Photo 20. Facing west, pilings (in blue boxes) at eastern end of Trench 55AN and west of TP-55-284.5.

Photo 21. Facing south, wood piling in edge of wall at TP-55AN-39.

Photo 22. Facing south, wood piling at TP-55AN-128.5.

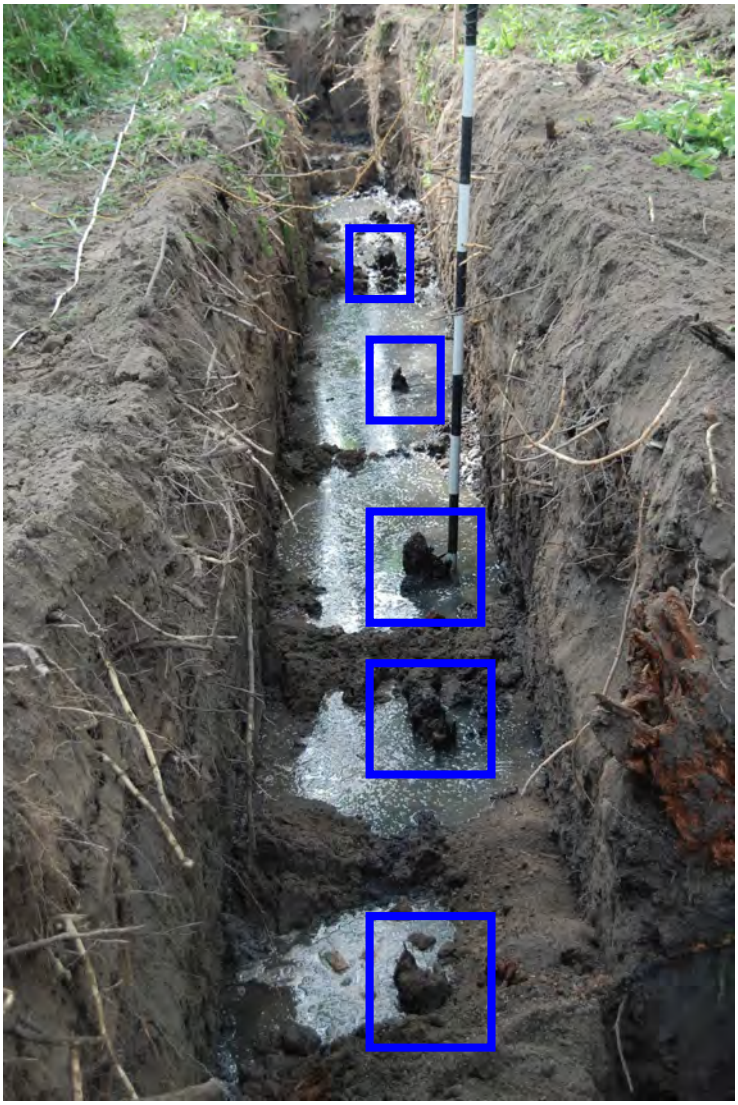


Photo 23. Facing east, wood pilings (in blue boxes) within Trench 55AN to the south of Trench 54A.

Photo 24. Facing west, wood piling at western end of Trench 55AN at TP-55AN-148.

Photo 25. Milled wood found adjacent to the wood piling at TP-55AN-148.

Photo 26. Gasket located in vicinity of Wood piling at TP-55AN-148 and recovered at a depth of approximately 8 ft below the surface.

Trench 55BS

At HP-TP-55-409, a piling and milled wood were encountered and it was determined that a trench perpendicular to Trench 55 away from the Onondaga Lake shoreline would help to determine if this piling represented the south wall of the Iron Pier Harbor (Figure 20, p. 60). A wide trench (approximately 3 to 5 m [10-15 ft] in width) was excavated at the western end and narrowed down as the trench went to the east. The width of the trench was needed to examine the pilings within the trench (Photo 27). An additional four pilings were identified east of HP-TP-55-409 (Figure 22, p. 64). The last piling was located along the north wall of the trench. Because of the depth of the pilings and the location of Trench 56 to the east, the trench excavation was halted 19.5 m (64 ft) east of Trench 55.

Photo 27. Facing northeast, piling fragments during excavation of Trench 55BS.

Trench 56

Trench 56 was excavated approximately 29.6-41.2 m (97 to 135 ft) east of Trench 55 (Figure 20, p. 60). The trench was excavated from the south to north. The trench was started to the south of the expected south wall of the Iron Pier Harbor. The trench was approximately 192 m (630 ft) in length. The soil stratigraphy was examined at five different locations along the trench, with the stratigraphy observed throughout the excavation of the trench. Cultural resources were encountered and these included: melted metal and concrete near the southern end of the trench, wood planks/beams/pilings, and a large piece of metal hardware. At the southern end of the trench, the soil stratigraphy consisted of 0.6-1.2 m (2-4 ft) of gravel with brick on top of grey brown sandy silt overlaying grey marl, which was encountered at 2.4 m (8 ft) below the surface.

At HB TP-56-22, a large fragment of concrete and melted metal was identified, and which obstructed excavation of 2 m (6.5 ft) of the trench (Photos 28-29). The fragment was later removed. Parts of pilings, concrete and metal objects were identified to the south of, and around the area between 6.7-8.7 m (22 and 28.5 ft) north. This would suggest that the area may have been the approximate western edge of the Iron Pier Harbor; this location matches the approximate locations of the pilings identified in Trench 55BS.

Photo 28. Facing south, concrete and metal deposit in Trench 56 at 22-28 ft north of south end.

Photo 29. Metal and concrete deposit from Trench 56.

At HB-TP-56-145, the excavator encountered a series of wood planks or wood pilings that could not be removed without total destruction (Photos 30-31). The wood planks/pilings continued for about 5.3 m (17.5 ft) to TP-56-162.5. The wood planks/pilings were initially identified 1.8-2 m (6 to 6.5 ft) below the surface and they extended to at least 3-3.7 m (10-12 ft) below the surface. Just to the west of the wood planks/pilings was a piece of metal hardware which measured a maximum of 107 cm (42 in) in height and 104 cm (41 in) in width (Photos 32-34). The metal hardward consists of a series of metal strips and bolts. The metal object appears to represent some form of hardware for a door or wall of a structure.

Photo 30. Facing north, wood fragments at TP-56-145.

Photo 31. Facing northwest, wood fragments at TP-56-145.

Photo 32. Metal hardware recovered in Trench 56 at TP-56-145.

Photo 33. Closeup of Metal hardware recovered at TP-56-145.

Photo 34. Closeup of metal hardware recovered at TP-56-145.

Between TP-56-28.5 and TP-56-145, soils were observed during excavation and stratigraphy was recorded at TP-56-100 (Photo 35). Within the backhoe trench, the stratigraphy included an upper horizon of grey gravelly sand from the surface to 1.4 m (4.5 ft) below the surface; from 1.4-1.7 m (4.5-5.5 ft) below the surface, a red brown gravelly sand was present; from 1.7 m (5.5 ft) below the surface to the base of the trench (2.9 m [9.5 ft] below surface), a grey and black marl was present. The sands at TP-56-100 differ from the sandy loams found outside of the former harbor in Trenches 54 and 55. In addition, larger amounts of oil appear to be present just above and within the marl. This continues from TP-56-100 through at least TP-56-228.

Photo 35. Facing northwest, west wall profile of Trench 56 at TP-56-100.

Because of time constraints, a continual trench was not excavated from TP-56-259 through TP-56-620. Instead, several 7.5 to 15 m (25 to 50 ft) trenches were excavated at three additional locations, with soil stratigraphy being examined at HB-TP-56-403, 56-508 and 56-620. At HB-TP-56-508 and 620, a black root mat (Photo 36) was encountered between 2.4-3 m (8 to 10 ft) below the surface with black marl and oil identified below the vegetative horizon. The stratigraphy at HB-TP-56-403 contained sandy silts above a grey marl, which was identified from 2.6-3 m (8.5 to 10 ft) below the surface. As with Trench 55, the stratigraphy in 56-403 versus that found in 56-508 and 620 may confirm the area of the lake extension versus the area of fill on the 1892 Sanborn map (Figure 11, p. 16).

Photo 36. Root mat from the base of Trench 56 at TP-56-508.

Trench 57

Trench 57 was excavated approximately 22.9-34.1 m (75-112 ft) east of Trench 56 and is located approximately 57 to 137 m (187 to 450 ft) east of the shoreline of Onondaga Lake. The trench was excavated south to north; testing covered approximately 171 m (560 ft), although some northern portions of the trench were skipped due to time constraints. The soil stratigraphy was examined at five different locations along the trench, with the stratigraphy observed wherever the trench was excavated. At the locations from HB-TP-57-50 to 57-560, sands were found below fill, with historic deposits or coal tar-like deposits found at a number of locations (Photos 37-41). At 57-50, brick fragments were identified between 3-3.5 m (10-11.5 ft) below the surface; at 57-160, a piece of decal ironstone was identified at 2.4 m (8 ft) below the surface, with coal tar and dark black sand from 3.2-3.5 m (10.5-11.5 ft) below the surface; at 57-260, dark black silty sand was identified at 3.4-3.7 m (11-12 ft) below the surface; similar soils were found between 3-3.4 m (10-11 ft) below the surface at 57-460; and shoe fragments with some black sand and silt were identified at 3-3.7 m (10-12 ft) below the surface at 57-560 (Photo 42). No pilings or historic features were identified along Trench 57. The fill soils and the cultural material at 2.4-3.7 m (8 ft to 12 ft) appear to reflect the filled in Iron Pier Harbor and the Onondaga Lake extension identified on the 1892 Sanborn map (Figure 11, p. 16).

Photo 37. Facing east, east wall profile of TP 57 at TP-57-50.

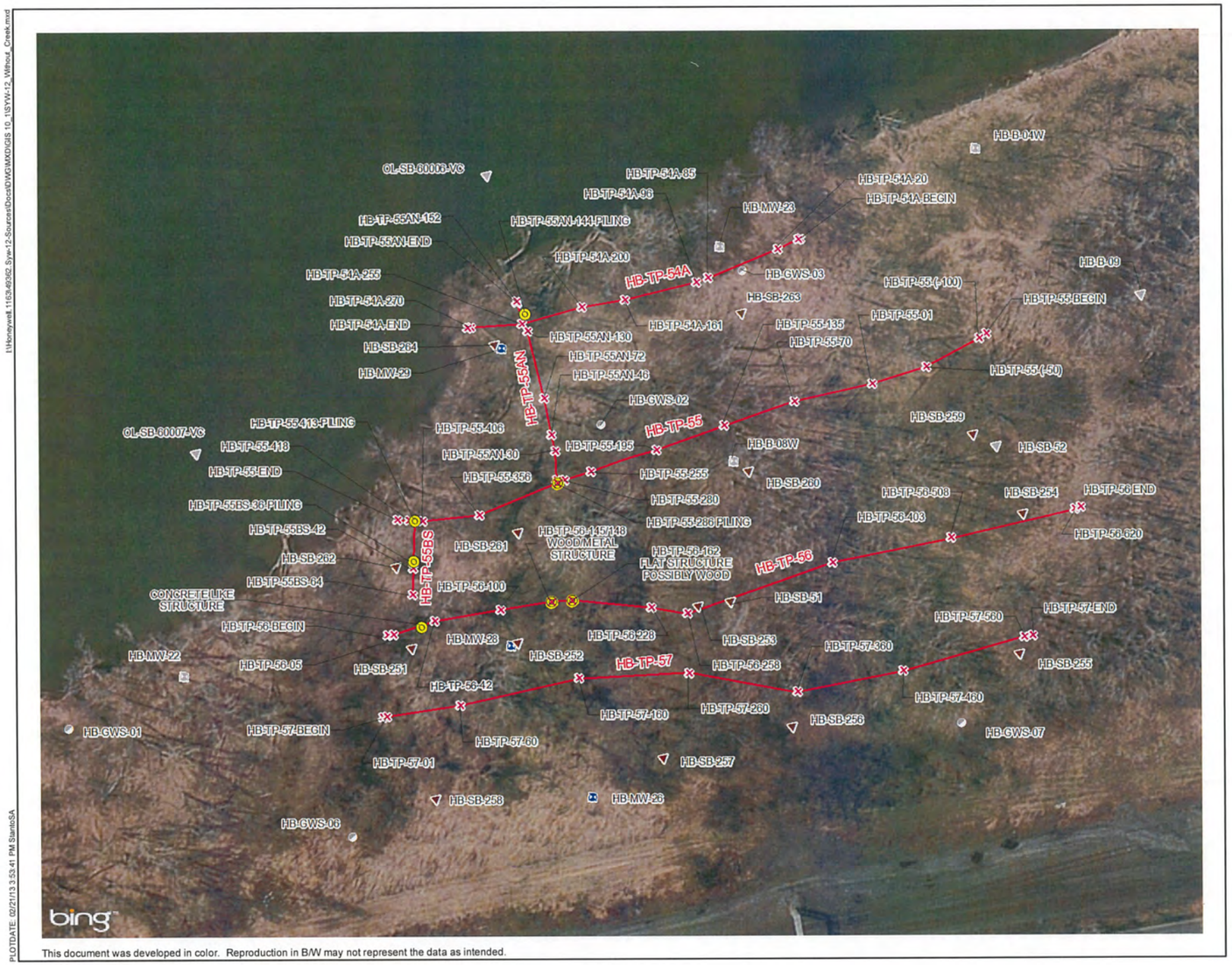
Photo 38. East wall profile of Trench 57 at TP-57-160.

Photo 39. Facing east, east wall profile in Trench 57 at TP-57-360.

Photo 40. Facing east, east wall profile of Trench 57 at TP-57-460.

Photo 41. Facing north, northern end of Trench 57 at TP-57-560.

Photo 42. Shoe fragment recovered at 3-3.7 m (10-12 ft) below the surface in Trench 57 at TP-57-560.



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LEGEND

- GROUND WATER SCREENING
- MONITORING WELL
- SOIL BORING
- TEST PIT SAMPLE LOCATION
- TEST PIT
- EXISTING LOCATIONS
- FORMER ONONDAGA CREEK INFRASTRUCTURE

HONEYWELL
SYRACUSE, NY

SYW-12 SAMPLE LOCATIONS

0 40 80 160
Feet

FEBRUARY 2013
1163 49362

O'BRIEN & GERE

Figure 20. Location of Trenches for the SYW-12 Wetlands Testing (Red lines- trenches).

VIII. IRON PIER HARBOR SITE (SUBi-3037)

Four of the six backhoe trenches excavated through SYW-12 identified wood pilings or wooden features. The wood pilings appear to reflect the northern and southern walls of the channel and basin of the former Iron Pier Harbor. These wood pilings suggest that the majority of the channel from Onondaga Lake to the east was approximately 38 m (125 ft) in width, which is similar to the width of the channel on the 1908 Hopkins map (Figure 15, p. 19). The harbor contained a series of pilings with wood planks lining the harbor, with wooden boathouses situated adjacent to the pilings (Figures 12-13, p. 17). At the eastern end of the harbor, the harbor turned northward to a dock just to the south of the Iron Pier Amusement Park (1892 and 1908, Figures 11 and 15, pp. 16 and 19). The wood pilings and planks, as well as the metal hardware are the remains of the Iron Pier Harbor infrastructure and are designated as the Iron Pier Harbor Site (SUBi-3037). These are a contributing property of the Syracuse Maritime Historic District.

Site Location. The Iron Pier Harbor Site is located within the project area identified as SYW-12 adjacent to the southeastern side of Onondaga Lake in the City of Syracuse, Onondaga County, New York. The property is located at the southwest intersection of CSX Transporation Line (which runs along the northeast side of Onondaga Lake) and the Conrail line of CSX Transportation (which runs along the southern end of Onondaga Lake) (Figures 1-2, pp. 2-3). The site is located at an elevation of approximately 110.7 m (363 ft) ASL (Figure 1, p. 2). The site is also associated with Anomaly 38 that was identified and investigated during the underwater archaeological survey (Kane et.al. 2011).

Context. The wood pilings, planks and metal hardware of the Iron Pier Harbor Site are the remnants of the infrastructure adjacent to the harbor and the possible remains of a former boathouse that bordered the basin of the Iron Pier Harbor. The Iron Pier was an amusement resort with a public pavilion constructed in 1890 by the People's Railway Company. The resort contained a long, narrow wooden pavilion measuring 50 x 600 ft (Sanborn 1892, Fig. 11, p. 16) (Thompson 2002). On the north end of the pier pavilion were bowling alleys and a concert hall was on the south end. Besides shops, restaurants, and amusements, the Iron Pier Park hosted a variety of activities including baseball games, concerts, boat rentals, a large toboggan water slide, swimming, and fishing (Thompson 2002). The portion of the resort along the channel and basin of the Iron Pier harbor included a pier for boats, as well as a building adjacent to the lake, a waterslide, and boathouses (Figures 11-13, pp. 16-17). By the end of 1906, the Iron Pier resort closed and on March 16, 1907, the resort was demolished (Syracuse Post Standard 3/16/1957). By 1908, the area of the Iron Pier pavilion and amusement area had been covered with soda ash refuse and an area had been created on top of the wastes adjacent to the original mouth of Onondaga Creek and adjacent to the channel basin and identified as the Iron Pier Park (Figure 15, p. 19). Boathouses remained standing at that time along the channel basin and were not demolished as part of the Iron Pier resort. By 1924, the Iron Pier Park was no longer situated on the southern shore of Onondaga Lake (Figure 16, p. 20).

Site Size. Based on 19th and 20th century historic maps, current aerials, and archaeological evidence identified during Phase 1 trenching, it is estimated that the Iron Pier Harbor covers approximately 1.6 acres of the project area. In addition, former boathouses, the Iron Pier pavilion, and other pavilions may cover an additional 2.6 acres within the SYW-12 area.

Summary of Artifacts. The Iron Pier Harbor Site produced one piece of metal hardware that was found within Trench 56 at TP56-145/148. The base of the metal hardware is approximately 1.2 m (4 ft) in length, with the metal bands being at least 104-107 cm (41-42 in) in length. The metal artifact resembles hardware on a building or door and may be from a former boathouse. Other artifacts found during excavation, including shoe soles, ceramics, glass, and metal appear to be fill or could not be directly associated with the site.

Features. The Iron Pier Harbor Site is defined by a series of wood pilings and wood planks (part of harbor wall). The wood pilings were initially found at TP-55-284.5 and were continually encountered within Trench 55AN. These wood pilings and some wood planks (30 cm [12 in] wide and 5 cm [2 in] thick) are suggestive of the northern wall of the channel of the Iron Pier Harbor and may match the wall assembly in Figure 13, p. 17. The wood piling at TP-55-284.5 was pulled out of the ground and was found to be 4.4 m (14.5 ft) long with a 16 cm (6 ½ in) diameter. The base of the wood piling was hand shaped to a tapered point. The wood planks were milled with even cuts at the edges of the planks. Additional wood pilings were found to the west of TP-55-284.5 within the lower portion of Trench 55AN. However, because an attempt was made not to destroy the pilings and water quickly filled in the base of the trench, it is not certain if all the

pilings were identified. The additional 18 pilings were found west of TP-55-284.5 (Figures 21-22, pp. 63-64). Although additional wood pilings were not found in Trench 56 (about 27.4-45.7 m [90-150 ft] east of Trench 55), wood planks at TP-56-145 (along with the above mentioned metal hardware) and impenetrable wood (pilings or logs) between TP-56-145 and TP-56-162 were suggestive of a boathouse or some other structure along the northern edge of the channel or basin of the Iron Pier Harbor.

The south wall of the Iron Pier Harbor was located initially in Trench 55 at TP-55-409/413. At TP-55-409, a wooden structure (logs or pilings) was located and could not be removed without destruction; just behind the pile of wood, a wood piling was found with wood planks behind the piling. The piling was removed and was determined to be 4 m (13 ft) in length. The wood planks were similar to that found at the east wall, being milled 5 cm (2 in) thick boards that were 30 cm (12 in) wide. The excavation of Trench 55B to the east of TP-55-409/413 identified several additional wood pilings (Figure 22). In addition, several piling fragments were observed during the excavation of the trench. The trench was excavated to deeper depths, as the pilings were not identified between 1.8-2.4 m (6-8 ft) below the surface. Within Trench 56, at TP-56-22 to 56-28, a large fragment of concrete and melted metal was identified within the trench at 0.76 to 0.9 m (2.5 to 3 ft) below the surface, and a fragment of a piling was found within the vicinity of the concrete/metal object. This object may be fill near the edge of the former south wall of the basin of the harbor. No remnants of the south wall were found in Trench 57 although the excavation may not have gotten to the depth of the former harbor wall, as brick fragments were found between 3-3.5 m (10–11.5 ft) below the surface at TP-57-50. The deeper depth of the pilings in Trench 55B and the lack of remains in Trench 57 may suggest that the slight elevational rise of the current land may have more fill (depth-wise) above the former Iron Pier Harbor.

Integrity. The Iron Pier Harbor Site has good integrity. The walls of the Iron Pier Harbor appear to remain intact, suggesting that when the harbor was abandoned, the walls of the harbor (and the harbor, itself) were filled in. In addition, the recovery of metal hardware and possible wood structural remains at TP56-145 to 162, suggests that the subsurface remains of former structures may remain intact within the area of SYW-12. These remains could extend beyond boathouses to the former subsurface remains of the Iron Pier Resort as well.

Research Potential. The identification of pilings, planks, and metal hardware of the Iron Pier Harbor Site during the excavation of trenches are intact remnants of the infrastructure of the Iron Pier Harbor, and suggest that more may be present buried underneath 2.4-3.7 m (8-12 ft) of fill across the property of SYW-12. These structural remains are an extension of Anomaly 38, which is a contributing property of the Syracuse Maritime Historic District, initially identified by the Champlain Maritime Museum during the Onondaga Lake Underwater Survey (Kane et. al. 2011). There is limited information available on the construction of the Iron Pier pavilion and amusement center, as well as the location of the boathouses and any other structures that were part of the resort during the period between 1890 and 1906. Historic maps are limited to a partial view of the area on the 1892 Sanborn map. The 1908 Hopkins map shows the landscape after the pavilion and amusement center were demolished. Therefore, any additional work beneath the fill may contain research potential in regards to the layout and construction of a lakeside historic tourism center and harbor facilities in the late 19th to early 20th centuries.

Potential Impacts. The Iron Pier Harbor Site may be impacted if contaminated soils are removed during a potential remediation of the area of SYW-12.

Recommendations. The Iron Pier Harbor Site, as a contributing part of the Maritime Historic District, is eligible for the National Register of Historic Places. We recommend that any remediation actions that will extend beyond 1.8 m (6 ft) below the surface be monitored for cultural resources (structural remains) associated with the Iron Pier Harbor, the Iron Pier pavilion, boathouses or other associated structures. An excavation work plan would be submitted to NYSOPRHP, NYSDEC and EPA for their review and comment. It is expected that because of the contamination and the depth below the surface, evaluation of cultural resources encountered would be limited to marking their location, obtaining their approximate measurements, and photographing the resources. Additional resources located during monitoring would be added to the Iron Pier Harbor Site, and by extension, to the Syracuse Maritime Historic District.

Figure 21. Approximate location of Iron Pier Harbor and Onondaga Lake Extension based on Archaeological Findings, 1892 Sanborn map and 1908 Hopkins map.

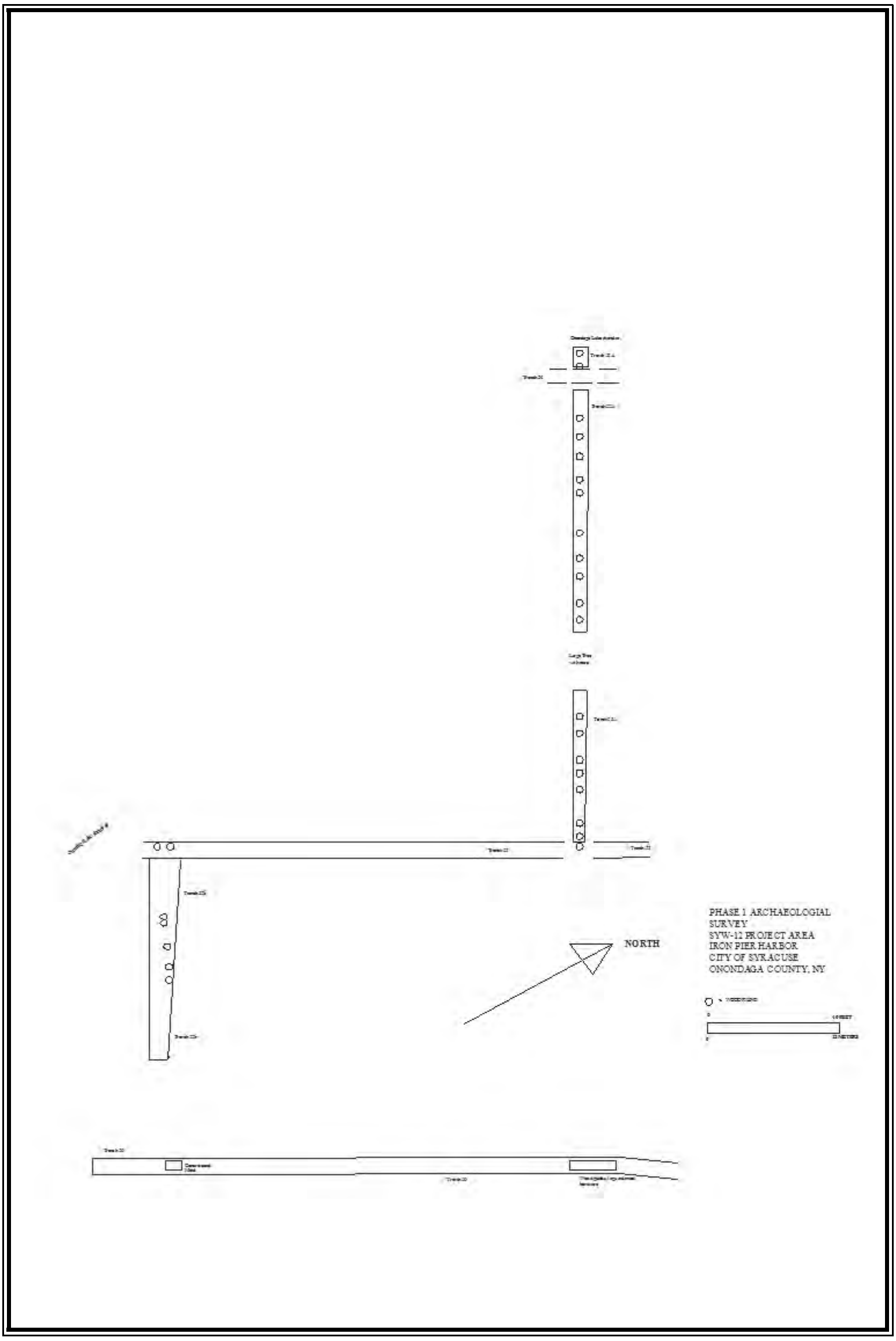

Figure 22. Location of pilings within backhoe trenches for SYW-12.

