October 6, 2020

Mr. Christopher Dilorio
Director of Community Development and Planning
Town of Hull
253 Atlantic Avenue
Hull, MA 02045

Tel: (781) 925-3595
Email: cdilorio@town.hull.ma.us

Proj.: Historic Fort Revere Water Tower Rehabilitation
Re: Preliminary Assessment Report
CBI Job No.: CB191842

Dear Mr. Dilorio:

Per our agreement, CBI Consulting, LLC, a Vidaris company (CBI), has completed a limited existing conditions assessment of the Historic Fort Revere Water Tower in Hull, MA. The purpose of our evaluation is to review the condition of the 117-year-old structure and to provide recommendations for repairs required to extend the useful life of the facility.

The Water Tower was built in 1903 and is approximately 85'-0" in height. The construction of the Water Tower is a cast in place steel reinforced concrete structure. The exterior walls of the tower are an octagonal shape with cast in place steel reinforced columns that spring from the concrete base to the roof structure. The eight (8) reinforced concrete columns are infilled with brick masonry, two (2) wythes in thickness at the central wall area and three (3) wythes in thickness around the perimeter of the masonry infill.

Within the center of the tower is the circular cast in place reinforced concrete water tank. Between the circular water tower and exterior wall of the tower is a reinforced concrete stair system approximately 22" wide that wraps around the circular water tank and terminates approximately 4'-0" below the observatory level.

The roof of the water tower is slate shingles with copper strips at the intersection of the eight (8) sided roof.

During the previous repairs to the Water Tower that were completed after it was decommissioned, concrete patching was completed with a shallow cementitious skim coating applied over concrete surfaces, and an exterior coating installed. The Water Tower was subsequently deemed unsafe to users, circa 2011 due to the potential life safety concerns for pedestrians below.

The concrete at the base of the water tower has areas of deep delamination, although the sloped concrete surface above the base is only exhibiting minor concrete delamination. At the reinforced concrete columns, there are isolated deep delaminated concrete at some locations and the steel reinforcement is exposed with varying degrees of corrosion visible.

The observatory is a cast-in-place steel reinforced concrete slab approximately 4-1/2" thick. The top surface of the slab is exposed to the weather due to the open sides of the observatory and there is no waterproof coating on the slab. Below the observatory are two (2) concrete beams and these members are structurally compromised. The underside of the observatory slab is exhibiting concrete spalls and exposed corroded steel reinforcement at isolated locations.

The water table/decorative bands located above the base of the tower and at the observation deck are cast in place reinforced concrete. The decorative bands are exhibiting delaminated concrete and delaminated cementitious skim coat. The brick masonry appears to have multiple layers of coating, still adhered to the brick masonry. A complete determination of the condition of the mortar joints cannot be made until all of the coating is removed. However, the brick masonry appears to be in fair condition with the exception of isolated areas of eroded brick, vertical cracks, and

failed mortar joints. There are also isolated areas where the outer wythe of brick is loose. It appears the brick was constructed without interlocking tie bricks between the multi- wythe brick layers. The majority of the coating at the base, columns and bands has worn away.
The existing metal fences around the observatory are corroded and anchorage is questionable. The metal access stair to the observatory level above the reinforced concrete stairs, is corroded with steel sections failed.

The reinforced concrete stairs and observatory platform are in poor condition. The stairs appear to have previously been patched and these patches have failed. The stair system appears to be cantilevered from the vertical columns at the stair platforms. The stair runs are connected to the stair platforms. The stair system is constructed with a space of approximately 2" from the water tank, possibly due to the potential vertical movement of the water tank with or without water. There are spalls and corroded reinforcement bars at the underside of the stairs and platforms. One section/portion of the stair has failed and is missing.

The slate roof of the water tower appears to be in fair to poor condition. Missing and broken slate shingles were observed during our visit. Locations of the roof were noted to be missing underlayment and the top surface of the wood planking was visible.

Concrete core samples were retrieved during our visit. Samples will be tested for concrete strength, percentage of chlorides, and material composition. The final test results are pending, and these results will be utilized in the preparation of the concrete repair details.

During a subsequent visit our consultant, MyCadd, performed laser scanning of the interior and exterior of the tower in order to prepare a 3D computer model. On the basis of the model data and the measurements gathered by CBI using a 4'-0" level and plumb bob we did not detect any measurable evidence of foundation settlement.

Handicap Access

The tower is not handicap accessible. Ultimately, "equal access" would include being able to get into the building and up to the observation level along with any other visitor to the site.

