The GLMRIS Report

Appendix J - Civil Design

USACE
01/06/2014

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J.1 INTRODUCTION

The purpose of this appendix is to present the engineering analysis for the formation of Great Lakes Mississippi River Interbasin Study plans. Each alternative plan contains several project features, including physical barriers, electric barriers, reservoirs, tunnels, and others. For an explanation of how these features fit into each alternative, refer to the main report, Chapter 3.

J.1.1 Purpose and Scope

The purpose of this appendix is to: (1) describe design criteria, engineering methods, procedures, and assumptions that were used for site layout and perform preliminary design analysis of the alternatives; (2) present the methods used and calculations developed for quantities; (3) present the real estate requirements; (4) present criteria and requirements for utility interferences; and (5) discuss the engineering design analytical requirements for the next phase of the project.

J.1.2 Existing Survey Data

> **Disclaimer:** While the U.S. Army Corps of Engineers (USACE) Chicago District has made a reasonable effort to ensure the accuracy of the maps and associated data, it should be explicitly noted that USACE makes no warranty, representation, or guarantee, either express or implied, as to the content, sequence, accuracy, timeliness, or completeness of any of the data provided herein. The USACE, its officers, agents, employees, or servants shall assume no liability of any nature for any errors, omissions, or inaccuracies in the information provided regardless of how caused. The USACE, its officers, agents, employees, or servants shall assume no liability for any decisions made or actions taken or not taken by the user of the maps and associated data in reliance upon any information or data furnished here. By using these maps and associated data, the user does so entirely at his or her own risk and explicitly acknowledges that he/she is aware of and agrees to be bound by this disclaimer and agrees not to present any claim or demand of any nature against the USACE, its officers, agents, employees, or servants in any forum whatsoever for any damages of any nature whatsoever that may result from or may be caused in any way by the use of the maps and associated data.

Local geographic information system (GIS) data was used for the design of hydro-separation sites and represents conditions existing at that time. The GIS data used includes 2-ft contours, real estate parcels, streets and highways, and streams and water bodies. The GIS data was provided by Tele Atlas North America, Northeastern Illinois Planning Commission, Illinois Department of Transportation Bureau of Information Processing, Lake County GIS/Mapping Division, and other local organizations.

The horizontal coordinates reference the Illinois State Plane Coordinate System, East Zone, or the Indiana State Plane Coordinate System, West Zone, North American Datum of 1983, in U.S. feet. All elevations used reference the North American Vertical Datum of 1988 in U.S. feet.

Baseline utility information is available for the conceptual design of the separation structures and other measures for this study. At this level of design, preliminary utility coordination with utility companies was not performed to identify existing utilities in significant conflict with the proposed features. Existing utility information was pulled from GIS and any existing project information for the sites in question. Designs were reviewed for any major conflicts and adjusted accordingly, with more minor relocations and coordination to be performed later. A detailed survey of all existing utilities within and adjacent to the project sites will be required during the design phase for each alternative plan.

J.1.3 Figures and Mapping

All alternative plan figures are included in the main body of this report and are referenced accordingly in this appendix. Overview figures of the proposed sites are provided in this appendix. Detailed site plans are not included in this report for this level of design; figures should be considered conceptual, showing the general location and system of each feature rather than the exact layout.

J.2 HYDRO-SEPARATION BARRIERS

The sites detailed in this section were chosen using extensive hydraulic and hydrologic modeling of the Chicago Area Waterway System (CAWS). Several locations were chosen based on this analysis as the least disruptive locations to separate the waterways. These locations are used in both the hydro-separation and technology alternatives. For detailed analysis of this modeling process, refer to Appendix D, Hydrologic & Hydraulic Analyses.

J.2.1 Wilmette (IL) Separation Barrier (Lakefront Hydrologic Separation)

The Wilmette Separation Barrier (Figure J.2.1) blocks the North Branch of the Chicago River adjacent to the existing Wilmette control structure. The new Wilmette control structure will be placed about 200 ft upstream of the existing control structure, which will remain in place. Modifying the existing control structures will require significant changes, such as an elevation increase to meet the hydrologic separation requirements. Access to the site will be from the property surrounding the existing closure structures, which is owned by the Metropolitan Water Reclamation District of Greater Chicago (MWRD). The existing parking and storage areas of the plant will be used as temporary staging and storage areas during construction. Close coordination will be required with MWRD to continue its operations during construction.

This feature will also require an aquatic nuisance species (ANS) treatment plant adjacent to the barrier, with a capacity of 200 MGD. The plant will be placed somewhere in the open land directly west of the existing control structure, with direct access via the existing access road to the control structure and Sheridan Road. Personnel and equipment will use this road to access the treatment plant for operation and waste disposal. An area of 0.9 acres is required for the plant’s permanent easement, including access, parking, and associated features. Specific real estate will need to be identified for the plant during further design. Existing electric lines and other utilities for Wilmette control structure will be extended slightly for operation of the new plant.

See 3.10 in the main report for the entire Lakefront Hydrologic Separation Alternative layout.

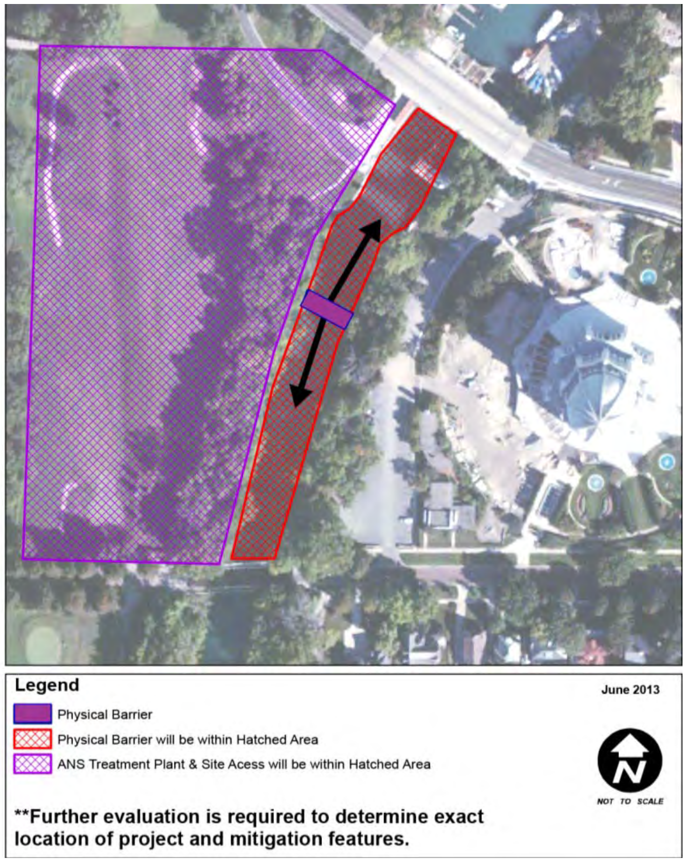

FIGURE J.2.1 Wilmette Barrier (Lakefront Hydrologic Separation)

J.2.2 Chicago (IL) Separation Barrier (Lakefront Hydrologic Separation)

The Chicago barrier (Figure J.2.2) blocks the Chicago River in downtown Chicago, slightly west and upriver of the existing lock structure. This barrier will be placed slightly upstream of the existing Chicago Lock structure just west of the Michigan Avenue Bridge, so the existing lock structure can remain in operation for certain uses such as local recreational boat traffic. This location will allow recreational boats that currently dock near the Michigan Avenue Bridge to continue to travel out into Lake Michigan. The exact barrier location will be determined in final design, taking into consideration adjacent real estate. The major issues with construction will revolve around site access and limited construction space, as the barrier will be placed in the heavily trafficked downtown area. The permanent easement will include the area of the barrier and access for maintenance of the structure. During construction, the majority of the work will be performed from floating barges in the water. The final design will have to work around the extensive existing utilities, transportation, and structures in the surrounding downtown area, with minimal disruptions.

The barrier will require an ANS Treatment Plant east of the barrier, with a capacity of 450 MGD. The plant will be placed on the open land intended for use in a failed residential high-rise construction project, which is currently unused. This site is approximately 3,000 ft east of the proposed barrier at North Water Street and McClurg Court, so the water from the barrier will be piped to this location. The treatment plant permanent easement will cover an area of 3.2 acres, to include access, parking and other associated features. The existing roads will be used for personnel and equipment to access the plant, for operation, and for waste disposal. Existing utilities in the area will be extended slightly to connect with the new treatment plant. The site was prepped for the development, which fell through several years ago, so there may be connections in place. This will be determined during further design investigations. During further design, the exact placement and layout of the barrier and related features will be determined. It may be desirable to build a wider physical barrier across the river, which will allow for the placement of the ANS Treatment Plant on top of the barrier instead of piping the material to another location. This widening could also incorporate green space into the design, if desired by the City of Chicago and any potential sponsors. Open land is very limited in the downtown Chicago location and this project will provide a unique opportunity to create new open space in the area.

See Figure 3.10 in the main report for the entire Lakefront Hydrologic Separation layout.

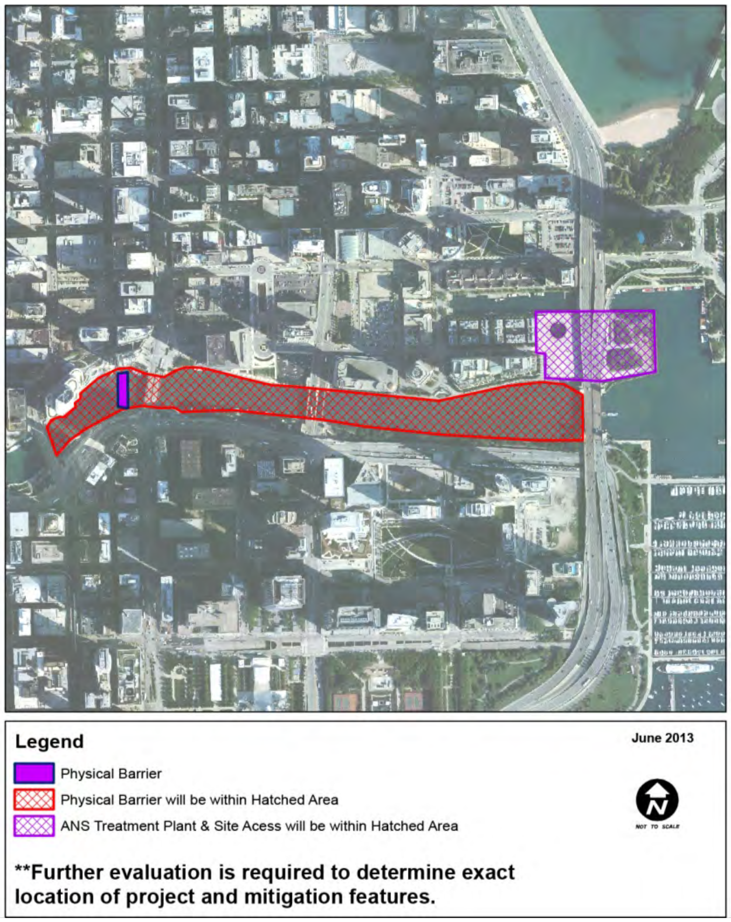

FIGURE J.2.2 Chicago Barrier (Lakefront Hydrologic Separation)

J.2.3 Hammond (IN) Separation Barrier (Lakefront Hydrologic Separation, CAWS Buffer Zone Alternative, Hybrid Cal-Sag Open Alternative)

The Hammond separation barrier (Figure J.2.3) blocks the Little Calumet River in Hammond, Indiana. USACE has built the existing Hart Ditch Structure in this location, 1,000 ft west of the Hart ditch confluence and 200 ft east of the Northcote Avenue Bridge. The existing structure is gabion construction with no gate. The new separation barrier will be constructed approximately 50 ft east of this existing structure on its lakeside.

The site has existing access off the adjacent Northcote Avenue and River Drive roadways. The area to the south is residential. The structure will be small enough to avoid inconveniencing these property owners during construction and maintenance. To the north of the site is the existing reservoir, along with riprap for slope protection and some open land. The open area to the north and south of the River will be used for staging and access. If additional staging/storage space is needed, the open land north of the reservoir owned by Cabela's, Inc. will be used.

See Figure 3.10 in the main report for the entire Lakefront Hydrologic Separation layout, Figure 3.6 in the main report for the entire CAWS Buffer Zone layout, and Figure 3.19 in the main report for the entire Hybrid Cal-Sag Open layout.

FIGURE J.2.3 Hammond Barrier (Lakefront Hydrologic Separation, CAWS Buffer Zone, Hybrid Cal-Sag Open)

J.2.4 Alsip (IL) Separation Barrier (Mid-System Hydrologic Separation, Hybrid CSSC [Chicago Sanitary and Ship Canal] Open Alternative)

This barrier location blocks the Cal-Sag Channel in Alsip, Illinois (Figure J.2.4). The barrier will be located just west of the existing Crawford Avenue/Pulaski Road Bridge over the channel, east of the I-294 Tollway Bridge. These existing bridges will remain intact without damage or major access changes. Access to the construction site will be via city property. The south bank provides clear access, while the north bank holds existing public utility structures. The barrier will tie into existing steep banks on each side of the canal, which is quite wide at this location. It is essential to locate the barrier to the west of the existing outfall on the south bank next to the Crawford Avenue Bridge, which deposits water from Natalie Creek into the Cal-Sag.

An ANS water treatment plant will be built on the north bank of the river, to the east of the Crawford Avenue Bridge on currently vegetated land. The treatment plant will have a capacity of 450 MGD and the permanent easement will cover an area of 5.3 acres, with access directly off Crawford Avenue/South Pulaski Road. Personnel and equipment will use this road access for operation and waste removal activities. Access to the 294 highway is directly east of this location. Access for the physical barrier will be via the south bank, along an existing pathway to the river. Modifications and improvements will be made to this pathway to serve as permanent access for the barrier. Utilities will be extended to the site of the ANS Treatment Plant on the north bank. The surrounding area is developed and should have most utilities in place.