NEW YORK STATE HISTORIC ARCHAEOLOGICAL SITE INVENTORY FORM
Confidential: For Agency Use Only

For Office Use Only – Site Identifier: _____

Project Identifier: SYW-12 Wetlands **Date**: January 28, 2013
Name: Christopher D. Hohman **Phone**: 607-777-4786
Address: Rm. 146, Science I, Binghamton University, Binghamton NY

Organization (if any): Public Archaeology Facility

1. **Site Identifier(s)** Iron Pier Harbor Site (SUBi-3037)

2. **County**: Onondaga

   City: Syracuse
   Township:
   Incorporated Village:
   Unincorporated Village or Hamlet:

3. **Present Owner**
   Address:

4. **Site Description:** (check all appropriate categories)

Structure/Site:

Superstructure:	Complete	☐ Partial	☐ Collapsed	X Not evident
Foundation:	Above	☐ Below	☐ Not evident	(ground level)
Structural Subdivisions:	☐ Apparent	☐ Only surface traces visible	X Buried traces	Undetected

List construction materials: (be as specific as possible) Wood pilings; wood planks, metal hardware

Grounds:	☐ Under cultivation	X Never cultivated	Previously cultivated	☐ Sustaining erosion
	☐ Upland	☐ Pastureland	☐ Woodland	☐ Floodplain
Soil Drainage:	☐ Excellent	Good	☐ Fair	X Poor
Slope:	X Flat	Gentle	☐ Moderate	☐ Steep

Distance to nearest water from site (approx.): Site is located adjacent to Onondaga Lake
Elevation: 122 m (365 ft) asl

4. **Site Investigation:** (append additional sheets if necessary)
Surface Testing Date(s):
☐ Site Map (Submit with form*)
☐ Collection
Subsurface Testing Date(s): June 2012
Testing: Shovel ☐ Coring X Other: 6 Backhoe trenches across SYW-12 project area
Unit size:
Number of Units: 6 Backhoe Trenches (Submit plan of unit with form*)
Investigator: Christopher Hohman

Manuscript or published report(s) (reference fully):

Hohman, Christopher D. with contributions by Joseph Schuldenrein, Eva Hulse, Johnathan Garland and Chelsea Richard
2013 *Cultural Resource Management Report, Phase 1B Cultural Resource Survey, Onondaga Lake Project, Upland and Shoreline Area, SYW-12 Wetlands, City of Syracuse, Onondaga County, New York.*

Present repository of materials: Public Archaeology Facility

5. Site Inventory:

a. Date constructed or occupation period: Iron Pier Resort and Harbor constructed in 1890; Iron Pier resort demolished in 1907; Iron Pier harbor and park gone by 1924

b. Previous owners if knownModifications if known (append additional sheets if necessary):

6. Site documentation: (append additional sheets if necessary)

a. Historic map references: 1892 Sanborn, 1908 Hopkins

b. Representation in existing photography:

c. Primary and secondary source documentation (reference fully):

d. Persons with memory of the site:

7. List of materials other than those used in construction: (be as specific as possible in identifying object and material)

Archaeologists excavated 6 backhoe trenches across the property and found wood pilings and planks that represent the north and south walls of the former Iron Pier Harbor. In addition, a large piece of metal hardware and 17 ft of impenetrable set of wood suggest a possible boathouse on the edge of the harbor. A total of 20 wood pilings found within two trenches represent a portion of the north harbor wall and 7 wood pilings found within two trenches represent a portion of the south harbor wall.

8. Map References: Map or maps showing exact location and extent of site must accompany this form and must be identified by source and date. Keep this information to 8½" by 11" if possible.

USGS 7 ½ Minute Series Quad. Name: 1978 Syracuse West

For Office Use Only – UTM Coordinates: _____

9. Photography: (optional for environmental impact survey)

Please submit 5" by 7" black and white print(s) showing the current state of the site. Provide a label for the print(s) on a separate sheet.

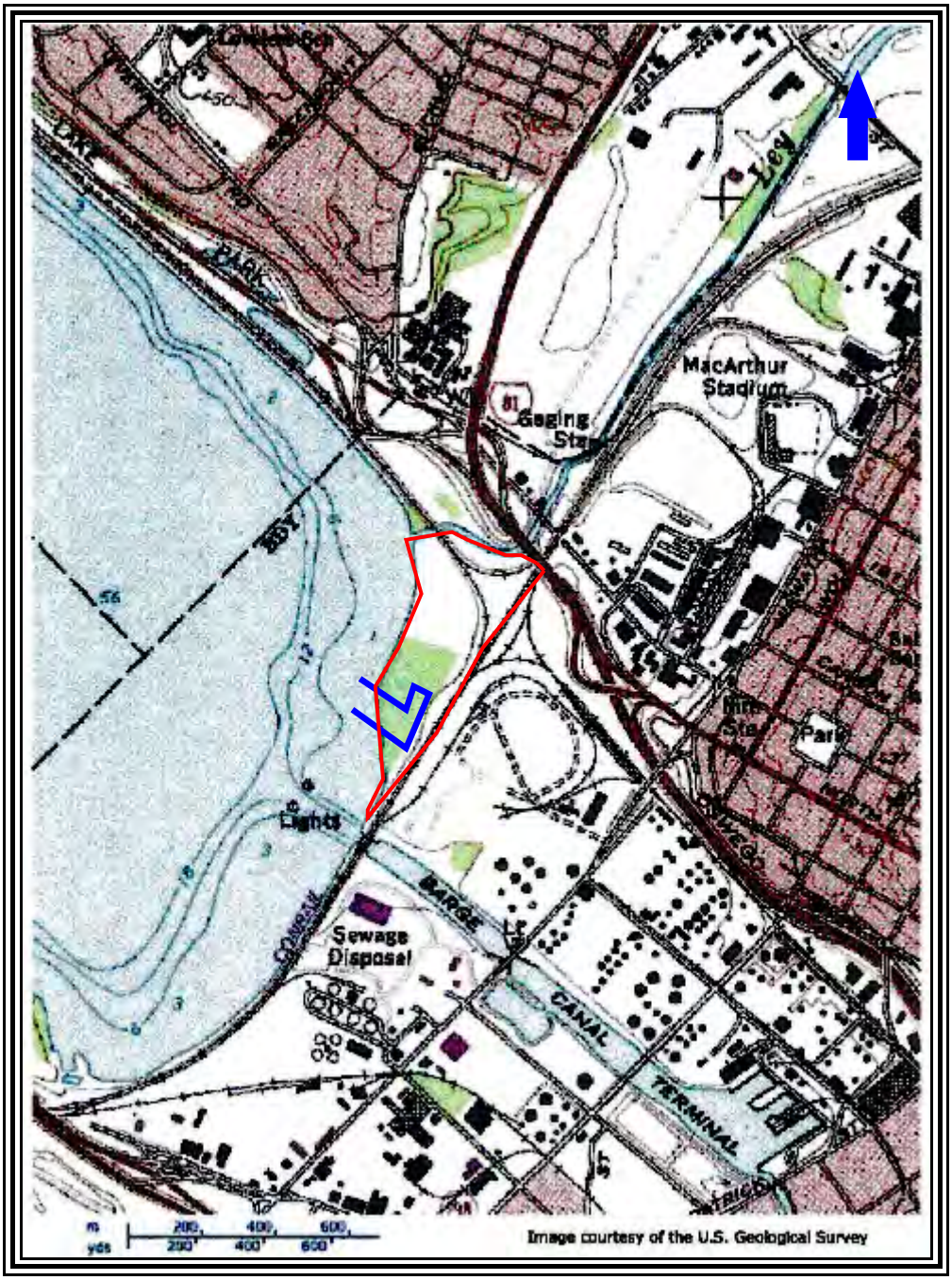

Figure 23. Location of Iron Pier Harbor Site (in blue) on the 1978 USGS map.

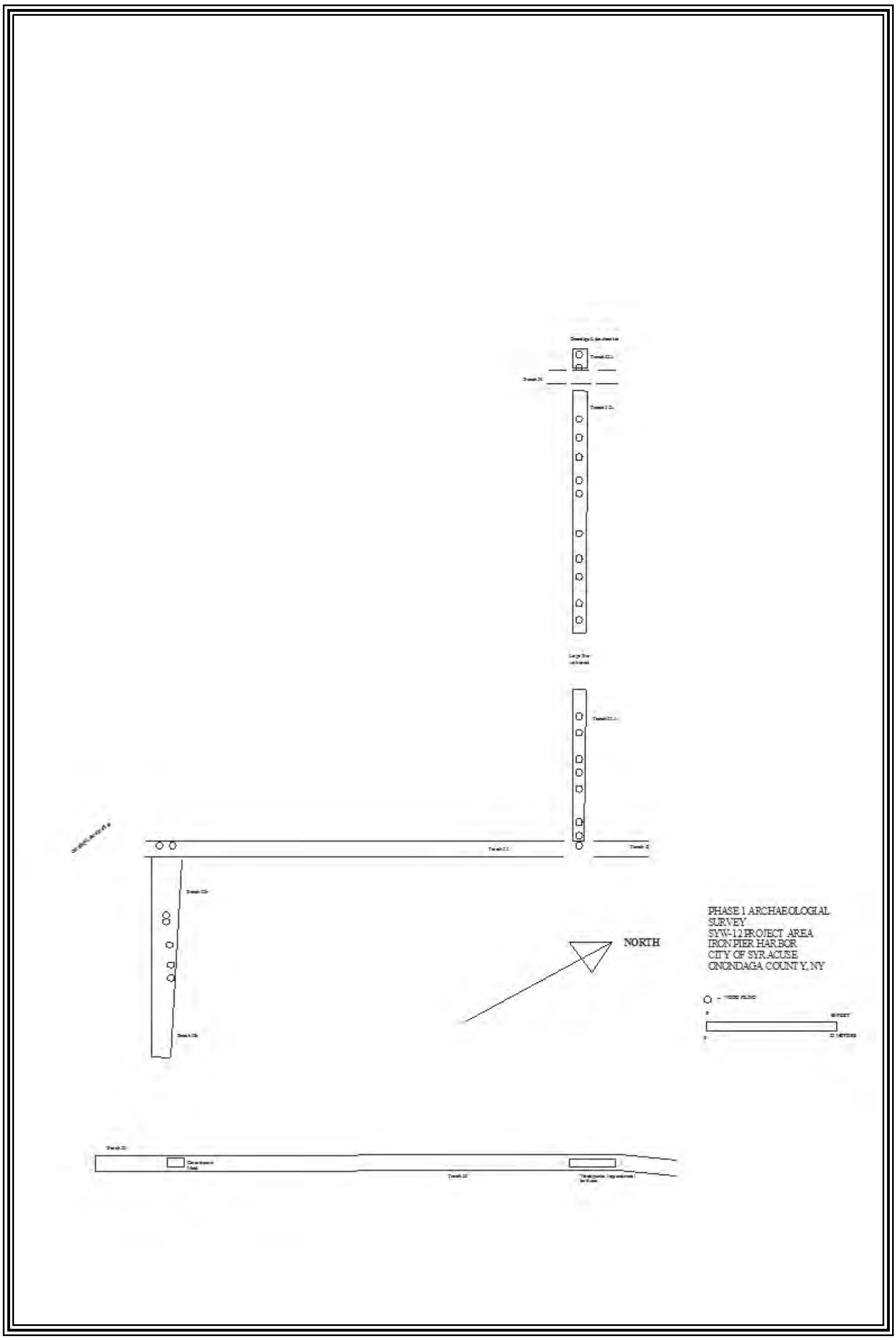

Figure 24. Site map of piling locations and wood/metal hardware of the Iron Pier Harbor Site.

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APPENDIX II. GEOARCHAEOLOGICAL ASSESSMENT REPORT

FINAL REPORT:
Phase 1 Geoarcheological Assessment of the Onondaga Lake Project, Upland and Shoreline Area: SYW-12

City of Syracuse, Onondaga County, New York

Prepared for:

Public Archeology Facility
State University of New York at Binghamton
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May 7, 2013
revised November 21, 2013

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1 INTRODUCTION

This report presents the preliminary results of geoarchaeological field investigations conducted in June of 12-14, 2012 for the Onondaga Lake Project. Geoarcheology Research Associates (GRA) of Yonkers, NY was contracted by the Public Archaeology Facility (PAF) of Binghamton, NY to conduct a geoarchaeological study of the SYW-12 in Syracuse, NY on the eastern shore of Onondaga Lake. This property is slated for environmental remediation work, which will impact underlying deposits of potential archeological sensitivity. The present report supplements two previous studies conducted by GRA as part of the Onondaga Lake remediation effort (Aiuvalasit and Schuldenrein 2010, GRA 2011). This study presents the results of a field and analysis effort for the project area. Nine (9) geoarcheological borings documented by GRA are interpreted using supplementary data from twenty-five (25) borings collected by O'Brien and Gere Engineers, Inc. in 2006 and 2007 (Figure 1). The stratigraphic interpretations are based on the nine borings that GRA was present for and the remaining borings are used to enrich the final geoarchaeological interpretations, and to evaluate areas of potential interest beyond the footprint of the nine borings. By conducting a systematic survey involving deep testing, GRA is providing a working schema of subsurface stratigraphic relations in this project's area of potential effects (APE).

The boring locations are situated within Onondaga County, NY. The SYW-12 parcel is delineated by Ley Creek to the north, Conrail Railroad tracks to the east and south, and Onondaga Lake to the northwest (Figure 1). The parcel encompasses 6.9 hectares (17 acres), and the borings collected in 2012 span an area of 1.5 hectares (3.7 acres), or 21.7% of the APE. The 2012 boring locations were placed in the vicinity of the former natural outlet of Onondaga Creek, prior to canalization in the late 19th century (Sanborn Fire Insurance Co. 1911).

The borings were collected using a machine-based (split-spoon) auger that drilled to a depth of at least 20 feet (610 cm), with isolated exceptions. Borings displayed complex stratigraphic sequences of fill, buried historic surfaces, and underlying natural, unconsolidated geological deposits. A critical objective of the overall study was the identification of intact historic and prehistoric surfaces beneath 20th century fill deposits. To this end, we present the results and establish the contexts of four (4) radiocarbon dates. These chronological markers as well as diagnostic components of the stratigraphic profile confirm the age of sampled sediments within the APE.

The report details the results of our geoarchaeological investigation. A thorough overview of the geomorphic, geological and topographic setting of the region is initially discussed (this section; Figures 1-3), with a particular focus on the landscape history of Onondaga Lake (Chapter 2). A methods section follows which outlines both field and laboratory techniques employed in this work (Chapter 3). Detailed descriptions of the test borings are provided in Chapter 4, and Chapter 5 presents a discussion of the results of geoarchaeological testing, as well as recommendations for further work.

Detailed sedimentological documentation for each core is presented in Appendix A accompanied by photographic mosaics of the examined core. Appendix B provides formal radiocarbon reports. Finally, Appendix C summarizes the results of a malacological study that proved to be pivotal in separating the Late Holocene from historic depositions because of the presence and vertical distributions of taxa that are clearly of historic age. A key taxon of the malacological population was *Bithynia tentaculata*, which was introduced from Europe in the late 19th century. The vertical variability within the historic shell distributions coupled with the absence of a disconformable surface, otherwise signifying the Late Holocene to historic interface, argues for sediment reworking and, by extension, erosion of any potential intact surface of prehistoric age.

This study found extensive historic sedimentation within the project area, and traces of the former Iron Pier harbor. The historic sedimentation is extensive and the cores provided compelling evidence for buried surface disturbance and resultant reworking of primary depositional complexes. The borings did not identify buried soils that could have served as living surfaces for pre-contact inhabitants. Instead, the stratigraphic sequence in SYW-12 appears to register infilling of the abandoned harbor.

Figure 1: Aerial imagery of project area with boring locations.

Figure 2: Quaternary geological units in the project area.

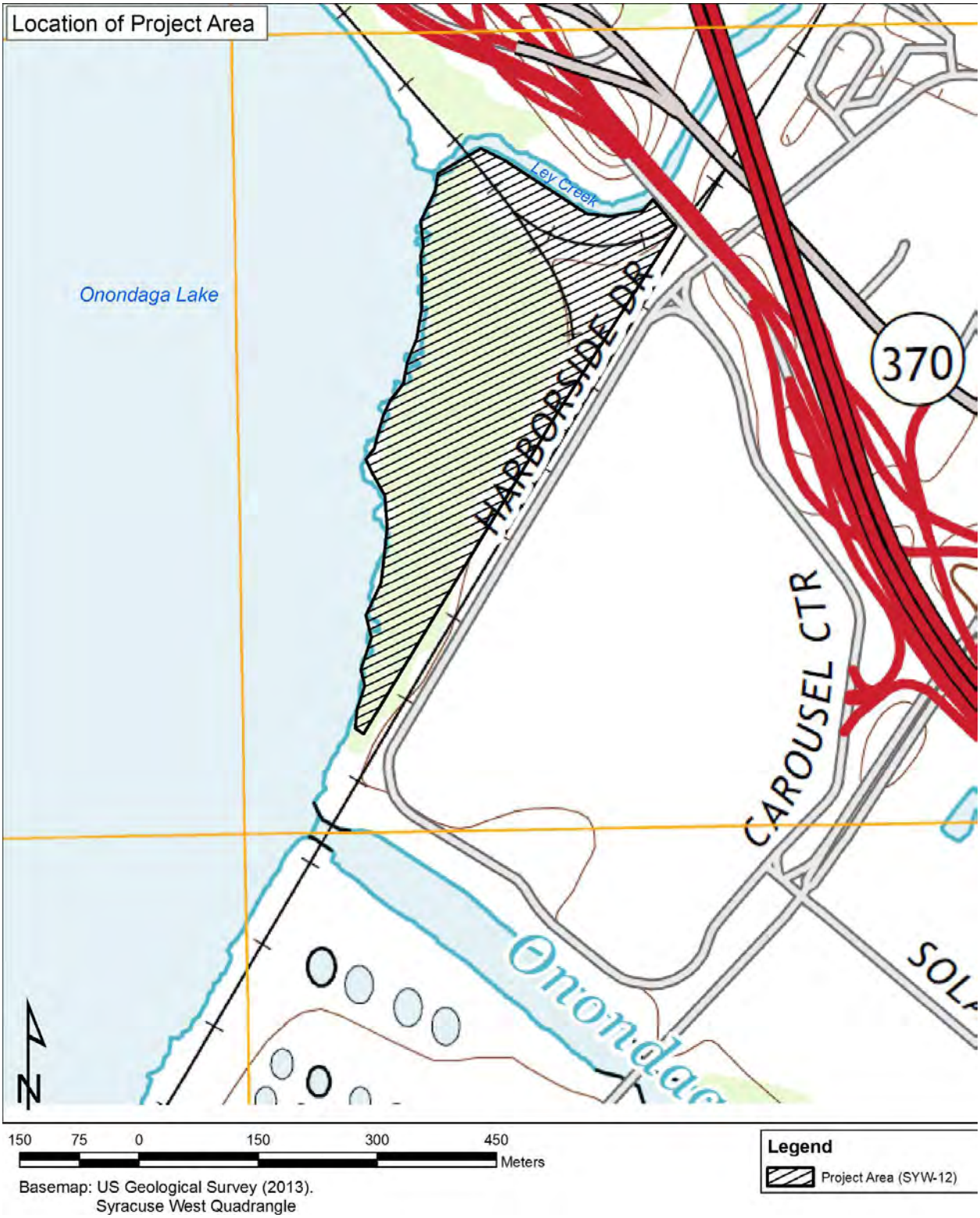


Figure 3: Quadrangle Map of Western Syracuse, NY.

2 PROJECT GEOMORPHIC BACKGROUND

The site is located at the base of the Onondaga Escarpment, on the boundary of the Ontario Lowlands and Allegheny Plateau adjacent to Onondaga Lake. Elevations range from 110.6 m asl (meters above sea level) at the surface of Onondaga Lake to greater than 300 m asl along the highest terrain of the escarpment (Figure 4). The lowlands are underlain by the Silurian Age Vernon Shale Formation, with low relief and unconsolidated glaciolacustrine and glaciofluvial sediments of variable thicknesses overlying the bedrock. These sediments were deposited during the glacial retreat in pro-glacial Lake Iroquois, and later within Onondaga Lake. The uplands are underlain by variable bedrock formations, from the Silurian Vernon Formation at the base, to the Syracuse and Helderberg, as well as the Devonian Onondaga Formation, at the top. Overlying the bedrock are higher relief unconsolidated glacial drift or valley train deposits (Fisher et al. 1970, Cadwell and Muller 1986, Kappel and Miller 2005).

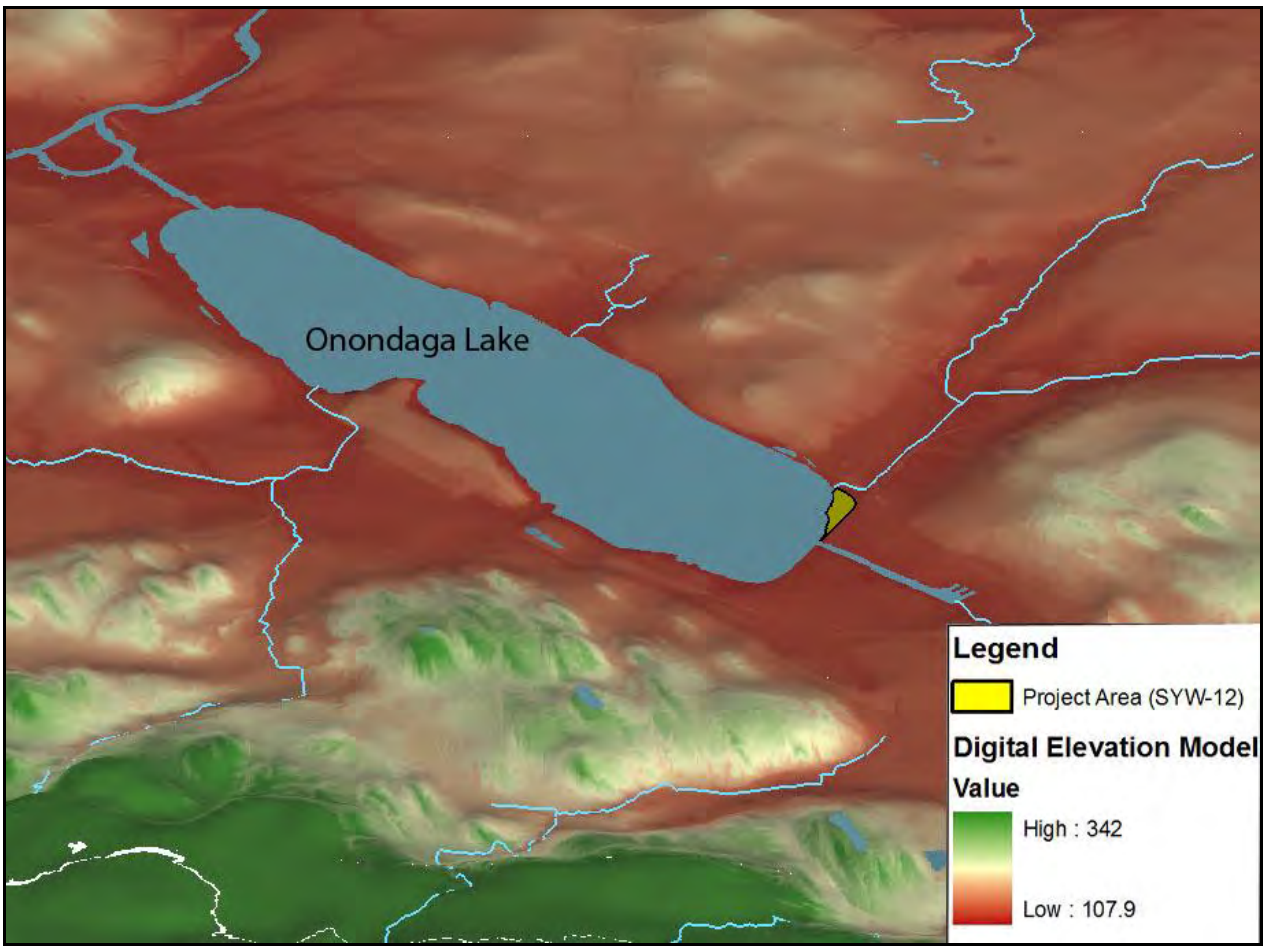


Figure 4: Shaded relief map of Onondaga Lake highlighting the project area.

