CLFLWD
WATERSHED DISTRICT

DRAFT CLFLWD Floodplain Resilience Action Plan Framework

07.03.2025

EOR water ecology community

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1 PROJECT BACKGROUND

The Comfort Lake Forest Lake Watershed District (CLFLWD) has proactively engaged in addressing stormwater management, localized flooding, and associated infrastructural, environmental, and socioeconomic impacts linked to climate change. This Flood Risk Assessment Action Plan represents the final phase of a comprehensive project aimed at enhancing community resilience collaboratively with member communities. The study areas (Forest Lake urban area, Sunrise corridor, south drainage to Little Comfort and Shields Lake drainage area) are shown in Figure 1 to Figure 13.

In the initial phase (Phase I), the project utilized GIS analysis and numerical scoring to prioritize areas of concern based on flood vulnerability across four critical categories:

- Flood Hazard – Areas with potential high flooding risks
- Infrastructure – Including roadways, electrical substations, places of worship, schools, city/county services, emergency routes, etc.
- Socioeconomics - Including population density, percentage of renters, poverty levels, vulnerable age groups, single-parent households, land use and zoning classification, etc.
- Environmental - Including groundwater pollution sensitivity areas, impaired waters, native plant communities, soil erosion risk, and biological survey sites of biodiversity significance

Phase I assessed these vulnerabilities with the ultimate purpose of improving preparedness for current and evolving climate conditions. The integrated scoring map is shown in Figure 1.

Through collaborative meetings with watershed district staff and community stakeholders, Sunrise River drainage area and Shields Lake were selected as high-priority areas for a more detailed analysis.

Phases II and III, concentrated on developing detailed hydrologic and hydraulic (H&H) modeling was performed to refine understanding of flooding dynamics within these prioritized areas.

Phase II included one-dimensional (1D) modeling to determine flooding impacts under current and future extreme climate conditions. Phase III expanded upon this by integrating advanced two-dimensional (2D) modeling techniques, providing enhanced resolution and accuracy in floodplain delineation, particularly in regions with complex flooding dynamics and potential critical infrastructure vulnerabilities. These included the section of the city of Forest Lake draining to the Sunrise River, the Sunrise River itself, and Shields Lake drainage areas.

The outputs from Phases II and III were utilized to develop this Phase IV (Floodplain Resilience Action Plan Framework). This Phase IV identifies specific infrastructure improvements, including flood storage opportunities and stormwater conveyance upgrades, to provide the foundation for actionable recommendations to strengthen community resilience against current and future flooding events.

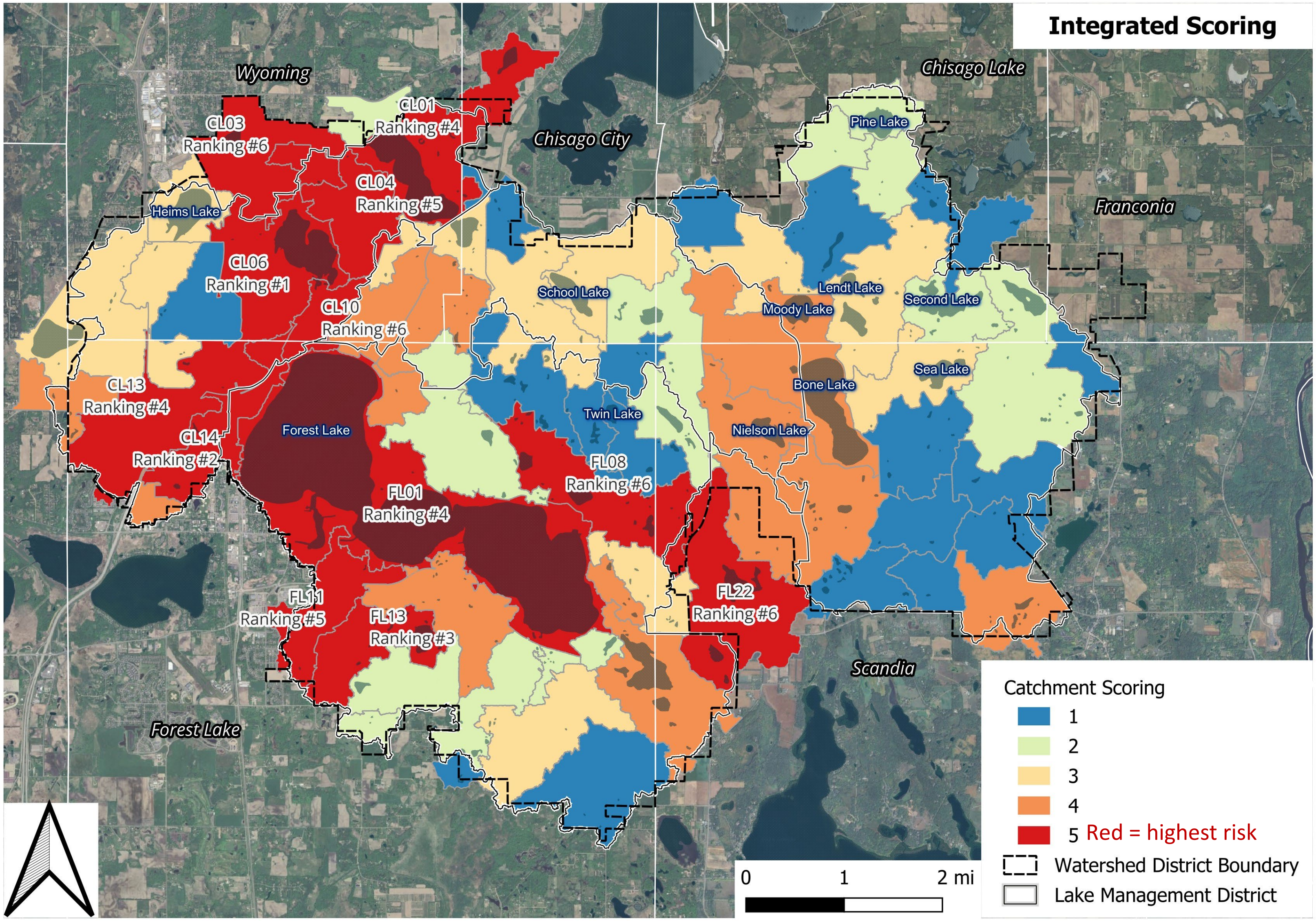

Figure 1. CLFLWD Flood Vulnerability Integrated Scoring Map

2 SUMMARY OF RESULTS

2.1 Infrastructure Risk Overview

The refined 1D/2D H&H modeling completed in Phases II and III provides a detailed picture of current (mean-event) and future (90th-percentile event) flood exposure across the studied areas. Results are summarized below for critical infrastructure, buildings, roadways, and stream channels. Figure 2 to Figure 13 illustrate:

1. The potential flood footprint for the current and future 100-year events
2. Structures that could be inundated during current and future 100-year events
3. Potential road overtopping locations for the 10-year and 100-year events
4. Stream reaches where peak flow for the future 2-year event is projected to increase by more than 15%, indicating a higher erosion risk.

2.2 Critical Infrastructure

Modeling results show that no hospitals, police or fire stations, schools, churches, or electrical substations are flooded or lie within 15 ft of the flood footprint under current and future precipitation events. The 15-ft buffer was selected to account for the vertical uncertainty of LiDAR data and potential geospatial offsets in aerial imagery. The 15-ft buffer also aligns with FEMA's Risk Rating 2.0 emphasis on proximity over rigid floodplain boundaries.

All the facilities identified as critical are positioned at least 50 ft from projected inundation under the modeled events. However, some access routes and parking areas remain vulnerable. For example, water depths of approximately 1.3 ft are projected on 1st St NE, which provides primary access to Faith Lutheran Church.

2.2.1 Buildings

As shown in Table 1, 155 residential and commercial structures are either adjacent to, or within 15 ft of, the flood-inundation footprint in the Forest Lake Urban Area & Sunrise River Corridor & Little Comfort South Drainage area under current precipitation conditions. That total rises to more than 190 structures under projected future rainfall. Across both the Forest Lake urban area and the Shields Lake drainage area, roughly 65 additional buildings are affected during the modeled future 100-year storm. These results highlight the increasing need for proactive flood-mitigation measures. Commercial precincts such as the Walmart–ALDI block west of 12th St SW experience significant parking-lot flooding, while nearby residential streets (1st and 2nd Avenues SW/NW) are constrained by undersized pipe networks and limited upstream and downstream storage.

Table 1. Model Simulations Summary –Increase in Affected Buildings in 100-Year Events

	Number of Buildings Affected by Flooding		
	Forest Lake Urban Area + Sunrise River Corridor + Little Comfort South Drainage area	Shields Lake Drainage Area	Total
Likely Flooding (Present Precipitation)	75	2	77
Likely Flooding (Future Precipitation)	104 (+29)	5 (+3)	109 (+32)
At Risk of flooding – Buffer < 15’ (Present Precipitation)	155	9	164
At Risk of flooding – Buffer < 15’ (Future Precipitation)	194 (+39)	35 (+26)	229 (+65)

2.2.2 Roadways

One of the advantages of 2D modeling is the ability to pinpoint roadway’s overtopping depth, velocities, and overtopping duration. This information is useful for public-safety planning and traffic management.

For example, 12th St SW overtops by up to 2.6 ft with velocities exceeding 1.75 feet/second, interrupting connectivity between two major retail parking lots for nearly 24 h during the future 100-year event. Such depths can disable small vehicles, while velocities above 2–3 feet/second pose risks to pedestrians.

Table 2 summarizes the number of roadways affected by each rain event. These numbers only pertain to the number of roads and do not capture increases in inundated length, water depth, flood duration, or flow velocity.

Table 2. Model Simulations Summary – Increase in Affected Roadways

Rainfall Event	Number of Roadways Affected by Flooding		
	Forest Lake Urban Area + Sunrise River Corridor + Little Comfort South Drainage area	Shields Lake Drainage Area	Total
Present 10-year	18	5	23
Future 10-year	24 (+6)	8 (+3)	32 (+9)
Present 100-year	39	13	52
Future 100-year	48 (+9)	16 (+3)	64 (+12)

2.2.3 Streams & Channels

The Sunrise River, the ditch connecting the urban areas of Forest Lake to the Sunrise River, and several lateral channels are projected to experience peak-flow increases exceeding 15 % under future rainfall scenarios, heightening concerns regarding erosion and channel instability. These findings support further evaluation of floodplain storage expansion, grade-control structures, and riparian restoration as part of the action planning process.

