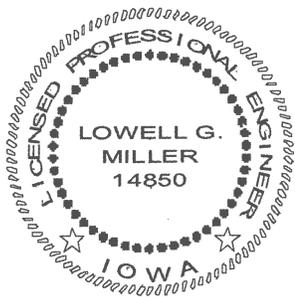


**CHARLES CITY
FLOYD COUNTY**

**MAIN STREET BRIDGE FEASIBILITY
FHWA NO. 001820**



I HEREBY CERTIFY THAT THIS ENGINEERING DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

A handwritten signature in blue ink, appearing to read "Lowell G. Miller", written over a horizontal line.

Signature

August 29, 2025

Date

My Registration expires December 31, 2026

Pages covered by this seal: Letter report (pages 1-14), Appendix G, H and I

**CALHOUN-BURNS AND ASSOCIATES
WEST DES MOINES, IA**



CALHOUN-BURNS
&
ASSOCIATES

August 29, 2025

John Fallis, P.E. & CFM
Charles City Engineer
105 Milwaukee Mall
Charles City, IA 50616

**RE: FEASIBILITY STUDY
MAIN STREET BRIDGE IN CHARLES CITY
OVER CEDAR RIVER
FHWA No. 001820
CB&A No. 2022192**

Dear Mr. Fallis:

Calhoun-Burns and Associates was retained by the City of Charles City to perform a feasibility study of the Main Street Bridge over the Cedar River. This letter report is a summary of our work on this project, and includes a description of our field investigations, office analysis and alternates considered.

GENERAL

Charles City is built around the Cedar River with the city split nearly equally on each side of the river. Charles City is the county seat for Floyd County and provides services for the entire county. As such, the river crossings within the city play an important role in the social and economic wellbeing of Charles City and Floyd County. The Main Street bridge is in the heart of the city and is located just southwest of the city's downtown district. Due to its important location, it carries a traffic volume of 6,000 vehicles per day, per Iowa Department of Transportation (IDOT) traffic data.

The existing structure is a three-span earth filled concrete arch bridge. Each span is approximately 80 feet long with a total length of 240 feet. This structure lies in a southwest to northeast orientation. For the purpose of this report, Main Street is assumed to be in a north south direction. There is a low head dam approximately 80 feet upstream of the bridge. Due to its close proximity the dam will have a direct effect on any work needed in the river channel. The roadway is classified as an Urban Minor Arterial.

As this is an earth filled arch the roadway paving is carried across the bridge with a 51 foot back-to-back of curb width. There is an approximate 9.5 foot wide sidewalk located on west side and 8.2 foot wide sidewalk of the east side. The bridge is currently load posted at 10 tons to restrict truck traffic. The bridge was completed in 1910 which makes it 115 years old.

HISTORICAL ASPECTS

The intent of this report is an engineering study related to the Main Street bridge. This report will provide some background and touch on historic aspects as it relates to potential impacts that may

occur related to future work on the Main Street bridge. This report is not intended to be an in-depth historical study.

Emmons-Oliver Resources, Inc (EOR) has completed an initial archaeological and cultural resources desktop assessment and literature review for this site. Due to sensitive archaeological information contained within this report it is not to be released to the public and is not included with this report.

The Main Street bridge is listed on the National Register of Historic Places. In larger urban areas the concrete arch bridge was a relatively common choice in this era for major river crossings. It is noted as historic due to its relatively early construction date and being well preserved.

The Charles City downtown business area is a historic district and is known as Central Park. The Floyd County courthouse is also considered historical. It is anticipated that construction work on the Main Street bridge will not alter these historical properties. There may be some secondary effects, such as vibration issues, that will require monitoring of the historic properties during construction.

The upstream dam is considered potentially eligible for the National Register of Historic Places. There is a gate system located on the south end of the dam. These gates were designed to allow the release of water from upstream of the dam into a flume that follows the south bank of the river. The flume was originally used to power a hydroelectric power plant that was located approximately 1,000 feet east of Main Street. A significant section of the flume was abandoned and partially removed in the 1970's. At that time the flume outlet, that is currently in place, was constructed east of the Main Street Bridge to route water from the flume back into the river.

On the north bank, between the bridge and the dam, is a concrete pad that is currently being used as a recreational area. This concrete pad is open below and is supported on an old foundation to span over water between the bridge and dam. Based on old mapping the foundation was part of a flour mill.

EXISTING CONDITIONS

The original construction of the Main Street bridge was completed in 1910. In 1997 a project was let to complete concrete repairs to the structure. This included concrete patching of the structural arches and foundations. In addition, the sidewalks and the storm sewer intakes were replaced.

Continued settlement of the fill within the arches led to drainage issues on the top surface during rain events. This settlement directed storm water to low spots on the bridge which led to excessive water infiltrating the fill within the arches. In 2020 another project was let to level settled areas and seal joints between the curb and sidewalk. This work improved the drainage toward the storm intakes which minimizes infiltration. As part of this work the intakes were repaired and concrete surface repair work was completed to the northwest wing. Timber formwork from the original construction is extending through the arches which is allowing fill from under the pavement to be lost, especially during flood events

A special inspection was completed on July 8, 2024 upon the request of the city following flooding that occurred. The city had closed the bridge to all traffic due to concerns of movement. A routine inspection of the bridge was completed on December 23, 2024 as part of the city's most recent

biennial bridge inspection program. A copy of these inspection reports is included as **Appendix A**. Overall the structure is in poor condition. The structural arches have spalled areas with exposed reinforcement. There is also noted cracking and leaching of the arches. The 28 year old structural concrete patches are deteriorated, debonding, failing, and ineffective.

The foundations also have general deterioration with spalling, especially along the waterline. The wings at the four corners of the bridge, which retain the earth fill, are cracking and spalling. The varying size of the cracks indicates the wings are moving and shifting over time and with seasonal weather changes. The repaired northwest wing is already showing signs of cracking which indicate continual movement of the underlying original wing. The northeast wing partially consists of an abandoned brick flume. This area is losing fill and starting to undermine the sidewalk.

The fascia walls have significant spalling, cracking and general deterioration. At the connection from the arch to the fascia walls the concrete is in poor condition with concrete fully missing at numerous locations along the arches. The fascia walls are moving laterally due to the pressures from the soil they are retaining and due to seasonal changes.

Following the completion of the special inspection a recommended load posting of 20 tons was recommended. The city elected to remove the road from the truck route and post the bridge 10 tons for enforcement purposes.

Collins Engineers Inc completed an underwater inspection of the bridge in November 2024. Their work confirmed that some of the bridge foundations are exposed due to scour. The bridge is founded on bedrock and footings are not undermined. Therefore, the existing bridge foundations remain stable from a scour perspective. General concrete cracking and deterioration was noted below the waterline which appears consistent with what is being observed directly above the waterline. A copy of their full report is included as **Appendix D**.

In April 2025 American Engineering Testing complete their field work. They completed sounding of the arches to determine the spalled and delaminated areas. These areas represent areas where concrete is currently missing and where the surface of the concrete is not sound and will spall off soon. Their work also included obtaining samples for laboratory testing. The samples of the concrete were taken at random locations that were readily accessible with the snooper rig they were using to access the bridge. The results of their work are included as **Appendix E**.

Laboratory analysis was complete to determine the general condition of the existing concrete. The condition of the concrete is consistent with its 115 year age and its exposure to the elements. Based on the year of construction, the concrete would have been mixed on site in small batches. This method of producing concrete produces inconsistent concrete. Testing revealed unmixed cement and poorly distributed aggregates in the mix. These issues are consistent with the mixing methods used at the time of construction.

Several other types of testing were completed to determine chemical deterioration and chemical penetration of the concrete. Presence of certain chemicals will cause the embedded reinforcing to corrode over time. Random locations, that appear to be in fair to good condition, had test levels indicating that the embedded reinforcing is corroding. The corrosion will lead to future spalling of the concrete in areas that currently appear to be in fair condition.

The Main Street bridge was completed in 1910 which was one year before the completion of the Charley Western bridge in 1911. These two bridges are of similar design, being earth filled arches, with the Charley Western being designed for railroad loading and Main Street being designed for vehicular traffic. Although it is not common for this type of bridge, it should be noted that the Charley Western bridge had a major structural failure in 2017 which led to its replacement.

There were two dams on the Cedar River. The Beauty dam, which was located downstream of Main Street, has been substantially removed and creates the whitewater rapids that are currently being used for recreation. The Main Street dam is located upstream of Main Street and remains in place. We understand that the city currently does not have a plan to remove the Main Street dam.

Collins Engineers Inc completed an inspection of the Main Street dam in November 2024. The dam is founded on bedrock and no undermining was noted. There is some general deterioration of the concrete but does not present any major concerns currently. Additional information is available in **Appendix D**.

There is a gate system at the south end of the Main Street dam. When the gates are opened, they release water through a concrete flume along the south bank which outlets east, downstream, of Main Street. Per the city's operational plan (letter dated May 31, 1973) on file with the Iowa Department of Natural Resources (DNR) the current use of the gates and flume is for maintenance and repair of the dam during low flow. A copy of the 1972 Iowa DNR permit for the dam and the city's 1973 operational plan are included in **Appendix F** for reference. The concrete flume is not integrally tied to the Main Street bridge and therefore is not evaluated as part of the bridge inspections and not a part of the coding of the bridge.

Collins Engineering Inc completed an inspection of the flume as part of their underwater work. It appears that the gate system was replaced by a series of timber planks to create a stop log structure. This area is not watertight with water passing through. The timber planking is decayed but still intact. Within the flume there are numerous areas with complete concrete loss. The flume was constructed on limestone bedrock. Portions of the bedrock have deteriorated over time which has resulted in portions of the flume being unsupported. The water that is flowing through the stop log structure is exiting through the floor in locations of complete concrete loss and do not make it to the outlet of the flume. General photos of the flume are in **Appendix B** and see **Appendix D** for Collins Engineering inspection information.

The concrete slab and the flour mill foundation on the north bank are also in poor condition. There is extensive deterioration throughout. The main structural elements tie into the northwest corner of the bridge. Any major work to the bridge will require removal of this concrete slab and structural elements. General photos of the flour mill foundation are in **Appendix C** and see **Appendix D** for Collins Engineering inspection information.

The downtown district currently has two-way traffic with one lane in each direction. There is a third lane added at the intersections to allow for a left-hand turn lane. In addition to the traffic lanes there is on-street parking. Due to the physical restrictions of the downtown area the addition of traffic lanes facilitated by street widening does not appear feasible.

The existing travelled way on the bridge is laid out based on four lanes. At the north end of the bridge there are three north bound lanes allowing for left and right turning movements and a

through lane. For southbound traffic there is one lane. These traffic patterns appears to function well with downtown traffic flow that begin at the Riverside Drive intersection just north of the bridge.

At the south end of the bridge there are four lanes with two lanes in each direction. This traffic pattern is extended from this point to the south end of town. The current posted speed limit through the site is 20 MPH.

The bridge and approach roadway lies within the road right-of-way. There is publicly owned property along the banks of the river at all four corners of the bridge that starts at the road right-of-way. This includes the Lion's Club Rose Garden that is located at the northeast corner of the bridge. There is also privately owned ground within the anticipated limits of the project.

Charles City is included in the Floyd County Flood Insurance Study (FIS) which was last revised on June 19, 2020. The Cedar River was modeled with HEC-RAS in 2012 with HEC-RAS still being the current modeling software. A review of the HEC-RAS modeling indicates that the existing bridge creates approximately 1.7 feet of backwater for the 100 year flood event. Backwater is the difference in water surface elevation from downstream to upstream at a structure which is caused by the structure. This exceeds the current Iowa DNR backwater criteria of 1.0 feet. This indicates an improved hydraulic opening is required if work at this site is extensive enough that an Iowa DNR floodplain permit is required.

There are numerous residential properties located within the 100 year floodplain, as identified on the current Flood Insurance Rate Maps (FIRM). Actual flood events confirm that upstream structures are impacted by Cedar River flooding. An improvement to the hydraulic opening of the bridge and a reduced backwater stage will improve, but not eliminate, flooding potential to upstream residences.

ALTERNATES CONSIDERED

As work to the Main Street bridge will affect a historic structure it is prudent to consider alternates. The intent of the alternate analysis provided in the report is to start the discussion of the long term planning for this structure at the local level. As this project progresses the Iowa DOT Location and Environment Bureau and State Historical Preservation Office will become involved assuming federal money is obtained for construction.

There currently are two vehicular bridges crossing the Cedar River in Charles City. Both of these structures have a significant volume of traffic, 6,000 VPD on Main Street and 11,800 VPD on 200th Avenue (US Highway 18). Due to the city's reliance on its river crossings, it is highly desirable to maintain two crossings within Charles City.

Due to the close proximity of the Main Street bridge to the downtown area this bridge plays a vital role in the success of the downtown district. Any alternate considered needs to reconnect the downtown in a similar manner as the existing condition.

The traffic lanes and patterns across the bridge appear to be adequately functioning. Due to the restrictions with the downtown area, there are no anticipated changes to the traffic pattern in the vicinity of the bridge. As such, the alternates that are to be considered shall be laid out to maintain traffic patterns similar to their current condition.

Geometric criteria for design will be governed by the Iowa Statewide Urban Design and Specifications (SUDAS). The required bridge width would be based on four 12 foot wide lanes along with two 4 foot wide shoulders across the bridge. This would result in a 56 foot width for vehicular traffic. In addition to vehicular traffic, two 10 foot wide sidewalks/trails would be considered. Considering necessary width for fencing and rails, a total width of approximately 81'-2 would be required.

Based on the above criteria the following options are considered:

Alternate 1, Rehabilitation: As presented in the "Existing Conditions" section of this report the structure continues to deteriorate with movement noted. This is due to its 115 plus years of traffic, winter maintenance and exposure to the elements. The existing width of the structure does not meet current criteria. Widening of the structure as an earth filled arch would apply additional loading to the structure which would accelerate the deterioration and movement of the structure.

If modifications of the structure to accommodate the widening affect the waterway opening below the 100 year event, then Iowa DNR would require the structure to meet current criteria. As noted, the existing structure does not meet current backwater requirements. Additional waterway area is needed to reduce backwater and this cannot be achieved with the existing structure.

For the above reasons rehabilitation as an earth filled structure is not a feasible option.

In lieu of rehabilitation as an earth filled arch the structure could be reviewed for conversion to an open spandrel option. For this option the roadway and sidewalk surfaces would be removed. The earth fill would also be removed above the structure, exposing the top arches. The fascia walls and the wings, that are highly deteriorated, would be removed. The flour mill foundation at the northwest would be removed as the bridge wing is highly deteriorated and in need of replacement. At this point the concrete arches and foundations would be the only remaining portions of the structure. Cofferdams would need to be constructed around the foundations. This would allow the foundations to be exposed and dewatered to facilitate repairs in dry conditions. Deteriorated concrete on the arches and foundations would be removed and patch material installed. Some full depth concrete replacement of the arches may be required. Concrete repairs would include a considerable amount of overhead concrete removal with jack hammers which is challenging construction work. A stable platform, such as scaffolding, would need to be erected to allow this work to be completed. The river would need to be diverted in stages to allow the platform to be created in each span as work progressed.

Once repair work is completed, replacement fascia walls would be constructed to replicate the current condition. Between the fascia walls numerous transverse walls would also be constructed. These transverse walls are for structural support of the road surface and will be hidden once the structure is complete and hence not affect the appearance of the structure. With these items in place a new structural deck surface would be installed. The deck surface would cantilever over the existing structure to provide the required width to meet current requirements.

Appendix G provides visual depiction of the necessary work required for a rehabilitation.

This type of rehabilitation would eliminate the weight of the existing earth fill. The reduction in dead load is needed to account for the additional weight of the widened structure and improve the structure's capacity.

The top of the arches have not been exposed since the bridge was built 115 years ago. The condition of the top of the arches will be unknown until a significant amount of the removals have been completed.

The existing plans are one sheet with limited data and the as built structure was altered from the original plans. Rehabilitation plans would be an approximation for bidding purposes. When removals are complete the condition and geometry of the remaining structure will be fully known. It should be anticipated that plans will need to be adjusted at this point. Adjustment of plans will affect the contractor's scope of work and bid costs will need to be adjusted appropriately.

The concrete patching of the arches and foundation are in a harsh environment. In addition, the original concrete adjacent to the patches will continue to deteriorate. This will lead to the patches failing over time. As the concrete testing indicates there are other random areas in the bridge that are currently sound but will spall over time as the embedded reinforcing corrodes. Due to the random locations of these areas, it is not practical to identify all areas in the field.

This alternate requires significant removals and modifications to the existing structure with new areas replicating the existing condition. The State Historical Preservation Office (SHPO) may consider this alternate as an "Adverse Effect." If this determination is made it will require mitigation due to an impact to a historic structure.

Alternate 2, Do Nothing: If nothing is done to the bridge, the structural conditions will continue to worsen until such a time that the bridge needs additional load restrictions and eventually closed to all traffic. As discussed earlier in this report, this bridge has an important social and economic impact for the City of Charles City and Floyd County as it connects residences and commercial businesses to other parts of the city and the road system. Therefore, permanent closure of this route is not desirable, and this is not a feasible option.

Alternate 3, Relocation of the Existing Structure to an Alternate Site. The concrete superstructure elements are poured integrally into the foundation elements. The foundation elements are tied into footings bearing on natural bedrock. It should be noted that foundation footings are embedded in the bedrock to provide vertical and lateral support of the structure. In order to relocate without significant concrete removals, the entire structure would need to be relocated in one piece. This would include the concrete arches, the concrete foundations along with fascia walls and wings.

Relocation of the structure in this fashion is not practical due to its size and weight. In addition, instability would be created if it were detached from the bedrock. Disassembly of the structure for relocation would destroy the structure itself. Therefore, relocation is not a feasible alternate.

Alternate 4, Road Realignment. Maintaining a Cedar River crossing within the City of Charles City that connects directly to the downtown district is highly desirable. If an alternate bridge location were chosen, Main Street would need to be shifted up or downstream of the existing bridge. With the dam on the upstream side, shifting the road to the east would be the logical choice. Due to the close proximity of the north intersection to the downtown district there would be a direct loss of buildings that are housing downtown businesses to accommodate the approach roadway transition. This would have a negative impact to the function of downtown. As downtown is a historic district this alternate would have a negative impact on historic structures which would be an adverse effect. Also, a couple of businesses south of the bridge would need to be removed.

This alternate would occupy a significant portion of the Lion's Rose Garden Park and have permanent negative effect to this public property which we anticipate would be classified as 4f. Due to the high impact of surrounding buildings associated with the road realignment this is not a feasible alternate.

Alternate 5, Replace the Bridge at its Current Location. We have reviewed the HEC-RAS modeling for this site. Replacement of the bridge with a modern four span pretensioned prestressed concrete beam (PPCB) style bridge with a trapezoidal opening would significantly improve the hydraulic capacity. This in turn will reduce the bridge's backwater. The backwater created by a new structure would be less than the current Iowa DNR requirements.

This option keeps the bridge in its current location and reconnects the downtown area similar to the current situation. Since the bridge is on the original alignment, removal of downtown businesses would not be required. The bridge would be designed to current width and design loading requirements along with the incorporation of modern day safety features. This option will provide the city with a long-term structure that will carry legal loads well into the future. A sketch of this alternate is shown in **Appendix H**.

COMPARISON OF ALTERNATE 1 and 5

The following analysis is intended to provide a general comparison of the cost of the two alternates over an extended period of time. These are based on approximations and past experience. Costs listed are in today's dollars for comparison purposes. Costs will need to be adjusted to account for inflation.

Major cost for Alternate 1, Rehabilitation:

Complete a major rehabilitation as described in the **Alternates Considered** section.

The current patching of the arch is 27 years old and well past its intended life span. It should be anticipated that the life span of patching will be shorter as the bridge continues to age. The areas requiring patching will increase with each round of repairs. Therefore, consider future repairs approximately 20 years following the major rehabilitation. These repairs would consist of patching on the arches and foundations. The patch areas with this repair will be larger than the major rehabilitation. Cofferdams will need to be reinstalled such that the repair work can be completed on the piers. River diversion will be needed to allow a stable platform to be constructed to complete the repairs.

Once the repair round of patches reaches 15 years old the bridge is assumed to be at its end of life. This results in the major rehabilitation having a 35 year life span.

Cost for major rehabilitation: \$14,100,000

Cost for repairs: \$2,100,000

Total Cost: \$16,200,000 for a 35 year life

\$463,000/year

Major Cost for Alternate 5, Replace the Bridge at its Current Location:

Construct a new bridge as described in the **Alternates Considered** section.

Future repairs approximately 35 years following construction. Some spalling of the top surface of the deck may be occurring. Repairs would consist of patching the top surface of the deck and installing a high density PCC overlay. Bridge approach pavement may also need to be removed and replaced as well. It is anticipated that the overlay will last 30 years. It is common that this type of bridge could receive a second high density PCC overlay and extend its life even farther. For this analysis we will conservatively say the new bridge end of life is at the end of the first overlay, 65 years.

Cost for new bridge: \$12,500,000

Cost for repairs: \$1,800,000

Total Cost: \$14,300,000 for a 65 year life

\$220,000/year total

Routine inspections of a rehabilitated alternate will have a higher cost than a new structure. Based on the configuration of the rehabbed structure, the biannual bridge inspections will require inspectors to enter a confined space. This requires special equipment and extra staff to monitor air quality. To monitor concrete deterioration on the underside of the arches an in-depth inspection using a snoopers rig should be conducted routinely. We estimated snoopers inspections on a 4 year cycle for a rehabilitated bridge compared to 10 year interval for a new bridge. Underwater inspection of the upstream dam and bridge foundations are to be completed on a 6 year cycle for both alternates. The average bi-annual inspection is \$19,000 for Alternate 1, Rehabilitation and \$12,000 for Alternate 5, New Bridge.

Based on this analysis the cost for a new bridge is less than one half of the cost of rehabilitation when reviewing annual costs.

CONCLUSIONS OF ALTERNATE ANALYSIS

The existing 115 plus year old structure is deteriorated with movement observed. Due to the traffic volume and continued exposure to the elements, the bridge continues to deteriorate. The structure is currently posted for load which is restricting truck traffic. Continue deterioration will lead to additional weight restrictions and eventual closure if no action is taken. As part of Charles City's long-term planning, it is prudent to consider the next steps for this project. An improved Cedar River crossing is needed at this site to serve Charles City and the residents of Floyd County.

Although Alternate 1, Rehabilitation is physically possible, it requires significant removals of the existing structure. The portion of the historic structure that is left intact will be the thin edge of the arch and the tops of the piers when viewing from the sides. The majority of the visible portions of the bridge will be new construction. Combine this with the cost being nearly two times that of **Alternate 5, Replace the Bridge at its Current Location** the replacement alternate is clearly the preferred alternate from an engineering perspective. This option would require the elimination of the existing bridge, which would be considered an adverse effect to a historic structure.

Appendix H shows the general scope for **Alternate 5**. We anticipate that the existing structure would be replaced with a new 326'-0 x 56'-0 four span PPCB bridge. In addition, two 10 foot wide sidewalks would be included. This results in approximately an 81'-2 out to out width. The bridge would be placed on a zero degree skew. The substructures will consist of concrete integral abutments along with concrete Tee piers bearing on the underling bedrock.

The 200th Street bridge over the Cedar River would be used as a detour route during construction. This would allow the Main Street site to be closed to vehicular and pedestrian traffic for the duration of the construction period to minimize construction costs.

Due to significant site restrictions, limiting the overall length of the project between Court Street and Riverside Drive is prudent. A 3 to 4 foot grade raise will be required near the center of the bridge to provide freeboard to the proposed structure. Freeboard is the clearance between anticipated high water and the bottom of beams. This is an Iowa DNR requirement and is needed to provide passage of drift and minimize the chance of damage to the bridge during extreme flood events. This grade raise can be accomplished within the limits noted based on a 25 MPH design speed which is 5 MPH greater than the posted speed limit.

With the close proximity of the bridge to the downtown district it is appropriate to consider aesthetic details. There is a wide variety of basic aesthetic features that can be selected to improve the appeal of a bridge. Decorative structural steel fencing that has an arch theme could be used to tie into the history of the site. Similarly decorative lighting comparable to existing fixtures could also be used along with a decorative concrete separation rail between vehicular and pedestrian traffic. Basic features as described have been included in the cost opinion. More intricate or complex aesthetic details, such as arched fascias, can be incorporated into the design. These details would need to be further developed in order to develop construction cost figures.

There are currently sidewalk/trails that parallel the river on the south side and tie into sidewalks along Main Street. The sidewalks on Main Street are near the back of curb. The current layout promotes pedestrian and bike traffic to cross between the bridge and Court Street where there is no marked crosswalk. As a portion of the bike/trail system will need to be reconstructed as part of the bridge project it is prudent to rework this area and promote pedestrian and bike traffic to use the established crosswalk at Court and Main. Alternately the path could be taken under Main Street in the south bridge span. The trail would need to be lowered substantially to provide clearance to the new bridge which would result in it being flooded regularly.

As noted previously, the flume along the south bank is in poor condition. The landscaping in the area invites people to the top of the flume for recreational activities. The severe deterioration of the flume is creating a safety concern. Therefore, the condition of the flume needs to be addressed if the city intends to maintain the dam for the foreseeable future. The flume also serves as a flood wall to protect the riverbank from the turbulent water flow downstream of the dam, therefore maintaining it in some manner is appropriate. Because the flume is needed to protect the bridge and the contractor will be adjacent to the flume, addressing it as part of this project is necessary. For the purposes of the cost analysis, we have assumed that the flume will be replaced from near the dam to the current outlet location. With a rebuilt flume, the contractor likely would utilize it to divert low flow around the construction site which would assist with dewatering the site for bridge construction. If the city determines that the flume is not needed for future maintenance, the existing flume could be left in place and filled with grout. In addition, the undermining would need to be repaired.

The concrete slab and flour mill foundation at the north bank will need to be removed as part of bridge demolition. This will result in the loss of several park benches and planters that are currently on the slab. Protection of the slope from the dam to downstream of the bridge will be required due to the turbulent water flow downstream of the dam. A concrete wall along the toe

would be constructed to a similar height of the south bank flume. From the concrete wall to natural groundline the bank would be sloped back similar to the south side.

The historic properties in the vicinity of the project will need to be protected from damage during construction. The main concern associated with bridge construction is damages induced by vibration. During the design phase, select buildings will be identified for vibration monitoring. A preconstruction inspection of the buildings would be completed to document existing conditions. Equipment would be installed to measure the vibrations during construction and an alarm system set up to alert the appropriate people if a set threshold was exceeded. When construction is substantially completed a post construction inspection of the buildings would be completed to check for any notable change in condition from the original inspection. This work would be completed as part of the contract and the cost is included in the cost opinion.

COSTS AND FUNDING

The opinion of probable cost for **Alternates 1 and 5** can be found in **Appendix I**. Costs for individual items of the work were developed. The total of the individual item costs are indicated as the "Opinion of Probable Construction Costs" figure. An allowance for contingencies was added to the opinion of probable construction cost. "Total Opinion of Probable Project Cost" is the sum of the opinion of probable construction cost and contingencies.

While the opinion of probable costs is not a guarantee of the bids that will be received from bridge contractors they can be used for project planning and budgeting. The figures, however, should be adjusted to reflect inflation from now to the year of construction, and/or changes in the currently acceptable bridge and/or grading design standards.

The cost opinion for **Alternate 5** consists of a beam type bridge with some assumed aesthetic details to enhance its appearance. A beam and concrete deck system similar to the recently completed Charley Western bridge would be used. If a signature bridge is desired at this location the costs will increase dramatically. An example is the steel arch bridge in Iowa Falls that was constructed in 2010. This bridge used two steel arches that spanned across the river as the primary load carrying members. The cost for this bridge was around four times the cost of a typical beam bridge.

Our understanding is that funding for this bridge has not been secured at this time. As the project develops the city should be seeking City Bridge Replacement funds and/or other funding and grants to assist with the cost of the project. A vast majority of bridge funding in the State of Iowa is currently federal aid. Therefore, it is assumed that federal funds will be involved with this project and federal requirements will need to be followed during the design and construction phases.

NEXT STEPS

Current safety concerns:

- Due to the very poor condition of the flume structure this area should be closed to the public.
- During large events, such as city festivals, where large groups tend to congregate we would recommend that the flour mill area be restricted to keep people off of the area.

General overview of the next steps for bridge replacement:

- Review alternates available at the local level and provide approval/comments on the selected **Alternate 5, Replace the Bridge at its Current Location**.
- Review the operation plan for the Main Street Dam and update if needed
- Determine long term plan of the Main Street Dam
- Investigate potential funding sources
- Get the project programmed and IDOT project number established
- Submit the Concept Statement and supporting documentation to the IDOT to start the NEPA/SHPO process
- Complete preliminary plans for submittal to review agencies
- Continued coordination with the review agencies to obtain necessary permits and approvals
- Develop final plans and obtain necessary easements from landowners
- Let project through the IDOT for construction

The following provides a more detailed explanation of the above general overview that will be required to develop this project.

In the **Alternates Considered**, five alternates were reviewed in this report. We recommend that you review/discuss internally and with interested parties in the community the alternates available at this site and provide your concurrence and/or comments with the selected **Alternate 5, Replace the Bridge at its Current Location**. If discussions are held in a committee or open public forum a copy of the agenda and minutes of the meetings should be kept with the bridge file along with a copy provided to our office. This documentation likely will be needed as part of future discussion with review agencies.

The 1973 operation plan for releasing water via the gates and flume was during low flow for maintenance and repair of the Main Street dam. The city should review this operational plan and determine if it is appropriate moving forward. The inspection of the dam indicated that the gate system is a stop log structure that is in need of repair. The city will need to decide if they want to install an improved gate system and a new flume to function as intended or if all or portions of this system should be abandoned.

The city needs to discuss what is the long term plan of the Main Street dam. Based on the results of the dam inspection the dam has no major safety concerns at this time, and it is anticipated it will continue to function for the time being. Will the city continue to invest money in the inspection and maintenance of the dam or is there consideration of removing the dam similar to what was done with the Beauty dam? Due to the close proximity of the Main Street dam to the bridge, the removal of the dam would have a direct effect on the proposed layout of the bridge. Construction work directly downstream of a dam is challenging and hence the decision to remove the dam would also affect the contractor's operations. If there is consideration of removing the dam in the foreseeable future, decisions will need to be made related to the timing of the dam removal in relation to bridge construction.

The city should investigate potential funding sources for the project. Due to the magnitude of this project, it is likely that multiple funding sources may be required. One available source is the City Bridge Replacement fund. These are federal funds with a current maximum limit of \$1,500,000. This bridge currently qualifies to apply for these funds and has a high chance to receive funds based on its score.

Assuming federal funding is involved in the project, the IDOT will have review authority related to expenditure of federal funds. In addition, they will coordinate with the State Historical Preservation Office (SHPO). In order for this process to commence the project will need to be programmed and an IDOT project number established. There may be an option to set the project up as 'illustrative' to allow the IDOT to commence their reviews even if it is not feasible to have it programmed.

Once the project is established with the IDOT a concept statement can be submitted. The concept statement will identify the approximate limits of disturbance related to the project. The submittal will include the Determination of Effects (DOE) form, which is a review of the site for state and federal endangered species. If endangered species and/or their habitat are identified a method to minimize the impacts will also be developed. A Phase I archeological investigation will be completed of the area. This would include a desktop and a field investigation of the area related to potential archaeological sites that could potentially be disturbed by the project. Although rare, additional archaeological investigation could be required if the Phase I work identifies potential sites near the bridge that cannot be cleared based on the original work. Additional work related to the historic bridge will also be required.

This project will have an effect on publicly owned properties outside of road right of way, which includes the Lion's Rose Garden Park and the concrete slab on the flour mill foundation. The IDOT will require written confirmation that the department that is in control of the properties agree with the project and the proposed impacts. This documentation will be needed as part of the concept statement submittal. As this project continues to develop, please keep the Parks Department and other interested parties informed so this documentation can be prepared when needed.

With the above referenced information submitted the IDOT Location and Environment Bureau (LEB) can begin their review. Their work will include coordination with US Fish and Wildlife related to endangered species, if required. LEB will also review the archaeological and historical reports and determine if they concur with the recommendations as presented. Assuming they concur then they will start the coordination process with SHPO. The removal of the existing bridge will be classified as an adverse effect. The adverse effect will need to be signed off by SHPO. As part of this process a Memorandum of Agreement (MOA) will need to be developed. This document spells out what is agreed to between the various parties involved. There are generally some requirements of the city to compensate for the adverse effect. This could be special documentation of the existing bridge, preservation of certain features of the existing bridge or even funding of other historical work. SHPO will have significant input on what is acceptable and any suggestions of items at this time are purely speculative. Once the SHPO process is complete then LEB can finish their review related to National Environmental Policy Act (NEPA) clearance.

The Main Street dam is currently considered potentially eligible for the National Register of Historic Places. If the city desires to pursue modifications or removal of the dam this may become part of the bridge discussion with SHPO even if a different funding source is used for this work. Adjustments on how the review agencies are handled will evolve as this project develops.

The preliminary plan preparation can begin in conjunction with the concept phase. This would include site survey along with the hydrologic and hydraulic studies. This information is used to determine the type, size and location of the new bridge and the development of the preliminary

plans. With this work completed the preliminary plans would be submitted to the Iowa DNR to obtain a floodplain permit and to the US Army Corps of Engineers to obtain a nationwide permit.

With NEPA clearance and permits in place a letting schedule can be set assuming funding is available at that time. Remaining items would include the city purchasing any necessary easements for the project along with the development of the detailed plans needed for construction. The IDOT would handle the letting documents and conducting the letting for the city.

CONCLUSIONS AND RECOMMENDATIONS

This is a complex site with the bridge and dam being in close proximity along with the various modifications that have occurred over the decades. The current Main Street Bridge has served the community for many years. Due to its age and deterioration, it is appropriate to consider the long term planning of this structure. The community has a connection to its historical past and getting local input early in the process is important. The city and community need to decide what the long-term plan is for both the bridge and the dam.

We understand that the city will be pursuing outside funding and grants to assist with construction costs. Therefore, it is reasonable to assume that this project will be developed with at least some federal aid funding. As previously discussed, there will be multiple governmental agencies involved, and numerous studies and reports required to get through the design and review process. The city should anticipate a minimum of 2-3 years from notice to proceed with the concept statement to a letting.

Please feel free to call if you have any questions related to this Feasibility Report. We look forward to working with you as we continue to move this project forward.

Thank You.

Sincerely,



Lowell G. Miller, P.E.
Project Manager

Enclosures

APPENDIX A

MAIN STREET INSPECTION REPORT

Date Printed: 7/24/2025

* Sufficiency Rating 26

* Do Not Change

Note:

IDENTIFICATION COUNTY ENGR.

