APPENDIX D
PHOTOS
Upper and Lower Collinsville Dams Hydroelectric Project
Canton, Avon, Burlington, CT

Photo 1: Upper Powerhouse looking downstream.

Photo 2: Collins Company forebay looking easterly.
Photo 3: Upper Dam primary spillway looking easterly.

Photo 4: Lower Dam primary spillway in foreground. Side view of lower gatehouse looking easterly.
Photo 5: Power canal looking upstream. Overflow waste weir on left side.

Photo 6: Lower Powerhouse and adjacent canal looking easterly from far river bank.
Upper Powerhouse Observations

General
Based on measurements taken during the field visit, the Upper Powerhouse is approximately 23'-2" wide by 30'-71/2" long to the outside face of the masonry. These are in general agreement with the plan diagram contained in the 1979 Feasibility Study. Overall, the exterior masonry shell of the structure is in reasonably good condition, with no significant signs of masonry deterioration, spalling, or cracking. Visual comparison to the Lower Gatehouse and Powerhouse, suggests the Upper Powerhouse exterior shell is in much better condition, because there has been less moisture infiltration into the walls. The good condition of the shell will make rehabilitation of the building feasible depending on what adjustments to the structure may be necessary to outfit it for generation of hydropower. If a watertight enclosure is the desired result, the roof, windows, and doors will need to be replaced, at a minimum.

The following are visual observations of the Upper Powerhouse only, since no “as-built” drawings were available. Close visual observations of the east wall (water-side) and roof were not possible during the field visit.

Walls
Exterior walls of the Powerhouse are constructed of 12" solid masonry consisting of unreinforced brick and mortar. The thickness increases to approximately 18” at intermediate and corner pilasters. The height of the brick walls extends upward approximately 25', at which point the brick coursing corbels elegantly around the perimeter of the structure where it abuts the roof. (Image 1)

![Image 1](image1.jpg)

Interior brick pilasters are located at building corners, and north, and south wall midpoints. The pilasters support interior overhead steel beams spanning the east-west direction. The beams support a large traveling crane/gantry mechanism which appears to be fully intact. (Image 2)

![Image 2](image2.jpg)

Overall, there were no visible signs of settlement or cracking in the masonry walls, nor was any deterioration of the mortar joints open to view. A previously existing opening had been in-filled with Concrete Masonry Units (CMU) and brick on the west wall of the structure. The overhead corbelled brick appeared in good condition from the ground; however there was visible damage to the northwest corner brick coursing. (Image 3) Various pipe penetrations through the brick walls were also visible on the north and west walls.
There are a total of 8 large rectangular openings roughly 44 ½" wide by 10'-2" high around the lower perimeter of the Powerhouse. Above each of the larger openings there are small square openings. All of the openings contained steel window frames but no glazing, leaving the interior structure open to the elements. The remnant of a glazing compound was observed in the steel frames.

Window sills and headers appear to be cast-in-place concrete in good condition. There is minor visible weathering and deterioration of the larger sills below the larger north wall openings. (image 4)

One double door opening is in the south wall of the structure. The door consists of diagonal wood boards with a wire mesh pair of doors toward the exterior wall.

**Wall Openings**

There are a total of 8 large rectangular openings roughly 44 ½" wide by 10'-2" high around the lower perimeter of the Powerhouse. Above each of the larger openings there are small square openings. All of the openings contained steel window frames but no glazing, leaving the interior structure open to the elements. The remnant of a glazing compound was observed in the steel frames.

Window sills and headers appear to be cast-in-place concrete in good condition. There is minor visible weathering and deterioration of the larger sills below the larger north wall openings. (image 4)

One double door opening is in the south wall of the structure. The door consists of diagonal wood boards with a wire mesh pair of doors toward the exterior wall.
Roof
The roof is a clay tile material supported on steel trusses and purlins. Viewed from below, the steel trusses appear to be embedded into, and to bear upon, the exterior brick walls. (Image 5)

There are visible gaps between the roof sheathing components, allowing water infiltration. Close visual observation of the roofing tiles was not possible during the site visit.

Foundation
The foundation consists of concrete walls with assumed reinforcing. No significant deterioration or spalling was visible during the site visit.

