


Deep River Flood Risk Management

Final Presentation to LCRBDC

June 10, 2015

SEH

Presentation Overview

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- Project Overview & Background Information
- Data Collection
- Model Development
- Flood Mitigation Alternatives
  - Levee Construction
  - Bridge Modifications
  - Lake Station Dam Modifications
  - Bypass Tunnel
  - Floodplain Storage
  - Lake George Dam Modifications
  - Brickie Bowl Flooding
  - Lake George Sedimentation
  - Channel Conveyance
  - Green Infrastructure
  - Property Acquisition
- Project Prioritization

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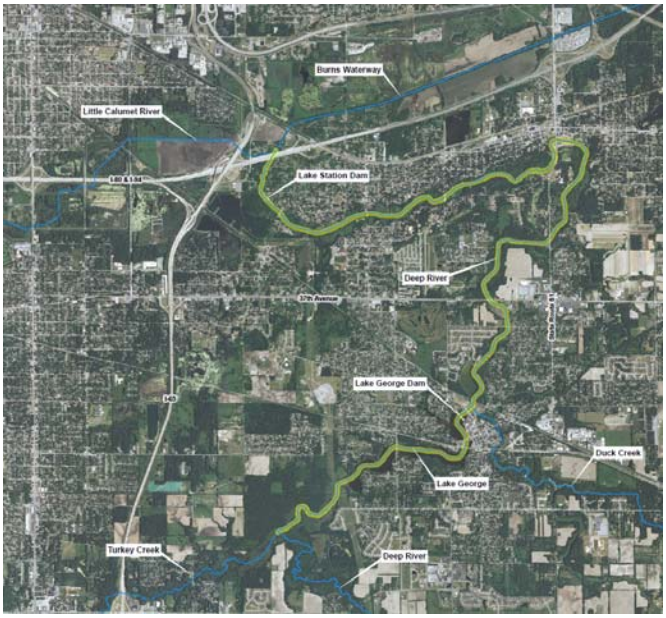
Project Location



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Historical Flooding

- Flood of Record: September 2008
  - Inundated numerous buildings along Deep River, from Lake Station to Hobart
  - Lake George Dam sustained significant damage but has been rehabilitated.
  - This event will serve as basis for several alternatives evaluated.
  - Peak Discharge at USGS Gage = 5,280 cfs
  - 100-year Discharge = 4,700 cfs
  - 500-year Discharge = 6,250 cfs

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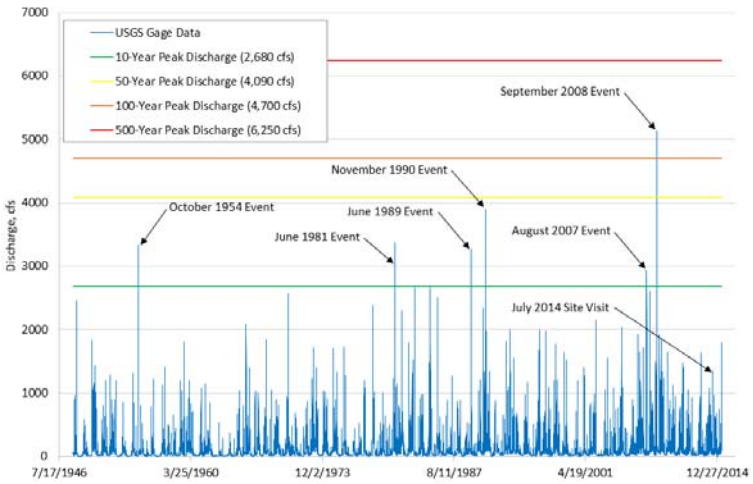
Historical Flooding

- Data from USGS Gage No. 04093000



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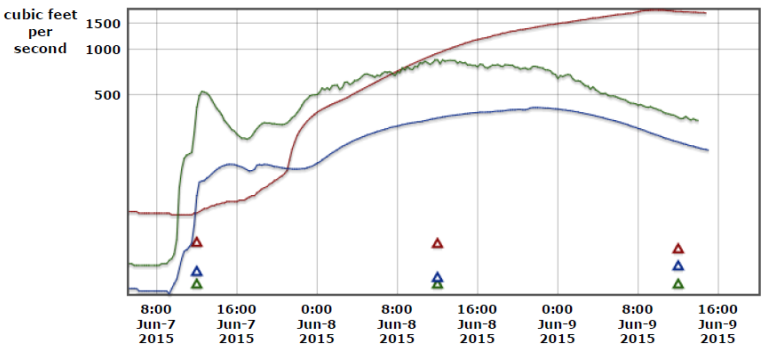
Current Conditions

- Gage Data Comparison
  - 04093000: Deep River (Red)
  - 05536190: Hart Ditch (Green)
  - 05536195: Little Calumet River (Blue)



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Current Conditions

- Downtown Hobart

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Current Conditions

- Downtown Hobart

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Historical Flooding

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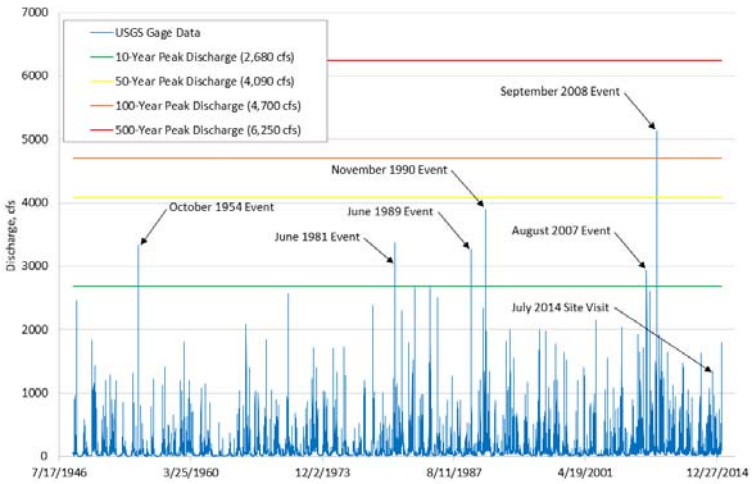

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September 2008 Event

Beverly Lane crossing north of Lake George.

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September 2008 Event

Wastewater treatment plant downstream of Old Ridge Road.

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September 2008 Event

Downtown Hobart

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Data Collection

- Collected & reviewed several previous reports and projects
- Collected & reviewed several previous models from:
  - IDNR
  - USACE
  - MWRD
  - Stantec (FEMA's Contractor for effective Flood Insurance Study)

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Data Collection

- IDNR Hydraulic Model
  - Steady State Only
  - Cross Sections are Approximate
  - Outdated Bridge Modeling Methodologies
  - Lake George Dam Modeled as Bridge
  - Lake Station Dam Excluded
  - Does Not Include Interaction with Little Cal
  - Regulatory Model
    - Results are within 0.2' of the water surface elevations published in the effective Flood Insurance Study

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Data Collection

- USACE Hydraulic Model
  - Unsteady State Only
  - Cross Sections are Approximate
  - Includes Interaction with Little Cal
  - Peak Flows vary significantly from those published in the effective Flood Insurance Study for the 100-year plan.

