ENGINEERING REPORT

ANALYSIS OF CLOSURES

HOUSATONIC RIVER and NAUGATUCK RIVER

FLOOD PROTECTION PROJECTS

SECTION 1

ANSONIA and DERBY, CONNECTICUT

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MMI #1560-119 and #3118-03

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1.0 PROJECT DESCRIPTION

In June of 2010, Ansonia and Derby retained Milone & MacBroom, Inc. (MMI) of Cheshire, Connecticut to perform the investigative and engineering services required to evaluate and certify the Housatonic River and Naugatuck River Flood Control Systems in support of the municipalities' request to obtain accreditation from the Federal Emergency Management Agency (FEMA). The descriptions and supporting documentation included in this report were performed only for Section 1 of the flood control systems, which is explained below and graphically depicted in Figure 1:

- Section 1 – The left (east) bank of the Housatonic River in Derby from Bridge Street to the confluence with the Naugatuck River/Route 8 embankment and the right (west) bank of the Naugatuck River from the Main Street (Route 34) bridge north through Derby to the embankment supporting Pershing Drive in Ansonia

1.1 Federal Regulatory Criteria

In order to establish and/or maintain accreditation of a levee system, the City of Ansonia and the City of Derby are required to demonstrate compliance with Section 65.10 under Title 44, Chapter 1, Subchapter B, Part 65 of the Code of Federal Regulations. For the purposes of this report, MMI performed an analysis of the closure devices in accordance with Section 65.10(b)(2) of the National Flood Insurance Program (NFIP), "Closures," which is provided on the following page.

§ 65.10 Mapping of Areas Protected by Levee Systems

(2) *Closures.*

- *The levee closure requirement is that all openings must be provided with closure devices that are structural parts of the system during operation and design according to sound engineering practice.*

2.0 EXISTING CONDITIONS AND OBSERVATIONS

In order to identify the existing conditions, a review of U.S. Army Corps of Engineers (USACE) as-built plans for the Derby Local Flood Protection Project and the Ansonia Local Flood Protection Project was performed in addition to site inspections, observations of the operations of the closure devices, and a review of the entire levee system to determine if any openings exist beyond those shown on the as-built plans. Within the project limits, there are a total of 15 openings/closure devices, which are summarized below:

Housatonic River (Derby)

- 24" and 36" pressure conduit storm drain outlet pipes with cast iron flap gates
- Railroad Flood Gate #3 (Housatonic Railroad)
- Railroad Flood Gates #2A and 2B (Housatonic Railroad)
- Post-indicator valve and valve adjacent to Railroad Gate 2B
- Three 36" steel force main discharge pipes from Derby the Pumping Station
- 8'x6' gravity storm drainage outlet with Sluice Gate Structure #2
- Sanitary sewer pipe at Sluice Gate Structure #3

Naugatuck River (Derby)

- Railroad Flood Gate #1 (CT DOT/Metro-North Railroad)
- Gravity storm drainage outlet with Sluice Gate Structure #1
- Pressure conduit storm drainage outlet with Sluice Gate Structure #11

Naugatuck River (Ansonia)

- Gravity storm drainage outlet with Sluice Gate Structure #10
- Force main discharge pipes from Division Street Pumping Station
- Sanitary sewer pipes with Sluice Gate Structure #8
- Sanitary sewer pipes with Sluice Gate Structure #7
- Railroad Gate #4
- Sanitary sewer pipe with Sluice Gate Structure #5

Pressure Conduit Storm Drain Outlet Pipes (Housatonic River)

These penetrations through the flood wall are for 24" and 36" pressure conduits that convey surface runoff from upland areas in Derby. The outlets are located adjacent to Bridge Street at the northern limits of the flood protection system along the Housatonic River. This conduit under normal conditions and during the base flood should be able to convey stormwater as the system is closed until the inlet, which is at a higher elevation than the base flood. These two outlet pipes are equipped with flap gates. Both flap gates appeared free of debris and appeared to be in good working order when MMI witnessed their operation. Closed circuit television (CCTV) inspections performed on the accessible portions of these pipes indicated that the pipes are in good condition. Additional information regarding the pipe and culvert inspections can be found in Appendix F – Engineering Report – Interior Drainage, provided in support of the overall FEMA certification package.