Onondaga Lake formed within the Onondaga Trough after a complex succession of landscape changes associated with cycles of glacial advances and retreats (Von Engeln 1988). The most recent Wisconsinan advance marked the Last Glacial Maximum and is dated to Cal BP 28,200-27,200 years (calibrated to calendar years before present). The Laurentide ice sheet completely covered the Onondaga Trough, with ice attaining thicknesses of hundreds to thousands of feet. As the ice sheet melted during the Late Pleistocene, moraines formed along the ice front. The Valley Heads moraine blocked the south end of the Onondaga Basin as well as the other glacial basins of central New York, ultimately accounting for the northward drainage pattern represented by the present Finger Lakes. This moraine was laid down about 14,350 to 13,500 uncalibrated radiocarbon years ago (Cal BP 17,200-16,200); subsequently the ice front receded northward. By 11,400 uncalibrated radiocarbon years (Cal BP 13,400) the glacial ice approached its present location in Canada (Rowell 1986, Cadwell et al. 2003, Cadwell and Muller 2004). Thus, Onondaga Lake is a remnant of a proglacial lake system that formed during this time and created impounded basins between the glacial front and the moraines (Cadwell and Muller 2004).

Former natural and artificial channels of Onondaga Creek are identified in historical topographic maps and drawings. Onondaga Creek coursed through the project area until the early 20th century, though its channel geometry points to stream migration and channelization starting in 1822. The stream mouth was displaced southward, disconnecting stream flow from the channel junction with Ley Creek (Onondaga Environmental Institute 2009). Manipulations of the creek's outlet into the lake continued until a barge canal and barge terminal were constructed between 1915 and 1924. The building of the terminal necessitated stabilization of the channel's terminus (U.S. Army Corps of Engineers 1915). Beginning in 1854, upstream modifications facilitated sewage removal for the City of Syracuse, by increasing water velocities with straighter and deeper stream troughs (Onondaga Environmental Institute 2009).

The project landscape was significantly different prior to historical manipulations of Onondaga Lake. In 1822, the water in the lake was lowered to present levels to create an outlet to the Seneca River (Hohman 2004, Crawford 2009). Before water level reduction, much of the current project terrain would have been dotted with marshes, swamps, salt springs, and irregular embankments immediately offshore. After the drop in water levels, formerly inundated areas along the shoreline were left dry.

2.1 Expected geological sequence within the project area

Borings collected by GRA in 2011, on the western shore of the lake, show that the lower terrace and shoreline positions preserve sequences consistent with submerged landforms and formerly higher lake water levels (GRA 2011). Borings demonstrate that the industrial Solvay wastes and fill were laid down immediately above the Holocene lacustrine marl. Some cores had trace organic fragments and lenses of peat, but there was no consistent spatial pattern or lateral zonation that would suggest an intact marsh surface or living surface. The marl is described as a light olive gray wet sand and silt, with trace shell fragments, a sulfurous odor, and occasional organic lenses. This deposit was typically encountered below approximately 2 m (6.5 ft) of fill and extended to depths of 9 m (30 ft) below ground surface (GRA 2011).

The expected stratigraphic sequence for the present project area is, from the base upward, *Bedrock*; *Glacial Till*; *Lacustrine Sand*; *Lacustrine Sand, Silt, and Clay* (split into two components; upper and lower); and *Made Land* and *Cut and Fill Land* (Crawford 2009). All units are described on the 1986 Surficial Geologic Map of New York: Finger Lakes Sheet, with the exception of the *Made Land* unit. The latter is described by the 2011 USDA-NRCS Soil Survey map (Muller and Cadwell 1986, Soil Survey Staff 2012).

Glacial Till (t) is a poorly sorted diamicton that is the residuum beneath the glaciers of the Wisconsinan ice sheet. It forms a relatively impermeable loamy matrix with variable clast lithologies (Muller and Cadwell 1986). Within the project footprint, till is red and compact, and consists of sand and gravel in a clay and silt matrix, ranging in thicknesses from 0.3-10.7 m (1 to 35 ft) (Hohman 2012: Appendix II).

Lacustrine Sand (ls) was deposited within pro-glacial Lake Iroquois, that occupied the southern edge of the Wisconsinan ice sheet and filled the Onondaga Basin around 13,000 years BP. Lake Iroquois linked Onondaga Lake to Lake Ontario and the merger resulted in a single basin. The sands that settled at the bottom of the lake are well sorted, stratified, and typically dominated by quartz. The deposit varies in thickness from 2.1-20.1 m (7 to 66 ft) thick (Muller and Cadwell 1986). Within the project confines, this unit coarsens downward (from fine to coarse sand into coarse sand and gravel), where it unconformably overlies the underlying till and, at times, bedrock (Hohman 2012: Appendix II).

As the water level of Lake Iroquois fell, Onondaga Lake emerged as a separate body of water. Within the lake, a deposit of *Lacustrine Sand, Silt, and Clay* (*lsc)* formed on top of the sands of Lake Iroquois (Figure 2). This lacustrine silt and clay unit is generally calcareous and laminated, a sedimentological signature commonly in evidence in proglacial lake-bottom profiles such as Onondaga Lake (Muller and Cadwell 1986). This unit is broken into two components: a deeper silt and fine-grained sand component of up to 10.6-13.7 m (35-45 ft) thick, and a slightly thinner upper silt and clay component 6.1-13.7 m (20-45 ft) thick. The unit is thickest on the long axis of Onondaga Lake, and thins to the south as bedrock and till extend to higher elevations (Hohman 2012: Appendix II).

Overlying all of the natural sediments is anthropogenic fill, described by the USDA Soil Survey of Onondaga County, NY as *Made Land (ML)* (USDA 1977). In Onondaga County, made-land sediment textures typically consist of loam with pebbles and cobble fragments (Hohman 2012: Appendix II). In some places along the shore of Onondaga Lake, this fill is composed of Solvay waste measuring 60 to 70 ft thick (Hohman 2012: Appendix II).Within the project area, the fill is chiefly a loamy sand and industrial debris (i.e. coal distillation waste). This unit is analogous to *Cut and Fill Land (CFL)* (Soil Survey Staff 2012).

On a finer scale, and site-specific level, the primary lithostratigraphic units can be sub-divided into more discrete sub-units whose sedimentological properties were identified in the field and have critical bearing on the historic sequence. As discussed below, an anthropogenic *Historic lake-edge* facies forms an intermediary unit between the terminal Late Holocene *Lacustrine (lsc)* complex and the capping *Made Land (ML)* fill. That mixed deposit of fine sands, silts, and clays represents the combined effects of lacustrine accretion, stream-mouth discharge,

and wave-generated shoreline redistributions of contaminated (post-1879) sediment complexes. Moreover, the *Historic lake-edge* deposits laterally interdigitate with *Marsh/Estuarine Peats* that formed in micro-basins fashioned in the historically re-landscaped edge of Lake Onondaga in the late 19th century. The documentation for these two additional facies is presented in the next section. For geoarchaeological purposes it is noted that the *Historic lake-edge* facies does not form an unconformity with the upper *Late Holocene Lacustrine* complex. Accordingly, the prospective archaeologically-significant surfaces at the interface of the Late Holocene and historic lake-shore locations were potentially compromised by extensive near-shore reworking at the lake edge.

3 METHODS

For this investigation, the bores and coring configurations were aligned on a grid, with intervals ranging from 30.5-61 m (100-200 ft) (Figure 1). The precise placements resulted from in-field adjustments to the 30.5 m (100 ft) interval boring grid. Alterations to boring locations were based on obstructions encountered in the field, locations were finalized with the agreement of representatives of O'Brien and Gere, GRA and Parsons, with approval by NYSDEC.

Core extraction was conducted by NYEG Drilling, using a track-mounted drill rig and a split spoon auger (Figure 5). For this project, cores of approximately 5 cm (2 in) diameter were collected in 61 cm (2 ft) sections to 6.1 m (20 ft) below ground surface. Sequential recovery of segmented cores resulted in preservation of the key litho- and pedo-stratigraphic units. All primary depositional facies and soil (weathered) horizons were registered in our observations at recorded depths that very closely approximate actual thicknesses and vertical contexts.

Each core was split open and inspection of the samples was performed in the field, together with photographic documentation and initial soil and sediment characterizations (Figure 6). The cores were described using standardized pedo- and litho-stratigraphic terminology (ISSC 1994; USDA 1994). Sampling for special analysis was performed under field conditions. Key specimens for dating and related analyses were identified, recorded, sampled and taken to the GRA laboratory for detailed inspection and preparation for shipping to appropriate outside laboratory facilities. Upon completion of core identifications and sampling, the discarded sediment and soil fractions were returned to the core hole. Upon completion of the project, stored specimens were packed for transport to a disposal facility.

Safety gear included the use of protective eye-wear, hard-hats, steel-toed boots, nitrile gloves, and reflective safety vests. A trained environmental geologist from O'Brien and Gere Engineers, Inc. collected soil samples for characterization of contaminants, and ran a photo-ionization detection (PID) meter over the samples to test for volatile organic compounds. The in-field examinations of the borings were guided by health and safety procedures attendant to the handling and collection of the cores.

It should be noted that while core soil retrievals were good, it was not uncommon to obtain less than complete yields. This is typical, and can be due to compression of the sample, backfilling of the core hole by slump, or poor recovery due to saturated, unconsolidated soils. Based on GRA's general experience working with this technique, as well as regional conditions, the team has developed a method for extrapolating both the thicknesses and depths of deposits.

Figure 5: Field collection of cores.

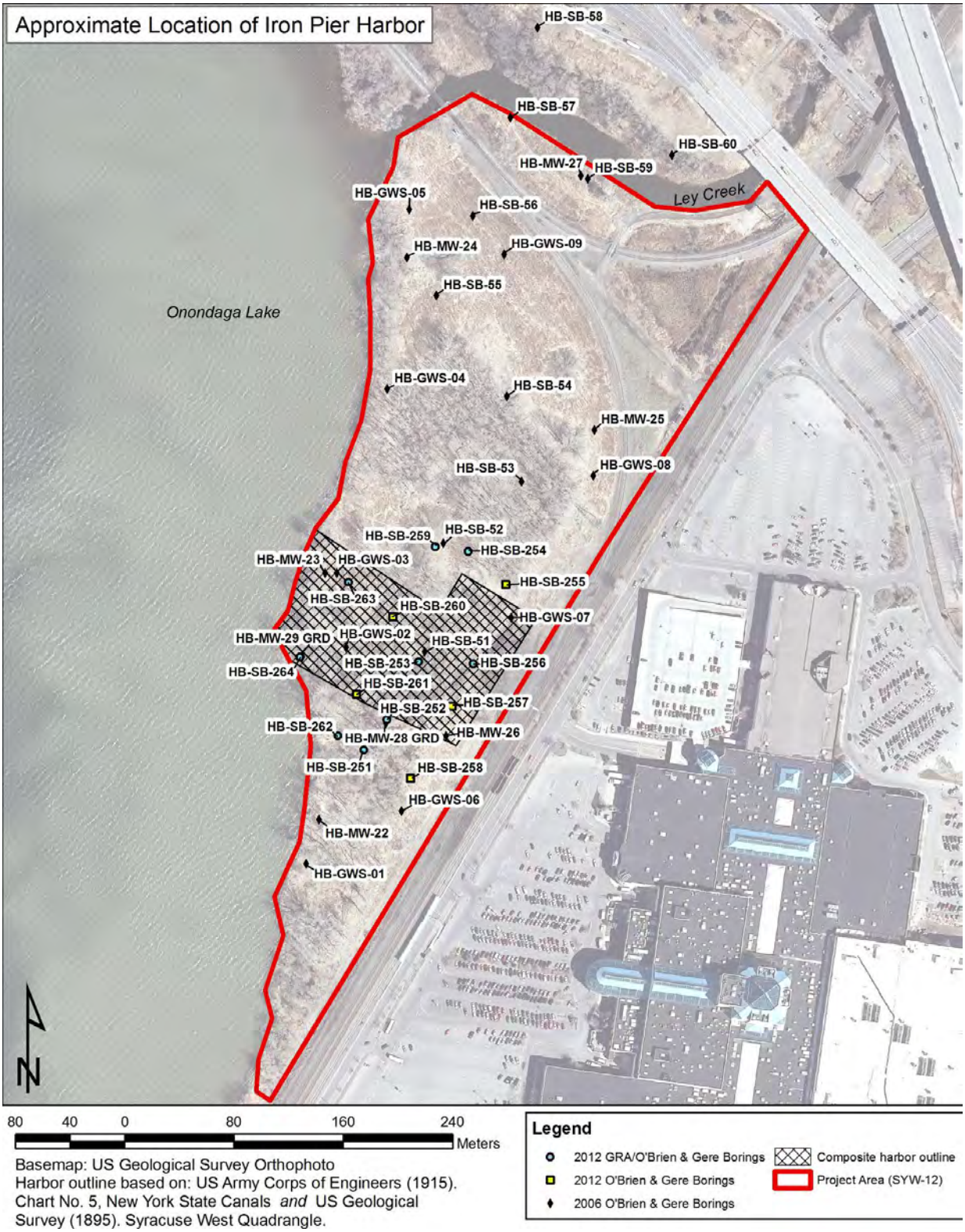
Figure 6: Split-spoon auger samples during field analysis.

4 PRELIMINARY RESULTS

The nine (9) Iron Pier Harbor cores are distributed across a general grid adjacent to the historic location of the harbor site (Figure 7). Previous archaeological studies indicate that there is low potential for pre-contact resources and a strong potential for encountering post-contact resources related to the Salina Pier pavilion and Iron Pier Resort and Park within SYW-12. Archaeological resources related to the former piers, boathouses or related structures are considered important to the history of the Pier Marine Infrastructure within the Syracuse Maritime Historic District.

During the precontact period, the SYW-12 APE was a wetland adjacent to Onondaga Creek and is unlikely to have supported prehistoric camps. However, there are 13 known precontact sites and 135 potential postcontact sites within 1.6 km of SYW-12. These sites were all first identified in the early 20th century (Parker 1922). One of the closest sites is a small lithic scatter located on an elevated area near a marsh to the west of Onondaga Creek. Geo-referenced historic maps indicate that the early 18th century Native American village of Kaneenda was situated approximately 1200 m (3900 ft) to the southwest of the project area (Hohman 2012). No known precontact sites are located within the boundaries of the SYW-12 project area.

SYW-12 is considered to have high potential sensitivity for historic resources related to the construction of recreational piers in the late 19th century. In 1890, the area of SYW-12 was developed as the Iron Pier Resort and Park. Remnants of attendant historic structures were identified in the underwater survey of Onondaga Lake and are likely preserved within the boundaries of the APE (Kane et al. 2011). The buildings were demolished in 1907, and by 1908 the remains were sealed in by fill (Kane et al. 2011). The harbor appears on a 1932 nautical chart (Figure 8; U.S. Army Corps of Engineers 1932) but not on a broadly contemporaneous Sanborn map (Figure 9; Sanborn Fire Insurance Co.1928), and the area may have been in-silting by this time. The harbor is conspicuously absent from a 1939 map (Figure 10; USGS 1939).



Basemap: US Geological Survey Orthophoto
Harbor outline based on: US Army Corps of Engineers (1915). Chart No. 5, New York State Canals *and* US Geological Survey (1895). Syracuse West Quadrangle.

Figure 7: Approximate location of Iron Pier Harbor superimposed on SYW-12 project area.

Figure 8: Nautical chart showing harbor (USACE 1932).

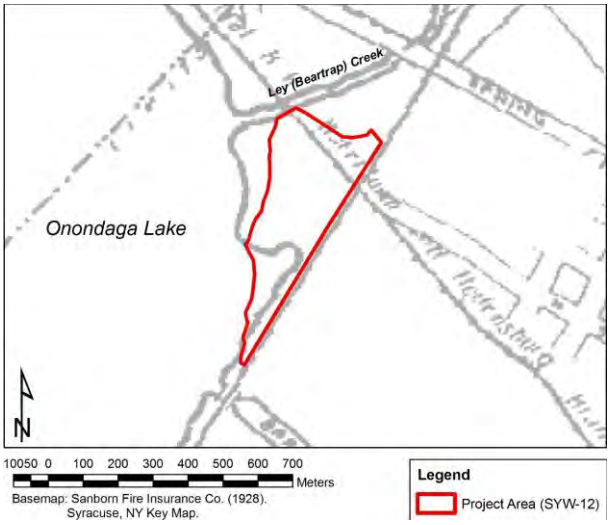


Figure 9: Sanborn map showing eroded outline of harbor (Sanborn Fire Insurance Co. 1928).

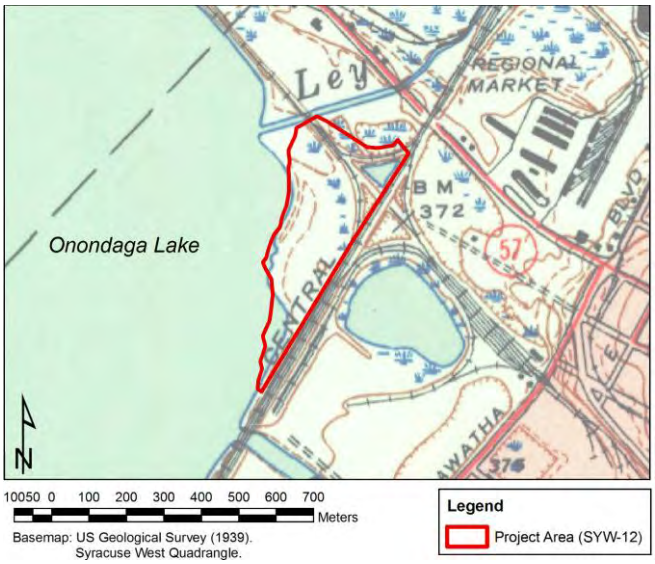


Figure 10: USGS map with no visible remains of the harbor (USGS 1939).

For the greater project area, archaeological materials, surfaces and features are expected to be preserved beneath variable but typically thick accumulations of artificial fill. The surficial deposits are recorded and classified as historic to modern *Made Land* and *Cut and Fill Land*. These more massively-bedded anthropogenic layers cap two other facies naturally accumulated by the ongoing activity of a historically contaminated Lake Onondaga: the *Historic Lake-edge* and *Marsh Peat* complexes. As noted these latter are vertically, but *not* unconformably offset from the Late Holocene *Lacustrine Sand, Silt, and Clay (lsc)*. Thus the historic depositional environment is effectively continuous with late Holocene fluvio-limnic processes. The primary difference between these sediment complexes is that the historic facies is contaminated and reworked by near-shore wave action, while the latter (Late Holocene) represents more homogeneous limnic deposition.

The current set of cores did not penetrate into underlying proglacial Lake Iroquois sediments or diagnostic till facies. Historic chrono-stratigraphic markers were present within the larger units. These are briefly summarized in Section 4.1. The units identified within the project area are described in Section 4.2. The cores are described individually in Section 4.3.

Lithostratigraphic descriptions of the cores with accompanying photographic documentation are presented in Appendix A. Discrete strata were sampled for organic material. Four (4) samples were sent to Beta Analytic laboratories for ^{14}C dating and analysis. Documentation for these dates is presented in Appendix B. Appendix C is an inventory and graphic representation of malacological taxa.

4.1 Chrono-stratigraphic markers

During the late 19th and early 20th century, a variety of non-native materials were introduced into Onondaga Lake as a result of industrial activities, linkages with Erie Canal shipping routes, and construction along the shoreline. Relict artifacts and identifiable by-products of industrial waste are present within the cores described in this report. These chrono-stratigraphic markers reflect dated historic events, and permit the assignment of ages to diagnostic sediments within each core. Each type of marker and its general contexts and chrono-stratigraphic implications is described below.

Oncolites

Oncolites in Onondaga Lake are concretions of calcite around a nucleus of algae, shell, or other material. Atypically elevated concentrations of calcite were introduced into the lake as a by-product of soda ash manufacturing beginning in 1884. These elevated levels accelerated dense oncolite formation (Dean and Eggleston 1984).

Coke production and coal distillation byproducts

Coal tar and other byproducts of coke production and coal distillation entered the lake sediments no earlier than 1892, when coke ovens began operating at the Main Plant of the Syracuse Works (PTI 1992).

Gastropod shells

The invasive gastropod *Bithynia tentaculata* (Appendix C: Figure 2) entered the ecosystem of the Great Lakes and the Hudson River between 1879 and 1892, and had spread across the Finger Lakes by the early 20th century. *B. tentaculata* rapidly became the most abundant gastropod in the ecosystem (Harman 1968, Harman and Forney 1970). By the late 1960s, the entire mollusk population of Onondaga Lake was almost completely decimated due to pollution. Only a single living genus (*Physa*) remained (Harman and Berg 1970). The cessation of industrial activity in Syracuse allowed mollusk populations to rebound, and a 2009 species inventory showed that 31 mollusk species thrived in the lake (Johnson 2009).

Structural remains of the Iron Pier complex

The Iron Pier buildings and harbor were built in 1890. The structures were demolished a year after the resort's closure in 1907, and the structural remains were capped with fill (Kane et al. 2011). The harbor itself filled in during the 1920s and 1930s.

4.2 General sequence of stratigraphic units

The general sequence stratigraphy for SYW-12 is presented below, followed by more detailed descriptions of the individual borings. Stratigraphic units correspond to those used in Appendix A. Table 1 incorporates dates by depth and source materials. Both gastropod shell and enveloping or underlying organic sediment matrices provided legitimate contexts for dating specimens. Thus it was possible to determine the integrity and sedimentological processes associated with specific depositional environments and to develop accurate measures of chronology and landscape transformation. Finally, the borings are illustrated in profile in Figure 11, Figure 12, Figure 13, and Figure 14.

Table 1: Brief descriptions of the geologic units identified within SYW-12

Unit	Description
Humus	All cores are capped by humus, a layer of very dark grayish brown (10YR 3/2 or 10YR 3/1), firm, subangular, friable silty loam with high organic matter content. In HB-SB-254, HB-SB-263, and HB-SB-264, there is prominent sandy A horizon development below the humus. This organic layer measures between 3 and 18.3 cm (1.2 and 7.2 in) thick.
Fill	In all cases, the humus formed atop sandy fill. The fill consists of brown to light yellowish brown (10YR 5/3 to 10YR 6/4), loose to very friable, granular to subangular blocky, poorly-sorted silty sand or silty clay sand with some gravel. The sediments display evidence of lake-edge processes. For example, lacustrine oncolites are common in HB-SB-251, and a few layers of well-sorted water-laid fine sand appear between bands of poorly-sorted sand across all cores. The fill reaches an average depth of 161.4 cm (5.3 ft) bgs.
Historic lake-edge deposits	Below the fill, sediments show clear evidence of lake-edge processes. Finely laminated sands alternate with reworked deposits of industrial materials such as coal and petroleum product. The sands are typically very dark gray (2.5Y 3/1 or 10YR 3/1), well-sorted fine or medium grained in texture, with loose to very friable consistence and single grain to granular structure. Between some strata are lenses of densely-packed gastropod shells. Many of these shells have been identified as the invasive species *Bithynia tentaculata*, which was introduced from Europe in the late 19th century (Appendix C: Figure 2). The historic lake-edge deposits reach depths of between 237.7 and 536.5 cm (7.8-17.6 ft) bgs.

(continued on next page)

Table 1, continued

Interbedded peats	Peats are interbedded with the sands throughout the lake-edge deposit, and are present in the underlying lacustrine sediments as well. Only HB-SB-252 and HB-SB-263 lack a layer of peat. The upper layers of peat are black (10YR 2/1), fibrous, matted, and well-preserved. Lower layers are mucky, silty clays containing very decomposed plant material. The peat is contaminated with product in four borings (HB-SB-254, HB-SB-259, HB-SB-262, HB-SB-264), and one of the cores with no peat deposit (HB-SB-252) shows evidence of product contamination at the fill/historic lake-edge interface. Across the nine cores, peat and sand complexes measure an average of 93 cm (3.1 ft) thick, and begin 283 cm (9.3 ft) bgs. Boring HB-SB-251 has a particularly thin peat deposit, measuring only 5.6 cm (2.2 in) thick.
Lacustrine facies	The historic lake-edge sediments and wetland peats were laid down over Holocene lacustrine sediments, typically characterized as limestone-rich marl. The transition between historic lake-edge deposits and marl is clear but not abrupt. A few layers of transitional sediment (such as well-sorted coarse-grained sands) mark the transformation from deep water to shoreline/lake-edge, as sediment deposition and changes in lake levels resulted in new shoreline configurations within the SYW-12 project area. The lacustrine marls are gray (2.5Y 5/1) to light gray (2.5Y 6/1), friable, subangular blocky, very fine-grained clay silts and sandy silts. These are infrequently banded with very dark gray (10YR 3/1) sediment below the interface with the overlying lake-edge facies, and are sometimes contaminated with product. Small (2-4 mm/0.08-0.16 in) gastropod shells are common, and are dispersed throughout the silty matrix rather than concentrated into lenses as in the lake-edge facies. Many of these shells are the invasive *B. tentaculata* species. Across all borings, the marl deposit extends from the base of the shoreline sands to the end of the core. Organic sediment within the lacustrine deposit returned conventional ^{14}C dates of 2780±40 BP (Beta-335203), 3400±30 BP (Beta-335202), 4510±30 BP (Beta-335204), and 6310±40 BP (Beta-335205).