In order to create accessibility, there needs to be an accessible parking space and an accessible route to the front door. There is no dedicated parking adjacent to the tower. The existing sidewalk is not currently accessible and would have to be reworked. The existing concrete stoop, at the entry door, would have to be raised to be the same elevation as the door threshold. Additional landscape elements would be installed to blend the new entrance construction into the site.

Once inside the entry door, the vestibule inside is the same width as the stair, 22 inches, and not sufficient for wheelchair access. In order to make the first floor interior accessible, the thick wall of the concrete water tower structure would have to be sawcut and removed to create enough turnaround space within the vestibule. At the same time, this would provide access to the first floor or base of the water tower itself which could be converted into an exhibition and museum space to highlight the history of the tower, the history of the site, and include a video feed from the observation deck. As we have not been able to access the interior of the water tower structure itself, the effort for this task is unknown.

Handicap accessibility to the observation tower would require an elevator. Less expensive wheelchair lifts are not certified to reach that height. Therefore, a full-service elevator would need to be installed. There is likely enough room within the abandoned water tower structure itself for an elevator shaft. When it penetrates the observation deck, it will consume a great deal of floor space. It would also interrupt the existing concrete structure of the observation deck which will require a costly rework. Therefore, the cost and the spatial concerns of an elevator likely make it infeasible for this project. A variance would be required from the Massachusetts Architectural Access Board to eliminate the need for an elevator.

The concept of accessibility can likely be achieved in other ways. The point of the observation deck is to observe the magnificent views from the top of the tower. Cameras can be installed and a direct video feed to an exhibition space on the first floor. This is all standard technology that can provide " inclusion" to those who cannot physically access the stairs upward.

Existing Stair

The existing concrete stair, within the tower to the observation deck, is approximately 22 inches wide and is in poor condition. Our recommendation is to replace it, in kind, from a historic standpoint.

However, the stair does not meet the requirements of the building code for egress and cannot be used by the public. The stair can best be described as a “service stair”. It contains one handrail. Because of the steepness and the geometry, we recommend a second rail be installed on the other side. This stair can be used by maintenance personnel and technicians who are servicing the electronic equipment located on the Observation Deck level.

In order for the public to access the observation deck, a new code compliant egress stair must be installed. Again, if a vestibule is created inside the front door by cutting out a section of the existing water tower structure, there is likely space within the tower to build a freestanding stair that would emerge into the observation deck. The stair could be open to the weather eliminating the need for an enclosure at the top with a weatherproof door. The steel structure would likely be hot dip galvanized steel. New lighting would be required as well as exit signs, emergency lighting, and pull stations.

Recommendations

In addition to the completion of the life safety and accessibility requirements, CBI recommends that the deteriorated and delaminated concrete throughout the interior and exterior surfaces of the tower be removed and the concrete be repaired. Concrete repairs shall also be performed at the outside face of the water tank. Concrete repairs will require removal of corrosion at exposed steel reinforcement, existing steel reinforcing with excessive corrosion will require reinforcement to be supplemented with new reinforcement to improve the performance of the steel reinforced cast in place concrete. Exposed steel reinforcement encountered will be treated with a rust inhibitor coating prior to the installation of restoration mortar.

Areas of delaminated and/or debonded cementitious skim coat shall be removed and a new skim coat applied to match the surface concrete profile.

We recommend that the remaining existing exterior coating at the brick masonry and concrete surfaces be removed and a breathable weatherproof coating system be installed.

The brick masonry will require isolated rebuilding at areas of loose masonry. The interior and exterior brick surfaces will require cutting and re-pointing of failed mortar joints. Vertical brick cracks shall be routed and sealed with a high-quality sealant compatible with the breathable waterproof coating. The intersection of the brick masonry and concrete will receive at a high-quality sealant to reduce water infiltration.

CBI recommends injection of structural epoxy at wide and deep concrete cracks at the exterior and in some locations, interior of the water tower.

The deteriorated windows should be removed and replaced, to reduce water infiltration to the interior of the tower.

We recommend the removal and replacement of the existing slate roof and copper work. An adhered membrane should be installed below the slate shingles to improve the water tightness and reduce decay of the wood roof framing below. The wood framing requires further review to assess the condition and to evaluate the hold downs to the concrete structure. Currently the roof structure is concealed with a wood framed ceiling. The worn paint at the ceiling below the roof visible from the observation deck will need to be painted with a high-quality paint to protect against weather.

The top surface at the observatory level is unprotected concrete. We recommend an application of a pedestrian grade traffic-bearing coating to protect the concrete from weather.

The metal fences around the observatory have outlived their life span due to corrosion and we recommend that a new metal rail, coated with a high-quality marine paint, be installed.