Floor
The floor material appeared to be cast-in-place concrete; however close visual inspection was not possible due to coverage by debris. There are two large openings in the floor. One rectangular at the
Lower Gatehouse Observations

General
Based on measurements taken during the field visit, the Lower Gatehouse is approximately 16’-11” wide by 61’-0” long. These dimensions were taken to the inside face of masonry walls. In comparison to the Upper Powerhouse, the exterior masonry shell of the Gatehouse building is in less favorable condition for rehabilitation. There are visible signs of masonry and mortar deterioration around the perimeter of the building, most significantly at the upper parapets on the east and west ends of the building. The visible damage is due to excessive moisture penetration from above because the roof assembly has started to fail. Subsequent freezing and thawing also is affecting the condition of the walls. If a watertight enclosure is the desired result a new roof, windows, and doors will need to be provided at a minimum. A more detailed analysis of the masonry deterioration is necessary, but it’s likely that some portion of the brick walls and parapet caps will need to be replaced. Installation of flashings and counter-flashings at all roof-to-intersections and wall openings will be necessary.

The following are observations based on examination of the Upper Powerhouse that was limited to visual observation only, since no “as-built” drawings were available. Close visual observation of the west wall (water-side) and roof of the structure was not possible during the field visit.

Walls
The exterior walls of the Gatehouse are constructed of 12” solid masonry consisting of unreinforced brick and mortar.  (Image 7) There is a considerable amount of graffiti (spray paint) on the exterior and interior walls.

There are five brick pilasters on the north and south exterior walls, as well as pilasters on each of the four building corners.  The brick wall thickness at the pilaster could not be determined; however, they project out approximately 4” beyond the face of the adjacent walls.  These pilasters are likely the vertical load bearing elements for the steel roof trusses above.  (Image 8)

At recessed brick areas, between pilasters, the exterior brick corbels for three courses up to a horizontal band on the north and south walls.  This brick appears to be in relatively good condition from the ground.  Above the pilasters the brick corbels for another three courses where it meets the roof on north and south walls.  At the upper corbels courses, there is significant damage and deterioration at the northeast and southeast corners of the building.  (Image 9)

The east and west exterior brick corbels to a parapet level that extends above the roof level.  There is visible deterioration to the brick and mortar joints at this level. (Image 10) Wall movement is visible on the east corners of the upper wall area.
There are a total of 9 openings, some in-filled, in the exterior walls. There are 2 arched openings roughly 42 ½" wide in the north wall, 6 arched openings the have been in-filled with brick on the north wall, and one arched opening on the east wall. (Image 11)

The sills at the wall openings all appear to be a natural stone material. There is visible damage to the brick jamb returns in the south wall. (Image 12)
Roof
The roofing is a slate shingle material that is supported on wood decking and steel trusses. As viewed from below, the steel trusses appear to be embedded and bear on the exterior brick walls at corresponding brick pilaster locations. (Image 13) There is also a steel beam spanning in the east-west direction anchored to the bottom chord of each truss. A horizontal steel rod pulley-shaft also runs in the east-west direction for the entire length of the building. This rod is anchored north of center on the bottom chord of each truss.

There is significant visible deterioration (rot and holes in the roof assembly) and water damage to the roof assembly at the east and west ends of the enclosure. (Images 14 and 15) The large openings in the roof
are allowing a great deal of water to penetrate the masonry walls, causing visible deterioration of the wall assembly. Close visual observation of the slate roofing tiles was not possible during the site visit.

Image 13

Image 14
Foundation
The foundation consists of concrete walls with assumed reinforcing. No significant deterioration or spalling was visible during the site visit.

Floor
The floor material appeared to be cast-in-place concrete; however, close visual inspection was not possible due to debris. There are six large gear assemblies mounted to the concrete floor, with openings through the floor at each assembly for connection to the gate below.

Lower Powerhouse Observations

General
Field dimensions of this structure were not taken during the field visit due to obstructing conditions around the structure. The exterior masonry shell of the Lower Powerhouse building is in poor condition. There are visible signs of masonry damage and mortar deterioration around the perimeter of the building, most significantly at the upper portions of the walls where they intersect the roof. There are also visible signs of mildew and efflorescence on the brick. The visible damage is due to excessive moisture penetration from above because the roof assembly and structure have failed and no longer provide any overhead enclosure. Subsequent freezing and thawing is also affecting the condition of the walls.

If a watertight enclosure is the desired result a new roof assembly including structural members, windows, and doors will need to be provided at a minimum. More detail analysis of the masonry deterioration is necessary to determine the feasibility of rehabilitating the exterior walls, but it’s likely a large portion of the brick walls will need to be replaced or reconstructed for the structure to be safe. Installation of flashings at all roof to wall and parapet intersection also will be necessary.