See Figure 3.14 in the main report for the entire Mid-System Hydrologic Separation layout. Refer to 3.24 in the main report for the entire Hybrid CSSC Open Alternative layout.

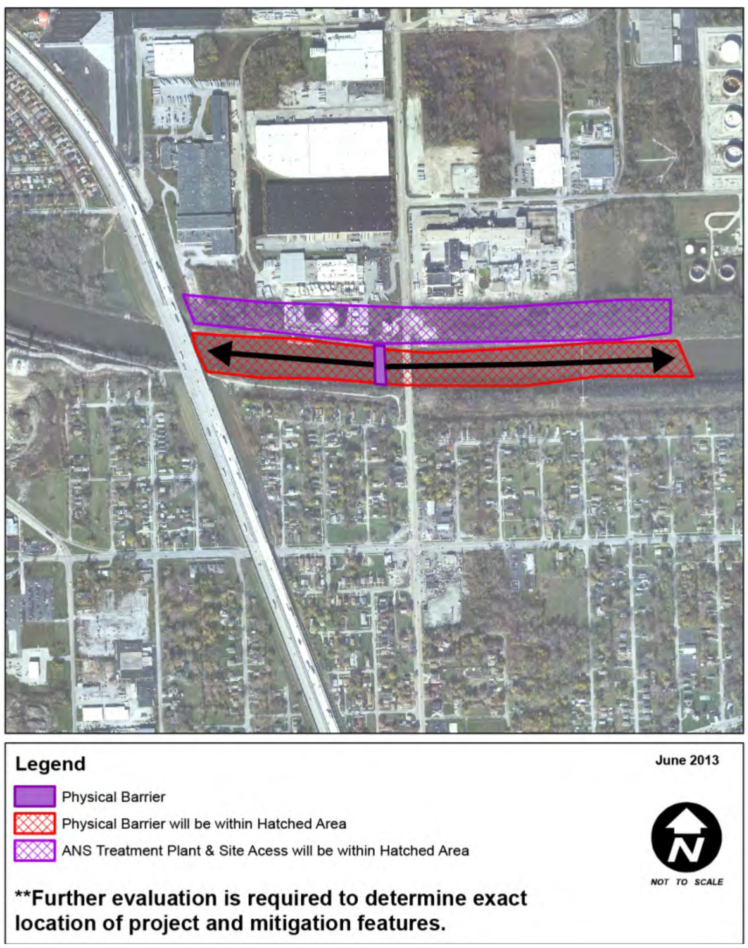

FIGURE J.2.4 Alsip Barrier (Mid-System Hydrologic Separation, Hybrid CSSC Open)

J.2.5 Calumet City (IL) Separation Barrier (Lakefront Hydrologic Separation)

The Calumet City separation barrier (Figure J.2.5) blocks the Grand Calumet River in Calumet City, Illinois. The new structure will be built into the existing bridge carrying the Bishop Ford Highway over the Grand Calumet River, or the bridge will be rebuilt to incorporate the barrier as a part of the project. To complete this combined project USACE will have to coordinate closely with the Illinois Department of Transportation on design requirements, schedule, traffic rerouting during construction, and other details. The land to the north and south of the river adjacent to the bridge is open, allowing easy construction access and convenient staging areas. If the combined bridge and barrier proves to be impractical for any reason, the barrier will be built in the water closely adjacent to the existing bridge.

An ANS Water Treatment plant with a capacity of 450 MGC will be built on a permanent easement of 3.3 acres to the northeast of the barrier, adjacent to the existing T.J. O'Brien Lock and Dam,. Access to the plant will be available via an extension to the existing parking/access for the Lock. Personnel and equipment can use this access for plant operation and waste removal. Electricity and other utilities will be extended from the adjacent lock site to hook up to the new treatment plant.

See Figure 3.10 in the main report for the entire Lakefront Hydrologic Separation layout.

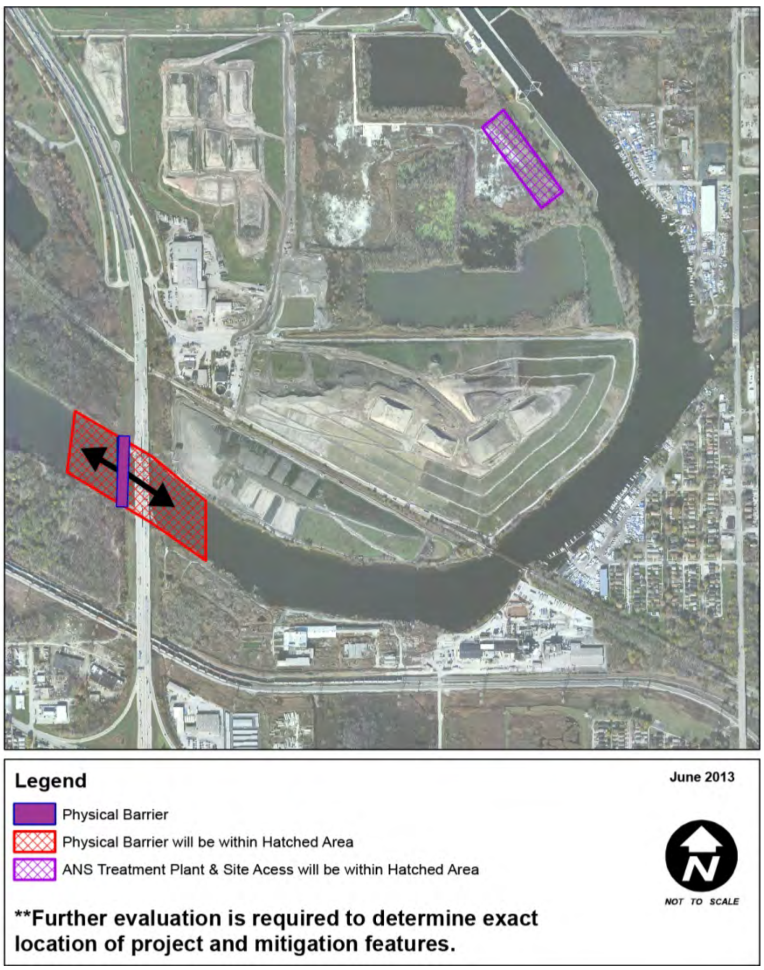

FIGURE J.2.5 Calumet City Barrier (Lakefront Hydrologic Separation)

J.2.6 Stickney (IL) Separation Barrier (Mid-System Hydrologic Separation, Hybrid Cal-Sag Open Alternative)

The Stickney Separation barrier (Figure J.2.6) blocks the Chicago Sanitary and Ship Canal in Stickney, Illinois. The new structure will be built within the boundaries of the existing MWRD-owned Stickney Water Reclamation Plant along the Chicago Sanitary and Ship Canal. The barrier will be slightly west of the existing Central Avenue Bridge. The canal is very wide at this location, but contains steep, high slopes, which is significant in terms of any tie-ins that may be required. There are existing components of the water treatment plant along the banks that must be avoided during active construction. Coordination with MWRD is vital to working on this site. Existing railroads run adjacent to the canal on both banks, so construction and access must avoid these rail lines.

Access will be from Cicero Avenue, using the private access roads to the north and south of the canal. These access roads run closer to the canal than the railroads, which will allow construction without interfering with railroad-owned land. These roads may need to be improved in order to be used as continual access for vehicles and equipment to operate and maintain the barrier and treatment plant. The preferred staging and storage area during construction is the land to the south of the canal, as it is currently open and undeveloped, with limited brush and trees. The ANS Treatment Plant will be built on this land as well. Permanent easements will be required for the treatment plant and access to plant and barrier. The treatment plant will have a capacity of 650 MGD and require a permanent easement of 10 acres, to include associated features and access from nearby roads. Utilities will be extended from the surrounding Stickney treatment plant to the new ANS Treatment Plant. If access and land availability become an issue at this site during further design, this will be a potential location to build the ANS treatment plan on top of a larger physical barrier instead of on adjacent land.

See Figure 3.14 in the main report for the entire Mid-System Hydrologic Separation layout. Refer to 3.18 D-2 in the main report for the entire Hybrid Cal-Sag Open layout.

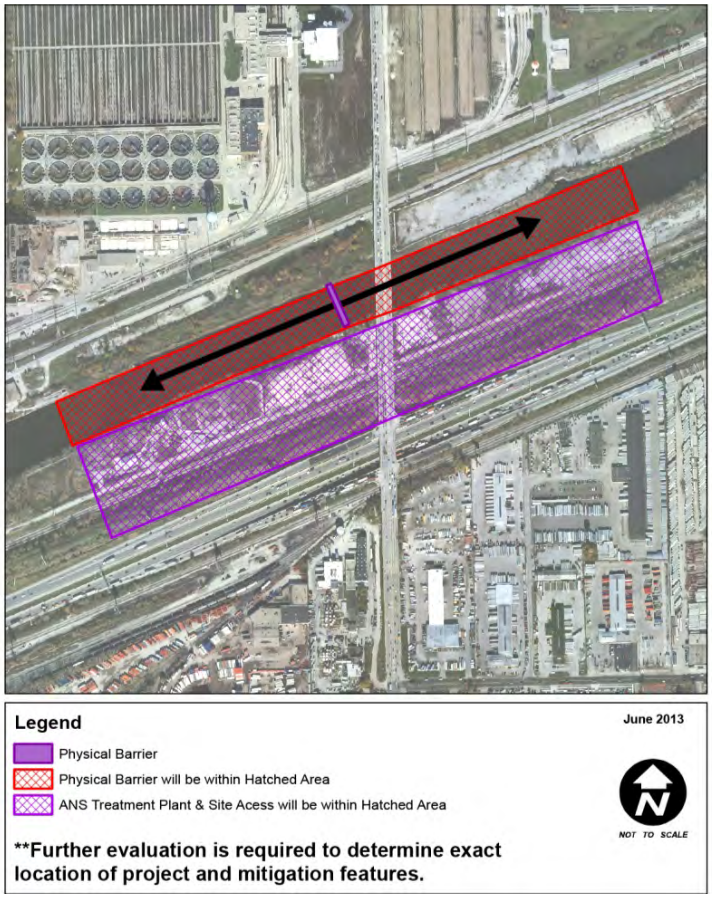

FIGURE J.2.6 Stickney Barrier (Mid-System Hydrologic Separation, Hybrid Cal-Sag Open)

J.2.7 Oak Lawn (IL) Separation Barrier (Mid-System Hydrologic Separation, Hybrid CSSC Open Alternative, Flow Bypass Alternative)

The Oak Lawn barrier is a complement to the Alsip barrier. The new Oak Lawn structure will avert water transfer along the Thorn Creek tributary leading into the Cal-Sag channel near the Alsip barrier location. At this location, the creek is rerouted through several underground tunnels and pipes. The barrier will be placed in these pipes, which will be closed off with concrete.

See Figure 3.14 in the main report for the entire Mid-System Hydrologic Separation layout, 3.2 in the main report for the entire Flow Bypass layout, and 3.24 in the main report for the entire Hybrid CSSC Open layout.

J.2.8 State Line (IL/IN) Separation Barrier (Hybrid Cal-Sag Open Alternative, CAWS Buffer Zone Alternative)

The State Line barrier (Figure J.2.7) blocks the Grand Calumet River at the border of Illinois and Indiana. The new State Line structure will avert transfer of water on the Grand Calumet River. The barrier will be approximately 40 ft across the river, just east of the Indiana Harbor Belt Railway crossing in Calumet City, Illinois, just west of the Indiana state border. Access to the barrier will be maintained via the industrial land on the north and south banks of the River. Overflow water will be sent slightly upriver to the new reservoir constructed for State Line barrier. See the Mitigation Design section for reservoir details.

See 3.19 in the main report for the entire Hybrid Cal-Sag Open layout. Refer to 3.6 in the main report for the entire CAWS Buffer Zone layout.

FIGURE J.2.7 State Line Barrier (Hybrid Cal-Sag Open, CAWS Buffer Zone)

J.3 MITIGATION DESIGN

Several of the proposed hydrologic separation barrier locations require mitigation under Flood Risk Management for the flooding they will induce. Additional mitigation is required to avoid water quality degradation to the waterways. The mitigation proposed includes reservoirs and tunnel systems, with similarities to the Tunnel and Reservoir Project (TARP) currently being constructed in the Chicago area. Specifically, the construction of the underground tunnels is assumed to mimic the construction of the TARP system tunnels, constructed by MWRD. The hydraulic engineering group determined the reservoir sizes, general locations, and tunnel locations during modeling. Refer to Appendix D for more information on the modeling performed.

J.3.1 New Reservoir at Oak Lawn (Mid-System Hydrologic Separation Alternative, Hybrid CSSC Open Alternative, Flow Bypass Alternative)

The Oak Lawn barrier along Thorn Creek requires a reservoir adjacent to the barrier, referred to as the Oak Lawn reservoir (Figure J.3.1). Based on the placement of the barrier in the system, the reservoir must hold 530 acre-ft of water (0.2 Billion Gallons). This reservoir will be a dike system, placed in the open area at 115th Street and Cicero Avenue in Oak Lawn, Illinois. Access is available directly off these roads. This area is currently open land owned by the adjacent cemetery. Only open land will be used for the reservoir, and no existing structures at the cemetery will be disturbed. The reservoir will be surrounded by approximately 10-ft-tall berms with a 3:1 slope, for a reservoir covering an area of 80 acres, requiring a 90 acre permanent easement. This 10-ft height can be achieved with a combination of excavating existing soil and building up new berms. It will incorporate the existing ponds on site, and expand these into a much larger reservoir. The planned reservoir has berms with top elevation 598 ft, only slightly higher than the existing site elevations. The reservoir base is at 588 ft, the bottom elevation of the existing ponds. Incorporating 2 ft of freeboard, the maximum water elevation will be 596 ft, for a storage capacity of approximately 597 acre-ft. Further design would modify and optimize the design. The two ponds on site will be incorporated into the reservoir design.

