 distribution has a very short intense period of rainfall where the majority of the rain falls within a 20 to 30 minute time period. The historic 2007 storm had slower steady rainfall spread over a longer time, which does not result in the same peak runoff even though the total reported storm totals are near the 100 year Atlas 14 depths.

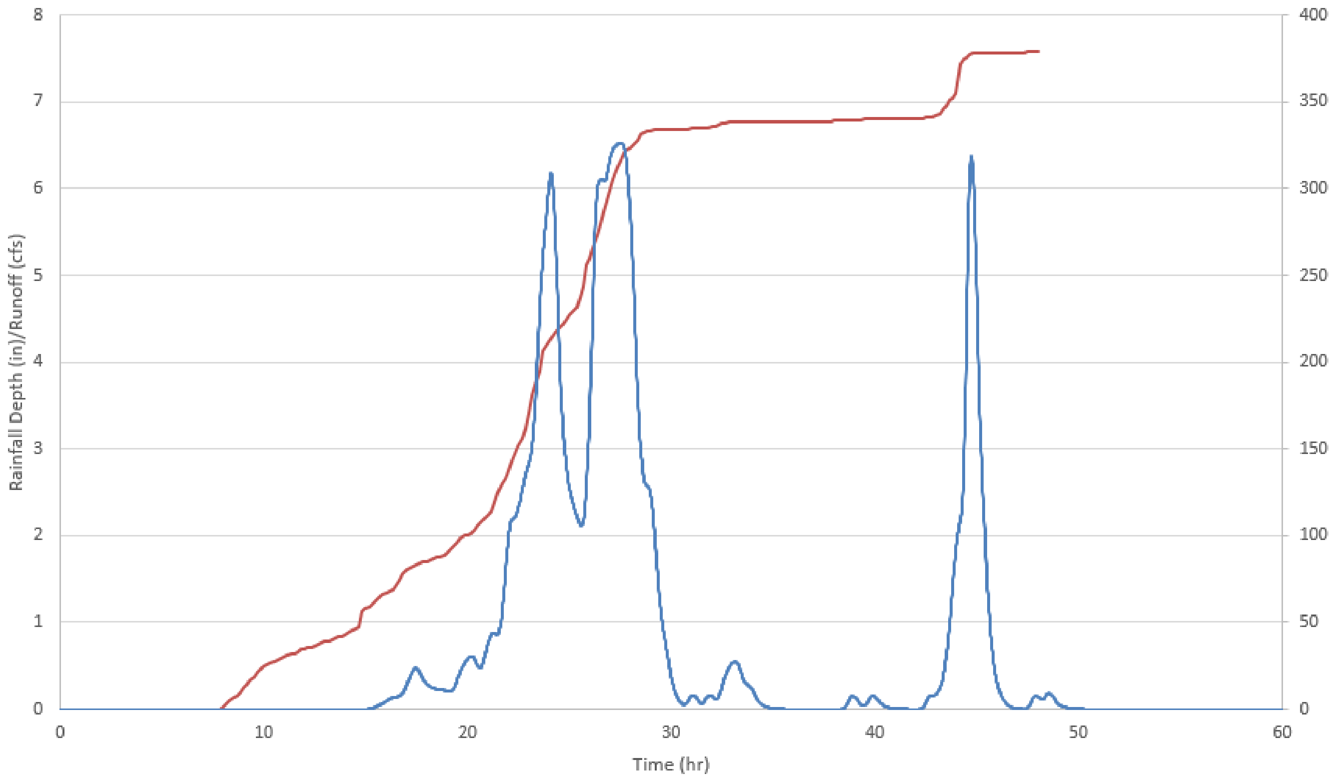

Figure 5: 2007 Historic Cumulative Rainfall and Resulting Runoff from FIS Calibrated HMS Model

See Figure 2 for the flooding inundation area results of the 2007 event from HEC-RAS. The inundation results from both the FIS calibration and RRE calibration are shown. The structures that would be at least partially inundated with the FIS calibration are also shown. For both calibrations, there is only very minimal flooding and only 2 structures that would appear to be inundated. For the FIS calibration, a small amount of flow would still break out from the Ebner Coulee ditch upstream from the 29th Street culvert, and flow would break out over the west bank between Jackson and Farnam Street. The RRE calibrated model is showing inundation to the west of the train tracks north of Farnam Street; flooding in this area is likely overestimated by the model because as previously discussed, not all of the runoff from the drainage area delineated to Jackson Street would actually get into the channel. Much of it would be picked up by storm sewer or stored in other depressions.