* COUNTY/CITY **Charles City**
COUNTY ID **001820**
* 8 STRUCTURE NO **001820**
* 5 INVENTORY ROUTE **1 5 1 00 01**
2 STATE AREA NO **7**
6 FEATURES CROSSED **CEDAR RIVER**
7 FACILITY CARRIED **MAIN ST**
9 LOCATION **095161205**
11 MILE POINT **0.000**
98 BORDER BRIDGE CODE **0** SHARE **0** %
* 99 BORDER BRIDGE NO

INSPECTIONS

10 INSPECTION DATE: **12/23/2024** NEXT INSPECTION DATE: **12/23/2026**
91 INSPECTION FREQ: **24**
FEATURE INSPECTIONS
92A F.C.: **N** FREQ. **93A DATE:** _____
92B U.W. **N** FREQ. **93B DATE:** **11/21/2024**
92C SPECIA **N** FREQ. **93C DATE:** _____
OTHER INSP FREQ. **OTHER DATE:** **7/8/2024**
OTHER DESCRIPTION **SNOOPER**
Inspected By: **DENMAN, JORDAN**
Consulting Firm Name: **CALHOUN-BURNS & ASSOCIATES, INC.**

STRUCTURE TYPE AND MATERIAL

43 MAIN STRUCTURE TYPE **211**
44 APPROACH TYPE **NEAR 0 FAR 0**
45 NO OF SPANS - MAIN **3**
46 NO OF APPR SPANS **NEAR 0 FAR 0**
107 DECK TYPE **N**
108 WEARING SURFACE/PROTECTIVE SYSTEM **6 0 0**

CONDITION

RATING (9-0)

58 DECK **SPALLED SIDEWALKS W/ EXPOSED REINF., BROKEN UTILITY MOUNTS** **N**
59 SUPER **SPALLED/PATCHED AREAS, EXPOSED REINFORCING, CRACKS, EFFLORESCENCE** **4**
60 SUB **PATCHES, SPALLING, UNDERMINING, SCALING** **4**
61 CHAN & PROT **SCOUR, EROSION** **5**
62 CULV **N**

AGE AND SERVICE

27 YEAR BUILT **1909**
106 YEAR RECONST **0000**
42 TYPE OF SERVICE **15**
28 LANES: **ON 4 UNDER 0**
* 29 EST AVE DAILY TRAFFIC **4971**
* 30 YEAR ADT **2022**
* 109 TRUCK ADT **00** % (PRIMARY ONLY)
19 BYPASS, DETOUR LENGTH **1.000**

LOAD RATING AND POSTING

31 DESIGN LOAD **0** 64 OPERATING RATING **20.0** 66 INVENTORY RATING **15.0**
63 METHOD USED - OPERATING RATING **0** 65 METHOD USED - INVENTORY RATING **0**
70 BRIDGE POSTING **2** 41 STRUCTURE OPEN, POSTED OR CLOSED **P**
ACTUAL **10 TONS**
RECOMM. **20 30 30**
ADDT'L POSTING _____

GEOMETRIC DATA

48 LONGEST SPAN **80** 112 NBIS BR **Y**
49 STRUCTURE LENGTH **248**
50 CURB OR SIDEWALK: **RT 1.0 LT 9.**
51 BR RDWY WIDTH C-C **50.0**
52 DECK WIDTH O-O **72.0**
32 APPR RDWY WIDTH (W/ SHOULDERS) **50**
33 BRIDGE MEDIAN **NO MEDIAN**
34 SKEW **0**
35 STRUCTURE FLARED **NO**
10 MIN VERT CLEAR 3m LANE **99 99**
47 TOTAL HORIZ CLEAR **RT 50 0 LT**
53 VERT CLEAR OVER BR RDWY **RT 99 99 LT**
54 VERT UNDERCLEAR **RT N 0 0**
55 LAT UNDERCLEAR **RT N 0 0**
56 LAT UNDERCLEAR **LT 0**

APPRAISAL

RATING (9-0)

67 STRUC EVAL **LOW CAPACITY** **4**
68 DECK GEO **3**
69 UNDERCLEAR, VERT & HORI **N**
71 WATER ADQ **7**
72 APP RDWY ALIG **CRACKING APPROACH PAVING** **6**
36 TRAFFIC SAFETY FEATURES **0 NN N** 113 SCOUR CRIT BR **8**

NAVIGATION DATA

38 NAVIGATION CONTROL **0**
111 PIER PROTECTION
39 NAV VERT CLEARANCE **0**
116 VERT-LIFT BR NAV MIN VERT CLEAR **00.0**
40 NAVIGATION HORIZ CLEAR **0 0**

PROPOSED IMPROVEMENTS

75 TYPE OF WORK **311** 76 LENGTH OF STRUCT. IMPR **326**
94 BRIDGE IMP. COST (1000's) **9000** 95 RDWY. IMPROVE COST (1000's) **900**
96 TOTAL PROJ. COST (1000's) **9999** 97 YEAR IMPROVE ESTIMATE MADE **2025**

CLASSIFICATION

101 PARALLEL HIGHWAY **N** 103 TEMPORARY STRUCTURE
102 DIRECTION OF TRAFFIC **2** * 26 FUNC. CL **16**
20 TOLL **3** 21 MAINTAIN **04** 22 OWNER **04**

KEEP "10 TONS".

MONITOR CONCRETE DETERIORATION.

SCHEDULE FOR REPLACEMENT.

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 1

Photo Taken: 07/08/2024

SIDE VIEW LOOKING EAST



Photo Number: 2

Photo Taken: 07/08/2024

LOOKING NORTHEAST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 3

Photo Taken: 07/08/2024

LOOKING SOUTHEAST



Photo Number: 4

Photo Taken: 07/08/2024

LOOKING SOUTHEAST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 5

Photo Taken: 07/08/2024

LOOKING WEST



Photo Number: 6

Photo Taken: 07/08/2024

LOOKING NORTHWEST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 7

Photo Taken: 07/08/2024

LOOKING WEST



Photo Number: 8

Photo Taken: 07/08/2024

LOOKING SOUTHWEST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 9

Photo Taken: 07/08/2024

LOOKING SOUTHEAST AT WEST FACE OF SOUTH ABUTMENT



Photo Number: 10

Photo Taken: 07/08/2024

SPALL AT SOUTH ABUTMENT, WEST FACE

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 11

Photo Taken: 07/08/2024

SPALL AT SOUTH ABUTMENT, WEST FACE



Photo Number: 12

Photo Taken: 07/08/2024

SPALL AT WEST FASCIA, NEAR MIDSPAN OF SOUTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 13

Photo Taken: 07/08/2024

LOOKING NORTH ALONG WEST FASCIA, SOUTH SPAN



Photo Number: 14

Photo Taken: 07/08/2024

WEST FACE OF SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 15

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, SOUTH PIER



Photo Number: 16

Photo Taken: 07/08/2024

WEST END OF SOUTH PIER NOSE

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 17

Photo Taken: 07/08/2024

WEST END OF SOUTH PIER NOSE



Photo Number: 18

Photo Taken: 07/08/2024

LOOKING SOUTH AT SOUTH PIER, WEST FACE

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 19

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, SOUTH PIER



Photo Number: 20

Photo Taken: 07/08/2024

LOOKING SOUTH, NORTH OF SOUTH PIER, ARCH TO FASCIA

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 21

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, NORTH OF SOUTH PIER



Photo Number: 22

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, NORTH OF SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 23

Photo Taken: 07/08/2024

LOOKING SOUTH AT SOUTH PIER, WEST SIDE



Photo Number: 24

Photo Taken: 07/08/2024

LOOKING NORTH AT NORTH PIER, WEST SIDE

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 25

Photo Taken: 07/08/2024

SPALLED FASCIA, SOUTH OF NORTH PIER



Photo Number: 26

Photo Taken: 07/08/2024

SPALLED ARCH, LOOKING SOUTH FROM NORTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 27

Photo Taken: 07/08/2024

SPALLED NORTH PIER, WEST END



Photo Number: 28

Photo Taken: 07/08/2024

LOOKING SOUTH AT WEST FACE, NORTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 29

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, NORTH OF NORTH PIER



Photo Number: 30

Photo Taken: 07/08/2024

LOOKING NORTH AT WEST SIDE

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 31

Photo Taken: 07/08/2024

LOOKING SOUTH AT WEST FACE, NORTH SPAN



Photo Number: 32

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, SOUTH OF NORTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 33

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, NORTH ABUTMENT



Photo Number: 34

Photo Taken: 07/08/2024

SPALLED WEST FASCIA, NORTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 35

Photo Taken: 07/08/2024

WEST FACE OF NORTH ABUTMENT



Photo Number: 36

Photo Taken: 07/08/2024

WEST FACE OF NORTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 37

Photo Taken: 07/08/2024

LOOKING EAST AT NORTHWEST WING



Photo Number: 38

Photo Taken: 07/08/2024

LOOKING EAST AT NORTHWEST WING

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 39

Photo Taken: 07/08/2024

SOUTHEAST WING



Photo Number: 40

Photo Taken: 07/08/2024

LOOKING SOUTH, EAST FACE OF SOUTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 41

Photo Taken: 07/08/2024

SPALLED EAST FACE, SOUTH ABUTMENT



Photo Number: 42

Photo Taken: 07/08/2024

SPALLED EAST FASCIA, NORTH OF SOUTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 43

Photo Taken: 07/08/2024

LOOKING NORTH AT SPALLED TOP OF EAST FASCIA



Photo Number: 44

Photo Taken: 07/08/2024

LOOKING NORTHWEST, EAST END OF SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 45

Photo Taken: 07/08/2024

LOOKING NORTH, EAST FASCIA, SOUTH OF SOUTH PIER



Photo Number: 46

Photo Taken: 07/08/2024

LOOKING NORTH, EAST FASCIA, SOUTH OF SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 47

Photo Taken: 07/08/2024

SPALLED EAST FASCIA, SOUTH OF SOUTH PIER



Photo Number: 48

Photo Taken: 07/08/2024

EAST FASCIA, LOOKING SOUTH AT SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 49

Photo Taken: 07/08/2024

LOOKING SOUTH AT EAST END OF SOUTH PIER



Photo Number: 50

Photo Taken: 07/08/2024

SPALLED EAST FASCIA, SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 51

Photo Taken: 07/08/2024

LOOKING NORTH, EAST FACE, CENTER SPAN AND NORTH PIER



Photo Number: 52

Photo Taken: 07/08/2024

EAST FASCIA, SOUTH OF NORTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 53

Photo Taken: 07/08/2024

SPALLED EAST FASCIA, SOUTH OF NORTH PIER

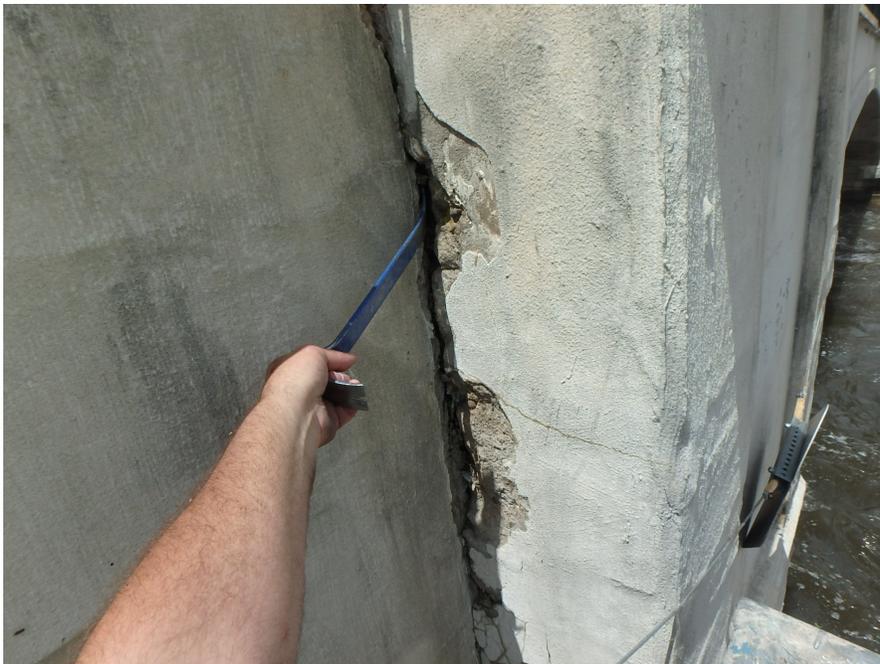


Photo Number: 54

Photo Taken: 07/08/2024

SPALLED EAST FASCIA, NORTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 55

Photo Taken: 07/08/2024

LOOKING NORTH, EAST END OF NORTH PIER



Photo Number: 56

Photo Taken: 07/08/2024

LOOKING SOUTH, EAST FACE, NORTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 57

Photo Taken: 07/08/2024

SPALLED EAST FASCIA, NORTH PIER



Photo Number: 58

Photo Taken: 07/08/2024

LOOKING SOUTH, SPALLED EAST FASCIA, SOUTH OF NORTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 59

Photo Taken: 07/08/2024

LOOKING SOUTH, SPALLED EAST FASCIA, SOUTH OF NORTH ABUTMENT



Photo Number: 60

Photo Taken: 07/08/2024

LOOKING NORTH, SPALLED EAST FASCIA, SOUTH OF NORTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 61

Photo Taken: 07/08/2024

NORTHEAST WING



Photo Number: 62

Photo Taken: 07/08/2024

LOOKING SOUTH AT SOUTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 63

Photo Taken: 07/08/2024

LOOKING SOUTHEAST AT SOUTH SPAN



Photo Number: 64

Photo Taken: 07/08/2024

SPALL WITH EXPOSED REBAR, SOUTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 65

Photo Taken: 07/08/2024

WOOD FROM ORIGINAL FORM WORK



Photo Number: 66

Photo Taken: 07/08/2024

HOLE THROUGH CONCRETE OF FORM WORK, SOUTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 67

Photo Taken: 07/08/2024

HOLE THROUGH CONCRETE AT FORM WORK, SOUTH SPAN



Photo Number: 68

Photo Taken: 07/08/2024

HOLE THROUGH CONCRETE AT FORM WORK, SOUTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 69

Photo Taken: 07/08/2024

HOLE THROUGH CONCRETE AT FORM WORK, SOUTH SPAN



Photo Number: 70

Photo Taken: 07/08/2024

WATER THROUGH PATCH, SOUTH SPAN NEAR PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 71

Photo Taken: 07/08/2024

LOOKING SOUTH AT CENTER SPAN



Photo Number: 72

Photo Taken: 07/08/2024

LOOKING SOUTH AT CENTER SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 73

Photo Taken: 07/08/2024

LOOKING NORTH AT CENTER SPAN



Photo Number: 74

Photo Taken: 07/08/2024

WEEP HOLE NEAR CENTERLINE OF BRIDGE, SOUTH PIER, NORTH FACE, TYPICAL

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 75

Photo Taken: 07/08/2024

HOLE THROUGH CONCRETE AT FORM WORK, CENTER SPAN,
APPROXIMATELY 10 FEET FROM WEST SIDE, SOUTH 1/4 POINT



Photo Number: 76

Photo Taken: 07/08/2024

SPALLED CENTER SPAN, NEAR NORTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 77

Photo Taken: 07/08/2024

VOID IN PATCH, CENTER SPAN, APPROXIMATELY NORTH 1/4 POINT



Photo Number: 78

Photo Taken: 07/08/2024

LOOKING SOUTH AT NORTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 79

Photo Taken: 07/08/2024

LOOKING SOUTH, WEST END OF NORTH PIER



Photo Number: 80

Photo Taken: 07/08/2024

LOOKING NORTH AT NORTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 81

Photo Taken: 07/08/2024

TYPICAL FORM BOARD HOLES



Photo Number: 82

Photo Taken: 07/08/2024

LOOKING NORTH AT NORTH SPAN

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 83

Photo Taken: 07/08/2024

LOOKING SOUTH AT NORTH PIER



Photo Number: 84

Photo Taken: 07/08/2024

FORM HOLE, NORTH SPAN, EAST PORTION OF ARCH

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 85

Photo Taken: 07/08/2024

FORM WORK HOLE, NORTH SPAN, EAST PORTION OF ARCH



Photo Number: 86

Photo Taken: 07/08/2024

FORM WORK HOLE, NORTH SPAN, SOUTH 1/4 POINT, APPROXIMATELY 5 FEET FROM EAST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 87

Photo Taken: 07/08/2024

LOOKING SOUTHEAST AT NORTH SPAN



Photo Number: 88

Photo Taken: 07/08/2024

LOOKING NORTH ALONG WEST RAIL

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 89

Photo Taken: 07/08/2024

LOOKING NORTH AT EAST HANDRAIL



Photo Number: 90

Photo Taken: 07/08/2024

WEST LIGHT POLE OVER NORTH PIER, TIPPED TO EAST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 91

Photo Taken: 07/08/2024

LOOKING NORTH OVER SOUTH PIER



Photo Number: 92

Photo Taken: 07/08/2024

LOOKING NORTH OVER NORTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 93

Photo Taken: 07/08/2024

LOOKING NORTH OVER NORTH ABUTMENT



Photo Number: 94

Photo Taken: 07/08/2024

LOOKING SOUTH OVER SOUTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 95

Photo Taken: 07/08/2024

LOOKING SOUTH OVER SOUTH PIER



Photo Number: 96

Photo Taken: 07/08/2024

CRACKED SIDEWALK OVER SOUTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 97

Photo Taken: 07/08/2024

LOOKING SOUTH OVER NORTH ABUTMENT



Photo Number: 98

Photo Taken: 07/08/2024

CRACKED SIDEWALK OVER NORTH PIER

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 99

Photo Taken: 07/08/2024

LOOKING SOUTH OVER NORTH ABUTMENT

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 1

Photo Taken: 12/23/2024

ROAD VIEW LOOKING NORTH



Photo Number: 2

Photo Taken: 12/23/2024

SIDE VIEW LOOKING WEST

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 3

Photo Taken: 12/23/2024

UNDER VIEW LOOKING NORTH, SOUTH PIER



Photo Number: 4

Photo Taken: 12/23/2024

UNDER VIEW LOOKING SOUTH, NORTH PIER

Pictures

NBI Number: 1820

Bridge ID: 001820

Facility Carried: MAIN ST

Feature(s) Intersected: CEDAR RIVER



Photo Number: 5

Photo Taken: 12/23/2024

DETERIORATED SOUTHEAST WING



Photo Number: 6

Photo Taken: 12/23/2024

SOUTH ABUTMENT SPRINGLINE DETERIORATION

Pictures

NBI Number: 1820

Bridge ID: 001820

Facility Carried: MAIN ST

Feature(s) Intersected: CEDAR RIVER



Photo Number: 7

Photo Taken: 12/23/2024

DETERIORATED SOUTHWEST WING



Photo Number: 8

Photo Taken: 12/23/2024

DETERIORATED WEST FACIA

Pictures

NBI Number: 1820
Facility Carried: MAIN ST

Bridge ID: 001820
Feature(s) Intersected: CEDAR RIVER



Photo Number: 9

Photo Taken: 12/23/2024

MISSING COVER ON LIGHT STANDARD, 2ND FROM SOUTH AT EAST



Photo Number: 10

Photo Taken: 12/23/2024

DETERIORATED NORTHEAST WING

Pictures

NBI Number: 1820

Bridge ID: 001820

Facility Carried: MAIN ST

Feature(s) Intersected: CEDAR RIVER



Photo Number: 11

Photo Taken: 12/23/2024

NORTH ABUTMENT SPRINGLINE DETERIORATION



| | | |
|---|---|----------------------------------|
| Bridge No. <u>001820</u> | Bridge Type <u>CONCRETE EARTH FILLED ARCH</u> | Date <u>12/23/2024</u> |
| FHWA No. <u>001820</u> | Crossing <u>CEDAR RIVER</u> | Inspector <u>Denman, Jordan</u> |
| Sect. <u>12</u> T- <u>95</u> N, R <u>16</u> | | City <u>Charles City</u> |
| Structure Length <u>248</u> | Deck Width O-O <u>72</u> | Est. Remaining Life <u>7</u> Yrs |
| BR Roadway Width C-C <u>50</u> | Fracture Critical <u>N</u> | ADT <u>4971</u> |
| | Item 113 Code <u>8</u> | Year Built <u>1909</u> |
| | | Yr. Reconst. <u>0</u> |

LOAD POSTING Remarks: _____

Actual Tons 10 TONS

Recomm. Tons 20 30 30 POSTED PER 7-24-24 RESOLU

SIGNING Legibility Visibility: Remarks: _____

Adv. Posting Good Good

Posted Loads Good Good

Narrow _____

One Lane _____

Object Markers _____

72. APPR. ALIGNMENT COND. RATING REMARKS

| | | |
|-------------------------|----------|-------|
| 1. Approach Slab | _____ | _____ |
| 2. Relief Joints | _____ | _____ |
| 3. Approach - Guardrail | <u>N</u> | _____ |
| 4. Embankment | <u>7</u> | _____ |

INSPECTOR'S CONDITION RATING **F**

| <u>DECK ITEMS</u> | <u>RATING</u> | <u>REMARKS</u> |
|---|-----------------|---|
| 1. Wearing Surface | _____ | _____ |
| 2. Curbs | _____ | _____ |
| 3. Median | <u>0</u> | _____ |
| 4a. Sidewalks, Left (B.G.07) | _____ | FOAM-JACKED IN 2020. SPALLS. CRACKS |
| 4b. Sidewalks, Right (B.G.08) | _____ | FOAM-JACKED IN 2020. SPALLS. CRACKS |
| 5. Railing (B.C.05) | <u>N</u> | _____ |
| 6. Transition Rating (B.C.06) | <u>N</u> | _____ |
| 7. Rail Protection Sys. | _____ | _____ |
| 8. Drains | _____ | _____ |
| 9. Utility Connections | <u>5</u> | <u>ALONG W. EDGE, MISSING COVER PLATE 2ND F.S. AT E.</u> |
| 10. Joint Leakage | _____ | _____ |
| 11. Exp. Joints/Devices (B.C.09) | <u>N</u> | _____ |
| 12. Deck- Structural Condition | _____ | _____ |
| B.C.01 Deck Condition Rating | <u>N</u> | SPALLED SIDEWALKS w/ EXPOSED REINF., BROKEN UTILITY MOUNTS |

| <u>SUPERSTRUCTURE ITEMS</u> | <u>RATING</u> | <u>REMARKS</u> |
|---|-----------------|---|
| 1. Bearing Devices (B.C.07) | <u>N</u> | _____ |
| 2. Stringers | _____ | _____ |
| Lateral Support () | _____ | _____ |
| 3. Girders/Beams | <u>4</u> | <u>SPALLED AREAS w/ SOME PATCHED, 1" P.V.C., DRAINS ON 15' CENTERS AT SUBSTRUCTURES, CRACKING, SPALLS w/ EXP. REBAR, LONGIT. CRACKS</u> |
| Lateral Support (<u>FULL</u>) | _____ | _____ |
| 4. Floor Beams | _____ | <u>DECAYED FORM BOARDS ALLOWING LOSS OF FILL</u> |
| Lateral Support () | _____ | _____ |
| 5. Trusses - General | _____ | _____ |
| Portals | _____ | _____ |
| Bracing | _____ | _____ |
| 6. Paint | _____ | _____ |
| 7. Rivets or Bolts | _____ | _____ |
| 8. Welds - Cracks | _____ | _____ |
| 9. Rust | _____ | _____ |
| 10. Timber Decay | _____ | _____ |
| 11. Concrete Cracking | <u>4</u> | <u>IN ARCHES. FASCIA WALLS SPALLING AND STARTING TO LOSE FILL</u> |
| 12. Collision Damage | _____ | _____ |
| 13. Deflection Under Load | <u>8</u> | _____ |
| 14. Alignment of Members | _____ | _____ |
| 15. Vibration Under Load | <u>8</u> | _____ |
| B.C.02 Superstructure Condition Rating | <u>4</u> | SPALLED/PATCHED AREAS, EXPOSED REINFORCING, CRACKS, EFFLORESCEN |

CONDITION RATING

(Use for SIA items 58, 59, 60, 61, 62, 62)

Date: 12/23/2024County: Charles CityBridge No.: 001820

- N Not Applicable
- 9 Excellent Condition
- 8 Very Good Condition - No problems noted.
- 7 Good Condition - Some minor problems.
- 6 Satisfactory Condition - Structural Elements show minor deterioration
- 5 Fair Condition - Primary structural elements have minor section loss, spalling, cracking or scour.
- 4 Poor Condition - Advanced section loss, deterioration, spalling or scour. Posting for some truck traffic is warranted.
- 3 Serious Condition - Primary structural elements affected by section loss, deterioration, cracking or scour. Posting for most truck traffic is warranted immediately.
- 2 Critical Condition - Advanced deterioration of concrete or steel and/or critical scour. Structure should be closed to all traffic.
- 1 "Imminent" Failure Condition - Major deterioration of structural elements. Structure is closed but corrective action may allow light service.
- 0 Failed Condition - Out of service and beyond repair.

SUBSTRUCTURE ITEMS**RATING****REMARKS**

| | | |
|----------------------------------|---|---|
| 1. Abutments - Caps | | |
| Wings | 3 | SPALLS SW.. SE. -- JACKET POURED AT NW.. CRACKS WITH EFFLORESCENCE |
| Backwall | 4 | SOME CRACKING. PATCHED SPALLS. SPALLS AT S.. SCALING NEAR WATERLINE |
| Footing | 4 | UNDERMINED NW. |
| Piles | | |
| Erosion | 5 | N. ABUTMENT. AT S. ABUTMENT ALONG FLUME STRUCTURE |
| Settlement | | |
| 2. Piers or Bents - Caps | | |
| Columns | | |
| Footings | 4 | SPALLS & GENERAL DETER'N. CRACKING. N. UNDERMINED AT W. END |
| Piles | | |
| Scour | | |
| Settlement | | |
| 3. Concrete Cracking | 4 | |
| 4. Steel Corrosion | | |
| 5. Timber Decay | | |
| 6. Debris on Seats | | |
| 7. Protection System | | |
| 8. Collision Damage | 4 | SPALLING AT EDGES |
| 9. U.W. Insp. Condition (B.C.15) | 6 | [2024] UNDERWATER INSPECTION: SCALING UP TO 1/2 INCH DEEP TYPICAL AT BOTH PIERS |

B.C.03 Substructure Condition Rating**4**

PATCHES, SPALLING, UNDERMINING, SCALING

CHANNEL AND CHANNEL PROTECTION ITEMS**RATING****REMARKS**

| | | |
|---------------------------------|---|---|
| 1.Channel Scour (B.C.11) | 7 | DAM 100' UPSTREAM. [2024] UNDERWATER INSPECTION: NO SCOUR OBSERVED WITHIN T |
| 2.Channel Protection (B.C.10) | 7 | NE. CORNER. [2024] UNDERWATER INSPECTION: SHORELINES AND EMBANKMENTS WERE |
| A. Fender System | 4 | UPSTREAM LIMESTONE RETAINING WALLS, DETERIORATION & UNDERMINING S. |
| B. Spur Dikes and Jetties | | |
| C. Vegetation | 8 | |
| D. Riprap | 5 | MASONRY RETAINING WALLS & RIPRAP LINE CHANNEL, NW. WING |
| 3.Channel Cond. Rating (B.C.09) | 7 | EROSION. [2024] UNDERWATER INSPECTION: CHANNEL BOTTOM WAS SOUND BEDROCK A |
| A. Embankment Erosion | 5 | NE. CORNER |
| B. Drift | 8 | |
| C. Channel Change | | |
| D. Adequacy of Opening | 7 | |

CULVERT ITEMS**RATING****REMARKS**

| | | |
|----------------------|--|--|
| 1. Barrel - Concrete | | |
| Steel | | |
| Timber | | |
| 2. Headwall | | |
| 3. Cut-off Wall | | |
| 4. Adequacy | | |
| 5. Debris | | |

B.C.04 Culvert Condition Rating**N**

APPENDIX B

PHOTOS OF FLUME
ALONG SOUTH BANK

**CHARLES CITY
MAIN STREET
FLUME ALONG SOUTH BANK
OCTOBER 5, 2022**



UNDERMINED OUTLET OF SOUTH BANK FLUME



**LOOKING SOUTHWEST, HIGHLY DETERIORATED FLUME WITH SUPPORTING
BEDROCK PARTIALLY MISSING**

CHARLES CITY
MAIN STREET
FLUME ALONG SOUTH BANK
OCTOBER 5, 2022



LOOKING SOUTHWEST, HIGHLY DETERMINED FLUME WITH SUPPORTING
BEDROCK PARTIALLY MISSING WITH WATER FLOWING FROM UNDER FLUME



LOOKING UNDER FLUME

**CHARLES CITY
MAIN STREET
FLUME ALONG SOUTH BANK
OCTOBER 5, 2022**



LOOKING EAST AT GATE CONTROLS

APPENDIX C

PHOTOS OF FLOUR MILL
FOUNDATION AND SLAB
LOCATED ON NORTH BANK

**CHARLES CITY
MAIN STREET
FLOUR MILL FOUNDATION
AND SLAB LOCATED AT NORTH BANK
OCTOBER 5, 2022**



LOOKING SOUTHEAST



LOOKING SOUTH

CHARLES CITY
MAIN STREET
FLOUR MILL FOUNDATION
AND SLAB LOCATED AT NORTH BANK
OCTOBER 5, 2022



LOOKING SOUTHWEST



LOOKING WEST

CHARLES CITY
MAIN STREET
FLOUR MILL FOUNDATION
AND SLAB LOCATED AT NORTH BANK
OCTOBER 5, 2022



LOOKING NORTHWEST



LOOKING NORTH

CHARLES CITY
MAIN STREET
FLOUR MILL FOUNDATION
AND SLAB LOCATED AT NORTH BANK
OCTOBER 5, 2022



LOOKING NORTHEAST



LOOKING EAST

**CHARLES CITY
MAIN STREET
FLOUR MILL FOUNDATION
AND SLAB LOCATED AT NORTH BANK
OCTOBER 5, 2022**



HEAVING LEACHING AND SPALLING SLAB WITH CORRODED REINFORCING



HEAVY LEACHING AND SPALLING SLAB WITH CORRODED REINFORCING

APPENDIX D

UNDERWATER INSPECTION REPORT



STRUCTURE CONDITION REPORT
BRIDGE (001820), DAM, FLUME AND
FLOUR MILL FOUNDATION
MAIN STREET over CEDAR RIVER

November 21, 2024

Prepared for:



City of Charles City
105 Milwaukee Mall
Charles City, IA 50616



Calhoun Burns and Associates
6775 Vista Drive
West Des Moines, IA 50266

Prepared by:

COLLINS
ENGINEERS INC

1599 Selby Avenue, Suite 206
St. Paul, MN 55104
612.646.8502 • www.collinsengr.com



Table of Contents

| | |
|--|-----|
| Executive Summary..... | 3 |
| Inspection Procedures | 3 |
| Bridge 001820 Condition Assessment..... | 4 |
| Field Observations Summary..... | 4 |
| Recommendations | 5 |
| Main Street Dam Condition Assessment | 5 |
| Field Observations Summary..... | 6 |
| Recommendations | 6 |
| Main Street Dam Flume Condition Assessment..... | 6 |
| Field Observations Summary..... | 6 |
| Recommendations | 8 |
| Flour Mill Foundation Condition Assessment | 8 |
| Field Observations Summary..... | 8 |
| Recommendations | 9 |
| Appendix A – Inspection Photographs | A-i |
| Appendix B – Inspection Drawings | B-i |



Executive Summary

Collins Engineers, Inc. (Collins) was sub-contracted by Calhoun Burns and Associates to complete the underwater inspection of Bridge 001820, Main Street Dam, Flume, and Flour Mill Foundation located on the Cedar River. The work was performed for the City of Charles City. The inspections were conducted on November 21, 2024.

South Pier, North Pier and North Abutment of Bridge 001820 and the Main Street Dam were inspected underwater by Collins. The Main Street Dam Flume and Flour Mill Foundation were inspected above and below water by Collins.

See Appendix A – Inspection Photographs for overall views of the site and supplementary detail for observed deficiencies.

See Appendix B – Inspection Drawings for details of the inspection of all structures and channel profiles at each fascia of Bridge 001820.

Inspection Procedures

The underwater inspection team consisting of four NBIS qualified engineer-divers conducted the underwater inspection. The team was led by an engineer inspection team leader qualified to the National Bridge Inspection Standards. The inspection was conducted using commercial SCUBA equipment and operations. During the inspection, the divers worked from shore and a note taker recorded the inspection notes topside.

The underwater inspection consisted of a 100 percent level I and 10 percent level II inspection. The accessible surfaces of the substructure units from the high waterline to the channel bottom received a visual and tactile examination with particular attention given to any observed areas of deterioration or apparent distress. Various areas on the underwater surfaces of the substructure units were cleaned so that the substrate condition could be more closely examined. Photographs were taken to document the general conditions and observed deficiencies. The type of channel bottom material, the presence or extent of scour, the presence or extent of riprap, the presence or extent of drift and debris, and the location of any foundation exposure or undermining were noted. The channel bottom was sounded utilizing a survey grade rod. Soundings were taken parallel to the bridge along the upstream and downstream fascia's and around the substructure units.

Inspection Data:

Team Leader: Kyle Nicks

Dive Supervisor: Kyle Nicks

Inspector/Diver: Tanner Wild

Inspector/Diver: Nick Donnell

Notetaker: Edgar Nunez



Bridge Access Method: Shore

Access Location: South embankment from Grace Larson Park.

| Site Conditions | | | |
|-----------------------|-------|-------------------------|-----|
| Air Temperature (°F): | 35 | Water Temperature (°F): | 54 |
| Skies: | Clear | Visibility (ft): | 5 |
| Max Depth (ft) | 5.3 | Velocity (Max.) (fps): | 1.5 |

| Underwater Inspection Equipment | | | |
|---------------------------------|-------------------------------|---|-------------------------------------|
| | Surface Supplied Air (A09) | X | Lead line |
| X | SCUBA (A08) | X | Folding ruler |
| | Waders (A05) | | Boat (A06) |
| | Tending Line | | Depth finder/fathometer (I14) |
| X | Lights | | Underwater imaging (I13) |
| X | Hammer | | GPS |
| X | Probe | X | Underwater still camera |
| X | 25-foot rod | X | Underwater video camera |
| X | Unmanned aerial systems (A13) | | UW Ultrasonic Thickness Gauge (I01) |

Bridge 001820 Condition Assessment

The inspected substructure units of Bridge 001820 consisted of reinforced concrete piers supported by reinforced concrete footings founded on bedrock based on field observations. The substructure units are designated as South Abutment, South Pier, North Pier and North Abutment from south to north.

Field Observations Summary

The channel bottom typically consisted of sound bedrock with no probe rod penetration.

Concrete of both piers and the North Abutment typically exhibited scaling up to 1/2-inch deep extending from the channel bottom to 2 feet above the waterline.

Vertical cracking with efflorescence measuring up to 1/8-inch wide at approximately 5 foot spacing on the both faces of the South Pier, and along the North Abutment breastwall.

Isolated area of heavy scaling around the upstream nose of the South Pier, with up to 3 inches of



penetration extending from the top of footing up 4 inches. The exposed aggregate was secure.

Footing exposure was observed around the South Pier for the entire perimeter, extending down to bedrock with no observed undermining. Footing concrete typically exhibited scaling up to 1/8-inch deep and hairline vertical cracking.

Three vertical cracks measuring up to 1/8-inch wide were observed on the north face of the North Pier located near the downstream quarter point, upstream quarter point, and upstream nose interface, extending from the channel bottom up to the spring line.

NBIS Underwater Inspection Ratings for each Bridge 001820 Substructure Unit inspected underwater:

| Substructure Unit | Recommended B.C.15 (Underwater Inspection) Rating |
|-------------------|---|
| South Pier | 6 |
| North Pier | 6 |
| North Abutment | 6 |

NBIS ratings based on Bridge 001820 underwater inspection only:

| Item ID (description) | Recommended Rating |
|--------------------------------|--------------------|
| B.C.09 (Channel) | 8 |
| B.C.10 (Channel Protection) | 8 |
| B.C.11 (Scour) | 8 |
| B.C.15 (Underwater Inspection) | 6 |

Recommendations

- 1) Continue underwater inspection at minimum required National Bridge Inspection Standards (NBIS) underwater inspection interval of 60-months.

Main Street Dam Condition Assessment

The Main Street Dam was inspected underwater. The dam configuration comprised of a spillway, apron and end sill. Due to waterway conditions at the time of inspection, the upstream face of the spillway was inaccessible.



Field Observations Summary

The channel bottom upstream of the dam consisted of firm sand with up to 8 inches of probe rod penetration.

The channel bottom downstream of the dam consisted of natural bedrock and rip rap up to 2 feet in diameter with no probe rod penetration.

All concrete surfaces below the waterline typically exhibited light scaling up to 1/16-inch deep.

Isolated spall measuring 7 feet long by 10 inches wide up to 8 inches deep was observed along the downstream vertical face of the dam along the joint near the north quarter point.

The material of the end sill was typically smooth and sound.