In our opinion that the cast in place concrete service stairs and platforms are in poor condition and are unsafe for use. We recommend that the stairs and platforms be removed and replaced. The replacement stairs can be either new cast in place concrete, or a metal stairs system, coated with a marine grade coating.

To access the observatory level from the service stair the existing plywood hatch should be replaced with a proper access hatch.

Please contact the undersigned with any questions.

Very truly, yours,
CBI Consulting, LLC

Stephen McDermott
Project Manager
smcdermott@cbiconsultingllc.com

SAM/rtb
CB191842 L001 Assessment Report 10-6-20

	PROJECT			CBI Consulting LLC	
	COST ESTIMATE			Project No.	CB191842
	Design Development				
	Fort Revere Water Tower- Interior and Exterior Repairs				
	Hull, MA			SUBMISSION	Preliminary
				DATE:	6-Oct-20
ITEMIZED SCOPE		Unit	Quantity	Unit Cost	Sub-totals
DIVISION 1 - GENERAL REQUIREMENTS					
A)	Protections and Cleaning	LS	1	$ 5,000.00	$ 5,000.00
B)	Exterior Vertical access	LS	1	$ 35,000.00	$ 35,000.00
C)	Interior Vertical access	LS	1	$ 50,000.00	$ 50,000.00
D)	Temp Disconnect & Re-Connects	LS	1	$ 5,000.00	$ 5,000.00
	Sub-Total				**$ 95,000.00**
DIVISION 2 - EXISTING CONDITIONS					
A)	Window sealant and glazing abatement	LS	1	$ 6,500.00	$ 6,500.00
	Sub-Total				**$ 6,500.00**
DIVISION 3 - CONCRETE					
A)	Base Repair-Exterior	SF	750	$ 45.00	$ 33,750.00
B)	Sloped Base Repair- Exterior	SF	150	$ 90.00	$ 13,500.00
C)	Column Repairs-Exterior	SF	450	$ 90.00	$ 40,500.00
D)	Decorative Band Repairs-Exterior	SF	1250	$ 125.00	$ 156,250.00
E)	Crack Injection	LF	350	$ 15.00	$ 5,250.00
F)	Cementitious Skim Coat-Exterior	SF	800	$ 35.00	$ 28,000.00
G)	Base Repair-Interior	SF	100	$ 45.00	$ 4,500.00
H)	Column Repairs-Interior	SF	150	$ 90.00	$ 13,500.00
I)	Water Tank Wall Repairs	SF	250	$ 75.00	$ 18,750.00
J)	Observatory Slab soffit Repairs	SF	100	$ 95.00	$ 9,500.00
K)	Observatory Beam Repairs	EA	2	$ 7,500.00	$ 15,000.00
L)	New Slab/Foundation for new egress stairs	EA	1	$ 5,000.00	$ 5,000.00
	Sub-Total				**$ 343,500.00**
DIVISION 4- MASONRY					
A)	Cut and Repoint mortar joints	SF	1250	$ 25.00	$ 31,250.00
B)	Remove and Rebuild deteriorated bricks	SF	250	$ 50.00	$ 12,500.00
C)	Install helifix anchors	SF	2400	$ 12.00	$ 28,800.00
D)	Clean existing coating	SF	7400	$ 3.50	$ 25,900.00
	Sub-Total				**$ 98,450.00**
DIVISION 5 - METALS					
A)	Remove and Replace Concrete Stairs with new metal stairs and metal railings	LF	90	$ 650.00	$ 58,500.00
B)	Install new roof hatch	LS	1	$ 3,250.00	$ 3,250.00
C)	Remove and Repair existing observatory Fence	EA	8	$ 1,500.00	$ 12,000.00
D)	New metal stair in water tank	EA	1	$ 50,000.00	$ 50,000.00
	Sub-Total				**$ 123,750.00**
DIVISION 7 - THERMAL AND MOISTURE PROTECTION					
A)	Remove and replace slate shingles	SF	1,200	$ 90.00	$ 108,000.00
B)	Repair deteriorated sheathing	SF	150	$ 25.00	$ 3,750.00
C)	Replace deteriorated trim	LF	200	$ 30.00	$ 6,000.00
D)	Pedestrian traffic coating on Observatory concrete slab	SF	920	$ 7.00	$ 6,440.00
E)	Paint ceiling at observatory	SF	920	$ 3.50	$ 3,220.00
F)	Breathable elastomeric coating on exterior concrete	SF	7,000	$ 5.00	$ 35,000.00
	Sub-Total				**$ 162,410.00**

