memo

Project Name |	Barth Floodplain BFE modeling	**Date** |	5/07/25
To / Contact info |	Nancy Barth		
Cc / Contact info |			
From / Contact info |	Evan Murdock, PhD, CFM		
Regarding |	Barth Floodplain BFE modeling		

BACKGROUND

EOR was contracted to define a Base Flood Elevation (BFE) at your property located at 3140 STH 73 in Deerfield, WI, in anticipation of a potential sale. The property is a 20.39-acre parcel (ID 061203287010) located south of Deerfield, WI, between State Highway 73 to the west and US 12/18 to the north. The flooding source is Mud Creek (WBIC 810300), which runs from southwest to northeast along the southeastern border of the property. Proposed development for the site includes a new building on high ground north of Mud Creek served by an extension of the existing driveway connecting to STH 73.

The parcel is in a Zone A floodplain, so no BFE has been established. The floodplain at the site is also designated as a flood storage district, meaning that any fill in the floodplain must be compensated by creation of an equivalent volume of new flood storage. Immediately downstream of the property, on the northern side of US 12/18, is the upstream terminus of the Zone AE floodplain established by the most recent flood study of the creek as part of Flood Insurance Study (FIS) #55025CV000E. The BFE at this location is 851.6'.

EOR constructed a new HEC-RAS model using 2017 Dane County LiDAR elevations supplemented with survey data collected in April 2025 by Wisconsin Mapping, LLC.

HYDROLOGY METHODS

The 100-year flow for EOR's model was taken from the Current Effective model for the reach of Mud Creek that begins immediately downstream of the project site. This flow of 2536 cfs matches the value published in the FIS.

The HEC-HMS model used in the FIS that is the source of this flow estimate is not well documented, however the flows come from a single 19.65 mi^2 subbasin. This is significantly larger than the appropriate scale for a single subbasin in TR-55 analyses, which is around 3 mi^2. This gives reason to question the accuracy of this estimate, though both the scale and the direction of any possible error are not known.

The FIS flow is considerably higher than the regression-based flows used to size the bridges for Highways 73 and 12/18 at the upstream and downstream ends of the property (800 cfs and 920 cfs, respectively). Finally, modern USGS regression methods applied by EOR yield a flow estimate of 1290 cfs, with a 90% prediction interval from 536 cfs to 3100 cfs (a range that encompasses each of the other estimates).

Given the discrepancy between the FIS flow and other estimates, it is possible that a refined hydrologic model would yield a lower 100-yr flow estimate, which would result in a lower Base

Flood Elevation at the property. We tested the impact of reduced flows by running arbitrary discharges of 1300 cfs, 1500 cfs, and 2000 cfs through the model.

HYDRAULICS METHODS

The new hydraulic model was constructed in HEC-RAS 6.5. The model cross sections were largely based on survey data collected by Wisconsin Mapping, LLC, supplemented with 2017 LiDAR. Roughness was 0.04 in the channel and 0.05 in the overbank areas, based on Chow (1959). We expect very little sensitivity to roughness due to the low velocities and the controlling influence of Highway 12/18 downstream of the site.

The STH 73 and US 12/18 bridges over Mud Creek were built in 2015. They are listed in the State of Wisconsin Highway Structures Information System (HSI) as B-13-802 (SHW 73) and B-13-358 (US 12/18). EOR obtained design drawings showing the Highway 73 crossing with two 8'H x 12'W box culverts set 1' below the stream bed (for an open height of 7') and the Highway 12/18 crossing with two 7'H x 11'W box culverts set 5 ½" below the stream bed (for an opening height of 6' 6½"). An unnamed tributary of Mud Creek also crosses STH 73 just north of the Mud Creek channel via an 8' x 8' concrete box culvert surveyed by Wisconsin Mapping, LLC.