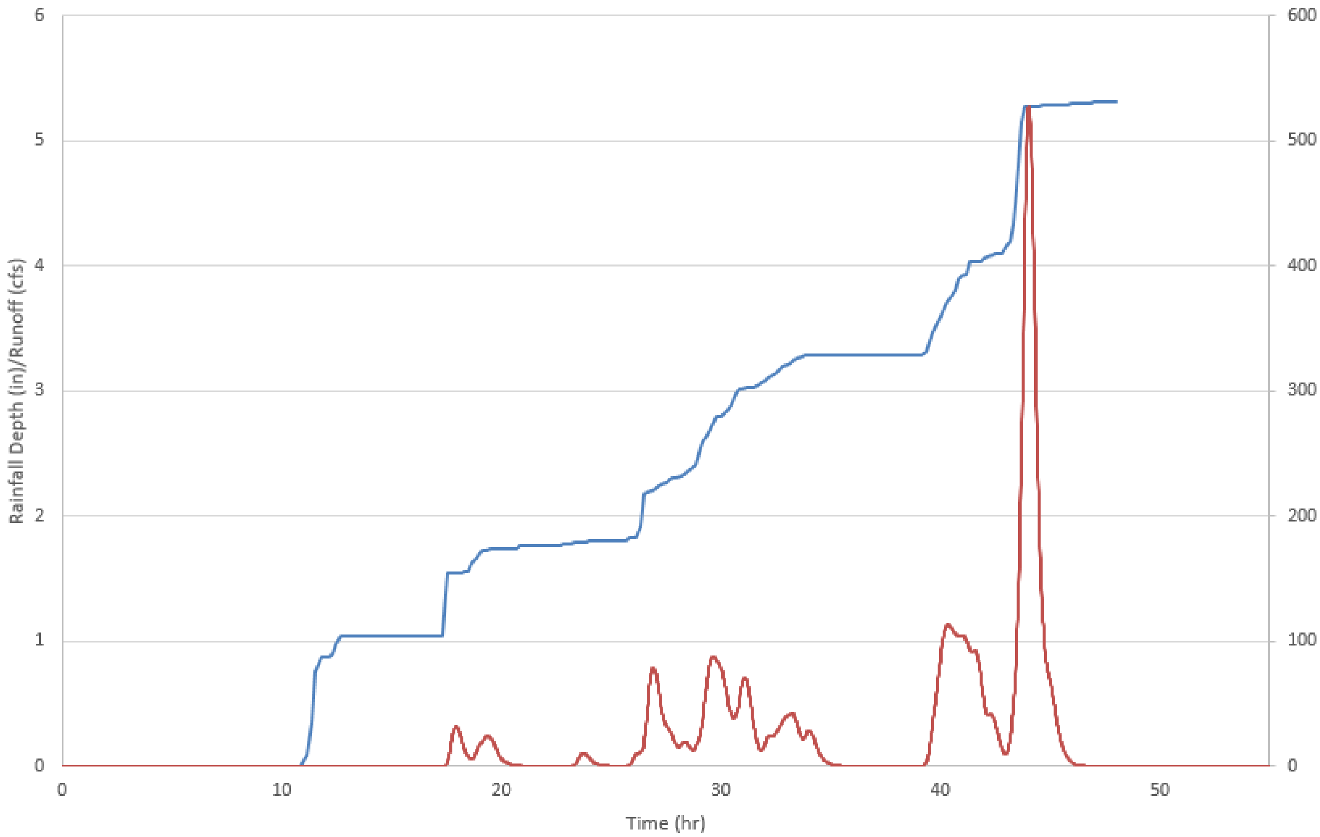

Figure 7: 2008 Historic Cumulative Rainfall and Resulting Runoff from FIS Calibrated HMS Model

For the 2008 event, more flow breaks out of the Ebner Coulee ditch upstream from the 29th Street culvert in the FIS calibrated model. This water then runs down the street and ponds up north of Farnam Street. Like with the first phase of modeling, the city storm sewer in this area was not modeled; this is consistent with the original FIS modeling technique. Approximately 24 homes appear to be at least partially inundated with this calibrated modeling. Based on feedback obtained during the City of La Crosse Floodplain Task Force Committee meeting, no homes were inundated during this event. The 2008 event results from the RRE calibrated model, shows only extremely minimal flooding to the west of the train tracks north of Farnam Street, which appears to be more in line with historic observations in the field.