As currently shown, the reservoir will require approximately 850,000 CY of material be disposed. InRoads reports created for this design can be seen in Enclosure C. If some or all of the on-site material is found through further soil investigations to be unsuitable for berm construction, outside clay will be brought in. The reservoir will then be redesigned to allow for more fill and minimal cut. Thorn Creek briefly flows through underground tunnels here, before daylighting again farther downstream. This reservoir connection will be just upstream of the Oak Lawn barrier. The connection of the reservoir to Thorn Creek is through a drop shaft and pipe connection to the tunnel system at that location, from which the water will be pumped into the reservoir. Water will also need to be pumped out of the reservoir when storage is no longer required. This pump station will be added in further study and design of the site. The surrounding area is highly developed and mainly residential, so electricity will simply need to be extended onto the site.

Further design of this reservoir should investigate soil properties in the area, and verify the real estate can reasonably be acquired. The design was performed using existing topography and the InRoads program. Storage volumes were calculated with the pond volume tool, and overall cut and fill were calculated using a triangle comparison of the existing and designed surfaces.

See Section 3.15 in the main report for the entire Mid-System Hydrologic Separation mitigation layout, Section 3.25 in the main report for the entire Hybrid CSSC Open mitigation layout, and Section 3.3 in the main report for the entire Flow Bypass mitigation layout.

FIGURE J.3.1 New Reservoir at Oak Lawn (Mid-System Hydrologic Separation, Hybrid CSSC Open, Flow Bypass)

J.3.2 New Reservoir at State Line (CAWS Buffer Zone Alternative, Hybrid Cal-Sag Open Alternative)

The State Line barrier requires overflow water to be piped from the barrier to a newly constructed reservoir referred to as State Line reservoir (Figure J.3.2). The reservoir will be located on the land south of the intersection of Brainard Avenue and Burnham Avenue. Access is available directly off these roads. The property is currently being used as a golf course and will need to be transferred to the government. The site is adjacent to the Grand Calumet River so the water could be directed into the reservoir via a spillway or weir, or a pump station if necessary. Further analysis will determine the inflow/outflow required.

The reservoir will be surrounded by approximately 14-ft-tall berms with a 3:1 slope, for a reservoir covering an area of 110 acres and holding the required capacity of 921 acre-ft, or 0.3 billion gallons. The 14-ft height can be achieved with a combination of excavating existing soil and building up new berms. The planned reservoir has berms with a top elevation of 594 ft, slightly higher than the existing site elevations. The reservoir interior base is at 580 ft, and the exterior base elevation varies, meeting up with the existing site elevations. Incorporating 2 ft of freeboard, the maximum water elevation will be 592 ft, for a storage capacity of approximately 990 acre-ft. Further design would modify and optimize the design.

As currently designed, the reservoir will require approximately 430,000 CY of material be disposed. InRoads reports created for this design can be seen in Enclosure C. If some or all of the on-site material is found through further soil investigations to be unsuitable for berm construction, outside clay will be brought in. The reservoir will then be redesigned to allow for optimization of cut and fill.

Further design of this reservoir should investigate soil properties in the area, and verify that the real estate can be reasonably acquired. Final design will address further reservoir requirements such as permanent interior drainage, weir or pump station, and others. The total permanent easement for the reservoir to include these features is 130 acres.

See Section 3.7 in the main report for the entire CAWS Buffer Zone mitigation layout. Refer to Section 3.20 in the main report for the entire Hybrid Cal-Sag Open mitigation layout.

FIGURE J.3.2 New Reservoir at State Line (CAWS Buffer Zone, Hybrid Cal-Sag Open)

J.3.3 Second Reservoir at McCook (Flow Bypass Alternative)

J.3.3.1 Tunnel System

The Stickney Lock and Electric Barrier require a conveyance tunnel to bring overflow water from the lock to a newly constructed reservoir at McCook reservoir (Figure J.3.3). The tunnel will run a distance of 4.9 miles with a 14-ft diameter. Creation of the tunnel will require disposal of 147,500 CY of material. It is assumed that the tunnel will be placed within the public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

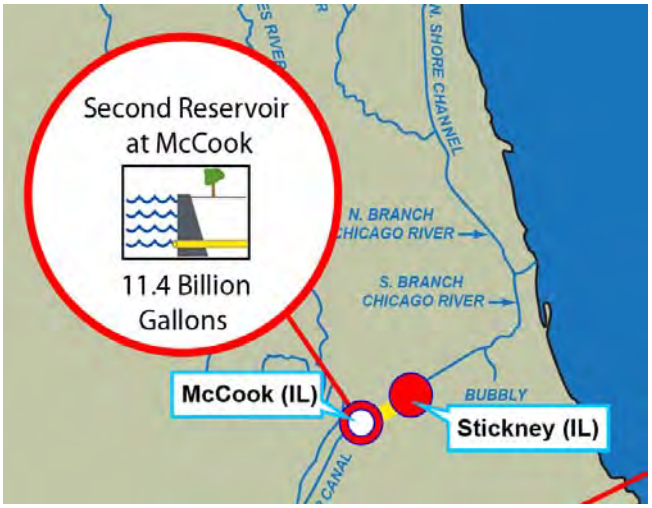

FIGURE J.3.3 McCook Tunnel (Flow Bypass)

J.3.3.2 Reservoir

This reservoir is assumed to be placed near the existing McCook reservoir (Figure J.3.4), either in the existing quarry or in a newly blasted area adjacent to it. The existing quarry belongs to private company, Vulcan Materials Company, and can be accessed from Joliet Road in Joliet, Illinois. The Stickney Reservoir must hold a minimum of 11.4 billion gallons, or 35,000 acre-ft. A reservoir of this size requires significant real estate and/or deep excavation and is a major construction project. A comparison can be made to the existing construction project McCook reservoir, which holds 10 billion gallons compared to this reservoir's 11.4 billion. Using a similar depth to McCook of 292 ft, the site requires 120 acres for the reservoir alone, with an estimated 140 acre permanent easement. This will result in an approximately 2,000-ft-wide by 2,614-ft-long reservoir on the proposed site. See Figure J.3.5 for a full analysis of footprint vs. excavation options and Enclosure B for further calculations.

Some additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. These features will not be designed until further in the study or design work, when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage.

No large-scale mining and disposal of rock will be needed based on the use of the existing quarry, which is the ideal design option. If the existing quarry is not available or not large enough, additional stone will be excavated to create the reservoir and the stone will require disposal. Reservoir design assumptions were based on the existing Thornton and McCook reservoir projects.

See 3.3 in the main report for the entire Flow Bypass mitigation layout.

FIGURE J.3.4 Second Reservoir at McCook (Flow Bypass)

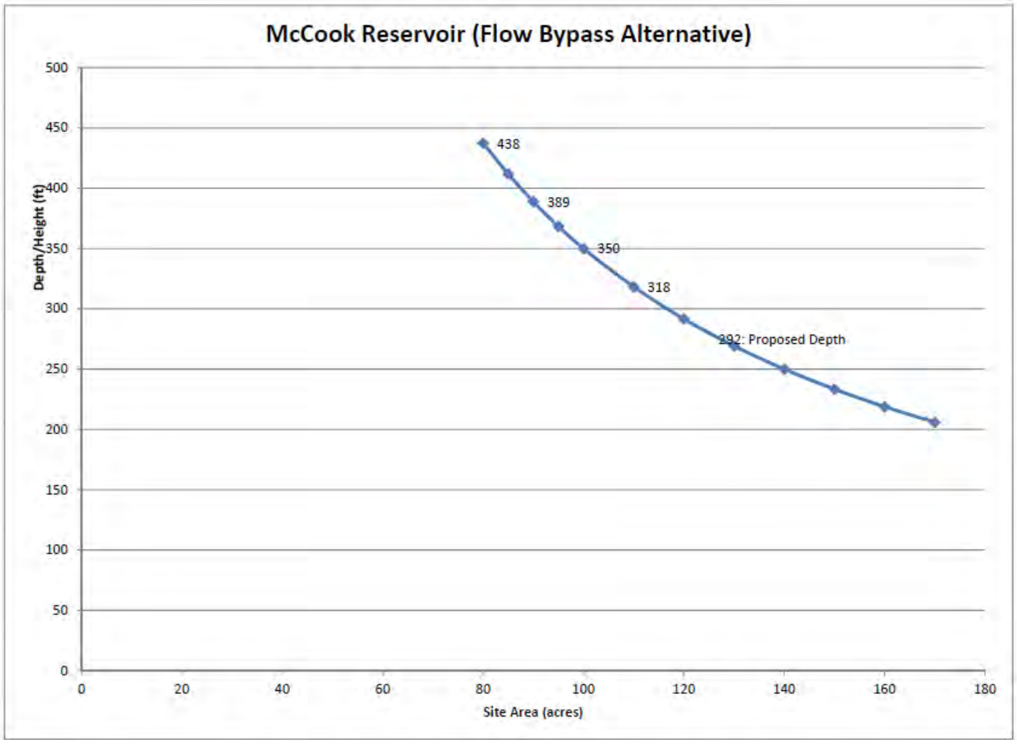

FIGURE J.3.5 Second Reservoir at McCook – Sizing (Flow Bypass)

J.3.4 Second Reservoir at McCook (Lakefront Hydrologic Separation)

J.3.4.1 Tunnel System

The Chicago and Wilmette barriers require a storage reservoir for Flood Risk Management mitigation at McCook. This reservoir is combined with a system of conveyance tunnels. A tunnel extends from the Wilmette barrier to the Chicago barrier for a total of 13.1 miles with a 22-ft diameter. A second tunnel extends from the Chicago barrier to the McCook reservoir expansion location for a distance of 12.5 miles with a 42-ft diameter (Figure J.3.6). Creation of the Wilmette to Chicago tunnel will require disposal of 973,818 CY of material and creation of the Chicago to McCook tunnel will require disposal of 3,386,645 CY of material. See Enclosure B for calculations. The new reservoir is then assumed to be located at the McCook reservoir expansion site. It is assumed that the tunnel will be placed adjacent to the existing TARP tunnels along the Chicago Sanitary and Ship Canal and the North Branch of the Chicago River, within MRWD and public right-of-ways as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD TARP tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

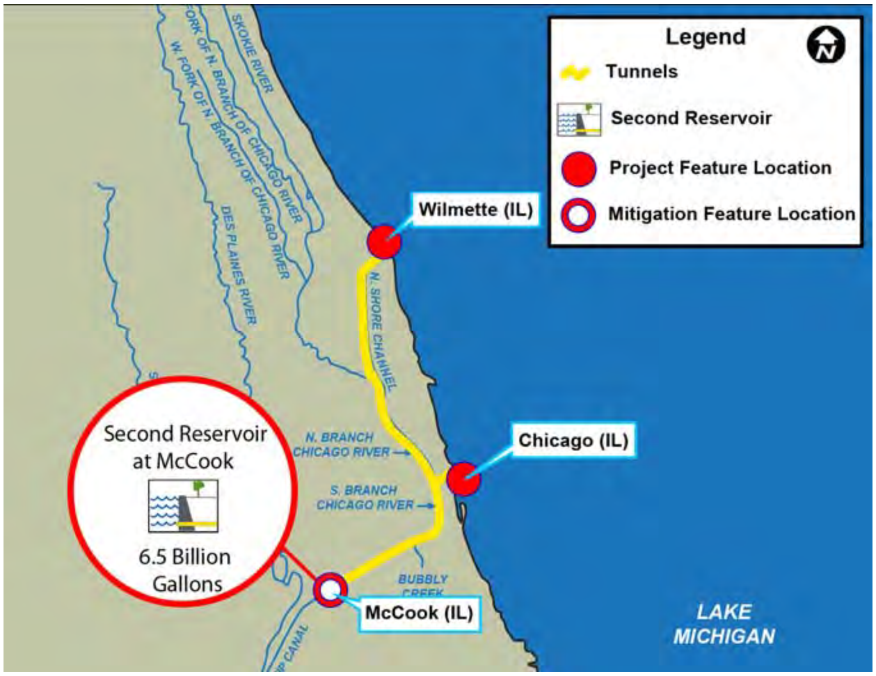

FIGURE J.3.6 McCook Tunnels (Lakefront Hydrologic Separation)

J.3.4.2 Reservoir

The Chicago and Wilmette Barrier locations collectively require a reservoir of 20,000 acre-ft, or 6.5 billion gallons, to meet Flood Risk Management requirements (Figure J.3.7). This reservoir is assumed to be placed near the McCook reservoir, either in the existing quarry or in a newly blasted area adjacent to it. The existing quarry belongs to private company, Vulcan Materials Company, and can be accessed from Joliet Road in Joliet, Illinois. Possible sizing options for the new reservoir are shown in Figure J.3.8. For further calculations see Enclosure B. Using the McCook depth of 286 ft, the site requires 70 acres for the reservoir alone, with 80 acres assumed for the overall site permanent easement. This will result in a 1,000-ft-wide by 3,050-ft-long reservoir on the proposed site.

Some additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. These features will not be designed until further in the study or design work, when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage. No large-scale mining and disposal of rock will be needed based on the use of the existing quarry, which is the ideal design option. If the existing quarry is not available or not large enough, additional stone will be excavated to create the reservoir and the stone excavated will require disposal. Reservoir design assumptions were based on the existing McCook reservoir project.

See Section 3.11 in the main report for the entire Lakefront Hydrologic Separation mitigation layout.