Area of heavy scaling, 14 feet long by 7 feet high by 3 inches deep exposing multiple rebar exhibiting up to 15 percent section loss, located along the north retaining wall adjacent to the dam.

Recommendations

- 1) Based on the guidance from the Association of State Dam Safety Officials (ASDSO), it is recommended that the dam be visually inspected annually by the owner. Additionally, a comprehensive detailed underwater inspection should be conducted every five years or following any major flow events.

Main Street Dam Flume Condition Assessment

The Main Street Dam Flume was inspected above and below water. The structure consisted of a rectangular reinforced concrete box with a hydraulic opening varying in size.

Field Observations Summary

Concrete surfaces typically exhibited scaling up to 1/2-inch deep with isolated areas up to 3 inches deep throughout the length of the flume excluding the concrete surrounding the outlet. Transverse cracks with efflorescence extending from the base of both walls through the ceiling up to 0.050 inches wide with associated edge spalling typically spaced every 5 to 10 feet along the full length of the flume. Floor to wall interfaces exhibited spalling and cracking typically 1 to 3 inches deep with isolated areas of full depth section loss exposing multiple rebar exhibiting up to 100 percent section loss.

Heavy scaling on the south and north walls, up to 4 inches deep exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 40 feet from the inlet.

Spall in the floor, measuring 4 feet in diameter with full depth penetration exposing multiple rebar

STRUCTURE UNDERWATER CONDITION REPORT

Main Street Bridge, Dam, Flume and Flour Mill Foundation
City of Charles City • November 2024



exhibiting up to 100 percent section loss, located approximately 60 feet from the inlet. Heavy flow through the spall was observed.

Spall in the north wall to floor interface, measuring 5 feet long by 2 feet high with full depth penetration exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 85 feet from the inlet.

Spall in the north wall to floor interface, measuring 3 feet long by 2 feet high with full depth penetration exposing six rebar exhibiting up to 100 percent section loss, located near the mid-length of the flume.

Full perimeter fracture, up to 1 inch wide with associated spalling exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 85 feet from the outlet.

Full perimeter fracture, up to 1 inch wide with associated spalling exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 50 feet from the outlet.

Spall in the south wall to floor interface, measuring 25 feet long by 2 feet high with full depth penetration exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 15 feet from the outlet.

Spall in the south wall to floor interface, measuring 5 feet long by 2 feet high with full depth penetration exposing multiple rebar exhibiting up to 10 percent section loss, located approximately 10 feet from the outlet.

Undermining of the flume with up to 4 feet of horizontal penetration extending from the floor through hole approximately 60 feet from the inlet extending the remaining length of the flume to the outlet.

The north masonry wall supporting the flume exhibited areas of severe deterioration and failure resulting in areas of the flume to be cantilevered from the south masonry wall.

Accumulation of timber debris, consisting of branchy material up to 3 inches in diameter and buildup of sediment, was observed around the through hole in the floor approximately 60 feet from the inlet.

Inlet gate horizontal timber planks exhibited moderate to severe decay throughout.

Inlet gate exhibited areas of seepage through section loss in the horizontal timber planks, joints between the horizontal timber planks, and through deteriorated connections of the timber frame.

Inlet gate vertical concrete supports exhibited moderate to severe deterioration including scaling and hairline cracking with efflorescence.



Recommendations

- 1) Removal and replacement are recommended due to severe deterioration throughout the flume. Repairs necessary to the north masonry wall supporting the structure, fractured portions, through hole in floor, full depth spalling of wall to floor interface throughout, and deterioration of inlet gate.
- 2) Due to concerns regarding the structural integrity of the flume, it is advised to restrict access in order to mitigate potential hazards to public safety.
- 3) Based on the guidance from the Association of State Dam Safety Officials (ASDSO), it is recommended that the flume be visually inspected annually by the owner. Additionally, a comprehensive detailed underwater inspection should be conducted every five years or following any major flow events.

Flour Mill Foundation Condition Assessment

The Flour Mill Foundation was inspected above and below water. The flour mill foundation comprised of a reinforced concrete ceiling supported by two arches and three walls.

Field Observations Summary

Longitudinal hairline cracking with efflorescence on South Arch underside for entire length.

Hairline cracking with efflorescence and random areas of moderate section loss on the south exterior headwall.

Spall on the north face of the North Arch near mid-length, measuring 2 feet long by 6 inch high and 4 inches deep, exposing 1 rebar exhibiting minor surface corrosion.

Spall in the South Bay ceiling extending from the east wall near the South Arch, up to 5 feet wide by 20 feet long and 4 inches deep, exposing multiple rebar exhibiting up to 100 percent section loss.

Spall in the South Bay ceiling located in the southeast quadrant up to 5 feet in diameter and 3 inches deep, exposing multiple rebar exhibiting up to 50 percent section loss.

Spall in the South Bay ceiling extending along the North Arch near the west wall, up to 2 feet in diameter by 8 inches deep, exposing 2 rebar exhibiting minor surface corrosion.

Random spalls in the North Bay ceiling up to 6 inches in diameter and 4 inches deep exposing multiple rebar exhibiting minor surface corrosion.

Hairline map cracking was observed throughout the North Bay ceiling.



Section loss around the perimeter of the South Arch west base measuring up to 9 inches deep with unsound substrate from the waterline up 3 feet.

Spall with associated delamination in the South Arch east base on the northwest corner, up to 1 foot wide by 2 feet high and 4 inches deep, located approximately 2 feet above the waterline.

Vertical crack in the west wall near the south quarter-point measuring 1/16-inch wide extending from the bottom of deck to 2 feet above the waterline.

Hairline map cracking with efflorescence throughout the north wall.

The foundation of the North Arch was vertically exposed at both the west and east ends exhibiting a band of section loss up to 1.2 feet deep, extending from the waterline up 2 feet. Rock was observed on top of the foundation at both ends.

Four outtakes in the north wall were filled with masonry exhibiting section loss up to 1 inch deep.

Recommendations

- 1) Remove and repair areas of unsound concrete.
- 2) Continue inspection at next regularly scheduled inspection interval of 60 months.

Respectfully submitted,
COLLINS ENGINEERS, INC.



Kyle Nicks

Inspection Team Leader/Project Manager



Appendix A – Inspection Photographs



Table of Contents

OVERALL SITE PHOTOGRAPHS 1
BRIDGE 001820 INSPECTION PHOTOGRAPHS 9
MAIN STREET DAM INSPECTION PHOTOGRAPHS..... 20
MAIN STREET DAM FLUME INSPECTION PHOTOGRAPHS 23
FLOUR MILL FOUNDATION INSPECTION PHOTOGRAPHS 37

APPENDIX A: INSPECTION PHOTOGRAPHS

Main Street Bridge, Dam, Flume and Flour Mill Foundation
City of Charles City • November 2024



Table of Photos

OVERALL SITE PHOTOGRAPHS

| | |
|---|---|
| PHOTO 1. SITE OVERALL VIEW LOOKING NORTHWEST | 1 |
| PHOTO 2. SITE PLAN VIEW LOOKING TOP NORTH | 1 |
| PHOTO 3. BRIDGE 001820 UPSTREAM PROFILE LOOKING NORTHEAST | 2 |
| PHOTO 4. BRIDGE 001820 DOWNSTREAM PROFILE LOOKING NORTHWEST | 2 |
| PHOTO 5. SOUTH ABUTMENT AND FLUME OVERALL LOOKING SOUTHWEST | 3 |
| PHOTO 6. MAIN STREET DAM OVERALL LOOKING NORTHWEST | 3 |
| PHOTO 7. MAIN STREET DAM OVERALL LOOKING SOUTHWEST | 4 |
| PHOTO 8. FLUME OVERALL LOOKING SOUTHWEST | 4 |
| PHOTO 9. FLOUR MILL FOUNDATION OVERALL LOOKING NORTH | 5 |
| PHOTO 10. UPSTREAM CHANNEL LOOKING WEST | 5 |
| PHOTO 11. DOWNSTREAM CHANNEL LOOKING EAST | 6 |
| PHOTO 12. SOUTHWEST SHORELINE LOOKING SOUTHWEST | 6 |
| PHOTO 13. SOUTHEAST SHORELINE LOOKING SOUTHEAST | 7 |
| PHOTO 14. NORTHWEST SHORELINE LOOKING NORTHWEST | 7 |
| PHOTO 15. NORTHEAST SHORELINE LOOKING NORTHEAST | 8 |

BRIDGE 001820 INSPECTION PHOTOGRAPHS

| | |
|---|----|
| PHOTO 16. BRIDGE 001820 UPSTREAM PROFILE LOOKING NORTHEAST | 9 |
| PHOTO 17. BRIDGE 001820 DOWNSTREAM PROFILE LOOKING NORTHWEST | 9 |
| PHOTO 18. SOUTH PIER SOUTH FACE LOOKING NORTHWEST | 10 |
| PHOTO 19. SOUTH PIER NORTH FACE LOOKING SOUTHWEST | 10 |
| PHOTO 20. NORTH PIER SOUTH FACE LOOKING NORTHWEST | 11 |
| PHOTO 21. NORTH PIER NORTH FACE LOOKING SOUTHWEST | 11 |
| PHOTO 22. NORTH ABUTMENT LOOKING NORTHWEST | 12 |
| PHOTO 23. BRIDGE PLAN VIEW TOP NORTH | 12 |
| PHOTO 24. SOUTH PIER TYPICAL CONCRETE CONDITION LOOKING NORTH | 13 |
| PHOTO 25. SOUTH PIER FOOTING TYPICAL CONCRETE CONDITION BELOW WATER LOOKING NORTH | 13 |
| PHOTO 26. SOUTH PIER VERTICAL CRACK IN FOOTING LOOKING NORTH | 14 |
| PHOTO 27. SOUTH PIER VERTICAL CRACKING ABOVE FOOTING LOOKING NORTH | 14 |
| PHOTO 28. SOUTH PIER WEST NOSE HEAVY SCALING AT WATERLINE LOOKING EAST | 15 |
| PHOTO 29. NORTH PIER NORTH FACE VERTICAL CRACK LOOKING SOUTH | 15 |
| PHOTO 30. NORTH PIER TYPICAL SCALING NEAR WATERLINE LOOKING SOUTHWEST | 16 |
| PHOTO 31. NORTH PIER UPSTREAM END VERTICAL CRACK LOOKING SOUTHEAST | 16 |
| PHOTO 32. NORTH ABUTMENT TYPICAL CONCRETE CONDITION AT WATERLINE LOOKING NORTH | 17 |
| PHOTO 33. NORTH ABUTMENT TYPICAL HAIRLINE CRACKING WITH EFFLORESCENCE LOOKING NORTH | 17 |
| PHOTO 34. NORTH ABUTMENT VERTICAL CRACK LOOKING NORTH | 18 |
| PHOTO 35. NORTH ABUTMENT WITH SCALING AT WATERLINE UP 2 FEET LOOKING NORTHEAST | 18 |
| PHOTO 36. NORTHWEST WINGWALL CONDITION LOOKING EAST | 19 |

APPENDIX A: INSPECTION PHOTOGRAPHS

Main Street Bridge, Dam, Flume and Flour Mill Foundation
City of Charles City • November 2024



MAIN STREET DAM INSPECTION PHOTOGRAPHS

| | |
|--|----|
| PHOTO 37. MAIN STREET DAM OVERALL LOOKING SOUTHWEST | 20 |
| PHOTO 38. DAM VIEW ALONG LENGTH LOOKING NORTH..... | 20 |
| PHOTO 39. SPILLWAY AND APRON OVERALL LOOKING NORTHWEST | 21 |
| PHOTO 40. SPILLWAY TYPICAL CONDITION LOOKING WEST | 21 |
| PHOTO 41. SPILLWAY CREST AT NORTH END LOOKING NORTHWEST | 22 |
| PHOTO 42. AREA OF HEAVY SCALING ON THE NORTH RETAINING WALL ADJACENT TO THE DAM LOOKING NORTH | 22 |

MAIN STREET DAM FLUME INSPECTION PHOTOGRAPHS

| | |
|--|----|
| PHOTO 43. FLUME OVERALL LOOKING SOUTHWEST | 23 |
| PHOTO 44. VIEW THROUGH FLUME LOOKING WEST | 23 |
| PHOTO 45. TYPICAL CONCRETE CONDITION LOOKING NORTH | 24 |
| PHOTO 46. TYPICAL FLOOR TO WALL REPAIR LOOKING NORTHWEST | 24 |
| PHOTO 47. TYPICAL CRACKING WITH EFFLORESCENCE LOOKING SOUTH | 25 |
| PHOTO 48. INLET GATE OVERALL LOOKING WEST | 25 |
| PHOTO 49. TYPICAL TIMBER INLET GATE CONDITION LOOKING WEST | 26 |
| PHOTO 50. TYPICAL SEEPAGE THROUGH INLET GATE LOOKING WEST | 26 |
| PHOTO 51. HEAVY SEEPAGE THROUGH INLET GATE AT NORTH END LOOKING NORTHWEST | 27 |
| PHOTO 52. SCALING OF VERTICAL CONCRETE INLET GATE SUPPORTS LOOKING WEST | 27 |
| PHOTO 53. HEAVY SCALING IN SOUTH WALL NEAR INLET LOOKING SOUTHWEST | 28 |
| PHOTO 54. TIMBER DEBRIS AND FLOOR THROUGH HOLE LOOKING WEST | 28 |
| PHOTO 55. FLOOR THROUGH HOLE LOOKING WEST | 29 |
| PHOTO 56. UNDERMINING NEAR FLOOR THROUGH HOLE LOOKING WEST | 29 |
| PHOTO 57. NORTH WALL DETERIORATION AND FLUME UNDERMINING LOOKING SOUTHWEST | 30 |
| PHOTO 58. NORTH MASONRY WALL DETERIORATION AND FLUME UNDERMINING LOOKING WEST | 30 |
| PHOTO 59. UNDERMINING OF OUTLET LOOKING SOUTHEAST | 31 |
| PHOTO 60. SPALL IN NORTH WALL AT FLOOR INTERFACE 85 FEET FROM INLET LOOKING NORTH..... | 31 |
| PHOTO 61. SEEPAGE THROUGH SPALL 85 FEET FROM INLET LOOKING SOUTH | 32 |
| PHOTO 62. CEILING FRACTURED REBAR LOCATED 85 FEET FROM OUTLET LOOKING SOUTH | 32 |
| PHOTO 63. SPALL IN NORTH WALL AT FRACTURE 50 FEET FROM OUTLET LOOKING NORTH..... | 33 |
| PHOTO 64. FRACTURE 50 FEET FROM OUTLET LOOKING WEST | 33 |
| PHOTO 65. FRACTURE 50 FEET FROM OUTLET LOOKING SOUTH..... | 34 |
| PHOTO 66. FRACTURE 50 FEET FROM OUTLET LOOKING SOUTH..... | 34 |
| PHOTO 67. SPALL IN SOUTH WALL AT FRACTURE 50 FEET FROM OUTLET LOOKING SOUTH | 35 |
| PHOTO 68. SPALL IN SOUTH WALL 15 FEET FROM OUTLET LOOKING SOUTH | 35 |
| PHOTO 69. SPALL IN SOUTH WALL AT FLOOR INTERFACE WITH FRACTURED REBAR 15 FEET FROM OUTLET LOOKING SOUTH | 36 |
| PHOTO 70. OUTLET OVERALL LOOKING SOUTHWEST | 36 |

APPENDIX A: INSPECTION PHOTOGRAPHS

Main Street Bridge, Dam, Flume and Flour Mill Foundation
City of Charles City • November 2024



