Ebner Coulee Floodway Remapping Study

Potential Floodplain Maps & Their Regulatory Options

April 2020 Fact Sheet

Model & Regulation Options

How different Models Affect the Final Map & Zoning

The goal of this project is to update the Ebner Coulee floodplain mapping to appropriately represent the underlying flood risk while providing the City with the best tool to fit their needs in floodplain management. The following pages outline 3 different options that were identified through discussions with the WDNR as a potential routes to reaching a new more accurate floodplain map for the City.

It is important to recognize that different options will affect how the City must regulate their floodplain in the long term. In short, the City must decide between the option of higher flood elevations with less strict regulations or lower elevations with higher regulations.

1D Steady State Modeling

This option uses the typical flood modeling approach that was used for all other river based floodplains within the City limits. This option would require no special regulations but produces a flood elevation higher than the other options.

1D Unsteady State Modeling

Unsteady modeling allows for the City to use flood storage in the existing mapped floodplain to show a reduction in the flood elevations. The downside is that the City must then maintain this flood storage by requiring compensatory storage for all fill that is placed within the floodplain. FEMA and the WDNR will require that permits for this area be closely monitored in perpetuity.

2D Modeling

2D modeling offers the lowest flood elevations, but the highest potential regulations. Wisconsin has not currently approved any 2D floodplain models and the review period for this model would be extensive. Likely, the entire floodplain would be mapped as floodway and the model will need to be updated prior to any fill being placed to prove that there is no effect to the flood elevations.

Project Update

On April 23rd City staff and the team at SEH participated in a conference call with the WDNR to discuss potential paths forward for the Ebner Coulee LOMR.

The State Floodplain Engineer, Chris Olds, and the rest of the team at the WDNR will be the first round of reviews that the LOMR must go through before it can be adopted into the NFIP

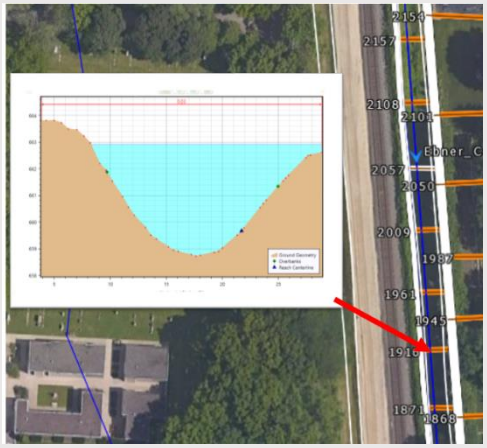
Out of this conversation, three different modeling approaches for final submittal were identified as potentially approvable by the DNR and by FEMA for incorporation into the City's floodplain maps.

For minutes from this meeting please contact Jordan Thole at Jthole@sehinc.com

HEC-RAS

Originally developed by the US Army Corps Of Engineers and used since the mid-90s for most flood analyses across the US. The model uses cross-sections of the channel along the centerline to calculate a water surface elevation based on a known peak flowrate. The model also assumes that the peak flowrate is constant and that all possible storage in the floodplains will be filled.

CROSS-SECTION EXAMPLE



1D- STEADY STATE MODEL

The current floodplain model for Ebner Coulee

BASICS

Steady-state models have been around for decades and are widely used to model floodplains across the world. The models are simplistic in comparison to modern techniques but have been proven over time to be as accurate as other models for a typical river model.

The model is called 1- Dimensional because the model assumes that water will only flow downstream. It cannot account for water flowing naturally around structures or the channel splitting without the user specifically forcing it to happen.

It is steady-state because the model assumes that the flow in the stream is constant and will flow forever at the peak flood flows. This works great for typical rivers, but not for areas where large low lying area provide storage for flood waters.

PROS

- Most commonly used model and is typically the easiest model to get approval from regulatory agencies
- Matches the City's current zoning regulations

CONS

- Highest floodplain elevations for Ebner Coulee
- Assumes water is flowing through neighborhoods leading to wider floodway delineations

SO WHAT DOES THIS MEAN?

If this methodology is used to submit the final maps to the WDNR and FEMA, the City will likely have a floodplain that is both higher and wider than other proposed options. The benefit is that it will make the area simpler for City staff to regulate using the currently adopted model zoning ordinances from the WDNR.

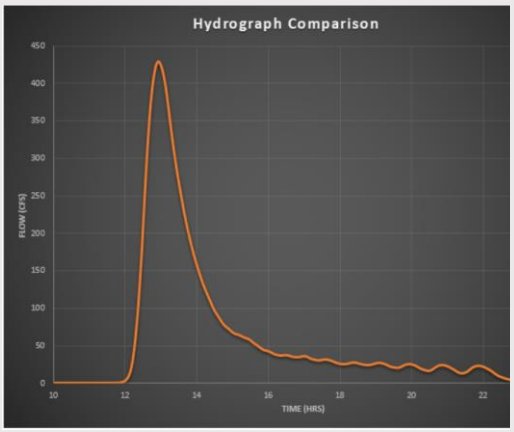
The current effective maps from FEMA utilize this modeling to map the regulatory floodplain. This methodology along with the higher flowrates in the FEMA model may be one of the reasons that the current maps seemingly over predict flood risk in Ebner Coulee.

UNSTEADY HEC-RAS

Inflow hydrographs replace the constant flowrates in the HEC-RAS model giving the model a finite volume of water to include in the flood analysis. This finite volume allows the engineer to look at the floodplain as not only a river channel, but also as a way to retain water to reduce the flood elevations.

This model is commonly used in dam and levee modeling to look at the effects that floods will have if there was a failure.