FIGURE J.3.7 Second Reservoir at McCook (Lakefront Hydrologic Separation)

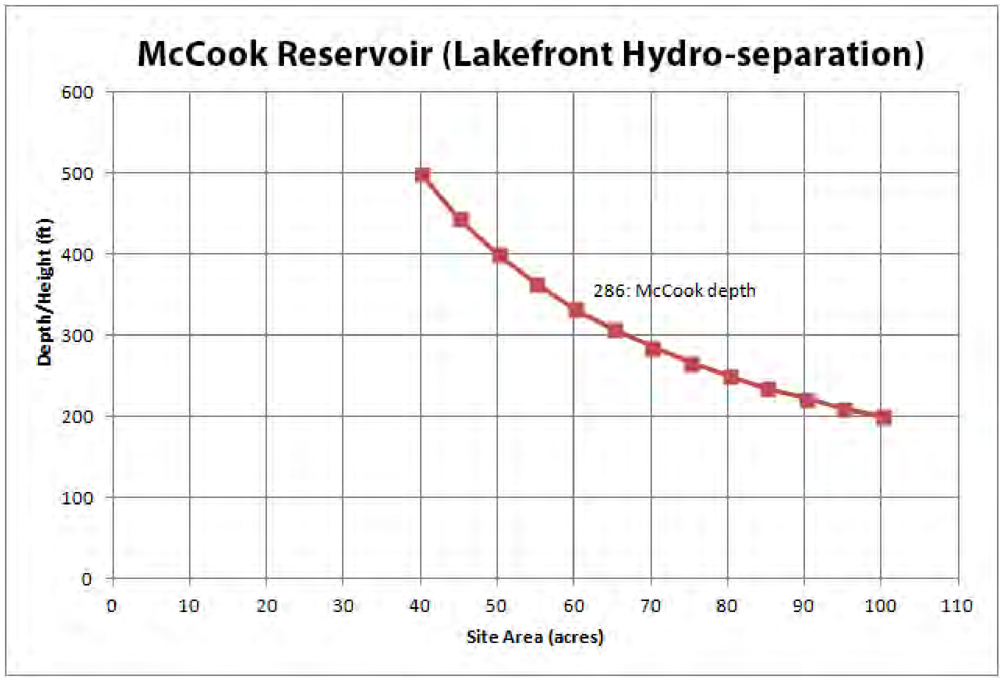

FIGURE J.3.8 Second Reservoir at McCook – Sizing (Lakefront Hydrologic Separation)

J.3.5 Second Reservoir at McCook (Mid-System Hydrologic Separation, Hybrid Cal-Sag Open Alternative)

J.3.5.1 Tunnel System

A new reservoir is required at the McCook site to contain combined sewer overflows (CSOs) and maintain water quality in the basin (Figure J.3.9). The tunnel will run a distance of 12.5 miles with a 32-ft diameter, starting at Lawrence Avenue and running along the North Branch of the Chicago River and channel to the McCook reservoir. Creation of the Lawrence to McCook tunnel will require disposal of 1,965,950 CY of material. See Enclosure B for calculations. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

A secondary tunnel will run from the Wilmette Water Reclamation Plant (WRP) to downstream of the Stickney barrier. This will divert the WRP outfalls out of the Great Lakes basin. The tunnel will run a distance of 12.5 miles with a 13-ft diameter. Creation of the Wilmette to Stickney tunnel will require disposal of 324,500 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

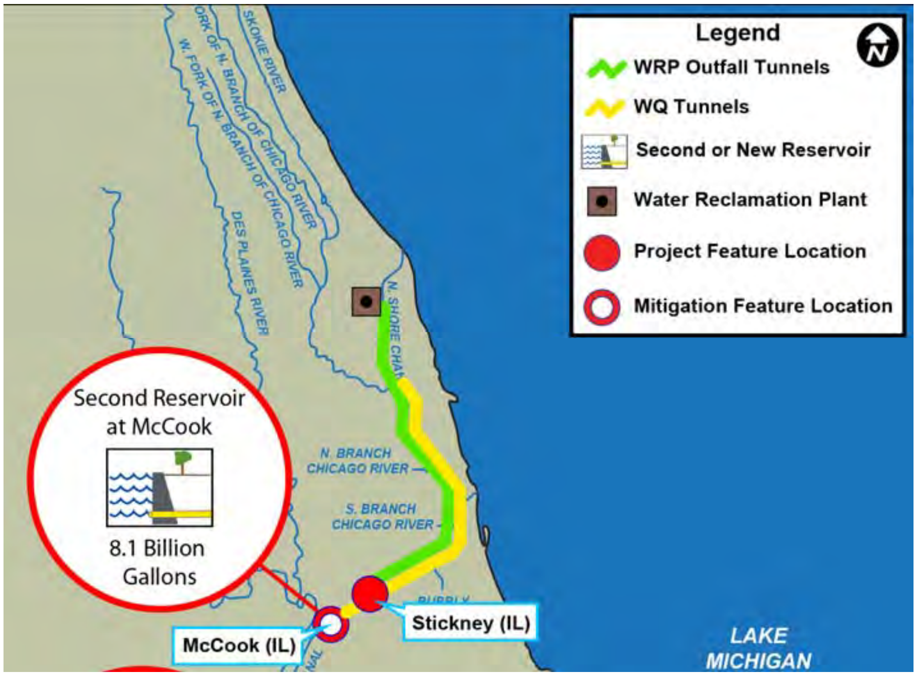

FIGURE J.3.9 McCook Tunnels (Mid-System Hydrologic Separation, Hybrid Cal-Sag Open)

J.3.5.2 Reservoir

The reservoir (Figure J.3.10) is assumed to be constructed at the previously mined McCook quarry. The existing quarry belongs to Vulcan Materials Company and can be accessed from Joliet Road in Joliet, Illinois. The reservoir must hold a minimum of 8.1 billion gallons, or 25,000 acre-ft. A reservoir of this size requires significant real estate and/or deep excavation and is a major construction project. A comparison can be made to the existing construction project McCook reservoir, which holds 10 billion gallons compared to this reservoir's 8.1 billion. Using a 250-ft depth, which is shallower than the depth of the existing reservoir, the site requires 100 acres for the reservoir alone. This will result in an approximately 2,000-ft-wide by 2,180-ft-long reservoir on the proposed site, with an estimated permanent easement of 110 acres. See Figure J.3.11 for a full analysis of footprint vs. excavation options and Enclosure B for further calculations.

Some additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. The assumed total permanent easement is 115 acres. These features will not be designed until further in the study or design work, when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage.

No large-scale mining and disposal of rock will be needed based on the use of the existing quarry, which is the ideal design option. If the existing quarry is not available or not large enough, additional stone will be excavated to create the reservoir and the stone excavated will require disposal. Reservoir design assumptions were based on the existing McCook and Thornton reservoir projects.

See 3.15 in the main report for the entire Mid-System Hydrologic Separation mitigation layout. Refer to 3.20 in the main report for the entire Hybrid Cal-Sag Open mitigation layout.

FIGURE J.3.10 Second Reservoir at McCook (Mid-System Hydrologic Separation, Hybrid Cal-Sag Open)

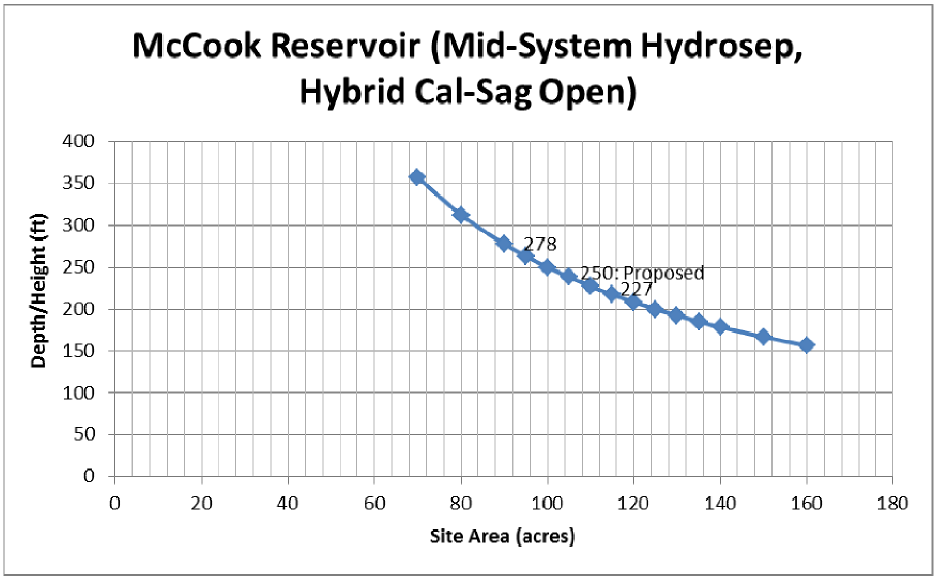

FIGURE J.3.11 Second Reservoir at McCook – Sizing (Mid-System Hydrologic Separation, Hybrid Cal-Sag Open)

J.3.6 Second Reservoir at Thornton (Flow Bypass Alternative)

J.3.6.1 Tunnel System

The Alsip Lock and Electric Barrier require a conveyance tunnel to bring overflow water from the lock to a newly constructed reservoir at Thornton (Figure J.3.12). The tunnel will run a distance of 5.0 miles with a 16-ft diameter. Creation of the tunnel will require disposal of 196,600 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

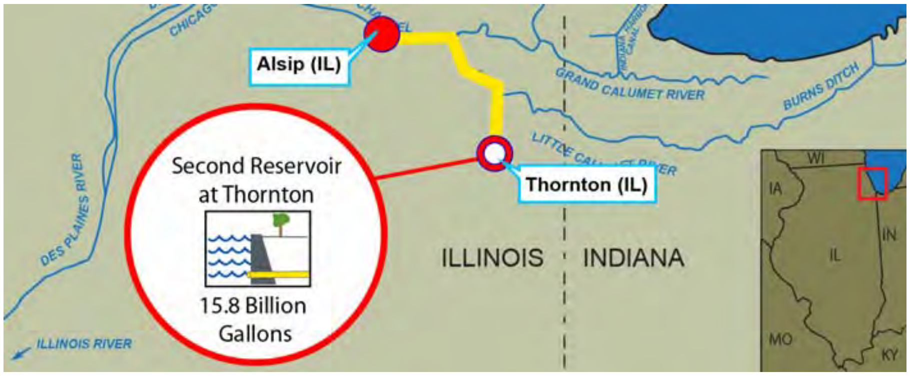

FIGURE J.3.12 Thornton Tunnels (Flow Bypass)

J.3.6.2 Reservoir

The reservoir (Figure J.3.13) will be constructed at one of the Thornton quarry locations owned by Hanson Material Service to address flooding impacts on the Calumet, Little Calumet, and Grand Calumet rivers. These quarries are located in Thornton, Illinois, with access off of Interstate I-80 and Williams Street. The Hammond reservoir must hold a minimum of 15.8 billion gallons, or 48,500 acre-ft. The reservoir could be placed on either of the existing quarries south of I-80, or in a combination of both quarries, connected via culverts. One of these quarries is currently holding a limited quantity of water as the Thornton transition reservoir, and the other is still being quarried. The proposed reservoir will have a depth of 285 ft, and an area of approximately 2,000 ft by 3,703 ft. See Figure J.3.14 for a full analysis of footprint vs. excavation options and Enclosure B for further calculations.

The proposed reservoir area requires 170 acres, with a total permanent easement area of approximately 190 acres. Some of this additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. These features will not be designed until further in the study or design work, when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage.

No large-scale mining and disposal of rock will be needed based on the use of the existing quarry, which is the ideal design option. If the existing quarry is not available or not large enough, additional stone will be excavated to create the reservoir and the stone excavated will require disposal. Reservoir design assumptions were based on the existing Thornton and McCook reservoir projects.

Refer to Section 3.3 in the main report for the entire Flow Bypass mitigation layout.

FIGURE J.3.13 Second Reservoir at Thornton (Flow Bypass)

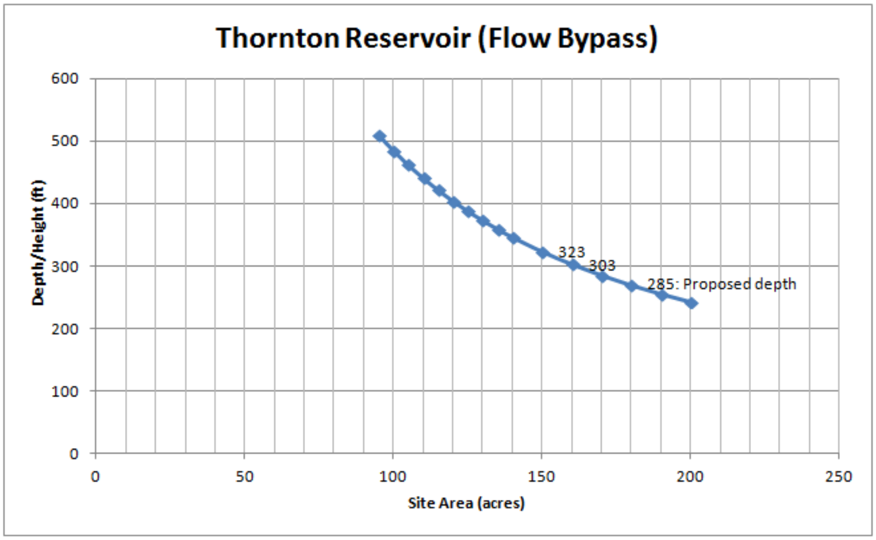

FIGURE J.3.14 Second Reservoir at Thornton – Sizing (Flow Bypass Alternative)

J.3.7 Second Reservoir at Thornton (CAWS Buffer Zone Alternative, Hybrid Cal-Sag Open Alternative)

J.3.7.1 Tunnel System

A new reservoir is required at Thornton to contain CSO overflows and maintain water quality in the basin due to the barrier at Hammond. A potential variation in this alternative includes the storage required for the State Line barrier in this reservoir, increasing the capacity and adding a tunnel from the barrier to the reservoir (Figure J.3.15). The tunnel to collect water from the Little Calumet River will run a distance of 7.2 miles from Hammond to Thornton, with a 14-ft diameter. Creation of the Hammond to Thornton tunnel will require disposal of 216,745 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