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Data Collection

- FEMA/Stantec Hydraulic Model
  - Steady State Only
  - Deep River Downstream of State Route 51
  - Cross Sections are Approximate
  - Lake Station Dam Excluded
  - Does Not Include Interaction with Little Cal
- MWRD Hydrologic Models
  - Several Historical Storms including September 2008 Event
  - 100-year Hydrographs
  - Does Not Include Interaction with Little Cal

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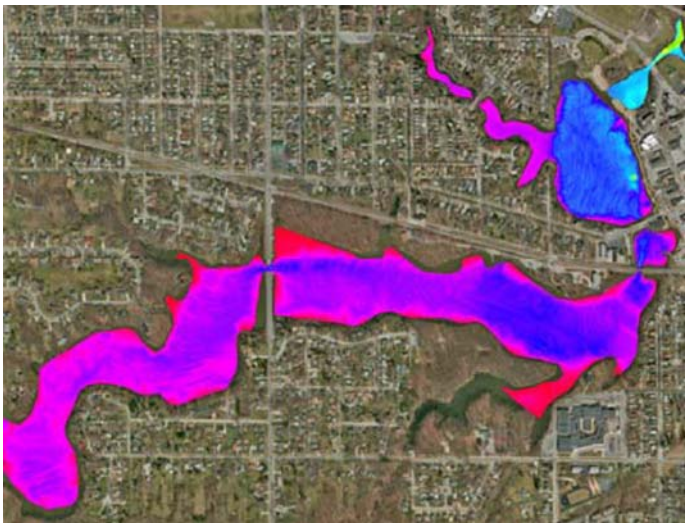
Data Collection

- LiDAR Data + Bathymetric Data



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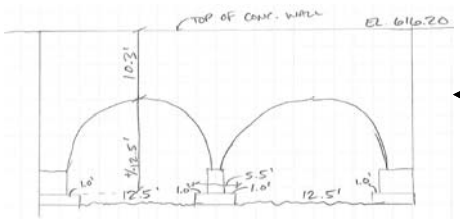
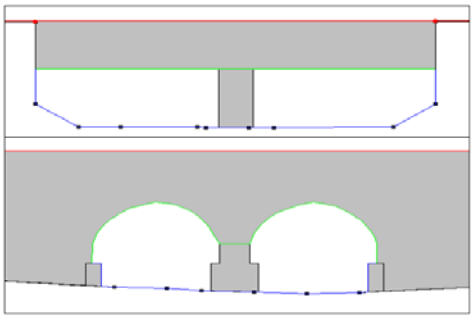
Data Collection

- Bridge Survey Data



Survey Notes



Previous Models

New Model

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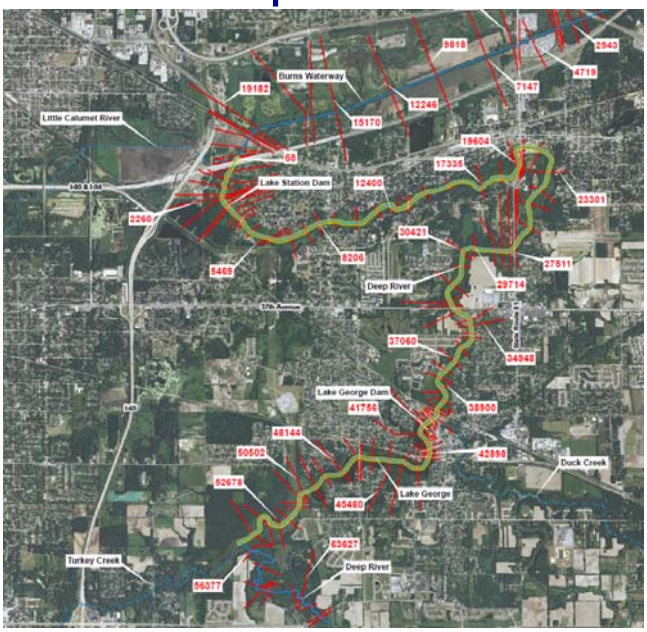
Model Development



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Model Development

- 16 River Miles
  - 12 Mi. Deep River
  - 4 Mi. Burns Waterway
- 126 Cross Sections
  - 102 on Deep River
  - 24 on Burns Waterway
- 24 Bridges
  - 18 on Deep River
  - 6 on Burns Waterway
- 2 Dams (Lake Station & Lake George)

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Model Development

- Steady & Unsteady Models
  - No new hydrology
  - Steady-state discharges from FIS
  - Unsteady discharges from MWRD models
- Georeferenced Models
  - Automated floodplain mapping
  - Public education & outreach

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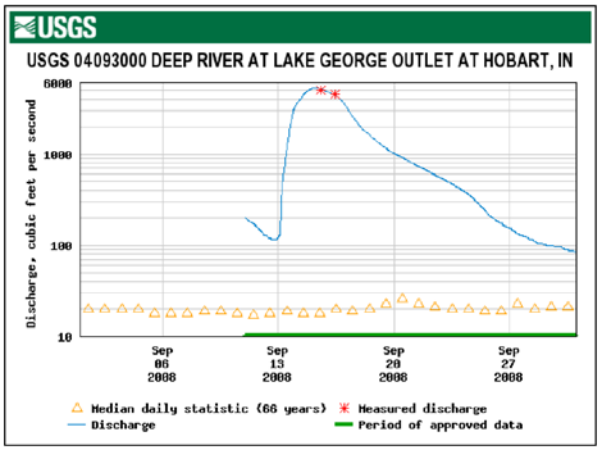
Model Calibration

- USGS Gage at Lake George Outlet (Gage No. 04093000)



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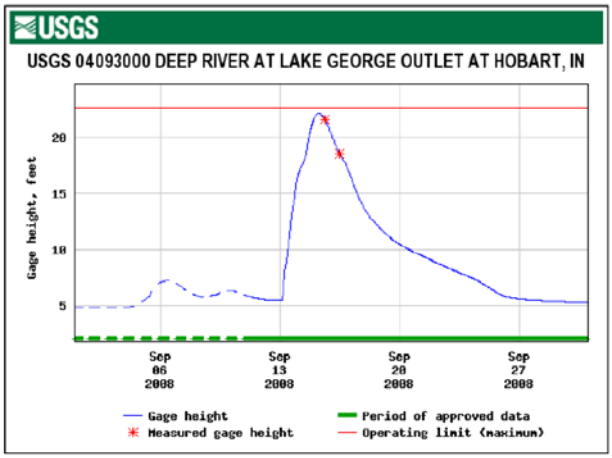

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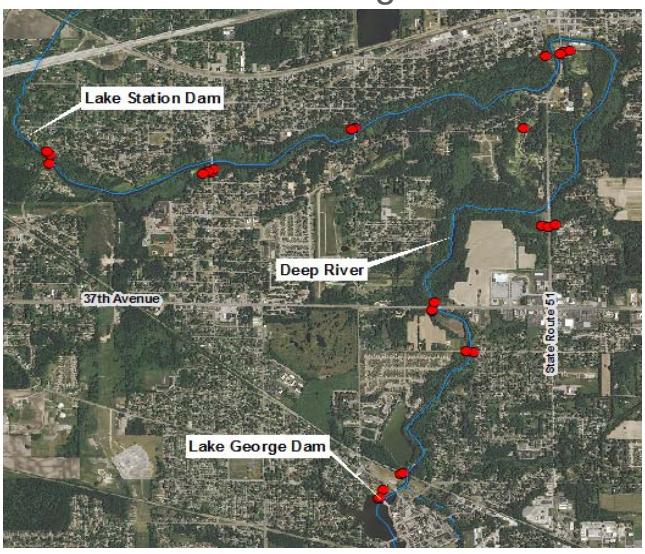
Model Calibration