The following are observations based on examination of the Upper Powerhouse that was limited to visual observation only, since no “as-built” drawings were available. Close visual observation of the west wall (water-side) and foundations of the structure was not possible during the field visit.

Walls
The exterior walls of the Powerhouse are constructed of 16” solid masonry consisting of unreinforced brick and mortar. (Image 16) The walls are not in good condition with damage due to water infiltration and exposure to weather around the upper perimeter of the structure. Visible damage to the brick in the lower wall areas occurs in various locations; most noticeably the southeast corner of the building. (Image 17) Deterioration of the mortar joints is also prevalent on the exterior and interior face of the brick walls. At the parapet level the brick coursing becomes ornamental with recessed and corbelled brick banding on all four sides of the exterior walls. There is visible bowing and curling of the interior wythe of brick due to collapse of the roof structure and exposure to water infiltration. Above the ornamental banding, the
parapet is capped with a clay tile material, whose condition could not be examined during the site visit. (Image 18)

There are four interior brick pilasters (8 total) on the north and south walls, as well as two pilasters on west interior walls. The pilasters support interior overhead wood beams spanning in the east-west direction. The beams support a traveling crane/gantry mechanism, similar to that in the Upper Powerhouse. (Image 19)
Wall Openings
There are a total of 32 total window-sized openings in the exterior walls. Each of the openings has a jack arch-header that is three courses high. On the east wall there is a large garage door-sized opening and a smaller arched door opening. Some of the lower window door openings were infilled with brick or corrugated metal for safety precautions, while remnants of the existing wood windows and frames were visible in the upper openings. The size of the openings varied; however, the ground level window openings were taller than those around the upper (celestory) locations. (Image 20)

The sills at of the window openings all appear to be a natural cleft stone material. There was some visible damage to the sills, but in general they appeared in good condition.
Roof
The roof assembly and structure have failed leaving the interior of the building open to the elements. One of the wood beams has collapsed and is leaning against the north wall. One wood timber beam still remains at the roof level on the west end of the building. (Image 21)

The remnant of the existing downspout system was visible from within the building. The downspouts appear to have been recessed into the interior wythe of brick and currently divert water into the structure. (Image 22)
Foundation
The foundation consists of concrete walls with assumed reinforcing. There appeared to be spalling at the ground level at the northeast corner of the building, but in general the close observation of the foundations was not possible west and south sides of the structure.

Floor
The floor material appeared to be cast-in-place concrete; however, close visual inspection was not possible due to debris, as well as the presence of growing plants and trees. There are two circular large openings in the floor for the previous turbine and shafts.
**Task 2: Suitability of Existing Structures for Rehabilitation and Oder of Magnitude costs**

Determination of suitability of the existing structures for rehabilitation will be based upon information gained during Task 1. It will assess the probable difficulty of rehabilitating the existing upper powerhouse, lower powerhouse, and lower gatehouse and will include an order of magnitude budget estimate of construction cost and AE fees for rehabilitation or replacement. The subconsultant's opinion of probable costs shall address the difference in cost between historically accurate techniques and materials versus standard building techniques and materials. It should be understood that the order of magnitude budget estimate will not be derived from extensive technical analysis but will be drawn from experience.

**Upper Powerhouse:**

Gross footprint – 710 sf  
Estimated exterior wall surface area - 2003sf  
Estimated roof area – 850sf  
Estimated window area – 427sf

As indicated in the field observations summary, the Upper Powerhouse exterior enclosure is in good condition for rehabilitation and shows no major visible signs deterioration of the brick walls. The good condition of the shell will make it easier to provide an addition to the exterior shell as illustrated as alternative PU-3.

In order to rehabilitate the enclosure only we recommend the following items will need repair or replacement:

- Exterior Walls – masonry repair and restoration, including mortar re-pointing, and cleaning will be required. In general, the existing walls appear in good visible conditions which should allow for a less labor intensive rehabilitation of the exterior shell.
- Exterior Windows – There are currently 18 masonry openings in the enclosure which will require new windows and glazing. Some opening may require new precast sills as well.
- Exterior Doors – A pair of exterior doors will be required.
- Roofing – A new clay tile roof and substrate will be necessary to provide a watertight enclosure.
- Interiors – There is cleaning and repainting needed at the interior walls of the building. If elected the existing paint can be removed to expose the clay brick surface.
- Selective Demolition – The existing roof tiles, window frames, doors, damaged brick, and damaged precast concrete sills will need to be removed prior to rehabilitation.