4.3 Descriptions of individual borings

HB-SB-251

HB-SB-251 was collected to a depth of 609.6 cm (20 ft) bgs. The boring contains a 7.6 cm (3 in) cap of humus. Below this, sandy fill extends to 216.4 cm (7.1 ft), with numerous oncolites from 7.6-109.7 cm (3 in-3.6 ft) bgs and glossy, loose, single-grain coal waste from 213.4-216.4 cm (7.0-7.1 ft) bgs. This historic fill caps 6 cm (2.4 in) of peaty clay silt. This layer marks the transition to a complex of historic lake edge deposits, which extend to 237.7 cm (7.8 ft) bgs. The basal stratum is a lacustrine marl, ranging in texture from very fine sandy silt to well-sorted medium-fine sand, and contains the occasional shell and fragment of wood, to the base of the core. *B. tentaculata* shells are present above 600.5 cm (19.7 ft) bgs.

HB-SB-252

HB-SB-252 was collected to a depth of 609.6 cm (20 ft) bgs. The boring is capped by 6 cm (2.4 in) of humus, over sandy fill to 213.4 cm (7.0 ft). The historic lake-edge deposits are composed of stratified sand, silt, and gravel extend between 213.4 and 457.2 cm (7.0-15.0 ft) bgs. Within the lake-edge sediments, invasive *B. tentaculata* shells are present above 238 cm (7.8 ft) bgs. Below this facies, the marl extends to the base of the core. The upper marl is contaminated with coal tar from 457.2-487.7 cm (7.0-16.0 ft) bgs.

HB-SB-253

HB-SB-253 was collected to a depth of 670.6 cm (22 ft) bgs. The boring has a 9 cm (3.5 in) humus cap, over sandy fill to 199.6 cm (6.5 ft) bgs. Historic lake-edge matrices consisting of reworked and redeposited historic materials (such as coal) extend to 570 cm (18.7 ft) bgs. A few dark bands of peat are interbedded with the shoreline materials from 527.3-548.6 cm (17.3-18.0 ft) bgs. Marl extends from 570 cm (18.7 ft) to the base of the core. Although the sediments contain *B. tentaculata* shells above 588 cm (19.3 ft) bgs, a conventional ^{14}C date of 2780±40 BP (Beta-335203) was derived from organic sediment at 573 cm (18.8 ft) bgs. The marl near the base of the core, at 658.4 cm (21.6 ft) bgs, provided a conventional ^{14}C date of 3400±30 BP (Beta-335202) and would appear to be more reliable for dating the latter phases of Holocene lake deposition. The apparent age discrepancy between the invasive species and the surrounding sediment is reconciled in the discussion on pages 31-32.

HB-SB-254

HB-SB-254 was collected to a depth of 670.6 cm (22 ft) bgs. The boring has a 9 cm (3.5 in) humus layer over a 9 cm (3.5 in) thick sandy A horizon. Beneath this developing soil, sandy fill extends to 146.3 cm (4.8 ft) bgs. Stratified, sandy historic lake-edge sediments cap product-contaminated peat at 292.6 cm (9.6 ft) bgs. Bands of peat and fine sand interbed to a depth of 402.3 cm (13.2 ft), where the lake-edge deposits accumulated above 39.6 cm (1.3 ft) of homogeneous, shell-dominated lacustrine sediment. This deposit contains *B. tentaculata* shells to a depth of 411.5 cm (13.5 ft) bgs. A second, 6 cm (2.4 in) -thick peat deposit lies at 435.9 cm (14.3 ft) bgs. Laminated lacustrine sediment extends from the base of this peat to the end of the core, but this deposit is not homogeneous. A band of oncolites is at 603.5 cm (19.8 ft) bgs.

HB-SB-256

HB-SB-256 was collected to a depth of 731.5 cm (24 ft) bgs. The boring is capped with humus to 12.2 cm (4.8 in) bgs, over gravelly sandy fill which extends to 141.7 cm (4.6 ft) bgs. This fill seals in stratified lake-edge sands which gradually transition to peaty silt by 426.7 cm (14.0 ft) bgs. This peat caps a shell-enriched lake-edge silty sand that lies between 530.4-536.5 cm (17.4-17.6 ft) bgs, and contains *B. tentaculata* shells. Beneath the lake-edge complex, marl extends to the base of the core. The upper marl is faintly banded, and returned a conventional ^{14}C date of 4510±30 BP (Beta-335204) for gastropod shells at 594.4 cm (19.5 ft) bgs. Again, this appears to be a reliable date. The lower marl is homogeneous, and returned a conventional ^{14}C date of 6310±40 BP (Beta-335205) at a depth of 667.5 cm (21.9 ft) bgs. The two radiocarbon

determinations in correct stratigraphic order would appear to index the middle to later Holocene evolution of the lake basin.

HB-SB-259

HB-SB-259 was collected to a depth of 609.6 cm (20 ft) bgs. The boring is capped by 15 cm (6 in) of humus, over sandy fill to 102.1 cm (3.3 ft) bgs. Within this fill are two bands of dark (10YR 4/2) firm, friable silty loam, which may indicate a buried A horizon: a 6 cm (2.4 in) –thick one at 91.4 cm (3.0 ft) bgs, and a 2 cm (0.8 in) –thick one at 100.6 cm (3.3 ft) bgs. Stratified lake-edge silts, sands and clays, containing *B. tentaculata* shells, begin below the fill and extend to 176.8 cm (5.8 ft) bgs. This deposit accumulated on top of 6 cm (2.4 ft) of product-contaminated peat. From 176.8 cm (5.8 ft) to 304.8 cm (10 ft) bgs, the peat is interbedded with clay and sand, and contains small shells to the base of the unit. Oncolites are present at 317 cm (10.4 ft) and 341.4 cm (11.2 ft) bgs. The lake-edge sediment complex is no longer peaty below this, and laminated clay silt marks the transition to the underlying marl at 414.5 cm (13.6 ft). The basal marl extends to the end of the core, and contains a 3 cm (1.2 in) -long piece of decaying wood at 536.5 cm (17.6 ft).

HB-SB-262

HB-SB-262 was collected to a depth of 609.6 cm (20 ft) bgs. The boring has an overburden of 18.3 cm (7.2 in) of recently disturbed sediment which was deposited on top of the 3 cm (1.2 in) layer of humus. Below the humus, sandy fill unconformably seals in stratified sandy historic lake-edge deposits at 109.7 cm (3.6 ft) bgs. The lake-edge deposit caps peat at 176.8 cm (5.8 ft) bgs. Peat thickness is 64 cm (2.1 ft) and the matrix is contaminated with product at 219.5 cm (7.2 ft) bgs. Beneath the peat, shell-dominant lacustrine sediment gives way to an older, 30.5 cm (1 ft) -thick deposit of interbedded peats and sands at 384.1 cm (12.6 ft) bgs. Below this deeper sand and peat complex, a homogeneous lacustrine deposit extends to the base of the core, and contains *B. tentaculata* shells above 581.5 cm (19.1 ft) bgs.

HB-SB-263

HB-SB-263 was collected to a depth of 609.6 cm (20 ft) bgs. The boring is capped by 18.3 cm (7.2 in) of developed, sandy A horizon. Below the soil, fill extends to 158.5 cm (5.2 ft) bgs, beneath which is a thin historic lake-edge deposit composed of oxidized strata of gravel and silt that extends to 256 cm (8.4 ft) bgs. The shoreline sediments collected atop banded lacustrine sediment that forms a deposit 210.3 cm (6.9 ft) thick. At 466.3 cm (15.3 ft) bgs, the lacustrine sediments become uniform shell-enriched marl, and *B. tentaculata* shells are present at a depth of 472.4 cm (15.5 ft) bgs. This marl extends to the base of the core.

HB-SB-264

HB-SB-264 was collected to a depth of 609.6 cm (20 ft) bgs. The boring is capped by a thin sandy A horizon that extends to 12.2 cm (4.8 in) bgs. Beneath this is 152.4 cm (5.0 ft) of sandy fill, with a band of oncolites at 112.8 cm (3.7 ft) bgs. Within the surface fill, a 12.2 cm (4.8 in) of granular brown silt at 140.2 cm (4.6 ft) bgs may represent a buried A horizon. At the base of the

fill is a 3 cm (1.2 in) band of coarse coal and ferrous granules at 161.5 cm (5.3 ft) bgs. This layer marks the transition to sandy historic lake-edge deposits with interbedded peat. This complex extends from 164.6-359.7 cm (5.4-11.8 ft) bgs and is contaminated with product at 207.3 cm (6.8 ft) bgs. Below this peat complex, laminated, lacustrine clay silts and silty sands extend from 359.6-454.2 cm (11.8-14.9 ft) bgs. A deeper peat deposit lies below this lacustrine sediment, between 454.2 and 506 cm (14.9 and 16.6 ft) bgs. This peat has a faint product odor. It formed over a basal matrix of laminated, lacustrine marl sediments which contain *B. tentaculata* shells to a depth of 509 cm (16.7 ft) bgs, and extend to the base of the core.

4.4 Summary of previous O'Brien and Gere borings

GRA supplemented in-field observations of nine (9) borings with the logs of twenty-five (25) borings recorded during 2006 and 2007 by O'Brien and Gere and provided as an appendix to Hohman's 2012 cultural resources assessment. Although these earlier borings were not recorded with geoarchaeological reconstruction in mind, the recorded strata match those observed by GRA. These boring logs confirm GRA's observations of the overall sequence of marl (including laminated marl), peat, sandy lakeshore facies, historic fills, and recent humus. They also note the presence and location of useful chronostratigraphic markers: petroleum contamination and oncolites. Shells were noted but not identified by species, so the presence of invasive *B. tentaculata* shells is not documented. In Section 5, the maps of laminated marl, peat, and contamination (Figures 16-20) were produced by combining these borings with those described by GRA in 2012.

4.5 Summary observations of the depositional environments

The most critical element of this reconstruction is the perpetuation of lake sedimentation processes subsequent to the accelerated influx of 19th century and subsequent contaminants into the lake basin. That feature continued to be a closed system and demonstrated classic laminar accretion of finer grained components. Near-shore accumulations of these and other contaminated deposits at the historic lake-edge margins also followed classic patterns of lakeshore landscape transformation. As discussed below, the absence of a disconformity between the apparent Late Holocene lake basin deposits and the historic lake-edge provides a complex chrono-stratigraphic dilemma that was resolved by the introduction of the historic *B. tentaculata* population. Since that species was only introduced in the late 19th century, its presence is a clear bio-stratigraphic marker. Variability in the depth and lateral distributions of the historic shells argues for significant "stratigraphic mixing" and the attendant destruction of any surfaces that may have existed along the lake-edge in the historic and prehistoric past.

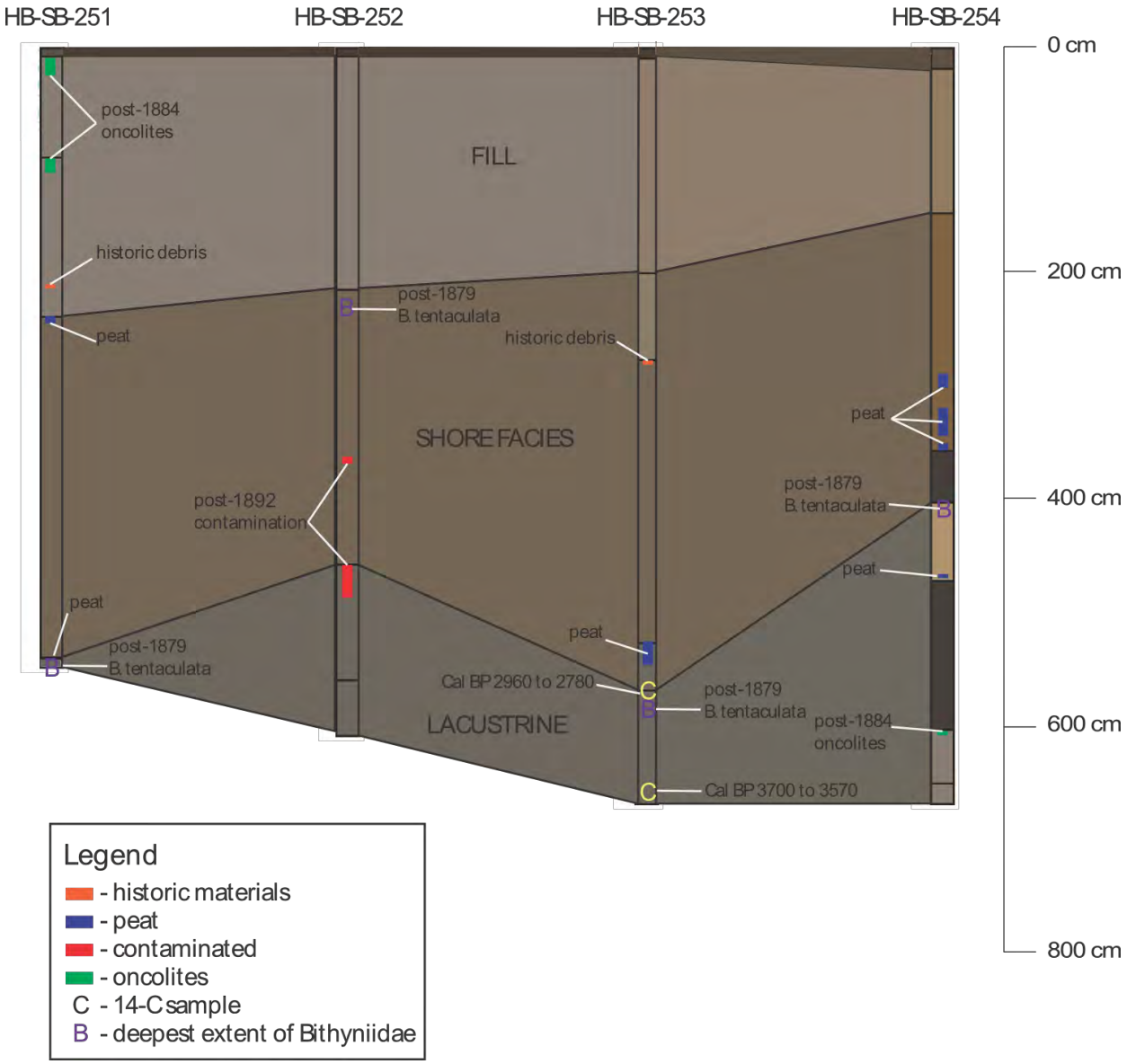


Figure 11: Borings HB-SB-251, -252, -253, and -254 with major depositional units and chrono-stratigraphic markers

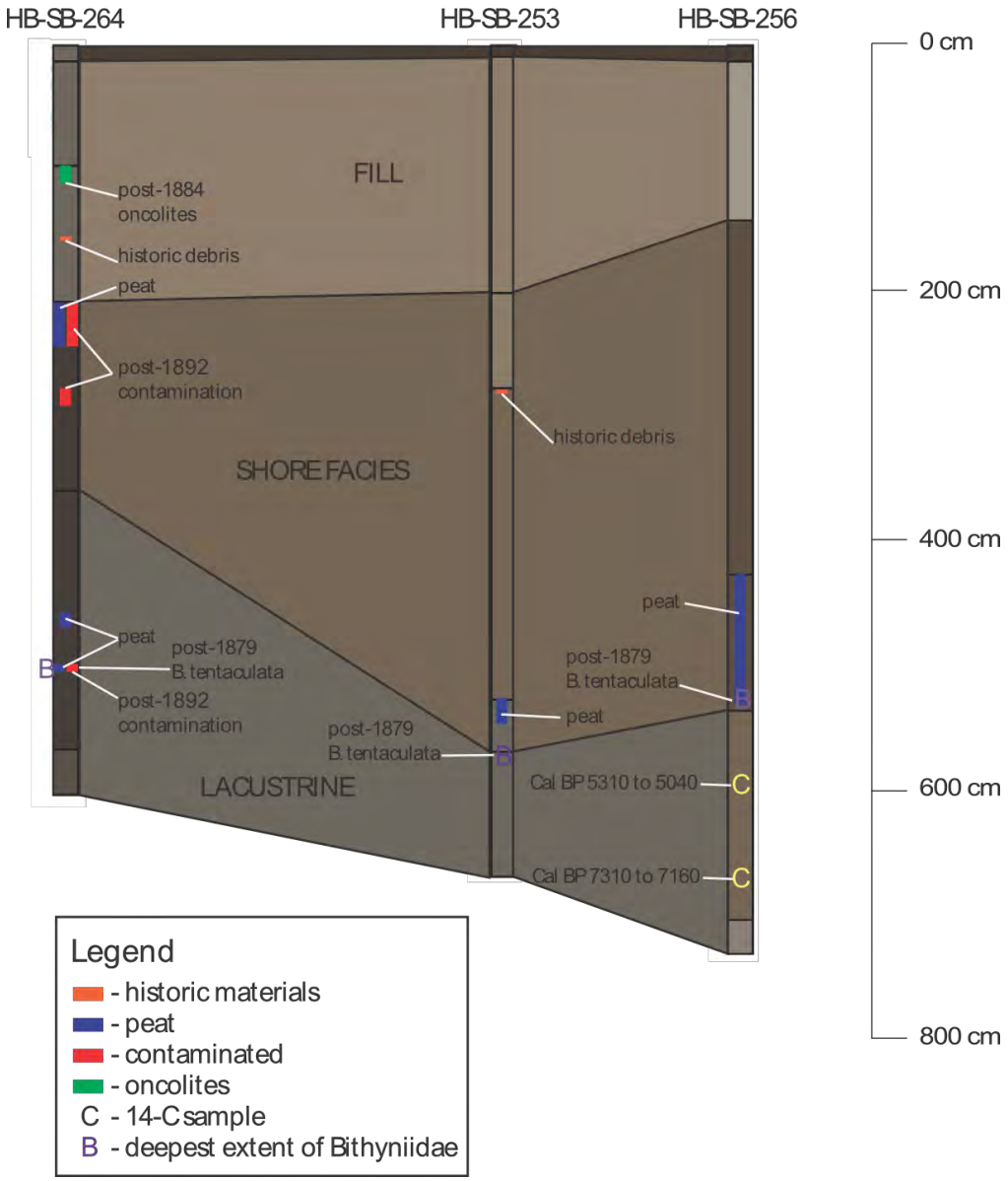


Figure 12: Borings HB-SB-253, -254, -264 with major depositional units and chrono-stratigraphic markers

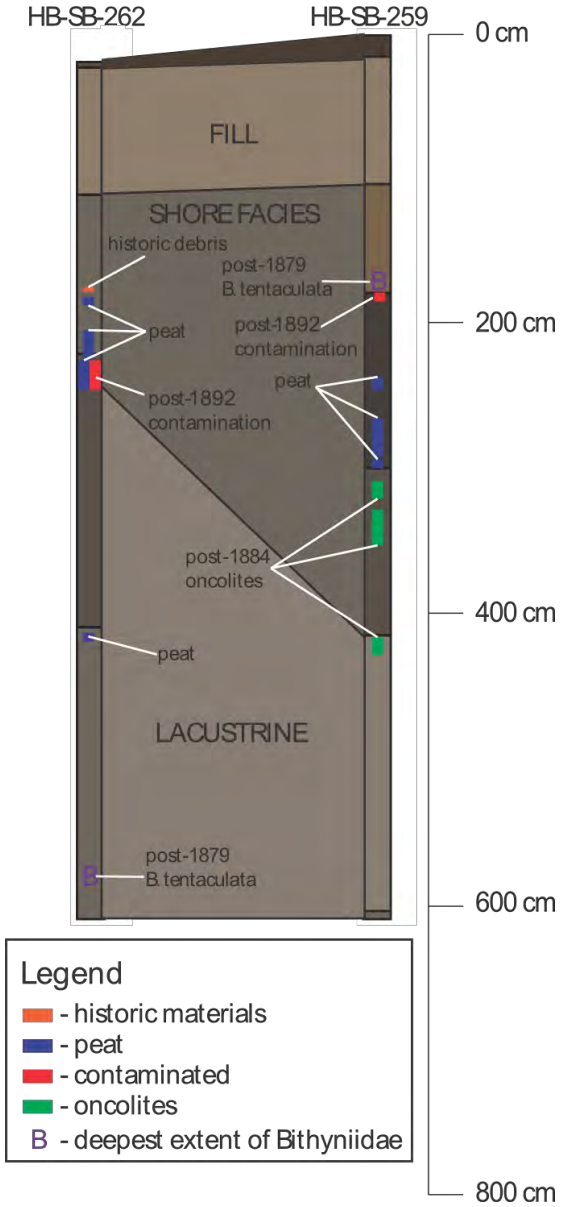


Figure 13: Borings HB-SB-259 and -262 with major depositional units and chrono-stratigraphic markers

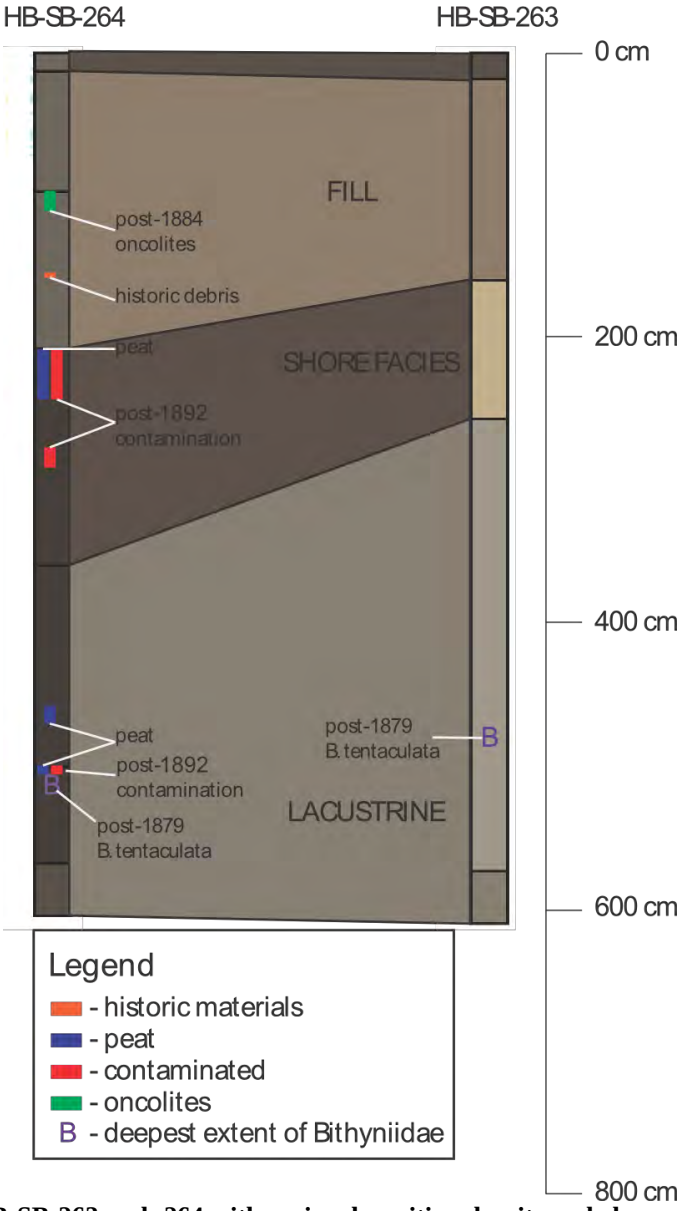


Figure 14: Borings HB-SB-263 and -264 with major depositional units and chrono-stratigraphic marker

5 GEOARCHAEOLOGICAL INTERPRETATIONS AND RECOMMENDATIONS

For these interpretations and recommendations, stratigraphic data from the GRA borings are combined with 25 borings collected by O'Brien and Gere. Taken together this broader array of cores covers a larger portion of the project area and offers a more comprehensive assessment of subsurface archaeological potential. As demonstrated, the sedimentological character of the cores, their dating, and the critical information afforded by the malacological study facilitated an in-depth assessment of landscape age, process, and archaeological significance. On-site observation, off-site stratigraphic analysis and documentary research were all drawn upon to assemble this synthesis. It was possible to reconstruct historic morphology of the historic lake shore and nearshore zones of Onondaga Lake. The ages of the sediments were determined using a combination of chrono-stratigraphic markers and ^{14}C dating of organic sediments and shells.

Some additional historic documentation helps to round out and confirm the reconstruction. Thus, we know that coal tar entered the lake system in 1892, when coke production began. Black, viscous product coats the upper portions of wooden piles discovered during trenching (Figure 15), and extends to a depth of about 274.3 cm (9 ft) bgs. The base of the contaminated band marks the likely bottom of the harbor after the demolition of the Iron Pier facilities, but would appear to pre-date the harbor filling. This dates the contaminated strata to between 1892 and 1930. Although the contamination extends across the project area, the deepest portion of the buried contaminated surface overlaps with the footprint of the Iron Pier harbor, as mapped in 1915 (Figure 16).

Figure 15: Wooden pile from Iron Pier harbor (upper portions are contaminated with coal tar)

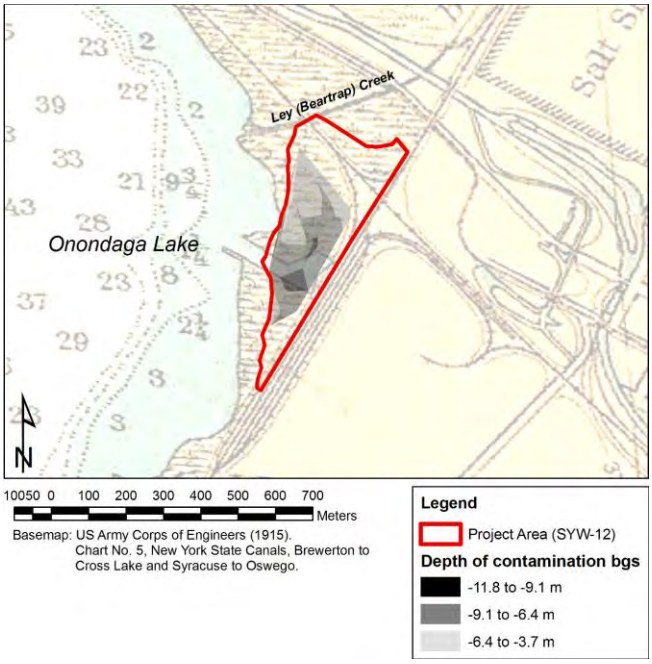


Figure 16: Depth of product contamination, in relation to Iron Pier harbor

As discussed above, perhaps the most useful chronological marker is the invasive gastropod *Bithynia tentaculata*. The absence of *B. tentaculata* in a sample should not be taken as proof that the stratum was deposited prior to 1879, but the presence of *B. tentaculata* definitively means that material from 1879 or later is present. *B. tentaculata* shells are present in all GRA cores (Appendix C: Figure 1). The O'Brien and Gere borings were not sampled for malacological analysis. The average depth of *B. tentaculata* is 535.3 cm (17.6 ft) bgs. Therefore, the majority of lake-edge sediment within the project area accumulated since 1879 and represents about 125 years of deposition, largely attributable to the human impacts to the eco-system.