- USGS Recorded High Water Marks



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Model Calibration

River Station	Observed High Water Mark Elevation (ft)	Uncalibrated Model Results W.S. Elev (ft)	Difference (ft)	Error	Calibrated Model Results W.S. Elev (ft)	Difference (ft)	Error
[illegible]	[illegible]	610.08	0.87	0.75	610.29	0.66	0.44
Lake Ozonia Dam							
41126.57	610.99	610.04	-0.04	0.00	610.15	-0.15	0.02
Old Ridge Road							
40261.27	[illegible]	609.79	0.20	0.04	609.75	0.24	0.06
Railroad Bridge							
40023.93	[illegible]	603.68	2.74	7.51	606.26	0.16	0.03
39949.93	[illegible]	603.17	2.41	5.81	605.35	0.23	0.05
Rand Street							
39312.99	[illegible]	602.85	2.28	5.20	601.91	0.22	0.05
39314.94	[illegible]	602.69	1.90	3.64	604.63	0.02	0.00
37th Avenue							
39449.21	[illegible]	602.54	1.57	2.46	604.2	-0.09	0.01
27899.44	[illegible]	602.04	0.68	0.77	603.05	-0.13	0.02
State Route 51							
27510.99	[illegible]	601.84	0.86	0.74	602.76	-0.06	0.00
21628.62	[illegible]	601.21	0.47	0.22	601.99	-0.31	0.10
21016.63	[illegible]	600.92	0.53	0.28	601.54	-0.09	0.01
State Route 51							
20447.49	[illegible]	600.87	0.55	0.30	601.33	0.09	0.01
19726.69	[illegible]	600.82	0.56	0.31	601.18	0.20	0.04
Folsom St Pedestrian Bridge							
13264.62	[illegible]	600.07	-0.27	0.07	600.02	-0.22	0.05
Grand Boulevard							
13092.18	[illegible]	599.73	-0.18	0.03	599.66	-0.11	0.01
8099.728	[illegible]	599.39	-0.19	0.04	599.33	-0.13	0.02
Dekalb Street Abandoned RR							
3994.411	[illegible]	598.68	-0.22	0.05	598.65	-0.19	0.04
Liverpool Road							
3712.327	[illegible]	598.49	-0.28	0.08	598.43	-0.22	0.05
Lake Station Dam							
			Total	28.52		Total	0.99

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Model Calibration

- Comparison to Effective Base Flood Elevations:

Location Along Deep River (FIS Cross Section ID)	Effective Base Flood Elevation (from FIS)	Calibrated Model Result	Difference (ft)
Liverpool Road (D)	597.4	597.4	0.0
Old Soo Line Railroad (E)	597.8	598.3	+0.5
Dekalb St/Michigan St (G)	598.1	598.9	+0.8
Grand Blvd (J)	598.7	599.7	+1.0
26th Avenue (M)	599.9	600.6	+0.7
State Route 51 North Crossing (N)	600.3	601.0	+0.7
State Route 51 South Crossing (R)	601.8	602.8	+1.0
37th Avenue (W)	603.1	604.9	+1.8
39th Ave/Rand (Y)	603.6	605.4	+1.8
Chicago, Ft. Wayne & Eastern Railroad D/S (AA)	604.1	606.3	+2.2
Chicago, Ft. Wayne & Eastern Railroad U/S	609.5	609.7	+0.2
Old Ridge Road (AB)	609.6	609.8	+0.2
Hobart Dam (AC)	610.0	610.0	0.0
3rd Street (AG)	611.8	611.6	-0.2
Norfolk Southern RR (AJ)	612.4	612.1	-0.3
Wisconsin Street (AO)	612.5	612.2	-0.3

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Model Calibration

- Comparison to Effective Base Flood Elevations:

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Flood Mitigation Alternatives

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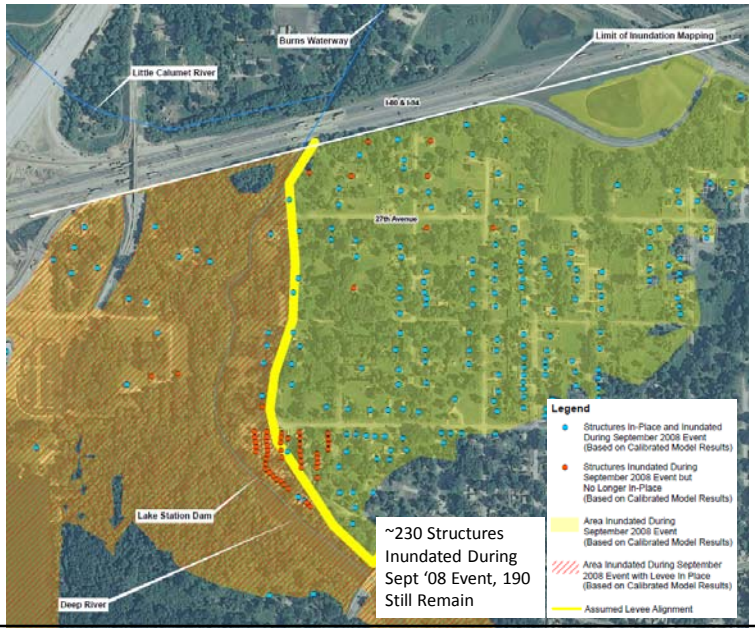
Levee Construction



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Levee Construction

- Both Unsteady & Steady Models Show No Increase in BFEs due to Levee
  - ~1% of Floodplain Storage Removed
  - Tailwater Conditions Control
  - Compensatory Storage Not Needed
- FEMA Accreditation
  - Lower Flood Insurance Rates
  - Remove Mandatory Purchase Requirement
- Property Acquisition Required (~20)
- Interior Drainage Facilities Needed

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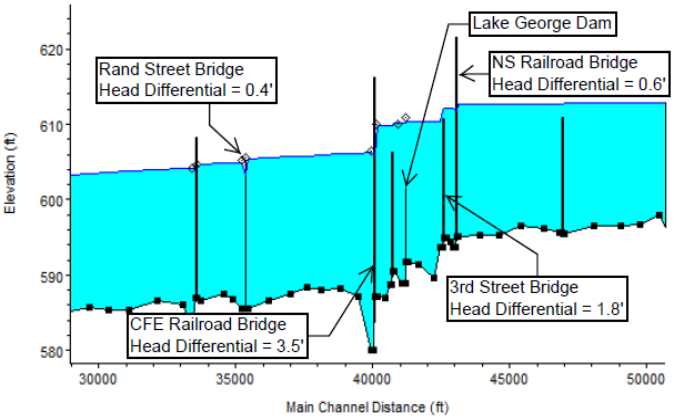
Bridge Modifications

- 4 Most Restrictive Bridges:



September 2008 Flood Profile

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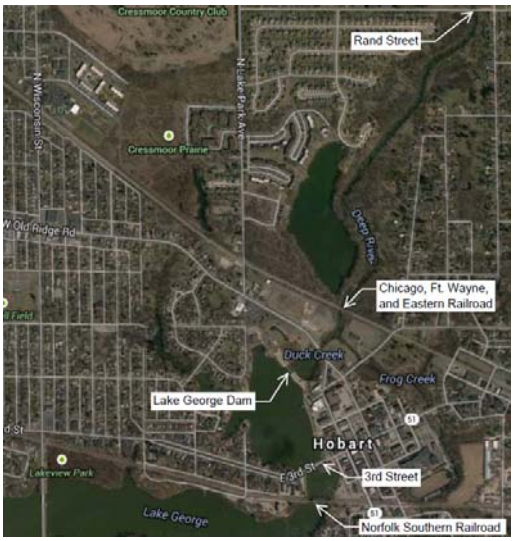

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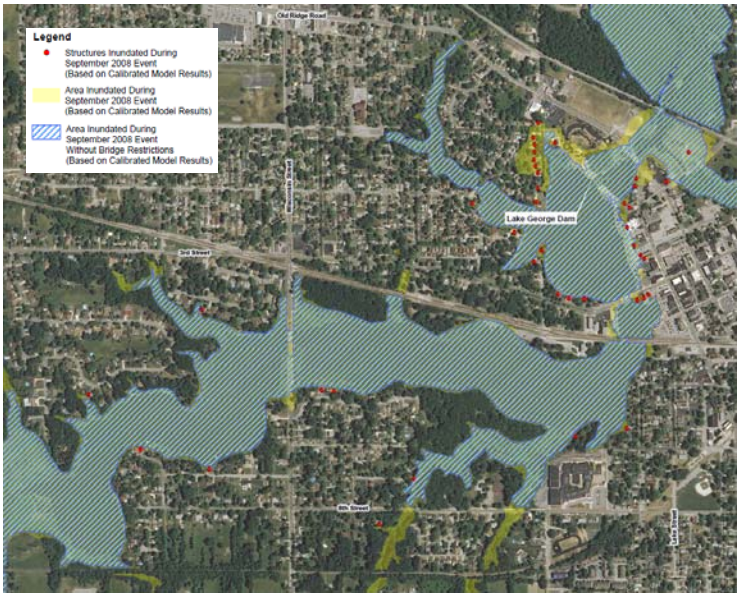