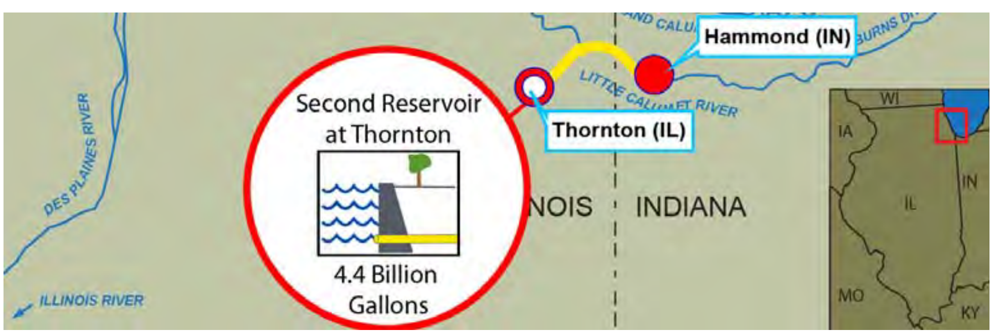

FIGURE J.3.15 Thornton Tunnels (CAWS Buffer Zone, Hybrid Cal-Sag Open)

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

If this reservoir is used to hold the overflow water from the State Line barrier, a second tunnel will run from the State Line reservoir to the Thornton reservoir. This will divert overflow water from the Grand Calumet River and avert Flood Risk Management impacts. The tunnel will run a distance of approximately 7 miles from State Line to Thornton. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size. Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

J.3.7.2 Reservoir

The Thornton reservoir (Figure J.3.16) is assumed to be constructed at one of the Thornton quarry locations owned by Hanson Material Service. These quarries are located in Thornton, Illinois, with access off Interstate I-80 and Williams Street. The Hammond/State Line reservoir must hold a minimum of 4.4 billion gallons, or 13,500 acre-ft. If the State Line reservoir is not used as a feature in this alternative, 14,500 acre-ft of storage will be required. The reservoir will need to be increased in depth and/or area to accommodate this extra capacity. The reservoir could be placed on either of the existing quarries south of I-80, or in a combination of both quarries, connected via culverts. One of these quarries is currently holding a limited quantity of water as the Thornton transition reservoir, and the other is still being quarried. The proposed reservoir will have a depth of 135 ft, and an area of approximately 2,000 ft × 2,200 ft. See Figure J.3.17 for a full analysis of footprint vs. excavation options and Enclosure B for further calculations.

The proposed reservoir area requires 100 acres, with a total permanent easement area of approximately 115 acres. Some of this additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. These features will not be designed until further along in the study or design when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage.

No large-scale mining and disposal of rock will be needed based on the use of the existing quarry, which is the ideal design option. If the existing quarry is not available or not large enough, additional stone will be excavated to create the reservoir and the stone excavated will require disposal. Reservoir design assumptions were based on the existing McCook and Thornton reservoir projects.

See 3.7 in the main report for the entire CAWS Buffer Zone mitigation layout. Refer to 3.20 in the main report for the entire Hybrid Cal-Sag Open mitigation layout.

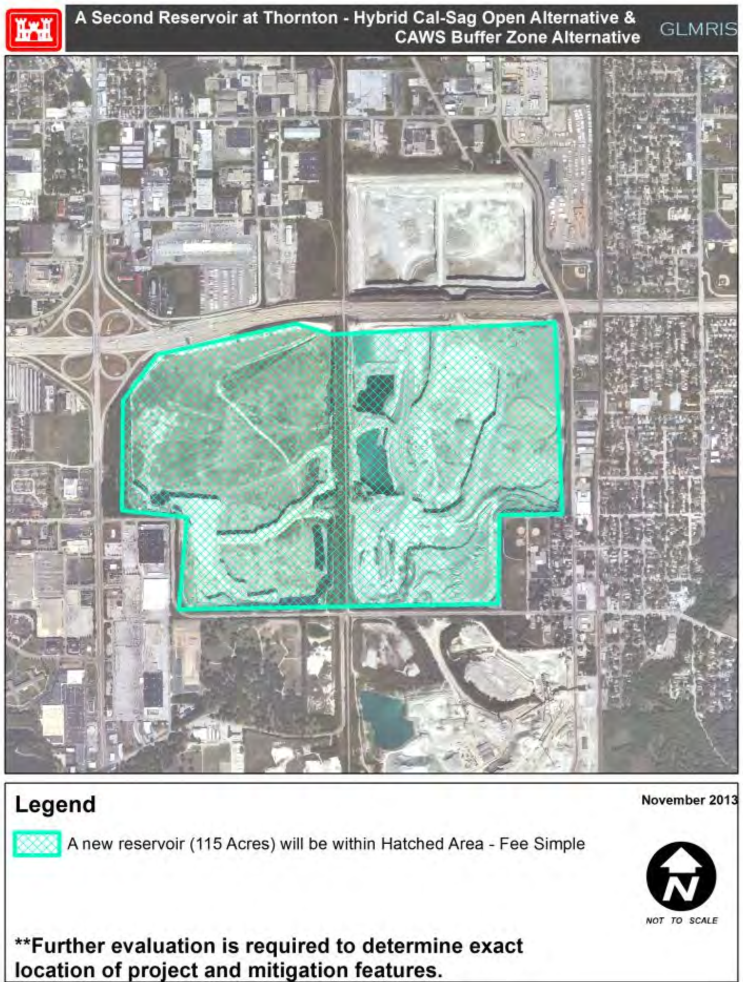

FIGURE J.3.16 Second Reservoir at Thornton (CAWS Buffer Zone, Hybrid Cal-Sag Open)

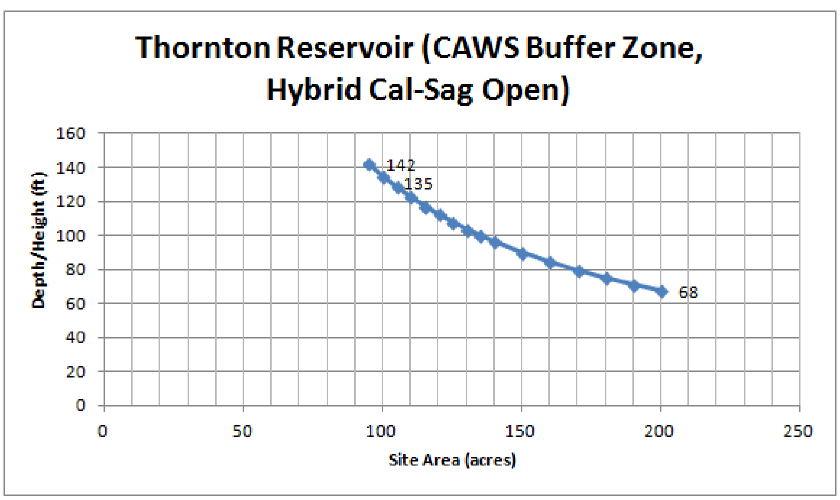

FIGURE J.3.17 Second Reservoir at Thornton – Sizing (CAWS Buffer Zone, Hybrid Cal-Sag Open)

J.3.8 Second Reservoir at Thornton (Lakefront Hydrologic Separation)

J.3.8.1 Tunnel System

The Calumet City barrier location requires a reservoir of 41,430 acre-ft, or 13.5 billion gallons, at Thornton to meet Flood Risk Management requirements. The reservoir uses a conveyance tunnel (Figure J.3.18) from the Calumet City barrier location to the Thornton reservoir location, where it is assumed the new reservoir will be located. The conveyance tunnel will run a distance of 5.5 miles with a 30-ft diameter. Creation of the tunnel will require disposal of 760,270 CY of material. See Enclosure B for calculations. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

The tunnel to collect water from the Little Calumet River will run a distance of 7.2 miles from Hammond to Thornton with a 14-ft diameter. Creation of the Hammond to Thornton tunnel will require disposal of 216,745 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

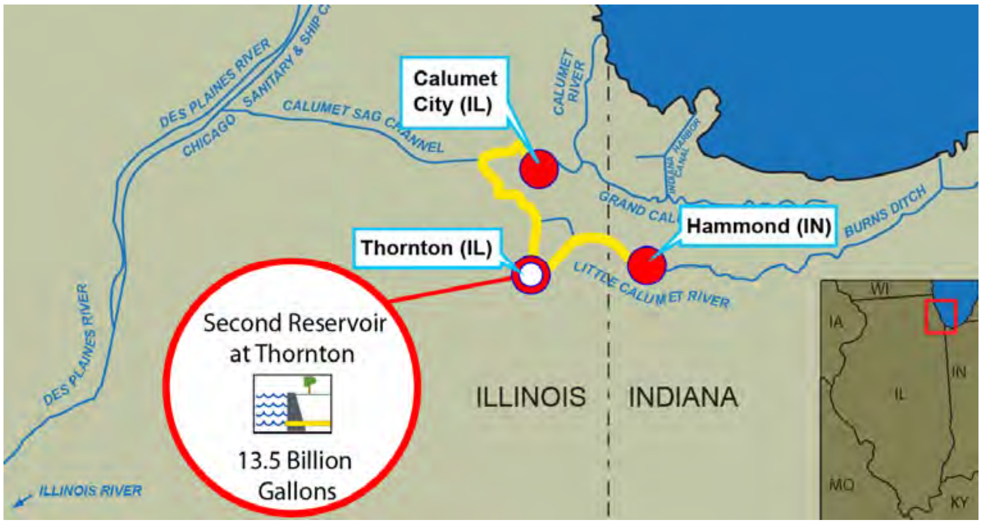

FIGURE J.3.18 Thornton Tunnels (Lakefront Hydrologic Separation)

J.3.8.2 Reservoir

The reservoir (Figure J.3.19) could be placed on either of the existing quarries south of I-80 owned by Hanson Material Service. These quarries are located in Thornton, Illinois, with access off of Interstate I-80 and Williams Street. One of these quarries is currently holding a limited quantity of water as the Thornton transition reservoir, and the other is still being quarried. This reservoir will need to hold a storage capacity of 41,430 acre-ft (13.5 Billion Gallons). A reservoir of this size requires significant real estate and/or deep excavation and is a major construction project. A comparison can be made to the existing construction project McCook reservoir, which holds 10 billion gallons compared with this reservoir's 13.5 billion. Using a similar depth to McCook of 296 ft, the site requires 140 acres for the reservoir alone, which will be 2,400 ft wide by 2,550 ft. See Figure J.3.20 for a full analysis of footprint vs. excavation options and Enclosure B for further calculations.

Some additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. These features will not be designed until further along in the study or design work when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage. The estimated total permanent easement is 160 acres.

No large-scale mining and disposal of rock will be needed based on the use of the existing quarry. If the existing quarry cannot be used, extensive mining and rock disposal will be required to construct the reservoir. Reservoir design assumptions were based on the existing Thornton reservoir project.

Refer to 3.11 in the main report for the entire Lakefront Hydrologic Separation mitigation layout.

FIGURE J.3.19 Second Reservoir at Thornton (Lakefront Hydrologic Separation)

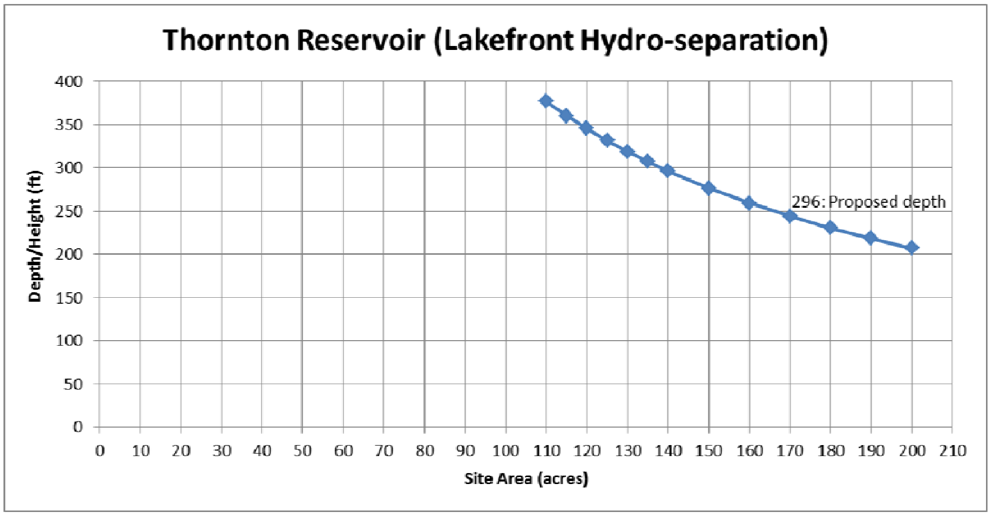

FIGURE J.3.20 Second Reservoir at Thornton – Sizing (Lakefront Hydrologic Separation)

J.3.9 Second Reservoir at Thornton (Mid-System Hydrologic Separation Alternative, Hybrid CSSC Open Alternative)

J.3.9.1 Tunnel System

A new reservoir is required at Thornton to contain CSO overflows and maintain water quality in the basin. The tunnel (Figure J.3.21) will run a distance of 5.5 miles from Hammond to Thornton with a 30-ft diameter. Creation of the Hammond to Thornton tunnel will require disposal of 760,267 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

A second tunnel will run from the Calumet Water Reclamation Plant (WRP) to downstream of the Alsip Barrier. This will divert the WRP outfalls out of the Great Lakes basin to the Mississippi River side. The tunnel will run a distance of 5.3 miles from Calumet to Alsip with a 13-ft diameter. Creation of the Calumet to Alsip tunnel will require disposal of 137,500 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size.

Tunnel design and construction is based on the existing tunnels of the TARP system. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the MWRD tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project.