Two cores produced datable samples from both the laminated top and homogeneous lower marl layers (Appendix B). These lacustrine sediments returned calibrated ^{14}C dates that indicate prehistoric mid- to late-Holocene organic material. HB-SB-253 contained banded lacustrine marl dating to Cal BP 2960 to 2780 (Beta-335203). This sample was collected above the deepest documented *B. tentaculata* specimen in the core. Beneath the banded marl, homogeneous marl returned a calibrated ^{14}C date of Cal BP 3700 to 3570 (Beta-335202). Indigenous *Planorbidae* shells within the banded marl in HB-SB-256 dated to Cal BP 5310 to 5040. The homogeneous marl below dates to Cal BP 7310 to 7160.

The mid- to late-Holocene dates can be reconciled with historic modifications to the landscape. The solution to the dilemma is evident in the sediments within the Iron Pier harbor. A notch in the shoreline on a 1928 Sanborn map (Figure 17) roughly corresponds with the mapped outline of the Iron Pier harbor on a nautical chart from 1915 (Figure 18). The data gathered for

this study suggest that this notch was a sheltered basin formed by the remains of the Iron Pier harbor after abandonment. Fine-grained, laminated sediments would have accumulated within the still water of the harbor basin after dredging ceased in 1907. Although organic material within the laminated marl dates to between 2780 and 5310 Cal years BP, *B. tentaculata* shells were recorded below the dated sample from HB-SB-253. Therefore, the deposit formed after 1879, and incorporated older materials eroding from the surrounding lakeshore.

The presence of *B. tentaculata* eliminates the possibility that the laminated marl is a deltaic deposit at the original mouth of Onondaga Creek. Marl deltas exist at the mouths of other waterways feeding Onondaga Lake (GRA 2010). However, an 1895 USGS map indicates that the old channel of Onondaga Creek was only an intermittent stream by the time the Iron Pier harbor was established (Figure 19). By this time, the creek had been redirected to an outlet south of SYW-12. Channelization would have severely limited delta development within the project area during the late 19th century. In addition, the laminated sediments extend beyond the mapped footprint of the harbor (Figure 18). Assuming that the nautical chart is accurate, the data and historic information converge around deposition of the laminated sediments prior to harbor construction in 1890 (unlikely though not impossible, given the presence of *B. tentaculata*), or after harbor abandonment in 1907. The latter scenario is most likely, given that: 1) the overwhelming bulk of the sediments in the project area accumulated after 1880, according to chrono-stratigraphic markers (Figure 11, Figure 12, Figure 13, Figure 14), and 2) the laminated sediments and the 1928 shoreline correspond very closely.

The lateral and vertical disposition of peat deposits further supports this hypothesis. As the old harbor silted up, and the water became shallow, a wetland developed in the sheltered notch in the shoreline. As a result, peat deposits are located precisely above, and occasionally interbed with, the laminated marl (Figure 20).

Finally, the absence of a chrono-stratigraphic marker that offsets the middle to late Holocene lake basin from the lake edge historic deposits is reflective of ongoing near shore activity at the lake margin. That activity was variably dynamic in response to both hydromorphic variability (during the Holocene) and extensive re-engineering of the landscape (19th and 20th centuries). The net effect was the erosion of any stable surfaces, the persistence of limnic sedimentation, and the elimination of any discrete surfaces of late Holocene or early historic age. Intrusive structural features may yet remain intact in the substrate.

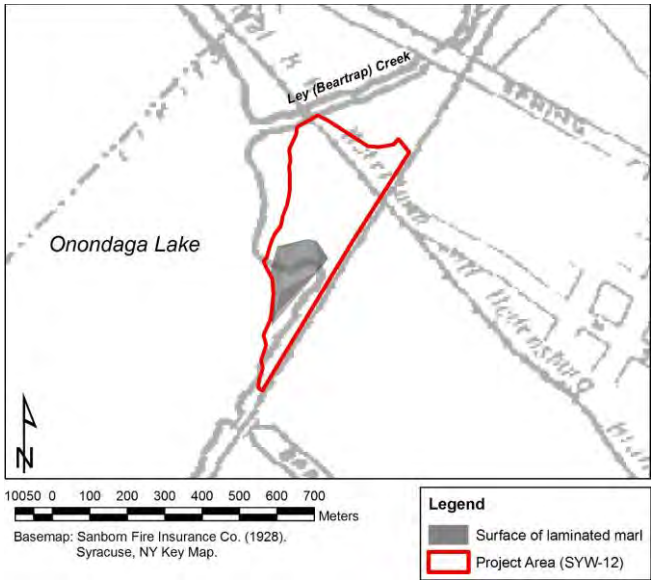


Figure 17: Laminated marl deposit, in relation to remains of harbor (1928)

Figure 18: Laminated marl deposit, in relation to harbor (1915)

Figure 19: Laminated marl deposit, in relation to old channel of Onondaga Creek (1895)

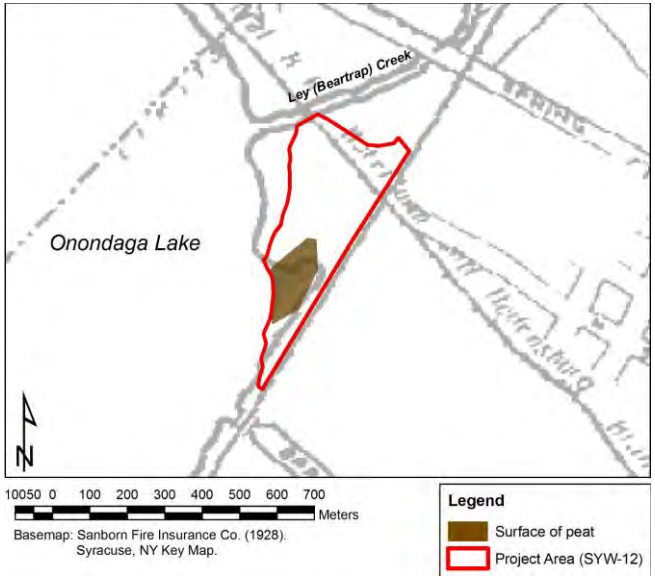


Figure 20: Peat deposit, in relation to harbor (1928)

Taken together, the data show that all of the sediments (excluding the lowest few feet of marl in each core) within the project area were deposited after 1879. Therefore, the wetland and shoreline sediments do not indicate sensitivity for pre-contact occupation in the surrounding area (Table 2). While the historic lacustrine, shoreline, and fill sediments contain many discrete layers, no structural remains are preserved with the exception of the eroded and infilled outline of the harbor itself, and some deeply-buried pilings discovered during the trenching phase of the environmental testing. However, the region delineated by the laminated marl and peat deposits may contain additional information about the structure of the Iron Pier harbor. All cores with both of these deposits are deemed potentially significant.

In the context of this geoarchaeological study, "significant" deposits are those affiliated with buildings, objects, features, locations, or structures which may be eligible for the National Register of Historic Places. Additional evaluation may be recommended in order to determine the exact nature of the relationship between the deposits and the historic or prehistoric cultural resource. Table 3 summarizes the archaeological significance of the deposits in each core. The deposits which preclude archaeological sensitivity are *deep fill* (too modern or disturbed to reflect discrete episodes of historic or prehistoric human occupation) and *till* (too old to bear traces of human occupation). Deposits with potential archaeological sensitivity are those which formed during the recorded period of human occupation at the margins of Onondaga Lake. Accordingly, we consider *the historic lake-edge*, and the *peat* and *laminated marl* deposits contained with the perimeters of the old harbor. Additional sensitivity is contributed by *proximity to known archaeological sites*. In this case, there are a number of archaeological sites in the area, but none of the deposits preserved within the borings are terrestrial (i.e., associated with dry land), and they are unlikely to house evidence for prehistoric occupation. *Radiocarbon dates* may also lend significance. The dates for these borings confirm that the sediments are sub-aqueous (or submerged).

> *SYW-12 contains the preserved traces of the Iron Pier harbor, dating to the late 19th-early 20th centuries. Additional deep testing is recommended, in order to identify structural remains. This testing should be conducted via mechanical trenching, in the manner established during the 2012 field season. The trenching should be limited to the area delineated by the laminated marl deposit.*

Table 2: Summary of archaeological recommendations

Core No.	Sensitivity Assessment	Preliminary Analysis Information			Comments
		Contamination	Modern Fill	Historic Strata	
HB-SB-251	low for prehistoric resources, low for historic resources	Product contamination at 243.84 cm		Sediments above 600.5 cm bgs were laid down after 1879 (B. tentaculata present)	Humus from 0-7.62 cm; fill of mostly sand with some gravel and silt from 7.62-216.408 cm; shoreline facies of fine sand with a speckled appearance from 216.408-237.744 cm with coal at base 3.048 cm; peat with organic fragments and possible coal tar from 237.744-243.84 cm; shoreline facies of mostly fine sand with some clay and silt containing small gastropod shell inclusions from 243.84-539.496 cm; thin peat organic layer of decayed wood and shell fragments from 539.496-541.02 cm; well sorted, medium sand grain marl from 541.02-548.64 cm
HB-SB-252	low for prehistoric resources, low for historic resources	Product contamination at least to 487.68 cm		Sediments above 487.7 cm bgs laid down after 1917 (coal tar contamination present)	Sandy fill from 0-408.4 cm; sandy historic lake-edge deposit with shell from 408.4-426.7 cm; contaminated very fine SiS from 426.7-609.6 cm
HB-SB-253	low for prehistoric resources, low for historic resources			Sediments above 588 cm bgs laid down after 1879 (*B. tentaculata* present)	Sandy fill from 0-152.4 cm; sandy historic lake-edge deposit from 152.4-344.4 cm; peat from 344.4-365.8 cm; sandy historic lake-edge deposit from 365.8-426.7 cm; sandy lacustrine marl with banding and gastropod shells from 426.7-670.7 (2780±40 BP (Beta-335203) at 573 cm, and 3400±30 BP (Beta-335202) at 658.4 cm)
HB-SB-254	low for prehistoric resources, moderate for historic resources	Coal tar and petrol contamination at least to depth of 292.6 cm		Sediments above 603.5 cm bgs laid down after 1884 (oncolites present). Both laminated marl and peat present.	Humus from 0-18.3 cm; sandy fill to 121.9 cm; sandy historic lake-edge deposit with rootlets and banding from 121.9-292.6 cm; mucky peat with fibrous organics and coal tar contamination from 292.6-344.4 cm; SiS historic lake-edge deposit from 344.424-356.616 cm; silty peat from 356.616-362.712 cm; S-Si lacustrine marl with shell from 362.712-472.44 cm; fibrous peat with strong petrol odor from 472.44-475.488 cm; SSi marl with shells from 475.488-603.504 cm ; oncolites with the texture of coarse sand and gravel from 603.504-606.552 cm; marl from 606.552-670.560 cm.

continued on next page

Table 2, continued

Core No.	Sensitivity Assessment	Preliminary Analysis Information			Comments
		Contamination	Modern Fill	Historic Strata	
HB-SB-256	low for prehistoric resources, moderate for historic resources			Sediments above 536.5 laid down after 1879 (B. tentaculata present). Both laminated marl and peat present.	organic humus from 0-30.48 cm; gravelly sand to sand fill from 30.48-121.92 cm; typically fine to medium sand historic lake-edge deposit with some small rounded gravel, shell inclusions, and banding from 121.92-304.8 cm; sand marl with gastropod shell inclusions from 304.8-426.72 cm; organic silt peat from 426.72-530.352 cm; fine sand to silty sand marl with gastropod shell inclusions from 530.352-731.520 cm (4510±30 BP (Beta-335204) for shell at 594.4 cm, 6310±40 BP (Beta-335205) for sediment at 667.5 cm)
HB-SB-259	low for prehistoric resources, moderate for historic resources	Contaminated until at least 182.88 cm with product		Sediments above 341.4 cm bgs laid down after 1884 (oncolites present). Both laminated marl and peat present.	Fill composed of variable amounts of sand, silt, and loam with some banding and rootlets from 0-121.92 cm; sand to sandy silt historic lake-edge deposit with some shell inclusions from 121.92-176.784 cm; dark sandy silt peat with petroleum odor from 176.784-182.88 cm; poorly sorted, fine to medium sand historic lake-edge deposit from 182.88-234.686 cm; black mucky peat with visible organic fibers and shells from 234.696-304.8 cm; oncolites in sandy silt matrix with shells from 304.8-329.184 cm; historic lake-edge deposit with fine sand and shells from 329.184-335.28 cm; mainly sandy silt marl with banding, oncolites, and shell inclusions and a large piece of decomposing wood from 335.28-609.6 cm
HB-SB-262	low for prehistoric resources, moderate for historic resources	Product at 219.5 cm bgs		Sediments above 581.5 cm bgs laid down after 1879 (*B. tentaculata* present). Both laminated marl and peat present.	Organic humus from 0-21.336 cm; fill composed of fine to medium sand with some silt component and some coal fragments near the base from 21.336-176.784 cm; fibrous and matted peat with variable sand to clay clastic component from 176.784-240.792 cm; very fine silty sand to sandy silt marl with small shell inclusions from 240.792-408.432 cm; fine silty sand peat with decomposing wood and fibers from 408.432-414.528 cm; sand to silt marl with shells and some substrata from 414.528-609.6 cm
HB-SB-263	low for prehistoric resources, low for historic resources			Sediments above 472.4 cm laid down after 1879 (*B. tentaculata* present)	Humus from 0-42.672 cm; fill of variable composition from sand to clay from 42.062-256.032 cm; mostly silty sand to sandy silt marl with some clay component with small gastropod shell inclusions and some laminations from 256.032-609.6 cm

continued on next page

Table 2, continued

Core No.	Sensitivity Assessment	Preliminary Analysis Information			Comments
		Contamination	Modern Fill	Historic Strata	
HB-SB-264	low for prehistoric resources, moderate for historic resources	coal tar odor as deep as 505.968 cm bgs		Sediments above 509 cm laid down after 1879 (*B. tentaculata* present). Both laminated marl and peat present.	Organic humus from 0-12.192 cm; fine sandy, silty, loam fill from 12.192-97.536 cm; poorly sorted sand oncolite strata with shell inclusions from 97.536-112.776 cm; silt to sand fill with mottling and iron fragments from 112.776-182.88 cm; peat with silt component and coal tar contamination from 182.88-243.84 cm; historic lake-edge deposit with sand to clay clastics and some organic component from 243.84-466.344 cm; black mucky peat with fibrous organics and coal tar odor from 466.344-505.968 cm; sandy silt marl with banding and few organic fibers from 505.968-603.504 cm

Table 3: Assessments of archaeological significance and follow-up testing

	Relative age: Youngest → Oldest Potentially archaeologically-sensitive								
	Holocene								
Core	Deep/ Mixed Fill	Historic lake-edge	Peat	Laminated marl	Till	~ 1 km to known Arc sites*	RC Dates	SIGNIFICANT	COMMENTS
HB-SB-251	NO	YES	YES	NO	NO	YES	NO	NO	Fill to 216.4 cm, lake-edge with peat and coal tar to 541 cm, marl to 609.6 cm
HB-SB-252	NO	YES	YES	NO	NO	YES	NO	NO	Fill to 408.4 cm, lake-edge to 426.7 cm, contaminated marl to 609.6 cm
HB-SB-253	NO	YES	NO	YES	NO	YES	YES	NO	Fill to 152.4 cm, shore faces with coal, wood, peat to 426.7 cm, marl to 670.6 cm. 2780±40 BP (Beta-335203) for organic sediment at 573 cm, and 3400±30 BP (Beta-335202) for organic sediment at 658.4 cm.
HB-SB-254	NO	YES	YES	YES	NO	YES	NO	YES	Fill to 121.9 cm, lake-edge with peat coal tar to 475.5 cm, marl to 670.6 cm, with oncolites at 603.5 cm.
HB-SB-256	NO	YES	YES	YES	NO	YES	YES	YES	Fill to 121.9 cm, lake-edge with peat to 530.4 cm, marl to 731.5 cm. 4510±30 BP (Beta-335204) for shell at 594.4 cm, 6310±40 BP (Beta-335205) for organic sediment at 667.5 cm.
HB-SB-259	NO	YES	YES	YES	NO	YES	NO	YES	Fill to 121.9 cm, lake-edge with peat, contamination, oncolites to 335.28 cm, marl with oncolites, wood to 609.6 cm.
HB-SB-262	NO	YES	YES	YES	NO	YES	NO	YES	Fill with coal to 176.9 cm, lake-edge with peat to 414.5 cm, marl to 609.6 cm
HB-SB-263	NO	YES	NO	YES	NO	YES	NO	NO	Fill to 256.032 cm, marl to 609.6 cm.
HB-SB-264	NO	YES	YES	YES	NO	YES	NO	YES	Fill with oncolites and industrial debris to 182.9 cm, lake-edge with peat and coal tar to 506 cm, marl to 609.6 cm.

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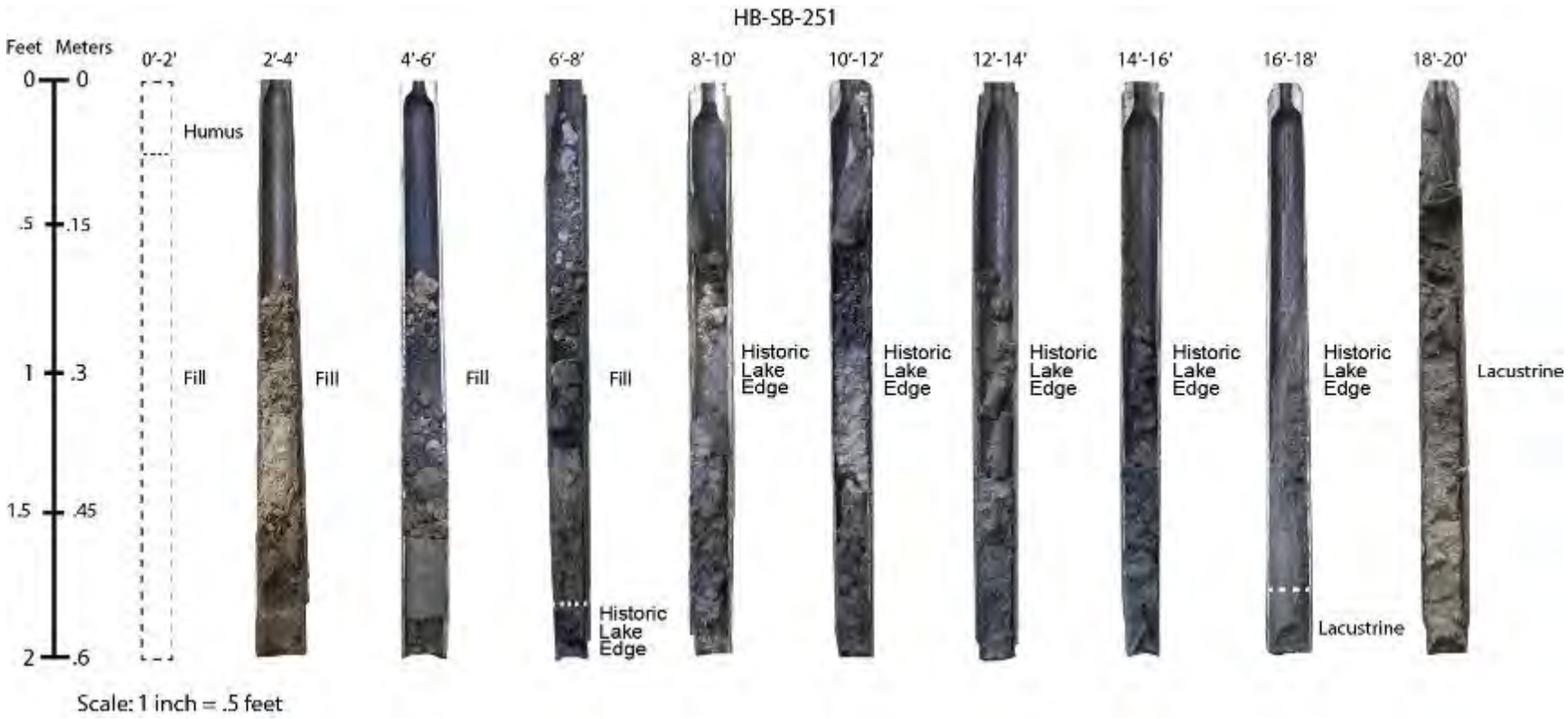
Appendix A: Core Photographs and Descriptions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Humus
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Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Lacustrine
Historic Lake Edge
Lacustrine
Scale: 1 inch = .5 feet

HB-SB-251

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	7.6	1O	10YR 3/1	Si	gr	fri	c	
fill	7.6	17.7	Ap1	10YR 5/1	SL	gr	l	n/a	poorly sorted, fine sand sandy loam, oncolites (1cm), dry
	25.3	35.7	NR					n/a	
	61.0	36.6	NR					n/a	
	97.5	12.2	Ap2	10YR 5/1	S	gr	fi	c	poorly sorted f-c sand, clumps (firmly packed), oncolites
	109.7	3.0	Ap3	10YR 4/1	GSi	abk	fi	c	silt and stone
	112.8	9.1	Ap4	10YR 4/1	S	sg	l	n/a	mod well sorted med sand
	121.9	36.6	NR					n/a	
	158.5	15.2	Ap5	7.5YR 4/2	SG	gr	fri	a	dark, granular, fragments, fine sand
	173.7	9.1	Ap6	10YR 3/1	SiS	1sbk	fi	n/a	f sand, coarse sand band, Fe ox, dk grey, compact
	182.9	24.4	NR					n/a	

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-251, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
fill	207.3	6.1	Ap7	10YR 3/2	Si	sbk	fi	a	firm and dry, crumbly, stone fragments
	213.4	3.0	Ap8	10YR 2/1	G	gr	l	a	black, coal, texture of coarse sand, loose
	216.4	21.3	Ap9	10YR 3/2	S	1sbk	fri	a	speckled appearance, fine sand, many fine substrata
historic lake-edge	237.7	6.1	2O	10YR 2/1	OCSi	sbk	fri	n/a	peaty, organic fragments, possible coal tar
	243.8	36.6	NR					n/a	
	280.4	6.1	1C	10YR 3/1	SSi	1sbk	fri	a	shell, coarse substrata or shells
	286.5	15.2	2C	10YR 3/2	S	gr	l	c	loose, wet, coarse sand, poorly sorted
	301.8	3.0	3C1	2.5Y 3/1	S	gr	fri	n/a	fine sand, many shells
	304.8	15.2	NR					n/a	
	320.0	6.1	3C2	2.5Y 3/1	S	gr	fri	c	fine sand, many shells
	326.1	18.3	4C1	2.5Y 4/2	CSiS	1sbk	fri	c	fine clay silt/sand, no inclusions

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
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Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-251, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	344.4	6.1	4C2	2.5Y 3/1	CSi	abk	fri	c	darker grey, moist
	350.5	15.2	5C1	2.5Y 3/1	S	1sbk	fri	n/a	fine, well sorted, shell fragments
	365.8	24.4	NR					n/a	
	390.1	6.1	5C2	2.5Y 3/1	S	gr	l	a	fine, well sorted, shell fragments
	396.2	12.2	5C3	2.5Y 3/1	SiS	1sbk	fri	c	fine sand, rootlets
	408.4	3.0	5C4	2.5Y 3/1	S	sg	fri	c	fine well sorted sand, shell fragments
	411.5	15.2	5C5	2.5Y 3/1	S	sg	fri	n/a	fine sand, wood fragments
	426.7	27.4	NR					n/a	
	454.2	15.2	5C6	2.5Y 3/1	S	sg	fri	g	wood fragments, poorly sorted, coarse to fine sand
	469.4	12.2	5C7	2.5Y 3/1	S	sg	fri	g	wood fragments, fine to med sand
	481.6	6.1	6C1	2.5Y 3/1	S	sg	l	n/a	well sorted, loose, med-fine wet sand
	487.7	45.7	NR					n/a	
	533.4	6.1	6C2	2.5Y 3/1	S	sg	fi	g	well sorted, med-fine sand

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-251, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	539.5	1.5	3O	10YR 2/1	O	2sbk	fi	g	thin organic layer, decayed wood and shell
lacustrine facies	541.0	7.6	7C1	2.5Y 2.5/1	S	1sbk	fi	g	well sorted, med-fine sandy marl, compact
	548.6	24.4	NR						
	573.0	18.3	7C2	10YR 5/1	S	1sbk	fi	c	well sorted, med-fine sandy marl, compact
	591.3	18.3	7C3	10YR 5/1	SiS	1sbk	fi	n/a	fine sandy marl with shells

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

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Historic Lake Edge
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Historic Lake Edge
Historic Lake Edge
Lacustrine
Lacustrine
Scale: 1 inch = .5 feet