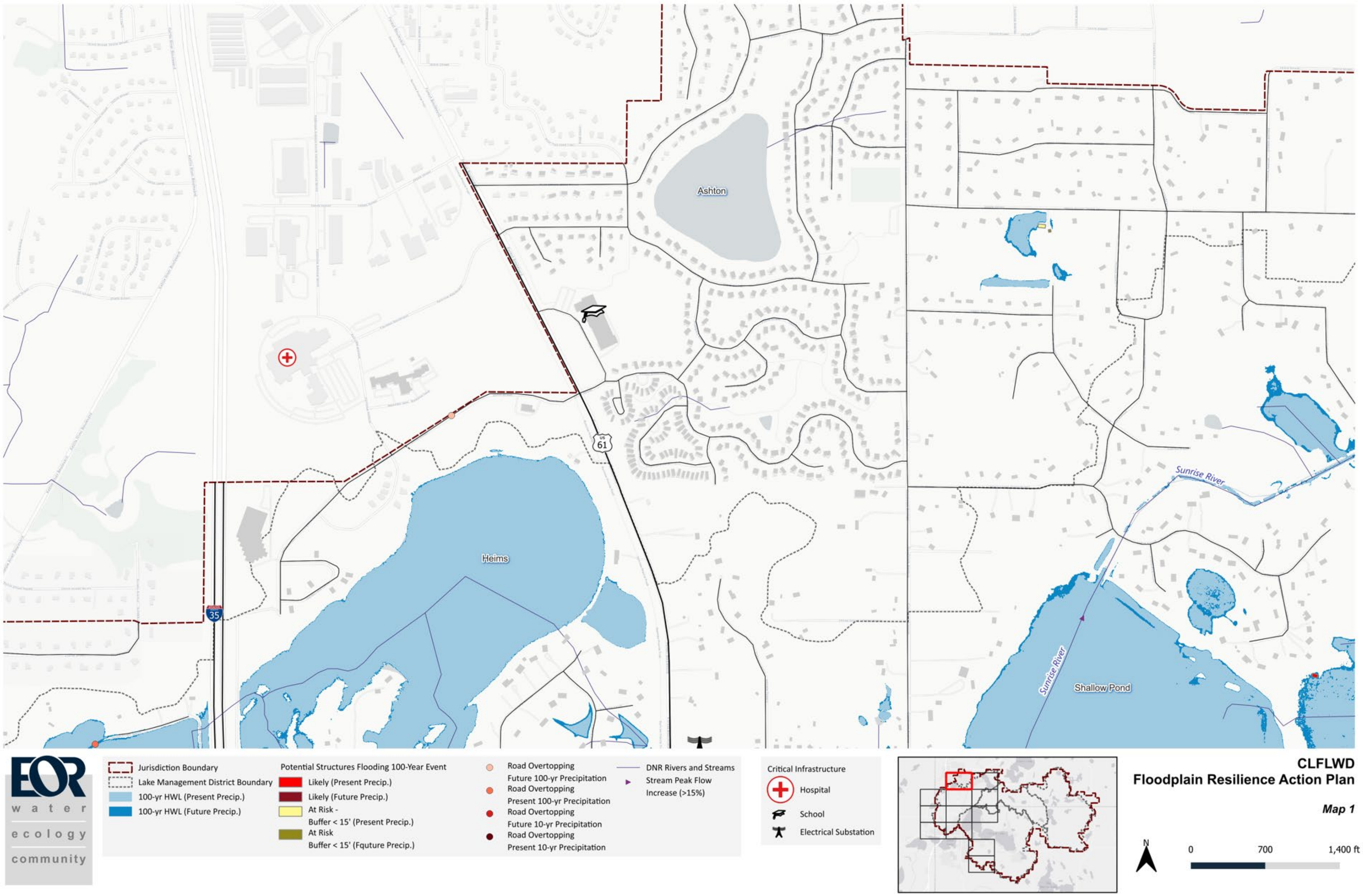

Figure 2. CLFLWD Floodplain Mapping Series – Map 1

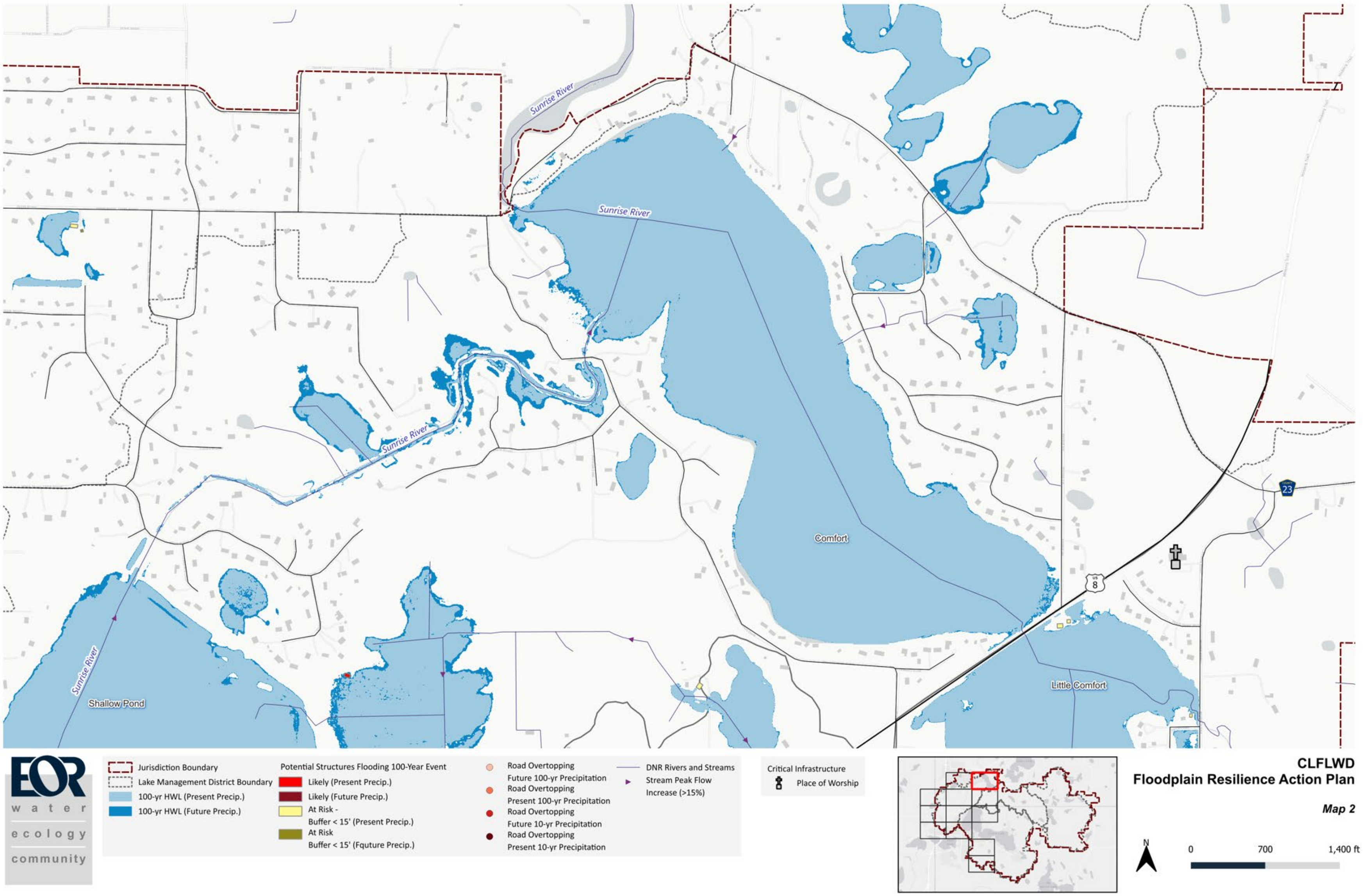

Figure 3. CLFLWD Floodplain Mapping Series – Map 2

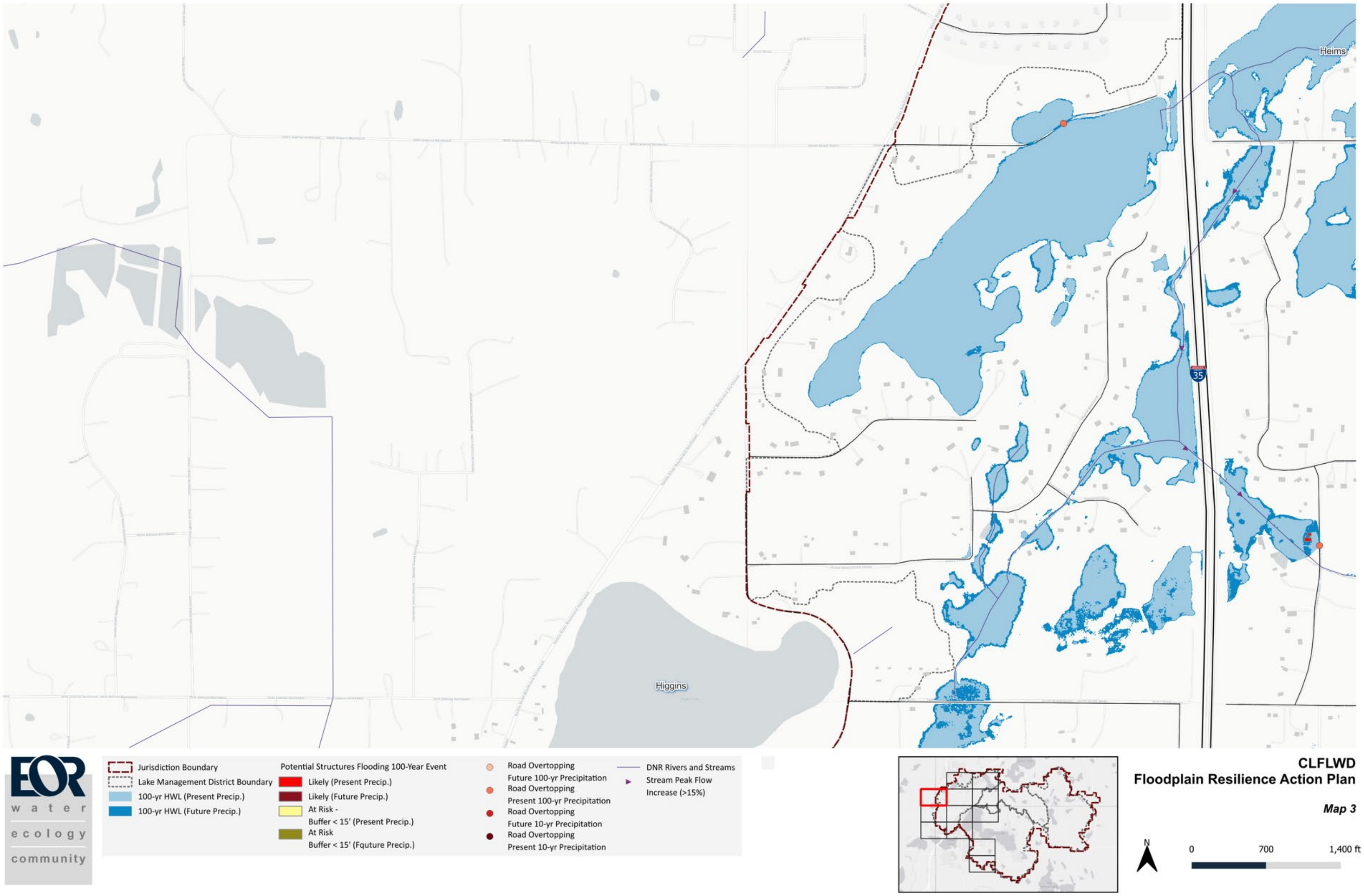

Figure 4. CLFLWD Floodplain Mapping Series – Map 3

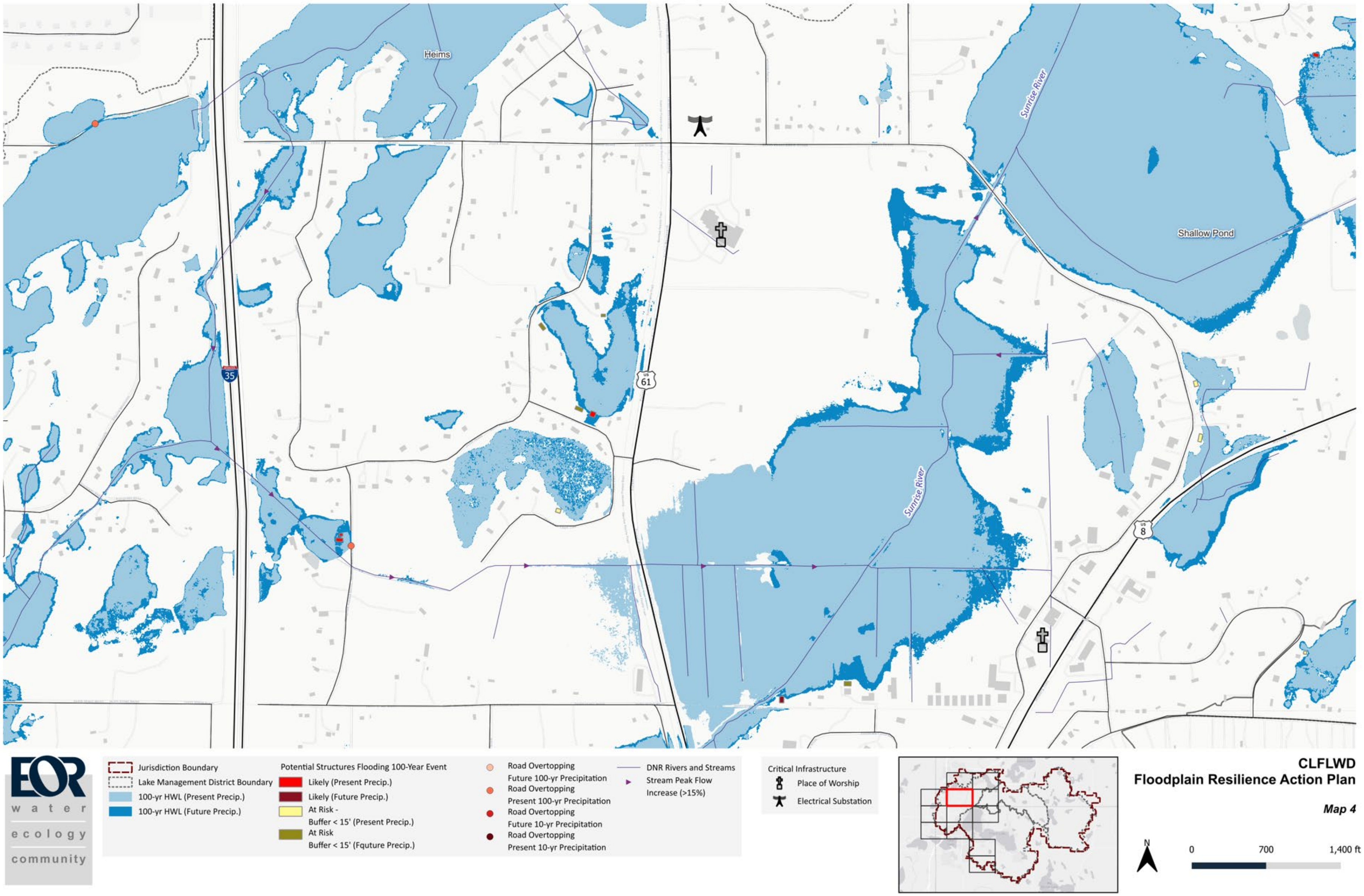

Figure 5. CLFLWD Floodplain Mapping Series – Map 4

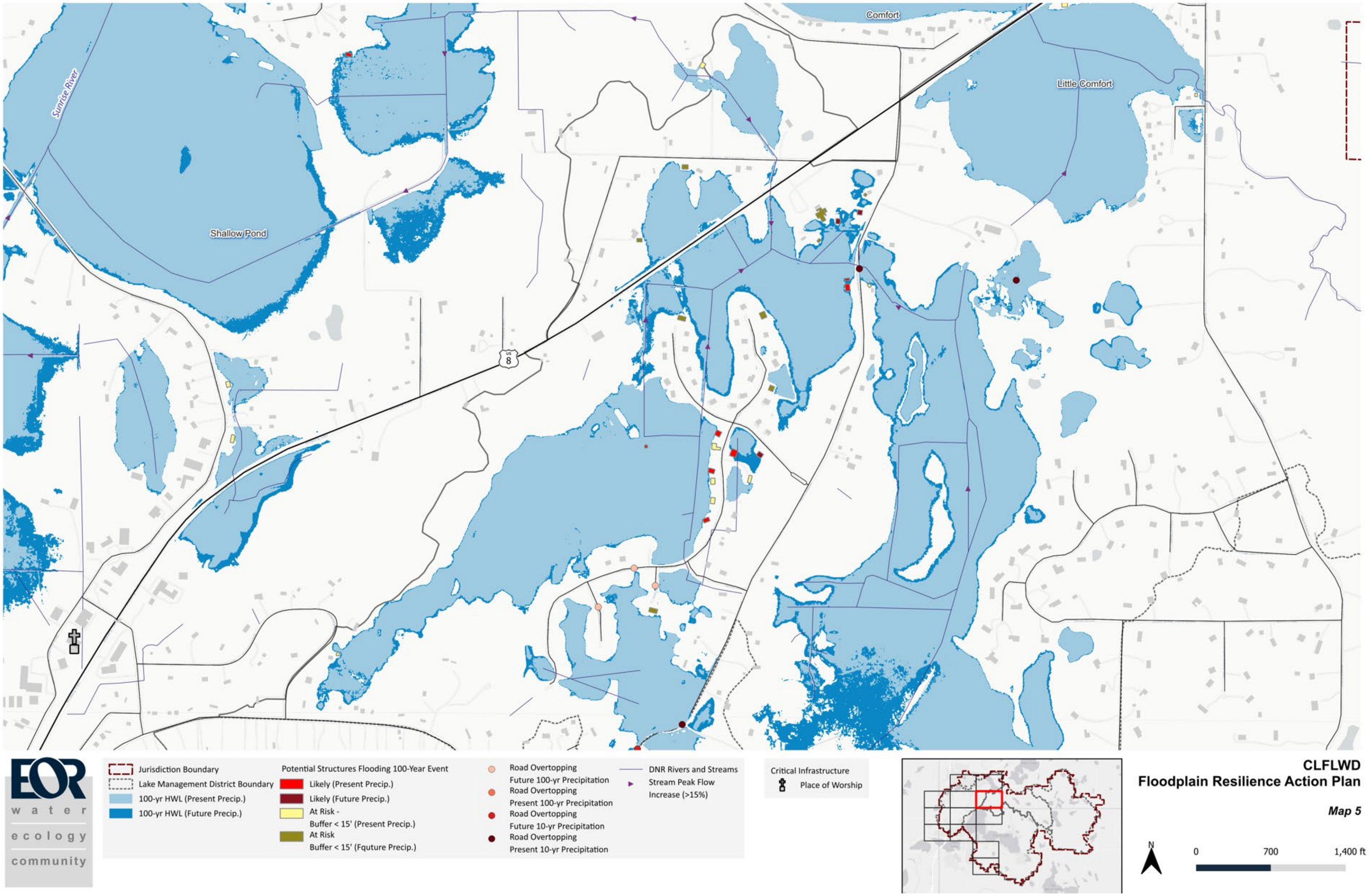

Figure 6. CLFLWD Floodplain Mapping Series – Map 5

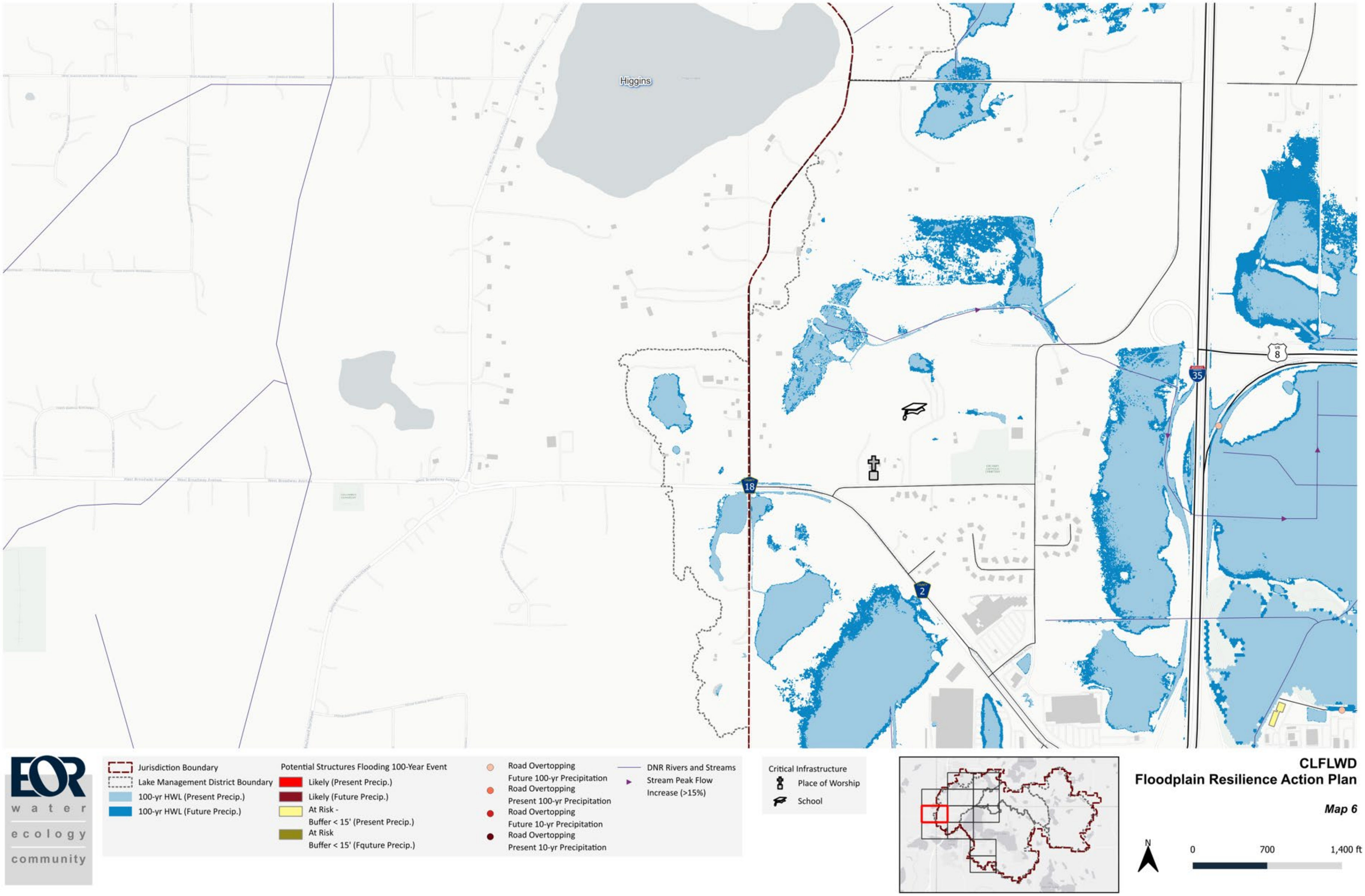

Figure 7. CLFLWD Floodplain Mapping Series – Map 6

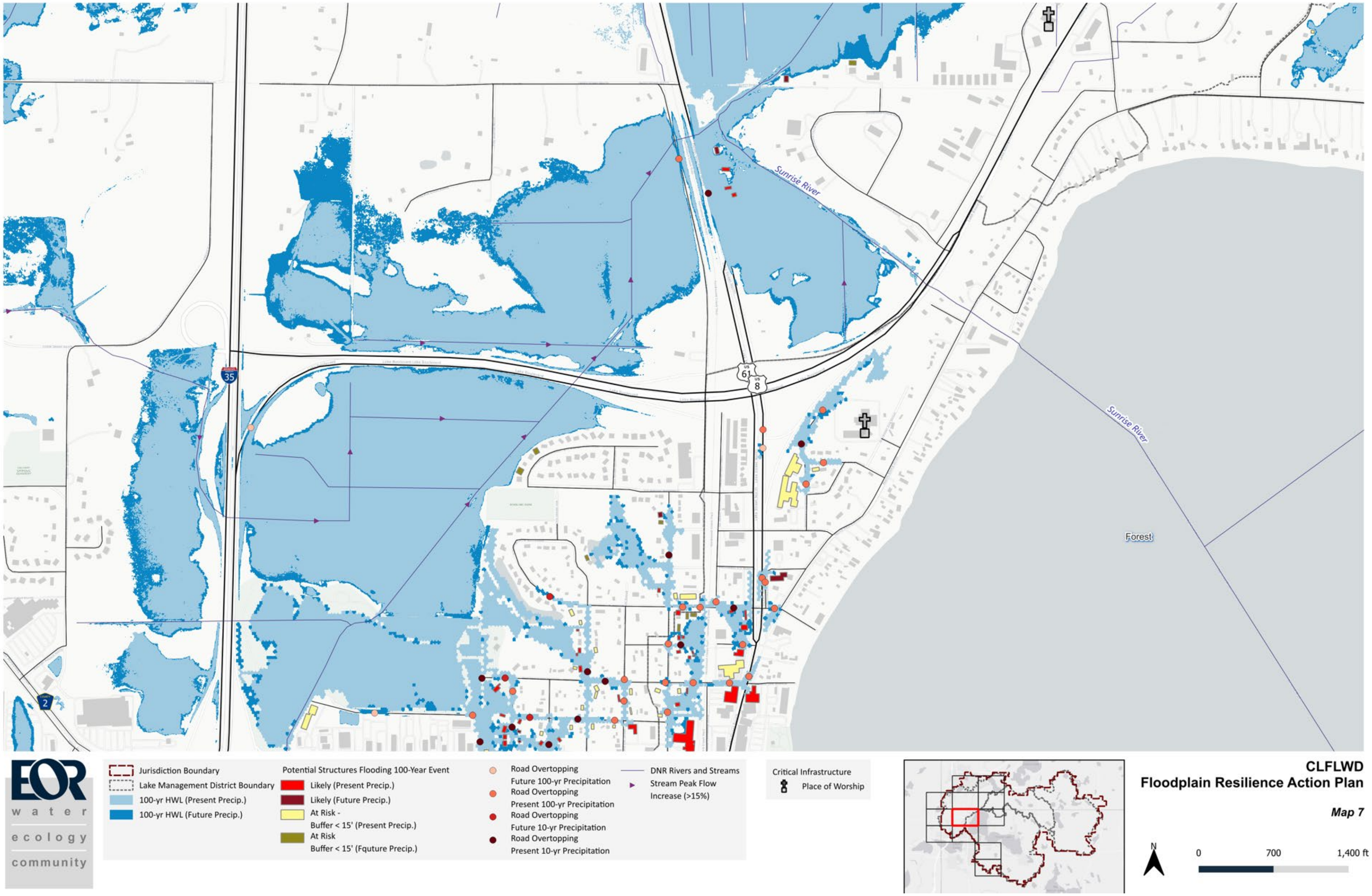

Figure 8. CLFLWD Floodplain Mapping Series – Map 7

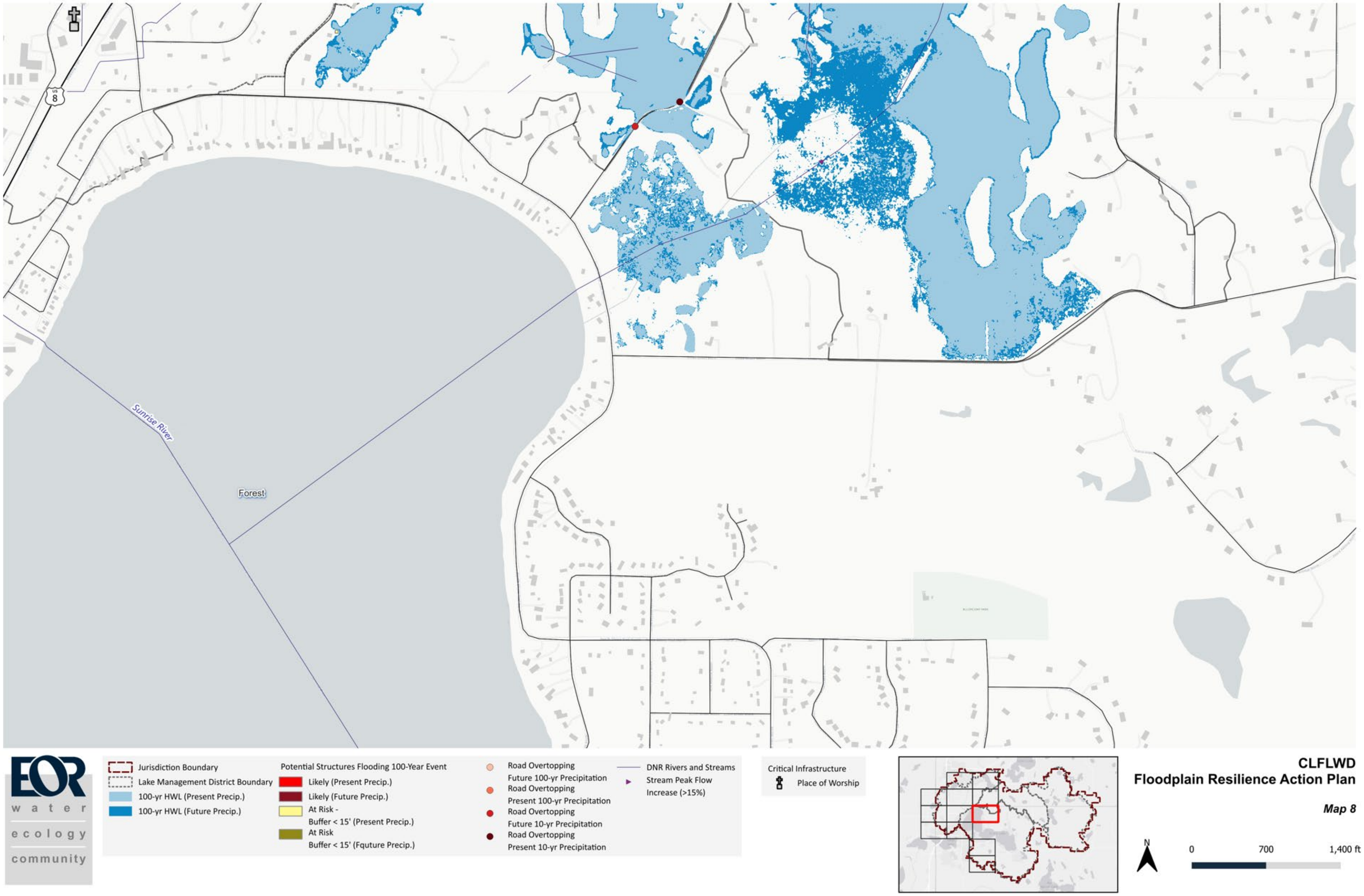

Figure 9. CLFLWD Floodplain Mapping Series – Map 8

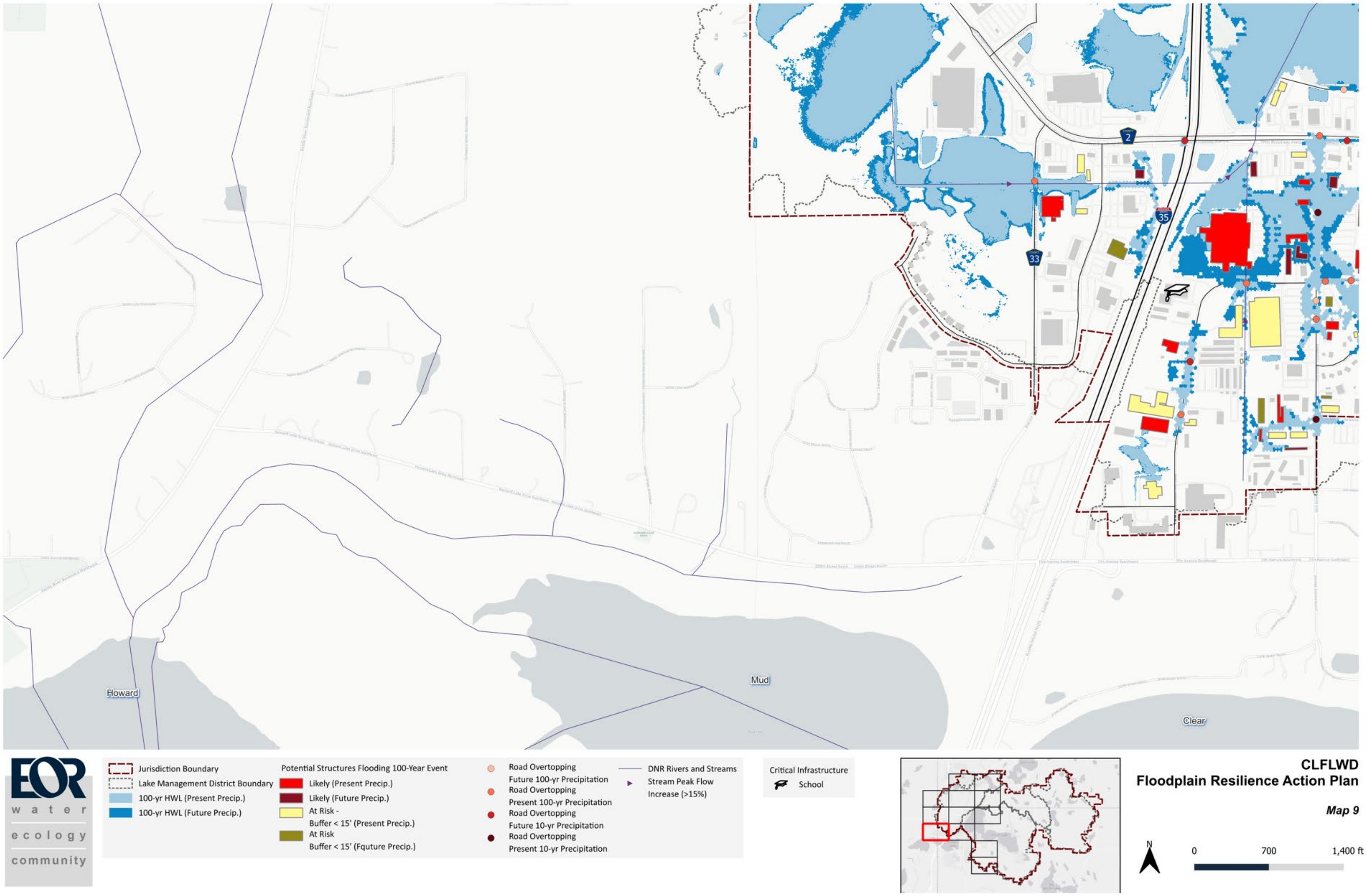

Figure 10. CLFLWD Floodplain Mapping Series – Map 9

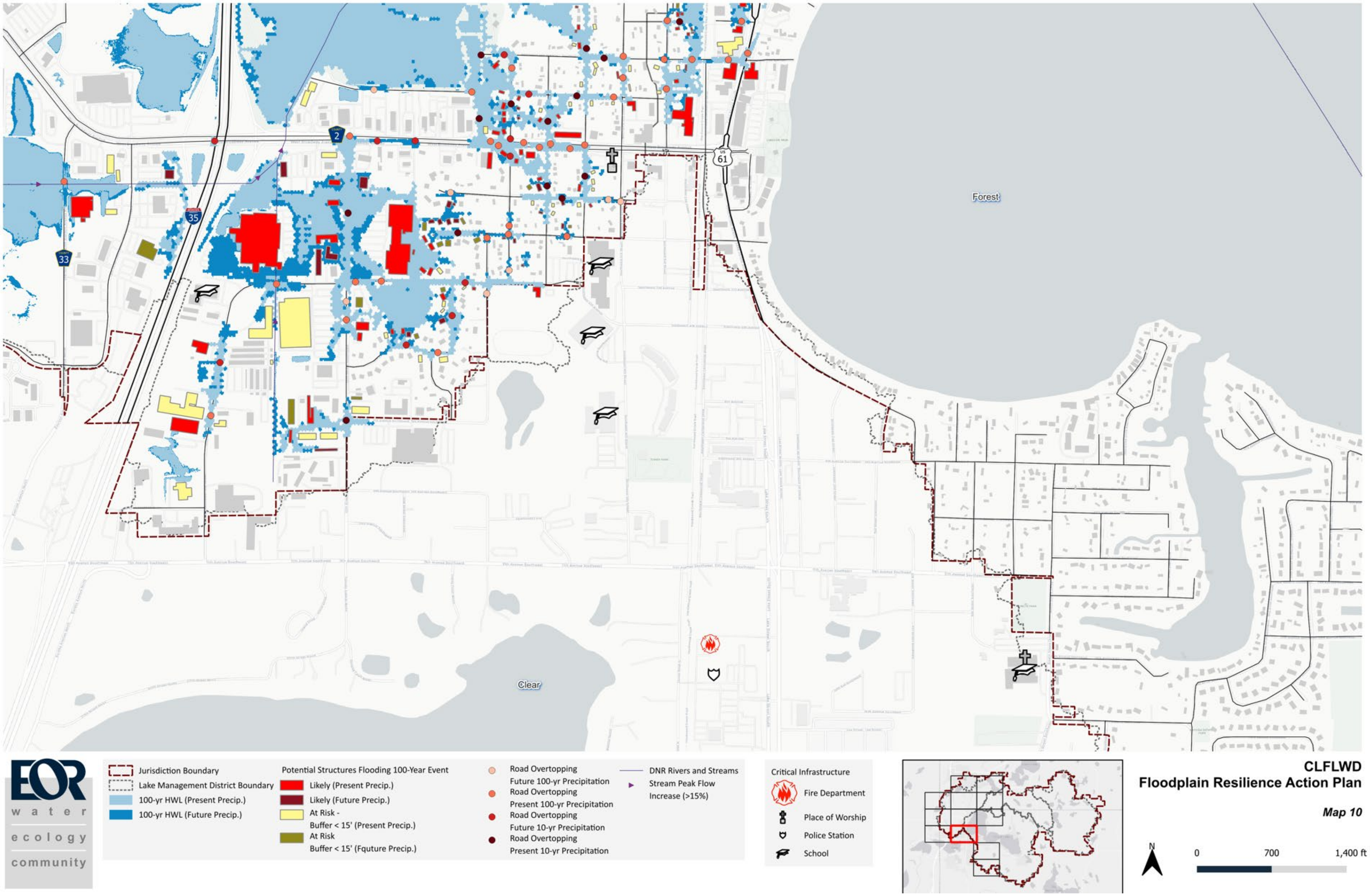

Figure 11. CLFLWD Floodplain Mapping Series – Map 10

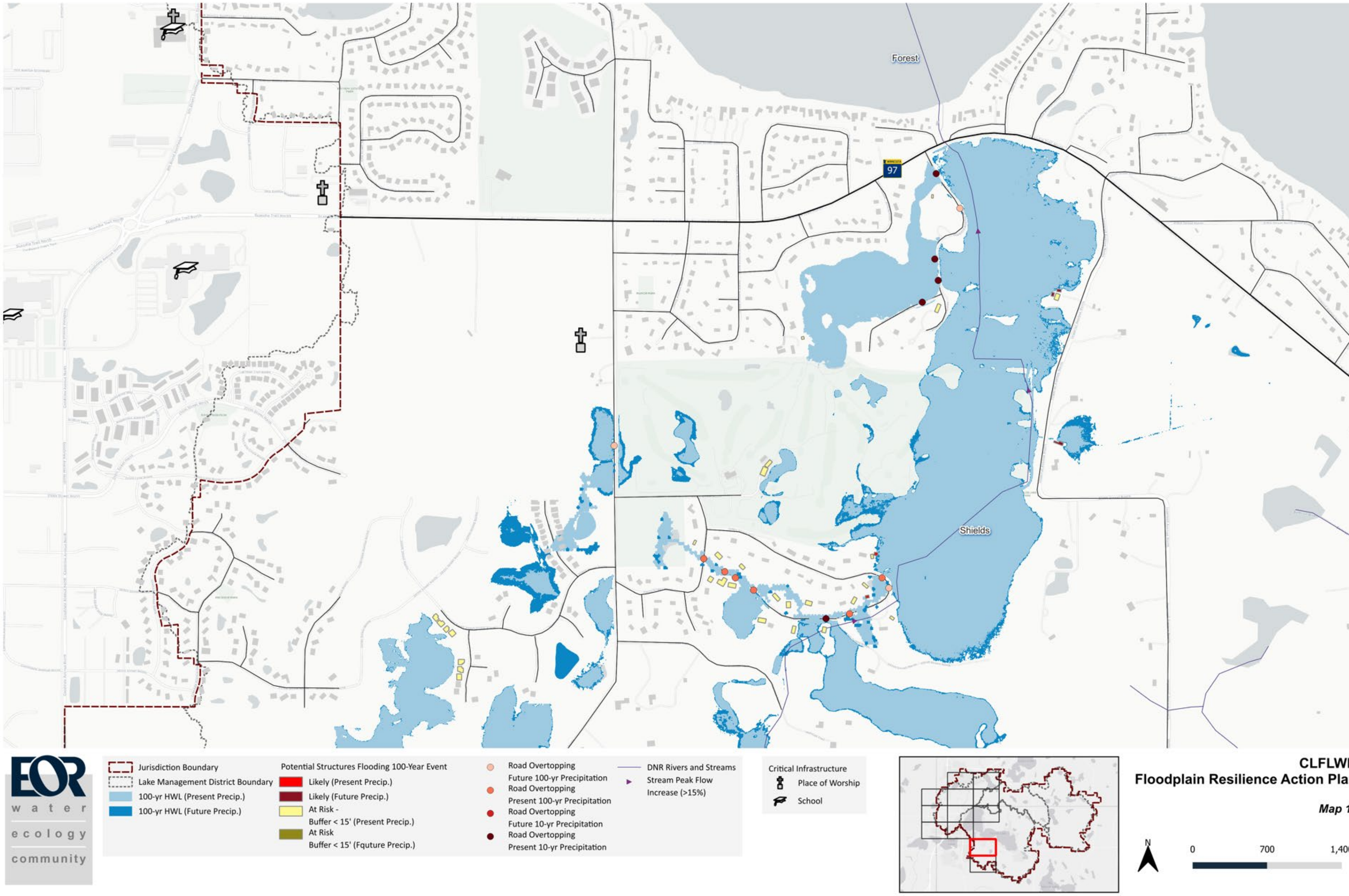

Figure 12. CLFLWD Floodplain Mapping Series – Map 11