DIVISION 8 - WINDOWS AND DOORS					
A)	Remove and Replace existing windows	EA	4	$ 1,500.00	$ 6,000.00
B)	Remove and Replace existing door	EA	1	$ 5,500.00	$ 5,500.00
	Sub-Total				**$ 11,500.00**
DIVISION 26 - ELECTRICAL					
A)	Install new interior/exterior lighting and pull stations	LS	1	$ 15,000.00	$ 20,000.00
	Sub-Total				**$ 20,000.00**
DIVISION 32- EXTERIOR IMPROVEMENTS					
A)	New exterior concrete paving (Tower Base)	SF	500	$ 10.00	$ 5,000.00
B)	Remove and install new fence around tower base	LF	300	$ 75.00	$ 22,500.00
C)	Grading paving for HC Parking and sidewalk	LS	1	$ 50,000.00	$ 50,000.00
	Sub-Total				**$ 77,500.00**
	Project Sub-Total				**$ 938,610.00**
	with General Conditions	x	0.12	$ 112,633.20	$ 1,051,243.20
	Total with Bonds & Insurance	x	0.03	$ 28,158.30	$ 1,079,401.50
	Overhead & Profit	x	0.15	$ 140,791.50	$ 1,220,193.00
	Escalation	x	0.04	$ 48,807.72	$ 1,269,000.72
	Total Construction Cost Estimate				**$ 1,269,000.72**
	Design and Construction Contingency	x	0.20	$ 253,800.14	$ 1,522,800.86
Total Project Cost					**$ 1,522,800.86**
Additional Soft Costs (see note #8 below)				TBD	
				TOTAL BUDGET	**$ 1,522,800.86**

Notes:

1. This estimate was prepared for the exclusive use of the Town of Hull
2. This estimate is based on the work described in the CBI Design Development dated August 31, 2020. Detailed specifications have not been prepared at this time.
3. All scope items and costs are based on the professional experience of the design professionals and professional cost estimator.
4. Additional study and investigation is required to finalize a Construction Document scope and budget.
5. The Owner should carry an Escalation cost of 4% per year, compounded every year that the project is not undertaken to account for rising construction costs and inflation. CBI has estimated 12 months until the midpoint of construction for the purposes of this estimate.
6. Costs assume public bidding and the payment of Prevailing wages to contractor personnel.
7. This estimate is not a prediction of the successful bid from a contractor as bids will vary due to fluctuating market conditions, proprietary specifications, lack or surplus of bidders, perception of risk, etc. Consequently, the estimate is expected to fall within the range of bids from a number of competitive contractors or sub-contractors. However, we do not warrant that bids will not vary from the final construction cost estimate.
8. Soft costs such as, relocation/reinstallation of existing telecommunications equipment, OPM, bid host services, Clerk and Printing not included in the budget above.

Historic Fort Revere Water Tower Rehabilitation
Photo Index
CBI Job No.: CB191842
August 31, 2020

Photo No.	Exterior Review	Description
1.		Typical elevation of the water tower.
2.		View at the entrance door to the water tower. Note highlight area with structural crack through entire concrete door header and decorative lower band.

CBI Consulting, LLC
250 Dorchester Avenue | Boston, MA 02127 | Tel.: +1 617 268 8977 | Fax : +1 617 464 2971
www.cbiconsultingllc.com

3.		View of deteriorated concrete patch at the base of the tower.
4.		View of deteriorated concrete patch at the base of the water tower.
5.		View of deteriorated concrete patch at the base of the water tower.

6.		View of deteriorated concrete patch at the base of the water tower.
7.		Photo of spalled and loose concrete at the lower decorative band.
8.		View at spalled and loose concrete at the lower decorative band.

9.		View of the reinforced concrete column and coated concrete brick masonry infill between the columns.
10.		Typical view of a dilapidated window possibly original to the construction of the water tower.
11.		View of a section of failed cementitious skim coat. All columns have a shallow layer of cementitious skim coat.

12.		Photo of the interface between the coated concrete brick masonry and the concrete column.
13.		View of cracked concrete at the upper decorative band at the observatory level.
14.		Exterior concrete columns at the observatory level.

15.		View of the exterior concrete columns at the observatory level.
16.		View of the delaminated concrete at the observatory level.
17.		Photo of failed and eroded mortar joints below the upper decorative concrete band.