Railroad Flood Gate Structure #3

This opening is provided for the Housatonic Railroad Company. The elevation of the sill at the gate closure for this particular crossing is at an elevation of 21.74, slightly higher than the base flood elevation of approximately 21.55. MMI witnessed the operation of the door for Gates #3, and it was observed to be in good working order. Sandbags and sand stockpiles are stored at the Department of Public Works (DPW) Garage facility located at Coon Hollow Road.

Force Main Discharge Piping From Derby Pumping Station

Three 36" steel force main discharge pipes exit the Derby Pumping Station and extend up and over the levee embankment. The outlets of the pipes are not equipped with flap gates; however, they were free of debris and sediment. The pipes reach a maximum height of 32.0 beneath the top of the levee, well above the base flood elevation of approximately 21.

Gravity Storm Drainage Outlet With Sluice Gate Structure #2

This structure is an 8'x6' gravity storm drainage culvert adjacent to the Derby Pumping Station. Under normal flow conditions, this culvert conveys storm runoff from upland areas in Derby and the outflow from the Derby Water Pollution Control Authority (WPCA) Facility. The outlet is equipped with a flap gate and Sluice Gate #2 in order to prevent elevated river elevations from backing up into interior areas. The flap gate appeared in good working order at a site visit, and Sluice Gate #2 also appeared in good working order when MMI witnessed its operation with city staff. CCTV inspections performed indicated that this culvert is in good condition. Additional information regarding the pipe and culvert inspections can be found in Appendix F – Engineering Report – Interior Drainage, provided in support of the overall FEMA certification package.

Sanitary Sewer Pipe With Sluice Gate Structure #3

This penetration through the levee consists of an 18" sanitary sewer pipe crossing beneath the levee with Sluice Gate #3, adjacent to the Derby WPCA Facility. The Operations and Maintenance Manual states that this gate is only closed in case of the rupture of the sewer pipe crossing the Naugatuck River (± 1,000 feet upslope of Sluice Gate #3). This gate was not reviewed as part of this analysis as it is not closed under base flood conditions as defined by FEMA.

Railroad Flood Gate #2 (A and B) w/Gravity Storm Drainage & Post-indicator and Valve

These openings are provided for the Housatonic Railroad crossing and railroad spur to the former location of the former Housatonic Lumber Yard with Railroad Gate Structures #2A and #2B. The elevations of the sills at both gates are below the base flood condition. MMI witnessed the operation of the doors for both gates 2A and 2B, and they are in good working order. Sandbags and sand stockpiles are stored under cover at the DPW Garage facility on Coon Hollow Road. An 8" storm drain pipe penetrates the floodwalls adjacent to Gate #2B. The landward side of this pipe is equipped with a post-indicator and valve that were located by MMI; however, operation of this valve was not witnessed during inspections. The post-indicator appeared wobbly, and the valve may need maintenance. In addition, the drain inlet grate is missing, and the structure needs to be cleaned of debris.

Railroad Flood Gate #1

This opening is provided for the Metro-North railroad crossing and Railroad Gate Structure #1 adjacent to the Derby train station. The elevation of the sill is below the base flood condition. The Derby DPW has operated this gate as part of its ongoing inspection procedures and, based on its experience, the sluice gate is in good working order. MMI was not able to witness the closing of this gate as proper coordination with Metro-North could not be achieved during our review. Sandbags and sand stockpiles are stored at the DPW Garage facility located on Coon Hollow Road.