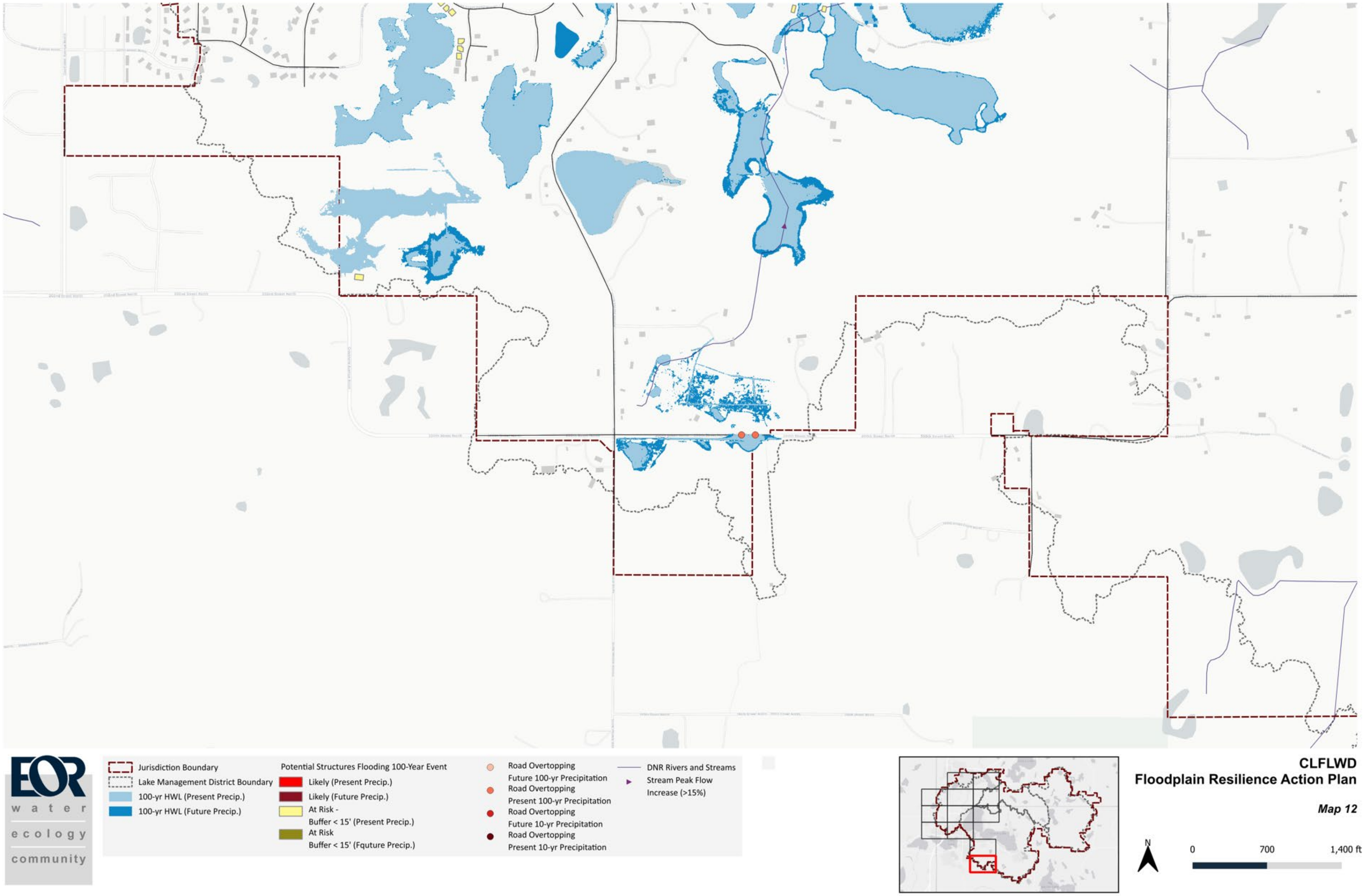

Figure 13. CLFLWD Floodplain Mapping Series – Map 12

2.2.4 Stormwater Pipe Network Limitations

Hydraulic diagnostics also pinpointed capacity bottlenecks within the existing stormwater pipe network. Constrained conveyance forces surcharge conditions that propagate upstream through manholes and catch basins, leading to surface flooding at multiple low points. Figure 14 shows where the stormwater pipe network reaches capacity and where catch-basins and manholes are at risk of backwater inundation during the present 10-year event.

Table 3. Model Simulations Summary – Duration of Stormwater Pipe Network Exceeds Design Capacity

Rainfall	1 - 2 ft. Diameter Pipes				> 2ft. Diameter Pipes			
	10 mins	30 mins	1 hour	2 hours	10 mins	30 mins	1 hour	2 hours
Present 10-year	103	54	**28**	20	26	23	**17**	15
Future 10-year	118	68	**39**	23	31	26	**22**	18

Table 4. Model Simulations Summary – Duration of MH/CB Overtop

Rainfall	Surcharged Manholes		