A third tunnel will run from the Calumet Water Reclamation Plant to Thornton reservoir, to remove water from the Thornton reservoir for treatment. Based on the TARP tunnels, which are similar in capacity, the proposed tunnel will run a distance of 5.8 miles with a 30-ft diameter. Creation of the Thornton to Calumet tunnel will require disposal of 732,650 CY of material. It is assumed that the tunnel will be placed within public right-of-way as much as possible. Further design and investigation will be needed to determine the extent of underground conflicts; some relocations are to be expected for a tunneling project this size. Tunnel shafts will also need to be placed approximately every 3,000 ft along the length of the tunnel. These will require a minimal 0.2-acre easement, which will also be placed in public right-of-way locations. The exact locations will be determined in further design based on available property in the required locations. These assumptions are based on the existing TARP tunnels and the Calumet Tunnel System designed as a part of the Little Calumet River flood damage reduction project. Additional hydraulic analysis is needed on this tunnel to confirm the placement and sizing will be sufficient for this design.

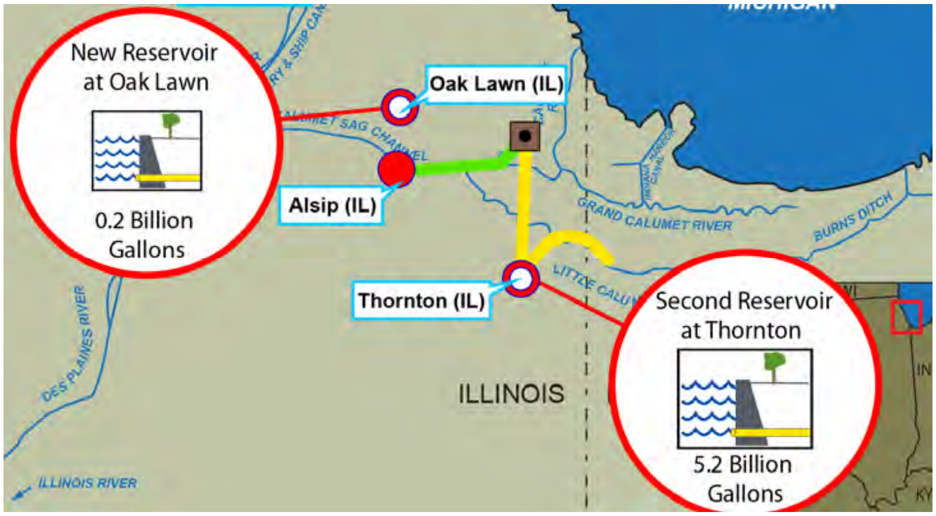

FIGURE J.3.21 Thornton Tunnels (Mid-System Hydrologic Separation, Hybrid CSSC Open)

J.3.9.2 Reservoir

The reservoir (Figure J.3.22) is assumed to be constructed at one of the Thornton quarry locations owned by Hanson Material Service. These quarries are located in Thornton, Illinois, with access off of Interstate I-80 and Williams St. The Hammond reservoir must hold a minimum of 5.2 billion gallons, or 16,000 acre-ft. The reservoir could be placed on either of the existing quarries south of I-80, or in a combination of both quarries, connected via culverts. One of these quarries is currently holding a limited quantity of water as the Thornton transition reservoir, and the other is still being quarried. The proposed reservoir will have a depth of 200 ft, and an area of approximately 2,000 ft × 1,742 ft. See Figure J.3.23 for a full analysis of footprint vs. excavation options and Enclosure B for further calculations.

The proposed reservoir area requires 80 acres, with a total permanent easement area of approximately 90 acres. Some of this additional real estate will be required for construction staging and access, permanent easements around the reservoir site, interior drainage, pump stations, and other incidental features. These features will not be designed until further along in the study or design work when specific real estate is identified for the project. This additional real estate will also account for the final design variations of the reservoir, which will include some ramps and other features that will slightly increase the reservoir area to accommodate the required storage.

No large-scale mining and disposal of rock will be needed based on the use of the existing quarry, which is the ideal design option. If the existing quarry is not available or not large enough, additional stone will be excavated to create the reservoir and the stone excavated will require disposal. Reservoir design assumptions were based on the existing McCook and Thornton reservoir projects.

See 3.15 in the main report for the entire Mid-System Hydrologic Separation mitigation layout. Refer to 3.25 in the main report for the entire Hybrid CSSC Open Alternative mitigation layout.

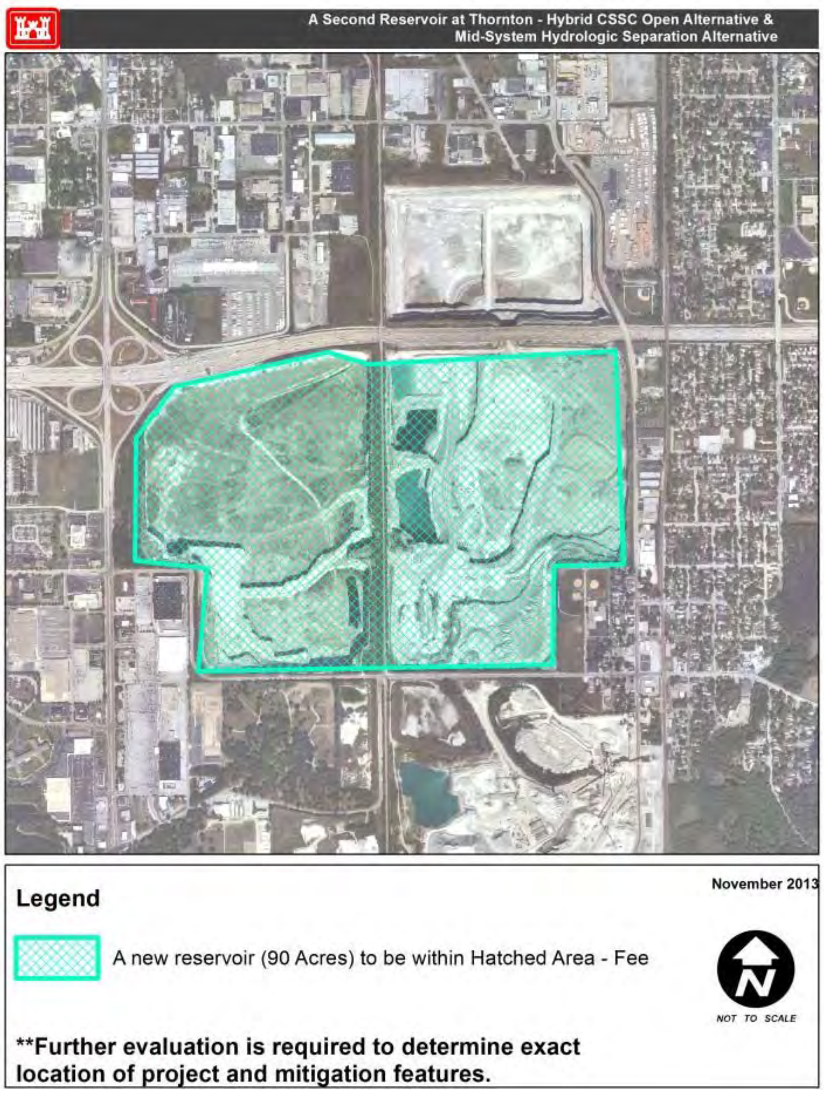

FIGURE J.3.22 Second Reservoir at Thornton (Mid-System Hydrologic Separation, Hybrid CSSC Open)

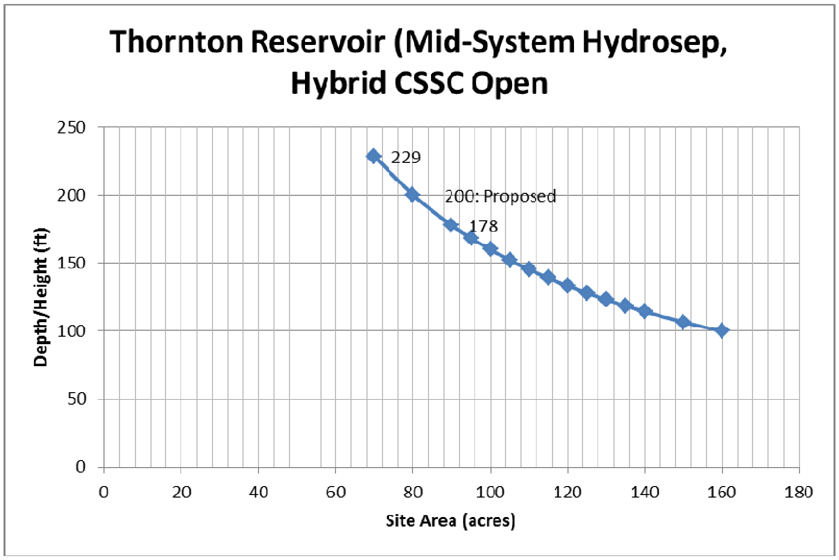

FIGURE J.3.23 Second Reservoir at Thornton – Sizing (Mid-System Hydrologic Separation, Hybrid CSSC Open)

J.4 TECHNOLOGY FEATURES

The sites detailed in this selection were chosen using extensive hydraulic and hydrologic modeling of the CAWS. Several locations were chosen based on this analysis as the most effective locations to place project features. For detailed analysis of this modeling process, refer to Appendix D, Hydrologic & Hydraulic Analyses.

J.4.1 Chicago (IL) Lock and Electric Barrier (CAWS Buffer Zone Alternative, Hybrid CSSC Open Alternative)

The existing Chicago Lock will be modified, and a new lock chamber added with an electric barrier (Figure J.4.1). No new real estate is required for the lock because the existing area is federal property. There will be an ANS Treatment Plant required with a capacity of 1,750 MGD, which will be built on newly created land between the old and new lock structures on a permanent easement of 12 acres. This area will also provide a location for the electric lock building. Existing utilities for the Chicago Lock will be used to operate the new features, with additional capacity added if necessary.

The new lock structure is proposed to be built on a slight southwestern angle, origination just south of the existing lock barrier. This will provide a larger open, queuing area for boats entering and leaving the lock. This will also keep the electric barrier farther away from the Navy Pier area to the north of the existing lock, which supports heavy recreational activity.

The new lock will be significantly longer than the current structure, with two separate lock closures. The more frequently used lock closure will be shallow, with a depth of no more than 10 to 15 ft for the majority of shall draft vessels that use the Chicago lock. For the small number of larger vessels that use the lock, a second parallel lock will be built deep enough to allow their passage. The extended length will provide a safety zone on either side of the electric barrier for additional safety. Full safety provisions will be determined in further design, with the input of all stakeholders particularly the U.S. Coast Guard. Further design will also allow for a redesign of the current breakwater structure to provide a direct entrance to the new lock, while providing wave protection to avoid the transfer of Lake Michigan water over the lock structures.

See Section 3.6 in the main report for the CAWS Buffer Zone layout. Refer to 3.24 in the main report for the Hybrid CSSC Open Alternative layout.

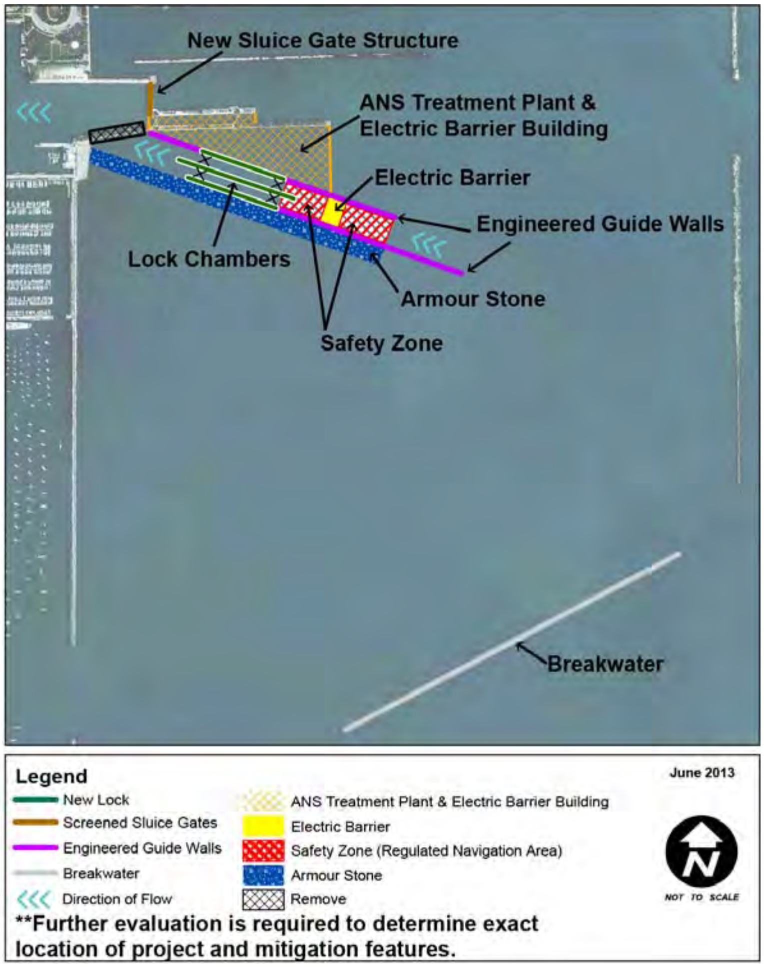

FIGURE J.4.1 Chicago Lock and Electric Barrier (CAWS Buffer Zone, Hybrid CSSC Open)

J.4.2 T.J. O'Brien (IL) Lock and Electric Barrier (Hybrid Cal-Sag Open Alternative, CAWS Buffer Zone Alternative)

A new GLMRIS Lock is planned at T.J. O'Brien Lock with an electric barrier (Figure J.4.2). An ANS water treatment plant will be required in conjunction with the lock and the new barrier, having a capacity of 1,280 MGD. The plant will have a permanent easement of 7.5 acres and will be placed on the open land adjacent to the lock, to be accessed via the existing roadway and parking area. Existing utilities for the T.J. O'Brien Lock and Dam will be used for the new structures, with additional capacity added if necessary. The existing controlling works structure will be removed and replaced with a new, larger, screened controlling works structure. These additions will all be built in the water with limited real estate requirements to allow for tie in and access on the east bank. See the Structural Appendix for details of the modifications required at T.J. O'Brien.

