

WRECK POND BROOK WATERSHED

2015 Habitat Assessment Report



Prepared for:
U.S. Fish and Wildlife Service
Award No. F14AC00250

November 2015

Prepared by:
Jenna Krug, Habitat Restoration Coordinator
Capt. Al Modjeski, Habitat Restoration Director
American Littoral Society



Table of Contents

I. EXECUTIVE SUMMARY	3
II. ACKNOWLEDGEMENTS	4
III. INTRODUCTION	4
IV. METHODS	5
V. RESULTS	6
A. BLACK CREEK	6
i. Summary.....	6
ii. Water Quality.....	8
B. HANNABRAND BROOK.....	9
i. Summary.....	9
ii. Water Quality.....	16
C. WRECK POND BROOK	18
i. Summary.....	18
ii. Water Quality.....	21
VI. DISCUSSION	22

Table of Figures

Figure 1. Wreck Pond Brook Watershed boundary map.....	5
Figure 2. Black Creek survey reach (red line) and potential barriers (green markers), June 16, 2015.	7
Figure 3. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 3, 2015.....	10
Figure 4. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 4, 2015.....	11
Figure 5. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 16, 2015.....	12
Figure 6. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 18, 2015.....	13
Figure 7. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 30, 2015.....	14
Figure 8. Wreck Pond Brook survey reach (red line) and potential barriers (green markers), June 30, 2015. No barriers observed on this day.	19
Figure 9. Wreck Pond Brook survey reach (red line) and potential barriers (green markers), July 1, 2015.	20
Figure 10. Map of the Wreck Pond Brook Watershed (green line), 2015 survey extent (red lines) and potential barriers (green markers).....	23

Table of Tables

Table 1. Dates and Locations of Wreck Pond Habitat Assessments, 2015.....	6
Table 2. Potential fish passage barriers in Black Creek, Wreck Pond Brook Watershed. Listed are the associated figure numbers, which can be found in Appendix B. Also see Figure 2 for a location map.	8
Table 3. Water quality measurements taken in Black Creek on June 16, 2015.	8
Table 4. Potential fish passage barriers in Hannabrand Brook, Wreck Pond Brook Watershed. Listed are the associated figure numbers, which can be found in Appendix B. Also see Figures 3-7 for location maps.....	15
Table 5. Water quality measurements taken in Hannabrand Brook on June 3 and 4, 2015.....	16
Table 6. Water quality measurements taken in Hannabrand Brook on June 16 and 18, 2015.....	16
Table 7. Water quality measurements taken in Hannabrand Brook on June 30, 2015.....	17
Table 8. Potential fish passage barriers in Wreck Pond Brook, Wreck Pond Brook Watershed. Listed are the associated figure numbers, which can be found in Appendix B. Also see Figures 8 and 9 for location maps.	21
Table 9. Water quality measurements taken in Wreck Pond Brook on June 30 and July 1, 2015.	21

List of Appendices

Appendix A – Results from Freehold Soil Conservation District Stream Assessment, 2005-2006

Appendix B – Survey Notes, Observations, and Photographs 2015

I. EXECUTIVE SUMMARY

The Wreck Pond Brook Watershed drains over 12 square miles of land from the boroughs of Sea Girt, Spring Lake, Spring Lake Heights, and Wall Township in Monmouth County, NJ (Figure 1). At the eastern extent of the watershed lies Wreck Pond, a 73-acre tidally influenced pond currently connected to the Atlantic Ocean by an 800' 84" diameter concrete pipe. Wreck Pond is fed by three main tributaries – Wreck Pond Brook, Black Creek, and Hannabrand Brook – that together with smaller creeks and streams, provide important habitat for birds, fish, and other wildlife.

Historically, Wreck Pond had a natural inlet; however, in the 1930's the inlet was filled in and the pipe was installed to connect the lake to the ocean. Over time, the restricted tidal flow caused by the pipe, coupled with impacts from increased development, led to a number of environmental issues within the watershed including erosion, impaired water quality, flooding, and reduced fish populations.

Since the early 2000's, a diverse group of partners has been working together to address these issues and help restore the ecological health of Wreck Pond and the larger watershed. Numerous monitoring studies, the extension of the existing outfall pipe, sewer infrastructure repair, dredging, the installation of stormwater manufactured treatment devices, and property owner education has resulted in improved water quality and provided a better understanding of the dynamics of Wreck Pond and the Wreck Pond Brook Watershed.

Following Hurricane Sandy, the American Littoral Society (ALS), in partnership with the US Fish and Wildlife Service, received a US Department of the Interior (DOI) Coastal Resiliency Grant to improve the aquatic connectivity of Wreck Pond. More specifically, the grant is funding the construction and installation of a 5.5' x 8' x 600' concrete box culvert just north of and adjacent to the existing pipe. The culvert was specifically designed to improve fish passage for anadromous river herring (collectively, alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*) and catadromous American eel (*Anguilla rostrata*). River herring once supported one of the largest commercial and recreational fisheries along the Atlantic coast. However, the blockage of spawning rivers, along with habitat degradation and overfishing, has led to severely diminished populations. The blockage of rivers has also negatively affected American eel, the only species of freshwater eel in North America.

Additional partners include the Army Corps of Engineers, the NJ Department of Environmental Protection (NJDEP), Monmouth County, the Borough of Spring Lake, Monmouth University, Rutgers Cooperative Extension, Leon S. Avakian, Inc., and Najarian Associates. This unique collaboration of public, private, academic, and nonprofit institutions has worked together to leverage more funding and expand the scope of the project to allow for more comprehensive restoration work that includes the creation of living shorelines around Wreck Pond and Black Creek, and the dredging of sediment from Wreck Pond. Additional funding received includes a Community Development Block Grant – Disaster Recovery (CDBG-DR) issued through the NJ Office of Flood Hazard Risk Reduction Measures and funded by US Department of Housing and Urban Development (HUD), and funding from the Borough of Spring Lake and NJDEP.

In 2005-2006, the Freehold Soil Conservation District completed a watershed-wide assessment of stream habitat. Reaches were scored using a modified scoring system from Standardized Visual Assessment Protocol developed by the US Department of Agriculture. The majority of the watershed scored in the sub-optimal range (Appendix A). The primary goals of this Habitat Assessment were to locate and identify any fish passage barriers and assess the quality of habitat throughout the watershed to gain a better understanding of the availability of habitat for river herring spawning. Surveys were conducted between June 3 and July 1 (Table 1). Surveys started at the downstream end of the reach surveyed that day as we were most interested in documenting the barriers to fish passage from the ocean upstream. Observations were recorded in a rite-in-the-rain notebook and water quality data was taken using a YSI Professional Series multi-probe sensor. This report includes a summary of all potential

fish passage barriers, water quality data and notes, observations and photographs (Appendix B) taken during habitat assessments conducted in the spring of 2015.

II. ACKNOWLEDGEMENTS

Funding for this project was provided for by a grant from the United States Fish and Wildlife Service (USFWS; Cooperative Agreement F14AC00250). We would like to specially thank Katie Conrad (USFWS), Sheri Shifren (NJDEP), Kathleen Devine (volunteer, American Littoral Society) and Jenny Worringer (volunteer, American Littoral Society) who assisted tremendously with the field surveys. American Littoral Society Interns, Sarah Garvey and Toniann Keiling, also assisted with field surveys. Thanks to the Freehold Soil Conservation District for providing their past Wreck Pond Brook Watershed habitat data and protocol guidance. Partners on the more expansive watershed enhancement project include USFWS, New Jersey Department of Environmental Protection (NJDEP), County of Monmouth, Boroughs of Spring Lake and Sea Girt, Leon S. Avakian LLC and Najarian Associates. Thanks to NJDEP Bureau of Marine Water Monitoring for providing and calibrating the water quality data testing equipment (YSI Professional Series) throughout the study.

III. INTRODUCTION

Wreck Pond is a 73-acre coastal pond that connects the 12 square mile Wreck Pond Brook Watershed with the Atlantic Ocean. The Pond has suffered over the years from poor water quality and sedimentation, and the areas around the pond have been affected by flooding of the Pond caused by heavy rainfall and high storm surge during extreme storm events.

Following Hurricane Sandy, in 2014, the American Littoral Society, in partnership with the US Fish and Wildlife Service, received a US Department of the Interior (DOI) Coastal Resiliency Grant to improve the aquatic connectivity of Wreck Pond. While there are several goals of the project, the USFWS project focuses on restoring fish passage between the Pond and the Ocean, and enhancing habitat within the Pond for native fish and wildlife. In 2015, the Borough of Spring Lake received additional funding from NJDEP and HUD to expand the work in Wreck Pond to include a dredging component and installation of approximately 6000 feet of elevated berm and living shorelines to further reduce flooding and enhance water quality and habitat.

Two species of anadromous (alewife, *Alosa pseudoharengus*, and blueback herring, *Alosa aestivalis*) and one catadromous species (American eel, *Anguilla rostrata*) reside in Wreck Pond. River herring, the collective term for alewife and blueback herring have historically used Wreck Pond as spawning grounds, and migrating adults were monitored in the spring of 2006, 2007, 2014 and 2015 using a fyke net and in 2008 using seine nets. Juvenile migration was monitored in 2014 and 2015 using seine nets. The data from these surveys has been inconclusive regarding the stability of the population, however to obtain a good understanding of population stability, further monitoring is necessary, and will be conducted as part of this study through 2017. We will be seeking additional funding to continue monitoring past 2017.

Here, we discuss the results of a habitat assessment conducted in the spring of 2015 as part of the larger watershed enhancement project. The goals of the assessment were to 1) identify fish passage impediments throughout the watershed (and possible barrier removal projects) and 2) assess the quality and availability of habitat suitable for river herring spawning.

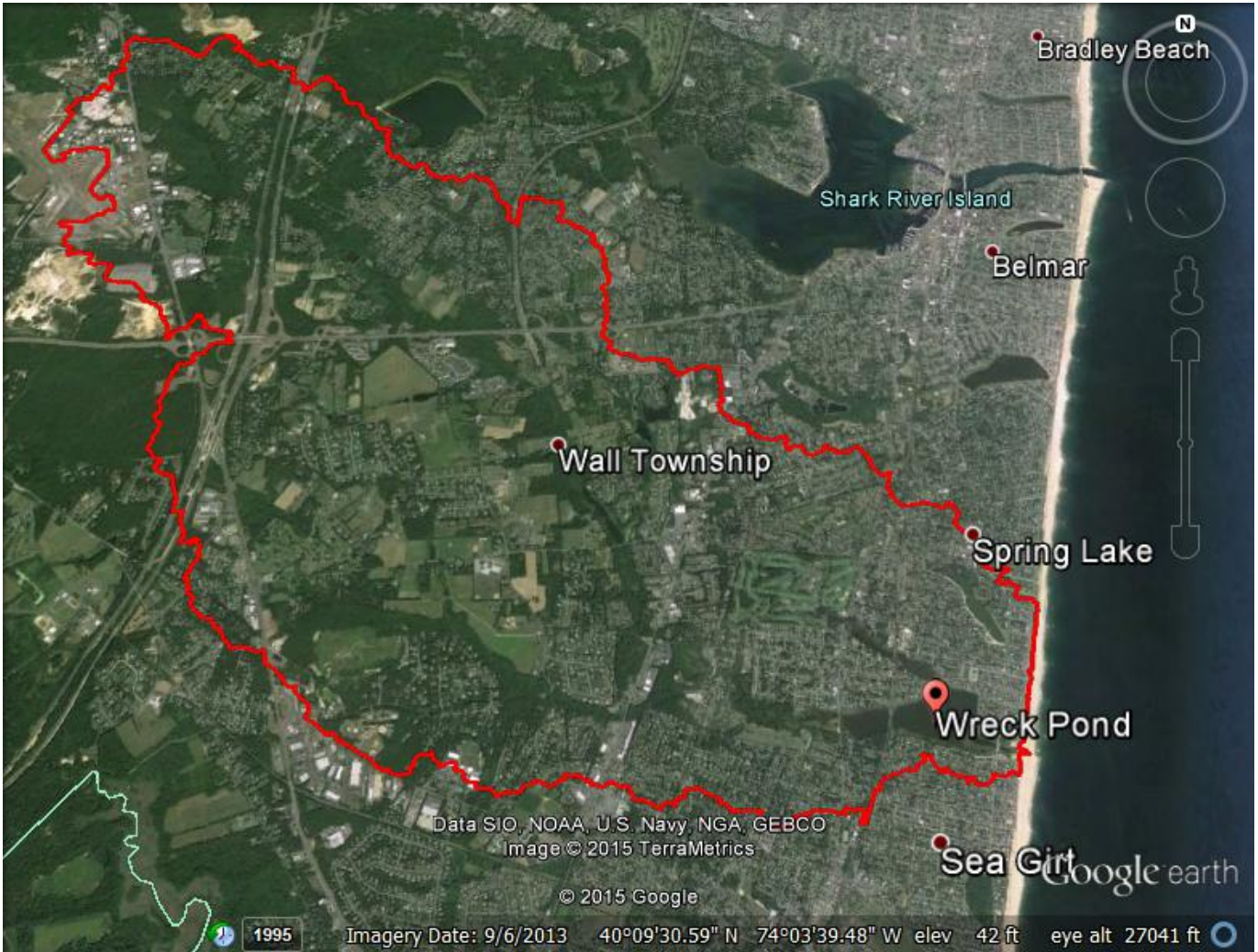


Figure 1. Wreck Pond Brook Watershed boundary map.

IV. METHODS

Freehold Soil Conservation District conducted a stream assessment within the Wreck Pond Brook Watershed between 2005 and 2006 (see Appendix A) following the United States Department of Agriculture Stream Visual Assessment Protocol (SVAP) methodology. We initially considered following this same protocol, however the goals of our assessment were somewhat different from the goals of their assessment. The primary difference being that we were mainly interested in the opportunity for fish passage and spawning throughout the watershed, upstream from the Ocean, whereas they were interested in evaluating the overall ecological health of the system. They conducted their surveys working from the top of the watershed downstream, while we worked from the Ocean upstream. We also were limited in time and personnel, and therefore decided to use a simpler approach to evaluating the stream habitat.

Two or three biologists and/or volunteers hiked from the downstream end of a reach upwards to assess fish barriers and habitat quality. Notes on fish barriers and habitat quality were taken in a Rite-in-the-Rain notebook. Any potential fish barriers were photographed and GPS coordinates were taken using a handheld Garmin GPS system. Notes were taken regarding the height and width of the potential barrier and downstream and upstream water depths. Observations of fish and wildlife were recorded, and water quality data was taken throughout. A YSI Professional Series multiprobe sonde, calibrated weekly by biologists at the New Jersey Department of

Environmental Protection (DEP), was used to take measurements on air temperature (°C), water temperature (°C), salinity (ppt), specific conductivity (µS/cm), pH, and dissolved oxygen (mg/L and % saturation). Table 1 lists the dates and locations of each survey as well as the survey team.

Table 1. Dates and Locations of Wreck Pond Habitat Assessments, 2015.