Gravity Storm Drainage Outlet With Sluice Gate Structure #1

This structure is a 6'x6' gravity storm drainage outlet adjacent to currently vacant City of Derby-owned property. Under normal flow conditions, this culvert conveys runoff from upland areas in Derby and low lying areas behind the levee. The area drained by this outlet is not equipped with a pump station or other means to evacuate accumulated water during elevated river conditions.

The outlet is equipped with a flap gate and Sluice Gate #1 in order to prevent elevated river elevations from backing up into landward areas. The flap gate appeared in good working order; however, debris had accumulated at the flap gate to prevent its closure at our initial site visit and as indicated in the latest USACE inspection report. The City of Derby was notified of the condition and has since removed the obstructions, and the gate has been returned to its proper operating condition. Sluice Gate #1 also appeared to be in good working order when MMI witnessed its operation with city staff. CCTV inspections performed indicated that this culvert is in good condition. Additional information regarding the pipe and culvert inspections can be found in Appendix F – Engineering Report – Interior Drainage, provided in support of the overall FEMA certification package.

Pressure Conduit Storm Drainage Outlet With Sluice Gate Structure #11

This structure is a 4'x4' storm drainage pressure conduit culvert south of Division Street that conveys surface runoff from upland areas in Derby. This culvert which is fed by a 48" reinforced concrete pressure conduit under normal conditions conveys runoff from upland areas behind the levee to the Naugatuck River and during the base flood the sluice gate remains open since the inlet to this since is higher than base flood water surface elevation. This outlet is equipped with a flap gate and Sluice Gate Structure #11. Both the flap gate and sluice gate appeared free of debris and seemed to be in good working order when MMI witnessed their operation with city staff. CCTV inspections performed on this conduit indicated that the pipes are in good condition with sections of the pipe requiring cleaning of accumulated sediment and debris. Additional information regarding the pipe and culvert inspections can be found in Appendix F – Engineering Report – Interior Drainage, provided in support of the overall FEMA certification package.

Gravity Storm Drainage Outlet With Sluice Gate Structure #10

This structure is a 6'x5' gravity storm drainage culvert adjacent to the Division Street pumping station. Under normal flow conditions, this culvert conveys runoff from upland areas west of the

Naugatuck River in southern Ansonia and northern Derby. The outlet is equipped with a flap gate and Sluice Gate #10 in order to prevent elevated river water surface elevations from backing up into landward areas. The flap gate appeared in good working order at a site visit, and Sluice Gate #10 is operated regularly by the City of Ansonia DPW as part of its ongoing inspection procedures. Based on its experience, the sluice gate is also in good working order. CCTV inspections performed indicated that this culvert is in good condition. Additional information regarding the pipe and culvert inspections can be found in Appendix F – Engineering Report – Interior Drainage, provided in support of the overall FEMA certification package.

Force Main Discharge Pipes From the Division Street Pumping Station

Three 30" steel force main discharge pipes exit the Division Street Pumping Station and extend up and over the levee embankment. The three pipes have flap gates at the riverside discharge that appear in good condition although some sediment has accumulated in the pipes themselves due to siltation from elevated river levels and the lack of flow from the pump station. In the event that the pump station is used to convey storm drainage, the accumulated sediment will be quickly forced out of the pipes. The pipes reach a maximum height of 32.5 beneath the top of the levee, well above the base flood elevation of approximately 24.

Sanitary Sewer Pipes With Sluice Gate Structure #8

This structure supports two sanitary sewer pipes (both 20") which cross beneath the levee. These pipes are the outlet from the Ansonia WPCF with one pipe used as a gravity outlet with Sluice Gate #8 and one pipe as a force main discharge in the event of elevated river conditions. Both outlets have flap gates at the discharge that appear in good condition. The Operations and Maintenance Manual states that Sluice Gate #8 and the post-indicator valve are to be closed in case of the rupture of the pipe(s) crossing the river. As part of the new WPCA Sewage Treatment Plant currently under construction, the post-indicator valve and gate valve associated with this closure system are being replaced. Sluice Gate #8 is operated regularly by the City of

Ansonia DPW as part of its ongoing inspection procedures. Based on its experience, the sluice gate is in good working order.