2017 Peak Event

The 2017 event had the second highest total rainfall depths and produced the highest calculated runoff in the last 20 years. There are several periods of very high rainfall intensity, with the highest producing over an inch of rain in approximately 10 minutes. Aside from the period around hour 25 where the rainfall stopped temporarily, the rainfall distribution of this storm is much closer in shape and intensity to the MSE3 distribution than the storms of 2007 and 2008. The total rainfall depth at the Weather Forecast Office station is approximately a quarter of an inch less than the Atlas 14 50-year, 24 hour rainfall depth of 6.53 inches. The total storm length was approximately 12 hours, with most of the rain falling in just 5 to 6 hours. The Atlas 14 100 year, 12 hour rainfall total is 6.72 inches; this indicates that the July 2017 storm had a recurrence interval nearly that of a 50 year event.

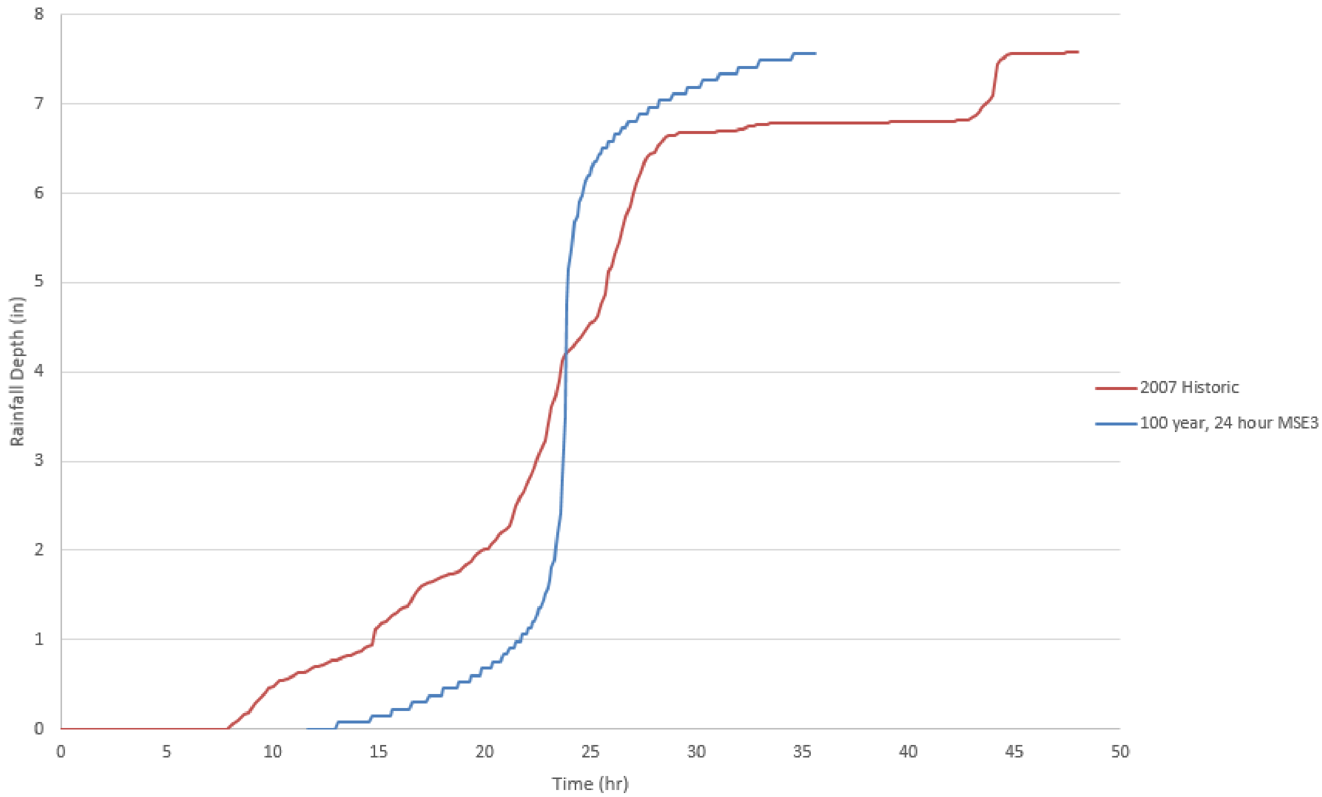

Figure 6: 2007 Historic Cumulative Depth and 100 year, 24 hour MSE3 Cumulative Depth

2008 Peak Event

As shown in Figure 7, the 2008 event has a similar cumulative rainfall distribution as the 2007 event, with slow, steady rain over a long time. However, the 2008 event had one period of high intensity where over an inch of rain fell in under an hour. This intense period resulted in a short but relatively high flow period of runoff.