	10 mins	30 mins	1 hours
Present 10-year	41	9	3
Future 10-year	50	16	3

As summarized in Table 3, approximately 100 pipe segments ranging from 1 ft to 2 ft in diameter are shown to be undersized (i.e., their design flow capacity is exceeded). The amount of time a pipe operates exceeding its design capacity is important. The longer the time a pipe (or network of pipes) operates over its capacity, the longer and more severe the localized flooding becomes. Any duration exceeding 1 hour (especially affecting multi-pipe networks) is considered problematic.

In Table 3, pipes have been analyzed for exceedances lasting more than 10 mins, 30 mins, 1 hour, and 2 hours for both present and future 10-year events. The bold numbers represent the number of pipe sections that should be prioritized to address the system's lack of capacity.

Table 4 shows that approximately 50 manholes and catch basins exhibit water level depths that exceed their top covers for the future 10-year event. This means that the system overflows and runoff spills out from the underground pipe network into the streets.

As in the case of undercapacity pipes, the amount of time that a manhole or catch basin overflows is also important. Manholes and catch basins have been analyzed for overflows lasting more than 10 mins, 30 mins and 1 hour. Any overflow exceeding 10 minutes is a concern.

Table 4 shows that three of these structures overflow for longer than one hour during both the current and future 10-year design storms. Two are on 3rd Avenue SW, just upstream of the Walmart parking lot and 12th Street SW, while the third is on 1st Avenue SW and 6th Street SW. This is an indication of a significant lack of capacity and/or an obstruction downstream.

Collectively, these pipe-and-junction limitations are the main cause of the localized flooding, reinforcing the need for targeted pipe upsizing, additional in-line storage, and downstream runoff detention/retention to improve conveyance resilience under future climate conditions.