FLOUR MILL FOUNDATION INSPECTION PHOTOGRAPHS

PHOTO 71. FLOUR MILL OVERALL LOOKING NORTH 37

PHOTO 72. FLOUR MILL PROFILE LOOKING NORTH 37

PHOTO 73. FLOUR MILL CEILING UNDERSIDE SOUTH BAY LOOKING EAST 38

PHOTO 74. FLOUR MILL CEILING UNDERSIDE NORTH BAY LOOKING EAST 38

PHOTO 75. FLOUR MILL NORTH ARCH LOOKING NORTHEAST 39

PHOTO 76. FLOUR MILL WEST WALL LOOKING WEST 39

PHOTO 77. FLOUR MILL NORTH WALL LOOKING NORTH 40

PHOTO 78. FLOUR MILL EAST WALL LOOKING EAST 40

PHOTO 79. FLOUR MILL CEILING SOUTH BAY NEAR EAST WALL SPALL LOOKING WEST 41

PHOTO 80. FLOUR MILL CEILING SOUTH BAY NEAR WEST WALL SPALL LOOKING NORTHWEST ... 41

PHOTO 81. FLOUR MILL CEILING SOUTH BAY SOUTHEAST CORNER SPALL LOOKING SOUTHWEST
..... 42

PHOTO 82. FLOUR MILL CEILING SOUTH BAY SOUTHEAST CORNER SPALL LOOKING SOUTH 42

PHOTO 83. FLOUR MILL NORTH BAY CEILING TYPICAL CONDITION LOOKING NORTHEAST 43

PHOTO 84. FLOUR MILL NORTH BAY CEILING TYPICAL SPALL LOOKING WEST 43

PHOTO 85. FLOUR MILL SOUTH FACE CRACKING AND SECTION LOSS LOOKING NORTH 44

PHOTO 86. FLOUR MILL SOUTH ARCH CRACKING WITH EFFLORESCENCE LOOKING EAST 44

PHOTO 87. FLOUR MILL NORTH ARCH NORTH FACE MIDPOINT SPALL LOOKING SOUTHWEST 45

PHOTO 88. FLOUR MILL SOUTH ARCH WEST END SECTION LOSS AT WATERLINE LOOKING
NORTHWEST 45

PHOTO 89. FLOUR MILL SOUTHWEST CORNER (SOUTH FACE) SECTION LOSS LOOKING
NORTHWEST 46

PHOTO 90. FLOUR MILL SOUTH ARCH EAST END SPALL AND DELAMINATION LOOKING
SOUTHEAST 46

PHOTO 91. FLOUR MILL NORTH ARCH EAST END FOUNDATION LOOKING SOUTHEAST 47

PHOTO 92. FLOUR MILL WEST WALL VERTICAL CRACK LOOKING WEST 47

PHOTO 93. FLOUR MILL NORTH ARCH WEST END FOUNDATION SECTION LOSS LOOKING WEST ... 48

PHOTO 94. FLOUR MILL NORTH ARCH WEST END SECTION LOSS AT WATERLINE UP 2 FEET
LOOKING SOUTHWEST 48

PHOTO 95. FLOUR MILL NORTH WALL TYPICAL CRACKING WITH EFFLORESCENCE LOOKING
NORTH 49

PHOTO 96. FLOUR MILL NORTH WALL TYPICAL MASONRY FILLED OUTTAKE LOOKING NORTH ... 49



OVERALL SITE PHOTOGRAPHS



PHOTO 1. SITE OVERALL VIEW LOOKING NORTHWEST

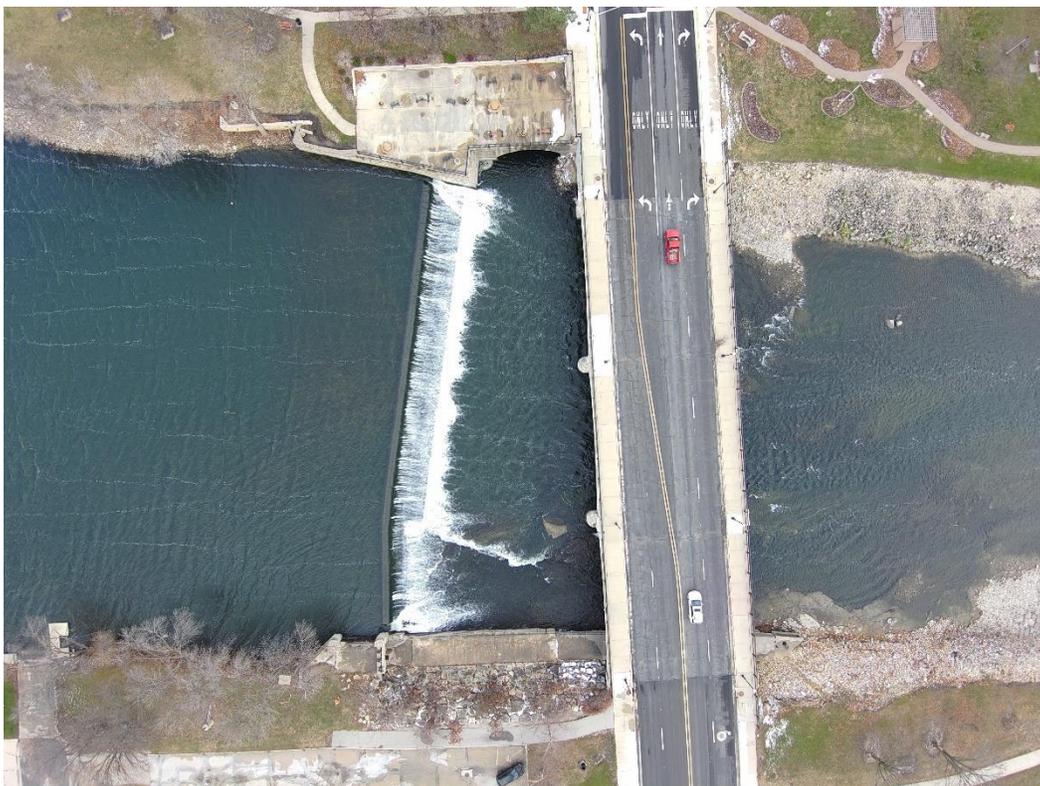


PHOTO 2. SITE PLAN VIEW LOOKING TOP NORTH



PHOTO 3. BRIDGE 001820 UPSTREAM PROFILE LOOKING NORTHEAST



PHOTO 4. BRIDGE 001820 DOWNSTREAM PROFILE LOOKING NORTHWEST



PHOTO 5. SOUTH ABUTMENT AND FLUME OVERALL LOOKING SOUTHWEST



PHOTO 6. MAIN STREET DAM OVERALL LOOKING NORTHWEST



PHOTO 7. MAIN STREET DAM OVERALL LOOKING SOUTHWEST



PHOTO 8. FLUME OVERALL LOOKING SOUTHWEST



PHOTO 9. FLOUR MILL FOUNDATION OVERALL LOOKING NORTH



PHOTO 10. UPSTREAM CHANNEL LOOKING WEST



PHOTO 11. DOWNSTREAM CHANNEL LOOKING EAST

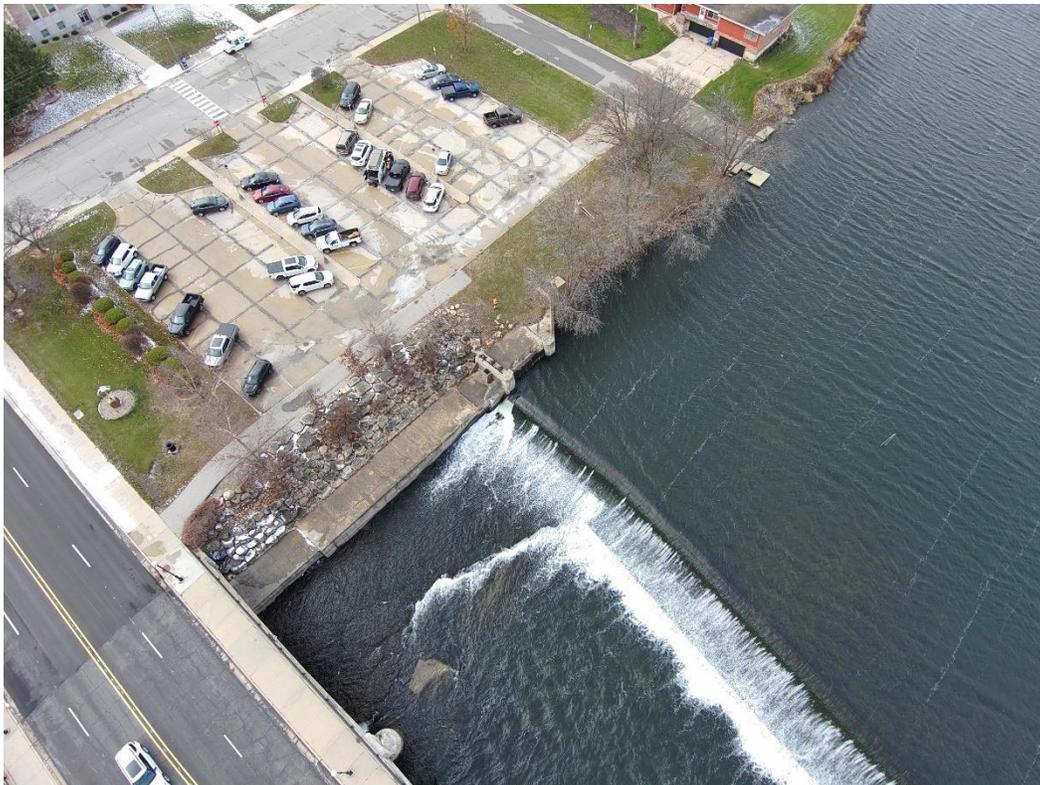


PHOTO 12. SOUTHWEST SHORELINE LOOKING SOUTHWEST



PHOTO 13. SOUTHEAST SHORELINE LOOKING SOUTHEAST

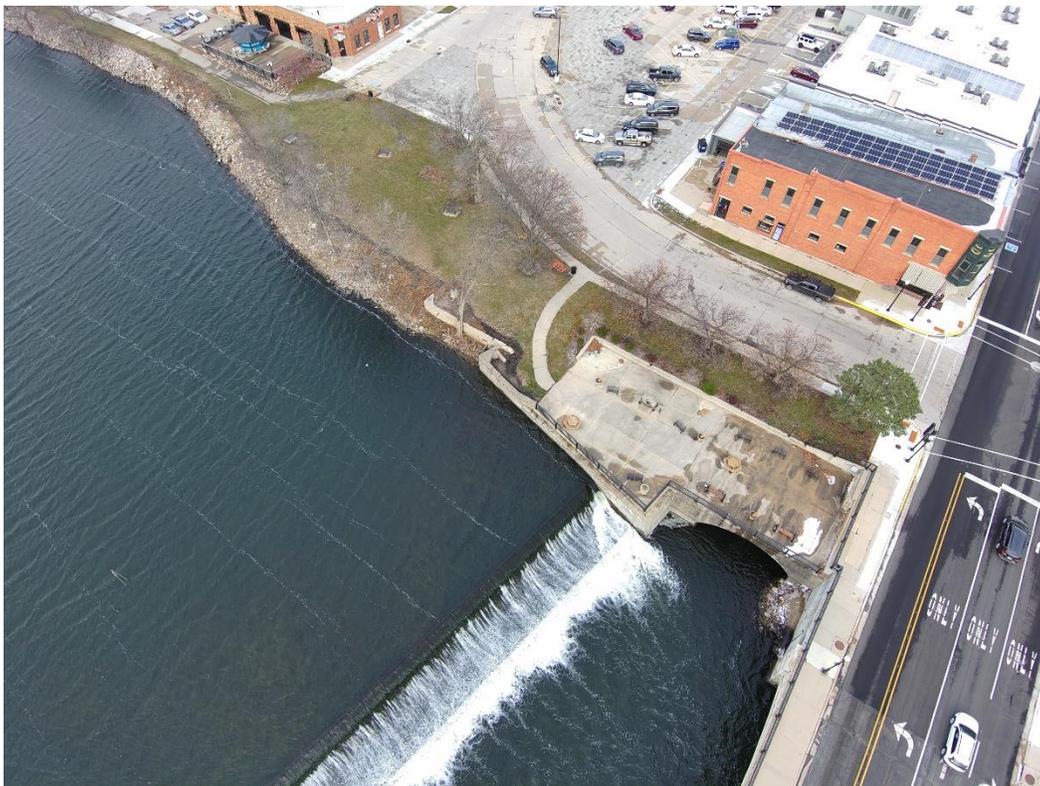


PHOTO 14. NORTHWEST SHORELINE LOOKING NORTHWEST

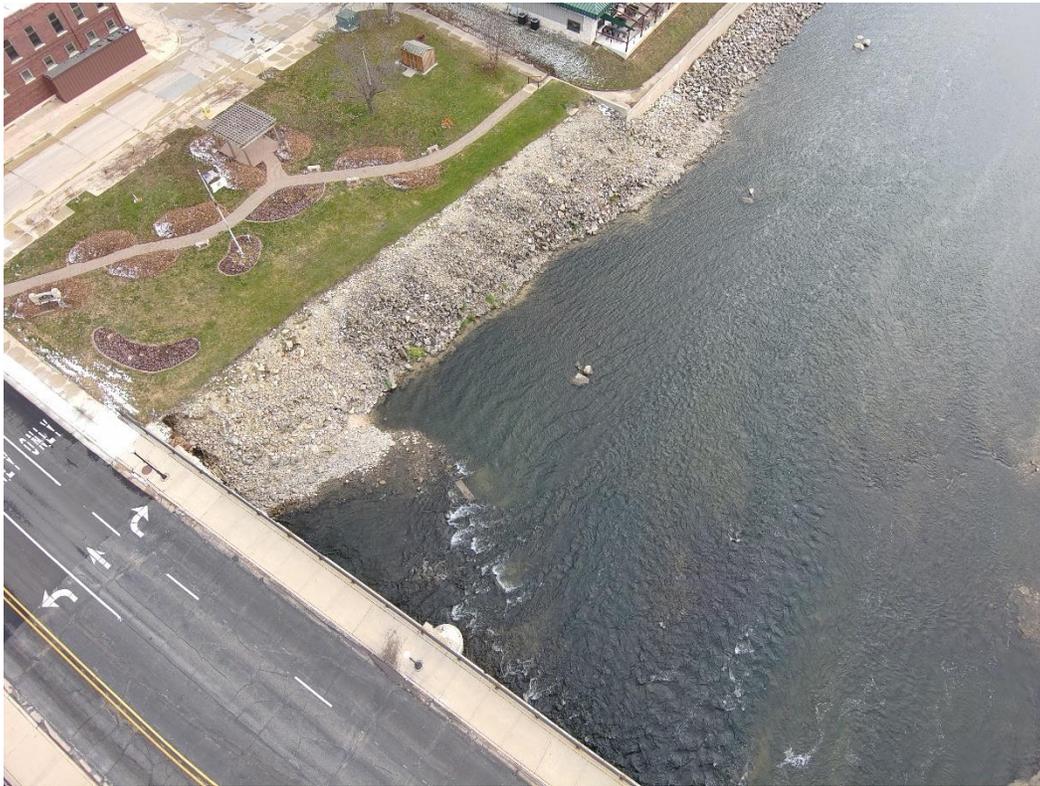


PHOTO 15. NORTHEAST SHORELINE LOOKING NORTHEAST



BRIDGE 001820 INSPECTION PHOTOGRAPHS



PHOTO 16. BRIDGE 001820 UPSTREAM PROFILE LOOKING NORTHEAST



PHOTO 17. BRIDGE 001820 DOWNSTREAM PROFILE LOOKING NORTHWEST



PHOTO 18. SOUTH PIER SOUTH FACE LOOKING NORTHWEST



PHOTO 19. SOUTH PIER NORTH FACE LOOKING SOUTHWEST



PHOTO 20. NORTH PIER SOUTH FACE LOOKING NORTHWEST



PHOTO 21. NORTH PIER NORTH FACE LOOKING SOUTHWEST



PHOTO 22. NORTH ABUTMENT LOOKING NORTHWEST

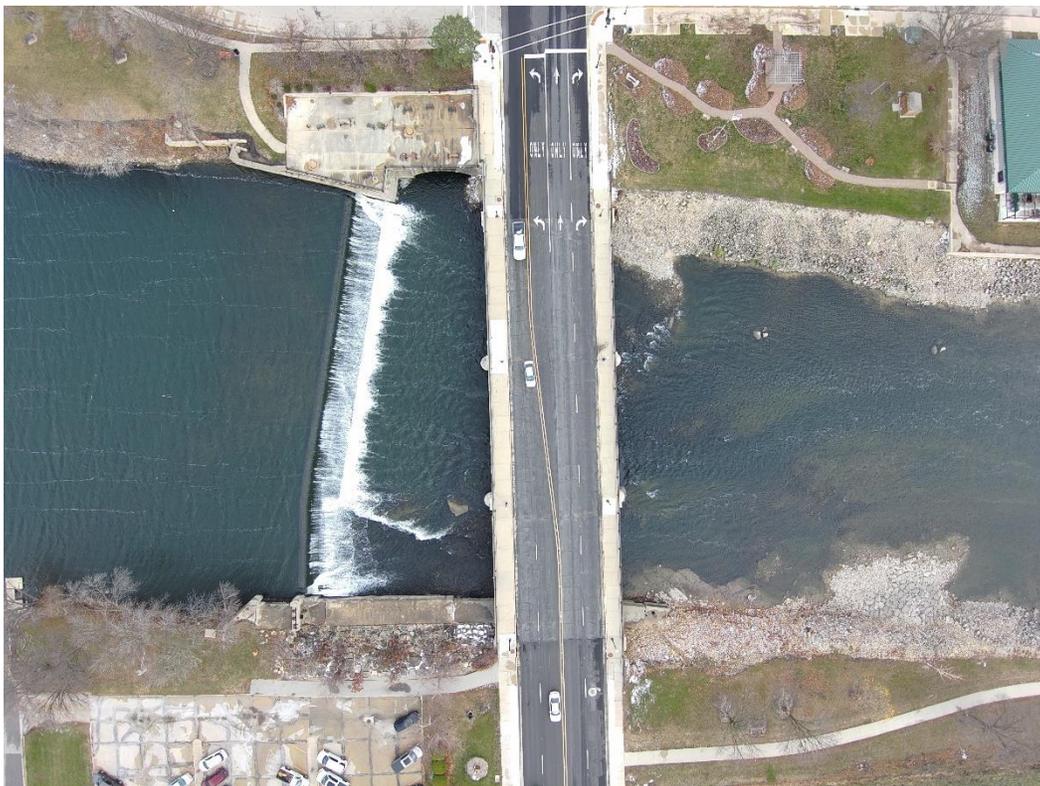


PHOTO 23. BRIDGE PLAN VIEW TOP NORTH

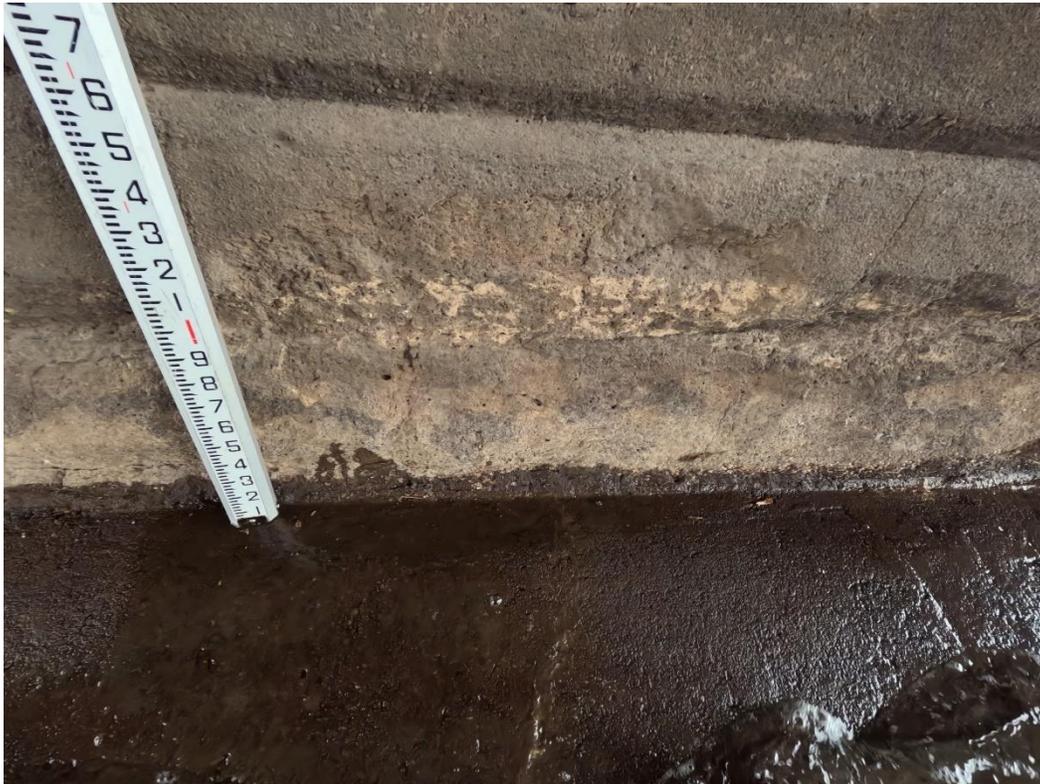


PHOTO 24. SOUTH PIER TYPICAL CONCRETE CONDITION LOOKING NORTH



PHOTO 25. SOUTH PIER FOOTING TYPICAL CONCRETE CONDITION BELOW WATER LOOKING NORTH

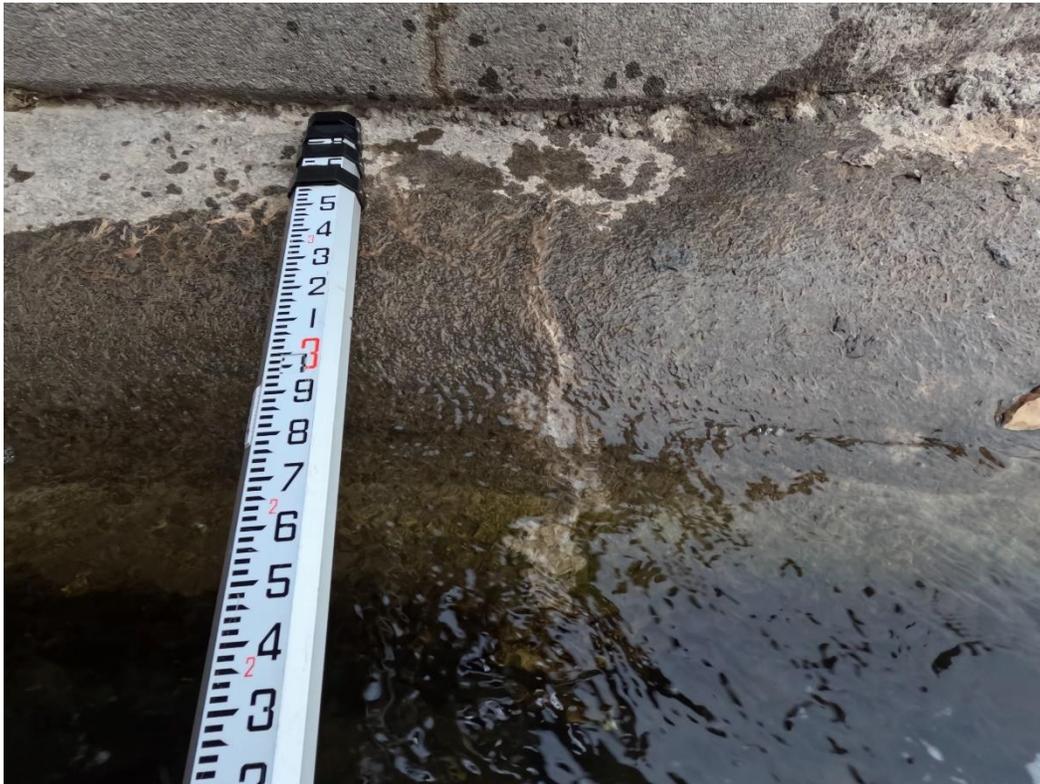


PHOTO 26. SOUTH PIER VERTICAL CRACK IN FOOTING LOOKING NORTH



PHOTO 27. SOUTH PIER VERTICAL CRACKING ABOVE FOOTING LOOKING NORTH



PHOTO 28. SOUTH PIER WEST NOSE HEAVY SCALING AT WATERLINE LOOKING EAST



PHOTO 29. NORTH PIER NORTH FACE VERTICAL CRACK LOOKING SOUTH



PHOTO 30. NORTH PIER TYPICAL SCALING NEAR WATERLINE LOOKING SOUTHWEST



PHOTO 31. NORTH PIER UPSTREAM END VERTICAL CRACK LOOKING SOUTHEAST

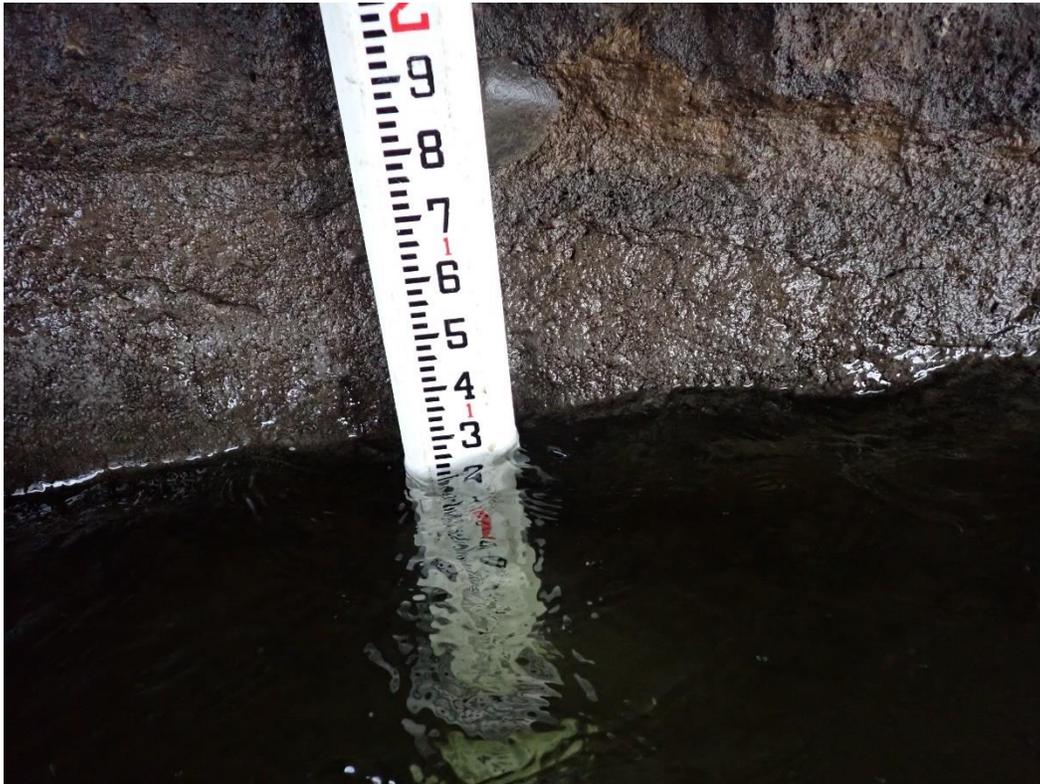


PHOTO 32. NORTH ABUTMENT TYPICAL CONCRETE CONDITION AT WATERLINE LOOKING NORTH



PHOTO 33. NORTH ABUTMENT TYPICAL HAIRLINE CRACKING WITH EFFLORESCENCE LOOKING NORTH



PHOTO 34. NORTH ABUTMENT VERTICAL CRACK LOOKING NORTH



PHOTO 35. NORTH ABUTMENT WITH SCALING AT WATERLINE UP 2 FEET LOOKING NORTHEAST



PHOTO 36. NORTHWEST WINGWALL CONDITION LOOKING EAST



MAIN STREET DAM INSPECTION PHOTOGRAPHS



PHOTO 37. MAIN STREET DAM OVERALL LOOKING SOUTHWEST



PHOTO 38. DAM VIEW ALONG LENGTH LOOKING NORTH



PHOTO 39. SPILLWAY AND APRON OVERALL LOOKING NORTHWEST

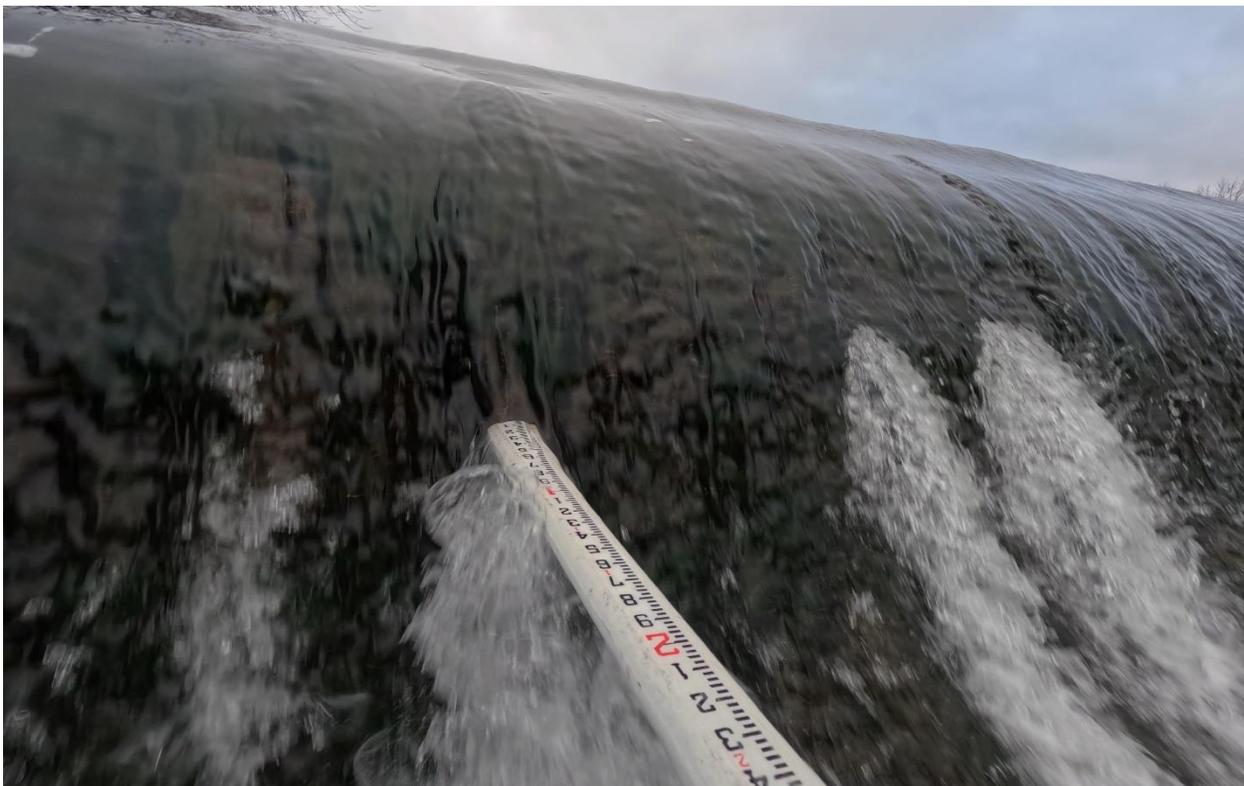


PHOTO 40. SPILLWAY TYPICAL CONDITION LOOKING WEST



PHOTO 41. SPILLWAY CREST AT NORTH END LOOKING NORTHWEST



PHOTO 42. AREA OF HEAVY SCALING ON THE NORTH RETAINING WALL ADJACENT TO THE DAM LOOKING NORTH



MAIN STREET DAM FLUME INSPECTION PHOTOGRAPHS



PHOTO 43. FLUME OVERALL LOOKING SOUTHWEST



PHOTO 44. VIEW THROUGH FLUME LOOKING WEST

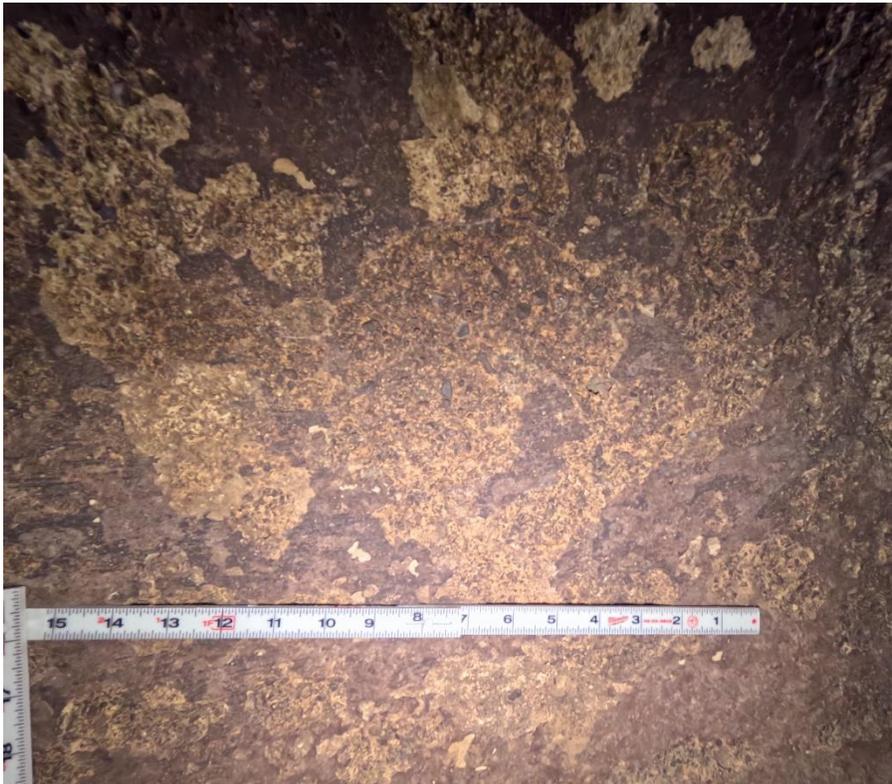


PHOTO 45. TYPICAL CONCRETE CONDITION LOOKING NORTH



PHOTO 46. TYPICAL FLOOR TO WALL REPAIR LOOKING NORTHWEST



PHOTO 47. TYPICAL CRACKING WITH EFFLORESCENCE LOOKING SOUTH



PHOTO 48. INLET GATE OVERALL LOOKING WEST



PHOTO 49. TYPICAL TIMBER INLET GATE CONDITION LOOKING WEST



PHOTO 50. TYPICAL SEEPAGE THROUGH INLET GATE LOOKING WEST



PHOTO 51. HEAVY SEEPAGE THROUGH INLET GATE AT NORTH END LOOKING NORTHWEST



PHOTO 52. SCALING OF VERTICAL CONCRETE INLET GATE SUPPORTS LOOKING WEST



PHOTO 53. HEAVY SCALING IN SOUTH WALL NEAR INLET LOOKING SOUTHWEST



PHOTO 54. TIMBER DEBRIS AND FLOOR THROUGH HOLE LOOKING WEST



PHOTO 55. FLOOR THROUGH HOLE LOOKING WEST



PHOTO 56. UNDERMINING NEAR FLOOR THROUGH HOLE LOOKING WEST



PHOTO 57. NORTH WALL DETERIORATION AND FLUME UNDERMINING LOOKING SOUTHWEST



PHOTO 58. NORTH MASONRY WALL DETERIORATION AND FLUME UNDERMINING LOOKING WEST



PHOTO 59. UNDERMINING OF OUTLET LOOKING SOUTHEAST



PHOTO 60. SPALL IN NORTH WALL AT FLOOR INTERFACE 85 FEET FROM INLET LOOKING NORTH



PHOTO 61. SEEPAGE THROUGH SPALL 85 FEET FROM INLET LOOKING SOUTH



PHOTO 62. CEILING FRACTURED REBAR LOCATED 85 FEET FROM OUTLET LOOKING SOUTH



PHOTO 63. SPALL IN NORTH WALL AT FRACTURE 50 FEET FROM OUTLET LOOKING NORTH



PHOTO 64. FRACTURE 50 FEET FROM OUTLET LOOKING WEST



PHOTO 65. FRACTURE 50 FEET FROM OUTLET LOOKING SOUTH



PHOTO 66. FRACTURE 50 FEET FROM OUTLET LOOKING SOUTH



PHOTO 67. SPALL IN SOUTH WALL AT FRACTURE 50 FEET FROM OUTLET LOOKING SOUTH



PHOTO 68. SPALL IN SOUTH WALL 15 FEET FROM OUTLET LOOKING SOUTH



*PHOTO 69. SPALL IN SOUTH WALL AT FLOOR INTERFACE WITH FRACTURED REBAR 15 FEET FROM OUTLET
LOOKING SOUTH*



PHOTO 70. OUTLET OVERALL LOOKING SOUTHWEST



FLOUR MILL FOUNDATION INSPECTION PHOTOGRAPHS



PHOTO 71. FLOUR MILL OVERALL LOOKING NORTH



PHOTO 72. FLOUR MILL PROFILE LOOKING NORTH



PHOTO 73. FLOUR MILL CEILING UNDERSIDE SOUTH BAY LOOKING EAST



PHOTO 74. FLOUR MILL CEILING UNDERSIDE NORTH BAY LOOKING EAST



PHOTO 75. FLOUR MILL NORTH ARCH LOOKING NORTHEAST



PHOTO 76. FLOUR MILL WEST WALL LOOKING WEST



PHOTO 77. FLOUR MILL NORTH WALL LOOKING NORTH



PHOTO 78. FLOUR MILL EAST WALL LOOKING EAST



PHOTO 79. FLOUR MILL CEILING SOUTH BAY NEAR EAST WALL SPALL LOOKING WEST



PHOTO 80. FLOUR MILL CEILING SOUTH BAY NEAR WEST WALL SPALL LOOKING NORTHWEST



PHOTO 81. FLOUR MILL CEILING SOUTH BAY SOUTHEAST CORNER SPALL LOOKING SOUTHWEST



PHOTO 82. FLOUR MILL CEILING SOUTH BAY SOUTHEAST CORNER SPALL LOOKING SOUTH



PHOTO 83. FLOUR MILL NORTH BAY CEILING TYPICAL CONDITION LOOKING NORTHEAST



PHOTO 84. FLOUR MILL NORTH BAY CEILING TYPICAL SPALL LOOKING WEST



PHOTO 85. FLOUR MILL SOUTH FACE CRACKING AND SECTION LOSS LOOKING NORTH



PHOTO 86. FLOUR MILL SOUTH ARCH CRACKING WITH EFFLORESCENCE LOOKING EAST



PHOTO 87. FLOUR MILL NORTH ARCH NORTH FACE MIDPOINT SPALL LOOKING SOUTHWEST



PHOTO 88. FLOUR MILL SOUTH ARCH WEST END SECTION LOSS AT WATERLINE LOOKING NORTHWEST



PHOTO 89. FLOUR MILL SOUTHWEST CORNER (SOUTH FACE) SECTION LOSS LOOKING NORTHWEST



PHOTO 90. FLOUR MILL SOUTH ARCH EAST END SPALL AND DELAMINATION LOOKING SOUTHEAST



PHOTO 91. FLOUR MILL NORTH ARCH EAST END FOUNDATION LOOKING SOUTHEAST



PHOTO 92. FLOUR MILL WEST WALL VERTICAL CRACK LOOKING WEST



PHOTO 93. FLOUR MILL NORTH ARCH WEST END FOUNDATION SECTION LOSS LOOKING WEST



PHOTO 94. FLOUR MILL NORTH ARCH WEST END SECTION LOSS AT WATERLINE UP 2 FEET LOOKING SOUTHWEST



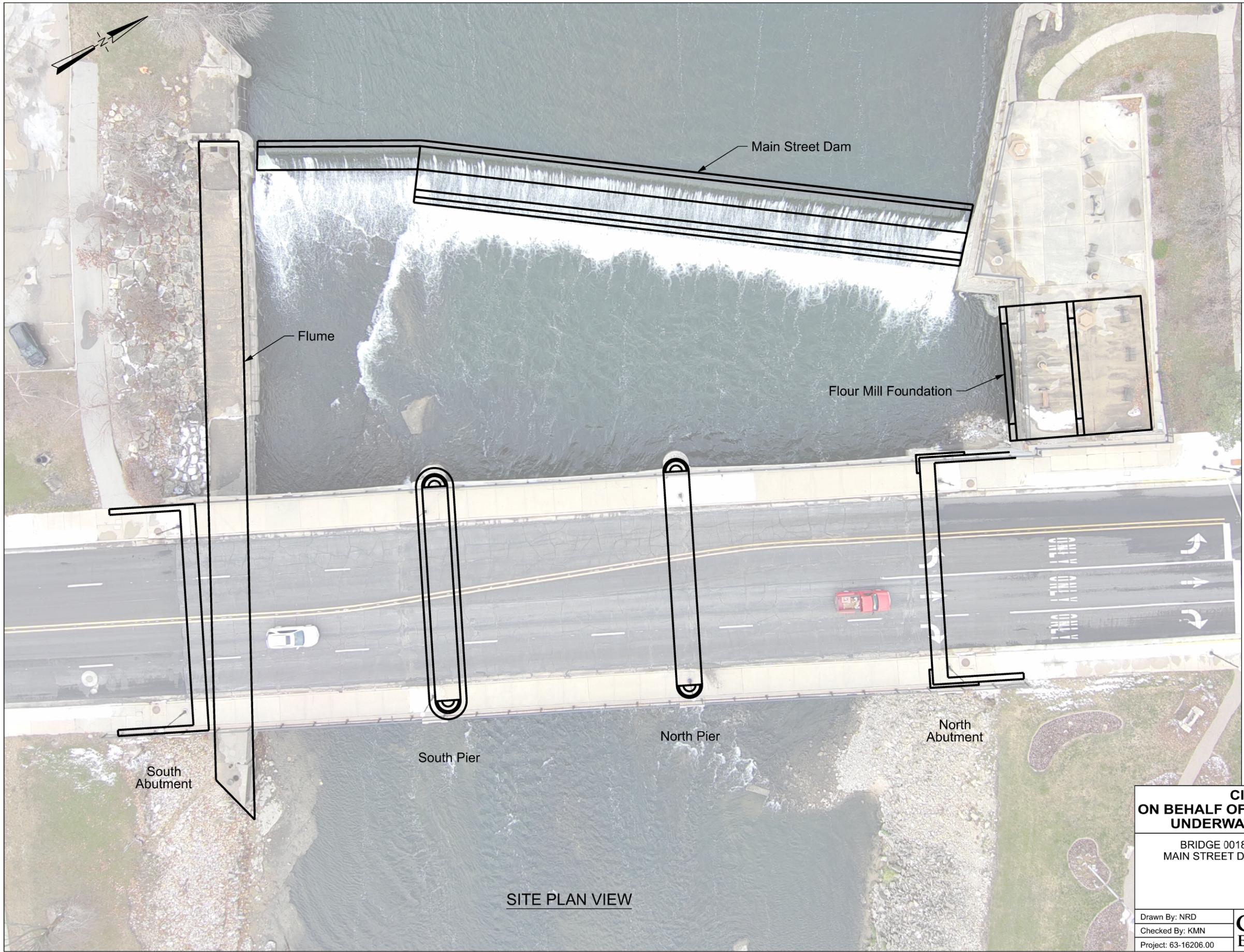
PHOTO 95. FLOUR MILL NORTH WALL TYPICAL CRACKING WITH EFFLORESCENCE LOOKING NORTH



PHOTO 96. FLOUR MILL NORTH WALL TYPICAL MASONRY FILLED OUTTAKE LOOKING NORTH



Appendix B – Inspection Drawings



- GENERAL NOTES:**
1. The underwater inspections of Bridge 001820, Main Street Dam, Flume and Flour Mill Foundation structures were completed on November 21, 2024.
 2. Refer to Figures 2 and 3 for inspection observations and channel cross sections at the upstream and downstream fascia of Bridge 001820.
 3. Refer to Figure 4 for inspection observations of the Main Street Dam.
 4. Refer to Figure 5 for inspection observations of the Flume.
 5. Refer to Figures 6 and 7 for inspection observations of the Flour Mill Foundation.

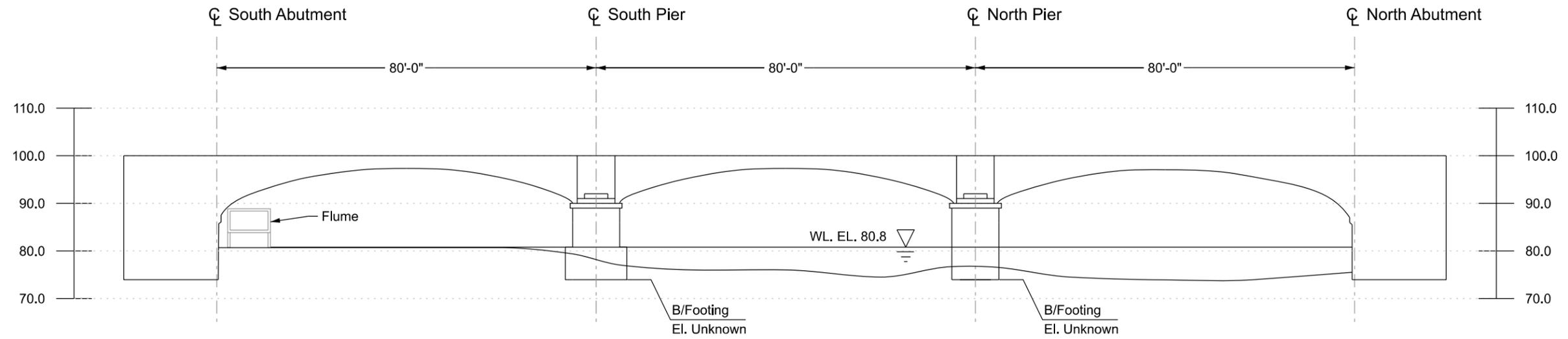
SITE PLAN VIEW

**CITY OF CHARLES CITY
ON BEHALF OF CALHOUN-BURNS & ASSOCIATES
UNDERWATER STRUCTURE INSPECTION**

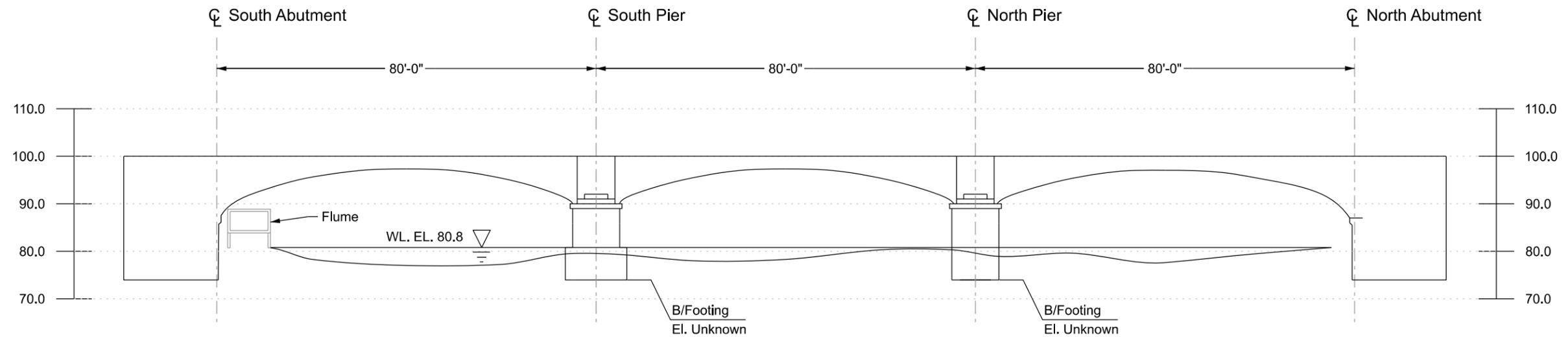
BRIDGE 001820 (MAIN STREET OVER CEDAR RIVER),
MAIN STREET DAM, FLUME, AND FLOUR MILL FOUNDATION
IN CHARLES CITY, IOWA

SITE PLAN VIEW

| | | |
|----------------------|---|-----------------|
| Drawn By: NRD | COLLINS ENGINEERS <small>1599 Selby Ave. Suite 206 St. Paul, MN, 55104 (651) 646-8502 www.collinsengr.com</small> | Date: NOV. 2024 |
| Checked By: KMN | | Scale: NTS |
| Project: 63-16206.00 | | Figure No.: 1 |



UPSTREAM FASCIA CHANNEL PROFILE
(Looking West)



DOWNSTREAM FASCIA CHANNEL PROFILE
(Looking West)

GENERAL NOTES:

1. Refer to Figure 2 for General Notes.
2. South Pier and North Pier are founded on bedrock based on the field inspection observations.

LEGEND:

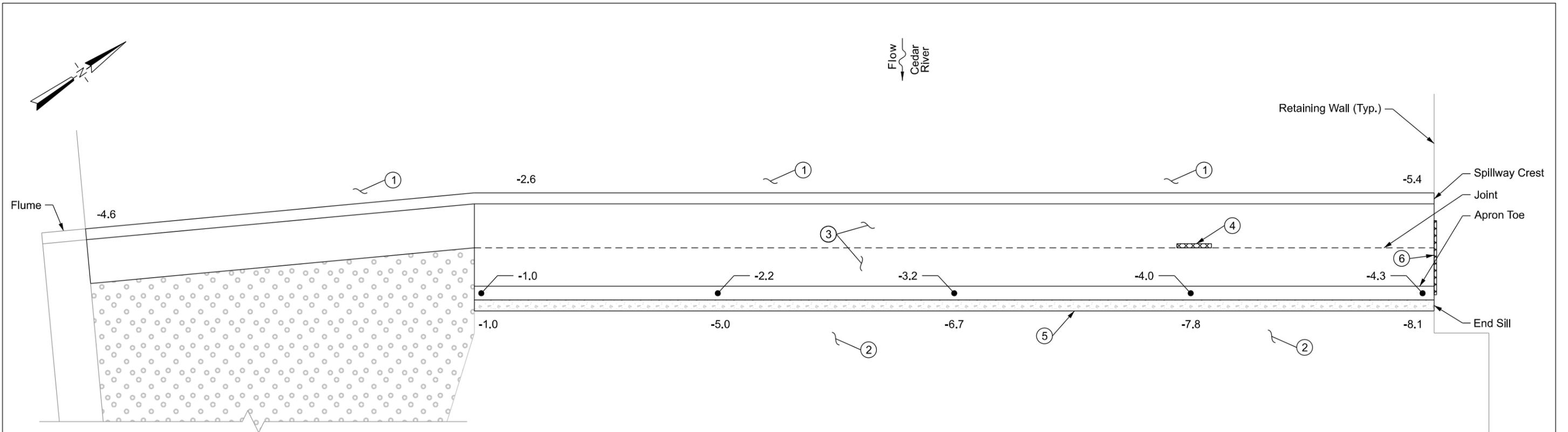
———— Channel Bottom on November 21, 2024

CITY OF CHARLES CITY
ON BEHALF OF CALHOUN-BURNS & ASSOCIATES
UNDERWATER STRUCTURE INSPECTION

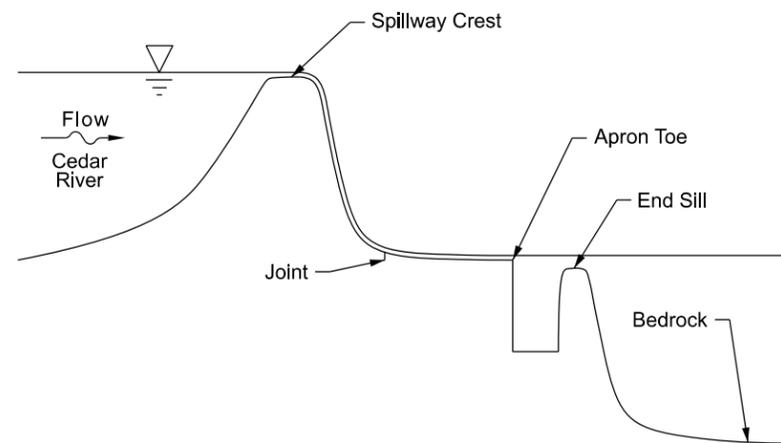
BRIDGE 001820 (MAIN STREET OVER CEDAR RIVER),
MAIN STREET DAM, FLUME, AND FLOUR MILL FOUNDATION
IN CHARLES CITY, IOWA

BRIDGE 001820
FASCIA CHANNEL PROFILES

| | | |
|----------------------|---|-----------------|
| Drawn By: NRD | COLLINS ENGINEERS <small>1599 Selby Ave. Suite 208 St. Paul, MN, 55104 (651) 846-8502 www.collinsengr.com</small> | Date: NOV. 2024 |
| Checked By: KMN | | Scale: NTS |
| Project: 63-16206.00 | | Figure No.: 3 |



PLAN



TYPICAL CROSS SECTION

INSPECTION NOTES:

- 1 The channel bottom upstream of the dam consisted of firm sand with up to 8 inches of probe rod penetration.
- 2 The channel bottom downstream of the dam consisted of natural bedrock and rip rap up to 2 feet in diameter with no probe rod penetration.
- 3 All concrete surfaces below waterline typically exhibited light scaling up to 1/16-inch deep.
- 4 Isolated spall measuring 7 feet long by 10 inches wide up to 8 inches deep was observed along the downstream vertical face of the dam along the joint near the north quarter point.
- 5 The material of the end sill was typically smooth and sound.
- 6 Area of heavy scaling, 14 feet long by 7 feet high by 3 inches deep exposing multiple rebar exhibiting up to 15 percent section loss, located along the north retaining wall adjacent to the dam.

GENERAL NOTES:

1. At the time of inspection on November 21, 2024, the waterline of the Cedar River downstream of the dam was located 19.2 feet below the top of deck at the upstream end above the South Pier of Bridge 001820 (Assumed El. 100.0), which corresponds to a waterline elevation of 80.8 based off the assumed reference.
2. Soundings were taken at quarter point intervals along the upstream and downstream faces of the dam.
3. Soundings indicate depth of channel in feet at the time of inspection.