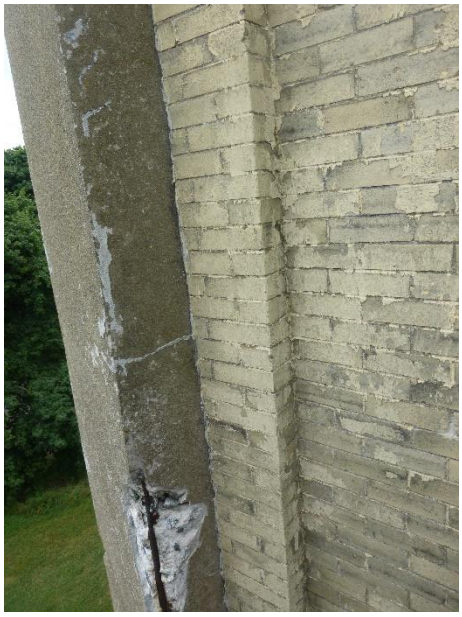
18.		Vertical hairline crack at the coated concrete brick masonry.
19.		View of eroded mortar joints at the coated concrete brick masonry.
20.		Typical view of the decorative concrete window header.

21.		Close-up of a typical window with a corroded window frame and rotted wood trim.
22.		Spalled concrete at the lower decorative concrete band.
23.		Photo of the exterior security fence typical at all eight faces of the water tower at the observation level. Note steel is corroded and anchorage is questionable.

24.		Typical view of the delaminated top surface of the upper decorative concrete band.
25.		Close-up view at a typical failed sealant at the intersection of the concrete column and coated concrete brick masonry.
26.		View at the underside of the upper decorative concrete band with loose cementitious skim coat.

27.		Close-up view of eroded mortar joints
28.		Photo looking upward at the top of the brick infill with a decorative corbel detail.
29.		Photo of the antenna that is used by the Town of Hull for emergency services.

30.		View of the slate roof of the water tower. Missing and broken slate was observed.
31.		View at the top of the slate shingle roof.
32.		Distorted copper cap.

33.		Open gaps at the copper hips and slate roofing shingles.
34.		Typical concrete spalls at the steel reinforced concrete column, with exposed corroded reinforcement steel.

35.		View of the top window below the observatory level. Note most of the brick coating has worn away.
36.		Close-up view of the crack through the door header.

Photo No.	Interior Review	Description
37.		Photo of spalled concrete and exposed steel reinforcement at the underside of the observatory level.
38.		View of one (1) of two (2) steel reinforced concrete beams below the observatory level. Both reinforced beams are compromised.
39.		Close-up view at the beam midspan with failed reinforcing steel.

40.		Close-up view of a typical concrete spall and exposed corroded steel reinforcement below the observatory level.
41.		View at the underside of the wood framing below the roof. Note paint is worn.
42.		Photo of missing wood boards with concrete beam exposed.

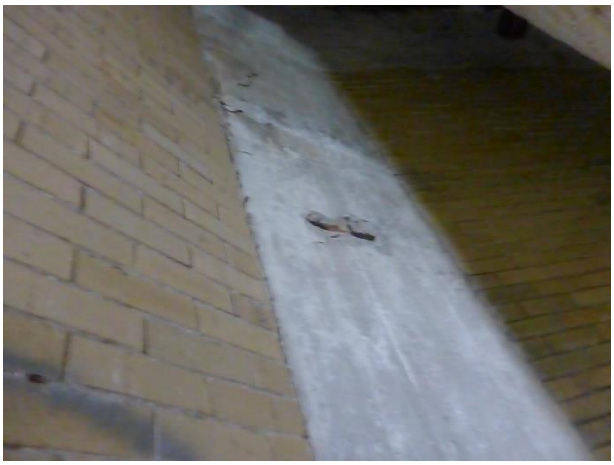
43.		View of a corroded and loose railing connection at the concrete column at the observatory level.
44.		View of the corroded steel angle that connects to the metal railing. Railing connection are compromised.
45.		Photo of the base of the railing system with an unsealed hole through the concrete deck at the observatory level. Note failed sealant over concrete crack.

46.		Photo looking down at failed concrete patch at the stair platform.
47.		Photo of a continuous crack along a run of steps.

48.		View of a continuous crack along a run of steps.
49.		Photo of a failed patch at the stair landing.

50.		Photo of a missing portion of a stair platform.
51.		Downward view at the missing stair platform. Note the entrance door is below.
52.		View at the corroded steel stair that accesses the observatory from the concrete stair.

53.		Photo of the delaminated beam end at one (1) of the reinforced beams supporting the observatory level,
54.		Photo of the underside of the observation level at the perimeter. Note rust staining from steel reinforcement due to water infiltration and salts chlorides.
55.		Spalled concrete at the concrete column.

56.		Spalled concrete at the concrete column.
57.		Deteriorated concrete at the water tank.
58.		Photo of exposed reinforcement at the concrete water tank.