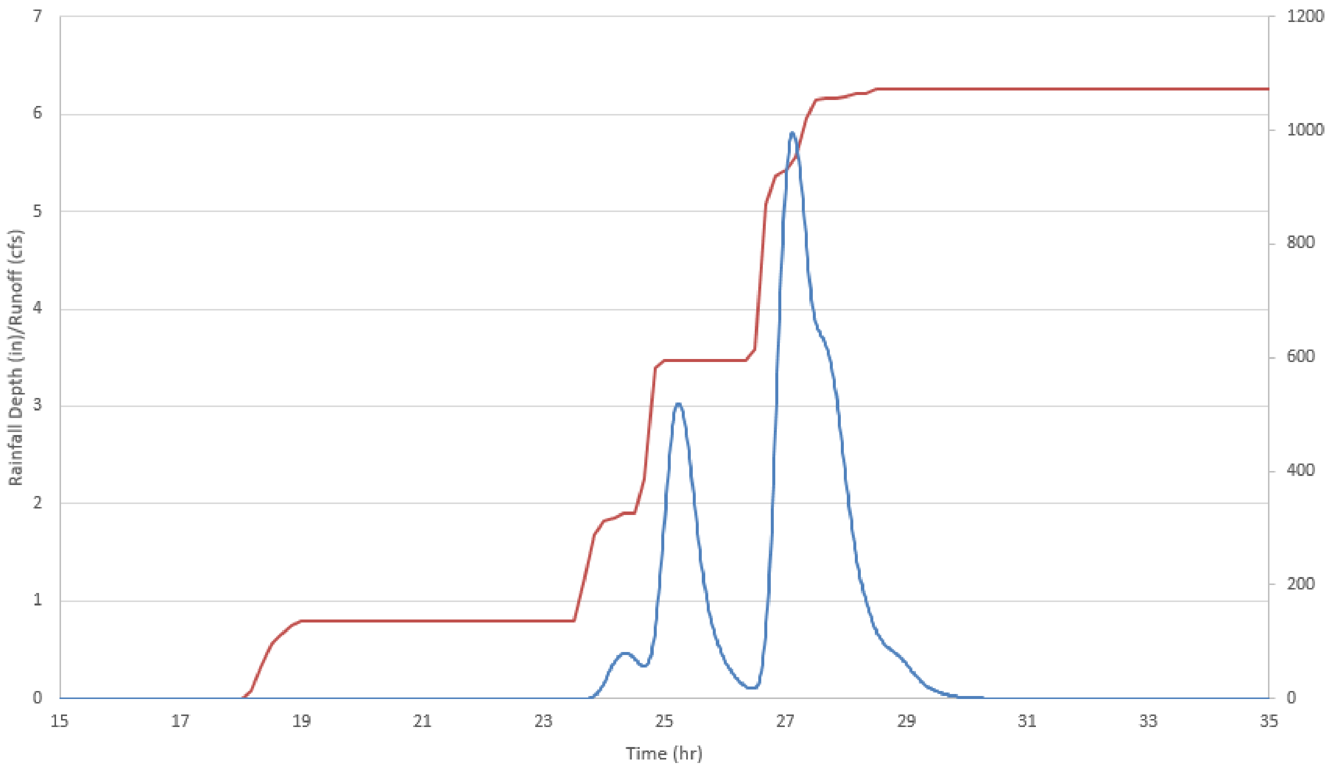

Figure 8: 2017 Historic Cumulative Rainfall and Resulting Runoff from Calibrated HMS Model

For the 2017 event FIS calibrated model, there is significant flow break out from the Ebner Coulee ditch upstream from the 29th Street culvert and flow break out from the right bank near the upstream end of the Ebner Coulee model. This results in additional inundation north of the drainage ditch, like what is seen in the effective FEMA inundation map. The flooding and ponding north of Farnam Street is major. Up to 88 homes appear to be at least partially inundated with this FIS calibrated modeling of the 2017 event, when no homes were reported to be inundated during this event.

For the 2017 event RRE calibrated model, there is still a significant amount of break out flow predicted from the left bank of the Ebner Coulee ditch upstream from the 29th Street culvert. This is similar to the amount of flooding seen with the model results associated with Regional Regression Equation developed 100 year event, from Phase 1 of the study. Based on input during the City's Flood Task Force Committee, even this inundation area is greater than that experienced in the field. This could suggest that even the Regional Regression Equation flow estimates over predict that experienced, but what may be more likely is that the 29th Street culvert or Ebner Coulee drainage ditch 1D geometry in the model is more restrictive than it is in reality, forcing more water out of the channel at this location. The 1D channel portion of the model has not been changed from the FIS effective model.