See Section 3.19 in the main report for the entire Hybrid Cal-Sag Open layout. Refer to Section 3.6 in the main report for the entire CAWS Buffer Zone layout.

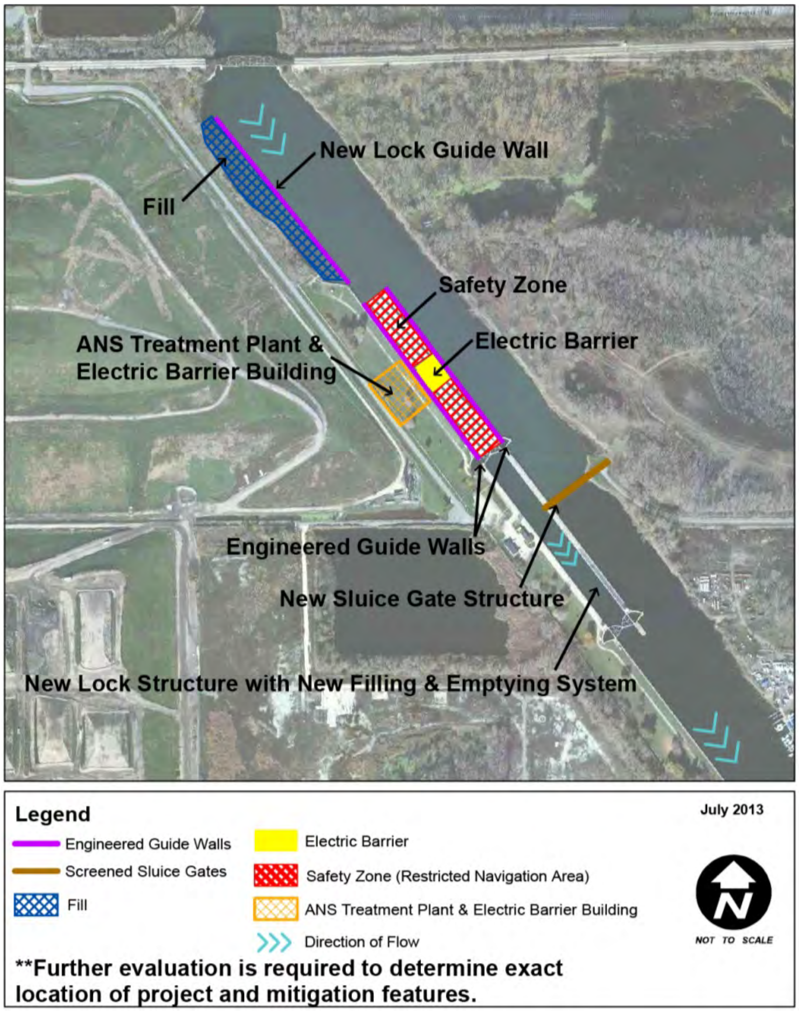

FIGURE J.4.2 T.J. O'Brien Lock and Electric Barrier (Hybrid Cal-Sag Open, CAWS Buffer Zone)

J.4.3 Brandon Road (IL) Lock and Electric Barrier (CAWS Buffer Zone Alternative, Hybrid Cal-Sag Open Alternative, Hybrid CSSC Open Alternative)

The existing Brandon Road Lock structure will be modified to include an electric barrier (Figure J.4.3). Modifications will be confined to the waterway and within the existing lock property. An operating building for the barrier will be constructed on the open land to the north of the lock. Existing utilities for Brandon Road Lock will be used for the new electric barrier and its associated operation, with additional capacity added if necessary.

See Section 3.6 in the main report for the entire CAWS Buffer Zone layout, Section 3.19 in the main report for the entire Hybrid Cal-Sag Open layout, and Section 3.24 in the main report for the entire Hybrid CSSC Open Alternative layout.

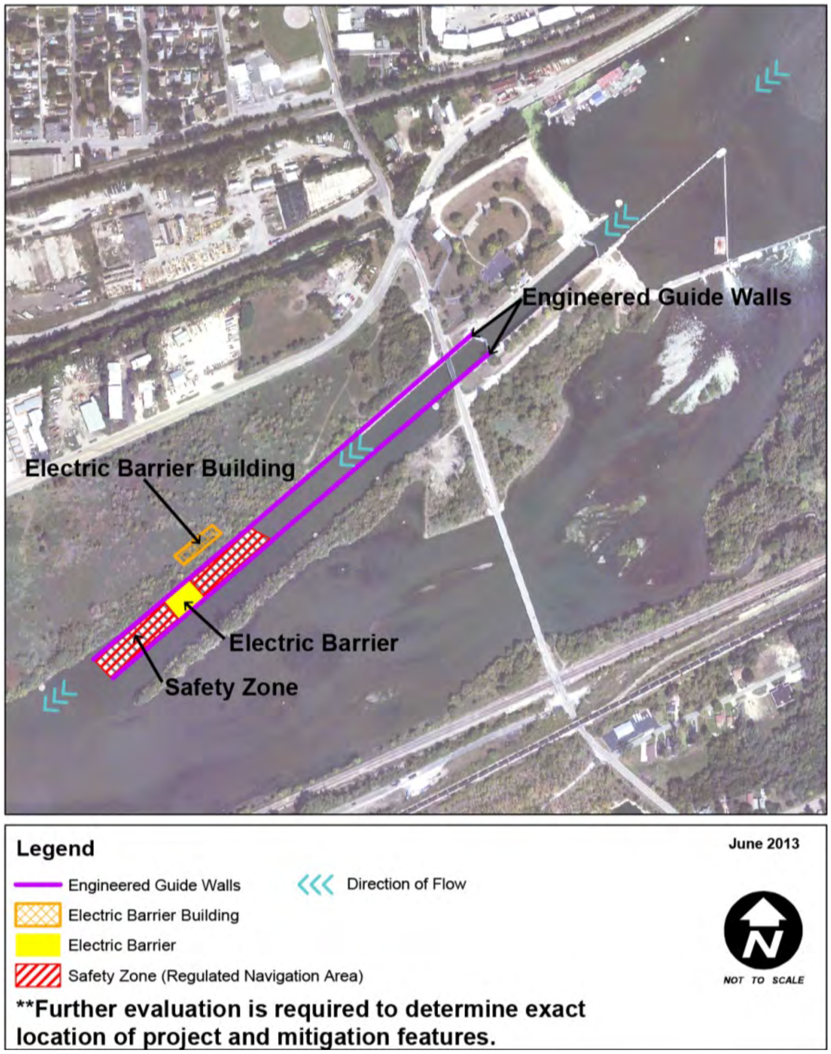

FIGURE J.4.3 Brandon Road Lock and Electric Barrier (CAWS Buffer Zone, Hybrid Cal-Sag Open, Hybrid CSSC Open)

J.4.4 Stickney (IL) Lock and Electric Barrier (Flow Bypass Alternative)

A new lock structure with electric barrier will be constructed in the waterway at the Stickney site (Figure J.4.4) . A new lock and barrier building will be built adjacent on the south bank, along with an ANS Treatment Plant for lockages. The ANS Treatment Plant will require a permanent easement of 9.1 acres and have a capacity of 700 MGD. Electric power, along with other utilities needed for the ANS Treatment Plant, will need to be extended to this site.

See 3.2 in the main report for the entire Flow Bypass layout.

FIGURE J.4.4 Stickney Lock and Electric Barrier (Flow Bypass)

J.4.5 Alsip (IL) Lock and Electric Barrier (Flow Bypass Alternative)

A new lock structure with electric barrier will be constructed in the waterway at the Alsip site (Figure J.4.5). A new lock and barrier building will be constructed on the adjacent banks, along with an ANS Treatment Plant for lockages. The ANS Treatment Plant will have a permanent easement of 9.9 acres with a capacity of 900 MGD, and the new lock and barrier building will require an easement of approximately 2.2 acres. Electric power, along with other utilities needed for the ANS Treatment Plant, will need to be extended to this site.

See Section 3.2 in the main report for the entire Flow Bypass layout.

FIGURE J.4.5 Alsip Lock and Electric Barrier (Flow Bypass)

J.5 REAL ESTATE

As identified earlier in this report, specific real estate has not been identified or acquired for these alternatives at this point in design. The team has identified that real estate is potentially available in the areas the features have been placed, with some level of variation deemed acceptable as to the final parcels chosen. Approximate sizes and types of easements were developed based on the alternative features, and areas identified where these easements could be placed. Specific factors used to identify these areas are included in the individual feature descriptions.

Temporary staging areas were included in the estimates, as well as permanent access easements for operation and maintenance of facilities. Because only conceptual levels of designs are available for the features at this point, estimates of the required real estate are conservative. This should allow for variations in the further design and the additional features included in this further design, such as parking lots, interior drainage, pump stations, utility extensions, and many more. Further design on any alternatives would also include research into available real estate and communication with parcel owners.

Refer to Enclosure A for a summary of the real estate areas identified. Full detail on the study's real estate is available in Appendix L.

ENCLOSURE A

REAL ESTATE SUMMARY

Mid-System Control Technologies without a Buffer Zone - "Flow Bypass Alternative"	Feature	Perm Estate Size (acres)	Permanent Estate Type	Associated Temporary Easement (acres)
Stickney (IL)	GLRMIS lock	10.5	Navigational Servitude	2.2
	Lock and Electric Barrier Building	2.8	Fee Simple	2.1
	ANS Treatment Plant	9.1	Fee Simple	
	Conveyance Tunnel	16.0	Utility Easement	
	Second Reservoir at McCook	140	Fee Simple	10
Alsip (IL)	GLRMIS lock	12.3	Navigational Servitude	1.7
	Lock and Electric Barrier Building	2.2	Fee Simple	
	ANS Treatment Plant	9.9	Fee Simple	1
	Conveyance Tunnel	17.5	Utility Easement	
	Second Reservoir at Thornton	190	Fee Simple	10
	New Reservoir at Oak Lawn	90	Fee Simple	12
Technology Alternative with a Buffer Zone - "CAWS Buffer Zone Alternative"	**Feature**	**Perm Estate Size (acres)**	**Permanent Estate Type**	**Associated Temporary Easement (acres)**
Wilmette (IL)	Rehab existing control structure	0.2		0.8
	ANS Treatment Plant	1.3	Fee Simple	
Chicago (IL)	Lock with electric barrier	12	Navigational Servitude	3.4
	ANS Treatment plant for lock structure		Fee Simple	
	ANS treatment plant for diversion		Fee Simple	
TJ O'Brien (IN)	Lock with electric barrier	10	Navigational Servitude	3.4
	ANS Treatment plans for lock structure	7.5	Fee Simple	1.75
	ANS Treatment Plant for diversion		Fee Simple	
State Line (IL/IN)	Physical barrier	0.03	Navigational Servitude	NA
	Barrier land	0.5	Fee Simple	1.2
	New Reservoir at State Line	130	Fee Simple	10

Technology Alternative with a Buffer Zone - "CAWS Buffer Zone Alternative" (Cont.)	Feature	Perm Estate Size (acres)	Permanent Estate Type	Associated Temporary Easement (acres)
Hammond (IN)	Physical barrier	0.05	Navigational Servitude	NA
	Barrier land	0.2	Fee Simple	1
	Conveyance Tunnel	23.5	Utility Easement	
	Second Reservoir at Thornton	115	Fee Simple	10
Brandon Road (IL)	Lock with electric barrier	10.5	Navigational Servitude	NA
	Barrier building	3	Fee simple	3.6

Lakefront Hydrologic Separation	Feature	Perm Estate Size (acres)	Permanent Estate Type	Associated Temporary Easement (acres)
Wilmette (IL)	Physical Barrier	0.05	Navigational Servitude	NA
	Barrier land	0.4	Fee Simple	0.9
	ANS Treatment Plant	0.9	Fee Simple	
	Conveyance Tunnel	55.4	Utility Easement	
Chicago (IL)	Physical Barrier	0.1	Navigational Servitude	NA
	Barrier land	0.5	Fee Simple	0.5
	ANS Treatment Plant	3.2	Fee Simple	1.4
	Conveyance Tunnel	83.2	Tunnel Eaesment	
	Second Reservoir at McCook	80	Fee Simple	10
	Small Boat Rec Harbor	30	Navigational Servitude	
	Rec Harbor Land area	5	Fee Simple	1
Calumet City (IL)	Physical Barrier	0.15	Navigational Servitude	NA
	Barrier land	2	Fee Simple	1.5
	ANS Treatment Plant	3.3	Fee Simple	1
	Conveyance Tunnel	28.6	Utility Easement	

Lakefront Hydrologic Separation (Cont.)	Feature	Perm Estate Size (acres)	Permanent Estate Type	Associated Temporary Easement (acres)
Hammond (IN)	Physical Barrier	0.05	Navigational Servitude	NA
	Barrier land	0.2	Fee Simple	1
	Conveyance Tunnel	22.8	Utility Easement	
	Second Reservoir at Thornton	160	Fee Simple	10
Mid-System Hydrologic Separation	**Feature**	**Perm Estate Size (acres)**	**Permanent Estate Type**	**Associated Temporary Easement (acres)**
Stickney (IL)	Physical Barrier	0.1	Navigational Servitude	NA
	Barrier	2	Fee Simple	1.4
	ANS Treatment Plant	10	Fee Simple	
Alsip (IL)	Physical Barrier	0.2	Navigational Servitude	NA
	Barrier land	1.6	Fee Simple	0.5
	ANS Treatment Plant	5.3	Fee Simple	1
	New Reservoir at Oak Lawn	90	Fee Simple	12
Water Quality features	Conveyance Tunnel (Lawrence To McCook)	68.0	Utility Easement	
	WRP Conveyance Tunnel (Wilmette to Stickney)	39.2	Utility Easement	
	Conveyance Tunnel (Hammond to Thornton)	28.6	Utility Easement	
	Conveyance Tunnel (Calumet to Thornton)	27.6	Utility Easement	
	WRP Conveyance Tunnel (Calumet to Alsip)	16.6	Utility Easement	
	Second Reservoir at McCook	110	Fee Simple	10
	Second Reservoir at Thornton	90	Fee Simple	10