59.		Exposed and corroded steel reinforcement and spalled concrete at the underside of the stairs.
60.		Close-up view of failed concrete at the concrete water tank.
61.		View of the interior stair. The electrical box is used for the communication equipment that is housed at the observatory.

62.		Delaminated concrete spall at the reinforced concrete column.
63.		Upward view between the inside face of the exterior wall and face of the concrete water tank.
64.		Upward view of the underside of the reinforced concrete stairs with spalled concrete and corroded exposed steel reinforcement.

65.		Interior/base of the water tower with a vertical crack between the concrete column and concrete base, typical at all eight columns.
66.		View at exposed corroded steel reinforcement and spalled concrete at the underside of a stair run.
67.		Corroded steel reinforcement and spalled concrete at the underside of a stair platform.

68.		View of exposed corroded reinforcement and spalled concrete at the underside of a stair run.
69.		Close-up view of a severely corroded reinforcement at the underside of a stair run.
70.		Photo of exposed corroded steel reinforcement and spalled concrete at the underside of a stair run.

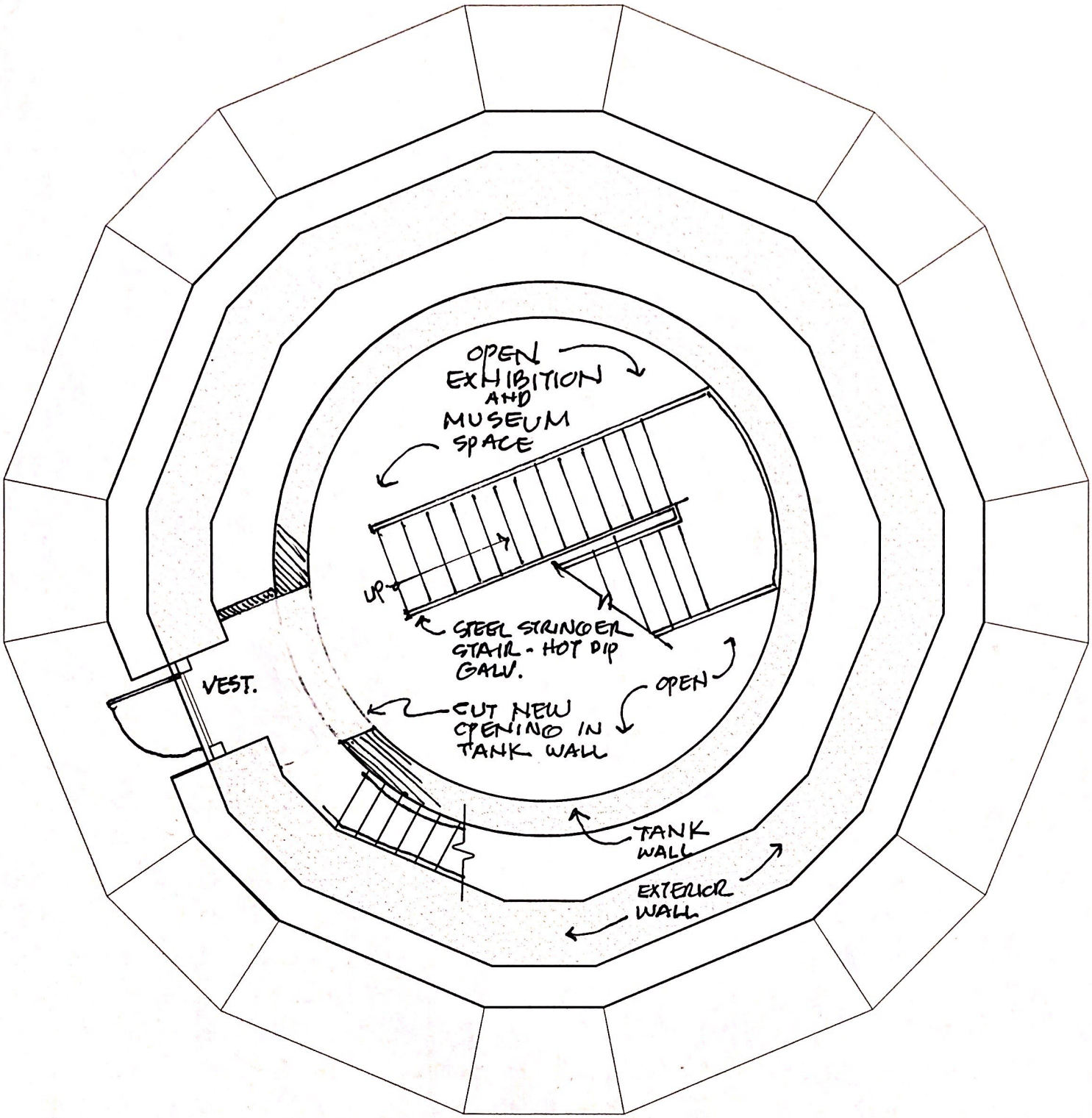
Photo No.	Investigation	Description
71.		Laterally displaced concrete brick masonry above the lower decorative band.
72.		View at loose bricks removed by hand.
73.		Concrete core location #1 through the base of the tower.