Summary

A 100-year (1-percent) event does not appear to have occurred in the Ebner Coulee watershed over the last 20 years; however, the 2017 storm was very close to that of a 50-year event. A 50-year flow rate is not reported in the Flood Insurance Study (FIS), but would be expected to be around 1100 cfs based on the FIS calibrated HMS model. The HEC-RAS modeling indicates that a 50-year event and the 2017 event would cause major flooding when using a model calibrated to the FIS 100-year flow. The fact that a nearly 50-year flood event and several other major events occurred in the last 20 years, and no major flooding was reported as the modeling would indicate strongly that the published 1-percent effective flow rate of 1430 cfs is too high and a Letter of Map Revision (LOMR) based on a hydrologic analysis with lower discharge rates predicated on a hydrologic model calibrated to the USGS Regional Regression equations would be warranted.

R.M.

Attachment 1: Technical Feasibility Report – Ebner Coulee Floodway FIRM Remapping
Attachment 2: Figure 1 – Weather Station Locations
Attachment 3: Figure 2 – 2007 Peak Event Calibrated Inundation
Attachment 4: Figure 3 – 2008 Peak Event Calibrated Inundation
Attachment 5: Figure 4 – 2017 Peak Event Calibrated Inundation

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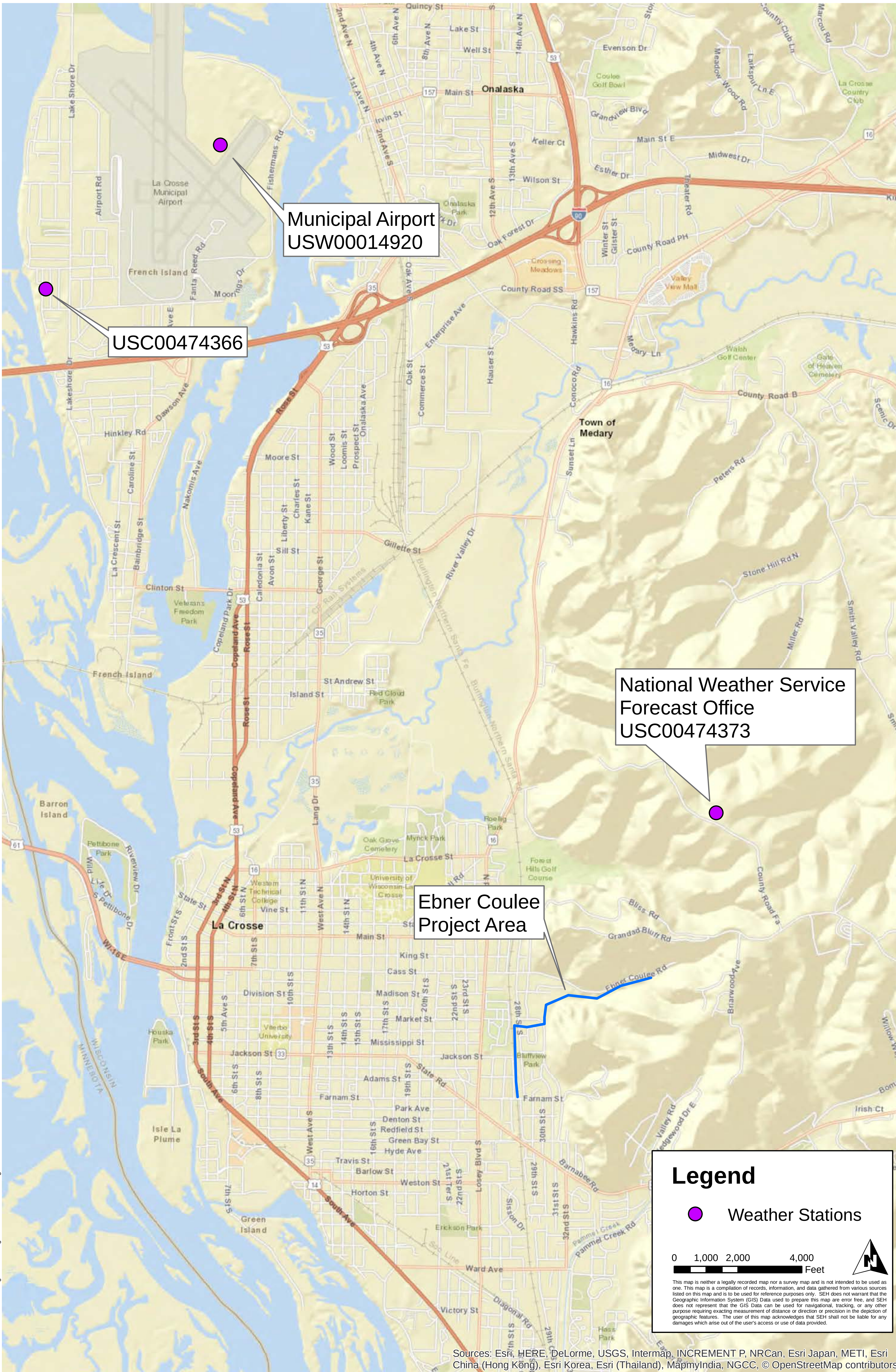