Date	Survey Reach	Survey Team
June 3	Hannabrand Brook; confluence to Route 35 (~935m; 0.60mi)	Jenna Krug (ALS), Katie Conrad (USFWS), Kathleen Devine (ALS Volunteer)
June 4	Hannabrand Brook; Route 35 to Shadowbrook Dr. (~1850m; 1.20mi)	Jenna Krug (ALS), Sheri Shifren (NJDEP), Kathleen Devine (ALS Volunteer)
June 16	Black Creek; weir to Fairway Mews Golf Course; (~1900m; 1.2mi)	Jenna Krug (ALS), Sheri Shifren (NJDEP), Jenny Worringer (ALS Volunteer)
June 16	Hannabrand Brook; Allaire Rd. to Route 34 (Allenwood Rd.; Bel-Aire Golf Course; ~1200m; 0.75mi)	Jenna Krug (ALS), Sheri Shifren (NJDEP), Jenny Worringer (ALS Volunteer)
June 18	Hannabrand Brook; Bailey’s Corner Rd. to Allaire Rd. (~2400m; 1.5mi)	Jenna Krug (ALS), Sheri Shifren (NJDEP), Kathleen Devine (ALS Volunteer)
June 30	Wreck Pond Brook (~1600m; 1.0mi), Hannabrand Brook (~935m; 0.60mi); RR tracks to Route 35	Jenna Krug (ALS), Sarah Garvey (ALS Intern), Toniann Keiling (ALS Intern)
July 1	Wreck Pond Brook; confluence with Hannabrand Brook to Allaire Rd. (~1800m; 1.1mi)	Jenna Krug (ALS), Jenny Worringer (ALS Volunteer), Kathleen Devine (ALS Volun.)

V. RESULTS

A. BLACK CREEK

i. Summary

Black Creek is the northernmost tributary flowing into Wreck Pond. The entire creek is approximately 1900 meters (1.2 miles; Figure 2). The lower portion of the creek flows through residential areas, whereas the upper portion flows through two golf courses. There are several potential barriers to fish passage downstream of the golf courses with the first major barrier located at the confluence of Black Creek and Wreck Pond (Figure 2; Table 2). The next major barrier is located about a half mile upstream at the Route 71 Bridge. In general, the substrate throughout Black Creek was silty and mucky. Dissolved oxygen levels were low throughout, however these were only snapshot measurements showing dissolved oxygen at one point in time at several locations (Table 3). More in-depth monitoring of dissolved oxygen and other water quality parameters is needed to fully assess the quality of water in Black Creek for fish and other wildlife.

If the first major barrier, the Black Creek weir, were to be removed, it would open up an additional half mile of potential habitat for river herring migration. The weir at Route 71 is the next fish passage barrier, located at the downstream end of the Spring Lake Golf Club. Between the Black Creek and Route 71 weirs is the Railroad Tracks Bridge which is only a potential barrier in the most extreme dry climate as there is a sand/gravel bar at the upstream end that is about 10 cm deep and at very low flow could become a barrier, although this is most likely only a possibility in an extremely dry climate. The sand/gravel is runoff from the railroad tracks above. The creek is connected through the Spring Lake Golf Club to the Fairway Mews Golf Course, however there are several weirs and culverts in this reach which serve as fish passage barriers.

Complete survey notes and observations, and site photographs can be found in Appendix B.

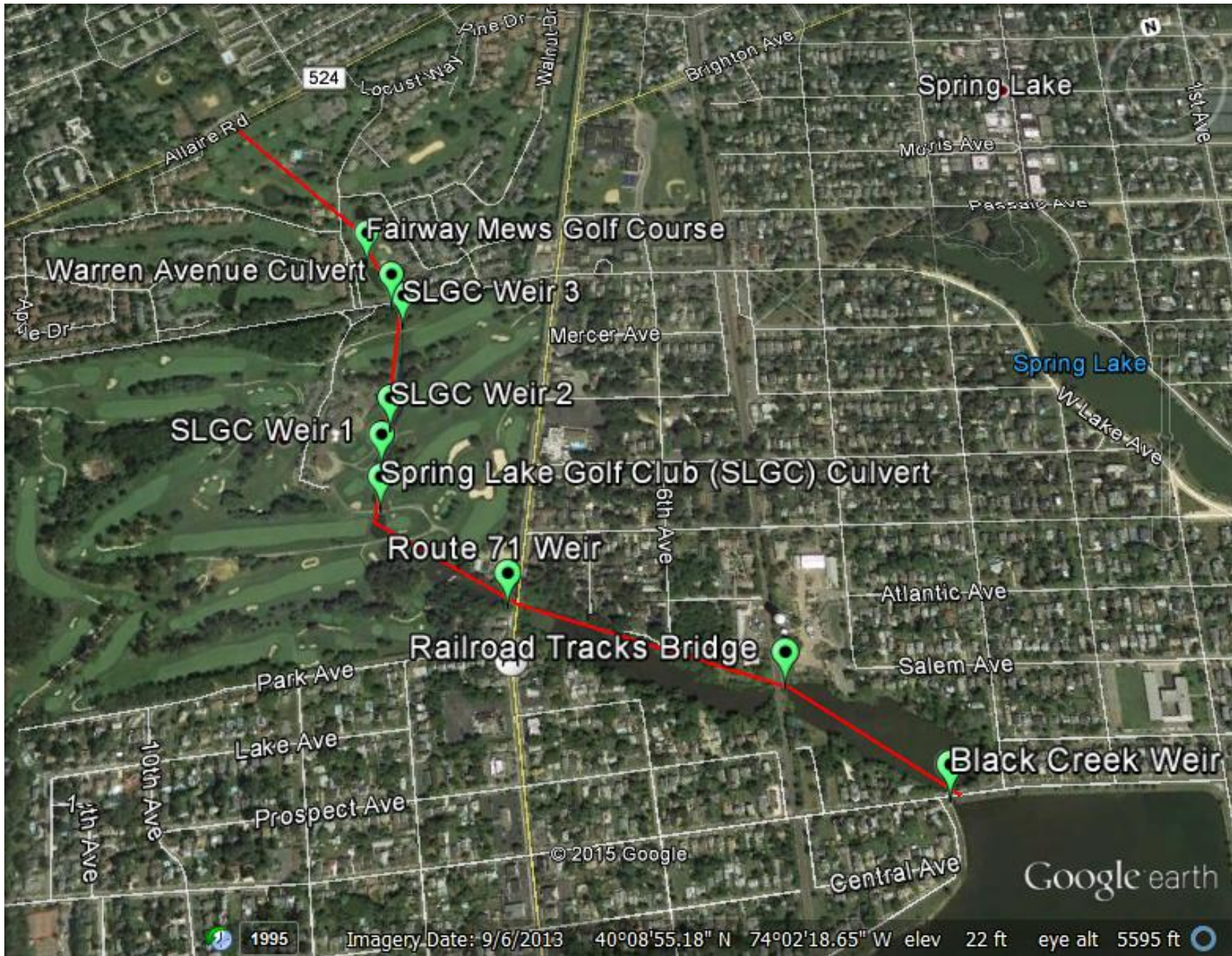


Figure 2. Black Creek survey reach (red line) and potential barriers (green markers), June 16, 2015.

Table 2. Potential fish passage barriers in Black Creek, Wreck Pond Brook Watershed. Listed are the associated figure numbers, which can be found in Appendix B. Also see Figure 2 for a location map.

Name/Location	Coordinates (Decimal °)	Type	Notes
Black Creek Weir (Figure 2)	40.14305N 74.03434W	Weir	Top of weir is ~60cm above stream bottom
Railroad tracks Culvert (Figure 9)	40.14511N 74.03660W	Culvert	Shallow; barrier at extreme low flow
Route 71 Weir (Figure 15)	40.14723N 74.04121W	Weir	Top of weir is ~80cm above stream bottom
Spring Lake Golf Club (Figure 20)	40.14913N 74.04314W	Culvert	Upstream end dry; stream not connected
Spring Lake Golf Club (Figure 21)	40.14977N 74.04295W	Weir	Top of weir is ~50cm above stream bottom
Spring Lake Golf Club (Figure 22)	40.15031N 74.04263W	Weir	Top of weir is ~100cm above stream bottom
Spring Lake Golf Club (Figure 23)	40.15191N 74.04194W	Weir	Top of weir is ~50cm above stream bottom
Warren Avenue (Figure 24)	40.15231N 74.04206W	Culvert	Upstream end TBD
Fairway Mews Golf Course (Figures 25-27)	40.15312N 74.04236W	Golf Course	Connectivity throughout TBD; poor habitat

ii. Water Quality

Table 3. Water quality measurements taken in Black Creek on June 16, 2015.

Location	Downstream Black Creek Weir	Upstream Ocean Road Bridge	Railroad Tracks Culvert	~10m DS of Rt 71 Bridge	Spring Lake GC 3 rd pond	Fairway Mews GC 2 nd pond
Coordinates Decimal °	40.14305N 74.03434W	ND*	40.14511N 74.03660W	40.14714N 74.04067W	40.14869N 74.04324W	40.15351N 74.04230W
GPS Error (±)	10'	ND	14'	20'	10'	10'
Mean Depth (cm)	30	70	15	30	30	No data
Air Temperature (°C)	24.4	24.4	24.4	24.4	24.4	24.4
Water Temperature (°C)	24.2	24.3	22.6	22.3	22.4	24.1
Dissolved Oxygen (%)	40.3	40.4	24.4	45.4	30.5	48.6
Dissolved Oxygen (mg/L)	3.32	3.48	2.09	3.95	2.61	3.76
Specific Conductivity (µS/cm)	1052	700.0	709.0	721.0	577.0	472.0
Salinity (ppt)	0.05	0.03	0.03	0.03	0.02	0.02
pH	6.83	6.93	6.51	6.28	5.95	6.58

*No Data

B. HANNABRAND BROOK

i. Summary

Currently, Hannabrand Brook serves as the only upstream spawning grounds for river herring as it is the only reach within the watershed that the river herring have access to. For this reason, we surveyed nearly the entire length of Hannabrand Brook. Water quality in Hannabrand Brook was somewhat better than Black Creek with generally higher levels of dissolved oxygen and cooler water temperatures likely due to better stream flow and higher percent cover of overhead canopy (Tables 5-7). Over 150 juvenile fish (15-20mm TL; potentially alewife) were observed in Hannabrand Brook between Route 71 and Bailey's Corner Road.

There are a few small, minor potential barriers throughout the lower part of Hannabrand Brook including a hand-placed rock weir just above the confluence of Hannabrand and Wreck Pond Brooks, an old wooden footbridge that could catch debris and become a barrier, an old wooden weir, and a hand-placed rock weir along a residential property downstream of Route 35 (Figure 3). Each of these are likely only barriers in the most extreme low flows and could be removed fairly easily using man power and some hand-operated tools. Upstream of Route 35, again there is just a small check dam made up of concrete rubble and some natural debris that could be potential impediments for fish passage (Figure 4). The first major barrier in Hannabrand Brook is the culvert/dam at Crystal Brook Drive which is helping to create Crystal Brook Lake just upstream. This barrier is about 2000 meters upstream of the confluence of Hannabrand and Wreck Pond Brooks. Upstream of this barrier, the creek runs through a development, although is somewhat natural upstream of the Crystal Brook Lake. The next road crossing is at Hiddenbrook Dr. where there is another culvert on the downstream side and a dam creating a Lake on the upstream side of the road. Upstream of this lake, the creek is a trickle coming down from a culvert/storm drain at Shadowbrook Dr. This is the upstream limit of the southern branch of Hannabrand Brook. The northern branch of Hannabrand runs from the split at the bike path upstream of Bailey's Corner Rd to west of Route 34 and Allenwood Rd. There are no barriers in this reach until you get to Allaire Rd where there is a broken weir upstream of the road at the downstream end of the Bel-Aire Golf Course. Technically, since the weir is broken, fish could pass through the structure, however, upstream of the structure is a mudflat which is unpassable as there is little flow through the mudflat. Upstream of the mudflat is a weir made of sand bags, which is a barrier to fish migration, followed by another broken weir and land that was filled in for the golf course. The creek runs subterraneously through this section and connects again above ground on the upstream end of the golf course. At this point, the creek has a natural meander and is surrounded by somewhat dense vegetation including trees, ferns and skunk cabbage.

See Appendix B for complete survey notes and observations, and site photographs.

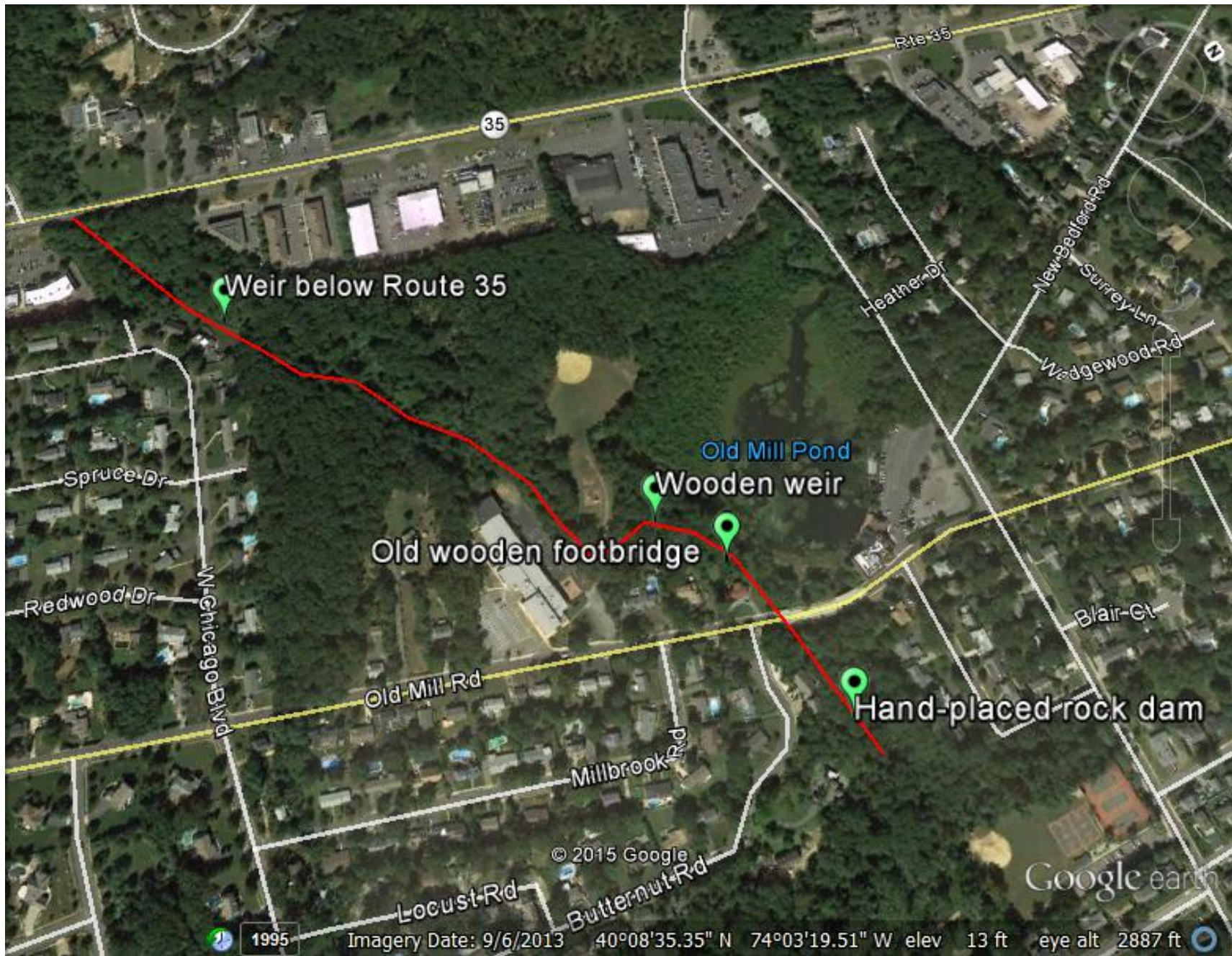


Figure 3. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 3, 2015.