These practices need to be done in combination and planned wholistically. Only addressing the pipe sizing often leads to higher downstream flow and often creates flow and/or water quality issues downstream

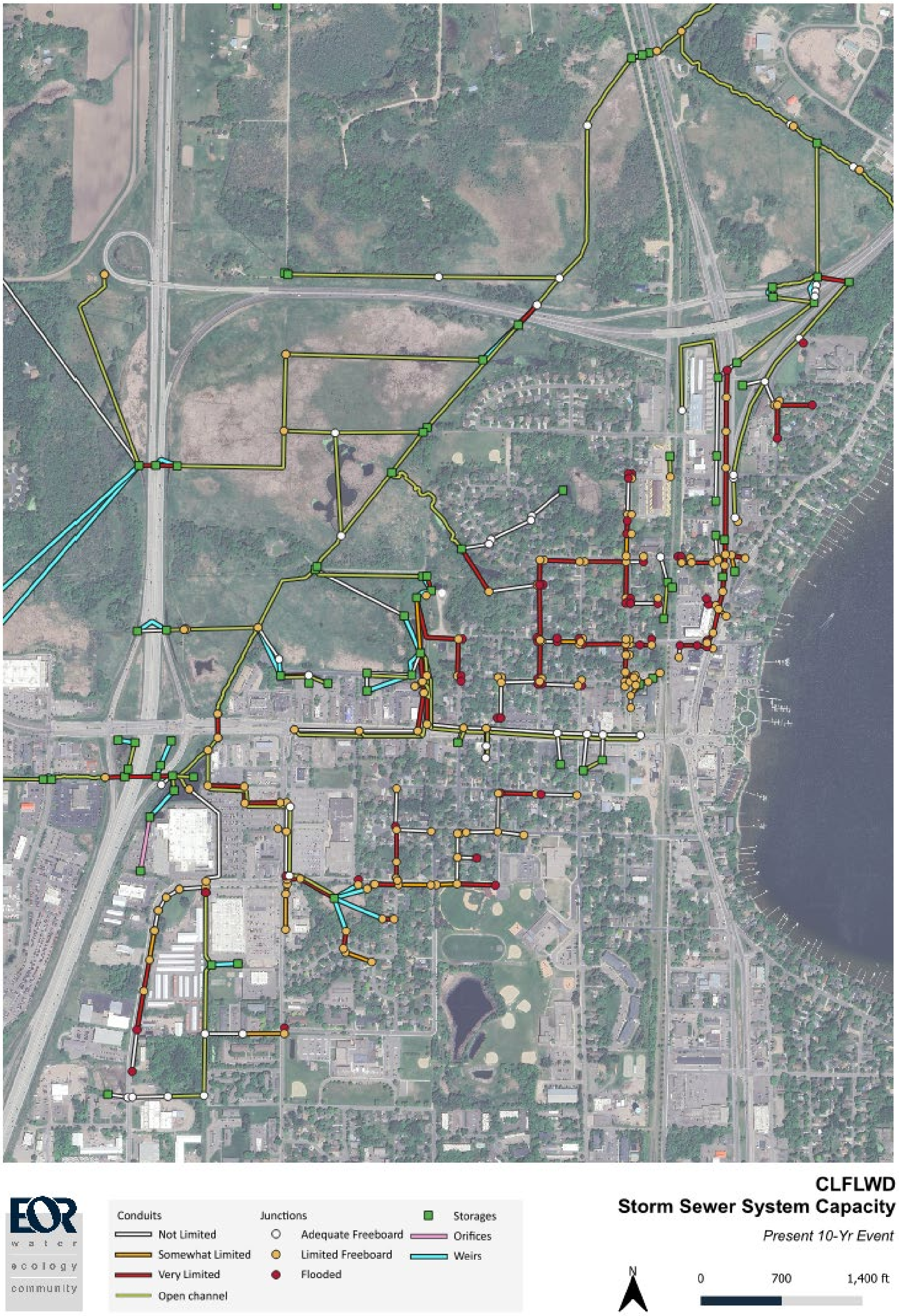

Figure 14. Capacity Limitations of the City of Forest Lake Urban Stormwater Pipe Network During the Present 10-Year Event

2.2.5 Phase I Priority Areas Verification

The integrated and detailed modeling performed in this Phase IV, corroborates the Phase I analysis, which ranked the densely developed urban core of the City of Forest Lake as the watershed's highest-priority flood-risk area (Rank 1). Even under today's precipitation patterns, localized flooding and runoff backups are predicted to be widespread across this area under the storm events modeled. This is largely driven by undersized stormwater pipes and limited downstream and upstream storage. Simulated 10-year and 100-year events under future rainfall intensities exacerbate these issues, overtopping more intersections, potentially affecting more homes, and overwhelming inlets for prolonged periods.

The Sunrise River riparian corridor emerged as the second-highest priority (Rank 2) in Phase I. This has been verified by model outputs showing extensive flood footprints across wetlands fringing the river and peak flow increases exceeding 15% under future rainfall scenarios. Peak flow increases exceeding 15% increases the risk of bank erosion, habitat degradation, and loss of flood storage capacity.

The Shields Lake drainage area was classified as the third-highest priority (Rank 3). Although less densely developed than Forest Lake, Shields Lake still exhibits flood potential (particularly along low-lying residential streets) due to restricted conveyance and limited upstream storage. Additionally, Shields Lake is located upstream of Forest Lake, the Sunrise River, and Comfort Lake. As such, it presents opportunities to address flooding at the headwaters of the watershed, thus providing flood mitigation benefits to the communities located downstream.

Collectively, the Forest Lake urban core, the Sunrise River wetlands, and the Shields Lake sub-watershed warrant focused attention in subsequent action planning. Effective mitigation will require a combination of additional storage capacity, targeted pipe-network upgrading, and channel or wetland stabilization to achieve meaningful flood-risk reduction.

These findings establish the quantitative baseline against which potential storage additions, pipe upsizing, and other mitigation actions are compared to.

3 PROPOSED FLOOD MITIGATION ACTIONS

3.1 Sunrise River Study Area

Complementary mitigation measures were evaluated by running additional modeling scenarios to address the flood, conveyance, and erosion issues documented above. Figure 15 and Table 5 provide an overview of the locations, concept footprints, and preliminary performance metrics.

Figure 16 illustrates the 10-year flood reduction, both in footprint and depth, if the improvements in Table 5 are implemented. The localized flooding footprint in the urban area gets reduced by about 80% to 90%.

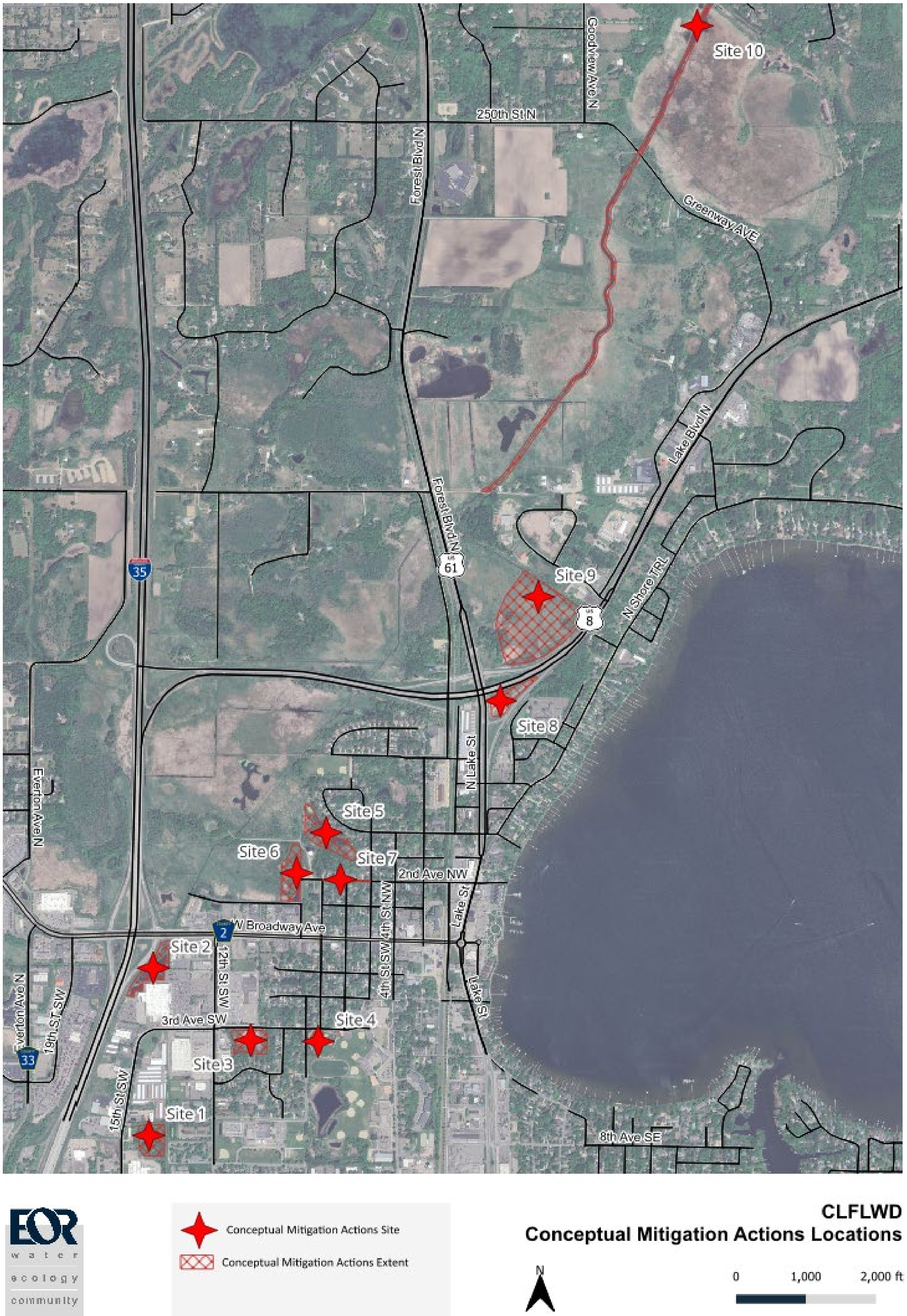

Figure 15. Conceptual Mitigation Actions Location Map

Table 5. Conceptual Mitigation Actions Performance Matrix

Location	Potentially Available Runoff Storage Volume (ac-ft) [1]	Mitigation Actions and Potential Benefits
Site 1	5	Intercepts runoff from adjacent industrial / commercial parcels, lowering peaks and relieving the stressed downstream pond and pipe system.
Site 2	10	Consolidated basin attenuates peak flows that currently flood Walmart–Target parking lots and overtops 12th St SW.
Site 3	5	Expanded detention / retention facility captures residential + school runoff, reduces pressure on downstream commercial corridors, and alleviates local street ponding.
Site 4	2	Underground vault cuts downstream peaks and supplies reuse water for potential baseball field, soccer field irrigation.
Site 5	10	Enlarged pond detains flow before it enters the Sunrise River, reducing peak discharge and erosion potential, and improving water quality.
Site 6	10	Extended pond receiving runoff from a potential 2nd Ave NW bypass. This would treat residential runoff and further reduces the Sunrise River peak flows as a result of the bypass
Site 7	N/A	Current capacity-limited conveyance will be improved by installing a new pipe connection along 2nd Avenue NW from 5th Street NW to 7th Street NW. This would significantly reduce local flooding. New ponding at Site 6 would treat the excess flow resulting from this pipe system upgrade.
Site 8	5	Create interchange pond at Hwy. 8 & Hwy. 61 to improve conveyance and detain additional runoff before the Hwy. 8 wetland improvements (Site 9) are performed. In addition to improving water quality, wetland and habitat / ecological restoration could also be incorporated.
Site 9	25	Berm and control-weir add upstream storage and lower high-water levels in the Hwy. 8 wetland complex, protecting downstream properties. As in Site 8, wetland and habitat / ecological restoration could also be incorporated.
Site 10	N/A	The overall restoration of the Sunrise River corridor not only would provide significant runoff volume and peak flow reductions from its heavily developed drainage area, but also multiple water quality and ecological restoration benefits. Ideally this project would be combined with Hwy. 61 Regional Pond Improvements (Site 9).
Stormwater Pipe Network Upgrade	N/A	Across the project area, key hydraulically constrained pipes could be upsized to significantly reduce local flooding. Downstream impacts due to upsizes need to be assessed and mitigated with additional storage.