LEGEND:

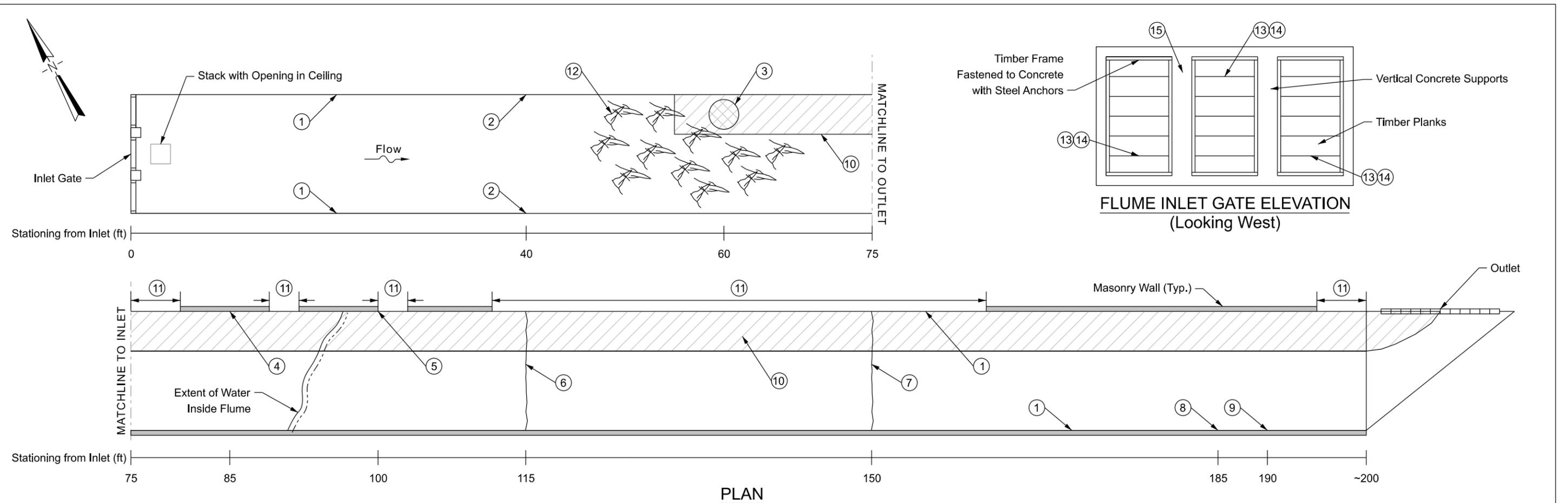
- 4.0 Channel Bottom Depth in Feet (11/21/2024)
- Bedrock
- End Sill

**CITY OF CHARLES CITY
ON BEHALF OF CALHOUN-BURNS & ASSOCIATES
UNDERWATER STRUCTURE INSPECTION**

BRIDGE 001820 (MAIN STREET OVER CEDAR RIVER),
MAIN STREET DAM, FLUME, AND FLOUR MILL FOUNDATION
IN CHARLES CITY, IOWA

MAIN STREET DAM
INSPECTION AND SOUNDING PLAN

| | | |
|----------------------|---|-----------------|
| Drawn By: NRD | COLLINS ENGINEERS <small>1599 Selby Ave. Suite 208 St. Paul, MN, 55104 (651) 846-8502 www.collinsengr.com</small> | Date: NOV. 2024 |
| Checked By: KMN | | Scale: NTS |
| Project: 63-16206.00 | | Figure No.: 4 |



PLAN

INSPECTION NOTES:

- 1 Concrete surfaces typically exhibited scaling up to 1/2-inch deep with isolated areas up to 3 inches deep throughout the length of the flume excluding the concrete surrounding the outlet. Transverse cracks with efflorescence extending from the base of both walls through the ceiling up to 0.050 inches wide with associated edge spalling typically spaced every 5 to 10 feet along the full length of the flume. Floor to wall interfaces exhibited spalling and cracking typically 1 to 3 inches deep with isolated areas of full depth section loss exposing multiple rebar exhibiting up to 100 percent section loss.
- 2 Heavy scaling on the south and north walls, up to 4 inches deep exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 40 feet from the inlet.
- 3 Spall in the floor, measuring 4 feet in diameter with full depth penetration exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 60 feet from the inlet. Heavy flow through the spall was observed.
- 4 Spall in the north wall to floor interface, measuring 5 feet long by 2 feet high with full depth penetration exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 85 feet from the inlet.
- 5 Spall in the north wall to floor interface, measuring 3 feet long by 2 feet high with full depth penetration exposing six rebar exhibiting up to 100 percent section loss, located near the mid-length of the flume.
- 6 Full perimeter fracture, up to 1 inch wide with associated spalling exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 85 feet from the outlet.
- 7 Full perimeter fracture, up to 1 inch wide with associated spalling exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 50 feet from the outlet.
- 8 Spall in the south wall to floor interface, measuring 25 feet long by 2 feet high with full depth penetration exposing multiple rebar exhibiting up to 100 percent section loss, located approximately 15 feet from the outlet.
- 9 Spall in the south wall to floor interface, measuring 5 feet long by 2 feet high with full depth penetration exposing multiple rebar exhibiting up to 10 percent section loss, located approximately 10 feet from the outlet.
- 10 Undermining of the flume with up to 4 feet of horizontal penetration extending from the floor through hole (see Note 3) approximately 60 feet from the inlet extending the remaining length of the flume to the outlet.
- 11 The north masonry wall supporting the flume exhibited areas of severe deterioration and failure resulting in areas of the flume to be cantilevered from the south masonry wall.
- 12 Accumulation of timber debris, consisting of branchy material up to 3 inches in diameter and build up of sediment, was observed around the through hole in the floor approximately 60 feet from the inlet.
- 13 Inlet gate horizontal timber planks exhibited moderate to severe decay throughout.
- 14 Inlet gate exhibited areas of seepage through section loss in the horizontal timber planks, joints between the horizontal timber planks, and through deteriorated connections of the timber frame.
- 15 Inlet gate vertical concrete supports exhibited moderate to severe deterioration including scaling and hairline cracking with efflorescence.

GENERAL NOTES:

1. The structure consisted of a rectangular reinforced concrete box approximately 200 feet long with a timber inlet gate and metal grated outlet. The hydraulic opening was 12 feet wide with a varying height of 6 feet from the inlet extending approximately 75 feet east and 4 feet high for the remaining length of the flume.

LEGEND:

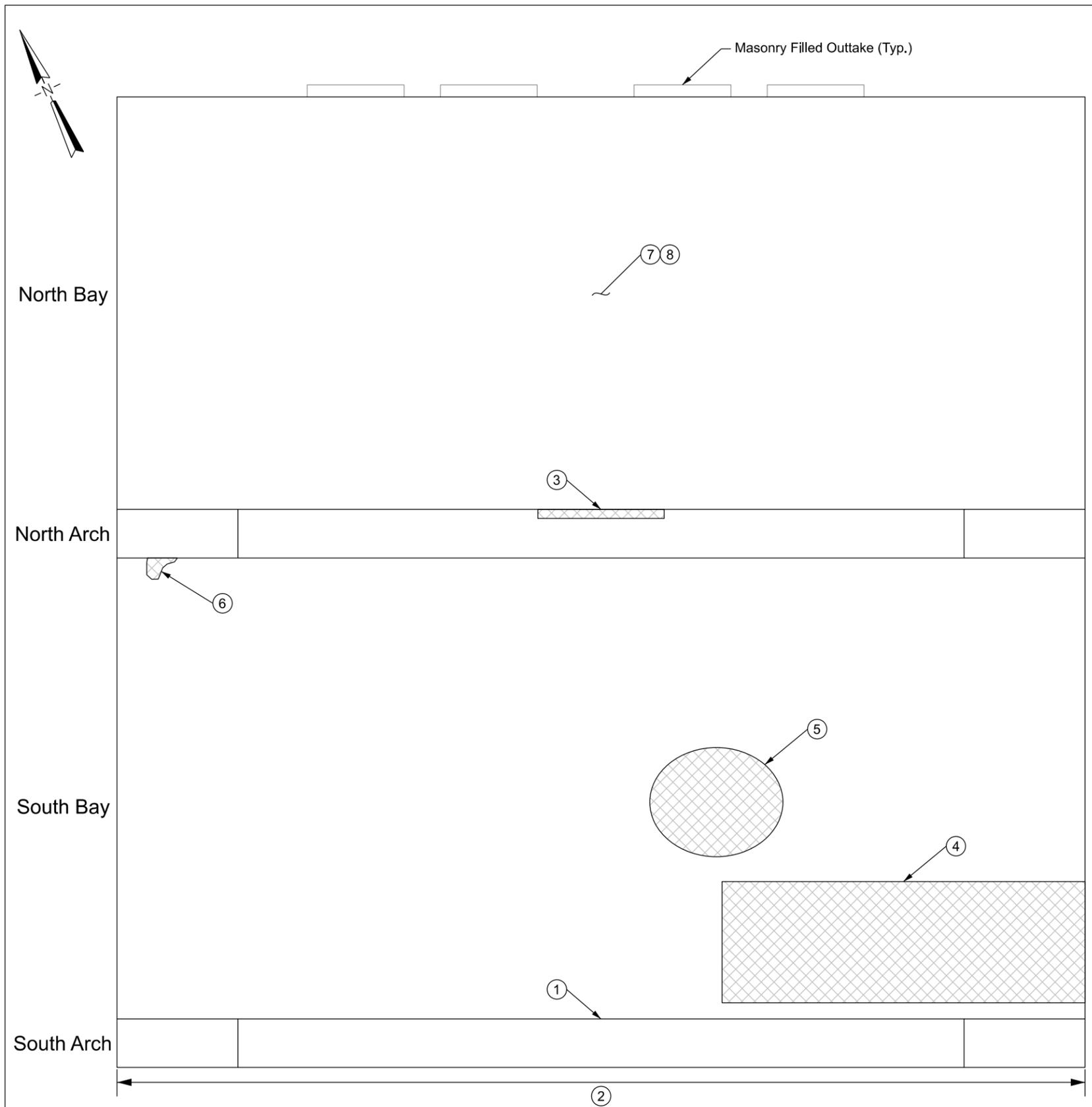
-  Undermining Extents
-  Spall Extents
-  Timber Debris

**CITY OF CHARLES CITY
ON BEHALF OF CALHOUN-BURNS & ASSOCIATES
UNDERWATER STRUCTURE INSPECTION**

BRIDGE 001820 (MAIN STREET OVER CEDAR RIVER),
MAIN STREET DAM, FLUME, AND FLOUR MILL FOUNDATION
IN CHARLES CITY, IOWA

**MAIN STREET DAM FLUME
INSPECTION AND SOUNDING PLAN**

| | | |
|----------------------|--|-----------------|
| Drawn By: NRD |  1599 Selby Ave. Suite 206 St. Paul, MN, 55104 (651) 846-8502 www.collinsengr.com | Date: NOV, 2024 |
| Checked By: KMN | | Scale: NTS |
| Project: 63-16206.00 | | Figure No.: 5 |



INSPECTION PLAN
(Ceiling and Arches)

INSPECTION NOTES:

- 1 Longitudinal hairline cracking with efflorescence on South Arch underside for entire length.
- 2 Hairline cracking with efflorescence and random areas of moderate section loss on the south exterior headwall.
- 3 Spall on the north face of the North Arch near mid-length, measuring 2 feet long by 6 inch high and 4 inches deep, exposing 1 rebar exhibiting minor surface corrosion.
- 4 Spall in the South Bay ceiling extending from the east wall near the south arch, up to 5 feet wide by 20 feet long and 4 inches deep, exposing multiple rebar exhibiting up to 100 percent section loss.
- 5 Spall in the South Bay ceiling located in the southeast quadrant up to 5 feet in diameter and 3 inches deep, exposing multiple rebar exhibiting up to 50 percent section loss.
- 6 Spall in the South Bay ceiling extending along the North Arch near the west wall, up to 2 feet in diameter and 8 inches deep, exposing 2 rebar exhibiting minor surface corrosion.
- 7 Random spalls in the North Bay ceiling up to 6 inches in diameter and 4 inches deep exposing multiple rebar exhibiting minor surface corrosion.
- 8 Hairline map cracking was observed throughout the North Bay ceiling.

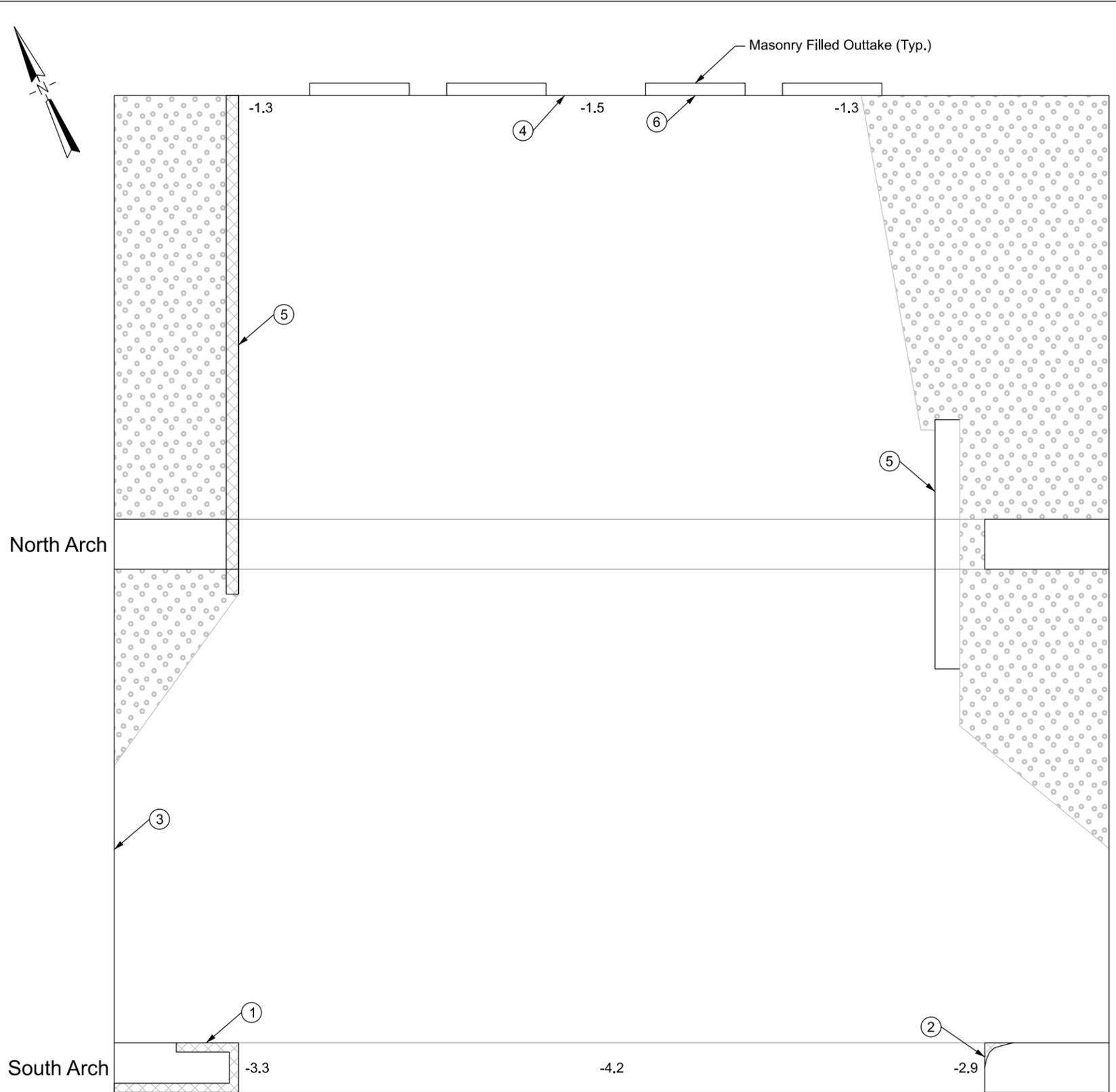
GENERAL NOTES:

1. The flour mill foundation configuration consists of a reinforced concrete ceiling supported by three reinforced concrete walls with two reinforced concrete arches at the opening and approximately half the distance between the opening and the north wall. The foundation of the north arch was exposed at the west and east ends.
2. Refer to Figure 7 for inspection observations regarding walls, foundations and depth soundings.

LEGEND:

 Spall Extents

| | | |
|---|---|-----------------|
| CITY OF CHARLES CITY ON BEHALF OF CALHOUN-BURNS & ASSOCIATES UNDERWATER STRUCTURE INSPECTION | | |
| BRIDGE 001820 (MAIN STREET OVER CEDAR RIVER), MAIN STREET DAM, FLUME, AND FLOUR MILL FOUNDATION IN CHARLES CITY, IOWA | | |
| FLOUR MILL FOUNDATION INSPECTION PLAN | | |
| Drawn By: NRD | COLLINS ENGINEERS <small>1599 Selby Ave. Suite 208 St. Paul, MN, 55104 (651) 846-8502 www.collinsengr.com</small> | Date: NOV, 2024 |
| Checked By: KMN | | Scale: NTS |
| Project: 63-16206.00 | | Figure No.: 6 |



INSPECTION NOTES:

- 1 Section loss around the perimeter of the South Arch west base measuring up to 9 inches deep with unsound substrate from the waterline up 3 feet.
- 2 Spall with associated delamination in the South Arch east base on the northwest corner, up to 1 foot wide by 2 feet high and 4 inches deep, located approximately 2 feet above the waterline.
- 3 Vertical crack in the west wall near the south quarter-point measuring 1/16-inch wide extending from the bottom of deck to 2 feet above the waterline.
- 4 Hairline map cracking with efflorescence throughout the north wall.
- 5 The foundation of the North Arch was vertically exposed at both the west and east ends exhibiting a band of section loss up to 1.2 feet deep, extending from the waterline up 2 feet. Rock was observed on top of the foundation at both ends.
- 6 Four outtakes in the north wall were filled with masonry exhibiting section loss up to 1 inch deep.

GENERAL NOTES:

1. The flour mill configuration consists of a reinforced concrete ceiling supported by three reinforced concrete walls with two reinforced concrete arches at the opening and approximately half the distance between the opening and the north wall. The foundation of the North Arch was exposed at the west and east ends.
2. At the time of inspection on November 21, 2024, the waterline of the Cedar River was located 19.2 feet below the top of deck at the upstream end above the South Pier of Bridge 001820 (Assumed El. 100.0), which corresponds to a waterline elevation of 80.8 based off the assumed reference.
3. Soundings were taken at half point intervals along the opening and north wall.
4. Soundings indicate depth of channel in feet at the time of inspection.
5. Refer to Figure 6 for inspection observation notes regarding the ceiling and arches.

LEGEND:

- 4.0 Channel Bottom Depth in Feet (11/21/2024)
- Rock
- Spall Extents

CITY OF CHARLES CITY
ON BEHALF OF CALHOUN-BURNS & ASSOCIATES
UNDERWATER STRUCTURE INSPECTION

BRIDGE 001820 (MAIN STREET OVER CEDAR RIVER),
MAIN STREET DAM, FLUME, AND FLOUR MILL FOUNDATION
IN CHARLES CITY, IOWA

FLOUR MILL FOUNDATION
INSPECTION AND SOUNDING PLAN

| | | |
|----------------------|---|-----------------|
| Drawn By: NRD | COLLINS ENGINEERS | Date: NOV. 2024 |
| Checked By: KMN | <small>1599 Selby Ave. Suite 208 St. Paul, MN, 55104 (651) 846-8502 www.collinsengr.com</small> | Scale: NTS |
| Project: 63-16206.00 | | Figure No.: 7 |

APPENDIX E

MATERIALS TESTING REPORT



REPORT OF CONCRETE TESTING

Project:
Service Life Assessment
Charles City Main Street Bridge
Charles City, IA

AET Project No.: P-0036871

Reported To:
Calhoun-Burns & Associates, Inc.
1500 30th Street
West Des Moines, IA 50266
Attn: Lowell Miller
Date: July 9, 2025

INTRODUCTION

American Engineering Testing (AET) is pleased to submit this report summarizing our findings at the above referenced project. We performed the following scope of work in accordance with our proposal dated September 3, 2024:

1. Performed concrete sounding on the underside and vertical faces of the concrete arches in accordance with ASTM D4580, *Standard Practice for Measuring Delamination in Concrete Bridge Decks by Sounding*.
2. Obtained four (4), 4" diameter concrete cores to test for acid-soluble chloride content in accordance with ASTM C1152, *Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete*. The concrete cores were drilled to a depth of approximately 8" – 9" from the concrete surface and were tested at 1" depth horizons along the length of the core. These cores were also tested for carbonation depth from the coring surface.
3. Obtained two (2), 4" diameter concrete cores to perform petrography in accordance with ASTM C856, *Standard Practice for Petrographic Examination of Hardened Concrete*.
4. Performed half-cell testing in general accordance with ASTM C876, *Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete*. AET picked three (3) locations on the underside of each arch (9 total locations) to test for corrosion potentials of reinforcement.
5. Prepared a report summarizing our findings. This report includes diagrams showing the locations of delaminated concrete, tabulated delamination quantities for repair estimates, representative photos from the project site and corrosion potential maps from the half-cell testing.

550 Cleveland Avenue North | Saint Paul, MN 55114

Phone (651) 659-9001 | (800) 972-6364 | Fax (651) 659-1379 | teamAET.com | AA/EEO

This document shall not be reproduced, except in full, without written approval from American Engineering Testing, Inc.

BACKGROUND INFORMATION

AET understands Calhoun-Burns & Associates, Inc. (CBA) is working with Charles City to determine the viability of rehabilitating the Charles City Main Street Bridge (Figure 1) in Charles City, Iowa. The bridge structure consists of three (3) concrete arches bearing on submerged concrete piers. The Main Street Dam is located upstream from the bridge and has a spillway structure spanning beneath the bridge at the west end of the project site. The bridge has displayed indications of leaching, concrete spalling, and corrosion of reinforcing steel. AET was requested to perform forensic testing on the arches and piers to assist the Engineer of Record (EOR) in their analysis of the existing bridge structure.



Figure 1: Charles City Main Street Bridge (Upstream Face)

TEST RESULTS

We visited the project site between April 28 and April 30, 2025. The following is a summary of our findings:

Concrete Sounding: AET observed 169 delaminated regions on the underside of the arches. The approximate number of delaminated regions on each of the arches are displayed in Table 1. Please note that there are possible additional delamination areas that were not able to be observed at this time due to the existing size, location, or depth.

Table 1: Number of delaminated regions on concrete arches

| Arch | No. of Delaminations | Approximate Total Delaminated Area (ft ²) |
|---------------|----------------------|---|
| West | 56 | 758 |
| Center | 59 | 520 |
| East | 54 | 746 |
| TOTAL | 169 | 2,025 |

Based on the results of the concrete sounding, approximately 13% to 14% of the underside of the arches were observed to contain delaminated / spalled concrete. Please refer to Sheets 1 and 2 in Appendix B for the locations of delaminated concrete. Photographs of the bridge are in Appendix A.

In general, AET observed larger delaminated regions in the vicinity of construction joints running parallel to the direction of the bridge in each of the arches (Figure 2).



Figure 2: West Arch (general) – Large delaminated regions were observed in proximity of construction joints (white lines) – Similar areas were observed in other arches



Acid-Soluble Chloride Testing:

Core 1A was obtained from the top of a pier, Core 2 was obtained from the face of a vertical stem above the arch, Core 3 was obtained from the side of a pier and Core 4A was obtained from the underside of the west arch. Please refer to Sheets 1 and 2 in Appendix B for the locations of where concrete cores were retrieved for testing.

In general, industry considers chloride concentrations from between 500-1000 parts per million (ppm) as the concentration threshold after which corrosion within the reinforcing steel can initiate. Detailed results of the acid-soluble chloride testing are in the attached AET Report of Chloride Analysis, dated May 22, 2025.

Cores 1A and 2 were the only locations with measured chloride contents above 500 ppm. Core 1A had chloride levels above 500 ppm at the depth intervals between 3” and 8-3/4” below the top surface of the pier. Core 2 had chloride levels above 500 ppm between 0” and 3” from the vertical face of the stem.

Petrographic and Carbonation Testing:

An additional 4” diameter core was obtained adjacent to the cores collected at chloride at test locations 1A and 4A. Detailed results of the petrographic testing are in the attached AET Report of Petrographic Analysis, dated July 7, 2025.

In general, the concrete condition of the core obtained from the top of the pier (location 1B) was considered fair and had no evidence of freeze-thaw damage and very minimal amounts of alkali-silica reaction (ASR). No mass deterioration or cracking was observed that could be associated with the ASR present within the core.

The concrete core obtained from the underside of the concrete arch (location 4B) was considered to be in fair to good condition. No evidence of freeze-thaw damage or chemical attack was observed. The depth of carbonation within the core was observed to range from 2-1/4” to 3-1/8” from the underside of the concrete arch. The reinforcement observed at the bottom of the concrete arches was observed to be within 1-1/2” of the underside of the arches.

The carbonation depths observed in the core samples retrieved are in Table 2 below.

Table 2: Carbonation Depths

| Sample ID | Location | Depth of Carbonation |
|-----------|-----------------------|--|
| 1B | Top of Pier | 1/4” to 7/16” |
| 2 | Vertical Stem | 3/8” to 7/8” |
| 3 | Vertical Face of Pier | Mottled carbonation throughout depth of core |
| 4B | Underside of Arch | 2-1/4” to 3-1/8” |



Half-Cell Testing:

AET performed half-cell testing at nine (9) locations (three locations each on the west, center and east arches). AET collected readings from two (2) areas near to delamination and one (1) area away from delaminated concrete at each arch. Maps showing the corrosion potential within each test area are attached. Table 3 below shows the results of the half-cell testing at each arch location. Sheet 3 (attached) shows the corrosion potential mapping of the test regions.

Table 3: Half-Cell Test Results

| Arch | % of Readings > -200 mV | % of Readings Between -200 mV and -350 mV | % of Readings < -350 mV |
|--------|-------------------------|---|-------------------------|
| East | 5.3 | 77.4 | 17.3 |
| Center | 88 | 12 | 0 |
| West | 48 | 52 | 0 |

The locations tested at the east arch were the only test locations that contained readings more negative than -350 mV indicating that greater than 90% of corrosion activity is occurring where the readings were collected. Both the east and west arches had greater than 50% of the readings in the indeterminant region between -200 mV and -350 mV indicating that corrosion activity is not certain. 88% of the readings collected at the center arch were observed to be more positive than -200 mV indicating that there is a greater than 90% chance of no corrosion activity being present where the readings were collected.

TEST PROCEDURES

Concrete Sounding (ASTM D4580): Concrete sounding was performed utilizing hammer tapping the concrete surface. Hollow sounds encountered while tapping the concrete surface were indicative of delamination near the concrete surface. AET carefully marked out the extents of the delaminated regions using sidewalk chalk and recorded the approximate sizes.

Ground Penetrating Radar (GPR): GPR equipment was used to mark out the locations of reinforcement prior to performing half-cell testing and coring into the concrete structure. The antenna was pushed across the concrete surface and was scrolled back along each scanline to mark the locations of embedded reinforcement. Once an embedded object was encountered by the transduced signal, it was reflected back to the receiver and no further signal penetration beyond that point was visible in the GPR data. This limits the ability of the antenna to detect anomalies beyond the reinforcing mat located closest to the scan surface. The antenna used on-site can transmit a signal up to 24” depending on the amount of reinforcement present and overall concrete condition.

Half-Cell Testing (ASTM C876): AET utilized an MC Miller RE-5 Electrode containing copper-copper sulfate solution with a Fluke Digital Multimeter. A sponge wetted with an electrical contact solution consisting of liquid household detergent and tap water served as the electrical junction device and was attached to the electrode. The reinforcement was marked out within an approximate 3' x 3' area at each test location. AET drilled a 1/2" diameter hole into the concrete to expose a reinforcing bar to attach a lead to the multimeter. Readings were collected at 6" to 8" on center across each test location and the measured voltage at each test location was recorded. Corrosion potential maps of each test location were created off-site. In general, readings more positive than -200 mV are considered to have a 90% chance of having no corrosion activity taking place. Readings more negative than -350 mV are considered to have a 90% chance of having corrosion. Readings between -200 mV and -350 mV are indeterminate with regard to corrosion potential.

LIMITATIONS

Our authorized work scope was limited to our observations in the requested areas only. As such, our conclusions and recommendations pertain only to those areas observed. Should conditions differing from those documented by AET at the time our work be found in the future, AET reserves the right to review our conclusions and recommendations and modify them accordingly.

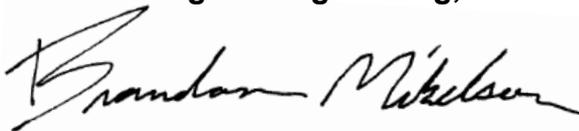
STANDARD OF CARE

The work performed by American Engineering Testing, Inc., has been conducted in a manner consistent with that level of skill and care ordinarily exercised by other members of the profession currently practicing in this area.

REMARKS

We appreciate the opportunity to assist you on this project. If you have any questions regarding this report or our services, feel free to contact us.

Sincerely,
American Engineering Testing, Inc.



Brandon Mikelson, P.E.*
Engineer II
E-mail: bmikelson@teamAET.com
Phone: 651.659.1331

*MN



Andrew T. Schmid, P.E.**
Principal Engineer
E-mail: aschmid@teamAET.com

**MN, ND, WI, FL, GA

Attachments:

- Appendix A – Photographs
- Appendix B – Delamination and Half-Cell Diagrams
- Appendix C – Report of Chloride Analysis
- Appendix D – Report of Petrographic Analysis

APPENDIX A

Photographs

PHOTOGRAPHS
AET PROJECT NO. P-0036871



Photo 1: Downstream face



Photo 2: Pier between east and center arches



Photo 3: Pier between west and center arches



Photo 4: Upstream face



Photo 5: Pier between west and center arches



Photo 6: Pier between east and center arches

PHOTOGRAPHS
AET PROJECT NO. P-0036871



Photo 7: Core locations 1A and 1B

Photo 8: Core location 2



Photo 9: Core location 3

Photo 10: Core locations 4A and 4B

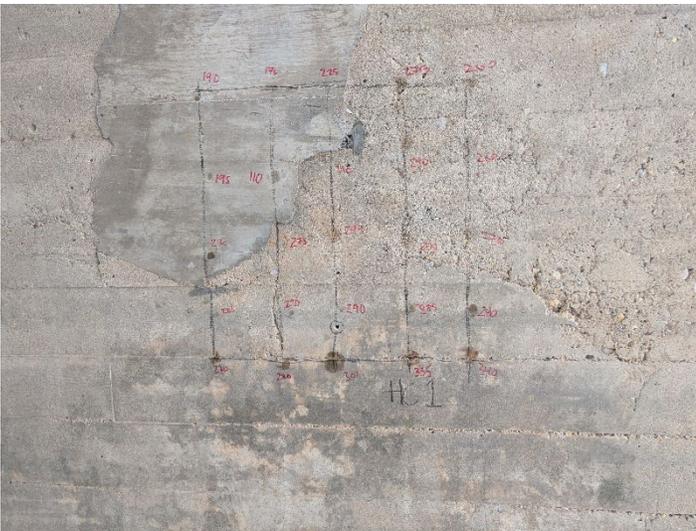


Photo 11: Half-cell test location 1

Photo 12: Half-cell test location 2

**PHOTOGRAPHS
AET PROJECT NO. P-0036871**

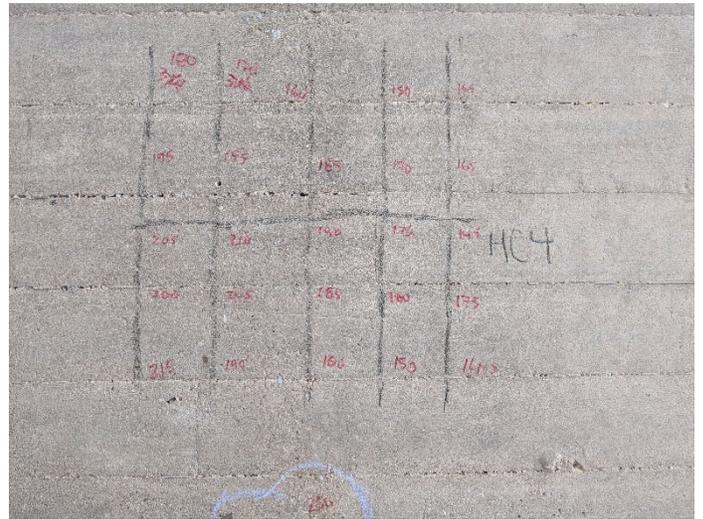


Photo 13: Half-cell test location 3

Photo 14: Half-cell test location 4

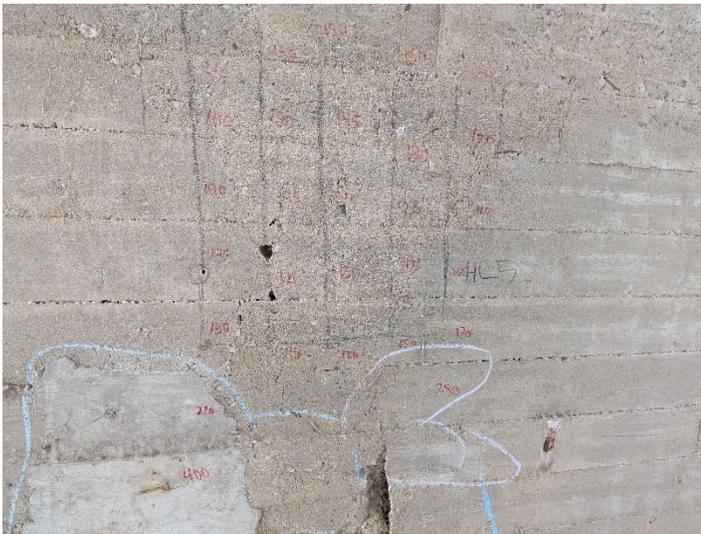


Photo 15: Half-cell test location 5

Photo 16: Half-cell test location 6



Photo 17: Half-cell test location 7

Photo 18: Half-cell test location 8

PHOTOGRAPHS
AET PROJECT NO. P-0036871

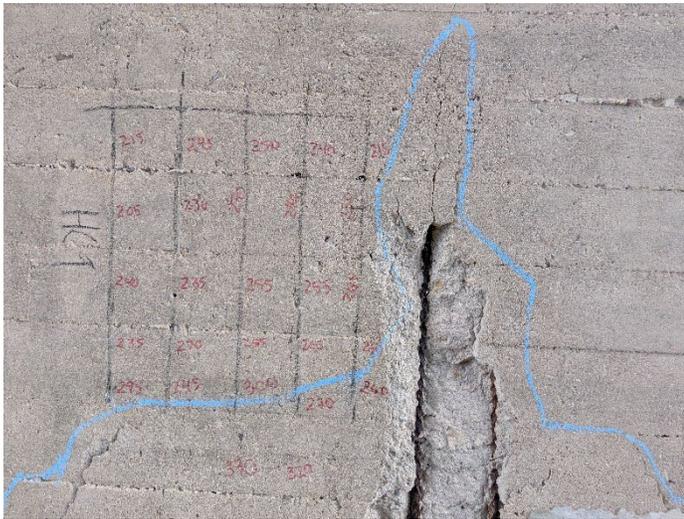


Photo 19: Half-cell test location 9

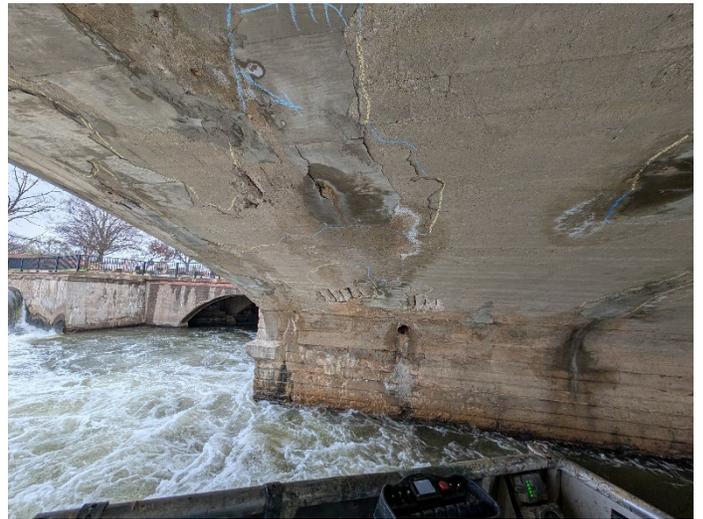


Photo 20: East arch underside



Photo 21: East arch underside



Photo 22: East arch underside



Photo 23: East arch underside



Photo 24: East arch – Upstream face

PHOTOGRAPHS
AET PROJECT NO. P-0036871



Photo 25: Center arch underside



Photo 26: Center arch underside



Photo 27: Center arch underside



Photo 28: Center arch underside



Photo 29: Center arch – Upstream face



Photo 30: Center arch underside

PHOTOGRAPHS
AET PROJECT NO. P-0036871



Photo 31: West arch underside



Photo 32: West arch underside



Photo 33: West arch underside



Photo 34: West arch underside



Photo 35: West arch – Downstream face



Photo 36: West arch – Downstream face

APPENDIX B

Sheet 1 – Plan View of Bridge Underside

Sheet 2 – Side Elevations of Bridge

Sheet 3 – Half-Cell Potential Maps



550 Cleveland Ave. North
Saint Paul, MN 55114
651-659-9001

CLIENT:
CALHOUN-BURNS & ASSOCIATES
1500 30TH STREET
WEST DES MOINES, IA 50266

PROJECT:
MAIN STREET BRIDGE
OVER THE CEDAR RIVER
CHARLES CITY, IA



LEGEND:

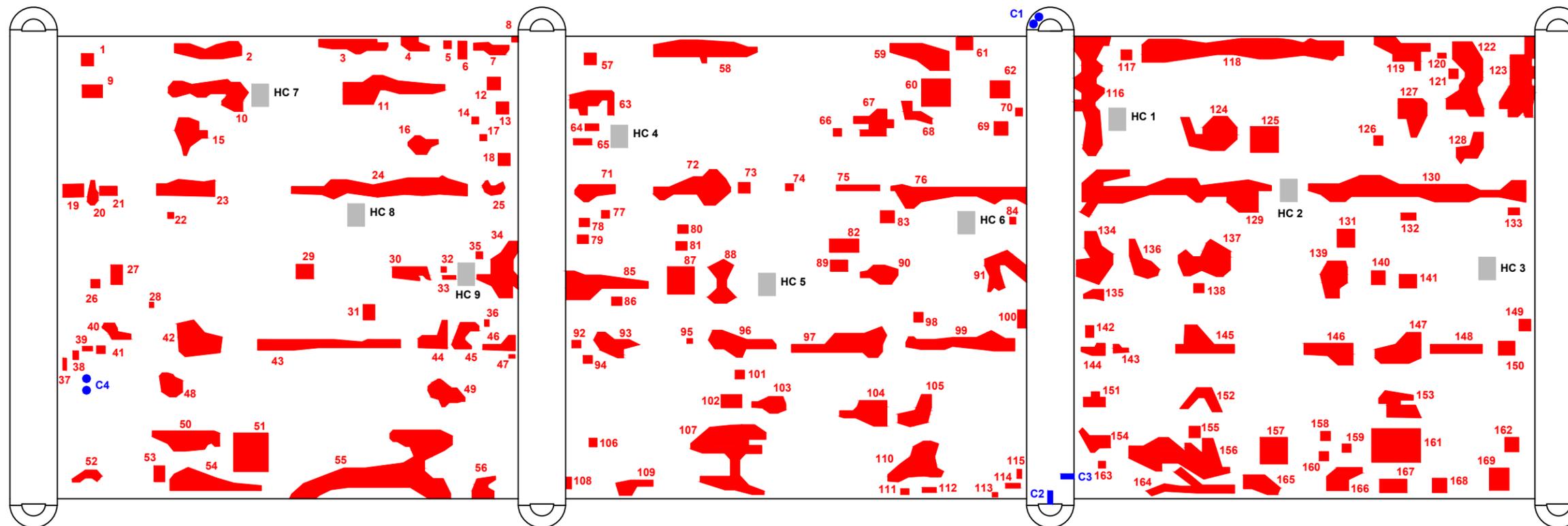
DELAMINATION



CORE LOCATION



HALF-CELL LOCATION



**UNDERSIDE OF
BRIDGE DECK**

Project No.: P-0036871

Drawn: BJM

Checked:

Scale: N.T.S.