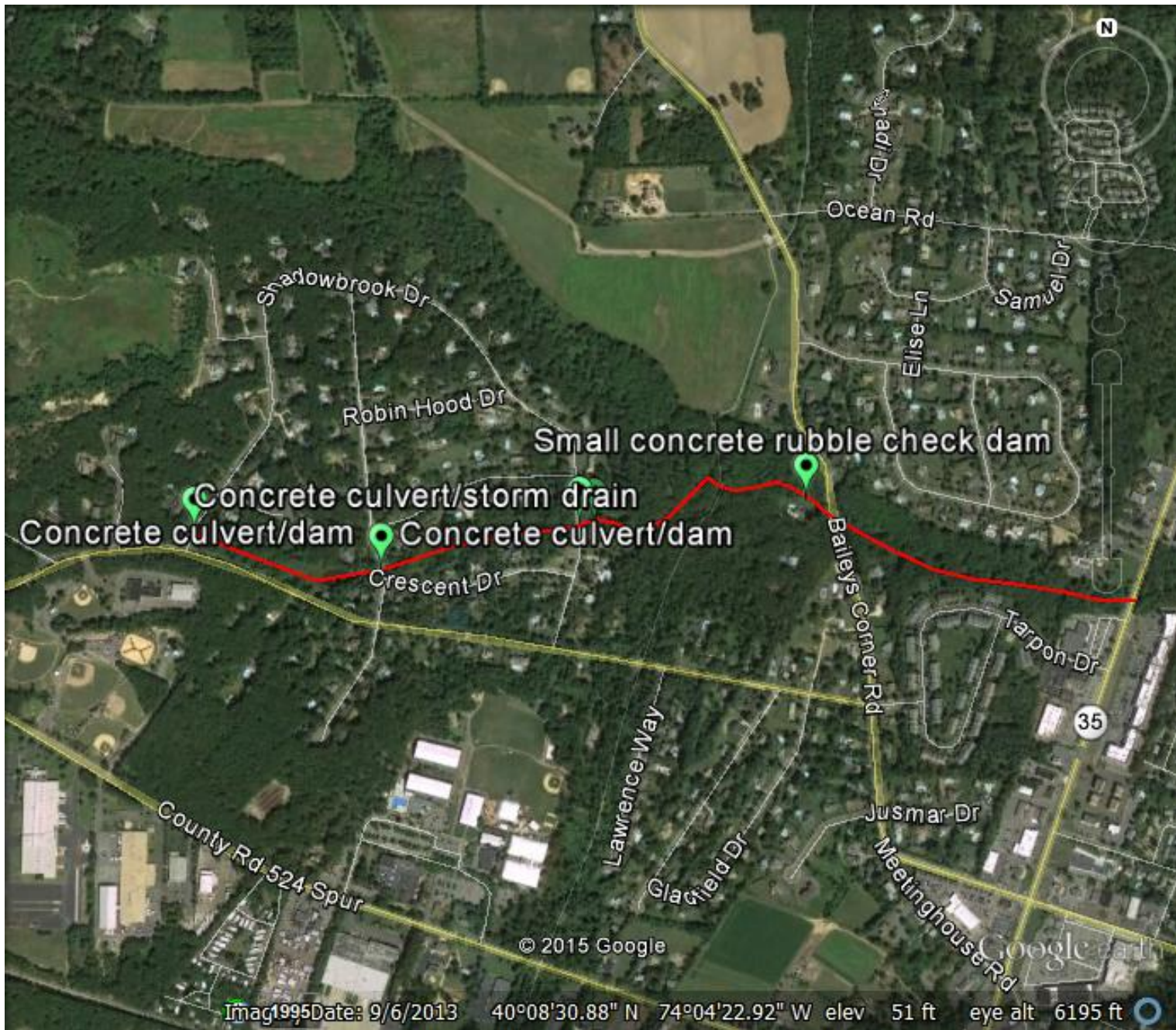


Figure 4. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 4, 2015.

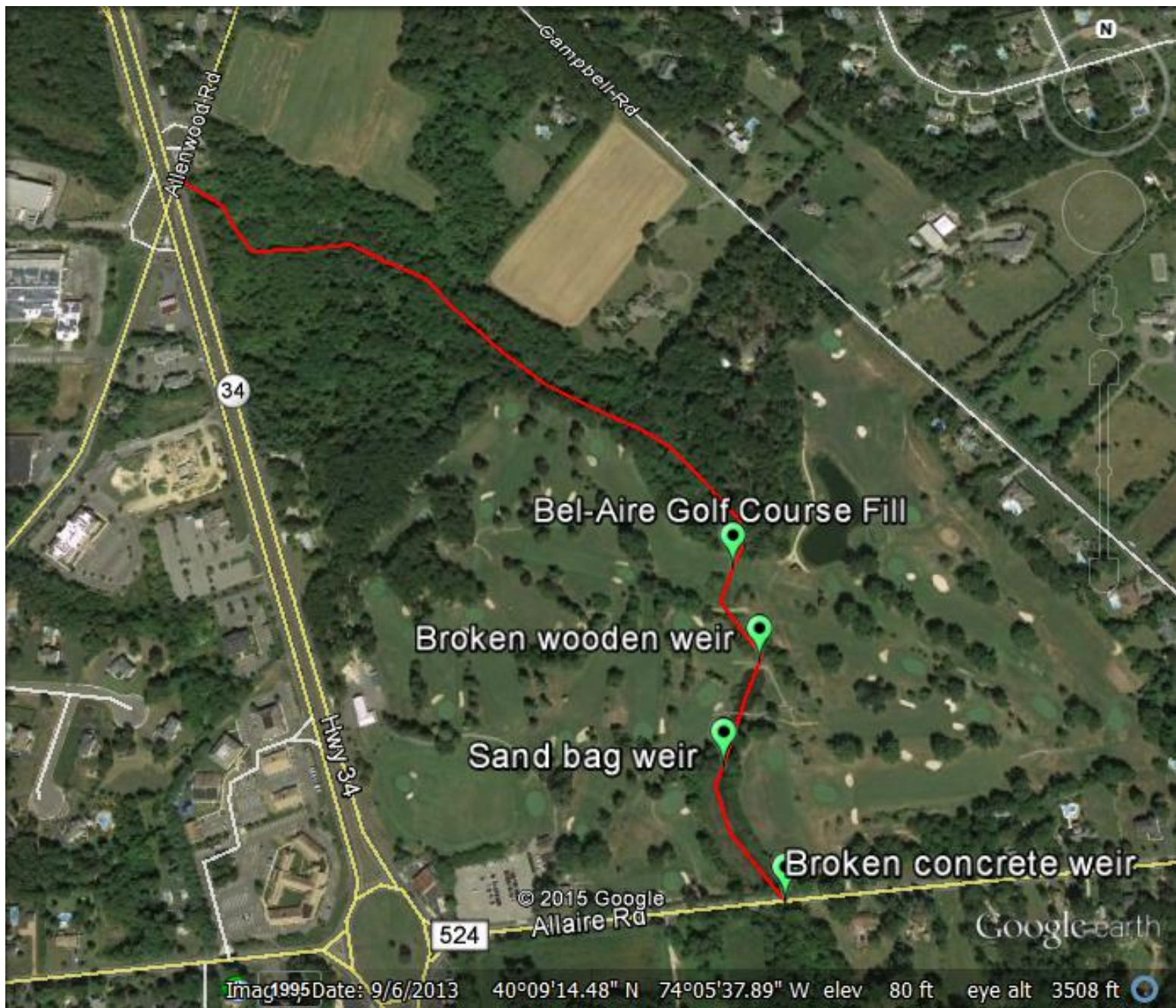


Figure 5. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 16, 2015.

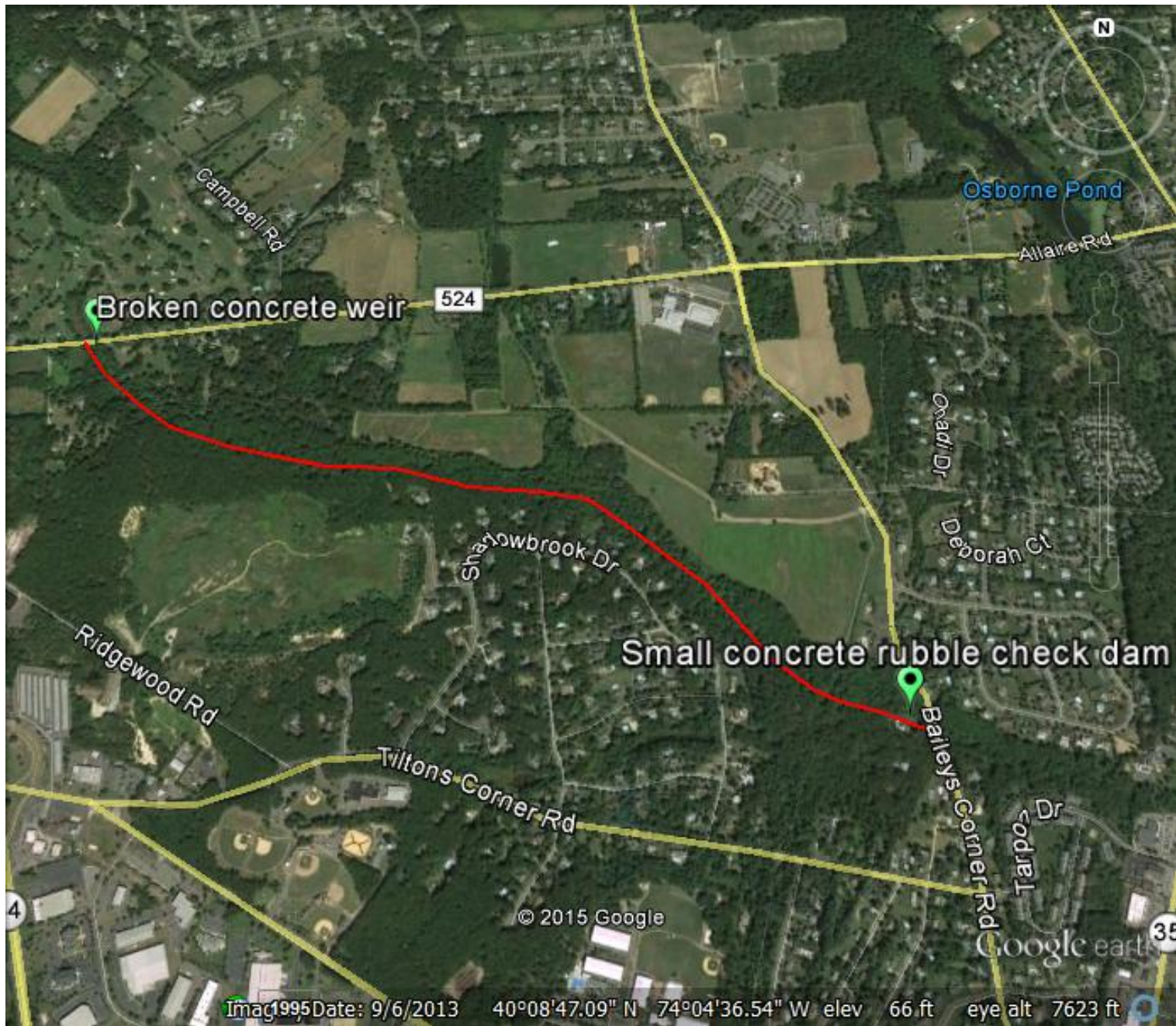


Figure 6. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 18, 2015.

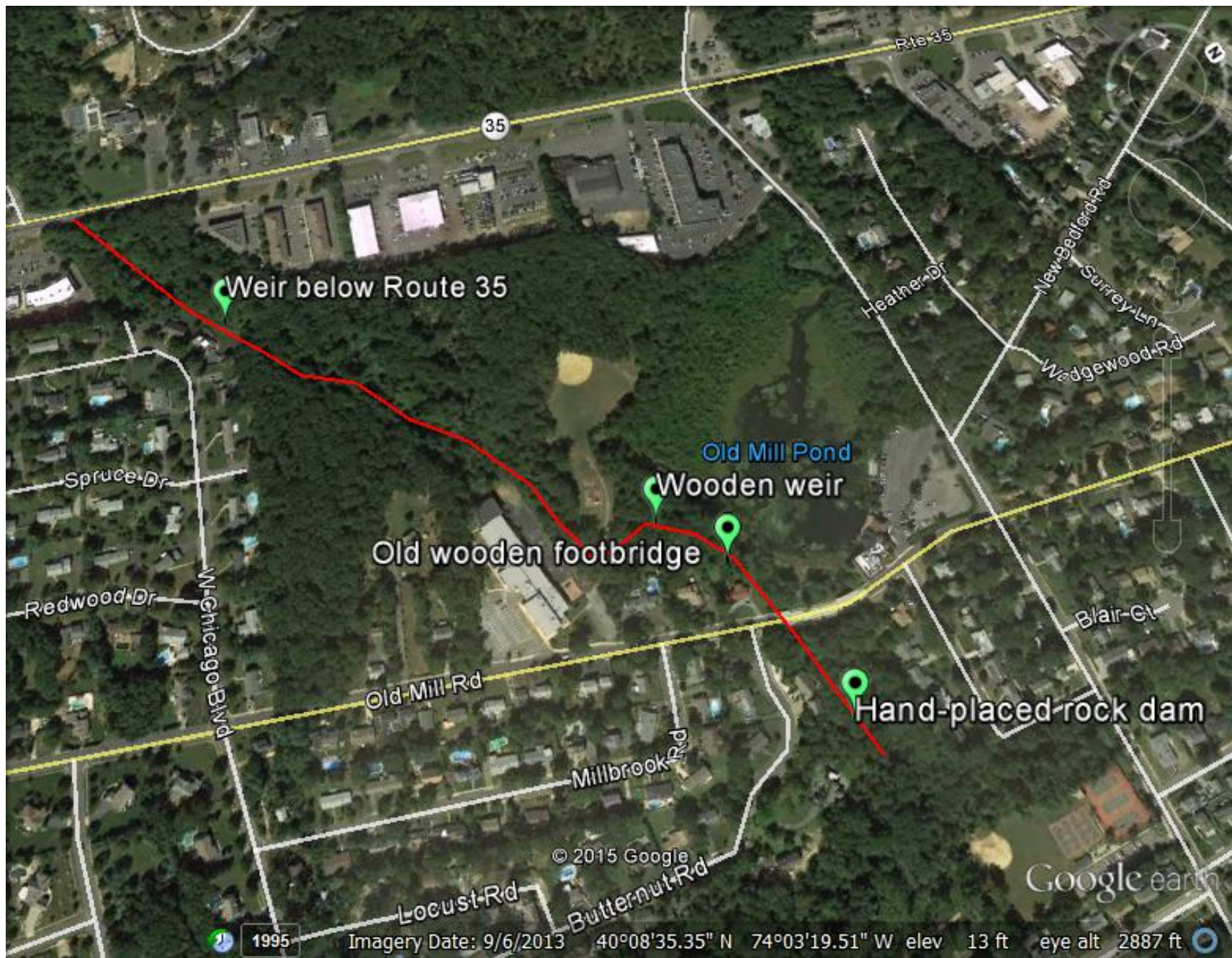


Figure 7. Hannabrand Brook survey reach (red line) and potential barriers (green markers), June 30, 2015.

Table 4. Potential fish passage barriers in Hannabrand Brook, Wreck Pond Brook Watershed. Listed are the associated figure numbers, which can be found in Appendix B. Also see Figures 3-7 for location maps.