Mid-System Separation Cal-Sag Open Control Technologies with a Buffer Zone - "Hybrid Cal-Sag Open Alternative"	Feature	Perm Estate Size (acres)	Permanent Estate Type	Associated Temporary Easement (acres)
Stickney (IL)	Physical barrier	0.1	Navigational Servitude	NA
	Barrier land	2	Fee Simple	1.4
	ANS Treatment Plant	10	Fee Simple	
TJ O'Brien (IN)	Lock with electric barrier	10	Navigational Servitude	3.4
	ANS Treatment Plant for lock structure	7.5	Fee Simple	1.75
	ANS treatment plans for diversion		Fee Simple	
State Line (IL/IN)	Physical barrier	0.03	Navigational Servitude	
	Barrier land	0.5	Fee Simple	1.2
	New Reservoir at State Line	130	Fee Simple	10
Hammond (IN)	Physical Barrier	0.05	Navigational Servitude	NA
	Barrier land	0.2	Fee Simple	1
	Conveyance Tunnel	23.5	Utility Easement	
	Second Reservoir at Thornton	115	Fee Simple	10
Brandon Road (IL)	New lock structure w/ electric barrier	10.5	Navigational Servitude	NA
	Barrier building	3	Fee Simple	3.6
Water Quality features	Conveyance Tunnel (Lawrence to McCook)	68.0	Utility Easement	
	Second Reservoir at McCook	110	Fee Simple	10
	Conveyance Tunnel (Wilmette to Stickney)	39.2	Utility Easement	

Mid-System Separation CSSC Open Control Technologies with a Buffer Zone - "Hybrid CSSC Open Alternative"	Feature	Perm Estate Size (acres)	Permanent Estate Type	Associated Temporary Easement (acres)
Wilmette (IL)	Rehab existing control structure	0.2		0.8
	ANS Treatment Plant	1.3	Fee Simple	
Chicago (IL)	New lock structure w/ electric barrier	13.2	Navigational Servitude	NA
	Treatment plant for barrier	12	Fee Simple	
	ANS Treatment Plant for diversion		Fee Simple	
Alsip (IL)	Physical barrier	0.2	Navigational Servitude	
	Barrier land	1.6	Fee Simple	0.5
	ANS Treatment Plant	5.3	Fee Simple	1
	New Reservoir at Oak Lawn	90	Fee Simple	12
Brandon Rd (IL)	New lock structure w/ electric barrier	10.5	Navigational Servitude	NA
	Barrier building	3	Fee Simple	3.6
Water Quality features	Conveyance Tunnel (Calumet to Alsip)	16.6	Utility Easement	
	Conveyance Tunnel (Calumet to Thornton)	27.6	Utility Easement	
	Conveyance Tunnel (Hammond to Thornton)	28.6	Utility Easement	
	Second Reservoir at Thornton	90	Fee Simple	10

Notes and Assumptions:

1. Tunnels are in road rights of way so there is no value.
2. Barriers were assumed to be dams.
3. Values are calculated using assessed values or historical knowledge of the area.
4. Temporary easements areas are included in the hatched area of each map.
5. Utility relocations are estimated at 10% of the Estimated Real Estate Value.
6. No business relocations are required.
7. No environmental concerns on any of the properties.
8. No title concerns on any of the properties.
9. All municipalities will support the projects.
10. Topography was not known at the time of the valuation.
11. No site visits were conducted at the time of the valuation.
12. Connections between barriers and treatment areas were not identified so not included in the valuation.
13. Areas of water were assumed to be Navigational Servitude.
14. No mineral rights were evaluated.
15. No grave sites will be disturbed.
16. No historical sites will be identified on any of the sites.
17. No easements or rights to other owners exist on any of the sites.
18. In the event that the area between the spreadsheet and the maps differ we assumed the large size.

ENCLOSURE B

GENERAL CALCULATIONS

US Army Corps of Engineers	PROJECT TITLE: GLMRIS	COMPUTED BY: LAURA VANDEN BERG	DATE: 3/29/2013
	COMPUTATION TITLE:	CHECKED BY:	DATE:

Aggregate Weight ton 1.8 x yd^3

Project Name: GLMRIS
Phase: Feasibility
Date: 31-May-13
Estimator: Rana Mishra

Second Reservoir at McCook

Reservoir for Chicago and Wilmette Barriers: (Lakefront Hydropsep Alternative
At McCook Expansion site
Required storage:

20,000	acre-feet
32,266,666	CY
871,199,982	CF
6,517,028,580	Gal

Site Area (acres)	Depth/Height (ft)	
40	500	
45	444	
50	400	
55	364	
60	333	
65	308	
70	286	*Equal to McCook Height
75	267	
80	250	
85	235	
90	222	
95	211	
100	200	

Proposed Reservoir:

	70	Acres
	3,049,200	sf
Width:	1000	ft
Length:	3049	ft

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations

Second Reservoir at McCook

Reservoir for Stickney Lock (Flow Bypass Alternative
At McCook Expansion site
Required storage:

35,000	acre-feet
56,466,666	CY
1,524,599,969	CF
11,404,800,015	Gal

Site Area (acres)	Depth/Height (ft)
80	438
85	412
90	389
95	368
100	350
110	318
120	292
130	269
140	250
150	233
160	219
170	206

Proposed Reservoir:

	120	Acres
	5,227,200	sf
Width:	2000	ft
Length:	2614	ft

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations

Second Reservoir at Thornton

Reservoir for Alsip Barrier (Flow bypass alternative
At Thorton Reservoir location
Required storage:

48,500	acre-feet
78,246,665	CY
2,112,659,956.35	CF
15,803,794,307	Gal

Site Area (acres)	Depth/Height (ft)	
95	511	
100	485	
105	462	
110	441	
115	422	
120	404	
125	388	
130	373	
135	359	
140	346	
150	323	
160	303	
170	285	*Close to McCook
180	269	
190	255	
200	243	

Proposed Reservoir:

	170	Acres
	7,405,200	sf
Width:	2000	ft
Length:	3703	ft
	1980	ft
	3740	ft

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations

Second Reservoir at Thornton

Reservoir for Calumet City & Hammond Barriers (Lakefront Hydrologic Separation
At Thorton Reservoir location
Required storage:

41,400	acre-feet
66,640,278	CY
1,804,867,460.34	CF
13,500,000,000	Gal

588,059,867,850,000

Site Area (acres)	Depth/Height (ft)	
110	377	
115	360	
120	345	
125	331	
130	318	
135	307	
140	296	*Close to McCook
150	276	
160	259	
170	244	
180	230	
190	218	
200	207	

Proposed Reservoir:

	140	Acres
	6,098,400	sf
Width:	2000	ft
Length:	3049	ft
Width:	2400	ft
Length:	2541	ft

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variation

New Oak Lawn Reservoir

Reservoir for Oak Lawn Barrier (Midsystem Hydrosep Alternative, Hybrid CSSC Open Alternative, Flow Bypass Alternative
Located in Oak Lawn, 115th St and Cicero Ave (Cemetery)
Required storage:

530	acre-feet
855,067	CY
23,086,799.52	CF
173,701,257	Gal

Site Area:	4746643	SF	
	109	Acres	
Assumed useable area:	80	Acres	*account for offsets, site features, etc.
	3484800	SF	

Conceptual Design:

Try:	3:1 berms @ 10 ft tall	
Width of berm:	62	ft
Inside berm area:	3019000	SF
	69	acres
	624	acre-feet

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations
InRoads Design (Final Design)

Cut	902583.8	cu yd
Fill	14441.5	cu yd
Net (Cut)	888142.3	cu yd
Storage Volume	26004888	cu ft
Storage Volume	597	acre-feet
Storage Volume	194,533,303	Gal

As initially assigned:

Cut	902583.8	cu yd
Fill	14441.6	cu yd
Net	888142.3	cu yd

New State Line Reservoir

Reservoir for State Line Barrier (CAWS Buffer Zone Alternative, Hybrid Cal-Sag Open Alternative
140 acre golf course at Brainerd Ave and Burnham Ave
Required storage:

921	acre-feet
1,485,239	CY
40,104,165.79	CF
300,000,000	Gal

Site Area:	6098402	SF	
	140	Acres	
Assumed useable area:	83	Acres	*account for offsets, site features, etc.
	3615480	SF	

Conceptual Design:

Try:	3:1 berms @ 14 ft tall	
Width of berm:	48	ft
Interior berm area:	2857824	SF
	66	acres
	787	acre-feet

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations
Pump water from Grand Cal to the south, and include pump station at south edge of reservoir
130 acres with easement

InRoads Design (Final Design)

	3:1 berms @ 14 ft tall	
Width of berm:	35	ft

InRoads Design (Final Design)

Cut	539171	cu yd
Fill	110319.4	cu yd
Net (Cut)	428851.6	cu yd
Volume	43200959	cu ft
Volume	991.8	acre-feet
Volume	323178447	Gal

Second Reservoir at Thornton

Reservoir for Indiana WQ (Midsystem Hydrosep Alternative, Hybrid CSSC Open Alternative
At Thorton Reservoir location
Required storage:

16,000	acre-feet
25,813,333	CY
696,959,985.60	CF
5,213,623,864	Gal

Site Area (acres)	Depth/Height (ft)
70	229
80	200
90	178
95	168
100	160
105	152
110	145
115	139

Proposed Reservoir:

	80	Acres
	3,484,800	sf
Width:	2000	ft
Length:	1742	ft

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations

1 of 1

120	133
125	128
130	123
135	118
140	114
150	107
160	100

Second Reservoir at McCook

Reservoir for Stress WQ (Hybrid Cal Sag Open Alternative, Midsystem hydrosa)

At McCook Reservoir location

Required storage

25,000	acre-feet
40,333,333	CY
1,088,999,977.50	CF
8,146,285,725	Gal

Site Area (acres)	Depth/Height (ft)
70	357
80	317.5
90	278 *Close to McCook
95	263
100	250
105	238
110	227
115	217
120	208
125	200
130	192
135	185
140	179
150	167
160	156

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations

Proposed Reservoir:

	100	Acres
	4,356,000	sf
Width	2000	ft
Length	2178	ft

Second Reservoir at Thornton

Reservoir for Hammond and State line Barrier (CAWS Buffer zone alternative, Hybrid Cal Sag Open

At Thornton Reservoir location

Required storage

13,500	acre-feet
21,780,000	CY
588,059,987.88	CF
4,398,964,250	Gal

Site Area (acres)	Depth/Height (ft)
95	142
100	135
105	129
110	123
115	117
120	113
125	108
130	104
135	100
140	96
150	90
160	84
170	79
180	75
190	71
200	68

*Notes: Height or area will have to vary slightly to allow for freeboard and final design variations
Potential variation to include the State Line reservoir, for a total capacity of 14,500 acre feet and reservoir size of approx. 110 acres

Proposed Reservoir

	100	Acres
	4,356,000	sf
Width	2000	ft
Length	2178	ft
	1960	ft
	2200	ft

Tunnels

	Length (miles)	Diameter(ft)	Easement (Acres)	Material displaced (CY	
Wilmette to Chicago	13.1	22	58.42	873,818	
Chicago to McCook	12.50	42	63.16	3,398,645	
Calumet City to Thornton	5.50	30	28.60	760,267	
Hammond to Thornton	5.50	30	28.60	760,267	
Alsip to Thornton	5.00	18	17.93	198,594	
Stickney to McCook	4.90	14	15.96	147,507	
Hammond to Thornton	7.00	14	22.83	210,723	
Calumet to Alsip	5.30	13	16.84	137,570	
Lawrence to WQ McCook	12.5	32	68.04	1,985,943	
Wilmette to Stickney	12.5	13	38.25	324,457	
Calumet to Thornton	5.3	30	27.56	732,621	
State Line to Thornton	7	14	30.16	210,735	*Used only as a variation to the State Line Reservoir
Hammond to Thornton	7.2	14	23.48	216,745	

Assumptions: The tunnels will be in the public right of way along the rivers as much as possible
Utility easement will be diameter of tunnel plus 10 feet
Access shafts every 3000 ft along the length, requiring 0.2 acre easement each

ENCLOSURE C

CUT AND FILL REPORTS

Triangle Volume Report

Report Created: 7/18/2013
Time: 9.45am

Mode: Fence
Input Grid Factor: 1.000000

Original Surface:	**Stony Creek**
Description:	
Preference:	Default
Type:	Existing
Design Surface:	**Stony Creek New Surface**
Description:	
Preference:	Default
Type:	Design
Cut Factor:	1.00
Fill Factor:	1.00

Cut:	24369763.7 cu ft
Fill:	389919.4 cu ft
Net:	23979844.3 cu ft
Cut:	902583.8 cu yd
Fill:	14441.5 cu yd
Net:	888142.4 cu yd

Triangle Volume Report

Report Created: 6/7/2013
Time: 4:17pm

Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface:	**State Line**
Description:	
Preference:	Default
Type:	Existing
Design Surface:	**State Line Reservoir 594**
Description:	Created from roadway designer
Preference:	Default
Type:	Design
Cut Factor:	1.00
Fill Factor:	1.00

Cut:	14556267.8 cu ft
Fill:	2978624.8 cu ft
Net:	11577643.0 cu ft
Cut:	539121.0 cu yd
Fill:	110319.4 cu yd
Net:	428801.6 cu yd