**Order of Magnitude Costs:** Based on the scope listed above and the gross square footage of floor, exterior wall and roof areas, the cost of rehabilitating this structure may be in the range of $185 - $190 per square foot, or roughly $130,000 – $135,000. For the Upper Powerhouse we see the greatest cost for a new roof and windows. Window installation on the east (water side) and south sides of the enclosure will need to be sequenced to occur from the interior side of the wall, as no platform is currently available to stage the installation.

If an estimated 208sf addition were constructed as illustrated in alternative PU-3, the estimated order cost for the addition only would be in the $400 - $435/sf range, or approximately $83,000 – $90,500. This would include new masonry walls, roof, foundations, and footings. In larger part the exterior wall construction and the assembly desired is the largest contributing factor to the enclosure costs. This rough estimate assumes the following:

- The height of the new brick walls will match the existing.
- The roof will match the existing.
- There will be two window and one door opening provided.
- The floor slab will remain at the same level as the existing slab.
Lower Gatehouse:
Gross foot print – 1220sf
Estimated exterior wall surface area - 2365sf
Estimated roof area – 1320sf
Estimated window area – 147sf

As indicated in the field observations summary, the exterior masonry shell of the Gatehouse building is in less favorable condition for rehabilitation.

In order to rehabilitate the exterior enclosure only we recommend the following items be repaired or replaced:

- **Exterior Walls** – masonry repair and restoration, including mortar re-pointing, and cleaning will be required. This will likely lead to reconstructing some portion of the exterior masonry walls which are more visibility damaged from water infiltration. There is more significant damage to the upper portion of the perimeter walls and the east and west parapet walls. The masonry cleaning effort will be more labor intensive for the Gatehouse due to the graffiti on all interior and exterior walls.

- **Exterior Windows** – There are currently 2 masonry openings in the north wall of the enclosure which will require new windows, glazing, and masonry repairs. We have also assumed windows will be installed in the 5 brick in-filled areas on the north wall. We've assumed new stone sills and flashing will be necessary for each opening.

- **Exterior Doors** – A pair of exterior doors will be required fill the existing opening in the west wall.

- **Roofing** – A new slate tile roof and wood decking substrate will be necessary to provide a watertight enclosure. All through wall and counter flashings should be provided as part of the roof installation.

- **Interiors** – There is cleaning required at the interior walls and floor of the building. If elected the interior wall surface can be painted.

- **Selective Demolition** – The existing roof tiles, wood decking, damaged brick, brick infill, and damaged stone sills will need to be removed prior to rehabilitation. Portions of the exterior masonry wall will also need to be removed for reconstruction.

Order of Magnitude Costs: Based on the scope listed above and the gross square footage of floor, exterior wall, and roof areas, the cost of rehabilitating the exterior enclosure of this structure may be in the range of $150 - $165 per square foot, or approximately $180,000 – $200,000. For the Gatehouse we see the largest costs attributable to providing a new roof and substrate, new masonry walls with flashings, and new windows.

Lower Powerhouse:
Gross foot print – 2008sf
Estimated exterior wall surface area - 5693sf
Estimated roof area – 1775sf
Estimated window area – 832sf

As indicated in the field observations summary, the exterior masonry shell of the Lower Powerhouse building is in poor condition for rehabilitation. Of the three structures, the Lower Powerhouse will require the most effort to rehabilitate from a materials, labor, and sequencing of construction standpoint due to the existing enclosure conditions.

In order to rehabilitate only the exterior enclosure we recommend the following items be repaired or replaced:

- **Exterior Walls** – masonry repair and restoration, including mortar re-pointing, and cleaning will be required. This will lead to reconstructing a good portion of the exterior masonry walls which have been damage by excessive moisture penetration and multiple freeze and thaw cycles. It may be cost prohibitive to save the existing solid masonry walls, however it can be accomplished.
- **Exterior Windows** – There are currently 32 masonry openings in the perimeter walls of the enclosure. Some openings contain no remnants of windows, while others have existing window frames within them which will need to be removed. We’ve assumed new stone sills and flashing will be necessary for each opening. A more detailed inspection of the stone sill conditions will be necessary to assess whether they can be removed, cleaned, and reinstalled for a rehabilitation effort.

- **Exterior Doors** – A large overhead exterior door will be required fill the existing opening in the west wall.

- **Roofing** – A new roof structure, roof covering, and roof substrate will be necessary to provide a watertight enclosure. All through wall and counter flashings should be provided as part of the roof installation. We’ve assumed a new steel structure of beams and support columns will be provided on the inside of existing walls. This will also require footing and foundations to be provided for the new roof structural system.