Name/Location	GPS Coordinates (Decimal °)	Type	Notes
Small boulder hand-placed dam (Figure 28)	40.14354N 74.05222W	Check dam	Top is ~30cm above bottom; could be easily dismantled
Old wooden footbridge (Figure 30)	40.14349N 74.05413W	Natural debris	Could catch debris flowing downstream and become a barrier
Old wooden weir (Figure 31)	40.14318N 74.05485W	Weir	Top is ~75cm from bottom; ~15-30cm from water surface
Small concrete check dam (Figure 39)	40.14122N 74.05919W	Check dam	Located along private property (1310 West Chicago Blvd., Sea Girt); ~30cm above bottom
Small concrete rubble check dam (Figure 59)	40.14227N 74.06844W	Check dam	Located between Bailey's Corner Rd and footbridge/bike path; ~50cm above bottom
Large tree root mass (Figure 62)	40.14181N 74.07304W	Natural debris	Located about 10m downstream of Crystal Brook Dr.; possible barrier
Concrete culvert/dam (Figures 63 and 64)	40.14183N 74.07333W	Culvert	Crystal Brook Dr. and upstream Lake; bottom of culvert is ~30cm above water surface
Concrete culvert/dam (Figures 65 and 66)	40.14116N 74.07741W	Culvert	Hiddenbrook Dr. and upstream Lake
Culvert/storm drain (Figure 67)	40.14195N 74.08121W	Culvert	Shadowbrook Dr., creek below culvert was dry; upstream limit of creekbed
Concrete weir (broken; Figure 70)	40.15071N 74.09148W	Concrete weir	Located on Bel-Aire Golf Course upstream of Allaire Rd.; would be barrier if not broken; mudflat area upstream unpassable
Sand bag weir (Figure 71)	40.15169N 74.09219W	Weir	Bel-Aire Golf Course at upstream end of mudflat
Broken wooden weir (Figure 73)	40.15263N 74.09178W	Weir	Bel-Aire Golf Course
Bel-Aire Golf Course	40.15346N 74.09211W	Stream filled in	Bel-Aire Golf Course, turf for ~30m

ii. Water Quality

Table 5. Water quality measurements taken in Hannabrand Brook on June 3 and 4, 2015.

Location	5m upstream of school footbridge	Small white pipe outfall ~40m	Upstream of bike path
Date	6/3/2015	6/4/2015	6/4/2015
Coordinates Decimal °	40.14242N 74.05527W	40.14098N 74.06276W	40.14233N 74.07092W
GPS Error (±)	46'	ND*	ND
Mean Depth (cm)	30	65	10
Air Temperature (°C)	14.9	13.9	13.9
Water Temperature (°C)	14.4	14.4	15.4
Dissolved Oxygen (%)	83.0	87.5	72.0
Dissolved Oxygen (mg/L)	8.5	9.0	7.23
Specific Conductivity (µS/cm)	919.0	3241	3356
Salinity (ppt)	0.04	0.12	0.13
pH	6.32	6.13	6.31

*No Data

Table 6. Water quality measurements taken in Hannabrand Brook on June 16 and 18, 2015.

Location Description	Sand bag weir	Hannabrand Brook	Baileys Corner Rd	Hannabrand Brook	Hannabrand Brook	10 meters downstream of Allaire Rd
Date	6/16/2015	6/16/2015	6/18/2015	6/18/2015	6/18/2015	6/18/2015
Coordinates Decimal degrees	40.15216N 74.09195W	40.15536N 74.09510W	40.14305N 74.07091W	40.14710N 74.07825W	40.14750N 74.08417W	40.15041N 74.09132
GPS Error (±)	10'	20'	17'	14'	65'	10'
Mean Depth (cm)	ND	15	40	ND	ND	100
Air Temperature (°C)	24.4	24.4	18.3	18.3	18.3	18.3
Water Temperature (°C)	20.8	18.6	17.5	17.4	17.6	19.9
Dissolved Oxygen (%)	44.5	65.5	83.1	80.4	78.2	66.5
Dissolved Oxygen (mg/L)	4.04	6.08	7.95	7.70	7.46	6.06
Specific Conductivity (mS/cm)	843	1006	913	950	951	894
Salinity (ppt)	0.04	0.04	0.04	0.04	0.04	0.04
pH	6.05	6.28	5.94	5.80	5.93	6.23

Table 7. Water quality measurements taken in Hannabrand Brook on June 30, 2015.

Location	Upstream of Old Mill Pond Rd	Red covered footbridge	Downstream of Route 35
Date	6/30/2015	6/30/2015	6/30/2015
Coordinates Decimal °	40 08.613 74 03.209	40 08.545 74 03.316	40 08.441 74 03.669
GPS Error (±)	17'	46'	19'
Mean Depth (cm)	20	30	80
Air Temperature (°C)	25.1	22.2	22.9
Water Temperature (°C)	18.0	18.6	19.0
Dissolved Oxygen (%)	87.9	86.7	75.4
Dissolved Oxygen (mg/L)	8.26	8.08	7.05
Specific Conductivity (µS/cm)	2902	2720	2565
Salinity (ppt)	0.12	0.11	0.11
pH	6.26	6.09	6.00

C. WRECK POND BROOK

i. Summary

Wreck Pond Brook is the main tributary in the Wreck Pond Brook Watershed. It is the only tributary that had several reaches score in the optimal range in the 2005-2006 Stream Assessment conducted by the Freehold Soil Conservation District (Appendix A). The reach between Route 35 and Allaire Road was one of those reaches that scored in the optimal range, and during these surveys appeared to be quality habitat for fish and other wildlife with primarily sand and cobble bottom, relatively good shading, natural vegetation along banks. Many small fishes were observed throughout the reach along with a black racer snake and box turtle. Aquatic grasses were present as well and covered in benthic macroinvertebrates, mainly Diptera and Trichoptera.

Wreck Pond Brook would be ideal habitat for river herring migration and spawning, however they are unable to use the majority of this tributary as it is blocked off by the dam at Old Mill Pond (Figure 9). Opening up passage beyond this dam would allow for use of an additional 1 mile of relatively good habitat before reaching another dam at Allaire Road (Osbornes Pond). As we were somewhat limited by time and personnel and we knew the extent of potential fish migration in this tributary, the limits of our survey did not extend past Osbornes Pond, however the creek extends another approximately 4.5 miles past Osbornes Pond to the northwest boundary of the watershed. Below the dam at Old Mill Pond and upstream of the Railroad Tracks Bridge is approximately one mile of available habitat.

See Appendix B for complete survey notes and observations, and site photographs.

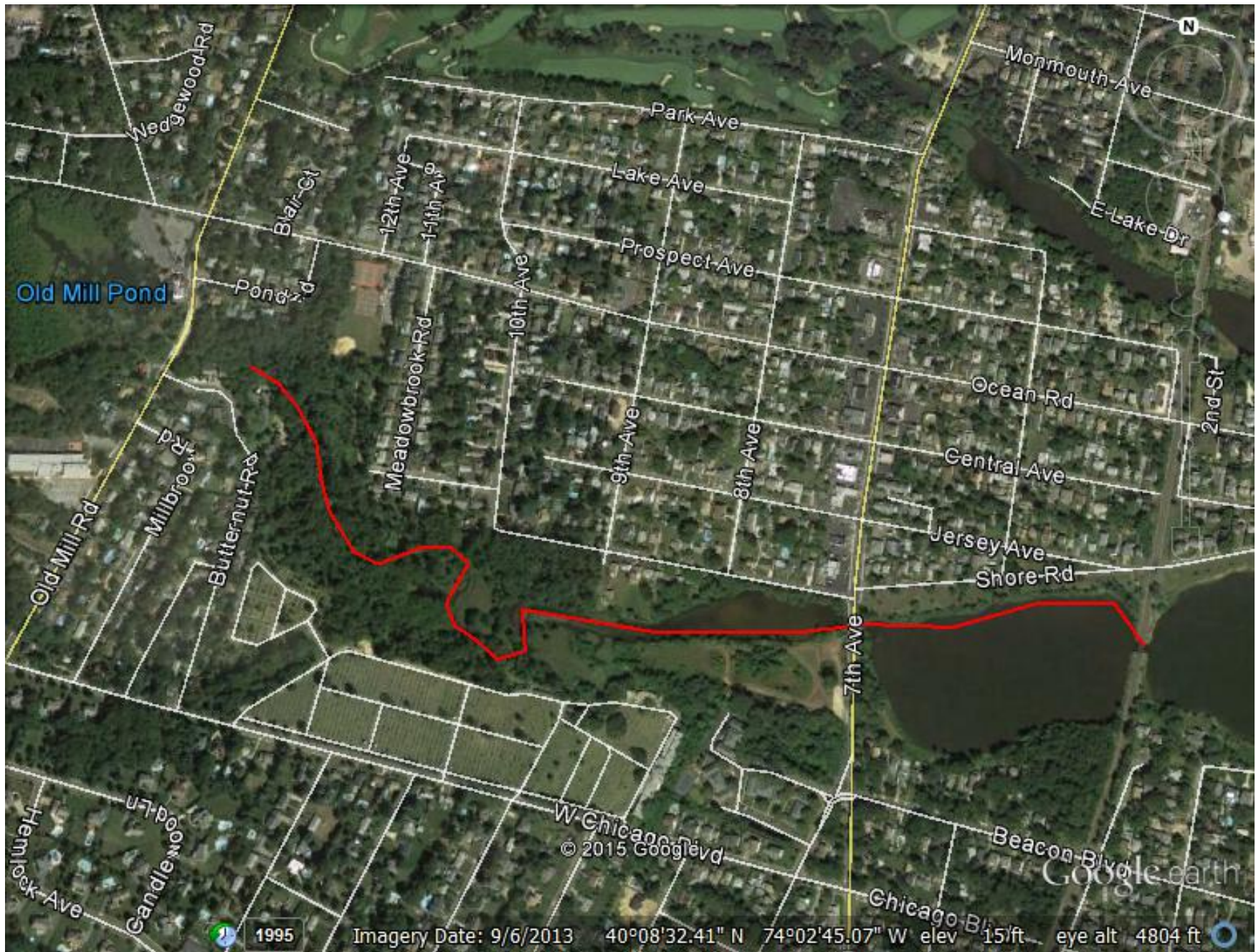


Figure 8. Wreck Pond Brook survey reach (red line) and potential barriers (green markers), June 30, 2015. No barriers observed on this day.

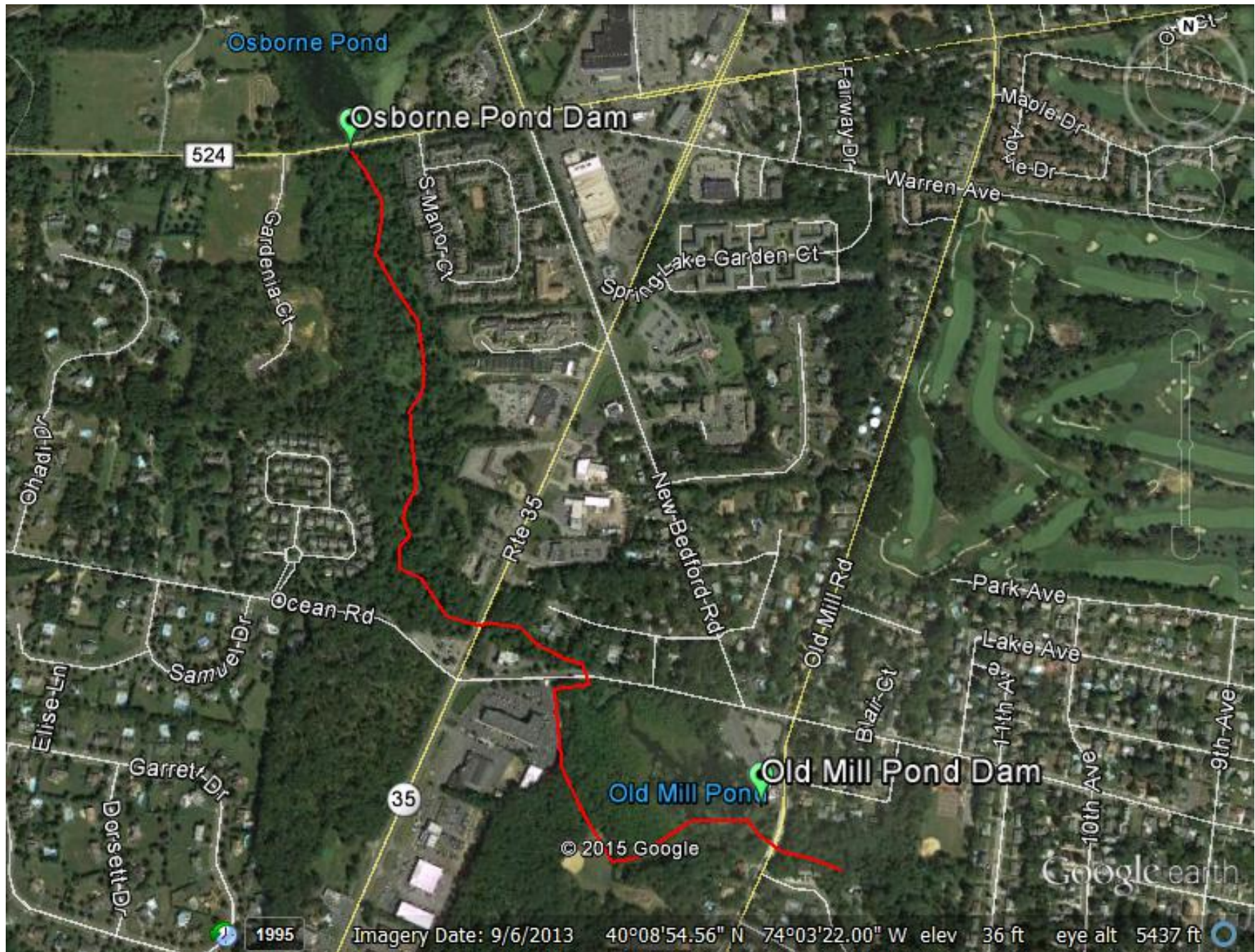


Figure 9. Wreck Pond Brook survey reach (red line) and potential barriers (green markers), July 1, 2015.

Table 8. Potential fish passage barriers in Wreck Pond Brook, Wreck Pond Brook Watershed. Listed are the associated figure numbers, which can be found in Appendix B. Also see Figures 8 and 9 for location maps.

Name/Location	GPS Coordinates	Type	Notes
Old Mill Pond Dam (Figure 91)	40.144222N 74.053566W	Dam	Definite barrier to fish migration
Osborne's Pond Dam (Figures 101-103)	40.15295N 74.06153W	Dam	Definite barrier to fish migration

ii. Water Quality

Table 9. Water quality measurements taken in Wreck Pond Brook on June 30 and July 1, 2015.

Location	RR tracks bridge	100m upstream of Route 71	Upstream of Ocean Rd	Upstream of Route 35	Downstream of Allaire Rd
Date	6/30/2015	6/30/2015	7/1/2015	7/1/2015	7/1/2015
Coordinates Decimal °	40 08.26.55 74 02.16.02	40 08.427 74 02.777	40 08.793 74 03.419	40 08.887 74 03.615	40 09.177 74 03.692
GPS Error (±)	ND	15'	45'	19'	17'
Mean Depth (cm)	65	30	50	25	150
Air Temperature (°C)	21.6	23.0	23.8	23.8	23.8
Water Temperature (°C)	21.9	20.8	22.5	22.9	24.2
Dissolved Oxygen (%)	70.6	88.7	70.8	79.8	80.7
Dissolved Oxygen (mg/L)	6.16	7.92	6.12	6.80	6.78
Specific Conductivity (µS/cm)	3205	2922	3286	3164	3294
Salinity (ppt)	0.14	0.13	0.15	0.14	0.15
pH	7.41	6.43	6.95	6.20	6.27

VI. DISCUSSION

As part of a larger project geared at restoring fish passage, enhancing water quality and reducing flooding, an assessment of the quality and availability of habitat in the three main tributaries of the Wreck Pond Brook Watershed was conducted in the spring of 2015. The extent of the surveys and possible barriers are shown in Figure 10 along with the Watershed boundary.