INFLOW HYDROGRAPH



1D-UNSTEADY STATE MODEL

A Volume Based Model

BASICS

Unsteady models operate very similar to their steady counterparts and can be built using the same software. The primary difference is that while steady state models assume that the flow in the channel is constant, unsteady models assume the flows will start at normal conditions and ramp up to a peak flow before returning to normal.

This inflow ramp up and slowdown is described with a flow hydrograph which is developed using a hydrology model. This gives the model not only the stream flows but also the volume of water a flood will generate which allows the user to now account for flood storage.

This model will also allow for the water along 28th St. to exit through the City storm sewer instead of being tied directly to the outlet at the downstream end of Ebner Coulee.

PROS

- Lower flood elevations
- Accounts for water leaving through City's storm sewer
- More accurate for Ebner Coulee where storage is key

CONS

- Higher regulations due to flood storage
- Less common in WI and will likely take longer to get approval from WDNR

SO WHAT DOES THIS MEAN?

Ebner Coulee only overtops its banks for a short period of time during the 100yr flood meaning that a relatively small volume of water enters the 28th St floodplain areas. With this model we can look at that estimated volume separate from Ebner Coulee which lowers the base flood elevation

The downside is that much of the storage area along 28th St is essential to maintaining those lower elevations and must be maintained. The City will be required to adopt new regulations that strictly require compensatory storage for all new fill brought into this area to maintain the flood storage volume.

2D- MODEL

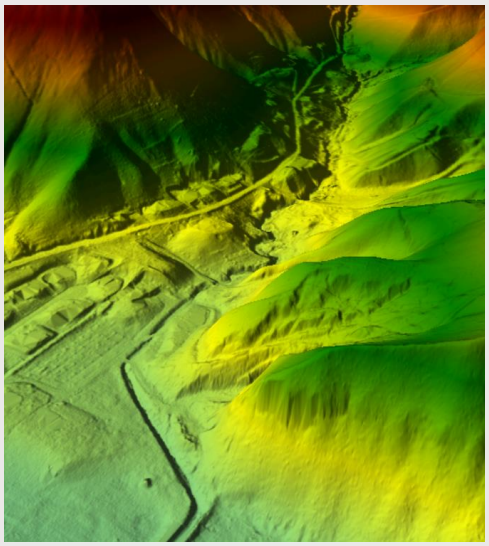
Advanced Floodplain Modeling

XP-SWMM 2D

XPSWMM utilizes another publically available hydraulic modeling engine that is accepted by FEMA and most states as an allowable floodplain model.

2D models are new to the scene in flood studies across the nation. Multiple states are working through options to incorporate these new studies into existing floodplain regulations but no standard method has been approved by FEMA.

SURFACE MODEL OF EBNER COULEE



BASICS

A 2D model uses the same type of inflow hydrographs as the unsteady models but replaces the cross-section based models with a topographic surface. The model allows the water to flow freely across the surface in any direction to determine its natural flow paths instead of the engineer having to manually define them as in the 1D models.

2D models account more accurately for flood storage due to the higher resolution of data used to develop them. They can also accurately account for all of the City's storm sewer infrastructure that can only be roughly estimated in the unsteady model.

2D models were used by SEH to identify the points in Ebner Coulee where water leaves the main channel and flows into adjacent floodplains.

PROS

- Most accurate flood extents and flood elevations

CONS

- Long model run times
- To date, the WDNR has not reviewed any 2D flood models and would require an exemption from NR116
- No FEMA approved way to delineate a floodway

SO WHAT DOES THIS MEAN?

This method arguably provides the most realistic flood maps but the higher definition comes at the price of very strict floodplain regulations as any change from the current conditions will alter the floodplain.

The WDNR would have to review this closely and would work with the City to develop the State's first floodplain based on a 2D model. Likely the entire floodplain would have to be zoned as floodway and would require an update to the study for any projects which add or remove fill from the floodplain.

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OTHER OPTIONS

SEH RECOMMENDATIONS:

SEH recommends that the City pursue the unsteady modeling option. This option produces a substantially reduced BFE that more accurately reflects the flooding conditions within Ebner Coulee. Flood storage mitigation has been successfully implemented in other communities in WI and the WDNR can provide guidance in updating the City's ordinances.

REQUESTED CITY ACTION:

Ultimately it is the City's choice in which route they would like to pursue. Once the City has reached a decision and notifies SEH, a final Letter of Map Revision application can be finalized and submitted to the City for approval before being sent to the WDNR and FEMA for review and approval.

QUESTIONS?

If you have any questions regarding this packet feel free to reach out to Brad Woznak (SEH Inc) at bwoznak@sehinc.com or by phone at (651) 490-2125

COMBINED STEADY/UNSTEADY

This is an approach that has been used successfully in other communities to incorporate the results of a Unsteady or 2D model into a 1D Steady state model that accounts for some of the effects of storm sewer and flood storage.

PROS

- Similar results to 1D Unsteady
- Fits regulatory framework

CONS

- Flood storage must be tracked and regulated
- City would be responsible to maintain multiple models

STORAGE BUFFERS

The City may choose to apply a buffer around all existing residences in the storage area, essentially assuming that these areas have already been filled above the BFE. Thus, future fill within these buffered areas may be permitted without the need for additional storage compensation.

PROS

- Effects of fill and mitigation known with little additional City oversight

CONS

- Higher initial BFES from those previously present (~0.25ft)

ENGINEERED STORAGE AREAS

City owned parcels, such as nearby parks, can be excavated to create flood storage areas that will further reduce the BFE. Parks are considered open space uses and may be constructed within the storage area to maintain the public space.

PROS

- Further reduces BFE or can be banked as mitigation credits

CONS

- Initial capital costs to construct basin and outlet controls
- Park will be occasionally inundated by flood water