74.		View of the retrieved concrete core location #1.
75.		Concrete core location #2 through the base of the tower.
76.		View of the retrieved concrete core location #2.

77.		Concrete core location #3 through the base of the tower.
78.		The retrieved concrete core location #3.
79.		View of the on-going coring through the base of the water tower.

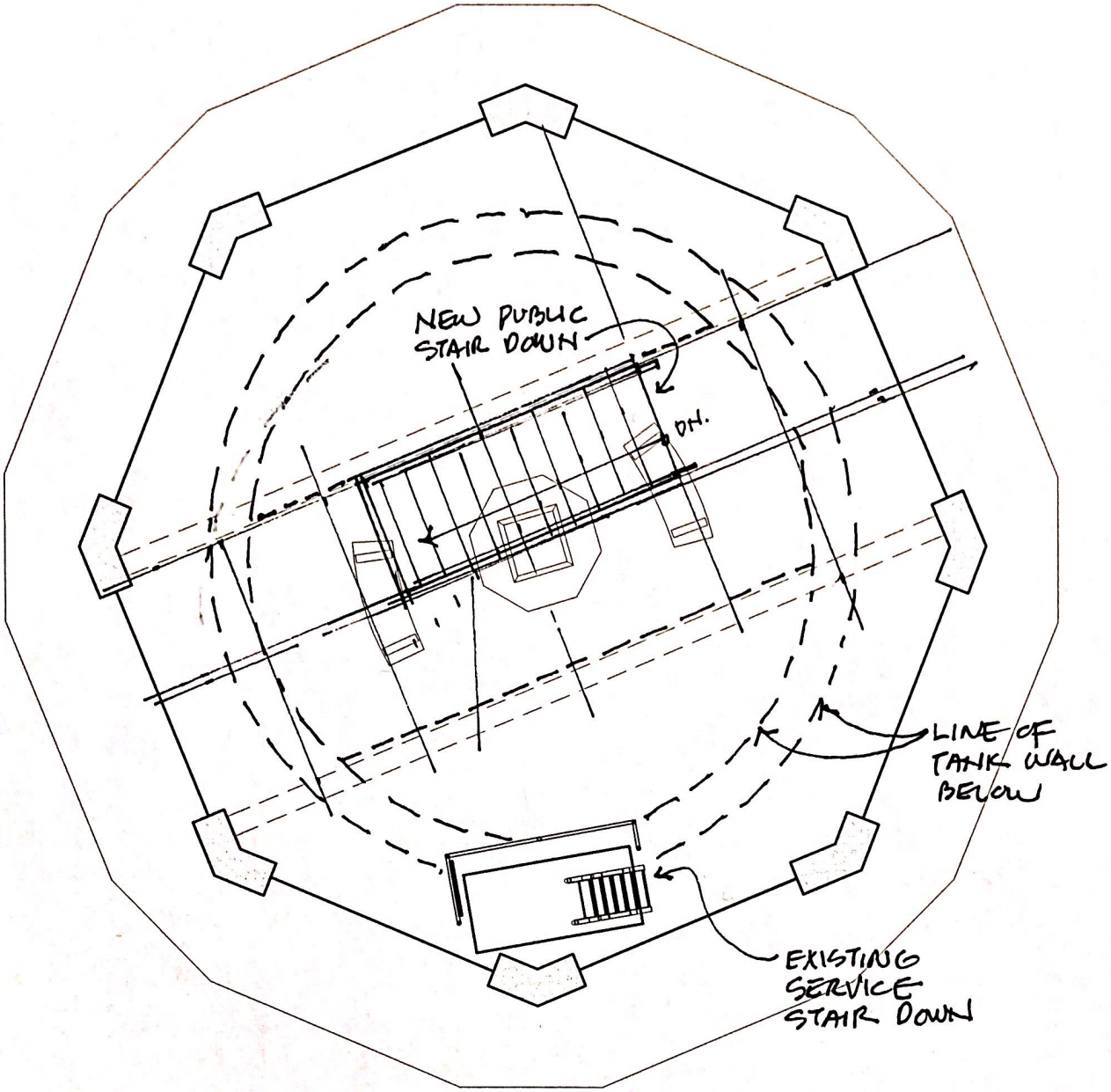
80.		Concrete core location #4 through the base of the tower.
81.		The retrieved concrete core location #4.
82.		Concrete core location #5 through the base of the tower.