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Project Number: LACRS 142540
Print Date: 11/29/2017

Map by: rmondloch
Projection: NAD_1983_StatePlane_Wisconsin_South_FIPS_4803_Feet
Source: ESRI, FEMA & SEH

Ebner Coulee Floodway FIRM Remapping
La Crosse, WI

FIGURE 1
Weather Station Locations

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Project Number: LACRS 142540
Print Date: 12/1/2017

Map by: rmondloch
Projection: NAD_1983_StatePlane_Wisconsin_South_FIPS_4803_Feet
Source: ESRI, FEMA & SEH

SEH

Ebner Coulee Floodway FIRM Remapping
La Crosse, WI

FIGURE 2
2007 Peak Event
Calibrated Inundation

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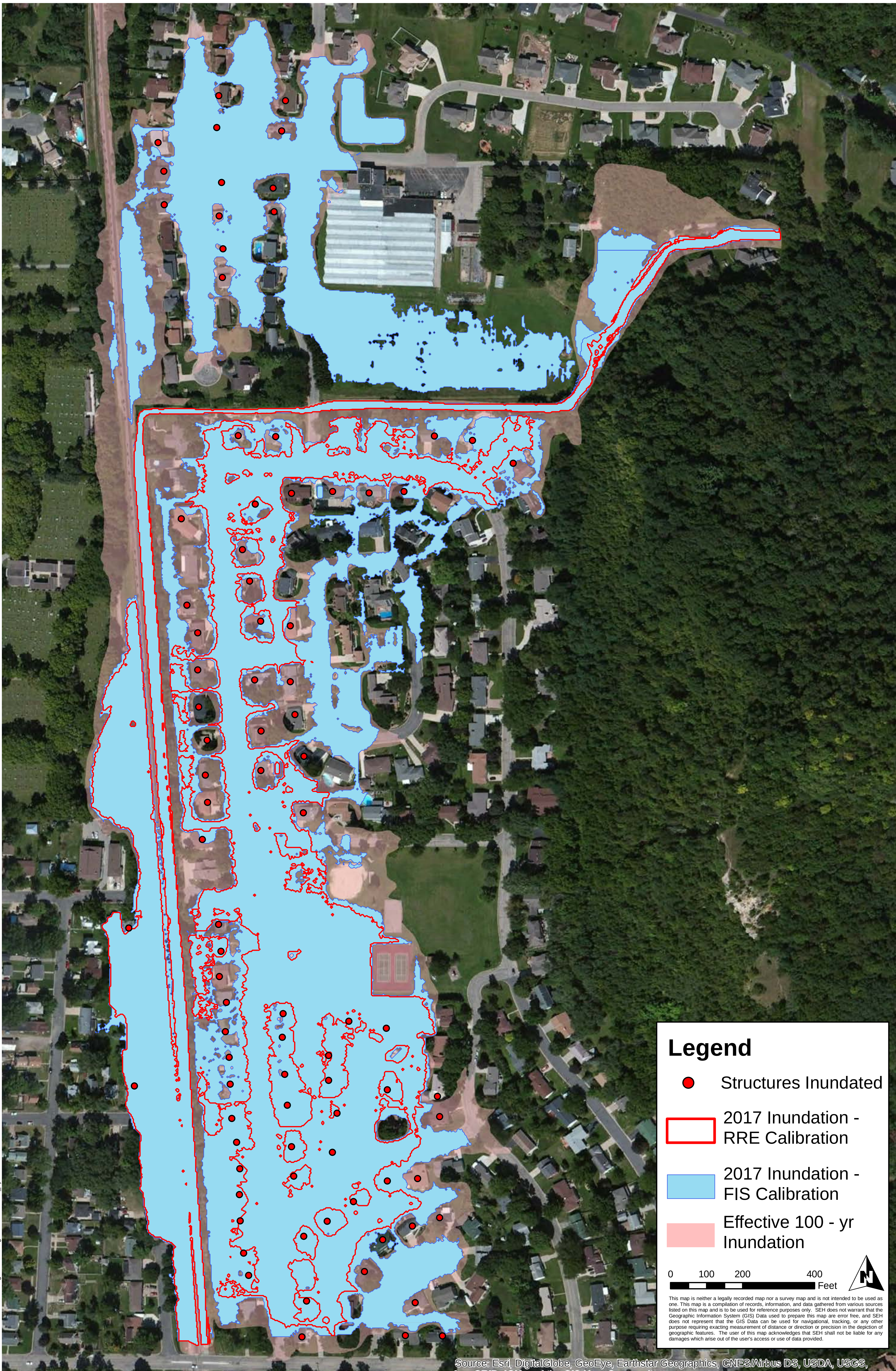
Project Number: LACRS 142540
Print Date: 12/4/2017