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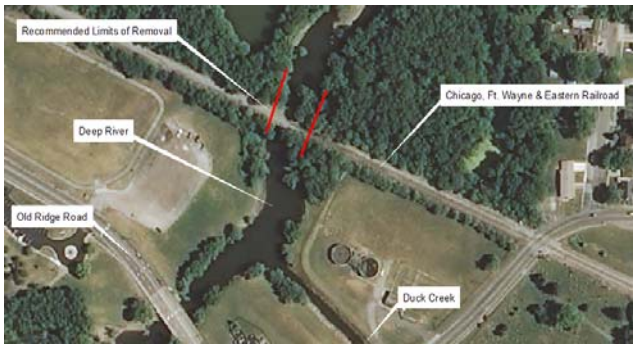
Bridge Modifications

- CFE Railroad Bridge
  - Removal of Existing Bridge
    - To remove restriction, need opening of ~70’
    - Recommended to provide opening of ~110’



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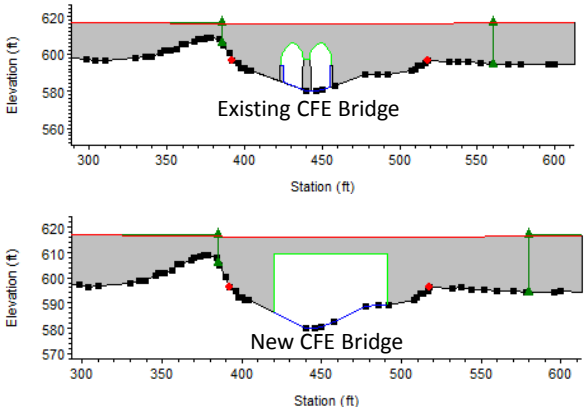
Bridge Modifications

- CFE Railroad Bridge
  - Bridge Replacement
    - To remove restriction, need span of ~70'
    - Expand to east to avoid brickyard waste



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Bridge Modifications

- 3rd Street Bridge at Lake George
  - Influences elevations at Wisconsin Street
  - Elevations of Interest (NAVD 88):
    - Normal Water Surface = 601.9 ft
    - Bottom of Bridge Deck = 606.3 ft
      - NWL Boater Clearance of 4.4 ft
    - Top of Bridge Deck = 610.8 ft
    - 100-Year Water Surface (FIS) = 611.9 ft
      - 1.1 ft Water Depth
    - September 2008 Water Surface = 612.1 ft
      - 1.2 ft Water Depth
      - 1.8 ft Head Differential

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Bridge Modifications

- 3rd Street Bridge at Lake George
  - Overtopped during September 2008 Event

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Bridge Modifications

- 3rd Street Bridge at Lake George
  - By eliminating restriction, peak water surface elevations upstream (in Lake George) could decrease by up to 1.8 feet for September 2008 event.
  - To eliminate restriction, bridge span must be increased from 65 feet to 125 feet.
  - New headwater elevation of 610.2, new minimum road elevation of 611.2 (at shoulder).
    - Current road elevation is approx. 610.8 at CL.

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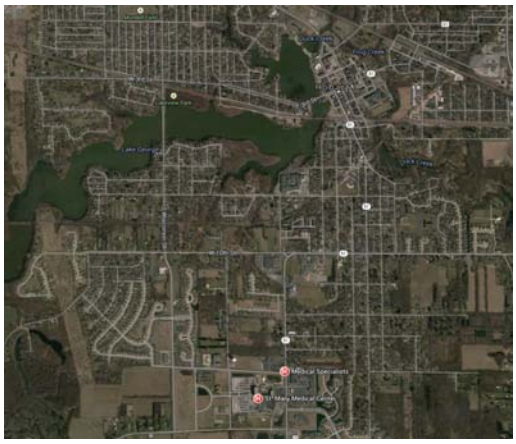
Bridge Modifications

- Wisconsin Street Crossing Lake George
  - Frequently Closed due to Overtopping
  - Critical Route to Hospital



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Bridge Modifications

- Wisconsin Street Crossing Lake George
  - Road Overtopping Elevation = 606.4 ft
  - Peak Water Surface Elevations (FIS):
    - 10-Year = 606.6 ft (0.2 ft Water Depth)
    - 50-Year = 610.5 ft (4.1 ft Water Depth)
    - 100-Year = 612.5 ft (6.1 ft Water Depth)
    - 500-Year = 617.4 ft (11 ft Water Depth)
    - September 2008 = 612.8 ft (6.4 ft Water Depth)
  - Bottom of Bridge Deck = 610.8 ft

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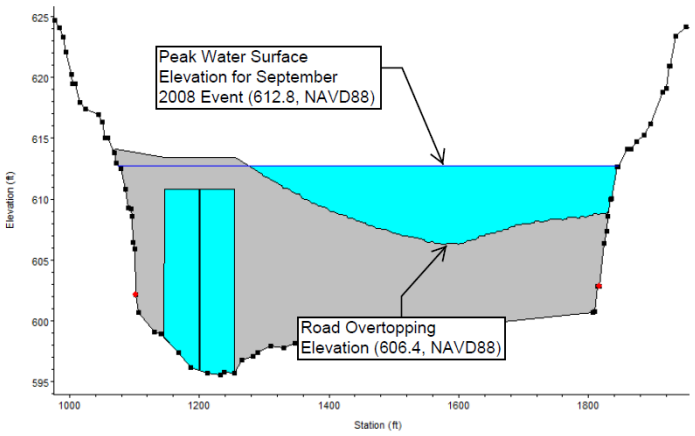

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Bridge Modifications

- Wisconsin Street Crossing Lake George

View from south side of Lake George during September 2008 event. Approximately 700 ft of road was inundated.

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Bridge Modifications

- Wisconsin Street Crossing Lake George
  - Due to overtopping, current crossing doesn't create significant flow restriction.
  - 2014 Inspection:
    - Cracks & spalls on bridge deck, abutments, and pier
    - Deteriorated fascia beam and pier cap

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Bridge Modifications

- Wisconsin Street Crossing Lake George
  - Bridge Improvement Scenario 1:
    - If profile is raised to reduce overtopping frequency and duration, bridge deck length will need to be increased.
      - New road shoulder at elev. 613.2 ft (1 ft above 100-year headwater elev. of 612.2 ft)
      - Bridge span needs to be ~340 feet long to prevent upstream stage increases
      - Current bridge span is 110 feet.

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Bridge Modifications

- Wisconsin Street Crossing Lake George
  - Bridge Improvement Scenario 2:
    - If 3rd Street is reconstructed first under separate project, bridge deck length could be reduced:
      - New road shoulder at elev 612.0 ft (1 ft above new 100-year headwater elevation of 611.0 ft)
      - Bridge span needs to be ~300 feet long to prevent upstream stage increases.
      - Scenario 1 bridge span was ~340 feet.
      - Current bridge span is 110 feet.

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Bridge Modifications

- Wisconsin Street Crossing Lake George
  - Bridge Improvement Scenario 3:
    - If 3rd Street and Wisconsin Street are reconstructed under same project,
      - Downstream BFE = 610.9 (1.3' lower than effective)
      - Upstream BFE = 611.1 (1.1' lower than effective)
      - New minimum road elev. 612.1 (at shoulder)
      - Increase head differential across bridge without increasing regulatory BFEs.
      - Bridge span could be reduced to ~140 feet.
      - Scenario 2 bridge span was ~315 feet.
      - Scenario 1 bridge span was ~340 feet.
      - Current bridge span is 110 feet.