Sanitary Sewer Pipes With Sluice Gate Structure #7

This opening consists of dual sanitary sewer siphon pipes (16" and 20") crossing beneath the Naugatuck River with manually operated sluice gates on the landward side of the levee adjacent to the Ansonia WPCF. The Operations and Maintenance Manual states that these gates are only closed in case of the rupture of the pipe(s) crossing the river. This gate was not reviewed as part of this analysis as it is not closed under base flood conditions (or the 100-year flood).

Railroad Flood Gate #4

This opening is provided for the Metro-North Railroad. The elevation of the sill at the gate closure for this particular crossing is at an elevation of 27.0, slightly higher than the base flood elevation of approximately 26.8. The Ansonia Department of Public Works (DPW) has operated this gate as part of their ongoing inspection procedures and based on their experience; the gate is in good working order. Sand bags and sand stockpiles are stored at the Ansonia DPW facility located at the end of North Division Street.

Sanitary Sewer Pipe With Sluice Gate Structure #5

This structure supports a 24" sanitary sewer pipe crossing beneath the levee with a manually operated sluice gate on the landward side of the levee, adjacent to the Metro-North railroad bridge. The Operations and Maintenance Manual states that this gate is only closed in case of the rupture of the pipe crossing the river. This gate was not reviewed as part of this analysis as it is not closed under base flood conditions as defined by FEMA.

3.0 CONCLUSION

All closure devices associated with the openings through the levee walls and embankments were observed to be in proper working order in general conformance with the original USACE as-built documents. As indicated in the Operations and Maintenance Manuals provided and recently updated and adopted by the municipalities, strict compliance with the operations and maintenance procedures outlined therein is critical to the longevity of the flood protection measures and their ability to maintain protection to interior areas. All flap gate outlets and sluice gate openings need to be regularly inspected and cleaned so that debris during a flood condition does not disrupt their proper use and implementation. Also, the sluice gates that are used for sanitary sewer crossings need to be inspected and maintained. While these structures are not necessarily critical to the protection provided during the base flood, proper operation and maintenance will help to identify potential sources of unintended inflow to the interior drainage system should failure of these conduits occur below the rivers. Based upon the review of the available documentation, the observations performed, and reports from the Derby and Ansonia DPW directors and staff, it is anticipated that the closure devices for Section 1 of the shared flood protection system for Derby and Ansonia will provide protection from the base flood as described and defined in the Summary of Certifications provided with the request for FEMA accreditation and in accordance with 44 CFR Section 65.10(b)(2).

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SUPPORTING DOCUMENTATION

Photographs of Closure Devices



Pressure Conduit Storm Drain Outlet Pipes (Housatonic River)