Bridge geometry in the model was based on available WisDOT bridge plans as well as field survey by Wisconsin Mapping, LLC. Road profiles were determined from LiDAR data with elevations validated with survey data. Six survey shots on Highway 73 varied from LiDAR by an average of -0.00083', so unadjusted LiDAR was used for this profile. Two survey shots on Highway 12/18 varied from LiDAR by an average of 0.04'; the LiDAR based profile for this road was adjusted accordingly. Bridge opening dimensions were provided by the surveyor, and depth-to-sediment measurements were used to model partial culvert blockage. The STH 73 crossing in the model includes the culverts on both Mud Creek and its unnamed tributary.

The downstream boundary condition at cross section 424 is a known water-surface elevation of 851', the BFE listed in the FIS. In order to tie in to the existing downstream modeling, this elevation cannot easily be changed.

ANALYSIS AND RESULTS

Three flows were evaluated: the current regulatory flow (2536 CFS) and three arbitrary lower flows (2000, 1500 and 1300 CFS) to evaluate the potential for reduced flood elevations at the site should HEC-HMS modeling show that lower flows are appropriate. The 1300cfs estimate is very close to modern regression estimates of flows at the site.

Flood elevations at your property are controlled by the US 12/18 bridge. The current regulatory flow overtops US 12/18 by 1.1'. The water surface is an almost flat pool upstream of this bridge, dropping only 0.05' from the upstream boundary of the model to the cross sections immediately upstream of US 12/18. STH 73 is overtopped by 4.4' for the current regulatory flow. This shows that the relevant elevation control is the US 12/18 crossing.

Table 1 summarizes water surface elevations at the upstream and downstream ends of the property (i.e. just downstream of Highway 73 at cross section 2104 and just upstream up US 12/18 at cross section 586).

Table 1. Modeled Water Surface Elevations at the upstream and downstream ends of the Barth property.

Location	2536 cfs	2000 cfs	1500 cfs	1300 cfs
Upstream (XS 2104)	856.63'	856.31'	855.64'	854.57'
Downstream (XS 586)	856.60'	856.28'	855.61'	854.66'
Driveway minimum elevation	852.84' (from LiDAR)			
Driveway connection to STH 73	855.68' (from LiDAR)			

The hydraulic modeling shows that, if the 100-yr flow is lower than the value in the FIS, the BFE on the property would also be lower. For a hypothetical flow of 1500 cfs, the water surface elevation is approximately one foot lower than for the FIS flow, and elevations for a 1300 cfs flow are nearly one foot lower still. However, implications of floodplain zoning requirements for the proposed development are similar for the FIS flow or potentially reduced flows, as described below.

2017 Dane County LiDAR data indicate that the lowest elevation of the existing driveway is roughly 852.84', so that several feet of fill would be required to raise it above the Base Flood Elevation. The LiDAR also indicate that the elevation of the existing driveway connection to STH 73 is 855.68' and the highway centerline at this location is at 854.2'. These elevations are below the modeled flood elevation at the Barth property even using the lower flood discharge of 1500 cfs. At a flow of 1300 cfs the model shows dryland access through the entrance to the driveway, suggesting that at this flow it would be possible grade permittable emergency access.

The driveway could potentially be relocated approximately 120' north near the northern boundary of the parcel, where the STH 73 elevation is 855.1' (centerline) and 855.8' (eastern shoulder where the driveway would connect. This is still below the water surface elevation calculated with the FIS flow and very close to the elevation for the lower 1500 cfs discharge.