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Bridge Modifications

- Summary of Scenarios:

Table 6
Wisconsin Street & 3rd Street Bridge Modeling Results

	Existing Conditions	Scenario 1	Scenario 2	Scenario 3
3rd Street Overtopping Elevation	610.8	610.8	611.5	611.5
3rd Street Bridge Deck Length (ft)	65	65	125	125
3rd Street Headwater Elevation	611.6	611.6	610.2	610.2
Wisconsin Street Tailwater Elevation	612.2	612.2	611.0	611.0
Wisconsin Street Headwater Elevation	612.2	612.2	611.0	611.1
Wisconsin Street Overtopping Elevation	606.4	613.5	612.3	612.4
Wisconsin Street Bridge Deck Length	110	340	300	140

All elevations refer to NAVD 88.
Headwater and tailwater elevations are based on the new steady-state model of 100-year event.

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Lake Station Dam

Lake Station Dam June 2014. USGS Gage Flow = 60 cfs.

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Lake Station Dam

Lake Station Dam July 2014. USGS Gage Flow = 1,400 cfs.

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Lake Station Dam

- 2 Flow Events Modeled:
  - September 2008 Event
  - August 2007 Event with Assumed Tailwater Condition
    - Between 10-year & 50-year frequency
- 2 Alternatives Considered:
  - Lake Station Dam Removed
  - Lake Station Dam Replaced with Dam Capable of Drawing Down prior to Event

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Lake Station Dam

- Lake Station Dam Removal
  - NWL above dam reduced from 590.4 to approx. 587.
  - Pool area water surface narrows from ~235 feet to ~120 feet.
  - Max decrease of 0.1' for Sept 2008 Event
  - Max decrease of 3.9' for August 2007 Event with low tailwater condition
    - No structures removed from inundation area due to narrow floodplain.

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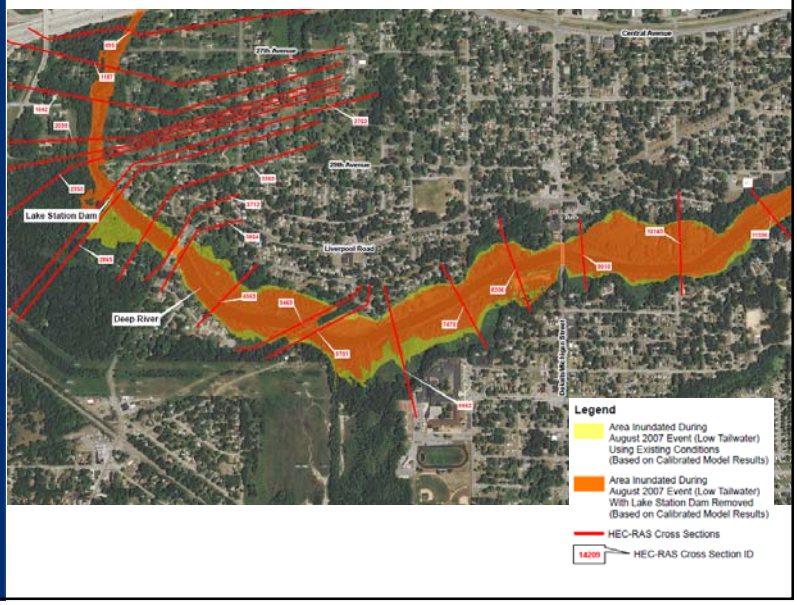
Lake Station Dam



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Lake Station Dam

- Lake Station Dam Replacement
  - Pool NWL of 590.4 (same as existing)
  - Drawdown to 587.8
  - Max decrease of 0.9 ft for August 2007 Event with low tailwater condition.
    - No structures removed from inundation area due to narrow floodplain.
  - No decrease shown for September 2008 Event.
- Existing Dam
  - Seepage through sheet pile wall
  - Sudden failure unlikely

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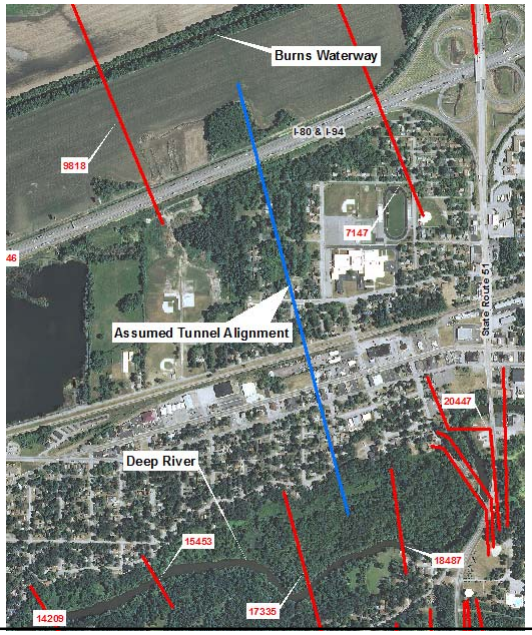
Bypass Tunnel



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Bypass Tunnel

- Tunnel Length = 4,600 feet
- 2 Options Evaluated:
  - Single 10-ft diameter tunnel
  - Three parallel 10-ft diameter tunnels
- For September 2008 Event, maximum benefit of single tunnel is a decrease of 0.2 ft; 0.6 ft for triple tunnel.
- No structures are removed from inundation area.

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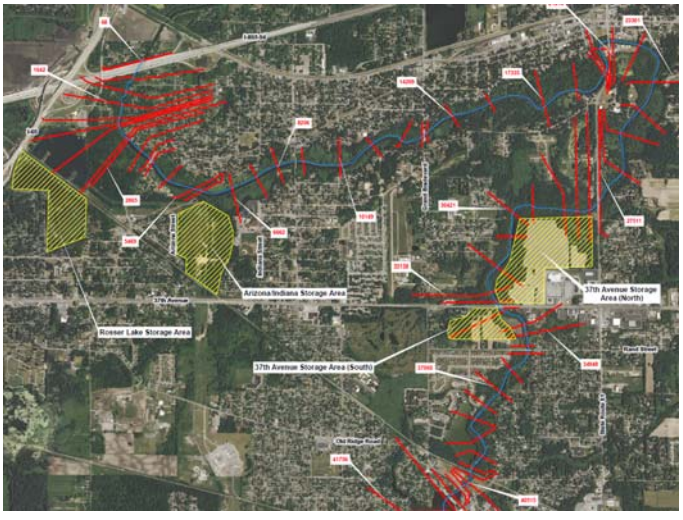
Floodplain Storage

- 3 Potential Storage Areas Evaluated



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Floodplain Storage

- Rosser Storage:
  - Area = 65 acres
  - Rosser Lake NWL = 597
  - Adjacent County Park Lake NWL = 591.5
  - 100-Year Peak Elevation = 597
  - Drawdown Rosser Lake to match adjacent lake NWL prior to event.
  - 600 ac-ft of storage gained for September 2008 Event (Less than 2% of Flood Volume of 36,000 ac-ft)
  - No reduction in peak water surface elevations.

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Floodplain Storage

- Indiana Street/Arizona Street Storage:
  - Area = 75 acres
  - Significant Excavation Needed (more than 3 Million CY assumed for this analysis)
  - 700 ac-ft of storage gained for September 2008 Event (Less than 2% of Flood Volume)
  - No reduction in peak water surface elevations.

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Floodplain Storage

- 37th Avenue Storage:
  - Area = 140 acres
  - Significant Excavation Needed (more than 5 Million CY assumed for this analysis)
  - 1,400 ac-ft of storage gained for September 2008 Event (4% of Flood Volume)
  - Maximum reduction in peak water surface elevation for September 2008 Event is 0.1 ft.