Black Creek is the shortest and northernmost tributary. The quality of habitat would likely benefit from removal of a large amount of sediment throughout the creek, and removal or notching of the Black Creek weir would open up about a half mile of habitat.

Hannabrand Brook is the southernmost tributary, and has the longest reach available to spawning river herring. There are some minor potential barriers in the lower portion of the creek, however these would only be an issue in the most extreme low flows and could also be somewhat easily removed with manpower and some small tools. Hannabrand Brook splits into two branches just upstream of a bike path located upstream of Bailey's Corner Road. The southern branch provides somewhat nice habitat for about 0.60 mi before the first major barrier, a culvert and dam which create an impoundment just upstream of Crystal Brook Dr. The creek runs through a development in this area and runs beneath two other roads before reaching its upstream limit. The northern branch extends about a mile and a half upstream of the split before reaching a barrier at Allaire Road. The creek within this mile and a half is surrounded by a riparian buffer on both sides. The barrier at Allaire Road is currently a broken weir which is technically not impeding fish passage, however upstream of the broken weir is a mudflat which would not be passable by fish, followed by a weir made of sand bags and the Bel-Aire Golf Course. Major improvements in this area would be needed in order to encourage fish passage through this area.

The Watershed's namesake tributary, the Wreck Pond Brook, is the largest. Wreck Pond Brook also has the best quality of habitat according to the survey conducted by the Freehold Soil Conservation District in 2005-2006 (Appendix A). During this assessment, we only surveyed up to Osbornes Pond as time and personnel were limited, but this appeared to be the best quality habitat in the watershed. This was merely based on visual assessment, however a more rigorous assessment would likely prove the same. Unfortunately, much of this tributary is blocked off to fish passage by the Old Mill Pond Dam, a listed cultural feature in Monmouth County. Fish passage alterations made to the dam would open up about a mile of habitat for fish migration and spawning. The next barrier is a dam at Osbornes Pond, which is where we ended our survey.

This habitat assessment provided a basic knowledge of fish passage migration opportunities throughout the Wreck Pond Brook Watershed as well as ideas on where to focus future projects. Monitoring of fish migration throughout the watershed using Passive Integrated Transponder (PIT) tags and instream antennas would provide a better understanding of how the adult migratory fish are using the main Pond and the three main tributaries as well as providing further information on where to focus future fish passage improvement projects.

Continued monitoring of adult and juvenile river herring migration into and out of the watershed will provide a better understanding of the population stability in the watershed, especially after the installment of the secondary bypass box culvert is completed in 2016.

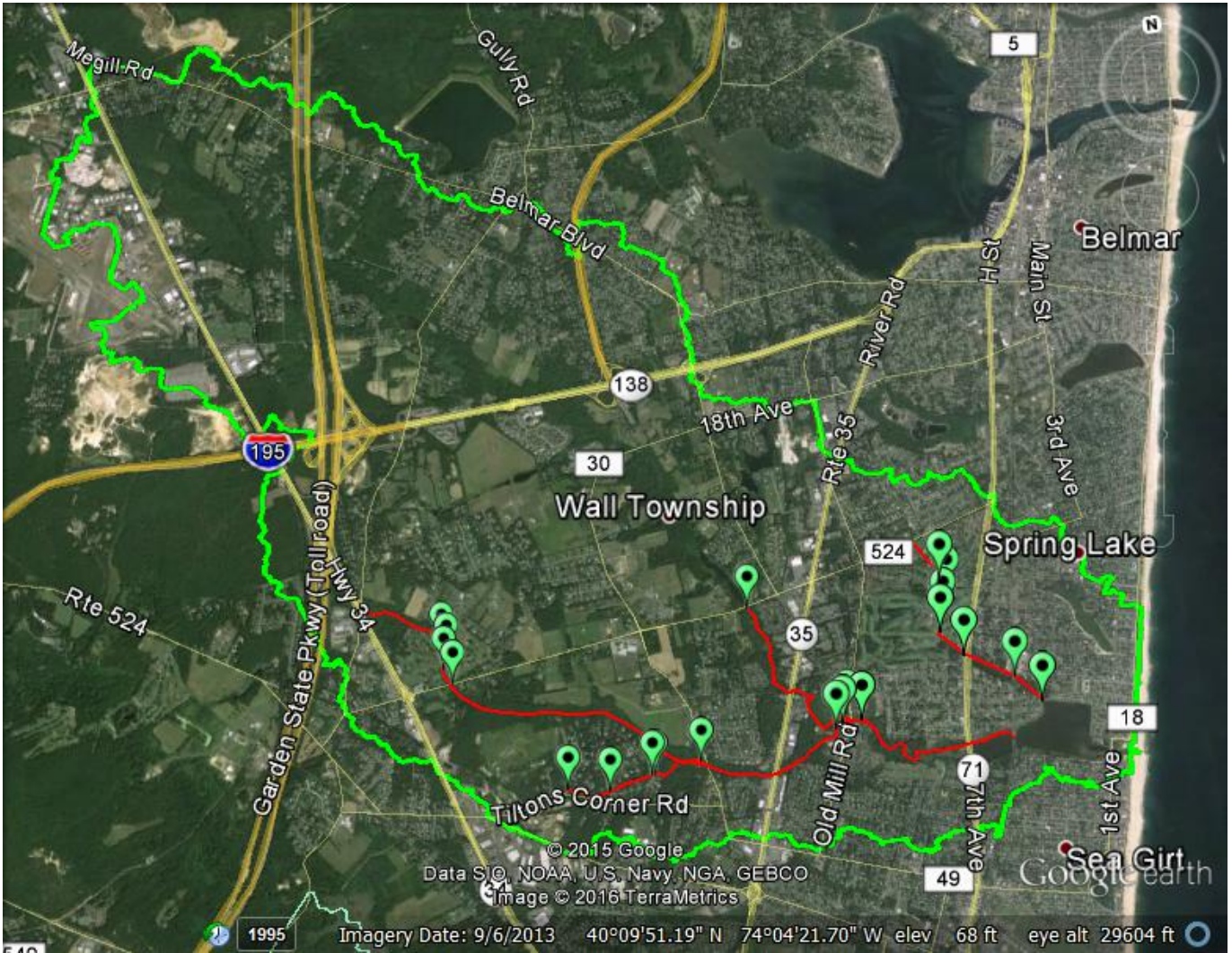


Figure 10. Map of the Wreck Pond Brook Watershed (green line), 2015 survey extent (red lines) and potential barriers (green markers).

4 STREAM ASSESSMENTS

In addition to the overall watershed assessments provided in Section 2, an in-field stream assessment was deemed necessary for the development of this Plan. All stream assessments within the watershed were performed by the Freehold Soil Conservation District (District). The assessments were performed between March 2005 and May 2006. The District utilized the United States Department of Agriculture Stream Visual Assessment Protocol methodology (SVAP) to execute the stream assessments.

4.1 Assessment Methodology

The SVAP method was developed by the Department of Agriculture as a first level assessment protocol to evaluate the aquatic ecosystems associated with streams. The SVAP method is the first step of a four-part assessment protocol to assess these ecosystems. This first level assessment provides information on basic health of the stream, specifically associated with the physical condition within the assessment area. The results of these assessments can then be used by stakeholders and planners to decide to conduct further ecological assessments, or develop design alternatives for stream restoration.

The method does not require specialized training, and can be implemented successfully with little biological, hydraulic or aquatic expertise. Essential to the method, however, are the use of reference sites. A reference site is a stream reach that has been least impacted by impairments and provides a standard for comparison during the assessment process. They represent the best condition attainable within a particular watershed or region.

The SVAP method uses a National Stream Assessment template. However, the SVAP method was designed to allow modification to the national template to better reflect conditions within a specific watershed. In this case, slight modifications to the national version included changes to the “assessment elements” and the “element scoring” by FSCD. Table 13 lists the assessment elements and their respective score ranges used during this assessment:

The information above was input into the Reach Assessment Score Sheet, which is located in Appendix B of this report. In addition to a scoring system, each element has condition categories, which include a small narrative describing what the stream reach should exhibit to warrant a specific scoring. The four condition categories include Optimal, Sub-Optimal, Marginal and Poor. For instance, in order for a reach to receive an Optimal score (score of 16 – 20) for channel flow status, the reach must exhibit the following: “Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.”

Table 13: Stream Assessment Scoring	
Assessment Element	Scoring Range (Poor to Optimal)
Pool Substrate Characterization	0 – 20
Pool Variability	0 – 20
Sediment Deposition	0 – 20
Channel Flow Status	0 – 20
Channel Alteration	0 – 20
Channel Sinuosity	0 – 20
Bank Stability – Left Bank	0 – 10
Bank Stability – Right Bank	0 – 10
Bank Vegetative Protection – Left Bank	0 – 10
Bank Vegetative Protection – Right Bank	0 – 10
Riparian Vegetative Zone Width – Left Bank	0 – 10
Riparian Vegetative Zone Width – Right Bank	0 – 10

FSCD performed all assessments by walking each stream and assessing individual reaches, recording the assessments and scores on individual Reach Assessment Score Sheets. Reaches were divided into manageable lengths, and each length received an assessment and score. In addition to the Reach Assessment Score Sheet, FSCD took photographs off all reaches assessed and recorded additional data on a Reach Assessment Data Sheet. The Data Sheet included information such as: channel width, buffer widths, bank slope descriptions, bank vegetation cover percentage, water clarity, debris, etc.

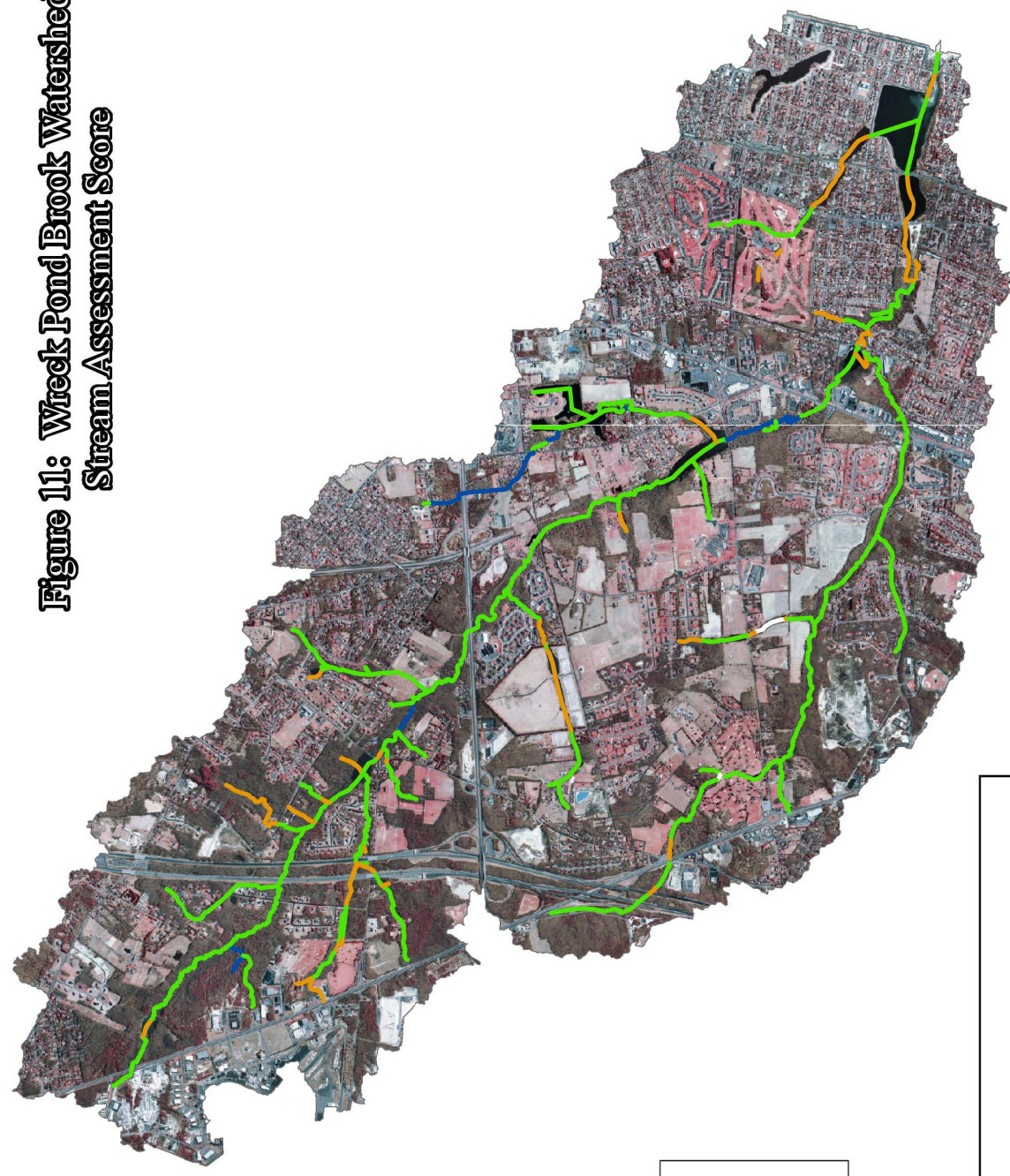
4.2 Data Collection and Management

During the assessment period, data sheets, scores, GPS coordinates of reaches and photographs were input into a controlled Microsoft Access database. Using information within the FSCD database, Najarian Associates developed a stream shapefile that can be imported into a GIS graphics program. This shapefile was then color coded according to the score ranges, and used to develop Figure 11 of this report. Figure 11 depicts each stream reach and its location within the watershed, and the color of the reach corresponds to the appropriate score range. Reaches not assessed by FSCD due to various circumstances are color coded on the figure as well.

4.3 Conclusions of Stream Assessment Study

As depicted in Figure 11, the majority of stream reaches fall under the Sub-Optimal category. These are spread throughout the watershed and exhibit no distinct pattern. The majority of Optimal reaches are located within the Waterford Glen sub-watershed. The small amount of Marginal reaches are located in the headwaters regions of the

**Figure 11: Wreck Pond Brook Watershed
Stream Assessment Score**



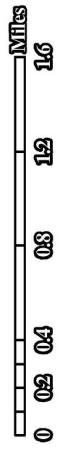
Legend

- 0 - 49 Poor
- 50 - 99 Marginal
- 100 - 144 Sub-Optimal
- 145 - 180 Optimal



N Najarian
ASSOCIATES, INC.
ENGINEERS, ARCHITECTS & SCIENTISTS

Sources:
Stream Assessment, Freehold Soil Conservation District
Map Author: Najarian Assoc., using FCSD Data
3/26/08



Hannabrand Brook, by the Garden State Parkway and Route 34, and the Wreck Pond Brook, located within the Hurley's Pond sub-watershed.

Overall, the data collected by FSCD provide information to focus stream restoration and remediation efforts and BMP implementation. Additionally, specific score results within the assessments may provide evidence of other physical or biological impairments within specific parts of the watershed. For example, reaches with poor bank stability scores may be indicative of high stormwater runoff flows, causing stream bank erosion.

APPENDIX B. SURVEY NOTES, OBSERVATIONS AND PHOTOGRAPHS

NOTES ON POTENTIAL FISH BARRIERS ARE BOLDED, AND NOTES ON OBSERVATIONS OF POSSIBLE JUVENILE RIVER HERRING ARE BOLDED AND ITALICIZED.