DRAWING NO:

Date:

7/8/25

Sheet 1 OF 3

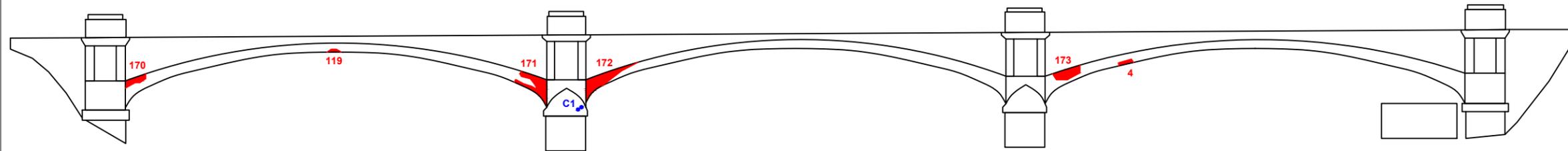


550 Cleveland Ave. North
Saint Paul, MN 55114
651-659-9001

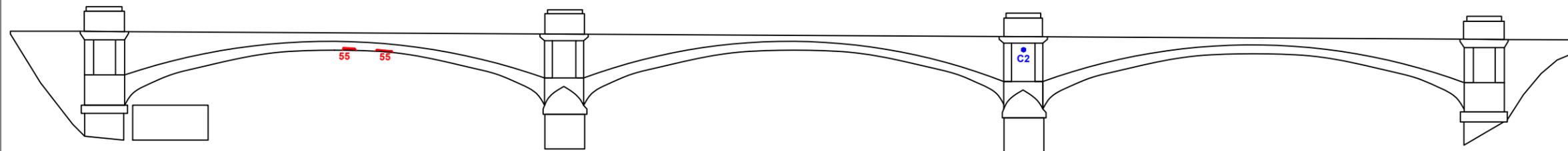
CLIENT:
CALHOUN-BURNS & ASSOCIATES
1500 30TH STREET
WEST DES MOINES, IA 50266

PROJECT:
MAIN STREET BRIDGE
OVER THE CEDAR RIVER
CHARLES CITY, IA

1. UPSTREAM FACE



2. DOWNSTREAM FACE



LEGEND:

DELAMINATION



CORE LOCATION



ELEVATION OF BRIDGE

Project No.: P-0036871

Drawn: BJM

Checked:

Scale: N.T.S.

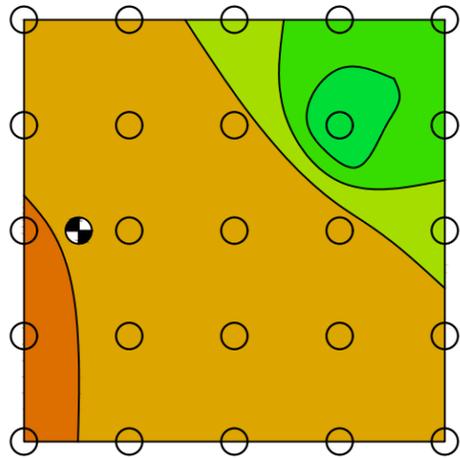
DRAWING NO:

Date:

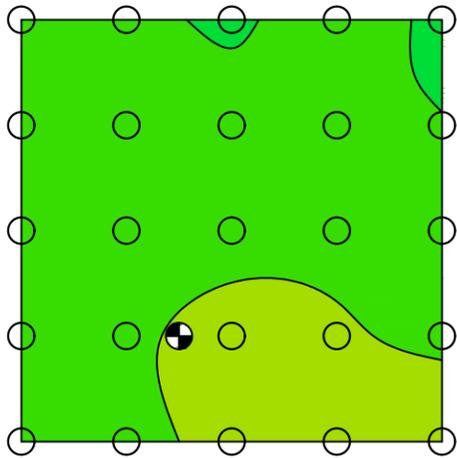
7/8/25

Sheet 2 OF 3

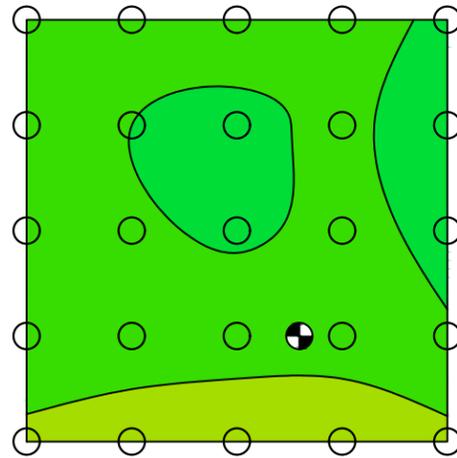
HC 1



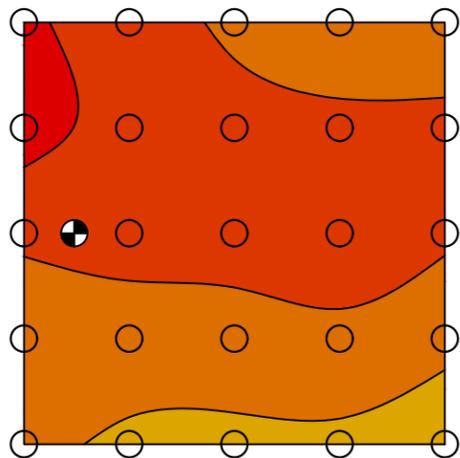
HC 4



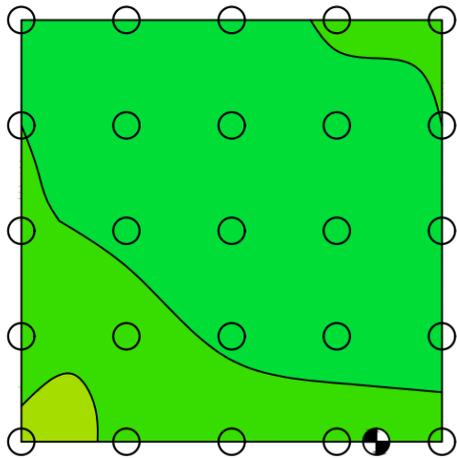
HC 7



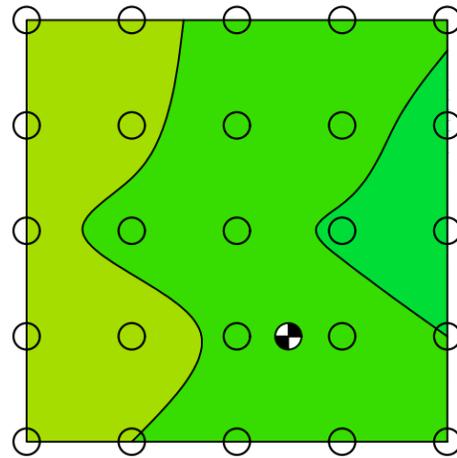
HC 2



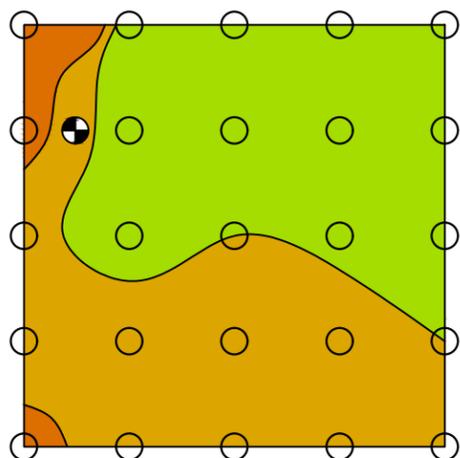
HC 5



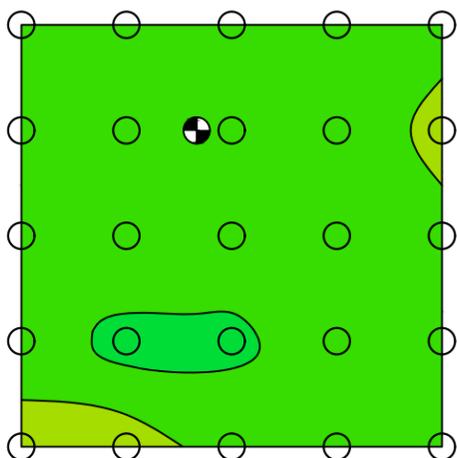
HC 8



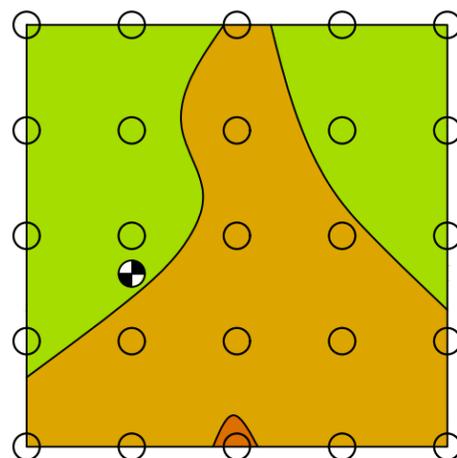
HC 3



HC 6



HC 9



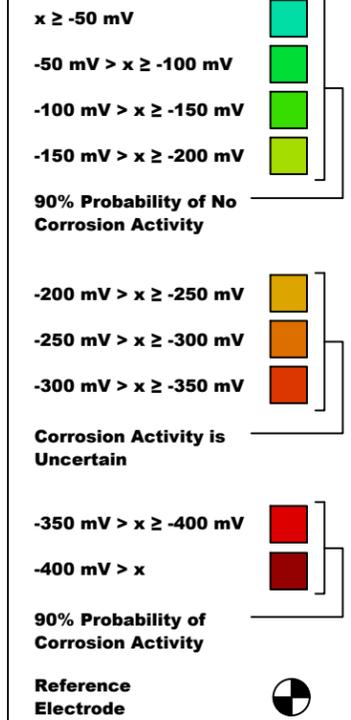
550 Cleveland Ave. North
Saint Paul, MN 55114
651-659-9001

CLIENT:
CALHOUN-BURNS & ASSOCIATES
1500 30TH STREET
WEST DES MOINES, IA 50266

PROJECT:
MAIN STREET BRIDGE
OVER THE CEDAR RIVER
CHARLES CITY, IA



LEGEND:



**HALF-CELL
POTENTIAL MAPS**

Project No.: P-0036871

Drawn: BJM

Checked:

Scale: N.T.S.

DRAWING NO:

Date:
7/8/25

Sheet 3 OF 3

APPENDIX C

Report of Chloride Analysis



REPORT OF CHLORIDE ANALYSIS

Project:

Charles City Main Street Bridge
Service Life Assessment
Charles City, IA

Reported To:

Calhoun-Burns & Associates, Inc.
1500 30th Street
West Des Moines, IA 50266

AET Project No.: P-0036871**Attn:** Lowell Miller
Date: May 22, 2025

INTRODUCTION

This report presents the results of laboratory work performed by our firm on four (4) core samples submitted by Brandon Mikelson, American Engineering Testing, Inc., on your behalf on May 1, 2025. The scope of our work was limited to documenting the acid-soluble chloride content of the cores at the specified test depths in accordance with ASTM C1152.

TEST PROCEDURES

Laboratory testing was performed on May 19, 2025, and subsequent dates in accordance with ASTM C1152-20, "Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete." The core samples were cut at the designated depths, crushed, dried in an oven, and processed to pass U.S.A. Standard Sieve No. 20. Results presented in Table 1 are reported on a dry weight 105 °C basis.

REMARKS

The test sample(s) will be retained for a period of at least sixty days from the date of this report. Unless further instructions are received by that time, the sample(s) may be discarded. The test results relate only to the sample(s) tested. No warranty, expressed or implied, is made.

Sincerely,

American Engineering Testing
An AASHTO Accredited Laboratory – Aggregates, Cement & Concrete

Report Prepared by:

Handwritten signature of Kattie Reamer in black ink.

Kattie Reamer
Scientist II
kreamer@teamAET.com
Work: 651-523-1270

Report Reviewed by:

Handwritten signature of Nick Wahl in black ink.

Nick Wahl
Scientist II
nwahl@teamAET.com
Work: 651-523-1271

550 Cleveland Avenue North | Saint Paul, MN 55114

Phone (651) 659-9001 | (800) 972-6364 | Fax (651) 659-1379 | teamAET.com | AA/EEO

This document shall not be reproduced, except in full, without written approval from American Engineering Testing, Inc.



TEST RESULTS

Table 1 – Acid-Soluble Chloride Content

| <u>Sample Identification</u> | <u>Sample Depth, in.</u> | <u>By Mass of Sample</u> | |
|------------------------------|--------------------------|--------------------------|--------------------|
| | | <u>%</u> | <u>ppm (mg/kg)</u> |
| Core 1A | 0 - 1 | 0.019 | 190 |
| | 1 - 2 | 0.033 | 330 |
| | 2 - 3 | 0.019 | 190 |
| | 3 - 4 | 0.077 | 770 |
| | 4 - 5 | 0.094 | 940 |
| | 5 - 6 | 0.053 | 530 |
| | 7 - 8 | 0.048 | 480 |
| | 8 - 8¾ | 0.052 | 520 |
| Core 2 | 0 - 1 | 0.195 | 1950 |
| | 1 - 2 | 0.286 | 2860 |
| | 2 - 3 | 0.075 | 750 |
| | 3 - 4 | 0.029 | 290 |
| | 4 - 5 | 0.016 | 160 |
| | 5 - 6 | 0.010 | 100 |
| | 7 - 8 | 0.004 | 40 |
| | 8 - 9 | 0.004 | 40 |
| Core 3 | 0 - 1 | 0.028 | 280 |
| | 1 - 2 | 0.027 | 270 |
| | 2 - 3 | 0.025 | 250 |
| | 3 - 4 | 0.030 | 300 |
| | 4 - 5 | 0.040 | 400 |
| | 5 - 6 | 0.032 | 320 |
| | 7 - 8 | 0.020 | 200 |
| | 8 - 9 | 0.014 | 140 |
| Core 4A | 7 - 8 | 0.003 | 30 |
| | 9 - 10 | 0.003 | 30 |
| | 11 - 12 | 0.003 | 30 |
| | 12 - 13 | 0.003 | 30 |
| | 13 - 14 | 0.003 | 30 |
| | 15 - 16 | 0.004 | 40 |
| | 16 - 17 | 0.003 | 30 |

APPENDIX D

Report of Petrographic Analysis



REPORT OF PETROGRAPHIC ANALYSIS

Project:

Charles City Main Street Bridge
Service Life Assessment
Charles City, IA

Reported To:

Calhoun-Burns & Associates, Inc.
1500 30th Street
West Des Moines, IA 50266

AET Project No.: P-0036871**Attn:** Lowell Miller, PE**Date:** July 7, 2025

INTRODUCTION

This report presents the results of laboratory work performed by our firm on six concrete core samples (1A, 1B, 2, 3, 4A, & 4B) obtained by representatives of American Engineering Testing, Inc. (AET) at the request of Lowell Miller of Calhoun-Burns & Associates, Inc. on April 28-30, 2025. Full petrographic analysis (including depth of carbonation analysis) was performed on samples 1B and 4B. Depth of carbonation analysis was performed on samples 2 and 3. Acid-soluble chloride content analysis was performed on samples 1A, 2, 3, and 4A and these results were reported separately. The concrete cores were obtained from the Charles City Main Street Bridge in Charles City, IA. Based on a cursory internet search, we understand that the bridge was completed in 1910. The scope of our work was limited to performing petrographic analysis on the samples to document the general overall condition of the concrete.

CONCLUSIONS

Based on our observations and analysis:

1. The general overall condition of the concrete in sample 1B was considered fair. No evidence of freeze-thaw deterioration or chemical attack was observed. Overall, the concrete was characterized by abundant finer consolidation voids ranging from less than 1 mm (1/32") up to 9 mm (3/8") in their longest dimension, throughout the depth of the core sample. The top up to 60 mm of the concrete exhibited a visually higher concentration of consolidation voids, and the consolidation voids produced partial "honeycombing" of the core top surface. A relatively small and inconsequential amount of alkali silica reaction (ASR) was noted in core 1B. Colorless to white alkali-silica gel lined to filled a few of the consolidation voids. The offending reactive aggregate particles were partly silicified carbonate coarse and fine aggregate particles, as well as chert fine aggregate particles. The amount of alkali-silica reactivity (ASR) observed was considered very minor for concrete of this age (100+ years), and no mass deterioration or

550 Cleveland Avenue North | Saint Paul, MN 55114

Phone (651) 659-9001 | (800) 972-6364 | Fax (651) 659-1379 | teamAET.com | AA/EEO

This document shall not be reproduced, except in full, without written approval from American Engineering Testing, Inc.



cracking associated with ASR was observed. The concrete was undermixed. Many spherical zones of darker-colored cement paste (“cement balls”) up to 9 mm (3/8”) in diameter were noted throughout the core sample. Similarly, concentrated cement was noted forming “halos” several millimeters thick around the perimeter of aggregate particles in the sample. In thin section, these zones of darker-colored paste were observed to contain a higher concentration of residual portland cement clinker particles exhibiting lower levels of hydration. The cement lumps and apparent poor mixing of cement were visually consistent with concretes produced in the former half of the 20th century. Depth of carbonation from the top surface of the sample ranged from 7 mm (1/4”) to 11 mm (7/16”).

2. The general overall condition of the concrete in sample 4B was considered fair to good. No evidence of freeze-thaw deterioration or chemical attack was observed. Like the concrete in sample 1B, the concrete in 4B was characterized by abundant fine consolidation voids throughout its depth. A similar small amount of ASR was also observed in this sample; the offending aggregate particles were partly silicified carbonate coarse and fine aggregate particles and chert fine aggregate particles. Depth of carbonation from the bottom surface of the sample ranged from 58 mm (2-1/4”) to 80 mm (3-1/8”).

3. The concrete in both samples 1B and 4B was of visually similar composition, consisting of relatively coarse ground portland cement, a natural gravel coarse aggregate, and a natural sand. The coarse aggregate in both samples was sparse and poorly distributed. The concrete in both samples contained air/consolidation void systems generally consistent with current American Concrete Institute (ACI) recommendations for freeze-thaw resistance. Colorless to white acicular ettringite was noted lining to filling many consolidation voids at various depths in both core samples, in non-carbonated areas. The formation of secondary ettringite as well as alkali-silica gel is indicative of persistently water-saturated conditions previously in the concretes service life.

SAMPLE IDENTIFICATION

Sample Type: Hardened Concrete Cores (C)

| <u>Sample ID</u> | <u>Diameter</u> | <u>Length</u> |
|------------------|-----------------|-----------------|
| 1A | 95 mm (3-3/4") | 114 mm (4-1/2") |
| 1B | 95 mm (3-3/4") | 146 mm (5-3/4") |
| 2 | 95 mm (3-3/4") | 146 mm (5-3/4") |
| 3 | 44 mm (1-3/4") | 114 mm (4-1/2") |
| 4A | 44 mm (1-3/4") | 108 mm (4-1/4") |
| 4B | 44 mm (1-3/4") | 108 mm (4-1/4") |



DEPTH OF CARBONATION ANALYSIS

| <u>Sample ID</u> | <u>Depth / description of carbonation</u> |
|------------------|--|
| 1B | Ranged from 7 mm (1/4") to 11 mm (7/16") from the top surface |
| 2 | Ranged from 10 mm (3/8") up to 23 mm (7/8") from the outer surface |
| 3 | Mottled carbonation was noted throughout the core's depth |
| 4B | Ranged from 58 mm (2-1/4") to 80 mm (3-1/8") from the bottom surface |

TEST RESULTS

Our complete petrographic analysis documentation appears on the attached sheets entitled 24-LAB-001 "Petrographic Examination of Hardened Concrete, ASTM C856." A brief summary of the general physical characteristics of the concrete in samples 1B and 4B is as follows:

1. The coarse aggregate was comprised of 19 mm (3/4") nominal sized natural gravel that appeared poorly to fairly graded and exhibited poor overall distribution. The fine aggregate was a natural sand.
2. The paste color in sample 1B was mottled light gray to very light gray to light olive gray (Munsell® N7 – N8 – 5Y 6/1) overall, and medium gray to medium dark gray (N5 – N3) in spherical zones of darker-colored paste throughout the sample. The paste color in sample 4B was very light gray to light gray (Munsell® N8-N7) overall, and similar to and darker than very pale orange (10YR 8/2) in carbonated paste. The paste hardness in sample 1B was moderately soft (Mohs hardness 2.5 -3) overall, and moderate to moderately hard (Mohs 3 – 3.5) in the spherical zones of darker-colored paste. The paste hardness in sample 4B was moderately soft. The paste-aggregate bond in both samples was considered poor.
3. The w/cm in sample 1B was estimated at between 0.40 and 0.50 with approximately 3 to 5% residual portland cement clinker particles overall. Abundant cement-balls exhibiting concentrated residual portland cement clinker particles and lower overall w/cm (0.30-0.35) were also noted in thin section - corresponding to the spherical zones of darker-colored paste in the concrete. The w/cm in sample 4B was also estimated at between 0.45 and 0.55 with approximately 3 to 5% residual portland cement clinker particles. No supplementary cementitious materials were observed in the concrete samples.



AIR CONTENT TESTING

| <u>Sample ID</u> | <u>Total Air Content (%)</u> | <u>"Entrained" Air (%) void <1 mm (0.040")</u> | <u>"Entrapped" Air (%) voids >1 mm (0.040")</u> | <u>Spacing Factor, in.</u> |
|------------------|------------------------------|---|--|----------------------------|
| 1B | 14.4 | 10.8 | 3.6 | 0.004 |
| 4B | 8.4 | 7.2 | 1.2 | 0.008 |

TEST PROCEDURES

Laboratory testing was performed on May 1, 2025 and subsequent dates. Our procedures were as follows:

1.0 Petrographic Analysis

A petrographic analysis was performed in accordance with AET Standard Operating Procedure 24-LAB-001, "Petrographic Examination of Hardened Concrete," ASTM C856-latest revision. The petrographic analysis consisted of reviewing the cement paste and aggregate qualities on a whole basis on saw cut, lapped, and fractured sections. Reflected light microscopy was performed under an Olympus SZX-12 binocular stereozoom microscope at magnifications up to 160x. The depth of carbonation was documented using a phenolphthalein pH indicator solution applied on freshly saw cut and lapped surfaces of the concrete sample. The paste-coarse aggregate bond quality was determined by fracturing a sound section of the concrete in the laboratory with a rock hammer.

The water/cementitious of the concrete was estimated by viewing a thin section of the concrete under a Nikon E600 polarizing light microscope at magnifications of up to 600x. Thin section analysis was performed in accordance with Standard Operating Procedure 24-LAB-009, "Determining the Water/Cement of Portland Cement Concrete, AET Method." An additional, smaller, saw cut subdivision of the concrete sample is epoxy impregnated, highly polished, and then attached to a glass slide using an optically clear epoxy. Excess sample is saw cut from the glass and the thin slice remaining on the slide is lapped and polished until the concrete reaches 25 microns or less in thickness. Thin section analysis allows for the observation of portland cement morphology, including: phase identification, an estimate of the amount of residual material, and spatial relationships. Also, the presence and relative amounts of supplementary cementitious materials and pozzolans may be identified and estimated.

2.0 Air Content Testing

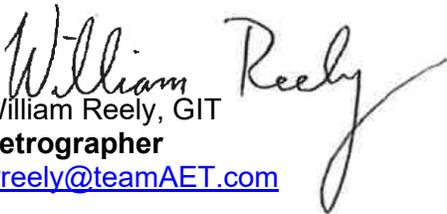
Air content testing was performed using Standard Operating Procedure 24-LAB-003, "Microscopical Determination of Air Void Content and Parameters of the Air Void System in Hardened Concrete, ASTM C457-latest revision." The linear traverse method was used. The concrete cores were saw cut parallel to the direction of coring and then lapped prior to testing.

REMARKS

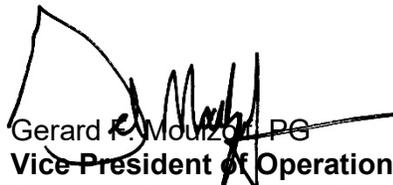
The test samples will be retained for a period of at least sixty days from the date of this report. Unless further instructions are received by that time, the samples may be discarded. Test results relate only to the items tested. No warranty, expressed or implied, is made.

We appreciate the opportunity to have been of service to you on this project. If you have any questions regarding the information presented in this report or if we can be of additional assistance, please contact us.

Report Prepared By:
American Engineering Testing, Inc.



William Reely, GIT
Petrographer
wreely@teamAET.com



Gerard F. Moulzolf, PG
Vice President of Operations
Principal Petrographer/Geologist
MN License #30023
gmoulzolf@teamAET.com
612-616-6155

24-LAB-001 PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE, ASTM C856

| | | | | | |
|--------------------|-----------|----------------------|------------------------|-----------------------|-------------|
| Project No. | P-0036871 | Date: | 5/27/2025 6/25/2025 | Date reviewed: | 7/7/25 |
| Sample ID: | 1B | Performed by: | G. Hemmila W. Reely | Reviewed by: | G. Moulzolf |

I. GENERAL OBSERVATIONS

1. Sample Dimensions: Our analysis was performed on a 210 mm (8-1/4") x 94 mm (3-11/16") x 44 mm (1-3/4") thick lapped profile section and a 76 mm (3") x 52 mm (2") thin section that were saw-cut and prepared from the original 95 mm (3-3/4") diameter x 210 mm (8-1/4") long core.
2. Surface Conditions:
Outer: Rough, irregular, partly formed and partly honeycombed and spalled surface
Inner: Rough, irregular, fractured surface.
3. Reinforcement: None observed.
4. General Physical Conditions: Approximately 40% of the outer surface exhibited poor consolidation (honeycombing) and spalling; this part of the top surface was recessed to depths of up to 23 mm (7/8") beneath the unaffected portion of the top surface. The intact outer surface was partly covered with remnants of a white mortar/parging and a 2mm layer of hardened gray cementitious parging; then overlain by gray paint.

Overall, the concrete was characterized by abundant consolidation voids, ranging from less than 1 mm (1/32") up to 9 mm (3/8") in their longest dimension, throughout its depth. The outer up to 60 mm of the concrete exhibited a visually higher concentration of consolidation voids. Colorless to white alkali-silica gel lined to filled a few of the consolidation voids; the offending reactive aggregate particles were partly silicified carbonate coarse and fine aggregate particles, as well as chert fine aggregate particles. Colorless to white acicular ettringite also lined many of the consolidation voids at various depths throughout the sample, in non-carbonated areas.

Many darker colored, denser cement or cement and sand balls up to 13mm (1/2") in diameter were scattered at various depths throughout the sample. Many coarse aggregate particles were also mantled by similar darker-colored cement. The concrete contained an air void system generally consistent with current American Concrete Institute (ACI) recommendations for freeze-thaw resistance; the total air void content was 14.4% and the spacing factor was 0.004 inches.

II. AGGREGATE

1. Coarse: 19 mm (3/4") nominal sized naturally occurring gravel consisting of felsite, limestone, and partly silicified carbonates. The particles were mostly sub-rounded in shape. The coarse aggregate appeared fairly graded and exhibited poor overall distribution.
2. Fine: Natural quartz, feldspar, and lithic sand (quartzite, chert, carbonates, felsite, and graywacke, with a few amphibole and iron oxide grains). The grains were mostly sub-rounded with many smaller sub-angular particles. The fine aggregate appeared fairly graded and exhibited good overall uniform distribution.

III. CEMENTITIOUS PROPERTIES

1. Air Content: 14.4% total
2. Depth of carbonation: Ranged from 7 mm (1/4") to 11 mm (7/16") from the top surface
3. Paste/aggregate bond: Poor
4. Paste color: Mottled light gray to very light gray to light olive gray (Munsell® N7 – N8 – 5Y 6/1) overall; medium gray to medium dark gray (N5 – N3) in spherical zones of darker-colored paste throughout the sample.
5. Paste hardness: Moderately soft (Mohs \approx 2.5 - 3) overall, moderate to moderately hard (3-3.5) in the spherical zones of darker paste.
6. Microcracking: One microcrack oriented sub-perpendicular to the bottom surface proceeded up to 76 mm (3") from that surface.
7. Secondary deposits: Colorless to white alkali-silica gel lined to filled a few of the consolidation voids. Colorless to white acicular ettringite also lined many of the consolidation voids at various depths throughout the sample, in non-carbonated areas.
8. w/cm: Estimated at between 0.40 and 0.50 with approximately 3 to 5% residual portland cement clinker particles overall. Abundant cement "balls" exhibiting more-abundant residual portland cement clinker particles and lower overall w/cm (0.30-0.40) were also noted in thin section - corresponding to the spherical zones of cement concentrations in the concrete.
9. Cement hydration: Alites: well to fully
Belites: low to well

24-LAB-001 PETROGRAPHIC EXAMINATION OF HARDENED CONCRETE, ASTM C856

| | | | | | |
|--------------------|-----------|----------------------|------------------------|-----------------------|-------------|
| Project No. | P-0036871 | Date: | 5/27/2025 6/25/2025 | Date reviewed: | 7/7/25 |
| Sample ID: | 4B | Performed by: | G. Hemmila W. Reely | Reviewed by: | G. Moulzolf |

I. GENERAL OBSERVATIONS

1. Sample Dimensions: Our analysis was performed on a 165 mm (6-1/2") x 95 mm (3-3/4") x 44 mm (1-3/4") thick lapped profile section and a 76 mm (3") x 52 mm (2") thin section that were saw-cut and prepared from the original 95 mm (3-3/4") diameter x 165 mm (6-1/2") long core.
2. Surface Conditions:
Outer: Rough, formed and mortar-eroded surface
Inner: Rough, irregular, fractured surface
3. Reinforcement: None observed.
4. General Physical Conditions: The outer surface of the sample had undergone mortar erosion to an unknown depth, exposing numerous fine aggregate particles and a few coarse aggregate particles. A few "bug-hole"/consolidation voids were also exposed. The depth of carbonation from the inner surface was negligible, and depth of carbonation from the outer surface ranged from 58 mm (2-1/4") to 80 mm (3-1/8"). Overall, the concrete was characterized by abundant irregular-shaped consolidation voids, ranging from less than 1 mm (1/32") up to 7 mm (1/4") in their longest dimension, throughout the depth of the core sample. Colorless to white alkali-silica gel lined to filled several air voids throughout the sample; the offending aggregate particles were rare, partly silicified, carbonate coarse and fine aggregate particles and chert fine aggregate particles. The concrete contained an air void system generally consistent with current American Concrete Institute (ACI) recommendations for freeze-thaw resistance; the total air void content was 8.4% and the spacing factor was 0.008 inches.

II. AGGREGATE

1. Coarse: 19 mm (3/4") nominal sized naturally occurring gravel felsite, limestone, and partly silicified carbonates. The particles were mostly sub-rounded in shape. The coarse aggregate appeared poorly graded and exhibited poor overall distribution.
2. Fine: Natural quartz, feldspar, and lithic sand (quartzite, chert, carbonates, partly silicified carbonates, graywacke, and felsite, with a few amphibole and iron oxide grains). The grains were mostly sub-rounded with many smaller sub-angular particles. The fine aggregate appeared fairly graded and exhibited good overall uniform distribution.

III. CEMENTITIOUS PROPERTIES

1. Air Content: 8.4% total
2. Depth of carbonation: Ranged from 58 mm (2-1/4") up to 80 mm (3-1/8") depth from the bottom surface.
3. Paste/aggregate bond: Poor
4. Paste color: Very light gray to light gray (Munsell® N8-N7) overall, similar to and darker than very pale orange (10YR 8/2) in carbonated paste.

5. Paste hardness: Moderately soft (Mohs \approx 2.5 - 3).
6. Microcracking: None observed.
7. Secondary deposits: White to colorless alkali-silica gel lined to filled several air voids throughout the sample.
8. w/cm: Estimated at between 0.45 and 0.55 with approximately 3 to 5% residual portland cement clinker particles. Many coarse clinker particles exhibiting internal "cores" with lower overall w/cm were also noted in thin section.
9. Cement hydration: Alites: well to fully
Belites: moderate to well



AIR VOID ANALYSIS

Project:

Charles City Main Street Bridge
 Service Life Assessment
 Charles City, IA

Reported To:

Calhoun-Burns & Associates, Inc.
 1500 30th Street
 West Des Moines, IA 50266

AET Project No.: P-0036871

Attn: Lowell Miller, PE

Date: July 7, 2025

Sample:

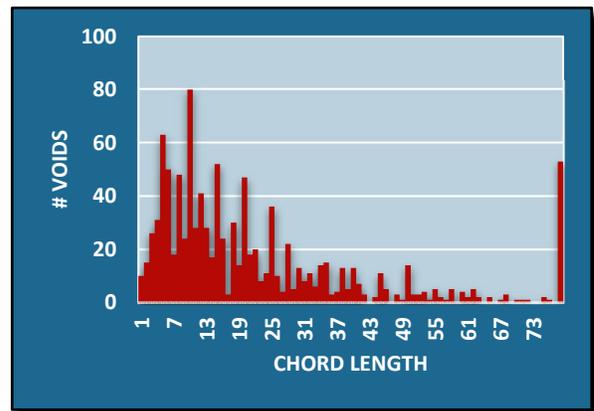
1B

Conformance: The sample contains an air void system generally consistent with current American Concrete Institute (ACI) recommendations for freeze-thaw resistance.