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Floodplain Storage

- Storage Required to Make a Difference
  - September 2008 Flood Volume = 36,000 ac-ft
  - Storage Provided Upstream of Lake George
  - 100-acre basin providing 1,000 ac-ft of storage results in decrease of 0.3’ through Lake George
  - 500-acre basin providing 4,000 ac-ft of storage results in decrease of 1.7’
  - 1,000-acre basin providing 6,000 ac-ft of storage results in decrease of 3.0’

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Lake George Dam

Lake George Dam during "Normal Stage"

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Lake George Dam

Lake George Dam during September 2008 Event

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Lake George Dam

- Single 7’ x 8’ Drawdown Gate
- For Q = 200 cfs, Lake George could be drawn down 3’ in 14 hours.
- If Lake is drawn down 3’ prior to September 2008 event, 400 ac-ft of storage is added, peak elevations decrease by 0.1’.

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Lake George Dam

- Other Considerations:
  - 3 ft draw down results in average lake depth of 1.5 ft
    - Lake bottom would be exposed in many areas
    - Dredging could help maintain pool
  - Retaining walls along Lake George could be damaged by draw down
  - No advance warning system
  - Court-established lake level of 601.93.

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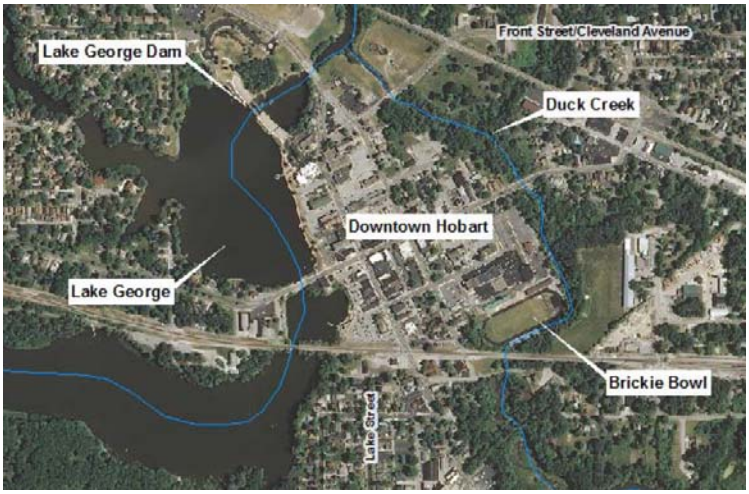
Brickie Bowl Flooding

Located along Duck Creek



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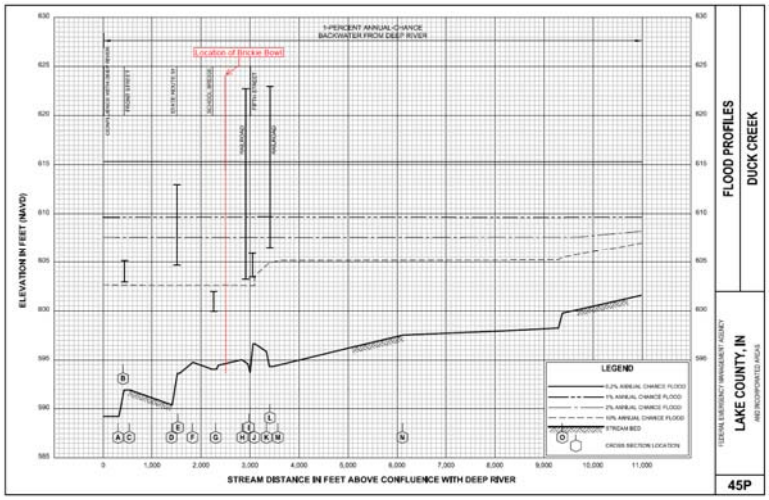
Brickie Bowl Flooding



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Brickie Bowl Flooding

- FIS profile of Duck Creek shows that Deep River controls peak elevations at Brickie Bowl for all events.
- Improving the railroad bridge could result in a peak water surface elevation decrease of 3.5 ft for the September 2008 event.
- September 2008 Peak WSE = 609.9 ft
- 100-Year Peak WSE = 609.6 ft
- Average field elevation = 603 ft

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Lake George Sedimentation

- Bathymetric survey compared to record drawings from 2000 dredging
  - 70,000 CY has accumulated
- Stoke's Law confirms that fine particles can settle out in basin size of Lake George
- Prepared cross sections showing accumulation at several points throughout Lake George

Lake George Sedimentation

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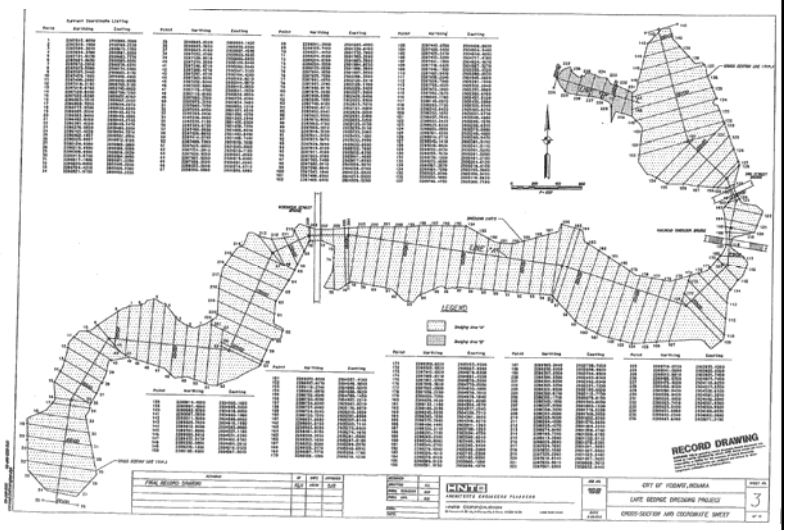

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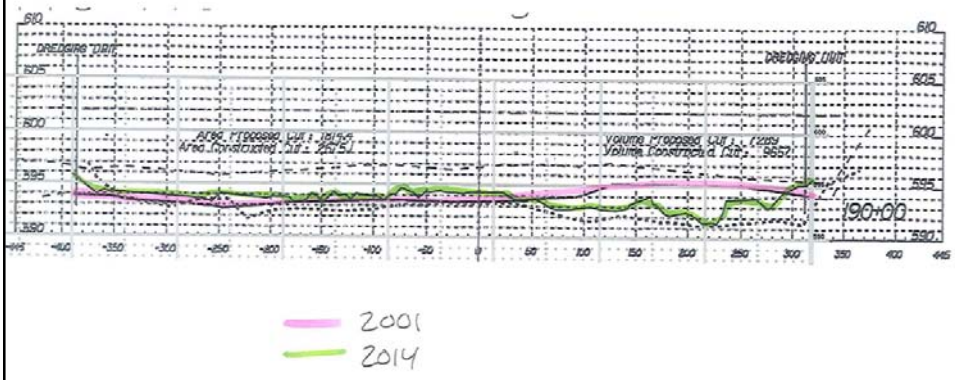
Lake George Sedimentation