TABLE OF CONTENTS

I.	BLACK CREEK.....	4
	NOTES AND OBSERVATIONS.....	4
	PHOTOGRAPHS.....	6
II.	HANNABRAND BROOK.....	15
	NOTES AND OBSERVATIONS.....	15
	PHOTOGRAPHS.....	20
III.	WRECK POND BROOK.....	39
	NOTES AND OBSERVATIONS.....	39
	PHOTOGRAPHS.....	41

LIST OF FIGURES

Figure 1.	Black Creek Weir, downstream Wreck Pond side.....	6
Figure 2.	Black Creek Weir, upstream Black Creek side (first pond).	6
Figure 3.	Freshwater Bryozoan (<i>Pectinatella</i> sp.).....	6
Figure 4.	Sheri Shifren (NJDEP) hiking through Black Creek.....	7
Figure 5.	Looking downstream along northern bank just below DPW yard.....	7
Figure 6.	Small side channel just between fence and DPW yard.	8
Figure 7.	Left-South side of Black Creek (below RR tracks). Right- North side.....	8
Figure 8.	Downstream end of railroad (RR) bridge.....	8
Figure 9.	Upstream of railroad (RR) bridge (second pond).....	9
Figure 10.	Gravel bar in upper area of second pond (~30m downstream of Route 71). Minimum depth ~10cm.	9
Figure 11.	Approximately 10 m downstream of Route 71 bridge.....	9
Figure 12.	Just downstream and below the Route 71 bridge.....	10
Figure 13.	Upstream of the Route 71 bridge.....	10
Figure 14.	Weir approximately 5m upstream of Route 71 bridge.....	10
Figure 15.	Upstream of Route 71 bridge. First pond on Spring Lake Golf Club property.....	11
Figure 16.	Second pond on Spring Lake GC property.....	11
Figure 17.	Third pond on Spring Lake GC. Passageway between third and fourth ponds.	11
Figure 18.	Downstream (upper) and upstream (lower) ends of fourth pond.	12
Figure 19.	Culvert separating fourth pond and fifth pond/run.	12
Figure 20.	Fifth pond/run to Warren Ave. First of three weirs located along this “run.”	12
Figure 21.	Second weir and above in fifth pond/run.....	13
Figure 22.	Upstream end of fifth pond/run and third weir.	13
Figure 23.	Culvert at Warren Rd.	13
Figure 24.	Upstream of Warren Rd. first pond in Fairway Mews Golf Course.	14
Figure 25.	Upstream end of first pond and second pond in Fairway Mews GC.....	14

Figure 26. Multiple pipes/culverts emptying into/connecting (?) ponds throughout Fairway Mews GC.....	14
Figure 27. Confluence of Hannabrand Brook (South) and Wreck Pond Brook (North).....	20
Figure 28. Hand-placed rock dam just upstream of confluence with Wreck Pond Brook.....	20
Figure 29. Old Mill Road Bridge	21
Figure 30. Fallen tree debris with old wooden footbridge in the distance.	21
Figure 31. Wooden weir just upstream of old wooden footbridge.....	21
Figure 32. Undercut bank and wooden bulkhead just downstream of the Old Mill Elementary School.....	22
Figure 33. Footbridge and storm drain culvert at the downstream end of the Old Mill Elementary School property.	22
Figure 34. Second footbridge at the Old Mill Elementary School property.	22
Figure 35. School of juvenile fish observed approximately 20m upstream of the Old Mill ES property.	23
Figure 36. Creek habitat where 150+ juvenile fish (possible alewife) were observed on June 3, 2015.	23
Figure 37. Stream gauge in creek (left photo; blue outline), Creek habitat upstream of stream gauge (right photo).	23
Figure 38. View of creek downstream of stone revetment (left photo), Property (1310 W Chicago Blvd., Sea Girt) with stone revetment along creek (right photo).	24
Figure 39. Small, concrete check dam located half way along residential property.....	24
Figure 40. White, slotted pipe in creek.....	24
Figure 41. Concrete culvert located just upstream of stone revetment property.....	25
Figure 42. Creek downstream of Route 35, Japanese knotweed on banks.....	25
Figure 43. Route 35 Bridge/Box Culvert.	25
Figure 44. Juvenile largemouth bass found just below Route 35 Bridge.	26
Figure 45. June 4 th survey start location, upstream of Route 35 Bridge (left photo) with one dead white sucker (right photo).....	26
Figure 46. Small, grey pipes emptying into creek at The Brookside School.....	26
Figure 47. Small step of concrete rip rap fallen into creek from stream bank.....	27
Figure 48. Juvenile fish (possible alewife) observed at the upstream end of Brookside School.....	27
Figure 49. Horses at the Brookside School.	27
Figure 50. Habitat upstream of the Brookside School in Hannabrand Brook.	28
Figure 51. Stream Team on June 4, 2015, Hannabrand Brook.	28
Figure 52. Small tributary on south side of Hannabrand Brook. GPS: 40.14124N 74.06582W.	28
Figure 53. Instream gravel bed, Hannabrand Brook.....	29
Figure 54. Pump system in-take in creek runs to house on adjacent property. GPS: 40.14161N 74.06663W ±30' ..	29
Figure 55. Gravel run just upstream of pump system. GPS: 40.14181N 74.06712W.....	29
Figure 56. Culvert located approx. 5m below Bailey's Corner Rd. GPS: 40.14214N 74.06772W ±16'	30
Figure 57. Looking downstream through Bridge at Bailey's Corner Rd, Hannabrand Brook.	30
Figure 58. Small tributary on south side of Hannabrand Brook, 5m upstream of Bailey's Corner Rd	30
Figure 59. Small check dam located at GPS: 40.14227N 74.06844W. Looking upstream (left photo), looking downstream (right photo).	31
Figure 60. Hand-placed wooden foot bridge beneath bike path. Creek splits just upstream of this.....	31
Figure 61. Black pipes emptying into creek below Crystalbrook Dr.....	32
Figure 62. Large tree root mass, possible fish barrier.	32
Figure 63. Culvert at downstream end of Crystalbrook Dr. (left photo) and upstream (right photo).	32
Figure 64. Lake upstream of Crystalbrook Dr.	33
Figure 65. Culvert downstream end of Hiddenbrook Dr. (left photo), habitat downstream of Hiddenbrook Dr. (right photo).	33

Figure 66. Impoundment upstream of Hiddenbrook Dr.....	33
Figure 67. Culvert at Shadowbrook Dr. (downstream left photo, upstream right photo). End location for June 4, 2015 survey.....	34
Figure 68. Culvert at Allaire Rd. Start location of June 16, 2015 survey.	34
Figure 69. Broken weir upstream of Allaire Rd (downstream of mudflat in above photo).....	35
Figure 70. Mudflat upstream of Allaire Rd. (Bel-Aire Golf Course). Start location for June 16, 2015 survey.	35
Figure 71. Sand bag weir upstream of mud flat. GPS: 40.15216N 74.09195W $\pm 10'$	35
Figure 72. Creek habitat upstream of wooden footbridge at downstream end of Bel-Aire Golf Course.	36
Figure 73. Broken wooden weir. GPS: 40.15263N 74.09178W $\pm 11'$	36
Figure 74. Hannabrand Brook habitat upstream of Bel-Aire golf course, downstream of Route 34.	36
Figure 75. Creek habitat upstream of Bailey's Corner Rd. Start location for June 18, 2015 survey.	37
Figure 76. Long, black pipe in creek GPS: 40.14462N 74.07369W $\pm 27'$	37
Figure 77. Creek splits at GPS: 40.14713N 74.07829W.	37
Figure 78. Large, single concrete pipe at GPS: 40.14717N 74.07893W $\pm 36'$ (looking upstream left photo, downstream right photo).	38
Figure 79. Creek habitat downstream of Allaire Rd. End survey location for June 30, 2015.	38
Figure 80. Wreck Pond upstream of Railroad Tracks Bridge (fyke net sampling location and start of June 30, 2015 survey).	41
Figure 81. Route 71 Bridge, Wreck Pond.....	41
Figure 82. Upstream of Route 71 Bridge, Jimmy Byrnes property.	41
Figure 83. American Littoral Society interns taking water quality measurements in Wreck Pond Brook, June 30, 2015.	42
Figure 84. Habitat in Wreck Pond Brook, approximately 600m below Old Mill Pond Dam.....	42
Figure 85. Properties along Wreck Pond Brook, rip rap on banks.....	42
Figure 86. Culvert at the upstream end of brown, shingled house. GPS: 40.14175N 74.05025W $\pm 21'$	43
Figure 87. Culvert opening not connected to anything just upstream of culvert in Figure 86.	43
Figure 88. Creek splits at the upstream end of this property. GPS: 40.143433N 74.05165W $\pm 21'$. Main channel on south side, small, short side channel on north side.	43
Figure 89. Habitat and stream team members in Wreck Pond Brook, approximately 100m downstream of Old Mill Pond Dam.	44
Figure 90. Confluence of Hannabrand Brook (left photo) and Wreck Pond Brook (right photo).	44
Figure 91. Old Mill Pond Dam and Old Mill Pond.	44
Figure 92. Downstream of Ocean Rd. Bridge, Wreck Pond Brook.	45
Figure 93. Upstream of Ocean Rd. Bridge, Wreck Pond Brook.	45
Figure 94. Culvert located at approximately GPS: 40.1467N 74.057483W.....	45
Figure 95. Route 35 Bridge (downstream on left, upstream on right), Wreck Pond Brook.....	46
Figure 96. Habitat upstream of Route 35 Bridge, Wreck Pond Brook.....	46
Figure 97. Wreck Pond Brook Habitat further upstream between Route 35 Bridge and Allaire Road.	46
Figure 98. Wreck Pond Brook habitat, grasses on creek bottom (left) and benthic macroinvertebrates on grasses (right).	47
Figure 99. Box turtle observed in Wreck Pond Brook at GPS: 40.150583N 74.06045W $\pm 20'$	47
Figure 100. Wreck Pond Brook habitat through stretch near townhouses downstream of Allaire Rd.....	47
Figure 101. Creek just downstream of Allaire Road. Brown foam on water surface in lower part of photo.....	48
Figure 102. Wreck Pond Brook, Allaire Road Bridge and Dam. GPS: 40.15295N 74.061533W $\pm 17'$	48
Figure 103. Osborne's Pond upstream of Allaire Road.....	48

I. BLACK CREEK

NOTES AND OBSERVATIONS

JUNE 16, 2015 – Started at Black Creek Weir (Ocean Road, Spring Lake) at 0800; fish passage barrier – top of weir is approximately 30 cm above water surface

- Depth just downstream of weir, approximately 30cm (~12")
- Depth just upstream of weir, approximately 100cm (~40")

Walked along the northern edge of the pond upstream of the Ocean Road Bridge. Depth along the edge was approximately 50 cm (~20"). Bottom is mucky, substrate primarily sand/gravel. Some (~30%) aquatic vegetation. Vegetation on bank included cattail, iris, swamp rose mallow, purple loosestrife (invasive), honeysuckle (invasive). 2 swans and 3 large common carp (*Cyprinus carpio*) observed. Thousands of water boatmen (*Sigara* sp.; wide range of pollution tolerance, some species are highly tolerant of water pollution) along the shore. Duckweed present on the water surface along the shore. Bottom was mucky, sunk in about 20cm (~8") with a sulfur (rotten egg) smell. A fence is located between a house and the DPW yard on the north side of the pond.

+10m above fence is a narrow and shallow (avg. 5 cm depth) creek trickling into the main pond with an oil sheen on surface (Figure 7). Concrete on west bank, high density of Japanese knotweed. GPS coordinates – 40.14473N 74.03515W

+3m Spring Lake DPW yard

Railroad Tracks/Culvert (Figure 9). Water quality taken (see Table 3 in report). Depth ~ 15-20cm; could be a fish barrier in very low flow conditions. Duckweed, oily sheen on water surface.

Upstream of railroad tracks is a second pond (Figure 10) with gravel/cobble substrate on north edge, murky, brown water; visibility ~15cm. North bank consisted on 75% Japanese knotweed, multiflora rose, honeysuckle (all invasive species).

Stormwater manufactured treatment device at 6th/North Lake Dr. GPS – 40.14595N 74.03827W ±22'

Halfway between railroad tracks and Rt. 71, bottom is mucky near edge, sunk in approx. 20cm, sulfur smell.

Approx. 40m downstream of Rt. 71 – gravel bed about 10m x 5m to about 10m x 1m. Many carp observed around the gravel bar located approximately 30m downstream of Route 71 Bridge and between the gravel bar and the bridge (Figure 11).

+30m (approx. 10m downstream of Rt. 71; Fig. 12) – visibility about 50cm, water quality taken (see Table 3 in the report), gravel/cobble/sand bottom; cattails, honeysuckle and other dense vegetation, lots of woody debris/snags.

+5m – small boulders, concrete rubble, decent flow, width approx. 1.5m

Rt. 71 culvert (GPS – 40.14719N 74.04082W) – concrete rubble along sides and bottom through culvert; depth approx. 30cm, width approx. 2m (Fig. 13); rock gabions on south bank just upstream of culvert (Fig. 14)

Rt. 71 weir (GPS – 40.14723N 74.04121W ±14'; Fig. 15) – just upstream of Rt. 71 culvert; rubble built up approx. 80cm high from stream bottom; approx. 50cm from water surface; fish passage barrier!

Figures 16-24 show photos of Black Creek through the Spring Lake Golf Club property. The first footbridge separates the first and second ponds GPS 40.14790N 74.04207W ±10'. The second footbridge separating the second and third ponds GPS 40.14869N 74.04324W ±10'. Water quality taken in 3rd pond (Table X). Third footbridge separating third and fourth ponds GPS 40.14914N 74.04308W ±10'. Fourth footbridge with culvert separating fourth pond and fifth pond/run; fish passage barrier; GPS 40.14977N 74.04295W ±10'. All ponds were shallow, mucky and have little to no shading.

+5m upstream of fourth footbridge – first weir, top is approx. 50cm above stream bottom, approx. 25cm above water surface; fish passage barrier.

Fifth footbridge located upstream of first weir GPS 40.15020N 74.04257W ±10'.

+10m upstream of fifth footbridge – second weir, top is approx. 100cm above stream bottom, approx. 80cm above water surface; fish passage barrier.

Sixth footbridge located upstream of second weir GPS 40.15184N 74.04189W ±10'.

+5m upstream of sixth footbridge – third weir, top is approx. 50cm above stream bottom, approx. 30cm above water surface; fish passage barrier.

+25m – Warren Avenue culvert GPS 40.15231N 74.04206W ±10' (Fig. 24). Fish passage not likely upstream of this culvert throughout Fairway Mews Golf Club.

Upstream of Warren Ave. is Fairway Mews Golf Course – manhole with double gate system into culvert (Fig. 25). Upstream of manhole/culvert system is a pond with fountain with a small pipe/culvert at the upstream end GPS 40.15312N 74.04236W ±10'. Very low flow trickling out through pipe. Pipe flows underground for ~30 meters to the next pond, which also has a fountain GPS 40.15351N 74.04230W ±10'. Two pipes flowing into/out of this pond. Storm drains in Fairway Mews drain to ponds (potential contributor to water quality issues). Third pond with fountain GPS 40.15496N 74.04418W ±10'. One great blue heron observed in third pond.

End survey at Allaire Road.

PHOTOGRAPHS



Figure 1. Black Creek Weir, downstream Wreck Pond side



Figure 2. Black Creek Weir, upstream Black Creek side (first pond).



Figure 3. Freshwater Bryozoan (Pectinatella sp.)



Figure 4. Sheri Shifren (NJDEP) hiking through Black Creek.



Figure 5. Looking downstream along northern bank just below DPW yard.