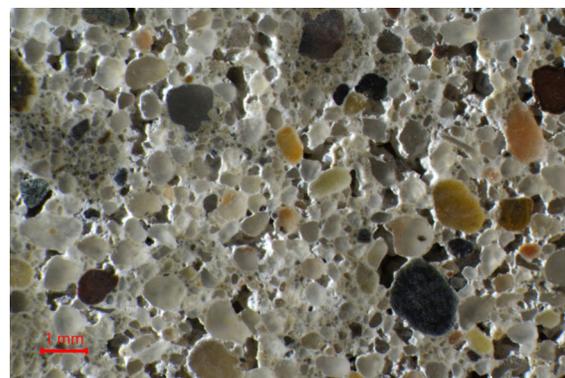
Sample Data:

Description: Concrete Core
 Dimensions: 95 mm (3-3/4") by
 210 mm (8-1/4") length
Test Data: By ASTM C457, Procedure A

| | |
|--|------------|
| Air Void Content, % | 14.4 |
| Entrained, % <0.040" (1mm) | 10.8 |
| Entrapped, % >0.040" (1mm) | 3.6 |
| Air Voids/inch | 11.5 |
| Specific Surface, in ² /in ³ | 320 |
| Spacing Factor, inches | 0.004 |
| Paste Content, % estimated | 19 |
| Magnification | 75x |
| Traverse Length, inches | 90 |
| Area Traversed, in ² | 15 |
| Test Performed By | G. Hemmila |



Chord Length, in: 0.00052



Magnification: 10x
 Test Date: 5/27/2025

550 Cleveland Avenue North | Saint Paul, MN 55114

Phone (651) 659-9001 | (800) 972-6364 | Fax (651) 659-1379 | teamAET.com | AA/EEO

This document shall not be reproduced, except in full, without written approval from American Engineering Testing, Inc.



AIR VOID ANALYSIS

Project:

Charles City Main Street Bridge
 Service Life Assessment
 Charles City, IA

Reported To:

Calhoun-Burns & Associates, Inc.
 1500 30th Street
 West Des Moines, IA 50266

AET Project No.: P-0036871

Attn: Lowell Miller, PE

Date: July 7, 2025

Sample:

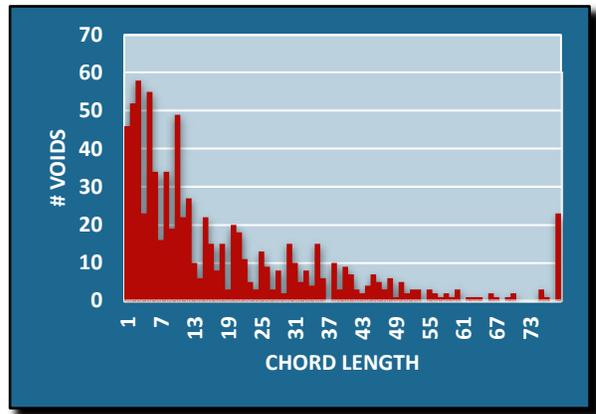
4B

Conformance: The sample contains an air void system generally consistent with current American Concrete Institute (ACI) recommendations for freeze-thaw resistance.

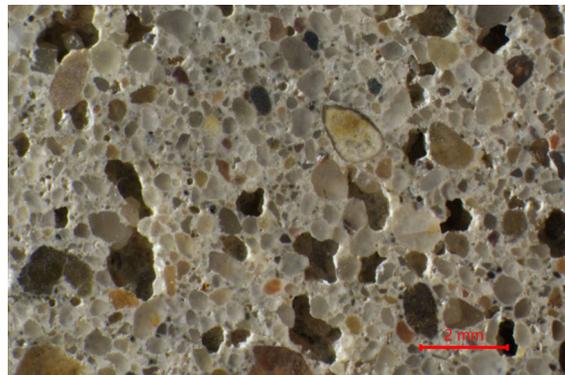
Sample Data:

Description: Concrete Core
 Dimensions: 95 mm (3-3/4") by
 165 mm (6-1/2") length
Test Data: By ASTM C457, Procedure A

| | |
|--|------------|
| Air Void Content, % | 8.4 |
| Entrained, % <0.040" (1mm) | 7.2 |
| Entrapped, % >0.040" (1mm) | 1.2 |
| Air Voids/inch | 8.6 |
| Specific Surface, in ² /in ³ | 410 |
| Spacing Factor, inches | 0.008 |
| Paste Content, % estimated | 27 |
| Magnification | 75x |
| Traverse Length, inches | 92 |
| Area Traversed, in ² | 12 |
| Test Performed By | G. Hemmila |



Chord Length, in: 0.00052



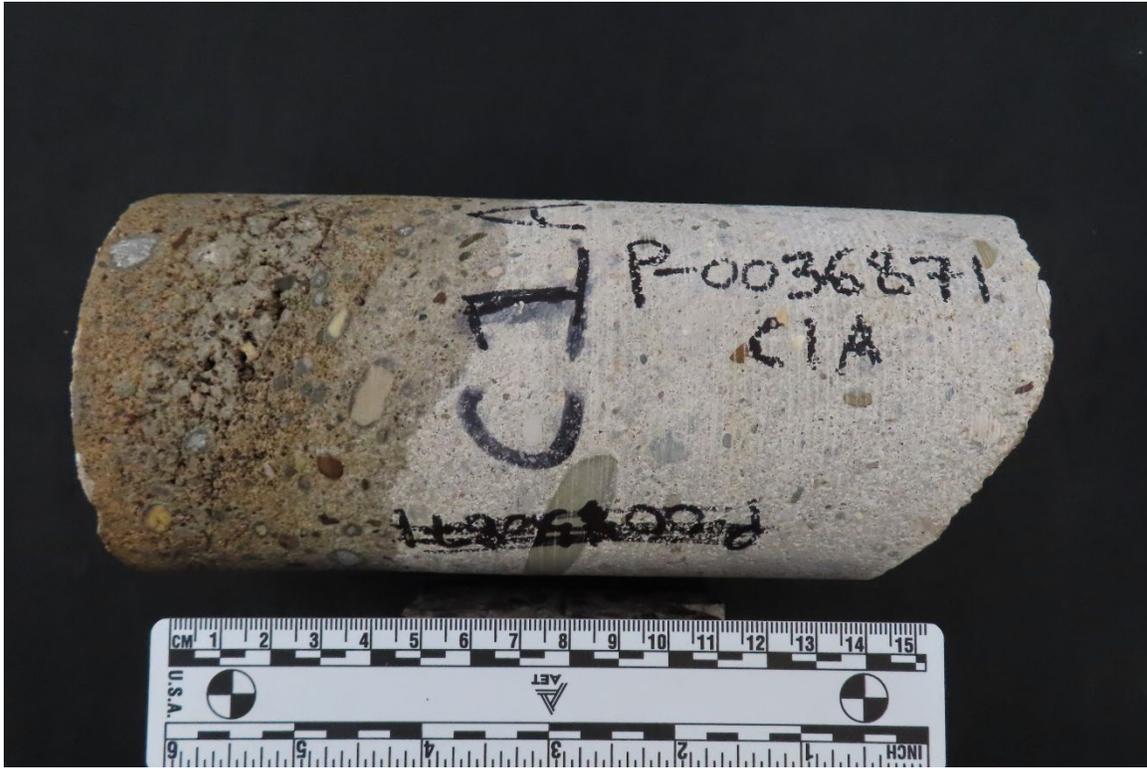
Magnification: 10x
 Test Date: 5/27/2024

550 Cleveland Avenue North | Saint Paul, MN 55114

Phone (651) 659-9001 | (800) 972-6364 | Fax (651) 659-1379 | teamAET.com | AA/EEO

This document shall not be reproduced, except in full, without written approval from American Engineering Testing, Inc.

Photo: 1



Sample ID:

1A

Description: The overall profile of the core sample as received with the outer surface oriented to the left. This sample was used for acid-soluble chloride content analysis.

Photo: 2



Sample ID:

1A

Description: The outer surface of the core sample as received.

Photo: 3

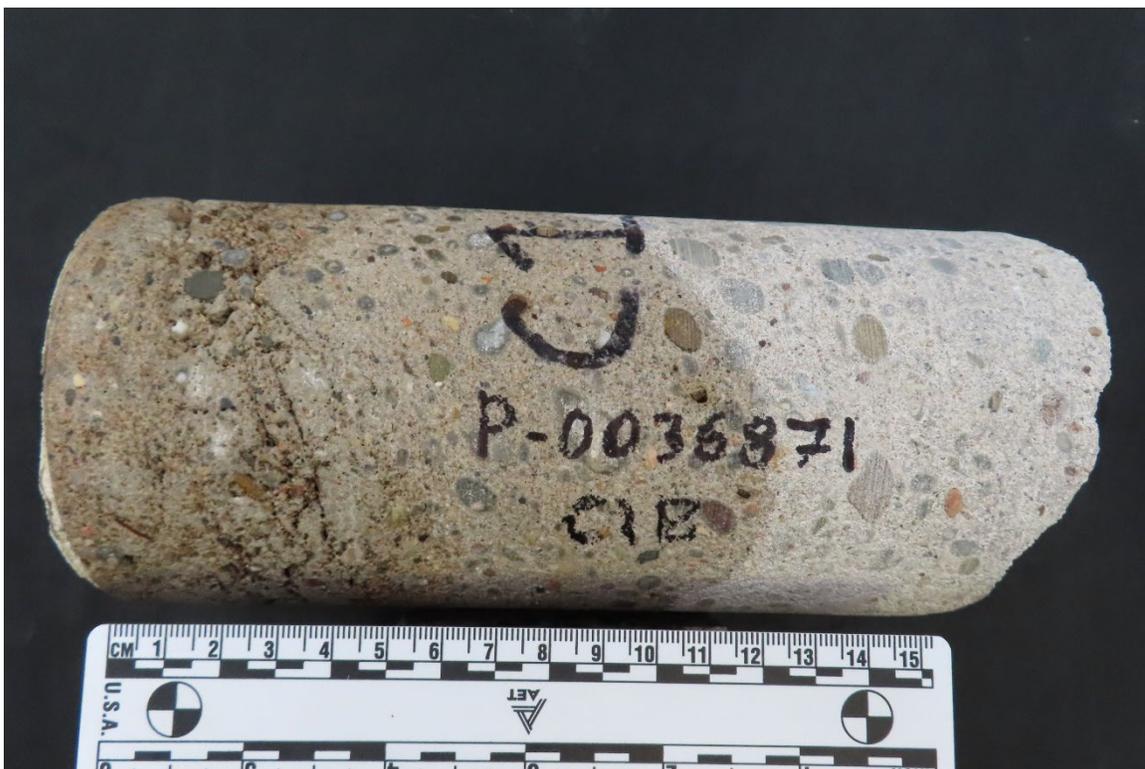


Sample ID:

1A

Description: The inner surface of the core sample as received.

Photo: 4



Sample ID:

1B

Description: The overall profile of the core sample as received with the outer surface oriented to the left. This sample was used for full petrographic analysis.

Photo: 5



Sample ID:

1B

Description: The outer surface of the core sample as received.

Photo: 6

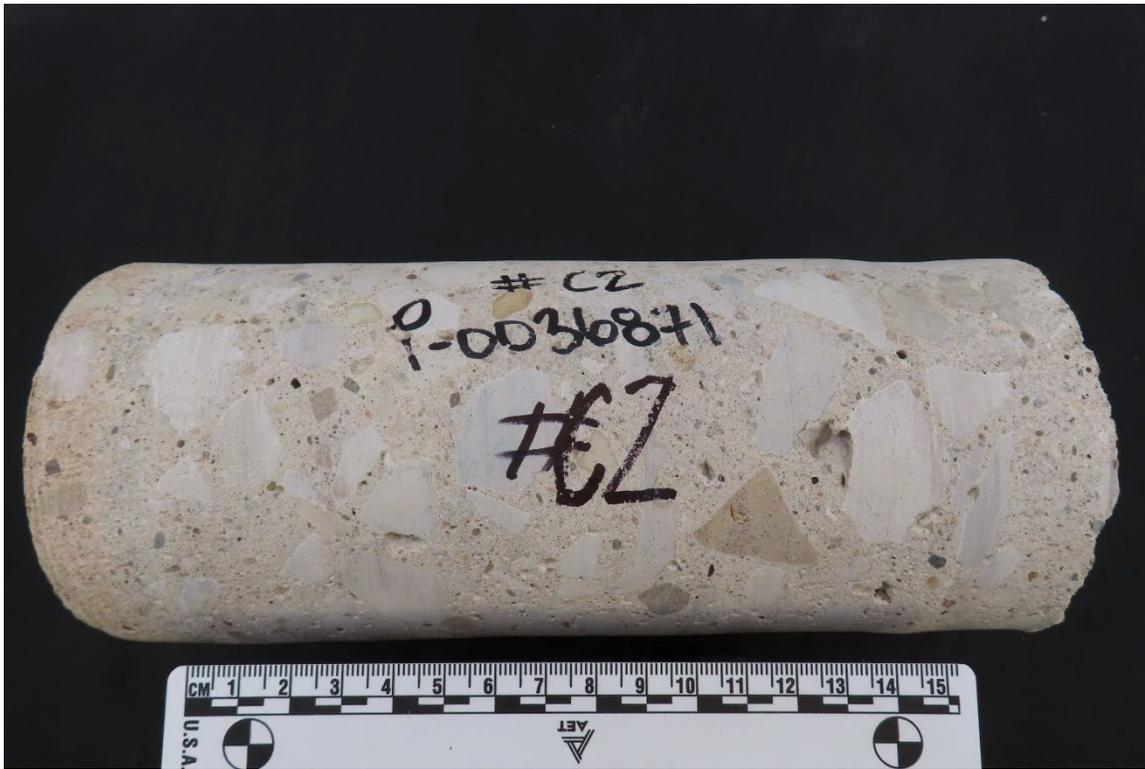


Sample ID:

1B

Description: The inner surface of the core sample as received.

Photo: 7



Sample ID:

2

Description: The overall profile of the core sample as received with the outer surface oriented to the left. This sample was used for depth of carbonation analysis and acid-soluble chloride content analysis.

Photo: 8



Sample ID:

2

Description: The outer surface of the core sample as received.

Photo: 9

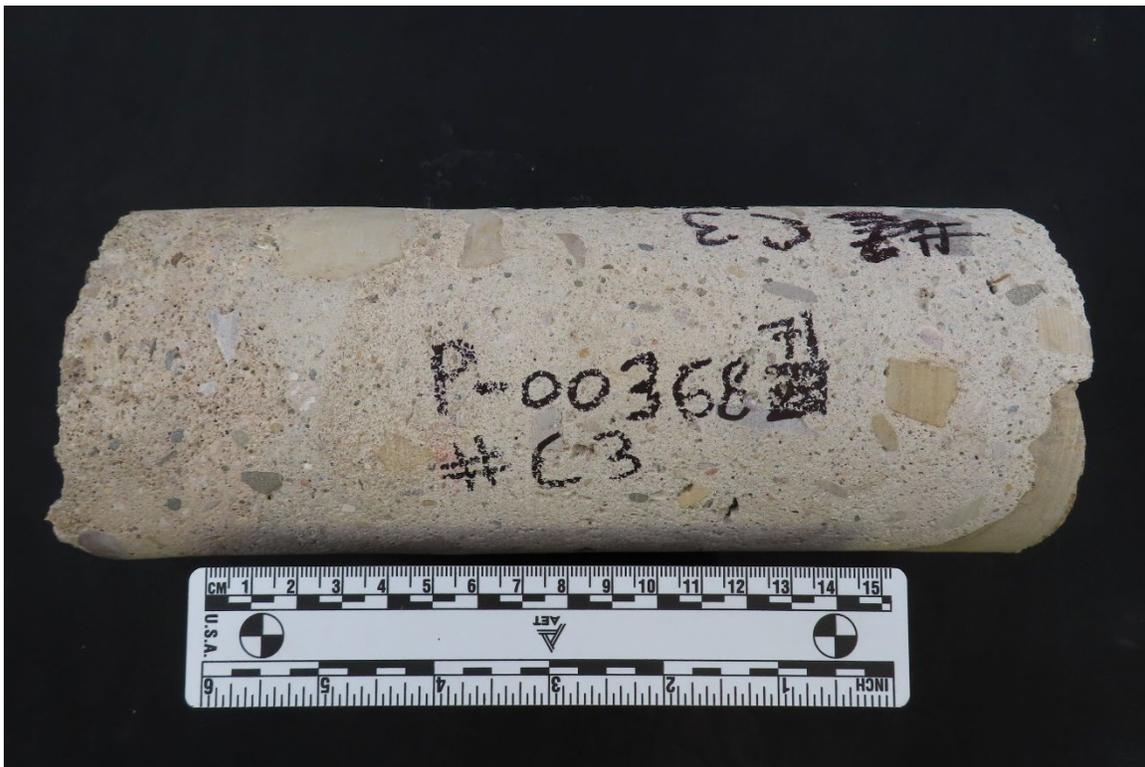


Sample ID:

2

Description: The inner surface of the core sample as received.

Photo: 10



Sample ID:

3

Description: The overall profile of the core sample as received with outer surface oriented to the left. This sample was used for depth of carbonation analysis and acid-soluble chloride content analysis.

Photo: 11



Sample ID:

3

Description: The outer surface of the core sample as received.

Photo: 12

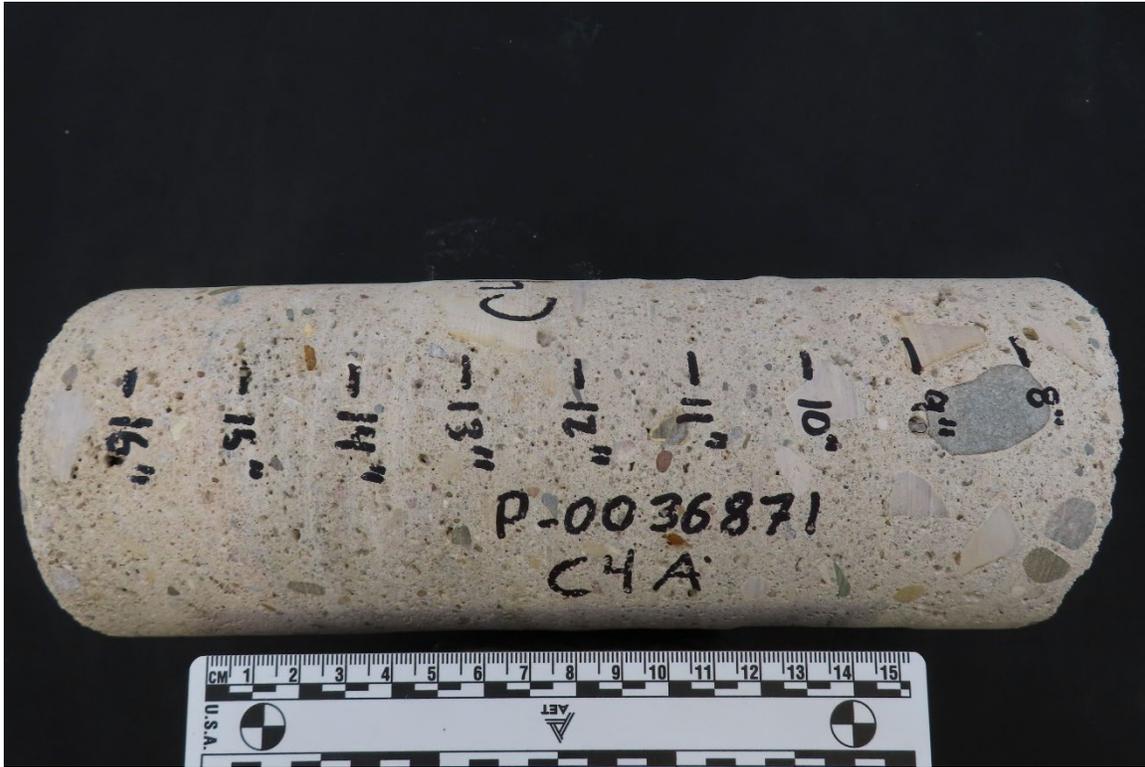


Sample ID:

3

Description: The inner surface of the core sample as received.

Photo: 13



Sample ID:

4A

Description: The overall profile of the core sample as received with the outer surface oriented to the left. This sample was used for acid-soluble chloride content analysis.

Photo: 14



Sample ID:

4A

Description: The outer surface of the sample as received.

Photo: 15

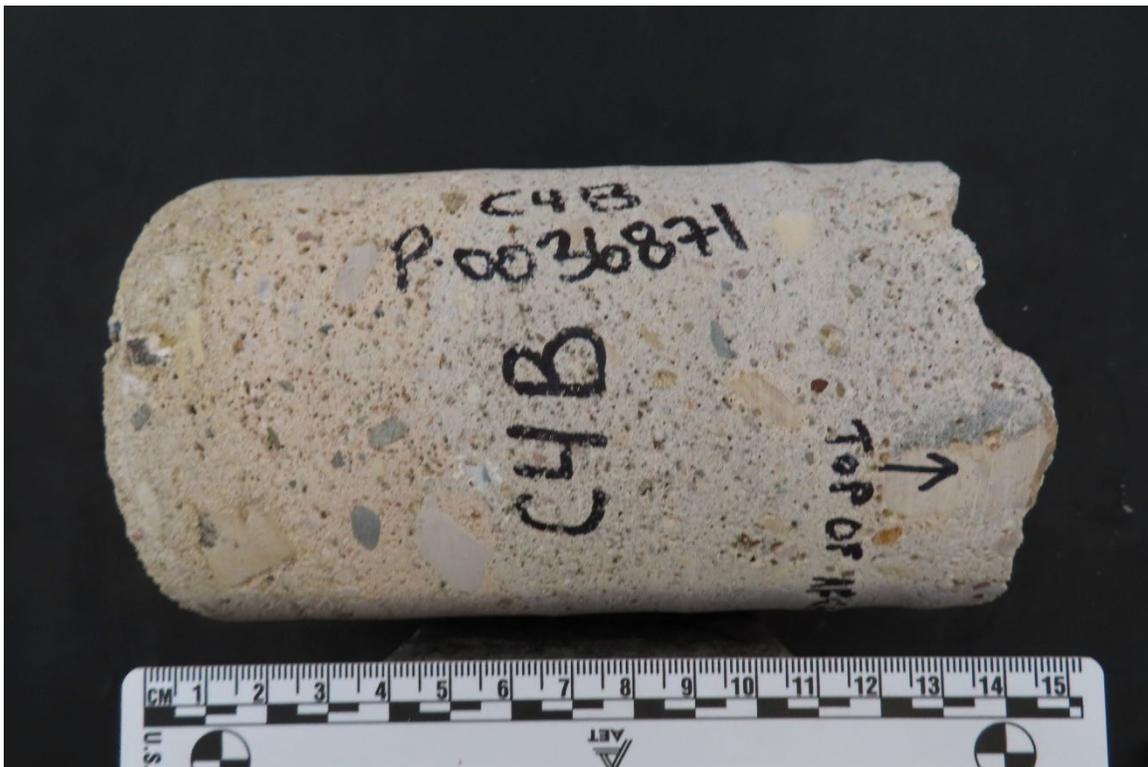


Sample ID:

4A

Description: The outer surface of the core sample as received.

Photo: 16



Sample ID:

4B

Description: The overall profile of the core sample as received with the outer surface oriented to the left. This sample was used for full petrographic analysis.

Photo: 17



Sample ID:

4B

Description: The outer surface of the sample as received.

Photo: 18



Sample ID:

4B

Description: The inner surface of the core sample as received.

Photo: 19

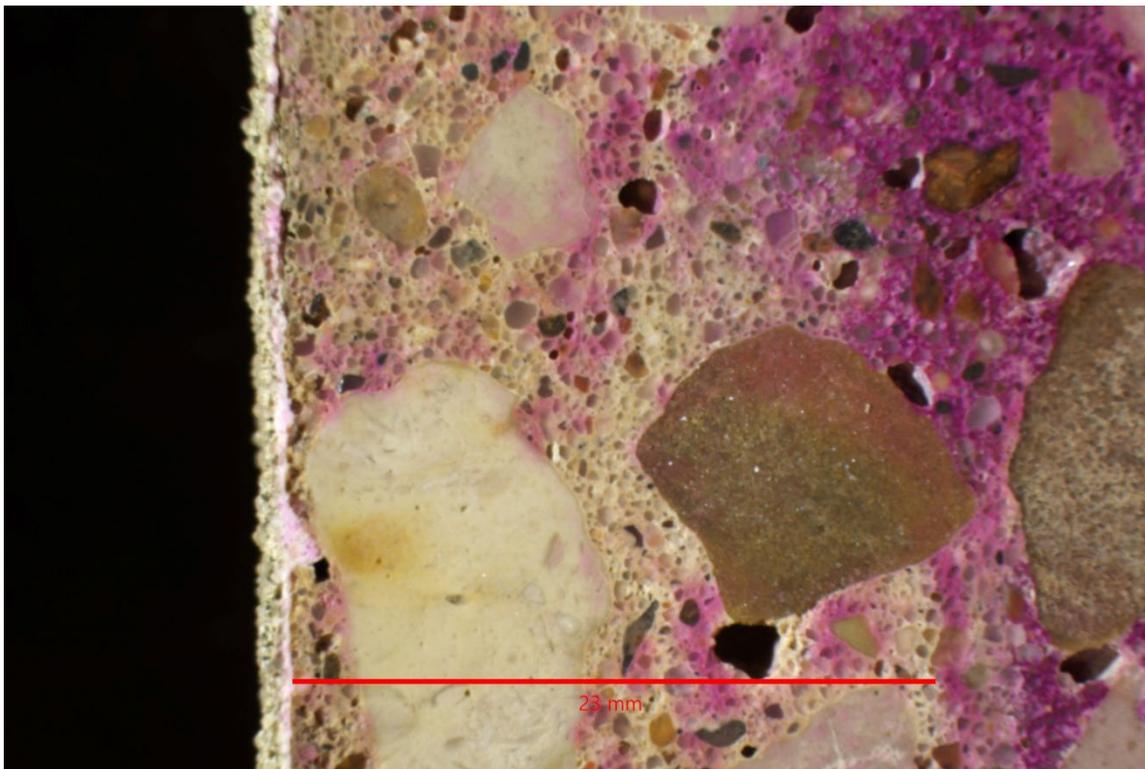


Sample ID:
Mag:

1B
5x

Description: Carbonation (unstained paste) proceeded up to 11 mm (7/16") from the outer surface (top); on a saw-cut and lapped cross section of the core sample after application of phenolphthalein pH indicator (pink stain). Note the consolidation voids.

Photo: 20

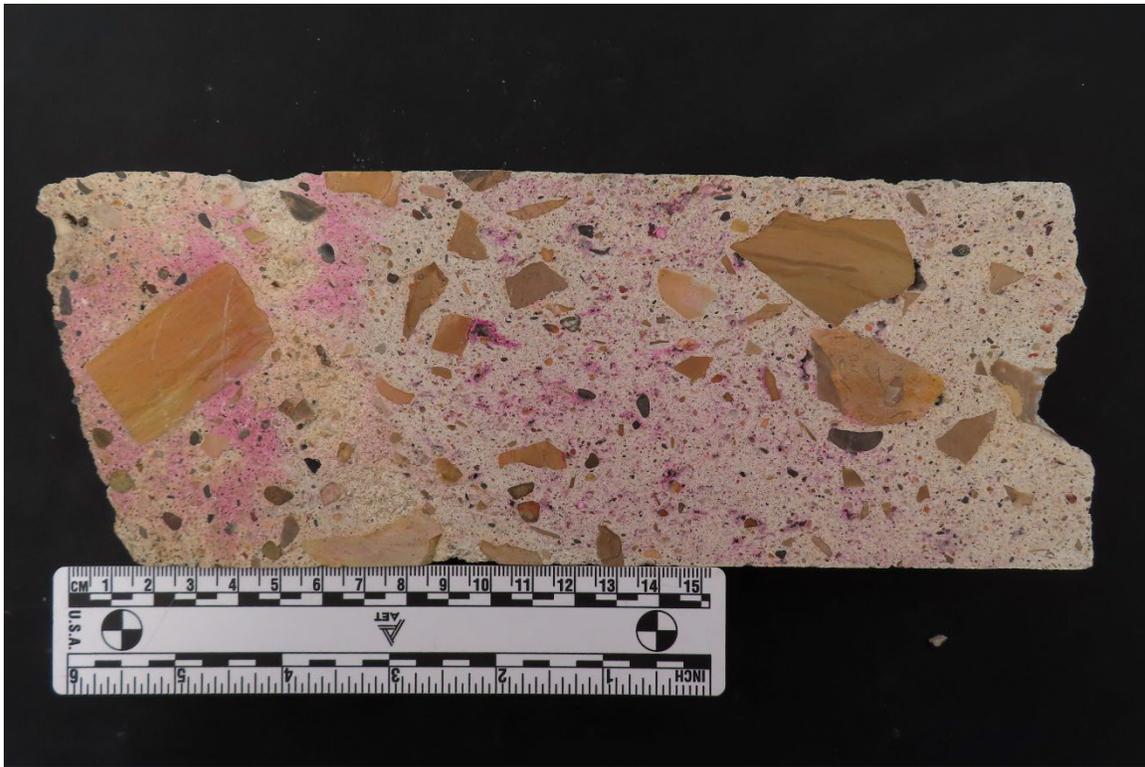


Sample ID:
Mag:

2
3.5x

Description: Carbonation (unstained paste) proceeded up to 23 mm (7/8") from the outer surface of the core (oriented left).

Photo: 21



Sample ID:

3

Description: Partial / mottled carbonation was noted throughout the depth of the sample. The outer surface of the sample is oriented to the left.

Photo: 22

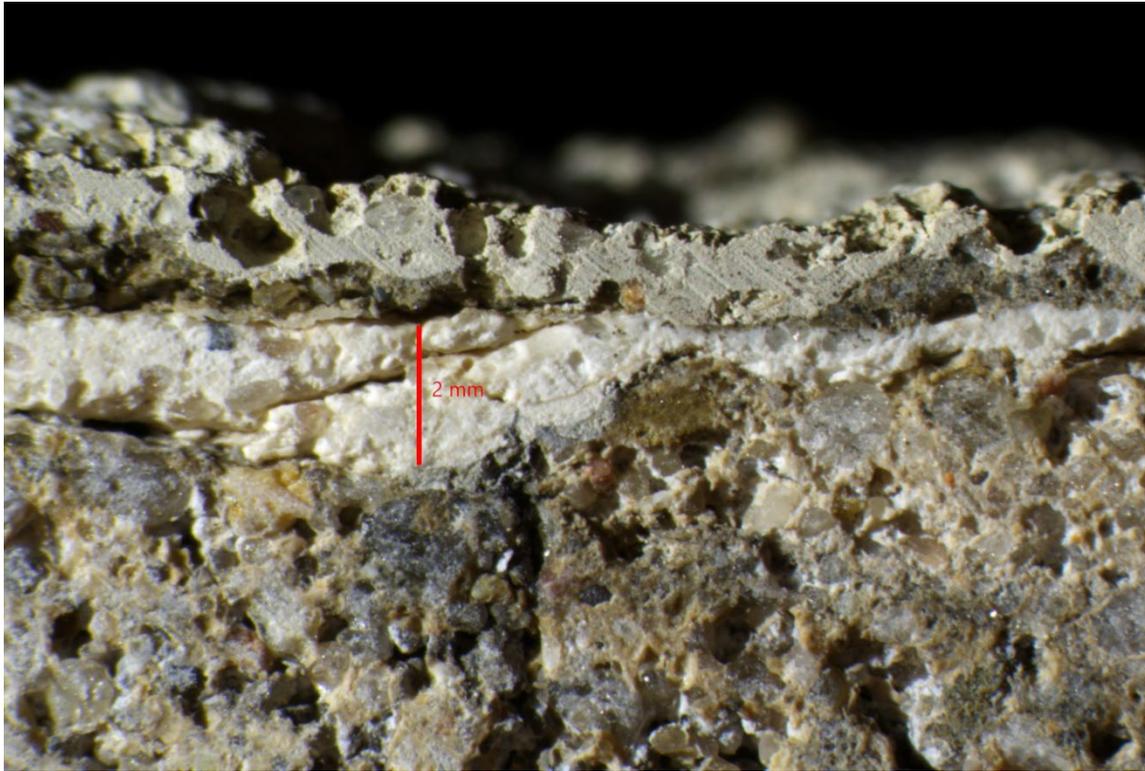


Sample ID:

4B

Description: Carbonation (unstained paste) proceeded up to 80 mm (3-1/8") from the outer surface (oriented left) of the concrete.

Photo: 23

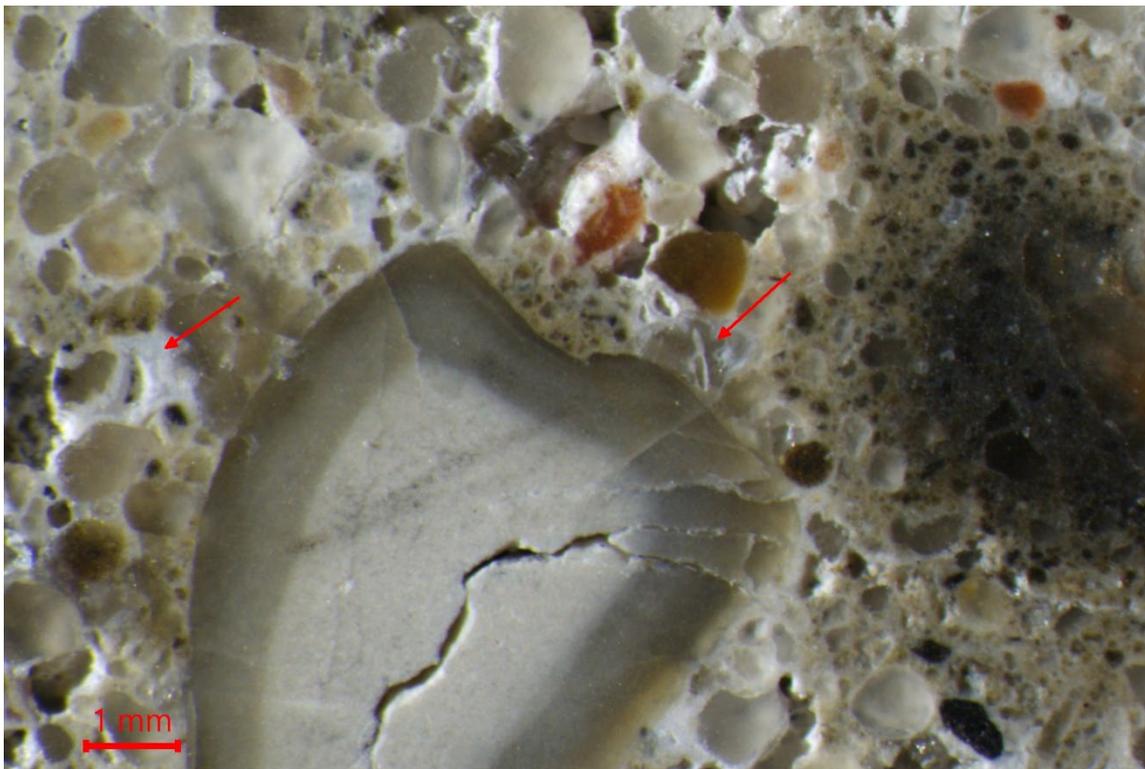


Sample ID:
Mag:

1B
10x

Description: Remnants of an up to 2 mm (1/16") thick layer of whitish mortar/parging was noted between the concrete and a coat of gray paint.