Note: [1] *Volumes shown are conceptual magnitude estimates only. Actual feasible storage would be confirmed during detailed design and permitting.*

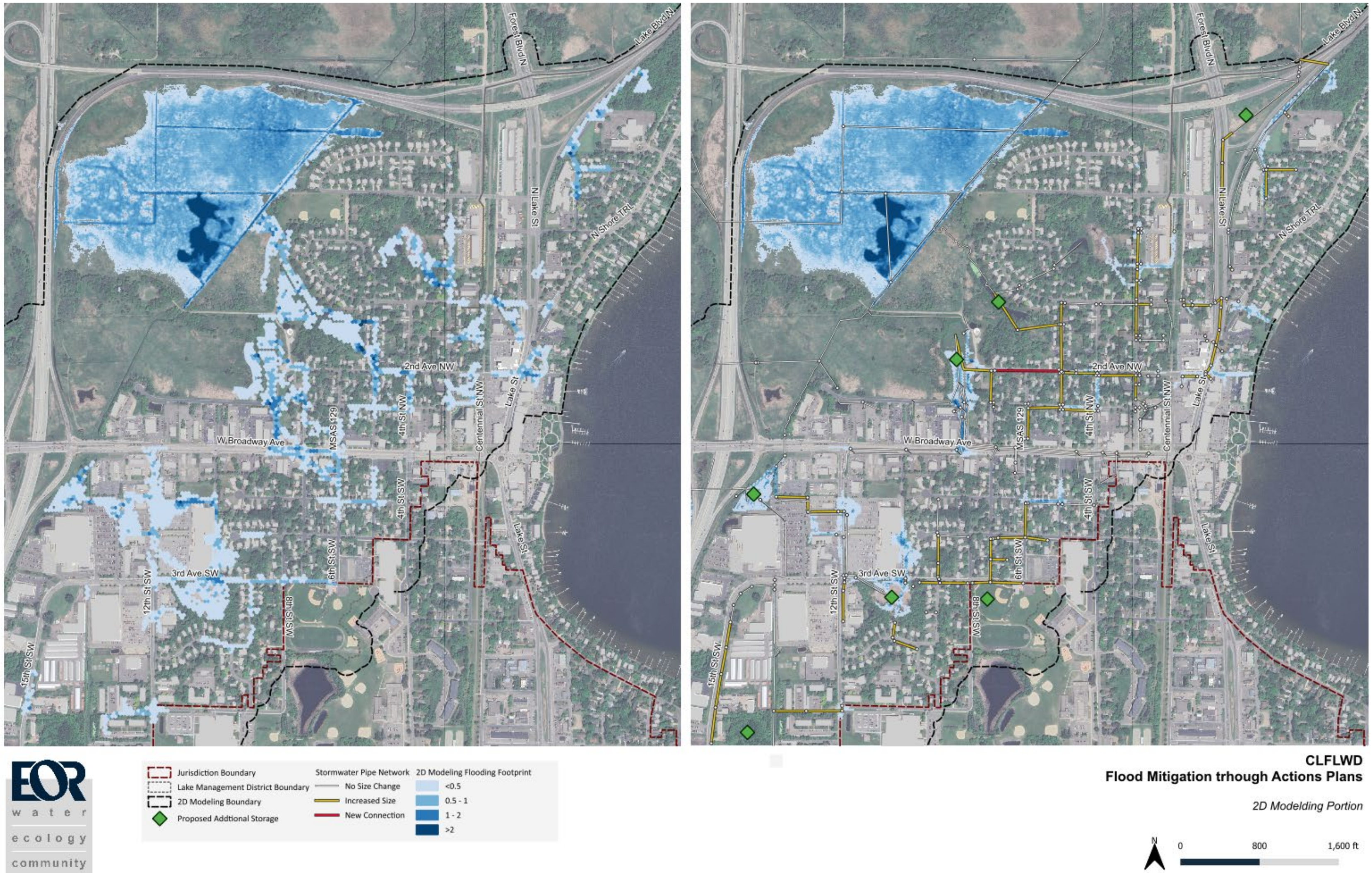

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Figure 16. Flood Mitigation through Action Plans under current conditions 10-year Event

3.1.1 SW 15th St (Site 1)

A potential opportunity for added flood storage lies within the wooded parcels. A shallow impoundment in this area would intercept runoff from the surrounding industrial and commercial parcels, relieving pressure on the downstream ponds and conveyance systems.

3.1.2 I-35/W Broadway interchange and north of Walmart (Site 2)

At Site 2, there are three ponds adjacent to the I-35/W Broadway interchange and north of Walmart. These basins could be more hydraulically connected and combined with expansion toward the interchange right-of-way. This would create a large, combined basin capable of storing the additional runoff that currently inundates nearby commercial parking lots and 12th Street SW.

3.1.3 3rd Avenue SW and 5th Avenue SW (Site 3)

In the residential district between 3rd Avenue SW and 5th Avenue SW, a low-lying degraded wetland and depressional area could potentially be excavated and expanded to provide greater storage volume. Capturing overland flow from the east and a portion of the Forest Lake Elementary School catchment will reduce runoff delivered to the downstream commercial corridors while, in tandem, upsizing key pipes through the neighbourhood mitigates local flooding. Wetland regulations and the large number of adjacent parcels would need to be evaluated as limiting factors for this site.

3.1.4 Forest Lake Elementary School (Site 4)

Beneath the Forest Lake Elementary School's baseball field, an underground storage facility could be constructed to store stormwater and alleviate downstream flooding. In addition to peak flow reduction, a significant co-benefit of underground storage is its potential for runoff reuse for irrigation and water conservation purposes. The baseball field, soccer fields, and other facilities, would be good candidates for reuse and water cost savings for the school. Reuse also has the advantage of significantly reducing the amount runoff volume currently being discharged downstream. This site is located on the boundary of CLFLWD and RCWD so coordination between watershed districts would be needed.

3.1.5 Schilling Circle NW and Southeast of Bixby Park (Site 5 and Site 6)

The existing pond just west of Schilling Circle NW (Site 5) and the pond southeast of Bixby Park (Site 6) could potentially be excavated and extended to detain additional runoff before it enters Bixby Park and the Sunrise River.

3.1.6 2nd Avenue NW and 5th Street NW (Site 7)

Conveyance will be improved by installing a new pipe connection along 2nd Avenue NW from 5th Street NW to 7th Street NW, thereby routing excess flow from capacity-limited residential pipes to the enlarged storage at Site 6.

3.1.7 Hwy. 61 and Hwy. 8 Pond (Site 8)

Stormwater pipes run from the northern portions of the downtown area of Forest Lake up Highway 61 and discharge at the Hwy. 8 & Hwy. 61 location. This site has long been identified as a location for a regional treatment facility to capture runoff from downtown urban areas. Coordination with MNDOT will be required. This regional treatment facility would capture runoff from the impervious areas that were developed prior to stormwater standards. This regional treatment pond could provide TP treatment, sediment removal, and peak flows reduction before discharge into the Highway 8 Wetland Complex discussed below.

3.1.8 Hwy. 8 Wetland Complex Improvements (Site 9)

As part of past Regional Stormwater Treatment Feasibility and Greenway Visioning. EOR has identified alternatives for improvements to the ditched wetland complex located just north and east of the Hwy. 8 and Hwy. 61 intersection. Alternatives being explored include:

a) Improving the hydrologic function of the ditch channel by shaping the channel banks to reconnect and expand the ditch floodplain,

b) Rerouting the ditch into a constructed natural stream meander across the wetland, and

c) A large-scale project encompassing rerouting the ditch into a constructed natural stream meander, wetland impoundment, and connection to a recreational trail system.

Hwy. 8 Wetland Complex Improvements project would provide significant runoff volume and peak flow reductions from the heavily developed drainage area. Ideally this project would be combined with Hwy. 61 Regional Pond Improvements discussed above which would provide pre-treatment of stormwater runoff before discharging to this project.

3.1.9 Sunrise River Greenway Corridor (Site 10)

The Sunrise River Greenway Corridor project represents a multi-year initiative to couple flood-risk reduction with water-quality and wetland/habitat restoration gains. Early planning and monitoring, funded in part through the District's Accelerated Implementation Grant, will identify projects along this corridor to further reduce phosphorus and sediment loading to Comfort Lake.

The flood mapping that has been produced as part of this effort will help guide areas that should be protected and acquired. The wetland complexes along the Sunrise River Greenway Corridor have a very significant capacity for flood storage. Although currently the Sunrise River corridor serves its flood storage function well, this should be preserved and/or enhanced as much as feasible in the future.

Development along this corridor without considering the impacts to the storage areas that naturally exist combined with changes in future precipitation, would result in significant negative impacts in the corridor itself and downstream. Upfront planning and protection of this corridor will be key for long-term flood, wetland, and habitat protection.

3.1.10 Comprehensive Stormwater Pipe Network Upgrade

A significant portion of the Forest Lake downtown stormwater network in this study shows capacity limitations for the 10-year rainfall event (Figure 14). The 10-year event is the stormwater piping design standard that most cities use.

To meet the 10-year design standard, the diameter of most of the under-capacity pipes identified in Figure 14 would need to be upsized by just 6-12 in. A few pipe segments would need to be upsized by 24 in. Typically, pipe upsizing is scheduled to coincide with streets upgrades to minimize disturbance to residents. Pipe size increases need to assess downstream impacts and should be mitigated, if needed, with additional storage to offset impacts to flow and/or water quality.

3.2 Shields Lake Drainage Area

Compared with the Forest Lake urban core, flooding in the Shields Lake drainage area is limited (Figure 12 and Figure 13).

Only few buildings are slightly at risk. Roadway overtopping is localized and minor under present-day and future 10-year storms. During the 100-year present-day and future events, flood risk remains modest, especially relative to the City of Forest Lake urban area. The primary issue is ponding along 208th Street N, where ditch flow on both sides of the roadway backs up before discharging to Shields Lake. A secondary issue is road overtopping at Hoekstra Ave.

3.2.1 Mitigation Concepts

Two complementary mitigation concepts are recommended:

1) Stormwater Pipe System Upgrade. Replace or upsize undersized culverts and stormwater segments beneath 208th St N to increase conveyance capacity and eliminate roadway overtopping.
2) Additional Storage Capacity. Expand the existing pond south of 208th St N and east of Hazel Ave N and evaluate the wetland adjacent to Holstad Trail for selective excavation or berm construction. These storage improvements would attenuate peak flows reaching Shields Lake, reduce local ponding along 208th St N, and provide resilience for future upstream development. They would also lessen flood stress on Shields Lake and the downstream Forest Hills Golf Course.

3.3 Little Comfort Lake South Drainage Area

Hydraulic modeling indicates that the stormwater pipe running along Heath Ave N. and discharging to Little Comfort Lake is undersized for both present and future design storms. Under the simulated 10-year and 100-year events the pipe surcharges, causing ponding within the right-of-way and overtopping toward adjacent residential lots. Upsizing this pipe segment (subject to downstream capacity verification and impacts assessment) would restore conveyance, reduce the frequency and depth of street flooding, and lower structural flood risk for nearby properties.

Feasibility assessment would need to determine pipes needing to be upsized, explore inline detention options, and confirm that the improvement does not adversely influence lake water levels or water quality. Due to the size of the drainage area, it may be difficult or unviable to mitigate for the increased flows pushed downstream. Any improvements would need to carefully weigh the impacts versus benefits of pipe capacity increases.

At this point, it is not recommended to include the Heath Ave N. stormwater pipe update under the prioritized actions.

3.4 Potential Storage West of Highway 35

Two existing wetland depressions offer promising wetland-restoration opportunities that can also serve as future volume-control banks, as shown in Figure 17.
The northern site (Site 11), located north of 235th St N and west of Falcon Ave N, could be selectively scraped and re-graded to restore wetland hydrology, add shallow storage cells, and improve habitat diversity. The resulting storage volume could be credited to future upstream developments that lack space for on-site detention.

The southern site (Site 12), situated southwest of W Broadway Ave and directly west of Menards, presents similar restoration potential. Restoring and slightly enlarging this depression (e.g., by partially blocking the ditch outlet with a low berm or adjustable weir), would reduce peak volumes reaching the downstream culverts crossing 19^{th} St SW and ultimately the Sunrise River. Restoring Site 12 would also deliver ecological co-benefits such as water-quality polishing, pollinator habitat, etc. Both concepts will require wetland-regulation review, detailed hydraulic sizing, and cooperation with private landowners before advancing to design.

3.5 Overall Anticipated Benefits

Preliminary model runs indicate that, collectively, these storage expansions and conveyance upgrades could eliminate potential for inundation of 35-60 buildings, reduce roadway overtopping by 30 - 50%, and lower peak channel velocities along critical Sunrise River segments by 10% - 20%. All these benefits are for the present-day and future 10-year and 100-year storms. Detailed feasibility and assessment would be needed for these projects before they move to the design phase.