Figure 6. Small side channel just between fence and DPW yard.



Figure 7. Left-South side of Black Creek (below RR tracks). Right- North side.



Figure 8. Downstream end of railroad (RR) bridge.



Figure 9. Upstream of railroad (RR) bridge (second pond).



Figure 10. Gravel bar in upper area of second pond (~30m downstream of Route 71). Minimum depth ~10cm.



Figure 11. Approximately 10 m downstream of Route 71 bridge.



Figure 12. Just downstream and below the Route 71 bridge.



Figure 13. Upstream of the Route 71 bridge.



Figure 14. Weir approximately 5m upstream of Route 71 bridge.



Figure 15. Upstream of Route 71 bridge. First pond on Spring Lake Golf Club property.



Figure 16. Second pond on Spring Lake GC property.



Figure 17. Third pond on Spring Lake GC. Passageway between third and fourth ponds.



Figure 18. Downstream (upper) and upstream (lower) ends of fourth pond.



Figure 19. Culvert separating fourth pond and fifth pond/run.



Figure 20. Fifth pond/run to Warren Ave. First of three weirs located along this "run."



Figure 21. Second weir and above in fifth pond/run.



Figure 22. Upstream end of fifth pond/run and third weir.



Figure 23. Culvert at Warren Rd.



Figure 24. Upstream of Warren Rd. first pond in Fairway Mews Golf Course.



Figure 25. Upstream end of first pond and second pond in Fairway Mews GC.



Figure 26. Multiple pipes/culverts emptying into/connecting (?) ponds throughout Fairway Mews GC.

II. HANNABRAND BROOK

NOTES AND OBSERVATIONS

JUNE 3, 2015 – Entered Hannabrand Brook at Old Mill Pond Road. Hiked downstream towards Wreck Pond. Started survey at 40.14344N 74.05171W. House within 50' of stream bank south side; slight split on south side and a channel that extends approximately 10m. Substrate is 70% gravel and 30% sand

Split on north bank; mean depth-30cm, max depth-80cm, canopy cover-50%, vegetation on both banks

Begin Hannabrand Brook at confluence with Wreck Pond Brook (30m downstream of Old Mill Pond Dam; Figure 27)

+10m upstream of split, there is a small check dam, about 30cm high, man-made, concrete/rock rubble GPS 40.14354N 74.05222W (Figure 28)

+5m upstream is a footbridge; both banks have man-made footpaths going to house on south bank for about 30m up to Old Mill Pond Road

Underpass at Old Mill Pond Road restricts natural stream flow but is not an impediment to fish passage, depth approx. 20cm (Figure 29)

Just upstream of Old Mill Pond Road, creek splits for about 20m; main channel on south side, small, shallow and narrow side channel on north side

On the main channel, there is a bamboo forest on the north side and a house/residential property on the north side

+5m – another split; main channel south side, small channel north side

+5m – main channel – footbridge

+5m – small check dam (coordinates recorded on USFWS trimble unit; HBCD1); not a barrier

+20m – fallen tree (coordinates recorded on USFWS trimble unit; HBFT1); 50cm opening for fish passage (Figure 30)

+5m – old, dilapidated wooden footbridge, water depth 30cm; could become a barrier to fish passage if debris gets caught up on bridge; GPS: 40.143497N 74.054133W ±32' (Figure 30)

+10m – old wooden weir; potential barrier in extreme low flow conditions; approx. 30 cm above water line, max depth approx. 60 cm; GPS: 40.143183N 74.05485W ±71' (Figure 31)

+10m – fallen tree (not a barrier) at pink house; south bank stabilized, wooden bulkhead; pvc pipe emptying from house property into creek (Figure 32)

Creek bends 90 degrees at downstream end of Old Mill Elementary School and there is a footbridge crossing over the creek

+5m – culvert emptying into creek from school, depth approx. 10-20cm (Figure 33)

+15m – second footbridge-red covered; upstream depth approx. 60cm (Figure 34)

+5m – Approx. 25 juvenile fish 15-20mm in length; photos taken; could be juvenile alewife (12:20pm); water quality taken (see Table 5 in report); also observed 1 small (<250mm) American eel, caddisfly larvae, mayfly adults, raccoon and deer tracks (couldn't get GPS, trimble stopped working; Figure 35)

+100m – Approx. 150 juvenile fish 15-20mm in length; photos; could be juvenile alewife; between this location and the last location where fish were observed, the stream is natural and sinuous, canopy cover was about 75%, substrate was 50% gravel and cobble and 50% sand, woody debris present, 5% aquatic vegetation (grasses), average depth approx. 30cm, max depth approx. 75cm, fish swimming mainly near banks; stream width approx. 2m on average, some good deeper pools (100cm+) at bends with undercut banks (Figure 36)

Approx. half way between Old Mill and Route 35 – depth is about 20cm, there is a lot of knotweed and a stream gauge measuring device (Figure 37)

+20m – large, brown shingled house on south bank has a stone revetment along their property and the stream bank (1310 West Chicago Blvd., Sea Girt; Figure 38); runs approx. 40 m along the entire length of the property with a small, concrete check dam about 30cm high half way between the downstream and upstream ends of property GPS 40.1412N 74.05919W (Figure 39); likely not a fish barrier, but potentially at extreme low flow

+5m – concrete culvert on south bank and downstream end of next property (Figure 41); no fish observed between brown shingled house and Route 35

End at Route 35 culvert (Figure 43)

JUNE 4, 2015 – overcast, cool (mid 50's °F), started upstream of Route 35; approx. 100cm depth and sandy bottom; The Brookside School is on the north side of the creek; one dead white sucker (Figure 45)

+20m – blue outfall GPS: 40.14075N 74.06177W; flow width – 5m; 60% sand, 40% gravel, 5% aquatic vegetation

Upstream end of school - there are 2 small, grey pipes going into creek GPS: 40.14071N 74.06203W (Figure 46)

+5m – small step made of concrete rip rap fallen from stream bank (Figure 47); passable; about 15cm high; 25+ plastic bottles and sports balls in creek and on bank (*possible creek clean up location?*)

+15m – small, white pipe outfall; lots of woody debris/leaf litter; 50% canopy cover, width 2m; sand bottom 50-70% GPS: 40.14098N 74.06276W; water quality taken (see Table 5 in report); about 15 juvenile fish (same species as yesterday; took video and photos; Figure 48); 2 horses and 1 donkey present on school property (Figure 29; possible source of bacteria in creek)

+30m – stream width 10m, avg depth 20cm, 98% sand substrate (Figure 50)

Concrete culvert GPS: 40.141004N 74.06353W; 95% sand substrate

Small, shallow (avg depth 10-15cm) tributary on south side of creek (Figure 52) GPS: 40.14124N 74.06582W

Upstream – 1 dragonfly nymph 40mm total length; run habitat with some small riffles; nice gravel bed for about 35m (Figure 53); knotweed present

Pump system GPS: 40.14161N 74.06663W ±30' (Figure 54)

Just upstream of pump – nice gravel substrate

+5m – nice run, gravel substrate, 30cm avg depth, 80% canopy cover GPS: 40.14181N 74.06712W (stream gauge present – 1.00; depth about 1m; Figure 55)

Downstream of Bailey's Corner Rd – nice fish habitat, 70% sand 30% gravel substrate, avg depth 30cm, max 100cm, small pools at bends of run

Outfall (culvert) located approx. 5m below Bailey's Corner Rd GPS: 40.14214N 74.06772W ±16' (Figure 56)

Upstream end of Bailey's Corner Rd Bridge GPS: 40.14215N 74.06786W (Figure 57)

+5m – small channel on south side of creek (Figure 58)

+10m – residential property, nice, wild vegetation on both banks; gravel/sand bottom, undercut bank on north side

Just upstream – a small check dam made of concrete rubble about 50cm high; potential barrier in low flow conditions GPS: 40.14227N 74.06844W (Figure 59)

+5m – small, white pipe, 5% aquatic vegetation present

Black pipe (septic pump drain?) at GPS: 40.14235N 74.06873W ±13'

Groundwater seeps throughout; sand substrate

Footbridge/bike path GPS: 40.14279N 74.07017W ±14'; creek splits just upstream of footbridge, mainstem runs on the north side; small, narrow (1-2m width; 10-40cm depth) channel on south side; we continued up the south channel towards Crystal Brook Dr.; hand-placed wooden "foot bridge" laid in creek under bike path (Figure 60)

Just upstream of split, there is a small wooden dam about 15cm high, low flow overtop, but probably not a barrier

GPS: 40.14248N 74.07085W – wooden debris, one striped frog

GPS: 40.14233N 74.07092W water quality taken (see Table 5 in report); vegetation on both banks mainly ferns and skunk cabbage; 25-50% large trees; water striders present

+40m – random black pipe (Figure 61), shallow throughout (5-10cm max depth), gravel/sand bottom; lots of macroinvertebrates present on gravel substrate (e.g., diptera, caddisfly larvae)

About 10m below Crystal Brook Dr – large tree root mass, possible barrier to fish movement (Figure 62)

Crystal Brook Dr. GPS: 40.14181N 74.07304W – concrete culvert (bottom of culvert is about 20-30cm off water surface); fish barrier; Upstream of Crystal Brook Dr. GPS: 40.14186N 74.07359W Crystal Brook lake dam (housing development surrounding creek; Figures 63 and 64)

GPS: 40.14116N 74.07741W – **culvert downstream of Hiddenbrook Dr.**; walked downstream of here to check out habitat – lots of skunk cabbage, ferns, bankful width 40-50m; wetted width 1m, a few meandering channels throughout bankful; substrate mainly sand, silt, lots of woody debris, average depth 15-20cm (Figure 65)

Impoundment upstream of Hiddenbrook Dr. (Figure 66)

GPS: 40.14162N 74.018122W – some, shallow stagnant water below this point; dry above this point

Culvert at Shadowbrook Dr. (storm drains from road flow into creek; Figure 67) GPS: 40.14195N 74.08121W

End at location upstream of Shadowbrook Dr. – culvert emptying into residential property rain garden; creek channel ends here (Figure 67)

JUNE 16, 2015 – Start at Allaire Rd. Bridge (Figure 68)

Upstream of road (Bel-Aire Golf Course; Monmouth County) – broken concrete weir (Figure 69) – water is flowing through; top of structure approx. 3-3.5 ft high; would be fish barrier if not broken, so not currently a barrier; GPS: 40.15071N 74.09148W ±20'; mudflat above broken weir, muddy, mucky bottom, sunk in about 50cm near edge (Figure 70)

Next barrier upstream of mud flat is a sand bag weir (Figure 71); approx. 25m below wooden footbridge (GPS: 40.15216N 74.09195W ±10'; Figure 72); water quality taken (see Table 6 in report)

Broken wooden weir GPS: 40.15263N 74.09178W ±11' (Figure 73)

Next pond on golf course GPS: 40.15330N 74.09197W ±10'

Creek flow begins (golf course ends) at GPS: 40.15536N 74.09510W ±20'; water quality taken (see Table 6 in report); water striders and riffle beetles present; downstream of this is mucky, mudflat (through upstream end of golf course); upstream of this is relatively nice creek habitat; sinuous channel about 1.5m wide; sand/gravel substrate; decent water flow, one crayfish observed; native vegetation on both banks (Figure 74)

GPS: 40.15723N 74.09697W ±10' creek reverts to mucky, mudflat

End at Allenwood Rd/Route 34 culvert GPS: 40.15726N 74.09942W ±10'

JUNE 18, 2015 – Start at Bailey's Corner Rd; hiked up mainstem at split; average width approx. 3-4m; average depth 40cm GPS: 40.14305N 74.07091W ±17'; water quality taken (see Table 6 in report); banks slightly undercut; native and non-native vegetation; canopy cover 90%; bottom is 80% sand, 20% gravel; 30% cover of leaf litter on bottom (Figure 75)

Long, black pipe GPS: 40.14462N 74.07369W ±27' (Figure 76); depth about 130cm about 3m upstream of this

Waterstriders, adult damselflies, riffle beetles present; corner pocket pools throughout; creek behind Shadowbrook development is meandering with 80-100% sand substrate

Pipe behind house GPS 40.14627N 74.07632W ±13'; 5% aquatic vegetation, waterstriders present; stream flow width 2m; banks vegetated with ferns and native plants; substrate is 30% gravel, 70% sand; large, woody debris and snags present

GPS: 40.14710N 74.07825W ±14' water quality taken (see Table 6 in report)

Creek splits at GPS: 40.14713N 74.07829W (Figure 77)

Large, concrete pipe at GPS: 40.14717N 74.07893W ±36' not connected to anything; one green frog (Figure 78)

Water quality taken at GPS: 40.14750N 74.08417W ±65' (see Table 6 in report)

Newly built hunting stand GPS: 40.14796N 74.08669W ±21' followed by a Christmas tree clearing and another hunting stand

Figure 79 shows creek habitat downstream of Allaire Rd.

Bridge GPS: 40.14865N 74.08883W ±20'; upstream of bridge – bottom is sand/silt, less gravel; silt could be coming from mudflat above broken weir on Bel-Aire golf course; water is very muddy, 1 juvenile turtle, 1 dead adult painted turtle GPS 40.15041N 74.09132W ±10'; water quality taken (see Table 6 in report), width 1-1.5m, sandy/silty bottom, max depth 100cm

End at Allaire Rd (Bel-Aire Golf Course)

JUNE 30, 2015 – Started at the Railroad Tracks Bridge (fyke net location) in Wreck Pond (see notes below for Wreck Pond Brook observations); at confluence of Wreck Pond Brook and Hannabrand Brook (Figure 27), we continued up Hannabrand to check again for juvenile fish, possible alewife, in the reach between here and Route 35

GPS: 40.143633N 74.0529W ±18' – Small, hand-placed check dam made of small boulders, 10-30cm high, probably not a barrier to fish migration (Figure 28)

+5m – footbridge going over creek (Figure 28)

+5m – lots of woody debris in creek

+5m – Old Mill Pond Rd Bridge (Figure 29) GPS: 40.14355N 74.053483W ±17', >5 damselfly adults observed; water quality taken (see Table 7 in report)

Small side pool with 25+ bullfrog tadpoles

Bamboo forest on north side, creek is overgrown with brush and can't walk through for about 30m, no visible barriers in this stretch

Old wooden footbridge GPS: 40.143497N 74.054133W ±32' (Figure 30)

+5m small riffle; small narrow, stagnant side channel closer to Old Mill Pond

Old wooden weir GPS: 40.143183N 74.05485W ±71'; 75cm from creek bottom, 15-20cm from water surface; potential barrier in low flow (Figure 31)

White pvc pipe emptying into creek GPS: 40.142933N 74.055W ±117'; wooden bulkhead and riprap on south bank approx. 10m downstream from 90 degree bend/footbridge (downstream end of school; Figure 32)

+5m upstream of bend/footbridge, there is a concrete culvert emptying from school yard into creek (Figure 33)

+5m – red covered footbridge (Figure 34) GPS: 40.142417N 74.055267W ±46'; water quality taken (see Table 7 in report)

GPS: 40.1421N 74.056867W ±149' – white pipe in creek

Creek overgrown for about 35m; walked around on bank

Water level marker stream gauge GPS: 40.141867N 74.058083W ±32' (Figure 37)

50m downstream of property with stone revetment along stream bank – 1 fish observed 8-10 in. couldn't ID; depth 35cm, width 4m, 60% sand/40% gravel bottom

Half way along stone revetment is a small check dam, 30cm high from bottom, 20cm high from water surface, probably not a barrier GPS: 40.141233N 74.0592W ±18' (Figure 39)

+10m – 10+ damselfly adults, 1 dragonfly adult observed; 3 small, black pipes emptying into creek, 2 white slotted pipes in creek (Figure 40)

+10m – concrete culvert emptying into creek (storm drain from development?) GPS: 40.141017N 74.059617W ±18' (Figure 41)

Further upstream – side channel on north side GPS: 40.141017N 74.0598W ±18'

Next 30m creek is overgrown with brush, walked around on bank; lots of Japanese knotweed on both banks as you get closer to Route 35 (Figure 42)

Downstream end of Route 35 bridge (Figure 43) GPS: 40.140683N 74.06115W ±19'; water quality taken (see Table 7 in report); 2 juvenile largemouth bass 30mm TL observed (Figure 44). End at Route 35

PHOTOGRAPHS



Figure 27. Confluence of Hannabrand Brook (South) and Wreck Pond Brook (North)



Figure 28. Hand-placed rock dam just upstream of confluence with Wreck Pond Brook



Figure 29. Old Mill Road Bridge



Figure 30. Fallen tree debris with old wooden footbridge in the distance.