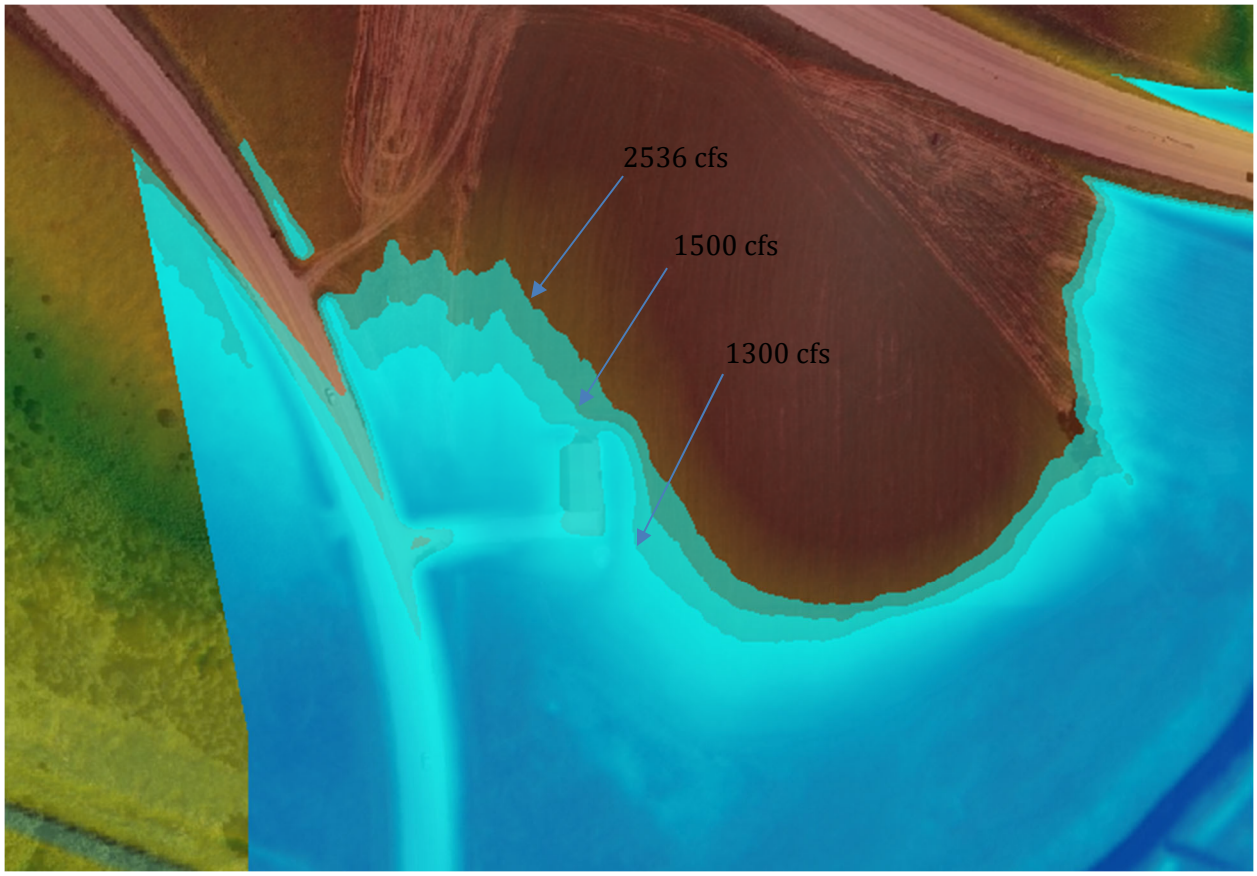

Figure 1 Modeled inundation extents in the vicinity of the existing driveway for the regulatory flows and two reduced flows. Only the 1300 cfs flow shows dry access clear through to the driveway.

CONCLUSIONS

- Using the existing regulatory flows it does not appear that dryland access could be achieved at the current driveway location.
- Achieving dryland access during the modeled 100-year flood would require a substantial reduction from the current regulatory flow estimate.
- More detailed hydrologic modeling would provide a more accurate flow estimate.
- It is hard to know the potential that the actual 100-year flow is substantially less than the current regulatory estimate, and there is the potential that the refined estimate would be higher than the current regulatory flow estimate.
- Raising the driveway will almost certainly be required regardless of the modeled flows, and this will require both a no-rise analysis and compensatory storage.
- The benefits of further modeling must be weighed against the possibility of alternative access options.