SAM/rtb
CB191842 L001 Photo Index Rev 10-6-20



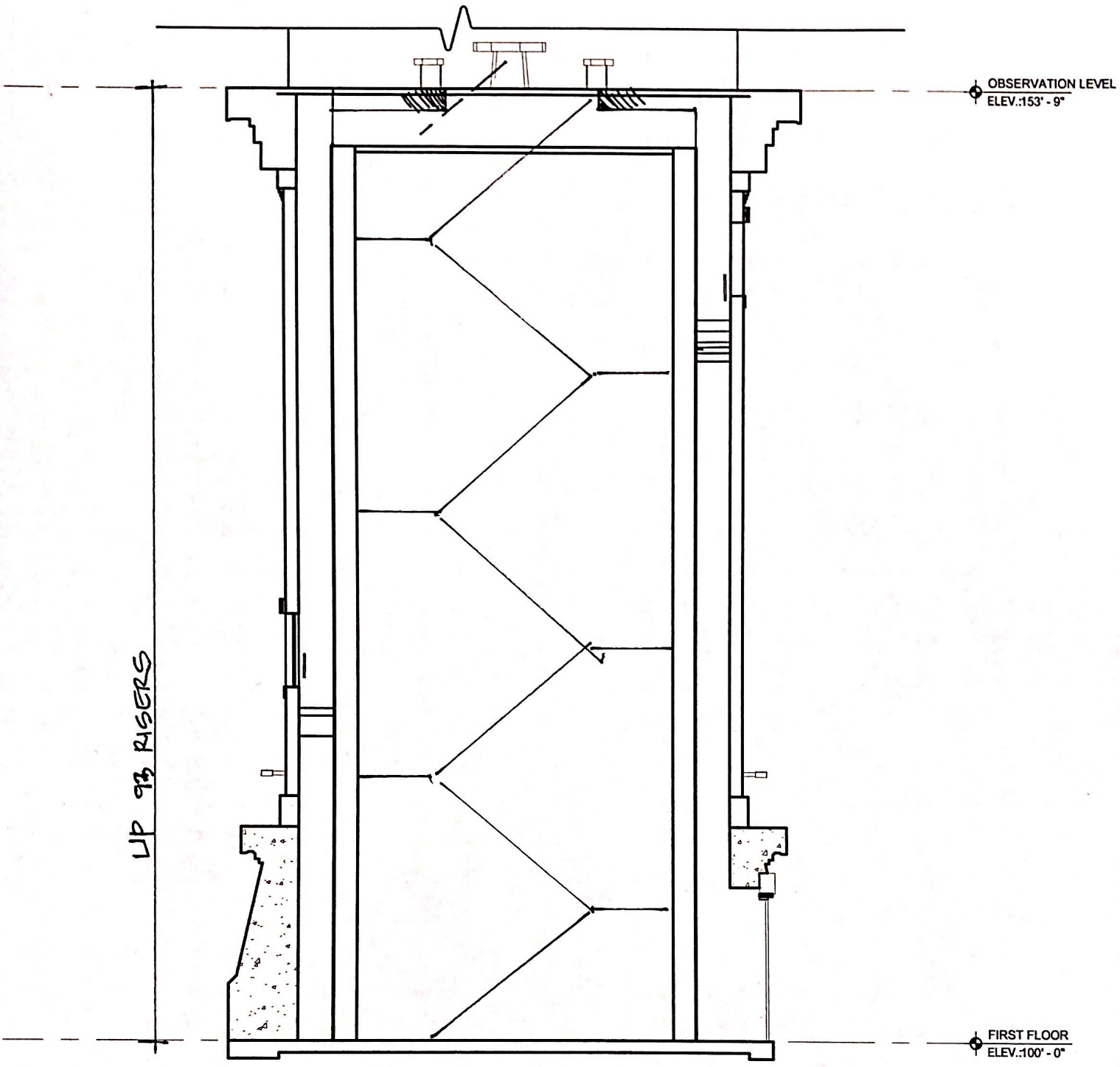
1 SECTION AT BASE OF TOWER

SCALE: 3/16"=1'-0"



2 FLOOR PLAN AT OBSERVATORY

SCALE: 3/16"=1'-0"



1 SECTION

SCALE: 1/8"=1'-0"