Photo: 24

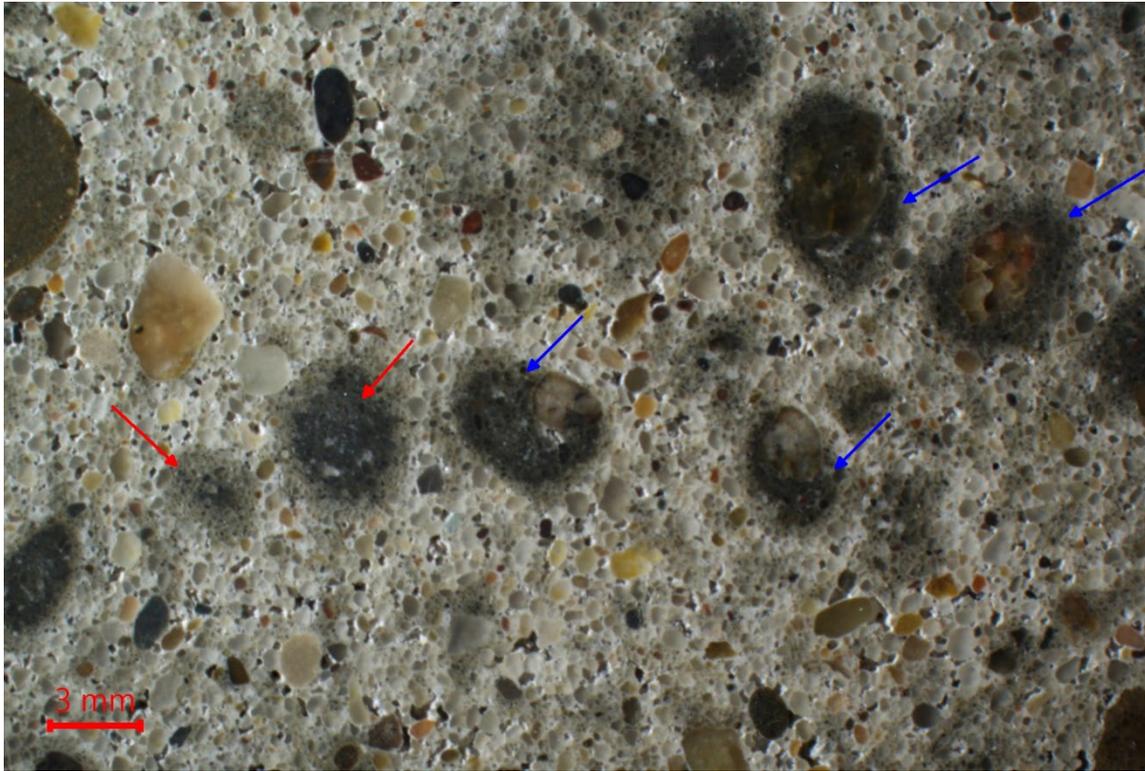


Sample ID:
Mag:

1B
15x

Description: Colorless to white alkali silica gel (red arrows) filling void space directly adjacent to a reactive chert aggregate particle – note the darker-colored “reaction rim” at the outer surface of the particle.

Photo: 25

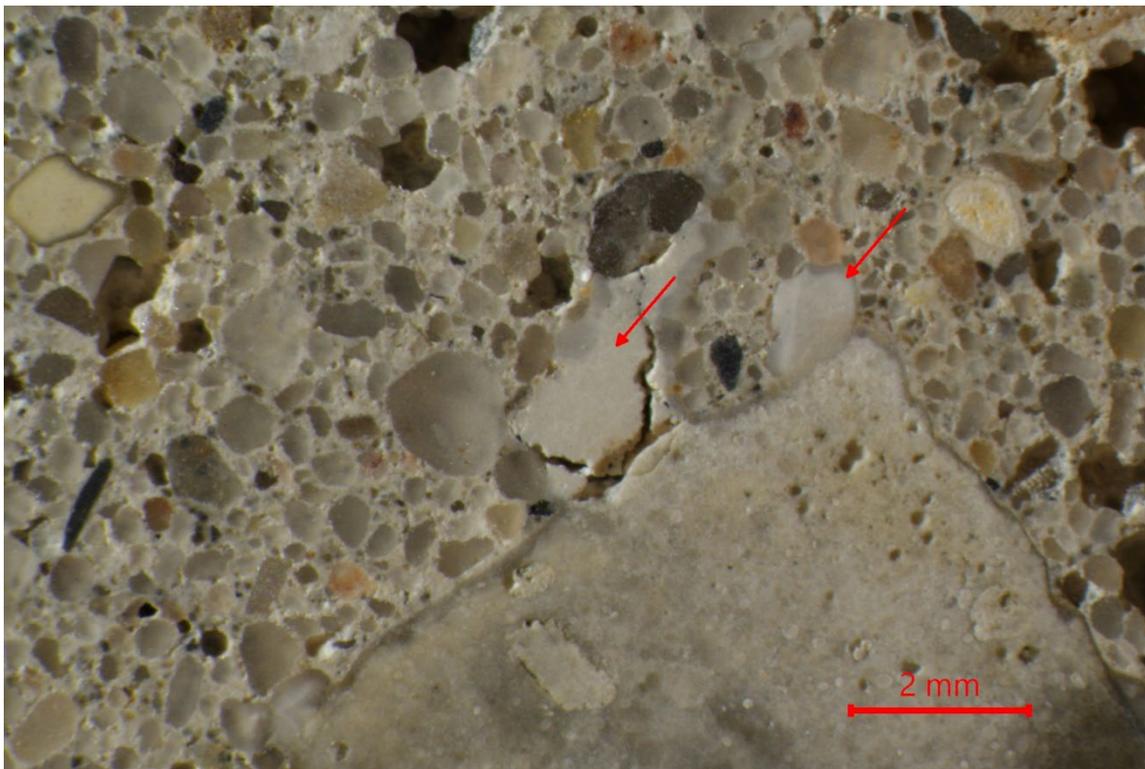


Sample ID:
Mag:

1B
3.5x

Description: Spherical, dark-colored cement balls (red arrows) and similarly dark-colored cement balls surrounding an aggregate particles (blue arrows).

Photo: 26

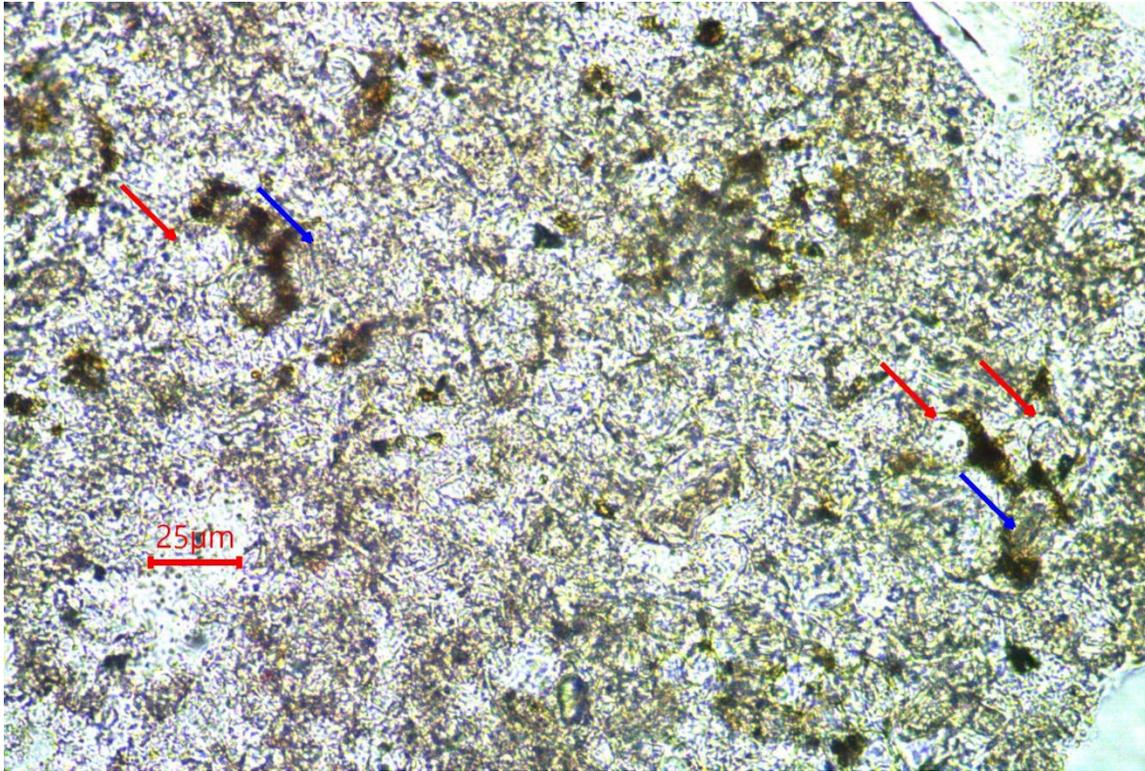


Sample ID:
Mag:

4B
10x

Description: Colorless to white alkali silica gel (red arrows) filling void space directly adjacent to a reactive, partly-silicified carbonate aggregate particle (bottom-right). Note the thin, darker-colored "reaction rim" at the outer surface of the particle.

Photo: 27

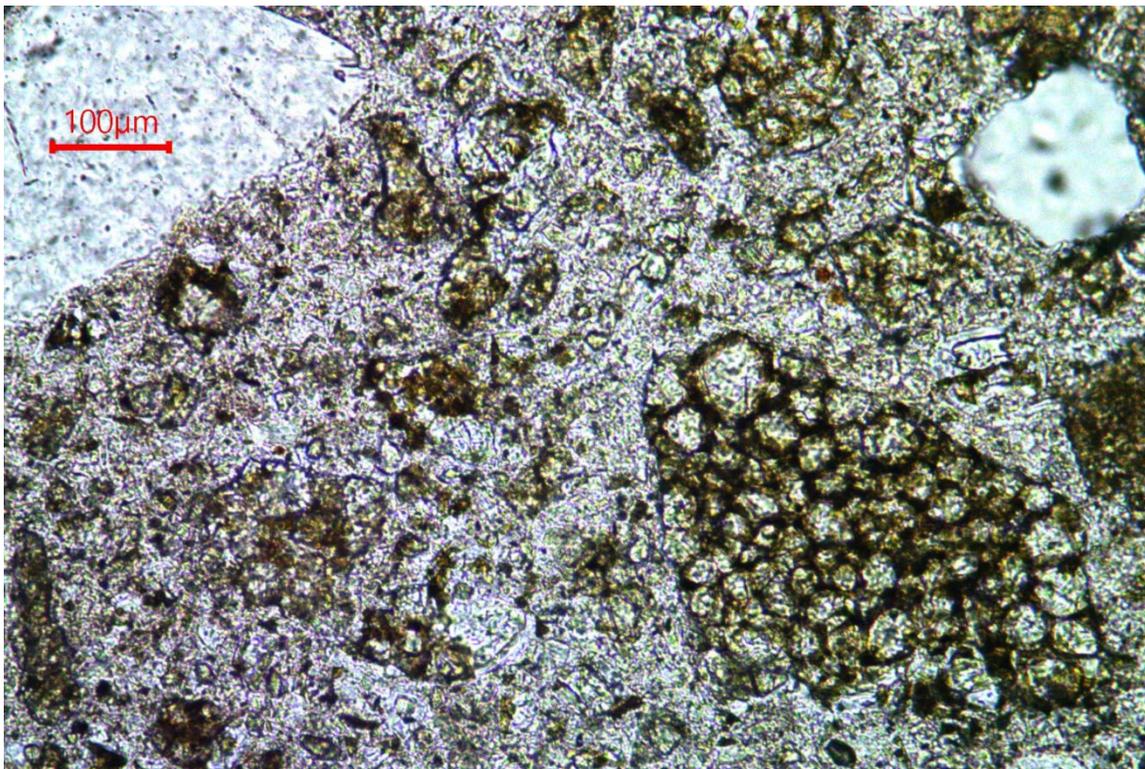


Sample ID:
Mag:

1B
600x

Description: Well to fully-hydrated residual alite (red arrows) and moderately to well-hydrated residual belite (blue arrows) portland cement clinker particles; in a thin section of concrete viewed under plane-polarized light.

Photo: 28



Sample ID:
Mag:

1B
200x

Description: Concentrated coarse-ground portland cement clinker particles exhibiting negligible to low levels of hydration; in a thin section of concrete viewed under plane-polarized light – representative of the “cement balls” observed in the concrete core hand sample.

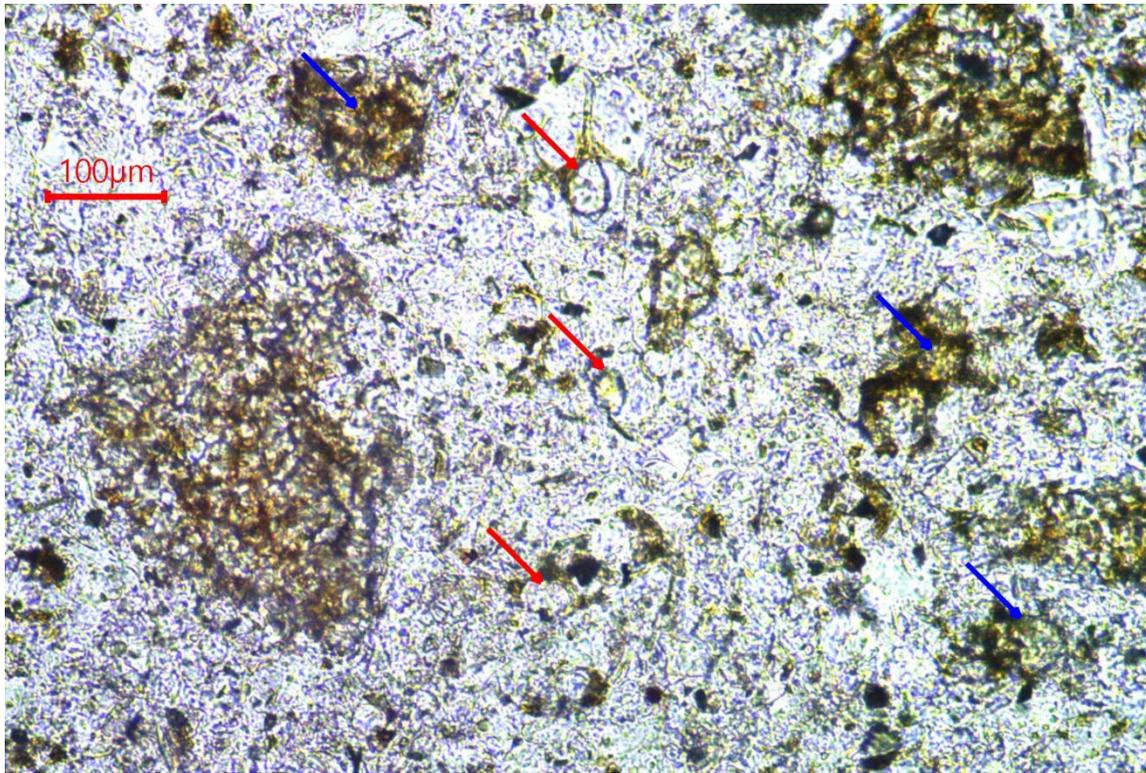


Photo: 29

Sample ID:
Mag:

4B
400x

Description: Well to fully-hydrated residual alite (red arrows) and moderately-hydrated residual belite (blue arrows); in a thin section of concrete viewed under plane-polarized light. Note the coarseness of the dark clinker particles exhibiting low levels of hydration.

APPENDIX F

IOWA DNR PERMIT AND CITY'S
OPERATIONAL PLAN FOR THE MAIN
STREET DAM

STATE OF IOWA
BEFORE THE IOWA NATURAL RESOURCES COUNCIL

IN THE MATTER OF A MODIFIED PERMIT)
TO THE CITY OF CHARLES CITY, IOWA)
)

ORDER NO. 72-185M

* * * * *

This matter having come on for final consideration by the Iowa Natural Resources Council at a meeting on the 2nd day of January, 1973.

WHEREAS, the Iowa Natural Resources Council acting under the authority of Chapter 455A, Code of Iowa, 1971, as amended, on the 6th day of July, 1972, found that the operation, maintenance, and structural modifications to structures appurtenant to a dam on the Cedar River at Charles City, Floyd County, Iowa, for recreational purposes in accordance with the application, plans, and specifications which were submitted by Iowa Public Service Company of Sioux City, Iowa, would not materially obstruct existing navigation, or materially affect other public rights, and would not endanger life or public health, and

WHEREAS, the Iowa Natural Resources Council on the 6th day of July, 1972, approved the application and plans of Iowa Public Service Company and granted a permit (Council Order No. 72-185) by the authority of Section 455A.34 and under provisions of Chapter 469, Code of Iowa, 1971, as amended, to Iowa Public Service Company to operate, maintain, and make structural modifications to structures appurtenant to the dam on the Cedar River at Charles City, Iowa, and

WHEREAS, Iowa Public Service Company has conveyed to the City of Charles City, Iowa, all its right, title, and interest in and to said dam and appurtenances by Quit Claim Deed dated October 10, 1972, and

WHEREAS, modification of said Council Order No. 72-185 is desirable to reflect the change in ownership.

IT IS, THEREFORE, ORDERED by the Iowa Natural Resources Council that a modified permit be and is hereby granted by the authority of Section 455A.34 and under provisions of Chapter 469, Code of Iowa, 1971, as amended, to the City of Charles City to operate and maintain the dam on the Cedar River at Charles City, Iowa, in the NW1/4 of the NE1/4 of Section 12, T95N, R16W, Floyd County, Iowa, subject to the following conditions

COUNCIL ORDER NO. 72-185M

- (1) the City of Charles City, Iowa, shall upon completion of the diversion outlet works by the Iowa Public Service Company, but no later than June 1, 1973, submit to the Iowa Natural Resources Council an operational plan for releasing flow through said diversion outlet during both high flow and low flow periods, with said plan to indicate the occasions for which flow would be released through the diversion outlet and how it will be used for flood control, at what stage elevation (referenced to the crest of the dam) would the diversion outlet be opened and closed and any other pertinent information relative to releasing flow through the diversion outlet;
- (2) no material change in operation or maintenance shall be made or undertaken unless first authorized by the Iowa Natural Resources Council;
- (3) the owner shall be responsible for proper maintenance and for such measures as are necessary for public use of the facility;
- (4) no flashboards shall be used unless first authorized by the Iowa Natural Resources Council
- (5) no legal or financial responsibility arising from the construction or maintenance of the approved works shall attach to the State of Iowa or the Iowa Natural Resources Council due to the issuance of this order;
- (6) the applicant shall obtain such titles, easements, and rights-of-way as are required for the operation and maintenance of the approved works.

BE IT FURTHER ORDERED that the Director of the Iowa Natural Resources Council be and is hereby authorized and directed to provide and deliver to the applicant a true and correct exhibit of his determination duly certified by him to be a true and correct exhibit of the proceedings of the Iowa Natural Resources Council in respect to this application at a meeting of the Iowa Natural Resources Council held on the date hereinabove indicated.

CERTIFICATION

I, OTHIE R. MC MURRY, do hereby certify that I am the duly appointed and acting Director of the Iowa Natural Resources Council and that the foregoing is a true and correct exhibit of the proceedings of the Iowa Natural Resources Council in respect to this application at a meeting held on January 2, 1973.

January 8, 1973


OTHIE R. MC MURRY, DIRECTOR



CITY OF CHARLES CITY

105 MILWAUKEE MALL

CHARLES CITY, IOWA 50616

May 31, 1973

Iowa Natural Resources Council
Grimes State Office Building
East 14th and Grand
Des Moines, Iowa 50319

Attention: Othie R. McMurry

Re: Charles City Dam (Council Order No. 72-185M)

Dear Mr. McMurry:

In fulfillment of requirements of Council order No. 72-185M, the City of Charles City is hereby submitting an operational plan for releasing flow through the newly constructed diversion outlet:

The only occasion for which flow would be released through the diversion outlet would be during a low flow period for required maintenance and repair of the dam structure.

Respectfully submitted,

Ted R. Blunck, EIT
Public Works Director

TRB:tb

LEO J. SCHULA, Mayor

COUNCIL:

Lee Albaugh
Clarence E. Gage
W. F. Hladky
Keith Sylvester
Katherine Zastrow

HELEN B. WEBSTER, City Clerk
JAMES F. SMITH, City Attorney
TED BLUNCK, Director of Public Works

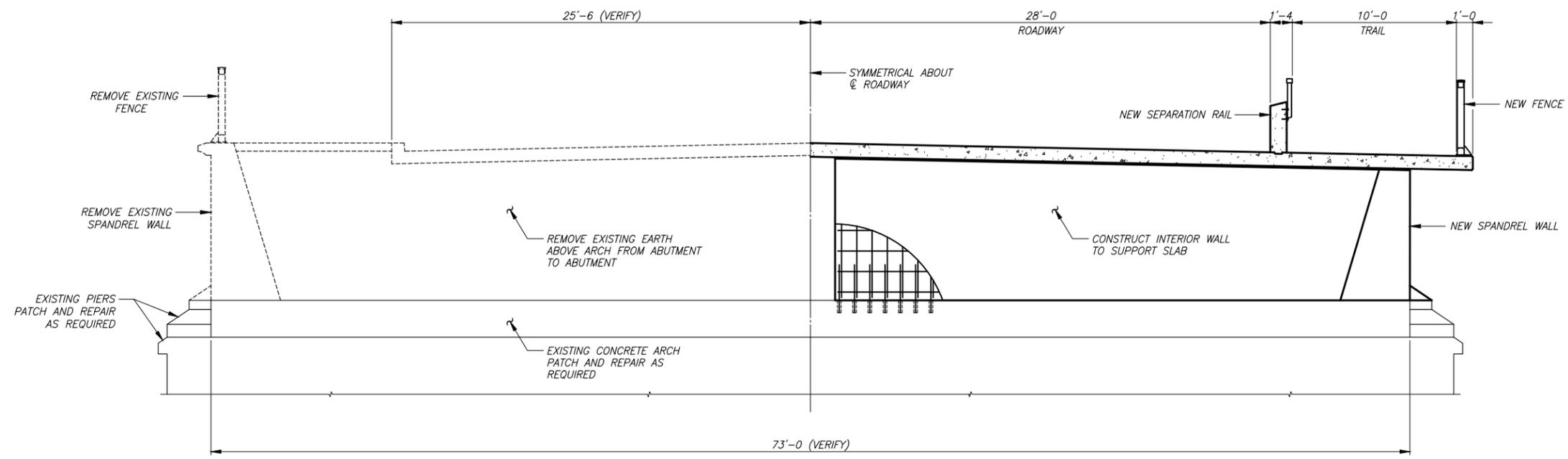
JOHN O. GORDON, Chief of Police

CHARLES M. ELLIS, Fire Chief



APPENDIX G

ALTERNATE 1: SKETCHES OF
REHABILITATION CONCEPT OF
EXISTING STRUCTURE



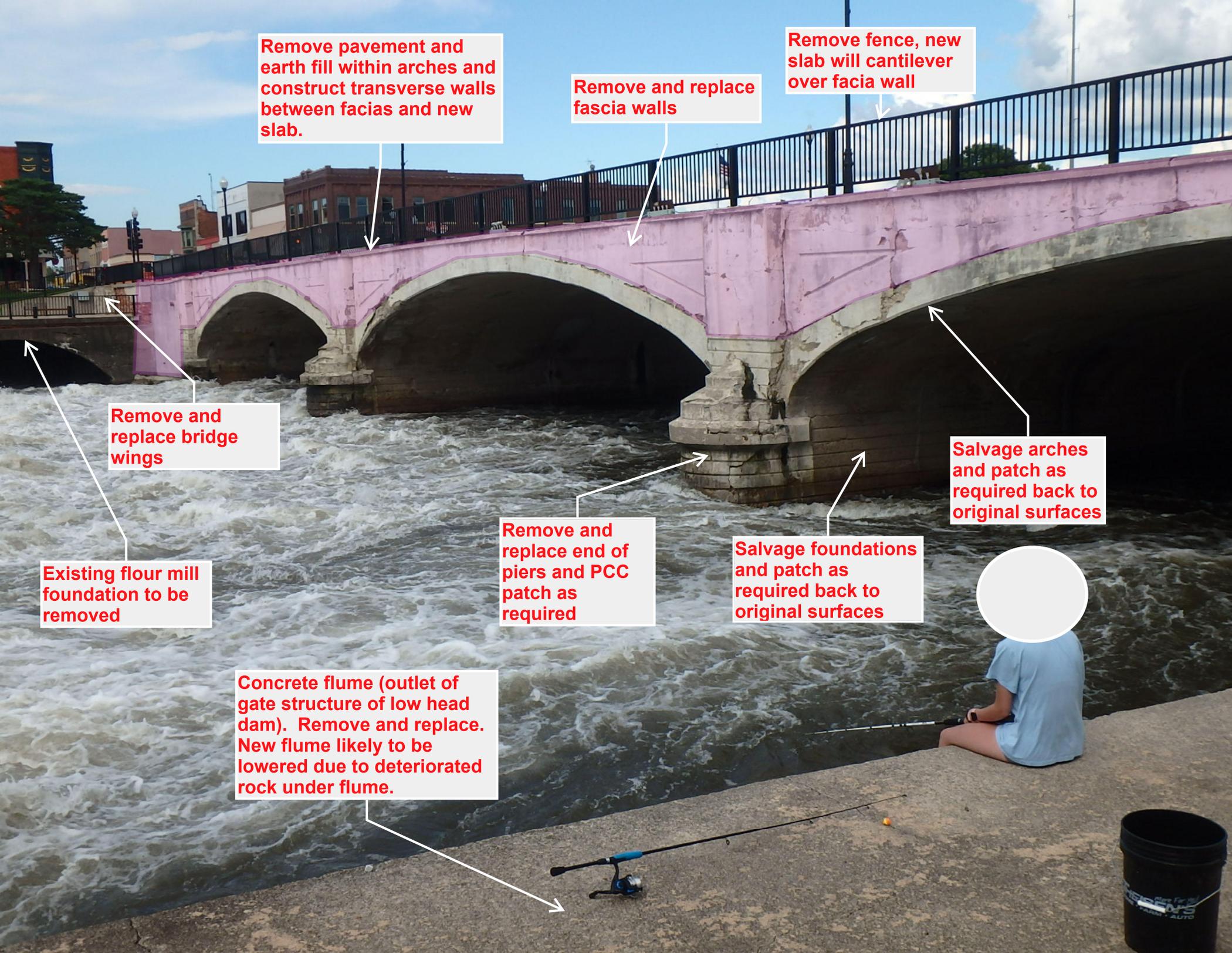
EXISTING BRIDGE REMOVAL DETAILS

PROPOSED REHABILITATION DETAILS

BRIDGE CROSS SECTION

CITY OF CHARLES CITY

IOWA



Remove pavement and earth fill within arches and construct transverse walls between facias and new slab.

Remove and replace fascia walls

Remove fence, new slab will cantilever over fascia wall

Remove and replace bridge wings

Existing flour mill foundation to be removed

Remove and replace end of piers and PCC patch as required

Salvage foundations and patch as required back to original surfaces

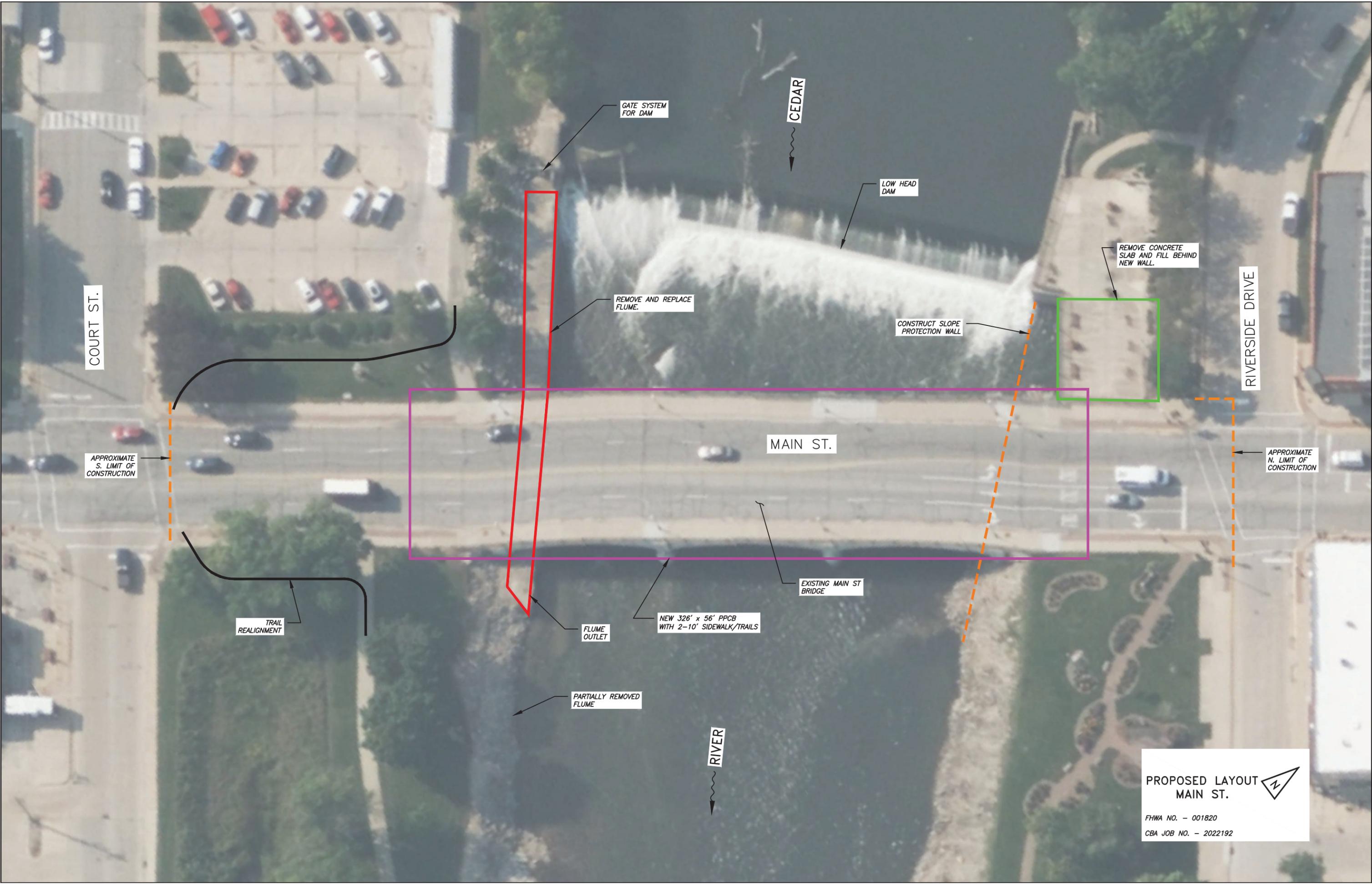
Salvage arches and patch as required back to original surfaces

Concrete flume (outlet of gate structure of low head dam). Remove and replace. New flume likely to be lowered due to deteriorated rock under flume.



APPENDIX H

AERIAL SHOWING
PROPOSED ALTERNATE 5 LAYOUT;
REPLACE THE BRIDGE AT ITS
CURRENT LOCATION



COURT ST.

RIVERSIDE DRIVE

CEDAR

RIVER

GATE SYSTEM FOR DAM

LOW HEAD DAM

REMOVE AND REPLACE FLUME.

CONSTRUCT SLOPE PROTECTION WALL

REMOVE CONCRETE SLAB AND FILL BEHIND NEW WALL.

MAIN ST.

APPROXIMATE S. LIMIT OF CONSTRUCTION

APPROXIMATE N. LIMIT OF CONSTRUCTION

TRAIL REALIGNMENT

EXISTING MAIN ST BRIDGE

FLUME OUTLET

NEW 326' x 56' PPCB WITH 2-10' SIDEWALK/TRAILS

PARTIALLY REMOVED FLUME

PROPOSED LAYOUT MAIN ST.



FHWA NO. - 001820
CBA JOB NO. - 2022192

APPENDIX I

ALTERNATE NO. 1 AND 5 COST
OPINION

**PRELIMINARY OPINION OF PROBABLE COSTS
MAIN STREET BRIDGE OVER CEDAR RIVER
CHARLES CITY, IOWA
FHWA No. 001820
August 20, 2025**

REHABILITATION OF THE EXISTING 3 SPAN EARTH FILL ARCH TO BE CONVERTED TO AN OPEN SPANDREL. APPROXIMATELY 240' X 56' WITH TWO 10' WIDE SIDEWALKS/TRAILS

ALTERNATE 1

| ITEM NO. | DESCRIPTION | OPINION OF PROBABLE COST |
|--|--|--------------------------|
| 1. | Removals including earth fill over the arches | \$ 680,000 |
| 2. | Rehabilitated 240' x 56' PPCB Bridge with two 10' sidewalks/trails | 6,550,000 |
| 3. | Basic aesthetic treatments | 575,000 |
| 4. | Remove and replace south bank flume | 860,000 |
| 5. | Remove north bank flour mill slab and construct concrete wall | 660,000 |
| 6. | Roadway hookup with minor city utility adjustments | 485,000 |
| 7. | Traffic Control | 50,000 |
| 8. | Mobilization | <u>990,000</u> |
| Opinion of Probable Construction Cost: | | \$ 10,850,000 |
| Contingencies: | | <u>\$ 3,250,000</u> |
| Total Opinion of Probable Construction Project Cost: | | <u>\$ 14,100,000</u> |

Engineer's opinions of probable Construction Cost are made on the basis of Engineer's experience and qualifications and represent Engineer's best judgment as an experienced and qualified professional generally familiar with the construction industry. However, since Engineer has no control over the cost of labor, materials, equipment, or services furnished by others, or over contractors' methods of determining prices, or over competitive bidding or market conditions, Engineer cannot and does not guarantee that proposals, bids, or actual Construction Cost will not vary from opinions of probable Construction Cost prepared by Engineer. Costs do not include extensive bridge aesthetics, staged construction, design engineering services, engineering services during construction, right-of-way, legal, administrative, environmental or wetland mitigation, utility relocations, and landscaping. The figures shown above should be adjusted to reflect changes in project concept, inflation from now to the year of construction, and/or changes in the currently acceptable bridge and/or grading design standards.

**PRELIMINARY OPINION OF PROBABLE COSTS
MAIN STREET BRIDGE OVER CEDAR RIVER
CHARLES CITY, IOWA
FHWA No. 001820
August 20, 2025**

**CONSTRUCT NEW 326' X 56' FOUR SPAN PPCB BRIDGE WITH TWO 10' WIDE
SIDEWALKS/TRAILS**

ALTERNATE 5

| ITEM NO. | DESCRIPTION | OPINION OF PROBABLE COST |
|--|---|-----------------------------|
| 1. | Removal of existing bridge | \$ 580,000 |
| 2. | New 326' x 56' PPCB Bridge with two 10' sidewalks/trails | 6,330,000 |
| 3. | Basic aesthetic treatments | 575,000 |
| 4. | Remove and replace south bank flume | 860,000 |
| 5. | Remove north bank flour mill slab and construct concrete wall | 660,000 |
| 6. | Roadway hookup with minor city utility adjustments | 485,000 |
| 7. | Traffic Control | 50,000 |
| 8. | Mobilization | <u>960,000</u> |
| Opinion of Probable Construction Cost: | | \$ 10,500,000 |
| Contingencies: | | <u>\$ 2,000,000</u> |
| Total Opinion of Probable Construction Project Cost: | | <u><u>\$ 12,500,000</u></u> |

Engineer's opinions of probable Construction Cost are made on the basis of Engineer's experience and qualifications and represent Engineer's best judgment as an experienced and qualified professional generally familiar with the construction industry. However, since Engineer has no control over the cost of labor, materials, equipment, or services furnished by others, or over contractors' methods of determining prices, or over competitive bidding or market conditions, Engineer cannot and does not guarantee that proposals, bids, or actual Construction Cost will not vary from opinions of probable Construction Cost prepared by Engineer. Costs do not include extensive bridge aesthetics, staged construction, design engineering services, engineering services during construction, right-of-way, legal, administrative, environmental or wetland mitigation, utility relocations, and landscaping. The figures shown above should be adjusted to reflect changes in project concept, inflation from now to the year of construction, and/or changes in the currently acceptable bridge and/or grading design standards.