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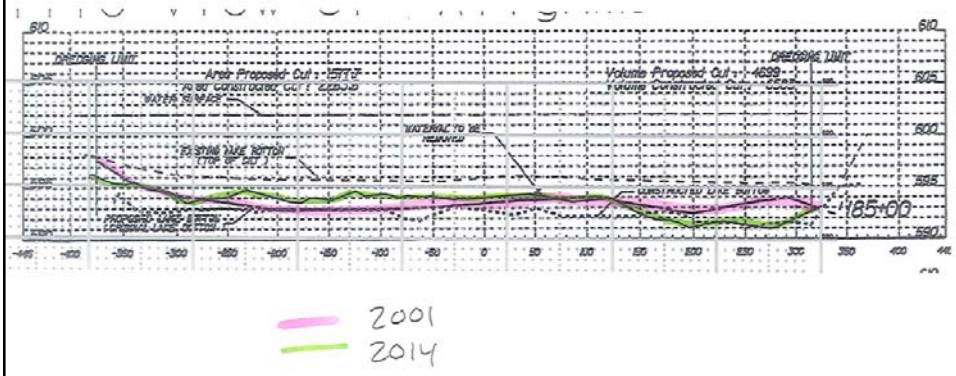
Lake George Sedimentation



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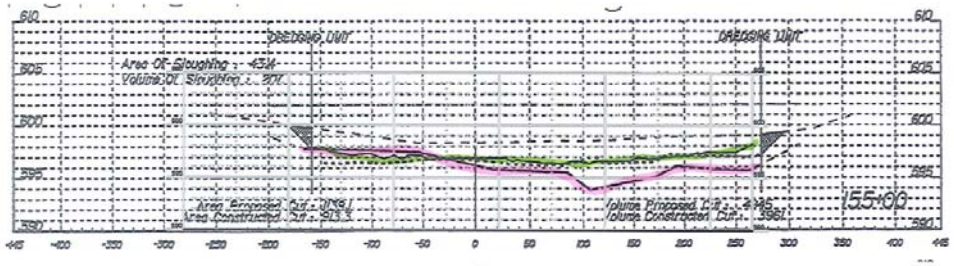
Lake George Sedimentation



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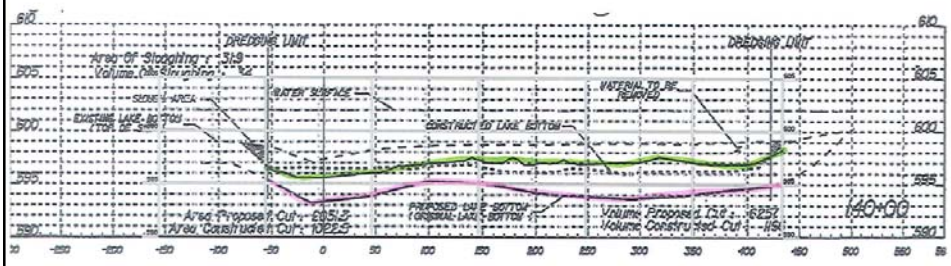
Lake George Sedimentation



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2014

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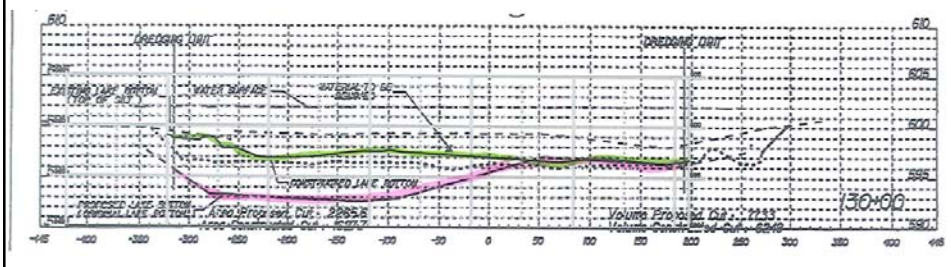
Lake George Sedimentation



2001

2014

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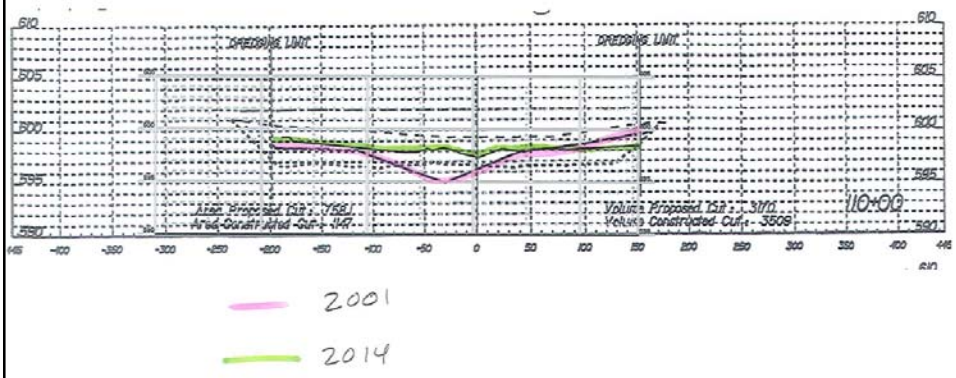
Lake George Sedimentation



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Lake George Sedimentation

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- Permanent Sediment Management
  - If the lake continues to act as a sediment trap, the decreasing pool area will reduce the sedimentation efficiency, sending more sediment downstream.
  - May be able to restrict dredging activities to upstream of 3rd Street
- Recreational & Ecological Impacts of Sedimentation
  - Current average lake depth is 4-5 ft
  - Upstream pools were not dredged in 2000, significant plant growth evident

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Lake George Sedimentation

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Channel Conveyance

- Overbank clearing could reduce losses, lower peak water elevations.
  - Heavy deciduous tree cover in overbank areas from CFE Railroad Bridge down to confluence with Little Calumet River
  - If cleared trees in the overbanks, decrease peak water surface elevations by up to 0.8' for Sept '08 event

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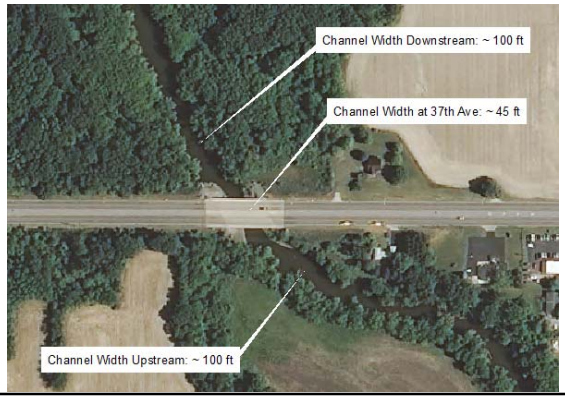
Channel Conveyance

- Channel narrows significantly at 37th Avenue Bridge crossing.
  - Eliminating restriction could lower peak water surface elevations by up to 0.3'



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Green Infrastructure

- EPA's Definition:

"Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of ***natural areas that provides habitat, flood protection, cleaner air and cleaner water.*** *At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and* ***storing water****."*

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Green Infrastructure

- Can be used in lieu of or together with traditional flood risk management solutions.
- 2008 hydrograph indicates quick response of rainfall/runoff in watershed.
  - If more runoff is detained upstream, can flatten out hydrograph and dampen peak flow.
- If implemented throughout watershed, benefits increase.
- Must be evaluated in detail to ensure green infrastructure does not cause adverse impact, especially in lower reaches of watershed.

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Property Acquisition/Structure Elevation

- Developing List of Properties within 100-yr Inundation Area
  - Addresses & Values
- Legal/Administrative Process
- Options for Reducing Risk
  - Acquire property & demolish
    - Limited future use of property
  - Rebuild elevated structure on property
    - Detailed feasibility and cost analysis required
  - Elevate existing structure on property
  - Relocate existing structure

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Other Considerations

- FEMA Hazard Mitigation Assistance
  - Hazard Mitigation Grant Program
    - For long-term hazard mitigation measures following a major disaster.
  - Pre-Disaster Mitigation Program
    - For hazard mitigation planning and projects on an annual basis
  - Flood Mitigation Assistance Program
    - For projects to reduce or eliminate risk of flood damage to buildings insured under NFIP on an annual basis.
- Model review by IDNR & FEMA
- Additional modeling of Burns Waterway & Little Calumet River needed.