HB-SB-252

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	7.6	1O	10YR 2/2	Si	gr	fri	a	silty loam, soil
fill	7.6	38.1	Ap1	10YR 5/1	S	gr	l	c	poorly sorted, fine-vc, gravel, some shell
	45.7	15.2	NR					n/a	
	61.0	30.5	Ap2	10YR 5/2	Si	2sbk	fi	n/a	firm silt
	91.4	30.5	NR					n/a	
	121.9	45.7	Ap3	7.5YR 4/2	S	sg	l	c	mod sorted, some coarse grains in fine-med sand, no inclusions, loose
	167.6	15.2	Ap4	10YR 3/2	C	mass	fi	n/a	irregular mottles of Fe oxidation (reddish)
	182.9	51.8	NR					n/a	
	204.2	6.1	Ap5	10YR 4/2	SiS	2sbk	fi	c	fine sand

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-252, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	213.4	27.4	1C	10YR 4/2	CS	1sbk	fi	c	fine grained
	240.8	3.0	2C	10YR 2/2	S	sg	fri	n/a	coarse sand w/ shells
	243.8	42.7	NR					n/a	
	286.5	6.1	3C	10YR 4/1	SiCL	2sbk	fi	c	
	292.6	6.1	4C	10YR 4/1	CS	1sbk	fri	c	v. fine with coarse sand inclusions, plastic consistency
	298.7	6.1	5C1	2.5Y 2.5/1	GS	gr	l	n/a	1/8" gravel, coarse sand, poorly sorted sand
	304.8	30.5	NR					n/a	
	335.3	12.2	5C2	2.5Y 2.5/1	S	sg	l	c	1/2" stones, wet
	347.5	12.2	5C3	2.5Y 2.5/1	S	sg	l	c	coarse sand, wet

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-252, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	359.7	6.1	6C	10YR 3/1	S	sg	l	n/a	rubber, fine sand, coarse inclusions, contaminated, wet
	365.8	30.5	NR					n/a	
	396.2	12.2	7C	2.5Y 2.5/1	S	sg	l	c	med-coarse sand, loose
	408.4	6.1	8C	2.5Y 4/1	S	sg	l	c	shells, med sand
	414.5	12.2	9C	2.5Y 3/1	S	sg	l	n/a	fine grey sand
	426.7	30.5	NR					n/a	
lacustrine facies	457.2	30.5	10C	10YR 4/1	SSi	1sbk	vfi	n/a	contaminated, fine grey SSI, mod firm, top of stratum not recovered
	487.7	27.4	NR					n/a	
	515.1	33.5	11C1	10YR 3/1	SSi	1sbk	fri	n/a	fine sand, v. wet
	548.6	12.2	NR					n/a	
	560.8	48.8	11C2	10YR 4/1	SSi	1sbk	fri	n/a	v. fine sand, marl

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
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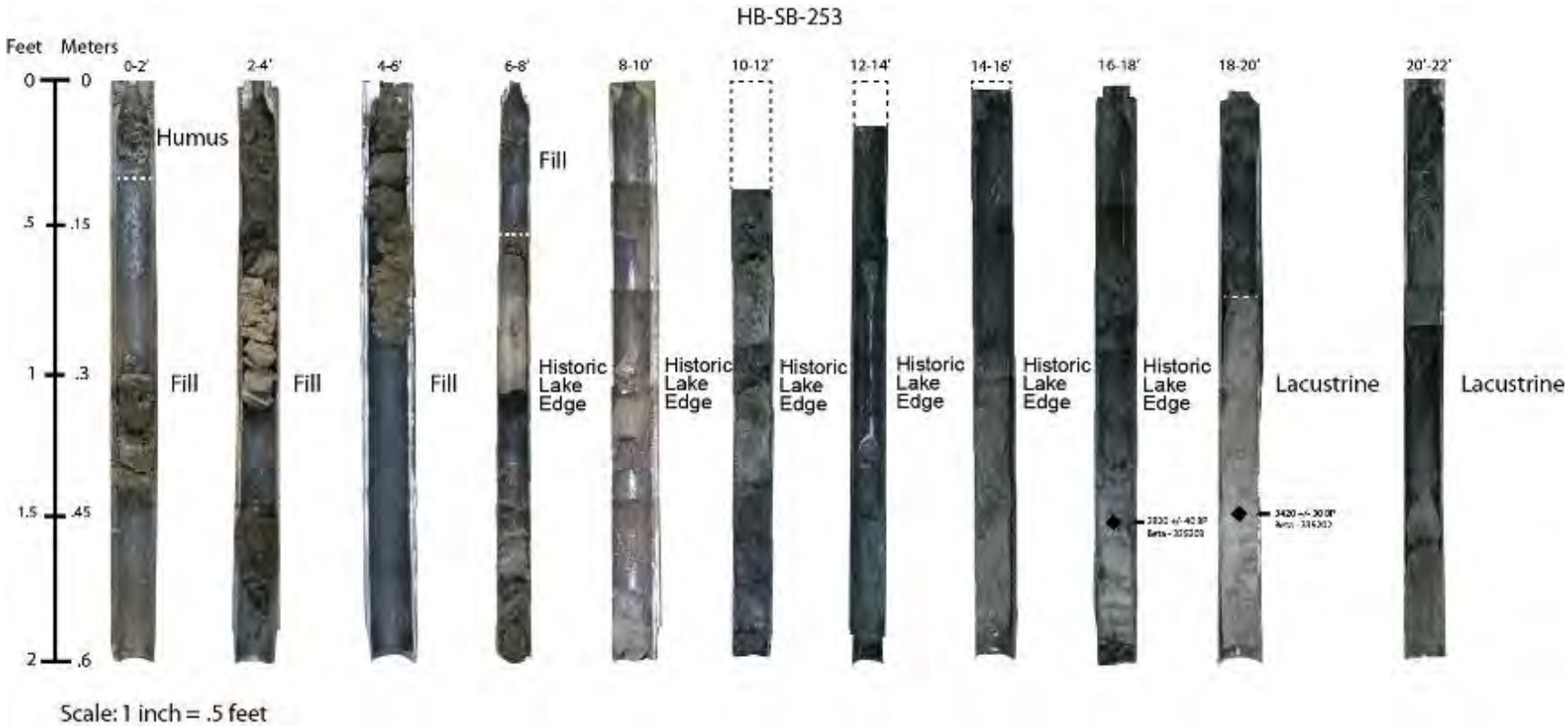
Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt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Humus
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Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Lacustrine
Lacustrine
Scale: 1 inch = .5 feet

HB-SB-253

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	9.1	1O	10YR 2/2	SiL	gr	fri	a	
fill	9.1	24.4	Ap1	10YR 5/2	SiS	sg	vfri	n/a	
	33.5	27.4	NR						
	61.0	21.3	Ap2	10YR 4/1	S	sg	l	g	vf sand
	82.3	15.2	Ap3	2.5Y 5/2	SiS	sg	vfri	n/a	vf sand
	97.5	12.2	NR					n/a	
	109.7	9.1	Ap4	10YR 3/2	S	gr	l	n/a	
	118.9	3.0	NR					n/a	
	121.9	30.5	Ap5	2.5Y 3/2	S	sg	l	n/a	
	152.4	47.2	NR					n/a	
historic lake-edge	199.6	33.5	1C	2.5Y 5/2	S	sg	l	a	gastropod shell (~1cm)

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
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sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-253, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	233.2	6.1	2C	2.5Y 5/1	SSi	sbk	vfri	a	laminated, oxidized bands, light and dark grey bands, vf sand,
	239.3	4.6	3C	2.5Y 3/2	S	sg	l	n/a	m grain, well sorted
	243.8	33.5	NR					n/a	
	277.4	3.0	4C	10YR 4/2	SiS	sg	fri	c	coal fragments, vf sand
	280.4	24.4	5C	5Y 4/1	S	sg	vfri	n/a	f sand, shell inclusions
	304.8	39.6	6C	10YR 3/2	SL	1sbk	vfri	c	vf sand,
	344.4	21.3	7C	10YR 2/1	SO	gr	l	n/a	silty wood fragments, looks like mulch
	365.8	61.0	8C	10YR 4/1	SiS-L	gr	vfri	n/a	shell inclusions, wet, f-m sand
	426.7	36.6	NR					n/a	
	463.3	24.4	9C	2.5Y 4/1	SiS	sg	vfri	n/a	2.5Y 4/1 to 2.5Y 4/2, fine sand
	487.7	39.6	NR					n/a	

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

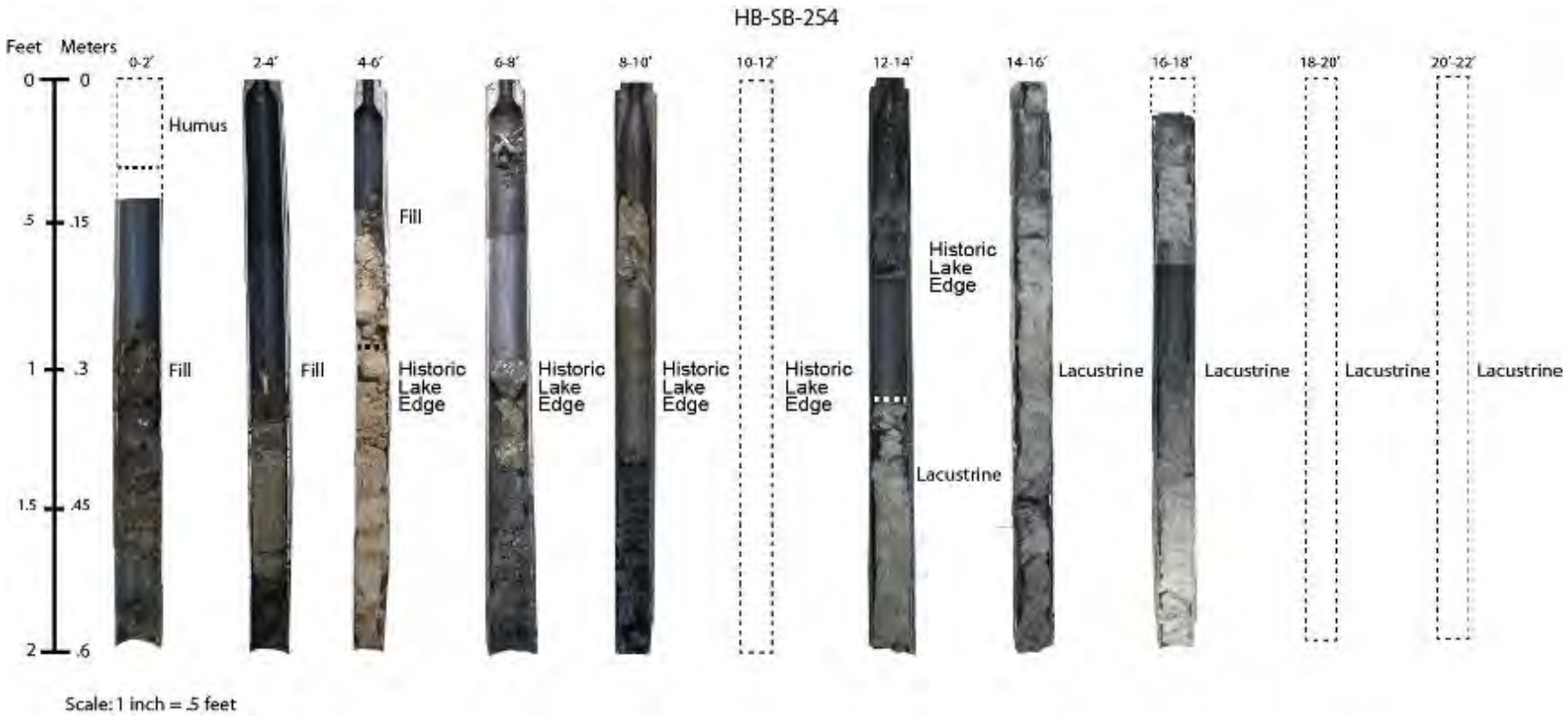
Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-253, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	527.3	21.3	10C	2.5Y 4/1	S	sg	vfri	n/a	banded/laminated, fine sand, vwell sorted, black organic bands
	548.6	21.3	NR					n/a	
lacustrine facies	570.0	39.6	11C1	2.5Y 4/1	SiS	sbk	fri	n/a	vf sand, weakly banded, small gastropod shell inclusions
	609.6	27.4	11C2	2.5Y 4/1	SiS	sbk	fri	n/a	vf sand, weakly banded, small gastropod shell inclusions
	637.0	15.2	NR					n/a	
	652.3	18.3	12C	2.5Y 4/1	SCSi	abk	fri	n/a	plastic consistency

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky;
pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt


HB-SB-254
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Humus
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Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Lacustrine
Lacustrine
Lacustrine
Lacustrine
Lacustrine
Lacustrine
Scale: 1 inch = .5 feet

HB-SB-254

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	9.1	1O	10YR 3/2	SiL	sbk	firm	c	humus
	9.1	9.1	A	10YR 5/2	OS	gr	fri	c	A development, v.fine sand with organics
fill	18.3	9.1	Ap1	10YR 5/3	S	gr	fri-l	n/a	vf sand, no org, some granular clumping
	27.4	73.2	NR					n/a	
	100.6	15.2	Ap1	10YR 6/4	S-Si	gr-sbk	fri	a	vf sand, no organics, crumbles to subangular clumps
	115.8	6.1	Ap2	10YR 4/2	S	gr	l	n/a	m-f sand, poorly sorted
	121.9	24.4	NR					n/a	
historic lake-edge	146.3	15.2	Ap3	10YR 4/4	S	sg	l	c	m-f sand, many fine substrata, lots of small shells from 5.0-5.3'
	161.5	21.3	Ap4	10YR 7/2	S	sg	l	n/a	wet, vf sand, reddish Fe banding (no band more than .25" thick), banding (10YR 6/4)

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-254, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	182.9	42.7	NR					n/a	
	225.6	3.0	Ap5	10YR 3/1	S	sg	l	c	poorly sorted m-f sand, loose, wet
	228.6	9.1	Ap6	10YR 3/1	S	sg	l	c	shells, coarse sand, wet, rootlets
	237.7	6.1	Ap7	10YR 3/1	S	sg	l	n/a	vf sand, wet
	243.8	39.6	NR					n/a	
	283.5	9.1	Ap7	10YR 2/1	S	sg	l	c	f sand, v. dark,
	292.6	12.2	2O1	10YR 2/1	O	1sbk	1fi	n/a	sticky, mucky, dark, fibrous organics, peaty, contaminated with coal tar
	304.8	15.2	NR					n/a	
	320.0	24.4	2O2	10YR 2/1	O	1sbk	fi	a	mucky, sticky, wet, peat, fibrous inclusions
	344.4	12.2	1C	10YR 5/2	SiS	2sbk	fi	a	fine, wet, grey substrata,
	356.6	6.1	3O	10YR 2/1	SiO	2sbk	fi	a	soft, sticky, silty peat, matted organic fibers,

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-254, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	362.7	3.0	2C	10YR 5/1	S	sg	l	n/a	f sand, many small shells, wet
	365.8	36.6	NR					n/a	
lacustrine facies	402.3	24.4	3C	10YR 6/4	SSi	2sbk	fi	n/a	vf sand, small shell inclusions, moist
	426.7	9.1	NR					n/a	
	435.9	6.1	4O	10YR 4/2	OSSi	2sbk	fi	c	brownish organic material in SSi, moist
	442.0	30.5	4C	10YR 5/1	SSi	2sbk	fi	a	vf sand, small shells, moist
	472.4	3.0	5O	10YR 2/1	O	pl	fi	c	black organic layer, fibrous, matted, strong petroleum odor
	475.5	12.2	5C1	10YR 5/1	SSi	2sbk	fi	n/a	shells, marl
	487.7	27.4	NR					n/a	
	515.1	33.5	5C2	10YR 5/1	SSi	2sbk	fi	n/a	shells

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-254, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	548.6	33.5	NR					n/a	
	582.2	12.2	5C3	10YR 5/1	SSi	2sbk	fi	g	shells, fine sand
	594.4	9.1	6C	10YR 5/1	CSi	2sbk	fi	a	no shells, vfine,
	603.5	606.6	7C	10YR 5/1	G	sg	l	a	oncolites, texture of coarse sand in .25-.5" gravel sized pieces,
	606.6	3.0	8C1	10YR 5/1	CSi	2sbk	fri	n/a	vfine, w/ shells
	609.6	12.2	NR					n/a	
	621.8	9.1	8C2	10YR 5/1	CSi	2sbk	fri	c	same as above
	630.9	12.2	9C	10YR 5/1	SiC	2sbk	fi	c	fine, sticky, many fine substrata 10YR 6/1 laminations
	643.1	9.1	10C	10YR 6/1	SSi	2sbk	fri	c	m-f sand, many small shells
	652.3	18.3	11C	10YR 5/1	CSi	pl	fi	n/a	vfine, no shells, plastic

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

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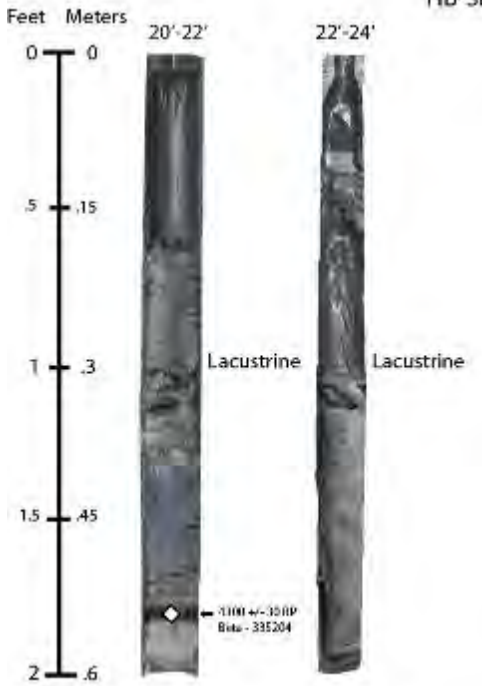
Lascustrine
Scale: 1 inch = .5 feet

HB-SB-256 (Continued)



Scale: 1 inch = .5 feet

HB-SB-256

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	12.2	1O	10YR 2/2	O	gr	l	c	organic
fill	12.2	30.5	Ap1	2.5Y 6/1	GS	gr	l	n/a	gravels subangular
	42.7	18.3	NR						
	61.0	30.5	NR					n/a	
	91.4	30.5	Ap1	2.5Y 6/1	GS	gr	l	n/a	gravels subangular
historic lake-edge	121.9	19.8	NR					n/a	
	141.7	38.1	1C1	10YR 3/2	S	gr	l	a	finely bedded, subrounded poorly sorted sand
	179.8	3.0	1C2	10YR 5/2	SiS	gr	l	n/a	vf sand, laminated
	182.9	27.4	NR					n/a	

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-256, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	210.3	21.3	1C3	2.5Y 5/2	S	gr	l	c	f-m sand, well sorted, rounded, banded, wet, some rounded gravels, small gastropod shells, marl
	231.6	12.2	1C4	10YR 4/2	S	gr	l	n/a	f-m sand, some organics, wet, small shell inclusions, marl
	243.8	33.5	NR					n/a	
	277.4	27.4	2C1	10YR 4/1	S	gr	l	n/a	f-m sand, rounded, small rounded gravels, wet, poorly sorted sand
	304.8	45.7	NR					n/a	slump from 11.1-11.5
	350.5	15.2	2C2	10YR 4/2	S	gr	l	n/a	f sand, vwell sorted, few shell inclusions
	365.8	61.0	NR					n/a	
	426.7	103.6	2O	10YR 3/2	Si	gr	fri	a	peaty, wet, organic component, wood fragments
	530.4	6.1	3C	10YR 5/2	SiS	gr	l	c	small gastropod shell inclusions, f-m well sorted sand

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

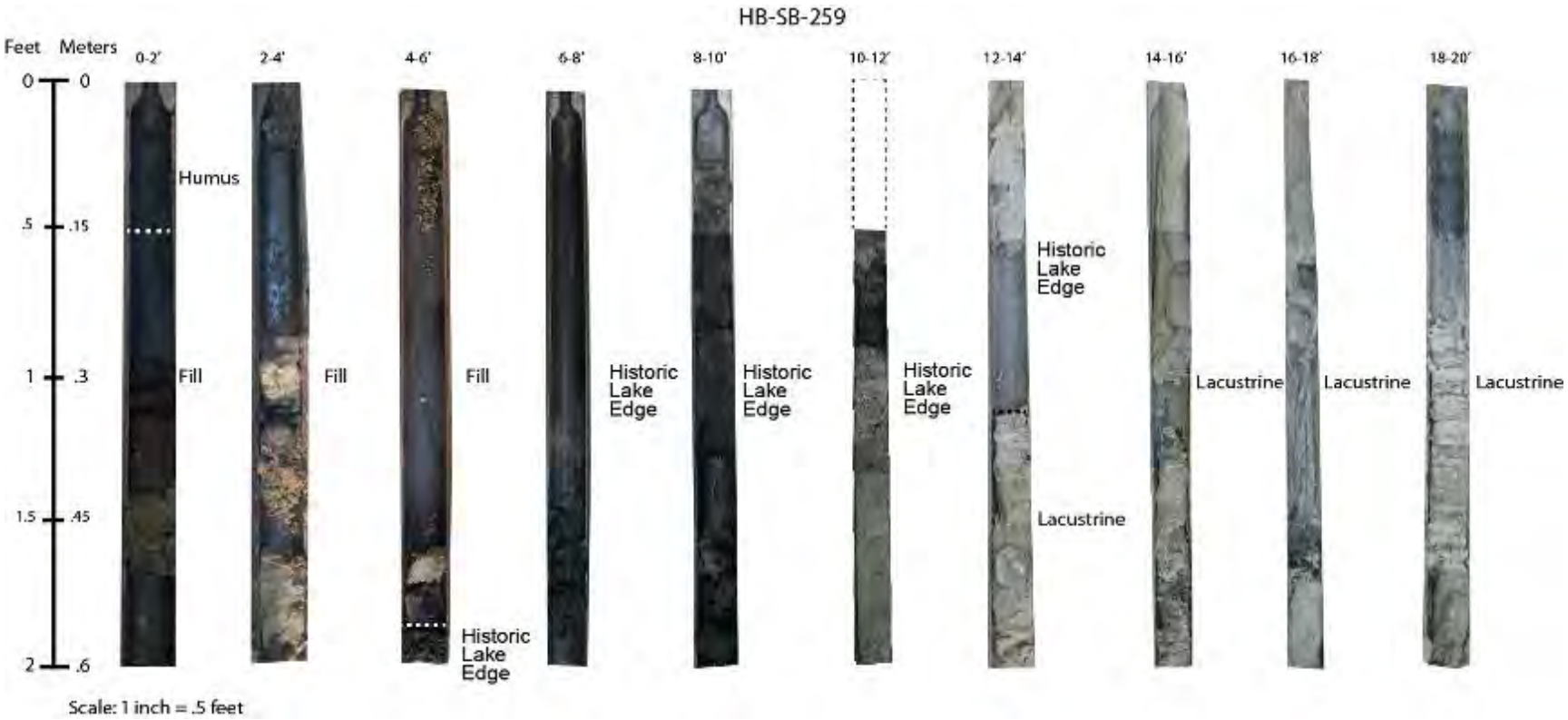
Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-256, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	536.4	12.2	4C1	10YR 4/2	SiS	gr	fri	n/a	vf sand, few shells, v well sorted sand
	548.6	33.5	NR					n/a	
	582.2	4.6	4C1	10YR 4/2	SiS	gr	fri	c	vf sand, few shells, v well sorted sand
	586.7	22.9	5C	2.5Y 5/2	SiS	2sbk	fri	n/a	small gastropod inclusions, banded?, vf sand
	609.6	18.3	NR					n/a	
	627.9	36.6	6C1	10YR 3/2	Si	2sbk	fri	a	marl
	664.5	6.1	6C2	2.5Y 5/2	CSi	2sbk	fri	n/a	marl
	670.6	33.5	NR					n/a	
	704.1	27.4	6C3	2.5YR 5/1	CSi	1sbk	fri	n/a	marl

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt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Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Lacustrine
Lacustrine
Lacustrine
Lacustrine
Scale: 1 inch = .5 feet

HB-SB-259

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	15.2	1O	10YR 2/2	SL	2sbk	fri	a	moist, fine grained, organic
fill	15.2	15.2	Ap1	10YR 5/2	SSi	gr	vfri	n/a	vf sand, damp
	30.5	30.5	NR					n/a	
	61.0	30.5	NR					n/a	
	91.4	6.1	1Ab	10YR 4/2	SiL	1sbk	vfi, fri	a	organic, buried A?,
	97.5	3.0	Ap2	10YR 6/4	Si	2sbk	fri	a	damp
	100.6	1.5	2Ab	10YR 2/1	OSiL	2sbk	fri	n/a	dark,
historic lake-edge	102.1	7.6	1C1	10YR 4/3	S	sg		c	damp, m-f sand, many fine substrata
	109.7	12.2	1C2	10YR 4/3	S	1sbk		c	banded, roots/rootlets, damp, fine sand

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-259, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	121.9	45.7	NR					n/a	
	167.6	6.1	2C1	10YR 6/6	Si	2sbk	fi	a	shells
	173.7	3.0	2C2	10YR 6/2	SSi	2sbk	fi	a	wet
	176.8	6.1	2O	10YR 2/1	OSSi	2sbk	pl	n/a	dark, peaty, petroleum odor,
	182.9	45.7	NR						
	228.6	6.1	3C	10YR 4/1	S	sg	l	g	wet, poorly sorted f-m grain
	234.7	9.1	3O1	10YR 3/1	OS	1sbk	fi	n/a	peaty, vf sand, vsmall mucky organics, rootlets
	243.8	21.3	NR					n/a	
	265.2	30.5	3O2	10YR 3/1	O	1sbk	fi	a	peaty, mucky, lots of fibers
	295.7	3.0	4C	10YR 3/1	C	mass	fi, pl	a	