- **Interiors** – There will be cleaning required at the interior walls and floor of the building. If elected the interior wall surface can be painted.

- **Selective Demolition** – The existing wall coping, remaining roof structure, damaged brick wall, and damaged stone sills will need to be removed prior to rehabilitation. The existing traveling crane mechanism will need to be dismantled in order for the exterior wall repairs and new roof roof structure to be installed.

**Order of Magnitude Costs:** Based on the scope listed above, the condition of the existing walls, the gross square footage of floor, exterior wall, and roof areas, the cost to rehabilitate the exterior enclosure of this structure may be in the range of $175 - $200 per square foot, or approximately $350,000 – $400,000. For the Lower Powerhouse we see the largest costs attributable to providing a new roof structural system and substrate, new masonry walls with flashings, and new windows. These costs would also assume a premium for reconstructing or matching the existing ornamental brick coursing around the perimeter of the building.

**Exclusions and recommendations for more extensive evaluations:**

Order of magnitude costs were not derived from extensive technical analysis but from our experience with similar construction. The estimate does not take into consideration the following items:

- Mechanical, Electrical, Plumbing, and Fire Protection equipment and installation costs
- Hydropower equipment and installation costs
- Costs for new powerhouse enclosures illustrated in options PL 1,2, and 3.
- Structural reinforcing of existing walls or new structural members required for the installation of new equipment for the generation of hydropower.
- Hazardous materials abatement.
- Site work.
- General Conditions, permitting, and insurance
- Design and Construction contingencies

The following items were not taken into account when considering costs or suitability to rehabilitate the existing Upper Powerhouse, Gatehouse, and Lower Powerhouse enclosures, but are recommended as part of moving forward into a more technical phases of analysis based on our experiences.

- **Structural Engineering analysis** – We recommend a more detailed structural analysis be provided to determine the following:
  - There existing structural components physical properties (for steel trusses roof trusses and solid masonry walls).
  - Whether the existing structural components can handle the loading requirements of the current Building Codes.
  - Seismic evaluation of the unreinforced masonry walls will also be important in order to confirm whether lateral bracing is required. The Lower Powerhouse and Gatehouse exterior shells are in poor condition and therefore more remedial structural work may be
required to bring them up to the code required minimums for masonry construction. For example, the Lower Powerhouse will require an entirely new roof structure, along with the internal load bearing structure to support the vertical load path from into a foundation or footing.

- **Hazardous material analysis** - With any older existing structure testing for hazardous materials is recommended. This would entail testing for items such as lead in paint or soil, and asbestos in sealants. The Owner should consult an independent hazardous materials specialist for this investigation as A/E design professionals would not provide this type of service.

- **Masonry restoration analysis** - Visual observation suggests the Upper Powerhouse masonry is in good condition, but the Lower Powerhouse and Gatehouse are a different story. It’s difficult to confirm to what extent the water infiltration has damaged the mortar and masonry by just visual inspection. A masonry restoration specialist could recommend additional testing to determine if the existing unreinforced masonry can remain in place, and not be demolished in favor of all new walls.

- **Zoning and Building Code analysis** - This would likely require research into the Canton zoning ordinances to better understand how the sites are zoned and what the “Historic District” moniker would require for the Upper Powerhouse in terms of restoration requirements. In general if historic replication is required for the existing structures a premium range of 10-20% could be added to the rehabilitation costs depending on how stringent the requirements may be. An example of this would be matching brick dimensions and color, as well as mortar color precisely.

- **Energy Efficient design** - Currently, the existing structures do not have an insulated envelope. If an insulated envelope were required to conform to the current Energy Conservation codes the rehabilitation of the existing masonry walls and roof would become more complex and costly. As structures not meant for human occupation, the authorities having jurisdiction would need to be consulted to determine what level of energy efficiency is required by the exterior envelope.

- **Accessibility** - Based on visual observation the existing structures are not currently accessible, and would not meet the ADA or ANSI A17.1 codes for accessibility. The final say in this matter will be the authority having jurisdiction over the structures, however if they are not meant for public occupancy they may not need to be accessible. However, if the structures were used to educate the general public on hydropower, and allow public tours in and around the facilities, it would trigger the necessity to provide accessibility within and to the structures. Any type of accessibility retrofit will add cost to a project of this nature, but it’s difficult to assume the variables that may impact cost for this level of study.