Railroad Flood Gate Structure #3



Force Main Discharge Piping From Derby Pumping Station



Gravity Storm Drainage Outlet With Sluice Gate Structure #2



Sanitary Sewer Pipe With Sluice Gate Structure #3



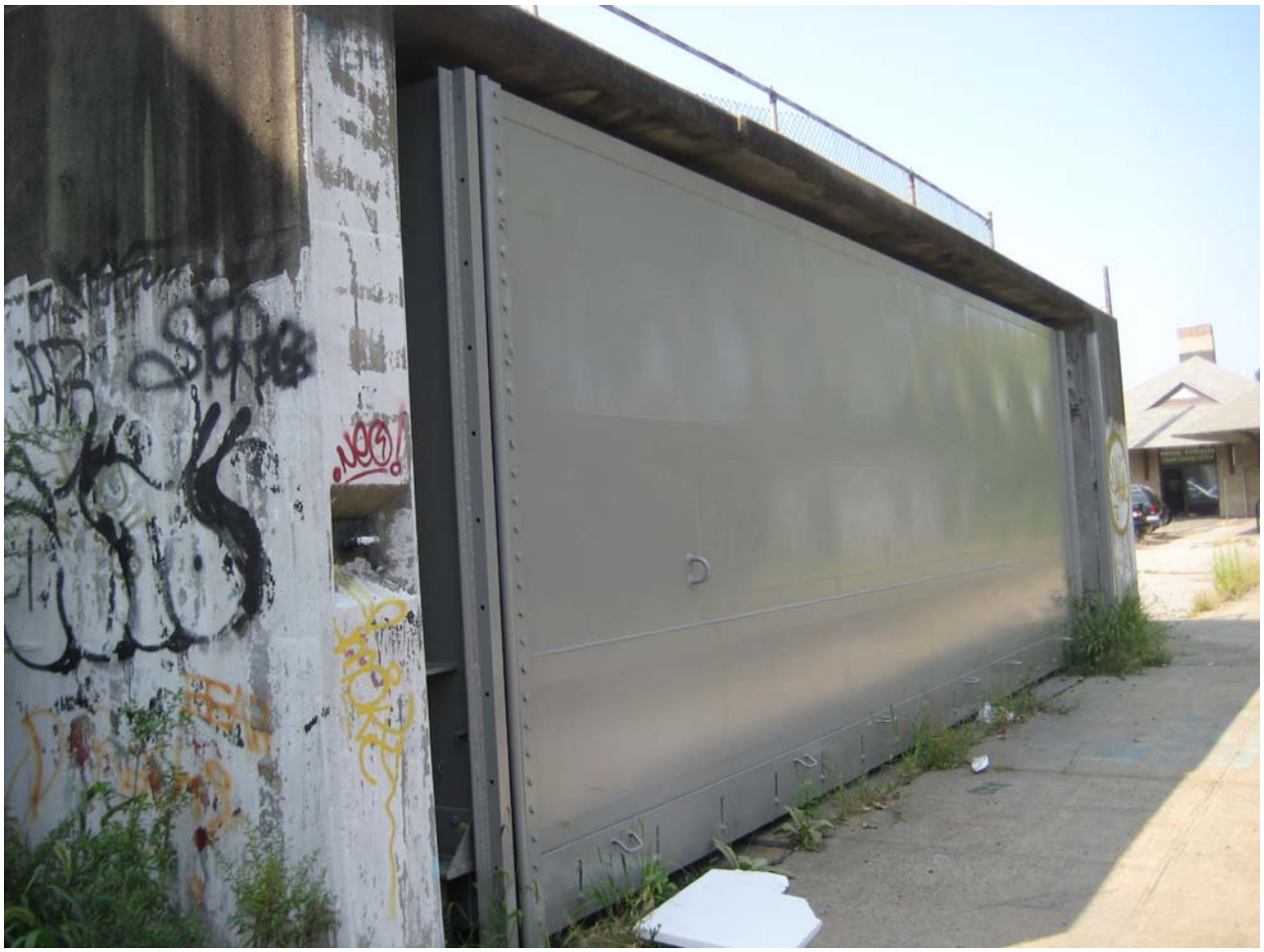
Railroad Gate #2A



Railroad Gate #2B



Post Indicator



Railroad Flood Gate #1



Gravity Storm Drainage Outlet With Sluice Gate Structure #1



Pressure Conduit Storm Drainage Outlet With Sluice Gate Structure #11



Gravity Storm Drainage Outlet With Sluice Gate Structure #10



Force Main Discharge Pipes From the Division Street Pumping Station



Sanitary Sewer Pipes With Sluice Gate Structure #8



Sanitary Sewer Pipes With Sluice Gate Structure #7



Railroad Flood Gate #4



Sanitary Sewer Pipe With Sluice Gate Structure #5 (Vegetation has been cleared)

Ansonia WPCA Gate Valve Replacement