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Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-259, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	298.7	6.1	4O	10YR 3/1	O	1sbk	fi	n/a	black mucky peat, shells, visible organic fibers
	304.8	12.2	NR						
	317.0	12.2	5C1	10YR 5/1	SSi	1sbk	fri	c	fine sand, 3/4" oval concretion, shells, organic layer at 10.7
	329.2	6.1	5C2	10YR 5/1	SSi	1sbk	fri	a	fine sand, lots of shell layers
	335.3	6.1	5C3	10YR 4/1	S	1sbk	fi	c	vf sand, some shells, damp
	341.4	24.4	5C4	10YR 5/1	SSi	1sbk	fi	n/a	fine sand, shell inclusions, oncolites, wet
	365.8	36.6	NR						
	402.3	12.2	6C	10YR 6/1	CSi	mass	fi, pl	g	fine banded w/ 10YR 4/1, plastic consistency, v. wet
lacustrine facies	414.5	12.2	7C1	10YR 5/1	SSi	sbk	fri	n/a	fine sand, shell inclusions, oncolites, wet

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Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

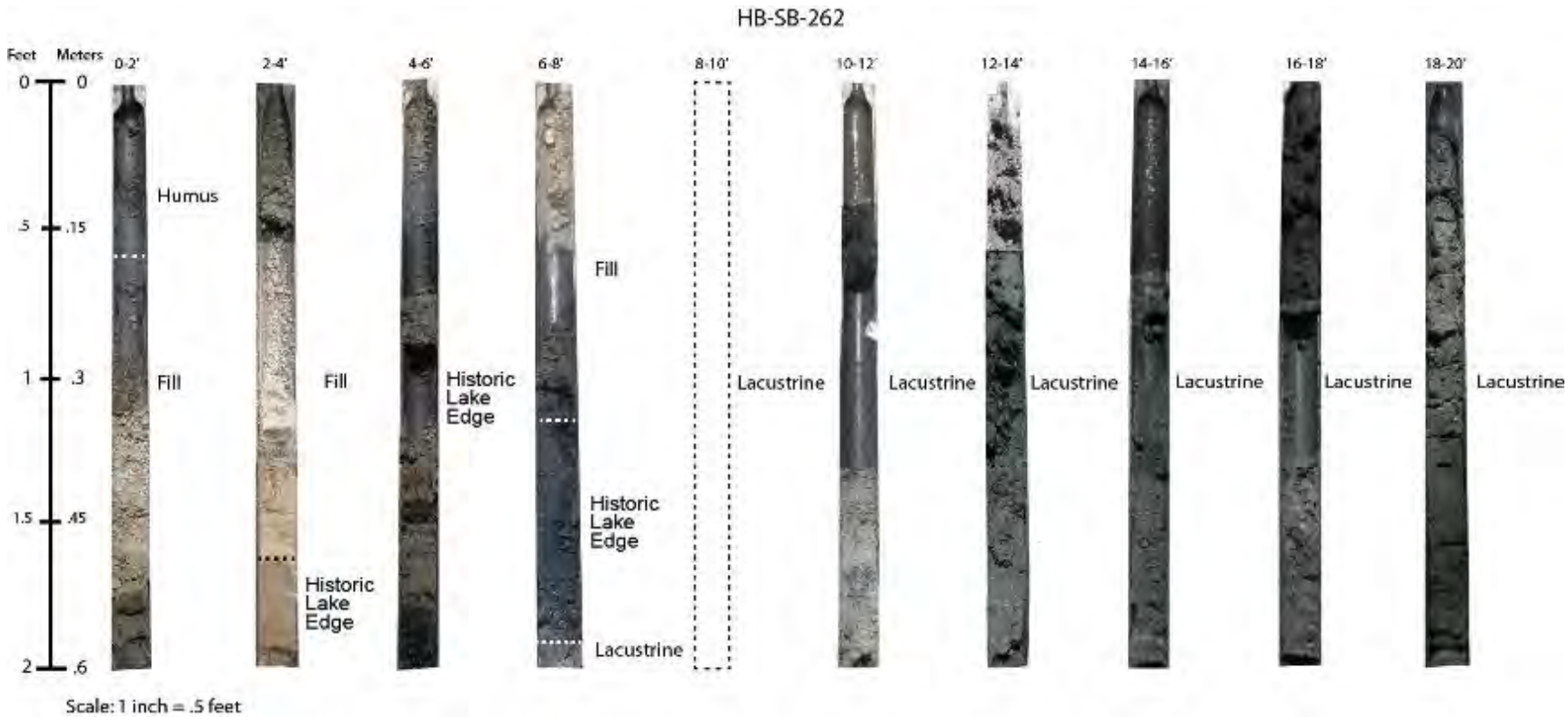
Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-259, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	426.7	36.6	NR					n/a	
	463.3	24.4	7C2	10YR 5/1	SSi	1sbk	fri	n/a	wetter than above, soft
	487.7	48.8	NR					n/a	
	536.4	3.0	5O	10YR 3/2	O	gr	fri	a	decomposing wood
	539.5	9.1	8C	10YR 4/1	SSi	1sbk	pl	n/a	v.wet, muddy, marl and shell,
	548.6	27.4	NR					n/a	
	576.1	27.4	9C	10YR 6/1	CSi	1sbk	pl	a	banded w/ 10YR 4/1, shell
	603.5	6.1	10C	10YR 4/1	Si	sbk	fi	n/a	v.fine, shell, wet

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky;
pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt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Scale: 1 inch = .5 feet

HB-SB-262

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
fill	0.0	18.3	Ap1		S	gr	v.fri-l	a	material piled up by backhoe during project
humus	18.3	3.0	1O	10YR 3/2	SiL	abk	v.fi	a	fine, humus
fill	21.3	39.6	Ap1	10YR 5/2	SiS	sg	l	n/a	med-fine, well sorted, lots of qtz grains, looks like fill
	61.0	36.6	NR					n/a	
	97.5	12.2	Ap1	10YR 5/2	SiS	sg	l	a	med-fine, well sorted, lots of qtz grains, looks like fill
historic lake-edge	109.7	12.2	1C	10YR 4/1	S	1sbk	fi	n/a	3.6-3.65 (darker silty material, firm, sbk), moist, f-m sand, banded with 10YR 3/3
	121.9	39.6	NR					n/a	
	161.5	6.1	2C	10YR 3/3	S	1sbk	fi	a	f-m sand, moist
	167.6	3.0	3C	10YR 2/1	S	sg	l	a	med sand/coal frags, dark

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-262, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
historic lake-edge	170.7	6.1	4C	10YR 5/2	S	sg	fi	a	f-m sand, wet
	176.8	6.1	2O1	10YR 2/1	O	pl	fri	n/a	wet, fibrous, matted peat, rootlets, decomposed, little mineral component
	182.9	15.2	NR					n/a	
	198.1	21.3	2O2	10YR 3/1	SO	sg	l	c	same fibrous peat as above but coarse sand component, wet, loose
	219.5	21.3	2O3	10YR 3/1	SiCO	p	fi	a	mucky SiC peat, coal tar smell, very few fibers, plastic
lacustrine	240.8	3.0	5C1	10YR 3/1	SSi	1sbk	fri	n/a	fine sand, small shells, same as previous marls
	243.8	45.7	NR					n/a	
	289.6	15.2	5C2	10YR 3/2	SSi	1sbk	fri	n/a	vfine sand, small shells

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-262, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	304.8	42.7	NR					n/a	
	347.5	18.3	5C3	10YR 3/2	SiS	1sbk	fri	n/a	vfine sand, small shells, wet
	365.8	18.3	NR					n/a	
	384.0	21.3	6C	10YR 4/1	S	sg	fi	c	med-fine sand, weakly subangular, wood frags, dark, soft peaty material(silty/mucky) around wood
	405.4	3.0	7C	10YR 4/1	SC	m	fi	c	plastic, clear transition
	408.4	6.1	8C	10YR 4/1	SiS	1sbk	fi	a	fine sand, lots of peaty fibers, some wood, moist
	414.5	12.2	9C	10YR 4/1	S	2sbk	fri	n/a	med-fine well sorted sand, shells, moist
	426.7	30.5	NR					n/a	

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

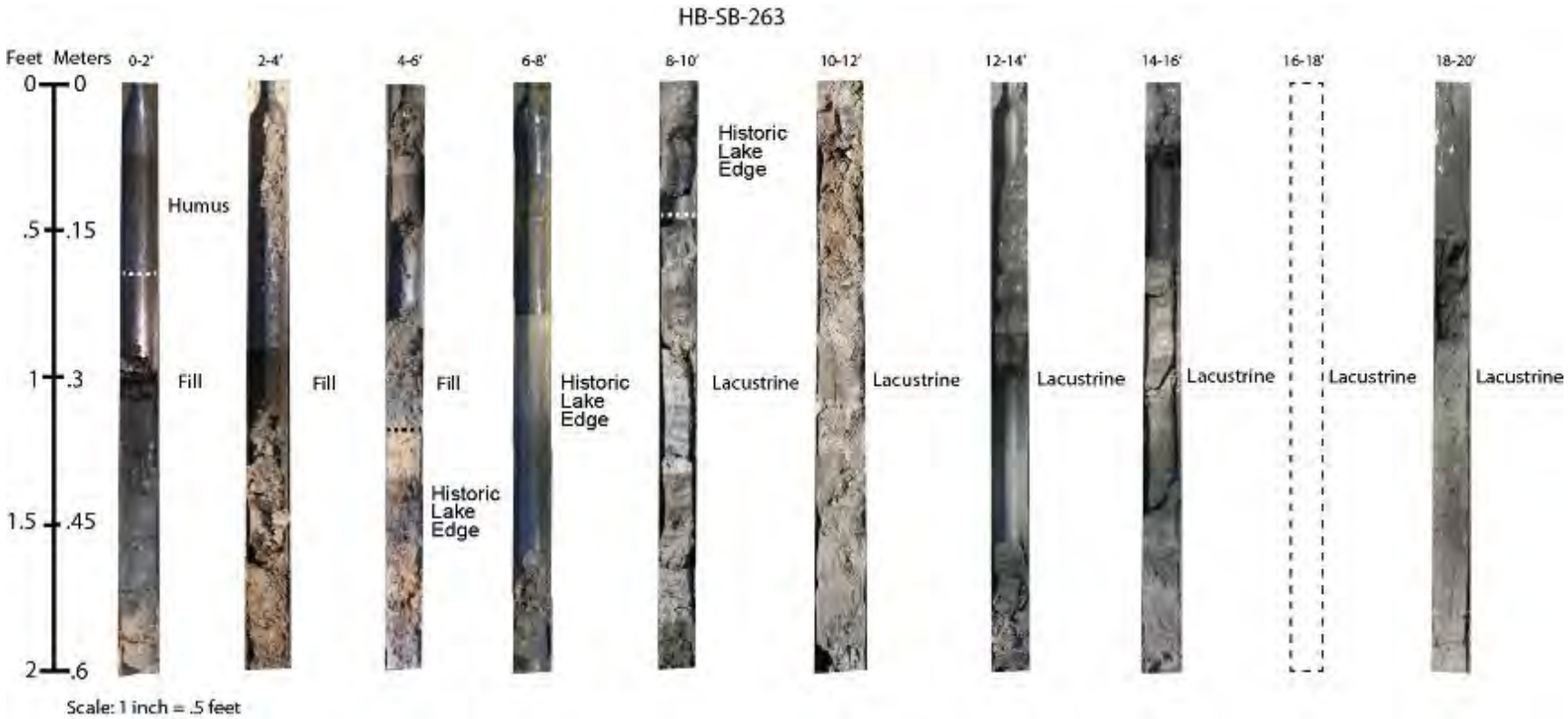
Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-262, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	457.2	30.5	10C1	10YR 4/1	SiS	1sbk	fi	n/a	fine silty sand, shells, rootlets, silty layer (15.3-15.35), wet
	487.7	36.6	NR					n/a	
	524.3	9.1	10C2	10YR 4/1	SiS	gr	l	g	possible slump, fine, wet, shells,
	533.4	15.2	11C	10YR 4/1	Si	2sbk	fi	n/a	banded with 10YR 4/2 fine substrata
	548.6	21.3	NR					n/a	
	570.0	9.1	12C1	10YR 4/1	SSi	1sbk	pl	c	small shells, wet
	579.1	30.5	12C2	10YR 4/1	Si	2sbk	fi	n/a	small shells occasionally, moist, rootlets

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky;
pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt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Historic Lake Edge
Historic Lake Edge
Lacustrine
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Lacustrine
Scale: 1 inch = .5 feet

HB-SB-263

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	18.3	1O	10YR 3/1	SiL	1sbk	l	g	organic roots
fill	18.3	18.3	Ap1	10YR 5/2	SSiL	1sbk	l	n/a	
	36.6	24.4	NR					n/a	
	61.0	18.3	NR					n/a	
	79.2	6.1	Ap2	2.5Y 6/1	Si	2sbk	fri	n/a	
	85.3	12.2	NR					n/a	
	97.5	12.2	Ap3	10YR 7/1	SiS	1sbk	fri	a	
	109.7	12.2	Ap4	10YR 5/1	SiS	gr	l	n/a	small poorly sorted gravels, vf sand and silt

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-263, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
fill	121.9	15.2	NR					n/a	
	137.2	21.3	Ap5	10YR 3/1	SL	gr	fi	c	
historic lake-edge	158.5	6.1	1C1	2.5Y 7/3	SSi	2sbk	fri	a	mottled
	164.6	18.3	1C2	10YR 5/1	CSi	gr	fri	n/a	wet, sticky, mottling from 5.6-5.8ft of oxidized sediment,
	182.9	51.8	NR					n/a	
	234.7	9.1	2C	10YR 3/1	GL	gr	l	n/a	gravel, ~25%
	243.8	12.2	3C	5Y4/1	CSi	1sbk	fri	a	
lacustrine facies	256.0	44.2	4C	2.5Y 6/1	CSi	sbk	fri	a	small gastropod inclusions, moist, light and dark laminations (varves), marl

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

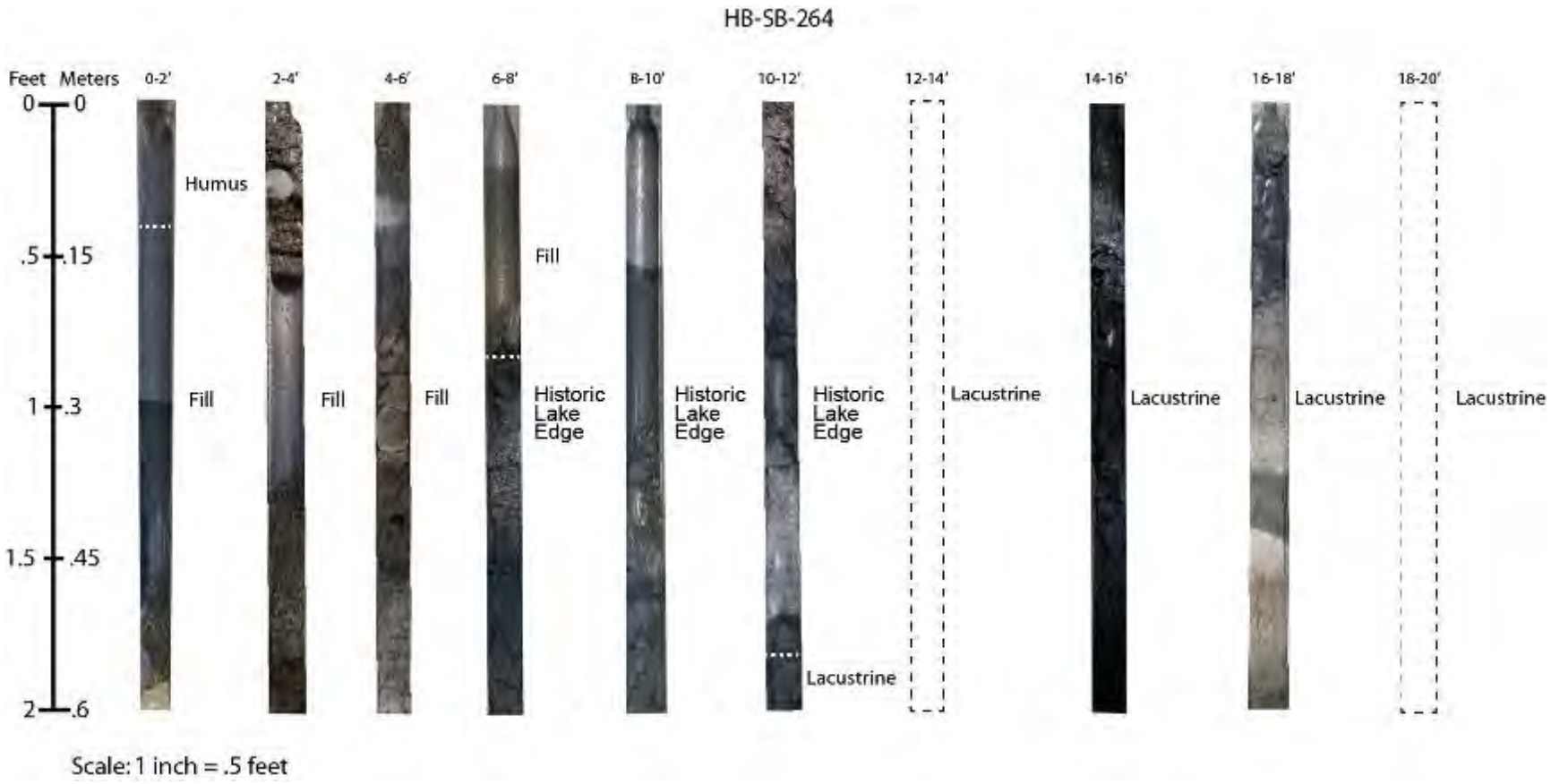
Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-263, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	300.2	4.6	5C	2.5Y 5/1	SSi	sbk	fri	n/a	vf sand
	304.8	15.2	6C	10YR 3/2	CSi	pl	fri	a	wet, shells
	320.0	36.6	7C	2.5Y 5/1	SSi	sbk	fri	c	light and dark fine laminations (varves?), marl,small gastropod shell inclusions, vf sand,
	356.6	9.1	8C	2.5Y 4/1	S	gr	l	n/a	med, well sorted, rounded, qtz sand
	365.8	21.3	NR					n/a	
	387.1	57.9	9C	2.5Y 4/1	SiS	sbk	wet	n/a	wet, gloppy in some places, vf sand, some organics (wood)
	445.0	42.7	10C	2.5Y 6/2	SiS	sbk	fri	n/a	vf sand, banded light and dark marl, 15.3ft starts gradual transition to gastropod shell inclusions
	487.7	85.3	NR					n/a	
	573.0	36.6	11C	2.5Y 5/1	SiS	sbk	fri	n/a	fibrous organics, vf sand, small gastropod shells

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky;
pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt


HB-SB-264
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18-20'
Humus
Fill
Fill
Fill
Fill
Historic Lake Edge
Historic Lake Edge
Historic Lake Edge
Lacustrine
Lacustrine
Lacustrine
Lacustrine
Lacustrine
Scale: 1 inch = .5 feet

HB-SB-264

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
humus	0.0	12.2	1O	10YR 4/1	SSiL	1sbk	fi	a	organic
fill	12.2	3.0	Ap1	10YR 4/1	SSiL	gr	l	n/a	fine
	15.2	82.3	NR					n/a	
	97.5	15.2	Ap2	10YR 4/1	GS	sg	l	a	poorly sorted, shell inclusions, m-vc sand, gravel .25", rounded concretions in last inch
	112.8	9.1	Ap3	10YR 4/2	SSi	1sbk	fri	n/a	fine sand, moist, mottled
	121.9	18.3	NR					n/a	
	140.2	12.2	Ap4	10YR 4/3	Si	2abk	fri	a	easily crumbles to granules, relatively dry
	152.4	9.1	Ap5	10YR 3/3	S	sg	l	c	med-coarse, wet
	161.5	3.0	Ap6	10YR 3/3	G	gr	l	c	coarse material, coal, iron frags, brown oxidized Fe
	164.6	18.3	Ap7	10YR 4/1	S	sg	l	n/a	f-m sand, wet, organic at 5.8

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-264, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
fill	182.9	24.4	NR					n/a	
historic lake-edge	207.3	36.6	2O	10YR 2/1	SiO	1sbk	pl	n/a	sticky, mucky, silty peat, coal, tar contamination, v. black, plastic consistency
	243.8	39.6	NR					n/a	
	283.5	6.1	1C1	2.5Y 3/1	SSiG	sg	l	g	stony (2in), mixed with below
	289.6	15.2	1C2	2.5Y 3/1	SSi	sg	l	n/a	wet, black, coal tar odor
	304.8	33.5	NR						
	338.3	3.0	2C1	10R 15/1	SiS	sg	l	c	vf sand, wet
	341.4	18.3	3C1	10YR 2/1	CSi	1sbk	pl	a	black, wet
lacustrine	359.7	6.1	4C	10YR 2/1	CSi	1sbk	fi, pl	n/a	lighter banding (10YR 15/1), firm, plastic, black

Continued on next page

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

HB-SB-264, continued

Unit	Depth (cm)	Thickness (cm)	Soil Horizon	Munsell Color	Text.	Struct.	Consist.	Bound	Comments
lacustrine facies	365.8	61.0	NR					n/a	
	426.7	27.4	NR					n/a	
	454.2	12.2	3O1	10YR 2/1	OSSi	1sbk	fi	c	sandy silt with silty peat, fibrous inclusions
	466.3	21.3	3O2	10YR 2/1	O	1sbk	fi	n/a	black mucky peat, some visible fibrous organics, small shells, moist
	487.7	12.2	NR					n/a	
	499.9	6.1	3O3	10YR 2/1	O	1sbk	fi	a	black, peaty, faint coal tar odor
	506.0	36.6	5C	10YR 4/1	SSi	sbk	fi	n/a	moist, sparse fibrous organics, lighther marl with fine bands (17-17.5; 10YR 5/1)
	548.6	18.3	NR					n/a	
	566.9	36.6	6C	10YR 3/1	SSi	sbk	fi	n/a	10YR 5/1 alternating bands of fine Simarl w/few shells and fine Smarl with more shells at 19.1, 19.4, and 19.6ft, plastic, wet

Texture: Si=silt; L=loam; C=clay; S=sand; G=gravel; O=organic
Structure: 1=weak; 2= moderate; 3=strong; f=fine; m=medium; c=coarse
sg=single grain; gr=granular; mass=massive; strat=stratified; sbk=subangular blocky; ab=angular blocky; pr=prismatic; pl=platy; dist=disturbed/no structure

Consistence: fri=friable; sl=slightly; v=very; l=loose; fi=firm; h=hard; st=sticky; ss=strongly sticky
Boundary Distinctness: a=abrupt; c=clear; d=diffuse; g=gradual; s=sharp
Boundary Topography: w=wavy; s=smooth; a=abrupt

Appendix B: Radiocarbon Results

BETA

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www.radiocarbon.com

Darden Hood
President

Ronald Hatfield
Christopher Patrick
Deputy Directors

November 26, 2012

Dr. Joseph Schuldenrein
Geoarcheology Research Associates
92 Main Street
Suite 207
Yonkers, NY 10701
USA

RE: Radiocarbon Dating Results For Samples HBSB253-69, HBSB253-70, HBSB256-97, HBSB256-100.

Dear Joe:

Enclosed are the radiocarbon dating results for six samples recently sent to us. They each provided plenty of carbon for accurate measurements and all the analyses proceeded normally. As usual, the method of analysis is listed on the report with the results and calibration data is provided where applicable.

As always, no students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analyses. We analyzed them with the combined attention of our entire professional staff.

If you have specific questions about the analyses, please contact us. We are always available to answer your questions.

The cost of the analysis was charged to the American Express card provided. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood

Digital signature on file

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Joseph Schuldenrein — Report Date: 11/26/2012

Geoarcheology Research Associates — Material Received: 11/12/2012

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 335202 SAMPLE : HBSB253-69 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 1750 to 1620 (Cal BP 3700 to 3570)	3420 +/- 30 BP	-26.3 o/oo	3400 +/- 30 BP
Beta - 335203 SAMPLE : HBSB253-70 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 1010 to 830 (Cal BP 2960 to 2780)	2820 +/- 40 BP	-27.5 o/oo	2780 +/- 40 BP
Beta - 335204 SAMPLE : HBSB256-97 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (shell): acid etch 2 SIGMA CALIBRATION : Cal BC 3360 to 3090 (Cal BP 5310 to 5040)	4300 +/- 30 BP	-11.9 o/oo	4510 +/- 30 BP
Beta - 335205 SAMPLE : HBSB256-100 ANALYSIS : AMS-Standard delivery MATERIAL/PRETREATMENT : (organic sediment): acid washes 2 SIGMA CALIBRATION : Cal BC 5360 to 5220 (Cal BP 7310 to 7160)	6310 +/- 40 BP	-24.9 o/oo	6310 +/- 40 BP

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.