Map by: rmondloch
Projection: NAD_1983_StatePlane_Wisconsin_South_FIPS_4803_Feet
Source: ESRI, FEMA & SEH

Ebner Coulee Floodway FIRM Remapping
La Crosse, WI

FIGURE 3
2008 Peak Event
Calibrated Inundation



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Project Number: LACRS 142540
Print Date: 12/4/2017

Map by: rmondloch
Projection: NAD_1983_StatePlane_Wisconsin_South_FIPS_4803_Feet
Source: ESRI, FEMA & SEH

Ebner Coulee Floodway FIRM Remapping
La Crosse, WI

FIGURE 4
2017 Peak Event
Calibrated Inundation

Building a Better World for All of Us®

December 4, 2017

RE: City of La Crosse
Ebner Coulee Floodway FIRM Mapping
SEH No. LACRS 142540 14.00

Mr. Christoper Olds
Water Regulations and Zoning Engineer
Wisconsin Department of Natural Resources
PO Box 7921
Madison, WI 53707-7921

Dear Mr. Olds:

SEH Inc. has been contracted by the City of La Crosse to review the effective floodplain mapping and associated hydrologic and hydraulic modeling for the Ebner Coulee watershed as depicted on FIRM panel 55063C 0262D effective 1/06/2012.

We are submitting the following information as an initial request for review and comment by the Wisconsin Department of Natural Resources against the requirements for the State of Wisconsin overview and concurrence in support of a Letter of Map Revision (LOMR) submittal by the City to formally modify the FIRM panel for the Ebner Coulee watershed. We understand that additional detail and effort may be required as part of a LOMR submittal package, but prior to the City expending additional funds, we want to first discuss the proposed approach.

The following is a summary of the provided information:

Phase 1 Ebner Coulee Floodway FIRM Remapping Technical Feasibility Report, dated August 22, 2017. This is referred to as the first phase of the study and was completed to reevaluate and update the hydrologic and hydraulic analysis of the Ebner Coulee watershed and floodplain using USGS regional regression equations to estimate peak flow rates and current HEC-RAS unsteady modeling routines with one-dimensional and two-dimensional capabilities to depict the flow and conveyance conditions of the complex urban floodplain system. The goal of the study was to determine if the use of an alternate hydrology method and inclusion of additional topographic mapping in the upper part of the watershed would result in a significantly different mapping of the 1-percent floodplain as compared to FEMA's effective Flood Insurance Rate Map (FIRM) for the area.

Ebner Coulee Floodway Remapping Study Fact Sheet, dated October 2017. This fact sheet outlines the analysis contained in the Draft Ebner Coulee Floodway FIRM Remapping Technical Feasibility Report. The fact sheet provides a summary overview of the initial analysis as it was presented to the City of La Crosse Flood Task Force Committee.

Ebner Coulee Modeling Phase 2 – Historic Rainfall Analysis Memorandum, dated December 4, 2017 from Brad Woznak and Riley Mondloch to Mr. Bernard Lenz. This memorandum summarizes the analyses and results from Phase 2 of the study which involved developing a HEC-HMS hydrologic model to estimate peak flow rates for the Ebner Coulee system. Model calibration and validation was also performed by analyzing historic rainfall events over the past 20 years with calibrated HEC-HMS models combined with a 1D/2D HEC-RAS model to estimate peak water surface elevations and resulting inundation areas. The ultimate goal of this study was to either verify that the FIS discharge rates are appropriate for the associated flood risk, or if not, develop a more appropriate methodology to move the project forward for a FEMA LOMR submittal. The ultimate results of the study indicated that the flow rates developed for a hydrologic model calibrated to the FIS discharge rates resulted in unrealistically high flood inundation areas than those that area experienced under historic conditions. Even lower discharge rates developed utilizing a RRE calibrated hydrologic model seem to over-predict flood inundation areas when comparing to the observed historic conditions.