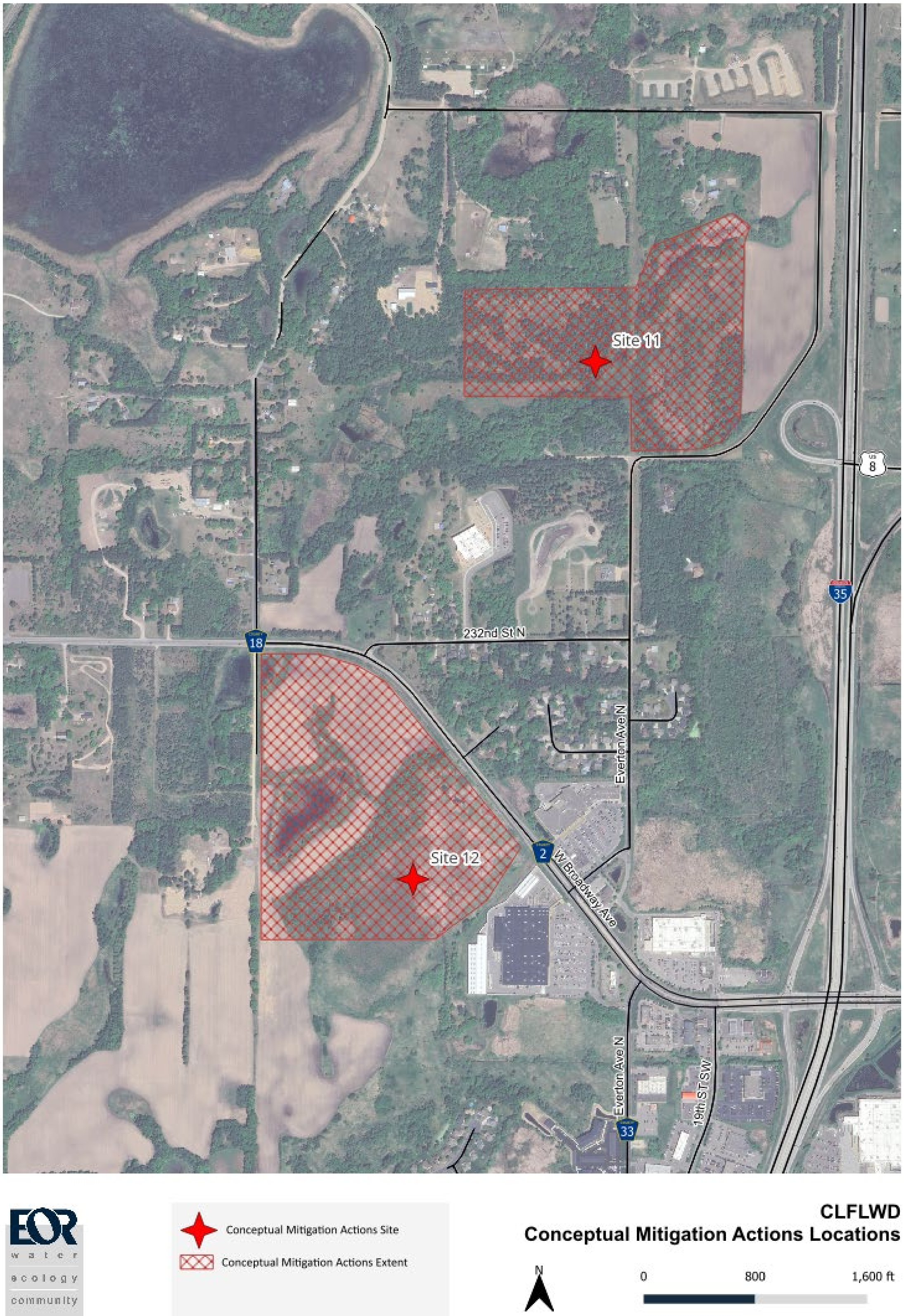

Figure 17. Conceptual Mitigation Actions Location Map - Wetland-Restoration Opportunities

4 PRIORITIZED ACTIONS AND GENERAL TIMELINE

Implementation and timeline are highly dependent on factors sometime outside District's control like land acquisition, cooperation/coordination with municipalities, funding, and grant awards. Therefore, the short, medium, and long-term actions proposed below need to be considered with this uncertainty in mind.

Similarly, the participation, roles and responsibilities of stakeholders (CLFLWD, Washinton Co., MNDOT, City of Forest Lake and Wyoming, landowners) implementing these actions are unknown at this point.

4.1 Short-Term Actions

Possible short-term actions to begin planning process and start initial steps for flood risk reduction:

I. Discuss the findings and recommendations of this report with the City of Forest Lake.

II. Explore Green Infrastructure Retrofits and reach out to large commercial property owners in the urban Forest Lake area (such as Walmart & ALDI parking lots) and adjacent streets to explore opportunities for impervious reduction and volume retention practices. These projects would be like what was previously done for the Target site to minimize parking lot flooding.

III. Work with Forest Lake and Wyoming to develop and adopt updated stormwater management rules that address the flooding potential for future larger and more intense rain events.

IV. Work with the City of Forest Lake to prioritize stormwater infrastructure (e.g., pipes, ditches, ponds) maintenance. Develop a maintenance strategy that ensures that downstream water resources are not adversely affected.

V. Develop a flood reduction community outreach plan and providing incentives (e.g., cost-share grants) to promote practices (e.g., rain-garden installation, downspout disconnection) that would reduce inflow to the already strained stormwater pipe network.

4.2 Medium-Term Actions

Moderate-scale capital projects and policy adjustments timed to allow feasibility assessment, detailed design, landowner coordination, and grant applications:

I. <u>Storage Expansion Projects</u>.

   a. Pursue feasibility, design and construction of the Third Avenue SW and Fifth Avenue SW Pond (Site 3). Site 3 is a low-lying and degraded wetland that would be excavated and expanded to provide greater storage volume and detention. Capturing overland flow from the east and a portion of the Forest Lake Elementary School catchment will reduce runoff to the downstream commercial corridors. Wetland regulations and the substantial number of adjacent parcels would need to be evaluated at the feasibility stage.
   b. Pursue feasibility, design, and construction to connect and enlarge the three ponds adjacent to the I-35/W Broadway interchange and north of Walmart (Site 2). These

basins would be better hydraulically connected and expanded toward the interchange's right-of-way. This would result in a larger, combined basin capable of storing additional runoff that currently inundates nearby commercial parking lots and 12th Street SW.

c. Pursue feasibility, design, and construction to excavate/extend the Schilling Circle NW and the Southeast of Bixby Park basins (Sites 5 & 6).
d. Pursue feasibility, design, and construction for adding flood storage within the wooded parcels (Site 1). Regrading and a shallow impoundment in this area would intercept runoff from the surrounding industrial and commercial parcels, relieving pressure on the ponds and convenance systems downstream.

II. Stormwater Reuse at Forest Lake Elementary School (Site 4)

Pursue feasibility, design, and construction of an underground storage tank beneath the Forest Lake Elementary School's baseball field to retain/detain stormwater significantly reducing the runoff volume currently being discharged downstream.

A significant co-benefit of underground storage is its potential for runoff reuse for irrigation and significant potable water costs savings for the school. This site is located on the boundary of CLFLWD and RCWD so coordination between watershed districts would be needed.

III. Residential Network Improvements (Site 7)

Upsize the pipe grid east of Site 3 and construct the 2nd Avenue NW and 5th Street NW bypass to route excess flow to the expanded storage at Site 6.

IV. Hwy. 61 and Hwy. 8 Pond (Site 8)

Work and coordinate with MnDOT to construct regional treatment basin at this location to provide enhanced water quality, sediment removal, and flood mitigation for both Highway 61 and the surrounding upstream drainage areas that were developed prior to current stormwater standards. Stormwater pipes run from the northern portions of the downtown area of Forest Lake up Highway 61 and discharge at the Hwy. 8 & Hwy. 61 location.
This site has long been identified as a potential location for a regional treatment facility.

V. Shields Lake Drainage Area

Two complementary flood mitigation actions are recommended:

a. Replace undersized culverts and stormwater segments beneath 208th St N to increase conveyance capacity and eliminate roadway overtopping.
b. Expand the existing pond south of 208th St N and east of Hazel Ave N and evaluate the wetland adjacent to Holstad Trail for selective excavation or berm construction.

4.3 Long-Term Actions

Large footprint or multijurisdictional projects will deliver the greatest system-wide benefits but need extended planning, right-of-way negotiation, and multiyear funding envelopes:

I. Sunrise River Greenway Corridor (Site 10).

Implement large scale projects, coupled with land acquisition or easements. These projects may be protection of existing flood storage and wetland areas and/or expansion of the existing ones.

The Sunrise River Greenway Corridor project represents a multi-year initiative to couple flood-risk mitigation with water-quality (phosphorus and sediment reduction) and wetland/habitat restoration gains. Early planning and monitoring, funded in part through the District's Accelerated Implementation Grant, will identify projects along this corridor. The flood mapping in this study will help guide areas that should be protected and or acquired.

II. Hwy. 8 Wetland Complex Improvements (Site 9)

Construct envisioned wetland complex improvements to increase upstream flood storage while lowering downstream peak stages.

As part of past Regional Stormwater Treatment Feasibility and Greenway Visioning. EOR has identified alternatives for improvements to the ditched wetland complex located just north and east of the Hwy. 8 and Hwy. 61 intersection. Alternatives explored include:

a. Improving the hydrologic function of the ditch channel by shaping the channel banks to reconnect and expand the ditch floodplain.
b. Rerouting the ditch into a constructed natural stream meander across the wetland.
c. A large-scale project encompassing rerouting the ditch into a constructed natural stream meander, wetland impoundment, and connection to a recreational trail system.

Ideally this project would be combined with Hwy. 61 Regional Pond Improvements discussed under Mid-Term Actions to provide pre-treatment of stormwater runoff before discharging into this Site 9.

III. Potential Storage West of Highway 35

Perform wetland-restoration that can also serve as future volume-control banks.

a. Selectively scrape and re-grade the northern site, located north of 235th St N and west of Falcon Ave N to restore wetland hydrology, add shallow storage cells, and improve habitat diversity.
b. Restoring and slightly enlarging the depression southwest of W Broadway Ave and directly west of Menards by partially blocking the ditch outlet with a low berm or adjustable weir.

Both concepts will require wetland-regulation review, detailed hydraulic sizing, and cooperation with private landowners before advancing to design.

IV. Comprehensive Stormwater Pipe Network Upgrade

Work with the City of Forest Lake to identify and repair/replace key under capacity stormwater pipes to achieve a higher standard of service. The 10-year event is the stormwater piping design standard that most cities use.

Coordinate with roadway reconstruction schedules to minimise disruption.

As part of the stormwater piping system upgrade, potential downstream impacts due to flow increases should be assessed and mitigated.

V. Large-scale, Regional Stormwater Treatment Capital Improvement Projects Financing

Consider stablishing a dedicated watershed-wide fund to purchase strategic flood storage easements and implement future adaptive measures as climate projections evolve.

4.4 Policy and Regulatory Support

Successful implementation short, mid-term, long-term implementation requires a supportive policy framework. Some potential actions that could be considered are:

I. District-wide Overlay Zone for Climate Resilience

Create Overlay Zones that would:

a) Set a uniform freeboard requirement (e.g., 2 ft) above the modeled 100-year flood footprint.
b) Restrict new development inside mapped 100-year flood footprint, unless compensatory storage or conveyance is provided.
c) Offer incentives for projects that include green-infrastructure practices such as bioretention, permeable paving, or stormwater reuse systems to increase flood resiliency.

II. Coordination with Municipal Capital-Improvement Plan

Work and coordinate with Forest Lake and Wyoming such that stormwater, street, and park projects earn watershed permitting credits and/or potential cost incentives when they deliver co-benefits such as flood mitigation, runoff-volume reduction, urban-heat mitigation, or pollinator habitat.

III. Align Emergency-Routing Protocols and Flood-Risk Mapping

Collaborate with MNDOT, Washington County Emergency Management, and municipalities to revise evacuation-route maps as needed and roadside signage using the roadway-overtopping analysis in this report.