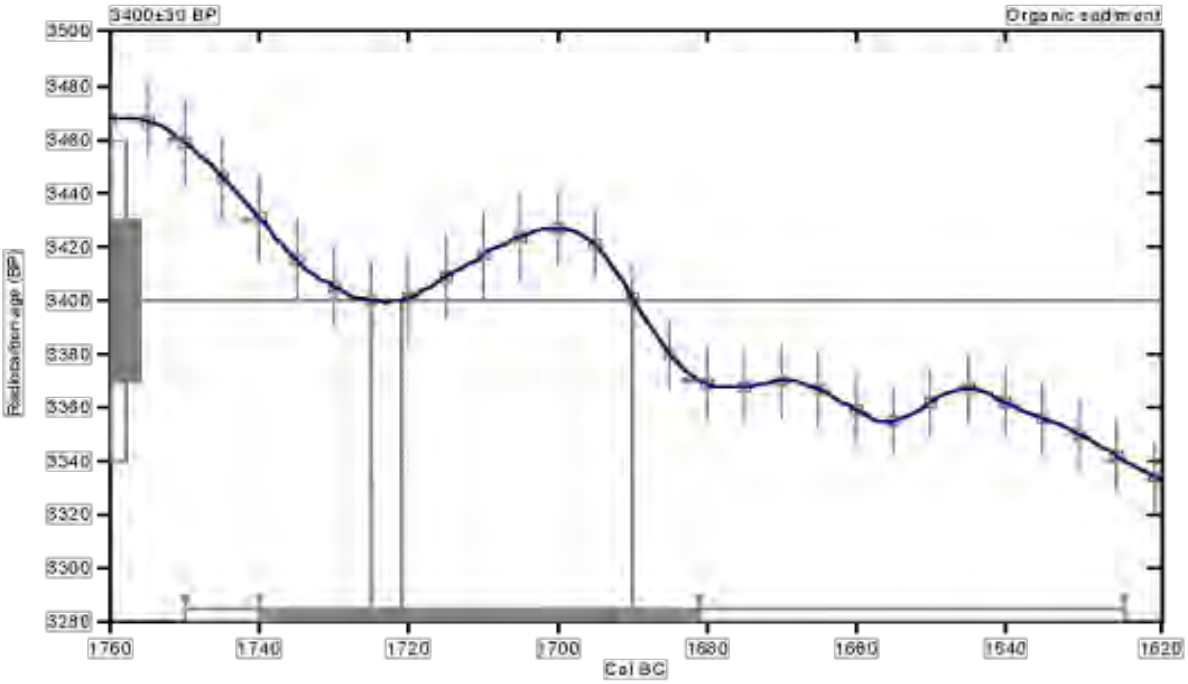
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-26.3,lab. mult=1)

Laboratory number:	**Beta-335202**
Conventional radiocarbon age:	**3400±30 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 1750 to 1620 (Cal BP 3700 to 3570)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal BC 1720 (Cal BP 3680) and Cal BC 1720 (Cal BP 3670) and Cal BC 1690 (Cal BP 3640)
1 Sigma calibrated result: (68% probability)	Cal BC 1740 to 1680 (Cal BP 3690 to 3630)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton et al. 2009, Radiocarbon 51(4):1151-1164; Reimer et al. 2009, Radiocarbon 51(4):1111-1150; Stuiver et al.1993, Radiocarbon 35(1):1-17-189; Oeschger et al. 1975,Tellus 27, 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory

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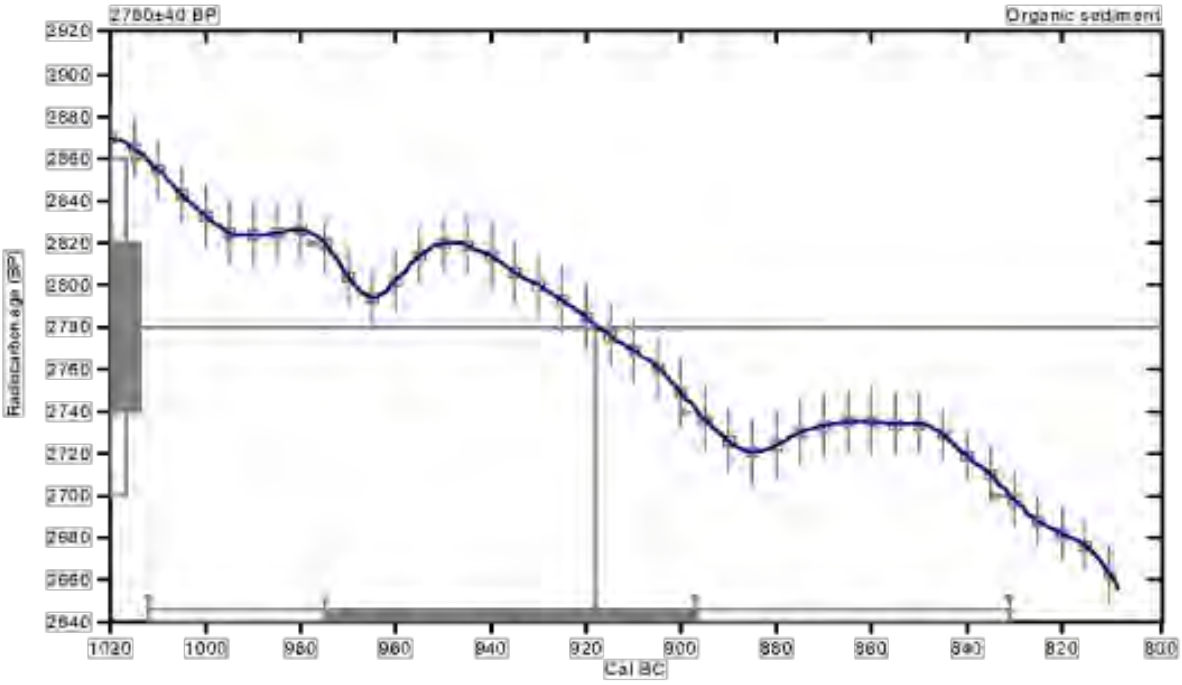
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-27.5,lab. mult=1)

Laboratory number:	**Beta-335203**
Conventional radiocarbon age:	**2780±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 1010 to 830 (Cal BP 2960 to 2780)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 920 (Cal BP 2870)
1 Sigma calibrated result: (68% probability)	Cal BC 980 to 900 (Cal BP 2920 to 2850)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton et al. 2009, Radiocarbon 51(4):1151-1164; Reimer et al. 2009, Radiocarbon 51(4):1111-1150; Stuiver et al.1993, Radiocarbon 35(1):1-19; Danzeglocke et al. 1975, Tellus 27, 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates
Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

Beta Analytic Radiocarbon Dating Laboratory

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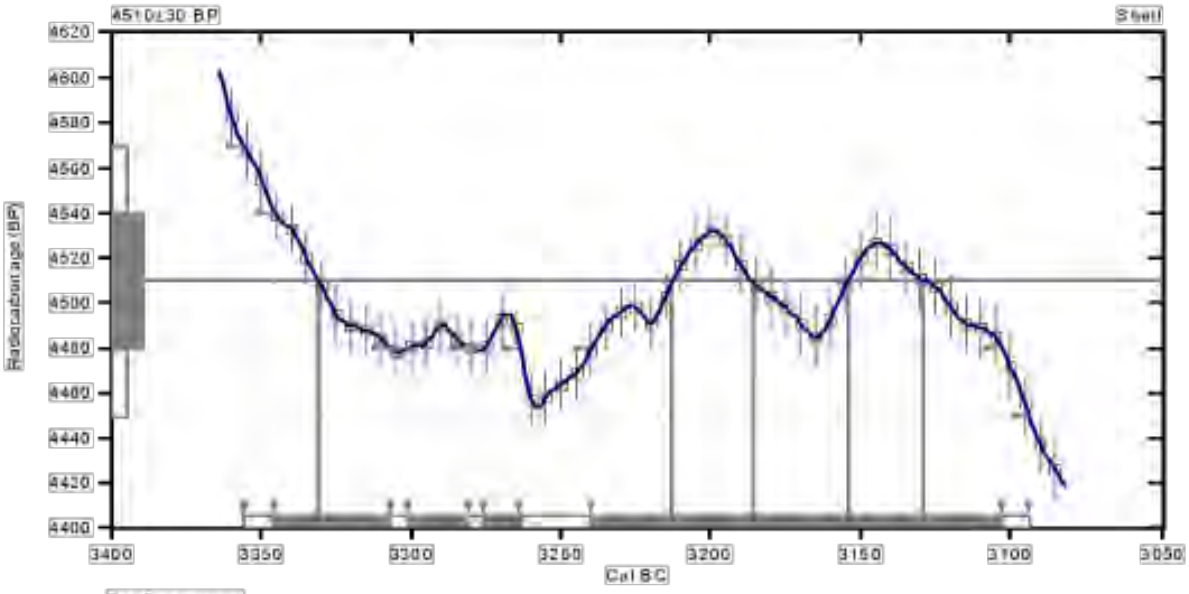
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-11.9;lab. mult=1)

Laboratory number:	**Beta-335204**
Conventional radiocarbon age:	**4510±30 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 3360 to 3090 (Cal BP 5310 to 5040)**

Intercept data

Intercepts of radiocarbon age with calibration curve:	Cal BC 3330 (Cal BP 5280) and Cal BC 3210 (Cal BP 5160) and Cal BC 3190 (Cal BP 5140) and Cal BC 3150 (Cal BP 5100) and Cal BC 3130 (Cal BP 5080)
1 Sigma calibrated results: (68% probability)	Cal BC 3350 to 3310 (Cal BP 5300 to 5260) and Cal BC 3300 to 3280 (Cal BP 5250 to 5230) and Cal BC 3280 to 3260 (Cal BP 5230 to 5210) and Cal BC 3240 to 3100 (Cal BP 5190 to 5050)



References:

Database used

INTCAL09

References to INTCAL09 database

Heaton,et.al. 2009, Radiocarbon 51(4):1151-1164, Reimer,et.al. 2009, Radiocarbon 51(4):1111-1150, Stuiver,et.al.1993, Radiocarbon 35(1):137-189; Oeschger,et.al. 1975,Tellus 27:168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1995, Radiocarbon 35(2):317-322

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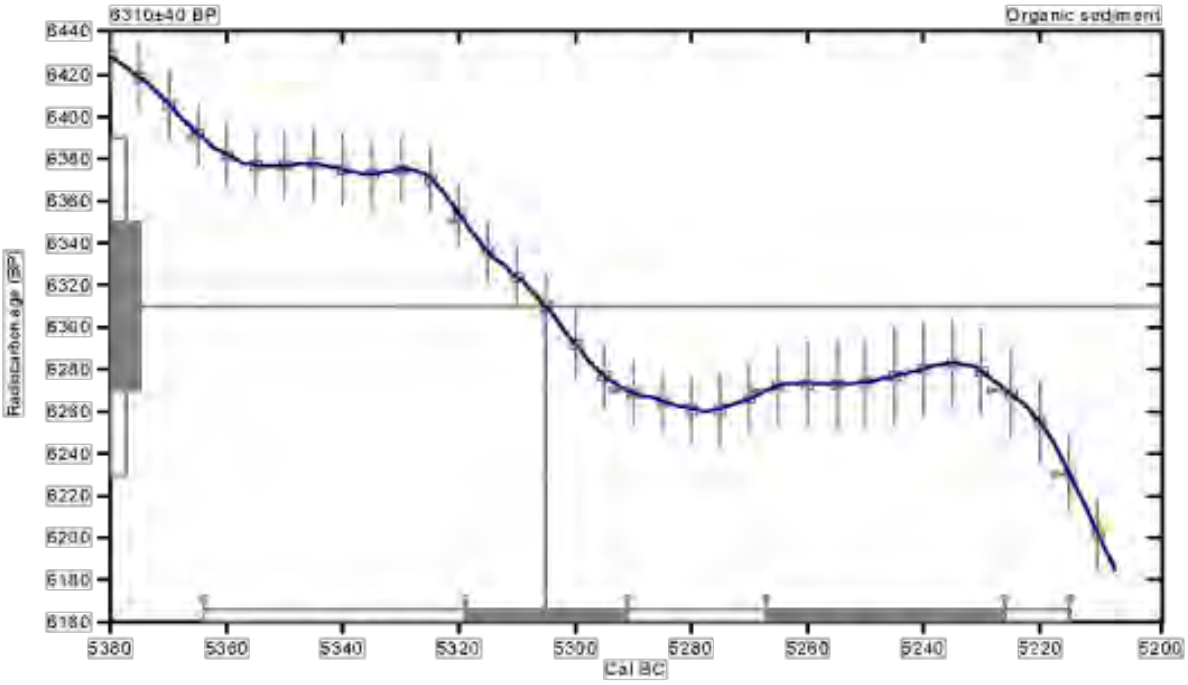
CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-24.9,lab. mult=1)

Laboratory number:	**Beta-335205**
Conventional radiocarbon age:	**6310±40 BP**
2 Sigma calibrated result: (95% probability)	**Cal BC 5360 to 5220 (Cal BP 7310 to 7160)**

Intercept data

Intercept of radiocarbon age with calibration curve:	Cal BC 5300 (Cal BP 7260)
1 Sigma calibrated results: (68% probability)	Cal BC 5320 to 5290 (Cal BP 7270 to 7240) and Cal BC 5270 to 5230 (Cal BP 7220 to 7180)



References:

Database used

INTCAL09

References to INTCAL09 database

Reimer et al. 2009, Radiocarbon 51(4):1111-1150; Stuiver et al.1993, Radiocarbon 35(1):1-19; Oeschger et al. 1975,Tellus 27, 168-192

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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Appendix C: Malacological Analysis

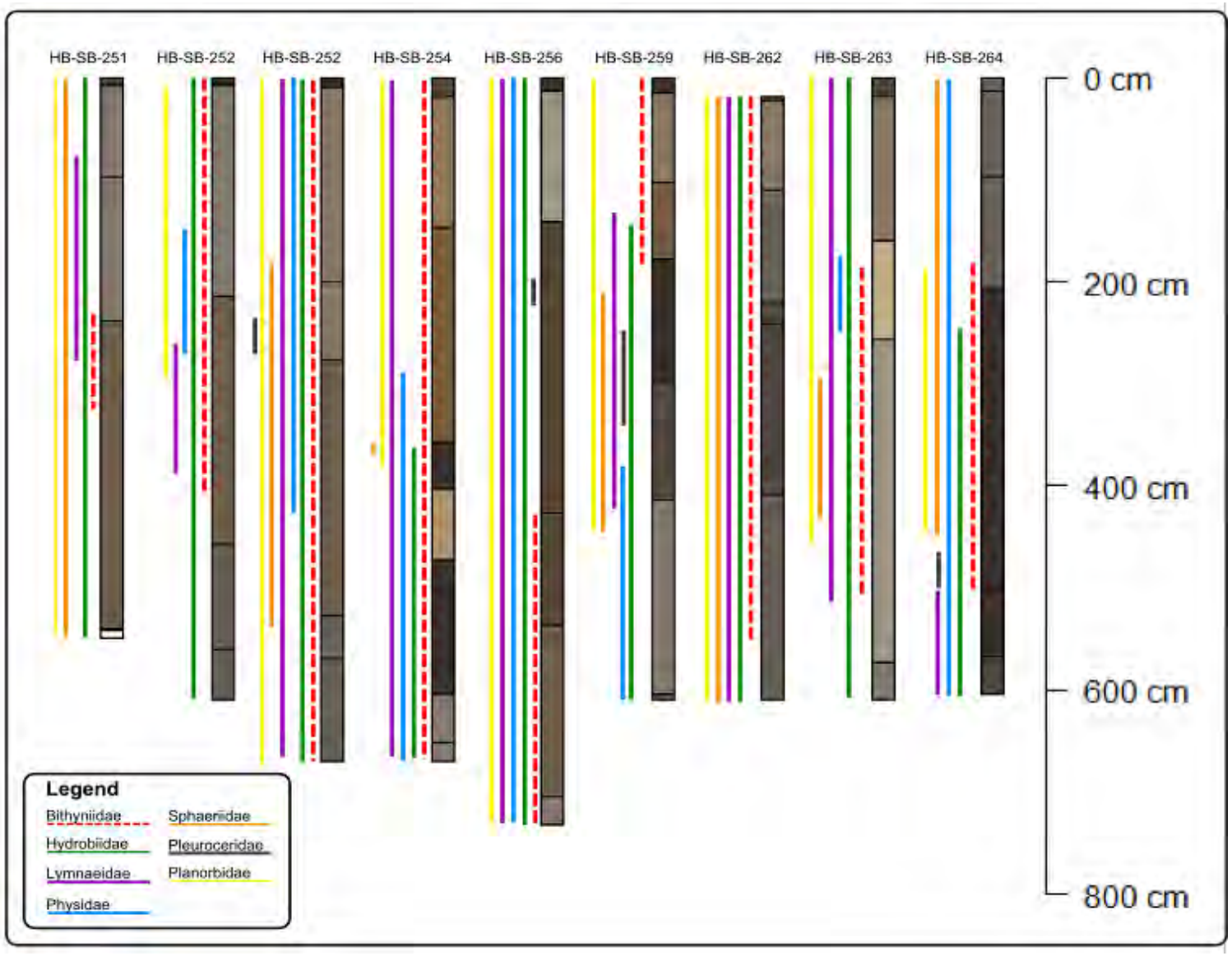

Figure 1: Distribution of gastropod shells, by depth

Table 1: Presence/absence of species in each sample

Core No.	Sample No.	Depth (cm)	*Physidae*	*Bithyniidae*	*Sphaeriidae*	*Pleuroceridae*	*Planorbidae*	*Lymnaeidae*	*Hydrobiidae*
HB-SB-251	28	15.24	-	+	+	-	+	-	+
HB-SB-251	30	97.536	-	-	-	-	-	+	-
HB-SB-251	35	280.416	+	-	+	-	+	+	+
HB-SB-251	37	298.704	+	+	+	-	+	+	+
HB-SB-251	40	350.52	-	+	-	-	+	-	-
HB-SB-251	44	469.392	-	-	-	-	+	-	-
HB-SB-251	45	481.584	-	-	-	-	+	-	+
HB-SB-251	48	579.12	-	+	+	-	+	-	+
HB-SB-251	49	600.456	-	+	+	-	+	-	+
HB-SB-252	15	207.264	-	-	-	-	+	-	+
HB-SB-252	17	237.744	-	+	-	-	+	+	-
HB-SB-252	24	414.528	-	-	-	-	-	-	+
HB-SB-252	25	420.624	-	-	-	-	-	-	+
HB-SB-253	53	131.064	+	+	-	-	+	+	-
HB-SB-253	55	210.312	-	+	+	-	+	-	+
HB-SB-253	59	277.368	+	+	-	+	+	-	+
HB-SB-253	60	301.752	+	-	-	-	+	-	-
HB-SB-253	63	371.856	-	-	-	-	+	-	+
HB-SB-253	64	414.528	+	+	-	-	+	+	+
HB-SB-253	66	423.672	-	+	+	-	+	-	-
HB-SB-253	67	542.544	-	-	-	-	+	+	-
HB-SB-253	70	573.024	-	+	-	-	+	-	+
HB-SB-253	68	588.264	-	+	+	-	+	+	+
HB-SB-254	74	161.544	-	+	-	-	+	+	-
HB-SB-254	77	356.616	+	-	-	-	-	-	-
HB-SB-254	78	365.76	+	+	+	-	+	-	+
HB-SB-254	79	387.096	+	+	-	-	+	-	+
HB-SB-254	80	411.48	+	+	-	-	-	+	+
HB-SB-256	86	225.552	+	-	-	+	+	+	+

Core No.	Sample No.	Depth (cm)	*Physidae*	*Bithyniidae*	*Sphaeriidae*	*Pleuroceridae*	*Planorbidae*	*Lymnaeidae*	*Hydrobiidae*
HB-SB-256	87	234.696	-	+	-	-	+	+	+
HB-SB-256	88	240.792	+	-	-	-	-	-	+
HB-SB-256	90	356.616	+	-	-	-	-	-	+
HB-SB-256	93	533.4	+	+	-	-	+	+	+
HB-SB-259	103	106.68	-	+	-	-	+	-	-
HB-SB-259	104	173.736	-	+	-	-	+	+	+
HB-SB-259	106	359.664	-	-	+	+	+	+	+
HB-SB-259	107	368.1984	-	-	+	-	+	+	+
HB-SB-259	108	585.216	+	-	-	-	-	-	+
HB-SB-262	141	173.736	-	+	+	-	+	+	+
HB-SB-262	140	393.192	-	+	+	-	+	+	-
HB-SB-262	143	581.5584	-	+	+	-	+	+	+
HB-SB-263	113	158.496	-	-	-	-	+	+	+
HB-SB-263	115	265.176	+	+	-	-	+	-	+
HB-SB-263	116	271.272	-	+	+	-	+	-	+
HB-SB-263	117	283.464	-	+	+	-	-	+	+
HB-SB-263	119	298.704	-	-	-	-	+	-	+
HB-SB-263	122	323.088	-	+	-	-	+	+	+
HB-SB-263	123	362.712	-	+	+	-	+	+	+
HB-SB-263	126	414.528	-	+	-	-	+	+	-
HB-SB-263	128	451.104	-	-	+	-	+	+	+
HB-SB-263	129	472.44	-	+	-	-	-	+	+
HB-SB-263	130	588.264	-	-	-	-	-	-	+
HB-SB-264	135	179.832	+	-	+	-	-	-	-
HB-SB-264	136	449.58	-	+	+	-	+	-	+
HB-SB-264	137	478.536	+	+	-	+	+	-	+
HB-SB-264	138	509.016	+	+	-	-	-	+	+

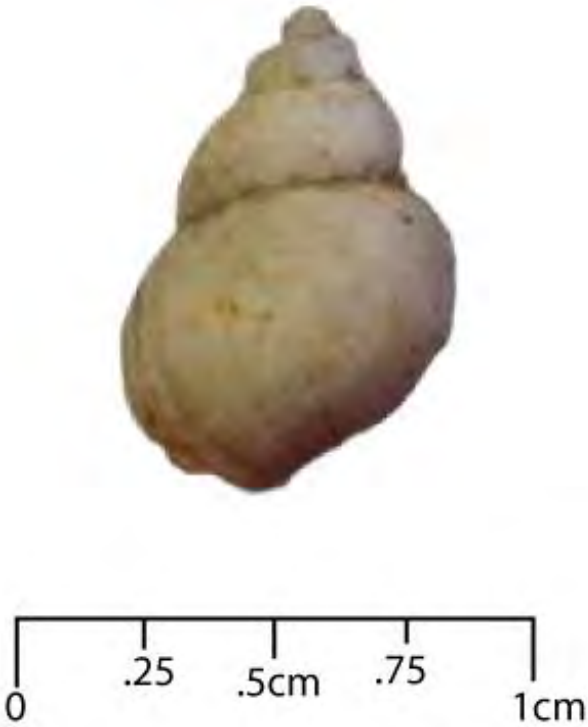

Figure 2: Bithyniidae

Figure 3: Pleuroceridae

Figure 4: Hydrobiidae

Figure 5: Lymnaeidae

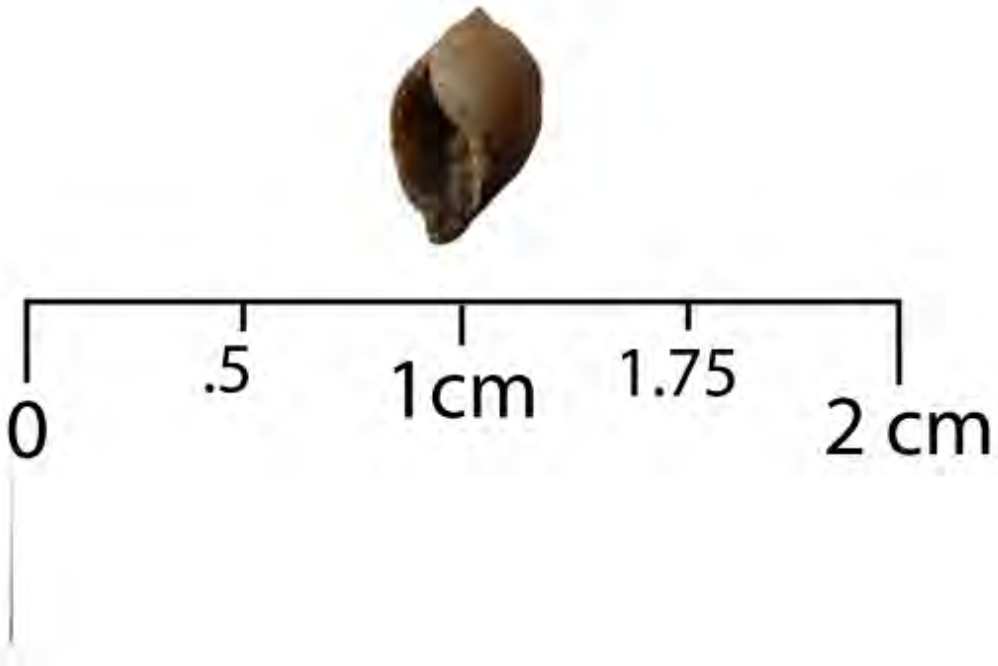

Figure 6: Physidae

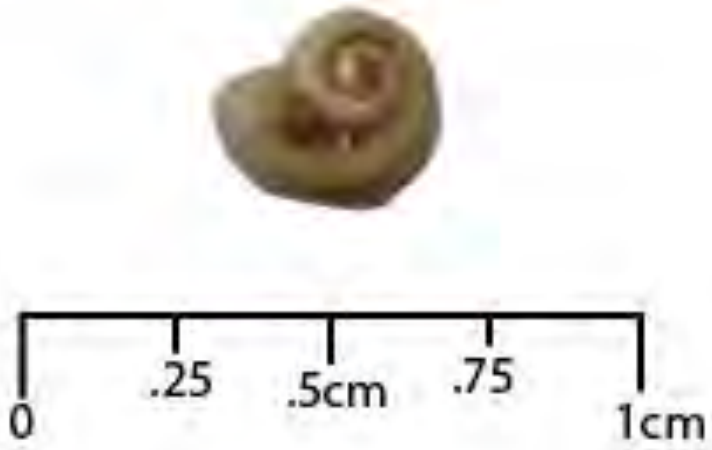

Figure 7: Planorbidae

Figure 8: Sphaeriidae