Once you have had a chance to review the provided information, we would like to schedule a discussion meeting. The goal of the meeting will be to discuss the analysis to date, obtain the State’s initial thoughts, and to help estimate the future level of effort required to receive the State’s overview and concurrence to support a LOMR to formally update the FIRM for the Ebner Coulee area.

I can be reached at 651.490.2125 or via e-mail at bwoznak@sehinc.com.

Sincerely,

SHORT ELLIOTT HENDRICKSON INC.

Brad T Woz

Brad T Woznak
Sr. Professional Engineer

btw
Enclosure
c: Mr. Bernard Lenz – City of La Crosse

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EBNER COULEE FLOOD SURVEY **February 2, 2018**

Greetings:
You are being contacted in an effort to gather historical flooding information from property owners located in the Ebner Coulee watershed of La Crosse and Shelby. The City has done preliminary studies that indicate the run-off model used to create current floodplain maps over predicts the extent of flooding in your neighborhood. The reason for this survey is to gather observations of flooding during the July 19-21 of 2017 rain event for the purpose of comparing observed flooding depth and extents to model predicted flooding depth and extents. The goal is to convince WDNR and FEMA to allow the City to revise the modeling approach to get results that more accurately match what is being observed. We need your help with those observations!

Pictures of water or debris lines would be the best documentation of flooding that we could get. But to document that you were not flooded is also very critical as the model used to make the current flood map indicated 88 houses would have been inundated with flood water during the July 2017 event. We don't believe that happened, so returning a survey indicating you were <u>not</u> flooded is very, very important data to have to help prove our case for a remapping. We hope that by improving these maps there is potential for reduced flood insurance rates for the properties impacted.

If you have historical pictures of flooding or debris lines those would also be useful, but we are particularly interested in the July 19-21, 2017 storm event. It is critical that we gather as much and as accurate of information as possible about this event to complete this project. Please complete this survey at your earliest convenience. We will be compiling results starting March 1st. Thank You.

Mail survey and pictures to:

Bernard Lenz – P. E.
City of La Crosse Engineering Department
400 La Crosse St.
La Crosse, WI 54601
608-789-7364

Or scan and email surveys and pictures to:

EbnerCouleeFlooding@cityoflacrosse.org

++

<u>Question 1</u>: Did you receive any flooding related impacts or damages to your property or residence from the July 19-21 of 2017 event?

YES ☐ NO ☒

<u>Question 2</u>: Did you see any significant standing water near or from the Ebner Coulee drainage ditch during the dates specified above?

YES ☒ NO ☐

<u>Question 3</u>: Did you observe any flowing water through your yard or a neighbor's yard?

YES ☐ NO ☒

<u>Question 4:</u> Did you see any evidence of flooding that had already disappeared? This would include things such as debris, flattened grass, exposed soil, or another indication there was standing or flowing water.

YES ☐ NO ☒

Question 5: Did you make any observations of water level within the Ebner Coulee drainage ditch itself?

YES ☒ NO ☐

Question 6: Did you make any other observations during this storm event that you feel would be helpful in assessing the flood levels? If so, please state them below.

The water reached a significant level in front of our home; however, this was due to the drainage grate being blocked with debris (tree limbs)

Question 7: Do you have any pictures or documentation of historical flooding in Ebner Coulee?

YES ☐ NO ☒

Question 8: Describe You.

Name: Brandon Eagan Year's in current residence: 2+

Address: 1214 27th St S Phone #: 608-433-3793

Email: Eagan06@gmail.com

Best Way and Time to Contact Email or Phone before 3pm

If your answer was YES to any of the questions please attach a description of your observations and/or provide any documentation or photos that you have of the damage or water levels. If you prefer we call you to discuss your observation check here.

CALL ME ☒

Depending on your survey responses, a representative from the City may be following up with you to gather additional information or survey data. We hope you are willing to meet with City staff at your residence and discuss/point out any observations you may have made so staff can survey the location and elevation of those observations. Again, Thank You.

Please email or mail the survey and pictures to the address listed on page 1.