Figure 31. Wooden weir just upstream of old wooden footbridge



Figure 32. Undercut bank and wooden bulkhead just downstream of the Old Mill Elementary School



Figure 33. Footbridge and storm drain culvert at the downstream end of the Old Mill Elementary School property.



Figure 34. Second footbridge at the Old Mill Elementary School property.



Figure 35. School of juvenile fish observed approximately 20m upstream of the Old Mill ES property.



Figure 36. Creek habitat where 150+ juvenile fish (possible alewife) were observed on June 3, 2015.



Figure 37. Stream gauge in creek (left photo; blue outline), Creek habitat upstream of stream gauge (right photo).



Figure 38. View of creek downstream of stone revetment (left photo), Property (1310 W Chicago Blvd., Sea Girt) with stone revetment along creek (right photo).



Figure 39. Small, concrete check dam located half way along residential property.



Figure 40. White, slotted pipe in creek.



Figure 41. Concrete culvert located just upstream of stone revetment property.



Figure 42. Creek downstream of Route 35, Japanese knotweed on banks.



Figure 43. Route 35 Bridge/Box Culvert.



Figure 44. Juvenile largemouth bass found just below Route 35 Bridge.



Figure 45. June 4th survey start location, upstream of Route 35 Bridge (left photo) with one dead white sucker (right photo).



Figure 46. Small, grey pipes emptying into creek at The Brookside School.



Figure 47. Small step of concrete rip rap fallen into creek from stream bank.

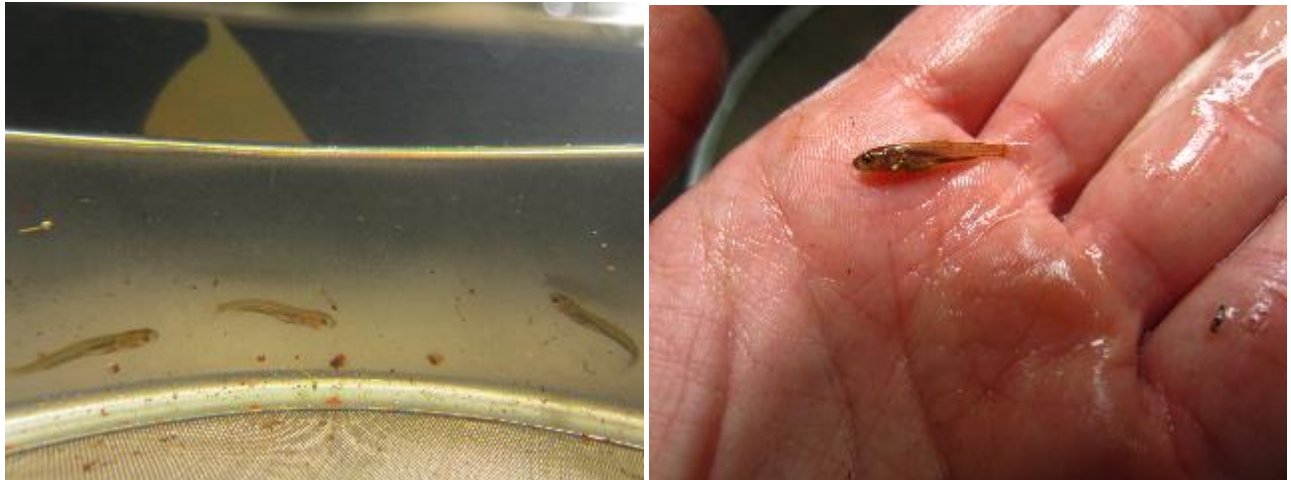


Figure 48. Juvenile fish (possible alewife) observed at the upstream end of Brookside School.



Figure 49. Horses at the Brookside School.



Figure 50. Habitat upstream of the Brookside School in Hannabrand Brook.



Figure 51. Stream Team on June 4, 2015, Hannabrand Brook.



Figure 52. Small tributary on south side of Hannabrand Brook. GPS: 40.14124N 74.06582W.



Figure 53. Instream gravel bed, Hannabrand Brook



Figure 54. Pump system in-take in creek runs to house on adjacent property. GPS: 40.14161N 74.06663W $\pm 30'$.



Figure 55. Gravel run just upstream of pump system. GPS: 40.14181N 74.06712W.



Figure 56. Culvert located approx. 5m below Bailey's Corner Rd. GPS: 40.14214N 74.06772W ±16'.



Figure 57. Looking downstream through Bridge at Bailey's Corner Rd, Hannabrand Brook.



Figure 58. Small tributary on south side of Hannabrand Brook, 5m upstream of Bailey's Corner Rd



Figure 59. Small check dam located at GPS: 40.14227N 74.06844W. Looking upstream (left photo), looking downstream (right photo).



Figure 60. Hand-placed wooden foot bridge beneath bike path. Creek splits just upstream of this.



Figure 61. Black pipes emptying into creek below Crystalbrook Dr.



Figure 62. Large tree root mass, possible fish barrier.



Figure 63. Culvert at downstream end of Crystalbrook Dr. (left photo) and upstream (right photo).

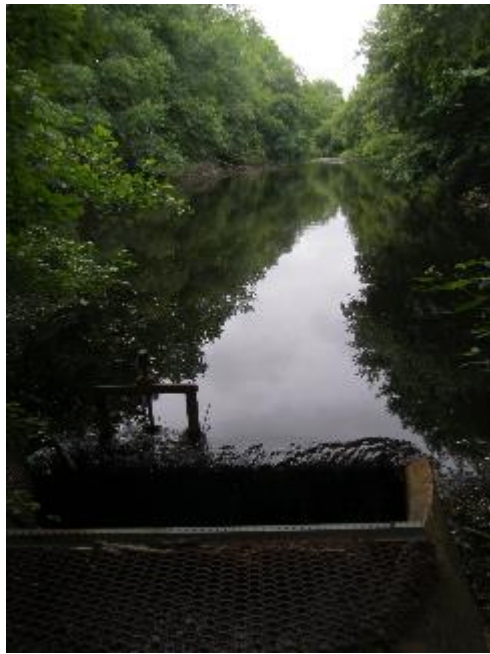


Figure 64. Lake upstream of Crystalbrook Dr.



Figure 65. Culvert downstream end of Hiddenbrook Dr. (left photo), habitat downstream of Hiddenbrook Dr. (right photo).



Figure 66. Impoundment upstream of Hiddenbrook Dr.



Figure 67. Culvert at Shadowbrook Dr. (downstream left photo, upstream right photo). End location for June 4, 2015 survey.



Figure 68. Culvert at Allaire Rd. Start location of June 16, 2015 survey.



Figure 69. Broken weir upstream of Allaire Rd (downstream of mudflat in above photo).



Figure 70. Mudflat upstream of Allaire Rd. (Bel-Aire Golf Course). Start location for June 16, 2015 survey.



Figure 71. Sand bag weir upstream of mud flat. GPS: 40.15216N 74.09195W $\pm 10'$.



Figure 72. Creek habitat upstream of wooden footbridge at downstream end of Bel-Aire Golf Course.



Figure 73. Broken wooden weir. GPS: 40.15263N 74.09178W ±11'.



Figure 74. Hannabrand Brook habitat upstream of Bel-Aire golf course, downstream of Route 34.



Figure 75. Creek habitat upstream of Bailey's Corner Rd. Start location for June 18, 2015 survey.



Figure 76. Long, black pipe in creek GPS: 40.14462N 74.07369W ±27'.



Figure 77. Creek splits at GPS: 40.14713N 74.07829W.



Figure 78. Large, single concrete pipe at GPS: 40.14717N 74.07893W ±36' (looking upstream left photo, downstream right photo).



Figure 79. Creek habitat downstream of Allaire Rd. End survey location for June 30, 2015.

III. WRECK POND BROOK

NOTES AND OBSERVATIONS

JUNE 30, 2015 – Start at railroad tracks bridge (fyke net location; GPS: 40.14511N 74.0366W); water quality taken (see Table 9 in report); walked around pond along north side by *Phragmites*; mucky bottom sink in about 10cm; two kayakers in pond; one small fish about 30cm observed (couldn't ID) about ¼ between railroad tracks and Route 71 bridge; also one painted turtle observed; substrate 70% gravel 30% sand, 100% *Phragmites* along north bank (Figure 80)

Route 71 bridge GPS: 40.140867N 74.042117W; width about 12m; depth about 150cm (Figure 81)

Upstream of Route 71 is Jimmy Byrnes property (Figure 82)

+100m GPS: 40.14045N 74.046283W ±15'; water quality taken (see Table 9 in report); many fish 30-60mm TL, unable to ID (sunfish?) observed (Figure 83)

Large sand peninsula formed at 90 degree bend in creek, 50% sand, 50% gravel, depth range 20-130cm, bank vegetation >90%, 3 baby ducklings, 1 adult duck

Further upstream from 90 degree bend, the substrate turns into mud and sand, sink in about 10cm; ferns and trees on south bank, *Phragmites*, Japanese knotweed and multiflora rose on north bank (Figure 84)

Side channel at GPS: 40.14105N 74.0495W ±20'; mainstem runs on north side; continued up mainstem

+12m – house on north bank, wide lawn and riprap on stream bank; creek average depth 30cm, max depth 110cm, 60% gravel, 40% sand substrate; one American eel 65cm length observed (Figure 85)

Concrete culvert emptying into creek at upstream end of brown shingled house GPS: 40.14175N 74.05025W ±21' (Figure 86)

+5m – old pipe in creek, but not connected to any pipe, just a piece of it (Figure 87)

Creek splits upstream end of brick house GPS: 40.143433N 74.05165W ±21', 80% gravel, 20% sand (Figure 88)

Confluence of Hannabrand Brook and Wreck Pond Brook GPS: 40.143717N 74.052717W ±22'; continued up Hannabrand Brook (Figure 90; see notes above). Figure 89 shows habitat downstream of confluence

JULY 1, 2015 – sunny and clear, rained last night; **started at Old Mill Pond Dam GPS: 40.144222N 74.053566W (Figure 91; definite barrier to fish migration)**

Hiked around south side perimeter of Old Mill Pond

Ocean Road Bridge GPS: 40.14575N 74.056783W ±23'; stream width downstream of bridge about 5m (Figure 92), one painted turtle observed, depth about 50cm+, riparian habitat on both banks about 15m wide; upstream of bridge width about 10m (Figure 93), houses on north bank, each house has a pipe running from it to creek

At the 2nd house/pipe, water quality taken (see Table 9 in report); GPS: 40.14655N 74.056983W ±45'

10m downstream of Route 35 Bridge, culvert on south side (Figure 94) GPS: 40.1467N 74.057483W (very weak signal); wetted width 7m, depth 35cm

Upstream of Route 35 Bridge 100cm average depth, 10m width, gravel/muck bottom, sink in about 20cm (Figure 95)

Further upstream the bottom turns sandy throughout reach up to Allaire Road with few spots of silty/mucky bottom; riparian habitat extending 20+m on both sides of creek; creek is sinuous, branching with multiple channels, wetted width 1.5-5m (Figure 96 and 97)

One black racer snake (black with red stripe) observed at GPS: 40.148117N 74.06025W $\pm 19'$; water quality taken (see Table 9 in report), bottom is 80% sand/20% gravel, 15% cover of aquatic plants, Asiatic clam beds present; adult damselflies throughout and a few small fish 40-70mm TL observed (largemouth bass? Hard to identify)

Up to 70% cover of aquatic plants/grasses with many benthic macroinvertebrates present – diptera larvae and pupae, caddisfly larvae, mosquito larvae and pupae, snails, amphipods, and others (Figure 98)

One box turtle observed (Figure 99) GPS: 40.150583N 74.06045W $\pm 20'$; creek wetted width 5m, average depth 30cm, max depth 50cm, substrate 95% gravel 5% sand, 70% instream cover of aquatic vegetation/grasses covered in diptera larvae and pupae and caddisfly larvae and others

Town houses on east side of creek about 50m away for a 280m stretch downstream of Allaire Road. Figure 100 shows creek habitat through stretch near town houses

Allaire Rd. Bridge/Dam (definite barrier to fish migration; downstream of Osbornes Pond; Figures 101, 102 and 103) GPS: 40.15295N 74.061533W $\pm 17'$; water quality taken (see Table 9 in report)

End at Allaire Road

PHOTOGRAPHS



Figure 80. Wreck Pond upstream of Railroad Tracks Bridge (fyke net sampling location and start of June 30, 2015 survey).



Figure 81. Route 71 Bridge, Wreck Pond.



Figure 82. Upstream of Route 71 Bridge, Jimmy Byrnes property.



Figure 83. American Littoral Society interns taking water quality measurements in Wreck Pond Brook, June 30, 2015.



Figure 84. Habitat in Wreck Pond Brook, approximately 600m below Old Mill Pond Dam.



Figure 85. Properties along Wreck Pond Brook, rip rap on banks.



Figure 86. Culvert at the upstream end of brown, shingled house. GPS: 40.14175N 74.05025W ±21'.



Figure 87. Culvert opening not connected to anything just upstream of culvert in Figure 86.



Figure 88. Creek splits at the upstream end of this property. GPS: 40.143433N 74.05165W ±21'. Main channel on south side, small, short side channel on north side.



Figure 89. Habitat and stream team members in Wreck Pond Brook, approximately 100m downstream of Old Mill Pond Dam.



Figure 90. Confluence of Hannabrand Brook (left photo) and Wreck Pond Brook (right photo).



Figure 91. Old Mill Pond Dam and Old Mill Pond.



Figure 92. Downstream of Ocean Rd. Bridge, Wreck Pond Brook.



Figure 93. Upstream of Ocean Rd. Bridge, Wreck Pond Brook.



Figure 94. Culvert located at approximately GPS: 40.1467N 74.057483W.



Figure 95. Route 35 Bridge (downstream on left, upstream on right), Wreck Pond Brook.



Figure 96. Habitat upstream of Route 35 Bridge, Wreck Pond Brook.



Figure 97. Wreck Pond Brook Habitat further upstream between Route 35 Bridge and Allaire Road.



Figure 98. Wreck Pond Brook habitat, grasses on creek bottom (left) and benthic macroinvertebrates on grasses (right).



Figure 99. Box turtle observed in Wreck Pond Brook at GPS: 40.150583N 74.06045W $\pm 20'$.



Figure 100. Wreck Pond Brook habitat through stretch near townhouses downstream of Allaire Rd.



Figure 101. Creek just downstream of Allaire Road. Brown foam on water surface in lower part of photo.



Figure 102. Wreck Pond Brook, Allaire Road Bridge and Dam. GPS: 40.15295N 74.061533W ±17'.



Figure 103. Osborne's Pond upstream of Allaire Road.