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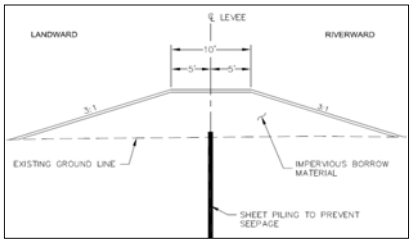
Project Prioritization

- Lake Station
  - Approx. 230 structures inundated in Sept '08
  - Property Acquisition
  - Levee Construction
    - Property acquisition
    - Interior drainage & pump station(s)
    - Typical section:



Project Prioritization

- Hobart
  - Sediment Management in Lake George
    - 70,000 CY accumulated since 2000
  - Property Acquisition
  - Snagging Fallen Trees
  - CFE Railroad Bridge Improvements
  - 3rd Street & Wisconsin Street Improvements
    - Assume they are permitted together
    - 3rd Street: Butler Fairman and Seufert, Inc.
    - Wisconsin Street:
      - Several considerations…

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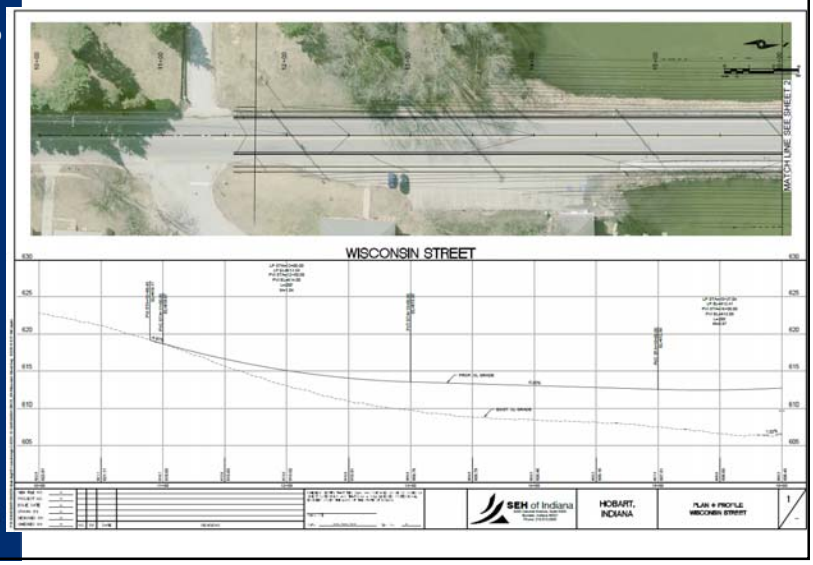
Project Prioritization

- Wisconsin Street



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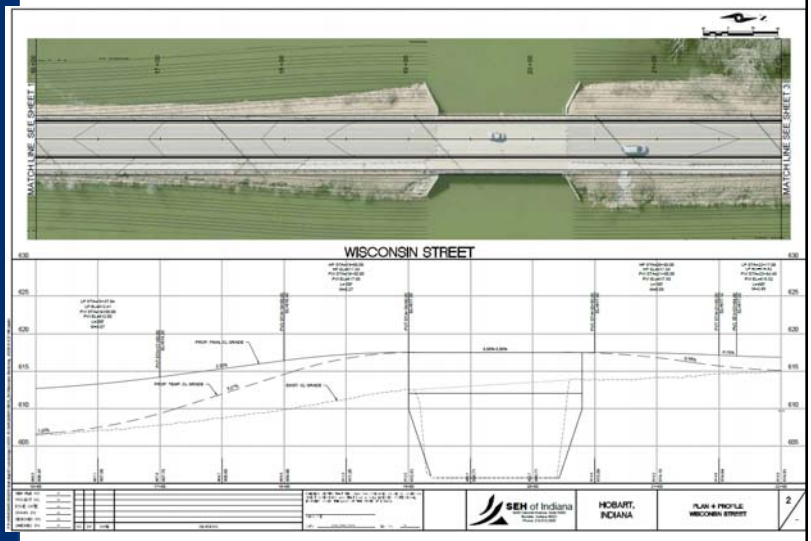
Project Prioritization

- Wisconsin Street



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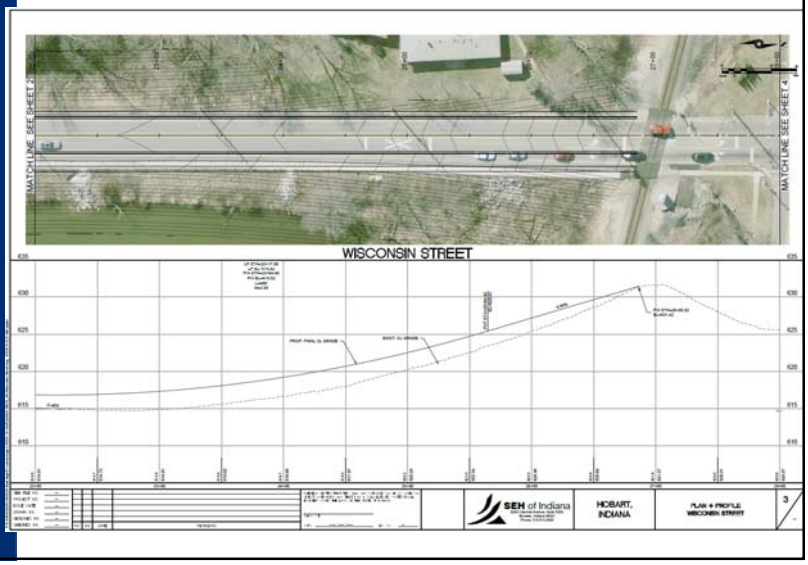
Project Prioritization

- Wisconsin Street



Project Prioritization

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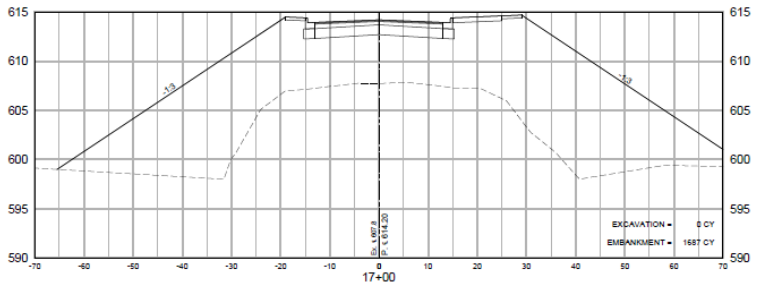
- Wisconsin Street



Project Prioritization

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- CFE Railroad Bridge Feasibility Study
  - 3.5' decrease for Sept '08 event
  - Coordination with railroad is key
- Lake George Dredging
  - Permanent dredging plan to maintain lake bathymetry and aesthetics
- Snagging/Clearing Debris
  - Prevent damage to structures and blockages
- Additional Analysis
  - Upstream & downstream

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Project Prioritization

- Additional analysis
  - Downstream:
    - Tailwater Impacts Deep River
    - FEMA FIS:
      - Q_{100} Burns Waterway = 4,640 cfs
      - Q_{100} Deep River = 5,500 cfs
    - Effective model doesn't include confluence
    - USACE model shows reverse flow of 1,000 cfs
    - Important to have more detailed model of downstream area prior to pursuing Lake Station levee option
  - Upstream:
    - Evaluate impact of future development and benefits of implementing Green Infrastructure

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Next Steps

- City of Hobart June 3 Letter
  - Requesting assistance with the following:
    - Reconstruction of Wisconsin Street & Bridge and 3rd Street Bridge
      - Permit together with Wisconsin Street to reduce overall construction costs.
      - Construction Sequence:
        - » Wisconsin Street Bridge first
        - » 3rd Street Bridge second
        - » Wisconsin Street Causeway third
    - Scoping Report for CFE Railroad Bridge
    - Lake George Dredging